



**Biodiversity and
Conservation Science**

Methods for survey and identification of Western Australian threatened ecological communities



Species and Communities Program

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Department of **Biodiversity,
Conservation and Attractions**

Methods for Identifying Western Australian Threatened Ecological Communities

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	Name of community	Summary Description	Key references	Key characteristics	Methods of identification
Aquatic and subterranean					
1	Aquatic Root Mat Community Number 1 of Caves of the Leeuwin-Naturaliste Ridge (Easter and Jewel Caves)	The community occurs in the cave system of the Leeuwin-Naturaliste Ridge incorporating Easter and Jewel Caves. It comprises a complete food web. Rootlets and their associated microflora provide the primary food source, and root mat grazers, predators, parasites, detritivores and scavengers complete the interactions. The root mats are produced by <i>Eucalyptus diversicolor</i> (karri). Aquatic cavernicoles (cave animals) in the community include <i>Cherax preissii</i> (koonacs), other crustaceans, mites, rotifers, microscopic worms, tardigrades and insects. The copepod <i>Diacyclops humphreysi</i> n. ssp. Karanovic in prep., and the ostracod <i>Acondona admiratio</i> Karanovic 2003 are specific to Jewel and Easter Caves. The community was originally described in Jasinska E.J. (1997) "Faunae of aquatic root mats in caves of southwestern Australia: origins and ecology" (unpublished doctoral dissertation, University of Western Australia).	Department of Environment and Conservation (2008). Interim Recovery Plan 2008-2013 for the 'Aquatic root mat communities numbers 1 to 4 of caves of the Leeuwin-Naturaliste Ridge'. Interim Recovery Plan No. 281 Department of Environment and Conservation, Perth. Eberhard, S. (2004). Ecology and hydrology of a threatened groundwater-dependant ecosystem: The Jewel Cave Karst System in Western Australia. Unpublished PhD Thesis, Murdoch University, Western Australia. Jasinska E. J. J. (1997). Faunae of aquatic root mats in caves of southwestern Australia: origins and ecology. Unpublished PhD Thesis submitted to the Zoology Department, University of Western Australia.	A key characteristic is habitat of pools or permanently damp areas in cave habitats on Leeuwin-Naturaliste Ridge (Easter and Jewel Caves). Comprises a distinctive suite of aquatic fauna, some of which are restricted to particular caves.	Sample and report on cave fauna using methods described in EPA (2021) and key references. Describe habitat including hydrological status. Compare habitat and cave fauna to summary description and descriptions in key references.
2	Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	The community occurs in caves at sites that include Yanchep National Park and surrounds. It comprises root mats of <i>Eucalyptus gomphocephala</i> (tuart) supported by groundwater fed streams and pools that occur in the caves. The root mats support a highly diverse and distinctive assemblage of cave fauna including the critically endangered Crystal Cave Crangonyctoid <i>Hurleya</i> sp. (amphipod).	Department of Conservation and Land Management (2003). Aquatic Root Mat Community of Caves of the Swan Coastal Plain, and the Crystal Cave Crangonyctoid Interim Recovery Plan 2003-2008. No. 117. Department of Conservation and Land Management, Perth. Knott, B., Storey, A.W. & Tang, D. (2008). Yanchep Cave streams and East Gngara (Lexia) – Egerton Spring & Edgecombe Spring: Invertebrate Monitoring. Unpublished report prepared for the Department of Water by School	A key characteristic is a habitat of pools or permanently damp areas in cave habitats in the Yanchep area. Comprises a distinctive suite of cave fauna.	Sample and report on cave fauna using methods described in EPA (2021) and key references. Describe habitat including hydrological status. Compare habitat and cave fauna to summary description and description in key references

			<p>of Animal Biology, the University of Western Australia. April 2008.</p> <p>Knott, B., Storey, A.W. & Tang, D. (2008). Yanchep Cave streams and East 3Gnangara (Lexia) – Egerton Spring & E4dgecombe Spring: Invertebrate Monitoring. Unpublished report prepared for the Department of Water by School of Animal Biology, the University of Western Australia. April 2008</p>		
3	<p>Aquatic Root Mat Community Number 2 of Caves of the Leeuwin-Naturaliste Ridge (Strong's Cave)</p>	<p>The community occurs in the cave system of the Leeuwin-Naturaliste Ridge incorporating Strong's Cave. It comprises a complete food web. Rootlets and their associated microflora provide the primary food source, and root mat grazers, predators, parasites, detritivores, and scavengers complete the interactions. The root mats are produced by <i>Eucalyptus diversicolor</i> (karri). Aquatic cavernicoles (cave animals) in the community include <i>Cherax preissii</i> (koonacs), other crustaceans, mites, rotifers, microscopic worms, tardigrades and insects. The ologochaete <i>Phreodrilidae</i> spp. indet., the copepod Harpacticoida Family indet., the syncarid Parabathynellidae indet., and the turbellarian <i>Stenostomum</i> sp. 3 (cf. Jasinska E.J. (1997)) are specific to Strong's Cave. The community was originally described in Jasinska E.J. (1997) "Fauna of aquatic root mats in caves of southwestern Australia: origins and ecology" (unpublished doctoral dissertation, University of Western Australia).</p>	<p>Department of Environment and Conservation (2008). Interim Recovery Plan 2008-2013 for the 'Aquatic root mat communities numbers 1 to 4 of caves of the Leeuwin-Naturaliste Ridge'. Interim Recovery Plan No. 281 Department of Environment and Conservation, Perth.</p> <p>Eberhard, S. (2004). Ecology and hydrology of a threatened groundwater-dependant ecosystem: The Jewel Cave Karst System in Western Australia. Unpublished PhD Thesis, Murdoch University, Western Australia.</p> <p>Jasinska E. J. J. (1997). Fauna of aquatic root mats in caves of southwestern Australia: origins and ecology. Unpublished PhD Thesis submitted to the Zoology Department, University of Western Australia.</p>	<p>A key characteristic is a habitat of pools or permanently damp areas in cave habitats on Leeuwin-Naturaliste Ridge (Strong's Cave). Comprises a suite of aquatic fauna, some of which are restricted to particular caves.</p>	<p>Sample and report on cave fauna using methods described in EPA (2021) and key references.</p> <p>Describe habitat including hydrological status.</p> <p>Compare habitat and cave fauna to summary description, and description in key references</p>
4	<p>Aquatic Root Mat Community Number 3 of Caves of the Leeuwin-Naturaliste Ridge (Kudjal Yolgah and Budjur Mar Caves)</p>	<p>The community occurs in the cave system of the Leeuwin-Naturaliste Ridge incorporating Kudjal Yolgah and Budjur Mar Caves. It comprises a complete food web. Rootlets and their associated microflora provide the primary food source, and root mat grazers, predators, parasites, detritivores and scavengers complete the interactions. The root mats are produced by <i>Eucalyptus diversicolor</i> (karri) and <i>Agonis flexuosa</i> (peppermint). Aquatic cavernicoles (cave animals) in the community include <i>Cherax</i></p>	<p>Department of Environment and Conservation (2008). Interim Recovery Plan 2008-2013 for the 'Aquatic root mat communities numbers 1 to 4 of caves of the Leeuwin-Naturaliste Ridge'. Interim Recovery Plan No. 281 Department of Environment and Conservation, Perth.</p> <p>Eberhard, S. (2004). Ecology and hydrology of a threatened groundwater-dependant</p>	<p>A key characteristic is a habitat of pools or permanently damp areas in cave habitats on Leeuwin-Naturaliste Ridge (Kudjal Yolgah and Budjur Mar Caves). Comprises a suite of aquatic fauna, some of which are restricted to particular caves.</p>	<p>Sample and report on cave fauna using methods described in EPA (2021) and key references.</p> <p>Describe habitat including hydrological status.</p> <p>Compare habitat and cave fauna to summary description,</p>

		<p><i>preissii</i> (koonacs), other crustaceans, mites, rotifers, microscopic worms, tardigrades and insects. The Acarina, Oribatida sp. 6 (cf. Jasinska E.J. (1997)), the oligochaetes <i>Aeolosoma</i> sp., Enchytraeidae sp. 5, Enchytraeidae sp. 6, <i>Antarctodrilus micros</i> 5Pinder and Brinkhurst, <i>Pristina longiseta</i> Ehrenberg, sensu lato, <i>Pristina aequiseta</i> Bourne, <i>Pristina</i> WA4 sp. n. Tubificidae WA12 sp. n. ?, the copepod '<i>Kudjalmoraria nana</i>' n.g., n.sp. Karanovic in prep., the syncarid Bathynellacea Family indet., the coleopteran Helodidae sp. indet., the turbellarian <i>Alloeocoela</i> sp. 1 (cf. Jasinska E.J. (1997)) and Tricladida spp. indet. are specific to Kudjal Yolgah Cave. The community was originally described in Jasinska E.J. (1997) "Faunae of aquatic root mats in caves of southwestern Australia: origins and ecology" (unpublished doctoral dissertation, University of Western Australia).</p>	<p>ecosystem: The Jewel Cave Karst System in Western Australia. Unpublished PhD Thesis, Murdoch University, Western Australia.</p> <p>Jasinska E. J. J. (1997). Faunae of aquatic root mats in caves of southwestern Australia: origins and ecology. Unpublished PhD Thesis submitted to the Zoology Department, University of Western Australia.</p>		<p>and description in key references</p>
5	<p>Aquatic Root Mat Community Number 4 of Caves of the Leeuwin-Naturaliste Ridge (Calgardup Cave)</p>	<p>The community occurs in the cave system of the Leeuwin-Naturaliste Ridge incorporating Calgardup Cave. It comprises a complete food web. Rootlets and their associated microflora provide the primary food source, and root mat grazers, predators, parasites, detritivores and scavengers complete the interactions. The root mats are produced by <i>Corymbia calophylla</i> (marri). Aquatic cavernicoles (cave animals) in the community include <i>Cherax preissii</i> (koonacs), other crustaceans (<i>Perithia acutitelson</i>, <i>Microcyclops</i>, <i>Paracyclops</i>, <i>Parastenocaris</i>, <i>Harpacticoida</i>, <i>Oniscoida</i>, <i>Bathynellacea</i>), meiobenthic mites (<i>Soldanellonyx monardi</i> and <i>Oribatida</i>), non-biting midges (<i>Chironomus</i> aff. <i>alternans</i> Walker, <i>Polypedilum</i> sp.), rotifers (<i>Rotifera</i>), microscopic worms (<i>Enchytraeidae</i>, <i>Phraeodrilidae</i>, <i>Insulodrilus</i> sp., <i>Stenostomum</i> sp.) and predatory coleoptera (<i>Helodidae</i>). The community was originally described in Jasinska (1997) "Faunae of aquatic root mats in caves of southwestern Australia: origins and ecology" (unpublished doctoral dissertation, University of Western Australia); and more recently by Storey and Knott (2002)</p>	<p>Department of Environment and Conservation (2008). Interim Recovery Plan 2008-2013 for the 'Aquatic root mat communities numbers 1 to 4 of caves of the Leeuwin-Naturaliste Ridge'. Interim Recovery Plan No. 281 Department of Environment and Conservation, Perth.</p> <p>Eberhard, S. (2004). Ecology and hydrology of a threatened groundwater-dependant ecosystem: The Jewel Cave Karst System in Western Australia. Unpublished PhD Thesis, Murdoch University, Western Australia.</p> <p>Jasinska E. J. J. (1997). Faunae of aquatic root mats in caves of southwestern Australia: origins and ecology. Unpublished PhD Thesis submitted to the Zoology Department, University of Western Australia.</p>	<p>A key characteristic is a habitat of pools or permanently damp areas in cave habitats on Leeuwin-Naturaliste Ridge (Calgardup Cave). Comprises a suite of aquatic fauna, some of which are restricted to particular caves.</p>	<p>Sample and report on cave fauna using methods described in EPA (2021) and key references. Describe habitat including hydrological status. Compare habitat and cave fauna to summary description, and description in key references</p>

		"Leeuwin/Naturaliste Caves: Stream Invertebrate Monitoring: Report to Threatened Species and Communities Unit, Department of Conservation and Land Management".			
6	Camerons Cave Troglitic Community	The community is known from Camerons Cave on the Cape Range peninsula. It comprises a unique assemblage of species, at least 8 of which are known only from this location. The listed threatened species <i>Stygiochiropus peculiaris</i> (Camerons Cave millipede) and <i>Indohya damacles</i> (Camerons Cave pseudoscorpion) (previously <i>Hyella</i> sp. BES 1154.2525, 1546, 2554) are endemic to Camerons Cave. <i>Milyeringa veritas</i> (blind gudgeon) and <i>Draculoides bramstokeri</i> (Barrow Island draculoides) also occur in the cave.	Department of Environment and Conservation (2012). Camerons Cave Troglitic Community, Camerons Cave Millipede and Camerons Cave Pseudoscorpion Interim Recovery Plan 2012-2017. Interim Recovery Plan No. 324. Department of Environment and Conservation, Western Australia Humphreys, W.F. and Brooks, D. (2015) Camerons Cave fauna and water quality, Exmouth. Final report to the Rangelands NRM, Western Australia.	Cave habitat on Cape Range. Comprises a distinctive suite of cave fauna.	Sample and report on cave fauna using methods described in EPA (2016b, 2021) and key references. Describe habitat including hydrological status. Compare habitat and cave fauna to summary description, and description in key references
7	Cape Range Remipede Community (Bundera Sinkhole)	The community is known from the Bundera Sinkhole, which is a landlocked body of water with a subterranean connection to the ocean (an anchialine cave). Anchialine ecosystems are inland underground mixohaline waters (seawater dilutes of variable salinity) affected by marine tides, usually with little if any surface exposure. The community comprises a rich stygobitic faunal assemblage composed primarily of crustaceans but also includes a blind fish, <i>Milyeringa veritas</i> (blind gudgeon). The crustaceans include atyid shrimp, ostracods, gammarid amphipods, diverse copepods, a remipede of the class Remipedia (a class of blind crustaceans). At least 16 stygobiont species as follows, are recorded from Bundera Sinkhole by Humphreys, W.H. (2020) in "Bundera Sinkhole. Presentation to Royal Society of Western Australia, Singleton, Western Australia 18 December 2020". These include: <i>Bunderia misophaga</i> epactericid calanoid, <i>Speleophria bunderae</i> speleophriid misophriid, <i>Stygocyclopia australis</i> pseudocyclopiid calanoid copepod, <i>Stygoidigewayia trispinosa</i> (Copepoda: Calanoida Ridgewayiidae), <i>Kumonga exleyi</i> Remipedia, <i>Welesina kornickeri</i> Thaumatoctypididae, <i>Halosbaena tulki</i> Thermosbaenacea, <i>Speleophria bunderae</i>	Department of Conservation and Land Management (2001). Cape Range Remipede Community (Bundera Sinkhole) and Cape Range Remipede Interim Recovery Plan 2000-2003. Interim Recovery Plan No. 75. Department of Conservation and Land Management, Western Australia. Humphreys, W.H. (2020). Bundera Sinkhole. Presentation to Royal Society of Western Australia, Singleton, Western Australia 18 December 2020.	Anchialine cave habitat on Cape Range. Comprises a distinctive suite of cave fauna.	Sample and report on cave fauna using methods described in EPA (2021) and key references. Describe habitat including hydrological status. Compare habitat and cave fauna to summary description, and description in key references

		speleophriid misophrioid, <i>Ophisternon candidum</i> Pisces, <i>Milyeringa veritas</i> Pisces, <i>Stygiocaris</i> sp. nov. (Page et al. 2008), <i>Haptolana</i> sp., <i>Hadzia</i> (<i>Liagoceradocus</i>) <i>branchialis</i> , <i>Phlyctenophora mesembria</i> Candonidae: <i>Paracypridinae</i> , <i>Nitokra fragilis</i> <i>Harpacticoida</i> Ameiridae, <i>Hydractinia betkensis</i> ? <i>Anthoathecata</i> <i>Hydractiniidae</i> , <i>Iravadia</i> sp. <i>Neotaenioglossa</i> <i>Iravadiidae</i> , <i>Halicyclops longifurcatus</i> Cyclopoidea <i>Cyclopidae</i> , <i>Kiefferulus intertinctus</i> <i>Chironomidae</i> , <i>Limnionus</i> sp. Hemiptera: <i>Gerridae</i> g. ' <i>Prionospio</i> ' sp. [under revision by Alejandro Martinez], <i>Bunderanthura bundera</i> , <i>Leptanthuridae</i> (<i>Isopoda</i>).			
8	Depot Springs stygofauna community	The community is known from the Depot Springs groundwater calcrete in Sandstone. It comprises an assemblage of stygofaunal (groundwater) species not known from anywhere else. The calcretes that support the community include those around Friday Well and Puncture Well (southern) and in the area of the shearing shed on Depot Springs Station (northern). Species restricted to this community include Dytiscidae (water beetles), <i>Limbodessus fridaywellensis</i> and <i>Paroster hinzeae</i> . The dytiscid (water beetle) species are known only from the Depot Springs calcrete, and the latter species only from Friday Well and belong to a different tribe of invertebrates (Hydroporini). Other fauna from Friday Well itself include Ostracoda (aquatic crustaceans: <i>Ryocypris</i> n. sp., <i>Plesiocypridopsis</i> n. sp., <i>Candonopsis</i> n. sp. 1), Cyclopoida (small crustaceans: <i>Halicyclops</i> n. sp. 2, <i>Apocyclops</i> n. sp. 1, <i>Metacyclops</i> n. sp. 1) and Harpacticoida (New genus sp. 1 (<i>Canthocamptidae</i>)).	Humphries, W.F. (2001) Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. <i>Records of the Western Australian Museum</i> Supplement No. 64: 63–83. Johnson, S.L., Commander, D.P. and O'Boy, C.A. (1999) Groundwater Resources of the Northern Goldfields, Western Australia: Water and Rivers Commission, Hydrogeological Record Series, Report HG 2, 57p. Watts, C.H.S. and Humphreys, W.F. (1999) Three new genera and five new species of Dytiscidae (Coleoptera) from underground waters in South Australia. <i>Records of the South Australian Museum</i> 32(2): 121–142.	The Depot Springs groundwater calcrete is known from a single occurrence between Sandstone and Leinster and contains a distinctive assemblage of stygofauna. Community is hosted in palaeochannel aquifers that are coupled with the superficial (shallow) calcrete aquifers. These are less than 5m below ground and commonly brackish to saline (between 2,000 and 6,000 mg/L Total Dissolved Solids). The community's habitat is maintained by saturation of these aquifers (Johnson et al. 1999).	Sample and report on stygofauna assemblages using methods described in EPA (2021) and key references. Describe habitat. Compare habitat, and stygofauna assemblages to summary description and descriptions in key references.
9	Ethel Gorge aquifer stygobiont community	The community is known from the Ethel Gorge (Ophthalmia Basin) alluvium calcrete aquifer on the Fortescue River in the vicinity of the town of Newman. It comprises a diverse assemblage of stygofaunal species. It includes Oligochaeta and the crustaceans Bathynellacea (Syncarida), cyclopoid and harpacticoid copepods, Candonidae: Candoninae C (Ostracoda: Podocopida), Candonidae: Candoninae D (Ostracoda:	Bennelongia Environmental Consultants (2015). Strategic Environmental Assessment: Description of Regional Subterranean Fauna. Final Report prepared for BHP Billiton Iron Ore. BHP Billiton Iron Ore (2019). Ophthalmia Borefield in Triennial Aquifer Review (TAR). BHP Billiton Perth.	Known from a single location in the southeast Pilbara, The Ethel Gorge/Ophthalmia Basin alluvium calcrete aquifer, on the Fortescue River. Invertebrate assemblage that inhabits groundwater aquifer habitat in the southeast Pilbara.	Sample and report on subterranean fauna and habitat, using methods described in EPA (2021); and key references. Compare aquifer habitat, and its' associated assemblages, to

		Podocopida), Limnocytheridae (Ostracoda: Podocopida), flabelliferan Isopod (Tainisopodidae) and one new genus of Crangonyctoid amphipoda (<i>Chydeakata</i> , family Paramelitidae), in which 14 species (13 in this aquifer) have been described on morphological characters. At least one species of <i>Chydeakata</i> is known only from this community.	Humphreys, W.F. (2001) Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. <i>Records of the Western Australian Museum</i> Supplement No. 64: 63–83.		summary description, and descriptions in key references.
10	Species-rich faunal community of the intertidal mudflats of Roebuck Bay	The community occurs on the intertidal mudflats of Roebuck Bay. Roebuck Bay is a sheltered marine embayment on the macrotidal Kimberley coast containing large intertidal flats composed predominantly of carbonate sediments that receive freshwater inputs mainly during the wet season. The community comprises a diverse and abundant marine fauna, with an estimated 300 to 500 species of macrobenthic fauna as well as a high diversity and abundance of migratory shorebirds. The threatened species <i>Caretta caretta</i> (loggerhead turtle), <i>Chelonia mydas</i> (green turtle), <i>Natator depressus</i> (flatback turtle) and the dwarf sawfish (<i>Pristis clavata</i>) (priority 1), as well as large proportions of the Australian populations of the birds <i>Limosa lapponica</i> (bar-tailed godwit) (migratory species) and the threatened <i>Calidris tenuirostris</i> (great knot), utilise the habitat and comprise part of the assemblage.	Bennelongia (2009) Ecological Character Description for Roebuck Bay. Report to the Department of Environment and Conservation. Bennelongia Pty Ltd, Jolimont. Pepping M., Piersma T., Pearson G. and Lavaleye M. (eds) (1999). Intertidal sediments and benthic animals of Roebuck Bay Western Australia: Report of the Roebuck Bay Intertidal benthic mapping programme, June 1997 (ROEBIM-97). Netherlands Institute for sea research, TEXEL, CALM, and Curtin University of Technology. Piersma T. and Watkins D. (1997). The Roebuck Bay Intertidal Benthic Mapping Program - Preliminary Report. Roebuck Bay and Eighty Mile Beach in "Wetlands nominated by the Government of Western Australia, Australia for inclusion on the List of Wetlands of International Importance". Department of Conservation and Land Management, Perth WA, 1990. Wetland Research and Management (2019) Development of a Monitoring Program for Benthic Infauna at Roebuck Bay and Eighty-Mile Beach. Prepared for the Department of Biodiversity, Conservation and Attractions, Parks and Wildlife Service, Broome, Western Australia, by Wetland Research & Management. Draft Report v1, 24 January 2019	Roebuck Bay is a sheltered marine embayment with large flats composed of sediments of carbonate origin exposed at low tide. It has relatively little fresh water input and slow tidal flows, and supports a diverse and abundant marine fauna (particularly benthic invertebrates) as well as a high diversity and abundance of transequatorial migratory shorebirds. The species-rich faunal community of the intertidal mudflats of Roebuck Bay community occurs as one large occurrence alongside the Broome townsite. The benthic faunal assemblage of the Roebuck Bay intertidal mudflats differs from assemblages in other well-surveyed northern Australian intertidal habitats. Many of the benthic invertebrate fauna known from Roebuck Bay are short-range endemics. Examples include <i>Anomalocardia squamosa</i> , <i>Sunetta contempa</i> and <i>Sunetta perexcavata</i> are restricted to north Western Australia; <i>Littoraria sulculosa</i> is only known from Exmouth Gulf to Vansittart Bay; <i>Littoraria cingulata</i> is only known from Exmouth Gulf to Buccaneer Archipelago.	Sample and report on fauna of intertidal mudflat fauna using methods described in EPA (2020) and key references. Describe and compare habitat and biota to summary description, and description in key references.
Aquatic - microbialites					

11	Rimstone pools and cave structures formed by microbial activity on marine shorelines (Augusta microbialites)	The community occurs along the south-west coast near Augusta and comprises microbialites (tufa), which are structures produced through the growth and metabolic activity of benthic microbial communities. The tufa that comprise the community are microbialite structures that have a less defined internal framework that are precipitated from freshwater springs and seeps, formed through the growth and metabolic activity of a diverse variety of microbial organisms, including cyanobacteria, diatoms and other algal components. They form chemical sedimentary rock composed of calcium carbonate. These tufa have many forms including drapes, curtains, small cylindrical stalactites and larger campanulate (bell-shaped) masses on the sea cliffs, as well as fans or terraces consisting of a series of rimstone pools and nodular masses in small brackish pools.	Forbes, M., Vogwill, R., and Onton, K. (2010). A characterisation of the coastal tufa deposits of south-west Western Australia. <i>Sedimentary Geology</i> , 232(1-2), 52–65. Government of Western Australia (2000). Bush Forever. Western Australian Planning Commission, Perth. Gradziński, M. (2010). Factors controlling growth of modern tufa: results of a field experiment. Geological Society, London, Special Publications, 336, 143-191. Grey, K. and Awramik, S.M. (2020). Handbook for the study and description of microbialites. Geological Survey of Western Australia, Bulletin 147 278p. Moore, L. (1993) The Modern Thrombolites of Lake Clifton South Western Australia. Unpublished PhD Thesis. University of Western Australia. Onton, K., Clarke, V., and Harding, C. (2009). Monitoring Protocol: Augusta Microbial Threatened Ecological Community. Version 1.0 (August 2009). Prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project, Department of Environment and Conservation, Western Australia. Regan, J. (2009) Effect of climate change and eutrophication on the thrombolites and microbial mats within Lake Clifton. Honours dissertation. University of Western Australia.	Community occurs in fresh to brackish waters with low nutrient status. Changes to physical parameters eg altered nutrient status could likely cause a shift in dominant microbes. Community identified by L. Moore, and further described in Forbes <i>et al.</i> (2010).	Sample microbial mats and microbialites as per Grey and Awramik (2020).
12	Stromatolite like freshwater microbialite community of	The community occurs on a relict foredune plain on Holocene sands at Lake Clifton. It is a thrombolitic community comprising a distinctive complex assemblage of photosynthetic cyanobacteria and purple	Grey, K. and Awramik, S.M. (2020). Handbook for the study and description of microbialites. Geological Survey of Western Australia, Bulletin 147 278p.	Community originally described by Moore (1993). Occurs at a single location in Lake Clifton, Yalgorup National Park. Thrombolite reef is in a zone ~15m wide on the eastern side of the lake and occupies a total area of ~5km ² .	Sample microbial mats and microbialites as per Grey and Awramik (2020).

	coastal brackish lakes (Lake Clifton)	sulphur bacteria, eukaryotic microalgae and “true bacteria”. The thrombolitic structures generally have an internal clotted structure, as opposed to those that have a laminated organisation, that are stromatolitic. The structures are formed through precipitation of calcium carbonate within the microenvironment of microbes as a result of photosynthetic and metabolic activity.	<p>Luu, R., Mitchell, D. and Blyth, J. (2004) Thrombolite (Stromatolite-like Microbialite) community of a coastal brackish lake (Lake Clifton). Interim Recovery Plan 2004-2009. Department of Conservation and Land Management, Western Australia.</p> <p>Moore, L. (1993) The Modern Thrombolites of Lake Clifton South Western Australia. Unpublished PhD Thesis. University of Western Australia.</p> <p>Moore, L.S. and Burne, R.V. (1994) The modern thrombolites of Lake Clifton, Western Australia. In Bertrand, J. and Monty, C. (eds), Phanerozoic Stromatolites II, Kluwer Academic Publishers, Netherlands.</p> <p>Moore, L., Knott, B., and Stanley, N. (1984) The Stromatolites of Lake Clifton, Western Australia. Living structures representing the origins of life. <i>Search</i> 14 (11-12): 309-313.</p> <p>Smith, M.D., Goater, S.E., Reichwaldt, E.S., Knott, B. and Ghadouani, A. (2010) Effects of recent increases in salinity and nutrient concentrations on the microbialite community of Lake Clifton (Western Australia): are the thrombolites at risk? <i>Hydrobiologia</i> 649: 207.</p> <p>Warden, J. G., Casaburi, G., Omelon, C. R., Bennett, P. C., Breecker, D. O., and Foster, J. S. (2016) Characterization of microbial mat microbiomes in the modern thrombolite ecosystem of Lake Clifton, Western Australia using shotgun metagenomics. <i>Frontiers in Microbiology</i> 7: 1064.</p> <p>Warden, J.G., Coshell, L., Rosen, M.R., Breecker, D.O., Rutrof, K.X. and Omelon, C.R. (2019). The importance of groundwater flow to the formation of modern</p>	<p>Isolated thrombolites also reported by Moore (1993) on north-western shoreline of the lake.</p> <p>The most abundant cyanobacterium in the early 1990s was <i>Scytonema</i>, as well as others including <i>Oscillatoria</i>, <i>Dichothrix</i>, <i>Chroococcus</i>, <i>Gloeocapsa</i>, <i>Johannesbaptista</i>, <i>Gomphosphaeria</i> and <i>Spirulina</i> (Moore 1993). More recent work by Warden <i>et al.</i> (2016) suggest there has been a dramatic shift in the cyanobacterial population toward coccoid, non-heterocystous forming taxa primarily from the order Chroococcales. Dominance of coccoid cyanobacteria occurs in microbialites of other hypersaline environments.</p>	Compare habitat, and composition to summary description, and descriptions in Moore (1993) and more recent characterisations by Warden <i>et al.</i> (2016).
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			thrombolitic microbialites. Geobiology 17 (5): 536-550.		
13	Stromatolite like microbialite community of coastal freshwater lakes (Lake Richmond)	The community occurs on a relict foredune plain on Holocene sands at Lake Richmond, Rockingham. It is a thrombolitic community comprising a distinctive complex assemblage of photosynthetic cyanobacteria and purple sulphur bacteria, eukaryotic microalgae and "true bacteria". The thrombolitic structures generally have an internal clotted structure, and are formed through precipitation of calcium carbonate within the microenvironment of microbes as a result of photosynthetic and metabolic activity.	<p>English, V., Blyth, J., Goodale, A., Goodale, B., Moore, L., Mitchell, D., Loughton, B., Tucker, J., Halse, S. and King, S. (2003) Thrombolite community of coastal freshwater lakes (Lake Richmond). Interim Recovery Plan 2003-2008. Department of Conservation and Land Management, Western Australia.</p> <p>Grey, K. and Awramik, S.M. (2020). Handbook for the study and description of microbialites. Geological Survey of Western Australia, Bulletin 147 278p.</p> <p>Guerreiro, J.P., Vogwill, R. and Collins, L.B. (2017) Lake Richmond Microbialites. Summary Report to the Department of Biodiversity, Conservation and Attractions (DBCA). Curtin University of Technology</p> <p>Moore, L. (1993) The Modern Thrombolites of Lake Clifton South Western Australia. Unpublished PhD Thesis. University of Western Australia.</p> <p>Regan, J. (2009) Effect of climate change and eutrophication on the thrombolites and microbial mats within Lake Clifton. Honours dissertation. University of Western Australia.</p> <p>Vogwill, R. and Whitehead, M. (2018) Lake Richmond – Microbialites, Microbial Mat Mapping and Hydrology Report. Report prepared for the City of Rockingham.</p>	<p>Community originally identified by Moore (1993). In the early 1990s <i>Dichothrix</i> sp., a cyanobacterium was the dominant microbe in microbialites in Lake Richmond. It grows in fresh to brackish waters with low nutrient status.</p> <p>Changes to physical parameters eg altered salinity and nutrient levels have likely caused a shift in dominant microbes.</p> <p>Microbial mats are persisting but composition is moving away from sulphur oxidation/reduction towards photosynthesis.</p>	Sample microbial mats and microbialites as per Grey and Awramik (2020). Compare habitat, and composition to descriptions in Moore (1993) and more recent characterisations (eg Vogwill and Whitehead 2018).
14	Stromatolite community of stratified hypersaline	The community occurs in Lake Thetis, in Cervantes. It comprises a distinctive and diverse group of benthic microbial assemblages, each producing a mat that is associated with one specific zone within the	Department of Environment and Conservation (2012) Stromatolite community of stratified hypersaline coastal lake – Lake Thetis. Interim Recovery Plan No. 325, 2012-	Lake Thetis is a small, permanent, hyper-saline lake located on the coastal plain east of Cervantes. It occupies a deflation basin with limestone pavement situated between Holocene parabolic and nested parabolic dunes, and is separated from the ocean by a	Sample microbial mats and microbialites as per Grey and Awramik (2020). Compare habitat, and

	coastal lakes (Lake Thetis)	lake. Crenulate cyanobacterial mats occur in the low-lying areas adjacent to the lake. Lithified stromatolites, resembling those at Shark Bay, with patches of living cyanobacterial mats and nodular mats characterise the littoral areas. Filamentous mats reside in cavities and coat the surface of the flocculant mat in the basin, a mobile diatomaceous mat occurs in the shallows, and thick flocculant mats of phototrophic prokaryotes, other microbes or diatoms (or microbes and diatoms) occur in the central basin. Lake Thetis has benthic microbial mats adjacent to the lithified stromatolites and well-developed flocculant mats in the basin. Under current conditions microbial reef-forming communities and flocculant mat communities are both scarce. Some stromatolites have branching columns.	<p>2017. Department of Environment and Conservation, Western Australia.</p> <p>Grey, K. and Awramik, S.M. (2020). Handbook for the study and description of microbialites. Geological Survey of Western Australia, Bulletin 147 278p.</p> <p>Grey, K, Moore, LS, Burne, RV, Pierson, BK and Bauld, J. (1990) Lake Thetis, western australia: an example of saline lake sedimentation dominated by benthic microbial processes. <i>Australian Journal of Freshwater Resources</i>, vol. 41, pp. 275-300.</p> <p>Grey, K. and Plavansky, N.J. (2009) Microbialites of Lake Thetis Cervantes, Western Australia – a field guide. Geological Survey of Western Australia Record 2009/11.</p>	<p>relict fore-dune plain. Lake is underlain by the Superficial Aquifer, an unconfined aquifer system constituted with sediments from sand and limestone (Tamala limestone) (Rutherford <i>et al.</i> 2005). The lake waters are typically alkaline and nutrient-poor, so ideal for the growth of benthic microbial communities (Grey <i>et al.</i> 1990).</p> <p>Lake Thetis is fed by direct rainfall, surface water, and possibly by groundwater bearing calcium and carbonates. It loses water by evaporation and no rivers or creeks discharge into it. There is no evidence for active subterranean water exchange with the sea (Por 1985). Water level fluctuates seasonally with rainfall, rather than with the tides, around mean sea level due to the proximity of the lake to sea level (Grey <i>et al.</i> 1990). Salinity varies from 39 to 59 gL⁻¹ (>35gL⁻¹ is classified as brine), and the ionic proportions of the lake water reflect seawater origins (Arp <i>et al.</i> 2001; DEC records 2009, 2010; Grey <i>et al.</i> 1990).</p> <p>Lake Thetis is characterised by a diverse assemblage of benthic microbial communities, each producing a distinctive mat type including: crenulate, nodular, filamentous, diatomaceous and flocculent mats. The mats are confined to specific zones that are determined by environmental controls (Grey <i>et al.</i> 1990; Grey and Plavansky 2009). The stromatolites are just one expression of the diverse microbial assemblage that occurs in the lake (DEC 2012).</p> <p>Crenulate mats grow in seasonally flooded high foreshore areas around Lake Thetis. They consist of a few millimetres of organic-rich sediment intercalated with lake sediments comprising mainly calcareous mud, underlain by coarse calcareous sand. The mat contains the filamentous cyanobacteria identified as <i>Calothrix</i> and <i>Scytonema</i> as well as small colonies of the coccoid cyanobacterium, <i>Gloeocapsa</i> (DEC 2012).</p> <p>Nodular mats are generally restricted to splash zones around the sides of stromatolite domes along the south-western shoreline of Lake Thetis. The nodular mat consists of coccoid cyanobacteria, principally <i>Gloeocapsa</i>, with variable quantities of diatoms depending on seasonal lake level. These organisms secrete mucilage which, along with the layer of living mat, forms a thin coating on the lithified nodules. Copious mucilage production provides a matrix for sediment accumulation and carbonate precipitation. Domes are one form of microbial mat in the lake and</p>	composition to descriptions in Grey <i>et al.</i> (1990, 2009).
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				<p>are marked by a thin outer rind that is dominated by coccoid cyanobacteria (<i>Gloeocapsa</i> and also <i>Entophysalis</i> (Arp <i>et al.</i> 2001)) and deeper layers that are dominated by filamentous cyanobacteria (<i>Scytonema</i>) and by branching and tufts (DEC 2012).</p> <p>Filamentous mats occur in areas of reduced light penetration where they mainly consist of oscillatorian cyanobacteria including chasmodoliths. In the deeper part of the lake, and within cracks of lithified plates and angular fragments on the lower marginal shelf, it forms a thin, fragile, often incomplete film comprising the uppermost layer of flocculent mat (DEC 2012).</p> <p>Diatomaceous mats form an orange-brown gelatinous band in the shallow parts of Lake Thetis, usually just below or sometimes coating the nodular mat. Diatom frustules are a significant component of the lithified surface of many of the Lake Thetis stromatolites. Diatoms as well as cyanobacteria are consistently associated with carbonate particles and may have a role in trapping or precipitating carbonate sediments (DEC 2012; Grey <i>et al.</i> 1990).</p> <p>Floating flocculant mats comprise a relatively thin (1-2mm) surface mosaic of brown-to-blue-green patches over a massive pinkish-red accumulation of biogenic sediment and colonise the bottom of the central, submerged basin, of Lake Thetis. The upper film is made up of several species of oscillatorian cyanobacteria and other non-phototrophic filamentous bacteria such as <i>Beggiatoa</i> sp., a boundary species that tolerates oxygen and oxidises hydrogen sulphide (H_2S). Other major contributors to biomass in this community include several pennate (long tapering) and naviculoid (boat shaped) diatom species and a small unicellular, coccoid cyanobacterium (<i>Synechocystis</i>). The underlying bulk of the mat lacks oxygen and has red-purple organic material mainly comprising purple sulfur bacteria (anoxygenic, H_2S utilizing photosynthetic bacteria, <i>Thiocystis/Thiocapsa</i> group) (Grey <i>et al.</i> 1990). The massive sediment in the lake basin is also likely home to sulphur reducing bacteria and other chemautotrophs (DEC 2012).</p>	
Soaks, swamps and mound springs					
15	Assemblages of Big Springs organic	The known occurrence of the community comprises a complex system of freshwater seepages and peaty springs with internal moats with broad tidal flats on the seaward	Department of Biodiversity, Conservation and Attractions (2020) Biodiversity Survey, Mapping, Delineation and	The permanent groundwater discharge from the springs provides aquatic habitats (pools and seepages, plus the saturated peat itself) that support distinct assemblages of aquatic invertebrates, often with stygal and restricted	Sample and report on habitat, flora and aquatic fauna using methods described in

	mound springs	<p>margin and cracking clay flats on the landward margin. It occurs in the West Kimberley. A further feature is the scattered clusters of small outlying, densely vegetated mound springs. The main seepage area supports well developed rainforest vegetation dominated by forests of <i>Terminalia microcarpa</i> (damson plum). Several mistletoe species (Loranthaceae) have been recorded in the <i>Terminalia</i> canopy, which reaches 20 m in places. Other trees present include <i>Ficus racemosa</i> (stem-fruit fig), <i>Ficus virens</i> (Albayi), <i>Melaleuca leucadendra</i> (paperbark), <i>Pandanus</i> sp. (screwpine), <i>Sesbania formosa</i> (white dragon tree) and <i>Timonius timon</i>. Much less common species noted were <i>Antidesma ghaesembilla</i> (Yangu), <i>Diospyros maritima</i> and <i>Nauclea orientalis</i> (Leichardt tree). The understorey varies from central open glades with turf of Cyperaceae to pure leaf litter under the <i>Terminalia</i> canopies. Internal moats support <i>Acrostichum speciosum</i> (mangrove fern). The outer perimeter of the large seepage feature is relatively dry in most places with this ring generally dominated by dense thickets of <i>Melaleuca alsophila</i> or <i>Acacia ampliceps</i> (or both) with scattered <i>Bauhinia cunninghamii</i>, <i>Dichrostachys spicata</i> (Pied Piper bush) and occasional <i>Adansonia gregorii</i> (boab) of small stature. Outlying mound spring islands on tidal flats vary markedly in size and in the diversity of vegetation. Some of the smallest islands consist solely of <i>Typha domingensis</i> (bulrush). Larger examples often feature <i>Pandanus spiralis</i>, <i>Sesbania formosa</i>, <i>Acacia neurocarpa</i> and occasionally <i>Terminalia microcarpa</i> and <i>Ficus</i> sp. (fig), with a range of Cyperaceae. Several islands were noted with unusual associations such as <i>Typha</i> sp. growing with the mangrove <i>Lumnitzera</i> sp.</p>	<p>Assessment of Selected Organic Mound Springs of the Kimberley Region. Department of Biodiversity, Conservation and Attractions, Kensington.</p> <p>Keneally, K.F., Keighery, G.J. and Hyland, B.P.M. (1991) Floristics and phytogeography of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N.L., Johnston, R.B. and Kendrick, P.G. (eds) Surrey Beatty and Sons, Norton, NSW.</p> <p>Pryde J (2017) Survey of assemblages of Bunda Bunda, and Big Springs organic mound springs of the west Kimberley threatened ecological communities: a report to the Kimberley Region - August 2017 survey of Bunda Bunda and Big Springs organic mound springs TECs. Department of Biodiversity, Conservation and Attractions, Kensington, WA. 26 p.</p> <p>Stoneham, T.C., McArthur, W.M. and Walsh, F.J. (1991) Soils and landforms of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N.L., Johnston, R.B. and Kendrick, P.G. (eds) Surrey Beatty and Sons, Norton, NSW.</p>	<p>elements. Big Springs organic mound springs contain a complex system of freshwater seepages, peaty springs and pools with internal moats. Internal moats surround peaty mounds supporting large mature trees. The largest mound (BIGS01) is a heavily vegetated mound to an elevation of approximately 8m. The main seepage area has an extensive outflow swamp on its north west side.</p> <p>The mound springs occur along the coast where groundwater discharges under pressure from depth through the overlying alluvium to the surface. The springs contain underlying hydrogeology, mineral composition and biogeochemical processes that are likely to be complex and variable.</p> <p>Community occurs on eastern shore of King Sound, with broad saline coastal tidal flats on the seaward margin at the mouth of the Meda River, and cracking clay flats on the landward margin. Surface geology is supratidal mudflat deposits with a mixture of clay, silt, sand and minor salt, and the substrate varies from peat through to peaty grey clay to grey clay, mostly damp with light to very heavy leaf litter and decaying vegetation (DBCA 2019).</p> <p>The invertebrates and flora in the community are a major part of characterising and differentiating the community. The Big Springs community contains six species of invertebrates that have rarely or never been collected in WA, including a water mite, <i>Arrenurus</i> sp. WA29, the ostracod <i>Strandesia</i> sp. 653 which was recorded from Big Spring in 1999 and 2017 (also occurring in King Gordon Spring), but is not known from elsewhere; <i>Mesocyclops woutersi</i> which has rarely been collected in Australia, but is widely distributed in south-east and east Asia; a harpacticoid copepod <i>Canthacampus grandidieri</i> which has rarely been collected in Australia; <i>Picroporeux quasidenticulatus</i> which is a new record for WA; and <i>Phyllognathopus volcanicus</i> which is the first collection record for Australia but the species is also known from New Zealand (DBCA 2019).</p> <p>Community is comparable to the Bunda Bunda organic mound springs community in its near tidal setting however, it has an entirely different physiography and flora. The vegetation found in the Bunda Bunda community also appear to be different from that of wetland rainforest patches described in the Kimberley Rainforest Survey (Keneally <i>et al.</i> 1991). Some of the same dominant species also occur at Walcott Inlet,</p>	<p>EPA (2016a, b), and key references.</p> <p>Determine if habitat meets description of permanently moist peat mounds. Clarify if wetland hydrology is supported by groundwater.</p> <p>Compare key peat substrate, and its' associated assemblages, to summary description, and descriptions in key references.</p>
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				90km north east of Big Springs; <i>Ficus</i> spp., <i>Nauclea orientalis</i> and <i>Celtis philippinensis</i> (Stoneman <i>et al.</i> 1991).	
16	Black Spring organic mound spring community	The community occurs in the East Kimberley and the known occurrence consists of a raised central mound supporting a forest of <i>Melaleuca viridiflora</i> (broadleaf paperbark), <i>Ficus</i> spp., <i>Timonius timon</i> and <i>Pandanus spiralis</i> (screwpine) over <i>Colocasia esculenta</i> (taro) and ferns, including <i>Cyclosorus interruptus</i> (swamp shield-fern). The tall <i>Phragmites karka</i> (tropical reed) dominates the outer edge of the mound and the entire mound is ringed by a moat of water supporting sedges and grasses. The springs contain a rich assemblage of aquatic invertebrate fauna.	Bennelongia Environmental Consultants (2017) Ecological Character of Kimberley Mound Springs. Bennelongia Environmental Consultants. Department of Biodiversity, Conservation and Attractions (draft 2019) Biodiversity Survey, Mapping, Delineation and Assessment of Selected Organic Mound Springs of the Kimberley Region. Department of Biodiversity, Conservation and Attractions, Perth. Halse, S. (2001) Comments on Kimberley Mound Springs sampled by Sally Black. Unpublished Report to Department of Conservation and Land Management.	Known from a single occurrence. Consists of raised peaty soils or wetlands that occur on saturated peaty black, clay soil with high organic content. Situated in either low tributaries or associated with floodplains adjacent to rivers and streams (Bennelongia 2017). Contains a raised, peaty mound surrounded by a moat or bog, and is fed by permanent freshwater seepage (Bennelongia 2017). Occurs where groundwater discharges under pressure from depth through the overlying alluvium to the surface. Invertebrate and flora assemblages that inhabit habitats comprising permanently moist or inundated mounds of peat in this East Kimberley. Distinguished from other mound springs in the Kimberley region by the invertebrate biota that inhabits it, and also the vegetation that typifies the core seepage zones of the spring. Other mound springs may be vegetated by sedges over herbs and grasses; this spring can be described as a forest on the mound with the outer edge dominated by tall grass, and sedgelands on the moat. Several rarely collected aquatic invertebrate species also occur within the mound spring community. Bennelongia (2017) recorded a unique and undescribed water mite (referred to as <i>Arrenurus</i> sp. WA27 in DBCA 2019); the darwinulid ostracod <i>Alicenula serricaudata</i> , a largely groundwater associated species with a Gondwanan distribution was the first record for Australia; the harpacticoid copepod <i>Canthacampus grandidieri</i> which is a pan-tropical species, but has rarely been collected in Australia; and an ostracod from the genus <i>Chrissia</i> , that has not previously been recorded in Australia (Bennelongia 2017; DBCA 2019).	Sample and report on flora and vegetation and habitat, using methods described in EPA (2016a, b); and key references. Bennelongia (2017) established permanent flora quadrats to record flora, inventory of aquatic invertebrates and water chemistry and soils. Compare key peat substrate, and associated assemblages, to summary description and description in key references.
17	Assemblages of Bunda organic mound springs	The community comprises a complex system of organic mound springs on tidal mudflats in Carnot Bay on the Dampier Peninsula north of Broome. Peaty mounds rise 2 to 3 m above the surrounding tidal flats and are composed of accumulated leaf litter and living vegetation, supporting a dense closed rainforest and tall shrubland, with mangroves forming a concentric form on the surrounding mudflats. The smaller mound is dry in the	Department of Biodiversity, Conservation and Attractions (2020). Biodiversity Survey, Mapping, Delineation and Assessment of Selected Organic Mound Springs of the Kimberley Region. Department of Biodiversity, Conservation and Attractions, Kensington	Known from two occurrences over a 1.2km range in the West Kimberley. The flora and invertebrates are a major part of characterising and differentiating the community. Comprises peaty mounds surrounded by a moat, stream channels and standing pools of water of variable depth. Saturated peaty black soils and thick leaf litter combine to form a quaking substrate.	Sample and report on habitat, flora and aquatic fauna using methods described in EPA (2016a, b, 2021), and key references (DBCA 2019; vegetation, physico-chemical, and invertebrate sampling).

	<p>centre but encircled by a moat, fed by permanent freshwater seepage. The larger mound is wet and incompletely enclosed by a very fine scale channel or moat of variable depth, which broadens to a microscale saline lake on the north side. The moats and pools are saline and occasionally inundated during large tides. The western end of the large mound is covered by a very dense closed forest dominated by evergreen <i>Carallia brachiata</i> trees and a bracken-like layer of the fern <i>Cyclosorus interruptus</i> (swamp shield-fern). <i>Timonius timon</i> and <i>Sesbania formosa</i> (white dragon tree) also occur. The eastern portion of the mound is covered by tall closed forest of <i>Melaleuca cajuputi</i>, <i>Timonius timon</i>, <i>Sesbania formosa</i> with fewer <i>Carallia brachiata</i> with an understorey of <i>Cyclosorus interruptus</i>. Climbers including <i>Cassytha filiformis</i> (love vine) and <i>Secamone elliptica</i>, drape from trees with ferns <i>Lygodium microphyllum</i> (climbing maidenhair) forming a curtain filtering the light. A moat-like channel surrounding the large mound contains mangroves, predominantly <i>Rhizophora stylosa</i> (spotted-leaved red mangrove) and <i>Avicennia marina</i> (white mangrove) with <i>Acrostichum speciosum</i> (mangrove fern).</p>	<p>Keneally, K.F., Keighery, G.J. and Hyland, B.P.M. (1991) Floristics and phytogeography of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N.L., Johnston, R.B. and Kendrick, P.G. (eds) Surrey Beatty and Sons, Norton, NSW.</p> <p>Pryde (2017). Kimberley threatened ecological communities: a report to the Kimberley Region - August 2017 survey of Bunda Bunda and Big Springs organic mound springs TECs. Department of Biodiversity, Conservation and Attractions, Kensington, WA. 26 p. DBCA, Kensington.</p> <p>Stoneham, T.C., McArthur, W.M. and Walsh, F.J. (1991) Soils and landforms of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N.L., Johnston, R.B. and Kendrick, P.G. (eds) Surrey Beatty and Sons, Norton, NSW.</p>	<p>The permanent groundwater discharge from the springs provides aquatic habitats (pools and seepages, plus the saturated peat itself) that support distinct assemblages of aquatic invertebrates, often with stygal and restricted elements. Community also supports three species of invertebrates rarely or never collected in Western Australia, including; a potentially new species of water mites <i>Axonopsella</i>; the darwinulid ostracod <i>Alicenula serricaudata</i>, also located in other Kimberley springs, is the first record for Australia; and a harpacticoid copepod <i>Nitokra 'lacustris'</i> B07 also likely to be undescribed and not previously collected (DBCA 2020).</p>	<p>Clarify if wetland hydrology is supported by groundwater. Compare key peat substrate, and its' associated assemblage, to summary description, and descriptions in key references.</p>
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18	Assemblages of Dragon Tree Soak organic mound spring	The community occurs in the Great Sandy Desert bioregion and is a wetland landform supporting plants and animals that are absent or scarce elsewhere in the bioregion. At its centre, the community comprises a closed sedgeland of jointed twig-rush <i>Baumea articulata</i> (jointed twig-rush) to 2.5 m high and 95% canopy cover. <i>Sesbania formosa</i> (white dragon tree) occurs as a sparse emergent and some clumps of <i>Typha domingensis</i> (bullrush) are also present in the centre of the soak. At the southern and northern ends of the wetland is a low-closed forest or scrub of <i>Sesbania formosa</i> , averaging 10 m in height, with some <i>Typha domingensis</i> understorey. In wet areas on the periphery of the wetland, a grassland of <i>Paspalum vaginatum</i> (couch grass) occurs, with sparse emergent <i>Fimbristylis ferruginea</i> . The slightly higher and drier surrounding flats support <i>Sporobolus virginicus</i> (marine couch), <i>Acacia ampliceps</i> and <i>Melaleuca glomerata</i> . The priority 3 sedge species <i>Fimbristylis sieberiana</i> also occurs.	Australian Nature Conservation Agency (1996) A Directory of Important Wetlands in Australia. Second Edition. Australian Nature Conservation Agency, Canberra. Pinder A, Lewis L, Shiel, R. 2020. Aquatic invertebrates of three wetlands in the Great Sandy Desert sampled in September 2018, Department of Biodiversity, Conservation and Attractions, Perth.	Invertebrate and flora assemblages that inhabit habitats comprising permanently moist or inundated mounds of peat on the in the Great Sandy Desert bioregion. Peat habitat is supported by groundwater seepage.	Sample and report on flora and vegetation and habitat, using methods described in EPA (2016a); and key references. Compare key peat substrate, and associated flora assemblage, to summary description.
19	Assemblages of the organic springs and mound springs of the Mandora Marsh area	The community occurs in the Mandora Marsh (Walyarta) area, which is located 140 km south-west of Broome, and approximately 40 to 100 km inland from Eighty-Mile Beach. Plant assemblages associated with the springs include paperbark <i>Melaleuca leucadendra</i> forest with or without an understorey of <i>Acrostichum speciosum</i> (mangrove fern), and <i>Sesbania formosa</i> (white dragon tree) woodland with or without an understorey of mangrove ferns. Stands of the bullrush <i>Typha domingensis</i> and sedgelands dominated by <i>Schoenoplectus</i> spp. with <i>Fimbristylis</i> spp., along with patches of the grass <i>Sporobolus virginicus</i> also occur. In addition, a few <i>Avicennia marina</i> (white mangrove) occur on the more brackish springs. <i>Acacia ampliceps</i> is often present in the mid-storey but is not abundant. <i>Typha domingensis</i> and sedges with a few emergent trees or mangroves dominate the vegetation on some of the small mound springs. The dominant vegetation of the springs varies between occurrences and over time due to	Department of Biodiversity, Conservation and Attractions (2019). Draft Interim Recovery Plan 2019-2024 for Assemblages of the organic springs and mound springs of Mandora Marsh area and inland mangroves community of Salt Creek. Department of Biodiversity, Conservation and Attractions, Western Australia. Quinlan K., Pinder A.M. and Lewis L. (2016) <i>Aquatic Fauna Survey at Mandora Marsh (Walyarta) in September 2015</i> . Department of Parks and Wildlife, Perth. Rutherford, J.L., Cendón, D.I., Soerensen, C., Batty, S., Huntley, B., Bourke, L., Quinlan, K., Englsih, V. and Coote, M. (2018) <i>Hydrological conceptualisation of the Walyarta Mound springs</i> . Department of Biodiversity, Conservation and Attractions,	Invertebrate and flora assemblages that inhabit habitats comprising permanently moist or inundated mounds of peat in the Walyarta area. Peat habitat is supported by groundwater seepage.	Sample and report on habitat, flora and aquatic fauna using methods described in EPA (2016a, b), and key references. Determine if habitat meets description of permanently moist peat mounds. Clarify if wetland hydrology is supported by groundwater. Compare key habitat of peat substrate, and its' associated assemblages, to summary description, and descriptions in key references.

		damage by cyclonic winds. Invertebrate fauna from mound springs of the Mandora Marsh area are much richer than in springs further north in the Kimberley, and very few species are common to both areas. The permanent water and dense vegetation of the springs provide a refuge for these invertebrate fauna within an otherwise arid desert landscape.	Wetlands Conservation Program, Perth Western Australia.		
20	Organic mound spring sedgeland community of the North Kimberley bioregion	Occurrences of the community are centred on mound spring habitat in the North Kimberley bioregion. The community is comprised of sedgelands and grasslands that are almost completely devoid of trees and shrubs due to a waterlogged seepage zone, and can also include boggy fernlands. At the margins are associated woodlands. The community encompasses these vegetation types that are affected by the hydrology of each mound spring. The community is distinguished in particular by the invertebrate biota that inhabit them, and also the sedgelands or grasslands that typify the core seepage zones of the springs. Most of the sedges present on these mound springs are restricted to the periphery of wetlands and creeks, or broad drainage depressions on sandier soils where grasses are dominant. Seven plant species are considered useful indicators of these mound springs, since their occurrence is almost entirely restricted to them or their margins: <i>Cyperus unioides</i> (papyrus sedge; priority 1), <i>Eleocharis ochrostachys</i> (spike rush; priority 3), <i>Eriocaulon inapertum</i> (pipewort; priority 1), <i>Lobelia leucotos</i> (blue lobelia; priority 1), <i>Rhynchospora gracillima</i> (thin beaksedge; priority 1), <i>Spiranthes sinensis</i> (austral ladies tresses; priority 1) and <i>Utricularia circumvoluta</i> (bladderwort; priority 1). <i>Rhynchospora rubra</i> (priority 3) is also found in the community.	Barrett, M. and English, V. (2017) A flora and vegetation survey of North Kimberley mound springs, Mt Elizabeth Station. Department of Parks and Wildlife, WA. Bennelongia Environmental Consultants (2017) <i>Ecological Character of Kimberley Mound Springs</i> . Bennelongia Environmental Consultants. Department of Biodiversity, Conservation and Attractions (draft 2019) Biodiversity Survey, Mapping, Delineation and Assessment of Selected Organic Mound Springs of the Kimberley Region. Department of Biodiversity, Conservation and Attractions, Perth	Community consists of raised peaty soaks or wetlands that occur on saturated peaty black, grey/black clayey soils with some sandstone. Generally occurs as freshwater seepages and vegetated mound springs with internal moats. Community occurs where groundwater discharges under pressure from depth through the overlying alluvium to the surface. Sampled springs were fresh and highly acidic, <i>in situ</i> , which is natural in peat bogs due to the release of organic acids from decomposition of plant matter. Rarely collected aquatic invertebrate species were recorded in the community; a unique and undescribed <i>Arrenurus</i> ; the darwinulid ostracod <i>Alicenula serricaudata</i> , the atyid shrimp <i>Caridina spelunca</i> , which is restricted to groundwater associated habitats in the central Kimberley.	Sample and report on habitat, flora and aquatic fauna using methods described in EPA (2016a, 2021), and key references. Determine if habitat meets description of permanently moist peat mounds. Clarify if wetland hydrology is supported by groundwater. Compare key peat substrate, and its' associated assemblage, to descriptions in summary description, and descriptions in key references. Detailed methods: Vegetation surveys (from Barrett and English 2017) Surveys best undertaken in June. Flora specimens should be collected from the central core mound spring seepage areas, and damplands that surround the springs. Physico-chemical sampling (from Bennelongia 2017)

					<p>Includes electrical conductivity (EC), pH and temperature, water samples, and analytes (TDS, pH, EC, major ions, ammonia, nitrate, nitrite, soluble reactive phosphorous (P_SR), total N and total P).</p> <p>Invertebrate sampling (from Bennelongia 2017):</p> <p>Collect aquatic invertebrates with bilge pump. A 1m length core of consolidated peat is extracted and the hole allowed to fill with porewater. Water is then pumped through a 53µm net using the bilge pump and retained material preserved in 100% ethanol. Dig a small well (i.e. 30cm x 30cm) around the base of the pump to allow water to infiltrate the pumping zone. Sort in laboratory under dissecting microscopes and all aquatic invertebrates identified to species level where possible. Animals dissected and examined under the compound microscopes as necessary. Species are identified using relevant keys, where available; otherwise, appropriate anatomical</p>
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					features from keys are used to characterise undescribed species, to which voucher codes are assigned. Some samples can be collected by sweep-netting through a range of surface water habitats
21	Assemblages of Roe River rainforest swamp	The known occurrence of the community is located within the Roe River area of the Prince Regent National Park in the northern Kimberley. The rainforest canopy is 16 m high. Tree species include <i>Aglaia elaeagnoidea</i> (priyangu), <i>Alphitonia excelsa</i> (red ash) (priority 2), <i>Alstonia actinophylla</i> (white cheesewood), <i>Antidesma ghaesembilla</i> (yangu), <i>Bombax ceiba</i> (kapok tree), <i>Carallia brachiata</i> , <i>Cryptocarya cunninghamii</i> , <i>Ficus hispida</i> , <i>Lophostemon grandiflorus</i> , <i>Melaleuca viridiflora</i> (broadleaf paperbark), <i>Melastoma affine</i> , <i>Memecylon pauciflorum</i> , <i>Nauclea orientalis</i> (Leichardt pine), <i>Monoon australe</i> , <i>Sersalisia sericea</i> (Nangi), <i>Syzygium angophoroides</i> , <i>Syzygium forte</i> subsp. <i>potamophilum</i> , <i>Timonius timon</i> , <i>Trema tomentosa</i> and <i>Vitex acuminata</i> . The camaenid land snail assemblages in rainforest communities of the Kimberley Region can be used to distinguish patches from similar rainforest communities elsewhere in northern Australia. The community was originally described in McKenzie N.L., Johnston R.B. and Kendrick P.G. (eds) (1991) "Kimberley rainforests of Australia" (Surrey Beatty & Sons, Chipping Norton, NSW, in association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment, Canberra).	Kenneally K. F., Keighery G. J. and Hyland B. P. M. (1991). Floristics and phytogeography of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW. McKenzie, N.L., Belbin, L., Keighery, G.J. and Kenneally, K.F. (1991) Kimberley rainforest communities: Patterns of species composition and Holocene biogeography. In: Kimberley Rainforests of Australia. McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (eds). Surrey Beatty and Sons, Norton, NSW. Solem, A. (1991). Land snails of Kimberley rainforest patches and biogeography of all Kimberley land snails. In: Kimberley Rainforests of Australia. McKenzie N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW. Stoneman, T. C., McArthur, W.M. and Walsh F.J. (1991). Soils and landforms of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW	The only known occurrence of this community is 2.0 ha in size, and is located within the Prince Regent Nature Reserve. Most of the camaenid land snails recorded in the McKenzie <i>et al.</i> (1991) are restricted endemics in the Kimberley. McKenzie <i>et al.</i> (1991) sampled 1 occurrence of this community, Patch 16/2. This patch classified by itself in the analysis of the species assemblages of 95 sites surveyed for McKenzie <i>et al.</i> (1991). It occurs in the wettest part of their study area (1200 mm rainfall). The lithology of the site is Quaternary alluvium and King Leopold Sandstone/Hart dolerite. Soil drainage is excessive or free, and soil inundation is seasonal.	Sample and report on habitat, flora and land snail fauna using methods described in EPA (2016a, b), and key references (McKenzie <i>et al.</i> 1991). Compare habitat, and its' associated assemblages, to summary description, and descriptions in key references.
22	Assemblages of Theda Soak rainforest swamp	The known occurrence of the community comprises a patch of rainforest around a spring-fed soak (Theda Soak) on a floodplain in the east Kimberley. Trees grow to 20 m high and include <i>Albizia lebbbeck</i> (lebbek tree),	Johnstone, R.E. and Burbidge, A.H. (1991) The Avifauna of Kimberley rainforests. In: Kimberley Rainforests of Australia. McKenzie, N.L., Johnston, R.B. and Kendrick,	The community originally described in McKenzie <i>et al.</i> (1991) in the Kimberley Rainforest Survey. The Theda Soak rainforest swamp community contains a discrete patch of rainforest occurring around a spring-fed soak,	Sample and report on habitat, flora and aquatic fauna using methods described in EPA (2016a, b), and

		<p><i>Antidesma ghaesembilla</i> (Yangu), <i>Bombax ceiba</i> (kapok-tree), <i>Garuga floribunda</i>, <i>Glochidion disparipes</i> (cheese tree), <i>Ficus aculeata</i> (sandpaper fig), <i>Ficus racemosa</i> var. <i>racemosa</i> (cluster fig tree), <i>Litsea glutinosa</i>, <i>Melaleuca leucadendra</i> (weeping paperbark), <i>Sesbania formosa</i> (white dragon tree), <i>Sterculia quadrifida</i> (redfruit kurrajong), <i>Syzygium nervosum</i> (Daly River satinash) and <i>Terminalia microcarpa</i> (damson plum). The camaenid land snail assemblage distinguishes this community. The community was originally described in McKenzie N.L., Johnston R.B. and Kendrick P.G. (eds) (1991) "Kimberley rainforests of Australia" (Surrey Beatty & Sons, Chipping Norton, NSW, in association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment, Canberra).</p>	<p>P.G. (eds). Surrey Beatty and Sons, Norton, NSW.</p> <p>McKenzie, N.L. (1991) An ecological survey of tropical rainforests in Western Australia: background and methods. In: Kimberley Rainforests of Australia. McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (eds). Surrey Beatty and Sons, Norton, NSW.</p> <p>McKenzie, N.L., Belbin, L., Keighery, G.J. and Kenneally, K.F. (1991) Kimberley rainforest communities: Patterns of species composition and Holocene biogeography. In: Kimberley Rainforests of Australia. McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (eds). Surrey Beatty and Sons, Norton, NSW.</p> <p>Solem, A. (1991) Land snails of Kimberley rainforest patches and biogeography of all Kimberley land snails. In: Kimberley Rainforests of Australia. McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (eds). Surrey Beatty and Sons, Norton, NSW.</p>	<p>on a floodplain. The community is likely to be supported by sustained upwelling of groundwater. Community can be distinguished from other rainforest assemblages through its species composition including perennial plants, birds and land snails; and physical attributes such as climate, lithology, geomorphic setting, soil and geographic location. The assemblage grouping is described by McKenzie <i>et al.</i> (1991) as a small patch of rainforest around a spring-fed soak on a floodplain, 0.5km from a tributary of the Morgan River. The camaenid land snail assemblages in rainforest communities of the Kimberley Region can be used to distinguish this patch from similar rainforest communities elsewhere in northern Australia (Solem 1991)</p>	<p>key references (McKenzie 1991). Determine if habitat meets description of permanently moist peat mounds. Clarify if wetland hydrology is supported by groundwater.</p> <p>Compare key peat substrate, and its' associated assemblages, to summary description, and descriptions in key references.</p> <p>McKenzie (1991) vegetation and molluscs survey methods:</p> <p>Surveys were undertaken in June and late January/early March for a wet season comparison. Included detailed geomorphic appraisal, soil profile description made along topographically representative transects and the soil profiles for laboratory analysis; flora (establishment of long-term monitoring quadrats along a transect) and fauna.</p>
23	Assemblages of the organic mound springs of the Three Springs area	<p>The community occurs in the Three Springs area. The mound spring habitat is characterised by continuous discharge of groundwater in raised areas of peat. The peat and surrounds provide a stable, permanently moist series of micro-habitats. There is a high level of heterogeneity of invertebrate fauna assemblages between occurrences, and all</p>	<p>Pinder, A., Clarke, V. and Harding, C. (2009). Monitoring of the Invertebrate Assemblages of Mound Springs of the Three Springs Area Threatened Ecological Community. Version 1.0 (August 2009). Prepared for Significant Native Species and</p>	<p>Invertebrate and flora assemblages that inhabit habitats comprising permanently moist or inundated mounds of peat in the Three Springs area. Peat habitat is supported by groundwater seepage.</p>	<p>Sample and report on habitat, flora and aquatic fauna using methods described in EPA (2016a, b), and key references. Determine if habitat meets description of</p>

		are associated with a rich and healthy fauna. The distinctive assemblages are composed of invertebrate groups that commonly include beetles, oligochaetes, non-biting midges and bugs. The vegetation component of the community contains many moisture loving species including an overstorey of <i>Melaleuca preissiana</i> (moonah) trees. <i>Eucalyptus camaldulensis</i> (river gum) and <i>Eucalyptus rudis</i> (flooded gum) are also found in a number of the mound springs. The shrub layer often includes <i>Hypocalymma angustifolium</i> (white myrtle) and <i>Acacia saligna</i> (orange wattle) over <i>Baumea vaginalis</i> (sheath twigrush) and other sedges. The herbaceous <i>Patersonia occidentalis</i> (swamp variant) has been recorded at several occurrences.	Ecological Communities – Resource Condition Monitoring Project. Rees, R. and Broun, G. (2005) Assemblages of Organic Mound Springs of the Three Springs area Interim Recovery Plan #196, 2005-2010. Department of Conservation and Land Management, Western Australia.		permanently moist peat mounds. Clarify if wetland hydrology is supported by groundwater. Compare key peat substrate, and its' associated assemblages, to summary description, and descriptions in key references.
24	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	The community occurs in tumulus springs (organic mound springs) on the Swan Coastal Plain. The habitat of the mound springs is characterised by continuous discharge of groundwater in raised areas of peat. The peat and surrounds provide a stable, permanently moist series of microhabitats, with a high level of heterogeneity of invertebrate fauna assemblages between sites. Groups commonly represented include Ostracoda, Nematoda, Cladocera, Copepoda, Oligochaeta, Tardigrada, Turbellaria and Insecta. Typical and common native vascular plant species associated with the tumulus springs are the trees <i>Banksia littoralis</i> (swamp banksia), <i>Melaleuca preissiana</i> (moonah) and <i>Eucalyptus rudis</i> (flooded gum), and the shrubs <i>Taxandria linearifolia</i> (willow myrtle), <i>Pteridium esculentum</i> (bracken), <i>Astartea scoparia</i> (common astartea) and <i>Cyclosorus interruptus</i> (swamp shield-fern) and sedges <i>Cyathochaeta teretifolia</i> , <i>Netrostylis</i> sp. Chandala.	Department of Conservation and Land Management (2006) Community of Tumulus (organic mound) springs of the Swan Coastal Plain Interim Recovery Plan 2005-2010. Interim Recovery Plan No. 198. Perth, Western Australia. Jasinska, E.J., and Knott, B., (1994) Aquatic fauna in Gnangara Mound discharge areas of the Ellen Brook catchment, Western Australia. A report submitted to the Water Authority of Western Australia. Tang, D., Storey, A.W. & B. Knott, (2008) <i>Mound (Tumulus) Springs of the Bullsbrook Region, Western Australia: Limnology and Invertebrates</i> . Report prepared for Department of Environment and Conservation by the School of Animal Biology, UWA. Groundwater Consulting Services Pty Ltd. (2006) <i>Shallow Groundwater Investigation and Monitoring. Northern Perth Springs, Neaves Nature Reserve, Western Australia</i> . Report prepared for Department of	Invertebrate and flora assemblages that inhabit habitats comprising permanently moist or inundated mounds of peat on the southern Swan Coastal Plain. Peat habitat is supported by groundwater seepage.	Sample and report on habitat, flora and aquatic fauna using methods described in EPA (2016a), and key references. Determine if habitat meets description of permanently moist peat mounds. Clarify if wetland hydrology is supported by groundwater. Compare key peat substrate, and its' associated assemblage, to summary description, and descriptions in key references.

			Conservation and Land Management.		
25	Assemblages of Walcott Inlet rainforest swamps	<p>The known occurrences of this community occur on the extensive floodplain that fringes a tidal mudflat in the Walcott Inlet in the north-west Kimberley. The community is focused on swampy rainforests, but associated swamp and woodland communities are included in the boundaries where they are closely linked with the rainforest. The vegetation structure varies with hydrology and includes dense rainforest to dense woodland, open savanna woodland, <i>Melaleuca</i> or grassy swamps and occasional open water. The rainforest vegetation comprises closed-canopy rainforest to 30 m in height, and is dominated by <i>Ficus</i> spp., <i>Nauclea orientalis</i> (Leichhardt pine), <i>Celtis strychnoides</i> (hackberry), and <i>Acrostichum speciosum</i> (mangrove fern). Eight priority flora occur in the community, including two not found anywhere else in Western Australia. Five threatened or endemic fauna including the northern quoll (<i>Dasyurus hallucatus</i> (endangered)) also occur. The tree <i>Cordia subcordata</i> and the snail <i>Torresitrachia</i> sp. were recorded at one patch of the community. The camaenid land snail assemblage distinguishes this community. The community was originally described in McKenzie N.L., Johnston R.B. and Kendrick P.G. (eds) (1991) "Kimberley rainforests of Australia" (Surrey Beatty & Sons, Chipping Norton, NSW, in association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment, Canberra).</p>	<p>Barrett, M. and Corey, B. (2016) Flora and fauna surveys of the Walcott River Threatened Ecological Community Rainforest Swamp. WA Department of Parks and Wildlife, Kununurra.</p> <p>Kenneally K. F., Keighery G. J., and Hyland B. P. M. (1991). Floristics and phytogeography of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW</p> <p>McKenzie N. L., Belbin, L., Keighery G. J., and Kenneally K. F. (1991). Kimberley rainforest communities: Patterns of species composition and Holocene biogeography. In: Kimberley Rainforests of Australia. McKenzie N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW</p> <p>McKenzie N.L., Johnston R.B. and Kendrick P.G. (eds) (1991) Kimberley rainforests of Australia. Surrey Beatty & Sons, Chipping Norton, NSW, in association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment, Canberra.</p> <p>Solem, A. (1991). Land snails of Kimberley rainforest patches and biogeography of all Kimberley land snails. In: Kimberley Rainforests of Australia. McKenzie N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW.</p> <p>Stoneman, T. C., McArthur, W.M. and Walsh F.J. (1991). Soils and landforms of Kimberley rainforests, Western Australia. In: Kimberley Rainforests of Australia. McKenzie</p>	<p>Three occurrences are known of this tall closed-canopied swamp rainforest on the extensive floodplain that fringes a tidal mudflat in the Walcott Inlet. The centre of the swamp supports <i>Melaleuca</i> forest on higher ground. The soils are generally highly organic and Quaternary alluvium. Most of the camaenid land snails recorded in the Kimberley Rainforest Survey are restricted endemics in the Kimberley. The median range for a wet area Kimberley camaenid is 20km, and 82 of the 93 camaenids were only collected in 1 to 5 patches (Solem 1991).</p>	<p>Sample and report on habitat, flora and invertebrate using methods described in EPA (2016a, b), and key references (McKenzie 1991). Determine if habitat meets description. Compare substrate, and its' associated assemblages, to summary description, and descriptions in McKenzie <i>et al.</i> (1991), who sampled 95 patches of tropical rainforest through inventory of perennial plants, birds and land snails.</p>

			N. L., Johnston R. B. and Kendrick P. G. (eds). Surrey Beatty and Sons, Norton, NSW		
Grasslands, wetlands, herbfields					
26	Herblands and bunch grasslands on gypsum lunette dunes alongside saline playa lakes	The community has been recorded from the Lake Magenta area, on grey sandy clay on the top of a lake edge dune on gypsum lunette dunes alongside saline playa lakes. Floristic composition includes the herbaceous taxa <i>Austrostipa juncifolia</i> , <i>Rytidosperma caespitosum</i> , <i>Podolepis rugata</i> , <i>Asteridea chaetopoda</i> , and shrubs <i>Atriplex paludosa</i> , <i>Maireana marginata</i> , <i>Tecticornia syncarpa</i> , <i>Scaevola spinescens</i> (currant bush) and <i>Lawrenzia squamata</i> .	Jones, D.C. (1993) Gypsum deposits of Western Australia. Geological Survey of Western Australia. Record 1993/5. Lyons, M.N., Gibson, N., Keighery, G.J. Lyons, S.D. (2004). Wetland flora and vegetation of the WA Wheatbelt. Records of the Western Australian Museum Supplement No. 67. 39-89. Mattiske Consulting Pty Ltd. (1995). A review of botanical values on a range of gypsum dunes in the Wheatbelt of Western Australia. Report to the Department of Conservation and Land Management, Perth. O'Keefe, M. (2003) Room for Discovery: do we know enough about Australia's gypsophiles? Australasian Plant Conservation 12: 6-7. Rick, A. (2011) Survey and analysis of plant communities growing on gypsum in the Western Australian Wheatbelt. A report for the wheatbelt NRM Region and the Department of Environment and Conservation WA.	Gypsum substrate forms from sediments sourced from shores during wet phases and exposed lake floors during dry, arid phases. Gypsum occurs in salt lakes or playas, coastal basins and sequences in ancient sedimentary rock. This community consists of a grey sandy clay substrate on the top of a playa lake, gypsum lunette dune. This distinctive floral assemblage is associated with gypsum substrate in the Lake Magenta area. Community occurs on transverse lunette dune on downwind margin of a playa lake.	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references including Rick (2011). Determine if gypsum substrate that is key to identification of the community, occurs. Verify if substrate and flora assemblage meet summary description.
27	Herbaceous plant assemblages on Bentonite Lakes as originally described by Griffin and Associates (1991)	The community occurs on the lake margins of bentonite lakes in the Watheroo-Marchagee region, as originally described by Griffin, E.A. and Associates (1991). Flora and Vegetation of Watheroo Bentonitic Lakes. Unpublished report prepared for Bentonite Australia Pty Ltd. The community comprises herbaceous plant assemblages dominated by a combination of <i>Triglochin mucronata</i> , <i>Trichanthodium exilis</i> , <i>Asteridea athrixoides</i> and <i>Puccinellia stricta</i> (marsh grass) on the lake beds, and a combination of <i>Siemssenia capillaris</i> (wiry podolepis), <i>Angianthus tomentosus</i> (camel-grass) and <i>Pogonolepis</i>	Department of Conservation and Land Management (2002). Interim Recovery Plan 2002-2007 for Herbaceous plant assemblages on bentonite lake beds (Vegetation Types 1,2,3&7) and margins (Vegetation Types 4,5&6) of the Watheroo-Marchagee region. Interim Recovery Plan No. 108. CALM, Perth. Griffin, E. A. and Associates (1991). <i>Flora and Vegetation of Watheroo Bentonitic Lakes</i> . Unpublished	Habitat is perched ephemeral freshwater playa lakes and claypans, and bentonite substratum. Known from between Watheroo and Marchagee /Enagu, immediately south and east of Lake Pinjarrega. Bentonite substate of lakes supports distinctive assemblages of herbaceous flora, and occasionally a tree or shrub layer. Floral assemblage differs from other lakes in the region, likely due to the bentonite substrate. Herb-dominated community depends on intermittent freshwater inundation and drying out within a few weeks of filling.	Sample and report on flora and vegetation and habitat, using methods described in EPA (2016a); and key references. Compare lake substrate and habitat and associated distinctive assemblages, to summary description, and descriptions in key references.

		<p><i>stricta</i> (stiff angianthus). These herbaceous plant assemblages are characterised by a dependence on a bentonite (saponite) substrate — naturally restricted to the lake beds and margins of perched, ephemeral freshwater playa lakes and claypans of the Watheroo-Marchagee region. While most lakes comprise only herbaceous species, there are a number with varying densities of <i>Casuarina obesa</i> trees, and shrubs of <i>Melaleuca lateriflora</i> (gorada) and <i>Acacia ligustrina</i>.</p>	<p>report prepared for Bentonite Australia Pty Ltd.</p>		
28	<p>Perched wetlands of the Wheatbelt region with extensive stands of living <i>Casuarina obesa</i> (swamp sheoak) and <i>Melaleuca strobophylla</i> (paperbark) across the lake floor</p>	<p>The community occurs in large ephemeral wetlands in the inland Wheatbelt of south-west Western Australia. It comprises intact <i>Casuarina obesa</i> (swamp sheoak) and <i>Melaleuca strobophylla</i> (paperbark) dominated stands of vegetation over the lake floor.</p>	<p>Department of Biodiversity, Conservation and Attractions (2017). Toolibin Lake Catchment Recovery Plan (2015) 2015–35. Toolibin Lake Recovery Plan (1994). Prepared by the Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group, September 1994. Perched wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor (Toolibin Lake) Recovery Plan (1994).</p>	<p>Seasonal wetlands that receive water from rainfall and overland flow. The wetlands are dominated by <i>Casuarina obesa</i> and <i>Melaleuca strobophylla</i> and occur in the inland agricultural area of south-west Western Australia.</p>	<p>Sample, analyse data and report on flora and vegetation and habitat, using methods described in EPA (2016a); and key references. Compare habitat and composition to summary description, and descriptions in DBCA (2017) and Toolibin Lake Recovery Team and Toolibin Lake Technical Advisory Group (1994)</p>

29	Sedgeland in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19 as originally described in Gibson <i>et al.</i> (1994))	The community is within wetland depressions (swales) occurring between parallel Holocene dunes, mostly located on the Rockingham-Becher Plain but also extending further north to Lancelin and south to Dalyellup. Typical and common native species in the community are the shrubs <i>Acacia rostellifera</i> (summer-scented wattle), <i>Acacia saligna</i> (orange wattle) and <i>Xanthorrhoea preissii</i> (balga), the sedges <i>Baumea juncea</i> (bare twigrush), <i>Ficinia nodosa</i> (knotted club rush) and <i>Lepidosperma gladiatum</i> (coast sword-sedge), and the grass <i>Poa porphyroclados</i> . The community is also known as "floristic community type 19" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Department of Environment and Conservation (2011) Interim Recovery Plan 2011-2016 for Sedgeland in Holocene dune swales. Interim Recovery Plan No. 314. Department of Environment and Conservation, Perth. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia. Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i> . Report prepared for the Department of Conservation and Land Management. Perth, Western Australia.	Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994). Community typically occurs in dampland and sumpland habitats that occur largely on Quindalup dunes in Holocene beach ridge dune swales. Typically a dense, species-poor sedgeland dominated by bare twigrush (<i>Baumea juncea</i>) and knotted club rush (<i>Ficinia nodosa</i>) in younger near-coastal dunes. In some of the older swales an open tree cover has developed over the sedgeland.	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.
30	Themeda grasslands on cracking clays (Hamersley Station, Pilbara)	The community is known from Hamersley Station in the Pilbara. It comprises an open to closed tussock grassland on cracking clays and is dominated by the perennial <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (priority 3) that grows to approximately 1.8 m high. A suite of other grasses and herbs also	Biota Environmental Sciences (2012) <i>Themeda Grasslands Threatened Ecological Community – Seasonal Botanical Survey</i> . Report prepared for Rio Tinto Iron Ore Pty Ltd.	Originally mapping of the community was based on land system mapping by the Department of Agriculture and Food (van Vreeswyk <i>et al.</i> 2004). Coincided with the Brockman land system in Hamersley subregion. Land system described by van Vreeswyk <i>et al.</i> (2004) as 'level alluvial plains with cracking clay soils and gilgai microrelief, supporting tussock grasslands (land	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references.

		<p>occur. In some areas there is scattered open overstorey of low trees present including <i>Hakea lorea</i> subsp. <i>lorea</i> (witinti) and <i>Eucalyptus victrix</i> (smooth barked coolabah).</p>	<p>CSIRO (2016) The Australian Soil Classification. Second Edition. CSIRO Publishing, Australia.</p> <p>Ecoscape (2011) 'Themeda Grasslands on Cracking Clay' TEC Assessment. Report prepared for Fortescue Metals Group Limited.</p> <p>Grant, C.D. and Blackmore, A.V. (1991) Self-mulching behaviour in clay soils: Its definition and measurement. <i>Australian Journal of Soil Research</i> 29: 155–173.</p> <p>Van Vreeswyk, A.M.E., Payne, A.L., Leighton, K.A. and Hennig, P. (2004) An inventory and condition survey of the Pilbara region, Western Australia. Department of Agriculture and Food, Western Australia, Perth. <i>Technical Bulletin</i> 92.</p>	<p>type 14)' and comprised six land units. Of these land units, the gilgai plains were associated with the tussock grassland vegetation types. The soils are described by van Vreeswyk <i>et al.</i> (2004) as 'self-mulching cracking clays (soil group 602)' and 'red/brown non-cracking clays (soil group 622)'. The term 'self-mulching' describes the way heavy clay soils (35%+ clay) form a loose granular mulch of fine aggregates at the soil surface, after wetting and drying, which falls to the bottom of the profile and increases its volume (Grant and Blackmore 1991). These soils have shrink-swell properties that exhibit strong cracking at depth when dry hence, 'cracking' soils (CSIRO 2016). The uppermost soil layer exhibits large surface cracks or has crumbly (self-mulching) surfaces when dry, and when wet heave, often showing rough mounded (gilgai) surfaces forming a network of gilgai plains. The soil surface is generally non-saline, to partially saline in deep sub soils.</p> <p>Community is dependent on inundation with fresh water from sporadic rainfall events and run-on rainfall from surface flows.</p> <p>The floristic units described by Biota (2012) are all dominated by <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) but vary in composition with the addition of scattered tall shrubs, woodlands and shrublands. The composition varies between sites depending on soil depth and probably chemistry, local hydrology, fire history, and possibly other factors such as land use.</p> <p>The following priority flora also occur in the community: <i>Euphorbia inappendiculata</i> var. <i>queenslandica</i> (P1); <i>Euphorbia australis</i> var. <i>glabra</i> (P2); <i>Glycine falcata</i> (P3); <i>Iotasperma sessilifolium</i> (P3); <i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3); <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3); <i>Stackhousia clementii</i> (P3); <i>Swainsona thompsoniana</i> (P3); <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3).</p> <p>Three vegetation units are considered a subtype of the TEC with <i>Hakea lorea</i> subsp. <i>lorea</i> scattered tall shrubs to low open woodland over <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) tussock grassland to be included in the TEC. HLTHs typically occurs on boundaries of the TEC providing a buffer to the community.</p>	<p>Determine if habitat (Pilbara cracking clay flats) and associated floral assemblages occur, and meet summary description, and are consistent with descriptions in key references.</p>
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31	Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by <i>Duma horrida</i> subsp. <i>abdit</i> and <i>Tecticornia verrucosa</i> across the lake floor (Lake Bryde)	The community occurs in freshwater wetlands (Lake Bryde wetland system) of the southern Wheatbelt of Western Australia. The habitat of this community is characterised by intermittent inundation, and it sometimes holds little water for several consecutive years. The major components of the community and other biota depend on relatively fresh water and regular drying out of the clay and silt wetland bed for survival. In addition to <i>Duma horrida</i> subsp. <i>abdit</i> (threatened) and <i>Tecticornia verrucosa</i> across the lake floor, the wetlands support fringing open woodlands of <i>Eucalyptus occidentalis</i> (flat-topped yate) over <i>Melaleuca strobophylla</i> dominated scrub.	Department of Biodiversity, Conservation and Attractions (2020). Lake Bryde Landscape Recovery Program 2020-2040. DBCA, Perth. Hamilton-Brown, S., and J. Blyth. 2001. Unwooded Fresh Water Lakes of the Southern Wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subsp. <i>abdit</i> and <i>Tecticornia verrucosa</i> across the lake floor and, <i>Muehlenbeckia horrida</i> subsp. <i>abdit</i> Interim Recovery Plan 2001- 2006., Department of Conservation and Land Management, Wanneroo, Western Australia.	Lakes that are seasonally inundated with fresh water, with key flora <i>Duma horrida</i> subsp. <i>abdit</i> and <i>Tecticornia verrucosa</i> . Only known from Lake Bryde, East Lake Bryde and Lakeland Nature Reserve. Major flora and other biota depend on relatively fresh water and regular drying out of the clay and silt wetland bed for survival.	Sample and report on flora and vegetation and habitat, using methods described in EPA (2016a); and key references. Compare seasonal freshwater lake habitat, and composition of dominant flora to summary description, and description in key references
Shrublands					
32	<i>Calothamnus graniticus</i> subsp. <i>graniticus</i> heaths on south-west coastal granites	The community is known from a narrow band parallel to the western shores of Geopraphe Bay near Meelup. It occurs in areas of exposed granite outcrops and isolated pockets of shallow gravelly-loam soils predominantly found lower in the landscape, but also in isolated pockets upslope where granite boulders dominate. The distinctive <i>Calothamnus graniticus</i> subsp. <i>graniticus</i> (one-sided bottle brush; priority 4) forms a dense shrub layer with <i>Gastrolobium spinosum</i> (prickly poison), <i>Allocasuarina humilis</i> (dwarf sheoak) and <i>Dodonaea ceratocarpa</i> . Downslope smaller shrubs include <i>Boronia tenuis</i> (blue boronia) (priority 4), <i>Chorizema aciculare</i> (needle-leaved chorizema), <i>Hibbertia hypericoides</i> (yellow buttercups), <i>Hibbertia spicata</i> , <i>Phyllanthus calycinus</i> (false boronia), <i>Thryptomene saxicola</i> (rock thryptomene) and <i>Xanthorrhoea preissii</i> (balga). <i>Burchardia congesta</i> , the orchid <i>Caladenia caesarea</i> subsp. <i>maritima</i> (critically endangered), a fern <i>Cheilanthes austrotenuifolia</i> , <i>Conostylis setigera</i> (bristly cottonhead), <i>Laxmannia sessiliflora</i> (nodding lily), <i>Lomandra micrantha</i> (small-flower mat-rush), triggerplants including <i>Stylidium affine</i> (Queen triggerplant), <i>Stylidium megacarpum</i> , <i>Sylidium</i>	Keating, C. and Trudgen, M. (1986) A Flora and Vegetation Survey of the Coastal Strip from Forrest Beach – Cape Naturaliste – Woodlands. Report prepared for the Department of Conservation and Environment, WA. Shire of Busselton (2007). Fire Management Plan Meelup Regional Park. Written by Meelup Regional Parks Management Committee Reviewed August 2007. Webb, A. (2013). The Flora and Vegetation of the Meelup reserve system. An unpublished report for the Meelup Park Management Committee. Bunbury, Western Australia.	The presence of <i>Calothamnus graniticus</i> subsp. <i>graniticus</i> is key to identification of the community. The following units are included in the community: <ul style="list-style-type: none"> AgCg – <i>Agonis flexuosa</i>, <i>Calothamnus graniticus</i> subsp. <i>graniticus</i> closed scrub. GH1 – <i>Calothamnus graniticus</i> subsp. <i>graniticus</i> Open to Closed Heath. AgM – <i>Agonis flexuosa</i>, <i>Eucalyptus calophylla</i> Low Woodland. Ah – <i>Allocasuarina humilis</i>, <i>Thryptomene saxicola</i>, <i>Dodonaea ceratocarpa</i>, <i>Calothamnus graniticus</i> subsp. <i>graniticus</i> low shrubland. MGr – <i>Eucalyptus calophylla</i> Woodland. These are amalgamated into 'Calothamnus graniticus Closed Heath' that represents the community. Webb (2013) dissimilarity analysis differentiates the vegetation of Big Rock from this community.	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Determine if <i>Calothamnus graniticus</i> subsp. <i>graniticus</i> occurs, (key to identification of the community). Verify if substrate and vegetation units meet summary description and descriptions in key references.

		<i>repens</i> (matted triggerplant) and sedges and grasses, <i>Lepidosperma squamatum</i> , <i>Morelotia octandra</i> and <i>Neurachne alopecuroidea</i> (foxtail mulga grass) can also be found in the understorey.			
33	Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson <i>et al.</i> (1994))	The community is generally dominated by <i>Melaleuca viminea</i> (mohan), <i>Melaleuca osullivanii</i> , <i>Melaleuca cuticularis</i> (saltwater paperbark) or <i>Casuarina obesa</i> (swamp sheoak) or a mixture of these species. It has been recorded between Mogumber and Ambergate on heavy clay soils that are generally inundated from winter into mid-summer. The species <i>Melaleuca cuticularis</i> and <i>Casuarina obesa</i> may indicate some saline influence for at least some part of the year. Herbs such as <i>Brachyscome bellidioides</i> , <i>Centrolepis polygyna</i> (wiry centrolepis), <i>Pogonolepis stricta</i> (stiff angianthus) and <i>Cotula coronopifolia</i> (waterbuttons) are typical of this community. In addition, species such as <i>Angianthus drummondii</i> (priority 3), <i>Eryngium pinnatifidum</i> subsp. <i>palustre</i> (priority 3), and <i>Blennospora drummondii</i> occur in the community in low frequency. A suite of annual flora is seen in the community as the season progresses. In early spring many of the occurrences of the community are covered by free water up to 30 cm deep. <i>Cotula coronopifolia</i> sometimes forms yellow floating mats in some pools while others may be dominated by <i>Ornduffia submersa</i> (priority 4). Aquatic species are common in the community early in the growing season. As the wetland dries a succession of species such as <i>Centrolepis</i> spp. and annual <i>Stylidium</i> spp. successively germinate, grow and flower, resulting in an extended flowering period of over three months. The community is also known as “floristic community type 7” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Department of Parks and Wildlife (2015). Interim Recovery Plan 2015-2020 for Clay pans of the Swan Coastal Plain (Swan Coastal Plain community types 7, 8, 9 and 10a) and Clay pans with mid dense shrublands of <i>Melaleuca lateritia</i> over herbs. Interim Recovery Plan No. 354. Perth. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) <i>Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset</i> . Department of Environment and Conservation, Kensington, Western Australia.	Community occurs on heavy clay soils that are generally wet, and may have surface water present, from winter to mid-summer. Many locations hold water up to 30cm deep in early spring, and early flowering aquatic species are common. A succession of species including <i>Centrolepis</i> spp. and <i>Stylidium</i> spp. flower as the clay pans dry over a period of up to three months. The community can occur under a shrub layer comprising <i>Melaleuca viminea</i> , <i>M. osullivanii</i> , <i>M. cuticularis</i> or <i>Casuarina obesa</i> or other shrubs but can also occur as woodlands or herblands. Some areas such as where <i>Melaleuca cuticularis</i> or <i>Casuarina obesa</i> occur as an overstorey may be saline for part of the year due to evaporation resulting in increased salinity. Herbs such as <i>Philydrella pygmaea</i> , <i>Brachyscome bellidioides</i> , <i>Centrolepis aristata</i> , <i>Centrolepis polygyna</i> , <i>Pogonolepis stricta</i> and <i>Cotula coronopifolia</i> (alien species in Florabase); frequently occur in the community. Species such as <i>Angianthus drummondii</i> , <i>Eryngium pinnatifidum</i> subsp. <i>palustre</i> (G.J. Keighery 13459) and <i>Blennospora drummondii</i> occur in low frequency and were not recorded in community types 8 to 10 (Gibson <i>et al.</i> 1994).	Sample, analyse data and report on flora, vegetation and habitat using methods described in EPA (2016a); and further detail in DBCA (2021 - see Appendix 1 below), and key references.

		Management and the Conservation Council of Western Australia (Inc.)).			
34	Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson <i>et al.</i> (1994))	The community has been recorded between Bullsbrook and Ludlow, and occurs in low lying flats with a clay impeding layer that facilitates seasonal inundation. The vegetation can be dominated by <i>Viminaria juncea</i> (swishbush), <i>Melaleuca viminea</i> (mohan), <i>Melaleuca lateritia</i> (robin redbreast bush) or <i>Melaleuca osullivanii</i> but also occasionally by <i>Eucalyptus wandoo</i> (wandoo). The occurrence of species such as <i>Hypocalymma angustifolium</i> (white myrtle), <i>Acacia lasiocarpa</i> var. <i>bracteolata</i> (long peduncle form) and <i>Verticordia huegelii</i> (variegated featherflower) at moderate frequencies, and aquatic annuals is common. The community is also known as "floristic community type 8" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Department of Parks and Wildlife (2015). Interim Recovery Plan 2015-2020 for Clay pans of the Swan Coastal Plain (Swan Coastal Plain community types 7, 8, 9 and 10a) and Clay pans with mid dense shrublands of <i>Melaleuca lateritia</i> over herbs. Interim Recovery Plan No. 354. Perth. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.	The surface pools in this community do not generally contain water to the same depth or for as long as in community type 7, but aquatic annuals are still common. In the most recent analysis of a more comprehensive dataset of clay pan data by Gibson <i>et al.</i> (2005) that included areas outside of the Swan Coastal Plain, however, sites in these deeper basin clay pans grouped separately into the community 'Clay pans with shrubs over herbs', described below. This includes clay pans in the Brixton St wetlands (occurrences 35, 53), Bandicoot Brook (occurrence 37), Pursers (occurrences 102, 103, 106, 107), Julimar (occurrence 101), and Drummond (occurrences 99, 100). <i>Viminaria juncea</i> , <i>Melaleuca viminea</i> , <i>M. lateritia</i> or <i>M. osullivanii</i> and occasionally <i>Eucalyptus wandoo</i> generally dominate this community. <i>Hypocalymma angustifolium</i> , <i>Acacia lasiocarpa</i> var. <i>bracteolata</i> (long peduncle form P1) and <i>Verticordia huegelii</i> can also occur. Typical herbs include <i>Centrolepis aristata</i> , <i>Chorizandra enodis</i> , <i>Drosera menziesii</i> subsp. <i>menziesii</i> , <i>Drosera rosulata</i> and <i>Hyalosperma cotula</i> . This community included a relatively high proportion of weeds due to historical disturbance (Gibson <i>et al.</i> 1994).	Sample, analyse data and report on flora, vegetation and habitat using methods described in EPA (2016a); and further detail in DBCA (2021 - see Appendix 1 below), and key references.
35	Dense shrublands on clay flats (floristic community type 9 as originally described in Gibson <i>et al.</i> (1994))	The community occurs as shrublands or open woodlands on clay flats that are inundated for long periods. It has been recorded between Moore River National Park and Dunsborough. Sedges are more apparent in the community than in other claypans, generally with moderate frequencies of <i>Chorizandra enodis</i> (black bristlerush), <i>Cyathochaeta avenacea</i> , <i>Lepidosperma longitudinale</i> (pithy sword-sedge) and <i>Leptocarpus coangustatus</i> . The	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.	Community recorded from shrublands or open woodlands that are inundated for longer periods and have lower species richness and numbers of weeds than the other clay pan types on the Swan Coastal Plain (FCT07, 08, 10a). Sedges including <i>Chorizandra enodis</i> , <i>Cyathochaeta avenacea</i> , <i>Lepidosperma longitudinale</i> and <i>Leptocarpus coangustatus</i> (formerly <i>Meeboldina coangustata</i>) are more common in this community. Shrubs including <i>Hakea varia</i> , <i>Melaleuca viminea</i> and <i>Eutaxia virgata</i> are common.	Sample, analyse data and report on flora, vegetation and habitat using methods described in EPA (2016a); and further detail in DBCA (2021 - see Appendix 1 below), and key references.

		community has a lower species richness and weed frequency than other claypan threatened ecological communities. The community is also known as “floristic community type 9” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Department of Parks and Wildlife (2015). Interim Recovery Plan 2015-2020 for Clay pans of the Swan Coastal Plain (Swan Coastal Plain community types 7, 8, 9 and 10a) and Clay pans with mid dense shrublands of <i>Melaleuca lateritia</i> over herbs. Interim Recovery Plan No. 354. Perth. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.	Community is known from the following vegetation complexes, that equate to soil and landform units: Bassendean Complex North, Guildford, Serpentine River, Bassendean Complex Central and South, Karakatta complex Central and South, and Southern River Complex.	
36	Ferricrete floristic community (Rocky Springs type)	The community comprises tall shrubland and has been recorded between Arrino and Eneabba, on irregularly inundated red brown sandy loams over ferricrete. It is generally dominated by <i>Acacia blakelyi</i> , <i>Allocasuarina campestris</i> and <i>Labichea lanceolata</i> subsp. <i>lanceolata</i> . Associated species include <i>Alyogyne hakeifolia</i> , <i>Borya sphaerocephala</i> (pincushions), <i>Isotoma hypocrateriformis</i> (Woodbridge poison), <i>Petrophile seminuda</i> , <i>Stylidium dichotomum</i> (pins-and-needles), <i>Thysanotus patersonii</i> and <i>Pterochaeta paniculata</i> (woolly waitzia).	Department of Parks and Wildlife (2004). Interim Recovery Plan 2004-2009 for ‘Ferricrete floristic community (Rocky Springs type)’ (update). Interim Recovery Plan No. 154. Department of Parks and Wildlife, Perth. Griffin, E. A., Hopkins, A. J. M and Hnatiuk, R. J. (1983) Regional variation in Mediterranean-type shrublands near Eneabba, south-western Australia. <i>Vegetatio</i> 52, 103-127. Hnatiuk, R. J. and Hopkins, A. J. M (1981) An ecological analysis of kwongan south of Eneabba, Western Australia. <i>Australian Journal of Ecology</i> 6, 423-438. Lowry, D.C. (1974) Dongara-Hill River, Western Australia 1:250,000 Geological Series – explanatory	Community is defined by the presence of ferricrete and derived substrates that underlie the distinctive vegetation. Ferricrete is formed in the soil profile at the water-table when iron-oxides accumulate and cement together to form a gravely or nodule-rich band. This community occurs on infrequently inundated red and brown sandy loams over ferricrete. Ferricrete substrate is extremely restricted in distribution in the Eneabba region. The floral composition of the Ferricrete community varies with substrate types and depths. The Rocky Springs sites lie within the ‘Rocky Springs complex’ - a combination of exposures of a ferruginous layer and Mesozoic sediments with varying amounts of shallow sand and gravel mantle. Community occurs over range of 45km between Arrino and Eneabba in the Northern Perth Basin.	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Compare key substrate characteristics, and its’ associated assemblages, to descriptions in key references. The range of flora and vegetation that occurs on Ferricrete substrate in the Eneabba area and the habitats of this TEC may not have been fully documented.

			notes. Geological survey of Western Australia. Mory, A. J. (1994) Geology of the Arrowsmith-Beagle Islands 1: 100,000. Geological Survey of Western Australia.		
37	Lesueur-Coomallo floristic community A1.2 as originally described by Griffin and Hopkins (1990)	The community is known from Warradarge. It comprises a species-rich heath with emergent <i>Hakea obliqua</i> (needles and corks) on sand with faithful species of <i>Hakea obliqua</i> and <i>Beaufortia elegans</i> (elegant beaufortia) and constant species of <i>Dasypogon bromeliifolius</i> (pineapple bush) and <i>Stirlingia latifolia</i> (blueboy) over well-drained grey sand over pale yellow sand on lateritic uplands. Associated species include <i>Allocasuarina humilis</i> (dwarf sheoak), <i>Calothamnus sanguineus</i> (silky-leaved blood flower), <i>Hibbertia hypericoides</i> (yellow buttercups), <i>Hypocalymma xanthopetalum</i> and <i>Schoenus subflavus</i> (yellow bog-rush). The community was originally described by Griffin E.A. and Hopkins A.J.M. in the vegetation chapter (pp. 25-38) in Burbidge A.A., Hopper S.D. and van Leeuwen S. (eds.) (1990) "Nature conservation, landscape and recreation values of the Lesueur area" (A report to the Environmental Protection Authority from the Department of Conservation and Land Management. Bulletin 424, Environmental Protection Authority, Perth).	Griffin, E. A. and Hopkins, A. J. M. (1990). Vegetation. In: Burbidge, A. A., Hopper, S. D. and van Leeuwen, S. (eds.) <i>Nature Conservation, Landscape and Recreation values of the Lesueur Area</i> , pp. 25-38. A report to the Environmental Protection Authority from the Department of Conservation and Land Management. Bulletin 424, Environmental Protection Authority, Perth. Griffin, E. A., Hopkins, A. J. M and Hnatiuk, R. J. (1983). Regional variation. Hamilton-Brown, S. (2002). Lesueur-Coomallo Floristic Community A1.2 Interim Recovery Plan No. 106. Department of Conservation and Land Management, Western Australia. Martinick, W. G. and Associates Pty Ltd. (1989). Hill River Project Biological Studies: Vegetation of the Project Area in a Regional Context. Unpublished Report.	A distinctive sand heath known from a single location in the Lesueur area. Community is strongly associated with landform and soil distribution and only occurs in the south-eastern part of the Banovich Upland landform, characterised by old undulating lateritic slopes. Martinick and Associates (1989) observed that sandplain heath with emergent <i>Hakea obliqua</i> (Floristic Community A1.2) only occurred in one site.	Sample and report on flora and vegetation and habitat, using methods described in EPA (2016a); and key references. Compare substrate and habitat, and associated distinctive assemblage, with summary description and description in key references.
38	Lesueur-Coomallo Floristic Community D1 as originally described by Griffin and Hopkins (1990)	The community occurs in Hill River. It comprises a species-rich low heath on moderately to well-drained lateritic gravels on lower slopes and low rises, dominated by <i>Allocasuarina microstachya</i> with <i>Allocasuarina ramosissima</i> (priority 3), <i>Allocasuarina humilis</i> (dwarf sheoak), <i>Babingtonia grandiflora</i> (large-flowered babingtonia), <i>Borya nitida</i> (pincushions), <i>Calytrix flavescens</i> (summer starflower), <i>Calothamnus sanguineus</i> (silky-leaved blood flower), <i>Conostylis androstemma</i> (trumpets), <i>Cryptandra pungens</i> , <i>Banksia armata</i> (prickly	Department of Conservation and Land Management (2002). Lesueur-Coomallo Floristic Community D1 Interim Recovery Plan 109. Sheila-Hamilton Brown, Western Australian Threatened Species and Communities Unit. Griffin, E. A. and Hopkins, A. J. M. (1990). Vegetation. In: Burbidge, A. A., Hopper, S. D. and van Leeuwen, S. (eds.). <i>Nature Conservation, Landscape and Recreation values of the Lesueur</i>	Heath of floristic composition as described in Griffin and Hopkins (1990), on habitat of lateritic gravels on lower slopes and low rises (Lesueur area).	Sample, analyse data and report on vegetation using methods described in EPA (2016a); and key references. Compare habitat and composition to summary description, and description in key references.

		<p>dryandra), <i>Gastrolobium polystachyum</i> (horned poison), <i>Hakea auriculata</i>, <i>Hakea incrassata</i> (marble hakea), <i>Hakea ?erinacea</i>, <i>Hibbertia hypericoides</i> (yellow buttercups), <i>Hypocalymma xanthopetalum</i>, <i>Melaleuca trichophylla</i>, <i>Petrophile chrysantha</i>, <i>Schoenus subflavus</i> (yellow bog-rush) and <i>Xanthorrhoea drummondii</i>. The community was originally described by Griffin E.A. and Hopkins A.J.M. in the vegetation chapter (pp. 25-38) of Burbidge A.A., Hopper S.D. and van Leeuwen S. (eds.) (1990) "Nature conservation, landscape and recreation values of the Lesueur area" (A report to the Environmental Protection Authority from the Department of Conservation and Land Management. Bulletin 424, Environmental Protection Authority, Perth).</p>	<p>Area, pp. 25-38. A report to the Environmental Protection Authority from the Department of Conservation and Land Management. Bulletin 424, Environmental Protection Authority, Perth.</p>		
39	<p><i>Melaleuca huegelii</i> — <i>Melaleuca systema</i> shrublands on limestone ridges (floristic community type 26a as originally described in Gibson <i>et al.</i> (1994))</p>	<p>The community occurs on skeletal soil on limestone ridge slopes and ridge tops north and south of Perth. The community comprises species-rich thickets, heaths and scrubs dominated by <i>Melaleuca huegelii</i> (chenille honeymyrtle), <i>Melaleuca systema</i> (coastal honeymyrtle) and <i>Banksia sessilis</i> (parrot bush) commonly over <i>Grevillea preissii</i> (spider net grevillea) and <i>Acacia lasiocarpa</i> (pajang). A suite of herbs commonly occur under the shrub layer. The community is also known as "floristic community type 26a" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).</p>	<p>Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.</p> <p>Department of Environment and Conservation (2005). Interim Recovery Plan 2004-2009 for <i>Melaleuca huegelii</i> – <i>Melaleuca systema</i> shrublands of limestone ridges (Swan Coastal Plain Community type 26a - Gibson <i>et al.</i> 1994) Interim Recovery Plan No. 193. DEC, Perth.</p> <p>Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i>. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A.</p>	<p>Floristic community type 26a (FCT26a) is highly restricted and known from massive limestone ridges around Yanchep north of Perth, and south of Perth near Lake Clifton.</p> <p>The Tamala limestone ridges that support the community occur intermittently as late Pleistocene ridges (1-2 million years old) that are roughly parallel to the coast on the Swan Coastal Plain.</p> <p>FTC26a occurs on the Cottesloe and Karrakatta soil units mainly within the Spearwood system. The Cottesloe soil unit consists of low hilly landscape with shallow brown sands over limestone, and Karrakatta is yellow sands with a limestone layer, and grey surface colouring due to organic matter.</p> <p>There are two distinct subgroups within the FCT26 type, related to the degree of soil development.</p> <p>Subgroup FCT26b is on the lower slopes or in pockets with deeper soil and is dominated by low shrubs such as <i>Acacia lasiocarpa</i>, <i>Trymalium ledifolium</i>, <i>Melaleuca systema</i>, <i>Hibbertia hypericoides</i>, and <i>Grevillea preissii</i> with overstorey of <i>Eucalyptus gomphocephala</i>, <i>E. foecunda</i> and <i>E. petrensis</i> on deeper soils. Subgroup FCT26a occurs on skeletal soil on ridge slopes and tops of ridges, and is dominated by <i>M. huegelii</i>, <i>M. systema</i> and <i>M. aff. systema</i> often over scattered limestone heath species such as <i>Dryandra sessilis</i> and <i>G. preissii</i> (Keighery <i>et al.</i> 2003).</p> <p>Other communities identified on limestone by Gibson <i>et al.</i> (1994) are 'species poor mallees and shrublands on limestone (floristic community type 27), FCT24 northern</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references. Determine if substrate and associated assemblages are as described in summary description, and description in key references.</p>

			(2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.	Spearwood shrublands and woodlands, and Southern <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodlands (floristic community type 25). Each of these is indicated as floristically distinct through statistical analyses.	
40	Montane Heath and Thicket of the South West Botanical Province, above approximately 900 m above sea level (Eastern Stirling Range Montane Heath and Thicket Community)	The community occurs in the high peaks of the eastern Stirling Range mountains. It is commonly found at altitudes of approximately 900 to 1 090 m above sea level, but extends to lower altitudes in two occurrences. It comprises a heathland and dense shrub thicket with a number of endemic species. Several endemic and characteristic species within the community and the near absence of <i>Eucalyptus</i> species differentiate it from other plant communities in the range. Thirteen species of threatened flora are known in the community: <i>Andersonia axilliflora</i> (giant andersonia), <i>Banksia brownii</i> (feather-leaved banksia), <i>Banksia montana</i> (Stirling Range dryandra), <i>Darwinia collina</i> (yellow mountain bell), <i>Darwinia nubigena</i> (Success bell), <i>Darwinia squarrosa</i> (pink mountain bell), <i>Daviesia obovata</i> (paddle-leaf daviesia), <i>Deyeuxia drummondii</i> (Drummond grass), <i>Lambertia fairallii</i> (Fairall's honeysuckle), <i>Latrobea colophona</i> , <i>Leucopogon gnaphalioides</i> (Stirling Range beard heath), <i>Persoonia micranthera</i> (small-flowered snottygobble) and <i>Sphenotoma drummondii</i> (mountain paper-heath). 23 priority flora taxa also occur in the community. <i>Andersonia axilliflora</i> is a characteristic endemic species of the community. 5 threatened fauna occur within the community: <i>Setonix brachyurus</i> (quokka), <i>Pseudococcus markharveyi</i> (<i>Banksia montana</i> mealybug), <i>Trioza barrettiae</i> (<i>Banksia brownii</i> plant-louse), <i>Zephyrarchaea robinsi</i> (eastern massif assassin spider), <i>Atelomastix tumula</i> (Bluff Knoll atelomastix millipede) as well as the priority fauna <i>Bothriembryon glauerti</i> (priority 2).	Barrett S. (1996). Biological Survey of Mountains of southern Western Australia. Department of Conservation and Land Management, Albany. Department of Parks and Wildlife (2016). Montane Heath and Thicket of the South West Botanical Province, above approximately 900 m above sea level (Eastern Stirling Range Montane Heath and Thicket Community). Interim Recovery Plan 2016-2021 for Interim Recovery Plan No. 370. Perth. Pignatti E., Pignatti S., Lucchese F. (1993). Plant Communities of the Stirling Range, Western Australia. J. Veg. Sci. 4: 477-488.	Heath and thicket composition including a suite of endemic flora and fauna as described in Barrett (1996), and DPaW (2016) on montane habitat in the eastern Stirling range	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a, and key references). Compare habitat and composition to summary description and descriptions in Barrett (1996), and DPaW (2016).
41	Perth to Gingin Ironstone Association	The community occurs on ironstone soils in the Perth area and is characterised by massed everlastings. Many of the plant species present are specifically adapted to	Department of Conservation and Land Management (2005). Interim Recovery Plan 2005-2010 for Shrublands and Woodlands on	Seasonal wetlands on ironstone and shallow ironstone-derived substrate on the eastern side of the Swan Coastal Plain, and characterised by massed everlastings and an open shrub layer.	Sample and report on flora and vegetation and habitat, using methods described in

		shallow seasonal inundation, specifically the rich herb layer present in late winter and early spring which is a major distinguishing characteristic of the community. The daisies <i>Rhodanthe manglesii</i> , <i>Rhodanthe spicata</i> and <i>Myriocephalus helichrysoides</i> dominate. Other common herbs include <i>Tribonanthes variabilis</i> , <i>Stylidium longitubum</i> (jumping jacks) (priority 4) and <i>Isotropis cuneifolia</i> subsp. <i>glabra</i> (priority 3). A very open shrub layer is typical with common shrubs <i>Melaleuca viminea</i> (mohan), <i>Banksia sessilis</i> (parrot bush), <i>Acacia saligna</i> (orange wattle), <i>Jacksonia furcellata</i> (grey stinkwood), <i>Grevillea curviloba</i> (endangered) and <i>Kunzea recurva</i> .	Perth to Gingin Ironstone. Interim Recovery Plan No. 197. Department of Conservation and Land Management, Perth. Halse S.A., Pearson G.P., McRae J.M. & Shiel R.J. (2000). Monitoring aquatic invertebrates and waterbirds at Toolibin and Walbyring Lakes in the Western Australian Wheatbelt. <i>Journal of the Royal Society of Western Australia</i> 83, 17–28		EPA (2016a), and key references. Compare habitat and composition to summary description, and descriptions in CALM (2005).
42	Scott River ironstone association	The community occurs in a winter-wet habitat on red clay to clay loam often over massive ironstone on the Scott Coastal Plain. It mainly comprises heaths, shrublands and thickets and is variously dominated by <i>Melaleuca preissiana</i> (moonah), <i>Hakea tuberculata</i> , <i>Kunzea micrantha</i> or <i>Melaleuca incana</i> subsp. <i>Gingilup</i> , depending on the degree of waterlogging. The understorey is generally dominated by <i>Loxocarya magna</i> (priority 3). Most occurrences have very diverse annual flora of <i>Stylidium</i> spp. (triggerplants), <i>Centrolepis</i> spp., <i>Schoenus</i> spp., <i>Aphelia</i> spp. and other herbs. The community also contains a number of endemic and restricted taxa such as <i>Darwinia ferricola</i> (threatened), <i>Grevillea manglesioides</i> subsp. <i>ferricola</i> (priority 3), <i>Lambertia orbifolia</i> subsp. <i>Scott River Plains</i> (threatened) and <i>Melaleuca incana</i> subsp. <i>Gingilup</i> (priority 2).	Burton, S. of Groundwater Consulting Services (2007) The Hydrogeology of the Southern and Scott River Ironstone Communities South West Western Australia. Unpublished report for the Department of Environment and Conservation. Department of Parks and Wildlife (2015) Scott River Ironstone Association (update) Interim Recovery Plan 2015-2020. Interim Recovery Plan No 339. Parks and Wildlife, Western Australia. Gibson, N., Keighery, G. and Keighery, B. (2000) Threatened plant communities of Western Australia. 1. The ironstone communities of the Swan and Scott Coastal Plains. <i>Journal of the Royal Society of Western Australia</i> 83, 1-11. Gibson, N., Keighery, G.J. and Lyons, M.N. (2001) Vascular flora of Scott National Park, Camping Reserve 12951 and Gingilup Swamps Nature Reserve, Western Australia. <i>DECScience</i> 3(4), 411-432. Groundwater Consulting Services Pty Ltd (2007) The Hydrogeology of the Southern and Scott River Ironstone Communities, South	Flora assemblages described by Gibson <i>et al.</i> (2000) in habitats comprising highly restricted ironstone and ironstone-derived substrates (sandy ironstone soils or grey sands over ironstone, in winter wet areas) on the Scott Coastal Plain. Occurrences are highly variable in floristic composition. Level of variation appears to be quite closely linked to soil depth and type. Vegetation in other areas does not correlate with the floristics and habitat in the Scott Ironstone community. Community supports a suite of threatened or priority flora and many are restricted to sites that experience seasonal inundation. Ironstone substrates also occur on the Swan Coastal Plain near Busselton, but very few flora that are confined to ironstone soils occur in both these areas. The assemblages are quite distinct. Tille and Lantzke (1990a, b) mapped ironstone substrate in the Scott River area. Ferruginisation of the Guildford Formation and the physical properties of the underlying geology are both considered important in local moisture retention that sustains the community.	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Compare key substrate characteristics, and their associated assemblages, to summary description, and descriptions in key references. The range of flora and vegetation that occurs in Scott River ironstone and the habitats of this TEC may not be fully documented.

			<p>West Western Australia. Unpublished report for the Department of Conservation and Land Management.</p> <p>Robinson, C. and Keighery, G. (1997) Vegetation and flora of Scott National Park and adjacent recreation reserves. <i>The Western Australian Naturalist</i> 21(4), 213-233.</p> <p>Tille, P.J. and Lantzke, N.C. (1990a) Busselton-Margaret River-Augusta land capability study. Land Resources Series No 5. Department of Agriculture, Perth.</p> <p>Tille, P.J. and Lantzke, N.C. (1990b) Busselton – Margaret River – Augusta land capability study; methodology and results Volume 1. Technical Report 109. Division of Resource Management. Western Australian Department of Agriculture, Perth.</p>		
43	Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson <i>et al.</i> (1994))	<p>The community occurs on clay flats with thin skeletal soils and has been recorded largely between Wattle Grove and Sabina River. It comprises rapidly drying clay flats. Typical and common shrubs include <i>Hakea sulcata</i> (furrowed hakea), <i>Verticordia densiflora</i> (compacted featherflower), <i>Hakea varia</i> (variable-leaved hakea), <i>Pericalymma ellipticum</i> (swamp teatree) and <i>Viminaria juncea</i> (swishbush). <i>Aphelia cyperoides</i> (hairy aphelia), <i>Centrolepis aristata</i> (pointed centrolepis), <i>Drosera gigantea</i> (giant sundew) and <i>Drosera menziesii</i> (pink rainbow) also commonly occur. The community is also known as “floristic community type 10a” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).</p>	<p>Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.</p> <p>Department of Biodiversity, Conservation and Attractions (2018). National Recovery Plan for the Clay pans of the Swan Coastal Plain ecological community. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.</p> <p>Department of Parks and Wildlife (2015). Interim Recovery Plan 2015-2020 for Clay pans of the Swan Coastal Plain (Swan Coastal Plain community types 7, 8, 9 and 10a) and Clay pans with mid dense shrublands of <i>Melaleuca lateritia</i></p>	<p>Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are ‘typical’ or ‘common’ to particular FCTs are listed in Gibson <i>et al.</i> (1994). Community occurs on skeletal soils that have shallow microtopography and the habitat is the most rapidly drying of the four clay pans identified in Gibson <i>et al.</i> (1994; FCTs 7, 8, 9, and 10a). All of the clay pan types, except community type 10a that is generally a shrubland, are dominated by annual flora.</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below); and key references.</p>

			<p>over herbs. Interim Recovery Plan No. 354. DPaW Perth.</p> <p>Gibson, N., Keighery, G.J., Lyons, M.N., Keighery, B.J. (2005) Threatened plant communities of Western Australia. 2 The seasonal clay-based wetland communities of the South West. <i>Pacific Conservation Biology</i> 11:287-301.</p> <p>Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i>. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).</p> <p>Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.</p> <p>Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i>. Report prepared for the Department of Conservation and Land Management. Perth, Western Australia.</p> <p>Webb (2019) A preliminary assessment of vegetation change after 25 years within ephemeral claypans (FCT07 & 08). Report in draft for Department of Biodiversity and Conservation, South West Region.</p>		
44	Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	The community occurs on the heavy soils of the eastern side of the Swan Coastal Plain and has been recorded between Beermullah and Wokalup. Known patches include wetland and well-drained habitats, in a variety of landforms. It is defined on the basis of substrates with a limestone influence. Many	<p>English, V and Blyth, J. (2000). Shrubland and woodlands on Muchea Limestone interim recovery plan No. 57 (2000-2003). Department of Conservation and Land Management. Perth.</p>	Community is defined on the basis of substrates with a limestone influence on the eastern side of the Swan Coastal Plain. Occurrences are highly variable in floristic composition. The level of variation appears to be quite closely linked to substrate and hydrology.	Sample, analyse data and report on habitat, flora and vegetation using methods described in EPA (2016a), and key references.

		<p>of the species are commonly associated with the limestone soils that occur on the coast, and do not generally occur further inland. Typical and common native species in areas of best developed limestone are: the tree <i>Casuarina obesa</i> (swamp sheoak); the mallees <i>Eucalyptus decipiens</i> (redheart) and <i>Eucalyptus foecunda</i> (narrow-leaved red mallee); the shrubs <i>Melaleuca huegelii</i> (chenille honey-myrtle), <i>Alyogyne huegelii</i> (lilac hibiscus), <i>Grevillea curviloba</i> (threatened), and <i>Grevillea evanescens</i> (priority 1), <i>Melaleuca systema</i> (narrow-leaved paperbark); and the herb <i>Thysanotus arenarius</i> (fringed lily). Where the limestone substrate is less well developed and limestone may occur as nodules or chunks, the flora assemblages can be influenced by other characteristics of the substrate, such as clay content, with the presence of calcicoles such as <i>Thysanotus arenarius</i>, <i>Gahnia trifida</i> (coast saw-sedge), <i>Eremophila glabra</i> (tar bush) and <i>Melaleuca brevifolia</i> (mallee honey-myrtle), providing evidence of the limestone influence. <i>Melaleuca huegelii</i> shrublands, <i>Eucalyptus decipiens</i> mallee, <i>Casuarina obesa</i> woodlands and <i>Melaleuca brevifolia</i>, <i>Melaleuca systema</i> or <i>Melaleuca viminea</i> shrublands are recorded on Muchea Limestone.</p>	<p>Gibson, N., Keighery, B., Keighery, G., Burbidge, A & Lyons, M. (1994). A floristic survey of the Southern Swan Coastal Plain. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Perth, Western Australia.</p> <p>Keighery, G. and Keighery, B. (1995). Muchea Limestones - Floristics Report for ANCA National Reserves Network. Unpublished report to Australian Nature Conservation Agency. Department of Conservation and Land Management and Department of Environmental Protection. Perth, Western Australia.</p> <p>Tauss, C. and Weston, A.S. (2010). The flora, vegetation and wetlands of the Maddington-Kenwick Strategic Employment Area. A survey of the rural lands in the vicinity of the Greater Brixton Street Wetlands. Report to the City of Gosnells, W.A</p>	<p>The range of flora and vegetation that occurs in Muchea Limestone and the habitats of this TEC are not well documented. Flora assemblages were originally described by Keighery and Keighery (1995) and further described in other key references. Muchea Limestone was originally described from a geological unit also known as Plain Limestone (Gozzard, 1982). It occurs on the eastern side of the Swan Coastal Plain in a discontinuous distribution from Muchea to Benger.</p>	<p>Compare key substrate characteristics, and their associated assemblages, to summary description, and descriptions in key references.</p>
45	<p>Shrublands on calcareous silts of the Swan Coastal Plain (floristic community type 18 as originally described in Gibson et al. (1994))</p>	<p>The community is recorded from between Yalgorup National Park and Bunbury. It is species-rich, consists of open low shrubs with a rich annual flora and is known from calcareous silt flats. A suckering form of <i>Acacia saligna</i> (orange wattle), <i>Melaleuca viminea</i> (mohan), <i>Melaleuca teretifolia</i> (banbar), <i>Hakea varia</i> (variable-leaved hakea), <i>Xanthorrhoea preissii</i> (balga) and <i>Leptomeria ellytes</i> are common in the shrub layer, with sedges including <i>Lepidosperma longitudinale</i> (pithy sword-sedge) and <i>Gahnia trifida</i> (coast saw-sedge), and a suite of herbs including <i>Meionectes tenuifolia</i> a priority 3 flora taxon are also common. The community is also known as "floristic community type 18" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons</p>	<p>Churchward, H.M. and McArthur, W.M. (1978). Darling System, Landforms and Soils. Department of Conservation and Environment. Division of Natural Resources Management, C.S.I.R.O. In: Atlas of Natural Resources Darling System, Western Australia. Perth. Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.</p>	<p>The community is very species rich and found on calcareous silt flats. It has been recorded as open low scrubs with rich annual flora. It occurs in calcareous silts in wetlands classified as damplands. The community is known from the Yoongarillup soil and landform unit. This unit is described as plains with low ridges and swales, comprising shallow yellow and brown sands on fossiliferous limestone of marine or estuarine deposits. The community also occurs on the Vasse unit that comprises poorly drained plains with variable mixed layers of recent estuarine and marine deposits.</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references. Determine if substrate is as described in key references.</p>

		M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia. Wilson, J. et al 2008 Vegetation monitoring – Swan Coastal Plain (Bunbury, Busselton-Capel Groundwater Areas). A report to Water Smart Australia and the Department of Water. Centre of Ecosystem Management, Edith Cowan University.		
46	Southern wet shrublands, Swan Coastal Plain (floristic community type 2 as originally described in Gibson <i>et al.</i> (1994))	The community comprises shrublands or open woodlands. It occurs on seasonally inundated sandy clay soils that are restricted to small remnants on the eastern side of the Swan Coastal Plain. It has been recorded from Forrestfield to Busselton. The community has moderate species richness with the occurrence of species reflecting the wetter nature of the sites. Typical and common native taxa in the community are the shrubs <i>Kingia australis</i> (Kingia), <i>Pericalymma ellipticum</i> (swamp teatree), <i>Hakea ceratophylla</i> (horned leaf hakea), <i>Calothamnus lateralis</i> , <i>Hypocalymma angustifolium</i> (white myrtle), <i>Eutaxia virgata</i> , <i>Stirlingia latifolia</i> (blueboy), <i>Banksia dallanneyi</i> (couch honeypot) and herbs, rushes and sedges including <i>Dampiera linearis</i> (common dampiera), <i>Comesperma virgatum</i> (milkwort), <i>Stylidium brunonianum</i> (pink fountain triggerplant), <i>Thysanotus multiflorus</i> (many-flowered fringe lily) and <i>Mesomelaena tetragona</i> (semaphore sedge).	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Gibson, N., Keighery, G.J., Lyons, M.N., Keighery, B.J. (2005) Threatened plant communities of Western Australia. 2 The seasonal clay-based wetland communities of the South West. <i>Pacific Conservation Biology</i> 11:287-301. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of	Combinations of flora are indicative of particular floristic community types (FCTs). Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994). Flora indicative of FCTs on the eastern side of the Swan Coastal Plain; that includes FCT 2 may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.

		<p>The community also contains priority flora including <i>Isopogon formosus</i> subsp. <i>dasylepis</i> (priority 3) and <i>Grevillea brachystylis</i> subsp. <i>brachystylis</i> (priority 3). This community is also known as “floristic community type 2” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).</p>	<p>Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.</p> <p>Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i>. Report prepared for the Department of Conservation and Land Management. Perth, Western Australia.</p> <p>Webb, A. (2019). A preliminary assessment of vegetation change after 25 years within the Parks & Wildlife South West Region. DBCA South West Region. (Unpublished report).</p>		
47	<p>Shrublands and woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20c as originally described in Gibson <i>et al.</i> (1994))</p>	<p>The community occurs mainly on the transitional soils of the Ridge Hill Shelf, on the Swan Coastal Plain adjacent to the Darling Scarp, but also extends marginally onto the alluvial clays deposited on the eastern fringe of the Swan Coastal Plain. It has been recorded between Stratton and Maddington. It generally comprises a shrubland or woodland of <i>Banksia attenuata</i> (slender banksia) and <i>Banksia menziesii</i> (firewood banksia), sometimes with <i>Allocasuarina fraseriana</i> (sheoak), over a shrub layer that can include the species <i>Adenanthos cygnorum</i> (common woollybush), <i>Hibbertia huegelii</i>, <i>Scaevola repens</i> var. <i>repens</i> (fan flower), <i>Allocasuarina humilis</i> (dwarf sheoak), <i>Bossiaea eriocarpa</i> (common brown pea), <i>Hibbertia hypericoides</i> (yellow buttercups) and <i>Stirlingia latifolia</i> (blueboy). A suite of herbs including <i>Conostylis aurea</i> (golden conostylis), <i>Trachymene pilosa</i> (native parsnip), <i>Lomandra hermaphrodita</i>, <i>Burchardia congesta</i> (milkmaids) and <i>Patersonia occidentalis</i> (purple flag), and the sedges</p>	<p>Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.</p> <p>Department of Environment and Conservation (2006) Interim Recovery Plan 2006-2011 for the shrublands and woodlands of the eastern side of the Swan Coastal Plain (community type 20c). Interim Recovery Plan No. 230.</p> <p>Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994) A floristic survey of the Southern Swan Coastal Plain. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land</p>	<p>Taxa indicative of the eastern side of the Swan Coastal Plain; that includes FCT20c may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of flora are indicative of particular floristic community types (FCTs). Lists of taxa that are ‘typical’ or ‘common’ to particular FCTs are listed in Gibson <i>et al.</i> (1994).</p> <p>The community reflects this transitional landform and soil zone between the Scarp and the Swan Coastal Plain, with many species such as <i>Cristonia biloba</i>, present in the community being more common on the Scarp. The assemblage also regularly contains species such as <i>Neurachne alopecuroides</i> more commonly associated with marri - wandoo woodlands on heavy soils.</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.</p>

		<p><i>Mesomelaena pseudostygia</i> (semaphore sedge) and <i>Lyginia barbata</i> usually occur in the community. The community is also known as "floristic community type 20c" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).</p>	<p>Management and the Conservation Council of Western Australia (Inc.). Perth, Western Australia Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia. Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i>. Report prepared for the Department of Conservation and Land Management. Perth, Western Australia</p>		
48	<p>Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (floristic community type 10b as originally described in Gibson <i>et al.</i> (1994))</p>	<p>This species-rich plant community is a seasonal wetland on ironstone sheet rock overlain by shallow loam soils on the Swan Coastal Plain and Whicher Scarp near Busselton. Much of the species diversity comes from annuals and geophytes (plants with an underground storage organ). Typical and common shrubs include <i>Kunzea rostrata</i>, <i>Pericalymma ellipticum</i> (swamp teatree), <i>Hakea oldfieldii</i> (priority 3), <i>Hemiandra pungens</i> (snakebush) and <i>Viminaria juncea</i> (swishbush). <i>Aphelia cyperoides</i> (hairy aphelia) and <i>Centrolepis aristata</i> (pointed centrolepis) also commonly occur. Many taxa in the community are endemic to this unusual geology including a suite of threatened flora. The community is also known as "floristic community type 10b" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).</p>	<p>Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Department of Conservation and Land Management (2005). Southern Swan Coastal Plain Ironstone (Busselton Area) (Busselton or Southern Ironstone Association). Interim recovery plan no 215: 2005- 2010. CALM, Perth, Western Australia Gibson, N., Keighery, B., Keighery, G., Burbidge, A & Lyons, M. (1994) <i>A floristic survey of the Southern Swan Coastal Plain</i>. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Perth, Western Australia</p>	<p>Occurs largely as shrublands of floristic composition as described in Gibson <i>et al.</i> (1994). In habitat of ironstone and derived substrates that are restricted to the eastern side of the Swan Coastal Plain along the base of the Whicher Scarp near Busselton. Occurs on poorly drained flats that are waterlogged in winter. Flora that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994). Eleven threatened and six priority flora are associated with the community and many are totally or largely confined to ironstone soils in Busselton or to another community on ironstone substrates on the Scott Coastal Plain.</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references. Compare key substrate characteristics, and its' associated assemblages, to descriptions in key references.</p>

			Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.		
49	Russell Range mixed thicket complexes	The community occurs within the Russell Range system and consists of an open mallee or shrub mallee-heath on the mid to upper slopes. Typical species are <i>Eucalyptus doratoxylon</i> (spearwood mallee), <i>Adenanthos oreophilus</i> , <i>Dampiera parvifolia</i> (many-bracted dampiera), <i>Dielsiodoxa oligarrhenoides</i> , <i>Chorizema nervosum</i> , <i>Acacia triptycha</i> , <i>Hakea pandanicaarpa</i> , <i>Daviesia grossa</i> , and the endemic priority taxa <i>Banksia prolata</i> subsp. <i>archeos</i> (priority 2), <i>Beaufortia raggedensis</i> (Mt Ragged beaufortia) (priority 2), <i>Rhadinothamnus rudis</i> subsp. <i>linearis</i> (priority 4), <i>Darwinia</i> sp. Mt Ragged (S. Barrett 663) (priority 2) and <i>Gastrolobium tergiversum</i> (priority 2). Other priority flora include <i>Beyeria simplex</i> (priority 2), <i>Dielsiodoxa propullulans</i> (priority 2), <i>Leucopogon apiculatus</i> (priority 3), <i>Styphelia rotundifolia</i> (priority 3), <i>Opercularia hirsuta</i> (silky-haired stinkweed) (priority 2), <i>Scaevola brookeana</i> (priority 2), <i>Gastrolobium pycnostachyum</i> (Mt Ragged poison) (priority 2) and <i>Kennedia becxiana</i> (Cape Arid kennedia) (priority 4) which occur mainly on the mid-lower slopes. <i>Anthocercis viscosa</i> (sticky tailflower) is common on granite on the south coast from Walpole to Cape Arid and occurs at its inland or eastern limit on Mt Ragged.	Barrett, S. (1996) Biological survey of mountains of southern Western Australia. Unpublished report by the Department of Conservation and Land Management for the Australian Nature Conservation Agency. Beard, J.S. (1973) The vegetation of the Esperance and Malcolm areas, Western Australia: map and explanatory memoir, 1:250,000 series. Vegetation Survey of Western Australia Lowry, D.C. and Doepel, J.J.G. (1974) Malcolm-Cape Arid. Geological Survey of Western Australia: 1:250,000 Geological Series Explanatory Notes. Geological Survey of Western Australia	Community was originally identified by Beard (1973) and then further defined by Barrett (1996) in a biological survey of mountains of southern Western Australia. It occurs on the highest peaks of the Russell Range, with characteristic open- mallee/shrub mallee-heath, with many endemic species. It comprises of five occurrences within chains running NNE to SSW, including the slopes of Mount Dean, Brooks Peak, Mount Ragged, Mount Esmond and Woolgrah Hill. The community is commonly found at altitudes of approximately 585 m above sea level but extends to lower altitudes. Several endemic and characteristic species within the community. Four priority flora taxa are endemic to the community including <i>Banksia prolata</i> subsp. <i>archeos</i> , <i>Beaufortia raggedensis</i> , <i>Rhadinothamnus rudis</i> subsp. <i>linearis</i> , <i>Darwinia</i> sp. Mt Ragged (S. Barrett 663) and <i>Gastrolobium tergiversum</i> . <i>Anthocercis viscosa</i> , although common on granite from Walpole to Cape Arid, is found at the inland or eastern limit of its range on the wave-cut bench on Mt Ragged. Community occurs within the Proterozoic Mt Ragged beds which over-lie Middle-Proterozoic granites, gneisses and migmatites of the Albany-Fraser Province (Lowry and Doepel 1974). The beds are composed of a sequence of quartzites, micaceous schists, quartz-pebble conglomerates and acid volcanic rocks exposed as a series of north-easterly trending belts. Mt Ragged is formed of vertically stratified gneiss with a central band of massive quartzite resistant to erosion. Soils are mostly acidic, have a low nutrient status and have been weathered from granitoid or quartzite bedrock. Soil depth is generally shallow with skeletal soils less than 25cm thick common on the upper slopes and peaks, and deeper in areas of more gentle topography (Barrett 1996).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Determine if habitat (Russell Range and footslopes) and associated floral assemblages occur, and meet summary description, and description in key references. Details of survey method: survey should be conducted in the spring to determine the full suite of native species present. The following should be recorded to identify the community: Landform, rock type, soil type and colour, drainage Vegetation classification, flora species (as compared to Barrett 1996) Condition including vegetation structure. Condition classes will also need to incorporate the fire history, dieback disease presence and the abundance of major weed species.

					A flora species list should be compared against that provided in The Mountain Top survey (Barrett 1996).
50	Thumb Peak, Mid Mount Barren, Woolburnup Hill (Central Barren Ranges) <i>Eucalyptus acies</i> mallee heath	The community is characterised by high species richness with a strong proteaceous element. It is restricted to three quartzite mountains within the Fitzgerald River National Park. Three threatened flora occur within the community (<i>Daviesia obovata</i> , <i>Coopernookia georgei</i> (mauve coopernookia) and <i>Grevillea infundibularis</i> (fan-leaf grevillea)) and a suite of priority flora also occur, some restricted only to mountain peaks. This community is characterised by a high diversity of proteaceous shrubs accompanied by several taxa endemic to or prevalent in high altitudinal areas of the Barren and Stirling Ranges. Common taxa include <i>Eucalyptus acies</i> (Woolburnup mallee), <i>Gastrolobium crenulatum</i> (priority 2), <i>Daviesia obovata</i> , <i>Andersonia echinocephala</i> (priority 4), <i>Petrophile divaricata</i> , <i>Grevillea coccinea</i> subsp. <i>lanata</i> (priority 3) and <i>Xanthosia candida</i> . Other taxa include <i>Eucalyptus preissiana</i> subsp. <i>preissiana</i> (bell-fruited mallee), <i>Banksia heliantha</i> (oak-leaved dryandra), <i>Banksia falcata</i> (prickly dryandra), <i>Banksia plumosa</i> subsp. <i>plumosa</i> , <i>Banksia baueri</i> (woolly banksia), <i>Banksia nutans</i> var. <i>nutans</i> (nodding banksia), <i>Banksia lemmaniana</i> (Lemman's banksia), <i>Banksia oreophila</i> (mountain banksia), <i>Hakea cucullata</i> (hood-leaved hakea), <i>Hakea hookeriana</i> , <i>Grevillea fistulosa</i> , <i>Adenanthos labillardierei</i> , <i>Beaufortia anisandra</i> (dark beaufortia), <i>Melaleuca striata</i> , <i>Sphaerolobium racemosum</i> , <i>Daviesia striata</i> , <i>Taxandria spathulata</i> , <i>Acacia cedroides</i> , <i>Rinzia oxycoccoides</i> (large-flowered rinzia), <i>Dampiera loranthifolia</i> , <i>Stachystemon mucronatus</i> and <i>Mesomelaena stygia</i> subsp. <i>stygia</i> .	Barrett, S. (1996). Biological Survey of Mountains of Southern Western Australia. Report for the National Reserves System Cooperative Program (Project Number AW03).	The central Barren Ranges (Thumb Peak- Mid-Mt Barren - Woolburnup Hill) form a distinct endemic community. Community is found only on these mountains with <i>Eucalyptus acies</i> dominant and includes four endemics as well as many species endemic to the Barren Ranges/quartzite ranges of Fitzgerald River National Park. Three threatened flora occur and a suite of priority taxa occur in the community.	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Determine if habitat Barren Ranges and footslopes) and associated floral assemblages occur, and meet summary description, and description in key references.
51	Vegetation alliances on ridges and	The community occurs on ridges and slopes of the chert hills of the Coomberdale floristic region. It was originally described in Griffin	Department of Parks and Wildlife (2013). Interim Recovery Plan 2013-2018 for Heath dominated by	The substrate on which the community is located is highly restricted and confined to the Noondine chert	Sample, analyse data and report on flora and vegetation using

	slopes of the chert hills of the Coomberdale floristic region	E.A. (1992) "Floristic survey of remnant vegetation in the Bindoon to Moora area, Western Australia" (Agriculture Western Australia Resource Management Technical Report 142, Perth). It encompasses seven vegetation alliances including the core units and three vegetation alliances of the buffer units of the Coomberdale Chert community. Vegetation alliances include <i>Allocasuarina campestris</i> (sheoak) shrubland, <i>Allocasuarina microstachya</i> scrub, <i>Regelia megacephala</i> (priority 4) shrubland, <i>Kunzea praestans</i> shrubland and scrub, <i>Melaleuca calyptroides</i> heath, <i>Hibbertia subvaginata</i> shrubland and <i>Xanthorrhoea drummondii</i> shrubland on ridges and slopes of the chert hills of the Coomberdale floristic region.	one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale Floristic Region (update). Interim Recovery Plan No. 338. Department of Parks and Wildlife, Perth. Griffin, E. A. (1992). Floristic survey of remnant vegetation in the Bindoon to Moora area, Western Australia. Agriculture Western Australia Resource Management Technical Report 142. Perth. Griffin, E. A. (1994). Floristic Survey of Northern Sandplains between Perth and Geraldton, Western Australia. Agriculture Western Australia Resource Management Technical Report 144. Perth. Trudgen, M.E., Morgan, B., and Griffin, E.A. (2006). <i>A flora survey, floristic analysis and vegetation survey of the Coomberdale Chert TEC</i> . Prepared for Simcoa Operations Pty Ltd. Perth	hills that extend discontinuously from Jingemba south to Moora and make up the Coomberdale Floristic Region. Based on the vegetation described in Trudgen <i>et al.</i> (2006), the community consists of the vegetation alliances 13, 14, 15, 16, 17, 18 and 19 are considered the 'core' parts of the with units 4, 9 and 11 being more peripheral parts of the community but still associated with it. Included units are described as: <i>Allocasuarina campestris</i> high shrublands to open and closed scrub; <i>Allocasuarina microstachya</i> open scrub; <i>Regelia megacephala</i> high shrubland to open and closed scrub; <i>Kunzea praestans</i> high shrubland to open and closed scrub; <i>Melaleuca calyptroides</i> open to closed heath; <i>Hibbertia subvaginata</i> low shrublands to low open heath; <i>Xanthorrhoea drummondii</i> shrubland; <i>Eucalyptus eudesmoides</i> mallee; <i>Allocasuarina huegeliana</i> woodlands; <i>Acacia acuminata</i> low woodlands	methods described in EPA (2016a); Compare substrate, and the associated assemblages, to summary description, and descriptions in key references.
Woodlands and forests					
52	<i>Banksia attenuata</i> woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson <i>et al.</i> (1994))	The community occurs on sands near Koondoola and at the base of the Darling Scarp largely between Chittering and Gosnells. It is usually dominated by <i>Banksia attenuata</i> (slender banksia) or occasionally <i>Eucalyptus marginata</i> (jarrah), with <i>Bossiaea eriocarpa</i> (common brown pea), <i>Conostephium pendulum</i> (pearl flower), <i>Hibbertia huegelii</i> , <i>Hibbertia hypericoides</i> (yellow buttercups), <i>Petrophile linearis</i> (pixie mops), <i>Scaevola repens</i> , <i>Stirlingia latifolia</i> (blueboy), <i>Mesomelaena pseudostygia</i> and <i>Alexgeorgea nitens</i> being common in the understorey. The community is also known as "floristic community type 20a" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Department of Parks and Wildlife (2016). <i>Banksia attenuata</i> woodlands over species rich dense shrublands (Swan Coastal Plain community type 20a – Gibson <i>et al.</i> 1994). Interim Recovery Plan No. 359. Parks and Wildlife, Kensington, Western Australia. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> .	Flora indicative of FCTs on the eastern side of the Swan Coastal Plain; that includes FCT20a may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994). Community is one of three subtypes of floristic community type 20 as identified in Gibson <i>et al.</i> (1994), that differ in floristic composition. These are FCT20a, FCT20b and FCT20c. Gibson <i>et al.</i> (1994) states that FCT20a was distinctive in its' diverse shrub layer and <i>Mesomelaena pseudostygia</i> in all plots. FCT20a sites were differentiated from the other two subtypes by occurrence of species such as <i>Alexgeorgia nitens</i> , <i>Daviesia nudiflora</i> , <i>Synaphea spinulosa</i> , <i>Hibbertia racemosa</i> and <i>Stylidium calcaratum</i> . The richest of any Banksia community located on the coastal plain by Gibson <i>et al.</i> (1994).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.

		Management and the Conservation Council of Western Australia (Inc.)).	<p>Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).</p> <p>Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.</p> <p>Keighery, G. and Keighery, B. (2016). How many banksia woodlands? Floristics of Banksia Woodlands of the Swan Coastal Plain. In Stevens J.C., Rokich D.P., Newton V.G., Barrett R.L. and Dixon K.W. (Eds) (2016, in press). Restoring Perth's Banksia woodlands. UWA Publishing. Crawley, Western Australia.</p> <p>Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i>. Report prepared for the Department of Conservation and Land Management. Perth, Western Australia.</p>	Occurs on sands at the base of the Darling Scarp between Chittering and Orange Grove and to date located on the Bassendean, Forrestfield, Southern River and Karrakatta soil and landform units, and on the Coonambidgee unit of the Dandaragan Plateau	
53	<i>Banksia attenuata</i> — <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20b as originally described in Gibson <i>et al.</i> (1994))	The community occurs on sands at the base of the scarp predominantly on the Pinjarra Plain and Ridge Hill Shelf. Most of the occurrences of this community type comprise <i>Banksia attenuata</i> (slender banksia) - <i>Eucalyptus marginata</i> (jarrah) woodlands but the community also occurs as Banksia woodlands and heaths. The sedge <i>Mesomelaena pseudostygia</i> is a common component of the community, which is very species rich and has a diverse shrub layer and low weed frequency. <i>Hakea stenocarpa</i> (narrow-fruited hakea), <i>Conostylis setosa</i> (white cottonhead), and <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i> (priority 2) generally differentiate the community from similar Banksia communities. The community is also	<p>Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.</p> <p>Department of Environment and Conservation (2012). Interim Recovery Plan 2012-2017 for <i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (Swan Coastal Plain community type 20b – Gibson <i>et</i></p>	Taxa indicative of FCTs on the eastern side of the Swan Coastal Plain; that includes FCT20b may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994). Generally dominated by <i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> , with <i>Mesomelaena pseudostygia</i> , <i>Tetraria octandra</i> , <i>Banksia dallanneyi</i> , <i>Desmocladius fasciculatus</i> , and <i>Chamaescilla corymbosa</i> being common in the understorey. FCT20b differs from the <i>Banksia attenuata</i> woodlands over species rich dense shrublands (FCT20a) and the eastern shrublands and woodlands (FCT20c) in the presence of understorey species that can include	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.

		known as “floristic community type 20b” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	<p>al. 1994). Interim Recovery Plan No. 328. Department of Environment and Conservation, Perth.</p> <p>Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i>. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).</p> <p>Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.</p> <p>Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i>. Report prepared for the Department of Conservation and Land Management. Perth, Western Australia.</p>	<p><i>Grevillea pilulifera</i>, <i>Babingtonia camphorosmae</i>, <i>Hibbertia vaginata</i>, <i>Caladenia flava</i>, <i>Hakea stenocarpa</i> and <i>Conostylis setosa</i>, and the general absence of <i>Alexgeorgea nitens</i> - a common component of FCT20a. Known from soil and landform units at the base of the Darling Scarp and largely on the Forrestfield unit (Ridge Hill Shelf), Guildford unit (Pinjarra Plain). Also located on Southern River unit, and mapped on Darling Scarp Unit, (latter is more correctly mapped as Forrestfield unit)</p>	
54	<i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i>) forests and woodlands, Swan Coastal Plain (floristic community type 30a as originally described in Gibson <i>et al.</i> (1994))	The community is located on calcareous sandy soils of the Quindalup Dunes generally occurring between Craigie and Point Peron, and on the Swan River in Peppermint Grove. The community also occurs on Garden Island and Rottnest Island. Typical and common native taxa in the community are: <i>Callitris preissii</i> (Rottnest Island pine), <i>Melaleuca lanceolata</i> , <i>Spyridium globulosum</i> (basket bush), <i>Acanthocarpus preissii</i> , <i>Rhagodia baccata</i> (berry saltbush), <i>Austrostipa flavescens</i> and <i>Trachymene pilosa</i> (native parsnip). The community is also known as “floristic community type 30a” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared	<p>Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington.</p> <p>Department of Parks and Wildlife (2014). <i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i>) forests and woodlands (Swan Coastal Plain community type 30a – Gibson <i>et al.</i> 1994). Interim Recovery Plan No. 340. Department of Parks and Wildlife, Perth</p> <p>Gibson, N., Keighery, G.J., Lyons, M.N., Keighery, B.J. (2005)</p>	<p>The coastal occurrences occur on calcareous sandy soils associated with the Quindalup dunes and the Swan River occurrence is on the aeolian deposits of the Cottesloe complex - central and south. Species richness is naturally quite low in the community. Community contains significant populations of the dominant tree species, <i>Callitris preissii</i> and <i>Melaleuca lanceolata</i> that are uncommon on the Swan Coastal Plain.</p> <p>Where vegetation is in poor condition it is not feasible to use quadrat data and statistical techniques to clarify the floristic community type present. <i>Callitris preissii</i> is considered, however, to be a definitive indicator of the <i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i>) forests and woodlands when it is present in appropriate vegetation and coastal habitat on the southern Swan Coastal Plain.</p> <p>On Rottnest, and other areas of native vegetation that naturally contain <i>Callitris preissii</i> in appropriate habitat</p>	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references. Determine if <i>Callitris preissii</i> is a naturally occurring and in vegetation and coastal habitat on the southern Swan Coastal Plain, that are appropriate for the community.

		by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Threatened plant communities of Western Australia. 2 The seasonal clay-based wetland communities of the South West. <i>Pacific Conservation Biology</i> 11:287-301. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.	near Perth are considered to represent types and subtypes of this community. A similar assemblage on Bald Island is considered floristically distinct from this community.	
55	<i>Corymbia calophylla</i> — <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain (floristic community type 3b as originally described in Gibson <i>et al.</i> (1994))	The community is known from the eastern side of the Swan Coastal Plain largely between Queens Park and Dunsborough. Most sites of the community type are dominated by both <i>Corymbia calophylla</i> (marri) and <i>Eucalyptus marginata</i> (jarrah) with additional common taxa comprising low shrubs, sedges, grasses and herbs. These include <i>Bossiaea eriocarpa</i> (common brown pea), <i>Conostylis juncea</i> , <i>Hibbertia hypericoides</i> (yellow buttercups), <i>Morelotia octandra</i> , <i>Chamaescilla corymbosa</i> (blue squill), <i>Desmocladius fasciculatus</i> , <i>Banksia dallanneyi</i> (couch honeypot), <i>Mesomelaena tetragona</i> (semaphore sedge), <i>Babingtonia camphorosmae</i> (camphor myrtle), <i>Lepidosperma squamatum</i> , <i>Neurachne alopecuroidea</i> (foxtail mulga grass), <i>Philotheca spicata</i> (pepper and salt), <i>Burchardia congesta</i> , <i>Caesia micrantha</i> (pale grass-lily), <i>Kingia australis</i> (kingia), <i>Drosera erythrorhiza</i> (red ink sundew), <i>Lomandra hermaphrodita</i> and <i>Caladenia flava</i> (cowslip orchid). The community is also known as “floristic community type 3b” as originally	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of	Flora indicative of FCTs on the eastern side of the Swan Coastal Plain; that includes FCT3b may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are ‘typical’ or ‘common’ to particular FCTs are listed in Gibson <i>et al.</i> (1994). Community is one of three subtypes of floristic community type 3 as identified in Gibson <i>et al.</i> (1994), that differ in floristic composition. These are FCT3a, FCT3b and FCT3c. FCT 3b are largely dominated by both <i>E. calophylla</i> and <i>E. marginata</i> . Species including <i>Bossiaea eriocarpa</i> and <i>Conostylis juncea</i> are useful in differentiating this subgroup. The community has been recorded from alluvial soils near the Peel - Harvey estuary and better drained sites on the eastern side of the Swan Coastal Plain. It occurs predominantly on the Guilford and Forrestfield vegetation complexes (equate to soil and landform units).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.

		described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Environment and Conservation, Kensington, Western Australia. Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i> . Report prepared for the Department of		
56	<i>Corymbia calophylla</i> — <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain (floristic community type 3a as originally described in Gibson <i>et al.</i> (1994))	The community occurs on heavy soils of the eastern side of the southern Swan Coastal Plain largely between Capel and Chittering. Typical native taxa in the community are: the tree <i>Corymbia calophylla</i> (marri); the shrubs <i>Banksia dallanneyi</i> (couch honeypot), <i>Philotheca spicata</i> (pepper and salt), <i>Kingia australis</i> (kingia) and <i>Xanthorrhoea preissii</i> (balga); and the herbs, rushes and sedges <i>Cyathochaeta avenacea</i> , <i>Dampiera linearis</i> (common dampiera), <i>Haemodorum laxum</i> , <i>Desmoclados fasciculatus</i> , <i>Mesomelaena tetragona</i> (semaphore sedge) and <i>Morelotia octandra</i> . The community is also known as "floristic community type 3a" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 3 June 2021. Species and Communities Program, DBCA Kensington. Department of Environment and Conservation (2011). Interim Recovery Plan 2011-2016 for <i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soil, Swan Coastal Plain. Interim Recovery Plan No. 315. DEC, Perth Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia. Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i> . Report prepared for the Department of Conservation and Land	Taxa indicative of the eastern side of the Swan Coastal Plain; that includes FCT3a may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.

			Management. Perth, Western Australia.		
57	<i>Corymbia calophylla</i> — <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in Gibson <i>et al.</i> (1994))	The community occurs on heavy soils of the eastern side of the southern Swan Coastal Plain, generally between Bullsbrook and Stratham. The community is dominated by <i>Corymbia calophylla</i> (marri) and <i>Xanthorrhoea preissii</i> (balga). It also occasionally includes <i>Eucalyptus wandoo</i> (wandoo). The more common shrubs include <i>Gompholobium marginatum</i> , <i>Hypocalymma angustifolium</i> (white myrtle) and <i>Banksia dallanneyi</i> (couch honeypot). The herbs, grasses and sedges including <i>Burchardia congesta</i> , <i>Cyathochaeta avenacea</i> , <i>Neurachne alopecuroides</i> (foxtail mulga grass), <i>Caesia micrantha</i> (pale grass-lily), <i>Mesomelaena tetragona</i> (semaphore sedge), <i>Morelotia octandra</i> , <i>Desmocladius flexuosus</i> , <i>Opercularia vaginata</i> (dog weed), <i>Sowerbaea laxiflora</i> (purple tassels), <i>Lepidosperma</i> spp. and <i>Drosera menziesii</i> (pink rainbow) are also common. The community is also known as “floristic community type 3c” as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) “A floristic survey of the southern Swan Coastal Plain” (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. English, V.J. and Blyth, J. (2000). Interim recovery plan for <i>Corymbia calophylla</i> – <i>Xanthorrhoea preissii</i> woodlands and shrublands 2000-2003. IRP No 60. Department of Conservation and Land Management, Wanneroo. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia. Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i> . Report prepared for the Department of Conservation and Land Management. Perth, Western Australia.	Taxa indicative of the eastern side of the Swan Coastal Plain; that includes FCT3c may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of plant species that are indicative of particular floristic community types (FCTs). Lists of taxa that are ‘typical’ or ‘common’ to particular FCTs are listed in Gibson <i>et al.</i> (1994).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references.
58	<i>Corymbia calophylla</i> woodlands on heavy soils of the southern	The community is known from heavy fertile soils of the southern Swan Coastal Plain south of Dardanup. It consists largely of <i>Corymbia calophylla</i> (marri) forests and woodlands. <i>Eucalyptus marginata</i> (jarrah) is	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern	Community is known from the Busselton area, over a range of about 50km. It occurs predominantly on the Swan Southern River and Abba vegetation complexes (these equate to soil and landform units).	Sample, analyse data and report on flora, vegetation and habitat using methods described in EPA

	Swan Coastal Plain (floristic community type 1b as originally described in Gibson <i>et al.</i> (1994))	also common in the tree layer. Common understorey species include <i>Acacia extensa</i> (wiry wattle), <i>Gompholobium polymorphum</i> , <i>Billardiera variifolia</i> , <i>Hibbertia hypericoides</i> (yellow buttercups), <i>Hypocalymmelupa angustifolium</i> (white myrtle) and <i>Xanthorrhoea preissii</i> (balga) over a rich herb layer including <i>Scaevola calliptera</i> , <i>Agrostocrinum scabrum</i> (blue grass lily), <i>Austrostipa semibarbata</i> , <i>Dampiera linearis</i> (common dampiera), <i>Mesomelaena tetragona</i> (semaphore sedge), <i>Morelotia octandra</i> and <i>Lomandra purpurea</i> (purple mat rush). The community is also known as "floristic community type 1b" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> . Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia. Keighery, B. and Trudgen, M. (1992). <i>Remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain</i> . Report prepared for the Department of	FCT1b is one of three community types are found on the heavy soils of the eastern coastal plain identified in Gibson <i>et al.</i> (1994). Community type 1 is restricted to the eastern side of the Swan Coastal Plain, south of Bunbury and has two distinct subgroups (FCT1a and FCT1b). These FCTs had the highest mean species richness recorded in Gibson <i>et al.</i> (1994). Community consists largely of <i>Corymbia calophylla</i> forests and woodlands on the eastern side of the Swan Coastal Plain south of Bunbury. Flora including <i>Acacia myrtifolia</i> , <i>Opercularia spermacoea</i> and <i>Acacia mooreana</i> are largely restricted to FCT 1b. Flora indicative of FCTs on the eastern side of the Swan Coastal Plain; that includes FCT1b may be particularly helpful in determining the FCTs present (Keighery and Trudgen 1992, Table 4). Combinations of plant species are indicative of particular floristic community types (FCTs). Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson <i>et al.</i> (1994).	(2016a); and further detail in DBCA (2021 - see Appendix 1 below), and key references.
59	Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (floristic community type 15 as originally described in Gibson <i>et al.</i> (1994))	The community has been recorded from Bambun to Nirimba, on alluvial sediments on sites that are inundated for long periods resulting in more typical aquatic and deep wetland flora taxa. The community is generally dominated by <i>Melaleuca rhaphiophylla</i> (swamp paperbark) or <i>Casuarina obesa</i> (swamp sheoak) over scattered <i>Melaleuca teretifolia</i> (banbar), <i>Melaleuca viminea</i> (mohan) with sedges including the threatened <i>Eleocharis keigheryi</i> and herbs. The presence of species including <i>Atriplex cinerea</i> (grey saltbush), <i>Samolus repens</i> (creeping brookweed), <i>Salicornia quinqueflora</i> (beaded samphire) and <i>Sporobolus virginicus</i> (marine couch) reflect the saline nature of the community. The community is also known as "floristic community type 15" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal	Department of Biodiversity, Conservation and Attractions (2021). Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain. Draft, 5 October 2021. Species and Communities Program, DBCA Kensington. Department of Environment and Conservation (2005). Interim Recovery Plan 2004-2009 for <i>Melaleuca huegelii</i> – <i>Melaleuca systena</i> shrublands of limestone ridges (Swan Coastal Plain Community type 26a - Gibson <i>et al.</i> 1994) Interim Recovery Plan No. 193. DEC, Perth. Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994). <i>A floristic survey of the Southern Swan Coastal Plain</i> .	Community occurs on alluvial sediments on sites that are inundated for long periods, resulting in more typical aquatic species and flora of deep wetlands. Gibson <i>et al.</i> (1994) lists the following native species as typical for this community: <i>Melaleuca rhaphiophylla</i> , <i>Isolepis producta</i> , <i>Lemna disperma</i> , <i>Triglochin procerum</i> , and <i>Melaleuca teretifolia</i> as a common species. Recorded as low forest A, low forest B, low woodland B and dense thicket in quadrats established for Gibson <i>et al.</i> (1994). Composition varies in particular in response to variations in salinity, and depth and timing of seasonal inundation. Community differs from other wetland floristic community types on the Swan Coastal Plain as it comprises the deep seasonal wetlands, as opposed to the shallower, generally more ephemeral wetlands of FCT07 and FCT08, which often occur in close proximity to FCT15 wetlands. Community recorded from Beermullah and Yanga fluvial deposits, Southern River, Bassendean sands, Pinjarra Plain (Guildford unit) and Vasse estuarine deposits. Most occurrences occur in more saline waters	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a); and further detail in DBCA (2021 -see Appendix 1 below), and key references. Verify if habitat and substrate are as described in key references.

		Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.). Keighery B.J., Keighery G.J., Longman V.M. and Clarke K.A. (2012) Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset. Department of Environment and Conservation, Kensington, Western Australia.	than other related floristic communities. Community has an impeding clay layer and poor drainage that supports retention of surface water that supports germination and growth of the component wetland flora.	
60	Koolanooka System as originally described in Beard (1976)	This community is known from the Koolanooka Hills, its footslopes and the Perenjori Hills. It comprises: <i>Eucalyptus ebbanoensis</i> subsp. <i>ebbanoensis</i> mallee and <i>Acacia</i> sp. scrub with scattered <i>Allocasuarina huegeliana</i> over red loam and ironstone on the upper slopes and summits; <i>Allocasuarina campestris</i> scrub over red loam on hill slopes, shrubs and emergent mallees on shallow red loam over massive ironstone on steep rocky slopes; <i>Eucalyptus loxophleba</i> woodland over scrub on the footslopes; and mixed <i>Acacia</i> sp. scrub on granite. The community was originally described in Beard J.S. (1976) "The vegetation of the Perenjori area, Western Australia: Map and explanatory memoir" (1:250,000 series, Vegmap Publications, Perth, Western Australia).	Beard J.S. (1976) The vegetation of the Perenjori area, Western Australia: Map and explanatory memoir (1:250,000 series, Vegmap Publications, Perth, Western Australia). Borger, J. (2018) Vegetation and flora survey of proposed drill sites and access tracks in Koolanooka Hills in mining tenement M70/1164. For Westralia Iron Pty Ltd. Jenny Borger Botanical Consulting, Kalamunda. Hamilton-Brown, S. (2000) Plant assemblages of the Koolanooka System Interim Recovery Plan #73, 2000-2003. Department of Conservation and Land Management, Western Australia. Van Dongen, R (2019) Vegetation cover assessment for "Koolanooka Hills System" using satellite imagery, Unpublished internal report for the Department of Biodiversity Conservation and Attractions.	Community described based on Beards' Koolanooka System. Known from Koolanooka Hills, and Perenjori Hills, a range to the south east. Community occurs on the Archaean metamorphic rocks of the Koolanooka Hills, the surrounding footslopes, and the fork-shaped range to the south-east, referred to in this document as the Perenjori Hills. The hills have a particular series of plant communities recurring in a catenary sequence or mosaic pattern linked to topographic, pedological and/or geological features. This catenary sequence or 'System' has a distinctive geology, topography and vegetation, different from that of any other comparable system. The plant community on the Koolanooka and Perenjori hills comprises <i>Eucalyptus ebbanoensis</i> subsp. <i>ebbanoensis</i> mallee and <i>Acacia</i> sp. scrub with scattered <i>Allocasuarina huegeliana</i> over red loam and ironstone on the upper slopes and summits, <i>Allocasuarina campestris</i> scrub over red loam on hill slopes; mixed shrubs and emergent mallees on shallow red loam over massive ironstone on steep rocky slopes. A mixed <i>Acacia ramulosa</i> , <i>A. quadrimarginea</i> , <i>A. tetragonophylla</i> and <i>Hakea preissii</i> scrub on a granitic outcrop occurs on the north-east flank of the Koolanooka Hills; and a <i>Eucalyptus loxophleba</i> woodland over scrub on its footslopes (Beard 1976).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Determine if habitat (Koolanooka or Perenjori Hills and footslopes) and associated floral assemblages occur, and meet summary description, and descriptions in key references.
61	Mt Lindesay — Little Lindesay vegetation complex	The community is known from two occurrences; Mount Lindesay and Little Lindesay. It comprises a unique combination of restricted flora including granite specialists. The granite complex also contains threatened flora and priority flora taxa. <i>Eucalyptus marginata</i> (jarrah), shrub-mallee and heath predominates the upper slopes and summit area with <i>Eucalyptus marginata</i> , <i>Corymbia</i>	Barrett, S. (1996). Biological survey of mountains of southern Western Australia. Unpublished report by the Department of Conservation and Land Management for the Australian Nature Conservation Agency. Clarke, V. (2009). Monitoring the impacts of fire and Phytophthora	Restricted to porphyritic (crystalline) granite batholiths (large volcanic-derived rock formations) with shallow low-nutrient acidic soils derived from the granitoid (granite-like) bedrock and granite outcrops that are skeletal in areas. Known from two occurrences on granite massifs and associated shallow soils on Mount Lindesay and Little Lindesay approximately 15 km northwest of Denmark	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a). Compare substrate and habitat, and associated distinctive assemblages, with

		<p><i>calophylla</i> (marri) and <i>Eucalyptus megacarpa</i> (bullich) low woodland in gullies. Soils are shallow or skeletal. In these areas typical shrubs include <i>Banksia grandis</i> (bull banksia), <i>Hakea varia</i> (variable-leaved hakea) and <i>Beaufortia decussata</i> (gravel bottlebrush) with sedges <i>Mesomelaena graciliceps</i> and <i>Netrostylis capillaris</i>. Other shrubs include <i>Sphenotoma parviflora</i>, <i>Gastrobium brownii</i> and <i>Billardiera drummondii</i>. Three priority taxa of <i>Andersonia</i> — <i>Andersonia hammersleyana</i> (priority 2), <i>Andersonia</i> sp. Mitchell River (B.G. Hammersley 925) (priority 3) and <i>Andersonia</i> sp. Virolens (G.J. Keighery 12000) (priority 3) are found in the complex. Relatively bare granite rock slabs dominate the middle slopes and support a unique community of scrub and open herbs including two species listed as threatened (<i>Grevillea fuscolutea</i> and <i>Laxmannia grandiflora</i> ssp. <i>brendae</i>) and four priority flora (<i>Borya longiscapa</i> (priority 3), <i>Cryptandra congesta</i> (priority 4), <i>Lasiopetalum</i> sp. Denmark (B.G. Hammersley 2012) (priority 3), and <i>Sphenotoma</i> sp. Stirling Range (P.G. Wilson 4235) (priority 4)). Additional non-endemic flora include <i>Drakaea micrantha</i> (threatened) and <i>Eucalyptus virginea</i> (Mount Lindesay white gum) (priority 4) with granite associates <i>Calothamnus scabridus</i> (priority 2) and <i>Verticordia endlicheriana</i> var. <i>angustifolia</i> (priority 3). The community was identified through "A biological survey of mountains in southern Western Australia" by S. Barrett in 1996.</p>	<p>within the shallow soil plant communities of the Mt Lindesay Threatened Ecological Community, Denmark WA. Version 1.0. (June 2009). Prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project – Department of Environment and Conservation, Western Australia https://www.dpaw.wa.gov.au/images/documents/plants-animals/monitoring/20090818_mt_lindesay_system_protocol_v1.0.pdf</p>	<p>within Mount Lindsay National Park and adjoining reserves and private land.</p>	<p>summary description, and description in and key references.</p>
62	<p>Monsoon (vine) thickets on coastal sand dunes of Dampier Peninsula</p>	<p>The community occurs on the coastal sand dunes of the Dampier Peninsula. The vine thickets of the Dampier Peninsula are a very distinctive type of rainforest in the Kimberley region. It occurs as discrete areas of dense vegetation and can occur as a stand of a few trees or as larger patches. Several tree and tall shrub species are common to many occurrences. Trees include <i>Terminalia petiolaris</i> (masroorl or blackberry tree), <i>Grewia breviflora</i> (currant or coffee fruit), <i>Celtis strychnoides</i> (Goonj), <i>Diospyros humilis</i> (ebony wood), <i>Sersalisia sericea</i> (nangi),</p>	<p>Biota Environmental Services (2009a). A Vegetation and Flora Survey of James Price Point: West Season 2009. Biota Environmental Sciences. Report prepared for Department of State Development. Black, S.J., Willing, T. and Dureau, D.M. (2010). A comprehensive survey of the flora, extent and condition of vine thickets on coastal sand dunes of Dampier Peninsula, West Kimberley 2000-2002. Final report September</p>	<p>McKenzie <i>et al.</i> (1991) determined assemblages in the region through statistical analysis of composition. The study included data from four rainforest sites on the Dampier Peninsula. These four sites were distinguished as a separate floristic group in the 18 Group level analysis of perennial plant species data. The vine thickets were termed 'Patch Group 6' and classified together on the basis of similarities of the perennial plant species. Black <i>et al.</i> (2010) note that about 25% of the plant species they recorded in the vine thickets were mostly or completely confined to the community.</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Wet season surveys are required to detect seasonal flora. Determine if habitat as described in key references, and associated</p>

		<p><i>Exocarpos latifolius</i> (broad-leaved cherry), <i>Mimusops elengi</i> (walara), <i>Bauhinia cunninghamii</i> (bauhinia or jigal tree) and <i>Gyrocarpus americanus</i> subsp. <i>pachyphyllus</i> (helicopter tree). Common tall shrubs include <i>Flueggea virosa</i> subsp. <i>melanthesoides</i> (dogwood), <i>Croton habrophyllus</i> and <i>Dodonaea platyptera</i> (broad-winged hop bush). The most common climbers include <i>Abrus precatorius</i> (crabs eyes), <i>Capparis lasiantha</i> (split jack), <i>Tinospora smilacina</i> (snakevine), <i>Jasminum didymum</i>, <i>Caesalpinia major</i> and <i>Vincetoxicum cinerascens</i> (oyster-catcher bill).</p>	<p>2010. Broome Botanical Society (Inc.). Broome, Western Australia. Department of Biodiversity, Conservation and Attractions (2018). Interim Recovery Plan 2018-2023 for the Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula. Interim Recovery Plan No. 383. DBCA, Perth</p> <p>Environs Kimberley (2010) Threatened Ecological Community Nomination Form - for listing or changing the status of an ecological community under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act).</p> <p>Harding, C. (2009). Monitoring of the extent of Dampier Peninsula Vine Thickets Threatened Ecological Community. Version 1.0 (June 2009). Prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project.</p> <p>Kenneally, K. F., Choules Edinger, D., Willing, T. (1996). <i>Broome and Beyond. Plants and People of the Dampier Peninsula, Kimberley, Western Australia</i>. Department of Conservation and Land Management.</p> <p>McKenzie, N.L., Johnston, R.B., and Kendrick, P.G (eds) (1991). <i>Kimberley Rainforests Australia</i>. Surrey Beatty & Sons in Association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment. Chipping Norton, NSW</p>	<p>While most patches were dominated by a mix of several different tree species that varied in height, a few patches were dominated by a single tree species at a uniform height, and had little to no understorey of shrubs.</p> <p>The main tree species include (from Black 2005; Environs Kimberley 2010): <i>Celtis philippinensis</i>, <i>Diospyros ferrea</i> var. <i>humilis</i>, <i>Ficus virens</i>, <i>Melaleuca cajuputi</i>, <i>Melaleuca dealbata</i>, <i>Melaleuca viridiflora</i>, <i>Mimusops elengi</i>, <i>Sersalicia sericea</i> and <i>Terminalia petiolaris</i>. Shrub species in the understorey include: <i>Croton tomentellus</i>, <i>Dodonaea platyptera</i>, <i>Exocarpos latifolius</i>, <i>Pandanus spiralis</i>, <i>Plumbago zeylanica</i> and <i>Santalum lanceolatum</i>. Vine species include <i>Abrus precatorius</i>, <i>Adenia heterophylla</i>, <i>Caesalpinia major</i>, <i>Gymnanthera nitida</i>, <i>Jacquemontia paniculata</i>, <i>Tylophora cinerascens</i> and <i>Tinospora smilacina</i>.</p> <p><i>Lophostemon grandiflora</i> often occurs in the wettest areas behind sand dunes as part of the vine thicket stand and occurs as a forest similar to the occurrence of <i>Melaleuca</i> sp. within vine thickets. <i>Capparis lasiantha</i> is a common sprawling vine found within most vine thicket occurrences, while <i>Capparis sepiaria</i> is a regular feature in most northern vine thicket patches. The vine thickets mainly occur on leeward slopes and swales and occasionally exposed dune crests. Many occurrences extend into the red pindan soils on the inland portions of the dunes. Landforms occupied by the vine thickets include beach fronts, sand-spit headlands, low cliffs above mangrove lined creeks, storm ridges within intertidal flats, and red soil gullies inland of coastal cliffs (Black <i>et al.</i> 2010). The soils in the Holocene dunes where the community occurs are deep coastal dunes, generally white but can be pink, with a thin humus layer.</p>	<p>assemblages occur, and meet summary description, and description in key references.</p> <p>The full extent of variation of habitats and assemblages may not have been fully documented for this community.</p>
63	Plant assemblages of the Inering System as originally	<p>The community occurs in the Inering Hills in the northern Wheatbelt of Western Australia. It comprises: <i>Allocasuarina campestris</i> scrub over chert and granite hills; <i>Allocasuarina campestris</i> thicket with scattered <i>Acacia acuminata</i> (jam) and <i>Allocasuarina</i></p>	<p>Beard, J. S. (1976). Vegetation Survey of Western Australia. The Vegetation of the Perenjori Area, Western Australia. 1:250,000 series. Vegmap Publications, Perth.</p>	<p>The Inering System as described by (Beard 1976). has a distinctive geology, topography and vegetation, different from that of any other comparable system described by J. Beard. Beard (1976) notes that like the Billeranga system, the Inering System “covers some small and localised outcrops of resistant rocks. Inering</p>	<p>Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references.</p>

	described in Beard (1976)	<i>huegeliana</i> (rock sheoak) over brown sandy loam over stony and lateritic summits and slopes; <i>Acacia</i> sp. mixed low woodland on red brown sandy loam over granite on summits and slopes; <i>Melaleuca cardiophylla</i> (tangling melaleuca) thicket with scattered <i>Eucalyptus loxophleba</i> (York gum) and <i>Eucalyptus salmonophloia</i> (salmon gum) over granite on the lower slopes and foothills; and <i>Eucalyptus loxophleba</i> woodland over clay loam on the foothills. The community was originally described in Beard J.S. (1976) "The vegetation of the Perenjori area, Western Australia: Map and explanatory memoir" (1:250,000 series, Vegmap Publications, Perth, Western Australia).	Department of Conservation and Land Management (2002) Interim Recovery Plan No. 107, Plant assemblages of the Inering System. CALM, Perth. Orsini, J. P. and Lewis, S. (1992). Conservation of Remnant Vegetation in the Inering Creek Catchment. In: V. Read (ed), <i>Inering Save the Bush Project, Bush Management Strategy</i>	hills is 12 km north of Carnamah and mapped as Archaean-granite complex. The system also includes Woodadying Hill west of Carnamah which is also granitic and some nearby hills to the northwest which are of the Proterozoic Coomberdale Chert. Community comprises a group of hills – stretching from Carnamah to Three Springs - with a particular series of plant assemblages recurring in a catenary sequence linked to topographic, pedological and/or geological features. Community on Inering Hills is different from others on other Systems (eg. Billeranga and Koolanooka Systems). Most available survey information is from Woondadying Hill – the southern-most occurrence. Orsini and Lewis (1992) recorded the vegetation of many hills of the Inering hill range that are now highly fragmented, and mapped most of the locations as <i>Allocasuarina campestris</i> , <i>Hakea recurva</i> , <i>Grevillea paniculata</i> , <i>Acacia acuminata</i> and <i>Acacia tetragonophylla</i> low woodland/scrub. These species are the least palatable to sheep. They did not locate the <i>Melaleuca filifolia</i> – <i>Allocasuarina campestris</i> assemblage on Proterozoic Noondine chert as reported by Beard (1976). Community supports Priority flora including: <i>Scholtzia brevistylis</i> subsp. <i>prowaka</i> (P2), <i>Epitriche demissus</i> (P2) and <i>Acacia nodiflora</i> (P3).	Determine if habitat (Inering Hills and footslopes) and associated floral assemblages occur, and meet summary description, and description in key references.
64	Plant assemblages of the Moonagin System as originally described in Beard (1976)	The community occurs on the fine-grained Archaean rocks of the Moonagin and Milhun Ranges. It comprises <i>Acacia</i> spp. scrub on red soil on the summits and slopes of the hills; <i>Acacia</i> spp. scrub with scattered <i>Eucalyptus loxophleba</i> (York gum) and <i>Eucalyptus oleosa</i> (giant mallee) on red loam flats on the foothills; and <i>Eucalyptus loxophleba</i> (York gum) woodland on red loam flats of the pediments. The community was originally described in Beard J.S. (1976) "The vegetation of the Perenjori area, Western Australia: Map and explanatory memoir" (1:250,000 series, Vegmap Publications, Perth, Western Australia).	Beard, J. S. (1976). <i>Vegetation Survey of Western Australia. The Vegetation of the Perenjori Area, Western Australia</i> . 1:250,000 series. Vegmap Publications, Perth. Department of Conservation and Land Management (2002). Interim Recovery Plan 2002-2007 for Plant assemblages of the Moonagin System. Interim Recovery Plan No. 105. Department of Conservation and Land Management, Perth	The Moonagin and Milhun Ranges, north-east of Morawa, comprise a group of low rounded granite hills formed from Archaean metamorphic rock (Baxter and Lipple 1985). They have a particular series of plant communities recurring in a catenary sequence or mosaic pattern linked to topographic, pedological and/or geological features. This catenary sequence or 'system' has a distinctive geology, topography and vegetation assemblages that differ from surrounding areas and from that of any other comparable system (eg. Koolanooka and Billeranga Systems; Beard 1976).	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references. Determine if habitat (Moonagin Hills and footslopes) and associated floral assemblages occur, and meet summary description, and description in key references.
65	Plant assemblages of the Billeranga System as originally	The community occurs in the Billeranga Hills in the north-eastern Wheatbelt of Western Australia. It comprises: <i>Melaleuca filifolia</i> (wiry honeymyrtle) — <i>Allocasuarina campestris</i> thicket on clay sands over laterite on slopes and ridges; open mallee over mixed scrub on yellow sand over gravel on western slopes;	Baxter, J. L. and Lipple, S. L. (1985). <i>Perenjori, Western Australia</i> . 1:250,000 Geological Series – Explanatory Notes. Geological Survey of Western Australia, Perth Beard, J. S. (1976). <i>Vegetation Survey of Western Australia. The</i>	The Billeranga System as described by (Beard 1976). has a distinctive geology, topography and vegetation, different from that of any other comparable system described by J. Beard. It covers the outcrop of the Billeranga group of Proterozoic rocks as expressed in the Billeranga Hills comprising sandstone, acid lavas,	Sample, analyse data and report on flora and vegetation using methods described in EPA (2016a), and key references.

	described in Beard (1976)	<p><i>Eucalyptus loxophleba</i> (York gum) woodland over sandy clay loam or rocky clay on lower slopes and creeklines; and mixed scrub or scrub dominated by <i>Dodonaea inaequifolia</i> over red brown loamy soils on the slopes and ridges. The community was originally described in Beard J.S. (1976) "The vegetation of the Perenjori area, Western Australia: Map and explanatory memoir" (1:250,000 series, Vegmap Publications, Perth, Western Australia).</p>	<p>Vegetation of the Perenjori Area, Western Australia. 1:250,000 series. Vegmap Publications, Perth. Hamilton-Brown (2000). Plant assemblages of the Billeranga System. Interim Recovery Plan 2000-2003. IRP number 71. Department of Conservation and Land Management, Wanneroo.</p> <p>Robertson, P. L. (2019). Vegetation cover assessment for "Plant assemblages of the Billeranga System as described by Beard (1976)" using satellite imagery. Unpublished internal report for the Department of Biodiversity, Conservation and Attractions, Kensington.</p> <p>True, D and O'Callaghan, A. (1998). <i>Community Bushland Surveys</i>. A joint project of Australian Trust for Conservation Volunteers, World Wide Fund for Nature Australia and Department of Conservation and Land Management</p>	<p>chert, siltstone and shale. It comprises a number of assemblages.</p> <p>The variation in the floristic composition of the community on the Billeranga System is assumed to correspond to different aspects/exposures, soil/substrate types and depths, and moisture regimes. A number of priority flora are either totally confined to the community or are very restricted in their distribution in Western Australia. These include: <i>Acacia pterocaulon</i> (P1), <i>Baeckea</i> sp. Billeranga Hills (P1), <i>Calytrix chrysantha</i> (P4), <i>Lepidobolus densus</i> (P4), <i>Scholtzia subsessilis</i> (P1).</p>	<p>Determine if habitat (Billeranga Hills and footslopes) and associated floral assemblages occur, and meet summary description, and description in key references.</p>
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Appendix 1

Vegetation survey methods and analysis to determine floristic community types on the southern Swan Coastal Plain

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Draft, 6 December 2021

1. Quadrat analysis

The best way to determine the floristic community types (FCTs) present at a new survey site on the southern Swan Coastal Plain is to repeat methods as described in the Gibson *et al.* (1994) report. That is, to establish 10 by 10m quadrats in vegetation in best condition and not in ecotones, and score them (ie record all the flora species present) at least twice at appropriate times. A form that provides standard format for recording quadrat-based data occurs in Keighery (1994). Permanent markers such as fence droppers or plastic survey markers should be used to mark corners, and corner locations recorded with a GPS with an accuracy of +/- 0.5 m. A photo of the quadrat should be taken from a specified corner; typically the north east corner, using a standard lens.

The scoring of quadrats should be planned around the flowering times of the majority of the species present. This will vary depending on whether the site is a wetland, and will also depend on the latitude, and specific characteristics of the season (late or early rains etc). Spring and late spring are usually best (September, and late October /early November). A third or even fourth scoring was sometimes undertaken for quadrats established for Gibson *et al.* (1994), especially in wetlands. In addition, some quadrats were scored over a series of years for Gibson *et al.* (1994), due to poor seasonal rains. It is therefore possible that climate will influence results for quadrats established, and scorings across a series of additional seasons or even years may be indicated.

A good quality flowering specimen of each taxon encountered should be collected, and confirmed with the WA herbarium. Specimens of plants that are new or poorly known to the location or have special conservation status should be vouchered.

Taxonomy should be reconciled between datasets to current or historic species names. The species data from quadrats established should then be compared and analysed against quadrat data held in Gibson *et al.* (1994) and Keighery *et al.* (2012) using appropriate statistical techniques and parameters (eg using PATN, Primer or PC-ORD).

Unless the new data are of similar quality, that is, where similar numbers of native plant taxa are recorded then compared to average species richness in quadrats established for the Gibson *et al.* (1994) report, results could be unreliable and potentially misleading. Determining appropriate locations for quadrats may be quite critical in this regard, in that they should be placed in areas in best condition.

The importance of the application of this quadrat-based method is highlighted where few taxa are recorded. Relevé data are generally not comparable with the quadrats for Gibson *et al.* (1994). In addition, it is generally not possible to exactly relocate relevés so they can't easily be rescored, and this will limit the likelihood of accurately observing all flora at a site over time.

Analyses should be carried out against the quadrat data from Gibson *et al.* (1994) and Keighery *et al.* (2012). That is, full species lists for all quadrats in these datasets should be utilised for these comparisons, and not partial species lists held in the tables in the Gibson *et al.* (1994) report. The original datasets are

available on the Department of Biodiversity, Conservation and Attractions website in the data directory under tools at <https://naturemap.dbca.wa.gov.au/> ('Swan Coastal Plain Survey' Gibson *et al.* 1994; and 'Weed and native flora data for the Swan Coastal Plain' Keighery *et al.* 2012).

Gibson *et al.* (1994) utilised the quadrat-based data collected during that survey and PATN was used to sort the quadrat data into a series of FCTs using specified parameters. To validly compare new data collected for new sites on the southern Swan Coastal Plain, these methods should be repeated. There are quite a number of ways the statistical analysis can be done. The new quadrat data can be inserted, the classification rerun and examined with cluster (some minor typological changes might be expected) or ordination techniques. Nearest neighbour distances of the new quadrats to the Gibson *et al.* (1994) and/or Keighery *et al.* (2012) data can be examined, or some form of multivariate discriminate analysis can be applied, such as CAP - canonical analysis of principal coordinates, in the Primer package. Single site insertions of new quadrat data into the existing datasets are advised as they will minimise disruption of the original datasets. Tables of similarity indices for the FCTs that have closest affinity to the new quadrats can assist in elucidating the most logical FCT assignments. Regardless of the methods used, the most reliable outcomes will be from comparison of adequately sampled quadrat data.

Critical analysis of the logic of the outcomes of analysis is required. For example, the typical habitat features such as soil and landform, and hydrological status of quadrats established for Gibson *et al.* (1994) should be explicitly discussed and compared in reporting. Comparison of 'typical' floristics and structure of the FCTs as defined by Gibson *et al.* (1994) may also be relevant. Results of analyses, key habitat characteristics, key flora combinations, hydrological status, and other relevant issues should be tabulated for each quadrat, and the logic used to determine the FCT/s present stated. If results of statistical analysis do not indicate a 'logical' outcome in this regard then the reasons for this should be discussed. This may include factors such as vegetation condition, timing of survey, potential presence of previously unsampled FCTs or transitional zones, and issues associated with data quality. The most logical conclusion regarding FCTs present in the new quadrats should be stated and the reasoning for concluding that a specified FCT occurs should be explicit.

2. Use of other methods

Species lists for vegetation units can be collected and analysed using other methods where native species richness is inadequate to provide good quality data for statistical analysis; for example where vegetation is not in suitable condition.

The flora and vegetation can be surveyed along a series of transects or [relevés](#) across the site, with species recorded for different vegetation units being compiled in separate lists. Detailed notes should be recorded about the species present, vegetation condition on Bush Forever scales, and soils and landform. Plant species that may be particularly significant in differentiating the floristic community types should also be noted.

The species lists for each identified vegetation unit should be compared to full species lists compiled from all quadrats established for the Gibson *et al.* (1994) report and Keighery *et al.* (2012), for floristic community types considered most likely to occur at the site on the basis of soil and landform characteristics and general species composition.

Results should be provided in the form of raw data (species lists) and tables that indicate the alignment (proportional overlap) of species present in each different vegetation unit, with species lists compiled for all quadrats in likely FCTs from Gibson *et al.* (1994) and Keighery *et al.* (2012).

Combinations of plant species that are indicative of particular FCTs should be evaluated from species present in each identified vegetation unit. Lists of taxa that are 'typical' or 'common' to particular FCTs are listed in Gibson *et al.* (1994). In addition, taxa that are indicative of the eastern side of the Swan Coastal Plain (Keighery and Trudgen 1992, Table 4), may be particularly helpful in determining the FCTs present. The eastern side of the Plain is characterized by the

presence of a suite of threatened ecological communities including three marri communities on heavy soils (floristic community types 3a, 3b and 3c, and three closely allied woodlands and shrublands - type 20a, 20b and 20c – ‘the 20 group of floristic community types’ as described in Gibson *et al.* (1994)). There is a suite of taxa listed in Keighery and Trudgen (1992) that are associated with the highly cleared heavier soils on this side of the plain, and that are associated with either or both of these two groups of TECs. These taxa are particularly helpful in distinguishing the presence of these threatened ecological communities.

In addition, information about Reference Sites that provide good examples of specific FCTs in Bush Forever sites is on the Western Australian Local Government Association web site at:

[BiodiversityProject > Project/Programs > Perth Region Plant Biodiversity Project > 7. Index to Bush Forever Reference Sites \(walga.asn.au\)](#) The location in question should be compared to these Reference Sites in terms of composition and structure of the vegetation, habitat, and soil and landform.

The logic used to determine the likely FCTs present at the new site should be evident in reporting, (eg soil and landform, geology, patterns of species composition). Table 14 in the Gibson *et al.* (1994) report provides a list of the most frequent landforms on which the FCTs occur, but this is not a definitive list of landforms on which the FCTs were found. Conclusions that certain Priority or threatened ecological communities could not occur because the soil and landform units from which they have been recorded do not occur at the survey site are not conclusive and additional data would need to be presented.

If taxa indicate that vegetation is generally transitional between specific FCTs, then this should be noted and the FCTs to which the vegetation aligns most closely should be identified. The status of each possible FCT should be noted (eg Priority or threatened ecological community, and rank).

3. Mapping

When applying existing floristic community type classifications from Gibson *et al.* (1994) and Keighery *et al.* (2012) for the southern Swan Coastal Plain, individual quadrats at the new site first need to be analysed to determine the FCT present at the quadrat location. FCT assignment of each quadrat needs to occur prior to mapping boundaries of FCTs or alignment with other pre-determined vegetation units. A pre-determined vegetation unit may contain one or a suite of FCTs. The assignment of FCTs to pre-determined and mapped vegetation units is likely to result in flawed interpretation of FCTs present and their boundaries.

The boundaries between vegetation condition classes using Bush Forever vegetation condition scales should be mapped and digitised.

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