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MEMORANDUM

To:

From: Tapuwa Marapara

Date: 29/04/2022

Re: Science approach to assigning Nitrogen (N) and Phosphorus (P) baseload loss values to farm typologies and other categories of land use

Name	Role	Date Completed
Tapuwa Marapara	Author	29/04/2022
Graeme Doole (AgResearch Ltd)	External Reviewer	10/10/2022

Purpose

This memo documents the estimated N and P loss for different typologies (different combinations of land use, climate, and topography).

Background

Development of the Land and Water Regional Plan (LWRP) requires the science team to provide effective environmental management strategies that improve water quality across the Otago region. Development of effective environmental management strategies is guided by the understanding of connections between contaminant sources and receiving environments, i.e., where contaminants originate from, within the catchments and their pathway to receiving waters.

Landscape characteristics such as topography, soil and climate influence the vulnerability risk of contaminant transport to water, while a diverse set of farm inputs, feedstock and soil management practices influence land use pressures that determine contaminant pathways. Aligning landscape characteristics (topography, soil and climate) with land use pressures (land use activity/farm type) provides 'typologies' (Monaghan et al., 2021; Srinivasan et al., 2021)

to which contaminant (N & P) discharges can be benchmarked. Knowing the variation of N & P loss across various typologies enables the alignment of management strategies with spatial extents of land use pressures and landscape features that determine vulnerability (Monaghan et al., 2021).

Farm/land use typology approach

New Zealand modelled and assumed values for N & P on-land annual losses (kg/ha/yr) in combined drainage and surface runoff flows were assigned to land use typologies that represent the Otago region. Otago's land use typologies were developed by combining spatial datasets of climate (rainfall and soil temperature), topography (slope), soil properties (e.g., drainage class) and land use (e.g., sheep, dairy, forestry, deer and others), all of which influence N & P losses from land to water. The combination of the spatial datasets led to the identification of 166 possible land use typologies for Otago (**Insert 2**).

The N & P loss values that were assigned to the Otago's typologies are based on the modelled and assumed values of pastoral and non-pastoral land use typologies derived from Table 3 in Srinivasan et al. (2021) (**Insert 1**) and the framework developed by Monaghan et al. (2021). The assigning process of N & P loss values was also guided by expert knowledge (Dr Ross Monaghan) and another NZ-based study (Drewry, 2018) for land use typologies that were not provided in the table by Srinivasan et al. (2021) (**Insert 1**). It is worth noting that there is more confidence with N loss estimates than P loss values which are P loss "risk" estimates. Also evident in **Insert 1** are the wide ranges of N and P loss per land use typology. While the typology approach uses a value of central tendency to represent losses from different land use activities, it also recognises that within any typology there can be a reasonably wide range of contaminant losses due to land management decisions and ranges in vulnerability factors (soil, topography and climate).

Insert 1 Image of Table 3 with N&P loss values for typologies from Srinivasan et al. (2021)

Table 3. Inventory of modelled and assumed yields of N and P for pastoral farm typologies and other categories of land use or cover. Values are assumed to represent N and P losses in combined drainage and surface runoff flows, although it should be recognised that studies (measured and modelled) did not always measure or model secondary pathways of loss; further details can be found in [Monaghan et al. \(in preparation\)](#) and [Drewry \(2018\)](#).

Land use	Slope	Moisture	N loss (kg N ha ⁻¹ y ⁻¹)		P loss (kg P ha ⁻¹ y ⁻¹)		
			Median	Range*	Median	Range*	
Dairy	Flat	Dry	29.5	23–38	0.85	0.6–1.2	
		Moist	39	29–45	1.05	0.6–1.4	
		Wet	48.5	34–55	1.25	0.6–1.4	
		Irrigated	55.5	33–82	0.95	0.8–1.1	
	Rolling	Dry	27	22–36	1.0	0.9–1.6	
		Moist	32	25–44	1.5	0.9–1.9	
		Wet	45	28–53	1.8	0.9–1.9	
	Easy Hill	Irrigated	52	29–63	1.3	1.1–1.6	
		Dry	28	26–36	1.0	0.9–1.6	
		Moist	32	25–44	1.5	0.9–1.9	
	Sheep / Sheep & Beef	Flat	Wet	45	28–53	1.8	0.9–1.9
			Irrigated	52	29–63	1.3	1.1–1.6
Dry			7		0.4		
Moist			18	15–21	0.6		
Rolling		Wet	24	18–30	0.75	0.7–0.8	
		Irrigated	20	17–23	0.6		
		Dry	7.5	7–8	0.35	0.3–0.4	
Easy Hill		Moist	11.5	9–14	0.7		
		Wet	17.5	11–24	0.8		
		Irrigated	11.5	9–14	0.7		
Steep		Dry	5	4–6	0.5		
		Moist	8.5	8–9	1.0		
	Wet	9	7–11	1.6			
Beef	Flat	Dry	4.5	4–5	0.6		
		Moist	6	4–8	1.6		
		Wet	6.5	5–8	2.8		
	Rolling	Dry	13		0.6		
		Moist	32	27–37	0.7		
		Wet	38	32–44	1.15	1.0–1.3	
		Irrigated	34.5	29–40	0.8		
		Dry	13	12–14	0.5		
		Moist	20.5	15–26	0.9		
	Easy Hill	Wet	27	20–34	1.2		
		Irrigated	20.5	15–26	1.2		
		Dry	9	7–11	0.7		
Steep	Moist	15.5	14–17	1.5			
	Wet	15.5	12–19	2.4			
	Dry	8	6–10	1.0			
Deer	All	Moist	10.5	8–13	2.4		
		Wet	12	10–14	4.3		
		Dry	7	7–9	0.75	0.2–1.0	
	Other pastoral support land used for winter forage crop grazing	Moist	12	9–12	1.9	0.4–2.8	
		Wet	18		0.8	0.6–1.0	
		Dry	17	17–18	0.35	0.3–0.4	
	Arable and mixed Crops	Flat	Moist	41	32–41	0.65	0.5–0.8
			Wet	49	39–49	1.0	0.8–2.0
			Irrigated	36	31–45	0.7	0.6–0.8
		Rolling	Dry	17	17–19	0.4	0.3–0.4
			Moist	33	25–36	0.8	0.7–0.8
			Wet	45	33–45	1.4	0.8–2.1
Vegetable growing	Irrigated	35	31–36	0.8	0.7–1.0		
	Flat	All	13.5	1–113	0.1	0.1–2.9	
	Flat	All	72	2–220	1.9		
Viticulture	Flat	Unknown	10	1–37	0.2	0.1–0.5	

Table 3. Continued.

Land use	Slope	Moisture	N loss (kg N ha ⁻¹ y ⁻¹)		P loss (kg P ha ⁻¹ y ⁻¹)	
			Median	Range*	Median	Range*
Forestry	All	All	4	1–28	0.4	0.1–1.3
Native Bush	All	All	2	1–7.1	0.3	0.1–0.6

*Ranges reflect variation caused by contrasting soil drainage and temperature typology attributes.

Insert 2 Land use typologies and their associated N & P losses for Otago Region. N & P values are based on Srinivasan et al. (2021), Expert opinion (Ross Monaghan) and Drewry, (2018)

Land_Use	Wetness	Slope	N loss (kg N/ha/yr)	P loss (kg P/ha/yr)
Arable		Flat/Undulating (<7°)	13.5	0.1
Arable	Dry	Easy Hill (15-25°)	13.5	0.1
Arable	Dry	Flat/Undulating (<7°)	13.5	0.1
Arable	Dry	Rolling (7-15°)	13.5	0.1
Arable	Dry	Steep (>25°)	13.5	0.1
Arable	Irrigated (>50%)	Easy Hill (15-25°)	13.5	0.1
Arable	Irrigated (>50%)	Rolling (7-15°)	13.5	0.1
Arable	Irrigated (>50%)	Steep (>25°)	13.5	0.1
Arable	Irrigated (>50%)	Flat/Undulating (<7°)	13.5	0.1
Arable	Irrigated (>50%)		13.5	0.1
Arable	Moist	Easy Hill (15-25°)	13.5	0.1
Arable	Moist	Flat/Undulating (<7°)	13.5	0.1
Arable	Moist	Rolling (7-15°)	13.5	0.1
Beef		Flat/Undulating (<7°)	13	0.6
Beef		Rolling (7-15°)	13	0.5
Beef	Dry		9	0.7
Beef	Dry	Easy Hill (15-25°)	9	0.7
Beef	Dry	Flat/Undulating (<7°)	13	0.6
Beef	Dry	Rolling (7-15°)	13	0.5
Beef	Dry	Steep (>25°)	8	1
Beef	Irrigated (>50%)	Easy Hill (15-25°)	15.5	1.5
Beef	Irrigated (>50%)	Flat/Undulating (<7°)	34.5	0.8
Beef	Irrigated (>50%)	Rolling (7-15°)	20.5	1.2
Beef	Irrigated (>50%)	Steep (>25°)		
Beef	Moist	Easy Hill (15-25°)	15.5	1.5

Beef	Moist	Flat/Undulating (<7°)	32	0.7
Beef	Moist	Rolling (7-15°)	20.5	0.9
Beef	Moist	Steep (>25°)	10.5	2.4
Beef	Wet	Easy Hill (15-25°)	15.5	2.4
Beef	Wet	Flat/Undulating (<7°)	38	1.15
Beef	Wet	Rolling (7-15°)	27	1.2
Commercial Use		Flat/Undulating (<7°)	5	1
Commercial Use			5	1
Commercial Use		Rolling (7-15°)	5	1
Commercial Use	Dry	Flat/Undulating (<7°)	5	1
Commercial Use	Dry	Easy Hill (15-25°)	5	1
Commercial Use	Dry	Rolling (7-15°)	5	1
Commercial Use	Dry	Steep (>25°)	5	1
Commercial Use	Moist	Flat/Undulating (<7°)	5	1
Commercial Use	Moist	Rolling (7-15°)	5	1
Commercial Use	Moist	Easy Hill (15-25°)	5	1
Commercial Use	Moist	Steep (>25°)	5	1
Commercial Use	Wet	Flat/Undulating (<7°)	5	1
Conservation			2	0.3
Conservation		Easy Hill (15-25°)	2	0.3
Conservation		Flat/Undulating (<7°)	2	0.3
Conservation		Rolling (7-15°)	2	0.3
Conservation		Steep (>25°)	2	0.3
Conservation	Dry		2	0.3
Conservation	Dry	Easy Hill (15-25°)	2	0.3
Conservation	Dry	Flat/Undulating (<7°)	2	0.3
Conservation	Dry	Rolling (7-15°)	2	0.3
Conservation	Dry	Steep (>25°)	2	0.3
Conservation	Irrigated (>50%)	Flat/Undulating (<7°)	2	0.3
Conservation	Irrigated (>50%)	Rolling (7-15°)	2	0.3
Conservation	Moist		2	0.3
Conservation	Moist	Easy Hill (15-25°)	2	0.3
Conservation	Moist	Flat/Undulating (<7°)	2	0.3
Conservation	Moist	Rolling (7-15°)	2	0.3
Conservation	Moist	Steep (>25°)	2	0.3
Conservation	Wet		2	0.3
Conservation	Wet	Easy Hill (15-25°)	2	0.3

Conservation	Wet	Flat/Undulating (<7°)	2	0.3
Conservation	Wet	Rolling (7-15°)	2	0.3
Conservation	Wet	Steep (>25°)	2	0.3
Dairy		Flat/Undulating (<7°)	29.5	0.85
Dairy		Rolling (7-15°)	27	1
Dairy		Easy Hill (15-25°)	28	1
Dairy	Dry		29.5	0.85
Dairy	Dry	Easy Hill (15-25°)	28	1
Dairy	Dry	Flat/Undulating (<7°)	29.5	0.85
Dairy	Dry	Rolling (7-15°)	27	1
Dairy	Dry	Steep (>25°)	5	1
Dairy	Irrigated (>50%)		55.5	0.95
Dairy	Irrigated (>50%)	Easy Hill (15-25°)	52	1.3
Dairy	Irrigated (>50%)	Flat/Undulating (<7°)	55.5	0.95
Dairy	Irrigated (>50%)	Rolling (7-15°)	52	1.3
Dairy	Irrigated (>50%)	Steep (>25°)	5	1
Dairy	Moist		39	1.05
Dairy	Moist	Easy Hill (15-25°)	32	1.5
Dairy	Moist	Flat/Undulating (<7°)	39	1.05
Dairy	Moist	Steep (>25°)	5	1
Dairy	Moist	Rolling (7-15°)	32	1.5
Dairy Support	Dry	Easy Hill (15-25°)	17	0.4
Dairy Support	Dry	Flat/Undulating (<7°)	17	0.4
Dairy Support	Dry	Rolling (7-15°)	17	0.4
Dairy Support	Dry	Steep (>25°)	17	0.4
Dairy Support	Dry		17	0.4
Dairy Support	Irrigated (>50%)	Easy Hill (15-25°)	17	0.4
Dairy Support	Irrigated (>50%)	Flat/Undulating (<7°)	17	0.4
Dairy Support	Irrigated (>50%)	Rolling (7-15°)	17	0.4
Exotic Forestry		Flat/Undulating (<7°)	4	0.4
Exotic Forestry		Easy Hill (15-25°)	4	0.4
Exotic Forestry		Rolling (7-15°)	4	0.4
Exotic Forestry	Dry		4	0.4
Exotic Forestry	Dry	Easy Hill (15-25°)	4	0.4
Exotic Forestry	Dry	Flat/Undulating (<7°)	4	0.4
Exotic Forestry	Dry	Rolling (7-15°)	4	0.4
Exotic Forestry	Dry	Steep (>25°)	4	0.4
Exotic Forestry	Irrigated (>50%)	Easy Hill (15-25°)	4	0.4

Exotic Forestry	Irrigated (>50%)	Flat/Undulating (<7°)	4	0.4
Exotic Forestry	Irrigated (>50%)	Rolling (7-15°)	4	0.4
Exotic Forestry	Moist		4	0.4
Exotic Forestry	Moist	Easy Hill (15-25°)	4	0.4
Exotic Forestry	Moist	Flat/Undulating (<7°)	4	0.4
Exotic Forestry	Moist	Rolling (7-15°)	4	0.4
Exotic Forestry	Moist	Steep (>25°)	4	0.4
Exotic Forestry	Wet	Flat/Undulating (<7°)	4	0.4
Exotic Forestry	Wet	Rolling (7-15°)	4	0.4
Horticulture	Dry	Easy Hill (15-25°)	72	1.9
Horticulture	Dry	Flat/Undulating (<7°)	72	1.9
Horticulture	Dry	Rolling (7-15°)	72	1.9
Horticulture	Dry	Steep (>25°)	72	1.9
Horticulture	Irrigated (>50%)	Easy Hill (15-25°)	72	1.9
Horticulture	Irrigated (>50%)	Flat/Undulating (<7°)	72	1.9
Horticulture	Irrigated (>50%)	Rolling (7-15°)	72	1.9
Horticulture	Irrigated (>50%)	Steep (>25°)	72	1.9
Industrial Use			5	1
Industrial Use		Flat/Undulating (<7°)	5	1
Industrial Use		Easy Hill (15-25°)	5	1
Industrial Use		Rolling (7-15°)	5	1
Industrial Use		Steep (>25°)	5	1
Industrial Use	Dry		5	1
Industrial Use	Dry	Easy Hill (15-25°)	5	1
Industrial Use	Dry	Flat/Undulating (<7°)	5	1
Industrial Use	Dry	Rolling (7-15°)	5	1
Industrial Use	Dry	Steep (>25°)	5	1
Industrial Use	Moist	Easy Hill (15-25°)	5	1
Industrial Use	Moist	Flat/Undulating (<7°)	5	1
Industrial Use	Moist	Rolling (7-15°)	5	1
Industrial Use	Moist	Steep (>25°)	5	1
Lifestyle Block			5	1
Lifestyle Block		Easy Hill (15-25°)	5	1
Lifestyle Block		Flat/Undulating (<7°)	5	1
Lifestyle Block		Rolling (7-15°)	5	1
Lifestyle Block		Steep (>25°)	5	1
Lifestyle Block	Dry		5	1
Lifestyle Block	Dry	Easy Hill (15-25°)	5	1

Lifestyle Block	Dry	Flat/Undulating (<7°)	5	1
Lifestyle Block	Dry	Rolling (7-15°)	5	1
Lifestyle Block	Dry	Steep (>25°)	5	1
Lifestyle Block	Irrigated (>50%)	Flat/Undulating (<7°)	5	1
Lifestyle Block	Irrigated (>50%)	Rolling (7-15°)	5	1
Lifestyle Block	Irrigated (>50%)	Easy Hill (15-25°)	5	1
Lifestyle Block	Irrigated (>50%)	Steep (>25°)	5	1
Lifestyle Block	Moist		5	1
Lifestyle Block	Moist	Easy Hill (15-25°)	5	1
Lifestyle Block	Moist	Flat/Undulating (<7°)	5	1
Lifestyle Block	Moist	Rolling (7-15°)	5	1
Lifestyle Block	Moist	Steep (>25°)	5	1
Lifestyle Block	Wet	Easy Hill (15-25°)	5	1
Lifestyle Block	Wet	Flat/Undulating (<7°)	5	1
Lifestyle Block	Wet	Rolling (7-15°)	5	1
Livestock Support		Flat/Undulating (<7°)	17	0.4
Livestock Support		Rolling (7-15°)	17	0.4
Livestock Support	Dry		17	0.4
Livestock Support	Dry	Easy Hill (15-25°)	17	0.4
Livestock Support	Dry	Flat/Undulating (<7°)	17	0.35
Livestock Support	Dry	Rolling (7-15°)	17	0.4
Livestock Support	Dry	Steep (>25°)	17	0.4
Livestock Support	Irrigated (>50%)	Flat/Undulating (<7°)	36	0.7
Livestock Support	Irrigated (>50%)	Rolling (7-15°)	35	0.8
Livestock Support	Irrigated (>50%)	Easy Hill (15-25°)	35	0.8
Livestock Support	Irrigated (>50%)	Steep (>25°)	5	1
Livestock Support	Moist	Flat/Undulating (<7°)	41	0.65
Livestock Support	Moist	Rolling (7-15°)	33	0.8
Livestock Support	Moist	Easy Hill (15-25°)	33	0.8
Livestock Support	Moist	Steep (>25°)	5	1
Majority Deer with Mixed Livestock	Dry		7	0.75
Majority Deer with Mixed Livestock	Dry	Easy Hill (15-25°)	7	0.75
Majority Deer with Mixed Livestock	Dry	Flat/Undulating (<7°)	7	0.75
Majority Deer with Mixed Livestock	Dry	Rolling (7-15°)	7	0.75
Majority Deer with Mixed Livestock	Dry	Steep (>25°)	7	0.75

Majority Deer with Mixed Livestock	Irrigated (>50%)	Flat/Undulating (<7°)	12	1.9
Majority Deer with Mixed Livestock	Irrigated (>50%)	Rolling (7-15°)	12	1.9
Majority Deer with Mixed Livestock	Irrigated (>50%)	Easy Hill (15-25°)	12	1.9
Majority Deer with Mixed Livestock	Irrigated (>50%)	Steep (>25°)		
Majority Deer with Mixed Livestock	Moist	Flat/Undulating (<7°)	12	1.9
Majority Deer with Mixed Livestock	Moist	Rolling (7-15°)	12	1.9
Majority Deer with Mixed Livestock	Moist	Easy Hill (15-25°)	12	1.9
Mixed Livestock	Dry		7	0.4
Mixed Livestock	Dry	Easy Hill (15-25°)	5	0.5
Mixed Livestock	Dry	Flat/Undulating (<7°)	7	0.4
Mixed Livestock	Dry	Rolling (7-15°)	7.5	0.4
Mixed Livestock	Dry	Steep (>25°)	4.5	0.6
Mixed Livestock	Irrigated (>50%)	Flat/Undulating (<7°)	18	0.6
Mixed Livestock	Irrigated (>50%)	Rolling (7-15°)	12	0.7
Mixed Livestock	Irrigated (>50%)	Easy Hill (15-25°)	9	1
Mixed Livestock	Irrigated (>50%)	Steep (>25°)	6	1.6
Mixed Livestock	Moist		18	0.6
Mixed Livestock	Moist	Easy Hill (15-25°)	9	1
Mixed Livestock	Moist	Flat/Undulating (<7°)	18	0.6
Mixed Livestock	Moist	Rolling (7-15°)	12	0.7
Mixed Livestock	Moist	Steep (>25°)	6	1.6
Mixed Livestock	Wet	Easy Hill (15-25°)	9	1
Mixed Livestock	Wet	Flat/Undulating (<7°)	18	0.6
Mixed Livestock	Wet	Rolling (7-15°)	12	0.7
Mixed Livestock	Wet	Steep (>25°)	6	1.6
Nurseries & Orchards	Dry		10	0.2
Nurseries & Orchards	Dry	Easy Hill (15-25°)	10	0.2
Nurseries & Orchards	Dry	Flat/Undulating (<7°)	10	0.2
Nurseries & Orchards	Dry	Rolling (7-15°)	10	0.2
Nurseries & Orchards	Dry	Steep (>25°)	10	0.2
Nurseries & Orchards	Irrigated (>50%)	Easy Hill (15-25°)	10	0.2
Nurseries & Orchards	Irrigated (>50%)	Flat/Undulating (<7°)	10	0.2
Nurseries & Orchards	Irrigated (>50%)	Rolling (7-15°)	10	0.2
Other Animals			5	1
Other Animals		Flat/Undulating (<7°)	5	1

Other Animals		Rolling (7-15°)	5	1
Other Animals		Easy Hill (15-25°)	5	1
Other Animals		Steep (>25°)	5	1
Other Animals	Dry		5	1
Other Animals	Dry	Easy Hill (15-25°)	5	1
Other Animals	Dry	Flat/Undulating (<7°)	5	1
Other Animals	Dry	Rolling (7-15°)	5	1
Other Animals	Dry	Steep (>25°)	5	1
Other Animals	Irrigated (>50%)	Flat/Undulating (<7°)	5	1
Other Animals	Irrigated (>50%)	Rolling (7-15°)	5	1
Other Animals	Irrigated (>50%)	Easy Hill (15-25°)	5	1
Other Animals	Irrigated (>50%)	Steep (>25°)	5	1
Other Animals	Moist	Easy Hill (15-25°)	5	1
Other Animals	Moist	Flat/Undulating (<7°)	5	1
Other Animals	Moist	Rolling (7-15°)	5	1
Other Animals	Moist	Steep (>25°)	5	1
Poultry	Dry	Flat/Undulating (<7°)	5	1
Poultry	Dry	Rolling (7-15°)	5	1
Poultry	Dry	Easy Hill (15-25°)	5	1
Poultry	Dry	Steep (>25°)	5	1
Poultry	Irrigated (>50%)	Flat/Undulating (<7°)	5	1
Public Use		Flat/Undulating (<7°)	5	1
Public Use		Rolling (7-15°)	5	1
Public Use	Dry		5	1
Public Use	Dry	Easy Hill (15-25°)	5	1
Public Use	Dry	Flat/Undulating (<7°)	5	1
Public Use	Dry	Rolling (7-15°)	5	1
Public Use	Dry	Steep (>25°)	5	1
Public Use	Moist	Easy Hill (15-25°)	5	1
Public Use	Moist	Steep (>25°)	5	1
Public Use	Moist	Flat/Undulating (<7°)	5	1
Public Use	Moist	Rolling (7-15°)	5	1
Residential Use			5	1
Residential Use		Easy Hill (15-25°)	5	1
Residential Use		Flat/Undulating (<7°)	5	1
Residential Use		Rolling (7-15°)	5	1
Residential Use		Steep (>25°)	5	1
Residential Use	Dry		5	1
Residential Use	Dry	Easy Hill (15-25°)	5	1

Residential Use	Dry	Flat/Undulating (<7°)	5	1
Residential Use	Dry	Rolling (7-15°)	5	1
Residential Use	Dry	Steep (>25°)	5	1
Residential Use	Moist		5	1
Residential Use	Moist	Flat/Undulating (<7°)	5	1
Residential Use	Moist	Easy Hill (15-25°)	5	1
Residential Use	Moist	Rolling (7-15°)	5	1
Residential Use	Moist	Steep (>25°)	5	1
Residential Use	Wet	Easy Hill (15-25°)	5	1
Residential Use	Wet	Flat/Undulating (<7°)	5	1
Residential Use	Wet	Rolling (7-15°)	5	1
Road & Rail			5	1
Road & Rail		Easy Hill (15-25°)	5	1
Road & Rail		Flat/Undulating (<7°)	5	1
Road & Rail		Rolling (7-15°)	5	1
Road & Rail		Steep (>25°)	5	1
Road & Rail	Dry		5	1
Road & Rail	Dry	Easy Hill (15-25°)	5	1
Road & Rail	Dry	Flat/Undulating (<7°)	5	1
Road & Rail	Dry	Rolling (7-15°)	5	1
Road & Rail	Dry	Steep (>25°)	5	1
Road & Rail	Moist		5	1
Road & Rail	Moist	Easy Hill (15-25°)	5	1
Road & Rail	Moist	Flat/Undulating (<7°)	5	1
Road & Rail	Moist	Rolling (7-15°)	5	1
Road & Rail	Moist	Steep (>25°)	5	1
Road & Rail	Wet		5	1
Road & Rail	Wet	Flat/Undulating (<7°)	5	1
Road & Rail	Wet	Easy Hill (15-25°)	5	1
Road & Rail	Wet	Rolling (7-15°)	5	1
Road & Rail	Wet	Steep (>25°)	5	1
Sheep			7	0.4
Sheep		Easy Hill (15-25°)	5	0.5
Sheep		Flat/Undulating (<7°)	7	0.4
Sheep		Rolling (7-15°)	7.5	0.35
Sheep		Steep (>25°)	4.5	0.6
Sheep	Dry		7	0.4
Sheep	Dry	Easy Hill (15-25°)	5	0.5
Sheep	Dry	Flat/Undulating (<7°)	7	0.4

Sheep	Dry	Rolling (7-15°)	7.5	0.35
Sheep	Dry	Steep (>25°)	4.5	0.6
Sheep	Irrigated (>50%)	Flat/Undulating (<7°)	20	0.6
Sheep	Irrigated (>50%)	Rolling (7-15°)	11.5	0.7
Sheep	Irrigated (>50%)	Steep (>25°)	5	1
Sheep	Irrigated (>50%)	Easy Hill (15-25°)	8.5	1
Sheep	Moist		18	0.6
Sheep	Moist	Easy Hill (15-25°)	8.5	1
Sheep	Moist	Flat/Undulating (<7°)	18	0.6
Sheep	Moist	Rolling (7-15°)	11.5	0.7
Sheep	Moist	Steep (>25°)	6	1.6
Sheep	Wet	Easy Hill (15-25°)	9	1.6
Sheep	Wet	Flat/Undulating (<7°)	24	0.75
Sheep	Wet	Rolling (7-15°)	17.5	0.8
Sheep	Wet	Steep (>25°)		
Sheep & Beef				
Sheep & Beef		Flat/Undulating (<7°)	7	0.4
Sheep & Beef		Rolling (7-15°)	8	0.4
Sheep & Beef		Steep (>25°)	7	0.4
Sheep & Beef		Easy Hill (15-25°)	7	0.4
Sheep & Beef	Dry	Easy Hill (15-25°)	5	0.5
Sheep & Beef	Dry	Flat/Undulating (<7°)	7	0.4
Sheep & Beef	Dry	Rolling (7-15°)	7.5	0.35
Sheep & Beef	Dry	Steep (>25°)	4.5	0.6
Sheep & Beef	Irrigated (>50%)			
Sheep & Beef	Irrigated (>50%)	Flat/Undulating (<7°)	20	0.6
Sheep & Beef	Irrigated (>50%)	Steep (>25°)	4.5	0.6
Sheep & Beef	Irrigated (>50%)	Easy Hill (15-25°)	8.5	1
Sheep & Beef	Irrigated (>50%)	Rolling (7-15°)	11	0.7
Sheep & Beef	Moist			
Sheep & Beef	Moist	Easy Hill (15-25°)	8.5	1
Sheep & Beef	Moist	Flat/Undulating (<7°)	18	0.6
Sheep & Beef	Moist	Rolling (7-15°)	11.5	0.7
Sheep & Beef	Moist	Steep (>25°)	6	1.6
Sheep & Beef	Wet			
Sheep & Beef	Wet	Easy Hill (15-25°)	9	1.6
Sheep & Beef	Wet	Flat/Undulating (<7°)	24	0.75
Sheep & Beef	Wet	Rolling (7-15°)	17.5	0.8
Sheep & Beef	Wet	Steep (>25°)	6.5	2.8

Small Land Holding		Flat/Undulating (<7°)	5	1
Small Land Holding		Rolling (7-15°)	5	1
Small Land Holding	Dry		5	1
Small Land Holding	Dry	Easy Hill (15-25°)	5	1
Small Land Holding	Dry	Flat/Undulating (<7°)	5	1
Small Land Holding	Dry	Rolling (7-15°)	5	1
Small Land Holding	Dry	Steep (>25°)	5	1
Small Land Holding	Irrigated (>50%)	Easy Hill (15-25°)	5	1
Small Land Holding	Irrigated (>50%)	Flat/Undulating (<7°)	5	1
Small Land Holding	Irrigated (>50%)	Rolling (7-15°)	5	1
Small Land Holding	Irrigated (>50%)	Steep (>25°)	5	1
Small Land Holding	Moist	Easy Hill (15-25°)	5	1
Small Land Holding	Moist	Flat/Undulating (<7°)	5	1
Small Land Holding	Moist	Rolling (7-15°)	5	1
Small Land Holding	Moist	Steep (>25°)	5	1
Small Land Holding	Wet	Flat/Undulating (<7°)	5	1
Small Land Holding	Wet	Rolling (7-15°)	5	1
Specialist Deer	Dry	Easy Hill (15-25°)	7	0.75
Specialist Deer	Dry	Flat/Undulating (<7°)	7	0.75
Specialist Deer	Dry	Rolling (7-15°)	7	0.75
Specialist Deer	Dry	Steep (>25°)	7	0.75
Specialist Deer	Dry		7	0.75
Specialist Deer	Irrigated (>50%)	Flat/Undulating (<7°)	12	1.9
Specialist Deer	Irrigated (>50%)	Rolling (7-15°)	12	1.9
Specialist Deer	Irrigated (>50%)	Easy Hill (15-25°)	12	1.9
Specialist Deer	Irrigated (>50%)	Steep (>25°)	12	1.9
Specialist Deer	Moist	Flat/Undulating (<7°)	12	1.9
Specialist Deer	Moist	Rolling (7-15°)	12	1.9
Specialist Deer	Wet	Easy Hill (15-25°)	18	0.8
Specialist Deer	Wet	Flat/Undulating (<7°)	18	0.8
Specialist Deer	Wet	Rolling (7-15°)	18	0.8
Tourism & Recreational Use			5	1
Tourism & Recreational Use		Easy Hill (15-25°)	5	1
Tourism & Recreational Use		Flat/Undulating (<7°)	5	1
Tourism & Recreational Use		Rolling (7-15°)	5	1
Tourism & Recreational Use		Steep (>25°)	5	1
Tourism & Recreational Use	Dry		5	1
Tourism & Recreational Use	Dry	Easy Hill (15-25°)	5	1

Tourism & Recreational Use	Dry	Flat/Undulating (<7°)	5	1
Tourism & Recreational Use	Dry	Rolling (7-15°)	5	1
Tourism & Recreational Use	Dry	Steep (>25°)	5	1
Tourism & Recreational Use	Irrigated (>50%)	Flat/Undulating (<7°)	5	1
Tourism & Recreational Use	Moist		5	1
Tourism & Recreational Use	Moist	Easy Hill (15-25°)	5	1
Tourism & Recreational Use	Moist	Flat/Undulating (<7°)	5	1
Tourism & Recreational Use	Moist	Rolling (7-15°)	5	1
Tourism & Recreational Use	Moist	Steep (>25°)	5	1
Tourism & Recreational Use	Wet	Easy Hill (15-25°)	5	1
Tourism & Recreational Use	Wet	Flat/Undulating (<7°)	5	1
Tourism & Recreational Use	Wet	Rolling (7-15°)	5	1
Tourism & Recreational Use	Wet	Steep (>25°)	5	1
Unknown Land Use				
Unknown Land Use		Easy Hill (15-25°)		
Unknown Land Use		Flat/Undulating (<7°)		
Unknown Land Use		Rolling (7-15°)		
Unknown Land Use		Steep (>25°)		
Unknown Land Use	Dry			
Unknown Land Use	Dry	Easy Hill (15-25°)		
Unknown Land Use	Dry	Flat/Undulating (<7°)		
Unknown Land Use	Dry	Rolling (7-15°)		
Unknown Land Use	Dry	Steep (>25°)		
Unknown Land Use	Irrigated (>50%)	Easy Hill (15-25°)		
Unknown Land Use	Irrigated (>50%)	Flat/Undulating (<7°)		
Unknown Land Use	Irrigated (>50%)	Rolling (7-15°)		
Unknown Land Use	Irrigated (>50%)	Steep (>25°)		
Unknown Land Use	Moist			
Unknown Land Use	Moist	Easy Hill (15-25°)		
Unknown Land Use	Moist	Flat/Undulating (<7°)		
Unknown Land Use	Moist	Rolling (7-15°)		
Unknown Land Use	Moist	Steep (>25°)		
Unknown Land Use	Wet	Flat/Undulating (<7°)		
Unknown Land Use	Wet	Rolling (7-15°)		
Unknown Land Use	Wet	Easy Hill (15-25°)		
Unknown Land Use	Wet	Steep (>25°)		
Unknown Land Use - Indigenous Cover			2	0.3

Unknown Land Use - Indigenous Cover		Easy Hill (15-25°)	2	0.3
Unknown Land Use - Indigenous Cover		Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Indigenous Cover		Rolling (7-15°)	2	0.3
Unknown Land Use - Indigenous Cover		Steep (>25°)	2	0.3
Unknown Land Use - Indigenous Cover	Dry		2	0.3
Unknown Land Use - Indigenous Cover	Dry	Easy Hill (15-25°)	2	0.3
Unknown Land Use - Indigenous Cover	Dry	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Indigenous Cover	Dry	Rolling (7-15°)	2	0.3
Unknown Land Use - Indigenous Cover	Dry	Steep (>25°)	2	0.3
Unknown Land Use - Indigenous Cover	Irrigated (>50%)	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Indigenous Cover	Moist		2	0.3
Unknown Land Use - Indigenous Cover	Moist	Easy Hill (15-25°)	2	0.3
Unknown Land Use - Indigenous Cover	Moist	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Indigenous Cover	Moist	Rolling (7-15°)	2	0.3
Unknown Land Use - Indigenous Cover	Moist	Steep (>25°)	2	0.3
Unknown Land Use - Indigenous Cover	Wet		2	0.3
Unknown Land Use - Indigenous Cover	Wet	Easy Hill (15-25°)	2	0.3
Unknown Land Use - Indigenous Cover	Wet	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Indigenous Cover	Wet	Rolling (7-15°)	2	0.3
Unknown Land Use - Indigenous Cover	Wet	Steep (>25°)	2	0.3
Unknown Land Use - Non- agricultural			2	0.3
Unknown Land Use - Non- agricultural		Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Non- agricultural		Rolling (7-15°)	2	0.3
Unknown Land Use - Non- agricultural		Easy Hill (15-25°)	2	0.3
Unknown Land Use - Non- agricultural	Dry	Easy Hill (15-25°)	2	0.3

Unknown Land Use - Non-agricultural	Dry	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Non-agricultural	Dry	Rolling (7-15°)	2	0.3
Unknown Land Use - Non-agricultural	Dry	Steep (>25°)	2	0.3
Unknown Land Use - Non-agricultural	Dry		2	0.3
Unknown Land Use - Non-agricultural	Moist	Easy Hill (15-25°)	2	0.3
Unknown Land Use - Non-agricultural	Moist	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Non-agricultural	Moist	Rolling (7-15°)	2	0.3
Unknown Land Use - Non-agricultural	Moist	Steep (>25°)	2	0.3
Unknown Land Use - Non-agricultural	Wet	Flat/Undulating (<7°)	2	0.3
Unknown Land Use - Non-agricultural	Wet	Rolling (7-15°)	2	0.3
Unknown Land Use - Pastoral Cover			5	1
Unknown Land Use - Pastoral Cover		Easy Hill (15-25°)	5	1
Unknown Land Use - Pastoral Cover		Flat/Undulating (<7°)	5	1
Unknown Land Use - Pastoral Cover		Rolling (7-15°)	5	1
Unknown Land Use - Pastoral Cover		Steep (>25°)	5	1
Unknown Land Use - Pastoral Cover	Dry		5	1
Unknown Land Use - Pastoral Cover	Dry	Easy Hill (15-25°)	5	0.5
Unknown Land Use - Pastoral Cover	Dry	Flat/Undulating (<7°)	7	0.4
Unknown Land Use - Pastoral Cover	Dry	Rolling (7-15°)	7.5	0.35
Unknown Land Use - Pastoral Cover	Dry	Steep (>25°)	4.5	0.6
Unknown Land Use - Pastoral Cover	Irrigated (>50%)	Flat/Undulating (<7°)	20	0.6
Unknown Land Use - Pastoral Cover	Irrigated (>50%)	Rolling (7-15°)	11.5	0.7
Unknown Land Use - Pastoral Cover	Irrigated (>50%)	Easy Hill (15-25°)	8.5	1
Unknown Land Use - Pastoral Cover	Moist			
Unknown Land Use - Pastoral Cover	Moist	Easy Hill (15-25°)	8.5	1

Unknown Land Use - Pastoral Cover	Moist	Flat/Undulating (<7°)	18	0.6
Unknown Land Use - Pastoral Cover	Moist	Rolling (7-15°)	11.5	0.7
Unknown Land Use - Pastoral Cover	Moist	Steep (>25°)	6	1.6
Unknown Land Use - Pastoral Cover	Wet	Easy Hill (15-25°)	9	1.6
Unknown Land Use - Pastoral Cover	Wet	Flat/Undulating (<7°)	24	0.75
Unknown Land Use - Pastoral Cover	Wet	Rolling (7-15°)	17.5	0.8
Unknown Land Use - Pastoral Cover	Wet	Steep (>25°)	6.5	2.8

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