



Transport
Roads & Maritime
Services

New Zealand Country Amendment NSW RMS Guide to Slope Risk Analysis Version 4, April 2014

Waka Kotahi
12 June 2023
Version 1

Guide to
Slope Risk Analysis
Version 4, April 2014

New Zealand Country Amendment: NSW RMS Guide to Slope Risk Analysis Version 4, April 2014

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1. Introduction

Waka Kotahi, New Zealand Transport Agency, is adopting the New South Wales (NSW) Roads & Maritime Services (RMS) 'Guide to Slope Risk Analysis' Version 4 dated April 2014.

This country amendment identifies country specific changes and sections of the document that are not being used/adopted at the present time.

In essence these are:-

- Embankments and retaining walls sections are not being adopted;
- Modification related to speeds to be adopted in the analysis;
- Soil descriptions to be used; and,
- Slope risk assessment in relation to earthquake and rainfall.

This country amendment details changes using the section and paragraph numbering used in the NSW RMS Guide to Risk Analysis Version 4, for ease of comparison.

Only accredited persons who have completed the Waka Kotahi training course *Slope Risk Analysis* and are accredited by Waka Kotahi may undertake the assessment procedure for Waka Kotahi.

Wherever 'Roads and Maritime Services' or 'Roads and Maritime' are used, they shall be substituted by Waka Kotahi.

It should be noted that the copyright of the NSW RMS 'Guide to Slope Risk Analysis' Version 4 dated April 2014, remains with NSW RMS and its successors.

2. Terminology

'Roads and Maritime Project Manager' to be replaced Waka Kotahi Geotechnical SME (Subject Matter Expert).

5. Risk Analysis – Hazard Identification

Paragraph 2

Add to the end of the paragraph as follows. 'However,conduct the analysis *and make recommendation to Waka Kotahi*.

Paragraph 4

Add to the end of the paragraph as follows. 'Any such.....case basis *and agreed with Waka Kotahi. Generally, lengths should not exceed 250m*'.

5.3.2.2 Embankments

Not used.

5.3.2.3 Retaining Structures

Not used.

5.3.2.4 Retaining Structures and Live Loading Mechanisms

Not used.

6. Risk Analysis – Likelihood Analysis

6.2.1 Detachment Probability for Retaining Structures

Not used.

6.2.2 Detachment Probabilities for Failure of Retaining Structures and Embankment Under Live Loading

Not used.

7. Risk Analysis – Consequence Analysis

7.2.1.1 Allocation of Temporal Probability Rating for Road Users

The AADT (Average Annual Daily Traffic) can be obtained from the Waka Kotahi appointing person, the applicable network manager or through the Waka Kotahi Geotechnical SME.

Table 12 Design stopping sight distances is replaced with the following table for New Zealand highways.

Table 12. Design stopping sight distances

(Source: adapted from Austroads Guide to Road Design 4A for Waka Kotahi adopted reaction times)

Posted Speed (km/h)	Total stopping distance (m)
50	75
60	95
70	115
80	155
90	180
100	210

7.2.2 Vulnerability (V)

NSW RMS uses the 'posted speed limit'. Generally, this will be significantly higher than that which can be achieved in many areas of New Zealand in our mountainous/semi-mountainous areas.

Consequently, in New Zealand the *lower* of the posted speed limit and the speed environment may be adopted. The speed environment is the 85th percentile speed through the area which can be obtained from Waka Kotahi. Clearly state which has been used.

7.2.2.3 Vulnerability for Failures Under Live Loading

Not used

10. Reporting

Insert the following after the first paragraph.

The completed report shall be provided to the Waka Kotahi appointing person and a copy sent to WKARLReports@nzta.govt.nz. Incorporation into the Waka Kotahi Geohazard Management System may also be required and will be specified in appointment award where and when required.

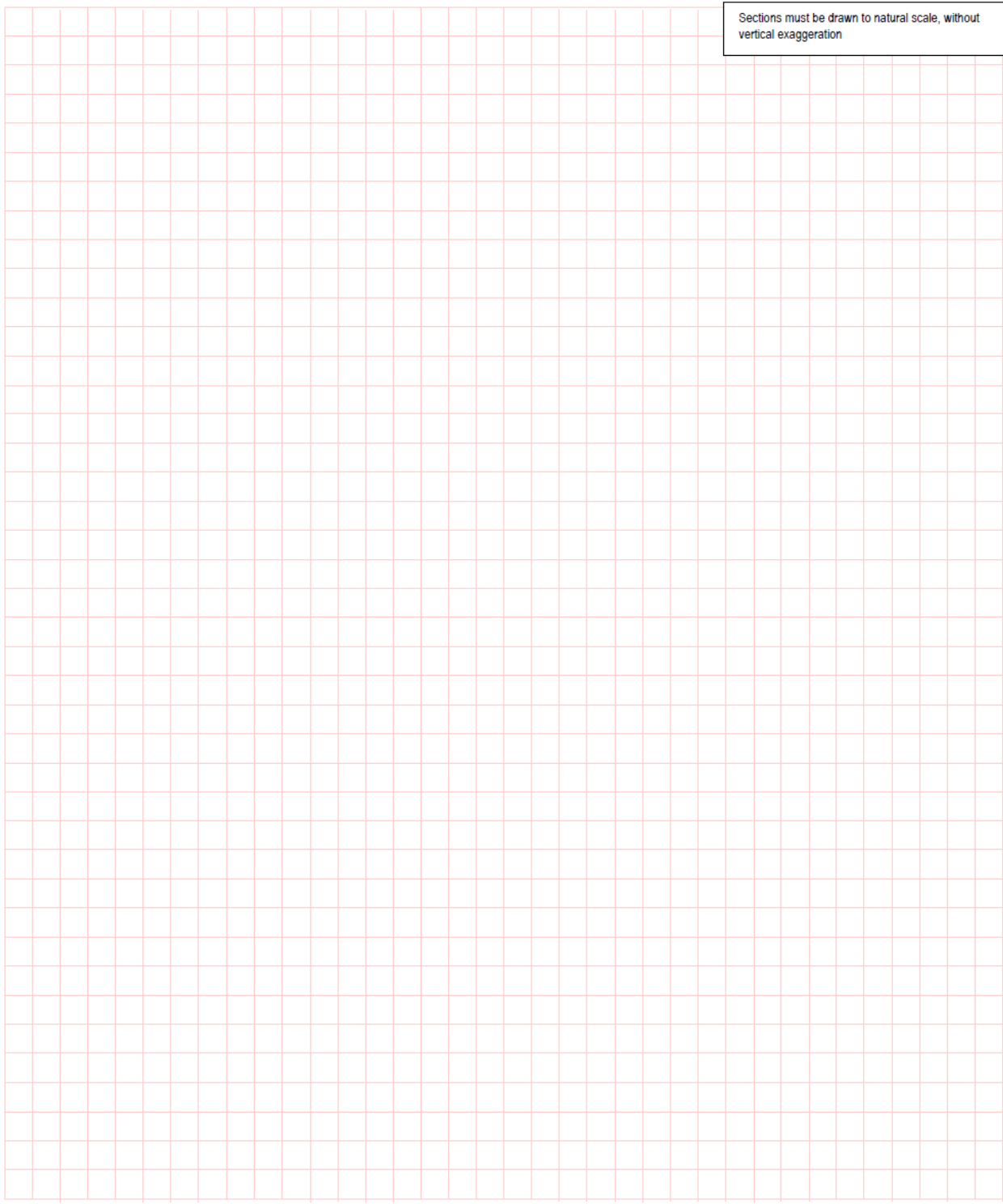
Appendix A

A1.1.1 Location

Slope locations shall be identified by SH/RS/RP and true left/right, together with associated GPS coordinates as identified on Waka Kotahi reporting sheets, examples of which are included in this document.

C. SLOPE FEATURES, GEOLOGY & GEOMORPHOLOGY Slope Identification No:

Sections must be drawn to natural scale, without vertical exaggeration



Notes:

Sketches, cross sections, photo references, describe distribution of materials, weathering profile, characteristics of materials, orientation of defects and their characteristics etc & relate to slope geometry.
Describe failure type and scale, mechanism if possible, maximum block size if relevant, distance travelled by debris if known, any other relevant information. Include any evidence of secondary failure mechanisms.
Include the location of any retaining structures and shotcrete, nails, etc relative to slope features.

Slope Risk Analysis Summary
Report Version NZ 1.0



Slope Identification No.						Date		
Inspection Date		Completed By:			Checked By:			
Slope Data	Slope Class		Max Slope Height (m)		Av. Slope Angle (°)		Material	
		Description:						
A Location								
Route position		State Highway No		Start Routes Station		End Routes Station		L or R?
			Start Route Pos.		End Route Pos.		Length	
GPS Coordinates (NZGD2000) Decimal Degrees to 5 places		Start	Latitude		Longitude		Elevation	
		Finish	Latitude		Longitude		Elevation	
UTM Coordinates		Start	Zone		Easting		Northing	
		Finish	Zone		Easting		Northing	
Plan Reference No./Road Rank					Plan Start Chainage		L or R?	
Locality Name								
Road Data								
		AADT			Year of Count		Speed Limit (km/hr)	
		No of Lanes	Prescribed Direction		Counter Direction		Sight Distance Adequate? (Y/N)	
Risk Analysis								
Hazard/Failure Mechanism	1	2	3	4	5	6	7	8
Hazard Type								
Failure Dynamics Ratings								
Scale of Failure Rating - for Volume (S1 - S5)								
Scale of Failure Rating - for Block Size (S1 - S5)								
Velocity of Failure Rating (R1 - R5)								
Likelihood Rating (L1 - L6)								
Consequence Class Ratings								
Temporal Probability (T1 - T5)								
Vulnerability (V1 - V5)								
Consequence Class for Loss of Life (C1 - C5)								
Consequence Class for property damage etc (C1 - C5)								
Risk Analysis Ratings								
Slope Attribute Score								
Event Magnitude (M1 - M5)								
Hazard Classification (H1 - H5)								
Assessed Risk Level (ARL1 - ARL5)								

Sketches and Photographs

File Name	Caption

Supporting Information

For Each Hazard or Failure Mechanism	1	2	3	4	5	6	7	8
Scale Dimensions for volume								
Length (m)								
Height (m)								
Width (m)								
Estimated volume (m ³)								
Scale dimensions for block size								
Length (m)								
Height (m)								
Width (m)								
Type of triggering mechanism								

Total Score:	A	B	C	D	F	G	H	I	J
---------------------	----------	----------	----------	----------	----------	----------	----------	----------	----------

Monitoring and Management

Inspection Features:

- Specific: Provide details of features requiring inspection eg. Loose blocks, tension cracks, subsidence
- General: Progressive deterioration or development of any of the features described

Instrumentation:

- Existing instrumentation - describe
- Proposed instrumentation - describe

Inspection and Report Interval:

- Routine (casual/intermittent). Specify frequency:
- During/after significant rainfall events (eg 10yr/20yr ARI). Specify Frequency:
- Following significant earth tremors/quakes. Specify Magnitude:
- Defined Interval. Specify frequency:

Responsibility:

- NOC
- SMC
- NZTA

Management:

- Signs
- Temporary barriers
- Lane Closure
- Risk Management Plan

SLOPE ID:

A Slope Geometry							Scoring- total on page 3.			
Overall Slope		Batter Slope		Benches			A1 Slope Angle			
Height (m)	Angle (°)	Height (m)	Angle (°)	Height (m)	Angle (°)	Rock Slope	Score	Soil Slope	Score	
CUT						≥60	10	≥45	20	
EMBANKMENT						≥50	8	≥35	15	
STRUCTURE						≥40	5	≥25	10	
Shoulder/Verge width:		Total Clear Fall Zone Width:				<40	0	<25	5	
Distance to Road Reserve Boundary (If Known):					Weather		A2 Batter Slope Height			
Slope above		Slope below					>30m	20		
Angle		Angle					20-30m	15		
Distance		Distance					10-20m	10		
Material		Material					5-10m	8		
B Evidence of Past Failures Score:		<input type="checkbox"/> YES 5 points		<input type="checkbox"/> NO (0)			<5m	0		
Material		Soil <input type="checkbox"/> Rock <input type="checkbox"/> Composite <input type="checkbox"/> Engineered <input type="checkbox"/>					A3 Total Clear Fall Width			
Mechanism		Fall <input type="checkbox"/> Topple <input type="checkbox"/> Wedge <input type="checkbox"/> Slide <input type="checkbox"/> Rotational <input type="checkbox"/>					>5m	0		
		Slide <input type="checkbox"/> Spread <input type="checkbox"/> Avalanche <input type="checkbox"/> Translational <input type="checkbox"/>					2-5m	5		
		Debris Flow <input type="checkbox"/> Other: _____					<5m	10		
C Potentially Adverse Features (typical score)							A4 Angle of Nat. Slope Above/below			
Rock Features							Rock Slope	Score	Soil Slope	Score
Loose Blocks/Boulders (10) <input type="checkbox"/>		Erodible Seams (5) <input type="checkbox"/>		Max. for rock slope is 55.			≥70	5	≥45	5
Tension Cracks (10) <input type="checkbox"/>		Vegetation in defects (5) <input type="checkbox"/>					≥60	4	≥35	4
Overhangs /Voids (10) <input type="checkbox"/>		Number					≥50	2	≥25	2
Shear/Fracture zones (10) <input type="checkbox"/>		Many (10) <input type="checkbox"/>					<50	0	<25	0
Spalling (5) <input type="checkbox"/>		Some (5) <input type="checkbox"/>								
Newly Constructed <input type="checkbox"/>		No adverse features (0) <input type="checkbox"/>								
Soil/Embankment Features							C Potentially Adverse Features Total Score			
Tension Cracks (20) <input type="checkbox"/>		Toe heave (20) <input type="checkbox"/>		Max. for soil slope is 80.			D Potentially Adverse Discontinuities Total Score			
Bulging (20) <input type="checkbox"/>		Hummocky Ground (20) <input type="checkbox"/>					E Installed Drainage Total Score			
Surface Deformation (10) <input type="checkbox"/>		Damage to Structures (20) <input type="checkbox"/>					F Water Carrying Services			
Erosion at toe (10) <input type="checkbox"/>		New Construction <input type="checkbox"/>					Water Mains <input type="checkbox"/>			
Number Many (10) <input type="checkbox"/>		Some (5) <input type="checkbox"/>					Sewer Pipes <input type="checkbox"/>			
D Potentially Adverse Discontinuities (typical score)							Irrigation <input type="checkbox"/>			
Rock Defects							Domestic water Supply <input type="checkbox"/>			
Planes (10) <input type="checkbox"/>		Condition		Max. Score is 45			Stormwater Drains <input type="checkbox"/>			
Wedges (10) <input type="checkbox"/>		Tight/Clean (0) <input type="checkbox"/>					Farm Dam <input type="checkbox"/>			
Potential toppling (10) <input type="checkbox"/>		Open/weathered/infilled (5) <input type="checkbox"/>					Reservoir <input type="checkbox"/>			
Number Many (10) <input type="checkbox"/>		Some (5) <input type="checkbox"/>					None <input type="checkbox"/>			
		None (0) <input type="checkbox"/>					Visible or marked <input type="checkbox"/>			
E Installed Drainage (typical scores)							Inferred <input type="checkbox"/>			
Surface Drains							From plans <input type="checkbox"/>			
Above batter slope: Lined <input type="checkbox"/>		Good conditions (0) <input type="checkbox"/>		Max. Score is 10			Water Mains Present (5) <input type="checkbox"/>			
Unlined <input type="checkbox"/>		None (5) <input type="checkbox"/>					No stormwater drainage (5) <input type="checkbox"/>			
Toe drains: Lined <input type="checkbox"/>		Type:					Max. Score (worst conditions) = 10			
Unlined <input type="checkbox"/>		None (5) <input type="checkbox"/>								
Culverts present <input type="checkbox"/> YES <input type="checkbox"/> NO		Size (mm):								
Condition of storm water drainage: Satisfactory (0) <input type="checkbox"/>		Unsatisfactory (10) <input type="checkbox"/>								
Separation of joints <input type="checkbox"/>		Misalignment <input type="checkbox"/>								
Cracking <input type="checkbox"/>		Under size <input type="checkbox"/>		F Water carrying services Total Score						
Deformed pipes <input type="checkbox"/>		Erosion <input type="checkbox"/>		G Conditions Affecting Infiltration Potential Total Score						
Headwall Damage <input type="checkbox"/>		Erosion <input type="checkbox"/>		H Seepage Total Score (max. 10)						
Comment										
Piped Drains: At toe of Batter <input type="checkbox"/>										
Along Median <input type="checkbox"/>										
Transverse <input type="checkbox"/>										
Subsurface Drainage										
Pavement Drainage <input type="checkbox"/>		Horizontal drains <input type="checkbox"/>		Subsoil Drains <input type="checkbox"/>						
Weepholes present in: Retaining structures <input type="checkbox"/>		Shotcrete <input type="checkbox"/>								
Drainage system behind retaining structures <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> UNKNO										
Geotextile composite drains under shotcrete <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> UNKNO										
Blocked weepholes/drains (5) <input type="checkbox"/>		Damaged drainage structures (5-10) <input type="checkbox"/>								
G Conditions Affecting Infiltration Potential (typical scores)										
No adverse condition (0) <input type="checkbox"/>		Tension Cracks (5) <input type="checkbox"/>		Open Joints (5) <input type="checkbox"/>						
Ponding on ground Surface/open drains (5) <input type="checkbox"/>		Leakage from services (5) <input type="checkbox"/>								
Blocked or damaged culverts (5) <input type="checkbox"/>		Surface drainage discharged on slope (5) <input type="checkbox"/>								
Blocked or damaged subsurface drainage <input type="checkbox"/>				Max. Score for Rock = 10						
Impounded water above slope or against slope <input type="checkbox"/>				for soil = 15						
Vegetation cover: None <input type="checkbox"/>		Dense <input type="checkbox"/>		Sparse <input type="checkbox"/>						
H Seepage										
None (0) <input type="checkbox"/>		From Installed subsurface drains: Weepholes <input type="checkbox"/>		Horizontal Drains <input type="checkbox"/>			Subsoil Drains <input type="checkbox"/>			
Slight (5) <input type="checkbox"/>		From elsewhere: Slope surface <input type="checkbox"/>		Defect surface <input type="checkbox"/>			Cracks in shotcrete <input type="checkbox"/>			
Heavy (10) <input type="checkbox"/>		Seepage water condition: Clear <input type="checkbox"/>		Muddy/Cloudy <input type="checkbox"/>			Clogged <input type="checkbox"/>			
Previous (5) <input type="checkbox"/>		Volume: Slight <input type="checkbox"/>		Mod. <input type="checkbox"/>			High <input type="checkbox"/>			
		Continuous <input type="checkbox"/>		Intermittent <input type="checkbox"/>			Rate?: _____			
		Changes from previous: no previous obs/New points/volume change/condition change/Cessation of previous								

SLOPE ID:

I Installed measures and their Condition (typical scoring)			
Describe the extent of damage/distress to installed measures on the sketches. Also any access restrictions or other features.			
NONE INSTALLED (0) <input type="checkbox"/>			
<i>Retaining Structures</i>			
Type *	Length (m)	Height (m)	
*Masonry/Reinforced Concrete/Gabion/RSW/Other			
Shotcrete <input type="checkbox"/>	Rock Bolts <input type="checkbox"/>	Fences/Barriers <input type="checkbox"/>	Soils Nails <input type="checkbox"/> Rock Fall Mesh: Draped <input type="checkbox"/> Fixed <input type="checkbox"/>
Anchors <input type="checkbox"/>	Dowels <input type="checkbox"/>	Signs <input type="checkbox"/> Monitoring <input type="checkbox"/>	Access Restrictions <input type="checkbox"/>
Other (Describe):			
Estimate area Shotcrete:	Est. qty: Anchor/Soil Nails:	Est. area Mesh:	Est. qty Rock bolts/Dowels:
Information from:			
Observation <input type="checkbox"/> Anecdotal <input type="checkbox"/> Search <input type="checkbox"/> Inferred <input type="checkbox"/>			
Condition			
All in generally Good Condition (0) <input type="checkbox"/>			
<i>Retaining Structures</i>			
Cracking (10) <input type="checkbox"/>	Bulging (10) <input type="checkbox"/>	Tilting (10) <input type="checkbox"/>	Sliding (10) <input type="checkbox"/> Settlement (10) <input type="checkbox"/> Corrosion (5) <input type="checkbox"/> Seepage through face (5) <input type="checkbox"/>
Seepage at or below toe (5) <input type="checkbox"/>			
<i>Shotcrete</i>			
Cracking (10) <input type="checkbox"/>	Seepage through cracks (5) <input type="checkbox"/>	Seepage at or below toe (5) <input type="checkbox"/>	Corrosion/acid attack (5) <input type="checkbox"/> Displacement (10) <input type="checkbox"/>
<i>Anchors/rock bolts/dowels/soil nails</i>			
Corrosion (5) <input type="checkbox"/>	Loss of Bond (10) <input type="checkbox"/>	Loss of Tension (10) <input type="checkbox"/>	Loose Plate (10) <input type="checkbox"/>
<i>Mesh/fence/barriers</i>			
Anchorage failure (10) <input type="checkbox"/>	Corrosion (5-10) <input type="checkbox"/>	Damage from impact (5-10) <input type="checkbox"/>	Accumulation of debris (5) <input type="checkbox"/>
Other:			
Scoring I Installed measures and their Condition Max. 70			
J Potentially Affected Development or Features (typical scores)			
<i>General Nature of Adjacent Development</i>			
Residential <input type="checkbox"/>	Industrial/Commercial <input type="checkbox"/>	Open Space <input type="checkbox"/>	NO DEVELOPMENT (0) <input type="checkbox"/> Nat. Park/Reserve/Water storage Catchment <input type="checkbox"/>
<i>Specific Development Features</i>			
Development Type	Distance from Road		Development Type
	Above (m)	Below (m)	
Regularly Occupied Buildings (10)			Water Supply (5)
-Domestic/Residential			-Mains
-Commercial/Residential			-Local
-Educational			Gas Supply (5)
-Offices			-Mains
-Industrial			-Local
-Other:			Telecommunications (5)
Normally unoccupied buildings (5)			-Telephone
-Storage			-Coaxial/fibre optic cable/NBN
-Automatic infrastructure			-Mobile Phone/microwave
Facilities			Carparks (5)
-Abandoned			Footpaths/cycleways (5)
-Other (describe):			Water Storage (5)
Other Roads (10)			Water storage structures (5)
Railways (10)			Other specify:
Power Distribution (5)			Public open space in regular use (5)
-Mains			Rural/Agriculture (2)
-Local			Forest (2)
-Above ground (poles/towers)			Other Open Space (2)
-Underground			Waterways/National Parks
Scoring J Potentially Affected Development or Features Max. 10			
Possible Remedial Measures			
Cutting			
<i>Removal/Reconstructions options:</i>		<i>Scale Down</i>	
<input type="checkbox"/> Remove selected blocks <input type="checkbox"/> Regrade Slope <input type="checkbox"/> Realign		<input type="checkbox"/> Local <input type="checkbox"/> Extensive <input type="checkbox"/> Remove vegetation	
<i>Mesh</i>		<i>Shotcrete</i>	
<input type="checkbox"/> Draped <input type="checkbox"/> Fixed <input type="checkbox"/> Mixed <input type="checkbox"/> Attenuation		<input type="checkbox"/> Structural <input type="checkbox"/> Surface Protection <input type="checkbox"/> Soil Nails	
<i>Rock face Support</i>		<i>Fences/Barriers</i>	
<input type="checkbox"/> Rock Bolts <input type="checkbox"/> Dowels <input type="checkbox"/> Rock Anchors		<input type="checkbox"/> Concrete Barrier <input type="checkbox"/> Other Rigid Barrier <input type="checkbox"/> Elastic Barrier <input type="checkbox"/> Bund	
<i>Drainage</i>			
<input type="checkbox"/> Surface <input type="checkbox"/> Shoulder <input type="checkbox"/> Batter <input type="checkbox"/> Toe <input type="checkbox"/> Crest		<input type="checkbox"/> Subsoil Drains <input type="checkbox"/> Trench Drains <input type="checkbox"/> Wells	
<input type="checkbox"/> Blanket Drains <input type="checkbox"/> Clean/Clear/Repair Existing drainage		<input type="checkbox"/> Horizontal Drains	
<i>Embankment</i>			
<i>Reconstruction options:</i>			
<input type="checkbox"/> Flatten Batter <input type="checkbox"/> Toe Berm		<input type="checkbox"/> Widen <input type="checkbox"/> Toe Wall <input type="checkbox"/> Remove/reconstruct <input type="checkbox"/> Other	
<i>Drainage Controls</i>			
<input type="checkbox"/> Seal tension cracks <input type="checkbox"/> Seal/improve shoulder <input type="checkbox"/> Extend/improve culvert or pipe outlets on batter		<input type="checkbox"/> Add kerbing	
<input type="checkbox"/> Improve surface drainage at toe <input type="checkbox"/> Horizontal Drains <input type="checkbox"/> Trench Drains		<input type="checkbox"/> Clean/Clear/Repair Existing drainage	
<input type="checkbox"/> Verify capacity of culvert(s) - hydraulic analysis			
<i>Measures are considered:</i>			
<input type="checkbox"/> Definable from a more detailed inspection		<input type="checkbox"/> Require geotechnical investigation and design	

Appendix C

A modified version of Appendix C is provided on the Waka Kotahi ARL Course and shall be used for New Zealand sites. The changes relate to removal of tables related to retaining walls and embankments: there are no changes to any of the remaining tables.

Appendix D

The descriptive terms for soils and rocks in Appendix D is substituted with *NZ Geotechnical Society Field Description of Soil and Rock, December 2005*.

Appendix E

Not used