Scottish Sanitary Survey Project

Restricted Sanitary Survey Report

Traigh Cille Bharra

UB 392

August 2008

Report Distribution – Traigh Cille Bharra

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1. Area Overview

Traigh Cille Bharra is located off the west coastline of Scotland, on the Isle of Barra, the most southern of the Outer Hebrides. Traigh Cille Bharra is roughly 1.1km wide and 0.5km long. Traigh Cille Bharra is very shallow and the depth varies from 0 – 2m.

Figure 1.1 Location of Traigh Cille Bharra

1.1 Land Cover

The land cover on the islands of Eoligarry and Barra is predominantly neutral and improved grassland.

1.2 Human Population

Figure 1.2 shows the census output area, which is directly adjacent to the Traigh Cille Bharra shellfish farm, has a total population of 147 (2001 census data from the General Register Office for Scotland). There are no specific villages within this area, only scattered dwellings and a school.

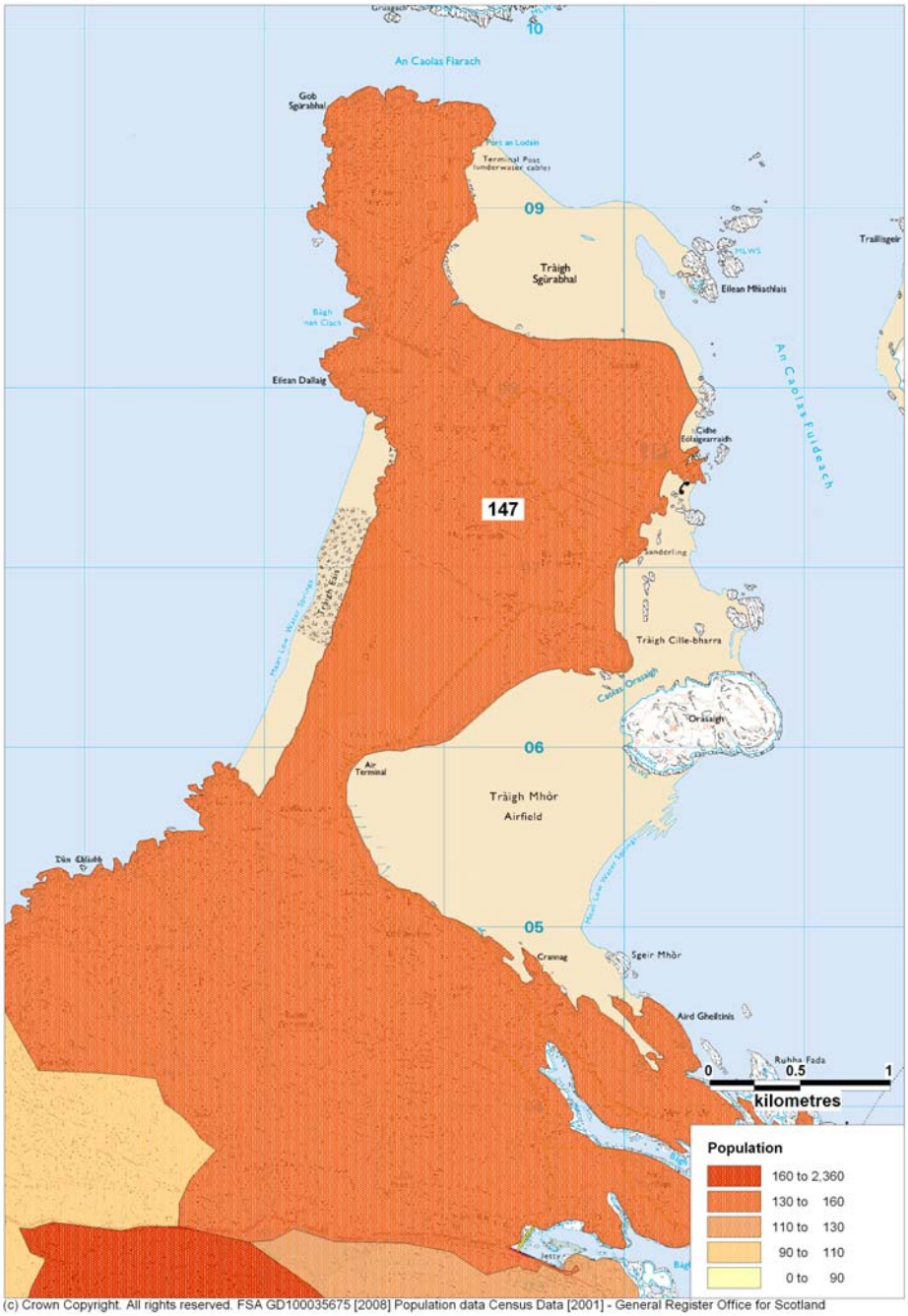

Figure 1.2 Population of Traigh Cille Bharra

2. Fishery

The fishery at Traigh Cille Bharra is comprised of a wild common cockle shellfish bed as listed in Table 2.1 below:

Table 2.1 Traigh Cille Bharra shellfish bed

Site	SIN	Species
Traigh Cille Bharra	UB 392 790 04	Common cockles

The current production area boundaries are given as the area bounded by lines drawn between NF 7103 0648 to NF 7185 0620 then from NF 7185 0620 to NF 7140 0750 (see Figure 2.1.)

There is currently no seabed lease or RMP assigned to this area. The area is not a designated shellfish growing water and so is not monitored by SEPA under this program.

The actual shellfishery covers the central section of the bay, as mapped in figure 2.1. Harvesting of the cockles occurs during the spring and autumn months (March – May, June and September to November) and is predominantly done by snorkelling.

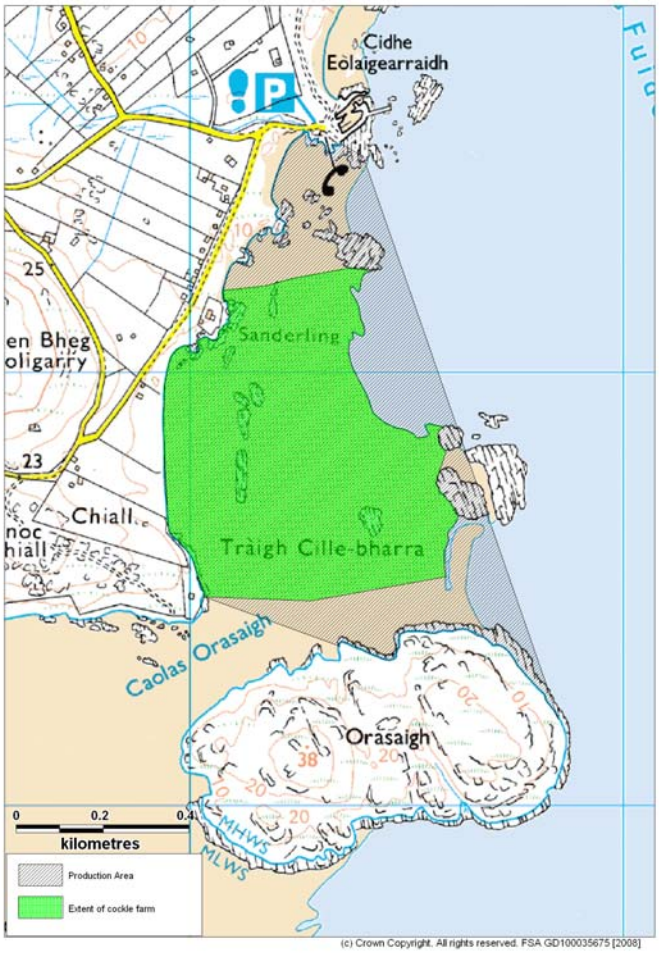

Figure 2.1 Traigh Cille Bharra fishery

3. Sewage Discharges

One sewage discharge was identified by Scottish Water for the area surrounding Traigh Cille Bharra. This is detailed in Table 3.1.

Table 3.1 Discharge identified by Scottish Water

Discharge Name	NGR of discharge	Discharge Type	Level of Treatment	Consented flow m3/day	Consented/ design PE	Q&S III Planned improvements?
Eoligarry	NF 7041 0759	Continuous	Septic tank	6	20	No

According to further communication from Scottish Water, the septic tank itself is located at national grid reference NF 7039 0765, which is adjacent to St. Vincents Church. No sanitary or microbiological data were available for this discharge. It was not possible during the shoreline survey to confirm the location of the septic tank or discharge. It is thought that this septic tank discharges into the stream at the northern end of the beach at Traigh Cille Bharra.

The corresponding discharge consent held by SEPA for this septic tank is listed in Table 3.2 and mapped in Figure 3.1.

Table 3.2 Discharge consent issued by SEPA

Ref No.	NGR of discharge	Discharge Type	Level of Treatment	Consented flow (DWF) m3/d	Consented/ design PE
WPC-N-61207	NF 7041 0759	Continuous	Septic tank	6	20

Observations of additional discharges, including septic tanks and outfall pipes made during the shoreline survey and are listed in Table 3.3. Their locations have been included in the mapped discharges in Figure 3.1. Further details can be found in the shoreline survey report in Appendix 2.

Table 3.3 Observations of potential sewage discharges

No.	Date	NGR	Description of potential sewage discharge
1	16/07/2008	NF 7132407538	Eoligarry Public toilets septic tank
2	16/07/2008	NF 7134307510	End of Eoligarry septic tank outfall
3	16/07/2008	NF 7036606774	Several drains at the front of the school. The school is thought to have its own septic tank which discharges onto the Machair leading down to the Traigh Mhor beach. At the time of the survey no one was available to confirm this.
4	16/07/2008	NF 7051406749	New council house development, across the road from the school. Houses have a shared septic tank system which is still under construction.
5	22/07/2008	NF 7131707550	Location of public toilets
6	22/07/2008	NF 7131207546	Disposal drain behind toilets
7	22/07/2008	NF 7132507540	Inspection cover of septic tank and outfall pipe

Figure 3.1 Sewage discharges at Traigh Cille Bharra

4. Animals

4.1 Livestock

Regulation (EC) No. 854/2004 requires the competent authority to:

(a) make an inventory of the sources of pollution of human or animal origin likely to be a source of contamination for the production area;
(b) 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, waste-water treatment, etc.

The only significant sources of information relating to livestock populations were the shoreline survey and the Western Isles Crofters Commission. The shoreline survey only relates to the time of the site visits on insert date.

The Western Isles Crofters Commission (2007) identified that in 2005, there was an estimated 713 cattle and 10209 sheep on the Isle of Barra. There is no information available concerning the seasonality of this data. There is no specific livestock census data for the area immediately surrounding the Traigh Cille Bharra fishery.

During the shoreline survey, approximately 20 cattle were visible in the crofts up the hill away from the shoreline and there was also a flock of approximately 30 sheep walking along the shoreline (see Figure 4.1).

4.2 Wildlife

The Western Isles are commonly populated with otters, red deer and large colonies of both Atlantic and common seals.

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*).

The amount 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 x 104 CFU (colony forming units) *E. coli* per gram dry weight of faeces (Lisle et al 2004).

The Sea Mammal Research Unit has recorded a decreasing number of harbour seals on the Isle of Barra over the past sixteen years (Table 4.1). Grey seals have also shown a slight decrease in numbers (Table 4.2).

Table 4.1 Harbour Seals

Location		Aug 1992	Aug 1996	Aug 2000	Aug 2003	Aug 2006
South Uist	**South Uist & Barra**	1243	921	801	718	605

Table 4.2 Grey Seals

Location		Aug 1992	Aug 1996	Aug 2000	Aug 2003	Aug 2006
South Uist	**South Uist & Barra**	398	1301	1174	805	535

No information was available regarding exact location of seal colonies within the South Uist and Barra region or in relation to the shellfish bed; however it is considered that the risk of faecal contamination is relatively low.

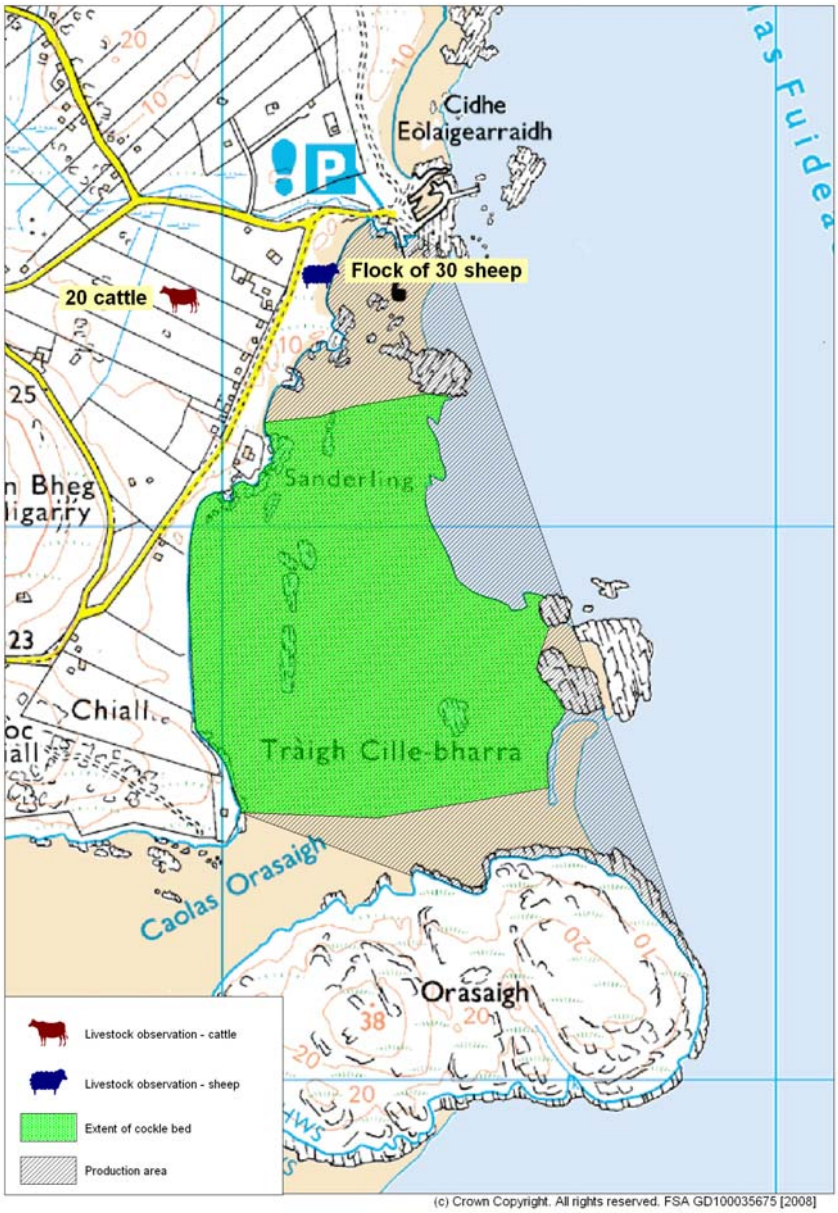

Figure 4.1. Livestock observations at Traigh Cille Bharra

5. Rainfall

The nearest weather station is located at Barra, Isle of Barra, approximately 1.7km southwest of the production area. Rainfall data was supplied for the period 01/01/03 to 31/12/2005 (total daily rainfall in mm). Insufficient rainfall data was available for 2006 and 2007 and has been excluded from analysis. It is likely that the rainfall experienced at Barra is very similar to that experienced at the production area due to their close proximity.

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 wastewater treatment plant overflows (e.g. Mallin et al, 2001; Lee & Morgan, 2003).

5.1 Rainfall at Barra

As the rainfall records from Barra are complete for the period 2003 - 2005, total annual rainfall and mean monthly rainfall can be calculated, and are presented in Figures 5.1 and 5.2.

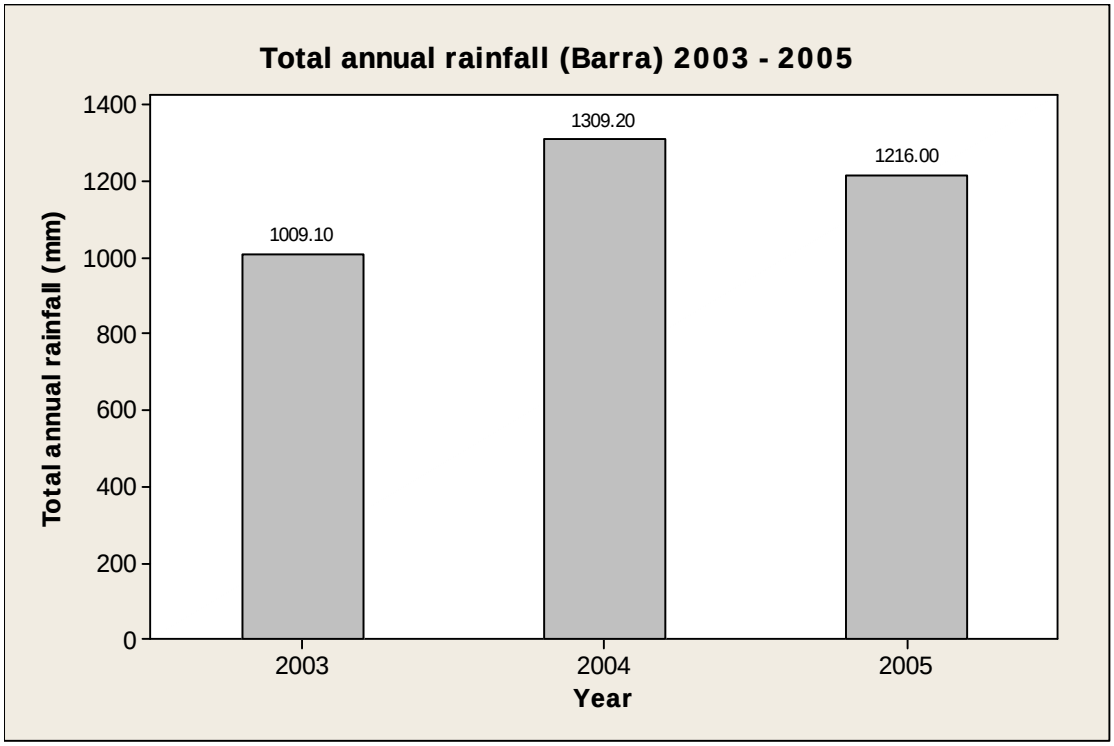

Figure 5.1 Total annual rainfall at Barra 2003 – 2005

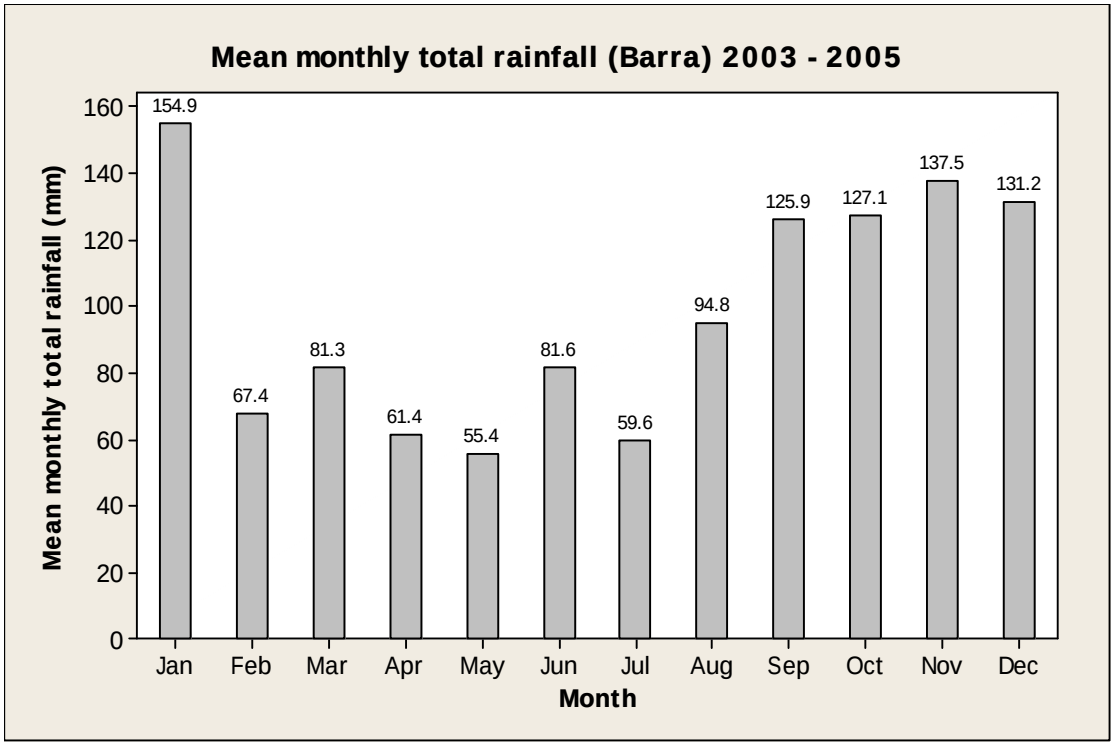

Figure 5.2 Mean total monthly rainfall at Barra 2003 – 2005

The wettest months were January and November while the driest month was May.

Based on the above data, months for which the mean rainfall represented an increase from the month before were considered further. The increase in mean rainfall is presented in Table 5.1 in both mm and expressed as a percentage increase over the prior month.

Table 5.1 Months showing increase in mean rainfall

Month	Increase over previous month (mm)	% Increase
Mar	13.9	21%
Jun	26.2	47%
Aug	35.2	59%
Sep	31.1	33%
Oct	1.2	1%
Nov	10.4	8%
Jan	23.7	18%

The largest month to month increases in mean rainfall occurred in June, August and September, with the largest change occurring in August, when a 59% increase over the mean July rainfall was recorded. It is the change in rainfall that is most significant to the occurrence of rainfall dependent runoff and flushing of bacteria from farm fields.

Based on historical rainfall data, the levels of rainfall dependant faecal contamination entering the production area from land runoff would be higher during the late summer. Faecal matter can build up on pastures during the

drier summer months when stock levels are at their highest, leading to more significant faecal contamination of runoff at the onset of wetter weather.

6. River Flow

There are no significant rivers or river gauging stations in the vicinity of Traigh Cille Bharra.

There is one stream discharging into Traigh Cille Bharra and its location is shown in Figure 6.1. This stream was sampled during the shoreline survey. This represented the only freshwater input into Traigh Cille Bharra. As mentioned in Section 3, it is thought that the Eoligarry septic tank would discharge into this fresh water source.

Table 6.1 Stream flow and loading – Traigh Cille Bharra

No	Grid Ref	Description	Width (m)	Depth (m)	Measured Flow (m/s)	Flow in m3/day	*E. coli* (cfu/ 100ml)	Loading (*E. coli* per m3)
1	NF 71272 07551	Stream	1.3	0.40	0.33	14826.24	100	$1.5 \times 10^{?}$

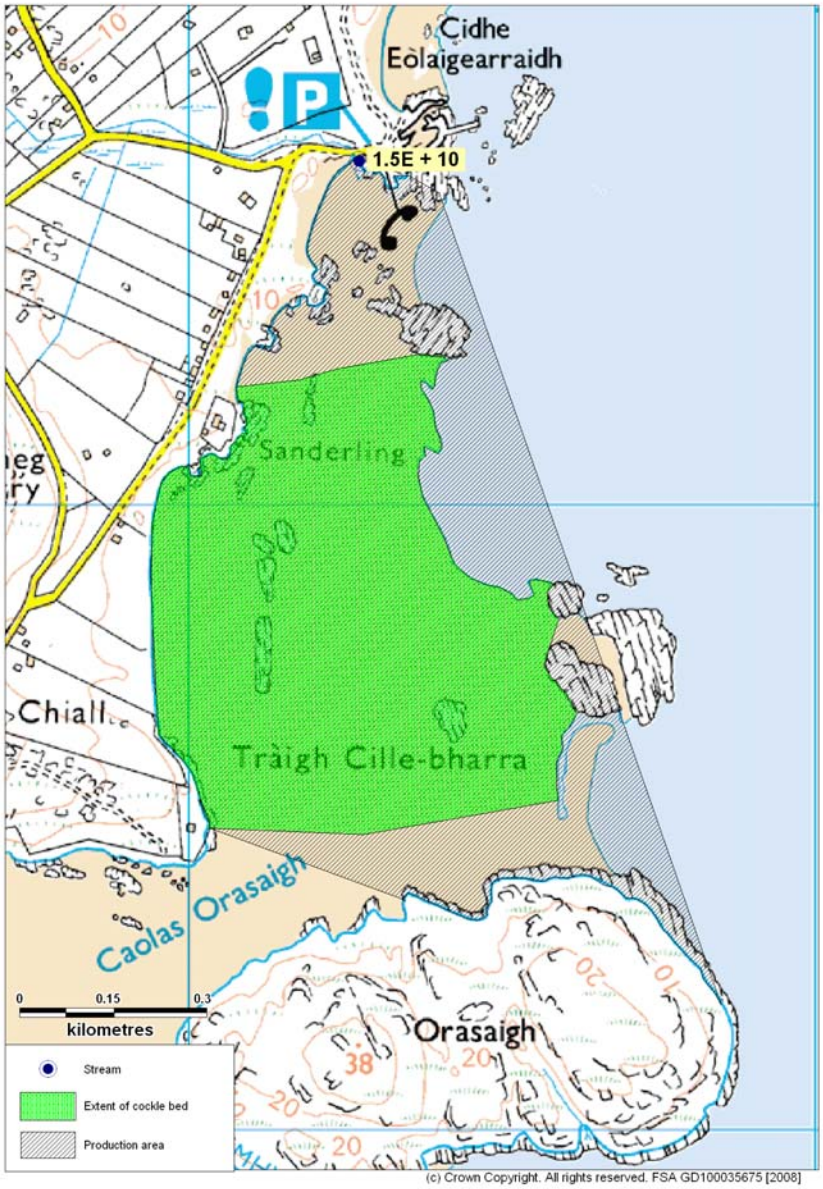

Figure 6.1 Location of the stream at Traigh Cille Bharra

7. Historical *E. coli* Monitoring Data

7.1 Validation

The *E. coli* results of all the shellfish samples taken from Traigh Cille Bharra from the middle of 2004 up to the end of 2007 were extracted from the database and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data.

The reported sampling location of one common cockle sample collected from Traigh Cille Bharra was NF705005, which falls 6.2 km outside the production area and as a consequence this sample was excluded from the analysis. Three razor clam samples from Traigh Cille Bharra were reported as being collected from NF 709067, which falls on land 50 m outside the production area. These 3 razor clam samples were included in the analysis as they were within 100m of the production area, the level of accuracy which can be expected when estimating a grid reference from an Ordnance Survey map.

For sample results that were reported as <20 a nominal value of 10 for purposes of statistical assessment and graphical presentation.

All *E. coli* results are reported in most probable number per 100g of shellfish flesh and intravalvular fluid.

7.2 Summary of sampling and results by species/monitoring point

A summary of the number of samples and the *E. coli* results is presented in Table 7.1.

Table 7.1 Summary of historical results from Traigh Cille Bharra

Sampling Summary									
Production area	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**	**Traigh Cille Bharra**
Site	Traigh Cille Bharra	Traigh Cille Bharra	Traigh Cille Bharra	Traigh Cille Bharra	Traigh Cille Bharra	Traigh Cille Bharra Cockles	Traigh Cille Bharra Cockles	Traigh Cille Bharra Cockles	Traigh Cille Bharra Cockles
Species	Razors	Razors	Razors	Razors	Razors	Common Cockles	Common Cockles	Common Cockles	Common Cockles
SIN	UB-281-164-16	UB-281-164-16	UB-281-164-16	UB-281-164-16	UB-281-164-16	UB-392-790-4	UB-392-790-4	UB-392-790-4	UB-392-790-4
Location	All (4)	NF709067	NF711069	NF714072	NF714075	All (3)	NF712070	NF713068	NF715067
Total no of samples	24	3	3	6	12	10	8	1	1
n 2004	18	3	3	6	6	0	0	0	0
n 2005	4	0	0	0	4	0	0	0	0
n 2006	2	0	0	0	2	0	0	0	0
n 2007	0	0	0	0	0	5	3	1	1
n 2008	0	0	0	0	0	5	5	0	0
Results Summary									
Minimum	10	10	10	10	10	10	10	130	90
Maximum	1300	10	10	160	1300	160	160	130	90
Median	15	10	10	30	20	55	40		
Geometric mean	24.2	10.0	10.0	31.0	33.3	46.4	37.5		
90 percentile	133				203				
95 percentile	211				706				
n exceeding 230/100g	1 (4%)				1 (8%)				
n exceeding 1000/100g	1 (4%)				1 (8%)				
n exceeding 4600/100g	0 (0%)				0 (0%)				
n exceeding 18000/100g	0 (0%)				0 (0%)				

7.3 Temporal pattern of results

Figure 7.1 presents a scatterplot of the individual results against date for all razor clam samples taken from Traigh Cille Bharra. There were insufficient results available to produce the same for the common cockle samples taken from Traigh Cille Bharra Cockles.

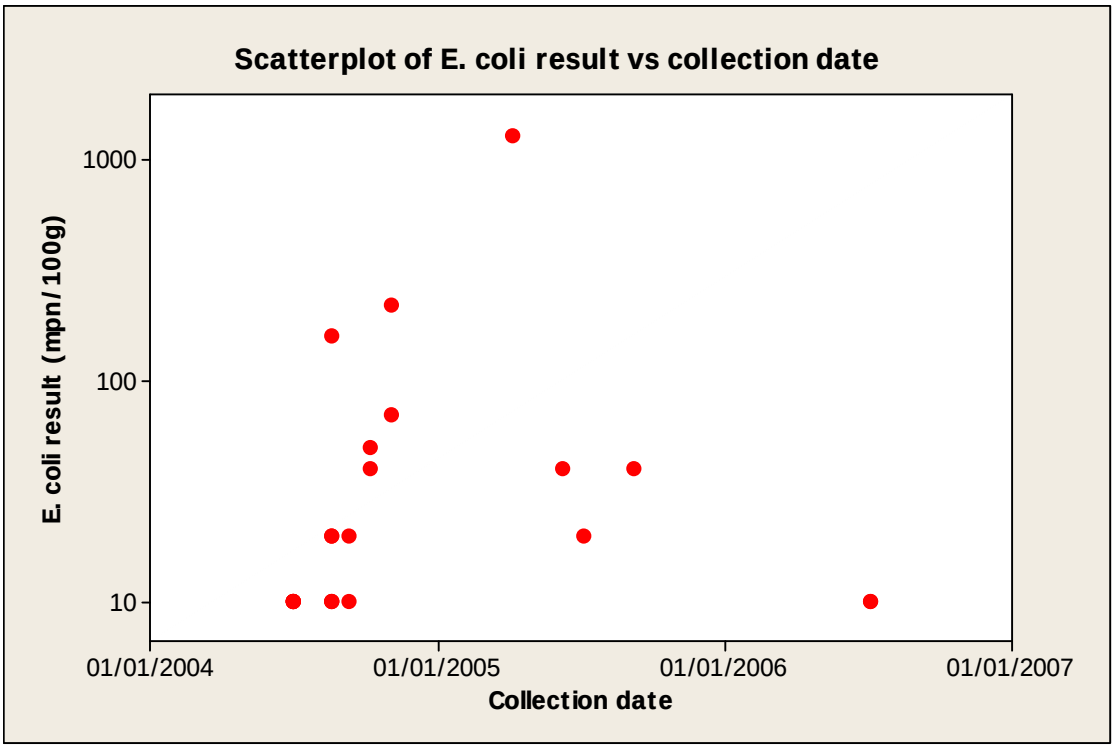

Figure 7.1 Scatterplot of *E. coli* result (mpn/100g) for razor clams vs collection date

No obvious overall trends are apparent in Figure 7.1.

There was insufficient data available to present geometric mean result by sampling location for both the razor clam and common cockle samples collected at Traigh Cille Bharra.

7.4 Geographical pattern of results

Figure 7.2 shows a map with the geometric mean results plotted at the sampling locations for both razor clams and common cockles at Traigh Cille Bharra.

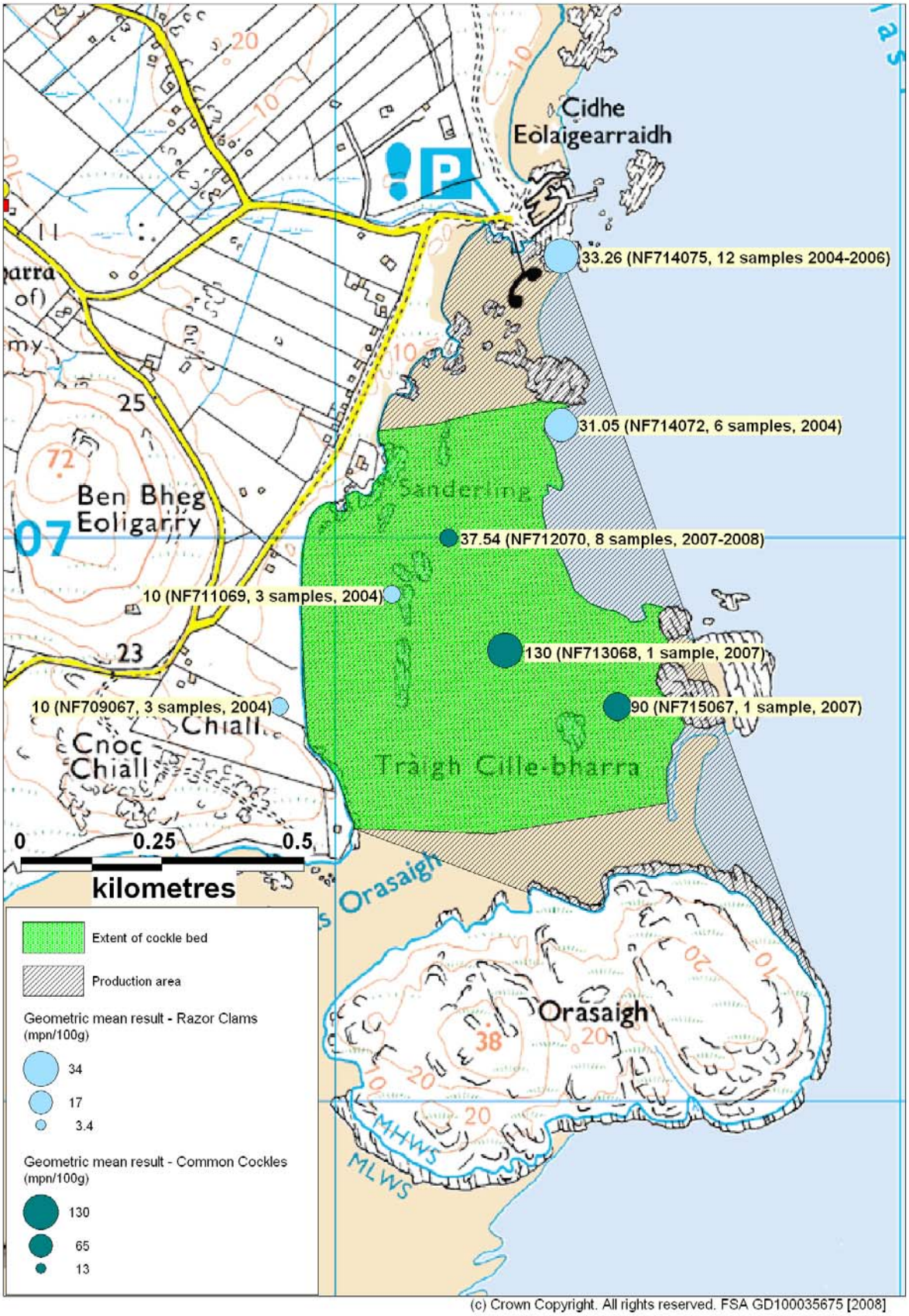

Figure 7.2 Geometric mean results by sampling location for razor clams and common cockles at Traigh Cille Bharra

For the razor clam samples, a comparison of log result by monitoring points was carried out using a one-way ANOVA test in Minitab (see Appendix 3.1). The results indicated that the log transformed *E. coli* results did not differ significantly between the monitoring point locations ($p = 0.273$, Appendix 3.1). There were insufficient results for this analysis to be undertaken on the common cockle samples.

8. Bathymetry and Hydrodynamics

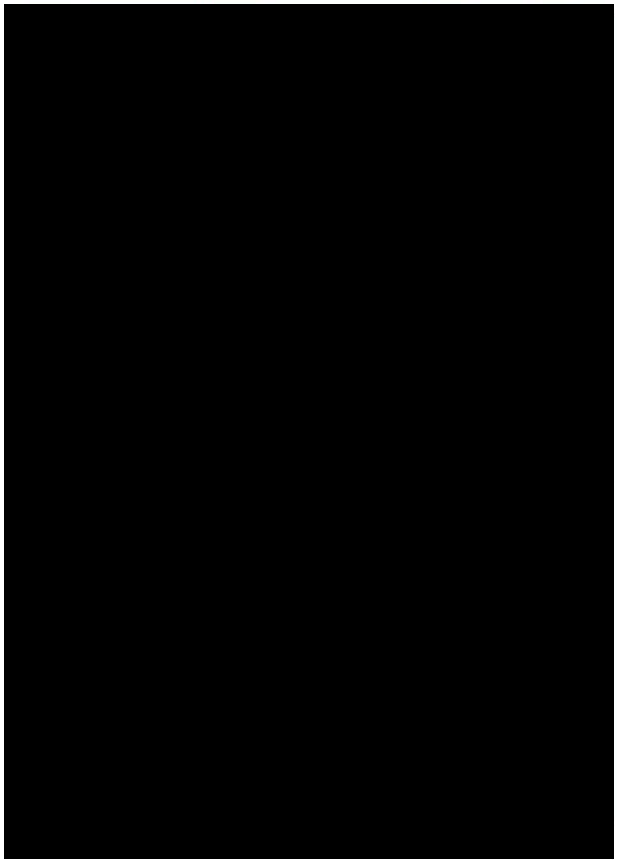

Figure 8.1 Traigh Cille Bharra bathymetry

Figure 8.2 Traigh Cille Bharra

The bathymetry chart above indicates that the majority of Traigh Cille Bharra is intertidal. Beyond the island of Orasaigh the depth gradually increases from 0 – 5 m.

8.1 Tidal curve and description

The two tidal curves below are for the port of Barra (North Bay), the nearest secondary port– they have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 14th April 2008. The second is for seven days beginning 00.00 GMT on 22nd April 2008. Together they show the predicted tidal heights over high/low water for a full neap/spring tidal cycle.

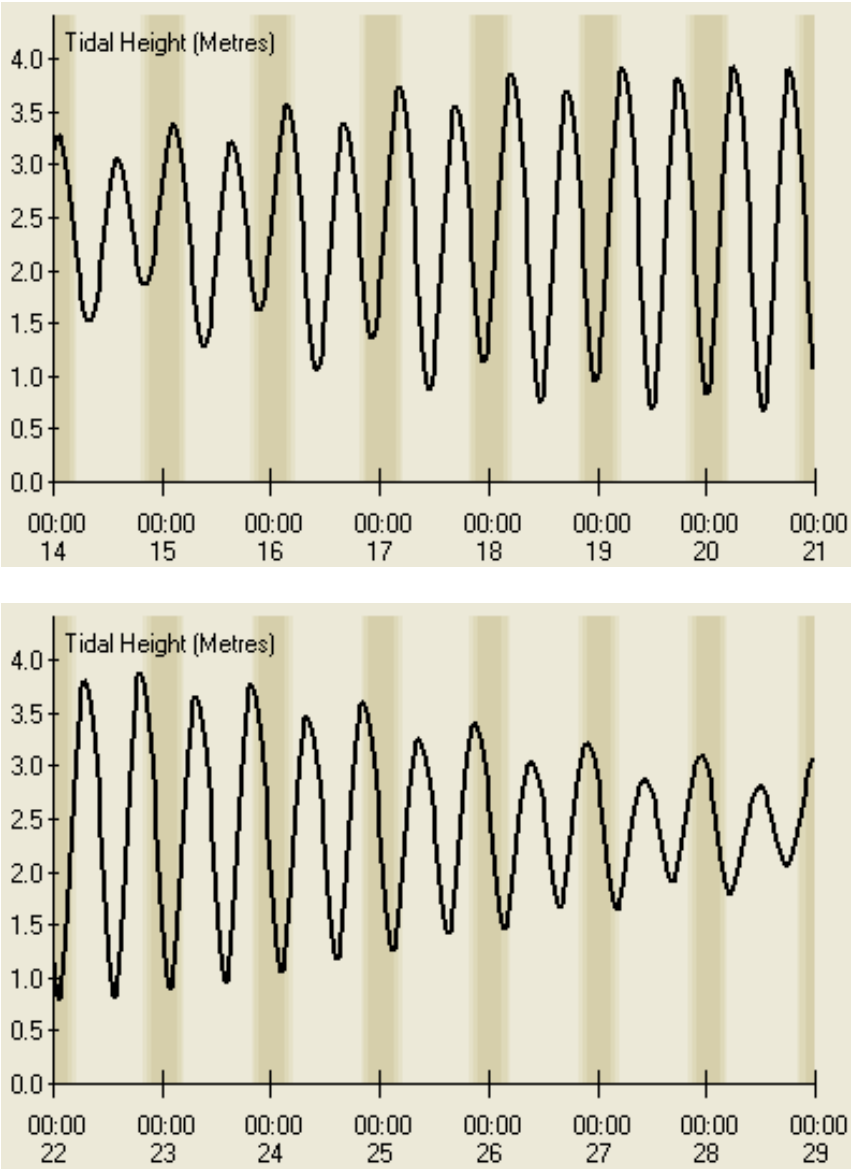

Figure 8.3 Tidal curves for Barra (North Bay)

The following is the UKHO summary description for Barra (North Bay):
Barra (North Bay) is a Secondary Non-Harmonic port. The tide type is Semi-Diurnal.

MHWS	4.2 m
MHWN	3.2 m
MLWN	1.8 m
MLWS	0.6 m

Predicted heights are in metres above chart datum. The tidal range at spring tide is therefore approximately 3.6 m and at neap tide 1.4 m.

8.2 Currents

Currents in coastal waters are driven by a combination of tide, wind and freshwater inputs. This section aims to make a simple assessment of water movements around the area.

No tidal stream information was available for the area. Tidal diamonds further afield (in the middle of the Minch, and to the South of Barra) did not provide sufficient information for a judgement to be made on either speed or direction of flows around the site at various states of the tide. As the tidal range is relatively large, and the water is shallow with large drying areas, tidal exchange is likely to be very important here. Tidal flows will be bidirectional, and generally will carry contamination from point sources parallel to the shore, thereby creating a region of influence around each source.

A southward moving flow past the public toilet outfall and the stream just next to it into which the Eolaigearraidh septic tank discharges are likely to carry contamination from these sources in the direction of Traigh Cille Bharra. Flow from this direction, however, would be complicated by the intertidal area and islands.

Strong winds will create a surface current that moves in the same general direction as the wind. The site is most exposed to the north and east and winds from these directions are likely to drive tidal heights higher and create wave action that is likely to reach further up the shoreline on a high tide and resuspend sediment that may contain contaminants. Winds from the west would generally drive water away from the shoreline resulting in lower tide heights and reducing the area over which any potential contamination may flow.

Wind driven currents can sometimes create currents moving in different directions to the wind at the bed but without hydrodynamic modelling it is difficult to predict the path of any such flow around the islands.

Density (freshwater) driven flows are likely to be of little importance as the area is unenclosed, shallow, and has little in the way of freshwater inputs.

Conclusions regarding effect on impacting sources

The impacting sources located north of the fishery are most likely to affect the area at times of high tides when the wind is blowing from the north or northeast. Without detailed information of tidal currents it is difficult to assess the impact of tidal movement of contaminants. In particular, whether sources to the north are likely to impact the production area under normal tidal conditions.

9. Shoreline Survey Overview

A map is provided in Figure 9.1 that shows the relative locations of the most significant findings of the shoreline survey. Where the bacterial concentration is labelled, 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 1×10^3, in this case it would be written as 1E+3.

In summary, identified sources of potentially significant contamination are:

- Light contaminated freshwater input.
- Inputs from livestock grazing on the shoreline.
- The septic tank at the northern end of the shoreline discharging onto the beach.

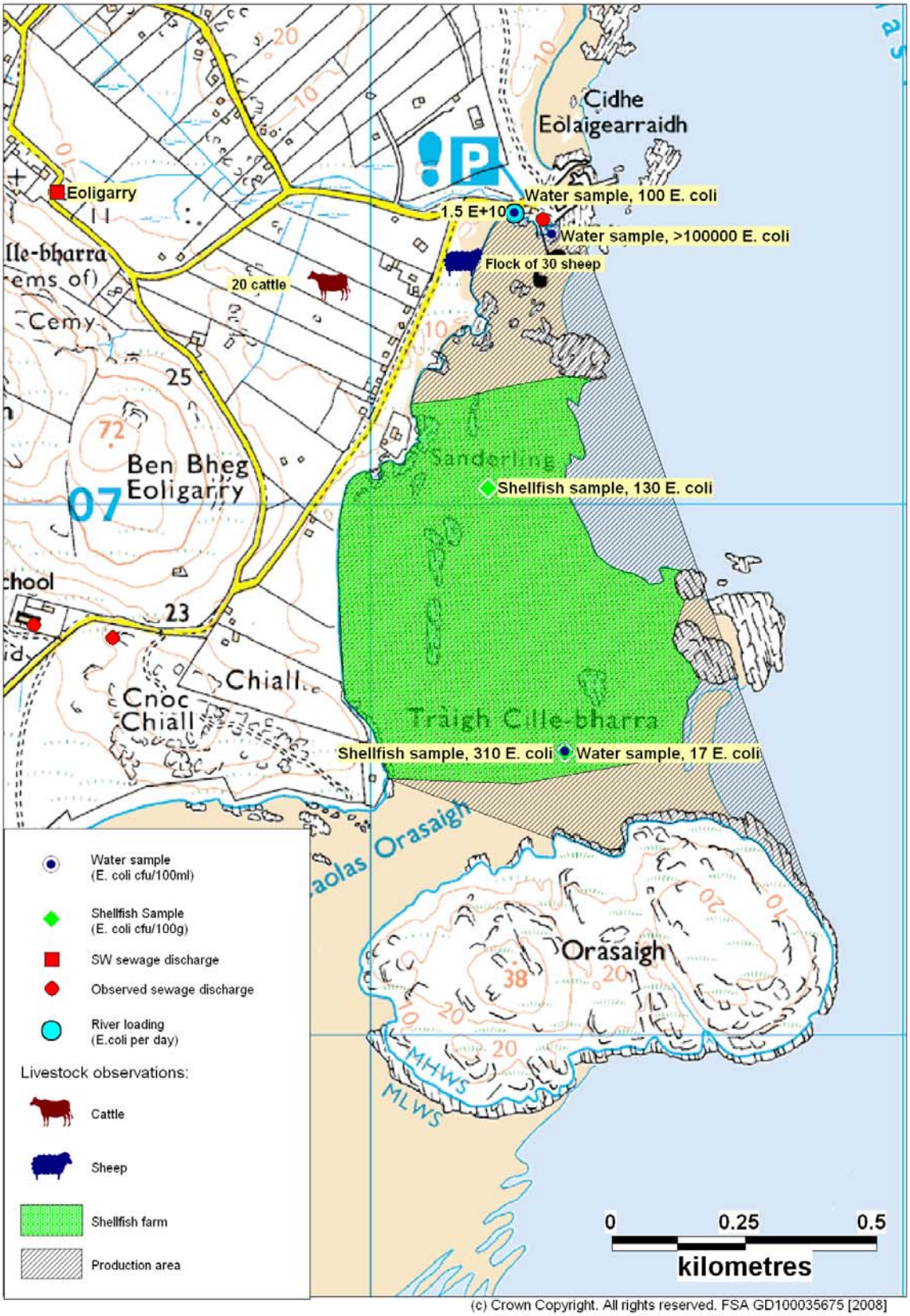

Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Human sewage inputs

With a neighbouring human population at the 2001 census of 147 and with Traigh Cille Bharra covering a small area, the overall loading of sewage to Traigh Cille Bharra is low. The area is not connected to any mains sewerage. A septic tank was identified by Scottish Water near Eoligarry; however the location could not be confirmed. A septic tank was found approximately 0.28 km north from the cockle bed. A water sample was taken from the overflow of the septic tank outfall and had a very high level of E. *coli* (>100000 cfu/100ml).

Agricultural inputs

There is no arable agriculture in the vicinity of Traigh Cille Bharra. Livestock density was relatively low overall. During the survey approximately 20 cattle were visible in the crofts up the hill away from the shoreline and a flock of approximately 30 sheep were seen walking along the shoreline. This could be considered as a significant source of contamination to the fishery, depending upon how much of the year sheep were accessible to the shoreline. However, the location and timing of the said inputs would be unpredictable.

Wildlife inputs

Wildlife such as seals, cetaceans, water birds and otter are likely to be resident in or visit the area, but not in large numbers. Overall, the wildlife impacts to the fishery at Traigh Cille Bharra are likely to be localized, minor and unpredictable and will therefore not be explicitly taken into account in determining the sampling plan, although impacts from wildlife may sometimes contribute to the bacterial contamination of shellfish.

Seasonal variation

There were insufficient results in the historical monitoring dataset to establish any patterns in seasonal variation. Livestock numbers in the area as a whole are likely to be at their highest during the summer months when lambs and calves are present. During the warmer months livestock may access the stream to drink and cool off more frequently, leading to higher levels of faecal contamination in the water. There is likely to be a slight increase in population during the summer months, but the population will remain at a relatively low density nevertheless. Boat traffic appeared to be minimal with only the occasional yachts passing. There is a pier however this is not used since the ferry service was cancelled. The fishery itself is seasonal (harvested only during autumn and spring) so is likely to be affected by higher runoff in autumn.

Rivers and streams

Approximately 0.3 km north of the cockle bed a single fresh water stream discharges onto the beach. A water sample taken indicated a relatively low

level of *E*. *coli* (100 *E. coli* cfu/100ml). It is therefore likely that this freshwater input to Traigh Cille Bharra would have a relatively low effect on the bacterial contamination of shellfish.

Rainfall

Rainfall patterns at Barra (the nearest rainfall station) show rainfall is highest from September to January. An increase in rainfall in September after the drier summer months may be expected to wash a flush of bacteria from the surrounding land into the production area.

Analysis of results

Historic shellfish hygiene monitoring results for razor clams are available from 2004 to 2006, with samples collected from four reported locations, two on the north eastern shore and two on the western shoreline. Results from the north eastern shoreline showed a higher average of results than those on the southern shoreline.

Historic shellfish hygiene monitoring results for common cockles are available from 2007 to present, with samples collected from three reported locations, within the central strip of the production area. There is a difference between the averages of results (geometric mean) obtained from these three locations (at two of the locations only one sample was taken). The sample point to the north end of the cockle bed has lower results than the samples taken from the southern end of the bed.

Seawater samples taken from three points along the shore, ranged from 6 to 17 *E. coli* cfu/100ml. All of these results have relatively low levels of *E. coli,* which would usually be associated with Class B waters.

Shellfish samples were taken from two points of the cockle bed during the shoreline survey. The sample taken from the northern end of the cockle bed indicated a relatively low level of *E*. *coli* (130 *E*. *coli* cfu/100g) whilst the sample taken from the southern end of the bed indicated a slightly higher level of *E. coli* (310 *E. coli* cfu/100g).

As noted in the previous section the level of contamination and calculated bacterial loading for the stream entering Traigh Cille Bharra is fairly low.

Summary

Factors of relevance to the sampling plan are as follows:

- Location of both the septic tank discharge and the stream discharge at the northern end of the beach
- Seasonality of harvest (spring and autumn only)
- Historical monitoring results suggest contamination is broadly evenly spread across the fishery

11. Recommendations

It is recommended that the boundaries of the new Traigh Cille Bharra Cockles production area be set as the area bounded by lines drawn between NF 7122 0734 and NF 7145 0727 and between NF 7145 0727 and NF 7169 0679 and between NF 7169 0679 and NF 7185 0620 and between NF 7134 0637 and NF 7103 0648 and extending to MHWS. The boundaries of the recommended production area exclude the far north end of the beach and the current production area where the septic tank and stream discharge. The excluded area is thought to be likely to be more contaminated than the remainder of the production area due to the discharges.

It is recommended that the RMP be established at NF 7130 0680, which lies near the centre of the fishery. Recommended tolerance for sampling is 50 metres.

Sampling frequency should be monthly as there is inadequate monitoring history on which to base less frequent sampling.

Figure 11.1 illustrates the recommended RMP and new production area boundaries for Traigh Cille Bharra.

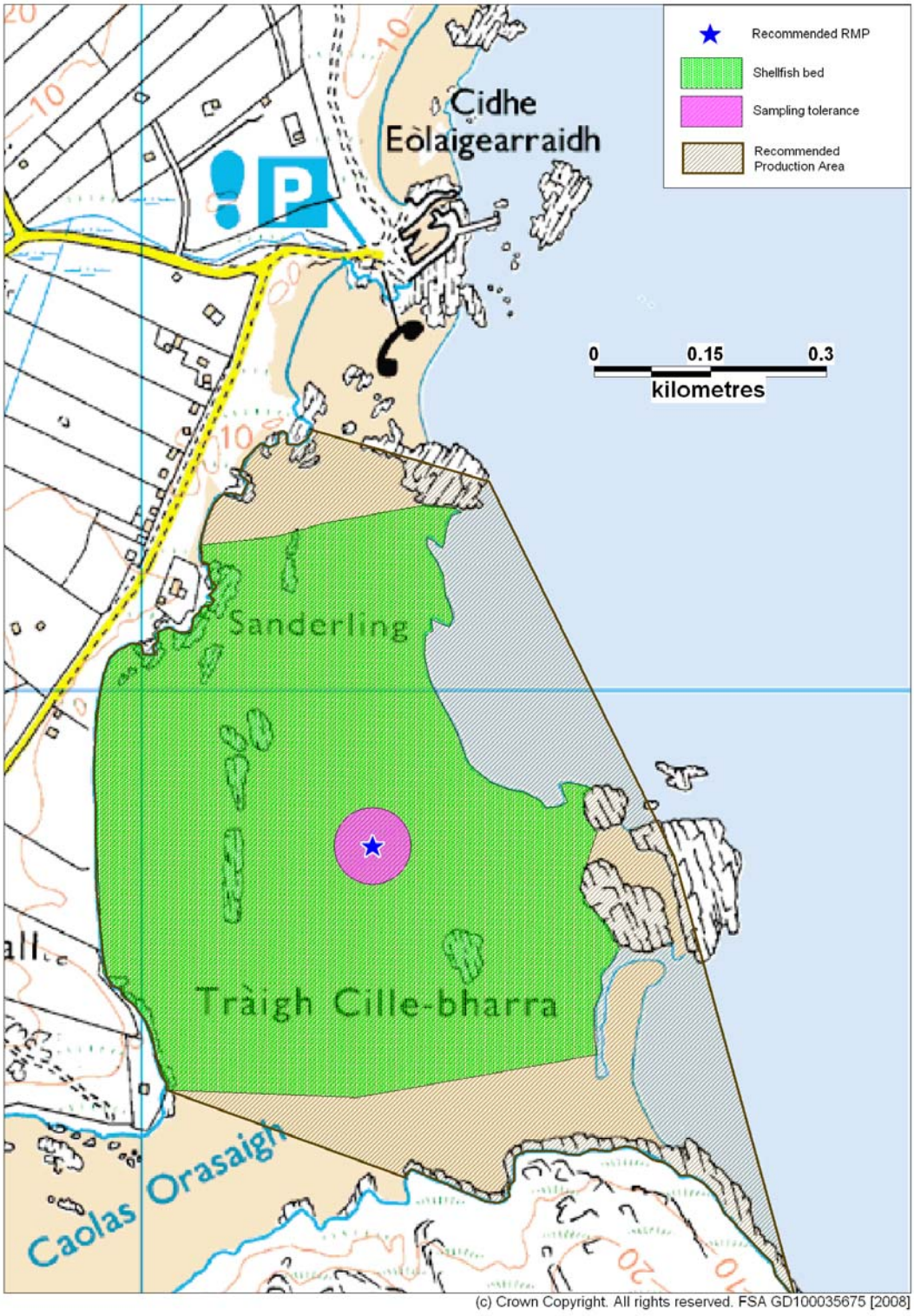

Figure 11.1 Recommendations for Traigh Cille Bharra

12. References

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Sea Mammal Research Unit (2000) *Surveys of harbour seals on the west and east coasts of Scotland. Report no, F00PA41.* St Andrews University

Lisle, J.T., Smith, J.J., Edwards, D.D., and McFeters, G.A. (2004). Occurrence of microbial indicators and clostridium perfringens in wastewater, water column samples, sediments, drinking water, and Weddell Seal feces collected at McMurdo Station, Antarctica. *Applied Environmental Microbiology*, 70:7269-7276.

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13. List of Figures and Tables

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Figures

Appendices

1. **Summary Sampling Plan**
2. **Shoreline Survey Report**
3. **Statistical Data**

Sampling Plan for Traigh Cille Bharra

PRODUC-TION AREA	SITE NAME	SIN	SPECIES	TYPE OF FISH-ERY	NGR OF RMP	EAST	NORTH	TOLER-ANCE (M)	DEPTH (M)	METHOD OF SAMPLING	FREQ OF SAMPLING	LOCAL AUTHORITY	AUTHORISED SAMPLER(S)	LOCAL AUTHORITY LIAISON OFFICER
Traigh Cille Bharra	Traigh Cille Bharra Cockles	UB 392	Common Cockles	Wild harvest	NF 7130 0680	71300	806800	50	NA	Hand	Monthly	CNES	Samantha Muir	Samantha Muir

Shoreline Survey Report

Traigh Cille Bharra
UB 392

Restricted Scottish Sanitary Survey Project

Scottish Sanitary Survey Project

Shoreline Survey Report

Production area:	Traigh Cille Bharra
Site name:	Traigh Cille Bharra Cockles
Species:	Common cockles
Harvester:	Calum Manford
Local Authority:	Uist & Barra
Status:	New site
Date Surveyed:	16th July 2008 and 22nd July 2008
Surveyed by:	Samantha Muir
Existing RMP:	Not yet established
Area Surveyed:	See Figure 1

Weather observations

On the day of the survey it was very windy (25-30mph, force 6-7 NW'ly) with black clouds, however there was no rain. There had been some light rain for a few days before the survey.

Site Observations

Fishery

This site is a wild shellfishery. High water and extreme low water marked the easterly and westerly boundaries of the bed. A line drawn between NF 71175 07201 and NF 71237 07219 marks the approximate northern boundary and a line drawn between NF 71279 06474 and NF 71465 06507 marks the southern boundary. Stock of sufficient size and quantity was present for sampling. The extent of the cockle bed was identified by a local resident with sufficient knowledge of the area.

Sewage/Faecal Sources

The Eoligarry public toilets septic tank is located at NF 72062 16797. The outfall of this septic tank discharges into the bay at NF 96843 05559. There were several drains visible within the school grounds (see Figures 6 -8) and it is believed that it has its own septic tank which discharges into Machair leading down to Traigh Mhor beach, however at the time of the survey no one was available to confirm this. There is a new council house development across the road from the school (see Figure 9) that has a shared septic tank system and is still under construction. There were approximately 12 houses immediately adjacent to the beach and a further 20 on the crofts further up the hill. All the croft houses are thought to be served by their own septic tanks, however no outfalls were observed going directly onto the beach.

Seasonal Population

There are no official campsites in the area however on the day of the survey there was a caravan and tent located beside the outfall pipe of the Eoligarry septic tank. Some camper vans do stay in the car park located at the north

end of Traigh Cille Bharra and some visitors camp on the grass on the west side of the beach however only about 2 or 3 at a time and not every day.

Boats/Shipping

At the time of the survey there were no boats visiting the area. The pier is rarely used since the ferry service was cancelled.

Land Use

Crofts were present indicating areas of improved pasture and rough grassland.

Wildlife/Birds

No wildlife was observed during the shoreline survey; however geese do visit the area seasonally.

Observations can be found in Table 1 and Figure 1.

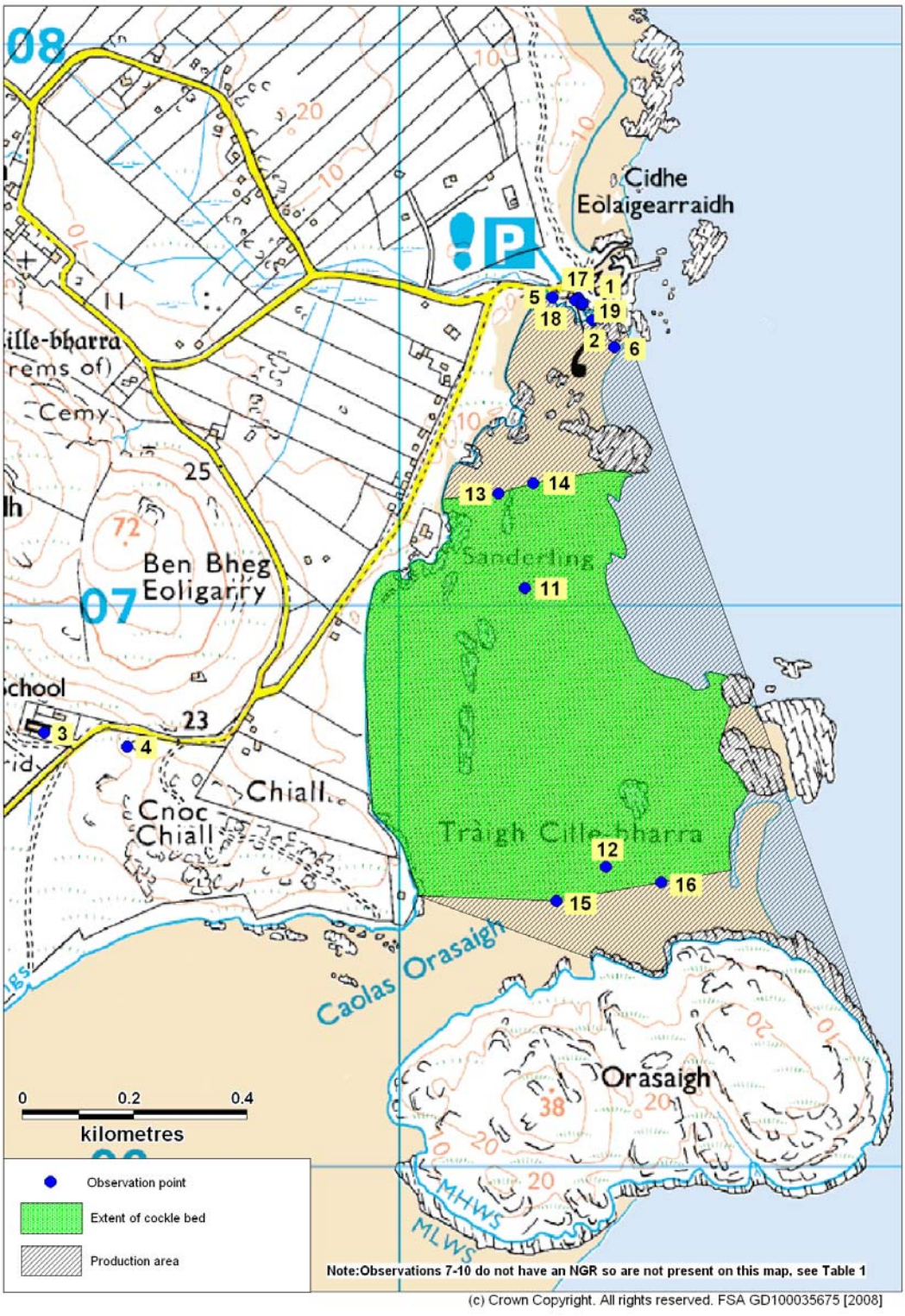

Figure 1. Shoreline Observations at Traigh Cille Bharra

Table 1. Shoreline Observations

No.	Date	NGR	East	North	Associated photograph	Description
1	16/07/2008	NF 7132407538	71324	807538		Eoligarry Public toilets septic tank
2	16/07/2008	NF 7134307510	71343	807510	Figures 4 & 5	End of Eoligarry septic tank outfall, water sample 1 (salinity 1ppt)
3	16/07/2008	NF 7036606774	70366	806774	Figures 6 – 8	Several drains at the front of the school. The school is thought to have its own septic tank, which discharges onto the Machair leading down to the Traigh Mhor beach. At the time of the survey no one was available to confirm this.
4	16/07/2008	NF 7051406749	70514	806749	Figure 9	New council house development, across the road from the school. Houses have a shared septic tank system, which is still under construction.
5	16/07/2008	NF 7127207551	71272	807551	Figure 10	Fresh water stream, water sample 2 (salinity 1ppt). 1.3m width x 0.40m depth x 0.33m/s flow.
6	16/07/2008	NF 7138207462	71382	807462	Figure 11	Seawater sample 3 (salinity 35ppt), taken at point that stream discharges into the sea.
7	16/07/2008				Figures 12 & 13	Approximately 12 houses along the seafront of the shellfish bed each within a delineated croft area. There are further houses (approximately 20) further up on the hill away from the shore.
8	16/07/2008					Approximately 20 cattle were visible in the crofts up the hill away from the shore and a flock of approximately 30 sheep walked across the beach approximately 100m south of the stream at the northern end to Orasaigh and the southern end.
9	16/07/2008					Land adjacent to the beach is croft land, all small scale/household planting of potatoes and other vegetables. Some crofts have cattle.
10	16/07/2008					All croft houses have their own septic tanks, no outfalls were observed going directly onto the beach
11	16/07/2008	NF 7122207033	71222	807033		Seawater sample 4 (salinity 36ppt) taken at Sanderlings. Shellfish sample 1.
12	16/07/2008	NF 7136706535	71367	806535	Figure 14	Seawater sample 5 (salinity 36ppt). Shellfish sample 2 taken at southerly boundary of the bed near Orasaigh.
13	16/07/2008	NF 7117507201	71175	807201	Figure 15	High water and extreme low water would mark the easterly and westerly boundaries of the bed. Northern boundary of bed.

No.	Date	NGR	East	North	Associated photograph	Description
14	16/07/2008	NF 7123707219	71237	807219		Other northern boundary of bed.
15	16/07/2008	NF 7127906474	71279	806474		Southern boundary of bed.
16	16/07/2008	NF 7146506507	71465	806507		Other southern boundary of bed.
17	22/07/2008	NF 7131707550	71317	807550	Figure 16	Location of Eoligarry public toilets.
18	22/07/2008	NF 7131207546	71312	807546	Figure 17	Disposal drain behind toilets.
19	22/07/2008	NF 7132507540	71325	807540	Figure 18	Inspection cover of septic tank.

Photographs referenced in the table can be found attached as Figures 4 – 18.

Sampling

Water and shellfish samples were collected at sites marked on Figures 2 and 3. Bacteriology results follow in Tables 2 and 3.

Two cockle samples were taken during the shoreline survey. The first was taken at Sanderlings and the second was taken at the southern end of the shoreline (see Figure 3). In total, five water samples were taken. The first was a fresh water sample taken from the overflow of the Eoligarry septic tank. The second was taken from the largest fresh water input to the beach. The third sample was a sea water sample taken from the point at which the stream discharges into the sea. The fourth and fifth were both seawater samples taken at Sanderlings and the southern end of the shoreline.

Seawater samples were tested for salinity using a hand held refractometer. These readings are recorded in Table 1 as salinity in parts per thousand (ppt).

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

Table 2. Water Sample Results

No.	Date	Type	Grid Ref	E. coli (cfu/100 ml)	Salinity (g/L)
1	16/07/08	Fresh water	NF 7134307510	>100000	-
2	16/07/08	Fresh water	NF 7127207551	100	-
3	16/07/08	Sea water	NF 7138207462	7	35.3
4	16/07/08	Sea water	NF 7122207033	6	37.3
5	16/07/08	Sea water	NF 7136706535	17	36.2

Table 3. Shellfish Sample Results

No.	Date	Sample	Grid Ref	E. coli (cfu/100g)
1	16/07/08	Common Cockles	NF 7122207033	130
2	16/07/08	Common Cockles	NF 7136706535	310

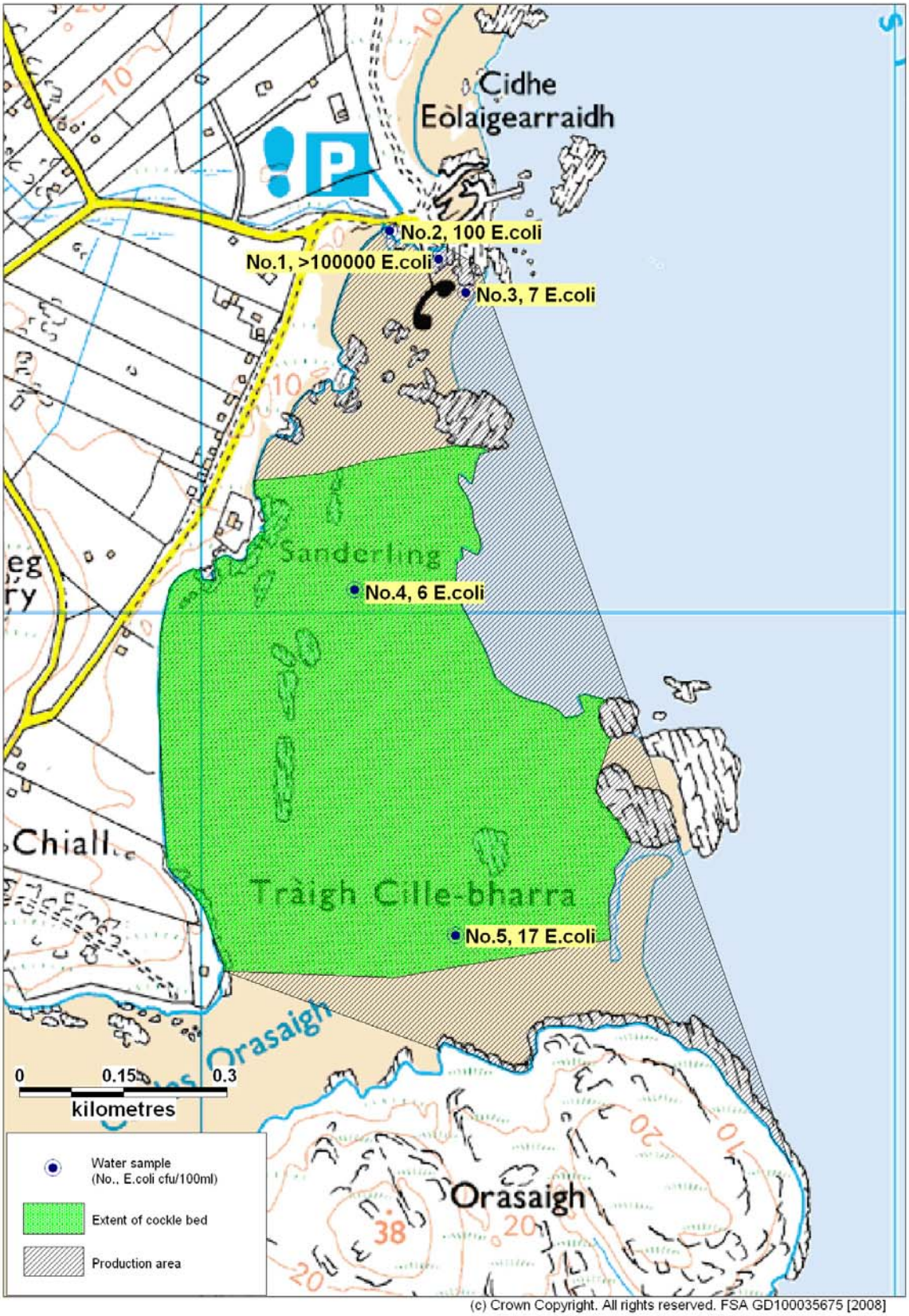

Figure 2. Water sample results map

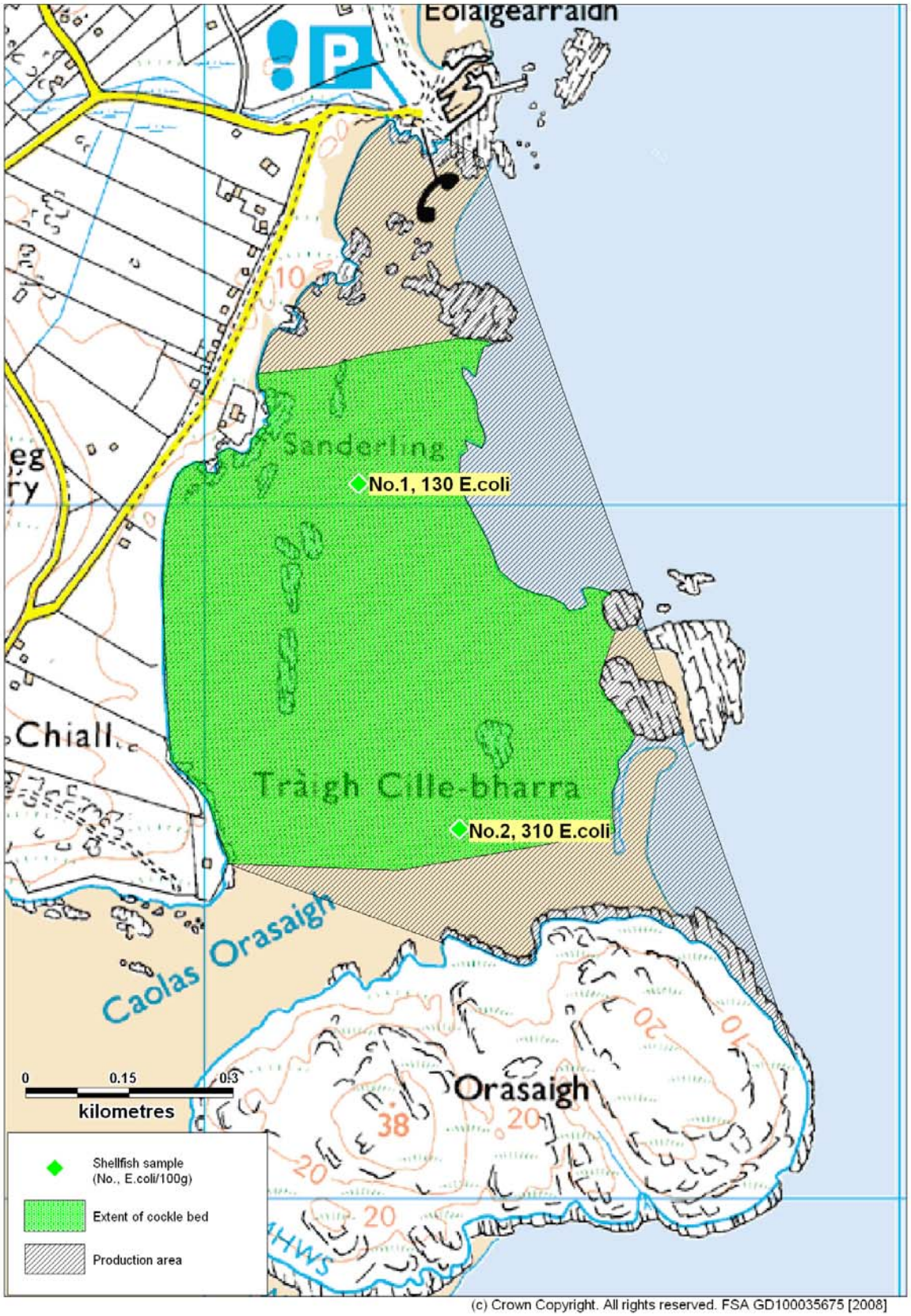

Figure 3. Shellfish sample results map

Photographs

Figure 4. Eoligarry public toilet outfall

Figure 5. Eoligarry public toilet outfall discharge point

Figure 6. School drains 1 – 3

Figure 7. School drain

Figure 8. Drain opposite school

Figure 9. New council house development at Eoligarry

Figure 10. Stream point of entry onto the beach

Figure 11. Stream discharge point

Figure 12. Houses at the southern end of the beach

Figure 13. Houses at the northern end of the beach

Figure 14. Extent of cockle bed view to Orasaigh

Figure 15. Extent of cockle bed

Figure 16. Eoligarry public toilets

Figure 17. Disposal drain behind toilets

Figure 18. Inspection cover of septic tank and outfall pipe

Statistical Data

3.1 ANOVA output from Minitab for comparison of log results by monitoring point

One-way ANOVA: LogRes versus GridRef

```
Source   DF     SS     MS     F      P
GridRef   3  1.183  0.394  1.40  0.273
Error    20  5.652  0.283
Total    23  6.835

S = 0.5316   R-Sq = 17.31%   R-Sq(adj) = 4.90%


                             Individual 95% CIs For Mean Based on Pooled
StDev
Level      N    Mean   StDev   -+---------+---------+---------+--------
NF709067   3  1.0000  0.0000   (---------------*---------------)
NF711069   3  1.0000  0.0000   (---------------*---------------)
NF714072   6  1.4921  0.4826                  (----------*----------)
NF714075  12  1.5219  0.6387                     (-------*-------)
                              -+---------+---------+---------+--------
                             0.40      0.80      1.20      1.60

Pooled StDev = 0.5316
```