November 2015

APPENDICES

Arariira / LII Catchment Hydrology, Ecology and Water Quality

Submitted to:
In Support of the Department of Conservation / Fonterra Living Water Partnership

Report Number. 1414458_7410-006-R-Rev1

REPORT

Golder Associates

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APPENDICES

INTRODUCTION

Living Water is a joint programme between the Department of Conservation (DOC) and Fonterra. Through working with local iwi, communities, dairy farmers, and other stakeholders, the Living Water partnership aims to improve water quality and biodiversity in a number of sensitive catchments. The Ararira / LII River catchment is one of five Living Water project areas throughout New Zealand.

The Ararira / LII River is a spring-fed tributary of Te Waihora / Lake Ellesmere and its headwaters are in the small town of Lincoln. The Ararira / LII River is highly modified and is primarily managed for drainage. However, there is growing interest in improving the catchment's ecological state, and a desire for the river to be managed for values in addition to drainage, including cultural values, water quality, ecology and recreation.

As part of Living Water's initiatives in the Ararira / LII River, Golder Associates (NZ) Limited (Golder) was commissioned to prepare a report to describe the hydrology, water quality and ecology of the catchment, to identify environmental enhancement opportunities, and to provide monitoring recommendations. This report provides the appendices for the above study and should be read in conjunction with the Golder report "Ararira / LII River Catchment Hydrology, Ecology and Water Quality" (Golder 2015[1]).

This Appendix report contains three sections: the first provides information on the Stream Walk Specification and the data collected using this method; while the second provides information on the water quality and presents the data obtained; the third contains supporting data maps.

The limitations outlined in the main report Golder 2015 are also applicable to this Appendices report.

[1] Golder 2015. Ararira / LII River Catchment Hydrology, Ecology and Water Quality. Report number 1414458_7410-003-R-Rev2 dated November 2015.

APPENDIX B

Stream Walk Specification & Data Collected

STREAM WALK SPECIFICATION

Overview

In late 2014, Golder Associates (NZ) Limited ('Golder') prepared the "Environment Canterbury Stream Walk Specification" draft specification, which at the time of writing this report is currently being finalised. The stream walk methodology has been developed and reviewed in other regions of New Zealand over several years, resulting in a regional database of stream and asset information.

The Stream Walk Specification uses a reach-scale approach, with streams being assessed and characterised reach by reach along their length. The longitudinal extent of each reach is determined by significant changes in linear characteristics such as land use, channel morphology, overhead cover etc.

The data collected using this method provides a snapshot of the existing condition of waterways that can be used to:

(i) evaluate the waterway against the freshwater objectives or outcomes detailed in the Land and Water Regional Plan (LWRP), and

(ii) to provide restoration recommendations.

Survey Scope

Stream Walk surveys were undertaken at 13 sites across the LII catchment: three on the Ararira / LII River mainstem (Englishs, Pannetts, Wolfes), and 10 on individual tributaries (LI Creek, Liffey Stream, Lincoln Main Drain [LMD], Springs Creek, Collins Rd Drain, Ellesmere Rd Drain, Carters Rd Drain, Days Rd Drain, Goodericks Rd Drain, Powells Rd Drain). The location of the 13 sites (and 79 reaches therein) can be seen in Figure B1. These Stream Walk sites were chosen to represent the range of tributary and mainstem conditions present within the catchment. The final decision on site selection was made in collaboration with representatives from the LII Drainage Committee.

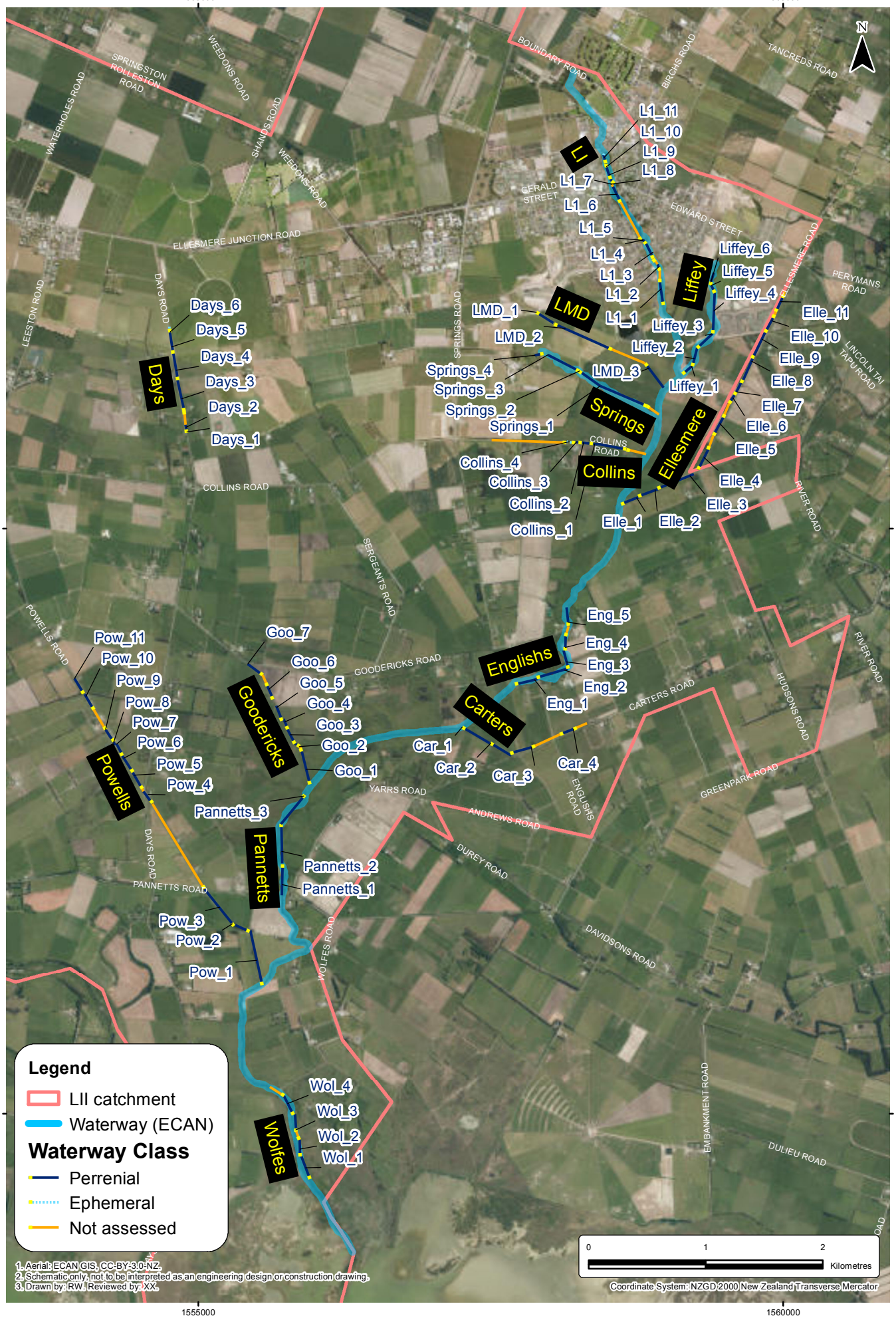
Attributes Assessed

Data collected per reach during the Stream Walk surveys included general aquatic and riparian habitat characteristics (Table B1). In addition, data on the following was also collected (where relevant):

- In-stream structures, including their potential impact on fish passage.
- Potential salmonid (trout and salmon) spawning habitat and redds.
- Wetlands.
- Management issues and opportunities.
- Miscellaneous information (e.g., bridges, spring sources etc.).

Data Collected

A general overview of the data collected from each site is provided in the following sections. While a large volume of data has been collected for each individual reach surveyed as part of the Stream Walk surveys, this data is best suited for viewing in tabular format on a spreadsheet (e.g., MS Excel) or on GIS mapping software (e.g., ArcGIS). The entire dataset can be made available upon request.



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B1

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Table B1: Definitions of attributes* assessed as part of the Stream Walk surveys.

Attribute	Definition / Categories
Flow habitat type (%)	Relative proportion of run, pool, riffle, rapid, cascade and backwater.
Wetted width (m)	The distance across the stream (perpendicular to flow) that is submerged by water on the day of sampling.
Water depth (m)	The vertical distance from the stream bed to the water surface.
Substrate composition (%)	Relative proportion of boulder, cobble, gravel, pebble and silt / sand.
Fine sediment cover (%)	Percent cover of visible streambed with fine sediment (<2 mm).
Channel modification	Categories: none; straightened; reinforced; lined; straight and lined.
Bank height (m)	The vertical distance between the stream bed and the top of the bank, and is calculated as water depth plus the average of the left and right bank heights above water level.
Bank angle	The gradient between the top of the bank and the water's edge. Categories: low (<30 °), moderate (31 – 60 °), steep (61 – 80 °), vertical (81 – 90 °). Assessed separately for each bank.
Emergent macrophyte cover (%)	Percent cover of emergent macrophytes, with identification of the dominant species.
Submerged macrophyte cover (%)	Percent cover of submerged macrophytes, with identification of the dominant species.
Periphyton cover (%)	Percent cover of thin films (<0.5 mm), medium mats (0.5 – 3 mm), thick mats (>3 mm), short filaments (<20 mm) and long filaments (>20 mm).
Riparian width (m)	This is the zone adjacent to the stream that has different land cover or management than the wider catchment. Assessed separately for each bank.
Riparian longitudinal extent (%)	Longitudinal extent of intact riparian vegetation. Assessed separately for each bank.
Adjacent canopy, understory and groundcover vegetation	Type of vegetation (native, exotic or mixed) in each of the three tiers on the TL and TR banks. Assessed separately for each bank.
Overhead cover / shading (%)	Proportion of the stream surface that is shaded by riparian vegetation, banks or other structures (e.g., fences).
Adjacent land-use	Categories: bush/forest/scrub; park/sports field; improved dryland pasture; extensive grazing; irrigated pasture; dairy support; cropping; residential; commercial; industrial; impervious. Assessed separately for each bank.
Bank erosion (%)	Percent cover of bank erosion. Erosion is identified as areas with exposed earth, or recently exposed with some herbaceous vegetation cover. Assessed separately for each bank.
Fencing type	Categories: none, temporary, deer, light-weight i.e., electric for dairy, standard sheep. Assessed separately for each bank.

*** Note:** Only selected attributes have been defined. The entire list of attributes assessed (and associated data) can be made available on request.

DATA TABLES

Data from individual reaches from each site are provided in tabular form in the following sections. It should be noted that certain attributes were not assessed (NA) in certain reaches due to the reach being too deep to safely wade (i.e., reaches greater than about 1.5 m free-water depth) and / or a high coverage of macrophytes obscuring vision of the stream / riverbed.

Aririra/LII River mainstem sites

Englishs		**Reach 1**	**Reach 2**	**Reach 3**
Reach length (m)		200	272	159
Flow habitat type (%)		100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		10.0 / 12.5	8.0 / 8.4	8.0 / 10.2
Water depth (m) – Mean / Max.		NA	NA	NA
Substrate composition (%)	Silt/Sand (<2 mm)	NA	NA	NA
	Gravel (2 – 16 mm)	NA	NA	NA
	Pebble (16 – 64 mm)	NA	NA	NA
	Cobble (64 – 256 mm)	NA	NA	NA
Fine sediment cover (%)		NA	NA	NA
Channel modification		None	None	None
Bank height (m) – TRB / TLB		NA	NA	NA
Bank angle – TRB / TLB		Low / Moderate	Moderate / Moderate	Moderate / Moderate
Emergent macrophyte cover (%)		15	5	10
Submerged macrophyte cover (%)		80	80	80
Filamentous algae cover (%)		NA	NA	NA
Riparian width (m) – TRB / TLB		0/0	5.0 / 2.0	7.0 / 0
Riparian longitudinal extent (%) – TRB / TLB		0/0	80 / 40	5 / 0
Adjacent vegetation type – TRB / TLB	Canopy	None / None	Exotic / Exotic	Exotic / None
	Understory	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		0	30	5
Adjacent land-use	TRB	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing
	TLB	Sheep / Beef grazing	Residential	Cropping
Bank erosion (%) – TRB / TLB		0 / 0	0 / 35	0 / 0
Fencing type	TRB	Standard sheep	Standard sheep	None
	TLB	None	None	None

Englishs		Reach 4	Reach 5
Reach length (m)		124	161
Flow habitat type (%)		100 % run	95 % run, 5 % backwater
Wetted width (m) – Mean / Max.		10.4 / 10.4	8.0 / 8.6
Water depth (m) – Mean / Max.		NA	NA
Substrate composition (%)	Silt/Sand (<2 mm)	NA	NA
	Gravel (2 – 16 mm)	NA	NA
	Pebble (16 – 64 mm)	NA	NA
	Cobble (64 – 256 mm)	NA	NA
Fine sediment cover (%)		NA	NA
Channel modification		None	None
Bank height (m) – TRB / TLB		NA	NA
Bank angle – TRB / TLB		Steep / Steep	Vertical / Low
Emergent macrophyte cover (%)		5	25
Submerged macrophyte cover (%)		90	70
Filamentous algae cover (%)		NA	NA
Riparian width (m) – TRB / TLB		0 / 0	0 / 5
Riparian longitudinal extent (%) – TRB / TLB		0 / 0	0 / 80
Adjacent vegetation type – TRB / TLB	Canopy	None / None	None / Exotic
	Understory	Exotic / Exotic	None / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		0	30
Adjacent land-use	TRB	Sheep / Beef grazing	Sheep / Beef grazing
	TLB	Cropping	Sheep / Beef grazing
Bank erosion (%) – TRB / TLB		0 / 5	80 / 0
Fencing type	TRB	Standard sheep	Standard sheep
	TLB	None	Standard sheep

Pannetts		Reach 1	Reach 2	Reach 3
Reach length (m)		268	339	325
Flow habitat type (%)		100 % run	100 % run	90 % run, 5 % pool, 5 % backwater
Wetted width (m) – Mean / Max.		13.0 / 14.0	13.5 / 16.0	15.0 /1 6.0
Water depth (m) – Mean / Max.		1.1 / 1.8	1.3 / 1.5	NA
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100
	Gravel (2 – 16 mm)	0	0	0
	Pebble (16 – 64 mm)	0	0	0
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		100	100	100
Channel modification		None	None	None
Bank height (m) – TRB / TLB		1.3 / 3.0	1.8 / 3.3	NA
Bank angle – TRB / TLB		Low / Steep	Low / Steep	Low / Moderate
Emergent macrophyte cover (%)		15	5	10
Submerged macrophyte cover (%)		80	90	85
Filamentous algae cover (%)		5	0	10
Riparian width (m) – TRB / TLB		4.0 / 6.0	0 / 10.0	25.0 / 25.0
Riparian longitudinal extent (%) – TRB / TLB		10 / 10	0 / 5	80 / 80
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / Exotic	None / Exotic	Exotic / Exotic
	Understory	None / Exotic	Mixed / Mixed	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		5	5	15
Adjacent land-use	TRB	Irrigated Pasture	Irrigated Pasture	Sheep / Beef grazing
	TLB	Sheep / Beef grazing	Irrigated Pasture	Irrigated Pasture
Bank erosion (%) – TRB / TLB		0 / 10	0 / 0	0 / 0
Fencing type	TRB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy
	TLB	Standard Sheep	Standard Sheep	Standard Sheep

Wolfes		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		206	143	149	181
Flow habitat type (%)		100 % run	100 % run	95 % run, 5 % backwater	100 % run
Wetted width (m) – Mean / Max.		14.0 / 15.0	14.0 / 15.0	11.0 / 12.5	11.0 / 11.5
Water depth (m) – Mean / Max.		1.0 / NA	1.0 / NA	1.0 / 1.6	1.0 / 1.2
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100	100
	Gravel (2 – 16 mm)	0	0	0	0
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	100	100
Channel modification		None	None	None	None
Bank height (m) – TRB / TLB		2.0 / 1.4	2.0 / 1.5	2.0 / 1.5	1.7 / 1.5
Bank angle – TRB / TLB		Vertical / Low	Moderate / Moderate	Steep / Moderate	Steep / Steep
Emergent macrophyte cover (%)		0	0	0	0
Submerged macrophyte cover (%)		45	60	75	50
Filamentous algae cover (%)		10	15	5	10
Riparian width (m) – TRB / TLB		1.5 / 8.0	1.5 / 6.0	1.0 / 12.0	0.5 / 15.0
Riparian longitudinal extent (%) – TRB / TLB		50 / 80	50 / 50	30 / 90	20 / 95
Adjacent vegetation type – TRB / TLB	Canopy	None / Exotic	Exotic / Exotic	None / Exotic	Exotic / Exotic
	Understory	Mixed / Mixed	Mixed / Exotic	Mixed / Exotic	Mixed / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		10	5	25	20
Adjacent land-use	TRB	Bush / Forest / Scrub	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing
	TLB	Bush / Forest / Scrub	Bush / Forest / Scrub	Bush / Forest / Scrub	Bush / Forest / Scrub
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0	0 / 0
Fencing type	TRB	None	None	Light Wt Dairy	None
	TLB	None	None	None	None

Tributary sites

L1		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		197	59	137	43
Flow habitat type (%)		80 % run, 15 % backwater 5 % pool	95 % run, 5 % backwater	85 % run, 15 % backwater	95 % run, 5 % pool
Wetted width (m) – Mean / Max.		2.0 / 3.4	6.0 / 8.0	6.0 / 6.3	6.0 / 6.2
Water depth (m) – Mean / Max.		0.5 / 0.6	0.5 / 0.6	0.5 / 0.6	0.5 / 1.0
Substrate composition (%)	Silt/Sand (<2 mm)	95	90	100	100
	Gravel (2 – 16 mm)	0	5	0	0
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	5	5	0	0
Fine sediment cover (%)		95	95	100	100
Channel modification		None	None	None	None
Bank height (m) – TRB / TLB		0.8 / 0.7	0.5 / 0.7	0.7 / 0.7	1.5 / 1.0
Bank angle – TRB / TLB		Low / Low	Low / Moderate	Low / Low	Steep / Low
Emergent macrophyte cover (%)		0	85	20	45
Submerged macrophyte cover (%)		15	10	10	10
Filamentous algae cover (%)		0	0	0	0
Riparian width (m) – TRB / TLB		2.5/20.0	8.0/2.0	8.0/2.0	7.0/7.0
Riparian longitudinal extent (%) – TRB / TLB		85/85	85/75	95/70	100/100
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / Exotic	Exotic / Exotic	Mixed / Mixed	None / Exotic
	Understory	Mixed / Mixed	Native / Native	Native / Native	Native / Native
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	None / Exotic
Overhead cover / shading (%)		85	15	20	30
Adjacent land-use	TRB	Residential	Residential	Residential	Parks/Sports Fields
	TLB	Sheep / Beef grazing	Residential	Residential	Parks / Sports Fields
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0	0 / 0
Fencing type	TRB	None	None	None	None
	TLB	Light Wt Dairy	None	None	None

L1		Reach 5	Reach 6	Reach 7	Reach 8
Reach length (m)		19	146	23	46
Flow habitat type (%)		100 % run	100 % run	100 % run	65 % riffle, 35 % run
Wetted width (m) – Mean / Max.		5.0 / 5.2	4.0 / 4.1	3.2 / 3.7	3.5 / 3.5
Water depth (m) – Mean / Max.		0.4 / 0.6	0.4 / 0.5	0.2 / 0.2	0.1 / 0.3
Substrate composition (%)	Silt/Sand (<2 mm)	40	100	55	15
	Gravel (2 – 16 mm)	40	0	30	55
	Pebble (16 – 64 mm)	20	0	10	20
	Cobble (64 – 256 mm)	0	0	5	10
Fine sediment cover (%)		50	100	85	35
Channel modification		None	None	None	None
Bank height (m) – TRB / TLB		2.0 / 2.2	0.8 / 0.8	0.9 / 1.0	1.0/0.7
Bank angle – TRB / TLB		Steep / Steep	Vertical / Vertical	Vertical / Vertical	Moderate / Moderate
Emergent macrophyte cover (%)		40	0	0	10
Submerged macrophyte cover (%)		5	0	0	0
Filamentous algae cover (%)		0	0	0	0
Riparian width (m) – TRB / TLB		4.0 / 2.0	10.0 / 10.0	4.0 / 4.0	10.0 / 4.0
Riparian longitudinal extent (%) – TRB / TLB		10 / 10	100 / 100	100 / 100	100 / 85
Adjacent vegetation type – TRB / TLB	Canopy	None / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
	Understory	Native / Native	Native / None	Native / Mixed	Native / Native
	Groundcover	Exotic / Exotic	None / None	Exotic / Exotic	None / Exotic
Overhead cover / shading (%)		10	90	15	35
Adjacent land-use	TRB	Parks / Sports Fields	Parks / Sports Fields	Parks / Sports Fields	Parks / Sports Fields
	TLB	Parks / Sports Fields	Parks / Sports Fields	Impervious	Bush / Forest / Scrub
Bank erosion (%) – TRB / TLB		0 / 0	70 / 70	5 / 10	0 / 5
Fencing type	TRB	None	None	None	None
	TLB	None	None	None	None

L1		Reach 9	Reach 10	Reach 11
Reach length (m)		111	32	75
Flow habitat type (%)		95 % run, 5 % backwater	95 % run, 5 % riffle	100 % run
Wetted width (m) – Mean / Max.		6.0 / 9.0	2.0 / 2.1	2.4 / 2.4
Water depth (m) – Mean / Max.		0.2 / 0.2	0.1 / 0.1	0.3 / 0.3
Substrate composition (%)	Silt/Sand (<2 mm)	100	20	45
	Gravel (2 – 16 mm)	0	60	50
	Pebble (16 – 64 mm)	0	20	5
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		100	70	85
Channel modification		None	None	None
Bank height (m) – TRB / TLB		0.6 / 0.8	0.6 / 0.5	1.0 / 0.8
Bank angle – TRB / TLB		Moderate / Steep	Low / Moderate	Moderate / Moderate
Emergent macrophyte cover (%)		0	0	0
Submerged macrophyte cover (%)		0	0	0
Filamentous algae cover (%)		0	5	0
Riparian width (m) – TRB / TLB		11.0 / 13.0	26.0 / 26.0	18.0 / 11.0
Riparian longitudinal extent (%) – TRB / TLB		100 / 100	100 / 100	100 / 100
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
	Understory	None / None	Mixed / Mixed	None / Mixed
	Groundcover	None / None	None / None	None / None
Overhead cover / shading (%)		90	75	85
Adjacent land-use	TRB	Parks / Sports Fields	Parks / Sports Fields	Parks / Sports Fields
	TLB	Parks / Sports Fields	Parks / Sports Fields	Parks / Sports Fields
Bank erosion (%) – TRB / TLB		70 / 70	5 / 10	20 / 20
Fencing type	TRB	None	None	None
	TLB	None	None	None

Liffey		Reach 1	Reach 2	Reach 3
Reach length (m)		104	163	179
Flow habitat type (%)		85 % run, 15 % backwater	95 % run, 5 % backwater	95 % run, 5 % backwater
Wetted width (m) – Mean / Max.		6.0 / 6.5	5.5 / 6.0	5.5/6.2
Water depth (m) – Mean / Max.		1.0 / 1.1	1.2 / 1.3	1.0 / 1.1
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100
	Gravel (2 – 16 mm)	0	0	0
	Pebble (16 – 64 mm)	0	0	0
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		100	100	100
Channel modification		None	None	None
Bank height (m) – TRB / TLB		1.4 / 2.0	2.2 / 2.2	2.0 / 2.0
Bank angle – TRB / TLB		Moderate / Moderate	Low / Moderate	Moderate / Moderate
Emergent macrophyte cover (%)		10	30	10
Submerged macrophyte cover (%)		NA	NA	NA
Filamentous algae cover (%)		NA	NA	NA
Riparian width (m) – TRB / TLB		6.0 / 2.5	0 / 0	5.5 / 0
Riparian longitudinal extent (%) – TRB / TLB		5 / 5	0 / 0	90 / 0
Adjacent vegetation type – TRB / TLB	Canopy	None / None	None / None	Exotic / None
	Understory	Mixed / Exotic	Exotic / Exotic	None / Exotic
	Groundcover	Exotic / None	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		5	5	50
Adjacent land-use	TRB	Residential	Bush/Forest / Scrub	Residential
	TLB	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing
Bank erosion (%) – TRB / TLB		5 / 0	0 / 5	5 / 5
Fencing type	TRB	None	None	None
	TLB	Light Wt Dairy	Standard Sheep	Standard Sheep

Liffey		Reach 4	Reach 5	Reach 6
Reach length (m)		343	73	111
Flow habitat type (%)		95 % run, 5 % backwater	100 % run	100 % run
Wetted width (m) – Mean / Max.		4.5 / 5.0	3.0 / 3.4	2.0 / 2.1
Water depth (m) – Mean / Max.		0.7 / 1.0	0.3 / 0.5	0.5 / 0.6
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	85
	Gravel (2 – 16 mm)	0	0	10
	Pebble (16 – 64 mm)	0	0	5
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		100	100	90
Channel modification		None	None	None
Bank height (m) – TRB / TLB		1.7 / 2.2	1.8 / 1.8	2.4 / 2.3
Bank angle – TRB / TLB		Moderate / Steep	Low / Steep	Low / Moderate
Emergent macrophyte cover (%)		40	15	5
Submerged macrophyte cover (%)		35	30	80
Filamentous algae cover (%)		5	5	10
Riparian width (m) – TRB / TLB		5.0 / 1.5	0.5 / 0	0.5 / 2.0
Riparian longitudinal extent (%) – TRB / TLB		95 / 5	50 / 0	95 / 80
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / None	None / None	None / Exotic
	Understory	Exotic / Exotic	Native / Exotic	Native / Native
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		60	10	10
Adjacent land-use	TRB	Residential	Parks / Sports Fields	Parks / Sports Fields
	TLB	Sheep / Beef grazing; SDC Wetland	Sheep / Beef grazing	Parks / Sports Fields
Bank erosion (%) – TRB / TLB		15 / 10	0 / 0	0 / 0
Fencing type	TRB	None	None	None
	TLB	None	None	None

LMD		Reach 1	Reach 2	Reach 3
Reach length (m)		172	510	260
Flow habitat type (%)		100 % run	95 % run, 5 % pool	100 % run
Wetted width (m) – Mean / Max.		2.0 / 3.5	2.3 / 4.0	1.6 / 2.0
Water depth (m) – Mean / Max.		0.5 / 0.7	1.0 / 1.5	0.8 / 1.0
Substrate composition (%)	Silt/Sand (<2 mm)	95	100	100
	Gravel (2 – 16 mm)	5	0	0
	Pebble (16 – 64 mm)	0	0	0
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		95	100	100
Channel modification		Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		3.0 / 3.5	3.4 / 3.3	2.3 / 2.6
Bank angle – TRB / TLB		Steep / Steep	Steep / Steep	Steep / Steep
Emergent macrophyte cover (%)		50	50	40
Submerged macrophyte cover (%)		15	30	35
Filamentous algae cover (%)		5	0	0
Riparian width (m) – TRB / TLB		0 / 0	0 / 0	0 / 0
Riparian longitudinal extent (%) – TRB / TLB		0 / 0	0 / 0	0 / 0
Adjacent vegetation type – TRB / TLB	Canopy	None / None	None / None	None / None
	Understory	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		5	5	5
Adjacent land-use	TRB	Irrigated Pasture	Irrigated Pasture	Irrigated Pasture
	TLB	Sheep / Beef grazing	Irrigated Pasture	Irrigated Pasture
Bank erosion (%) – TRB / TLB		5 / 10	10 / 35	5 / 10
Fencing type	TRB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy
	TLB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy

Springs		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		433	219	301	80
Flow habitat type (%)		100 % run	100 % run	100 % run	75 % run, 25 % backwater
Wetted width (m) – Mean / Max.		2.5 / 3.0	2.5 / 4.0	2.0 / 5.0	3.0 / 4.5
Water depth (m) – Mean / Max.		0.6 / 0.8	0.5 / 0.7	0.4/0.6	0.7 / 1.0
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100	95
	Gravel (2 – 16 mm)	0	0	0	5
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	100	95
Channel modification		Straightened	Straightened	Straightened	None
Bank height (m) – TRB / TLB		1.8 / 1.9	2.0 / 2.7	2.2 / 2.3	1.6 / 1.6
Bank angle – TRB / TLB		Steep / Steep	Steep / Steep	Vertical / Vertical	Low / Low
Emergent macrophyte cover (%)		10	15	10	10
Submerged macrophyte cover (%)		45	75	25	75
Filamentous algae cover (%)		0	0	5	0
Riparian width (m) – TRB / TLB		0/0	0/0	5.0 / 2.0	4.0 / 4.5
Riparian longitudinal extent (%) – TRB / TLB		0/0	0/0	15.0 / 5.0	5 / 15
Adjacent vegetation type – TRB / TLB	Canopy	None / None	None / None	Exotic / Exotic	Exotic / Exotic
	Understory	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		0	5	10	15
Adjacent land-use	TRB	Irrigated Pasture	Irrigated Pasture	Irrigated Pasture	Sheep / Beef grazing
	TLB	Irrigated Pasture	Irrigated Pasture	Irrigated Pasture	Sheep / Beef grazing
Bank erosion (%) – TRB / TLB		0/5	0/0	0/5	0/0
Fencing type	TRB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy	Standard Sheep
	TLB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy	Standard Sheep

Collins		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		290	102	58	74
Flow habitat type (%)		100 % run	100 % run	95 % run, 5 % pool	100 % run
Wetted width (m) – Mean / Max.		3.0 / 5.0	2.0 / 2.0	0.7 / 1.3	0.6 / 0.6
Water depth (m) – Mean / Max.		0.7 / 1.8	0.3 / 0.5	0.2 / 0.3	0.2 / 0.2
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	95	100
	Gravel (2 – 16 mm)	0	0	5	0
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	95	100
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.4 / 1.4	1.8 / 1.8	1.8 / 1.7	1.3 / 1.3
Bank angle – TRB / TLB		Vertical / Steep	Vertical / Steep	Vertical / Vertical	Vertical / Vertical
Emergent macrophyte cover (%)		5	0	70	0
Submerged macrophyte cover (%)		45	5	5	0
Filamentous algae cover (%)		20	0	0	0
Riparian width (m) – TRB / TLB		0/0	1.0/2.0	1.8/1.4	0/1.0
Riparian longitudinal extent (%) – TRB / TLB		0/0	5/80	15/15	0/30
Adjacent vegetation type – TRB / TLB	Canopy	None / None	Exotic / Exotic	None / Exotic	None / None
	Understory	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		0	60	10	40
Adjacent land-use	TRB	Impervious	Impervious	Impervious	Impervious
	TLB	Sheep / Beef grazing	Residential	Cropping	Cropping
Bank erosion (%) – TRB / TLB		0 / 20	5 / 5	0 / 0	0 / 0
Fencing type	TRB	None	None	None	None
	TLB	Light Wt Dairy	None	Standard Sheep	Standard Sheep

Ellesmere		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		170	180	333	194
Flow habitat type (%)		100 % run	100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		2.5 / 2.7	2.6 / 3.0	2.5 / 2.7	2.5 / 2.9
Water depth (m) – Mean / Max.		0.6 / 0.9	0.6 / 0.7	0.5 / 0.6	0.7 / 0.7
Substrate composition (%)	Silt/Sand (< 2 mm)	100	100	100	100
	Gravel (2–16 mm)	0	0	0	0
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	100	100
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.2/1.3	1.3/1.4	1.3/1.3	1.7/2.7
Bank angle – TRB / TLB		Steep / Steep	Steep / Moderate	Moderate / Moderate	Moderate / Vertical
Emergent macrophyte cover (%)		5	20	5	5
Submerged macrophyte cover (%)		85	60	60	80
Filamentous algae cover (%)		5	10	15	5
Riparian width (m) – TRB / TLB		1.5 / 2.0	1.2 / 2.5	1.0 / 2.5	2.0 / 2.0
Riparian longitudinal extent (%) – TRB / TLB		75 / 95	20 / 100	20 / 100	15 / 15
Adjacent vegetation type – TRB / TLB	Canopy	Exotic/Exotic	Exotic/None	Exotic/None	None/None
	Understory	Exotic/Native	Exotic/Native	Exotic/Native	Mixed/Mixed
	Groundcover	Exotic/Exotic	Exotic/Exotic	Exotic/Exotic	Exotic/Exotic
Overhead cover / shading (%)		10	15	20	30
Adjacent land-use	TRB	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing	Dairy Support
	TLB	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing	Impervious
Bank erosion (%) – TRB / TLB		5 / 0	0 / 0	0 / 0	0 / 0
Fencing type	TRB	Standard Sheep	None	Standard Sheep	Light Wt Dairy
	TLB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy	None

Ellesmere		Reach 5	Reach 6	Reach 7	Reach 8
Reach length (m)		175	81	114	232
Flow habitat type (%)		100 % run	100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		2.0 / 2.1	2.1 / 2.1	2.3 / 2.5	1.5 / 1.7
Water depth (m) – Mean / Max.		0.4 / 0.5	1.5 / 1.5	0.5 / 0.6	0.5 / 0.5
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	95	100
	Gravel (2 – 16 mm)	0	0	5	0
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	95	100
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.4 / 2.2	2.7 / 3.8	2.5 / 1.5	2.5 / 2.0
Bank angle – TRB / TLB		Steep / Vertical	Steep / Steep	Vertical / Steep	Moderate / Moderate
Emergent macrophyte cover (%)		0	5	10	85
Submerged macrophyte cover (%)		15	95	85	5
Filamentous algae cover (%)		0	40	70	10
Riparian width (m) – TRB / TLB		3.0 / 0	5.0 / 0	0 / 0	0 / 4.0
Riparian longitudinal extent (%) – TRB / TLB		100 / 0	100 / 0	0 / 0	0 / 30
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / None	None / None	Non e/ None	None / None
	Understory	Mixed/Exotic	Mixed/Exotic	Exotic/Mixed	Exotic/Mixed
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		85	10	10	10
Adjacent land-use	TRB	Dairy Support	Residential	Impervious	Impervious
	TLB	Impervious	Impervious	Cropping	Cropping
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0	0 / 0
Fencing type	TRB	Light Wt Dairy	Standard Sheep	None	None
	TLB	None	None	None	Light Wt Dairy

Ellesmere		Reach 9	Reach 10	Reach 11
Reach length (m)		246	140	132
Flow habitat type (%)		100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		2.7/3.1	2.6/2.6	2.6/2.6
Water depth (m) – Mean / Max.		0.7/0.8	0.7/0.7	0.7/0.7
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100
	Gravel (2 – 16 mm)	0	0	0
	Pebble (16 – 64 mm)	0	0	0
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		100	100	100
Channel modification		Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.9 / 1.5	2.0 / 0.9	2.1 / 1.0
Bank angle – TRB / TLB		Moderate / Moderate	Steep / Vertical	Steep / Moderate
Emergent macrophyte cover (%)		10	40	80
Submerged macrophyte cover (%)		75	20	15
Filamentous algae cover (%)		5	25	10
Riparian width (m) – TRB / TLB		0 / 6.5	0 / 0	0 / 1.0
Riparian longitudinal extent (%) – TRB / TLB		0 / 95	0 / 0	0 / 15
Adjacent vegetation type – TRB / TLB	Canopy	None / None	None / None	None / None
	Understory	None / Native	Exotic / Exotic	Exotic / Mixed
	Groundcover	Exotic / Mixed	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		20	0	10
Adjacent land-use	TRB	Impervious	Impervious	Impervious
	TLB	Sheep / Beef grazing	Residential	Sheep / Beef grazing
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0
Fencing type	TRB	None	None	None
	TLB	Light Wt Dairy	None	Light Wt Dairy

Days		Reach 1	Reach 2	Reach 3
Reach length (m)		43	25	270
Flow habitat type (%)		100 % run	95 % run, 5 % pool	100 % run
Wetted width (m) – Mean / Max.		1.1 / 1.3	1.2 / 1.2	1.0 / 1.0
Water depth (m) – Mean / Max.		0.2 / 0.2	0.1 / 0.1	0.3 / 0.4
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100
	Gravel (2 – 16 mm)	0	0	0
	Pebble (16 – 64 mm)	0	0	0
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		100	100	100
Channel modification		Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.6 / 1.6	1.3 / 1.2	1.3 / 1.3
Bank angle – TRB / TLB		Steep / Steep	Steep / Steep	Moderate / Moderate
Emergent macrophyte cover (%)		5	0	90
Submerged macrophyte cover (%)		50	15	5
Filamentous algae cover (%)		30	10	10
Riparian width (m) – TRB / TLB		2.0 / 6.0	4.0 / 5.0	2.0 / 3.0
Riparian longitudinal extent (%) – TRB / TLB		5 / 90	95 / 95	10 / 70
Adjacent vegetation type – TRB / TLB	Canopy	None / Exotic	Exotic / Exotic	None / None
	Understory	Exotic/ Mixed	Exotic / Mixed	Mixed / Native
	Groundcover	None / None	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		30	90	15
Adjacent land-use	TRB	Impervious	Impervious	Impervious
	TLB	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0
Fencing type	TRB	None	None	None
	TLB	Light Wt Dairy	Light Wt Dairy	Standard Sheep

Days		Reach 4	Reach 5
Reach length (m)		234	186
Flow habitat type (%)		100 % run	100 % run
Wetted width (m) – Mean / Max.		1.1 / 1.3	1.5 / 2.1
Water depth (m) – Mean / Max.		0.2 / 0.3	0.3 / 0.5
Substrate composition (%)	Silt/Sand (<2 mm)	100	100
	Gravel (2 – 16 mm)	0	0
	Pebble (16 – 64 mm)	0	0
	Cobble (64 – 256 mm)	0	0
Fine sediment cover (%)		100	100
Channel modification		Straightened	Straightened
Bank height (m) – TRB / TLB		1.6 / 1.6	1.3 / 1.0
Bank angle – TRB / TLB		Steep / Steep	Moderate / Moderate
Emergent macrophyte cover (%)		15	0
Submerged macrophyte cover (%)		30	5
Filamentous algae cover (%)		20	40
Riparian width (m) – TRB / TLB		0 / 4	0 / 3
Riparian longitudinal extent (%) – TRB / TLB		0 / 90	0 / 95
Adjacent vegetation type – TRB / TLB	Canopy	None / Exotic	None / Exotic
	Understory	Exotic / Exotic	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		40	60
Adjacent land-use	TRB	Impervious	Impervious
	TLB	Irrigated Pasture	Irrigated Pasture
Bank erosion (%) – TRB / TLB		0/0	0/0
Fencing type	TRB	None	None
	TLB	Light Wt Dairy	Standard Sheep

Carters		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		285	205	193	129
Flow habitat type (%)		100 % run	100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		4.2 / 4.3	3.2 / 3.3	2.8 / 2.8	2.4 / 2.4
Water depth (m) – Mean / Max.		0.6 / 0.9	0.5 / 0.6	0.5 / 0.5	0.5 / 0.5
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100	100
	Gravel (2 – 16 mm)	0	0	0	0
	Pebble (16 – 64 mm)	0	0	0	0
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	100	100
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.4 / 1.2	1.3 / 1.5	1.8 / 2.2	1.0 / 1.1
Bank angle – TRB / TLB		Vertical / Steep	Vertical / Steep	Steep / Steep	Moderate / Steep
Emergent macrophyte cover (%)		0	0	0	0
Submerged macrophyte cover (%)		15	20	5	5
Filamentous algae cover (%)		0	10	0	0
Riparian width (m) – TRB / TLB		3.5 / 0	3.5 / 0	3.0 / 3.0	4.0 / 0
Riparian longitudinal extent (%) – TRB / TLB		100 / 0	100 / 0	100 / 10	100 / 0
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / None	Exotic / None	Exotic / None	Exotic / None
	Understory	Exotic / None	None / None	Exotic / Exotic	None / Exotic
	Groundcover	Exotic / Exotic	None / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		60	80	25	30
Adjacent land-use	TRB	Cropping	Cropping	Sheep/Beef grazing	Sheep/Beef grazing
	TLB	Sheep / Beef grazing	Sheep / Beef grazing	Impervious	Impervious
Bank erosion (%) – TRB / TLB		0 / 20	80 / 0	0 / 0	0 / 0
Fencing type	TRB	Standard Sheep	Standard Sheep	Standard Sheep	Standard Sheep
	TLB	None	None	None	None

Goodericks		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		288	50	149	93
Flow habitat type (%)		80 % run, 20 % backwater	95 % run, 5 % backwater	100 % run	100 % run
Wetted width (m) – Mean / Max.		5.0 / 6.0	2.8 / 2.9	3.0 / 3.5	3.0 / 3.1
Water depth (m) – Mean / Max.		1.0 / 1.6	0.8 / 0.8	0.6 / 1.0	0.7 / 0.8
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100	10
	Gravel (2 – 16 mm)	0	0	0	55
	Pebble (16 – 64 mm)	0	0	0	35
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	100	NA
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.8 / 1.1	1.6 / 0.9	1.4 / 1.1	2.1 / 1.6
Bank angle – TRB / TLB		Moderate / Low	Moderate / Low	Moderate / Moderate	Moderate / Steep
Emergent macrophyte cover (%)		35	70	60	70
Submerged macrophyte cover (%)		60	25	35	30
Filamentous algae cover (%)		60	10	0	0
Riparian width (m) – TRB / TLB		0 / 20+	0 / 20+	0 / 2.5	0 / 2.5
Riparian longitudinal extent (%) – TRB / TLB		0 / 100	0 / 100	0 / 95	0 / 95
Adjacent vegetation type – TRB / TLB	Canopy	None / Exotic	None / Exotic	None / Exotic	None / None
	Understory	Exotic / Exotic	Exotic / Mixed	None / Mixed	Exotic / Mixed
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		5	15	35	10
Adjacent land-use	TRB	Bush / Forest / Scrub	Bush / Forest / Scrub	Sheep / Beef grazing	Sheep / Beef grazing
	TLB	Bush / Forest / Scrub	Bush / Forest / Scrub	Sheep / Beef grazing	Sheep / Beef grazing
Bank erosion (%) – TRB / TLB		0/ 0	0 / 0	0 / 0	0 /0
Fencing type	TRB	None	None	None	Temporary
	TLB	None	None	Light Wt Dairy	Light Wt Dairy

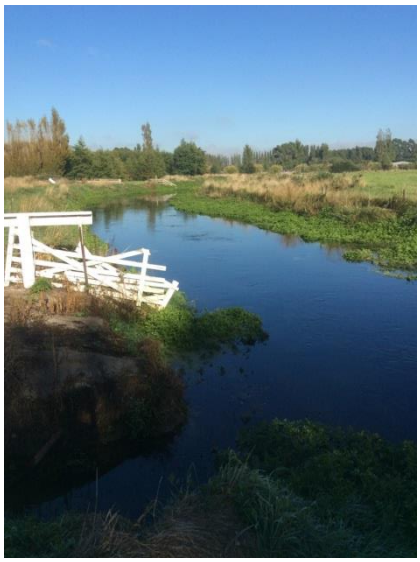
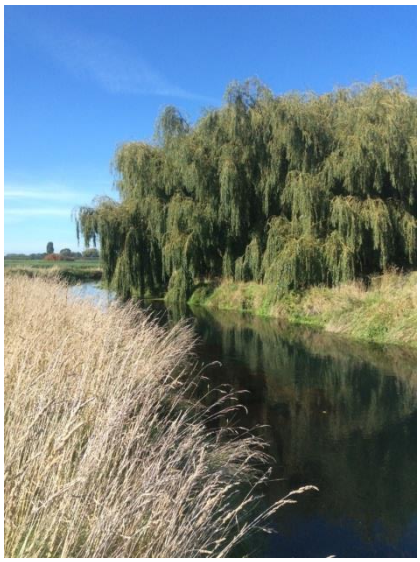
Goodericks		Reach 5	Reach 6	Reach 7
Reach length (m)		137	125	157
Flow habitat type (%)		100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		2.5 / 2.8	3.3 / 3.3	1.4 / 1.4
Water depth (m) – Mean / Max.		0.7 / 0.9	0.8 / 0.9	0.3 / 0.3
Substrate composition (%)	Silt/Sand (<2 mm)	10	10	10
	Gravel (2 – 16 mm)	55	55	55
	Pebble (16 – 64 mm)	35	35	35
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		NA	NA	NA
Channel modification		Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.7 / 1.6	2 / 1.5	1.8 / 1.1
Bank angle – TRB / TLB		Moderate / Steep	Moderate / Moderate	Moderate / Steep
Emergent macrophyte cover (%)		95	55	80
Submerged macrophyte cover (%)		5	40	0
Filamentous algae cover (%)		0	35	20
Riparian width (m) – TRB / TLB		0/2.5	0/0	0/0
Riparian longitudinal extent (%) – TRB / TLB		0/80	0/0	0/0
Adjacent vegetation type – TRB / TLB	Canopy	None / None	None / None	None / None
	Understory	Exotic/Exotic	Exotic / Exotic	Exotic / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		15	5	5
Adjacent land-use	TRB	Sheep / Beef grazing	Sheep / Beef grazing	Sheep / Beef grazing
	TLB	Sheep / Beef grazing	Cropping	Cropping
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0
Fencing type	TRB	Temporary	Temporary	Temporary
	TLB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy

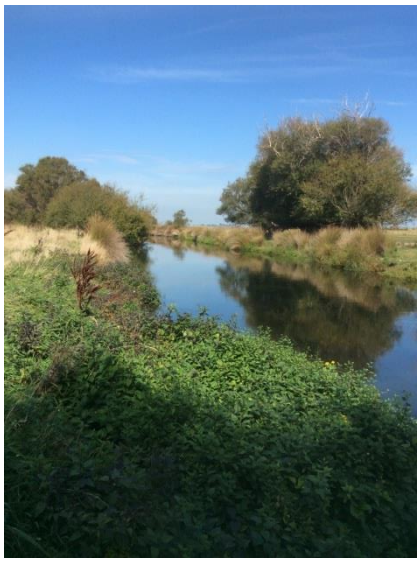
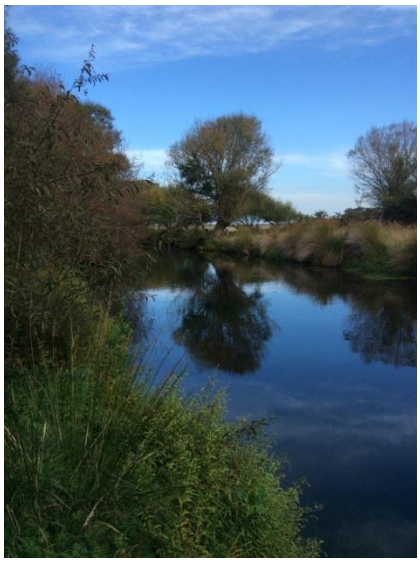
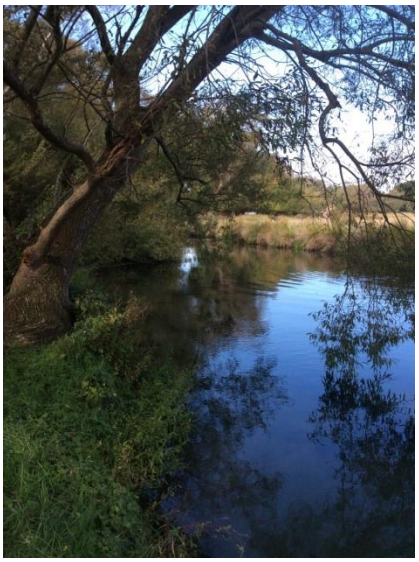
Powells		Reach 1	Reach 2	Reach 3	Reach 4
Reach length (m)		478	159	406	129
Flow habitat type (%)		100 % run	100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		4.0 / 4.5	2.9 / 3.2	3.5 / 4.0	3.3 / 4.2
Water depth (m) – Mean / Max.		0.5 / 0.6	0.7 / 1.0	0.9 / 0.9	0.4 / 0.4
Substrate composition (%)	Silt/Sand (<2 mm)	100	100	100	0
	Gravel (2 – 16 mm)	0	0	0	55
	Pebble (16 – 64 mm)	0	0	0	45
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		100	100	100	NA
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.9 / 1.6	1.7 / 1.9	1.6 / 2.2	0.8 / 1.6
Bank angle – TRB / TLB		Moderate / Moderate	Low / Moderate	Moderate / Moderate	Low / Moderate
Emergent macrophyte cover (%)		10	0	5	100
Submerged macrophyte cover (%)		90	100	90	0
Filamentous algae cover (%)		75	5	70	0
Riparian width (m) – TRB / TLB		2.0 / 2.0	0 / 3.0	0 / 0	4.0 / 0
Riparian longitudinal extent (%) – TRB / TLB		30 / 80	0 / 95	0 / 0	50 / 0
Adjacent vegetation type – TRB / TLB	Canopy	None / Exotic	None / Exotic	None / None	None / None
	Understory	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Native / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic	Non e/ Exotic
Overhead cover / shading (%)		10	30	0	0
Adjacent land-use	TRB	Irrigated Pasture	Irrigated Pasture	Sheep/Beef grazing	Cropping
	TLB	Irrigated Pasture	Sheep/Beef grazing	Sheep/Beef grazing	Impervious
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	5 / 5	0 / 0
Fencing type	TRB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy	None
	TLB	Light Wt Dairy	Light Wt Dairy	Light Wt Dairy	None

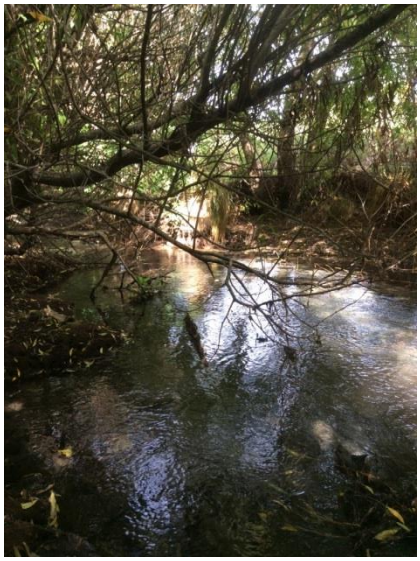
Powells		Reach 5	Reach 6	Reach 7	Reach 8
Reach length (m)		159	166	107	25
Flow habitat type (%)		100 % run	100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		2.0 / 2.2	2.0 / 2.4	2.6 / 2.9	2.4 / 2.4
Water depth (m) – Mean / Max.		0.5/0.6	0.3/0.4	0.3/0.3	0.3/0.3
Substrate composition (%)	Silt/Sand (<2 mm)	10	10	10	5
	Gravel (2 – 16 mm)	45	45	45	35
	Pebble (16 – 64 mm)	45	45	45	60
	Cobble (64 – 256 mm)	0	0	0	0
Fine sediment cover (%)		NA	NA	NA	NA
Channel modification		Straightened	Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.2/1.8	1.0/1.8	0.8/1.7	1.7/2.1
Bank angle – TRB / TLB		Moderate / Steep	Moderate / Steep	Low / Steep	Steep / Steep
Emergent macrophyte cover (%)		80	100	0	0
Submerged macrophyte cover (%)		5	0	NA	NA
Filamentous algae cover (%)		10	0	NA	NA
Riparian width (m) – TRB / TLB		4.0 / 0	0 / 0	2.2 / 0	5.0 / 0
Riparian longitudinal extent (%) – TRB / TLB		75 / 0	0 / 0	100 / 0	100 / 0
Adjacent vegetation type – TRB / TLB	Canopy	Exotic / None	None / None	Exotic / None	Exotic / None
	Understory	Exotic / Exotic	Exotic / Exotic	None / None	None / None
	Groundcover	Exotic / Exotic	Exotic / Exotic	None / Exotic	None / Exotic
Overhead cover / shading (%)		30	0	0	5
Adjacent land-use	TRB	Deer grazing	Deer grazing	Sheep / Beef grazing	Residential
	TLB	Impervious	Impervious	Impervious	Impervious
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	5 / 0	0 / 0
Fencing type	TRB	Deer	Deer	Standard Sheep	None
	TLB	None	None	None	None

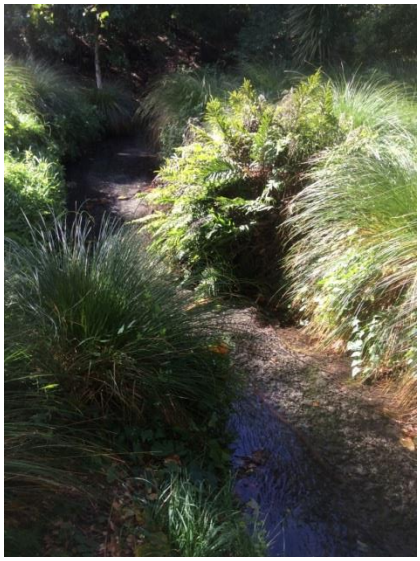
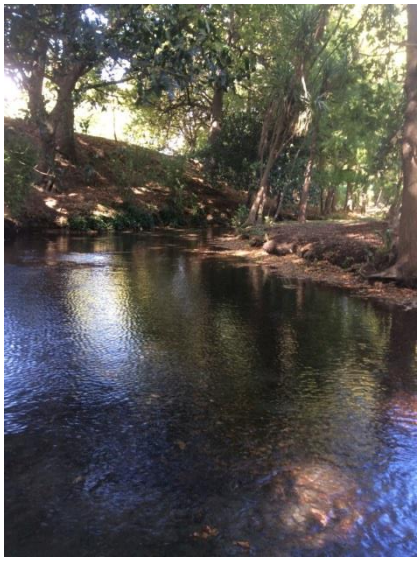
Powells		Reach 9	Reach 10	Reach 11
Reach length (m)		125	151	152
Flow habitat type (%)		100 % run	100 % run	100 % run
Wetted width (m) – Mean / Max.		1.5 / 2.0	1.3 / 1.9	1.9 / 2.3
Water depth (m) – Mean / Max.		0.3 / 0.4	0.2 / 0.2	0.2 / 0.2
Substrate composition (%)	Silt/Sand (<2 mm)	0	25	0
	Gravel (2 – 16 mm)	50	55	85
	Pebble (16 – 64 mm)	50	20	15
	Cobble (64 – 256 mm)	0	0	0
Fine sediment cover (%)		5	NA	NA
Channel modification		Straightened	Straightened	Straightened
Bank height (m) – TRB / TLB		1.9/2.3	2.4/2.7	1.9/2.3
Bank angle – TRB / TLB		Steep / Steep	Moderate / Steep	Moderate / Steep
Emergent macrophyte cover (%)		95	80	80
Submerged macrophyte cover (%)		0	5	0
Filamentous algae cover (%)		0	5	0
Riparian width (m) – TRB / TLB		3.8 / 5	4.4 / 0	4.5 / 0
Riparian longitudinal extent (%) – TRB / TLB		30 / 0	60 / 0	100 / 100
Adjacent vegetation type – TRB / TLB	Canopy	None / None	Exotic / None	Exotic / None
	Understory	Mixed/ Exotic	Mixed / Exotic	Mixed / Exotic
	Groundcover	Exotic / Exotic	Exotic / Exotic	Exotic / Exotic
Overhead cover / shading (%)		5	15	25
Adjacent land-use	TRB	Deer grazing	Sheep / Beef grazing	Sheep / Beef grazing
	TLB	Impervious	Impervious	Impervious
Bank erosion (%) – TRB / TLB		0 / 0	0 / 0	0 / 0
Fencing type	TRB	Deer	Deer	Deer
	TLB	None	None	None

SITE PHOTOGRAPHS

Englishs Reach 1	Englishs Reach 2	Englishs Reach 3
		
Englishs Reach 4	**Englishs Reach 5**	**Pannetts Reach 1**
		

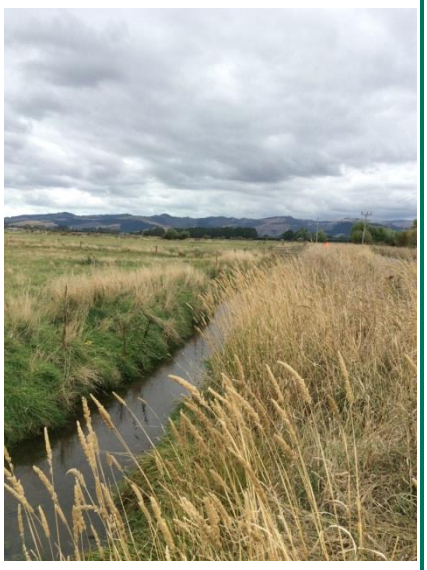
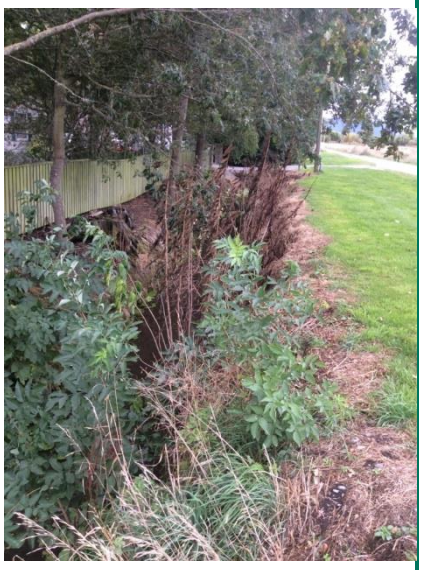
Pannetts Reach 2	Pannetts Reach 3	Wolfes Reach 1
		
Wolfes Reach 2	**Wolfes Reach 3**	**Wolfes Reach 4**
		

L1 Reach 1	L1 Reach 2	L1 Reach 3
		
L1 Reach 4	**L1 Reach 5**	**L1 Reach 6**
		

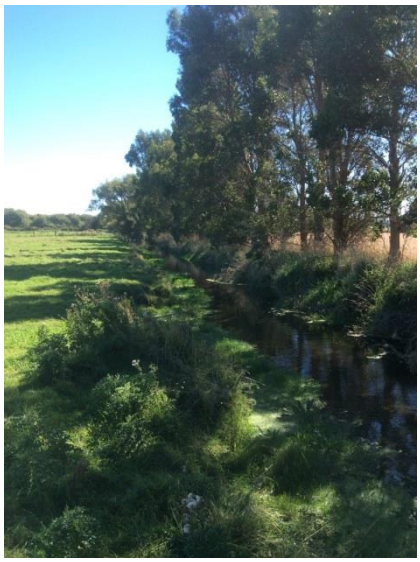
L1 Reach 7	L1 Reach 8	L1 Reach 9
		
L1 Reach 10	**L1 Reach 11**	**Liffey Reach 1**
		

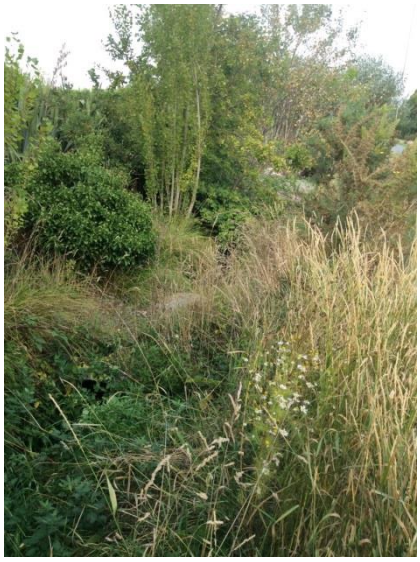
Liffey Reach 2	Liffey Reach 3	Liffey Reach 4
		
Liffey Reach 5	**Liffey Reach 6**	**LMD Reach 1**
		

LMD Reach 2	LMD Reach 3	Springs Reach 1
		
Springs Reach 2	**Springs Reach 3**	**Springs Reach 4**
		

Collins Reach 1	Collins Reach 2	Collins Reach 3
		
Collins Reach 4	**Ellesmere Reach 1**	**Ellesmere Reach 2**
		

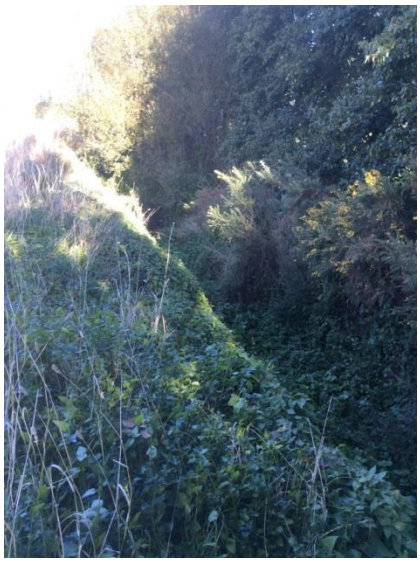
Ellesmere Reach 3	Ellesmere Reach 4	Ellesmere Reach 5
		
Ellesmere Reach 6	**Ellesmere Reach 7**	**Ellesmere Reach 8**
		

Ellesmere Reach 9	Ellesmere Reach 10	Ellesmere Reach 11
		
Carters Reach 1	**Carters Reach 2**	**Carters Reach 3**
		

Carters Reach 4	Days Reach 1	Days Reach 2
		
Days Reach 3	**Days Reach 4**	**Days Reach 5**
		

Goodericks Reach 1	Goodericks Reach 2	Goodericks Reach 3
		
Goodericks Reach 4	**Goodericks Reach 5**	**Goodericks Reach 6**
		

Goodericks Reach 7	Powells Reach 1	Powells Reach 2
		
Powells Reach 3	**Powells Reach 4**	**Powells Reach 5**
		

Powells Reach 6	Powells Reach 7	Powells Reach 8
		
Powells Reach 9	**Powells Reach 10**	**Powells Reach 11**
		

APPENDIX C

Water Quality Data Collected

WATER QUALITY SAMPLING & DATA COLLECTED

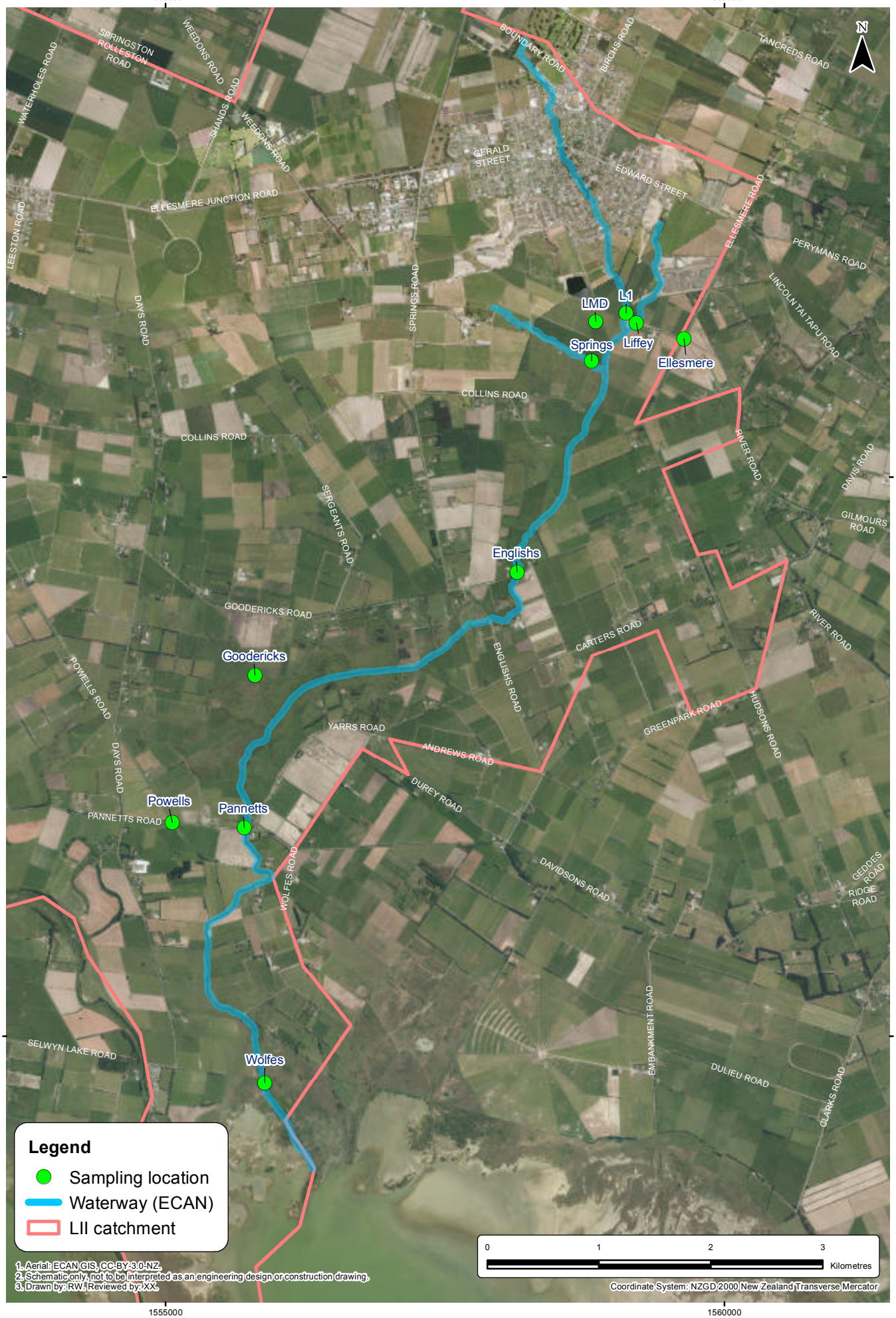
Water quality sampling was undertaken at 10 sites across the Ararira / LII River catchment as part of this study to provide a snapshot of the current water quality status at these sites. The location of these 10 sites can be seen in Figure C1.

Two rounds of water quality sampling were performed at each site: one during dry weather conditions and one following rainfall. The dry sampling event was carried out on 7 April 2015, while the wet sampling event was carried out 10 July 2015[2].

In-situ measurements of pH, dissolved oxygen concentration and saturation, electrical conductivity, and water temperature were collected at each site using a YSI handheld multi-parameter meter. In addition, water quality samples were collected at each site and sent to Hill Laboratories for analysis of turbidity, total suspended solids, total hardness, selected cations (calcium and magnesium), nutrients, *E. coli* and dissolved metals (cooper, lead and zinc).

The data collected as part of this water quality sampling can be seen in Table C1 and Table C2.

[2] Samples collected during the wet sampling event are currently being analysed at the time of writing this report.



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TITLE

LII WATERWAYS: SAMPLING LOCATIONS FOR WATER QUALITY

NOVEMBER 2015

PROJECT 1414458

C1

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Table C1: Water quality data collected in-situ during the dry and wet sampling events.

Site	Event	pH (unitless)	DO concentration (g/m^3)	DO saturation (%)	Conductivity (µS/cm)	Temperature (°C)
Englishs	Dry	7.8	11.6	121.7	204	14.9
	Wet	7.8	13.2	121.6	183	10.8
Pannetts	Dry	7.7	5.5	58.2	250	16.6
	Wet	7.7	12.3	110.5	181	10.3
Wolfes	Dry	7.8	8.1	84.9	209	16.2
	Wet	7.8	11.4	102.1	186	9.8
LI	Dry	7.6	7.8	77.6	246	14.0
	Wet	7.6	10.7	95.5	198	10.4
Liffey	Dry	7.9	7.3	73.3	208	14.6
	Wet	7.8	11.2	95.9	167	8.1
LMD	Dry	7.7	8.5	89.6	309	15.4
	Wet	7.7	11.8	101.3	238	8.1
Springs	Dry	7.9	6.3	61.8	178	14.1
	Wet	7.7	10.7	97.7	126	11.3
Ellesmere	Dry	7.6	3.2	32.7	178	14.7
	Wet	7.6	6.7	57.2	162	8.0
Goodericks	Dry	7.6	5.0	52.6	260	15.1
	Wet	7.7	10.8	113.6	234	11.5
Powells	Dry	7.7	3.3	38.0	281	15.3
	Wet	7.8	11.0	94.8	345	8.8

Table C2: Water quality data (laboratory results) from the dry and wet sampling events.

Site	Event	Turbidity	TSS	Total hardness	Ca	Mg	NH_4	NO_2	NO_3	NOx	DRP	TKN	TN	*E. coli*	Cu	Pb	Zn
Englishs	Dry	1.3	<3	81	25	4.9	<0.01	0.01	4.7	4.7	0.010	0.1	4.8	150	<0.0005	<0.0001	<0.001
	Wet	5.1	5	83	25	5	<0.01	0.006	4.5	4.5	0.012	0.19	4.7	200	<0.0005	<0.0001	0.0018
Pannetts	Dry	1.6	3	95	26	7.3	0.04	0.015	5.1	5.1	0.014	0.24	5.4	360	<0.0005	<0.0001	<0.001
	Wet	3.7	4	82	24	5.2	0.012	0.007	3.8	3.8	0.016	0.28	4.1	200	<0.0005	<0.0001	0.0013
Wolfes	Dry	0.9	<3	79	23	5.0	<0.01	0.014	3.6	3.6	0.020	0.22	3.8	240	<0.0005	<0.0001	<0.001
	Wet	3.0	<3	86	25	5.4	0.013	0.008	3.7	3.7	0.018	0.20	3.9	300	<0.0005	<0.0001	0.0015
LI	Dry	0.6	<3	95	27	6.5	<0.01	0.009	8.0	8	0.006	0.05	8.1	420	<0.0005	<0.0001	0.0013
	Wet	3.3	12	84	24	6	<0.01	0.005	6.5	6.5	0.008	0.19	6.7	900	<0.0005	<0.0001	0.0061
Liffey	Dry	7.1	7	85	26	4.9	0.016	0.019	4.7	4.7	0.011	0.18	4.9	180	<0.0005	<0.0001	<0.001
	Wet	13.6	19	79	25	4.3	0.019	0.011	4.4	4.4	0.006	0.49	4.9	100	<0.0005	<0.0001	<0.001
LMD	Dry	5.2	6	111	30	8.6	0.015	0.018	10.3	10.3	0.006	0.22	10.5	1000	<0.0005	<0.0001	0.0017
	Wet	19.3	103	100	27	7.9	0.019	0.007	9.0	9.0	0.008	0.37	9.4	200	<0.0005	<0.0001	0.0097
Springs	Dry	0.9	<3	60	19	2.9	<0.01	0.006	2.3	2.3	0.011	0.05	2.3	640	<0.0005	<0.0001	<0.001
	Wet	8.6	33	62	20	3	0.012	0.003	2.2	2.2	0.026	0.18	2.4	200	<0.0005	<0.0001	<0.001
Ellesmere	Dry	0.4	<3	75	24	3.9	<0.01	0.006	3.4	3.4	<0.004	0.1	3.5	60	<0.0005	<0.0001	<0.001
	Wet	2.4	<3	80	25	4.2	0.01	0.012	4.2	4.2	0.018	0.29	4.5	100	<0.0005	<0.0001	0.0013
Goodericks	Dry	1.0	6	104	28	8.4	<0.01	0.005	6.1	6.1	<0.004	0.16	6.3	130	<0.0005	<0.0001	0.0031
	Wet	2.2	4	104	28	8.1	0.013	0.008	5.8	5.8	0.014	0.27	6.0	80	0.0005	<0.0001	0.0024
Powells	Dry	0.8	4	114	32	8.5	<0.01	0.019	2.3	2.3	0.018	0.22	3.8	240	<0.0005	<0.0001	<0.001
	Wet	11.9	31	163	45	12.1	0.019	0.013	3.0	3.0	0.048	1.58	4.6	800	0.0016	0.00012	0.0025

Note: All units g/m^3 except for turbidity (NTU) and *E. coli* (*E. coli*/100 mL).

Parameter abbreviations – TSS: Total suspended solids; Ca: calcium; Mg: magnesium; NH_4: total ammoniacal-N; NO_2: nitrite-N; NO_3: nitrate-N; NOx: nitrite-N + nitrate-N; TKN: total kjehldahl nitrogen; TN: total nitrogen; Cu: copper; Pb: lead; Zn: zinc.

APPENDIX D

Ararira / LII River Catchment Supporting Data Maps

1. Aerials: ECan GIS. CC BY 3.0 NZ.
2. Schematic only, not to be interpreted as an engineering design or construction drawing.
3. Drawn by: RW. Reviewed by: XX.

Coordinate System: NZGD 2000 New Zealand Transverse Mercator

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TITLE | LANDUSE CHANGE - LINCOLN TOWN

NOVEMBER 2015

PROJECT | 1414458

D1

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1. Aerials: ECan GIS. CC BY 3.0 NZ.
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TITLE | LANDUSE CHANGE - LOWER CATCHMENT

NOVEMBER 2015

PROJECT | 1414458

D2

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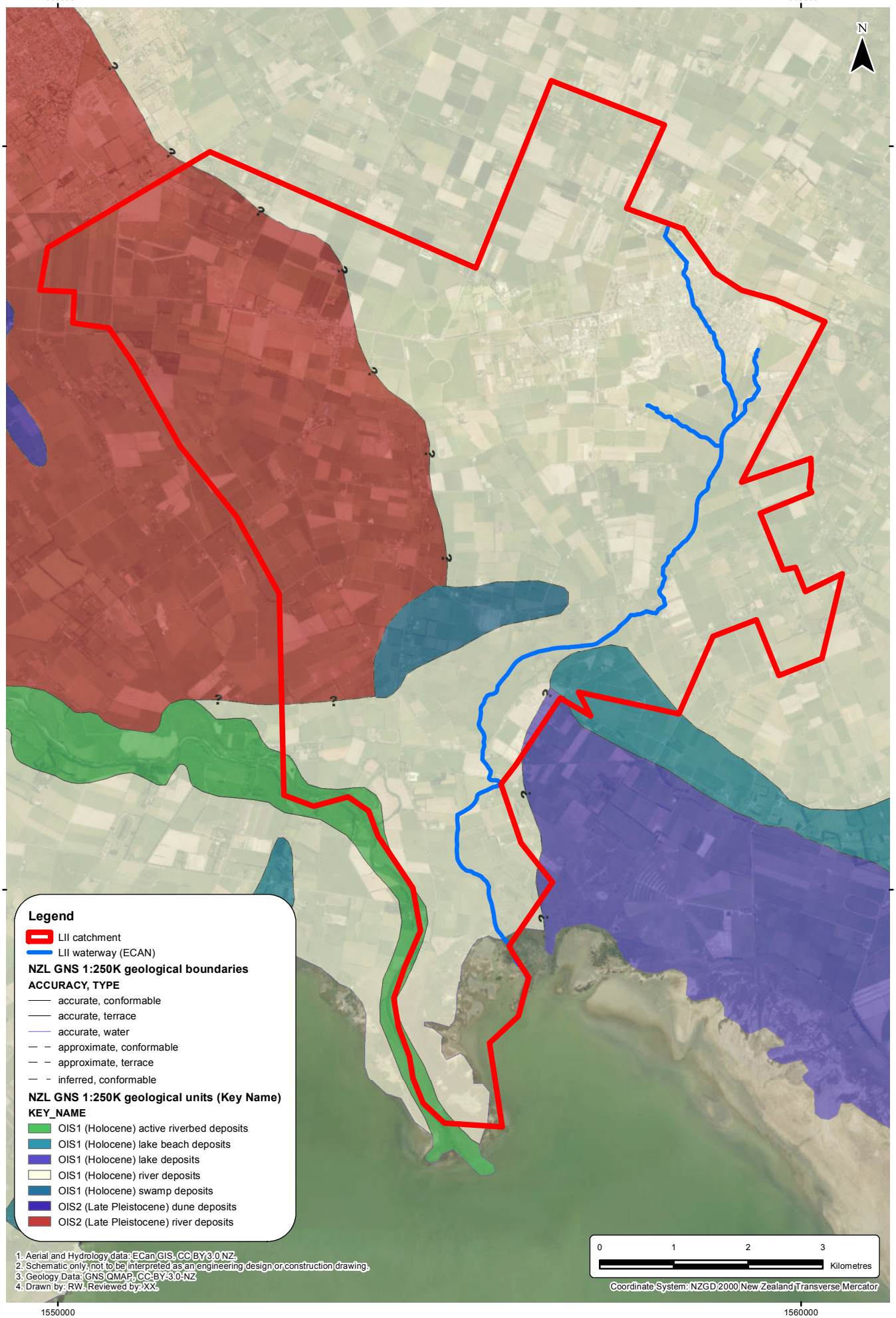

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TITLE: ARARIRA / LII RIVER - GEOLOGY QMAP

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PROJECT: 1414458

D3

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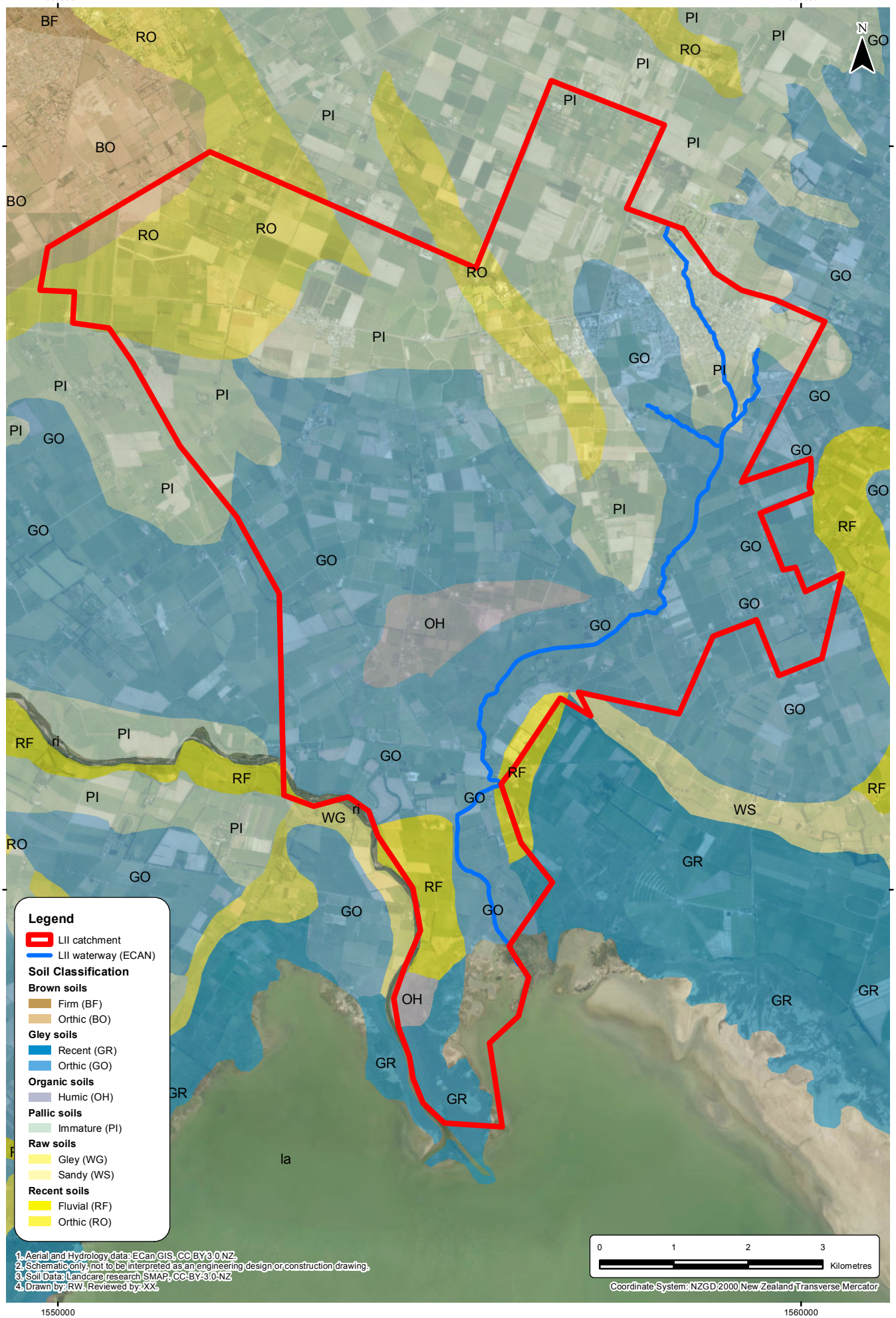

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TITLE

ARARIRA / LII RIVER - SOILS SMAP

NOVEMBER 2015

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D4

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