Scottish Sanitary Survey Project

Restricted Sanitary Survey Report

Northton Beach

LH 531

March 2011

Cefas

Food Standards Agency
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Buidheann Inbhe-Bìdhe

Draft Report Distribution – Northton Beach

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* Distribution of both draft and final reports to relevant agency personnel is undertaken by FSAS.

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1. Area Overview

Northton Beach is located at the south end of the Isle of Harris off the north western coast of Scotland (see Figure 1.1). Northton Beach is a sheltered sandy bay, surrounded by land and/or dunes and is open to the Atlantic Ocean to the north. The beach is 1.8 km from north to south and 2.3 km at its widest point. To the north of Northton Beach is the Sound of Taransay. Northton Bay is a Site of Special Scientific Interest due to its botanical, ornithological and physiographic features.

A restricted sanitary survey at Northton Beach was conducted in response to receipt of an application to classify the beach for commercial harvest of common cockles (*Cerastoderma edule*).

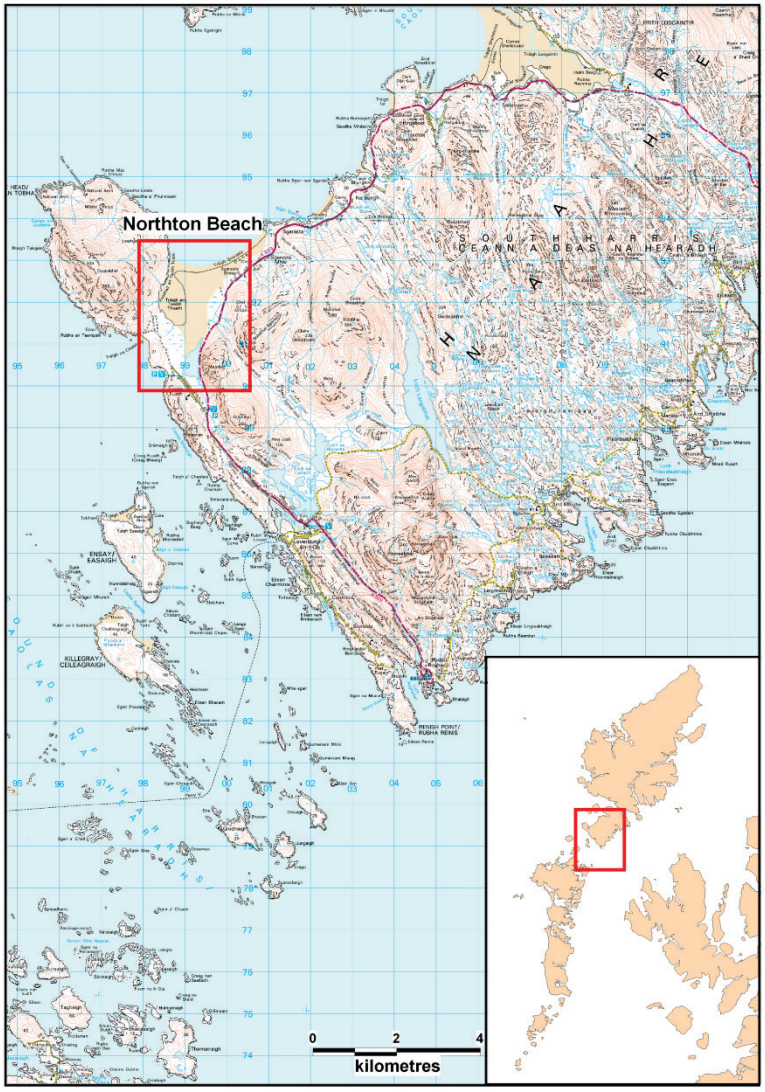

Figure 1.1 Location of Northton Beach

1.1 Land Use

At the time of writing this report, Land Cover 2000 data was not available for the Isle of Harris. The cockle bed is located within the very large sandy bay, which has areas of saltmarsh, brackish water fen, sand dunes and machair surrounding it. There is acid moorland on the hillside above the bay. During the shoreline survey it was noted that almost all land in the survey area is given over to livestock grazing. Some small patches of machair are ploughed and planted during the spring and summer months.

For Northton Beach, the highest contribution to contamination levels carried in surface runoff to the cockle bed would be from the areas of shoreline used for livestock grazing.

1.2 Human Population

Human population figures were obtained from the General Register Office for Scotland on the population within the census output areas in the vicinity of the Northton Beach. Figure 1.3 shows the population density of the census output areas that are adjacent to Northton Beach.

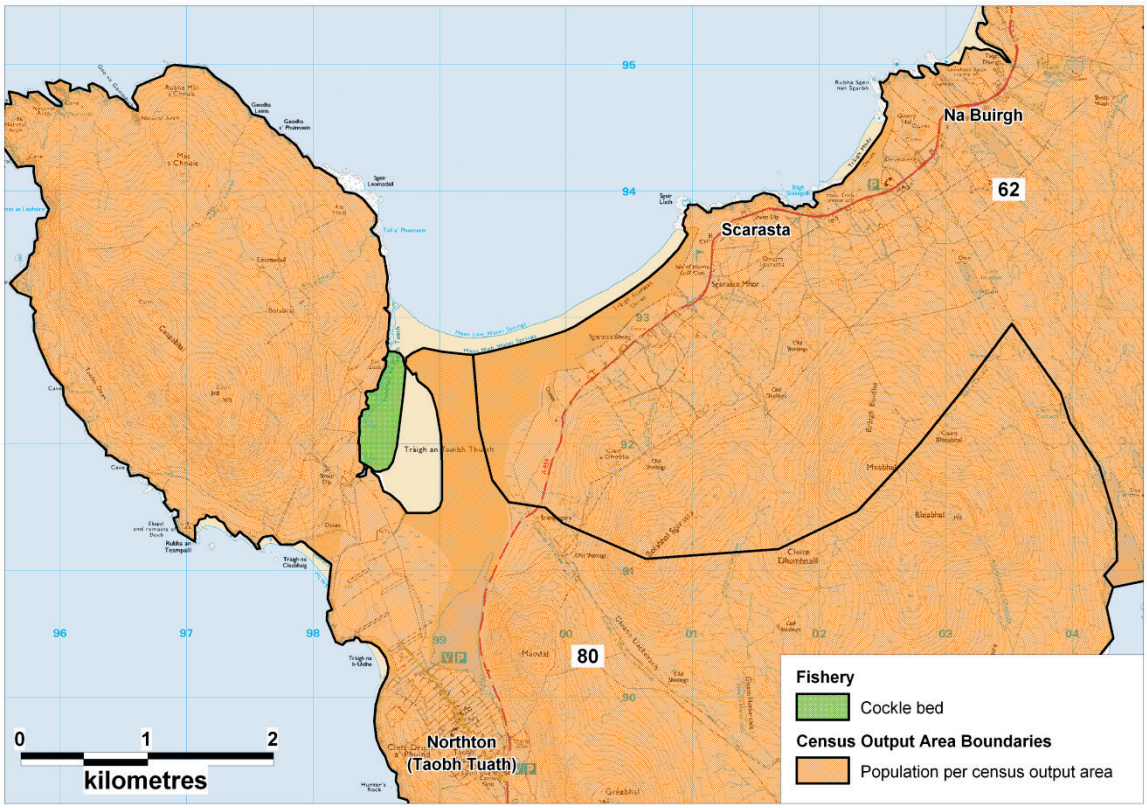

Figure 1.2 Population density of census output areas surrounding Northton Beach

There are only two population census areas adjacent to Northton Beach, with populations of 62 and 80. Both census areas are relatively large and sparsely populated.

Human habitation is spaced out along the Scarasta area to the north east of the survey area. There are small crofts and houses, of which a considerable number are holiday homes. These houses are situated on or immediately behind machair land – well drained sandy soil which occurs behind large sand dunes. There are no large centres of population in the area. The island to the west of the beach is uninhabited and inaccessible by road. There are no camp sites or cafes in the surrounding area. Two small settlements, Scarasta and Na Buirgh are located along the road east of the beach. Scarasta has approximately two dozen houses, a small country hotel, a golf course, church and six holiday chalets, with two more under construction. The holiday chalets are occupied for most of the year whereas the holiday homes, lie empty for much of the year. The village of Northton (Taobh Tuath) is located south of the fishery. There is one bed and breakfast in Northton. The Isle of Harris as a whole attracts tourists all year round. Any contamination arising from the human population would be expected to have the greatest impact at the eastern end of the beach and this would be higher during the period from late spring to early autumn.

Due to the exposed aspect of the beach there are no boats located along this stretch of coast.

2. Fishery

The fishery at Northton Beach (LH 531 964 04) is comprised of a common cockle (*Cerastoderma edule*) bed.

The cockle bed occupies a narrow band of the intertidal zone on the western edge of Northton beach (see Figure 2.1). Stock is currently not big enough to harvest and it is predicted harvesting will not take place until at least 2012. The cockles will be hand-gathered by various local harvesters and seasonality of harvesting has not yet been determined. The cockle bed at Northton Beach does not lie within a designated shellfish growing water.

Cockle harvesting in this area of Lewis only currently takes place at a beach 5 miles to the North East at Seilebost (LH 249 129 04): cockle gathering occurs there on an irregular basis.

On the 25th January 2010 a regulation (OPSI online, 2010) was put in place by the Scottish Government called The Inshore Fishing (Prohibition of Fishing for Cockles) (Western Isles) (Scotland) Order No.444 came into effect on 25th January 2010 (OPSI online 2010). This order prohibits fishing for cockles less than 30mm in size within inshore areas throughout the Western Isles, which includes the Isle of Harris.

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Figure 2.1 Northton Beach fishery

3. Sewage Discharges

Scottish Water and SEPA identified community septic tanks (ST) and other sewage discharges for the area within 7 km radius of Northton Beach (NF 9520 8937). The Scottish Water discharges are detailed in Table 3.1 and shown mapped in Figure 3.1. A short list of acronyms used in the tables is given at the end of this section.

Table 3.1 Sewage discharges identified by Scottish Water

SEPA Discharge Consent No.	Discharge Name	NGR of Discharge	Type	Level of Treatment	Design PE
N/A	Northton WWTW	NF 98565 90115	WWTW	Not provided	Not provided

*No information on consented flow volume or PE was provided

The Northton waste water treatment facility is located 1 km south west of the cockle bed. This discharges into the Sound of Harris, south of the island and not onto the fishery.

In addition, SEPA has provided consent information for the discharges listed in Table 3.2 below. The data has been mapped in Figure 3.1.

Table 3.2 SEPA discharge consents

No.	Ref No.	NGR of Discharge	Discharges to	Design PE
1	CAR/R/1043403	NG 03500 94830	STE to soakaway	10
2	CAR/R/1059751	NG 03290 94670	STE to soakaway	5
3	CAR/R/1065140	NG 03090 94640	STE to soakaway	5
4	CAR/R/1069060	NG 02806 94265	STE to unnamed tributary of coastal waters	17
5	CAR/R/1069052	NG 02700 94058	STE to unnamed tributary of Sound of Taransay	6
6	CAR/R/1043280	NG 02390 93940	STE to soakaway	5
7	CAR/R/1057604	NG 02242 93827	STE to soakaway	5
8	CAR/R/1049548	NG 01960 93770	STE to soakaway	5
9	CAR/R/1044644	NG 01350 93730	STE to soakaway	5
10	CAR/R/1044647	NG 01030 93580	STE to soakaway	10
11	CAR/R/1055883	NG 01137 93580	STE to land	5
12	CAR/R/1057271	NG 01170 93430	STE to land	5
13	CAR/R/1057267	NG 01170 93360	STE to land	7
14	CAR/R/1031967	NG 00770 93030	STE to land	5
15	CAR/R/1061752	NG 00642 92781	STE to soakaway	6
16	CAR/R/1061735	NG 00740 92780	STE to soakaway	5
17	CAR/R/1057260	NG 00235 92580	STE to land	5
18	CAR/R/1017736	NF 98690 90430	STE to land	6
19	CAR/R/1059970	NF 99044 90082	STE to soakaway	5
20	CAR/R/1059667	NF 99160 89826	STE to soakaway	5

The settlement of Scarasta has approximately two dozen houses, a small country hotel, a golf course, church and holiday accommodation. The majority of these are connected to private septic tanks – there is no mains sewer. SEPA has identified that two of the discharges (No. 4 & 5) that discharge to

unnamed tributaries that lead into coastal waters. Both are located at the far eastern end of Northton Beach. All of the remaining septic tanks drain into either a small stream alongside of the property or to a soakaway: the latter are unlikely to contribute directly to faecal contamination at the shellfishery. The golf course situated at the extreme north east end of the beach has a clubhouse with toilets and a septic tank that discharges to soakaway. Sewage infrastructure recorded during the shoreline survey is listed in Table 3.3 and mapped in Figure 3.1. A water sample was collected from the stream into which SEPA discharge consent CAR/R/1069060 flows (Table 3.2, entry 4) and this returned a result of <100 *E. coli* cfu/100 ml, indicating little or no contamination at the time of sampling.

Table 3.3 Sewage discharge observations recorded during the shoreline survey

No.	Date	NGR	Description
1	28/02/2011	NG 02670 94080	House with septic tank
2	28/02/2011	NG 02560 94000	House with septic tank
3	28/02/2011	NG 02460 93970	House with septic tank
4	28/02/2011	NG 02400 93950	House with septic tank
5	28/02/2011	NG 02210 93870	House with septic tank
6	28/02/2011	NG 01960 93790	House with septic tank
7	28/02/2011	NG 01130 93620	Golf club with club house that has toilets and a septic tank with soakaway
8	28/02/2011	NG 01140 93270	House with septic tank
9	28/02/2011	NG 00550 92830	Inspection cover
10	28/02/2011	NG 00340 92620	House with septic tank
11	01/03/2011	NF 00230 92520	House with septic tank
12	03/03/2011	NF 00150 92470	House with septic tank
13	03/03/2011	NF 00070 92530	Septic tank
14	03/03/2011	NF 00220 92590	Septic tank
15	03/03/2011	NF 00130 92450	Inspection cover by road
16	03/03/2011	NF 98920 90230	Inspection cover by bird hide - possible septic tank?
17	03/03/2011	NF 98980 90220	Small drain

List of acronyms

STE	Sewage Treated Effluent
PE	Population Equivalent
WWTW	Wastewater Treatment Works

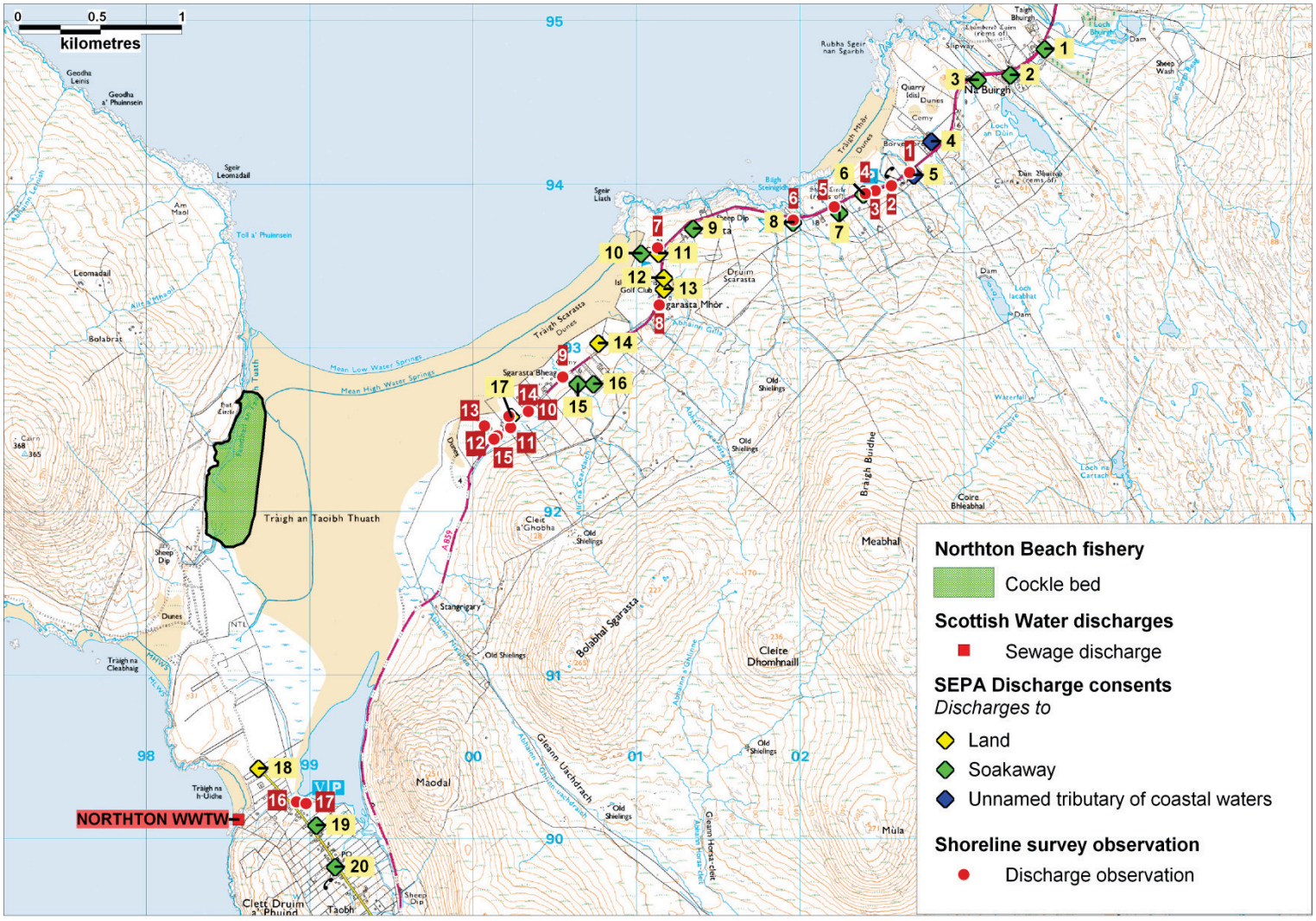

Figure 3.1 Northton Beach sewage discharges

4. Animals

4.1 Livestock

Agricultural census data to parish level was provided by the Rural Environment, Research and Analysis Directorate (RERAD) for the parish of Harris (see Figure 4.1). Livestock populations reported for the parish for the June 2009 census are listed in Table 7.1.

Table 4.1 Livestock numbers in Harris: 2009 Agricultural census

Parish: Harris Total area 503 km^2		
Year:	2009	
	Holdings	*Numbers*
Cattle	36	409
Sheep	249	31744
Horses and ponies	6	10
Other	0	0

The figures above indicate that livestock numbers are high on the Isle of Harris. Considerably more sheep than cattle and very few horses were reported. There are no reported pigs or other livestock types on the island. Livestock numbers on the surrounding land as a whole are likely to be at their highest during the summer months when young animals are present. During the warmer months livestock may access streams to drink and cool off more frequently, leading to higher levels of faecal contamination in freshwater streams and the shellfish bed itself. Although it was not investigated for this specific area, it is common during the winter months for livestock to be kept in barns causing a likely increase in slurry production and higher runoff from hard standing areas. Seasonal variation in the presence of livestock is therefore expected to lead to higher rates of deposition on the land at these times.

During the shoreline survey, grazing was observed on all edges of the beach, with numerous sheep and cattle present. Cattle were found in fields on both sides of the road at Scarasta, and sheep are permanent residents of the fields and the road verges. To the south of Scarasta the road is unfenced, so sheep are able to range between the open hill and moorland to the SE and the beach area. They are also free to cross the beach to the hill and moorland to the West of the area.

The machair land to the north west of Northton village supports around 200 sheep and 30 cattle. The village itself supports between 40 to 100 sheep and 20 cattle in the fields immediately adjacent to the croft houses. There are in addition around 100 chickens in the village area. The settlement of Scarasta and its surrounding environment supports a similar number of cattle and an equal or greater number of sheep. A small farmstead is situated at the south end of Scarasta where sheep are gathered, and a small sheep fank (outdoor sheep enclosure) is located close to the golf course where seasonal gathering and dipping / shearing take place. Large

amounts of sheep droppings were found in the strand line on the day of the shoreline survey. Figure 4.1 shows the actual livestock counts recorded during the shoreline survey.

Overall, considerable faecal input from livestock would be expected on the east and south sides of the fishery and some input on the west side of the fishery.

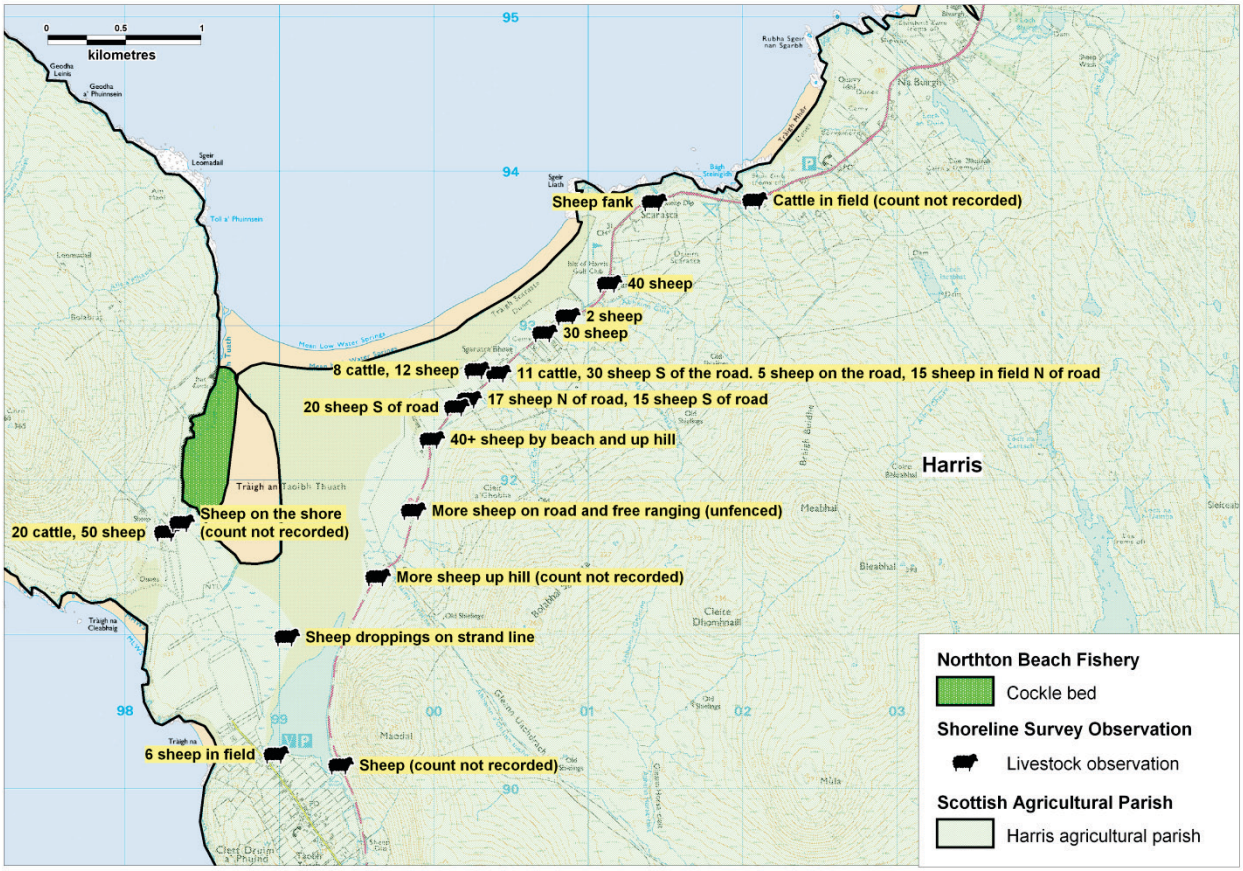

Figure 4.1 Livestock observations at Northton Beach and part of the Harris agricultural parish

4.2 Wildlife

Northton Bay is an SSSI and an important area in Lewis and Harris for breeding waders and an important feeding area for wildfowl. Greylag geese occur throughout the area at all times of the year. Flocks of 20 to 30 are regularly seen grazing on the short grass, and droppings are found throughout the area. During the shoreline survey approximately 83 geese were observed in total. Approximately 53 of the geese were observed south of Scarasta and the remaining 30 were observed near the village of Northton south of the fishery. Goose droppings were also observed in abundance on the shoreline south of the fishery. The beach itself supports gulls ducks and waders, particularly oystercatchers, common gulls and mallards. Herring gulls, black headed gulls, redshanks and knots were observed during the shoreline survey. Shelduck are also seen here during the summer, particularly on the standing water at the south end of the

beach. Herons regularly occur in the saltings by Northton village and flocks of up to 20 lapwing were seen over the fields and saltings.

A joint report by the Joint Nature Conservation Committee and the Scottish Government (2010) identified 9 areas within 2 km of Northton Bay where seabird colonies of various numbers (adjusted count units) were present. There were four small colonies (1-50), two medium colonies (51-100), two larger colonies (101-500) and one very large colony (501-1000). The largest colony (501-1000) was located offshore of Ceapabhal, the land mass to the west of Northton Bay.

Seabird 2000 data provided for Northton Beach, also indicated that seabird numbers in the area are relatively high. The actual counts and distribution of the Seabird 2000 data has been mapped in Figure 4.2. Note each occupied nest observation is assumed to be equal to at least two birds. It is possible that other animals including otters and seals may be present in the area. The distribution and numbers of these species was not investigated. Impact from seabirds, especially geese is likely to be highest on or near the areas where the seabirds nest and feed. Gulls may be found over much of the area and are as likely to deposit droppings on the sea as on land. Diffuse pollution from wildlife impacts is likely to be carried in streams via rainfall runoff.

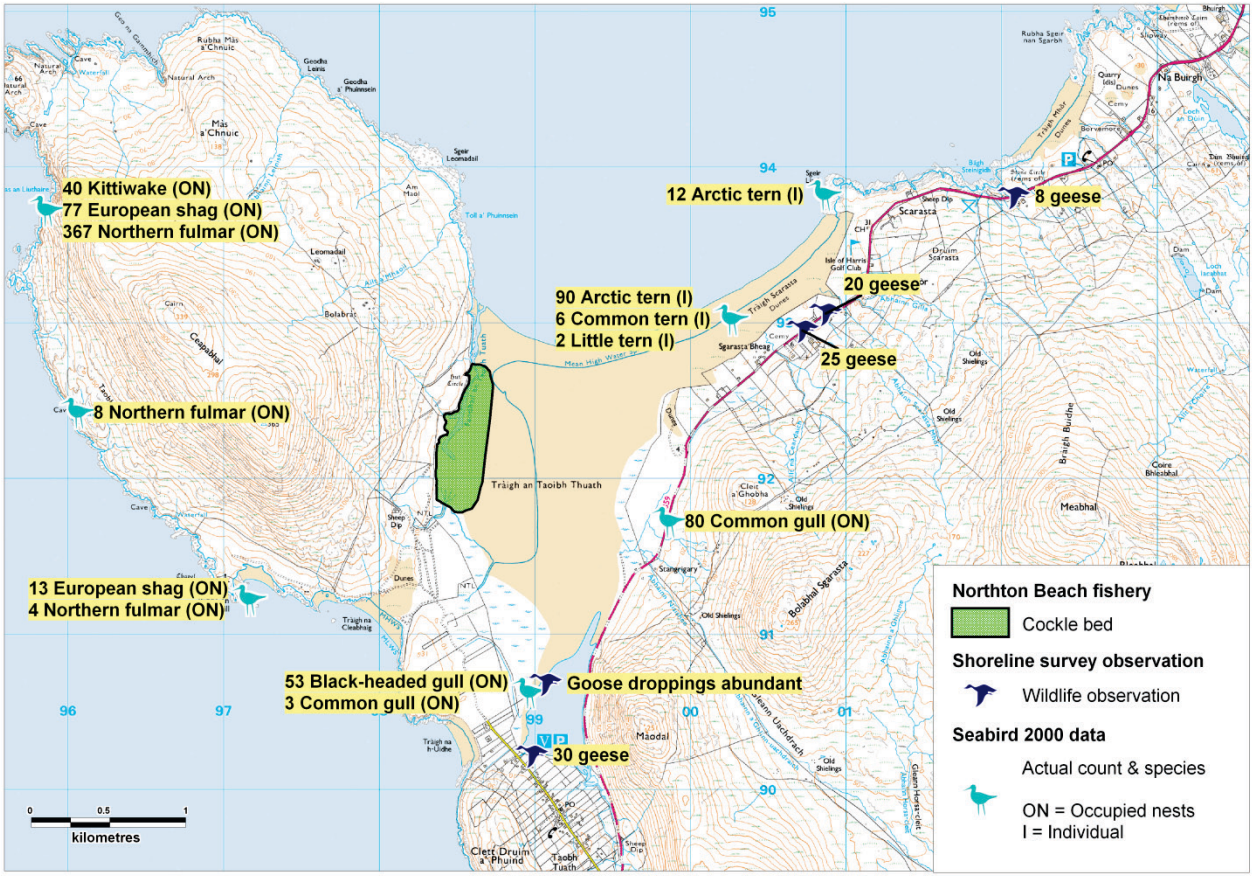

Figure 4.2 Wildlife observations at Northton Beach and Seabird2000 data

5. Rainfall

The nearest weather station is located at Harris: Borve Lodge, approximately 5 km north east of the fishery. Daily rainfall values for this station were purchased from the UK Meteorological Office for the period 1/1/2005 to 31/12/2009 inclusive. Data was missing for 47 days in total including the whole month of December 2009. Unless otherwise identified, the content of this section (e.g. graphs) is based on further analysis of this data undertaken by Cefas.

5.1 Rainfall at Harris: Borve Lodge

High rainfall and storm events are commonly associated with increased faecal contamination of coastal waters through surface water run-off from land where livestock or other animals are present, and through sewer and waste water treatment plant overflows (e.g. Mallin et al, 2001; Lee & Morgan, 2003). The influence of rainfall on microbiological quality will depend on factors such as local geology, topography, land use and sewerage infrastructure. Figures 5.1 and 5.2 present box and whisker plots summarising the distribution of individual daily rainfall values by year and by month. The grey box represents the middle 50% of the observations, with the median marked as a line within the box. The whiskers extend to the largest or smallest observations up to 1.5 times the box height above or below the box. Individual observations falling outside the box and whiskers are represented by the symbol '*'.

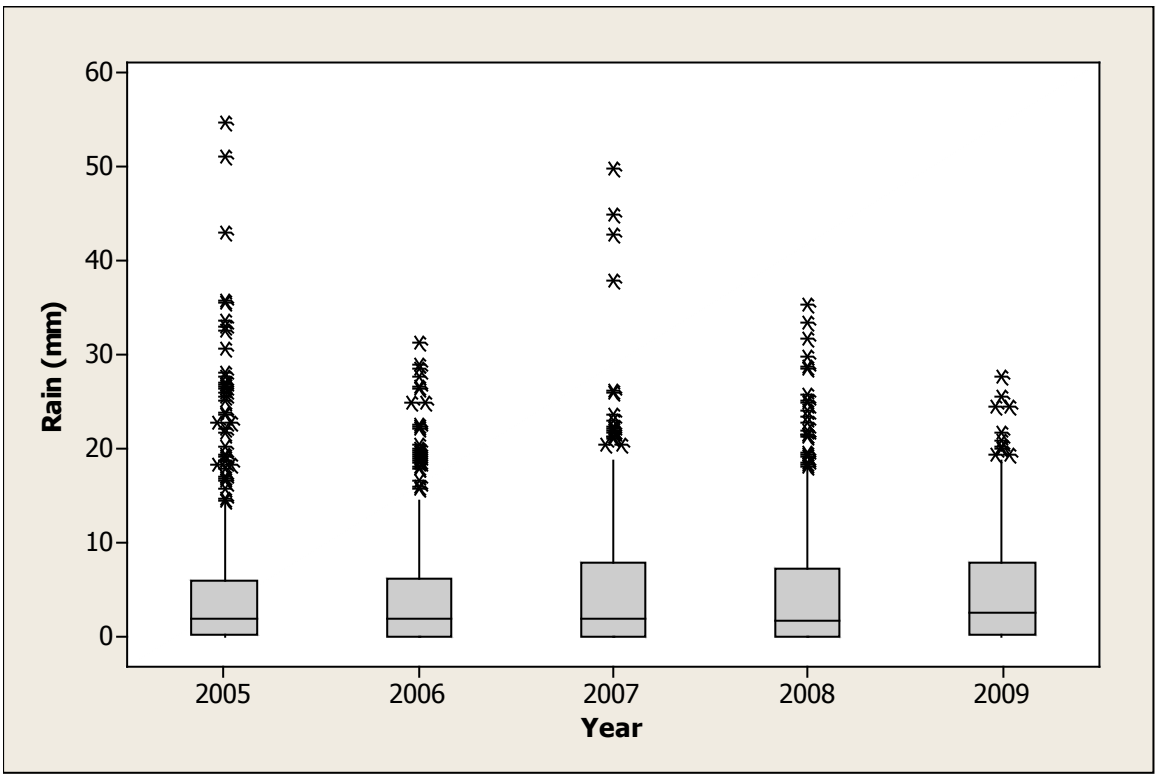

Figure 5.1 Box plot of daily rainfall values by year at Harris: Borve Lodge, 2005-2009

Figure 5.1 shows that there was some variation in rainfall patterns between the years presented here, with 2005 and 2006 being marginally drier than 2007, 2008 and 2009.Extreme rainfall events were greater in 2005, an otherwise dry year, and in 2007.

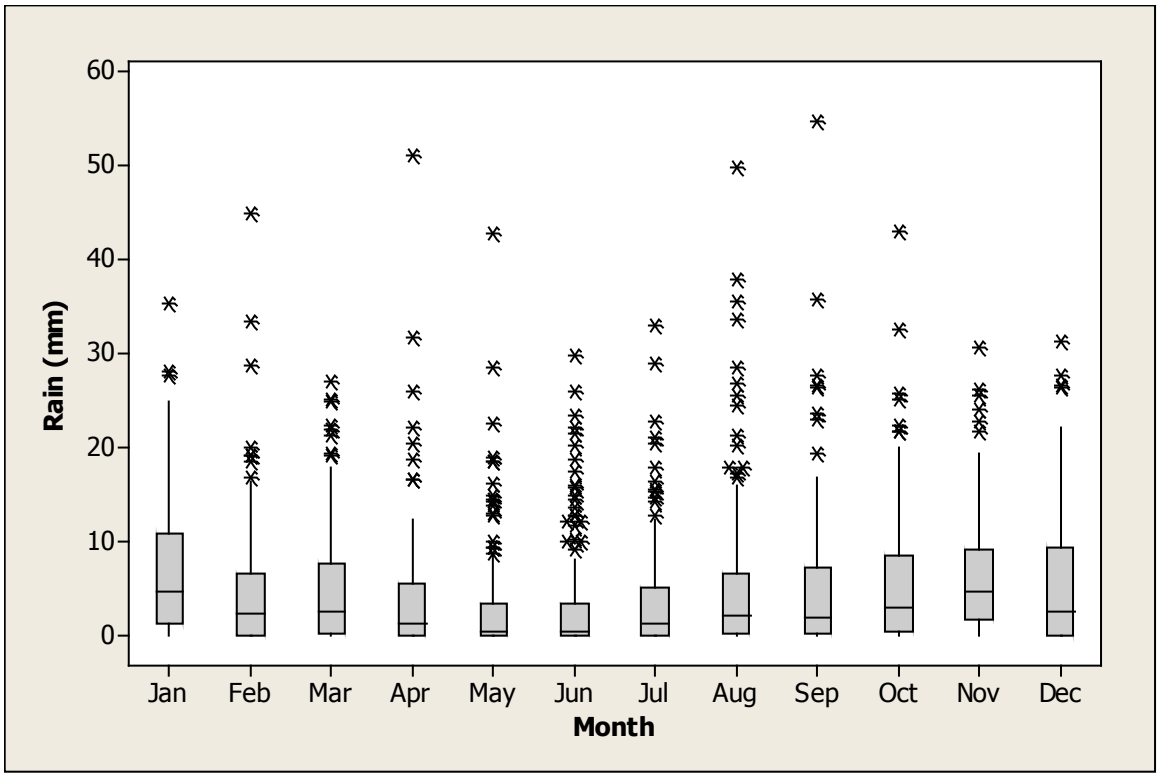

Figure 5.2 Box plot of daily rainfall values by month at Harris: Borve Lodge, 2005-2009

Figure 5.2 indicates that the wettest months were October to January. May and June were the driest months. For the period considered here (2005-2009), 40% of days experienced rainfall less than 1 mm, and 16% of days experienced rainfall of 10 mm or more. Extreme rainfall events (>30 mm) occurred in all months but March in this dataset. Rainfall of 40 mm or more in a day occurred during February, April, May, August, September and October.

It is likely that amount of rainfall dependent faecal contamination entering the production area will be higher on average during the autumn and winter months. High rainfall events can occur at any time of the year. However, these may result in a contaminated 'first flush' of pasture runoff which may be particularly acute during the summer when livestock numbers are likely to be highest and preceding dry periods may result in a build-up of faecal matter on pastures.

6. River Flow

There are no gauging stations on burns or streams along the Northton Beach coastline. Northton Beach is surrounded by steep terrain, especially to the east and west.

Freshwater inputs to the beach are limited to a small number of streams which drain the boggy moorland from the adjacent upland areas or the marshy saltmarsh. There are no major rivers in the area and no sources of industrial pollution. The watercourses listed in Table 6.1 were recorded and sampled and measured where possible, during the shoreline survey. The locations are shown on the map presented in Figure 6.1. 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 1 x 10^3, in digital format it is written as 1E+3.

Weather was dry at the time of the shoreline survey.

Table 6.1 Stream loadings and *E. coli* results for Northton Beach

No	Sample number	Grid Ref	Description	Width (m)	Depth (m)	Flow (m/s)	Flow in m^3/day	*E. coli* (cfu/ 100ml)	Loading (*E. coli* per day)
1	FW1	NF98430 92410	Stream	0.5	0.08	0.249	861	<100	<8.6 x 10^8
2	FW2	NF 98380 91750	Stream	1.0	0.28	0.048	1161	<100	<1.2 x 10^9
3	FW3	NF 98610 91610	Stream	2.8	0.08	0.034	658	<100	<6.6 x 10^8
4	FW4	NF 99410 90020	Stream	4.5	0.36	0.004	560	<100	<5.6 x 10^8
5	FW7	NF 99740 91460	Abhainn Nisishee	Not measured				<100	NA
6	FW8	NF 99780 91500	Small stream	Not measured				<100	NA
7	FW9	NF 99840 91620	Small stream	Not measured				100	NA
8	FW5	NG 00550 92820	Allt na Ceardaich	3.6	0.28	0.031	2700	200	5.4 x 10^9
9	FW6	NG 01050 93150	Abhainn Gilla	1.5	0.20	0.067	1737	<100	<1.7 x 10^9

During the shoreline survey a total of nine fresh water inputs were recorded discharging on to Northton Beach (see Figure 6.1). In addition to the nine streams there was a field drain leading from a saltmarsh located between stream number 2 and 3. The Ordnance Survey map indicated that there are likely to be more than the nine fresh water inputs recorded during the shoreline survey. Fresh water samples were collected at all nine streams; however streams numbered 5 – 7 were too small to measure flow. Nearly all water samples contained *E. coli* levels were below the limit of detection reported by the laboratory, therefore the only stream for which an actual loading could be calculated was number 8, Allt na Ceardaich. The remaining values given in the table should be considered as the upper boundaries

of the possible loadings and the actual values may have been significantly lower. Three of the streams discharge into the western side of Northton Beach, two of which discharge directly onto the cockle bed.

In general, loadings of streams would be expected to increase significantly following moderate to heavy rainfall and thus their potential effects on the microbiological quality of the cockles would also increase. Snowmelt, particularly in early spring would also cause an increase in the flow and potentially loading of the watercourses. Given the steep sided nature of the land surrounding the beach, there is also the potential for direct run-off after rainfall. All of the fresh water inputs would be potential pathways for contamination from animal faeces to enter the beach.

Although Allt na Ceardaich was calculated to contribute the highest loading to the environment on the day of the survey, it is approximately 2 km from the cockle bed and the two streams that discharge directly onto the bed would be expected to have the greatest impact on the microbiological quality of the shellfish, particularly after rainfall.

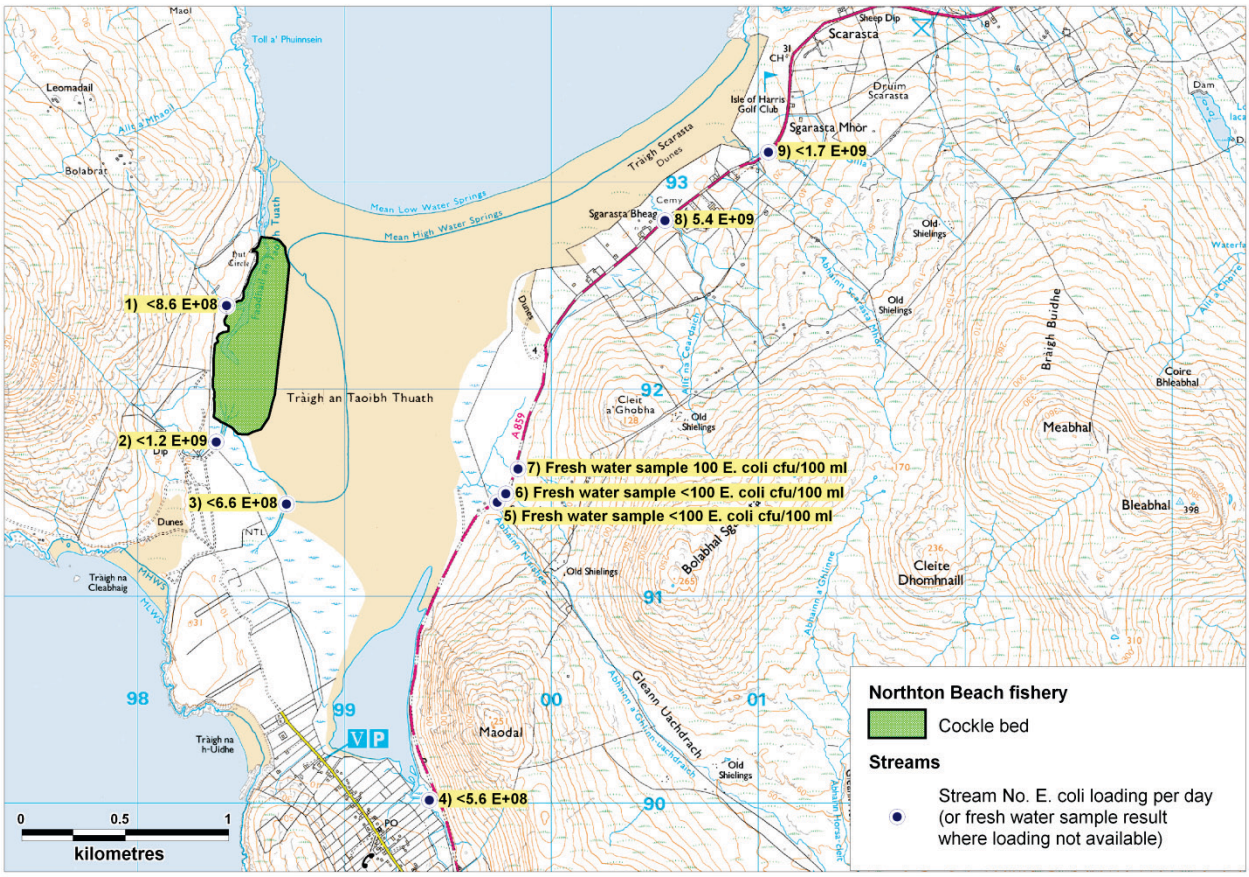

Figure 6.1 Stream loadings and *E. coli* results at Northton Beach

7. Historical *E. coli* Monitoring Data

There are no historical *E. coli* monitoring results available for Northton Beach.

8. Bathymetry and Hydrodynamics

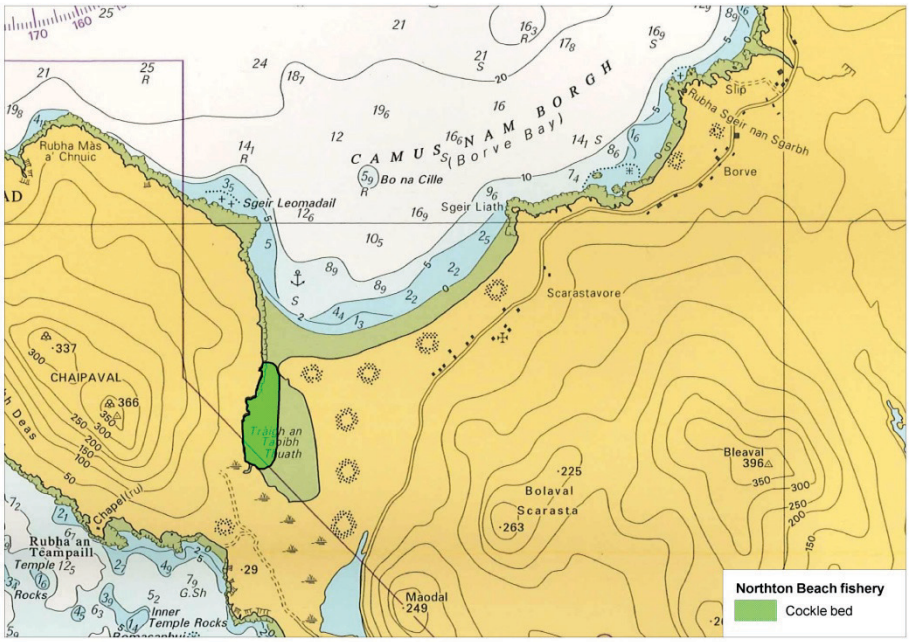

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Figure 8.1 Bathymetry at Northton Beach

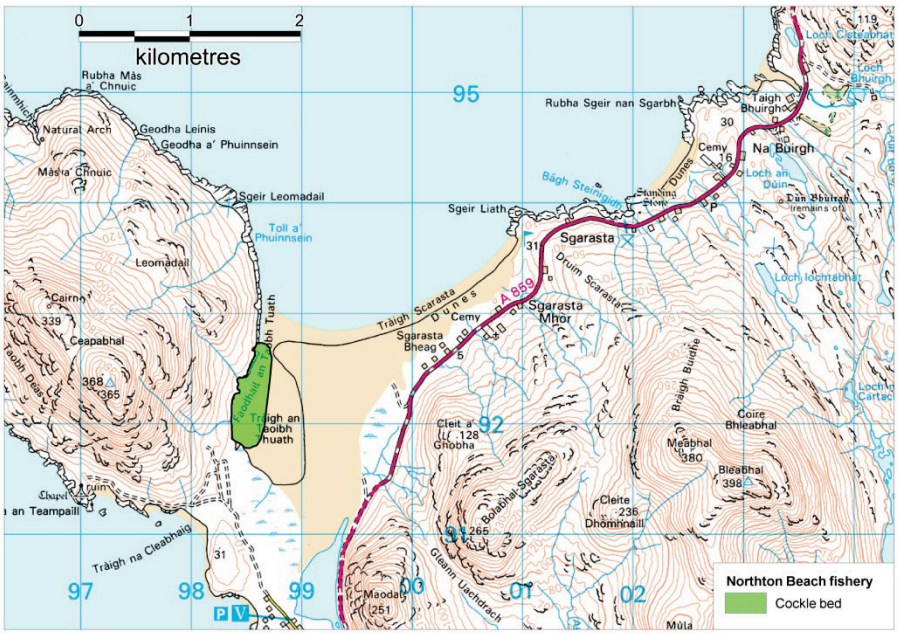

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Figure 8.2 Ordnance Survey Map of Northton Beach

The hydrographic chart in Figure 8.1 shows that the shellfish bed is located on a drying area between MHWS and MLWS. On either side of the beach the intertidal

strip is rocky. North of the shellfish bed, the seabed shelves fairly steeply to over 10 m. Further offshore, in Borve Bay, the depth exceeds 20 m and it reaches 50 m in the centre of the Sound of Tarransay. While the drying area is relatively narrow across most of the width of the embayment where the cockle bed is located, at the western end it extends approximately 1.5 km down the side of the headland, at high tide forming a separate body of water between the headland on the west and the dunes on the east.

The two tidal curves in Figure 8.3 are for the port of Leverburgh, the secondary non harmonic port located 5.8 km south east of Northton Beach. These have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 26th February. The second is for seven days beginning 00.00 GMT on 3rd March 2011. Together they show the predicted tidal heights over high/low water for the full neap/spring tidal cycle during which the shoreline survey was undertaken.

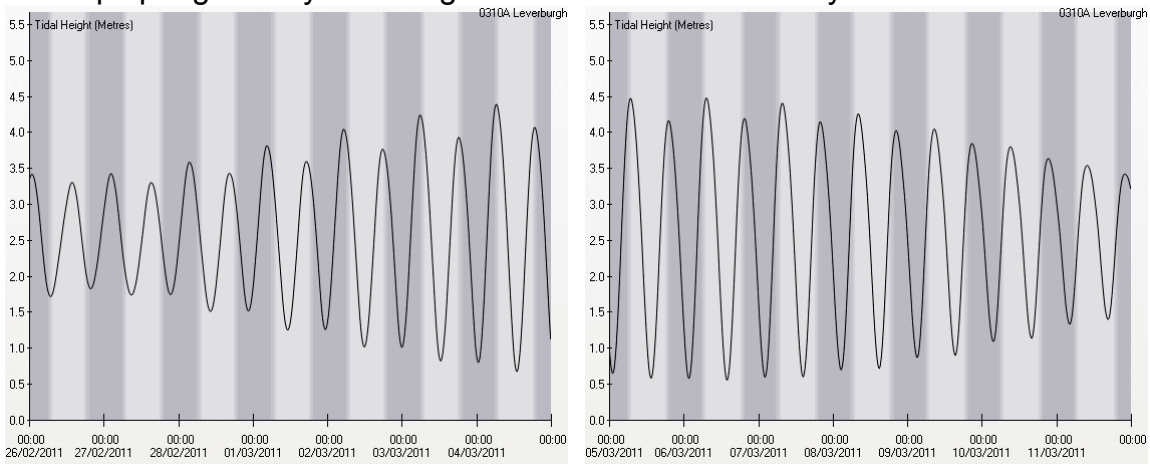

Figure 8.3 Tidal curves for Leverburgh

The following is the UKHO summary description for Leverburgh:

The tide type is Semi-Diurnal.

HAT	5.4 m
MHWS	4.6 m
MHWN	3.5 m
MSL	2.62 m
MLWN	1.8 m
MLWS	0.6 m
LAT	-0.1 m

Predicted heights are in metres above chart datum. The tidal range is therefore moderate approximately 4 m at spring tide and 1.7 m at neap tide.

The tides, and associated currents, would be expected to be markedly affected by weather conditions and a strong northerly wind would increase the effect of high tide and retard the effect of low tide.

8.1 Currents

Tidal stream information available was from TotalTide for a tidal diamond (SN032H) located in the Sound of Harris (see Figure 8.2). The tidal diamond information is given below in Table 8.1. The associated spring tidal streams are shown in Figure 8.4 (flood tide) and Figure 8.5 (ebb tide).

Table 8.1 Tidal diamond for station SN032H (57°47.48'N 7°06.86'W)

Time	Direction	Spring rate (m/s)	Neap Rate (m/s)
-06h	119°	0.36	0.15
-05h	109°	0.41	0.21
-04h	105°	0.41	0.21
-03h	116°	0.31	0.15
-02h	109°	0.15	0.05
-01h	329°	0.10	0.05
HW	294°	0.21	0.10
+01h	285°	0.36	0.15
+02h	290°	0.41	0.21
+03h	285°	0.41	0.21
+04h	281°	0.31	0.15
+05h	065°	0.10	0.05
+06h	122°	0.26	0.15

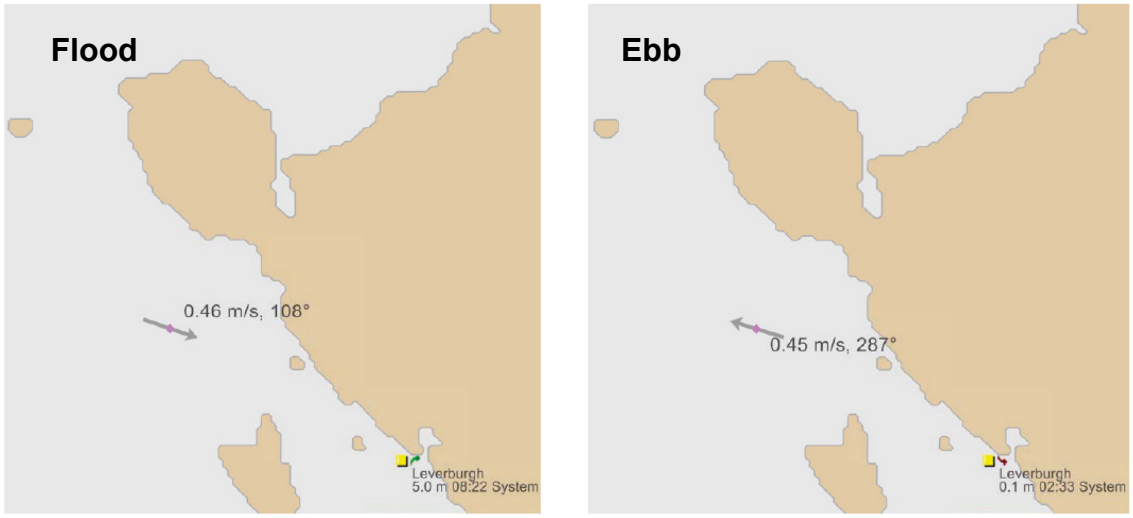

Figure 8.4 Tidal flows in the Sound of Harris

Maximum speeds of approximately 0.8 m/s (1.6 knots) are relatively weak. Within the Sound of Harris, tidal streams generally flow south-west on the flood tide and north-east on the ebb tide. However, around Lewis and Harris in general, the tidal streams are complex, and this may not reflect the situation in Borve Bay on the other side of the headland. Scottish Sea Kayaking (Cooper and Reid, 2005) indicates that the flood tide starts going into Loch Tarbert (to the north-east of Northton Sands) approximately 5 h 40 m after HW Ullapool and starts going out

approximately 30 m after HW Ullapool. A similar pattern would be expected at Traigh Luskentyre to the east of Borve Bay. Within Borve Bay, the currents would be expected to be gererally easterly on the flood tide and westerly on the ebb tide. The same reference indicates that the tidal streams around the island of Taransay (to the north of Borve Bay) are “almost imperceptible”.

8.2 Conclusions

Dilution of contaminants arising around the shore of Northton Beach and Borve Bay will be low but that of contaminants arising from further away will be high, due to the deeper water offshore. Currents will generally sweep around Borve Bay in an easterly direction on the flood tide and a westerly direction on the ebb tide. Available information indicates that these will be weak but there may be marked effects of wind. This pattern will be modified across the drying area where there will be a tendency for flow up and down the shore, especially into and out of the drying lagoon area in the vicinity of the cockle bed. Any contamination entering that area will remain over the period when the bed is submerged (and the cockles are feeding) but will be completely removed when the area empties on the ebb/low tide.

9. Shoreline Survey Overview

A restricted shoreline survey of the Northton Beach shoreline was undertaken by staff from CnES Council on the 28th February, 1st and 3rd March 2011 under calm and dry weather conditions.

The cockle bed at Northton Beach occupies a narrow band of sand between mean high water springs and low mean water springs on the western side of the beach.

The village of Scarasta, on the shoreline north east of the beach was relatively heavily populated with two dozen houses, a small country hotel, a golf course, church and holiday accommodation. All dwellings were connected to private septic tanks that discharged to soakaways. There are few dwellings on the immediate east and west shoreline of the fishery. To the south of the beach is the village of Northton which has a mains sewer that discharges into the Sound of Harris to the West.

Due to the exposed aspect of the beach there are no boats located along this stretch of coastline.

There was extensive grazing ground on all edges of the beach, with numerous sheep and cattle present all the year round. During the shoreline survey significant numbers of sheep and cattle were observed grazing along the roads and shoreline from Scarasta west and round all the way to the cockle bed. Sheep were free roaming in places and a large quantity of sheep droppings were found in a strand line on the beach south of the fishery.

Geese were the only wildlife observed during the shoreline survey. There were approximately 53 geese south of the golf course and another 30 geese near the village of Northton south of the fishery. An abundance of goose droppings were also found at the southern end of the beach.

Water samples were taken from significant and accessible watercourses and of sea water around the area. All of the fresh water samples were relatively low with results of between <100 and 200 *E. coli* cfu/100 ml. A total of four sea water samples were collected. Three returned results of <10 *E. coli* cfu/100 ml and a sample taken from over the cockle bed had a slightly higher result of 20 *E. coli* cfu/100 ml.

The majority of stock within the cockle bed had not fully matured and it was only possible to collect one sample from the far western side, closest to the shoreline. The cockle sample had a low result of <20 *E. coli* MPN/100 g.

A map is provided in Figure 9.1 that shows the relative locations of the most significant findings of the shoreline survey.

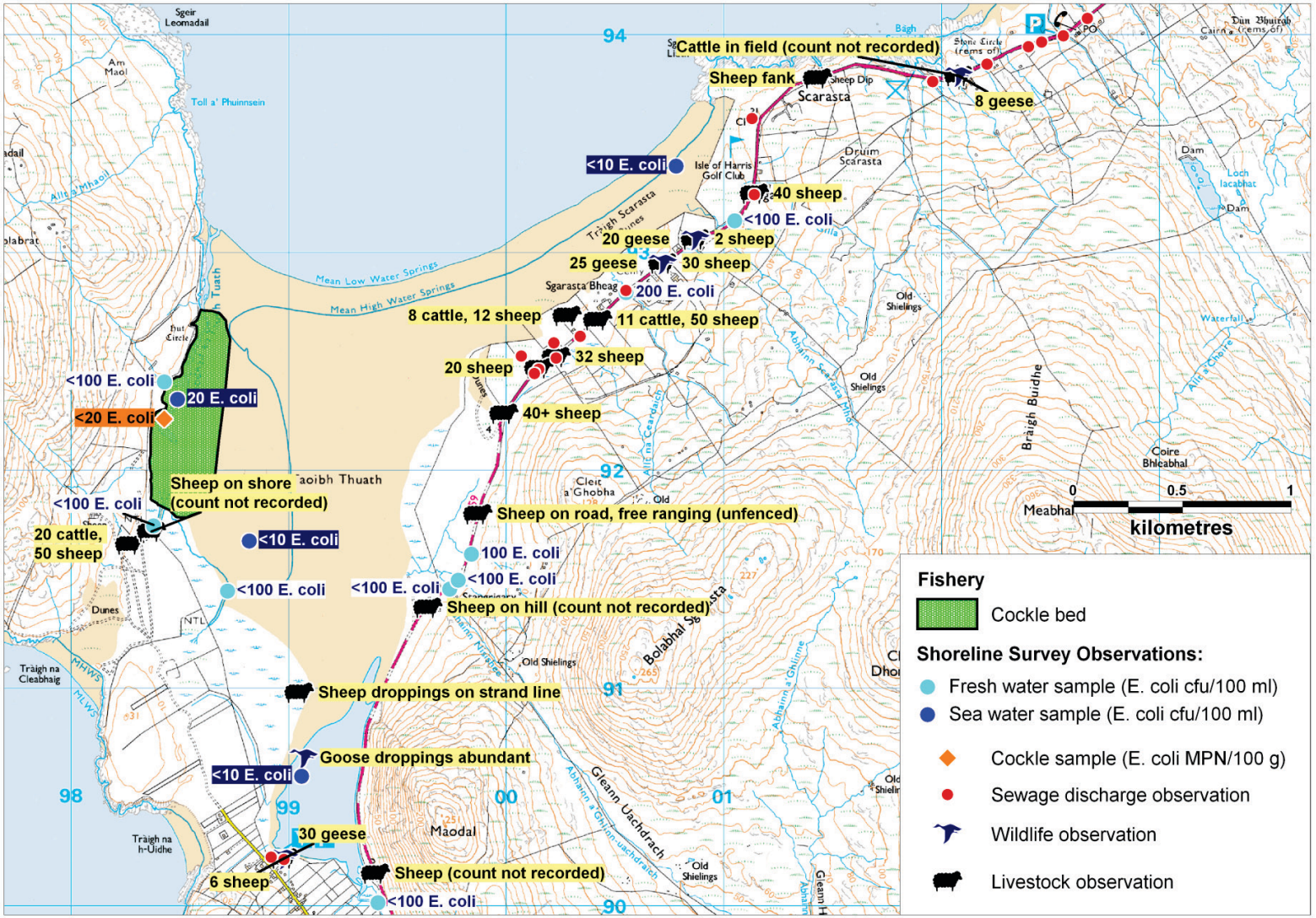

Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Fishery

A natural common cockle bed is located in the intertidal area on the western side of Northton Beach.

Human sewage inputs

Dwellings in the village of Scarasta to the north east, the majority of which have private septic tanks that discharge to soakways. The soil is very permeable and therefore discharges to a soakaway are unlikely to seep directly to the surface or into streams. SEPA identified that two of the septic tanks discharge to watercourses that flow into the sea. These are located several kilometres from the cockle bed. A fresh water sample was collected from one of the identified streams and this gave a result below the limit of detection, indicating very low, or no, sewage contamination at the time of the survey. Dwellings in the village of Northton to the south of the fishery are all thought to connect to a mains sewer which discharges on the western side of the Isle of Harris, and thus will not impact at the fishery. Due to the holiday accommodation in the area, there is likely to be an increase in human population during the spring and summer months.

Agricultural inputs

RERAD data indicated cattle and sheep predominate in the agricultural parish that covers Harris with considerably more sheep than cattle present. Consistent with this, in total approximately 280 sheep and 40 cattle were observed along the stretch of coastline from Scarasta to the shellfish bed. Additional groups of sheep and cattle were observed although numbers were not counted. Livestock were often free roaming and allowed access to the shoreline and cockle bed. Thus, although observed numbers were greatest to the north-east of the fishery, faecal contamination from cattle and sheep is likely to impact on all sides of the cockle bed.

Wildlife inputs

The combination of the Seabird 2000 data and shoreline survey observations indicate that seabirds and geese occur widely across the area. Faecal contamination would be expected to be greatest in the vicinity of nesting sites and so the eastern side of Northton Sands may be impacted to a greater extent from this source. However, spatial effects will not tend to be significant across the width of the cockle bed.

Rivers and streams

There are several streams that discharge into the area around Northton Beach. Only one contained sufficient contamination on the day of the shoreline survey to enable an actual loading to be calculated. However, this was approximately 2 km

from the cockle bed and the streams on the western shore, in the immediate vicinity of the fishery, are more likely to affect the microbiological quality of the cockles, especially after rainfall. Rainfall is greatest in the period from October to January but extreme rainfall events occur during various months of the year.

Analysis of results

There were no historical *E. coli* monitoring results available for Northton Beach.

During the shoreline survey, a single cockle sample was collected from the far western side of the beach, near to the land and returned a low result of <20 *E. coli* MPN/100 g.

Sea water samples were taken from four points along the beach. Three returned results of <10 *E. coli* cfu/100 ml and a sample taken from the cockle bed had a slightly higher result of 20 *E. coli* cfu/100 ml.

Movement of contaminants

Dilution of contaminants arising around the shore of Northton Beach and Borve Bay will be low. Currents will be weak but will generally sweep around Borve Bay in an easterly direction on the flood tide and a westerly direction on the ebb tide. At Northton Beach there will be a tendency for the flow to be up and down the shore, especially into and out of the drying lagoon area in the vicinity of the cockle bed. Any contamination entering that area will remain over the course of the higher tides, during which time the cockles will be feeding. The area will completely empty on the ebb tide.

Overall conclusions

The three main potential sources of contamination are:

- Sources to the north-east of the cockle bed: predominantly farm animals but also potentially some contribution from wild birds and human sewage. This will impact on the cockle bed on the flood tide.
- Sources to the south-east of the cockle bed, including the saltmarsh: predominantly farm animals but also wild birds. This will impact on the cockle bed at high and ebb tide.
- Sources at, and immediately to the west, of the cockle bed. This will be predominantly farm animals and contamination will arrive at the area of the cockle bed by direct deposition and via the streams immediately adjacent to the bed.

11. Recommendations

Production area

The recommended production area is “An area bounded by lines drawn between NF 9861 9300 and NF 9900 9300 and NF 9900 9155 and NF 9867 9155 and NF 9837 9187 and extending to MHWS between NF 9837 9187 and NF 9861 9300.

This covers all of the presently identified cockle bed and most of the rest of the western side of Norton Beach that lies below MHWS. It excludes those areas of Northton Beach that are closer to the identified sources of contamination on the eastern side. The complex nature of the MHWS mark in the area means that it has not been practical to completely exclude all parts towards the centre of the beach that lie above MHWS.

RMP

The recommended RMP is NF 9847 9200.

Tolerance

The recommended tolerance is 100 m. This will allow for some variability in stock density in location and time.

Depth

Not applicable

Frequency

Given that there is no historical data available for the area, it is recmommneded that the initial frequency of sampling be monthly. This can be reviewed when sufficient data has been gathered. The timing of sampling could also be reviewed if a defined and consistent harvesting season is subsequently identified.

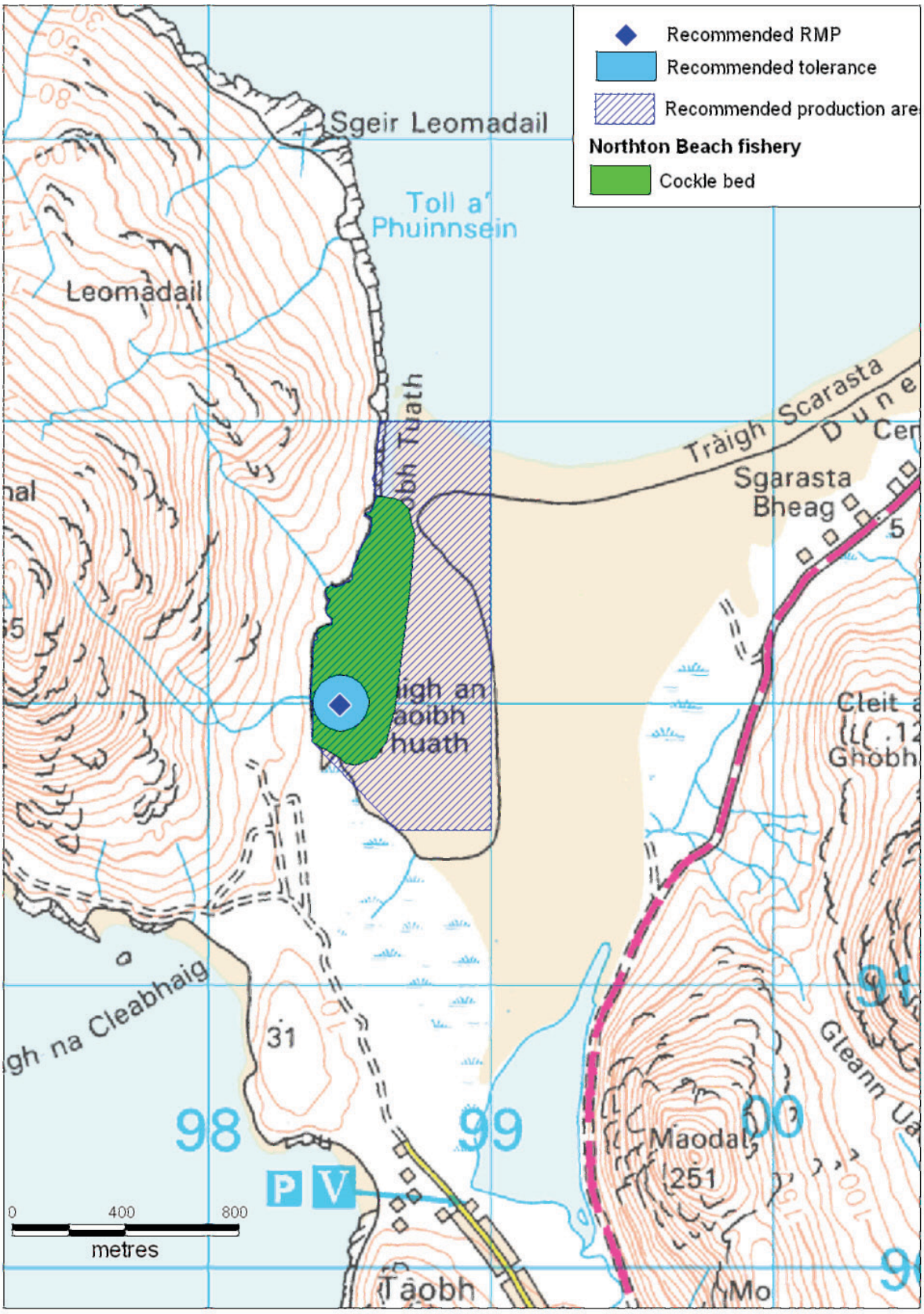

Figure 11.1 Recommendations for Northton Beach

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1. **Sampling Plan**
2. **Table of Proposed Boundaries and RMPs**
3. **General Information on Wildlife Impacts**
4. **Tables of Typical Faecal Bacteria Concentrations**
5. **Hydrographic Methods**
6. **Shoreline Survey Report**

Sampling Plan for Northton Beach

PRODUCTION AREA	Northton Beach
SITE NAME	Northton
SIN	LH 531 964 04
SPECIES	Common cockles (*Cerastoderma edule*)
TYPE OF FISHERY	Wild
NGR OF RMP	NF 9847 9200
EAST	98470
NORTH	892000
TOLERANCE (M)	100
DEPTH (M)	NA
METHOD OF SAMPLING	Hand raked
FREQUENCY OF SAMPLING	Monthly
LOCAL AUTHORITY	CnES Council
AUTHORISED SAMPLER(S)	Paul Tyler
LOCAL AUTHORITY LIAISON OFFICER	Colm Fraser

Table of Proposed Boundaries and RMPs – Northton Beach

PRODUCTION AREA	Northton Beach
SPECIES	Common cockles (*Cerastoderma edule*)
SIN	LH 531 964 04
EXISTING BOUNDARY	N/A
EXISTING SAMPLING AREA (RMP)	N/A
RECOMMENDED BOUNDARY	Area bounded by lines drawn between NF 9861 9300 and NF 9900 9300 and NF 9900 9155 and NF 9867 9155 and NF 9837 9187 and extending to MHWS between NF 9837 9187 and NF 9861 9300
RECOMMENDED RMP	NF 9847 9200
COMMENTS	Area covers west side of Northton Beach, RMP toward south end of cockle bed.

General Information on Wildlife Impacts

Pinnipeds

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

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

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

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

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

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

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

Cetaceans

As mammals, whales and dolphins would be expected to have resident populations of *E. coli* and other faecal indicator bacteria in the gut. Little is known about the concentration of indicator bacteria in whale or dolphin

faeces, in large part because the animals are widely dispersed and sample collection difficult.

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

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

Birds

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

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

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

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

Deer

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

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

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

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

Other

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

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

References:

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Tables of Typical Faecal Bacteria Concentrations

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

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

Source: Kay, D. et al (2008) Faecal indicator organism concentrations in sewage and treated effluents. *Water Research* 42, 442-454.

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

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

Source: Adapted from Geldreich 1978 by Ashbolt et al in World Health Organisation (WHO) Guidelines, Standards and Health. 2001. Ed. by Fewtrell and Bartram. IWA Publishing, London.

Hydrographic Methods

The new EU regulations require an appreciation of the hydrography and currents within a region classified for shellfish production with the aim to "determine the characteristics of the circulation of pollution, appreciating current patterns, bathymetry and the tidal cycle." This document outlines the methodology used by Cefas to fulfil the requirements of the sanitary survey procedure with regard to hydrographic evaluation of shellfish production areas. It is written as far as possible to be understandable by someone who is not an expert in oceanography or computer modelling. A glossary at the end of the document defines commonly used hydrographic terms e.g. tidal excursion, residual flow, spring-neap cycle etc.

The hydrography at most sites will be assessed on the basis of bathymetry and tidal flow software only. Selected sites will be assessed in more detail using either: 1) a hydrodynamic model, or 2) an extended consideration of sources, available field studies and expert assessment. This document will consider the more basic hydrographic processes and describes the common methodology applied to all sites.

Background processes

Currents in estuarine and coastal waters are generally driven by one of three mechanisms: 1) Tides, 2) Winds, 3) Density differences.

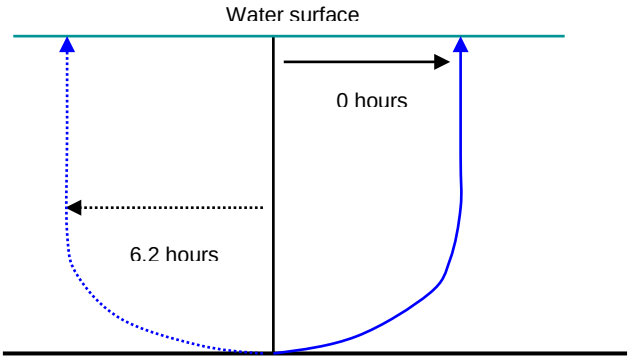
Tidal flows often dominate water movement over the short term (approximately 12 hours) and move material over the length of the *tidal excursion*. Tides move water back and forth over the tidal period often leading to only a small net movement over the 12 hours tidal cycle. This small net movement is partly associated with the *tidal residual* flow and over a period of days gives rise to persistent movement in a preferred direction. The direction will depend on a number of factors including the bathymetry and direction of propagation of the main tidal wave.

Wind and density driven current also lead to persistent movement of water and are particular important in regions of relatively low tidal velocities characteristic of many of the water bodies in Scottish waters. Whilst tidal flows generally move material in more or less the same direction at all depths, wind and density driven flows often move material in different directions at the surface and at the bed. Typical vertical profiles are depicted in Figure 1. However, it should be understood that in a given water body, movement will often be the sum of all three processes.

In sea lochs, mechanisms such as "wind rows" can transport sources of contamination at the edge of the loch to production areas further offshore. Wind rows are generated by winds directed along the main length of the loch. An illustration of the waters movements generated in this way is given in Figure 2. As can be seen the water circulates in a series of cell that draw material across the loch at right angles to the wind direction. This is a

particularly common situation for lochs with high land on either side as these tend to act as a steering mechanism to align winds along the water body.

a)



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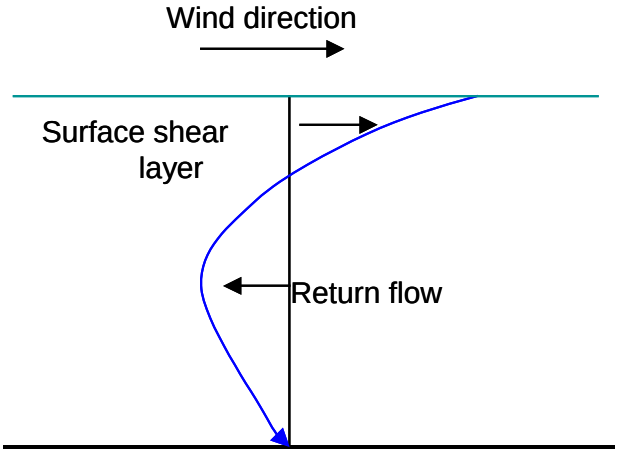

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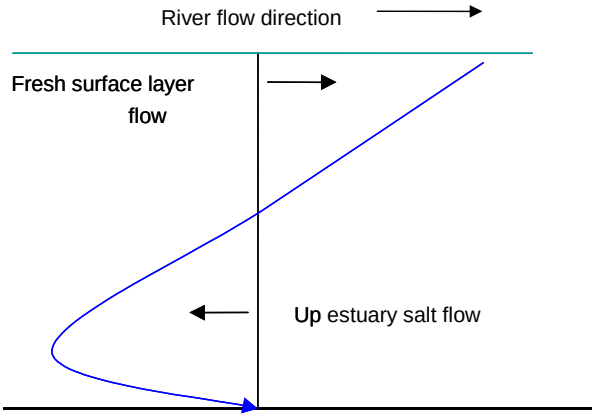

Figure 1. Typical vertical profiles for water currents. The black vertical line indicates zero velocity so portions of the profile to the left and right indicate flow moving in opposite directions. a) Peak tidal flow profiles. Profiles are shown 6.2 hours apart as the main tidal current reverses direction over a period of 6.2 hours. b) wind driven current profile, c) density driven current profile.

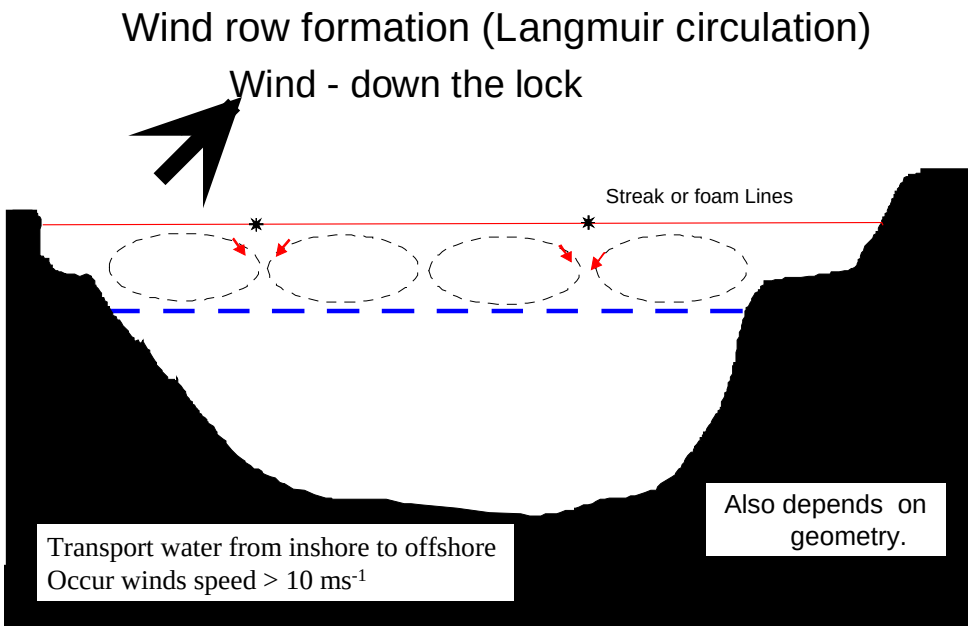

Figure 2. Schematic of wind driven 'wind row' currents. The dotted blue line indicates the depth of the surface fresh(er) water layer usually found in sea lochs.

Non-modelling Assessment

In this approach the assessment requires a certain amount of expert judgment and subjectivity enters in. For all production areas, the following general guidelines are used:

1. Near-shore flows will generally align parallel to the shore.
2. Tidal flows are bi-directional, thus sources on either side of a production area are potentially polluting.
3. For tidal flows, the tidal excursion gives an idea of the likely main 'region of influence' around an identified pollutant source.
4. Wind driven flows can drive material from any direction depending on the wind direction. Wind driven current speeds are usually at a maximum when the wind direction is aligned with the principle axis of the loch.
5. Density driven flows generally have a preferred direction.
6. Material will be drawn out in the direction of current, often forming long thin 'plumes'.

Many Scottish shellfish production areas occur within sea lochs. These are fjord-like water bodies consisting of one or more basins, deepened by glacial activity and having relatively shallow sills that control the mixing and flushing processes. The sills are often regions of relatively high currents, while the basins are much more tranquil often containing higher density water trapped below a fresh lower density surface layer. Tidal mixing primarily occurs at the sills.

The catalogue of Scottish Sea Loch produced by the SMBA is used to quantify sills, volume fluxes and likely flow velocities. Because the flow is so constrained by the rapidly varying bathymetry, care has to be used in the extrapolation of direct measurements of current flow. Mean flow velocities can

be estimated at the sills by using estimates of the sill area and the volume change through a tidal cycle. This in turn can be used to estimate the maximum distance travelled in a tidal cycle in the sill area. Away from the sill area, tidal velocities are general low and transport events are dominated by wind or density effects. Sea Lochs generally have a surface layer of fresher water; the extent of this depends on freshwater input, sill depth and quantity of mixing.

In addition to movement of particles by currents, dilution is also an important consideration. Dilution reduces the effect of an individual point source although at the expense of potentially contaminating a larger area. Thus class A production areas can be achieved in water bodies with significant faecal coliform inputs if no transport pathway exists and little mixing can occur. Conversely a poor classification might occur where high mixing causes high and permanent background concentrations arising from many weak diffuse sources.

References

European Commission 1996. Report on the equivalence of EU and US legislation for the Sanitary Production of Live Bivalve Molluscs for Human Consumption. EU Scientific Veterinary Committee Working Group on Faecal Coliforms in Shellfish, August 1996.

Glossary

The following technical terms may appear in the hydrographic assessment.

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

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

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

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

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

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

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

Spring/Neap Tides. The strongest tides in a month are called spring tides and the weakest are called neap tides. Spring tides occur every 14 days with neaps tides occurring 7 days after springs. Both tidal range and tidal currents are strongest at Spring tides.

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

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

Return flow. Often a surface flow at the surface is accompanied by a compensating flow in the opposite direction at the bed (see figure 1).

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

Shoreline Survey Report

Production area:	Northton Beach
Site name:	Northton
SIN:	LH 531 964 04
Species:	Common cockle
Harvester:	Various local gatherers
Local Authority:	Comhairle nan Eilean Siar
Status:	New application
Date Surveyed:	28th February, 1st & 3rd March 2011
Surveyed by:	Paul Tyler
Existing RMP:	None
Area Surveyed:	Scaristavore to Northton Beach, see Figure 1.

Weather observations
Weather fine and sunny, scattered cloud. Wind SW 3 to 4. Air temp 8.2°C.

General Description
The area surveyed comprises a large sandy beach which faces the open Atlantic Ocean to the North. The South and West areas of the beach are sheltered from major wave action and the centre of the area is inundated only on exceptional high tides. The beach is designated as an SSSI and supports numerous waders and wildfowl. Human habitation is well spaced along the Scarista area to the North East of the survey area, with small crofts and houses, of which a considerable number are holiday homes. These houses are situated on or immediately behind machair land – well drained sandy soil which occurs behind large sand dunes.
To the South of the survey area is the crofting village of Northton which is more densely populated. To the NW of the village is extensive machair and sand dunes, and salt marsh is found close to the village itself.
There is extensive grazing ground on all edges of the beach, with numerous sheep and cattle present all the year round.

Fishery
There is a cockle bed which occupies a narrow band of beach at its western edge. No commercial harvesting occurs there at present, however this site was requested by local gatherers as a possible new classified area. Cockle harvesting in this area is currently restricted to a beach 5 miles to the North East at Seilebost (LH 249 129 04) where cockle gathering occurs on an irregular basis.

Sewage/Faecal Sources
Human
The area to the North East (Scarista) has around 2 dozen houses, a small country hotel, a golf course, church and holiday accommodation. All of these are connected to private septic tanks – there is no mains sewer. Each septic tank drains into either a small stream alongside of the property or to a soakaway. In almost every instance the flow does not discharge directly into the sea; the small streams soak into the machair's sandy soil and rarely reach

as far as the beach, while the majority of soakaways are several hundred metres from the beach and unlikely to contribute directly to any faecal contamination in the water.
Northton village itself has a mains sewer which discharges into the Sound of Harris to the West, and therefore does not contribute any contamination to the fishery area. Three septic tank discharges were identified on the map as SEPA registered sites, although none were visible from the shore.

Livestock
Machair land is the most fertile agricultural land in the islands, and this is reflected by the large numbers of sheep and cattle which graze here all the year round. Cattle are found in fields on both sides of the road at Scarista, and sheep are permanent residents of the fields and the road verges. To the south of Scarista the road is unfenced, so sheep are able to range between the open hill and moorland to the SE and the beach area. They are also free to cross the beach to the hill and moorland to the West of the area.
The machair land to the NW of Northton village supports around 200 sheep and 30 cattle. The village itself supports between 40 to 100 sheep and 20 cattle in the fields immediately adjacent to the croft houses. There are in addition around 100 chickens in the village area (local crofter, pers comm.)
Scarista village and its environs supports a similar number of cattle and an equal or greater number of sheep. A small farmstead is situated at the South end of Scarista where sheep are gathered, and a small sheep fank is located close to the golf course where seasonal gathering and dipping / shearing takes place.

Seasonal Population
A small hotel is located in Scarista, which appears to be busy all the year round. This village also has half a dozen holiday chalets which are occupied for most of the year, with 2 more are under construction. Many of the residential houses are holiday homes, many of which lie empty for much of the year. Most of the houses in Northton appear to be occupied by local residents, although there are a couple of holiday chalets in this village as well. There are no camp sites or cafes in the survey area.

Boats/Shipping
Due to the exposed aspect of the beach there are no boats located along this stretch of coast.

Land Use
Almost all of the land in the survey area is given over to livestock grazing. A few small patches of machair are ploughed and planted during the spring and summer. A small golf course is situated at the extreme NE end of the beach – this has a clubhouse with toilets whose septic tank soaks away into the sand dunes.

Wildlife/Birds
Greylag geese occur throughout the area at all times of the year. Flocks of 20 to 30 are regularly seen grazing on the short grass, and droppings are found throughout the area. The beach itself supports gulls, ducks and waders,

particularly oystercatchers, common gulls and mallards. Herring gull, black headed gulls, redshanks and knots were also seen, and shelducks are seen here during the summer, particularly on the standing water immediately by Northon village. Rabbits were once common on the sandy machair, and a few were seen in Scarista, but their numbers are much reduced compared to previous years. Herons regularly occur in the saltings by Northton village and flocks of up to 20 lapwing were seen over the fields and saltings.

Freshwater inputs are limited to a small number of streams which drain the boggy moorland from the adjacent upland areas or the marshy saltmarsh. There are no major rivers in the area and no sources of industrial pollution.

Little if any human faecal bacterial contamination is likely to find its way on to the beach or into the sea - most if not all waste water that drains from buildings will be well filtered by sand before it reaches the sea. However there is considerable faecal input from livestock on 3 sides of the fishery area – this is particularly noticeable as a strand line which contains considerable amounts of sheep droppings. Contamination from wildlife is on a much smaller scale, with the majority probably coming from greylag geese.

Table 1 Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
1	28/02/2011	12:01	NG 02670 94080	102670	894080	Figures 4 & 5		House with septic tank
2	28/02/2011	12:06	NG 02560 94000	102560	894000	Figures 6 & 7		House with septic tank
3	28/02/2011	12:11	NG 02460 93970	102460	893970			House with septic tank
4	28/02/2011	12:12	NG 02400 93950	102400	893950	Figure 8		House with septic tank
5	28/02/2011	12:15	NG 02210 93870	102210	893870			House with septic tank
6	28/02/2011	12:20	NG 01960 93790	101960	893790	Figures 9 & 10		House with septic tank
7	28/02/2011	12:24	NG 01430 93800	101430	893800			Sheep fank
8	28/02/2011	12:27	NG 01180 93620	101180	893620			Holiday cottages
9	28/02/2011	12:28	NG 01130 93620	101130	893620	Figures 11, 12 & 13		Golf club with club house and toilets discharging to soakaway
10	28/02/2011	12:36	NG 01140 93270	101140	893270	Figure 14		House with septic tank Approx 40 sheep
11	28/02/2011	12:40	NG 01010 93120	101010	893120			2 large holiday chalets under construction
12	28/02/2011	12:42	NG 00870 93060	100870	893060	Figure 15		4 houses. 2 sheep, 20 geese
13	01/03/2011	10:30	NF 98270 91660	98270	891660	Figures 16 to 19		20 cattle, 50 sheep seen here
14	01/03/2011	10:35	NF 98370 91720	98370	891720	Figures 20 & 21		Sheep on the shore
15	01/03/2011	10:59	NF98430 92410	98430	892410	Figures 22 & 23	FW1	Freshwater stream. 0.5m wide, 8cm deep, flow rate 0.249m/s sd=0.013 Fresh water sample FW1
16	01/03/2011	11:12	NF 98490 92330	98490	892330	Figure 24	SW1	Seawater sample SW1. Numerous cockle shells.
17	01/03/2011	11:20	NF 98430 92240	98430	892240	Figure 25	CS1	Cockle sample CS1 taken
18	01/03/2011	12:09	NF 98380 91750	98380	891750	Figure 26	FW2	Freshwater stream. 1m wide, 28cm deep, flow rate 0.048m/s sd=0.004 Fresh water sample FW2
19	01/03/2011	12:29	NF 98610 91610	98610	891610	Figure 27		minor freshwater input - drain from saltmarsh
20	01/03/2011	12:35	NF 98720 91450	98720	891450	Figures 28 & 29	FW3	Freshwater stream. 2.8m wide, 8cm deep, flow rate 0.034m/s sd=0.003 Fresh water sample FW3
21	01/03/2011	12:48	NF 98820 91680	98820	891680		SW2 Salinity 7ppt	Seawater sample SW2. No cockles, plenty of lugworms
22	01/03/2011	13:10	NF 99070 90680	99070	890680	Figure 30		Goose droppings abundant
23	01/03/2011	13:12	NF 99060 90600	99060	890600		SW3 Salinity	Seawater sample SW3

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
							5ppt	
24	01/03/2011	13:18	NF 99040 90650	99040	890650	Figure 31		Scum at water's edge
25	01/03/2011	13:23	NF 99050 90980	99050	890980	Figure 32		sheep droppings on strand line
26	01/03/2011	14:20	NF 99410 90020	99410	890020	Figures 33 to 35	FW4	Freshwater stream. 4.5m wide, 36cm deep, flow rate 0.004m/s sd=0.003 Fresh water sample FW4
27	01/03/2011	14:34	NF 99740 91460	99740	891460	Figure 36	FW7	Small stream, fresh water sample FW7
28	01/03/2011	14:37	NF 99780 91500	99780	891500	Figure 37	FW8	Small stream, fresh water sample FW8
29	01/03/2011	14:45	NF 99840 91620	99840	891620	Figure 38	FW9	Small stream, fresh water sample FW9
30	01/03/2011	14:50	NG 00550 92820	100550	892820	Figures 39 & 40	FW5	Freshwater stream. 3.6m wide, 28cm deep, flow rate 0.031m/s sd=0.013 Fresh water sample FW5
31	01/03/2011	15:01	NG 00550 92830	100550	892830	Figure 41		inspection hatch
32	01/03/2011	15:08	NG 01050 93150	101050	893150	Figure 42	FW6	Freshwater stream. 1.5m wide, 20cm deep, flow rate 0.067m/s sd=0.022 Fresh water sample FW6
33	01/03/2011	15:38	NG 00780 93400	100780	893400	Figures 44 & 45	SW4 Salinity 36ppt	Seawater sample SW4. Numerous cockle washed up but none on beach, very exposed to heavy surf
34	03/03/2011	10:34	NG 02080 93810	102080	893810	Figures 43, 46 & 47		8 geese by road. Cattle in field
35	03/03/2011	10:46	NG 00720 92950	100720	892950	Figures 48 & 49		Hotel and 4 houses. 30 sheep, 25 geese
36	03/03/2011	10:49	NG 00600 92850	100600	892850	Figure 50		Church and manse
37	03/03/2011	10:51	NG 00420 92690	100420	892690	Figures 51 to 54		11 cattle and 30 sheep S of road. 5 sheep on the road, 15 sheep in field N of road
38	03/03/2011	10:54	NG 00340 92620	100340	892620			House with septic tank and caravan in garden
39	03/03/2011	10:57	NF 00230 92520	100230	892520			House with septic tank. 17 sheep N of road, 15 sheep S of road
40	03/03/2011	10:59	NF 00150 92470	100150	892470			House with septic tank 20 sheep S of road
41	03/03/2011	11:03	NF 00070 92530	100070	892530	Figure 55		Septic tank. Rabbits.
42	03/03/2011	11:08	NF 00180 92600	100180	892600			Dead sheep
43	03/03/2011	11:08	NF 00220 92590	100220	892590	Figure 56		Septic tank
44	03/03/2011	11:11	NG 00280 92710	100280	892710	Figures 57 to 59		8 cattle, 12 sheep
45	03/03/2011	11:17	NF 00130 92450	100130	892450			Manhole cover by road
46	03/03/2011	11:20	NF 99990 92260	99990	892260	Figures 60 & 61		40+ sheep by beach and up hill

No.	Date	Time	NGR	East	North	Associated photograph	Associated sample	Description
47	03/03/2011	11:23	NF 99870 91800	99870	891800	Figure 62		More sheep on road and free ranging (unfenced)
48	03/03/2011	11:25	NF 99640 91370	99640	891370			More sheep up hill
49	03/03/2011	11:28	NF 99400 90150	99400	890150	Figure 63		Sheep
50	03/03/2011	11:40	NF 98920 90230	98920	890230			Manhole cover by bird hide - possible septic tank?
51	03/03/2011	11:42	NF 98980 90220	98980	890220			Small drain. 30 geese seen, 6 sheep in field

Photographs referenced in the table can be found attached as Figures 4 – 63.

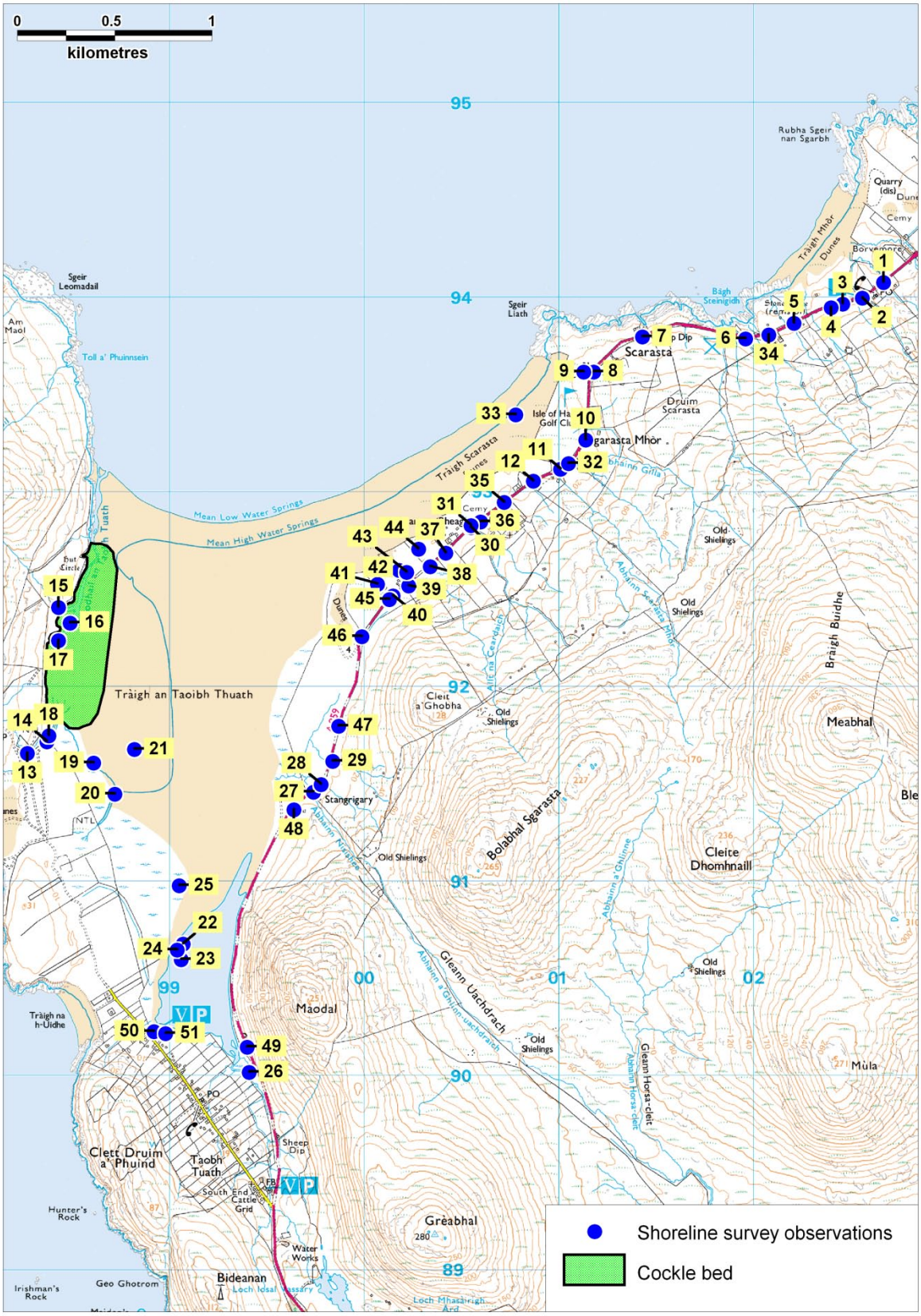

Figure 1. Shoreline observations at Northton Beach

Sampling

Water and shellfish samples were collected at sites marked in the maps in figures 2 and 3.

A single cockle sample was gathered from the far western side of the cockle bed (see Figure 3).

Bacteriology results follow in Tables 2 and 3.

Samples of seawater were tested for salinity by the laboratory using a salinity meter under controlled conditions. These results are shown in Table 2, given in units of grams salt per litre of water. This is the same as parts per thousand (ppt).

Table 2 Water sample results

No.	Date	Sample	Grid Ref	Type	E. coli (cfu/100ml)	Salinity (g/L)
1	01/03/2011	FW1	NF 98430 92410	Fresh water	<100	
2	01/03/2011	FW2	NF 98380 91750	Fresh water	<100	
3	01/03/2011	FW3	NF 98720 91450	Fresh water	<100	
4	01/03/2011	FW4	NF 99410 90020	Fresh water	<100	
5	01/03/2011	FW5	NG 00550 92820	Fresh water	200	
6	01/03/2011	FW6	NG 01050 93150	Fresh water	<100	
7	01/03/2011	FW7	NF 99740 91460	Fresh water	<100	
8	01/03/2011	FW8	NF 99780 91500	Fresh water	<100	
9	01/03/2011	FW9	NF 99840 91620	Fresh water	100	
10	01/03/2011	SW1	NF 98490 92330	Sea water	20	16.2
11	01/03/2011	SW2	NF 98820 91680	Sea water	<10	4.5
12	01/03/2011	SW3	NF 99060 90600	Sea water	<10	0.4
13	01/03/2011	SW4	NG 00780 93400	Sea water	<10	35.8

Table 3 Shellfish sample results

No.	Date	Sample	Grid Ref	Sample Type	E. coli (MPN/100g)
1	01/03/2011	CS1	NF 98430 92240	Common cockles	<20

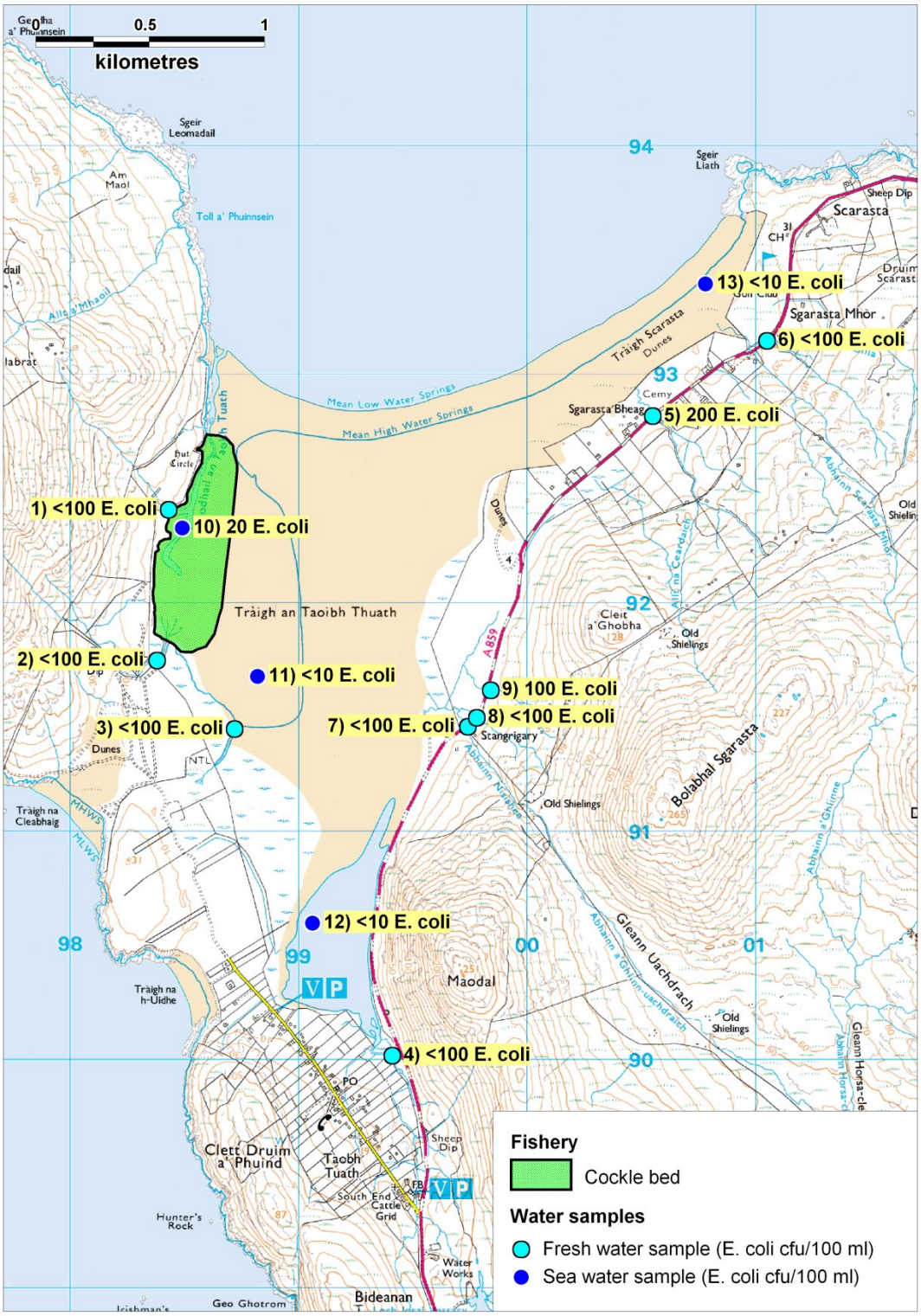

Figure 2. Water sample results

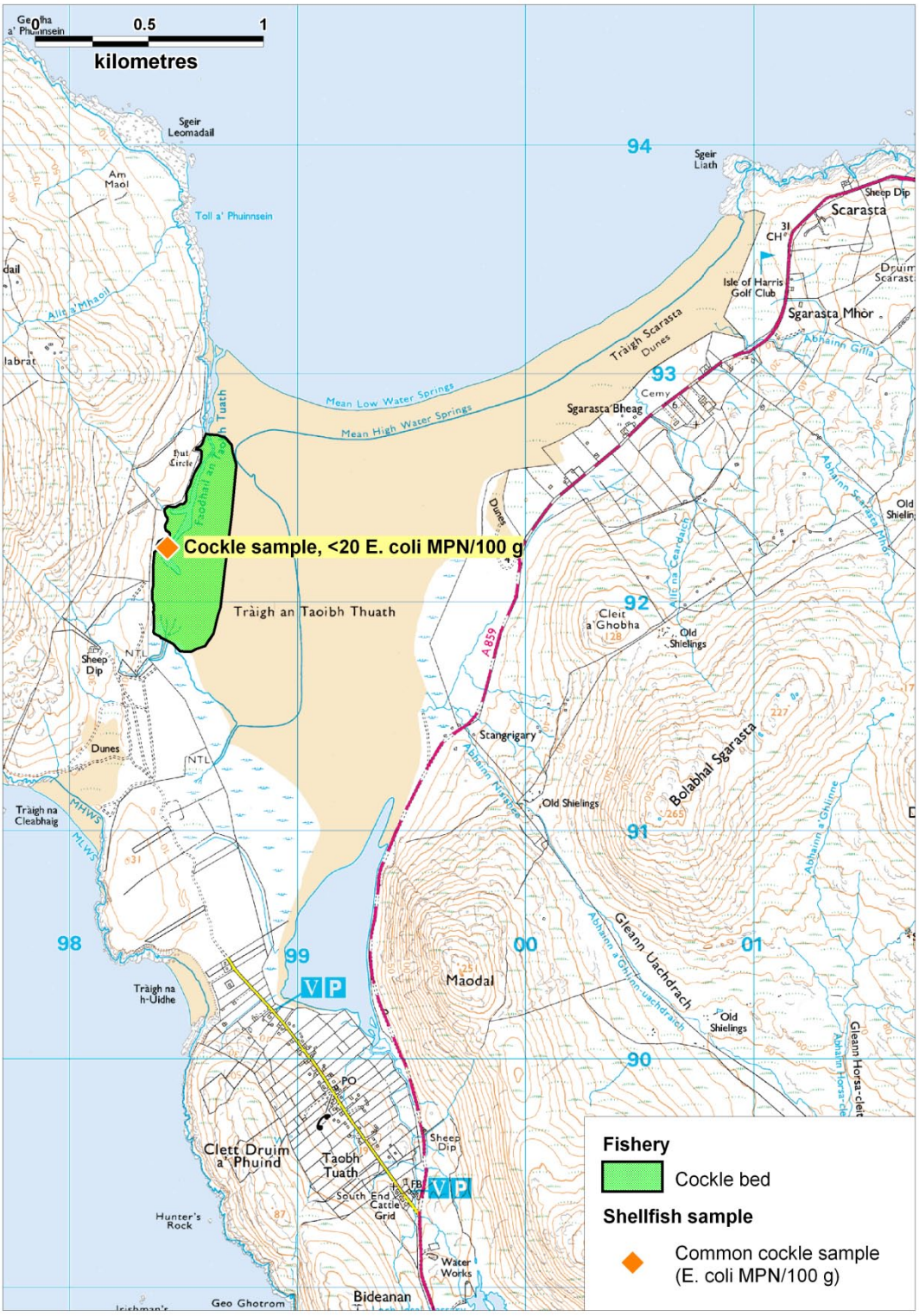

Figure 3 Shellfish sample results

Photographs

Figure 4. Septic tank at NG 02670 94080

Figure 5. NG 02670 94080 looking NW

Figure 6. and 7: NG 02560 94000 looking SE and NW, showing how most watercourses in the area drain into the sand dunes and not directly into the sea.

Figure 8. Septic tanks at NG 02400 93950

Figure 9. Septic tank at NG 01960 93790

Figure 10. NG 01960 93790 looking NW

Figure 11. Inspection covers for septic tank at golf course

Figure 12. Golf course looking NW NG 01130 93620

Figure 13. Golf course looking SW NG 01130 93620

Figure 14. Septic tank at NG 01140 93270

Figure 15. Stream at NG 00870 93060

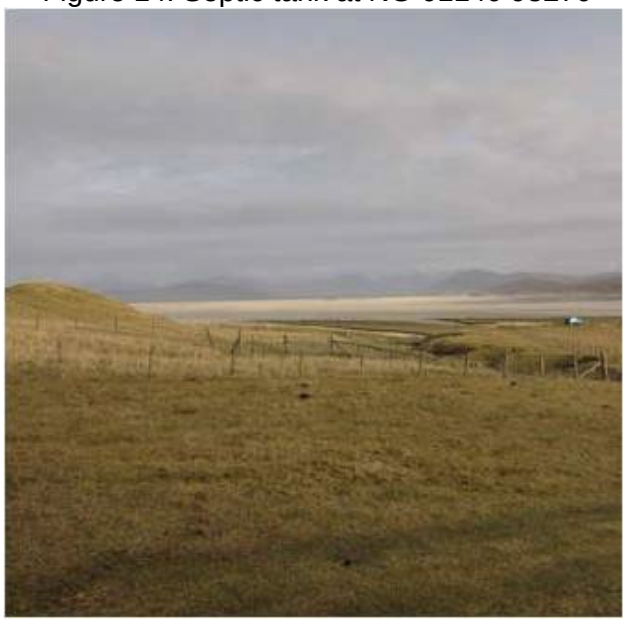

Figure 16 – 19. View of the cockle beach from NF 98270 91660 - looking N

Same location, looking E

Figure 20. Cattle at NF 98370 91720

Figure 21. Sheep at NF 98370 91720

Figure 22 & 23. Stream at NF 98430 92410

Figure 24. Seawater sample site NF 98490 92330

Figure 25. Cockle sample site NF 98430 92240

Figure 26. Stream NF 98380 91750

Figure 27. Stream NF 98610 91610

Figure 28 & 29. Stream at NF 98720 91450 looking S & looking N

Figure 30. Goose droppings at NF 99070 90680 Figure 31. Scum at NF 99040 90650

Figure 32. Sheep droppings on tideline NF 99050 890980 Figures 33 – 35. Saltmarsh at NF 99410 90020 Looking SW

Looking NW

Looking W

Figure 36. Stream at NF 99740 91460

Figure 37. Stream at NF 99780 91500

Figure 38. Stream at NF 99840 91620

Figure 39. Stream at NG 00550 92820

Figure 40. Sheep pen at NG 00550 92820

Figure 41: Manhole cover at NG 00550 92830

Figure 42. Stream at NG 01050 93150

Figure 43: Geese at NG 02080 93810

Figures 44 & 45. Exposed beach at NG 00780 93400 Looking W & Looking N

Figure 46. Cattle in field at NG 02080 93810

Figure 47. View to N from NG 02080 93810

Figure 48. Sheep and geese at NG 00720 92950

Figure 49. Hotel at NG 00720 92950

Figure 50. Church and manse at NG 00600 92850

Figure 51: livestock at NG 00420 92690

Figure 52. Livestock at NG 00420 92690

Figure 53. Livestock at NG 00420 92690

Figure 54. Livestock at NG 00420 92690

Figure 55: Septic tank at NF 00070 92530

Figure 56. Septic tank at NF 00220 92590

Figure 57. Caravan at NG 00130 92450

Figure 58. Livestock at NG 00130 92450

Figure 59. Livestock at NG 00130 92450

Figure 60. Livestock at NF 99990 92260

Figure 61. Livestock at NF 99990 92260

Figure 62. view of cockle beach from looking W

Figure 63. View of Northton village looking SW