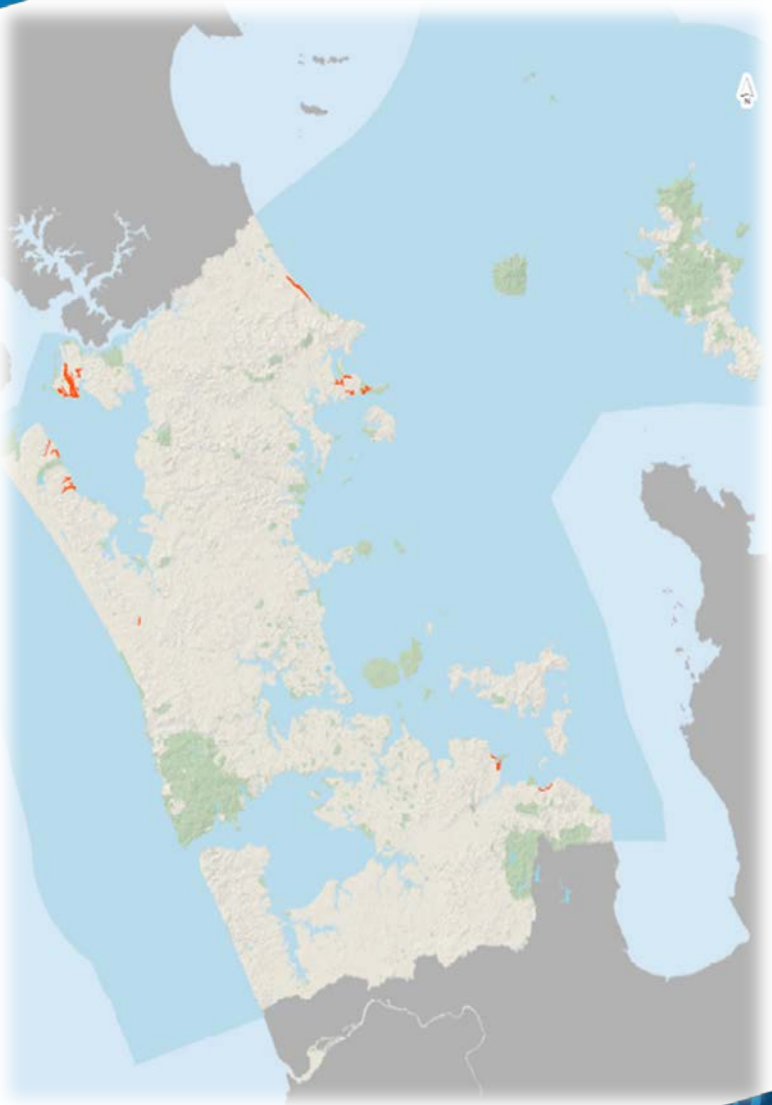
# Soil Information Inventory:
## Parore and related soils

October 2018 Soil Information Inventory 15



RIMU Research and Evaluation Unit

Auckland Council
Te Kaunihera o Tāmaki Makaurau

# Soil Information Inventory 15:

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be understood or used without referring to background information which is dispersed across old maps, publications, or unpublished reports.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

DSIR's published soil maps of North Auckland (1:100,000) depict alluvial sand soils as four series i.e. soils with distinct profiles and parent materials. They are labelled as:

| | |
|---|---|
| TZ, TZy | Tawharanui sand and peaty sand |
| PZ | Parore sand and peaty sand |
| MD | Marsden sand and peaty sandy loam |
| OT | One Tree Point peaty sand |

Three related series, more common in Northland, do not appear on North Auckland maps but are locally present on sand country:

| | |
|---|---|
| YUa, YUay | Waipu sand and peaty sand |
| KK | Kaikino sand |
| OH | Ohia sand |

Just one alluvial sand soil appears on DSIR's oldest maps of South Auckland (1:253,840):

| | |
|---|---|
| 109b | One Tree Point peaty sand |

Others are not separated on these maps, nor on a map of intermediate age covering part of Franklin district (1: 63,360). A more recent map of Manukau city (1:20,000) assigns alphanumeric labels to mapping units which contain eight spatially associated soil types, four of them alluvial sands:

| | |
|---|---|
| AAB2 | Marsden sand with un-named sand |
| AAB4 | Un-named loam over un-named sand |
| AB3 | Red Hill sandy loam with Marsden sand |
| AB4 | Whananaki sand with un-named loam |
| AB5 | Parore sand |

*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*
*Soil map of the North Island, sheets 2 and 3 (Auckland and Waikato);*
*NZ Soil Bureau maps 11/2, 11/3*
*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:

| | |
|---|---|
| TZ | No family name or sibling number assigned |
| TZy | No family name or sibling number assigned |
| YUa | No family name or sibling number assigned |
| YUay | No family name or sibling number assigned |
| PZ | No family name or sibling number assigned |
| MD | No family name or sibling number assigned |
| OT | No family name or sibling number assigned |
| KK | No family name or sibling number assigned |
| OH | No family name or sibling number assigned |
| 109b | No family name or sibling number assigned |
| AAB2 | Glen family, sibling 2, Mury family, sibling 1 |
| AAB4 | Hastings family, sibling 7 |
| AB3 | Kopu family, sibling 4, Wiku family, sibling 19 |
| AB4 | Tidl family, sibling 2, Himatangi family, sibling 1, Matapiro family, sibling 2 |
| AB5 | Fitz family, sibling 1 |

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

North of Auckland, any published map polygon labelled Parore (PZ), Marsden (MD), or One Tree Point (OT) generally turns out to be that series when investigated in the field by local mappers, though distinct types are differentiated at farm scale. These correspond with three situations:

- Parts of the polygon mantled by a veneer of stream alluvium (not necessarily sandy) or,
- Parts where the peat fraction of topsoil has oxidised after drainage, leaving a sandy residue or,
- Parts where sandy or peaty sand topsoil is shallow over older buried sand soil (usually a podsol).

On farm-scale soil maps (1:5,000 - 1: 10,000) the types are labelled as:

| | |
|---|---|
| Tz, Tzy | Tawharanui sand or peaty sand |
| Pzy | Parore peaty sand |
| Pz | Parore sand |
| Wf’ or Wfi’ or Wfm’/Pz | Whakapara sandy, silty or clay loam (shallow) over Parore sand |
| Oty | One Tree Point peaty sand |
| Ot | One Tree Point sand |
| Kk | Kaikino sand |
| Kk’/Tk | Kaikino sand (shallow) over Te Kopuru sandy loam (buried) |

Marsden and Ohia sands have not yet been mapped at farm scale. In the event they are, a local mapper (DLH) recommends:

| | |
|---|---|
| Mdy | Marsden (Parore) peaty sand |
| Md | Marsden (Parore) sand |
| Oh | Ohia sand |
| Oh’/Tk | Ohia sand (shallow) over Te Kopuru sandy loam (buried) |

South of Auckland, similar soils are found within published map polygons on sand country (labelled 24a, 24d, 80 or 86), when field investigations are undertaken by local mappers. Because no series names are defined for such soils in the South Auckland maps or bulletins, where differentiated at farm scale they are labelled the same as North Auckland series/types, as follows:

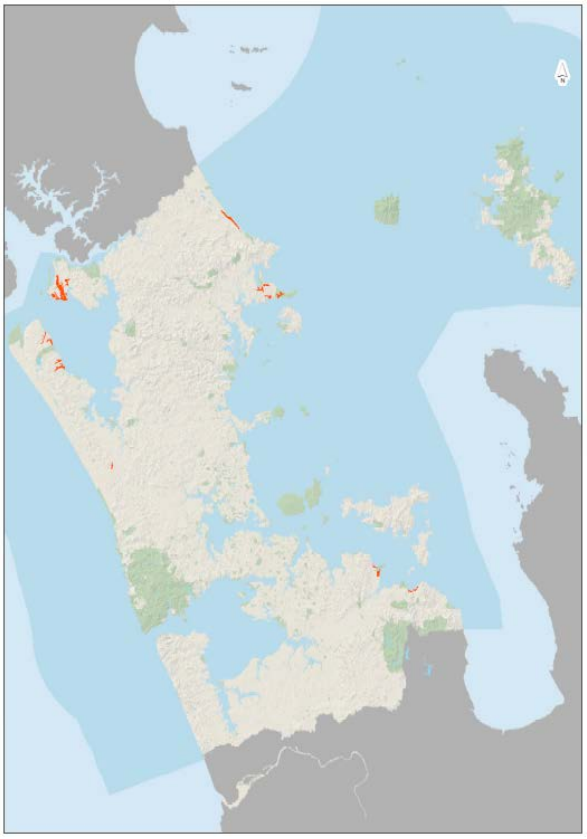
| | |
|---|---|
| Pzy | Parore peaty sand |
| Pz | Parore sand |

| | |
|---|---|
| Kk | Kaikino sand |
| Kk'/Hr | Kaikino sand (shallow) over Horea sandy clay loam (buried) |

*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

In sand country on the Okahukura, South Kaipara and Awhitu peninsulas, either as broad swathes or narrow strips in low-lying positions close to streams or tidal creeks. On the east coast of Auckland, landward of coastal foredunes behind surf beaches, also along the shores of estuaries. As small patches in similar situations on the larger Gulf islands (Great Barrier and Waiheke).



**Location of Parore and related soils**

Parore and related soils are mapped on 1,500 hectares (less than 1% of Auckland region). About 1,000 hectares (66% of the area mapped) are in agricultural use (estimated from overlay of Agribase 2010 on Fundamental Soils Layer (FSL). A larger area of Parore and related soil is present on the South Kaipara and Awhitu peninsulas, but does not appear in FSL.
*http://intermaps.arc.govt/AucklandCouncilViewer/*

**Parore and related soils are on the sand flat (foreground) between old vegetated dune ridges (left and middle distance)** *Photo: D. Hicks*

## 5.1 On what landform

Tawharanui, Marsden and Parore soils occur on broad sand flats where water table emerges at the surface between dune ridges, or as narrow floodways adjacent to streams and drains through old dissected sand country. The parent material is raw or recent sandy alluvium, derived from and deposited on top of, either estuarine alluvium within the Tauranga Group, or dunesands of young to intermediate age within the Karioitahi Group i.e. less than 5,000 years old (Pinaki dunefield) or 80,000-10,000 years old (Houhora-Red Hill dunefield).

One Tree Point, Kaikino and Ohia soils occur on elevated, dissected terraces above present-day position of the water table/streams. The parent material is old sandy alluvium, derived from and deposited on top of, old estuarine alluvium or dunesands within the Karioitahi Group i.e. more than 130,000 years old (Tangitiki-Te Kopuru dunefield). These soils typically occur as strips along dissected terraces, or as peripheral rings around peat swamps and dune lakes. What all four series have in common is that they are waterlaid sand, on top of buried soils which formed on older windblown sand:

- Tawharanui/Marsden on top of Pinaki
- Parore on top of Houhora or Red Hill
- One Tree Point on top of Tangitiki, Horea or Te Kopuru
- Kaikino/Ohia on top of Tangitiki, Horea or Te Kopuru

*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*

*Hicks, D.L., 1977, Pp 48 -52 in Soil Groups of New Zealand Part 1: Yellow-Brown Sands, New Zealand Society of Soil Science*

## 5.2 How they differ from other soils

The young soils (Tawharanui, Marsden, Parore) have deep sandy subsoil over estuarine alluvium or compact weathered sand (buried intermediate-age sand soil), usually two metres or more down though shallower towards the edge of dune flats. Drains can be easily dug, and once dug there is good downward flow of soil water through the first one to two metres of profile. For this reason, the soils may dry out excessively after drainage.

The old soils (One Tree Point, Kaikino, Ohia) have shallow sandy upper subsoil, over cemented hardpan (buried old sand soil) less than one metre down. It impedes downward drainage of soil water, so the soils drain laterally through a perched water table. In natural conditions they can turn dry in summer, but water table always rises to the surface for several months in winter. Development depends on artificial drains excavated into the hardpan, creating fall towards outlets that pierce it.

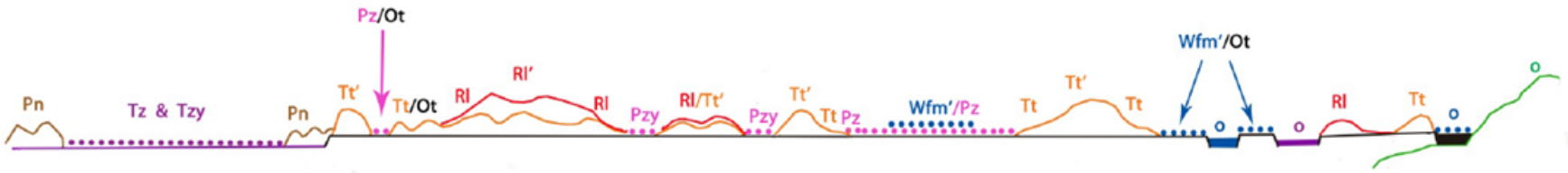
*Sourced from:*
*Cox, J.E. 1977 Northland Peninsula, Pp 18-47 in Soil Groups of New Zealand Part 1: Yellow Brown Sands, New Zealand Society of Soil Science*
*Wilson, A.D. and Mc Donald, W. 1984, Soils of Northland: Pinaki and Ruakaka suite, District Office Report KK4, Soil Bureau DSIR*

# 6 Classifications

| | |
|---|---|
| *NZ genetic (NZG):* | *Organic, yellow-brown sand, or podzol* |
| *NZ soil (NZSC):* | *Mesic humic organic, typic sandy recent, groundwater pan podsol* http://soils.landcareresearch.co.nz/contents/SoilNames_NZSoilClassification_SoilOrders.aspx |
| *Soil Taxonomy (USDA):* | *Humic psammaquept or typic haplaquod* http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051544.pdf |
| *World Soils (FAO):* | *Arenic gleysol or groundwater podsol* 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 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.

## Cross section showing Parore and related soils' position in the landscape




**On young dune ridges & flats:**

| | |
|---|---|
| Pn,Wd | Pinaki or Whananaki sand |
| Tz, Md | Tawharanui or Marsden sand |
| Tzy, Mdy | Tawharanui or Marsden peaty sand |

**On old dune ridges & flats:**

| | |
|---|---|
| Rl', Ho' | Red Hill or Houhora sandy loam |
| Rl, Ho | Red Hill or Houhorasandy loam (colluvial) |
| Pzy,Ohy | Parore or Ohia peaty sand |
| Pz,Oh | Parore or Ohia sand |
| Wfm'/Pz | Whakapara clay loam (shallow) over Parore sand |

**On weathered dune ridges & flats**

| | |
|---|---|
| Tt,'Tk' | Tangitiki or Te Kopuru sandy loam |
| Tt, Tk | Tangitiki or Te Kopuru sandy loam (colluvial) |
| Oty,Kky | One Tree Point or Kaikino peaty sand |
| Ot,Kk | One Tree Point or Kaikino sand |
| Wfm'/Ot | Whakapara clay loam (shallow) over One Tree Point peaty sand |

**On estuary and stream floodways or terraces, or clay slopes weathered from rock:**

| | |
|---|---|
| o, o, o, o | Other soils |

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

# 7 Soil profile descriptions


**Tawharanui sand** *Photo: D. HIcks*

There is no type profile for Tawharanui sand or peaty sand; neither amongst the DSIR's unpublished descriptions, nor in Soil Bureau Bulletin 5, nor in Soil Groups of New Zealand. Provisional profile descriptions are:

*Tawharanui sand*

| Horizon | Depth (cm) | Description |
|---|---|---|
| A | 0-30 | Dark grey (10Y/R 4/1) sandy loam; earthy structure and friable consistence when moist but loose and single grained when dry; diffuse boundary. |
| C(f) | 30-50+ | Light brownish grey (10YR 6/2) coarse sand; brown rust coloured mottles; compact in place, loose in the hand. |


**Tawharanui peaty sand** *Photo: D. Hicks*

*Tawharanui peaty sand*

| Horizon | Depth (cm) | Description |
|---|---|---|
| Oh | 0-10cm | Very dark grey (10YR 3/1) peaty loam; subrounded polyhedral structure and friable consistence when wet but subangular polyhedral and firm when dry; sharp boundary. |
| Cu | 10-30cm | Brown (10YR 5/3) peat-stained sand; compact in place, loose in the hand; diffuse boundary. |
| C(f) | 30-50+cm | Yellowish grey (10YR 6/2) coarse sand with brown mottles; compact in place, loose in the hand. |


**Parore peaty sand** *Photo: D. Hicks*

DSIR's unpublished profile descriptions do not contain a type profile for Parore peaty sand or sand. A local soil mapper (DLH) has prepared provisional profile descriptions.

*Parore peaty sand*

| Horizon | Depth (cm) | Description |
|---|---|---|
| Oh | 0-10cm | Very dark grey 10YR 3/1) peaty sand; earthy structure; friable consistence when moist, very friable and weak if it dries out; sharp boundary. |
| Crg1 | 10-30cm | Dark brown sand (10YR 3/3) (organic staining); firm, friable consistence, usually moist; diffuse boundary. |
| Crg2 | 30-150cm | Light brown grey (10YR 6/2) sand; loose becoming compact with depth; friable consistence, always moist, sharp boundary. |
| 2Crg | over | Very pale brown (10YR 7/3) silty or clayey sand, or cemented sand pan. |


**Parore sand** *Photo: D. Hicks*

Once drained, peat in the topsoil gradually oxidises. The profile changes to:

*Parore sand*

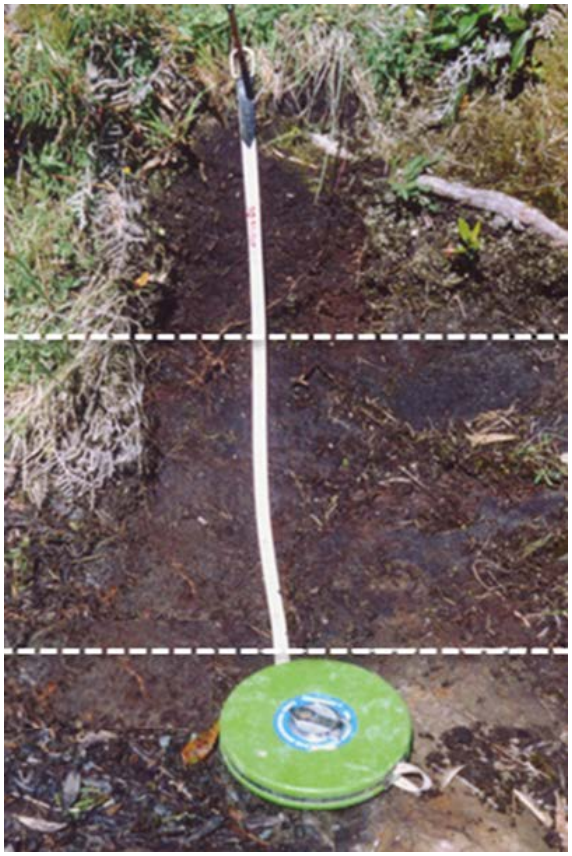
| Horizon | Depth (cm) | Description |
|---|---|---|
| Ap | 0 - 30 | Dark grey (10YR 4/1) sandy loam; loose, friable consistence when moist, very friable and weak when dry, sharp boundary. |
| Cr | 30-150cm | Light brownish grey (10YR 6/2) sand, loose structure becoming compact with depth, friable consistence, always moist, sharp boundary. |
| 2Crg | over | Very pale brown (10YR 7/3) silty or clayey sand, or cemented sand pan. |


**Marsden sand** *Photo: D. Hicks*

DSIR's unpublished type profiles do not include Marsden sand (on siliceous parent material behind east coast beaches). Soil Bureau Bulletin 5 (General Survey of the Soils of North Island) contains the following brief description:

| Horizon | Depth (cm) | Description |
|---|---|---|
| A | 0-13 | Dull brown sand. |
| C | on | Loose brown sand. |

The brown colour is organic staining (parent material is pale grey to white silica sand). Bulletin 5 also describes Marsden peaty sandy loam, as black peaty sandy loam, three feet-plus deep. A local soil mapper (DLH) comments that the peaty phase appears on wet flats, grading to the sandy phase where low foredune ridges protrude.




**One Tree Point peaty sand *Photo: D. Hicks***

DSIR's type profile for One Tree Point peaty sand is succinct, giving few details about the hardpan:

*One Tree Point peaty sand and sand*

| Horizon | Depth (cm) | Description |
|---|---|---|
| Oh1 | 0-19 | Black (10YR 2/1) peaty fine sand and fine sandy loam; very friable, earthy to a very weakly developed extremely fine subangular polyhedral structure, (structure improving in development under older pastures); many glistening silica sands; common grass roots. |
| Oh2 | 19-46 | Very dark brown (10YR 2/2) peaty fine sand; loose; single grain structure; many glistening sands; few fine grass roots; fragments of kauri gum throughout profile. |
| Bfm | on | Very dusky red (2.5YR 2/2); coarse sand; strongly indurated iron and humus sandstone pan; surface of pan uneven, many slight depressions; Grass roots form a thin mat on the surface of the pan, but do not appear to enter the pan;15 cm of water resting on the pan after recent heavy rain. |

Depth of the pan from the surface is 45 to 60 cm. The thickness of the pan is 90 to 120 cm or more. Another type profile, prepared for a loamy sand variant, contains a better description of the hardpan:

| Horizon | Depth (cm) | Description |
|---|---|---|
| A | 0-8 | Black (10YR 2/1) to dark reddish brown (5YR 3/2) slightly peaty loamy sand; friable; weakly developed fine and very fine nutty structure; few very fine pores; few clean quartz grains and fragments of kauri gum; abundant roots; indistinct wavy boundary. |
| Oh1 | 8-18 | Very dark grey peaty sand; friable; single grain to massive; contains abundant scrub roots and fragments of kauri gum; indistinct boundary. |
| Oh2 | 18-28 | Very dark grey to dark grey (10YR 3/1-4/1) peaty sand; friable; massive single grained; contains abundant white silica sand grains; also, numerous scrub roots; distinct wavy boundary. |
| B | 28-31 | Black (5YR 2/1) slightly peaty sand; friable; moderately developed extremely fine subrounded polyhedral structure; few fine pieces of dark reddish brown cemented sand; many roots forming a mat with the underlying horizon; sharp wavy boundary. |
| Bfm1 | 31-40 | Reddish black (10R 2/1) sand; hard and brittle; very high packing and massive with few fissures in which are red fine root pores in massive sandstone; sharp wavy boundary along which water seeps into pit. |
| Bfm2 | 40-59 | Dusky red (2.5YR 3/2) grading to reddish brown and strong brown massive sandstone; high packing and brittle; very thin black (5YR 2/1) indurated pans occur at the upper surface and at intervals through this horizon; organic matrix is vitreous and waxy; few fine roots; indistinct irregular boundary. |
| Cq | on | Pale brown (10YR 6/3) massive brittle sandstone with extensive dark brown and brown stains; no roots. |

A local mapper (DLH) who is also familiar with the One Tree Point soils in Northland, comments that the loamy sand variant is found where swamps were partly drained and repeatedly burned by gum-diggers.

*Sourced from:*
*Sutherland C.F., Cox, J.E., various dates, Type profile descriptions for North Auckland Soil Survey, Unpublished documents, Soil Bureau, DSIR*
*Gibbs, H. (ed), 1954, General Survey of Soils of North Island, Soil Bureau Bulletin 5, DSIR*

# 8 Properties of typical profile

Properties of typical profiles are best indicated by analysis results for the type profiles i.e. sites where Parore and related series were defined and described. Data for other sites will vary somewhat, particularly where different types within each series are found.

## 8.1 Chemical

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

No chemical analyses appear in the online version of National Soils Database (NSD). The following data (for Marsden and One Tree Point soils only) are sourced from Soil Bureau Bulletin 5.

*Marsden sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Acidity | 6.0 | - | pH |
| Total carbon | 2.0 | - | % |
| Total nitrogen | 0.12 | - | % |
| Available phosphorus | 0.005 | - | mg % |
| P retention | - | - | % |
| Available sulphur | - | - | % |
| Cation exchange capacity | 6.1 | - | me % |
| Base saturation | 38 | - | % |
| Calcium | 1.3 | - | me % |
| Magnesium | 0.8 | - | me % |
| Potassium | - | - | me % |
| Sodium | - | - | me % |

*Sourced from laboratory analysis SB01511, DSIR Soil Bureau*

*One Tree Point peaty sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Acidity | 5.8 | 5.7 | pH |
| Total carbon | 14.1 | - | % |
| Total nitrogen | 0.67 | - | % |
| Available phosphorus | 0.012 | 0.013 | mg % |
| P retention | - | - | % |
| Available sulphur | - | - | % |
| Cation exchange capacity | 40.9 | 32.8 | me % |

| | | | |
|---|---|---|---|
| Base saturation | 16 | 4 | % |
| Calcium | 4.8 | 0.4 | me % |
| Magnesium | 2.4 | 0.6 | me % |
| Potassium | - | - | me % |
| Sodium | - | - | me % |

*Sourced from laboratory analysis SB02581, DSIR Soil Bureau*

## 8.2 Physical

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

No physical analyses appear in the online version of NSD. The following data are sourced from old Soil Bureau laboratory records, plus some estimates from the Fundamental Soils Layer (FSL).

*Parore peaty sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Stones | 0-4 | | % |
| Sand | | | % |
| Silt | | | % |
| Clay | | | % |
| Dry bulk density | | | g/cm³ |
| Total porosity | | | % |
| Macroporosity | 5.0-7.4 | | % |

*Sourced from FSL table, Landcare Research*

*Marsden sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Stones | 0-4 | - | % |
| Sand | 98 | 99 | % |
| Silt | 1 | <1 | % |
| Clay | 1 | <1 | % |
| Dry bulk density | | | g/cm³ |
| Total porosity | | | % |
| Macroporosity | 5.0-9.9 | - | % |

*Sourced from laboratory analysis SB07277, DSIR Soil Bureau and FSL table, Landcare Research*

*One Tree Point peaty sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Stones | 0-4 | | % |
| Sand | 84-85 | 80-96 | % |
| Silt | 13-14 | 3-14 | % |
| Clay | 2-2 | 1-6 | % |
| Dry bulk density | | | g/cm³ |
| Total porosity | | | % |
| Macroporosity | 5.0-7.4 | - | % |

*Sourced from laboratory analysis SB09541, DSIR Soil Bureau and FSL table, Landcare Research*

## 8.3 Irrigation and drainage

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

No soil moisture analysis appears in the online version of NSD. The following estimates are sourced from FSL, plus data cited by Wilson and McDonald 1987:

*Parore peaty sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Field capacity | | | % w/w |
| Wilting point | | | % w/w |
| Plant-available water | | | % w/w |
| Plant-available water | 50-74 | >200 | mm |
| Depth to slowly permeable layer | - | 0.45-1.19 | m |
| Perm. at slowly permeable layer | - | <4 | mm/hr |

*Sourced from FSL table, Landcare Research*

*Marsden sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Field capacity | | | % w/w |
| Wilting point | | | % w/w |
| Plant-available water | | | % w/w |
| Plant-available water | 25-99 | 40-60 | mm |
| Depth to slowly permeable layer | | 1.20-1.49 | m |
| Perm. at slowly permeable layer | | <4 | mm/hr |

*Sourced from FSL table, Landcare Research*

*One Tree Point peaty sand*

| Property | Topsoil | Subsoil | Units |
|---|---|---|---|
| Field capacity | | | % w/w |
| Wilting point | | | % w/w |
| Plant-available water | | | % w/w |
| Plant-available water | 50-74 | 110-150 | mm |
| Depth to slowly permeable layer | | 0-0.89 | m |
| Perm. at slowly permeable layer | | <4 | mm/hr |

*Sourced from FSL table, 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 ten-year intervals to detect any trends. None were located on Parore, Marsden or One Tree Point soils during the initial 1995-2000 sampling round. Soil quality data are now available for Tawharanui sand soils sampled during the second round in 2014.

*Sourced from Sparling, G. et al, various dates, 500 Soils Project, Landcare Research Reports to Auckland Council*

# 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 |
|---|---|---|---|---|
| Free-draining sand flat | -,2w2 | 2o+e | Structural deterioration if peaty sand oxidises; water table in subsoil after heavy rain | Regular cropping; intensive dairy or drystock grazing |
| Imperfectly draining sand flat | 3w4,- | 3o+e | Structural deterioration if peaty sand oxidises; fluctuating water table in subsoil | Rotational cropping; intensive dairy or drystock grazing |
| Seasonally wet sand | 4w3,4w2b | 4o+e | Structural deterioration if peaty sand grazed when wet; perched water table above subsoil pan | Occasional fodder cropping; intensive dairy or drystock grazing in summer-autumn |
| Semi-drained swamp | 5w3,5w2 | 5o | Water table frequently at surface, winter-spring | Summer-autumn grazing; wetland retirement as sediment traps and nutrient filters |
| Seasonal swamp | 6w3,6w2 | 6o | Water table at surface through winter-spring | Emergency grazing in summer droughts; ecological restoration as wetlands |
| Permanent swamp | 7w2,7w2 | 7o | Water table at surface year-round | Conservation as wetlands |

*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

Parore and related soils were cultivated by early Maori. The peaty sands, well-structured but swampy, were favoured sites for taro gardens. In places where the soils were drained, kumara may have been grown on loamy sands (where the peat fraction has oxidised). These have good consistence and structure for cultivation. Flax would also have been harvested in quantity from natural stands in swamps.

From early European settlement 1800s up till 1930s, the swamps were harvested for flax and dug over for kauri gum. They were amongst the last soils to be developed for farming 1940s onwards; the more extensive areas as Lands and Survey development blocks which were subdivided into small dairy farms notably at Tapora. Elsewhere existing dairy farms on higher free-draining sand soils gradually expanded their grazeable area by draining swampy flats between existing paddocks. Dairy farming is now the main land use on these soils, though beef cattle breeding/fattening farms are interspersed.

Contract growing of fodder maize is widespread, as is growing for feed on-farm. Maize is grown for two or three years, then rotated with pasture, or sown as a single crop in course of pasture renewal. Other grain or fodder crops are uncommon, which is surprising because once drained, the soils have good structure for cultivation.

Fruit-bearing trees can grow on Parore and related soils once drained, but commercial orchards have not established yet. Low soil moisture available to plant roots in summer-autumn may be a constraint. Timber trees grow sizeable in farm shelter belts and woodlots, though shallow-rooted trees are prone to topple in westerly gales that sweep across the flats.

*Sourced from: Hicks, D.L, Campbell, D.J, and Atkinson, I.A, 2001, Options for management of the Kaimaumau wetland. Publication 155, Science Series, Department of Conservation and D. Hicks personal observations.*

## 10.1 Typical vegetable, crop, and pasture yields

| Vegetable | Yield | Units |
|---|---|---|
| Potato | ? | t/ha |
| Kumara | ? | t/ha |

*Source: Ruawai growers*

| Crop | Yield | Units |
|---|---|---|
| Maize | Up to 25 | t/ha |
| Forage brassica | Up to 8 | t/ha |
| Forage turnips | ? | t/ha |

*Source: grower advice*

| Pasture | Yield | Units |
|---|---|---|
| Improved pasture (dairy) | 13.9 | t dm/ha/yr |
| Improved pasture (drystock) | 11.8 | t dm/ha/yr |
| Semi-improved pasture | 9.4 | t dm/ha/yr |
| Un-improved pasture | 5.9 | 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

The alluvial or estuarine origin of Parore and related soils, combined with peaty sand texture, gives their topsoil and subsoil as good characteristics as the best soils on stream floodplains (which have textures and structures suited to cultivation). So, landowners regard them as good soils for pasture and cropping. Their light texture makes them somewhat droughty soils for pasture growth in summer and autumn, though ensures they are good for winter-spring grazing where well drained.

Management issues that may arise are:

- Adequate fertilizer to replace grass uptake
- Maintaining drains while avoiding excessive drainage
- Avoiding peat oxidation
- Maintaining crop and grass growth through dry summers
- Avoiding depletion of ground cover in dry summers
- Regrassing if sand is shifted around by floods
- Scheduling irrigation/effluent spraying to minimise nutrient loss towards, and faecal contamination of, drains

Given their low-lying position in the landscape and extensive drain networks, how Parore and related soils are managed impacts on water quality of estuaries as well as on farm production. Tips for drainage, maintaining plant cover, also for controlling sediment, nutrient and faecal matter losses, are contained in:

- *Low flats with peat soil* — *Soil Information Sheet 1, Auckland Council*
- *Young sand soils* — *Soil Information Sheet 7, Auckland Council*
- *Code of Practice for Nutrient Management* — *Fertiliser Association* *(Code of Practice for Nutrient Management)*
- *Riparian zone management: strategy guideline and planting guide TP148, Auckland Regional Council*
- *Streamside planting guide* — *Auckland Council*
- *Drainage construction and maintenance:* — *TP10, 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*
- *Poplars* — *Soil Conservation Leaflet, Auckland Regional Council*
- *Willows* — *Soil Conservation Leaflet, Auckland Regional Council*
- *Pasture management on sand country* — *Information leaflet, Awhitu Landcare Group*

**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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