Scottish Sanitary Survey Project

Restricted Sanitary Survey Report

Saddell Bay

AB 512

February 2010

Draft Report Distribution – Saddell Bay

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

** Distribution of draft and final reports to harvesters in undertaken by the relevant local authority.

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1. Area Overview

Saddell Bay is located 9.6 miles to the north of Campbeltown, on Kilbrannan Sound facing the Isle of Arran (see Figure 1.1).

Saddell Bay is 1 km wide and 0.4 km in length. The depth of Saddell Bay increases gradually from 0 to 10 m until the open waters of Kilbrannan Sound where depths reach up to 200 m in some areas. A restricted sanitary survey at Saddell Bay was conducted in response to receipt of an application to classify the area for commercial harvest of razor clams (*Ensis* spp.).

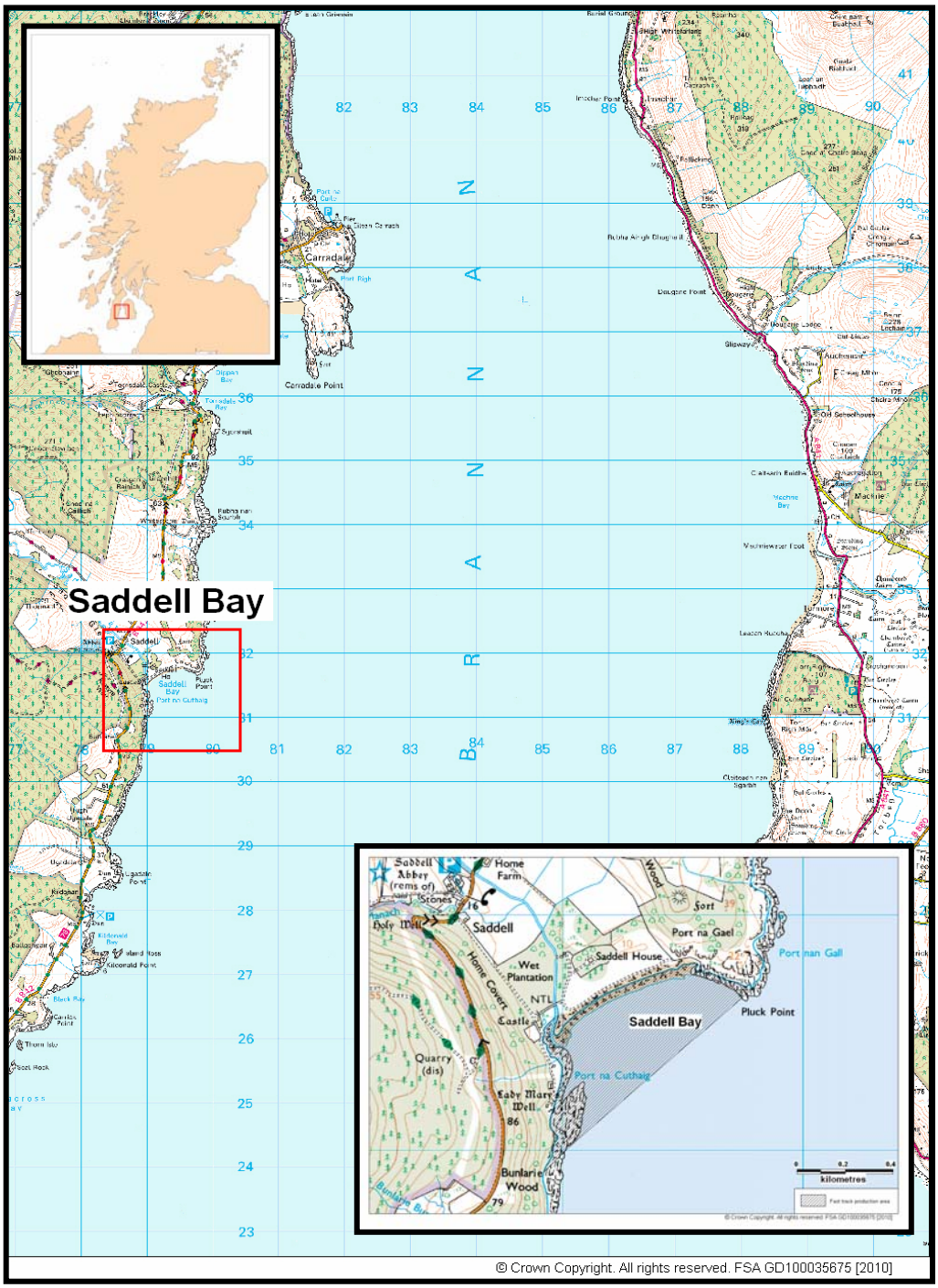

Figure 1.1 Location of Saddell Bay

1.1 Land Use

Land Cover 2000 data indicates that the land surrounding Saddell Bay is mainly coniferous woodland and broadleaf woodland with areas of improved grassland on the northern shoreline of the bay (see Figure 1.2).

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. The areas of improved grassland to the north of Saddell Bay would be expected to contribute the most to contamination levels carried in surface runoff to this side of the razor clam bed.

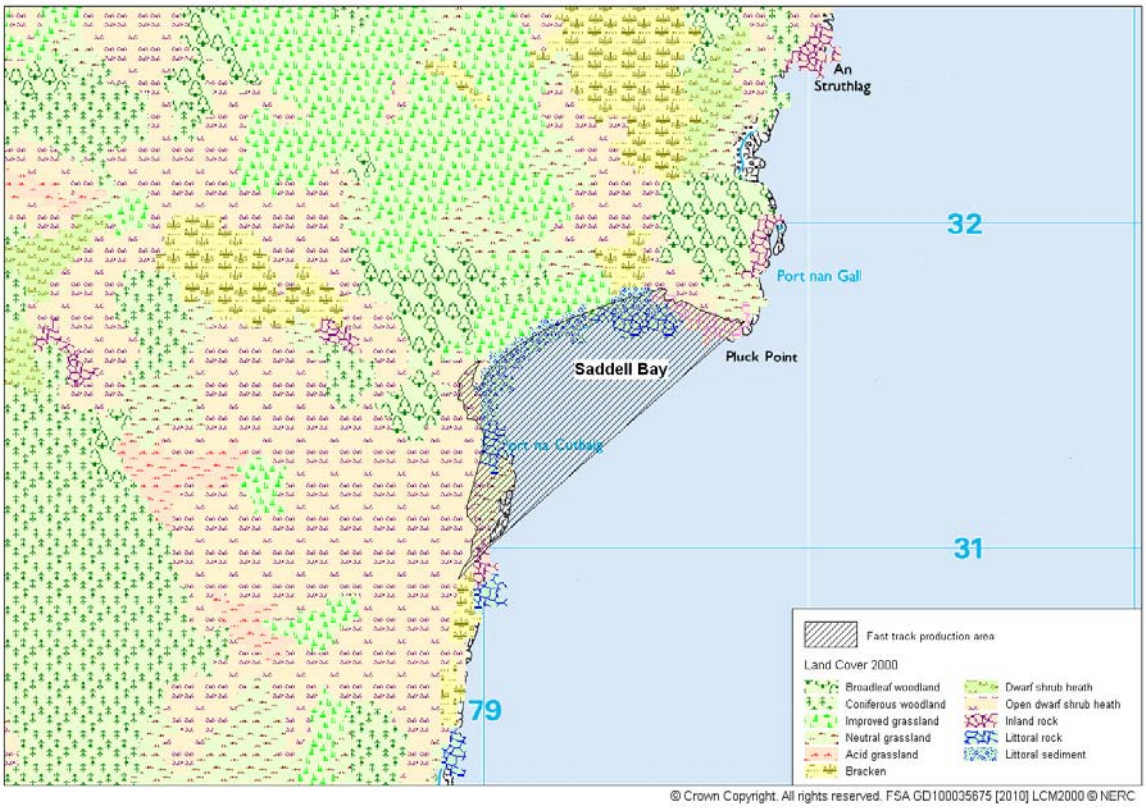

Figure 1.2 Land Cover 2000 data for Saddell Bay

1.2 Human Population

Figure 1.3 shows the census output areas that surround Saddell Bay. There are two census output areas with populations of 105 and 202 that are within the catchment area of Saddell Bay. The population surrounding Saddell Bay is mainly spread throughout scattered dwellings and the small settlement of Saddell inland to the north of the bay. Most of the dwellings are located around the course of Saddell Water.

Saddell Castle (2 single bedrooms, 2 twin rooms and 1 double room) and Saddell House (space for 13 people) are both owned by the Landmark Trust and rented out as holiday accommodation (for locations see Figure 2.1). There are also other

holiday cottages in the area. It is therefore expected that the population in the area will increase significantly from April to September.

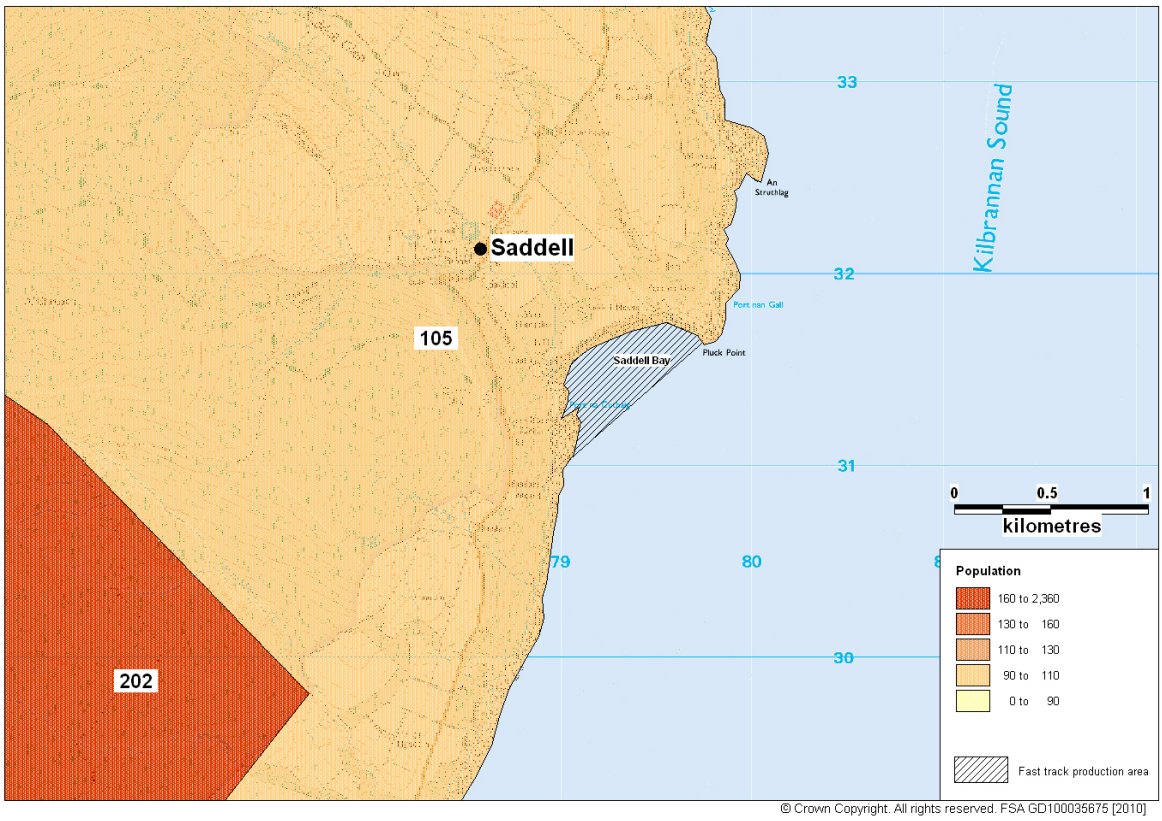

Figure 1.3 Human population surrounding Saddell Bay

2. Fishery

The fishery at Saddell Bay (AB 512 931 16) is comprised of a wild razor clam (*Ensis* spp.) bed.

The fast track classification production area boundaries as identified by the Food Standards Agency on 12th June 2009 are given as the area bounded by lines drawn between NR 7980 3170 to NR 7900 3100 extending to MHWS. When the area was mapped, however, the point NR 7900 3100 did not lie on the mean high water springs line so this point was adjusted to NR 7892 3091. The map below reflects the area with this amendment.

There is currently no RMP assigned to this area. The razor bed at Saddell Bay does not lie within a designated shellfish water.

The razor clam bed lies within the fast track production area boundaries, although the exact boundaries are not known (see Figure 2.1). Harvesting of razor clams is planned to take place throughout the year.

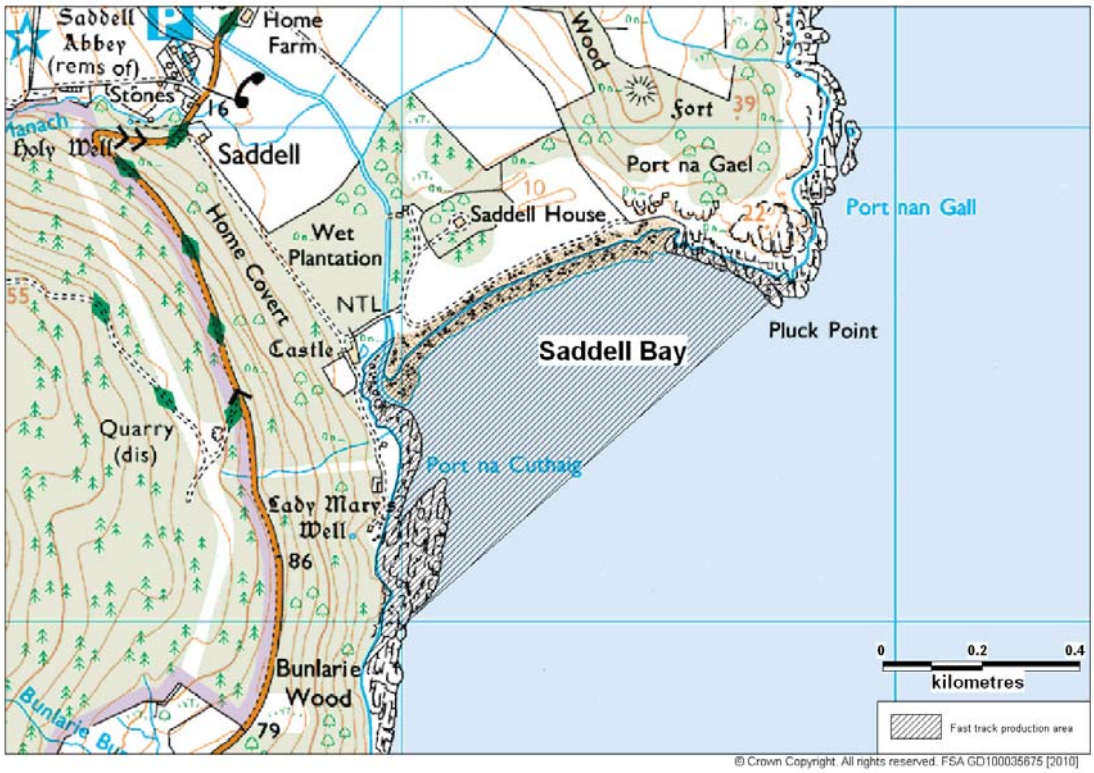

Figure 2.1 Saddell Bay fishery

3. Sewage Discharges

There are no known SEPA discharge consents or Scottish Water sewage discharges in the area surrounding Saddell Bay.

One possible outfall pipe was observed during the shoreline survey and details of this are listed in Table 3.1. The location of the outfall pipe has been mapped in Figure 3.1. Bunlarie Burn was sampled at this location (see Section 6).

Table 3.1 Observation of potential sewage discharge

No	Date	NGR	Description of potential sewage discharge
1	14/10/2009	NR 78547 30656	Grey pipe discharging into stream at Bunlarie

The settlement of Saddell, and many of the other buildings in the area, are located along the course of Saddell Water, and it's tributaries, and thus it is likely that this receives at least a proportion of septic tank effluent from these (some may go to soakaway). The potential impact of these sources on the microbiological quality of the razor clams will be much greater than any possible impact from the observed pipe which discharges into the Bunlarie Burn approximately 0.5 km south of the bay. It is expected that any sewage contributions will increase during the period April to September due to the holiday accommodation in the area.

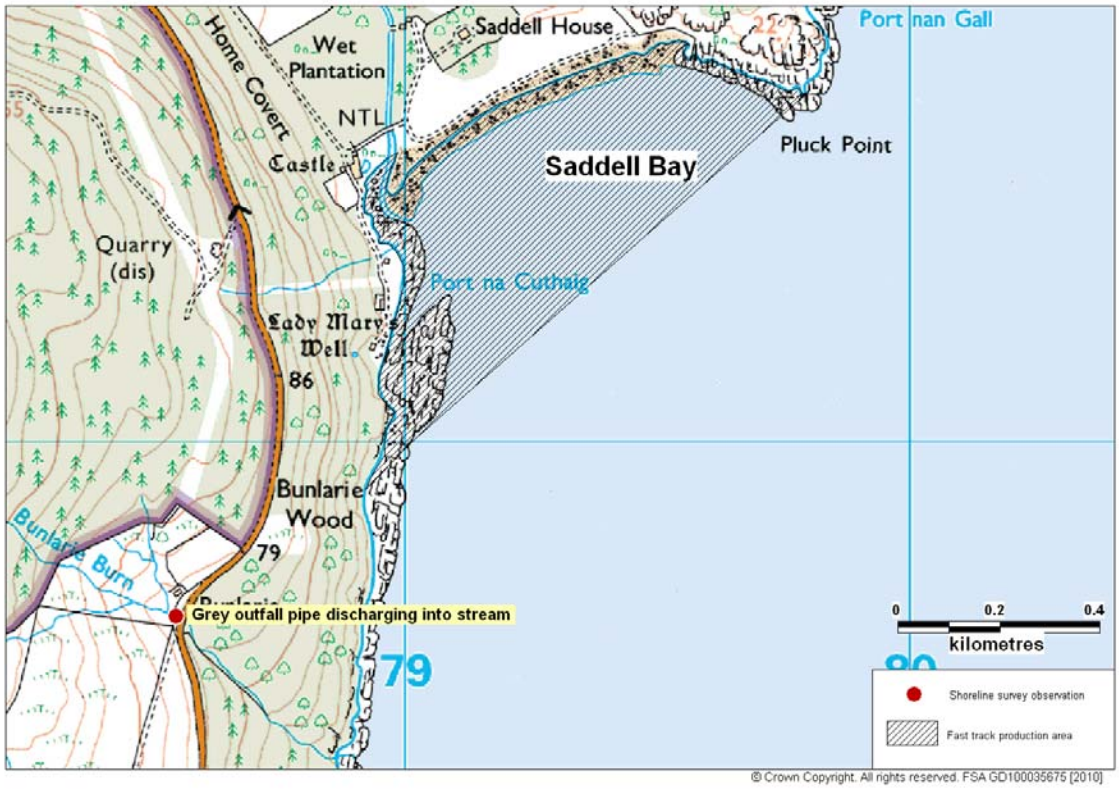

Figure 3.1 Location of potential sewage discharge at Saddell Bay

4. Animals

4.1 Livestock

The only significant available source of information concerning livestock numbers in the area surrounding Saddell Bay was the shoreline survey. This information relates to the time of the site visits on the 14th October 2009.

During the shoreline survey, 10 cattle and 300 sheep were observed in the fields between the Castle and Saddell (see Figure 4.1). Run-off from land contaminated by these animals would be expected to enter Saddell Water. There were no other livestock in the area at the time of the shoreline survey.

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

At the time of the shoreline survey no wildlife including birds were observed. However, seabirds such as gulls will always be present on and around the bay but, in the absence of defined roosting or nesting places, their distribution is likely to be relatively random over time. It is possible 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.

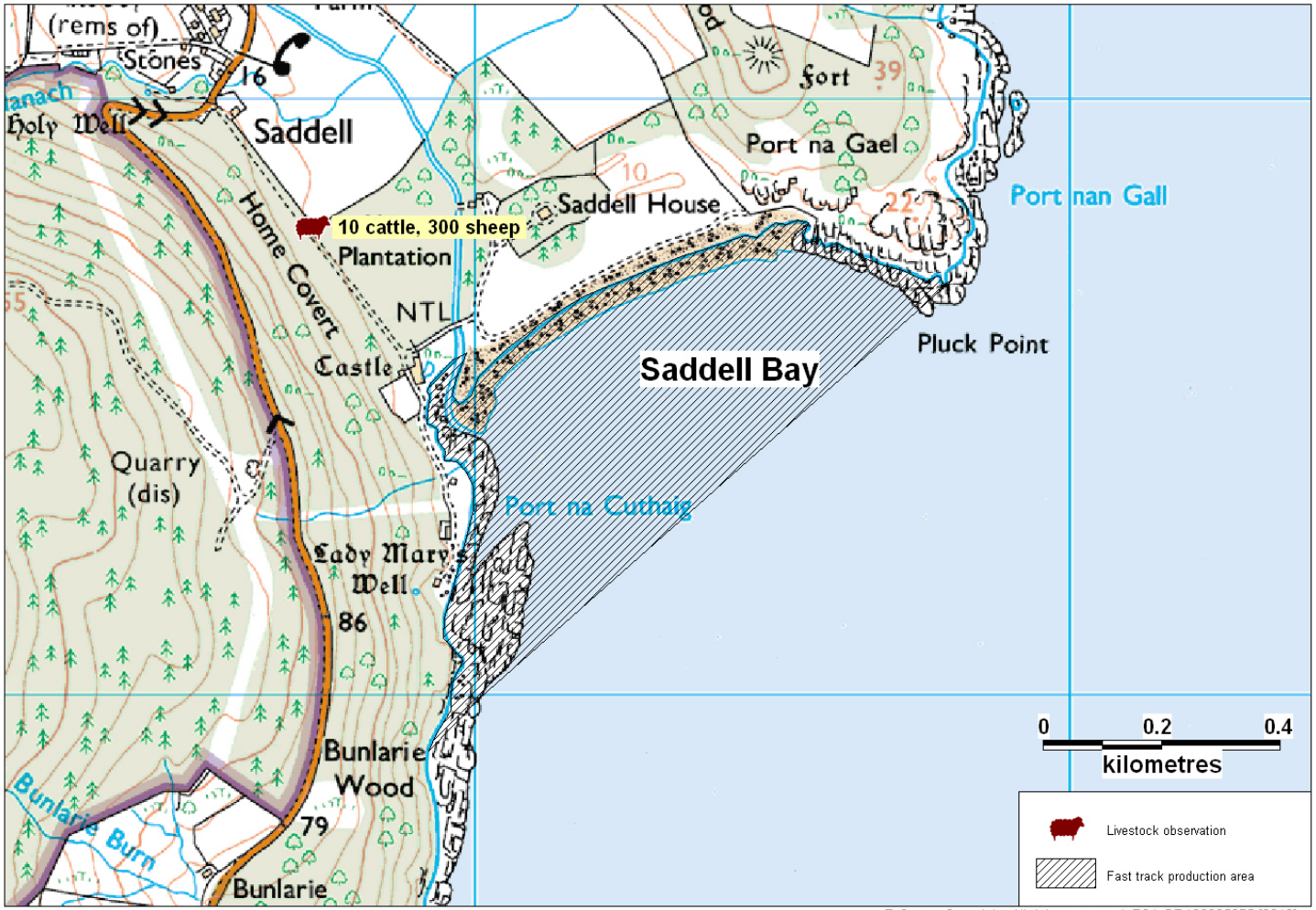

Figure 4.1 Livestock present at Saddell Bay during the shoreline survey

5. Rainfall

The nearest weather station is located at Arran Dougarie Lodge, approximately 10 km northeast of Saddell Bay. 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 close proximity of the weather station to Saddell Bay, rainfall recorded here is likely to be very similar to that experienced in the bay and the surrounding land.

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 *.

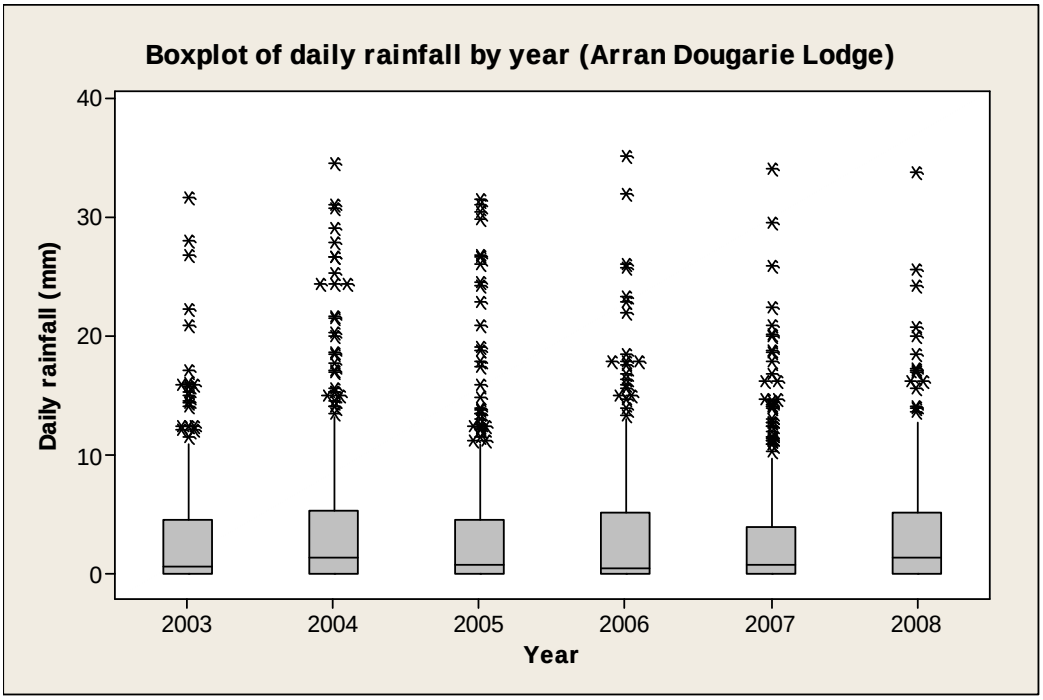

Figure 5.1 Boxplot of daily rainfall at Arran Dougarie Lodge by year

Figure 5.1 shows that there was some variation in the median daily rainfall from year to year though there was relatively little variation in extreme rainfall events.

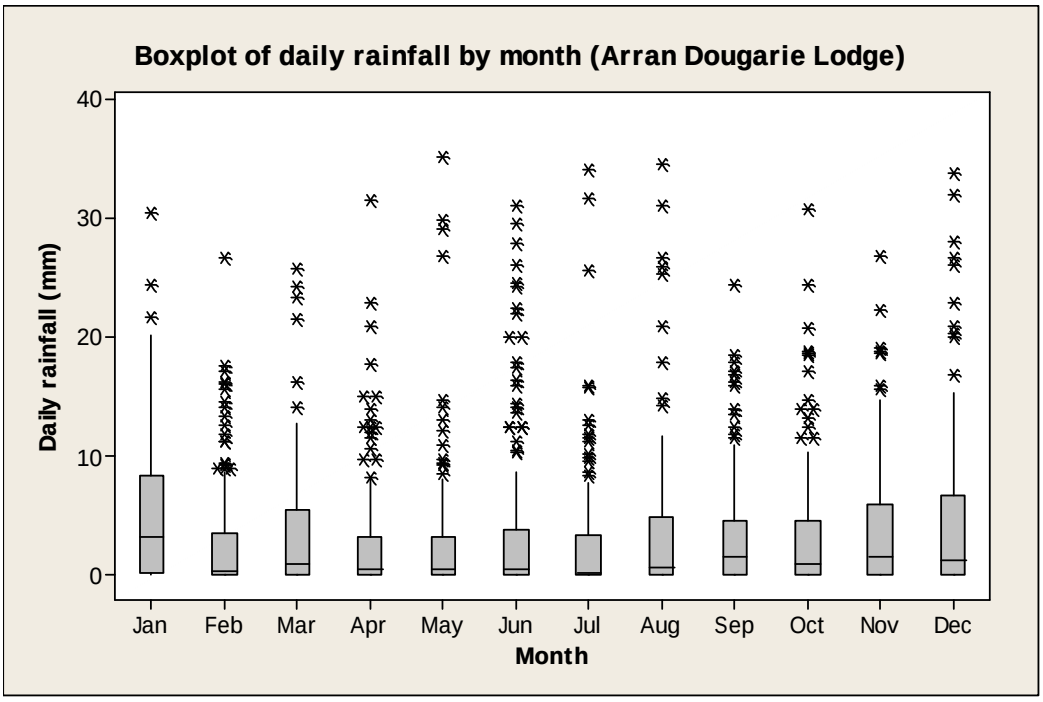

Figure 5.2 Boxplot of daily rainfall values at Arran Dougarie Lodge by month

The wettest months were December and January. 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 mm per day, maximum daily rainfall on certain day was recorded at levels greater than 30 mm. The highest daily rainfall recorded here fell in May, one of the driest months. 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 wash off of accumulated material.

6. River Flow

There is no river gauging station in the vicinity of the Saddell Bay. A total of three fresh water inputs were observed discharging into the bay. All were of a measurable size and had a measurable flow. The streams are listed in Table 6.1 and mapped in Figure 6.1. 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. There was light drizzle at the time of the shoreline survey in October 2009.

Table 6.1 Stream/river flow and loadings – Saddell Bay

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	Stream	0.35	0.1	0.15	454	800	3.6×10^9
2	NR 68961 45222	Saddell Water	4.7	0.2	0.814	66110	1300	8.6×10^{11}
3	NR 68975 45491	Bunlarie Burn	0.6	0.2	0.069	715	<100	$<7.2 \times 10^8$

The watercourse with the largest loading was Saddell Water (8.6×10^{11} *E. coli* per day). This enters on the western side of the bay. A small stream also discharges immediately to the south of there and contributes some extra loading to this part of the bay. The third fresh water input, the Bunlarie Burn discharges 0.5 km south of the bay, further down the coastline. At the time of the shoreline survey, this burn returned an *E. coli* result below the level of detection.

It is likely that the *E. coli* loadings of these watercourses would increase after significant rainfall. It is also likely that the *E. coli* content would be higher in the summer period due to an increased human population and greater contributions from animals. Irrespective of such variations, the greatest potential impact from freshwater sources on the microbiological quality of the shellfish will be on the western side of the bay and the fishery.

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 x 10^3, in this case it would be written as 1E+3.

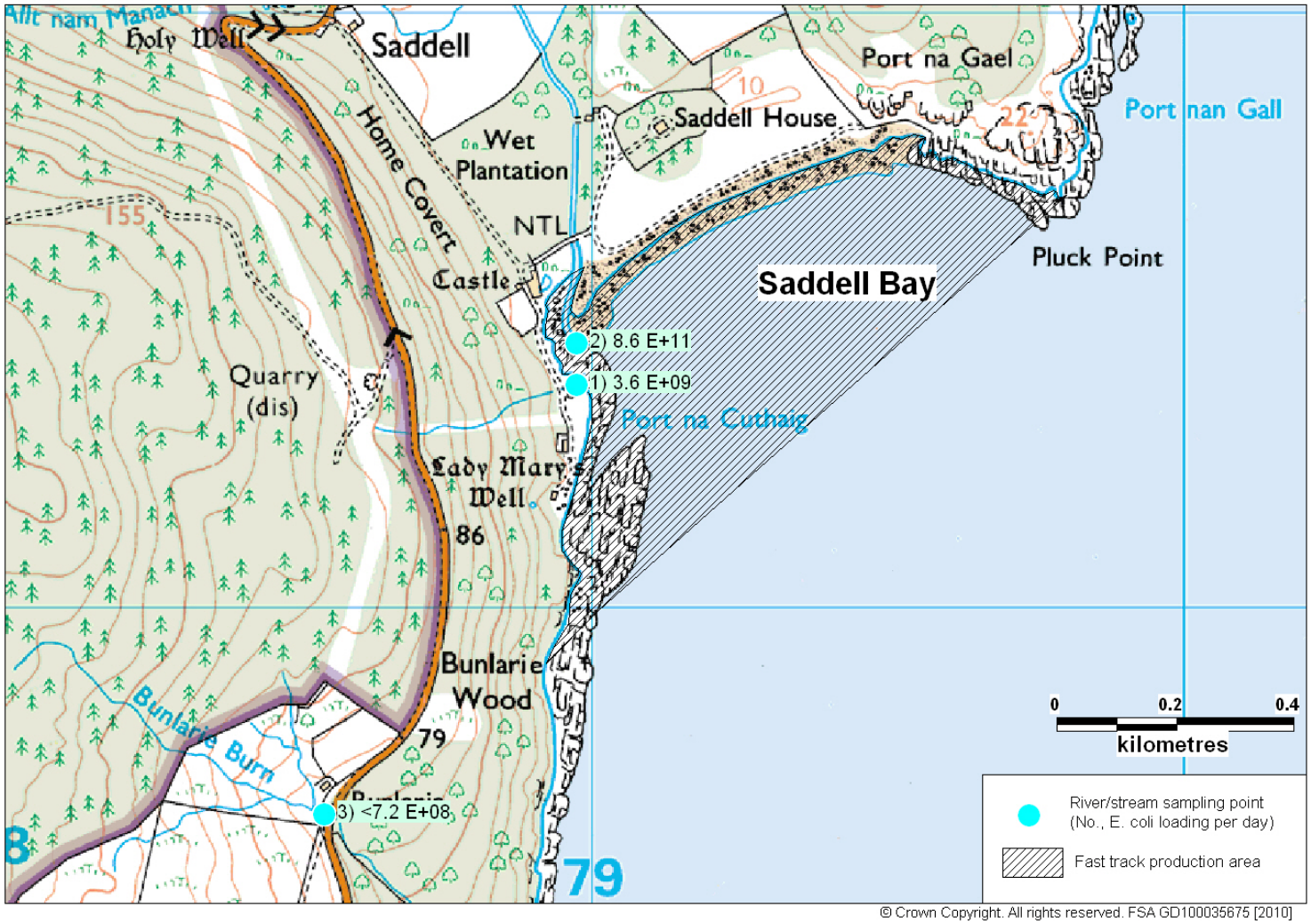

Figure 6.1. Location of river/stream loadings at Saddell Bay

7. Historical *E. coli* Monitoring Data

7.1 Validation of historical data

Four shellfish samples taken from Saddell Bay had been submitted at 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.

Table 7.1 Individual sample results from Saddell Bay

Collection date	Production area	Site	SIN	Species	Grid reference	*E. coli* (MPN/100g)
09/09/2009	Saddell Bay	Saddell Bay Razors	AB 512 931 16	Razor clams	NR 79645 31585	<20
30/09/2009	Saddell Bay	Saddell Bay Razors	AB 512 931 16	Razor clams	NR 79550 31599	230
14/10/2009	Saddell Bay	Saddell Bay Razors	AB 512 931 16	Razor clams	NR 79278 31448	50
27/01/10	Saddell Bay	Saddell Bay Razors	AB 512 931 16	Razor clams	NR 79223 31472	<20

The samples were taken between September 2009 and January 2010.

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 just east of the centre of the shellfish bed and was 230 *E. coli* MPN/100 g.

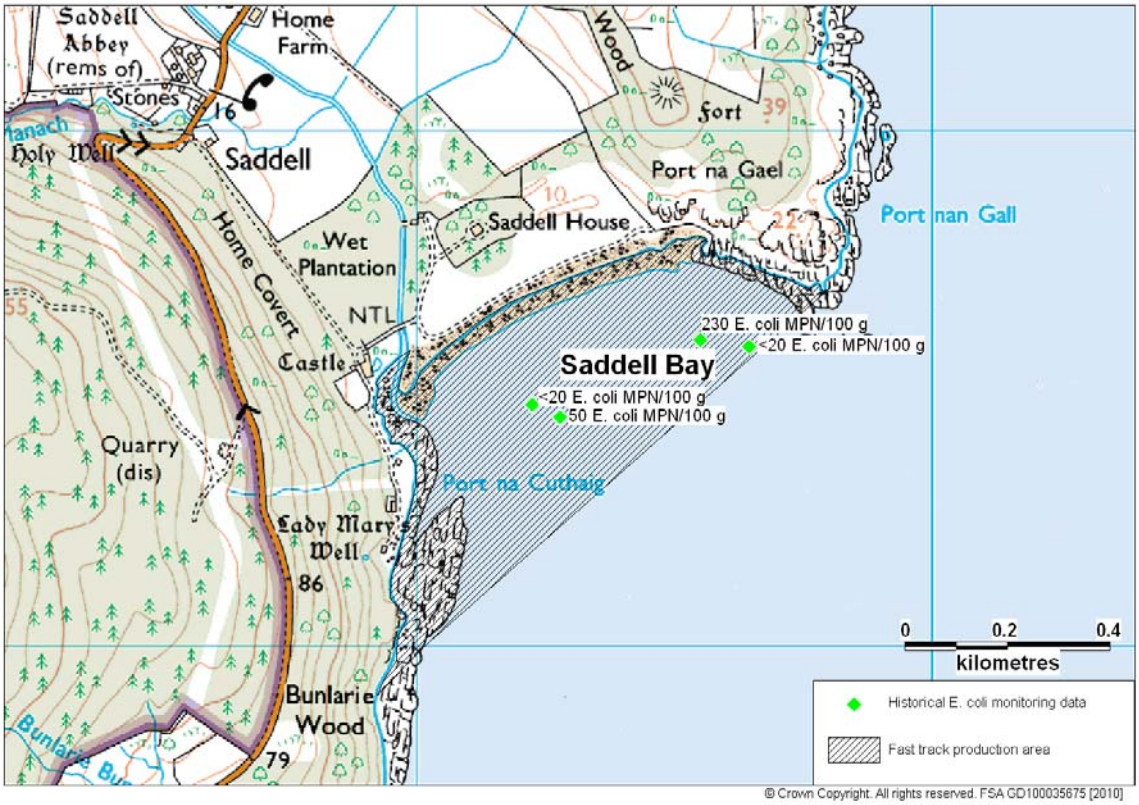

Figure 7.1 Geographical location of the Saddell Bay historical *E. coli* monitoring results

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

There is insufficient data on which to undertake any further analysis.

8. Bathymetry and Hydrodynamics

Figure 8.1 Saddell Bay bathymetry chart

Figure 8.2 Saddell Bay OS map

The depth of Saddell Bay increases with distance from the shoreline (see Figure 8.1). The depth of the bay increases gradually from 0 to 10 m until the open waters of Kilbrannan Sound where depths reach up to 200 m in some areas.

The two tidal curves below are for the port of Carradale, the nearest secondary port (5.5 km north of Saddell Bay). These have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 12th October 2009. The second

is for seven days beginning 00.00 GMT on 19th October 2009. Together they show the predicted tidal heights over high/low water for the full neap/spring tidal cycle during which the shoreline survey was undertaken.

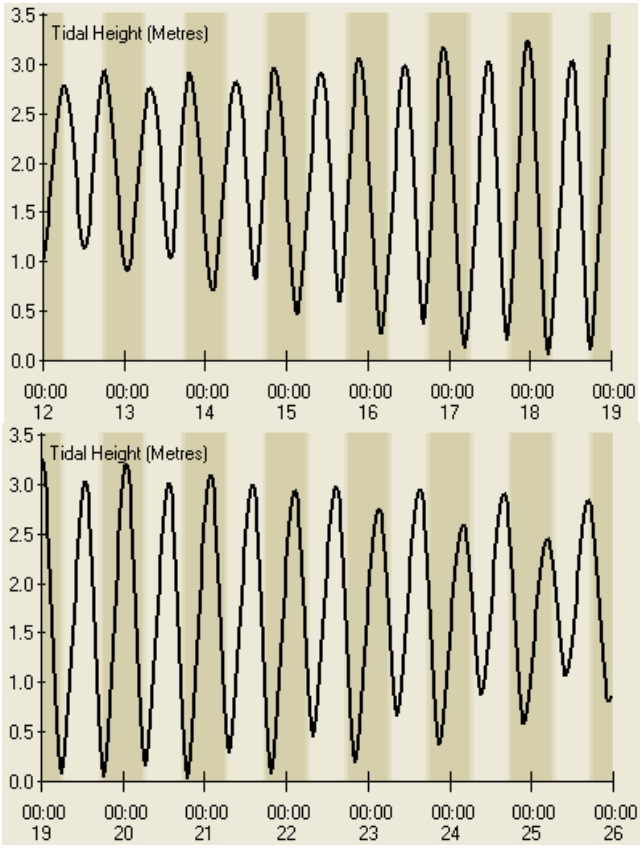

Figure 8.3 Tidal curves for Carradale

The following is the UKHO summary description for Carradale:

The tide type is Semi-Diurnal.

MHWS	3.1 m
MHWN	2.6 m
MLWN	1.1 m
MLWS	0.4 m

Predicted heights are in metres above chart datum. The tidal range at spring tide is therefore approximately 2.7 m and at neap tide 1.5 m.

8.2 Currents

The Admiralty Tidal Stream Atlas for Firth of Clyde and Approaches (UKHO 1992) indicates that the peak tidal stream within Kilbrannan Sound is approximately 0.2 (neap) to 0.3 knots (spring) in a northerly direction on the rising tide and 0.3 (neap) to 0.4 knots (spring) in a southerly direction on a falling tide. The relationship

between knots and metres per second is that the latter is approximately half the former (i.e. 0.2 knots is about 0.1 m/s).

As in many areas, the change from rising to falling and vice versa does not exactly coincide in time with change in direction of the tidal streams. No information was found regarding currents within Saddell Bay itself.

8.3 Conclusions

Contamination arising from sources within Saddell Bay will be taken across the fishery on the falling tide. This will include contamination that has accumulated within the lower part of Saddell Water on the flooding tide, once the tide has risen to the river mouth, and continuing into slack high water.

9. Shoreline Survey Overview

A restricted shoreline survey of Saddell Bay shoreline was undertaken by staff from Argyll and Bute Council on the 14th October 2009.

Sub surface sea water samples were taken from several points along the Saddell Bay coastline. Results ranged from 30 to 360 *E. coli* cfu/100 ml. The highest result of 360 *E. coli* cfu/100 ml; was taken from the western side of the bay, close to the mouth of Saddell Water.

Fresh water samples were taken at any streams or burns flowing at the time of the shoreline survey. Results ranged from <100 to 1300 *E. coli* cfu/100 ml. The two watercourses with measurable *E. coli* levels discharge into the western corner of the bay.

Razor clam samples were collected from two points within the bay. One sample was taken from the eastern end of the bay and the other sample was taken from just west of the centre of the bay. Both razor clam samples returned results low results of <20 *E. coli* MPN/100 g.

During the shoreline survey, approximately 10 cattle and 300 sheep were observed in the fields adjacent to the Allt nam Manach river.

A single possible outfall pipe was observed discharging into Bunlarie Burn, 0.5 km south of Saddell Bay.

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 bay on the western shoreline
- Possible outfall pipe discharging into the Bunlarie Burn, which in turn discharges into Kilbrannan Sound, south of the bay
- Livestock in the field, with the Allt nam Manach river in it, adjacent to Saddell Bay

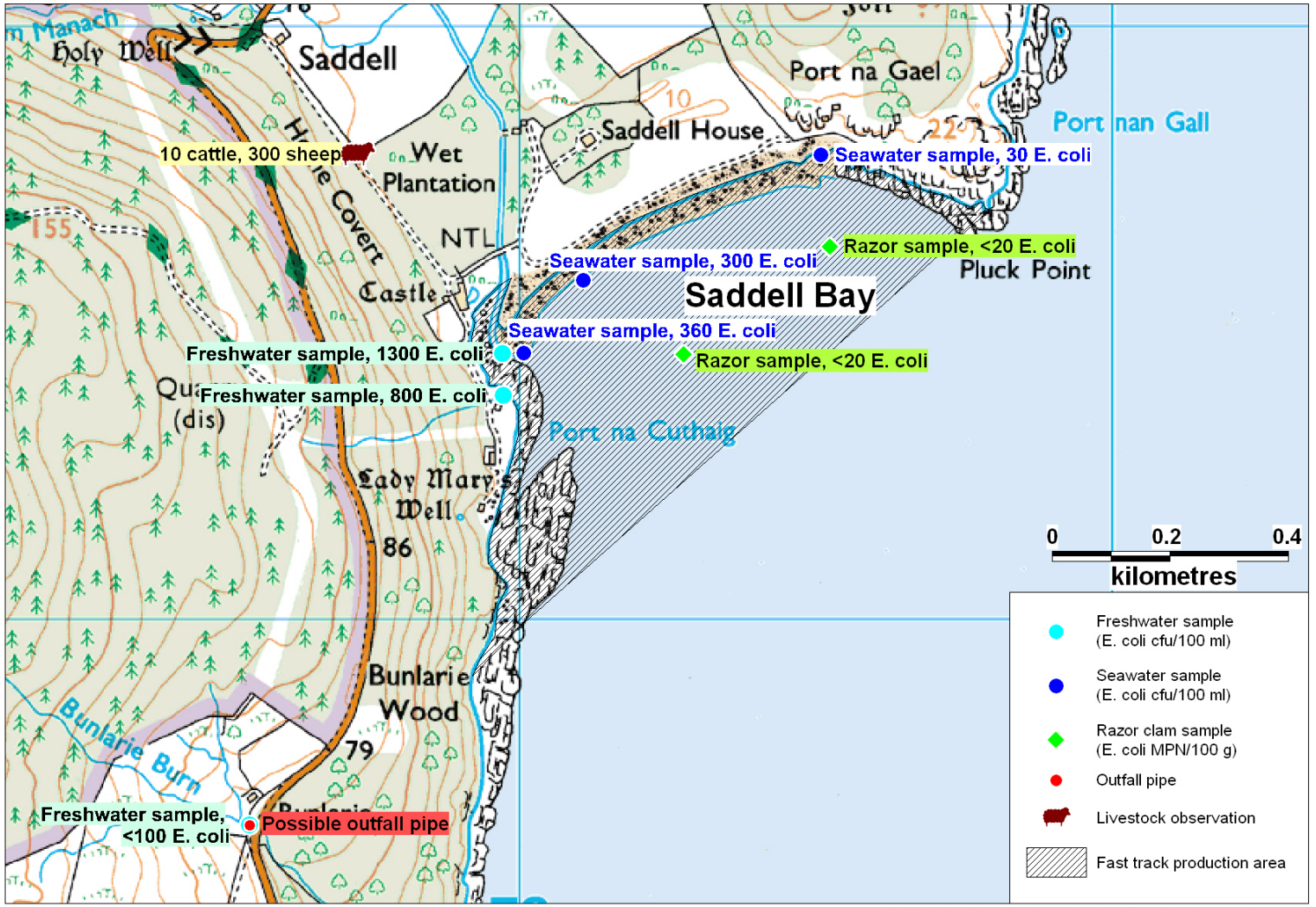

Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Fishery

The exact boundaries of the shellfish bed at Saddell Bay are not known. However, historical *E. coli* monitoring results and samples taken during the shoreline survey indicate that the razor clams are present within the boundaries identified for the fast track production area. The razor clams will be hand dived and harvesting is planned to take place throughout the year.

Human sewage inputs

There are no registered SEPA discharge consents or Scottish Water discharges for the catchment area surrounding Saddell Bay. Most dwellings in the area are located along the course of Saddell Water (and its tributaries), and thus any septic tanks that do not go to soakaway will be likely to discharge to this watercourse. A possible sewage outfall pipe was identified discharging into the Bunlarie Burn, 0.5 km south of the bay. However, a sample from the burn at this location gave an *E. coli* result lower than the limit of detection of the method. Any impact from sewage inputs will be likely to be greatest where Saddell Water enters the bay at the western end of the fishery.

Agricultural inputs

During the shoreline survey, approximately 10 cattle and 300 sheep were observed in a field behind Saddell Bay (see Figure 4.1). The livestock have access to the Allt nam Manach river that runs through this field and then enters Saddell Water. Due to the proximity of the livestock to the Allt nam Manach, agricultural sources may be a significant source of contamination to the area. The western side of the shellfish bed is likely to experience the largest amount of contamination where Saddell Water enters the bay.

Wildlife inputs

During the shoreline survey, no wildlife was observed. However, seabirds including gulls are likely to be present along the coastline but, in the absence of defined roosting and/or nesting sites their distribution and contamination effects, will tend to be randomly distributed.

Rivers and streams

A total of three watercourses were discharging into Saddell Bay at the time of the shoreline survey. All streams were located on the western side of the shellfish bed. Saddell Water had the largest loading of 8.6×10^{11} *E. coli* per day and discharges into the western corner of the bay. A small stream also discharges close to this area and had a loading of 3.6×10^{9} *E. coli* per day. The third fresh water input, the Bunlarie Burn discharges 0.5 km south of the bay and had a loading of 3.6×10^{8} *E. coli* per day. The loadings confirm that, as indicated above, the expectation that Saddell Water will contain significant levels of faecal contamination: it is likely that these come from both human

and animal sources. The principal effect on the microbiological quality of the shellfish will be seen on the western side of the fishery where Saddell Water and the adjacent stream enter the bay.

Rainfall

Rainfall patterns at Arran Dougarie Lodge (the nearest rainfall station) show that seasonal variation in rainfall levels occurs and the wettest months were March and November. An increase in rainfall may be expected to wash a flush of bacteria from the surrounding land into the production area. The impact of rainfall events is likely to be most acute nearest where the streams on the western side of shellfish bed enter the bay.

Analysis of results

There are only four historical monitoring results available for Saddell Bay and these were taken over a relatively short period of time (5 months). It was therefore not possible to determine establish a pattern of seasonal variation in microbiological quality of the shellfish. The highest result of 230 *E. coli* MPN/100 g was obtained from the eastern side of the fishery.

Razor clam samples were collected from two points within the bay. One sample was taken from the eastern side of the bay and a second from just west of the centre of the bay. Both samples retuned low results of <20 *E. coli* MPN/100 g.

Three seawater samples were taken during the shoreline survey and two returned relatively high *E. coli* concentrations of 300 and 360 E. coli cfu/100 ml. These samples were taken from the western side of the shellfish bed.

Movement of contaminants

Contamination from human and animal sources affecting Saddell Water will impact on the western side of the shellfish bed and will travel across that side of the bed during the falling tide. No sources were identified outside the bay that would be deemed to impact on the shellfishery.

Overall conclusions

The western edge of the shellfish bed is expected to receive the greatest contamination from both human and animal sources, through contamination from Saddell Water.

11. Recommendations

Production area

The only sources of information on the fishery were the fast track production area application and the location of razor samples taken during routine sampling and during the shoreline survey. The latter all fell within the fast track production area. As no significant contaminating sources fell immmediately outside that it, it is recommended that the same boundaries be maintained with a minor correction to the southern boundary point to bring it to the MHWS line. The production area should be defined as:

The area bounded by lines drawn between NR 7980 3170 to NR 7892 3091 extending to MHWS.

RMP

As the significant sources of contamination are on the western side of the bay, it is recommended that the RMP be established at NR 7915 3142.

The recommended tolerance is 50 m – this recognises the potential difficulty of gathering sufficient razors close to the identified point while constraining the sampling to that area identified as of higher risk. Given that the razors will be gathered from the seabed, it is not appropriate to specify depth of sampling.

Given that there is a very restricted data set available for this area, it is recommended that monthly sampling be undertaken for at least one year and then the variability reviewed ot determine whether the frequency can be reduced.

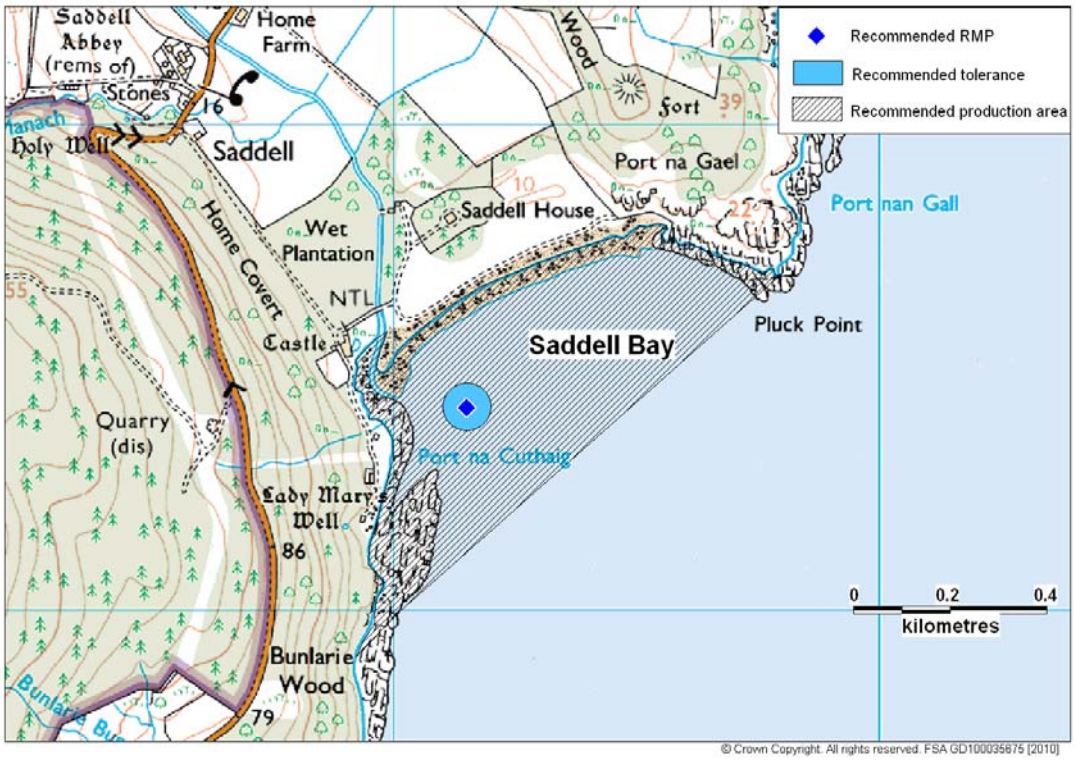

Figure 11.1 Recommendations for Saddell Bay

12. References

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2. **Comparative Table of Boundaries and RMPs**
3. **Restricted Shoreline Survey Report**

Sampling Plan for Saddell Bay

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
Saddell Bay	Saddell Bay Razors	AB 512	Razors	Wild harvest	NR 7915 3142	179150	631420	50	NA	Hand	Monthly	Argyll and Bute Council	Christine McLachlan William MacQuarrie Ewan McDougall Donald Campbell	Christine McLachlan

Comparative Table of Boundaries and RMPs – Saddell Bay

Production Area	Species	SIN	Existing Boundary	Existing RMP	New Boundary	New RMP	Comments
Saddell Bay	Saddell Bay Razors	AB 512 931 16	The area bounded by lines drawn between NR 7980 3170 to NR 7900 3100 extending to MHWS	N/A	**The area bounded by lines drawn between NR 7980 3170 to NR 7892 3091 extending to MHWS.**	**NR 7915 3142**	Minor correction to boundary. Newly defined RMP.

Shoreline Survey Report

Saddell Bay
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Restricted Sanitary Survey

Scottish Sanitary Survey Project

Shoreline Survey Report

Production area:	Saddell Bay
Site name:	Saddell Bay Razors
Species:	Razors (*Ensis* spp.)
Harvester:	Andrew Charlwood
Local Authority:	Argyll & Bute Council
Status:	New site
Date Surveyed:	Wednesday 14th October 2009
Surveyed by:	Christine McLachlan and William MacQuarrie
Existing RMP:	NA
Area Surveyed:	See Figure 1.

Weather Observations
Wednesday 14th October: Light Drizzle, Misty, Wind Southerly, Force 1.

Site Observations

Fishery
The Saddell Bay site is harvested for Razor clams (*Ensis* spp.). The razor clams are hand dived within the bay. The harvesters plan to harvest the razors all year round.

Sewage/Faecal Sources
The area surveyed has several scattered dwellings around the bay. There is also the small settlement of Saddell located 0.6 km inland, north of the bay. During the shoreline survey no septic tanks were observed. Only one grey pipe was observed discharging into a stream at Bunlarie, located south of Saddell Bay.

Seasonal Population
The Landmark Trust own three self catering accommodation units. Saddell House provides accommodation for 13 people and is located on the shoreline at the centre of Saddell Bay. Saddell Castle provides accommodation for 8 people and is located directly on the shoreline at the western corner of the bay. Saddell Lodge provides accommodation for 4 people and is located in the village on Saddell further inland. No caravans or campsites were observed during the shoreline survey.

Boats/Shipping
At the time of the shoreline survey no boats were observed near Saddell Bay.

Land Use
The land surrounding Saddell Bay is a mixture of coniferous and broadleaf woodland with an area of improved grassland to the north of the bay.

Livestock
During the shoreline survey approximately 10 cattle & 300 sheep were observed on the shoreline just inland, north of Saddell Bay.

Wildlife/Birds
No wildlife or birds were observed in the area of Saddell Bay at the time of 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	14/10/2009	10:15	NR 79525 31629	179525	631629	-	Razor sample (SBR) 1 Seawater temp = 14°C
2	14/10/2009	10:30	NR 79278 31448	179278	631448	-	Razor Sample (SBR) 2 Seawater sample = 14°C
3	14/10/2009	12:58	NR 78974 31379	178974	631379	-	Stream beside holiday cottage, Saddell FW 10, 0.35 x 0.10 x 0.15
4	14/10/2009	13:02	NR 78973 31450	178973	631450	Figure 4 & Figure 5	Allt nam Manach river beside Saddell Castle, Saddell FW 11, 4.70 x 0.20 x 0.814. Figure 4 shows Allt nam Manach river and holiday cottage in distance, Figure 5 shows Saddell Castle
5	14/10/2009	13:05	NR 79008 31451	179008	631451	-	Saddell SW 6, Sal = 16 ppt
6	14/10/2009	13:09	NR 79109 31573	179109	631573	Figure 6	Saddell SW 7, Sal = 24 ppt Landmark Trust Holiday accommodation behind shore [Figure 6]
7	14/10/2009	13:16	NR79509 31748	179509	631784	-	Saddell SW 8, Sal = 29 ppt
8	14/10/2009	13:30	NR78728 31784	178728	631784	Figure 7	10 cattle, 300 sheep [Figure 7, where the Allt nam Manach river runs through the field left to right]
9	14/10/2009	13:40	NR 78547 30656	178547	630656	Figure 8	Stream at Bunlarie, Saddell FW 12, 60cm x 20cm x 0.069, Also grey pipe to stream [Figure 8]

Photographs referenced in the table can be found attached as Figures 4 – 8.

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

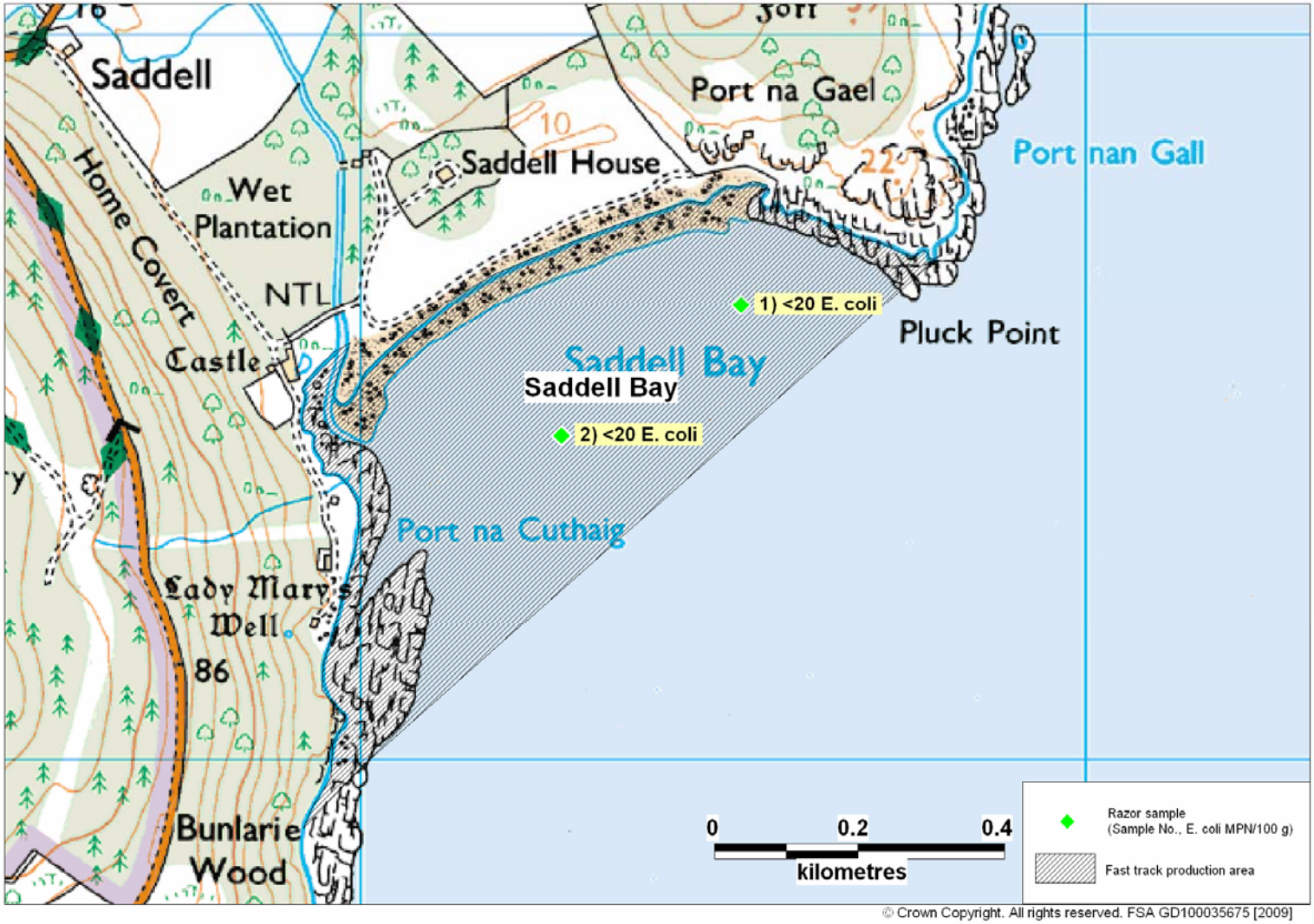
No.	**Date**	**Sample**	**Grid Ref**	**Type**	E. coli **(cfu/100 ml)**	**Salinity (g/L)**
1	14/10/2009	SADDELL FW10	NR 78974 31379	Fresh water	800	n/a
2	14/10/2009	SADDELL FW11	NR 78973 31450	Fresh water	1300	n/a
3	14/10/2009	SADDELL FW12	NR 78547 30656	Fresh water	<100	n/a
4	14/10/2009	SADDELL SW6	NR 79008 31451	Sea water	360	7920
5	14/10/2009	SADDELL SW7	NR 79109 31573	Sea water	300	9230
6	14/10/2009	SADDELL SW8	NR 79509 31784	Sea water	30	15600

Table 3. Shellfish sample results

No.	**Date**	**Sample**	**Grid Ref**	**Type**	***E. coli*** **(MPN/100 g)**
1	14/10/2009	SBR1	NR 79525 31629	Razor clams	<20
2	14/10/2009	SBR2	NR 79278 31448	Razor clams	<20

Figure 2. Water sample results

Figure 3. Shellfish sample results



Photographs

Figure 4. Allt nam Manach river, location of water sample 1 (SADDELL FW10)

Figure 5. Saddell Castle

Figure 6. Landmark Trust Holiday accommodation behind shore

Figure 7. 10 cattle, 300 sheep (where the Allt nam Manach river runs through the field left to right)

Figure 8. Grey pipe going into stream at Bunlarie