Regulation (EC) No 854/2004

CLASSIFICATION OF BIVALVE MOLLUSC PRODUCTION AREAS IN ENGLAND AND WALES

SANITARY SURVEY REPORT

Sidmouth (Chit Rocks) - Lyme Bay

2008

Cover photo: Chit Rocks.

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STATEMENT OF USE: This report provides information from a desk study evaluation of the information available relevant to perform a sanitary survey of a bivalve mollusc production area at Chit Rocks, Sidmouth. Its primary purpose is to demonstrate compliance with the requirements for classification of bivalve production areas, laid down in Regulation (EC) No 854/2004 of the European Parliament and of the Council. The Centre for Environment, Fisheries and Aquaculture Science (Cefas) undertook this work on behalf of the Food Standards Agency (FSA).

DISSEMINATION STATUS: Food Standards Agency, East Devon District Council, Environment Agency.

CONTENTS

EXECUTIVE SUMMARY

Under Regulation (EC) No 854/2004 there is a requirement for competent authorities intending to classify bivalve mollusc production and relaying areas (BMPAs) to undertake a number of tasks collectively known (in England and Wales) as 'sanitary surveys'. The main purpose of these surveys is to inform the sampling plans for the microbiological monitoring programme and classification of BMPAs. Other wider benefits of these surveys include the potential to improve identification of pollution events and the sources of those events such that in the future remedial action can be taken to the benefit of the fisheries.

This report documents the qualitative assessment made of potential sources of microbiological contamination of bivalves at Sidmouth (Lyme Bay BMPA) and presents the recommended sampling plan as a result of a sanitary survey undertaken by Cefas on behalf of the Food Standards Agency (FSA). The assessment is supported by published information for the Sidmouth area and new information obtained from a shoreline survey. The sampling plan presents information on the location of monitoring points and sampling frequency for a new harvesting area for mussels at Chit Rocks, Sidmouth.

The main potential sources of microbiological contamination at Chit Rocks are storm sewage spills from Sidmouth sea outfall and the freshwater discharge from the River Sid. Storm sewage spills occur most frequently during the autumn and winter and there is an increased risk of contamination during this period. Analysis of historical microbiological data collected during the EEC Bathing Waters Directive monitoring programme suggests that water quality is sufficient for the shellfishery to achieve class B, at least during the summer.

In the absence of any existing bacteriological data for shellfish collected from Chit Rocks, a bacteriological survey was undertaken between April and June 2008. The highest level of contamination was recorded at a monitoring point located on the east side of the harvesting area and it is recommended that a representative monitoring point (RMP) for Chit Rocks is located at this site.

1. INTRODUCTION

Filter-feeding bivalve shellfish can accumulate bacterial and viral pathogens from sewage-contaminated waters. The consumption of raw or insufficiently cooked shellfish harvested from such waters can cause illness (e.g. gastro-enteritis) and lead to outbreaks of infectious disease. In order to protect public health, under Regulation (EC) No 854/2004, bivalve mollusc production and relaying areas are classified on the basis of monitoring of levels of faecal indicator organisms (*Escherichia coli* in the EU) in bivalve molluscs. This classification determines the level of treatment required (e.g. purification, relaying or cooking) before human consumption or may prohibit harvesting.

Regulation (EC) No 854/2004, states that '*if the competent authority decides in principle to classify a production or relay area it must:*

i) make an inventory the sources of pollution of human or animal origin likely to be a source of contamination for the production areas;

ii) examine the quantities of organic pollutants released during the different periods of the year, according to the seasonal variations of both human and animal populations in the catchment area and environmental factors e.g. rainfall, river flow, level of waste-water treatment, etc.

iii) determine the characteristics of the circulation of pollutants by virtue of current patterns, bathymetry and the tidal regime in the production area; and

iv) establish a sampling programme of shellfish in the production area which is based on the examination of established data, and with a number of samples, a geographical distribution of the sampling points and a sampling frequency which must ensure that the results of the analysis are as representative as possible for the area considered'.

In England and Wales these activities are collectively known as a 'sanitary survey' (Cefas, 2007). The Centre for Environment Fisheries and Aquaculture Science (Cefas) is performing sanitary surveys for new bivalve mollusc production areas (BMPAs) in England and Wales on behalf of the Food Standards Agency (FSA). This report documents information arising from a sanitary survey relevant to a new BMPA at Sidmouth, East Devon. The sanitary survey was prompted by an application for monitoring and classification of wild mussels at Chit Rocks, Sidmouth.

The results of a shoreline survey of the area are documented in Appendix A, a bacteriological survey is described in Appendix B and the proposed sampling plan is detailed in Appendix C.

2. SITE DESCRIPTION

2.1 Background

Sidmouth is a small seaside resort on the East Devon coast situated at the mouth of the River Sid (Figure 2.1). The proposed wild mussel (*Mytilus* spp.) harvesting area is at Chit Rocks, which are located to the west of the town. The site lies within the Dorset and East Devon Coast UNESCO World Heritage Site (the Jurassic Coast) and Chit Rocks is a Site of Special Scientific Interest (SSSI).

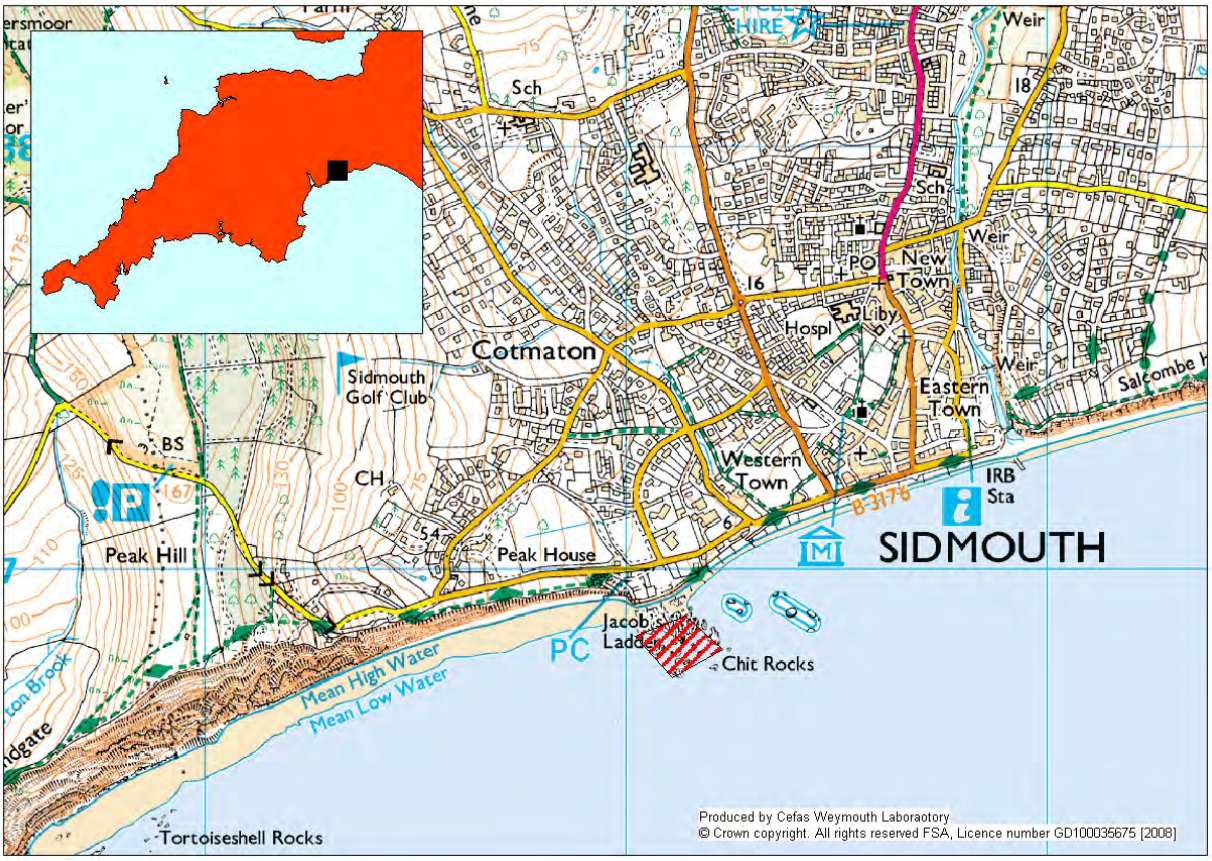

Figure 2.1 Sidmouth and Chit Rocks location map.

2.2 Population

Sidmouth has a resident population of around 14,144 (Family Health Services Authority mid-year 2007 estimate, Devon County Council, 2008). This population increases substantially during the summer months due to tourism. Gameson (1978) suggested an increase of some 60 per cent. The number of visitors to Devon peaks in August (Devon County Council, 2007). A folk festival is held in Sidmouth in the first week of August. This event attracts a large number of visitors and there may be an increased risk of pollution during this period due to the additional demands imposed on the local sewerage infrastructure.

2.3 Land use and agriculture

Farming is the main land use in the area (Environment Agency, 1999; South West Observatory, 2007). The dominant farm type in East Devon is cattle and sheep, closely followed by dairy (East Devon AONB, 2008). There is also some arable farming. Further information on livestock numbers and densities in the Sidmouth area is given in Section 3.3.

2.4 Climate

Rainfall at Sidmouth averages 773 m per year (Environment Agency, 1999). The pattern of mean monthly rainfall at Sidmouth is shown in Figure 2.2. The highest monthly rainfall totals tend to be in the autumn and winter months. The number of days per month with rainfall of over 1 mm follows a similar pattern to the monthly totals (Figure 2.3).

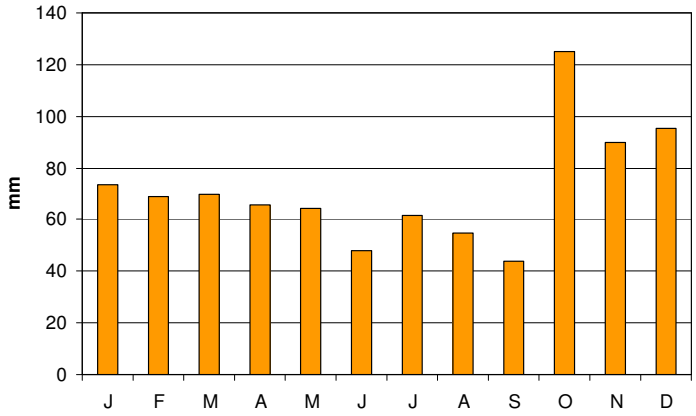

Figure 2.2: Mean monthly rainfall at Sidmouth, 2000 to 2006 (Data source Environment Agency).

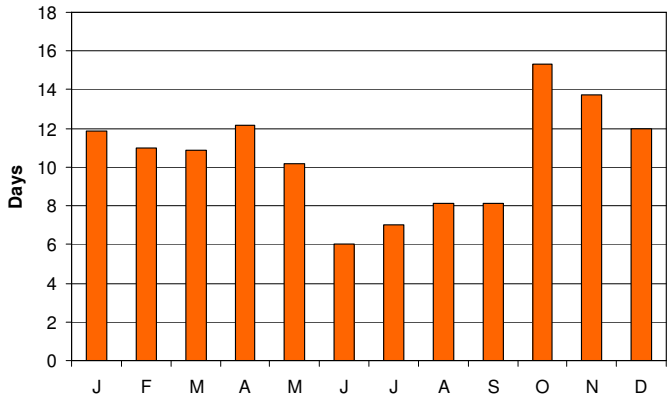

Figure 2.3: Mean number of days per month with rainfall over 1 mm at Sidmouth, 2000 to 2006 (Data source Environment Agency).

Total sunshine duration averages over 1600 hours at coastal sites in the South West of England (Met Office, 2007). Monthly variation in mean duration of sunshine hours at Teignmouth, 23 km south west of Sidmouth, is shown in Figure 2.4. July has the highest hours of sunshine.

The wind direction in coastal areas in the South West of England is predominantly from the southwest and the strongest winds nearly always blow from this direction (Met Office, 2007). Wind speeds are generally highest between November and March and lowest between June and August.

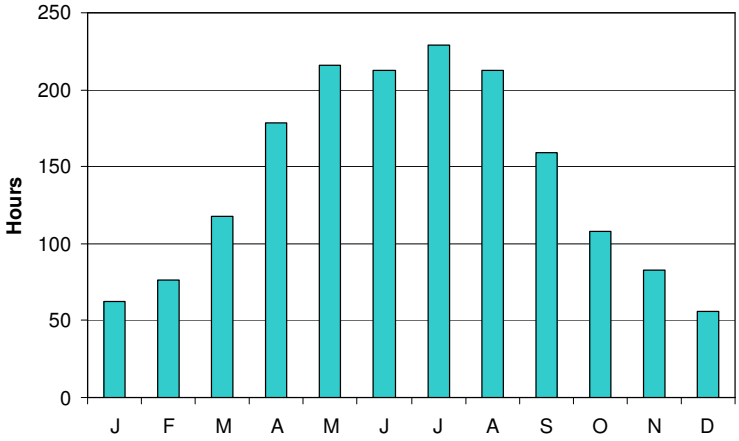

Figure 2.4: Mean monthly duration of sunshine hours at Teignmouth, 1971-2000 (Data source Met Office, 2007).

2.5 Bathymetry and tidal regime

Details of the bathymetry of Lyme Bay are given in Admiralty Chart No. 3315, Berry Head to Portland Bill (UKHO, 1987). Off Sidmouth, chart depths are less than 10 m below chart datum (LAT) within 1 km of the shoreline.

The tidal range at Sidmouth is approximately 4 m on springs and 1.5 m on neaps (Table 2.1). The tidal streams within Lyme Bay are weak and rarely more than 0.75 knots. The predominant currents are in a south-westerly direction on the flood and in a north-easterly direction on the ebb (UKHO, 2003).

Table 2.1: Tidal levels at Exmouth and Lyme Regis (UKHO, 1987).

Place	Height in metres above chart datum (LAT)			
	MHWS	MHWN	MLWN	MLWS
Exmouth (Approaches)	4.6	3.4	1.7	0.5
Lyme Regis	4.3	3.1	1.7	0.6

2.6 Shellfishery

Jurassic Coast Shellfish are proposing to harvest wild mussels (*Mytilus* spp.) from Chit Rocks. The site covers an area of approximately 0.02 km^2 and is predominantly in the intertidal (Figure 2.1). Mussels will be harvested all year round, either by hand picking or diving. This site has not previously been classified.

3. SOURCES OF MICROBIOLOGICAL CONTAMINATION

3.1 Sewage discharges

Sewage discharges often pose the greatest potential contamination risk to shellfisheries. The locations of continuous and intermittent sewage discharges in the vicinity of Chit Rocks are shown in Figure 3.1 below.

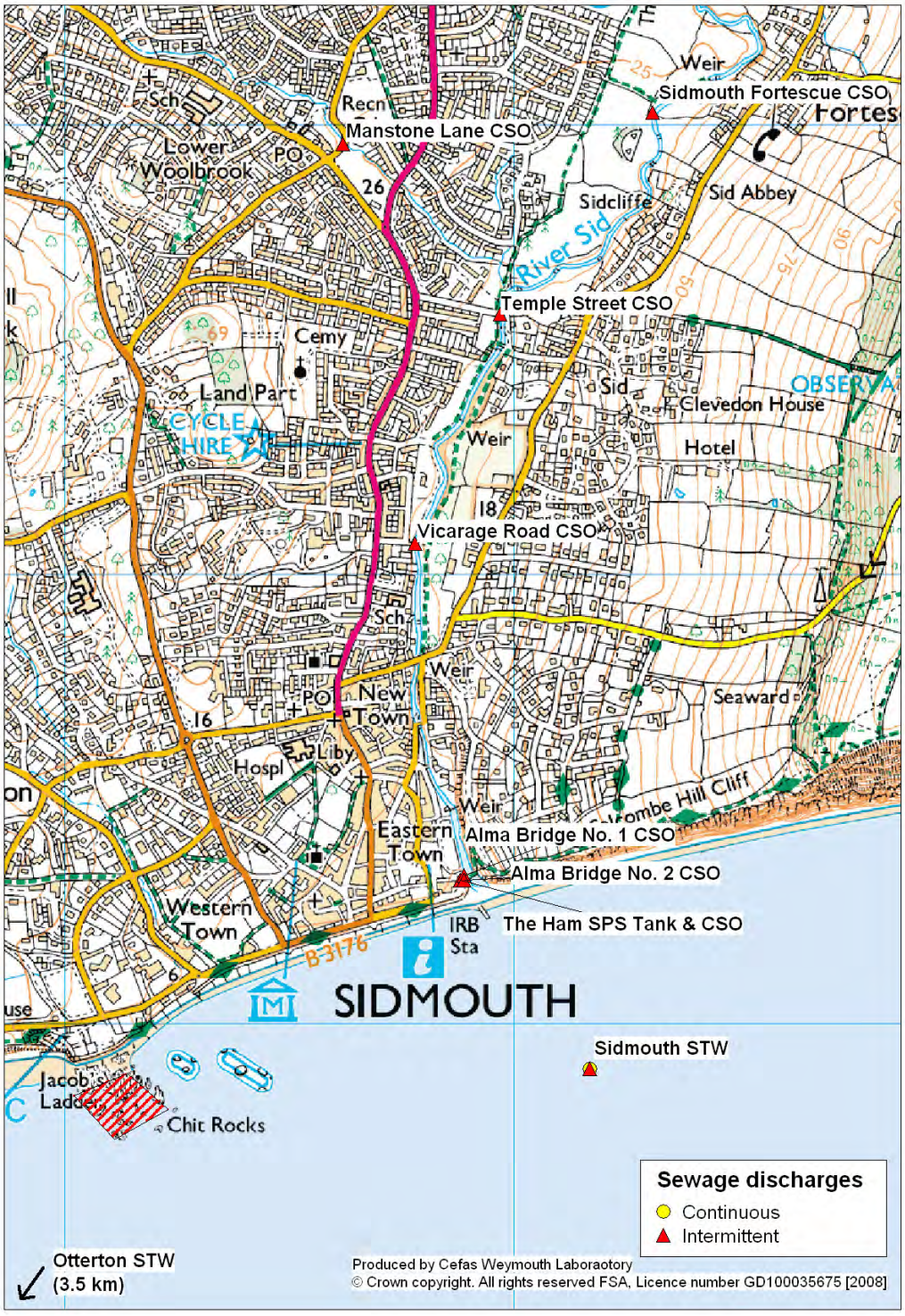

Figure 3.1: Sewage discharges at Sidmouth.

Details of continuous sewage discharges near Sidmouth are given in Table 3.1 below.

Table 3.1: Continuous sewage discharges with potential to impact shellfishery at Chit Rocks, Sidmouth.

Name	Level of treatment	DWF (m^3day^{-1})	NGR of outfall	Distance from bed (km)
Sidmouth STW	Tertiary (UV)	6,331	SY 1317 8690	0.9
Otterton STW	Tertiary (UV)	1,095	SY 0923 8409	3.9

N.B. STW = Sewage Treatment Works

Sidmouth sewage treatment works (STW) discharges tertiary treated effluent to Lyme Bay via Sidmouth sea outfall. The outfall is located 0.5 km offshore, 0.9 km east of Chit Rocks. Sewage flows of up to 12,355 m^3 day^{-1} are pumped to the STW where they receive full biological treatment followed by UV disinfection (year-round). Storm sewage flows above this flow are initially stored in storm tanks at The Ham. In heavy or prolonged rainfall there may be a discharge of settled storm sewage through the sea outfall. In the exceptional event of prolonged electrical or mechanical breakdown of the sewage pumping station (SPS) at The Ham and after the emergency storage is full, there may then be a screened emergency discharge to the River Sid through the outfall at The Ham, 0.8 km east of Chit Rocks. The STW was commissioned in 2000.

Sidmouth STW complied with the consent compliance criteria relating to UV disinfection in 2006 (Environment Agency, personal communication). Bacteriological data for the final effluent are summarised in Figure 3.2. The median faecal coliform count is 200 per 100 ml, which is typical of UV disinfected sewage effluents (Kay *et al.*, 2008).

Details of the frequency of recorded spills of storm sewage from the Ham SPS to Sidmouth sea outfall and the River Sid since 2005 are presented in Table 3.2. Spills to the sea outfall occur relatively frequently (47 times per year on average). The maximum spill duration recorded was 77 hours. Analysis of time series of STW flow and rainfall data indicates that these spills are clearly rainfall-related and tend to occur more often during the autumn and winter (Figure 3.3). There is no evidence of an increase in flows from the STW, or an increased incidence of spills, during the August holiday period.

Table 3.2: Number of storm sewage spills per year from The Ham SPS to Sidmouth sea outfall and the River Sid (Data from South West Water).

	2005	2006	2007	Average
To sea outfall	45	39	58	47.3
To River Sid	11	3	3	5.7

Storm sewage spills from Sidmouth outfall have the potential to significantly impact on the shellfishery at Chit Rocks, particularly if the spill coincides with the flood tide.

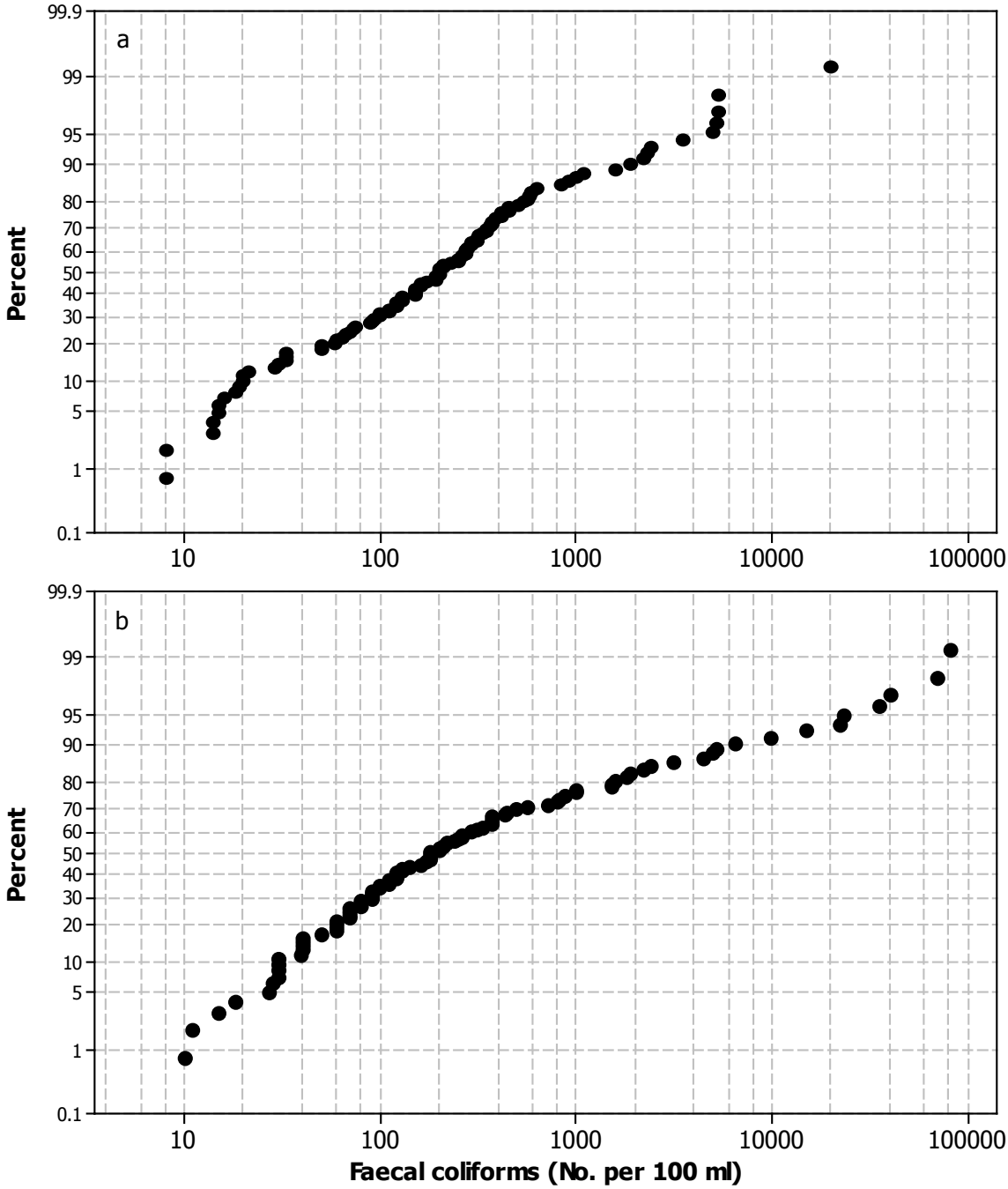

Figure 3.2: Distribution of presumptive faecal coliform counts in the final effluent from a) Sidmouth STW and b) Otterton STW, 2003-2006 (South West Water efficacy data provided by the Environment Agency).

Otterton STW discharges to Lyme Bay approximately 4 km south west of Chit Rocks. The effluent from this STW also receives year round UV disinfection. Otterton STW complied with the consent compliance criteria relating to UV disinfection in 2006 (Environment Agency, personal communication). Bacteriological data for the final effluent are summarised in Figure 3.2. Given the level of treatment of the effluent and the distance from the shellfishery, Otterton STW is unlikely to have a significant impact on levels of microbiological contamination at Chit Rocks.

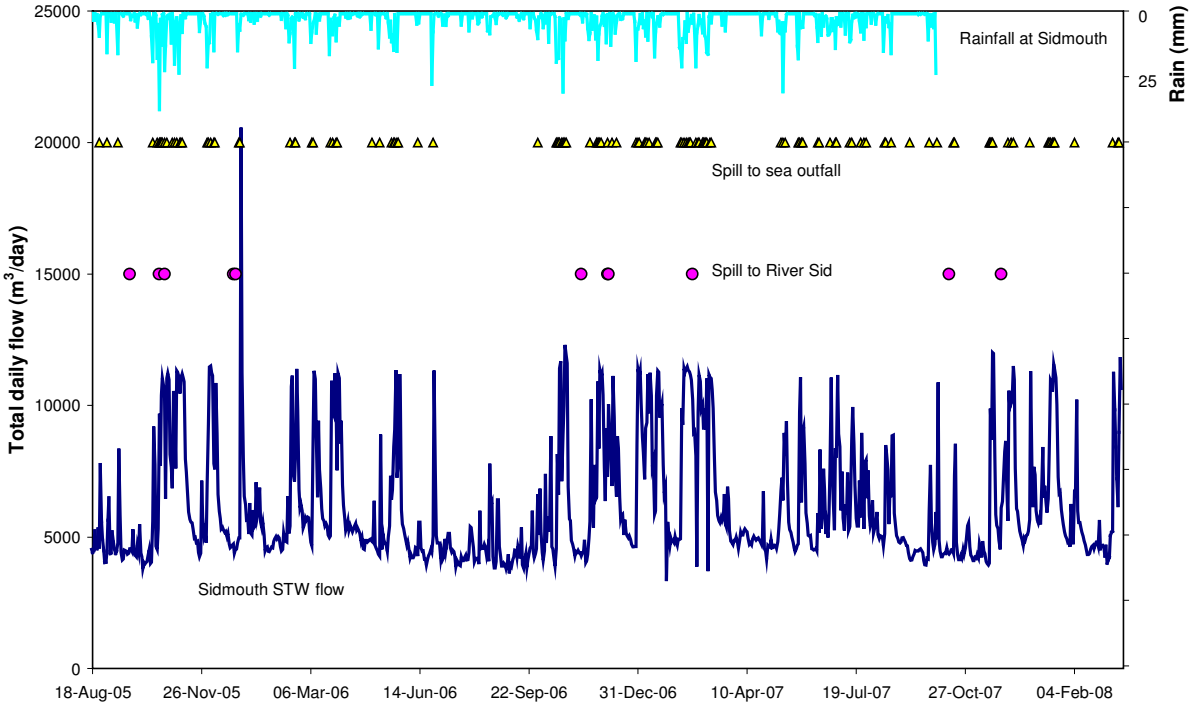

Figure 3.3: Time series of total daily final effluent flow from Sidmouth STW, storm spills from The Ham SPS and daily rainfall totals at Sidmouth (Data from the Environment Agency and South West Water, no rainfall data post September 2007).

In addition to The Ham SPS Tank & CSO, there are several combined sewer overflows (CSOs) in Sidmouth that may discharge storm sewage to the River Sid, or its tributary the Wool Brook, after prolonged or heavy rainfall. These are listed in Table 3.3 below. None of these CSOs have spill monitoring equipment and the spill frequency of these discharges is not known.

Table 3.3: Intermittent sewage discharges in Sidmouth (Data source South West Water).

Name	NGR of outfall	Receiving water	Distance from bivalve production area (km)
The Ham SPS Tank & CSO	SY 1317 8690	Lyme Bay	0.9
The Ham SPS Tank & CSO	SY 1288 8732	River Sid	0.8
Alma Bridge No. 1 CSO	SY 1288 8732	River Sid	0.8
Alma Bridge No. 2 CSO	SY 1288 8732	River Sid	0.8
Vicarage Road CSO	SY 1277 8806	River Sid	1.6
Temple Street CSO	SY 1296 8857	River Sid	2.2
Sidmouth Fortescue CSO	SY 1331 8903	River Sid	2.9
Manstone Lane CSO	SY 1262 8895	Wool Brook	2.8

N.B. SPS = Sewage Pumping Station, CSO = Combined Sewer Overflow

3.2 Freshwater inputs

Rivers and streams receiving point or diffuse pollution sources from within their catchments are often important sources of microbiological contamination of shellfisheries. The major freshwater discharge at Sidmouth is the River Sid which discharges to Lyme Bay approximately 800 m east of Chit Rocks (Figure 2.1). Under low flow conditions a shingle bank closes the river mouth and the water passes through the shingle to the sea (Figure 3.3). When the river is in spate, it cuts a channel directly through the shingle to the sea (Gameson, 1978). The river catchment (38 km^2) is predominantly rural, the only significant urban area being Sidmouth itself.

Figure 3.3: Mouth of the River Sid at low flow. Note the channelised lower river course, the river flow through the beach and the river training wall to the west of the river mouth. Image courtesy of Channel Coastal Observatory (www.channelcoast.org).

The Sid is a short, steep river with an average gradient of 20.1 m/km. It has a rapid response to rainfall because flow is derived mainly from direct surface run off from the steep and relatively impermeable clay catchment. There is no flow gauging station on the river but the Environment Agency have calculated a theoretical mean daily flow (MDF) of 0.574 $m^3 s^{-1}$ and a Q95 (the flow exceeded for 95% of the time, on average) of 0.134 $m^3 s^{-1}$ (Environment Agency, 1999). During spates the flow may be much greater (>10 $m^3 s^{-1}$).

Bacteriological data collected from the River Sid at Sidmouth collected during the bathing season (May to September) are summarised in Figure 3.4 below. The median faecal coliform count is 2100 per 100 ml, which is an order of magnitude higher than that for the disinfected effluent from Sidmouth STW. This suggests that, during baseflow conditions, the River Sid is a more significant source of microbiological contamination than Sidmouth sea outfall. Under spate conditions the River Sid is a potentially significant source of microbiological contamination of the shellfishery at Chit Rocks.

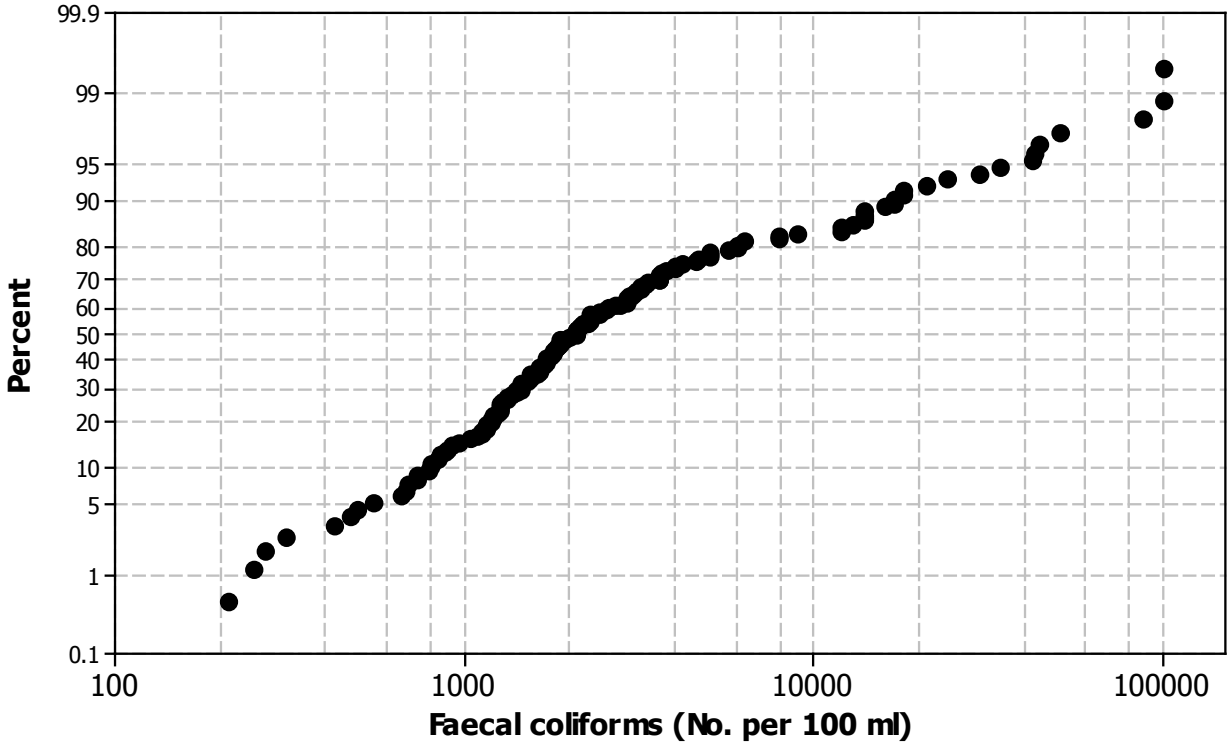

Figure 3.4: Frequency distribution of presumptive faecal coliform counts in the River Sid at Sidmouth, May to September, 2001-2007 (Data source Environment Agency).

Faecal coliform levels in the River Sid are positively correlated with antecedent rainfall (Table 3.4), rainfall explaining up to 22% of the variation in faecal coliform levels. Diffuse urban and agricultural pollution is likely to be a significant source of microbiological contamination of the River Sid (ref, BW inv.). As noted above, several CSOs in Sidmouth may discharge storm sewage to the river after prolonged or heavy rainfall.

Table 3.4: Summary of Spearman's rank correlation coefficients (r_s) between faecal coliform levels in the River Sid and rainfall at Sidmouth.

	No. samples	r_s	p
Rainfall in previous day	145	0.469	<0.001
Rainfall in previous 2 days	145	0.401	<0.001

In addition to the River Sid, there are also two small culverted streams that discharge to the sea between Chit Rocks and the mouth of the River Sid. The presence of these streams was noted by Gameson (1978) and confirmed during the shoreline survey (See report in Appendix A). One stream discharges onto the beach at the Esplanade, 270 m east of Chit Rocks, and the other discharges at the beacon, 130 m east of Chit Rocks. Levels of *E. coli* in both streams were found to be relatively high (2,100 and 14,000 per 100 ml respectively) indicating that they receive diffuse microbiological pollution from urban or agricultural sources and could potentially be sources of contamination of the shellfishery at Chit Rocks.

3.3 Other Sources

3.3.1 Dogs

Dog faeces are a potential source of microbiological contamination of shellfish at Chit rocks. Dogs were observed on the beach during the shoreline survey (See Appendix A). Dogs are banned from the Sidmouth beaches from 1st May to 30th September (East Devon District Council, 2008).

3.3.2 Farm animals

As noted above, diffuse agricultural pollution may be a source of microbiological contamination of the River Sid. Details of livestock numbers in the River Sid catchment are given in Table 3.5. No information on seasonal variation in animal numbers is available, although the greatest risk of contamination is likely to be during periods of heavy rainfall in the autumn and winter.

Table 3.5: Numbers and density of livestock in the Sid catchment (Data source Defra, June 2006 Agricultural Survey).

	Cattle	Pigs	Sheep	Poultry
Number	1,915	#	5,704	538
Density (no/km^2)	504	N/A	1,501	142

N.B. # Data suppressed by Defra for confidentiality reasons.

3.3.3 Birds

Although very few birds were observed in the vicinity of Chit Rocks during the shoreline survey (see Appendix A), seagulls (chiefly herring gulls, *Larus argentus*) are abundant in Sidmouth during the summer and are considered a nuisance (Chris Neal, Environmental Health Officer, East Devon District Council, personal communication). It is, however, unlikely that seagulls or other birds are a significant source of microbiological contamination of the shellfishery at Chit Rocks.

4. MICROBIOLOGICAL DATA

4.1 Seawater

There are EEC designated bathing waters at Sidmouth Town Beach, 600 m to the east, and Jacobs Ladder, 200 m to the west, of Chit Rocks (Figure 4.1). Levels of faecal indicator organisms (total coliforms, faecal coliforms and faecal streptococci) in seawater at these sites are monitored weekly from May to September by the EA. The compliance history of these beaches against the mandatory and guideline standards of the Bathing Waters Directive 76/160/EEC (Anonymous, 1976) is given in Table 4.1. Jacobs Ladder beach has passed the guideline standard in every year since 2001 (post commissioning of the new STW). Sidmouth Town Beach has passed the guideline standard in all years except 2006. This suggests that levels of faecal contamination in seawater in the vicinity of Chit Rocks are generally low, at least during the bathing season.

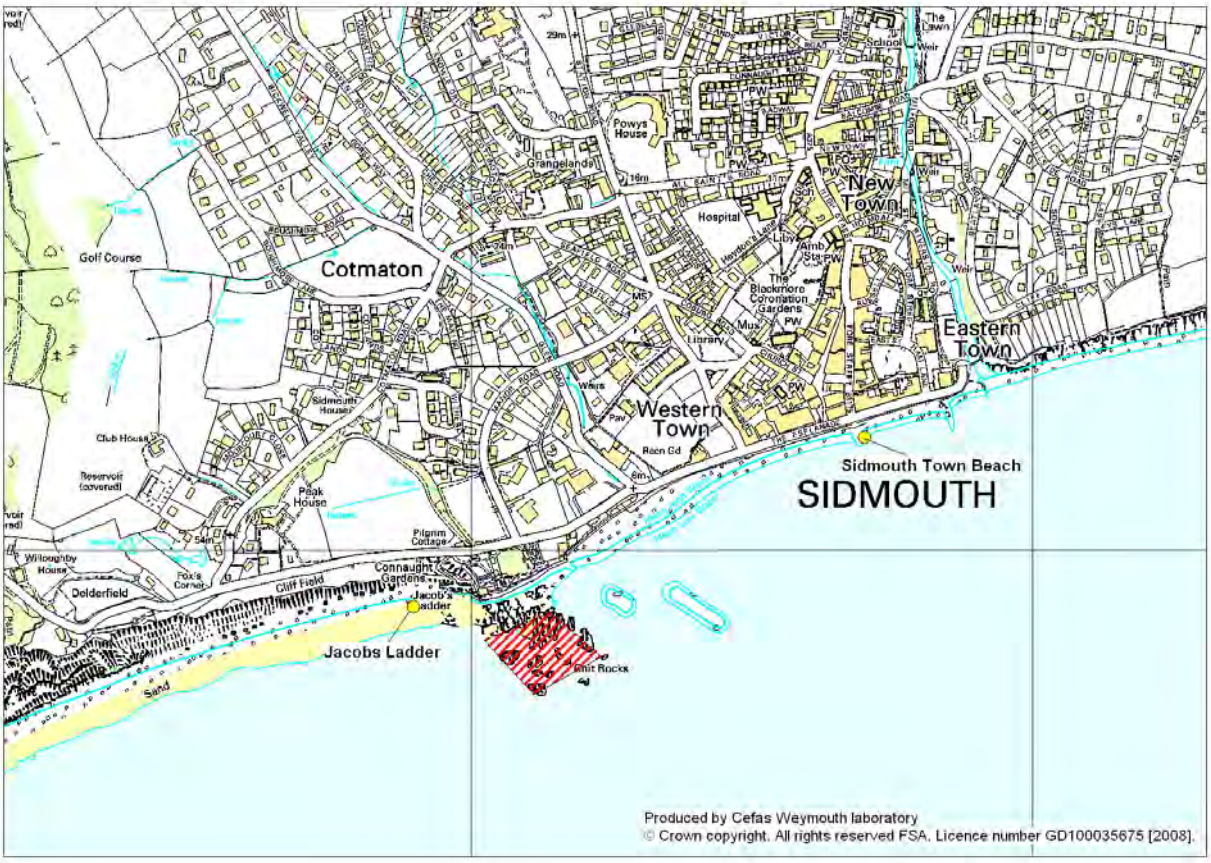

Figure 4.1: EEC Bathing Waters Directive monitoring sites in Sidmouth

Table 4.1: Compliance of Sidmouth beaches against standards of the EEC Bathing Waters Directive (Data source Environment Agency).

Beach	2001	2002	2003	2004	2005	2006	2007
Sidmouth Town	G	G	G	G	G	I	G
Jacobs Ladder	G	G	G	G	G	G	G

N.B. G=meets guideline, I=meets imperative

Levels of faecal coliforms are broadly equivalent to levels of *E. coli*, the indicator organism used for shellfish hygiene classification purposes (Environment Agency, 2003). Levels of faecal coliform concentrations in seawater at both designated bathing waters at Sidmouth are summarised in the boxplot in Figure 4.2. Faecal coliform concentrations at Jacobs Ladder, which is within 200 m of Chit Rocks, suggest that water quality is sufficient for the shellfishery to achieve class B. Faecal coliform concentrations are slightly higher at Sidmouth Town beach, presumably due to the proximity of the freshwater input from the River Sid.

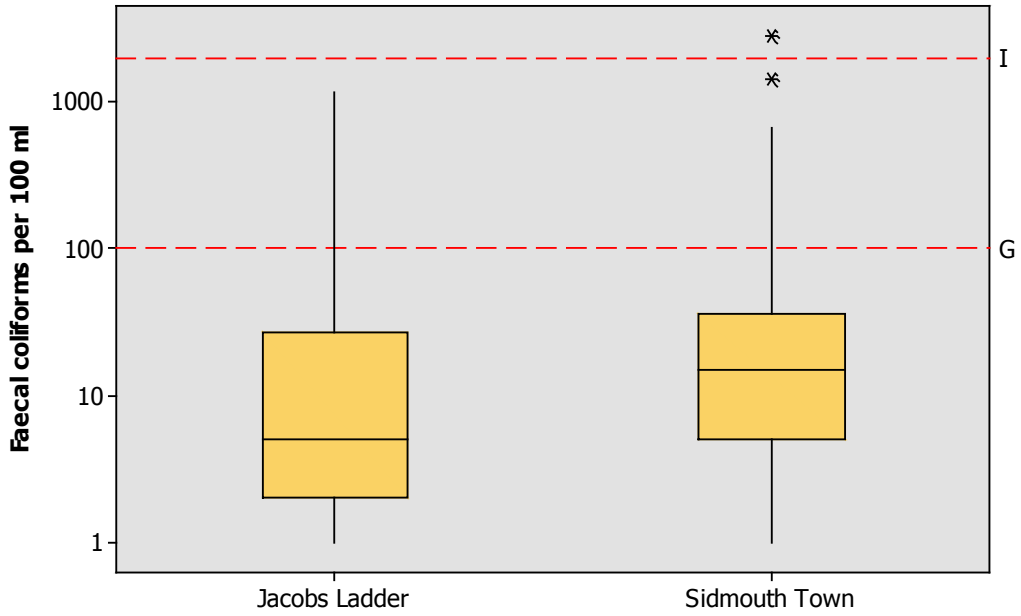

Figure 4.2: Boxplot of faecal coliform concentrations at Sidmouth beaches (Data source Environment Agency)

Faecal indicator organism concentrations in coastal waters often increase after rainfall due to urban and agricultural run off and discharges from CSOs. Faecal coliform levels are positively correlated with antecedent rainfall at both of the bathing waters in Sidmouth (Table 4.2), although these correlations are rather weak. Less than 13% of the variation in faecal coliform levels in seawater at Sidmouth can be attributed to rainfall.

Table 4.2: Results of Spearman's rank correlation between faecal coliform levels at bathing waters and rainfall at Sidmouth.

Beach	Rainfall on previous day			Rainfall in previous 2 days		
	No. of samples	r_s	*p*	No. of samples	r_s	*p*
Jacobs Ladder	140	0.354	<0.001	140	0.321	<0.001
Sidmouth Town	140	0.273	<0.01	140	0.279	<0.01

5.2 Shellfish

With the exception of the data collected during the shoreline and bacteriological surveys (See Appendix A and B), no microbiological data for shellfish are currently available from the Sidmouth area.

5. OVERALL ASSESSMENT

The most significant potential sources of microbiological contamination of the shellfishery at Chit Rocks are:

- Intermittent storm sewage discharges from Sidmouth outfall.
- The freshwater input from the River Sid, particularly under spate conditions.
- Two smaller but contaminated streams that discharge between Chit Rocks and the mouth of the River Sid.

All of these sources are to the east of Chit Rocks and there is potential for impact on the shellfishery if the spill or spate coincides with a flood tide. It is likely that levels of contamination will be highest at the eastern edge of the fishery. This has confirmed by the bacteriological survey in which the highest level of contamination was recorded at a monitoring point located on the east side of the harvesting area (See Appendix B). The RMP for ongoing microbiological monitoring should therefore be located on the east side of the fishery (BO90L).

Storm spills from Sidmouth sea outfall represent a significant contamination risk and are more frequent during the autumn and winter. In the absence of any existing hygiene monitoring data for the shellfishery at Chit Rocks, the LFA should consider sampling more frequently than monthly during this period.

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Acknowledgements

Cefas would like to thank Paul Huppler (East Devon District Council) and Ron McCawley (South West Water).

Glossary

Bathing Water	A body of water used for bathing by a significant number of people. Bathing waters may be classed as either EC designated or non-designated OR Those waters specified in section 104 of the Water Resources Act, 1991.
Bivalve mollusc	Any marine or freshwater mollusc of the class Pelecypoda (formerly Bivalvia or Lamellibranchia), having a laterally compressed body, a shell consisting of two hinged valves, and gills for respiration. The group includes clams, cockles, oysters and mussels.
Classification of bivalve mollusc production or relay areas	A system for grading harvesting areas based on levels of bacterial indicator organisms (usually E. coli or faecal coliforms) in shellfish (in European Union).
Coliform	Gram negative, facultatively anaerobic rod-shaped bacteria which ferment lactose to produce acid and gas at 37°C. Members of this group normally inhabit the intestine of warm-blooded animals but may also be found in the environment (e.g. on plant material and soil).
Combined Sewer Overflow	A system for allowing the discharge of sewage (usually dilute crude) from a sewer system following heavy rainfall. This diverts high flows away from the sewers or treatment works further down the sewerage system.
Discharge	Flow of effluent into the environment.
Dry Weather Flow (DWF)	The average daily flow to the treatment works during seven consecutive days without rain following seven days during which rainfall did not exceed 0.25 mm on any one day (excludes public or local holidays). With a significant industrial input the dry weather flow is based on the flows during five working days if production is limited to that period.
EC Directive	Community legislation as set out in Article 189 of the Treaty of Rome. Directives are binding but set out only the results to be achieved leaving the methods of implementation to Member States, although a Directive will specify a date by which formal implementation is required.
Emergency Overflow	A system for allowing the discharge of sewage (usually crude) from a sewer system or sewage treatment works in the case of equipment failure.
Escherichia coli (E. coli)	A species of bacterium that is a member of the faecal coliform group (see below). It is more specifically associated with the intestines of warm-blooded animals and birds than other members of the faecal coliform group.
Faecal Coliforms	A group of bacteria found in faeces and used as a parameter in the Hygiene Regulations, Shellfish and Bathing Water Directives, E. coli is the most common example of faecal coliform. Coliforms (see above) which can produce their characteristic reactions (e.g. production of acid from lactose) at 44°C as well as at 37°C. Usually, but not exclusively, associated with the intestines of warm-blooded animals and birds.
Geometric Mean	The geometric mean of a series of N numbers is the Nth root of the product of those numbers. It is more usually calculated by obtaining the mean of the logarithms of the numbers and then taking the anti-log of that mean. It is often used to describe the typical values of a

	skewed data such as one following a lognormal distribution.
Guideline (G) values	Values set in European Directives that the Member States have to endeavour to achieve.
Hydrodynamic models	In this context numerical models that approximate the detail of real fluid flow i.e. velocities and water levels as functions of time and space. Output from these models can then be used together with a representation of the diffusive process in the water column to represent the fate and dispersion of bacteria.
Imperative (I) Value	Also known as Mandatory values. Values set in European Directives which have to be met in all cases.
Primary Treatment	Removal of gross sewage solids by settlement process.
Secondary Treatment	Treatment to applied to breakdown and reduce the amount of solids by helping bacteria and other microorganisms consume the organic material in the sewage. OR Further treatment of settled sewage, generally by biological oxidation.
Sewage	Sewage can be defined as liquid, of whatever quality that is or has been in a sewer. It consists of waterborne waste from domestic, trade and industrial sources together with rainfall from subsoil and surface water.
Sewage Treatment Works (STW)	Facility for treating the waste water from predominantly domestic and trade premises.
Sewer	A pipe for the transport of sewage.
Sewerage	A system of connected sewers, often incorporating inter-stage pumping stations and overflows.
Storm Water	Rainfall which runs off roofs, roads, gulleys, etc. In some areas storm water is collected and discharged to separate sewers, whilst in combined sewers it forms a dilutes sewage.
Tertiary Treatment	Treatment applied to the effluent from a secondary treatment process in order to further reduce a component or components of that effluent, e.g. pathogenic micro-organisms or nutrients.
Waste water	Any waste water but see also “sewage”.

List of Abbreviations

AONB	Area of Outstanding Natural Beauty
BMPA	Bivalve Mollusc Production Area
BST	British Summer Time
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFU	Colony forming units
CSO	Combined Sewer Overflow
DWF	Dry Weather Flow
EDDC	East Devon District Council
EA	Environment Agency
E. coli	*Escherichia coli*
EC	European Community
EU	European Union
FSA	Food Standards Agency
G	Guideline
GMT	Greenwich Mean Time
HW	High Water
hr	Hour
I	Imperative
km	Kilometre
LAT	Lowest Astronomical Tide
LW	Low Water
MDF	Mean daily flow
m^3/day	Cubic metres per day
mg	Milligrams
ml	Millilitres
mm	Millimetres
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
MPN	Most probable number
NGR	National Grid Reference
OS	Ordnance Survey
p.e.	Population Equivalent
Q_{95}	95 percentile flow
RMP	Representative Monitoring Point
SPS	Sewage pumping station
STW	Sewage treatment works
UNESCO	United Nations Educational, Scientific and Cultural Organization

Appendix A. Chit Rocks, Sidmouth Shoreline Survey Report

A1. Objectives

The objectives of the survey were to confirm the presence of sources of microbiological contamination identified during the desk study and identify any additional sources of contamination that could impact on shellfisheries at Chit Rocks.

A2. Survey

The shoreline survey was undertaken at low water on 21 January 2008 between 10:30 and 12:00 (predicted low water at Exmouth Approaches was at 10:53). The survey was undertaken in conjunction with a member of staff from the local food authority (LFA), East Devon District Council (EDDC) and covered the shoreline between Jacobs Ladder and the mouth of the River Sid. Water and shellfish samples were collected from selected locations (Figure A1) and returned to Cefas Weymouth Laboratory for microbiological analysis.

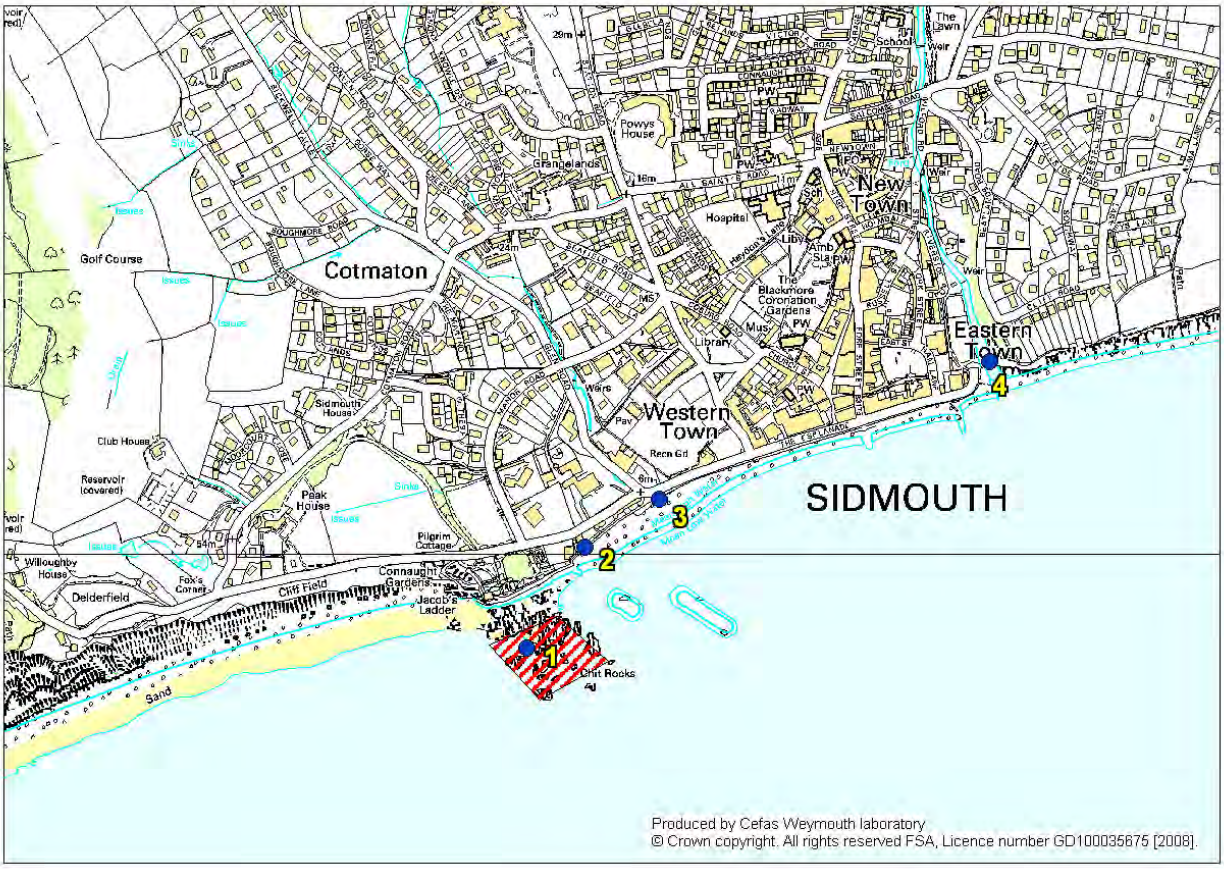

Figure A1: Locations of water and shellfish samples: 1) Chit Rocks (water and shellfish), 2) Stream at The Beacon, 3) Stream at The Esplanade, 4) River Sid (Numbers refer to samples in Table A2 and A3).

Although dry over the preceding period it was raining during the survey. Times of high and low water at Exmouth on the day of the survey are shown in Table A1 below.

Table A1: Times of high and low water at Exmouth Approaches on 21 January 2008 (Admiralty Total Tide, UKHO).

	HW	LW	HW	LW
Time (GMT)	05:23	10:53	17:57	23:13
Height (m)	3.9	0.9	4.0	1.0

A3. Results

A3.1 General observations

The land immediately behind Chit Rocks was predominantly green space (gardens and parkland). A large (0.8 ha) tarmac car park was set back approximately 100 m from the shellfishery.

A3.2 Sewage discharges

No sewage discharges that had not been identified in the desk study were found.

A3.3 Freshwater inputs

At the time of the survey the River Sid was flowing directly to the sea through a channel cut in the beach (Figure A2). The river was running low and clear. In addition to the River Sid, two small culverted streams that discharge to the beach between Chit Rocks and the mouth of the River Sid were found (Figure A2). Water samples were collected from all of these watercourses. The locations of these watercourses and bacteriological results are presented in Table A2 below.

Table A2: Water sample results.

No	Site	NGR	Time taken	*E. coli* CFU/100ml
1	Chit Rocks	SY 12086 86834	11:20	25
2	Stream at Beacon	SY 12188 87011	11:35	2,100
3	Stream at Esplanade	SY 12320 87097	11:56	14,300
4	River Sid	SY 12903 87340	12:19	175

The *E. coli* result for the River Sid appears anomalous in that it was lower than any of the faecal coliform results obtained from the river by the Environment Agency (See Section 3.2 in main report). Levels of *E. coli* in the two smaller streams (Samples 2 and 3) were relatively high and indicative of moderate levels of faecal contamination.

A3.4 Dogs

A single dog was being exercised on the beach in the vicinity of Chit Rocks.

A3.5 Birds

Small numbers of herring gulls (*Larus argentus*) were observed in the vicinity of Chit Rocks during the survey.

A3.6 Sanitary debris

No sanitary debris was observed during the shoreline survey

A3.7 Levels of contamination at the shellfishery

Levels of *E. coli* in the seawater at Chit Rocks were low (Table A2). A single sample of mussels was collected from Chit Rocks for microbiological analysis, the results of which are presented in Table A3. Levels of *E. coli* in mussels were moderate and corresponded to a class B.

Table A3: Shellfish sample results.

No	Site	NGR	Time taken	*E. coli* MPN/100g
1	Chit Rocks (mussels)	SY 12086 86834	11:20	1,100

A5. Conclusions

The following potential sources of microbiological contamination were identified during the shoreline survey:

- Freshwater inputs from the River Sid and two smaller streams that discharge onto the beach between Chit Rocks and the mouth of the River Sid.
- Small numbers of gulls.
- Dogs.

There is no farmland very close to the shellfishery that could be a direct source of *E. coli* contamination. Contaminated surface water run off from the tarmac car park behind Chit Rocks could potentially impact on the fishery but it is likely that the drainage network would intercept any surface water from this source.

Figure A2: Photos of: i) Chit Rocks, ii) stream discharging at the Beacon, iii) stream discharging to beach at the Esplanade, iv) River Sid at beach, v) view towards Sidmouth sea outfall.

Appendix B: Chit Rocks Bacteriological Survey

B1 Survey

In the absence of existing bacteriological data for shellfish at Chit Rocks, a bacteriological survey was undertaken in order to get a better idea of the location and extent of contamination and select a representative monitoring point for classification purposes.

Samples of mussels were collected from two sites (Chit Rocks A and B), the locations of which are detailed in the map in Figure B1. The local food authority undertook the sampling using standard sampling procedures. Sampling was undertaken on eleven occasions between April and June 2008.

Figure B1: Location of bacteriological survey sampling points.

B2 Results

The results of the bacteriological survey are given in Table B1. The highest peak *E. coli* concentration was recorded at Chit Rocks B. There was no statistically significant difference between sites in the geometric mean *E. coli* concentration (paired two sample t-test, df=10, T=0.25, P=0.81).

Table B1: Chit Rocks bacteriological survey results.

Collection Date/Time*	*E. coli* MPN per 100g		*Notes*
	B090K Chit Rocks A	B090L Chit Rocks B	
09/04/2008 10:00	80	<20	
16/04/2008 10:45	<20	20	
21/04/2008 14:00	330	790	
06/05/2008 12:45	170	80	
13/05/2008 08:10	<20	<20	
19/05/2008 12:15	330	1700	Highest *E. coli* result
02/06/2008 10:30	20	20	
11/06/2008 06:45	790	50	
16/06/2008 11:45	20	50	
25/06/2008 11:30	20	20	
30/06/2008 10:30	330	490	
Geometric mean	73	66	

N.B. Sample collection time is for Chit Rocks B. Samples from Chit Rocks A were collected within 30 minutes of this time.

B3 Conclusion

On the basis that the highest peak *E. coli* concentration was recorded at Chit Rocks B, the representative sampling point should be located at this site. This site is the nearest to the most significant sources of contamination identified during the desk study.

Appendix C: Sampling Plan

Cefas

Regulation (EC) No 854/2004

CLASSIFICATION OF BIVALVE MOLLUSC PRODUCTION AREAS IN ENGLAND AND WALES

SAMPLING PLAN

Sidmouth (Chit Rocks) - Lyme Bay

2008

C. Chit Rocks Sampling Plan

C1 General Information

Location Reference

Production Area	Lyme Bay
Cefas Main Site Reference	M090
Cefas Area Reference	FDR 4203
Ordnance Survey 1:25,000 map *Admiralty Chart*	Explorer OL 115 Exmouth and Sidmouth No 3315 Berry Head to Bill of Portland

Shellfishery

Species/culture	Mussels (*Mytilus* spp.)	Wild
Seasonality of harvest	Not applicable	

Local Food Authority

Local food authority	East Devon District Council
Address	Environmental Health East Devon District Council Knowle Sidmouth Devon EX10 8HL
E-mail	phuppler@eastdevon.gov.uk
Telephone	01395 517467
Sampling Officer	Mr G P Huppler

C2 Monitoring points and frequency of sampling

See maps and table below

C3 Requirement for review

The competent authority will review this sampling plan within six years or in light of any obvious known changes in sources of pollution of human or animal origin (e.g. following a sewerage improvement scheme).

Table B1: Representative Monitoring Point (RMP) and frequency of sampling for Chit Rocks.

RMP	Bed Name	Species	OSGB36		WGS84		Collection method	Sample Frequency
			Easting	Northing	Latitude	Longitude		
B090L	Chit Rocks East	Mussels	312180	86840	50°67.45'N	3°24.42'W	Hand picked	At least monthly

N.B. Tolerance around sampling point 10 m.

Figure C1: Representative Monitoring Point (RMP) at Chit Rocks.