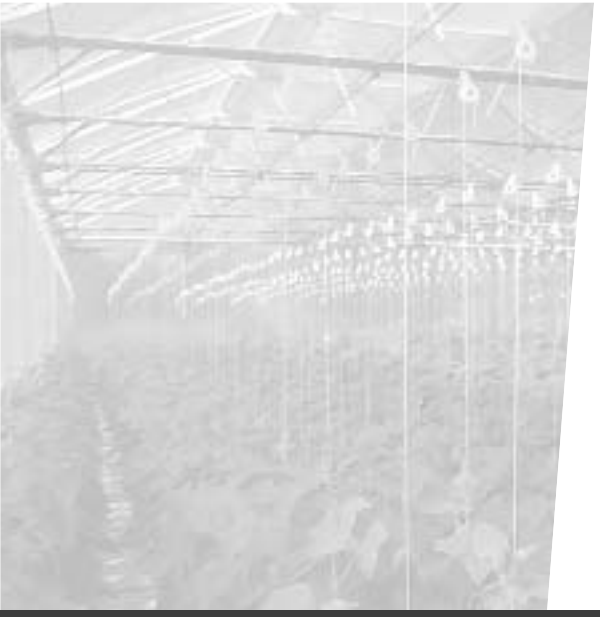
NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Guidelines for the development of controlled environment horticulture - Readers' Note

This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

http://www.dpi.nsw.gov.au/agriculture/horticulture/greenhouse

Updated versions of this document can also be found at the above web address.



Guidelines for the Development of Controlled Environment Horticulture

Striving for consistency, consensus and community

Planning Greenhouse and Hydroponic Horticulture in NSW

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

DISCLAIMER

The information in this publication is provided on the basis of understanding and knowledge at the time of writing in January 2005. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of NSW Department of Primary Industries or the user's independent adviser. Any representation, statement, opinion or advice expressed or implied in this publication is made in good faith but on the basis that NSW Department of Primary Industries, its agents and employees are not liable for any damage or loss whatsoever which has occurred or may occur in relation to a person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to in this publication. As legislative requirements may change over time, any reference to legal requirements will need to be checked to ensure its currency.

Recognising that some of the information in this document is provided by third parties, the State of New South Wales, the author and the publisher take no responsibility for the accuracy, currency, reliability and correctness of any information included in the document provided by third parties.

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and the inclusion of a product does not imply endorsement by NSW Department of Primary Industries over any other equivalent product from another manufacturer.

ALWAYS READ THE LABEL

Users of agricultural or veterinary chemical products must always read the label and any permit, before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this publication.

About the principal author

Jeremy Badgery-Parker BScAgr MBA is the extension horticulturist for protected cropping with NSW Department of Primary Industries.

He provides an extension service on all aspects of greenhouse and hydroponic production and is involved in a variety of research and extension projects for the protected cropping industry.

Mr Badgery-Parker is located at the National Centre for Greenhouse Horticulture, Research Road, Narara, NSW 2250

Acknowledgements

The author wishes to acknowledge the authors of the NSW Meat Chicken Farming Guidelines. In order to ensure greater consistency in the publication of industry guidelines, these guidelines have been largely based on their work. The efforts and contributions of Andrew Docking, Therese Hulme, John Fisher, Bettina Gollnow and Phil Wright as well as Michael Danelon (Nursery Industry Development Officer) and the many property owners who have drawn attention to these issues and provided feedback on these guidelines is greatly appreciated. Thank you to all involved with the former Hawkesbury-Nepean Catchment Management Trust, the many staff from local government, the former Department of Land and Water Conservation and NSW Department of Primary Industries, who participated in workshops and meetings to raise and discuss these issues. Also my appreciation to Barry Smith (Senior Land Use Specialist) and Karen Thomas (Land Use Agrologist) both of the Ministry of Agriculture, Food and Fisheries, British Columbia, who provided an insight into how similar land use issues are being successfully managed in Canada. Thank you to Robyn Hogan who assisted in the final preparation of these guidelines and the NSW Department of Primary Industries publications unit.

ISBN 0 7347 1633 8

PREFACE

The greenhouse horticulture industry is the fastest growing horticulture industry in NSW with an annual growth rate of approximately eight per cent.

The industry in NSW currently has an estimated farm gate value of $500 million per annum and encompasses greenhouse vegetables, cutflowers and nursery production. The industry is an economic driver with eight full-time jobs per hectare of cropping. It is estimated there are some 5,000 people directly employed and an additional 10,000 jobs indirectly created due to the demand for products and services.

Development in greenhouse horticulture is an industry response to market demand for consistent supply, quality and price using sustainable and resource efficient production systems.

The main area of industry expansion is in the Sydney region and the central and mid north coast of the State. By the nature of these regions, the enterprises are being developed in close proximity to urban areas and this interface with residential areas raises many issues for growers, planners and residents alike.

The purpose of this publication is to provide a consistent framework for industry to meet maximum production efficiency and sustainability focussed on minimising off-site impacts and meeting community needs.

This is achieved by providing:

- information on siting, design and construction of farms;
- performance objectives and best practice advice for the management of environmental impacts of greenhouse and hydroponic farm developments and their operation;
- explanations of the development application and approval processes, requirements and legislation.

This publication has been developed in consultation with appropriate government agencies, the controlled environment horticulture industry and community stakeholders.

B D BUFFIER
DIRECTOR-GENERAL
NSW DEPARTMENT OF PRIMARY INDUSTRIES

ABBREVIATIONS

ARA	Appropriate Regulatory Authority
CEH	Controlled Environment Horticulture
DA	Development Application
DEC	Department of Environment and Conservation (formerly Environment Protection Authority (EPA), NSW National Parks and Wildlife Service (NPWS), Resource NSW, Royal Botanical Gardens and Domains Trust)
DIPNR	Department of Infrastructure, Planning and Natural Resources (formerly Department of Land and Water Conservation (DLWC) and Planning NSW)
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
ESC	Erosion and Sediment Control Plan
IR	Infra Red (radiation)
LEP	Local Environmental Plan
LG Act	*Local Government Act 1993* (NSW)
MSDS	Material Safety Data Sheet
NSW	(State of) New South Wales
NFT	Nutrient Film Technique
OH&S Act	*Occupational Health and Safety Act 2000* (NSW)
PCA	Principal Certifying Authority
PFM	Planning Focus Meeting
PoEO Act	*Protection of the Environment Operations Act 1997* (NSW)
REP	Regional Environmental Plan
RTA	Roads and Traffic Authority
SEE	Statement of Environmental Effects
SEPP	State Environment Planning Policy
SIS	Species Impact Statement
TAFE	Technical and Further Education
UV	Ultra Violet (light)

CONTENTS

1 INTRODUCTION

1.1 IMPACT

Controlled environment horticulture (CEH) is a response to the demand by consumers for a reliable supply of fresh produce that is affordable, safe and clean, free of significant blemishes or damage, and produced from agricultural industries that are 'environmentally neutral'.

The intensification of horticulture through the use of greenhouse and hydroponic technology is occurring in many regions around the world. In New South Wales, it is the basis of a new, cleaner and more productive industry.

Due to the nature of the crops being produced, CEH farms are usually located in close proximity to key markets and large population centres in order to access consumers and labour. Intensification of horticultural industries enables a greater financial return per area of production. This allows sustainability of agriculture in areas of higher land value such as near the urban interface.

The rapid adoption of greenhouse and hydroponic horticulture in recent years has caused concern in some sectors of the community. An undesirable image of greenhouse horticulture has arisen through the poor maintenance and high visibility of older low technology structures. But even properly maintained greenhouse structures, just like new houses or any development, may appear out of place and highly visible for a period of time following construction.

The combination of intensive agricultural and non-agricultural land uses in close proximity can lead to conflict, due to perceived or actual impacts of one land use upon the other. The expansion of residential development into traditional agricultural districts increases the likelihood of these impacts.

A capacity for communities to accommodate the changing face of agriculture is essential for the future growth and development of this industry. For this to occur, shared understanding of the needs of the industry and the wider community is required. The risk of conflict can be reduced through regional planning and the adoption of best design and management practices.

Greenhouse and hydroponic horticulture is sustainable and, with appropriate planning and management, is compatible with urban development. Greenhouse and hydroponic horticulture provides

- a diversification of businesses
- a supply of jobs
- fresh and safe produce
- efficient use of water (including recycled water), fertilisers and space.

It is anticipated that these Guidelines will encourage the acceptability of CEH farms and thus preserve rural industries, family businesses and local agricultural jobs for the benefit of the whole community.

1.2 ISSUES

A major issue with any development, whether it is a dwelling or a greenhouse, is aesthetics – how a landscape is affected visually. People, used to a particular visual outlook, may object when someone else wishes to make changes to a landscape, such as constructing greenhouses or installing an outdoor hydroponic system. Aesthetics is often the most common issue, due to its subjectivity.

Other potential issues involve the siting of structures, land clearing and tree removal, water management, use of pesticides, management of solid wastes, increased traffic and intrusions such as odour, noise, light, dust and pests.

Agricultural, industrial and residential developments all alter the natural or existing landscape and are often especially conspicuous when first developed. Greenhouse structures, like windows of houses, can create glare at certain times of the day. The reflection of light from covering materials usually makes greenhouses highly visible. Different coloured coverings or netting materials may also be used and will influence the visibility of the development. The height or size of greenhouses will affect how visible the structure is to others. Heating and cooling equipment generates some noise. All of these issues can be managed.

Poor maintenance and the ageing of structures can decrease the aesthetic value of a

development over time. The visual intrusion of a development in the landscape, whether it be a residential dwelling, farm shed, cultivated field or greenhouse, is one of the most commonly cited areas for conflict, yet one of the most straightforward to resolve.

1.3 PLANNING

Intrusion of land uses into the lives of neighbours is not solved by limitations and restrictions, but rather by planning and common sense. Planning in rural zones needs to recognise and support the variety of agricultural practices which may be used.

Visual amenity of a region is readily preserved by the screening of developments and practical landscaping. The intrusion of noise and odour is most often noticed where developments are highly visible. Good property planning and screening of the development can assist in hiding the farm operations and thereby limiting intrusion.

Environmental concerns are most effectively addressed by encouraging the adoption of better practices and technologies by all land users.

Screening of developments preserves visual amenity and reduces land use conflicts

2 OVERVIEW

2.1 PURPOSE OF THE GUIDELINES

GUIDELINES for the development of Controlled Environment Horticulture has been developed to provide guidance for the planning, design, construction, operation and management of greenhouse and hydroponic farms in NSW.

The purpose of these Guidelines is to provide a framework for the economically, environmentally and socially sustainable development and operation of controlled environment horticulture.

The Guidelines have no authority under any statute, but have been prepared through extensive consultation to provide advice to proponents of CEH enterprises, current CEH farms and to consent authorities. They are recommended as a source of information on current best practices for design, operation and approval of CEH enterprises.

Lawfully established CEH developments may continue to operate in accordance with current approvals, subject to the requirements of legislation, although these Guidelines are intended to encourage all CEH farms to adopt and implement a culture of continuous improvement.

It is hoped that these Guidelines will assist consent authorities to implement a consistent State-wide approach for assessment of CEH proposals and industry development. The Guidelines could be referenced in local planning documents.

2.2 OBJECTIVES

For landholders and proponents of CEH enterprises:

- to provide advice on development application and approval processes and other relevant legislation;
- to provide technical information on siting, design, construction, environmental performance and maintenance of CEH enterprises;
- to provide best practice advice and encourage CEH enterprises to adopt a high standard of visual presentation and environmental responsibility;
- to help CEH farms address the reasonable concerns of the community with respect to amenity and environmental impacts.

For consent authorities and Government agencies:

- to aid the development of appropriate and reasonable development conditions for CEH enterprises;
- to promote development of policies for CEH enterprises which encourage good agricultural practice;
- to encourage consistency and consensus in planning policies, responsibilities and regulations impacting on the CEH industry.

For community:

- to reduce, to the extent possible, the incidence of agricultural land use conflict;
- to promote regional development through integration of CEH opportunities into local development plans.

2.3 SCOPE OF THE GUIDELINES

These Guidelines cover the establishment of new controlled environment horticulture developments, the expansion or renovation of existing farms, and the management of all farms involved in greenhouse or hydroponic horticulture production in NSW.

Advice on local development controls for controlled environment horticulture proposals should be sought from local government and NSW Department of Primary Industries.

2.4 OPERATION OF THE GUIDELINES

Anybody considering building a CEH farm, or expanding or renovating an existing farm, should use the Guidelines to plan and design their farm and determine the management practices they will use to minimise environmental impact. Existing farms may use the Guidelines for the development of an environmental management plan or simply to determine best management practice.

In assessing CEH proposals, responsible authorities should use the Guidelines to help determine reasonable best management practice. An approval authority may make reference to

the Guidelines in planning policies, plans and guidelines, as well as in the execution of its responsibilities as the appropriate regulatory authority under the provisions of the *Protection of the Environment Operations Act (NSW) 1997*.

Following the Guidelines alone will not ensure compliance with planning and environmental management requirements. The Guidelines must be read in conjunction with other planning and environmental management policies, plans, guidelines and legislation.

2.5 USING THE GUIDELINES

The contents of the Guidelines are as follows:

Section 3, Controlled environment horticulture, describes the production systems used in this industry and the general issues that need to be considered in the development and management of a CEH farm.

Section 4, Environmental planning and regulation, explains the planning process and the legislation that exists for regulating development and operation of these farms.

Section 5, Siting and design, presents the general recommendations for location, size, design and construction of CEH farms.

Section 6, Environmental impacts and how to manage them, defines objectives and performance criteria and identifies best management practices relating to the planning and operation of farms.

Section 7, Legislation affecting controlled environment horticulture, lists the legislation of relevance to the controlled environment horticulture industry.

Section 8, Glossary, explains the key terms used in the Guidelines.

Section 9, References and further reading, lists references for policies, guidelines, codes and other information on best practice in the controlled environment horticulture industry.

Appendix 1 provides a summary of the issues to address before submitting a development application for a controlled environment horticulture farm.

2.6 REVIEW

The Guidelines are based on current information, knowledge and practice in 2005. Further investigation, research and innovation in farm practice may, in the future, establish new practices and redefine best practice for the industry.

The Guidelines will be revised as new information relating to the design, operation, management and environmental impact of controlled environment horticulture becomes available. Major reviews are envisaged about every 5 years.

Between reviews, technical notes will be used to disseminate information on developments in best practice.

Printed copies of this document are considered 'uncontrolled' and may therefore not be the most current version. A controlled version of these Guidelines will be available on the website of the NSW Department of Primary Industries (www.dpi.nsw.gov.au).

3 CONTROLLED ENVIRONMENT HORTICULTURE

WHAT IS CONTROLLED ENVIRONMENT HORTICULTURE?

Controlled environment horticulture (CEH) is the production of horticultural crops within, under or sheltered by artificial structures to provide modified growing conditions and/or protection from pests and adverse weather. Controlled environment horticulture includes the use of greenhouses and glasshouses, shade houses, screen houses, crop top structures and hydroponic or soil-less growing systems.

CEH facilities generally require open space surrounding the structures to enable air movement for cooling and humidity control.

WHAT IS A GREENHOUSE?

A greenhouse is a generic term referring to the use of a transparent or partially transparent material supported by a structure to enclose an area for the propagation and cultivation of plants. Where the covering material is glass, the structure may be referred to as a 'glasshouse'. A 'polyhouse' refers to the use of plastic films or sheeting. When the enclosing material is woven or otherwise constructed to allow sunlight, moisture and air to pass through the gaps, the structure is known as a 'shade house' or 'screen house'.

Greenhouses may make use of supplementary heating to maintain a required internal temperature and relative humidity, or rely on air warmed in the day to maintain a minimum temperature at night.

WHAT IS HYDROPONIC PRODUCTION?

Hydroponics is a method of crop production which does not use soil and which relies on nutrients being supplied in the water. Plants may be grown directly in the nutrient solution or a non-soil growing medium may be used.

A tall structure with a large internal air volume and ventilation leads to good economic and environmental performance and better working conditions.

Hydroponic systems optimise crop growth and productivity.

Hydroponic production uses up to 40% less water and 40% less fertilisers than equivalent soil-based production and the systems enable the exclusion of soil-borne plant pathogens. A hydroponic system is tightly controlled to optimise crop growth and productivity. Hydroponic systems, depending on the crop being grown, can generate as much as 10 times more produce for a given area of land than less intensive, soil-based production. In addition, the quality of produce is generally better.

THE CONTROLLED ENVIRONMENT HORTICULTURE INDUSTRY

The CEH industry encompasses the production of a wide variety of market vegetables, cutflowers and nursery plants.

Major crops produced in CEH systems are tomato, cucumber and loose leaf lettuce. NSW is the largest producer of hydroponic lettuce in Australia. Other vegetable crops grown in CEH include capsicum and eggplant, while fresh herbs and leafy asian vegetables are increasingly being grown in these types of systems.

Cutflower crops are also extremely important. Gerbera, roses and carnations are some of the many cutflower crops commonly grown in CEH systems, while a number of native Australian species have potential for successful cultivation.

The nursery industry produces a diverse range of seedlings and ornamental plants. Nurseries may be involved in the production of containerised ornamental plants, seedlings or tube stock.

Greenhouse market vegetable and cutflower production in NSW is currently worth approximately $250 million per annum and the nursery industry is worth up to $350 million per annum. Growth of the greenhouse industry is around 6% to 10% per annum. Growth is occurring through the development of new enterprises as well as in the expansion and upgrade of existing enterprises.

However, average Australian greenhouse productivity is presently as much as 40% below international best practice due mostly to the dependence on low technology structures. As the technology level of structures improves, the use of pesticides can be significantly reduced, water and fertiliser efficiency increases, and the return on investment can be as high as 15%–20% per annum. This represents substantial economic and social benefits for communities.

Crops in CEH have greater consistency, production is more reliable and yields are greater per unit of input than conventional farming systems. In many countries, CEH is the backbone of a clean, sustainable and well-presented horticultural industry. The key to achieving this result is good planning at both the enterprise and regional levels.

4 ENVIRONMENTAL PLANNING AND REGULATION

4.1 INTRODUCTION

In NSW, controlled environment horticulture (CEH) has to comply with a range of legislation and regulations that is designed to protect the environment and the expectation of local communities. There are various consents or licences, mainly provided by local councils and the Department of Environment and Conservation (DEC) that define the required environmental performance outcomes for the CEH farm. They take into consideration the interests of farmers, neighbours and the environment.

Well-sited, planned, designed and managed greenhouse developments should have little difficulty in meeting planning and operating requirements.

Although initially the range of requirements may seem complex, a path through them is clearly defined in these Guidelines. Putting in some simple measures can address many of the planning issues and often they will improve the performance of a farm as well.

In planning a greenhouse or hydroponic development:

1. Contact the Local Government Council before beginning any development, to identify areas suitable for greenhouse horticulture in the medium to long term,
2. Determine whether a development application (DA) is required.
3. Take note of Local Environmental Plans (LEPs), Regional Environmental Plans (REPs) and Development Control Plans (DCPs) for the area and their potential impact on your planned greenhouse or hydroponic operation.
4. Check out any covenants, such as restriction on greenhouses, on your land title.
5. Be aware of the regulations and schedules of the various pieces of legislation which may impact on your proposed development.
6. Consider how your development may affect the environment and neighbours.

4.2 STRATEGIC LAND USE PLANNING

Strategic land use planning provides a framework for sustainable development in a region by integrating economic development, resource management, and conservation of biodiversity to meet community needs and aspirations in the short, medium and longer term.

Local Environmental Plans (LEP) define zones that designate permissible land uses and the criteria for assessing development proposals. To achieve long-term sustainable development of CEH enterprises, local government needs to implement LEPs that provide CEH farms with certainty in their operating environment and security of tenure so that the costs of investment can be recouped.

For the CEH industry to maximise the benefits from strategic land use planning, peak industry organisations as well as individual growers need to participate in state government and council initiatives to ensure that the interests and needs of the industry are understood and appropriately considered.

The CEH industry needs to consider local land use planning as part of its own strategic planning in a region. It is principally through the local council planning process that changes to the land uses in proximity to farms occur over time. A risk-based approach should therefore be taken in relation to the possible short and longer term impacts of change on individual farms as well as the industry's continued operation in an area. Growers need to participate in the planning process to reduce the risk of future conflict with neighbours, such as the introduction of residential developments which could threaten the continued operation of CEH in the area.

Planning authorities need to consider the impacts of any changes in land use or proposed developments on the continued viability of existing CEH enterprises in a locality. As existing CEH enterprises can contribute significantly to the local economy, consideration needs to be given to the implications for them when making planning decisions and approving residential development in the vicinity.

Key factors for the successful participation in the strategic planning processes of government are:

1. a clear CEH industry strategic plan that outlines the industry's short, medium and longer term goals and demonstrates its commitment and value (economic, social and environmental) to the locality
2. a willingness to actively promote the industry in a locality
3. an awareness of the land use and other strategic planning activities of local and State government and a willingness to be actively involved. This includes attending meetings and writing submissions when there are proposed changes to the Local Environment Plan (LEP) or when there are development applications for development in the vicinity of greenhouse and hydroponic farms.

4.3 NEW FARM DEVELOPMENT

All new commercial CEH operations must go through a development assessment and approval process. This process is designed to provide information to the applicant, the community and the approval authorities on the likely environmental, social and economic implications of the proposal. In assessing a new farm proposal, the potential impacts of the proposal on the local community and economy as well as the physical environment must be considered.

The scale and complexity of the proposed CEH development, as well as the characteristics of the location, will determine the detail and depth of the assessment to be undertaken.

May I build my farm here?

The first step in strategic planning for controlled environment horticulture is to consult the local council to find out whether the LEP includes provisions that are likely to encourage or constrain CEH in the area. As land use may change over time, due to the changing needs of the community, it is important to discuss with council the current trends and to identify localities that are likely to be appropriate for CEH in the medium to longer term. This should be done before identifying individual pieces of land.

Once individual blocks of land have been identified in these localities, a preliminary evaluation should be undertaken as to their suitability, based on practical, financial and environmental factors discussed in Section 5 of these Guidelines. Issues to be considered include:

- zoning and other provisions under environment planning instruments such as the Local Environment Plan (LEP)
- size and shape of land
- access to the markets (distance and suitability of roads for trucks)
- water and power supply (perhaps gas also)
- drainage and flooding issues
- topography and vegetation
- separation from residences and other sensitive land uses.

Zoning and the LEP

It is important to undertake a preliminary evaluation before you make a financial commitment to a particular site. If the LEP provisions do encourage CEH development then the process of obtaining approval will not be as difficult or expensive. If the zoning does not currently allow CEH, you will generally not be able to lodge a development application for approval unless it is rezoned.

A Local Environment Plan (LEP) zones land into categories. These categories include commercial, residential, industrial, rural-residential and rural to provide a clear indication of what types of development are permitted in certain localities. Maps accompanying the LEP will indicate what zone the property is in. Rural zones are generally referred to as either 1(a), 1(b), 1(c), etc. The zone tables, usually in the first half of the LEP, will indicate whether the land use: is permitted without consent; requires consent; or is prohibited. For example, '*agriculture*' is almost always permitted without consent in rural zones. This is why most primary producers have not needed to consult LEPs in the past. On the other hand, '*intensive horticulture*' may require consent (that is, approval) from council in general rural zones. In some rural zones, such as rural residential zones, '*controlled environment horticulture*' or '*greenhouse and hydroponic horticulture*' may be restricted because of potential conflict with residential neighbours over issues of odour, noise and dust. These guidelines are part of the process of striking a suitable balance between CEH and urban development.

Controlled Environment Horticulture may be covered in different planning documents under different names such as '*intensive horticulture*', '*intensive agriculture*', '*greenhouse horticulture*', '*controlled environment horticulture*' or '*hydroponics*'. Talk to the council's town planning staff to be sure of how CEH enterprises are dealt with in a particular local government area. Also, ask if there are any other planning requirements (for example, dams). Since CEH requires buildings, other aspects of LEPs in addition to those for agriculture may be relevant.

Regional Environment Plans (REPs) are in place in some areas of the State, such as the Hunter Valley, North Coast, Murray and Sydney regions. State Environment Planning Policies (SEPPs), such as SEPP 58 – Protecting Sydney's Water Supply, may also have implications for some types of farming activities. Local council planning staff will be able to provide information on the requirements of any relevant REPs and SEPPs.

Information on planning requirements is also being made available on the Internet at www.iplan.nsw.gov.au. In time it will be possible to click on a lot of land and display the full set of planning instruments that relate to that land.

Covenants

Even if the LEP and REP allow controlled environment horticulture, be aware that an individual, privately placed Land Covenant restricting certain development may apply to a particular Land Title. Depending on the circumstances, covenants may be able to be reversed if they are contrary to permissible development for the land zone. Other restrictions and easements could also apply. Consult your conveyancing solicitor.

Community and neighbours

While decisions by consent and regulatory authorities will be made according to the law and planning instruments, the level of support by the local community and neighbours will influence the ease of operation of the CEH enterprise. If there is community resistance to CEH developments, then management time that should be used in operating the CEH enterprise will be diverted to dealing with complaints.

It is a good practice to talk to potential neighbours before committing to a proposal. The more information you can provide, the more likely neighbours are to accept the proposal. Often minor changes in siting and design can avoid future problems that would be insoluble. Time invested in communication at the beginning will establish a firm foundation for on-going good relationships. Be open and honest about all aspects of the proposal.

For neighbours or communities that are unfamiliar with CEH operations, organising a visit to a high standard enterprise may alleviate concerns. It is human nature to fear the unknown.

4.4 EXPANSION OR ALTERATION OF EXISTING CONTROLLED ENVIRONMENT HORTICULTURE FARM

Before any expansion of an existing greenhouse or hydroponic farm is undertaken, consult the local council to find out whether an approval is required. You should also find out the level of development assessment you will need to go through for the specific alteration or expansion that you are planning. This will depend on the scale of the proposed changes and the likely extent of additional impacts that may arise.

It may also be worthwhile to undertake a risk assessment and cost–benefit analysis to consider the appropriateness of continuing operation on the site, and to compare relocation options with expansion on the existing site. Where surrounding land use is changing and residential or rural residential development is starting to occur in the vicinity of your CEH enterprise, discussions should be held with council regarding the likely implications of this trend. This advice should be considered in the risk assessment and is best obtained in writing by a written request to council.

Existing CEH farms with no previous development approval

For older greenhouse or hydroponic farms operating prior to the introduction of a Local Environment Plan or provisions in the plan that required development consent for CEH farms, there may be existing use rights. Existing use rights enable the use of land or building to continue if it was legally being used for that purpose immediately before the introduction of an environmental planning instrument such as a Local Environment Plan. These provisions also allow continued operation at a location where a CEH enterprise may now be a prohibited land use.

However, existing use does not include:

- alterations, extensions or rebuilding
- any increase in the area used
- an enlargement, expansion or intensification of an existing use
- any continuance of existing use that is in breach of any consents or conditions of consent
- any recommencement where use was abandoned (that is, not used for 12 months).

Where the alteration or expansion proposes a change which goes beyond the 'existing use', a development application will be required from the consent authority. Consult with your local council on the development approval process required for these activities.

If seeking advice from your local council, put your request in writing. The advice you receive will then also be written and you will have a copy to refer to during the application process.

Existing CEH farms with development consent

When proposing to expand or modify an existing CEH operation that has development consent, you should consult with the consent authority.

In some circumstances where the impacts of the proposed change are inconsequential, the consent authority may agree to change the consent without notification of neighbours. In circumstances where the proposed changes are of more consequence but the development can be considered to be substantially the same development as that already approved, the consent authority may agree to modify the consent after notifying the community of the proposed changes.

Where the proposed changes are of a more substantial nature, the consent authority may require you to lodge a new Development Application for approval of the changes. In these circumstances the consent authority will need to consult Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* (NSW) to determine whether the existing operation plus the change is a designated development and will require an Environmental Impact Statement (EIS). Part 2 of Schedule 3 lists matters for the consent authority to consider in making this decision, including the environmental performance of the existing operation, the likely impacts of the expanded or changed operation and the proposed mitigation and management regime.

- If a proposed change to your existing CEH operation will result in the whole operation being classified as a designated development for the first time, the expansion will usually be assessed as a designated development. The EIS prepared will need to cover all aspects of the proposal, including the existing operation.
- If a proposed change to an existing designated development will not significantly increase the environmental impacts of the total development, a new EIS is not required. However, approvals for the proposed alterations will still need to go through the development assessment process including the preparation of a Statement of Environmental Effects (SEE).
- If a proposed change to an existing designated development will significantly increase the environmental impacts of the total development, a new EIS must be prepared. While the EIS should focus on the new aspects of the CEH operation, all aspects of the proposal, including the existing operations, will need to be considered.

Provisions relating to State Significant Development, Integrated Development, Complying Development and Designated Development may also apply as discussed below.

4.5 WHAT APPROVALS ARE NEEDED TO ESTABLISH OR EXPAND A CONTROLLED ENVIRONMENT HORTICULTURE FARM?

You will need development consent under Part 4 of the EP&A Act from the consent authority, either the local government or Department of Infrastructure, Planning and Natural Resources (DIPNR), to establish or expand a commercial CEH enterprise in NSW. Other approvals, for example in relation to pollution control, water supply or road access, may also be required.

To clarify what approvals and requirements apply, it is best to contact the Local Government Council for the area. Depending on its size, location and other approvals required, a CEH development or expansion may be classed as one of the following types.

State Significant and local development

Under the provisions of *State Environment Planning Policy (SEPP) No. 34 'Major Employment-Generating Industrial Development'*, farms which employ more than 20 people (full-time equivalent) or have a capital investment of more than $20 million (excluding land value) are considered to be *State Significant* development. The Minister for Infrastructure and Planning is the consent authority for State Significant development and DIPNR undertakes the assessment. If the development is State Significant, you should contact the Major Development Assessment Branch of DIPNR in Sydney, at the outset.

Any development which is not State Significant is *Local Development* and the development application must be lodged with the local council.

Designated and non-designated development

The EP&A Act has regulations that list or designate particular types, sizes and locations of developments according to potential for significant environmental impacts (Schedule 3 of the EP&A Regulation).

If your proposal is a '*designated development*', an Environmental Impact Statement (EIS) must accompany the DA lodged with the consent authority. If your proposal is '*non-designated development*', a Statement of Environmental Effects (SEE) must accompany the DA lodged with the consent authority. The required information is listed in Table 1.

Integrated developments

If the development also requires an approval listed in Table 2, the DA is considered to be '*integrated development*' and is subject to specific planning processes.

If your application involves development of land that is part of critical habitat or is likely to significantly affect a threatened species, population or ecological communities, or their habitats, a Species Impact Statement (SIS) will need to be prepared in accordance with the *Threatened Species Conservation Act 1995* (NSW).

For CEH developments within Sydney's drinking water catchments, the Sydney Catchment Authority has a concurrence role, in accordance with *State Environmental Planning Policy 58 – 'Protecting Sydney's Water Supply'*.

The consent authority must consult with the relevant approval body during the assessment of the project and integrate the requirements of the subsequent approval into the development consent to ensure a consistent and integrated approach to regulation of the controlled environment horticulture enterprise. For controlled environment horticulture enterprises, additional license/approvals may be required with respect to wastewater management under the *Protection of the Environment Operations Act 199*7 (NSW) (PoEO Act) or for the construction of dams or bores under the *Water Management Act 2000* (NSW).

Complying development

The LEP may also list certain types of local developments that have predictable and minor environmental impacts as '*complying development*'. Complying developments are required to comply with specified predetermined development standards. CEH enterprises are generally not considered to have predictable and minor impacts and are unlikely to be identified as complying developments. However, minor additions to farm structures may fall into this category of development. Again, the council should be consulted to determine the development approval requirements for any changes to the physical layout of the farm.

Developments not requiring consent

In some circumstances, development consent may not be required. However, the farm should still comply with industry best practice, especially in relation to odour, noise, dust and waste management. Local councils must still regulate these premises using their powers under the PoEO Act.

In circumstances where development consent is not required, but an approval is required under other legislation (such as for water supply or pollution control), the provisions of Part 5 of the EP&A Act apply. This means that before granting the approval or licence under the other legislation, the government authority must determine whether the proposal requires an EIS to be prepared. If not, the approval authority will usually require a *Review of Environmental Factors* to be prepared by the applicant. This document will be similar to the Statement of Environmental Effects.

Table 1. Requirements for an Environmental Impact Statement (EIS) or Statement of Environmental Effects (SEE)

Schedule 2 of the EP&A Regulation sets out specific requirements for an EIS. These requirements also apply to SEEs. In either case, the level of assessment should match the level of impact of the proposed enterprise.

A) Executive summary

B) Description of the proposal

- objectives – reason for undertaking the proposal
- size of the operation – for example, area under production; production targets
- production, packing and/or processing facilities (if any)
- previous and existing operation on the site
- site layout plans including any waste storage and disposal areas
- water and power supply, road access and proposed truck movements
- outline of any construction to be undertaken
- plan for the storage and disposal of wastes; for example, crop residues, unsaleable produce, used growing media and wastewater
- emergency contingency plans, for example, for power failure or exotic disease outbreaks
- best management strategies to minimise the potential for risk events
- consideration of alternatives

C) Location description

- whether the proposal is consistent with any relevant SEPP, REP or LEP
- topography, drainage and flooding pattern, vegetation, soil type and groundwater depth (particularly where there is on-site wastewater disposal)
- relationship with surrounding land uses, for example, distances to any houses, property boundaries or watercourses

D) Identification of key issues

E) Assessment of environmental issues

- amenity issues, including noise, odour, dust and visual impacts
- water quality, drainage, flooding, and water supply impacts
- erosion and sedimentation
- traffic and road impacts
- waste management – on-site wastewater, growing media or crop residue disposal
- health risks
- native vegetation and, if relevant, threatened species, populations, ecological communities and their habitats
- economic and social effects

F) List of approvals and licences

G) Proposed environmental management plan and mitigation measure

- Summary of how potential environmental impacts will be minimised or managed
- Proposed actions to minimise and manage land-use conflicts

H) Justification for the proposal

Table 2. Additional approvals and licences that may be required

Department of Infrastructure, Planning and Natural Resources	*Water Act 1912 – Part 2* *Water Act 1912 – Part 5* *Water Act 1912 – Part 8*	– Surface water licences – Groundwater and bore licences – Approvals for works on floodplains banks of rivers and lakes – Approvals for works that affect the flow of water to or from a river or lake
	Water Management Act 2000	– Water Sharing Plans – Water Management Plans
	Rivers and Foreshores Improvement Act 1948	– Approval for works within 40 metres of the bed or bank of a river or lake
	Native Vegetation Conservation Act 1997	– Clearing of native vegetation
Department of Environment and Conservation	*Protection of the Environment Operations Act 1997*	– Licence authorising the carrying on of a scheduled activity, or the work designed to enable such activities to be carried on – Licence to control water pollution from a non-scheduled activity
Local Council (and Roads and Traffic Authority)	*Roads Act 1993*	– Approval to undertake work in a road corridor (may also be subject to concurrence of RTA)
Mine Subsidence Board	*Mine Subsidence Compensation Act 1961*	– Approval to undertake works in a Mine Subsidence District
NSW National Parks and Wildlife Service	*National Parks and Wildlife Act 1974*	– Consents to destroy Aboriginal artefacts, relics or places
NSW Fisheries (NSW Department of Primary Industries)	*Fisheries Management Act 1994*	– Approval to cut, remove or damage marine vegetation – Approval to dredge or reclaim land – Approval of aquaculture enterprises
NSW Rural Fire Service	*Rural Fires Act 1997*	– Approval to subdivide or develop bushfire-prone land
Work Cover NSW	*Occupational Health & Safety Act 2000*	– Risk assessment to ensure infrastructure health and safety – features
The Heritage Office	*Heritage Act 1977*	– Approval to undertake works affecting an item protected by a conservation order

4.6 THE DEVELOPMENT ASSESSMENT AND APPROVALS PROCESS

The key steps in the planning assessment are outlined in Figure 1 and discussed below.

Deciding what needs to be included in the development application

Before preparing a development application, the applicant should meet with the consent authority and other key Government agencies so that issues can be discussed and the Government authorities can indicate what issues are required to be assessed and the appropriate assessment methodology.

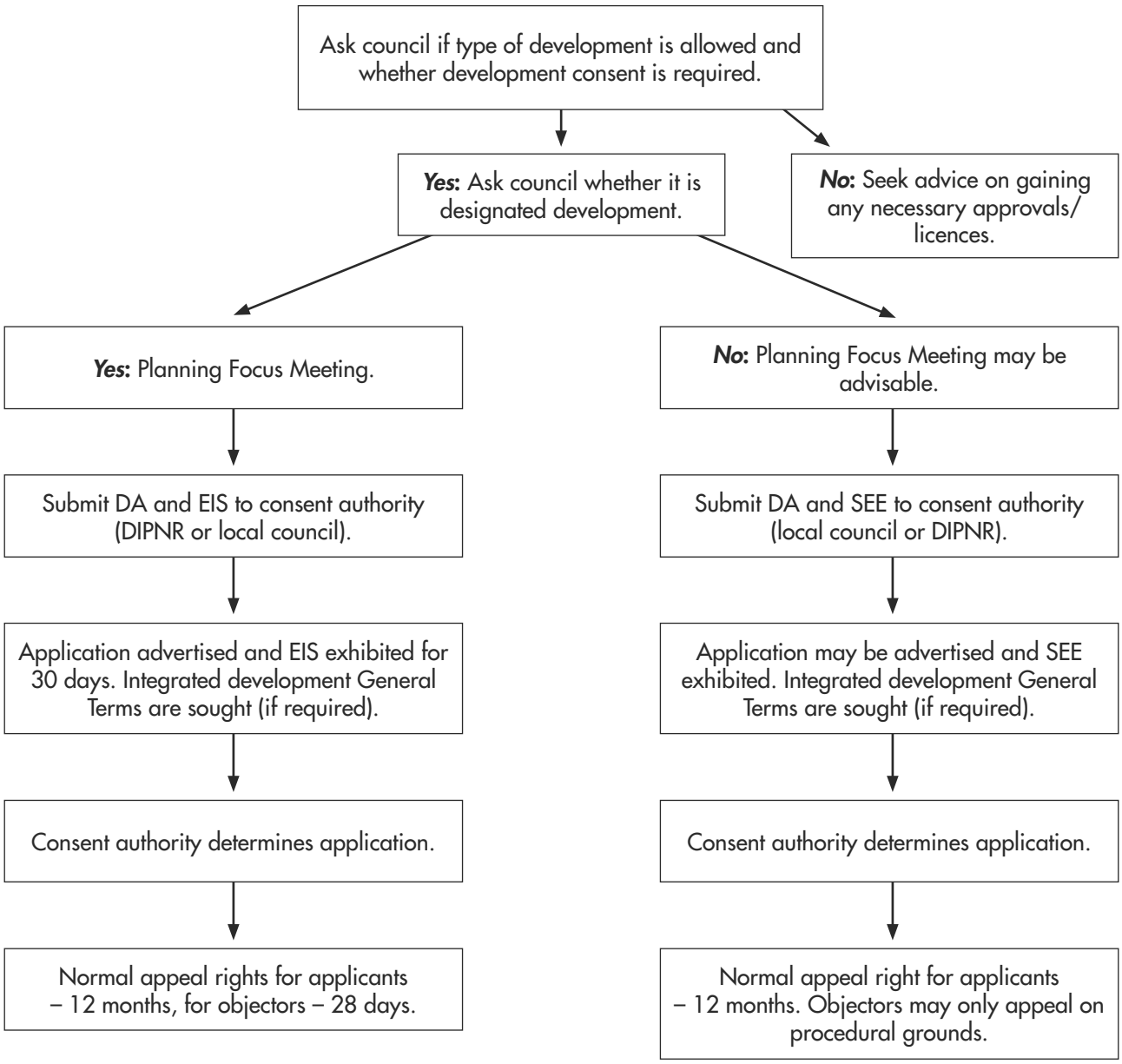
For proposals for major developments or developments in sensitive locations (such as new residential areas) where there are a large number of issues to be considered, a Planning Focus Meeting (PFM) is recommended so that relevant parties can meet and discuss the proposal.

A PFM should include a site visit and would normally include:

- the applicant
- the applicant's consultants
- representatives from the local council
- DEC, DIPNR, NSW DPI and other appropriate State Government agencies
- other potentially involved parties.

The PFM is usually organised by the consent authority, or else NSW DPI's Agricultural Environment Officers can assist. The applicant

Figure 1. The planning assessment process



should provide the PFM organiser with a Project Outline (a 6 to 10 page document including a map and project specification) about 2 weeks before the PFM. The PFM organiser should send this to the participants so they have time to consider the relevant issues. The PFM will help identify the issues to be covered in the DA and will often save time and money.

If the project is designated development, the proponent must consult with DIPNR for the 'Director-General's Requirements' for the EIS. The minutes of the PFM should be sent to DIPNR when requesting Director-General Requirements.

If the development is integrated development, Department of Infrastructure, Planning and Natural Resources will contact the approval authorities for their requirements to integrate into the Director-General's Requirements.

NSW Department of Primary Industries can provide technical advice on the siting, design and management of intensive agricultural enterprises and can help coordinate input from State agencies and consent authorities.

Preparing the Development Application

The proponent or their consultant must prepare supporting documentation (either an EIS or SEE) to accompany the DA. An Environmental Management Plan (EMP) and an Erosion and Sediment Control Plan (ESC) should also be prepared as described below.

The documents should provide:

- an outline of the size and nature of the proposed development
- a description of the site and surrounding environment
- the management practices to be employed
- the environmental impact mitigation strategies to be employed
- an assessment of the likely impacts of the proposal within the environment, and
- justification for undertaking the enterprise.

The purpose of these documents is to allow the applicant, members of the public, the appropriate regulatory authority and relevant government agencies to properly understand and consider the environmental consequences of the proposed development. Support the application with maps, plans, diagrams and photographs where appropriate.

Agencies such as DIPNR and DEC have guidelines in relation to assessment and management of environmental issues which can assist in preparation of the EIS or SEE. Generally, the issues agencies require to be addressed will be detailed during the PFM. If a PFM is not required, or has not been organised, it is desirable that agencies be consulted about their requirements.

The EP&A Act requires that the consent authority (usually Local Government Council) determine whether threatened species, populations or ecological communities are likely to be significantly affected. An assessment of flora and fauna must be undertaken and submitted to the consent authority to determine if a Species Impact Statement (SIS) is needed. To avoid delays, this should be undertaken prior to the finalisation of the SEE or EIS. It is advisable to consult the DEC and NSW Fisheries if an SIS is likely to be required.

During the preparation of the SEE, EIS or EMP, the applicant should consult with neighbours and the broader community to ensure that issues of importance to the community are appropriately addressed in the assessment. In addition, the community may have information that will assist in the preparation of the assessment.

The burden of justification rests with the applicant (the farmer). The better the quality of the supporting information, the easier it is for the consent authority to make its assessment and subsequent decision.

Lodging the development application

The DA and supporting documents must be submitted to the consent authority. You should check with the consent authority about the number of copies of the supporting documents needed for exhibition and consultation purposes.

Depending on the scale of the development, the consent authority will be either the local council (local development) or the Minister for Infrastructure and Planning (State Significant development). If the Minister is the consent authority, development applications should be lodged with DIPNR; for local development, the application is to be lodged with local council.

The application should be accompanied by 'land owners' consent if the land is not owned at the time of the development application being lodged or is to be leased. If any of the land is Crown land, permission must be obtained from the Department of Lands.

A DA fee must be paid based on the estimated capital value of the project. Additional charges are levied if the DA must be advertised and if the project is integrated development. The consent authority will receipt the application, date it, and issue a DA number.

Public consultation

The consent authority usually notifies neighbours of the proposal to provide the opportunity to comment. If the project is State Significant development, designated development or integrated development, the DA must be advertised in the newspaper and the documentation exhibited with an invitation to comment on the proposal. The consent authority may also send copies of the documentation to other agencies to seek their views.

If the project is integrated development or requires concurrence, copies of the DA and the documentation must be immediately sent to the integrated approval and/or concurrence authorities. These authorities along with the consent authority can 'stop the clock' and request additional information if appropriate information is not provided in the EIS or SEE.

Assessment

The consent authority (and any integrated approval authorities) will assess the impact of the proposed development on the physical environment, the community and economy of the local area. Integrated and concurrence authorities will assess the proposed development against their specific requirements.

The consent authority is required to incorporate the requirements of integrated and concurrence authorities. Matters taken into account include:

- the requirements of any local, regional or State planning instrument, development control plan and planning legislation that relates to the site or the proposed development
- the impact the proposed development is likely to have on the natural environment, the built environment and the local community
- whether the site is suitable for the proposed development
- any submissions made by neighbours, the wider community and government agencies after the DA was advertised
- the public interest.

In determining a DA for a CEH enterprise, the consent authority may seek advice from NSW DPI, DEC, DIPNR and other State government agencies.

The decision

The consent authority will either approve or refuse the DA. If the application is approved, the consent authority will usually set out conditions that the applicant must meet in the construction and operation of the project.

Right of appeal

If the applicant is unhappy with the decision, they may ask the consent authority to review the application. This must be done within 28 days of the decision being made. In addition, any applicant who is dissatisfied with the consent authority's decision may also appeal to the Land and Environment Court, asking it to review the decision. This appeal must be made within 12 months of the consent authority's decision.

If the project is designated development, and approved, a person who objected in writing to the proposal during the exhibition period may appeal to the Land and Environment Court on the merits of the proposal. This must be done within 28 days of the decision being made. For non-designated developments, the merits of the decision cannot be appealed in the Land and Environment Court.

However, anyone may appeal to the Land and Environment Court to remedy or restrain a breach of the EP&A Act that may have occurred in determining the Development Application (that is, due process was not followed). If consent authority notifies the decision, this appeal can only be lodged within 3 months of the decision.

Approval to begin building works

If the development involves building works (for example a building, road or stormwater system), the applicant must apply to the council, the Minister or an accredited certifier for a construction certificate. This certificate

certifies that the work the applicant intends to do will comply with required standards. The applicant needs to provide detailed designs and documentation with their application. These must be consistent with the plans lodged with the Development Application, and it must be clear that any building work will comply with the Building Code of Australia. Note: Councils often require a construction certificate for large greenhouses.

Before any work can start, the applicant must choose a Principal Certifying Authority (PCA). This can be the council, the Minister (for DIPNR) or an accredited certifier. The PCA will make sure that the work is done in accordance with the development consent and approved construction plans.

At least two days before starting work, the applicant must notify the council who the PCA is (if not the council) and that work is about to commence.

Controlled environment structures, in particular greenhouses, should have an engineering certificate. This certificate would certify that the structure is safe and has been designed and constructed to withstand an appropriate wind load and crop load.

Approval to occupy

The applicant must obtain from the certifying authorities an Occupation Certificate before occupying or using a new building or changing the use of an existing building.

Compliance check

The authority that has approved the development will monitor the development to make sure that the approval conditions are being complied with. If the development does not comply, the applicant can be:

- fined (given a penalty notice)
- ordered to make changes to the development or the activities carried on at the premises
- taken to the Land and Environment Court. The court may order the applicant to carry out necessary works (such as altering the development or making repairs), or may forbid the applicant to use the premises in certain ways.

You should also be aware, as a grower and citizen, that you have opportunities to influence planning and environmental legislation. The long-term future of the CEH industry will be directly affected by the effectiveness of industry participation and influence in the development, implementation and review of strategic initiatives under planning and environmental legislation.

5 SITING AND DESIGN

A CEH enterprise is a substantial long-term investment. It is therefore critical that an appropriate development locality and site is chosen. The operation and management of a greenhouse or hydroponic farm which has been established on an unsuitable site will be more costly and there may be difficulties that risk the longer term viability of the operation.

5.1 PROPERTY AND SITE SELECTION

Appropriate siting is the most cost-effective way of dealing with environmental performance issues such as odour, dust, noise and protection of waters. By addressing these issues at the planning stage, ongoing operational costs and management issues will be significantly reduced.

The siting of greenhouses will need to take into consideration the shading effect of vegetative screens and windbreaks. Locating greenhouses against a tree line will result in lower yields because of reduced light levels. Greenhouse-covering materials near trees will also become quite dirty, further reducing light transmission.

- Favour a property with natural visual screening.
- Consider proximity to key markets.
- Prevent a direct line of sight between the development and adjoining dwellings or roadways.
- Locate new developments, such as additional greenhouses, behind existing structures.
- Locate structures with sufficient setbacks from roadsides and boundaries.
- Use landscaping, mounding and vegetation to soften the impact of the development.
- Keep existing vegetation and landforms wherever practical.

Favour a property with natural visual screening.

- While orientation has limited impact in most areas of NSW, a north–south orientation is normally used.
- Consider transport routes and the availability of labour and services.
- Avoid development in areas that are visually prominent or which are highly exposed, such as ridgelines.
- Locate structures so that they follow the contours of the land.
- Avoid locating structures on steep slopes (greater than 1 in 5).
- Test soils if planning soil-based production.
- Check potential impacts of adjacent land uses in terms of pests, diseases and weeds.
- Take note of adjacent sensitive areas (such as wetlands, waterways, native vegetation) and site greenhouses appropriately.

Locality

The production of fresh produce benefits from being located within a reasonable proximity to the key markets. Close proximity minimises the cost of transport and its impact on produce quality. Ready access to labour and services is also important.

Significant advantages from central packing, labour pools, co-operative marketing and access to training can be attained by locating greenhouse operations within reasonable proximity to other greenhouse enterprises.

Close proximity to other horticultural enterprises can increase pest and disease incursions, but these can be minimised with appropriate management practices. Adjacent field crops and poor weed control in the locality are the more likely causes of problems.

Property size and shape

A property needs to be of sufficient size and shape to accommodate the facilities required. Facilities include:

- the greenhouses and hydroponic systems
- hot water storage
- fuel storage
- vegetative screens
- setbacks
- storage and pumping sheds
- cool storage, packing shed and office
- internal roads
- staff amenities if necessary
- residence where applicable

The containment and management of wastewater and surface run-off and other waste products need to be considered.

The minimum lot size will vary with local government areas. Room for expansion and buffers for potential changed land uses on neighbouring properties should be considered when purchasing a new property.

Square-shaped blocks are preferred over long narrow blocks as farm layout and siting options can more readily accommodate screening and setbacks. An elevated site provides superior natural ventilation, while a level site substantially reduces building costs and improves manageability of an operation.

Topographical features of a property can be used to screen CEH developments and lessen any visual impact they may have on the surrounding area.

- Avoid using a narrow property; select a square-shaped lot where possible.
- Make sure the property is large enough for all the required facilities.
- Use the size, shape and topography of the property to maximise visual screening when planning the farm layout.
- Ensure there is room for sufficient setbacks from boundaries and existing dwellings.
- Select a property with compatible topography, such as an elevated, flat development site.

Power and fuel supply

Access to reliable power is essential for most CEH developments, particularly high technology greenhouses. Modern greenhouses use automated systems to provide better environmental control for heating, cooling, lighting, insect control, irrigation and fertigation. Discuss your needs for electricity and fuel (e.g. natural gas) for future expansion with the energy supplier when you are estimating your heating and electric equipment requirements.

Arrangements for electricity supply need to be made with the local electricity authorities. Private contractors may install electricity infrastructure on the property. Access to power may be a considerable cost if power is not already present on the site.

Installation of standby generators is recommended to minimise the adverse consequences of power disruptions, particularly if you are going to depend on automated controls. Other sources of energy may also be used and should be considered, for example, gas and solar. Co-generation of heat and power from gas (or other fuel sources) is a common practice internationally.

Road access

Suitable all weather vehicle access should be provided for the transport of produce, fertiliser and packaging supplies, growing media and wastes.

- Choose a transport route to the farm that avoids truck movements near sensitive land uses such as schools, hospitals and through towns as much as possible.
- Provide a convenient parking area for staff and visitors.
- Consider the impact of noise, dust, lights and road safety on nearby sensitive land users when locating access roads, parking and turning areas.

Contact the Roads and Traffic Authority or your local council for further information.

Water supply

Make sure that there is an adequate supply of good quality water available for your proposed development. Failure of a water supply for even a short period can cause substantial losses in yields and even loss of the crop. Reticulated town water is usually preferable, but is not always available. Alternatives are groundwater (bore), surface water (dam or river) and greenhouse or building roof water (tank storage). Water storage facilities may be needed to obtain sufficient irrigation flow pressure and volume. The capacity of reserves should be based on water availability and reliability at the development site.

In the Sydney Basin there will be increasing restrictions on availability of raw water, since Sydney is now using more than the sustainable yield of water from the catchment. Plans for water supply for developments in the Sydney Basin should make use of water collected from greenhouses and sheds or stormwater.

Although hydroponic greenhouse production is very efficient in use of water (returning > $50,000 per megalitre compared with field production which returns up to $5000/ML), the intensive nature of CEH operations means the required volumes for a unit area may be significant. Water is needed primarily for:

- irrigation and fertilising the crop
- cooling
- sanitation
- packing and processing
- fire protection
- chemical application
- domestic use
- irrigation of landscaping.

A hectare of greenhouse hydroponic vegetables may require 20 megalitres (ML) annually or half as much for closed production systems. Crop type, stage of growth, season and management practice will affect water needs.

All water sources should be tested for quality. Water should be tested for salts, minerals and pH. High levels of chlorine, sodium, iron and alkalinity should be avoided or a management plan developed.

Surface water and reused water should be filtered and treated to remove plant pathogens before use. Chlorination, iodination, ultraviolet light systems, ozone, sand filtration or other appropriate disinfection procedures may be used to disinfect the water.

State Government guidelines and regulations are in place for sourcing water from bores or surface watercourses, or for catching water in dams. A licence from DIPNR may be required. Guidelines have also been developed for recovering or reusing water from sewerage systems.

Contact the DIPNR or NSW DPI for further information.

Hydrology

Bases of greenhouses should be raised to facilitate drainage of stormwater away from the structures. The use of wide, gently sloping, open drains that are well grassed and kept tidy and weed-free will minimise erosion. The vegetation cover will help filter solid particles from the run-off.

Site selection needs to consider the potential impact of floods. Road access to the farm should be designed to ensure flooding does not impede farm activities. Some CEH structures could be developed on flood-prone areas, subject to the economic feasibility of potential crop losses. CEH structures can be constructed to avoid damage from slow flow flood water if the site is potentially a flood area but not in the main flow.

Vegetation

Removing vegetation affects the appearance of a landscape and may affect the local environment in terms of native plant and animal species. Clearing and tree removal can increase incidence of dust and contribute to the introduction of weeds that may harbour crop pests and diseases. In some areas, land clearing may lead to salinity problems.

Selecting a site which avoids the need to disturb or clear native vegetation and habitat greatly reduces potential impacts and the need for additional studies. Existing vegetation should be maintained where possible. Approval from DIPNR, the Catchment Management Authority or local council may be required to clear vegetation.

When developing a site, the area should be clear for a distance of 2–2.5 times the mature height of the trees around the proposed greenhouses or hydroponic systems to allow adequate ventilation, avoid shading and protect the structures and workers from falling debris and branches.

Ground vegetation (for example mown grass) should be maintained around the greenhouses and sheds to avoid soil erosion and minimise dust. These vegetated areas will also help reduce the heat load on the buildings from radiation off the bare ground.

The site boundary should be planted with suitable trees and shrubs. Plantings need to allow the benefits of prevailing cooling breezes and form a windbreak to westerly winds.

Vegetative windbreaks should be permeable and at least 3 rows thick to effectively slow air movement and trap dust and odour within the vegetative buffer.

While a densely planted screen of broadleaved trees and shrubs will look effective and will block the development from view, it is not appropriate. If the windbreak is too dense it will act like a wall, resulting in lifting and dumping of the air, as well as dust and odour.

Where a windbreak is not required, vegetative screening (at least one row thick) should be used to hide or soften a development and create a more natural looking landscape. A hedgerow will look good and will block the farm complex from public view. Vegetative screening will also hide light reflecting off greenhouses and sheds and assist in reducing noise from machinery and equipment.

When planting native vegetation, use local provenance native species. Forests NSW or a reputable local nursery will be able to advise on suitable and appropriate species.

Land coverage

In planning for a farm it is important to ensure a property is of a suitable size to be viable. At the same time, it is necessary to avoid an area becoming overdeveloped with a single land use. Developments should be well screened and must not cause any adverse impacts on the environment.

- When planning a site, land also needs to be allocated on the property for:
  - greenhouses, shadehouses and screenhouses
  - sheds
  - packing house
  - storage area, head house
  - hot water storage tank
  - fuel storage tank
  - pesticide and fertiliser storage sheds
  - wastewater retention system
  - stormwater detention system
  - parking area
  - office
  - roadway
  - water tanks
  - screenings and windbreak
  - setbacks
  - noise mitigation structures
  - land-forming and landscaping
  - open space
  - native vegetation
  - expansion opportunities
- Avoid locating structures adjacent to roadsides or dwellings on adjoining land.

- Provide sufficient adjoining open area to allow structures to be extended if appropriate.
- Avoid scattering buildings across the site. Group structures and incorporate screening.
- Appropriate* setbacks to watercourses, residential dwellings, boundaries, and so on, as well as screening, should be accommodated in the property plan.
- Maintain a balance between development and non-developed land.

Farm layout

The layout of the farm should provide for efficient management of the greenhouses or hydroponic system, delivery of inputs and packing and transport of produce as well as handling and treatment of wastes. It must also minimise off-site impacts on neighbouring land uses. Locate new developments behind existing structures, where possible.

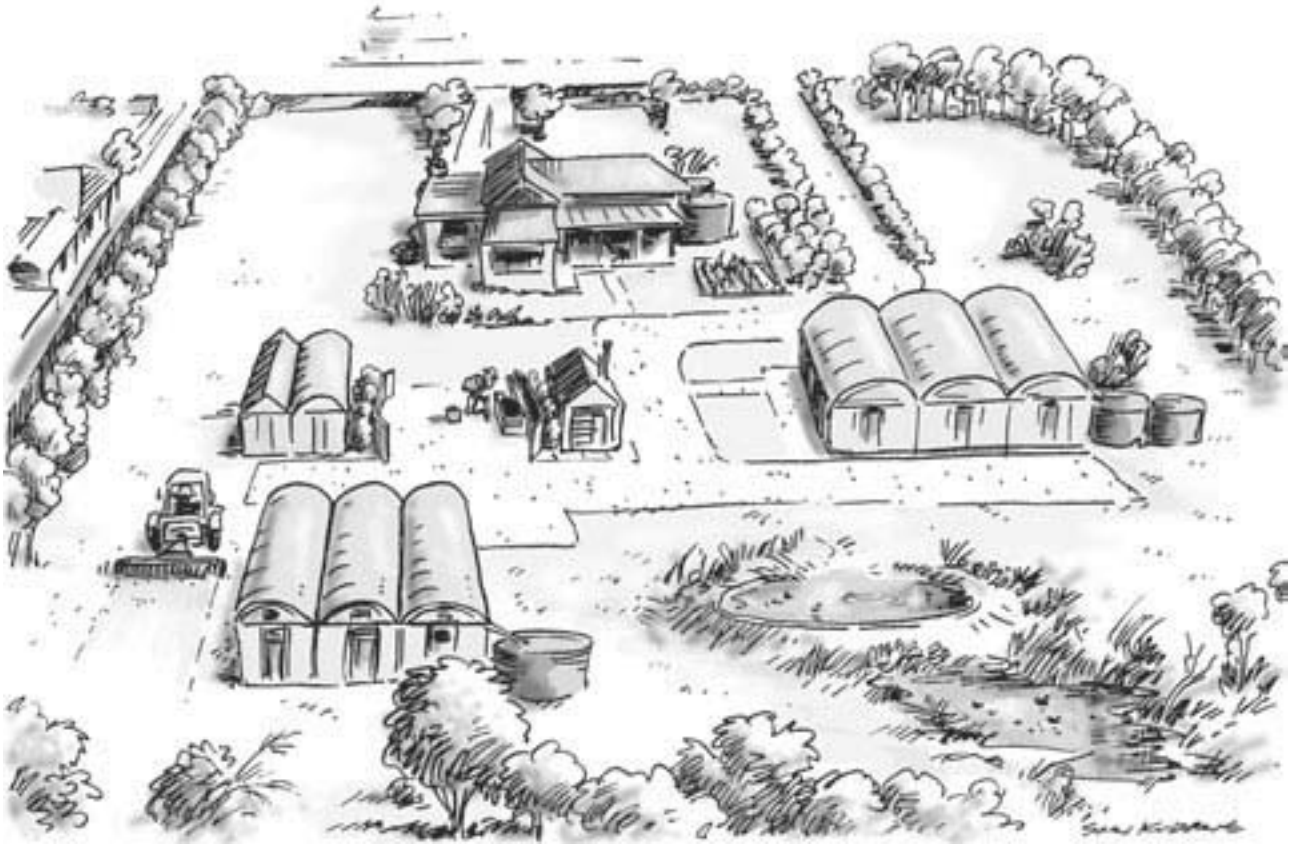
Factors to be taken into account when laying out a new farm or redevelopment include:

- existing buildings
- roads
- dams, watercourses, drainage lines and other bodies of water
- slopes and other topographical features
- vegetation and valuable habitat
- local meteorological conditions such as wind patterns and atmospheric stability.

Setbacks for community amenity and natural resources protection

Setbacks are one management strategy to minimise potential conflict and community impacts.

Setbacks (separation distances) provide a separation between land uses and property boundaries to reduce the potential impact of noise, odour, pests, spills and potential allergens. Individual local governments may have their own requirements for separation distances in guidelines or development control plans, so check the compliance needs of the specific local government area.



Good farm layout improves productivity and minimises potential conflicts.

* Refer to development control plan or relevant agency guidelines for appropriate distances. For example, to maintain fish habitat, a 50 metre setback is required from waterways.

Potential sites must be evaluated by you for suitability on their individual merits, based on the characteristics of the site and proposed development, and the proposed management practices. The impact of an activity can be subject to a range of influences including topography and wind direction.

When other strategies are also used, smaller setbacks may be possible. It is not possible to specify minimum setback distances that would be suitable for all developments because a predetermined setback does not consider the use of other strategies which may be more appropriate in some situations or the local conditions. An outcomes approach should be used.

When planning a farm layout and determining setbacks, you need to consider the impact of your operation on all surrounding sensitive areas. Sensitive areas include natural areas such as waterways and native vegetation as well as other developments such as neighbouring dwellings. Nutrient pollution, odour, noise, dust, traffic and spray drift are potential impacts which can be addressed with setbacks.

Separation distances alone do not guarantee the removal of environmental impacts on neighbours. Other options, including improved technology, farm design and good management practice, should be used to manage external impacts. For example, noise can often be a significant community impact and the requirement is to reduce noise to an acceptable level at the nearest residence. While average noise levels dissipate in a predictable manner with distance and can hence be calculated, actual noise is influenced by other factors such as topography and wind. Required separation distances may be large but can be reduced through alternative management strategies such as soundproofing and noise barriers.

5.2 DESIGN AND CONSTRUCTION

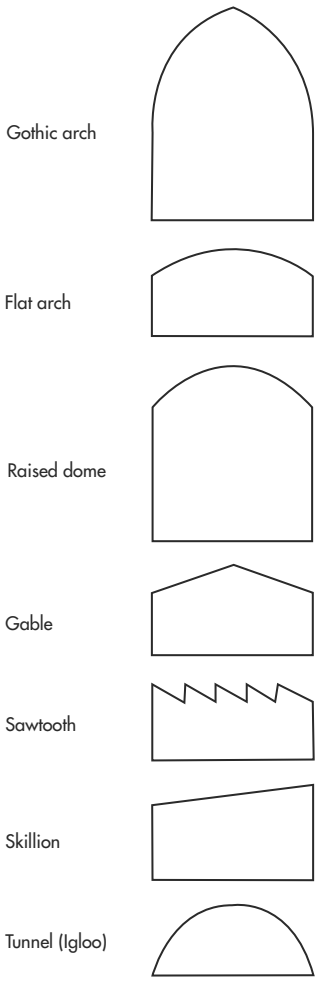
The design and construction should minimise off-site impacts and promote the economic and operational efficiency of greenhouse and hydroponic farms. The development should utilise site topography, existing vegetation and strategic planting of trees and shrubs to integrate the development into the landscape.

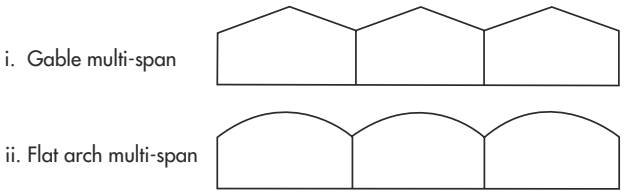
Consideration must also be given to minimising the potential for environmental impacts during the construction phase including noise and vibration impacts and the control of erosion and sediment. An environmental management plan may be required for the construction phase of the development.

CEH structures

A wide range of technology and numerous designs are available in the CEH industry. At the most basic level, greenhouses provide an opportunity to extend cropping seasons and growing locations as well as protect crops from wind, rain and hail. More sophisticated greenhouse structures provide a number of advantages. Growers can optimise yields and product quality. Fresh, quality produce can be reliably produced throughout the year. Furthermore, in some enterprises, the same area may be used to produce 2 or 3 crops per year. Greater efficiencies of inputs including water, fertilisers and energy can be attained. Growers are also able to utilise superior, environmentally sustainable pest and disease management strategies, substantially reducing the use of pesticides.

Basic types





Classification of a greenhouse is according to its basic shape. Types include gable, flat arch, raised dome, sawtooth, skillion, and tunnel.

Multi-span structures

Multi-span greenhouses have a surface area smaller than a number of single span greenhouses of equivalent production capacity. This results in less heat loss and significant energy savings. Substantial economies of scale and production efficiencies are also attainable using multi-span designs.

Multi-spans are typically more robust in design. As a result they tend to suffer less damage during storms and gale force winds.

Height

Height is one of the most important aspects of a greenhouse. The height of a structure directly affects natural ventilation, the stability of the internal environment and crop management. Wherever feasible plan for greenhouse structures with wall heights of at least 4 metres. The international benchmark for wall height of sustainable, high technology greenhouses is 6.3 metres.

Good ventilation is critical in maintaining an optimal growing environment and improves the overall efficiency of a greenhouse. Substantial reductions in pesticide use can be attained with better greenhouse designs. For most crops, a tall, well-ventilated greenhouse will require significantly less pesticide than a low profile house. This is a direct result of a more uniform, stable and ultimately superior growing environment. There is also scope for effective management of pests and diseases using non-chemical management strategies.

A low profile greenhouse requires forced cooling to provide similar suitable conditions. Cooling is critical in the Australian environment and is most efficiently achieved using natural roof ventilation.

Low technology greenhouses

A significant proportion of the industry in New South Wales currently uses low technology structures. These greenhouses, known as tunnel houses, are less than 3 metres in total height. Tunnel houses do not have vertical walls and have poor ventilation. This type of structure is relatively inexpensive and easy to erect. Little or no automation is used.

While this type of structure provides basic advantages over field production, crop potential is limited by the growing environment and crop management is relatively difficult. Low level greenhouses generally result in a suboptimal growing environment which restricts yields and does little to reduce the incidence of pests and diseases. Pest and disease control, as a result, normally requires a chemical spray program.

Low technology greenhouses have production and environmental limitations.

Low technology greenhouses have significant production and environmental limitations, and OH&S implications but they offer a cost effective entry to the industry.

Medium technology greenhouses

Medium level greenhouses are typically characterised by vertical walls less than 4 metres tall and a total height usually less than 5.5 metres. They may have roof or side wall ventilation or both. Medium level greenhouses are usually clad with either single or double skin plastic film or glass and use varying degrees of automation.

Medium level greenhouses offer a compromise between cost and productivity and provide a reasonable economic and environmental basis for the industry. Production of crops in medium level greenhouses is more efficient than field production. Hydroponic systems increase the efficiency of water use. There is greater opportunity to use non-chemical pest and disease management strategies but overall the full potential of CEH is difficult to attain.

High technology greenhouses

High level greenhouses have a wall height of at least 4 metres, (but ideally over 6 metres) with

Medium technology greenhouses offer a good compromise between cost and production potential.

High technology greenhouses offer superior crop and environmental performance.

the roof peak being up to 8–10 metres above ground level. These structures offer superior crop and environmental performance. High technology structures will have roof ventilation and may also have side wall vents. Cladding may be plastic film (single or double), polycarbonate sheeting or glass. Environmental controls are almost always automated. Use of pesticides can be significantly reduced.

High technology structures provide a generally impressive sight and internationally are increasingly being used in agribusiness opportunities. Although these greenhouses are capital intensive, they offer a highly productive, environmentally sustainable opportunity for an advanced fresh produce industry. Planning policies and investment decisions should, wherever possible, encourage the installation of high technology greenhouses.

Associated structures

Packing and grading facilities, cool room storage and an office are also important components of a professional operation.

Heating

Heating is used for both temperature and humidity control and may be called upon throughout the year, not just in winter. Heat should ideally be applied as low as possible in the greenhouse though specialised 'grow pipes' may also be used higher in the crop. Heat is usually applied as either hot air or radiant heat from hot water pipes. When hot air heating is used, the heater must be located at or within the greenhouse. When hot water heating is used, the boilers may be situated away from the greenhouse. The latter system provides the opportunity to locate potentially noisy boilers away from boundaries without having to move the greenhouses.

Other types of structures

Shade houses

Shade houses are structures which are covered in woven or otherwise constructed materials to allow sunlight, moisture and air to pass through the gaps. The covering material is used to provide a particular environmental modification, such as reduced light or protection from severe weather conditions. The height of the structure will vary according to the type of crop being produced and may be as high as 8 metres.

Shade houses are used over outdoor hydroponic systems, particularly lettuce and herb production and some nursery crop production.

Screen houses

Screen houses are structures which are covered in insect screening material instead of plastic or glass. They provide environmental modification and protection from severe weather conditions as well as exclusion of pests. They are often used to get some of the benefits of greenhouses in hot or tropical climates.

Crop top structures

A crop top is a structure with a roof but which does not have walls. The roof covering may be a greenhouse covering material such as plastic or glass, or shade cloth or insect screening. These structures provide some modification of the growing environment such as protection of the crop from rain or reduction of light levels.

Orientation

The orientation of the greenhouse is typically north–south. This has some effect on minimising shading caused by the structure on the crop. Crop rows are also typically aligned north-south to minimise shading within the crop. In most areas, vents will be on the east and west. Direction of prevailing winds should be taken into consideration, with sheds oriented to take advantage of cooling summer breezes.

Where fans are used for forced ventilation, they should be positioned to minimise any likely impact on neighbours.

Greenhouse covering materials

The covering material used on a greenhouse influences the productivity and performance of a structure. A torn or poorly covered greenhouse can lose a lot of energy and significantly increase production costs. Poor appearance is an annoyance for neighbours and passers-by and reflects poorly on the industry generally.

Glass coverings should be kept clean and broken panes replaced. Plastic coverings need to be replaced routinely. The performance of plastic coverings declines over time. Old coverings reduce light transmission, which can restrict yield. The useful life of plastic films depends on the specifications of the plastic purchased. All plastic covering materials need to be replaced before they visibly start to break down; discolouration is an early indication of aging.

'Whitewash' is a water-based paint or chalk sometimes used to coat the outside of greenhouses during summer. This coating reduces the incoming radiation and helps to keep the greenhouse cooler.

Diffusing materials are designed to scatter incoming light and result in better light conditions for crops. A cloudy white plastic film diffuses light better than a clear plastic film. Specific plastics are regularly being developed with a range of characteristics.

New coverings being marketed in the industry have a variety of additives which are used to give plastic films useful properties. For example, films may exclude ultra violet (UV) light for chemical-free pest control or reflect long wave infra red (IR) radiation to improve heat retention at night. As a result, some plastic covering materials are coloured or tinted.

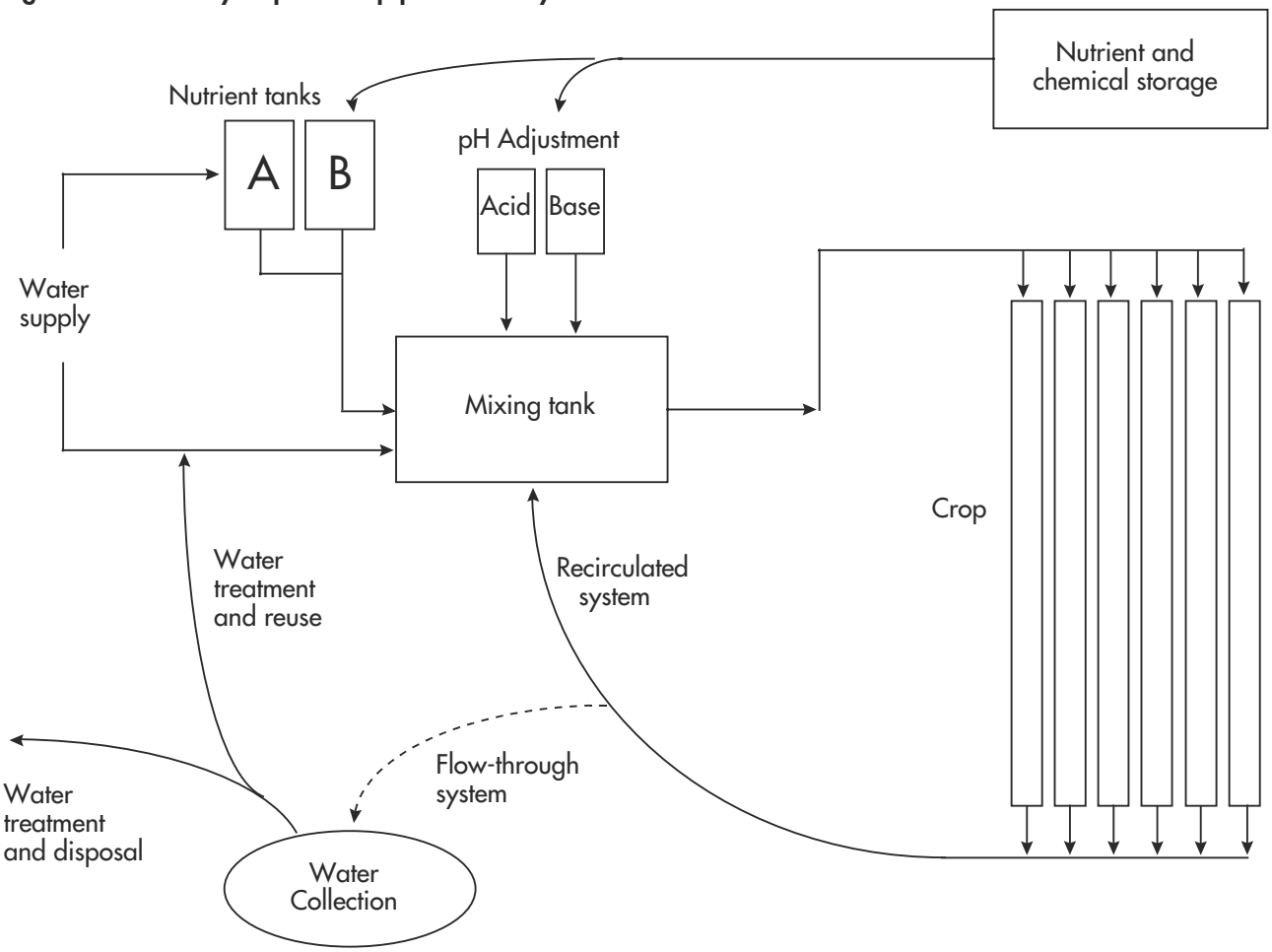
Some coloured materials may intrude on a rural landscape while glass, polycarbonate and some plastic film covering materials can produce glare at certain times of the day – similar to any window in a building. These potential problems can often be addressed with appropriate vegetative screening. Local topography will also have an influence.

Best practice guidelines

- Choose the highest standard of greenhouse possible within your budget.
  - Aim for wall heights of 4 metres or more.
  - Select roof ventilation in preference to side wall ventilation.
  - Automate the control of temperature and relative humidity.
  - Make sure the greenhouse is engineered for appropriate wind loads and crop loads.
- Have an upgrade and improvement plan for greenhouse facilities.
- Keep greenhouses, including covering materials, well maintained.
- Keep equipment such as boilers, fans and pumps well maintained and enclosed to minimise noise.

Greenhouse covering materials need to be well maintained to ensure the right environment for plants.

Figure 2. Generic hydroponic crop production system



Hydroponic systems

There are three broad categories of hydroponic (soil-less) production systems: water culture, substrate culture and air culture. These can be further described as either recirculated (closed) or flow-through (open). See Figure 2.

1. Water culture

In this type of system, the plant roots grow directly in nutrient solution. The most commonly used form of this system is nutrient film technique (NFT). Nutrient solution flows down a channel in which the plant sits. Flood and drain is another common system.

2. Substrate culture

Substrate culture refers to hydroponic systems that use an inert growing medium. The plant roots grow through the medium, the nutrient solution may be provided by dripper, micro-spray or flood and drain.

There are numerous substrates available including sand, gravel, perlite, vermiculite, expanded clay pellets, Versarock®, pumice, scoria, expanded plastics, pine bark, sawdust and rockwool.

A substrate, while providing support for the plant, also provides a balance between moisture and air in the root zone. Choosing a substrate depends on cost, durability, availability, climate, crop and container.

3. Air culture

Air culture (aeroponics) is a system whereby plant roots are kept moist with a mist of nutrient solution. A substrate is not used as such. A young plant may be propagated in a small container of growing media, but the roots will grow out into the moist air.

Recirculated systems

Known as closed systems, the nutrient solution is reused several times. NFT and flood and drain systems should be recirculated (otherwise a lot of water is needed!). All types of systems can be recirculated.

Recirculated systems have to be carefully managed to avoid nutrient imbalances and diseases.

Flow-through systems

These systems have traditionally been called 'run-to-waste' but this is an unfortunate

misnomer which implies a very poor level of environmental responsibility. Any nutrient solution which is supplied to the plants but not used drains away rather than being recirculated through the system. These systems are deliberately managed to have a run-off volume of up to 25% of irrigation. This 'wastewater' can (and should) be collected and treated to reduce nutrient loading and it can be reused and/or recycled.

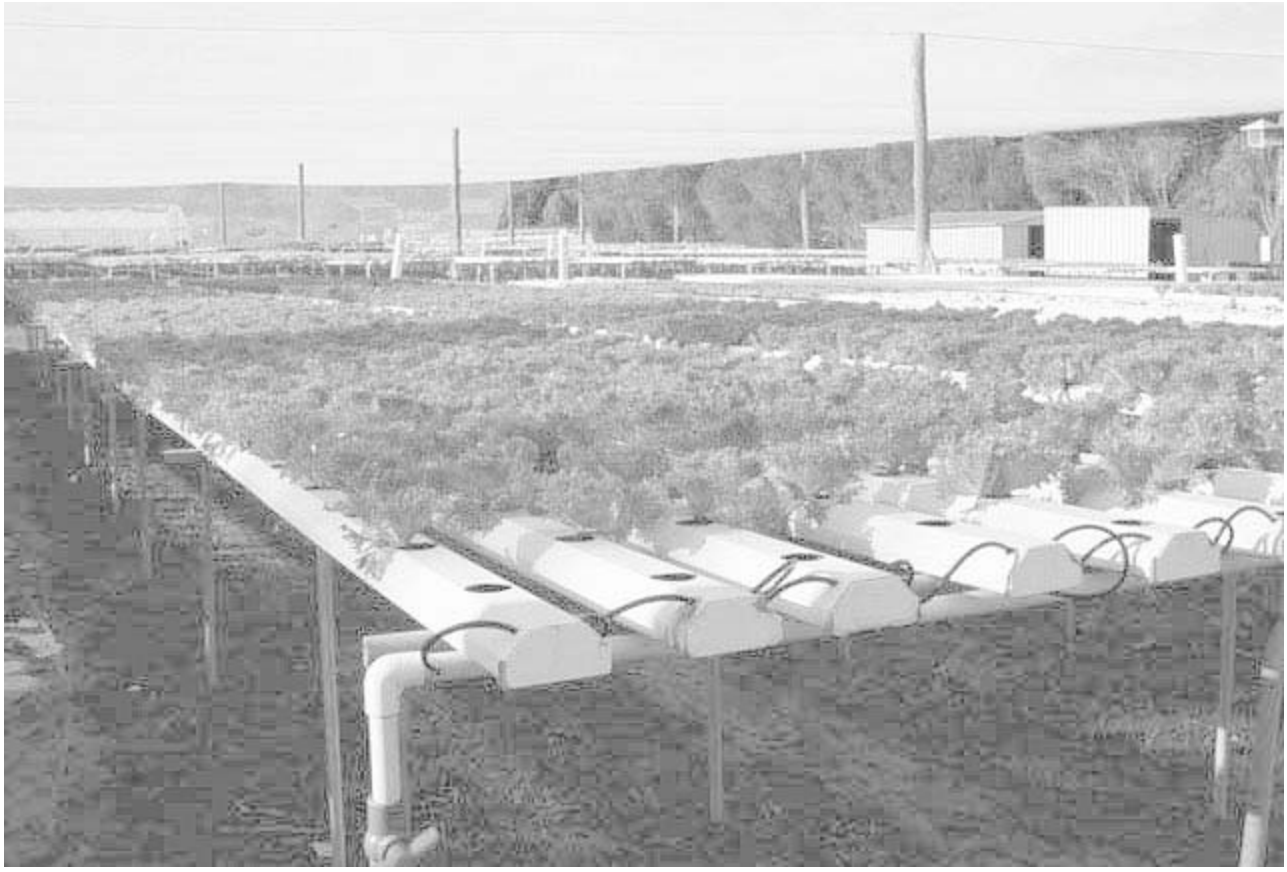
Infrastructure

Fans may be fitted in greenhouses to facilitate air movement (ventilation) and for cooling. Fans may be installed in structures instead of passive ventilation. Circulating fans may also be used inside passively ventilated sheds to assist air movement. To ensure correct capacity and installation, select the fans in consultation with the manufacturer and an independent expert. Other factors to consider are noise levels and fan efficiencies that influence running costs. It is important to clean and maintain fans to ensure that they are functioning properly.

Evaporative cooling pads and fogging systems are installed for evaporative cooling inside the greenhouse to assist in providing an optimal environment for the crop being grown. Fogging line pressure and fogging nozzles need to be properly maintained. A poorly maintained system may not provide sufficient cooling or could result in wetting of leaves and fruit. This can lead to reduced product quality and an increased incidence of pests and diseases.

Heating is used to provide optimal temperatures for crop growth and for management of the humidity in the greenhouse. Either hot air or hot water is used for greenhouse heating. In many low technology structures, gas-fired burners are used inside the structure. High technology greenhouses tend to make more use of piped hot water for heating (known as hydronic heating). In this sort of system, water is heated with a boiler and piped through the greenhouse.

Medium and high technology greenhouses make use of automated systems. These systems can control heating, venting, fans, screens, nutrient dosing, irrigation and fogging systems. Correct operation of the automatic controllers is essential to management of an optimal growing environment. Emergency alarms and backup



In water culture systems such as nutrient film technique (NFT), plants grow directly in nutrient solution flowing in channels.

generators may be used in case of problems or power failure due to the large investments made in producing a crop. A manager of a high technology greenhouse would typically be on site or on call 24 hours a day.

All infrastructure should be planned to ensure the health and safety of employees, contractors and other visitors to the farm. An Occupational Health & Safety (OH&S) risk assessment should be undertaken before finalisation of plans, and relevant modifications should be made to control identified risks.

In substrate culture systems, plants grow in a substrate and are drip irrigated with a nutrient solution.