



Adapting Computer Software To Evaluate The Visual Impact Of Farm Forestry Layouts

**A report for the RIRDC/LWRRDC/FWPRDC
Joint Venture Agroforestry Program**

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FOREWORD

Over recent years, the land planning and design methodologies developed by the Western Australian Department of Conservation and Land Management's Farm Forestry Unit, in association with The University of Western Australia, have attempted to evaluate and ameliorate the visual impact of farm forestry layouts. Experience in the southwest of Western Australia has shown that the ability to visualise the impact of proposed revegetation strategies is instrumental in supporting landowner's revegetation placement and implementation decisions.

To date, this work has utilised a range of computer software tools that try to realistically simulate farm forestry proposals across the landscape, with varying levels of success. A number of impediments, however, have been identified in the wide spread use of these computer aided design representation tools.

This report documents the software reviews, their adaptation, application and evaluation with the support of a case study farming property and community located in the Boree Gully, Blackwood Basin, southwest, Western Australia.

The research demonstrates that selected, readily available software can be suitably adapted to aid in the representation and evaluation of visual impacts associated with farm forestry layouts. It is expected that such design tools will provide greater value to the revegetated landscapes aimed at receiving the more traditional economic, water use and wind break benefits.

This project was funded by three R&D Corporations — RIRDC, LWRRDC and FWPRDC. These Corporations are funded principally by the Federal Government. The report is a new addition to RIRDC's diverse range of over 450 research publications. It forms part of our Agroforestry and Farm Forestry R&D program, which aims to integrate sustainable and productive agroforestry in the Australian farming system.

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Contents

Foreword	<i>iii</i>
Acknowledgements	<i>iv</i>
List of Figures	<i>viii</i>
List of Tables	<i>ix</i>
About the Authors	<i>x</i>
Abbreviations	<i>xi</i>
Executive Summary	<i>xiii</i>
1. SETTING THE SCENE	
1.1 General introduction.....	1
1.2 Research Objectives, Strategies and Methodologies.....	1
1.3 Organisation of this Report.....	2
2. WHAT DESIGN SIMULATION SOFTWARE EXISTS?	
2.1 General Introduction.....	3
2.2 Investigation Methodology and Software Assessment Criteria To Evaluate Forest Visualisation Software.....	3
2.3 Results.....	8
2.3.1 Geographic Information Systems Software Results	
2.3.2 Computer Aided Design Software Results	
2.3.3 Forest Visualisation Software Results	
2.4 Visual Design Simulation Products.....	11
2.4.1 Static Visual Simulation - Image	
2.4.2 Dynamic Visual Simulations - Animations	
2.4.3 Virtual Reality Models	
2.4.4 Three-Dimensional Application	
2.5 Simulation Process Factors.....	13
2.5.1 Source of Data	
2.5.2 Complexity of Model(s) Required	
2.5.3 Landscape Assessment Required	
2.5.4 The Cost and Time Required.	
2.5.5 Evaluation of Geographic Information System Software.	
2.5.6 Evaluation of Computer Aided Design Software	
2.5.7 Evaluation of Forest Visualisation Software	
2.5.8 Evaluation of 3D Application Software	

2.6	Possible Methods of Providing Visual Simulations Of Farm Forestry Layouts.....	15
2.6.1	Method 1: Providing Images & Animations without complex models.	
2.6.2	Method 2: Providing Images & Animations with complex geometric models.	
2.6.3	Method 3: Providing Virtual Reality Models	
2.6.4	Method 4: Providing a 3D Application	
2.7	Evaluation Of Software Survey.....	19
2.8	Features Required Of The Software.....	20
2.9	Appropriate Visual Simulation Method For This Project.....	20
2.10	Appropriate Software For This Project.....	21
3.	ADAPTING THE DESIGN SIMULATION SOFTWARE	
3.1	Design of Application.....	23
3.1.1	Simulation Process Tasks	
3.1.2	Simulation Task Discussion	
3.1.3	Data Requirements	
3.1.4	Tools Identified	
3.1.5	Application Summary	
3.2	Testing The Design Application.....	28
3.2.1	Survey One Methodology	
3.2.2	Survey Results	
3.2.3	Survey Limitations	
3.2.4	Discussion	
4.	RE-ADAPTING THE DESIGN SIMULATION SOFTWARE	
4.1	Introduction.....	37
4.2	Survey Two Methodology.....	37
4.3	Survey Results And Discussion.....	43
4.4	Survey Limitations.....	46
4.5	Future Research Potential.....	47
5.	SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS	
5.1	Key Research Findings.....	49
5.2	Research Evaluation.....	50
5.3	Study Limitations.....	52
5.4	Future Research Opportunities and Recommendations.....	52
6.	APPENDICES	
6.1	GIS Software and Data Application Evaluation Summaries.....	57
6.2	CAD Software and Data Application Evaluation Summaries.....	67
6.3	Forest Visualisation Software and Data Application Evaluation Summaries.	77
6.4	Computer Hardware and Software Specifications Used In This Study.....	83
6.5	Mark Samwell Survey One Results.....	85
6.6	John Beatty Survey One Results.....	103
6.7	Mal Gibbs Survey One Results.....	117

6.8	Survey Two Proforma.....	131
6.9	Survey Two Results - Category One Images.....	133
6.10	Survey Two Results - Category Two Images.....	137
6.11	Survey Two Results - Category Three Images.....	139
6.12	Survey Two Results - Comparing Images of Existing Landscapes With Computer Modified Images.....	141
6.13	Survey Two Results For Each Respondent.....	145
7.	GLOSSARY	185
8.	BIBLIOGRAPHY	187

List of Figures

Figure 1	Using ARC/INFO, AutoCAD, 3D Studio MAX and Corel Paint 7 to create a Visual Simulation of the Farm Forestry Layouts.....	xv
Figure 2	Using GIS for Visual Simulation.....	15
Figure 3	Using ARC/INFO & Virtual Forest for Visual Simulation.....	16
Figure 4	Using CAD for Visual Simulation.....	17
Figure 5	Using GIS and CAD for Visual Simulation.....	17
Figure 6	Using CLRview or PolyTRIM for Visual Simulation.....	18
Figure 7	Using GIS and CAD to create a Virtual Reality Model for Visual Simulation.....	18
Figure 8	Using GIS and CAD to create a Virtual Reality Model for Visual Simulation.....	19
Figure 9	Using GIS and CAD for Visual Simulation of Farm Forestry Layouts.....	10
Figure 10	Using ARC/INFO, AutoCAD and 3D Studio MAX to create a Visual Simulation of the Farm Forestry Layouts.....	23
Figure 11	Using ARC/INFO, AutoCAD and 3D Studio MAX to create a Visual Simulation of the Farm Forestry Layouts with Landscape Analysis Features.....	24
Figure 12	Methodology For Creating Category Two Images.....	38
Figure 13	Methodology For Creating Category Three Images.....	39
Figure 14	Survey Two Images.....	40

List of Tables

Table 1 Geographic Information Systems Software Results.....	8
Table 2 Computer Aided Design Software Results.....	9
Table 3 Forest Visualisation Software Results.....	10
Table 4 Respondent Scores For Category One Images.....	43
Table 5 Respondent Scores For Category Two Images.....	44
Table 6 Respondent Scores For Category Three Images.....	46

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Abbreviations

The source of the following terms is from McDonnell and Kemp, (1995). *The International GIS Dictionary*, GeoInformation International.

Computer Aided Design (CAD) - A computer based information processing system that supports engineering planning and illustrating activities.

Digital Elevation Model (DEM) - A digital representation of the elevation of locations on the land surface.

Digital Terrain Model (DTM) - A digital representation of the elevation of the ground surface generated from elevation as well as topological data.

Digital Exchange Format (DXF) - A format for transforming digital data between computer systems, widely used as a de facto standard in the engineering and construction industries.

Geographic Information System (GIS) - A computer system for capturing, managing, integrating, manipulating, analysing, and displaying data which is spatially referenced to the Earth.

Executive Summary

This report summarises the major results and conclusions of the research project - Adapting Computer Software to Evaluate the Visual Impact of Farm Forestry Layouts. The study has been undertaken by the University of Western Australia's School of Architecture and Fine Arts and the Department of Geography in conjunction with farm forestry projects led by Western Australia's Department of Conservation and Land Management's Farm Forestry Unit in Busselton.

The Samwell farming property located at Boree Gully, southwest Western Australia, and its immediate community has been the specific case study for this research project. Suitable visual simulations have been prepared to model the visual imagery of a proposed agro-forestry type Landscape Master Plan prepared by the University of Western Australia, in conjunction with the Samwell family.

Simulation methodologies and products have been continually evaluated and re-developed over the course of the study using public participation techniques. Future research opportunities have been identified.

In summary, the research initially investigated the range of available design software products, evaluated their advantages and disadvantages, and determined the most suitable software in the context of current farm forestry practices. The software review process included the development of the evaluation criteria; identified alternative visual design procedures, products, simulation outcomes and their preferred methods of creation.

For the purposes of this study, the most suitable combination of adaptive software included Geographic Information System (GIS) software, and Computer Aided Design (CAD) software. The software nominated for use in this project included *ARC/INFO*, *3D Studio MAX* and *AutoCAD*. These packages met the criteria of data compatibility and were able to create the following visual simulation products: images; animations; and virtual reality models. The availability of these visual products offered the opportunity to provide an accurate, unbiased and graphically interesting design simulation of the proposed farm forestry layouts.

Actual visual image products were created from the above computer models simulating the terrain and re-vegetation features of a proposed Landscape Master Plan. Figure 1 summarises this visual simulation development process.

The prepared computer models assisted in the evaluation of the data quality and provided an early assessment of the visual imagery of the design plan. Poor image qualities, principally due to the available computer hardware resources, prompted the development and undertaking of a survey with local farmers to further understand farmers' perceptions and requirements of computer modeled agro-forestry environments.

The survey highlighted the need to amend the process and techniques of developing suitable computer models for simulating the selected farm forestry landscapes. The following improvements were identified:

- Terrain models needed to be vertically exaggerated to three or four times;

- Foreground tree models needed to be detailed in their designs - including texture, shape, form and colour elements;
- Computer modeled trees in the middle ground needed to be detailed, but tree models with appropriate outlines simulating the detailed trees can be strategically placed to achieve the same effect;
- Simple background tree models were adequate;
- Views should ideally be located from lane ways, ridgelines and high points across the landscape;
- Computer generated images needed to be of a minimum resolution of 150 Dots per Inch (DPI); and
- The final visual simulations needed to consider content and context of the farm forestry layouts, to include elements such as surrounding paddocks, fence lines, access points and existing vegetation.

Corel Paint Version 7 computer software was selected to incorporate the above recommendations and to improve the rendered images previously created by *3D Studio MAX* computer software. Three new categories of images, prepared from specific viewpoints identified by the Samwell family, were trialled. These were:

- Category One: Scanned photographs without modifications.
- Category Two: Scanned photographs modified by superimposing computer-modeled imagery for scale, proportions and agro-forestry layouts.
- Category Three: Cloning textures onto images prepared from computer models.

The three image categories were used to evaluate the computer visual simulations of the proposed Samwell farm forestry layout. A second survey questionnaire was prepared and conducted to evaluate observer perceptions and preferred requirements of the computer modeled agro-forestry landscapes.

No survey respondent was able to visually distinguish the computer-simulated modifications made to the realistic images that adopted the advanced Category Two software preparation techniques. From within the participatory evaluation methodology and framework of this study, it can be concluded that the recommended software adaptation techniques provide effective and efficient simulation tools for evaluating the visual impact of proposed farm forestry layouts.

For the purposes of visualising farm forestry layouts, it is recommended that the best currently available Computer Aided Design and Image Development software would be *Power Animator* or *Maya*, requiring *Silicon Graphics* hardware. The appropriate computer hardware would aim for the fastest Central Processing Unit (CPU), the largest amount of Rapid Access Memory (RAM) and hard drive space.

Finally, further research on the design simulation of agroforestry environments is required, and in particular with respect to the qualities of terrain form; visual penetration; tree shapes; tree positions and image composition. This recommended research should provide a greater understanding of how humans perceive the positive and negative impacts of these environments and assist in the development, acceptability and implementation of farm forestry layouts.

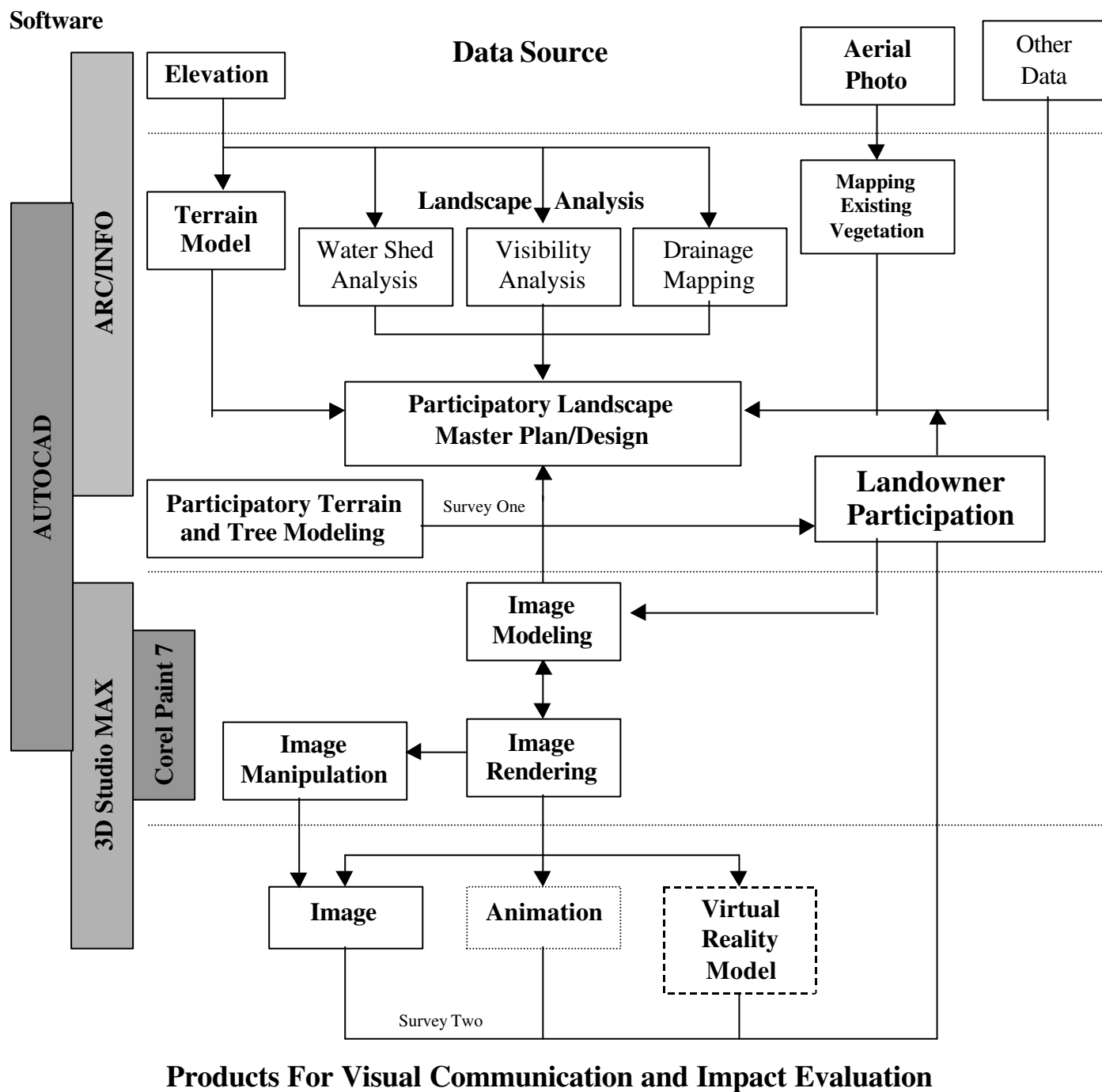


Figure 1 Using ARC/INFO, AutoCAD, 3D Studio MAX and Corel Paint 7 to create a Visual Simulation of the Farm Forestry Layouts

1. Setting the Scene

1.1 General Introduction

Until recently, few resources have been directed towards the systematic research of aesthetic values associated with farmland revegetation practices across Australia. Visual landscape management and assessment methodologies currently practiced in forestry related disciplines have their origins in native forest management, and are principally designed to manage the removal or harvest of native vegetation, as opposed to the revegetation of farmland areas.

This research study acknowledges the innovative farm forestry design related projects undertaken over recent years by resource managers from CALM in partnership with landscape architects from UWA. The creative use of computer data sets in the inventory, planning and design of these projects has identified the need and opportunity for employing a range of computer aided landscape design and simulation software products. The prime advantage of using these software products lies in their ability to assist the farm forestry designer to communicate the revegetation proposal to the landowner, property manager, and other stakeholders, and ascertain the likely impacts – both positively and negatively across the landscape.

To the research team's best knowledge, no evaluation of farm forestry design simulation software has been made or documented in Australia. This study is aimed at addressing this critical shortfall in research activity, and attempts to suitably adapt readily available software products in their wider application for farm forestry project use. Throughout the course of the study the research team have ensured that the design generation and evaluation procedures maintain farmer involvement wherever possible. The challenge lies ahead in ensuring that such design simulation and evaluation techniques are available and useable by farmers across the nation.

1.2 Research Objectives, Strategies and Methodologies

The major research objectives of this study was to provide a method of adapting design software that realistically simulates the visual effects of farm forestry layouts and their associated impacts on landscape character, visual amenity and agricultural management.

The following research strategies, and methodologies were employed:

(1) Analysis of Current Practices in Australia-

Investigate and document the procedures currently available that assist or supplement the adaptation of design simulation software.

(2) Design of Application

Investigate and document the requirements of the proposed farm forestry design simulation application in cooperation with CALM's Farm Forestry Unit, the proposed Research Team and its collaborators.

(3) Software Adaptation and Application

Adapt and document the design simulation procedures. Apply the model to a selected farm site and evaluate the farmers' perceptions of the images and their associated visual impacts (Survey 1).

(4) Software Adaptation Refinement and Documentation

Refine the adapted software techniques and application procedures. Evaluate the farmers' perceptions of the redeveloped images and their associated visual impacts (Survey 2). Document the results and identify opportunities for further research.

(5) Communications and Commercial Strategies

Communication and potential commercialisation of the design simulation application procedures will be offered as part of the farm forestry training modules being developed by CALM for land owners, and agency revegetation advisers. These initiatives will be pursued by CALM subsequent to the research.

1.3 Organisation of this Report

This final report documents the major collective research milestones and outcomes over an extensive research period of over two years.

The body of this report consists of four sections. **Section One – Setting The Scene** - introduces the project and outlines the research objectives and key tasks undertaken. **Section Two – What Design Simulation Exists?** - identifies and evaluates a selected range of readily available software products, and then determines the most suitable software in the context of current farm forestry practices. **Section Three – Adapting The Design Simulation Software** - applies an adaptation of the preferred software products to a farm forestry case study property. The simulation techniques and products are evaluated through a survey of local farmers. New methods are defined. **Section Four – Re-Adapting the Design Simulation Software** – incorporates the findings of the first survey into a re-adaptation of the software products. New simulation techniques and imagery are trialled at the same case study property, and again evaluated for their abilities to assess likely visual impacts associated with the farm forestry layouts. A second observer survey is undertaken with the local farmers. **Section Five – Summary of Conclusions and Recommendations** – outlines the major findings of the research project and assesses the research methods with a discussion on reliability, sensitivity, validity, utility, and valuation. Study limitations and future research opportunities are discussed.

2. What Design Simulation Software Exists?

2.1 General Introduction

An investigation of the visual simulation software used currently in farm forestry practices and related design disciplines, and their data acquisition and presentation standards was undertaken. The approach taken for researching software to visually simulate farm forestry layouts was not limited to finding suitable software to display geographically referenced individual trees or re-vegetation areas. The objective was to investigate software that would be potentially adaptable to current farm forestry practices and applicable to future trends in software development.

Within CALM's current land information services, data that depicts the natural and cultural features of the rural landscape are derived from Geographic Information System (GIS) software, most commonly *ARC/INFO* or Computer Aided Design (CAD) software, most commonly *MicroStation* and *AutoCAD*. As part of adapting computer software to create visual simulations of farm forestry layouts, the software used for this project will require data compatibility to these software packages.

The following software categories were investigated:

- 1) Software capable for visualising farm forestry designs;
- 2) Geographic Information System software due to their ability to *analyse spatial data* and limited ability to visually simulate farm forestry design conditions;
- 3) Computer Aided Design software due to their *modeling and rendering ability* and ability to visually simulate farm forestry design conditions; and
- 4) Software with the functionality of both Geographic Information System and Computer Aided Design software components.

2.2 Investigation Methodology and Software Assessment Criteria

In assessing current practices and possible computer software, the following steps were undertaken.

- Determine criteria required for selecting appropriate visual simulation software.
- Investigate visual simulation software used currently in farm forestry practices and related disciplines.
- Investigate visual simulation software available.
- Investigate data compatibility with visual simulation software.
- Rank software according to each category.
- Determine overall ranking for each software genre.
- Investigate possible visual simulation products.
- Consider important factors to determine appropriate software.
- Investigate possible visual simulation methods.
- Evaluation of software survey.
- Determine crucial features required of the software.
- Determine desired features required of the software.
- Determine suitable visual simulation method.
- Determine appropriate software for this project.

Three software genres were distinguished based on their functionality: Geographic Information Systems (GIS); Computer Aided Design Software (CAD); and Forest Visualisation software applicable to farm forestry.

Each software package was then evaluated within its appropriate genre, using appropriate criteria. For each package, the following categories were investigated:

- Ability to import and export vector data;
- Ability to import and export raster data;
- Database compatibility; and
- Functionality.

Industry standard vector and raster data requirements used in the survey to evaluate GIS, CAD and Forest Visualisation software are summarized immediately below. In part, these data standards have been further categorised into their origin and/or purpose; these are CAD, GIS, Internet and Topographic and spatial vector data.

Data is collected and stored in a structured manner (a database). The ability of the software investigated to use and manipulate this data in a database reflects *compatibility*. The *functionality* of software refers to the tasks that the software is capable of performing.

Details also follow that outline the industry standard database support software used in the survey to evaluate GIS software, including the most common and specialised functions of GIS, CAD and Forest Visualisation software. The GIS tasks have been divided into the categories of analysis, modeling and tools. Modeling, lighting, rendering, applying materials and tools represent the categories of CAD tasks.

(1) Vector Data used to evaluate GIS software.

CAD vector data files used to evaluate GIS software:

- | | |
|-----------------------|---------------------------|
| ▪ 3D Studio (3ds) | ▪ Autodesk MapGuide SDF |
| ▪ 3D Studio Max (Max) | ▪ MicroStation DGN |
| ▪ ArcCAD | ▪ TurboCAD Drawing (TCW) |
| ▪ AutoCAD (DXF) | ▪ TurboCAD Metafile (WMF) |
| ▪ AutoCAD (DWG) | |

GIS vector data files used to evaluate GIS software:

- | | |
|--------------------------------|---------------------------|
| ▪ Atlas GIS | ▪ IGDS |
| ▪ ARC/INFO Coverage | ▪ IGES |
| ▪ ARC/INFO Shape | ▪ IDRISI |
| ▪ ArcView Shape File (Shp) | ▪ MapInfo MIF |
| ▪ ArcView Attribute File (shx) | ▪ MapInfo MID |
| ▪ Erdas (lan) | ▪ MapInfo Attribute (TAB) |
| ▪ ERDAS (gis) | ▪ MOSS |
| ▪ Grass | ▪ PC ARC/INFO |

Internet vector data files used to evaluate GIS software:

- DWF
- VRML (1.0)
- VRML (2.0)

Topographic and spatial standard vector data files used to evaluate GIS software:

- | | |
|-----------|---------|
| ▪ DEM | ▪ SDTS |
| ▪ DLG | ▪ TIGER |
| ▪ ODYSSEY | ▪ USGS |

(2) Vector Data used to evaluate CAD software.

CAD vector data files used to evaluate CAD software:

- | | |
|-------------------|---------------------------|
| ▪ 3D Studio (3DS) | ▪ Lightwave 3D |
| ▪ 3D Studio Max | ▪ MicroStation DGN |
| ▪ 3D Studio VIZ | ▪ TurboCAD Drawing (TCW) |
| ▪ AutoCAD (DXF) | ▪ TurboCAD Metafile (WMF) |
| ▪ AutoCAD (DWG) | ▪ Wavefront |
| ▪ Direct X | |

GIS vector data files used to evaluate CAD software:

- | | |
|----------------------------|---------------------------|
| ▪ ArcView Shape File (Shp) | ▪ MapInfo MID |
| ▪ ARC/INFO Coverage | ▪ MapInfo Attribute (TAB) |
| ▪ ERDAS (lan) | |
| ▪ IDRISI | |
| ▪ MapInfo MIF | |

Internet vector data files from a variety of sources used to evaluate GIS software:

- | | |
|--------------|--------------|
| ▪ DWF | ▪ VRML (2.0) |
| ▪ VRML (1.0) | |

Topographic and spatial standard vector data files used to evaluate GIS software:

- | | |
|---------|-------|
| ▪ ASCII | ▪ DLG |
| ▪ DEM | |

(3) Vector Data used to evaluate Forest Visualisation software.

No CAD vector data files were compatible with the *Forest Visualisation software*.

GIS vector data files used to evaluate Forest Visualisation software:

- | | |
|-----------|------------------|
| ▪ ArcView | ▪ MOSS |
| ▪ ERDAS | ▪ Stand File |
| ▪ MAPS | ▪ Tree List File |

No Internet vector data files were compatible with the Forest Visualisation software.

Topographic and spatial standard vector data files used to evaluate GIS software:

- DEM
- DLG
- DTM

(4) Raster Data used to evaluate GIS, CAD and Forest Visualisation Software.

The following raster data files were used to evaluate GIS and CAD software:

- | | | |
|---------|-----------------|--------------|
| ▪ ADRG | ▪ EPS | ▪ Landsat |
| ▪ AVI | ▪ ERDAS Imagine | ▪ NITF |
| ▪ BIL | ▪ FLIC | ▪ PCX |
| ▪ BIP | ▪ GeoTIFF | ▪ PICT |
| ▪ BMP | ▪ GIF | ▪ PNG |
| ▪ BSQ | ▪ GeoSpot | ▪ RLC |
| ▪ CADRG | ▪ IDRISI | ▪ SPOT |
| ▪ CALS | ▪ IGDS | ▪ Sun Raster |
| ▪ CIB | ▪ IG4 | ▪ TARGA |
| ▪ CGM | ▪ IGS | ▪ TIFF |
| ▪ DOQ | ▪ JPEG | ▪ WMF |

(5) Database support for GIS and Forest Visualisation software.

The following database software were used to evaluate GIS software:

- | | | |
|----------|------------|-----------|
| ▪ ACCESS | ▪ FoxBASE | ▪ Lotus |
| ▪ ASCII | ▪ FoxPro | ▪ Oracle |
| ▪ DB2 | ▪ INFO | ▪ Paradox |
| ▪ DBASE | ▪ Informix | ▪ Sybase. |
| ▪ Excel | ▪ Ingres | |

The following database structure/methodology were used to evaluate GIS software:

- | | |
|---------------------------------|---------------|
| ▪ ODBC/SQL compliant | ▪ SQL Server. |
| ▪ Spatial Database Engine (SDE) | |

(6) GIS Functionality.

The following analysis capabilities were used to evaluate GIS software:

- | | | |
|------------|------------|--------------|
| ▪ Aspect. | ▪ Slope. | ▪ Vector. |
| ▪ Network. | ▪ Spatial. | ▪ View-shed. |
| ▪ Raster. | ▪ Surface. | ▪ Watershed. |

The following modeling capabilities were used to evaluate GIS software:

- Hydrologic.
- Network.
- Raster.
- Surface.
- Vector.

The following tools were used to evaluate GIS software:

- Create Animations or Fly-Bys.
- Cartographic Map Production.
- Database Management.
- Developer Environment.
- Editing Environment.
- Geocoding.
- Image Processing.
- Reporting Capability.
- Rubber Sheeting.

(7) CAD Functionality.

The following modeling capabilities were used to evaluate CAD software:

- Boolean Operations
- Geometric Transformations
- Mesh
- Metaballs
- Nurbs
- Splines
- Solid Modeller
- Surface Modeller
- Terrain Modeling
- Text

The following lighting capabilities were used to evaluate CAD software:

- Free directional.
- Free spot.
- Omni.
- Target directional.
- Target spot.

The following rendering capabilities were used to evaluate CAD software:

- Radiosity
- Ray Tracing
- Reflection
- Refraction
- Shadows

The following materials capabilities were used to evaluate CAD software:

- Material Properties.
- Procedural Maps.
- UVW Editing.
- UVW Mapping.

The following tools were used to evaluate CAD software:

- Animations
- Developer Environment.
- Internet Tools
- Modules/Plugins
- Sound Support
- View Control

(8) Functionality of Forest Visualisation software.

The following capabilities were used to evaluate Forest Visualisation software:

- Animations
- Customise Trees
- Database Query
- Developer Environment
- Growth Models
- Rendering
- Scripting Language
- Tree Library

2.3 Results

The following tables outline the software evaluation results. The best performing software are highlighted in bold type.

2.3.1 Geographic Information Systems Software Results

Ranking	Software Name	CAD Vector Input	CAD Vector Output	GIS Vector Input	GIS Vector Output	W.W.W Vector Input	W.W.W vector Output	Topographic Input	Topographic Output	Raster Input	Raster Output	Database	Database/Structure	Analysis	Modeling	Tools	Overall Rank
	<i>AutoCAD MAP</i>	4	1	5	5	0	1	0	0	2	0	3	3	7	2	4	3
	<i>ARC/INFO v7.2.1 **</i>	6	4	8	8	0	1	2	2	7	4	4	2	1	1	1	1
	<i>ArcView **</i>	2	0	2	10	0	0	0	0	1	0	1	1	5	3	3	2
	<i>CLView *</i>	6	0	5	5	0	0	4	0	10	5	0	0	4	2	4	
	<i>Gena **</i>	5	3	4	4	0	0	3	4	7	0	5	0	2	2	4	
	<i>Geo Media</i>	5	3	7	7	0	0	0	0	0	0	7	0	7	0	5	
	<i>GRASS **</i>	6	4	3	3	0	0	3	3	5	0	8	0	1	1	1	2
	<i>IDRISI</i>	6	4	3	3	0	0	3	3	9	6	6	0	6	0	0	
	<i>ILWIS</i>	6	4	9	9	0	0	0	0	9	0	0	0	0	3	5	
	<i>IMAGINE</i>	6	4	2	2	0	0	2	2	3	2	8	0	2	2	4	
	<i>MapInfo v5.0</i>	3	2	6	6	0	0	4	4	6	3	2	2	7	0	5	
	<i>PolyTRIM *</i>	6	4	5	5	0	0	4	0	10	5	0	0	4	0	3	
	<i>SAGE & Capture</i>	6	0	7	0	0	0	0	0	4	1	8	0	2	4	5	4
	<i>SitePro</i>	1	0	7	0	0	0	4	0	6	0	3	0	0	0	6	4
	<i>SURFER</i>	6	4	0	0	0	0	4	0	8	4	7	0	0	4	0	
	<i>TNT **</i>	5	3	1	1	0	0	1	1	5	2	7	0	3	3	2	1

Table 1 - Geographic Information Systems Software Results

* Note: Software has characteristics of GIS and CAD software.

** Note: Plugins/Modules have been included as part of the software evaluation.

The above table shows GIS software ranked according to the guidelines outlined in Section 2.2 Software Criteria. Refer to Appendix 6.1 for information about how the software performed in each category. The number of times the software ranked number one, according to the categories outlined in Section 2.2, was summed. The overall ranking result was a list of these sums, from highest to lowest.

The top three ranking GIS software are:

ARC/INFO and TNT (1)

AutoCAD MAP (3)

GRASS and ArcView (2)

2.3.2 Computer Aided Design Software Results

Object Data																
Software Name	CAD Vector Input	CAD Vector Output	GIS Vector Input	GIS Vector Output	W.W.W Vector Input	W.W.W Vector Output	Topo/Spatial Vector Input	Topo/Spatial Vector Output	Raster Input	Raster Output	Modeling	Lighting	Rendering	Materials	Tools	Overall Rank
3D Studio Max **	5	4	0	0	0	2	3	0	2	2	2	1	3	1	1	3
AutoCAD r14 **	5	4	0	0	0	2	0	0	1	5	3	2	4	3	3	5
CLRview *	8	0	1	11	0	0	3	0	7	7	3	4	5	1	3	4
EVS	8	7	2	2	1	2	3	0	0	5	4	0	6	4	4	5
ForeSight	7	6	0	0	0	0	3	1	0	0	0	0	6	0	0	5
FormZ	2	1	0	0	1	2	0	0	4	4	1	0	1	1	4	1
Lightscape	2	1	0	0	0	2	0	0	3	0	6	2	4	1	5	4
Lightwave	3	2	0	0	0	0	0	0	3	1	3	3	3	1	3	4
Maya	7	6	0	0	0	0	0	0	5	5	1	1	2	1	1	2
MicroStation	6	5	0	0	0	2	0	0	0	7	3	2	4	2	3	
PolyTRIM *	8	7	1	1	0	0	3	0	7	7	3	4	5	1	2	3
P.O.V **	4	3	0	0	0	0	0	0	0	8	3	4	3	1	3	5
Power Animator	7	6	0	0	0	1	0	0	8	9	1	1	2	1	1	1
RealiMation	1	0	0	0	1	2	0	0	5	8	6	2	5	1	4	3
TruFlite	0	0	2	0	0	0	2	0		6	0	0	6	2	6	
VistaPro	0	0	0	0	0	0	1	0	6	4	6	0	6	4	6	5
Voxel Analyst	4	3	0	0	0	0	3	1	0	0	5	0	6	0	0	5
World Builder	7	6	0	0	0	2	3	0	3	3	6	3	5	1	6	5
World Up	4	3	0	0	0	2	0	0	0	0	6	3	4	1	3	5

Table 2 - Computer Aided Design Software Results

- Note: Software has characteristics of GIS and CAD software.
- ** Note: Plugins/Modules has been included as part of the software evaluation.

The above table shows the CAD software ranked according to the stated criteria. Refer to Appendix 6.2 for information about how the software performed in each category.

The top three ranking CAD software are:

Power Animator and FormZ (1)
Maya (2)

3D Studio Max, RealMation and
PolyTRIM (3)

2.3.3 Forest Visualisation Software

Vector Data									
Software Name	Vector Input	Vector Output	Topo/Spatial Vector Input	Topo/Spatial Vector Output	Raster Input	Raster Output	Database	Functionality	Overall Rank
Landscape Management System (LMS)	4	0	1	0	0	0	1	4	2
SmartForest II	2	0	2	0	0	0	2	3	
Stand Visualisation System (SVS)	3	0	0	0	0	0	2	1	3
UTOOLS and UVIEW	1	1	1	0	0	1	1	2	1
Vantage Point	0	0	1	0	0	0	0	4	4
Virtual Forest	1	0	2	0	0	2	0	2	3

Table 3 - Forest Visualisation Software Results

The above table shows the Forest Visualisation Software ranked according to the stated criteria. Refer to Appendix 6.3 for information about how the software performed in each category.

The top three ranking Forest Visualisation Software are:

UTOOLS and UVIEW (1)
Landscape Management System(2)

Virtual Forest and Stand Visualisation
System (3)

2.4 Visual Design Simulation Products

As the results indicate, there is an extensive range of software available, all of which are capable of providing some form of visual simulation for farm forestry layouts. Before deciding the appropriate software for this project, it was important to discuss the possible processes to provide effective simulations and the products. Generally, the following products are useful to communicate the visual simulation of farm forestry layouts: Images, Animations, Virtual Reality Models, and 3D Applications.

2.4.1 Static Visual Simulation - Image

Static visual simulations or images refer to the method of representing three-dimensional objects (models) onto a two-dimensional plane. Software stores the two-dimensional plane as a file that contains an array of pixel values.

The advantages of using images to communicate the visual simulation of farm forestry layouts are:

- 1) Able to be displayed on existing and future operating systems.
- 2) Output as hard copy (printed).
- 3) File storage is minimal.
- 4) Images can be manipulated by Image processing software.
- 5) The designer determines the realism of the image.
- 6) Relatively low cost.
- 7) Requires less time to generate.

The disadvantages of using images are:

- 1) There is no movement, objects are static.
- 2) They rely upon fixed viewing points.
- 3) Users are unable to move through the scene.
- 4) Requires Image program to view image.
- 5) Sound cannot be integrated.

2.4.2 Dynamic Visual Simulations - Animations

Dynamic visual simulations, or animations, are an ordered collection of images. Each image has a slight variation to its predecessor when placed in order and, when viewed in sequence, it appears that motion is taking place.

The advantages of using animations to communicate the visual simulation of farm forestry layouts are:

- 1) Movement of cultural and natural objects can be simulated (i.e. within a vehicle).
- 2) A variety of views can be simulated within one file (i.e. selected viewpoints).
- 3) Changes of the environment can be simulated (i.e. seasons).
- 4) The designer determines the realism of the animation.
- 5) Sound can be combined.

The disadvantages of using animations are:

- 1) File storage can be large.
- 2) Requires compatible operating systems.
- 3) Requires extensive computer facilities.

- 4) Time consuming.
- 5) Requires media/movie player to view animation.

2.4.3 Virtual Reality Models

Virtual Reality Models are three-dimensional models that can be accessed and interacted with via the Internet. The user is able to move within the model and has control of direction and speed.

The advantages of using virtual reality models to communicate the visual simulation of farm forestry layouts are:

- 1) Movement of cultural and natural objects can be simulated.
- 2) User can control direction and speed within the model.
- 3) Model can be access/played over the Internet.
- 4) Sound can be combined.
- 5) User can interact with objects within the model.

The disadvantages of using virtual reality models are:

- 1) File storage can be large.
- 2) Requires compatible operating systems.
- 3) Time consuming.
- 4) Limited model, object and environment complexity.

2.4.4 Three-Dimensional Application

3D application refers to a set of computer programs designed and constructed to allow the user to interact within the models.

The advantages of using 3D application programming software to communicate the visual simulation of farm forestry layouts are:

- 1) Real time 3-D graphics & visual simulation.
- 2) The designer and programmer determine the level of complexity of the environment and objects within the model.
- 3) The designer and programmer can simulate movement of any cultural and natural objects.
- 4) Can be very portable between operating systems without drastic changes.
- 5) Code is reusable therefore can be applied to other projects, reducing the time required.
- 6) Sound can be added.
- 7) Apart from the latest operating systems, no other software is required to interact or view the model; the user interacts with the model(s) by starting the 3D application as any other application.

The disadvantages of using 3D Application software are:

- 1) Requires high-end software development knowledge.
- 2) Requires advanced hardware to generate the application.
- 3) Time consuming.
- 4) Costly.
- 5) File storage is large.

Each product has a valid role in providing an effective visual simulation of farm forestry layouts. Determining which method should be applied will depend on the project opportunities and

constraints. Using a combination of these products would most likely provide accurate, unbiased and interesting graphic design simulations.

2.5 Simulation Process Factors

Important factors that need to be considered in determining appropriate software to evaluate the visual simulation of farm forestry layouts are:

- 1) The source of data
- 2) The complexity of model(s) and visual simulation product required.
- 3) Is Landscape Assessment required.
- 4) Cost and time constraints.

The importance of these factors is discussed below. The discussion also addresses requirements of these factors.

2.5.1 Source of Data

In most cases data available for visual simulations of farm forestry layouts vary from a sketch provided by the landowner, to land survey ink maps to digital information from land surveys, to satellite imagery. Thus, it is important for the software used in this project to be able to accommodate a variety of data sources.

2.5.2 Complexity of Model(s) Required

To create realistic models, large amounts of detail are required, increasing the complexity of the model. Often, when the software is capable of creating complex models, simple models are also available. As the complexity of the model increases the amount of resources required to produce the visual simulation product increases.

2.5.3 Landscape Assessment Required.

Landscape Assessment requires the analysis of spatial data. Common spatial analysis includes mapping of watershed boundaries, slope and aspect, view-shed boundaries, and land compatibility.

2.5.4 The Cost and Time Required.

Required cost and time resources are factors of the efficiency of the selected software. Generally, if the software is current, the software is mostly likely to take advantage of the new hardware and operating systems available, helping to reduce the amount of time required to generate visual simulation products. When preparing the models, as the amount and complexity of the model increases, the required time to generate the visual product will also increase. The ability for the designer to program the software to perform common and complex tasks and/or plugin software (if available), will help reduce the amount of time required to generate the visual simulations. When the desired product(s) involves the use of more than one software genre, the time required to exchange data will depend on the input/output data quality.

2.5.5 Evaluation of Geographic Information System Software.

The survey shows, the Geographic Information System (GIS) software genre can import and export a diverse range of vector and raster data. This includes strong support for importing and exporting

Computer Aided Design software data, however there is little support to import and export Virtual Reality Model data.

There is strong support for terrain models within GIS, however the creation of objects/models using GIS is limited to simple objects for visual simulation of farm forestry layouts. GIS software has strong support for Landscape Assessment, as GIS has the ability to manipulate and analyse spatial data, a task achieved with only limited success using Computer Aided Design software. The visual simulation products available using GIS software to create visual simulations of farm forestry layouts is limited to images and animations.

2.5.6 Evaluation of Computer Aided Design Software

This software genre is suitable when no Landscape Assessment is required and the data can be generated using CAD software. Often, data is derived from GIS software, thus the ability to directly input data generated from GIS software need to be considered when choosing CAD software. Alternatively, the GIS software exports the data into a format that the CAD software is able to use. CAD software is appropriate for visual simulations that require complex and realistic three-dimensional models for farm forestry layouts.

The visual products available using CAD software to create visual simulations of farm forestry layouts include images, animations, and some CAD software are capable of exporting Virtual Reality Models to be used via the Internet. The models created using CAD software can be used for 'real time' 3D graphics using 3D Applications.

2.5.7 Evaluation of Forest Visualisation Software

From the forest visualisation software surveyed, common requirements include elevation and tree stand data. In most cases, data are prepared from outside sources, usually from GIS software. Thus, the forest visualisation software serves as an interface to visualise the data rather than providing the necessary data processing for visualisation.

For projects requiring only modeling of the landscape and vegetation, the forest visualisation software could be appropriate. However, common features of the rural landscape, such as buildings and fences, are unable to be modeled, hence using this software reduces the accuracy and complexity of the visual simulation.

The size of the elevation and tree stand data will affect the amount of time required to generate the visual product. As the complexity of the models generated are limited this will reduce the time necessary to generate the visual products. However, in some of the products surveyed the hardware and operating software used have been updated, and the forest visualisation software surveyed may not be able to take advantage of the efficiency of new hardware and operating software.

Of all the forest visualisation software surveyed, the products are restricted to images or animations. As the software has limited ability to export the object data to other formats it cannot be used to generate Virtual Reality models or 'real time' 3D graphics using 3D Applications.

2.5.8 Evaluation of 3D Application Software

No software capable of providing 3D Applications has been surveyed as the cost and time required is beyond the scope of this project. The advantage of using such software is that the programmer can manipulate the objects within the model(s) to create complex and realistic environments within real-time. This software has been considered theoretically, so that the method determined for this project will consider the data requirements to use this software for possible future applications. This will help ensure, where possible, that the method applied to this project does not become obsolete.

2.6 Possible Methods of Providing Visual Simulations Of Farm Forestry Layouts

As the survey reflects, a large variety of software is available with a wide diversity of properties. Choosing appropriate software to use is not straightforward. To choose appropriate software, the source of data, the complexity and realism of the model(s) and the type of analysis required needs to be considered. Summarised below are possible methods of providing visual simulations for farm forestry layouts.

2.6.1 Method 1 - Providing Images & Animations without complex models.

When the desired visual product is an image or animation with no complex geometric modeling and involves the creation of a terrain with raster and vector data draped, or polygon shading, then GIS software is capable of this task. Of the software surveyed, those that performed well with the required functionality and the input and export of raster and vector data, included ARC/INFO, Grass, and TNT.

The minimal data required to generate a terrain, the simplest form of visual simulation, is elevation data (vector data), which is used by GIS software to generate a Digital Elevation Model (DEM) or Digital Terrain Model (DTM). Vector and raster data can then be draped over the terrain to visualise the data in a three-dimensional model, as illustrated in Figure 2.

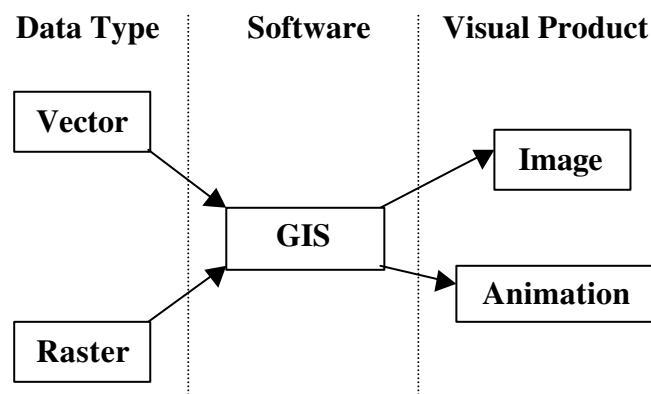


Figure 2: Using GIS for Visual Simulation

An alternative process, without the use of geometric models, is the use of the Forest Visualisation software Virtual Forest. "Virtual Forest is stand alone 3-D visualisation software that generates

data and visually realistic images of treed surfaces."¹ Virtual Forest is software that uses an ARC/INFO GRID DEM, ARC/INFO polygon coverages and ArcView shape files. The process to generate images or animations using Virtual Forest and ARC/INFO or ArcView is illustrated in Figure 3. It should be noted that this software does not use geometric models rather it uses "3-D symbols" to generate the vegetation. There is no indication that Virtual Forest has the ability to generate other 3-D symbols such as fences and buildings.

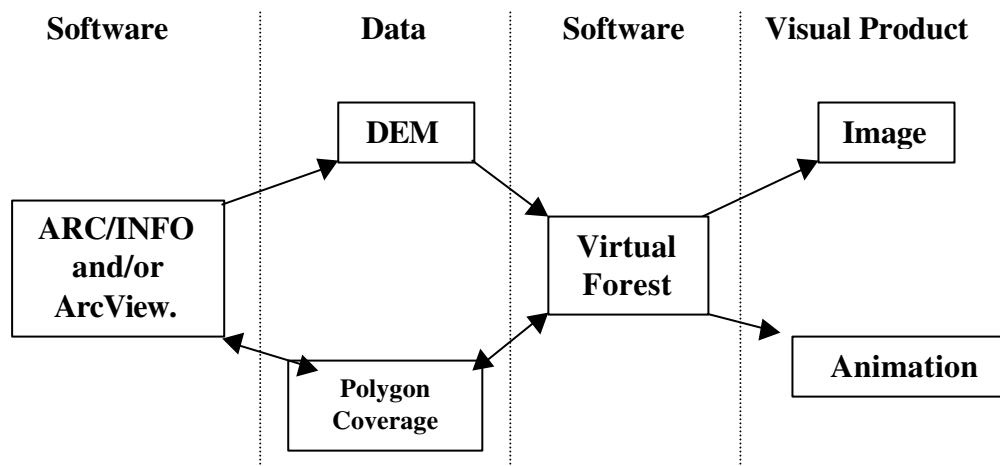


Figure 3: Using ARC/INFO & Virtual Forest for Visual Simulation

2.6.2 Method 2 - Providing Images & Animations with complex geometric models.

When complex geometric modeling is required, the use of CAD software is necessary, as most GIS software do not allow complex geometric models to be created. When the source of data is CAD compatible, then only CAD software is required to generate images and animations of the farm forestry layout, as summarised in Figure 4. If the source of data is in a GIS format, then GIS and CAD software need to be compatible. Of the software surveyed, those that performed well with functionality and the input and export of raster and vector data from GIS and CAD sources included *Power Animator*, *Maya*, *3D Studio MAX* and *FormZ*.

¹ Innovative GIS Solutions Inc, Virtual Forest. <http://www.innovativegis.com/products/vforest/faq.html>

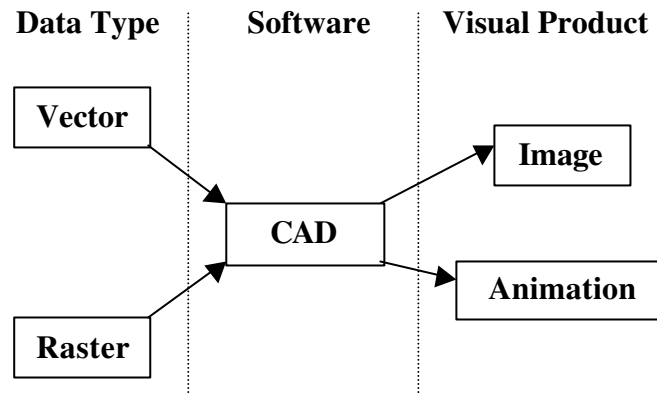


Figure 4: Using CAD for Visual Simulation

If spatial analysis is required to create visual simulations of farm forestry layouts, then the use of GIS software is necessary, as CAD software has limited spatial analysis ability. The process of using CAD and GIS software to create visual simulations has been illustrated in Figure 5. From the GIS software survey, the dominant export file types included AutoCAD DXF and MicroStation DGN. Both are CAD software common within Government Departments. Thus, AutoCAD and MicroStation need to be considered as appropriate CAD software for this project.

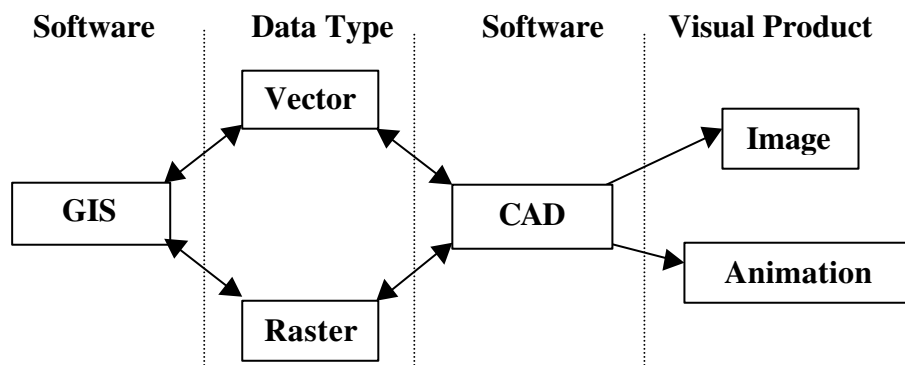


Figure 5: Using GIS and CAD for Visual Simulation

To increase efficiency and compatibility, the ideal solution would be one software package that had the capability of both GIS and CAD software, as summarised in Figure 6. Two programs meet these requirements, CLRview and PolyTRIM. Both are able to accept ARC/INFO data and AutoCAD DXF data and both software packages are able to provide images and animations.

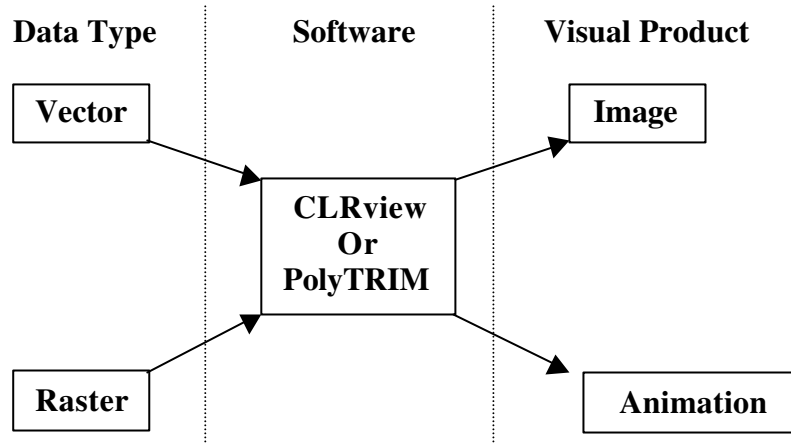


Figure 6: Using CLView or PolyTRIM for Visual Simulation

2.6.3 Method 3 - Providing Virtual Reality Models

The software survey has resulted with a limited range of software to choice from, capable of creating Virtual Reality Models. ARC/INFO was the only GIS software able to write a Virtual Reality Model, but is limited to exporting the terrain. Of the CAD software surveyed, those that performed well in functionality and the input/export of raster and vector data, and able to produce Virtual Reality Models included Power Animator, Maya, 3D Studio MAX, FormZ and RealiMation. Using this selection of CAD software, most surface and geometric models can be exported to a Virtual Reality Model. Illustrated in Figure 7 is the possible process of using GIS and CAD software to generate a Virtual Reality Model.

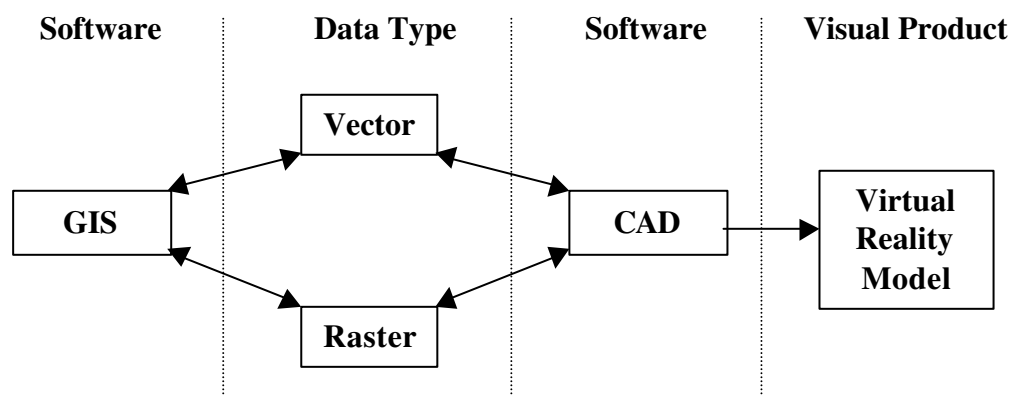


Figure 7: Using GIS and CAD to create a Virtual Reality Model for Visual Simulation

2.6.4 Method 4 - Providing a 3D Application

High-end development of visual simulation of farm forestry layouts entails the same level of interaction as computer and video games. The user can interact with the farm forest layout by walking or flying through the design. The difference between animations or Virtual Reality Models is the complexity that the programmer can use with objects by programming or using functions available within the programming language. Not only can motion be attributed to objects but also other functions, such as collision detection and height above terrain, can be achieved, the complexity of the environment is dependent on the developer. Models and terrains can either be imported from CAD software or created within the software to produce an application that uses OpenGL to generate an application that is portable with real-time 3-D rendering. Figure 8 illustrates the process of using GIS and CAD software to provide the models used by 3D Application software to generate real time 3D graphics.

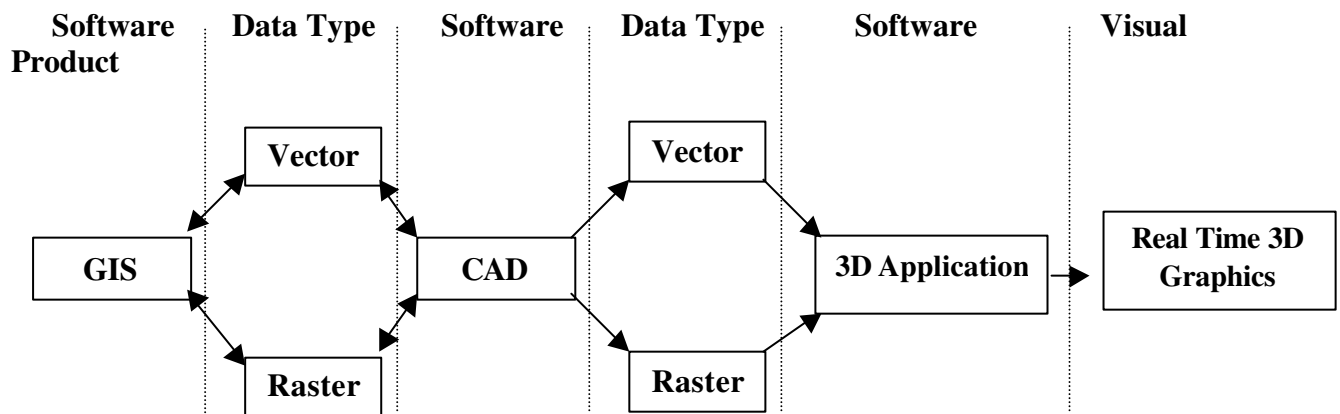


Figure 8: Using GIS and CAD to create a Virtual Reality Model for Visual Simulation

2.7 Evaluation Of Software Survey

Summarised below is a list of limitations of the software survey.

- The survey relies on web site discussions and information. Without actual testing of the software, some Internet sites may be misleading.
- Some of the software surveyed is packaged as modules. The best attempt has been made to include these modules as part of the software surveyed.
- Many Geographic Information System and Computer Aided Design software are available. Software with both vector and raster data capabilities were surveyed to restrict this amount. It is acknowledged that software fitting this category has not been surveyed.
- Some software claims the ability to import and export to other file formats. This can be misleading, as essential data components native to the software could be lost.
- Software is available to convert between file formats. Thus, the ability of software to import and export large varieties of data is not critical.
- Functionality of software has depicted the requirements for farm forestry layouts. It is acknowledged that more functionality options could have been surveyed given greater resources and time for this project.

2.8 Features Required Of The Software

The following is a list of the features examined in the software survey and considered **essential** or **desirable** in the determination of appropriate software to create visual simulations of farm forestry layouts for this project.

Essential Features:

- Overall functionality.
- Scripting language.
- Visibility Assessment.
- Hydrological Assessment.
- Raster & Vector modeling.
- Raster & Vector analysis.
- Data integrity.
- Ability to create realistic models.
- Rendering capability.
- Solid modeling.
- Software compatible with latest hardware and operating systems.
- Compatibility with industry software standards

Desirable Features:

- User-friendly software.
- Compatibility with common Government Department software.
- Software has extensive users throughout the world.

2.9 Appropriate Visual Simulation Method For This Project

The appropriate method for this project to create visual simulations of farm forestry layouts is a combination of method 2 and method 3 as discussed previously in Section 2.6. The method outlined in Figure 9 below has been determined as the suitable visual simulation method for this project, for the following reasons.

- Takes advantage of the unique capabilities of GIS and CAD software.
- A variety of visual products can be generated through this process. Images, animations, and Virtual Reality Models allow catering for projects with different requirements.
- The model(s) from this method can eventually be used to generate 3D Applications if industry standards are followed.
- Landscape Assessment can be incorporated depending on the project requirements.
- The availability of these visual products allows the opportunity to provide an accurate, unbiased and interesting design simulation of farm forestry layouts.

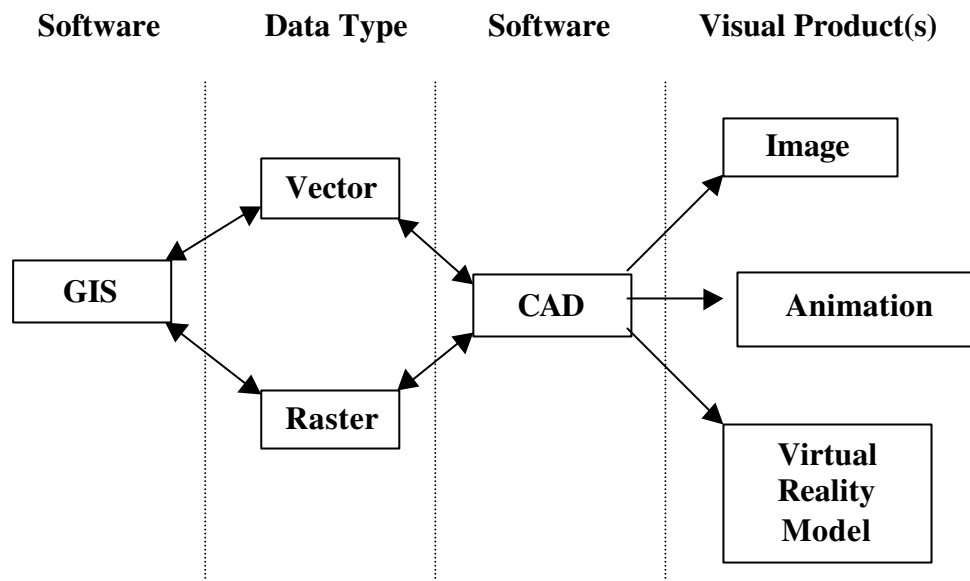


Figure 9: Using GIS and CAD for Visual Simulation of Farm Forestry Layouts

2.10 Appropriate Software For This Project

Of the Geographic Information System software surveyed, the following met the essential and desired feature requirements - *ARC/INFO*, *Grass*, *TNT* and *ArcView*

Of the Computer Aided Design software surveyed, the following met the crucial and desired feature requirements - *Power Animator*, *Maya*, *3D Studio MAX*, *AutoCAD* and *MicroStation*. With respect to the resources available to this project, from the software and hardware available at the University of Western Australia's Department of Geography and School of Architecture Fine Arts and the resources of CALM, the research study team recommend the following software selections:

Option 1 - Software with current facilities and software

ARC/INFO is available within the Department of Geography at U.W.A, and *3D Studio MAX* and *AutoCAD* are available with the Department of Architecture and Fine Arts, U.W.A. Using this software, the following products are possible: images, animations, and Virtual Reality Models.

Option 2 - New software to support current facilities and software.

Virtual Forest with *ARC/INFO* or *ArcView* would assist in generating images and animations when the project requires only the terrain and vegetation to be modeled.

Option 3 - New hardware and software.

Ideally, the best *CAD* software would be *Power Animator* or *Maya*, requiring *Silicon Graphics* machines.

It should be noted that all optional design simulation procedures will require levels of training in their suitable and efficient application.

3. Adapting The Design Simulation Software

3.1 Design of Application

As discussed in the previous Section, the appropriate *method* to create design simulations of farm forestry layouts for this project was identified using, and adapting the unique capabilities of GIS and CAD software. This method is further illustrated as Figure 10 below. For this project, *ARC/INFO* (GIS software) was selected to import, model and analyse the data. *AutoCAD* is the CAD software used to import the data from *ARC/INFO* to create simple tree and terrain models. Using *AutoCAD*, simple models were exported to *3D Studio MAX* where the models were rendered. If required, *3D Studio MAX* would be used to create complex simulation models.

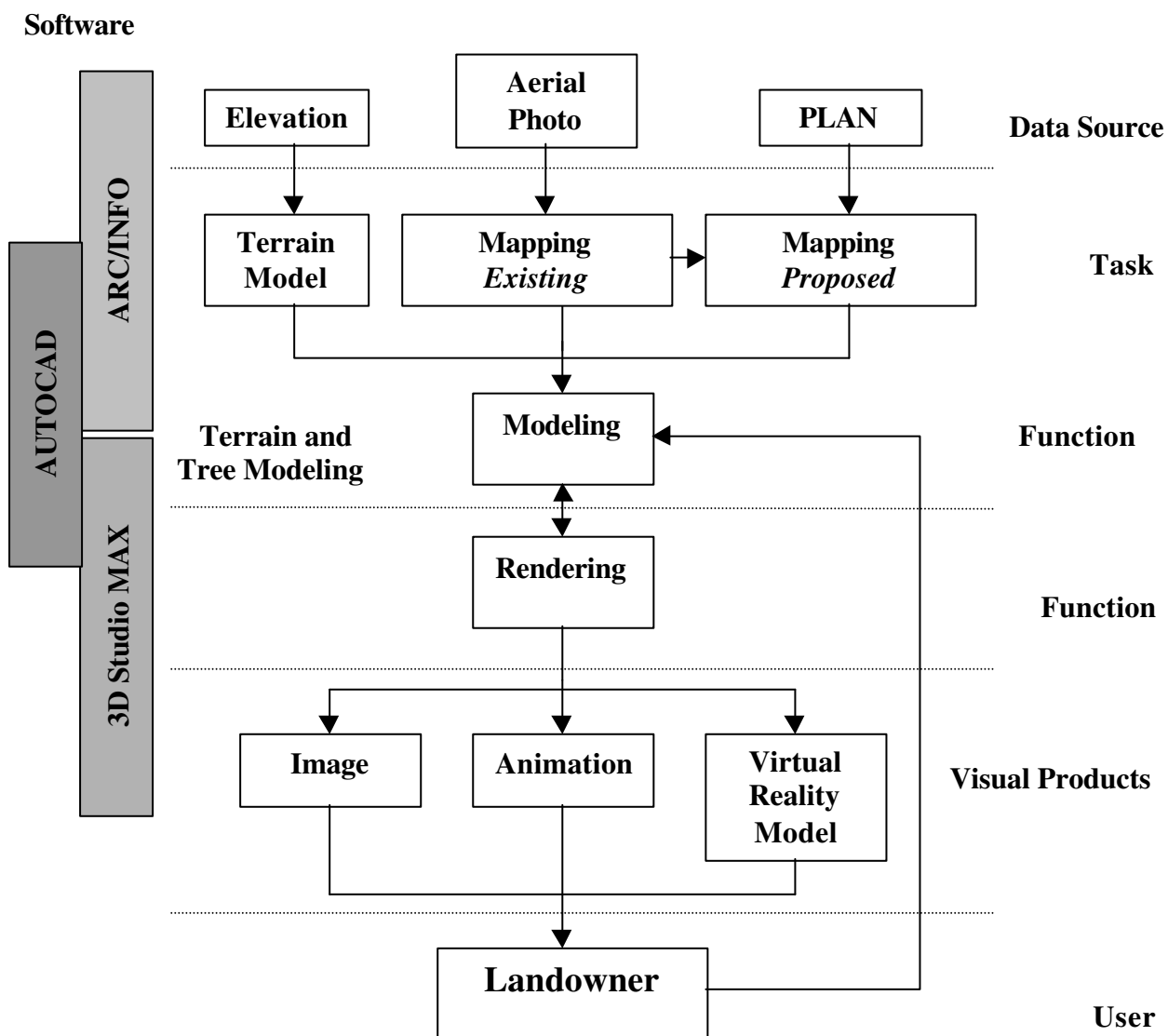


Figure 10 Using ARC/INFO, AutoCAD and 3D Studio MAX to create a Visual Simulation of the Farm Forestry Layouts

Landscape Analysis assists in the process of developing and modeling the Landscape Master Plan. Using ARC/INFO, the following Landscape Analysis was developed for the project case study: watershed boundaries, drainage locations and view-shed boundaries.

The process of incorporating Landscape Analysis and a Landscape Master Plan to create the visual products depicting the proposed farm forestry layout is summarised in Figure 11 below.

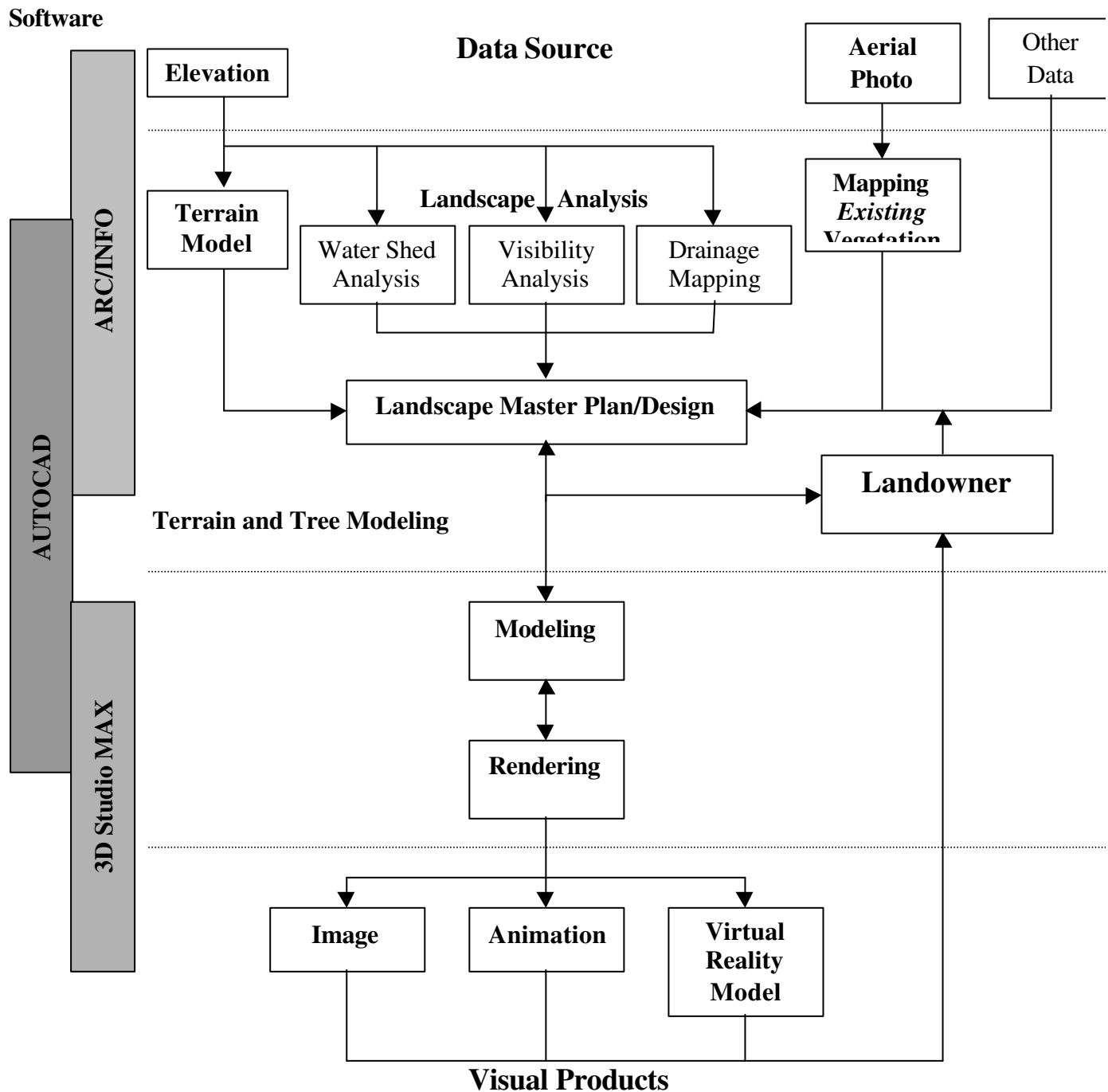


Figure 11 Using ARC/INFO, AutoCAD and 3D Studio MAX to create a Visual Simulation of the Farm Forestry Layouts with Landscape Analysis Features

3.1.1 Simulation Process Tasks

The necessary software application tasks required to create a visual simulation of the Samwell Family case study property in the Boree Gully are detailed below. The unique characteristics of the chosen software from Task 1 (ARC/INFO, AutoCAD and 3D Studio MAX) are described.

(1) Tasks performed using ARC/INFO.

Spatial analysis and modeling functions are the required characteristics of ARC/INFO.

Input

- Elevation data.
- Cadastre data.
- Road data.
- Building location data.
- Dam location data.

Rectify

- Terrain data
- Cadastre boundary data.
- Road location data.
- Building location data.
- Dam location data.

Create

- Terrain model.
- Cadastre, road, dam and building coverages.
- Tree locations and boundaries.
- Watershed boundaries.
- Drainage locations.
- View-shed boundaries.
- Landscape Master Plan.

Visual Product(s):

An aerial photo with the prepared Landscape Master Plan, cadastre, roads, buildings, dams and tree locations were draped over the terrain to create images and animations.

(2) Tasks performed using AutoCAD.

The modeling functions are the required characteristics of AutoCAD.

Input

- Terrain model.
- Cadastre, road, dam and building coverages.
- Tree locations and boundaries.
- Landscape Master Plan.

Rectify

- Terrain data
- Cadastre boundary data.
- Road location data.
- Building location data.
- Dam location data.

Create

- Terrain model.
- Simple tree models.

Export

- Virtual Reality Model.

Visual Product(s):

Terrain and Trees images and a Virtual Reality Model were created using AutoCAD.

(3) Tasks performed using 3D Studio MAX.

Rendering and modeling functions are the required characteristics of 3D Studio MAX.

Input

- Terrain model.
- Cadastre, road, dam and building coverages.
- Tree locations and boundaries.
- Landscape Master Plan.

Create

- Tree models.
- Complex tree models.

Export

- Virtual Reality Model.

Visual Product(s):

Terrain and tree images, animations and a Virtual Reality Model were created using 3D Studio MAX.

3.1.2 Simulation Task Discussion

The AutoCAD DXF file format was used to exchange data between ARC/INFO, AutoCAD and/or 3D Studio MAX. If 3D Studio MAX were to be used to import a DXF file format, point data would be lost. This data is necessary to create the terrain surface and to mark the tree locations. Thus, AutoCAD was used for this process.

Although AutoCAD and 3D Studio MAX share certain functions, each is essential. AutoCAD is required to import point data and 3D Studio MAX is required for quality rendering. For example, AutoCAD can be used to create simple geometric tree models while 3D Studio MAX would be required to create complex geometric tree models with textures and lighting.

3.1.3 Data Requirements

The following Samwell property data was available from CALM.

Cultural data:

- | | |
|------------------------|--------------|
| ▪ Cadastre boundaries. | ▪ Dams. |
| ▪ Roads. | ▪ Buildings. |

Natural data:

- Elevation data at five metre contours.
- Soils - topsoil and top two metres.
- Lineaments.

The minimum data requirements needed to create a visual simulation of a farm forestry layout included elevation data (to create the terrain model) and the existing vegetation data locations. For the Samwell property, elevation data was available however, existing and proposed vegetation data was unavailable. To create existing vegetation data, a digitised aerial photo depicting the vegetation areas was required.

To represent the final farm forestry layout or Landscape Master Plan the required data is often a combination of digital and non-digital data. It is likely that components of the Landscape Master Plan would require digitising to visually simulate the Farm Forestry layout.

3.1.4 Tools Identified

Tools were required to assist in the development of terrain and tree models. Following the visual simulation process outlined in Figure 10, ARC/INFO would be used to create the terrain, while AutoCAD and 3D Studio MAX would be used to create the tree models.

Four general categories emerged when examining the required simulation tools: importing, rectifying, creating, and exporting data.

(1) Importing and Exporting Data

Although the software alone was capable of importing and exporting the data, the visual simulation process would be assisted by the development of a menu driven tool within ARC/INFO. This would assist the user to import and export MicroStation (dgn) and AutoCAD (dxf) file formats.

(2) Rectifying Data

The success of identifying and rectifying errors was dependent on the knowledge and experience of the operator. To create tools to meet the diverse range of errors that may occur is beyond the scope of this project. If the user finds an error while using the tools, appropriate messages will alert the user to the cause of the problem and allow the user to recover. To assist with future projects, errors encountered while using the data made available to this project shall be noted with suggestions about how to fix the errors.

(3) Creating Data

Using ARC/INFO, the tools to create and view the terrain and draped data were available as one application tool. The user interacts with the tool via menus following the steps required to create, model and view the terrain with ease.

The model created in ARC/INFO was further developed using AutoCAD. The terrain surface was derived from point data. The surface can then be exported to 3D Studio MAX. As previously mentioned, if the model were exported directly to 3D Studio MAX from ARC/INFO, point data would be lost.

Spatial data representing the tree locations generated from ARC/INFO act as markers within AutoCAD. A tool was needed to use these markers to locate where simple tree models need to be created. Another tool was required to export the point data into a format that 3D

Studio MAX is able to utilise, without losing data. Following this, a tool within 3D Studio MAX will use this data to create complex tree models with textures.

3.1.5 Application Summary

In summary, the Samwell property located at Boyup Brook in the South West of Western Australia was selected for the case study work. CALM supplied the data of the Samwell property.

The following computer software were adapted to create visual simulations of farm forestry layouts:

- ARC/INFO,
- AutoCAD,
- 3D Studio MAX.

The software has been chosen for the following functions:

- Spatial Analysis,
- Modeling,
- Rendering.

Four general categories emerged when examining the tools required assisting in the process to create visual simulations of farm forestry layouts:

- Importing,
- Rectifying,
- Creating,
- Exporting data.

Using the software and methodology discussed the following visual products will be developed:

- Images,
- Animations,
- Virtual Reality Models.

3.2 Testing The Design Application

Preliminary models were prepared using ARC/INFO and AutoCAD software to digitise a Landscape Master Plan. These models assisted in the evaluation of the data quality and provided an early assessment of the visual imagery of the plan. In response to initial study models that were limited due to available computer hardware specifications (refer to Appendix 6.4), a survey was prepared and conducted with three farmers from the case study area. The purpose of the survey was to understand farmers' perceptions and requirements of computer-modeled agroforestry environments. The outcomes of the survey aim to assist in determining modeling priorities in constructing the visual simulations.

Key references used in developing the survey included Perkins (1992), Reid (1993), Sheppard (1989), Steinitz (1992), Vogel (1996). Two software techniques for creating visual simulations included the use of ARC/INFO and 3D Studio MAX software. The following seven components were used to create the visual simulations and required further investigation:

- 1) Landscape Elements.
- 2) Viewpoints.
- 3) Agroforestry Elements.
- 4) Quality Vs Content.
- 5) Terrain Details.
- 6) Tree Details.
- 7) Level of Image Realism

3.2.1 Survey One Methodology

The survey consisted of four sections. Section A, introduced concepts to the farmers about landscape characteristics and perceptions. Section B presented various agroforestry modeling components and techniques. In Section C the farmers' evaluated prepared images prepared using the simulation techniques identified in the proposed design application. Section D provided an opportunity for the farmers to express their opinions further.

A draft survey was prepared and piloted with a range of students, thirty in total, from the School of Architecture and Fine Arts of the University of Western Australia on June 19, 1999. The students' responses helped to refine the terminology used in the survey questions. The essential findings from the pilot survey indicated that the respondents approved of the level of computer image detail presented to them. The respondents also indicated that the images within the survey need to be presented using a computer, as the differences in image quality between the monitor display, and hard paper copies were too high.

The survey was undertaken with three respondent farmers from the Boree Gully project area, namely M.Gibbs, M.Samwell, and J.Beatty on June 24, 1999.

Section A

The first part of the survey introduced concepts relating to agroforestry environments. The questions attempted to evaluate which landscape or agroforestry characteristics were perceived at a paddock and farm scale. Within the farmer's property, each farmer was required to define important views and the views relevance, and identify major landscape elements required for future computer visual simulations.

Section B

This section of the survey addressed farmer's evaluations of various model components, the level of quality and their effectiveness. Questions focused on the initial models prepared for the Samwell property and their results will assist in the final modeling procedure.

Section C

This section asked the farmers to evaluate three images per modeling technique. The first technique evaluated used ARC/INFO software to generate the terrain and tree models, while the second technique used 3D Studio MAX software. The images presented attempted to model various components discussed within the first two sections of the survey. The outcome from these questions will aid in evaluating the consistency of farmers' responses within the survey. These results, combined with the outcome of the first two sections of the survey, will assist in determining the preferred computer modeling technique for constructing final visual simulations.

Section D

The final component of the survey provided an opportunity for the farmers to express their opinions about any issues within the survey. These issues would then be considered for any additional modifications to the final computer visual simulations.

3.2.2 Survey Results

The survey results are summarized below and have been expanded to discuss the components requiring further research investigation. The detailed responses are presented alongside each survey question in Appendix 6.5, 6.6 and 6.7. A portable laptop computer was used to present the survey to the respondent farmers as was used to document responses. Refer to Appendix 6.4 for a description of this computer. In summary the survey results were as follows:

Section A - Landscape Elements (Questions 1,2,3)

The first three questions of the survey were aimed at encouraging farmers to think about landscape features, and to introduce and explain terminology that would be encountered in the survey.

The purpose of Question One was to identify specific elements of the landscape that farmers associate or perceive with re-vegetation proposals. The final computer visual simulations of the farm forestry layouts would need to model and visualise these elements. All three farmers indicated that the most important landscape features that needed to be visualised were the natural features of the landscape rather than cultural features, including the terrain, water features and vegetation.

Question Two identified what specific features farmers perceived in paddock landscapes. The farmers indicated that they analysed the terrain, and evaluated paddock features such as slope and drainage. Other features included trees and dams. The results from Question Fifteen and Sixteen, which attempted to analyse the ability of the farmer to interpret the qualities in terrain, supported these results.

Question Three investigated the thought process of the farmer, attempting to test how they would rationalise the landscape elements of their properties. The results varied, however each farmer responded with functionality as being of great importance. Here, functionality was referred to as the ability of a landscape or paddock to support the farming land-use activity.

Section A - Viewpoints (Questions 4,5,6,7)

Questions Four to Seven identified what views the farmers believed to be important. From within these views, the farmers were required to identify essential landscape elements. These questions are important for identifying key views and viewpoints and their respective contents worthy of visual simulation. All the farmers responded that views are important from the following viewpoints within their properties: lane ways, high points and ridgelines. The farmers indicated that these views were important for management issues. For example to check the weather, hazards such as fires and to check livestock and crops. The elements of the landscape within these views reflected the results from Question One and Question Two.

Section A - Agroforestry Elements (Questions 8,9,10)

Question Eight sought to identify features of tree plantations and remnant vegetation areas and how farmers distinguish between the two. The farmers remarked that tree plantations represented areas of uniformity in layout, shape, colour, texture and form, while remnant vegetation areas represented areas of non-uniformity. Visually distinguishing between the two agroforestry areas will aid in designing the tree models, which will assist in achieving a level of realism with the final visual agroforestry landscape simulations.

Questions Nine and Ten asked the farmers to establish the level of detail required in the visualisation of terrain and trees respectively. With regard to the terrain elements, the farmers emphasised the close relationship between the elements, form, slope, outline, shape, texture and colour, while their interpretation of tree models placed importance with the trees' overall form.

Section B - Quality Vs Content (Questions 11,12)

The purpose of Question Eleven was to establish the level of quality required of computer generated images, photographically scanned at varying levels of image resolution from 50dpi (dots per inch) to 400dpi. The farmers' results varied, from none of the images being adequate, to all the images being adequate. Each farmer responded that the first two images were blurred (50dpi and 75dpi) and lacked quality, while the remaining images (100dpi, 150dpi, 200dpi, 300dpi and 400dpi) were adequate. Thus ideally, computer generated images will need to have a minimum quality of 100dpi.

Question Twelve asked whether the farmer was responding to the quality or content of an image. Two out of three of the respondent farmers argued that they were responding to both quality and content of an image, while the third farmer argued that he was responding to the image quality only.

The results of Questions Eleven and Twelve reflect that the process of creating computer visual simulations must satisfy the need for quality images, as well as the content within the images.

Section B - Terrain Details (Questions 13,14)

Question Thirteen presented images of the Boree Gully terrain at various levels of resolution. The farmers needed to answer whether the perspective and plan view images suitably represented the terrain of the Boree Gully area. All three farmers indicated that none of the selected images were suitable.

Question Fourteen was used to determine whether vertical scale exaggeration was an influential factor in the interpretation of terrain imagery. Using the terrain from Question Thirteen with the highest resolution, the farmer needed to indicate which vertically exaggerated terrain image suitably represented the Boree Gully terrain. One of the farmers indicated that none of the vertically exaggerated terrains were adequate, as he could not comprehend the terrain's scale. However, the other two farmers answered that the best-represented exaggerated terrain was a factor between three and four.

Section B - Tree Details (Questions 15,16)

Question Fifteen depicted a variety of tree models representing a Pine tree, asking the farmers to indicate whether each tree model was adequate in replicating as a stand-alone

Pine tree. The results varied, one farmer indicated that none of the tree models were adequate due to lack of form and details. One farmer indicated that only two tree models were adequate, the three-dimensional detail ranked first, followed by the two-dimensional outline tree. The remaining tree models were considered inadequate. The remaining respondent farmer ranked the two-dimensional triangle tree first, followed by the three-dimensional detail and finally the two-dimensional circle model, whilst the rest were considered inadequate.

Of the eight tree models presented, only the three-dimensional detail was considered adequate for two out of three farmers. This tree model represented the highest quality from the available selection, with modeled leaves, branches and trunks. However, it also required the most of the very limited computer hardware processing (CPU) resources. The other models were either simple three-dimensional shapes or two-dimensional shapes with no modeled leaves or branches. These models require minimal computer hardware resources. The farmers expected the highest quality tree models when viewed in close range.

Question Sixteen of the survey asks whether the same results occur when the tree models are shown at various viewing distances within an image. Each image contained thirteen tree models that were located at various locations. The farmers were required to indicate which tree models were visually adequate. The first image presented only the three-dimensional detail tree. The second image used only the two-dimensional outline tree model. The last two images were created using a mixture of these two tree models to test if the models were distinguishable and if there were any discrepancies with the results from the first two images presented.

The results of the first image in Question Sixteen were inconsistent. One farmer indicated that all the tree models were adequate. One farmer indicated that the trees in the background were adequate while the trees in the foreground were inadequate. In addition, the last farmer indicated that the trees in the foreground were adequate, and the trees in the background were not adequate. The second image results varied slightly. The general response was that the middle ground and background trees were adequate. The results from image three and four, reflected the same as image one and image two.

These survey techniques will be of great assistance for the modeling of trees, however further work is required for close-up tree models. For example, one farmer commented about the depth of a particular tree model, which he considered adequate. However, the next tree model, which was positioned further away, had the same texture and outline and was considered inadequate. The only difference between the two tree models, was the textures position.

This result was unexpected, as the pilot survey indicated that as the position of the tree models moved further away, the more likely the farmers would visually accept the representation of the tree models.

Section B - Level of Image Realism (Questions 17)

By this stage of the survey, it was considered that the farmer would be familiar enough with the language to answer Question Seventeen, identifying what characteristics were helpful to convey visual realism in agroforestry landscapes. The form of the terrain and vegetation were the main visual characteristics identified. The farmers also emphasised the need for

more detail of the survey examples provided. As the survey was asking specific details about the components of agroforestry landscapes, these results were expected. These details will be helpful in the modeling stage of the visual simulations. The images presented from Question One to Seventeen did not attempt to represent agroforestry environments, rather, the components of these environments.

Questions Eighteen to Twenty Two of the survey presented images that represented agroforestry landscapes. By placing components together, the aim was to establish if the farmers viewed these visual components separately, or understood the components in a greater landscape context.

Section C - Technique One Using ARC/INFO to Create Visual Simulations (Questions 18,19,20)

The first technique presented to the farmers used ARC/INFO computer software. Three images were shown to represent an agroforestry environment using this technique. The first image represented a large land area, with an aerial photo draped over a vertically exaggerated terrain model. The second and third images presented the same terrain with draped aerial photo and mesh lines, but from a ground perspective. The second image had tree symbols placed in an area that represented a treed area, and the third image had no tree symbols.

Question Eighteen asked the farmer to identify the objects within the images. The purpose of this question was to understand how much landscape detail the farmers actually perceive. With the first image, each farmer was able to distinguish the following objects: roads, vegetated areas, paddocks, boundaries, dams, homesteads and the terrain. The second image caused some difficulty; the farmers could not clearly identify the terrain and the trees. The third image presented to the farmers again caused some confusion. Although they identified the image to represent a terrain, they were not satisfied of its authenticity.

Question Nineteen asked the farmers whether these images were useful to gauge the possible visual impact of the agroforestry work. The first image yielded the best response from the farmers. The farmers thought that this image would be a useful tool for visual impact evaluation because they could clearly identify the objects at a regional perspective and see the relationships of the objects. This scale represented an area that they were familiar with, due to the common use of maps. One farmer commented that the vegetation needed more visual form. With the second image, the farmers commented that they appreciated the perspective view, but the trees lacked detail and form. It was difficult for them to gauge any visual impact. The farmers thought that the third image was not very useful for evaluating potential visual impact of agroforestry improvements, which was the anticipated response, as the terrain was the only object presented.

The final question about the ARC/INFO generated images was included in Question Twenty, asking respondents what was missing from the images. The farmers commented that the trees used in the images lacked visual form and detail. In regard to the terrain, they would prefer more colours and textures with more visual clarity.

Section C - Technique Two Using 3D Studio MAX to Create Visual Simulations (Questions 21,22,23)

The comments about lack of vegetation form with the ARC/INFO images was predicted and is why a modeling tool such as 3D Studio MAX was initially chosen to create the visual simulations. It was recognised that the ARC/INFO images would be useful for displaying regional perspectives as depicted in the first image and accordingly it was considered valuable to evaluate this benefit.

As with Question Eighteen, Question Twenty-One asked the farmer to identify objects within the three images. The images were created using 3D Studio MAX and used a similar display format as presented with ARC/INFO images. The first image used a regional perspective with an aerial image draped over the terrain. Each farmer was able to distinguish the following objects: roads, vegetated areas, paddocks, boundaries, dams, homesteads and the terrain. In the second image, the farmers were able to distinguish fences, trees and the terrain. The farmers were able to identify the terrain and trees within the third image.

Question Twenty-Two asked the farmers whether these images were useful to gauge the possible visual impact of the agroforestry improvement. Two of the three farmers agreed that all the images were useful, however one farmer argued that none of the images were useful. The farmers that agreed with the first image commented how they appreciated the regional scale relationship of the objects. The farmer that did not agree preferred a closer perspective within paddock scales. The second image received the best response from the farmers. Two of the farmers remarked that the scale was appropriate and that the terrain and the trees were realistic. The third image received similar comments as the second image.

The last question of the survey, Question Twenty-Three, asked the farmers what was missing from the 3D Studio MAX generated images. The general response from the farmers indicated that the terrain needed further exaggeration and the terrain needed "realistic" improvement with surface textures that reflect either toiled soils or crops. The farmers commented that the tree form needed improving, especially at close viewpoints. One farmer remarked that close viewpoints were not necessary and that it would be better to have an overall regional perspective view instead.

Section D - Survey Comments

Briefly, the following comments were made by the farmers regarding their expectations and desires of computer visual simulations to suitably represent agroforestry landscapes.

- The visual simulations of the agroforestry improvements need to be more realistic.
- Further image textures are required.
- Textures and colours need to represent various seasons.
- Individual tree models need to be more realistic.
- Views need to be more representative of the Boree Gully environment.

3.2.3 Survey Limitations

This survey was undertaken with the three farming families participating within the Boree Gully project area. Consequently, the results are specific to the Boree Gully landscape

condition both physically and socially, and may have limitations for their broader application in farm forestry projects. Nonetheless, the study team considered that particular local conditions needed to be surveyed and incorporated into landscape assessment and design projects of this kind. The study methodology, however, now provides a framework and a set of computer design principles that can be incorporated in related farm forestry computer design simulation work.

This phase of the study had identified the following future research opportunities:

- The specific visual details of vegetation models that provide a greater level of perceived visual realism.
- Computer hardware specifications required to match detailed, realistic vegetation imagery.

3.2.4 Discussion

The survey results indicate that computer visual simulations representing Farm Forestry layouts need to contain large amounts of visual information to successfully represent the proposed landscape.

An aerial photograph draped over a terrain, viewed at some distance from the site, is visually satisfactory according to the survey results. This was considered acceptable, as aerial photography are common tools as visually representing landscapes. However, when the same aerial photograph is draped over the terrain and viewed from a ground perspective, the image becomes pixelated and unsatisfactory. A higher resolution scanned aerial photograph draped over the same terrain attempted to rectify this, yet was considered unsatisfactory according to the survey results. Thus, the use of aerial photo draping is a tool adequate for aerial perspectives only. Either ARC/INFO or 3D Studio MAX software is capable of creating these images.

The survey displayed that the respondent viewer suitably reads the aerial photograph at some distance, as the untrained eye does not interpret form well. For example, tree height. The viewer interprets the aerial photograph by association, such as the shape, outline and colour of an area and then perceives that the area is vegetation in context to scale. However, enlarging the same area, these features loose context, and are hard to interpret.

These same principles also apply to the perception of computer tree details. Within the survey, the respondent farmers were asked to evaluate individual tree models. Suitable tree models were then evaluated at various distances. The responses indicated that the trees in the background and middle ground were adequate, while the same tree in the foreground was inadequate. Trees in the background and middle ground were considered acceptable, as the associated detail expected in the foreground were not expected.

As discussed earlier in the design of the application, the best available software for creating detail computer tree models is 3D Studio MAX. Initial visual simulations using detailed computer tree models were prepared using this software. Although the software was capable of creating and managing large amounts of trees, the available hardware was unable to manage the model byte sizes (Refer to Appendix 6.4 for hardware specifications). High-end super graphics machines are required for such computer modeling. To overcome these difficulties simple yet detailed tree models are recommended to replace the complex tree

models. These tree models are adequate for treed areas in the background and middle ground of the visual simulations, however, are not adequate in the foreground as suggested from the survey results. Instead, tree models in the foreground will act as markers within a "paint" software package, where the tree models will be graphically corrected. Corel Paint Version 7 is recommended as suitable "paint" software as it is readily available to the study team. Figure 1, noted earlier in the report in the Executive Summary illustrates the revised design application process and incorporates the application of Corel Paint Version 7 to suitably detail foreground image details.

In summary, the above survey highlighted the need to amend the process and techniques of developing suitable computer models for simulating farm forestry landscapes. Corel Paint Version 7 computer software was selected to improve the rendered images produced using 3D Studio MAX computer software.

In summary, the following computer modeling techniques were defined to assist in developing the final computer visual simulations of farm forestry layouts:

- Terrain models need to be vertically exaggerated to three or four times.
- Foreground tree models need to be detailed in their designs - including texture, shape, form and colour elements.
- Middle ground trees in the middle ground need to be detailed, but tree models with appropriate outlines simulating the detailed trees can be strategically placed to achieve the same effect.
- Simple background tree models are adequate.
- Views would ideally be located from lane ways, ridgelines and high points.
- Computer generated images need a minimum resolution of 150 dpi.
- The final visual simulations will need to consider content and context of the farm forestry landscape, to include elements such as surrounding paddocks fence lines, access points and existing vegetation.

4. Re-Adapting The Design Simulation Software

4.1 Introduction

To incorporate the simulation image requirements from Survey One, discussed in the previous Section, further software adaptation was undertaken. Due to the available computer hardware specifications, tree models with high levels of detail were not used. Instead, basic tree computer models were used. Using *Corel Paint* software, the images of these basic tree computer models were enhanced with tree images cloned from photographs. This methodology attempted to capture the high level of colour, texture, form and shape that had been identified as important by viewer respondents from Survey One. A second survey was undertaken to ascertain the suitability of the improved simulated farm forestry layout images, as well as their corresponding readings of visual impact.

4.2 Survey Two Methodology

A survey questionnaire was designed to allow respondents to evaluate the potential visual impacts of farm forestry layouts simulated on the screen of a portable laptop computer. Respondents were asked to score each image presented from –10 (strongly dislike) to +10 (strongly like). Ten respondents from the Boree Gully community participated in the study, undertaken over seven days, in July 1999. Refer Appendix 6.8 for a copy of the survey.

Three introductory images of the Boree Gully rural landscape were shown to the survey respondents. The first and second test images were scanned photographs, while the third image was a scanned photograph modified with additional vegetation.

The fifteen images presented in the survey consisted of three categories. The first category consisted of scanned photographs without any modifications. In the second category, the images presented were scanned photographs modified using the techniques identified from the previous study findings, in conjunction with images created from computer models. The third category included images prepared from computer models enhanced by cloning details from photographs.

All images presented in the survey had a resolution of 150 dots per inch - the minimum acceptable resolution identified from previous survey evaluation. The dimensions of each image were approximately 800 by 600 pixels. These specifications allow images to be readily transferred via the Internet or via floppy disk.

Category One Images – Scanned Photographs Only.

As part of the survey, the respondents were asked to evaluate scanned photographs that were not modified. The photographs represented the Boree Gully rural landscape. These images presented a further opportunity to understand whether the respondent evaluated the image quality and/or content. The unaltered images also provided an opportunity to compare the various details interpreted by the respondents.

From the fifteen images presented in the survey, the following images were scanned photographs without modifications: Images One, Two, Seven, Nine, Twelve, Thirteen and Fourteen. From these images, the case study farmer identified the following as important viewpoints: Images Seven, Thirteen and Fourteen. Images One and Twelve were also taken

within the case study property, while images Two and Nine were not, but can be found within a five-kilometre radius from the case study property.

Of the images selected for the survey, various lighting conditions had been chosen to represent various times of the day. The purpose was to test whether the respondents are evaluating the content or the quality of the image. Images One, Two and Nine were taken at midday, while images Twelve, Thirteen and Fourteen were taken at dusk and image Seven was taken in the morning. All the images were taken during the winter season in July 1999. These images had also been chosen to represent various stages of vegetation development to investigate respondents' preferences to shape, age, colour and texture of the vegetation.

Category Two Images – Scanned Photographs with Computer Enhanced Modifications.

The survey respondents were asked to evaluate images representing photographs that had been modified to meet the improved techniques. The applied techniques involved a computer model of the case study property where the terrain had been vertically exaggerated by three times, with simple tree computer models placed within existing and proposed vegetation areas identified within the proposed Landscape Master Plan. Photographs taken from viewpoints identified by the case study landowner were manipulated to be overlayed on to images that were created from the computer model.

To verify the tree positions within the landscape computer model, the tree models were colour coded, the colours matching various components of the proposed Landscape Master Plan design. Existing vegetation was matched with the vegetation within the original photograph. Proposed vegetation was verified by changing the transparency level of the overlayed photograph. If any of these components were visible within the overlayed image the photograph was enhanced to incorporate the proposed design, refer to Figure 12 below. Where possible, these enhancements used components already available within the image. For example, if a *Pinus radiata* plantation was already captured within the image and needed to be portrayed elsewhere within the image, the plantation would be visually cloned. If the component was not available within the image, other images from the Boree Gully landscape were used instead.

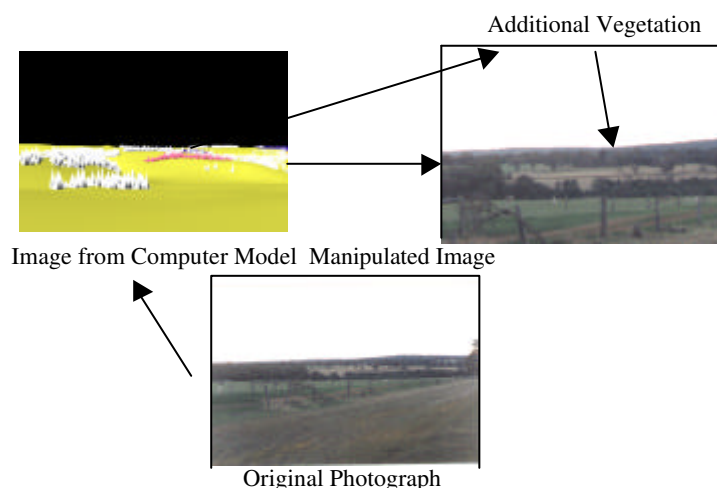


Figure 12 Methodology For Creating Category Two Images.

From the fifteen images presented in the survey, the following images were scanned photographs with modifications: Images Three, Five, Ten, Eleven and Fifteen. As previously identified by the case study farmer, Images Three, Ten and Fifteen were considered important viewpoints. The remaining images, images Five and Eleven were taken within the case study property. Images Three and Ten were taken at dusk, images Five and Eleven at midday and Image Fifteen was taken in the morning. All the images were taken during the winter season in July 1999.

All the images prepared within this category were based on original photographs presented in Category One of the survey methodology. This provided an opportunity to evaluate how the respondents would interpret image quality, content and various image details. Briefly, the matching image pairs were as follows: Images One and Five, Seven and Fifteen, Twelve and Eleven, Thirteen and Ten and Fourteen with Image Three.

Category Three Images – Computer Models From Photographs.

These images were developed with the application of textures cloned from scanned photographs taken within the Boree Gully rural landscape, as well as computer images created using a computer model of the case study property. These images were created without the aid of viewpoint photographs, relying on the computer model quality to position the image elements correctly.

The purpose of this category was to evaluate the respondents' observations towards surreal images with photographic quality images. The technique of applying textures from photographs to the computer tree model images was adopted due from previous identified techniques. Briefly, it was found that the possible computer tree models developed from using the available hardware were inadequate. The cloning technique of creating imagery was given preference.

Survey images that adopted this technique were Images Four, Six and Eight. All three images represented viewpoints within the case study property. Image Eight represented a viewpoint identified by the case study landowner as important and needed to be visually simulated with proposed farm forestry improvements.

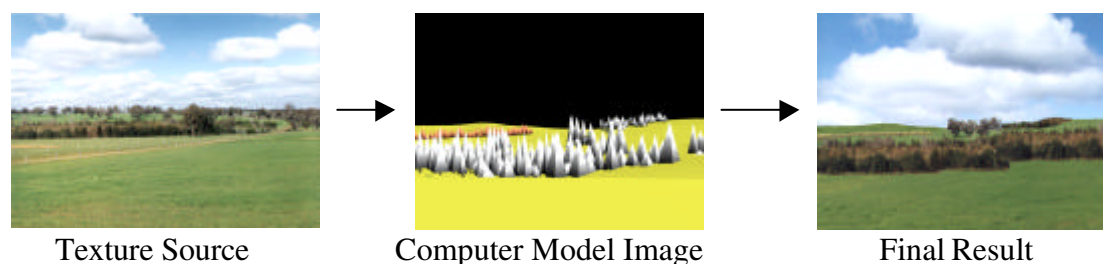


Figure 13 Methodology For Creating Category Three Images.

Figure 14 Survey Two Images (below)



Introductory
Image



Introductory
Image



Introductory Image



Image One - Category One



Image Two - Category One



Image Three – Category Two



Image Four - Category Three



Image Five - Category Two



Image Six - Category Three



Image Seven - Category One



Image Eight - Category Three



Image Nine - Category One



Image Ten - Category Two



Image Eleven – Category Two



Image Twelve - Category One



Image Thirteen - Category One



Image Fourteen - Category One



Image Fifteen - Category Two

4.3 Survey Results And Discussion

The survey results are presented below, grouped according to Image Category type. A portable laptop computer was used to both present the survey and record results from the respondents. Refer to Appendix 6.4 for a further description and specifications of this computer.

Category One Images – Scanned Photographs Only.

Of the seven images in this category, five images were scored positive, i.e. likable (the score was greater or equal to three) and two images were positively neutral (the score was greater than or equal to zero and less than three). The average score for this category was 3.5. Briefly, the scores have been summarised in Table 1, for further analysis see Appendix 6.9.

Image Number	Average Score	Lowest Score	Highest Score
1	3.2	-10	8
2	5.6	0	10
7	5.4	2	10
9	4.0	-5	8
12	2.8	-5	8
13	0.2	-10	10
14	3.3	-5	8

Table 4 Respondent Scores For Category One Images.

The purpose of showing Boree Gully rural landscape photographs was to understand whether the respondents are evaluating the content and/or quality of the images and to compare the results when these images have been modified to incorporate the design ideas of the proposed Landscape Master Plan

From the seven images in Category One, the case study landowner responded with four values that were greater or equal to the average score (Refer to Appendix 6.10). The remaining images were below the average score. The landowner knew where these images were taken from, as five of the images were taken of his property and the remaining two were taken nearby. He was fully aware of the content within these images. However, the results indicate that the highest factor for these low scores (Images One, Seven and Thirteen) was the quality of the image. Blurred and grey images (due to dusk lighting) were considered unappealing, even though the contents were correct. This survey did not evaluate enough seasonal and lighting conditions too fully support and test this evidence.

The results from respondents of the Boree Gully landscape area were slightly different from the landowner. Comparing the average scores, five out of the seven images brought results that were equally divided. For example, two respondents' results were above the average and the other two respondents' results were below. In regard to the two remaining images, the Boree Gully respondents scored Image Seven below the average, and Image Twelve above the average. These results reflected the difficulty of interpreting people's responses to the same image, even though these respondents were from the same rural landscape area and presumably interact with the same landscape daily.

Comparing the results from non-Boree Gully residents, with the case study landowner, only three out of the seven images shared similar values compared to the average score. These were Images Two, Seven and Nine. Both types of respondents were satisfied with the image's composition, colour, texture, terrain shape and visual penetration.

Of the remaining images that the case study landowner and non Boree Gully residents differed, Images Twelve and Fourteen were rated higher by the case study landowner (compared to the average score) than the non Boree Gully residents. Both these images were taken during days of overcast and near the time of dusk. The landowner commented that he appreciated the time that these photographs were taken and thought that these images were realistic with respect to the textures, colours and lack of clarity. However, the non-Boree Gully residents did not appreciate these visual features and scored accordingly.

Comparing the Boree Gully residents with non-Boree Gully residents, significant differences occurred. Image Seven was the only image scored below the average by both groups. Generally, both groups liked the image (second highest average), however, both groups commented about how the lighting, affected the image clarity. The remaining images were scored significantly different. The entire Boree Gully residents' scores were divided evenly compared to the average score, except for Image Twelve. However, the non-Boree Gully residents scored four images above the average, one image below and one image split evenly. These results indicate that non-Boree Gully residents have a strong preference for the following visual elements within the selected imagery:

- Well defined and proportion composition.
- Well-defined textural boundaries.
- Plenty of mature trees.

Category Two Images – Scanned Photographs with Computer Enhanced Modifications.

Of the five images fitting this category, one image was scored positive (the score was greater or equal to three); one image was positively neutral (the score was greater than or equal to zero and less than three), while three images were scored negatively neutral (the score was less than zero and greater than negative three). The average score for this category was 3. Briefly, the scores have been summarised in Table 2, for further analysis see Appendix 6.10.

Image Number	Average	Lowest Score	Highest Score
3	-2.2	-10	3
5	-1.1	-10	6
10	-0.9	-10	10
11	3.9	-1	8
15	1.3	-5	8

Table 5 Respondent Scores For Category Two Images.

Category Two images were prepared by modifying photographs to satisfy the techniques previously identified in the research findings. Images prepared from computer models were used to position proposed vegetation from the Landscape Master Plan prepared for the case study property. Vegetation textures were then cloned onto the image where proposed vegetation was visible. No respondents were able to distinguish the visual impact from modified images of this category. After the survey, some respondents requested that some related images be shown together, as they could not recall any major differences between them. Respondents were quick to identify differences with the images in the foreground, however many respondents could not identify image changes in the middle and background.

However, differences were identified when average scores were compared between modified and original images. From the five images, Image Eleven was the only modified image where the modified image (Category Two) had a higher average (Refer to Appendix 6.10) compared to the original image (Category One). The major visual differences between the two images included:

- Strengthening of image composition.
- Enclosing edge boundaries.
- Reduction in visual penetration distance.
- Increase in vertical exaggeration of the terrain.
-

The modified (Category Two) Images Three and Five had negative neutral average scores, however, the original images (Category One) received positive average scores by the respondents. The major visual differences between the two images included:

- Reduction in view shed width.
- Increase in foreground height (I.e. change of composition).
- Reduction in image clarity.

The image with the smallest decline between the original and modified average score was Image Ten (Category Two). Increasing the vertical exaggeration of Image Thirteen (Category One) and a reduction in the foreground height produced Image Ten. Both images received neutral average scores by the respondents. To improve these two images, it was suggested by respondents that:

- The visual clarity be improved.
- The images should be taken in times from 10:00am to 3:00pm.

The source of Image Fifteen, Image Seven received the highest average score by the survey respondents within Category Two. However, the modified image (Image Fifteen) did not receive a similar response. The main reasons included:

- A reduction in image visual clarity.
- Did not appreciate the swamp like tree textures.

Category Three Images – Computer Models From Photographs.

Category Three images were prepared by cloning textures on to computer model generated images. Although the three images fitting this category did not generate high average scores, (all three averages received positive neutral scores) the range of scores by the

respondents was the lowest compared to Category One and Two. This may indicate that the respondents were interpreting these images in similar ways. The average score for this Category was 1.9. Briefly, the scores have been summarised in Table 3. For further analysis see Appendix 6.11.

Image Number	Average	Lowest Score	Highest Score
4	1.6	-6	9
6	2.7	-4	9
8	1.5	-4	5

Table 6 Respondent Scores For Category Three Images.

Comparing the number of Boree Gully respondents' scores to the average, Images Six and Eight received three out of four scores below the average and Image Four was split evenly (Refer to Appendix G5). However, the number of non-Boree Gully respondents' scores to these three images was clearly above the average (Refer to Appendix G6). Thus, there is a clear distinction in how these images have been interpreted between Boree Gully and non-Boree Gully respondents.

The scores by the Boree Gully residents reflected their dislike to these three images and the scores by the non-Boree Gully residents indicated their approval. However, both groups shared similar comments, with how to improve the likeness of these images, listed below:

- Improve texture qualities by increasing definition.
- Increase range of colours.
- Improve reality.
- Use natural edges.
- Improve tree spacing and positions.
- Increase object definition.
- Increase visual penetration to be able to interpret terrain.
- Improve image composition.

Although the Boree Gully residents ranked these three images with below average scores, elements of these images did appeal to them. Briefly, listed below are elements that appealed to the Boree Gully and non-Boree Gully residents.

- Number of trees portrayed.
- Maturity of trees.
- Terrain is appealing.
- Scale and proportions are correct.
- Textures are appealing.

4.4 Survey Limitations

Ideally the amount of people surveyed from the rural and urban community needs to be increased to diversify the responses. A sample of ten respondents was very limited. A

larger range of images also needs to be surveyed that reflect various levels of image quality, image content and seasonal conditions. Both of these limitations would be overcome with greater research resources. The study methodology, however, now provides a valuable and workable framework that has adapted and evaluated computer design principles that can be incorporated in related farm forestry computer design simulation work elsewhere.

Further studies will need to consider re-evaluating the methodology of displaying visual images to the survey respondents. Problems were encountered with the image preparation methodology, as there was a large colour variation between computer monitors used in the laboratory and the computer monitor used in the survey in the field. It is suggested that further studies restrict the lighting environment and the types of computer monitors used. Problems were also encountered by reducing the image resolution and image file size to a standard that can be transferred via the Internet or floppy disk. For example, some images were reduced from forty megabytes in file size to one megabyte. These techniques reduced the available colours and reduced the contrast of the images. Consequential influences on the public's evaluation of these images need to be studied.

4.5 Future Research Potential

Results from this survey have indicated that further research is required in the following areas of computer image development:

- Tree and terrain visual texture quality.
- Visual penetration. The ability to see into a patch of trees.
- Terrain form. Referring to vertical exaggeration and distance zones.
- Position and shape of trees. Proportions and scales of the trees relative to the viewing position.
- Image composition. The collection of different visual elements into a satisfying and identifiable whole image.
- Techniques of displaying images to respondents, using computers.

Future computer generated images require a large source of material to obtain realistic textures. A library of such visual materials could be developed with the following feature requirements:

- Need to depict various vegetation species types.
- Need to depict various times of the day from dawn to dusk.
- Need to depict various seasons.
- Images of agroforestry features need to be taken at various distances from the source, e.g. Fore, Middle and Background distance zones.
- Investigate image acceptability using various computer monitors.

It is recommended that further research depicting agroforestry environments with various degrees of terrain form; visual penetration; tree shapes; tree positions and image composition, will assist greater understanding of how humans perceive the positive and negative impacts of these environments and help determine their influence in the development, acceptability and implementation of farm forestry layouts.

5. Summary of Conclusions And Recommendations

5.1 Key Research Findings

In summary, the research initially investigated the range of available design software products, evaluated their advantages and disadvantages, and determined the most suitable software in the context of current farm forestry practices. The software review process included the development of the evaluation criteria; identified alternative visual design procedures, products, simulation outcomes and their preferred methods of creation.

For the purposes of this study, the most suitable combination of adaptive software included Geographic Information System (GIS) software, and Computer Aided Design (CAD) software. The software nominated for use in this project included *ARC/INFO*, *3D Studio MAX* and *AutoCAD*. These packages met the criteria of data compatibility and were able to create the following visual simulation products: images; animations; and virtual reality models. The availability of these visual products offered the opportunity to provide an accurate, unbiased and graphically interesting design simulation of the proposed farm forestry layouts.

Actual visual image products were created from the above computer models simulating the terrain and re-vegetation features of a proposed Landscape Master Plan. The prepared computer models assisted in the evaluation of the data quality and provided an early assessment of the visual imagery of the design plan. Poor image qualities, principally due to the available computer hardware resources, prompted the development and undertaking of a survey with local farmers to further understand farmers' perceptions and requirements of computer modeled agro-forestry environments.

Survey One highlighted the need to amend the process and techniques of developing suitable computer models for simulating the selected farm forestry landscapes. The following improvements were identified:

- Terrain models needed to be vertically exaggerated to three or four times;
- Foreground tree models needed to be detailed in their designs - including texture, shape, form and colour elements;
- Computer modeled trees in the middle ground needed to be detailed, but tree models with appropriate outlines simulating the detailed trees can be strategically placed to achieve the same effect;
- Simple background tree models were adequate;
- Views should ideally be located from lane ways, ridgelines and high points across the landscape;
- Computer generated images needed to be of a minimum resolution of 150 Dots per Inch (DPI); and
- The final visual simulations needed to consider content and context of the farm forestry layouts, to include elements such as surrounding paddocks, fence lines, access points and existing vegetation.

Corel Paint Version 7 computer software was selected to incorporate the above recommendations and to improve the rendered images previously created by *3D Studio MAX* computer software. Three new categories of images, prepared from specific viewpoints identified by the Samwell family, were trialled. These were:

- Category One: Scanned photographs without modifications;
- Category Two: Scanned photographs modified by superimposing computer-modeled imagery for scale, proportions and agro-forestry layouts; and
- Category Three: Cloning textures onto images prepared from computer models.

A second survey questionnaire was prepared and conducted to evaluate observer perceptions and preferred requirements of the revised computer modeled, simulated agro-forestry landscapes.

In summary, Category Two images involved the manipulation of scanned photographs and achieved the best survey results. Under the conditions of this study, no respondent was able to distinguish the modifications made to these images. The simulation techniques applied to these images were capable of effectively representing a level of authenticity to the observer while conveying the potential visual impact (positive and negative) of the proposed farm forestry layout.

Category Three images, involved applying cloned textures onto computer generated images and were not considered as authentic visual representations by the survey respondents. However, critical responses have been recorded, assessed and documented, which will aid in future image software adaptation and development.

No survey respondent was able to visually distinguish the computer-simulated modifications made to the realistic images that adopted the advanced Category Two software preparation techniques. From within the participatory evaluation methodology and framework of this study, it can be concluded that the recommended software adaptation techniques provide effective and efficient simulation tools for evaluating the visual impact of proposed farm forestry layouts.

For the purposes of visualising and evaluating the visual impacts of farm forestry layouts, it is recommended that the best currently available Computer Aided Design and Image Development software would be *Power Animator* or *Maya*, requiring *Silicon Graphics* hardware. The appropriate computer hardware would aim for the fastest Central Processing Unit (CPU), the largest amount of Rapid Access Memory (RAM) and hard drive space.

5.2 Research Evaluation

The research processes and outcomes of this study are evaluated using the criteria of assessing Landscape Quality methodologies established by Daniel and Vining, 1983, as follows.

Reliability and Sensitivity

The methodology adapted in this study to create computer generated images relied on public survey evaluation techniques and the expert application of these findings. Reliability of these images depended on the consistency and accuracy of the individual researcher applying the method. The accuracy of Category Two Images has been increased with the use of Globally Positioned Systems (G.P.S.) to locate the viewing position, in conjunction with the use of geo-referenced computer models.

Although Category Three Images used geo-referenced computer models, the application of cloned textures on these images relied on the accuracy skills, and abilities of the computer operator. The survey results indicated that these images were not very successful due to the anomalies in texture appearance. To improve this technique, it has been suggested that a resource library of photographic imagery be developed, where the specific textures at various times of the year and lighting conditions can be clone. If records are kept of the lighting conditions, time of day, direction and position of the photographs, and object types the accuracy to create Category Three Images could be significantly improved.

It should be noted that the *reliability* and *sensitivity* of the image simulations and their corresponding impact assessment procedures followed a farm forestry landscape plan designed in collaboration with the case study property owner. It is felt that this 'ownership' of the design influences the way the farmer perceives the near realistic simulated images and their associated impacts. Such influences need further research.

Validity

The research attempted to refine the methodologies to adapt computer software to evaluate the visual impact of farm forestry layouts. Software adaptation techniques were adapted and re-adapted and applied to create the three final Image Categories. These resultant images were then evaluated by a limited sample of ten respondents. The research methodologies provided a valuable and workable framework of adapted and evaluated computer design principles that can be incorporated in related farm forestry computer design simulation work elsewhere.

Survey Two attempted to specifically question whether the respondents were evaluating image content, quality or context. It is acknowledged that the analysis of these characteristics of the landscape was not fully explored. These characteristics require further respondent analysis to assist in developing effective computer models.

Utility

Computer modeling of large-scale agroforestry type landscapes can be achieved. With sufficient hardware and software resources, farm forestry layouts can be modeled with efficiency and accuracy to provide useful visual products. These products have not been commonly available to landowners. However, caution is warranted, as the respondents in this study expected a large amount of image detail. Current standard computer equipment is not sufficient to achieve large amounts of detail using computer models of rural landscapes. Necessary computer requirements, including operation skills, are unlikely to be available to the average user. However, the standard computer user can access some visual products, including images and animations, which can be readily transferred or requested via the Internet.

Further research is required to investigate the feasibility of having landowners access this equipment or receive the visual products from planners and designers via the Internet. Inconsistencies may occur (such as lack of colour quality) between the source and user computer hardware and software. It is acknowledged that the Internet allows people to access Web Sites using a large range of computer hardware, however the lowest common denominator is required. The study has indicated further research is required that defines acceptable levels of image quality. The use of floppy disks or Internet standards reduces the quality image, and thus their acceptability.

The potential commercialization of an ‘on-line’ image service bureau needs further exploration. Such services could be integrated into the planning and design support programmes of farm forestry agencies like CALM.

Valuation

The social value construct of ‘likeness’ was selected to judge the potential visual impact of the simulated farm forestry images in Survey Two. ‘Likeness’ embraces a range of social values including visual quality. It was considered important to keep the *construct* of landscape quality as broad as possible and most importantly survey the respondents as to why they valued the simulated image. Therefore, to encourage responses that would define respective valuations. The valuation methodology used in this study is based on a hybrid of assessment methodologies (i.e. Formal Aesthetic Model, Psychophysical Model, Psychological Model and Phenomenological Model – see Daniel and Vining, 1983). Until researchers gather a range of knowledge sets concerning the representation and assessment of re-vegetated landscapes, methodologies should be kept as broad as possible to capture a wide range of responses. In time, this body of knowledge will help provide more definitive reasons for preferences to rural re-vegetated landscapes.

5.3 Study Limitations

Ideally the numbers of people surveyed from the rural and urban community needs to be increased to diversify the responses. Samples of three and ten respondents, respectively for Surveys One and Two, were very limited. A larger range of images also needs to be compiled to reflect various levels of image quality, image content and seasonal conditions. Both of these limitations would be overcome with greater research resources. The study methodology, however, now provides a valuable and workable framework that has adapted and evaluated computer design principles that can be incorporated in related farm forestry computer design simulation work elsewhere.

Further studies will need to consider re-evaluating the methodology of displaying visual images to the survey respondents. Problems were encountered with the image preparation methodology, as there was a large colour variation between computer monitors used in the laboratory and the computer monitor used in the survey in the field. It is suggested that further studies restrict the lighting environment and the types of computer monitors used. Problems were also encountered by reducing the image resolution and image file size to a standard that can be transferred via the Internet or floppy disk. For example, some images were reduced from forty megabytes in file size to one megabyte. These techniques reduced the available colours and reduced the contrast of the images. The consequential influences on the public’s evaluation of these images need to be studied.

5.4 Future Research Opportunities and Recommendations.

In summary, the study has indicated that further research is required in the following areas of computer image development:

- Tree and terrain visual texture quality.
- Visual penetration. The ability to see into a patch of trees.
- Terrain form. Referring to vertical exaggeration and distance zones.

- Position and shape of trees. Proportions and scales of the trees relative to the viewing position.
- Image composition. The collection of different visual elements into a satisfying and identifiable whole image.
- Techniques for displaying images to respondents, using computers.

Future computer generated images require a large source of material to obtain realistic textures. A library of such visual materials could be developed with the following feature requirements:

- Need to depict various vegetation species types.
- Need to depict various times of the day from dawn to dusk.
- Need to depict various seasons.
- Images of agroforestry features need to be taken at various distances from the source, e.g. Fore, Middle and Background distance zones.
- Investigate image acceptability using various computer monitors.

Finally, it is recommended that the above topics be developed into potential research projects, prioritised into a research action plan and attract relevant funding support where possible.

6. Appendices

Appendix 6.1: GIS Software and Data Application Evaluation Summaries

GIS SOFTWARE USING CAD VECTOR DATA

Object Data Software Name	3D Studio (3ds)	3D Studio Max (Max)	ArcCAD	AutoCAD (DXF)	AutoCAD (DWG)	Autodesk Map Guide SDF	MicroStation DGN	TurboCAD Drawing (TCW)	TurboCAD Metafile (WMF)	Input Score	Input RANKING	Output Score	Output RANKING
<i>AutoCAD MAP</i>				R/W	R/W	N/A	R/W			3/8	4	3/8	1
<i>ARC/INFO v7.2.1</i>				R/W						1/9	6	1/9	4
<i>ARCVIEW</i>			R	R	R		R			4/9	2	0/9	0
<i>CLRview</i>				R						1/9	6	0/9	0
<i>Gena</i>				R/W			R/W			2/9	5	2/9	3
<i>Geo Media</i>				R/W			R/W			2/9	5	2/9	3
<i>GRASS</i>				R/W						1/9	6	1/9	4
<i>IDRISI</i>				R/W						1/9	6	1/9	4
<i>ILWIS</i>				R/W						1/9	6	1/9	4
<i>IMAGINE</i>				R/W						1/9	6	1/9	4
<i>MapInfo v5.0</i>				R/W	R/W		R/W			3/9	3	3/9	2
<i>PolyTRIM</i>				R/W						1/9	6	1/9	4
<i>SAGE & Capture</i>				R						1/9	6	0/9	0
<i>SitePro</i>	R			R	R		R	R	R	6/9	1	0/9	0
<i>SURFER</i>				R/W						1/9	6	1/9	4
<i>TNT</i>				R/W			R/W			2/9	5	2/9	3

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

GIS SOFTWARE USING GIS VECTOR DATA

Object Data	Software Name	Atlas GIS	ARC/INFO Coverage	ARC/INFO Shape	ArcView Shape File (Shp)	ArcView Attribute File (shx)	Erdas (lan)	Erdas (gis)	Grass	IGDS	IGES	IDRISI	MapInfo MIF	MapInfo MID	MapInfo Attribute (TAB)	MOSS	PC ARC/INFO	Input Score	Input RANKING	Output Score	Output RANKING
	<i>AutoCAD MAP</i>		R/W		R/W								R/W	R/W				4/16	5	4/16	5
	<i>ARC/INFO v7.2.1</i>		N/A	N/A	R/W												R/W	2/14	8	2/14	8
	<i>ARCVIEW</i>	R	R	R/W	N/A	N/A							R	R			R	6/14	2	1/14	10
	<i>CLView</i>		R/W										R/W	R/W	R/W			4/16	5	4/16	5
	<i>Gena</i>						R/W	R/W	R/W		R/W					R/W		5/16	4	5/16	4
	<i>Geo Media</i>		R/W	R/W	R/W													3/16	7	3/16	7
	<i>GRASS</i>	R/W	R/W				R/W		N/A			R/W				R/W		5/15	3	5/15	3
	<i>IDRISI</i>	R/W	R/W				R/W	R/W	R/W			N/A						5/15	3	5/15	3
	<i>ILWIS</i>				R/W		R/W											2/16	9	2/16	9
	<i>IMAGINE</i>		R/W	R/W	R/W		N/A	N/A	R/W	R/W	R/W							6/14	2	6/14	2
	<i>MapInfo v5.0</i>			R/W	R/W					R/W			N/A	N/A	N/A			3/13	6	3/13	6
	<i>PolyTRIM</i>		R/W										R/W	R/W	R/W			4/16	5	4/16	5
	<i>SAGE & Capture</i>		R				R					R						3/16	7	0/16	0
	<i>SitePro</i>				R	R									R			3/16	7	0/16	0
	<i>SURFER</i>																	0/16	0	0/16	0
	<i>TNT</i>		R/W				R/W	R/W	R/W				R/W	R/W	R/W	R/W		8/16	1	8/16	1

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

GIS SOFTWARE USING INTERNET VECTOR DATA

Object Data							
Software Name	DWF	VRML (1.0)	VRML (2.0)	Input Score	Input RANKING	Output Score	Output RANKING
<i>AutoCAD MAP</i>	W			0/3	0	1/3	1
<i>ARC/INFO v7.2.1</i>		W		0/3	0	1/3	1
<i>ARCVIEW</i>				0/3	0	0/3	0
<i>CLRview</i>				0/3	0	0/3	0
<i>Gena</i>				0/3	0	0/3	0
<i>Geo Media</i>				0/3	0	0/3	0
<i>GRASS</i>				0/3	0	0/3	0
<i>IDRISI</i>				0/3	0	0/3	0
<i>ILWIS</i>				0/3	0	0/3	0
<i>IMAGINE</i>				0/3	0	0/3	0
<i>MapInfo v5.0</i>				0/3	0	0/3	0
<i>PolyTRIM</i>				0/3	0	0/3	0
<i>SAGE & Capture</i>				0/3	0	0/3	0
<i>SitePro</i>				0/3	0	0/3	0
<i>SURFER</i>				0/3	0	0/3	0
<i>TNT</i>				0/3	0	0/3	0

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

GIS USING TOPOGRAPHIC AND SPATIAL VECTOR DATA.

Object Data Software Name	DEM	DLG	ODYSSEY	SDTS	Tiger	Input Score	Input RANKING	Output Score	Output RANKING
<i>AutoCAD MAP</i>						0/5	0	0/5	0
<i>ARC/INFO v7.2.1</i>		R/W		R/W	R/W	3/5	2	3/5	2
<i>ARCVIEW</i>						0/5	0	0/5	0
<i>CLRview</i>	R					1/5	4	0/5	0
<i>Gena</i>	R/W				R	2/5	3	1/5	4
<i>Geo Media</i>						0/5	0	0/5	0
<i>GRASS</i>		R/W			R/W	2/5	3	2/5	3
<i>IDRISI</i>		R/W	R/W			2/5	3	2/5	3
<i>ILWIS</i>						0/5	0	0/5	0
<i>IMAGINE</i>	R/W	R/W		R/W		3/5	2	3/5	2
<i>MapInfo v5.0</i>				R/W		1/5	4	1/5	4
<i>PolyTRIM</i>	R					1/5	4	0/5	0
<i>SAGE & Capture</i>						0/5	0	0/5	0
<i>SitePro</i>		R				1/5	4	0/5	0
<i>SURFER</i>	R					1/5	4	0/5	0
<i>TNT</i>	R/W	R/W		R/W	R/W	4/5	1	4/5	1

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

GIS USING RASTER DATA

Image Data	Software Name	ADRG	AVI	BIL	BIP	BMP	BSQ	CADRG	CALS	CIB	CGM	DOQ	EPS	ERDAS Imagine	FLIC	GeoTIFF	GIF	GeoSpot	IDRISI	IGDS	IGA	IGS	JPEG	Landsat	NITF	PCX	PICT	PNG	RLC	SPOT	Sun Raster	TARGA	TIFF	WMF	Input Score	Input RANKING Output Score	Output RANKING		
	AutoCAD MAP					R			R						R	R	R	R			R	R	R			R	R	R	R			R	R	R	16/33	2	0/33	0	
	ARC/INFO			R/W	W						R		R	R/W						R			W										R/W		6/33	7	5/33	4	
	ARCVIEW	R		R	R	R	R	R	R	R		R	R	R		R	R						R	R	R					R	R	R		R		20/33	1	0/33	0
	CLRview																						R/W					R/W					R/W		3/33	10	3/33	5	
	Gena			R	R		R									R							R										R		6/33	7	0/33	0	
	Geo Media																																		0/33	0	0/33	0	
	GRASS			R			R					R		R			R							R						R	R		R		9/33	5	0/33	0	
	IDRISI			R	R																									R			R/W		4/33	9	1/33	6	
	ILWIS					R											R									R							R		4/33	9	0/33	0	
	IMAGINE		W	R/W	R/W		R/W			R		R/W				R/W	R						R/W	R		R/W				R	R		R/W		13/33	3	9/33	2	
	MapInfo v5.0					R/W											R/W						R/W			R/W				R/W			R/W	R/W	7/33	6	7/33	3	
	PolyTRIM																						R/W				R/W						R/W		3/33	10	3/33	5	
	SAGE & Capture					R/W			R/W				R/W										R/W			R/W		R/W			R/W	R/W	R/W	R / W	10/33	4	10/33	1	
	SitePro					R							R										R			R							R	R	R	7/33	6	0/33	0
	SURFER					R/W											W									R/W							R	R/W	R / W	5/33	8	5/33	4
	TNT			W	W											R/W	R/W		R				R	R/W		R/W					R/W			R/W	R/W	9/33	5	9/33	2

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

GIS USING COMMON DATABASE SOFTWARE

Database Source Software Name	ACCESS	ASCII	DB2	DBASE	Excel	FoxBASE	FoxPro	INFO	Informix	Ingres	Lotus	Oracle	Paradox	Sybase	Score	RANKING
<i>AutoCAD MAP</i>	X	X		X	X		X					X	X		7/14	3
<i>ARC/INFO v7.2.1</i>	X							X	X	X		X		X	6/14	4
<i>ARCVIEW</i>	X	X	X	X		X		X		X		X	X	X	10/14	1
<i>CLRview</i>															0/14	0
<i>Gena</i>		X							X	X		X		X	5/14	5
<i>Geo Media</i>	X							X				X			3/14	7
<i>GRASS</i>		X													1/14	8
<i>IDRISI</i>	X	X		X			X								4/14	6
<i>ILWIS</i>															0/14	0
<i>IMAGINE</i>		X													1/14	8
<i>Map Info v5</i>	X	X		X	X				X	X	X	X		X	9/14	2
<i>PolyTRIM</i>															0/14	0
<i>SAGE & Capture</i>		X													1/14	8
<i>SitePro</i>	X	X		X	X		X				X		X		7/14	3
<i>SURFER</i>		X			X						X				3/14	7
<i>TNT</i>		X		X				X							3/14	7

Applicable X
No Score - 0

GIS USING DATABASE STRUCTURE/METHODOLOGY

Database Source					
Software Name	ODBC/SQL compliant	Spatial Database Engine (SDE)	SQL Server	Score	RANKING
<i>AutoCAD MAP</i>	X			1/3	3
<i>ARC/INFO v7.2.1</i>		X	X	2/3	2
<i>ARCVIEW</i>	X	X	X	3/3	1
<i>CLRview</i>				0/3	0
<i>Gena</i>				0/3	0
<i>Geo Media</i>				0/3	0
<i>GRASS</i>				0/3	0
<i>IDRISI</i>				0/3	0
<i>ILWIS</i>				0/3	0
<i>IMAGINE</i>				0/3	0
<i>Map Info v5</i>	X		X	2/3	2
<i>PolyTRIM</i>				0/3	0
<i>SAGE & Capture</i>				0/3	0
<i>SitePro</i>				0/3	0
<i>SURFER</i>				0/3	0
<i>TNT</i>				0/3	0

Applicable X
No Score - 0

GIS FUNCTIONALITY - ANALYSIS CAPABILITIES

Functionality	Aspect	Network	Raster	Slope	Spatial	Surface	Vector	View Shed	Water Shed	Score	RANKING
Software Name											
<i>AutoCAD MAP</i>					X					1/9	7
<i>ARC/INFO v7.2.1</i>	X	X	X	X	X	X	X	X	X	9/9	1
<i>ARCVIEW</i>					X	X	X			3/9	5
<i>CLRview</i>			X		X	X	X			4/9	4
<i>Gena</i>	X	X	X	X	X		X	X		7/9	2
<i>Geo Media</i>					X					1/9	7
<i>GRASS</i>	X	X	X	X	X	X	X	X	X	9/9	1
<i>IDRISI</i>			X		X					2/9	6
<i>ILWIS</i>										0/9	0
<i>IMAGINE</i>	X		X	X	X	X	X	X		7/9	2
<i>Map Info v5</i>					X					1/9	7
<i>PolyTRIM</i>			X		X	X	X			4/9	4
<i>SAGE & Capture</i>	X		X	X	X		X	X	X	7/9	2
<i>SitePro</i>										0/9	0
<i>SURFER</i>										0/9	0
<i>TNT</i>		X	X			X	X	X	X	6/9	3

Applicable X
No Score - 0

GIS FUNCTIONALITY - MODELLING CAPABILITIES

Functionality	Hydrologic	Network	Raster	Surface	Vector	Score	RANKING
Software Name							
<i>AutoCAD MAP</i>		X	X		X	3/5	2
<i>ARC/INFO v7.2.1</i>	X	X	X	X	X	5/5	1
<i>ARCVIEW</i>				X	X	2/5	3
<i>CLRview</i>			X	X	X	3/5	2
<i>Gena</i>			X	X	X	3/5	2
<i>Geo Media</i>						0/5	0
<i>GRASS</i>	X	X	X	X	X	5/5	1
<i>IDRISI</i>						0/5	0
<i>ILWIS</i>			X		X	2/5	3
<i>IMAGINE</i>			X	X	X	3/5	2
<i>Map Info v5</i>						0/5	0
<i>PolyTRIM</i>						0/5	0
<i>SAGE & Capture</i>					X	1/5	4
<i>SitePro</i>						0/5	0
<i>SURFER</i>				X		1/5	4
<i>TNT</i>			X		X	2/5	3

Applicable X

No Score - 0

GIS FUNCTIONALITY - TOOLS

Functionality												
Software Name	Animation\Fly -Bys	Cartographic Map Production	Database Management	Developer Environment	Editing Environment	Geocoding	Image Processing	Reporting Capability	Rubber Sheetting	Score	RANKING	
AutoCAD MAP		X	X	X	X	X			X	6/9	4	
ARC/INFO v7.2.1	X	X	X	X	X	X	X	X	X	9/9	1	
ARCVIEW	X	X	X	X	X	X		X		7/9	3	
CLRview	X	X	X	X	X			X		6/9	4	
Gena		X	X	X	X		X	X		6/9	4	
Geo Media		X	X	X				X		4/9	5	
GRASS	X	X	X	X	X	X	X	X	X	9/9	1	
IDRISI										0/9	0	
ILWIS		X	X		X		X			4/9	5	
IMAGINE	X	X		X	X		X		X	6/9	4	
Map Info v5		X	X	X				X		4/9	5	
PolyTRIM	X	X	X	X	X			X	X	7/9	3	
SAGE & Capture		X		X	X		X			4/9	5	
SitePro		X						X		2/9	6	
SURFER										0/9	0	
TNT	X	X	X	X		X	X	X	X	8/9	2	

Applicable X
No Score – 0

Appendix 6.2: CAD Software and Data Application Evaluation Summaries

CAD SOFTWARE USING CAD VECTOR DATA.

Object Data																		
Software Name	3D Studio (3ds)	3D Studio Max (Max)	3D Studio VIZ	AutoCAD (DXF)	AutoCAD (DWG)	Direct X	Lightwave 3D	MicroStation DGN	TurboCAD Drawing (TCW)	TurboCAD Metafile (WMF)	Wavefront	Input Score	Input RANKING	Output Score	Output RANKING			
3D Studio Max	R	N/A	N/A	R/W		W						2/9	5	2/9	4			
<i>AutoCAD r14</i>	R/W			N/A	N/A					R/W		2/9	5	2/9	4			
<i>CLView</i>				R								1/11	8	0/11	0			
<i>EVS</i>				R/W								1/11	8	1/11	7			
<i>ForeSight</i>				R/W	R/W							2/11	7	2/11	6			
<i>FormZ</i>	R/W			R/W	R/W		R/W				R/W	5/11	2	5/11	1			
<i>Lightscape</i>	R/W	R/W	R/W	R/W			R/W					5/11	2	5/11	1			
<i>Lightwave</i>	R/W			R/W			N/A				R/W	3/10	3	3/10	2			
<i>Maya</i>				R/W							R/W	2/11	7	2/11	6			
<i>MicroStation</i>				R/W	R/W			N/A				2/10	6	2/10	5			
<i>PolyTRIM</i>				R/W								1/11	8	1/11	7			
<i>P.O.V</i>	R/W			R/W							R/W	3/11	4	3/11	3			
<i>Power Animator</i>				R/W							R/W	2/11	7	2/11	6			
<i>RealMation</i>	R	R		R	R	R		R				6/11	1	0/11	0			
<i>TruFlite</i>												0/11	0	0/11	0			
<i>VistaPro</i>												0/11	0	0/11	0			
<i>Voxel Analyst</i>				R/W	R/W			R/W				3/11	4	3/11	3			
<i>World Builder</i>	R/W			R/W								2/11	7	2/11	6			
<i>World Up</i>	R/W			R/W							R/W	3/11	4	3/11	3			

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

CAD SOFTWARE USING GIS VECTOR DATA

Object Data	Software Name	ARC/INFO Coverage	ArcView Shape File (.Shp)	Erdase (.lan)	IDRISI	MapInfo MIF	MapInfo MID	MapInfo Attribute (.TAB)	Input Score	Input RANKING	Output Score	Output RANKING
	<i>3D Studio Max</i>								0/7	0	0/7	0
	<i>AutoCAD r14</i>								0/7	0	0/7	0
	<i>CLRview</i>	R/W			R/W	R/W	R/W		4/7	1	4/7	11
	<i>EVS</i>	R/W	R/W						2/7	2	2/7	2
	<i>ForeSight</i>								0/7	0	0/7	0
	<i>FormZ</i>								0/7	0	0/7	0
	<i>Lightscape</i>								0/7	0	0/7	0
	<i>Lightwave</i>								0/7	0	0/7	0
	<i>Maya</i>								0/7	0	0/7	0
	<i>MicroStation</i>								0/7	0	0/7	0
	<i>PolyTRIM</i>	R/W			R/W	R/W	R/W		4/7	1	4/7	1
	<i>P.O.V</i>								0/7	0	0/7	0
	<i>Power Animator</i>								0/7	0	0/7	0
	<i>RealMation</i>								0/7	0	0/7	0
	<i>TruFlite</i>			R	R				2/7	2	0/7	0
	<i>VistaPro</i>								0/7	0	0/7	0
	<i>Voxel - Analyst</i>								0/7	0	0/7	0
	<i>World Builder</i>								0/7	0	0/7	0
	<i>World Up</i>								0/7	0	0/7	0

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

CAD SOFTWARE USING INTERNET VECTOR DATA.

Object Data							
Software Name	DWF	VRML (1.0)	VRML (2.0)	Input Score	Input RANKING	Output Score	Output RANKING
<i>3D Studio Max</i>			W	0/3	0	1/3	2
<i>AutoCAD r14</i>	W			0/3	0	1/3	2
<i>CLRview</i>				0/3	0	0/3	0
<i>EVS</i>			R/W	1/3	1	1/3	2
<i>ForeSight</i>				0/3	0	0/3	0
<i>FormZ</i>		R/W		1/3	1	1/3	2
<i>Lightscape</i>		W		0/3	0	1/3	2
<i>Lightwave</i>				0/3	0	0/3	0
<i>Maya</i>				0/3	0	0/3	0
<i>MicroStation</i>		W		0/3	0	1/3	2
<i>PolyTRIM</i>				0/3	0	0/3	0
<i>P.O.V</i>				0/3	0	0/3	0
<i>Power Animator</i>		W	W	0/3	0	2/3	1
<i>RealiMation</i>			R/W	1/3	1	1/3	2
<i>TruFlite</i>				0/3	0	0/3	0
<i>VistaPro</i>				0/3	0	0/3	0
<i>Voxel - Analyst</i>				0/3	0	0/3	0
<i>World Builder</i>		W		0/3	0	1/3	2
<i>World Up</i>		W		0/3	0	1/3	2

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

CAD SOFTWARE USING TOPOGRAPHIC AND SPATIAL VECTOR DATA.

Object Data								
Software Name	ASCII	DEM	DLG	USGS	Input Score	Input RANKING	Output Score	Output RANKING
<i>3D Studio Max</i>		R			1/4	3	0/4	0
<i>AutoCAD r14</i>					0/4	0	0/4	0
<i>CLRview</i>		R			1/4	3	0/4	0
<i>EVS</i>	R				1/4	3	0/4	0
<i>ForeSight</i>	R/W				1/4	3	1/4	1
<i>FormZ</i>					0/4	0	0/4	0
<i>Lightscape</i>					0/4	0	0/4	0
<i>Lightwave</i>					0/4	0	0/4	0
<i>Maya</i>					0/4	0	0/4	0
<i>MicroStation</i>					0/4	0	0/4	0
<i>PolyTRIM</i>		R			1/4	3	0/4	0
<i>P.O.V</i>					0/4	0	0/4	0
<i>Power Animator</i>					0/4	0	0/4	0
<i>RealiMation</i>					0/4	0	0/4	0
<i>TruFlite</i>	R	R			2/4	2	0/4	0
<i>VistaPro</i>	R	R		R	3/4	1	0/4	0
<i>Voxel - Analyst</i>	R/W				1/4	3	1/4	1
<i>World Builder</i>		R			1/4	3	0/4	0
<i>World Up</i>					0/4	0	0/4	0

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

CAD USING RASTER DATA.

Image Type	AVI	BMP	CALS	CGM	EPS	FLIC	GIF	JPEG	MPEG	PCX	PICT	PNG	RGB	Sun Raster	TARGA	TIFF	WMF	Input Score	Input RANKING	Output Score	Output RANKING
Software Name																					
<i>3D Studio Max</i>	R/W	R/W			R/W	R/W	R	R/W				W			R/W	R/W		8/17	2	8/17	2
<i>AutoCAD</i>		R/W	R		R/W	R	R	R		R	R	R			R/W	R/W	W	11/17	1	5/17	5
<i>CLRview</i>								R/W			R/W					R/W		3/17	7	3/17	7
<i>EVS</i>	W	W							W						W	W		0/17	0	5/17	5
<i>ForeSight</i>																		0/17	0	0/17	0
<i>FormZ</i>		R/W			R/W					R/W	R/W				R/W	R/W		6/17	4	6/17	4
<i>Lightscape</i>		R			R		R	R					R		R	R		7/17	3	0/17	0
<i>Lightwave</i>	W	R/W				W		R/W		R/W	R/W			R/W	R/W	R/W		7/17	3	9/17	1
<i>Maya</i>					R/W		R/W	R/W					R/W			R/W		5/17	5	5/17	5
<i>MicroStation</i>				W				W								W		0/17	0	3/17	7
<i>PolyTRIM</i>								R/W			R/W					R/W		3/17	7	3/17	7
<i>P.O.V</i>		W						W										0/17	0	2/17	8
<i>Power Animator</i>																R/W		1/17	8	1/17	9
<i>RealMation</i>	W	R						R		R			R		R/W			5/17	5	2/17	8
<i>TruFlite</i>	W					W			W						R/W			1/17		4/17	6
<i>VistaPro</i>	W	R/W				W		R/W		R/W					R/W			4/17	6	6/17	4
<i>Voxel - Analyst</i>																		0/17	0	0/17	0
<i>World Builder</i>	R/W	R/W					R/W	R/W		R/W					R/W	R/W		7/17	3	7/17	3
<i>World Up</i>																		0/17	0	0/17	0

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

CAD FUNCTIONALITY - MODELLING CAPABILITIES

Function												
Software Name	Boolean Operations	Geometric Transformations	Mesh	Metaballs	Nurbs	Solid Modeller	Splines	Surface Modeller	Terrain Modeling	Text	Score	RANKING
<i>3D Studio Max</i>	X	X	X	X	X	X	X	X		X	9/10	2
<i>AutoCAD</i>		X	X			X		X	X	X	6/10	3
<i>CLRview</i>		X	X			X		X	X	X	6/10	3
<i>EVS</i>		X	X					X	X	X	5/10	4
<i>ForeSight</i>											0/10	0
<i>FormZ</i>	X	X	X	X	X	X	X	X	X	X	10/10	1
<i>Lightscape</i>		X									1/10	6
<i>Lightwave</i>	X	X		X	X	X	X				6/10	3
<i>Maya</i>	X	X	X	X	X	X	X	X	X	X	10/10	1
<i>MicroStation</i>		X			X	X	X	X		X	6/10	3
<i>PolyTRIM</i>		X	X			X		X	X	X	6/10	3
<i>P.O.V</i>		X	X			X		X	X	X	6/10	3
<i>Power Animator</i>	X	X	X	X	X	X	X	X	X	X	10/10	1
<i>RealMation</i>		X									1/10	6
<i>TruFlite</i>											0/10	0
<i>VistaPro</i>									X		1/10	6
<i>Voxel - Analyst</i>	X					X					2/10	5
<i>World Builder</i>			X								1/10	6
<i>World Up</i>		X									1/10	6

Applicable X
No Score - 0

CAD FUNCTIONALITY - LIGHTING CAPABILITIES

Function							
Software Name	Free directional	Free spot	Omni	Target directional	Target spot	Score	RANKING
<i>3D Studio Max</i>	X	X	X	X	X	5/5	1
<i>AutoCAD</i>	X	X	X			3/5	2
<i>CLRview</i>			X			1/5	4
<i>EVS</i>						0/5	0
<i>ForeSight</i>						0/5	0
<i>FormZ</i>						0/5	0
<i>Lightscape</i>	X	X	X			3/5	2
<i>Lightwave</i>	X	X				2/5	3
<i>Maya</i>	X	X	X	X	X	5/5	1
<i>MicroStation</i>	X	X	X			3/5	2
<i>PolyTRIM</i>			X			1/5	4
<i>P.O.V</i>		X				1/5	4
<i>Power Animator</i>	X	X	X	X	X	5/5	1
<i>RealiMation</i>	X	X	X			3/5	2
<i>TruFlite</i>						0/5	0
<i>VistaPro</i>						0/5	0
<i>Voxel - Analyst</i>						0/5	0
<i>World Builder</i>	X	X				2/5	3
<i>World Up</i>	X	X				2/5	3

Applicable X

No Score - 0

CAD FUNCTIONALITY - RENDERING CAPABILITIES

Function								
Software Name	Radiosity	Ray Tracing	Reflection	Refraction	Shading	Shadows	Score	RANKING
<i>3D Studio Max</i>			X	X	X	X	4/6	3
<i>AutoCAD</i>			X		X	X	3/6	4
<i>CLRview</i>					X	X	2/6	5
<i>EVS</i>					X		1/6	6
<i>ForeSight</i>					X		1/6	6
<i>FormZ **</i>	X	X	X	X	X	X	6/6	1
<i>Lightscape</i>	X	X	X				3/6	4
<i>Lightwave</i>		X	X	X		X	4/6	3
<i>Maya</i>		X	X	X	X	X	5/6	2
<i>MicroStation</i>			X		X	X	3/6	4
<i>PolyTRIM</i>					X	X	2/6	5
<i>P.O.V</i>		X	X		X	X	4/6	3
<i>Power Animator</i>		X	X	X	X	X	5/6	2
<i>RealiMation</i>					X	X	2/6	5
<i>TruFlite</i>					X		1/6	6
<i>VistaPro</i>					X		1/6	6
<i>Voxel - Analyst</i>					X		1/6	6
<i>World Builder</i>			X		X		2/6	5
<i>World Up</i>			X		X	X	3/6	4

Applicable X
No Score - 0

CAD FUNCTIONALITY - MATERIALS CAPABILITIES

Function						
Software Name	Material Properties	Procedural Maps	UVW Editing	UVW Mapping	Score	RANKING
<i>3D Studio Max</i>	X	X	X	X	4/4	1
<i>AutoCAD</i>	X	X			2/4	3
<i>CLRview</i>	X	X	X	X	4/4	1
<i>EVS</i>	X				1/4	4
<i>ForeSight</i>					0/4	0
<i>FormZ</i>	X	X	X	X	4/4	1
<i>Lightscape</i>	X	X	X	X	4/4	1
<i>Lightwave</i>	X	X	X	X	4/4	1
<i>Maya</i>	X	X	X	X	4/4	1
<i>MicroStation</i>	X	X		X	3/4	2
<i>PolyTRIM</i>	X	X	X	X	4/4	1
<i>P.O.V</i>	X	X	X	X	4/4	1
<i>Power Animator</i>	X	X	X	X	4/4	1
<i>RealiMation</i>	X	X	X	X	4/4	1
<i>TruFlite</i>	X		X	X	3/4	2
<i>VistaPro</i>	X				1/4	4
<i>Voxel - Analyst</i>					0/4	0
<i>World Builder</i>	X	X	X	X	4/4	1
<i>World Up</i>	X	X	X	X	4/4	1

Applicable X
No Score - 0

CAD FUNCTIONALITY - TOOLS

Function										
Software Name	Animations	Developer Environment	Internet Tools	Modules/Plugins	Sound Support	Splines	Surface Modeller	View Control	Score	RANKING
3D Studio Max	X	X	X	X	X	X	X	X	8/8	1
AutoCAD		X	X	X			X	X	5/8	3
CLRview	X	X		X			X	X	5/8	3
EVS	X		X				X	X	4/8	4
ForeSight									0/8	0
FormZ			X			X	X	X	4/8	4
Lightscape	X		X					X	3/8	5
Lightwave	X	X		X		X		X	5/8	3
Maya	X	X	X	X	X	X	X	X	8/8	1
MicroStation		X	X			X	X	X	5/8	3
PolyTRIM	X	X	X	X			X	X	6/8	2
P.O.V	X	X		X			X	X	5/8	3
Power Animator	X	X	X	X	X	X	X	X	8/8	1
RealiMation	X	X			X			X	4/8	4
TruFlite	X							X	2/8	6
VistaPro	X							X	2/8	6
Voxel - Analyst									0/8	0
World Builder	X							X	2/8	6
World Up	X	X	X		X			X	5/8	3

Applicable X
No Score - 0

Appendix 6.3: Forest Visualisation Software and Data Application Evaluation Summaries

FOREST VISUALISATION SOFTWARE- VECTOR DATA FILES

Vector Data											
Software Name	ARC/INFO	ArcView	ERDAS	MAPS	MOSS	Stand File	Tree List File	Input Score	Input RANKING	Output Score	Output RANKING
<i>Landscape Management System (LMS)</i>						R		1/7	4	0/7	0
<i>SmartForest II</i>	R					R	R	3/7	2	0/7	0
<i>Stand Visualisation System (SVS)</i>						R	R	2/7	3	0/7	0
<i>UTOOLS and UVIEW</i>	W		R	R	R	R		4/7	1	1/7	1
<i>Vantage Point</i>								0/7	0	0/7	0
<i>Virtual Forest</i>	R	R				R	R	4/7	1	0/7	0

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

FOREST VISUALISATION SOFTWARE- USING TOPOGRAPHIC AND SPATIAL VECTOR DATA.

Object Data Software Name	DEM	DLG	DTM	Input Score	Input RANKING	Output Score	Output RANKING
<i>Landscape Management System (LMS)</i>	R		R	2/3	1	0/3	0
<i>SmartForest II</i>	R			1/3	2	0/3	0
<i>Stand Visualisation System (SVS)</i>				0/3	0	0/3	0
<i>UTOOLS and UVIEW</i>	R		R	2/3	1	0/3	0
<i>Vantage Point</i>	R		R	2/3	1	0/3	0
<i>Virtual Forest</i>	R			1/3	2	0/3	0

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

FOREST VISUALISATION SOFTWARE- RASTER DATA

Software Name	AVI	BMP	CALS	CGM	EPS	FLIC	GIF	JPEG	MPEG	PCX	PICT	PNG	RGB	Sun Raster	TARGA	TIFF	WMF	Input Score	Input RANKING	Output Score	Output RANKING
<i>Landscape Management System (LMS)</i>																		0/17	0	0/17	0
<i>SmartForest II</i>																		0/17	0	0/17	0
<i>Stand Visualisation System (SVS)</i>																		0/17	0	0/17	0
<i>UTOOLS and UVIEW</i>									W	W								0/17	0	2/17	1
<i>Vantage Point</i>																		0/17	0	0/17	0
<i>Virtual Forest</i>									W									0/17	0	1/17	2

FILE INPUT (READ) - R
FILE OUPUT (WRITE) - W
Not Applicable - N/A
No Score - 0

FOREST VISUALISATION SOFTWARE- DATABASE

Database Source Software Name	ACCESS	ASCII	DB2	DBASE	Excel	FoxBASE	FoxPro	INFO	Informix	Ingres	Lotus	Oracle	Paradox	Sybase	Score	RANKING
<i>Landscape Management System (LMS)</i>		X											X		2/14	1
<i>SmartForest II</i>		X													1/14	2
<i>Stand Visualisation System (SVS)</i>		X													1/14	2
<i>UTOOLS and UVIEW</i>		X											X		2/14	1
<i>Vantage Point</i>															0/14	0
<i>Virtual Forest</i>															0/14	0

Applicable X
No Score - 0

FOREST VISUALISATION SOFTWARE FUNCTIONALITY

Software Name	Animations	Customise Trees	Database Query	Developer	Growth Models	Rendering	Scripting Language	Tree Library	Score	RANKING
<i>Landscape Management System (LMS)</i>					X	X			2/8	4
<i>SmartForest II</i>					X	X		X	3/8	3
<i>Stand Visualisation System (SVS)</i>		X			X	X	X	X	5/8	1
<i>UTOOLS and UVIEW</i>			X	X		X	X		4/8	2
<i>Vantage Point</i>		X				X			2/8	4
<i>Virtual Forest</i>	X	X				X		X	4/8	2

Applicable X

No Score - 0

Appendix 6.4: Computer Hardware and Software Specifications Used In This Study

UWA's School of Architecture and Fine Arts.

Hardware:

Manufacturer: Dell Computer
Processor: Pentium III 450 Mhz.
Memory: 128 Megabytes of RAM.
Local Hard Drive Capacity: 4 Gigabytes.
Network Hard Drive Capacity: 9 Gigabytes.
CD-ROM SPEED: 24
Video Card: TNT Video Card with 16 Megabytes of Video RAM
OpenGL
Monitor Size : 19 inch VGA

Software:

3D Studio MAX II
AutoCAD r14
Corel Draw

UWA's Department of Geography.

Hardware:

Manufacturer: Sun SPARC IV
Memory: 32 Megabytes of RAM.
Network Hard Drive Capacity: 9 Gigabytes.

Software:

ARC/INFO v7

The following is a description of the portable computer used to present the surveys.

Manufacturer: Toshiba Satellite 4060XCDT Notebook
Processor: Pentium II, 333Mhz.
Memory: 128 Megabytes of RAM.
Local Hard Drive Capacity: 2 Gigabytes.
CD-ROM SPEED: 24
Video Card Resolution: 1024x768 resolution
Monitor Size : 14 inch XGA

Appendix 6.5: Mark Samwell Survey One Results

Survey Introduction

As you may be aware, the University of Western Australia and CALM have been undertaking a project to study the visual impact of revegetation over rural landscapes.

We are interested in preparing computer generated visual simulations to predict possible revegetation design layouts and associated visual improvements and possible visual impacts.

The following questionnaire will take about an hour and is about testing our work undertaken so far.

We appreciate your help.

Lorne Leonard
Grant Revell
Julie Delaney
The University of Western Australia

SECTION A

(No images or photos are to be present for this page)

Question 1 (a)

In developing visual simulations of revegetation proposals, which landscape features, should we attempt to visualise?

Object	Mentioned? Yes/No	Most Important
Landform/Terrain	y	y
River/Streams	y	y
Trees	y	y
Shrubs	y	y
Grasses	n	
Crops	n	
Fences	y	
Roads	y	y
Homesteads	y	y
Sheds	y	y
Electricity Poles	n	
People	n	
Animals	y	

Any others? (Please List)

Dams. Crops - although they vary yearly, therefore less important

Question 1 (b)

Please identify the most important objects that should be visualised.

Question 2

When you look at a paddock what landscape features first come to mind?

Where the trees and dams are positioned. Also the slope paddock (major influence).

Question 3

Referring to Question 1 and Question 2, is there a general theme to these features?

	Question 1	Question 2
Functionality	Y	Y
Economics		
Aesthetics		
Don't care		
Don't know		

Why? Please explain.

Because it is the way you run the farm (either livestock or cropping).

(No images or photos are to be present for this page)

Question 4 (a)

Please indicate which views are important for you to visualise and why?

Views	VIEWS FROM	
	Mentioned? Yes/No	Most Important
From Front-Gate		
From Back-Gate		
From Shed		
From Homestead		
From Neighbours property		
From nearby public roads		

Any Others?

Laneways - personal dirt tracks not the bitumen roads.

Both types of tracks are used for the same purpose (MOST IMPORTANT).

Gates on the property are necessary not in a good position for viewing.

Dams - located centrally or good watering spot - useful for monitoring animals.

VIEWS OF

Views	Mentioned? Yes/No	Most Important
Of Front-Gate		
Of Back-Gate		
Of Shed		
Of Homestead		
Of Neighbours property		
Of public roads		

Any Others?

Dams - located centrally or good watering spot - useful for monitoring animals.
 Sheds - what's happening around them - who's there.
 Animals - conditions/health - lambing (MOST IMPORTANT).

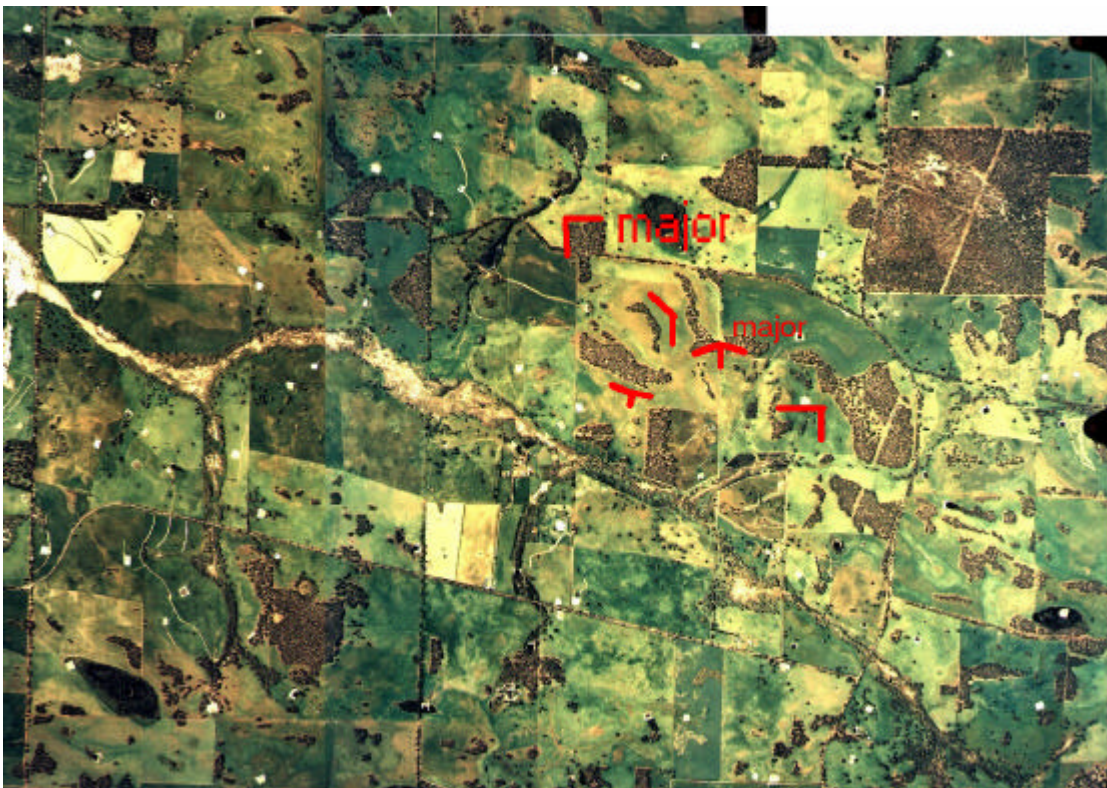
Question 4 (b)

Please identify the most important views.

See above question.

Question 5

Refer to the aerial photo and indicate the location and direction of the important views discussed in Question four.



Question 6

Please identify the elements contained within these important landscape views. For example trees, streams etc.

Trees, pastures, neighbouring properties.

Question 7

Please explain why these views are important to you?

To evaluate risks from weather and/or fires.

(No images or photos are to be present for this page)

Question 8

How do you distinguish between a tree plantation and "natural forested or woodland" area?

(a) Forested or Woodland Areas

Shape - No Response.

Outline -No Response.

Colour - Mixture of colours.

Texture - Varied mixtures.

Species Type - Varies because of these that the above varies.

Variety of Species -Varies understorey.

Visual Penetration (Ability to see into the treed area) - Density varies, because trees at all ages generally get good visibility. Limited darkness.

Layout - Chaos depends on soil and rock formations.

Context - Around rock formations, some ridges (usually rock formations), water features and swamps.

Age - Varies.

Form - Varies.

Any others? - No Response.

(b) Tree Plantation

Shape- No Response.

Outline - No Response.

Colour - Blue/green uniform.

Texture - Similar/uniform.

Species Type -Mono/

Variety of Species - Mono/

Visual Penetration (Ability to see into the treed area) - Limited for blocking visibility at early stage of growth limits sunlight

Layout - Uniform.

Context - Control ground water movement.

Wind movement.

Paddocks boundaries (agroforestry).

Age - Uniform.

Form - Normally uniform (depending on parrot damage).

Any others? - No Response.

Question 9 (a)

When you visualise the terrain/landform, what visual characteristics come to mind?

Characteristic	Mentioned? Yes/No	Most Important
Height	Y(pastures)	
Colour	Y(pastures)	
Outline	Y(landforms, aesthetically pleasing)	
Shape	Y	
Textures	Y(pastures)	
Functionality	(seasonal)	
Slope	Y	
Aspect	(seasonal) N	

Any others?

Slopes. Vegetation. Pastures. Buildings. Surface water movement (streams and drains)
All these are important, because they all tie together.

Question 9 (b)

Please identify the most important characteristics.

All important.

(No images or photos are to be present for this page)

Question 10 (a)

When you visualise trees, what visual characteristics come to mind?

Colour of bark. Thickness of canopy (density of canopy). Height. Width.

Characteristic	Mentioned? Yes/No	Most Important
Height	Y	
Colour	Y	
Leaf Shape		
Canopy Shape		
Trunk Shape		
Textures		
Functionality		
Lighting	Y	
Fauna		
Density	Y	

Any others?

Depends if you are looking at a plantation or natural vegetation.
With plantations, your concerned about everything answered above with yes.

With natural vegetation - you tend to leave it alone - not going to pay too much attention too it.

Question 10 (b)

Please identify the most important characteristics.

No Response.

SECTION B

Question 11 (a)

(Step 1 Show original photo)

The following images are copies of a photo at varying levels of visual quality.



A

B

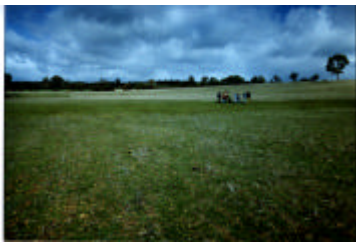
C



D

E

F



G

Please Note: The size and resolution of these images have been reduced due to the print media.

(Step 2 Show copies)

Please indicate which images are adequate.

Image	Adequate? Yes/No	Highest Quality
A	N	
B	N	
C	Y/N Halfway	
D	Y/N Halfway	
E	Y/N Halfway Too Dark	
F	N Comments on image	
G	N Same comments as F	BEST Choice

Question 11 (b)

Please identify which image has the highest quality.

Image D

Question 12

Referring to Question 11, where the quality varies, however the content is the same. Are you responding to the quality of an image or the content of an image, and which is more important and why?

Definitely content because you try to get performance from a paddock. Distinguishing between foreground, middle ground and background, to establish a purpose or position of contents. Forming a composition of your images at various scales i.e. part of a paddock to the paddock to a few paddocks to the whole farm. Quality is more important than colour. Clarity is very significant

Question 13 (a)

(Step 1: Show Terrain/Landform Images).

The following images represent Boree Gully Landform/Terrain.



Please indicate which landforms are adequate for a visual simulation.

Landform/Terrain	Adequate? Yes/No	Best Representation
A	No for both	None
B	No for both	None
C	No for both getting worse	None
D	No for both getting worse	None
E	No bit better	None

Question 13 (b)

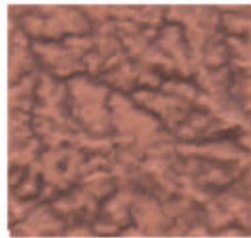
Please identify which images represent Boree Gully the best.

None.

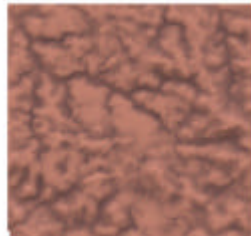
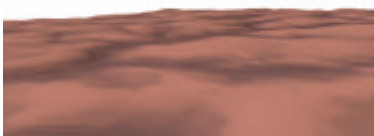
Question 14 (a)

(Step 1: Show Landform/Terrain Images).

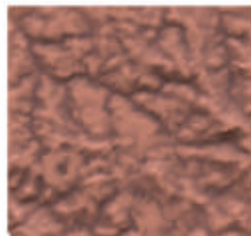
The following images represent Boree Gully Landform at different vertical exaggerations.



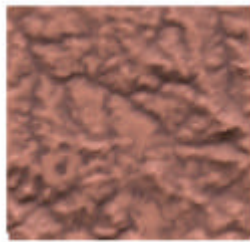
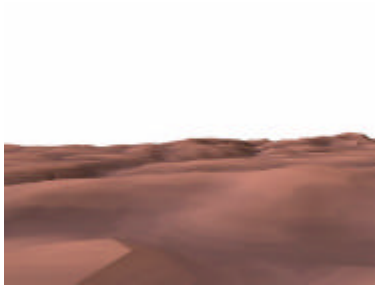
Landform A



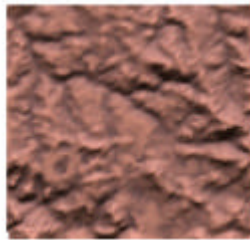
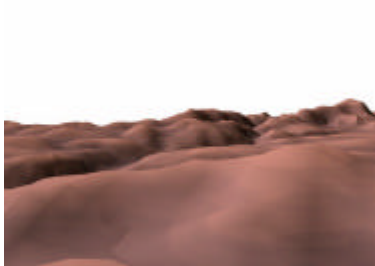
Landform B



Landform C



Landform D



Landform E

Please indicate which landforms/terrains are adequate for a visual simulation.

Landform (Image)	Adequate? Yes/No	Best Representation
A	No for both	
B	No for both getting worse	
C	Yes but could get better	Clarity? YES
D	Yes but not as good as C	YES
E	No a bit extreme	

Question 14 (b)

Please identify which images represent the terrain/landform of Boree Gully the best.

Best would be between c and d.

Question 15 (a)

(Step 1: Show Tree Images).

The following images represent Pines tree specimen generated from computer models.



2D Circle



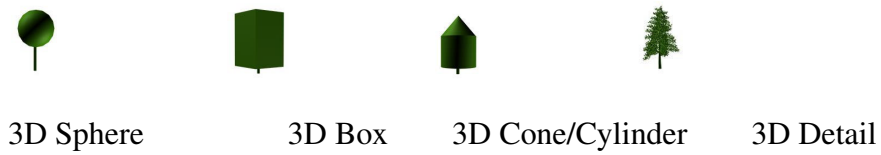
2D Triangle



2D Box



2D Outline



Please indicate which trees are adequate for visual simulation purposes.

Tree Shape	Adequate? Yes/No	Rank (1 = Highest)
2D Circle	N	5
2D Triangle	n	3
2D Box	n	5
2D Outline	y getting better	2
3D Sphere	n	5
3D Box	n	5
3D Cone/Cylinder	n	5
3D Detail	y good	1

Question 15 (b)

Please rank these tree images from highest too lowest visual quality.

3D Detail ranked 1st. See above.

Question 16

(Step 1: Show Tree Images).

The following computer generated images represent trees at varying distances from the same viewpoint.

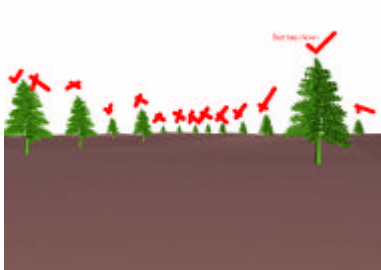


Image A



Image B



Image C



Image D

(a) Please identify which of these images have adequate visual quality.

Image	Adequate
A	y
B	y
C	Y
D	y

Treated as visual trees, not as tree groups, however, some are adequate for tree groupings.

(b) Please mark on the images which tree models are inadequate and explain why?

Refer to above images.

(c) On some of the images, there may be a distinction between the qualities of the tree models represented. Please mark on the images this distinction if any.

Refer to above images.

Question 17

With the previous questions, we have been analysing the characteristics of computer generated visual simulations. Which of these characteristics have you found to be helpful to convey realism in agroforestry environments?

The landform is important (Rank - 1).

Vegetation is important (Rank - 1).

The photo comparisons - colour and depth the composition (Rank - 2).

Every paddock will have its viewpoint (Rank - 3).

Elevated viewpoints are important to understand landscape characteristics.

SECTION C

Please show simulations to landowner.
Technique One: Using ARC/INFO Draped Images

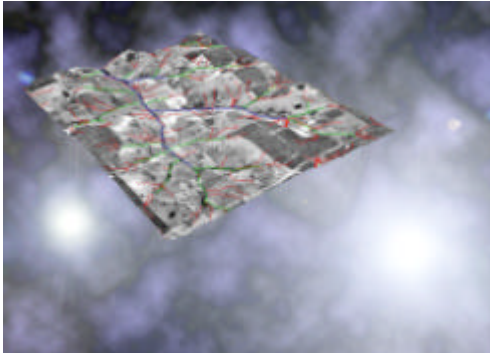


Image One

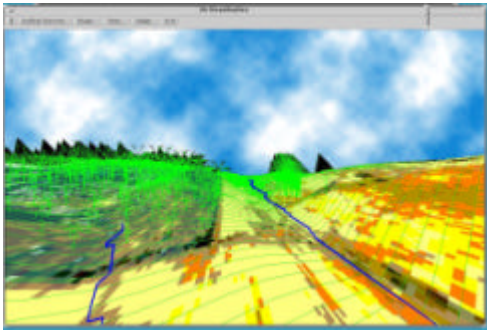


Image Two

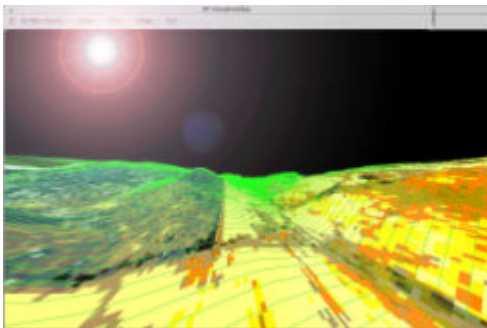


Image Three

Question 18

What objects in the computer simulations can you identify?

Image One

Creek lines. Blocks of trees.
Slope. Landform

Image Two

Hard to identify.
Sky.

Image Three

Sun dominates.

Can see landform - didn't appeal.

Question 19

**Referring to the images illustrated in Question 18, are they useful to gauge the possible visual impact of the agroforestry work?
Please explain why or why not.**

Image One

More depth and detail required.
Trees require more dimensions.
Hills need to be more distinct/exaggerated.
You can identify streams easily - useful tool.

Image Two

Difficult to identify features.
Hard to look at.
Didn't like it.

Image Three

Looks like the planet Mars.
Not enough detail.
Doesn't look like a landform.
Depends on what you are use to looking at (used to looking at maps).

Question 20

Referring to the images illustrated in Question 18, what is missing from these images?

Image One

Need more depth, form (3d) and clarity.
You loose clarity when zooming in/out.
Too grey - requires more colour (colours need to represent actual form).

Image Two

Trees lacked form, weren't 3d.
Could only distinguish they were trees, because they were green.
Trees look like a pine (because of triangle shape).
Not real colours to represent farms.

Image Three

Not realistic in colours or landform.
Need trees.

Please show simulations to landowner.
Technique Two: Using 3D Studio Draped Images



Image One



Image Two

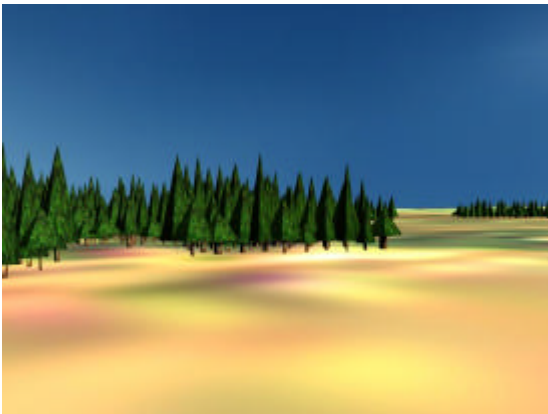


Image Three

Question 21 What objects in the simulations can you identify?

Image One

Can identify paddock shapes/boundaries. Can identify vegetation/bush association.
Landform needs more exaggeration and more variation in colours to understand depth.
Dams. Laneways (not sure).

Image Two

Can see fence line. Pine trees and water feature (bottom left corner).

Image Three

Snow. Pine trees.

Question 22

**Referring to the images illustrated in Question 21, are they useful to gauge the possible visual impact of the agroforestry work?
Please explain why or why not.**

Image One

Not useful because need to focus on particular area within a couple paddocks.

Image Two

No, because no depth of image (which would be useful).

Image Three

No, because no depth of image (which would be useful).

Question 23

Referring to the images illustrated in Question 21, what is missing from these images?

Image One

Too much in one position.
Missing landform exaggeration.
Definitely need more colours (cautious of the time of year).
Require more clarity and form in vegetation.

Image Two

Landform requires exaggeration.
Trees need more clarity and form.
Fences aren't enough in foreground.
Better colour variation, especially in foreground.
Trees would be better suited from images h and c of question 17.
Trees would be better with landform exaggeration. At present only just satisfactory.

Image Three

Lack of context.
Trees inadequate.
Shape and colours are wrong.

SECTION D

FEEDBACK/COMMENTS

Prefer the map aerial view context because you can identify more features, thus more information from the simulation.

Want viewpoint/perspective - not aerial directly above.

Prefer animation/simulation going along a laneway or from any viewpoint marked earlier (Question 5).

Require vegetation distinction.

Require drains, trees together on slopes, to visualise viewing and effect on wind speed. To be able to determine the density of agroforestry planting's and species required.

Ideal times for simulation are winter (moist effect on animals on cold and wind) or spring (content).

Beware of shadow effect.

Simulate sun position around noontime.

Appendix 6.6: John Beatty Survey One Results

SECTION A

(No images or photos are to be present for this page)

Question 1 (a)

In developing visual simulations of revegetation proposals, which landscape features, should we attempt to visualise?

Rock outcrops. Crops. Soil type. Existing vegetation. Earth works-roads, drainage banks and dams.

Object	Mentioned? Yes/No	Most Important
Landform/Terrain	Y	Y
River/Streams	Y	Y
Trees	Y	
Shrubs	Y	
Grasses	Y	
Crops	Y	
Fences	Y	
Roads	Y	Y
Homesteads	Y	
Sheds	Y	
Electricity Poles	Y	Y
People	N	
Animals	N	

Any others? (Please List)

Dams. Drainage

Question 1 (b)

Please identify the most important objects that should be visualised.

See above.

Question 2

When you look at a paddock what landscape features first come to mind?

Elevation. Terrain. Slope. Landform. Drainage.

Question 3

Referring to Question 1 and Question 2, is there a general theme to these features?

	Question 1	Question 2
Functionality	Y	Y
Economics	Y	Y
Aesthetics	Y	Y
Don't care		
Don't know		

Why? Please explain.

They all interlink, relate to each other.

Got to be functional with some aesthetics and economical (i.e. able to afford it).

Question 4 (a)

Please indicate which views are important for you to visualise and why?

VIEWS FROM		
Views	Mentioned? Yes/No	Most Important
From Front-Gate	y	y
From Back-Gate		
From Shed		
From Homestead	y	y
From Neighbours property		n
From nearby public roads		n

Any Others?

From internal laneways. High or lows points.

VIEWS OF		
Views	Mentioned? Yes/No	Most Important
Of Front-Gate		
Of Back-Gate		
Of Shed		
Of Homestead		
Of Neighbours property		
Of public roads		

Any Others?

No Response.

Question 4 (b)

Please identify the most important views.

See above question.

Question 5

Refer to the aerial photo/sketch map and indicate the location and direction of the important views discussed in Question four.

No Response. Property outside aerial photo extents.

Question 6

Please identify the elements contained within these important landscape views. For example trees, streams etc..

From various high points - panoramic views.

You can see a far distance - you can visualise tree belts etc.

Provides an opportunity to visualise landscape elements.
Elements include trees, streams, landform, hills, ridges, gullies and creeks.

Question 7

Please explain why these views are important to you?

Widest coverage - allowing the ability to choose which features at a time.
Encompass most areas of the farm.
Saves time and money.

Question 8

How do you distinguish between a tree plantation and "natural forested or woodland" area?

(a) Forested or Woodland Areas

Shape - Vary.
Outline - Not defined - No conformity.
Colour - Vary.
Texture - Vary.
Species Type - Vary.
Variety of Species - Mixed.
Visual Penetration (Ability to see into the treed area) - Good.
Layout - Not defined.
Context - No Response.
Age - Vary.
Form - Not consistent.
Any others? Visually more pleasing than plantations.

(b) Tree Plantation

Shape - Used to identify trees. All same shape. Similar height (depending on soil).
Outline - Regimented.
Colour - Much the same.
Texture - Same/similar.
Species Type - All similar.
Variety of Species - Monoculture. Wood lots - have a variety.
Visual Penetration (Ability to see into the treed area) - Not there. Usually fairly dense.
Layout - Standard - evenly spaced.
Context - Man-made and natural barriers define boundaries.
For example, stop at roadways powerlines, ridges and streams.
Age - Generally the same.
Form - Block formation.
Any others? - No Response.

(No images or photos are to be present for this page)

Question 9 (a)

When you visualise the terrain/landform, what visual characteristics come to mind?

Shape. Outline. Undulations. Existing vegetation. Colour varies. Red soils in summer.

Characteristic	Mentioned? Yes/No	Most Important
Height	Y	
Colour	Y	Y
Outline	Y	
Shape	Y	Y (Form) also outline
Textures	Y	Y (relate to colour) for association
Functionality	Y	
Slope	Y	Y (Ties in with height)
Aspect		

Any others?

Relationships with surrounding context i.e. landscape relating to functionality.

Question 9 (b)

Please identify the most important characteristics.

See Above

Question 10 (a)

When you visualise trees, what visual characteristics come to mind?

Green colour. Generally form (density). Symmetry is always different. Aesthetics.

Each tree has its own characteristics - admire each tree.

Prefer Australian native trees.

Relate the trees to nature.

Species habitats - birds home.

Characteristic	Mentioned? Yes/No	Most Important
Height	Y (FORM)	
Colour	Y	
Leaf Shape		
Canopy Shape		
Trunk Shape	Y	
Textures		
Functionality	Y (i.e. is it productive)	
Lighting	Y	
Fauna	Y	
Density	Y	

Any others?

Form Y Y

Light always coming through.

I visualise eucalypt not pines. I generally visualise native species.

Form encompasses everything, gives it a value in all context.

Question 10 (b)

Please identify the most important characteristics.

Form

SECTION B

Question 11 (a)

(Step 1 Show original photo)

The following images are copies of a photo at varying levels of visual quality.



Image A



Image B



Image C

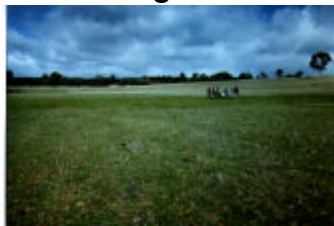


Image D

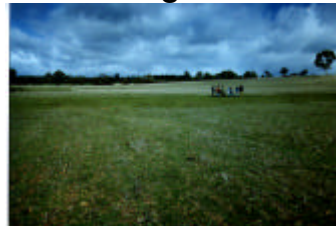


Image E

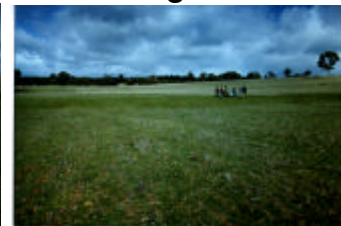


Image F

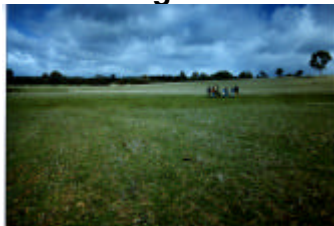


Image G

Please Note: The size and resolution of these images have been reduced.

(Step 2 Show copies)

Please indicate which images are adequate.

Image	Adequate? Yes/No	Highest Quality
A	Y	
B	Y	Y
C	Y	
D	Y	Y
E	Y	Y
F	Y	
G	Y	

Question 11 (b)

Please identify which image has the highest quality.

See Above.

Question 12

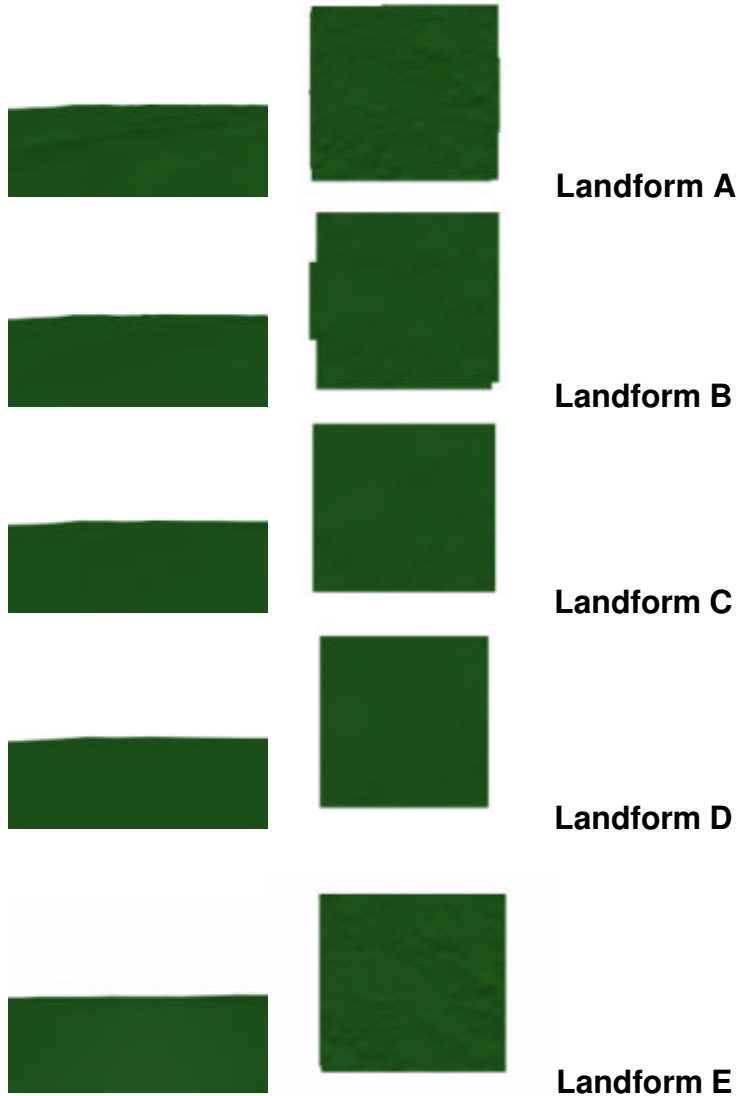
Referring to Question 11, where the quality varies, however the content is the same. Are you responding to the quality of an image or the content of an image, and which is more important and why?

I respond to the quality of the image.

Question 13 (a)

(Step 1: Show Terrain/Landform Images).

The following images represent Boree Gully Landform/Terrain.



Please indicate which landforms are adequate for a visual simulation.

Landform/Terrain	Adequate? Yes/No	Best Representation
A	N	
B	N	
C	N	
D	N	
E	N	

Question 13 (b)

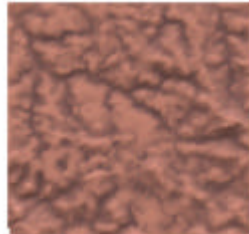
Please identify which images represent Boree Gully the best.

None of these represent the gully.

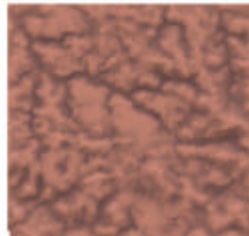
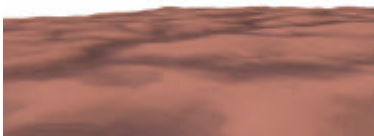
Question 14 (a)

(Step 1: Show Landform/Terrain Images).

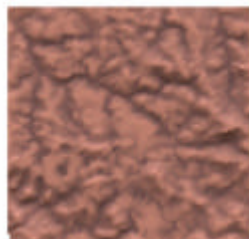
The following images represent Boree Gully Landform at different vertical exaggerations.



Landform A



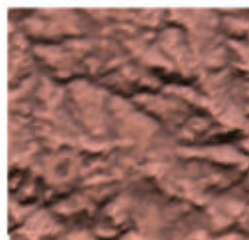
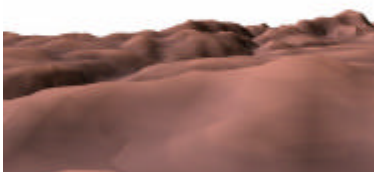
Landform B



Landform C



Landform D



Landform E

Please indicate which landforms/terrains are adequate for a visual simulation.

Landform (Image)	Adequate? Yes/No	Best Representation
A	Y	
B	Y	Y
C	N	
D	N	
E	N	

Question 14 (b)

Please identify which images represent the terrain/landform of Boree Gully the best.

See Above.

Question 15 (a)

(Step 1: Show Tree Images).

The following images represent Pines tree specimen generated from computer models.



2D Circle



2D Triangle



2D Box



2D Outline



3D Sphere



3D Box



3D Cone/Cylinder



3D Detail

Please indicate which trees are adequate for visual simulation purposes.

Tree Shape	Adequate? Yes/No	Rank (1 = Highest)
2D Circle	y	3
2D Triangle	y	1
2D Box	n	5
2D Outline	n	5
3D Sphere	n	5
3D Box	n	5
3D Cone/Cylinder	n	4
3D Detail	y	2

Question 15 (b)

Please rank these tree images from highest too lowest visual quality.

See Above.

Question 16

(Step 1: Show Tree Images).

The following computer generated images represent trees at varying distances from the same viewpoint.

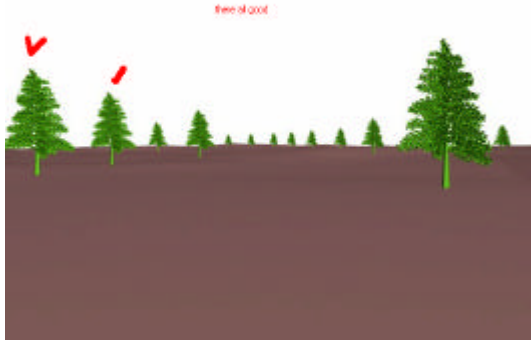


Image A



Image B



Image C



Image D

(a) Please identify which of these images have adequate visual quality.

Image	Adequate
A	y
B	y
C	y
D	y

(b) Please mark on the images which tree models are inadequate and explain why?

See Above.

(c) On some of the images, there may be a distinction between the qualities of the tree models represented. Please mark on the images this distinction if any.

The textures help to distinction between good/bad trees. Preferred the dark trees for realism.

Colour helped for trees in the far background. Lighter colours are better to help distinction that it was actually a tree

Question 17

With the previous questions, we have been analysing the characteristics of computer generated visual simulations. Which of these characteristics have you found to be helpful to convey realism in agroforestry environments?

Clarity- informing the user of possible changes. Placing emphasis on shape and the forms. Symbolism - what you are looking at, in the context and relationship with other forms in the landscape.

SECTION C

Please show simulations to landowner.

Technique One: Using ARC/INFO Draped Images

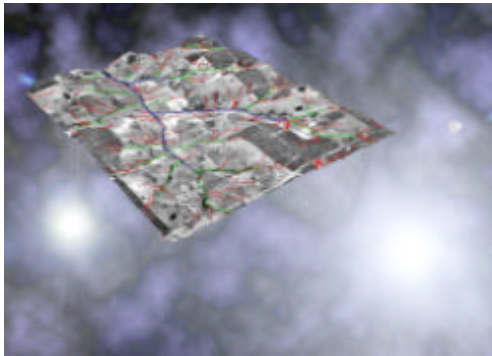


Image One

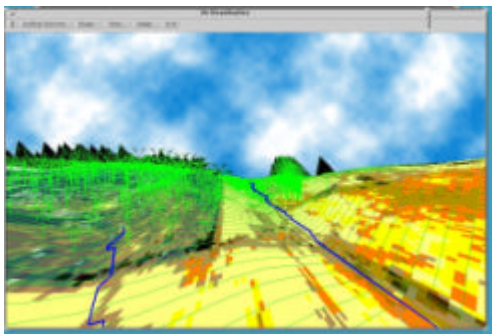


Image Two

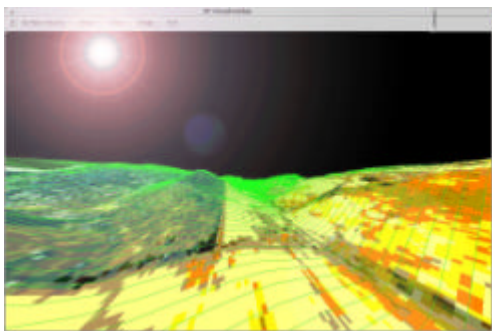


Image Three

Question 18

What objects in the computer simulations can you identify?

Image One

Creek lines. Drainage lines. Landform. Elevation. Relationship to these elements.
Vegetation changes. Roads.

Image Two

See highs and lows - but not sure if it's a landform.
See squiggly lines.

Image Three

See highs and lows - but not sure if it's a landform.
Wavy line - no definition.

Question 19

**Referring to the images illustrated in Question 18, are they useful to gauge the possible visual impact of the agroforestry work?
Please explain why or why not.**

Image One

Yes it is useful to gauge.
Provides me with a perspective of a defined area.

Image Two

Yes it is useful to gauge.
Local perspective from a paddock point of view.
The tree heights help.
The outline of the trees.
Doesn't help to define form.

Image Three

Yes it is useful to gauge.
I can conjure up a mental image of the possibilities.

Question 20

Referring to the images illustrated in Question 18, what is missing from these images?

Image One

You can see the landform, but can not distinction 3d form.
No real perspective - from looking at different directions.
Nothing is there to enhance the trees depth etc.
Regional perspective.

Image Two

Trees are adequate, although they could be better.
Image is suitable for local perspective.
Enhancement is required.

Provides a basic understanding.
Provides a starting point for understanding.

Image Three

Acts as template for this particular position/plan.
You can see the landform.

Please show simulations to landowner.
Technique Two: Using 3D Studio Draped Images



Image One

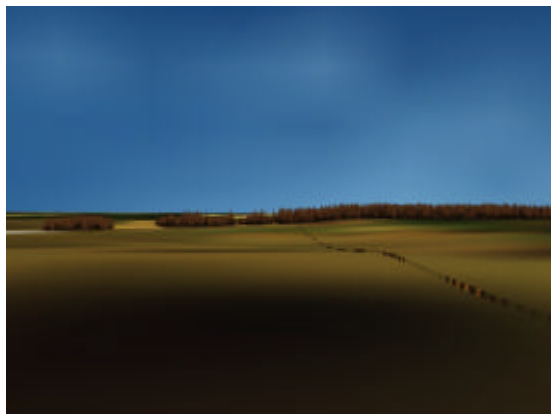


Image Two

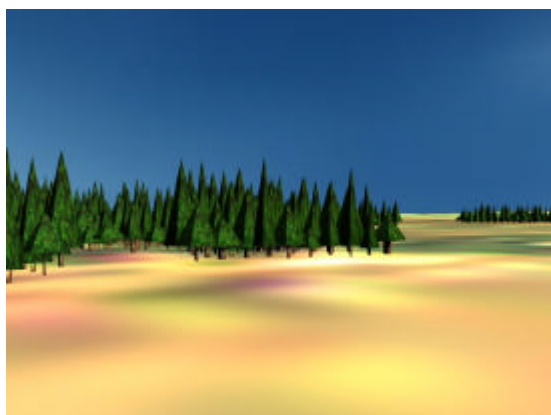


Image Three

Question 21

What objects in the simulations can you identify?

Image One

Drainage lines. Water courses. Vegetation. Trees. Grasses. Roads. Drains.
Dams. Able to see the terrain/landform.

Image Two

Able to see the terrain/landform. Vegetation. Trees. Fences. Shadows. See tree height changes.

Judge of distance. Can see 3d form.

Image Three

Able to see openness. Able to see tree variations. Able to see forms and densities.

Question 22

Referring to the images illustrated in Question 21, are they useful to gauge the possible visual impact of the agroforestry work?

Please explain why or why not.

Image One

Yes, gives impact of vegetation layout in the broader context of an area.

Image Two

Yes, more a specific impact of a relating to the terrain of particular area.

Image Three

Yes, closer look without portraying the dimensions of the surrounding area.

Question 23

Referring to the images illustrated in Question 21, what is missing from these images?

Image One

You can see the landform, but can not distinction 3d form.

No real perspective - from looking at different directions.

Nothing is there to enhance the trees depth etc.

Regional perspective.

Image Two

In a site-specific area this is fine.

Good to see in general.

More of a natural view.

Image Three

Require this view but I need image two to compare.

Not an adequate overview point.

Not a big drama to have close views.

Need to see an overview picture.

SECTION D

FEEDBACK/COMMENTS

Got relevance in the long term.

Produce perspective's that are real.

Real perspective's. With image B created using 3D Studio MAX, you feel as thou you are there.

It's got to be realistic.

Needs to be a useful tool.

Enhances what you can see.

Need to be able to back it up.

Aesthetics in balance, harmony with surrounding area.

Planning needs to be more critical.

Appendix 6.7: Mal Gibbs Survey One Results

SECTION A

(No images or photos are to be present for this page)

Question 1 (a)

In developing visual simulations of revegetation proposals, which landscape features, should we attempt to visualise?

Anything brought back to native- state all stratus.
No money in revegetation - maintain some corridors.
Economic sustainability. Native species - priority.
Cash tree crops need to be considered.
Terrain with water control drainage.
Modify the landscape to control waterlogging.

Object	Mentioned? Yes/No	Most Important
Landform/Terrain	y	y
River/Streams	y	y
Trees	y	y
Shrubs	y	y
Grasses	y	y
Crops	y	
Fences		
Roads		
Homesteads		
Sheds		
Electricity Poles		
People		
Animals	y	

Any others? (Please List)

Animals. In regard to native species grasses are a problem.

Question 1 (b)

Please identify the most important objects that should be visualised.

See Above.

(No images or photos are to be present for this page)

Question 2

When you look at a paddock what landscape features first come to mind?

Topography. Trees. Species of trees (relate to quality of the land soil type).

Question 3

Referring to Question 1 and Question 2, is there a general theme to these features?

Question 1

Question 2

Functionality	y	y
Economics	y	y
Aesthetics		
Don't care		
Don't know		

Why? Please explain.

Sustainable development/agriculture.

Question 4 (a)

Please indicate which views are important for you to visualise and why?

Views	MENTIONED? Yes/No	Most Important
From Front-Gate		
From Back-Gate		
From Shed		
From Homestead	y	
From Neighbours property		
From nearby public roads		

Any Others?

No Response.

Views	MENTIONED? Yes/No	Most Important
Of Front-Gate		
Of Back-Gate		
Of Shed		
Of Homestead		
Of Neighbours property		
Of public roads		

Any Others?

Of the whole property for security purposes and potential fires.

Question 4 (b)

Please identify the most important views.

Most important views are from high points/ ridgelines.

Question 5

Refer to the aerial photo and indicate the location and direction of the important views discussed in Question four.

No Response. Property outside aerial photo extents.

Question 6

Please identify the elements contained within these important landscape views. For example trees, streams etc.

No Response.

Question 7

Please explain why these views are important to you?

No Response.

Question 8

How do you distinguish between a tree plantation and "natural forested or woodland" area?

(a) Forested or Woodland Areas

Shape - Distinguishing canopy layers.
Outline - Not consistent. Rounded horizon.
Colour - Dull grey green.
Texture - No Response.
Species Type - Varies.
Variety of Species - Varies.
Visual Penetration (Ability to see into the treed area)- No Response.
Layout - Not uniform.
Context - No Response.
Age - Varies.
Form - Varies.
Any others? - No Response.

(b) Tree Plantation

Shape - No Response.
Outline - Point consistent.
Colour - Uniform.
Texture - Uniform.
Species Type - Mono.
Variety of Species - Mono.
Visual Penetration (Ability to see into the treed area) - No Response.
Layout - Geometrical.
Context - No Response.
Age - Uniform young.
Form - Geometrical.
Any others? - No Response.

(No images or photos are to be present for this page)

Question 9 (a)

When you visualise the terrain/landform, what visual characteristics come to mind?

Characteristic	Mentioned? Yes/No	Most Important
Height	y	
Colour	y	
Outline		
Shape		
Textures		
Functionality	y	y

Slope
Aspect

Any others?

Depends why you go there! I.e. slope important for cropping.
Aspect important for vineyards.
Height varies on low/high paddock.
Colour varies according to season.
Outline.

Question 9 (b)

Please identify the most important characteristics.

See Above.

Question 10 (a)

When you visualise trees, what visual characteristics come to mind?

Characteristic	Mentioned? Yes/No	Most Important
Height	y	y
Colour	y	y
Leaf Shape	y	y
Canopy Shape	y	y
Trunk Shape	y	y
Textures	y	y
Functionality	y	y
Lighting	y	y
Fauna	y	y
Density	y	y

Any others?

Question 10 (b)

Please identify the most important characteristics.

See Above.

SECTION B

Question 11 (a)

(Step 1 Show original photo)

The following images are copies of a photo at varying levels of visual quality.



Image A



Image B



Image C

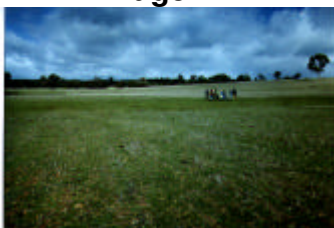


Image D

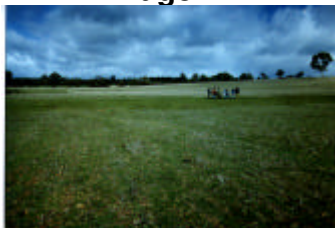


Image E



Image F

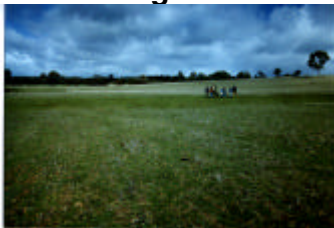


Image G

Please Note: The size and resolution of these images have been reduced.

(Step 2 Show copies)

Please indicate which images are adequate.

Image	Adequate? Yes/No	Highest Quality
A	n y	
B	n y	
C	n y	
D	n y	
E	n y	
F	n y	
G	n y	

Question 11 (b)

Please identify which image has the highest quality.

None.

Question 12

Referring to Question 11, where the quality varies, however the content is the same. Are you responding to the quality of an image or the content of an image, and which is more important and why?

Responding to quality.

Question 13 (a)

(Step 1: Show Terrain/Landform Images).

The following images represent Boree Gully Landform/Terrain.



Landform A



Landform B



Landform C



Landform D



Landform E

Please indicate which landforms are adequate for a visual simulation.

Landform/Terrain	Adequate? Yes/No	Best Representation
A	n	
B	n	
C	n	
D	n	
E	n	

Question 13 (b)

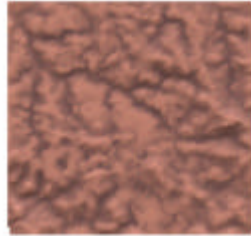
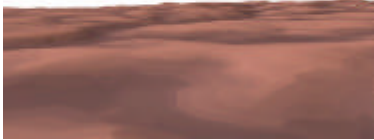
Please identify which images represent Boree Gully the best.

None.

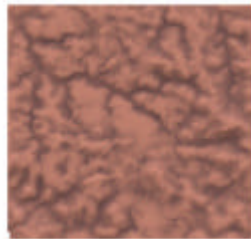
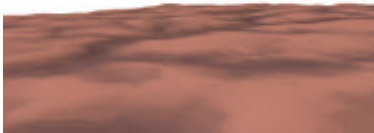
Question 14 (a)

(Step 1: Show Landform/Terrain Images).

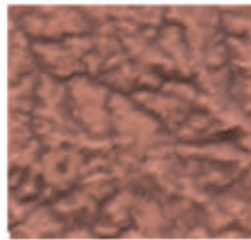
The following images represent Boree Gully Landform at different vertical exaggerations.



Landform A



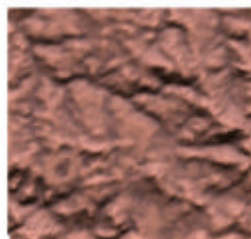
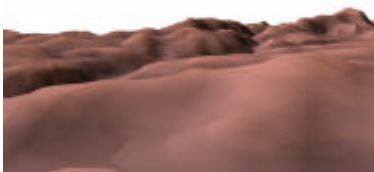
Landform B



Landform C



Landform D



Landform E

Please indicate which landforms/terrains are adequate for a visual simulation.

Landform (Image)	Adequate? Yes/No	Best Representation
A	n	
B	n	
C	n	
D	n	
E	n	

Finding it difficult to distinguish scale of the terrain.

Question 14 (b)

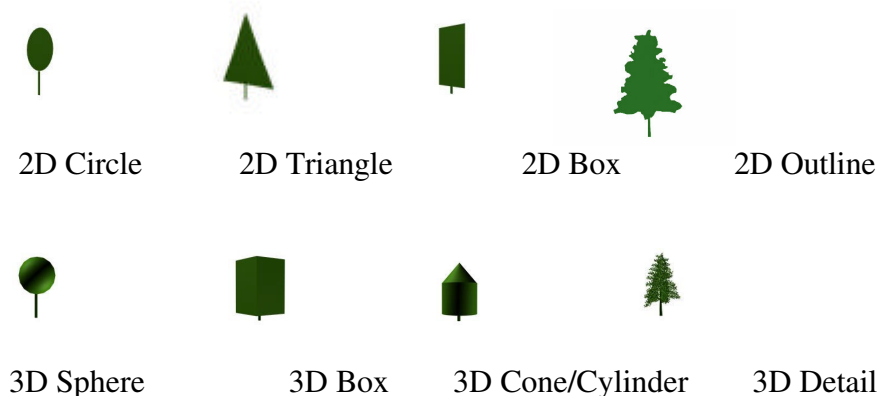
Please identify which images represent the terrain/landform of Boree Gully the best.

None.

Question 15 (a)

(Step 1: Show Tree Images).

The following images represent Pines tree specimen generated from computer models.



Please indicate which trees are adequate for visual simulation purposes.

Tree Shape	Adequate? Yes/No	Rank (1 = Highest)
2D Circle	n	0
2D Triangle	n	0
2D Box	n	0
2D Outline	n	0
3D Sphere	n	0
3D Box	n	0
3D Cone/Cylinder	n	0
3D Detail	n/y	0

Question 15 (b)

Please rank these tree images from highest too lowest visual quality.

None.

Question 16

(Step 1: Show Tree Images).

The following computer generated images represent trees at varying distances from the same viewpoint.

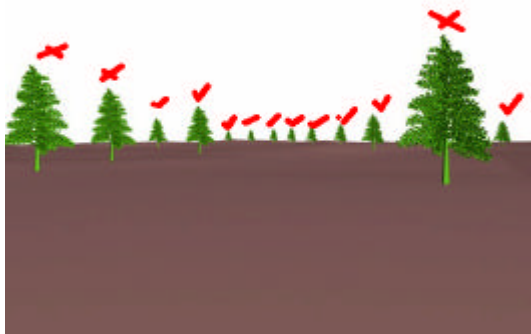


Image A



Image B



Image C

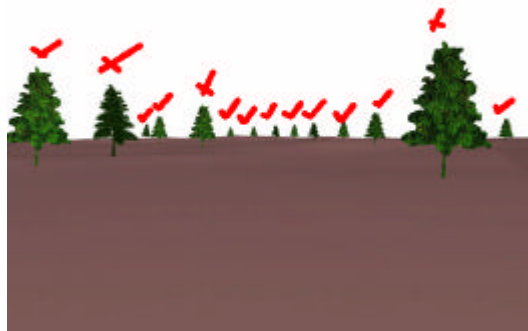


Image D

(a) Please identify which of these images have adequate visual quality.

Image	Adequate
A	
B	
C	
D	

As background trees they were adequate, but not for foreground trees.

(b) Please mark on the images which tree models are inadequate and explain why?

See Above.

(c) On some of the images, there may be a distinction between the qualities of the tree models represented. Please mark on the images this distinction if any.

Needs a pointy top for pines and pointy branch extremities.

Question 17

With the previous questions, we have been analysing the characteristics of computer generated visual simulations. Which of these characteristics have you found to be helpful to convey realism in agroforestry environments?

More details - specific to the variety.

SECTION C

Please show simulations to landowner.
Technique One: Using ARC/INFO Draped Images

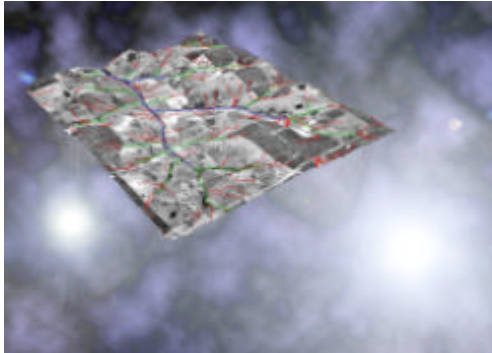


Image One

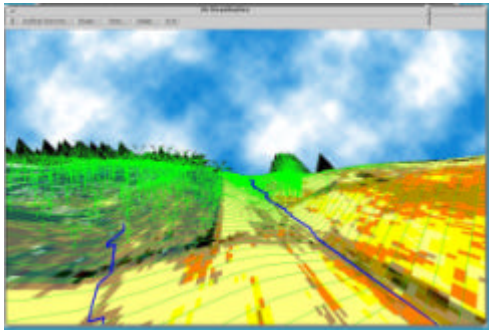


Image Two

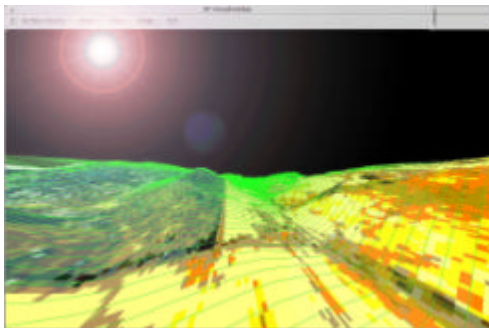


Image Three

Question 18

What objects in the computer simulations can you identify?

Image One

Valley hills. Water courses. Vegetation/shade belts. Fence lines.

Image Two

Terrain. Watercourse. Vegetation.

Image Three

Terrain. Hard to define what the colours are.

Question 19

Referring to the images illustrated in Question 18, are they useful to gauge the possible visual impact of the agroforestry work?

Please explain why or why not.

Image One

Better example. Recognise more objects in this image.

Acceptable, because the image is familiar.

Image Two

Hard to recognise.

Topography almost there, but not enough for visual impact of trees.

Trees are too stylised.

More realistic forms of trees.

Image Three

Hard to recognise.

Topography almost there, but not enough for visual impact of trees.

Question 20

Referring to the images illustrated in Question 18, what is missing from these images?

Image One

No Response – Refer to Question 19.

Image Two

No Response – Refer to Question 19.

Image Three

No Response – Refer to Question 19.

Please show simulations to landowner.

Technique Two: Using 3D studio Draped Images



Image One



Image Two

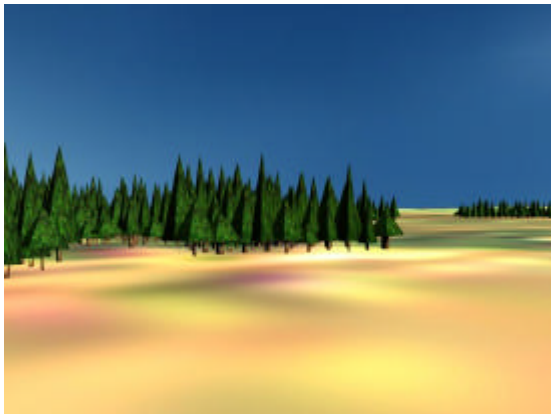


Image Three

Question 21

What objects in the simulations can you identify?

Image One

Roads. Fences. Dams. Can see terrain features. Landscape contours. Vegetation changes. Trees.

Image Two

Fence. Trees. Tundra appearance. Real vegetation green to get appearance of pastures (early growth). Applied golden colour canola crop. Not happy with terrain (wasn't typical- too flat).

Image Three

Trees.

Question 22

**Referring to the images illustrated in Question 21, are they useful to gauge the possible visual impact of the agroforestry work?
Please explain why or why not.**

Image One

Yes the image is adequate.
Because of regional scale - kilometre away.

Image Two

Yes, because image has realistic trees.
Parts of the fence line.
Inadequate terrain colour.
Apply smoothness of colour crop.
Apply foreground detail to depict variety of species.

Image Three

No response.

Question 23

Referring to the images illustrated in Question 21, what is missing from these images?

Image One

Clarity of built objects is required i.e. mark home.
Image quality- improve pixelisation.

Image Two

Background/horizon trees are required if representing area, otherwise for wheat belt it is fine.
Lines in foreground pasture could be developed towards cultivation or towards contour tree planting tea-tree olive trees.
Shadow helps to achieve realism.

Image Three

Need to improve Eucalyptus skyline or include grass trees.
Improve terrain colour.
Distance appears too far.
Everything around here is closer.
Pastures and trees need more detailed/realism.
Shadow helps to achieve realism (Not Represented).

SECTION D

FEEDBACK/COMMENTS

Represent spring - by placing yellow flowers (to represent dandelions).
In winter - green and puddles of water.
Needs more realism.
Avoid long distances in terrain.
Terrain needs to represent local area.
Include local native vegetation i.e. blackboys, red gums and white gums, wandoo and marri.

Appendix 6.8: Survey Two Proforma

Introduction

The purpose of this survey is to evaluate your responses to rural landscapes in the Boree Gully area of South West of Western Australia. We will be showing you some individual images and will be asking you to evaluate and score them according to your personal preferences.

We have provided some example images of the Boree Gully area, to familiarise you with this particular rural landscape. Please use this opportunity to ask any questions about this rural area. Following these examples, we will ask you to evaluate ten images of the Boree Gully rural landscape.

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like		
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					

Question Two

With the images that you like, could you please explain why you like them?

Question Three

With the images that you dislike, could you please explain why you dislike them?

END OF SURVEY TWO

Appendix 6.9: - Survey Two Results - Category One Images

Scanning photographs created the following images in category one. No modifications were applied to these images.

1 Image One

Respondent	1	2	3	4	5	6	7	8	9	10
Score	7	8	1	-10	4	2	6	6	4	4

The above scores indicate a positive reaction by the respondents.
The average score for Image One is 3.2.

2 Image Two

Respondent	1	2	3	4	5	6	7	8	9	10
Score	9	2	0	7	3	6	3	10	10	6

The above responses indicate an overall positive score.
The average score for Image Two is 5.6.

3 Image Seven

Respondent	1	2	3	4	5	6	7	8	9	10
Score	6	5	4	2	5	5	4	10	10	3

The above responses indicate an overall positive score.
The average score for Image Seven is 5.4.

4 Image Nine

Respondent	1	2	3	4	5	6	7	8	9	10
Score	4	1	-5	7	6	7	5	7	8	0

The above responses indicate an overall positive score.
The average score for Image Nine is 4.0.

5 Image Twelve

Respondent	1	2	3	4	5	6	7	8	9	10
Score	6	7	-5	8	-2	-5	3	8	7	1

The above responses indicate an overall neutral but positive score.
The average score for Image Twelve is 2.8.

6 Image Thirteen

Respondent	1	2	3	4	5	6	7	8	9	10
Score	10	3	-6	-2	0	2	-10	5	6	4

The above responses indicate an overall neutral score.

The average score for Image Thirteen is 0.2.

7 Image Fourteen

Respondent	1	2	3	4	5	6	7	8	9	10
Score	2	7	2	8	2	3	-5	8	4	2

The above responses indicate an overall positive score.

The average score for Image Fourteen is 3.3.

8 Case Study Property Owner Respondent

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent	Average	Less than average	Greater or equal to average
	4			
1	-10	3.2	☒	
2	7	5.6		☒
7	2	5.4	☒	
9	7	4.0		☒
12	8	2.8		☒
13	-2	0.2	☒	
14	8	3.3		☒

9 Boree Gully Respondents

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent				Average	Less than average	Greater or equal to average
	1	2	3	4			
1	7	8	1	-10	3.2	2	2
2	9	2	0	7	5.6	2	2
7	6	5	4	2	5.4	3	1
9	4	1	-5	7	4.0	2	2
12	6	7	-5	8	2.8	1	3
13	10	3	-6	-2	0.2	2	2
14	2	7	2	8	3.3	2	2

10 Non-Boree Gully Respondents

The following respondents are from outside the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent						Average	Less than average	Greater or equal to average
	5	6	7	8	9	10			
1	4	2	6	6	4	4	3.2	1	5
2	3	6	3	10	10	6	5.6	2	4
7	5	5	4	10	10	3	5.4	4	2
9	6	7	5	7	8	0	4.0	1	5
12	-2	-5	3	8	7	1	2.8	3	3
13	0	2	-10	5	6	4	0.2	2	4
14	2	3	-5	8	4	2	3.3	4	2

Appendix 6.10: - Survey Two Results - Category Two Images

Modifying scanned photographs created the following images in category two.

1 Image Three

Respondent	1	2	3	4	5	6	7	8	9	10
Score	-10	-1	-5	-5	3	1	-2	-3	0	0

The above scores indicate a negative neutral reaction by the respondents.
The average score for Image Three is -2.2.

2 Image Five

Respondent	1	2	3	4	5	6	7	8	9	10
Score	6	2	-6	-10	2	0	-7	2	2	-2

The above scores indicate a negative neutral reaction by the respondents.
The average score for Image Five is -1.1.

3 Image Ten

Respondent	1	2	3	4	5	6	7	8	9	10
Score	10	0	-7	-4	1	0	-10	-2	1	2

The above scores indicate a negative neutral reaction by the respondents.
The average score for Image Ten is -0.9.

4 Image Eleven

Respondent	1	2	3	4	5	6	7	8	9	10
Score	4	6	1	6	4	2	2	8	7	-1

The above scores indicate a positive reaction by the respondents.
The average score for Image Eleven is 3.9.

5 Image Fifteen

Respondent	1	2	3	4	5	6	7	8	9	10
Score	7	8	-3	-2	0	-5	-4	4	5	3

The above scores indicate a positive neutral reaction by the respondents.
The average score for Image Fifteen is 1.3.

6 Case Study Property Owner Respondent

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent	Average	Less than average	Greater or equal to average
	4			
3	-5	-2.2	☑	
5	-10	-1.1	☑	
10	-4	-0.9	☑	
11	6	3.9		☑
15	-2	1.3	☑	

7 Boree Gully Respondents

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent				Average	Less than average	Greater or equal to average
	1	2	3	4			
3	-10	-1	-5	-5	-2.2	3	1
5	6	2	-6	-10	-1.1	2	2
10	10	0	-7	-4	-0.9	2	2
11	4	6	1	6	3.9	1	3
15	7	8	-3	-2	1.3	2	2

8 Non-Boree Gully Respondents

The following respondents are from outside the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent						Average	Less than average	Greater or equal to average
	5	6	7	8	9	10			
3	3	1	-2	-3	0	0	-2.2	1	5
5	2	0	-7	2	2	-2	-1.1	2	4
10	1	0	-10	-2	1	2	-0.9	2	4
11	4	2	2	8	7	-1	3.9	3	3
15	0	-5	-4	4	5	3	1.3	3	3

9 Category Two (Modified) Averages compared to Category One (Original) Averages

Image Number (Modified)	Image Number (Original)	Category One Average (Original)	Category Two Average (Modified)
3	14	3.3	-2.2
5	1	3.2	-1.1
10	13	0.2	-0.9
11	12	2.8	3.9
15	7	5.4	1.3

Appendix 6.11: - Survey Two Results - Category Three Images

These images were prepared by cloning photographic textures onto computer model images.

1 Image Four

Respondent	1	2	3	4	5	6	7	8	9	10
Score	8	2	-6	-2	2	3	9	3	-1	-2

The above scores indicate a positively neutral reaction by the respondents.
The average score for Image Three is 1.6.

2 Image Six

Respondent	1	2	3	4	5	6	7	8	9	10
Score	9	0	-4	-3	3	5	7	4	5	1

The above scores indicate a positively neutral reaction by the respondents.
The average score for Image Three is 2.7.

3 Image Eight

Respondent	1	2	3	4	5	6	7	8	9	10
Score	2	-4	-3	-3	5	2	4	4	4	4

The above scores indicate a positively neutral reaction by the respondents.
The average score for Image Three is 1.5.

4 Case Study Property Owner Respondent

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent	Average	Less than average	Greater or equal to average
	4			
4	-2	1.6	☒	
6	-3	2.7	☒	
8	-3	1.5	☒	

5 Boree Gully Respondents

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent				Average	Less than average	Greater or equal to average
	1	2	3	4			
4	8	2	-6	-2	1.6	2	2
6	9	0	-4	-3	2.7	3	1
8	2	-4	-3	-3	1.5	3	1

6 Non-Boree Gully Respondents

The following respondents are from outside the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Image Number	Respondent						Average	Less than average	Greater or equal to average
	5	6	7	8	9	10			
4	2	3	9	3	-1	-2	1.6	2	4
6	3	5	7	4	5	1	2.7	1	5
8	5	2	4	4	4	4	1.5	0	6

Appendix 6.12: Results - Comparing Images of Existing Landscapes with Computer Modified Images.

From the fifteen images within the survey, seven were scanned photographs without modifications. Five of these images were taken within the case study property and these were used to create computer visual simulations. These modified images are the images represented in Category Two. Below are the survey results with the original image compared to the modified image. These modified images had been modified to meet the techniques identified earlier in this study.

1 Image One (Original) compared to Image Five (Modified)

Respondent	1	2	3	4	5	6	7	8	9	10
Image One Score	7	8	1	-10	4	2	6	6	4	4
Image Five Score	6	2	-6	-10	2	0	-7	2	2	-2
Score Variation Between Modified and Original	1	6	7	0	2	2	13	4	2	6
Direction Between Modified and Original	Below	Below	Below	Same	Below	Below	Below	Below	Below	Below

The average scores for Image One indicate a positive reaction by the respondents.

The average score for Image One is 3.2.

The average scores for Image Five indicate a negative neutral reaction by the respondents.

The average score for Image Five is -1.1.

2 Image Seven (Original) compared to Image Fifteen (Modified)

Respondent	1	2	3	4	5	6	7	8	9	10
Image Seven Score	6	5	4	2	5	5	4	10	10	3
Image Fifteen Score	7	8	-3	-2	0	-5	-4	4	5	3
Score Variation Between Modified and Original	1	3	7	4	5	10	8	6	5	0
Direction Between Modified and Original	Above	Above	Below	Below	Below	Below	Below	Below	Below	Same

The average scores for Image Seven indicate an overall positive score.

The average score for Image Seven is 5.4.

The average scores for Image Fifteen indicate a positive neutral reaction by the respondents.

The average score for Image Fifteen is 1.3.

3 Image Twelve (Original) compared to Image Eleven (Modified)

Respondent	1	2	3	4	5	6	7	8	9	10
Image Twelve Score	6	7	-5	8	-2	-5	3	8	7	1
Image Eleven Score	4	6	1	6	4	2	2	8	7	-1
Score Variation Between Modified and Original	2	1	6	2	6	7	5	0	0	2
Direction Between Modified and Original	Below	Below	Above	Below	Above	Above	Below	Same	Same	Below

The average scores for Image Twelve indicate an overall neutral but positive score.

The average score for Image Twelve is 2.8.

The average scores for Image Eleven indicates a positive reaction by the respondents.

The average score for Image Eleven is 3.9.

4 Image Thirteen (Original) compared to Image Ten (Modified)

Respondent	1	2	3	4	5	6	7	8	9	10
Image Thirteen Score	10	3	-6	-2	0	2	-10	5	6	4
Image Ten Score	10	0	-7	-4	1	0	-10	-2	1	2
Score Variation Between Modified and Original	0	3	1	2	1	2	0	7	5	2
Direction Between Modified and Original	Same	Below	Below	Below	Above	Below	Same	Below	Below	Below

The average scores for Image Thirteen responses indicate an overall neutral score.

The average score for Image Thirteen is 0.2.

The average scores for Image Ten indicate a negative neutral reaction by the respondents.

The average score for Image Ten is -0.9.

5 Image Fourteen (Original) compared to Image Three (Modified)

Respondent	1	2	3	4	5	6	7	8	9	10
Image Fourteen Score	2	7	2	8	2	3	-5	8	4	2
Image Three Score	-10	-1	-5	-5	3	1	-2	-3	0	0
Score Variation Between Modified and Original	12	8	7	13	1	2	3	11	4	2
Direction Between Modified and Original	Below	Below	Below	Below	Above	Below	Above	Below	Below	Below

The average scores for Image Fourteen indicate an overall positive score.

The average score for Image Fourteen is 3.3.

The average scores for Image Three indicate a negative neutral reaction by the respondents. The average score for Image Three is -2.2.

6 Case Study Property Owner Respondent

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Original Image versus Modified Image	Score Variation Between Modified and Original	Direction Between Modified and Original
1 vs 5	0	Same
7 vs 15	4	Below
12 vs 11	2	Below
13 vs 10	2	Below
14 vs 3	13	Below

7 Boree Gully Respondents

The following respondents are from the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Original Image versus Modified Image	Score Variation Between Modified and Original				Average Difference	Occurrence of Below Direction	Occurrence of Above Direction	Occurrence of Same Direction
	1	2	3	4				
1 vs 5	1	6	7	0	3.5	3	0	1
7 vs 15	1	3	7	4	3.75	2	2	0
12 vs 11	2	1	6	2	2.75	3	1	0
13 vs 10	0	3	1	2	1.5	3	0	1
14 vs 3	12	8	7	13	10	4	0	0

8 Non-Boree Gully Respondents

The following respondents are from outside the Boree Gully area. The respondents' scores have been compared to the average score from all the respondents.

Original Image versus Modified Image	Score Variation Between Modified and Original						Average Difference	Occurrence of Below Direction	Occurrence of Above Direction	Occurrence of Same Direction
	5	6	7	8	9	10				
1 vs 5	2	2	13	4	2	6	4.8	6	0	0
7 vs 15	5	10	8	6	5	0	5.6	5	0	1
12 vs 11	6	7	5	0	0	2	3.3	2	2	2
13 vs 10	1	2	0	7	5	2	2.8	4	1	1
14 vs 3	1	2	3	1 1	4	2	3.8	4	2	0

Appendix 6.13: Survey Two Results For Each Respondent

1 Respondent One

Introduction

The purpose of this survey is to evaluate your responses to rural landscapes in the Boree Gully area of South West of Western Australia. We will be showing you some individual images and will be asking you to evaluate and score them according to your personal preferences.

We have provided some example images of the Boree Gully area, to familiarise you with this particular rural landscape. Please use this opportunity to ask any questions about this rural area. Following these examples, we will ask you to evaluate ten images of the Boree Gully rural landscape.

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like				
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10		
1																		☒					
2																				☒			
3	☒																						
4																			☒				
5																	☒						
6																				☒			
7																	☒						
8													☒										
9															☒								
10																					☒		
11															☒								
12																	☒						
13																					☒		
14													☒										
15																		☒					

Question Two

With the images that you like, could you please explain why you like them?

Image One

Liked the clouds and the glare.

Natural sunlight.

Liked the trees and grass.

Liked the quantity of trees.

Liked the slope.

Image would be better if there were more trees in the foreground - my personal desire or preference. However, trees in the image foreground would inhibit vision.

Left row of trees does not look natural because of straight line.

Right side of trees look natural because of curve and random position of trees.

Image Two

Liked the maturity of the trees - their compactness and colour.

Liked all the greens including the grass.

Liked the sheep.

Image Four

Liked the greenness of the trees and the grass.

Not sure whether they are trees or shrubs.

Don't like the tree rows -not natural planting.

Questioning the design - motive of the design.

Image Five

Image is blurred especially in the middle.

Preferred random size and position of trees.

Image Six

Liked the trees and the greenness - especially the trees.

Liked the hills - its gentle characteristics.

The hedge at the background - looked like stone fence -looks unnatural. (Not sure what it is)?

Liked the trees because they're bigger.

Don't like the tree edge in right background.

Liked the quantity of trees.

Liked the older trees.

Image Seven

In this image, the trees are fitting into the landscape.

Liked the quantity of trees.

Liked the shape and spacing of the trees.

Don't appear to be hedge like.

Liked the greenness of the grass.

Liked the terrain gully.

Liked the road - blends in more - doesn't dominate i.e. image proportional.

Image Eight

Trees are little. Liked mature trees. Too many trees.
Nothing in foreground - bare contrast to background where there are too many trees.
Rather trees on right side.
Trees on left are shrubby doesn't appeal.
Trees are out of proportion need a gap between the old and new trees.
Edge here does not look right.

Image Nine

No understorey - don't like.
Dead sticks - don't like.
Straight line - don't like.
Don't like bare fields.
Don't like gravel.

Image Ten

Less of road.
Image not clear.
Image quality is slightly lacking.
Liked the sheep.
Liked the hills - its gentle characteristics.
Liked the trees and the greenness.
Prefer everything when it's green i.e. didn't like the road.
Prefer natural features i.e. trees.

Image Eleven

Don't like the straightness of trees on right side.
Liked the big old tree.
Dead trees do not appeal.
Dead grass not appealing.
Liked the trees and grass.

Image Twelve

Don't like the straightness of trees on right side.
Liked the big old tree.
Dead trees do not appeal.
Dead grass not appealing.
Liked the trees and grass.

Image Thirteen

Liked the sheep.
Liked the hills - its gentle characteristics.
Liked the trees and the greenness.
Prefer everything when it's green i.e. didn't like the road.
Prefer natural features i.e. trees.
Liked the content and the image quality.

Image Fourteen

No greenness.
Want a blue sky
Don't like trees in a straight line but like maturity of trees.
Don't like stubble.
Like the background trees.
Don't like dead wood/trees.

Image Fifteen

In this image, the trees are fitting into the landscape.
Liked the quantity of trees.
Liked the shape and spacing of the trees.
Don't appear to be hedge like.
Liked the greenness of the grass.
Liked the terrain gully.
Liked the road - blends in more - doesn't dominate i.e. image proportional.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image 3

The image is blurry.
Dusk sky - would be better with different colours than grey.
Want actual sunlight.
Don't like stubble.
Liked mature trees.
Trees in line don't like.
Like background trees (numbers).

Thank you.

Your responses are part of a Rural Industries Research Development Corporation (RIRDC) project investigating means of preparing suitable computer images for revegetation projects in rural Western Australia.

Lorne Leonard
Grant Revell
Julie Delaney

2 Respondent Two

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like				
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10		
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
13																							
14																							
15																							

Question Two

With the images that you like, could you please explain why you like them?

Image One

Better contrast within image.
Pleasant scene - aesthetically pleasing.
Good perspective - long distances can be judged.
Good proportions between crop and trees.

Image Two

Colours are real.
Middle trees are not real.
Trees on outer image are real.
Slight blurriness.
Hard to judge terrain.

Small area to see what happens.

Image Four

Foreground is good. Back ground blurred.
Can't see a lot in the background.
Like the perspective but there's no information (lacking).
See trees in foreground. Graphic right side.
Trees in front look real but not in background --too blurred.
Straight lines. Left side does not look like trees - not reality - not like a real photograph.

Image Five

Images on left side are not clear - lack contrast of trunks.
Pleasant scene - aesthetically pleasing.
Good perspective - long distances can be judged.
Good proportions between crop and trees.

Image Six

Can't distinguish what it is.
Healthy trees outer? -Don't know!
All dead trees?
Not sure what I am looking at?
Sheep or shrubs in the background?
Clump of graphics in back right.
Not sure what it is - back left of image?
Trees in middle ground fine.
Colour of grass -good.
Grass in foreground surreal more like a palette of grass - close but not there.
Can read terrain well.
Foreground confusing - trees not real.

Image Seven

Not clear -blurred.
Perspective is right -objective image.
Trees on left side real.
Trees on right side not real.
Hard to judge ridgelines in the background.
Blue haze - like smoke.
Image is more realistic when viewed from a longer distance (1 metre away from the screen).

Image Nine

No clarity/blurriness back & middle ground on right side.
Needs more contrast.
Lack of distinguished terrain.
Does not portray flow.
Lacking true perspective distortion.
Canopy a bit heavy.

Image Ten

Longer perspective background.
Reading the topography well.
Image is slightly blurred.
Evening/morning photograph - not too much contrast.
Expect some cloudless.
Image lacks a little bit of contrast.
Green lacking --dull.
Scored neutral because lack of contrast.
Image is too blurred.
Lacking contrast between back and fore ground.
Rely on contrast heavily to judge objects.

Image Eleven

Better close up image.
Better vision of area - the way it flows because of far background.
Better balance within image.

Image Twelve

Better colours.
Close perspective.
Contrast of colours.
Limited vision - small area.
Not useful image - limited value.
Need to encompass a bigger area.

Image Thirteen

Longer perspective foreground/background.
Reading the topography well.
Image is slightly blurred.
Evening/morning photograph - not too much contrast.
Expect some cloudless.
Image lacks a little bit of contrast.
Green lacking --dull.
Scored neutral because lack of contrast.
Image is too blurred.
Lacking contrast between back and fore ground.
Rely on contrast heavily to judge objects.

Image Fourteen

Fairly typical scene of this area - south west of wandoo country.
Good perspective - real.
Colours washed - not enough contrast.

Image Fifteen

Like how you can see hills and contours/shapes - gives a good perspective.
Proportional with back and middle ground.
Textures fairly real.
Contrast between trees.

Lacking contrast with colours too much grey.
Image slightly blurred.
Sky colours not true - colour/reality.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Three

Lack of contrast in foreground initially.
Distance is acceptable.
Tree line is distinguishable but is slightly blurred.
Judging foreground first, then middle ground then background.
Background less of priority when evaluating image.
Now that I have determined that the image was taken around dusk time I would re-score this photograph with a rating of +5.

Image Eight

Looks like two images superimposed.
No symmetry.
Trees in left side of image not relating to large tree and trees in the back right.
Difficult to judge middle/back ground terrain.
Foreground terrain is ok.
Left-hand side confused at what you looking at.
Central area hard to visualise with the way the landscape moves.
After moving the computer screen to a different position I would re-score this image with a +4.

3 Respondent Three

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like		
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Question Two

With the images that you like, could you please explain why you like them?

Image One

Volume of light in middle is very interesting.
 Detail is overexposed in centre of image.
 Peripherals quality and detail are good.
 Colour good.
 Art sense light in middle is fine and interesting if trying to convey information.
 It is lacking topographic information.
 Images are recognisable.
 Trees -ok.
 Grass -ok.
 Recognisable trees.

Image Two

Find image pleasant.
 I would re-score this image to +4.
 Balanced in proportions and colour.

Subject matter all recognisable.
Definitions pretty good.
Tree shadows and sky authentic.
Some sheep are out of focus lack definition.

Image Seven

Has clarity.
Sky very appealing.
Sky focal point.
Recognisable vegetation it is clear and acceptable.
Middle ground is too confine -too much information.
While foreground is lacking information.
Background detail is fine - satisfactory.
Realistic image.

Image Eleven

Dullness of foreground is not appealing.
Brighter sky is not appealing.
Lack of information or interest in sky.
Foreground information dullness makes it difficult to find information.
Not a lot of interest.
Trees are recognisable.

Image Fourteen

Silhouette in skyline is the most attractive part of picture.
Foreground is defined, interesting information about it.
Clarity of trees not there.
Can see that it is poor light - doesn't make it attractive.
Sky is bland i.e. not interesting.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Three

Fuzzy image which makes it hard to decipher information.
Lacks clarity.
Don't like colours.
Like colour of tree tops/with some penetrating sunglow?
Insufficient of that to make it attractive.
Overexposed sky.
Fuzzy image which is very annoying.
Image is balanced.
Has a background midfield

Image Four

Unbelievable.

Some definition in trees but inconsistent.
Rocks in middle ground are ok slightly inconstancy in definition.
Questioning the middle ground and half of pastures.
Foreground is fine in detail gets worse further in.
Foreground sets the images of vegetation growth and not consistent portrayed in the middle ground.
Furry background trees.
Middle left horizon is believable as large granite hills bolder hills.
Looks like a cut and paste image.
Sky good.
Trees on right foreground lack trunk shadows.
Just something wrong with them.

Image Five

Left side some merit.
Right side overexposed.
Shithouse fuzzy.
Hard to interpret.
Unrealistic foreground grass and trees.
Looks like remains of nuclear explosion.
Proportions are ok.
Topography acceptable.
Sky acceptable.

Image Six

Lacks clarity.
Sheep and trees to the right of them have some clarity (middle trees).
Sheep on the left lack clarity.
Sheep easily recognised -clarity not uniform in the mob.
Trees are too blurred.
Sky is blurred.
Grass again blurred.
Terrain is ok.

Image Eight

Looks false - looks like a cut and paste picture.
Not natural edge on horizon in regard to vegetation.
Distorted.
Large trees are fine and trees at the front row edge.
However trees in the middle ground are not fine.
Confused distorted fuzzy.
Colours are good for whole image.
Grass in foreground has poor definition and colours not a real colour.
In contrast to the sky which is far more realistic or natural.
Proportions are fine.

Image Nine

Definition could be sharper.

Appears slightly overexposed which detracts from the clarity and definition right hand side of image.
Left side more depth of colour and definition slightly fuzzy.
Trees are ok.
Pleasant picture I nearly could put the image on my own wall.
Happy with terrain.
Middle, fore and background is ok.
I know the location and can see that it could be a cut and paste picture.
Because it's a plantation because of density of plantation doesn't give you any background.
Sky or paddock in trees would be realistic, which is not always possible.
Need to thin the trees up.

Image Ten

Very poor definition over whole picture.
Dull grey.
Overexposed sky.
Out of proportion sky too much sky.
Red line on horizon possibly realistic very important for dusk/dawn times portrayal.
Lack of definition ruins entire image.
One patch of greenness that gives some credibility.

Image Twelve

Image is realistic but bland and dull.
Light dusk or dawn achieved clarity of subject matter.
Image clarity is pretty good.
Information is clear.
I would re-score this image to -1.

Image Thirteen

Dull and grey almost balanced.
Because nothing in sky it is out of proportion.
Fuzzy and dullness makes it difficult to interpret information.
All recognisable but fuzzy.
In proportion.
Happy with trees although fuzzy.
Image is unrealistic foreground will be more colourful.
I want green to be green.
Pertaining to the closeness of the green it is too grey.
Could be taken dusk/dawn but foreground would be greener.

Image Fifteen

Poor definition and out of focus.
Balanced picture.
Sky authentic.
Vegetation fine apart from distortion.

4 Respondent Four

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike						Mildly Dislike				Neutral				Mildly Like						Strongly Like			
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Question Two

With the images that you like, could you please explain why you like them?

Image Two

Grass in foreground should be greener.
Overall clarity good.
Good sky.
Realistic image.
Trees are fine.
All proportional.

Image Seven

Good sky.
Good horizon.
Pasture could be darker.
Good clarity of trees.
Photograph looks overexposed.

When 50% smaller green is better.
Proportion and scale fine.
Trees are fine.

Image Nine

Lost clarity in foreground and background but middle ground is fine.
Like the trees.
Terrain realistic.
Colours are fine could be better contrast in the greens of the pasture and trees.

Image Eleven

Clarity in foreground fine.
Colour contrast not vivid enough to identify trees.
The image is too dark.
Trees in proportion no clarity.
Sky satisfactory.
Happy with the distances conveyed.

Image Twelve

Good foreground better photograph than image fourteen.
Like the colours better colours.
Clarity in distance is a bit blurred but you expect that because of the time of day (late part of the day)
Trees are realistic.

Image Fourteen

Colours like clarity.
Colours are good. (I am colour blind with greens brown red blue shades of them).
Good clarity of stubble in foreground.
Middle ground trees are fine.
Background trees a little bit fuzzy.
Scale right proportion.
Realistic image.
I appreciate the time of day i.e. colour extremes of shadow.
I would rather have morning photograph because you get better colours at this time (around 10am to 2pm).

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image One

Clarity is better than image five but not good enough.
Overexposed and blurred.
Proportions and scale are wrong.
If you didn't know position of photograph it would make no sense.

Image does make sense for myself.
The pastures are overexposed, compared to trees this makes pasture appear bigger than reality.
Terrain is too flat and is inadequate.
Too blurred to judge distances using the photograph.

Image Three

Information is fine.
Too fuzzy and dull.
Tone and colours are wrong.
Foreground wrong.
Background and middle ground wrong.
Tree scale right.
Proportion right.

Image Four

Colour scheme wrong.
Clarity of trees not good and pasture not good.
Colours don't look realistic just the wrong colours.
Rocks are not clear.
A bit blurred so hard to judge distances.
Vegetation not proportion rocks look like too large for the distance and trees too small when compared to the fence height and position.
Detail and clarity in foreground fine but not the colours.

Image Five

Overexposed and blurred.
Proportions and scale are wrong.
If you didn't know position of photograph it would make no sense.
Image does make sense for myself.
The pastures are overexposed, compared to trees this makes pasture appear bigger than reality.
Terrain is too flat and is inadequate.
Too blurred to judge distances using the photograph.

Image Six

Grasses and rocks hard to identify.
Trees are ok.
Scale and proportion is ok.
Grass texture needs to be darker.
Colour of all vegetation is wrong except maybe the middle ground large trees.
Need to improve the clarity.
Need to improve colour scheme.
Terrain is ok.
Colours of rocks stand out too much overpowering.
Possible if trees became clearer rocks wouldn't be an issue.
Trees in the middle ground (large mature trees) are fine.
Slope off terrain.
Further the distance in image the worst the image gets i.e. blurred.

Reducing image size (50%) improves the colour but nothing else.
Sky is good.
Good colours.

Image Eight

Clarity and colour scheme needs to be improved, which may improve the clarity.
Vegetation scale is ok.
Colour of all vegetation is wrong except maybe the middle ground large trees.
Skyline is ok.
Proportion is ok.
Density is ok.
Grass texture needs to be darker.

Image Ten

Too dull.
Too fuzzy.
Tone and colours not right.
Otherwise good -except for colour.
Information is fine.
Tree scale right.
Proportion right.

Image Thirteen

Colours are wrong.
The tones too grey.
Clarity of distance not great.
Dusk photograph.
Greens not vivid enough looks like summer grass green.
Middle ground of photograph is fine i.e. the fence, the sheep but not the grass.
Everything is in proportion.
Scale is ok.

Image Fifteen

Image is fuzzy.
Trees are fuzzy.
Colours are good but too fuzzy.
Content fine.
Scale good.
Proportion fine.
Sky is fine.
Grass too light should be darker.

5 Respondent Five

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like				
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Question Two

With the images that you like, could you please explain why you like them?

Image One

Like the movement in the landscape.

Terrain is fine.

Too much foreground.

Could be better composed maybe by improving proportions.

Scales of trees seem fine.

Textures and colours are fine.

Content fine.

Image Two

Textures are fine.

Colours are fine.

Middle ground blocks visual penetration. I don't like it. It is unsettling to the eye.

Scale is ok.

Proportions are ok.

Image Three

Dull in colour.
I appreciate the colours.
Fuzzy quality.
Could be less sky.
Like the visual penetration in the background.
Like the proportions with the fore/middle/background.
Fuzzy quality - blurry i.e. can't tell the textures.
I liked the lighting.

Image Four

Picture is surreal.
Can't identify objects.
Cliffs in background?
Boulders in middle ground?
Like the clouds.
Lack of depth two-dimensional.
Box like.
Cut and paste.
Textures are wrongly scaled.

Image Five

Blurry and boring.
Lacks defined textural quality.
Improve focus.
Get camera off the grass.

Image Six

Colours are bright and sit oddly.
Each element looks separate.
Cut and paste.
Photograph is flat.
Two-dimensional.
Looks like boulder wall or stacked sheep not sitting properly in the landscape.
The perspective could be wrong because of block of objects.
Looks like its flat maybe because of viewing position?
Lighting seems unrealistic.
Image is not realistic it's been composed.
But you can appreciate these images.
Terrain looks like it sloping upwards.

Image Seven

Textures are fine.
Composition fine.
Flow to the landscape.
Lighting bright (maybe the screen?).
Real photograph with possible insertions in the middle ground trees in the left

band.
Visual penetration is fine.

Image Eight

Foreground comes to a definite edge, which is unsettling and not quite right.
Not visually pleasing composition for photography but maybe informative i.e. depending on why you are looking at.
Looks like a strip in middle ground.
Hard to judge scale seems all right but not sure what looking at.
Textures are fine.
Images don't work well.
Very stripped photograph.

Image Nine

A bold photograph.
Composition is good.
Elements are well defined.
Got elements in the immediate foreground not pastures and grasses.
Trees and textures are fine.

Image Ten

Fuzzy quality.
Fog.
Like the light but the fuzzy lacks atmosphere.
If trying to create atmosphere not happening.
Everything looks in proportion.
All in a quite a distance though.
Taken a photograph strips.
Composition is in question not sure?
Terrain fine.

Image Eleven

Contents not fascinating.
Like the composition.
Colours are good.
Scale is fine.
Proportions are fine.
Textures are good.
Terrain seems fine.
Vegetation is fine.

Image Thirteen

Dull in colour.
This is a real photograph.
Seems all well in proportion and scale.
Composition not exciting.
Distance effects the textural quality of the photograph.
Terrain is fine.

Image Fourteen

Too much foreground.
Depends why you are taking the photograph questioning the motive of the photograph?
Composition could be better has affected the proportion.
Texture is fine.
Middle ground hard to interpret.

Image Fifteen

Blurry image.
Sky bright whole photograph.
Lush photography.
Terrain is fine. Seems to work. Rolling landscape.
Textures aren't good because they are blurred.
Scale is ok.
Composition is fine.
Sky is dominant.
Not sure if image is real.
Vegetation is fine.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Twelve

Preferred image composition of image eleven compared to image twelve
Contents not fascinating.
Colours are good.
Scale is fine.
Proportions are fine.
Textures are good.
Terrain seems fine.
Vegetation is fine.

6 Respondent Six

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like				
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Question Two

With the images that you like, could you please explain why you like them?

Image One

Didn't like the light.
 Old eighty pictures-- different colours/tones brightness.
 Terrain is interesting.
 Could be better composed.
 Scale is ok.
 Don't like sky where it's overexposed.
 Content fine.

Image Two

Colours are good.
 Textures and colours are fine.
 Middle ground blocks visual penetration, still like it thou.
 Scale and proportions are ok.

Image Three

Dull in colour but that's the time year thou.
Fuzzy quality, blurry i.e. cant tell the textures (bothers me)
Like the visual penetration in the background.
Lighting soft, which I like.

Image Four

Don't like trees.
Can't identify objects.
Maybe shrubs?
Fence is good.
Clouds are nice sky proportions in question?
Cut and paste.
Textures are wrongly scaled.

Image Five

Blurry and boring.
Textures aren't picked up in foreground i.e. it is blurred.
Visual penetration fine but not interesting.
Objects in proportion not sure about the scale.
Still overexposed.
Sunlight in better position.

Image Six

Colours are bright.
Dead trees in middle ground.
Boulders or sheep not in proportion what are they?
Looks like its flat maybe because of viewing position?
Trees are out of proportion.
Don't mind the brightness but if meant to be realistic its not right.
Position of the older trees look like they have been stuck there because of their brightness above the middle ground.
Terrain looks like it goes up.

Image Seven

A lot of foreground.
Sky is good, especially clouds.
Composition is fine.
Lightning is fine, not artificial.
Real photograph.
Visual penetration is fine.
Eyes follow the road.
Textures are fine.

Image Eight

No visual penetration.
A bit blurry.
Not visually pleasing composition for a photography but maybe informative i.e. depending on why you are looking at.
Foreground is flat not enough texture.

Hard to judge scale seems all right but not sure what looking at.
Sky is the most interesting part.

Image Nine

Colours are strong.
Good visual penetration.
Composition is good.
Got elements in the immediate foreground not pastures and grasses.
Sky a bit white.
Trees and textures are fine.

Image Eleven

I like the composition.
Colours are bit flat.
Scale and proportions are fine.
Textures are good.
Terrain seems fine.
Vegetation is fine.

Image Twelve

Like the composition.
Colours are bit flat.
Scale and proportions are fine.
Textures are good.
Terrain seems fine.
Vegetation fine.
More fore ground required.

Image Thirteen

Colours are good for what it's showing.
Composition is good.
Background is boring.
Textures are not great/suck.
Scale and proportion fine.
Looks realistic from a photograph.
Terrain is fine.

Image Fourteen

Too much foreground (out of proportion).
Depends why you are taking the photograph questioning the motive of the photograph?
Composition band thing happening.
Foreground texture is fine.
Middle ground hard to interpret.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Ten

Fuzzy.
Dust storms or fog.
Light all right -looks like late afternoon.
Be all right without the fuzz.
Proportional lots of sky thou.
Foreground has stuff.
Terrain fine.
Composition is boring because of strips in background.

Image Fifteen

Middle ground a bit blurry worst big block of stuff.
Sky bright whole photograph.
Composition is good because of visual penetration.
Textures aren't good because blurred.
Scale is ok.
Sky is dominant.
Vegetation is fine.

7 Respondent Seven

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like		
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Question Two

With the images that you like, could you please explain why you like them?

Image One

I like the image because the landscape and space is open with nice trees in the background.
 Colours are nice and bright.
 Textures are normal.
 Tree shapes are nice.
 Well proportion and composition is good.

Image Two

Colours are good because of the greens and blues.
 Like the textures of the tree and grass.
 Grazing cattle is good.
 Like the sky brightness.
 Shapes of trees are nice.
 Positions of trees are good - height nice.

Image is proportional.
Visual penetration bothers you a little bit i.e. blocked of panoramic view.
I would re-score this image to +5.

Image Four

I like the textures of the grass and shrubs and trees.
Doesn't worry me that I can see a large view.
The landscape is attractive.
I like the composition with fence in the foreground and middle ground and background with trees and rocks.
Fairly low terrain, which I like.
I like the sky very becoming.
Like the shrub shapes - hedges.

Image Six

I like the sky its great.
Textures of grass nice, looks likes it being grazed.
Trees are interesting.
Nice view.
I like the rocks in background, which adds something different other than grass and stuff.
Undulating hills ok.
Colours are nice.
Can see a still bit nice visual penetration with degree of height.

Image Seven

I like the sky blue.
The landscape is flat and boring.
Trees on left are ok; trees on right are spaced and woody which I don't like.
Textures are ok.
Colours are ok.
Viewing position are ok a wide visual area.

Image Eight

Trees on left side are ok because they contain different greens.
Trees on right side are uniform and boring.
Like the sky.
Well proportion.
Scale is ok.
Foreground too much of.
Textures are average.
Colours are boring.
Terrain too flat.

Image Nine

I like the visual penetration on right side in contrast to the forest on left side.
The textures are good -pine forest.
Like different types of soils brown and grass.
Foreground contains immediate objects (gate) they add interest.

Like the shapes of trees with their long trunks.
Scale all right.
Proportions are all right.
Colour is good because lots of different colours.

Image Eleven

I don't like the sky.
There are not many trees, which I don't like.
Vegetation is very flat which I don't like.
Nothing exciting about this image, it is quite boring.
Don't the composition.
Don't like the colours they're bland.
Textures are poor.
Terrain is too flat.
I would re-score this image to -5.

Image Twelve

I don't like the sky.
There are not many trees, which I don't like.
Vegetation is very flat which I don't like.
Nothing exciting about this image, it is quite boring.
Don't the composition.
Don't like the colours they're bland.
Textures are poor.
Terrain is too flat.
I would re-score this image to -5.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Three

Dull and grey.
Overcast makes me feel depressed.
Dry ground.
Un-kept trees.
Don't like the shape of the trees.
The trees look sick/unwell unhealthily.
Don't like the linear shapes.
Grass textures are adequate.
Visual penetration is poor because it is blurred not high enough point.
Would rather see the tree canopy and especially trees behind the foreground trees.
Sky dull, just white, lacks colour.
Overcast i.e. going to rain.
Late afternoon sun going down.
Rather see images during the day early morning.

Image Five

Very boring because tree shapes are small and insignificant because they are so far away and look brown doesn't feel part of your immediate landscape.
Rather closer viewing position to the trees.
Don't like the sky it is bland.
Terrain is a bit boring, just grass, rather see other vegetation than grass or animals.

Image Ten

Dull bleak and grey.
Colours are bad.
Poor visual penetration.
Tree lines are flat which I don't like.
Shapes of trees look too small - inadequate which I don't like.
Viewing position is ok.
Terrain is ok - no big deal.
Textures are hard to tell.
Scale I don't like.

Image Thirteen

Contents are very dry.
Not enough trees.
Very boring foreground.
Needs more colour and texture.
Poor viewing position.
No visual penetration.
Ugly landscape.
Terrain is flat, thus uninteresting.
Don't like the sky it is bland.
Too much foreground.
Not an interesting background.

Image Fourteen

It looks doggy and muddy.
Poor colours.
Poor textures.
Bad visual penetration.
I feel isolated viewing this image.
Terrain is flat and boring.
Trees are uninteresting.

Image Fifteen

Image is blurry.
Sky is all right.
Nothing in foreground.
Trees in background are ok.
Landscape is too flat and uninteresting.
Trees in middle ground are boring.
Textures not too bad because of grasses and trees.

Visual penetration is ok.
I like the proportions.
Scale is ok.

8 Respondent Eight

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

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Question Two

With the images that you like, could you please explain why you like them?

Image One

Light in the middle, too much exposure.
 Acceptable colours (trees on sides, grass, sky on sides).
 Young crop.
 Life like.
 Out of proportion.
 Too much sky.

Image Two

Very realistic.
 Trees a little too pointy.
 Sky good colour.
 Grass great colour.
 Very realistic.
 Proportions are right.

Image Four

Trees aren't lifelike.
Colour of trees is wrong.
Shape of trees and features aren't distinct.
Not in proportion. I.e. there is a fore ground and background but no middle ground.

Image Five

Too blurry.
Too much exposure.
Can't see features of trees.
Inadequate middle ground.

Image Six

The way I look at the screen affects the image quality.
I like the grass.
I like the proportions although there is a little too much sky.

Image Seven

Overall I like it - clouds, sand, grass, road, trees, and the proportions.

Image Eight

Screen affects the quality of the picture.
Not enough middle ground.
Slope of the trees isn't right.

Image Nine

Trees on left are too dark.
I like the visual penetration.
I like the colour of the grass.

Image Eleven

I would re score this image to +9.
Little too exposed.
I like the colours.
Trees look good.
I like the grass (colour and texture).

Image Twelve

Darker in colour, I don't feel any differently about this one compared to image eleven.
I would re score this image to +9.
Little too exposed.
I like the colours.
Trees look good.
I like the grass (colour and texture).

Image Thirteen

Colour too light.
Almost overexposed.

Middle ground too small.

Image Fourteen

Trees are too dark.

Sky too light.

I like the grass/ground.

Middle ground is too small as compared to background.

Image Fifteen

Too blurry.

Trees blurry, not lifelike.

I like the road.

I like the grass and sky.

There a little too much sky but I like the foreground and middle ground proportions.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Three

Too blurry.

Too much sunlight - overexposed.

Can't see features of trees. I.e. twigs, leaves etc in proportion

Image Ten

Far too blurry.

Too much sunlight.

I can't see the features of the trees.

9 Respondent Nine

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral			Mildly Like					Strongly Like				
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10		
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Question Two

With the images that you like, could you please explain why you like them?

Image One

Light in the middle, too much exposure.
Acceptable colours (trees on sides, grass, sky on sides).
Young crop.
Realistic.
Appreciate the horizon.

Image Two

I like the sheep and rocks.
Very lifelike - everything is very realistic compared to image one.
I like the grass, trees, and clouds.
Proportions are right.
Like tree shadow.

Image Three

Colourings are wrong.
Too much glare.
I like tree shapes but not clear.
I can't see features of trees. I.e. twigs leaves etc.

Image Five

Left side good (colours).
Crop good as well.
Right side blurry.

Image Six

Don't like the rocks.
I like the grass.
I like the proportions.

Image Seven

Overall I like it - clouds, sand, grass, road, trees, and the proportions.

Image Eight

Not enough middle ground.
Slope of the trees isn't right.

Image Nine

I like the dead wood.
I liked the way the paddocks have been ploughed.
Trees on left are too dark.
I like the visual penetration.

Image Ten

Out of focus.
Too blurry.
Can't see the features of the trees.

Image Eleven

I would re-score this image to +8.
I like the trees.
The way that there is a difference between one paddock to the next.

Image Twelve

Taken further back from image eleven.
Edge of pasture and trees different to eleven.

Image Thirteen

Very dark image.

Image Fourteen

Too dark.
Too much light in back ground.
Trees are out of focus.

Image Fifteen

Way out of focus.
Trees don't look right.
Grass isn't the right colour green.
Sky looks good.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Four

Dry grass at front?
Trees aren't lifelike.
Clouds are good.
Rocks aren't lifelike.

10 Respondent Ten

Question One

Please indicate whether you *like* or *dislike* the image. (Please Tick)

We encourage you to use the full range of scores available.

Image Number	Strongly Dislike					Mildly Dislike					Neutral				Mildly Like					Strongly Like				
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10			
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Question Two

With the images that you like, could you please explain why you like them?

Image One

There are trees so can wonder through. I.e. pleasant walk.

Tree shapes I liked.

Like the terrain hills undulating green fields bordered by trees. This is appealing.

Fairly equal scale and composition.

Textures are fine.

Image Two

Greenness is appealing and its freshness to it.

Colours are nice.

Contrast is nice.

Closeness (not isolated) does appeal.

Terrain is ok.

Composition fine.

Image Three

Dull and lifeless foreground, which spoils the image. It needs to be lush.
Trees would compensate the foreground.
Nice terrain.
I like the visual penetration.
Colours are dull.

Image Six

Don't like swamp trees.
If I drove past I wouldn't give it a second look.
Back of terrain is ok. Foreground terrain bad right up to the wall because of dead terrain features.
Don't like dead trees.
Void of any life.
Grass is ok and that's all.

Image Seven

Undulating terrain, which I like.
Trees fit into the undulation.
Like the foliage - natural trees.
Whole image needs to be darker its too light.
Scale and proportion is normal.

Image Eight

Right side of vegetation doesn't appeal real.
Didn't like textures i.e. don't like swamp textures.
Starting to lose its freshness in foreground grass.
Scale and proportion on right side don't appear right in conjunction with background mature trees.

Image Nine

Left side is appealing for a picnic.
Right side is not appealing due to the brownness edges; rather have lushness than bare soil.
Trees on the left hedge should be broader.
If pine plantation the trunk are ok but the foliage is wrong.
But if blue gum plantations if the foliage is too high and too thick for immature plantations.
I like visual penetration distance - could lengthen background.

Image Ten

Too blurry.
Colours and textures are poor.
Apart from this, the scales and proportions are terrific and all fit together well.
Looks like a real photograph taken with bad film or camera.
I like the terrain undulating.

Image Twelve

Fairly dull.
Big expansive with fringe of trees and nothing behind them.

Don't like the foreground grass -waterlogged type species.
Background is poor.
Not sure if a windbreak or remnant veg?; Too uniformly planted.
I like the green grass in the middle ground.
The old tree in middle ground is odd because stuck on edge of row would be better in the paddock.
This image you can distinct the outline of the trees better than image eleven
this image is lighter and makes it better.

Image Thirteen

Colouring is bad, but apart from this it is fine.
Proportions are ok and scale is ok.
Dead colouring.
Everything seems to be right with textures and outlines and composition.

Image Fourteen

Ordinary cleared farm.
Sizing and scale is fine.
Colour perspective is wrong.
Too dull.
Its a not picnic spot.
It's not summer brown.
It's not winter.
Doesn't tie in with any season hard to distinguish the time of year.
Apart from this, the image is fine.

Image Fifteen

Nothing in the foreground in regard to colour is right i.e. its fake.
Nothing is sharp in the image i.e. blurred.
Image a bit light.
Background trees are fine.
Foreground trees fit into a wetland format, but if it wasn't a wetland sort, then the trees aren't right.
Don't like the textures (i.e. my preference).
Composition is fine and scale is ok.

Question Three

With the images that you dislike, could you please explain why you dislike them?

Image Four

Image is bland.
Looks like a back paddock. I would like to see hills, greenery and rocks.
Looks like a beach scene on land.
Planted shrubs don't appeal to me in an opened scene.
Rock wall does not appeal. Needs to be natural in appearance.
Terrain too flat.

Image Five

Colours starting to lose freshness and lushness and as a consequence white sky becomes expansive which loses appeal.
Terrain ok. Nothing out of ordinary.
Trees are ok.
Scale and proportion are ok.

Image Eleven

Fairly dull.
Big expansive with fringe of trees and nothing behind them.
Don't like the foreground grass -waterlogged type species.
Background is poor.
Not sure if a windbreak or remnant veg?
Too uniformly planted.
I like the green grass in the middle ground.
The old tree in middle ground is odd because stuck on edge of row would be better in the paddock.

7. Glossary

Computer Aided Design (CAD) - A computer based information processing system, which supports engineering planning and illustrating activities.

Digital Elevation Model (DEM) - A digital representation of the elevation of locations on the land surface.

Digital Terrain Model (DTM) - A digital representation of the elevation of the ground surface generated from elevation as well as topological data.

Digital Exchange Format (DXF) - A format for transforming digital data between computer systems, widely used as a de facto standard in the engineering and construction industries.

Geocoding - The process by which the geographic co-ordinates of a location are determined by its address, postcode, or other explicitly non-geographic description.

Geographic Information System (GIS) - A computer system for capturing, managing, integrating, manipulating, analysing, and displaying data which is spatially referenced to the Earth.

Raster Data Model - The representation of spatial data as a matrix of cells holding values for an attribute.

Rendering - The conversion of the geometry, colouring, texturing, lighting, and other characteristics of entities stored in a data set into a display image in such a way that it has the characteristics of a photograph of a 3D object.

Spatial Analysis - Analytical techniques whose results depend upon the location of the entities being studied.

Vector Data Model - An abstraction of the real world in which spatial elements are represented in the form of points, lines and polygons.

Unity is the coalescing of the separate design elements to allow an easy overall grasp and perception of the whole composition as one.

Harmony is a state of accord among elements and with their surroundings. Elements that blend, mesh, or fit with each other are harmonious. Elements that seem to violate each other's integrity or their settings are disharmonious.

Interest is the feeling of curiosity, fascination, or absorption.

Simplicity is the result of reducing or eliminating non-essentials.

Emphasis or dominance is the importance or significance imparted to an element in the landscape.

Balance is a perceived state of equilibrium. It implies stability and is used to evoke a sense of peace and security.

Scale and proportion refer to relative comparison of heights, lengths, areas, masses, and volumes.

Sequence has to do with movement. Connected series of spaces and events become a sequence.

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Reid, G. 1993. **From Concept to Form in Landscape Design**. Melbourne: Van Nostrand.

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Steinitz, C. 1992. 'Some words of caution' In: **Landscape and Urban Planning**, Vol. 21, 1992, p273-274,. Amsterdam: Elsevier.

Vogel, S. 1996. 'Farmers' Environmental Attitudes and Behavior A Case Study for Austria' In: **Environment and Behaviour**, Vol. 28 No 5, September, p591-613, Sage Publications.

GEOGRAPHICAL INFORMATION SYSTEM SOFTWARE REFERENCES:

ARC/INFO

<http://www.esri.com/software/index.html>

<http://www.esri.com/software/arcinfo/description.html>

ArcView

<http://www.esri.com/software/arcview/index.html>

<http://www.esri.com/software/arcview/extensions/3dext.html>

AutoCAD MAP

<http://www.autodesk.com/products/acadmap/index.htm>

GENA

<http://www.genasys.com/>

GEOMEDIA

<http://www.intergraph.com/>

GRASS

<http://www.cecer.army.mil/grass/viz/VIZ.html>

<http://www.cecer.army.mil/grass/GRASS.main.html>

http://www.geog.uni-hannover.de/grass/main_develop.html

<http://www.baylor.edu/~grass/5.0release.info.html>

http://www.geog.uni-hannover.de/grass/main_linuxbin.html
http://www.geog.uni-hannover.de/grass/main_docu.html

IDRISI

<http://www.clarklabs.org/>

ILWIS

<http://www.itc.nl/home.html>

IMAGINE

<http://www.erdas.com/>

MapINFO

<http://www.mapinfo.com/software/mapinfopro/details/index.html>

SAGE & CAPTURE

<http://www.rockware.com/>
<http://www.dlsr.com.au/software/index.htm>

SitePro

<http://www.envsoft.com/>

Surfer

<http://www.golden.com/>

TNT

<http://www.microimages.com/>

COMPUTER AIDED DESIGN SOFTWARE REFERENCES:

3D Studio MAX

http://www.ktx.com/3dsmaxr2/html/concise_feature_listing_1.html

AutoCAD r14

<http://www.autodesk.com/products/acadr14/>

EVS

<http://www.ctech.com/>

Foresight

<http://www.tdsaway.com/>

FormZ

<http://www.formz.com/>

Lightscape

<http://www.lightscape.com/>

Lightwave

<http://www.newtek.com/>

MAYA

<http://www.aw.sgi.com/>

MicroStation

<http://www.bentley.com/products/mstation/>

Persistence of Vision Ray Tracer (POV)

<http://www.povray.org/>

Power Animator

<http://www.aw.sgi.com/>

RealiMation

<http://www.realimation.com/>

TruFlite

<http://www.truflite.com/>

VistaPro

<http://www.andromedasoftware.com/cd213.htm>

<http://www.dlsr.com.au/software/index.htm>

<http://www.romt.com/vistapro/Default.htm>

Voxel_Analyst

<http://www.intergraph.com/>

World Builder

http://www.animatek.com/index_frame.htm

http://www.animatek.com/products_awb20.htm

World Up

<http://www.sense8.com/products/>

FOREST VISUALISATION SOFTWARE REFERENCES:**Landscape Management System (LMS)**

<http://lms.cfr.washington.edu/lms/lms.html>

http://so4702.usfs.auburn.edu/research/prob4/vis_sys.html

<http://so4702.usfs.auburn.edu/research/prob4/prob4.html>

Smart Forest

<http://www.imlab.uiuc.edu/SF2/smfor.html/>

<http://www.clr.toronto.edu:1080/ptdoc/RTF/PT-Fund-Entity.rtf.Z.html>

Stand Visualisation System (SVS)

<http://www.cfr.washington.edu/smc/bobmgy.htm>

<http://www.imlab.uiuc.edu/SF2/smfor.html/>

<http://forsys.cfr.washington.edu/svs.html>

Utools and Uview

<http://forsys.cfr.washington.edu/svs.html>

<http://forsys.cfr.washington.edu/utools.html>

Vantage Point

<http://forsys.cfr.washington.edu/~vp/index.html>

Virtual Forest

<http://www.innovativegis.com/products/products.html>

END OF REPORT

