

Local Planning Policy

Horticultural Development

Prepared by Planning and Sustainability Services
May 2018

Introduction

The expansion of in-ground horticulture in Peel-Harvey Coastal Catchment Area (Coastal Catchment Area) provides special environmental and planning challenges for the Catchment and Peel-Harvey Estuary. Some types of horticulture can significantly increase the loads of nutrients, mainly phosphorus and nitrogen, entering groundwater, watercourses, wetlands, and the Peel-Harvey Estuary. Once in the environment, nutrients reduce water quality, cause algal blooms, change conditions for aquatic fauna and can lead to fish kills.

The Peel-Harvey Estuary is in a perilous state, and current levels of phosphorus entering the catchment's watercourses are double that which is estimated to return the estuarine system and lower rivers to a healthy state (EPA, 2008; Kelsey et al, 2011).

Of all types of production, in-ground horticultural production systems (e.g. vegetable gardens, turf farms) pose the greatest risk to catchment water quality in some parts of the coastal catchment. As shown in Table 1, development of many of the Coastal Catchment' soil-landscape systems for some types of horticulture poses a very high risk of nutrient export and water quality in Catchment rivers and the Peel Harvey Estuary.

Table 1, Table 2 (Appendix B) and regional-scale soil-landscape unit mapping prepared by DAFWA provide important information on the potential suitability of a proposal with respect to its nutrient export risk and risk to catchment water quality. They are key information resources supporting the implementation of this Policy.

Of all types of production, in-ground horticultural production systems (e.g. vegetable gardens, turf farms) pose the greatest risk to catchment water quality. This is due to the high amount of nutrients that horticultural crops require, the poor nutrient holding characteristics of many of the catchment's soils, high groundwater tables and the intensive drainage system on the Coastal Catchment Area.

A significant challenge is therefore to shift future production from in-ground systems to closed hydroponic systems, particularly for vegetable growing. Other solutions and technical advances to reduce nutrient export may also play a part for other production systems, but as yet have not been demonstrated to reduce nutrient export levels to those required to meet catchment water quality improvement targets.

This policy provides guidance for best practice land management for horticulture to ensure further degradation of the Shire of Murray's waterways is minimised.

Application of the Policy

The policy applies to:

- All proposals for new horticulture within the Shire of Murray. This includes proposals in areas within the Peel-Harvey Coastal Plain Catchment as gazetted in State Planning Policy 2.1 and as shown in Figure 1;
- Proposed changes/upgrades to horticultural operations where the proposed change/upgrade constitutes development under the Scheme or will likely result in increased nutrient export above which the development was originally approved; and
- All proposals that may compromise existing or potential future horticultural areas where relatively high capability soils are located.

The policy does not apply to upgrades to an existing horticultural operation in relation to the irrigation, fertilisation or production system which would result in a reduction in nutrient application and/or export (and no other development is proposed as part of the upgrade).

Applications will need to clearly demonstrate the proposal meets the objective and requirements of this policy. Applications must also meet any other requirement of the Shire's planning framework that may be applicable for a particular property under the Scheme, Structure Plan or Local Planning Policy.

Policy Objectives

The objectives of this policy are:

- to ensure new horticultural enterprises pose a low risk to catchment water quality and are able to meet or improve catchment standards for water quality improvement;
- to encourage new types of horticultural enterprises to the Policy Area which are compatible with Catchment Water Quality Improvement Standards;
- to encourage high-standards in horticultural management practices in all parts of the local government area;
- to ensure strategic and statutory proposals do not compromise existing well-managed horticultural developments, or compromise potential future horticultural development of relatively high capability areas.

Interpretations

Bushland	Land on which there is vegetation which is either a remainder of the natural vegetation of the land, or, if altered, is still representative of the structure and floristics of the natural vegetation, and provides the necessary habitat for native fauna (EPA, 2008b).
Catchment	Is the area around the wetland or waterway that contributes surface run-off or groundwater to the wetland or waterway.
Catchment Water Quality	The quality of water in ground and surface waters of the Peel-Harvey Coastal Catchment (Figure 1) including drains, creeks, wetlands, rivers and estuarine areas. Water quality parameters include levels of phosphorus, nitrogen, organics, salinity, acidity and total suspended solids.
Catchment Water Quality Improvement Standards	The threshold levels of nutrients applied to land, or exported from land, as set in Appendix A of this policy.
Closed system (as in closed system hydroponics)	Hydroponics system in which the nutrient solution is recirculated and the nutrient concentrations are monitored and adjusted accordingly. There is zero or minimal discharge of the solution or water to the environment.
Coastal Catchment Area	Same meaning as for Peel-Harvey Coastal Catchment
Horticulture or 'agriculture – intensive'	Has the same meaning as 'agriculture – intensive' in the Model Scheme Text, that being premises used for trade or commercial purposes, including outbuildings and earthworks, associated with the following — <ul style="list-style-type: none"> a.) the production of grapes, vegetables, flowers, exotic or native plants, or fruit or nuts; b.) the establishment and operation of plant or fruit nurseries; c.) the development of land for irrigated fodder production; d.) irrigated pasture (including turf farms); or e.) aquaculture.

Hydroponics	<p>The process of growing plants using mineral nutrient solutions, without soil. Although hydroponic systems do not involve soil, they may involve a wide variety of growing media, such as perlite, gravel, peat, sand, rockwool and other.</p> <p>There are two main types of hydroponic systems – closed hydroponic systems and open hydroponic systems. Hydroponic systems that do not involve growing media are usually closed systems, while hydroponic systems that involve growing media (container plants) may be closed or open systems. Closed systems may have zero or minimal discharge to the environment. Open systems where excess nutrient solution drains past the rootzone of plants may have a requirement for regular discharge to the environment. All hydroponic systems have wastes which require disposal at some point.</p>
In-ground Horticulture	Horticulture where the crop is grown directly into in-situ soils and landforms, whether the soils have been amended or not.
Land capability	Land capability refers to the ability of land to support a type of land use without causing damage.
Land suitability	Takes land capability information and other information (such as rainfall, environmental sensitivity) and looks at the overall suitability of a piece of land to accommodate a particular kind of development. It is useful for site selection and can also underpin the manner in which a particular type of development is carried out, so that the environmental limitations or constraints are fully recognised (EPA 2008b).
Nutrient Export Risk Assessment	An assessment of the nutrient export risk posed by a proposal on a specific site and production area. It should be carried out by a suitably qualified expert and able to be independently verified. See Section 9.2 of this local planning policy.
Peel-Harvey Coastal Catchment	The catchment area defined in State Planning Policy 2.1 Peel-Harvey Coastal Plain Catchment.
Production area	The area under crop production (excluding non-production areas on the Lot or Site)
Site	The lot or lots on which the production area is located.
Site Management Plan	The plan prepared by the proponent to document how the production area and site will be managed over the lifespan of the operation to reduce nutrient export and manage all aspects of the operation in relation to the natural environment, pollution risk, visual landscape and maintenance of the amenity to neighbouring properties. A checklist to guide preparation of a Site Management Plan is included in Appendix E.
Soil-landscape systems of the Peel-Harvey Coastal Catchment	Forrestfield System, Pinjarra System, Bassendean System, Vasse System, Spearwood System and Quindalup System
Viticulture vines or	The growing of grapes for wine; or growing of low yield olives.
Watercourse	A river, stream, creek or manmade drainage features in which water flows in a channel, whether permanently or intermittently (EPA, 2008b).
Wetland	Areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or artificial, fresh or saline (EPA, 2008b)

Planning Approval Requirements

In determining or providing advice on strategic or statutory horticultural planning proposals, the following provisions shall apply:

1. Proponents should be encouraged to move towards closed production systems, such as closed hydroponics, where such systems are available for particular crops.
2. Proposals for horticulture should pose a low risk to Catchment Water Quality, the environment and land resources and aim to achieve the Catchment Water Quality Improvement Standards as set out in Appendix A.
3. All proposals for horticulture should be accompanied by a Site Management Plan. Guidance on preparation of a Site Management Plan is included in Appendix D.
4. All proposals for nurseries (potted plants) and closed systems (e.g. closed system hydroponics) should be accompanied by a Site Management Plan sufficiently detailed to ensure that the proposal will pose a low risk to catchment water quality and other environmental values and be well managed.
5. All proposals for annual and perennial horticulture and viticulture in the Coastal Catchment Area which are located on Soil-landscape mapping units which are not potentially suitable for the proposed type of horticulture (Appendix E) should be accompanied by a Site Management Plan which reduces nutrient export risks to achieve Catchment Water Quality Improvement Standards, and includes:
 - a. Site-specific soil testing
 - b. Site-specific land capability assessment
 - c. Nutrient Export Risk Assessment.
 - d. All other details listed in Appendix E, including measures to reduce risk of nutrient export.
6. Outside of the Coastal Catchment Area, where a risk is posed to Catchment Water Quality or other environmental values, the local government may on the advice of the Department of Agriculture and Food WA or other relevant state agencies, require proponents to provide site specific soil testing and land capability assessment and a Nutrient Export Risk Assessment as part of the Site Management Plan.
7. Unless otherwise demonstrated through site specific studies as described in Clause 8, the Shire of Murray shall consider a proposal likely to pose a significant risk to catchment water quality and likely to be substantially at variance with the objectives and provisions of SPP2.1 and the Peel-Harvey Environmental Protection Policy where the site's soil-landscape unit(s) is not potentially suitable for the proposed annual or perennial horticulture or viticulture as denoted in Table 2, Column 5 (Appendix C).
8. Where on-site soil-landscape conditions vary from the mapped land units shown in Regional-scale soil-landscape unit mapping prepared by DAFWA, then this may be demonstrated through site-specific soil testing and site-specific land capability assessment for the proposed type of horticultural land use. This site-specific testing and assessment shall be included in the Site Management Plan, carried out by an appropriately qualified expert and supported by Department of Agriculture and Food WA. The standards of soil testing and land capability assessment should be generally in accordance with Appendix C, or as otherwise advised by DAFWA.
9. Based on all available evidence, proposals which pose a significant risk to catchment water quality and are very likely to be substantially at variance with the objectives and provisions of SPP2.1 and the Peel-Harvey Environmental Protection Plan should be refused, even in a modified form, with reasons given. Available evidence includes Table 2, Site Management Plan including site specific soil testing and land capability assessment and the advice of DAFWA and other relevant agencies.
10. Due regard shall be given to the 'Other Considerations' listed in Appendix D and any other relevant matters, when assessing all proposals for horticulture.

- 11 Consideration shall be given to the advice of the relevant government departments, including the Department of Agriculture and Food and Department of Water, when making determinations or providing advice or recommendations on horticultural proposals. For example, such advice may include the:
- a. Adequacy of soil testing regimes;
 - b. Review of results and analysis of soil testing and other site testing;
 - c. Likely implications of the proposal on Catchment Water Quality;
 - d. The level of risk posed by the proposal to Catchment Water Quality; and
 - e. Assessment of groundwater availability to the site.
- 12 When determining proposals, the local government may give consideration to imposing conditions, among others, so as to minimise the ongoing risk that the development may pose to catchment water quality, such as:
- a. Placing a finite time limit on the Development Approval;
 - b. Conditioning the ongoing operation of the development on the results of surface and groundwater monitoring.
 - c. Conditioning the ongoing operation of the development on the implementation of contingency measures, as triggered by the results of surface and groundwater monitoring.
- 13 Where an approval or conditional approval is issued, Council should advise the proponent that a further separate approval is required for any proposed changes to the operation of the horticultural development that would increase the risk of nutrient export (from that which was approved).

All Proposals

- 14 All strategic and statutory proposals should give due regard to the impact on existing horticultural enterprises, and should aim to protect potential future horticultural areas with relatively high capability soils.
- 15 Following a review of any relevant technical information or advice provided by a State government agency, where a proposal is likely to compromise the buffer requirements of an established horticultural operation then there should be a presumption against approval of the proposal unless the proponent can satisfactorily demonstrate that the proposal is compatible with the horticultural operation.
- 16 Due regard shall be given to accepted buffer requirements set by government, including:
- i. Guidelines for Separation of Agricultural and Residential Land Uses (Department of Health, 2012);
 - ii. Protection of buffer areas as set out in the Peel Region Scheme Strategic Agricultural Resource Policy.
- 17 In accordance with State Planning Policy 2.5 Land Use Planning in Rural Areas (as amended), where a proposal is likely to compromise the future potential development of rural zoned lands having soils of a relatively high capability for horticultural use, then the local government should aim to protect the potential future use of the land for horticulture or other productive agriculture.

Other issues to consider

- 18 Protection of groundwater and surface waters
- Potential impacts of dam or drain construction (note: Approvals are generally required for dams and drain construction);
 - Storage of hydrocarbons, pesticides and other chemical;
 - Levels of total suspended solids and organics in discharge waters (e.g. hydroponics) or drains/watercourses on the site;
 - Levels of salinity and acidity of discharge waters (e.g. hydroponics).

19 *Stormwater Management*

Management of runoff from hard surfaces and production area and site

20 *Wetlands*

Proposals should comply with State Government policy in regard to:

- protection and management of Conservation Category Wetlands;
- protection and management of Resource Enhancement Wetlands, and
- management of Multiple Use Wetlands (Water and Rivers Commission, 2001) (EPA, 2008b)

21 *Wetland Buffers*

Wetland buffers should be determined in accordance with the Draft Guideline for the Determination of Wetland Buffer Requirements (WAPC, 2005).

22 *Watercourse protection*

- Identification of suitable buffers to watercourses;
- Physical delineation and protection of the buffer area;
- Restoration of vegetated buffers.

23 *Native vegetation and bushland protection*

- Protection of:
 - Peel Regionally Significant Natural Areas;
 - Known location of Declared Rare and listed species of flora and fauna;
 - Threatened Ecological Communities;
 - Priority Ecological Communities;
 - Other significant vegetation and flora;
 - Other habitat for wildlife;
 - Buffers to native vegetation and bushland protection.

24 *Weeds, pests and diseases*

- Compliance with control and management of species listed under the Biosecurity and Agricultural Management Act and Regulations;
- Other weed management;
- Other feral animal management.

25 *Odours/Noise*

- Storage and use of manures.
- Operating hours;
- Types and standards of machinery or motors.

26 *Visual amenity*

- Existing vegetation;
- Proposed revegetation and landscaping.

27 *Management of effluent*

- Workers ablution facilities;
- Effluent treatment systems with nutrient retentive capability.

28 Waste from Production

- Waste products from closed system horticulture must be disposed into an approved facility off-site or if on-site in a manner that does not adversely impact the **Peel-Harvey Coastal Catchment Area** and is approved by regulatory authorities.

29 Transport Impact Assessment

Consider road access standard and property access standards to local roads.

Supporting Documentation

This policy is supported by:

Appendix A	Peel Harvey Catchment Water Quality Improvement Standards and guidance
Appendix B	Table 1 - Indicative risk of horticultural proposals to catchment water quality and soil resources
Appendix C	Table 2 - Suitability of soil-landscape mapping units for annual horticulture, perennial horticulture and viticulture
Appendix D	Guidance on site specific soil testing and land capability assessment for horticulture on the Peel Harvey coastal plan catchment.
Appendix E	Check list for Site Management Plans
Appendix F	References

Administration

Directorate	Officer Title
Planning and Sustainability	Director Planning and Sustainability

Version	Decision to Advertise	Decision to Adopt/Amend	Current Status
1	OCM16/067 – 14/4/2016	OCM16/154 – 14/7/2016	Adopted

Appendix A: Catchment Water Quality Improvement Standards and guidance

A1. Phosphorus - For proposals within the Peel-Harvey Coastal Plain Catchment Area (Figure 1)

Phosphorus application rates

To meet targets for phosphorus reduction established in the Peel-Harvey EPP (EPA, 1992) and supported in SPP2.1, proposals for new horticulture should not apply phosphorus at rates exceeding 6.5 kg P/ha/yr (Kelsey *et al*, 2011) or should demonstrate that the proposal will not result in export phosphorus rates above those presented below.

Phosphorus export rates

The following export rates of phosphorus from the Coastal Catchment Area have been determined by State Government (Kelsey *et al*, 2011) to ensure that catchment targets for phosphorus reduction are met:

- 0.29 kg P/ha/yr for sites in the Serpentine River Subcatchments
- 0.28 kg P/ha/yr for sites in the Murray River Subcatchments
- 0.47 kg P/ha/yr for sites in the Harvey Basin.³

These export rates of phosphorus from the Coastal Catchment Area are end of sub-catchment targets (measured at the end of the sub-catchment). Phosphorus export rates measured at each Site would be higher due to dilution and in-stream losses. However, the actual loss rate that is acceptable will vary depending upon the location of the site taking into account distance to the receiving water body, shape of sub-catchment, slope of the land amongst other factors.

A.2 Phosphorus – For all proposals

All other proposals should demonstrate, through a Site Management Plan including a Nutrient Export Risk Assessment, how the proposal will minimise the application and export of phosphorus from the production area and site.

A3 Nitrogen – For proposals within the Peel-Harvey Coastal Plain Catchment Area (Figure 1)

To meet targets for nitrogen reduction, proposals for new horticulture should not apply nitrogen (in all forms) at rates exceeding 45 kg N/ha/yr or on average not discharge nitrogen at rates above 1.2 mg/L (Total Nitrogen) (Kelsey *et al*, 2011).

A4 Nitrogen – for all proposals

All other proposals should demonstrate, through a Site Management Plan including a Nutrient Export Risk Assessment, how the proposal will minimise the application and export of nitrogen from the production area and site.

³ Based on the river basin phosphorus targets from the Peel-Harvey EPP, and quoted in Kelsey *et al* 2011, page 80

Appendix B - Table 1 Indicative risk of horticultural proposals to catchment water quality and soil resources

Table 1 presents the indicative potential suitability of various general types of horticulture on the major soil-landscape systems of the Peel-Harvey Coastal Catchment. More specific advice, applicable to individual land units, is provided in Table 2 (Appendix C). The tables have been prepared with advice from the Department of Agriculture and Food. The codes used in the tables for each System and land unit (e.g. 213Fo for the Forrestfield System) are unique identifiers used in DAFWA land capability maps and databases.

Table 1: Indicative potential suitability of soil-landscape systems for horticulture, based on nutrient export risk and capability assessment

Soil Landscape Systems	Overall Nutrient export risk	Suitability for horticulture		
		Annual e.g. vegetable gardens, turf farms, flowers, seedling nurseries	Perennial e.g. citrus, orchards, table grapes, other fruits and high yielding	Viticulture - e.g. wine grapes, low yield olives,
The Forrestfield System (213Fo) consists of undulating foot slopes of the Darling Scarp on colluvium over granitic and sedimentary rocks in the eastern margin of the Swan Coastal Plain.	Moderate	Potentially suitable		
	Very high along streams and poorly drained areas			
The Pinjarra System (213Pj) is a poorly-drained coastal plain on alluvium over sedimentary rocks.	Moderate on better drained sandy duplex soils; and deep loams and clays on river terraces.	Potentially suitable away from low lying areas and deep bleached sands.	Potentially suitable	
	Very high on deep bleached sands, and poorly drained soils	(Note: Many elevated areas within the Pinjarra System are associated with deep bleached Bassendean sands.		

Soil Landscape Systems	Overall Nutrient export risk	Suitability for horticulture			
		Annual e.g. vegetable gardens, turf farms, flowers, seedling nurseries	Perennial e.g. citrus, orchards, table grapes, other fruits and high yielding	Viticulture - e.g. wine grapes, low yield olives;	Closed system horticulture and nurseries (potted plants) ³
The Bassendean System (212Bs) is sand dunes and sand plains with flats and swamps on sandy alluvium over sedimentary rocks.	Very high on deep bleached sands, very small areas of yellow sands with moderate risk.	Not suitable due to nutrient export risk			Potentially suitable
The Vasse System (211Va) is poorly drained estuarine flats and swampy depressions of the Swan Coastal Plain.	Very high	Not suitable due to risk of flooding (tidal), waterlogging and nutrient export risk			Not suitable due to risk of flooding (tidal)
The Spearwood System (211Sp) is sand dunes and plains on windblown sand and limestone over sedimentary rocks in the western edge of the Swan Coastal Plain.	Moderate on yellow/brown sands and duplex soils,	Potentially suitable			Potentially suitable
	Very high on deep bleached sands				
The Quindalup System (2111Qu) is coastal dunes with sand flats on wind-blown sand over sedimentary rocks on the western margin of the Swan Coastal Plain.	Moderate	Generally not suitable.			Not suitable due to wind exposure.
		May have native vegetation remnants. Risk of wind erosion also needs to be considered.			

Appendix C: Table 2 - Suitability of soil-landscape mapping units for annual horticulture, perennial horticulture and viticulture

Table 2 provides summary advice from the Department of Agriculture and Food WA of the potential suitability of mapped soil-landscapes within the Peel-Harvey Coastal Catchment for in-ground horticulture (Column 5). Mapping of soil-landscape units is available from Peel Harvey Catchment Council website at <http://www.peel-harvey.org.au>. The advice is based on two major assessments:

- The risk of phosphorus export from the soil-landscape unit (Column 3); and
- The land capability class rating of the soil-landscape unit for annual horticulture (A), perennial horticulture (P) and vines (V) (Column 4). Land capability refers to the ability of land unit to support a type of land use without causing damage (Austin and Cocks, 1978).

Land capability class ratings (Column 4) are denoted in Table 2 using the following symbols: A1 A2, B1, B2, C1 OR C2. These symbols represent the following:

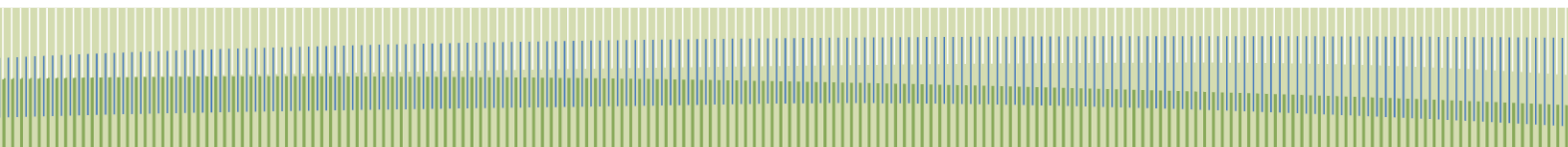
- A1 More than 70% of the unit has high capability land (class 1 and 2);
- A2 50-69% of the unit has high capability land (class 1 and 2);
- B1 More than 70% of the unit has moderate or high capability land (Class 1, 2 or 3);
- B2 50-69% of the unit has moderate or high capability land (Class 1, 2 or 3);
- C1 50-69% of the unit has low capability land (class 4 and 5);
- C2 More than 70% of the unit has low capability land (class 4 and 5).

Further information on land capability assessment and land capacity classes is provided in the Technical Notes which accompany this policy.

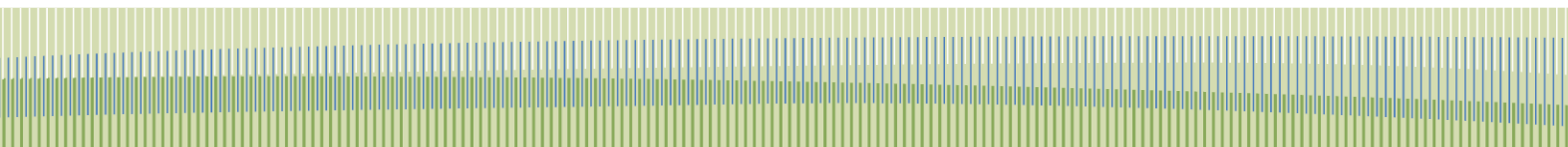
Note: Land capability ratings are designed for broad-scale map units in which proximity to waterways has not been considered. Any on-site assessment should consider this.

Column 1	Column 2	Column 3	Column 4			Column 5
	Soil-landscape mapping unit	Greater than 50% of the map unit classed as a High Very High or Extreme risk of phosphorous export.	Capability Class Rating for In-ground Horticulture			Is the map unit potentially suitable for in-ground horticulture?
Map Unit Symbol	Map Unit Description		Annual	Perennial	Vine	A = Annual
			(A)	(P)	(V)	P= Perennial V = Vine
<p>The Forrestfield System (213Fo) consists of undulating foot slopes of the Darling Scarp on colluvium over granitic and sedimentary rocks in the eastern margin of the Swan Coastal Plain. Soils include duplex sandy gravels, pale deep sands and grey deep sandy duplexes. Native vegetation is jarrah-marri forest and woodland.</p>						
F 1a	1-15% lower slopes with well drained shallow to moderately deep, very gravelly acidic yellow duplex soils and common laterite.	No	B2	B2	B2	Yes APV
F 1b	1-15% lower slopes with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	No	B1	B1	B1	Yes APV
F1c	1-15% lower slopes with well drained deep uniform yellowish brown sands which are generally free of laterite or gravel.	No	B1	A2	A2	Yes APV
F2a	Low slopes and foot slopes up to 5-10% with well drained shallow to moderately deep, very gravelly acidic yellow duplex soils and common laterite.	No	B1	B2	B2	Yes APV

F2b	Low slopes and foot slopes up to 5-10% with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.	No	A2	A2	AS	Yes APV
F2c	Low slopes and foot slopes up to 5-10% slopes with well drained deep uniform yellowish brown sands which are generally free of laterite or gravel.	No	B1	A1	A1	Yes APV
F4	Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	Yes	C1	C1	C2	No
F5	Poorly defined stream channels on lowest slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	Yes	C2	C2	C2	No
F3	1-3% foot slopes with deep, imperfectly drained yellow and, less commonly, acidic gley duplex soils.	No	B1	B2	B1	Yes APV



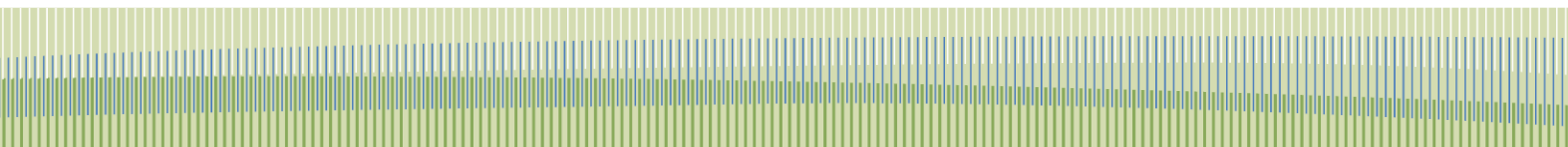
Ff1	Foot and low slopes < 10% with deep rapidly drained siliceous yellow brown sands, and pale or bleached sands with yellow-brown subsoil. Shrubland of unidentified species.	No	B1	A2	A1	yes APV
Ff10	Alluvial fans on lower slopes <5-10% with variable poorly drained soils.	Yes	C1	C1	C1	No
Ff2	Foot and low slopes < 10%. Well drained gravelly yellow or brown duplex soils with sandy topsoil. Woodland of <i>E.marginata</i> , <i>E. calophylla</i> and some <i>B.grandis</i> .	No	B1	A2	A2	Yes APV
Ff3	Foot and low slopes <10%. Well drained gravelly yellow or red duplex soils with sandy loam to loam topsoil. Woodland of <i>E. wandoo</i> and <i>E. marginata</i> .	No	B1	A2	A2	Yes APV
Ff7	Alluvial fans on slopes <5-10%. Variable, imperfectly drained soils comprising layers of sand, sandy loam, clay, grit and weathered granitic detritus. Low woodland of <i>E. calophylla</i> , <i>Banksia attenuata</i> and <i>B. grandis</i> and some <i>Casuarina</i> spp.	Yes	C1	C2	C1	No



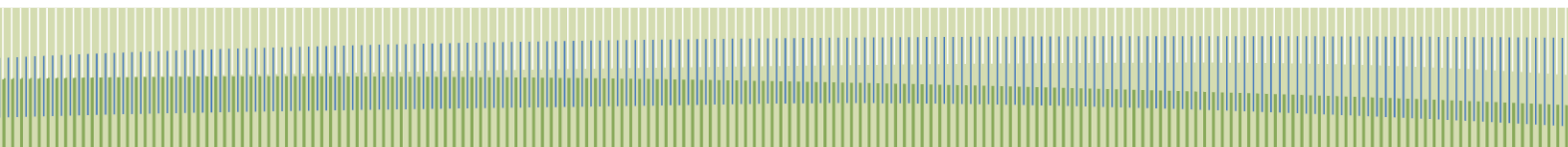
Ff9	Seepage areas and non-incised drainage channels on foot slopes <3% with poorly drained bleached grey sands over an iron-organic hardpan.	Yes	B2	C2	B2	No
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The Pinjarra System (213Pj) is a poorly-drained coastal plain on alluvium over sedimentary rocks. Soils include semi-wet soils, grey deep sandy duplexes, brown loamy earths, pale sands and clays. Native vegetation is mainly jarrah-marri-wandoo-paperbark forest and woodland

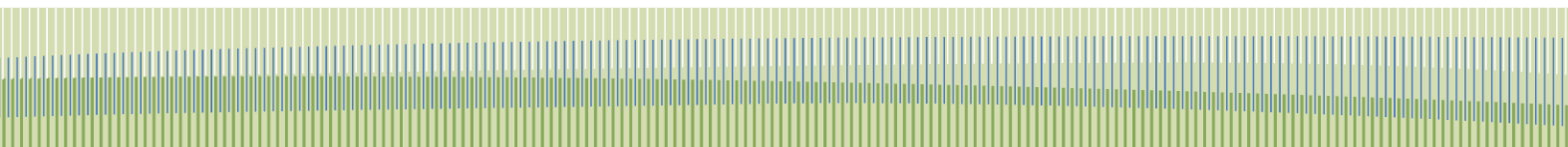
B1	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	Yes	B1	B1	B1	No
B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1- 2 m.	Yes	B1	B1	B1	No
B2a	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.	No	B1	A1	A1	Yes APV



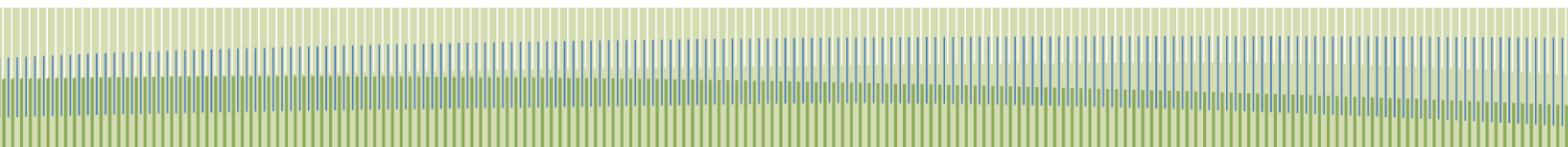
B3	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.	Yes	C2	C2	C2	No
B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	Yes	C2	C2	C2	No
B6	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	Yes	C2	C2	C2	No
P1a	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or “effective duplex”) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and generally not susceptible to salinity.	No	B2	C2	C1	Yes A
P1b	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or “effective duplex”) soils. Moderately deep pale sand to loamy sand over clay; imperfectly drained and moderately susceptible to salinity in limited areas.	No	B2	C2	B2	Yes for AV



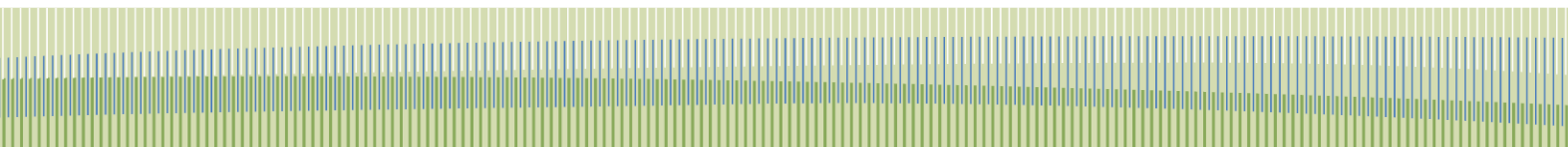
P1c	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or “effective duplex”) soils. Deep pale brown to yellowish sand to sandy loam over clay; imperfectly drained and moderately susceptible to salinity in limited areas.	No	B1	C2	B1	yes for AV
P1d	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or “effective duplex”) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and moderately susceptible to salinity.	No	C2	C2	C2	No
P1e	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or “effective duplex”) soils. Shallow pale sand to sandy loam over very gravelly clay; moderately well drained.	No	B1	B2	B1	Yes for APV
P2	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.	No	C2	C2	C2	No
P2a	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam with a silcrete hardpan at 50-100 cm depth generally on top of an olive-grey clay.	No	C2	C2	C2	No



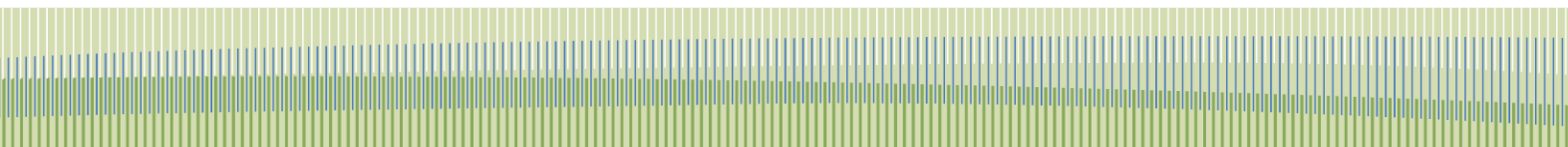
P3	Flat to very gently undulating plain with deep, imperfect to poorly drained acidic gradational yellow or grey-brown earths and mottled yellow duplex soils, with loam to clay loam surface horizons.	No	C2	C2	C2	No
P4	Poorly drained flats, sometimes with gilgai microrelief and with moderately deep to deep black, olive grey and some yellowish brown cracking clays and less commonly non-cracking friable clays with generally acidic subsoils.	No	C2	C2	C2	No
P4a	Poorly drained flats. Cracking clays similar to P4 with a thin veneer of grey sand.	No	C2	C2	C2	No
P5	Poorly drained flats, commonly with gilgai microrelief and with deep black-grey to olive-brown cracking clays with subsoils becoming alkaline.	No	C2	C2	C2	No
P5a	Poorly drained flats. Cracking clays similar to P5 with a thin veneer of grey sand.	No	C2	C2	C2	No
P7	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley sandy duplex and effective duplex soils.	Yes	C2	C2	C2	No



P7a	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley duplex soils becoming alkaline with depth.	Yes	C2	C2	C2	No
P7b	Seasonally inundated swamps and depressions or seepage areas near the base of the foothills with very poorly drained deep bleached siliceous sands.	Yes	C2	C2	C2	No
P8	Broad poorly drained flats and poorly defined stream channels with moderately deep to deep sands over mottled clays; acidic or less commonly alkaline grey and yellow duplex soils to uniform bleached or pale brown sands over clay.	No	C2	C2	C2	No
P9	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.	Yes	C2	C2	C2	No
P9a	Generally shallow incised stream channels of minor creeks and rivers with poorly drained deep mottled yellow duplex soils, becoming alkaline with depth.	Yes	C2	C2	C2	No
SW2	Low level, occasionally flooded, alluvial terraces with imperfectly drained variable alluvial soils with loamy surfaces.	Yes	C2	C2	C2	No



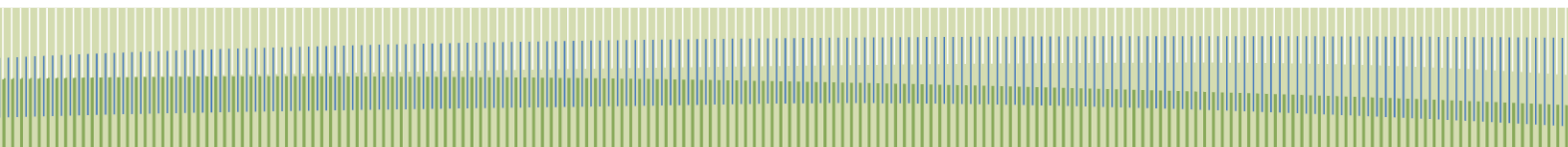
P11	Shallow brown loamy soils or less commonly, very shallow sands over ironstone pavement which is a clear barrier to drainage.	No	C2	C2	C2	No
P11a	Shallow sand to sandy loam over lateritic material; imperfect to moderately well-drained.	No	C1	C2	C1	No
SWP10	Gently undulating to flat terraces adjacent to major rivers, but below the general level of the plain, with deep well drained uniform brownish sands or loams subject to periodic flooding.	No	B2	B1	A2	Yes APV
jSWP10	Flat terraces adjacent to major rivers with deep black cracking clays with alkaline subsoils; soils similar to P5.	Yes	C2	C2	C2	No
SWP6a	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with major current river systems and larger streams. Acidic red and yellow duplex soils, less common	No	A1	B1	A1	Yes APV
jSWP6b	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with prior stream deposits. Soils are uniform brownish sands.	No	B1	B1	A1	Yes APV



2SWP6c	Very gently undulating, alluvial terraces and fans. Moderate to moderately well- drained uniform friable brown loams, orwell- structured gradational brown earths.	No	A1	B1	A2	Yes APV
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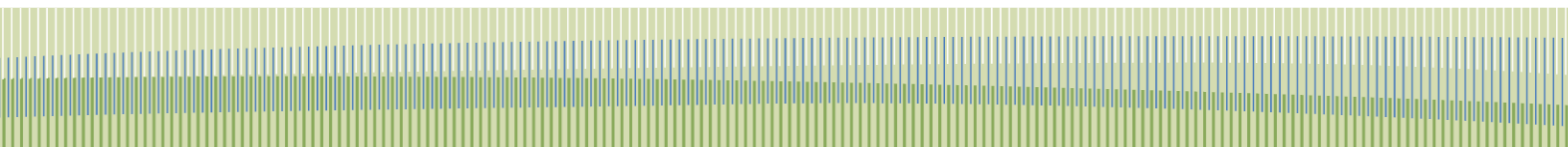
The Bassendean System (212Bs) is sand dunes and sand plains with flats and swamps on sandy alluvium over sedimentary rocks. Soils include pale deep sand, semi-wet soil and wet soil. These soils have low fertility and are susceptible to leaching. In the Peel, these soils may become waterlogged because of high groundwater levels and may become flooded in some areas. Native vegetation is mainly banksia- paperbark woodlands and mixed heaths.

B1	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	Yes	B1	B1	B1	No
B1a	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	No	B1	B1	A1	Yes APV
B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1- 2 m.	Yes	B1	B1	B1	No

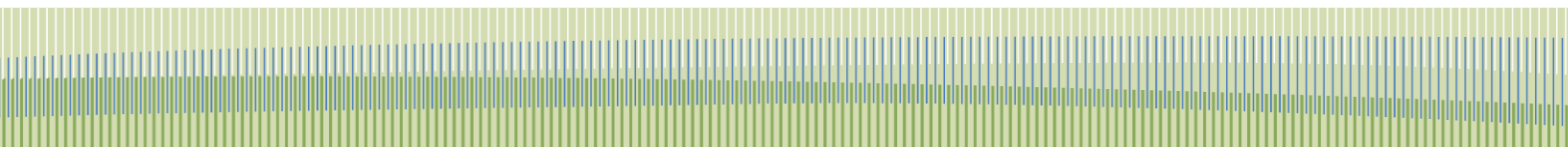


B2a	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.	No	B1	A1	A1	Yes APV
B3	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.	Yes	C2	C2	C2	No
B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	Yes	C2	C2	C2	No
B5	Shallowly incised stream channels of minor creeks and rivers with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	Yes	C2	C2	C2	No
B6	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	Yes	C2	C2	C2	No

The Vasse System (211Va) is poorly drained estuarine flats and swampy depressions of the Swan Coastal Plain. Soils include tidal flat soil, saline wet soil and pale deep sand. Native vegetation includes samphire, sedges and paperbark woodland.



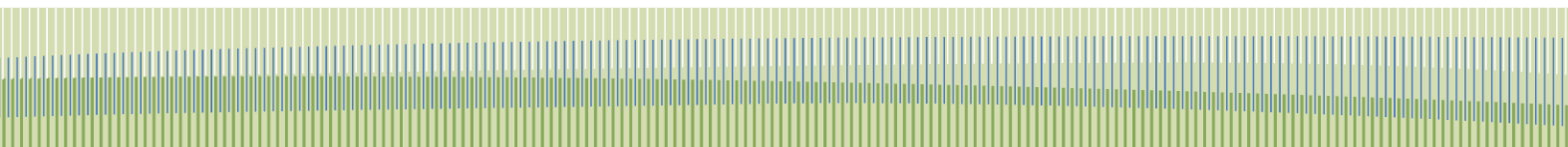
V1	Saline tidal flats composed of grey, black and brown foetid muds and humic sandy clays with locally common shell and limestone fragments.	Yes	C2	C2	C2	No
V2	Samphire covered sand and mud flats marginally higher than V1 and frequently inundated; with deep alkaline alluvial sands and clayey sands.	Yes	C2	C2	C2	No
V3	Sand flats marginally higher than V2. Frequently inundated; with deep alkaline alluvial sands and clayey sands, commonly supporting stands of <i>Melaleuca</i> spp.	Yes	C2	C2	C2	No
V4	Low level storm beach ridges and terraces with shallow to moderately deep uniform alkaline black sandy loams to loams overlying unconsolidated shell beds or clayey marl.	No	C1	C2	C2	No
V5	Upper level sandy terrace and gently undulating beach ridges with shallow to moderately deep grey siliceous sands overlying soft shelly limestone or shell beds.	No	B2	A2	A2	Yes APV



V6	Upper level sandy terrace and gently undulating beach ridges with deep grey or bleached pale brown siliceous sands overlying soft shelly limestone.	Yes	C2	C2	C2	No
V6a	Gently undulating beach ridges similar to V6, but formed from reworked Pleistocene Bassendean sands. Deep bleached grey acidic siliceous sands with iron-organic hardpan.	Yes	C1	C2	C2	No
V7	Very broad shallow depression with deep, poorly drained, fine textured alkaline estuarine alluvium.	Yes	C2	C2	C2	No
V8	Flat poorly drained plains forming the margins of the estuarine deposits which border and partially overlie the Pinjarra Plain with variable, moderately deep to deep saline soils. Commonly, these are mottled yellow duplex soils over calcar	Yes	C2	C2	C2	No
V9	Areas of former swamps which have been artificially drained, with uniform loamy or peaty sands.	Yes	C2	C2	C2	No

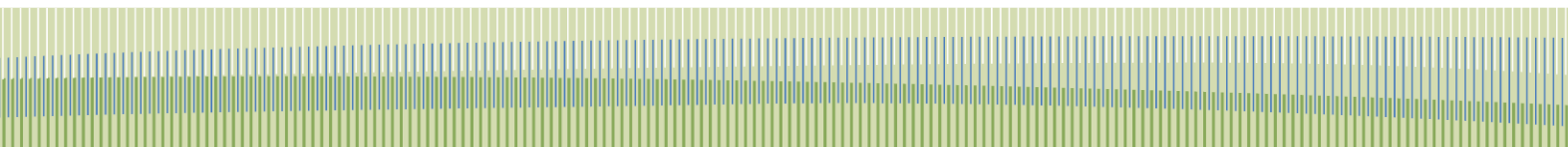
The Spearwood System (211Sp) is sand dunes and plains on windblown sand and limestone over sedimentary rocks in the western edge of the Swan Coastal Plain. Soils include yellow deep sands, pale deep sands and yellow/brown shallow sands. Native vegetation includes tuart-marri forest and woodland in south changing to heath and open woodland in north.

S1a	Dune ridges with shallow to moderately deep siliceous yellow-brown sands, very common limestone outcrop and slopes up to 15%.	Yes	C2	B2	C2	No
S1b	Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%.	No	B1	A2	A1	Yes APV
S1c	Dune ridges with deep bleached grey sands with yellow-brown subsoils, and slopes up to 15%.	No	B1	B1	A2	Yes APV
S1d	Dune ridges with moderately deep to very deep siliceous yellow-brown sands, rare limestone outcrop and slopes 3-20% occurring on the eastern slip face.	Yes	C2	B1	C2	No
S2a	Lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop.	No	B1	A2	A1	Yes APV
S2b	Lower slopes (1-5%) of dune ridge with shallow to deep siliceous yellow-brown sands and common limestone outcrop.	No	B1	B1	A1	Yes APV
S2c	Lower slopes (1-5%) of dune ridge with bleached or pale sands with a yellow-brown or pale brown subsoil (like S1c). Usually occurs on the eastern edge of the Spearwood Dunes.	No	B1	A1	A1	Yes APV



S3	Inter-dunal swales and depressions with gently inclined side slopes and deep rapidly drained siliceous yellow-brown sands.	No	A1	A1	A1	Yes APV
S4a	Flat to gently undulating sandplain with deep, pale and sometimes bleached, sands with yellow-brown subsoils.	No	B1	A2	A1	Yes APV
S4b	Flat to gently undulating sandplain with shallow to moderately deep siliceous yellow-brown and grey-brown sands with minor limestone outcrop.	No	B1	B1	A1	Yes APV
S4c	Flat to gently undulating sandplain with deep, yellow-brown or dark brown siliceous sands that are seasonally inundated.	Yes	C2	C2	C2	No
S6	Flat stony plain with poorly drained shallow siliceous sands and large areas of bare limestone pavement.	No	C2	C2	C2	No
<p>The Quindalup System (2111Qu) is coastal dunes with sand flats on wind-blown sand over sedimentary rocks on the western margin of the Swan Coastal Plain. Soils are mainly calcareous sands with native vegetation of mixed coastal scrub.</p>						
Qf2	Relict fore dunes and gently undulating beach ridge plain with deep uniform calcareous sands.	No	B1	B1	B1	Yes APV

Qp1	Complex of nested low relief parabolic dunes with moderate to steep slopes and uniform calcareous sands showing variable depths of surface darkening.	No	C1	B2	C1	Yes P
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Appendix D: Guidance on site specific soil testing and land capability assessment for horticulture on the Peel-Harvey coastal plain catchment

The following guidelines have been developed by the Department of Agriculture and Food specifically for on-site assessment of annual or perennial horticulture on the Peel-Harvey Coastal Plain. If you have queries regarding this guidance please contact Department of Agriculture and Food.

Soil sampling, survey and land capability assessment undertaken as a requirement of this policy need to adhere to the following published guidelines:

Soil survey and characterisation

McKenzie NJ, Grundy, MJ, Webster, R and Ringrose-Voase AJ 2008 *Guidelines for Surveying Soil and Land Resources* Second Edition Australian Soil and Land Survey Handbooks Series 2 CSIRO Publishing

National Committee on Soil and Terrain 2009 *Australian Soil and Land Survey Field Handbook* Third edition Australian Soil and Land Survey Handbooks Series 1 CSIRO Publishing; specifically Soil profile (RC McDonald and RF Isbell)

Soil analysis

Rayment, GE and Lyons DJ 2010 *Soil Chemical Methods - Australasia* Australian Soil and Land Survey Handbooks Series CSIRO Publishing

Allen, DG and Jeffery, RC 1990 *Methods for analysis of phosphorus in Western Australian soils*. Report of investigation No:37. Chemistry Centre of Western Australia.

Soil type description and land capability

Isbell, R 2002 *The Australian Soil Classification* Revised Edition Australian Soil and Land Survey Handbooks Series 4

Schoknecht N and Pathan S 2013 *Soil Groups of Western Australia A simple guide to the main soils of Western Australia* Fourth edition Resource Management Technical Report 380 Department of Agriculture and Food. Western Australia

Van Gool, D, Tille P and G Moore 2005 *Land evaluation standards for land resource mapping* Third edition Resource Management Technical Report 298 Department of Agriculture and Food

Minimum requirements

- Grid survey, free or transverse survey at scale of 1:10 000
- Observations in the range of 1 per ha to a minimum of 0.25 per ha.
- On deep sands profiles, observations to extend to at least 100 cm (or to impeding layers if less than 100cm)
- Detailed profile descriptions and sampling of each main soil type at a minimum one site per 10 ha
- GPS coordinates of soil profiles and soil sampling sites or sites located on aerial photo base image
- Detailed soil profiles described to at least 100 cm (or to impeding layers if less than 100cm)
- Description of impeding layer if present
- Horizons depths recorded and for each horizon:
 - Soil colour (Munsell colour chart) main colours and mottles
 - Soil texture
 - Soil structure (if described from soil pit)

- Information on soil samples collected for analysis: sampling depths and type of analysis
- Main soil types identified and classified to WA soil group (plus Australian Soil Classification is preferred)
- The above should be included in a report (e.g. Site Management Plan) and descriptions included in Appendix
- Map of main soil types, preferably marked on aerial photo background, scale and north needs to accompany report; map should also identify area that is to be developed for horticulture. This map should show location of nearest surface drains creeks and waterways
- The depth to groundwater in winter needs to be assessed. This is difficult if studies are undertaken in summer and may require subsequent information to be provided by proponent if not available. The levels and dates of measurement need to be included in the Site Management Report.

Soil testing

Analysis for soil pH 1:5 Calcium chloride, salinity (EC 1:5), total phosphorus and soil PRI should be undertaken by an accredited laboratory.

The most important aspect for soil phosphorus (P) retention is the Phosphorus Retention Index (PRI) as described by Allen and Jeffery (1990)

Allen, DG and Jeffery, RC 1990 Methods for analysis of phosphorus in Western Australian soils. Report of investigation No:37. Chemistry Centre of Western Australia.

It is also important to interpretation of results of soil PRI against relevant experimental data for horticultural crops on the Swan coastal plain.

Dellar GA, Eales M, McPharlin IR, Delroy ND, and Jeffery RC (1990) Phosphorus retention of sandy horticultural soils on the Swan Coastal Plain Journal of Agriculture Western Australia 4 ser. V31(1) 28-

Dellar et al (1990) has evaluated existing horticultural sites on sandy soils and assessed the P leaching with respect to the PRI. All of the P was retained in the top metre of soil from 25 years of horticultural operations in a soil with a PRI of 7. Based on this, a target PRI of 10 in the top 100 centimetres of the soil profile would retain P for at least this period of time.

This could be achieved by a shallower depth of higher PRI but the minimum depth of the high PRI soil should be greater than the usual operational tillage depth or 30cm. Note that this pertains to predominantly sandy soils and relies on their permeability to make contact with the subsoil and the water table must be greater than 1 metre.

Qualifications of consultant

The report should outline the experience and background of the consultant in soil survey and land capability assessment. A Certified Professional Soil Scientist or Fertcare Accredited Advisor is preferred.

Appendix E: Checklist for Site Management Plans



The following provides a checklist of the type of information that should be included within a Site Management Plan. Not all information may be required for all proposals. The checklist is not intended to be used as the format/structure of the Site Management Plan. It is intended to list the type of information that are used by government to assess development applications.

Information should be provided in map form where appropriate

Site conditions	<ul style="list-style-type: none"> • Soil types and mapping of soil types <ul style="list-style-type: none"> - Nutrient retaining capacity of soils - Other soil capability issues • Site-specific land capability assessment • Location of vegetation, watercourses and wetlands • Depth to groundwater • Existing structures and fences
Crop and cultivation details	<ul style="list-style-type: none"> • Location and size of production area • Future stages of development • Types of crops • Cultivation system • Physical barriers to soil (plastics)
Nutrient inputs and management	<ul style="list-style-type: none"> • Fertiliser regimes – rate and frequency • Total nutrient input calculation • Nutrient content of fertiliser • Application method • Nutrient monitoring – soil and water • Crop nutrient monitoring
Irrigation management	<ul style="list-style-type: none"> • Type of irrigation • Water source • Irrigation control and monitoring
Nutrient Export Risk Assessment	<ul style="list-style-type: none"> • As per Appendix A of the local planning policy
Nutrient reduction strategies	<ul style="list-style-type: none"> • Production area design and establishment • Soil amendment • Soil ameliorants • Type of fertiliser – controlled release fertilisers • Crop monitoring and testing • Soil condition monitoring • Fertiliser application methods • Type of irrigation methods • Cultivation methods • Physical barriers • Vegetative barriers
Details of any other nutrient reduction strategies	e.g. Where not addressed above: Offset plantings
Site Drainage	<ul style="list-style-type: none"> • Drainage of the buildings and worksite need to show a separation of rainfall and clean runoff from potentially contaminated areas and growing area (to avoid potential spillages/contamination entering stormwater runoff).
Information to address other considerations	<ul style="list-style-type: none"> • See Other Considerations under Policy

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