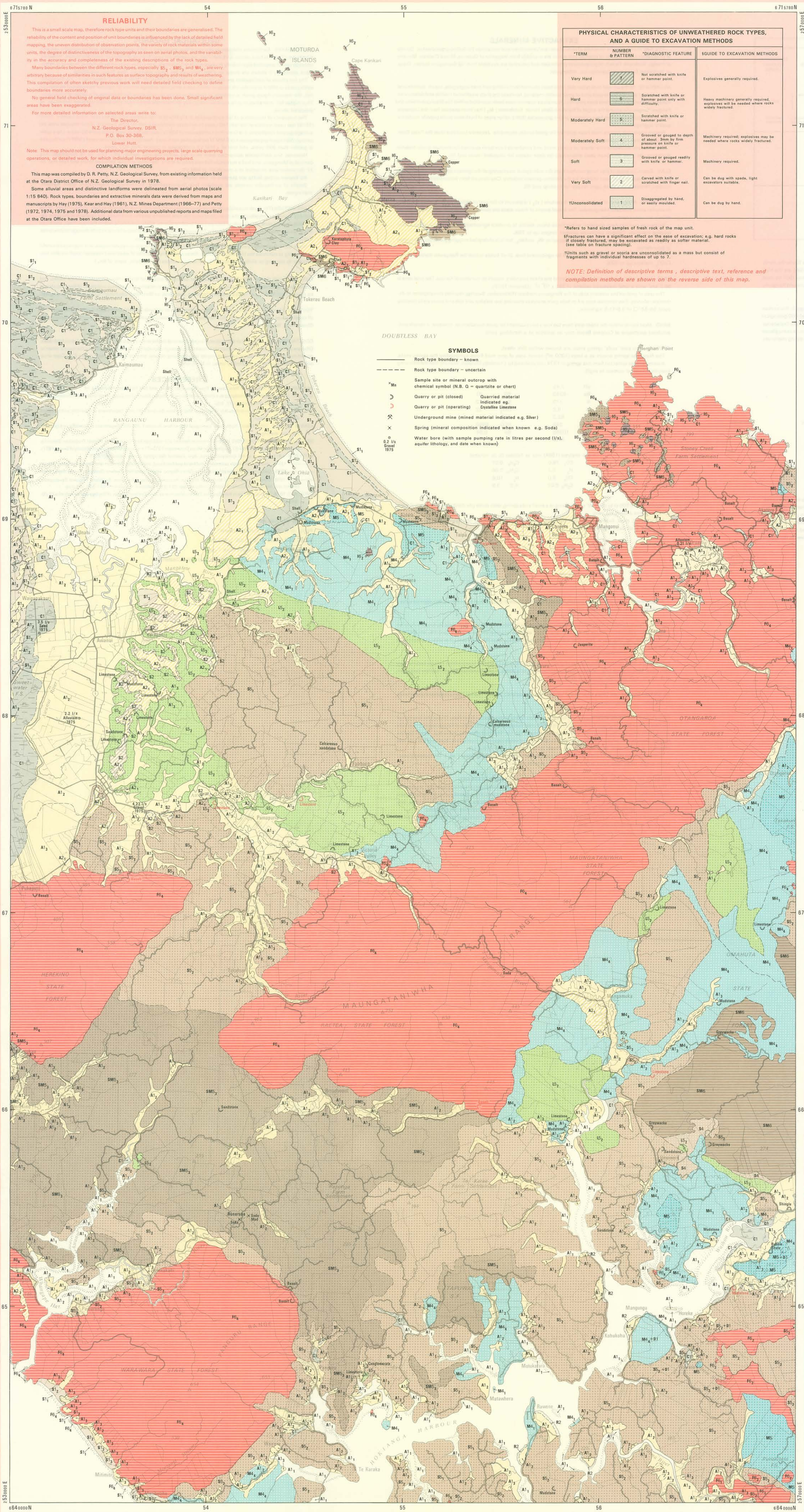


# KAITAIA-RAWENE



**RELIABILITY**

This is a small scale map, therefore rock type units and their boundaries are generalised. The reliability of the content and position of unit boundaries is influenced by the lack of detailed field mapping, the uneven distribution of observation points, the variety of rock materials within some units, the degree of distinctiveness of the topography as seen on aerial photos, and the variability in the accuracy and completeness of the existing descriptions of the rock types.

Many boundaries between the different rock types, especially  $S_2$ ,  $SM_2$  and  $M_4$ , are very arbitrary because of similarities in such features as surface topography and relative abundance.

This compilation of other sketchy previous work will need detailed field checking to define boundaries more accurately.

No general field checking of original data or boundaries has been done. Small significant areas have been exaggerated.

For more detailed information on selected areas write to:  
The Director,  
N.Z. Geological Survey, DSIR,  
P.O. Box 30-388,  
Lower Hutt.

Note: This map should not be used for planning major engineering projects, large scale quarrying operations, or detailed work, for which individual investigations are required.

**COMPILED METHODS**

This map was compiled by D. R. Petty, N.Z. Geological Survey, from existing information held at the Otago District Office of N.Z. Geological Survey in 1978.

Some alluvial areas and distinctive landforms were delineated from aerial photos (scale 1:15 040). Rock types, boundaries and extractive minerals data were derived from maps and manuscripts by Hay (1975), Kear and Hay (1961), N.Z. Mines Department (1966-77) and Petty (1972, 1974, 1975 and 1978). Additional data from various unpublished reports and maps at the Otago District Office have been included.

**PHYSICAL CHARACTERISTICS OF UNWEATHERED ROCK TYPES, AND A GUIDE TO EXCAVATION METHODS**

TERM	NUMBER & PATTERN	DIAGNOSTIC FEATURE	GUIDE TO EXCAVATION METHODS
Very Hard	6	Not scratched with knife or hammer point.	Explosives generally required.
Hard	5	Scratched with knife or hammer point and with difficulty.	Heavy machinery generally required, explosives will be needed where rocks widely fractured.
Moderately Hard	4	Scratched with knife or hammer point.	Machinery required, explosives may be needed where rocks widely fractured.
Moderately Soft	3	Grooved or gouged to depth of about 3mm by firm pressure on knife or hammer point.	Machinery required.
Soft	2	Grooved or gouged readily with knife or hammer.	Can be dug with spade, light excavators suitable.
Very Soft	1	Disaggregated by hand, or easily moulded.	Can be dug by hand.

\*Refers to hand sized samples of fresh rock of the map unit.

Fractures can have a significant effect on the ease of excavation; e.g. hard rocks if closely fractured, may be excavated as readily as softer material.

Units such as gravel or scoria are unconsolidated as a mass but consist of fragments with individual hardnesses of up to 7.

**NOTE: Definition of descriptive terms, descriptive text, reference and compilation methods are shown on the reverse side of this map.**

- SYMBOLS**
- Rock type boundary - known
  - Rock type boundary - uncertain
  - Sample site or mineral outcrop with chemical symbol (N.R. Q = quartzite or chert)
  - Quarry or pit (closed)
  - Quarry or pit (operating)
  - Quarried material indicated as Cystalline Limestones
  - Underground mine (mined material indicated e.g. Silver)
  - Spring (mineral composition indicated when known e.g. Soda)
  - Water bore with sample pumping rate in litres per second (l/s), aquifer lithology, and date when known

**INTRODUCTION**

Rock types maps are intended to help planners and land users to:

- identify the characteristics of near surface rock types;
- recognise areas of existing and potential mineral resources;
- become aware of geological hazards.

**ROCK TYPE DESCRIPTIONS (LITHOLOGIES)**

The map unit symbols are listed alphabetically within the two major rock type categories — sedimentary and igneous. The first letter of each symbol indicates the major lithology, and the second letter (where present) a significant interbedded lithology. The numeral indicates the typical hardness (see Physical Characteristics table) of the unweathered rock material, and the subscript numeral indicates a variation.

The description for each map unit may include common name, distinctive landform, colour, hardness, grain size, bedding, fracturing and chemical composition. Major and minor lithologies are described and also the weathered material in terms of changes in colour, hardness and grain size. The range of depth of the weathered mantle is also given. (See Definitions of Descriptive Terms shown on the reverse side of this map.)

**SEDIMENTARY ROCK TYPES**

**ALLUVIUM**

Undifferentiated intertidal deposits: mainly mud and sand, some shell and gravel; unconsolidated.

Alluvium: mainly mud and sand, some gravel and peat, forming river bed. Flood plain and terrace deposits up to 20 m thick and up to 10 m above stream level; unconsolidated to very soft. Unweathered.

Alluvium: mainly sand and mud with some gravel, forming terrace deposits more than 10 m above stream level and as much as 30 m thick; unconsolidated to very soft. Moderately to slightly weathered to soft silt clay to depths of 2 m.

Alluvium: mud, sand and gravel, with some iron oxide pans, forming dissected terrace surfaces 30-150 m above sea level; very soft to soft. Weathered to brown very soft silt clay with some rock fragments to depths of 10 m.

Alluvium: mud, sand, gravel, lignite, carbonaceous sandstone and mudstone, rare iron oxide pans, forming dissected terrace surfaces up to 150 m above sea level; very soft to moderately soft. Weathered to multicoloured clay with some rock fragments to depths of 10 m. Surfaces are modified by erosion.

**PEAT**

Peat: dark brown, fibrous, carbonaceous swamp deposits usually less than 4 m but up to 11 m thick, some mud and sand; very soft to soft.

**DEBRIS**

Debris: scattered, loose, basaltic ( $FG_2$ ) boulders downslope of volcanic plateau areas (not mapped separately on this sheet).

**LIMESTONE**

Muddy limestone: Light blue-grey, 50-75% calcium carbonate, closely fractured, in places interbedded with minor greensand ( $S_4$ ) and mudstone ( $M_4$ ); moderately hard to hard. Weathered to yellow white and brown very soft slightly calcareous clay to depths of 2m.

**MUDSTONE**

Mudstone: black, grey, brown and green, thinly bedded and closely fractured, locally calcareous or siliceous, with minor muddy limestone ( $LS_1$ ), carbonaceous siltstone, calcareous claystone and greensand ( $S_4$ ); moderately soft to moderately hard. Weathered to soft non-calcareous whitish clay to depths of 10 m; unstable in places.

Mudstone with sandstone: blue-grey, thinly to medium bedded mudstone, thinly to thickly interbedded with fine sandstone in places; both lithologies calcareous and rarely carbonaceous in places; moderately fractured; moderately soft to moderately hard. Weathered to soft silty clay to depths of 10 m.

Siliceous mudstone: dark grey and closely fractured with a silica content of up to 80% (known locally as shale), also containing locally multi-coloured mudstones ( $M_4$ ), carbonaceous mudstone (of shale) and concentration sandstone ( $SS_1$ ); moderately hard to hard. Weathered to light grey, soft clay containing harder coes to depths of 10 m.

**SAND AND SANDSTONE**

Sand: mostly quartz and feldspar, some shell, forming intertidal and beach deposits; unconsolidated.

Sand: feldspathic with some quartz, forming moving and partially fixed dunes; unconsolidated and unweathered.

Sand: feldspathic with some quartz, minor dark minerals and clay, forming fixed dunes; unconsolidated to very soft. Unweathered or weathered to brown stained, very soft, clayey sand to depths of 5 m.

Sandstone: carbonaceous with iron sulphide and limonite, containing bands of well weathered conglomerate, lignite and some olive shale; very soft to soft. Weathered to mainly brown-stained clay with some white clay underlying the lignite seams; to depths of 10 m.

Glauconitic sandstone (greensand): quartz-feldspar sandstone containing up to 5% glauconite, in places calcareous or carbonaceous, with light blue-grey calcareous mudstone; thickly bedded and widely fractured; moderately soft to moderately hard. Weathered to soft brown, non-calcareous silty clay to depths of 10 m.

Calcareous sandstone: grey and green-grey to brown quartz-feldspar sand stone with a calcium carbonate content up to 20%, thickly bedded and moderately fractured with interbedded grey calcareous mudstone ( $M_4$ ), muddy limestone ( $LS_1$ ) and glauconitic sandstone ( $S_4$ ); moderately hard. Weathered to soft, brown, non-calcareous silty clay to depths of 10 m.

Sandstone: blue-grey quartz-feldspar sandstone, with a mica content of up to 5%, in places calcareous or carbonaceous; thinly to thickly bedded and moderately to widely fractured, with hard blue-grey siliceous claystone and mudstone ( $M_4$ ), hard conglomerate, and large calcareous concretions locally; moderately hard to hard. Weathered to soft brown silty clay to depths of 10 m.

Interbedded sandstone and mudstone: grey, quartz-feldspar sandstone and grey mudstone, commonly carbonaceous and rarely calcareous, minor conglomerate and many calcic cemented concretions, locally baked by interbedded basalt; moderately hard to hard. Weathered inland to light coloured clay to depths of 10 m.

Interbedded sandstone and mudstone (greywacke and argillite): blue-grey quartz-feldspar greywacke sandstone and argillite; blue-grey argillite mudstone; closely to widely fractured and quartz veined, locally very siliceous, with minor chert, quartzite and volcanic (spilitic) beds. All lithologies hard to very hard. Weathered to soft, brown, sandy clay with harder cores to depths of 30 m.

**IGNEOUS ROCK TYPES**

**VOLCANIC BRECCIA**

Basalt and dolerite breccia: coarse angular fragments of very fine to medium grained crystalline basalt and dolerite, in a matrix of medium grained tuff, closely to widely fractured; moderately hard to hard. Weathered to soft clay with moderately soft fragments to depths of 20 m (not mapped separately on this sheet).

**EXTRUSIVE ROCK**

Basalt with scoria: flows of very fine to medium grained crystalline basalt, dense or vesicular, moderately fractured; hard to very hard. Surfaces conspicuously rocky. Weathered to soft red brown clay to depths of 3 m.

Basalt: flows of very fine to medium grained crystalline basalt, dense and moderately fractured; hard to very hard. Surfaces form terraces and plateaus generally without rocky outcrops. Weathered to soft red brown or dark grey brown clay to depths of 20 m with many rounded core stones.

Basalt and dolerite: very fine to medium grained, crystalline basalt and dolerite with some breccia ( $BS_1$ ), with rare blocks of  $BS_2$ ,  $M_4$ , and  $LS_1$ ; closely to moderately fractured with some curved jointing; hard to very hard. Weathered to soft brown clay to depths of 30 m.

Keratophyre, spilitic and granophyre: dark grey generally fine grained but some with large crystals, moderately fractured; hard to very hard. Altered and weathered to soft brown clay to depths of 30 m.

**INTRUSIVE ROCK**

Granite and diorite: bodies of medium to coarse grained porphyritic, granite, tonalite and diorite intruding thinly bedded mudstone and sandstone, locally interbedded with keratophyre and dacite; closely to widely fractured; hard to very hard. Weathered or hydrothermally altered to soft clay to depths of 10 m.

**MAN MADE LAND**

Man made land: a variety of natural and processed materials, forming reclaimed and filled land.

**NEW ZEALAND LAND INVENTORY**

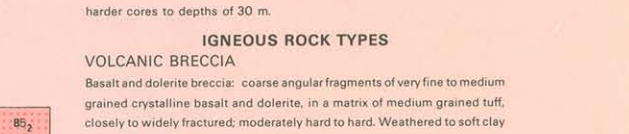
SCALE 1 : 100 000

Metres 1000 0 1 2 3 4 5 6 7 8 Kilometres

- REFERENCE**
- WHANGAREI Cities
- KAIKŌHE Towns
  - Huahua Settlements
  - State highways
  - Other roads
  - Tracks
  - Railways
  - Rivers and streams
  - Trig stations
  - Vincula (separate parcels under same ownership)
  - Land holding boundaries
  - Sand and mud
  - Wetlands
  - Rocks

**SHEET INDEX**

Compiled by D. R. Petty, New Zealand Geological Survey, Department of Scientific and Industrial Research.



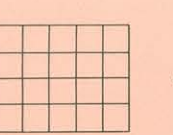
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P.D.Hasselberg, Government Printer, Wellington, New Zealand.

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This map is drawn on the New Zealand Map Grid Projection, a minimum-error conformal projection. The grid is the New Zealand Map Grid, showing coordinates in metres in terms of the Geodetic Datum 1949, based on the International (Hayford) Spheroid.

The smallest area mapped is generally not less than 10 hectares. Calculation of areas from this map should be within the limitations of scale. For example, individual areas should be rounded to the nearest 5 hectares. Accumulated areas should be rounded to the nearest 50 hectares.



**AREAL SCALE**  
500 hectares divided into units of 25 hectares

**COMPILED NOTE**—The base map is compiled from the NZMS 1 series (1:63360) dated 1971, 72, 75, 77. This map is one of a series. Themes mapped in this study are: Land Tenure and Holding, Rock Types, Soils, Existing Land Use, Wildlife, Indigenous Forest.