

Appendix

A quick guide to Auckland terrestrial & wetland ecosystems using a hierarchy of environmental gradients and factors as an abiotic framework against which diagnostic species are arranged.

Table 1: Forest ecosystems						
Ecosystem drivers			Ecosystem unit/ variant		Diagnostic species	Diagnostic features
Temperature and humidity	Landform	Soils and fertility	Code	Ecosystem name		
Warm temperate and sub-humid	Hill-slopes and hill-crests exposed to frequent coastal winds and salt spray.	Moderate to low fertility, including allophanic, brown, granular, recent and ultic soils.	WF4	Pōhutukawa, pūriri, broadleaved forest [Coastal broadleaved forest]	Pōhutukawa, pūriri, kohekohe and locally taraire, karaka, tawa, tītoki, mangeao, rewarewa, puka, tawāpou, ngaio and nīkau.	Coastal broadleaved forest. Mostly up to 600-800m from shore, but further inland in exposed locations. On sheltered coastlines, pūriri often common and pōhutukawa may be absent. Does not include coastal forest on stabilised dunes (WF5). Away from the coast this species mix could be WF7, WF9, or gully vegetation of kauri forest types (WF10, WF11 & WF12). Classify as treeland (TL) if tree and shrub cover is <80%.
	Stable dunes	Free-draining sandy brown soils and acidic orthic recent soils. Fertility is generally low.	WF5	Tōtara, kānuka, broadleaved forest [Dune forest]	Kānuka and pōhutukawa. Historically also included tōtara, tītoki, māhoe and rewarewa.	Dune forest on stabilised dunes ranging from recent Holocene coastal sands to Pleistocene sands with higher (10-20%) clay content. South Head peninsula and on western side of Awhitu Peninsula in Auckland.
	Alluvial terraces	Recent, free-draining (often stony) soils of moderate to high natural fertility.	WF7.1	Pūriri, tōtara forest	Pūriri with occasional tōtara, mataī, kahikatea and tītoki, locally with kōwhai and taraire.	Very little left in Auckland. Originally abundant on the Auckland isthmus, in the large river valleys of the north including Riverhead, Coatesville, Waikoukou Valley and Kaukapakapa; and in the south it was widespread on the Mānukau and Franklin lowlands and on SE Awhitu. Includes volcanic rock forest remnants (WL7.2). Easily confused with WF9, WF10, WF11 & WF12 . Differentiate from these by topography and soil type. WF4 if exposed to coastal influences.
	Flat to rolling land	Volcanic loams derived from basalt e.g. orthic granular soils, oxidic granular soils, orthic melanic soils, oxidic brown soils.	WF7.2	Pūriri , taraire forest	Pūriri with locally abundant taraire and kohekohe and occasional pukatea, rewarewa, karaka, tawa, tītoki and northern rātā. Historically also included tōtara and mataī.	
	Narrow river valleys and wide flood plains and undulating to rolling terraces	Imperfectly drained recent fluvial soils and orthic allophanic soils and locally perch-gley melanic soils and mottled orthic recent soils.	WF7.3	Kahikatea, pūriri forest	Pūriri, kohekohe and with occasional emergent kahikatea .	
	Recent alluvial terraces and older dune plain basins	Poor-draining gley and organic soils and small areas of sandy perch-gley ultic soils and humus-pan podzols.	WF8	Kahikatea, pukatea forest	Kahikatea and or pukatea and locally rimu, swamp maire and tawa.	
	Rolling hill-slopes and older alluvial surfaces (below 450m a.s.l.)	Brown, granular and recent soils and andesitic and basaltic derived clay loams of moderate fertility.	WF9	Taraire , tawa, podocarp forest	Taraire, kohekohe, tawa and locally tōwai with emergent rimu, northern rātā and kahikatea in gullies.	

Table 1: Forest ecosystems continued

Ecosystem drivers			Ecosystem unit/ variant		Diagnostic species	Diagnostic features
Temperature and humidity	Landform	Soils and fertility	Code	Ecosystem name		
	Hill-slopes and hill-crests	Ultic or oxidic soils developing towards podzols that are often seasonally waterlogged and of low fertility.	WF10.1	Mature kauri forest	Mature abundant to common kauri. Also small statured miro, rimu, toatoa, thin-barked tōtara, tōtara, tānekaha, monoao, rātā, tawa, taraire, hīnau, rewarewa, kohekohe and tōwai.	Dense stand of large kauri , often of similar size/age. Sub-canopy characterised by kiekie, <i>Dracophyllum</i> spp., <i>Gahnia</i> spp. and kauri grass.
			WF10.2	Kauri ricker forest	Pole and ricker kauri, tānekaha often also tōtara, rewarewa and tōwai.	Extremely dense stands of young kauri with other tree species occasionally interspersed.
	Hill-slopes and hill-crests	Ultic, oxidic soils developing towards podzols or recent soils of low fertility.	WF11	Kauri, podocarp, broadleaved forest	Kauri, rimu, tōtara, thin-barked tōtara, miro, tānekaha, kahikatea and taraire, kohekohe and pūriri and/or tawa, tōwai.	Widespread diverse forest with kauri interspersed , although most dominant on upper slopes/ridges. Broadleaved species and kahikatea common in gullies. Often only gully component of this ecosystem type remains and kauri is absent.
	Hill-slopes and hill-crests on sandstone, mudstone and greywacke	Ultic and brown soils of low fertility, derived from weathered parent materials such as greywacke, argillite, dacite and rhyolite.	WF12	Kauri, podocarp, broadleaved, beech forest	Kauri, hard beech and tānekaha. Also thin-barked tōtara, tōtara, rimu, miro, tawa, hīnau, northern rātā, rewarewa, tōwai and, locally, kohekohe, narrow-leaved maire and tāwari.	Hard beech interspersed with kauri, podocarp and broadleaved species. Classify as WF11 if beech occurs only occasionally (as is often the case in Rodney).
	Shallow to steep hill-slopes and gullies 150–550 m a.s.l. especially in the Hunua and Waitākere Ranges	Moderately fertile soil types, including allophanic, brown, and recent soils.	WF13	Tawa, kohekohe , rewarewa, hīnau podocarp forest	Tawa and kohekohe. Also rimu, northern rātā, miro, hīnau, rewarewa, locally mangeao, pukatea and kahikatea.	Tawa and kohekohe most dominant canopy species. Kauri absent. Largely restricted to Hunua Ranges and Waitākere Ranges.
Mild	Frost prone recent alluvial terraces	Moderate to high-fertility poorly drained gleyed and organic gleyed soils.	MF4	Kahikatea forest	Kahikatea, ribbonwood , <i>Hoheria</i> spp, kōwhai , tītoki, pōkākā, māhoe, kaikōmako and divaricating shrubs including tūrepo, round-leaved coprosma and poataniwha.	Kahikatea swamp forest dominant . Typically found in frost-prone areas, e.g. Kaipara Flats, Coatesville, Riverhead and Clevedon. Could be confused with WF8 but different understorey composition. Also could be confused with gully component of kauri forest types (WF11-12). Check topography and soils.
Mild temperate and humid	Hill-slopes, hill-crests, and plateaux	Low-fertility leached brown and granular soils developing towards podzols.	MF24	Rimu, tōwai forest	Tōwai and emergent rimu, northern rātā and miro. Locally also includes tawa.	High altitude (>450m) forest in Hunua Ranges.
	Hill-slopes and hill-crests.	Strongly leached low-fertility brown soils developing towards podzols.	MF25	Kauri, tōwai, rātā, montane podocarp forest	Tāwari, tāwheowheo and southern rātā with stunted conifers including kauri, toatoa and Hall’s tōtara. Silver pine, monoao and yellow-silver pine on GBI.	High altitude forest on Little Barrier (LBI) and Great Barrier Islands (GBI) (>600m on LBI and Mt Hobson on GBI).

Table 2: Cliff ecosystems

Ecosystem drivers			Ecosystem unit/ variant		Diagnostic species	Diagnostic features
Physical disturbance	Temperature and humidity	Landform	Code	Ecosystem name		
Erosion associated with gravity and wind ablation	Warm temperate and sub-humid.	Coastal cliffs, bluffs, rock-stacks, and their talus in association with atmospheric salinity (e.g. spume and salt-spray).	CL1	Pōhutukawa treeland/ flaxland/rockland	Pōhutukawa, houpara, taupata, karo, wharangi, kawakawa and tūrepo. New Zealand broom, species of hebe, harakeke, rengarenga lily, coastal astelia, knobby clubrush.	Coastal cliffs, erosion-prone hill-slopes and colluvial slopes with pōhutukawa treeland, shrubland, flaxland and/or rockland. Grades into WF4 (coastal forest) on and above coastal escarpments where easier terrain permits forest establishment. Classify as treeland (TL) if tree and shrub cover is <80%.
	Warm to mild temperate and semi-arid to sub-humid.	Inland cliffs, bluffs, tors, and their talus.	CL6	Hebe, wharariki flaxland/rockland	Wharariki, broad-leaved poa, hebe species, snowberry, New Zealand daphne, tree daisy, kōwhai and New Zealand broom, mingimingi, <i>Dracophyllum</i> , broadleaf, mānuka, tutu and, locally, rātā lianes, ngaio, kānuka, perching lily, tūrutu and locally tank lily and harakeke.	Inland cliffs, rock outcrops and bluffs. Vegetation includes lichens, bryophytes, short-statured herbs, grasses, wharariki, shrubs and low forest species. Most common in Auckland on bluffs in Waitākere and Hunua Ranges.

Table 3: Regenerating ecosystems

Ecosystem drivers			Ecosystem unit/ variant		Diagnostic species	Diagnostic features
Combustion and/or volcanicactivity [Vegetation succession]	Temperature and humidity	Landform	Code	Ecosystem name		
Large-scale disturbance associated with fire or erosion or volcanic activity	Warm and sub-humid	Hill-slopes, ridges, terraces.	VS1	Pōhutukawa scrub/ forest	Pōhutukawa, northern rātā, puka, kānuka, karamū, akepiro, koromiko, Kirk’s tree daisy, māpou, rewarewa and akeake are also locally present.	Early successional pōhutukawa-dominated forest and scrub on Auckland lava flows. Largest sites in Auckland are Rangitoto Island and an area of rockfall (Pohutukawa Flat) on Hauturu / Little Barrier Island.
	Warm to cool temperate and semi-arid to sub-humid	Hill-slopes, ridges, terraces, and plains especially on free-draining soils.	VS2	Kānuka scrub/forest	Kānuka, mingimingi, prickly mingimingi, <i>Coprosma rhamnoides</i> , tauhinu, kōhūhū, māhoe, māmāngi, five-finger, lancewood, kōwhai, karamū, putaputawētā.	Kānuka-dominated forest with insufficient emergent secondary species to determine trajectory to mature forest type. WF5 if on stabilised dunes.
	Warm to cool temperate and sub-humid.	Hill-slopes, ridges, and terraces on free-draining soils.	VS3	Mānuka, kānuka scrub	Mānuka and kānuka. Also present hangehange, māhoe, species of <i>Coprosma</i> , <i>Pittosporum</i> and <i>Pseudopanax</i> , locally kawakawa, māpou, rewarewa and tree ferns.	Mixed mānuka-kānuka scrub (can be mānuka dominated in exposed locations) with insufficient emergent secondary species to determine trajectory to mature forest type. Further down the soil fertility and drainage continuum with more fertile and better drained soils than WL1 (gumland). Presence of kānuka, tree ferns, and broadleaved species such as hangehange indicates VS3 rather than WL1. Differs from mānuka-dominated fen wetland (WL12), which typically has a higher water table, better soil fertility, and a different species assemblage.
	Warm to cool temperate and sub-humid to humid	Hill-slopes, ridges, and terraces on low-fertility soils.	VS5	Broadleaved species scrub/forest	Species of <i>Coprosma</i> (especially māmāngi karamū, shining karamū and kanono), <i>Pseudopanax</i> , <i>Pittosporum</i> , tree daisy, hebe, rangiora, tutu, putaputawētā, māhoe, māpou, wineberry, kōtukutuku, patē, tōwai and tree ferns.	Scrub/forest dominated by early successional broadleaved species often with abundant tree ferns. Insufficient emergent secondary species to determine trajectory to mature forest type. Includes young broadleaved dominated (e.g. māhoe) scrub/forest dominated on lava flows.

Table 4: Wetland ecosystems

Ecosystem drivers			Ecosystem unit/ variant		Diagnostic species	Diagnostic features
Hydrosystem	Fertility or chemistry	Landform	Code	Ecosystem name		
Freshwater [including palustrine, riverine and lacustrine]	Oligotrophic-low nutrient status and high acidity [bogs]	Hill-slopes and depressions with kauri podzols	WL1.1	Gumland heath	Mānuka, gumland grass tree, tangle fern, species of <i>Machaerina</i> , <i>Schoenus</i> , <i>Gahnia</i> , <i>Tetraria</i> and <i>Lepidosperma</i> sedges, and locally tamingi.	Waikumete Cemetery is the only known true gumland heath site in Auckland (per Clarkson <i>et al.</i> 2011 definition).
		Ultic soils or abated soil (lacking A or B horizon) of low fertility and occasional fires	WL1.2	Fire-induced gumland heath	Mānuka, <i>Dracophyllum</i> spp., tangle fern, sword sedge, kauri sedge, kūmarahou, toru.	Gumland that doesn’t meet the true gumland definition characterised by low scrub, sedgeland and fernland. Low-fertility and acidic soil, poor drainage, often seasonally dry. May succeed to kauri forest if left undisturbed. Differs from mānuka-kānuka scrub (VS3) which has more fertile and better-drained soils. Presence of kānuka, tree ferns, and broadleaved species such as hangehange indicates VS3 rather than WL1. Differs from mānuka dominated fen wetland (WL12), which typically has a higher water table, better soil fertility, and a different species assemblage.
		Depressions or the lagg of raised bogs with organic soils.	WL2	Mānuka, greater wirerush, restiad rushland	Mānuka, tamingi, greater wirerush, tangle fern, <i>Schoenus brevifolius</i> , <i>Machaerina tenax</i> , sphagnum and <i>Tetraria</i> .	Only known from dune lakes in the north-east of the region.

Table 4: Wetland ecosystems continued

Ecosystem drivers			Ecosystem unit/ variant		Diagnostic species	Diagnostic features
Hydrosystem	Fertility or chemistry	Landform	Code	Ecosystem name		
Estuarine		Raised bogs on in-filled lagoons/ river oxbows with deep organic soils.	WL3	Bamboo rush , greater wirerush, restiad rushland	Bamboo rush , greater wirerush, mānuka, gumland grass tree, Sinclair’s tamingi, <i>Lycopodiella lateralis</i> , <i>Machaerina teretifolia</i> , <i>Schoenus brevifolius</i> , tangle fern, sphagnum, <i>Utricularia</i> and <i>Drosera</i> spp.	‘Collapsed’ in the Auckland Region (equivalent to species extinction).
	Mesotrophic- moderate fertility and weak to neutral acidity [fens and marshes]	Freshwater margins of estuaries, tidal rivers, coastal lagoons, and some inland lakes.	WL10	Oioi restiad rushland/reedland	Abundant oioi, locally with large Machaerina and Bolboschoenus spp. , kuta , lake clubrush , often with scattered raupō and harakeke .	On stream margins where freshwater meets saline at the coast, in estuaries and in coastal lagoons. Differentiated from SA1.3 (estuarine saltmarsh) and DN5.1 (dune plains), which are often dominated by oioi, by the influence of freshwater and the presence of the other wetland species listed.
		Depressions and lake and lagoon margins.	WL11	<i>Machaerina</i> sedgeland	Species of <i>Machaerina</i> , <i>Eleocharis</i> , lake clubrush and locally <i>Carex</i> spp.	A relatively common sedgeland-rushland wetland type.
		Depressions.	WL12	Mānuka, tangle fern, scrub, fernland	Mānuka, <i>Machaerina</i> , <i>Lepidosperma</i> , tangle fern, sphagnum, <i>Carex</i> spp., <i>Gahnia</i> and <i>Astelia</i> species.	Mānuka-dominated wetland . Fluctuating water table. Often occurs in small patches on edge of WL11 or WL2. Largest examples on GBI. Could be confused with WL1 (gumland) or VS3 (scrub) where mānuka is also dominant, but has different species mix, hydrology and soils.
		Coastal lake and lagoon margins.	WL15.1	Herbfield [coastal lakeshore turf]	Half star, bachelor’s button and species of water milfoil, <i>Crassula</i> , <i>Isolepis</i> , <i>Leptinella</i> , <i>Lobelia</i> and buttercup. Also <i>Limosella lineata</i> and <i>Lilaeopsis novae-zelandiae</i> .	Narrow band of permanent herbfield on edge of fluctuating lakeshore margins, often between aquatic (hydrophytic) vegetation and taller lakeshore emergent vegetation. Occurs on shallow-gradient lake margins in freshwater and brackish conditions, towards the sea. Grades into salt marsh with increasing salinity. Could be confused with other herbfield ecosystems: SA5 (exposed coast), SA1.4 (estuarine) or DN5.2 (dune slack), though WL15.1 is dominated by hydrophytes tolerant of submergence.
		Inland lake and lagoon margins.	WL15.2	Herbfield [inland lakeshore turf]	<i>Glossostigma elatinoides</i> , species of water milfoil, <i>Lilaeopsis</i> , <i>Carex</i> , <i>Eleocharis</i> , <i>Lobelia</i> , <i>Centrolepis</i> , <i>Hydrocotyle</i> , <i>Plantago</i> , <i>Ranunculus</i> , <i>Crassula</i> and <i>Viola</i> .	Narrow band of permanent herbfield on edge of fluctuating lakeshore margins, often between aquatic (hydrophitic) vegetation and taller lakeshore emergent vegetation. Ecosystem occurs on shallow lake margins. Could be confused with other herbfield ecosystems: SA5 (exposed coast), SA1.4 (estuarine) or DN5.2 (dune slack), though this ecosystem is dominated by hydrophytes tolerant of submergence.
	Eutrophic- high fertility and weak acidity to weak alkalinity [Swamps and marshes].	Depressions and terraces with recent and organic soils.	WL18	Flaxland	Harakeke usually with toetoe, kiokio, species of <i>Carex</i> , <i>Machaerina</i> , and scattered cabbage tree, <i>Coprosma</i> spp. and mānuka	Flax-dominated freshwater wetland . Later successional examples may be dominated by cabbage trees.
		Depressions and lake and lagoon margins with recent and organic soils.	WL19	Raupō reedland	Raupō , locally with purua grass, lake clubrush, jointed twig rush, toetoe, pūkio, swamp millet.	Raupō-dominated freshwater wetland . Includes modified wetland examples where <i>Carex</i> spp, <i>Juncus</i> spp and swamp millet are common.
	Salinity >5 % associated with tides or in lagoons.	River mouths, inlets, estuaries, and lagoons with sulphuric gley and recent gley soils, locally with shell and or gravel barrier beaches.	SA1.1	Sea grass On low-lying mud or sandy-silt flats, where tidal inundation is longest	Sea grass.	Presence of sea grass.

Table 4: Wetland ecosystems continued

Ecosystem drivers			Ecosystem unit		Diagnostic species	Diagnostic features
Hydrosystem	Fertility or chemistry	Landform	Code	Ecosystem name		
			SA1.2	Mangrove forest and scrub In areas of frequent tidal inundation where silt deposition is abundant near stream and rivers mouths	Mangrove.	Presence of mangroves
			SA1.3	Sea rush and oioi Upper estuarine zone where salt and freshwater dilution is greatest [Saltmarsh]	Sea rush and oioi.	Presence of sea rush and oioi within estuarine ecosystem. May grade into WL10 in freshwater zones at stream mouths. Differentiate based on hydrology and species mix.
			SA1.4	Halophytic herbfield (In depressions where salt water low-lying pools, and subsequently evaporates creating hypersaline conditions)	Glasswort, sea primrose and sea blite.	Estuarine herbfield. Could be confused with other herbfield ecosystems: SA5 (exposed coast), WL15.2 (lakeshore margins) or DN5.2 (dune slack). Differentiated by location (estuarine).
			SA1.7:	Basaltic lava rockland/ coastal needle grass tussockland	Coastal needle grass, oioi, knobby clubrush, glasswort, shore celery and shore lobelia.	Coastal needle grass tussockland occupies the saline margin of lava flows between the sea (often mangrove scrub) and pōhutukawa forest, typically at, or slightly above, mean high water springs. Largely restricted to Rangitoto Island and Anns Creek.

Table 5: Saline ecosystems

Temperature and humidity	Landform and soils	Salinity	Code	Ecosystem name		
Warm and sub-humid	Shell barrier beaches (formed from dead mollusc shells and sand forming long and narrow ridges)	Atmospheric salinity (e.g., spume and salt-spray) associated with persistent wind and occasional spring tide and storm surge inundation	SA1.5	Shell-barrier beaches [Chenier Plains]	Shellfield with occasional glasswort, <i>Austrostipa stipoides</i> , knobby clubrush, sea rush, sea primrose, bachelor's button and <i>Suaeda novae-zelandiae</i> , oioi, saltmarsh ribbonwood and tauhinu.	Auckland examples include shell/sandy spits at Shoal Bay, Ngataringa Bay, Hobson Bay, Tahuna Torea, Pollen Island, and in the Okura and Weiti River estuaries. There are other small spits in Auckland harbours and estuaries, e.g. within Kaipara Harbour. See Table 4 for other estuarine ecosystem variants.
	Beach ridges with raw estuarine soils (silt, sand, mollusc shells, gravel and locally with driftwood)	Atmospheric salinity (e.g., spume and salt-spray) associated with persistent wind and occasional spring tide and storm surge inundation.	SA1.6	Coastal scrub On low mounds and estuarine margins	Salt marsh ribbonwood, harakeke, coastal tree daisy and locally grading into ngaio, kōwhai, mānuka and cabbage tree.	Scrub on estuarine margins and on raised mounds within estuaries.
	Beach ridges with raw, stony and shingle soils, locally with driftwood	Atmospheric salinity (e.g., spume and salt-spray) associated with persistent wind.	SA4	Shore bindweed, knobby clubrush gravelfield/ stonefield	Gravelfield/stonefield locally with glasswort, half star, shore celery, knobby clubrush and shore bindweed.	Extremely rare in Auckland. Herbfield above MHWS on gravel and boulder beaches . Two known Auckland sites on Waiheke and two at Matingarahi. Probably on LBI and GBI.

Table 5: Saline ecosystems continued

Ecosystem drivers			Ecosystem unit		Diagnostic species	Diagnostic features
Temperature and humidity	Landform and soils	Salinity	Code	Ecosystem name		
	Marine terraces, hill-slopes, rocks, and cliffs rarely with marine mammal disturbance	Atmospheric salinity (e.g., spume and salt-spray) associated with persistent wind. Soils contain high concentrations of soluble salts.	SA5	Herbfield [Coastal turf]	Half star, sea primrose, <i>zoysia</i> , native spinach, ice plant, shore lobelia, NZ celery, dichondra, glasswort, shore groundsel and New Zealand sea spurrey.	Herbfield (turf) on shoreline rock landforms and, infrequently, on consolidated sand and gravel. Exposed to persistent wind and heavy salt deposition. Could be confused with SA1.4 (estuarine herbfield) or WL15.1 (ephemeral herbfield on coastal lakeshore margins), but SA5 does not occur within estuaries or on lakeshore or lagoon margins .
	Coastal hill-slopes and cliffs with seabird disturbance. Guano-enhanced soil fertility	Atmospheric salinity (e.g., spume and salt-spray) associated with persistent wind.	SA7	Iceplant, glasswort herbfield/loamfield	Seabird burrows and bare ground with herbfield of glasswort, iceplant, pigweed, shore groundsel, sea primrose, New Zealand celery amongst scrub of taupata, houpara, harakeke, ngaio and coastal māhoe.	Rare on Auckland mainland. Scrub and herbfield on coast in seabird nesting areas . Also known colloquially as petrel scrub.

*See other estuarine ecosystem types in Table 4 (above).

Table 6: Dune ecosystems

Ecosystem drivers			Ecosystem unit		Diagnostic species	Diagnostic features
Physical and climatic disturbance	Salinity	Landform	Code	Ecosystem name		
Wind ablation	Atmospheric salinity (e.g., spume and salt-spray)	Erosion and accretion of sand resulting in dunes with raw sandy soils	DN2	Spinifex, pīngao grassland/sedgeland	Spinifex and pīngao , locally with sand tussock and shore bindweed and, further inland, sand coprosma, tauhinu, sand daphne and small-leaved pohuehue.	Active dune ecosystems dominated by spinifex and pīngao.
		Dune plains , damp sand plains, exposed coastal hill slopes and ridges, and rock stacks with raw sandy soils	DN5.1	Oioi, knobby clubrush sedgeland	Oioi, knobby clubrush, harakeke, toetoe.	Typically associated with rapidly accreting coastlines and formed behind mobile dunes where dune plains have formed. Oioi and knobby clubrush common.
		Recent deflation hollows and stream terraces with seasonally high water table and raw sandy soil [dune slack]	DN5.2	Herbfield [Dune slack]	Sand spike sedge, mudwort, <i>Lilaeopsis novae-zelandiae</i> , slender clubrush, sand tussock.	Ephemeral wetlands formed between sand ridges.

Table 7: Geothermal ecosystems

Ecosystem drivers			Ecosystem unit		Diagnostic species	Diagnostic features
Temperature	Hydrology	Landform	Code	Ecosystem name		
Soil and associated ground water with temperatures >20°C associated with geothermal heat	Water and steam of a range of temperature, pH and chemistry.	Geysers, pools, springs, streams, fumaroles, and sinter terraces (including their margins).	GT2	Geothermally-heated water and steam	Algae, fungi, bryophytes, invertebrates, bacteria, archaeobacteria, cyanobacteria, diatoms, tasmanitids and amoeba.	Found in areas influenced by geothermal activity, e.g. Kaitoke Hot Springs, GBI.

Table 8: Cave ecosystems

Ecosystem drivers			Ecosystem unit		Diagnostic species	Diagnostic features
Solar radiation deficiency	Temperature	Landform	Code	Ecosystem name		
Lacking solar energy and associated photosynthetic energy inputs.	Low temperature fluctuation producing near constant atmospheric conditions.	Basaltic lava caves.	CV1	Subterranean rockland, stonefield	Detritivorous and predatory organisms, both epigean and specialist troglobites including species of molluscs, flies, glow worms, spiders, ground beetles, pseudo-scorpions and amphipods.	Found within caves

Table 9: Anthropogenic ecosystems

Ecosystem drivers			Ecosystem unit		Diagnostic species	Diagnostic features
Pastoral grazing [Anthropogenic succession]	Temperature and humidity	Landform	Code	Ecosystem name		
Disturbance associated with pastoral grazing	Warm to cool temperate and semi-arid to sub-humid	Moderately steep pastoral hill country of low to moderate fertility and localised areas on alluvial soils	AVS1	Anthropogenic tōtara forest	Tōtara is the dominant coloniser, often with kānuka and locally mānuka, and also kahikatea in humid areas. Kānuka and mānuka is frequently suppressed as stands mature. Minimal understorey due to grazing.	Forest within a pastoral landscape (typically develops in unfenced areas grazed by stock). Tōtara is dominant with minimal other diversity. Common in hill country in Rodney and parts of Mānukau Ecological District, also localised areas on alluvial soils. Over time can transition to other forest ecosystem types once fenced and if seed sources are available. Classify as treeland (TL) if tree and shrub cover is <80%.

Table 10: Additional ecosystem categories

Ecosystem type & code	Description	Variants	Notes
Treeland-TL	Treeland - Tree canopy cover 20-80%, tree cover exceeding that of any other growth form, but tree canopy discontinuous above lower non-woody vegetation. NB: Forest is defined as > 80% canopy cover of trees and shrubs.	TL.1: native-dominated treeland	Native-dominated: >75% native tree cover (NB: % relates to tree cover not overall cover across all tiers).
		TL.2: mixed native/exotic treeland	Mixed native/exotic: with 25-75% native tree cover (NB: % relates to tree cover not overall cover across all tiers).
		TL.3: exotic-dominated treeland	Exotic-dominated: <25% native with exotic tree cover dominant (NB: % relates to tree cover not overall cover across all tiers).
Exotic Forest-EF	Forest vegetation with >50% cover of exotic species in the canopy	EF.1 with >50% native understorey and/or groundcover biomass EF.2 with <50% native understorey and/or groundcover biomass	Use this category when exotic canopy species are dominant.
Exotic Scrub-ES	Exotic secondary scrub or shrubland with >50% cover/biomass of exotic species.		Exotic species are dominant (>50% cover or biomass) and the future trajectory is uncertain.

Table 10: Additional ecosystem categories continued			
Ecosystem type & code	Description	Variants	Notes
Exotic Grassland -EG	Grassland dominated by exotic species		Grassland dominant. Minimal cover/biomass from plants in any other vegetation tier.
Exotic Wetland -EW	Wetland ecosystems with >50% exotic plant biomass. Wetlands with exotic-dominated canopy (e.g. crack willow) but >75% native understorey/groundcover should be categorised as appropriate native wetland ecosystem type.		
Planted vegetation -PL	Native restoration plantings with <50% exotic biomass, or exotic and/or native amenity plantings.	P.1: planted native scrub and forest <20 years old or wetland <10 years old. P.2: planted native scrub and forest >20 years old or wetland >10 years old. P.3: native and/or amenity plantings.	
Brown Field - BF	Industrial zones, metalled carparks, rail corridors, unmanaged or managed land within urban settings, road median strips, pavements, cracks in concrete.	BF.1: largely exotic herbfield with some native herbaceous species may have occasional exotic or native woody species. BF.2: exotic herbfield.	Throughout the urban zone commonly thought of as wasteland. Substrate includes metal (stone chip) and concrete surfaces.