
Scottish Sanitary Survey Project



Restricted Sanitary Survey Report

Castle Stalker

AB 492

June 2009



Report Distribution – Castle Stalker

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Table of Contents

1.	Area Overview	1
2.	Fishery	4
3.	Sewage Discharges	5
4.	Animals	7
5.	Rainfall	9
6.	River Flow	11
7.	Historical <i>E.coli</i> Monitoring Data	13
8.	Bathymetry and Hydrodynamics	14
9.	Shoreline Survey Overview	17
10.	Overall Assessment	19
11.	Recommendations	21
12.	References	22
13.	List of Tables and Figures	23

Appendices

1. Summary Sampling Plan
2. Restricted Shoreline Survey Report

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1. Area Overview

The Castle Stalker production area is located at the western end of Loch Laich (see Figure 1.1). Castle Stalker is situated between the Lynn of Lorn and the Sound of Shuna. Loch Laich is an inlet off Loch Linhe. The entrance of Loch Laich is 0.7 km wide and it is 1.15 km in length. A restricted sanitary survey at Castle Stalker was conducted in response to receipt of an application to classify the area for commercial harvest of common cockles.

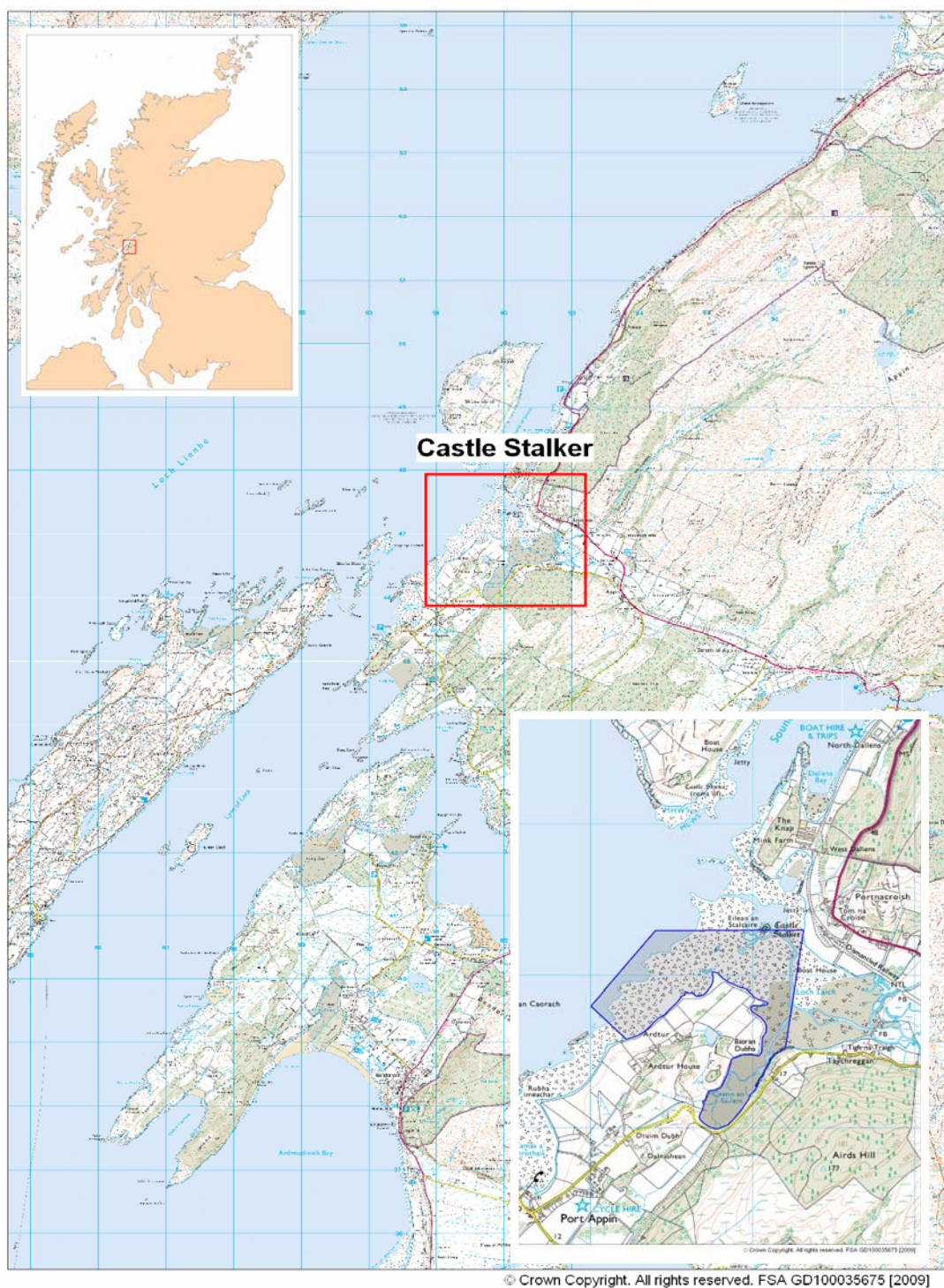


Figure 1.1 Location of Castle Stalker

1.1 Land Cover

The land cover surrounding Loch Laich is varied. The land cover on the west coastline around the settlement of Ardtur is a mixture of patches of heath land, acid grassland, neutral grassland and broadleaf woodland. The land south of Loch Laich and Ceann an t-Sailein is predominantly coniferous woodland with a small patch of broadleaf woodland. The land surrounding the estuary entering Loch Laich and the land buffering the disused railway line are improved grassland. The rest of the eastern shoreline is composed of patches of coniferous woodland, neutral grassland and heath land.

Faecal coliform contributions from improved grassland have been shown to be approximately 8.3×10^8 cfu km⁻² hr⁻¹ (Kay et al, 2008). The contributions to the contamination of 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 Loch Laich would be expected to contribute the most to contamination levels carried in surface runoff to this side of the common cockle bed.

1.2 Human Population

Figure 1.2 shows the census output areas that are directly adjacent to Castle Stalker. There are three main settlements surrounding the Castle Stalker production area are Port Appin on the western coastline, Appin on the south eastern coastline and Portnacraish on the eastern coastline. Appin is the most densely populated settlement and is also located close to the fresh water inputs entering the loch.

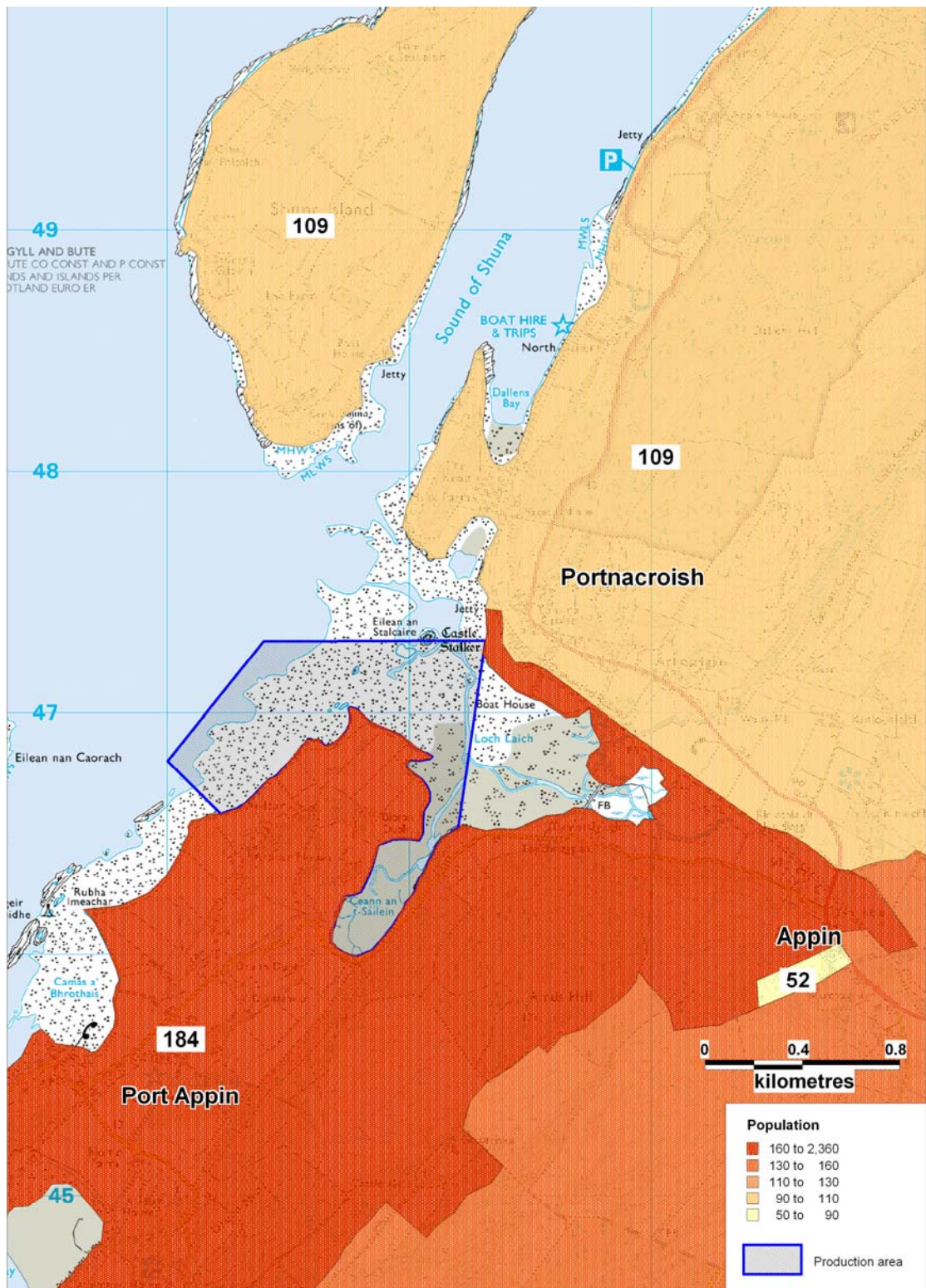


Figure 1.2 Human population surrounding Castle Stalker

There is a ferry service from Port Appin over to the Isle of Lismore, which is located southwest of the Castle Stalker production area and runs several sailings daily.

2. Fishery

The fishery at Castle Stalker is comprised of a wild common cockle (*Cerastoderma edule*) bed within the Castle Stalker (SIN AB 492 909 04) production area.

The fast track classification production area boundaries as identified by the Food Standards Agency on 3rd April 2009 are given as the area bounded by lines drawn between NM 9120 4660 to NM 9100 4680 and from NM 9100 4680 to NM 9140 4730 and from NM 9140 4730 to NM 9230 4730 and from NM 9230 4730 to NM 9220 4650 extending to MHWS.

There is currently no RMP assigned to this area. The common cockle bed at Castle Stalker does not lie within a designated shellfish water.

The cockle bed lies within the production area and follows the sandy strip of the shoreline, although the exact boundaries are not known. Harvesting of cockles is planned to take place throughout the year.

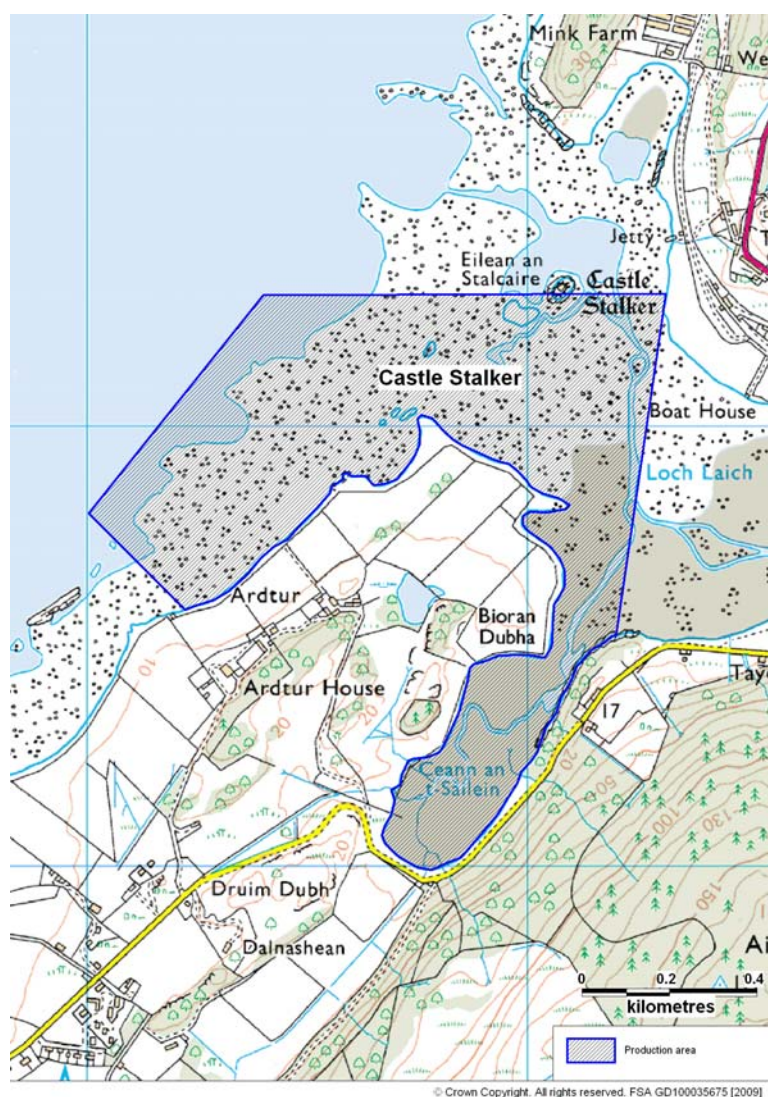


Figure 2.1 Castle Stalker fishery

3. Sewage Discharges

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

Table 3.1 SEPA discharge consents

Ref No.	NGR of discharge	Discharge type	Discharges to	PE	Discharge Vol m ³ per day
CAR/R/1019378	NM 9106 4591	Continuous	Land via soakaway	5	-
CAR/R/1018247	NM 9107 4584	Continuous	Land via soakaway	16	-
CAR/R/1017964	NM 9122 4589	Continuous	Land via soakaway	5	--
CAR/R/1012088	NM 9051 4558	Continuous	Lynn of Lorn	5	-
CAR/R/1019134	NM 9074 4548	Continuous	Land via soakaway	5	-
CAR/R/1015596	NM 9111 4571	Continuous	Land	5	-
CAR/S/1009904	NM 9079 4541	Continuous	Land	17	3.4
CAR/L/1000365	NM 9420 4610	Continuous	Unnamed stream	200	44
CAR/L/1000420	NM 907 456	Continuous	Lynn of Lorn	-	-

Community septic tanks and sewage discharges were identified by Scottish Water for the area adjacent to Castle Stalker. They are detailed in Table 3.2 and mapped in Figure 3.1.

Table 3.2 Discharges identified by Scottish Water

Discharge Name	NGR of discharge	Discharge Type	Level of Treatment	Consented flow m ³ /day	Consented/design PE
Port Appin	NM 9070 4560	Continuous	Septic tank	-	30
Appin STW	NM 9420 4610	Continuous	Secondary	44	200

No sanitary or microbiological data were available for these discharges.

Several 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
1	04/06/2009	NM 92297 47818	Outfall pipe, barely flowing
2	04/06/2009	NM 92793 46557	6" clay pipe below house, not flowing but evidence of previous flow
3	04/06/2009	NM 92754 46585	4" plastic pipe to shore, dripping, no smell, house above
4	04/06/2009	NM 92257 46529	6" cast iron pipe, not flowing, house above

A large number of septic pipe outlets were observed on the shoreline at Port Appin during the Loch Creran shoreline survey on 31st July 2007. Some of the septic tanks appeared to be malfunctioning at the time of that survey.

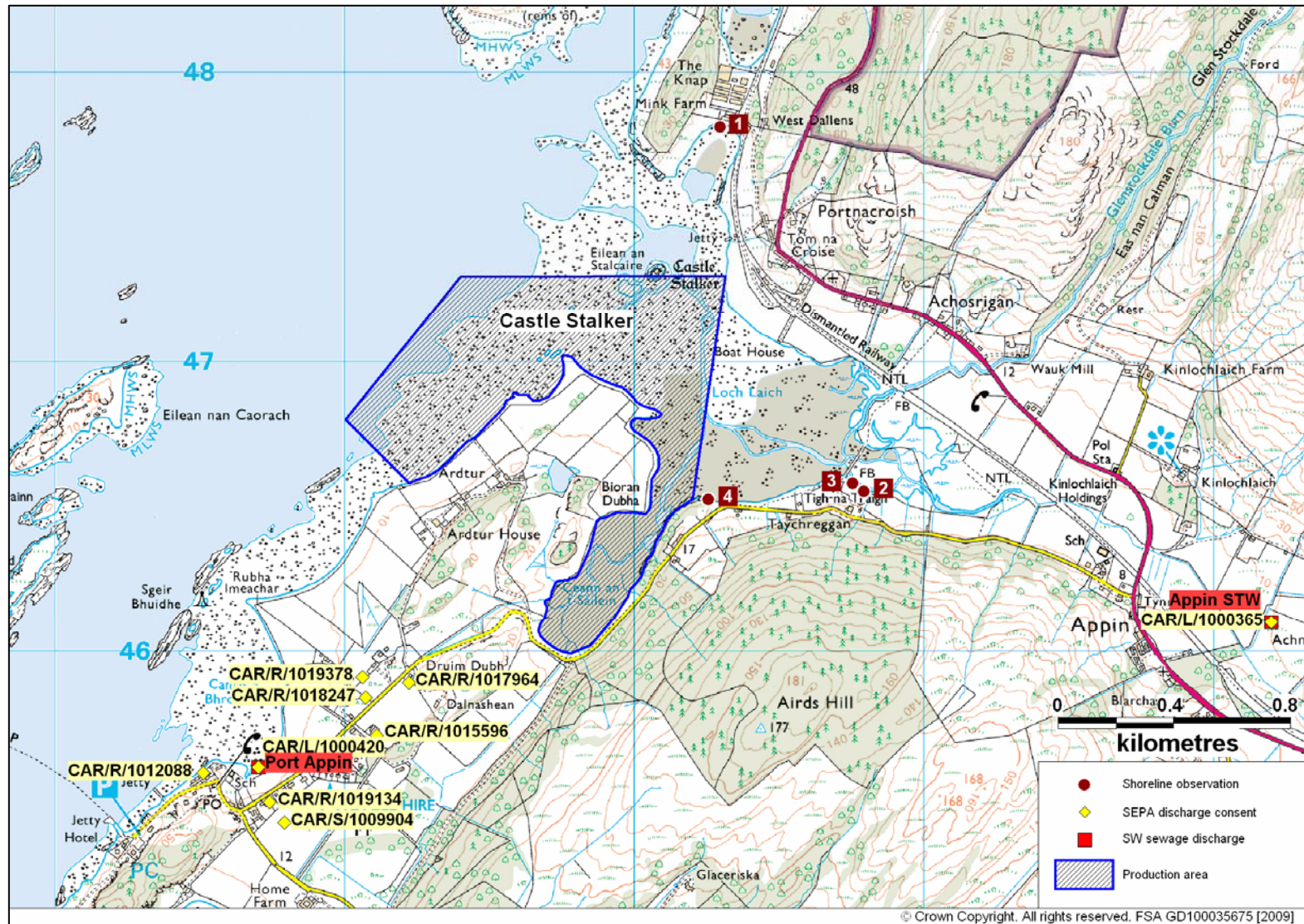


Figure 3.1 Sewage discharges at Castle Stalker

4. Animals

4.1 Livestock

The only significant source of information concerning livestock numbers in the area surrounding Castle Stalker was available from the shoreline survey. The shoreline survey only relates to the time of the site visits on the 4th June 2009.

During the shoreline survey, fifteen cattle were observed on the sand and mud at the centre of the Castle Stalker production area (see Figure 4.1). A group of twenty sheep were observed close to the shoreline at Ardtur towards the southern extent of the production area. There was also a group of fifteen sheep close to the dismantled railway on the western shoreline of Loch Laich. Horse dung was also observed on the shoreline at the northern end of Loch Laich, close to The Knap.

4.2 Wildlife

Seabirds such as gulls will always be present on and around Loch Laich but their distribution is likely to be even over time and as such would not materially affect placement of an RMP. During the shoreline survey gulls and two geese were observed on the mud and sand in the centre of the Castle Stalker production area (see Figure 4.1).

No other wildlife was observed at the time of the shoreline survey. However, it is likely that other animals including seals, otters and deer may be present in the area. However, the distribution and numbers of these species is unknown.

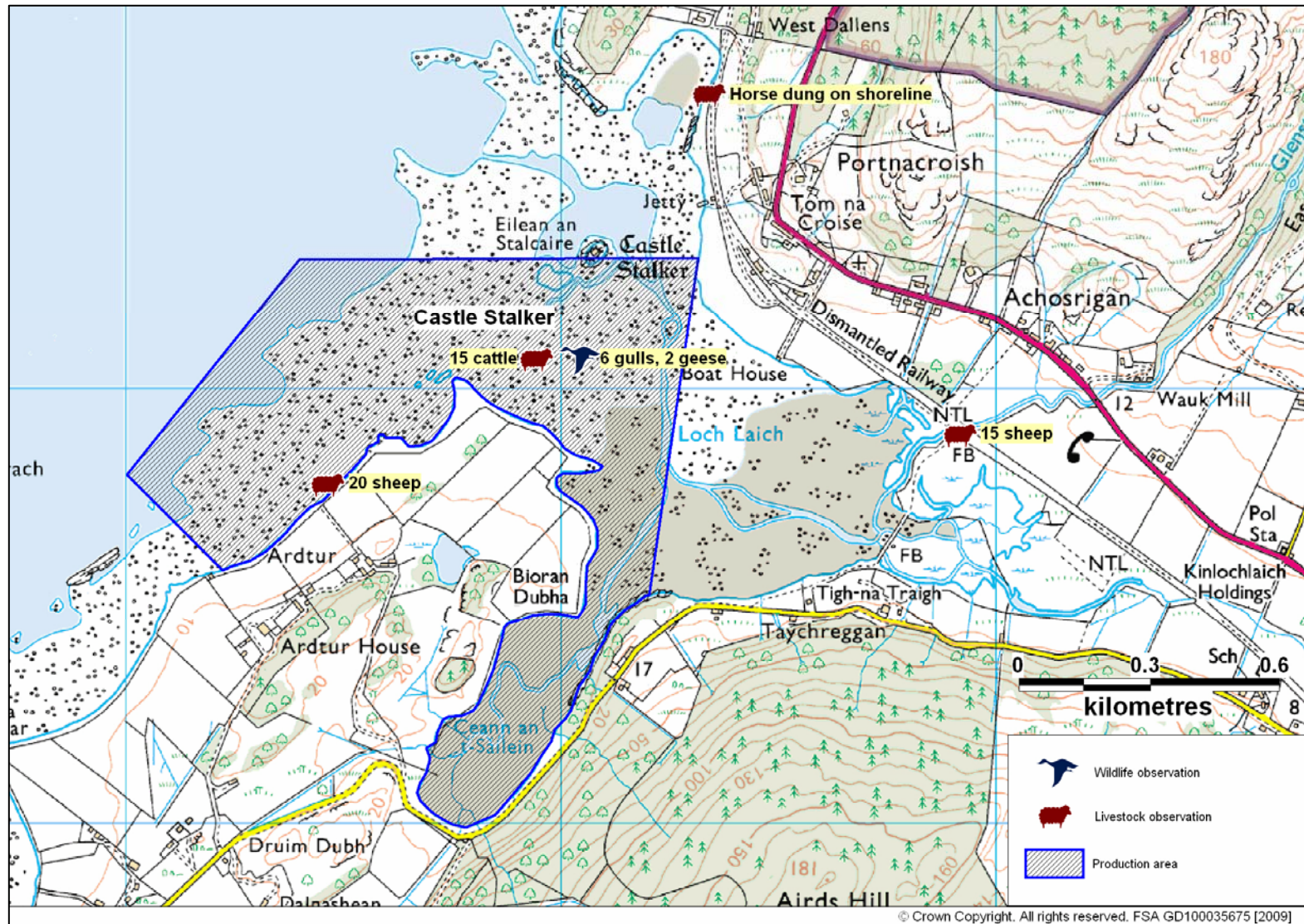


Figure 4.1 Livestock and wildlife present at Castle Stalker during the shoreline survey

5. Rainfall

The nearest weather station is located at Strath of Appin, approximately 4.2 km south east of Loch Laich. Daily rainfall values were purchased from the Meteorological Office for the period 1/1/2003 to 31/12/2008 inclusive, although there were no records for 241 days during this period. Due to the very close proximity of the weather station to Castle Stalker, rainfall recorded here is likely to be very similar to that experienced on Loch Laich 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 Strath of Appin

Due to the missing data it is not appropriate to present total rainfall at Strath of Appin by year or month. Instead, Figures 5.1 and 5.2 summarise the pattern of rainfall recorded at Strath of Appin. 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 at the midline. 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 *.

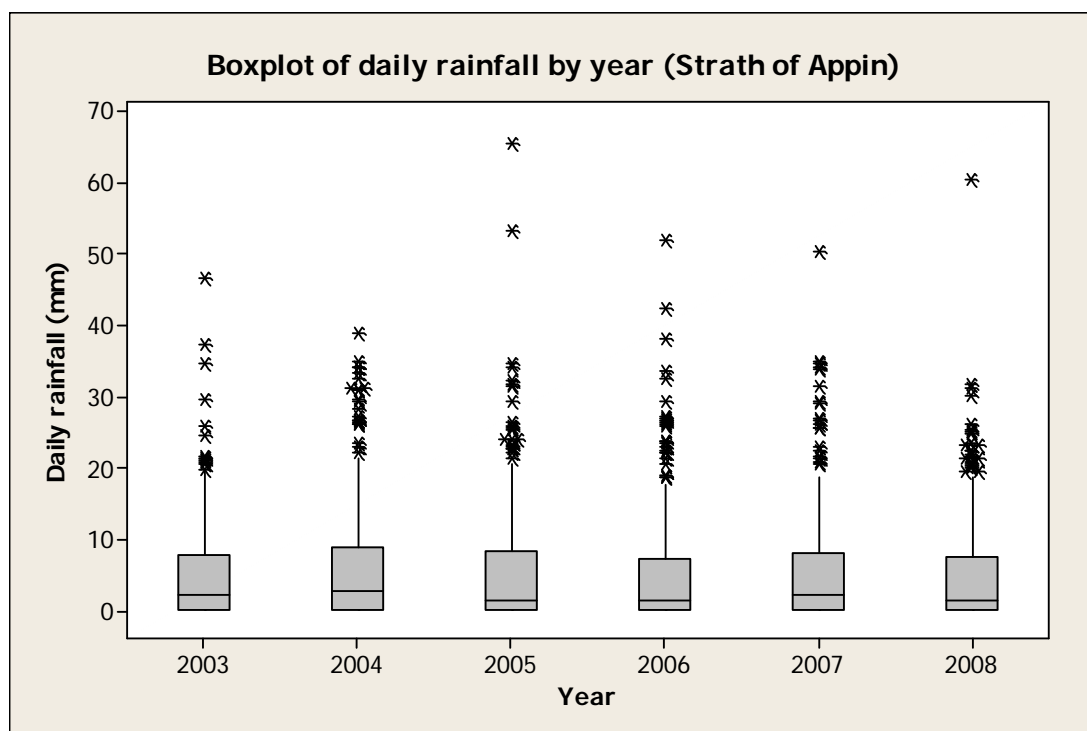


Figure 5.1 Boxplot of daily rainfall at Strath of Appin by year

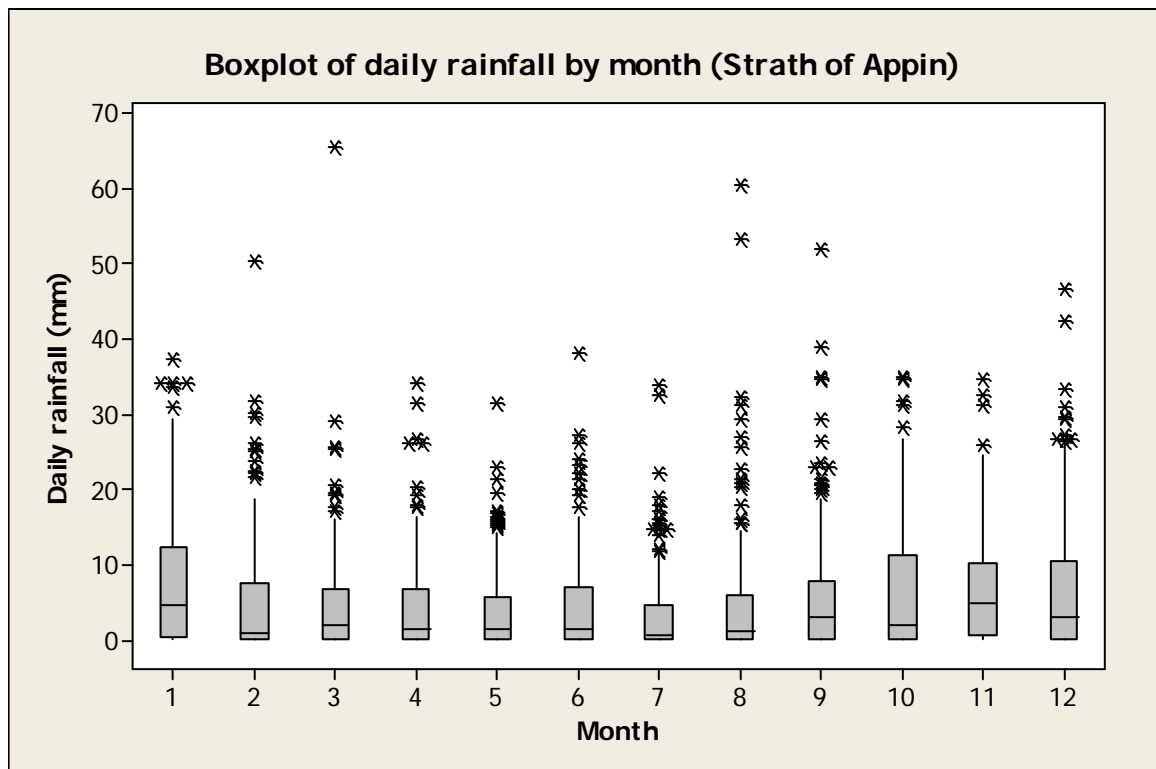


Figure 5.2 Boxplot of daily rainfall values at Strath of Appin by month

The wettest months were September to January inclusive. For the period considered here (2003 – 2006), 30% of days for which records were available experienced no rainfall while 43% of days experienced rainfall of 1mm or less.

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 station in the vicinity of Castle Stalker. A total of seventeen fresh water inputs were observed discharging into Loch Laich. Only eight of these were of a measurable size and had a suitable flow. These eight 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 River flow and loadings – Castle Stalker

No	Grid Ref	Description	Width (m)	Depth (m)	Measured Flow (m/s)	Flow in m ³ /day	<i>E. coli</i> (CFU/100 ml)	Loading (<i>E. coli</i> per day)
1	NM 92342 47409	Stream	0.22	0.03	0.202	115.2	3600	4.1 x 10 ⁹
2	NM 92508 47065	Stream	0.4	0.02	0.265	183.2	3400	6.2 x 10 ⁹
3	NM 92792 46981	Stream	0.12	0.025	0.34	88.1	500	4.4 x 10 ⁸
4	NM 92919 46892	Glenstockdale Burn	3.2	0.35	0.047	4548.1	700	3.2 x 10 ¹⁰
5	NM 92469 46510	Stream	0.15	0.025	0.217	70.3	<100*	3.5 x 10 ⁷
6	NM 92062 46316	Stream	0.09	0.015	0.231	26.9	20	5.4 x 10 ⁶
7	NM 93472 46514	Burn	1.8	0.3	0.024	1119.7	2400	2.7 x 10 ¹⁰
8	NM 91820 45995	Stream	0.12	0.02	0.512	106.2	<100*	5.3 x 10 ⁷
9	NM 91780 45996	Stream	^	^	^	^	3700	^

* Water samples with a *E. coli* result of <100 have been assigned a nominal value of 50 to calculate the loadings.

^ Freshwater input dimensions and flow were not measured

At the time of the shoreline survey, the main *E. coli* concentrations from freshwater sources were therefore on the north side and at the head of the loch.

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.

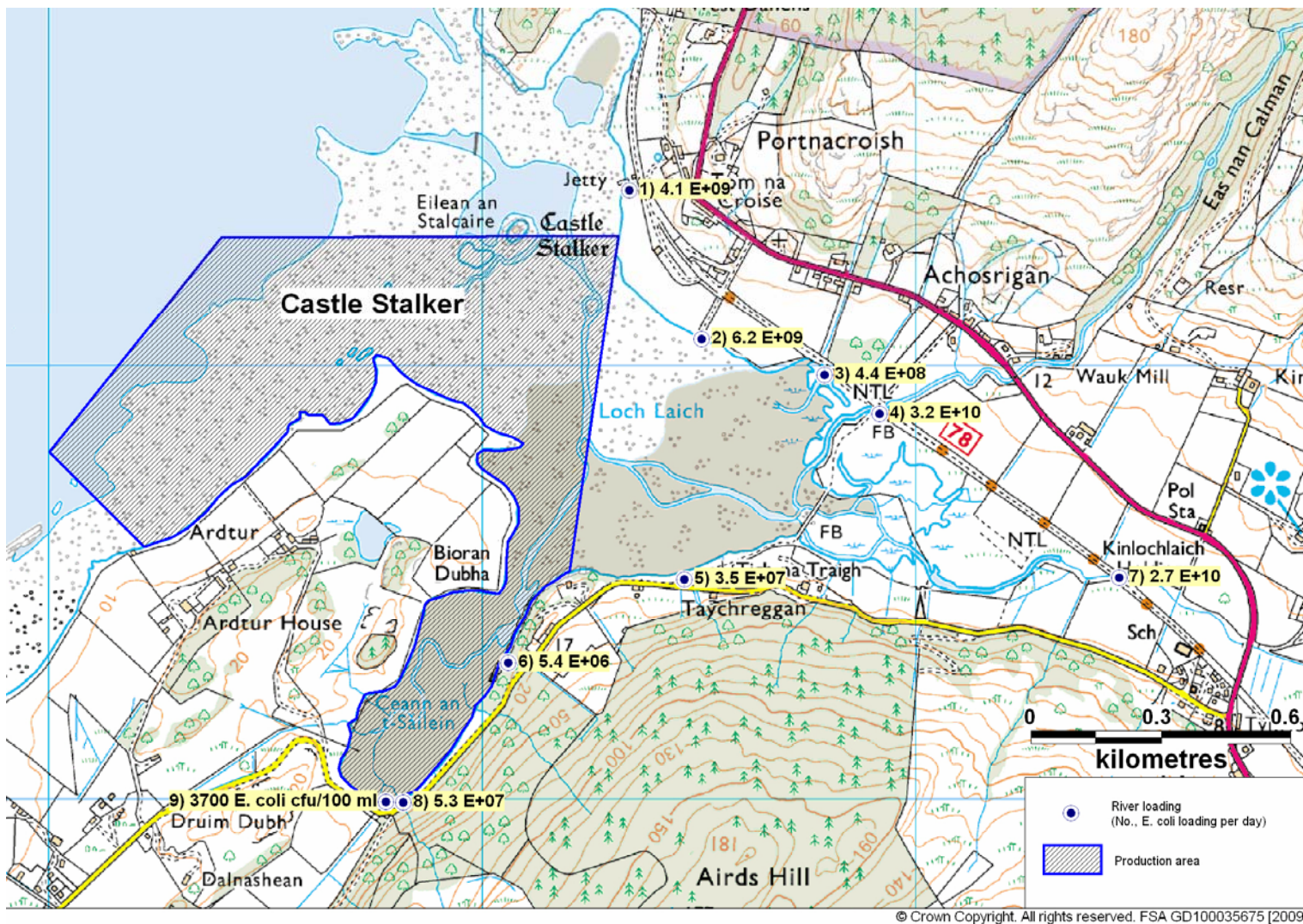


Figure 6.1. Location of river flows and loadings at Castle Stalker

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.

7. Historical *E. coli* Monitoring Data

At the time of writing the report, only two *E. coli* monitoring results were available. The cockle sample was collected on 25th June 2009 at NM 91816 47074 and had a result of 5400 *E. coli* MPN/100 g. The second cockle sample was collected on 8th July 2009 at NM 91762 47052 and had a result of 1700 *E. coli* MPN/100 g.

8. Bathymetry and Hydrodynamics

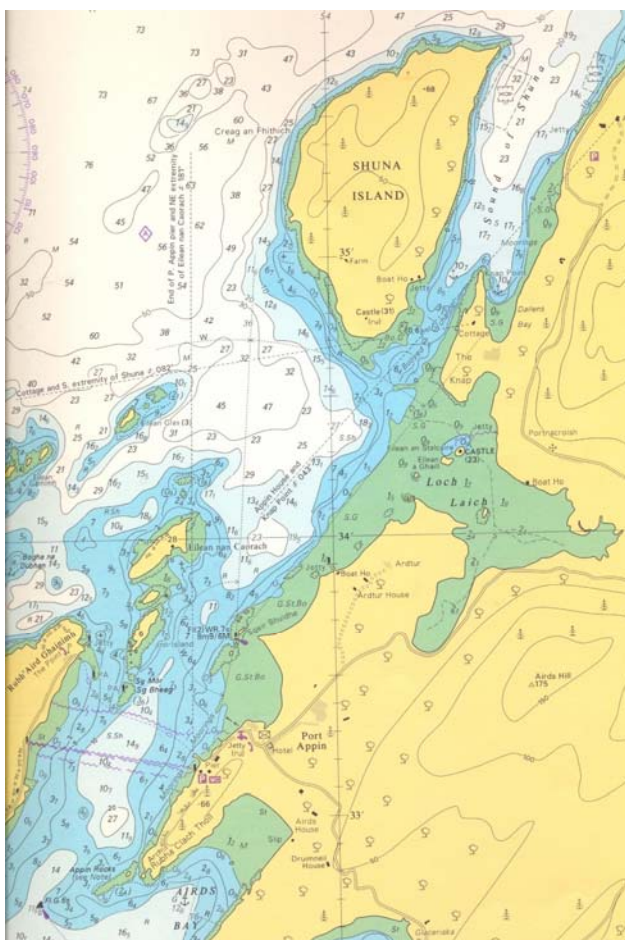


Figure 8.1 Castle Stalker Admiralty chart

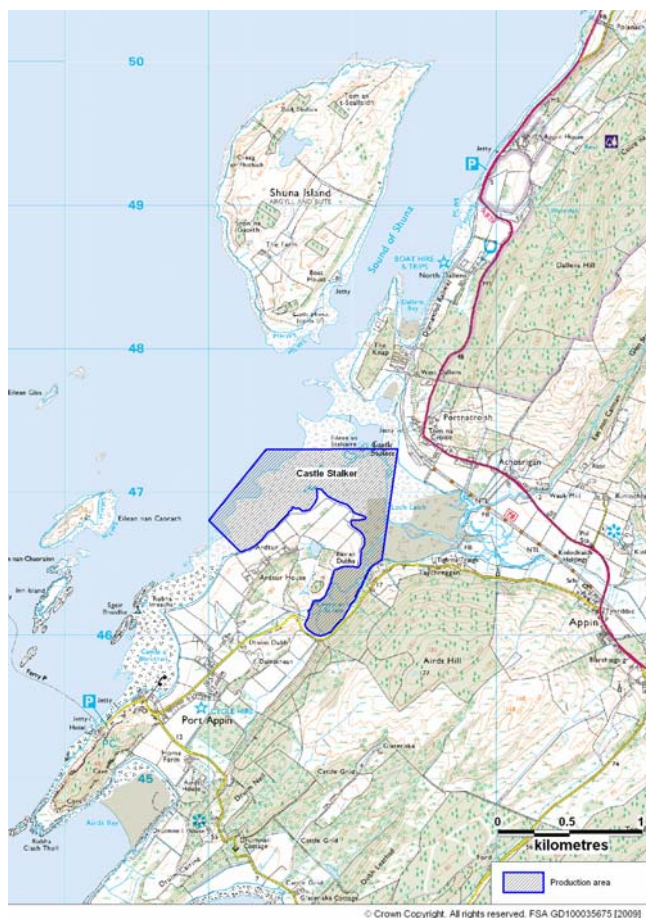


Figure 8.2 Castle Stalker

The UKHO Admiralty chart above (Figure 8.1) shows that the whole of Loch Laich and some of the water either side of it is a drying area.

8.1 Tidal curve and description

The two tidal curves below are for the port of Port Appin, the nearest secondary port– they have been output from UKHO TotalTide. The first is for seven days beginning 00.00 GMT on 2nd June 2009. The second is for seven days beginning 00.00 GMT on 9th June 2009. Together they show the predicted tidal heights over high/low water for a full neap/spring tidal cycle.

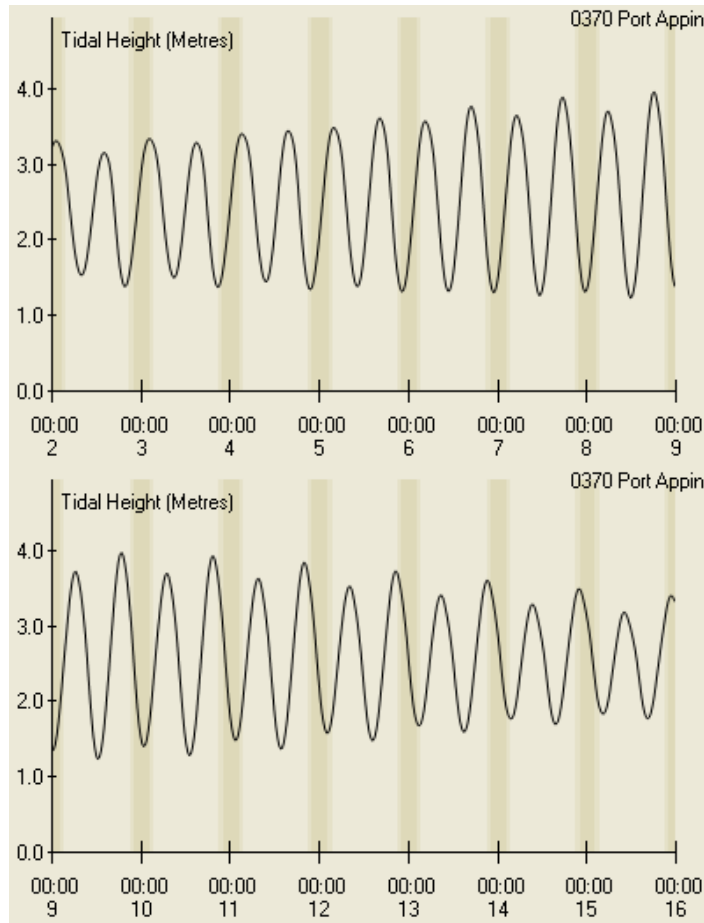


Figure 8.3 Tidal curves for Port Appin

The following is the UKHO summary description for Port Appin:
The tide type is Semi-Diurnal.

MHWS	4.2 m
MHWN	3.1 m
MLWN	1.9 m
MLWS	0.8 m

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Predicted heights are in metres above chart datum. The tidal range at spring tide is therefore approximately 3.4 m and at neap tide 1.2 m.

8.2 Currents

Scottish Sea Kayaking (Cooper and Reid, 2005) identifies that the current between the Isle of Shuna and the mainland is in the order of 1 knot at spring tide (approximately 0.5 m/s). However, just to the south of Loch Laich it is stated to be approximately 2 knots at spring tide (approximately 1 m/s). The values will be roughly halved at neap tides. A north going stream starts approximately 6 hours after HW Oban and a south going stream starts about 15 minutes before HW Oban.

8.3 Conclusions

Any contaminants arising within the loch will be taken out over the cockle bed on the ebbing tide. Contamination arising outside the loch, principally immediately to the south, may be carried into the loch on the flooding tide. The part of the shoreline bed immediately outside the loch may also be exposed to contamination from north of its mouth on the ebbing tide.

9. Shoreline Survey Overview

A restricted shoreline survey of the Castle Stalker shoreline was undertaken by staff from Argyll and Bute Council on the 4th June 2009.

Sub surface sea water samples were taken at several points along the Castle Stalker coastline and also from within the shellfish bed area. Results ranged from 0 to 30 *E. coli* cfu/100 ml. The highest result of 30 *E. coli* cfu/100 ml; was taken from the south east end of the production area at the point where the production area boundary meets the land.

Fresh water samples were taken all along the coastline of the Castle Stalker shellfish bed area at any streams or burns flowing at the time of the shoreline survey. Results ranged from 20 to 37000 *E. coli* cfu/100 ml. A stream on the eastern side of Loch Laich had the highest *E. coli* loading of 3.2×10^{10} per day.

Approximately 15 cattle were present on the central mud and sand area of the production area. Sheep were also observed, with one flock of twenty near Ardtur and another flock of 15 close to the dismantled railway and Glenstockdale Burn.

Common cockle samples were collected from two points within the production area. The first sample was collected from the south western side and returned a result of 310 *E. coli* MPN/100 g. The second sample was collected from the north eastern side of the production area and returned a higher result of 750 *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 in the area
- Sewage outfall pipes discharging into the area
- Livestock grazing on the shoreline

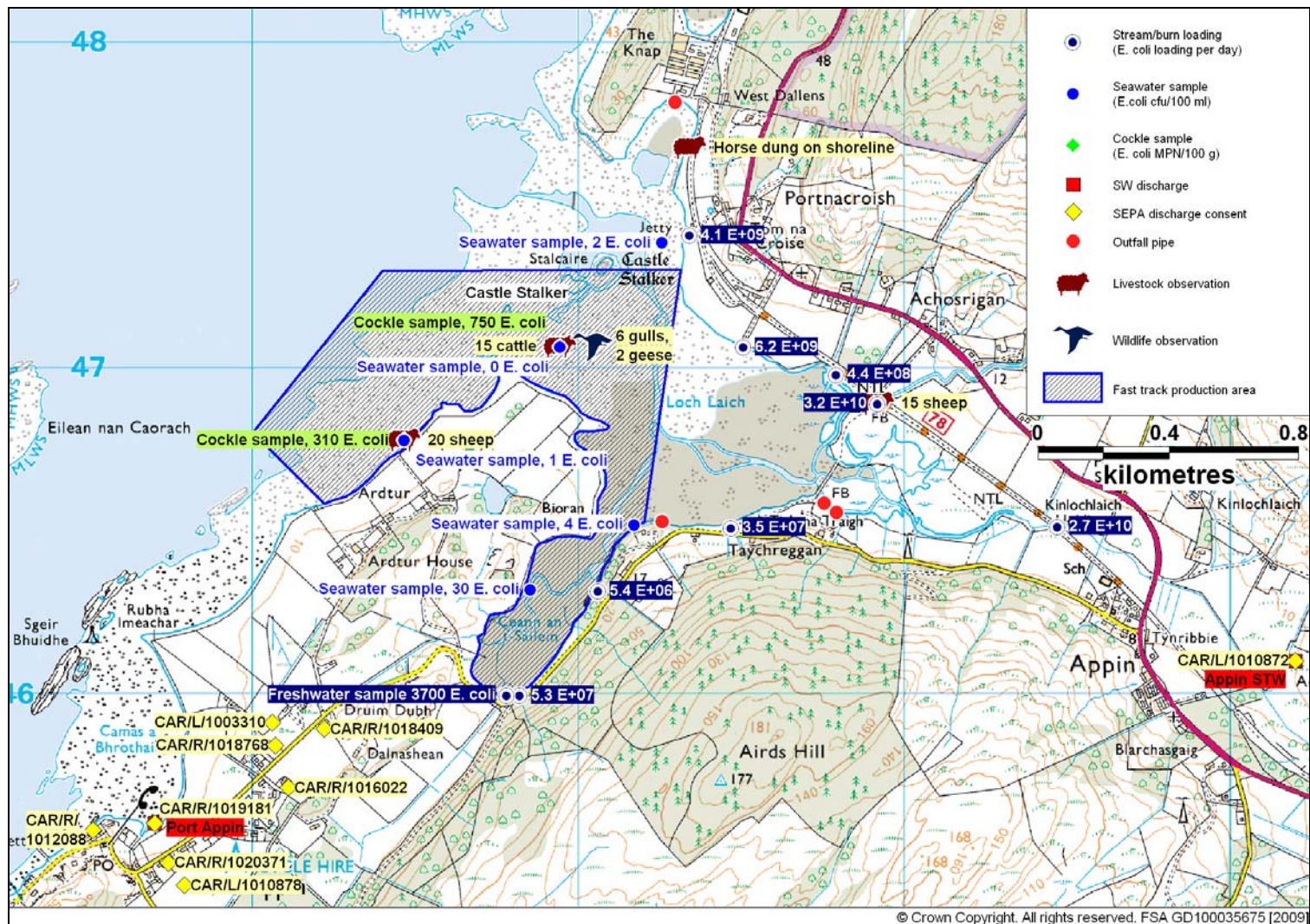


Figure 9.1 Summary of shoreline observations

10. Overall Assessment

Fishery

The shellfish bed is located in Loch Laich, within the Castle Stalker production area. The exact boundaries of the shellfish bed are unknown.

Human sewage inputs

There are four census output areas surrounding the Castle Stalker production area. Within these census output areas are the three settlements of Portnacroish, Port Appin and Appin. Port Appin is the largest settlement and has eight SEPA discharge consents and one Scottish Water community septic tank in the area. In addition to the above discharges, a further SEPA discharge consent and Scottish Water community septic tank is located at Appin. During the shoreline survey a total of four outfall pipes were also observed around the shoreline of the loch. Input of human sewage to the production area is significant with sources potentially impacting from the south of the production area and across the northern end of the production area.

Agricultural inputs

During the shoreline survey, three separate groups of livestock were observed. A group of fifteen cattle were on the sand and mud at the centre of the production area. There was also a flock of twenty sheep close to the shoreline at Ardtur towards the southern end of the production area and another flock of fifteen sheep close to the dismantled railway on the western side of the loch. Due to the close proximity of the livestock to the shellfish bed, it is likely that this will have an affect of the faecal contamination of the shellfish and sea water.

Wildlife inputs

During the shoreline survey six gulls and two geese were observed on the mud and sand in the centre of the Castle Stalker production area. 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 affect placement of an RMP.

Seasonal variation

There were no historical monitoring results available to establish a pattern of seasonal variation.

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.

Port Appin and Castle Stalker are popular with tourists and there is likely to be an increase in human presence during the summer months.

Rivers and streams

A total of eight streams and burns were discharging into Loch Laich and Castle Stalker shellfish bed area at the time of the shoreline survey. All of these freshwater inputs were located on the eastern side of the Castle Stalker production area. The three streams with the greatest *E. coli* loadings of 6.2×10^9 , 3.2×10^{10} and 2.7×10^{10} were located on the eastern side of the loch and shellfish bed. The stream with the loading of 2.7×10^{10} carries the discharge from the Appin STW. Overall it is expected that the freshwater inputs into Castle Stalker will have a relatively low effect on the bacterial contamination of shellfish.

Rainfall

Rainfall patterns at Strath of Appin (the nearest rainfall station) show that rainfall levels are higher between September 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 loch and sea.

Analysis of results

There are no historical monitoring results available for Castle Stalker.

Seawater samples were taken at several points along the coastline. Results ranged from 0 to 30 *E. coli* (cfu/100 ml). The result of 30 *E. coli* (cfu/100 ml) was taken from the south eastern corner of the Castle Stalker production area.

None of the outfall pipes had sufficient flow to take a sample at the time of the shoreline survey. Therefore only fresh water samples from streams and burns were sampled.

Cockle samples were collected at two points within the production area. The first sample with a result of 750 *E. coli* MPN/100 g was taken from the centre of the production area and the second sample with a result of 310 *E. coli* MPN/100 g was taken from the western side of the production area.

Movement of contaminants

Contamination arising within the loch will be taken over the cockle bed on the ebbing tide. Contamination, specifically of the area outside the loch mouth may also arise from sources to the north and south of the area.

Overall conclusions

The main potential sources of contamination (including the discharge at Appin) are within the loch itself and at Port Appin to the south. *E. coli* concentrations in freshwater inputs were low at the time of the shoreline survey.

11. Recommendations

Given that no additional information could be obtained on the location of the cockle bed itself, it is proposed that the boundaries be kept as defined for the fast track application. The production area boundaries are therefore given as the area bounded by lines drawn between NM 9120 4660 to NM 9100 4680 and from NM 9100 4680 to NM 9140 4730 and from NM 9140 4730 to NM 9230 4730 and from NM 9230 4730 to NM 9220 4650 extending to MHWS.

It is proposed that the RMP be located at NM 9190 4710 in order to reflect contamination arising within the loch and from Port Appin to the south (see Figure 11.1). The proposed tolerance is 100 m. This should allow for some variation in cockle density around the recommended RMP location but while still allowing potential sources of contamination to be reflected. The proposed sampling frequency is monthly. This can be reviewed when sufficient data has been accumulated.

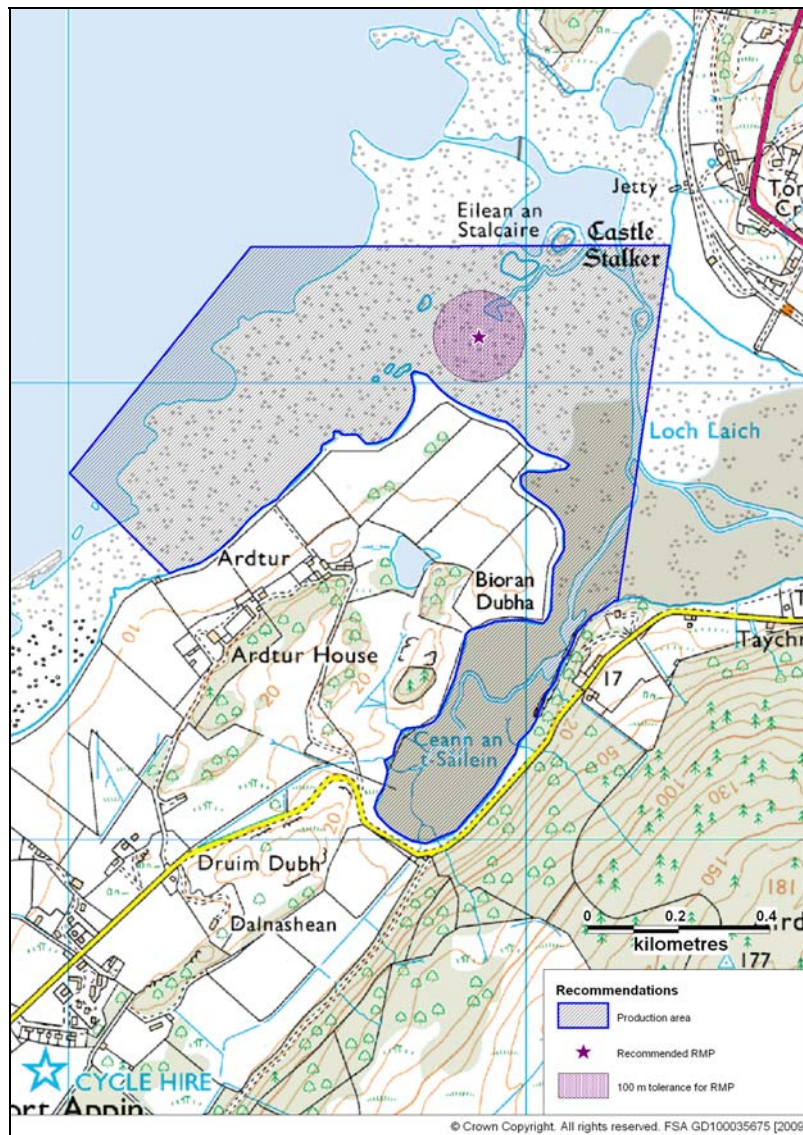


Figure 11.1 Recommendations for Castle Stalker

12. References

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13. List of Figures and Tables

Tables

Table 3.1	SEPA discharge consents	5
Table 3.2	Discharges identified by SW	5
Table 3.3	Observations of potential sewage discharges	5
Table 6.1	River flow and loadings – Castle Stalker	11

Figures

Figure 1.1	Location of Castle Stalker	1
Figure 1.2	Human population surrounding Castle Stalker	3
Figure 2.1	Castle Stalker fishery	4
Figure 3.1	Sewage discharges at Castle Stalker	6
Figure 4.1	Livestock and wildlife present at Castle Stalker during the shoreline survey	8
Figure 5.1	Boxplot of daily rainfall at Strath of Appin by year	9
Figure 5.2	Boxplot of daily rainfall values at Strath of Appin by month	10
Figure 6.1	Location of river flows and loadings at Castle Stalker	12
Figure 8.1	Castle Stalker Admiralty chart	14
Figure 8.2	Castle Stalker OS map	14
Figure 9.1	Summary of shoreline observations	18
Figure 11.1	Recommendations for Castle Stalker	21

Appendices

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

Sampling Plan for Castle Stalker

PRODUCTION AREA	SITE NAME	SIN	SPECIES	TYPE OF FISHERY	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
Castle Stalker	Port Appin	AB 492	Common cockles	Wild harvest	NM 9190 4710	191900	747100	100	NA	Hand raked	Monthly	Argyll and Bute Council	Christine McLachlan William MacQuarrie Ewan McDougall Donald Campbell	Christine McLachlan

Shoreline Survey Report



Castle Stalker AB 492

Restricted Shoreline Survey

Scottish Sanitary Survey Project  **Cefas**

Shoreline Survey Report

Production area: Castle Stalker
 Site name: Port Appin
 Species: Common cockles (*Cerastoderma edule*)
 Harvester: Iain McIntyre
 Local Authority: Argyll & Bute Council
 Status: New site

Date Surveyed: Thursday 4th June 2009
 Surveyed by: Christine McLachlan, Ewan McDougall, Donald Campbell,
 William MacQuarrie

Existing RMP: NA
 Area Surveyed: See Figure 1.

Weather observations

Thursday 4th June: Dry and sunny, no previous rain for past 7 days. Wind NE, Force 2.

Site Observations

Fishery

The Port Appin site is harvested for Common cockles (*Cerastoderma edule*). The cockles are hand raked within the boundaries of the Castle Stalker production area identified in Figure 1. The harvester plans to harvest the cockles all year round.

Sewage/Faecal Sources

The area surveyed has several small villages scattered along the coastline of the production area, including Portnacraish, Appin and Achosrigan on the north shoreline of Loch Laich and the settlement of Port Appin further inland to the south. There are eight SEPA discharges and one Scottish Water discharge in Port Appin and a further single SEPA and Scottish Water discharge in Appin. During the shoreline survey, four outfall pipes were discovered. The first was located at close to The Knap on the northern shoreline of Loch Laich and the other three were located near Taychreggan on the southern shoreline of Loch Laich.

Seasonal Population

A single static caravan was observed close to The Knap on the northern shoreline of Loch Laich. No hotels or B&Bs were observed during the shoreline survey.

Boats/Shipping

During the shoreline survey a boathouse and jetty with one small moored boat was observed near Tom na Croise on the northern shoreline of Loch Laich. There is also a boat house and jetty on the southern end of Shuna Island, which is located north of the production area.

Land Use

The land behind the settlement of Portnacroish and Airds Hill is composed of patches of coniferous and deciduous woodland. The land surrounding the estuary entering Loch Laich and the land buffering the disused railway line are improved grassland. There are also small areas of heath land, acid grassland and neutral grassland.

Wildlife/Birds

During the shoreline survey six gulls and several geese were observed on the mud flats just south of the Castle Stalker monument within the boundaries of the production area.

Observations made during the shoreline survey are mapped in Figure 1 and more detailed information on each observation is contained in in Table 1.

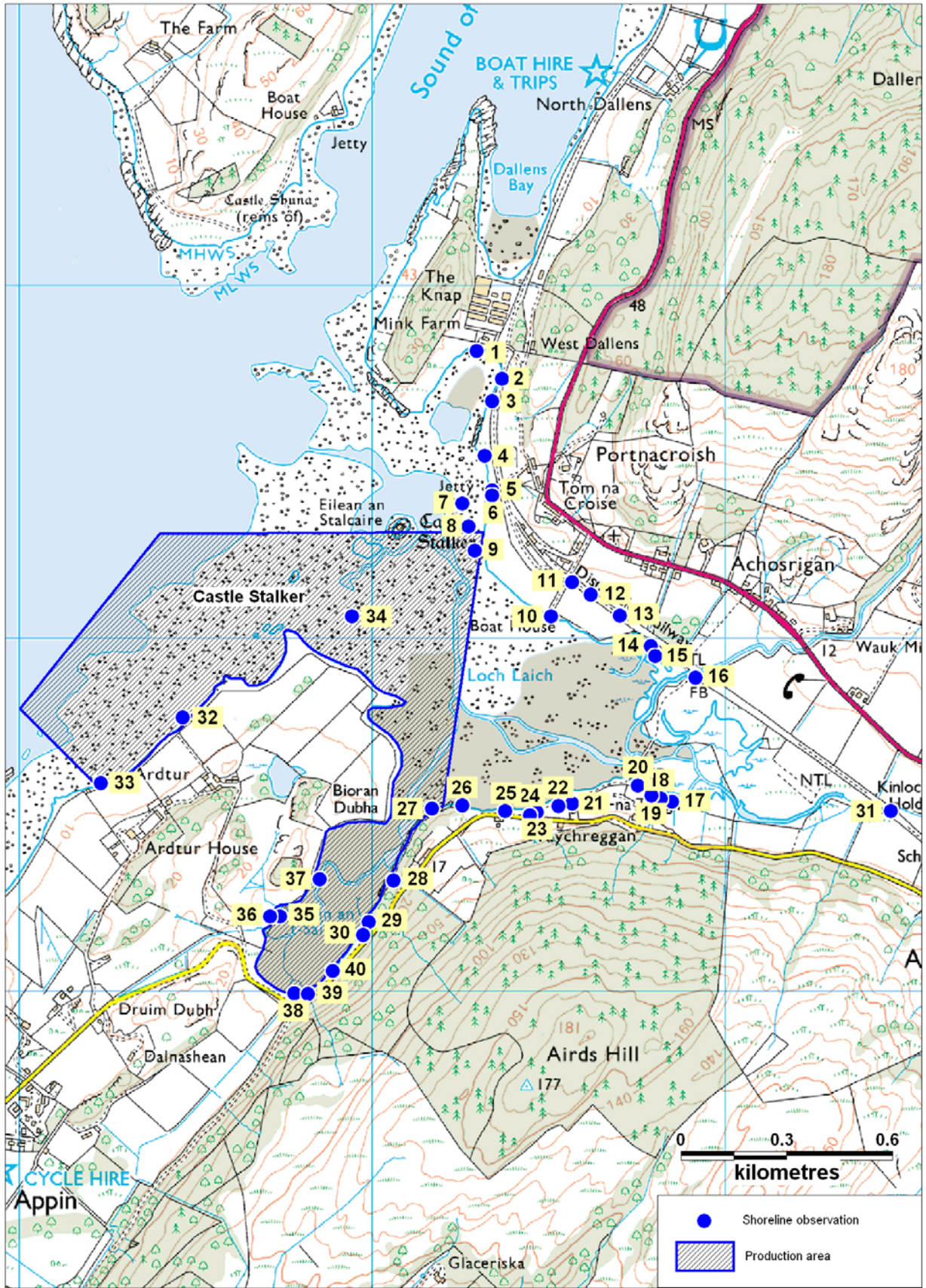


Figure 1. Shoreline Observations

Table 1. Shoreline Observations

No.	Date	Time	NGR	East	North	Associated photograph	Description
1	04/06/2009	11:52	NM 92297 47818	192297	747818	Figure 4	Survey start point. One house (occupied) & static caravan, outfall pipe barely flowing (see photo 2)
2	04/06/2009	11:56	NM 92370 47738	192370	747738	Figure 5	Small stream, not measurable, Castle Stalker fresh water sample 1
3	04/06/2009	11:58	NM 92342 47676	192342	747676		Horse dung on shore
4	04/06/2009	12:01	NM 92321 47521	192321	747521		Small stream, too small to measure and sample. 2 houses, no outfall pipes visible
5	04/06/2009	12:04	NM 92341 47423	192341	747423	Figure 6	Boathouse & jetty, 1 small boat moored
6	04/06/2009	12:05	NM 92342 47409	192342	747409		Small stream flowing, 22cm x 3cm x 0.202 Castle Stalker fresh water sample 2
7	04/06/2009	12:09	NM 92257 47386	192257	747386		Castle Stalker seawater sample 3, salinity = 30ppt
8	04/06/2009	12:13	NM 92275 47321	192275	747321		3 houses, no pipes visible on shore, cockle shells
9	04/06/2009	12:15	NM 92292 47252	192292	747252		Works shed (possibly Roads dept)
10	04/06/2009	12:21	NM 92508 47065	192508	747065		Stream flowing, 40cm x 2cm x 0.265 Castle Stalker fresh water sample 4
11	04/06/2009	12:28	NM 92568 47163	192568	747163		3 houses (railway cottages), no pipes seen
12	04/06/2009	12:30	NM 92621 47127	192621	747127		Church, no pipes seen
13	04/06/2009	12:35	NM 92704 47067	192704	706981		12 houses, no pipes seen
14	04/06/2009	12:40	NM 92792 46981	192792	746981		Small stream flowing, 12cm x 2.5cm x 0.340 Castle Stalker fresh water sample 5
15	04/06/2009	12:45	NM 92804 46953	192804	746953	Figure 7	Small stream, not flowing Castle Stalker fresh water sample 6
16	04/06/2009	12:50	NM 92919 46892	192919	746892	Figure 8	Burn, flowing, 320cm x 35cm x 0.047 Castle Stalker fresh water sample 7 12 houses, no pipes seen 15 sheep in fenced field
17	04/06/2009	13:28	NM 92852 46540	192852	746540		New house under construction Pipe?
18	04/06/2009	13:30	NM 92819 46548	192819	746548		Small stream, not measurable Castle Stalker fresh water sample 8 Work shed

Appendix 2

No.	Date	Time	NGR	East	North	Associated photograph	Description
19	04/06/2009	13:32	NM 92793 46557	192793	746557	Figure 9	House, 6" clay pipe below house. Not flowing but evidence of previous flow
20	04/06/2009	13:34	NM 92754 46585	192754	746585	Figure 10	4" plastic pipe to shore, dripping, no smell, no house above No seawater sample tide out
21	04/06/2009	13:40	NM 92569 46535	192569	746535		Small stream, not measurable Castle Stalker Fresh water 9
22	04/06/2009	13:43	NM 92530 46527	192530	746527		House, no pipe visible
23	04/06/2009	13:44	NM 92469 46510	192469	746510	Figure 11	Small stream 15cm x 2.5cm x 0.217 Castle Stalker Fresh Water 10
24	04/06/2009	13:47	NM 92449 46501	192449	746501		Bird hide
25	04/06/2009	13:49	NM 92378 46514	192378	746514		Stream, Castle Stalker Fresh Water 11, not measurable. Wet area on bank, house behind but no pipe visible
26	04/06/2009	13:53	NM 92257 46529	192257	746529	Figure 12	6" cast iron pipe, not flowing house behind
27	04/06/2009	13:56	NM 92171 46520	192171	746520		Castle Stalker Sea Water Sample 12 (on the incoming tide), Salinity = 25ppt
28	04/06/2009	14:14	NM 92062 46316	192062	746316		Small stream, flowing 9cm x 1.5cm x 0.231 Castle Stalker Fresh water 13
29	04/06/2009	14:20	NM 91992 46198	191992	746198		Very small stream, too small to measure or sample
30	04/06/2009	14:21	NM 91975 46161	191975	746161		Very small stream, too small to measure or sample
31	04/06/2009	14:57	NM 93472 46514	193472	746514	Figure 13	Burn, 30cm x 180cm x 0.024 Castle Stalker Fresh water sample 14
32	04/06/2009	11:50	NM 91465 46779	191465	746779		Castle Stalker Cockle Sample 1 (30 cockles found after 30mins), Castle Stalker Cockle seawater 1, Salinity =34ppt. 20 sheep, 3 houses (appears only one permanent residence)
33	04/06/2009	12:00	NM 91233 46593	191233	746593		Broken cast iron pipe not flowing and no evidence of recent flow
34	04/06/2009	12:25	NM 91944 47066	191944	747066		Castle Stalker Cockle Sample 2 (30 cockles found after 40mins) Castle Stalker Seawater Sample 2, salinity =26ppt. 6 seagulls, 2 geese, 15 cattle in field behind near the small fresh water

No.	Date	Time	NGR	East	North	Associated photograph	Description
							input to Loch Laich
35	04/06/2009	13:50	NM 91741 46214	191741	746214		Small stream Castle Stalker Fresh Water Sample A.
36	04/06/2009	13:55	NM 91712 46214	191712	746214		Castle Stalker Fresh Water Sample B
37	04/06/2009	13:57	NM 91853 46320	191712	746320		No cockles here in any numbers. Ground – thick muddy sand, no practical for raking/walking. Castle Stalker Cockle Seawater 3. Salinity = 24 ppt
38	04/06/2009	14:09	NM 91780 45996	191780	745996		Castle Stalker Fresh Water Sample C.
39	04/06/2009	14:13	NM 91820 45995	191820	745995		Castle Stalker Fresh Water Sample D. Small stream, flowing 12cm x 2cm 0.512
40	04/06/2009	14:15	NM 91890 46059	191890	746059		Castle Stalker Fresh Water Sample E.

Photographs referenced in the table can be found attached as Figures 4 – 13.

Sampling

Water and shellfish samples were collected at sites marked on the maps in Figures 2 and 3. 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).

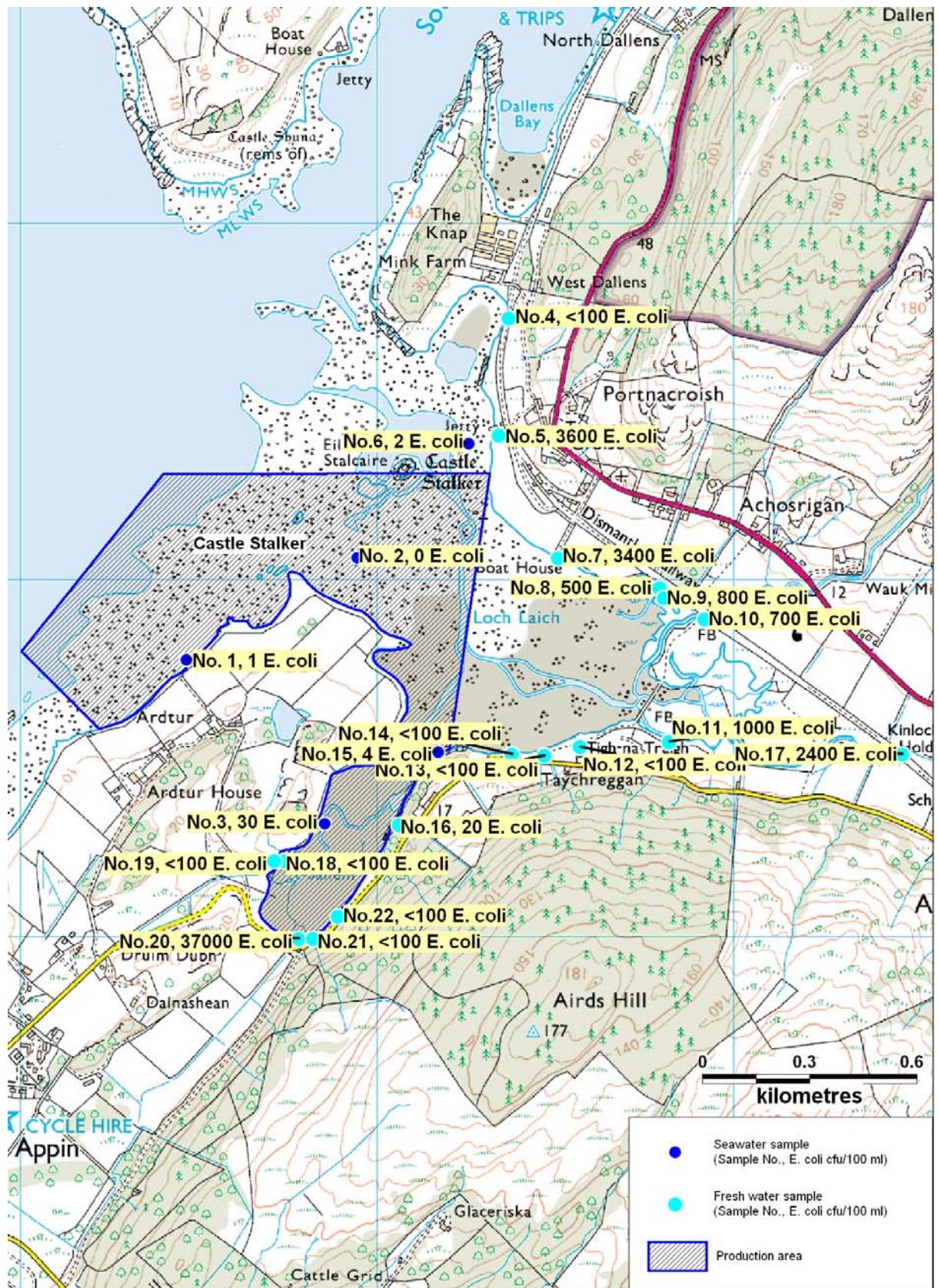
Samples were also tested for salinity by the laboratory using a salinity meter under more controlled conditions. These results are shown in Table 2, given in units of grams salt per litre of water. This is the same as ppt.

Table 2. Water Sample Results

No.	Date	Sample	Grid Ref	Type	<i>E. coli</i> (cfu/100 ml)	Salinity (g/L)
1	04/06/2009	Cockle SW1	NM 91465 46779	Seawater	1	24.3
2	04/06/2009	Cockle SW2	NM 91944 47066	Seawater	0	32.5
3	04/06/2009	Cockle SW3	NM 91853 46320	Seawater	30	24.3
4	04/06/2009	CSFW1	NM 92370 47738	Freshwater	<100	
5	04/06/2009	CSFW2	NM 92342 47409	Freshwater	3600	
6	04/06/2009	CSSW3	NM 92257 47386	Seawater	2	33.2
7	04/06/2009	CSFW4	NM 92508 47065	Freshwater	3400	
8	04/06/2009	CSFW5	NM 92792 46981	Freshwater	500	
9	04/06/2009	CSFW6	NM 92804 46953	Freshwater	800	
10	04/06/2009	CSFW7	NM 92919 46892	Freshwater	700	
11	04/06/2009	CSFW8	NM 92819 46548	Freshwater	1000	
12	04/06/2009	CSFW9	NM 92569 46535	Freshwater	<100	
13	04/06/2009	CSFW10	NM 92469 46510	Freshwater	<100	
14	04/06/2009	CSFW11	NM 92378 46514	Freshwater	<100	
15	04/06/2009	CSFW12	NM 92171 46520	Seawater	4	28.2
16	04/06/2009	CSFW13	NM 92062 46316	Freshwater	20	
17	04/06/2009	CSFW14	NM 93472 46514	Freshwater	2400	
18	04/06/2009	CSFWA	NM 91741 46214	Freshwater	<100	
19	04/06/2009	CSFWB	NM 91712 46214	Freshwater	<100	
20	04/06/2009	CSFWC	NM 91780 45996	Freshwater	37000	
21	04/06/2009	CSFWD	NM 91820 45995	Freshwater	<100	
22	04/06/2009	CSFWE	NM 91890 46059	Freshwater	<100	

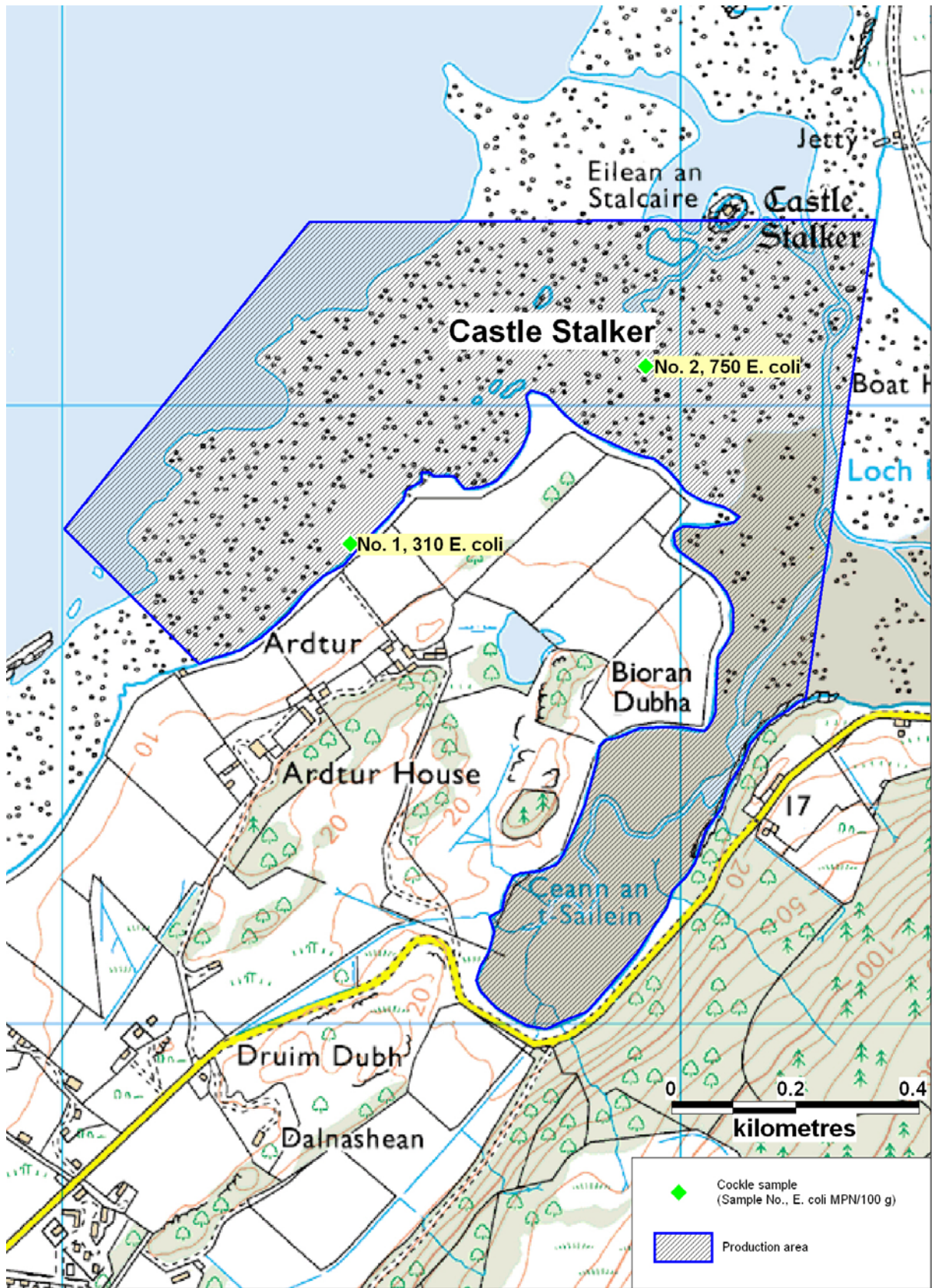
Table 3. Shellfish Sample Results

No.	Date	Sample	Grid Ref	Type	<i>E. coli</i> (cfu/100g)
1	04/06/09	CSC1	NM 91465 46779	Common cockle	310
2	04/06/09	CSC2	NM 91944 47066	Common cockle	750



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Figure 2. Water sample results



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Figure 3. Shellfish sample results

Photographs



Figure 4. Outfall pipe



Figure 5. Small stream, water sample 4



Figure 6. Jetty for boathouse



Figure 7. Small stream, water sample 9



Figure 8. Burn, water sample 10



Figure 9. 6" clay pipe below house



Figure 10. 4" plastic pipe down to shore, dripping, no smell

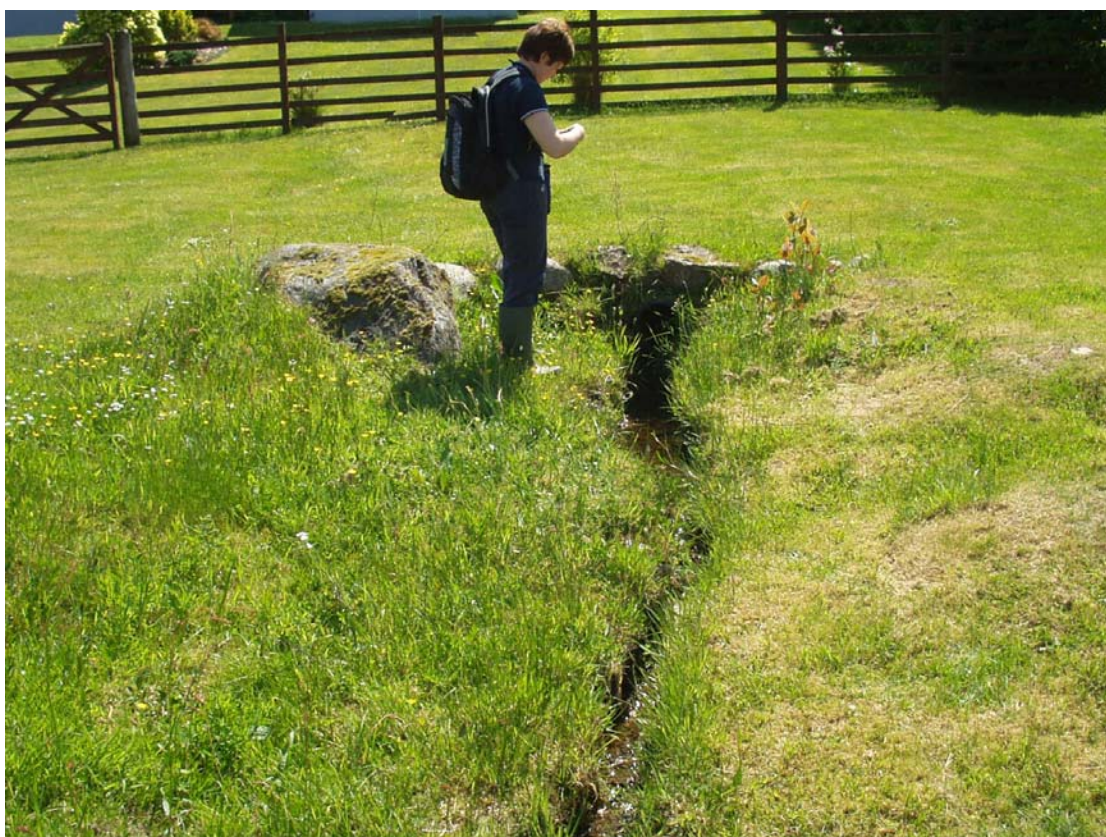


Figure 11. Small stream, water sample 13



Figure 12. 6" cast iron pipe, not flowing



Figure 13. Burn, water sample 17