

Outstanding Natural Features Identifying and Mapping sites in Waitomo District

Methodology Report

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1.0 Introduction

This report outlines the way that outstanding natural features (ONFs) in Waitomo District have been identified, their geoheritage values assessed and their extent mapped. It also explains how each ONF has been categorised on the basis of its size and robustness, to assist in protecting their differing values. This report is for information purposes only and does not form part of the District Scheme.

1.1 Advice and acknowledgments

To assist the author with information on the location and values of certain sites in the District, assistance and advice was obtained from experts in their fields:

a. Dr Donald MacFarlan (New Plymouth) for Mesozoic rock and fossil sites;
and b. from an Advisory panel of speleologists and karst geomorphologists consisting of Prof Paul Williams (Auckland University), Dave Smith (DoC, Auckland), Peter Crossley (Speleologist and cave mapper, Auckland) and John Ash (Waitomo Cave Museum Society and Discovery Centre), on cave and karst sites.

This assistance is gratefully acknowledged.

2.0 Background

2.1 Resource Management Act

Protection of outstanding natural features from inappropriate subdivision, use and development is a matter of national importance according to Section 6(b) of the Resource Management Act 1991. This is reinforced in Policy 15 of the New Zealand Coastal Policy Statement, which states:

“Policy 15

Natural features and natural landscapes

To protect the natural features and natural landscapes (including seascapes) of the coastal environment from inappropriate subdivision, use, and development:

- (a) avoid adverse effects of activities on outstanding natural features and outstanding natural landscapes in the coastal environment; and
- (b) avoid significant adverse effects and avoid, remedy, or mitigate other adverse effects of activities on other natural features and natural landscapes in the coastal environment;
including by:
- (c) identifying and assessing the natural features and natural landscapes of the coastal environment of the region or district, at minimum by land typing, soil characterisation and landscape characterisation and having regard to:
 - (i) natural science factors, including geological, topographical, ecological and dynamic components;
 - (ii) the presence of water including in seas, lakes, rivers and streams;
 - (iii) legibility or expressiveness – how obviously the feature or landscape demonstrates its formative processes;
 - (iv) aesthetic values including memorability and naturalness; ...”

2.2 Other District Schemes

A number of territorial local authorities in New Zealand have now prepared a schedule of identified ONFs in their district with accompanying objectives, policies and rules as a method of implementing RMA Section 6(b). Until now the Waitomo District Plan has not identified ONFs. Neither has the Waikato Regional Policy Statement. This document builds on previous work undertaken by the author for Auckland City Council, Northland Regional Council, Whangarei and Far North District Councils to identify, assess, map and document potential ONFs for their planning schemes.

For each of these previous projects the major initial source of information on their ONFs was the Geoscience Society of New Zealand’s Geopreservation Inventory of Important Geological Sites and Landforms in New Zealand. This on-line inventory was compiled through the goodwill and combined knowledge of a large sector of the nation’s specialist geological, geomorphological, speleological and soil Outstanding Natural Features – Identifying and mapping Waitomo sites Report August 2018)

science communities. Compilation, upgrading and review of the inventory has been ongoing over the past 30 years, under the guidance of the author (Convenor). The goal of this inventory has been to identify the best and most outstanding examples of New Zealand's geological sites and landforms so that planners and others can use this information to assist in the long-term protection of the best of New Zealand's irreplaceable geoheritage.

Of particular relevance to Waitomo District was a national review of caves and karst features in New Zealand undertaken in 2009-2011 by the Geoscience Society using a Lottery Heritage grant to ensure that the best examples of these features in each region were included and mapped in the Geopreservation Inventory.

2.3 Waitomo District Scheme (2009) karst overlay

The operative Waitomo District Scheme (2009) already contains one zone that provides a level of protection for 68 identified and mapped significant karst features (Appendix 6) not including those on Conservation Land. Features were classified into categories A-E based on the perceived level of significance from A international to E local.

“Policy 11.4.2. To avoid, remedy or mitigate any adverse effects of vegetation clearance, extractive industry, earthworks, tourism developments, or other rural activities on karst and cave systems therein, with the approach dependent on the significance and sensitivity of the particular cave or karst features.”

“11.5.2 Karst Systems

11.5.2.1 For any land overlying features described in Appendix 6 (and indicated on the Planning Maps as karst overlay) all extractive industries are:

- (a) a discretionary activity for cave systems in categories C to E.
- (b) a non-complying activity for cave systems in categories A and B.

11.5.2.2 For any land overlying features described in Appendix 6 (and indicated on the Planning Maps as karst overlay) clearance of more than 0.5 of a hectare of indigenous vegetation in any one calendar year shall be a non-complying activity for cave systems in categories A, B.

11.5.2.3 For any land overlying features described in Appendix 6 (and indicated on the Planning Maps as karst overlay), any clearance of vegetation or earthworks or fill placement within 50m upslope of an entry or opening into any cave or associated karst formation is a Restricted Discretionary Activity.

11.5.2.4 For any land overlying features described in Appendix 6 (and indicated on the Planning Maps as karst overlay), establishment of structures in, artificial entrances to, or other modification that causes loss of cave features, or change to cave processes, shall be a Restricted Discretionary Activity.”

3.0 Methodology for this assessment and mapping exercise

3.1 Source of initial list of sites to be assessed for potential inclusion (Appendix 1):

An initial list of 144 potential ONFs in the Waitomo District was compiled from the following sources:

- a. All sites in the Waitomo District listed in the November 2017 version of the New Zealand Geopreservation Inventory.
- b. All sites listed, mapped and protected on the karst overlay of the operative Waitomo District Scheme and originally mapped in mid 1990s by Mr Dave Smith.
- c. Additional cave and karst sites identified by a regional karst workshop organised by Waikato Regional Council several years ago.
- d. Additional landforms identified as potential candidates by staff of the Waitomo District Council.
- e. Additional landform features identified by BWH from topographic maps or when driving the roads of the district.

All sites had to be natural landforms, exposures (natural or man-made) of natural rocks and their features, or natural physical process systems.

3.2 Assessment criteria

The following criteria were used to identify and assess potential Outstanding Natural Features (ONFs) in the Waitomo District:

- (a) the extent to which the landform, feature or geological site contributes to the understanding of the geology or evolution of the biota in the region, New Zealand or the earth;
- (b) the rarity or unusual nature of the site or feature;
- (c) the extent to which the feature is an outstanding representative example of the diversity of Waitomo District's natural landforms and geological features;
- (d) the extent to which the landform, geological feature or site is part of a recognisable group of features (e.g. caves and karst group);
- (e) the extent to which the landform or geological feature contributes to the aesthetic value or visual legibility of the wider landscape;
- (f) the extent of community association with, or public appreciation of, the values of the feature or site;
- (g) the potential value of the feature or site for public education;
- (h) the potential value of the feature or site to provide additional understanding of the geological or biotic history;
- (i) the state of preservation of the feature or site;
- (j) the extent to which a feature or site is associated with an historically important natural event, geologically related industry, or individual involved in earth science research;
- (k) the importance of the feature or site to Mana Whenua (not assessed here, as this is more appropriately undertaken by local iwi).

An excel spreadsheet has been compiled for every recommended ONF, which documents and scores it under each of these criteria.

3.3 Results of assessment

After these assessments, a total of 76 sites or features are recommended for scheduling as Outstanding Natural Features and a further 30 sites (mostly caves) are recommended to retain in the Karst Overlay with identical rules to the existing karst overlay. Sites recommended as ONF are assessed as being more significant than those in the karst overlay. Sites that were in the original WDC karst overlay and are now recommended for ONF status have been removed from the karst overlay. On the recommendation of the advisory panel of speleologists and karst geomorphologists (1.1), all former karst overlay sites in the Waitomo Valley hydrological system have been combined to create a single larger site that covers Outstanding Natural Features – Identifying and mapping Waitomo sites Report August 2018)

the entire Waitomo catchment above the Waitomo Glowworms Cave. This was argued to be required to better protect the large number of caves in this system which can be impacted by what happens in their catchment and around their entrances. The same argument was applied to the smaller cave catchment areas of the Mangaou, Mangawhitikau and Troopers Road cave systems and the Kokakoroa-Mangapohue polygonal karst area.

3.4 Mapping methodology

GIS mapping was done at a scale of 1:10000 using the same GIS aerial photography base map (2012) as the Waitomo District planning maps. The preliminary GIS maps (using Topo50 base maps) from the NZ Geopreservation Inventory were used as a starting point for sites obtained from that source. The Waitomo District Scheme karst overlay GIS map was also used as a starting point for features obtained from that source. Other features were mapped from scratch mainly in a desk-top exercise using published scientific descriptions, topographic contours and google earth satellite images.

The feature map boundaries were determined or modified using the following criteria:

- a. Where the whole or part of a recommended ONF was on public land (e.g. intertidal, esplanade reserves, road reserves, parks and reserves) the boundaries were accepted or slightly modified: to better fit the air photo base map; to align with the reserve boundary; or lie within it.
- b. Where the whole or part of a recommended ONF occurs within private land, the mapped boundaries were more carefully drawn to enclose the minimum land area for realistic protection and wherever possible to exclude areas of habitation and intense farming activities.



Marokopa Falls proposed ONF

4.0 Categories of Outstanding Natural Features

4.1 Feature categories

To assist management and decision-making, outstanding natural features have been categorised by type to provide an indication of the kind of values that make them significant and what rules may be needed to manage potential risks to these values. The categories described below are essentially the same as in the Auckland Unitary Plan and Northland Regional Policy Statement, except that the volcanoes categories have been deleted and lava caves renamed caves.

A. Large landforms (non-coastal)

Prominent landforms that are sufficiently large and robust to withstand small-scale earthworks or constructions without significant impact. The values of such features typically relate to the underlying geology which tells of the history of their formation and the resulting outstanding large-scale landforms, rather than or in addition to their visual amenity or landscape type factors. Major building construction, large scale earthworks (e.g., quarry or significant farm road cuttings) or planting and harvesting of commercial exotic forest can significantly detract from the integrity or hide these prominent landforms.

These are:

Castle Craig bluffs, Marokopa includes Ngahuinga Bluff
 Eight Mile Junction ignimbrite bluffs
 Lake Taharoa dune-dammed lakes
 Lower Mangaotaki Gorge
 Mangapohue-Hauturu Rd polygonal karst
 Mangapu Gorge and blind valley
 Mangawharawhara Stream natural bridges & tunnels, Piopio
 Mangawhitikau Gorge, Waitomo
 Tawarau caves and karst
 Ten Acre Tomo system
 Waipuna polygonal karst, Waitomo



Temperate polygonal karst, Waitomo. Photo by Paul Williams.

B. Smaller more fragile landforms

Small landforms or other features that could be damaged or destroyed by relatively small-scale earthworks or constructions. The values of these often spectacular, localised landforms relate to their visual and aesthetic appeal and/or scientific interest. Most earthworks, buildings, constructions or commercial forest plantings would adversely impact on the visual and aesthetic appeal or scientific value of these fragile features.

These are:

- Double Falls, Tawarau River,
- Hikurangi Falls, Paritikona Stream
- Lake Harihari sand-dune dammed lake
- Lake Rotokawau
- Lake Rotokotuku
- Mangaokewa Stream scalloped ignimbrite bluffs
- Mangaokewa Valley ignimbrite-capped castle hill
- Mangaotaki overhang, Piopio
- Mangapohue natural bridge
- Marokopa Falls
- Marokopa River natural tunnel
- Omaru Falls
- Puketutu ignimbrite amphitheatre and waterfall
- Ruakuri natural bridge and karst, Waitomo
- Tawarau Falls
- Totoro Gorge karst, Mokau River
- Wairere Falls
- Waitanguru Falls
- Waitoru karst lake



Mangaotaki overhang, Piopio, proposed ONF.



Mangaokewa Valley ignimbrite-capped castle hill proposed ONF

C. Dynamic landforms and features in the coastal zone

Landforms or features that rely on the continuation of natural physical processes in and beyond the feature for their continued existence. Because of this, these dynamic landforms or features are not only susceptible to direct damage, but to more distant actions that may impact the continuation of the natural processes (e.g. sand supply; dune stabilisation; soil erosion in catchments). Permanent earthworks, building construction, commercial exotic forest plantings, or other actions could adversely affect the functioning and appearance of these features. The NZ Coastal Policy states that adverse effects on these features must be avoided.

These are:

- Awakino River mouth barrier
- Mangaorongo Gorge /Natural Bridges.
- Marokopa River mouth sandspit and dune field
- Mokau River estuary
- South Awakino Bluffs and waterfall
- Waikawau River meandering estuary



Awakino River mouth barrier proposed ONF.

D. Robust exposures of geological material (non-coastal)

Natural or man-made exposures that are sufficiently large and robust that small-scale earthworks or road widening will have no significant adverse impact and in most cases will improve the exposure of fresh rock. Their values relate to the natural geological features that can be seen within the rocks and the information they contain about the history of their formation, the geological origins of the region or the fossil history of the biota of New Zealand. Large-scale earthworks, construction of buildings, vegetation plantings, grass seeding or constructions of retaining walls or erosion barriers could adversely impact the visual, educational or scientific values of these exposures. Where quarrying is already permitted it should be allowed to continue.

These are:

Awakino Gorge tunnel Oligocene and Miocene record

Mahoenui coal mine Miocene coal measures

Marokopa Rd quarry Jurassic fauna

Rauroa Stream Jurassic fossils

South Awakino Gorge Miocene unconformity on greywacke

Wairere serpentinite, rodingite and rosenhahnite

Whakapirau Road Jurassic fossils



New Zealand's largest fossil ammonite (Jurassic age) from Whakapirau road cutting proposed ONF.

E. Fragile exposures of geological material (mostly in coastal zone)

Small, natural or man-made exposures that could be damaged or destroyed by small-scale earthworks or construction. Their values relate to the information they contain about the history of their geological formation or the fossil biota of New Zealand. Most earthworks, building constructions, vegetation plantings, grass hydroseeding or constructions of walls or erosion barriers could adversely impact the visual, educational or scientific values of these exposures. Periodic vegetation clearance may improve their values.

These are:

Anaomaki Point volcanic section

Arataura Point Jurassic sequence.

Awakino River mouth evidence of earliest volcanism

Heteri Point Jurassic fossils

Kawhia West Coast Early to middle Jurassic fossiliferous sequence

Kiritehere Coast Triassic section

Marokopa Coast Triassic-Jurassic fossil-bearing sequence

Ohaua Point Jurassic fossils

Pureora buried forest

Te Maika Point Jurassic sequence and fossil forest

Totara Point and Captain Kings Shell Bed Jurassic fossils

Waikawau Beach Miocene sediments

Waipa River exhumed fossil forest buried by Taupo Eruption



Waipa River exhumed fossil forest buried by Taupo Eruption proposed ONF. Note ignimbrite ash still left on top of trunk that has been knocked sideways by force of the eruption 1800 yrs ago.

F. Caves

Caves may, depending upon their depth underground, be susceptible to damage from significant earthworks constructions and quarrying above them or from constructions at their entrances or inside them. Vegetation clearance, earthworks or other changes that increase erosion in their catchments or around cave entrances may result in damage and burial inside the cave from sediment deposition.

These are:

Aranui Cave

Deception Cave

Gardners Gut Cave, Waitomo

Grand Canyon Cave, Piopio

Hollow Hill Cave, Hauturu

Kairimu Cave System

Kuratahi Cave, Piopio

Mangapu Cave System, Waitomo

Mangawhitikau Cave System, Waitomo

Paparahia Cave

Piripiri Public Cave

Pukeroa Cave System, Piopio

Puketiti Flower Cave, Piopio

Reserve Cave

Ruakuri Cave

Troopers Road Cave System (=Black system - F1, Fred, Virginia etc)

Waipapa Rd cave system

Waipuna Cave, Waitomo

Waitomo Stream headwaters cave system

Waitomo Glowworm Cave



Spelothems in Ruakuri Cave proposed ONF.

KO. Karst overlay

These are mostly karst and cave features that have been included and mapped in the karst overlay in the operative 2009 Waitomo District Scheme and were classified as being of D and E importance. The overlay is designed to give some protection to a larger number of recreational and other caves and surface karst areas than those that qualify for ONF scheduling. In addition nine enlarged catchment areas have been added to provide a buffer zone against excess erosion impacting the main tourist and recreational caves in the district. The protection given to areas in the karst overlay is designed to prevent the most adverse impacts of large-scale earthworks and erosion associated with forest clearance as well as some control over constructions within the caves.

These are listed in appendix 3.



Te Maika Jurassic fossil forest proposed ONF.

4.2 Suggested activity table that relates to categories of ONF and the Karst Overlay and assessment criteria

This activity table has been modified from the Auckland Unitary Plan and the operative Hauraki Gulf Islands District Plan, by excluding provisions for volcanoes and lava caves and adding the categories for limestone caves, surface karst and karst overlay. The table relates to resource consent requirements for land use and development on ONFs and the Karst Overlay. Category C and E ONFs are located within the coastal zone and as a consequence are required by the NZ Coastal Policy to have greater protection which is reflected in this activity table.

Table 1: Suggested activity table for types of ONF - Land use and development

Feature Types are: **A** = Large landforms (non-coastal);
B = Smaller more fragile landforms;
C = Dynamic landforms and features in the coastal zone;
D = Robust exposures of geological material (non-coastal);
E = Fragile exposures of geological material (mostly in coastal zone);
F = Caves;
KO = Karst overlay

Activity	A	B	C	D	E	F	KO
Construction of:							
Buildings and similar structures	RD	NC	NC	NC	NC	P	-
Retaining or erosion protection walls	P	RD	NC	P	NC	-	-
Structures in, artificial entrances to, or other modification that causes loss of cave features, or change to cave processes	RD	D	-	-	-	D	RD
Earthworks:							
Removal, fill, modification of 40-100 cubic metres	P	D	P	P	NC	RD	P
Removal, fill, modification of 100-250 cubic metres	RD	NC	D	RD	Pr	D	RD
Removal, fill, modification of more than 250 cubic metres	NC	Pr	NC	D	Pr	NC	RD
Any earthworks within 50m upslope of an entry or opening into any cave	D	D	-	-	-	NC	D
Commercial, farm or forestry quarries	Pr	Pr	Pr	RD	Pr	Pr	D
Any fill or rubbish placement within 50m upslope of an entry or opening into any cave	Pr	Pr	-	-	-	Pr	D
Vegetation management:							
Commercial forestry planting	D	Pr	Pr	D	Pr	P	P
Hydroseeding or matting to encourage grass or vegetation cover	P	RD	RD	NC	RD	P	P
Clearance of indigenous forest >0.5 ha in one calendar year	D	D	D	P	P	NC	D
Any clearance of vegetation within 50m upslope of an entry or opening into any cave	RD	D	-	-	-	D	RD
Utilities:							
Minor infrastructure upgrading	P	RD	D	RD	D	RD	P

P = permitted
RD = restricted discretionary
D = discretionary
NC = non-compliant
Pr = prohibited

Assessment criteria

The council will consider the relevant assessment criteria below for the restricted discretionary activities listed above:

1. Whether the nature, form and extent of the proposed works or activity adversely affects the ONF for which the item was scheduled:
 - a. whether the activity will result in increased erosion of the ONF
 - b. for grazing applications, whether the proposed stocking intensity will result in increased compaction or erosion of the ONF, or will result in changes to the vegetation on site in ways that will affect the values for which the ONF is scheduled e.g.
 - c. for fencing applications, whether the proposed fence requires ground disturbance or earthworks that will affect the values for which the ONF is scheduled
 - d. whether the activity will interfere with natural processes e.g. forestry or vegetation planting effects the natural dynamic supply of sand to wind-blown dunes and ground preparation and harvesting increases soil erosion into cave systems.
2. Whether the proposed works or activity cause adverse visual effects or adversely affect visual appreciation of the ONF.
3. The degree to which the ONF has already been modified so that further modification will not cause significant additional loss of geological value.
4. The extent to which the modification is necessary.
5. The purpose of the proposed works or activity and whether it has specific connections or relevance to the scheduled ONF.
6. What alternative methods and locations are available to the applicant for carrying out the work or activities that do not affect a scheduled ONF.
7. The extent to which the proposed works will protect the ONF from further damage, such as erosion protection, or remediate it from previous damage. This excludes potential damage from the activity for which consent is sought.
8. In the case of the subdivisions, the extent to which the resultant sites can be developed without affecting the values for which the ONF is scheduled.



Triassic fossil scallops in Kiritehere Coast Triassic section proposed ONF.

Appendix 1

Recommended Outstanding Natural Features for Waitomo District for inclusion in the WDS, with notes on how their boundaries have been mapped or why certain features were ruled out for recommended ONF status.

Feature name	Source of suggested site of significance	Mapping notes
Albatross Point, Kawhia Coast Jurassic sediments and syncline	NZ Geopreservation Inventory	Not so important, no easy access, too remote. Not ONF. Not mapped
Anaomaki Point volcanic section	NZ Geopreservation Inventory	All sea cliffs and shore platform in NCA Coastal Zone, mostly private land.
Aranui Cave	Oversight by Geopreservation Inventory	All in reserve.
Arataura Point Jurassic sequence, Kawhia Harbour	NZ Geopreservation Inventory	Combined with Kawhia West Coast Early to middle Jurassic fossiliferous sequence
Aussie	WDC Plan (E22)	Keep in karst overlay as mapped in operative District Scheme.
Awakino Gorge Mesozoic section	NZ Geopreservation Inventory	Beside busy highway. Best management is to allow road works to clean up exposures. Not suitable for ONF.
Awakino Gorge Miocene fossils	NZ Geopreservation Inventory	No longer visible. Not suitable for ONF.
Awakino Gorge tunnel Oligocene and Miocene record	NZ Geopreservation Inventory	Almost all SNA, mostly private but some crown land. No road except tunnel.
Awakino River mouth barrier	NZ Geopreservation Inventory	All public land (Waitomo District Council) or private in north that is SNA and NCA - coastal
Awakino River mouth evidence of earliest volcanism	NZ Geopreservation Inventory	Mapped as intertidal foreshore and low sea cliffs owned by Crown and Waitomo District Council.
Black's System Taumatamaire Rd Blacks Cave, Breakwater hole, Groove	WDC Plan (D10)	Keep in karst overlay as mapped in operative District Scheme.
Blizzard	WDC Plan (E24)	Keep in karst overlay as mapped in operative District Scheme.
Broken Hill System	WDC Plan (D13)	Keep in karst overlay as mapped in operative District Scheme.
Castle Craig bluffs, Marokopa includes Ngahuinga Bluff	NZ Geopreservation Inventory (C),	Includes all of Ngahuinga Reserve and large area of

	nominated by WDC staff	private farm land much of which is in SNA.
Deception Cave	WDC Plan (B8)	All private land, some SNA.
Digme-Camelot Cave	WDC Plan (D1)	Keep in karst overlay as mapped in operative District Scheme.
Double Falls, Tawarau River,	Topo map	All on crown or DoC land.
Ecch	WDC Plan (D15)	Keep in karst overlay as mapped in operative District Scheme.
Eight Mile Junction ignimbrite bluffs	Driving main roads	All on private land, two properties. Limited to bluffs and some of scree below.
Gardners Gut Cave, Waitomo	NZ Geopreservation Inventory (B), Karst workshop, WDC Plan (B4)	Half in DoC Reserve, remainder private – some SNA.
Grand Canyon Cave, Piopio	NZ Geopreservation Inventory (B), Karst workshop	All DoC land. Nature Reserve
Hairy Foot karst bluffs, Mangaitoka Rd	Tourist attraction.	Considered to be part of much larger upper Mangaotaki Gorge that is best treated as ONL
Hauturu Road karst, Waitomo	NZ Geopreservation Inventory (B)	Merged with Mangapohue polygonal karst in ONF. Mostly private land. One third in QE2 covenant; another third in SNA areas.
Heteri Point Jurassic fossils	NZ Geopreservation Inventory	In foreshore and low sea cliffs in two private properties all in SNA.
Hikurangi Falls, Paritikona Stream	Topo map	Small area around waterfall on one privately-owned farm.
Hochstetter Hole	WDC Plan (E7)	Included in Troopers Road Cave System ONF.
Hollow Hill Cave, Hauturu	NZ Geopreservation Inventory (C), karst workshop	All in Hollow Hill Scenic Reserve, DoC.
Huhunui	WDC Plan (E6)	Included within Waitomo Caves catchment on karst overlay
Kawhia West Coast Early to middle Jurassic fossiliferous sequence	NZ Geopreservation Inventory	All foreshore and coastal cliffs in crown land or SNA.
Kairimu Cave System	WDC Plan (C5)	Part reserve, part private land.
Kiritehere Coast Triassic section	NZ Geopreservation Inventory	Shore platform and coastal cliffs in crown land, scenic reserve and minor private land.

Kiritehere Moeatoa Conglomerate lowest Triassic sequence	NZ Geopreservation Inventory	Combined with Kiritehere Coast Triassic sequence.
Kokakoroa polygonal karst	NZ Geopreservation Inventory	Recommended for adding to karst overlay.
Kuratahi Cave, Piopio	NZ Geopreservation Inventory (C), WDC Plan (B7)	All private land, some SNA. Same mapped area as in karst overlay in District Scheme.
Lake Harihari sand-dune dammed lake	Topo map	Almost entirely in SNA on private land.
Lake Rotokawau	Karst workshop, WDC Plan (D4)	Lake and surrounding forested slopes. All in SNA on private land.
Lake Rotokotuku, near Te Kuiti	Karst workshop	On private land all in SNA
Lake Taharoa dune-dammed lakes	WDC staff nominated	Mostly owned by Taharoa Lake Trustees minor private surrounding land. All SNA.
Lee's Swamp/General Ward	WDC Plan (E3)	Keep in karst overlay as mapped in operative District Scheme.
Lower Mangaotaki Gorge	Karst workshop	Mostly DoC reserve and SNA, some private land.
Mahoenui coal mine Miocene coal measures	NZ Geopreservation Inventory	All in DoC reserve land.
Mahoenui Scenic Reserve (Gribbon Rd) limestone gorge and bluffs	Karst workshop	More appropriate as ONL than ONF.
Mangaokewa Gorge Scenic Reserve	Karst workshop, WDC staff nominated	More appropriate as ONL than ONF.
Mangaokewa ignimbrite section A	NZ Geopreservation Inventory	Overgrown road cutting – not suitable for ONF
Mangaokewa ignimbrite section B	NZ Geopreservation Inventory	Overgrown road cutting – not suitable for ONF
Mangaokewa ignimbrite section C	NZ Geopreservation Inventory	Overgrown road cutting – not suitable for ONF
Mangaokewa ignimbrite section D	NZ Geopreservation Inventory	Overgrown road cutting – not suitable for ONF
Mangaokewa Valley ignimbrite-capped castle hill	Driving roads	All in farmed private land – restricted to hill only.
Mangaokewa Stream scalloped ignimbrite bluffs	Driving roads	All in private land mapped as SNA bluffs beside stream.
Mangaorongo Gorge /Natural Bridges.	WDC Plan (E26)	Half in DoC Reserve, rest private in SNA. ONF
Mangaotaki overhang, Piopio	NZ Geopreservation Inventory (C)	In two private properties. Half in SNA rest bluffs in farmland.
Mangaotaki River Gorge	WDC staff nominated	More appropriate as ONL than ONF.
Mangapehi coal mine, Benneydale	NZ Geopreservation Inventory	NOT ONF, historical values only.
Mangapohue natural bridge	NZ Geopreservation Inventory (B), karst workshop	All in DoC reserve

Mangapohue polygonal karst	NZ Geopreservation Inventory (B), karst workshop	Private land centred around Stubb's QE2 covenanted area.
Mangapu Cave System, Waitomo Includes Lost World, Hamland Hole, Wellington Hole	NZ Geopreservation Inventory (B), Karst Workshop, WDC Plan (A2)	All private land, some SNA
Mangapu Gorge and blind valley	Suggested by P.W. Williams.	Recommended C significance suitable for ONF, all private land.
Mangawharawhara Stream natural bridges & tunnels, Piopio	NZ Geopreservation Inventory (B), WDC Plan (E27)	Part DoC Reserve and part private land.
Mangawhitikau slit gorge	NZ Geopreservation Inventory (C), karst workshop	West end in DoC reserve rest in private land, partly SNA.
Mangawhitikau Cave System, Waitomo	NZ Geopreservation Inventory (B), karst workshop, WDC Plan (B1)	All in private land.
Mangawhitikau - Pakeho karst	Karst workshop	Leave out as mostly biotic values.
Maniapoto	WDC Plan (D5)	Keep in karst overlay as mapped in operative District Scheme.
Marokopa Falls	NZ Geopreservation Inventory	All in reserve.
Marokopa Gorge	WDC Plan (E13)	Merged within Kokakaroa-Mangapohue catchmen in karst overlay.
Marokopa River natural tunnel	NZ Geopreservation Inventory (C), karst workshop	Entirely within reserve land.
Marokopa River mouth sandspits and dune field	NZ Geopreservation Inventory	Virtually all SNA or NCA coastal zones.
Marokopa Coast Triassic-Jurassic fossil-bearing sequence	NZ Geopreservation Inventory	Foreshore and coastal cliffs in crown land or SNA, small section in private land.
Marokopa Rd quarry Jurassic fauna	NZ Geopreservation Inventory	Periodically active quarry. Partly road reserve and partly private land.
Marmont's	WDC Plan (E30)	Keep in karst overlay as mapped in operative District Scheme.
Mason's Dry cave system	Karst workshop, WDC Plan (B)	Included in Mangawhitikau Cave system.
Matawhero	WDC Plan (E23)	Keep in karst overlay as mapped in operative District Scheme.
Mathews	WDC Plan (E5)	Within Mangawhitikau Cave System catchment in karst overlay.
Mein Hole Cave System	WDC Plan (C4)	Keep in karst overlay as mapped in operative District Scheme.

Millar's Waterfall	WDC Plan (D6)	Keep in karst overlay but merged with Waitomo Caves catchment.
Moa Egg Shell Cave, Waitomo	NZ Geopreservation Inventory (C), WDC Plan (B5)	Deleted from all protection in Scheme. Best protected by not showing on a map.
Mokau River estuary	Topo map	No non-public land included in mapped area.
Murder Canyon/ Mahoenui Natural Bridge/ Hangover Hole	WDC Plan (E20)	Keep in karst overlay as mapped in operative District Scheme.
Ngararahae Bay coastal cliffs and platforms	Topo map	Not sufficiently significant to propose as an ONF.
Ngararahae Bay sand dunes	Topo map	Not sufficiently significant to propose as an ONF.
Ohaua Point Jurassic fossils	NZ Geopreservation Inventory	In shore platform and low sea cliffs in one private property, all in SNA.
Okahua	WDC Plan (E18)	Included in Waitomo Caves watershed on karst overlay
Omaru Falls	WDC staff nominated	Almost all on DoC land.
Oyster Cave	WDC Plan (E19)	Within Mangapu Cave System catchment in karst overlay.
Papamaru	WDC Plan (E15)	Within Mangapu Cave System catchment in karst overlay.
Paparahia Cave	WDC Plan (D9)	Regionally significant moved to ONF status..
Phloughte-Agamemnon	WDC Plan (E33)	Keep in karst overlay as mapped in operative District Scheme.
Piopia Water	WDC Plan (E31)	Keep in karst overlay as mapped in operative District Scheme.
Piripiri Public Cave	Topo Map	Entirely within DoC Reserve.
Plumbers Pass	WDC Plan (E17)	Keep in karst overlay as mapped in operative District Scheme.
Pomarangai Road quarry Jurassic fossils	NZ Geopreservation Inventory	No longer well preserved and not up to being an ONF.
Pompeii - Long John	WDC Plan (E36)	Keep in karst overlay as mapped in operative District Scheme.
Pouerua buried forest	Driving roads	All in Crown Land
Pukeroa Cave System, Mahoenui	NZ Geopreservation Inventory (C), karst workshop, WDC Plan (C2)	All under private farm land.
Puketiti Flower Cave, Piopia	NZ Geopreservation Inventory (B), karst workshop	All on Puketiti Station private land.

Puketiti Swamp karst, Piopio	NZ Geopreservation Inventory (C), karst workshop, WDC Plan (C3)	Exact location could not be determined and therefore has been excluded.
Puketutu ignimbrite bluffs and waterfall	Driving roads	All in private farmland, limited to bluffs and scree below.
Rauroa System	WDC Plan (E21)	Keep in karst overlay as mapped in operative District Scheme.
Rauroa Stream Jurassic fossils	NZ Geopreservation Inventory	All within Conservation Zone and SNA.
Reserve Cave	WDC Plan (E1)	Under private land and road. Mostly SNA. Recommended to B significance ONF.
Rimu-Togyp System	WDC Plan (D12)	Keep in karst overlay as mapped in operative District Scheme.
Ripper – Moe-Ana	WDC Plan (D7)	Separated into two areas on karst overlay. Moe-Ana as separate and Ripper as part of Waitomo Caves watershed.
Ruakuri natural bridge and associated karst, Waitomo	NZ Geopreservation Inventory (B), karst workshop	All in Reserve.
Ruakuri Cave, Waitomo	NZ Geopreservation Inventory (B), karst workshop, WDC Plan (B3)	All in Reserve.
Shangri La	WDC Plan (E9)	Keep in karst overlay as mapped in operative District Scheme.
Skyline Cave	WDC Plan (D11)	Keep in karst overlay as mapped in operative District Scheme.
South Awakino Bluffs and waterfall	Driving main roads	All on very steep farmland, mostly private, partly Waitomo District Council and part SNA.
Southern Awakino Gorge Miocene unconformity on greywacke	NZ Geopreservation Inventory	Road cutting on side of highway, mostly on private land.
Spotlight	WDC Plan (E35)	Keep in karst overlay as mapped in operative District Scheme.
Taharoa dune fields	NZ Geopreservation Inventory	All owned by Taharoa Iron sands and mostly mined or will be. Not suitable as ONF.
Taumatotara karst/stream cave	Karst workshop, WDC Plan (E12)	Keep in karst overlay as mapped in operative District Scheme.
Tawarau caves and karst	Karst workshop	Recommended to raise to ONF status – all in reserve land.

Tawarau Falls	Topo map	On private land in SNA.
Te Ana Kapiti	WDC Plan (D8)	Added to Marokopa Natural Tunnel ONF.
Te Ana Tahī System	WDC Plan (D3)	Combined with Marakopa Natural Tunnel ONF
Te Anaroa Cave	WDC Plan (D2)	Keep in karst overlay as mapped in operative District Scheme.
Te Koots Sewer	WDC Plan (E8)	Keep in karst overlay as mapped in operative District Scheme.
Te Maika Point Jurassic sequence and fossil forest	NZ Geopreservation Inventory	All on public land in foreshore and sea cliffs.
Ten Acre Tomo system	Karst workshop, WDC Plan (D14)	Recommended to raise to ONF status. All in private land, some in SNA.
Thistlebob-Maui	WDC Plan (E37)	Keep in karst overlay as mapped in operative District Scheme.
Totara Point and Captain Kings Shell Bed Jurassic fossils	NZ Geopreservation Inventory	Foreshore and low costal cliffs all in SNA. Mostly crown land some in Te Maika Trust land.
Totoro Gorge karst, upper Mokau River	NZ Geopreservation Inventory (B), WDC Plan (E34)	In crown river bed or in private land, much of it SNA or otherwise rocky karst areas.
Trespasser's West	WDC Plan (E25)	Keep in karst overlay as mapped in operative District Scheme.
Trio Hole	WDC Plan (E2)	Within Mangapu Cave System catchment in karst overlay.
Troopers Road Cave System (=Black system - F1, Fred, Virginia etc), Waitomo	NZ Geopreservation Inventory (B), Karst Workshop, WDC Plan (B2)	All under private land.
Urenui	WDC Plan (E11)	Kept in karst overlay as mapped in operative District Scheme but merged with Waitomo Caves catchment area.
Ururoa Pt Hole-in-the-Wall	NZ Geopreservation Inventory	Combined with Kawhia West Coast Early to middle Jurassic fossiliferous sequence
Verry's Disappointment	WDC Plan (E32)	Keep in karst overlay as mapped in operative District Scheme.
Waiharakeke Bridge-Kinohaku Jurassic sediments	NZ Geopreservation Inventory	All in degraded road cuttings. Best management would be to allow further road works and cuttings. Not suitable for ONF protection.

Waikawau Beach Miocene sediments	NZ Geopreservation Inventory (C)	All publicly owned land – cliffs and shore platform.
Waikawau River meandering estuary	Topo map	Almost all is in crown owned river course but in places river and cut-off meanders shown as on private land.
Waipa River exhumed fossil forest buried by Taupo Eruption	GSNZ Conference paper 2013	All on one private property.
Waipapa Rd cave system	Karst workshop, WDC Plan (C6)	All under private land, some SNA.
Waipuna polygonal karst, Waitomo	NZ Geopreservation Inventory (C), karst workshop	Southern part in DoC reserve, remainder private land, partly in SNA.
Waipuna Cave, Waitomo	NZ Geopreservation Inventory (C), karst workshop, WDC Plan (C1)	Half in DoC Reserve, rest in private SNA land.
Wairere Falls	WDC staff nominated	River bed is crown land and east bank cliffs are in private land.
Wairere serpentinite, rodingite and rosenhahnite	NZ Geopreservation Inventory	Small exposure of rock in private land on edge of lake that has flooded disused quarry.
Waitanguru Falls	WDC staff nominated	All in DoC Reserve.
Waitomo Caves catchment	NZ Geopreservation Inventory catchments	Recommended for karst overlay
Waitomo Stream headwaters cave system (=Waitomo master system cave)	NZ Geopreservation Inventory (B), Karst workshop, WDC Plan (B6)	All under private land, some SNA.
Waitomo Glowworm Cave	NZ Geopreservation Inventory (A), karst workshop, WDC Plan (A1)	Almost all in reserve land except small area near resurgence.
Waitoru karst lake	Driving main roads	On private land, limited to lake extent and 3-5 m wide surrounding strip.
Whakapirau Road Jurassic section	NZ Geopreservation Inventory	All as road cuttings in crown road reserve.
Whispering Pot System	WDC Plan (E10)	Keep in karst overlay as mapped in operative District Scheme.
Whites Cave	WDC Plan (E14)	Within Kokakoroa-Mangapohue polygonal karst site in karst overlay.
Yours Mad	WDC Plan (E16)	Combined with Waitomo Caves catchment in karst overlay.

Appendix 2

Documentation for features recommended for scheduling as Outstanding Natural Features for Waitomo District. See accompanying GIS layer for maps. C = feature category (A-F); I = importance assessment (A= international, B = national, C = regional importance); Sc = assessment score (see excel worksheet for detailed scoring and justification statements).

Name	C	Significance statement	Location	I	Sc
Anaomaki Point volcanic section	E	Well preserved and southernmost occurrence of Orangiwhao Volcanics. Only volcanic centre in Waitomo District.	On west coast, south of Kawhia.	C	44
Aranui Cave	F	Dense speleothem assemblage. Tourist cave.	Adjacent to Ruakuri Cave and bridge carpark, off Tumutumu Rd.	B	84
Arataura Point Jurassic sequence.	E	Stratotype of the New Zealand Jurassic, Aratauran Stage.	South shore of Kawhia Harbour	B	64
Awakino Gorge tunnel Oligocene and Miocene record	D	Most easily seen and one of the best exposed sequences recording the Oligocene and Miocene sedimentary and tectonic history of north Taranaki.	North end of Awakino Gorge Road, SH3.	C	64
Awakino River mouth barrier	C	The largest river mouth barrier in the district.	North side of Awakino River mouth.	C	64
Awakino River mouth evidence of earliest volcanism	E	Best and most easily accessible exposure of onset of volcanism off west coast of Waikato-North Taranaki.	South side of Awakino River mouth.	C	66
Castle Craig bluffs	A	Impressive isolated limestone citadel surrounded by high bluffs.	Ridge south of Marokopa Rd	C	64
Deception Cave	F	Spectacular gypsum speleothems.	East of Troopers Rd.	B	72
Double Falls, Tawarau River,	B	Double waterfalls like this uncommon in Waikato region.	Tawarau River	C	46
Eight Mile Junction ignimbrite bluffs	A	Best and most visible columnar-jointed ignimbrite bluffs in Waitomo District.	1 km south of Eight Mile Junction	C	48
Gardners Gut Cave	F	Longest cave in the North Island (approx. 12km long). High recreational and education use. Significant speleothems, fossil and sediment deposits. Example of two-tier development.	Either side of Te Anga Rd.	B	82
Grand Canyon Cave, Piopio	F	Large horizontal passage - part of a dismembered cave system, entrances either end. Maternity roost for long tail bats.	South side of Haku Rd. Permit for entry.	B	76
Heteri Point Jurassic fossils	E	Stratotype of Late Jurassic New Zealand Heterian Stage.	South shore of Kawhia Harbour.	B	60
Hikurangi Falls, Paritikon Stream	B	Named waterfall over hard early Miocene sedimentary rocks.	Paritikon, Rd, Mangaokewa.	C	40
Hollow Hill Cave, Hauturu	F	Largest cave chamber in North Island. Large horizontal stream passage, three small inlet passages; excellent speleothems.	Hollow Hill Reserve, DoC.	C	58

Kairimu Cave System	F	Several named caves that may be linked. Significant sedimentary deposits, biota and speleothems.	West of end of Kairimu Rd	C	60
Kawhia West Coast Early to middle Jurassic fossiliferous sequence	E	Most important, continuous and fossiliferous Lower to Middle Jurassic sequence in New Zealand. Stratotypes of NZ Jurassic stages Ururoan and Aratauran. Includes important Dactyloceras bed with a rich fossil fauna.	On west coast south of Kawhia Harbour mouth.	B	110
Kiritehere Coast Triassic section	E	Best continuous exposure of Triassic sequence in North Island including many New Zealand stages and rich fossil beds.	For 7 km south from Kiritehere Beach.	B	120
Kuratahi Cave, Piopio	F	Kuratahi has dendritic development, gypsum crystal trees and other significant gypsum speleothems, sediment deposits.	West of Mangaotaki Rd	C	64
Lake Harihari sand-dune dammed lake	B	One large and one small lake dammed by moving coastal sand dunes, surrounded by swamp lands.	South of Taharoa.	C	48
Lake Rotokawau	B	Small lake at head of small side valley of unknown origin - landslide blocked or karst solution. Surrounded by native forest.	South Waitomo.	C	46
Lake Rotokotuku	B	Well defined small lake with no overflow drainage in limestone area.	East of Te Kuiti.	C	44
Lake Taharoa dune-dammed lakes	A	Largest dune-dammed lake on Waikato west coast and several smaller ones.	Taharoa, south of Kawhia.	C	56
Lower Mangaotaki Gorge	A	Most publicly visible limestone gorge in Waitomo District.	On either side of Hwy 3, 12-14 km SW of Piopio.	C	50
Mahoenui coal mine Miocene coal measures	D	Exposures of Miocene Mokau Formation and Maryville Coal Measures, with under and overlying marine sandstones. Many thin coal seams.	In hills 7 km north of Awakino gorge tunnel.	C	56
Mangaokewa Stream scalloped ignimbrite bluffs	B	Easily seen, unusual scalloped bluffs of ignimbrite with small water fall.	North side of Mangaokewa Rd	C	48
Mangaokewa Valley ignimbrite-capped castle hill	B	Best and most easily seen example of an ignimbrite-capped steep-sided circular hill (butte-like) in region.	North side of Mangaokewa Rd	C	60
Mangaorongo limestone gorge and natural bridges	B	Spectacular limestone gorge with karst bluffs and rocks. Also several natural bridges.	7 km along Mangaorongo Stream.	C	52
Mangaotaki overhang, Piopio	B	Best "breaking-wave" overhang in the region. Easily visible from public road.	North side of Mangaotaki Rd, west of Piopio.	B	74
Mangapohue natural bridge	B	One of most spectacular and accessible natural bridges in North Island. Tourist feature, unusual in that it has 2 tiers.	North side of Te Anga Rd.	B	98
Mangapohue-Hauturu Rd polygonal karst	A	Most accessible and readily seen (from roads) area of temperate cockpit polygonal karst in NZ. Includes disappearing streams, blind valleys, sinkholes, springs, arches and fluted bluffs. Includes sinkholes, dry valleys, caves and bridges.	Northeast side of Te Anga Rd, and either side of Hauturu Rd. Much QE2 covenanted.	A	148
Mangapu Cave System Includes Lost World, Hamland Hole, Wellington Hole.	F	Claimed to be the second largest underground river in North Island. Many important speleothems including the only calcite shields and the only aragonite speleothems so far recognised in North Island. Major use for tourism and recreation. Two side caves nearby have some of densest straws and best calcite speleothem	Between Oparure and Troopers Roads	B	110

		assemblages in New Zealand. Best example of karst window in New Zealand.			
Mangapu Gorge and blind valley	A	Where the Mangapu Stream sinks is best example of a blind valley in the Waitomo District.	South east of Oparure Rd	C	45
Mangawharawhara Stream natural bridges & tunnels, Piopio	A	Spectacular karst landscape including Mangawharawhara Cavern, one of the two largest natural tunnels in the North Island. The presence of 2 tunnels and 5 bridges of such large size along one stream is unique in New Zealand. Catchment with numerous dolines, stream sinks, blind valleys and resurgences.	4 km of stream course, south of Haki Rd.	B	100
Mangawhitikau Gorge, Waitomo	A	Spectacular 1 km-long slit gorge incised in Oligocene limestone. Scenically attractive towering limestone karst formations. Runs into large glowworm cave.	3km length of stream bed, east of end of Waipapa Rd	C	62
Mangawhitikau Cave System, Waitomo	F	One of the largest river caves in North Island. High recreational and tourist value. Over 8 km of cave passage. Classic two tiered geomorphic development and dry valley leading to former stream cave upstream. Includes Mason's Dry Cave (fossil deposits), Flood Caverns, Mason's Glowworm Cave, Mangawhitikau Gorge and other small caves.	South side of Boddies Rd.	B	86
Marokopa Falls	B	Largest waterfall in Waitomo District. Spectacular high falls flow over greywacke bluff from level of Oligocene peneplain.	Next to Te Anga Rd.	C	68
Marokopa Rd quarry Jurassic fauna	D	Richest middle Jurassic fossil fauna in New Zealand.	On side of Marokopa Valley Rd.	B	66
Marokopa River natural tunnel and Te Ana Kapiti Cave	B	One of two largest natural tunnel features in the North Island. Contains speleothems and glow-worms.	Within Kokakoroa polygonal karst overlay area.	B	74
Marokopa Coast Triassic-Jurassic fossil-bearing sequence	E	Most complete and best exposed sequence through upper Triassic strata in the North Island.	Between Marokopa and Kiritehere in coastal cliffs and rocks.	B	84
Marokopa River mouth sandspit and dune field	C	One of the most pristine southward-extending sandspits on the west Waikato coastline. Fixed dunes and swamps at north end.	North side of Marokopa River mouth.	C	64
Mokau River estuary	C	Most natural, least modified tidal estuary in Waitomo District. Flooded meandering river.	Lower 3 km of Mokau River.	C	74
Ohaua Point Jurassic fossils	E	Stratotype of Late Jurassic New Zealand Ohauan Stage, with rich macrofossils.	South coast of Kawhia Harbour.	B	64
Omaru Falls	B	Classic curtain waterfall held up by thick cemented limestone unit. One of highest single drop waterfalls in Waitomo District.	Walking Track from Omaru Rd.	C	60
Paparahia Cave	F	Stream passage in Miocene limestone with beautiful speleothems.	Paparahia Station	C	61
Piripiri Public Cave	F	Easily accessible small tourist cave, free access. Speleothems inside entrance cavern.	North side Te Anga Rd.	C	53
Pukeroa Cave System	F	Second deepest known cave in the North Island. Crystal pools, speleothems, fossils. Recreational use. Major streamway, waterfalls, multiple entrances.	West side of Mangaorongo Rd.	C	58

Puketiti Flower Cave	F	Speleothems - gypsum flowers. Gated cave to protect the delicate cave formations since 1970s.	On Puketiti Station.	B	90
Puketutu ignimbrite amphitheatre and waterfall	B	Readily visible amphitheatre of columnar-jointed ignimbrite that has been eroded back by small stream that forms waterfall over it.	South side of Hwy 30, 3 km south of Puketutu	C	54
Pureora buried forest	E	Best studied and most easily accessible site of a forest and its forest floor fauna knocked over and buried by Taupo eruption 1800 years ago.	3 km NE of Pureora Village.	B	76
Rauroa Stream Jurassic fossils	D	Rare sequence of middle Jurassic marine fossil faunas.	North of north end of Awakino Gorge.	C	50
Reserve Cave	F	Contains thick ignimbrite deposits from Kidnappers Tephra eruptions 1.2 Ma. Paleokarst fragment, oldest known cave in the Waitomo area.	On either side of Tumutumu Rd.	B	88
Ruakuri natural bridge and karst, Waitomo	B	Spectacular tourist features. High natural bridge with dog leg of Waitomo Stream passing through it.	Just south of Waitomo	B	114
Ruakuri Cave, Waitomo	F	Major tourist cave. Large stream passage. Speleothem assemblages. Historic tourist cave. Approx. 4 km of passage. Current tourism use. Horizontal stream system containing c. 4 km of passage in Oligocene limestone, some upper levels.	Just south of Waitomo	B	102
South Awakino Bluffs and waterfall	A	One of most visible high waterfalls in District. Unusual bluffs of Miocene sandstone showing groundwater flowing through the sandstone and out along the bluff.	East side of Highway 3, just south of Awakino.	C	62
Southern Awakino Gorge Miocene unconformity on greywacke	D	Excellent exposure of steeply dipping Murihiku Supergroup rocks containing rich Monotis beds unconformably overlain by Mokau sandstone.	On side of Highway 3	C	46
Tawarau caves and karst	A	Most extensive cave and karst system in North Island that is still under natural forest.	Mostly west of Tawarau River.	C	74
Tawarau Falls	B	25 m high cascade waterfall over Oligocene Te Kuiti Group rocks.	Tawarau River.	C	46
Te Maika Point Jurassic sequence and fossil forest	E	Second best Jurassic fossil forest in New Zealand (after Curio Bay). Stratotype of middle Triassic Te Maikan Stage. Mostly non-marine sedimentary sequence with tree stumps in-situ.	South head of Kawhia Harbour entrance.	B	88
Ten Acre tomo and associated caves.	A	Impressive large collapse feature with associated caves.	At end of Mangaorongo Rd.	C	64
Totara Point and Captain Kings Shell Bed Jurassic fossils	E	Lower part of stratotype of New Zealand Late Jurassic Heterian Stage, includes historically important Captain Kings Shellbed containing a rich bivalve and brachiopod fossils.	South coast of Kawhia Harbour.	B	70
Totoro Gorge karst, Mokau River	B	Easily accessible and one of the best examples of sculptured limestone karstic river gorges and adjacent areas in the District. Includes fluting, tors and canyons.	On Mokau River upstream from Totoro Rd.	C	58
Troopers Road Cave System (=Black system - F1, Fred, Virginia)	F	One of the most extensive cave systems in North Island. Selenite needles, calcite speleothems. Major fossil deposits. High recreational value.	Southwest of Troopers Rd.	B	84
Waikawau Beach Miocene sediments	E	Best and most easily accessible exposure through late Miocene sedimentary sequence in the	West coast cliffs for 2 km	C	62

		Waikato Region deposited between 11 and 10 Myr ago.	north of Waikawau R.		
Waikawau River meandering estuary	C	Some of best and most easily seen cut-off river meander loops in district at upper end of natural estuary.	Lower 1 km of estuary,	C	54
Waipa River exhumed fossil forest buried by Taupo Eruption	E	Decapitated, charred and blown over tree trunks that were killed and buried by the ignimbrite flow from the Taupo Eruption 1800 yrs ago. Recently exhumed by river floods - some trunks stand tall on flood plain - several are still seen in terrace bank exposures buried by the ignimbrite.	True right bank of Waipa River.	B	85
Waipapa Rd cave system	F	Multiple caves in two systems. High recreational use. Speleothems include best calcified tree roots in district.	On both sides of end of Waipapa Rd.	C	58
Waipuna polygonal karst, Waitomo	A	High-density deep polygonal karst over surface, disappearing streams and blind valleys. Temperate cockpit karst. Forested.	Both sides of Waipuna Rd.	B	88
Waipuna Cave, Waitomo	F	Only major cave in Waitomo area with forested catchment (this can affect speleothem growth, biota, sedimentation). Impressive speleothems.	East of Waipuna Rd under forest.	C	60
Wairere Falls and Cave	B	Waterfall over basement greywacke with exposures of limestone, karst and a cave unconformably on top.	West of Wairere bridge on Aria Rd.	C	54
Wairere serpentinite, rodingite and rosenhahnite	D	Only exposure in North Island of Dun Mountain Ophiolite Terrane - serpentinite between Murihiku and Waipapa Terranes. Only known occurrence of rosenhahnite in New Zealand. Exposure of serpentinite faulted against Oligocene limestone.	Disused Wairere serpentinite quarry, Kohua Rd	B	90
Waitanguru Falls	B	One of the highest waterfalls over greywacke in the Waitomo District.	On east side of Mangaotaki Rd, 20 km from Piopio. In Waitanguru Scenic Reserve.	C	56
Waitomo Stream headwaters cave system (=Waitomo master system cave)	F	One of the longer caves in the North Island. High recreational and tourism use. Important speleothems (calcite (pearls), palygorskite), fossil deposits (best known Mappins Bush Moa). Consists of many medium length caves linked hydrologically.	West of Waipuna Rd.	B	90
Waitomo Glowworm Cave	F	Nationally important, internationally renowned tourist cave for its accessibility and glowworms. Good speleothems.	Waitomo tourist cave	B	118
Waitoru karst lake	B	One of most publicly visible sinkhole lakes in Waitomo District.	South side of Highway 3, 8 km SW of Piopio.	C	42
Whakapirau Road Jurassic fossils	D	Most accessible sequence of fossil-rich Jurassic in district.	Road cuttings on east side of Whakapirau Rd.	C	44

Appendix 3

Documentation for features recommended to remain and catchments to be added to existing Waitomo District Scheme karst overlay. See accompanying GIS layer for maps.

Name	Significance statement
Aussie	Speleothems. Fossilised fish. Recreational use.
Black's System Taumatamaire Rd (Blacks Cave, Breakwater hole, Groove)	High recreational use, significant speleothems, length. Deep caves in strongly tilted limestones. Includes Black's Cave, Breakwater Hole, Groove.
Blizzard	Gypsum deposits.
Broken Hill System	Very large passage. On greywacke contact. Significant length.
Digme-Camelot Cave	Only example of gypsum rope in New Zealand (Digme). Part of largest autogenic karst system known in North Island. Troglodytic biota. Two caves. Large streamway (Camelot).
Ecch	Significant length (3.7km) and recreational use.
Kokakoroa-Mangapohue polygonal karst	Extensive area of polygonal; karst with some subsurface caves.
Lee's Swamp/General Ward	Recreational use. Cave crosses drainage divides
Mangapu Cave System catchment	Added to protect the cave system downstream.
Mangawhitikau Cave System catchment	Added to protect the cave system downstream.
Maniapoto	Significance to Maori. (NB: this rating refers to karst significance, not cultural significance).
Marmont's	Length. Recreational use.
Matawhero	Length approx 2km
Mein Hole Cave System	Length over 4km long. Numerous speleothems and excellent fossil whale remains.
Moe-Ana	Two systems. Approx 2.5km long. Partly still under native vegetation.
Murder Canyon/ Mahoenui Natural Bridge/ Hangover Hole	One of the longest shafts in the North Island. Recreational use. Very thin spectacular natural bridge.
Paparahia Cave	Miocene, sheltered from tephra, sediment deposits. In Mohakatino Group limestone's. Very isolated from the rest of karst area – potential important biota and fossil records. Speleothems.
Phloughte-Agamemnon	Two systems. Long caves
Piopio Water	Source of Piopio water supply.
Plumbers Pass	Recreational use, Gypsum.
Pompeii - Long John	Long system.
Rauroa System	Unusual speleothems (red). Length.
Rimu-Togyp System	Long cave, significant recreational use, speleothems. Waterfall exits into gorge.
Shangri La	2km long. Recreational use.
Skyline Cave	Significant speleothems (including oolites), fossil deposits, recreational use, length. Highest altitude cave in region at 320 m ASL.
Spotlight	Major fossil deposits.
Taumatatotara karst/stream cave	Large stream cave. Largest stalactite in region.
Te Anaroa Cave	Tourist cave. Fossil deposits. Speleothems.
Te Koots Sewer	Only extensive cave in eastern region. Length 3.3km
Thistlebob-Maui	Long system.
Trespasser's West	Excellent speleothem formation.

Troopers Road Cave System catchment	Added to protect the cave system from sediment runoff.
Verry's Disappointment	Potentially long system.
Waitomo caves catchment	This is the most important, because it can be justified in terms of its \$ value for the tourist business in the Glowworm Cave and at the same time enclose many other important sites in the Waitomo basin.
Whispering Pot System	Several caves. Cultural significance, fossil deposits