Appendix D3

Watercourse Report

Water course report for the proposed Maybole By-pass

Electrofishing and invertebrate survey

September 2012

Ayrshire Rivers Trust

1. Introduction

Ayrshire Rivers Trust (ART) is a Scottish registered charity that provides expertise in the management of freshwater habitats across Ayrshire.

ART was commissioned by AMEY in 2012 to survey watercourses that could potentially be affected by the construction and operation of the proposed Maybole By-pass in South Ayrshire. ART visited a total of seven survey locations during September 2012 in order to assess and quantify existing fish populations and to sample aquatic invertebrates. Four of the locations surveyed fall within the River Doon catchment, with the remaining three in the Water of Girvan catchment. Both the River Doon and the Water of Girvan are important and highly valued salmonid fisheries and both rivers support Fresh Water Pearl Mussel (*Margaritifera margaritifera*) (FWPM) populations and European Eels (*Anguilla anguilla*). Both rivers are of significant economic and ecological importance to South Ayrshire and South West Scotland.

Following massive declines in recent years, European Eels are listed on the IUCN red list of threatened species as 'Critically Endangered'. In 2007 they were included as UKBAP priority species and in 2008, Marine Scotland Science developed an Eel Management Plan for the species. Eels are protected under the Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008.

FWPMs are fully protected under Schedule 5 of the Wildlife and Countryside Act (1981) and are also listed on annexes II and V of the EU Habitats and Species Directive and Appendix III of the Bern Convention. They are included on the IUCN Invertebrate Red List, where its status is described as 'Critically Endangered'. Classified as a priority species by the UK Biodiversity Steering Group, a national Species Action Plan has been prepared to encourage measures for its survival.

Since 2002, ART has regularly surveyed fish populations within both the Doon and Girvan catchments for and on behalf of the respective District Salmon Fishery Boards to whom they also provide management and conservation advice in order to protect and improve the fisheries, habitat and ecological diversity within each system. ART also provides expert opinion, comment and monitoring for developments with potential to impact the freshwater environment across Ayrshire.

In order to ensure that the surveys provided representative baseline data against which changes within the fish populations could be monitored over an extended period of time, sites were chosen that were downstream of the development area and representative of typical riparian habitat found within the vicinity of the proposed route. The proposed route crosses four watercourses along its length; three Burns flowing to the River Doon via the Chapelton Burn (the Brockloch Burn, the Black Glen Burn, and an unnamed Burn near Nether Culzean Farm) and the fourth (unnamed) flows to the Water of Girvan via the Abbeymill Burn and then Barlewan Burn.

Initially ART proposed that a total of six sites should be surveyed however following a nil result on the unnamed Burn within the Girvan catchment, it was decided that a further site downstream may provide valuable data as fish access to the initial site was restricted by morphological alterations. Individual survey results are presented in section 4 and results discussed in section 5.

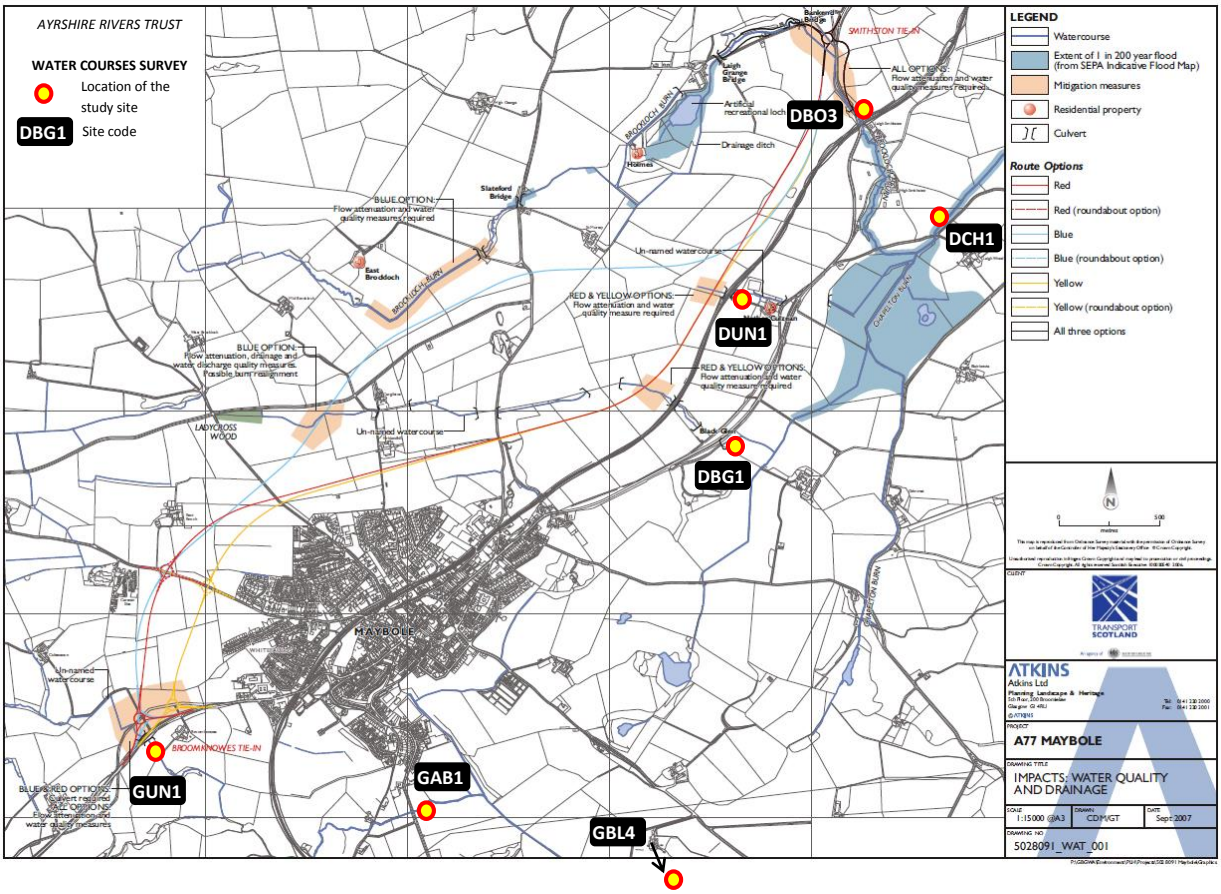


Figure 1: study area

2. Method

2.1. Survey Method

Fish populations at each of the selected sites were assessed using electrofishing. This is a widely used technique to examine freshwater fish communities. The method uses electricity to attract and stun fish, which allows operators to remove them from the water. The fish are transferred to a holding container until they have recovered and then anaesthetised using a mild solution of MS222 (Tricaine Methane Sulphonate). Each individual is then identified, measured and returned unharmed to the area from which they were captured.

A battery powered electrofishing set (Hans Grassl model IG600) was used at all sites. Smooth DC current, with a minimum voltage of 200V was used at all sites, to maximise catch efficiency, while minimising potential damage to fish and other wildlife. In deeper pools with high conductivity waters, pulsed current was used as this proves to be more effective.

For all surveys, the survey sweep began at the downstream end of the section and moved back and forwards across the channel so that every part of the bed was covered.

Figure 2:

Upstream stop net in place during the fully quantitative electrofishing survey of the Barlewan Burn site

2.2 Fish Density surveys

All sites were sampled using an area-delimited survey so that fish densities could be calculated. All salmon (*Salmo salar*) and trout (*Salmon trutta*) captured during the survey were separated into year classes on the basis of length frequency histograms. As fish grow at very different rates between sites, this was repeated for each site individually. Age classifications were checked by examining the number of annual rings on scales taken from reference fish of each age class. Other fish species found were counted and recorded.

A fully quantitative 3-run depletion technique, using upstream and downstream stop nets, was used at all sites. Where sufficient fish were present, absolute fish densities were calculated, together with a measure of statistical confidence, otherwise a minimum density estimate was used. Thus, data from all the sites can be compared accurately, regardless of whether catch efficiency changes.

The results from surveys where fish densities are obtained are now classified according to the SFCC Scottish national classification scheme which was derived using data from over 1600 Scottish sites covering the period 1997-2002 (*Godfrey, 2005*). This allows

ART and the reader to interpret local fish populations in a Scotland-wide context. The national classes should be periodically revised as fish populations will inevitably change over time, even on a national scale.

Throughout this report the following notation has been used to distinguish fish year classes: salmonid fish less than one year old, are recorded as 0+ year class or fry, whilst fish one year or older are recorded as 1+ (parr), 2+ or 3+.

Table 1: *SFCC classification salmon fry and parr density breakpoints*

Salmon fry (No/100m²)	Classification	Salmon parr (No/100m²)
0.0	Absent	**0.0**
<4.7	**E** – Very poor	**<2.6**
4.7 -<10.3	**D** - Poor	**2.6 -<5.1**
10.3 - <20.3	**C** - Moderate	**5.1 - <9.1**
20.3 - <42.1	**B** - Good	**9.1 - <15.8**
>42.1	**A** - Excellent	**>15.8**

Table 2: *SFCC classification trout fry and parr density breakpoints*

Trout fry (No/100m²)	Classification	Trout parr (No/100m²)
0.0	Absent	**0.0**
<2.5	**E** – Very poor	**<1.6**
2.5 -<5.3	**D** - Poor	**1.6 -<3.1**
5.3 - <12.4	**C** - Moderate	**3.1 - <5.6**
12.4 - <30.3	**B** - Good	**5.6 - <10.4**
>30.3	**A** - Excellent	**>10.4**

ART is a full member of the Scottish Fisheries Coordination Centre (SFCC), which is an association of Scottish fisheries management organisations including the River and Fisheries Trusts Scotland (RAFTS) and Marine Scotland (MS). SFCC provides electrofishing training courses for its members. ART staff are SFCC qualified to conduct electrofishing surveys and have permission from the District Salmon Fishery Boards to carry out electrofishing work in Ayrshire. At all sites, an SFCC accredited team leader was present.

The SFCC has developed methodologies and record sheets for use during electrofishing surveys. All data was also entered into the SFCC database. (Record sheet templates are included in the appendix).

Figure 3:

ART disinfect all equipment when used between different river catchments. Simple biosecurity measures such as this reduce the risk of transferring disease and invasive non native species across watersheds.

Further site details (substrate and flow records) are included in section 8: Appendix1

2.3 Water Quality sampling

Water quality parameters were recorded using an YSI Model 556 multi-parameter field sampling meter. Samples were logged after allowing the meter reading to stabilise, in accordance with the manufacturer's recommendations. The pH meter has consistently given erratic results even straight after recalibrating, therefore the pH results have not been included.
Results from this sampling are included in table 10 in the Appendix.

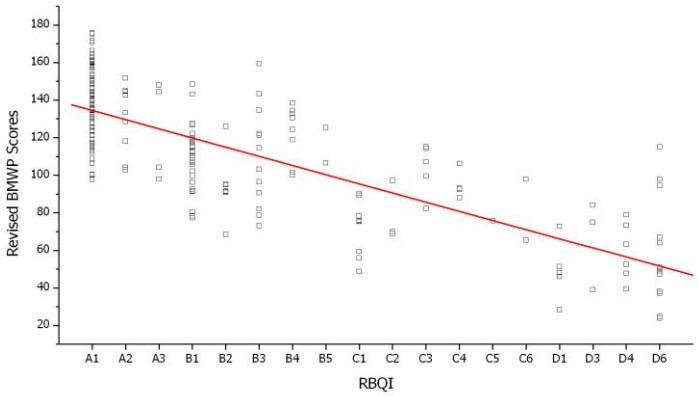
2.4 Invertebrate sampling

In 2005 ART introduced an invertebrate sampling system at each site. The methodology used was that developed by the Riverfly Partnership (***www.riverflies.org***). A three minute kick sample was taken at each site, identified to taxonomic group level along with an estimate of abundance. ART in conjunction with the Clyde River Foundation developed the Rapid Biological Quantitative (RBQI) Index to allow a score to be developed from the results of kick sampling without relying on laboratory analysis.

When the Riverfly Partnership method is used in conjunction with the RBQI scoring system, this allows relatively quick analysis of invertebrate samples compared to other systems such as the BMWP method and in contrast it takes account of abundance. The RBQI awards two scores, one for water biodiversity and the other is a simple measure of abundance.

As the RBQI method is currently unpublished, comparative results between RBQI and BMWP have been analysed by the Clyde River Foundation and ART and the two systems appear to correlate well (see chart 1 below). ART has adopted this method at electrofishing sites and use results to compare invertebrate results between years. This could alert ART to changes in water quality over time. Further analysis using BMWP methods would be appropriate where changes are noted as this method is limited to select few and high scoring taxon. Water quality assumptions should not be drawn on the basis of RBQI invertebrate results alone.

Chart 1. *ART / Clyde Foundation analysis of RBQI method in comparison to the BMWP method.*



Linear Regression for rBMWP:

Y = A + B * X

Parameter	Value	Error
A	139.29213	2.26097
B	-4.87264	0.28165

R	SD	N	P
-0.78211	21.62995	192	<0.0001

The invertebrate scoring system has two components, with a letter, from A to D, for diversity and a number, from 1 to 5 to represent abundance. A score of A1 would indicate high diversity and abundance, whilst D5 would be a site with low diversity and abundance. Scores such as B3-5 are typically found in upland areas with good water quality but relatively low productivity.

The data used in chart 1 were prepared by ART in conjunction with the Clyde Foundation to evaluate the RBQI in comparison to the BMWP system. These results are felt to indicate a close correlation between the RBQI scoring system and the BMWP's method.

3. Survey Limitations

a. Electrofishing is a common means of obtaining data on fish populations (*SEERAD 2007).* The electrofishing techniques used by ART are specifically designed for assessing juvenile salmonid populations therefore fish from other groups may not be quantified effectively.

b. The survey sites chosen were selected to be representative of the general habitat type present within each sub-catchment and to include a range of flow and substrate types. The SFCC protocol recommends that the minimum survey length is six times the mean channel width at the site, with a minimum of 20m length (*Godfrey 2005*). If the site selected is representative of the local habitat the survey should provide a robust estimate of local fish populations. However it is possible that if fish populations are low or have a clumped distribution, the survey data may not sample the full fish population in that area.

c. It is usually impossible to capture all the fish present within a site, therefore depletion sampling, where fish are removed from a site in a series of successive electrofishing runs, are used to provide an estimate of the total fish population present. The rate of decline in each run and the total number of fish captured are used to estimate fish stocks. However, if fish numbers are low (less than 40 per site) the confidence limits will be wide and the depletion estimates will be unreliable (*Schnute, 1983*).

d. It is considered that it is impossible to prove the absence of fish by electrofishing, therefore, whilst the failure to capture fish at a site may indicate that the population is low, but it cannot be assumed that fish are necessarily absent.

4. Results

4.1 Electrofishing

Details of the seven electrofishing sites are shown in Table 3.
Note that the average width at the site will vary from day to day depending on water levels and over longer time scales with changes in stream morphology.

Table 3: *Details of electrofishing sites*

Site Code	Study date	River Catch-ment	Burn	Location	Grid Ref	Average Width (m)	Site length (m)	Area Fished (m^2)	Approx. altitude (m)
DBO3	6/9/2012	Doon	Brockloch Burn	d/s A77 road bridge	E:232245 N:612451	2.43	30.7	74.6	54
DCH1	7/9/2012	Doon	Chapelton Burn	d/s B743 bridge	E:232663 N:611921	2.08	56.7	117.9	43
DBG1	7/9/2012	Doon	Black Glen Burn	d/s A77 road bridge	E:231613 N:610857	0.4	46.0	0	53
DUN1	7/9/2012	Doon	Unnamed Burn 1	At Nether Culzean, d/s railway	E:230509 N:614409	1.26	48.0	60.4	66
GAB1	6/9/2012	Girvan	Abbeymill Burn	d/s road bridge	E:230040 N:609023	1.34	36.8	49.3	59
GUN1	6/9/2012	Girvan	Unnamed Burn 2	South West of Maybole	E:228725 N:609370	1.06	56.6	60	90
GBL4	10/9/2012	Girvan	Barlewan Burn	Behind Glenview house, B7023	E:231903 N:608383	3.18	27.4	87.13	57

The sites were surveyed between the 6th and the 10th September 2012 and the results are shown in Table 2.

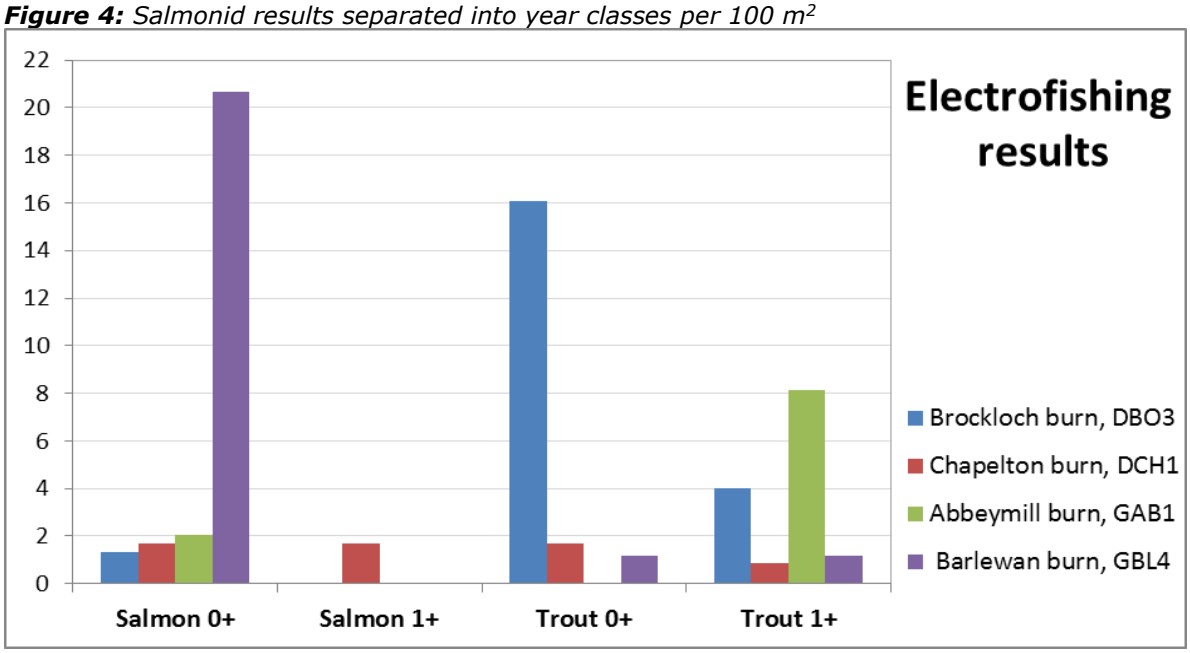
Table 4: *Results from the 2012 electrofishing survey. Where available, calculations of absolute densities are given, along with confidence limits, otherwise minimum densities are supplied*

Site Code	Burn	Fish Densities (Number/100m^2)					Other fish species*	Invertebrates score
		Salmon		Trout				
		0+	1+	0+	1+	2+		
DBO3	Brockloch Burn	1.34	0	16.09	4.02	0	E(1-10)	**A1**
DCH1	Chapelton Burn	1.7	1.7	1.7	0.85	0	SL(1-10), ST(101-1000), E (1-10)	**A1**
DBG1	Black Glen Burn	0	0	0	0	0	None	**n/a**
DUN1	Unnamed Burn 1	0	0	0	0	0	None	**C3**
GAB1	Abbeymill Burn	2.03	0	0	8.11	0	SL(11-100), ST(101-1000), E(1-10)	**A1**
GUN1	Unnamed Burn 2	0	0	0	0	0	None	**C1**
GBL4	Barlewan Burn	20.7	0	1.15	0	1.15	SL(101-1000), M(101-1000),ST(1-10), E(1-10)	**B1**

*****Codes for other species are SL = Stone loach, ST = Three spined Stickleback, M = Minnow, E = Eel. Numbers in brackets indicate number category for each species.

Raw data for substrate composition and flow at each site is included in section 8: Appendix 1

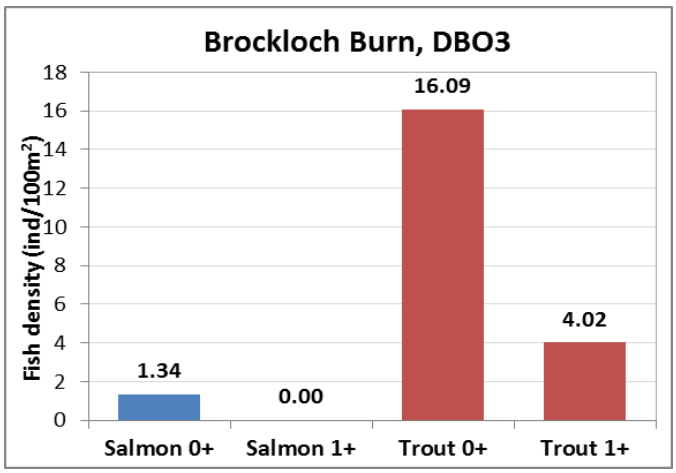
Figure 4: *Salmonid results separated into year classes per 100 m²*



Salmon, Brown trout and Eel were recorded at four sites (DB03, DCH1, GAB1, GBL4). Stoneloach (*Barbatula barbatula*) and Three-Spined Stickleback (*Gasterosteus aculeatus*) were recorded at three sites (DCH1, GAB1 and GBL4). Minnows (*Phoxinus phoxinus*) were only recorded at GBL4. At three sites (DBG1, DUN 1 and GUN 2), no fish were found. The reasons why three surveys failed to produce any fish are detailed in the discussion section below.

Brockloch Burn (DBO3)

Figure 5: *Survey results for the Brockloch Burn.*



Brockloch Burn			
SFCC Classification	Salmon	0+	E
		1+	absent
	Trout	0+	B
		1+	C
Other fish species	Eels (1-10)		
Invertebrates score	A1		

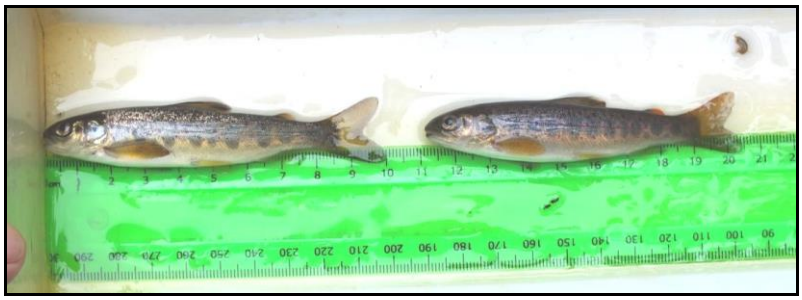


Figure 6:

Measuring salmon and trout fry caught in the Brockloch Burn (DBO3), downstream the A77 road bridge

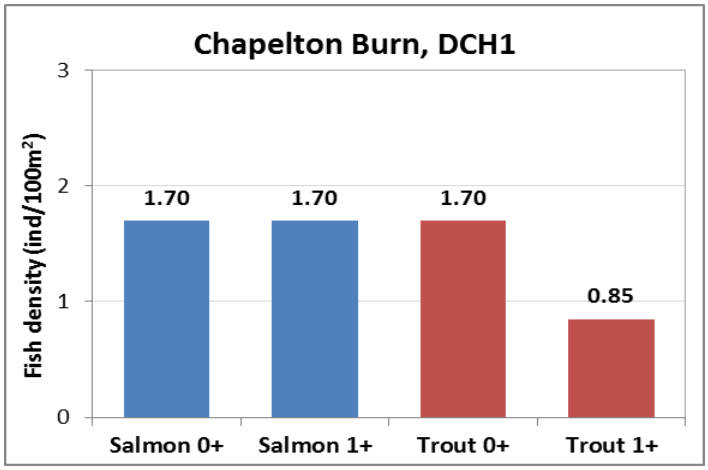
Figure 7:

Two of the seven European eels captured in the Brockloch Burn

Figure 8: *Brockloch Burn site*

Chapelton Burn (DCH1)

Figure 9: *Survey results for the Chapelton Burn*



Chapelton Burn			
SFCC Classification	**Salmon**	0+	**E**
		1+	**E**
	Trout	0+	**E**
		1+	**E**
Other fish species	Stoneloach (1-10) Three-Spined Stickleback (101-1000) Eel (1-10)		
Invertebrates Score (RBQI)	**A1**		

Figure 10: *DCH1 site downstream the B743 road bridge*

Figure 11: *Anaesthetised salmon and trout awaiting measurement at the Chapelton Burn*

Figure 12:

Bank erosion and siltation in the Chapelton Burn as a result of over grazing and poor land management

Black Glen Burn (DBG1)

Black Glen Burn			
SFCC Classification	**Salmon**	0+	absent
		1+	absent
	Trout	0+	absent
		1+	absent
Other fish species	None		
Invertebrates Score (RBQI)	**Not assessed**		

Figure 13: *Survey results for the Black Glen Burn*

Figure 14: *Black Glen Burn (DBG1), downstream the A77 road. This burn was suitable for neither electrofishing nor invertebrate sampling*

Unnamed Burn 1 (DUN1)

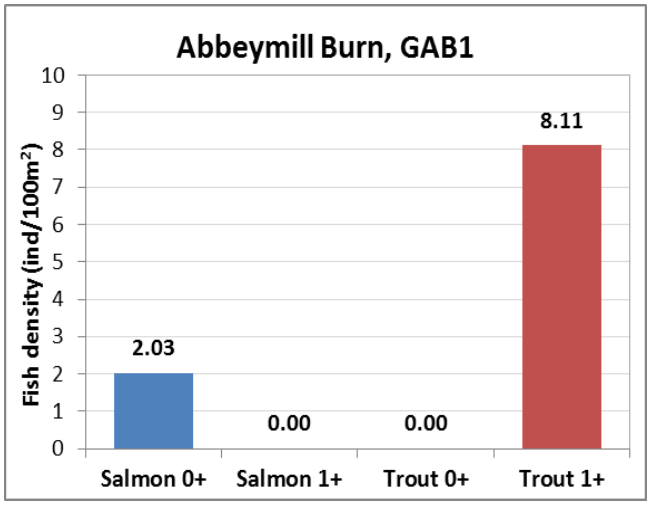
Unnamed Burn			
SFCC Classification	**Salmon**	0+	absent
		1+	absent
	Trout	0+	absent
		1+	absent
Other fish species	None		
Invertebrates Score (RBQI)	**C3**		

Figure 15: *Survey results for Unnamed Burn DUN1*

Figure 16: *Unnamed Burn at Nether Culzean (DUN1) downstream of the railway*

Abbeymill Burn (GAB1)

Figure 17: *Survey results for the Abbeymill Burn*



Abbeymill Burn			
SFCC Classification	**Salmon**	0+	**E**
		1+	absent
	Trout	0+	absent
		1+	**B**
Other fish species	Stoneloach (11-100) Three-Spined Stickleback (101-1000) Eel (1-10)		
Invertebrates Score (RBQI)	**A1**		

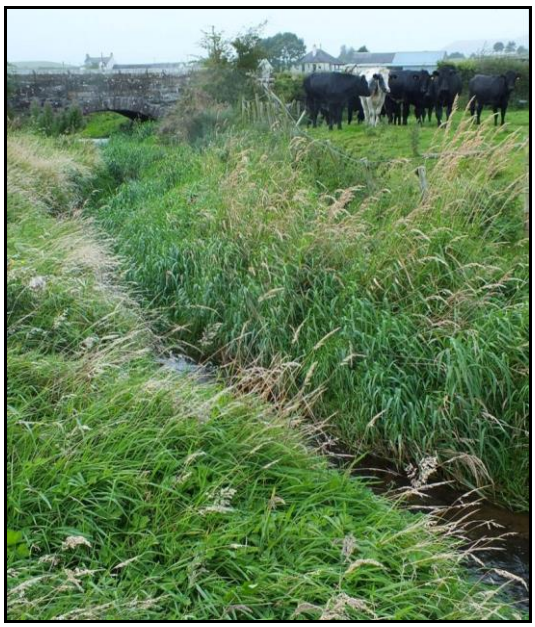


Figure 18:
Abbeymill Burn (GAB1) downstream the road bridge to the south of Maybole

Figure 19*:*
2 trout parr (1+) and large salmon fry (below) (0+) caught in the Abbeymill Burn

Unnamed Burn 2 (GUN1)

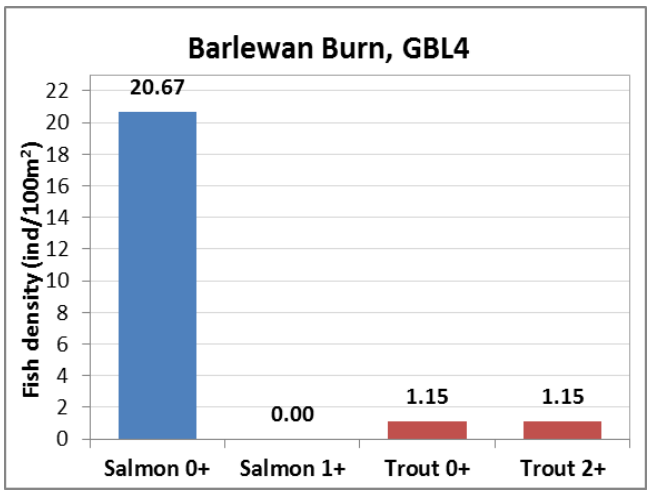
Unnamed Burn			
SFCC Classification	**Salmon**	0+	absent
		1+	absent
	Trout	0+	absent
		1+	absent
Other fish species	None		
Invertebrates Score (RBQI)	**C1**		

Figure 20: *Survey results for unnamed burn GUN1*

Figure 21:
Unnamed Burn (GUN2) to the west of Maybole downstream the A77 road

Barlewan Burn (GBL4)

Figure 22: *Survey results for the Barlewan Burn*



Barlewan Burn			
SFCC Classification	**Salmon**	0+	**B**
		1+	absent
	Trout	0+	**E**
		1+	**E**
Other fish species	Stoneloach (101-1000) Minnow (101-1000) Three-Spined Stickleback (1-10) Eel (1-10)		
Invertebrates Score (RBQI)	**B1**		

Figure 23:

Electrofishing site in the Barlewan Burn (GBL4) behind Glenview near the B7023

Figure 24:
3+ years old brown trout (238mm long) caught in the Barlewan Burn

4.2 Invertebrates

The results from the invertebrate samples are shown in the table below.

***Table 5**: Raw data from the invertebrate sampling, along with the final quality score*

Site code	BURN	RAW RESULTS OF INVERTEBRATES SAMPLING									RBQI INVER-TEBRATE SCORE
		CADDIS		MAYFLIES		STONEFLY (Perlidae)	SHRIMP	LEECH	SNAIL	WATER HOGLOUSE	
		Cased	Case-less	Baeti-dae	Heptage-niidae						
DBO3	Brockloch Burn	10	20	100	10	7	300	10	5	0	A1
DCH1	Chapelton Burn	10	16	300	0	3	250	11	0	80	A1
DBG1	Black Glen Burn										n/a
DUN1	Unnamed Burn 1	2	3	80	0	0	100	1	0	50	C3
GAB1	Abbeymill Burn	8	20	300	10	5	50	7	0	30	A1
GUN1	Unnamed Burn 2	0	0	300	3	4	300	0	0	0	C1
GBL4	Barlewan Burn	10	5	250	2	0	80	1	0	60	B1

Invertebrate scores varied widely between sites reflecting different habitats and possibly pollution pressures on each burn. Three Burns (Brockloch, Chapelton and Abbeymill) had excellent species diversity and a high abundance of macro invertebrates, with good numbers of Caddis (*Goeridae*), Mayfly (*Ephemeropteroidea*) and Stonefly (*Perlodidae*) (high scoring taxa). The Barlewan Burn had a high number of invertebrates, but lacked high scoring species, whilst supporting elevated numbers of pollution tolerant species resulting in a lower classification. The elevated number of pollution tolerant fish species recorded on this burn may support this result.

Both invertebrate samples from the unnamed burns lacked species richness and abundance resulting in lower scores. Poor scores such as these often reflect poor water quality, but on their own cannot be used to deduce this.

The Black Glen Burn was not sampled due to the small scale of the burn and low water levels that made it physically impossible to collect a sample however there were obvious signs of pollution from agriculture and possibly road run off. Poaching and excrement from cattle were found in this burn and road drains appear to discharge to this burn. Based on experience of similarly affected burns elsewhere, results from the Black Glen Burn could reasonably be expected to be poor however a BMWP assessment would be required to confirm this.

Figure 25:
Assessing an invertebrate kick sample in a tray at site GUN1

5. Discussion

Salmonids are native to freshwater rivers and burns in Ayrshire. Salmon and Sea trout (*Salmo trutta- a genetically identical but anadromous form of brown trout*) distribution is limited to accessible watercourses however Brown trout may exist in areas upstream of obstacles and barriers that are barred to their migratory relatives. All salmonids are sensitive to pollution and morphological changes to their natural habitat. Adults lay their eggs annually in rivers and burns during November, December and occasionally January following which the ova develop within the substrates. Juveniles emerge between March and May. These species rely on a supply of well oxygenated water flowing through the gravel during incubation. Silt and fine sediment deposition is known to reduce the free flow of oxygen to developing ova and poor survival rates may result.

Stoneloach, Minnow and Three-Spined Stickleback's are pollution tolerant species and the range of their natural distribution has been extended by human activities. These species are recorded for completeness however they are of little value when assessing salmonid populations.

The burns surveyed within this report vary in size and quality (water and habitat). Each burn is discussed separately in detail below. For ease of interpretation, results tables are repeated for each site.

DB03 Brockloch Burn

Brockloch Burn			
SFCC Classification	**Salmon**	0+	**E**
		1+	absent
	Trout	0+	**B**
		1+	**C**
Other fish species	Eels (1-10)		
Invertebrates Score (RBQI)	**A1**		

The survey site offered good juvenile salmonid habitat with a variety of substrates and cover available. Historic morphological changes to the bank faces were evident however the instream habitat was good. Although siltation was recorded at the site, this was not felt to be limiting. Cattle have access to the burn upstream and this is likely to be the source of most of the siltation.

A single salmon fry was captured proving that salmon accessed and spawned in this area of the burn during winter 2011/12. (No artificial stocking takes place on this burn). Salmon fry density was very poor and parr were absent. This was the first time ART has recorded the species on this burn and their presence is encouraging. Two previous surveys further upstream failed to find any salmon. Limiting factors may be linked to poor habitat and agricultural enrichment elsewhere in the system.

Trout fry densities were good and parr were recorded as moderate. Adult trout were absent from the survey site but immediately upstream, mature trout were viewed at the upper end of the road culvert less than 40m from the upper survey limit.

Seven eels were captured during electrofishing. Although ART makes no attempt to quantify the density of eels at any electrofishing sites, a count is regularly taken and seven eels would be a good result from a similar area, anywhere in Ayrshire.

The invertebrate score was an A1 indicating high diversity and abundance. This score indicates that water quality was good despite agricultural pressures upstream. The extremely wet winter, spring and summer of 2011/12 and resultant higher than average flows may have helped to improve water quality by diluting inputs to acceptable levels as reflected in the diverse and abundant kick sample. EC (electrical conductivity) was elevated at 372µS/cm (micro Siemens/cm) possibly indicating nutrient enrichment or as a result of underlying geology.

DCH1 Chapelton Burn

Chapelton Burn			
SFCC Classification	**Salmon**	0+	**E**
		1+	**E**
	Trout	0+	**E**
		1+	**E**
Other fish species	Stone Loach (1-10) Three spined stickleback (101-1000) Eel (1-10)		
Invertebrates Score (RBQI)	**A1**		

The Chapelton Burn was historically an important spawning burn for salmon and trout but intensive agriculture and morphological alterations aimed at improving land drainage have led to habitat degradation and reduced availability of spawning substrates. Siltation and enrichment are the main issues both of which are associated with livestock accessing the watercourse and degrading the banks. Upstream, extensive land drainage also contributes to siltation. Downstream of the site, riparian fencing has been installed along both banks for a considerable distance and this is having beneficial effects on the habitat and morphology of the burn although siltation from upstream continues to be a major problem.

Both trout and salmon were captured during the survey but in low densities and all year classes present were recorded as very poor. Adult trout were absent from the survey site. ART has surveyed DCH1 site previously. Salmon and trout populations in recent years were largely consistent with the 2012 survey results although adult trout usually feature but in low numbers.

A single eel was recorded at the site. Stoneloach were found in low numbers and three spined stickle back were abundant.

The poor quality of instream habitat is the main limiting factor at the site and this is consistent with most areas of the Chapelton Burn. Undercut banks, marginal and draped vegetation provides good fish cover in places however the stream bed was so degraded that spawning opportunities are extremely limited and certainly the most limiting factor in the salmonid population. To a certain extent, the condition of the habitat at DCH1 and elsewhere on Chapelton Burn may limit recruitment upstream on the Brockloch Burn as few migratory fish will enter such degraded system in search of suitable spawning locations.

The invertebrate score of A1 was surprisingly good considering the siltation and enrichment that has been a constant feature of this burn over recent years. Once again improved water quality may be attributed to the increased rainfall experienced in Ayrshire over the last year.

EC was high at 408µS/cm, possibly indicating nutrient enrichment but may also be as a result of underlying geology.

(DBG1) Black Glen Burn

Black Glen Burn			
SFCC Classification	**Salmon**	0+	absent
		1+	absent
	Trout	0+	absent
		1+	absent
Other fish species	None		
Invertebrates Score (RBQI)	**Not assessed**		

The Black Glen Burn site was surveyed downstream of the A77. On inspection, it was immediately obvious that it was impossible to electro fish the burn due to its small scale and low flows. Similarly kick sampling was impossible. No fish or invertebrates were recorded.

Marginal and draped vegetation obscured most of the wetted area which averaged 0.4m wide. Despite recent rainfall, the burn contained very little water and may dry up completely during fair weather.

Cattle have access to the burn and the banks and bed were poached and in places covered with faeces. Surface water run off from the A77 trunk road was suspected of contributing not only to the meagre flow but also to pollution within the burn. The water was opaque and dark grey in colour.

EC was moderate at 244µS/cm, possibly indicating nutrient enrichment but this level is not unusual in agricultural catchments. Underlying geology may also affect conductivity.

The Black Glen Burn is assumed to be of no value to fish at the survey location. The burn flows into the Chapelton Burn which in turn discharges to the River Doon and therefore has the potential to contribute to pollution and siltation in sensitive areas for fish and macro invertebrates especially during high rainfall conditions when road run off may be elevated.

(DUN1) Unnamed Burn

Unnamed Burn			
SFCC Classification	**Salmon**	0+	absent
		1+	absent
	Trout	0+	absent
		1+	absent
Other fish species	None		
Invertebrates Score (RBQI)	**C3**		

The survey location DUN1 was a short distance downstream of the railway in a steep sided and heavily wooded glen. The gradient was high and there were several falls that were assumed to be impassable to fish. Woody debris frequently blocked the burn causing bank erosion in places. Despite recent rainfall, there was limited flow on the day of survey.

Electrofishing failed to find any fish within the site and the survey was limited to a single run. It seems unlikely that salmonids survive in this location as pollution of the burn was obvious.

A short distance upstream of the site the burn was culverted and impassable to migratory species. Upstream of the railway the burn was little more than a field ditch and grazing stock had unrestricted access to the watercourse leading to organic enrichment. Due to the small catchment area of the burn, it may be expected to dry up completely in the upper reaches during periods of fair weather.

The burn flows into the Chapelton Burn which in turn discharges to the River Doon and therefore has the potential to contribute to pollution and siltation in sensitive areas for fish and macro invertebrates

The invertebrate kick sample was poor and scored C3 which may reflect the poor water quality that was apparent at the site. EC was elevated at 316µS/cm possibly indicating nutrient enrichment but underlying geology may also influence this result.

(GUN1) Unnamed burn

Unnamed Burn			
SFCC Classification	**Salmon**	0+	absent
		1+	absent
	Trout	0+	absent
		1+	absent
Other fish species	None		
Invertebrates Score (RBQI)	**C1**		

The site at GUN1 was immediately downstream of the A77 to the west of Maybole. The burn flows through agricultural land that has high level of grazing pressure before it joins with the Abbeymill Burn and then the Barlewan Burn which flows into the Water of Girvan.

The burn has been subjected to considerable morphological alterations in the upper reaches including straightening and the installation of several culverts. The downstream limit of this site was a perched culvert that may allow passage of fish at certain flows. The upper

limit was the downstream end of the culvert under the A77 and this too was perched but completely impassable to migratory species.

Despite the habitat providing ample cover for fish, electrofishing failed to produce any species. Absence of fish in this area is most likely due to barriers that prevent migration such as the perched culverts mentioned earlier.

The invertebrate sample scored C1 indicating moderate diversity but high numbers of Baetidae and Gammarus were present. Pollution sensitive species were present but in very low numbers.

EC was high at 405µS/cm indicating nutrient enrichment possibly as a result of agriculture or underlying geology.

As the site failed to provide any data that could be used to monitor the proposed by pass, it was decide to survey an additional site downstream that was accessible to migratory species.

(GAB1) Abbeymill Burn

Due to the lack of fish in site GUN1, it was decided to include the Abbeymill Burn in the survey program as it receives water from the unnamed burn discussed above. ART had no previous experience of this burn and were unaware of its fish populations and habitat conditions but suspected that salmonids may be present.

The electrofishing survey confirmed that salmon and trout have access to Abbeymill Burn and generated valuable base line data.

Abbeymill Burn			
SFCC Classification	**Salmon**	0+	**E**
		1+	absent
	Trout	0+	absent
		1+	**B**
Other fish species	Stone Loach (11-100) Three spined stickleback (101-1000) Eel (1-10)		
Invertebrates Score (RBQI)	**A1**		

The burn habitat was of high quality with substrates suitable for spawning purposes for both trout and salmon. Siltation was evident but this doesn't appear to be limiting. The burn was fenced along the left bank and both banks were stable and well vegetated. Marginal and overhanging plants provide excellent cover for fish. Undercutting along both banks offers further areas of refuge.

Salmon and trout were present although not in all year classes. Salmon fry density was very poor but parr were absent. Trout fry were absent but parr densities were good. Eels were also present as were stoneloach, minnow and three-spined stickle back.

Invertebrates sampling returned an excellent RBQI score of A1 reflecting abundance and diversity within the sample. EC was elevated at 383µS/cm possibly indicating nutrient enrichment arising from agriculture or as a result of the underlying geology.

With such good water quality results and excellent habitat at the site, it was rather surprising that fish results were not better although there may be several reasons for this.

(GBL4) Barlewan Burn

ART regularly monitor fish populations on the Barlewan Burn at sites downstream of GBL4. In recent years following investment in agricultural and environmental schemes, water quality has improved resulting in increased salmonid recruitment in the Barlewan Burn with associated benefits for angling on the Water of Girvan.

The Barlewan Burn does suffer from siltation and other forms of pollution but at lower levels than in the recent past.

Barlewan Burn			
SFCC Classification	**Salmon**	0+	**B**
		1+	absent
	Trout	0+	**E**
		1+	**E**
Other fish species	Stone Loach (101-1000) Minnow (101-1000) Three spined stickleback (1-10) Eel (1-10)		
Invertebrates Score (RBQI)	**B1**		

GBL4 was a new survey location for ART. It is situated downstream of the confluence of the Abbeymill Burn and the Kilhenzie Burn but upstream of the Maybole sewage treatment works discharge point.

Habitat at GBL4 was typical of this burn in the survey area. Bank modifications have been performed in the past and much of the right bank face was constructed from boulders. Fish cover between the boulders was excellent. Instream cover was good but in some areas bedrock dominated the stream bed. Marginal vegetation provided additional cover for fish.

As expected, salmon fry density was good but surprisingly parr were absent. Trout fry and parr densities were both poor and again this was surprising. A single 3+ year old trout was captured and is shown in figure 22. This trout was in excellent condition.

The invertebrate sample scored B1 (RBQI) as it lacked abundance and key species from the highest scoring taxa. EC was elevated at 348µS/cm.

6. Conclusions

Both rivers Doon and Girvan support regionally important populations of FWPMs. FWPMs are long-lived molluscs that are highly sensitive to pollution and changes in water quality. The River Doon population has been widely surveyed and is found throughout the main-stem of the river both up and downstream of the confluence with the Chapelton Burn. The range of the Water of Girvan population has not yet been fully surveyed. FWPMs have been recorded in limited areas several kilometres upstream of the confluence with the Barlewan Burn. It is unknown whether they occur in downstream areas. Known populations are currently functionally extinct and this is thought to be largely as a result of nutrient enrichment. ART failed to find juvenile FWPM's in recent surveys and no evidence of recruitment was obvious. Due to their longevity, it is hoped that solutions may be found before the species becomes extinct.

No attempt was made to survey FWPM's during this survey as the tributary burns are unlikely to support the species, however it was felt essential to mention the species to ensure potential developers are aware of their existence within both the Doon and Girvan catchments.

Salmon and trout are also sensitive to many forms of pollution. They require high oxygen levels, clean water and suitable habitat, all of which can be impacted by surrounding land use, morphological changes and inputs to the freshwater environment.

Four of the burns surveyed lie within the River Doon catchment and three within the Water of Girvan catchment. Survey results indicate that salmonid populations are present at four of the seven sites surveyed.

Without exception, the four burns supporting salmonids populations are functioning well below their carrying capacity. Organic enrichment and habitat degradation appear to be the main reasons why salmonid productivity is limited. In both catchments, efforts have been made to reduce the impacts of agriculture on the burns and this is having positive localised benefits for the freshwater ecology.

The burns that failed to produce evidence of fish have all been subjected to morphological alterations that may restrict the natural movements of fish (but may not necessarily prevent access). Water quality appears to be poor on these burns and this too may be responsible for the lack of fish recorded. While individually they contribute to diffuse pollution they are not the only sources as other burns and ditches negatively impact both sub catchments.

The proposed Maybole bypass has the potential to negatively impact water quality, habitat and ecology on the burns surveyed, both during construction and following completion. Modern construction processes and building standards aim to reduce impacts on the freshwater environment and where necessary include mitigation measures. It is essential during the construction phase that adequate protection measures are employed to prevent siltation, enrichment and other pollutants entering the burns regardless of prevailing weather conditions. Surface water management following completion of the road must also be carefully and sustainably designed to protect the freshwater environment.

The Brockloch Burn supports migratory salmonids just a short distance downstream of the proposed route. It is feasible that migratory species may access areas further upstream on this burn and this should not be limited by road and culvert design. The remaining three burns to be crossed by the proposed route are currently of little value to fish at the survey locations, however this situation may change in future and culvert design again should allow for migration. It is worth reiterating that it is considered impossible to prove the absence of fish by electrofishing, therefore, whilst the failure to capture fish at a site may indicate that the population is very low, it cannot be assumed that fish are necessarily absent. The Chapelton, Abbeymill and Barlewan Burns all support salmonids populations that could be affected by the proposed road.

To conclude, we recommend that the following list of concerns be addressed when designing and constructing the proposed Maybole By-pass in order to protect the ecology and fisheries that may be affected.

- Surface water management during the construction phase and following completion should be designed to prevent pollution entering watercourses at all times, regardless of prevailing weather conditions.
- Culvert design should meet with requirements for fish passage and migration.
- A survey of the Water of Girvan downstream of the Barlewan Burn confluence should be considered to identify the presence or absence of FWPMs.
- Monitoring of FWPM populations may be required.
- On-going monitoring of Salmonid populations at the survey locations should be regarded as essential.

7. References

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8. Appendix

Substrate

Substrate is recorded in eight different categories from high organic material, silt, sand, gravel, pebble, cobble, boulder, and bedrock. Size ranges for each substrate type follow the Wentworth scale,(Wentworth 1922) Substrate sizes are always measured along the longest axis and are apportioned into the following categories;

- HO - High organic: Very fine organic matter including peat substrate and thick leaf cover on stream bed,
- SI - Silt: Fine, sticky, mostly inorganic material, individual particles invisible,
- SA - Sand: Fine, inorganic particles, < 2mm diameter, individual particles visible,
- GR - Gravel: Inorganic particles 2-16mm diameter,
- PE - Pebble: Inorganic particles 16-64mm diameter,
- CO - Cobble: Inorganic particles 64-256mm diameter,
- BO - Boulder: Inorganic particles >256mm diameter,
- BE - Bedrock: Continuous rock surface (see figure 5),
- OB - Obscured: Roots, wood, sheets of iron, barrels etc. that obscure the river bed.

The percentage of substrate types found in each of the Burns is presented in Table 6 shown below indicating that cobbles closely followed by pebbles dominate the river substrate in the all of the Burns surveyed.

Table 6: Summary of substrate present in the Burns surveyed

Burn	Substrate type	High Organic	Silt	Sand	Gravel	Pebbles	Cobbles	Boulders	Bedrock	Totally Obscured
Brockloch Burn	Percentage %	0	0	10	5	20	55	10	0	0
Chapelton Burn	Percentage %	0	70	5	2	7	6	10	0	0
Back Glen Burn	Percentage %	0	15	0	0	0	0	0	0	85
Unnamed Burn 1	Percentage %	0	15	20	10	15	10	30	0	0
Abbeymill Burn	Percentage %	0	10	20	10	20	18	20	0	2
Unnamed Burn 2	Percentage %	0	15	2	5	20	40	18	0	0
Barlewan Burn	Percentage %	0	20	5	0	10	20	20	25	0

Water flow and depth

Table 7: Summary of percentage of water flow types along the five Burns survey stretches

Burn	Flow type	Still Marginal	Deep Pool	Shallow Pool	Deep Glide	Shallow Glide	Run	Riffle	Torrent
Brockloch Burn	Percentage %	0	0	10	0	30	50	10	0
Chapelton Burn	Percentage %	2	5	0	80	8	5	0	0
Back Glen Burn	Percentage %	70	0	10	0	0	20	0	0
Unnamed Burn 1	Percentage %	20	0	10	0	48	20	2	0
Abbeymill Burn	Percentage %	0	0	0	10	35	50	5	0
Unnamed Burn 2	Percentage %	0	10	0	0	28	60	0	2
Barlewan Burn	Percentage %	2	0	0	10	18	70	5	0

Table 8: Summary percentage of water depths along the five Burns survey stretches

Burn	Water depth	0 -100mm %	110 - 200mm %	210 - 300mm %	310 - 400mm %	410 – 500mm %	>500mm %
Brockloch Burn	Percentage %	10	40	50	0	0	0
Chapelton Burn	Percentage %	10	2	6	80	0	2
Back Glen Burn	Percentage %	90	10	0	0	0	0
Unnamed Burn 1	Percentage %	40	40	10	10	0	0
Abbeymill Burn	Percentage %	0	30	60	10	0	0
Unnamed Burn 2	Percentage %	5	40	45	5	5	0
Barlewan Burn	Percentage %	2	8	30	60	0	0

Other water quality measurements

Table 9: YSI Model 556 multi-parameter field sampling meter results

Site Code	Burn	Grid Ref E N	Conductivity (μScm^{-1})	Temperature (°C)	DO%
DBO3	Brockloch Burn	232245 612451	372	12.3	103.3
DCH1	Chapelton Burn	232663 611921	408	13.5	82.4
DBG1	Back Glen Burn	231613 610857	244	14.3	80.5
DUN1	Unnamed Burn 1	230509 614409	316	14.1	105.6
GAB1	Abbeymill Burn	230040 609023	383	13.4	106.4
GUN1	Unnamed Burn 2	228725 609370	405	12.3	101.3
GBL4	Barlewan Burn	231903 608383	348	13.5	86.8

SFCC GENERAL ELECTROFISHING HABITAT SURVEY

Easting:_____**metres** **Northing:** _____ **metres** **Site code:**..... **Date:**.....

Widths (m)	At	Wet width	Bed width	Bank width
A - Upst.	0 metres			
B				
C				
D				
E				
F				
G				
H				
I				
J - Downst.				

Site length:

.....**metres**

Depths (cm)	<10	11-20	21-30	31-40	41-50	>50
Percent						

Substrate	HO	SI	SA	GR	PE	CO	BO	BE	OB
Percent									

[***Definitions: HO*** v. fine org. matter ***SI*** inorg, indiv. part. invisible ***SA*** inorg. part. <=2mm ***GR*** inorg. part 2-16mm ***PE*** inorg. part 16-64mm ***CO*** inorg. part 64-256mm ***BO*** inorg. part >256mm ***BE*** cont. rock surface ***OB*** wood barrels etc; cannot move]

Instream veg:.....% **Silted?**: Y / N **Substrate:** Stable / Unstable & Compacted / Partly / Uncompacted

Substrate notes:.....

Flow	SM	DP	SP	DG	SG	RU	RI	TO
Percent								

[***Definitions: SM*** <10cm; still/eddy; smooth ap.; silent ***DP*** >=30cm; slow/eddy, smooth ap.; silent ***SP*** <30cm; slow/eddy; smooth ap.; silent ***DG*** >=30cm; mod/fast; smooth ap.; silent ***SG*** <30cm; mod/fast; smooth ap.; silent ***RU*** fast; unbroken waves; silent ***RI*** fast; broken waves; audible ***TO*** white water; noisy, substrate invisible]

Flow notes:.....

Bankside %	UC	DR	BA	MA	RT	RK	OTH
LB							
RB							

[***Definitions: UC*** undercut banks ***DR*** vegetation rooted in riparian zone; branch/leaves touch or almost touch surface ***BA*** no cover or fish can't get to cover due to lack of water ***MA*** veg rooted in stream bed/bank incl. tree roots; excl. fully aquatic veg.]

Total LB fish cover:.....% **Total RB fish cover:**.....%

LB bankface veg.: Bare / Uniform / Simple / Complex **RB bankface veg.:** Bare / Uniform / Simple / Complex

LB banktop veg.: Bare / Uniform / Simple / Complex **RB banktop veg.:** Bare / Uniform / Simple / Complex

LB overhang. boughs: .....% **RB overhang. boughs:** .....% **Canopy cover:** .....%

Bankside Notes:.....

Gen. landuse: AR / BL / CP / FW / GA / IG / IN / MH / NC / OR / OW / RD / RP / RS / SC / SU / TH / TL / WL

Equipment Type : GEN / BACK **Volts:**..... **Amps:**..... SMOOTH / PULSED **Effective fishing?:** Y / N

Cond:.....μScm^{-1} **Temp:**.....°C **Time:**..... **Stopnet:** UP / DO / BO / NO **Water:** LO / ME / HI & CLR / COL

Team leader:..... **No of staff:**..... **Photo taken & IDS?:** Y...../ N

Stocking? Y / N **Pollution?** Y / N

SP Notes:.....

AccessSal?: Y / N / S / ? **AccessTrt?:** Y / N / S / ? **Purpose:** M / I

Access Notes:.....

SFCC 1MM. ELECTROFISHING RECORDING SHEET (Sheet 1 of 2)

Easting:_ _ _ _ _ _ metres Northing: _ _ _ _ _ _ metres Site code:..... Altitude:.....metres
River:.....
Site situation:.....
Access/permission:..... Date:.....

Instream cover: None / Poor / Moderate / Good / Excellent

	Sa0+	Sa1+	Sa2+	Sa3+	Sa4++	Tr0+	Tr1+	Tr2+	Tr3+	Tr4++
Present										

	SALMON																	
mm	1	2	3	4	mm	1	2	3	4	mm	1	2	3	4	mm	1	2	3	4
30					90					150					210				
31					91					151					211				
32					92					152					212				
33					93					153					213				
34					94					154					214				
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40					100					160					220				
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87					147					207									
88					148					208									
89					149					209									

Scales:.....
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Other species:.....
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Site notes:.....
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SFCC 1MM. ELECTROFISHING RECORDING SHEET (Sheet 2 of 2)

Easting:_ _ _ _ _ _ **metres Northing:** _ _ _ _ _ _ **metres Site code:**..... **Date:**.....

	TROUT																	
mm	1	2	3	4	mm	1	2	3	4	mm	1	2	3	4	mm	1	2	3	4
30					90					150					210				
31					91					151					211				
32					92					152					212				
33					93					153					213				
34					94					154					214				
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89					149					209									

Scales:.....

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