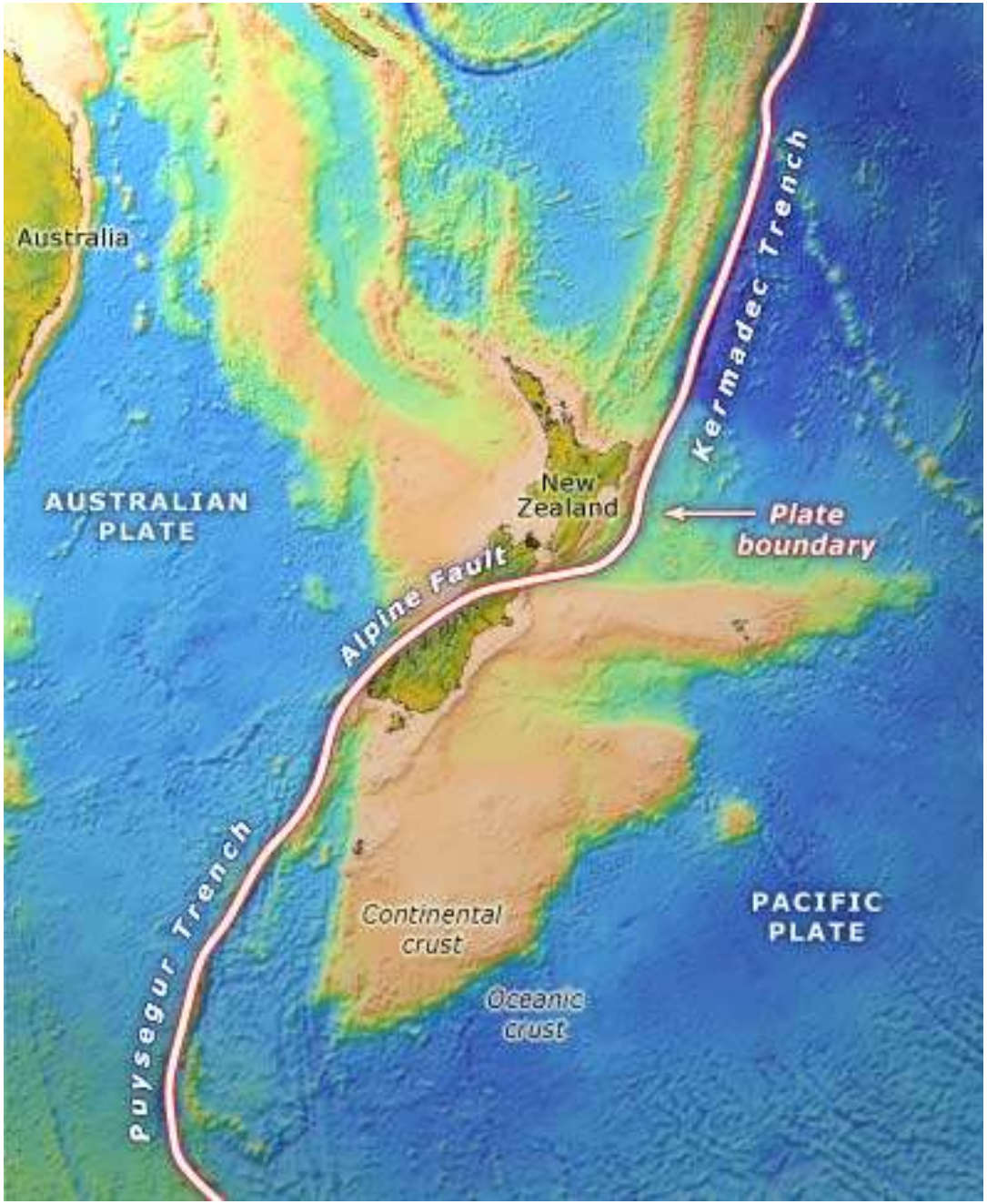
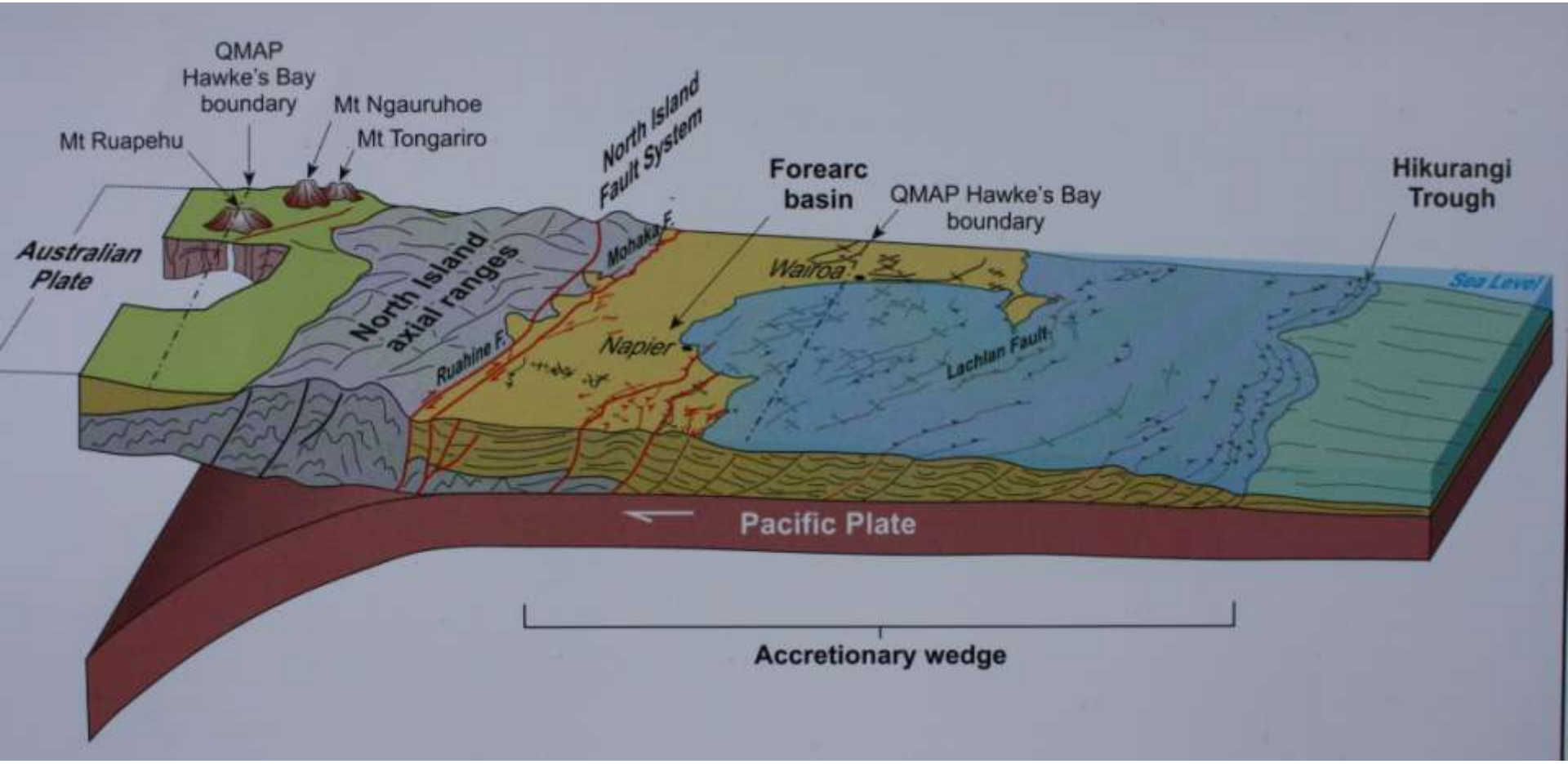
Welcome to Middle Earth

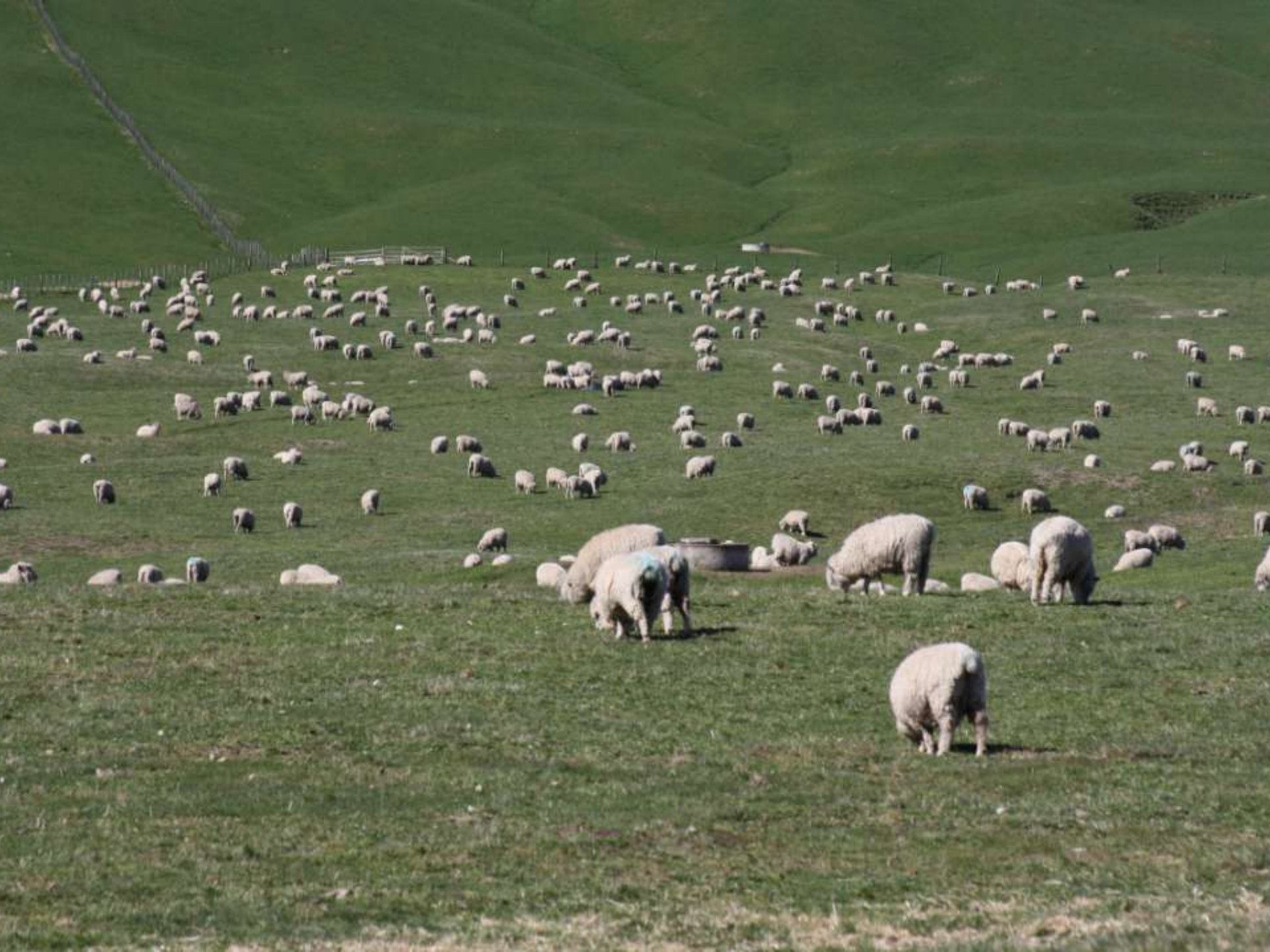
Garth Eyles

Trustee of the New Zealand
Poplar and Willow Research Trust

from Wellington to all parts of the World.


Australia
AUSTRALIAN PLATE
New Zealand
Kermadec Trench
Plate boundary
Alpine Fault
Puysegur Trench
Continental crust
Oceanic crust
PACIFIC PLATE


QMAP
Hawke's Bay
boundary
Mt Ruapehu
Mt Ngauruhoe
Mt Tongariro
North Island
Fault System
Forearc
basin
QMAP Hawke's Bay
boundary
Hikurangi
Trough
Australian
Plate
North Island
axial ranges
Mohaka F.
Wairoa
Sea Level
Ruahine F.
Napier
Lachlan Fault
Pacific Plate
Accretionary wedge



New Zealand's Erosion History

- Humans have increased the rate of erosion – up to 16 times greater under pasture compared to native forest.
- From the 1500s Maori burnt vegetation creating a fern cover – a thick, tangled mass of living and dead fronds providing generally good erosion protection.
- From the 1830s Europeans converted fern and forest to English pastures.

- Soil fertility of hill country pastures declined until after WW11 when aerial topdressing was introduced.
- Catchment Boards were established from 1941 to control flooding and soil erosion.
- The Government required erosion control measures to allow continued stock grazing.
- Willow and poplar poles were the only trees that met this requirement.

- From the 1950s poplars and willows were selected and bred for erosion control. The programme was led by Chris van Kraayenoord, culminating in the establishment of the National Plant Materials Centre.
- In the mid 1990s government dramatically reduced financial support for the poplar and willow breeding programmes causing the closure of the Centre.
- The breeding programme continued under ‘survival mode’ conditions.

- In 1976 New Zealand joined the International Poplar Commission.
- 2011…

  The Poplar and Willow Trust was formed to support the development and release of new, versatile poplar and willow clones.

- Sufficient funding is currently available to enable a sustainable programme.

The Poplar and Willow Research Trust

- Our goal is to develop robust poplars and willows for protecting erosion prone soils, particularly on pastoral hill country slopes.
- The Trustees represent the interests of regional councils, and the NZ primary production sectors - pastoral, dairy and horticulture.
- The Trust currently employs two scientists.
- The Trust gains funding and sponsorship from government and the private sector.

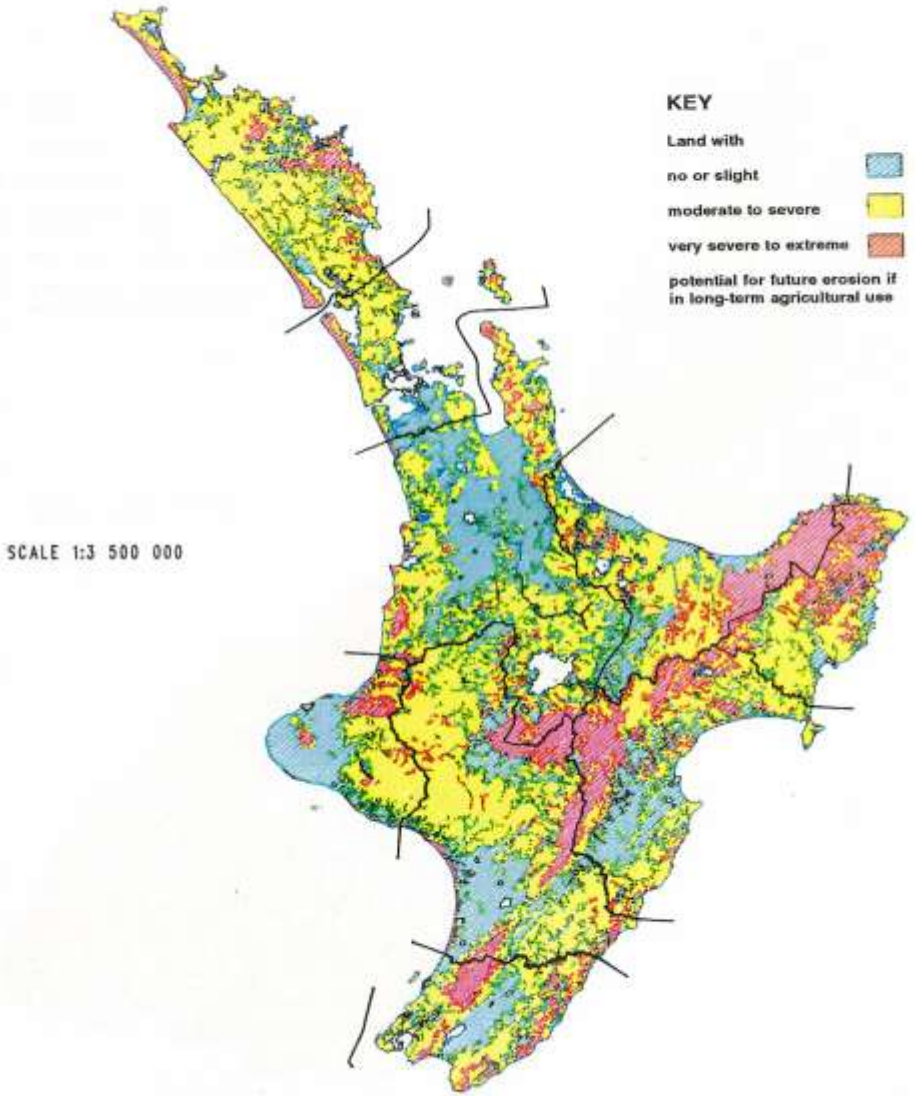
Why do we need poplars and willows?

- This next section provides a thumb nail summary of soil erosion in New Zealand.
- Unlike most areas of the world we have pastured, and graze most of our hill country, irrespective of its natural stability or fertility.
- Erosion is a constant threat to sustainability, with landslide (slipping) and fluvial (gully) erosion the major concerns.

Region	Area at risk (hectares)	At-risk area being farmed	Percentage of farmland that is:	
			stable	erodible
Northland	874,300	521,100 (60%)	30	70
Auckland	263,300	150,600 (57%)	52	48
Waikato	945,900	511,700 (54%)	63	37
Bay of Plenty	682,400	153,500 (22%)	56	44
Gisborne	697,700	497,300 (71%)	17	83
Hawke's Bay	967,400	537,900 (56%)	38	62
Taranaki	341,400	116,000 (34%)	72	28
Manawatu-Whanganui	1,299,800	809,700 (62%)	42	58
Wellington	454,300	279,100 (61%)	42	58
New Zealand	**18,382,200**	**8,681,000 (47%)**	**32**	**68**

Erosion susceptible land in New Zealand (State of New Zealand's Environment 1997, MfE, Chapter Eight and Clough & Hicks, 1993, 4)

MAP 1A SUSCEPTIBILITY OF LAND TO EROSION, NORTH ISLAND



SCALE 1:3 500 000

Derived from NZ Land Resource Inventory
J Willoughby 1992

Manaaki Whenua
Landcare Research

TABLE 3 PERCENTAGES OF AGRICULTURAL LAND SUSCEPTIBLE TO DIFFERENT EROSION PROCESSES

Region	*Surface erosion*	*Gullies*	*Deep mass movement*	*Shallow mass movement*	*Debris avalanches*
Northland	41	49	10	32	<1
Auckland	18	18	2	32	0
Waikato	23	6	4	21	<1
Bay of Plenty	29	8	<1	21	<1
Gisborne	9	35	41	68	<1
Hawkes Bay	30	13	17	45	<1
Taranaki	6	1	5	24	<1
Wanganui-Manawatu	25	10	20	39	<1
Wellington	16	17	28	36	<1
Nelson-Marlborough	77	9	<1	27	10
West Coast	6	<1	0	4	<1
Canterbury	86	4	1	14	3
Otago	88	6	1	16	<1
Southland	59	4	<1	7	<1
New Zealand	51	11	8	25	1

Source: Clough & Hicks, 1993, 6

Sheet erosion

- Occurs when surface soil material is washed off.
- An insidious erosion form as it removes fertiliser and topsoil.
- Controlled by maintaining a complete surface cover.
- Heavy stock can shear low strength hill country soils.

Wind erosion

- Wind erosion can occur on any bare surface.
- Most fine tilths blow.
- Volcanic ash (tephric) soils are very susceptible.
- Wind erosion is controlled by shelter belts and ground cover.

Slip erosion

- Slips are the rapid sliding or flowing of soil and regolith, exposing a distinct slip surface.
- Slips occur during heavy rains when the soil gets saturated and slides/floats off downslope.
- Production on the slip scar never gets back to more than 80% of the uneroded surface.
- Slip erosion is controlled by space or close planted trees.

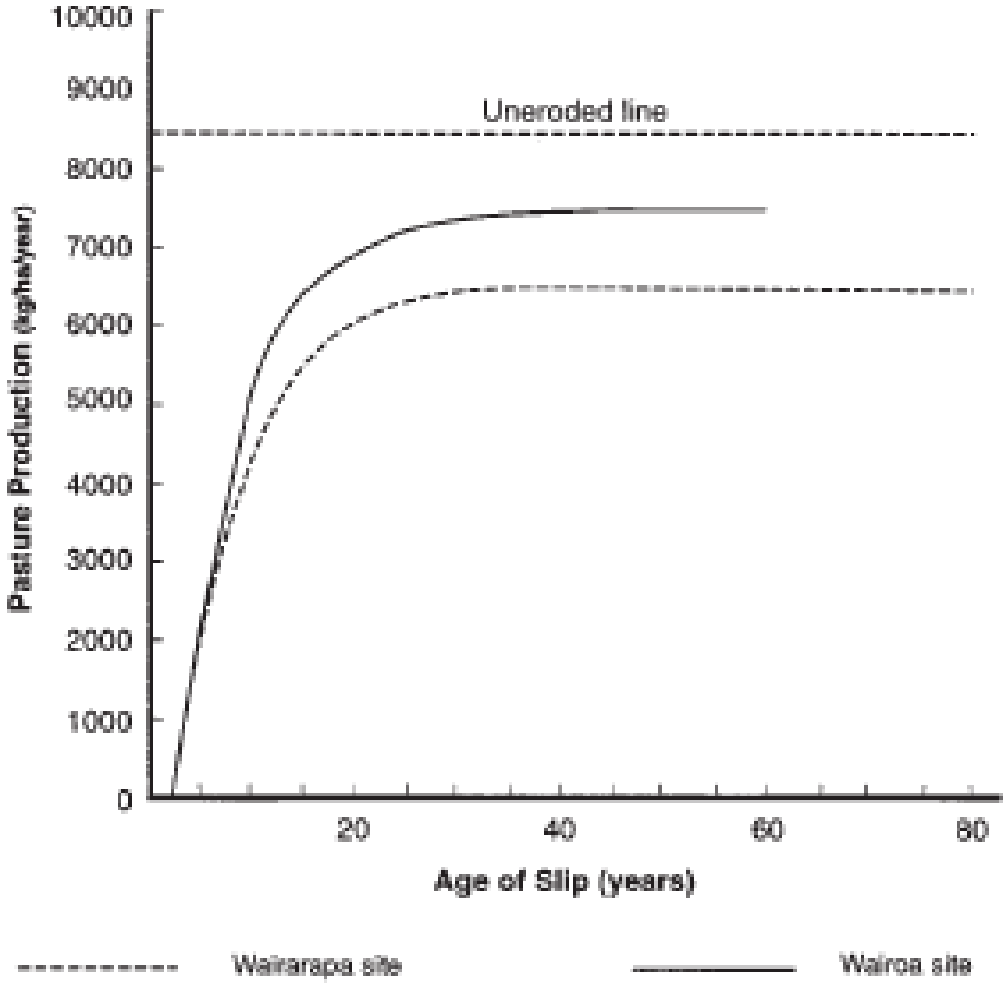
Note the sharp boundary between the soil and underlying rock, forming a slip plane.


Soil Slip on Pohangina sands in 2004

- On individual farms up to 30% of sub catchments can be affected by one event.
- Severe storms generally affect about 5% of a farm.

Rate of pasture recovery on slips.

From replicated studies in the Wairarapa and Wairoa areas.



Multi purpose plantings reduce the risk of slip erosion. Central Hawke's Bay.

Earthflow erosion

- Earthflow is the flow of soil and underlying regolith and parent material.
- It is usually characterised by the retention of a surface cover, broken by tension cracks and smaller secondary movements.

Deep Earthflow Erosion

Shallow earthflow on frittered mudstone

Shallow Earthflow Erosion stabilised by space planted poplars

A partly planted hill slope susceptible to earthflow

Gully erosion

- The type of gully depends on the rock type.
- Gullies are very significant as they:
  - Remove large amounts of debris into waterways and downstream deposition sites
  - Destroy on-farm communication lines
  - Destroy fences
  - Are hard to repair.


Gully formed in uncemented ignimbrite
S Stokes

The underlying rock has a pH of about 2.1 making remedial planting very difficult.

Gullies on mudstone are often combined with earthflow to form a complex system.

The debris dams are built progressively and act as a series of controlled drop structures.

Long term control of gully erosion relies on the root mats of willows planted in conjunction with debris dams.

Tunnel Gully erosion

- Occurs where concentrated subsurface flows are parallel to the surface, creating tunnels which collapse.

Tunnel Gully Erosion in clay soils

G Eyles

Photo: Northland Regional Council

Photo: Northland Regional Council

Stream bank erosion

- Stream bank erosion is the removal of material from the bank during or following floods.

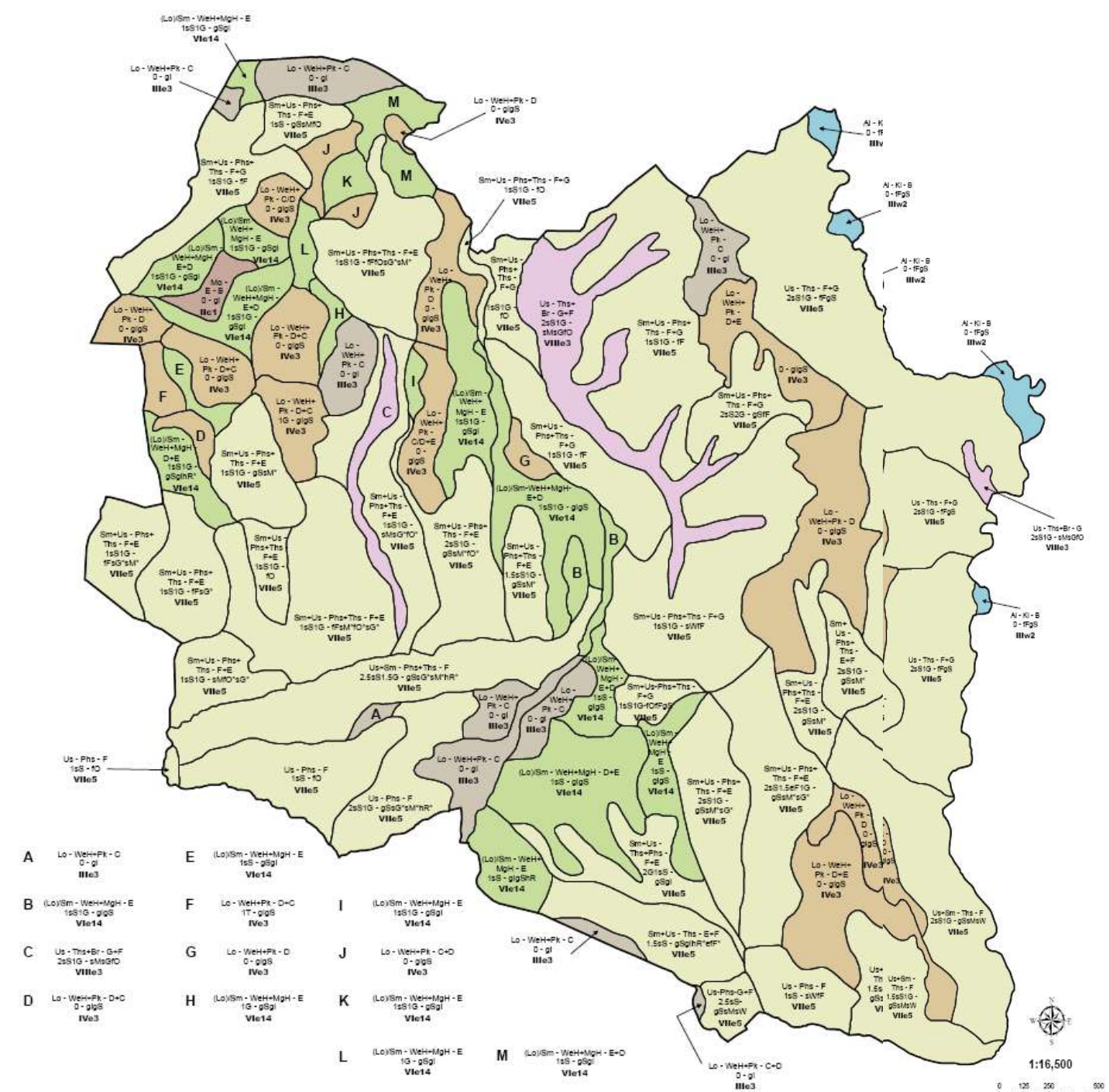
- Stream bank protection using willows is a major river control activity.


Photo: N Ngapo

Deposition

On Farm erosion control

- Tree planting is the main control measure used but effective planning is needed.
- Farm Plans are the most effective planning tool to minimise erosion while maximising production as they identify where erosion is likely to be a problem.
- Individual works involve the planting of poplars and willows.



LAND USE CAPABILITY

LUC & description

IIc1

Flat to undulating high terrace with soils formed from weathered loess and tephra

IIIe3

Undulating to rolling downlands with soils developed from weathered loess and tephra

IIIw2

Flat, narrow alluvial valley floors and areas of higher terraces mantled with colluvium from nearby valley slopes

IVe3

Rolling to strongly rolling downlands with soils developed from weathered and volcanic tephra.

VIe14

Moderately steep to steep hill country formed on unconsolidated to moderately consolidated sandstone +/-mantled with loess

VIIe5

Steep to very steep slopes formed on unconsolidated to moderately consolidated sandstone

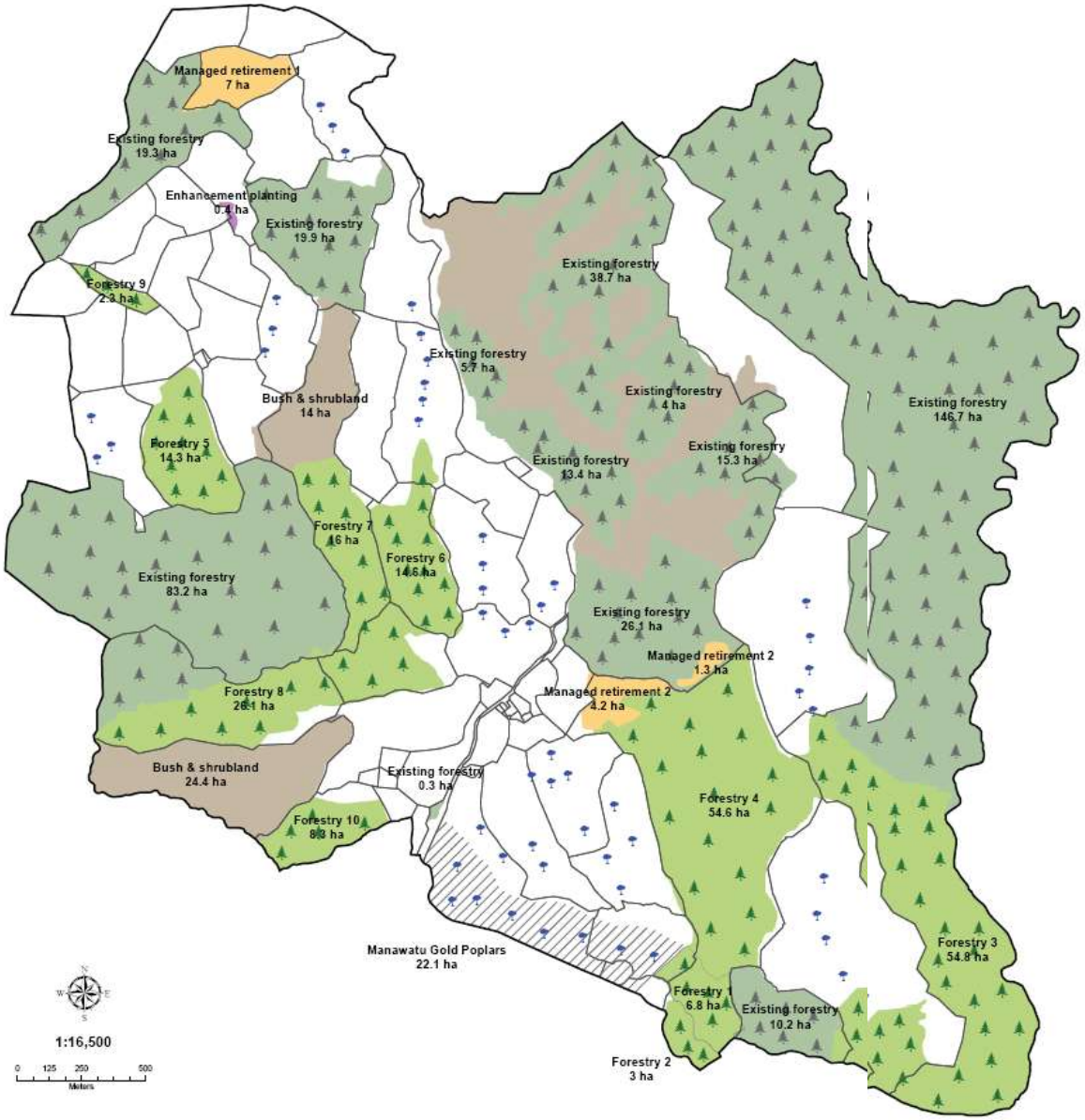
VIIIe3

Very steep slopes formed from unconsolidated to moderately consolidated sandstone

Land Use Capability classifications according to Fletcher, 1987.

Fletcher, J.R. (1987). Land use capability classification of the Taranaki-Manawatu region : a bulletin to accompany the New Zealand land resource inventory worksheets. National Water and Soil Conservation Authority by the Water and Soil Directorate, Ministry of Works and Development, Wellington, N.Z.

Date: 1 October 2006	Surveyors: LandVision Ltd.
Property owner(s):	Survey scale: 1:10,000
Property:	Aerial photo: Supplied by Horizons Regional Council (0.75m orthophoto from Terralink). Flown 2004/05.



RECOMMENDED WORKS

- Existing forestry
- New forestry
- Space planted conservation trees

- Bush & shrubland (102 ha)
- Enhancement planting (0.4 ha)
- Existing forestry (383 ha)
- Forestry 1 (6.8 ha)
- Forestry 10 (8.3 ha)
- Forestry 2 (3 ha)
- Forestry 3 (55 ha)
- Forestry 4 (55 ha)
- Forestry 5 (14 ha)
- Forestry 6 (15 ha)
- Forestry 7 (16 ha)
- Forestry 8 (26 ha)
- Forestry 9 (2.3 ha)
- Managed retirement 1 (7 ha)
- Managed retirement 2 (5.5 ha)
- Manawatu Gold Poplars (22 ha)

Date: 1 October 2006	Surveyors:
Property owner(s):	Survey scale: 1:10,000
Property:	Aerial photo: Supplied by Horizons Regional Council (0.75m orthophoto from Terralink). Flown 2004/05.

The versatility of Poplars and Willows

- Poplars and willows are not widely used as a timber tree.
- In addition to erosion control they have many ‘on farm’ uses some of which are:
  - Shade
  - Shelter
  - Fodder
  - Phyto remediation