Scottish Sanitary Survey Review

West of Lunna

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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 in 2008 for West of Lunna. 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 output of the sanitary survey included a report and recommended sampling plans for the four production areas within the sound. 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 2008 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 2008 sanitary survey report.

Sampling Plan – West of Lunna

	2008 report	2014 review	Changes from 2008
PRODUCTION AREA	West of Lunna		No change
SITE NAMES	Culness		
SIN	SI-380-770-08		
SPECIES	Common mussels		
TYPE OF FISHERY	Long-line		
NGR OF RMP	HU 4759 6935	HU 4759 6935	No change
EAST	447590	447590	
NORTH	1169350	1169350	
TOLERANCE (M)	20	40	Amended consistent with other longline mussel areas
DEPTH (M)	3-5	1-3	Changed due to assessment of contaminants near surface
METHOD OF SAMPLING	Hand		No change
FREQUENCY OF SAMPLING	Monthly		
LOCAL AUTHORITY	Shetland Island Council		
AUTHORISED SAMPLER(S)	Sean Williamson, George Williamson, Kathryn Winter, Marion Slater	Sean Williamson, Marion Anderson, Gwen Williamson, Vicki Smith	Change in personnel
RECOMMENDED PRODUCTION AREA	Area bounded by lines drawn between HU 4780 6917 and HU 4783 6955 and HU 4764 7005 and HU 4697 6922 extending to MHWS.	Area bounded by lines drawn between HU 4780 6917 and HU 4783 6955 and HU 4764 7005 and HU 4697 6922 extending to MHWS.	No change

1. Area Description and Fishery

The location of West of Lunna is shown in Figure 1.1.

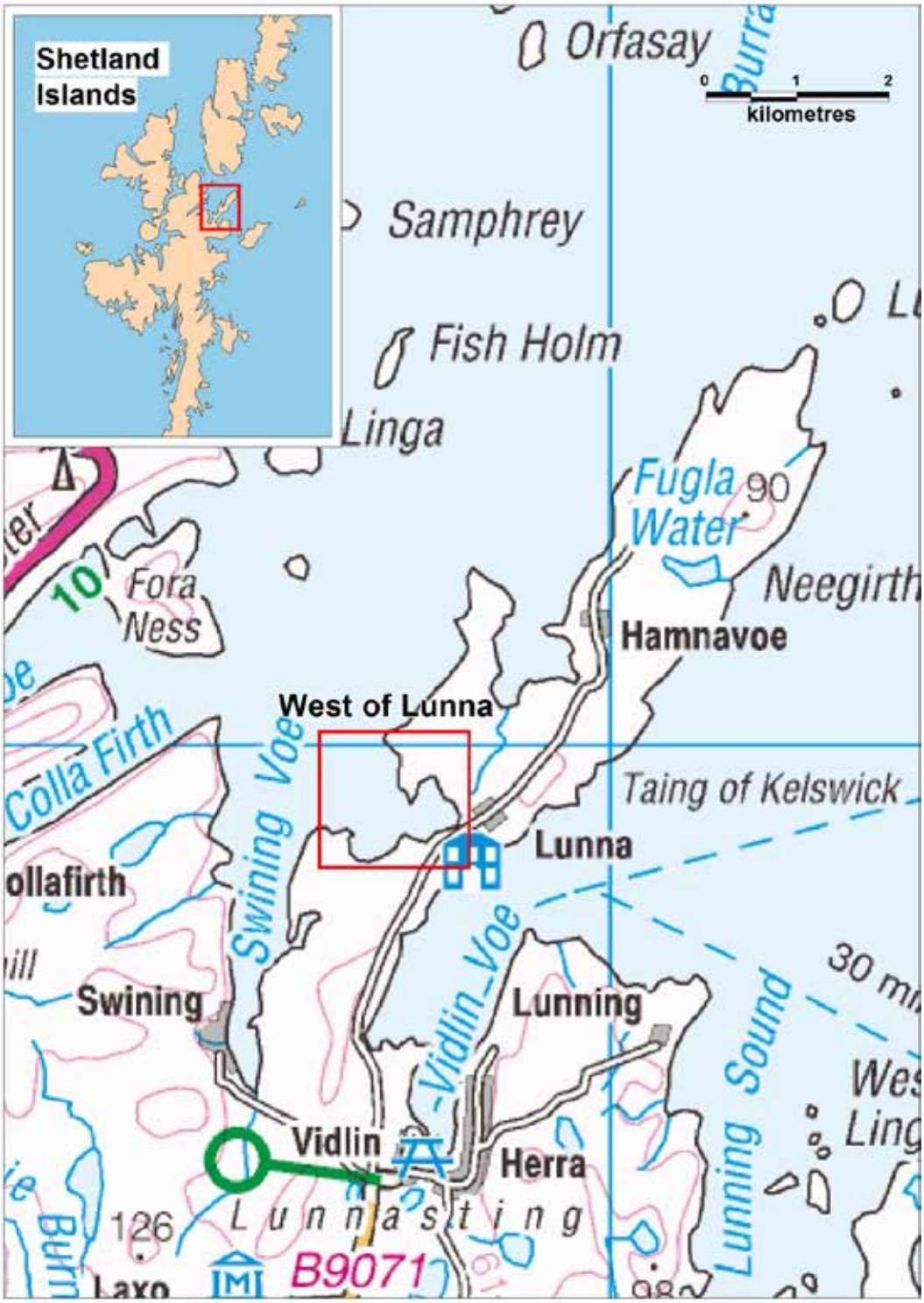

Figure 1.1 Location of West of Lunna

A single common mussel farm is classified at West of Lunna; a summary is given in Table 1.1.

Table 1.1 Currently monitored fisheries operating in West of Lunna

Production area	Site	SIN	Species	RMP
West of Lunna	Culness	SI-380-770-08	Common mussels	HU 4759 6935

The current production area boundaries and RMP are currently the same as those recommended in the 2008 report, and are displayed in Figure 1.2 with the farm boundaries recorded during the 2007 and 2014 shoreline surveys.

The size of the mussel farm is noted to have increased since 2007. The 2014 survey reported nine double headed longlines with 8 m droppers, a substantial increase over the three lines present in 2007. The site is licensed for 12 x 300 m twin-headline long-lines, suggesting there is potential to increase the size of the farm in the future. The operator planned to completely harvest the site over summer 2014 and new droppers were to be added immediately afterwards.

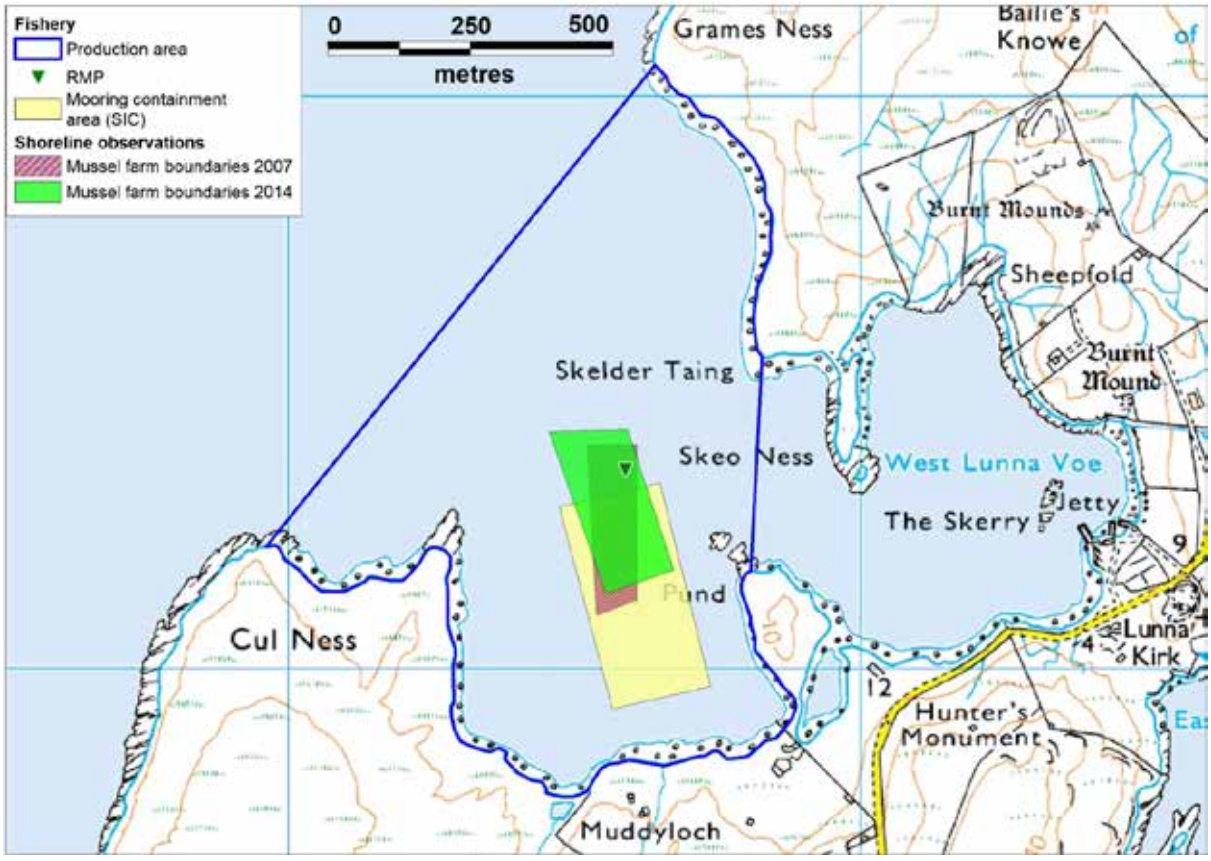

Figure 1.2 West of Lunna fishery

2. Population and Human Sewage Impacts

2.1 Population

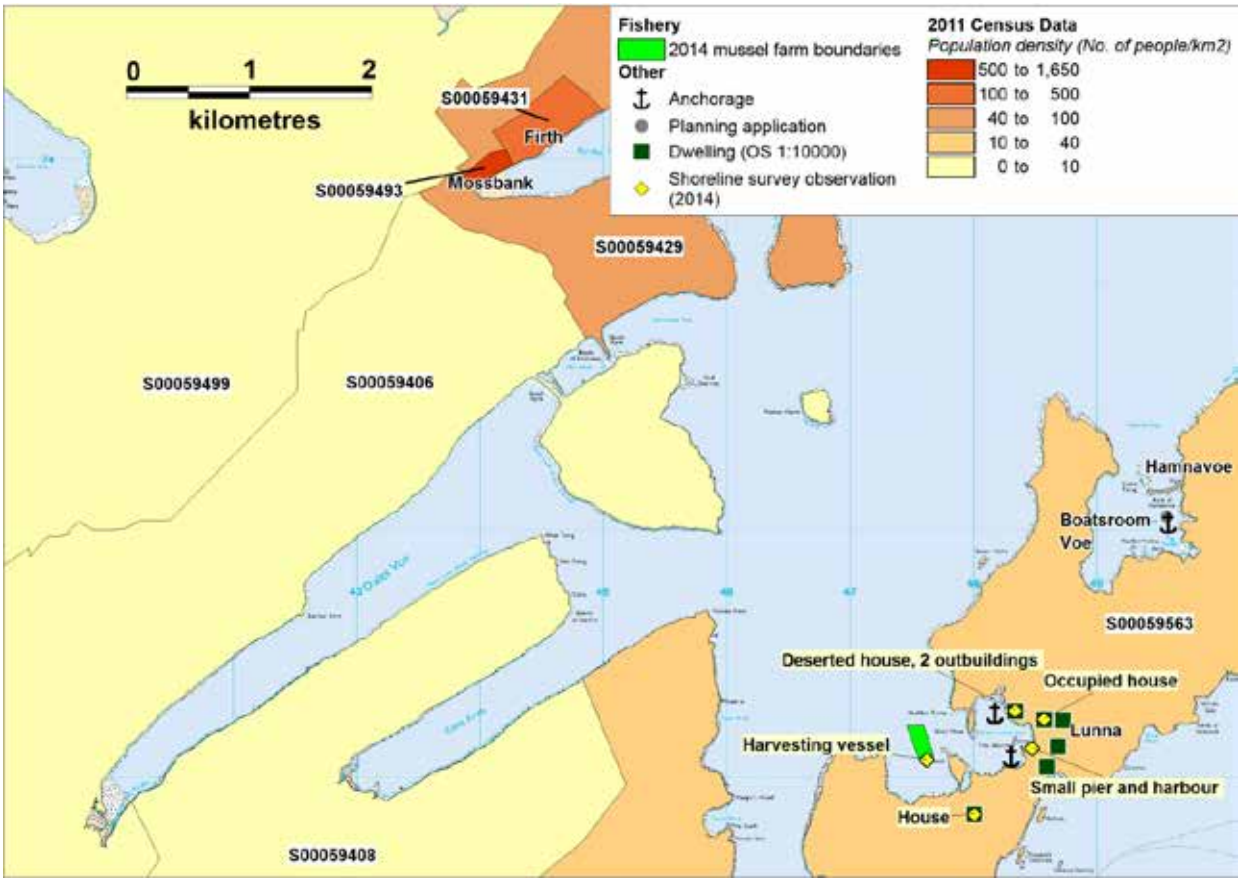

Figure 2.1 Current distribution of human population around West of Lunna

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	
60RD000159	214	S00059563	161
60RD000045	203	S00059406	170
60RD000047	105	S00059408	108
60RD000157	239	S00059429	154
60RD000065	63	S00059431	117
60RD000158	86	S00059493	106
TOTAL	**910**	**TOTAL**	**816**

The overall human population in the areas around West of Lunna fishery has decreased between census years. In the area immediately adjacent to the fishery (S00059563) there has been a relatively large decrease in population. Population increases were noted in two areas approximately 6 km northwest of the fishery, where the villages of Mossbank and Firth are located. The main settlements around West of Lunna include Lunna, Hamnavoe and Collafirth. A search was carried out on the Shetland Island Council Planning Portal in October 2014 for planning applications within these areas (Shetland Islands Council, 2014). Only one application of relevance was noted (Reference No. 2013/007/WL), which was for the deployment of a pontoon at Boatsroom Voe northeast of West of Lunna and would consist of a 50x50 m steel framed structure (see comment below on aspects relating to boating activity.) One house noted near the shoreline was observed to be unoccupied at the time of shoreline survey. Not all properties were visible from the shoreline, therefore additional properties further from the shoreline in the vicinity of the fishery were identified from the OS 1:10000 map and are shown in Figure 2.1.

There is a B&B with a sleeping capacity of four located to the east of the fishery, West Lunna Voe (Lunna House, 2014). However it was noted that the B&B would be closed throughout 2014.

Boating activity is not expected to have changed significantly since the 2008 report. Two anchorages are noted immediately east of the fishery in West Lunna Voe (Clyde Cruising Club, 2005). In addition, there is an anchorage associated with the new pontoon in Boatsroom Voe, approximately 5 km to the northeast of the mussel farm. Boat activity is largely associated with the nearby finfish and shellfish farms, with a finfish processing shorebase located at the small pier/harbour within West Lunna Voe. There was also a small fishing boat moored here at the time of the 2014 survey, with a boat noted at the West of Lunna fishery and two empty moorings were also identified slightly offshore from the pier.

2.2 Sewage Discharges

No community or private sewage discharges were identified in the 2008 report. No sewage related infrastructure was observed during the 2007 shoreline survey, although it was assumed that the six houses along the shoreline would have private septic tanks (STs).

No further information on STs around West of Lunna was found during the internet search carried out for this review. During the 2014 survey, two sewage related observations were made, which are listed in Table 2.2 with their location displayed in Figure 2.2.

Table 2.2 Sewage discharge-related observations around West of Lunna from the 2014 shoreline survey

No.	NGR	Description
1	HU 4830 6952	Concrete septic tank below deserted house and 2 outbuildings.
2	HU 4828 6952	Discharge pipe below tank, emerging from bank above rocky foreshore. Inactive, and capped.

The two observations related to a ST and its outflow pipe, though as they were seen below a deserted house, they are not expected to have an impact on the fishery. Several other houses were visible during the survey, but were set back from the shoreline. The remaining houses are expected to have STs to soakaways, though it remains unclear whether runoff would enter West Lunna Voe or East Lunna Voe following significant rainfall events.

Conclusions

Human population impacts are expected to have decreased since the 2008 report. Boat activity remains small, limited to a local fishing fleet and boats servicing nearby aquaculture farms, which are expected to use the anchorages noted in West Lunna Voe.

Impacts from sewage are also expected to have decreased since the 2008 report. Whilst the house with a ST discharging to West Lunna Voe was derelict, the remaining houses are expected to have STs to soakaway. However, it remained unclear whether contamination from these STs would potentially impact West Lunna Voe should the soakaway fields fail.

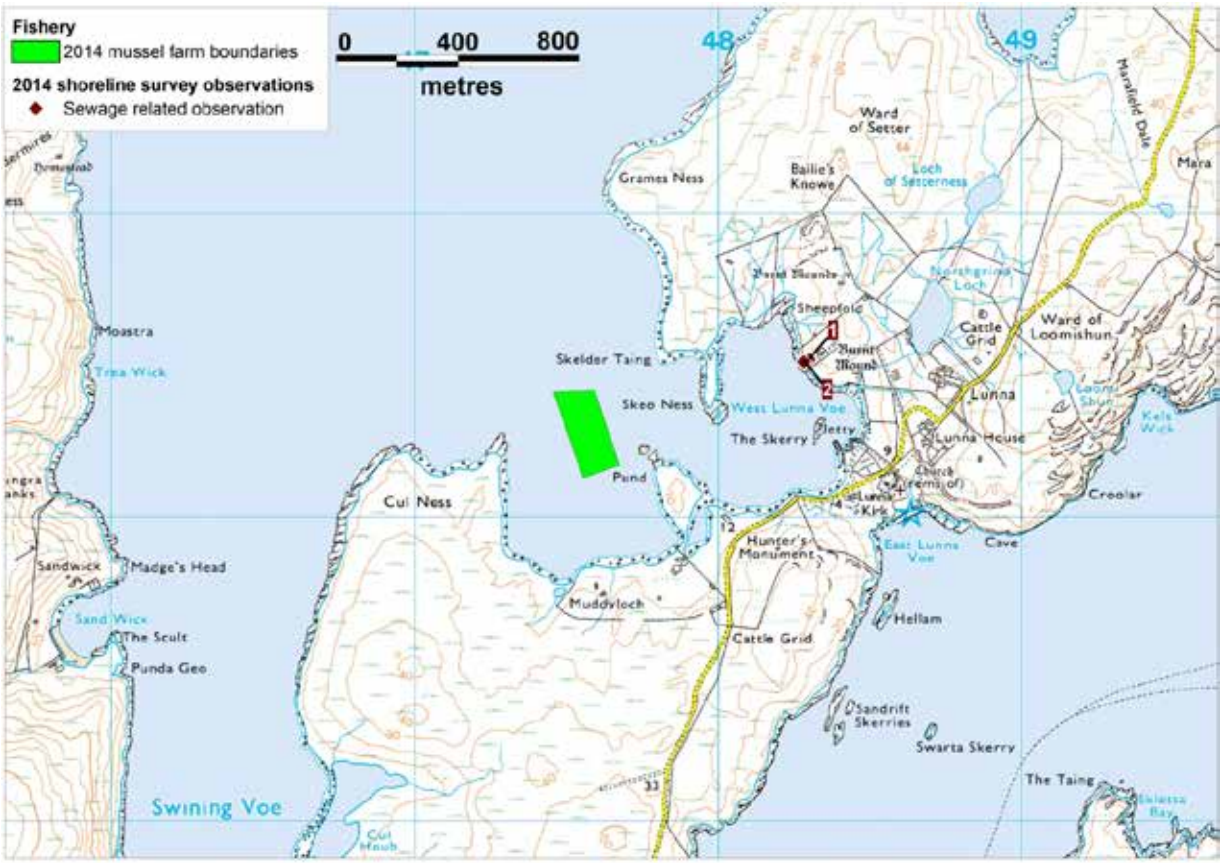

Figure 2.2 Map of sewage related observations from the 2014 shoreline survey

3. Farm Animal Population and Agricultural Impacts

Information on agricultural based contamination sources has been obtained through shoreline surveys conducted in 2007 and 2014, and through a desk-based internet search undertaken for this review. Agricultural census data for this area had been requested for the 2008 sanitary survey but was not made available due to confidentiality concerns on the part of the data holder. Shoreline survey observation information only relates to the time of the surveys undertaken in May 2007 and on the 29th July 2014. Figure 3.1 displays the locations of animals observed during the 2014 survey only.

The 2007 shoreline survey recorded that sheep were reared in large numbers across the land adjacent to the fishery: four cattle were also observed on land to the east. The area was dominated by improved pasture, where livestock were largely concentrated. Livestock were noted to have access to the shoreline and overall agricultural contamination was anticipated to be the most significant contamination source to the fishery.

The extent of the improved pasture area has been obtained from satellite imagery (van Excel, 2014) and is displayed in Figure 3.1. From satellite imagery, two farms were also noted east of West Lunna Voe; these are also displayed in Figure 3.1. Both farms had large sheds associated with the main farm building, but it remained unclear whether these were used for storing agricultural machinery or livestock during harsher winter months. It should also be noted that sheep were visibly on the small grassy outcrop of Pund to the southeast of the fishery.

The 2014 shoreline survey recorded a similar number of sheep on land to the east and south of the fishery (n=134). The shore remains accessible along much of the coastline, although no livestock were observed on the shoreline during the survey. Evidence of cattle (hoof prints and faeces) was noted on three separate occasions on land east of the fishery, including along the watercourse that links Northgrind Loch to the voe. A seawater sample was taken adjacent to the mouth of this watercourse and it returned a high result of 800 *E. coli* cfu/100 ml, suggesting livestock were likely to have contributed to contamination levels in this watercourse.

Overall, agricultural based faecal contamination impacts remain significant at the West of Lunna fishery. Sheep remain the predominant livestock in the area, with livestock concentrated on areas of improved pasture and with access to the shoreline. Significant contamination is expected from the watercourse associated with Northgrind Loch, which appears to be used by cattle kept in the area. Contamination is also anticipated to be washed into surrounding watercourses and West Lunna Voe during periods of significant rainfall, which will also wash across the fishery. Overall, contamination impacts are expected to remain highest at the eastern extent of the fishery from contamination entering from West Lunna Voe. However,

there may also be impacts from livestock kept on the southern shore, particularly from Pund where sheep were observed.

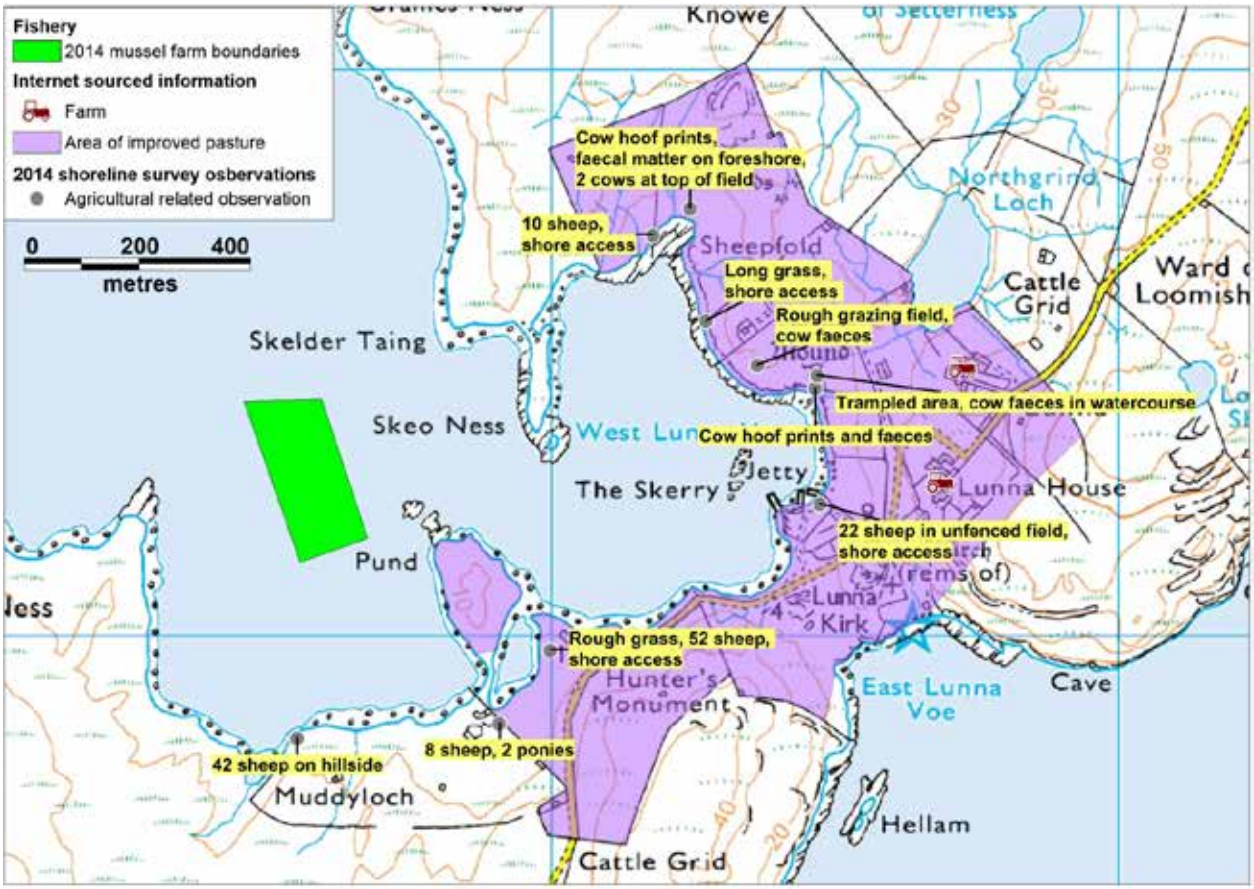

Figure 3.1 Map of potential agricultural sources at West of Lunna

4. Wildlife

The 2008 report concluded contamination from wildlife was not expected to have a significant impact on the West of Lunna fishery. During the 2007 shoreline survey the harvester was noted to say that otters were common in the area. One seal was observed at the that time.

For this review, information on pollution sources from wildlife has been obtained through shoreline surveys conducted in 2007 and 2014, and through a desk-based internet search. Shoreline survey observation information only relates to the time of the surveys undertaken in May 2007 and on the 29th July 2014. Wildlife observations are displayed in Figure 4.1.

Pinnipeds

The Special Committee on Seals Report (Special Committee on Seals, 2013) identified that populations of both common seals and grey seals are located on the east side of Shetland around Yell Sound where West of Lunna fishery is located. The harbour seal population within Shetland is noted to have decreased between 2000 and 2010 by 30%. The Yell Sound Coast Special Area of Conservation (SAC) was designated in 2005 for internationally important common seal populations and extends around the area where the fishery is located. Data from the Marine and Spatial Plan for Shetland (NAFC Marine Centre, 2012) report highlights that common seal habitat is located to the north and northeast of the fishery, with grey seal habitat also located to the northeast at the end of the Lunna peninsula. No seals were observed during the 2014 shoreline survey.

Cetaceans

No new information relating to cetaceans in West of Lunna was found during internet searches for this review. No cetaceans were observed during the 2014 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 West of Lunna production area is listed in Table 4.1 and displayed in Figure 4.1.

Table 4.1 Seabird 2000 census data for West of Lunna

Common name	*Species*	Count*	Type	Accuracy
Great Skua	*Stercorarius skua*	24	Occupied territory	Accurate
Common Tern	*Sterna hirundo*	3	Individuals on land	Accurate
Arctic Tern	*Sterna paradisaea*	534	Individuals on land and occupied nests	Accurate and one estimate
Shag	*Phalacrocorax aristotelis*	2	Occupied nests	Accurate
Fulmar	*Fulmarus glacialis*	906	Occupied sites	Accurate
Atlantic Puffin	*Fratercula arctica*	100	Individuals on sea	Estimate
Black Guillemot	*Cepphus grylle*	597	Individuals on land	Accurate
Great Black-Backed Gull	*Larus marinus*	161	Individuals on land, occupied territory, occupied nests	Accurate
Herring Gull	*Larus argentatus*	48	Individuals on land, occupied territory, occupied nests	Accurate
Common Gull	*Larus canus*	80	Individuals on land, occupied territory, occupied nests	Accurate
Great Skua	*Stercorarius skua*	2	Occupied territory	Accurate
Arctic Skua	*Stercorarius parasiticus*	16	Occupied territory	Accurate

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

The JNCC data highlights that Arctic terns, Fulmars and black guillemots are found in particularly high numbers in the area around the fishery in Yell Sound. The largest aggregations of birds were noted approximately 3.5 km northwest of the fishery at the uninhabited islands of Linga and Fish Holm. These areas are important breeding sites for fulmars and 100 Atlantic puffins were also observed at sea in this vicinity. Dense nesting sites were also noted southeast of the fishery around Lunning. Whilst these sites are unlikely to directly impact contamination levels at the fishery, birds are expected to use the surrounding areas close to the fishery and may add to background levels of contamination there. A relatively small number of birds were observedon land adjacent to the fishery these may contribute more directly to contamination levels at the fishery, particularly during the May to September breeding season .

The Marine and Spatial Plan for Shetland (2012) data indicated the area contains suitable habitat for a wide variety of different birds. During the 2014 shoreline survey, birds were the only wildlife observed. Present in highest numbers were the greylag geese, with Arctic terns also present in moderate numbers.

Otters

The Eurasian otter (*Lutra lutra*) is common in Shetland, which holds approximately 12% of the UK population (Shetland Otters, 2014). The Yell Sound Coast SAC was designated for otters, as well as seals, and Yell Sound Coast Site of Special Scientific Interest (SSSI) designated in 1998 was also for otters. The Marine and

Spatial Plan for Shetland 2012 report indicated otter habitat was found around the entirety of West of Lunna and nearby surrounding shorelines. Anecdotal accounts state otters maybe seen around the fish farm piers in West Lunna Voe (Visit Shetland, 2014). No otters were observed during the 2014 survey.

Conclusions

New information suggests contamination impacts from wildlife may be more significant than assumed in the 2008 report. The area is now known to support populations of both common and grey seals, as well as significant bird colonies and plenty of suitable coastal habitats to support a healthy otter population. However, overall the contamination impact from wildlife is expected to remain relatively small and will be localised and unpredictable.

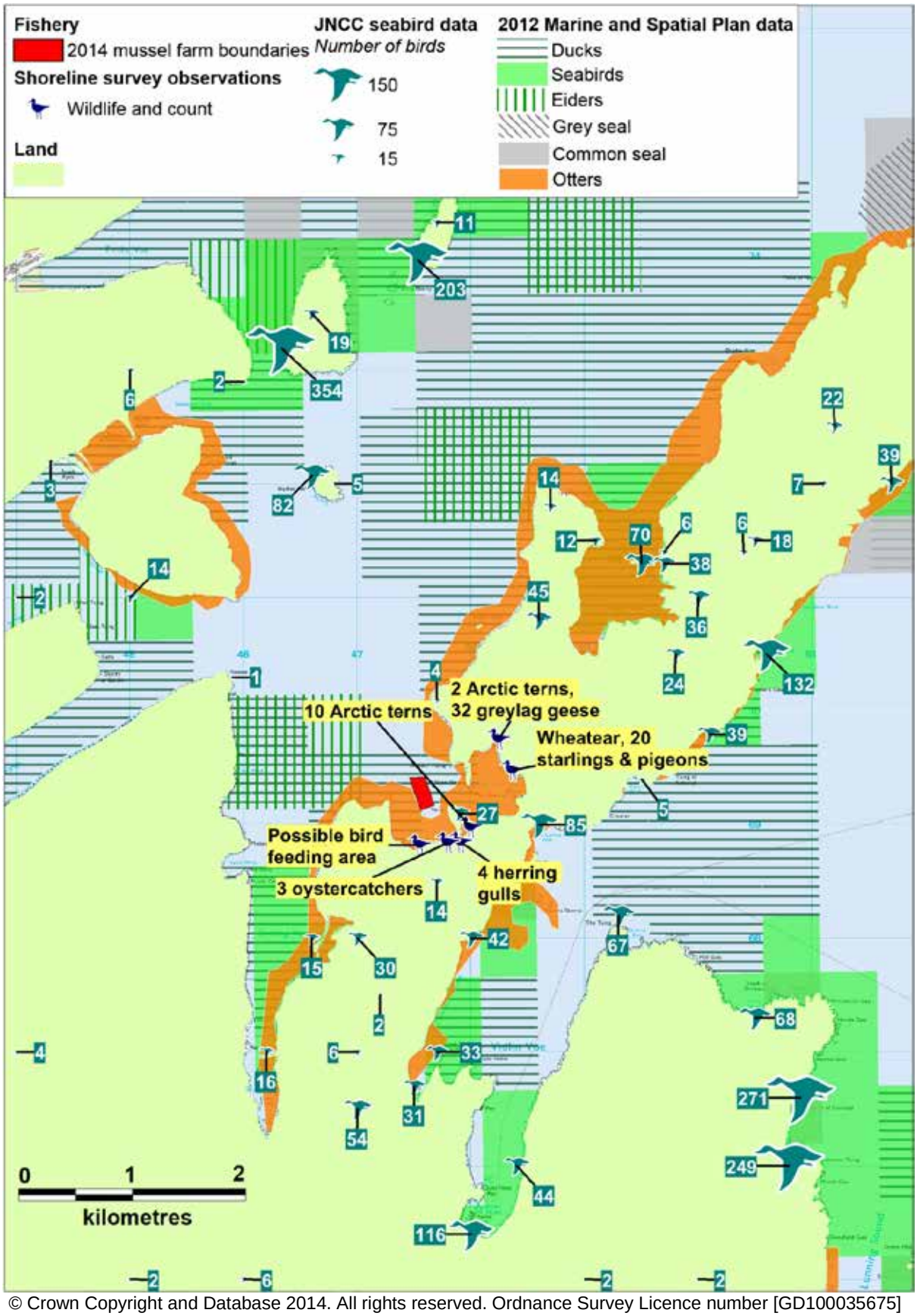

Figure 4.1 Map of wildlife around West of Lunna

5. Watercourses

There are no gauging stations on watercourses entering into the West of Lunna area. The weather was dry during the 2007 shoreline survey while light rain was reported in the evening prior to the 2014 shoreline survey. The 2014 shoreline survey extended approximately 250 m further north along the east shore of West Lunna Voe than did the earlier survey.

Only one flowing watercourse was recorded during the 2007 shoreline survey, for which the calculated loading was moderate (4×10^{10} *E. coli* cfu/100 ml). This related to outflow from Northgrind Loch, on the east side of West Lunna Voe.

No watercourses were found to be flowing sufficiently to allow for measurement and sampling during the 2014 survey. Therefore, no comparison of loadings between the two surveys is possible. However, a seawater sample taken adjacent to the outflow from Northgrind Loch returned an high result of 800 *E. coli* cfu/100 ml, suggesting contamination levels at this watercourse remained high. Cattle hoofprints and droppings were noted around the watercourse, which may have contributed to the recorded contamination. The locations of areas of land drainage and bog noted during the 2014 survey are displayed in Figure 5.1.

It is anticipated areas of land drainage, and potentially the boggy areas as well, would flow during and after periods of heavy rainfall. This would act to flush land based contamination e.g. from wildlife, livestock and STs into surrounding watercourses or directly to the voe.

There is no evidence to suggest that significant contamination will arise from freshwater inputs other than the watercourse coming from Northgrind Loch. During and after periods of heavy rainfall, freshwater contamination impacts are expected to be higher, particularly at the eastern and southern extents of the fishery.

Figure 5.1 Areas of potential freshwater input to West of Lunna from the 2014 shoreline survey

6. Meteorological data

Meteorological data had been purchased from the Meteorological Office for the survey period 01/01/2003 – 31/12/2006 for the analyses undertaken for the 2008 West of Lunna Sanitary Survey Report: rainfall box-plots and wind roses for 2003-2006 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 29 km south of the West of Lunna. 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 01/01/2007 - 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 & Morgan, 2003).

The Lerwick weather station rainfall dataset for 2007-2013 is presented by year in Figure 6.1 and by month in Figure 6.2.

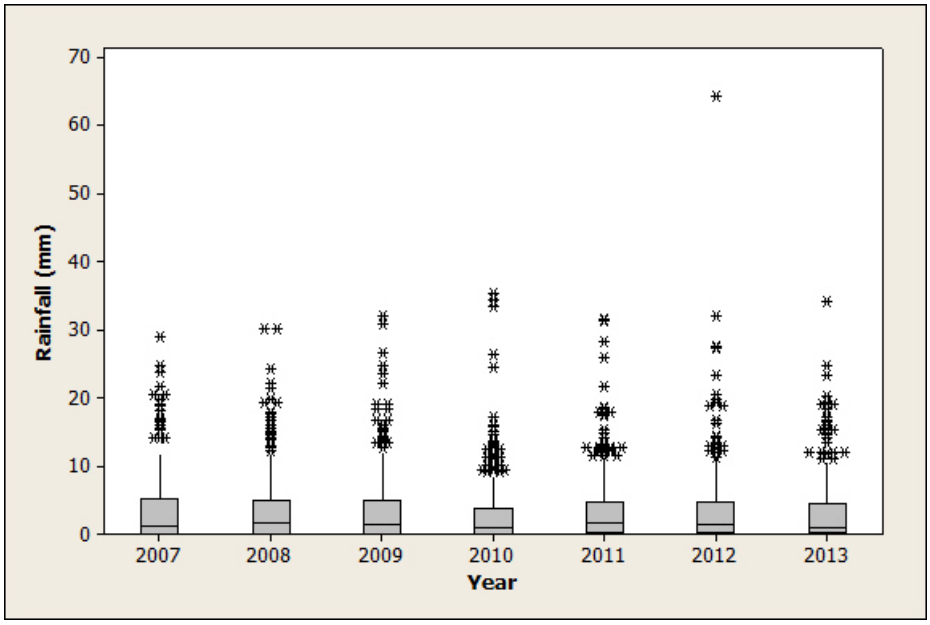

Figure 6.1 Boxplot of daily rainfall at Lerwick by year (2007-2013)

The 2007-2013 data showed that rainfall on the majority of days is less than 10 mm, with rainfall greater than 30 mm occurring in nearly all years and one exceptionally high rainfall event of over 60 mm occurring in one year. This represented no change from the pattern seen in the data used in the 2008 sanitary survey report.

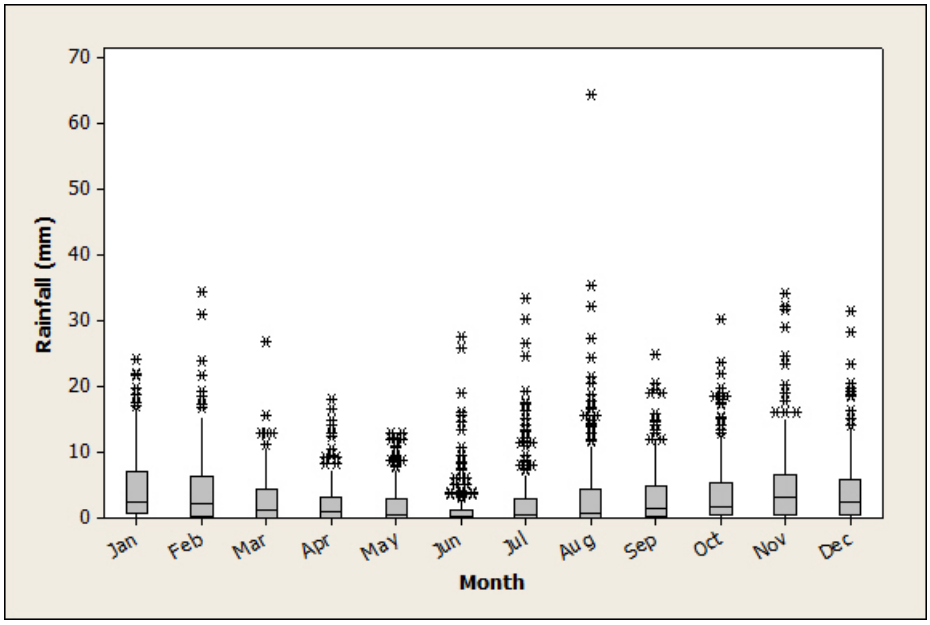

Figure 6.2 Boxplot of daily rainfall at Lerwick by month (2007-2013)

The 2008 report noted that the months September to January were the wettest, with July and August the driest. In the 2007-2013 dataset, daily rainfall values were higher during the autumn and winter. Rainfall peaked in October (1348 mm) and was driest in June (429 mm). Rainfall values exceeding 30 mm/d occurred in February, July, August, October, November and December. There has also been an increase in the number of months where >30 mm rainfall/day is recorded, though this could be affected by the second assessment period covering a greater number of years. Extreme events of >60 mm rainfall/day occurred in August during both periods.

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 orientation of West of Lunna is similar to Lerwick and it is therefore expected that there will be little variation in wind patterns to those shown in the wind roses.

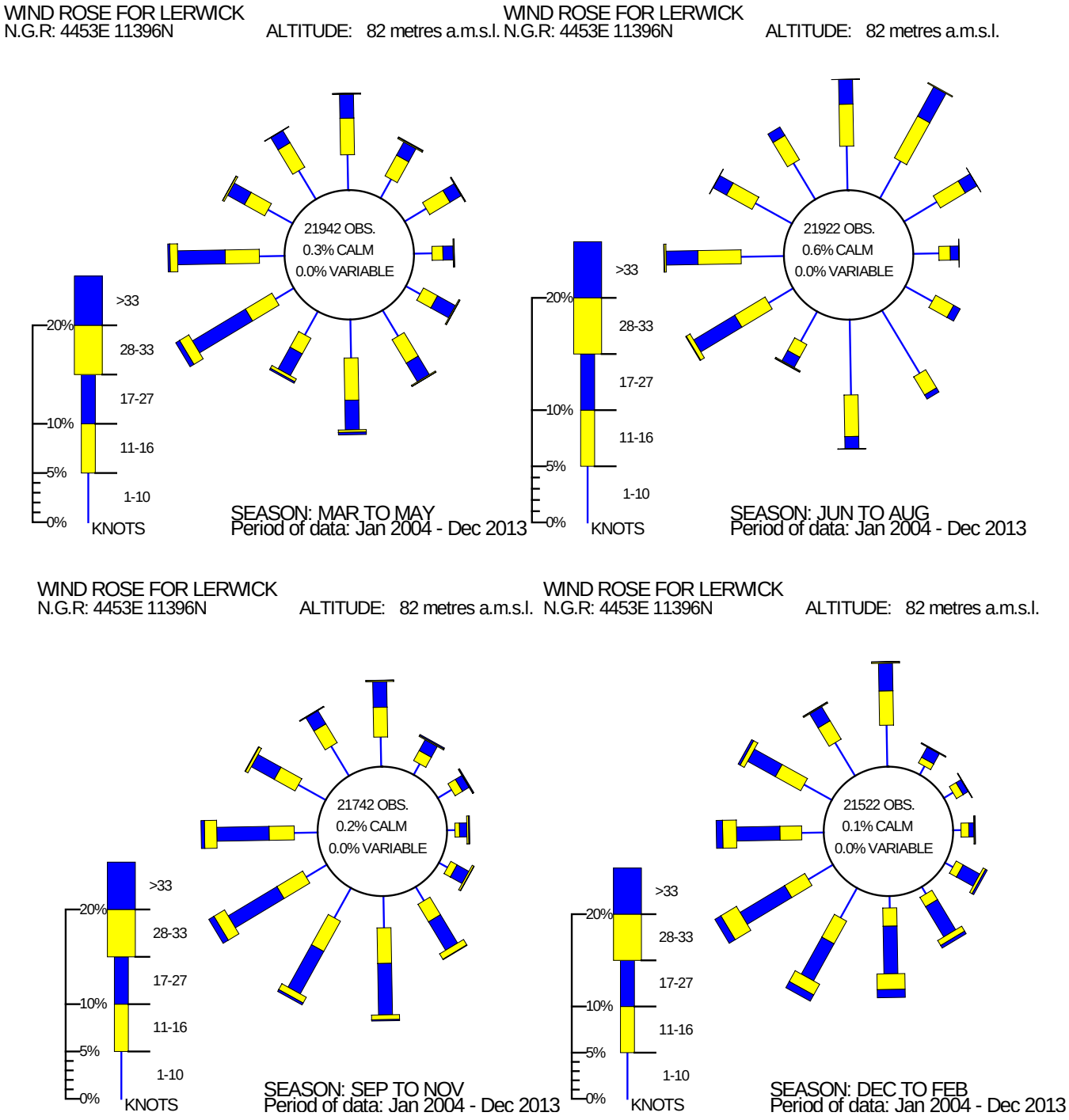

Figure 6.3 Seasonal wind roses for Lerwick (2004-2013)

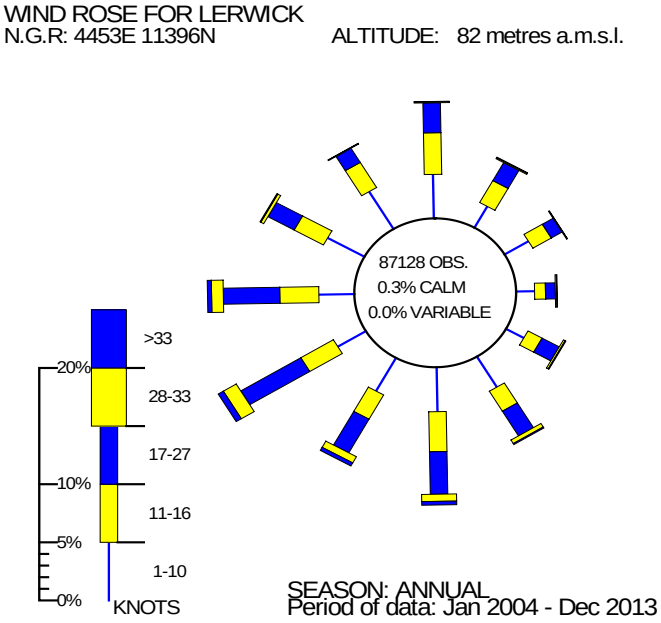

Figure 6.4 Annual wind rose for Lerwick (2004-2013)

Overall the annual wind direction showed that wind was stronger when coming from the west than the east, and winds from the southerly direction were stronger than those from the north. Predominant winds were from the southwest. Winds changed from north-northeast in the summer months to southwest in the winter months and winds were much stronger in the winter months than in the summer months.

7. Historical *E. coli* Data

Results for West of Lunna production area between 01/01/2008 and 09/09/2014 were extracted from the FSAS database in September 2014 and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data. Historical *E. coli* data used in the 2007 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.

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

One sample had an invalid result and was omitted from further analysis in this review. One sample also lay >100 m outside the production area boundaries and was omitted from further analysis. The remaining 55 sample results were received at the laboratory within 48 hours since collection and upon arrival had box temperatures of <8^{o}C.

7.1 Summary of microbiological results

Summary results from West of Lunna are displayed in Table 7.1. Although results from a nearby production area, Lunnaness, were used in the 2008 sanitary survey report, this area was declassified in 2009 due to a lack of samples and therefore the results have not been considered further here.

Table 7.1 Sampling summary results for West of Lunna 2007-2014

Sampling Summary				
Production area	West of Lunna			
Site	Cul Ness			
Species	Common mussels			
SIN	SI-380-770-08			
Location	Various			
Years	2007		2008-2014	
Total no. of samples	8		55	
	2007	8	2008	7
			2009	7
			2010	5
			2011	9
			2012	10
			2013	10
			2014	7
Results summary				
Minimum	<20		<20	
Maximum	500		3500	
Median	20		<20	
Geometric mean	37		22	
90 Percentile	500		170	
95 Percentile	500		230	
No. Exceeding 230/100g	1 (13%)		1 (2%)	
No. Exceeding 1000/100g	0		1 (2%)	
No. Exceeding 4600/100g	0		0	
No. Exceeding 18000/100g	0		0	

Overall, the majority of sample results at West of Lunna have been low, with only two sample results >230 *E. coli* MPN/100 g reported in the 2007-2014 sampling period.

7.2 Geographical patterns of results

The sampling locations of all 55 samples assigned to West of Lunna are displayed in Figure 7.1.

There are two distinct areas of sampling at the fishery, which can be divided into a northern area and a southern area. Samples taken in the northern area have been taken within 72 m of the current RMP at NM 4759 6935, and were taken between 2011 and 2014 (excluding most samples from 2012). Samples taken in the southern area were reported against locations within 300 m southwest of the RMP and were taken between 2008 and 2010, and in 2012.

A summary of results taken at these two areas of sampling are listed in Table 7.2.

Table 7.2 Comparison of summaries sampling results from the two sampling areas at West of Lunna (2008-2014)

Site	No. of samples	Minimum	Median	Maximum	Geometric mean	90%
North	29	<20	<20	230	20	230
South	26	<20	<20	3500	24	125

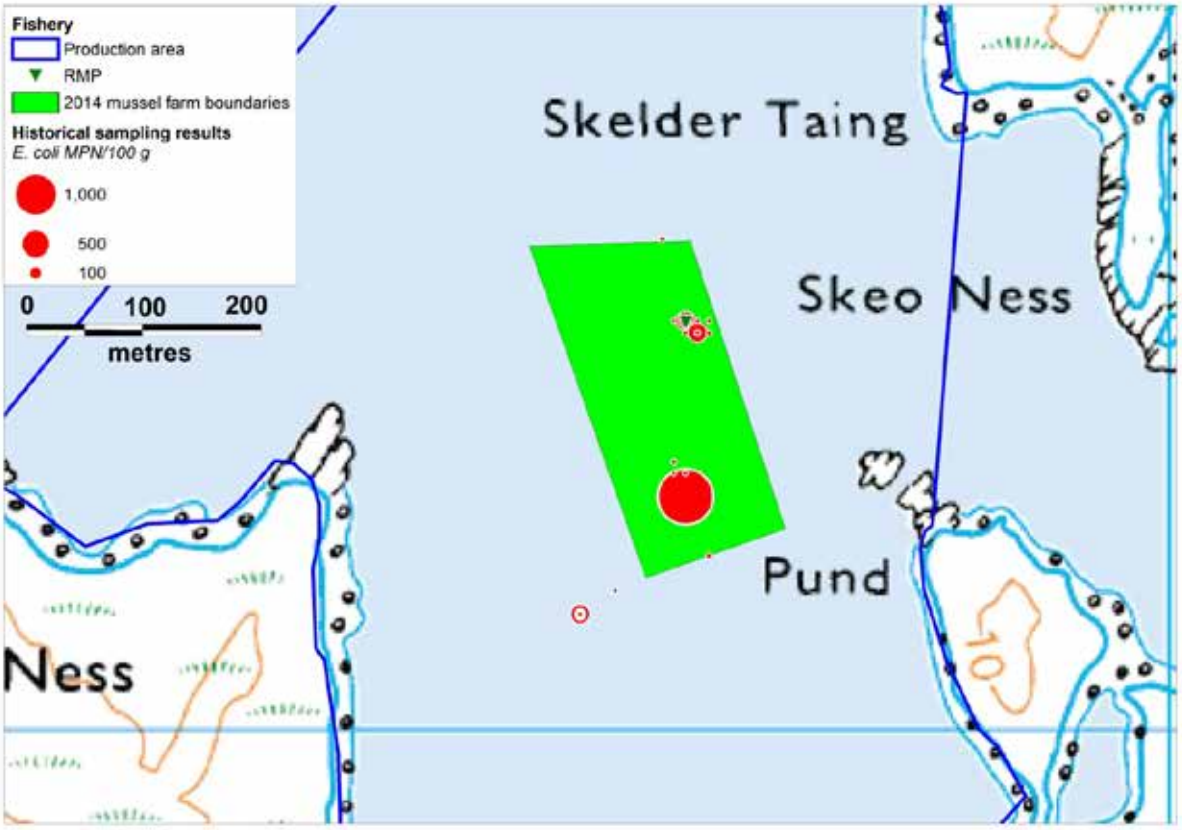

Figure 7.1 Sample results and locations from West of Lunna common mussel fishery

An unpaired t-test was carried out to determine whether there was a statistically significant difference between sampling results between the areas. No statistically significant difference was found between sample results between the two areas (T-test, t= -0.62, DF = 46, p = 0.536).

7.3 Temporal patterns of results

The trends of *E. coli* sampling results for West of Lunna have been analysed for the years between 2007 and 2014. As only eight samples were taken at West of Lunna prior to 2008, it was not possible to evaluate whether there had been a statistically significant change in results since that time. Temporal trends for West of Lunna are therefore displayed in a scatterplot in Figure 7.2.

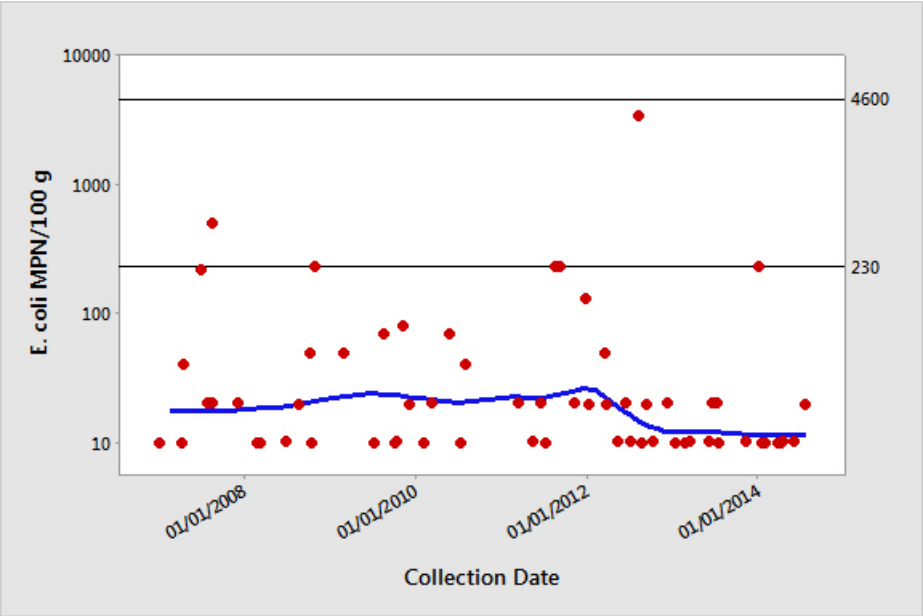

Figure 7.2 Scatterplot of West of Lunna *E. coli* results by date (2007-2014)

There was an increase in the proportion of sample results below the limit of detection (<20 *E. coli* MPN/100 g) from approximately mid-2012 onward. However, the highest result also occurred during this time frame, in August 2012.

Conclusions

Overall, West of Lunna sample results have been low, with only two results exceeding 230 *E. coli* MPN/100 g since sampling began in 2007. Sampling location has varied between the RMP and the southern end of the mussel farm over time, with the highest result recorded against a sample taken at the southern end of the mussel farm. However, no statistically significant difference was found in results between sampling areas. An improvement in *E. coli* results from 2012 onward is apparent due to an increase in the number of results below the limit of detection.

8. Movement of contaminants

Findings from the hydrographic modelling study conducted for the 2008 report were as follows:

- West of Lunna and West Lunna Voe are shallow, providing less potential for dilution of pollutants.

- Flushing time in Swining Voe is six days, though the open aspect of the fishery may mean it takes less time to flush.

- The area of West Lunna Voe is semi enclosed and contaminants are likely to become well mixed when moved on the outgoing tide through the restriction at the entrance to the voe.

Current data was received for two locations near West of Lunna. However, the nearest of these was approximately 4 km to the northwest of the mussel farm and in a more exposed part of Yell Sound. The other was approximately 8 km southeast of the mussel farm, near the mouth of Dury Voe. Neither was considered sufficiently representative of conditions at the fishery to warrant further assessment. No other hydrographic information has been obtained from internet searches undertaken for this review. It is therefore assumed that there has been no significant change in movement of contaminants within West Lunna Voe and subsequently across the fishery.

9. Overall Assessment

The following section discusses the changes in contamination impacts since the 2008 report.

Human sewage Impacts

Human population around the fishery remains very small, and may have decreased slightly since the 2008 report, owing to the unoccupied house noted northeast of West Lunna Voe. Boating activity remains limited to one or two small fishing vessels and boats associated with the nearby aquaculture farms.

Sewage based contamination also remains very limited. Impacts from STs serving houses noted further from shore along West Lunna Voe may add to contamination levels flushing from land during significant rainfall events. The only discharge pipe noted along the shoreline was associated with an unoccupied property, and therefore was not discharging. Should this property come back into use, the septic tank outfall would be expected to be the nearest known point source of sewage discharge to the fishery. No other point source discharges were found. Boats associated with aquaculture farms in the area are a potential source of faecal contamination should they discharge overboard in the vicinity of the mussel farm.

It remains unclear whether contamination from septic tanks associated with properties east of the voe would affect West Lunna Voe or East Lunna Voe if the soakaways were insufficient or fouled.

Agricultural impacts

Impacts from agricultural based contamination remains significant. Sheep remain concentrated on improved pasture, which dominates the shores around West Lunna Voe and to the south of the fishery. Evidence indicated cattle were also still kept on land east of West Lunna Voe, and posed as a significant contamination source to the watercourse from Northgrind Loch and subsequently West Lunna Voe. Although two farms have been identified at Lunna, it remains unclear whether agricultural sheds associated with the farms are used to store agricultural machinery or livestock. If the latter, these may pose a risk of contamination to the voe when in use. Overall, contamination levels are not expected to have changed significantly since the 2008 report and remain highest at the east side of the fishery.

Wildlife Impacts

Additional information was found on the spatial distribution of seabirds that suggests that seabirds nest in modest numbers on shoreline to the south and southeast of the mussel farm. The information on seals suggests a potential decrease in impact due to the reported decline of the Shetland common seal population. No information was

found to suggest any change in the otter population. Overall, the likely contamination impact from wildlife to the fishery remains low.

Seasonal Variation

Some seasonality is expected in livestock kept on land surrounding the fishery. An increase in the number of animals, and therefore the amount of potential faecal input from land-based runoff, is expected during the spring and summer months. Any livestock kept in winter housing would lead to the accumulation of faecal waste in the vicinity and whether this would impact the fishery depends on how the bedding waste is handled. If it is spread on local pasture, there could be an increase in potential contribution to contaminated runoff in winter and spring, when the waste is most likely to accumulate.

Increased contamination levels from birds in the surrounding area are also anticipated during the main breeding season between May and September.

No change was noted in the meteorological data, which suggested that there was higher rainfall in the autumn and winter, though extreme rainfall events could occur in most months. Rainfall is expected to flush land based contamination into surrounding watercourses and to West Lunna Voe. It will then be carried across the fishery on outgoing tides.

Watercourses

There has been no change in freshwater impacts at the fishery. The most significant input is associated with the watercourse formed by the outlet from Northgrind Loch. Overall freshwater contamination remains low, but may become more significant during periods of heavy/sustained rainfall and will impact the eastern and southern extents of the fishery most significantly.

Movement of contaminants

There has been no change in information relating to the movement of contaminants around West of Lunna fishery.

Analysis of Results

Historical *E. coli* results

Sampling results from West of Lunna have been predominantly low, with only two results >230 *E. coli* MPN/100 g since 2007. Although the elevated results were from samples taken in the area south of the RMP, no statistically significant difference was found in sample results between the geographically distinct northern and southern areas of sampling. Shellfish *E. coli* levels declined from mid-2012 onward, with the majority of 2013 and 2014 sample results below the limit of detection. However, the highest result (3500 *E. coli* MPN/100 g) also occurred near the

beginning of this period and came from a sample collected on 28/08/2014. This was approximately one week after an exceptionally high one-day rainfall event of 64.2 mm, which occurred on 21/08/2014. It is possible that the two are linked, though this cannot be conclusively determined. The previous rainfall event of this magnitude occurred in August 2004, well before this fishery was established and monitored. It would be useful to monitor this site after any further similar rainfall events to determine whether there is a deleterious impact on shellfish quality.

Shoreline Survey results

Four mussel samples were taken during the 2014 survey; two from the northeast and two from the southeast extents of the fishery, with one from the top and one from the bottom of the dropper arrays. Sample results were higher from samples taken at the surface at both locations and were slightly higher at the southeast (78 and 20 *E. coli* MPN/100 g) than the northeast (45 and <18 *E. coli* MPN/100 g). Accompanying seawater samples indicated low levels of background contamination at <1 and 2 *E. coli* cfu/100 ml, with the higher result from the southeast extent.

The seawater sample taken adjacent to the watercourse coming from Northgrind Loch showed high levels of contamination, suggesting that the outlet from the loch may be a significant source of contamination to the area.

No freshwater samples were taken during the 2014 survey.

All salinity profiles indicated normal salinities throughout their depth profiles (see Appendix 1.)

Conclusions

The 2008 concluded agricultural based contamination was the most significant source to the West of Lunna fishery, with additional inputs also expected from faecal contamination carried to sea via small land drains and streams located in West Lunna Voe. Contamination levels were anticipated to be highest during periods of significant rainfall, from September to January.

The current reviews findings are as follows:

- Agricultural based sources remain the most significant sources of faecal contamination to the West of Lunna fishery. Impacts are expected to be highest at the eastern and southern extent of the fishery.

- Faecal contamination from land runoff remains an additional source of contamination during periods of heavy/sustained rainfall, in months between August and February. Impacts are anticipated to be greatest at the eastern extent of the fishery.

- Although seabird nesting areas have been identified along the shore to the south and southeast of the mussel farm, Impacts from wildlife are still predicted to be minor.

- Highest contamination levels have been found in shellfish samples taken from the southern extent of the current fishery location, and results are higher from both sampling locations from samples taken from the surface. This was also observed in sample results taken during the 2014 survey.

Overall, there has been little change in contamination sources entering West of Lunna. However, there appears to be higher contamination levels within samples taken from the southerly extent of the fishery and from the surface, rather than at depth. These findings will therefore be used in recommending slight variations in the current sampling plan.

10. Recommendations

There have been some small changes to the recommended sampling plan in light of slight changes in the location of the main contamination sources. The revisions to the sampling plan are as follows:

Production area

This is to remain as the area bounded by lines drawn between HU 4780 6917 and HU 4783 6955 and HU 4764 7005 and HU 4697 6922 extending to MHWS.

RMP

There was no compelling evidence to suggest that any other part of the fishery is subject to greater levels of contamination than the RMP location, and therefore no change to the RMP is recommended.

Tolerance

The tolerance should be amended to 40 m to allow for movement of the lines This makes it consistent with recommendations at other long line mussel sites.

Depth

Sampling depth should changed to 1-3 m, as the observation made in the 2008 sanitary survey report of higher results at depth has not been repeated in the present assessment.

Sampling frequency

Sampling frequency should remain as monthly.

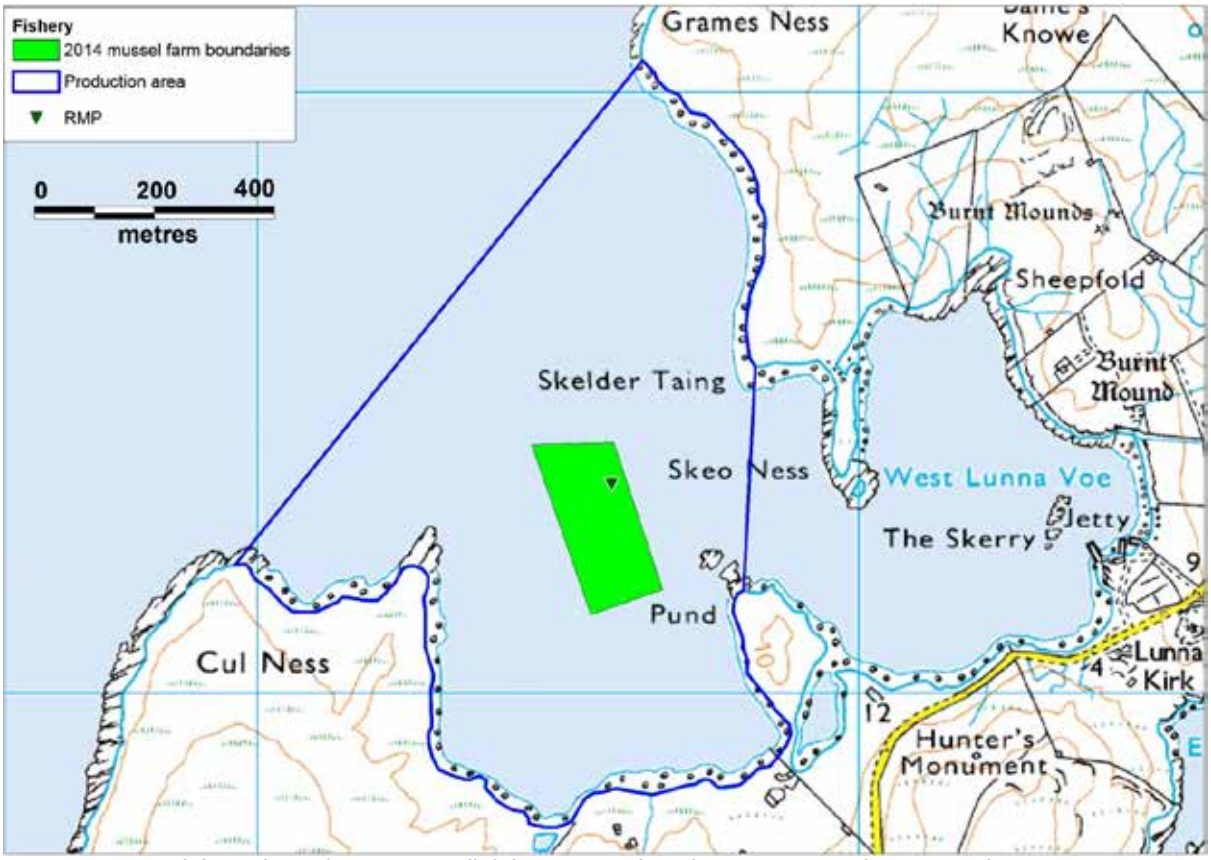

Figure 10.1 Recommended production area boundaries and RMPs for the West of Lunna fishery

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12. List of Figures and Tables

Appendices

1. Shoreline Survey Report 2014

Appendix 1

Shoreline Survey Report

Production Area:	West of Lunna
Site Name:	Cul Ness
SIN:	SI-380-770-08
Harvesters:	**C & S Mussels**: Mr. Erland Smith & Mr. Gibby Clark
Local Authority:	Shetland Islands Council
Status:	Existing area
Date surveyed:	29 July 2014
Surveyed by:	Sean Williamson (Hall Mark Meat Hygiene Ltd.) Alan Harpin (SSQC Ltd.) We are grateful to C & S Mussels for providing assistance during the marine survey work.
Existing RMP:	HU 4759 6935 *(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 4-12.

Weather

Tuesday 29 July 2014

Overcast conditions and an F4 SW breeze persisted throughout most of the survey with a light shower occurring towards the end of the shoreline walk. Conditions improved with occasionally sunny spells during the boat work.

Preceding the shoreline survey, Sunday 27 July was mostly cloudy with occasional periods of fog, a F2/3 ENE breeze and no precipitation. Monday 28 July began with foggy conditions, becoming overcast or mostly cloudy for the rest of the day. Initial F2/3 WSW winds strengthen to F4 later in the day which was accompanied with some drizzle.

Fishery

The location of the mussel lines for the fishery is mapped in Figure 1. The fishery had stocked mussel lines and the operator was harvesting at the time of the survey.

The Cul Ness fishery consisted of nine mussel lines arranged in a NNW-SSE orientation (Figures 4 and 5). All lines were double-headed longlines with 8 metre droppers. The site is licenced for 12 no. 300 metre twin-headline longlines. The operator stated that he intended to completely harvest the site in the coming weeks and add new droppers as soon as this was complete.

Sewage/Faecal Sources

The shoreline at West Lunna Voe is sparsely populated with five dwellings recorded, only one of which was directly adjacent to the West of Lunna production area.

A single septic tank was identified which was associated with the northernmost property on the eastern shore of the inner part of the voe (Figure 6). The tank was located between the house and the shoreline. This property appeared to be unoccupied and there was no evidence of flow at the tank, or at an outfall below this which emerged onto the rocky shore. A cover was present on the end of the pipe (Figure 7). A planned seawater sample at this location, as indicated in the survey plan, was not collected due to the property being unoccupied and the apparent inactivity at the outfall.

Other properties encountered during the walk were situated above the fields fringing the shoreline, or beyond the road that serves the Lunna Ness peninsular (Figure 8).

At the small jetty at the head of the voe a stone building and a shipping container serve as a shore base for creel fishing activity (Figure 9). Pipework between the container and the sea were assumed to be associated with a water recirculation system for temporary live storage the catch ashore.

Sample analysis

No freshwater samples were obtained from any of the three watercourses indicated in the survey plan due to a lack of flow at the time of the survey. These watercourses were boggy areas, sometimes with small stagnant pools (Figure 10). At a watercourse near the head of the voe flow measurements were attempted although these were unsuccessful. A seawater sample was collected instead from the beach, warranted by the presence of cattle hoof prints and faeces along the watercourse (Figure 11), and this was found to have an *E.coli* count of 800 cfu/100 ml.

Additional seawater samples collected as per the survey plan. Two were obtained from locations on the Cul Ness fishery; at either end of the easternmost line. *E.coli* levels were between <1 and 2 cfu/100ml. Away from the fishery two seawater samples were collected; one at the south east corner of the production area, and another at the northern boundary of the production area. Both had *E.coli* levels of <1 cfu/100ml.

Mussel samples were obtained from the same two locations on the Cul Ness fishery as the seawater samples. 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 northern end of the line returned results of 45 *E.coli* MPN/100g and <18 *E.coli* MPN/100g for the top and bottom samples respectively. At the southern end of this line levels were 78 *E.coli* MPN/100g and 20 *E.coli* MPN/100g for the top and bottom respectively.

Salinity profiles were obtained from the Cul Ness fishery again at the two locations described above and at the south east corner of the production area, although the latter was limited by

depth. In all cases observed variation in salinity measurements with depth did not exceed the accuracy value of the probe used (± 0.35 ppt). Surface salinity ranged from 35.17 ppt to 35.21 ppt at each location.

Temperature profiles were also obtained from these locations. All three profiles showed a slight increase in temperature towards the surface, which was most apparent at the two locations on the Cul Ness fishery (0.3/0.4°C difference). Surface temperature ranged from 12.2°C to 12.4°C.

Salinities of the seawater samples analysed at the laboratory showed salinities ranging from 29.65 PSU present at the location of the sample collected from the beach, and between 35.05 to 35.28 PSU at the four samples collected away from the shore.

Seasonal population

The only guest house present is Lunna House which provides bed and breakfast accommodation with two rooms available. All other houses identified on the shoreline survey route were assumed to be private dwelling houses.

Boats/Shipping

Boat traffic within the West Lunna Voe production area is largely associated with the fishery, creel fishing and leisure activities. A workboat was present at the lines during the survey. Near the head of the voe there is a stone jetty and harbour where a small fishing vessel was moored. Several creels were stacked on the jetty. Two moorings buoys were present in the bay adjacent to the jetty.

Farming and Livestock

The majority of the land observed during the survey around the production area was rough grazing. A total of 134 sheep, 10 cattle and 2 ponies were recorded along the survey route although it should be noted that the full extent of several of the fields could not be observed due to the topography. The majority of the sheep were recorded towards the end of the shoreline walk, while all of the cattle were observed early on in the fields surrounding the head of West Lunna Voe. All of these animals had access to the shore, with exception of 8 cattle in a field above the one fringing the shoreline. However relatively fresh faecal matter present in the latter indicated that cattle were using this field as well. Sheep faeces were recorded throughout the walk.

Land Use and Land Cover

At the eastern end of the walk near the head of the voe the shoreline was characterised with rocky beaches, above which there were fields of rough grass and the occasional stands of wild flag iris around the watercourses. At the western extent of the walk fields were characterised by patches of heather among the rough grass. Two pebble beaches were

recorded. For a short duration the single track road runs adjacent to the shoreline, with a drainage ditch on the landward side (Figure 12).

Watercourses

All watercourses encountered were dry or had insufficient flow to warrant sampling and flow measurements at the time of the survey. This included the three locations indicated in the survey plan. Flow measurements were attempted at only one watercourse near the head of the voe, although the readings were considered unreliable and rejected.

Wildlife/Birds

Birds were observed throughout the survey. Approximately 32 greylag geese took flight from a field near the head of the voe. At a pebble beach which linked the island at Pund to the mainland 10 Artic tern were recorded in flight and on the beach indicating that this may be a potential breeding area. Starlings, pigeons, a wheatear, herring gulls and oystercatchers were also identified as well as shell and crab debris on the grass immediately above the shore. These potential feeding areas were more common on the western extent of the survey route.

General observations

Recorded observations apply to the date 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.

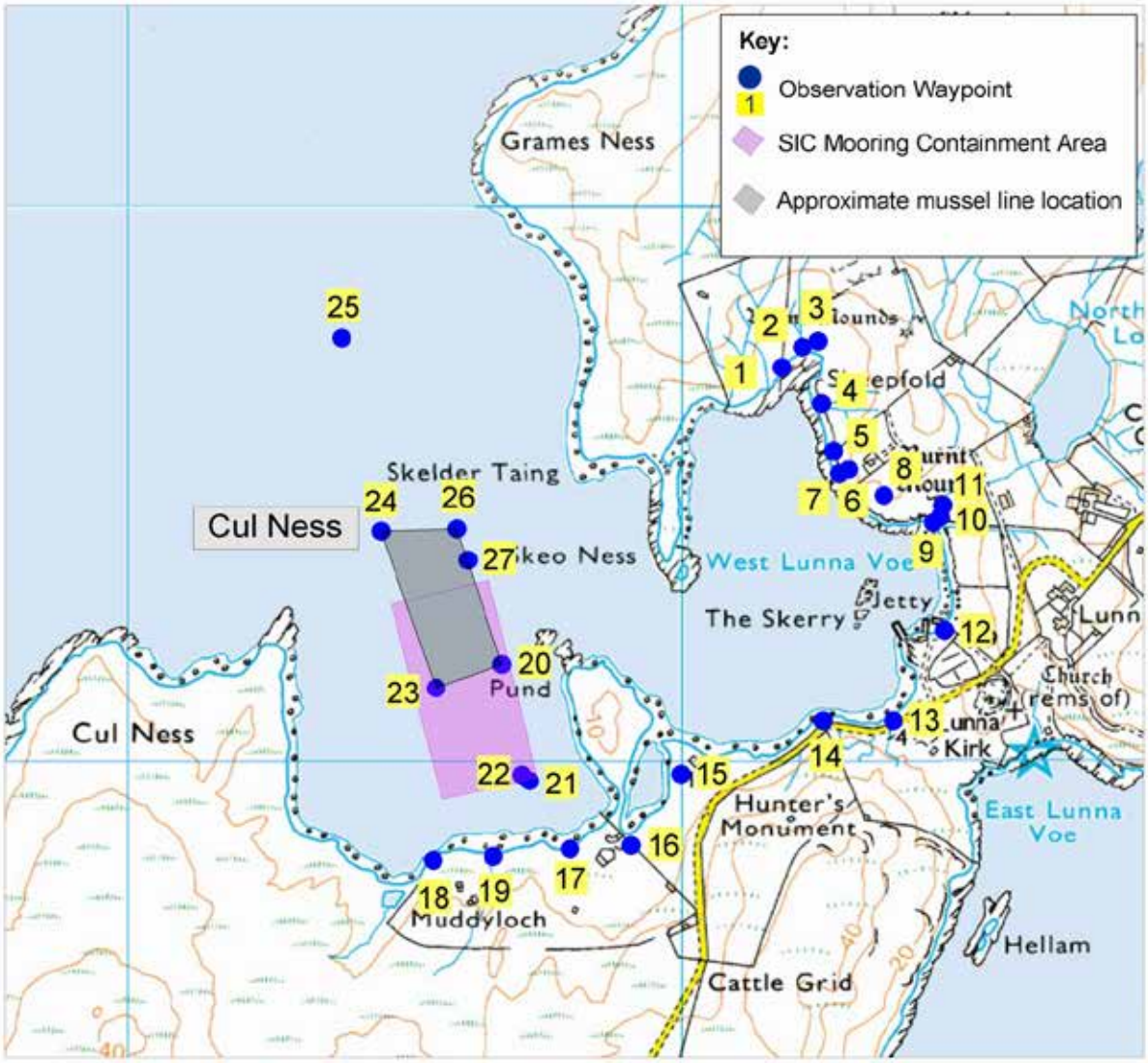

Figure 1 Map of shoreline observations West of Lunna

Table 1 Shoreline Observations

No.	Date/Time (UT)	NGR	Easting	Northing	Associated Photograph	Associated Sample	Description
1	29/07/2014 08:28	HU 48179 69708	448179	1169708			West of Lunna shoreline survey; shoreline walk - From northern shore of the voe clockwise. Weather, overcast F4 breeze from the SW. Tide, low to mid and rising. Start of walk at stone dyke which meets the shore. Field beyond, rough grass with 10 sheep present with access to the shore.
2	29/07/2014 08:32	HU 48217 69744	448217	1169744			Drainage ditch (dry).
3	29/07/2014 08:33	HU 48245 69755	448245	1169755			Head of small bay into the voe. Wetter area with flag iris in field of rough grass with access to the shore. Cattle hoof prints and faecal matter on foreshore, characterised by boggy grass and small stagnant pools. 2 cows observed at top of field near gate which was open to adjoining field but not visible over the horizon. 2 Arctic terns in flight. 32 greylag geese took flight from this field on approach to the starting point of the walk.
4	29/07/2014 08:39	HU 48251 69644	448251	1169644			Location of watercourse indicated to sample in the plan, however this was mostly dry with small pools. Not sampled or measured.
5	29/07/2014 08:43	HU 48273 69557	448273	1169557			Field of long grass with access to the shore.
6	29/07/2014 08:45	HU 48301 69523	448301	1169523	Figure 6		Concrete septic tank below deserted house and 2 outbuildings.

7	29/07/2014 08:48	HU 48283 69516	448283	1169516	Figure 7		Discharge pipe below tank, emerging from bank above rocky foreshore. Inactive, and capped and because of this seawater sample indicated on survey plan not collected.
8	29/07/2014 08:57	HU 48364 69478	448364	1169478			Field of rough grazing in front of deserted house, with access to the shore. Cattle faeces present. Rabbit, wheatear, group of 20 starlings and pigeons in flight.
9	29/07/2014 09:01	HU 48452 69428	448452	1169428		WLV-SW01	Watercourse with flow deemed too low to collect a planned freshwater sample. Drains on to rocky beach. Seawater sample collected instead.
10	29/07/2014 09:05	HU 48466 69438	448466	1169438	Figure 10		Flow measurement attempted, negative reading obtained. Watercourse consisted of interconnected semi-stagnant pools amongst a stand of flag iris before being channelled to flow under the wall to the beach. Numerous cattle hoof prints and faeces present surrounding the watercourse.
11	29/07/2014 09:09	HU 48470 69460	448470	1169460	Figure 11		Further up the streambed, trampled area with cattle faeces in the watercourse. Flow considered too slow to measure, and standing water not considered representative to sample. House (occupied) above the field.

12	29/07/2014 09:20	HU 48474 69234	448474	1169234	Figure 9		Small pier and harbour with small fishing boat moored. Creels stacked on the pier. Stone building and shipping container adjacent to pier associated with fishing activity. Pipework for seawater circulation system observed leading to and coming from container. 2 moorings in the bay beyond the pier. 22 sheep in rough grazing field surrounding pier, with access to the shore. This area is unfenced and includes the hillside above the road.
13	29/07/2014 09:28	HU 48381 69071	448381	1169071	Figure 12		Single track road that serves the Lunna Ness peninsular runs just above the rocky shoreline. Drainage ditch on the inland side of the road with occasional culverts under the road to the shore.
14	29/07/2014 09:33	HU 48254 69071	448254	1169071	Figure 8		Photo illustrating distribution of properties and their proximity to the voe.
15	29/07/2014 09:39	HU 47998 68975	447998	1168975			Field of rough grass with 52 sheep which have access to the shore. Small lagoon behind an island also occupied by sheep accessed along a pebble beach at low water. Approximately 10 Artic terns observed, in flight and on the beach indicating that this may be a breeding habitat.
16	29/07/2014 09:45	HU 47908 68846	447908	1168846			Dry watercourse leading to the lagoon, appears to be land drainage for adjacent field beyond a stone dyke. 8 sheep and 2 ponies present within, characterised by rough grass and heather. Property above the field. 4 herring gulls in flight.

17	29/07/2014 09:50	HU 47798 68840	447798	1168840			Pebble beach with boggy area behind. Photo of the Cul Ness fishery, 1 vessel present harvesting. 3 oyster catchers disturbed.
18	29/07/2014 09:57	HU 47551 68820	447551	1168820			End of walk extent. Light shower. Shell and crab debris indicative of bird feeding area. 42 sheep observed on hillside above shore.
19	29/07/2014 09:59	HU 47659 68826	447659	1168826			Returned to planned freshwater sampling point although the indicated watercourse was dry. No sample collected. End of shoreline walk.
20	29/07/2014 11:17	HU 47675 69172	447675	1169172	Figure 4	WLV-MUSS01 (Top), WLV-MUSS02 (Bottom) & WLV-SW02	Boat work. Weather: improving although still overcast, wind decreasing. Sea state: small wavelets, no white caps. At SE corner of Cul Ness fishery which consists of 9 double headed longlines with a dropper depth of 8m. 2 mussel samples collected; surface sample collected from the top of a dropper, bottom sample collected from bottom of a dropper. Salinity Profile 1 collected (ppt/°C): 10m 35.23/12.1, 5m 35.21/12.2, 3m 35.23/12.3, surface 35.21/12.4. Seawater sample collected.
21	29/07/2014 11:35	HU 47725 68963	447725	1168963		WLV-SW03	Seawater sample collected from SE corner of production area. Depth here <5m so opted to relocate NW for salinity profile
22	29/07/2014 11:37	HU 47711 68973	447711	1168973			Salinity profile 2 collected in 6.8m of water. (ppt/°C): 10m (no data), 5m 35.21/12.1, 3m 35.22/12.1, surface 35.19/12.2.
23	29/07/2014 11:42	HU 47556 69130	447556	1169130			SW corner of the Cul Ness fishery
24	29/07/2014 11:45	HU 47457 69413	447457	1169413			NW corner of the Cul Ness fishery

25	29/07/2014 11:49	HU 47386 69761	447386	1169761		WLV-SW04	Seawater sample collected at northern production area boundary.
26	29/07/2014 11:55	HU 47594 69417	447594	1169417	Figure 5	WLV-MUSS03 (Top), WLV-MUSS04 (Bottom) & WLV-SW05	NE corner of Cul Ness fishery. 2 mussel samples collected; surface sample collected from the top of a dropper, bottom sample collected from bottom of a dropper. Salinity Profile 3 collected (ppt/°C): 10m 35.28/12.2, 5m 35.15/12.3, 3m 35.15/12.3, surface 35.17/12.6. Seawater sample collected.
27	29/07/2014 12:12	HU 47613 69361	447613	1169361			Monthly *E.coli* sample collected from RMP by SW

Sampling

Water and shellfish samples were collected at the locations indicated in Figures 2 and 3. The only seawater indicated in the survey plan to be collected from the shore at the septic tank outfall was not obtained as the associated property was deserted and there was no flow at the outfall. A seawater sample not indicated on the plan was collected from the shore near the head of the voe at a watercourse where the flow within was deemed insufficient to sample. 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	WLV-SW01	29/07/2014 09:01	HU 48452 69428	SW	800	29.65
2	WLV-SW02	29/07/2014 11:17	HU 47675 69172	SW	2	35.07
3	WLV-SW03	29/07/2014 11:35	HU 47725 68963	SW	<1	35.28
4	WLV-SW04	29/07/2014 11:49	HU 47386 69761	SW	<1	35.10
5	WLV-SW05	29/07/2014 11:55	HU 47594 69417	SW	<1	35.05

*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	WLV-MUSS01	29/07/2014 11:17	HU 47675 69172	Common Mussel	Top	78
2	WLV-MUSS02	29/07/2014 11:17	HU 47675 69172	Common Mussel	Bottom	20
3	WLV-MUSS03	29/07/2014 11:55	HU 47594 69417	Common Mussel	Top	45
4	WLV-MUSS04	29/07/2014 11:55	HU 47594 69417	Common Mussel	Bottom	<18

Table 4 Salinity profiles

Profile	Date/Time (UT)	Position	Depth (m)	Salinity (ppt) (± 0.35 ppt)	Temperature (°C)
1	29/07/2014 11:17	HU 47675 69172	surface	35.21	12.4
			3	35.23	12.3
			5	35.21	12.2
			10	35.23	12.1
2	29/07/2014 11:37	HU 47711 68973	surface	35.19	12.2
			3	35.22	12.1
			5	35.21	12.1
			10	-	-
3	29/07/2014 11:55	HU 47594 69417	surface	35.17	12.6
			3	35.15	12.3
			5	35.15	12.3
			10	35.28	12.2

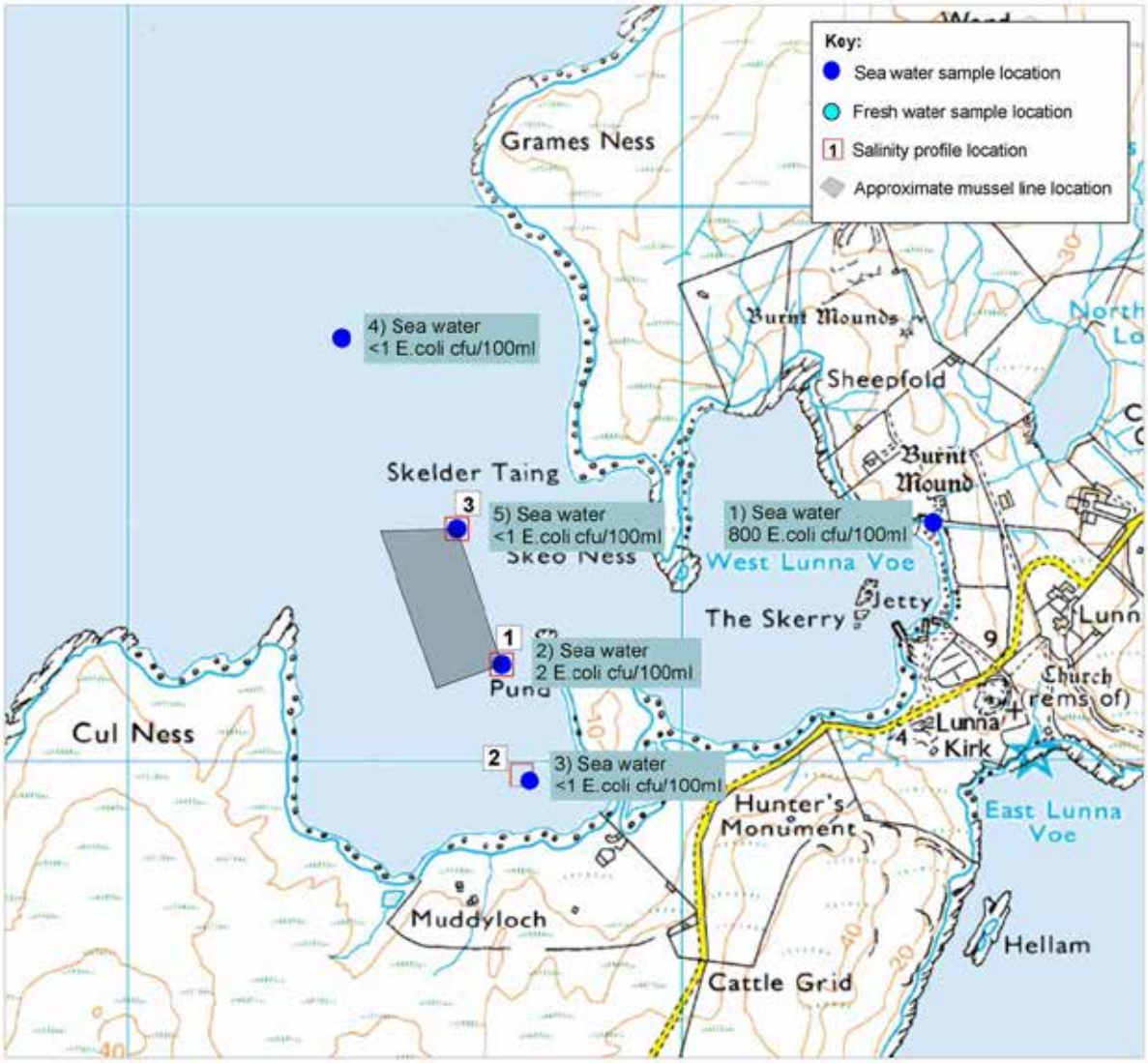

Figure 2 Map of water sample results and salinity profile locations for West of Lunna

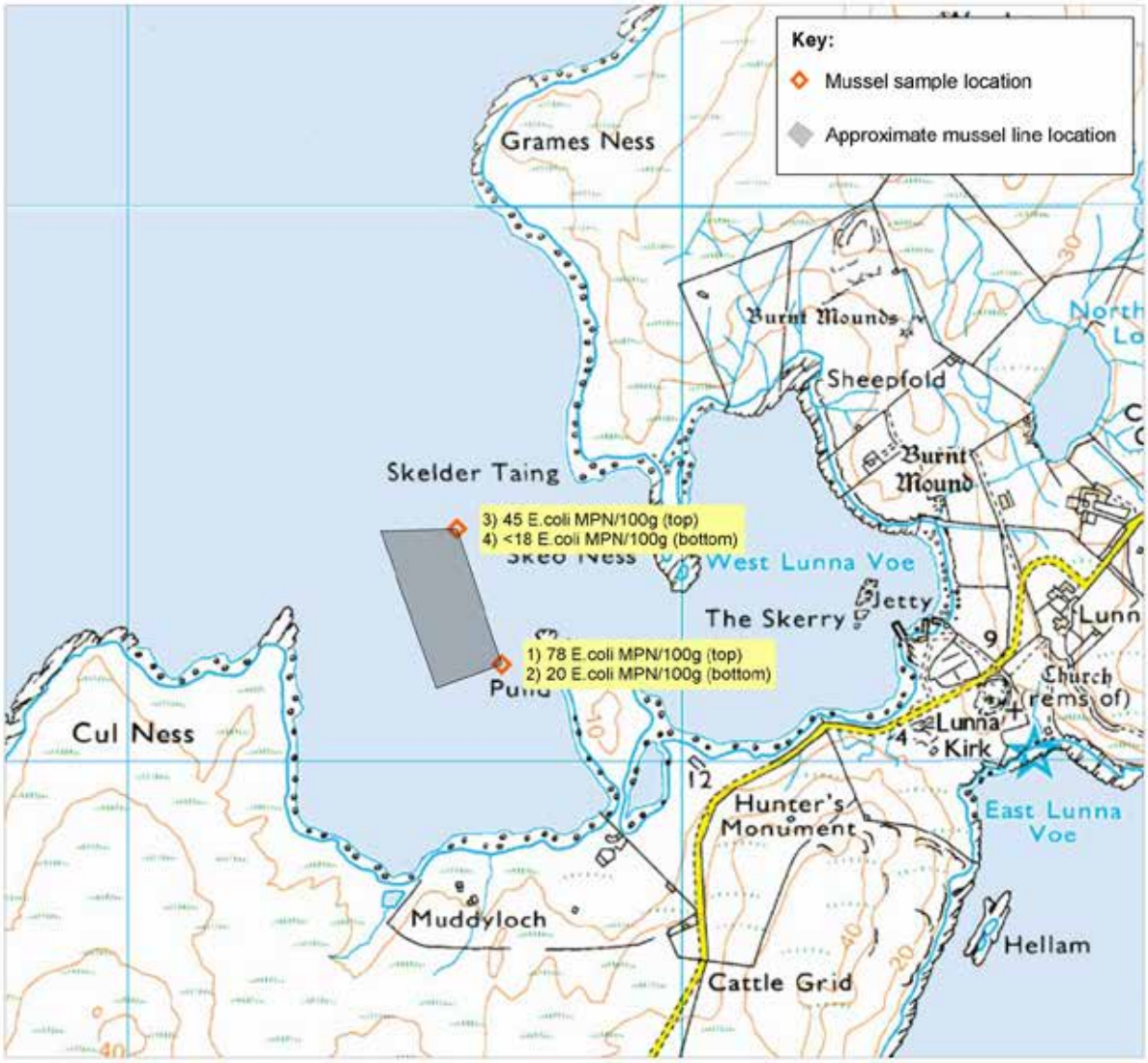

Figure 3 Map of shellfish sample results for West of Lunna

Photographs

Figure 4 – Mussel lines at the Cul Ness fishery looking north west.

Figure 5 – Mussel lines at the Cul Ness fishery looking south.

Figure 6 – Concrete septic tank associated with a deserted property.

Figure 7 – Capped pipe associated with the septic tank in Figure 6.

Figure 8 – Overview of properties scattered around West Lunna Voe.

Figure 9 – Jetty and workboat at the head of West Lunna Voe.

Figure 10 – Watercourse illustrating low water level.

Figure 11 – Watercourse with cattle faeces.

Figure 12 – The single track road serving Lunna Ness illustrating proximity to shore

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