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From Engler to APGIV: a short history of the botanical arrangement of the Western Australian Herbarium collections

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SHORT COMMUNICATION

Modern herbarium collections typically have one of three different systems of arrangement: alphabetical, phylogenetic, or a combination of the two. Originally Western Australia had three recognised botanical collections housed in separate institutions. It is not documented how the early collections were initially arranged by Bernard Henry Woodward, the Director of the Museum and Art Gallery herbarium collections (1894–1916), by the Forests Department Herbarium (established in 1916), or by the Bureau of Agriculture's first botanist Alexander Morrison in 1897; however it is likely they were all arranged in alphabetical order by family. In 1913, Frederick Stoward, Botanist and Pathologist of the Department of Agriculture (renamed in 1898 from Bureau), mentioned a need for rearrangement and cataloguing of the Herbarium, which was undertaken by assistant Mr [F.W.] Wakefield (Stoward 1913). In 1920, Desmond Andrew Herbert, appointed Economic Botanist and Pathologist, was assisted by Vera McNeilance Prowse in a further re-organisation of this herbarium. Numbering about 6,000 specimens, several collections the herbarium had received were combined, including those of James Drummond, William V. Fitzgerald, George Maxwell, and Ferdinand von Mueller (Gardner 1947; Green 1990; Underwood 2011).

The first documented systematic family arrangement of botanical collections of Western Australia commenced in July 1924 with the appointment of Charles Austin Gardner as Assistant Botanist in the Department of Agriculture and was completed by June 1926 (Carne 1925; Carne 1926). Being taken with the Englerian notion of arranging families in order of increasing flower complexity within monocotyledons and dicotyledons, Gardner arranged the families and genera in the Herbarium according to Engler's system published in Engler and Prantl's (1887–1915) *Die Natürlichen Pflanzenfamilien*.

When the State Herbarium was officially established in 1929 within the Department of Agriculture headquarters on St Georges Terrace (Fitzpatrick 2011), after the amalgamation of the Department of Agriculture Herbarium and Forests Department Herbarium, this classification system was continued. The collection was soon rehoused within the State Observatory in West Perth (December 1933 to 1959) (Underwood 2011). At about this time Gardner, now Government Botanist and Curator of the State Herbarium (Green 1990), allocated a consecutive number for every plant family in the world then recognised by Engler. Where a family had not been recorded for Western Australia, it was still allocated a number, despite there being no folders or specimens in the Western Australian Herbarium at the time. Gardner annotated a copy of J.C. Willis' (1919) 4th edition of *A Dictionary of the Flowering*

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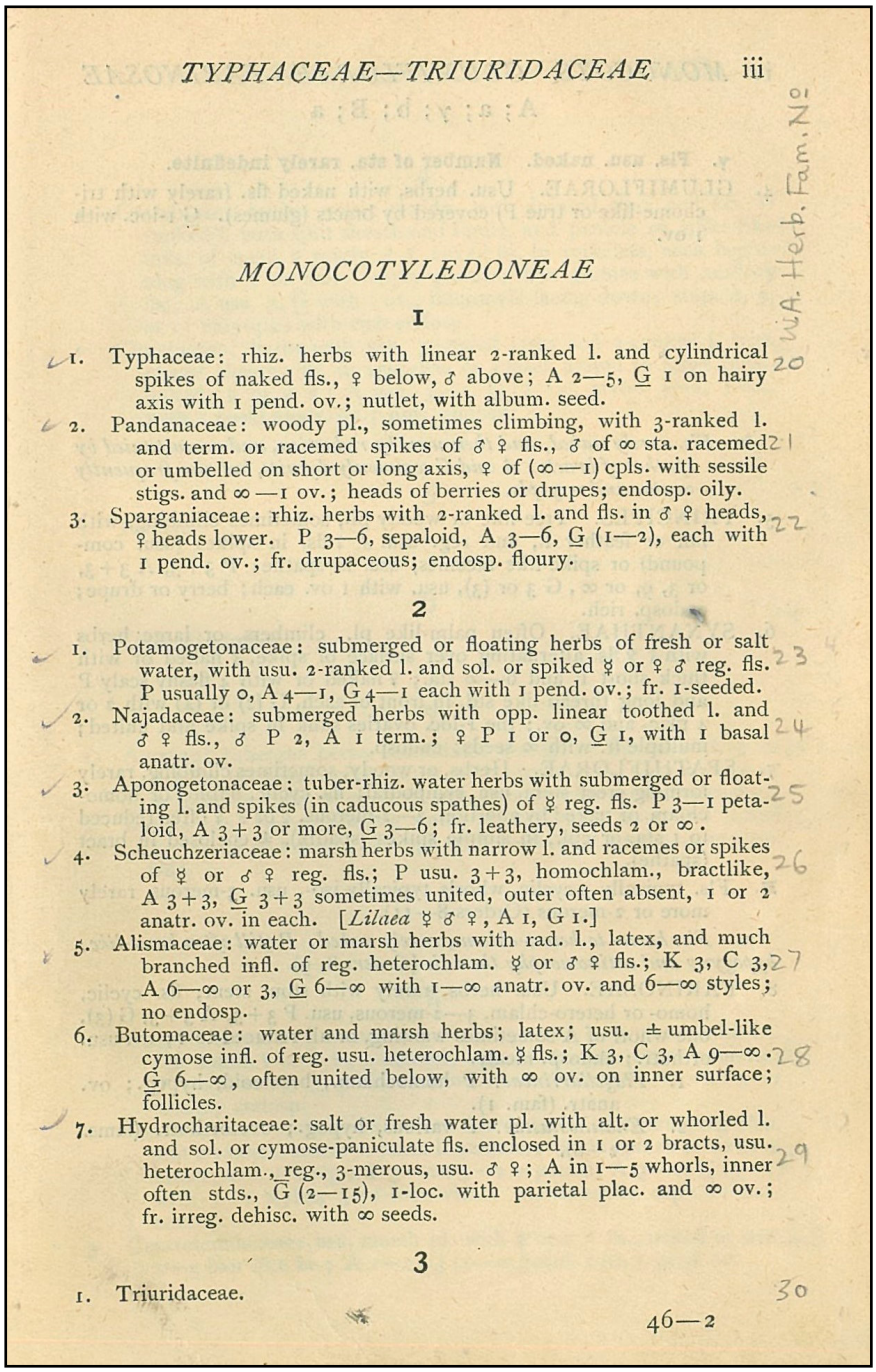
Plants and Ferns, a portable version of the Engler system, with his numbering system (Figure 1), presumably on the basis that *Die Natürlichen Pflanzenfamilien*, consisting of multiple, large volumes, was likely too unwieldy to manage.



TYPHACEAE—TRIURIDACEAE iii

WA. Herb. Fam. No

MONOCOTYLEDONEAE

1

1. Typhaceae: rhiz. herbs with linear 2-ranked l. and cylindrical spikes of naked fls., ♀ below, ♂ above; A 2—5, G̲ 1 on hairy axis with 1 pend. ov.; nutlet, with album. seed. 20
2. Pandanaceae: woody pl., sometimes climbing, with 3-ranked l. and term. or racemed spikes of ♂ ♀ fls., ♂ of ∞ sta. racemed or umbelled on short or long axis, ♀ of (∞—1) cpls. with sessile stigs. and ∞—1 ov.; heads of berries or drupes; endosp. oily. 21
3. Sparganiaceae: rhiz. herbs with 2-ranked l. and fls. in ♂ ♀ heads, ♀ heads lower. P 3—6, sepaloid, A 3—6, G̲ (1—2), each with 1 pend. ov.; fr. drupaceous; endosp. floury. 22

2

1. Potamogetonaceae: submerged or floating herbs of fresh or salt water, with usu. 2-ranked l. and sol. or spiked ☿ or ♀ ♂ reg. fls. P usually 0, A 4—1, G̲ 4—1 each with 1 pend. ov.; fr. 1-seeded. 23
2. Najadaceae: submerged herbs with opp. linear toothed l. and ♂ ♀ fls., ♂ P 2, A 1 term.; ♀ P 1 or 0, G̲ 1, with 1 basal anatr. ov. 24
3. Aponogetonaceae: tuber-rhiz. water herbs with submerged or floating l. and spikes (in caducous spathes) of ☿ reg. fls. P 3—1 petaloid, A 3+3 or more, G̲ 3—6; fr. leathery, seeds 2 or ∞. 25
4. Scheuchzeriaceae: marsh herbs with narrow l. and racemes or spikes of ☿ or ♂ ♀ reg. fls.; P usu. 3+3, homochlam., bractlike, A 3+3, G̲ 3+3 sometimes united, outer often absent, 1 or 2 anatr. ov. in each. [*Lilaea* ☿ ♂ ♀, A 1, G 1.] 26
5. Alismaceae: water or marsh herbs with rad. l., latex, and much branched infl. of reg. heterochlam. ☿ or ♂ ♀ fls.; K 3, C 3, A 6—∞ or 3, G̲ 6—∞ with 1—∞ anatr. ov. and 6—∞ styles; no endosp. 27
6. Butomaceae: water and marsh herbs; latex; usu. ± umbel-like cymose infl. of reg. usu. heterochlam. ☿ fls.; K 3, C 3, A 9—∞. G̲ 6—∞, often united below, with ∞ ov. on inner surface; follicles. 28
7. Hydrocharitaceae: salt or fresh water pl. with alt. or whorled l. and sol. or cymose-paniculate fls. enclosed in 1 or 2 bracts, usu. heterochlam., reg., 3-merous, usu. ♂ ♀; A in 1—5 whorls, inner often stds., G̲ (2—15), 1-loc. with parietal plac. and ∞ ov.; fr. irreg. dehisc. with ∞ seeds. 29

3

1. Triuridaceae. 30

46—2

Figure 1. A copy of the 1919 4th edition of J.C. Willis' *A Dictionary of the Flowering Plants and Ferns* as annotated by C.A. Gardner, archived at the Department of Biodiversity, Conservation and Attractions Library, Perth.

In his *Enumeratio Plantarum Australiae Occidentalis*, Gardner (1930) only listed families and genera recorded for Western Australia, with the arrangement following Engler and Prantl (1887–1915), except for Leguminosae which he divided into three families (Mimosaceae, Caesalpiniaceae and Papilionaceae) as suggested by Hutchinson (1926) in his *The Families of Flowering Plants*. While families are not numbered in the publication, genera are numbered consecutively, again following Engler and Prantl (1887–1915).

A report written by Gardner (1947) states that the State Herbarium collection was arranged under the system adopted at the Herbarium of the Royal Botanic Gardens, Kew. Given the system adopted at Kew was based on Bentham and Hooker's *Genera Plantarum* (1862–1883), it is assumed that Gardner is referring to the concept of a phylogenetic arrangement of families, rather than the specific Kew arrangement.

The family numbers used to assist the physical organisation of the State Herbarium derived from Engler and Prantl (1887–1915) were not consecutive, but they formed the basis for a Dewey-type decimal system for genera later adopted by Gardner sometime in the decade between 1930 and 1940. The decimal number was unique to the family (whole number) and genus (decimal). For example, the Guttiferae (now Clusiaceae) was given the decimal number 233.000, the Elatinaceae was given decimal number 235.000, while the family number 234.000 for Dipterocarpaceae was not represented in Western Australia (Appendix 1). Genera within families were allocated a unique consecutive number like 233.001, 233.002, and so on, with the arrangement of genera following the arrangement in Engler and Prantl (1887–1915) (Gardner 1930). In the rare cases where a genus was not recognised in Engler and Prantl (1887–1915), Gardner would have allocated a decimal number using available references and his own conclusion on its morphological or phylogenetic affinities. The ferns, fern allies, and gymnosperms were allocated the numbers 1.000 to 19.000. Monocotyledons started at 20.000 and finished with the Orchidaceae (66.000), and the dicotyledons from Casuarinaceae (70.000) to the Compositae (now Asteraceae) (345.000). While family numbering included families not naturally found within Western Australia, generic numbering was based on the order of genera as presented in Gardner (1930) (Table 1). Letter suffixes were subsequently added as new families and genera became recognised due to changes in taxonomic circumscription, such as the splitting of a family (e.g., Liliaceae (Green 1985)) (Appendix 1).

The collections remained unmounted prior to 1938, but as of July 1946, all were mounted (Gardner 1947). Until around 1955, outer brown folders had the genus name, handwritten mostly by Gardner, on the lower left-hand side, and the genus initial with specific epithet written on the lower right side (Neville Marchant, pers. comm.). The arrangement number, unique to the family (whole number) and genus (decimal), was in the centre. In 1955, as a new Herbarium Assistant, Neville Marchant was tasked with replacing all the old folders with new ones that were labelled using the then newly available UNO pens and plastic stencils (Figure 2).

Table 1. Example of the Englerian and decimal numbering system implemented by Gardner as demonstrated by Sterculiaceae (now Malvaceae) (family 223).

Genus	Genus Number allocated in Engler & Prantl (1887–1915)	Order of listing in Gardner (1930)	Decimal number for Genus folders, and 1953 Herbarium Index
Dicarpidium	13	4th	223.004
Waltheria	14	5th	223.005
Rulingia	15	6th	223.006
Commersonia	16	7th	223.007
Hannafordia	26	8th	223.008

The general arrangement of the collection within the 25 wooden cupboards in the State Observatory building has been documented (Figure 3). A bound herbarium index was typeset for the collections in order to physically locate taxa in cabinets and it was periodically updated based on taxonomic understanding at the time. Only the 1953 and 1959 editions remain. Constant reshuffling of specimens precluded the maintenance of these manually typed indexes until the advent of computer and database information technologies in the 1980s.

In 1957 the botanical collections of the Western Australian Museum were finally transferred to the State Herbarium and incorporated within the then designated arrangement. The State Herbarium was officially named as the Western Australian Herbarium, moved to the Department of Agriculture headquarters (B Block) in South Perth (1959–1970), and was given the *Index Herbariorum* (http://sweetgum.nybg.org/science/ih/) code PERTH in 1962.

In February 1981 John Green, then Curator of the Herbarium, published *Census of the Vascular Plants of Western Australia* (Green 1981) and for the first time the Gardner assigned family sequence numbers appeared formally in print (but not the genus numbers). Green (1985) followed this with a second edition and subsequent supplements.

In 1987, the Western Australian Herbarium was administratively transferred from the Department of Agriculture to the Department of Conservation and Land Management (CALM) (Fitzpatrick 2011). Changes in government resulted in subsequent administrative transfers to the Department of Environment and Conservation (2006–2013), Department of Parks and Wildlife (2013–2017), and now the Department of Biodiversity, Conservation and Attractions (2017–present).

By the 2000s, Gardner's arrangement was becoming increasingly out of step with the modern understanding of vascular plant systematics and the changing Herbarium strategic priorities. The Western Australian Herbarium was able to undertake a significant update to the arrangement of its collections as part of the move in 2009 to new premises at the Keiran McNamara Conservation Science Centre in Kensington. The collections were reorganised to largely reflect systematic relationships recognised by the Angiosperm Phylogeny Group (2009) following the linear sequence of Haston *et al.* (2009). The Gardner numbering system was disbanded, and the PERTH Linear Sequence Number (Appendix 1) was implemented only as a numerical system to manage taxon names data. The changes reflected the vastly improved modern knowledge of flowering plant relationships resulting from the Angiosperm Phylogeny Group projects (Angiosperm Phylogeny Group 1998, 2003, 2009) and other taxonomic work around the world. Along with the opportunity for reordering the physical collection, the taxonomic hierarchy within the associated Western Australian Plant Census database and collections management system was updated.

In 2018 the Herbarium implemented the APG IV (Angiosperm Phylogeny Group 2016) phylogenetic arrangement of families. Based on a wide range of evidence and repeatable analysis methods, this arrangement (Appendix 1), with several exceptions adopted by PERTH's Taxonomic Review Committee (TRC) following recommendations by specialists, is expected to remain relatively stable for the immediate future, although further changes are always possible as new evidence comes to light. The APG III (Angiosperm Phylogeny Group 2009) and APG IV (Angiosperm Phylogeny Group 2016) systems involved numerous family level changes. Some of these required the simple merging of one or more families whilst others necessitated more complex changes to family circumscriptions. Genera and species remain alphabetically arranged within a family for ease of collections management, particularly given the vast number of users of the collection that would find phylogenetic arrangement cumbersome and would result in increased misfiling of the collections.

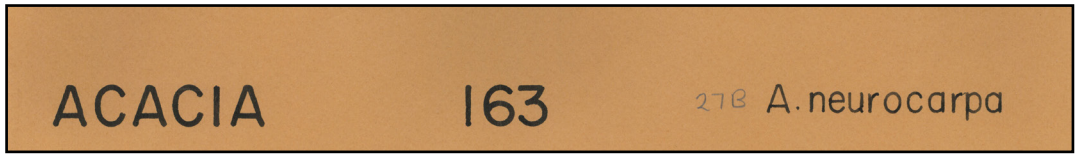


Figure 2. An example of the annotation of brown outer folders with the genus name, family number and species drawn using the stencil, implemented after 1955. Family 163 was Mimosaceae (now Fabaceae), and the genus decimal no longer used. The pencil annotation is a curatorial addition.

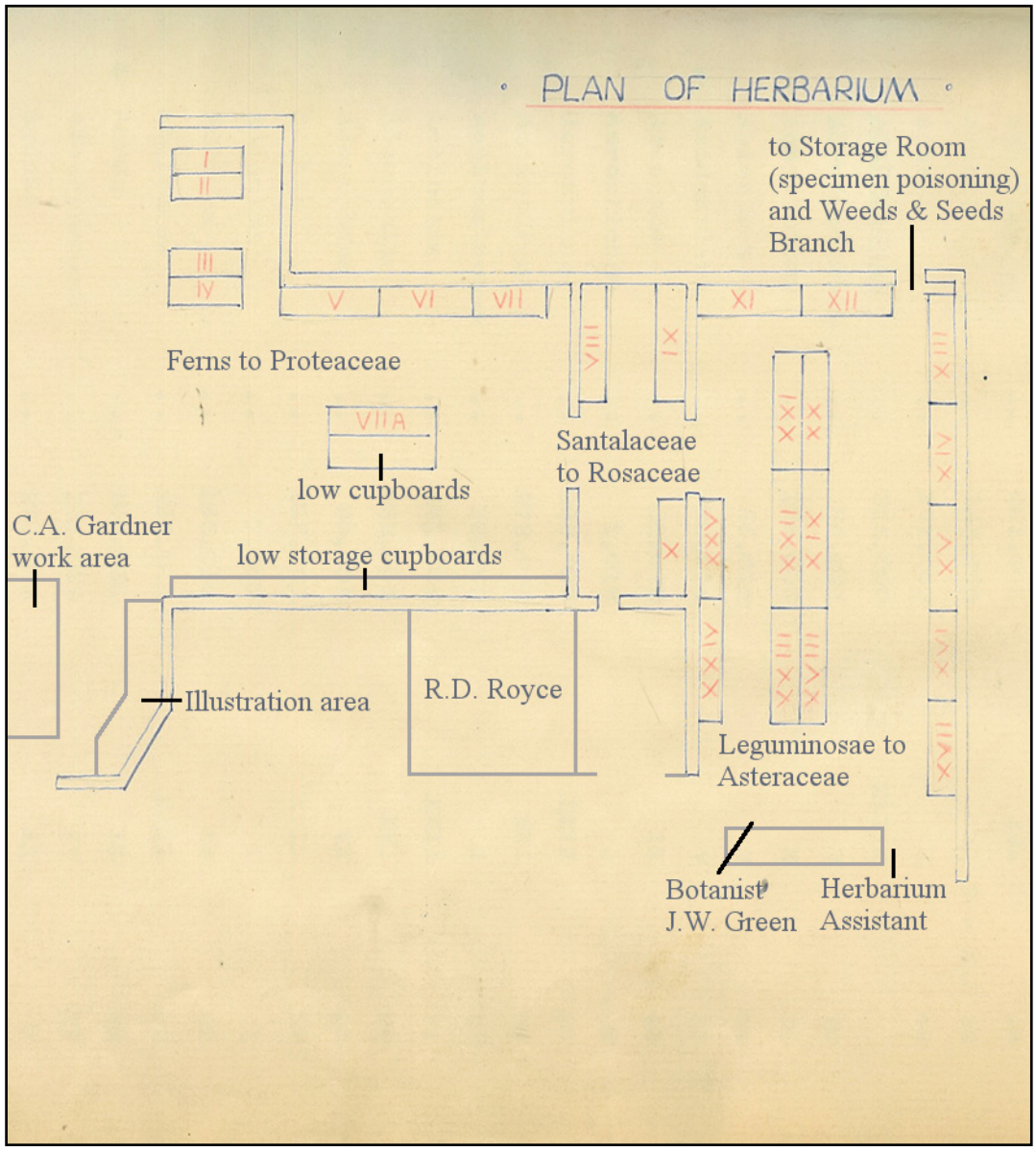


Figure 3. A sketch of the layout in the State Observatory Building, West Perth, around 1933–1959. At the time, herbarium specimens were housed in 25 wooden cabinets.

For the ferns, fern allies, and gymnosperms, PERTH previously utilised the arrangement as published in *Mabberley's Plant-Book* (Mabberley 2008). Mabberley (2008) in turn used Smith *et al.* (2006) as his reference for fern phylogeny. Most recently, the PPG I (Pteridophyte Phylogeny Group 2016) family linear sequence was published, which formed the basis for the classification of Australian fern taxa (Field 2020). The PPG I classification was implemented within the PERTH collections in 2020. Arrangements for gymnosperms follows Christenhusz *et al*. (2011).

The Western Australian Herbarium research collections are now housed in four main vaults (Figure 4), and a fifth smaller Types Vault. A sixth vault houses specimens on loan to PERTH. Herbarium indexes, similar to those in the former buildings, are produced electronically with location information for ease of specimen discovery within the collection spaces. In 2022, PERTH continues to replace now acidic folders with archival-quality pH-buffered folders, with taxon names being pencilled in the lower right corner of folders. The collection is secondarily arranged using coloured folders for Australian States and Territories and extra-Australian collections; further geographic division within Western Australia has not been uniformly implemented. Non-vascular plants, including algae, fungi, lichens, mosses, liverworts and hornworts, remain arranged alphabetically by genus due to continued high-level taxonomic instability and for ease of management. However, family circumscriptions currently (2022) follow that accepted by *AlgaeBase* (https://www.algaebase.org/), The *National Species List* (https://biodiversity.org.au/nsl/) and *MycoBank* (https://www.mycobank.org/).

The type and historical collections of the Western Australian Herbarium are separately housed within a dedicated vault, with increased security and fire protection. Both collections are alphabetically arranged by currently recognised families. The type collection is stored alphabetically by the typified name or basionym. Type specimens were originally housed as part of the main collections, and documented by way of a physical type register. Significant historical collections, made prior to 1829, such as those of Robert Brown, Joseph Banks and Daniel Solander, William Baxter, Allan Cunningham, James Drummond and Archibald Menzies, have also been relocated from the main collections due to their fragility and are stored alphabetically by currently accepted name in the Types Vault.

Several other collections within the Western Australian Herbarium are housed and arranged separately due to current management efficiencies. The wet or spirit collections are arranged by jar or bottle size and systematically by accession number. The carpological collection is stored in boxes at the end of the associated family. The type photographic collection is arranged in the same way as the type specimen collection but housed outside the Type Vault, photographic slides are arranged in filing cabinets, and digital images are stored within a Departmental digital repository. Microscope slide collections and molecular tissue collections are currently being developed and are not yet systematically arranged.

PERTH has adopted a 'punctuated equilibrium model' whereby future linear family rearrangements of the collections will be based on widely available collaborative taxonomic syntheses such as those mentioned here, best practice for storage, and community consensus rather than on the very latest research as it is published. Numbering systems are no longer implemented. In this way we can provide step-wise improvement in systematic knowledge while providing stable, documented research and reference collections. Appendix 1 and 2 list the vascular plant families that have been changed in Western Australia and the Herbarium over time (and hence as discoverable via the online platform *Florabase* (https://florabase.dpaw.wa.gov.au/)) and outline the most recently implemented classification and organisation of vascular plant families within the Western Australian Herbarium.

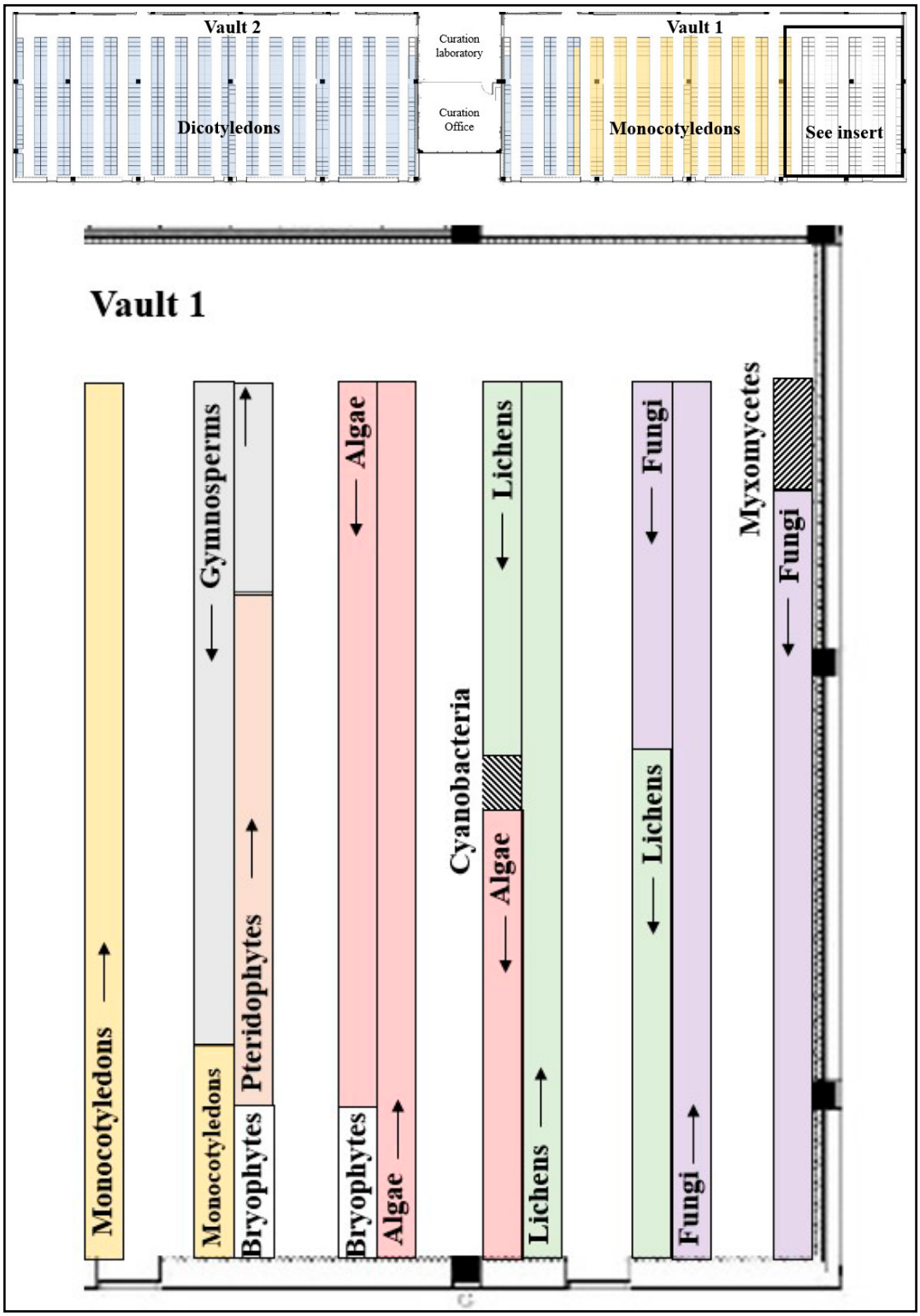


Figure 4. Floor plan of the Western Australian Herbarium in 2022 indicating the arrangement of the major plant groups. Only Vaults 1 and 2 (Floor 1) of the Keiran McNamara Conservation Science Centre are shown; Vaults 3 and 4 contain Dicotyledons only.

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We thank Neville Marchant for his helpful insights and memories of the Western Australian Herbarium. The authors would also like to thank Brendan Lepschi and Kelly Shepherd for their constructive comments on the manuscript. We also acknowledge and thank the Herbarium staff through the ages who have spent many an hour arranging and rearranging the collections to maintain their scientific value.

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Appendix 1. The current PERTH Linear Sequence reflecting the phylogenetic arrangement for vascular plant families held in the Western Australian Herbarium in 2022 and summary of previous arrangements. * = not considered native or naturalised in Western Australia but represented in herbarium collections; ^ = excluded name, currently not regarded as occurring in WA; APG IV = Angiosperm Phylogeny Group (2016); PPG I = Pteridophyte Phylogeny Group (2016); TRC = Taxonomic Review Committee (PERTH); APC = Australian Plant Census. Note that the current linear sequence number is for internal data management; specimens are not annotated with these numbers. Missing numbers indicate a current lack of representation of those families at PERTH. Blue columns indicate the current arrangement at PERTH.

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [2010–2017]	PERTH Linear Sequence Number [2018–]	PERTH Family [2018–]	PERTH Order [2018–]	PERTH Source	Family in APG IV/PPG I/ Christenhusz *et al.* (2011)
Fern allies								
	8.000	002	Lycopodiaceae	1	Lycopodiaceae	Lycopodiales	PPG I	Lycopodiaceae
	11.000	004	Isoetaceae	2	Isoetaceae	Isoetales	PPG I	Isoetaceae
	9.000	003	Selaginellaceae	3	Selaginellaceae	Selaginellales	PPG I	Selaginellaceae
Ferns								
		004A		4	Equisetaceae *	Equisetales	PPG I	Equisetaceae
	10.000	001	Psilotaceae	5	Psilotaceae	Psilotales	PPG I	Psilotaceae
	5.000	005	Ophioglossaceae	6	Ophioglossaceae	Ophioglossales	PPG I	Ophioglossaceae
		006C		7	Marattiaceae *	Marattiales	PPG I	Marattiaceae
		005A		8	Osmundaceae *	Osmundales	PPG I	Osmundaceae
		013B		9	Hymenophylla-ceae *	Hymenophyllales	PPG I	Hymenophyllaceae
	2.000	009	Gleicheniaceae	12	Gleicheniaceae	Gleicheniales	PPG I	Gleicheniaceae
		006A	Lygodiaceae	13	Lygodiaceae	Schizaeales	PPG I	Lygodiaceae
	4.000	006	Schizaeaceae	14	Schizaeaceae	Schizaeales	PPG I	Schizaeaceae
	7.000	014	Salviniaceae	16	Salviniaceae	Salviniales	PPG I	Salviniaceae
	6.000	013	Marsileaceae	17	Marsileaceae	Salviniales	PPG I	Marsileaceae
		013A		24	Dicksoniaceae *	Cyatheales	PPG I	Dicksoniaceae

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [2010–2017]	PERTH Linear Sequence Number [2018–]	PERTH Family [2018–]	PERTH Order [2018–]	PERTH Source	Family in APG IV/PPG I/ Christenhusz *et al.* (2011)
		011A	Cyatheaceae	25	Cyatheaceae	Cyatheales	PPG I	Cyatheaceae
		011D	Lindsaeaceae	29	Lindsaeaceae	Polypodiales	PPG I	Lindsaeaceae
		008	Pteridaceae	30	Pteridaceae	Polypodiales	PPG I	Pteridaceae
		011C	Dennstaedtiaceae	31	Dennstaedtiaceae	Polypodiales	PPG I	Dennstaedtiaceae
		011E	Aspleniaceae	37	Aspleniaceae	Polypodiales	PPG I	Aspleniaceae
		012C		38		Polypodiales	PPG I	Woodsiaceae
		011G	Blechnaceae	40	Blechnaceae	Polypodiales	PPG I	Blechnaceae
		012B		41	Athyriaceae *	Polypodiales	PPG I	Athyriaceae
		011B	Thelypteridaceae	42	Thelypteridaceae	Polypodiales	PPG I	Thelypteridaceae
		011F	Dryopteridaceae	45	Dryopteridaceae	Polypodiales	PPG I	Dryopteridaceae
				46	Nephrolepidaceae	Polypodiales	PPG I	Nephrolepidaceae
		014B	Lomariopsidaceae	47		Polypodiales	PPG I	Lomariopsidaceae
				48	Tectariaceae *	Polypodiales	PPG I	Tectariaceae
		011H		49		Polypodiales	PPG I	Oleandraceae
		014A		50	Davalliaceae *	Polypodiales	PPG I	Davalliaceae
	1.000	010	Polypodiaceae	51	Polypodiaceae	Polypodiales	PPG I	Polypodiaceae
Gymnosperms								
	14.000	016	Cycadaceae	52	Cycadaceae	Cycadales	Christenhusz *et al.* (2011)	Cycadaceae
		016A	Zamiaceae	53	Zamiaceae	Cycadales	Christenhusz *et al.* (2011)	Zamiaceae

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [2010–2017]	PERTH Linear Sequence Number [2018–]	PERTH Family [2018–]	PERTH Order [2018–]	PERTH Source	Family in APG IV/PPG I/ Christenhusz *et al.* (2011)
				55		Pinales	Christenhusz *et al.* (2011)	Welwitschiaceae
		017A	Pinaceae	58	Pinaceae	Pinales	Christenhusz *et al.* (2011)	Pinaceae
	15.000	017	Podocarpaceae	60	Podocarpaceae	Pinales	Christenhusz *et al.* (2011)	Podocarpaceae
	16.000	018	Cupressaceae	62	Cupressaceae	Pinales	Christenhusz *et al.* (2011)	Cupressaceae
		018		63		Pinales	Christenhusz *et al.* (2011)	Taxaceae
Basal angiosperms								
		040A	Hydatellaceae	65	Hydatellaceae	Nymphaeales	APG IV	Hydatellaceae
				66	Cabombaceae *	Nymphaeales	APG IV	Cabombaceae
115	115.000	115	Nymphaeaceae	67	Nymphaeaceae	Nymphaeales	APG IV	Nymphaeaceae
				69	Trimeniaceae *	Austrobaileyales	APG IV	Trimeniaceae
Magnoliids								
		123A		72	Winteraceae *	Canellales	APG IV	Winteraceae
71				73		Piperales	APG IV	Saururaceae
72		072	Piperaceae	74	Piperaceae	Piperales	APG IV	Piperaceae
100		100	Aristolochiaceae	75	Aristolochiaceae	Piperales	APG IV	Aristolochiaceae
128	128.000	128	Myristicaceae	76	Myristicaceae	Magnoliales	APG IV	Myristicaceae

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123		123		77	Magnoliaceae *	Magnoliales	APG IV	Magnoliaceae
127				80	Eupomatiaceae *	Magnoliales	APG IV	Eupomatiaceae
126		126	Annonaceae	81	Annonaceae	Magnoliales	APG IV	Annonaceae
124				82	Calycanthaceae *	Laurales	APG IV	Calycanthaceae
129				84		Laurales	APG IV	Gomortegaceae
				85	Atherospermataceae *	Laurales	APG IV	Atherospermataceae
132	132.000	132	Hernandiaceae	86	Hernandiaceae	Laurales	APG IV	Hernandiaceae
130		130		87	Monimiaceae *	Laurales	APG IV	Monimiaceae
131	131.000	131	Lauraceae	88	Lauraceae	Laurales	APG IV	Lauraceae
73				89		Chloranthales	APG IV	Chloranthaceae
Monocots								
35	35.000	035	Araceae	91	Araceae	Alismatales	APG IV	Araceae
27	27.000	027	Alismataceae	93	Alismataceae	Alismatales	APG IV	Alismataceae
28		028		94		Alismatales	APG IV	Butomaceae
29	29.000 [as Vallisneriaceae]	029	Hydrocharitaceae	95	Hydrocharitaceae	Alismatales	APG IV	Hydrocharitaceae
25	25.000	025	Aponogetonaceae	97	Aponogetonaceae	Alismatales	APG IV	Aponogetonaceae
26 [as Scheuchzeriaceae]	26.000 [as Scheuchzeriaceae]	026	Juncaginaceae	98	Juncaginaceae	Alismatales	APG IV	Juncaginaceae
		023D	Zosteraceae	100	Zosteraceae	Alismatales	APG IV	Zosteraceae
23	23.000	023	Potamogetonaceae	101	Potamogetonaceae	Alismatales	APG IV	Potamogetonaceae
	23.000	023B	Posidoniaceae	102	Posidoniaceae	Alismatales	APG IV	Posidoniaceae

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	23.000	023E	Ruppiaceae	103	Ruppiaceae	Alismatales	APG IV	Ruppiaceae
		023C	Cymodoceaceae	104	Cymodoceaceae	Alismatales	APG IV	Cymodoceaceae
65	65.000	065	Burmanniaceae	107	Burmanniaceae	Dioscoreales	APG IV	Burmanniaceae
58	58.000	058	Taccaceae	108	Taccaceae	Dioscoreales	TRC	
59	59.000	059	Dioscoreaceae	109	Dioscoreaceae	Dioscoreales	APG IV	Dioscoreaceae
30				110		Pandanales	APG IV	Triuridaceae
57				111		Pandanales	APG IV	Velloziaceae
53		053	Stemonaceae	112	Stemonaceae	Pandanales	APG IV	Stemonaceae
34				113		Pandanales	APG IV	Cyclanthaceae
21	21.000	021	Pandanaceae	114	Pandanaceae	Pandanales	APG IV	Pandanaceae
		054R		117	Melanthiaceae *	Liliales	APG IV	Melanthiaceae
		054K	Alstroemeriaceae	119	Alstroemeriaceae	Liliales	APG IV	Alstroemeriaceae
		054J	Colchicaceae	120	Colchicaceae	Liliales	APG IV	Colchicaceae
	54A.000 [as Philesiaceae]			121		Liliales	APG IV	Philesiaceae
		054A	Smilacaceae	123	Smilacaceae	Liliales	APG IV	Smilacaceae
54	54.000	054		124	Liliaceae	Liliales	APG IV	Liliaceae
66	66.000	066	Orchidaceae	125	Orchidaceae	Asparagales	APG IV	Orchidaceae
		054L	Boryaceae	126	Boryaceae	Asparagales	APG IV	Boryaceae
		054N		128	Asteliaceae *	Asparagales	APG IV	Asteliaceae
		056A	Hypoxidaceae	130	Hypoxidaceae	Asparagales	APG IV	Hypoxidaceae
		055A	Tecophilaeaceae	133	Tecophilaeaceae	Asparagales	APG IV	Tecophilaeaceae

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60	60.000	060	Iridaceae	134	Iridaceae	Asparagales	APG IV	Iridaceae
		054D	Xanthorrhoeaceae	136	Xanthorrhoeaceae	Asparagales	TRC	
		054G	Asphodelaceae	137	Asphodelaceae	Asparagales	TRC	Asphodelaceae
		054P	Hemerocallidaceae	138	Hemerocallidaceae	Asparagales	TRC	
56	56.000	056	Amaryllidaceae	139	Amaryllidaceae	Asparagales	APG IV	Amaryllidaceae
		054Q	Agapanthaceae	140	Agapanthaceae	Asparagales	TRC	
		054I	Alliaceae	141	Alliaceae	Asparagales	TRC	
		054B	Asparagaceae	142	Asparagaceae	Asparagales	APG IV	Asparagaceae
		054C	Dasypogonaceae	143	Dasypogonaceae	Arecales	APG IV	Dasypogonaceae
33 [as Palmae]	33.000 [as Palmae]	033	Arecaceae	144	Arecaceae	Arecales	APG IV	Arecaceae
47	47.000	047	Commelinaceae	146	Commelinaceae	Commelinales	APG IV	Commelinaceae
50	50.000	050	Philydraceae	147	Philydraceae	Commelinales	APG IV	Philydraceae
48	48.000	048	Pontederiaceae	148	Pontederiaceae	Commelinales	APG IV	Pontederiaceae
55	55.000	055	Haemodoraceae	149	Haemodoraceae	Commelinales	APG IV	Haemodoraceae
				150	Strelitziaceae *	Zingiberales	APG IV	Strelitziaceae
61		061	Musaceae	153	Musaceae	Zingiberales	APG IV	Musaceae
63		063	Cannaceae	154	Cannaceae	Zingiberales	APG IV	Cannaceae
64			Marantaceae	155	Marantaceae	Zingiberales	APG IV	Marantaceae
62				157		Zingiberales	APG IV	Zingiberaceae
20	20.000	020	Typhaceae	158	Typhaceae	Poales	APG IV	Typhaceae
46				159		Poales	APG IV	Bromeliaceae

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45				160		Poales	APG IV	Rapateaceae
42	42.000	042	Xyridaceae	161	Xyridaceae	Poales	APG IV	Xyridaceae
43	43.000	043	Eriocaulaceae	162	Eriocaulaceae	Poales	APG IV	Eriocaulaceae
41				163		Poales	APG IV	Mayacaceae
44				164		Poales	APG IV	Thurniaceae
52	52.000	052	Juncaceae	165	Juncaceae	Poales	APG IV	Juncaceae
32	32.000	032	Cyperaceae	166	Cyperaceae	Poales	APG IV	Cyperaceae
39	39.000	039	Restionaceae	167	Restionaceae	Poales	APG IV	Restionaceae
		039B	Anarthriaceae	168	Anarthriaceae	Poales	TRC	
40	40.000	040	Centrolepidaceae	169	Centrolepidaceae	Poales	TRC	
38	38.000	038	Flagellariaceae	170	Flagellariaceae	Poales	APG IV	Flagellariaceae
		039A	Ecdeiocoleaceae	172	Ecdeiocoleaceae	Poales	APG IV	Ecdeiocoleaceae
31 [as Gramineae]	31.000 [as Gramineae]	031	Poaceae	173	Poaceae	Poales	APG IV	Poaceae
Eudicots								
116		116	Ceratophyllaceae	174	Ceratophyllaceae	Ceratophyllales	APG IV	Ceratophyllaceae
135	135.000	135	Papaveraceae	176	Papaveraceae	Ranunculales	APG IV	Papaveraceae
120				178		Ranunculales	APG IV	Lardizabalaceae
122	122.000	122	Menispermaceae	179	Menispermaceae	Ranunculales	APG IV	Menispermaceae
121				180	Berberidaceae	Ranunculales	APG IV	Berberidaceae
119	119.000	119	Ranunculaceae	181	Ranunculaceae	Ranunculales	APG IV	Ranunculaceae
208				182		Proteales	APG IV	Sabiaceae
		114		183	Nelumbonaceae *	Proteales	APG IV	Nelumbonaceae

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159		159	Platanaceae	184	Platanaceae	Proteales	APG IV	Platanaceae
90	90.000	090	Proteaceae	185	Proteaceae	Proteales	APG IV	Proteaceae
117				186		Trochodendrales	APG IV	Trochodendraceae
190				187		Buxales	APG IV	Buxaceae
Core eudicots								
226	226.000	226	Dilleniaceae	190	Dilleniaceae	Dilleniales	APG IV	Dilleniaceae
Superrosids								
46 [as Bromeliaceae]		046		193		Saxifragales	APG IV	Altingiaceae
156		156		194	Hamamelidaceae *	Saxifragales	APG IV	Hamamelidaceae
118				195		Saxifragales	APG IV	Cercidiphyllaceae
151	151.000	151		199	Saxifragaceae *	Saxifragales	APG IV	Saxifragaceae
149	149.000	149	Crassulaceae	200	Crassulaceae	Saxifragales	APG IV	Crassulaceae
		155A	Aphanopetalaceae	201	Aphanopetalaceae	Saxifragales	APG IV	Aphanopetalaceae
276	276.000	276	Haloragaceae	204	Haloragaceae	Saxifragales	APG IV	Haloragaceae
Rosids								
216	216.000	216	Vitaceae	206	Vitaceae	Vitales	APG IV	Vitaceae
173	173.000	173	Zygophyllaceae	208	Zygophyllaceae	Zygophyllales	APG IV	Zygophyllaceae
		162	Fabaceae	210	Fabaceae	Fabales	APG IV	Fabaceae
		160A	Surianaceae	211	Surianaceae	Fabales	APG IV	Surianaceae
183	183.000	183	Polygalaceae	212	Polygalaceae	Fabales	APG IV	Polygalaceae
161	161.000	161	Rosaceae	213	Rosaceae	Rosales	APG IV	Rosaceae
264				216		Rosales	APG IV	Elaeagnaceae

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215	215.000	215	Rhamnaceae	217	Rhamnaceae	Rosales	APG IV	Rhamnaceae
86	87.000	086		218	Ulmaceae	Rosales	APG IV	Ulmaceae
		086B	Cannabaceae	219	Cannabaceae	Rosales	APG IV	Cannabaceae
87	87.000 [as Ulmaceae]	087	Moraceae	220	Moraceae	Rosales	APG IV	Moraceae
88	88.000	088	Urticaceae	221	Urticaceae	Rosales	APG IV	Urticaceae
		085		222	Nothofagaceae *	Fagales	APG IV	Nothofagaceae
84		084		223	Fagaceae	Fagales	APG IV	Fagaceae
77		077		224	Myricaceae *	Fagales	APG IV	Myricaceae
80		080		225	Juglandaceae *	Fagales	APG IV	Juglandaceae
70	70.000	070	Casuarinaceae	226	Casuarinaceae	Fagales	APG IV	Casuarinaceae
83				228		Fagales	APG IV	Betulaceae
		101A	Apodanthaceae	229	Apodanthaceae	Cucurbitales	APG IV	Apodanthaceae
197				231		Cucurbitales	APG IV	Corynocarpaceae
192				232		Cucurbitales	APG IV	Coriariaceae
337	337.000	337	Cucurbitaceae	233	Cucurbitaceae	Cucurbitales	APG IV	Cucurbitaceae
252				235		Cucurbitales	APG IV	Datiscaceae
253				236		Cucurbitales	APG IV	Begoniaceae
199	199.000	199	Celastraceae	238	Celastraceae	Celastrales	APG IV	Celastraceae
168	168.000	168	Oxalidaceae	241	Oxalidaceae	Oxalidales	APG IV	Oxalidaceae
155	155.000	155		242	Cunoniaceae *	Oxalidales	APG IV	Cunoniaceae
217		217	Elaeocarpaceae	243	Elaeocarpaceae	Oxalidales	APG IV	Elaeocarpaceae
150	150.000	150	Cephalotaceae	244	Cephalotaceae	Oxalidales	APG IV	Cephalotaceae

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153				245		Oxalidales	APG IV	Brunelliaceae
166				246		Malpighiales	APG IV	Pandaceae
269	269.000	269	Rhizophoraceae	249	Rhizophoraceae	Malpighiales	APG IV	Rhizophoraceae
172		172	Erythroxylaceae	250	Erythroxylaceae	Malpighiales	APG IV	Erythroxylaceae
228				251		Malpighiales	APG IV	Ochnaceae
233 [as Guttiferae]	233.000 [as Guttiferae]	233	Clusiaceae	253	Clusiaceae	Malpighiales	APG IV	Clusiaceae
140		140	Podostemaceae	255	Podostemaceae	Malpighiales	APG IV	Podostemaceae
232 [as Theaceae]		232	Hypericaceae	256	Hypericaceae	Malpighiales	APG IV	Hypericaceae
229				257		Malpighiales	APG IV	Caryocaraceae
		185C	Putranjivaceae	259	Putranjivaceae	Malpighiales	APG IV	Putranjivaceae
235	235.000	235	Elatinaceae	261	Elatinaceae	Malpighiales	APG IV	Elatinaceae
179		179		262	Malpighiaceae *	Malpighiales	APG IV	Malpighiaceae
78				263		Malpighiales	APG IV	Balanopaceae
180				264		Malpighiales	APG IV	Trigoniaceae
184				265		Malpighiales	APG IV	Dichapetalaceae
	161.000	161A	Chrysobalanaceae	267	Chrysobalanaceae	Malpighiales	APG IV	Chrysobalanaceae
171				268		Malpighiales	APG IV	Humiriaceae
249				269		Malpighiales	APG IV	Achariaceae
243	243.000	243	Violaceae	270	Violaceae	Malpighiales	APG IV	Violaceae
248	248.000	248	Passifloraceae	272	Passifloraceae	Malpighiales	APG IV	Passifloraceae
246		246	Turneraceae	273	Turneraceae	Malpighiales	TRC	

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74				274		Malpighiales	APG IV	Lacistemataceae
75		075	Salicaceae	275	Salicaceae	Malpighiales	APG IV	Salicaceae
101	101.000	101		277		Malpighiales	APG IV	Rafflesiaceae
185	185.000	185	Euphorbiaceae	278	Euphorbiaceae	Malpighiales	APG IV	Euphorbiaceae
170	170.000	170	Linaceae	279	Linaceae	Malpighiales	APG IV	Linaceae
		185B	Picrodendraceae	281	Picrodendraceae	Malpighiales	APG IV	Picrodendraceae
		185A	Phyllanthaceae	282	Phyllanthaceae	Malpighiales	APG IV	Phyllanthaceae
167	167.000	167	Geraniaceae	283	Geraniaceae	Geraniales	APG IV	Geraniaceae
209			Melianthaceae	284	Francoaceae	Geraniales	APG IV	Francoaceae
272	272.000	272	Combretaceae	285	Combretaceae	Myrtales	APG IV	Combretaceae
265	265.000	265	Lythraceae	286	Lythraceae	Myrtales	APG IV	Lythraceae
275	275.000	275	Onagraceae	287	Onagraceae	Myrtales	APG IV	Onagraceae
181				288		Myrtales	APG IV	Vochysiaceae
273	273.000	273	Myrtaceae	289	Myrtaceae	Myrtales	APG IV	Myrtaceae
274		274	Melastomataceae	290	Melastomataceae	Myrtales	APG IV	Melastomataceae
				291	Crypteroniaceae *	Myrtales	APG IV	Crypteroniaceae
261				293		Myrtales	APG IV	Penaeaceae
260				295		Crossosomatales	APG IV	Geissolomataceae
203				297		Crossosomatales	APG IV	Staphyleaceae
245				299		Crossosomatales	APG IV	Stachyuraceae
160		160		300		Crossosomatales	APG IV	Crossosomataceae

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		175A	Nitrariaceae	307	Nitrariaceae	Sapindales	APG IV	Nitrariaceae
177	177.000	177	Burseraceae	309	Burseraceae	Sapindales	APG IV	Burseraceae
194	194.000	194	Anacardiaceae	310	Anacardiaceae	Sapindales	APG IV	Anacardiaceae
207	207.000	207	Sapindaceae	311	Sapindaceae	Sapindales	APG IV	Sapindaceae
175	175.000	175	Rutaceae	312	Rutaceae	Sapindales	APG IV	Rutaceae
176		176	Simaroubaceae	313	Simaroubaceae	Sapindales	APG IV	Simaroubaceae
178	178.000	178	Meliaceae	314	Meliaceae	Sapindales	APG IV	Meliaceae
		221A		316	Muntingiaceae *	Malvales	APG IV	Muntingiaceae
221	221.000	221	Malvaceae	318	Malvaceae	Malvales	APG IV	Malvaceae
263	263.000	263	Thymelaeaceae	320	Thymelaeaceae	Malvales	APG IV	Thymelaeaceae
240		240	Bixaceae	321	Bixaceae	Malvales	APG IV	Bixaceae
239				322		Malvales	APG IV	Cistaceae
234				324		Malvales	APG IV	Dipterocarpaceae
169	169.000	169	Tropaeolaceae	326	Tropaeolaceae	Brassicales	APG IV	Tropaeolaceae
141 [Sarraceniaceae and Moringaceae]		141	Moringaceae	327	Moringaceae	Brassicales	APG IV	Moringaceae
250		250		328	Caricaceae	Brassicales	APG IV	Caricaceae
193				329		Brassicales	APG IV	Limnanthaceae
81 [as Batidaceae]		081	Bataceae	332	Bataceae	Brassicales	APG IV	Bataceae
201				333		Brassicales	APG IV	Salvadoraceae
137b		137B	Emblingiaceae	334	Emblingiaceae	Brassicales	APG IV	Emblingiaceae
138a				335		Brassicales	APG IV	Tovariaceae

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108		108	Gyrostemonaceae	337	Gyrostemonaceae	Brassicales	APG IV	Gyrostemonaceae
139	139.000	139	Resedaceae	338	Resedaceae	Brassicales	APG IV	Resedaceae
137 [as orthographic variant Capparidaceae]	137.000	137A	Capparaceae	339	Capparaceae	Brassicales	APG IV	Capparaceae
		137C	Cleomaceae	340	Cleomaceae	Brassicales	APG IV	Cleomaceae
138 [as Cruciferae]	138.000 [as Cruciferae]	138	Brassicaceae	341	Brassicaceae	Brassicales	APG IV	Brassicaceae
Superasterids								
342 [as Brunoniaceae]	342.000 [as Brunoniaceae]			342		Berberidopsidales	APG IV	Aextoxicaceae
95	95.000	095	Olacaceae	344	Olacaceae	Santalales	APG IV	Olacaceae
93	93.000	093	Opiliaceae	345	Opiliaceae	Santalales	APG IV	Opiliaceae
98				346		Santalales	APG IV	Balanophoraceae
92	92.000	092	Santalaceae	347	Santalaceae	Santalales	APG IV	Santalaceae
97	97.000	097	Loranthaceae	350	Loranthaceae	Santalales	APG IV	Loranthaceae
236	236.000	236	Frankeniaceae	351	Frankeniaceae	Caryophyllales	APG IV	Frankeniaceae
237		237	Tamaricaceae	352	Tamaricaceae	Caryophyllales	APG IV	Tamaricaceae
294	294.000	294	Plumbaginaceae	353	Plumbaginaceae	Caryophyllales	APG IV	Plumbaginaceae
103	103.000	103	Polygonaceae	354	Polygonaceae	Caryophyllales	APG IV	Polygonaceae
143	143.000	143	Droseraceae	355	Droseraceae	Caryophyllales	APG IV	Droseraceae
142		142		356	Nepenthaceae *	Caryophyllales	APG IV	Nepenthaceae
254				359		Caryophyllales	APG IV	Ancistrocladaceae

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		187		361	Simmondsiaceae *	Caryophyllales	APG IV	Simmondsiaceae
				364	Macarthuriaceae	Caryophyllales	APG IV	Macarthuriaceae
113	113.000	113	Caryophyllaceae	366	Caryophyllaceae	Caryophyllales	APG IV	Caryophyllaceae
106	106.000	106	Amaranthaceae	368	Amaranthaceae	Caryophyllales	APG IV	Amaranthaceae
105	105.000	105	Chenopodiaceae	369	Chenopodiaceae	Caryophyllales		
110	110.000	110	Aizoaceae	376	Aizoaceae	Caryophyllales	APG IV	Aizoaceae
109	109.000	109	Phytolaccaceae	377	Phytolaccaceae	Caryophyllales	APG IV	Phytolaccaceae
107	107.000	107	Nyctaginaceae	380	Nyctaginaceae	Caryophyllales	APG IV	Nyctaginaceae
		110A	Molluginaceae	381	Molluginaceae	Caryophyllales	APG IV	Molluginaceae
				382	Montiaceae	Caryophyllales	APG IV	Montiaceae
		111A		383	Didiereaceae	Caryophyllales	APG IV	Didiereaceae
112		112	Basellaceae	384	Basellaceae	Caryophyllales	APG IV	Basellaceae
111	111.000	111	Portulacaceae	387	Portulacaceae	Caryophyllales	APG IV	Portulacaceae
				388	Anacampserotaceae	Caryophyllales	APG IV	Anacampserotaceae
256	256.000	256	Cactaceae	389	Cactaceae	Caryophyllales	APG IV	Cactaceae
Asterids								
270				390		Cornales	APG IV	Nyssaceae
148				391		Cornales	APG IV	Hydrostachyaceae
			Hydrangeaceae	392	Hydrangeaceae	Cornales	APG IV	Hydrangeaceae
251				393		Cornales	APG IV	Loasaceae
94				395	Grubbiaceae *	Cornales	APG IV	Grubbiaceae
282				396		Cornales	APG IV	Cornaceae

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210		210	Balsaminaceae	397	Balsaminaceae	Ericales	APG IV	Balsaminaceae
230				398		Ericales	APG IV	Marcgraviaceae
238				400		Ericales	APG IV	Fouquieriaceae
308	308.000	308	Polemoniaceae	401	Polemoniaceae	Ericales	APG IV	Polemoniaceae
268	268.000	268	Lecythidaceae	402	Lecythidaceae	Ericales	APG IV	Lecythidaceae
196				404	Pentaphylacaceae *	Ericales	APG IV	Pentaphylacaceae
296	296.000	296	Sapotaceae	405	Sapotaceae	Ericales	APG IV	Sapotaceae
297	297.000	297	Ebenaceae	406	Ebenaceae	Ericales	APG IV	Ebenaceae
293	293.000	293	Primulaceae	407	Primulaceae	Ericales	APG IV	Primulaceae
298		298		409	Symplocaceae *	Ericales	APG IV	Symplocaceae
289				410		Ericales	APG IV	Diapensiaceae
299				411		Ericales	APG IV	Styracaceae
141 [Sarraceniaceae and Moringaceae]				412		Ericales	APG IV	Sarraceniaceae
284				415		Ericales	APG IV	Clethraceae
195				416		Ericales	APG IV	Cyrillaceae
287		287	Ericaceae	417	Ericaceae	Ericales	APG IV	Ericaceae
204				420		Icacinales	APG IV	Icacinaceae
158				422		Garryales	APG IV	Eucommiaceae
76				423		Garryales	APG IV	Garryaceae
331	331.000	331	Rubiaceae	424	Rubiaceae	Gentianales	APG IV	Rubiaceae
303	303.000	303	Gentianaceae	425	Gentianaceae	Gentianales	APG IV	Gentianaceae

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [2010–2017]	PERTH Linear Sequence Number [2018–]	PERTH Family [2018–]	PERTH Order [2018–]	PERTH Source	Family in APG IV/PPG I/ Christenhusz *et al.* (2011)
302	302.000	302	Loganiaceae	426	Loganiaceae	Gentianales	APG IV	Loganiaceae
304	304.000	304	Apocynaceae	428	Apocynaceae	Gentianales	APG IV	Apocynaceae
310	310.000	310	Boraginaceae	429	Boraginaceae	Boraginales	APG IV	Boraginaceae
307	307.000	307	Convolvulaceae	431	Convolvulaceae	Solanales	APG IV	Convolvulaceae
315	315.000	315	Solanaceae	432	Solanaceae	Solanales	APG IV	Solanaceae
338		338	Sphenocleaceae	434	Sphenocleaceae	Solanales	APG IV	Sphenocleaceae
		314	Hydroleaceae	435	Hydroleaceae	Solanales	APG IV	Hydroleaceae
301	301.000	301	Oleaceae	438	Oleaceae	Lamiales	APG IV	Oleaceae
		321A	Calceolariaceae	440	Calceolariaceae	Lamiales	APG IV	Calceolariaceae
321		321		441	Gesneriaceae *	Lamiales	APG IV	Gesneriaceae
329	329.000	329	Plantaginaceae	442	Plantaginaceae	Lamiales	APG IV	Plantaginaceae
316	316.000	316	Scrophulariaceae	443	Scrophulariaceae	Lamiales	APG IV	Scrophulariaceae
		330	Linderniaceae	445	Linderniaceae	Lamiales	APG IV	Linderniaceae
154 [as Myrothamnaceae]	154.000	154	Byblidaceae	446	Byblidaceae	Lamiales	APG IV	Byblidaceae
319		319	Martyniaceae	447	Martyniaceae	Lamiales	APG IV	Martyniaceae
318	318.000	318	Pedaliaceae	448	Pedaliaceae	Lamiales	APG IV	Pedaliaceae
325	325.000	325	Acanthaceae	449	Acanthaceae	Lamiales	APG IV	Acanthaceae
317	317.000	317	Bignoniaceae	450	Bignoniaceae	Lamiales	APG IV	Bignoniaceae
323	323.000	323	Lentibulariaceae	451	Lentibulariaceae	Lamiales	APG IV	Lentibulariaceae
311	311.000	311	Verbenaceae	454	Verbenaceae	Lamiales	APG IV	Verbenaceae
312 [as Labiatae]	312.000 [as Labiatae]	313	Lamiaceae	455	Lamiaceae	Lamiales	APG IV	Lamiaceae

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [2010–2017]	PERTH Linear Sequence Number [2018–]	PERTH Family [2018–]	PERTH Order [2018–]	PERTH Source	Family in APG IV/PPG I/ Christenhusz *et al.* (2011)
327		327	Phrymaceae	457	Phrymaceae	Lamiales	APG IV	Phrymaceae
320	320.000	320	Orobanchaceae	459	Orobanchaceae	Lamiales	APG IV	Orobanchaceae
198	198.000	198	Aquifoliaceae	464	Aquifoliaceae	Aquifoliales	APG IV	Aquifoliaceae
		151C		465	Rousseaceae *	Asterales	APG IV	Rousseaceae
339	339.000	339	Campanulaceae	466	Campanulaceae	Asterales	APG IV	Campanulaceae
343	343.000	343	Stylidiaceae	468	Stylidiaceae	Asterales	APG IV	Stylidiaceae
		343A		469	Donatiaceae *	Asterales	TRC	
				470	Alseuosmiaceae *	Asterales	APG IV	Alseuosmiaceae
				472	Argophyllaceae *	Asterales	APG IV	Argophyllaceae
		303A	Menyanthaceae	473	Menyanthaceae	Asterales	APG IV	Menyanthaceae
341	341.000	341	Goodeniaceae	474	Goodeniaceae	Asterales	APG IV	Goodeniaceae
344				475		Asterales	APG IV	Calyceraceae
345	345.000 [as Compositae]	345	Asteraceae	476	Asteraceae	Asterales	APG IV	Asteraceae
		151B		477	Escalloniaceae *	Escalloniales	APG IV	Escalloniaceae
		151A	Eremosynaceae	478	Eremosynaceae	Escalloniales	TRC	
322				479		Bruniales	APG IV	Columelliaceae
157				480	Bruniaceae *	Bruniales	APG IV	Bruniaceae
		154A		481	Paracryphiaceae *	Paracryphiales	APG IV	Paracryphiaceae
333		333		482	Adoxaceae *	Dipsacales	APG IV	Adoxaceae
332		332	Caprifoliaceae	483	Caprifoliaceae	Dipsacales	APG IV	Caprifoliaceae

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [2010–2017]	PERTH Linear Sequence Number [2018–]	PERTH Family [2018–]	PERTH Order [2018–]	PERTH Source	Family in APG IV/PPG I/ Christenhusz *et al.* (2011)
152	152.000	152	Pittosporaceae	487	Pittosporaceae	Apiales	APG IV	Pittosporaceae
280	280.000	280	Araliaceae	488	Araliaceae	Apiales	APG IV	Araliaceae
281	281.000 [as Umbelliferae]	281	Apiaceae	490	Apiaceae	Apiales	APG IV	Apiaceae

Appendix 2. Summary of families synonymised during the APG II, III and IV (Angiosperm Phylogeny Group 2003; 2009; 2016) rearrangements with their historical numbers. For source of current family adopted at PERTH, see Appendix 1; * = not considered native or naturalised in Western Australia but represented in herbarium collections. Blue columns indicate the current arrangement at PERTH.

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [*c.* 1930–2009]	PERTH Family [2018–]	PERTH Linear Sequence Number [2018–]
		006B	Angiopteridaceae	Marattiaceae *	7
		007	Adiantaceae	Pteridaceae	30
	3.000	007A	Parkeriaceae	Pteridaceae	30
		008A	Vittariaceae	Pteridaceae	30
		009A	Grammitidaceae	Polypodiaceae	51
		009B	Platyzomataceae	Pteridaceae	30
		012A	Aspidiaceae	Dryopteridaceae	45
		015	Azollaceae	Salviniaceae	16
		018A	Taxodiaceae	Cupressaceae	62
		023A	Zannichelliaceae	Potamogetonaceae	101
24	24.000	024	Najadaceae	Hydrocharitaceae	95
36	36.000	036	Lemnaceae	Araceae	91
		054E	Phormiaceae	Hemerocallidaceae	138
		054F	Anthericaceae	Asparagaceae	142
		054H	Hyacinthaceae	Asparagaceae	142
		054O	Trilliaceae	Melanthiaceae *	117
		056B	Agavaceae	Asparagaceae	142
		056C	Aloeaceae	Asphodelaceae	137
		097A	Viscaceae	Santalaceae	347
136	136.000	136	Fumariaceae	Papaveraceae	176
163	163.000	163	Mimosaceae	Fabaceae	210
164	164.000	164	Caesalpiniaceae	Fabaceae	210
165	165.000 [as Leguminosae]	165	Papilionaceae	Fabaceae	210
182	182.000	182	Tremandraceae	Elaeocarpaceae	243
186	186.000	186	Callitrichaceae	Plantaginaceae	442
200		200	Hippocrateaceae	Celastraceae	238
202	202.000	202	Stackhousiaceae	Celastraceae	238
209		209	Melianthaceae	Francoaceae	284
220	220.000	220	Tiliaceae	Malvaceae	318
222	222.000	222	Bombacaceae	Malvaceae	318
223	223.000	223	Sterculiaceae	Malvaceae	318
227		227	Eucryphiaceae	Cunoniaceae *	242

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [*c.* 1930–2009]	PERTH Family [2018–]	PERTH Linear Sequence Number [2018–]
		006B	Angiopteridaceae	Marattiaceae *	7
		007	Adiantaceae	Pteridaceae	30
	3.000	007A	Parkeriaceae	Pteridaceae	30
		008A	Vittariaceae	Pteridaceae	30
		009A	Grammitidaceae	Polypodiaceae	51
		009B	Platyzomataceae	Pteridaceae	30
		012A	Aspidiaceae	Dryopteridaceae	45
		015	Azollaceae	Salviniaceae	16
		018A	Taxodiaceae	Cupressaceae	62
		023A	Zannichelliaceae	Potamogetonaceae	101
24	24.000	024	Najadaceae	Hydrocharitaceae	95
36	36.000	036	Lemnaceae	Araceae	91
		054E	Phormiaceae	Hemerocallidaceae	138
		054F	Anthericaceae	Asparagaceae	142
		054H	Hyacinthaceae	Asparagaceae	142
		054O	Trilliaceae	Melanthiaceae *	117
		056B	Agavaceae	Asparagaceae	142
		056C	Aloeaceae	Asphodelaceae	137
		097A	Viscaceae	Santalaceae	347
136	136.000	136	Fumariaceae	Papaveraceae	176
163	163.000	163	Mimosaceae	Fabaceae	210
164	164.000	164	Caesalpiniaceae	Fabaceae	210
165	165.000 [as Leguminosae]	165	Papilionaceae	Fabaceae	210
182	182.000	182	Tremandraceae	Elaeocarpaceae	243
186	186.000	186	Callitrichaceae	Plantaginaceae	442
200		200	Hippocrateaceae	Celastraceae	238
202	202.000	202	Stackhousiaceae	Celastraceae	238
209		209	Melianthaceae	Francoaceae	284
220	220.000	220	Tiliaceae	Malvaceae	318
222	222.000	222	Bombacaceae	Malvaceae	318
223	223.000	223	Sterculiaceae	Malvaceae	318
227		227	Eucryphiaceae	Cunoniaceae *	242
241	241.000	241	Cochlospermaceae	Bixaceae	321
244		244	Flacourtiaceae	Salicaceae	275
266	266.000	267	Sonneratiaceae	Lythraceae	286

Gardner annotation in Willis (1919)	PERTH Family Number [1953–1958]	PERTH Family Number [*c.* 1930–2009]	PERTH Family [*c.* 1930–2009]	PERTH Family [2018–]	PERTH Linear Sequence Number [2018–]
288	288.000	288	Epacridaceae	Ericaceae	417
291		291	Theophrastaceae	Primulaceae	407
292	292.000	292	Myrsinaceae	Primulaceae	407
		302A	Buddlejaceae	Scrophulariaceae	443
305	305.000	305	Asclepiadaceae	Apocynaceae	428
		307A	Cuscutaceae	Convolvulaceae	431
309	309.000	309	Hydrophyllaceae	Boraginaceae	429
		311A	Chloanthaceae	Lamiaceae	455
312	311.000a	312	Avicenniaceae	Acanthaceae	449
326	326.000	326	Myoporaceae	Scrophulariaceae	443
334		334	Valerianaceae	Caprifoliaceae	483
336	336.000	336	Dipsacaceae	Caprifoliaceae	483
340	340.000	340	Lobeliaceae	Campanulaceae	466