Scottish Sanitary Survey Project

Restricted Sanitary Survey Report

Sound of Gigha
AB 510
February 2010

Report Distribution – Sound of Gigha

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1. Area Overview

The Sound of Gigha is a body of water between the Isle of Gigha and the Kintyre peninsula of the southwest coastline of Scotland (see Figure 1.1). The narrowest point of the sound is 2.6 km and the widest point of the sound is 7.7 km. The depth of the sound varies from 2 m close to the shoreline, up to 50 m towards the centre of the channel. A restricted sanitary survey at the Sound of Gigha was conducted in response to receipt of an application to classify the area for commercial harvest of razor clams (*Ensis* spp.).

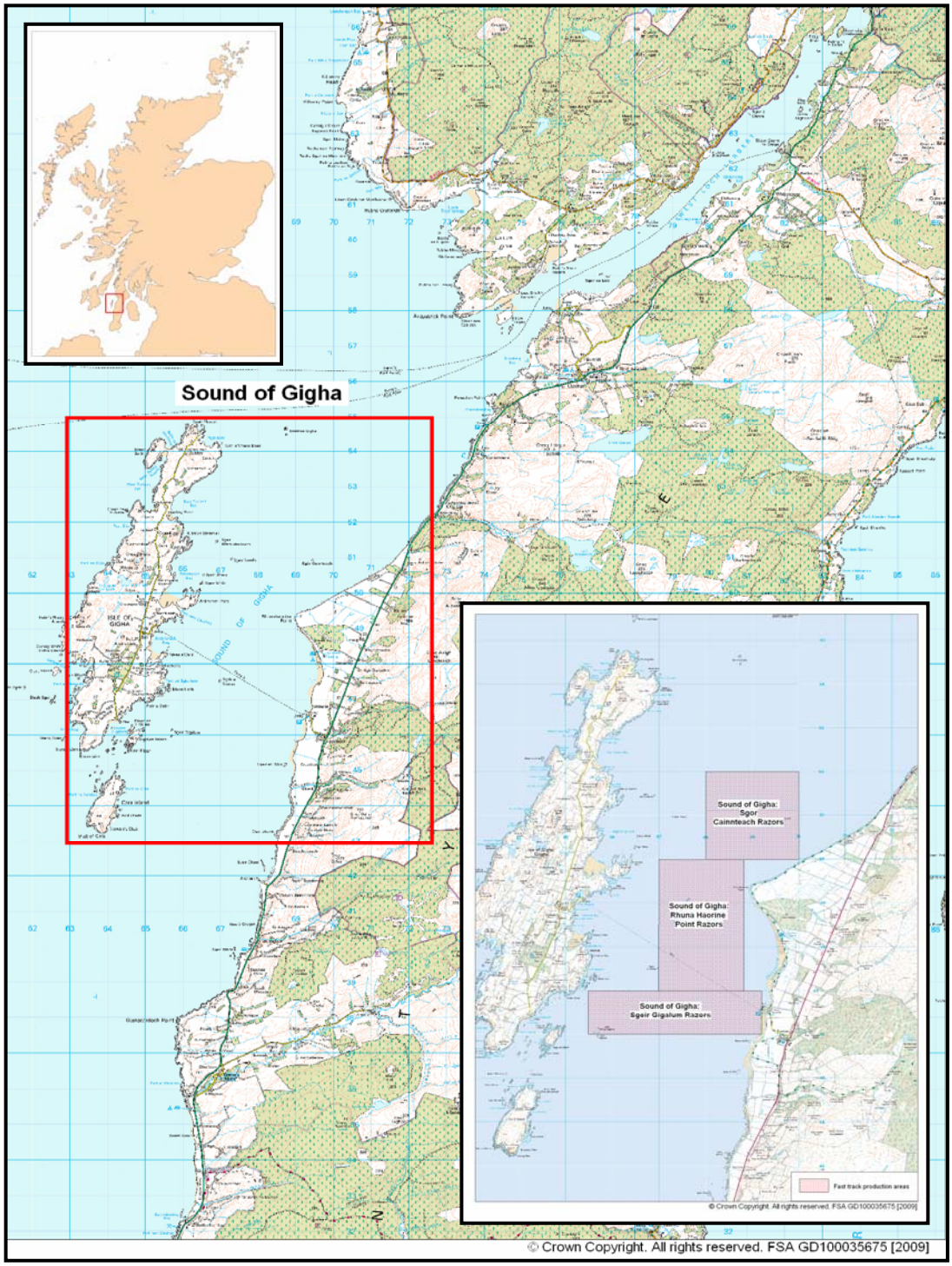


Figure 1.1 Location of the Sound of Gigha

1.1 Land Use

Land Cover 2000 data indicates that the land use on the Isle of Gigha is mainly neutral grassland, open heath and dwarf shrub heath with an area of improved grassland at the northern end of the island. The land use on the Kintyre peninsula is predominantly improved grassland along the coastline with patches of neutral grassland, open heath, dwarf shrub heath and coniferous woodland further inland.

Faecal coliform contributions from improved grassland have been shown to be approximately 8.3 x 10^8 cfu km^{-2} hr^{-1} (Kay et al, 2008). The contributions to the contamination if shellfish from all land cover types would be expected to increase significantly after marked rainfall events. This increase would be highest, at more than 100-fold, for improved grassland. Areas of improved grassland on the eastern side of the Sound of Gigha would be expected to contribute the most to contamination levels carried in surface runoff to this side of the razor clam bed.

1.2 Human Population

Figure 1.2 shows the census output areas that are directly adjacent to the Sound of Gigha, from the 2001 census data obtained from the General Records Office. The Isle of Gigha is one single census output area with a population of 110 people. There are no main large settlements on the island, just scattered dwellings and farms. On the adjacent Kintyre peninsula there are two census output areas in the Sound of Gigha catchment area. The larger census output area has a population of 132 people and consists of mainly scattered dwellings and the second census output area covers the settlement of Tayinloan and has a population of 77 people. There is a daily ferry service from Tayinloan over to the Isle of Gigha which crosses the lower two Sound of Gigha sites.

The Isle of Gigha is visited by tourists daily and there is likely to be an increase in human presence during the summer months. There is also a campsite (see Figure 1.2) and some public toilets in the area.

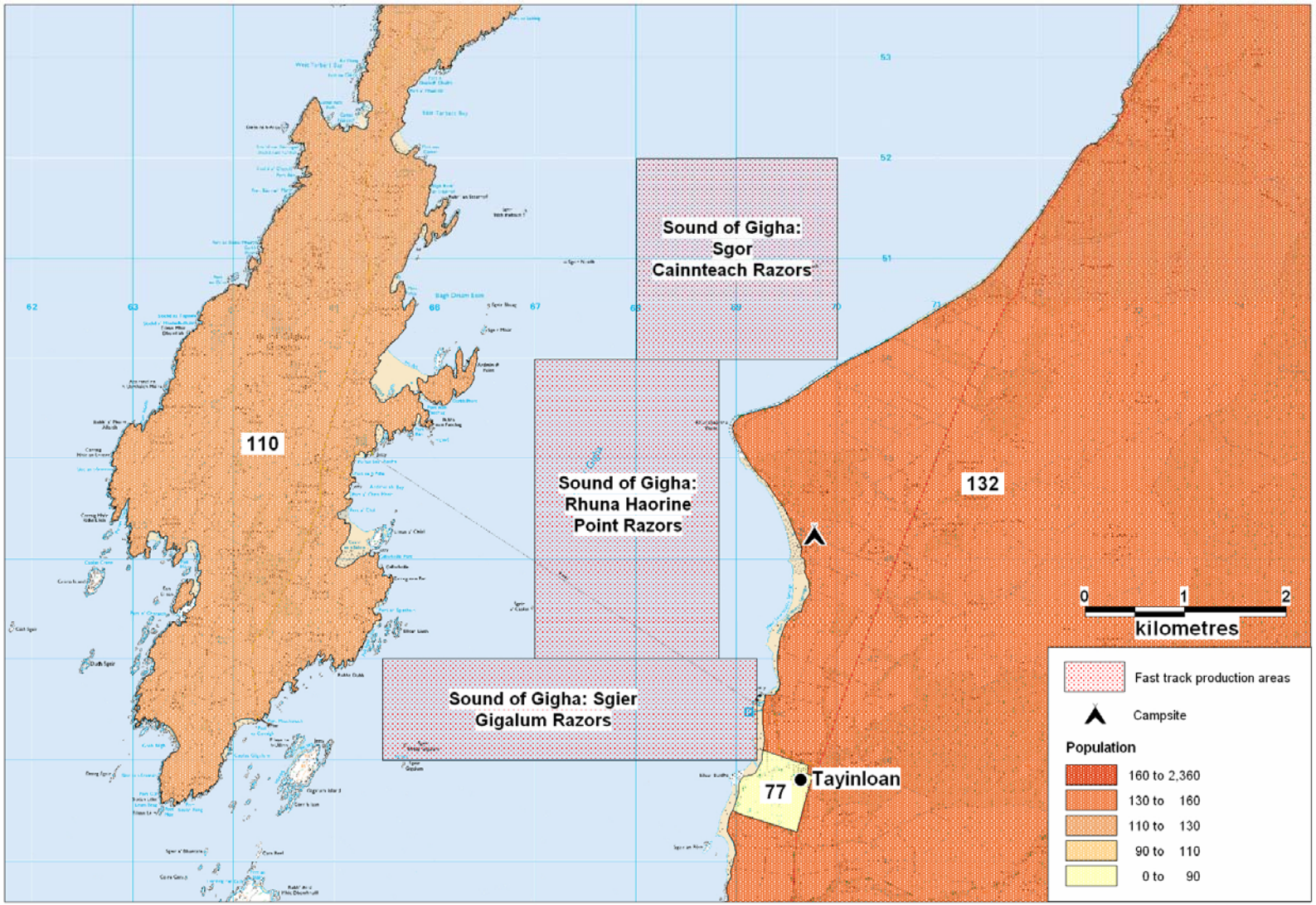


Figure 1.2 Human population surrounding the Sound of Gigha

2. Fishery

The fishery at the Sound of Gigha is comprised of a wild razor (*Ensis* spp.) bed. There are three sites within this wild razor bed:

Table 2.1 Sound of Gigha shellfish sites

Production Area	Site	SIN	Species
Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razors
Sound of Gigha	Rhuna Haorine Point Razors	AB 515 933 16	Razors
Sound of Gigha	Sgier Gigalum Razors	AB 515 934 16	Razors

The fast track classification production area boundaries for the three sites as identified by the Food Standards Agency on 1st July 2009 are:

Sound of Gigha: Sgor Cainnteach Razors: the area bounded by lines drawn between NR 6800 5200 to NR 7000 5200 and between NR 7000 5200 to NR 7000 5000 and between NR 7000 5000 to NR 6800 5000 to NR 6800 5200 and between NR 6800 5000 to NR 6800 5200.

Sound of Gigha: Rhuna Haorine Point Razors: the area bounded by lines drawn between NR 6700 5000 to NR 6880 5000 and between NR 6880 5000 to NR 6880 4700 and between NR 6880 4700 to NR 6700 4700 and between NR 6700 4700 to NR 6700 5000.

Sound of Gigha: Sgier Gigalum Razors: the area bounded by lines drawn between NR 6550 4700 to NR 6920 4700 and between NR 6920 4700 to NR 6920 4600 and between NR 6920 4600 to NR 6550 4600 and between NR 6550 4600 to NR 6550 4700.

There is currently no RMP assigned to this area. The razor bed at the Sound of Gigha does not lie within a designated shellfish water.

Discussions with the local authority indicated that the actual razor bed boundaries are not known. However, the razor clams are very widespread in the area and the razor bed is thought to extend beyond the boundaries of all three sites. The razors will be hand dived within the <20 m depth range in areas of soft and sandy substrate. Harvesting is planned to take place throughout the year.

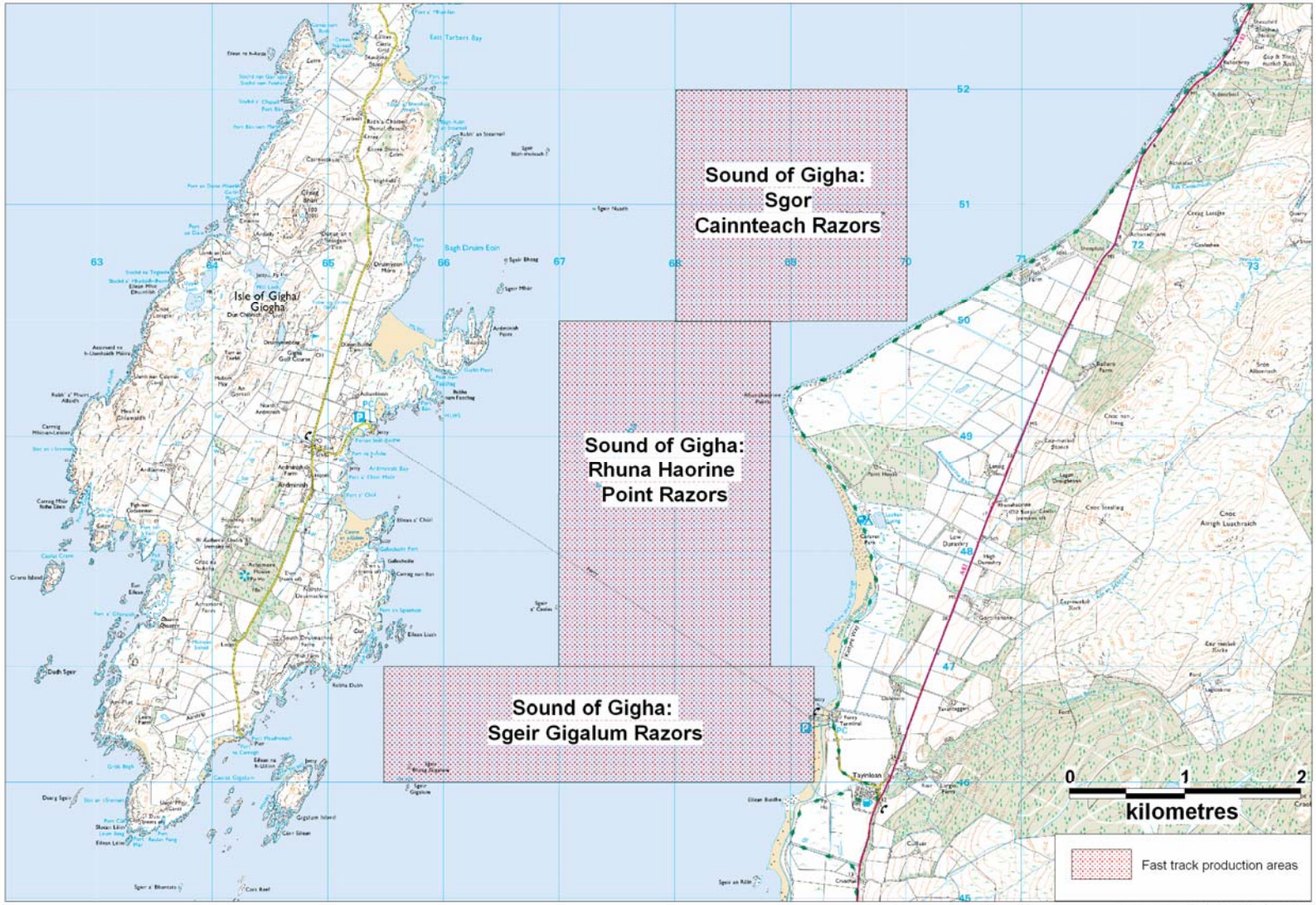


Figure 2.1 Sound of Gigha fishery

3. Sewage Discharges

A number of discharge consents were provided by SEPA for the area adjacent to the Sound of Gigha. These are listed in Table 3.1 and mapped in Figure 3.1.

Table 3.1 SEPA discharge consents

Consent No.	NGR of discharge	Discharge type	Discharges to	PE	Discharge Vol m^3 per day
CAR/R/1032879	NR 6540 5090	Continuous	Land via soakaway	5	-
CAR/R/1031109	NR 6489 4849	Continuous	Land via soakaway	30	-
CAR/R/1022576	NR 6417 4812	Continuous	Land via soakaway	6	-
CAR/R/1027022	NR 6492 4778	Continuous	Land via mound soakaway	15	-
CAR/R/1027370	NR 6487 4775	Continuous	Land via soakaway	5	-
CAR/R/1032095	NR 6445 4681	Continuous	Land via soakaway	6	-
CAR/R/1032414	NR 6416 4679	Continuous	Unnamed watercourse	12	-
CAR/R/1037038	NR 6374 4640	Continuous	Land via soakaway	15	-
CAR/R/1019853	NR 6421 4642	Continuous	Unnamed tributary of Caolas Gigalum via partial soakaway	6	-
CAR/R/1025483	NR 7190 5055	Continuous	Leth Uillt	8	-
CAR/R/1015945	NR 7029 4706	Continuous	Land	6	-
CAR/S/1020309	NR 6929 4665	Continuous	Sound of Gigha	-	4.75
CAR/L/1020309 (Tayinloan ST)	NR 6940 4600	Continuous	Tayinloan Burn	-	165
CAR/R/1020252	NR 6958 4599	Continuous	Land via soakaway	15	-
CAR/R/1023039	NR 6973 4597	Continuous	Land via soakaway	20	-

The first nine entries in Table 3.1 relate to discharges on the Isle of Gigha and the last six entries to discharges on the Kintyre peninsula. It is assumed that the septic tank discharges to soakaway will not impact on water quality unless the systems are malfunctioning. The water courses to which most of the others discharge flow into the Sound of Gigha: on the western side for the Isle of Gigha discharges and the eastern side for the Kintyre discharges. Only one discharge, CAR/S/102039, located on the Kintyre peninsula, was identified as discharging directly into the Sound.

One community septic tank and sewage discharge was identified by Scottish Water for the area adjacent to the Sound of Gigha. This is detailed in Table 3.2 and mapped in Figure 3.1.

Table 3.2 Discharge identified by Scottish Water

Consent No.	Discharge Name	NGR of discharge	Discharge Type	Level of Treatment	Consented flow m^3/day	Consented/ design PE
CAR/L/1020309	Tayinloan ST	NR 6940 4600	Continuous	Septic tank	165	-

No sanitary or microbiological data were available for these discharges.

Several septic tanks and sewage outfall pipes were also observed during the shoreline survey and these 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 the appendix.

Table 3.3 Observations of potential sewage discharges

No	Date	NGR	Description of potential sewage discharge	Sample No.	E. coli cfu/100 ml
1	16/09/2009	NR 69524 45939	Tayinloan septic tank. 3 inspection covers, 2 vents and outfall pipe to Tayinloan Burn.	NA	-
2	16/09/2009	NR 69342 46549	Public toilets. Septic tank – no outfall pipe.	NA	-
3	16/09/2009	NR 69336 46579	Septic tank – no outfall pipe.	NA	-
4	16/09/2009	NR 69356 46613	Outfall pipe from farm, flow visible in concrete chamber but unreachable.	NA	-
5	17/09/2009	NR 65395 49091	Public toilets. Septic tank and outfall pipe – no flow.	NA	-
6	17/09/2009	NR 65158 48738	Toilets with septic tank and outfall pipe – no flow.	NA	-
7	17/09/2009	NR 65151 48712	10cm diameter cast iron outfall pipe with flow, source unknown.	EFW8	4500000
8	17/09/2009	NR 65039 48403	Cottage with septic tank and outfall pipe – no flow.	NA	-
9	17/09/2009	NR 65378 48014	3 cottages with inaccessible septic tank – no visible outfall pipe.	NA	-
10	17/09/2009	NR 69469 47194	20cm diameter cast iron outfall pipe – flowing.	FWA	130

NA – Not applicable

Of the observed discharge pipes, two were flowing sufficiently to sample on the date of the shoreline survey. The outfall pipe on the Isle of Gigha showed *E. coli* level of 4500000 (*E. coli* cfu/100 ml), of the same order as primary treated sewage or septic tank effluent, which has levels of ≥5000000 *E. coli* cfu/100 ml (Halcrow, 1995). The second located on the Kintyre peninsula, near Tayinloan contained a much lower level of faecal bacteria of 130 *E. coli* cfu/100 ml. Overall contamination of the shellfish from the sewage discharges discussed is likely to affect the bottom two sites; Sound of Gigha: Rhuna Point Haorine Razors and Sound of Gigha: Sgier Gigalum Razors the greatest.

Overall, the greatest impacts on water quality arising from sewage discharges would be expected to occur in the vicinity of Tayinloan on the Kintyre peninsula and Ardminish Bay on the Isle of Gigha.

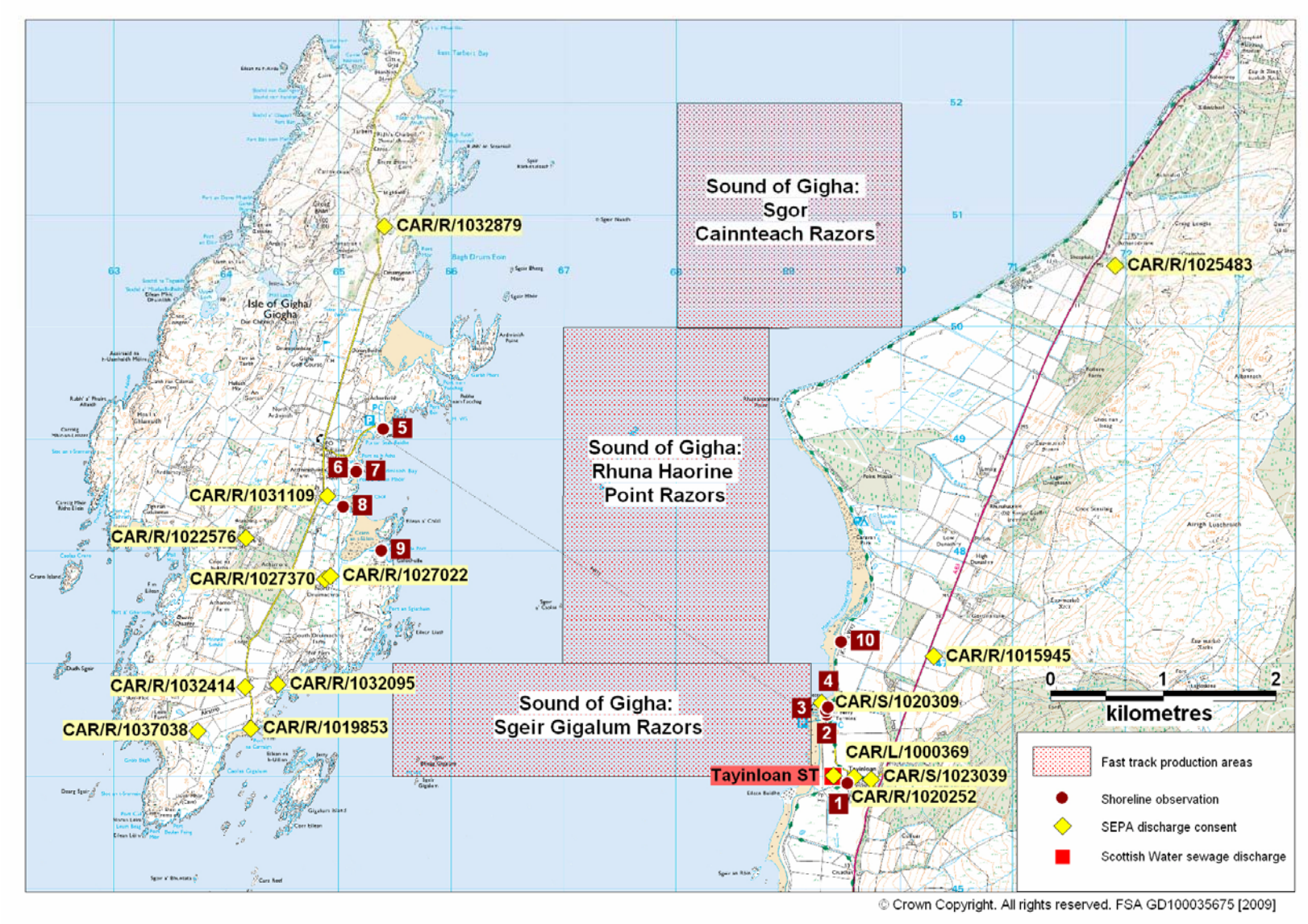


Figure 3.1 Sewage discharges at the Sound of Gigha

4. Animals

4.1 Livestock

The only significant source of information concerning livestock numbers in the area surrounding the Sound of Gigha was available from the shoreline survey. The shoreline survey relates to the time of the site visits on the 16th and 17th September 2009.

On the south western peninsula of Kintyre, a farm with a silage store, approximately 200 sheep and 10 cattle was observed (see Figure 4.1). There was also a farm located close to the Tayinloan ferry terminal with 50 cattle and 4 horses and further north there were an additional 60 cattle in a field. Further north still, 30 cattle and 70 sheep were observed. On the northeastern shoreline of the Isle of Gigha a dairy farm was noted with approximately 80 cattle. Slightly further south of the dairy farm 20 cattle were seen on the shoreline. At the south-eastern end of the Isle of Gigha, was another dairy farm with approximately 100 cattle. Overall larger numbers of livestock are concentrated at the southern end of the area surveyed on the Kintyre peninsula; therefore contamination of shellfish is likely to be higher on the eastern side of the most southern site - Sound of Gigha: Sgier Gigalum Razors. There may also be some impact on the western side of the same site and on the north-eastern part of the Sound of Gigha: Rhuna Haorine Point site and the south- eastern part of the Sound of Gigha: Sgor Cainnteach site.

Livestock numbers in the area as a whole are likely to be at their highest during the summer months when calves and lambs 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.

During the winter months, livestock, including dairy cattle are likely to be kept in barns with a likely increase in slurry production and a 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.

4.2 Wildlife

Seabirds such as gulls will always be present on and around the Sound of Gigha but their distribution is likely to be relatively random over time and as such would not materially affect the overall assessment. During the shoreline survey approximately 24 gulls were observed in the small bay on the northeastern shoreline of the Isle of Gigha (see Figure 4.1). Several rabbits were spotted scattered along each side of the shoreline.

No other wildlife was observed at the time of the shoreline survey. However, it is likely that other animals including seals, otters and other seabirds may be present in the area. The distribution and numbers of these species was not investigated.

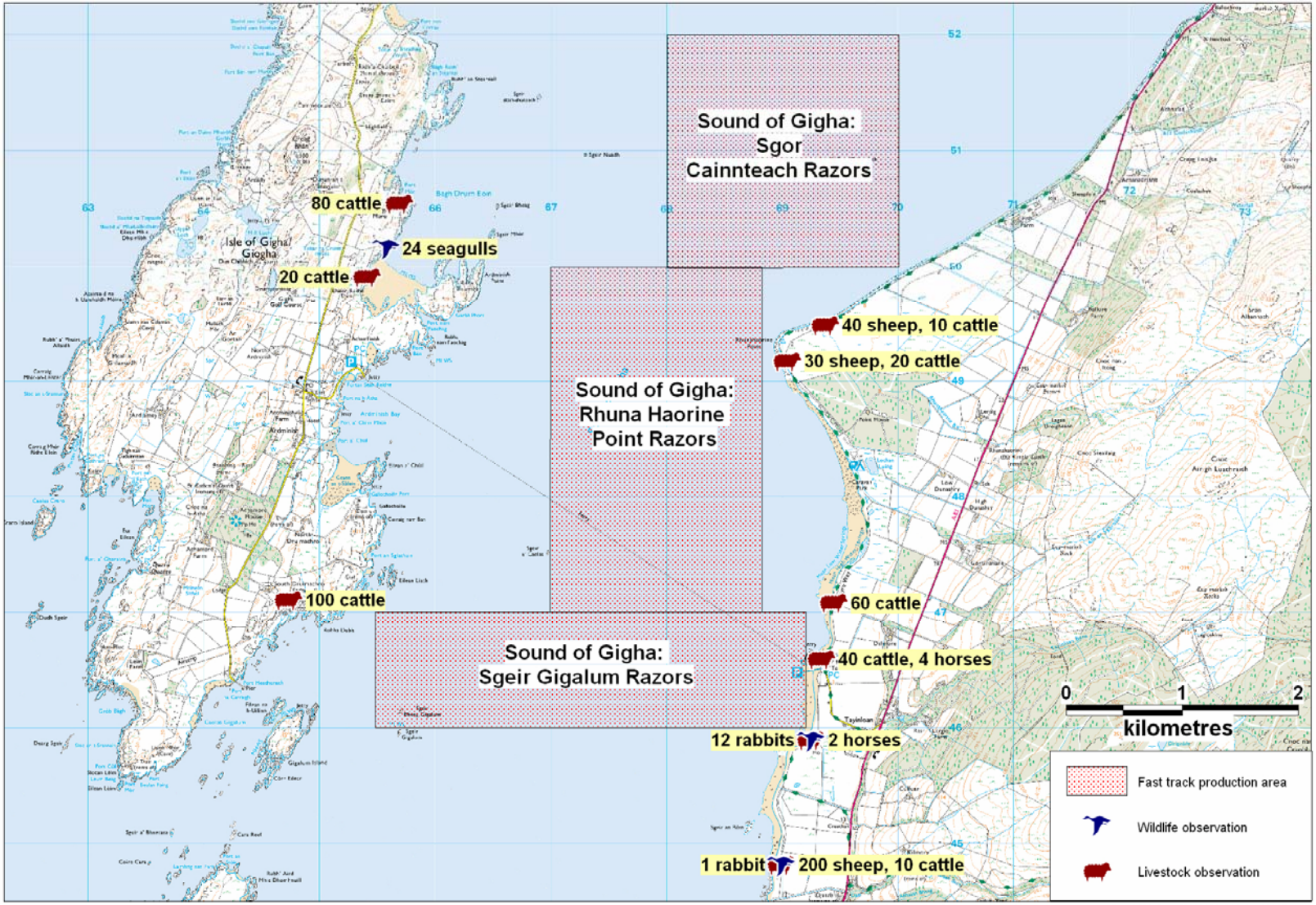


Figure 4.1 Livestock and wildlife present at the Sound of Gigha during the shoreline survey

5. Rainfall

The nearest weather station for which data was available was located at Arran Dougarie Lodge, approximately 21 km south east of the Sound of Gigha. Daily rainfall values were purchased from the Meteorological Office for the period 1/1/2003 to 31/12/2008 inclusive for the Arran Dougarie Lodge weather station. For this period of 2192 days, total daily rainfall was not recorded for 206 days, including the entire month of October 2006. Due to the distance of the weather station from the Sound of Gigha, rainfall is likely to vary somewhat between the shellfish site and the weather station. The nearest weather station to the production area is located at Ormsary House, approximately 18.5 km north of the Sound of Gigha, however data for this station had not been obtained from the Meteorological Office under the annual Sanitary Survey data licensing arrangement.

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 (Mallin et al. 2001, Lee and Morgan 2003).

The influence of rainfall on microbiological quality will depend on factors such as local geology, topography, land use and sewerage infrastructure.

5.1 Rainfall at Arran Dougarie Lodge

Due to the missing data it is not appropriate to present total rainfall at Arran Dougarie Lodge by year or month. Instead, Figures 5.1 and 5.2 summarise the pattern of rainfall recorded at Arran Dougarie Lodge. The box and whisker plots present the distribution of individual daily rainfall values (observations) by year (Figure 5.1) or by month (Figure 5.2). The grey box represents the middle 50% of the observations, with the median represented by 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 *.

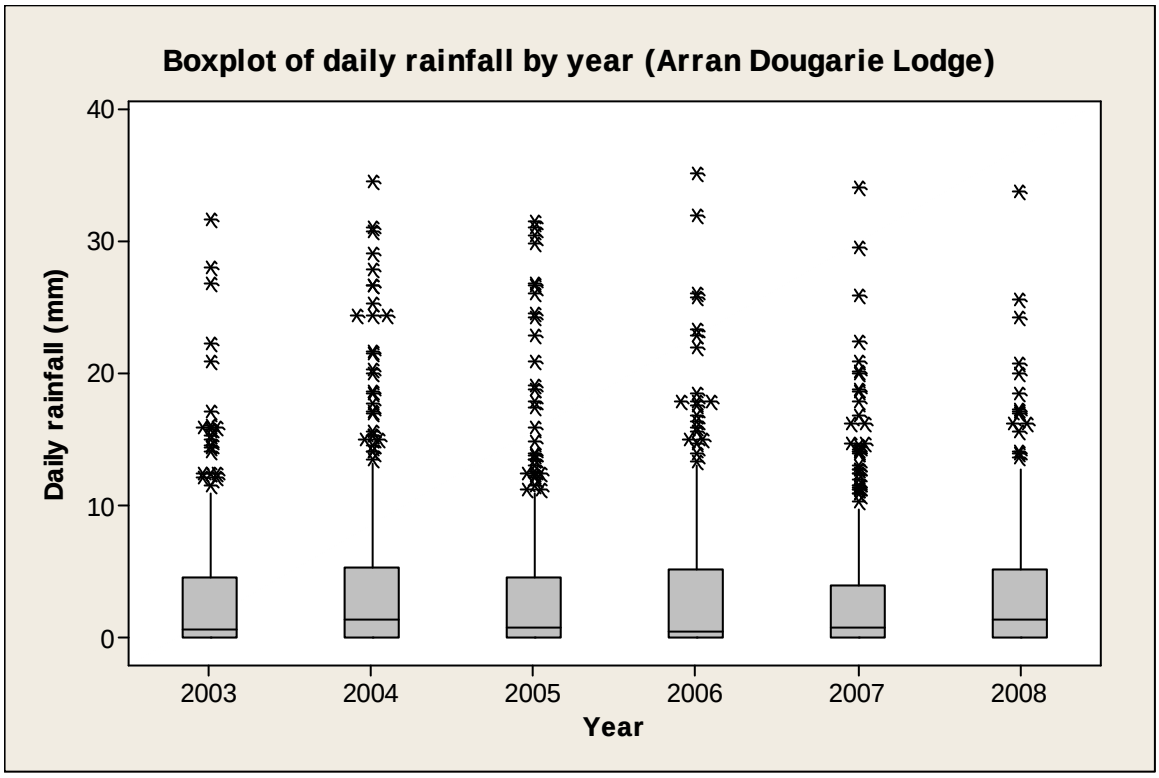


Figure 5.1 Boxplot of daily rainfall at Arran Dougarie Lodge by year

Figure 5.1 shows that there is relatively little variation between years observed.

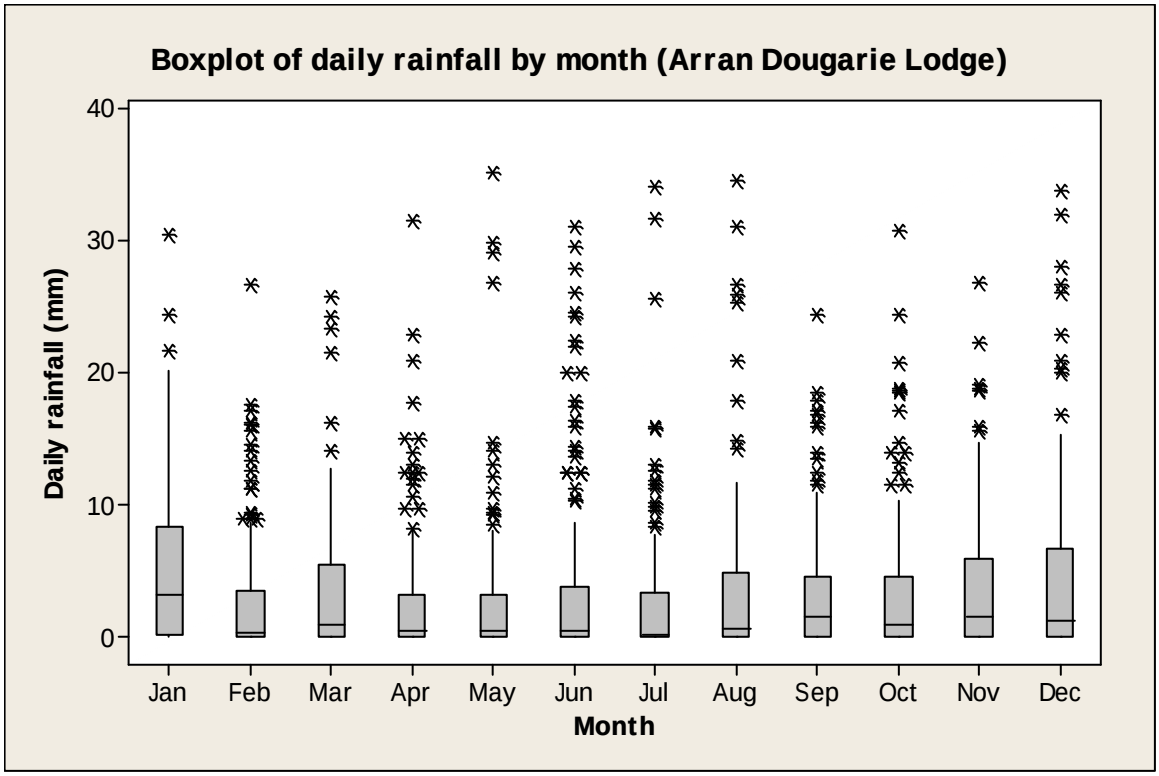


Figure 5.2 Boxplot of daily rainfall values at Arran Dougarie Lodge by month

The wettest months were November and March. For the period considered here (2003 – 2008), 35% of days for which records were available experienced no rainfall while 52% of days experienced rainfall of 1mm or less. Though mean

rainfall was less than 10 cm per day, maximum daily rainfall on certain day was recorded at levels greater than 30 cm. The highest daily rainfall recorded here fell in May, one of the driest months, on average. Overall, relatively high rainfall events occurred through the year and in all years.

Periods of increased rainfall are generally associated with higher levels of contaminated surface water runoff. Marked changes in the level of rainfall may also cause significant washoff of accumulated material.

Faecal contaminants from other sources may be independent of rainfall and so episodes of contamination may occur outside identified periods of higher rainfall, for example when livestock are present on the shoreline.

6. River Flow

There is no river gauging stations in the vicinity of the Sound of Gigha. A total of seventeen fresh water inputs were observed discharging into the sound. All but one of these were of a measurable size and had a measurable flow. These streams represented the largest freshwater inputs to the area and are listed in Table 6.1 and mapped in Figure 6.1.

Table 6.1 Stream/river flow and loadings – Sound of Gigha

No	Grid Ref	Description	Width (m)	Depth (m)	Measured Flow (m/s)	Flow in m^3/day	*E. coli* (CFU/ 100 ml)	Loading (*E. coli* per day)
1	NR 68900 44504	Killean Burn	0.8	0.1	0.18	1244.2	400	5.0×10^9
2	NR 68961 45222	Stream	^	^	^	^	300	NA
3	NR 68975 45491	Tayinloan Burn	0.6	0.02	0.14	145.2	300	4.4×10^8
4	NR 69248 45882	Stream	2.6	0.08	0.25	4492.8	3200	1.1×10^{11}
5	NR 69392 46634	Stream	1.1	0.12	0.25	2851.2	2800	8.0×10^{10}
6	NR 65507 50068	Stream	0.45	0.02	0.22	171.1	110	1.9×10^8
7	NR 65407 49897	Stream	0.6	0.1	0.17	881.3	190	1.7×10^9
8	NR 65035 48452	Stream	1.5	0.15	0.17	3304.8	5840	1.9×10^{11}
9	NR 69563 47381	Stream	0.3	0.02	0.15	77.8	10	7.8×10^6
10	NR 69691 47691	Stream	1	0.02	0.2	345.6	150	5.2×10^8
11	NR 69619 47989	Stream	1	0.07	0.2	1209.6	8000	9.7×10^{10}
12	NR 69651 48144	Stream	0.3	0.06	0.5	777.6	48	3.7×10^8
13	NR 69548 48401	Stream	0.2	0.05	0.5	432.0	*	NA
14	NR 69496 48523	Stream	0.4	0.03	0.35	362.9	36400	1.3×10^{11}
15	NR 69410 49523	Stream	2	0.1	0.35	6048.0	170	1.0×10^{10}
16	NR 70579 50201	Stream	0.5	0.05	0.25	540.0	520	2.8×10^9
17	NR 71605 50902	Stream	2	0.1	0.5	8640.0	260	2.2×10^{10}

^ Freshwater input dimensions and flow were not measured

* Sample lost during shoreline survey

At the time of the shoreline survey (during dry weather), *E. coli* loadings from freshwater sources predominated along the eastern shoreline of the Kintyre peninsula, although stream 8, located in Ardminish Bay on the Isle of Gigha, actually showed the highest loading from a single source.

Stream 14 had an *E. coli* concentration of 36400 cfu/100 ml, this high result is consistent with contamination with significant amounts of sewage or animal faecal material. In addition, streams 4, 5, 8 and 11 showed relatively high concentrations of faecal contamination. However, when considering the flow as well, streams 15 and 17 also contributed high loadings of faecal bacteria to the sound.

It should also be noted that stream 3 showed both relatively low *E. coli* concentrations and calculated loadings. This is despite it receiving the discharge from Tayinloan ST.

Therefore, the impact of faecal loadings from watercourses discharging in the vicinity of the fishery is higher along the eastern side of the fishery and particularly where the identified areas for fishing lie close to the shore.

Calculated loadings are based on the flows and dimensions recorded during the shoreline survey and do not necessarily reflect those that would apply under different conditions.

Where the bacterial loading is labelled as 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 1×10^3, in this case it would be written as 1E+3. No loading indicates that at the time of the shoreline survey measurements and flow of the stream/river could not be taken.

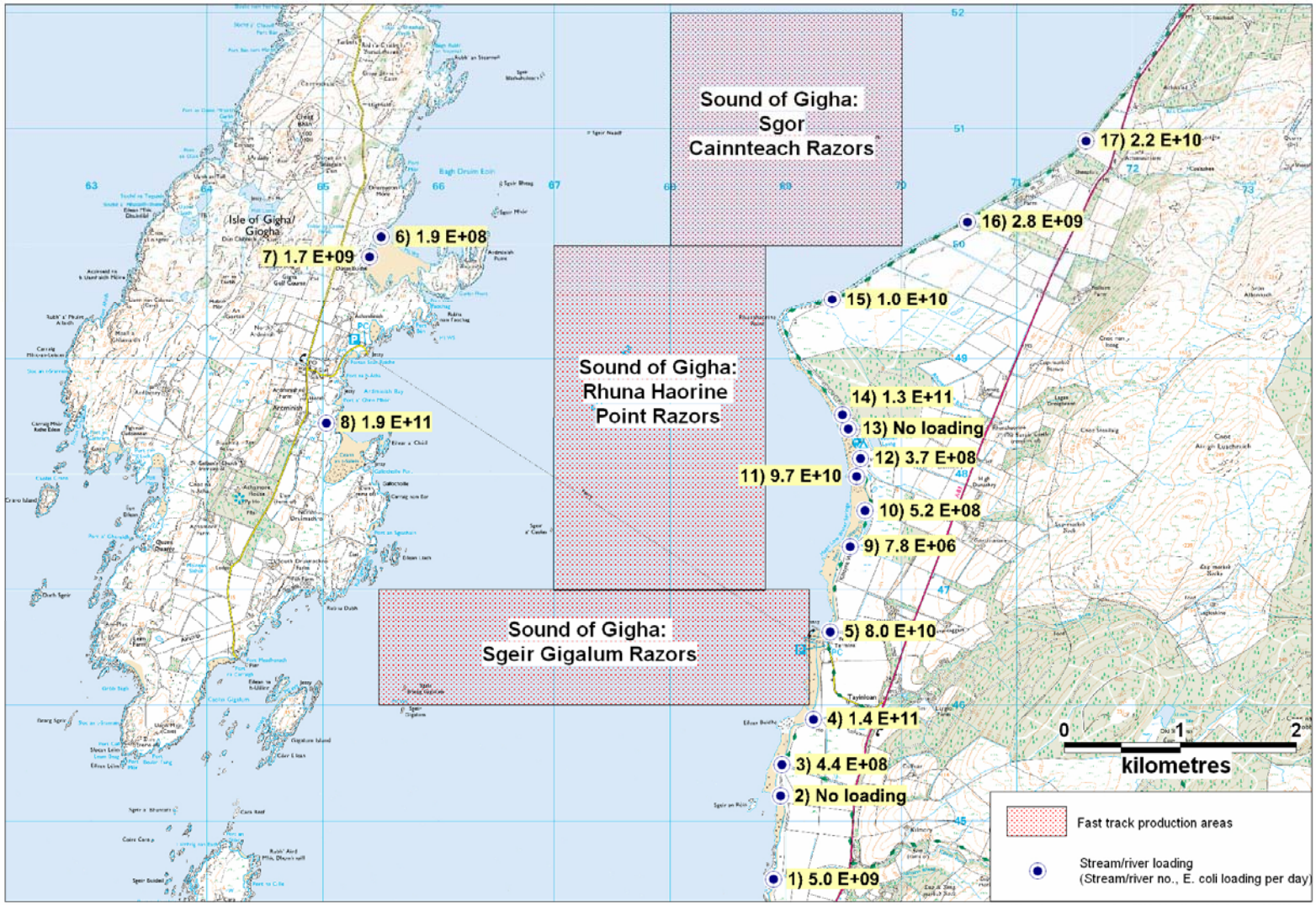


Figure 6.1. Location of stream/river flows and loadings at Sound of Gigha

7. Historical *E. coli* Monitoring Data

7.1 Validation of historical data

All shellfish samples taken from the Sound of Gigha from the middle of 2009 up to the time of writing this report were extracted from the database and validated according to the criteria described in the standard protocol for validation of historical *E. coli* data.

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

7.2 Summary of microbiological results

Individual sample details are presented in Table 7.1. All samples were collected in 2009, following the receipt of the application to classify the area. The samples have been collected from two out of the three sites.

Table 7.1 Individual sample results from Sound of Gigha

Collection date	Production area	Site	SIN	Species	Grid reference	*E. coli* (MPN/100g)
22/07/2009	Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razor clams	NR 69995 51043	<20
15/07/2009	Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razor clams	NR 69966 51086	<20
08/07/2009	Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razor clams	NR 6997 50779	<20
01/07/2009	Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razor clams	NR 69877 51035	<20
19/08/2009	Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razor clams	NR 69099 50668	20
19/08/2009	Sound of Gigha	Sgeir Gigalum Razors	AB 515 934 16	Razor clams	NR 67950 46706	50
16/09/2009	Sound of Gigha	Sgor Cainnteach Razors	AB 515 932 16	Razor clams	NR 69258 50483	20
16/09/2009	Sound of Gigha	Sgeir Gigalum Razors	AB 515 934 16	Razor clams	NR 67962 46439	<20

All results were below 230 *E. coli* MPN/100g.

7.3 Overall geographical pattern of results

Figure 7.1 shows the location of the above historical *E. coli* monitoring results. There are not enough results to assess the geographical pattern of contamination statistically. The highest result was obtained at the southern end of the area but this was only 50 *E. coli* MPN/100 g.

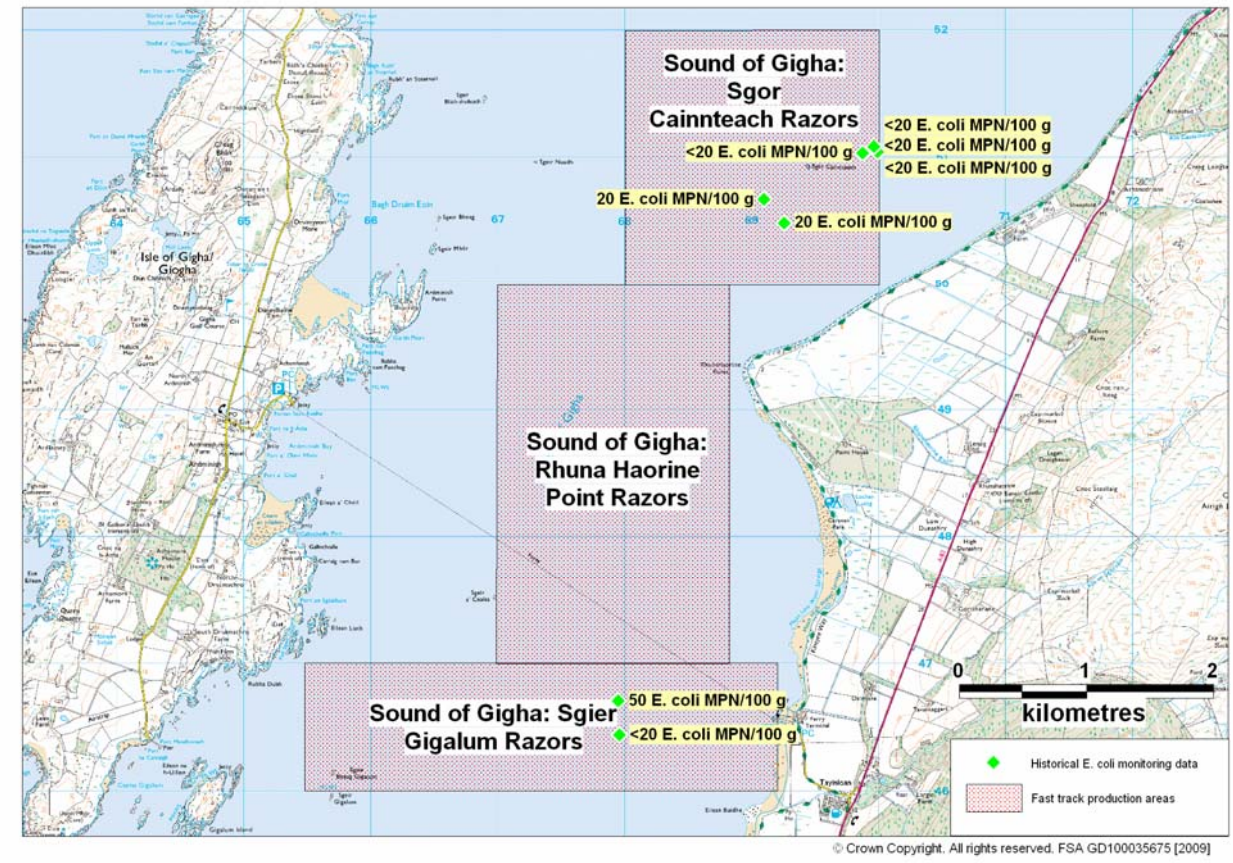


Figure 7.1 Geographical location of the Sound of Gigha historical *E. coli* monitoring results

7.4 Further analysis of results (seasonality, effects of environmental variables)

There is insufficient data to conduct meaningful analyses of the effects of season and environmental variables on *E. coli* levels in shellfish at the Sound of Gigha.

8. Bathymetry and Hydrodynamics

Figure 8.1 Sound of Gigha bathymetry chart

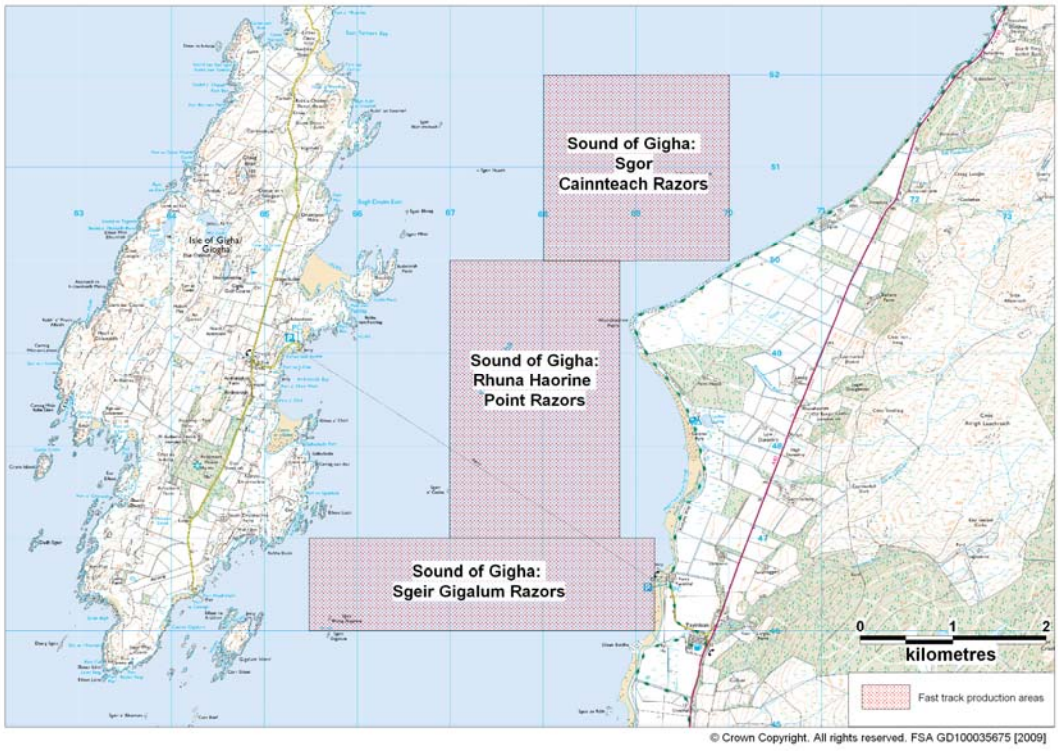


Figure 8.2 Sound of Gigha OS map

The depth of the sound increases with distance from the shoreline (see Figure 8.1). The western side of the sound shelves off steeply in places from 0 to 20 m, whilst the eastern side of is shallow (0 – 5 m) and slopes gently for 1 – 2 km

towards the centre of the sound, where in small pockets the depth increases sharply to up to 50 m.

8.1 Tidal curve and description

The two tidal curves below are for the port of the Sound of Gigha, the nearest secondary port– they have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 13th September 2009. The second is for seven days beginning 00.00 GMT on 20th September 2009. Together they show the predicted tidal heights over high/low water for a full neap/spring tidal cycle.

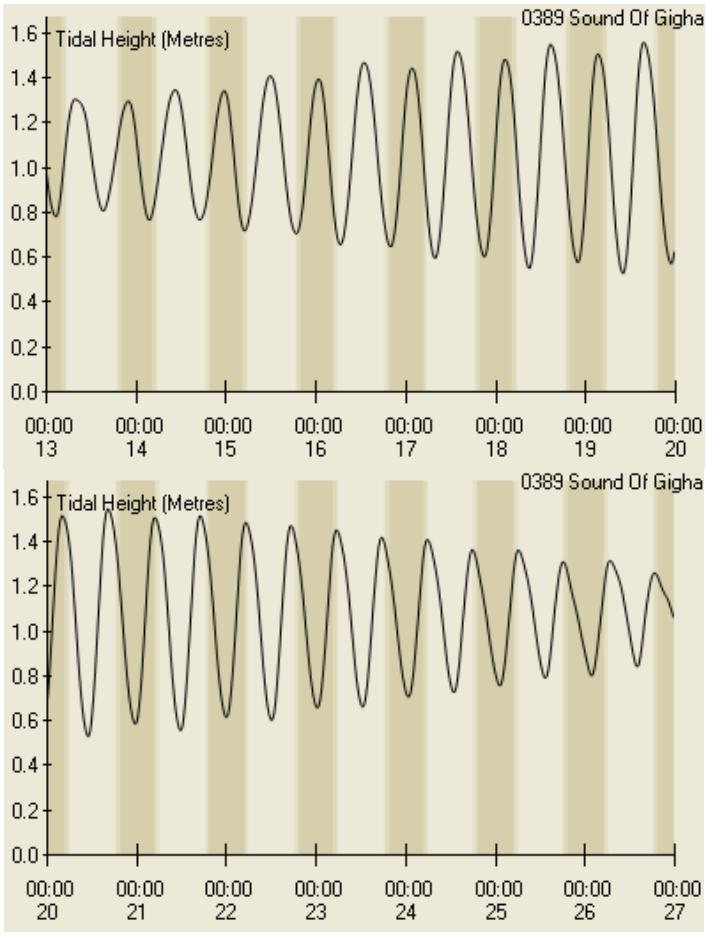


Figure 8.3 Tidal curves for the Sound of Gigha

The following is the UKHO summary description for Sound of Gigha:

The tide type is Semi-Diurnal.

MHWS	1.5 m
MHWN	1.3 m
MLWN	0.8 m
MLWS	0.6 m

Predicted heights are in metres above chart datum. The tidal range at spring tide is therefore approximately 0.9 m and at neap tide 0.6 m.

8.2 Currents

The Clyde Cruising Club Sailing Directions and Anchorages for Kintyre to Ardnamurchan (2007) identifies that the north and south-going stream between the Isle of Gigha and Kintyre is in the order of 1.5 knot at spring tide (approximately 0.75 m/s). The values will be roughly halved at neap tides. A north going stream starts approximately 4.5 hours after HW Oban and a south going stream starts about 1.9 hours before HW Oban.

Given that the tidal stream speed is low, wind effects may be relatively great and these may produce a modified current. For example, a strong south-westerly wind would be expected to increase the along-shore travel on the eastern shore during the north going tidal stream and to reduce the opposite along-shore travel during the south going tidal stream.

8.3 Conclusions

The tidal range and current speeds throughout the sound are relatively low. Currents will tend to run roughly parallel to the shore along the channel in the sound. Currents likely to be slower over areas near the shore. Contamination will be greatest near to significant sources and then impact along the shore with the direction dependent on the state of tide. The maximum tidal excursion will be approximately 11 km at spring tide but due to the small size of the identified sources, dilution and dispersion will mean that the actual distance over which any one source will significantly affect water quality will be much less than this. Contamination effects should be less towards the centre of the Sound due to direction of tidal flow and the greater dilution with increasing depth.

9. Shoreline Survey Overview

A restricted shoreline survey of the Sound of Gigha shoreline was undertaken by staff from Argyll and Bute Council on the 16th and 17th September 2009.

Sub surface sea water samples were taken from several points along the Sound of Gigha coastline and also from within the shellfish bed area. Results ranged from 0 to 120 *E. coli* cfu/100 ml. The highest result of 120 *E. coli* cfu/100 ml; was taken from the west side of the sound, just off the Isle of Gigha shoreline.

Fresh water samples were taken all along the eastern coastline of the Isle of Gigha and the western Kintyre peninsula at any streams or burns flowing at the time of the shoreline survey. Results ranged from 10 to 36400 *E. coli* cfu/100 ml. A stream on the on the eastern side of the Isle of Gigha had the highest *E. coli* loading of 1.9×10^{11} per day.

Approximately 200 cattle were present on the Isle of Gigha at the time of the shoreline survey. A further 140 cattle, 270 sheep and 6 horses were also observed, along a 5 km stretch of the Kintyre peninsula.

Razor clam samples were collected from four points within the sound. Three samples were taken from the northern Sound of Gigha: Sgor Cainnteach Razors site and returned results of <20, <20 and 20 *E. coli* MPN/100 g. The fourth sample was collected from the central Sound of Gigha: Rhuna Haorine Point razors site and returned a result of 40 *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. 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:

- Contaminated freshwater streams flowing into the sound
- Sewage outfall pipes discharging into the sound
- Livestock grazing on the shoreline

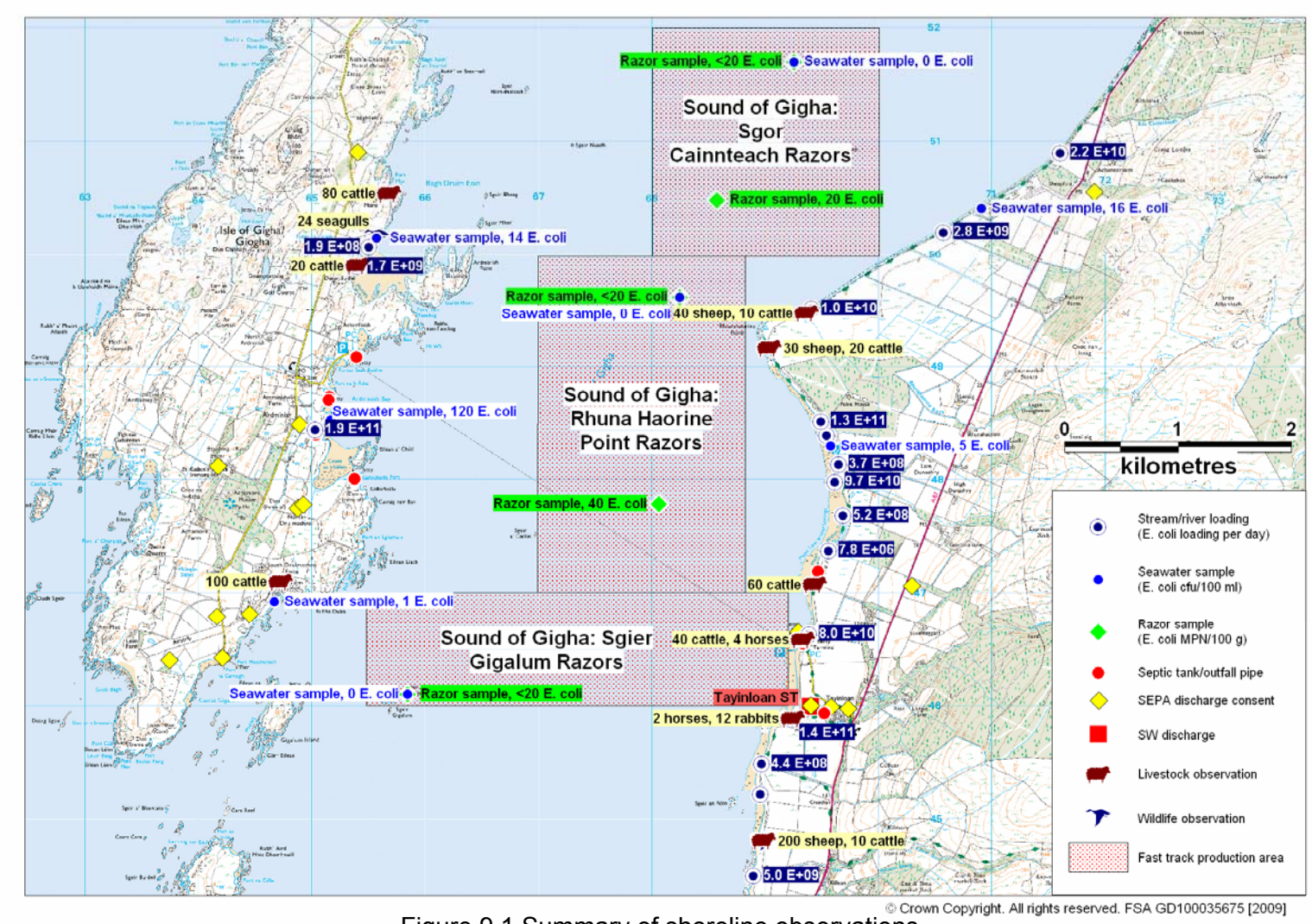


Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Fishery

The shellfish bed is located within the Sound of Gigha. The exact boundaries of the shellfish bed are unknown. The actual razor bed boundaries are not known, however the razor clams are very widespread in the area and the razor bed is thought to extend beyond the boundaries of all three previously identified sites. The razors will be hand dived within the <20 m depth range in areas of soft and sandy substrate. Harvesting is planned to take place throughout the year. All classification samples to date were taken from the eastern half of the Sound, indicating that the predominant commercial interest to date has been in that area. It should be noted, however, that one of the razor samples obtained during the shoreline survey was obtained from the western half of the sound (in the southern part of the production area) and thus razors do occur elsewhere.

Human sewage inputs

The population of the Isle of Gigha was 110 at the time of the 2001 census. The Isle of Gigha is one single census output area with a population of 110 people. There are no main large settlements on the island, just scattered dwellings and farms. There are nine SEPA discharge consents for the island and an additional four septic tanks were observed during the shoreline survey.

On the adjacent Kintyre peninsula there are mainly scattered dwellings with an overall population of 209 including the settlement of Tayinloan and has a population of 77 people. In the region of Tayinloan there are five SEPA discharge consents and one Scottish Water sewage discharge. During the shoreline survey an additional three septic tanks and two outfall pipes were observed close to Tayinloan.

Three outfall pipes had sufficient flow to take an *E. coli* sample at the time of the shoreline survey. Two of the outfall pipes were located on the eastern Isle of Gigha shoreline and had results of 5840 *E. coli* cfu/100 ml and 4500000 *E. coli* per 100 ml. The third outfall pipe was located north of Tayinloan on the Kintyre peninsula and had a result of 130 *E. coli* cfu/100 ml.

Overall contamination of the shellfish bed from the sewage discharges on the eastern side of the sound is likely to affect the Rhuna Point Haorine and Sgier Gigalum sites the most due to the larger number of outfalls located at the southern end of the sound.

Agricultural inputs

During the shoreline survey, four separate farms with cattle present were observed. Two dairy farms were observed on the Isle of Gigha, both with livestock (approximately 180 cattle in total) present close to the shoreline. On the adjacent Kintyre peninsula there were a further two farms with mixed livestock (sheep, cattle and horses) and an additional large group of mixed livestock further north. All livestock was observed close to the shoreline. Due to the close proximity of the

livestock to the shellfish bed, agricultural sources are considered to be a significant source of contamination in the area. Larger numbers of livestock are concentrated at the southern end of the sound on the Kintyre peninsula coastline; therefore contamination of shellfish is likely to be higher along the eastern side of the Sgier Gigalum site.

Wildlife inputs

During the shoreline survey 24 gulls were observed in a bay on the Isle of Gigha and approximately 13 rabbits were observed along the Kintyre peninsula. Seabirds including gulls will always be present along the coastline but their distribution, and contamination effects, is likely to be even over time and as such not materially influence the overall assessment.

Rivers and streams

A total of seventeen streams were discharging into the Sound of Gigha shellfish bed area at the time of the shoreline survey. All but three of these freshwater inputs were located on the Kintyre peninsula side of the sound. The stream with the largest *E. coli* loading of 1.9×10^{11}, was located on the eastern side of the Isle of Gigha. The streams on the Kintyre shoreline also had high *E. coli* loadings and ranged from 7.8×10^{6} to 1.4×10^{11}. Overall due to the high concentration of streams on the Kintyre shoreline it is expected that the freshwater inputs into the Sound of Gigha will have an intermediate effect on the bacterial contamination of shellfish.

Rainfall

Rainfall patterns at Arran Dougarie Lodge (the nearest rainfall station) show that seasonal variation in rainfall levels occurs and are higher between November and January than during the remainder of the year. An increase in rainfall, especially early in this period and after the dry summer months, may be expected to wash a flush of bacteria from the surrounding land into the production area. Individual days of very high rainfall do occur throughout the whole year. The impact of rainfall events is likely to be most acute nearest where the streams enter the sound.

Analysis of results

Historical monitoring results were available for three months in 2009. The samples were collected from the Sound of Gigha: Sgor Cainnteach Razors site and the Sound of Gigha: Sgeir Gigalum Razors site. The eight samples submitted returned results of between <20 to 50 *E. coli* MPN/100 g. There are insufficient historical monitoring results available to establish a pattern of seasonal variation in microbiological quality of the shellfish. The highest result was obtained at the southern end of the fishery.

During the shoreline survey, razor clam samples were collected from five points within the sound. Two samples were taken from the northern Sound of Gigha: Sgor Cainnteach Razors site and returned results of <20 and 20 *E. coli* MPN/100 g. Two samples were also collected from the central Sound of Gigha: Rhuna Haorine

Point razors site and returned results of <20 and 40 *E. coli* MPN/100 g. The final result was taken from the Sound of Gigha: Sgier Gigalum Razor site at the south western end and returned a result of <20 *E. coli* MPN/100 g.

Seawater samples were taken at several points along the coastline and within the sound. Results ranged from 0 to 120 *E. coli* (cfu/100 ml). The highest result of 120 *E. coli* cfu/100 ml was taken from the west side of the sound, just off the Isle of Gigha shoreline.

Movement of contaminants

The principal effect of impacting sources will be in the near vicinity of, and to a relatively small distance either side of each source, parallel to the shore, due to the direction of prevailing tidal currents and relatively low tidal stream speed. Dilution and dispersion will markedly reduce the impact of the small identified sources with distance. Both the general current direction and increasing depth will limit the effect of contamination towards the centre of the sound.

Overall conclusions

The main combination of sewage, freshwater and animal inputs of faecal contamination area concentrated in the south-eastern part of the current production area, in the vicinity of Tayinloan. The effect on microbiological quality of the shellfish would therefore be expected to be greater in that area and due to the current and dilution effects, the impact would not be expected to extend a great distance from the original sources. There are local impacts that will affect other parts of the current production area and some, such as in Ardiminish Bay, that could become more significant if commercial fishing extended there.

It should be noted that full assessment has been limited due to the lack of information on the exact location of commercial quantities of razors in the area.

11. Recommendations

RMP

Due to the predominance of the sources of contamination in the vicinity of Tayinloan, and in order to reflect these sources, the RMP should be located at NR 6830 4650. Due to the nature of the wild fishery, a 500 m radius tolerance is recommended around the RMP.

Production area

The recommended production area is the area bounded by lines drawn between :

NR 6800 5200 to NR 7000 5200 and between
NR 7000 5200 to NR 7000 5010 and between
NR 7000 5010 to NR 6880 5010 and between
NR 6880 5010 to NR 6880 4600 and between
NR 6880 4600 to NR 6550 4600 and between
NR 6550 4600 to NR 6550 4700 and between
NR 6550 4700 and NR 6800 5200.

This covers the general area previously covered by the three separate fast track classification areas while excluding small areas close to shore in the vicinity of significant sources of contamination. The available information does not indicate that the three fast track areas constitute separately identifiable fisheries.

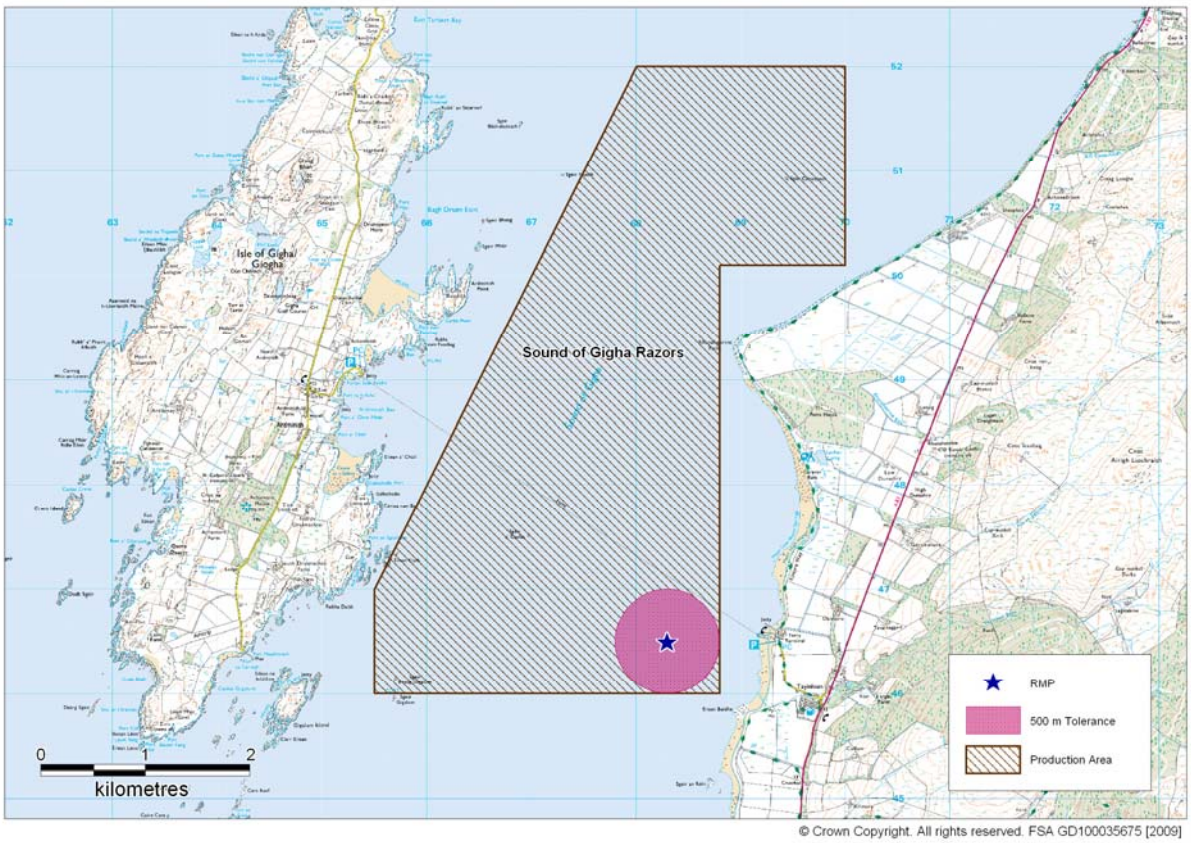


Figure 11.1 Recommendations for the Sound of Gigha

12. References

Clyde Cruising Club (2007) *Clyde Cruising Club: Sailing Directions and Anchorages – Kintyre to Ardnamurchan.* Clyde Cruising Club Publications Ltd. Cumbria

Halcrow (1995). Final Report to the Department of the Environment: Revision of the Bathing Water Directive: Study of the cost implications to the UK sewerage undertakers and regulators. Halcrow Ltd, Burderop Park, Swindon.

Kay, D, Crowther, J., Stapleton, C.M., Wyer, M.D., Fewtrell, L., Anthony, S.G., Bradford, M., Edwards, A., Francis, C.A., Hopkins, M. Kay, C., McDonald, A.T., Watkins, J., Wilkinson, J. (2008). Faecal indicator organism concentrations and catchment export coefficients in the UK. *Water Research* 42, 2649-2661.

Lee, R.J., Morgan, O.C. (2003). Environmental factors influencing the microbial contamination of commercially harvested shellfish. *Water Science and Technology* 47, 65-70.

13. List of Figures and Tables

Tables

Figures

Appendices

1. **Summary Sampling Plan**
2. **Comparative Table of Boundaries and RMPs**
3. **Shoreline Survey Report**

Sampling Plan for Sound of Gigha

PRODUC-TION AREA	SITE NAME	SIN	SPECIES	TYPE OF FISH-ERY	NGR OF RMP	EAST	NORTH	TOLE R-ANCE (M)	DEPTH (M)	METHOD OF SAMPLING	FREQ OF SAMPLING	LOCAL AUTHORITY	AUTHORISED SAMPLER(S)	LOCAL AUTHORITY LIAISON OFFICER
Sound of Gigha	Sound of Gigha Razors	AB 515	Razors	Wild harvest	NR 6830 4650	168300	646500	500	NA	Hand dived	Monthly	Argyll and Bute Council	Christine McLachlan	Christine McLachlan

Comparative Table of Boundaries and RMPs – Sound of Gigha

Production Area	Species	SIN	Existing Boundary	Existing RMP	New Boundary	New RMP	Comments
Sound of Gigha: Sgor Cainnteach Razors	Razor clams	AB 515 932 16	Fast track production area - Area bounded by lines drawn between NR 6800 5200 to NR 7000 5200 and between NR 7000 5200 to NR 7000 5000 and between NR 7000 5000 to NR 6800 5000 to NR 6800 5200 and between NR 6800 5000 to NR 6800 5200.	**Not applicable**	**Not applicable**	**Not applicable**	See combined production area
Sound of Gigha: Rhuna Haorine Point Razors	Razor clams	AB 515 933 16	Fast track production area - Area bounded by lines drawn between NR 6700 5000 to NR 6880 5000 and between NR 6880 5000 to NR 6880 4700 and between NR 6880 4700 to NR 6700 4700 and between NR 6700 4700 to NR 6700 5000.	**Not applicable**	**Not applicable**	**Not applicable**	See combined production area
Sound of Gigha: Sgeir Gigalum Razors	Razor clams	AB 515 934 16	Fast track production area - Area bounded by lines drawn between NR 6550 4700 to NR 6920 4700 and between NR 6920 4700 to NR 6920 4600 and between NR 6920 4600 to NR 6550 4600 and between NR 6550 4600 to NR 6550 4700.	**Not applicable**	**Not applicable**	**Not applicable**	See combined production area
Sound of Gigha: Razors	Razor clams	To be defined	Not applicable	**Not applicable**	Area bounded by lines drawn between NR 6800 5200 to NR 7000 5200 and between NR 7000 5200 to NR 7000 5010 and between NR 7000 5010 to NR 6880 5010 and between NR 6880 5010 to NR 6880 4600 and between NR 6880 4600 to NR 6550 4600 and between NR 6550 4600 to NR 6550 4700 and between NR 6550 4700 and NR 6800 5200.	NR 6830 4650	Combination of the previous three fast track production areas

Shoreline Survey Report

Sound of Gigha
AB 515

Restricted Sanitary Survey

Scottish Sanitary Survey Project

Shoreline Survey Report

Production area:	Sound of Gigha
Site name:	Sgor Cainnteach Razors Rhuna Haorine Point Razors Sgier Gigalum Razors
Species:	Razors (*Ensis spp.*)
Harvester:	John Grieve, David Leadbetter, Craig Barrett
Local Authority:	Argyll & Bute Council
Status:	New site
Date Surveyed:	Wednesday 16th & Thursday 17th September 2009
Surveyed by:	Ewan McDougall and William MacQuarrie
Existing RMP:	To be established
Area Surveyed:	See Figure 1.

Weather observations

16th September:	Dry. Wind NW Force 3. Sea temperature 15^0C.
17th September:	Dry. Wind SW Force 3.

Site Observations

Recorded observations are listed in Table 1.

Fishery

The Sound of Gigha Razors production area is harvested for Razors (*Ensis spp.*). The razors are hand dived within the boundaries of the three sites as identified in Figure 1. The harvesters plan to harvest the razors all year round.

Sewage/Faecal Sources

The area surveyed has a few scattered dwellings along the coastline adjacent to the sites and a small settlement called Tayinloan on the southwest peninsula of Kintyre. There is one Scottish Water septic tank and another two additional septic tanks at Tayinloan. There are four septic tanks on the Isle of Gigha on the eastern side of the island.

Seasonal Population

Point Sands Caravan Park is located on the western shoreline of the Kintyre peninsula adjacent to the Rhuna Haorine Point Razors. The caravan park offers camping in addition to spaces for static and mobile caravans, there are on site toilets and showers, no septic tank visible. There is one B&B with a septic tank just north of Tayinloan.

Boats/Shipping

There is a daily ferry service from Tayinloan to the Isle of Gigha. Close to the ferry slip on the Isle of Gigha, there were seven visiting yachts on moorings at the time of the shoreline survey.

Land Use
The land adjacent to the Sound of Gigha was primarily a mixture of pasture, rough grazing and woodland/forestry.

Livestock
On the south western peninsula of Kintyre there was a farm with a silage store, approximately 200 sheep and 10 cattle. There was a farm located close to the Tayinloan ferry terminal with 50 cattle and 4 horses, further north of this farm there were an additional 60 cattle in a field. Further north still at the point a further 30 cattle and 70 sheep were spotted. On the northeastern shoreline of the Isle of Gigha was a dairy farm with approximately 80 cattle. Slightly further south of this farm there were 20 cattle on the shoreline. At the south-eastern end of the Isle of Gigha next to the onshore halibut farm is another dairy farm with approximately 100 cattle.

Wildlife/Birds
During the shoreline survey 24 gulls were observed in the small bay on the northeastern shoreline of the Isle of Gigha. Rabbits were observed scattered along both shorelines. No other wildlife/birds were observed at the time of the shoreline survey.

Figure 1. Shoreline Observations

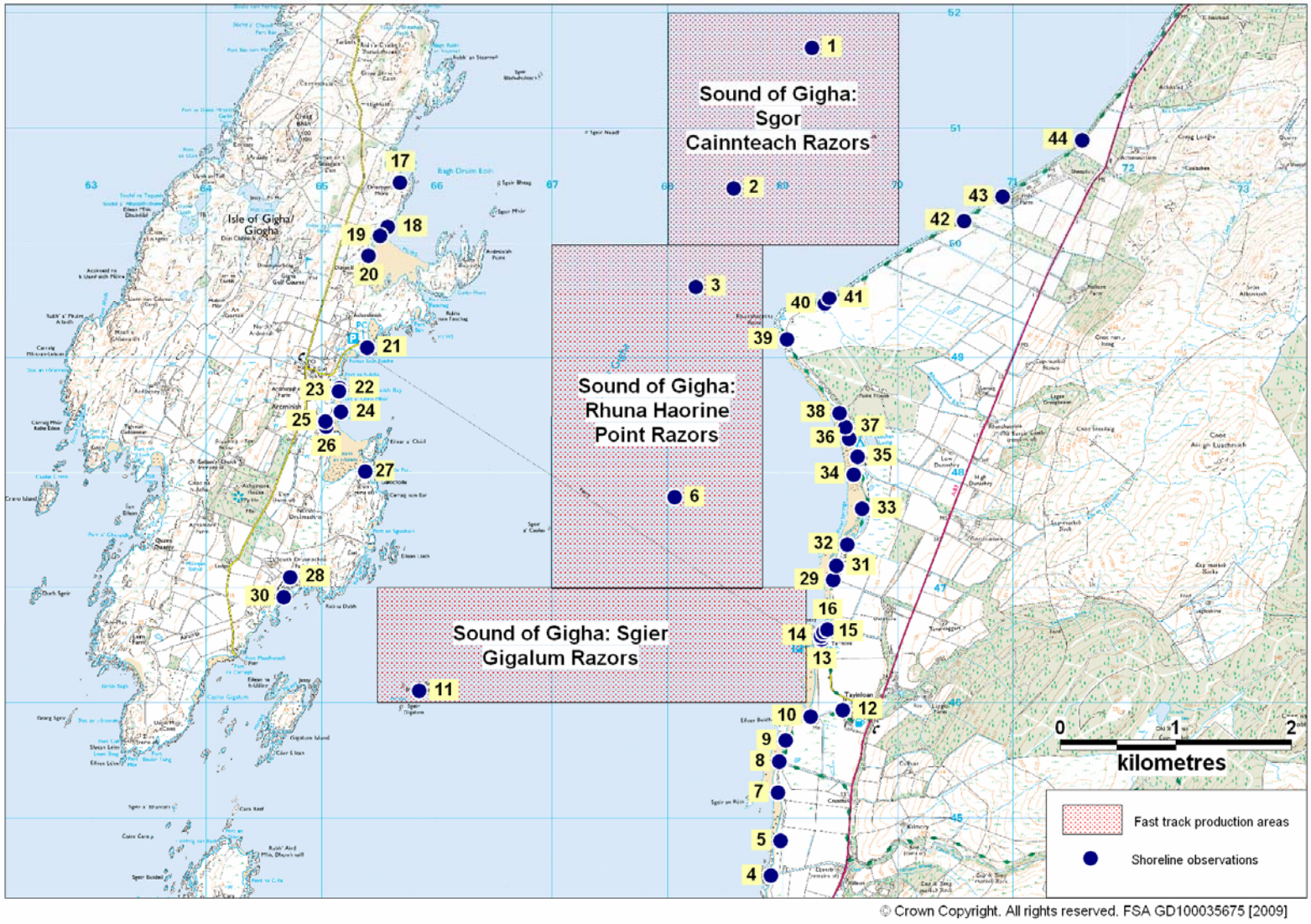


Table 1. Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Description
1	16/09/2009	09:30	NR 69258 51705	169258	651705	-	Shellfish sample RAZ1. Sea water sample SWR1.
2	16/09/2009	10:15	NR 68577 50483	168577	650483	-	Shellfish sample RAZ2.
3	16/09/2009	11:15	NR 68248 49626	168248	649626	-	Shellfish sample RAZ3. Sea water sample SWR2.
4	16/09/2009	12:06	NR 68900 44504	168900	644504	Figure 4.	Killean Burn. 80cm x 10cm x 0.18m/s. Fresh water sample EFW1. Large farm sheds and silage store.
5	16/09/2009	12:21	NR 68987 44806	168987	644806	-	Approx 200 sheep, 10 cows, 1 rabbit.
6	16/09/2009	12:30	NR 68065 47791	168065	647791	-	Shellfish sample RAZ4.
7	16/09/2009	12:31	NR 68961 45222	168961	645222	-	Small spring. Red ochre deposit. Fresh water sample EFW2.
8	16/09/2009	12:39	NR 68975 45491	168975	645491	Figure 5.	Small stream. 60cm x 2cm x 0.14m/s. Fresh water sample EFW3.
9	16/09/2009	12:48	NR 69028 45673	169028	645673	Figure 6.	Sea water sample ESW1. Salinity 34ppt.
10	16/09/2009	12:56	NR 69248 45882	169248	645882	Figure 7.	Tayinloan Burn. 260cm x 8cm x 0.25m/s. Fresh water sample EFW4. 2 horses, 12 rabbits.
11	16/09/2009	13:00	NR 65848 46102	165848	646102	-	Shellfish sample RAZ5. Sea water sample SWR3.
12	16/09/2009	13:09	NR 69524 45939	169524	645939	Figure 8.	Tayinloan septic tank. 3 inspection covers, 2 vents and outflow to Tayinloan Burn.
13	16/09/2009	13:27	NR 69342 46549	169342	646549	Figure 9.	Ferry terminal and public toilets. Septic tank – no outfall.
14	16/09/2009	13:29	NR 69336 46579	169336	646579	-	'Ferry Farm and B&B'. Septic tank – no outfall. Large sheds, 50 cows, 4 horses.
15	16/09/2009	13:47	NR 69356 46613	169356	646613	Figure 10.	Pipe from Ferry Farm. Flow visible in concrete chamber but unreachable.
16	16/09/2009	13:52	NR 69392 46634	169392	646634	Figure 11.	Small stream by Ferry Farm. 110cm x 12cm x 0.25m/s. Fresh water sample EFW5.
17	17/09/2009	09:06	NR 65683 50534	165683	650534	-	Port Mor. Overlooking offshore fish farm – 16 cages and large service raft. Dairy farm 0.5km to west, approx 80 cows.
18	17/09/2009	09:21	NR 65573 50147	165573	650147	-	Sea water sample ESW2. Salinity 34ppt. 24 seagulls.
19	17/09/2009	09:27	NR 65507 50068	165507	650068	-	Small stream. 45cm x 2cm x 0.22m/s. Fresh water sample EFW6.
20	17/09/2009	09:37	NR 65407 49897	165407	649897	-	Small stream. 60cm x 10cm x 0.17m/s. Fresh water sample EFW7. 20 cows on shore.
21	17/09/2009	10:02	NR 65395 49091	165395	649091	Figure 12.	Ferry slip and public toilets. Septic tank and outfall – no flow.
22	17/09/2009	10:17	NR 65158 48738	165158	648738	-	Café, toilets and launderette with septic tank and outfall – no flow. 7 visiting yachts on moorings.
23	17/09/2009	10:20	NR 65151 48712	165151	648712	Figure 13.	10cm diameter cast iron pipe with flow, source unknown. Grey deposits in pipe and on shore. Fresh water sample EFW8.

No.	Date	Time	NGR	East	North	Associated photograph	Description
24	17/09/2009	10:28	NR 65170 48533	165170	648533	-	Sea water sample ESW3. Salinity 33ppt.
25	17/09/2009	10:34	NR 65035 48452	165035	648452	Figure 14.	Stream near village. 150cm x 15cm x 0.17m/s. Fresh water sample EFW9.
26	17/09/2009	10:40	NR 65039 48403	165039	648403	-	Cottage with septic tank and outfall – no flow.
27	17/09/2009	10:50	NR 65378 48014	165378	648014	-	2 cottages with inaccessible septic tank – no visible outfall.
28	17/09/2009	11:17	NR 64729 47097	164729	647097	Figure 15.	Onshore halibut farm (Gigha Halibut). Next to dairy farm with approx 100 cows.
29	17/09/2009	11:20	NR 69443 47071	169443	647071	-	60 cows in field.
30	17/09/2009	11:24	NR 64671 46926	164671	646926	-	Sea water discharge from halibut farm. Sea water sample ESW4. Salinity 34ppt.
31	17/09/2009	11:25	NR 69469 47194	169469	647194	Figure 16.	20cm diameter cast iron pipe – flowing. Unable to measure flow. Fresh water sample FWA.
32	17/09/2009	11:35	NR 69563 47381	169563	647381	-	Small stream. 30cm x 2cm x 0.15m/s. Fresh water sample FWB.
33	17/09/2009	11:50	NR 69691 47691	169691	647691	-	Small stream. 100cm x 2cm x 0.2m/s. Fresh water sample FWC.
34	17/09/2009	11:55	NR 69619 47989	169619	647989	-	Small stream. 100cm x 7cm x 0.2m/s. Fresh water sample FWD.
35	17/09/2009	12:00	NR 69651 48144	169651	648144	-	Small stream. 30cm x 6cm x 0.5m/s. Fresh water sample FWE. Photo of Point Sands Caravan Park.
36	17/09/2009	12:05	NR 69580 48302	169580	648302	-	Sea water sample SWA. Salinity 34ppt.
37	17/09/2009	12:10	NR 69548 48401	169548	648401	-	Small stream. 20cm x 5cm x 0.5m/s. Fresh water sample FWF (lost on survey).
38	17/09/2009	12:15	NR 69496 48523	169496	648523	Figure 17.	Small stream flowing through 35cm diameter plastic pipe. 40cm x 3cm x 0.35m/s. Fresh water sample FWG.
39	17/09/2009	12:30	NR 69038 49162	169038	649162	-	20 cows and approx 30 sheep.
40	17/09/2009	12:40	NR 69367 49474	169367	649474	-	Approx 40 sheep and 10 cows.
41	17/09/2009	12:45	NR 69410 49523	169410	649523	-	Stream. 200cm x 10cm x 0.35m/s. Fresh water sample FWH.
42	17/09/2009	13:10	NR 70579 50201	170579	650201	-	Small stream. 50cm x 5cm x 0.25m/s. Fresh water sample FWJ. Approx 20 sheep in field behind stream.
43	17/09/2009	13:15	NR 70911 50409	170911	650409	-	Sea water sample SWB. Salinity 27ppt.
44	17/09/2009	13:30	NR 71605 50902	171605	650902	-	Large stream. 200cm x 10cm x 0.5m/s. Fresh water sample FWK.

Photos referenced in the table can be found attached as Figures 4 – 17.

Sampling

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

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	Sample	Grid Ref	Type	E. coli (cfu/100ml)	Salinity (g/L)
1	16/09/2009	EFW1	NR 68900 44504	Fresh water	400	-
2	16/09/2009	EFW2	NR 68961 45222	Fresh water	300	-
3	16/09/2009	EFW3	NR 68975 45491	Fresh water	300	-
4	16/09/2009	EFW4	NR 69248 45882	Fresh water	3200	-
5	16/09/2009	EFW5	NR 69392 46634	Fresh water	2800	-
6	16/09/2009	ESW1	NR 69028 45673	Sea water	800	34.5
7	16/09/2009	SWR1	NR 69258 51705	Sea water	0	35.6
8	16/09/2009	SWR2	NR 68248 49626	Sea water	0	35.6
9	16/09/2009	SWR3	NR 65848 46102	Sea water	0	35.8
10	17/09/2009	SWA	NR 69580 48302	Sea water	5	34
11	17/09/2009	SWB	NR 70911 50409	Sea water	16	27
12	17/09/2009	FWA	NR 69469 47194	Fresh water	130	-
13	17/09/2009	FWB	NR 69563 47381	Fresh water	10	-
14	17/09/2009	FWC	NR 69691 47691	Fresh water	150	-
15	17/09/2009	FWD	NR 69619 47989	Fresh water	8000	-
16	17/09/2009	FWE	NR 69651 48144	Fresh water	48	-
17	17/09/2009	FWG	NR 69496 48523	Fresh water	36400	-
18	17/09/2009	FWH	NR 69410 49523	Fresh water	170	-
19	17/09/2009	FWJ	NR 70579 50201	Fresh water	520	-
20	17/09/2009	FWK	NR 71605 50902	Fresh water	260	-
21	17/09/2009	EFW6	NR 65507 50068	Fresh water	110	-
22	17/09/2009	EFW7	NR 65407 49897	Fresh water	190	-
23	17/09/2009	EFW8	NR 65151 48712	Fresh water	4500000	-
24	17/09/2009	EFW9	NR 65035 48452	Fresh water	5840	-
25	17/09/2009	ESW2	NR 65573 50147	Sea water	14	34
26	17/09/2009	ESW3	NR 65170 48533	Sea water	120	33
27	17/09/2009	ESW4	NR 64671 46926	Sea water	1	34

Table 3. Shellfish Sample Results

No.	Date	Sample	Grid Ref	Type	*E. coli* (MPN/100g)
1	16/09/2009	RAZ1	NR 69258 51705	Razor clams	<20
2	16/09/2009	RAZ2	NR 68577 50483	Razor clams	20
3	16/09/2009	RAZ3	NR 68248 49626	Razor clams	<20
4	16/09/2009	RAZ4	NR 68065 47791	Razor clams	40
5	16/09/2009	RAZ5	NR 65848 46102	Razor clams	<20

Figure 2. Water sample results

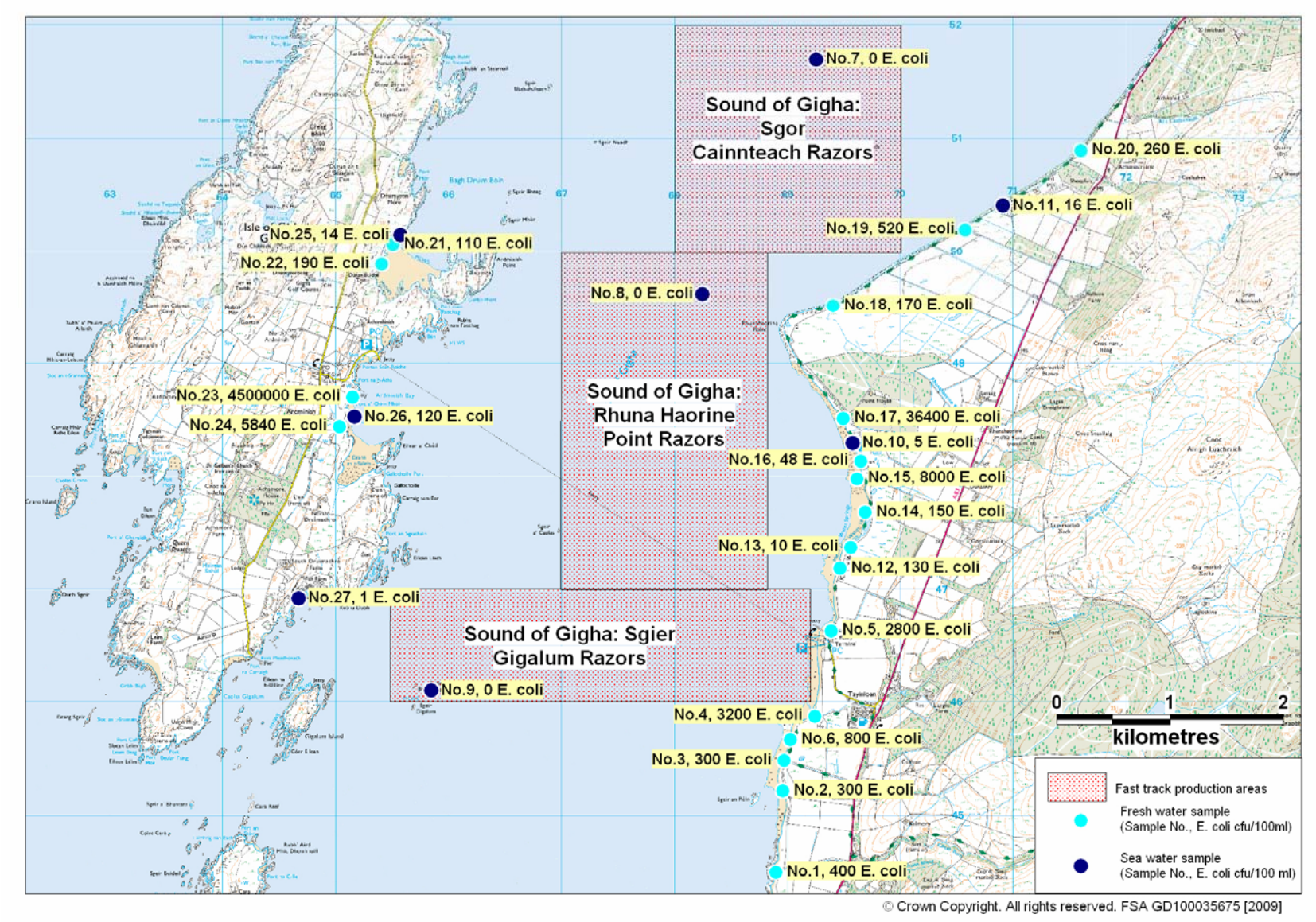
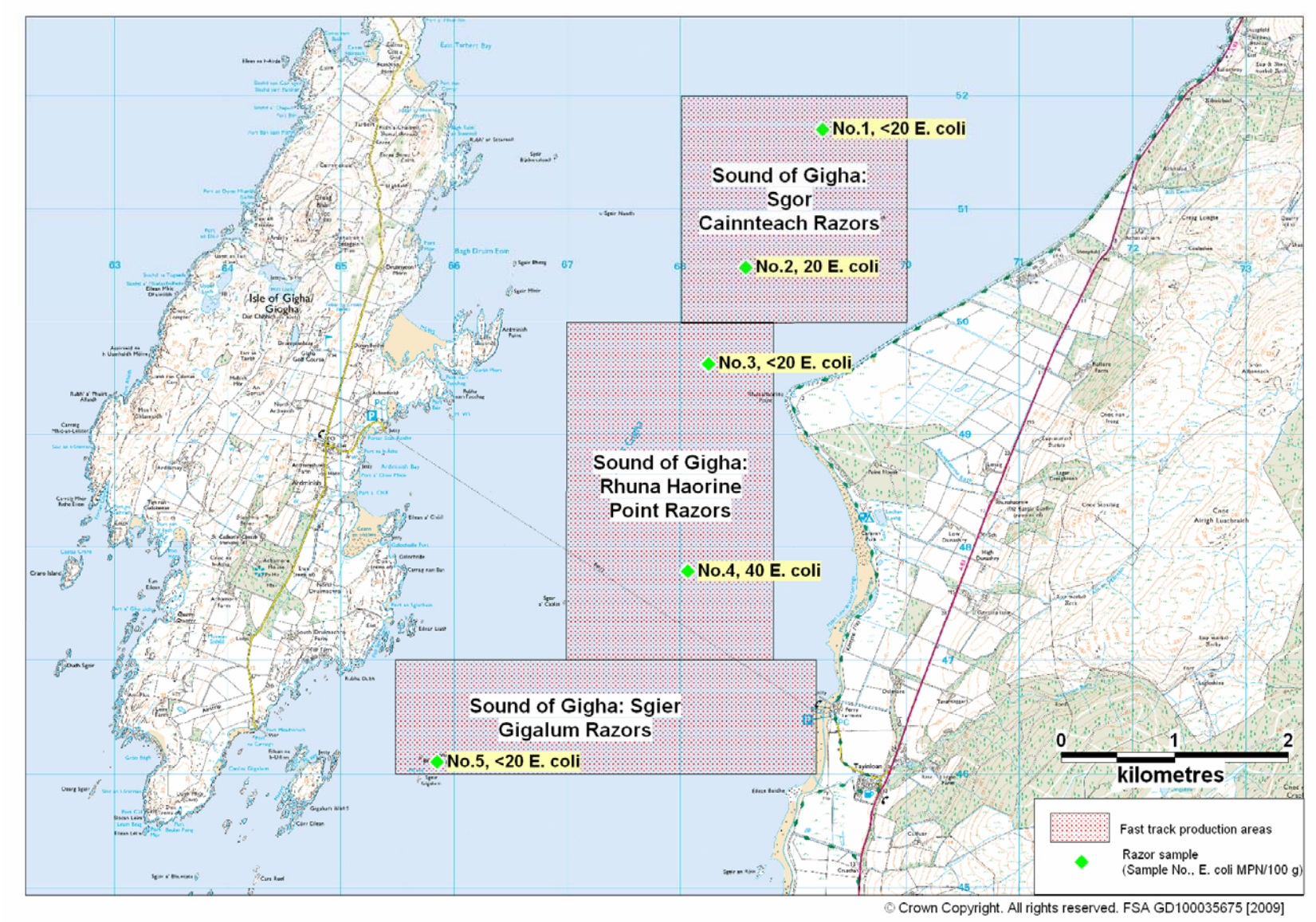


Figure 3. Shellfish sample results



Photographs

Figure 4. Kilean Burn, location of fresh water sample 1 (EFW1)

Figure 5. Small stream, location of fresh water sample 3 (EFW3)

Figure 6. Location of sea water sample 6 (ESW1)

Figure 7. Tayinloan Burn, location of fresh water sample 4 (EFW4)

Figure 8. Tayinloan septic tank and inspection covers

Figure 9. Ferry terminal and public toilets with septic tank

Figure 10. Pipe from farm flowing into the sea

Figure 11. Small stream by farm, fresh water sample 5 (EFW5)

Figure 12. Septic tank, public toilets and outfall pipe

Figure 13. Outfall pipe, fresh water sample 23 (EFW8)

Figure 14. Stream near village, fresh water sample 24 (EFW9)

Figure 15. Onshore halibut farm

Figure 16. Cast iron outfall pipe, location of fresh water sample 12 (FWA)

Figure 17. Outfall pipe, location of fresh water sample 17 (FWG)