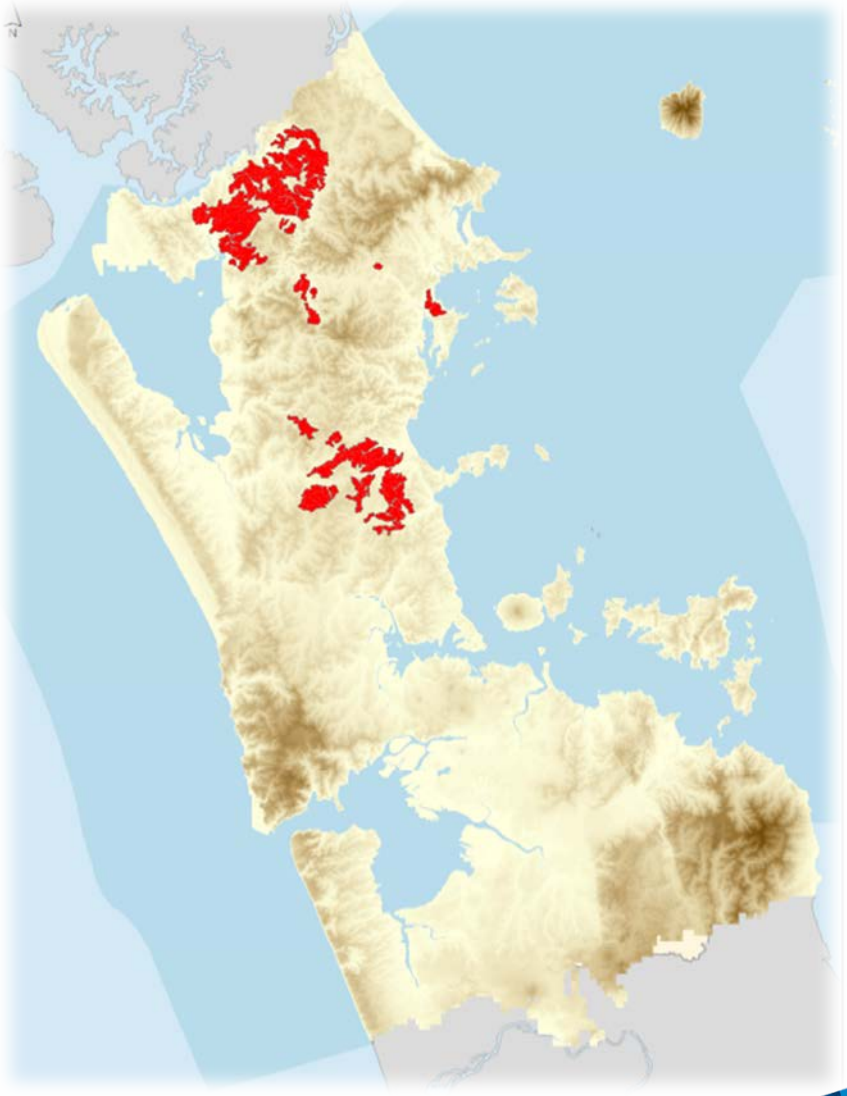
Soil Information Inventory:

Aponga and related soils

October 2018 Soil Information Inventory 1



RIMU Research and Evaluation Unit

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Soil Information Inventory 1:

Aponga and related soils

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Auckland Council
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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be understood or used without referring to background information which is dispersed across old maps, publications, or unpublished reports.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

Aponga and related soils weathered from mudstone are depicted on the DSIR's published soil maps of North Auckland (1:100,000) as two series i.e. soils with distinct profiles and parent materials:

AP, APH	Aponga clay
OA, OAH	Okaka clay or silty clay

Labels appear singly, or in combination e.g. AP + OA, APH + OAH. OA + YK (Waikare silt loam or silty clay) is another common combination on map polygons; and rarely AP + YK.

Similar soils do not appear on DSIR's maps of South Auckland, where mudstone parent material is absent.

Sourced from:

Soil maps of Maungaturoto-Kaipara area; Mangawhai-Warkworth area; Helensville-Waitakere area; Whangaparaoa-Auckland area NZ Soil Bureau maps 189, 190, 220, 221.

3 Online maps

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

AP, APH Whangaripo family, sibling 10a, Kaiapo family, sibling 9a, Puketitoi family, sibling 3a

OA, OAH Whangaripo family, sibling 14b

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.

4 Farm-scale maps

When investigated in the field by local soil mappers, any published map polygon labelled as AP etc. contains several soil types i.e. series divided according to texture or other profile characteristics. On farm-scale soil maps (1:5,000-1:10,000) the main ones are:

Ap	Aponga clay loam
Apc	Aponga clay
Oa	Okaka silty clay loam
Oac	Okaka silty clay

Waikare soils are associated with Okaka and Aponga soils almost everywhere on farms, regardless of whether the DSIR map labels indicate their presence. On farm maps they are differentiated where-ever scale permits, and labelled as:

Yk	Waikare clay loam or clay
Ykc	Waikare silty clay loam (colluvial variant)

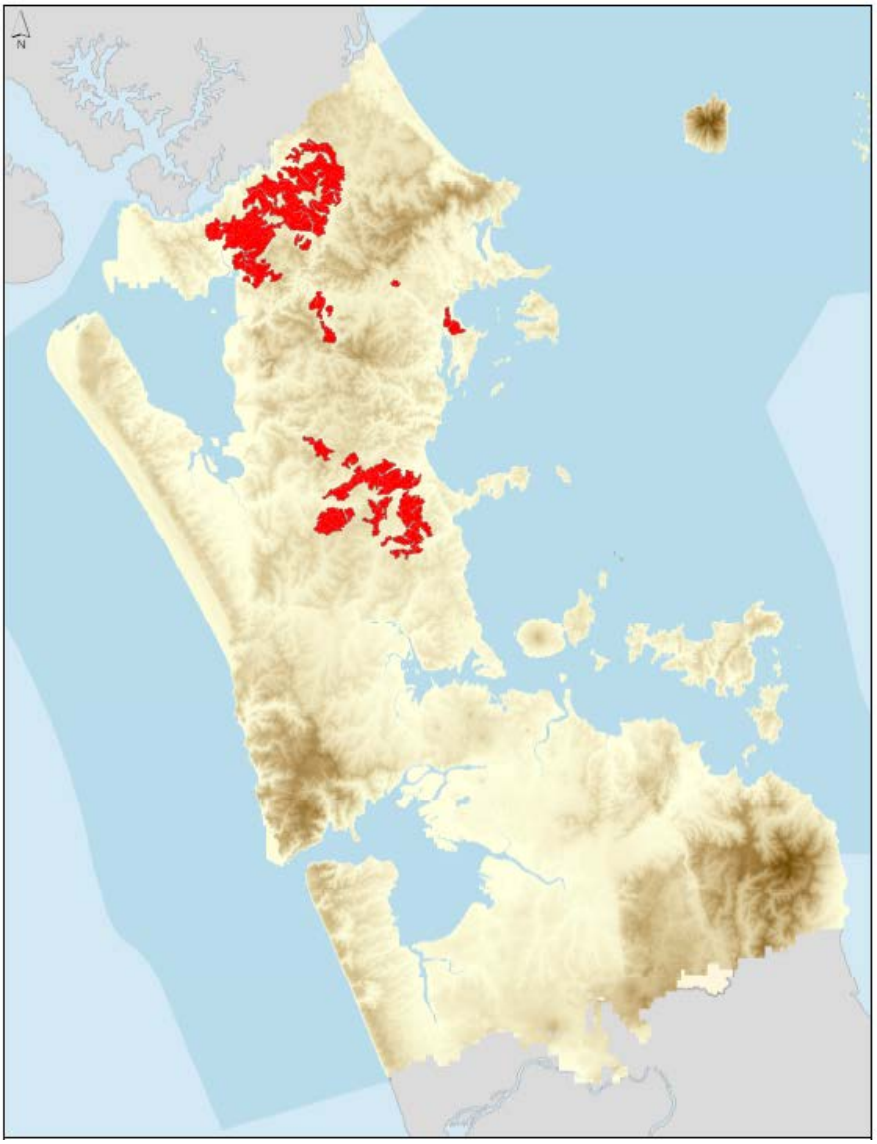
The two are so different from Aponga or Okaka, that they are described in a separate soil information inventory.

Local series names have been retained on Auckland Council's farm-scale maps for continuity with published nomenclature.

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

Widespread from Dairy Flat through Waitoki to Wainui; as pockets from Warkworth to Kaipara Flats; extensively from north side of the Hoteo River mouth to the Auckland region's boundary at Te Hana.



Location of Aponga and related soils

Aponga and related soils are mapped on 16,800 hectares (3% of Auckland region's area). About 12,000 hectares (71% of the area mapped) are in agricultural use, as drystock or dairy pasture (estimated from overlay of Agribase 2010 on Fundamental Soils Layer). *http://intermaps.arc.govt/AucklandCouncilViewer*

5.1 On what landform

Rolling downland formed from siliceous or calcareous mudstone, interspersed with bands of sandstone or limestone. The rocks are marine sediments deposited from end of the Cretaceous period (70 million years ago) through early epochs of the Tertiary period (up till 25 million years ago). These geological formations comprise the Northland Allochthon, emplaced over younger siltstone, sandstone or volcanic rocks of the Waitemata Group by sea floor landslides during the Miocene epoch (between 25 and 8 million years ago). They alternate from intact blocks rafted in the landslides, through rock with shattered but visible bedding, to crushed rock without visible structure. The allochthon has been eroded away from high ground, where resistant Waitemata Group rocks outcrop, but survives as a mantle over low-lying parts of North Auckland's landscape.

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.

Aponga clay loam on crushed mudstone footslopes (old slump terrain, now stable) in foreground. Okaka silty clay loam on bedded mudstone upper slopes (with re-grassed slip scars) in distance. *Photo: D Hicks*

5.2 How they differ from other soils

Aponga and related soils weathered from mudstone have a mixture of silt and clay in their topsoil, making it difficult to cultivate when wet (or dry). Their clay-rich subsoil resembles Whangaripo and related soils, but has poorer structure and lower permeability, so root penetration by fruit trees or vines is limited. The same properties render them equally good soils for pasture growth; though can constrain grazing when the soils turn wet in winter and spring. Unlike the associated Waikare series, Aponga and Okaka soils have not yet developed an eluvial horizon in lower topsoil, or a perched-gley horizon in upper subsoil.

Sourced from: Wilson, A.D. and Cox, J.E., Soils of Rodney County, Unpublished report, Soil Bureau DSIR

6 Classifications

NZ genetic (NZG): Northern yellow-brown earth

NZ soil (NZSC): Typic yellow ultic or mottled yellow ultic

http://soils.landcareresearch.co.nz/contents/SoilNames_NZSoilClassification_SoilOrders.aspx

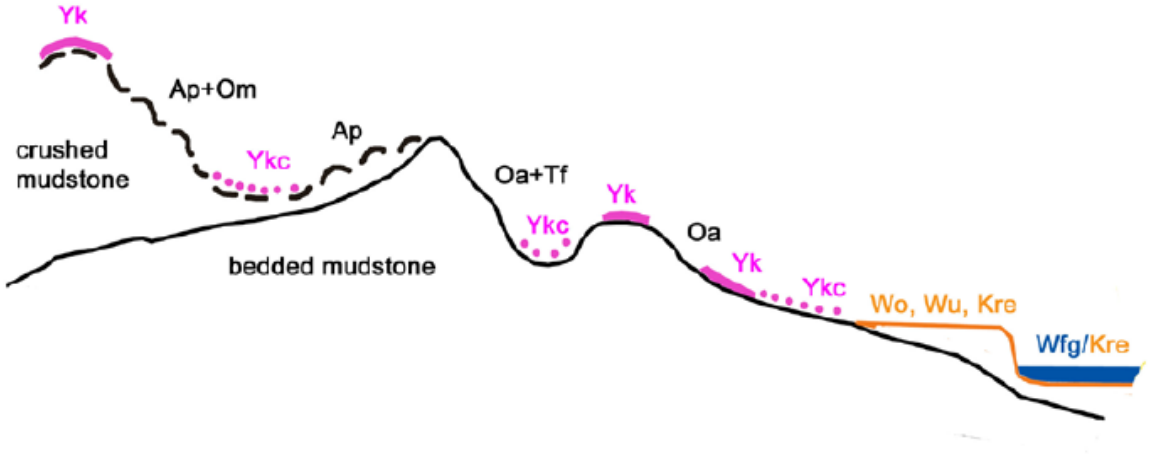
Soil taxonomy (USDA): Typic or aquic hapludult

http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051544.pdf

World soils (FAO): Nitisol or cambisol *http://www.fao.org/3/a-i3794e.pdf*

DSIR replaced the New Zealand genetic classification dating from 1930s with the New Zealand soil classification in the 1990s. DSIR's soil scientists considered Soil Taxonomy did not work well in New Zealand, nor did World Soils. Soil Taxonomy and World Soils remain internationally accepted classifications.

Cross section showing Aponga and related soils' positions in landscape



On bedded mudstone:
Oa Okaka silty clay loam or clay
Tf Te Tio stony clay loam

On crushed mudstone:
Ap Aponga clay loam or clay
Om Omu clay

On clay weathered from mudstone:
Yk Waikare clay loam or clay
Ykc Waikare silty clay loam (colluvial variant)

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

7 Soil profile descriptions

Aponga clay loam *Photo: D Hicks*

DSIR's soil mappers described Aponga clay as formed from "deeply weathered cretaceous (*calcareous)* mudstone and some siliceous mudstone" with "partial slumping resulting in rumpled hummocky or stepped surface and intermittent seepage areas". Its type profile is:
Aponga clay = Aponga clay loam

Horizon	Depth (cm)	Description
Ap	0-9	Greyish brown (10YR 5/2) clay; firm when moist and friable when dry; medium, fine and very fine polyhedral structure; diffuse boundary.
Bw(f)	9-23	Light brownish grey (10YR 6/2) clay; faint yellow mottles; firm when moist and friable when dry; fine and very fine polyhedral structure, breaks (crumbles) readily when disturbed; sharp irregular boundary.
B(g)	23-38	Light yellowish brown (10YR 6/3-6/4) clay, distinct light grey (10YR 7/1), strong brown (7.5YR 5/8) and reddish yellow (7.5YR 7/6) mottling; firm (when moist) but friable (when dry), easy to dig; medium, fine and very fine polyhedral structure, breaks down readily when disturbed; few particles of parent material; diffuse boundary.
Bg	38-66	Light grey (5Y 7/2) clay with prominent reddish yellow (5YR 6/8) speckles; firm (when moist) but friable (when dry), easy to dig; fine and very fine polyhedral structure; more particles of parent material; diffuse boundary.
Cg	on	White (5Y 8/2) clay; prominent red-yellow speckles; firm (when moist); fine and very fine polyhedral structure; contains some black manganese flecks; many particles of strongly weathered parent material.

DSIR's type profile description states that this is the modal (most common) profile; and that that two others are found "within this soil type". The second is named as Okaka silty clay (see below) on smooth crests; the third (un-named) as "gleyed wet seepage areas" on lower slopes.

A local soil mapper (DLH) considers the type profile is a reasonably good description of Aponga soil, except that on most DSIR map polygons labelled AP, topsoil texture is better described as clay loam, and subsoil structure is massive when moist, blocky or prismatic when dry. C horizon clay is weathered from shattered to crushed rock, either siliceous or calcareous mudstone. "Manganese" flecks may be ferrous (unhydrated) oxide. Rumpled hummocky or stepped relief is old slump terrain, now inactive and smoothed by cultivation; wet seepage areas are now usually drained.

Okaka silty clay loam *Photo: D Hicks*

DSIR's soil mappers described Okaka silty clay or clay as formed from "deeply weathered siliceous and non-siliceous mudstones, cretaceous" (*calcareous*)". Its type profile is:

Okaka silty clay or clay = Okaka silty clay loam

Horizon	Depth (cm)	Description
Ap	0-8	Dark grey (10YR 4/1) silty clay; firm (when moist but friable when dry); massive structure ... developing medium and fine polyhedral structure (on pressure); distinct boundary.
Bt(f)	8-23	Very pale brown (10YR 7/3) clay, abundant faint and distinct mottles of yellowish brown (10YR 6/4) to brownish yellow (10YR 6/6); prominent old root channels filled by dark grey clay; very firm when moist but friable when dry; medium and coarse polyhedral structure, almost massive in place, upper part is prismatic; dark grey clay coatings on faces of the prisms and aggregates; diffuse boundary.
B(f)	23-51	Very pale brown (10YR 8/3) clay with abundant faint mottling of very pale brown (10YR 7/4), yellowish brown (10YR 6/4-6/6), light grey (10YR 7/1), also some yellow-red iron flecks along root channels; firm when moist but friable when dry; medium and coarse polyhedral structure, aggregates fall apart when disturbed; lower part prismatic; diffuse boundary.
Cg	on	White (5Y 8/2), pale yellow (5Y 8/3), and light grey (5Y 7/1) clay, prominent reddish yellow (7.5YR 7/6-7/8) iron flecks; firm when moist but friable when dry.

DSIR's type profile description comments that this is the modal (most common) profile; also, that two others are found "of this type, in this area". It describes the second as "light yellow-brown, also strongly mottled ... prismatic structure not so well developed" but does not name it. The third is named as "Waikare clays ... on some of the easier rolling slopes ... mapped Okaka-Waikare OA-YK".

A local soil mapper (DLH) considers the type profile a poor description. Within most polygons labelled Okaka on the DSIR's maps, topsoil texture is clay loam and the A/B horizon (mixing layer) is not mottled; structure of both layers is better described as crumbly when moist and polyhedral when dry. Subsoil mottles are often absent, typically faint, occasionally distinct; subsoil structure is massive when moist and nutty when dry, rarely prismatic. C horizon is silty clay weathered from intact to shattered rock (either siliceous or calcareous mudstone); it contains numerous rock fragments with visible bedding. Surface relief is usually rounded and smooth i.e. undisturbed by slumps or earthflows, though under-runners and shallow open gullies may be present.

Published map polygons labelled AP + YK or OA + YK frequently contain patches of leached soil with poor structure, identified by the DSIR's mappers as Waikare silt loam or silty clay. Refer to the relevant soil information inventory (Waikare and related soils) for photographs and profile descriptions.

The polygons also contain narrow bands of soil with sandier texture and better structure, which DSIR's mappers identified but did not label. These bands resemble Waiotira and Riponui soils which are mapped on extensive tracts of allochthonous sandstone in Northland. On DSIR's maps of Auckland, the soils appear just at one location, the Okahukura Peninsula; on Auckland Council's farm-scale maps they are occasionally recorded elsewhere. For photographs and profile descriptions, refer to the Soil Information Inventory for Waiotira and related soils (yet to be prepared).

Adapted from Sutherland C.F., Cox, J.E., various dates. Type profile descriptions for North Auckland Soil Survey, Unpublished documents, DSIR Soil Bureau

8 Properties of typical profile

Properties of typical profiles are best indicated by analysis results for the type profiles i.e. sites where Aponga and Okaka soils were defined and described. Data for any other site will vary somewhat, particularly where different types within the series are found. Properties of the related Waiotira and Riponui soils may differ considerably.

8.1 Chemical

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

No chemical analysis for either soil appears in the online version of National Soil Database (NSD). The following analyses appear in Soil Bureau Bulletin 5 (General Survey of the Soils of North Island).

Aponga clay loam

Property	Topsoil	Subsoil	Units
Acidity	5.1	5.2	pH
Total carbon	6.4	-	%
Total nitrogen	0.22	-	%
Available phosphorus	0.008	0.005	%
P retention	-	-	%
Available sulphur	-	-	%
Cation exchange capacity	19.8	14.9	me %
Base saturation	39	16	%
Calcium	5.3	1.6	me %
Magnesium	2.7	1.0	me %
Potassium	-	-	me %
Sodium	-	-	me %

Sourced from laboratory analysis SB1434, DSIR Soil Bureau

Okaka clay loam

Property	Topsoil	Subsoil	Units
Acidity	4.8	4.7	pH
Total carbon	4.1	-	%
Total nitrogen	0.17	-	%
Available phosphorus	0.004	0.004	%
P retention	-	-	%
Available sulphur	-	-	%
Cation exchange capacity	20.1	26.5	me %
Base saturation	20	13	%
Calcium	2.0	1.4	me %
Magnesium	2.1	1.4	me %
Potassium	-	-	me %
Sodium	-	-	*me %*

Sourced from laboratory analysis SB3261, DSIR Soil Bureau

8.2 Physical

No physical analysis for either soil appears in the online version of NSD. The following estimates are sourced from Fundamental Soils Layer (FSL) and the relevant S-map factsheet. *http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nj/home/?cid=nrcs141p2_018993*

Aponga clay loam

Property	Topsoil	Subsoil	Units
Stones	0-14	-	%
Sand	2-4	2-4	%
Silt	58-60	38-56	%
Clay	36-40	40-60	%
Dry bulk density	1.08	1.26	g/cm³
Total porosity	-	-	%
Macroporosity	0-7.4	-	%

Sourced from FSL table and S-map factsheet, Landcare Research

Okaka clay loam

Property	Topsoil	Subsoil	Units
Stones	0-4	-	%
Sand	2-5	2-5	%
Silt	33-55	33-45	%
Clay	40-65	50-65	%
Dry bulk density	1.08	1.26	g/cm³
Total porosity	-	-	%
Macroporosity	5-14.9	-	%

Sourced from FSL table and S-map factsheet, Landcare Research

8.3 Irrigation and drainage

No soil moisture analysis for either soil appears in the online version of NSD. The following estimates are sourced from FSL and the relevant S-map factsheet.

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

Aponga clay loam

Property	Topsoil	Subsoil	Units
Field capacity	-	-	% w/w
Wilting point	-	-	% w/w
Plant-available water	-	-	% v/v
Plant-available water	61	49	mm
Depth to slowly permeable layer	-	0.45-0.89	m
Perm. at slowly permeable layer	-	<4	mm/hr

Sourced from FSL table and S-map factsheet, Landcare Research

Okaka clay loam

Property	Topsoil	Subsoil	Units
Field capacity	40	42	% w/w
Wilting point	25	28	% w/w
Plant-available water	-	-	% v/v
Plant-available water	43	40	mm
Depth to slowly permeable layer	-	0.6-1.19	m
Perm. at slowly permeable layer	-	<4	mm/hr

Sourced from FSL table 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 many Auckland 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 10-year intervals to detect any trends.

Little horticulture or cropping is practiced on Aponga and related soils, so soil quality has been sampled just under bush and pasture, the most widespread land uses. Consideration needs to be given to sampling under scrub and tree plantations, in a future year.

Land use		**Natural cover**		**Pasture**		**Forest**	
Type		**Bush**	**Scrub**	**Drystock**	**Dairy**	**Mature**	**Logged**
Sample number		**98-17**		**98/18**	**98/17**		
Acidity	pH	5.6	-	5.6	6.0	-	-
Total carbon	%	10.9	-	10.6	8.7	-	-
Total nitrogen	%	0.6	-	0.9	0.6	-	-
Available nitrogen	µg/ cm³	139	-	217	171	-	-
Available phosphorus	µg/ cm³	4	-	7	14	-	-
Cation exchange capacity	cmol/cm³	46.0	-	35.4	40.7	-	-
Base saturation	%	59	-	57	70	-	-
Calcium	cmol/ cm³	18.6	-	4.0	3.2	-	-
Magnesium	cmol/ cm³	7.0	-	4.0	3.2	-	-
Potassium	cmol/ cm³	0.9	-	0.4	0.3	-	-
Sodium	cmol/ cm³	0.6	-	0.2	0.2	-	-
Bulk density	t/ m³	0.83	-	0.62	0.84	-	-
Particle density	t/ m³	2.40	-	2.25	2.37	-	-
Aggregate stability	mm mwd	2.55	-	2.48	2.68	-	-
Total porosity	%	65	-	73	65	-	-
Macroporosity	%	56	-	67	52	-	-
Total available water	%	17	-	31	21	-	-
Readily available water	%	6	-	8	7	-	-

Sourced from 500 Soils Project, Landcare Research Reports to Auckland Council

500 Soils Project, Soil Quality of Dairy Sites in the Auckland Region in 2009, Soil Quality of Drystock Sites in the Auckland Region in 2010

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 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
Colluvial footslopes	-	3e	Moderate sheetwash risk if cropped	Rotational fodder crops, improved pasture
Regolithic footslopes	4e6, 4e8	4t	Severe sheetwash risk if cropped	Occasional fodder crops, improved pasture
Spurs and ridges	-	5s	Slope or irregular shape	Improved pasture
Moderate slopes, stable	5e7, 5e12	5g, 5g+u	Slight gully slip or earthflow risk	Improved pasture, woodlots

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

Settlers attempted grain cropping on Aponga and Okaka soils when first clearing scrub or bush from their land 1850s-1860s, but quickly discovered that these heavy clay soils had poor structure and variable yield. Associated bands of Waiotira and Riponui soil had better structure for cultivation but were narrow and irregular within fields. Farmers persisted with forage crops, albeit infrequently in course of pasture renewal. Forage strike and yield on these soils is best described as patchy.

Another attempt at intensive use – pip fruit orchards in the 1890s-1910s around Port Albert – did not spread, because fruit trees did not root well in seasonally wet subsoil. Advent of fireblight about 1910 was also a factor in orchards' decline.

Aponga and Okaka soils proved more suited to dairying, where contour permitted on the mudstone downlands. Here farmers could grow pasture and produce milk just as well as from lighter clay soils on adjacent sandstone country. Pugged by grazing in winter and spring, the heavy clay soils stayed moist longer into summer, though remained susceptible to late summer to early autumn drought. Dairying is still the most widespread use.

Drystock breeding and fattening always has been and remains the second-largest use by area. In recent decades sheep numbers have dropped. Many drystock farms are now solely beef cattle; very few are solely sheep. Where lifestyle subdivision occurs (notably in vicinity of Wellsford) the easy-contour downland tends to remain in pasture grazed by drystock.

There are no extensive commercial tree plantations on Aponga or Okaka soils within the regional boundary, though small farm woodlots are common. They have often been established for soil conservation as much as timber production, on pockets of unstable mudstone where pasture has been disrupted by gullies and slips, or by secondary earthflows and gullies in slump debris.

No extensive tracts of uncleared bush remain, nor are there many intact bush patches within the farms. However, a feature of the landscape is scattered remnant bush trees within grazed paddocks, particularly kahikatea groves on wet footslopes. Scrub patches reverted quickly on unstable land after initial bush clearance, becoming widespread by the 1910s-1940s. They almost entirely disappeared due to woodlot conversion 1950s onwards.

Apart from inside the Wellsford town boundary, there is almost no urban development on Aponga or Okaka soils. This is just as well, because their smectite clay content – with associated shrinking and swelling around foundations, pipes and cables – is worse than on the Whangaripo and Warkworth soils that are so problematical for builders within

Auckland's metropolitan limit (see Soil Information Inventory for Whangaripo and related soils).

Sourced from Anonymous, 1962, Albertland: the first hundred years, Albertland and District Museum

10.1 Typical crop, pasture and timber yields

Crop	Yield	Units
Maize	?	t/ha
Forage turnips	?	t/ha
Forage brassica	?	t/ha

Source: contract growers

Pasture	Yield	Units
Improved pasture (dairy)	12.9	t dm/ha/yr
Improved pasture (drystock)	10.9	t dm/ha/yr
Semi-improved pasture	8.5	t dm/ha/yr
Un-improved pasture	6.2	t dm/ha/yr

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

Timber	Yield	Units
Radiata pine (clearwood regime)	?	m^3/ha
Radiata pine (unpruned pulpwood)	?	m^3/ha
Macrocarpa cypress (woodlot)	?	m^3/ha
Eucalypt (woodlot)	?	m^3/ha
Acacia (woodlot)	?	m^3/ha

Source: FRI trials cited by SCION; various papers in NZ Journal of Forestry or NZ Farm Forestry

11 Information about soil management

Aponga and Okaka soils are not versatile - they do not sustain vegetable, fruit or grain crops on a commercial scale – though they support productive dairy and drystock farms.

Key issues that may arise when managing these soils under pasture are:

- Adequate fertilizer to replace grass uptake.
- Maintaining good structure for pasture growth.
- Disposing dairy effluent onto land safely.
- Developing and keeping deep topsoil (originally shallow under scrub or bush).
- Controlling any gullies and slips or earthflows in old slump debris.

Aponga and Okaka soils have similar management needs to other ultic (clay) soils that have weathered from more stable marine sedimentary rocks. One difference is a greater need for soil conservation planting on the Aponga soils because they are susceptible to gullies and earthflows, and on the Okaka soils which also have some susceptibility to gullies and slips. Tips for managing soil structure and nutrients, for controlling erosion, and for applying irrigation water or effluent, are contained in:

- *Light clay soils* *Soil Information Sheet 11, Auckland Council*

- *Heavy clay soils* *Soil Information Sheet 12, Auckland Council*

- *Code of practice for nutrient management* *Fertiliser Association*
  http://www.fertiliser.org.nz/site/code_of_practice/default.aspx

- *Control of soil erosion in farmland* *Technical Paper 95/4, MAF Policy*
  http://maxa.maf.govt.nz/mafnet/rural-nz/sustainable-resource-use/land-management/soil-erosion.htm

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

- *Poplars* *Soil Conservation Leaflet, Auckland Regional Council*

- *Willows* *Soil Conservation Leaflet, Auckland Regional Council*

- *Streamside planting guide* *Auckland Council*

- *Native forest restoration guide* *Auckland Council*

Find out more: phone 09 301 0101, email rimu@aucklandcouncil.govt.nz or visit aucklandcouncil.govt.nz **and knowledgeauckland.org.nz**

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