Scottish Sanitary Survey Review

Vaila Sound

SI-288 and SI-289

January 2015

Cefas

Food Standards Agency
food.gov.uk

Report Title	Vaila Sound Sanitary Survey Review
Project Name	Scottish Sanitary Survey
Client/Customer	Food Standards Agency Scotland
Cefas Project Reference	C6316D
Document Number	C6316D_2014_18
Revision	V1.0
Date	27/02/2015

Revision History

Revision number	Date	Pages revised	Reason for revision
0.1	13/01/2015	-	Draft for external consultation
1.0	27/02/2015	iv,v,vi,17,23,35,37,39	Amend sampling officers, minor corrections to text and formatting

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Review Specification and Introduction

Sanitary surveys are used to demonstrate compliance with the requirements stated in Annex II (Chapter II Paragraph 6) of Regulation (EC) 854/2004, whereby if the competent authority decides in principle to classify a production or relay area it must:

- make an inventory of pollution sources of human/animal origin likely to be a contamination source for the production areas;
- examine the quantities of organic pollutants which are released during the different periods of the year, according to the seasonal variations of both human and animal populations in the catchment area, rainfall readings, wastewater treatment, etc.;
- determine the characteristics of the circulation of pollutants by virtue of current patterns, bathymetry and the tidal regime in the production area;
- establish a sampling programme of bivalve molluscs in the production area which is based on the examination of established data, and with a number of samples, a geographical distribution of the sampling points and a sampling frequency which must ensure that the results of the analysis are as representative as possible for the area considered.

The EURL Good Practice Guide (GPG) for the monitoring of bivalve molluscs harvesting areas recommends the re-evaluation of sanitary surveys every six years. Location, extent and nature of fisheries and faecal pollution sources may change over time and the review is conducted to determine whether the sampling plan and/or production area boundaries remain appropriate and protective of public health.

As specified by the Food Standards Agency, this review is comprised of a brief desktop search of publicly available information together with a shoreline survey. No additional data requests are submitted to external bodies. The review is intended to identify significant changes in:

- Historic microbiological data.
- Sewage treatment and sewerage infrastructure.
- Housing and development.
- Harvester operations.

The output of the review is a report identifying any new information that has been obtained and/or whether major elements of the original sanitary survey can be regarded as essentially unchanged. That report includes an overall assessment as to whether the production area/classification zone boundaries and/or RMPs should be modified from those recommended in the original report and if so, a description of the revised boundaries and a revised sampling plan with the boundaries and RMP(s) locations.

A sanitary survey was undertaken for Vaila Sound in 2009. The survey was conducted to identify the location, extent and nature of the shellfishery and the potential sources of faecal contamination to the shellfishery, and to recommend boundaries and sampling plans for the production areas. The associated shoreline survey was undertaken in July 2008.

The output of the sanitary survey included a report and recommended sampling plans for three production areas within the sound:

Vaila Sound: Linga

Vaila Sound: East of Linga & Galtaskerry

Vaila Sound: Riskaness

These sampling plans are identified on the following pages alongside the recommended changes following findings from this review.

The present report constitutes a review of publicly available information in order to assess changes that have occurred since the 2009 sanitary survey report (see the Review Specification section for further detail). It is not intended to present detailed information relating to pollution sources that were identified in the previous report. This review should be read in conjunction with the 2009 sanitary survey report.

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APPENDICES

Sampling Plan – Vaila Sound Linga

	2009 sanitary survey	2014 review	Changes
PRODUCTION AREA	Vaila Sound: Linga		No change
SITE NAMES	Linga		
SIN	SI-288-457-08		
SPECIES	Common mussels		
TYPE OF FISHERY	Long-line		
NGR OF RMP	HU 2393 4842		
EAST	423930		
NORTH	1148420		
TOLERANCE (M)	20	40	Changed to allow for a greater movement of mussel lines
DEPTH (M)	1		No change
METHOD OF SAMPLING	Hand		
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Shetland Islands Council		
AUTHORISED SAMPLER(S)	Sean Williamson George Williamson Kathryn Winter Marion Slater	Sean Williamson Marion Anderson Gwen Williamson	Change in personnel
RECOMMENDED PRODUCTION AREA	Area bounded by lines drawn between HU 2382 4832 and HU 2382 4858 and between HU 2382 4858 and HU 2432 4858 and between HU 2432 4858 and HU 2432 4824 and between HU 2432 4824 and HU 2405 4824 extending to MHWS		No change

Sampling Plan – Vaila Sound: East of Linga

	2009 sanitary survey	2014 review	Changes
PRODUCTION AREA	Vaila Sound: East of Linga and Galtaskerry	Vaila Sound: East of Linga	Changed to reflect currently operational sites within the area
SITE NAME	Galtaskerry	Whitesness	
SIN	SI-288-456-08	SI-288-1061-08	
SPECIES	Common mussels		No change
TYPE OF FISHERY	Long-line		
NGR OF RMP	HU 2440 4703	HU 2442 4758	Changed to reflect currently operational sites within the area
EAST	424400	424420	
NORTH	1147030	1147580	
TOLERANCE (M)	20	40	Changed to allow for greater movement of mussel lines
DEPTH (M)	1		No change
METHOD OF SAMPLING	Hand		
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Shetland Islands Council		
AUTHORISED SAMPLER(S)	Sean Williamson George Williamson Kathryn Winter Marion Slater	Sean Williamson Marion Anderson Gwen Williamson	Change in personnel
RECOMMENDED PRODUCTION AREA	Area bounded by lines drawn between HU 2480 4809 and HU 2409 4812 and between HU 2388 4766 and HU 2433 4689 extending to MHWS		No change

Sampling Plan – Vaila Sound: Riskaness

	2009 sanitary survey	2014 review	Changes
PRODUCTION AREA	Vaila Sound: Riskaness		No change
SITE NAME	Riskaness		
SIN	SI-289-458-08		
SPECIES	Common mussels		
TYPE OF FISHERY	Long-line		
NGR OF RMP	HU 2312 4831*		
EAST	423120		
NORTH	1148310		
TOLERANCE (M)	20		
DEPTH (M)	1		
METHOD OF SAMPLING	Hand		
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Shetland Islands Council		
AUTHORISED SAMPLER(S)	Sean Williamson George Williamson Kathryn Winter Marion Slater	Sean Williamson Marion Anderson Gwen Williamson	Change in personnel
RECOMMENDED PRODUCTION AREA	Area bounded by lines drawn between HU 2290 4848 and HU 2317 4862 and between HU 2342 4842 and HU 2360 4800 and between HU 2360 4800 and HU 2214 4800 and between HU 2214 4800 and HU 2204 4831 extending to MHWS		No change

Note: *in the 2009 sanitary survey report a second RMP was recommended at HU 2221 4831 (Lera Voe) in order to support an extended bacteriological survey over a period of a year.

1. Area Description and Fishery

The location of Vaila Sound is shown in Figure 1.1.

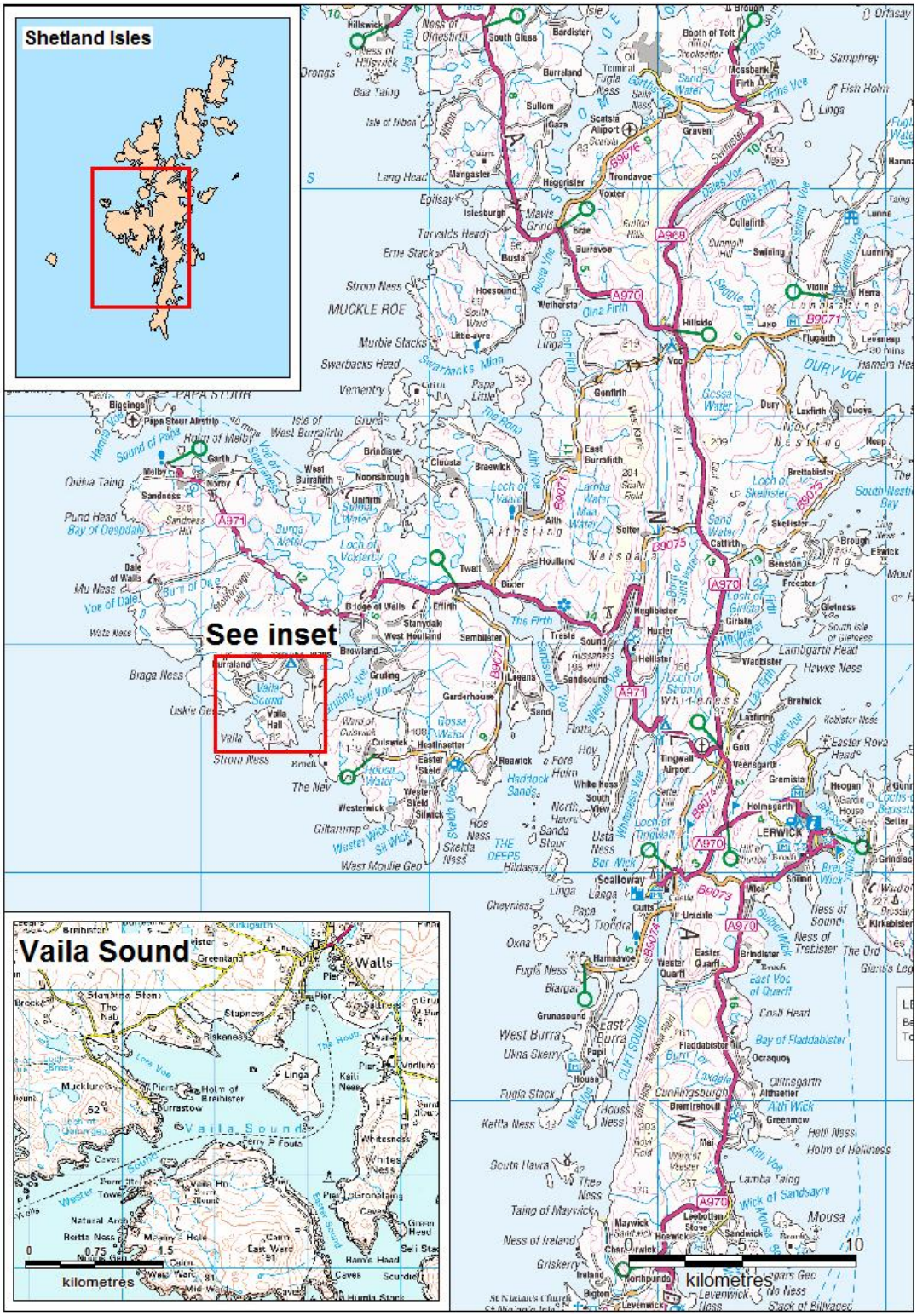

Figure 1.1 Location of Vaila Sound

At the time of the 2008 shoreline survey, the production area contained five separate long-line mussel farm sites. The currently classified production areas and sites are given in Table 1.1.

Table 1.1 Currently classified shellfish farms in Vaila Sound

Production area	Site	SIN	Species	RMP
Vaila Sound: Linga	Linga	SI-288-457-08	Common mussels	HU 2393 4842
Vaila Sound: East of Linga and Galtaskerry	East of Linga	SI-288-455-08	Common mussels	HU 2439 4706
	Whitesness	SI-288-1061-08		
Vaila Sound: Riskaness	Lera Voe	SI-289-805-08	Common mussels	HU 2312 4831
	Riskaness	SI-289-458-08		

The location of the current RMPs and production area boundaries as identified in the 2014/15 FSAS classification document are displayed in Figure 1.2. The Linga and Riskaness production areas and RMPs remain unchanged from those recommended in the 2009 sanitary survey report. The boundaries of the East of Linga & Galtaskerry production area also remains unchanged. The location of the currently specified RMP for this production area is slightly different from that recommended in the 2009 sanitary survey report (HU 2440 4703): the current RMP lies on the now defunct Galtaskerry site.

Site boundaries as reported in the 2008 and 2014 shoreline surveys are shown in Figure 1.2. Information on the five operational sites from the 2014 shoreline surveys is as follows:

- Linga: has increased from six to eight double-headed long-lines, with dropper length remaining at 8 m. The site is licensed for five 200 m quad-headline long-lines.
- East of Linga: has stayed the same with five double-headed long-lines, which were reported to be 200 m long in the 2014 survey. The dropper length has increased from 8 m to 8-15 m. The site is licensed for five 18 m twin-headline long-lines.
- Galtaskerry: this site is no longer in operation.
- Whitesness: five 440 m double headed long-lines, with 12-15 m droppers. The site is licensed for six 440 m twin-headline long-lines. This site commenced operation since the 2009 sanitary survey report was produced.
- Lera Voe: consists of five 220 m double-headed long-lines. The dropper length has increased from 8 m to 8-10 m. The site is licensed for five 270 m twin-headline long-lines.

- Riskaness: has increased from six to nine double-headed long-lines. The dropper length has decreased from 10 m to 8-10 m. The site is licensed for six 220 m quad-headline long-lines.

Harvesting takes place year-round at the East of Linga, Lera Voe, Riskaness and Whiteness sites. Linga is harvested as required: a workboat was noted harvesting the site at the time of the 2014 shoreline survey.

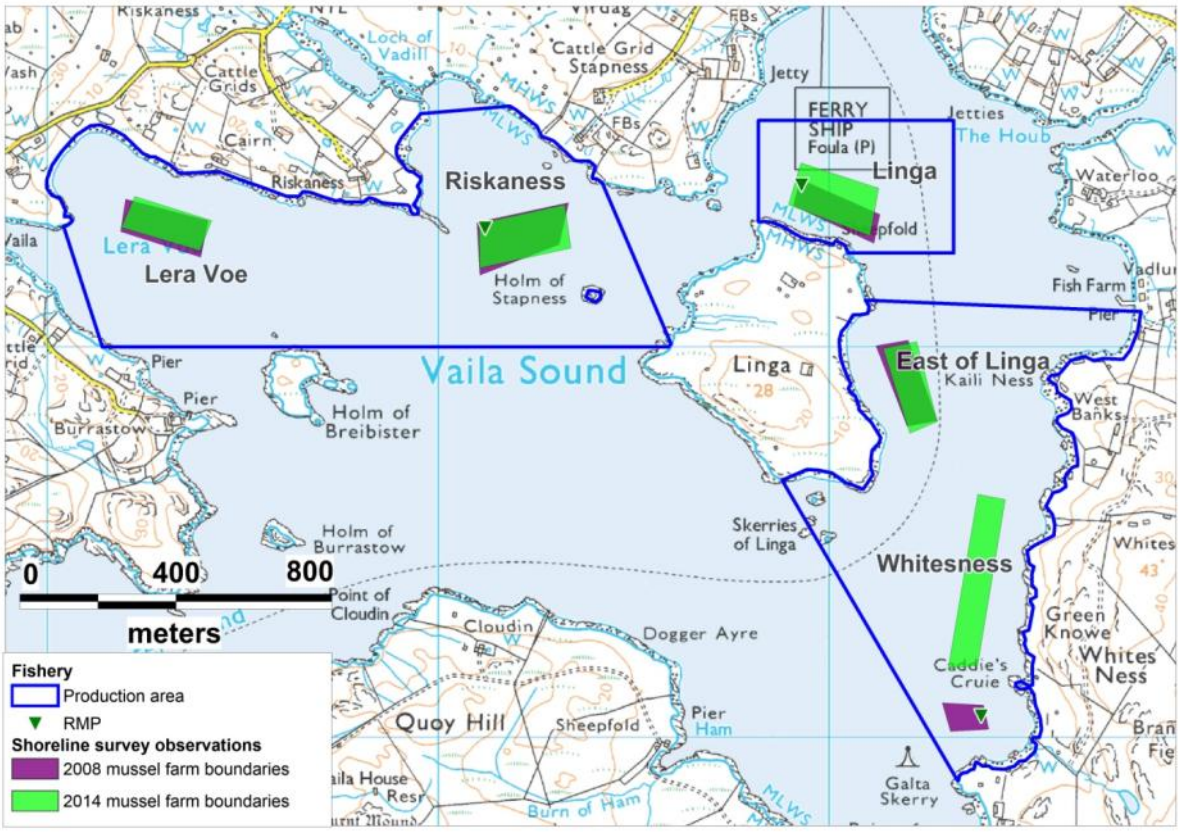

Figure 1.2 Vaila Sound fisheries

2. Population and Human Sewage Impacts

2.1 Population

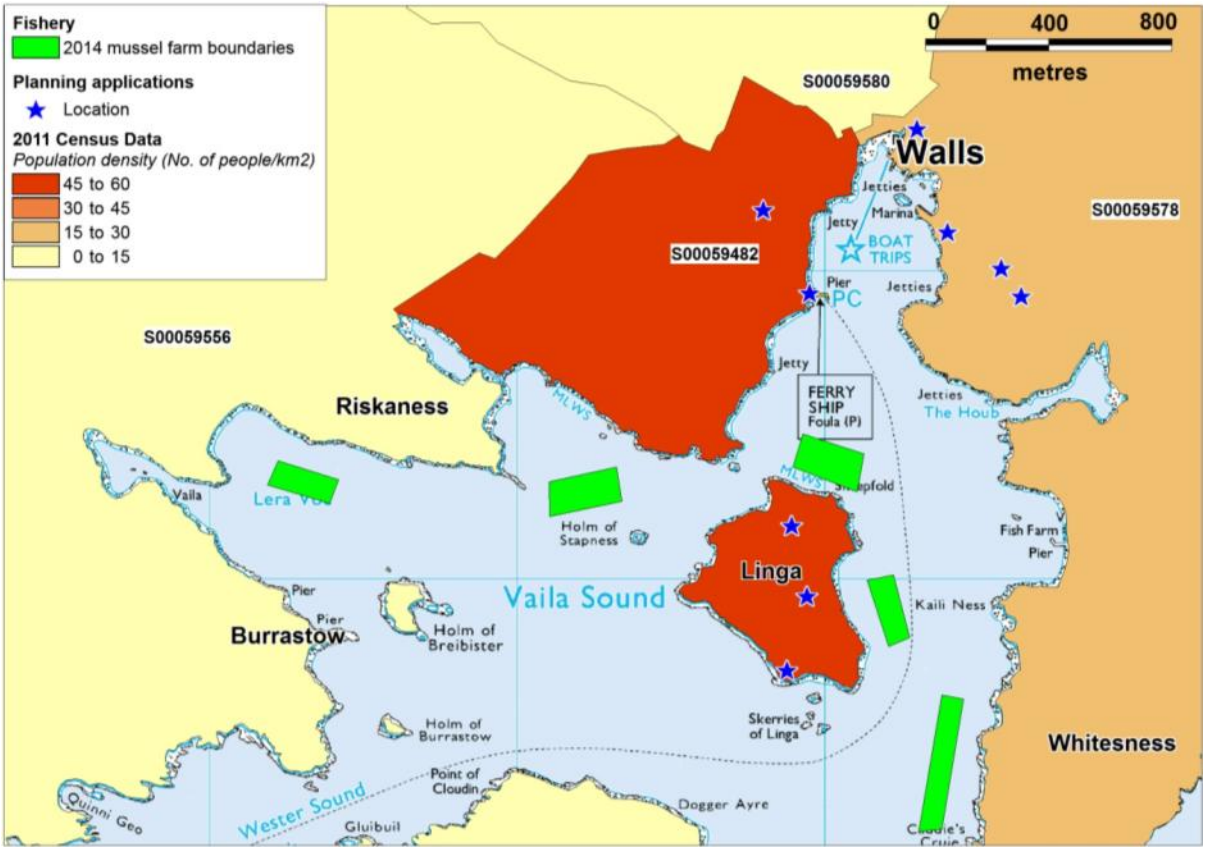

Figure 2.1 Distribution of human population around Vaila Sound

It should be noted that although the islands of Linga and Holm of Breibister are included in population census output areas, and thus are thematically mapped by population density of their associated areas, they have been uninhabited in recent times.

Population data from the General Register Office for Scotland from both the 2001 and 2011 censuses are shown in Table 2.1.

Table 2.1 Scottish Government Census data for years 2001 and 2011

2001 Census data		2011 Census data	
60RD000134	147	S00059556	163
60RD000028	188	S00059482	85
		S00059580	96
60RD000029	190	S00059578	108
TOTAL	**525**	**TOTAL**	**452**

Overall, total human population around Vaila Sound has decreased between 2001 and 2011. The major change was a decrease reported in the area to the east of the

sound. Human population remains centred around the hamlet of Walls at the head of the sound.

Walls contains local amenities including a nursery and primary school with 55 pupils (Happyhansel Primary School, 2014), a church and grave yard, a community hall, GP surgery and several shops. It also contains a care home for people over 16 and has a capacity of 15 residents (Carehome.co.uk, 2014). Holiday accommodation is limited. A camping bod accommodating 16 people was noted on the west side of Walls. It operates seasonally between the 1st April and 31st October (Shetland Amenity Trust, 2014). A small hotel and an unoccupied holiday cottage were noted at Burrastow, on the southeast shore of Lera Voe.

Nine planning applications pertaining to areas around Vaila Sound have been approved since the 2009 sanitary survey report. These applications were downloaded from the Shetland Island Council Planning Portal in November 2014 (Shetland Islands Council, 2014), with full details listed in Appendix 1. Locations of these planning applications are displayed in Figure 2.1.

Out of the nine applications, eight related to dwelling houses and one related to renovations at the Foula ferry pier. Three of the dwelling house applications were for houses on the presently uninhabited Island of Linga. Further information on these permitted plans was returned during an internet search undertaken for this review. It indicated the island had been put up for sale in November 2014 and permitted planning consents included the building of a pier with storage/reception sheds, agricultural buildings, the rebuilding of two derelict cottages and the erection of a new cottage (Neil Risk, Solicitor, 2014). All three applications identified that sewage would go to new septic tanks (STs) with reed bed soakaways.

The remaining five planning applications related to dwelling houses on the mainland, with the majority situated around Walls. Three indicated plans to connect to mains sewage, one would use an existing connection and one specified installation of a new ST to soakaway and was located near the jetties in Walls.

The planning application pertaining to the renovations at Foula ferry terminal/pier was made in 2010 and included the construction of a new pier and breakwater, erection of a ferry building with storage and the relocation of the ST. The application indicated that the ST would have a marine outfall. Major renovations were taking place at the Foula ferry pier at the time of the 2014 shoreline survey .

Boat traffic remains associated with the Foula ferry, workboats servicing local aquaculture sites and pleasure yachts/boats.

During the 2014 survey, the Foula ferry and three workboats were observed at the Foula pier. Twenty-five mixed use boats were moored at Walls pier and marina whilst a jetty with a pontoon with two moored sailing boats were noted at Walls

Regatta club house just north of Walls pier. Several other piers, jetties and moorings were recorded at locations around the sound. A number of those piers and jetties are shown on the background OS map in Figure 2.1.

The Foula ferry operates twice a week during the winter, increasing to three times over the summer from the 1st May (B.K. Marine Ltd, 2014). An annual Round Foula Yacht Race and Walls Regatta take place in July and start from the Walls Regatta Club boat house (Shetland News, 2013), though attendance to the race has declined over recent years.

2.2 Sewage Discharges

The 2009 sanitary survey report included information on three community discharges and four domestic STs to soakaway. A summary of these discharges can be found in the sanitary survey report: the locations are displayed in Figure 2.2. The 2008 shoreline survey also identified a large number of additional private sewage inputs. These were mostly located around Walls, with several also recorded adjacent to the Lera Voe, Riskaness and East of Linga sites. One overflowing sewage discharge pipe was noted approximately 290 m northwest of the Riskaness site, with a dripping discharge pipe also noted to the north in Walls. Overall, the highest contamination impacts from sewage were expected at the Linga site, though Lera Voe and Riskaness sites would also experience low levels from private discharges on nearby shorelines.

Sewage discharge information stated in the 2011 Shellfish Growers Water (SGW) report for Vaila Sound is listed in Table 2.2 and mapped in Figure 2.2.

Table 2.2 Sewage discharges identified in the 2011 SGW for Vaila Sound

Type	Name	Treatment	Consent No.	NGR	PE	Additional Information
Scottish Water Asset	Walls ST	ST (discharges to below low water at all tidal stages)	CAR/L/1002294	HU 243 489	260	Installed 2000
	Foula ferry pier	-	SD42	HU 239 489	<50	-
Other	Single private household ST	ST	-	-	<100	-

- No information provided.

The SGW report states information on the two community STs that varies from the Scottish Water and SEPA information given in the 2009 report. The SGW report identifies the Walls ST as being approximately at the location given for Saltness ST in the 2009 sanitary survey report. It also gives Foula ferry pier ST as being approximately at the location given for Walls ST in the 2009 report. The precise locations variedfrom those given in the 2008 sanitary survey report and from locations recorded during the shoreline survey. It was noted in the sanitary survey that the Saltness ST served the majority of the community of Walls, and that the

Walls ST served only a small number of properties around the ferry pier.The population equivalent (PE) value given for the Walls/Saltness ST in the sanitary survey report is much lower(70) than that shown in Table 2.2. The consented PE was given in the sanitary survey report and it is assumed that the design PE was given in the SGW report.

The SGW report did not include any information relating to the Walls pumping station (PS). However, the SGW report did provide information on a single private household ST with a PE of <100. No spatial data was included, the location of this discharge in Vaila Sound remains unclear. The 2014 shoreline survey included 30 sewage related observations. These are listed in Table 2.3 and displayed in Figure 2.2.

Table 2.3 Sewage-related observations at Vaila Sound - 2014 shoreline survey

No.	NGR	Description
1	HU 2232 4784	White pipe running into sea, end not visible underwater, slight sewage smell.
2	HU 2202 4806	Old concrete septic tank below house on shore side of road, no outfall noted. One house on upper side of road.
3	HU 2191 4819	Septic tank associated with recently built dwelling house, outflow with discoloured water and slight sewage smell.
4	HU 2187 4826	One dwelling house and associated septic tank with outflow to sea; end of pipe not visible underwater, slight smell.
5	HU 2163 4837	Small self-catering holiday chalet at head of voe, septic tank close to shore with channel cut leading to sea. Some odour.
6	HU 2192 4833	One dwelling house on hill above shore, possible discharge point to sea in armoured stone, no tank identified.
7	HU 2199 4847	One dwelling house, plastic septic tank, overflowing with raw sewage near shoreline. Not actively discharging onto beach. Seawater sample VAL-SW-01 result 35 *E. coli* cfu/100 ml.
8	HU 2264 4865	One dwelling house with septic tank identified some distance from shoreline.
9	HU 2279 4840	Septic tank with no active discharge.
10	HU 2283 4839	Plastic pipe leading into sea, end of pipe not visible underwater so unable to establish if currently discharging. No source identified.
11	HU 2327 4855	Concrete duct running into sea, no source identified.
12	HU 2364 4848	Concrete septic tank for dwelling house, no outflow noted, appears to flow to soakaway near beach.
13	HU 2381 4872	One dwelling house above shoreline, septic tank with plastic pipe to underwater.
14	HU 2389 4887	Concrete septic tank with sewer pipe to underwater, end of pipe not visible so not known if discharging. Two dwelling houses above road.
15	HU 2396 4891	Large pier, part of which has been recently constructed. Public toilets at end of older pier still in use, though a waste pipe was running from the toilets back towards the shore. Store building has been constructed and will also house public toilets. Location of Walls ST. Three dwelling houses at head of pier above road.
16	HU 2396 4894	Dwelling house in close proximity to shoreline. Cast iron discharge pipe noted but not accessible due to high tide. Tide too high for surveyors to access shoreline where two other discharges were reported. Two dwelling houses immediately above road.
17	HU 2428 4949	Public toilets in Walls

No.	NGR	Description
18	HU 2427 4943	Walls Sewage Pumping Station. No outfall observed.
19	HU 2433 4933	White 12 cm plastic sewer pipe, end not visible underwater. One dwelling house close to shoreline, large concrete land drain ending in the sea, not clear if actively discharging into water.
20	HU 2437 4925	Plastic pipe discharging underwater, end of pipe not visible.
21	HU 2434 4918	White plastic pipe dripping into sea beyond marina walkway.
22	HU 2439 4905	Ceramic sewer pipe with no flow.
23	HU 2439 4893	Saltness ST, no visible outflow.
24	HU 2469 4834	Septic tank obscured by grass, no visible outflow, two dwelling houses above.
25	HU 2478 4817	Concrete cast outfall to beach with clear discharge. Area around water egress contains some shell debris from factory above. Depuration plant seawater intake pipes positioned above.
26	HU 2478 4814	Emerging from rock armouring between pier and depuration pontoon are 5 plastic pipes draining onto beach and 1 outfall not visible underwater associated with septic tank. Included one orange pipe with cloudy discharge. Seawater sample collected from beach VAL-SW03 70 *E. coli* cfu/100 ml.
27	HU 2478 4813	Septic tank with outflow underwater, end of pipe not visible. Positioned in front of mussel factory.
28	HU 2481 4805	Location of septic tank for dwelling house, not observed as in home owner's garden.
29	HU 2475 4781	Septic tank associated with property above, no overflow visible, possibly disused, no smell.
30	HU 2471 4779	Second concrete septic tank and soakaway, in use, also associated with dwelling house above.

Observations were made at two community STs and at Walls PS.These locations coincided with those observed in 2008. Public toilets were noted at two locations near the foreshore at Walls: the area has mains sewerage and therefore both may be connected to this.

The majority of pipes noted during the 2014 survey ended beneath the sea surface and it was not possible to determine whether they were discharging at the time of the survey. This included the two overflowing discharge pipes identified during the 2008 shoreline survey. The 2014 survey did identify that a ST had recently overflowed on the southwest shoreline, adjacent to the Lera Voe site. A seawater sample taken adjacent to the overflow returned a result of 35 *E. coli* cfu/100 ml. A second seawater sample was taken adjacent to a ST to sea outfall associated with Shetland Mussels shore-base, southeast of the sound. The sample was taken close to a cloudy discharge area observed and returned a result of 70 *E. coli* cfu/100 ml. Neither result indicates marked faecal contamination at the sampling location at the time of sampling.

Conclusions

Human population around Vaila Sound is moderate with respect to Shetland (although low compared to other parts of the UK) and is centred predominantly around Walls at the head of the sound. Outside of Walls, dwellings are located along

roads at several points around the sound, and some of these are located near to mussel farms. Sewage contamination is expected to be greatest in the vicinity of Walls and this will principally affect the Linga site. Contamination from private septic tanks will affect other locations around the sound with impacts anticipated to be greatest at the Lera Voe and Riskaness sites. Additional input of human sewage may come from the overboard discharge of marine toilets from boats. Habitation of the isle of Linga may cause additional localised inputs to the area.

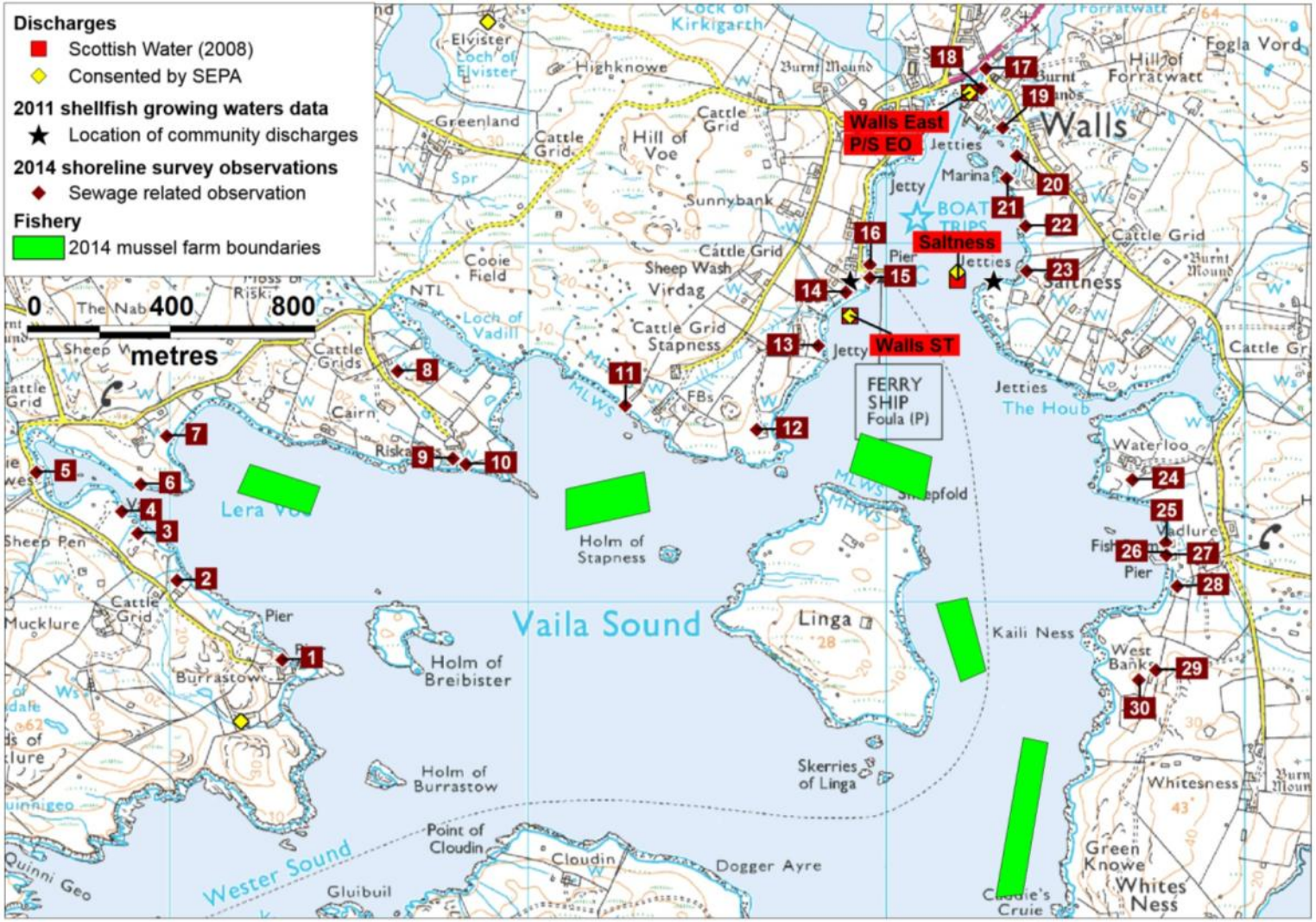

Figure 2.2 Map of sewage discharges in the vicinity of Vaila Sound

3. Farm Animal Population and Agricultural Impacts

Farm census data was provided by Scottish Government in support of the 2009 sanitary survey report. The data indicated that sheep were the dominant species kept on the surrounding land. This was supported by observations made during the 2008 shoreline during which 363 sheep were observed. Low numbers of pigs and cattle were also seen. As livestock were evenly distributed along the coastline, it was concluded that no single mussel site would be impacted to a greater extent than the others. It was noted that the number of sheep observed was likely to be approximately double the winter population, owing to the shoreline survey having taken place shortly after the lambing season.

More recent information on agricultural based contamination sources was been obtained through a shoreline survey conducted in September 2014 and by means of an internet search.

The locations of agriculture-related observations made during the 2014 shoreline survey are shown in Figure 3.1. Slightly fewer sheep (311) were recorded during the 2014 survey than during the 2008 survey and this may reflect the difference in time of year during which the two surveys were conducted. Sheep were evenly distributed along the coastline, with droppings also noted in fields without sheep. Eight cattle were observed in a field south of Walls with cattle faeces also noted in the adjacent field. Cattle hoof prints were observed on the adjacent shoreline. One cow was also noted in a field in the vicinity of Lera Voe. Eight ponies were noted in a field south of Saltness. Pony manure was observed noted at other locations around the sound. Animals had direct access to the shore access around Lera Voe and along parts of the eastern shore of the sound.

Three agricultural sheds were also reported on the western side of the side (around and near Lera Voe). The purpose of these were not clear but, if used for livestock, may result in significant concentrations of faecal material.

The internet search identified that an annual agricultural show takes place at Stove on the northern outskirts of Walls(Shetland Community Directory, 2009). Satellite imagery from Bing maps (http://www.bing.com/maps/) showed that crofted areas generally coincided with the locations of the farm animal observations.

Conclusions

Sheep remain a significant source of faecal contamination to shellfisheries in Vaila Sound, with smaller inputs expected from cattle and ponies kept near Walls. The Lera Voe site may be exposed to the greatest extent of contamination from farm animal sources as it is surrounded on three sides by land used for sheep grazing. The East of Linga site may be subject to the least contamination as only the small number of sheep on the isle of Linga are near to it.

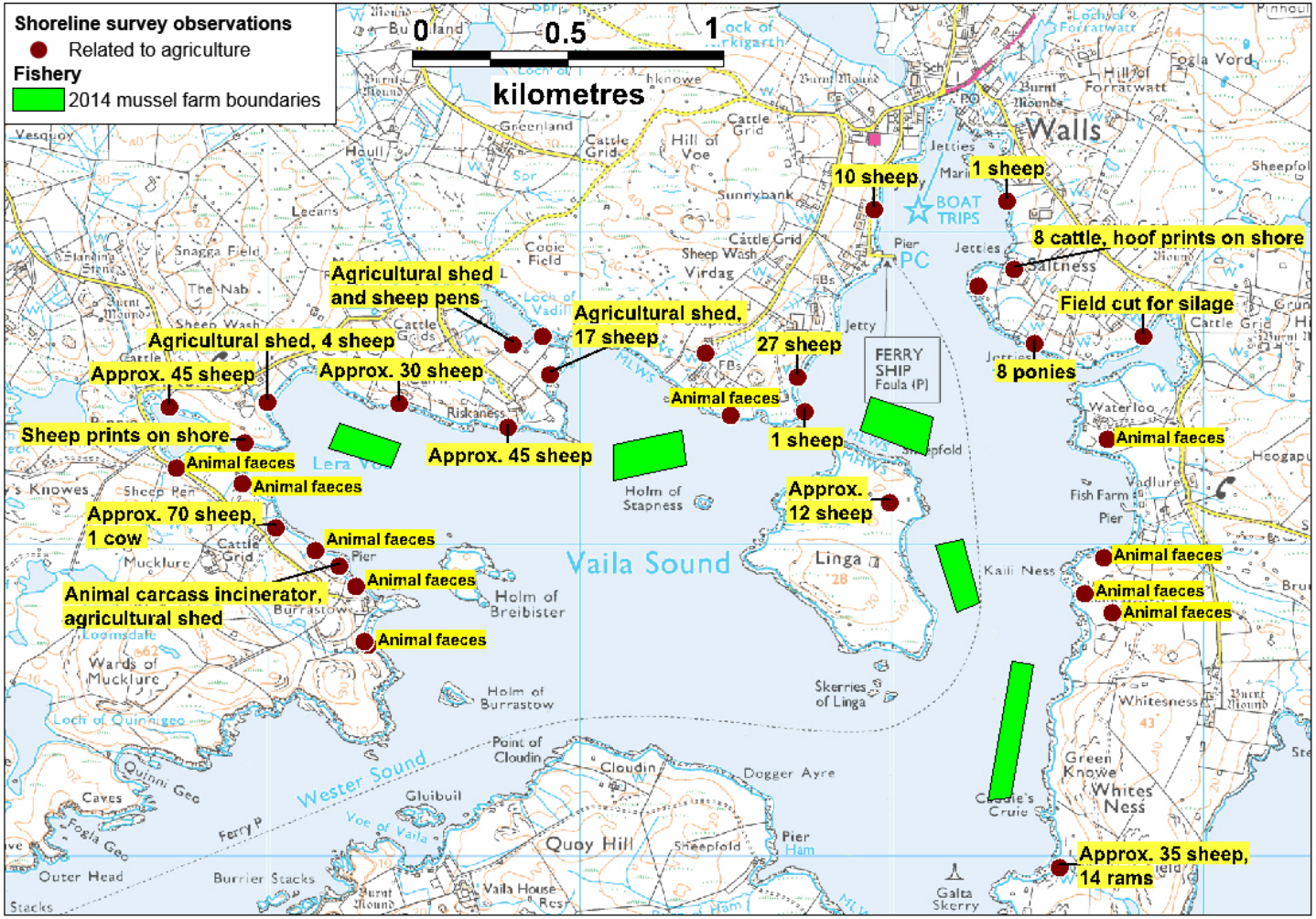

Figure 3.1 Map of 2014 shoreline survey farm animal-associated observations

4. Wildlife

The 2009 sanitary survey report concluded that geese, seabirds and seals would be the most significant wildlife contributors of faecal contamination at the sites but that wildlife impacts would be unpredictable and would affect all sites. For this review, information on pollution sources from wildlife was obtained from the JNCC collated dataset (http://jncc.defra.gov.uk/page-4460), through the 2014 shoreline survey, and via an internet search. The shoreline survey observation information only relates to the time of the survey on the 29th and 30th September 2014. Wildlife information from the JNCC dataset and observations from the 2014 shoreline survey and are displayed in Figure 4.1.

Pinnipeds

The Special Committee on Seals Report (Special Committee on Seals, 2013) identified that small populations of both common seals and grey seals are located on the west side of Shetland around Vaila Sound. The harbour seal population within Shetland is noted to have decreased between 2000 and 2010 by 30%. Data from the Marine and Spatial Plan for Shetland (NAFC Marine Centre, 2012) report highlights that common seal habitat is located to in the adjacent Voe of Browland northeast of Vaila Sound, whilst grey seal habitat is located to outside and to the west of the sound. A planning application submitted in 2010 identified plans to deploy a seal scarer next to an existing salmon farm at Burrastow, suggesting that seals are present in sufficient numbers to cause nuisance to salmon farmers in Lera Voe. Three seals were observed in Lera Voe during the 2014 shoreline survey.

Cetaceans

No additional information was found relating to cetaceans within Vaila Sound. No cetaceans were observed during the 2014 shoreline survey.

Seabirds

Seabird data was downloaded from the JNCC website (http://jncc.defra.gov.uk/page-4460) in April 2014. Data from a 5 km radius around Vaila Sound is listed in Table 4.1. In order to aid visualisation, only the records relating to locations within 3 km of Vaila Sound are displayed in Figure 4.1.

Table 4.1 JNCC seabird data for Vaila Sound

Common name	Species	Count*	Type	Accuracy
Common Gull	*Larus canus*	503	Occupied territory and nests, individuals on land	Accurate
Herring Gull	*Larus argentatus*	224	Occupied territory and nests, individuals on land	Accurate
Lesser Black-Backed Gull	*Larus fuscus*	2	Occupied territory	Accurate
Great Black-Backed Gull	*Larus marinus*	362	Occupied territory and nests, individuals on land	Accurate
Black-Headed Gull	*Chroicocephalus ridibundus*	212	Occupied territory and nests, individuals on land	Accurate
Great Skua	*Stercorarius skua*	44	Occupied territory	Accurate
Arctic Skua	*Stercorarius parasiticus*	76	Occupied territory	Accurate
Razorbill	*Alca torda*	10	Individuals on land	Accurate
Shag	*Phalacrocorax aristotelis*	624	Occupied nests	Accurate
Kittiwake	*Rissa tridactyla*	180	Occupied nests	1 unknown, 9 accurate
Arctic Tern	*Sterna paradisaea*	1046	Individuals on land and one count of occupied nests	1 estimate, 30 accurate
Fulmar	*Fulmarus glacialis*	5586	Occupied sites	Accurate
Black Guillemot	*Cepphus grylle*	137	Individuals on land	Accurate
Common Guillemot	*Uria aalge*	830	Individuals on land	Accurate
Atlantic Puffin	*Fratercula arctica*	54	Individuals on land	Accurate

*Counts for occupied nests, sites and territory were doubled, with total counts given using the adjusted data.

A large number of occupied fulmar sites were located within the 5 km of Vaila Soundbut most of these were located at Culswick, more than 4 km to the southeastof Vaila Sound. However, there were also large numbers recorded on both sides of Wester Sound to the souithwest of Vaila Sound. A large number of European shag nests and moderate numbers of Arctic tern and common guillemots were also reported. It is expected that contamination from birds will be greatest during the general breeding season (May to October.

Cormorants and common gulls were observed frequently during the 2014 shoreline survey, with cormorants observed resting on the buoys at Lera Voe, Riskaness and Linga sites. Common gulls were noted on buoys at Whitesness. Bird droppings were observed on buoys at all sites. Shell debris, suggesting bird feeding areas, were noted on land northeast of Riskaness and southeast of the East of Linga sites. Other birds such as sparrows, snipes and curlews were also observed.

Otters

The Eurasian otter (*Lutra lutra*) is common in Shetland, which hosts approximately 12% of the UK population (Shetland Otters, 2014). There are no scientific reports on

otters within Vaila Sound and no suitable otter habitat in the sound was identified in the 2012 Marine and Spatial Plan for Shetland. However, anecdotal accounts suggest otters reside within Vaila Sound (Shetland Amenity Trust, 2010). Otters are also noted to reside on the Island of Linga, particularly the southeast corner of the island (Neil Risk, Solicitor, 2014), with planning applications noting the need to undertake action to reduce impacts of planning on the islands otter population. No otters were observed during the 2014 shoreline survey.

Conclusion

The predominance of seabird nesting sites to the southwest of the sound implies that the mussel sites located on the western side of the sound may be subject to a greater extent of contamination from that source. Inputs may occur at all sites from seabirds resting on buoys and this would be expected to have a greater effect at the surface. Seals may also contribute faecal indicator levels in the area.

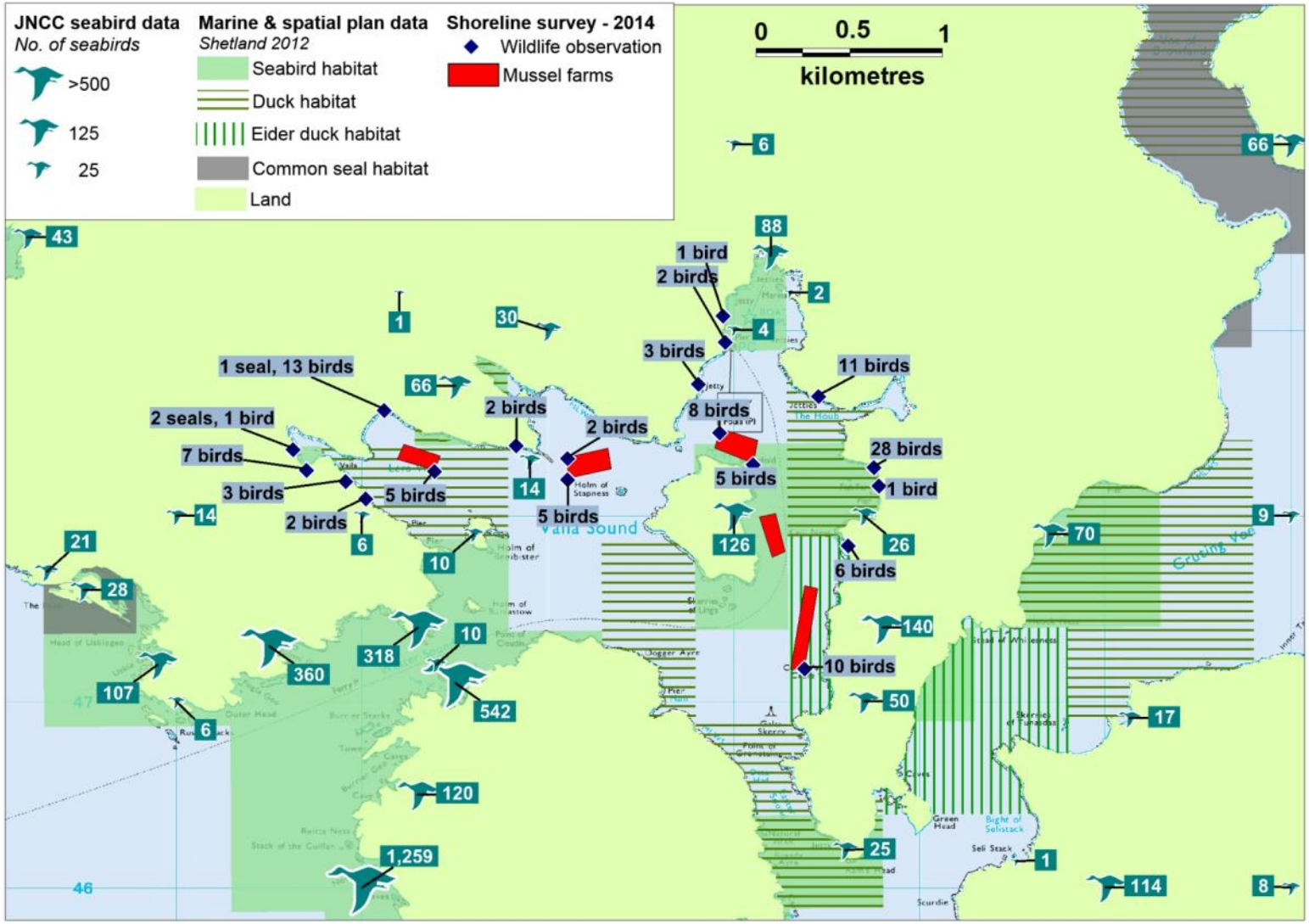

Figure 4.1 Map of wildlife in the vicinity of Vaila Sound

5. Watercourses

There are no gauging stations on watercourses entering into Vaila Sound. Information for the 2009 sanitary survey came from the shoreline survey conducted in July 2008. The sanitary survey report concluded that watercourses were important pathways by which diffuse contamination from livestock will be carried into the production areas. It identified that the majority of the observed watercourses discharged to the north shores of the sound and therefore that the Riskaness and Lera Voe sites may be more affected by them than the other sites. In addition, note was made of a small stream that discharged in close proximity to the Galtaskerry site.

Additional information for this review came from the shoreline survey undertaken in July 2014. Weather conditions during the shoreline surveys were as follows:

2008: overcast, with showers on the first day and sunny on the last day. Westerly winds varying between 16 km/hr and 22 km/hr

2014: light showers turning heavy on the first day, but remaining dry with sunny spells on the second day. Some light rainfall was recorded in the 48 hrs preceding the survey.

A comparison of watercourse loadings estimated on the basis of the 2008 and 2014 shoreline survey measurements and *E. coli* concentrations are displayed in Table 5.1. In total, fourteen watercourses were measured and sampled in the 2008 survey, nine of which were re-sampled in 2014. Sample loadings from the 2014 survey are displayed in Figure 5.1. A full list of recorded flow measurements and sample results from the 2014 shoreline survey can be found in Appendix 2.

Table 5.1 Watercourse loadings to Vaila Sound - 2008 and 2014 shoreline surveys

No.[1]	Grid Ref	Description	2009 Loading (*E. coli* per day)	2014 Loading (*E. coli* per day)
1	HU 2232 4768	Unnamed watercourse	$2.0x10^9$	$5.4x10^8$
2	HU 2191 4820	Small burn	Not determined	$1.2x10^9$
3	HU 2159 4848	Drainage via two watercourses from Loch of Breck	$1.4x10^8$	$8.9x10^7$
4	HU 2212 4858	Small burn	$8.4x10^7$	Not determined
5	HU 2259 4883	Burn of Houll	$1.0x10^{10}$	Not determined
6	HU 2327 4855	Unnamed watercourse	Not determined	$2.4x10^9$
7	HU 2480 4808	Unnamed watercourse	$5.5x10^7$	Not determined
8	HU 2475 4827	Unnamed watercourse	Not determined	Not determined
9	HU 2454 4697	Unnamed watercourse	$2.0x10^8$	$2.1x10^8$
10	HU 2404 4944	Drainage from Loch of Kirkigarth	$2.2x10^8$	$1.3x10^9$
11	HU 2428 4949	Drainage from Loch of Forratwatt	$2.8x10^9$	$6.0x10^9$
12	HU 2439 4889	Unnamed watercourse	Not determined	Not determined
13	HU 2492 4879	Drainage from Loch of Grunnavoe	$4.4x10^8$	$6.0x10^8$

[1]Corresponds to the number allocated to watercourses sampled in the 2014 survey, as shown in Figure 5.1

The highest loading calculated in the 2009 report was from the Burn of Houll, which had insufficient flow to sample or measure at the time of the 2014 survey. The highest loading estimated from the 2014 data was associated with drainage from the Loch of Forratwatt at the head of Vaila Sound. The drainage from the Loch of Kirkigarth also enters at the head of the sound.

Conclusions

Freshwater contamination loading to Vaila Sound remains low to moderate. Impacts remain highest at the Lera Voe and Riskaness sites. There is also expected to be impact to the eastern extent of the East of Linga site and the southern extent of the Whitesness site.

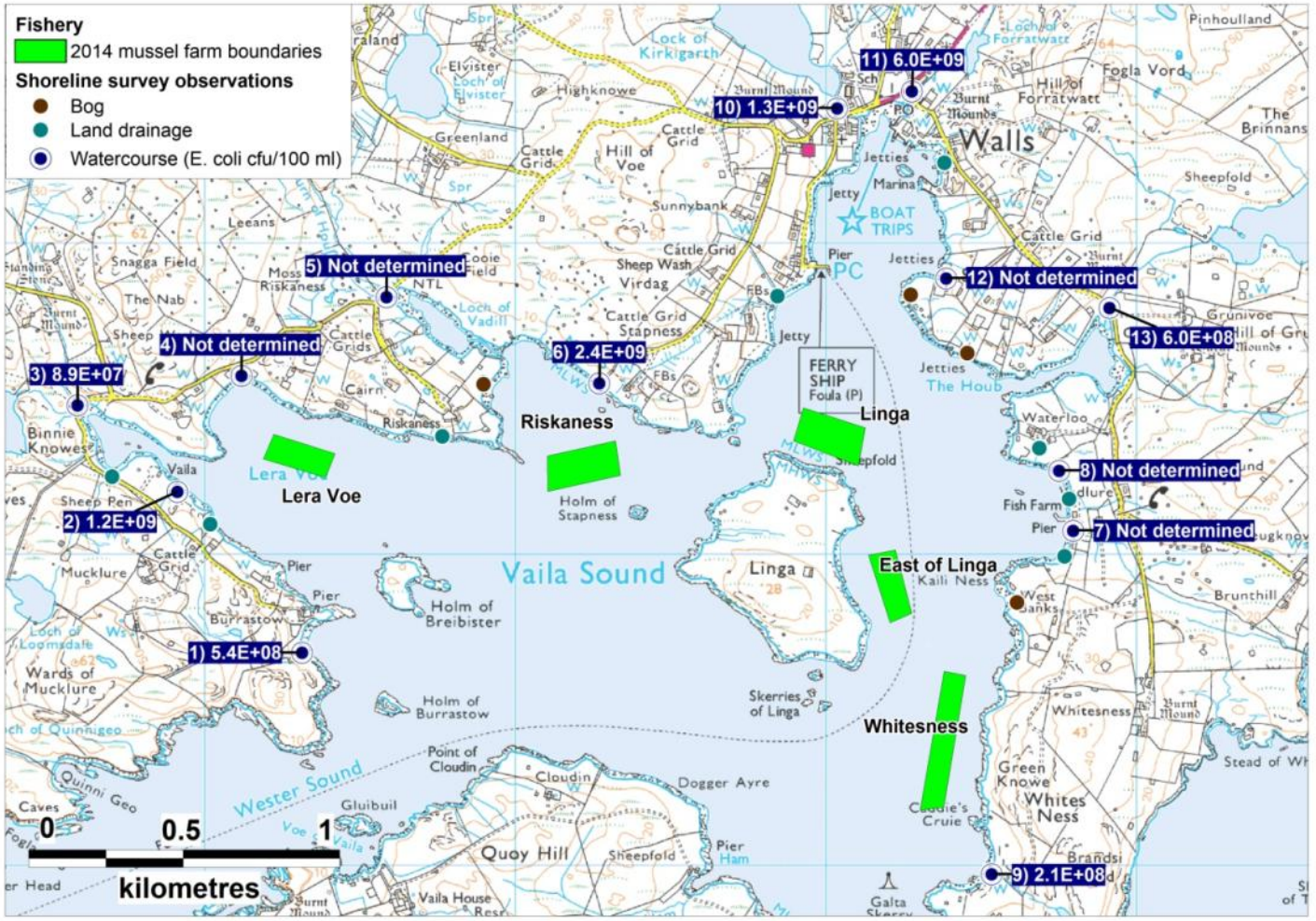

Figure 5.1 Watercourse loadings at Vaila Sound during the 2014 shoreline survey

Where the bacterial loading is labelled on the map, the scientific notation is written in digital format, as this is the only format recognised by the mapping software. So, where normal scientific notation for 1000 is $1x10^3$, in digital format it is written as 1E+03.

6. Meteorological data

Meteorological data had been purchased from the Meteorological Office for the survey period 01/01/2003-31/12/2007 for the analyses undertaken for the 2009 Vaila Sound sanitary survey report: rainfall box-plots and wind roses for 2003-2007 period are presented in that report and have not been reproduced here. Rainfall was recorded in total daily rainfall (mm) were taken from the Lerwick weather station, which lies 20 km southeast of Vaila Sound. Wind roses were also taken from the Lerwick weather station.

Meteorological data for this Review was purchased from the Meteorological Office in March 2014 for the period 01/01/2008-31/12/2013. Rainfall data from Lerwick was available for all of the survey days.

6.1 Rainfall

Storm events and high rainfall levels are commonly associated with increased faecal contamination of coastal waters through surface water run-off from land where livestock or wild animals are present and through sewer and waste water treatment plant (WWTP) overflows (Mallin *et al*, 2001: Lee and Morgan, 2003).

The Lerwick weather station rainfall dataset for 2008-2013 is presented by year in Figure 6.1 and by month in Figure 6.2.

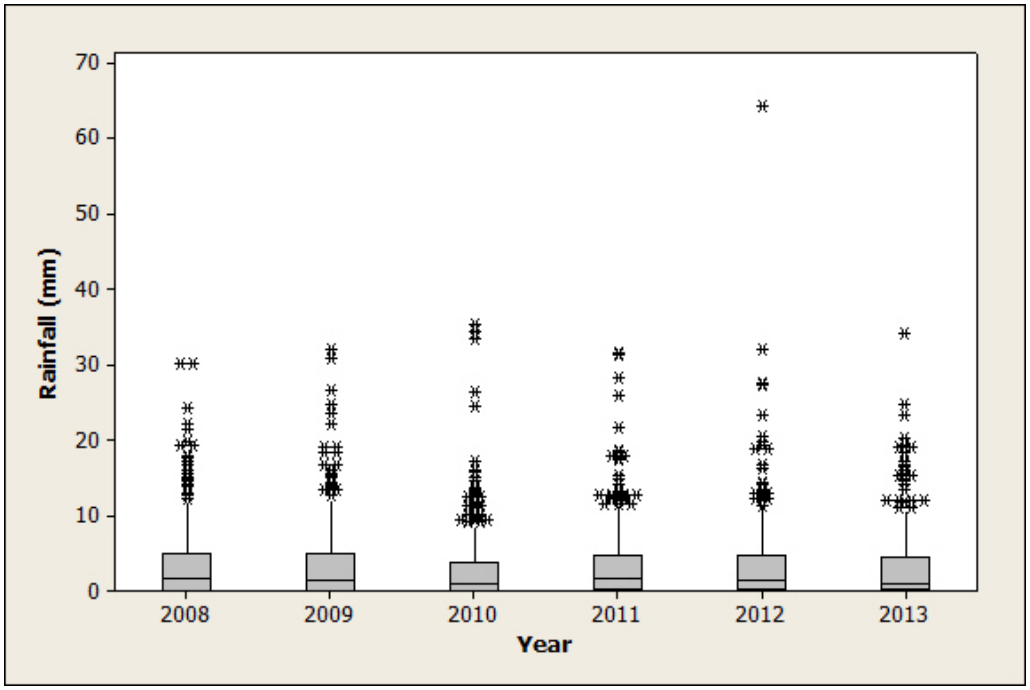

Figure 6.1 Boxplot of daily rainfall at Lerwick by year (2008-2013)

In both data sets, the bulk of the observations were below 10 mm rainfall/day, with the majority of years yielding at least one rainfall event >30 mm. Incidence of a rainfall event >60 mm occurred in both datasets: in 2004 and again in 2012.

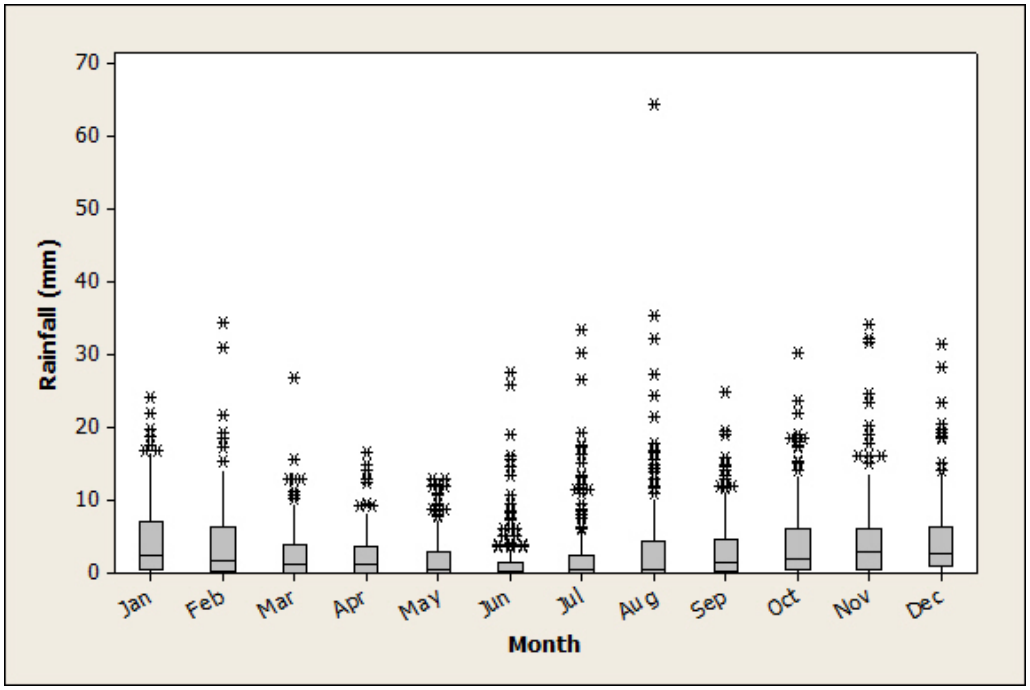

Figure 6.2 Boxplot of daily rainfall at Lerwick by month (2008-2013)

The 2009 sanitary survey report noted that the months October to January were the wettest and with July the driest. In the 2008-2013 dataset, the wettest months were October to February (total rainfall between 774 and 860 mm) whilst the driest month was June (330 mm). Rainfall values exceeding 30 mm/day occurred in February, July, August, October, November and December. The extreme event of >60 mm rainfall/day occurred in August.

6.2 Wind

Wind speed and direction drive surface water and currents that play an integral part in particulate dispersal. Winds typically drive surface water at ca. 3% of the wind speed (Brown, 1991) so a gale force wind (a minimum of 34 knots/17.2 m/s) would drive a surface water current of about 1 knot or 0.5 m/s.

Figure 6.3 shows seasonal wind roses for Lerwick for the period 2004-2013 while Figure 6.4 shows the annual wind rose for the same period. The local topography and direction of Vaila Sound is likely to cause a variation in wind patterns from those shown in the wind roses (Lerwick is located on the east coast of mainland Shetland, whilst Vaila Sound is on the west coast).

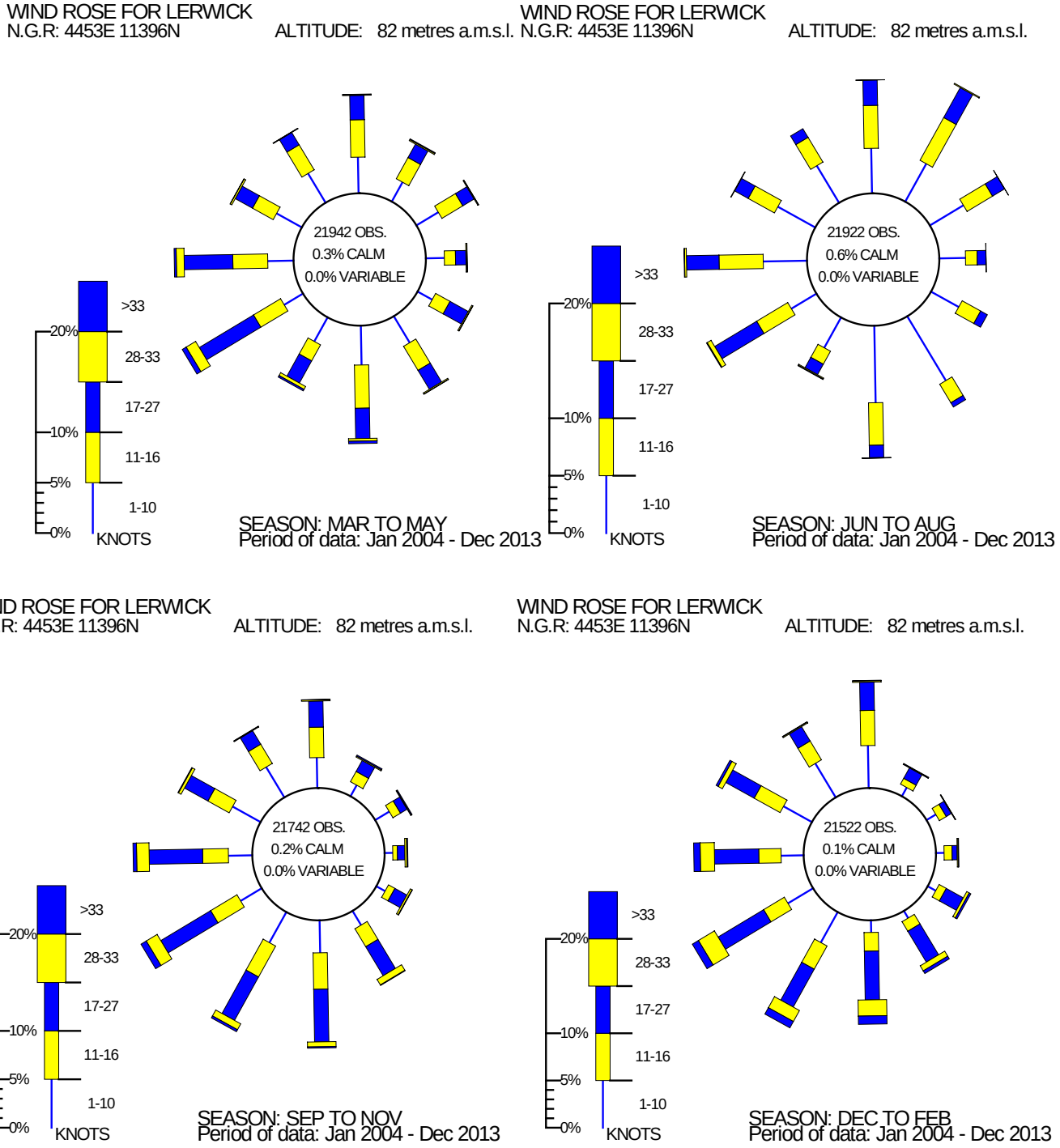

Figure 6.3 Seasonal wind roses for Lerwick (2004-2013)

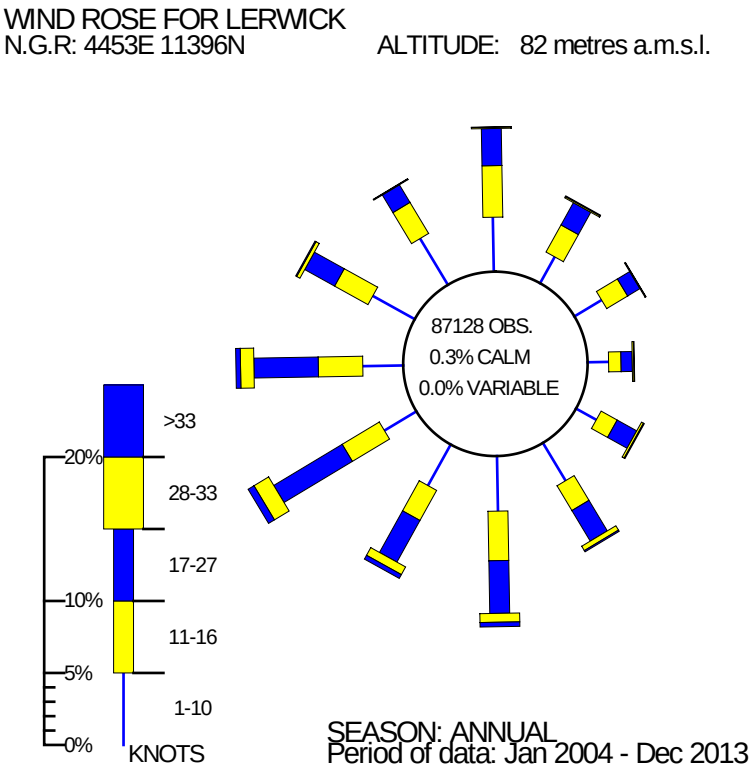

Figure 6.4 Annual wind rose for Lerwick (2004-2013)

Overall the annual wind direction showed that wind was stronger from the south and west than from the north and east. The strongest winds tended to come from the southwest quarter although winds from the north occurred relatively frequently. During the summer, winds also often blew from the north-northeast. Winds were strongest during the winter and were weakest during the summer. The local topography and direction of Vaila Sound is likely to cause a variation in wind patterns from those shown in the wind roses (Lerwick is located on the east coast of mainland Shetland, whilst Vaila Sound is on the west coast). Vaila Sound is relatively sheltered by the surrounding land, but opens to the Atlantic Ocean. The Island of Vaila lies at the mouth of Vaila Sound and is expected to affect the flow of northerly and southerly winds.

7. Historical *E. coli* Data

Results for samples taken from the sites within the Linga, East of Linga & Galtaskerry and Riskaness production areas between 01/01/2008 and 06/11/2014 were extracted from the FSAS database and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data. Data was extracted in November 2014. Historical *E. coli* data used in the 2009 report had already been extracted and validated. All *E. coli* results were reported as most probable number per 100 g of shellfish flesh and intravalvular fluid.

E. coli results recorded as <18, 19 or <20 were reassigned a value of 10 *E. coli* MPN/100 g for the purposes of statistical evaluation and graphical representation.

A sample identified as rejected in the Lera Voe dataset was omitted from further analysis in this review. The remaining samples were received at the laboratory within 48 hours of collection and had box temperatures of ≤8^{o}C. Samples assigned to the Lera Voe, Riskaness and Whitesness sites all plotted within their appropriate production areas. Some samples assigned to the East of Linga production area were identified to the Linga site and plotted within the Linga production area. Results assigned to East of Linga between 2008 and 2011 have therefore been combined in the Linga dataset for this review. Only four results were available for the Galtaskerry site for the 2008-2014 period (all taken in 2010): as the site is no longer extant, these were omitted from further analysis.

7.1 Summary of microbiological results

Summary statistics for the Linga, Whitesness, Riskaness and Lera Voe sites are displayed in Tables 7.1 to 7.4.

Table 7.1 Sampling summary results for Linga (2008-2014)

Sampling Summary		
Production area	Vaila Sound: Linga	
Site	Linga	
Species	Common mussels	
SIN	SI-288-457-08	
Location	Various	
Years	2008-2014	
Total no. of samples	74	
	2008	9
	2009	11
	2010	8
	2011	12
	2012	12
	2013	12
	2014	10
Results summary		
Minimum	<18	
Maximum	16000	
Median	43	
Geometric mean	45	
90 Percentile	410	
95 Percentile	643	
No. Exceeding 230/100g	10 (14%)	
No. Exceeding 1000/100g	3 (4%)	
No. Exceeding 4600/100g	1 (1%)	
No. Exceeding 18000/100g	0	

Table 7.2 Sampling summary results for Whitesness (2011-2014)

Sampling Summary		
Production area	Vaila Sound: East of Linga and Galtaskerry	
Site	Whitesness	
Species	Common mussels	
SIN	SI-288-1061-08	
Location	Various	
Years	2011-2014	
Total no. of samples	43	
	2011	9
	2012	12
	2013	12
	2014	10
Results summary		
Minimum	<18	
Maximum	490	
Median	20	
Geometric mean	24	
90 Percentile	136	
95 Percentile	414	
No. Exceeding 230/100g	2 (5%)	
No. Exceeding 1000/100g	0	
No. Exceeding 4600/100g	0	
No. Exceeding 18000/100g	0	

Table 7.3 Sampling summary results for Lera Voe (2010-2012)

Sampling Summary		
Production area	Vaila Sound: Riskaness	
Site	Lera Voe	
Species	Common mussels	
SIN	SI-289-805-08	
Location	HU222483	
Years	2010-2012	
Total no. of samples	18	
	2010	4
	2011	11
	2012	3
Results summary		
Minimum	<20	
Maximum	490	
Median	<20	
Geometric mean	22	
90 Percentile	346	
95 Percentile	490	
No. Exceeding 230/100g	2 (11%)	
No. Exceeding 1000/100g	0	
No. Exceeding 4600/100g	0	
No. Exceeding 18000/100g	0	

Table 7.4 Sampling summary results for Riskaness (2002-2014)

Sampling Summary				
Production area	Vaila Sound: Riskaness			
Site	Riskaness			
Species	Common mussels			
SIN	SI-289-458-08			
Location	HU 232 483		Various	
Years	2002-2007		2008-2014	
Total no. of samples	67		74	
	2002	11	2008	9
	2003	12	2009	9
	2004	14	2010	10
	2005	11	2011	12
	2006	10	2012	12
	2007	9	2013	12
			2014	10
Results summary				
Minimum	<20		<18	
Maximum	3500		2400	
Median	40		20	
Geometric mean	42		34	
90 Percentile	310		200	
95 Percentile	472		598	
No. Exceeding 230/100g	7 (10%)		3 (4%)	
No. Exceeding 1000/100g	1 (1%)		3 (4%)	
No. Exceeding 4600/100g	0		0	
No. Exceeding 18000/100g	0		0	

Sampling frequency has been relatively even at all sampled sites except for Lera Voe, where the sanitary survey report recommended sampling for a year in the 2009 report to determine whether results were higher there than at the Riskaness site.

7.2 Geographical patterns of results

A sampling summary of results at all four sites; Linga, Whitesness, Lera Voe and Riskaness is listed in Table 7.5.

Table 7.5 Summary of sample results from all four sites between 2008 and 2014

Site	No. of samples	Sampling years	Minimum	Maximum	GM	90%
Linga	74	2008-2014	<18	16000	45	410
Whitesness	43	2011-2014	<18	490	24	136
Lera Voe	18	2010-2012	<20	490	22	346
Riskaness	74	2008-2014	<18	2400	34	200

The highest individual result (16000 *E. coli* MPN/100 g) and geometric mean were recorded in the Linga dataset. The Riskaness dataset had the second highest sampling result and geometric mean. Only Linga and Riskaness had been sampled across the whole date range from 2008 to 2014 inclusive. Although there were 74 samples in both data sets, some of the sample dates did not match at the two sites. A two-sample t-test was therefore undertaken: there was no significant difference between the mean $\log_{10}$ *E. coli* at the two sites (T=1.18, p=0.239).

The sampling locations of all samples assigned to the Linga, Whitesness, Lera Voe and Riskaness sites are displayed in Figures 7.1 to 7.4. The sizes of the symbols in Figures 7.2 to 7.4are proportional to the magnitude of the *E. coli* results.

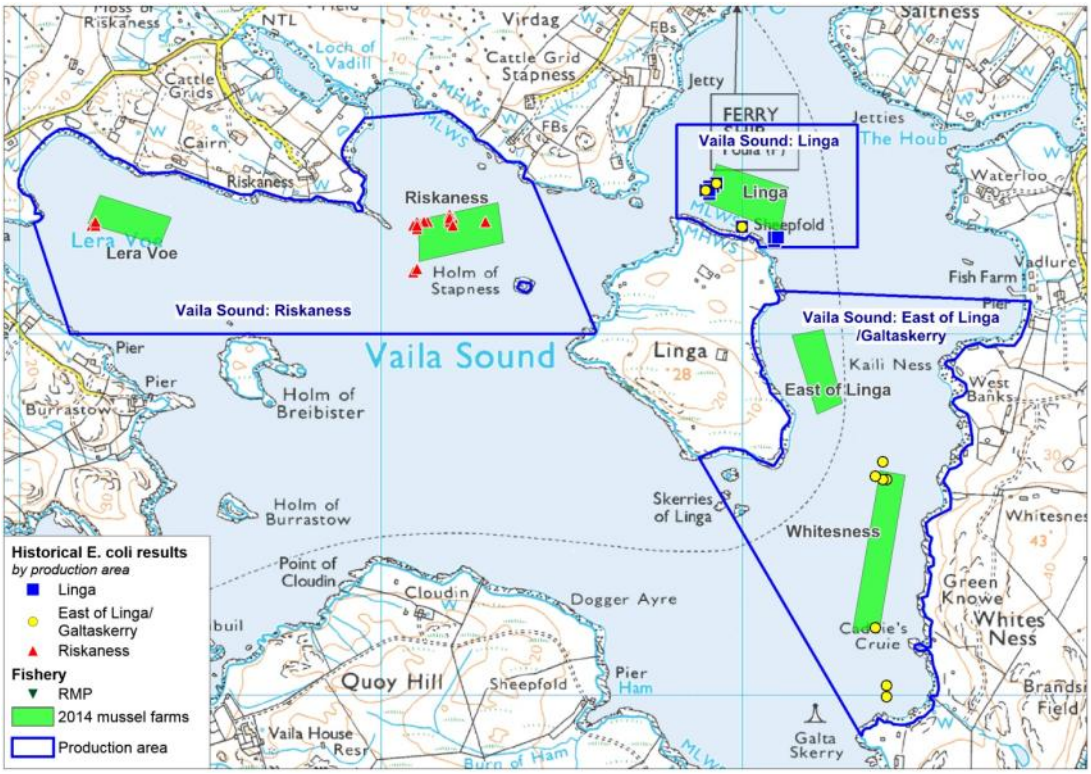

Figure 7.1 Sample locations at Vaila Sound

Linga

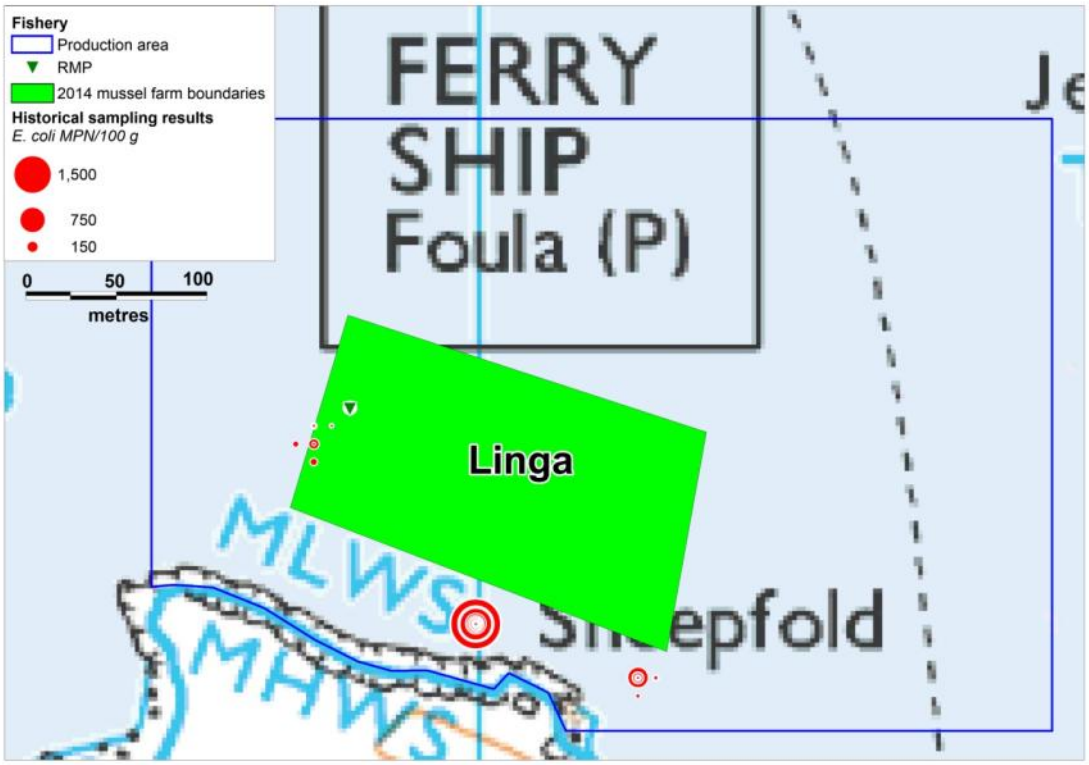

Figure 7.2 Sample locations at the Linga site

Reported sampling locations fell into three areas at the Linga site. Two of these were south of the current mussel farm area. Fifty results were reported as having been

taken between the present mussel farm location and the island of Linga. These were assigned to the East of Linga site with the NGR recorded to 100 m accuracy. That location was reported up to and including July 2010. Eleven samples were reported to locations within 40 metres of the southeast corner of the mussel farm. These were assigned to the Vaila Sound Linga production area and were reported between February 2012 and March 2013. Forty-two results were reported from near the RMP at the western side of the mussel farm. Four were attributed to the East of Linga production area, and all were reported from the period 2010 to 2014.

Lera Voe and Riskaness

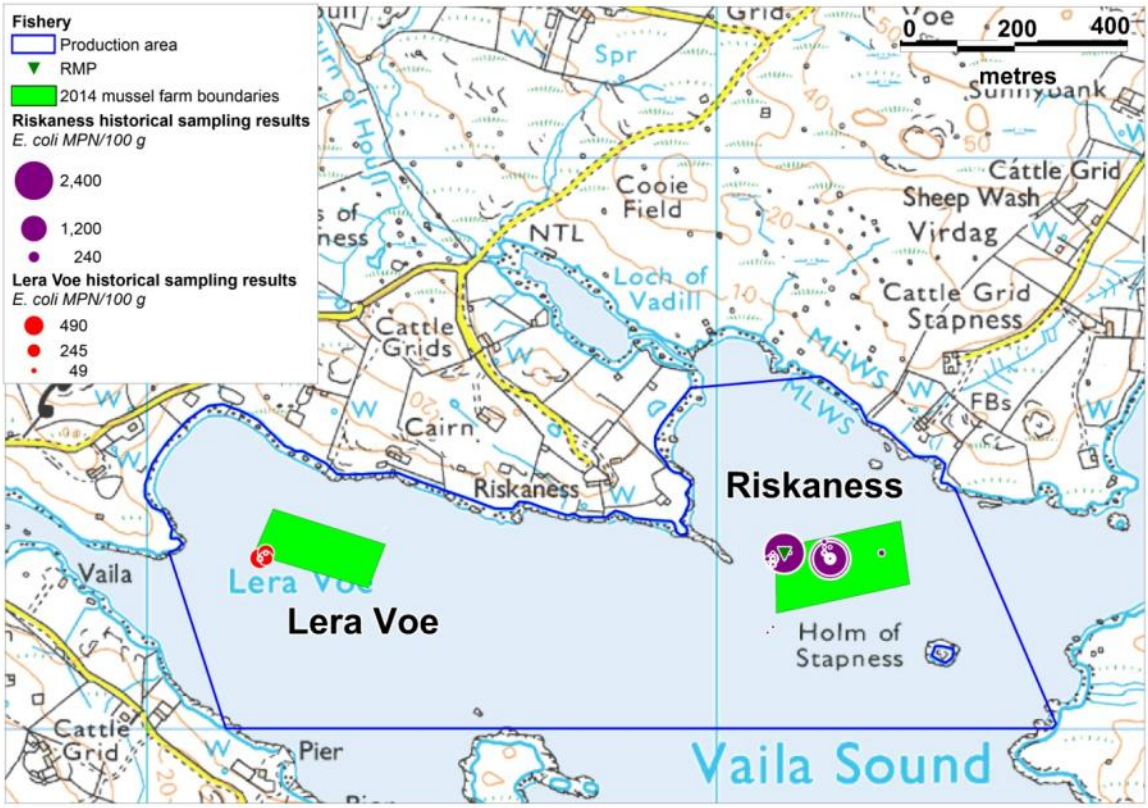

Figure 7.3 Sample locations at the Lera Voe and Riskaness sites

The Lera Voe sampling locations plot within close vicinity of one another, at the southwestern extent of the 2014 farm boundaries.

Two main areas of sampling are apparent at the Riskaness site; one in the vicinity of the current RMP (HU 2312 4831) and the other approximately 75 m to the east of that location. The majority of samples that were taken at the eastern location were from 2008 to 2010 and in 2012, whilst those from the vicinity of the RMP were mainly from 2011, 2013 and 2014. There was no apparent association of magnitude of *E. coli* results with sampling location at Riskaness.

Further to a recommendation in the sanitary survey report for an extended bacteriological survey in this production area, sampling had been undertaken at Riskaness and Lera Voe on the same day on seventeen occasions between October

2010 and March 2012. A paired t-test was undertaken on this subset of results at the two sites. A significant difference was found in the mean $\log_{10}$ *E. coli* values at the two sites (T=2.18, p=0.044) with that at Riskaness being higher than at Lera Voe.

Whitesness

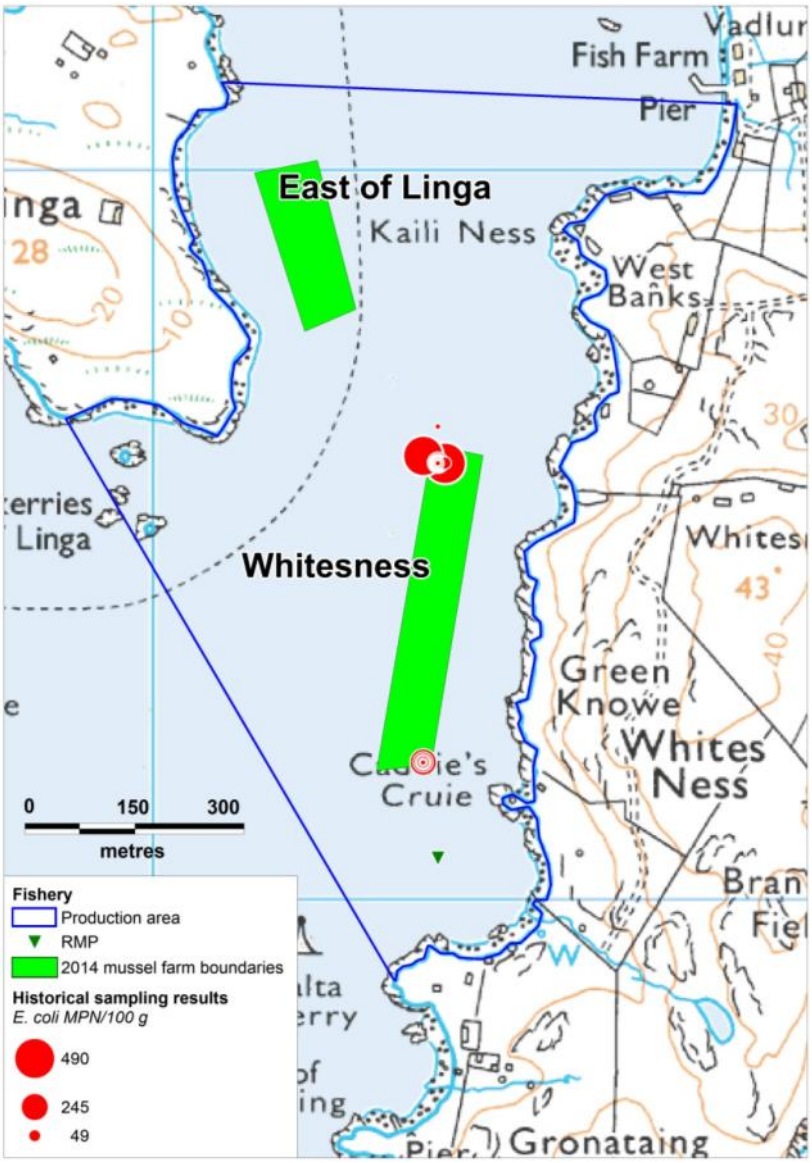

Figure 7.4 Sample locations at the Whiteseness site

Two areas of sampling were apparent at the Whitesness site. These included 13 samples taken from the southeastern corner of the site between 2011 and April 2012 (all with the same reported NGR to 10 m accuracy) and those taken from the northwestern corner of the site since May 2012 (most with the same NGR to 10 m accuracy). The highest results have been seen in the samples taken at the northwestern corner of the site.

7.3 Temporal patterns of results

Temporal trends for the four sites at Vaila Sound are displayed in Figures 7.5 to 7.8. Results from the t-test and Fisher's Exact Test for the Riskaness site are also given.

Linga

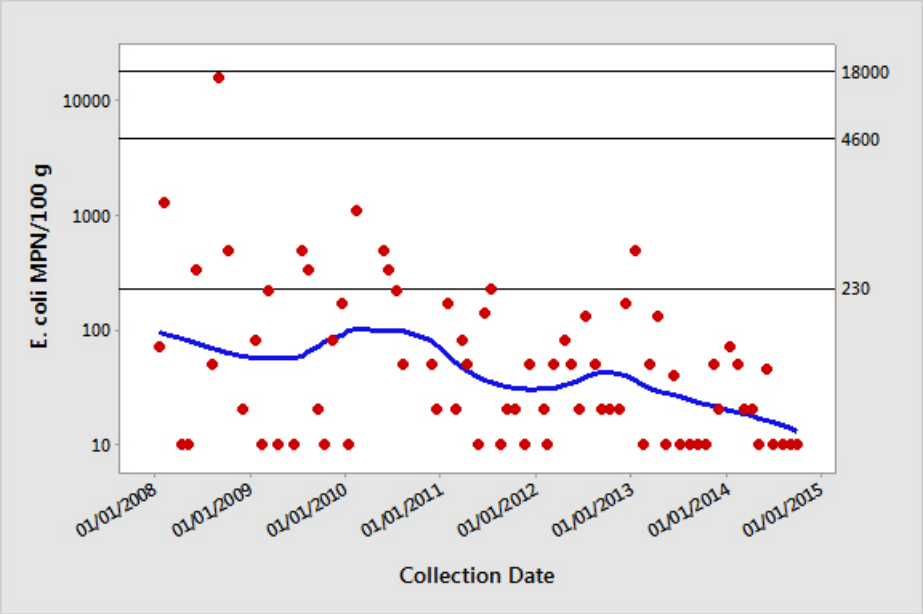

Figure 7.5 Scatterplot of Linga *E. coli* results by date (2011-2014)

A decrease in results at Linga is noted in the trend-line. This is related to an absence of samples with results >230 *E. coli* MPN/100 g since mid 2010, excluding one sample taken in 2013.

Lera Voe

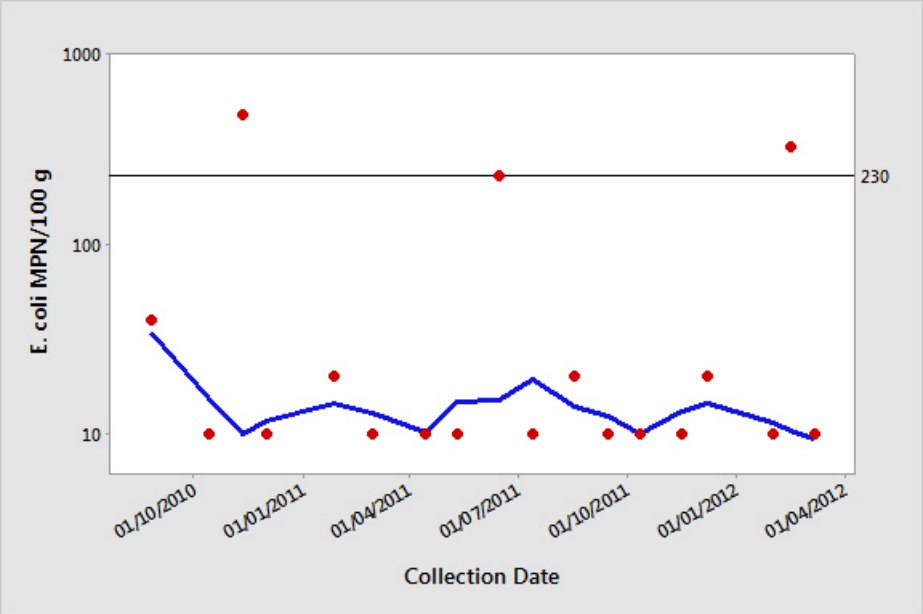

Figure 7.6 Scatterplot of Lera Voe *E. coli* results by date (2009-2011)

Results at Lera Voe were largely stable. All but four results were at or below the limit of detection. Of the four results above 20 *E. coli* MPN/100 g, three were at or above 230 *E. coli* MPN/100 g

Riskaness

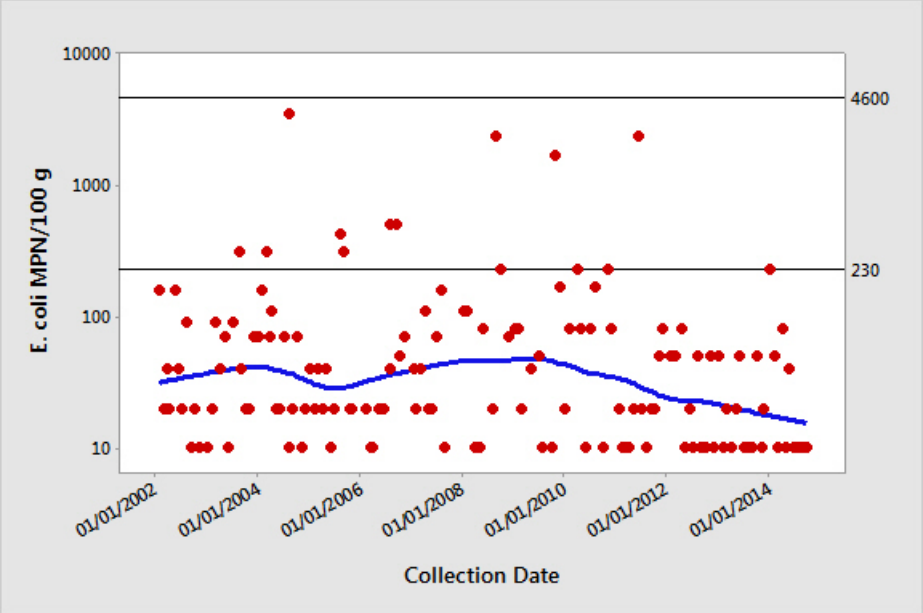

Figure 7.7 Scatterplot of Riskaness *E. coli* results by date (2002-2014)

Results have been generally constant at the Riskaness site. A gradual decrease is noted in the trend-line, related to the increase in <20 *E. coli* MPN/100 g sample results since 2012.

The trends of *E. coli* sampling results from the Riskaness site have been analysed for the years between the previous sampling period (2002-2007) and the current sampling period (2008-2014). Analysis between sampling periods was not possible at the other sites, which only contained results from the present sampling period.

To test for significant differences between Riskaness samples taken over the two sampling periods, the following statistical analyses were carried out on the statistical software package Minitab:

A two sample t-test (using $\log_{10}$ transformed *E. coli* data) to determine whether there was a statistically significant difference between *E. coli* results between the two sampling periods.

A Fisher's Exact Test was used to test for a significant difference in the observed and expected *E. coli* results above the critical levels of 230 and 1000 *E. coli* MPN/100 g from both sampling periods. A Fisher's Exact Test was used instead of a Chi-squared test as two cells had expected counts at less than five from both sampling periods. Results are shown in Table 7.6.

Table 7.6 Results above and below 230 and 1000 *E. coli* MPN/100 g at Riskaness

	***E. coli* MPN/100g**			***E. coli* MPN/100g**		
	≤230	>230	**Total**	≤1000	>1000	**Total**
2002-2007	60	7	67	66	1	67
2008-2014	71	3	74	71	3	74
Total	131	10	141	137	4	141

No significant difference was found between Riskaness common mussel log transformed *E. coli* results from the two survey periods (two sample t-test, t = 1.02, DF = 138, p = 0.311).

No statistically significant difference was found between sampling results ≤230 and >230 *E. coli* MPN/100 g between sampling periods (Fisher's Exact Test, p = 0.192).

No statistically significant difference was found between sampling results ≤1000 and >1000 *E. coli* MPN/100 g between sampling periods (Fisher's Exact Test, p = 0.621).

Whitesness

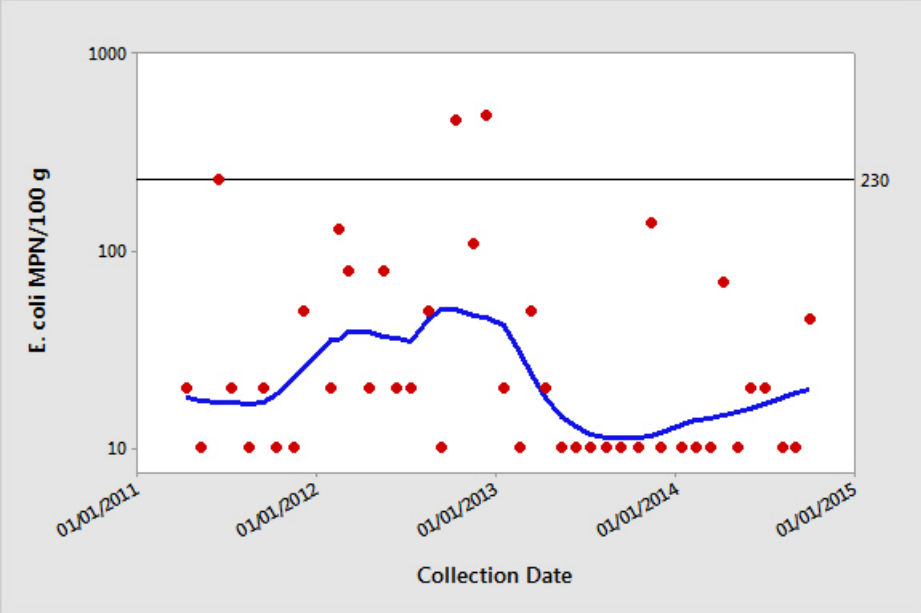

Figure 7.8 Scatterplot of Whitesness *E. coli* results by date (2011-2014)

The trend in results at the Whitesness site shows a sharp decrease in 2013, owing to an increase in the number of samples with results of <20 *E. coli* MPN/100 g.

Conclusions

The highest results came from the Linga site. Samples reported against the location between the island and the mussel farm (to 100m accuracy) showed the highest results. However, these samples will have come from locations within 100 m on the mussel farm, which includes a large proportion of the southern side of the farm, and overlaps one of the sampling locations to the southeast. The highest result overall was reported from this site, and a greater proportion of results over 230 *E. coli* MPN/100 g (14%) was reported from here than the other sites.

Results from Whitesness have been predominantly low. No statistically significant difference was found in sample results between the sampling locations. The sampling location was moved from the southeast to northwest corner of the site in May 2012.

Sampling at the southwest corner of Lera Voe was conducted as recommended in the 2009 report. Sample results taken over an 18 month period showed no statistically significant difference from those taken over the same period at the Riskaness site.

No statistically significant difference was found in results between two areas of sampling at Riskaness. No statistically significant differences were found in sample results between sampling periods, or between sample results above and below the critical levels of 230 and 1000 *E. coli* MPN/100 g between sampling periods.

8. Movement of contaminants

A hydrographic assessment was undertaken for the 2009 sanitary survey report. The conclusions were as follows:

- Circulation around Vaila sound will be driven primarily by tide and winds and possibly by fresh water inputs at times.
- Tidal currents are strongest through Wester Sound, along the north shore of Vaila, and through Easter Sound, and weaker around Linga and the north shore of Vaila Sound.
- Where tidal currents were stronger, they followed a bidirectional, alongshore pattern.
- Contamination originating from Walls may be expected to travel slowly south on an ebbing tide, then around the east and northwest shores of Linga potentially impacting on the East of Linga and possibly the Riskaness sites depending upon conditions.
- Due to the very slow current speeds, little flushing is expected to occur in the upper parts of the south and that contaminants may tend to persist near to where they were discharged for more than one tidal cycle.
- Superimposed on this, wind driven currents are likely to alter circulation within Vaila Sound, particularly near the surface, depending on wind strength and direction.
- The complex shape of Vaila Sound makes the exact effects of wind on currents difficult to accurately predict. Although generally wind will be expected to drive a surface current in the same direction, return currents and eddies are likely to form around the complex coastline and islands.
- Following heavy rainfall, any large influx of freshwater is likely to form a density driven surface current of freshwater flowing slowly seaward until it is mixed with the underlying seawater by wind-driven or tidal processes. However, density driven flows are not expected to play a major role in the movement of contaminants within Vaila Sound.

No estimates of particle transport distance were included in the 2009 sanitary survey report. However, on the basis of the mean current speeds presented in that report, mean particle transport distances have been estimated as ranging from approximately 0.5 km to 2.5 km. The transport distances to the north and east of the isle of Linga would be towards the lower end of this range, those in Wester Sound at the upper end and those to the west of the isle of Linga intermediate between these extremes. These are based on mean current flows and no differentiation has been made between spring and neap tides

Salinity profiles were taken at 0, 3, 5 and 10 m depth intervals at the five fishery sites. All sites salinities showed a very slight increase with increasing depth.

9. Overall Assessment

The following section details the main changes in contamination inputs that have occurred since the 2009 survey report.

Human sewage Impacts

The majority of the human population remains centred in Walls at the head of Vaila Sound. Overall, the human population in the area has decreased, although this is largely associated with the census area on the eastern side of the voe, which is quite extensive. Several planning applications were identified for dwelling houses in the vicinity of Walls. Boating activity is distributed around the area but is likely to be greatest in the summer.

The main sewage inputs are associated with the community discharges entering from Walls, at the head of the sound: a number of private discharges and Walls PS are also situated in that area. These will primarily affect the Linga mussel site. Other private discharges located around the sound may impact the other mussel sites with the greatest effects being anticipated at Lera Voe and Riskaness. Rehabitation of the isle of Linga may produce localised inputs affecting the Linga and East of Linga sites.

Agricultural impacts

The major farm animal input will continue to be associated with sheep which may have the greatest impact at the Lera Voe and Riskaness sites. Additional contamination on the eastern side of the side will arise from cows and horses kept to the south of Walls.

Wildlife Impacts

While all of the mussel sites will be exposed to faecal contamination from seabirds, those on the western side of the sound may be impacted to a greater extent due to the preponderance of nesting sites located to the southwest of the sound. Seals may also contribute to contamination at the lines. Although this might be expected to affect all sites equally, sightings have been largely concentrated in Lera Voe, implying that this site may be more prone to contamination from this source.

Seasonal Variation

Some increase in human and farm animal populations are expected in the spring and summer. The latter is also expected to see a peak in boating activity. There is expected to be a seasonal increase in contamination inputs from seabirds, with an increase expected between May and October, during the general breeding season. Historical mussel *E. coli* data showed no obvious pattern in time series plots.

Watercourses

The Riskaness and Lera Voe sites are expected to be impacted to the greatest extent by contamination from freshwater sources.

Movement of contaminants

Estimated particle transport distances indicate that while contamination from Walls is expected to reach the Linga mussel site, it is not expected to reach other sites within the sound unless driven by freshwater effects or a northerly wind. The other sites are likely to be mainly impacted by local sources.

Salinity profiles undertaken during the 2014 shoreline survey showed no significant variation of salinity with depth and all values were in the range expected from full-strength seawater around the UK.

Analysis of Results

Historical *E. coli* results

The highest mussel *E.* coli results in Vaila Sound have been seen in samples taken at the Linga site. Results from an extended bacteriological survey for the Riskaness production area showed that *E. coli* levels at Riskaness are significantly higher than those at Lera Voe. Generally low results have been seen in samples from the Whitesness site since sampling began in 2011. No spatial patterns in results were evident from the data available. There is no evidence for a marked change in results in Vaila Sound over time.

Shoreline Survey results

Shellfish sample results were highest at Linga (3500 and 330 *E. coli* MPN/100 g) and lowest at East of Linga ((20 and <18 *E. coli* MPN/100 g). Results were higher in samples taken at the surface than at depth at Linga and Whitesness, whereas the opposite was true at Lera Voe and Riskaness.

The highest result in the seawater samples taken at the mussel sites was seen at the northeast extent of East of Linga (14 *E. coli* cfu/100 ml). The next highest result was from a sample taken at the northwest corner of Linga (8 *E. coli* cfu/100 ml). All other seawater samples taken at the shellfisheries yielded results of <1 and 1 *E. coli* cfu/100 ml.

Three additional seawater samples were taken. The highest result, 70 *E. coli* cfu/100 ml, was from a sample taken adjacent to a private ST outfall on the eastern shoreline of the sound. A sample taken adjacent to a discharge pipe in Lera Voe yielded a result of 35 *E. coli* cfu/100 ml.

Conclusions

The following conclusions were made during the 2009 sanitary survey report on the most significant inputs and spatial impacts to the Vaila Sound shellfish sites:

- Two community and several private STs located around Walls would have the most significant impact on the Linga site
- Private ST discharges around the southwest shorelines were also anticipated to impact the Lera Voe and Riskaness sites
- Discharges from boats at Foula ferry pier and Walls pier/pontoon were expected to impact the Linga site, with discharges from boats using the pier to the southwest also anticipated to impact the Lera Voe site
- Livestock (predominantly sheep) are expected to evenly add to contamination levels at all sites and is expected to be highest during the spring-summer lambing season
- Freshwater contamination loading was expected to be most significant to the southwest of the sound and would have the greatest impacts the Lera Voe and Riskaness sites
- Although significant breeding colonies of birds, individual geese and seals were noted around Vaila Sound, contamination impacts were expected to be unpredictable and would be evenly distributed at all sites

In general, no marked change is anticipated in the sources and movement of contaminants. The Linga site is expected to remain the most at risk from contamination arising from Walls. While more contamination sources have been identified in the vicinity of Lera Voe than Riskaness, the extended bacteriological survey showed that the results from Riskaness were significantly higher than those from Lera Voe. This may be due to contamination from Walls reaching the Riskaness site under certain environmental conditions. On the east side of the isle of Linga, the new Whitesness site is closer to identified sources of contamination than the East of Linga site. However, this may change in future with rehabitation of the isle. Higher *E. coli* results have been seen in mussels from the northern end of the Whitesness site than those from the southern end.

10. Recommendations

The following recommendations have been made in light of the findings from this review. A summary is shown in Figure 10.1.

Vaila Sound: Linga

It is recommended that the production area boundaries and RMP location be maintained as recommended in the 2009 sanitary survey report.

Production area: The area bounded by lines drawn between HU 2382 4832 and HU 2382 4858 and between HU 2382 4858 and HU 2432 4858 and between HU 2432 4858 and HU 2432 4824 and between HU 2432 4824 and HU 2405 4824 extending to MHWS.

RMP: HU 2393 4842

Vaila Sound: East of Linga

Production area: It is recommended that the production area boundaries remain as those recommended in the 2009 sanitary survey report, as It is recommended that the RMP be moved to the Whitesness site. It is further recommend that the RMP be located at the northern end of the site in order to reflect the potential impact from private septic tanks and watercourses located immediately to the north of Kaili Ness.

Production area: the area bounded by lines drawn between HU 2480 4809 and HU 2409 4812 and between HU 2388 4766 and HU 2433 4689 extending to MHWS.

RMP: HU 2442 4758

Vaila Sound: Riskaness

It is recommended that the production area boundaries remain as those recommended in the 2009 sanitary survey report. It is also recommended that the RMP be maintained as recommended in the 2009 report.

Production area: Area bounded by lines drawn between HU 2290 4848 and HU 2317 4862 and between HU 2342 4842 and HU 2360 4800 and between HU 2360 4800 and HU 2214 4800 and between HU 2214 4800 and HU 2204 4831 extending to MHWS.

RMP: HU 2312 4831

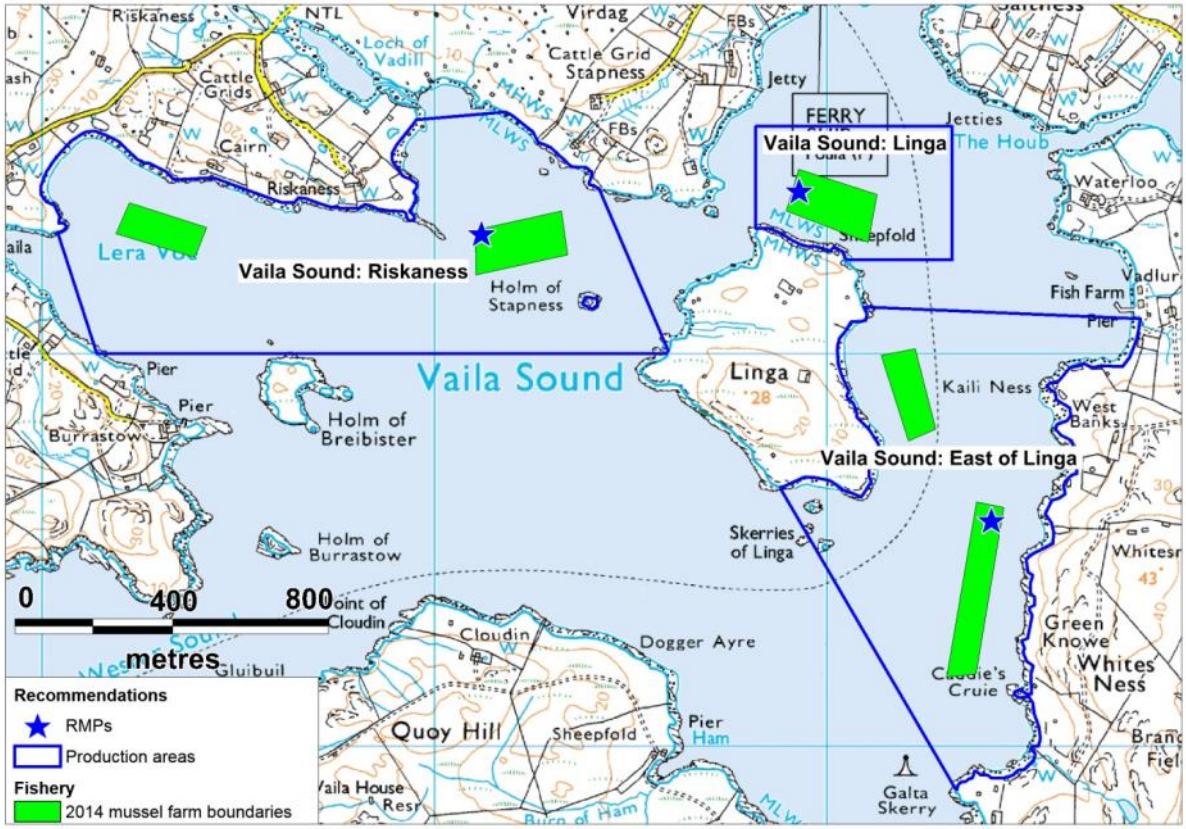

Figure 10.1 Recommended production area boundaries and RMPs – Vaila Sound

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12. List of Figures and Tables

Appendices

1. List of planning applications
2. Shoreline Survey Report 2014

Appendix 1

Planning Applications

Planning applications expected to change the human population and overall faecal loading to Vaila Sound are listed in Table 1.

Table 1 Planning applications to areas around Vaila Sound

Location	Date	Ref No	Description	Area
Island of Linga	Mar-14	2014/091/PPF	Erect new cottage and create access track	Walls Shetland ZE2 9PF
	Jun-13	2013/229/PPF	Renovation and extend for self catering holiday accommodation, install septic tank, underground water storage tank, and create new access track with electricity cable and water pipe alongside	Walls Shetland ZE2 9PF
	May-12	2012/189/PPF	To renovate existing uninhabited dwelling house; install 11kW turbine on 15m mast and create pathway to dwelling house	Walls ZE2 9PF
Walls	May-13	2013/175/RPP	Renew planning permission 2008/116/PCD: To erect dwelling house and garage	Walls Shetland ZE2 9PF
	Jan-13	2013/002/PPF	To convert tea room into self contained apartment	Walls Shetland ZE2 9PF
	May-12	2012/164/AMSC	Demolish existing house and byre and construct 2 no. new detached dwelling houses with new access road	Walls ZE2 9PB
	Aug-11	2011/264/PPP	To demolish existing house and byre and planning permission in principle for 2 house sites	Walls Shetland ZE2 9PB
	Jul-11	2011/211/PPF	Erect storey and a half dwelling house with single storey garage	Walls Shetland ZE2 9PF
	Jun-11	2011/191/PCD	Erect dwelling house	Walls ZE2 9PF
	Apr-10	2010/136/PCD	Construct new pier and breakwater, erect ferry building, create storage, compounds and relocate septic tank	Walls ZE2 9PG

Appendix 2

Shoreline Survey Report

Production Areas:	Vaila Sound: Linga	
	Vaila Sound: East of Linga and Galtaskerry	
	Vaila Sound: Riskaness	
Site Names:	Linga	
	East of Linga	
	Whitesness	
	Lera Voe	
	Riskaness	
SIN:	Linga:	SI-288-457-08
	East of Linga:	SI-288-455-08
	Whitesness:	SI-288-1061-08
	Lera Voe:	SI-289-805-08
	Riskaness:	SI-289-458-08
Harvesters:	**Shetland Mussels**: Michael Tait	
	Blueshell Mussels: Michael Laurenson	
Local Authority:	Shetland Islands Council	
Status:	Existing area	
Date surveyed:	29 & 30 September 2014	
Surveyed by:	Sean Williamson (Hall Mark Meat Hygiene Ltd.)	
	Alan Harpin (SSQC Ltd.)	
	Helena Mackay (SSQC Ltd)	
	We are grateful to Shetland Mussels for providing assistance during the marine survey work.	
Existing RMPs	HU 2393 4842 *(E.coli)*	
	HU 2439 4706 *(E.coli)*	
	HU 2312 4831 *(E.coli)*	

Area Surveyed: See Figure 1

Specific observations made on site are mapped in Figure 1 and listed in Table 1. Water and shellfish samples were collected at the locations marked on Figures 2 and 3. Bacteriology results are given in Tables 2 and 3. Salinity profiles are presented in Table 4 with profile locations marked on Figure 2. Photographs are presented in Figures 4-30.

Weather

Monday 29 September 2014

Overcast conditions with some light showers in the morning with periods of heavier rain throughout the afternoon during the shoreline walk. A F2/F3 easterly breeze, veering southerly, at times gusting up to F4 persisted throughout the day.

Tuesday 30 September 2014

Overcast and foggy with poor visibility at the beginning of the survey, brightening up in time for the site visits. Sunny spells continued throughout the day. F3/4 SSE breeze.

Preceding the shoreline survey, Saturday 27 September was partly cloudy and dry with SW winds initially F6 decreasing to F5 and Sunday 28 September began with scattered cloud becoming mostly cloudy for most of the day. F4 westerly winds became south westerly F3/4 later in the day. Some light rain was recorded overnight from Saturday to Sunday.

Fishery

The location of the mussel lines for all five fisheries are mapped in Figure 1. All fisheries had stocked mussel lines on site. Harvesting at East of Linga, Whitesness and Lera Voe fisheries continues year round. Harvesting at the Linga fishery is as required. The Riskaness site is to be harvested out and restocked with juvenile mussels.

The **Linga** fishery consisted of eight mussel lines running parallel to the north eastern shoreline of the island of Linga (Figure 4). All lines were double-headed longlines with 8 metre droppers. The site is licenced for five 200 metre quad-headline longlines. Two mussel samples were collected from the RMP at this site.

The **East of Linga** fishery consisted of 5 x 200m long mussel lines running parallel to the eastern shoreline of the island of Linga (Figure 5). All lines were double-headed longlines with droppers between 8 and 15 metres. The site is licenced for five 180 metre twin-headline longlines. Two mussel samples were collected at the north east corner of the site.

The **Whitesness** fishery consisted of 5 x 440m long mussel lines running parallel to the west coastline of Whitesness peninsula (Figure 6). All lines were double-headed longlines with 12 to 15 metre droppers. The site is licenced for six 440m twin-headline longlines. Two mussel samples were collected from the north end of the second mussel line in from the eastern side of the fishery.

The **Lera Voe** fishery consisted of 5 x 220m long mussel lines aligned along the long axis of Lera Voe (Figure 7). All lines were double-headed longlines with 8 to 10 metre droppers. The site is licenced for five 270 metre twin-headline longlines. Two mussel samples were collected from the south west corner of the site.

The **Riskaness** fishery consisted of nine mussel lines inside the Holm of Stapness to the north west of the island of Linga (Figure 8). All lines were double-headed longlines with 8-10 metre droppers. The site is licenced for six 220 metre quad-headline longlines. Two mussel samples were collected from the north east corner of the site.

Sewage/Faecal Sources

Burrastow to Loch of Vadill section of survey

Burrastow, on the western side of Lera Voe, is a sparsely populated area with eight dwelling houses situated between Burrastow and the head of Lera Voe. Five of these are positioned above the road some distance from the shore. Also in this area is a shorebase associated with salmon farming, a seasonal guest house and a holiday-lets chalet. A white plastic pipe from which there was a slight smell was observed receding underwater near Burrastow House guest house, no associated septic tank was seen (Figure 9). Four septic tanks were observed along this stretch of shoreline. The first, an old concrete tank with no discernible outfall, was located some distance from the shore (Figure 10). Moving north, an outflow of odorous, discoloured water was seen dispersing from a septic tank into a small burn running onto the beach (Figure 11). A concrete tank with outflow to the sea associated with a house in close proximity to the shore was also noted to have a slight smell (Figure 12). The final septic tank, associated with the holiday chalet at the head of Lera Voe, was situated close to the shore with a channel cut leading to the sea; some odour present (Figure 13).

On the survey route from the head of Lera Voe to Loch of Vadill, there are eight dwelling houses visible from the shoreline with only one in close proximity to the sea. Three septic tanks were identified. A possible discharge point to the sea in armoured stone was noted below a house up on the hill at Crookataing; no septic tank was identified. A plastic septic tank associated with a neighbouring property was overflowing with raw sewage near the shoreline although was not actively discharging onto the beach (Figure 14). A septic tank with no active discharge was noted below two dwelling houses up on the hill at Riskaness. A plastic pipe was observed entering the sea further along the shoreline (Figure 15) however a high tide obscured the end of the pipe so it was not established if this was currently in use. Some sheep pens associated with an agricultural shed were noted positioned directly over the shore at Loch of Vadill (Figure 16). One house with associated septic tank was identified some distance from the shoreline near the end of this section.

Stapness to Pier Road section of survey

There are twelve houses along this section of shoreline with several more dwellings further up the hill. At the most westerly point of the survey, a possible discharge point, with no identifiable source, exits to the sea through concrete ducting (Figure 17) below a holiday-lets property. A concrete septic tank located at Pointataing appears to flow to a soakaway near the beach. Moving north east along the coast towards Walls signals a more densely populated area above the New Pier. There are two septic tanks associated with the first and second houses encountered; both with pipes disappearing under water (Figures 18 and 19). A public septic tank is situated near the head of the pier (Figure 20), and it is believed this may serve several of the houses in the vicinity as well as the public toilets sited on the pier; no outfall pipe to sea was noted. A cast iron discharge pipe was noted associated with a house in close proximity to the sea (Figure 21), but this was not accessible due to high tide. High tides also prevented closer observation of the shoreline from the north side of the pier to the end of this section of walk.

Wast Banks to Waterloo section of survey

On the east side of the voe there were six dwelling houses in the area surveyed, with one being particularly close to the shore. Five septic tanks were observed on this section. The first, at the start of the walk and associated with a house up on the hill, appeared disused with no visible outflow and no smell (Figure 22). Towards the shoreline, a concrete septic tank and soakaway, probably associated with the same house was in use (Figure 23). Nearing Shetland Mussel's shorebase, an outflow pipe to the beach was observed with no discharge (Figure 24) associated with a house in close proximity to the beach. According to the homeowner, this is currently used for discharging kitchen wastewater only. The end of the outflow pipe from the septic tank serving the shorebase was not visible underwater. Also within this area, there were 5 plastic pipes draining onto the beach, one of which had a cloudy discharge (Figure 25). The fifth septic tank, noted below two houses at Waterloo, was obscured by grass and had no visible outflow.

Clockaburn to Outlet, Loch of Grunnavoe section of survey

The largest settlement in the area is the village of Walls with many of the properties here linked to community septic tanks in the village. Walls has a number of local amenities for the community and visitors including a shop, post office, bakery, primary school, swimming pool, public hall, regatta clubhouse, fire and coastguard stations, health centre and care home. Other local businesses include aquaculture sea sites and associated processing facilities, several holiday accommodation providers and a garage.

Situated near the outlet of Clockaburn is the Walls East Pumping Station EO (Figure 26) from which no outfall was observed. Two sewer pipes associated with houses overlooking the marina were noted however the ends of these pipes were not visible underwater (Figure 27). One land drain was flowing into the sea near the marina (Figure 28). Only one tank was observed along this coastline, this being the community septic tank at Saltness. There was no visible outflow pipe. No further sanitary outlets were observed after this point.

Sample analysis

Nine freshwater samples were obtained from watercourses around Vaila Sound, four on the western shore and five from the eastern shore. Nine sampling points were outlined in the survey plan and eight of these were collected. At one location, defined as a field drain below Riskaness, there was no identifiable watercourse so no sample was collected. An additional sample was obtained from a small burn near the head of Lera Voe. Seven of the nine watercourses sampled were found to have *E.coli* levels between 14-180 cfu/100 ml. Of the two samples with the highest *E.coli* counts, one was from the additional sample collected from a small watercourse leading to the beach that was not on the survey plan (1,500 cfu/100 ml). This watercourse was in close proximity to discoloured septic tank discharge. The second was from an unnamed watercourse (No 4 in Table 7 of plan) below Stapness (900 cfu/100 ml).

Seawater samples were obtained from all five fisheries. Samples were collected from the north ends of the sites with the exception of Lera Voe fishery where the sample was

obtained from the south side. A further sample from the Whitesness fishery on the sample plan was obtained from the south side. *E.coli* levels were between <1 to 70 cfu/100ml. Away from the fishery three seawater samples were collected, one of which was on the sample plan. For the planned sampling point *E.coli* levels were 5 cfu/100ml. Additional samples were collected during the shoreline walk at Crookataing, from the water's edge near a discharge pipe associated with the overflowing septic tank here (*E.coli* levels at 35 cfu/100ml) and the shorebase at Vadlure, from the water's edge near a discharge pipe causing some discolouration of the voe (*E.coli* levels at 70 cfu/100ml).

Mussel samples were obtained from the same locations at the five fisheries as the seawater samples, with the exception that no sample was taken from the SE corner at the Whitesness fishery. Two samples were collected at each location, one from the top of a mussel dropper and one from the bottom of the dropper. The sample from the RMP of the Linga fishery returned results of 3,500 *E.coli* MPN/100g and 330 *E.coli* MPN/100g for the top and bottom samples respectively. The sample from the NE corner of the East of Linga fishery returned results of 20 *E.coli* MPN/100g and <18 *E.coli* MPN/100g for the top and bottom samples respectively. The sample from the NE corner of the Whitesness fishery, second line in from Whitesness coastline, returned results of 78 *E.coli* MPN/100g and 20 *E.coli* MPN/100g for the top and bottom samples respectively. The sample from the SW corner of the Lera Voe fishery returned results of 78 *E.coli* MPN/100g and 330 *E.coli* MPN/100g for the top and bottom samples respectively. The sample from the NE corner of the Riskaness fishery returned results of 170 *E.coli* MPN/100g and 330 *E.coli* MPN/100g for the top and bottom samples respectively.

Salinity profiles were obtained from the five fisheries again at the five locations described above. At four of the sites observed variation in salinity measurements with depth did not exceed the accuracy value of the probe used (± 0.35 ppt). At the Linga fishery, the variation in salinity measurements was 0.42 ppt. Surface salinity ranged from 34.64 ppt to 34.99 ppt at each location.

Temperature profiles were also obtained from these locations. The profile at the Whitesness fishery showed a slight increase in temperature from 10m to the surface; the remaining four profiles all showed a slight decrease in temperature from 10 metres to the surface, in particular at the Lera Voe fishery (0.3°C difference). Surface temperature ranged from 11.8°C to 12.1°C.

Salinities of the seawater samples analysed at the laboratory showed salinities ranging from 32.63 PSU present at the sampling point below Crookataing on the western shore of Vaila Sound to 34.79 PSU present at the NE corner of the East of Linga fishery.

Seasonal population

Burrastow House (sleeps 9+), and a small holiday chalet overlook Lera Voe. In the village of Walls there are several self-catering holiday properties including The Aurora (sleeps 8), Rocklea (sleeps 8), South Voe (sleeps 4), and Sparrowayre (sleeps 4). A camping böd and Skeovarick B&B are also situated in the village.

Boats/Shipping

Boat traffic within the Vaila Sound area is largely associated with the fishery, salmon farming, creel fishing and leisure activities. Cooke Aquaculture operates a shorebase with a pier and pontoon at Burrastow servicing salmon sites within Vaila Sound. Shetland Mussels service sites from a shorebase at Vadlure. Blueshell Mussels service sites from the New Pier in the village of Walls. A workboat was observed harvesting at the Linga fishery during the survey. A small shorebase in Lera Voe services the island of Vaila and two workboats were recorded at the associated pier. The Walls Marina is situated at the head of the voe where 25 boats were noted during the survey (Figure 29). A freshwater and waste disposal service is offered to visiting yachts. The Regatta club also has a small slip and pier. The Foula ferry operates between Foula and the New Pier in Walls with a route through Vaila Sound three times a week, weather permitting. Three workboats were observed at the New Pier, which has recently undergone major renovations to enlarge the facility and to provide a new store and waiting room for the Foula ferry service. Several small leisure boats were recorded ashore on beaches at various points during the shoreline walk. Private piers, pontoons and moorings were also observed.

Farming and Livestock

The majority of the land observed during the survey around the production areas was rough grazing. Approximately 250 sheep were observed on the western shore, between Burrastow and Clockaburn, of which 119 had access to the shore. Sheep faeces were noted on 6 occasions where animals were not present. On the eastern shore 14 rams and 26 sheep were observed, of which all the rams and 1 sheep had access to the shore. A further 12 sheep were recorded on the island of Linga, all of which had access to the shore. Sheep faeces were noted twice where no animals were present. Access to some parts of the shore on the western coastline may have been restricted through steep escarpments.

One cow was noted in a field above Burrastow with no access to the shore. Eight cattle were recorded in an enclosed field above the eastern coastline at Saltness. Although this field did not have access to the shoreline, there was evidence of hoof prints immediately above the beach.

Pony faeces were observed in an enclosed field above the beach at Burrastow. No animals were present at the time of the survey. Eight ponies were recorded in a field close to the eastern shoreline beyond Saltness with no access to the shore.

Agricultural buildings were noted on five occasions during the shoreline survey, all of which were situated between Burrastow and the village of Walls. Three of these were well above the shoreline whilst two are in close proximity to the shore; one with sheep pens directly above the sea (Figures 16 and 30).

Land Use and Land Cover

Rough grassland dominates the coastline around Vaila Sound. The shoreline from Burrastow on the western edge of the voe is characterised by bedrock and rocky outcrops

interspersed with pebble beaches. A number of high embankments limit access to the shore in places, though lowland areas typically characterise the areas flanking Lera Voe, Loch of Vadill and the approach to the settlement of Walls from Pointataing onwards. The village of Walls is a typical urbanised area with a developed waterfront although the built up neighbourhood quickly returns to rough grassland beyond the marina towards Saltness. Lowland littoral stretches, again interspersed with pebbled beaches typify the eastern shoreline of Vaila Sound. A number of wet boggy areas were noted between Saltness and the inlet near Loch of Grunnavoe. A silage field was recorded beyond Saltness. From Waterloo to Wastbanks, a lowland coastline gradually gives way to a significantly more rocky seafront with rough grassland enclosed fields and heathland patches beyond. The coastline beyond, viewed from the boat, appears to consist of increasingly high embankments and scattered small beaches.

Watercourses

Nine watercourses were sampled during the shoreline survey, eight of which were outlined on the sample plan. No defined watercourse was identified in the vicinity of one sampling point, and an additional sample was collected from a watercourse exiting onto a beach in Lera Voe near discoloured discharge from a septic tank. Flow rates were recorded at eight of the nine watercourses sampled and from an additional four watercourses. There was insufficient flow to obtain a measurement from one of the watercourses scheduled to be sampled on the plan.

Wildlife/Birds

Birds were observed in all areas surveyed with the exception of the small part of shoreline east of Galta Skerry. Snipes, oystercatchers and a heron were noted on the shorefront at Lera Voe. Between Lera Voe and the village of Walls, 13 curlews, 1 common gull, 1 heron and 1 swan were recorded. On the eastern coastline, a large variety of birds were noted between Wast Banks and Waterloo with sightings of 1 common gull, starlings,1 heron, 1 turnstone, oystercatchers, common crows, 1 black backed gull and 20-30 sparrows. Eleven common gulls were noted near Saltness. Two areas were observed to contain shell and crab debris indicating possible bird feeding sites; one below Stapness and the other near Wast Banks.

Seabirds were present at all the fisheries with the exception of East of Linga. Bird faeces were observed on mussel line buoys at all fisheries.

Three seals were noted in Lera Voe and rabbits were sighted on both east and west shorelines.

General observations

Recorded observations apply to the dates of survey only. Animal numbers were recorded on the day from the observer's point of view. This does not necessarily equate to total numbers present as natural features may obscure individuals and small groups of animals from view.

Dimensions and flows of watercourses are estimated at the most convenient point of access and not necessarily at the point at which the watercourse enters the voe.

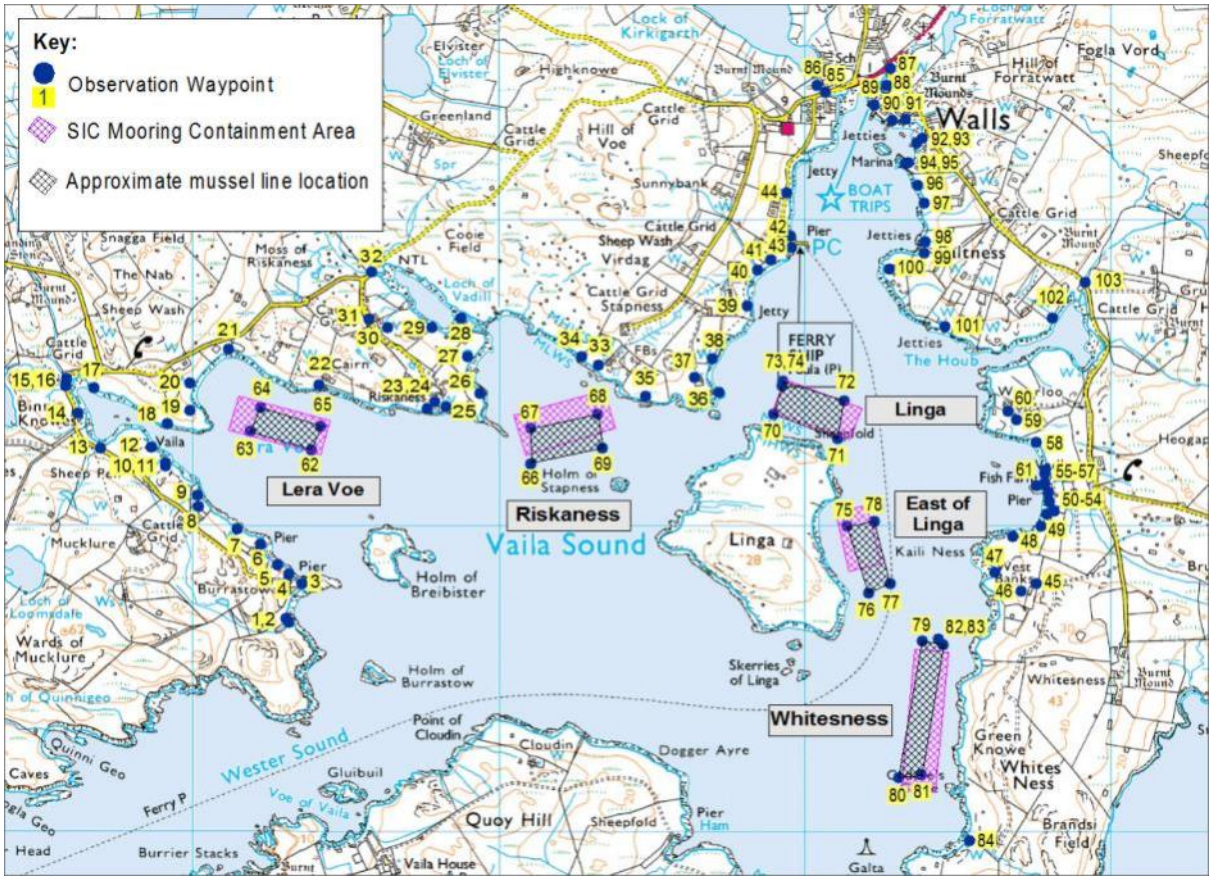

Figure 1 Map of shoreline observations Vaila Sound.

Table 1 Shoreline Observations

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
1	29/09/14 09:13:38	HU 22315 47684	422315	1147684		VAL-FW-01	Vaila Sound shoreline survey; Shoreline walk section Burrastow to Loch of Vadill. Weather overcast, light showers, F3-4 SE breeze. Start of walk at small burn flowing onto shore, freshwater sample collected as indicated in the plan (No 1 in Table 7 on survey plan). Dimensions: 7cm wide, 5cm deep. Flow 0.994cm/s and SD 0.071cm/s. Shoreline characterised by bedrock leading to a pebbled beach. Fenced field of rough grazing above with no access to shore.
2	29/09/14 09:24:41	HU 22306 47696	422306	1147696			Dwelling house on hill above shoreline. Pony faeces observed in field, no access to shore.
3	29/09/14 09:27:46	HU 22360 47811	422360	1147811			Burrastow House (seasonal guest house) and 1 other dwelling house. Small pier with 2 small open boats.
4	29/09/14 09:31:14	HU 22315 47842	422315	1147842	Figure 9		White pipe running into sea, end not visible underwater, slight sewage smell.
5	29/09/14 09:34:47	HU 22279 47871	422279	1147871			Rough grazing field containing sheep faeces, no animals present. Photo of shorebase with Lera Voe fishery in background.
6	29/09/14 09:37:18	HU 22225 47938	422225	1147938			Cooke Aquaculture shorebase associated with salmon farming. Pier and small pontoon, 2 open workboats, larger working boat at mooring. Animal carcass incinerator on pier. Agricultural shed noted on hill above shorebase.
7	29/09/14 09:41:41	HU 22148 47989	422148	1147989			Grazing field with access to shoreline, sheep faeces present.
8	29/09/14 09:44:28	HU 22021 48062	422021	1148062	Figure 10		Old concrete septic tank below house on shore side of road, no outfall noted. 1 house on upper side of road. Approximately 70 sheep and 1 cow in fenced field on upper side of road.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
9	29/09/14 09:47:16	HU 22019 48099	422019	1148099			Small drainage burn, 1 dwelling house below road near shoreline. 2 snipes taking flight from small beach.
10	29/09/14 09:51:32	HU 21912 48194	421912	1148194	Figure 11		Septic tank associated with recently built dwelling house, outflow with discoloured water and slight sewage smell (No 7 in Table 6 of plan). Heron and 2 oystercatchers on beach.
11	29/09/14 09:53:50	HU 21913 48202	421913	1148202		VAL-FW-02	Additional freshwater sample collected (not on plan) from small burn with flow to beach (near above mentioned septic tank outflow). Dimensions: 12cm wide, 2cm deep. Flow 0.384cm/s and SD 0.004cm/s. Sheep faeces present at shoreline.
12	29/09/14 09:59:07	HU 21867 48255	421867	1148255	Figure 12		1 dwelling house and associated septic tank with outflow to sea; end of pipe not visible underwater, slight smell (No 6 in Table 6 of plan). Pier and slipway, 2 workboats present. Small open boat noted further along beach.
13	29/09/14 10:09:12	HU 21702 48252	421702	1148252			Low level rough grassland with limited access to shoreline from neighbouring fields. Road runs close to shoreline. Small drainage burn originating from field above road, passing through culvert to beach. 3 boats at mooring in voe and 1 onshore. 7 snipes on small stony beach.
14	29/09/14 10:15:47	HU 21628 48365	421628	1148365	Figure 13		Small self-catering holiday chalet at head of voe. Septic tank close to shore with channel cut leading to sea (No 5 in Table 6 of plan). Some odour. 2 seals present in voe; 1 wren on beach.
15	29/09/14 10:18:11	HU 21587 48454	421587	1148454			End of first section of walk at head of Lera Voe.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
16	29/09/14 10:20:53	HU 21592 48480	421592	1148480		VAL-FW-03	Start of second section of walk, weather overcast. Small burn draining to sea under road through culvert. 2 larger watercourses, from Loch of Breck and higher agricultural fields merging before passing under road and discharging to sea through culvert consisting of 4 large circular tunnels. Flow measured from 4 large circular culverts; starting from southernmost culvert (1) 20cm wide, 3cm deep. Flow 0.854cm/s and SD 0.014cm/s (2) 25cm wide, 4cm deep. Flow 1.16cm/s and SD 0.016cm/s (3) 20cm wide, 3 cm deep. Flow 1.003cm/s and SD 0.073cm/s (4) 15cm wide, 2cm deep. Flow 0.403cm/s and SD 0.008cm/s. Freshwater sample collected (No 2 in Table 7 of plan). Photo taken highlighting proximity of road to shoreline.
17	29/09/14 10:27:32	HU 21681 48450	421681	1148450			Rough grazing field with access to shoreline. Approximately 45 sheep observed in field. 2 rabbits.
18	29/09/14 10:35:06	HU 21920 48331	421920	1148331			1 dwelling house on hill above shore. Possible discharge point to sea in armoured stone, no tank identified. Sheep prints on shore.
19	29/09/14 10:38:13	HU 21993 48376	421993	1148376			Photo looking SW to Lera Voe mussel fishery.
20	29/09/14 10:44:00	HU 21993 48465	421993	1148465	Figure 14	VAL-SW-01	Pebbled beach. 1 dwelling house and agricultural shed on hill above shoreline. 4 sheep in fenced field above. Plastic septic tank, overflowing with raw sewage near shoreline. Not actively discharging onto beach. Sheep faeces on beach. Seawater sample taken, not on plan.
21	29/09/14 10:52:31	HU 22120 48575	422120	1148575			Small burn running into sea at end of pebbled beach, flow measured. Dimensions: 10cm wide, 4cm deep. Flow 0.446cm/s and SD 0.007cm/s. 1 seal in voe, 13 curlews in flight.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
22	29/09/14 11:03:00	HU 22415 48458	422415	1148458			1 dwelling house close to shoreline. Small stone built jetty. 1 open boat hauled up. Approx. 30 sheep in field with access to shore. No septic tank identified. 2 moorings noted in voe. Photo from above jetty looking S to Lera Voe mussel fishery.
23	29/09/14 11:17:21	HU 22766 48382	422766	1148382			2 dwelling houses on hill above shoreline. Approximately 45 sheep contained in fenced field. Approximate location of planned water sample from field drain (No 3 in Table 7 of plan), however no defined watercourse was observed.
24	29/09/14 11:19:23	HU 22791 48402	422791	1148402			Septic tank with no active discharge.
25	29/09/14 11:21:22	HU 22828 48387	422828	1148387	Figure 15		Plastic pipe leading into sea, end of pipe not visible underwater so unable to establish if currently discharging (No 16 in Table 6 of plan). No source identified. Open boat in noost above shoreline. 2 ringed plovers.
26	29/09/14 11:29:01	HU 22939 48431	422939	1148431			Photo looking SE to Riskaness Mussel Fishery
27	29/09/14 11:33:25	HU 22899 48550	422899	1148550			Agricultural shed visible on hill above shore. 17 sheep noted with access to shore. Character of shoreline changing from higher bedrock coastline to a low pebbled beach. Small body of water formed behind grassland strip. Sheep and rabbit faeces present on beach.
28	29/09/14 11:37:40	HU 22878 48675	422878	1148675		VAL-SW-02	Sheep faeces present at shoreline along narrow body of water, inlet to Loch of Vadill (seawater loch). Planned seawater sample collected.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
29	29/09/14 11:43:26	HU 22783 48646	422783	1148646	Figure 16		1 dwelling house on hill above shoreline. Agricultural shed with multiple sheep pens down at sea level. Photo taken indicating proximity of agricultural buildings to sea. Small boat with outboard engine at mooring.
30	29/09/14 11:47:17	HU 22637 48646	422637	1148646			1 dwelling house with septic tank identified some distance from shoreline.
31	29/09/14 11:48:54	HU 22576 48672	422576	1148672			End of walk section. Showers increasing.
32	29/09/14 11:53:14	HU 22587 48828	422587	1148828			Two water courses join before flowing through culvert under road into Loch of Vadill. Flow measurements recorded. Dimensions: 140cm wide, 15cm deep. Flow 0.297cm/s and SD 0.026cm/s
33	29/09/14 12:21:25	HU 23327 48524	423327	1148524			Third section of walk started from shoreline below Stapness to Pier Road. Field beyond comprised of rough grassland and heathland. Photo looking W to Riskaness mussel fishery.
34	29/09/14 12:22:38	HU 23272 48551	423272	1148551	Figure 17	VAL-FW-04	Small unnamed watercourse running to the sea, freshwater sample taken (No 4 in Table 7 of plan). Flow measurements taken. Dimensions: 25cm wide, 40cm deep. Flow 0.031cm/s and SD 0.005cm/s. Photo of concrete duct running into sea, no source identified.
35	29/09/14 12:38:54	HU 23481 48421	423481	1148421			Rocky shoreline, not easily accessible. Some sheep faeces present in field. Shell and crab debris present, possible bird feeding area.
36	29/09/14 12:46:18	HU 23719 48434	423719	1148434	Figure 30		1 dwelling house and small agricultural shed. Small pebbled beach. Sheep faeces present above shoreline, 1 sheep noted. Photo looking E to Linga mussel fishery.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
37	29/09/14 12:50:22	HU 23640 48483	423640	1148483			Concrete septic tank for dwelling house mentioned at observation 36, no outflow noted, appears to flow to soakaway near beach (No 4 in Table 6 of plan).
38	29/09/14 12:53:49	HU 23697 48544	423697	1148544			27 sheep noted in fenced field which is open at one end to shoreline. Sheer rock face, so shoreline not easily accessible. Small pebble beach further along.
39	29/09/14 13:02:20	HU 23811 48717	423811	1148717	Figure 18		1 dwelling house above shoreline. Septic tank with plastic pipe to underwater (No 3 in Table 6 of plan). Road runs close to shoreline. 2 common gulls, 1 wren.
40	29/09/14 13:05:35	HU 23846 48833	423846	1148833			Field drain running under road to beach - clear discharge.
41	29/09/14 13:08:25	HU 23889 48867	423889	1148867	Figure 19		Concrete septic tank with sewer pipe to underwater, end of pipe not visible so not known if discharging (No 2 in Table 6 of plan). 2 dwelling houses above road.
42	29/09/14 13:22:26	HU 23955 48943	423955	1148943	Figure 21		Dwelling house in close proximity to shoreline. Cast iron discharge pipe noted but not accessible due to high tide. Tide too high for surveyors to access shoreline further on, unable to observe Nos. 9-11 in Table 6 of plan). 2 dwelling houses immediately above road. 1 heron, 1 common gull.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
43	29/09/14 13:23:13	HU 23956 48906	423956	1148906	Figure 20		Large pier, part of which has been recently constructed. Public toilets at end of older pier still in use. There was a waste pipe running from the toilets back towards the shore. New ferry waiting and store building has been constructed and will also house public toilets. Location of Walls ST (No 1 in Table 5 of plan). 3 workboats and Foula ferry present at pier. 3 dwelling houses at head of pier above road. No evidence of Septic tank and 12cm cast iron pipe to underwater serving pier toilets and nearby houses (No 1 in Table 6 of plan). This area has been subject to major construction work in relation to new pier.
44	29/09/14 13:32:04	HU 23942 49083	423942	1149083			Grazing field above road with 10 sheep noted, no access to shoreline. 1 swan. End of walk section at New Road.
45	30/09/14 07:11:44	HU 24754 47812	424754	1147812	Figure 22		Start of walk section from West Banks to Waterloo. Weather overcast, misty, poor visibility, dry. F3/4 S breeze. Rough grazing field. Septic tank associated with property above, no overflow visible, possibly disused, no smell.
46	30/09/14 07:16:38	HU 24707 47786	424707	1147786	Figure 23		Second concrete septic tank and soakaway, in use, also associated with dwelling house above (possibly No 21 in Table 6 of plan). Sheep faeces present in field, no access to shore. Shell debris present, possible bird feeding spot.
47	30/09/14 07:21:12	HU 24618 47847	424618	1147847			Foreshore is rocky/exposed bedrock followed by a pebble beach. Boggy area above beach draining from field above. Some sheep faeces present above beach. 2 cultivated stone enclosures above shoreline containing brassicas/vegetables. Common gull, heron and 4 starlings in flight noted.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
48	30/09/14 07:27:54	HU 24679 47965	424679	1147965			Rough grazing field with sheep faeces present, no access to shore - however there is access from a neighbouring field.
49	30/09/14 07:31:01	HU 24770 47996	424770	1147996			Low field with drainage ditch to pebbled beach - mainly standing water.
50	30/09/14 07:35:58	HU 24788 48036	424788	1148036	Figure 24		Dwelling house in close proximity to beach. Outflow pipe to beach with no discharge - not in use from septic tank but discharges kitchen wastewater according to resident (No 19 in Table 6 of plan).
51	30/09/14 07:39:31	HU 24813 48046	424813	1148046			Location of septic tank for dwelling house at observation 50, not observed as in home owner's garden.
52	30/09/14 07:41:08	HU 24799 48076	424799	1148076			Small burn running under road through culvert onto beach. Flow measurements recorded; Dimensions: 25cm wide, 5cm deep. Flow 0.421cm/s and SD 0.013cm/s.
53	30/09/14 07:43:03	HU 24795 48108	424795	1148108			Shetland Mussels shorebase. Pier and mussel processing factory with associated equipment and buildings on site. Floating pontoon with intake pipes for depuration plant. 2 workboats tied up at pier.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
54	30/09/14 07:44:53	HU 24782 48139	424782	1148139	Figure 25	VAL-SW-03	Emerging from rock armouring between pier and depuration pontoon are 5 plastic pipes draining onto beach and 1 outfall not visible underwater associated with septic tank. 1) Plastic pipe with outflow onto beach, no smell. 2)&3) are in the vicinity of 18 in Table 6 of plan, 2 pipes together: 1 blue plastic pipe with no discharge, 1 black with land burn running to outflow through pipe under hard standing at shorebase, discharge clear. Flow measurements recorded; Dimensions: 15cm wide, 5cm deep. Flow 0.191cm/s and SD 0.017. 4cm/s) Orange pipe with cloudy discharge. Seawater sample collected from beach. 5) Black pipe with clear discharge.
55	30/09/14 07:47:24	HU 24782 48169	424782	1148169			Concrete cast outfall to beach with clear discharge. Area around water egress contains some shell debris from factory above. Depuration plant seawater intake pipes positioned above. 1 turnstone on beach.
56	30/09/14 07:52:49	HU 24785 48181	424785	1148181			Plastic land drain running onto beach; water clear. Some discolouration of the water closest to the shore to the north (and downwind) of the pipes in Obs. 54 and 55. Weather conditions improving, some sunshine. Approximately 12 sheep present on Island of Linga opposite shorebase.
57	30/09/14 08:01:09	HU 24784 48133	424784	1148133			Septic tank with outflow underwater, end of pipe not visible. Positioned in front of mussel factory.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
58	30/09/14 08:03:38	HU 24754 48269	424754	1148269			Pebble beach. Small burn running onto beach, boggy area at side. Flow measurements taken; Dimensions: 20cm wide, 5 cm deep. Flow 0.257cm/s and SD 0.014cm/s. Oystercatcher on beach, 5 common crows, 1 black-backed gull, 1 starling, 20-30 sparrows and 1 rabbit noted.
59	30/09/14 08:07:52	HU 24689 48344	424689	1148344			Septic tank obscured by grass, no visible outflow, 2 dwelling houses above (No 17 in Table 6 of plan). Grazed field, some pony faeces. Plastic drainage pipe in field, no discharge.
60	30/09/14 08:10:32	HU 24662 48372	424662	1148372			End of walk section at Waterloo
61	30/09/14 08:29:56	HU 24754 48131	424754	1148131			Start of boatwork. Sunny with fresh SSE breeze.
62	30/09/14 08:35:00	HU 22390 48246	422390	1148246			SE corner of Shetland Mussels' Lera Voe fishery. Fishery consists of 5 x 220m lines with droppers 8-10m aligned along the long axis of Lera Voe. Some bird faeces on bouys at the fishery. 5 cormorants on buoys.
63	30/09/14 08:36:30	HU 22189 48306	422189	1148306	Figure 7	VAL-MUSS-01 (top), VAL-MUSS-02 (bottom) & VAL-SW-04	SW corner of Lera Voe fishery. 2 mussel samples collected; surface sample collected from the top of a dropper, bottom sample collected from the bottom of a dropper. Seawater sample collected. Salinity Profile 1 collected (ppt/°C): 10m 34.80/12.10; 5m 34.83/12.00; 3m 34.79/11.80; surface 34.67/11.80. Photo 1 looking NE towards Riskaness, Photo 2 looking NW.
64	30/09/14 08:49:38	HU 22223 48385	422223	1148385			NW corner of Lera Voe fishery.
65	30/09/14 08:51:09	HU 22420 48323	422420	1148323			NE corner of Lera Voe fishery. Photo looking SW towards head of Lera Voe.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
66	30/09/14 08:53:57	HU 23106 48202	423106	1148202	Figure 8		SW corner of Blueshell Mussels' Riskaness fishery. Fishery consists of 9 x 220m lines with 8-10m droppers, inside Holm of Stapness. Some bird faeces on buoys at the fishery. 5 cormorants noted. Photo looking NE towards Stapness.
67	30/09/14 08:55:34	HU 23105 48316	423105	1148316			NW corner of Riskaness fishery. RMP. 2 guillemots.
68	30/09/14 08:57:38	HU 23324 48364	423324	1148364		VAL-MUSS-03 (top), VAL-MUSS-04 (bottom) & VAL-SW-05	NE corner of Riskaness fishery. 2 mussel samples collected; surface sample collected from top of a dropper, bottom sample collected from the bottom of a dropper. Seawater sample collected. Salinity Profile 2 collected (ppt/°C): 10m 35.10/12.10; 5m 35.01/12.00; 3m 34.90/12.00; surface 34.82/12.00. Photo looking SE towards Isle of Vaila and Burrastow. Wind further freshening, white caps visible.
69	30/09/14 09:08:21	HU 23340 48253	423340	1148253			SE corner of Riskaness fishery.
70	30/09/14 09:10:35	HU 23897 48364	423897	1148364			SW corner of Blueshell Mussels' Linga fishery. Fishery consists of 8 x 200m lines with 8m droppers, running adjacent to NE side of the island of Linga. Some bird faeces on buoys at the fishery. Workboat onsite, currently harvesting.
71	30/09/14 09:12:02	HU 24106 48284	424106	1148284	Figure 4		SE corner of Linga fishery. 5 cormorants in flight. Photo looking NW.
72	30/09/14 09:13:26	HU 24128 48406	424128	1148406			NE corner of Linga fishery.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
73	30/09/14 09:16:54	HU 23925 48455	423925	1148455		VAL-MUSS-05 (top), VAL-MUSS-06 (bottom) & VAL-SW-06	Sampling from RMP (1 line in from NW corner). 2 mussel samples collected; surface sample collected from top of a dropper, bottom sample collected from bottom of a dropper. Seawater sample collected. Salinity Profile 3 collected (ppt/°C): 10m 35.06/12.10; 5m 34.99/12.10; 3m 34.89/12.00; surface 34.64/12.00. 7 cormorants and 1 common gull noted.
74	30/09/14 09:26:39	HU 23929 48471	423929	1148471			NW corner of Linga fishery.
75	30/09/14 09:28:39	HU 24139 47996	424139	1147996			NW corner of Shetland Mussels' East of Linga fishery. Fishery consists of 5 x 200m long lines with droppers between 8-15m. Some bird faeces on buoys at the fishery.
76	30/09/14 09:29:37	HU 24208 47779	424208	1147779	Figure 5		SW corner of East of Linga fishery. Photo looking N towards village of Walls.
77	30/09/14 09:31:03	HU 24278 47809	424278	1147809			SE corner of East of Linga fishery.
78	30/09/14 09:32:54	HU 24225 48013	424225	1148013		VAL-MUSS-07 (top), VAL-MUSS-08 (botton) & VAL-SW-07	NE corner of East of Linga fishery. 2 mussel samples collected; surface sample collected from top of a dropper, bottom sample collected from the bottom of a dropper. Seawater sample collected. Salinity Profile 4 collected (ppt/°C): 10m 35.02/12.10; 5m 35.01/12.00; 3m 35.00/12.00; surface 34.99/12.00. Photo looking SW across fishery.
79	30/09/14 09:44:54	HU 24382 47623	424382	1147623			NW corner of Shetland Mussel's Whitesness fishery. Fishery consist of 5 x 440m lines with droppers between 12-15m positioned N-S along Whitesness coastline. Some bird faeces on buoys at the fishery.
80	30/09/14	HU 24306	424306	1147177			SW corner of Whitesness fishery.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
	09:46:26	47177					
81	30/09/14 09:47:49	HU 24381 47185	424381	1147185	Figure 6	VAL-SW-08	SE corner of Whitesness fishery. Seawater sample taken. Photo looking NW across fishery. 10 common gulls on buoys.
82	30/09/14 09:49:55	HU 24452 47609	424452	1147609			NE corner of Whitesness fishery
83	30/09/14 09:52:31	HU 24434 47628	424434	1147628		VAL-MUSS-09 (top), VAL-MUSS-10 (bottom) & VAL-SW-09	2 mussel samples collected (2nd line in from Whitesness coastline); surface sample collected from top of a dropper, bottom sample collected from bottom of a dropper. Seawater sample collected. Salinity Profile 5 collected (ppt/°C): 10m 35.11/12.00; 5m 35.02/12.00; 3m 35.01/12.10; surface 34.99/12.10.
84	30/09/14 10:14:58	HU 24536 46971	424536	1146971		VAL-FW-05	Landed at Gronataing to measure and sample burn indicated on sampling plan. Rough grazing above beach, 14 rams with access to shore, approximately 25 sheep in field above. Sheep faeces around shoreline. Small burn running off hill onto pebbled beach (photo taken). Freshwater sample taken (No 8 in Table 7 of plan). Flow measurements recorded. Dimensions: 15cm wide, 6cm deep. Flow 0.148cm/s and SD 0.007cm/s. Gronataing to Vadlure shoreline characterised as rocky coast interspersed with small pebble beaches overlooked by mostly fenced in, rough grazing fields. End of boat work.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
85	30/09/14 10:57:03	HU 24068 49414	424068	1149414		VAL-FW-06	Burn flowing from Loch of Kirkigarth to sea. Planned freshwater sample collected (No 5 in Table 7 of plan). 3 dwelling houses, church and churchyard below road; 1 dwelling house, school and nursery, swimming pool and self-catering holiday accommodation property above road. One commercial building sits adjacent to the burn in close proximity.
86	30/09/14 10:59:12	HU 24039 49435	424039	1149435			Flow measurements recorded for outlet from Loch of Kirkigarth. Dimensions: 90cm wide, 25cm deep. Flow: 0.322cm/s and SD 0.033cm/s. The 10cm cast iron sewer pipe (No 8 in Table 6 of plan) was not observed.
87	30/09/14 11:05:33	HU 24279 49490	424279	1149490		VAL-FW-07	Start of walk section from Walls Public Hall to outlet from Loch of Grunnavoe. Weather dry with sunny spells. Planned freshwater sample taken (No 6 in Table 7 of plan). Flow measurements recorded. Dimensions: 120cm wide, 22cm deep. Flow 0.218cm/s and SD 0.012cm/s. In addition to the community hall there is a garage, shop and post office, bakery, public toilets and several dwelling houses nearby.
88	30/09/14 11:09:55	HU 24267 49434	424267	1149434	Figure 26		Walls Sewage Pumping Station (Point 2 in Table 5 of plan). No outfall observed.
89	30/09/14 11:12:03	HU 24225 49369	424225	1149369			2 small jetties with 2 dwelling houses above shoreline.
90	30/09/14 11:16:15	HU 24285 49322	424285	1149322			Walls Regatta Clubhouse with associated jetty and pontoon. 2 sailing boats on site.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
91	30/09/14 11:18:39	HU 24327 49325	424327	1149325	Figure 28		White 12cm plastic sewer pipe, end not visible underwater (No 12 in Table 6 of plan). 1 dwelling house close to shoreline. Large concrete land drain ending in the sea, not clear if actively discharging into water.
92	30/09/14 11:22:06	HU 24383 49262	424383	1149262			Land drain with no flow observed. 12cm metal sewer pipe (No 13 in Table 6 of plan) was not observed.
93	30/09/14 11:23:19	HU 24366 49247	424366	1149247	Figures 27 & 29		Plastic pipe discharging underwater (photo), end of pipe not visible (No 14 in Table 6 of plan). Photo looking SW towards Walls Marina
94	30/09/14 11:26:10	HU 24338 49184	424338	1149184			White plastic pipe dripping into sea beyond marina walkway.
95	30/09/14 11:27:09	HU 24328 49180	424328	1149180			Walls pier and marina, 25 berthed boats ranging from small open boats to workboats and pleasure craft were noted. Local fire and coastguard stations are situated at the head of the pier with the Wastview Care Centre directly above.
96	30/09/14 11:29:09	HU 24367 49109	424367	1149109			Rough grazing field. 1 sheep noted with access to shore. This part of the shoreline is characterised by small pebble beaches separated by small rocky outcrops.
97	30/09/14 11:31:42	HU 24390 49050	424390	1149050			Ceramic sewer pipe with no flow (No 15 in Table 6 of plan).
98	30/09/14 11:39:40	HU 24393 48925	424393	1148925			Saltness ST (No 3 in Table 5 of plan/No 20 in Table 6 of plan). No visible outflow.
99	30/09/14 11:42:15	HU 24390 48888	424390	1148888		VAL-FW-08	Boggy area above seashore, cow faeces in field. 8 cattle noted in field above and hoove prints down at shoreline. Small watercourse with limited flow. Planned freshwater sample taken, unnamed watercourse in Table 7 of plan.

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Figure	Associated Sample	Description
100	30/09/14 11:50:27	HU 24275 48837	424275	1148837			Rough grazing field. Small boggy area near shoreline, cow faeces in field. Occasional drainage ditches, running clear.
101	30/09/14 11:56:19	HU 24457 48650	424457	1148650			Field with access to shoreline, some small boggy areas. Pony and rabbit faeces present in field. 8 ponies, 11 common gulls. Small workboat on opposite side of voe.
102	30/09/14 12:03:33	HU 24806 48676	424806	1148676			Field cut for silage.
103	30/09/14 12:07:25	HU 24916 48793	424916	1148793		VAL-FW-09	Planned freshwater sample taken (No 7 in Table 7 of plan). Burn (outlet for Loch of Grunnavoe) runs through culvert under road to beach. Flow measurements recorded; Dimensions: 40cm wide, 20cm deep. Flow 0.62cm/s and SD 0.032cm/s. End of walk section.

Sampling

Water and shellfish samples were collected at the locations indicated in Figures 2 and 3. Eight of the nine freshwater samples detailed in the survey plan were obtained, as well as one additional freshwater sample which was collected from a watercourse running into Lera Voe in close proximity to a discoloured septic tank discharge. Two additional seawater samples were obtained; one from below an overflowing septic tank at Crookataing and one in front of the shorebase at Vadlure. All samples were transported initially by a cool backpack and then in a cool box to SSQC Ltd. for analysis within 24 hours of sample collection.

Bacteriology results are present in Table 2 and 3 and mapped in Figures 2 and 3.

Seawater samples were also tested for salinity at SSQC Ltd. In the field salinity profiles were collected using a YSI Professional Plus handheld meter and CT probe which had an accuracy of (± 0.35 ppt). Results are presented in Table 4 and locations of the profiles are mapped in Figure 2.

Table 2 Water sample *E. coli* results

No.	Sample Ref.	Date/Time (UT)	Position	Type	*E. coli* (cfu/100ml)	Salinity*
1	VAL-FW-01	29/09/2014 09:13	HU 22315 47684	FW	180	-
2	VAL-FW-02	29/09/2014 09:53	HU 21913 48202	FW	1500	-
3	VAL-FW-03	29/09/2014 10:20	HU 21592 48480	FW	20	-
4	VAL-SW-01	29/09/2014 10:44	HU 21993 48465	SW	35	32.63
5	VAL-SW-02	29/09/2014 11:37	HU 22878 48675	SW	5	34.28
6	VAL-FW-04	29/09/2014 12:22	HU 23272 48551	FW	900	-
7	VAL-SW-03	30/09/2014 07:44	HU 24782 48139	SW	70	34.36
8	VAL-SW-04	30/09/2014 08:36	HU 22189 48306	SW	<1	34.23
9	VAL-SW-05	30/09/2014 08:57	HU 23324 48364	SW	<1	34.59
10	VAL-SW-06	30/09/2014 09:16	HU 23925 48455	SW	8	34.5
11	VAL-SW-07	30/09/2014 09:32	HU 24225 48013	SW	14	34.79
12	VAL-SW-08	30/09/2014 09:47	HU 24381 47185	SW	<1	34.78
13	VAL-SW-09	30/09/2014 09:52	HU 24434 47628	SW	1	34.77
14	VAL-FW-05	30/09/2014 10:14	HU 24536 46971	FW	180	-
15	VAL-FW-06	30/09/2014 10:57	HU 24068 49414	FW	21	-
16	VAL-FW-07	30/09/2014 11:05	HU 24279 49490	FW	120	-
17	VAL-FW-08	30/09/2014 11:42	HU 24390 48888	FW	80	-
18	VAL-FW-09	30/09/2014 12:07	HU 24916 48793	FW	14	-

*Practical Salinity Scale 1978 (PSS-78)

Table 3 Shellfish sample *E. coli* results

No.	Sample Ref.	Date/Time (UT)	Position	Type	Depth	*E. coli* (MPN/100g)
1	VAL-MUSS 01	30/09/2014 08:36	HU 22189 48306	Common Mussels	Top	78
2	VAL-MUSS 02	30/09/2014 08:36	HU 22189 48306	Common Mussels	Bottom	330
3	VAL-MUSS 03	30/09/2014 08:57	HU 23324 48364	Common Mussels	Top	170
4	VAL-MUSS 04	30/09/2014 08:57	HU 23324 48364	Common Mussels	Bottom	330
5	VAL-MUSS 05	30/09/2014 09:16	HU 23925 48455	Common Mussels	Top	3500
6	VAL-MUSS 06	30/09/2014 09:16	HU 23925 48455	Common Mussels	Bottom	330
7	VAL-MUSS 07	30/09/2014 09:32	HU 24225 48013	Common Mussels	Top	20
8	VAL-MUSS 08	30/09/2014 09:32	HU 24225 48013	Common Mussels	Bottom	<18
9	VAL-MUSS 09	30/09/2014 09:52	HU 24434 47628	Common Mussels	Top	78
10	VAL-MUSS 10	30/09/2014 09:52	HU 24434 47628	Common Mussels	Bottom	20

Table 4 Salinity profiles

Profile	Date/Time (UT)	Position	Depth (m)	Salinity (ppt) (± 0.35 ppt)	Temperature (°C)
1	30/09/14 08:36:30	HU 2218948306	surface	34.67	11.80
			3	34.79	11.80
			5	34.83	12.00
			10	34.80	12.10
2	30/09/14 08:57:38	HU 2332448364	surface	34.82	12.00
			3	34.90	12.00
			5	35.01	12.00
			10	35.10	12.10
3	30/09/14 09:16:54	HU 2392548455	surface	34.64	12.00
			3	34.89	12.00
			5	34.99	12.10
			10	35.06	12.10
4	30/09/14 09:32:54	HU 2422548013	surface	34.99	12.00
			3	35.00	12.00
			5	35.01	12.00
			10	35.02	12.10
5	30/09/14 09:52:31	HU 2443447628	surface	34.99	12.10
			3	35.01	12.10

			5	35.02	12.00
			10	35.11	12.00

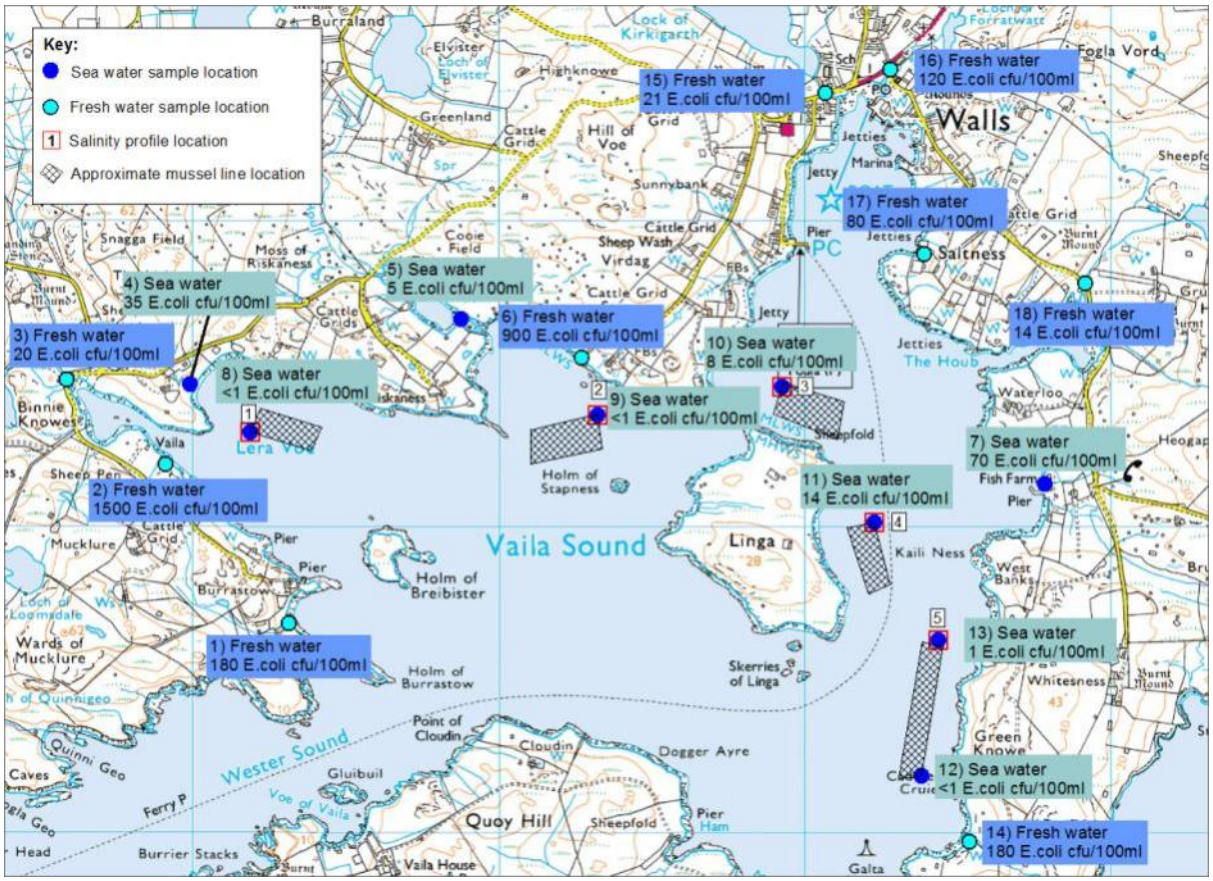

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Figure 2 Map of water sample results and salinity profile locations Vaila Sound.

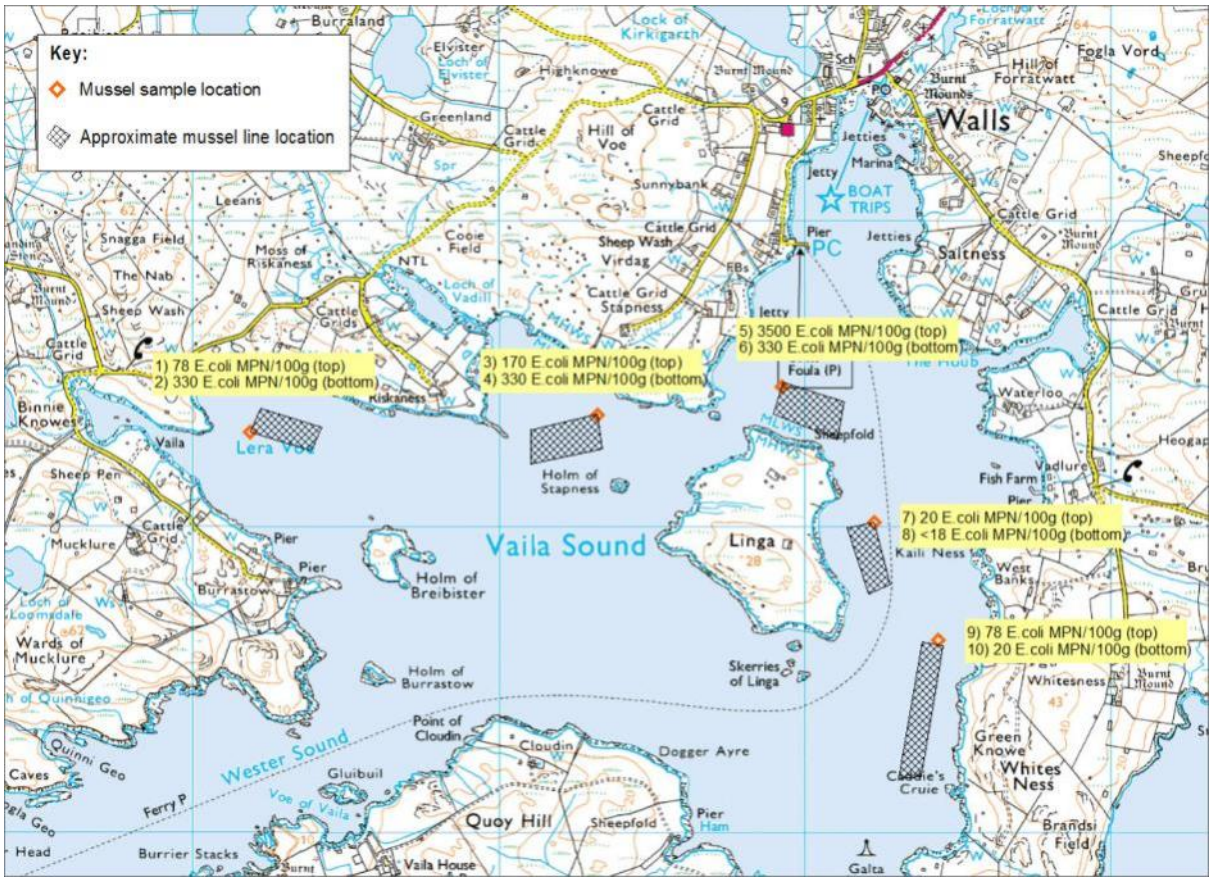

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Figure 3 Map of shellfish sample results Vaila Sound.

Photographs

Figure 4 – Mussel lines at the Linga fishery looking northwest.

Figure 5 – Mussel lines at the east of Linga fishery looking north.

Figure 6 – Mussel lines at the Whitesness fishery looking northwest.

Figure 7 – Mussel lines at the Lera Voe fishery looking NE towards Riskaness.

Figure 8 – Mussel lines at the Riskaness fishery looking NE towards Stapness.

Figure 9 – A white plastic pipe receding underwater near Burrastow House.

Figure 10 – A concrete septic tank on hill above the shore at Lera Voe.

Figure 11 – Discoloured discharge from a septic tank at Lera Voe.

Figure 12 – A concrete septic tank with outflow to Lera Voe.

Figure 13 – A septic tank including channel leading to sea at the head of Lera Voe.

Figure 14 – Overflowing septic tank at Crookataing, a seawater sample was collected here.

Figure 15 – A plastic pipe leading into the sea at Riskaness

Figure 16 – Photo indicating proximity of agricultural buildings to sea at Loch of Vadill.

Figure 17 – Concrete ducting running into sea below Stapness.

Figure 18 – A septic tank with plastic pipe disappearing underwater near Walls pier.

Figure 19 – Concrete septic tank near Walls pier.

Figure 20 – The Walls septic tank at head of pier.

Figure 21 – A house in close proximity to shoreline at Pier Road.

Figure 22 – A septic tank below house at West Banks, possibly disused.

Figure 23 – A concrete septic tank with soakaway at West Banks.

Figure 24 – Outflow pipe to beach at Vadlure, believed to be in use for kitchen wastewater only.

Figure 25 – Various pipes draining onto the beach at Vadlure, additional seawater sample collected.

Figure 26 – Walls East Pumping Station.

Figure 27 – A plastic pipe receding underwater below house at head of voe in Walls.

Figure 28 – A land drain and small pipe underwater opposite Walls marina.

Figure 29 – Walls marina.

Figure 30 – An agricultural shed near shoreline at Pointataing.

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