

‘How Does Your Garden Grow?’ Horticulture in Western Australia

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Abstract

In a traditional nursery rhyme the question is posed: ‘How does your garden grow?’ Within Western Australia, a proud home owner of a well-maintained garden may receive a similar question from a neighbor and/or visitor. The response may be along the lines of: ‘I have green fingers’, or ‘I have a keen gardener assisting me’. The surprise in the question comes about from the fact that home-owners in many of the cities and towns in Western Australia experience water restrictions; the soil is perceived to be ‘sandy’ and hence not suitable for growing any plants; and, the day-time temperatures of summer are generally at a higher level for the good of plant life. Home-owners are often advised and encouraged to grow native plants rather than focusing on growing roses and other delicate plants. A commentary on horticulture in Western Australia is offered in this presentation which discusses briefly the geography and climate, the soils and typical primary agricultural products; the availability of educational courses in horticulture; and employment opportunities.

Keywords: Climate; Horticulture; Rainfall; Soil; Water quality; Water-table

Introduction of Geography and Climate

Western Australia has a north-south span that extends from about Latitudes 14° to 35° S. The climate experienced over the state varies from tropical type in the Kimberley in the north to desert in the interior, for example, the Great Sandy Desert, and to Mediterranean in the south-west. Rainfall in the far north is monsoonal and is experienced in the summer months (namely, November of one year through to February of the following year) whereas in the south-west the rainfall is winter-dominant (June to September) and increases with proximity to the coast. The rainfall received in the central, interior and northern areas is summer-dominant.

The State of Western Australia is the western third of the island continent of Australia (Figure 1). The land surface area is about 2.529 million square kilometres (sq. km) or approximately 976,790 sq. miles. As a comparison, it is slightly larger than the collective size of the states of Alaska and Texas of the United States of America.

Western Australia’s weather is generated from the level of global circulation such as the sub-tropical ridge and the monsoon, to a

regional scale, such as frontal systems and the west coast trough (Figure 2). Analysis of tree rings dating back to nearly three-hundred-and-fifty years infer alternating 20 to 30-year periods of relatively dry weather and 15-year periods of above-average rainfall that reflect low-level variation in the El Nino-Southern Oscillation [ENSO] [1].

The sub-tropical ridge is an extensive area of high pressure that encircles the globe at middle latitudes. The position of the ridge varies with the seasons, allowing cold fronts to pass over southern Western Australia in the winter, but pushing them south of the state in the summer. Conditions along the ridge tend to be stable and dry (Figures 2 and 3) [2].

Administrative Regions in Western Australia

The Department of Agriculture and Food (WA) [3] delineates the map of the state of Western Australia, in particular the southern portion for administrative purposes, into five regions, namely: Central, Great Southern, Northern, South-east and South-west. Annual rainfall in the Central region varies approximately 450 mm in the west and south, down to 300 mm the eastern areas; in the Great Southern region varies from 497 mm inland to 928 mm in Albany, on the south coast and down to 386 mm at a town inland some 000 km northeast of Albany. The grain producing agricultural zone of Western Australia is located in the south-west of Australia. In this region the majority of soils are relatively low in clay and soil organic matter. Consequently their inherent soil quality is naturally low. Sustainable management of the soil resource is therefore essential to the continued viability of the Western Australian agricultural industry (Figure 4).

Soils of Western Australia: Brush-Stroke Description

A brush-stroke description of the soils-landscape of Western

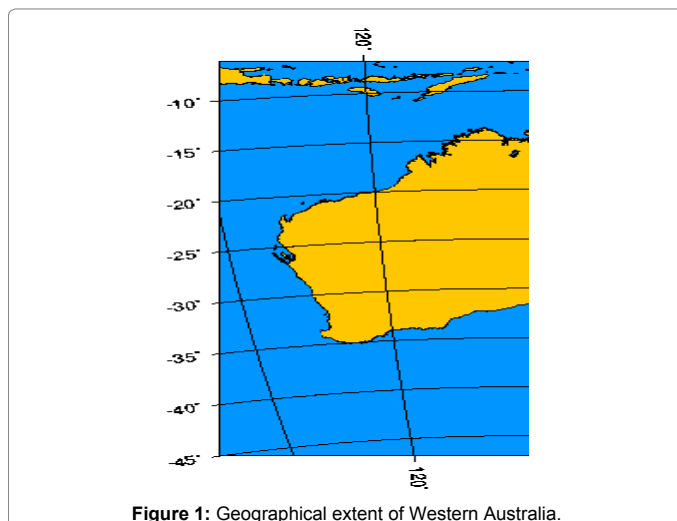


Figure 1: Geographical extent of Western Australia.

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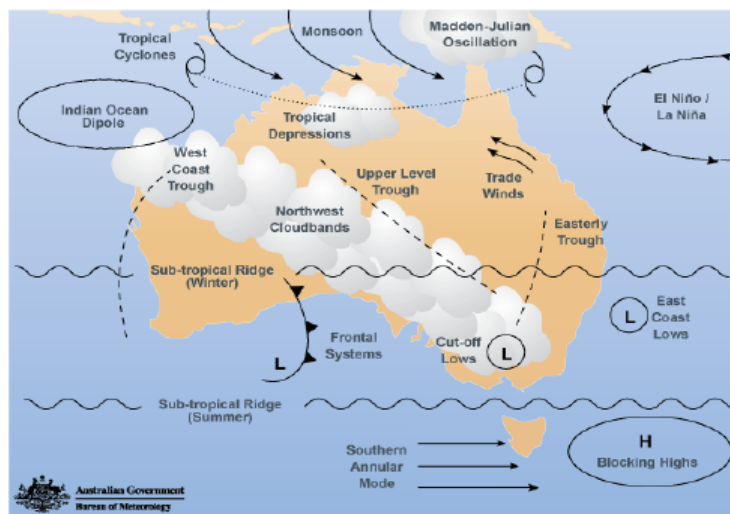


Figure 2: Major weather and climate drivers across Australia [2].

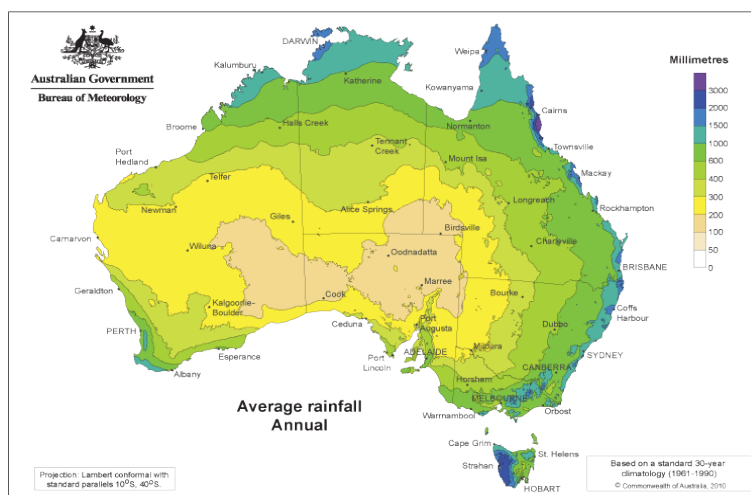


Figure 3: Average Rainfall Annual in Australia.

Australia is offered here. The State is large and is a part of an ancient island continent. Ample literature exists on the topic of landscape, geology and soil. In the Kimberley region sandy soils are dominant on the sand plains; shallow gravel are found on lateritic plains and tablelands; red-brown hardpan shallow loams are found on wash plains; and, calcareous loamy earths occur plains while salt lakes soils are also present. The soils in the Pilbara region are varied due to the wide range of parent materials and climatic conditions [4].

Duplex soils are layers of sand or sandy loam over clay and soil acidity is a measure of the power or concentration of hydrogen in the soil. Soils contain a wide diversity of micro-organisms and small animals which are important for maintaining a suitable environment for the growth of plants. The soils of the Northern Agricultural region range from very sandy soils along the coastal areas midlands to heavier red-loams along the eastern area. Low natural nutrition as well as agriculture induced acidity constrains the soil in the region. In the Central agricultural region the major soil constraints include low natural nutrition, production induced subsoil acidity and salinity related to rising water

tables. Soils of the central part of the region are dominated by duplex soils containing large gravel fractions in some places. In higher rainfall areas, these texture contrasts create waterlogging problems in low lying parts. Salinity from rising water tables, compaction and subsoil acidity are all constraints to production in the Great Southern Agricultural Region. The dune system of the South-west Region is particularly clay, loam and sandy which is susceptible to nutrient leaching.

If managed properly, most soil types can be suitable for horticulture according to the authorities in Western Australia [4]. In the instance where irrigation water is available, the most limiting factor to establishing perennial horticulture is the soil depth. The Department of Agriculture and Food, Western Australia (DAFWA) produces maps of soil and land capability. These maps give a general overview of the different soil types that may occur on the land area and their suitability for horticulture. Soil map extracts of the region within the vicinity of Geraldton, a coastal town, the map legend and a map extract of the broad soil classification in the Perth metropolitan area are appended in the Appendix.

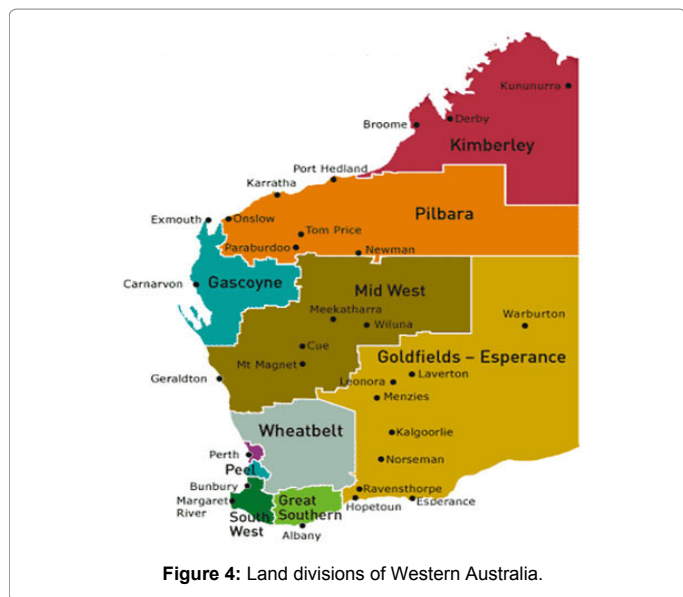


Figure 4: Land divisions of Western Australia.

Before considering what type of crop to grow, a thorough inspection and evaluation of the site and soil must be undertaken. At each site the following parameters should be recorded – soil texture (including stone and/or gravel content), depth of each soil layer, soil structure, presence of compaction and impeding layers, soil pH, soil salinity and sodicity. Soil type and soil conditions influence the type of crop that may be grown and/or the management techniques required to grow the crop successfully. Other important factors that must be considered include soil nutrient-holding capacity, acid sulphate soils, water repellence, saline patches, rocky outcrops, soil erosion, shallow water-table levels, flood susceptibility, slope, access, water courses, weed infestation, herbicide resistance and residues and plant diseases.

The major issue is that of water availability. The amount of water available, and its quality, will decide what crop type and the amount that ideally may be planted. Consideration must also be given to the high evaporation rates, crop water requirements and variability of rainfall – areas that experience 300 millimeters (mm) and more – may be considered as most suited for many commercial horticultural developments. Water dictates a plant’s growth rate, planting density, yields and greatly influences fruit and flower quality.

DAFWA offers the following advice to horticulturalists: plant a small area of crop and risk being left with excess water than to plant a relatively larger area and risk not supplying enough water to the crop. For example, another hint offered is that farmers should have access to 85,000 litres per day during the summer months to irrigate one hectare (2.5 acres) of fruit trees or vegetables.

Horticulture in Western Australia: Brief Discussion

The natural vegetation of the Kimberley region is mostly arid desert of hummock grasslands of spinifex and mixed scrub. The vegetation of the Pilbara is highly variable that includes grasslands, woodlands and shrublands of mulga [3].

Agriculture in the Northern Agriculture Region is mainly on the production of cereal, oilseed and pulse grain as well as cattle for beef and sheep for both meat and wool in the higher rainfall areas. The majority of primary production in the Central Region is centred on the cropping of cereals, oilseeds and legumes mixed with cattle and sheep farming. The Great-Southern Agricultural Region is largely dominated by dryland agricultural production grain, and livestock in the form of cattle and sheep. The South-west region is agriculturally diverse as a result of the higher winter rainfall that is received. Vegetable, dairy and beef production dominate the Swan Coastal Plain. In the past, forestry was a major primary industry along the Darling Escarpment and throughout the south-west of the state.

Suffice to offer brief comments here on selected crops grown in South-west region of the State of Western Australia due to word limitation allocated for this commentary. Asparagus, being more tolerant to large variations in temperature than most vegetables is best grown on deep, well-drained soils where there water-table is not shallow. This vegetable is grown in a wide variety of climates throughout Western Australia; however, yields and quality are best in the South-west region.

Other fruit and vegetables grown to a high standard of quality includes avocados, brassicas, carrots, Chinese jujubes, cider apples, citrus, custard apples, figs, green tea, mangoes, olives, passionfruit, persimmons, pome fruit (apples, pears, etc.), pomegranates, potatoes, stone fruits (apricots, nectarines, plums, etc.), table grapes, tomatoes



Figure 5: Images of flower bed and vegetable patch in a Perth homeowner's garden are depicted below.

and wine grapes. For a detailed account of horticultural crops grown in Western Australia, their challenges, scope and problems (disease and pests) the reader may wish to visit the webpages of the Department of Agriculture and Food and other sources, especially The Horticulture Handbook (Bulletin 4847) and others as listed in the References below.

Education in Horticulture

Horticultural courses are available at all the tertiary education universities in Western Australia at under-graduate and post-graduate levels. The Technical and Further Education (TAFE) division of the Education Department of Western Australia offers a course in horticulture at a certificate level. This course will develop the skills a student needs to design, plan, implement, manage and evaluate horticultural operations and processes to effectively manage and maintain public and private parks, reserves, gardens, natural bushland and community recreation areas. The course includes developing the student's skills in how to: establish and manage a horticultural business or project, which includes preparing estimates, quotes and tenders; selecting plants and landscape solutions; managing plant health programs; developing production plans; and managing staff and services. This course has no core units and 10 elective units. The elective unit students study may differ between TAFE colleges. A Certificate III in Horticulture enables the candidate to enter the workforce for a career working with plants as school or council gardener, groundskeeper, or self-employed landscaper [4].

Further details on the courses offered, entry criteria and cost amongst other information can be obtained from the webpages of the institutions that are scattered throughout the country. Word limitation for this study would not permit a detailed commentary of the education courses offered, however, the following may provide a good indication of what is offered.

Courses are offered in nursery manager, garden centre operator, parks and gardens manager, horticultural consultant and landscape designer. By completing an additional two units with the Diploma of Horticulture a candidate gains a dual qualification, incorporating the Diploma of Conservation and Land management. There are no formal entry requirements for this course. It is, however, recommended that applicants have at least three to five years' experience within the industry, or have completed Certificate IV in Horticulture or Conservation and Land Management. A Certificate II in Horticulture is suitable for home gardeners and sole traders, including handypersons, landscapers and gardeners. This nationally accredited course is delivered by industry experts. Students are taught how to recognise plants, prepare plant specimens and provide information on products and services on:

- The fundamentals of planting, potting and maintaining trees, shrubs and plants.
- Soil testing and how to treat weeds, pests and diseases
- How to work effectively in the industry and Work Health and Safety practices.

The student may then choose one of three streams to develop their knowledge in a specialist area, namely: in the Nursery stream the student will discover how to maintain nursery plants, pot up plants and participate in environmentally sustainable work practices; whilst in the Parks and Gardens stream will teach the student how to operate basic machinery, support turf establishment and maintain properties and structures.

If the student chooses the Landscaping stream, they will learn

how to operate basic machinery, lay paving and assist with landscape construction. Whichever stream is chosen, the student will get a deeper understanding of this growth area and help one develop in-demand, industry-specific skills.

The AHC30716 Certificate III in Horticulture is delivered by industry experts and will give students the fundamental horticulture skills they will need to succeed in the industry, as well as teach them the specialist skills that are in demand by organisations that would create and maintain large open spaces, including parks, sporting fields, playgrounds and other public spaces.

The AHC30716 Certificate III in Horticulture will teach the student:

- How to recognise plants; prepare plant specimens and plant trees and shrubs.
- The fundamentals of installing and maintaining plant displays and nursery plants.
- The implementation of soil improvements for plant and turf areas, and plant nutrition programs.
- How to conduct site inspections and operational inspections of park facilities.
- Methods to control weeds, plant pests, diseases and disorders.
- How to implement a grassed area maintenance program.

This is an 'online course' with work-based projects. This means that the student can complete the basic course via 'online learning'. The student will need to complete work-based projects in a workplace setting (for example, a local council, golf course, park, sporting field or holiday resort) in order to successfully complete the assessments

At Open Colleges, the student is considered as being central to everything that is undertaken. With more than 100 years of experience in distance learning, the Colleges have the expertise in delivering education and training to individuals seeking to launch, change or accelerate their careers. The focus is on meeting the specific needs of adult learners by delivering highly flexible, accessible and affordable learning opportunities. The unique learning model provides everyone attending with ultimate control – to study anywhere, anytime and at their own pace. Our online campus – OpenSpace – provide students with access to learning resources, expert trainers and assessors, collaboration with other learners and a comprehensive range of support services.

The horticulture industry in Australia has grown tremendously over the past 10 years. Today it is worth \$5.6 billion with \$1.2 billion in exports and still growing. Horticulture is made up of over 50 industries, from ornamentals and urban horticulture to a vast range of intensively produced food crops. Career opportunities in horticulture are just as diverse, ranging from production, management, breeding, biotechnology, marketing, food safety and sustainable natural resource management. Many industries are just beginning to realize the global marketing opportunities, stemming from our 'clean and green' image and our ability to produce a wide range of high quality tropical and temperate crops. Employment over the next 20 years in this industry promises to be at the cutting edge of developments in plant sciences [5].

Bachelor of Horticultural Science

In undertaking the applied science degree a student will focus on the development of analytical, quantitative, computing and communication skills. Teaching and research are based on sustainable

horticultural practices. They will gain research skills in fourth year that are highly regarded by employers, through the completion of a research thesis. In the first two years of the degree students undertake core units of study designed to provide broad-based science training as well as a basic overview of horticultural science. In the third year the course offers options in post-harvest technology and production and marketing of fruit, vegetables, cut flowers and nursery stock, and a range of elective units that are appropriate for progression to the fourth year major in Horticultural Science. The fourth year specialization includes units of study in production horticulture, urban horticulture, and post-harvest biology, together with a research project in an area of your choice related to horticulture [6].

Major studies in this degree include: fruit, vegetable and ornamental production, post-harvest biology and technology, urban/amenity horticulture and horticultural specializations within areas of agribusiness, biometry, biotechnology, chemistry, economics, entomology, genetics and plant breeding, plant pathology, resource economics and soil science. In undertaking this applied science degree you will relate the application of knowledge and principles of science to the understanding, management and conservation of our land and water resources. The course will provide you with an understanding of important environmental and community issues, such as salinity, acid-sulphate soils, land clearing, soil erosion and water quality. Units of study are drawn from the disciplines of Science, Geography and Agriculture and are relevant to students from urban and rural backgrounds seeking a professional career related to natural resources, landcare and total catchment management [7-9]. The content includes relevant foundation science, quantitative and computing skills, the science of assessing, monitoring and sustainably managing land and water resources, and related socio-economic issues. The student will gain highly regarded problem-solving skills in fourth year through completion of a research project. The course will be delivered mainly on campus, but will have fieldwork, excursions and off-campus professional experience.

In undertaking this applied economics degree students will develop strong analytical, quantitative, computing, and communication skills with an emphasis on commodity markets, trade, and agricultural and natural resource issues. Half of the units of study are taken in the Faculty of Economics and Business and most of the economics and commerce units are available to Agricultural Economics students. Access to accounting units depends on the university's entry requirements. Modern language units are available to Agricultural Economics students. The program provides excellent qualifications for students to enter finance and business. They will gain research skills highly regarded by employers in fourth year through the completion of a research thesis or a set of research exercises. University Faculties of Agriculture seeks to provide a high quality education in terms of course content and teaching and extra-curricular learning experience that prepare students for employment in the industry [10].

Employment in Horticulture

The Western Australian Department of Primary Industries and Regional Development (Agriculture and Food) offers a wide range of employment and career opportunities throughout Western Australia. In the area of agriculture research, there are development and technology careers in research, pathology, veterinary science, entomology, hydrology and biosecurity available. The Department also requires people with skills in management, finance, administration, economics, information technology and communications. The

Department of Primary Industries and Regional Development works closely with all sections of the industry supply chain from paddock to plate [11].

Western Australia (WA) grows a diverse range of top-quality horticultural crops from the Ord River Irrigation Area in the north, to the Gascoyne River at Carnarvon, the coastal sands near Perth and throughout the cooler south-west region. Crops include tropical and temperate fruits, delicious vegetables and outstanding table wines. WA also leads the country in flower exports, mostly from the unique native flora, thereby offering ample employment opportunities.

The rigorous nature of the four-year applied economics degree equips graduates for a competitive market place across a diverse range of career paths which include: merchant banking, commodity trading, agribusiness management, economic journalism, public policy analysis, and economic research. Organizations such as New South Wales Agriculture, NSW Department of Environment and Conservation, ABARE, Meat & Livestock Australia, and the Productivity Commission, and employment internationally with the OECD and the World Bank are attractive work places. Graduates are employed with the premier finance and rural organisations in the city include: Macquarie Bank, Sydney Futures Exchange, KPMG Chartered Accountants and Hassall & Associates, CSR and *Unifood* to name but a few organisations. To prepare for careers with an international focus, many students now study abroad for a few weeks, a semester, or a year. Students have travelled to the United States, South America, Canada, the United Kingdom, the Czech Republic, South Africa, South-East Asia, Vietnam, Japan, Nepal, Fiji and New Zealand. A student who undertakes an *Agricultural Economics course after studying other degree and who wishes to be involved in financial markets and more specifically, the futures market may find employment in a bureau of agricultural economics, or in an multi-national bank and with AusAID.*

'How Does Your Garden Grow In Perth?'

As the State experiences the effects of a drying climate, more West Australians are embracing fresh water thinking and switching to water-wise plants and varying gardening practices. Water-wise plants are not just beautiful and full of colour – they're easy to maintain too! By combining these principles with the water-wise designs and plants and create a functional, attractive garden that will thrive in the conditions of the metropolitan area. The Water Corporation of Western Australia offers advice on water-wise design and the types of plants to seed or graft for an attractive garden.

Nursery and *Garden Industry Western Australia (NGIWA)* has been the peak industry body representing commercial growers, retailers and suppliers in WA since 1939. NGIWA is committed to providing professional and technical leadership through education, support and representation to advance the growth and profitability of its members. It is estimated that it contributes over \$200 million annually to the Western Australian economy and supports in excess of 200 grower nurseries, retail garden centres and allied trade manufacturers.

The Botanical Garden at Kings Park, parks in the Perth Metropolitan Region and at urban and regional centres all pride themselves for the well-maintained gardens. The same could be stated for the homeowners of Perth and surrounding neighbourhood.

Growing vegetables in the garden can be a great joy. It gives the homeowner something interesting and productive to do it saves money and it means having confidence in what is being consumed. All sorts of vegetables may be grown in a sandy soil garden that over the course

of a year will more than pay for itself despite that fact that Western Australia with some of the most degraded and nutrient poor soils in the world. With the use a limited amount of NPK fertilizer, some soil wetting agent (which is a real necessity in W.A.) and where possible home-made and bio-organic pest control methods composting kitchen and garden waste it is possible to grow and harvest quality vegetables and flowers especially dedication and hard work. Yes, of course, with a few 'green fingers' to assist!

With water restrictions having been in place in Perth since the summer of 2001, there is an increasing trend to incorporate native plants into garden beds. This is a trend that the Botanic Gardens and Parks Authority supports, as it preserves fresh water supplies, celebrates our unique flora and provides resources for the fauna of Perth which manage to survive in urban areas.

The biggest misconception about Australian garden plants is that they have to be treated quite differently from plants from other continents. This idea results in two opposing beliefs - one being that they can be neglected, and the other being they have fussy needs that make them difficult to grow, especially when mixed with exotics. In reality, however, the same general horticultural rules apply to all ornamentals. Every plant, whatever its origins, grows better with a little care and attention, and some plants have slightly different requirements regarding soil and position [12].

There are a number of web sites that advertise for either industry specific roles or general employment in the agriculture industry. Researching and searching online is a great first point of call. Agriculture plays a huge role in Australia and is a vital part of our economy. It also contributes to our social and environmental sustainability. Professional development can be any activity, formal or informal, that contributes to the development of your knowledge, skills or ability in any given industry. Images of flower bed and vegetable patch in a Perth homeowner's garden are depicted below (Figure 5).

Western Australian Horticultural Council

The Western Australian Horticultural Council has been promoting, encouraging and assisting the development of amateur horticulture in Western Australia since 1932. The Council encourages, promotes and sanctions the formation of affiliated societies. It supports affiliated societies by sponsoring and arranging two plant fairs a year enabling them to share their expertise and plants with members of the public. The Council produces *The Gardener's Handbook* to assist exhibitors, judges and societies in all aspects of horticultural competition. Affiliated members offer amendments and updates as they become available.

It allocates State and District Championships for competitive shows run by its members and provide sashes and certificate awards. Applications are considered at the February and November Council meetings. Once established, members participate in the decisions of Council. The Council is affiliated with kindred bodies that include Araluen Botanic Park Inc., Garden Clubs of Australia Inc. and the Royal Horticultural Society of Victoria Inc [13,14].

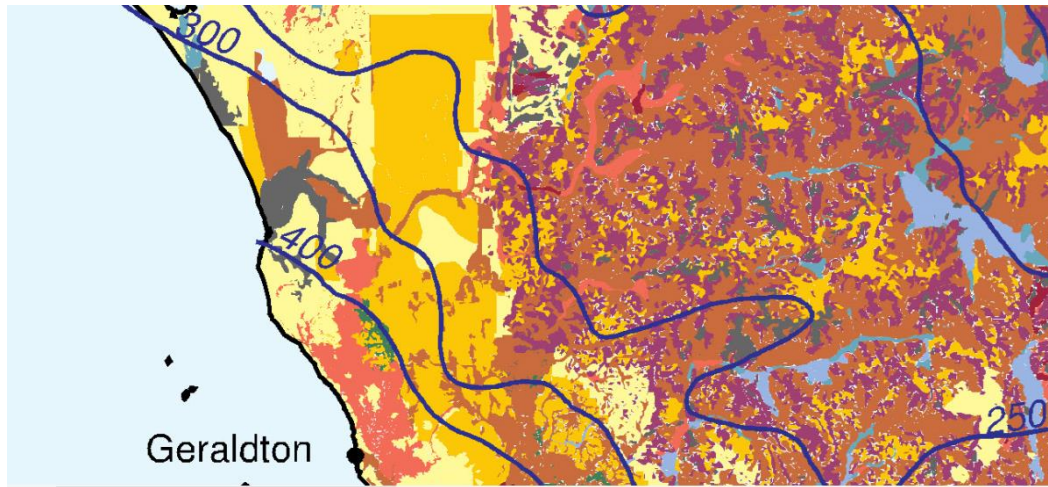
Summary

This study offered brief discussions on the geography and climate of the State of Western Australia, the administrative regions of the State as delineated by the Department of Agriculture and Food and a brush-stroke description of the soils of Western Australia noting that the major issue for the horticulture industry is that of water availability. Water dictates the plant's growth rate, planting density, yields and greatly influences flower and fruit quality. Further discussion is made on the education of horticulture and the employment opportunities in the State. The final portion of the study offered some answers to the question: 'How does your garden grow?' posed to the homeowners and proud gardeners of metropolitan Perth. Advice and assistance is offered by authorities, agencies and industry.

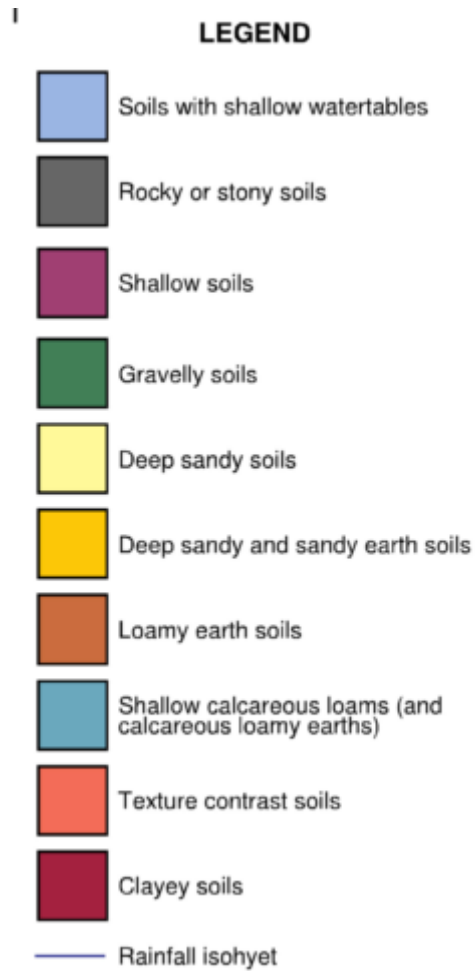
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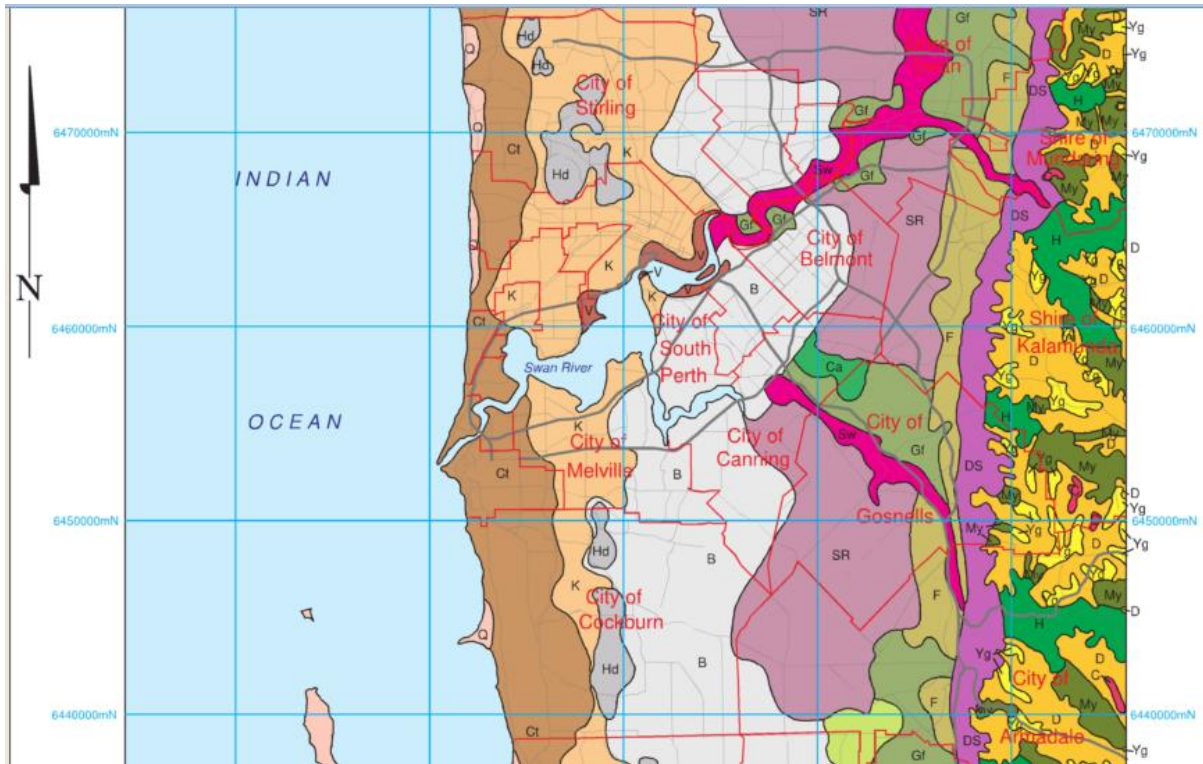
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Appendix



The Legend for the above map extract is appended below.





Extract of 'Soil map of the greater portion of Perth Metropolitan Region'.

Information on Australian climate zones can be found at the [YourHome](http://www.yourhome.gov.au) website.

An extract is reproduced below.

Australia - arid

This zone crosses Australia from coastal Western Australia to the Great Dividing Range in the East. It includes all the desert area, Kalgoorlie, Alice Springs and dry inland areas of Queensland.

Australia - cool/mountain

Mild or warm summer. Cold winter with frosts. Includes high areas of the New South Wales Northern Tablelands (Armidale, Guyra, Glen Innes), Southern Tablelands, Canberra/ACT, and most of Tasmania.

Australia - sub-tropical

Warm humid summer (average January maximum temperature < 30 degrees C). Mild dry winter. Includes the eastern seaboard from Rockhampton to Brisbane and south through Coffs Harbour to Sydney. Coastal WA from approx Geraldton to Canarvon.

Australia - temperate

Warm summer (average January maximum <30 degrees C), cool winter. Includes inland Queensland, New South Wales tablelands and coastal region south of Sydney, and much of southern coastal Australia from Melbourne, Adelaide through to Perth.

Australia - tropical

Hot humid summer (average January maximum temperature > 30 degrees C). Warm winter. Extends across the north of Australia from Canarvon through Port Hedland, Broome, Darwin, Cairns, and south to Rockhampton.