Scottish Sanitary Survey Report

Sanitary Survey Report
East Loch Tarbert
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Partner Organisations

The hydrographic assessment and the shoreline survey and its associated report were undertaken by SRSL, Oban.

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I. Executive Summary

Under (EC) Regulation 854/2004, which sets forth specific rules for the organisation of official controls on products of animal origin intended for human consumption, sanitary surveys of production areas and their associated hydrological catchments and coastal waters are required in order to establish the appropriate representative monitoring points (RMPs) for the monitoring programme.

The purpose of the sanitary survey is to demonstrate compliance with the requirements stated in Annex II (Chapter II Paragraph 6) of Regulation (EC) 854/2004. The sanitary survey results in recommendations on the location of RMPs, the frequency of sampling for microbiological monitoring, and the boundaries of the production areas deemed to be represented by the RMPs. A sanitary survey was undertaken on the classified mussel fishery at East Loch Tarbert on the basis recommended in the European Union Reference Laboratory publication: "Microbiological Monitoring of Bivalve Mollusc Harvesting Area Guide to Good Practice: Technical Application" (https://eurlcefas.org/media/13831/gpg_issue-5_final_all.pdf).

East Loch Tarbert is broad inlet on the east coast of Harris, in the Outer Hebrides. Commercial activity at The shellfishery at East Loch Tarbert is currently suspended due to a dispute over use of the seabed in the desired area at Sound of Scalpay. A test site at Fuam an Tolla, southeast of the Sound of Scalpay site, was damaged during a storm leaving only a monitoring line in place. Classification samples are stated to be currently being collected from this line.

The main sources of contamination to the fishery are discharges from both private and community septic systems along the Sound of Scalpay and around the northwest side of the island of Scalpay. Sources arising from Tarbert, at the head of the loch, are likely to contribute to background levels of contamination at the fishery.

Potential local sources at the proposed fishery include septic tank discharges and watercourses along the north shore of the Sound of Scalpay, mainly to the west of the proposed mussel farm site. Sheep were seen along the shoreline north of the mussel farm site, and therefore diffuse contamination from livestock is also likely to contribute to contamination levels there.

Potential local sources at the sampling line include septic tanks located on the west side of Scalpay, including both the north and south harbours, as well as any livestock grazed along the west side of the island or on the smaller islands near to the line.

There is likely to be seasonal variation in these impacts, and a distinct pattern in results over the year was seen with low results from January to May and higher results from June to December.

Assessment of available hydrographic data suggested transport distances could vary widely depending on the location within the loch. Reported maximum flows in the Sound of Scalpay were high, and estimated maximum transport distance based on these was over 8 km. However, flow data from elsewhere in the loch suggested much slower flows and associated transport distances of less than 1 km. Therefore, the Sound of Scalpay site is more likely to be affected by sources from further afield than the sampling line at Fuam an Tolla.

No basis was found for comparatively assessing the extent of contamination between the proposed mussel farm and the sampling line. Local sources differ between the two, and therefore the sampling line is not considered to adequately represent conditions at the proposed mussel site.

Due to the lack of an active fishery, it is recommended that monitoring be suspended until such time as there is clear direction on the outcome of the dispute over seabed use in the sound. The recommended RMP is NG 2261 9750, at the northeast extent of the planned mussel farm. Should there be a preference to continue sampling, bagged shellfish may be used at this location. Any bagged shellfish need to be in situ for at least two weeks prior to sampling to ensure they are representative of conditions at the site. Once the harvester has approval to move his equipment onto the site, the RMP should established at the northeastern extent of the mussel farm and the location recorded using GPS. It is recommended that the production area boundaries be curtailed along the western side to encompass just the fishery area of interest to the harvester and exclude areas with sewage discharges to the marine environment and that it be extended to the east to encompass the full area of the mussel farm that has been proposed by the harvester.

II. Sampling Plan

Production Area	East Loch Tarbert
Site Name	Sound of Scalpay
SIN	LH-057-106-08
Species	Common mussels
Type of Fishery	Long-line aquaculture
NGR of RMP	NG 2261 9750
East	122610
North	897500
Tolerance (m)	40 m
Depth (m)	1-3
Method of Sampling	Hand
Frequency of Sampling	Monthly
Local Authority	Comhairle nan Eilean Siar
Authorised Sampler(s)	Paul Tyler
Local Authority Liaison Officer	Colm Fraser
Production Area Boundary	The area bounded by lines drawn from NG 2170 9762 to NG 2170 9742 and from NG 2206 9760 to NG 2235 9762 and from NG 2300 9745 to NG 2300 9673 and extending to MHWS.

III. Report

1. General Description

East Loch Tarbert is broad inlet on the east coast of Harris. The loch is east-facing, and its western boundary terminates at the narrow isthmus of Tarbert. It is in the Comhairle nan Eilean Siar council area.

East Loch Tarbert is 1.2 km long, has a width of approximately 500 m and a maximum recorded depth of 21 m.

The surrounding area is moderately populated with the settlement of Tarbert at the head of the loch and settlements lining the roads around the loch. The island of Scalpay, at the mouth of the loch, is populated around its western and southern coasts and is connected to Harris by a road bridge.

A sanitary survey was undertaken on the classified fishery at East Loch Tarbert on the basis recommended in the European Union Reference Laboratory publication: "Microbiological Monitoring of Bivalve Mollusc Harvesting Area Guide to Good Practice: Technical Application" (https://eurlcefas.org/media/13831/gpg_issue-5_final_all.pdf). This production area was selected for survey at this time based on a risk-based ranking of the area amongst those in Scotland that have yet to receive sanitary surveys.

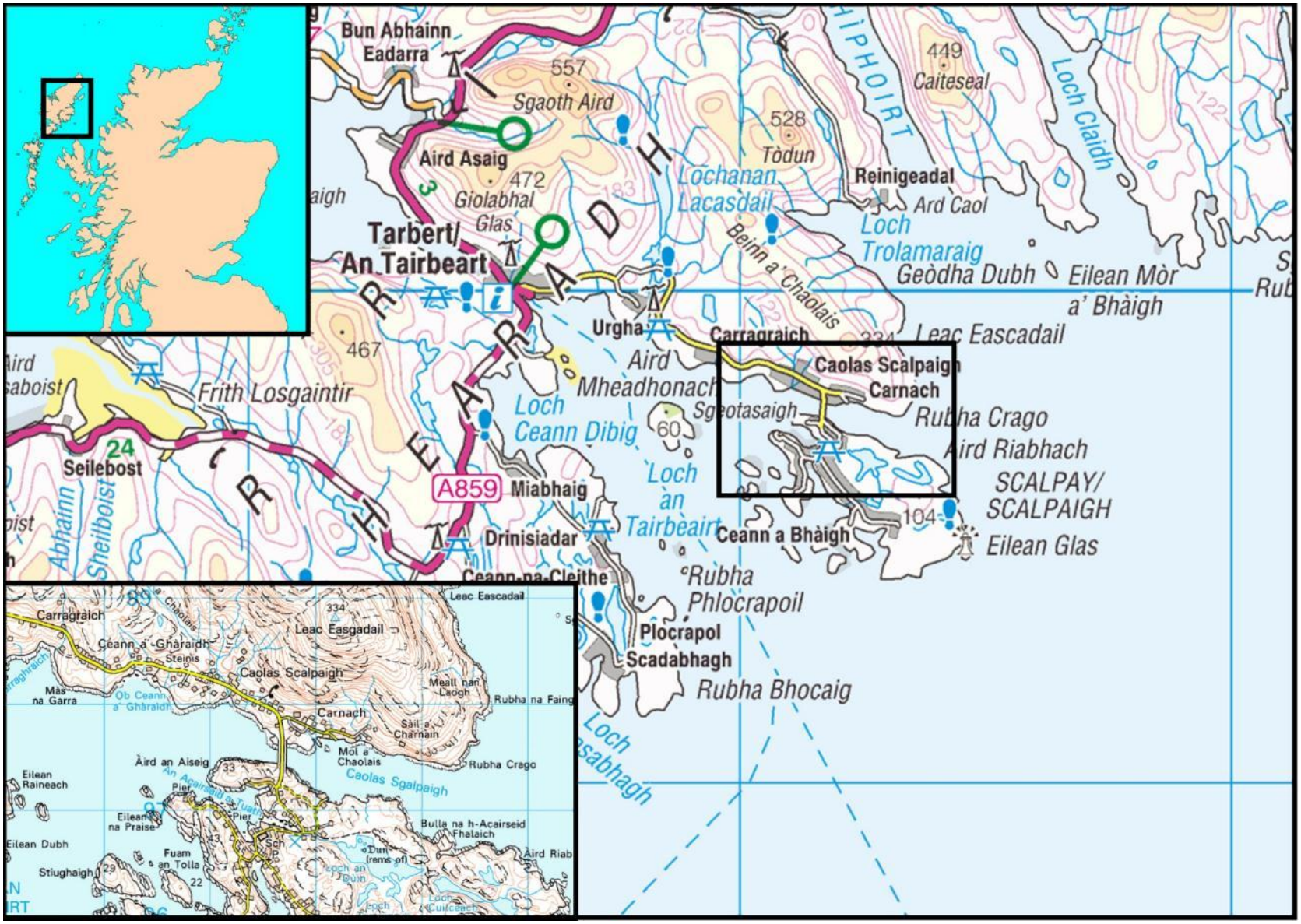


Figure 1.1 Location of East Loch Tarbert

2. Fishery

East Loch Tarbert is classified for the production of common mussels (*Mytilus edulis*). The area was first scheduled to receive a sanitary survey in 2011, however it was withdrawn from the schedule at that time by FSAS due to the lack of an active shellfishery on the site. A summary of the sites given in the 2014-2015 classification document is presented in Table 2.1.

Table 2.1 Area shellfish farms

Production area	Site	SIN	Species	RMP
East Loch Tarbert	Fuam an Tolla	LH-057-104-08	Common mussels	
	Sound of Scalpay	LH-057-106-08	Common mussels	NG 2240 9758

The production area is defined as the area bounded by lines drawn between NG 2000 9653 to NG 2000 9810 then from NG 2281 9753 to NG 2281 9706 and from NG 2095 9596 to NG 2037 9619.

Mussel spat are normally collected on lines in Loch Seaforth, to the north of East Loch Tarbert, and the lines towed to the Sound of Scalpay for on-growing. At the time of the shoreline survey there were no mussel lines in the Sound of Scalpay due to a dispute between the harvester, SSE Ltd., and the Crown Estate over seabed rights and an electrical cable. The fishery would normally consist of six mussel lines with 8 – 10 m droppers. There is currently no seabed lease associated with this site: however, the harvester demonstrated the proposed site extent during the shoreline survey. The eastern end of the proposed site lies outside the current production area boundaries.

The harvester has been testing a site to the east of the island of Fuam an Tolla. The site had proved to be too exposed and mussels had slipped off the lines. At the time of the shoreline survey, one mooring with a single dropper was on this site in order to provide samples for the sampling officer. No classification samples have been attributed to that location.

The extent of the proposed mussel farm mooring area at Sound of Scalpay and the location of the single dropper for sampling at Fuam an Tolla are plotted in Figure 2.1.

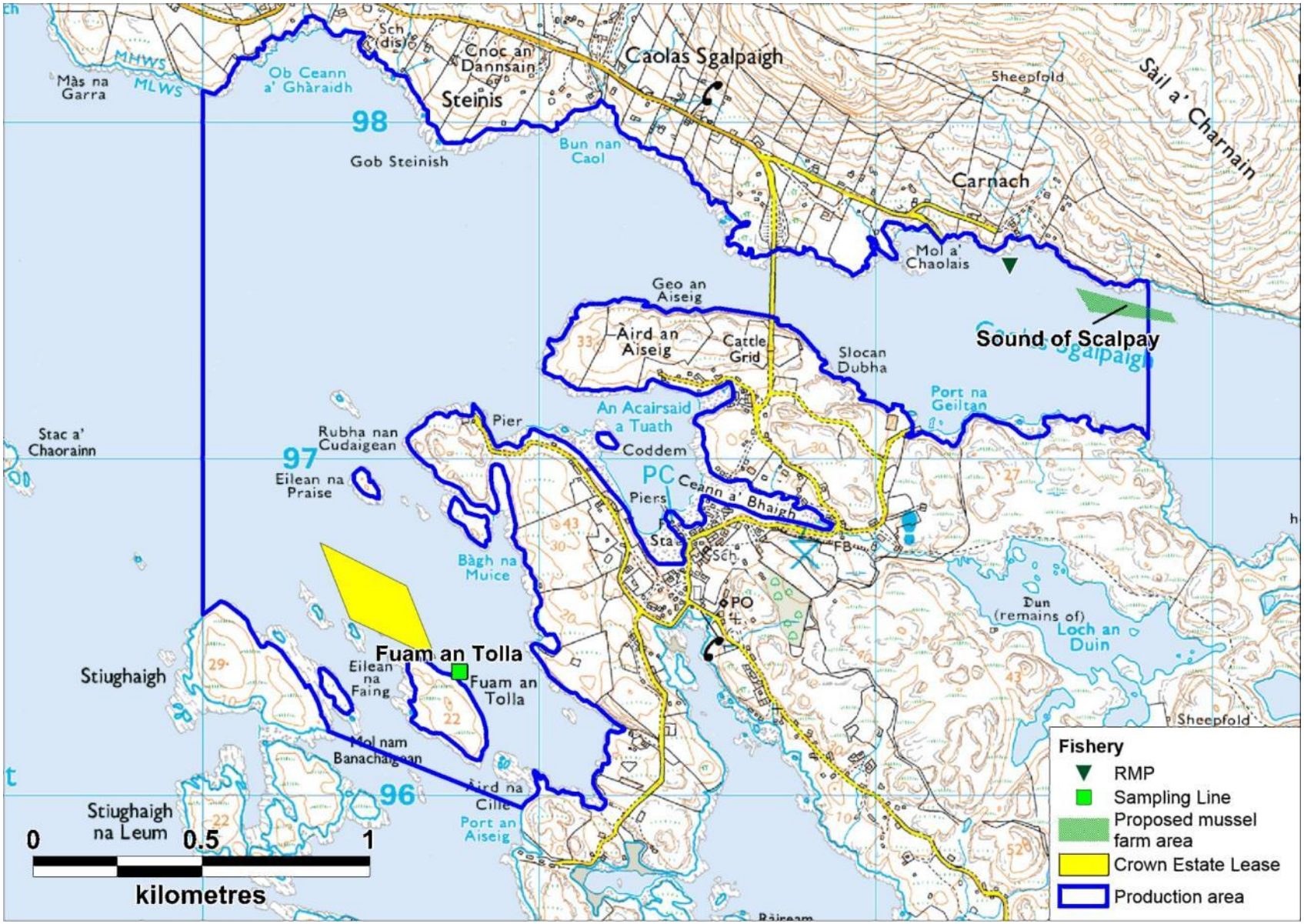


Figure 2.1 East Loch Tarbert Fishery

3. Human Population

Information was obtained on the population within the vicinity of the East Loch Tarbert production area from the General Register Office for Scotland. The last census was undertaken in 2011. The census output areas immediately surrounding East Loch Tarbert are shown in Figure 3.1 thematically mapped by the 2011 population densities. The census output areas vary in size and population within them will not be evenly distributed.

Table 3.1 Census output area and population – East Loch Tarbert

Census Output Area ID	Population	Area (km^2)	Density
S00072919	103	31	3.4
S00074274	71	0.90	79
S00072905	105	69	69
S00072731	115	5.0	23
S00072800	181	22	8.2
S00072851	101	24	4.3
S00072805	85	66	1.3
S00072927	90	0.08	1,000
S00072734	94	0.92	100
S00072798	122	11	11
S00072893	111	0.19	590

The largest settlement in the area is the village of Tarbert, located approximately 6 km to the northwest of the mussel farm areas. It has a population of 550 (Rural Housing Scotland, n.d.). Approximately 60 homes are located along the road that follows the north shoreof the loch between Tarbert and Scalpay. T There is visitor accommodation (both B&B and self-catering) on Scalpay, which had a resident population of 291 at the 2011 census. Locations of tourist accommodation in the survey area are shown in Figure 3.1.

Tarbert is the main ferry terminal for Harris and the centre for boat tours in the area. There will therefore be a significant number of boats passing through East Loch Tarbert to access the harbour at Tarbert. There is a small harbour on the northwest shore of Scalpay, which is where the island's main centre of population is located. During the shoreline survey, small numbers of fishing boats and leisure boats were seen in and around Scalpay harbour and along the south shore of Harris near the bridge. There are three anchorages located north of Scalpay Harbour and two more at the northern end of An Acairsaid a Deas on Scalpay (Clyde Cruising Club, 2007).

Overall, the location population of roughly 1100 is mainly concentrated around the northwest end of Scalpay and at Tarbert, on the western end of the loch. There are also a large number of homes scattered along the road on the north shore of the loch. The amount of visitor accommodation appears to be relatively high in comparison to the permanent population, and therefore a seasonal increase in the human population is expected, particularly during the traditional holiday months of July and August.

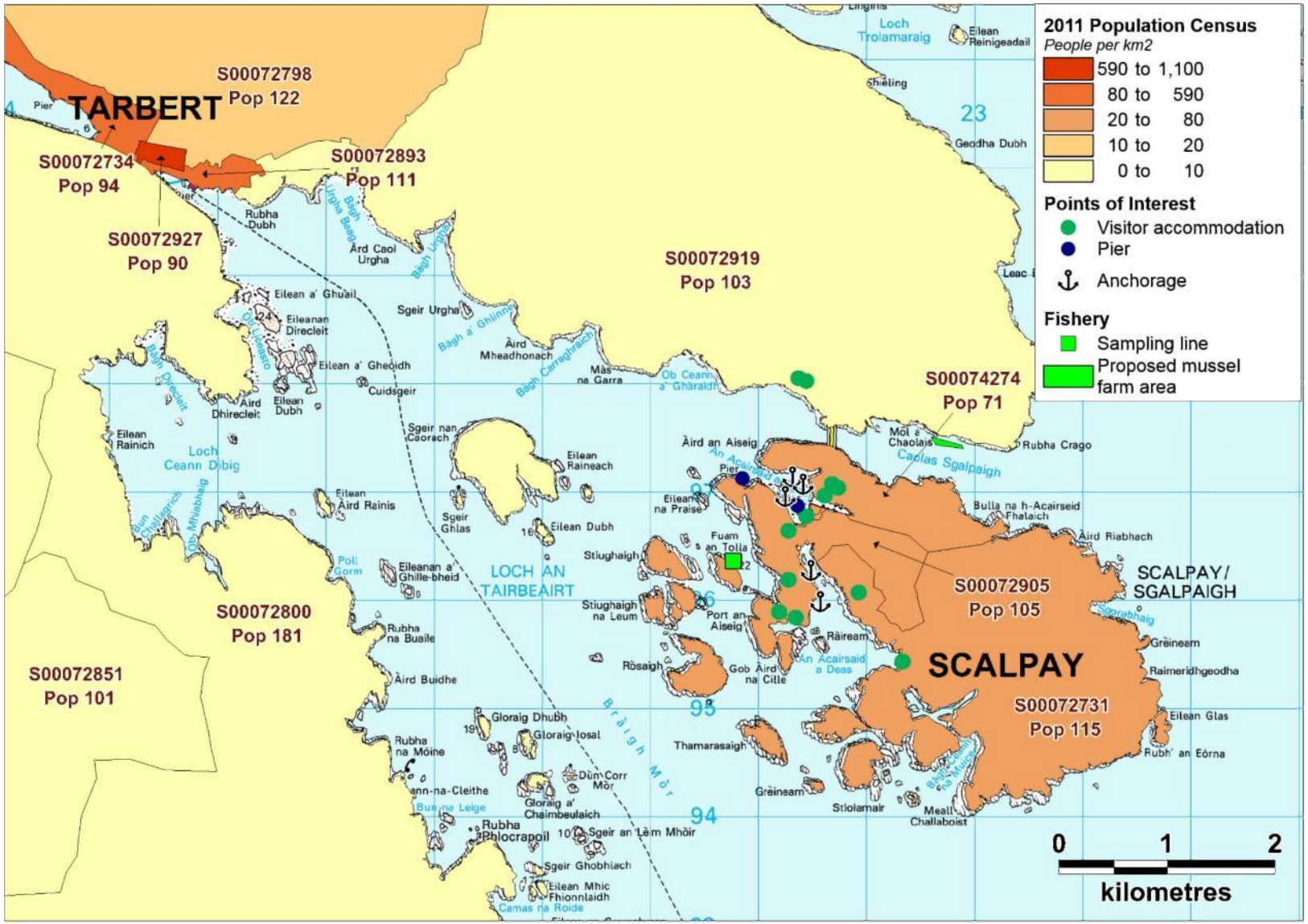


Figure 3.1 Population map for the area around East Loch Tarbert

4. Sewage Discharges

Information on sewage discharges within a 7 km circumference around grid reference NG 1950 9640, in the middle of East Loch Tarbert, was sought from Scottish Water and the Scottish Environment Protection Agency (SEPA). Data requested included the name, location, type, size (in either flow or population equivalent), level of treatment, sanitary or bacteriological data, spill frequency, discharge destination (to land, watercourse or sea), any available dispersion or dilution modelling studies, and whether improvements were in work or planned. No information was provided on sanitary or bacteriological data, spill frequency, dispersion or dilution modelling studies, or whether improvements were in work or planned.

4.1 Community Discharges

Several community discharges were identified by both SEPA and Scottish Water.

Two of the ten community discharges identified by Scottish Water discharged to West Loch Tarbert, so were not included in this assessment.

SEPA also identified ten community discharges within the request area. Of these, three were identified as discharging to the head of West Loch Tarbert so were not considered further here.

Summary data for community sewerage discharges from both SEPA and Scottish Water is provided in Table 4.1.

Scottish Water were unable to provide information on the licence number for the Scalpay West, Scalpay Ceann a Mhuigh, and Deiraclete septic tanks. As no licence number was provided, the SEPA registry office was unable to provide any corresponding information on these discharges.

Information on locations where sewage sludge is applied to land had been requested from SEPA: it was identified that little data was held on this and that the data that was held could not be made available for assessment within the sanitary survey programme.

4.2 Private Discharge Consents – SEPA

SEPA provided information regarding a large number of private consented discharges within the request area identified. Many of these were for activities that would not involve the discharge of sewage effluent, such as engineering works, water abstraction, etc. These consents were excluded from assessment.

Table 4.1 Community sewage discharges East Loch Tarbert

Scottish Water						SEPA					
Discharge Name	**Licence number**	**Location**	**Treatment Level**	**PE**	**MDF**	**Discharge Name**	**Licence number**	**Location**	**Treatment Level**	**PE**	**DWF (m3/day)**
Tarbert Pier Sep	CAR/L/1001875	NG 1580 9980	Septic Tank	1000		Tarbert No 1	CAR/L/1001875	NG 1580 9980	Primary	1000	
Tarbert Sunnyhill Sep	CAR/L/1005037	NG 1610 9975	Septic Tank	-	26 m^3/day	Tarbert Sunnyhill ST	CAR/L/1005037	NG 16101 99750	Primary	-	26
Tarbert Harris WWPS	WPC/N/71850	NG 1559 9990	CSO/6mm screen	-	-	East Loch Tarbert WWPS CSO	WPC/N/71580	NG 1559 9990	CSO	-	-
Tarbert Harris WWPS	WPC/N/71851	NG 1559 9990	EO/6mm screen	-	-	East Loch Tarbert WWPS EO	WPC/N/71581	NG 1559 9990	EO	-	-
Scalpay North Harbour Sep	CAR/L/1002885	NG 2140 9690	Septic Tank	50	-	North Harbour Scalpay 1 Septic Tank	CAR/L/1002885	NG 2140 9690	Primary	50	-
Scalpay East Sep	CAR/L/1004171	NG 2140 9680	Septic Tank	50	-	North Harbour, Scalpay 2 Septic Tank	CAR/L/1004171	NG 2140 9680	Primary	50	-
Scalpay West Sep	Not in database	NG 2154 9719	Septic Tank	41	-	No licence on record	-	-	-	-	-
Scalpay Mid Sep	CAR/L/1004172	NG 2140 9640	Septic Tank	105	-	South Harbour, Scalpay 3 Septic Tank	CAR/L/1004172	NG 2140 9640	Primary	105	-
Scalpay Ceann A Muigh Sep	Not in database	NG 2190 9590	Septic Tank	35	-	No licence on record	-	-	-	-	-
Deiraclete Sep	Not in database	NG 1520 9910	Septic Tank	16	-	No licence on record	-	-	-	-	-

CSO= Combined sewer overflow, DWF= Dry weather flow, EO=Emergency overflow, MDF=Mean daily flow, PE=Population equivalent, ST=Septic tank, WWPS=Wastewater pumping station

SEPA provided information on 149 sewage discharges from dwellings and businesses within the requested area. Details of these consents along with consents for fish farms, water treatment works and other pertinent consents are given in Appendix 6.

A large number of septic tanks (36) are recorded as discharging to sea in the assessment area. One septic tank (CAR/R/1059683) discharges within 500 m of the proposed mussel farm. Other private discharges are located all around the loch shore and on Scalpay and as far south as Loch Ghreosabhagh and north as Loch Trolamaraig.

Registration is required for all new properties and upon sale of existing properties. Information provided by SEPA is considered to be correct at the time of writing; however there may be additional discharges that are not yet registered with SEPA.

4.3 Discharge Observations from Shoreline Survey

Seventeen observations potentially related to sewage infrastructure were recorded during the shoreline survey, which covered the shoreline from Ceann a Gharaidh to Caolas Sgalpaigh, at Carnach and around An Acairsaid a Tuath These observations are listed in Table 4.2 and are shown in Figures 4.1 and 4.2.

The majority of sewage observations were recorded around Scalpay North Harbour.

Observations 5 and 6 was thought to be a disused septic tank outfalls. They appear to relate to consents CAR/R/1056149 and CAR/R/1057101 respectively, both of which are for private septic tank discharges to soakaway.

Observation 7 relates to a consented private discharge to sea (CAR/R/1042585).

Observation 8 relates to active outfall pipe with a strong smell. A sample taken from this outfall returned a value of >10000000 *E.coli* (cfu/100 ml) and a flow of 10 ml/s. This gives a loading of 8.6×10^{10} *E.coli* / day. This does not appear to coincide with any of the consents identified by SEPA.

Observation 9 appears to relate to a consented discharge to sea (CAR/R/1063368).

Observation 10 appears to relate to a consented discharge to sea (CAR/R/1068152), but the location at which the pipe was found is approximately 23 m east of the location identified in the consent.

Observation 12 refers to a community septic tank. This probably relates to CAR/L/1002885 as it is closest to the outfall location given by Scottish Water and licence document.

Table 4.2 Discharge-associated observations made during the shoreline survey

No.	Date	NGR	Associated Photograph (Appendix 5)	*E. coli* (cfu/100ml)	Description
1	30/07/2014	NG 22469 97656	-	-	Black plastic pipe 150 mm diameter, outfalling into sea secured by stainless steel bands to bags of cement aggregate ending underwater. Pipe lying in line below occupied dwelling.
2	30/07/2014	NG 21530 96945	-	-	Standard plastic 100 mm soil pipe outfall on beach encased in old concrete. No flow.
3	30/07/2014	NG 21529 96939	-	-	Metal outfall pipe 150 mm diameter. Barnacles growing in end. No flow observed.
4	30/07/2014	NG 21549 96933	-	-	Standard plastic 100 mm soil pipe outfall. No flow.
5	30/07/2014	NG 21713 96893	-	-	Septic tank with 150 mm ceramic outfall pipe, no flow, presumed disused
6	30/07/2014	NG 21747 96876	Fig. 6	-	Outfall pipe, 150 mm metal, broken, appears disused.
7	30/07/2014	NG 21800 96842	-	-	Septic tank outfall in use discharging onto beach.
8	30/07/2014	NG 21823 96845	Fig. 7	> 10000000	Black 'Alkathene' plastic, 50 mm diameter PVC pipe emerging from grass with flow, stong smell.
9	30/07/2014	NG 21864 96797	-	-	Painted septic tank with outfall onto beach. Possibly in use but no flow at time of survey.
10	30/07/2014	NG 21875 96783	Fig. 8	-	Ceramic outfall pipe, 150 mm diameter encased in concrete. Stagnant but active. Toilet tissue debris on shore.
11	30/07/2014	NG 21672 96817	Fig. 10	-	Septic tank, old, 100 mm plastic soil pipe connecting to ceramic on shore. Shore section pipe broken in several places and tank appears not to be in use.
12	30/07/2014	NG 21488 96859	Fig. 11	-	New communal septic tank on the west side of pier with inspection cover on shore below.
13	30/07/2014	NG 21464 96793	-	-	Septic tank below café & shop. Outflow pipe buried and no pipe end observed from tank.
14	30/07/2014	NG 21408 96771	-	-	Communal septic tank on sea wall beside Scalpay Fire Station. Sound of running water and associated smell. Outfall not observed (below water).
15	30/07/2014	NG 21171 96959	-	-	Outfall pipe from septic tank for isolated dwelling. Ceramic pipe encased in concrete with almost blocked end. No sign of recent flow onto shore.
16	30/07/2014	NG 21053 97053	-	-	Plastic 100 mm soil pipe emerging onto grass from rear garden of isolated dwelling. Remains of toilet tissue in grass.
17	30/07/2014	NG 21404 96491	-	-	Communal septic tank south side of village. Sound of running water. Concrete cracked around top.

Observation 14 relates to a communal septic tank. The area smelt of sewage and the sound of running water could be heard. This discharge probably relates to Scalpay East and West septic tanks (CAR/L/1004171) based on the location given by Scottish Water.

Observation 17 relates to a community septic tank. The concrete top of the tank was cracked. This tank likely to be the Scalpay Mid septic tank (CAR/L/1004172), and the location matches that given by Scottish Water.

Summary

The area around East Loch Tarbert is served by a mixture of community sewage systems and small private septic tanks. Discharges from two community septic tanks (Tarbert Pier and Tarbert Sunnyhill) and from a CSO/EO are present at the head of the loch. Tarbert Pier has a PE of 1000, while Tarbert Sunnyhill has a maximum daily flow of 26 m^3/day. Another small septic tank is reported by Scottish Water at Deiraclete, however it has a reported PE of only 16. In light of its size and location inland, it is considered unlikely to impact water quality in Loch Tarbert.

Two community septic tanks discharge to North Scalpay Harbour, whilst two further tanks discharge to South Scalpay Harbour. Discharges to North Scalpay Harbour, which lies nearer the fishery, have a total consented PE of 141. The majority of discharge pipes seen during the shoreline survey were located around Scalpay Harbour and it was not clear how many of these are no longer in use as homes have been connected to the community septic tanks.

Private sewage discharges are reported throughout the area, in particular on the northern side of Scalpay Sound, the area closest to the fishery. One sewage discharge outfall was observed during the shoreline survey <200 m from the proposed fishery area. The closest discharges to the sample line lies to its south, approximately 600 m from the line.

List of Acronyms

NGR=	National Grid Reference	EO	Emergency Overflow
PE=	Population Equivalent	CSO=	Combined Sewer Overflow
DWF=	Dry Weather Flow	U/T	Unnamed Tributary

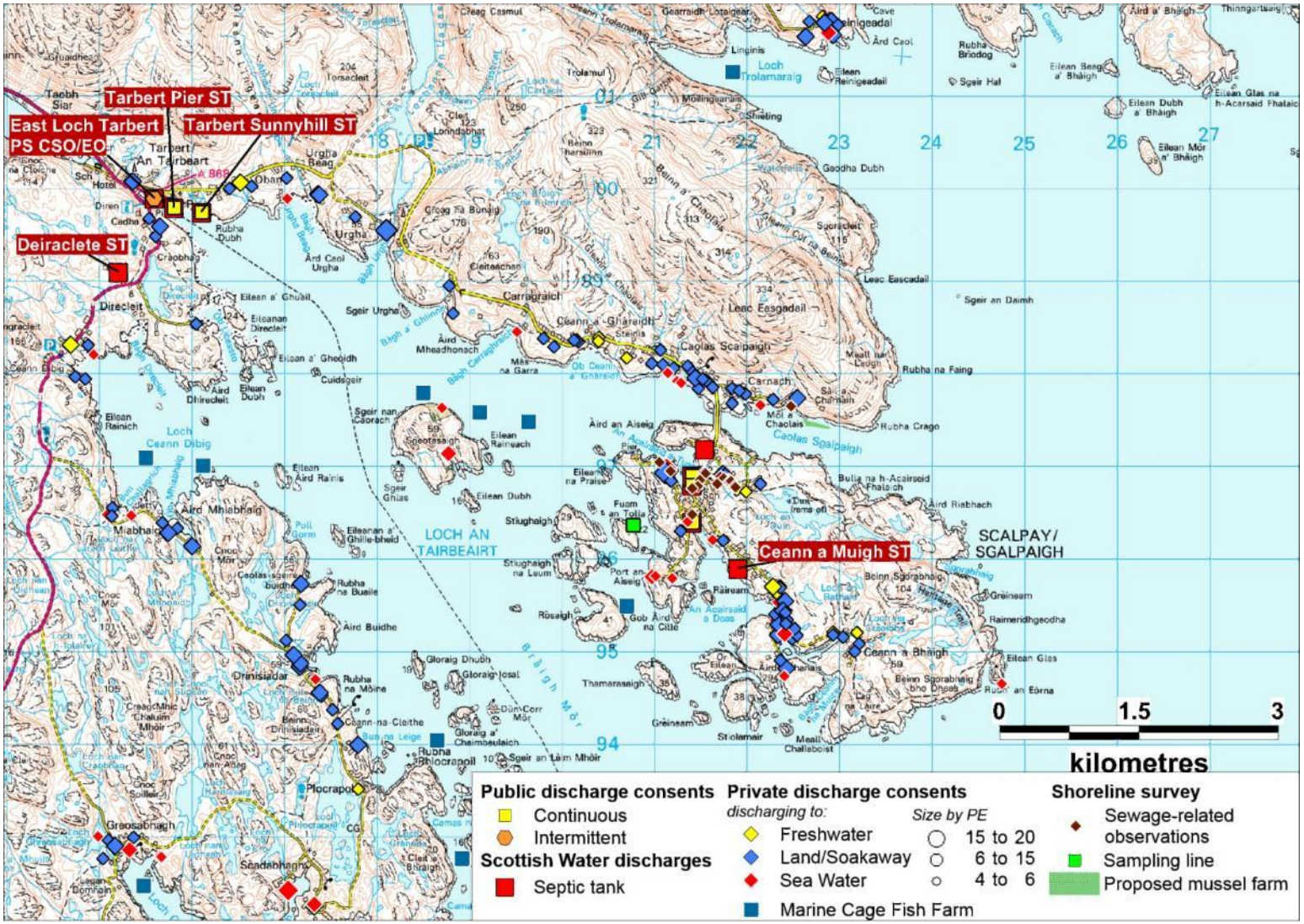


Figure 4.1 Map of discharges for area around East Loch Tarbert

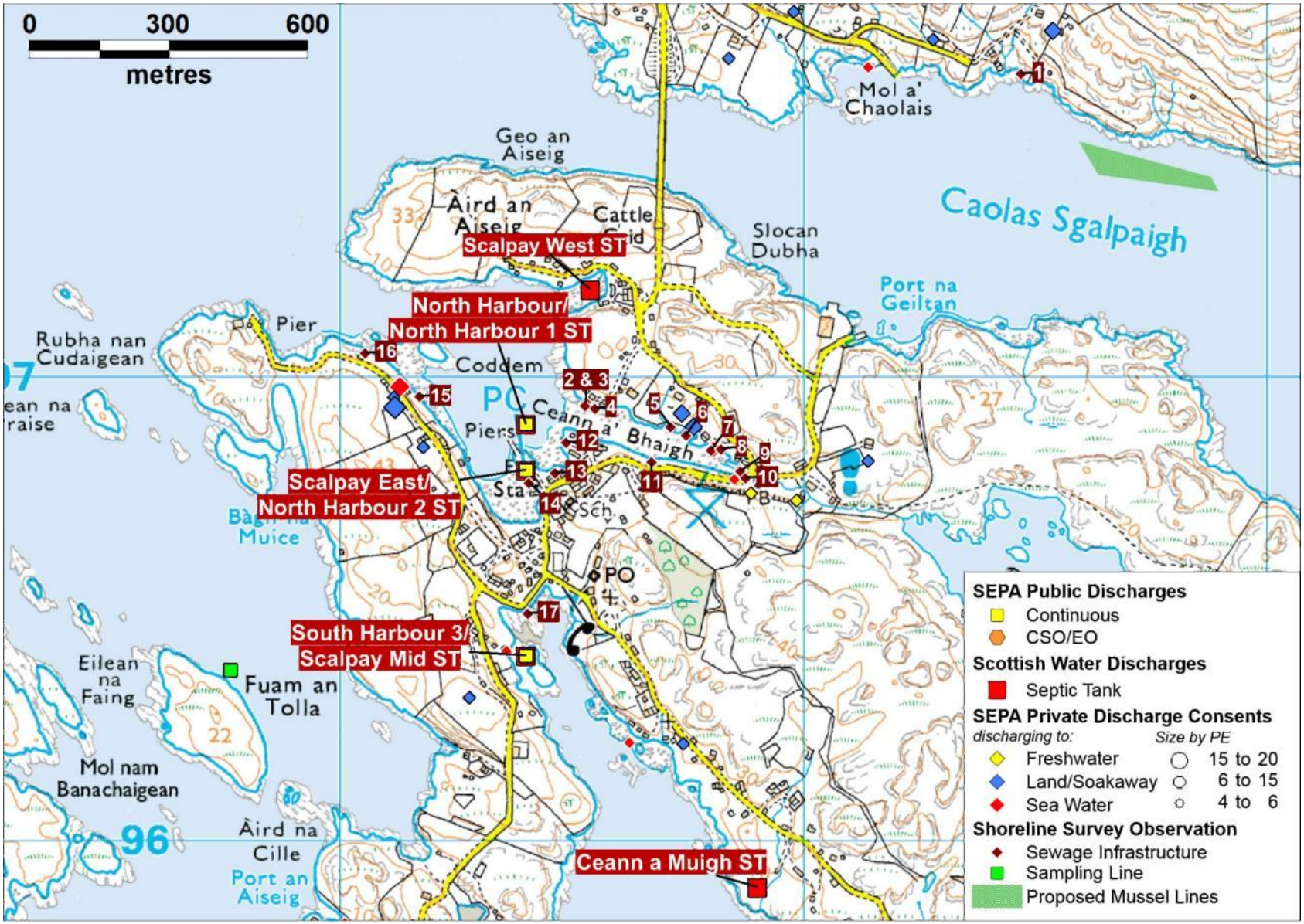


Figure 4.2 Map of discharges on Scalay and to the Sound of Scalpay

5. Agriculture

Information on the spatial distribution of animals on land adjacent to or near the fishery can provide an indication of the potential amount of organic pollution from livestock entering the shellfish farm area. Agricultural census data to parish level was requested from the Scottish Government Rural Environment, Research and Analysis Directorate (RERAD) for the Harris parish. Reported livestock populations for the parish in 2013 are listed in Table 5.1. RERAD withheld data for reasons of confidentiality where the small number of holdings reporting would have made it possible to discern individual farm data. Any entries which relate to fewer than five holdings, or where two or fewer holdings account for 85% or more of the information, are replaced with an asterisk.

Table 5.1 Livestock numbers in the Harris agricultural parish 2013

	Harris	
	504 km^2	
	Holdings	Numbers
Pigs	*	*
Poultry	45	611
Cattle	34	422
Sheep	232	28448
Horses used in Agriculture	0	-
Other horses and ponies	5	11

* data withheld

The livestock census numbers for Harris relate to a very large parish area, therefore it is not possible to determine the spatial distribution of the livestock on the shoreline adjacent to the survey area or to identify how many animals are likely to impact the catchment around the shellfish farm. Although the figures are of little use in assessing the potential impact of livestock contamination to the shellfishery they do give an idea of the total numbers of livestock over the broader area. Sheep were kept in high numbers while poultry, cattle and other horses and ponies were kept in small numbers and. No pigs were reported for the parish due the small number of holdings. There were no reported horses used in agriculture.

A source of spatially relevant information on livestock population in the area was the shoreline survey (see Appendix 5) which only relates to the time of the site visit on the 30th – 31st July 2014. Observations made during the survey are dependent upon the viewpoint of the observer some animals may have been obscured by the terrain.

During the shoreline survey, approximately 6 sheep were observed on the northern shoreline adjacent to the proposed shellfish farm and a further four sheep were observed on the northwestern shore of Scalpay.

Information on locations where animal slurry is stored and/or applied to land had been requested from SEPA: it was identified that little data was held on this and that the data that was held could not be made available for assessment within the sanitary survey programme.

Numbers of sheep are expected to be approximately double during the spring and summer months when lambs are present. Any contributions of faecal contamination from livestock are expected to be low, with livestock grazing on the improved pasture on the Harris coastline adjacent to the proposed shellfish farm location potentially affecting any mussel lines closest to the shoreline.

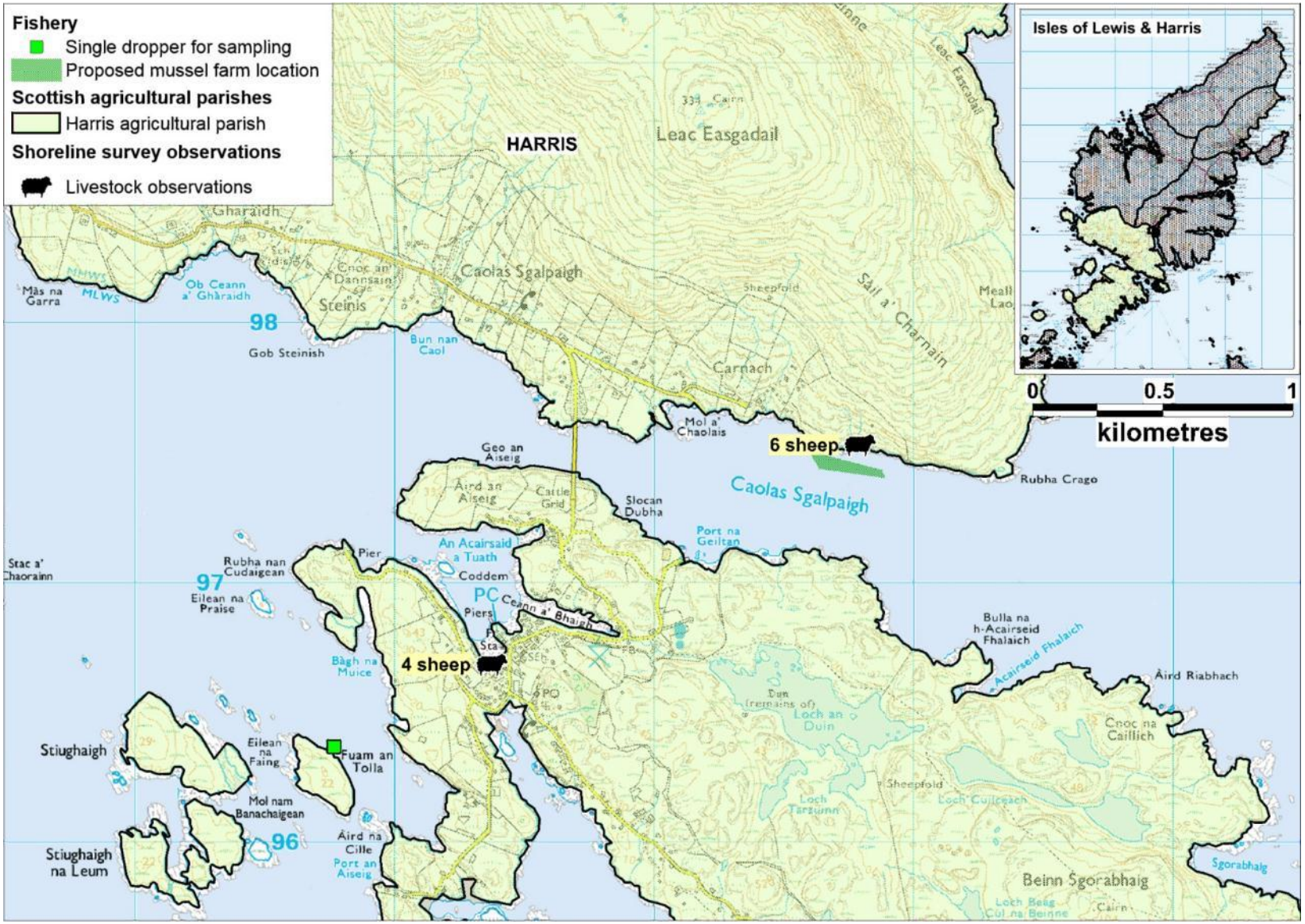


Figure 5.1 Livestock observations at East Loch Tarbert

6. Wildlife

Wildlife species present in and around the production area will contribute to background levels of faecal contamination at the fishery, and large concentrations of animals may constitute significant sources when they are present. Seals (pinnipeds), whales (cetaceans) and some seabirds may deposit faecal wastes directly into the sea, whilst birds and mammals present on land will contribute a proportion of any faecal indicator loading carried in diffuse run-off or watercourses.

The species for which information was potentially available and which could contribute to faecal indicator levels at East Loch Tarbert are considered below.

Pinnipeds

The Special Committee on Seals 2013 report indicated that both harbour seals and grey seals are found within the Outer Hebrides. Harbour seal populations here are shown to have recovered significantly since a 35% decrease between 1996 and 2008, with 2,739 harbour seals observed within the Outer Hebrides between 2007 and 2012. No population estimates are available for grey seals, though the Outer Hebrides are known to contain one of two main UK grey seal breeding colonies. No seals were observed during the shoreline survey.

Cetaceans

Seven common dolphins were sighted within East Loch Tarbert in 2014 (Hebridean Whale and Dolphin Trust, 2014). No other reports or anecdotal accounts of cetaceans in East Loch Tarbert were found during internet searches for this report. No whales or dolphins were observed during the shoreline survey.

Seabirds

Seabird data was downloaded from the collated JNCC dataset from the website (JNCC, 2014) in March 2014. The dataset was then manipulated to show the most recent data where repetitions of counts were present. It should be appreciated that the sources of this data are varied, with some recorded as unknown or estimated, whilst some come from reliable detailed surveys such as those carried out for the Seabird 2000 report by Mitchell *et al.*, (2004). Data applicable for the 5 km area around the fishery are listed in Table 6.1.

Table 6.1 Seabird counts within 5 km of East Loch Tarbert

Common name	Species	Count	Method	Accuracy
Black Guillemot	*Cepphus grylle*	49	Individuals on land	Accurate

The JNCC data only included observations of 49 black guillemot individuals on land, >2.5 km southeast of the fishery on the east side of Scalpay.

During the shoreline survey only 12 oystercatchers were observed.

Otters

The Outer Hebrides are known to support a Eurasian otter population (*Lutra lutra*). No specific reports of otters within East Loch Tarbert were available when writing this report. An otter was observed during the shoreline survey in the water adjacent to the fishery. Otter spraint was also observed next to a watercourse on the adjacent coastline.

Deer

Red deer are found the Outer Hebrides (Vist Scotland, 2014). Red deer are reported to usually inhabit hillside moorland during summer months and lowland areas, particularly woodland, during winter months (http://www.wildlifeonline.me.uk/red_deer.html). No deer were observed during the shoreline survey.

Summary

Overall, input of faecal contamination from wildlife is anticipated to come from a range of species, including seals, otters, birds and red deer. However, insufficient data was available to indicate whether any one part of the fishery may be more affected than another.

Figure 6.1 Map of wildlife distributions around East Loch Tarbert

7. Land Cover

The Land Cover Map 2007 data for the area is shown in Figure 7.1. There are no built up or urban areas represented. The predominant land cover types adjacent to the proposed mussel farm location are rough grassland, acid grassland, dwarf shrub heath and bog. There are also scattered areas of improved grassland and littoral sediment. Sections of shoreline known to be land on the south coast of Harris and northwest coast of Scalpay are shown as either freshwater or salt water, therefore there are some inaccuracies with the Land Cover Map 2007 dataset for this area. During the shoreline survey, it was noted that almost all of the land observed was used for rough grazing.

Faecal indicator organism export coefficients for faecal coliform bacteria have been found to be approximately $8.3x10^8$ cfu/km^2/hr for areas of improved grassland and approximately $2.5x10^8$ cfu/km^2/hr for rough grazing (Kay, et al., 2008). The contributions from all land cover types would be expected to increase significantly after rainfall events, however this effect would be particularly marked from improved grassland areas (roughly 1000-fold) (Kay, et al., 2008).

The potential contribution of contaminated run-off attributable to land cover type is difficult to assess due to the inaccuracies in the land cover data. Almost all of the land around the fishery is potentially used for rough grazing and therefore the risk from this source would be moderate from all areas around the proposed mussel farm, as well as around the sampling line.

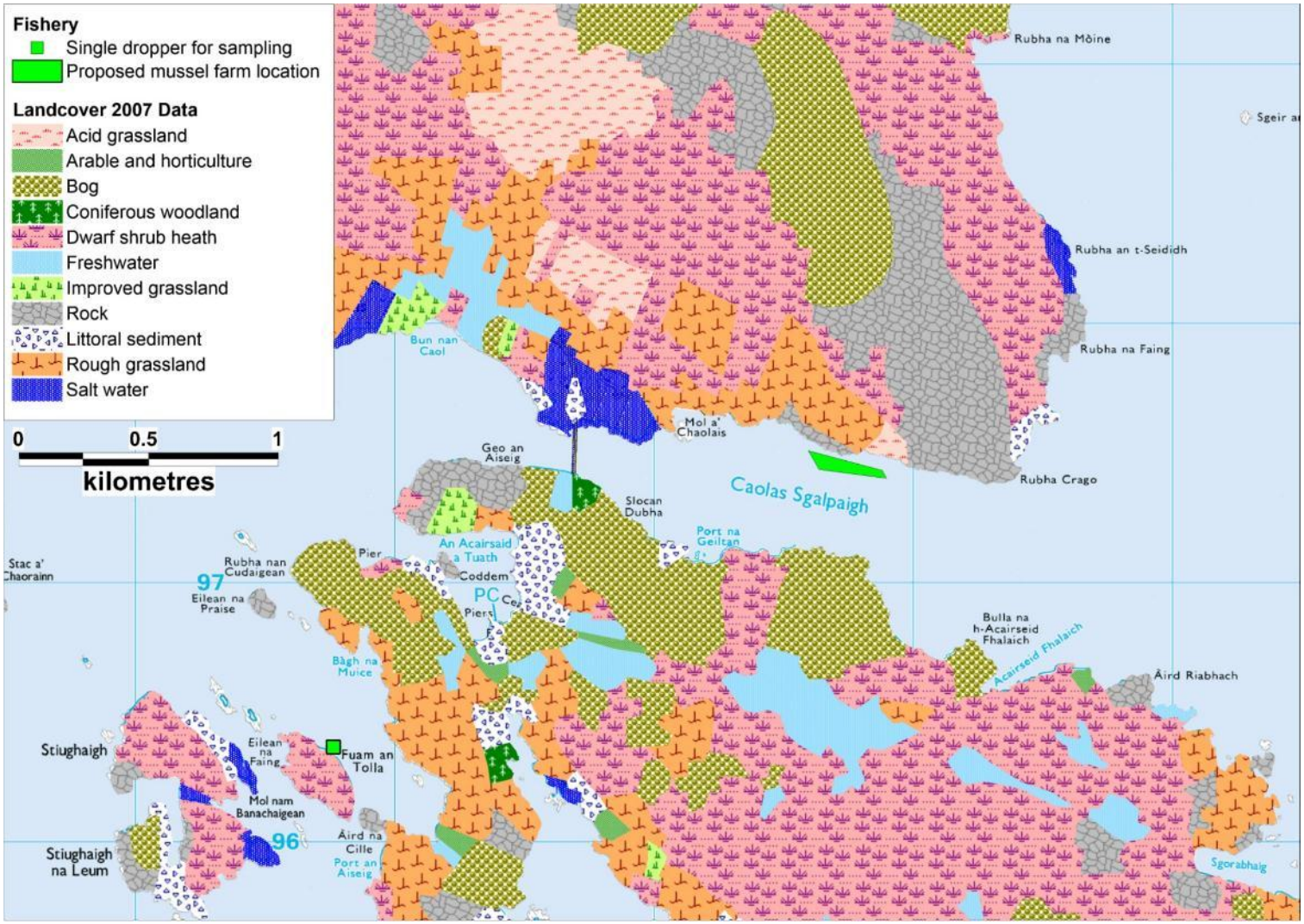


Figure 7.1 LCM2007 land cover data for the area around East Loch Tarbert

8. Watercourses

There are no gauging stations on watercourses entering East Loch Tarbert.

Spot measurements of flow and microbial content were obtained during the shoreline survey conducted on the 30th and 31st July 2014. No precipitation was recorded in the 48 hrs prior to the survey. The watercourses listed in Table 8.1 are those recorded during the shoreline survey. No areas of land drainage were recorded. The locations and loadings of measured watercourses are shown in Figure 8.1.

Table 8.1 Watercourses entering East Loch Tarbert

No.	NGR	Description	Width (m)	Depth (m)	Flow (m^3/d)	Loading (*E. coli* per day)
1	NG 19638 98625	Carragreich River	0.28	0.05	218	8.7×10^7
2	NG 21186 98106	Abhainn Ceann a' Ghearraidh	1.9	0.13*	4190*	9.6×10^9
3	NG 21979 97693	Unnamed watercourse	1.55	0.02	81	2.2×10^8
4	NG 22442 97658	Unnamed watercourse	0.2	0.04	151	2.1×10^8
5	NG 21880 96777	Tributary of Loch an Duin	1.1	0.06	2355	$>1.4 \times 10^{11}$

* Average taken from two measurements

Several small watercourses are located along the shoreline adjacent to the shellfishery. Three of these watercourses were within 700 m of the proposed mussel farm location and had low to moderate estimated *E. coli* loadings. The watercourse with the highest estimated *E. coli* loading of $>1.4 \times 10^{11}$ was located on the western shore of Scalpay. Two land drainage pipes were recorded at the same location but not measured or sampled. The remaining watercourses all had low estimated *E. coli* loadings. One watercourse along the shore to the north of the fishery was found to be too small to accurately record, but a water sample taken from the small flow returned a result of 260 *E. coli* cfu/100 ml, which indicated low levels of faecal contamination.

Overall, freshwater inputs would be expected to provide low to moderate levels of contamination to the production area at East Loch Tarbert, with the highest impact expected from the watercourses that discharge adjacent to the proposed shellfish farm. The sampling location at Fuam an Tolla is located away from any of the observed watercourses and therefore will not be directly impacted by them.

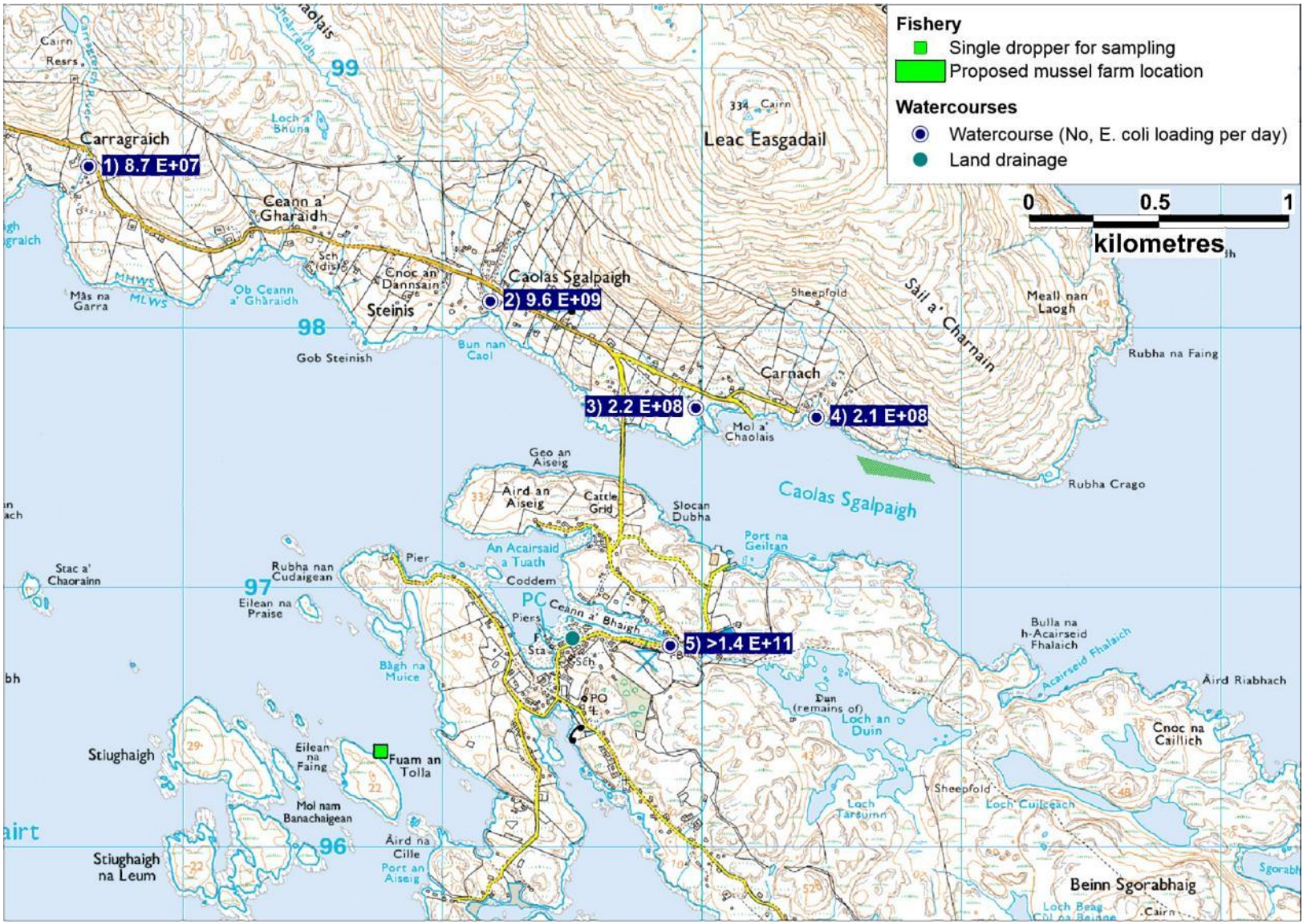


Figure 0.1 Map of watercourse loadings at East Loch Tarbert

9. Meteorological Data

The nearest weather station for which a nearly complete rainfall data set was available is located at Harrish: Quidnish, situated approximately 16 km to the South West of the production area. Rainfall data was available for January 2008 – December 2013. Values for the 10/10/2008 and 27-28/10/2010 have been excluded from assessment as they are either not recorded or are estimates. The nearest wind station is Stornoway, 42 km to the northeast of the fishery. Conditions may differ between this station and the fisheries due to the distances between them. However, this data is still shown as it can be useful in identifying seasonal variation in wind patterns.

Data for these stations was purchased from the Meteorological Office. Unless otherwise identified, the content of this section (e.g. graphs) is based on further analysis of this data undertaken by Cefas. This section aims to describe the local rain and wind patterns in the context of the bacterial quality of shellfish at East Loch Tarbert.

9.1 Rainfall

High rainfall and storm events are commonly associated with increased faecal contamination of coastal waters through surface water run-off from land where livestock or other animals are present, and through sewer and waste water treatment plant overflows (Mallin, et al., 2001; Lee & Morgan, 2003). The box and whisker plots in Figures 9.1 and 9.2, present a summary of the distribution of individual daily rainfall values by year and by month. The grey box represents the middle 50% of the observations, with the median at the midline. The whiskers extend to the largest or smallest observations up to 1.5 times the box height above or below the box. Individual observations falling outside the box and whiskers are represented by the symbol *.

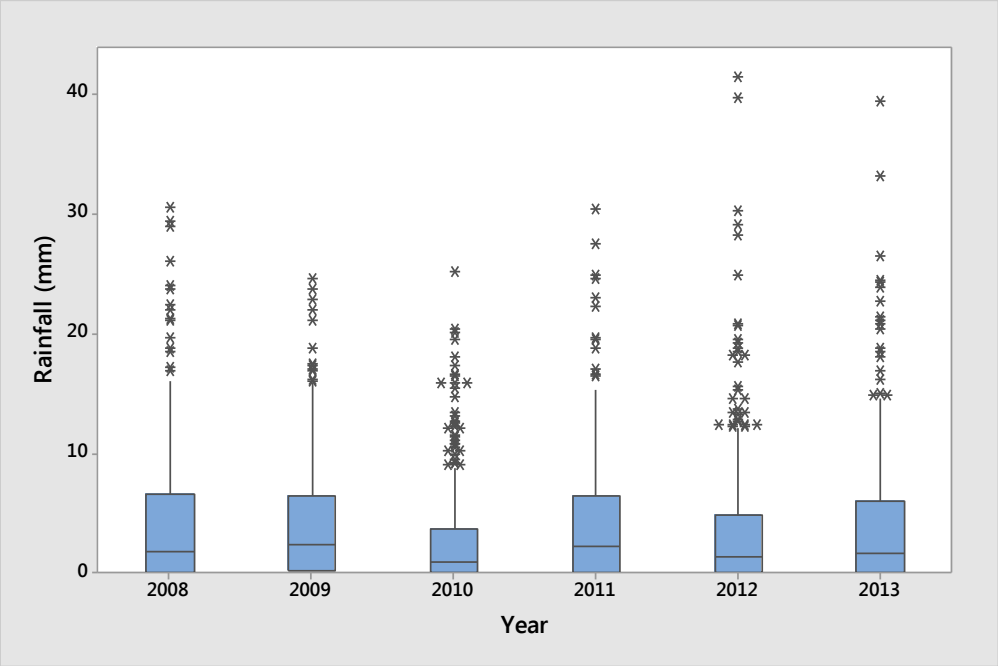


Figure 9.1 Box plot of daily rainfall values by year at Harrish-Quidnish (2008 – 2013)

Rainfall values varied from year to year, with 2010 being the driest year (977 mm). The wettest year was 2008 (1561 mm). Peak rainfall values were between 25 and just over 40 mm/d. Days with greater than 30 mm rainfall were recorded in 2008, 2011, 2012 and 2013: a single rainfall event exceeding 40mm occurred in 2012.

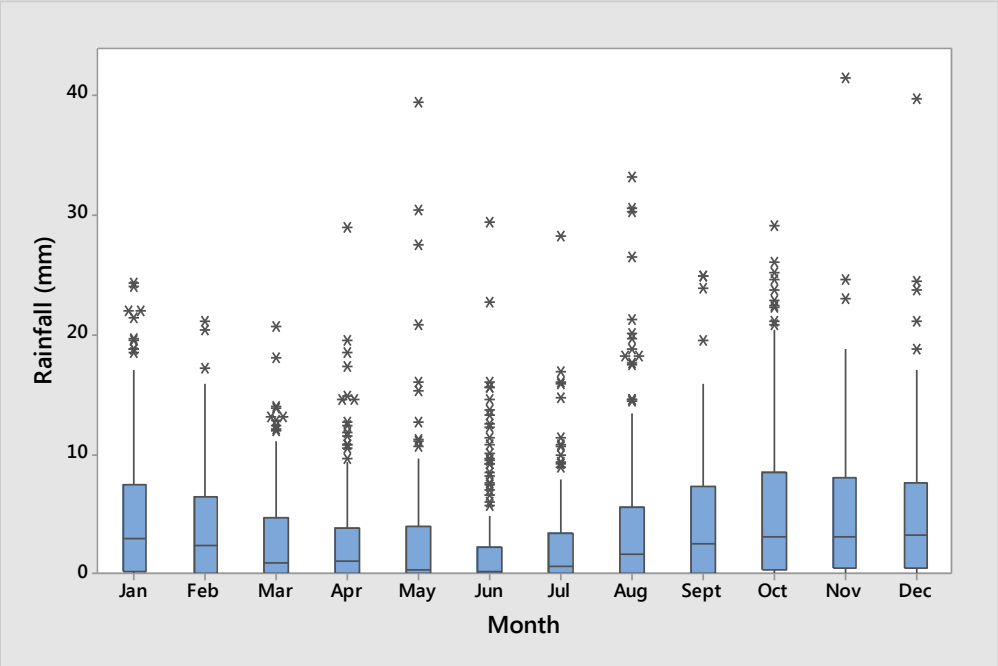


Figure 9.2 Box plot of daily rainfall values by month at Harris - Quidnish (2008 – 2013)

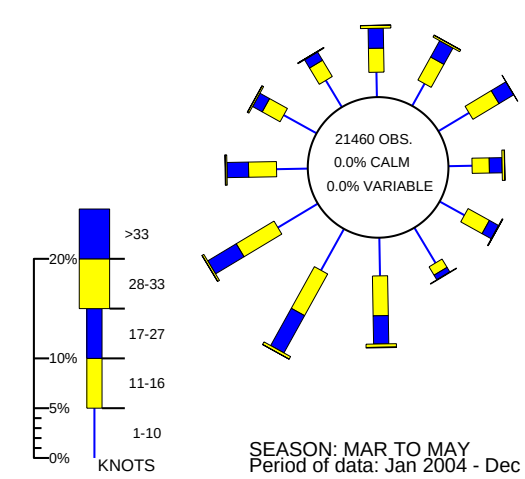
Daily rainfall values were higher during the autumn and winter. Rainfall peaked in October (1002 mm) and was lowest in June (402 mm). Rainfall values exceeding 30 mm/d occurred in May, August, November and December with the highest recorded rainfall occurring in November.

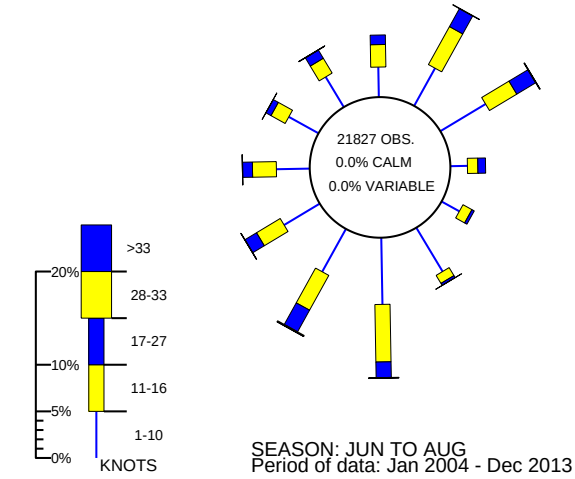
For the period considered here (2008 – 2013), 45 % of days received daily rainfall of less than 1 mm and 12 % of days received daily rainfall of over 10 mm.

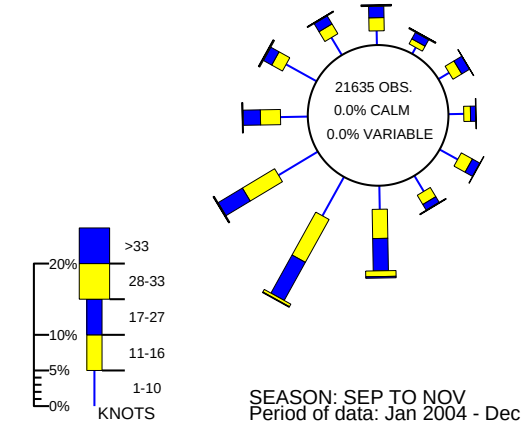
It is therefore expected that run-off due to rainfall will be higher during the autumn and winter months. However, extreme rainfall events leading to episodes of high runoff can occur in most months and when these occur during generally drier periods in late spring and summer, they are likely to carry higher loadings of faecal material that has accumulated on pastures when greater numbers of livestock were present.

9.2 Wind

Wind data was collected from Stornoway and summarised in seasonal wind roses in Figure 9.3 and annually in Figure 9.4.







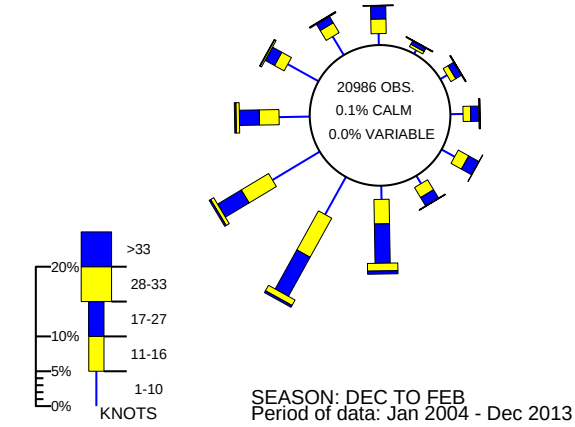


Figure 9.3 Seasonal wind roses for Stornoway

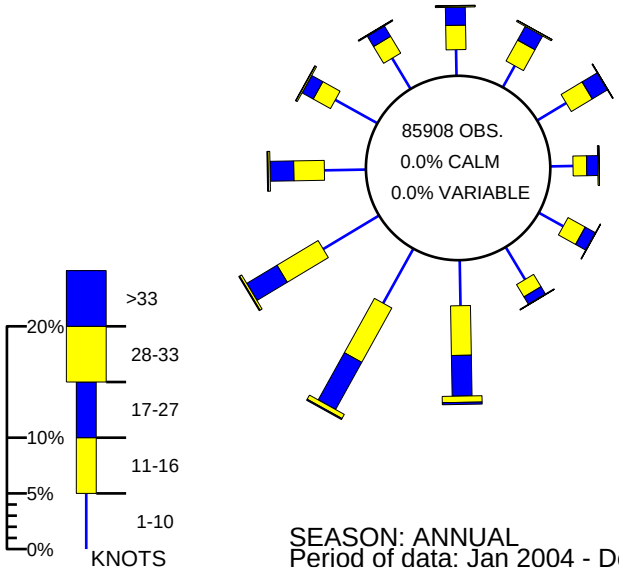


Figure 9.4 Annual wind rose for Stornoway

Overall, winds were predominantly from the southwest. However, during summer, southerly winds were more frequent and there were also relatively strong winds from the northeast. Wind is an important factor in the spread of contamination as it has the ability to drive surface water at about (3%) of the wind speed (Brown, 1991) so a gale force wind (34 knots or 17.2 m/s) would drive a surface water current of about 1 knot or 0.5 m/s. Therefore strong winds can significantly alter the pattern of surface currents. Strong winds also have the potential to affect tide height depending on wind direction and local hydrodynamics of the site. A strong wind combined with a spring tide may result in higher than usual tides, which will carry any accumulated faecal matter at and above the normal high water mark into the fishery area.

10. Classification Information

East Loch Tarbert is classified for production of common mussels (*Mytilus edulis*). The classification history since 2006 is given in Table 10.1 below.

Table 10.1 Loch Eishort: (common mussel) classification history

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	A	A	A	A	A	B	B	B	B	A	A	A
2007	A	A	A	A	A	A	B	B	B	A	A	A
2008	A	A	A	A	A	A	A	A	B	A	A	A
2009	A	A	A	A	A	A	A	A	A	A	A	A
2010	A	A	A	A	A	A	A	A	A	A	A	A
2011	A	A	A	A	A	A	A	A	A	A	A	A
2012	A	A	A	A	A	A	A	A	A	A	A	A
2013	A	A	A	A	A	A	A	A	A	A	A	A
2014	A	A	A	A	A	A	A	A	A	A	A	A
2015	A	A	A									

Although the area was classified B during the summer to early autumn months in 2006 and 2007, since 2009 the area has been classified A year round.

11. Historical *E. coli* Data

11.1 Validation of historical data

Results for all samples assigned against the East Loch Tarbert production area for the period 01/01/2009 to the 28/10/2014 were extracted from the FSAS database on 28/10/2014 and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data. All *E. coli* results were reported as most probable number (MPN) per 100 g of shellfish flesh and intravalvular fluid.

Twenty-two sample results reported as <18 or <20 were reassigned a value of 10 *E. coli* MPN/100 g and one sample reported as >18000 was reassigned a value of 36000 *E. coli* MPN/100 g, for the purposes of statistical evaluation and graphical representation.

Two samples were reported as rejected and were omitted from the dataset for this report. Two samples received at the laboratory >48 hours since collection were similarly omitted from this dataset. The remaining 59 samples plotted within the production area boundaries and had box temperatures of ≤8^{o}C.

11.2 Summary of microbiological results

The sampling and results summaries for sample results from East Loch Tarbert between 2009 and 2014 are displayed in Table 11.1.

Table 11.1 Summary of historical sampling and results

Sampling Summary	
Production area	East Loch Tarbert
Site	Sound of Scalpay
Species	Common mussels
SIN	LH-057-106-08
Location	Various
Total no of samples	59
No. 2009	10
No. 2010	9
No. 2011	10
No. 2012	11
No. 2013	13
No. 2014	6
Results Summary	
Minimum	<18
Maximum	>18000
Geometric mean	40
90 percentile	490
95 percentile	1300
No. exceeding 230/100g	9 (15%)
No. exceeding 1000/100g	3 (5%)
No. exceeding 4600/100g	2 (3%)
No. exceeding 18000/100g	1 (2%)

Few samples were submitted in 2014, presumably due to damage to the site at Tuam an Folla.

11.3 Overall geographical pattern of results

The geographical locations of all sample results assigned to East Loch Tarbert are mapped thematically in Figure 11.1.

All 59 samples plotted west of the estimated mussel farm boundaries, at and west of the nominal RMP. The nominal RMP lies approximately 210 m west of the reported fishery boundaries. Two distinct areas of sampling can be observed; one around the nominal RMP (East) and another to the west of the RMP (West) Samples in the east site have predominantly been taken in 2012 and 2013, compared to samples from the west site which date from 2009-2011 and 2014. No samples had reported locations that coincided

with the sampling line at Tuam an Folla recorded during the shoreline survey. A summary of sample results by area (East and West) is given in Table 11.2.

Table 11.2 Summary of historical results at the two sampling locations

Site	No. of samples	Minimum	Maximum	GM	90%
East	26	<20	>18000	31	490
West	33	<20	5400	48	760

An un-paired t-test was carried out to determine whether there was a statistically significant difference in sample results between the two sampling sites. No statistically significant difference was found (t-test, t= -0.95, DF = 52, p = 0.346).

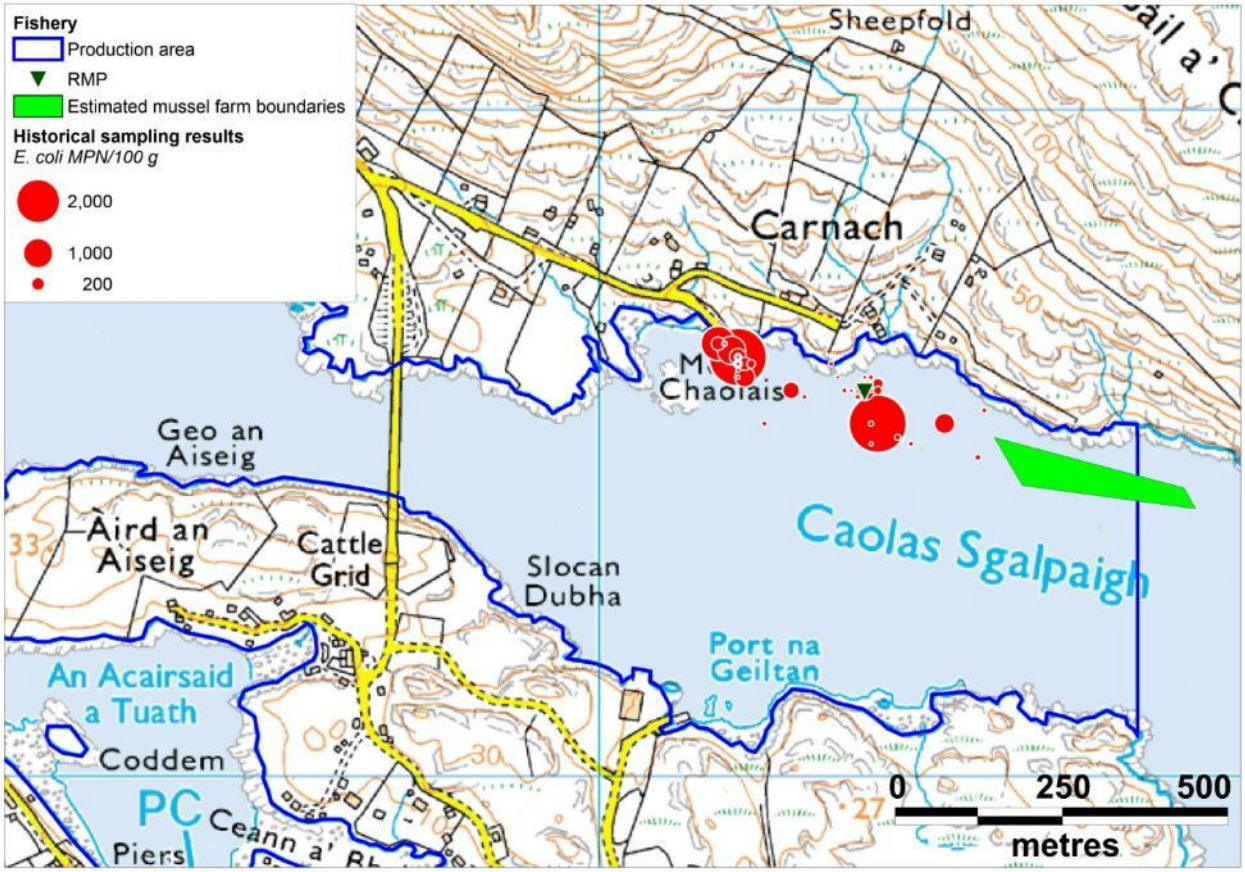


Figure 11.1 Map of reported sampling locations for common mussels at East Loch Tarbert

11.4 Overall temporal pattern of results

A scatterplot of *E. coli* results against date for sites in East Loch Tarbert is presented in Figure 11.2. The dataset is fitted with a lowess trend line. Lowess trendlines allow for locally weighted regression scatter plot smoothing. At each point in the dataset an estimated value is fitted to a subset of the data, using weighted least squares. The approach gives more weight to points near to the x-value where the estimate is being made and less weight to points further away. In terms of the monitoring data, this means that any point on the lowess line is influenced more by the data close to it (in time) and

less by the data further away. A trend line helps to highlight any apparent underlying trends or cycles.

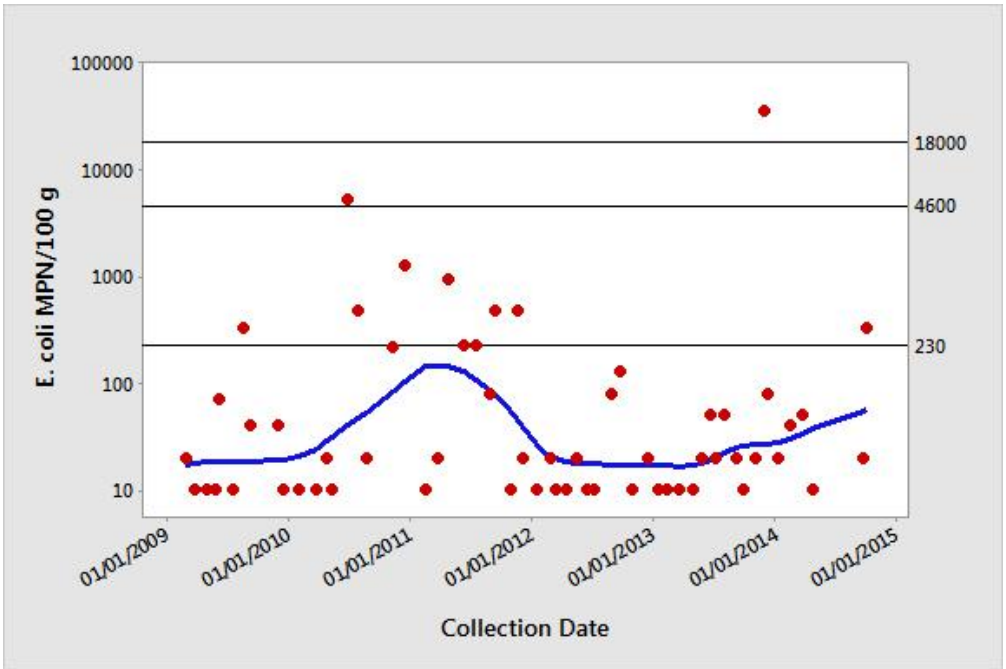


Figure 11.2 Scatterplot of *E. coli* results by collection date at East Loch Tarbert, fitted with a lowess line

There is a peak in the trend line in early 2011, when there were few very low results and a cluster results ≥ 230 *E. coli* MPN/100 g. A slight increase is also noted from mid 2013 onward, though this is expected to have been influenced by a lack of samples between May and September.

11.5 Seasonal pattern of results

Season dictates not only weather patterns and water temperature, but livestock numbers and movements, presence of wild animals and patterns in human distribution. All of these can affect levels of microbial contamination, causing seasonal patterns in results. A scatterplot of *E. coli* results by month, overlaid by a lowess line to highlight trends for East Loch Tarbert is displayed in Figure 11.3. Jittering was applied to points at 0.02 (x-axis) and 0.001 (y-axis) respectively.

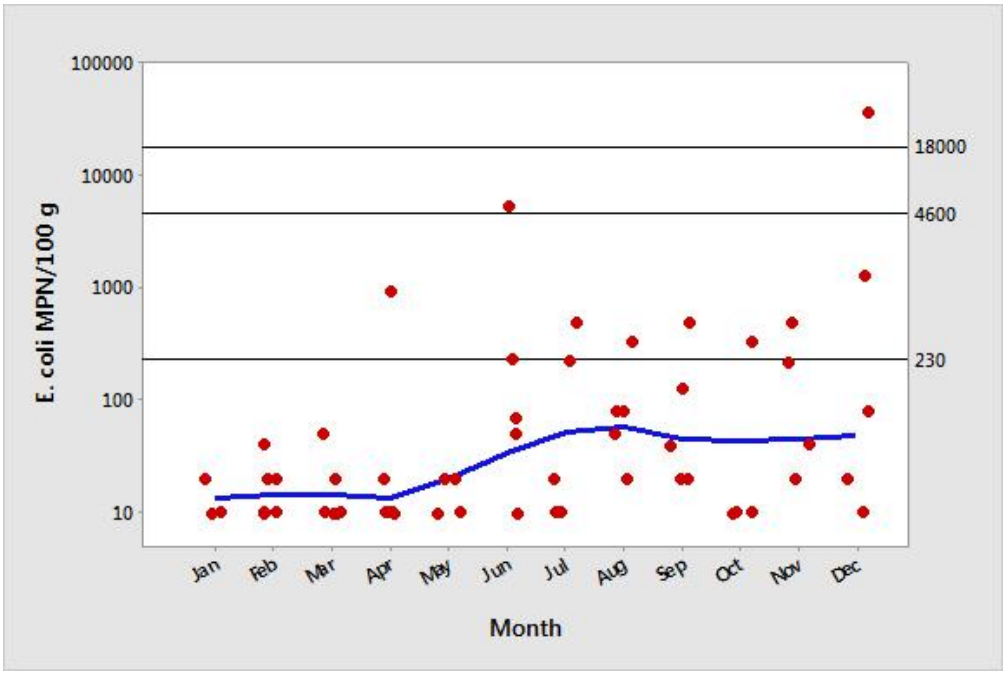


Figure 11.3 Scatterplot of *E. coli* results by month at East Loch Tarbert, fitted with a lowess line

Sample results appear to split into two distinct " seasons". Results were higher from June to December, with the highest individual results occurring in June and December. For statistical evaluation, seasons were split into spring (March-May), summer (June-August), autumn (September-November) and winter (December-February). A boxplot of *E. coli* results by season for East Loch Tarbert is presented in Figure 11.4.

No significant differences were found between *E. coli* results for East Loch Tarbert by season (one-way ANOVA, p = 0.112) (Appendix 4).

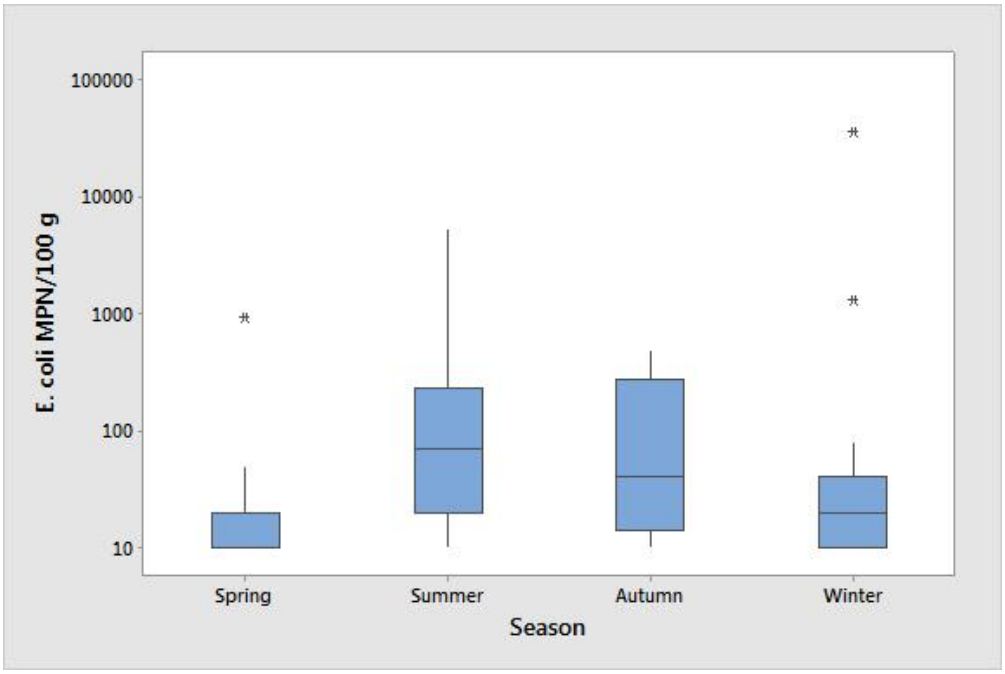


Figure 11.4 Boxplot of *E. coli* results by season at East Loch Tarbert

11.6 Analysis of results against environmental factors

Environmental factors such as rainfall, tides, wind, sunshine and temperature can all influence the flux of faecal contamination into growing waters (Mallin, et al., 2001; Lee & Morgan, 2003). The effects of these influences can be complex and difficult to interpret. This section aims to investigate and describe the influence of these factors individually (where appropriate environmental data is available) on the sample results .

11.6.1 Analysis of results by recent rainfall

The nearest weather station with available rainfall data was at Harrish: Quidnish approximately 16 km southwest of East Loch Tarbert. Rainfall data was purchased from the Meteorological Office for the period of 30/12/08 - 31/12/2013 (total daily rainfall in mm).

Two-day rainfall

A scatterplot of *E. coli* results against total rainfall recorded on the two days prior to sampling for East Loch Tarbert is displayed in Figure 11.5. Rainfall data was available for 53 of the 59 sampling results. Jittering was applied to points at 0.02 (x-axis) and 0.001 (y-axis) respectively.

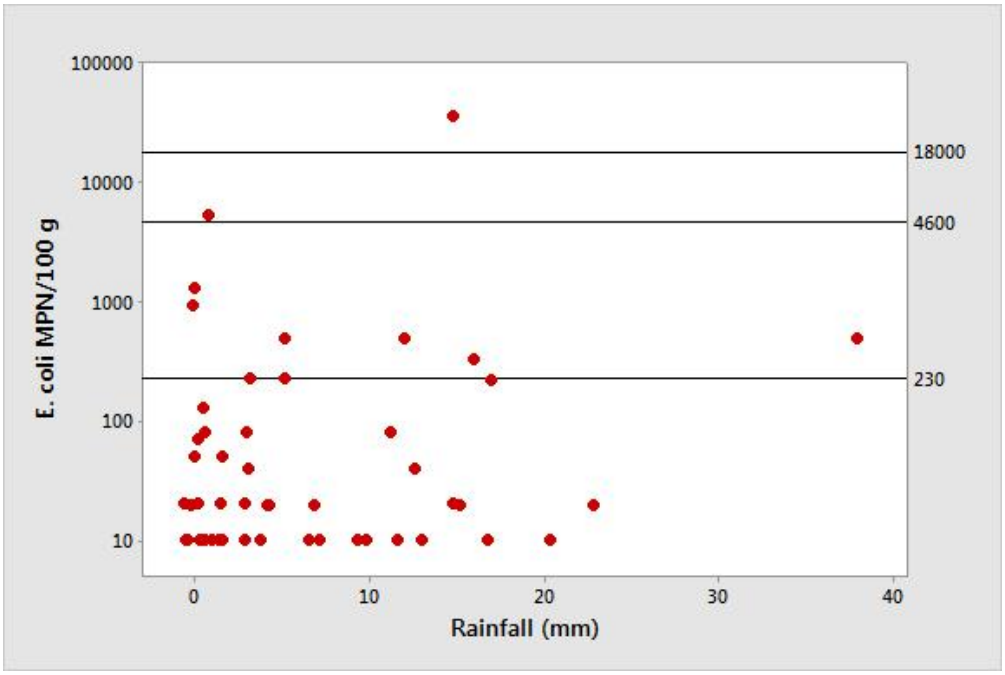


Figure 11.5 Scatterplot of *E. coli* results against rainfall in the previous two days at East Loch Tarbert

No significant correlation was found between *E. coli* results and rainfall during the two days prior to sampling (Spearman's rank correlation r = 0.026, p = 0.854). Both high and low results occurred at very low rainfall levels.

Seven-day rainfall

The effects of heavy rainfall may take differing amounts of time to be reflected in shellfish sample results in different systems. Therefore, the relationship between rainfall during the seven days prior to sampling and sample results was investigated in an identical manner to the above. A scatterplot of *E. coli* results against total rainfall recorded for the seven days prior to sampling at East Loch Tarbert is shown in Figure 11.6. Rainfall data was available for 53 of the 59 sampling results. Jittering was applied to points at 0.02 (x-axis) and 0.001 (y-axis) respectively.

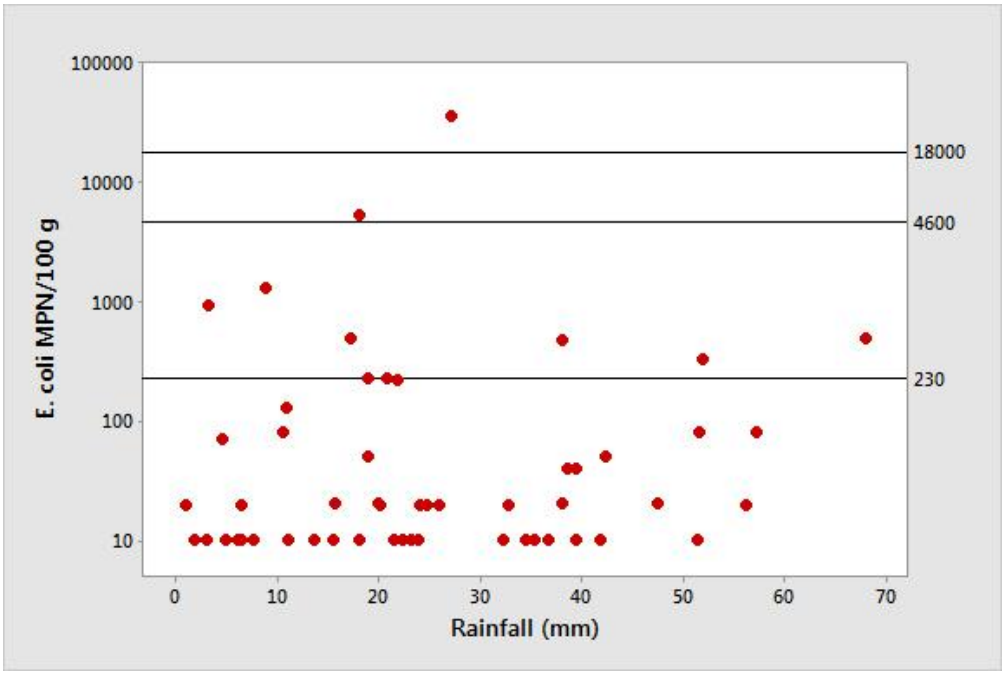


Figure 11.6 Scatterplot of *E. coli* results against rainfall in the previous seven days at East Loch Tarbert

No statistically significant correlation was found between *E. coli* results and the previous seven day rainfall (Spearman's rank correlation r = 0.109, p = 0.436). Results exceeding 230 *E. coli* MPN/100 g occurred across nearly the full range of seven-day rainfall values.

11.6.2 Analysis of results by tidal cycle

Spring/neap tidal cycle

Spring tides are large tides that occur fortnightly and are influenced by the state of the lunar cycle. They reach above the mean high water mark and therefore increase circulation and particle transport distances from potential contamination sources on the shoreline. The largest (spring) tides occur approximately two days after the full/new moon, at about 45º on a polar plot. The tides then decrease to the smallest (neap) tides, at about 225º, before increasing back to spring tides. A polar plot of *E. coli* results against the lunar cycle is shown for East Loch Tarbert in Figure 11.7. It should be noted that local meteorological conditions (e.g. wind strength and direction) can also influence tide height, but are not taken into account in this section.

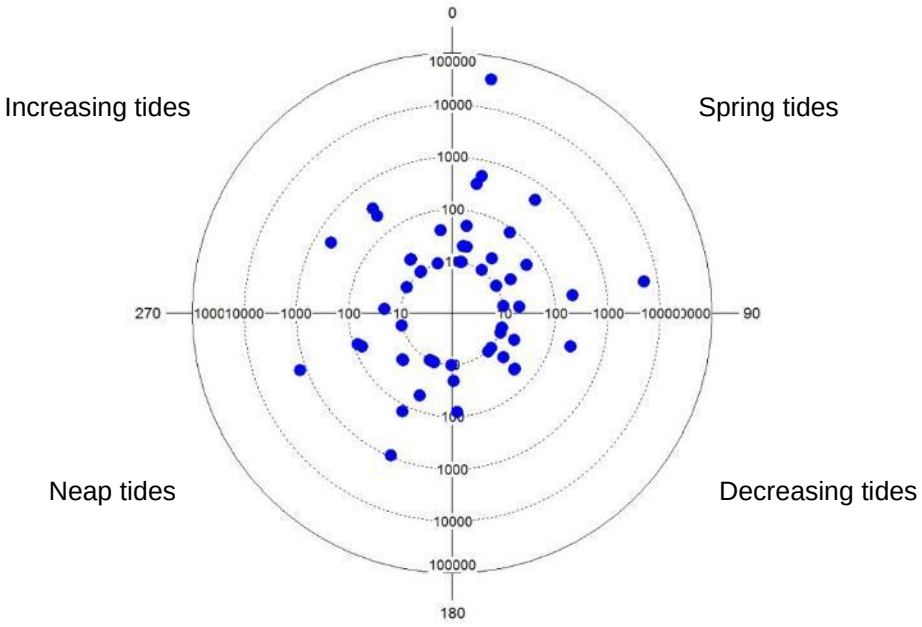


Figure 11.7 Polar plot of *E. coli* results on the spring/neap tidal cycle at East Loch Tarbert

No statistically significant correlation was found between $\log_{10}$ *E. coli* results and the spring/neap tidal cycle (circular-linear correlation r = 0.152, p = 0. 275).

High/low tidal cycle

Tidal state (high/low tide) changes the direction and strength of water flow around production areas. Depending on the location of contamination sources, tidal state may cause marked changes in water quality near the vicinity of the farms. Shellfish species response time to *E. coli* levels can vary from within an hour to a few hours.

High and low water data from East Loch Tarbert was extracted from POLTIPS-3 in October 2014. This site was the closest to the production area (approximately 7 km to the west) and it is assumed that the tidal state will be similar between sites. A polar plot of *E. coli* results against the high/low tidal cycle for East Loch Tarbert is shown in Figure 11.8. High water is located at 0^{o} on the polar plot and low water at 180^{o}.

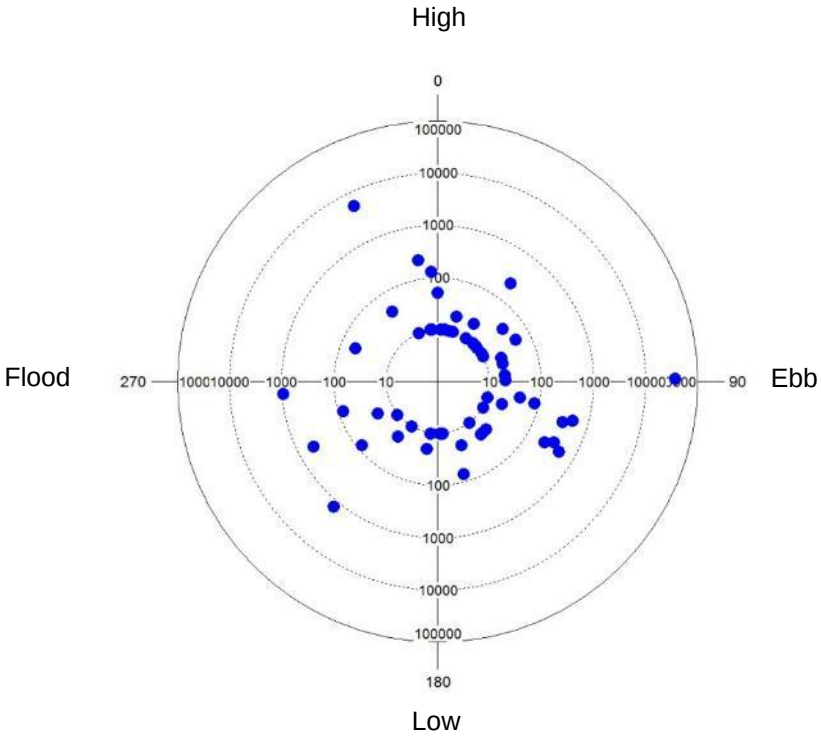


Figure 11.8 Polar plot of *E. coli* results on the high/low tidal cycle at East Loch Tarbert

No statistically significant correlation was found between $\log_{10}$ *E. coli* results and the high/low tidal cycle (circular-linear correlation r = 0.115, p = 0.477).

11.6.3 Analysis of results by water temperature

Water temperature can affect survival time of bacteria in seawater (Burkhardt, *et al*., 2000). It can also affect the feeding and elimination rates in shellfish and therefore may be an important predictor of *E. coli* levels in shellfish flesh. Water temperature is obviously closely related to season. Any correlation between temperatures and *E. coli* levels in shellfish flesh may therefore not be directly attributable to temperature, but to the other factors e.g. seasonal differences in livestock grazing patterns. Water temperature was recorded for 41 of the 59 of the sample results. A scatterplot of *E. coli* results against water temperature for East Loch Tarbert is shown in Figure 11.9. Jittering was applied to points at 0.02 (x-axis) and 0.001 (y-axis) respectively.

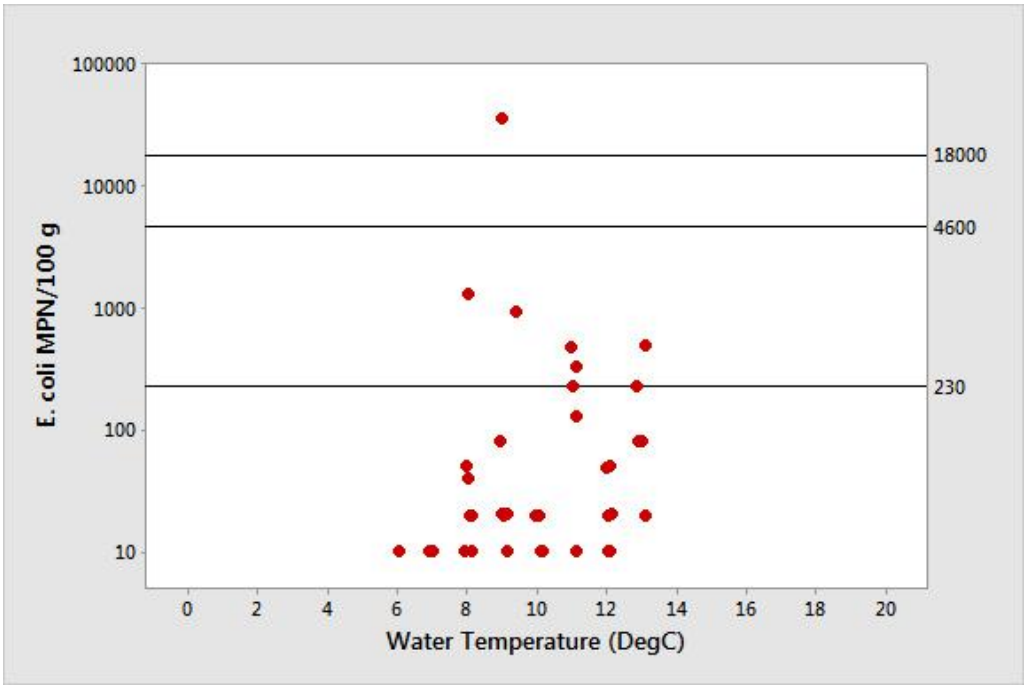


Figure 11.9 Scatterplot of *E. coli* results against water temperature at East Loch Tarbert

A statistically significant correlation was found between *E. coli* results and water temperature (Spearman's rank correlation r = 0.365, p = 0.019). There is no clear pattern in the graph but results >230 *E. coli* MPN/100 g correlated with water temperatures of between 8 and 13ºC.

11.6.4 Analysis of results by salinity

Salinity will give a direct measure of freshwater influence and hence freshwater borne contamination at a site. Salinity was recorded for only 21 (36%) of the samples, therefore no analysis of results by reported salinity was undertaken.

11.7 Evaluation of results over 1000 *E. coli* MPN/100 g

Three common mussel samples yielded results >1000 *E. coli* MPN/100 g and summary information is listed in Table 11.3.

Table 11.3 East Loch Tarbert historic *E. coli* sampling results over 1000 *E. coli* MPN/100 g

Collection Date	*E. coli* (MPN/ 100g)	Location	2 day rainfall (mm)	7 day rainfall (mm)	Water Temp (ºC)	Salinity (ppt)	Tidal state (spring/neap)	Tidal State (high /low)
29/06/2010	5400	NG 2221 9763	1.1	18.1	-	-	Increasing	High
15/12/2010	1300	NG 2218 9765	0.0	9.4	8	36	Neap	Low
03/12/2013	36000	NG 2242 9753	14.4	28.0	9	-	Decreasing	High

-No data available

The three samples were taken in 2010 and 2013, with two of the samples taken in December and one in June. Sampling location varied: the highest result was from a sample taken approximately 57 m southeast of the RMP and the two other results were

from samples taken approximately 200 m to the west of the RMP. Rainfall over the previous two days varied between 0.0 and 14.4 mm and over the previous seven days between 9.4 and 28.0 mm. Water temperature was only recorded for two of the samples and were recorded as 8 and 9ºC. One salinity result was recorded at 36 ppt. Two of the results came from samples taken on high tides.

11.8 Summary and conclusions

Sampling frequency had been even until April 2014, when the fishery was removed owing to a disagreement over the site. Sampling re-started in September 2014, however none of the sampling locations were reported to have come from the sampling line. Sampling locations have all been to the west of the area identified by the harvester. It remains unclear whether the fishery will be placed at the estimated location or further west where the RMP is located. Samples have historically been taken from two distinct locations. No statistically significant difference was found in results between sampling sites, though two of the three results >1000 *E. coli* MPN/100 g were taken to the western extent of the Carnach settlement.

Most of the higher results occurred between the latter half of 2010 and through 2011, although the highest result of >18000 *E. coli* MPN/100 g was from a sample taken in late 2013. However, as no mussel farm was in place by summer of 2011, it is not clear where some of the samples were taken from. Results showed an increase between April and August, although no statistically significant difference was found in results between seasons.

No statistically significant correlation was found between results and previous two day rainfall or results and previous seven day rainfall. A statistically significant correlation was found between results and water temperature with the majority of results >230 *E. coli* MPN/100 g taken at temperatures of between 8 and 13ºC.

No statistically significant correlations were found between results and high/low tidal state or spring/neap tidal state. However, two of the three results >1000 *E. coli* MPN/100 g were from samples taken at high tide.

12. Designated Waters Data

Shellfish Water Protected Areas

The Shellfish Waters Directive (2006/113/EC) has been repealed (as at 31 December 2013) and equivalent protection for areas previously designated under that Directive is given by The Water Environment (Shellfish Water Protected Areas: Environmental Objectives etc.) (Scotland) Regulations 2013. The East Loch Tarbert Shellfish Water Protected Area (SWPA) is one of ten new SWPA's designated in 2014. The SWPA designation covers 3 km^2 would include the western end of the proposed mussel farm and has the same boundaries as the current production area. There was no site report available on the SEPA website for this area. The designated SWPA for East Loch Tarbert is shown in Figure 12.1.

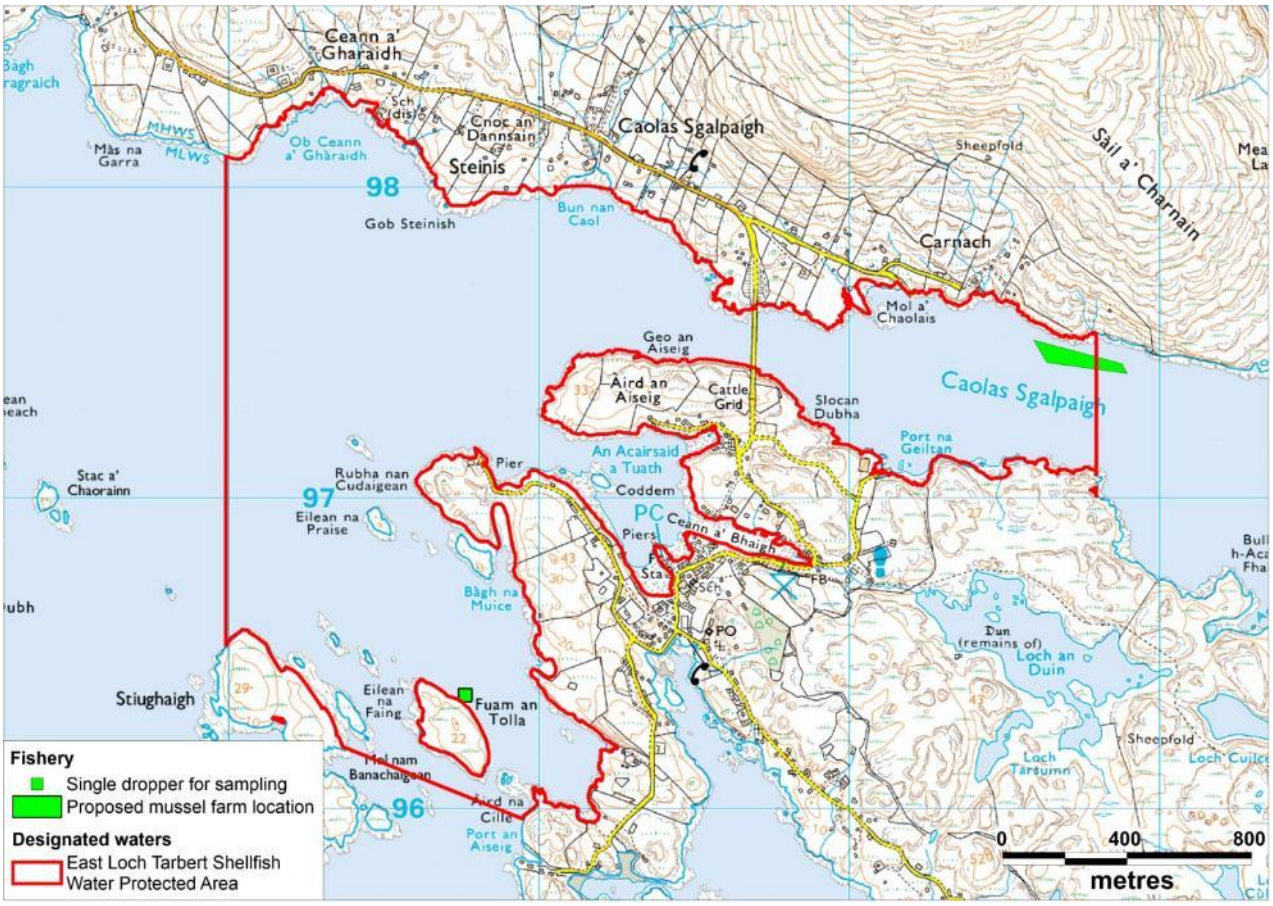


Figure 12.1 Designated shellfish water protected area – East Loch Tarbert

Bathing Waters

There are no designated bathing waters within East Loch Tarbert.

13. Bathymetry and Hydrodynamics

13.1 Introduction

13.1.1 The Study Area

East Loch Tarbert lies on the eastern coast of the Isle of Harris in the Outer Hebrides Region of Scotland. East Loch Tarbert is a large sea loch characterised by numerous small and large islands, the largest being Sgeotasaigh in the middle of the Loch, and Scalpay at the mouth of the loch. East Loch Tarbert is open to the Minch in the east.

The hydrographic assessment area for East Loch Tarbert is illustrated in Figure 1.1, with the red line demarcating the boundaries of the area. The assessment area covers only the innermost portion of East Loch Tarbert to the north of Loch Cheann Dibig and closest to the town of Tarbert. The eastern boundary of the hydrographic assessment area runs between Direcleit, to the west of Eilean a' Ghuail in the south to Rubha na Tuatha in the north.

Several small unnamed streams flow into the assessment area around its northern and southern coasts. There are no major rivers running into the larger East Loch Tarbert, but again numerous small streams flow into the body of the loch. The landscape around the assessment area is relatively low-lying, and the surroundings of East Loch Tarbert are characterised by small hills and freshwater lochs.

The length of the assessment area is 1.2 km, compared to the total length of East Loch Tarbert of approximately 9.8 km. The assessment area is widest at the eastern edge, at approximately 1.1 km wide, and narrows to the northwest.

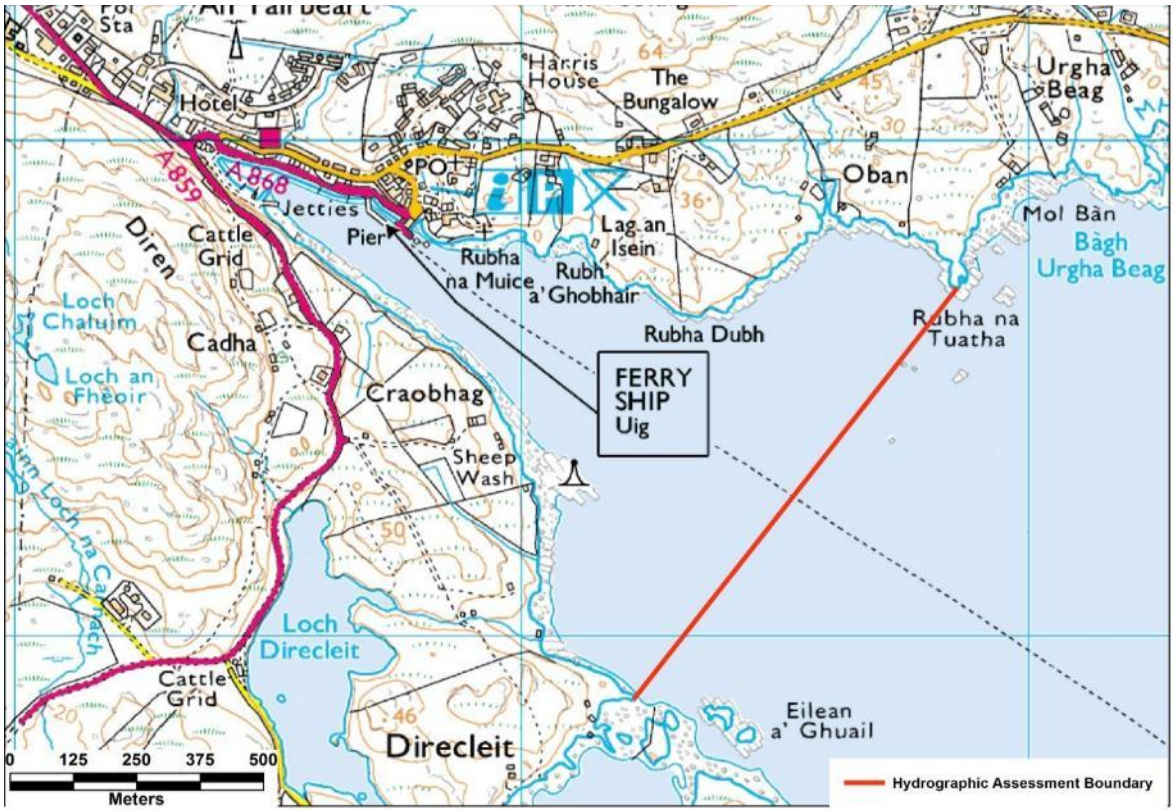


Figure 13.1 Extent of the hydrographic study area

Coordinates for East Loch Tarbert:
57°53.631278 N 006°47.389997 W
OSGB36 National Grid 116274.304 899443.614

13.2 Bathymetry and Hydrodynamics

13.2.1 Bathymetry

Figure 2.1 shows the bathymetry of the assessment area. There are no sills within the assessment area. Bathymetry is deepest at the eastern boundary of the assessment area, and gradually shallows towards the west, to an intertidal area at the head of the assessment area. The maximum depth of the assessment area is 24 m at the eastern boundary.

While a deeper area of approximately 46 m can be found immediately to the east of the assessment area, bathymetry is complex within the larger East Loch Tarbert, varying from approximately 25 m depth in many places to numerous shallow areas scattered with tidally exposed rocks.

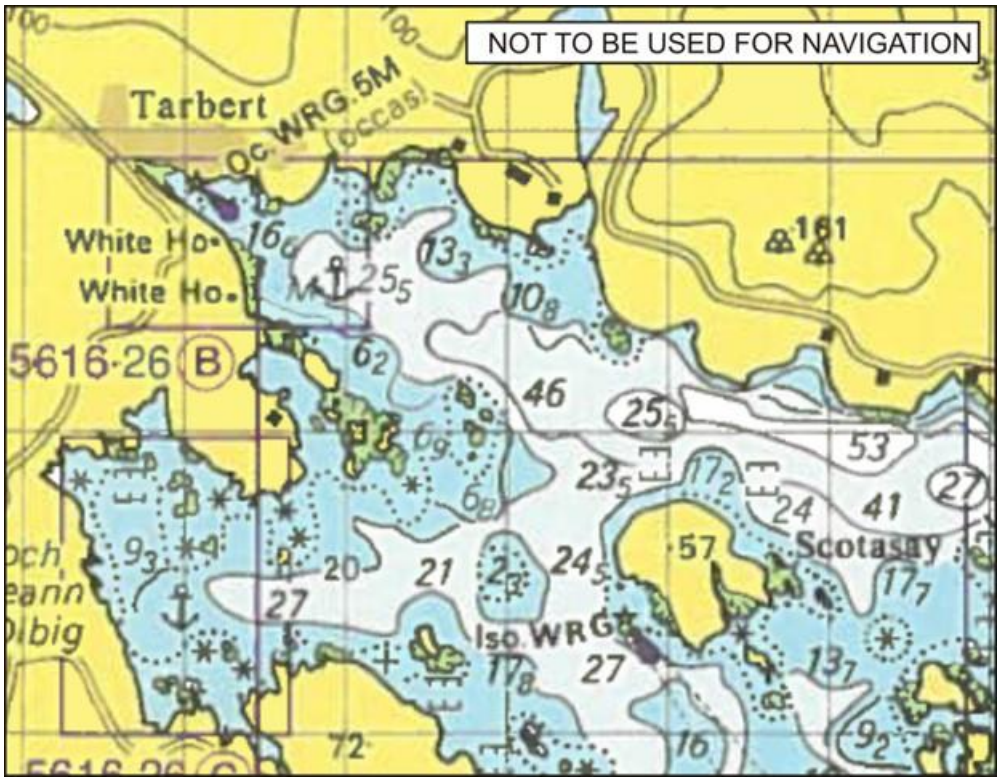
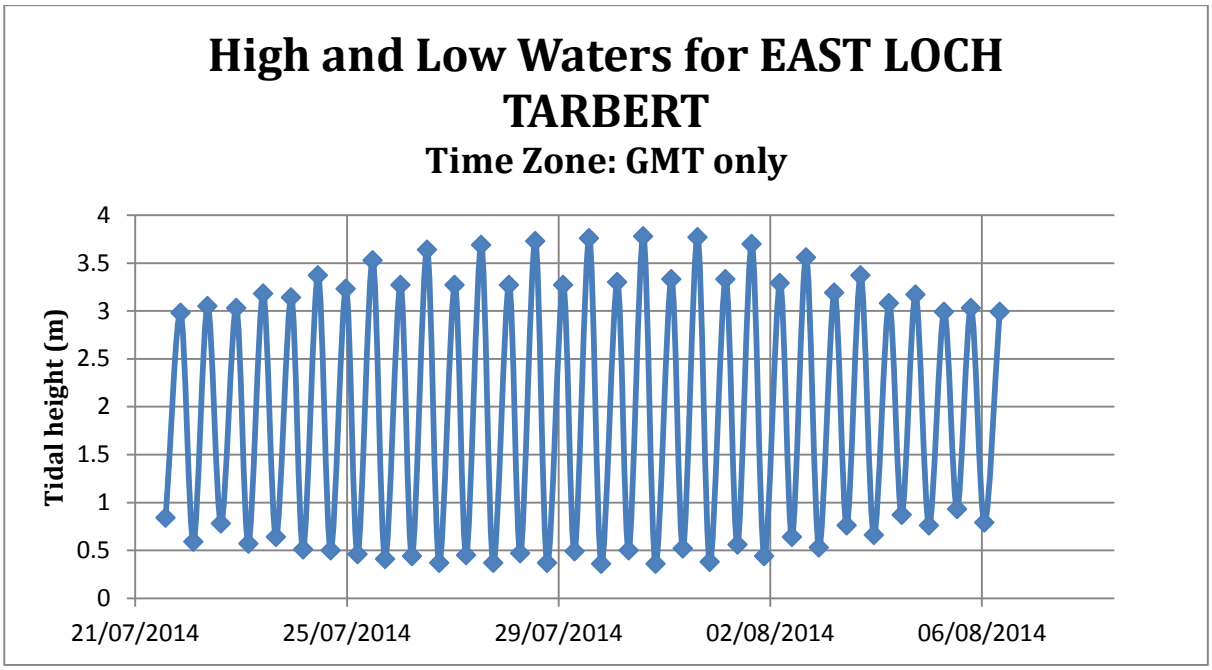


Figure 13.2 – Admiralty chart (2905) extract for East Loch Tarbert.

13.2.2 Tides

Tidal information is provided based on tidal characteristics determined from East Loch Tarbert. East Loch Tarbert is located within the assessment area.

Standard tidal data for East Loch Tarbert, centred around the survey date of 29th July 2014, are shown in Figure 2.2. Tidal predictions indicate that in this region the tidal characteristics are semi-diurnal, with a spring-neap cycle.



Reproduced from Poltips3 [www.pol.ac.uk/appl/poltips3]

Figure 13.3 Two week tidal curve for East Loch Tarbert.

Tidal heights at East Loch Tarbert, data from Poltips3 [www.pol.ac.uk/appl/poltips3]:

Mean High Water Springs = 3.6 m
Mean Low Water Springs = 0.3m
Mean High Water Neaps = 2.9 m
Mean Low Water Neaps = 1.0 m

This gives an approximate tidal volume of water within the assessment area during each tidal cycle of:

Springs: 1.88×10^6 m^3
Neaps: 1.08×10^6 m^3

13.2.3 Tidal Streams and Currents

No current meter data was available from SEPA for the assessment area or the greater East Loch Tarbert. Historical current data was not available from the British Oceanographic Data Centre, nor are any tidal diamonds located in the vicinity of East Loch Tarbert.

Admiralty Chart 2905 indicates that tidal flows can reach speeds of 1.2 knots through the narrow passage of the Sound of Scalpay on an ebb tide, though this location is approximately 5.5 km southeast of the assessment area and unlikely to reflect current speeds within the assessment areas. In general there will be localised enhancement of flow speeds through the many narrow gaps between the islands and exposed rocks in the outer part of East Loch Tarbert. However, current speeds are likely to be considerably slower within the assessment area.

Given the location of the assessment area at the head of East Loch Tarbert, away from rocks and narrow straits and lacking a sill, current flows at this location are likely to be low to moderate. However, it is not possible to provide a quantitative assessment of tidal streams and currents, given the absence of current meter or tidal stream information in the vicinity of the assessment area.

Dispersion is an important property of a water body with respect to redistribution of contaminants over time. There are no measurements or published data relating to dispersion in East Loch Tarbert, or within the assessment area. Without such data it is difficult to judge what the dispersive environment might be like. However, dispersion is likely to be enhanced in the outer part of East Loch Tarbert by flows around islands and tidally exposed rocks.

The assessment area will also be exposed to wave energy in the form of longer period swells originating in the Minch, and shorter period waves generated within the loch. This wave energy is likely to enhance dispersion of surface contaminants within the assessment area.

13.2.4 River/Freshwater Inflow

The assessment area is fed by numerous streams and burns, some flowing from the adjacent Loch Direcleit. The wider East Loch Tarbert is also fed by many streams and burns, originating from inland freshwater lochs such as the Laxadale Lochs, Loch Bràigh na h-Imrich, Loch Drinisiadair, and Loch Phlocrapoil.

13.2.5 Meteorology

The nearest weather station for which a continuous rainfall dataset is available is located at Quidnish, on the Isle of Harris. This station is situated approximately 16 km to the west of the assessment area. Rainfall records are available from January 2008 to December 2013.

While 2010 generally was the driest year (977 mm), the highest rainfall for this time period was recorded in 2008 (1561 mm). High rainfall values (> 30 mm d^{-1}) occurred in 2008 and 2011-2013, but one rainfall event of > 40 mm d^{-1} was recorded in November 2012. Rainfall events of > 30 mm d^{-1} occurred in May, August, November, and December. Daily rainfall varied seasonally, with lowest mean daily rainfall occurring in summer months (May-July) and highest mean daily rainfall occurring in winter months (October-January). Mean rainfall at Quidnish peaks in October, though the high rainfall events of >= 40 mm d^{-1} occurred in May, November, and December. For the duration of the dataset, daily rainfall of below 1 mm occurred on 45% of days, while daily rainfall above 10 mm occurred on 12% of days.

Run-off due to rainfall is expected to be highest in the winter months. However, it must also be noted that high rainfall events occurred in most months and consequently that high run-off can occur throughout the year.

Wind data were obtained from Stornoway on the Isle of Lewis, located 42 km to the northeast of the assessment area. Given the distance between these two locations and varying topography, wind statistics may not be directly transferrable to the specific production area at East Loch Tarbert. They are, however, valuable in providing the general pattern of the seasonal wind conditions. Data collected between January 2004 and December 2013 indicate that the predominant wind direction is from the southwest, but strong winds also come from the northeast in summer months, between June and August. Seasonally, the strongest winds occurred during the autumn and winter. Local wind directions within the assessment area are likely to be influenced by the surrounding topography.

13.2.6 Model Assessment

Due to the paucity of data for this location and its relatively small size it was not considered appropriate to set up a box model run for the assessment area. However, it is worth noting that the estimate of exchange for the entire East Loch Tarbert system using a simple tidal prism method is 3.6 days (Marine Scotland, 2012).

13.3 Hydrographic Assessment

13.3.1 Surface Flow

The site data indicate that the discharge of freshwater into the surface will occur across all of the assessment area. Unusually, there is no significant discharge of freshwater into the head of the Loch. This means that there is likely to be rather weak estuarine circulation within the assessment area. The meteorological data indicate a moderate seasonal variation in freshwater discharge.

From the rather simple geometry of the assessment area it is possible to assume that the pattern of flow will follow a simple up-loch flow on the flood and down-loch on the ebb, broadly axial with the loch and following the coastline. There is nothing to suggest significant variation to this across the assessment area. Without any quantitative measures of flow we are unable to estimate likely transport distances.

Transport of the surface layer would appear to be rather unimpeded by topography. Surface transport out of the assessment will be enhanced by winds having the predominantly westerly direction and will be impeded by winds from the east.

Given the relatively shallow water, moderate tidal flow and relatively low run-off it is anticipated that surface waters will become rather well mixed.

13.3.2 Exchange Properties

Due to the lack of available data it is not possible to provide a quantitative measure of exchange. However, it is anticipated that East Loch Tarbert will have a relatively short flushing time, on the order of a few days. Further, dispersion of surface contaminants from the assessment area will be enhanced by predominantly westerly winds.

The lack of data for this site and the absence of any descriptive literature or related studies limit the extent to which exchange and transport can be assessed for this area. However, the assessment area is rather simple in form where exchange will be dominated by tidal forcing and further enhanced by winds. Nevertheless, the assessment is somewhat speculative and therefore the confidence level of this assessment is LOW.

14. Additional Hydrographic Data

Additional summary current meter data was obtained from SEPA for locations in East Loch Tarbert in the broad vicinity of the proposed mussel farm and present sampling line. This data was obtained after the primary hydrographic assessment had been completed.

The locations of the current meters are shown in Figure 14.1.

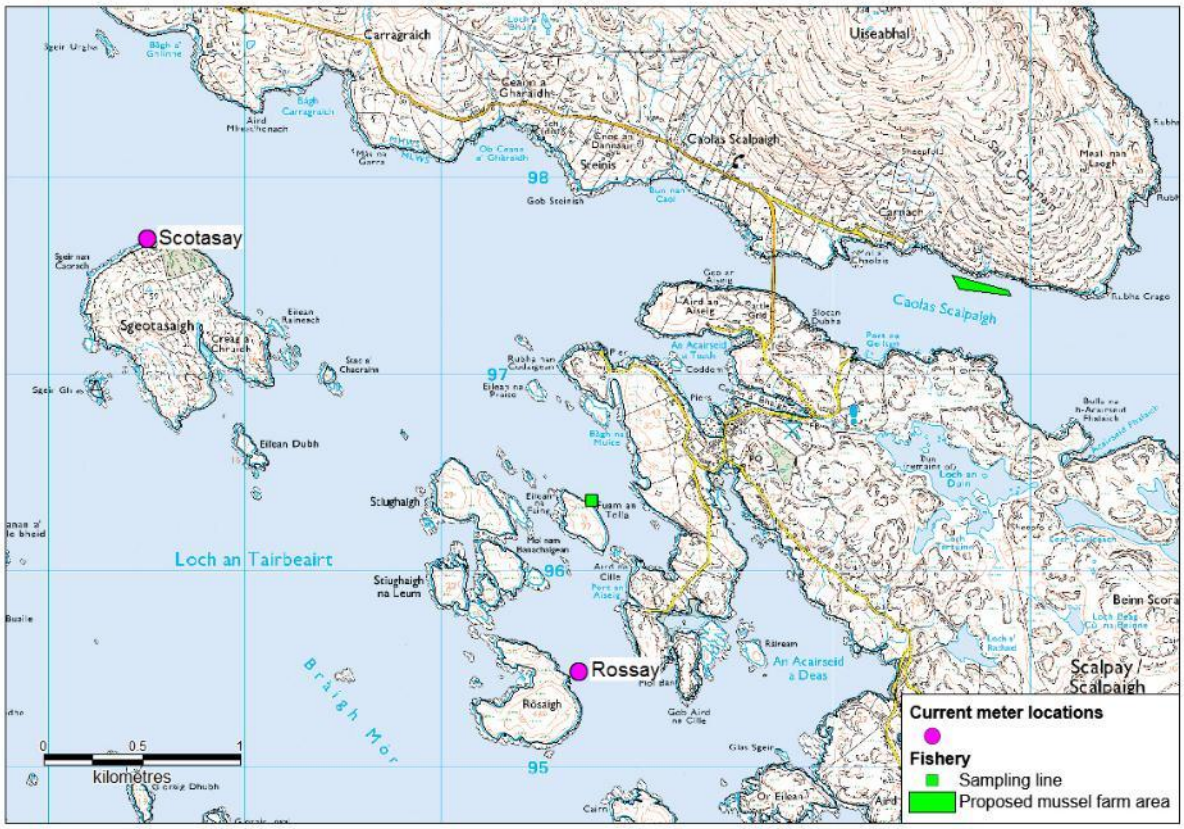


Figure 14.1. Location of current meters in East Loch Tarbert

Summary data from the current meter deployments are shown in Table 14.1.

Table 14.1 Summary of current meter deployment data – East Loch Tarbert

Site	NGR	Mean current speed (m/s)			Vector-averaged residual	
		Sub-surface	Mid-depth	Near bottom	Speed (m/s)	Direction (deg)
Scotasay	NG 1850 9770	0.063	0.049	0.056	0.011	314
Rossay	NG 2070 9550	0.062	0.051	0.063	0.009	347

Current direction was not available. Based on the mean current speeds (using a value of 0.06 m/s), the particle transport distance over a single phase of a tidal cycle (flood or ebb) would be expected to be approximately 0.8 km.

Using a vector- averaged residual speed of 0.01 m/s, the expected residual transport distance over a full flood/ebb tidal cycle would be approximately 0.4 km. This is relatively large compared to the transport distance over a single phase of the tidal cycle. Residual flow is towards the northwest at Scotasay and towards north-northwest at Rossay.

15. Shoreline Survey Overview

The East Loch Tarbert shoreline survey was conducted on the 30th and 31st July 2014. No rainfall was recorded in the 48 hours preceding the survey. Brief and intermittent showers fell on the first survey day, whilst the second day was dry. Temperature varied between 22 and 16ºC, with wind changing from a westerly to a north-westerly and increasing from 19.4 to 22 knots. The areas surveyed were the north shore of the Sound of Scalpay from Ceann a Charaidh to Caolas Sgalpaigh and along the shore at Carnach, and along the north shore of Scalpay, including the north harbour.

No active mussel farms were present at the time of survey. The main production site was previously located in the Sound of Scalpay, however due to a conflict over the use of the seabed there, the lines were removed in May 2014. The havester is currently awaiting permission to replace the farm on a proposed site slightly to the east of the previous farm, which he demonstrated to the survey team. The farm would consist of 6 longlines with 8-10 m droppers. A second seabed lease on the west side of the island was trialled by the harvester, but conditions were found to be unsuitable. A single stocked dropper used for sampling purposes is in place on this site.

Human population was centred at Scalpay, where just fewer than 40 residential houses, a cafe/gift shop, a salmon farm net washing station and East Loch Tarbert Salmon Farms shore base were observed. Several houses were observed on land adjacent to the fishery. A Scottish Water facility was also observed at Carragraich Only one sewage outfall pipe was observed on the north side of the Sound of Scalpay. The remaining sewage observations were made on the west side of Scalpay. Many of the observed private discharges appeared disused. Two discharge pipes were observed to have recently overflowed, with toilet paper on the grass below both pipes. A flowing discharge pipe was also observed and it returned a freshwater sample result of >10000000 *E. coli* cfu/100 ml. A ST was observed below the cafe/gift shop, but it was unclear whether it was in use as the outfall pipe was buried. No pipes were observed at the other commercial premises.

Scalpay harbour contained a pier, where the harvester's boat, a small storage cargo ship and four small fishing boats were moored. Five leisure boats were also stored onshore in the main harbour area. Six leisure boats were moored beside the old ferry slipway on the north side of the Sound of Scalpay.

Two salmon farm shore-bases were noted on Scalpay and to the west of the island an array of 16 circular salmon farm cages with an automatically operated feed barge were noted..

Most of the surrounding land was rough grazing, with bedrock present on the hillside along the north side of the Sound of Scalpay. Lightly grazed improved grassland was noted at Scalpay. Ten sheep were observed..

Six watercourses were sampled and measured, the majority of which were located along the north side of the sound. Sample results varied between 40 and >1000 *E. coli* cfu/100 ml, with the highest result from a sample taken from the freshwater draining out of Loch an Duin at Scalpay. All watercourses had very low flow at the time of the survey.

Only 12 oystercatchers and an otter were observed during the survey.

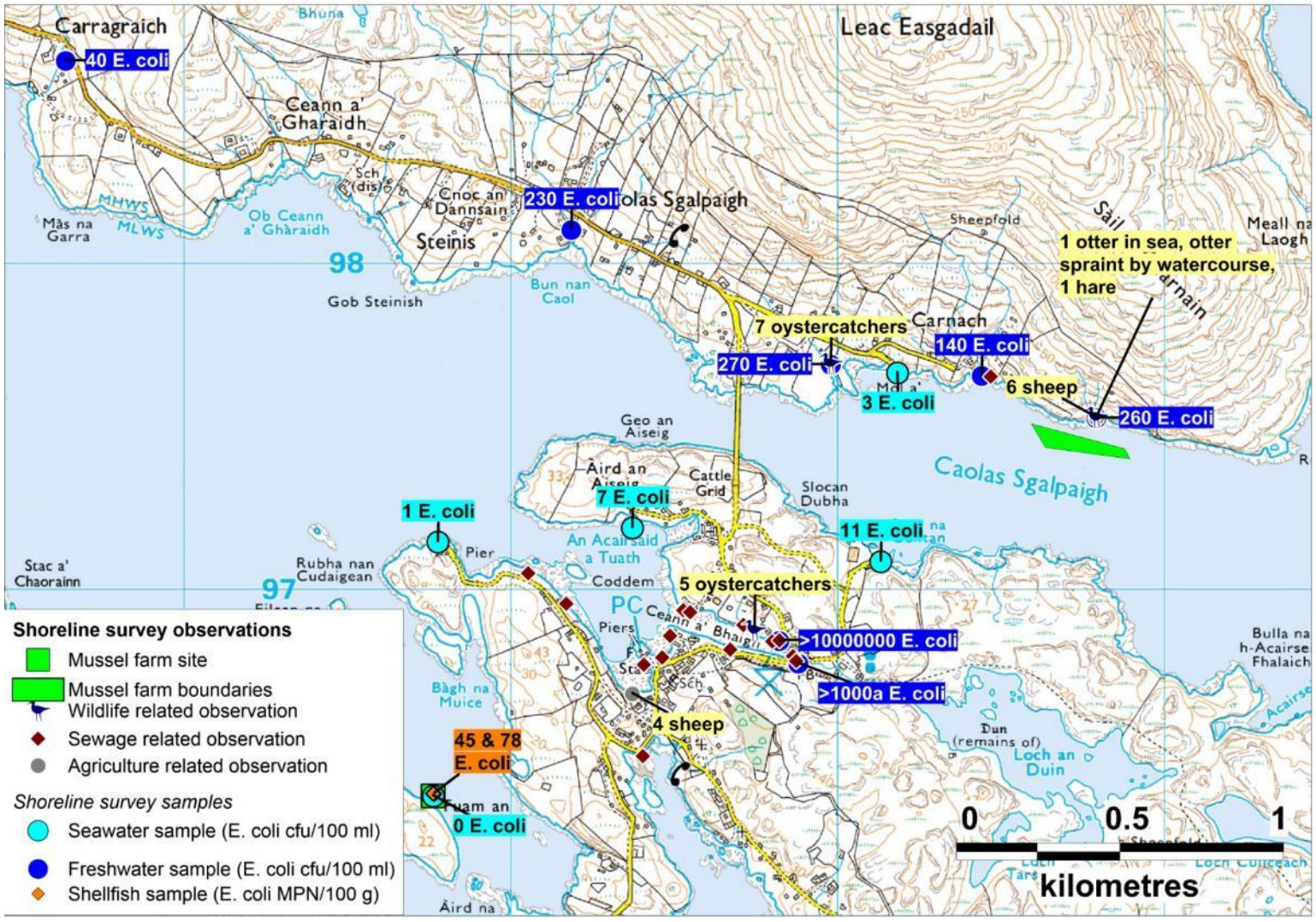


Figure 15.1 Summary of shoreline survey findings for East Loch Tarbert

16. Bacteriological Survey

Due to the absence of an active fishery, no bacteriological survey was undertaken at this production area.

17. Overall Assessment

Human sewage impacts

The main sources of human sewage to the area come from centres of population at the head of the loch (Tarbert), on the west side of Scalpay, and along the north shore of the Sound of Scalpay. The majority of dwellings are not connected to mains sewerage, and there are a very large number of septic tanks discharging to soakaway in the area. There are five private septic tank discharges to the Sound of Scalpay, within 2 km west of the proposed mussel farm. The closest of these is approximately 200 m northwest of the western end of the proposed farm. The nearest community discharge to the proposed farm is at Scalpay Harbour, approximately 2 km to the southwest. In addition, there are a large number of septic tanks discharging to soakaway along the north shore of the sound, west of the proposed farm. Any of these that are malfunctioning, or that have been rerouted to sea, would potentially result in additional loading of faecal contaminants to the western side of the mussel farm on an ebb tide.

There are fewer identified sewage discharges near the sampling line. The nearest are two private septic tank discharges approximately 600 m south of the line and the nearest of the community discharges at Scalpay Harbour is approximately 1.6 km north and east of the line. The extent to which these might impact the sampling line is dependent on tidal flows in the area.

Agricultural impacts

There is little in the way of agricultural land in the area, though nearly all the surveyed area was used as rough grazing for sheep. The sheep population on Harris is high, though it is not known what proportion of these are grazed around the shores of the production area. Few sheep were seen during the shoreline survey. There was insufficient spatial information on grazing patterns in the area on which to base an assessment of whether one part of the mussel farm, or the sampling line, might be more impacted than another.

Wildlife impacts

Little information was found on specific populations of wildlife species in the vicinity of the shellfishery. Some sea birds are likely to be present around the area generally, as are seals, otters and dolphins. Impacts from these animals are likely to be widely spread and unpredictable in terms of timing and proximity to the fishery. Deer (as well as other land mammals) are likely to contribute to faecal indicator concentrations found in watercourses throughout the area.

Seasonal variation

There is seasonal accommodation in the area, particularly on Scalpay and this is likely to result in a seasonal increase in contamination around the west side of the island. Seasonal usage of septic tanks with soakaways is likely to result in poor formation of the microbial mat that breaks down the sewage and therefore an increased risk of contamination of ground water and runoff when the tanks are used.

No statistically significant seasonal variation was found in *E. coli* results by season, however looking at the pattern of results by month, there appeared to be a marked two-season trend: low results were seen from January to May and higher results from June to December.

Rivers and streams

A limited number of watercourses were found in the area covered by the shoreline survey, and these were found to have low to moderate *E. coli* loadings, based on recorded flows and samples taken at the time of shoreline survey. The majority of these were observed along the north side of the sound, to the west of the proposed mussel farm. Two watercourses were seen on shore within close proximity to the proposed mussel farm area. Due to dry weather preceding and during the shoreline survey, the observed flows were low to very low. A watercourse directly north of the proposed area had too little flow to accurately measure, and a water sample taken from the outflow returned a result of 260 *E. coli* cfu/100 ml, suggesting low levels of faecal contamination at the time. Estimated loadings based on shoreline survey sampling from the other watercourses indicated low to moderate levels of faecal contamination. These would be expected to increase significantly under rainfall conditions.

Although the shoreline adjacent to the sampling line was not walked during the shoreline survey, it lies adjacent to small islands that have no identified watercourses noted on the OS 1:25000 maps.

The greatest predicted impact from diffuse pollution carried in watercourses is therefore to the western side of the proposed mussel farm area in the Sound of Scalpay. Impacts will be highest after rainfall.

Movement of contaminants

Current speeds in the Sound of Scalpay, where the mussel farm is to be located, are reported to be up to 0.5 m/s on the ebb, or from west to east. This would give a transport distance over 6 hours of up to 9 km. However, outside of the sound itself, current speeds are predicted to be substantially lower. Predicted transport distances based on fish-farm assessment data were less than 1 km. It is therefore likely that whilst larger point sources in and around Tarbert and Scalpay Harbour will contribute

to background levels of contamination found in the loch, sources closer to the proposed fishery will be more significant in terms of contamination.

Temporal and geographical patterns of sampling results

Sample results appeared to cluster into two geographic locations, both of which lay to the west of the proposed mussel line area identified by the harvester. No significant difference was found in results between these two locations. No samples were reported against the sampling line identified by the harvester at Tuam an Folla. It is therefore unclear as to the purpose of the sampling reported to be undertaken at that location.

An increase in *E. coli* results was observed in 2011, however at this time the area was withdrawn from a scheduled sanitary survey due to the absence of an active shellfishery. It is not clear what location was sampled during this time when there was no equipment on site.

Conclusions

The shellfishery at East Loch Tarbert is currently inactive, with the harvester's preferred mussel farm location currently unavailable due to a dispute over seabed leases. An alternative site at Fuam an Tolla was trialled by the harvester and found to be unviable.

Although there are community septic tanks on Scalpay and at the head of East Loch Tarbert. there are also a large number of active private septic tanks in and around the fishery area. These are expected to be the most significant sources of faecal contamination at the proposed fishery. Local sources of contamination differ between the two, as does the predicted transport of contaminants, therefore samples taken from the sample line are not considered to represent conditions at the proposed mussel farm in the Sound of Scalpay.

Sheep are kept in the area, but only small numbers of animals were seen. Any sheep kept along the sound or on smaller islands around the sampling line would be expected to contribute to diffuse contamination reaching the fishery. No correlation was found between rainfall and *E. coli* results, suggesting that diffuse contamination via freshwater runoff from streams is not a significant pathway for contamination at this area. No change in salinity with depth was seen in any of the CTD casts undertaken during the shoreline survey.

Seasonal changes in livestock and human populations are expected, however there was insufficient information to assess the extent of any changes.

18. Recommendations

Production area

It is recommended that the production area be curtailed to exclude Scalpay Harbour as well as parts of the north shore of the sound where sewage discharges were identified. As the Fuam an Tolla site was not found to be viable, it is recommended that this also be excluded from the production area. The boundary should be extended along its eastern side to incorporate the entire planned mussel farm area identified by the harvester. The recommended boundaries are as follows:

> The area bounded by lines drawn from NG 2170 9762 to NG 2170 9742 and from NG 2206 9760 to NG 2235 9762 and from NG 2300 9745 to NG 2300 9673 and extending to MHWS.

RMP

It is recommended that consideration be given to suspending sampling activities until such time as an active fishery has been re-established. The current sampling point, NG 2076 9637, is located approximately 80 m from the seabed lease at Fuam an Tolla, where there are fewer contaminating sources and no planned mussel farm.

The proposed mussel farm is located within the Sound of Scalpay, however it is not clear when permission might be granted for the harvester to re-establish the farm there. The recommended RMP, based on the site location provided by the harvester, is NG 2261 9750. This is at the northeast extent of the planned site. Bagged shellfish may be placed at this location if monitoring is to be continued. Bagged shellfish should be in situ for at least 2 weeks prior to sampling to ensure they are representative of conditions at the site. When growing equipment is installed on the site, the RMP should be placed on the northeast extent of the farm and the NGR for this location recorded using GPS.

Tolerance

A sampling tolerance of 40 metres is recommended, as a long-line farm is proposed. This will allow for some movement of the longlines.

Depth of sampling

Samples should be taken from a depth of 1-3 metres.

Frequency

Once sampling has commenced, a monthly monitoring frequency is recommended.

Figure 18.1 Map of recommendations at East Loch Tarbert

19. References

Bell, A. K., Elsaesser, B. & Whittaker, T. J. T., 2000. *Environmental impact of fast ferry wash..* London, Proc. Hydrodynamics of High Speed Craft - Wake Wash and motions Control RINA.

Bell, C. & Carlin, L., 1998. Generation of UK tidalstream atlases from regularly gridded hydrodynamic moddelled data.. *Journal of Navigation,* 51(1), pp. 73-78.

Brown, J., 1991. The final Voyage of Rapaiti:A measure of surface drift velocity in relation to the surface wind. *Marine Pollution Bulletin,* 22(1), pp. 37-40.

Burkhardt, W. et al., 2000. Inactivation of indicator microorganisms in estuarine waters. *Water Research,* 34(8), pp. 2207-2214.

Dickson, M., 2009. Loch Ryan- Scotland's native oyster sanctuary. *Fishfarmer Magazine*, 18 06, pp. 18-20.

Dumfries and Galloway Council, 2013. *Dumfries and Galloway Council : Harbours.* [Online]
Available at: http://www.dumgal.gov.uk/index.aspx?articleid=2474 [Accessed 12 02 2013].

Edwards, A. & Sharples, F., 1986. *Scottish Sea Lochs - a Catalogue.* Oban, Argyll: Scottish Marine Biological Association.

European Communities, 2006. *Directive 2006/113/EC of the European Parliment and of the Council of 12 December 2006 on the quality required of shellfish waters (codified version),* Brussels: Official Journal of the European Union.

Faber Maunsell, 2006. *Strategic Environmental Assessment of the Shetland Regional Transport Strategy,* s.l.: Shetland Islands Council.

Gillibrand, P. A., Inall, M. E., Portilla, E. & Tett, P., 2012. A box model of seasonal exchange and mixing in regions of restricted exchangeL application to two contrasting Scottish inlets.. *Undeer revision for Environmental Moddelling and Software..*

Hugh-Jones, T., 2011. *Loch Ryan oyster beds (Ostrea edulis) Scotland.* Stirling, Presentation to the 14th International Conference on Shellfish Restoration.

Kay, D. et al., 2008a. Faecal indicator organism concentrations and catchment export coefficients in the UK. *Water Research,* 42(10/11), pp. 2649-2661.

Kay, D. et al., 2008. Faecal indicator organism in concentration sewage and treated effluents. *Water Research,* 42(1/2), pp. 442-454.

Kruuk, H., Carss, D. N., Conroy, J. W. H. & Durbin, L., 1993. Otter (Lutra lutra) Numbers and fish productivity in two areas in North East Scotland. *Symposia if the Zoological Society of London,* Volume 65, pp. 171-191.

Lee, R. J. & Morgan, O. C., 2003. Envrionmental factors influencing the microbial contamination of commercially harvested shellfish.. *Water Science and Technology,* Issue 47, pp. 65-70.

Mallin, M. A. et al., 2001. Demographis, landscape and meterological factors controlling the microbial pollution of coastal waters. *Hydrobiologica,* Issue 460, pp. 185-193.

Mitchell, I. P., Newton, S. F., Ratcliffe, N. & Dunn, T. E., 2004. *Seabird populations of Britain and Ireland: results of the Seabird 2000 census (1998-2002),* London: T & A D Poyser.

NAFC Marine Centre, 2012. *Shetland Marine Spatial Plan.* [Online] Available at: http://www.nafc.ac.uk/ssmei.aspx [Accessed 10 10 2012].

Rural Housing Scotland, n.d.. http://ruralhousingscotland.org/home/oih/guide/island-social-housing/harris. Accessed 04/12/14.

Special Committee on Seals, 2011. *Scientific Advice on Matters Related to the Management of Seal Populations: 2011.* [Online] Available at: www.smru.st-andrews.ac.uk/documents/389.pdfShare [Accessed 12 02 2013].

Strachan, R., 2007. *National Survey of otter Lutra lutra distribution in Scotland 2003-04,* ROAME No. F03AC309: Scottish Natural Heritage Commissioned Report No 211.

Stranraer & The Rhins of Galloway Community & Tourist Information Site, 2008. *Scottish Wildlife in the Rhins of Galloway.* [Online] Available at: http://www.visitstranraerandtherhins.co.uk/wildlife.html [Accessed 12 02 2013].

University Marine Biological Station Milport, 2007. *Conservation of the Native Oyster (Ostrea edulis) in Scotland. Scottish Natural Heritage Commissioned Report No.251 (ROAME No. F02AA408).,* Perth: Scottish Natural Heritage.

20. List of Figures and Tables

Appendices

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1. General Information on Wildlife Impacts

Pinnipeds

Two species of pinniped (seals, sea lions, walruses) are commonly found around the coasts of Scotland: These are the European harbour, or common, seal (*Phoca vitulina vitulina*) and the grey seal (*Halichoerus grypus*). Both species can be found along the west coast of Scotland.

Common seal surveys are conducted every 5 years and an estimate of minimum numbers is available through Scottish Natural Heritage.

According to the Scottish Executive, in 2001 there were approximately 119,000 grey seals in Scottish waters, the majority of which were found in breeding colonies in Orkney and the Outer Hebrides.

Adult Grey seals weigh 150-220 kg and adult common seals 50-170 kg. They are estimated to consume between 4 and 8% of their body weight per day in fish, squid, molluscs and crustaceans. No estimates of the volume of seal faeces passed per day were available, though it is reasonable to assume that what is ingested and not assimilated in the gut must also pass. Assuming 6% of a median body weight for harbour seals of 110kg, that would equate to 6.6kg consumed per day and probably very nearly that defecated.

The concentration of *E. coli* and other faecal indicator bacteria contained in seal faeces has been reported as being similar to that found in raw sewage, with counts showing up to 1.21×10^4 CFU (colony forming units) *E. coli* per gram dry weight of faeces (Lisle *et al* 2004).

Both bacterial and viral pathogens affecting humans and livestock have been found in wild and captive seals. *Salmonella* and *Campylobacter* spp., some of which were antibiotic-resistant, were isolated from juvenile Northern elephant seals (*Mirounga angustirostris*) with *Salmonella* found in 36.9% of animals stranded on the California coast (Stoddard, et al., 2005) *Salmonella* and *Campylobacter* are both enteric pathogens that can cause acute illness in humans and it is postulated that the elephant seals were picking up resistant bacteria from exposure to human sewage waste.

One of the *Salmonella* species isolated from the elephant seals, *Salmonella typhimurium*, is carried by a number of animal species and has been isolated from cattle, pigs, sheep, poultry, ducks, geese and game birds in England and Wales. Serovar DT104, also associated with a wide variety of animal species, can cause severe disease in humans and is multi-drug resistant (Poppe, et al., 1998)

Cetaceans

As mammals, whales and dolphins would be expected to have resident populations of *E. coli* and other faecal indicator bacteria in the gut. Little is known about the concentration of indicator bacteria in whale or dolphin faeces, in large part because the animals are widely dispersed and sample collection difficult.

A variety of cetacean species are routinely observed around the west coast of Scotland. Where possible, information regarding recent sightings or surveys is gathered for the production area. As whales and dolphins are broadly free ranging, this is not usually possible to such fine detail. Most survey data is supplied by the Hebridean Whale and Dolphin Trust or the Shetland Sea Mammal Group and applies to very broad areas of the coastal seas.

It is reasonable to expect that whales would not routinely affect shellfisheries located in shallow coastal areas. It is more likely that dolphins and harbour porpoises would be found in or near fisheries due to their smaller physical size and the larger numbers of sightings near the coast.

Birds

Seabird populations were surveyed all over Britain as part of the SeaBird 2000 census. These counts are investigated using GIS to give the numbers observed within a 5 km radius of the production area. This gives a rough idea of how many birds may be present either on nests or feeding near the shellfish farm or bed.

Further information is gathered where available related to shorebird surveys at local bird reserves when present. Surveys of overwintering geese are queried to see whether significant populations may be resident in the area for part of the year. In many areas, at least some geese may be present year round. The most common species of goose observed during shoreline surveys has been the Greylag goose. Geese can be found grazing on grassy areas adjacent to the shoreline during the day and leave substantial faecal deposits. Geese and ducks can deposit large amounts of faeces in the water, on docks and on the shoreline.

A study conducted on both gulls and geese in the northeast United States found that Canada geese (*Branta canadiensis*) contributed approximately 1.28×10^5 faecal coliforms (FC) per faecal deposit and ring-billed gulls (*Larus delawarensis*) approximately 1.77×10^8 FC per faecal deposit to a local reservoir (Alderisio & DeLuca, 1999). An earlier study found that geese averaged from 5.23 to 18.79 defecations per hour while feeding, though it did not specify how many hours per day they typically (Gauthier & Bedard, 1986)

Waterfowl can be a significant source of pathogens as well as indicator organisms. Gulls frequently feed in human waste bins and it is likely that they carry some human pathogens.

Deer

Deer are present throughout much of Scotland in significant numbers. The Deer Commission of Scotland (DCS) conducts counts and undertakes culls of deer in areas that have large deer populations.

Four species of deer are routinely recorded in Scotland, with Red deer (*Cervus elaphus*) being the most numerous, followed by Roe deer (*Capreolus capreolus*), Sika deer (*Cervus nippon*) and Fallow deer (*Dama dama*).

Accurate counts of populations are not available, though estimates of the total populations are >200,000 Roe deer, >350,000 Red deer, < 8,000 Fallow deer and an unknown number of Sika deer. Where Sika deer and Red deer populations overlap, the two species interbreed further complicating counts.

Deer will be present particularly in wooded areas where the habitat is best suited for them. Deer, like cattle and other ruminants, shed *E. coli*, *Salmonella* and other potentially pathogenic bacteria via their faeces.

Otters

The European otter (*Lutra lutra*) is present around Scotland with some areas hosting populations of international significance. Coastal otters tend to be more active during the day, feeding on bottom-dwelling fish and crustaceans among the seaweed found on rocky inshore areas. An otter will occupy a home range extending along 4-5km of coastline, though these ranges may sometimes overlap (Scottish National Heritage, n.d.). Otters primarily forage within the 10 m depth contour and feed on a variety of fish, crustaceans and shellfish (Paul Harvey, Shetland Sea Mammal Group, personal communication).

Otters leave faeces (also known as spraint) along the shoreline or along streams, which may be washed into the water during periods of rain.

References

Alderisio, K. A. & DeLuca, N., 1999. Seasonal enumeration of fecal coliform bacretia from the feces of ring-billed gulls (Larus delawerensis) and Canada geese (Branta canadensis). *Applied and Environmental Microbiology,* 65(12), pp. 5628-5630.

Gauthier, G. & Bedard, J., 1986. Assessment of faecal output in geese. *Journal of Applied Ecology,* 23(1), pp. 77-90.

Lisle, J. T., Smith, J. J., Edwards, D. D. & McFeters, G. A., 2004. Occurence of microbial indicators and Clostridium perfringens in wastewater, water coloum samples, sediments, drinking water and weddel seal faeces collected at McMurdo Station, Antarctica. *Applied and Environmental Microbiology,* 70(12), pp. 7269-7276.

Poppe, C. et al., 1998. Salmonella typhimurium DT104: a virulent and drug-resistant pathogen. *The Canadian Veterinary Journal,* 39(9), pp. 559-565.

Scottish National Heritage, n.d. *Otters and Development.* [Online] Available at: http://www.snh.org.uk/publications/on-line/wildlife/otters/biology.asp [Accessed 10 10 2012].

Stoddard, R. A. et al., 2005. Salmonella and Campylobacter spp. in Northern Elephant Seals, California. *Emerging Infections Diseases,* 11(12), pp. 1967-1969.

2. Tables of Typical Faecal Bacteria Concentrations

Summary of faecal coliform concentrations (cfu $100ml^{-1}$) for different treatment levels and individual types of sewage-related effluents under different flow conditions: geometric means (GMs), 95% confidence intervals (CIs), and results of t-tests comparing base- and high-flow GMs for each group and type.

Indicator organism	**Base-flow conditions**				**High-flow conditions**			
Treatment levels and specific types: Faecal coliforms	*n*[c]	Geometric mean	Lower 95% CI	Upper 95% CI	*n*[c]	Geometric mean	Lower 95% CI	Upper 95% CI
Untreated	252	1.7×10^{7} * (+)	1.4×10^{7}	2.0×10^{7}	282	2.8×10^{6} * (-)	2.3×10^{6}	3.2×10^{6}
Crude sewage discharges	252	1.7×10^{7} * (+)	1.4×10^{7}	2.0×10^{7}	79	3.5×10^{6} * (-)	2.6×10^{6}	4.7×10^{6}
Storm sewage overflows					203	2.5×10^{6}	2.0×10^{6}	2.9×10^{6}
Primary	127	1.0×10^{7} * (+)	8.4×10^{6}	1.3×10^{7}	14	4.6×10^{6} (-)	2.1×10^{6}	1.0×10^{7}
Primary settled sewage	60	1.8×10^{7}	1.4×10^{7}	2.1×10^{7}	8	5.7×10^{6}		
Stored settled sewage	25	5.6×10^{6}	3.2×10^{6}	9.7×10^{6}	1	8.0×10^{5}		
Settled septic tank	42	7.2×10^{6}	4.4×10^{6}	1.1×10^{7}	5	4.8×10^{6}		
Secondary	864	3.3×10^{5} * (-)	2.9×10^{5}	3.7×10^{5}	184	5.0×10^{5} * (+)	3.7×10^{5}	6.8×10^{5}
Trickling filter	477	4.3×10^{5}	3.6×10^{5}	5.0×10^{5}	76	5.5×10^{5}	3.8×10^{5}	8.0×10^{5}
Activated sludge	261	2.8×10^{5} * (-)	2.2×10^{5}	3.5×10^{5}	93	5.1×10^{5} * (+)	3.1×10^{5}	8.5×10^{5}
Oxidation ditch	35	2.0×10^{5}	1.1×10^{5}	3.7×10^{5}	5	5.6×10^{5}		
Trickling/sand filter	11	2.1×10^{5}	9.0×10^{4}	6.0×10^{5}	8	1.3×10^{5}		
Rotating biological contactor	80	1.6×10^{5}	1.1×10^{5}	2.3×10^{5}	2	6.7×10^{5}		
Tertiary	179	1.3×10^{3}	7.5×10^{2}	2.2×10^{3}	8	9.1×10^{2}		
Reed bed/grass plot	71	1.3×10^{4}	5.4×10^{3}	3.4×10^{4}	2	1.5×10^{4}		
Ultraviolet disinfection	108	2.8×10^{2}	1.7×10^{2}	4.4×10^{2}	6	3.6×10^{2}		

Source: (Kay, et al., 2008b)

Table 3 – Geometric mean (GM) and 95% confidence intervals (CIs) of the GM faecal indicator organism (FIO) concentrations (cfu/100ml) under base- and high-flow conditions at the 205 sampling points and for various subsets, and results of paired t-tests to establish whether there are significant elevations at high flow compared with base flow

FIO	*n*	**Base Flow**			**High Flow**		
Subcatchment land use		Geometric mean	Lower 95% CI	Upper 95% CI	Geometric mean[a]	Lower 95% CI	Upper 95% CI
Total coliforms							
All subcatchments	205	5.8×10^{3}	4.5×10^{3}	7.4×10^{3}	7.3×10^{4}**	5.9×10^{4}	9.1×10^{4}
Degree of urbanisation							
Urban	20	3.0×10^{4}	1.4×10^{4}	6.4×10^{4}	3.2×10^{5}**	1.7×10^{5}	5.9×10^{5}
Semi-urban	60	1.6×10^{4}	1.1×10^{4}	2.2×10^{4}	1.4×10^{5}**	1.0×10^{5}	2.0×10^{5}
Rural	125	2.8×10^{3}	2.1×10^{3}	3.7×10^{3}	4.2×10^{4}**	3.2×10^{4}	5.4×10^{4}
Rural subcatchments with different dominant land uses							
≥75% Imp pasture	15	6.6×10^{3}	3.7×10^{3}	1.2×10^{4}	1.3×10^{5}**	1.0×10^{5}	1.7×10^{5}
≥75% Rough Grazing	13	1.0×10^{3}	4.8×10^{2}	2.1×10^{3}	1.8×10^{4}**	1.1×10^{4}	3.1×10^{4}
≥75% Woodland	6	5.8×10^{2}	2.2×10^{2}	1.5×10^{3}	6.3×10^{3}*	4.0×10^{3}	9.9×10^{3}
Faecal coliform							
All subcatchments	205	1.8×10^{3}	1.4×10^{3}	2.3×10^{3}	2.8×10^{4}**	2.2×10^{4}	3.4×10^{4}
Degree of urbanisation							
Urban	20	9.7×10^{3}	4.6×10^{3}	2.0×10^{4}	1.0×10^{5}**	5.3×10^{4}	2.0×10^{5}
Semi-urban	60	4.4×10^{3}	3.2×10^{3}	6.1×10^{3}	4.5×10^{4}**	3.2×10^{4}	6.3×10^{4}
Rural	125	8.7×10^{2}	6.3×10^{2}	1.2×10^{3}	1.8×10^{4}**	1.3×10^{4}	2.3×10^{4}
Rural subcatchments with different dominant land uses							
≥75% Imp pasture	15	1.9×10^{3}	1.1×10^{3}	3.2×10^{3}	5.7×10^{4}**	4.1×10^{4}	7.9×10^{4}
≥75% Rough Grazing	13	3.6×10^{2}	1.6×10^{2}	7.8×10^{2}	8.6×10^{3}**	5.0×10^{3}	1.5×10^{4}
≥75% Woodland	6	3.7×10	1.2×10	1.2×10^{2}	1.5×10^{3}**	6.3×10^{2}	3.4×10^{3}
Enterococci							
All subcatchments	205	2.7×10^{2}	2.2×10^{2}	3.3×10^{2}	5.5×10^{3}**	4.4×10^{3}	6.8×10^{3}
Degree of urbanisation							
Urban	20	1.4×10^{3}	9.1×10^{2}	2.1×10^{3}	2.1×10^{4}**	1.3×10^{4}	3.3×10^{4}
Semi-urban	60	5.5×10^{2}	4.1×10^{2}	7.3×10^{2}	1.0×10^{4}**	7.6×10^{3}	1.4×10^{4}
Rural	125	1.5×10^{2}	1.1×10^{2}	1.9×10^{2}	3.3×10^{3}**	2.4×10^{3}	4.3×10^{3}
Rural subcatchments with different dominant land uses							
≥75% Imp. pasture	15	2.2×10^{2}	1.4×10^{2}	3.5×10^{2}	1.0×10^{4}**	7.9×10^{3}	1.4×10^{4}
≥75% Rough Grazing	13	4.7×10	1.7×10	1.3×10^{2}	1.2×10^{3}**	5.8×10^{2}	2.7×10^{3}
≥75% Woodland	6	1.6×10	7.4	3.5×10	1.7×10^{2}**	5.5×10	5.2×10^{2}
[a] Significant elevations in concentrations at high flow are indicated: **po0.001, *po0.05.							
[b] Degree of urbanisation categorised according to percentage built-up land: 'Urban' (X10.0%), 'Semi-urban' (2.5–9.9%) and 'Rural' (o2.5%).							

Source: (Kay, et al., 2008a)

Table 4 - Comparison of faecal indicator concentrations (average numbers/g wet weight) excreted in the faeces of warm-blooded animals

Animal	Faecal coliforms (FC) number	Excretion (g/day)	FC Load (numbers/day)
Chicken	1,300,000	182	2.3×10^8
Cow	230,000	23,600	5.4×10^9
Duck	33,000,000	336	1.1×10^{10}
Horse	12,600	20,000	2.5×10^8
Pig	3,300,000	2,700	8.9×10^8
Sheep	16,000,000	1,130	1.8×10^{10}
Turkey	290,000	448	1.3×10^8
Human	13,000,000	150	1.9×10^9

Source: (Gauthier & Bedard, 1986)

References

Gauthier, G. & Bedard, J., 1986. Assessment of faecal output in geese. *Journal of Applied Ecology,* 23(1), pp. 77-90.

Kay, D. et al., 2008a. Faecal indicator organism concentrations and catchment export coefficients in the UK. *Water Research,* 42(10/11), pp. 2649-2661.

Kay, D. et al., 2008b. Faecal indicator organism in concentration sewage and treated effluents. *Water Research,* 42(1/2), pp. 442-454.

3. Statistical Data

One-way ANOVA: logec versus Season

Method

Null hypothesis	All means are equal
Alternative hypothesis	At least one mean is different
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Season	4	1, 2, 3, 4

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Season	3	3.509	1.1696	2.09	0.112
Error	55	30.721	0.5586		
Total	58	34.229			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.747367	10.25%	5.36%	0.00%

Means

Season	N	Mean	StDev	95% CI
1	16	1.242	0.504	(0.868, 1.617)
2	15	1.888	0.757	(1.501, 2.274)
3	13	1.728	0.656	(1.312, 2.143)
4	15	1.579	0.990	(1.192, 1.965)

Pooled StDev = 0.747367

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Season	N	Mean	Grouping
2	15	1.888	A
3	13	1.728	A
4	15	1.579	A
1	16	1.242	A

Means that do not share a letter are significantly different.

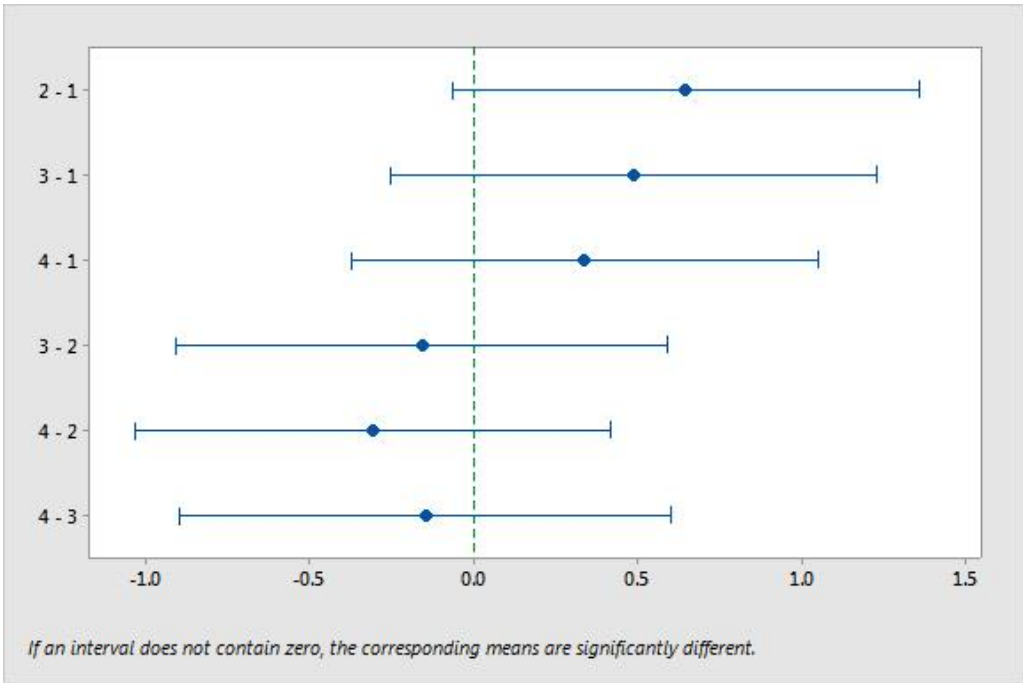

Figure 1 Tukey pairwise comparison test between sampling results and season

4. Hydrographic Assessment Glossary

The following technical terms may appear in the hydrographic assessment.

Bathymetry. The underwater topography given as depths relative to some fixed reference level e.g. mean sea level.

Hydrography. Study of the movement of water in navigable waters e.g. along coasts, rivers, lochs, estuaries.

MHW. Mean High Water, The highest level that tides reach on average.

MHWN. Mean High Water Neap, The highest level that tides reach on average during neap tides.

MHWS. Mean High Water Spring, The highest level that tides reach on average during spring tides

MLW. Mean Low Water, The lowest level that tides reach on average.

MLWN. Mean Low Water Neap, The lowest level that tides reach on average during neap tides.

MLWS. Mean Low Water Spring, The lowest level that tides reach on average during spring tides.

Tidal period. The dominant tide around the UK is the twice daily one generated by the moon. It has a period of 12.42 hours. For near shore so-called rectilinear tidal currents then roughly speaking water will flow one way for 6.2 hours then back the other way for 6.2 hours.

Tidal range. The difference in height between low and high water. Will change over a month.

Tidal excursion. The distance travelled by a particle over one half of a tidal cycle (roughly~6.2 hours). Over the other half of the tidal cycle the particle will move in the opposite direction leading to a small net movement related to the tidal residual. The excursion will be largest at Spring tides.

Tidal residual. For the purposes of these documents it is taken to be the tidal current averaged over a complete tidal cycle. Very roughly it gives an idea of the general speed and direction of travel due to tides for a particle over a period of several days.

Tidal prism. The volume of water brought into an estuary or sea loch during half a tidal cycle. Equal to the difference in estuary/sea loch volume at high and low water.

Spring/Neap Tides. Spring tides occur during or just after new moon and full moon when the tide-generating force of the sun acts in the same direction as that of the moon, reinforcing it. The tidal range is greatest and tidal currents strongest during spring tides.

Neap tides occur during the first or last quarter of the moon when the tide-generating forces of the sun and moon oppose each other. The tidal range is smallest and tidal currents are weakest during neap tides.

Tidal diamonds. The tidal velocities measured and printed on admiralty charts at specific locations are called tidal diamonds.

Wind driven shear/surface layer. The top metre or so of the surface that generally moves in the rough direction of the wind typically at a speed that is a few percent (~3%) of the wind speed.

Return flow. A surface flow at the surface may be accompanied by a compensating flow in the opposite direction at the bed.

Stratification. The splitting of the water into two layers of different density with the less dense layer on top of the denser one. Due to either temperature or salinity differences or a combination of both.

5. Shoreline Survey Report

Shoreline Survey Report

Report Title	East Loch Tarbert, Harris, Shoreline Survey Report
Project Name	Shellfish Sanitary Surveys
Client/Customer	Cefas
SRSL Project Reference	00561_B0067

Document Number	B0067_Shoreline 0035

Revision History

Revision	Changes	Date
A	Draft issue for internal review	12/08/2014
B	Second draft issue for internal review	18/08/2014
01	First formal issue to Cefas	19/08/2014
02	Second issue to client incorporating corrections from Issue01	01/09/2014
03	Third issue to client	03/09/2014

	Name & Position	Date
Author	Alison Clarke, Peter Lamont	12/08/2014
Checked	Andrea Veszelovszki	03/09/2014
Approved	Mark Hart	03/09/2014

SRSL, Scottish Marine Institute, Oban, Argyll, PA37 1QA, tel 01631 559 470, www.samsrsl.co.uk

Production area:	East Loch Tarbert
Site name:	East Loch Tarbert
SIN:	UB-259-162-04
Species:	Common mussels
Harvester:	Alasdair Cunningham
Local Authority:	Comhairle nan Eilean: Lewis & Harris
Status:	Existing area
Date Surveyed:	30th – 31st July 2014
Surveyed by:	Peter Lamont, Alison Clarke
Existing RMP:	NG 2240 9758
Area Surveyed:	30/07/2014; From the harvesters pontoon to the Marine Harvest, East Loch Tarbert salmon farm, shore base at Cuddy Point. 31/07/2014; From 300 meters east of the Kyles Scalpay road end to Carragraich, 2.3 km west of Scalpay Bridge.

Weather

The team were informed by sampling officer, Mr Paul Tyler that the previous week in the Outer Hebrides had been exceptionally warm and dry with temperatures up to 27 degrees. Several watercourses sampled during the survey were very low and some with almost no flow.

Wednesday 30th July 2014 – Mild with brief intermittent showers, 100% cloud cover, Westerly wind 19.4 knots, temp 22.4°C

Thursday 31st July 2014 – Dry and mild, 90% cloud cover, NW wind 22 knots, temp 16°C.

Stakeholder engagement during the survey

Both the harvester and the Sampling Officer were very helpful during the planning.

The team met with both the Sampling Officer Mr Paul Tyler and the harvester Mr Alasdair Cunningham at the harvester's home on Scalpay on the morning of Thursday 30th July. The harvester conveyed the team in his boat to the site of the mussel cultivation in the Sound of Scalpay and also to a new site being applied for on the west side of Scalpay.

Fishery

Common mussels (*Mytilus edulis*) are cultivated within the East Loch Tarbert fishery. Mussel spat are collected on lines in Loch Seaforth, the next sealoch adjacent to the north and the lines towed to the Sound of Scalpay for on-growing.

At the time of the survey all mussel lines in the Sound of Scalpay had been taken up and removed by the harvester in May 2014. This was due to a conflict of interests over the site. The power company SSE laid the cable, delivering 3 phase power to Net Services Shetland Ltd on the south side of the Sound, after the harvester had set up his site. The harvester is awaiting the Crown Estates decision on the future of the site. The team were informed that the lines were ready and waiting to be moved back to the Sound of Scalpay once the dispute was resolved.

Normally the Sound of Scalpay site would consist of six mussel lines with droppers of 8 to 10 metres in length. Since the lines were absent at the time of the survey, the boat was positioned by the harvester at each corner in sequence of the desired site so that the team could take seawater, CTD samples and GPS positions.

The harvester had also been testing a site he applied for on the west side of Scalpay to the east of the island of Fuam an Tolla, but this was proving to be too exposed and mussels were slipping off the lines. One mooring with a single dropper was on this site in order to provide samples for regular testing by the sampling officer and the team also acquired the shellfish samples from this location (Figs. 3&4).

The harvester has found from experience to date that local mussel growth is best in the Sound of Scalpay.

Sewage Sources

The north side of the Sound of Scalpay is served by a single track road and has a small number (<40) of well separated properties most of which appeared to the team to be permanently occupied.

On the island of Scalpay there is a concentration of housing around the harbour area covered by the designated shore walk (Fig. 12). Elsewhere on Scalpay dwellings tend to be well separated. The team observed commercial premises at each of two road ends on Scalpay (waypoints 30 and 33) and in the harbour area near the school, where there is a community café and gift shop run as a charity (waypoint 40). The team did not visit the café but did observe a septic tank below the premises but were unable to confirm if it was disconnected or currently in use as the outfall pipe was buried.

The commercial premises consist of a former shellfish processing factory on the north side of the island at the old ferry slip (waypoint 30, NG 22133 97088). This is now in use as a net washing station for salmon farm nets. The team did not observe any outfall pipes in the vicinity. The team observed about four staff working there on the day of the visit.

The other commercial premises are at the road end to the west of the harbour area (waypoints 32 and 33) and consist of the East Loch Tarbert Salmon Farms Cuddy Point Base with a large metal shed, fenced hard standing area, a slipway and a nearby pontoon for workboats. The team did not observe any outfall pipe from this facility.

On Scalpay the team encountered many septic tanks and outfall pipes together with three Scottish Water communal septic tanks in two of which running water could be heard (waypoints 38, 41 and 44). The Scottish Water installations appear to be new while many of the outfall pipes appeared disused (examples in Figs. 6&10). It would appear that many of the dwellings have been connected to the communal tanks but that the old private tanks have not been dismantled.

The first is on the south side of a pier (Fig. 11, waypoint 38, NG 21488 96859). A second is on the south side of the fire station (waypoint 41, NG 21408 96771). The third was away from the designated shorewalk (waypoint 44, NG 21404 96491) and encountered by the team while in transit by road.

Some Scalpay private septic tank discharges were found to be active. Effluent discharging from one 50 mm plastic pipe was found to be highly contaminated with an *E. coli* level of >1x 10^7 cfu/100 ml (Fig. 7, waypoints 23 & 24, Table 2). The team could not establish the origin of this pipe because it emerged from a steeply sloping, grassy bank.

Seasonal Population

No caravan parks, campsites, hotels or obvious holiday accommodation were observed by the team on Scalpay or along the coast or road east and west of Scalpay Bridge to the limit of the survey. Almost all the properties observed by the team appeared to be occupied (vehicles parked outside or washing on lines etc.). The team had the impression that most properties were permanently occupied having either well-kept gardens, stores of wood or accumulated materials and redundant or surplus equipment. The survey did not include the occupied southern part of Scalpay.

Boats/Shipping

The harvester's boat was moored to a pontoon at the west end of the Scalpay shore walk on the north side of the main harbour bay area. The rusting hulk of a small cargo ship of about 30 m length was berthed at one part of the bay on the north side and appeared to be used for storage. There were four small fishing boats (of less than 10 m length) moored to the main pier in the harbour and five leisure boats of various types, including one yacht, were either moored or tied onshore in the main harbour area. A pontoon at the west end

of the Scalpay harbour area, belonging to the East Loch Tarbert Salmon Farms Cuddy Point Base, accommodated several work boats and what appeared to be a small fishing boat.

Only a few small leisure boats (less than about 6 m in length) were observed on the north side of Scalpay Sound. Five open leisure boats and a sixth with a cuddy were moored beside the old Scalpay ferry slipway (Fig. 15). A property opposite the mussel array site at Carnach had some small boats onshore and one boat was tied at the high shore at a small harbour near Mol a Chaolais (waypoint 59, NG 21979 97693).

To the west of the survey area at the time of the survey was an array of sixteen circular salmon farm cages with a feed barge in the middle. The team were informed that the feed barge was unmanned and operated automatically. One small cargo vessel was observed sailing eastwards through the Sound of Scalpay on the second day of the survey.

Farming and Livestock

The only cattle grid in the surveyed area is at the south side of Scalpay Bridge. No cattle were seen by the team, and only a few sheep mentioned in the observations in Table 1 were observed (four on Scalpay and six on Harris).

Almost all the land is used for rough grazing and upland hillside with a significant amount of bedrock especially on the north side of the Sound of Scalpay. On Scalpay the land around the surveyed shore consisted of better grassland that appeared only lightly grazed.

Land Use

The team observed only two industrial premises and both were on Scalpay, servicing the salmon farm industry. One is a former shellfish processing factory on the north shore of Scalpay by the old Scalpay ferry slipway and is currently used for washing salmon farm nets (nets can be seen in Fig.9). The second is situated at a slipway on the road end at the west of Scalpay with an associated pontoon for mooring workboats. Scottish Water has a significant facility in the form of a large metal shed at Carragraich the function of which was not clear.

Land Cover

Trees and scrub were present only where grazing was prevented usually in private property. All land elsewhere consisted of rough grazing, bedrock or naturally occurring grassland around the Scalpay shore surveyed. On Scalpay scrub and trees along the survey route were only present in a small patch that

had been adopted as community woodland according to a notice beside the road above the south side of Ceann a Bhaigh. Elsewhere scrub and small trees were seen in private garden grounds. Sometimes such vegetation cover was dense and prevented the team from detecting the presence of any drainage.

Watercourses

All watercourses observed by the team were very low at the time of the survey. The previous week had been exceptionally dry and hot (27 degrees according to local sources). The single planned sample on Scalpay (waypoint 28 & 29, NG 21881 96775) was from a watercourse draining from Loch an Duin, a substantial loch. This was the only natural watercourse observed during the shore survey on Scalpay.

Two of the three watercourses east of Scalpay Bridge designated for sampling were almost stagnant with hardly any flow while the middle watercourse at Carnach (waypoint 53 & 54) constituted a small stream. The easternmost burn sampled could be measured because the soft vegetation at its outflow to the sea made it possible to stop all flow with a measuring jug (waypoint 50). It was not possible to measure flow at Mol a Chaolais (waypoint 58) where the watercourse constituted a series of pools with a trickle flow over the solid, hard substratum in between. On the west side of the bridge the team were unable to take the planned sample from the designated watercourse at Ceann a Gharaidh because the watercourse was not found but did take an unplanned sample from a small watercourse at Carragraich (Fig. 18, waypoint 62 & 63). A Scottish Water premises lies upstream above the road and two dwellings lying within 50 m of the west of the watercourse are upstream of the point sampled. The nearest property has a septic tank within 20 m of the watercourse. The team did not observe any pipes discharging into this watercourse. No other obvious watercourses were apparent to the survey team along the two Harris shore walk sections and the dry and exceptionally hot weather conditions prior to the survey should be noted.

Wildlife/Birds

East of Scalpay Bridge, at the extreme of the shore survey section, one hare and one otter were seen by the team. The otter was swimming in the sea some distance from the shore and a suspected otter spraint was observed beside the watercourse sampled (Fig. 13, waypoint 50).

Very few seabirds were seen throughout the survey. Seven oystercatchers were observed in a group at Mol a Chaolis east of Scalpay Bridge.

Specific observations made during the survey are mapped in Figure 1 and listed in Table 1. Water and shellfish samples were collected at the locations marked on Figure 2. Bacteriology results are given in Tables 2 and 3. Photographs are presented in Figures 3-18.

Shoreline maps

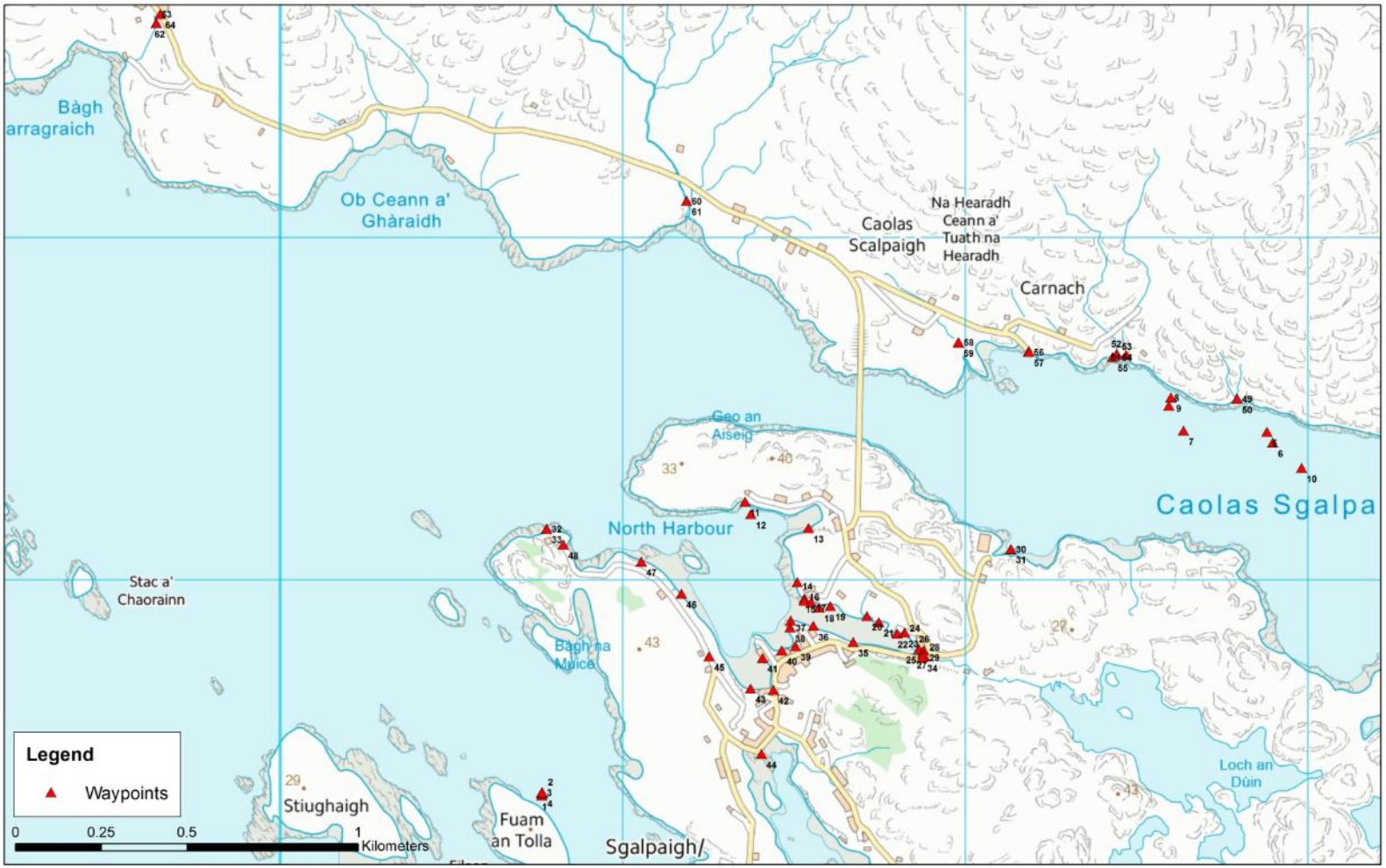

Figure 1. East Loch Tarbert, Harris, waypoints

Figure 2. East Loch Tarbert, Harris, samples

Table 1 Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
1	30/07/2014	10:15	NG 20763 96369	120763	896369	Fig. 3	ELTSW1	Site of single mussel line east of Fuam an Tolla, Scalpay.
2	30/07/2014	10:30	NG 20766 96376	120766	896377		ELTSF1	Planned shellfish sample - mussels from surface.
3	30/07/2014	10:37	NG 20763 96377	120763	896378	Fig. 4	ELTSF2	Planned shellfish sample - mussels from 2 m depth.
4	30/07/2014	10:49	NG 20764 96378	120765	896379		CTD1	CTD cast 1.
5	30/07/2014	11:16	NG 22880 97431	122880	897432			NE corner of planned/desired array Caolas Sgalpaigh (Sound of Scalpay).
6	30/07/2014	11:18	NG 22897 97400	122897	897401			SE corner of planned/desired array Caolas Sgalpaigh (Sound of Scalpay).
7	30/07/2014	11:20	NG 22637 97435	122637	897436			SW corner of planned/desired array Caolas Sgalpaigh (Sound of Scalpay).
8	30/07/2014	11:21	NG 22594 97507	122595	897508	Fig. 5		NW corner of planned/desired array Caolas Sgalpaigh (Sound of Scalpay).
9	30/07/2014	11:24	NG 22600 97532	122600	897532		CTD2	CTD cast 7.85 m recorded
10	30/07/2014	11:34	NG 22981 97326	122982	897327		CTD3	CTD cast 3.
11	30/07/2014	12:42	NG 21356 97227	121357	897228			Start of shoreline walk, Scalpay.
12	30/07/2014	12:48	NG 21373 97191	121374	897191		ELTSW2	Seawater sample taken from end of pontoon using pole.
13	30/07/2014	12:59	NG 21542 97151	121542	897151			No visible pipes from properties overlooking shore and harbour.
14	30/07/2014	13:06	NG 21509 96992	121509	896993			Photos taken looking towards Scalpay harbour.
15	30/07/2014	13:08	NG 21530 96945	121531	896946			Standard plastic 100 mm soil pipe outfall on beach encased in old concrete. No flow.
16	30/07/2014	13:10	NG 21529 96939	121529	896939			Metal outfall pipe 150 mm diameter, barnacles growing in end. No flow observed.
17	30/07/2014	13:11	NG 21549 96933	121550	896933			Standard plastic 100 mm soil pipe outfall. No flow.
18	30/07/2014	13:14	NG 21573 96919	121573	896919			Beach covered in metal scrap and concrete debris.
19	30/07/2014	13:16	NG 21606 96923	121606	896923			Rusting remains of vehicle.
20	30/07/2014	13:23	NG 21713 96893	121713	896894			Disused septic tank with 150 mm ceramic outfall pipe, no flow.
21	30/07/2014	13:26	NG 21747 96876	121747	896876	Fig. 6		Outfall pipe, 150 mm metal, broken, disused. Five oystercatchers in bay.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
22	30/07/2014	13:32	NG 21800 96842	121801	896843			Septic tank outfall in use discharging onto beach.
23	30/07/2014	13:38	NG 21822 96844	121823	896845		ELTFW1	Unplanned freshwater sample - contaminated. Sample associated with observations at waypoint 24.
24	30/07/2014	13:38	NG 21823 96845	121823	896846	Fig. 7		Black 'Alkathene' plastic, 50 mm diameter PVC pipe emerging from grass with flow smelling strongly. Flow rate 0.6 L/min (20 ml in 2 sec).
25	30/07/2014	13:42	NG 21864 96797	121865	896798			Painted septic tank with outfall onto beach. Possibly in use but no flow at time of survey.
26	30/07/2014	13:46	NG 21878 96794	121879	896794			Four pipes emerging from walling. No flow from any. Three of 50 mm diameter plastic and the fourth of 150 mm diameter metal. Possible land drainage from paved areas of dwellings above.
27	30/07/2014	13:46	NG 21875 96783	121875	896783	Fig. 8		Ceramic outfall pipe, 150 mm diameter encased in concrete. Stagnant but active. Toilet tissue debris on shore.
28	30/07/2014	13:54	NG 21881 96775	121881	896776		ELTFW2	Planned freshwater sample from burn.
29	30/07/2014	13:55	NG 21880 96777	121881	896778			Watercourse measurements associated with sample at waypoint 28. Flow 0.413 m/sec, SD 0.012, depth 6 cm, width 1.1 m.
30	30/07/2014	14:17	NG 22133 97088	122133	897088		ELTSW3	Planned seawater sample from industrial slipway beside the salmon farm net washing station, Scalpay north shore, opposite planned Sound of Scalpay mussel array.
31	30/07/2014	14:18	NG 22132 97089	122133	897090	Fig. 9		Photograph taken at the site of planned seawater sample associated with waypoint 30.
32	30/07/2014	14:34	NG 20777 97148	120778	897149		ELTSW4	Planned seawater sample from west end of survey shore, west of Scalpay harbour area.
33	30/07/2014	14:34	NG 20778 97149	120778	897149			Site of planned seawater sample, beside Marine Harvest facility East Loch Tarbert Salmon Farms Cuddy Point Base, associated with waypoint 32.
34	30/07/2014	14:48	NG 21874 96773	121874	896773			Resumption of Scalpay shore walk.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
35	30/07/2014	14:53	NG 21672 96817	121673	896818	Fig. 10		Septic tank, old, 100 mm plastic soil pipe connecting to ceramic on shore. Shore section pipe broken in several places and tank appears not to be in use.
36	30/07/2014	14:57	NG 21556 96864	121556	896865			Dwellings and other properties above shore. No outfall pipes observed.
37	30/07/2014	14:59	NG 21490 96880	121490	896880			Old stone pier east side of Scalpay Harbour. No outfall pipes observed.
38	30/07/2014	15:02	NG 21488 96859	121488	896860	Fig. 11		New communal septic tank on the west side of pier with inspection cover on shore below.
39	30/07/2014	15:05	NG 21504 96806	121504	896806			Two corrugated plastic field drain pipes in small bay between Scalpay Harbour piers.
40	30/07/2014	15:07	NG 21464 96793	121464	896794			Septic tank below café & shop. Outflow pipe buried and no pipe end observed from tank.
41	30/07/2014	15:16	NG 21408 96771	121408	896772			Communal septic tank on sea wall beside Scalpay Fire Station. Sound of running water and associated smell. Outfall not observed (below water).
42	30/07/2014	15:19	NG 21440 96678	121440	896678			Retaining walling with concrete blocks. Possible pipework route to tie in properties to communal septic tank.
43	30/07/2014	15:26	NG 21373 96681	121373	896682			Three sheep on shoreline and one above. No outfall pipes visible.
44	30/07/2014	15:37	NG 21404 96491	121405	896491			Communal septic tank south side of village. Sound of running water. Concrete cracked around top.
45	30/07/2014	15:42	NG 21252 96775	121252	896776	Fig.12		Overview photographs of Scalpay Harbour from this waypoint.
46	30/07/2014	15:50	NG 21171 96959	121171	896959			Outfall pipe from septic tank for isolated dwelling. Ceramic pipe encased in concrete with almost blocked end. Appeared not in use - no sign of recent flow onto shore.
47	30/07/2014	15:55	NG 21053 97053	121054	897053			Plastic 100 mm soil pipe emerging onto grass from rear garden of isolated dwelling. Signs of use - remains of toilet tissue in grass.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
48	30/07/2014	15:58	NG 20826 97102	120827	897103			End of Scalpay shore survey at Marine Harvest East Loch Tarbert Salmon Farms Cuddy Point shore base facility. Photographs of facility and pontoon with five moored boats (2 ribs, 1 clinker skiff, 1 Cygnus fishing boat, 1 salmon farm steel workboat).
49	31/07/2014	7:59	NG 22793 97528	122793	897528		ELTFW3	Start of East Loch Tarbert shoreline survey (north shore, east of Scalpay Bridge, easternmost point. Planned freshwater sample.
50	31/07/2014	8:00	NG 22793 97528	122793	897529	Fig.13		Site of observations associated with waypoint 49. Watercourse low with very slow flow. Flow ending above seawater filled rock gully. Flow rate volume 1.2 L/min (jug measurement 200 ml in 10 sec at outfall), width above outfall10 cm, depth approximately 0.5 cm. Otter seen in sea and six sheep and one hare on the hillside. Suspected otter spraint beside watercourse.
51	31/07/2014	8:30	NG 22469 97656	122470	897656			Black plastic pipe 150 mm diameter, outfalling into sea secured by stainless steel bands to bags of cement aggregate ending underwater. Pipe lying in line below second occupied dwelling from the start of the shore walk. Dwelling seen in photo 1517 between dwellings in photo 1518.
52	31/07/2014	8:30	NG 22469 97656	122470	897656	Fig.14		Photographs taken of pipe associated with waypoint 51.
53	31/07/2014	8:36	NG 22442 97658	122442	897659		ELTFW4	Planned freshwater sample from burn (see details waypoint 54).
54	31/07/2014	8:36	NG 22442 97658	122443	897658			Site of planned freshwater sample associated with waypoint 53. Watercourse adjacent to small concrete slipway at shore. Flow rate in 'V' shaped channel 0.218 m/sec, SD 0.003, width 20 cm, depth in middle 4 cm. Wetted bank to wetted bank 30 cm.
55	31/07/2014	8:41	NG 22430 97650	122430	897651			Plastic 100 mm soil drain onto shore below dwelling immediately west of watercourse associated with waypoints 53 and 54. No flow.
56	31/07/2014	8:50	NG 22184 97667	122185	897667		ELTSW5	Planned seawater sample.

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
57	31/07/2014	8:50	NG 22185 97665	122186	897665	Fig.15		Site of planned seawater sample at former Scalpay concrete ferry slipway. Six small leisure boats moored nearby.
58	31/07/2014	9:00	NG 21980 97692	121981	897692		ELTFW5	Planned freshwater sample from burn.
59	31/07/2014	9:01	NG 21979 97693	121980	897694	Fig.16		Site of planned freshwater sample associated with waypoint 58. Water only just flowing, no flow rate measurement possible. Width 1.55 m, depth 2 cm and 3 cm. Sample taken from pool to avoid disturbing sediment. Small harbour with one leisure craft. Seven oystercatchers seen.
60	31/07/2014	9:21	NG 21186 98106	121187	898106		ELTFW6	Planned freshwater sample from burn.
61	31/07/2014	9:21	NG 21186 98106	121186	898107	Fig.17		Site of planned freshwater sample at Caolas Sgalpaigh associated with waypoint 60. Flow 0.111 m/sec, SD 0.016, depth 13 cm; flow 0.282 m/sec, SD 0.005, depth 13 cm, watercourse width 1.9 m.
62	31/07/2014	9:42	NG 19638 98625	119638	898625		ELTFW7	Unplanned freshwater sample beyond west end of designated shore survey section.
63	31/07/2014	9:42	NG 19638 98625	119639	898626	Fig.18		Site of unplanned freshwater sample associated with waypoint 62 at Carragraich. Flow 0.18 m/sec, SD 0.033, depth 5 cm. Wetted bank to wetted bank 28 cm. Scottish Water installations above road beside watercourse.
64	31/07/2014	10:06	NG 19649 98652	119649	898653			West end of East Loch Tarbert Sound of Scalpay shore survey.

Photographs referenced in the table can be found attached as Figures 3-18

Sampling

Seawater and freshwater samples were collected at the sites marked in Figure 2.

One watercourse sample at Ceann a Gharaidh was not collected as there was no obvious flow. An extra sample was taken instead from Carragraich. An additional unplanned sample (contaminated) was taken from a black 50 mm plastic pipe outflow in Scalpay harbour.

Two common mussel samples were taken from a single point mooring dropper situated just east of Fuam an Tolla, west of Scalpay, as no mussel lines were *in situ* east of the Scalpay Bridge at the time of the visit. The team did not observe any wild mussels along the east section of the Harris shore walk adjacent to the normal mussel line array position.

All the samples were transferred to Biotherm 30 boxes with ice packs and posted to Glasgow Scientific Services (GSS) for *E. coli*. analysis. Two freshwater, four seawater and two mussel samples were collected and sent to the laboratory from Stornoway airport on the 30th July, the temperature on arrival at the laboratory was recorded as 1.9 °C. Five freshwater and one seawater samples were collected and sent in a Biotherm box to the laboratory from Kyle Post Office on the 31st July, the temperature on arrival at the laboratory was recorded as 4.1°C.

Seawater samples were tested for salinity by GSS and the results were reported in mg Chloride per litre. These results have been converted to parts per thousand (ppt) using the following formula:

$$\text{Salinity (ppt)} = 0.0018066 \times Cl^{-} \text{ (mg/L)}$$

Table 2. Water Sample Results [

No	Date	Sample	Grid Ref	Type	E. coli (cfu/100ml)	Salinity (ppt)
1	30/07/2014	ELT FW1	NG 21822 96844	Freshwater	> 10000000	
2	30/07/2014	ELT FW2	NG 21881 96775	Freshwater	>1000[a]	
3	31/07/2014	ELT FW3	NG 22793 97528	Freshwater	260	
4	31/07/2014	ELT FW4	NG 22442 97658	Freshwater	140	
5	31/07/2014	ELT FW5	NG 21980 97692	Freshwater	270	
6	31/07/2014	ELT FW6	NG 21186 98106	Freshwater	230	
7	31/07/2014	ELT FW7	NG 19638 98625	Freshwater	40	
8	30/07/2014	ELT SW1	NG 20763 96369	Seawater	0	35.4
9	30/07/2014	ELT SW2	NG 21373 97191	Seawater	7	35.2
10	30/07/2014	ELT SW3	NG 22133 97088	Seawater	11	35.4
11	30/07/2014	ELT SW4	NG 20777 97148	Seawater	1	35.0
12	31/07/2014	ELT SW5	NG 22184 97667	Seawater	3	35.2

[a] Result queried by SRSL. GSS confirmed the sample was sent and analysed as a freshwater (clean) sample, and as such this result should not be reported in this form. SRSL informed GSS of the issue and an investigation did not help resolve the non-conformance. SRSL contacted CEFAS to inform them of the issue and instigated an improvement action for future water microbiological results.

Table 3. Shellfish Sample Results

No	Date	Sample	Grid Ref	Type	Sample Depth (m)	E. coli (MPN/100g)
1	30/07/2014	ELT SF1	NG 20766 96376	Shellfish	surface	45
2	30/07/2014	ELT SF2	NG 20763 96377	Shellfish	2 m	78

Salinity Profiles

CTD profiles were taken at two locations in the normal production area from the harvester's boat. The absence of the mussel array at the time of the team visit meant it was not possible to moor the boat and there was some boat drift while the casts were being taken. A CTD cast was taken at the site of the single point dropper east of Fuam an Tolla. The gathered data will be sent to client as a separate document. A “Castaway” S/N 10G100653 instrument was used to collect the data.

Photographs

Figure 3. Site of harvesters' single mussel line E of Fuam an Tolla, Scalpay. Waypoint 1. Site of sample ELTSW1.

Figure 4. Planned mussel sample (ELTSF2) from only available dropper. Waypoint 3.

Figure 5. SW corner of planned/desired array, Caolas Sgalpaigh (Sound of Scalpay). Net Services Shetland Ltd situated directly south and Scalpay Bridge visible on the right. Waypoint 8.

Figure 6. Broken and disused outfall pipe Ceann a Bhaigh, Scalpay. Waypoint 21.

Figure 7. Unplanned freshwater sample (ELTFW1), contaminated.
Waypoint 24.

Figure 8. Stagnant but active ceramic outfall pipe.
Waypoint 27.

Figure 9. Location of planned seawater sample (ELTSW3) taken from Port na Geiltan slipway, directly opposite the harvesters preferred site. Nets awaiting washing stacked on the left. Waypoint 30.

Fig. 10. Disused septic tank with broken outfall pipe south side of Ceann a Bhaigh. Large rusting marine metal fragments onshore in the background looking east. Waypoint 35.

Fig. 11 Scottish Water communal septic tank Scalpay harbour north. Waypoint 38.

Figure 12. Overview of Scalpay harbour area looking north with the two harbours, either side of the pier. Ceann a' Bhaigh middle distance, partially hidden. Waypoint 45.

Figure 13. Planned freshwater sample (ELTFW3). Low flow ending in drips above steep gully. Waypoint 50.

Fig. 14 Outfall pipe of 150 mm black plastic secured by bags of cement aggregate. Pipe end underwater. Waypoint 51.

Figure 15. Planned seawater sample (ELTSW5). Former Scalpay ferry slipway, Harris, looking SW towards Scalpay Bridge. Waypoint 57.

Figure 16. Planned freshwater sample (ELTFW5). Waypoint 59.

Figure 17. Planned freshwater sample (ELTFW6). Waypoint 61.

Figure 18. Unplanned freshwater sample (ELTFW6). Waypoint 63.

6. SEPA Discharge Consents

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1010055	NG 22140 96820	Dwelling, Bayhead, Scalpay	Sewage (Private) Primary	Dwelling, Bayhead, Scalpay, STE to soakaway	Soakaway	=	5
CAR/R/1012320	NG 22360 95700	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Scalpay, Laggandoin, Isle of Scalpay, STE to soakaway	Soakaway	=	5
CAR/R/1014053	NG 15170 91440	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Cluer, Isle of Harris, STE to land	Land	=	5
CAR/R/1014785	NG 15370 93000	Dwelling, Grosebay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to land, Grosebay	Land	=	5
CAR/R/1016507	NG 21116 96958	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Scalpay, Isle of Harris, STE to land	Land	=	5
CAR/R/1017283	NG 17179 95715	Dwelling, Drinishader,Isle of Lewis	Sewage (Private) Primary	Dwelling, STE to Land, Caolas Sgeir Bhuidhe, 1 Drinishader, Isle of Harris	Land	=	5
CAR/R/1017572	NG 22515 95252	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to soakaway, Scalpay, Harris	Soakaway	=	5
CAR/R/1019274	NG 17163 94848	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Drinishader, STE to land, Isle of Harris	Land	=	6
CAR/R/1021249	NG 17170 94880	Dwelling,, Drinshader, Isle of Harris	Sewage (Private) Primary	Dwelling, Drinishader, STE to soakaway, Isle of Harris	Soakaway	=	6
CAR/R/1021666	NG 21836 97848	Dwelling, Kyles Isle of Harris, Western Isles	Sewage (Private) Primary	Dwelling, Kyles, STE to land, Isle of Harris, Western Isles	Land	=	5
CAR/R/1022158	NG 22380 95450	Dwelling, Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to land, Scalpay, Isle of Harris	Land	=	6
CAR/R/1023442	NG 17799 93522	Dwelling, Plockrepool, Harris	Sewage (Private) Primary	Dwelling, STE to Loch Plockropool, Plockrepool, Isle of Harris	Loch Plockropool	=	5
CAR/R/1027991	NG 21980 97790	Dwelling, Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles Scalpay, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1029571	NG 17030 99900	Dwelling, Urgha, Isle of Harris	Sewage (Private) Primary	Dwelling, Urgha, STE to Bagh Urgha Beag, Isle of Harris	Bagh Urgha Beag	=	5
CAR/R/1029848	NG 17770 99700	Dwelling, Harris, Isle of Harris	Sewage (Private) Primary	Dwelling, Urgha, STE to soakaway, Harris, Isle of Harris	Soakaway	=	5
CAR/R/1031215	NG 18770 97150	2 Dwellings,	Sewage (Private) Primary	2 Dwellings, Scotasay, STE to Loch Tarbe	Loch Tarbert	=	10
CAR/R/1033096	NG 22430 95350	Dwelling, Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to land, Scalpay, Harris	Land	=	5
CAR/R/1033900	NG 19510 98460	Tarbert WTW,Carragraich, by Tarbert, Harris	Sewage (Private) Primary	Tarbert WTW, STE to Loch an Tairbeairt, Carracgraich	Loch an Tairbeairt	=	5
CAR/R/1037774	NB 14930 00200	Dwelling, Tarbert	Sewage (Private) Primary	Dwelling, Old Pier Road, STE to soakaway, Tarbert	Soakaway	=	5
CAR/R/1037908	NG 21980 97790	Dwelling, Kyles, Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to soakaway, Harris	Soakaway	=	5
CAR/R/1038784	NG 15160 91440	Dwelling, Cluer, Isle of Harris	Sewage (Private) Primary	Dwelling, Cluer, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1040947	NG 23034 95166	Dwelling, Isle Of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to soakaway, Isle Of Scalpay	Soakaway	=	5
CAR/R/1040974	NG 14984 93012	Dwelling, Grosebay, Isle Of Harris	Sewage (Private) Primary	Dwelling, Grosebay, STE to Loch Ghreosabhagh, Isle Of Harris	Loch Ghreosabhagh	=	5

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1041824	NG 15310 91200	Dwelling, Cluer	Sewage (Private) Primary	Dwelling, Cluer, STE to Land, Isle of Harris	Land	=	10
CAR/R/1042585	NG 21804 96845	Dwelling, Isle Of Scalpay	Sewage (Private) Primary	Dwelling, STE to An Acairsaid a'Tuath, Isle Of Scalpay	An Acairsaid a'Tuath	<=	7
CAR/R/1042683	NG 14936 98213	Dwelling, Kendebig, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Loch Kendebig, Kendebig	Loch Kendebig	=	5
CAR/R/1042798	NG 17790 94000	Dwelling, Isle Of Harris	Sewage (Private) Primary	Dwelling, Drinishader, STE to soakaway, Isle Of Harris	Soakaway	<=	6
CAR/R/1043383	NG 15652 92797	Dwelling, Isle Of Harris	Sewage (Private) Primary	Dwelling, STE to Loch Grosebay, 1 Grosebay, Isle Of Harris	Loch Grosebay	<=	5
CAR/R/1043438	NG 22272 95709	Dwelling, Western Isles	Sewage (Private) Primary	Dwelling, Scalpay, STE to U/T to An Acairsaid a' Deas, Isle of Scalpay, Western Isles	U/T of An Acairsaid a'Tuath	<=	6
CAR/R/1043667	NG 18780 98960	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Carrigreich, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1045055	NB 17022 00119	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Urgha, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1045273	NG 22410 95430	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to soakaway, Outend, Isle of Scalpay	Soakaway	<=	5
CAR/R/1045282	NG 21470 97850	Dwelling, Oakbank, Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1045294	NG 20390 98362	Dwelling, Kyles Harris	Sewage (Private) Primary	Dwelling, STE to u/n w/c, 22 Kyles Harris, Isle of Harris	U/N W/C	<=	5
CAR/R/1045318	NG 20401 98402	Dwelling, Harris, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles Harris, STE to u/n w/c, Isle of Harris	U/N W/C	<=	5
CAR/R/1045611	NG 21411 98026	Dwelling, Kyles Harris, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Land, Isle of Harris	Land	=	5
CAR/R/1045727	NG 21087 98108	Dwelling, Kyles Harris, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles Harris, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1047455	NG 15170 91310	Dwelling,Cluer, Isle of Harris	Sewage (Private) Primary	Dwelling, Cluer, STE to soakaway, Isle Of Harris	Soakaway	=	5
CAR/R/1047456	NG 23210 95090	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to soakaway, Isle Of Scalpay	Soakaway	=	5
CAR/R/1047664	NG 20698 98182	Dwelling, Kyles, Isle Of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to u/n w/c, Isle Of Harris	U/N W/C	<=	5
CAR/R/1048182	NG 14740 97973	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Kendibig, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1048343	NG 15108 96489	Dwelling, South Harris	Sewage (Private) Primary	Dwelling, STE to U/T of Loch Ceann Dibig, Isle of South Harris	Loch Ceann Dibig	<=	8
CAR/R/1049102	NG 15140 96560	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Cean Dibig, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1049917	NG 21360 96410	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to South Harbour, Scalpay	South Harbour	=	5
CAR/R/1049975	NG 22400 95200	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to Bagh Ceam na Muice, Isle of Scalpay	Bagh Ceam na Muice	=	7
CAR/R/1049978	NG 21130 96980	Dwelling, Isle Of Scalpay	Sewage (Private) Primary	Dwelling, STE to An Acairsaid A Tuath, Rubha Nan Cudaigean, Isle Of Scalpay	An Acairsaid a'Tuath	<=	15

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1050566	NG 17400 94530	Dwelling, Drinishader, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Saokawy, Isle of Harris	Soakaway	<=	5
CAR/R/1051523	NG 21119 96935	Dwelling, Isle Of Scalpay+2	Sewage (Private) Primary	Dwelling, Cuddy Point, Oran Na Mara & Cuddy Point, STE to soakaway, Isle Of Scalpay	Soakaway	=	15
CAR/R/1052277	NG 15463 91353	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Grosebay, STE to Loch Chollaim, Isle of Harris	Loch Chollaim	=	6
CAR/R/1053117	NG 21625 96213	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Laggandoin, STE to South Harbour Scalpay, Isle of Scalpay	South Harbour	=	5
CAR/R/1053955	NG 17174 95740	1 Drinishadder,Isle of Harris,	Sewage (Private) Primary	Dwelling, Drinishader, STE to soakaway, Isle of Harris	Soakaway	=	6
CAR/R/1054746	NG 14849 97951	Dwelling, Kendebig, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1055851	NG 15680 96400	Dwelling, Meavaig, South Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Meavaig, South Harris	Soakaway	=	5
CAR/R/1055867	NG 21180 96850	Dwelling, Cuddy Point, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to soakaway, Cuddy Point, Isle of Scalpay	Soakaway	=	5
CAR/R/1056049	NG 20178 98354	Dwelling, Isle of Harris	Sewage (Private) Primary	Dwelling, Carragreich, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056071	NG 20158 98369	Dwelling, Carragreich, Isle of Harris	Sewage (Private) Primary	Dwelling, Carragreich, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056149	NG 21737 96924	Dwelling, Harris	Sewage (Private) Primary	Dwelling, Scalpay, STE to Soakaway, Isle of Harris	Soakaway	=	6
CAR/R/1056340	NG 17095 94974	Dwelling, DRINSHADER, ISLE OF HARRIS	Sewage (Private) Primary	Dwelling, STE to soakaway, 4 Drinshader, Isle Of Harris	Soakaway	=	6
CAR/R/1056350	NG 21741 96210	Dwelling, Laggandoin, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to soakaway, Isle of Scalpay	Soakaway	=	5
CAR/R/1056374	NG 21435 97966	Dwelling, KYLES HARRIS	Sewage (Private) Primary	Dwelling, STE to soakaway, Kyles, Harris	Soakaway	=	12
CAR/R/1056404	NB 22920 01670	Dwelling, Rhenigidale, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Soakaway, Rhenigidale, Isle of Harris	Soakaway	=	6
CAR/R/1056407	NB 22768 01767	Dwelling, ISLE OF HARRIS	Sewage (Private) Primary	Dwelling, Rhenigidale, Isle of Harris, HS3 3BD	Burn of Calrnie	=	5
CAR/R/1056425	NG 21140 98020	Dwelling, Kyles, Isle Of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to East Loch an Tairbeairt, Isle of Harris	East Loch Tarbert	=	5
CAR/R/1056429	NB 22813 01865	Dwelling, Rhenigidale, Isle of Harris	Sewage (Private) Primary	Dwelling, Rhenigidale, STE to Abhainn a Ghlinne, Isle Of Harris	Abhainn a Ghlinne	=	5
CAR/R/1056435	NG 21286 97909	Dwelling, Isle Of Harris	Sewage (Private) Primary	Dwelling, Kyles Harris, STE to Bun nan Caol, Isle of Harris	Bun nan Caol	=	5
CAR/R/1056440	NG 21245 97929	Dwelling, Kyles, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to Bun nan caol, Isle Of Harris	Bun nan Caol	=	5
CAR/R/1056441	NB 14771 00360	Dwelling, WEST TARBERT, ISLE OF HARRIS	Sewage (Private) Primary	Dwelling, STE to Loch a Siar, West Tarbert, Isle Of Harris	Loch a Siar	=	5
CAR/R/1056489	NB 22670 01810	Dwelling, Rhenigidale, Harris	Sewage (Private) Primary	Dwelling, STE to Land, Rhenigidale, Isle of Harris	Land	=	5

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1056552	NG 22420 95310	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to Soakaway, Isle of Scalpay	Soakaway	=	5
CAR/R/1056558	NG 22394 95366	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to Soakaway, Isle of Scalpay	Soakaway	=	5
CAR/R/1056565	NG 21839 97690	Dwelling, Kyles-Scalpay, I. of Harris	Sewage (Private) Primary	Dwelling, Camus An Loin, STE to Soakaway, isle of Harris	Soakaway	=	5
CAR/R/1056568	NG 15650 99600	Dwelling, Direcleit, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Soakaway, Isle of Harris	Soakaway	=	6
CAR/R/1056574	NG 21917 97824	Dwelling, Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling,Kyles, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056587	NG 18821 98658	Dwelling, Glen Carragreich, Isle of Harris	Sewage (Private) Primary	Dwelling, Glen Carragraich, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056590	NG 22330 95190	Dwelling, Scalpay	Sewage (Private) Primary	Dwelling, STE to Soakaway, Isle of Scalpay	Soakaway	=	7
CAR/R/1056591	NG 21985 96735	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to U/T of An Acairsaid a'Tuath, Isle of Scalpay	U/T of An Acairsaid a'Tuath	=	5
CAR/R/1056620	NG 15319 92869	Dwelling, Grosebay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Loch Ghreosabhagh, Isle of Harris	Loch Ghreosabhagh	=	6
CAR/R/1056621	NB 22979 01776	Dwelling, Rhenigidale, Isle of Harris	Sewage (Private) Primary	Dwelling, Rhenigidale, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056725	NG 15136 96471	Dwelling, Meavaig, South Harris	Sewage (Private) Primary	Dwelling, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056764	NG 15345 96475	Dwelling, Meavaig, South Harris	Sewage (Private) Primary	Dwelling, STE to Loch Ceann Dibig, Isle of Harris	Loch Ceann Dibig	=	5
CAR/R/1056768	NG 15843 96340	Dwelling, Meavaig, South Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1056773	NG 15740 96290	Dwelling, Meavaig, South Harris	Sewage (Private) Primary	Dwelling, STE to Soakaway, South Harris	Soakaway	=	9
CAR/R/1056778	NG 14686 98321	Dwelling, Kendibig, Harris	Sewage (Private) Primary	Dwelling, STE to U/T of Loch Ceann Dibig, Isle of Harris	U/T of Loch Ceann Dibig	=	6
CAR/R/1057101	NG 21762 96895	Dwelling, Scalpay	Sewage (Private) Primary	Dwelling, STE to soakaway, Bayhead, Scalpay	Soakaway	=	6
CAR/R/1057124	NG 21558 97936	Dwelling, Kyles Harris, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles (Limbach), STE to soakaway, Isle of Harris	Soakaway		6
CAR/R/1057320	NB 14166 00851	Dwelling, Leachin, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Loch A Siar, Isle of Harris	Loch a Siar	=	5
CAR/R/1057682	NB 16521 00072	Dwelling, Tarbert, Isle of Harris,	Sewage (Private) Primary	Dwelling,Tarbert, STE to u/n w/c, Isle of Harris	U/N W/C	=	5
CAR/R/1057737	NG 18100 99550	Dwelling, Urgha, Isle of Harris	Sewage (Private) Primary	Dwelling, Urgha, STE to soakaway, Isle of Harris	Soakaway	<=	15
CAR/R/1059459	NG 22296 95343	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to An Acairseid a Deas, Isle of Scalpay	An Acairsaid a Deas	=	5
CAR/R/1059472	NG 23159 95011	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to Soakaway, Isle of Scalpay	Soakaway	=	5
CAR/R/1059523	NG 21627 97859	Dwelling, Kyles, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to Soakaway, Harris	Soakaway	=	5

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1059633	NB 15356 00083	Dwelling, Scott Road, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Isle of Harris	Soakaway	=	6
CAR/R/1059652	NG 15040 92770	Dwelling, Grosebay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1059683	NG 22140 97670	Dwelling, kyles of Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to Sounds of Scalpay, Isle of Harris	Sounds of Scalpay	=	5
CAR/R/1059728	NG 22335 95301	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to Land, Isle of Scalpay	Land	=	6
CAR/R/1059732	NG 17020 95130	Dwelling, Drinishader, Isle of Harris	Sewage (Private) Primary	Dwelling, Drinishader, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1059782	NG 22330 95540	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to Na h-Eileanan An Iar, Isle of Scalpay	Na h-Eileanan An Iar	=	5
CAR/R/1059788	NG 15670 92790	Dwelling, Grosebay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to Loch Ghreosabhagh, Isle of Harris	Loch Ghreosabhagh	=	5
CAR/R/1059836	NG 21063 98262	Dwelling, Kyles, Tarbert, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles Harris, Isle of Harris	Soakaway	=	5
CAR/R/1059910	NG 17320 92260	Dwelling, Scadabay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to u/t of Loch Scadabhagh, Scadabay, Isle of Harris	U/T of Loch Scadabhagh	=	7
CAR/R/1059976	NG 17376 94566	Dwelling, Drinishader, Harris	Sewage (Private) Primary	Dwelling, Drinishader, STE to soakaway, Isle of Harris	Soakaway	=	7
CAR/R/1059978	NG 23187 95211	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to U/T of Bagh Ceann na Muice, Outend, Isle of Scalpay	U/T of Bagh Ceann na Muice	=	5
CAR/R/1060058	NG 17320 92280	Dwelling, Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to U/T to Loch Scadabhagh, Isle of Harris	Loch Scadabhagh	=	7
CAR/R/1061602	NB 16649 00032	Dwelling, Urgha, Isle of Harris	Sewage (Private) Primary	Dwelling, Urgha, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1061645	NG 22925 95220	Dwelling, Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, Outend, STE to u/n w/c, Scalpay, Isle of Harris	U/N W/C	=	5
CAR/R/1061771	NG 22420 94830	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to Soakaway, Isle of Scalpay	Soakaway	=	6
CAR/R/1062055	NG 21520 97950	Dwelling, Kyles Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1062122	NG 22319 95635	Dwelling, Scalpay, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Scalpay, STE to U/T of Na H-Eileanan an Iar, Isle Of Scalpay	U/T of Na H-Eileanan an Iar	=	5
CAR/R/1063067	NG 22404 95552	Dwelling, Outend Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to soakaway, Outend, Isle of Scalpay	Soakaway	=	6
CAR/R/1063311	NG 22486 95148	Dwelling, Outend, Isle of Scalpay, HS4 3YG	Sewage (Private) Primary	Dwelling, STE to Soakaway, Outend	Soakaway	=	5
CAR/R/1063368	NG 21864 96802	Dwelling, bayhead, Scalpay, HS4 3XY	Sewage (Private) Primary	Dwelling, STE to Ceann A Bhaigh, Bayhead, Isle of Scalpay	Ceann A Bhaigh	=	5
CAR/R/1063370	NG 21887 96751	Dwelling, Cuddy Point, Scalpay	Sewage (Private) Primary	Dwelling, STE to U/T of An Acairsaid a Tuath, Isle Of Scalpay	U/T of An Acairsaid a'Tuath	=	5
CAR/R/1065854	NB 22872 01690	Dwelling, Reinigeadal, Isle of Harris	Sewage (Private) Primary	Dwelling, Reinigeadal, STE to Loch Trolamaraig, Isle Of Harris	Loch Trolamaraig	=	6

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1065859	NB 22630 01650	Dwelling, Reinigeadal, Isle of Harris	Sewage (Private) Primary	Dwelling, Reinigeadal, STE to Land, Isle of Harris	Land	=	6
CAR/R/1066287	NG 22300 95410	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to Soakaway, Outend, Isle of Scalpay	Soakaway	=	5
CAR/R/1066290	NG 22360 94910	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, High Hill, STE to Soakaway, Outend, Isle Of Scalpay	Soakaway	=	5
CAR/R/1066346	NG 20130 98370	Dwelling, Carragreich, Isle of Harris	Sewage (Private) Primary	Dwelling, Carragreich, STE to soakaway, Isle Of Harris	Soakaway	=	5
CAR/R/1066428	NG 20970 98121	Dwelling, Kyles, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to soakaway, Isle Of Harris	Soakaway	=	5
CAR/R/1066765	NG 17044 92427	3 Dwellings, Isle of Harris	Sewage (Private) Primary	Dwelling, Scadabay, STE to Loch Scadabhagh, Isle of Harris	Loch Scadabhagh	=	15
CAR/R/1068022	NG 20967 95815	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Ard Na Cille, STE to Port an Aiseig, Isle Of Scalpay	Port an Aiseig	=	7
CAR/R/1068108	NB 22911 01840	Dwelling, Rhenigidale, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Isle Of Harris	Soakaway	=	5
CAR/R/1068152	NG 21851 96781	Dwelling, Bayhead, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to Ceann a'Bhaign, Isle Of Scalpay	Ceann a'Bhaigh	=	5
CAR/R/1068199	NG 21011 95823	Dwelling, Airdnacille, Scalpay,Harris	Sewage (Private) Primary	Dwelling, Airdnacille, STE to Port Na Aiseig, Scalpay, Isle of Harris	Port an Aiseig	<=	5
CAR/R/1070527	NB 22830 01800	Dwelling, Rhenigidale,Isle of Harris	Sewage (Private) Primary	Dwelling, Rhenigidale, STE to soakaway, HS3 3BD	Soakaway	=	6
CAR/R/1075725	NG 15100 92970	Dwelling, Grosebay, Isle of Harris	Sewage (Private) Primary	Dwelling, Grosebay, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1075734	NG 15163 92909	Dwelling, Grosebay, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, 5 Grosebay, Isle Of Harris	Soakaway	=	6
CAR/R/1075752	NG 17574 94227	Dwelling, Drinishader, Isle of Harris	Sewage (Private) Primary	Dwelling, Drinishader, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1075757	NG 21280 96310	Dwelling, Isle of Scalpay	Sewage (Private) Primary	Dwelling, STE to soakaway, Isle of Scalpay	Soakaway	=	5
CAR/R/1075763	NG 16045 98544	Dwelling, Deiraclete, Isle of Harris	Sewage (Private) Primary	Dwelling, Deiraclete, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1075821	NG 21210 98070	Dwelling, Kyles, Isle Of Harris	Sewage (Private) Primary	Dwelling, Kyles, STE to soakaway, Isle Of Harris	Soakaway	=	5
CAR/R/1075825	NB 16405 00006	Dwelling,East Tarbert, Isle of Harris	Sewage (Private) Primary	Dwelling, East Tarbert, STE to soakaway, Isle Of Harris	Soakaway	=	5
CAR/R/1076417	NG 19910 98300	Dwelling, Carragreich, Isle of Harris	Sewage (Private) Primary	Dwelling,Carragreich, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1077763	NG 17338 94709	Dwelling, Drinishader, Harris	Sewage (Private) Primary	Dwelling, STE to Loch an Tairbeairt, Drinishader	Loch an Tairbeairt	=	5
CAR/R/1078085	NG 16000 96150	Dwelling, Meavaig South, Harris	Sewage (Private) Primary	Dwelling, STE to soakaway,Harris	Soakaway	=	6
CAR/R/1079719	NG 22350 95713	Dwelling, Laggandoin, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Scalpay, STE to Soakaway, Isle Of Scalpay	Soakaway	=	5

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/R/1083725	NG 18700 97640	Business, E Loch Tarbert, Cuddy Point	Sewage (Private) Secondary	Business, Cuddy Point, Scotasay STW FE to East Loch Tarbert	East Loch Tarbert	=	5
CAR/R/1084861	NG 21190 95800	Dwelling, Ardnakille, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Ardnakille, STE to coastal waters, Isle of Scalpay	Coastal Waters	=	5
CAR/R/1098385	NG 22280 97730	Dwelling, Down End, Kyles, Tarbert, Isle of Harris	Sewage (Private) Primary	Dwelling, Down End, Kyles, STE to soakaway, Tarbert.	Soakaway	=	5
CAR/R/1101844	NG 15538 99684	Dwelling, Tarbert, Isle of Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Tarbert	Soakaway	=	5
CAR/R/1102378	NG 14880 98320	Dwelling, Kendebig, Isle of Harris	Sewage (Private) Primary	Dwelling, Kendebig, STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1104860	NG 21360 98090	Dwelling, Kyles Harris, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyle Harris, STE to Soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1109660	NG 15610 99490	Dwelling, Caw, Direcleit, Tarbert	Sewage (Private) Primary	Dwelling, Caw, Direcleit, Tarbert - STE to soakaway	Soakaway	=	5
CAR/R/1111870	NG 19800 98390	Dwelling, Carragreich, Tarbet	Sewage (Private) Primary	Dwelling, Carragreich, Tarbet - STE to land via a soakaway	Soakaway	=	5
CAR/R/1115500	NG 21558 97936	Dwelling, Kyles Scalpay, Isle of Harris	Sewage (Private) Primary	Dwelling, Kyles (Limbach), STE to soakaway, Isle of Harris	Soakaway	=	5
CAR/R/1117386	NG 17360 99950	Dwelling, Urgha, Isle of Harris	Sewage (Private) Primary	Dwelling,Urgha, STE to Land, Isle of Harris	Land	=	10
CAR/R/1117581	NG 17520 94380	Dwelling, Drinishader, Harris	Sewage (Private) Primary	Dwelling, STE to Land, Dirnishader, Harris	Land	=	5
CAR/R/1117733	NG 24750 94660	Dwelling, Harris	Sewage (Private) Untreated	Dwelling, Crude to Minch, Eilean Glas, Harris	Minch	=	5
CAR/R/1117931	NG 22538 97750	Dwelling, Kyles Scalpay, Harris	Sewage (Private) Primary	Dwelling, Kyles Scalpay, STE to Soakaway, Harris	Soakaway	=	6
CAR/R/1118011	NG 17370 99940	Dwelling, Urgha, Isle of Harris	Sewage (Private) Primary	Dwelling,Urgha, STE to Soakaway, Isle of Harris	Soakaway	=	10
CAR/R/1118347	NG 22930 95190	Dwelling, Outend, Isle of Scalpay	Sewage (Private) Primary	Dwelling, Outend, STE to soakaway, Isle of Scalpay	Soakaway	=	5
CAR/R/1120487	NB 16521 00072	Dwelling, Tigh an Urrais, Tarbert	Sewage (Private) Secondary	Dwelling, STW FE to U/T of Loch an Tairbeairt	U/T of Loch an Tairbeairt	=	12
CAR/R/1121236	NG 22540 95180	Dwelling, Outend, Isle of Scalpay, Harris	Sewage (Private) Primary	Dwelling, STE to soakaway, Outend, Isle of Scalpay	Soakaway	=	5
CAR/L/1003901	NG 22100 97107	Scalpay Salmon Processing Factory	Other Effluent Food Processing	Scalpay Fish Processing Factory Bayhead Isle of Scalpay			
CAR/L/1001851	NB 18400 02100	Loch Lacasdale	Fish Farm Freshwater Cage	Upper Loch Lacasdail FCFF, Urgha, Isle of Harris			
CAR/L/1001882	NG 18650 94050	Plocrapol MCFF, Loch Plocrapol	Fish Farm Marine Cage	Plocrapool MCFF, Loch an Ear, Plockropool, Isle of Harris			
CAR/L/1001972	NG 16003 96200	Meavaig Hatchery, Isle of Harris	Fish Farm Freshwater Tank or Hatchery	Meavaig Hatchery, TE to Ob Mhiabhaig, Isle of Harris			
CAR/L/1002201	NG 15969 93308	Loch Harmasaig Fish Cages	Fish Farm Freshwater Cage	Loch Harmasaig FCFF, TE to Loch Harmasaig, Isle of Harris			
CAR/L/1002366	NB 21844 01267	Trollamarig MCFF, Loch Seaforth	Fish Farm Marine Cage	Loch Trollamarig MCFF, Rhenigidale, Isle of Harris			

Licence No.	NGR	Site Name	Discharge Type	Site Description	Discharges to	Op	PE
CAR/L/1003022	NG 15500 97100	Ceann Dibig MCFF, Loch Ceann Dibig	Fish Farm Marine Cage	Loch Ceann Dibig MCFF, Isle of Harris			
CAR/L/1003915	NG 15480 92480	Grosebay MCFF, Loch Grosebay	Fish Farm Marine Cage	Grosebay Loch MCFF, Grosebay, Isle of Harris			
CAR/L/1004080	NG 19110 97594	Scotasay MCFF, East Loch Tarbert	Fish Farm Marine Cage	Sgeotasaigh MCFF, TE to Loch an Tairbeairt, Isle of Harris			
CAR/L/1004083	NG 16120 97019	Meavaig MCFF, East Loch Tarbert	Fish Farm Marine Cage	Meavaig MCFF, East Loch Tarbert, NW of Arderanish, Isle of Harris			
CAR/L/1004084	NG 20700 95500	Rossay MCFF, East Loch Tarbert	Fish Farm Marine Cage	Rossay MCFF, East Loch Tarbert, Scalpay, Isle of Harris			
CAR/L/1016553	NG 18650 94050	Plocrapol MCFF, East Loch Tarbert	Fish Farm Marine Cage	Plocrapool MCFF, Loch an Ear, N of Rubha Phlocrapoil Pt, Isle of Harris			
CAR/L/1087591	NG 18500 97800	West Scotasay Salmon Farm, East Loch Tarbert	Fish Farm Marine Cage	Scotasay West MCFF, East Loch Tarbert, Isle of Harris			
CAR/L/1099410	NG 19640 97490	Raineach, East Loch Tarbert, Isle of Harris	Fish Farm Marine Cage	Raineach MCFF, East Loch Tarbert, Isle of Harris			
CAR/L/1108748	NG 18920 92772	Reibinish MCFF, East Loch Tarbert	Fish Farm Marine Cage	Reibinish MCFF, East Loch Tarbert, Isle of Harris			
CAR/L/1109424	NG 15900 91920	Scadabay MCFF, Loch Grosebay, Isle of Harris	Fish Farm Marine Cage	MCFF Loch Grosebay, Grosebay reference station			
CAR/L/1004203	NG 19619 99005	Carragreich WTW, Isle of Harris	Other Effluent Potable Water Treatment and Supply	Carragraich WTW, Isle of Harris, TE to Abhainn Charragraich			
CAR/L/1004999	NG 19517 98465	Tarbert WTW,Carragraich, by Tarbert, Harris	Other Effluent Potable Water Treatment and Supply	Tartbert WTW to Bagh Carragraich, Carragraich, Isle of Harris		=	80.2
CAR/S/1011856	NB 22733 01820	Rhenigadale, Isle of Harris	Other Effluent Potable Water Treatment and Supply	Rhenigidale WTW, TE to unnamed watercourse, Isle of Lewis		<=	4.3
CAR/S/1115611	NG 15820 99680	Isle of Harris Distillery, Isle of Harris	Other Effluent Distilling Effluent	Isle of Harris Distillery, TE Discharge to East Loch Tarbert, Isle of Harris		=	3120
WML/L/1058222	NB 16810 00270	NHT Urgha Site, Adj to CNES Depot, Harris	Tip	Urgha Civic Amenity Site, Tarbert, Isle of Harris, HS3 3BW			

LS=Land/Soakaway, SW= Seawater Body, FW= Freshwater Body, PE= Population Equivalent, - = Not applicable

7. East Loch Tarbert CTD data

Data obtained during the shoreline survey. The locations of the casts are shown in Figure A7.1.

Figure A7.1 Location of CTD cast

CAST 1

Data Header

% Device	10G100653
% File name	10G100653_20140730_094743
% Cast time (local)	30/07/2014 10:47:00
% Sample type	Cast
% Cast data	Processed
% Location source	GPS
% Start latitude	57.8692596
% Start longitude	-6.7107571
% Start GPS horizontal error(Meter)	1.659999967
% Start GPS vertical error(Meter)	2.140000105
% Start GPS number of satellites	10
% Cast duration (Seconds)	48
% Samples per second	5
Calibration Date	March 2013
Calibration offset for Temperature	-0.033
Calibration offset for Salinity	0.029

CTD data (calibration offsets applied)

Depth (Meter)	Temperature (Celsius)	Salinity (Practical Salinity Scale)
0.148902434	12.74005656	34.61763051
0.446687142	12.73848716	34.61684861
0.744478093	12.73454776	34.61686163
1.042268717	12.73555254	34.61605607
1.340059295	12.73424635	34.61421839
1.637850532	12.73446559	34.60696411
1.935642526	12.73376958	34.60440821
2.233434686	12.73627098	34.60298286
2.531226524	12.73584451	34.60483799
2.829017788	12.73629215	34.60512331
3.126809112	12.73836535	34.60199486
3.424600293	12.73820916	34.60391117
3.7223901	12.73294295	34.60987582
4.020178571	12.7365384	34.61238865
4.317966609	12.73390967	34.61100922
4.615754551	12.73399216	34.60963275
4.913542974	12.73762736	34.60472169
5.211331627	12.73671438	34.60531788
5.509119366	12.73700995	34.6097367
5.806906431	12.73320119	34.60743697
6.104693311	12.73094499	34.60687858
6.402480049	12.73299336	34.60567632
6.700266753	12.73128956	34.60431145
6.998053008	12.73051042	34.60607061
7.29583865	12.72829756	34.60603831
7.593624389	12.72761508	34.60150555
7.891409527	12.72193255	34.60678976
8.189193204	12.71817387	34.60912571
8.48697837	12.71868932	34.58975619
8.7847643	12.70611927	34.59629505
9.082548083	12.71169601	34.60410282
9.288962092	12.7228201	34.59761873

CAST 2

Data Header

% Device	10G100653
% File name	10G100653_20140730_102258
% Cast time (local)	30/07/2014 11:22:00
% Sample type	Cast
% Cast data	Processed
% Location source	GPS
% Start latitude	57.8807952
% Start longitude	-6.681467
% Start GPS horizontal error(Meter)	1.5
% Start GPS vertical error(Meter)	2.470000029
% Start GPS number of satellites	9
% Cast duration (Seconds)	41.6
% Samples per second	5
Calibration Date	March 2013
Calibration offset for Temperature	-0.033
Calibration offset for Salinity	0.029

CTD data (calibration offsets applied)

Depth (Meter)	Temperature (Celsius)	Salinity (Practical Salinity Scale)
0.148894271	12.58502662	34.64749262
0.446663482	12.58570837	34.65179882
0.744437979	12.58563847	34.65283758
1.042212196	12.58453288	34.65103044
1.33998683	12.58537928	34.6460984
1.637761686	12.58510121	34.646238
1.935536084	12.58647289	34.64748695
2.233309996	12.58541047	34.64766618
2.531083354	12.58519198	34.64912399
2.828856874	12.58746136	34.64378853
3.12663083	12.58640236	34.64259124
3.42440466	12.58669537	34.64174213
3.722177399	12.58553798	34.64911279
4.019949126	12.58744108	34.64796361
4.317721429	12.58815212	34.64168961
4.615493816	12.58596732	34.64387795
4.913265602	12.58661335	34.64368743
5.211037255	12.58665883	34.64226216
5.50880852	12.58606935	34.64404264
5.806579208	12.58704895	34.64452413
6.104350519	12.58473557	34.63519682
6.402121663	12.58631242	34.64286861
6.699891696	12.58588418	34.64239444
6.99766281	12.58695543	34.6304645
7.29543412	12.58892059	34.63845533
7.593203668	12.5877338	34.64335915

7.844935276	12.5887504	34.64692147
0.148894271	12.58502662	34.64749262

CAST 3

Data Header

% Device	10G100653
% File name	10G100653_20140730_103011
% Cast time (local)	30/07/2014 11:30
% Sample type	Cast
% Cast data	Processed
% Location source	GPS
% Start latitude	57.879447
% Start longitude	-6.6760986
% Start GPS horizontal error(Meter)	1.639999986
% Start GPS vertical error(Meter)	2.75
% Start GPS number of satellites	8
% Cast duration (Seconds)	40
% Samples per second	5
Calibration Date	March 2013
Calibration offset for Temperature	-0.033
Calibration offset for Salinity	0.029

CTD data (calibration offsets applied)

Depth (Meter)	Temperature (Celsius)	Salinity (Practical Salinity Scale)
0.148895498	12.58752082	34.63612324
0.446669206	12.58870954	34.62987127
0.744448411	12.58653851	34.63669695
1.042227546	12.58917287	34.62764323
1.340007313	12.58878168	34.62869169
1.637787151	12.58978983	34.62420579
1.935566527	12.58979137	34.63008103
2.233345469	12.5888956	34.62487819
2.53112425	12.58777608	34.62804239
2.828902104	12.58757293	34.62981482
3.12667966	12.58544377	34.62713716
3.424457783	12.5863282	34.62149697
3.722235753	12.58519493	34.62546453
4.020013213	12.58674982	34.62318271
4.317790618	12.58598951	34.62318283
4.615567597	12.58596486	34.62380635
4.913344349	12.58445869	34.62185517
5.211121122	12.58486389	34.62038012
5.508897148	12.58423837	34.62546708
5.806671937	12.58633078	34.62878465
6.104446591	12.58529849	34.62397351

6.27586003	12.58856868	34.62514051

CAST 4

Data Header

% Device	10G100653
% File name	10G100653_20140730_103224
% Cast time (local)	30/07/2014 11:32:24
% Sample type	Cast
% Cast data	Processed
% Location source	GPS
% Start latitude	57.8792875
% Start longitude	-6.6753586
% Start GPS horizontal error(Meter)	1.320000052
% Start GPS vertical error(Meter)	2.200000048
% Start GPS number of satellites	9
% Cast duration (Seconds)	38
% Samples per second	5
Calibration Date	March 2013
Calibration offset for Temperature	-0.033
Calibration offset for Salinity	0.029

CTD data (calibration offsets applied)

Depth (Meter)	Temperature (Celsius)	Salinity (Practical Salinity Scale)
0.148896315	12.58191505	34.62679217
0.446671372	12.58310233	34.62707812
0.744451685	12.5827097	34.62863108
1.042231407	12.58474606	34.62977346
1.340010374	12.58436418	34.63280668
1.637789714	12.58607199	34.62381991
1.935570721	12.58712041	34.61573702
2.233351252	12.58700019	34.62531615
2.531132564	12.58727382	34.60587314
2.828913391	12.58567318	34.62632695
3.126692825	12.5867879	34.61516423
3.424471947	12.58482103	34.62592697
3.722249785	12.5860036	34.62340841
4.020027186	12.58595969	34.62713153
4.317804471	12.58728974	34.62180831
4.615580861	12.58727902	34.63246124
4.913356167	12.58631774	34.62822472
5.211131721	12.58671255	34.62715211
5.508907489	12.58599957	34.62328016
5.806682694	12.58553663	34.62889977
6.104457351	12.58574236	34.62511038
6.402234093	12.58851421	34.60817112
6.700010584	12.5884379	34.6250535
6.99778487	12.58796052	34.62467052
7.295558501	12.58746859	34.62767245

7.700546737	12.59078595	34.62587592