



Living Water Pūkorokoro-Miranda Programme

Establishing Freshwater Fauna Monitoring Sites in the Miranda Catchment

June 2018



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Draft Report submitted: 5 June 2018

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Citation: Roxburgh, J. 2018: Establishing freshwater fauna monitoring sites in the Miranda catchment. Report prepared for the Living Water Programme by Living Matters Ltd. 25 p. + appendices.

Table of Contents

1	Introduction	5
1.1	The wider Pūkoro-koro-Miranda catchment and Ti Kapa Moana/Firth of Thames	5
1.2	The Miranda catchment	5
1.3	Landowner permissions	7
2	Design and Methods	7
2.1	Project brief and description	7
2.2	Sampling	8
3	Results	9
3.1	West (Miranda Stream) sub-catchment	9
3.1.1	West Lower	9
3.1.2	West Mid	10
3.1.3	West Upper	11
3.2	The Centre sub-catchment	12
3.2.1	Centre Lower	12
3.2.2	Centre Mid	13
3.2.3	Centre Upper	14
3.3	The East sub-catchment	14
3.3.1	East Lower	14
3.3.2	East Mid	15
3.3.3	East Upper	16
3.4	The Coast sub-catchment	17
3.4.1	Coast Lower	17
3.4.2	Coast Mid	18
3.4.3	Coast Upper	19
3.5	Miranda catchment fish surveys by EcoQuest	20
3.5.1	Glatt (2002)	21
3.5.2	Beckley (2002)	21
3.5.3	Adams (2002)	22
3.5.4	Rivard (2002)	22
4	Discussion	22
4.2	Landowners	22
4.2	Higher altitude stream flows	23
4.3	Pest fish	23
4.4	Freshwater mussels/kākahi	23
4.5	Potential barriers to fish passage	23
4.6	Inanga spawning sites	23
5	Recommendations	24
5.1	Centre Lower sampling site	24
5.2	West Upper site	24
5.3	Pest fish	24
5.4	Freshwater mussels/kākahi	24

5.5	Inanga _____	24
5.6	Assessment of riparian and adult tuna habitat quality _____	24
5.7	Provision of this report to landowners _____	24
6	<i>Acknowledgements</i> _____	25
7	<i>References</i> _____	25
	<i>Appendix 1: Fish Collection Forms</i> _____	27

1 Introduction

1.1 The wider Pūkoro-Miranda catchment and Ti Kapa Moana/Firth of Thames

The Living Water Programme contracted Living Matters Ltd to design and implement a repeatable freshwater fish monitoring programme for the Miranda catchment, part of the wider Pūkoro-Miranda catchments. These flow into Tikapa Moana/Firth of Thames and the associated 8500 ha coastal wetland, which is protected under the Ramsar Convention on Wetlands. According to the Living Water website:

“The shorebird area and habitat at Pūkoro-Miranda has been significantly degraded and reduced in size. Water quality is poor due to increased levels of suspended sediment. Much of this has been caused by various productive land uses in the catchment and the highly modified hydrology and drainage system that has been put in place to reduce inundation and flooding for landowners in the lower catchment. Living Water’s key focus is protecting and expanding the shorebird habitat, reducing sediment loads and connecting on-farm biodiversity via ‘mountains to sea’ blue corridors.”

1.2 The Miranda catchment

This is the southern-most of five in the Living Water Pūkoro-Miranda project area, dividing into four sub-catchments. These are locally known by various names, and for consistency referred to in this report as follows (see Figure 1):

- **West:** the western-most of the four sub catchments, widely known as Miranda Stream.
- **Centre:** the next stream toward the coast, between the east and west streams.
- **East:** this stream sits between the Centre stream and the Findlay Road ridgeline.
- **Coast:** this stream sits on the coastal side of the Findlay Road ridgeline.

Roxburgh and McQueen (2015) noted this catchment has the least modified outlet to the sea, and the least barriers to fish migration of the Pūkoro-Miranda catchments. The upstream extent of the saltwater wedge was located and marked by Roxburgh (2018) over three March and April 2018 spring tide events, at:

- For the stream that drains the Centre, East, and Coast tributaries, about 50 m downstream of the Miranda Road bridge, just to the east of the intersection with Findlay Road.
- For the West tributary, about 200 m downstream of where this stream passes beneath Miranda Road.

Kendal et al. (2017) notes two barriers to fish passage in the catchment (See Figure 2):

- One in the Centre stream near the end of a small third-order tributary, and not considered in this report as it has little habitat above it.
- The other in the mainstem of the East stream. Per the Project Brief, sampling sites were established to be up and downstream of this barrier, to enable comparison of the fish fauna over time.

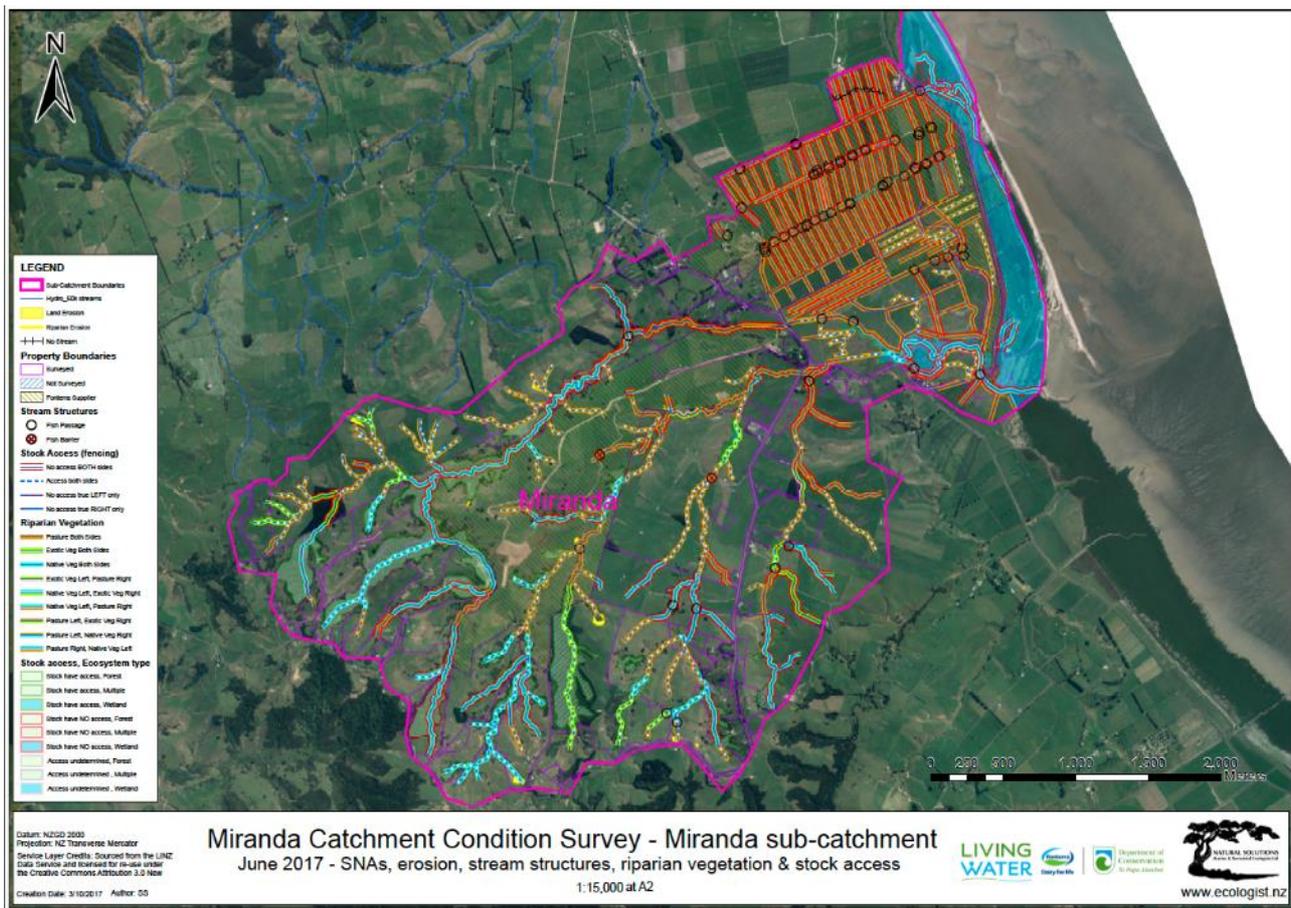
The one dairy farm in the catchment covers about 25% of the land area., with the remainder in mixed dry-stock farm and lifestyle blocks with scattered indigenous vegetation, primarily riparian. The catchment vegetation is about 75% farmland, 20% native forest and scrub, and 5% exotic forest plantation. The stream substrate in much of the mid and upper reaches of the catchment is compacted, with little loose material for fish to use as refuges or general habitat. There are a few formally protected area within the catchment, including:

- Near the mouth of Miranda Stream, the Pūkoro-Miranda Naturalist’s Trust 27.7 ha QEII National Trust covenant, and the DOC managed Miranda Stream Conservation Area, and adjoining Miranda Conservation Covenant (DOC covenant)
- In the upper part of the West (Miranda) Stream, two blocks of the KR & E Parkinson Conservation Covenant (DOC covenant)

Figure 1: The location of the Miranda sub-catchment (top) and sampling sites within the catchment (bottom).



Figure 2: Figure from Kendal et al (2017) showing the two fish passage barriers in the catchment, and the status of riparian vegetation and fencing.



1.3 Landowner permissions

Once sites had been identified and ownership established (see Section 3.2), contact details for each owner were obtained, with considerable assistance from Gary and Adrienne Dalton. There are seven landowners covering the twelve selected sampling reaches and sites, though many more were contacted for access to their property during the site selection process. Landowners were phoned or approached via door-knocking several weeks prior to the work beginning, to gain their approval for entry onto their property to assess the sites. Once the sites were chosen, those with sites on their property were asked for permission to undertake the freshwater fish monitoring, and the others thanked for allowing us to look at their site. The landowners with chosen sites were then contacted or visited just prior to the sampling occurring.

Permission for access was denied by only one landowner, so another allied site was chosen (Coast Upper). No properties were accessed without confirming permission from the landowner or manager. Landowners provided some very useful information on site selection, valuable observations of freshwater fauna and the history of stream modification on their properties and in the wider catchment. They were asked about any risks or hazards we needed to manage while on their property. High visibility clothing was worn at all times during freshwater fish sampling.

2 Design and Methods

2.1 Project brief and description

DOC's Helen Kettles provided a project outline, from which we developed a Project Brief. After feedback and alterations from Helen and several other DOC staff, this was approved (Roxburgh, 2018b). As measured from the upper reach of the saltwater wedge, the longest and shortest tributaries are the 5.5 km West sub-

catchment, and the 2.7 km Coast sub-catchment respectively. The highest point in the catchment is 224 m, but the streams in this catchment only are too small to be sampled using the Protocol until considerably lower. To establish the twelve stratified random sampling sites, on paper the catchment was split into three zones for each of the four stream systems:

Lower Zone: up to 30 m altitude. From where they cross Miranda Road this equates to:

- West and Centre Streams: 2000 m upstream¹.
- For the East and Coast Streams: 1500 m upstream.

Mid Zone: 30-60m altitude, which equates to (from where they cross the Miranda Road):

- West and Centre streams: 2000-3500 m upstream.
- East and Coast Streams: 1500-2300 m upstream.

Upper Zone: 60+ m altitude, which equates to (from where they cross the Miranda Road):

- West and Centre Streams: 3000-3500 m upstream.
- East and Coast Streams: 2300-3400 m upstream.

All three sites used by Roxburgh and McQueen (2015) in this catchment (West Mid, Centre Lower, and Centre Mid, marked as # in Table 1)) were used for this work. For the remainder, the geographical mid-point of each Zone was assessed on the ground for suitability as a sampling reach. The location was tweaked to meet the requirements for sampling under the Protocols, and topographical and physical constraints, including finding trees or other solid objects to mark the up or downstream extents of the sampling reach. Therefore, as far as practicable the design is stratified random, with the final sampling sites are shown in Figure 1 and Table 1:

Table 1: Altitude and distance upstream of final sampling sites (# = surveyed by Roxburgh & McQueen, 2015)

Sub-catchment	Zone	Actual	
		Altitude (m)	Distance Upstream (m)
West	Upper	78	3880
	Mid#	40	2430
	Lower	7	630
Centre	Upper	45	2720
	Mid#	37	1010
	Lower#	9	760
East	Upper	58	3120
	Mid	38	2110
	Lower	15	1150
Coast	Upper	58	2600
	Mid	19	1140
	Lower	5	260

The Project Brief required the sampling to be completed in February 2018. However, because February-March in this area normally has 6-8 weeks with no rain, we recommended this be moved to mid-March/April. However, this year saw season three successive tropical cyclones, with well above normal flows until mid-late March 2018, meaning sampling was not able to be completed until early April 2018 anyway.

2.2 Sampling

Sampling was undertaken by Jason Roxburgh (Living Matters Ltd) and Stella McQueen (then at Kessels Ecology), using The New Zealand Freshwater Fish Sampling Protocols² (Joy et al. 2013, hereafter referred to as “the Protocol”). Though not part of the original Project Brief, Macro-invertebrate Community Index (MCI)

¹ As measured from the upstream extent of the saltwater wedge

² www.niwa.co.nz/static/web/New_Zealand_Freshwater_Fish_Sampling_Protocols.pdf

samples were also taken, using accepted protocols. These samples are held by Living Matters Ltd until Living Water is in a position to have them analysed.

During initial site visits we found the Coast sub-catchment has:

- Good riparian vegetation in the upper zone and upper part of the mid zone, but a very small flow.
- Apart from the site used for the Coast Mid MCI sampling, which has a narrow riparian canopy of kanuka, very dense instream vegetation of *Apium nodiflorum* (water celery) and *Glyceria maxima* (reed sweet grass), and/or dense overhanging pasture/kikuyu grasses.
- Thick orange floc/algal layers which cover some of the Mid and Lower sections

The tree methods in the Protocol require a basic minimums to be useful:

- **Electric Fishing:** sufficient water depth is required to effectively use an Electric Fishing Machine (EFM).
- **Spotlighting:** sufficiently open riparian areas, otherwise shadows cast by the vegetation makes spotlighting impossible.
- **Netting/Trapping:** Sufficient depth of water, and width of stream to be able to fit Fyke nets into the stream

Various combinations across the Coast sub catchment meant this stream was unsuitable for the Protocol’s sampling methods, so we took only MCI samples. All four streams are relatively small, with low stable base flows. When Roxburgh and McQueen (2015) sampled three sites in this sub-catchment, higher water levels enabled EFM sampling of two of them (West Mid and Centre Mid). However, during the field work for this contract, the lower water levels meant EFM could only be used for one sampling reach (West Mid). Table 2 shows the combination of methods that were used for the sampling reaches and sites.

Table 2: Sampling methods used at the twelve sampling reaches and sites.

	West			Centre			East			Coast		
	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower	Upper	Mid	Lower
EFM		🐟										
Spotlighting	🐟			🐟	🐟		🐟					
Netting			🐟			🐟		🐟	🐟			
MCI	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟

3 Results

3.1 West (Miranda Stream) sub-catchment

This sub-catchment is widely known as Miranda Stream, the western-most and largest in the catchment. The Mid and Lower sites are completely within a dairy farm, and the Upper is partly within a dairy farm, and partly within a bush/lifestyle block. The stream substrate in most of the mid and upper reaches of the catchment is compacted, with little loose material for fish to use as refuges or general habitat. This stream confluences with the one that leads to the other three in the catchment at E1805151 N5882288, 1150 m upstream of the East Coast Road bridge

3.1.1 West Lower

The marked³ upstream end of this sampling reach is at E1804195 N5882480 (Figure 1) and the downstream end is at E1804340 N5882485. The riparian areas are fenced with 2-5 m margins, though there are no longer stock in on the true right as this is now part of Te Whangai Trust’s nursery operation. The vegetation is large, tall alders and other introduced species forming a narrow band of canopy, over a ground cover of mostly rank grass. Immediately upstream of the sampling site the riparian vegetation is similar to that of the sampling site, which is also fenced on both sides. This reach has been channelised, and the stream is deeply

³ All sampling reaches are marked at either their upstream or downstream extents with a yellow or blue plastic triangle nailed to a tree or fence post. Given the lack of trees in many of the mid and lower sampling reaches, we were not able to consistently mark either the upstream, or the downstream, end of each sampling reach.

incised into the soft alluvial substrate. Water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Netting/Trapping method. Table 3 summarises the fish species found, with the full record shown in Appendix 1. Figure 2 shows the sampling reach downstream end photo-point and location map.

Table 3: Summary of species found in the West Lower sampling reach.

Species	Abundance	Length Range (mm)
Koura	10	20-30
Freshwater shrimp (<i>Paratya</i>)	Present in large numbers	
Longfin eel	9	300-700*
Bully (unidentified) ⁴	20	30-110
Inanga	106	50-120
Smelt	5	60-90
Kakahi ⁵		

* = Expected size range of this species not found at this sampling reach

Figure 2: West Lower start photopoint and location.



Left: West Lower sampling reach, photopoint of downstream end looking upstream (note yellow triangle on tree at mid left for reference (photo by Living Matters). Right: West Lower sampling reach location (photo Webmaps).

3.1.2 West Mid

The marked downstream end of this sampling reach is at E1802721 N5881744, and the upstream end is at E1802617 N5881648. The riparian areas are fenced with 40-50 m margins, with a canopy of tall manuka and kanuka, over an understory of rank grass, mahoe, horopito, and tree ferns. Immediately upstream of the sampling site the riparian vegetation is much more established, with large emergent rimu and kauri, and an understory of the above, plus tutu, rangiora, and cabbage tree. The vegetation condition is good, although the riparian fenced area is irregularly grazed. The water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's EFM method, but the conditions during the field work for this project meant this was the only site that could be sampled using the EFM. Table 4 summarises the fish species found, with the full record shown in Appendix 1. Figure 3 is the monitoring photo-point at the start of this sampling reach.

⁴ Dr. Bruno David (Waikato Regional Council) and Stella McQueen advise there are three bully species where definitive identification is difficult in the field without a microscope, and this is further complicated by their wide overlap in distribution. Although adult male Cran's Bullies are relatively simple to distinguish from Common Bullies, other Cran's and Common Bullies are difficult to distinguish from one another in the field, especially when small. Therefore, unless definitively identified, these were classified as "Bully (unidentified)".

⁵ Roxburgh and McQueen (2015) found a small number of live kākahi and shells in this stream (at about E1804357 N5882486, about 20 m downstream of the West Lower sampling site). These were not measured, and the site was not used as one of their survey sites.

Table 4: Summary of species found in the West Mid sampling reach.

Species	Abundance	Length Range (mm)
Koura	14	15-30
Freshwater shrimp (<i>Paratya</i>) ⁶	24	-
Eel (unidentified) ⁷	3	100-300*
Bully (unidentified)	14	30-75
Longfin eel	12	100-900
Shortfin eel	2	300-520
<i>Latia neritoides</i> (FW limpet)	3	-
Banded kōkopu	13	35-140

* = Expected size range of this species not found at this sampling reach

Figure 3: West Mid sampling reach (note yellow triangle photo-point marker at top left).



Left: West Mid sampling reach, photopoint of downstream end looking upstream (note yellow triangle on tree at upper left for reference) (photo by Living Matters). Right: West Mid sampling reach location (photo Webmaps).

3.1.3 West Upper

The marked downstream end of this sampling reach is at E1802060 N5881013 (as shown in Figure 1) and the upstream end is at E1802191 N5880983. The riparian areas are partially fenced, with the first half within a fenced bush block, and the last half fenced on one side. The vegetation is a canopy of tall manuka and kanuka, over an understory of rank grass (in places), mahoe, horopito, and tree ferns. Where there is fenced native vegetation it is in good condition. Just upstream of the sampling reach the stream passes through an area that is pugged by cattle accessing the stream to drink, and it is likely this area is the reason for the high levels of fine sediment in this sampling reach.

The water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Spotlighting method. The substrate of this sampling reach is a mixture of clay and gravel, and the water was quite cloudy. Immediately upstream of the sampling site the riparian vegetation is similar to that of the sampling site. Table 5 summarises the fish species found, with the full record shown in Appendix 1 Figure 4 shows the sampling reach start photo-point and location map.

Table 5: Summary of species found in the West Upper sampling reach.

Species	Number found	Length Range (mm)
Koura	48	20-40
Banded kōkopu	3	110-170
Longfin eel	2	400-1200*

* = Expected size range of this species not found at this sampling reach

⁶ Per conventions in the NZ Freshwater Fish Database, and Joy et al. (2013), freshwater shrimp were only counted. *Latia* freshwater limpets were also only counted

⁷ This comprises eels that were unable to be identified to species level because they were either too small to identify, or could not be caught.

Figure 4: West Upper start photo-point and location.



Left: West Upper sampling reach, photopoint of downstream end looking upstream (note yellow triangle on tree at left for reference) (photo by Living Matters). Right: West Upper sampling reach location (photo Webmaps).

3.2 The Centre sub-catchment

This sub-catchment is drained by a stream that also receives the East and Coast streams, and confluences with the West stream at E1805151 N5882288, 1150 m upstream of the East Coast Road bridge. Parts of the upper and mid-section are through dairy farm, with the remainder through dry-stock farm and lifestyle blocks.

3.2.1 Centre Lower

The marked upstream end of this sampling reach is at E1804207 N5882022 (as shown in Figure 1) and the downstream end is at E1804252 N5882119. The riparian vegetation of this sampling reach is dominated by rank grasses, but the stream is riparian fenced on both sides with a 5-10 m margin, and has been replanted with a range of native riparian species. This sampling reach was surveyed using the Protocol's Netting/Trapping method.

At the time of this survey an area near the upstream end was being grazed by horses. The vegetation is a mixture of rank pasture grasses and kikuyu, and replanted native species. The stream is incised into the mostly soft clay and alluvial substrate. Immediately upstream and downstream of the sampling reach the riparian vegetation is similar. This sampling reach runs through dairy farm on the true left and dry-stock farm on the true right. The water levels were at or near stable base flow for the time of year. Table 6 outlines the species found, and Figure 5 shows the sampling reach start photo-point and location. This sampling reach runs 150 m downstream from this photo-point.

Table 6: Summary of species found in Centre Lower sampling reach.

Species	Abundance	Length Range (mm)
Inanga	91	20-100
Freshwater shrimp (<i>Paratya</i>)	23	-
Longfin eel	8	500-800*
Smelt	21	50-100
Mosquito fish (<i>Gambusia</i>)	169	-
Bully (unidentified)	19	20-100

* = Expected size range of this species not found at this sampling reach

Figure 5: Centre Lower sampling reach (including upstream extent photo-point).



Left: Centre Lower sampling reach, photopoint of upstream end looking downstream (note yellow triangle on post at left for reference) (photo by Living Matters). Right: Centre Lower sampling reach location (photo Webmaps).

3.2.2 Centre Mid

The marked downstream end of this sampling reach is at E1803352 N5881415 (as shown in Figure 1) and the upstream end is at E1803266 N5881319. The riparian area of this sampling reach is fenced with 10-50 m margins, and well vegetated. The canopy at this site dominated by tanekaha, with an understory of manuka, mahoe, kanuka, lemonwood, red matipo, hangehange, tree ferns, and horopito. The ground cover is a mix of native and introduced grasses, Gahnia, water fern, various *Blechnum* ferns. The stream runs through a steep-sided gully, and is gravel and cobbles with some areas of bedrock. Immediately upstream of the sampling site the riparian vegetation is similar to that of the sampling site, which is fenced on both sides. The water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol’s Spotlighting method. Table 6 summarises the fish species found, with the full record shown in Appendix 1. Figure 6 shows the sampling reach start photo-point and location map.

Table 6: Summary of species found in Centre Mid sampling reach.

Species	Abundance	Length Range (mm)
Koura	11	10-30
Longfin eel	4	550-1000
Eel (unidentified)	1	100
Bully (unidentified)	34	30-90
Banded kōkopu	1	70
Redfin bully	5	70-80
Freshwater shrimp (<i>Paratya</i>)	19	-

Figure 6: Centre Mid sampling reach start photo-point and location.



Left: Centre Mid sampling reach, photopoint of downstream end looking upstream (note yellow triangle on tree at right for reference) (photo by Living Matters). Right: Centre Mid sampling reach location (photo Webmaps).

3.2.3 Centre Upper

The marked downstream end of this sampling reach is at E1802991 N5880907 (as shown in Figure 1) and the upstream end is at E1802905 N5880833. The riparian areas of this sampling reach are partially fenced, surrounded by dairy farm. The vegetation is a canopy of tall manuka and kanuka, over an understory of rank grass (in places), mahoe, horopito, and tree ferns. Water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Spotlighting method. The substrate of this sampling reach is a mixture of clay and gravel. Immediately upstream of the sampling site the riparian vegetation is similar to that of the sampling site. The water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Trapping method. Table 7 summarises the fish species found, with the full record shown in Appendix 1. Figure 7 shows the sampling reach start photo-point and location map.

Table 7: Summary of species found in Centre Mid sampling reach.

Species	Abundance	Length Range (mm)
Koura	1	30
Longfin eel	2	600-700*
Bully (unidentified)	7	50-70
Banded kōkopu	16	50-179
Inanga	3	90-100
Freshwater shrimp (<i>Paratya</i>)	19	-

* = Expected size range of this species not found at this sampling reach

Figure 7: Centre Upper sampling reach start photo-point and location.



Left: Centre Upper sampling reach, photopoint of downstream end looking upstream (note yellow triangle on tree fern at mid-left for reference) (photo by Living Matters). Right: Centre Upper sampling reach location (photo Webmaps).

3.3 The East sub-catchment

This sub-catchment is drained by a stream that also receives the Centre and Coast streams, and confluences with the West stream at E1805151 N5882288, 1150 m upstream of the East Coast Road bridge. The upper section is through lifestyle blocks and dry-stock farm, and the mid and lower reaches through dry-stock farms.

3.3.1 East Lower

The marked downstream end of this sampling reach is at E1804136 N5881703 (as shown in Figure 1) and the upstream end is at E1804041 N5881600. The riparian area of this sampling reach is largely unfenced and vegetated in rough pasture and willows as part of a dry-stock farm. Water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Trapping/Netting method. The substrate of this sampling reach is mostly clay with some gravel. Immediately upstream of the sampling site the riparian vegetation is the same as that of the sampling site. The water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Trapping method. Table 8 summarises the fish species found, with the full record shown in Appendix 1. Figure 8 shows the sampling

reach start photo-point and location map.

Table 8: Summary of species found in East Lower sampling reach.

Species	Abundance	Length Range (mm)
Koura	12	15-25
Smelt	2	50-75
Inanga	34	45-110
Freshwater shrimp (<i>Paratya</i>)	109	-

Figure 8: East Lower sampling reach start photo-point and location.



Left: East Lower sampling reach, photopoint of downstream end looking upstream (note yellow triangle on willow at mid-left for reference) (photo by Living Matters). Right: East Lower sampling reach location (photo Webmaps).

3.3.2 East Mid

The marked downstream end of this sampling reach is at E1803904 N5880889 (as shown in Figure 1) and the upstream end is at E1803858 N5880794. The riparian area of this sampling reach is largely unfenced and vegetated in swampy rough pasture with occasional large totara and kahikatea. The stream at this site was sampled by the Protocol's Trapping/Netting method. Table 9 shows the overall results for this reach, and Appendix 1 contains the full sampling record. Figure 9 shows the East Lower sampling reach start photo-point and location

Table 9: Summary of species found in East Mid sampling reach.

Species	Abundance	Length Range (mm)
Koura	2	25-30
Bully (unidentified)	37	40-75
Inanga	78	30-150
Freshwater shrimp (<i>Paratya</i>)	29	-

Figure 9: East Lower sampling reach downstream end photo-point and location.



Left: East Mid sampling reach, photopoint of downstream end looking downstream (note yellow triangle on tree at mid-left for reference) (photo by Living Matters). Right: East Mid sampling reach location (photo Webmaps).

3.3.3 East Upper

The marked upstream end of this sampling reach is at E1803936 N5879956 (as shown in Figure 1) and the downstream end is at E1803882 N5880064. The riparian area of this sampling reach is fenced along the upstream half (lifestyle block) and vegetated in mature kanuka forest with a mixed broadleaf understory and well-established ground cover. It is unfenced along the downstream half (dry-stock farm), and vegetated in pasture grasses under a mixed native and exotic canopy. Water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Spotlighting method. The substrate of this sampling reach is mostly gravel and cobbles. Immediately upstream of the sampling site the riparian vegetation is the same as that of the sampling site. Table 8 summarises the fish species found, with the full record shown in Appendix 1. Figure 10 shows the sampling reach start photo-point and location map.

Table 8: Summary of species found in East Upper sampling reach.

Species	Abundance	Length Range (mm)
Koura	24	15-40
Longfin eel	1	900
Bully (unidentified)	5	50-60
Banded kōkōpu	11	50-160
Inanga	4	70-80

Figure 10: East Upper sampling reach downstream end photo-point and location.



Left: East Upper sampling reach, photopoint of upstream end looking downstream (note yellow triangle on tree at mid-left for reference) (photo by Living Matters). Right: East Upper sampling reach location (photo Webmaps).

3.4 The Coast sub-catchment

This sub-catchment sits on the seaward side of Findlay Road, and is drained by a stream that flows into the mainstem that also receives the Centre and East streams, and confluences with the West stream at E1805151 N5882288, 1150 m upstream of the East Coast Road bridge. Locals report the stream originates in a spring, and runs through a mixture of dry-stock farms and lifestyle blocks. There is little in the way of native riparian vegetation in the catchment, with almost all of this in the Upper Zone. As said previously, this stream was not able to be sampled using the Protocol's methods, so MCI samples were taken. These samples are currently held by Living Matters, and have not yet been sorted, or MCI's calculated. However, we were able to establish the Coast Lower sampling reach near the confluence with the stream that receives the East and Centre Streams.

3.4.1 Coast Lower

The marked upstream end of this sampling reach is at E1804614 N5882180 (as shown in Figure 1) and the downstream end is at E1804715 N5882175. This sampling reach is located between the Findlay Road bridge and immediately upstream of where the Coast stream enters the mainstem that forms the East and Centre streams. Because we were unable to use the Protocols methods in this stream, we established this site near the confluence with the stream that receives the East and Centre Streams.

This sampling reach is entirely fenced, with 2-5 m setbacks. There are scattered large oak trees along this reach. Otherwise the vegetation is rank pasture grasses, into which considerable numbers of native species have recently been planted. Parts of this reach have thick instream infestations of water celery (*Apium nodiflorum*) and *Glyceria maxima*. Water levels were at or near stable base flow for the time of year, and the sampling was undertaken using the Protocol's Trapping/Netting method, and a MCI sample was taken. The substrate of this sampling reach is mostly clay, with some gravel in places. Immediately upstream of the sampling site the riparian vegetation is the same as that of the sampling site, but without the mature oak trees. Table 8 summarises the fish species found, with the full record shown in Appendix 1. Figure 11 shows the sampling reach start photo-point and location map.

Table 8: Summary of species found in Coast Lower sampling reach.

Species	Abundance	Length Range (mm)
Koura	4	15-50 ⁸
Longfin eel	13	500-900*
Bully (unidentified)	14	40-100
Mosquito fish (<i>Gambusia</i>)	136	-
Inanga	58	50-100
Shortfin eel	19	350-1000
Kakahi	Kakahi shells were found in the centre of this reach	

* = Full size range of this species not found at this sampling reach

⁸ One very large 50 mm carapace koura

Figure 11: Coast Lower sampling reach start photo-point and location.



Left: Coast Lower sampling reach, photopoint of upstream end looking downstream (note yellow triangle on tree at mid-left for reference) (photo by Living Matters). Right: Coast Lower sampling reach location (photo Webmaps).

3.4.2 Coast Mid

This sampling site is at E1804574 N5881328, and was unfenced during the original field sampling. However, when it was revisited in March 2019 to retake the MCI sample, the fencer was completing the riparian fence, and riparian plantings had been completed on the true left of the stream.

The riparian vegetation is a canopy of 4-5 m high kanuka, with some wattle, on both sides of the stream. The shade this creates excludes the water celery (*Apium nodiflorum*) and *Glyceria maxima* that clogs the waterway up and down stream of the sampling site, and for much of its length up to near the Coast Upper sampling site. This site was chosen because it has effectively the only tall riparian vegetation in the Mid section of this stream, and hence the only area where instream vegetation did not preclude taking an MCI sample.

Water levels were at or near stable base flow for the time of year. The substrate is mostly clay, with some gravel in places, and a very low flow. Like much of the mid and lower reaches of this stream, the substrate is thickly coated in an orange flock/algal bloom. This is up to 400 mm thick through the area shown in the Mid Right photo in Figure 12. If disturbed this substance it clouds the water for many minutes. Immediately upstream of the sampling site the riparian vegetation reduces to rank pasture grasses, with thick in-stream water celery (*Apium nodiflorum*) and *Glyceria maxima* (as shown in the Bottom photo in Figure 12). Figures 1 and 12 show the sampling site.

Figure 12: Coast Mid MCI sampling location.



Left Top: Coast Mid photopoint of MCI sampling site looking upstream. Right Top: Coast Mid sampling reach location (photo Webmaps).



Left Mid: Coast Mid site looking downstream showing riparian vegetation. Right Mid: Coast Mid East sampling site.



Bottom: Coast Mid sampling site looking upstream, showing change in riparian vegetation.

3.4.3 Coast Upper

This sampling site is at E1804356 N5880181, and is fenced both sides, with a 6-8 m high kanuka dominated canopy, and a varied but slightly sparse (probably due to the low light levels beneath the canopy) understory and ground cover. Water levels were at or near stable base flow for the time of year, but a very small flow, so a MCI sample was taken. The substrate of this sampling site is mostly bedrock, with some gravel and mud in places. Immediately upstream and downstream of the sampling site the riparian vegetation is the same as that of the sampling site. According to the landowner, this waterway originates in a small spring some 400 m upstream on an adjoining property. Figures 1 and 13 show the sampling point. The Left Bottom photo in Figure 13 shows a likely fish passage barrier just upstream of the sampling site, where the stream flows through a culvert beneath the owner's driveway, from the pond shown in the Bottom Right photo. All of the 650-700 m of this stream that flows through this landowner's property is riparian fenced, along with several tributary arms of this small waterway, with widths up to 40 metre either side of the stream.

Figure 13: Coast Upper MCI sampling location.



Left Top: Coast Upper photopoint of MCI sampling site looking upstream. Right Top: Coast Mid sampling reach location (photo Webmaps).



Left Bottom: Likely fish passage barrier under driveway just upstream of Coast Upper. Right Bottom: Pond above Coast Upper sampling site.

3.5 Miranda catchment fish surveys by EcoQuest

Students at EcoQuest (Rivard (2002), Adams (2002), Beckley (2002), and Glatt (2002)) continued a series of directed research projects as part of a longitudinal study examining the range of species, habitat, and water chemistry in the marine-estuarine-freshwater continuum of Miranda Stream. The sites for this work are shown in Figures 14 and 15 below.

Figure 14: Sites used for EcoQuest Directed Research Projects (right) and sites used for this work (left).



All sites are downstream of the current sampling locations. Brejaart (2018) summarises this work, saying the sites were selected to cover a range of habitat types and also for sampling accessibility. The channel's habitats have been distinguished into four groups: intertidal mud flat channel, cockle/mangal channel mouth, sheltered mangrove channel and open inland mudflat.

Four different sampling techniques were used over the course of the study. Four Gee Minnow traps, two Fyke nets, one cast net, and one beach seine were used to sample for a range of fish sizes and species. Apart from the seine, which was only used once at Site 2, each technique was used at all the sites. Fyke and minnow traps were baited with ox liver and staked to the bottom of the channel. A 1.8m diameter cast net was also used, with its perimeter weighted with a lead line and attached to a draw line that closes the lead line once it is retracted. It was systematically thrown five times per sampling period and worked by enclosing the fish from above.

Sites 1-4 are tidal and receive daily salt water inundation, so are dominated by saline tolerant species, and not suitable for comparison with our work. Site 5 was added at the end of the EcoQuest study, so has a limited dataset, and is located in the upper extent of the saltwater wedge on spring tide events. Although it is the upstream-most of the EcoQuest sites, it is 120 m downstream of the Coast Lower site, and is discussed in Roxburgh (2018) as the Miranda South inanga spawning site. This site is the most similar to our study sites, and it lies downstream of the confluences of the Centre, East, and Coast streams. However, it is influenced by saltwater incursion during spring tides, and is channelised and straightened, so is less useful for comparisons with our work. The Site 5 methods pre-date the Protocol used for this work and, although useful, are not directly comparable.

Figure 15: The EcoQuest sampling sites (from Brejaart 2018).



3.5.1 Glatt (2002)

Glatt (2002) examined the benthic fauna at the five sites, across the marine-estuarine-freshwater continuum in Miranda Stream. They found the substrate and benthic fauna composition differs dramatically from that of the adjoining intertidal mudflats. They also found the salinity gradient appears define the benthic fauna habitats more than the substrate. Within the five sites they found several species at their up and downstream limits depending on their salinity tolerance, and several other species that are euryhaline, and found throughout the area sampled.

3.5.2 Beckley (2002)

Beckley's (2002) objective was to describe, compare, and contrast habitat features and salinity at the five EcoQuest sites in the lower Miranda Stream, including the information from previous studies at the same sites. At each site they measured:

- The physical profile of the waterway
- Water conductivity (salinity)

- Habitat features using randomised quadrats, measuring vegetation and substrate cover, and species abundance

They found a wide range of habitats in terms of substrate, vegetation, and salinity, with mangrove, intertidal mud flat, shell fragments, soft mud, firm mud, pasture land, *Sarcocornia* saltmarsh, and vegetated stop bank. They found the saltwater wedge extends upstream to around or just below Site 4.

3.5.3 Adams (2002)

This study uses the same EcoQuest sites in Miranda Stream, and focusses on the fish species in the marine-estuarine-freshwater continuum. However, it omits Site 5 making it less useful for comparisons with our work. Smelt are the most abundant fish species across all sites, and they note that “*Miranda Stream has very similar distribution patterns to those present in other estuaries throughout New Zealand. Having a stream dominated by a few fish species is very common. Smelt, yellow-eyed mullet and yellowbelly flounder are the most abundant fish in the stream*”

They note the earlier studies they repeated, and compare/contrast had anomalies in methods, including setting the fyke nets facing upstream, and variously baiting the traps with different baits. This lack of consistency makes many of the results not directly comparable to our work.

3.5.4 Rivard (2002)

This study uses EcoQuest Sites 1-4, and examines the abundance of eels using a range of netting and trapping techniques in the saltwater-estuarine-freshwater continuum. The range of methods for using Fyke nets and Gee Minnow traps is different to that of our work, and predates the Protocol’s methods by over a decade. Although the information is useful (see Figure 16), it is not directly comparable to our work. Unfortunately they also excluded Site 5, which is the most similar of the five to our Coastal Lower site.

Figure 16: Across the five sites and three years of sampling in Rivard (2002) and Adams (2002), the following species were recorded:

• common bully (<i>Gobiomorphus cotidanus</i>)	• inanga (<i>Galaxias maculatus</i>)
• common smelt (<i>Retropinna retropinna</i>)	• parore (<i>Girella tricuspidata</i>)
• longfin eel (<i>Anguilla dieffenbachii</i>)	• sand flounder (<i>Rhombosolea plebeia</i>)
• shortfin eel (<i>Anguilla australis</i>)	• speckled sole (<i>Peltorhamphus novaezeelandiae</i>)
• estuarine triplefin (EcoQuest list this species as “ <i>Grahamina</i> sp”, but Helen Kettles advises this was more likely to have been <i>Forsterygion nigripenne</i>)	• torrentfish (<i>Cheimarrichthys fosteri</i>)
• goby (<i>Favonigobius lateralis</i>)	• yellow-eyed mullet (<i>Aldrichetta forsteri</i>)
• grey mullet (<i>Mugil cephalus</i>)	• yellow-belly flounder (<i>Rhombosolea leporina</i>).

4 Discussion

4.2 Landowners

All but one of the landowners approached were happy for us to access their properties. During our discussion with them, many asked if we were working with Living Water and/or the Miranda Catchment Group, so awareness of these streams of work is good in the catchment. Many were concerned about our safety on their land, and their associated liability, so we explained our safety protocols. The risks most commonly identified by landowners were bulls, electric fences, slippery conditions and working around water. Per our safety plan we always worked together for this work, carried mobile phones and a monitored Garmin InReach device at all times, and maintained a check in system via the InReach each time we changed locations during the day. The landowner who denied access did so because they no longer live on site full time, and lease their farm, so thought it simpler if we didn’t access the property.

Due to Gary and Adrienne Dalton's comprehensive local knowledge, finding contact details for many landowners was relatively straight-forward. Landowners of some company-owned properties were found through the NZ Companies Register (www.companies.govt.nz), and some were reached by door-knocking. We expected there to be some apprehension from landowners about what the information gathered would be used for, and what that might encumber them to do (or stop them being able to do) on their land. However, once we explained we this information will be used to compare freshwater fauna over time to measure the success of restoration efforts through the Living Water project, they were happy to have their property included. Several were keen to show us their riparian protection work.

4.2 Higher altitude stream flows

Above about 100 m altitude the waterways in this catchment are difficult to sample using the Protocol's methods, as the flows are too small. The substrate across the sampling reaches provides relatively little loose cobble and boulder material for fish to use as habitat and refuges. This appears to be at least partly natural, and may be reflected in the low diversity of species.

4.3 Pest fish

Our sampling recorded *Gambusia affinis* (Mosquito fish) at the Coast Lower and Centre Lower sites, and Roxburgh and McQueen (2015) recorded them in the Centre Lower site. No other pest fish species were recorded during this work.

4.4 Freshwater mussels/kākahi

Kakahi shells were found at the West Lower site, near where Roxburgh and McQueen (2015) found live kākahi and shells. Shells were found at the Coast Lower site, but due to time constraints we were not able to search for them. Although kākahi are widespread across the country, they have suffered serious decline, and they may be found in other parts of this catchment.

4.5 Potential barriers to fish passage

Kendal et al. (2017) identified two barriers to fish passage within the catchment:

- One is near the end of a small tributary of the East Stream and has little habitat above it, so does not need immediate (if any) attention.
- The other is in the mainstem of the East stream. Both the surveyed sites upstream of this barrier (East Mid and East Upper) had inanga present, with large numbers at East Mid, so this barrier does not appear to be excluding inanga. However, Smelt were recorded in the two sites directly downstream of the barrier (East Lower and Centre Lower), but not the sites above the barrier. This may be due to the barrier excluding Smelt, but it may also be due to the habitat upstream of the barrier being unsuitable for Smelt.

We discovered another potential barrier to fish passage in the catchment, just upstream of the Coast Upper site. This is a 400 mm diameter corrugated steel culvert beneath the landowner's driveway, with a 500 mm drop from the culvert lip to the stream. This culvert is beginning to corrode on the downstream end, so may need to be replaced in the medium term, and a replacement could be placed to minimise the barrier to fish passage.

4.6 Inanga spawning sites

As part of a separate report under the same contract (Roxburgh, 2018), the extent of the saltwater wedge was located for the two main tributaries in this catchment:

- The stream that contains the West sampling sites (known as Miranda Stream)
- The stream that leads to the tributaries containing the Centre, East, and Coast sampling sites

These were marked, and photo-points established to record their riparian vegetation. Due to ongoing land

purchase negotiations, and the landowner's grazing requirements, these two sites were not used for the Community Day referred to in Roxburgh (2018), which was held to involve locals in inanga spawning site restoration. Relatively large numbers of inanga were found in all the Lower sampling reaches in this catchment, as well as many of the other sampling reaches, so they are successfully spawning to some degree. Locating where these spawning sites are, and establishing what could be done to protect and enhance them, will provide benefits to the freshwater fish fauna.

5 Recommendations

5.1 Centre Lower sampling site

At the time of this survey an area near the upstream end of the Centre Lower site was being grazed by horses. The vegetation is a mixture of rank pasture grasses and kikuyu, and replanted native species, and permanently excluding all stock would allow the plantings in this area to regrow and provide shade cover for the stream.

5.2 West Upper site

The riparian areas of the upstream part of this sampling reach are only partially fenced, with parts unfenced. The first half is within a fenced bush block, and the last half fenced on one side only, so completing this fencing would benefit this area of the stream. Where there is fenced native vegetation it is in good condition. Just upstream of the sampling reach the stream passes through an area that is pugged by cattle accessing the stream to drink, and fencing this would reduce the amount of sediment entering this stream.

5.3 Pest fish

Our sampling recorded *Gambusia affinis* (Mosquito fish) from the Coast Lower and Centre Lower sites, and Roxburgh and McQueen recoded them in the Centre Lower site. Although eradication of these species would be ideal, eradication of Mosquito fish is very difficult as females are able to store sperm for 6 months, so only one female needs to remain to re-establish the population (pers. com. Stella McQueen). However, if the extent of infestation is limited, it would be worth assessing the feasibility.

5.4 Freshwater mussels/kākahi

Kākahi shells were found at the West Lower site, near where Roxburgh and McQueen (2015) found live kākahi and shells, and shells were found at the Coast Lower site, but due to time constraints we were not able to search for kākahi. These sites have the kinds of substrate kākahi prefer, and from our observations so do other sites in the Lower sections of all four sub-catchments. It would be relatively easy to survey these streams for kākahi presence and distribution, using a search technique like that in Roxburgh and McQueen (2015). Although kākahi are widespread across the country, they have suffered serious decline, and they may be found in other parts of this catchment.

5.5 Inanga

Relatively large numbers of inanga were found in all the Lower sampling reaches in this catchment, as well as many of the other sampling reaches, so they are successfully spawning to some degree. Locating where all these spawning sites are, and establishing what could be done to protect and enhance them, will provide benefits to the freshwater fish fauna.

5.6 Assessment of riparian and adult tuna habitat quality

This piece of work was tentatively part of the original brief for this project, but could not be completed due to budget constraints. This assessment could be a very useful assessment of the freshwater habitat in the catchment, and it would contribute to understanding the need and scope for rehabilitation to benefit fish populations.

5.7 Provision of this report to landowners

Most of the landowners with sites on their properties asked if they could receive a copy of the results of this work.

6 Acknowledgements

- Thanks to Helen Kettles (DOC's fish survey project lead for this work) for her guidance and support for this work, and to Helen and Nikki Atkinson for their comments and critique of this report.
- Many landowners were approached to ask if we could look at potential sites on their properties, and all were thanked at the time. From this initial assessment twelve sites were chosen on multiple properties across the four sub-catchments. For being able to use these sites we sincerely thank:
 - ✓ Gary, Adrienne, and Mark Dalton for access to the sites on their property (West Lower, Mid, and part of Upper, and Centre Lower, Mid, and Upper), and for their generosity of time and encyclopedic local knowledge and contacts.
 - ✓ Wayne Eddy for access to the sites on his property (East Lower and Mid), and for his information on fish species he has noted in the catchment.
 - ✓ Laurence Oldham and Melissa Johnston, for access to the site on their property (East Upper), and their son Thomas who ably assisted us with the spotlight sampling on their property, and impressed us with his level of freshwater fish knowledge.
 - ✓ Graham Brown for access to, and sampling of, the site on their property (part of West Upper)
 - ✓ Trudi Lane for access to the site on her property (Coast Lower), and great local knowledge, contacts, and information on the Miranda Catchment Group
 - ✓ Dianne Mizen for access to the site on her property (Coast Mid), via permission given by her neighbor and friend Hugh Harris, who was completing riparian fencing on Diane's property at the time.
 - ✓ Rachel and Wayne Barker for access to the site on their property (Coast Upper)
- Ria Brejaart and Jono Clark from EcoQuest generously provided data and reports they and their students have collected through various studies over the past 15+ years, and information on the catchment and its management.
- Warren Coffey, Waikato Regional Council's Paeroa-based Catchment Management Officer, provided valuable discussion and insights into the management issues in the catchment.
- Gerry Kessels (then of Kessels Ecology, now Tonkin and Taylor's Hamilton Office) for the use of his EFM and netting gear, and being able to again work with Stella McQueen.
- Thanks to Stella McQueen (then of Kessels Ecology) for her truly expert freshwater ecology knowledge and field skills, and for being great to work with.

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Appendix 1: Fish Collection Forms

Miranda West Lower

FISH COLLECTION FORM (TRAPPING)

Page 1 of 3

Site: Miranda West Lower

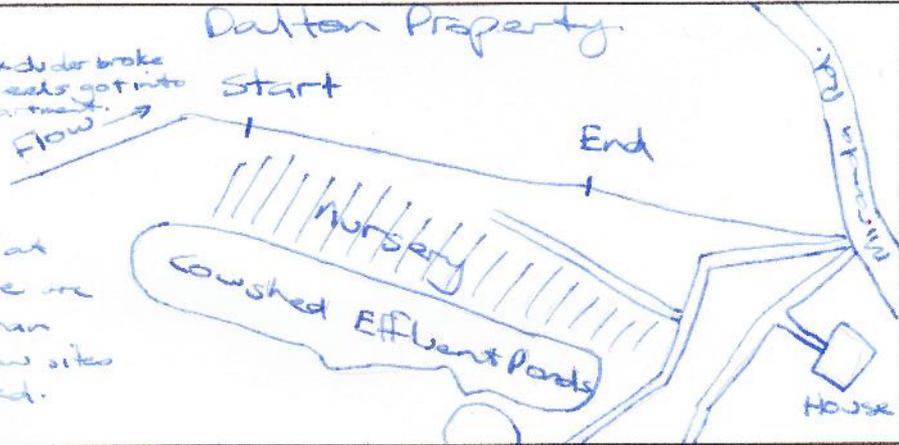
Date: 7/4/18

	Easting	Northing	Water quality
Upstream end	<u>1804195</u>	<u>5882480</u>	Water temp (°C) _____
Downstream end	<u>1804340</u>	<u>5882485</u>	DO (%) _____
Fyke 1:	<u>1804195</u>	<u>5882480</u>	DO (mg/L) _____
Fyke 2:	<u>1804217</u>	<u>5882470</u>	Conductivity (µS/cm) _____ <input type="checkbox"/> specific <input type="checkbox"/> ambient
Fyke 3:	<u>1804257</u>	<u>5882488</u>	
Fyke 4:	<u>1804281</u>	<u>5882481</u>	
Fyke 5:	<u>1804315</u>	<u>5882487</u>	Team members <u>Jason Roxburgh</u>
Fyke 6:	<u>1804340</u>	<u>5882485</u>	<u>Stella McQueen</u>
Nets set @ <u>5:15pm</u>		Nets retrieved @ <u>9:00 am</u>	
Mesh Sizes (mm)		Fyke dimensions	
Fyke Leader	<u>4</u>	Leader height (cm):	<u>64</u>
Fyke Trap	<u>4</u>	Fyke mouth entrance diameter (cm):	<u>75</u>
Gee minnow trap	<u>3</u>	Fyke exclusion grid size (mm):	<u>25</u>
		No. of funnels (baffles)	<u>3</u>

Notes:

Fyke 3 excluder broke & larger eels got into end compartment.

Inanga at this site are better than other low sites measured.



Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Fyke 1	Koura	20		Fyke 1 contd	Inanga	80	
		25			Kamburahi	X1	
	Shrimp				Bully	30	
	Inanga	60				40	
		70				40	
		70			GF Eel	300	
		50		Gee 1	Inanga	100	
		100				70	
		60				80	
		50				50	
		50				60	
		50				70	
		60				60	
		50			Bully	80	
		60			Koura	20	
		60				25	



FISH COLLECTION FORM (TRAPPING)

Site: Miranda West Lower

Date: 7/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Gee 2	Bully	80			WGO	500	
Fyke 2	LFEed	600			Inanga	90	
		700				50	
	Inanga	60				100	
		60				70	
		80				70	
		110				90	
		100				70	
		60				70	
		100				60	
		100			Smelt	100	
		80		Gee 3	Inanga	80	
		80				70	
		60				80	
		70				70	
		50			Smelt	70	
		70				80	
		70				60	
		100			Bully	50	
		40			shrimp		
		120		Gee 4	shrimp		
		80		Fyke 4	LFEed	400	
		80			Inanga	500	
		50				100	
		70				60	
		100				80	
		110				60	
		100				60	
		110				50	
		120				50	
		70				60	
		70				90	
		70				80	
		80				50	
		70				80	
		70				70	
	smelt	90				60	
		10				70	
		70				60	
		80				60	
		60				60	
	Bully	80				70	
		90				80	
		50			Bully	110	
		70				110	
		30				60	
	shrimp		Large 12c			50	
Fyke 3	LFEed	700			shrimp		Large 13c

FISH COLLECTION FORM (TRAPPING)

Site: Miranda West Lower

Date: 7/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Fyke 4	Koura	30					
		30					
		30					
		20					
		25					
		20					
		15					
Gear 5	Gambusia	X 2					
	Inanga	80					
		50					
		80					
		60					
	Bolly	60					
	Shrimp						
Gear 6	Shrimp	X 2					
Fyke 5	LFEch	500					
		450					
		350					
			80				
			60				
		70					
		80					
	Bolly	50					
	Koura	25					
	Gambusia	X 3					
	Shrimp		large 12s				
Gear 7	Inanga	80					
		70					
		80					
		70					
	Shrimp						
Gear 8	Gambusia	X 5					
	shrimp						
Fyke 6	LFEch	600					
		350					
		400					
			100				
			100				
			70				
			70				
			40				
	Bolly	40					
		30					
		60					
Gear 9	Gambusia	X 1					
	Shrimp						
Gear 10							

Miranda West Mid

FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING) – Wadeable Streams/Rivers

Reviewed by (Initials) _____

Team members: Jason Roxburgh
Stella McQueen

Lat/Long (GPS bottom): E 180 2721
N 588 1744

Lat/Long (GPS top): E 180 2617
N 588 1648

Site ID Miranda West Mid Date 21 / 4 / 18 Page 1 of 2

not fished other fished none collected fished all 10 subreaches fished 5-9 subreaches fished <5 subreaches flag for fished/not fished

Fish sample ID _____ Total shock (button) time (min) 2.8 Fishing time start 1 0 15 finish 1 1 25 Sample distance (m) 150 Area Fished (m²) _____

Sampling gear spotlight EFM netting net type _____ net No. _____

Water visibility good average poor Water temp. (°C) _____ Cond (uS) _____

EFM Volts (x100) _____ Spotlight (watts) _____ Pulse Rate (pps or Hz) _____ EFM Pulse Width (ms) _____ EFM anode big small DO _____ mg/L _____ %

Common Name	Subreach Tally										Total count	Anom. count	Vouch. count	LENGTH (mm)		Mortality count	Flag
	A	B	C	D	E	F	G	H	I	J				Minimum	Maximum		
Eel	2									1	3						
Koura	2	4		2				2	2	2	14						
Banded Kokopu	3	3		2		3					13						
Bully (Common)	3	2	3	2			2				14						
LF Eel		4		3	2		1	2			12						
SF Eel		1					1				2						
Latia		1		1			1				3						
Shrimp			6		11				7		24						

Flag	Comment	Flag	Comment

Flag codes: K = No measurement made, U = Suspect measurement, F1, F2, etc. = flags assigned by each field crew. Explain all flags in comments. LENGTH - Enter single fish as minimum.

Miranda West Mid

Subreach Size Class Information (mm) Actual length Category lengths FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING)

Common Name	A	B	C	D	E	F	G	H	I	J
Unidentified Eel	100, 300									100
Koura	20, 25	15, 20, 20, 15		20, 30				25, 30	30, 20	15, 20
Banded Kokopu	70, 140, 75	130, 70, 65		90, 75			35, 75, 100			65, 100
Bully (Common)	55, 60, 30	45, 40	70, 35, 75	50, 40				30, 50		75, 40
Long fin Eel		120, 100, 150, 900		120, 110, 110	300, 250			140	120, 400	
Short fin Eel		520						300		
Latia		1 found		1 found				1 found		
Shrimp			found 6		found 11					found 7
Unfishable										
Densimeter Shaded squares (max 95)	US R DS L			US R DS L			US R DS L		US R DS L	US R DS L
Wet width (m)										
Gradient										

Miranda West Upper

FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING) – Wadeable Streams/Rivers

Reviewed by (Initials) _____

Team members: <i>Jessie Roxburgh</i> <i>Stella McQueen</i>		Lat/Long (GPS bottom): <i>180 2060</i> <i>588 1013</i>	Site ID: <i>Miranda west upper</i>	Date: <i>7 / 4 / 18</i>	Page: <i>1</i> of <i>2</i>												
Lat/Long (GPS top): <i>180 2191</i> <i>588 0983</i>		<input type="radio"/> not fished other <input type="radio"/> fished none collected <input checked="" type="radio"/> fished all 10 subreaches <input type="radio"/> fished 5-9 subreaches <input type="radio"/> fished <5 subreaches <input type="checkbox"/> flag for fished/not fished															
Fish sample ID: _____	Total shock (button) time (min): _____	Fishing time start: <i>20.10</i>	finish: <i>21.30</i>	Sample distance (m): <i>150</i>	Area Fished (m ²): _____												
Sampling gear <input checked="" type="checkbox"/> spotlight <input type="checkbox"/> EFM <input type="checkbox"/> netting net type: _____ net No.: _____		Water visibility <input type="radio"/> good <input checked="" type="radio"/> average <input type="radio"/> poor Water temp. (°C): _____ Cond. (µS): _____															
EFM Volts (x100): _____ Spotlight (watts): _____ Pulse Rate (pps or Hz): _____ EFM Pulse Width (ms): _____ EFM anode: <input type="radio"/> big <input type="radio"/> small DO: _____ mg/L %: _____																	
Common Name	Subreach Tally										Total count	Anom. count	Vouch. count	LENGTH (mm)		Mortality count	Flag
	A	B	C	D	E	F	G	H	I	J				Minimum	Maximum		
<i>Koura</i>	<i>6</i>	<i>1</i>	<i>1</i>	<i>4</i>	<i>4</i>	<i>13</i>	<i>1</i>	<i>4</i>	<i>10</i>	<i>4</i>	<i>48</i>						
<i>Banded Kokapu</i>	<i>1</i>	<i>1</i>		<i>1</i>							<i>3</i>						
<i>Long fin Eel</i>							<i>1</i>	<i>1</i>			<i>2</i>						

Flag codes: K = No measurement made, U = Suspect measurement, F1, F2, etc. = flags assigned by each field crew. Explain all flags in comments. LENGTH* = Enter single fish as minimum.

Subreach Size Class Information (mm)
 Actual length
 Category lengths
Miranda west upper
 FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING)

Common Name	A	B	C	D	E	F	G	H	I	J
<i>Koura</i>	<i>30, 30, 20</i> <i>30, 25, 25</i>	<i>20</i>	<i>25</i>	<i>40, 40, 30</i> <i>30</i>	<i>20, 30, 15</i>	<i>20, 15, 5, 5</i> <i>35, 40, 30</i> <i>30, 20, 10</i>	<i>20</i>	<i>5, 10, 30</i> <i>10</i>	<i>40, 30, 30</i> <i>20, 20, 30</i> <i>30, 40, 30, 40</i>	<i>25, 30, 40</i> <i>40</i>
<i>Banded Kokapu</i>	<i>170</i>	<i>110</i>		<i>150</i>		<i>20, 20, 25</i>				
<i>Long fin Eel</i>							<i>700 (eel quite thin)</i> <i>1000</i>	<i>1200 (eel quite thin)</i>		
Unfishable										
Densimeter Shaded squares (max 96)		US R DS L		US R DS L		US R DS L		US R DS L		US R DS L
Wet width (m)										
Gradient										

Miranda Centre Lower

FISH COLLECTION FORM (TRAPPING)

Page 1 of 2

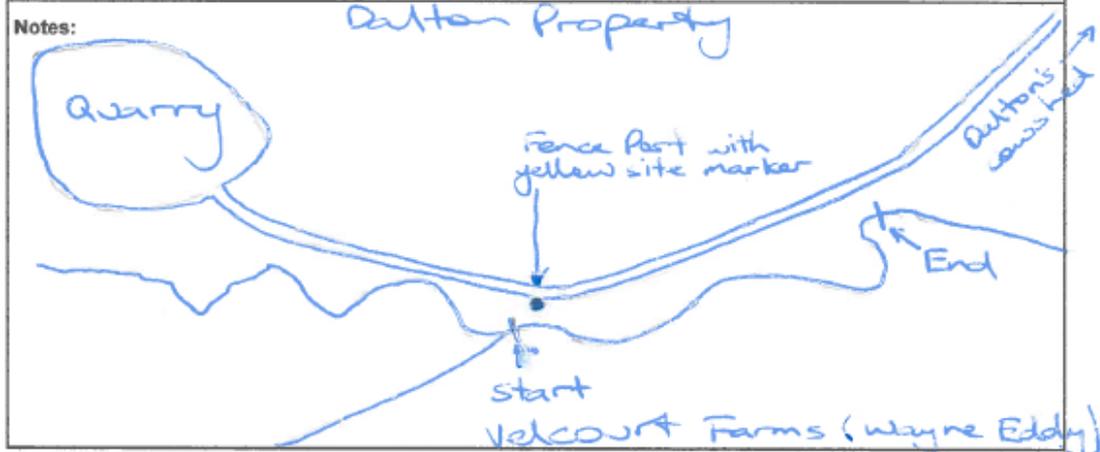
Site: Miranda Centre Lower

Date: 15/4/18

	Easting	Northing	Water quality
Upstream end	<u>1804207</u>	<u>5882022</u>	Water temp (°C) _____
Downstream end	<u>1804257</u>	<u>5882119</u>	DO (%) _____
Fyke 1:	<u>1804207</u>	<u>5882022</u>	DO (mg/L) _____
Fyke 2:	<u>1804223</u>	<u>5882043</u>	Conductivity (µS/cm) _____
Fyke 3:	<u>1804226</u>	<u>5882073</u>	<input type="checkbox"/> specific
Fyke 4:	<u>1804251</u>	<u>5882096</u>	<input type="checkbox"/> ambient
Fyke 5:	<u>1804248</u>	<u>5882111</u>	Team members <u>Jason Roxburgh</u>
Fyke 6:	<u>1804252</u>	<u>5882119</u>	<u>Stella McQueen</u>

Nets set @ 4:30 pm Nets retrieved @ 7:30 pm

Mesh Sizes (mm)	Fyke dimensions
Fyke Leader <u>4</u>	Leader height (cm): <u>64</u>
Fyke Trap <u>4</u>	Fyke mouth entrance diameter (cm): <u>75</u>
Gee minnow trap <u>3</u>	Fyke exclusion grid size (mm): <u>25</u>
	No. of funnels (baffles) <u>3</u>



Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Fyke 1	LFFed	500		Fyke 1	Tringa	70	
		600				80	
		650				60	
		700				60	
		800				75	
	bambusia	X40				70	
	Tringa	60				60	
		80			smelt	60	
		60				80	
		60			bully	60	
		40				50	
		100				60	
		80				50	
		60				40	
		70				110	
		60				20	

Site: Miranda Centre Lower

Date: 15/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment				
Fyke 1 contd	Inanga	30		Gee 6 contd	Inanga	70					
		50				80					
		70				60					
		60				40					
		50				105					
		35				Bully					
		20				Gambusia	X 1				
		20				Fyke 4	Smelt	100			
		20						100			
		40						40			
70		40									
30		80									
60		40									
50		Inanga	Inanga	60							
7				60							
Gee 1	Shrimp			60				Gee 2	Bully	70	
				60						shrimp	70
Gee 2	Gambusia			X 14		bambusia	X 27	70			
				Fyke 2	LFEel			60		Fyke 3	Inanga
600						60					
500						60					
70						60					
60						60					
60		40									
60		80									
70		40									
65		70									
75		70									
50		60									
Gee 3	Bully	50		Gee 4	Shrimp	70					
		10				Fyke 3	Inanga	70			
		80						100			
Gee 4	Inanga	70		Gee 7	Gambusia			X 2			
		—				Inanga	70				
Fyke 3	Inanga	70		Gee 8	Gambusia		X 25				
		60				Inanga	60				
		80		Fyke 5	Smelt		100				
		Bully				80					
		50				60					
		50				60					
		Koura				60					
		Smelt				100					
		90				80					
		Gambusia				60					
		X 20				60					
		Shrimp				60					
Gee 5	Gambusia	X 9				70					
		9				70					
Gee 6	Inanga	70				50					

FISH COLLECTION FORM (TRAPPING)

Site: Miranda Centre Lower

Date: 15/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Fyke 5	Koura	30					
		90					
		60					
Gear 9	Gambusia	X25					
		60					
		60					
Gear 10	Bully	50					
		50					
		50					
Fyke 6	LFFel	600					
		500					
		400					
		90					
		70					
		80					
		70					
		60					
		60					
		60					
		60					
		60					
		Gear 11	Inanga	60			
80							
60							
80							
70							
100							
60							
70							
60							
50							
70							
70							
60							
70							
60							
	Smelt	60					
	Gambusia	X6					

Miranda Centre Mid

FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING) – Wadeable Streams/Rivers

Reviewed by (Initials) _____

Team members: Jason Roxburgh
Stella MacLellan

Lat/Long (GPS bottom): 1803352
5881415

Lat/Long (GPS top): 1803266
5881319

Site ID: Miranda Centre Mid Date: 6 / 4 / 18 Page 1 of 2

not fished other fished none collected fished all 10 subreaches fished 5-9 subreaches fished <5 subreaches flag for fished/not fished

Fish sample ID _____ Total shock (button) time (min) _____ Fishing time start 2.0.20 finish 2.0.25 Sample distance (m) 150 Area Fished (m²) _____

Sampling gear spotlight EFM netting net type _____ net No. _____ net type _____ net No. _____

Water visibility good average poor Water temp. (°C) _____ Cond. (µS) _____

EFM Volts (x100) _____ Spotlight (watts) _____ Pulse Rate (pps or Hz) _____ EFM Pulse Width (ms) _____ EFM anode big small DO _____ mg/L _____ %

Common Name	Subreach Tally										Total count	Anom. count	Vouch. count	LENGTH (mm)		Mortality count	Flag
	A	B	C	D	E	F	G	H	I	J				Minimum	Maximum		
<u>Cross/Common Bully</u>	<u>5</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>1</u>	<u>3</u>	<u>-</u>	<u>10</u>	<u>-</u>	<u>8</u>	<u>34</u>			<u>30</u>	<u>80</u>		
<u>Red Fin Bully</u>	<u>1</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>2</u>	<u>2</u>	<u>-</u>	<u>-</u>	<u>5</u>			<u>60</u>	<u>80</u>		
<u>Koura</u>	<u>3</u>	<u>-</u>	<u>-</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>-</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>11</u>			<u>20</u>	<u>30</u>		
<u>Elver</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1</u>			<u>100</u>	<u>100</u>		
<u>Long fin Eel</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>2</u>	<u>1</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1</u>	<u>4</u>			<u>550</u>	<u>1000</u>		
<u>Shrimp</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>15</u>	<u>18</u>	<u>-</u>	<u>16</u>	<u>-</u>	<u>19</u>			<u>-</u>	<u>-</u>		
<u>Banded Kokopu</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>1</u>	<u>-</u>	<u>1</u>			<u>70</u>	<u>70</u>		

Flag	Comment	Flag	Comment

Flag codes: K = No measurement made, U = Suspect measurement, F1, F2, etc. = flags assigned by each field crew. Explain all flags in comments. LENGTH* - Enter single fish as minimum.

Subreach Size Class Information (mm) Actual length Category lengths Centre Mid FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING)

Common Name	A	B	C	D	E	F	G	H	I	J
<u>Cross/Common Bully</u>	<u>50, 50, 50</u>	<u>50</u>	<u>60, 70</u>	<u>40, 60, 50</u>	<u>60</u>	<u>60, 70, 50</u>		<u>30, 40, 70</u>		<u>50, 80, 50</u>
<u>Red Fin Bully</u>	<u>60, 50</u>							<u>30, 30, 40</u>		<u>30, 50, 50</u>
<u>Koura</u>	<u>20, 20, 30</u>			<u>20</u>	<u>20</u>	<u>30</u>		<u>60, 50, 50, 60</u>	<u>70, 60</u>	<u>70, 50</u>
<u>Elver (LF Eel?)</u>				<u>100</u>						
<u>Long fin Eel</u>					<u>600, 600</u>	<u>550</u>				<u>1000</u>
<u>Shrimp</u>						<u>15</u>	<u>18</u>		<u>16</u>	
<u>Banded Kokopu</u>									<u>70</u>	
Unfishable										
Densimeter Shaded squares (max 96)		US R DS L			US R DS L			US R DS L		US R DS L
Wet width (m)										
Gradient										

Miranda Centre Upper

FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING) – Wadeable Streams/Rivers

Reviewed by (Initials) _____

Team members: <i>Jason Roxburgh Stella McQueen</i>		Lat/Long (GPS bottom): <i>180 2991 588 0907</i>	Site ID <i>Miranda Centre upper</i>	Date <i>6 / 4 / 18</i>	Page <i>1</i> of <i>2</i>																																																																																																						
Lat/Long (GPS top): <i>180 2905 588 0833</i>		<input type="radio"/> not fished other <input type="radio"/> fished none collected <input type="radio"/> fished all 10 subreaches <input type="radio"/> fished 5-9 subreaches <input type="radio"/> fished <5 subreaches <input type="checkbox"/> flag for fished/not fished																																																																																																									
Fish sample ID _____	Total shock (button) time (min) _____	Fishing time start <i>1900</i> finish <i>2030</i>	Sample distance (m) <i>150</i>	Area Fished (m ²) _____																																																																																																							
Sampling gear <input checked="" type="checkbox"/> spotlight <input type="checkbox"/> EFM <input type="checkbox"/> netting net type _____ net No. _____ net type _____ net No. _____		Water visibility <input type="radio"/> good <input checked="" type="radio"/> average <input type="radio"/> poor Water temp. (°C) _____ Cond. (µS) _____																																																																																																									
EFM Volts (x100) _____	Spotlight(watts) _____	Pulse Rate (pps or Hz) _____	EFM Pulse Width (ms) _____	EFM anode <input type="radio"/> big <input type="radio"/> small	DO _____ mg/L _____ %																																																																																																						
Common Name	Subreach Tally										Total count	Anom. count	Vouch. count	LENGTH (mm)		Mortality count	Flag																																																																																										
	A	B	C	D	E	F	G	H	I	J				Minimum	Maximum																																																																																												
<i>Banded Kōkoiu</i>	<i>3</i>	<i>6</i>	<i>2</i>	<i>2</i>		<i>3</i>					<i>16</i>																																																																																																
<i>Shrimp</i>	<i>√7</i>	<i>√10</i>		<i>√2</i>							<i>19</i>																																																																																																
<i>Cross/kanon Billy</i>	<i>1</i>	<i>2</i>					<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>7</i>																																																																																																
<i>Long fin Eel</i>		<i>1</i>							<i>1</i>		<i>2</i>																																																																																																
<i>Koura</i>	<i>1</i>										<i>1</i>																																																																																																
<i>Inanga</i>	<i>3</i>					<i>1</i>	<i>1</i>	<i>1</i>			<i>6</i>																																																																																																
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>Flag</td> <td colspan="8">Comment</td> <td>Flag</td> <td colspan="8">Comment</td> </tr> <tr><td> </td><td colspan="8"> </td><td> </td><td colspan="8"> </td></tr> </table>																		Flag	Comment								Flag	Comment																																																																															
Flag	Comment								Flag	Comment																																																																																																	

Flag codes: K = No measurement made, U = Suspect measurement, F1, F2, etc. = flags assigned by each field crew. Explain all flags in comments. LENGTH* - Enter single fish as minimum.

Subreach Size Class Information (mm) Actual length Category lengths *Centre upper* FISH COLLECTION FORM (ELECTROFISHING & SPOTLIGHTING)

Common Name	A	B	C	D	E	F	G	H	I	J
<i>Banded Kōkoiu</i>	<i>60, 60, 130</i>	<i>120, 120, 50, 60, 50, 60</i>	<i>50, 60</i>	<i>100, 80</i>	<i>fish recorded</i>	<i>170, 100, 70</i>				
<i>Freshwater Shrimp</i>	<i>√7</i>	<i>√10</i>		<i>√2</i>						
<i>Cross/kanon Billy</i>	<i>50</i>	<i>50, 60</i>					<i>60</i>	<i>70</i>	<i>70</i>	<i>70</i>
<i>Long fin Eel</i>		<i>700</i>							<i>600</i>	
<i>Koura</i>	<i>30</i>									
<i>Inanga</i>	<i>100, 100, 100</i>					<i>2</i>	<i>100</i>	<i>40</i>	<i>100</i>	
Unfishable										
Densimeter Shaded squares (max 96)		US R DS L			US R DS L			US R DS L		US R DS L
Wet width (m)										
Gradient										

Miranda East Lower

FISH COLLECTION FORM (TRAPPING)

Page 1 of 2

Site: Miranda East Lower

Date: 29/4/18

	Easting	Northing	Water quality
Upstream end	<u>1804041</u>	<u>5881600</u>	Water temp (°C) _____
Downstream end	<u>1804136</u>	<u>5881703</u>	DO (%) _____
Fyke 1:	<u>1804136</u>	<u>5881703</u>	DO (mg/L) _____
Fyke 2:	<u>1804128</u>	<u>5881689</u>	Conductivity (µS/cm) _____
Fyke 3:	<u>1804117</u>	<u>5881675</u>	<input type="checkbox"/> specific
Fyke 4:	<u>1804116</u>	<u>5881647</u>	<input type="checkbox"/> ambient
Fyke 5:	<u>1804077</u>	<u>5881629</u>	Team members <u>Jason Roxburgh</u>
Fyke 6:	<u>1804041</u>	<u>5881600</u>	_____
Nets set @ <u>4.30pm</u>		Nets retrieved @ <u>7.30am</u>	
Mesh Sizes (mm)		Fyke dimensions	
Fyke Leader	<u>4</u>	Leader height (cm):	<u>64</u>
Fyke Trap	<u>4</u>	Fyke mouth entrance diameter (cm):	<u>75</u>
Gee minnow trap	<u>3</u>	Fyke exclusion grid size (mm):	<u>25</u>
		No. of funnels (baffles)	<u>3</u>
Notes:			

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Fyke 1	Tranga	90		Fyke 2	Shrimp	X 6	
		75			LF Fel	350	
		65			Tranga	100	
		70				85	
		85				90	
		40					
	Shrimp	X 10		Gee 3	Shrimp	X 3	
	Gambusia	X 2		Gee 4	Tranga	55	
	Smelt	50		Fyke 3	Tranga	90	
		75				45	
Gee 1	Tranga	55			Shrimp	X 4	
		110		Gee 5	Tranga	55	
	Shrimp	X 4				65	
Gee 2	Tranga	100			Kare	25	
		105				30	
		65		Gee 6	Shrimp	X 3	

FISH COLLECTION FORM (TRAPPING)

Site: Miranda East Lower

Date: 29/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
Fyke 4	Inanga	45					
		65					
		75					
	shrimp	X36					
	Koura	20					
		25					
Gear 7	shrimp	X5					
	Inanga	70					
		65					
Gear 8	shrimp	X2					
	Inanga	90					
		65					
Fyke 5	Koura	25					
		20					
	Inanga	70					
		65					
		shrimp	X11				
Gear 9	shrimp	X2					
	Koura	20					
		15					
Gear 10	Inanga	55					
	shrimp	X6					
Fyke 6	Inanga	55					
		75					
		80					
		90					
		70					
	shrimp	X12					
	Koura	20					
			25				
		15					
Gear 11	shrimp	X3					
Gear 12	shrimp	X2					
	Inanga	55					
		75					
	Koura	20					

Miranda East Mid

FISH COLLECTION FORM (TRAPPING)

Page 1 of 2

Site: Miranda East Mid

Date: 28/4/18

	<u>Easting</u>	<u>Northing</u>	<u>Water quality</u>
Upstream end	<u>1803858</u>	<u>5880794</u>	Water temp (°C) _____
Downstream end	<u>1803904</u>	<u>5880889</u>	DO (%) _____
Fyke 1:	<u>1803904</u>	<u>5880889</u>	DO (mg/L) _____
Fyke 2:	<u>1803907</u>	<u>5880876</u>	Conductivity (µS/cm) _____ <input type="checkbox"/> specific <input type="checkbox"/> ambient
Fyke 3:	<u>1803897</u>	<u>5880855</u>	
Fyke 4:	<u>1803889</u>	<u>5880826</u>	
Fyke 5:	<u>1803877</u>	<u>5880793</u>	Team members <u>Jason Roxburgh</u>
Fyke 6:	<u>1803858</u>	<u>5880794</u>	
Nets set @ <u>5:15 pm</u>		Nets retrieved @ <u>10:10 am</u>	
<u>Mesh Sizes (mm)</u>		<u>Fyke dimensions</u>	
Fyke Leader	<u>4</u>	Leader height (cm):	<u>64</u>
Fyke Trap	<u>4</u>	Fyke mouth entrance diameter (cm):	<u>75</u>
Gee minnow trap	<u>3</u>	Fyke exclusion grid size (mm):	<u>25</u>
		No. of funnels (baffles)	<u>3</u>
Notes: <u>- Fyke 6 is just upstream of the farm road</u> <u>- Fyke 5 " " downstream of the farm road</u> <u>- Fyke 1 is at the downstream end of this sampling reach</u>			

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
<u>Fyke 1</u>	<u>Shrimp</u>	<u>X6</u>					
	<u>Inanga</u>	<u>90</u>		<u>Gee 5</u>	<u>Inanga</u>	<u>110</u>	
		<u>60</u>			<u>Inanga</u>	<u>75</u>	
<u>Gee 1</u>	<u>Inanga</u>	<u>65</u>			<u>Inanga</u>	<u>60</u>	
<u>Gee 2</u>	<u>Inanga</u>	<u>70</u>		<u>Gee 6</u>	<u>shrimp</u>	<u>X1</u>	
		<u>85</u>			<u>Inanga</u>	<u>55</u>	
<u>Fyke 2</u>	<u>Shrimp</u>	<u>X2</u>		<u>Fyke 4</u>	<u>shrimp</u>	<u>X7</u>	
	<u>Inanga</u>	<u>150</u>			<u>Inanga</u>	<u>10</u>	
		<u>10</u>				<u>70</u>	
		<u>100</u>				<u>65</u>	
		<u>90</u>		<u>Gee 7</u>	<u>-</u>		
<u>Gee 3</u>	<u>Inanga</u>	<u>65</u>		<u>Gee 8</u>	<u>Inanga</u>	<u>55</u>	
<u>Gee 4</u>	<u>Inanga</u>	<u>70</u>				<u>65</u>	
		<u>85</u>		<u>Fyke 5</u>	<u>shrimp</u>	<u>X1</u>	
<u>Fyke 3</u>	<u>Inanga</u>	<u>75</u>			<u>Koura</u>	<u>25</u>	
		<u>65</u>				<u>30</u>	
					<u>Inanga</u>	<u>70</u>	

FISH COLLECTION FORM (TRAPPING)

Site: Miranda East Mid

Date: 28/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment			
Fyke 5	Inanga	70		Gear 9	Shrimp	X2				
		110				Inanga	70			
		120			60					
		150			55					
		70			80					
		60			Gear 10	Inanga	75			
		100					65			
		100					40			
					110		Fyke 6	Shrimp	X10	
					110				Inanga	50
					90			55		
					110			65		
					100			110		
					105			135		
					40			95		
		80		75						
		110		80						
		120		60						
		80		40						
		50		110						
Bully		50				120				
		70				90				
		40				70				
		60			Bully	60				
		50		65						
		50		65						
		40		70						
		80		25						
		50		45						
		30		Gear 11	Inanga	40				
40		45								
50		30								
50		90								
50		100								
		70		Gear 12	Inanga	105				
		60				85				
		50				80				
		50			70					
		45			70					
		60			110					
		50			Bully	45				
		55				60				
		60				70				
		55				75				
		65								
		50								
Gear 9	Gear 9									

Miranda Coast Lower

FISH COLLECTION FORM (TRAPPING)

Page 1 of 2

Site: Miranda Coast Lower

Date: 4/4/18

	Easting	Northing	Water quality	
Upstream end	<u>1804614</u>	<u>5882180</u>	Water temp (°C)	_____
Downstream end	<u>1804715</u>	<u>5882175</u>	DO (%)	_____
Fyke 1:	<u>1804614</u>	<u>588 2180</u>	DO (mg/L)	_____
Fyke 2:	<u>1804627</u>	<u>588 2188</u>	Conductivity (µS/cm)	_____ <input type="checkbox"/> specific <input type="checkbox"/> ambient
Fyke 3:	<u>1804644</u>	<u>588 2202</u>		
Fyke 4:	<u>1804672</u>	<u>588 2203</u>		
Fyke 5:	<u>1804696</u>	<u>588 2198</u>	Team members	<u>Jason Roxburgh</u> <u>Stella McQueen</u>
Fyke 6:	<u>1804715</u>	<u>588 2175</u>		
Nets set @ _____		Nets retrieved @ _____		
Mesh Sizes (mm)		Fyke dimensions		
Fyke Leader	<u>4</u>	Leader height (cm):	<u>64</u>	
Fyke Trap	<u>4</u>	Fyke mouth entrance diameter (cm):	<u>75</u>	
Gee minnow trap	<u>3</u>	Fyke exclusion grid size (mm):	<u>25</u>	
		No. of funnels (baffles)	<u>3</u>	
Notes:				

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment
<u>Fyke 1</u>	<u>Inanga</u>	<u>70</u>			<u>Koura</u>	<u>50</u>	<u>Huge</u>
		<u>65</u>		<u>Gee 1</u>	<u>Gambusia</u>	<u>11</u>	
		<u>70</u>			<u>Shrimp</u>	<u>12</u>	
		<u>50</u>		<u>Gee 1</u>	<u>Inanga</u>	<u>60</u>	
		<u>55</u>		<u>Gee 2</u>	<u>Inanga</u>	<u>50</u>	
		<u>55</u>			<u>Smelt</u>	<u>90</u>	
		<u>60</u>		<u>Fyke 2</u>	<u>LFEel</u>	<u>550</u>	
		<u>65</u>			<u>Inanga</u>	<u>65</u>	
		<u>50</u>				<u>70</u>	
<u>GEEL</u>	<u>SFEel</u>	<u>250</u>			<u>SFEel</u>	<u>400</u>	
		<u>400</u>				<u>450</u>	
		<u>300</u>			<u>Inanga</u>	<u>70</u>	
		<u>500</u>				<u>70</u>	
		<u>450</u>				<u>60</u>	
		<u>550</u>				<u>60</u>	
		<u>500</u>				<u>60</u>	

Site: Miranda Coast + Lower

Date: 4/4/18

Gear Type & Number	Species	Length / # of fish	Comment	Gear Type & Number	Species	Length / # of fish	Comment					
Fyke 2 contd	Inanga	70	Inanga in this sampling reach have a lot of intra-muscular parasites are quite thin.			60						
		30				70						
		70				60						
		70				60						
	Bully	55						Gambusia → WK1878	X5			
		80							Gee 7		Gambusia	X3
		95							Gee 8		—	—
	Koura	30						Fyke 5	LFEed	500		
		25							Bully	90		
		Gambusia			X30					100		
Gee 3	Gambusia	X6				90						
Gee 4	—	—				85						
Fyke 3	Inanga	70				90						
		65				Koura		15				
		60				Inanga		60				
		55						50				
		60						60				
	LFEed				450					70		
					700					60		
					60				Gee 9	Gambusia		X6
					50					Bully		80
					60					50		
Gee 5	Inanga	60				90						
		50				Gee 10		Bully	90			
		60				Fyke 6		SFEed	400			
		60						LFEed	600			
		60							600			
	80				500							
	60				500							
		Gambusia			X20				700			
	Gee 6	Gambusia			X60				1000	4.0 kg		
	Fyke 4	Inanga			100					600		
80			650									
80			500									
60			900	2.66 kg								
50			500									
		70	SFEed	500								
		90		500								
		70		600								
		60		600								
		80		700								
Bully		100				800						
		90			600							
		90			700							
		70			700							
		70			700							
Koura		40										
SFEed		350										
Inanga		60										
		70										

lots of large eels here because it is the confluence of 2 streams
Both are heavily vegetated with Glyceria + water celery.