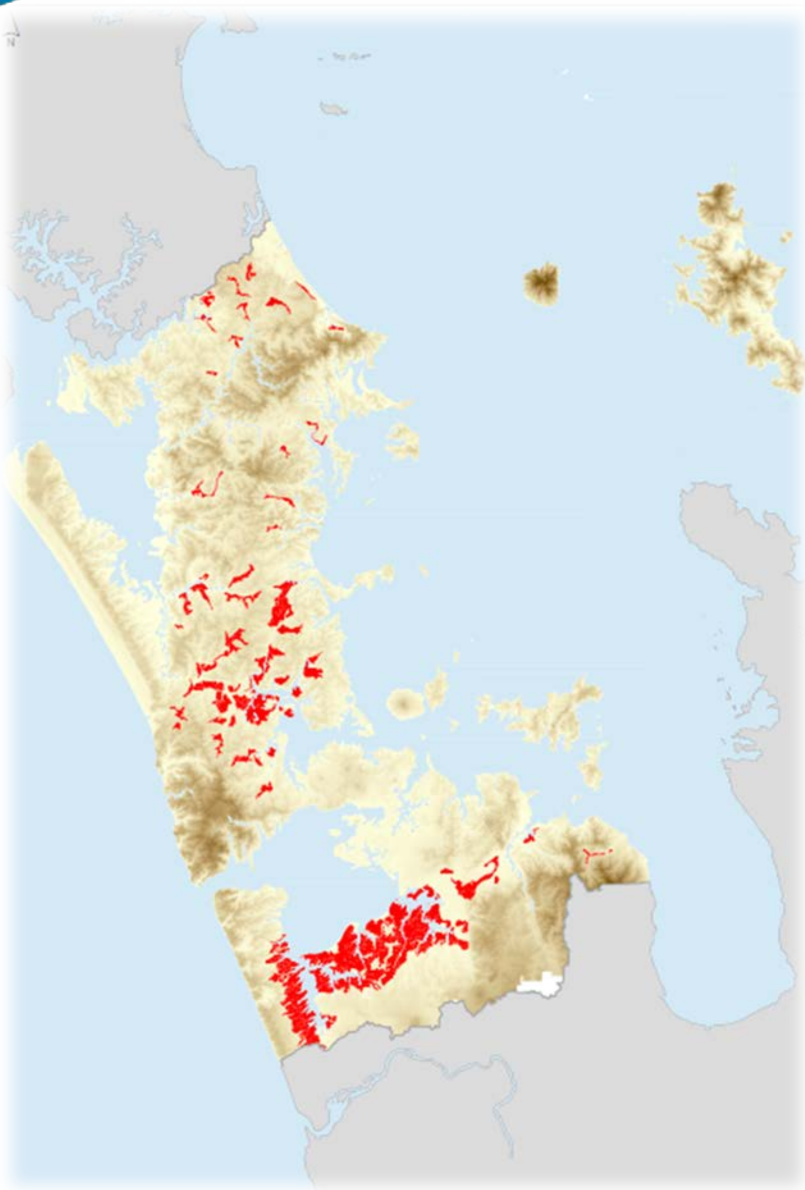
Soil Information Inventory:

Karaka and related soils

October 2018 Soil Information Inventory 7



RIMU Research and Evaluation Unit

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Soil Information Inventory 7:

Karaka and related soils

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Auckland Council
Soil Information Inventory, SII 7

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1 Introduction

With Auckland's expected growth from 1.7 to 2.0 million people in the next 30 years (The Auckland Plan 2050) and a goal to double New Zealand's agricultural exports by 2025 (Ministry for Primary Industries), an understanding of Auckland's soil resources is essential for planning urban growth, and sustaining if not expanding rural production, while managing the impacts of both on our region's environment.

Existing information on Auckland's soils is difficult to assess and interpret. Electronic versions of soil maps are available on research institute websites. Some have been uploaded into Auckland Council's geographic information system (GIS, GeoMaps) for use by council staff and for public viewing. However, the GIS maps and their attached attribute lists cannot be understood or used without referring to background information which is dispersed across old maps, publications, or unpublished reports. Many of these documents are now hard to find.

Auckland Council has undertaken to compile old information for the region's main soils into single documents called soil information inventories (SIIs). These may be viewed on Knowledge Auckland, www.knowledgeauckland.org.nz council's research and technical publications website, downloaded and printed. It is expected that there will be gaps in each inventory. The gaps will be filled as new information becomes available. Each inventory is a repository for information old and new and will be a "living document".

Their intent is to:

- ease access to soil information
- enable better understanding of the soils' properties
- enhance public awareness about the location of productive or problematical soils
- improve awareness of the soils' potential and limitations, amongst consultants and planners
- help council staff provide better advice, and make more informed decisions.

Our role has been document compilers, not authors. We have selected information which appears useful for landowners, farm, forest, environmental or planning consultants, and the council staff who deal with them. While we regard the selected information as reliable, responsibility for accuracy of contents rests with the organisations which originally collected and published the maps or documents which we cite. Auckland Council makes the information available on the Knowledge Auckland website with this understanding.

Acknowledgments are due principally to old soil surveyors of the DSIR's Soil Bureau, who collected most of the information reproduced here, notably Charles Sutherland, Charles Wright, Norman Taylor, Edward Cox, and Gary Orbell.

Assistance from Mandy Holt (cross-section), Tyana Rowe-Kurene, Tony Edhouse and Linda Wallis (document editing and layout), Fiona Curran-Cournane (internal publication referee) and Malcolm McLeod (external publication referee) is also acknowledged.

Michael Martindale, Douglas Hicks and Peter Singleton
June 2016, October 2018

2 Published maps

Karaka and related soils on thin weathered volcanic ash are depicted on DSIR's older published soil maps south of Auckland (1:253,840) as five series i.e. soils with distinct profiles and parent materials, within three complexes i.e. associated with other unrelated soils. The soils are labelled as:

72	Karaka complex
72a	Karaka fine sandy loam (Otao variant)
72b	Flat Bush silt loam
72c	Papatoetoe silt loam
73a	Koheroa complex
73b	Torehape complex

On a map of intermediate age covering part of Franklin district (1:63,360), one series (Karaka) is divided into two types i.e. soils with differences in texture or other characteristics, plus an extra series:

Ka	Karaka silt loam
Kam	Karaka silt loam (mottled)
Wp	Whatapaka silt loam

A recent map (1:20,000) which covers the Manukau area separates the soils into mapping units that contain spatially associated soil types i.e. soils with differences in texture or other characteristics. It assigns them alphanumeric labels as follows:

AHA1	Karaka silt loam
AHA2	Karaka silt loam over Ardmore peat
AHA3	Karaka clay loam
AHA4	Karaka sandy loam
AHA5-7	Whatapaka silt loam, Ardmore peaty loam, and Kaipaki peaty clay
AHA8-10	Torehape silt loam complexed with old ash and old alluvial soils
AHA11-14	Karaka sandy loam complexed with old ash and young alluvial soils
AHA15	Kaipaki peaty clay, Ardmore peaty loam, and Whatapaka silt loam
BHA1	Karaka silt loam
BHA2	Karaka sandy loam
BHA3	Karaka sandy loam and clay loam
BHA4	Karaka loam over Kara clay
BHA5	Torehape silt loam complexed with old ash and old alluvial soils

Soil information inventory 7: Karaka and related soils.

BHA6	Karaka sandy loam complexed with old ash and old alluvial soils
BHA7	Karaka sandy loam over Waipuna clay

North of Auckland DSIR's soil maps (1:100,000) depict similar soils as another three series, within or as part of another complex:

OL, OLm	Otao silt loam
WE, WEm	Waitemata silt loam
CV	Coatesville silt loam
C1	Waitemata complex

Different soils are included within published map polygons labelled as Karaka complex or Waitemata complex though are separable at farm scale as Manurewa and Clevedon series (south), or Whareora and Waipuna series (north). These are described by other soil information inventories.

Sourced from:
Soil maps of Helensville-Waitakere area; Whangaparaoa-Auckland area
NZ Soil Bureau maps 220, 221
Soil map of the North Island, sheets 2 and 3 (Auckland and Waikato)
NZ Soil Bureau maps 11/211/3
Soil map of part Franklin county *NZ Soil Bureau map 149/1*
Soil map of Manukau City *NZ Soil Bureau map unpublished*

3 Online maps

Landcare Research's online soil map (S-map, 1:50,000) re-names and re-labels the soils as follows:

72	No family or sibling assigned
72a, b, c	No family or sibling assigned
73a, b	No family or sibling assigned
Ka	Kapu family, sibling 1
Kam	No family or sibling assigned
Wp	No family or sibling assigned
AHA1	Ormiston family, sibling 6
AHA2	Ormiston family, sibling 7
AHA3	Baver family, sibling 1
AHA4, 12, 13, 14	Small family, sibling 2
AHA5	Taitapu family, sibling 35
AHA6	Oronoko family, sibling 16
AHA7, 11	Bram family, sibling 10
AHA 8, 9, 10	Redo family, sibling 1
AHA15	Paro family, sibling 10
BHA1	No family or sibling assigned
BHA2, 3, 5, 6, 7	Small family, sibling 2
BHA4	Otara family, sibling 9
OL, OLm	No family or sibling assigned
WE, WEm	No family or sibling assigned
CV	No family or sibling assigned
C1	No family or sibling assigned

Reasons for the basis of S-map can be found in the S-map database manual. The names and numbers were assigned by computer-matching local soil properties with different soils in other parts of the country.

Sourced from S-map Online – Home [*http://smap.landcareresearch.co.nz/home*](http://smap.landcareresearch.co.nz/home)

4 Farm-scale maps

When investigated in the field by local soil mappers, any published map polygon labelled as 72 etc. turns out to be a mosaic of 72 plus several other soil types i.e. series divided according to texture. On farm-scale soil maps (1:5,000 - 1: 10,000) south of Auckland the Karaka series is labelled as:

Kas	Karaka sandy loam
Ka	Karaka silt loam
Kam	Karaka silt loam (mottled)
Wps	Whatapaka sandy loam
Wp	Whatapaka silt loam
Wpg	Whatapaka silt loam or sandy loam (gleyed)

Related soils within the Koheroa and Torehape complexes are labelled as one or other of the above. Areas in Manukau where published maps show Papatoetoe or Flat Bush silt loam are now urban, so no farm-scale maps have been prepared here.

Where farm-scale maps have been prepared within published map polygons labelled C1 (Waitemata complex) north of Auckland, the soils related to Karaka series are differentiated as:

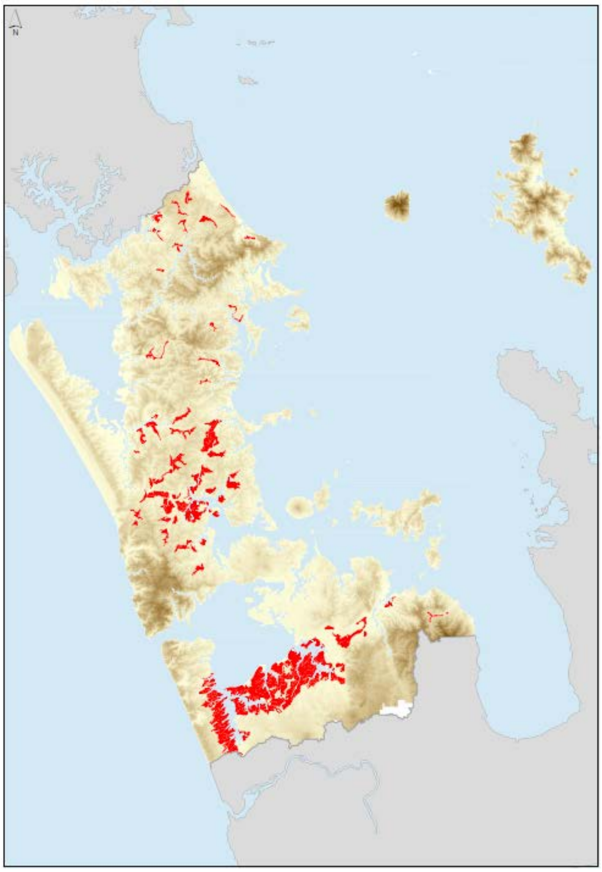
Ols	Otao sandy loam
Ol	Otao silt loam
Olm	Otao silt loam (mottled)
Wes	Waitemata sandy loam
We	Waitemata silt loam
Cv	Coatesville silt loam or sandy loam (gleyed)

Local series names for Karaka and related soils have been retained on Auckland Council's farm-scale maps for continuity with published nomenclature. A local mapper (DLH) considers they could be regarded as the same series, north and south of Auckland.

Sourced from 1995-2015 farm-scale maps and soil notes prepared for private landowners, Auckland Regional Council or Auckland Council

5 Where the soils occur

Throughout Franklin district, from lower part of the Awhitu Peninsula through Glenbrook and Kingseat; then Papakura district from Karaka through Drury and Papakura to Clevedon. On northern outskirts of Auckland from Henderson to Kumeu, and through valleys in Rodney district.



Location of Karaka and related soils

Karaka and related soils are mapped on 33,100 hectares (7% of Auckland region). About 17,400 hectares (53% of the area mapped) are in agricultural use. Most of the balance is now urban (estimated from overlay of AgriBase 2010 on Fundamental Soils Layer). *http://intermaps.arc.govt/AucklandCouncilViewer/*

Karaka and related soils mantle undulating terraces around upper shores of the Manukau and Waitemata harbours. Otao loam (pictured) is usually in vines, fruit trees or vegetable crops. *Photo: D Hicks*

5.1 On what landform

Flat to undulating, dissected estuarine terraces around shores of the upper Manukau and upper Waitemata harbours, grading into alluvial terraces that extend up stream valleys. The soils are a thin mantle of water-sorted volcanic ash, also pockets of air fall ash on high parts, over old estuarine sediments (Puketoka Formation) or stream sediments (Tauranga Group). Geologists interpret these terraces as formed during or before the last interglacial (130,000 to 80,000 years ago), and the water-sorted ash mantle as derived from Hamilton Ash, a sequence of nine rhyolitic ash showers between 300,000 and 50,000 years ago.

Sourced from Edbrooke, S. W., 2001, Geology of the Auckland Area, Institute of Geological and Nuclear Sciences 1: 250,000 map 3 and accompanying bulletin

5.2 How they differ from other soils

Karaka and related soils are intermediate in colour between the bright red-brown Patumahoe soil and the dark brown Ohaeawai soil. Their topsoils and upper subsoils are lighter –textured (contains more sand and silt) than Patumahoe though resemble Ohaeawai soils in this respect. Lower subsoil is clay rich weathered estuarine sediment, very different from the granular clay that weathers from thick airfall ash (Patumahoe soil), or the stony loam that weathers from young basalt (Ohaeawai soil).

Sourced from:
Wilson, A.D. and Cox, J.E., Soils of Rodney County, Unpublished report, Soil Bureau DSIR
Orbell, G., 1977, Soils of part Franklin County, Report 33, Soil Bureau DSIR

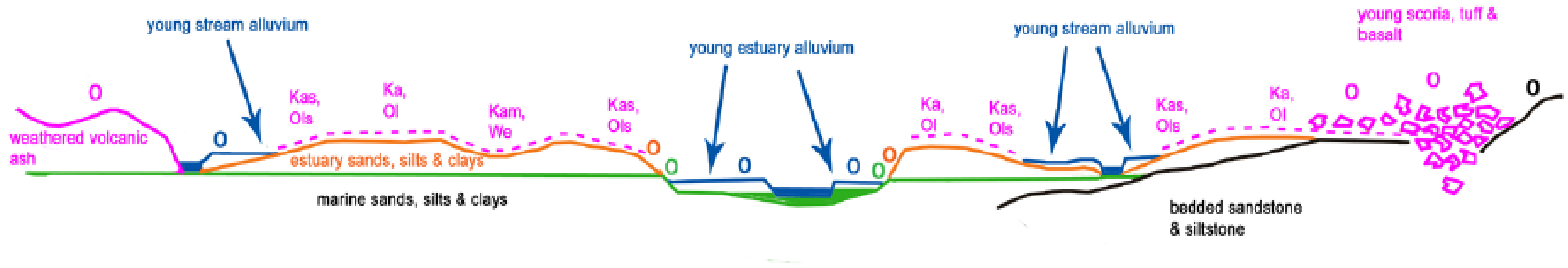
6 Classifications

NZ genetic (NZG):	Yellow-brown loam
NZ soil (NZSC):	Typic orthic allophanic or typic impeded allophanic *http://soils.landcareresearch.co.nz/contents/SoilNames_NZSoilClassification_SoilOrders.aspx*
Soil Taxonomy (USDA):	Typic udand or aquic udand *http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051544.pdf*
World Soils (FAO):	Andosol *http://www.fao.org/3/a-i3794e.pdf*

DSIR replaced the NZ genetic classification with the NZ soil classification in 1990s. DSIR's soil scientists considered that Soil Taxonomy did not work well in New Zealand, nor did World Soils. Soil Taxonomy and World Soils remain internationally accepted classifications.

Karaka and related soils form from volcanic ash which overlies old estuarine sediment *Photo: D Hicks*

Cross section showing Karaka and related soils' positions in landscape



On weathered volcanic ash (water-laid)

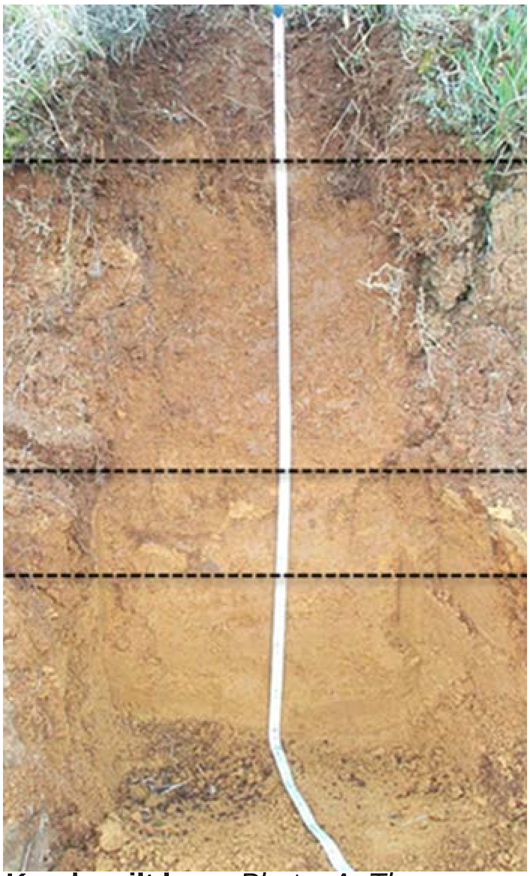
Kas, Ols	Karaka or Otao sandy loam	- undulating terraces
Ka, Ol	Karaka or otao silt loam	- flat terraces
Kam, We	Karaka mottled or Waitemata silt loam	- depressions in terraces

On underlying rocks or overlying sediments

o, o, o, o, o Other soils (refer to relevant soil information inventory)

Soil type labels on the cross-section are sourced from Auckland Council's farm-scale maps

7 Soil profile descriptions



Karaka silt loam *Photo: A. Thompson*

The DSIR's type profile description for Karaka series is:

Karaka silt loam

Horizon	Depth (cm)	Description
Ap	0-15	Very dark greyish brown (10YR 3/2) silt loam; friable; strongly developed medium polyhedral structure crushing easily to fine and extremely fine polyhedral; distinct boundary.
Bw	15-61	Yellowish brown (10YR 5/6) silt loam; medium blocky structure crushing easily to very fine polyhedral structure; few faint reddish mottles; medium packing; diffuse boundary.
2C	on	Strong brown (7.5 YR 5/8) clay loam; firm; moderate medium blocky structure crushing to fine polyhedral structure; distinct boundary.
R	over	Pale grey and yellowish brown clay and sandy clay.

A mottled phase (no profile description) mapped in hollows is similar to Karaka silt loam except that B and C horizons have many red and few grey mottles. A few grey and red mottles are found in topsoil in places. A sandy phase is also observed when identifying soils for sampling, and when mapping at farm scale. It has a sandy loam topsoil and sandy clay upper subsoil, better-structured though shallower than Karaka silt loam's B horizon.

Otao silt loam *Photo: F. Curran-Cournane*

Otao series on alluvial terraces north of Auckland is similar to Karaka series. The type profile description is:

Otao silt loam

Horizon	Depth (cm)	Description
Ap	0-24	Very dark greyish brown (10YR 3/2-4/2) silt loam (in places fine sandy loam); friable (when dry); fine and very fine subangular polyhedral and medium to fine subrounded polyhedral structure; distinct boundary.
A/B	24-32	Yellowish brown 10YR 5/4 silt loam; friable when dry; fine and very fine subangular polyhedral and extremely fine and very fine subrounded polyhedral structure; diffuse boundary.
Bw1	32-47	Yellowish brown (10YR 5/8) silt loam; sensitive and non-sticky when moist, friable when dry; fine and very fine polyhedral to blocky structure, breaks down to earthy on gentle pressure; diffuse boundary.

Horizon	Depth (cm)	Description
Bw2	47-57	Brownish yellow (10YR 6/6) silt loam, sensitive and non-sticky when moist, friable when dry; fine and very fine polyhedral to blocky structure; sharp irregular boundary.
2C(f)	57-70	White (5Y 8/1) very fine pumice sand (volcanic grit weathered to clay), few faint to distinct yellow and reddish brown mottles; firm when moist; apedal single grained; breaks to a very fine powder on moderate pressure; indistinct wavy boundary.
3C	on	Brownish yellow (10YR 6/6-6/8) clay; firm when moist; medium polyhedral to blocky structure, aggregates separate readily when disturbed (old estuary or stream alluvium).

The “pumice alluvium” or “pumice sand” is particles of volcanic grit which have weathered to kaolin clay. A typical Otao B2 horizon is thicker, while the 2C horizon is abnormal (lenses of weathered volcanic grit occasionally occur; one such happens to be at base of the B in the type profile). The typical Otao C horizon is weathered stream alluvium, as described except that grey mottles are often present. A mottled phase of Otao silt loam has a similar profile, except that its B horizon is pale brown, often with red and grey mottles.

Whatapaka silty or sandy loam *Photo: M Martindale*

Related soils, found in damp hollows on the terraces, are mapped as Whatapaka series south of Auckland and Waitemata series to the north. They occur where the original ashfall or weathered ash has been mantled by waterlaid ash washed off higher ground by overland runoff. The type profile description for Whatapaka series is:

Whatapaka silty or sandy loam

Horizon	Depth (cm)	Description
Apg	0-20	Black to dark grey silt loam; slightly firm; moderately developed medium polyhedral structure; many grey mottles; many reddish mottles and root channels; diffuse boundary,
B(g)	20-40	Brown clay loam; firm; moderately developed medium polyhedral structure; many greyish mottles; diffuse boundary,
Br	on	Greyish brown clay; very firm; strongly developed coarse prismatic breaking to coarse blocky structure; few yellowish brown mottles

This may not be the modal profile, as Whatapaka sandy loam appears equally widespread. Its profile is similar, except that the A horizon is sandy loam, the B(g) sandy clay loam.

North of Auckland, soil in similar landscape positions to Whatapaka is included in the Waitemata complex (C1) on published maps, though is differentiated as Waitemata series (Wea, We) at farm scale. There does not appear to be a clearly identified DSIR type profile. A provisional profile description (prepared by D. Hicks) is:

Waitemata silty or sandy loam

Horizon	Depth (cm)	Description
Ap	0-22	Dark grey silty or sandy loam; slightly firm or friable consistence; earthy structure when moist, polyhedral when dry; diffuse boundary.
B(g)	22-49	Yellow-brown silty or sandy clay loam, with grey mottles; firm or slightly firm consistence; massive structure when moist, subangular and subrounded polyhedral structure when dry; sharp boundary.
Cr	49-64+	Grey clay; sticky; massive structure when wet, blocky to prismatic if dry; few or no roots.

Topsoil (Ag)

Upper subsoil (Br)

Lower subsoil (Cr)

Coatesville silt loam *Photo: D Hicks*

South of Auckland a third phase of Whatapaka series is differentiated on wet depositional sites at farm scale. Compared with standard Whatapaka, its upper subsoil is thicker, coarser and gleyed. A provisional profile description (prepared by D. Hicks) is:

Whatapaka silty or sandy loam (gleyed)

Horizon	Depth (cm)	Description
Ag	0-20	Black to dark grey silty or sandy loam; firm in place and friable; earthy structure when moist, subangular and subrounded polyhedral when dry; some grey and/or red mottles; diffuse boundary.
Br	20-60	Grey silt, sandy silt or sand; loose consistence; friable when moist, powdery when dry; sharp boundary.
Cr	on	Grey-brown clay with red mottles, or grey clay with yellow mottles; sticky; massive structure when wet, blocky to prismatic if dry; few or no roots.

The different coloured C horizons appear related to parent material: grey-brown clay where weathered airfall ash; grey clay with yellow mottles where weathered estuarine sediment. The above profile description applies equally well to Coatesville series (Cv) in wet depositional sites on ash-mantled terraces north of Auckland; another soil which appears not to have a DSIR type profile. Published maps include it in the Waitemata complex, though local mappers differentiate it at farm scale.

Sourced from:
Orbell G.E., 1977, Soils of part Franklin County, Report 33, DSIR Soil Bureau
Sutherland, C.F., Cox, J.E., Type profile descriptions for North Auckland Soil Survey, Unpublished document, DSIR Soil Bureau

8 Properties of typical profile

The properties of typical profiles are best indicated by analysis results for the type profile i.e. site where Karaka silt loam was defined and described. Data for other sites will vary somewhat, particularly where different types within the series are found. Properties of the related soils may differ from those reported below.

8.1 Chemical

http://soils.tfrec.wsu.edu/mg/chemical.htm

Chemical data for the Karaka type profile (SBO8273) are incomplete in the online version of National Soils Database (NSD). The complete analysis has been sourced from an unpublished Soil Bureau Laboratory record:

Property	Topsoil	Subsoil	Units
Acidity	5.9	5.8 - 6.0	pH
Total carbon	10.9	1.4 - 3.3	%
Total nitrogen	0.8	0.1 - 0.2	%
Available phosphorus	118	9 - 20	mg %
P retention	96	99 - 100	%
Available sulphur	148	578 - 1438	µg/g
Cation exchange capacity	34.2	15.3 - 16.9	me %
Base saturation	56	19 - 29	%
Calcium	17.6	2.5 - 4.3	me %
Magnesium	1.3	0.3 - 0.5	me %
Potassium	0.3	0.1 - 0.1	me %
Sodium	0.1	<0.1 -0.1	me %

Sourced from laboratory analysis SB08273, DSIR Soil Bureau

8.2 Physical

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nj/home/?cid=nrcs141p2)018993

Physical data for SB08273 do not appear in the online version of NSD. A single parameter from another analysis (SBT 135) is given by Purdie 1982. Other estimates are sourced from an S-map factsheet.

Property	**Topsoil**	**Subsoil**	**Units**
Stones	0	0	%
Sand	10-15	10-15	%
Silt	71-64	71-64	%
Clay	19-21	19-21	%
Dry bulk density	0.75	0.82-1.20	g/cm^3
Total porosity	-	-	%
Macroporosity	-	-	%

Sourced from laboratory analysis SBT135, DSIR Soil Bureau, S-map factsheet, Landcare Research

8.3 Irrigation and drainage

http://irrigationefficiency.co.nz/assets/Uploads/Farmers-Guide.pdf

Soil moisture data for SB08273 do not appear in the online version of NSD. A few parameters from another analysis (135) are given by Purdie 1982. Other estimates are sourced from an S-map factsheet.

Property	**Topsoil**	**Subsoil**	**Units**
Field capacity	29	20-38	% w/w
Wilting point	23	11-19	% w/w
Plant-available water	6	9-19	% w/w
Plant-available water	64	97	mm
Depth to slowly permeable layer	-	>1	m
Perm. at slowly permeable layer	-	4-72	mm/hr

Sourced from laboratory analysis SBT135, DSIR Soil Bureau, and S-map factsheet, Landcare Research

8.4 Topsoil properties under different uses

Local management practices affect the properties of soil, so the history of land use needs to be considered. For Karaka and related soils, an indication is provided by soil test results collected by Auckland Council from sites known to have been under the same use long-term. These sites are being re-sampled at five to ten-year intervals to detect any trends.

Sourced from Sparling, G. et al, various dates, 500 Soils Project, Landcare Research Reports to Auckland Council
Soil Quality for Horticultural Sites in the Auckland Region 2013,
Soil Quality of Dairy Sites in the Auckland Region in 2009),
Soil Quality of Drystock Sites in the Auckland Region in 2010

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Land use:		Natural cover	Pasture				Market Garden		Orchard	
Types:		Bush	Life style	Organic	Dry stock	Dairy	Conventional	Organic	Conventional	Organic
Sample Number:		**98/1**	**00/1**	**00/2**	**-**	**97/1**	**97/2**	**-**	**00/3**	**98/2**
Acidity	pH	5.4	6.6	6.9	-	6.2	6.6	-	6.6	6.2
Total carbon	%	13.9	7.5	7.9	-	7.1	6.5	-	6.1	6.5
Total nitrogen	%	1.2	0.6	0.7	-	0.6	0.6	-	0.5	0.6
Available nitrogen	ug/ cm^3	98	158	211	-	154	73	-	133	99
Available phosphorus	ug/cm^3	2	23	74	-	43	19	-	60	48
Cation exchange capacity	cmol/cm^3	31.2	29.5	37.7	-	30.6	32.6	-	29.1	24.3
Base saturation	%	28	80	96	-	64	78	-	97	73
Calcium	cmol/ cm^3	5.7	13.1	26.7	-	14.8	21.3	-	23.4	14.8
Magnesium	cmol/ cm^3	2.2	3.3	2.6	-	2.4	1.8	-	2.4	1.8
Potassium	cmol/ cm^3	0.5	1.3	1.5	-	2.0	1.7	-	1.4	1.1
Sodium	cmol/ cm^3	0.2	0.5	0.2		0.2	0.2	-	0.2	0.2
Bulk density	t/ m^3	0.52	0.77	0.85		0.95	0.85	-	0.96	0.91
Particle density	t/ m^3	2.24	2.41	2.39	-	2.40	2.46	-	2.51	2.31
Aggregate stability	mm mwd	2.63	2.62	2.69	-	-	-	-	2.63	2.86
Total porosity	%	77	68	65	-	60	65	-	62	61
Macroporosity	%	56	53	53	-	47	50	-	44	45
Total available water	%	17	28	27	-	22	22	-	14	19
Readily available water	%	6	10	9	-	7	8	-	5	7

9 Land use capability

Land use capability is a classification of land according to properties that determine its capacity for sustained primary production. Classes 1 to 4 are arable, classes 5 to 8 non-arable. Class 1 is versatile i.e. capable of many uses, with negligible limitations to any use. Class 8 is land with extreme limitations that preclude productive use.
http://www.landcareresearch.co.nz/publications/books/luc

Three factors - geology, soil and slope - are considered when assigning land use capability classes. Another two - erosion and vegetation - may be recorded but rarely affect the decision. On regional-scale maps, notably the 1: 50,000 New Zealand Land Resource Inventory (NZLRI), limitations to use are indicated by four subclasses, c (climate), w (wetness), s (soil) or e (erosion). Unit numbers (1, 1b etc.) are used as labels for areas of land (map polygons) with the same geology, soil and slope, which are considered to have similar productive potential and management needs. General descriptions of productive potential and management needs are attached to 1:50,000 NZLRI unit numbers.

NZLRI sub-classes and unit numbers were used for farm-scale land use capability maps (1:5,000 - 1: 10,000) prepared by Auckland Regional Authority or Auckland Regional Council between 1979 and 2010. On farm-scale soil maps prepared for Auckland Council since 2011, the four sub-classes are now replaced by twenty specific limitations. NZLRI unit numbers and their attached general descriptions are replaced by farm-specific tables.

Landform	NZLRI	Farm	Main limitation	Sustainable uses
Flat terraces	2s4,2s2	1c	c = absent or negligible (other than climate)	vegetables, grain and fodder crops, tree and vine crops
Undulating terraces	2e4,2e2	2c	t = slight risk of topsoil loss if cultivated	vegetables, grain and fodder crops, tree and vine crops
Rolling terraces	3e5,3e2c	3c+t	t = moderate risk of topsoil loss if cultivated	rotational grain and fodder crops, tree and vine crops
Strongly rolling dissected terraces	4e5, -	4c+t	t = severe risk of topsoil loss if cultivated	rotational grain and fodder crops, tree and vine crops
Seasonally wet hollows	3w4b,4w4c	3w	w = imperfectly draining	occasional grain and fodder crops, improved pasture

Sourced from: Harmsworth, G.R. 1996, Land use capability classification of the Northland region, Publication 9, Landcare Research; Anonymous 1979, NZLRI Waikato region land use capability extended legend, Water and Soil Division, MWD; Jessen, M.R. 1984, Additions to NZLRI Waikato Region land use capability extended legend, Water and Soil Division, MWD; Hicks, D. and Vujcich, V. 2017, Farm-scale land use capability classification for Auckland. Auckland Council Technical Report TR2017/016.

10 Past and present land uses

A growing proportion of Karaka soil is in continuous cultivation for vegetable crops, principally onions and potatoes. Since about 2000 Pukekohe growers have started leasing paddocks from livestock farmers towards Glenbrook, Kingseat and Karaka, as an alternative to buying or leasing higher-priced land on Patumahoe or Pukekohe soils. Chinese immigrant market gardeners located themselves on Mangere and Weymouth soils in the 1920s-1940s. Some properties here are still cropped by their descendants, but most were taken over by urban uses 1960s onwards.

A few pip-fruit and citrus orchards were established on Karaka and related soils during early settlement, but large-scale fruit production never developed except between Henderson and Kumeu, where Otao loam occurs as a mosaic with other soils favoured by fruit-growers. In this district Dalmatian immigrants focussed on pockets of Otao loam, when buying land for small market gardens and vineyards. Since the 1970s sub-tropical fruit orchards such as kiwifruit, persimmon and feijoa have been planted on Karaka and Otao soils. They are not numerous though have persisted, so appear commercially viable.

Grain cropping was undertaken on Karaka soil during early settlement 1850s-1870s but was quickly supplanted either by pasture rotated with fodder crops or by permanent pasture once dairy farming became economic. By the 1890s this became the main use, persisting to the present. The number of dairy farms has dropped in recent decades; not because livestock grazing is uneconomic, but because of demand for lifestyle block subdivisions within commuting distance of Auckland. Such subdivision has been a common fate of farms when elderly owners retire. The lifestyle blocks are either lightly grazed by drystock or planted with hobby orchards and similar.

Woodlots and tree plantations are not a feature of the landscape on Karaka or related soils, because much better returns can be obtained from vegetable growing, orcharding, or dairying.

Historically just a small patch of Karaka soil was under urban uses within Papakura borough. The situation changed as Papakura expanded 1950s onwards, and as new suburbs sprang up on former farmland from Mangere through Papatoetoe and Otara towards East Tamaki. Urban expansion onto Karaka and related soils has intensified since 2000, with new subdivisions at Flat Bush, Karaka and Drury; also towards Hobsonville and Albany.

Sourced from:
Hunt, D. (1959), Market Gardening in Metropolitan Auckland, New Zealand Geographer 15: 130-155.

Shing, P.M. (1977), Locational and structural changes of market gardening in Pukekohe-Bombay-Patumahoe Unpublished MA thesis, University of Auckland.
Hicks, D. (2006), A review of scientific information relating to the sustainability of current land use practices on cultivated land in the Franklin district of Auckland. Technical Publication 2006/319, Auckland Regional Council.

10.1 Typical vegetable, crop, and pasture and tree plantation yields

Vegetable	**Yield**	**Units**
Onion	Up to 55	t/ha
Potatoe	Up to 50	t/ha
Cabbage	Up to 30	t/ha
Lettuce	Up to 55	t/ha

Source: grower advice cited in Molloy, L. 1988, Soils in the New Zealand Landscape, N.Z. Society of Soil Science.

Crop	**Yield**	**Units**
Maze	Up to 25	t dm/ha/yr
Oats	7.4	t dm/ha/yr
Sorghum	3.0	t dm/ha/yr
Phacelia	3.3	t dm/ha/yr
Forage brassica	3.6	t/ha

Source: Williams, P.H. et al 1999, Year two results from the cover crop and nitrate leaching experiments in the Franklin Sustainability Project, Cropinfo Report 564, Crop and Food Research

Pasture	**Yield**	**Units**
Improved pasture (dairy)	13.7	t dm/ha/yr
Improved pasture (drystock)	12.9	t dm/ha/yr
Semi-improved pasture	10.9	t dm/ha/yr
Un-improved pasture	6.5	t dm/ha/yr

Source: MAF and Dexcel trials cited in Lincoln Farm Technical Manual 2008; various papers in NZ Journal of Agricultural Research

11 Information about soil management

Karaka and related soils are versatile i.e. can sustain many uses including intensive food production. Key management issues that may arise are:

- adequate fertilisation to replace crop uptake,
- minimising groundwater contamination by fertiliser (principally nitrogen) or pesticide residue,
- dairy effluent disposal on land,
- maintaining the soils' excellent structure for cultivation,
- coping with topsoil movement downslope and into drains.

So how these soils are managed, impacts on quality of Auckland region's environment as well as on farm production. The soils have somewhat different management needs to soil on thick old airfall ash beds. The difference is that they are shallow, underlain one to two metres down by clayey estuary or stream sediment which causes imperfect drainage through the subsoil above. Tips for managing soil structure and nutrients, for controlling erosion, and for applying irrigation water or effluent, are contained in:

- *Dissected terraces with waterlaid volcanic soil Soil Information Sheet 5, Auckland Council*
- *Code of practice for nutrient management* *Fertiliser Association* *http://www.fertiliser.org.nz/site/code_of_practice/default.aspx*
- *Erosion and sediment control guidelines for vegetable production* *Horticulture NZ* *http://www.hortnz.co.nz/assets/Uploads/Auckland-Waikato-ES-Control-Guidelines-1-1.pdf*
- *Streamside planting guide* *Auckland Council*
- *Riparian zone management: strategy guideline and planting guide TP148, Auckland Regional Council*
- *A guide to managing farm dairy effluent (Auckland)* *Dairy NZ* *http://www.dairynz.co.nz/media/880785/auckland_guide_to_managing_farm_dairy_effluent.pdf*

There has been considerable investigation of current and alternative land use practices on Karaka and related soils. Findings are summarised in:

- *A review of scientific information relating to the sustainability of current land use practices on cultivated land in the Franklin district of Auckland Technical Report TP319, Auckland Regional Council*

Find out more: phone 09 301 0101, email
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aucklandcouncil.govt.nz and knowledgeauckland.org.nz

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