

Scottish Sanitary Survey Project



Restricted Sanitary Survey Report

Kilbride Bay

AB 420

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Kilbride Bay Restricted Sanitary Survey Report Final 17/12/09



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Table of Contents

1.	Area Overview	1
1.1	Land Cover	2
1.2	Human Population	2
2.	Fishery	3
3.	Sewage Discharges	4
4.	Animals	6
4.1	Livestock	6
4.2	Wildlife	7
5.	Rainfall	8
5.1	Rainfall at Skipness House	8
6.	River Flow	10
7.	Historical <i>E. coli</i> Monitoring Data	12
8.	Bathymetry and Hydrodynamics	13
8.1	Tidal curve and description	14
8.2	Currents	15
8.3	Conclusions	15
9.	Shoreline Survey Overview	16
10.	Overall Assessment	17
11.	Recommendations	20
12.	References	22
13.	List of Tables and Figures	23
	Appendices	24
1.	Summary Sampling Plan	
2.	Shoreline Survey Report	

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1. Area Overview

Kilbride Bay is located in Cowal on the western coastline of Scotland, at the mouth of Loch Fyne and to the north of the Isle of Arran. Kilbride Bay is 0.9km wide and 0.4km long, and has an open aspect to the south. The bay is very shallow and the depth ranges from 0 – 5m.

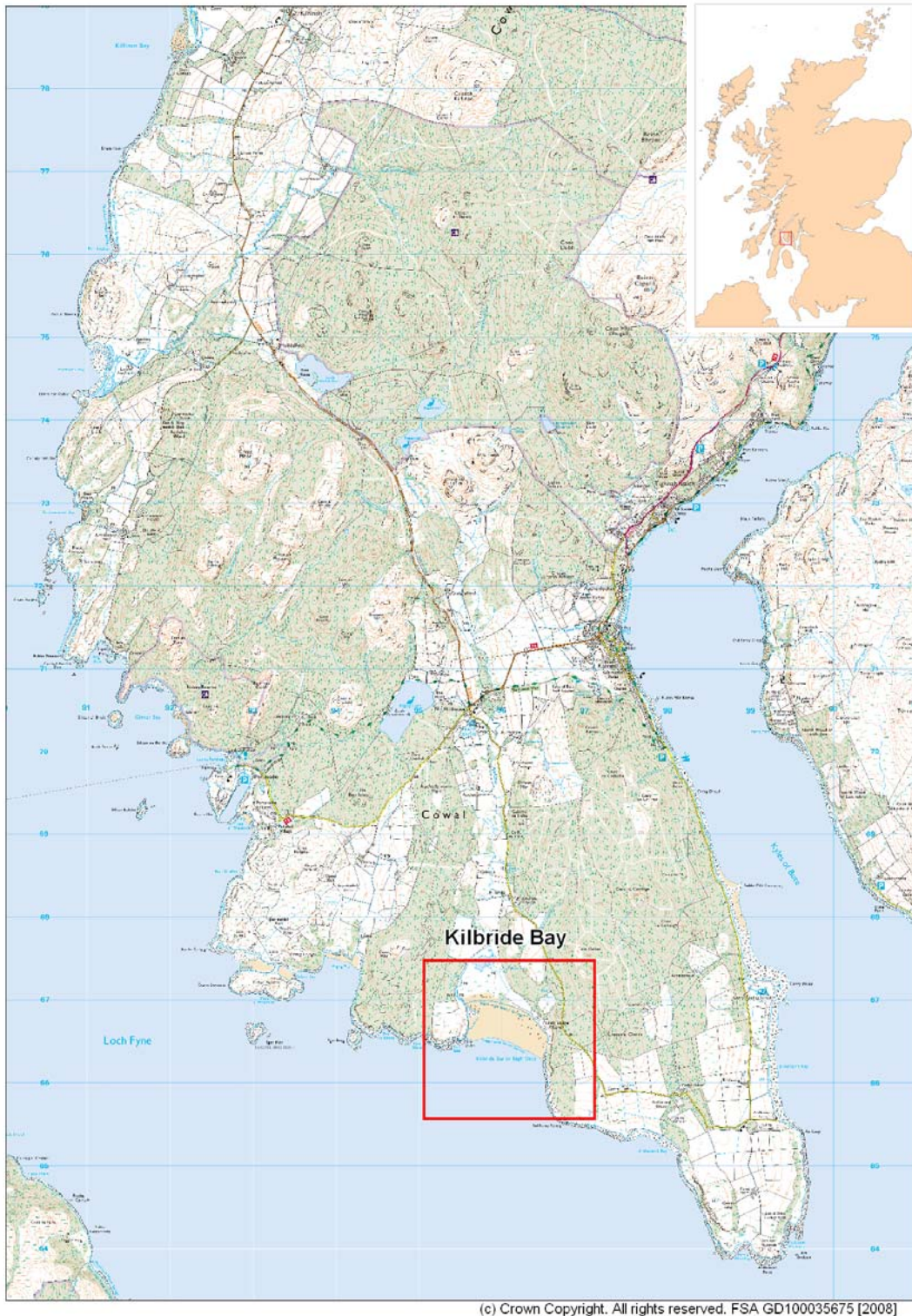


Figure 1.1 Location of Kilbride Bay

1.1 Land Cover

The land cover directly surrounding Kilbride Bay is predominantly improved and neutral grassland. This grassland covers a roughly 0.5km band of the coastline and then develops into dense coniferous woodland. Further along the catchment of the Allt Osda are further areas of improved grassland used for grazing livestock. The contribution of faecal indicator organisms (FIOs) to streams from improved grassland or pasture would be roughly 8.3×10^8 cfu km⁻² hr⁻¹ during dry weather conditions (Kay et al. 2008). This contribution would be expected to increase substantially after wet weather to roughly 4.6×10^{10} cfu km⁻² hr⁻¹.

Wooded area was found in the same study to contribute lower levels of GM FCs than grassland, with contributions of FC at roughly 3.3×10^9 cfu km⁻² hr⁻¹.

Contributions of faecal coliforms, and thus *E. coli*, are likely to be higher in streams carrying runoff from the grassland and farm areas than from the wooded areas, particularly after rainfall. At Kilbride Bay, the Allt Osda drains most of the grassland area and so would be expected to carry higher loads of faecal bacteria carried in runoff from surrounding land.

1.2 Human Population

The single census output area surrounding Kilbride Bay has a population of 144. The nearest settlement is the small village of Kilbride to the north of the bay.



Figure 1.2 Human population of Kilbride Bay

2. Fishery

The fishery at Kilbride Bay is comprised of a wild Razor fish (*Ensis* spp.) bed as listed in Table 2.1 below:

Table 2.1 Kilbride Bay production area

Site	SIN	Species
Kilbride Bay	AB 420 824 16	Razor fish

There is currently no production area, seabed lease or RMP assigned to this area. The bay falls within the Loch Fyne coastal strip designated shellfish growing water, though the nearest monitoring point for this area is in Whitehouse Bay, approximately 20 km to the northwest.

The actual shellfishery covers the area bounded by lines drawn between NR 95647 66666, NR 96438 66666, NR 96440 66190 and NR 95473 66190. The shellfish bed itself falls partly within the designated Shellfish Growing Water.

Razor fish are harvested using diving and both suction pump methods.

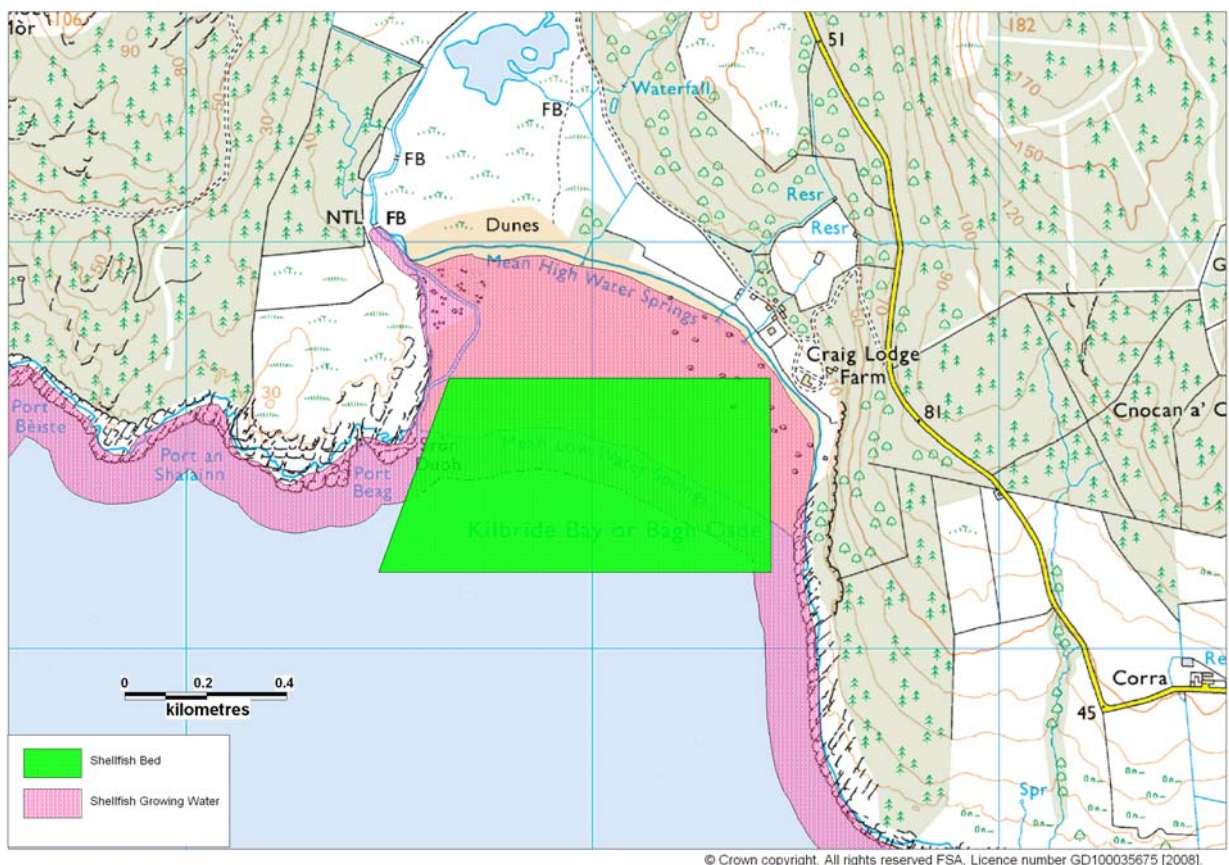


Figure 2.1 Kilbride Bay fishery

3. Sewage Discharges

There are no community septic tanks or sewage discharges identified by Scottish Water for the area around Kilbride Bay.

Two sewage discharge consents are held by SEPA for this area and are listed in Table 3.1 and mapped in Figure 3.1.

Table 3.1 Discharge consent held by SEPA

Ref No.	NGR of discharge	Discharge Type	Level of Treatment	Consented flow (DWF) m3/d	Consented/design PE
CAR/R/1018189	NR 9809 6569	Domestic	Sewage (Private) Primary	-	30
CAR/R/1010405	NR 9916 6641	Domestic	Sewage (Private) Primary	-	5

CAR/R/1010405 is a discharge to soakaway for one holiday chalet and is located on the eastern side of the Cowal peninsula. It is very unlikely to affect the fishery. CAR/R/1018189 is a discharge to soakaway for a cluster of houses near Ardiamont Bay, approximately 2km south and east of the MLWS line at Kilbride Bay. It is nearer to the actual shellfishery than the other listed discharge, though if in good working order it is unlikely to significantly impact water quality at the shellfish bed.

Observations of additional discharges made during the shoreline survey including outfall pipes are listed in Table 3.2. 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 1. On the day of survey, the cast iron pipe was discharging clean water so it is unknown whether the pipe ever carries foul discharge.

Table 3.2 Observations of potential sewage discharges

No.	Date	NGR	Description of potential sewage discharge
1	11.09.08	NR 96340 66809	Concrete pipe (60cm diameter) into the sea
2	11.09.08	NR 96483 66644	Cast iron pipe, 15cm diameter

There are a number of larger discharges approximately 10 km north of the Kilbride Bay fishery, but these are believed unlikely to significantly impact the water quality in Kilbride Bay due to their distance.

Overall, discharges from the outfall pipes closest to the eastern end of the bay are likely to have the greatest impact on water quality at the fishery.



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Figure 3.1 Sewage discharges near Kilbride Bay

4. Animals

4.1 Livestock

The Local Authority (Argyll & Bute Council, 2003) identified that there were 245 agricultural holdings, including 30 dairy cattle holdings and 80 beef cattle holdings and 39,477 breeding ewes in the Bute and Cowal area in 2002. Specific livestock numbers for the area surrounding Kilbride Bay were unavailable.

During the shoreline survey, 40 sheep were observed in a field adjacent to the bay near Craig Lodge Farm. Fresh cow pats and hoof prints were seen on western end of the beach near the Allt Osda, however there were no cattle visible in the area on the day (see Figure 4.1).

It is likely that there are further livestock associated with farms located to the north along the Allt Osda, which discharges into the western side of Kilbride Bay. During warm weather livestock will access streams to drink and cool off, directly contributing faecal contamination to the streams. Direct contamination of seawater is likely to occur on high tides when animals have been present on the shoreline. Distribution of livestock on the shoreline in this case is assumed to be even over time, however may vary markedly from week to week.

Overall, the direct contamination from livestock to the fishery is likely to be most acute nearest the farm at the eastern end of the bay as well as wherever livestock have access to the beach. Indirect contamination via runoff from farm areas and grazing land are likely to be highest at the northeastern corner of the fishery where a farm and two streams are located as well as along the western boundary where the Allt Osda carries runoff from grazing land to discharge into Kilbride Bay.



Figure 4.1 Livestock observation at Kilbride Bay

4.2 Wildlife

While the Bute and Cowal area does host some colonies of breeding seabirds, Kilbride Bay does not host significant colonies. Seabirds such as gulls will always be present in the vicinity but their distribution is likely to be even over time and as such would not materially affect placement of an RMP.

The area around Kilbride Bay contains large tracts of both deciduous and coniferous woodland and plantation. These areas are likely to contain deer, though no specific data on populations in Bute and Cowal was available at the time of writing. Any impact to the fishery from this source is likely to be found in streams and watercourses feeding into the bay. This impact would be higher after forestry activities, especially clear cutting, as this increases runoff to streams during rainfall.

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*). Scotland hosts significant populations of both species.

Common seals 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 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 growing number of harbour seals in the Loch Fyne area over the past twenty years (Table 4.1). Grey seals have also been spotted but in very small numbers and were absent in 1996 (Table 4.2).

Table 4.1 Harbour Seals

Location		Aug 1989	Aug 1996	Aug 2000	Aug 2007
Loch Fyne	Kilbride Bay	1	0	0	0
	More of Loch Fyne	104	70	34	78

Table 4.2 Grey Seals

Location		Aug 1989	Aug 1996	Aug 2000	Aug 2007
Loch Fyne	Kilbride Bay	0	0	0	3
	More of Loch Fyne	16	0	7	9

Only 3 grey seals were surveyed in Kilbride Bay in 2007, though more may be present. The impact may be significant when the seals are physically present, but their presence is not likely to be predictable and so will not be considered in establishing a sampling plan for this area.

5. Rainfall

The nearest weather station is located at Skipness House, approximately 10.2km southwest of the production area. Rainfall data was supplied for the period 01/01/03 to 31/12/07 (total daily rainfall in mm). For this period of 1765 days, total daily rainfall was not recorded for 91 days, including Jan, Nov and Dec 2006. It is likely that the rainfall experienced at Skipness House 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 Skipness House

Rainfall records from Skipness House are nearly complete for years 2003-2005 and 2007. However, there were no records for January, November or December 2006. Therefore, total annual rainfall was calculated using only data from years with complete records, and is presented in Figure 5.1.

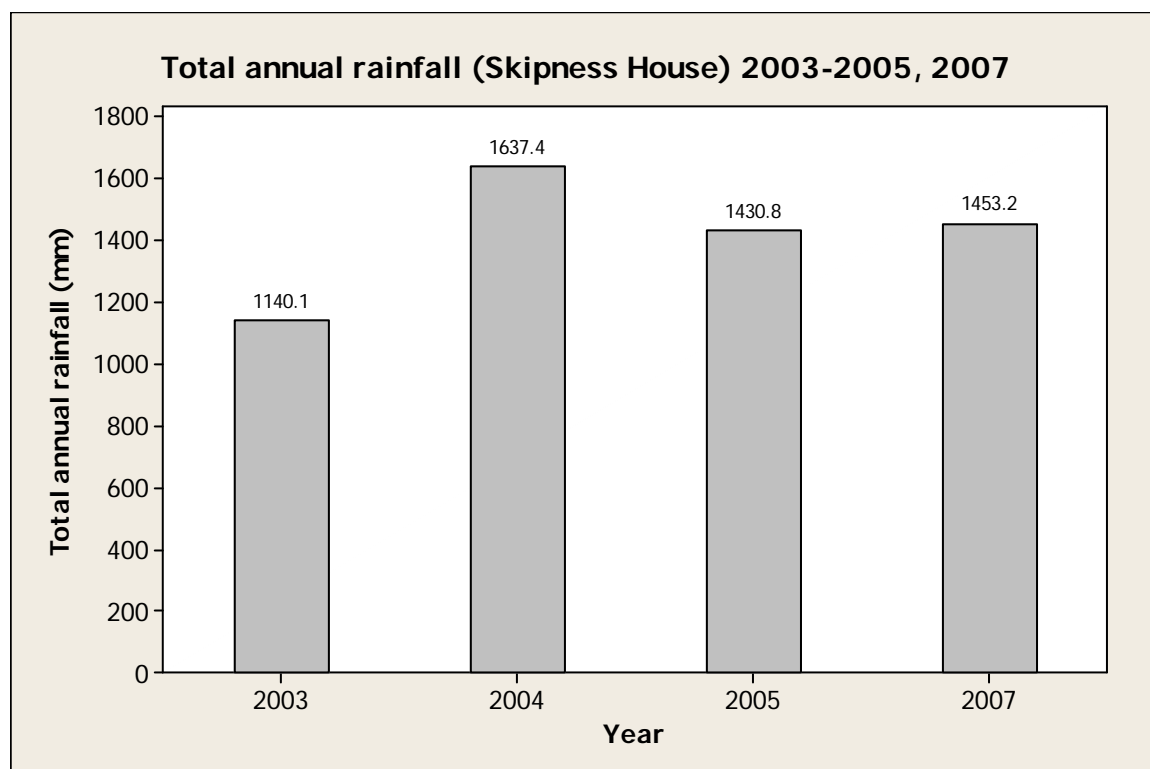


Figure 5.1 Total annual rainfall at Skipness House 2003 – 2005, 2007.

Mean monthly rainfall was calculated using all available data; however the mean calculation was altered by dividing the total monthly rainfall by four years instead of five years for those months with missing data.

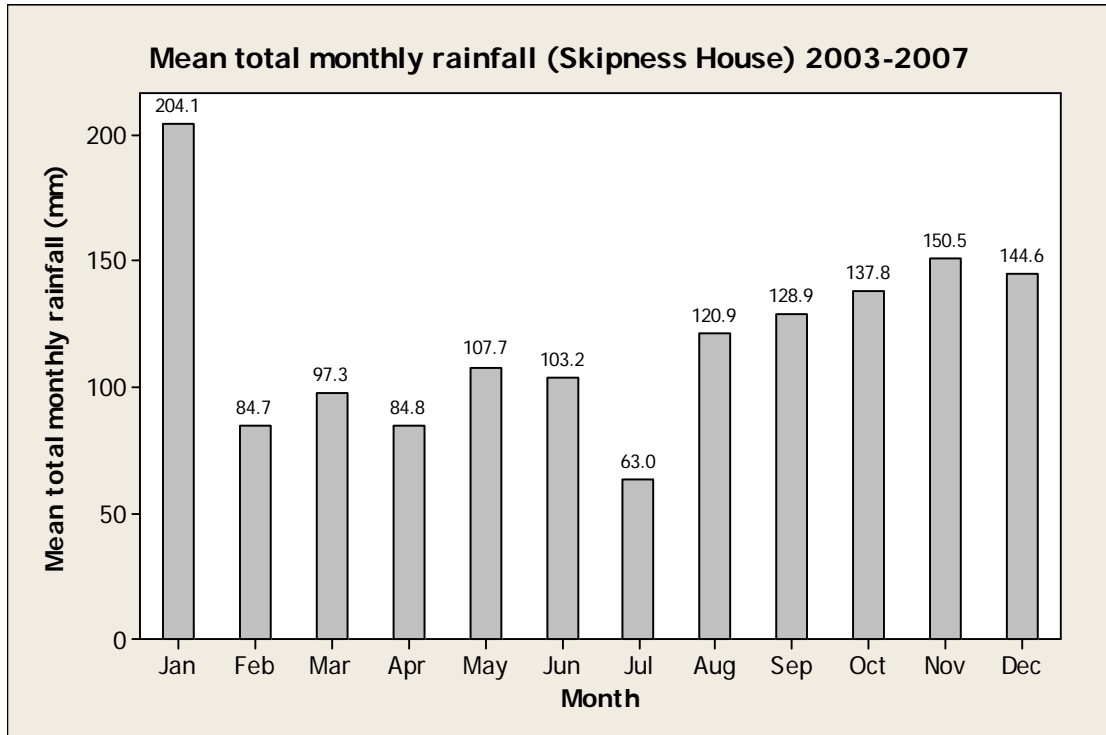


Figure 5.2 Mean total monthly rainfall at Skipness House 2003 – 2007.

The wettest month was January and then November and December. For the period considered here (2003 – 2007), only 33.77% of the days experienced no rainfall. 15.52% of days experienced rainfall of 1mm or less. The greatest increases in rainfall from one month to the next occurred in January and August.

It can be expected that levels of rainfall dependant faecal contamination entering the production area from these sources will be higher during months in which higher rainfall is observed, in this case August to January inclusive.

Accumulation of faecal material on fields during a preceding dry period could lead to higher levels of contaminated runoff when followed by a period of markedly wetter weather, as is observed in August.

6. River Flow

There are no significant rivers or river gauging stations in the vicinity of Kilbride Bay.

Four streams discharge into Kilbride Bay. Their locations are shown in Figure 6.1. Three of these streams were sampled during the shoreline survey, representing the largest freshwater inputs into Kilbride Bay. Measurements taken on the day of survey may not be representative of flow conditions at all times of the year.

Table 6.1 Stream flows and loadings – Kilbride Bay

No.	Grid Ref	Description	Width (m)	Depth (m)	Measured Flow (m/s)	Flow in m ³ /day	<i>E. coli</i> (cfu/100ml)	Loading (<i>E. coli</i> per day)
1	NR 95468 67029	Allt Osda	2.5	1.2	0.386	100051	900	9.0E+11
2	NR 96340 66827	Stream	0.8	0.1	0.275	1900	50	9.5E+08
3	NR 96400 66766	Stream	0.7	0.08	0.454	2197	200	4.4E+09

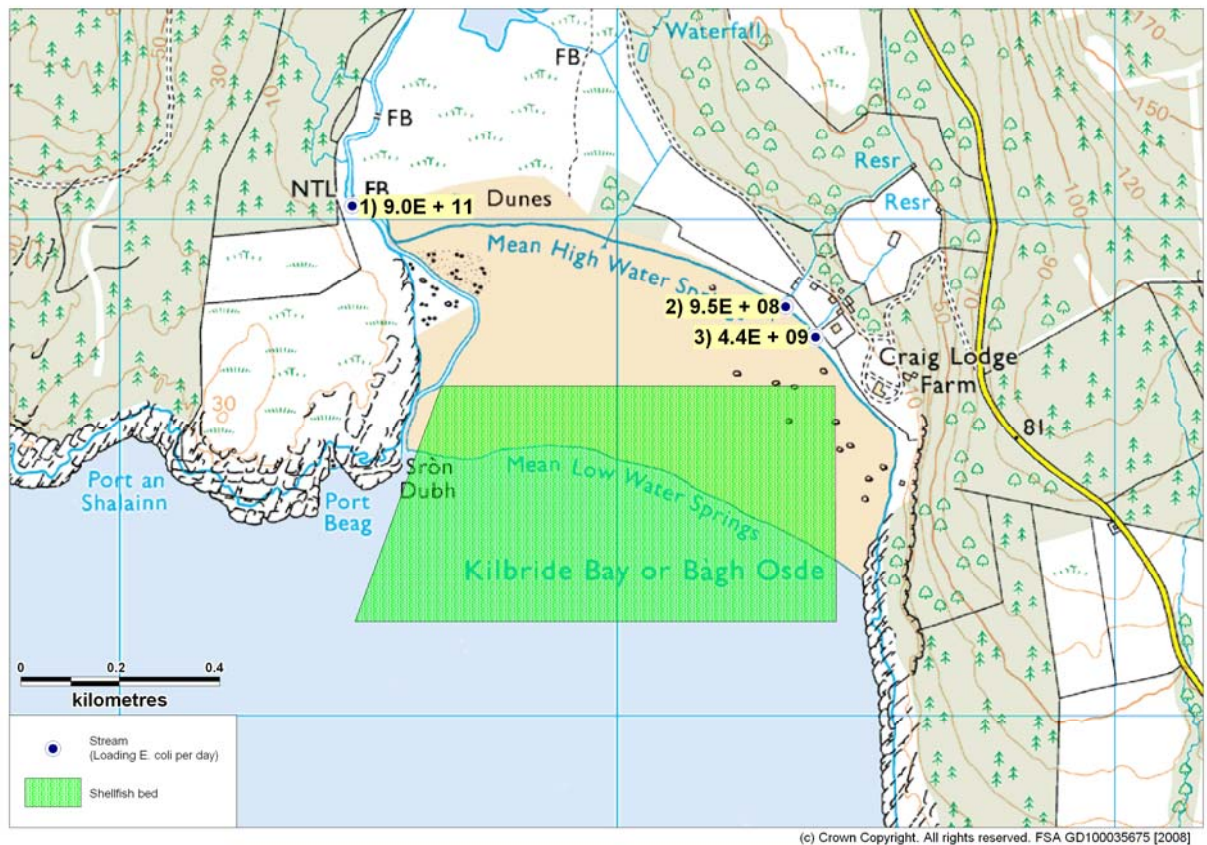


Figure 6.1 Location of streams and loadings at Kilbride Bay

The Allt Osda is by far the largest of the streams, draining a catchment area of 15.8 km² that stretches 10 km north from the shoreline and includes a number of farms and the small settlement of Millhouse. It was also the most contaminated of the three. Only one discharge consent was noted for this settlement by SEPA and though it was for a soakaway to land, as the stream passes near the area it is possible that some septic tanks there may discharge directly to it. Livestock held

on the various farms in the catchment are likely to be a more significant source of faecal contamination to this stream, however.

The other two measured streams pass through woodland and past a farm on the eastern side of the bay. These showed still significant loadings of *E. coli* on the day of survey, despite the fact that they did not drain a significant land area.

All of these streams deliver significant levels of faecal contamination to the fishery, with the highest probable impact nearest the mouth of the Allt Osda at the western end of the bay as this carried substantially higher loadings than the other two streams combined.

7. Historical *E. coli* Monitoring Data

There is an insufficient monitoring history at Kilbride Bay to undertake analysis of results. Only three shellfish hygiene monitoring results for razor clams are available for Kilbride Bay. The first was taken on 09/07/2008 and had a result of <20 *E. coli* per 100 g, the second result was taken on 13/08/2008 and had a result of 40 *E. coli* per 100 g and the third was taken on 17/09/08 and had a sample of 3500 *E. coli* per 100 g. A further sample was taken from the western side of the bay on 17/09/08 to satisfy sampling requirements associated with the shoreline survey and this contained 500 *E. coli* per 100 g.

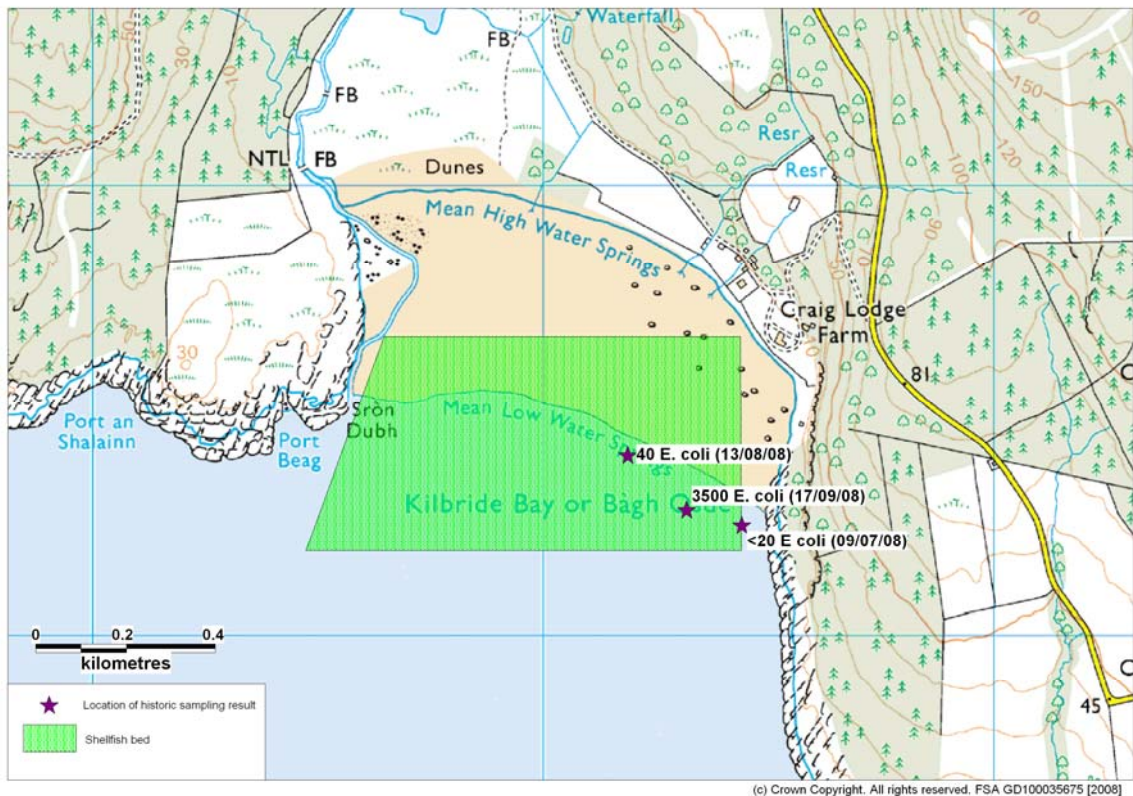


Figure 7.1 Location of monitoring results at Kilbride Bay

8. Bathymetry and Hydrodynamics

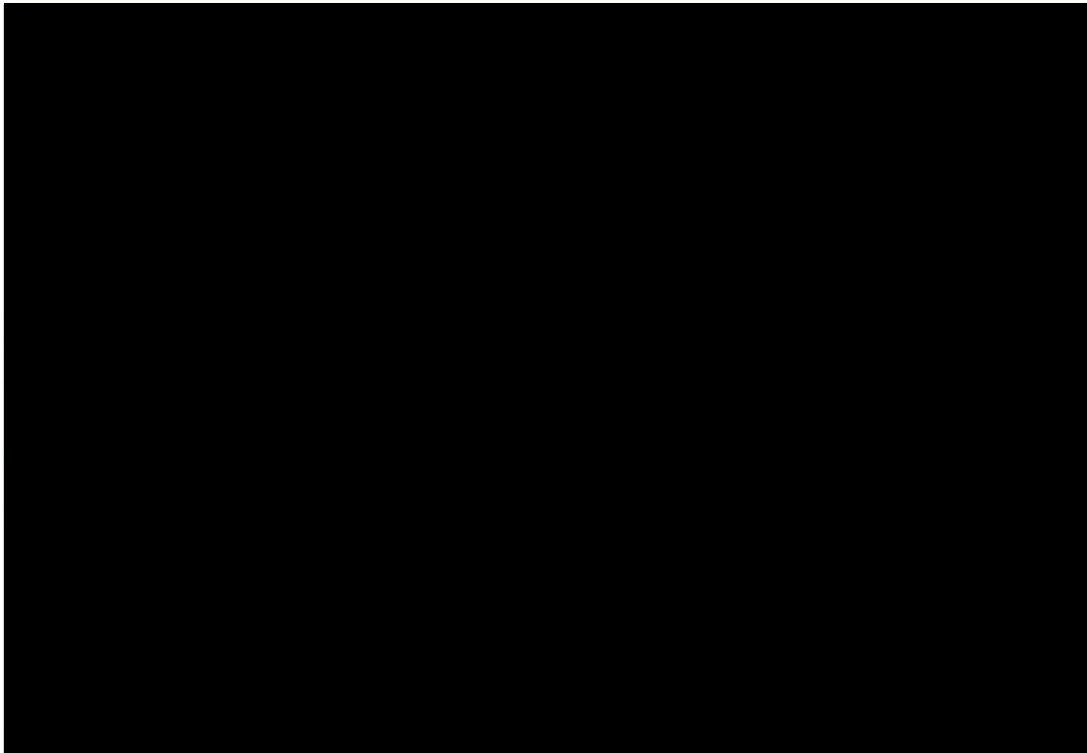


Figure 8.1 Kilbride Bay bathymetry

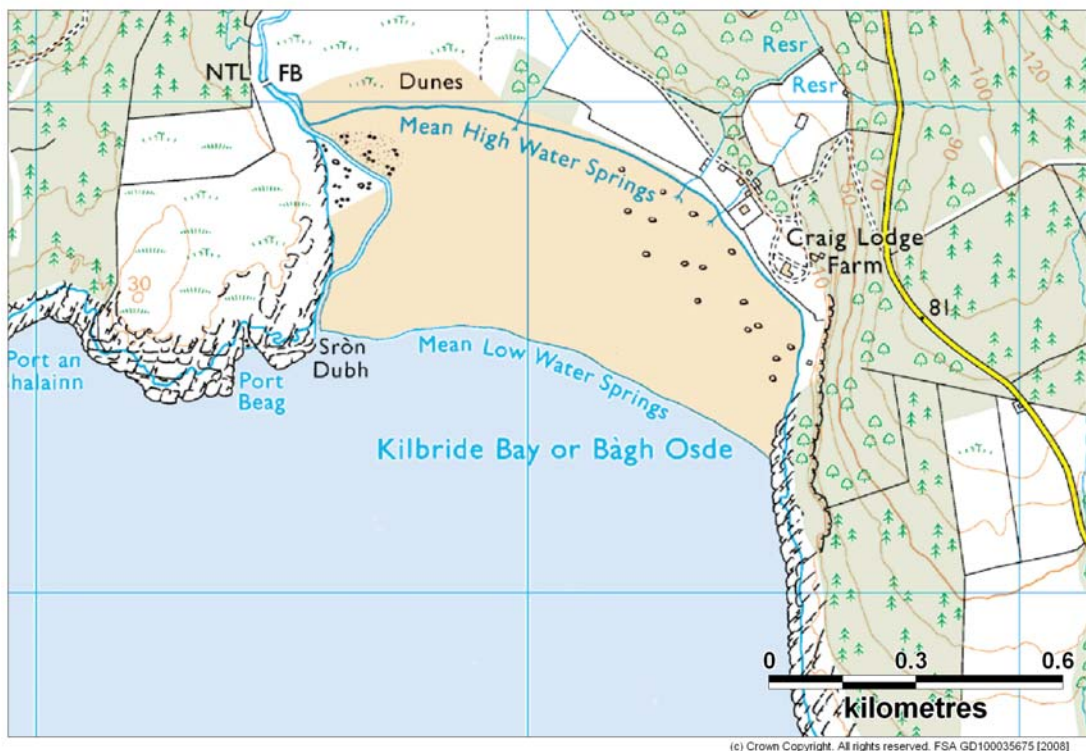


Figure 8.2 Kilbride Bay

The bathymetry chart above shows that there is a large intertidal area directly adjacent to the coastline. Beyond this, the depth steadily increases to 20 metres approximately 500 metres from the coastline.

8.1 Tidal curve and description

The two tidal curves below are for the port of East Loch Tarbert, the nearest tidal port. They have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 10th September 2008. The second is for seven days beginning 00.00 GMT on 18th September 2008. Together they show the predicted tidal heights over high/low water for a full neap/spring tidal cycle.

East Loch Tarbert lies approximately 9km northwest of Kilbride Bay. Times of high and low water are likely to be slightly earlier at Kilbride Bay as the tidal port lies further up the loch and away from the open sea.

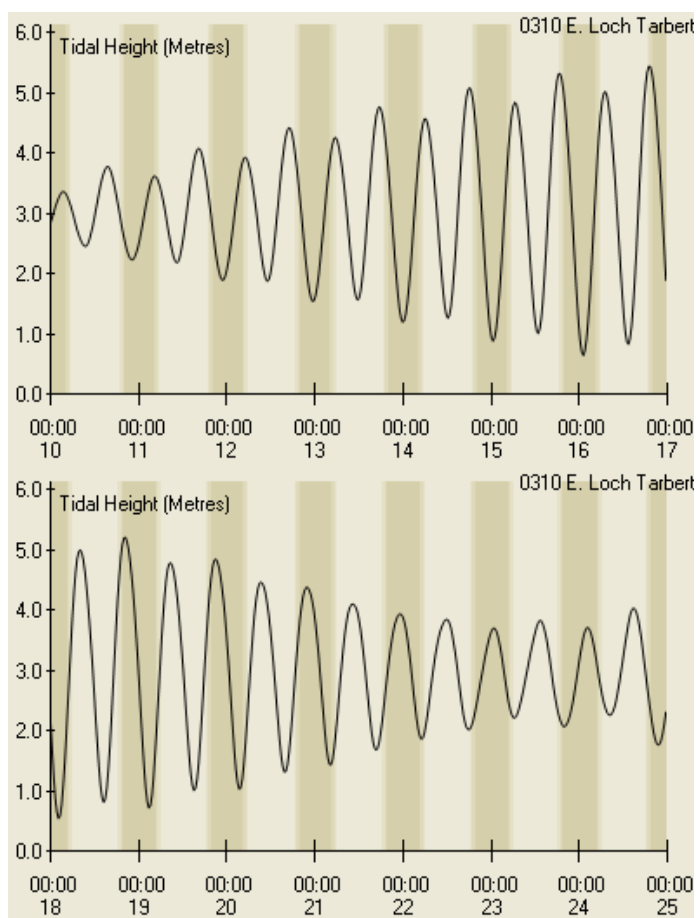


Figure 8.3 Tidal curves for East Loch Tarbert

The following is the UKHO summary description for East Loch Tarbert:
E. Loch Tarbert is a Secondary Non-Harmonic port. The tide type is Semi-Diurnal.

HAT	5.8 m
MHWS	5.0 m
MHWN	3.7 m
MSL	3.05 m
MLWN	2.1 m
MLWS	0.8 m

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Predicted heights are in metres above chart datum. The tidal range at spring tide is approximately 4.2 m and at neap tide 1.6 m.

8.2 Currents

The nearest tidal stream information comes from Inchmarnock Water, approximately 11km south of Kilbride Bay (Admiralty chart 2131, Tidal Diamond G). The chart information states that the tidal stream in this area is weak and irregular, with flows of 0.25 knots (0.13 m/s) or less.

As the tidal stream information available is for a point over 10km away from Kilbride Bay, it may not provide an accurate prediction of tidal streams at and within the bay itself.

8.3 Conclusions

Kilbride Bay is an open, south-facing bay and will be impacted by tidal movement as well as wind-driven currents.

Strong winds from the south or southwest will tend to drive water and waves into the bay, releasing contaminants left by farm livestock from higher up the shoreline into the bay. Tidal currents are likely to be stronger than those observed at Tidal Diamond G due the coastal influences at Kilbride Bay, such as shallower depth and the potential for wind-driven long shore currents.

Streams discharging into the bay are likely to most acutely affect the end of the bay nearest where they discharge, beyond which dilution may significantly reduce the amount of contamination carried across the remainder of the area.

It is further possible that faecal contaminants from the large soakaway system near Ardiamont Bay, approximately 2 km to the southeast, could affect shellfish in the identified bed should the system fail. Any impact would be most likely observed on the southeastern corner of the fishery.

9. Shoreline Survey Overview

A physical survey of the site was conducted by representatives from the local authority on 11th September 2008. Further to the shoreline walk, the harvester provided shellfish samples and a water sample on 17th September 2008.

The map provided in Figure 9.1 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:

- Allt Osda burn at western end of bay carrying contaminated runoff to fishery.
- Input from livestock grazing on and near the shoreline.
- Septic pipes and streams observed at eastern end of bay.

A seawater sample collected from adjacent to the burn contained 600 E.coli cfu/100 ml and both shellfish samples contained concentrations higher than the limit for Class A.



Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Human sewage inputs

With a neighbouring human population at the 2001 census of 144 and no settlements in the immediate vicinity, the overall loading of sewage to Kilbride Bay is low. However, the area is not connected to any mains sewerage and two outfall pipes were identified during the shoreline survey. A sample taken from a cast iron pipe discharging to the shoreline contained no *E. coli* on the day of survey. As the other pipe discharged underwater, it was not possible to observe or sample any outflow.

A further source of potential impact would be the soakaway system at Ardiamont should it fail, though this is of much lower importance than the potential discharges closer to the fishery.

Agricultural inputs

There is no arable agricultural land in the immediate vicinity of Kilbride Bay, though there are areas of grassland that could be used to graze livestock.

There are a number of farms within the Allt Osdá catchment and it is likely that a significant number of livestock are resident within the area upstream of Kilbride Bay. The closest farm to the fishery is located along the eastern shore of the bay immediately adjacent the shellfish bed. During the shoreline survey approximately 40 sheep were observed in a field adjacent to the bay and there was evidence that cattle had recently been on the shoreline.

Two smaller streams pass near to Craig Lodge Farm and adjacent to the field in which the sheep were observed. During warmer weather, it is probable that any livestock present would access these watercourses to drink and cool off leading to increased bacterial loads in the streams and subsequently in the bay.

Wildlife inputs

Wildlife such as seals and water birds are likely to be resident in or visit the area, but not in large numbers. Given the large amount of wooded area, it is likely that significant numbers of deer are present in the area, though none were directly observed during the shoreline survey.

Overall, the wildlife impacts to the fishery at Kilbride Bay are likely to be localised, 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 with which 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 the livestock may access the streams discharging into Kilbride Bay to drink and cool off more frequently, leading to higher levels of contamination in the water. There is also likely to be an increase in population during the summer months, but the population will remain at a relatively low level density nonetheless.

Rivers and streams

In total, three fresh water streams discharge into Kilbride Bay. Water samples taken from the streams showed *E. coli* concentrations varying from 50 and 200 *E. coli* cfu/100ml at the eastern end of the bay to 900 *E. coli* cfu/100ml for the Allt Osda at the western end. A fourth stream that appeared on the map to discharge into the centre of the bay was found to actually flow into one of the other streams before reaching the bay.

It is expected that the freshwater input at the western end of the bay is likely to have a higher effect on the bacterial contamination of shellfish than the freshwater inputs at the eastern end of the bay.

Rainfall

Rainfall patterns at Skipness House (the nearest rainfall station) show rainfall levels are higher between August 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. The impact of this is likely to be most acute nearest where the streams enter the sea.

Analysis of results

Only three shellfish hygiene monitoring results for razor clams were available for Kilbride Bay. These were taken in consecutive months between July and September of 2008. The first two samples contained very low concentrations of *E. coli*. The sample collected in September contained 3500 *E. coli* per 100 g, placing it toward the upper end of Class B limits. The three samples were taken from within 300 metres of one another, with the highest result bracketed spatially by the other two.

Seawater samples were taken from three points along the shoreline. Compliance thresholds based on results observed in seawater have been estimated at a geometric mean value of 1.1 cfu *E. coli* per 100 ml for Class A standard for combined species and at a geometric mean value of 111.7 cfu *E. coli* per 100 ml for compliance with Class B standard. All of the seawater samples returned results in excess of that estimated for Class A compliance. The two seawater samples taken from the western end of the bay were more contaminated, with one (600 *E. coli* cfu per 100 ml found near the outlet of the Allt Osda) exceeding the estimate for Class B compliance.

Shellfish samples were taken from two points of the razor bed during the shoreline survey. One sample was collected from the eastern end of the bay as part of the

monitoring program (3500 *E. coli* per 100 g). The second sample was taken on the western side of the bay and was significantly less contaminated than the eastern sample (500 *E. coli* per 100 g).

This seemed to contradict the findings in water, which showed higher levels of contamination on the western side of the bay. However, the number of shellfish sampling occasions was extremely limited and the water results relate only to the day of survey.

Movement of Contaminants

As noted in Section 8 tidal flows in the area are likely to be weak and so movement of contaminants is likely to be more strongly influenced by wind driven flows and long shore currents. Potentially, these may lead to east-west movement of contamination across the shellfish bed. Given the small size of the area, this may vary significantly on a day to day basis and between tides.

Ultimately, there are insufficient data on which to base any prediction of spatial or temporal variation in levels of contaminants likely to be found in shellfish at Kilbride Bay.

Summary

It is evident from the limited water and shellfish sampling results obtained to date that significant amounts of faecal contamination reach the shellfish bed at Kilbride Bay from streams discharging into the bay and possibly from septic tank discharges directly to the bay.

Factors of relevance to the sampling plan are as follows:

- Locations of the streams discharging into the eastern and western end of the bay.
- Location of the outfall pipes observed during the shoreline survey.
- Location of homes and farm at the east end of the bay.
- Observation of livestock droppings on shoreline.
- Limited shellfish sampling results indicating higher contamination at east end of bay.

11. Recommendations

The Kilbride Bay Production Area is recommended to be the area bounded by lines drawn between NR 9542 6655 and NR 9542 6600 and between NR 9655 6600 and NR 9555 6645 and between NR 9600 6658 and NR 9556 6655 extending to MHWS (Figure 11.1).

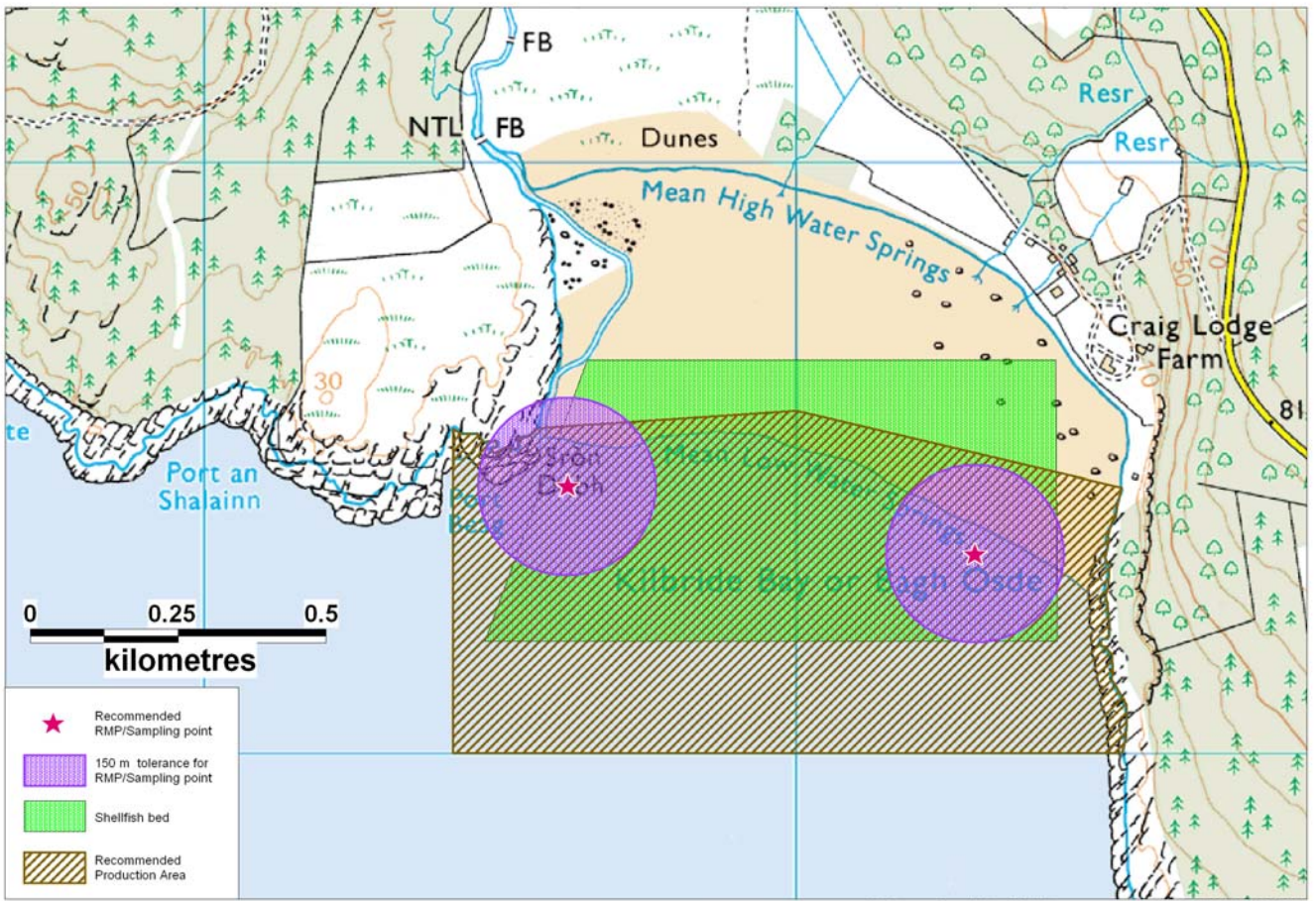
This area excludes the northernmost extent of the shellfish bed as it is not currently fished and is also closer to noted sources of contamination.

Due to inconsistency in bacteriological results obtained from both water and shellfish sampling, it is recommended that an extended bacteriological survey be conducted in parallel with monitoring sampling. Significant known sources of contamination exist at either end of the bay and so before a single RMP for the production area can be established it is necessary to determine whether significant variation in contamination levels exists between the two sides of the production area.

The recommended interim RMP is NR 9630 6634 and the recommended parallel sampling point is NR 9561 6645. Both sites should be sampled on the same day for 6 months, after which the results will be assessed to see whether the two points can be rationalised to one.

Sampling frequency is recommended to be monthly as the harvester intends to harvest year round when possible.

Sampling tolerance is recommended to be 150 metres to allow for sufficient availability of stock for sampling.



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Figure 11.1 Kilbride Bay recommendations

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13. List of Tables and Figures

Figures

Figure 1.1 Location of Kilbride Bay	1
Figure 1.2 Human population of Kilbride Bay	2
Figure 2.1 Kilbride Bay fishery	3
Figure 3.1 Sewage discharges near Kilbride Bay	5
Figure 4.1 Livestock observation at Kilbride Bay	6
Figure 5.1 Total annual rainfall at Skipness House 2003 – 2005, 2007.	8
Figure 5.2 Mean total monthly rainfall at Skipness House 2003 – 2007.	9
Figure 6.1 Location of streams and loadings at Kilbride Bay	10
Figure 7.1 Location of monitoring results at Kilbride Bay	12
Figure 8.1 Kilbride Bay bathymetry	13
Figure 8.2 Kilbride Bay.....	13
Figure 8.3 Tidal curves for East Loch Tarbert.....	14
Figure 9.1 Summary of shoreline observations.....	16
Figure 11.1 Kilbride Bay recommendations	21

Tables

Table 2.1 Kilbride Bay production area	3
Table 3.1 Discharge consent held by SEPA	4
Table 3.2 Observations of potential sewage discharges.....	4
Table 4.1 Harbour Seals	7
Table 4.2 Grey Seals	7
Table 6.1 Stream flows and loadings – Kilbride Bay	10

Appendices

- 1. Summary Sampling Plan**
- 2. Shoreline Survey Report**

Sampling Plan for Kilbride Bay

PRODUCTION AREA	SITE NAME	SIN	SPECIES	TYPE OF FISHERY	NGR OF RMP	EAST	NORTH	TOLERANCE (M)	DEPTH (M)	METHOD OF SAMPLING	FREQ OF SAMPLING	LOCAL AUTHORITY	AUTHORISED SAMPLER(S)	LOCAL AUTHORITY LIAISON OFFICER
Kilbride Bay	Kilbride Bay Razors	AB 420	Razors	Wild harvest	NR 9630 6634	19630	66634	150	NA	Hand/Dived	Monthly	Argyll & Bute Council	Christine McLachlan William MacQuarrie Ewan McDougall Donald Campbell	Christine McLachlan
			Razors	Wild harvest	NR 9561 6645	19561	66645	150	NA	Hand/Dived	Monthly	Argyll & Bute Council	Christine McLachlan William MacQuarrie Ewan McDougall Donald Campbell	Christine McLachlan

Shoreline Survey Report



Kilbride Bay
AB 420

Scottish Sanitary Survey Project  **Cefas**

Shoreline Survey Report

Production area: Kilbride Bay
 Site name: Kilbride Bay Razors
 Species: Razors
 Harvester: Mr Hector Stewart
 Local Authority: Argyll and Bute Council
 Status: New site

 Date Surveyed: 11/09/08 and 17/09/08
 Surveyed by: Ewan McDougall and Donald Campbell (11/09/08) and William MacQuarrie (17/09/08)
 Existing RMP: N/A
 Area Surveyed: See Figure 1

Weather observations

11/09/08 – Wind S Force 5, light showers. Rain in previous 24 hours.
 17/09/08 - Cloudy, dry, Wind SE Force 1. Heavy rain previous 2 days.

Site Observations

Fishery

This site is a wild shellfishery. The harvester farms the area bounded by lines drawn between NR 95647 66666, NR 96438 66666, NR 96440 66190 and NR 95473 66190. Stock of sufficient size and quantity was present for sampling.

Sewage/Faecal Sources

There are no known sewage discharges in the Kilbride Bay area. During the shoreline survey a concrete pipe leading into the sea and cast iron pipe on the shoreline were identified.

Seasonal Population

Kilbride Bay has no significant seasonal population.

Streams

Three streams were observed during the shoreline survey. The Allt Osda and two unnamed streams were measured and sampled. A fourth stream, the Allt a Chaorainn, was found to not flow directly into the sea. It ran along a ditch parallel to the beach to join the next stream to the east. Flow measurements at observation point three include this stream.

Boats/Shipping

There were no boats visiting the area at the time of the shoreline survey.

Land Use

The land use surrounding Kilbride Bay was primarily grassland (with grazing sheep and beef cattle) there were also areas of natural woodland and forestry planted woodland.

Wildlife/Birds

No wildlife or birds were observed during the shoreline survey.

Observations can be found in Table 1.

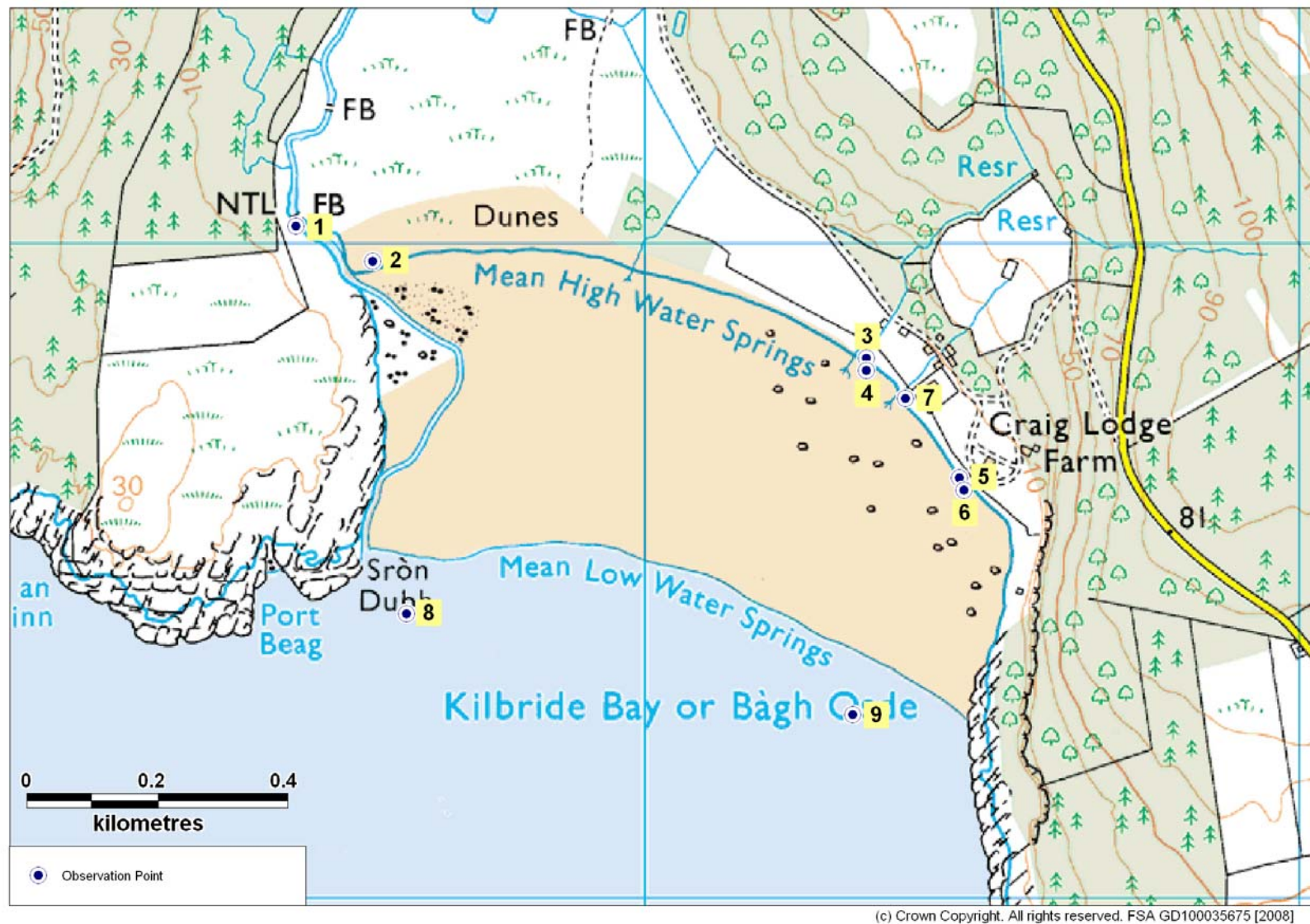


Figure 1. Shoreline Observations

Table 1. Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Description
1	11/09/2008	10:30	NR 95468 67029	195468	667029		Big burn (Allt Osda).W 2.5m, D 1.2m, F 0.386m/s. Water sample K1.
2	11/09/2008	10:36	NR 95585 66976	195585	666976	Figures 4 & 5	Sea water sample K2. Salinity 1016. Fresh cow pats and hoof prints on beach – no animals in sight.
3	11/09/2008	10:55	NR 96340 66827	196340	666827		Small stream. W 0.8m, D 0.1m, F 0.275m/s. Water sample K4. 40 sheep in field. Three houses nearby.
4	11/09/2008	11:00	NR 96340 66809	196340	666809		Concrete pipe into sea, unable to measure flow or sample. 0.6m diameter.
5	11/09/2008	11:00	NR 96483 66644	196483	666644		Cast iron pipe, 0.15m diameter. Water sample K5.
6	11/09/2008	11:05	NR 96489 66626	196489	666626		Sea water sample K3. Salinity 1022.
7	11/09/2008	11:09	NR 96400 66766	196400	666766		Small stream. W 0.7m, D 0.08m, F 0.454m/s. Water sample K6.
8	17/09/2008	07:45	NR 95637 66437	195637	666437		Kilbride Razor sample 1, Seawater sample 3
9	17/09/2008	07:55	NR 96319 66282	196319	666282		Kilbride Razor sample 2.

Photographs referenced in the table can be found attached as Figures 4 and 5.

Sampling

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

Two Razor samples were taken during the shoreline survey. The first sample was taken at the western end of the bay and the second sample was taken at the eastern end of the bay (see Figure 3). In total, seven water samples were taken. Three were taken from streams discharging into the bay, one from a cast iron pipe and the remainder were seawater samples.

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

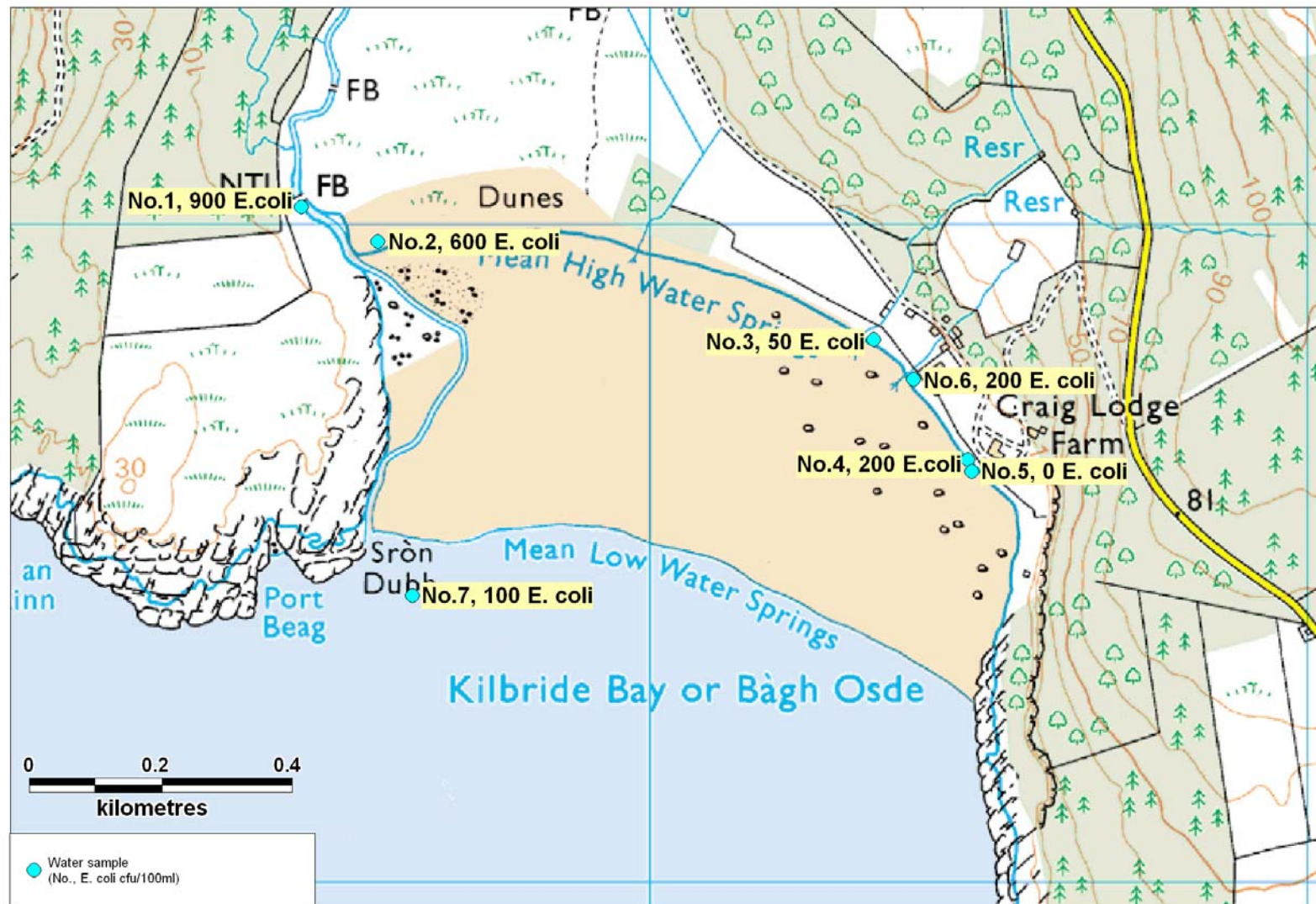
Samples were also tested for salinity by the laboratory using a salinity meter under more controlled conditions. These results are shown in Table 2, given in units of grams of salt per litre of water. This is the same as ppt.

Table 2. Water sample results

No.	Date	Sample	Grid Ref	Type	E. coli (cfu/100 ml)	Salinity (g/L)
1	11/09/2008	K1	NR 95468 67029	Freshwater	900	
2	11/09/2008	K2	NR 95585 66976	Seawater	600	23.4
3	11/09/2008	K3	NR 96340 66827	Seawater	50	30.0
4	11/09/2008	K4	NR 96483 66644	Freshwater	200	
5	11/09/2008	K5	NR 96489 66626	Freshwater	0	
6	11/09/2008	K6	NR 96400 66766	Freshwater	200	
7	17/09/2008	Kilbride Bay 3	NR 95637 66437	Seawater	100	28.3

Table 3. Shellfish sample results

No.	Date	Sample	Grid Ref	Type	E. coli (cfu/100g)
1	17/09/2008	Kilbride Bay 1	NR 95637 66437	Razor	500
2	17/09/2008	Kilbride Bay 2	NR 96319 66282	Razor	3500



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Figure 3. Water sample results

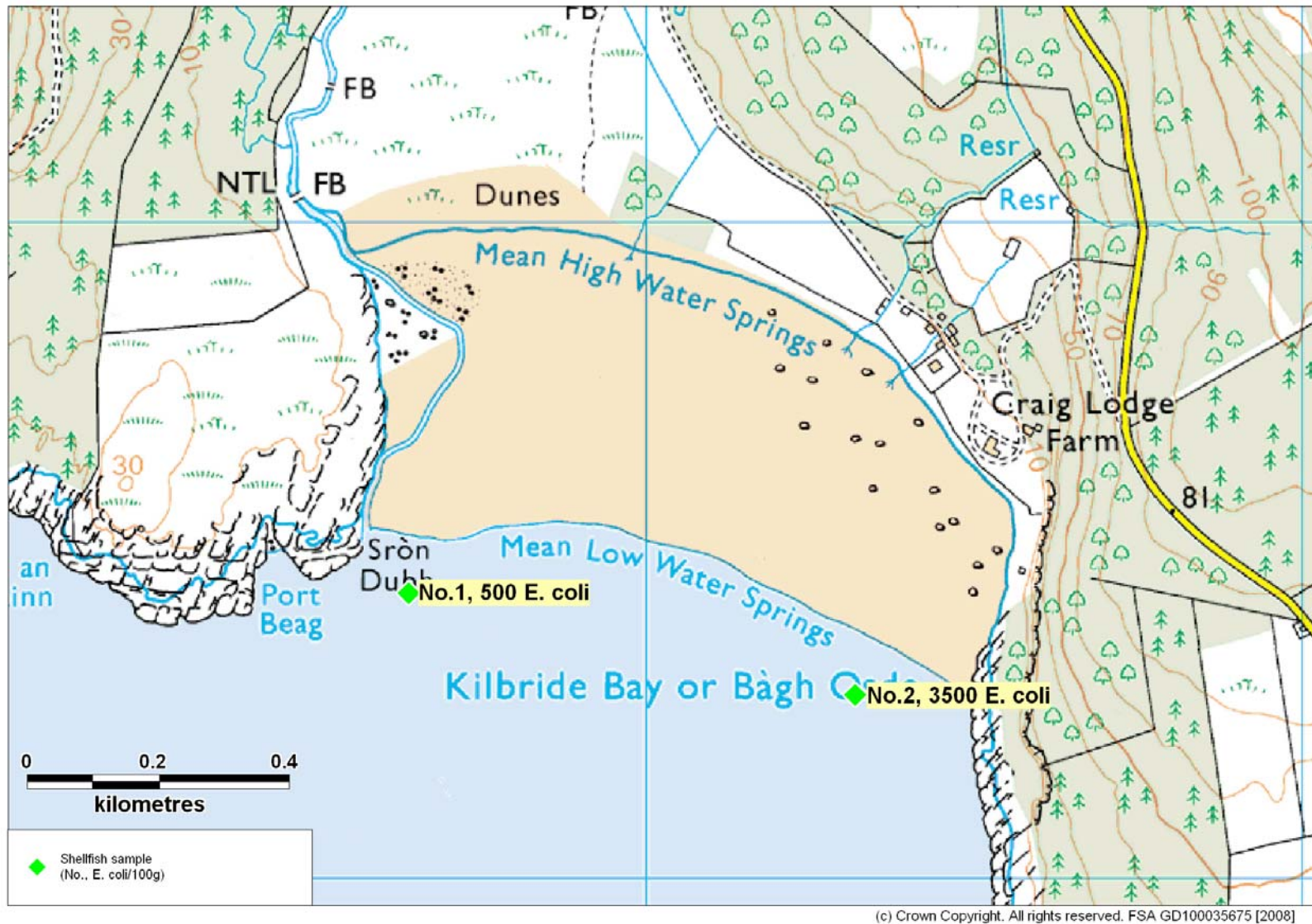


Figure 4. Shellfish sample results

Photographs



Figure 4. Kilbride Bay, collection point of seawater sample 2



Figure 5. Kilbride Bay