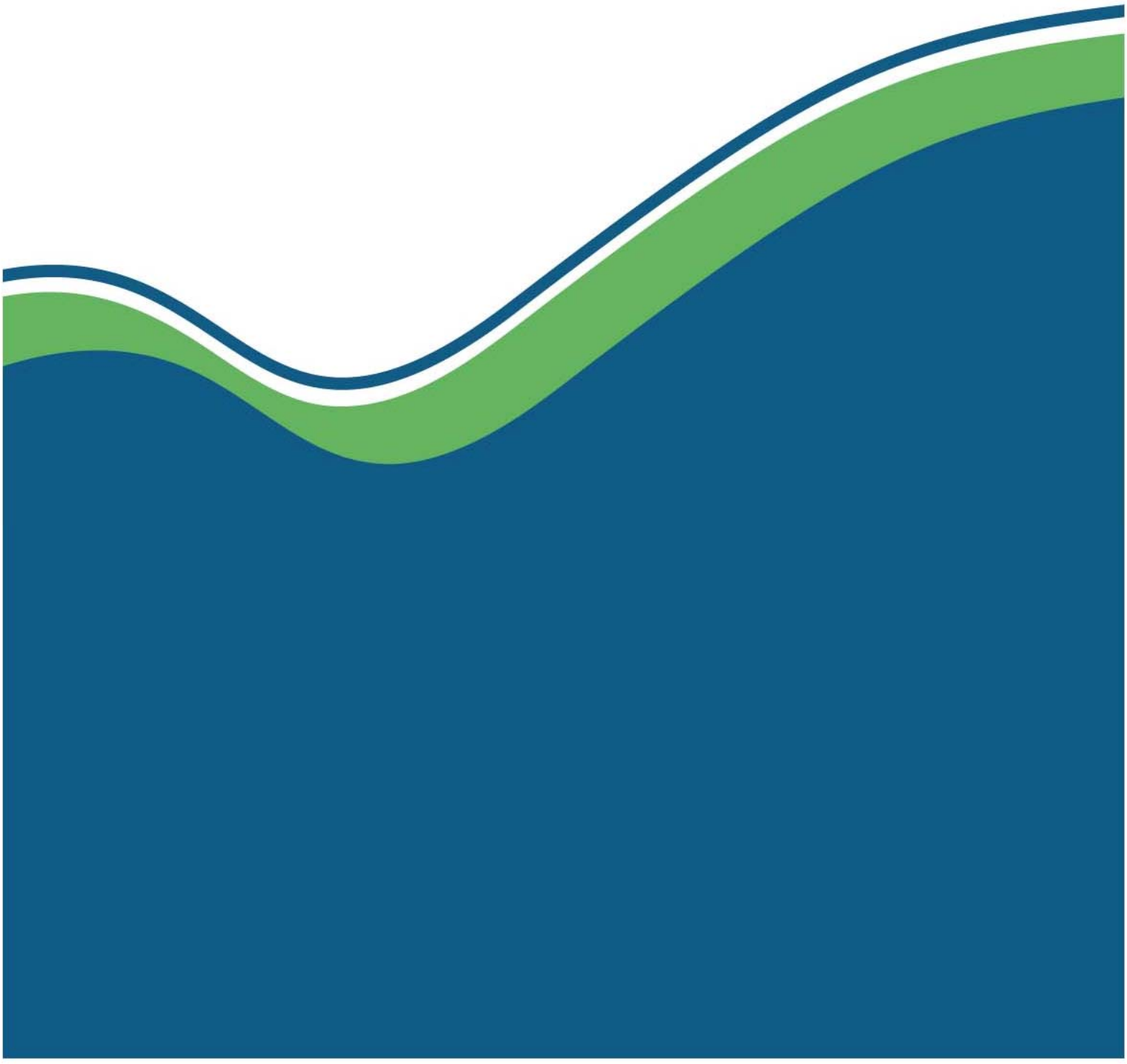
Radiological Habits Survey: Torness, 2006



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Radiological Habits Survey: Torness, 2006

FINAL REPORT

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SUMMARY

This report presents the results of a survey, conducted in 2006, into the habits and consumption patterns of people living and working in the vicinity of the Torness nuclear site. British Energy Generation Ltd holds the authorisation to discharge gaseous radioactive wastes to the atmosphere and liquid radioactive wastes to the North Sea. The site also has sources of direct radiation.

Potential exposure pathways investigated during the survey included: the consumption of locally sourced terrestrial and aquatic foods; occupancy of intertidal areas; handling of fishing gear and sediment; and occupancy of dwellings within 1 km of the site centre. Interviews were conducted with members of the public and data collected for 341 adults and 42 children are presented and discussed.

In the aquatic survey area, the main fishing activities were creeling for crustaceans and collecting winkles. The consumption of fish, crustaceans and molluscs was identified. The main aquatic species consumed by the adult critical groups for fish were mackerel, bass, cod, for crustaceans were lobster, crab, and for molluscs was winkles. Wildfowling was identified in the survey area, and although it was reported that wildfowl were being consumed, no quantitative data were obtained. No consumption of marine plants/algae was identified. The adult critical groups for intertidal occupancy included people who were angling, walking, winkle collecting, dog walking and beach cleaning. The only activity in the critical group for handling fishing gear was creeling and the only activity in the critical group for handling sediment was winkle collection. People were undertaking water-based activities such as swimming, kayaking, diving, angling, sailing and commercial fishing.

In the terrestrial survey area, farmers produced beef, lamb and arable crops. Arable crops were sold for human consumption and were also kept for livestock feed. No allotment sites were identified in the survey area but many people grew fruit and vegetables in their gardens for their consumption. Foods were consumed from the following foods groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, cattle meat, pig meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi and venison. No consumption of milk, freshwater fish and local cereals was identified.

In the direct radiation survey area, the highest occupancy rates were for residents. Occupancy rates were also recorded for people who occupied caravans for significant periods of the summer, for people working in the area, and for anglers who spent significant time angling near the Torness site pipe outfall.

1. INTRODUCTION

1.1 Regulation of radioactive waste discharges

There are generally three main sources of radiation exposure to members of the public from nuclear sites in routine operations: discharges of radioactive waste to the aquatic environment, discharges to the atmosphere, and direct radiation from the site. Regulation of waste discharges in Scotland is carried out under the Radioactive Substances Act 1993, (RSA93) (UK Parliament, 1993). Authorisations granted under RSA93 set limits on the quantities and types of radioactivity that are permitted to be released from the site. For discharges in Scotland, the Scottish Environment Protection Agency (SEPA) is the regulatory authority under RSA93. Sources of direct radiation from sites are regulated by the Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE).

1.2 The critical group concept

Radiological protection of the public is based on the concept of a critical group. The critical group is defined as those people who, because of where they live and their habits, receive the highest radiation dose from the site and its discharges. It is the assessed radiation dose to the critical group that is compared to relevant limits and constraints. If the dose to the critical group is acceptable, it follows that the lower doses received by other members of the public will be below any limits and constraints, and overall protection of the public is provided. This survey provides information to assist SEPA in determining critical groups around the Torness site.

1.3 Dose limits and constraints

Assessed radiation doses to critical groups are compared to nationally and internationally recommended dose limits and constraints. The Radioactive Substances (Basic Safety Standards) (Scotland) Direction 2000 (Scottish Executive, 2000) directs SEPA to ensure that the sum of doses of ionising radiation to the public does not exceed the limits set out in Article 13 of Council Directive 96/29/Euratom (CEC, 1996) and that doses should be as low as reasonably achievable (ALARA), economic and social factors being taken into account. In connection with the latter, SEPA is directed to have regard to the following maximum doses which may result from a defined source, for use at the planning stage in radiation protection:

a) 0.3 millisieverts per year from any source from which radioactive discharges are first made on, or after 13 May, 2000: or
b) 0.5 millisieverts per year from the discharges from any single site.

Additionally, the Government accepts that, in general it should be possible to operate existing facilities within the 0.3 mSv per year constraint. The International Commission on Radiological Protection (ICRP).recommends a dose limit of 1 mSv per year to members of the public from all anthropogenic sources.

2. THE SURVEY

2.1 Survey aims

The Centre for Environment, Fisheries & Aquaculture Science (Cefas) undertook the survey in July 2006 on behalf of SEPA (Cefas contract C2448 and SEPA contract R40067/PUR). The aim of the survey was to obtain information on the habits of the public that might lead them to be exposed to liquid discharges, atmospheric discharges and direct radiation from the routine activities undertaken at the Torness site.

Investigations were carried out to ascertain the following:

- The consumption of food from the aquatic survey area
- Activities and occupancy over intertidal areas
- The handling of fishing gear and sediment
- Activities and occupancy in and on water
- The use of seaweed as human or animal food or use as a fertiliser
- The consumption of food from the terrestrial survey area
- The production, use and destination of local produce
- The consumption and use of groundwater and surface water in the terrestrial survey area
- The transfer of contamination off-site by wildlife
- Occupancy within 1 km of the site centre
- Any new or unusual exposure pathways

The habits data are used in combination with monitoring data to determine the critical group(s) and identify critical exposure pathways to the local population. The last full habits survey of the Torness site conducted by Cefas was in 2001 (Joyce, *et al.*, 2002). The data from this survey are currently being used for dose assessments in the Torness area.

2.2 Site activity

The Torness site is located on the coast of Berwickshire, approximately 2.5 km north-east of the village of Innerwick and 4 km north-west of the village of Cockburnspath. British Energy Generation Ltd owns the site and holds the authorisations for its operation. The Torness nuclear power station is powered by twin Advanced Gas-Cooled Reactors (AGRs) which came into operation at the end of 1987. Gaseous emissions are released to the local environment via stacks and the liquid discharges are released into the North Sea. The site also has sources of direct radiation.

At the time of the survey, there was an outage of one reactor, which was being refuelled. It was reported that this would have a negligible effect on the direct radiation measurements taken during the survey because of the insignificant contribution from the reactor buildings. It was also reported that nothing unusual was occurring on site during the survey that would give rise to any further variations in direct radiation.

2.3 Survey areas

Three survey areas were defined to encompass the main areas potentially affected by the discharges from the site and sources of radioactivity. These were, an aquatic area relating to liquid discharges, a terrestrial area relating to the deposition of gaseous discharges, and a direct radiation area relating to ionising radiation emanating directly from the site. The survey areas were the same as those used in the 2001 survey.

The aquatic survey area (based on Admiralty tidal data), shown in Figure 1, covered the coastline of Berwickshire from North Berwick in the north to Eyemouth in the south, and extended 3 km offshore.

The terrestrial survey area, shown in Figure 2, was defined as the full circle to a radius of 5 km from the Torness site centre (National Grid Reference NT 745 752).

For the direct radiation area, also shown in Figure 2, the survey covered the area within 1 km of the Torness site centre.

2.4 Conduct of the survey

The fieldwork component of the survey was carried out during the period 4th to 16th July 2006 by three members of staff from the Cefas laboratory at Lowestoft, according to techniques as described by Leonard *et al* (1982).

On 5th July 2006, a meeting was held between representatives from the Torness site and Cefas. This discussion provided details about current site activities, local information, potential exposure pathways and activities in the area, and the transfer of contamination off-site by wildlife.

People with a local knowledge of the survey areas were contacted for information relevant to the exposure pathways, including Eyemouth Fishery Officers, harbour masters and East Lothian Council staff. Interviews were used to establish individuals' consumption and occupancy rates relevant to all pathways and to obtain any general information of possible use to the survey. Using this information, a list of occupations and activities was built up to produce a picture of potential exposure pathways. Emphasis was placed on those individuals who were likely to be in the most exposed groups. These

included commercial fishermen, hobby fishermen, shellfish collectors, anglers, farmers, gardeners, beekeepers and individuals spending time within the direct radiation survey area.

Gamma dose rate measurements were taken over intertidal substrates and were also taken indoors and outdoors at most of the properties in the direct radiation survey area. For comparison, background readings were taken outside the direct radiation survey area.

3. METHODS FOR DATA ANALYSIS

3.1 Data recording

Data collected during the fieldwork were recorded in logbooks. On return to the laboratory, the data were examined and any notably high rates were double-checked, where possible, by way of a follow-up phone call. In rare cases where follow-up phone calls were not possible (e.g. interviewees who wished to remain anonymous), the data were accepted at face value. The raw data were entered into a purpose-built database where each individual for whom information was obtained was given a unique identifier (the observation number) to assist in maintaining data quality.

3.2 Data conversion

During the interviews, people could not always provide consumption rates in kilograms per year for food or litres per year for milk. In these circumstances, interviewees were asked to provide the information in a different format. For example, some estimated the size and number of items (e.g. eggs) consumed per year, whereas others gave the number of plants in a crop or the length and number of rows in which the crop was grown per year. This data was converted into standard consumption rates by the database using a variety of conversion factors. These factors included produce weights (Hessayon 1997 and Good Housekeeping, 1994), edible fraction data researched by Cefas, and information supplied by the Meat and Livestock Commission.

3.3 Rounding and grouping of data

The consumption and occupancy data in the text of this report are rounded to two significant figures, except for values less than 1.0, which are rounded to one decimal place. This method of presentation reflects the authors' judgement on the accuracy of the methods used. In the tables and annexes, the consumption rate data are usually presented to one decimal place. Occasionally, this rounding process causes the computed values (row totals, mean rates and 97.5 percentiles), which are based on un-rounded data, to appear slightly erroneous. Consumption rates less than 0.05 kg y^{-1} are presented to two decimal places in order to avoid the value of 0.0 kg y^{-1}. External exposure data are quoted as integer numbers of hours per year.

The habits data are structured into groups of food items or substrate types with similar attributes. For example, when considering terrestrial food consumption, all types of root vegetables are grouped together in a food group called 'root vegetables'. Similarly, for aquatic food consumption, all crustacean species are grouped as 'crustaceans'. For external exposure over intertidal sediments, occupancies over the same substrate, such as sand, are grouped together. The typical food groups used in habits surveys are shown in Table 1.

Data are structured into age groups because different dose coefficients (i.e. the factors which convert intakes of radioactivity into dose) can apply to different ages. The age groups and their relevant age ranges are based on the recommendations in ICRP 72 (ICRP, 1996), and are listed below:

Age group	Age range in group
3-month-old	Under 1-year-old
1-year-old	1-year-old
5-year-old	2-year-old to 6-year-old
10-year-old	7-year-old to 11-year-old
15-year-old	12-year-old to 16-year-old
Adult	17-year-old and over

3.4 Data analysis

The habits data have been analysed to indicate high rates of consumption, occupancy and handling, prior to a formal assessment being undertaken. Two approaches have been used:

Firstly, the 'cut-off' method described by Hunt *et al.* (1982) was used. With the 'cut-off' method, the appropriate high rate was calculated by taking the arithmetic mean of the maximum observed rate and all observed rates within a factor of three of the maximum value (termed the lower threshold value). In this report, the term high-rate group is used to represent the individuals derived by the 'cut-off' method. The mean of the high-rate group was calculated for each food group, intertidal substrate and handling pathway identified in the survey. In certain cases, using the 'cut-off' method can result in a single person high-rate group. In these cases, expert judgement was used to decide whether the high-rate group should remain as one individual or whether others should be included. If it was appropriate to include others, the second highest rate was divided by three to give a new cut-off value and all observations above this were included in the high-rate group.

Secondly, 97.5 percentile rates were calculated using the Excel mathematical function for calculating percentiles. The use of percentiles accords with precedents used in risk assessment of the safety of food consumption.

Mean and 97.5 percentile rates based on national statistics have been derived by the Ministry of Agriculture, Fisheries and Food (MAFF) (now part of Defra) and the Food Standards Agency (Byrom *et al.,* 1995 and FSA, 2002), and these are referred to as generic rates in this report. The observed 97.5 percentile rates can be compared with the generic 97.5 percentile rates.

For the direct radiation pathway, mean occupancy rates and 97.5 percentile rates have not been calculated. Such an analysis is of limited value without a detailed knowledge of the spatial extent of dose rates due to direct radiation.

3.5 Child ratios for use in dose assessments

For ingestion pathways, mean rates for the high-rate groups for children have been calculated from the survey data. However, because few child observations were identified, the rates should be viewed with caution. For assessment purposes, an alternative approach may be taken which involves scaling the mean rates for the adult high-rate groups by ratios. These ratios are given in Table 2 and have been calculated using generic 97.5 percentile consumption rates.

4. AQUATIC RADIATION PATHWAYS

4.1 Aquatic survey area

The aquatic survey area, shown in Figure 1, covered the coastline from North Berwick in the north to Eyemouth in the south, and extended 3 km offshore. The coastline was generally rocky, with steep cliffs hindering access to many parts of the shoreline. There were a number of sandy beaches, particularly around the populated areas of North Berwick, Dunbar and Eyemouth, which were easily accessible.

North Berwick to Dunbar

North Berwick Bay beach was predominantly sandy and became rocky towards its western limit. The beach was not well used, but people were observed sunbathing and walking, and members of a local yacht club used the beach to launch their training yachts. No swimming or paddling activities in the sea were observed off this stretch of beach. Eight boats were observed moored in the bay, two of which were lifeguard inflatable boats and one was a commercial fishing boat.

North Berwick Harbour was a base for four commercial creel fishing boats and three charter boats, which provided angling, diving, bird watching and sightseeing trips. Several yachts owned by members of the yacht club also had a number of reserved moorings. The car park next to the harbour also contained dinghies associated with the yacht club, whose headquarters were on the harbour-side. Across the road from the harbour was an RNLI station and the lifeboats were launched via a concrete slipway into North Berwick Bay. A diving centre was located in North Berwick, which had its own dive boat. It operated the boat out of the bay for both local and visiting diving clubs. The main dive locations were around Bass Rock and several local wrecks.

East of the harbour area, Milsey Bay beach consisted of a long stretch of sand with rocks at its extremes. Anglers were observed fishing from these rocks on occasions. Rock pools were exposed at low tide but no children were observed playing in them. This beach was observed to be very popular, especially at the western end, where a sea-filled swimming pool was situated. Beach activity became sparser farther away from North Berwick, although a car park and viewpoint at the eastern end of the beach attracted a number of people. The beach was accessible along its length via a road and small beach wall. In addition to swimming in the pool, some paddling in the sea was observed and there were a number of people walking, dog walking, sunbathing and playing on the beach. There was a rocky headland at the eastern end of Milsey Bay beach.

The shore beyond Milsey Bay and as far as Castleton was for the most part inaccessible, consisting of rocky stretches backed by steep cliffs. The beach road at Castleton was private and no public access to the beach was permitted. Further south, a private road, which led to Seacliff beach could

be used by members of the public via a coin-operated barrier. South of Seacliff, the John Muir Country Park encompassed 6 km of coastline between Tyninghame and Dunbar. At the northern end of the country park there was a continuous stretch of sandy beach which included Peffer Sands, Ravensheugh Sands and Bathan's Strand. Approximately 20 people were observed using this beach and activities included paddling, walking, sunbathing and dog walking. There was a rocky headland to the south of Bathan's Strand, on the other side of which, was another expanse of sand which included Tyne Sands and Hedderwick Sands. A small number of people were observed on Hedderwick Sands engaged in recreational activities such as sunbathing and paddling in the exposed rock pools. The River Tyne entered the sea at this location. In the Tyne estuary at low water, areas of mud and sand were exposed which backed onto an area of salt marsh. Wildfowling was undertaken on this salt marsh area, which was managed by East Lothian Council.

To the south east of the River Tyne, the John Muir Country Park extended around Belhaven Bay as far as the town of Dunbar. Belhaven Bay had a long, wide stretch of sand, backed by dunes, which was principally accessed from West Barns. A stream, called Biel Water, flowed into the southern end of the bay.

Dunbar to Eyemouth

Dunbar Harbour had three separate harbour areas. The newer deepwater harbour was connected to the older outer and inner harbours via a swing bridge. Commercial fishing boats, private recreational boats, and charter boats for sightseeing, diving and sea angling were moored in the deepwater harbour. Lobster creels were observed stacked on the harbour walls. The outer and inner harbours dried out at low tide, leaving a layer of thick mud. A few boats were aground on the mud in these harbours and some children were observed playing in the shallow water. A slipway into the outer harbour was used by members of the public for launching pleasure craft including angling and diving boats.

The shore around Dunbar was predominantly rocky with a sandy beach to the south-east of Dunbar Harbour. Occasional dog-walkers were observed on the beach during the survey and commercial winkle collectors frequently worked on the rocky areas. Seaweed was regularly washed ashore onto this beach and it was frequently removed by the East Lothian Council using raking equipment attached to a tractor. It was reported that in previous years much of this seaweed was used by a local farmer as a fertiliser. To the south-east of Dunbar, the coastline was rocky and largely inaccessible.

White Sands was a large sandy beach, which was backed on either side by low rocks. People were observed dog walking and bait digging on the beach. Winkles were collected commercially from the rocks and were being exported to France and Spain. East of White Sands was Barns Ness, where the foreshore was predominantly rock interspersed with patches of sand. Several commercial winkle collectors were interviewed at this location, including a group of five people from outside the area who regularly collected winkles between Barns Ness and Skateraw Harbour. The winkles were being

exported to France and Spain. Other individuals were also identified collecting winkles for their own consumption.

Skateraw Harbour was located to the south-east of Barns Ness. The shore was predominantly rock with a small sandy beach. Occasional angling was identified on the beach and one individual collected approximately 1500 litres of seaweed per year to use as a fertiliser. Two boats were observed moored in the harbour in close proximity to the Torness power station. There was a coastal path leading from the beach at Skateraw Harbour, around the power station to Thorntonloch beach.

Directly to the east of the Torness power station, the shelving rocky shore was very popular with anglers fishing for bass in the warm water near the site outfall. The anglers were mainly local people and visitors staying for long periods at the nearby caravan park. South of the rocky area, Thorntonloch beach was predominantly sand with patches of rock and seaweed. Activities identified on the beach were walking, horse riding, swimming and sunbathing.

South-east of Thorntonloch beach, access was limited along the rocky coastline except at Dunglass where one individual was identified who occasionally set lobster creels off the rocks. Further south-east was the village of Cove which had a small harbour where two commercial creel fishermen kept their fishing boats. Winkle collecting was taking place outside of the harbour wall on the rocks at low water.

South-east of Cove was Pease Bay, which had a small sandy beach surrounded by grassy cliffs. A large caravan park was situated on cliffs behind the bay and numerous tourists from the caravan park used the beach for recreational activities. Water sports such as swimming, jet skiing and boating were frequently observed. There was no road access to the coast between Pease Bay and St Abbs.

The shore around the village of St Abbs was rocky and at low tide an area of rock pools was exposed. The village had a harbour where several pleasure boats, angling boats and one commercial creel fisherman were based. This stretch of coast was very popular with divers since it formed part of the St Abbs and Eyemouth Voluntary Marine Reserve. Several dive boats were observed with up to 10 divers on board. The main public slipway was in the inner harbour, which dried out at low tide exposing mud, sand and rock. There was an RNLI station which had a direct slipway into the outer harbour. Winkles were observed on the rocks near the harbour in large numbers, although no collectors were seen at this location.

South of St Abbs was Coldingham Bay, which had a small sandy beach, rock pools that were exposed at low tide and was backed by steep rocky cliffs. There were a number of beach huts and a municipal lifeguard hut, which was staffed every day through the summer months. The beach was popular, with over 80 people, both local residents and tourists, being observed on one occasion. It was reported that over 200 people could be seen on the beach during particularly busy periods in the

summer. There were no observations of water based activities, although several interviewees reported that they paddled, swam and surfed in the sea. One interviewee reported that they walked their dog on Linkim Shore, an area to the south of Coldingham Bay that was only accessible via a coastal path.

The shore between Coldingham and Eyemouth had a succession of rocky coves backed by steep cliffs, and apart from Linkim Shore, access to these coves was limited. In the vicinity of Eyemouth, Killiedraught Bay had a small beach of sand and stones. At low tide, a large expanse of rock pools was exposed and it was reported that this area was popular with winkle collectors. The beach was backed by a cliff where a caravan park was located. East of Killiedraught Bay there were two small bays, one of which was accessible but no activity was observed during the survey.

Eyemouth was located at the south of the survey area. The beach was predominantly sand with seaweed covered rocks exposed at low water and had a slipway at the southern end. It was popular with people dog walking, jogging, sunbathing and paddling. Eyemouth Harbour was the base for many boats including commercial fishing vessels, charter angling boats, dive boats and boats for site-seeing trips. The smaller commercial fishing boats were creeling for crabs and lobsters in the survey area and the larger vessels were trawling for *Nephrops* (*Nephrops norvegicus)* in the deeper waters outside of the aquatic survey area. There was an RNLI station and several diving club bases at the harbour.

4.2 Commercial fisheries

The main commercial fishery in the survey area was creeling for brown crabs (*Cancer pagurus*) and lobsters (*Homarus gammarus*), with smaller quantities of velvet crabs (*Liocarcinus puber*) caught as a by-catch. The commercial fishing boats that were identified operating in the survey area were based in the harbours at North Berwick, Dunbar, Skateraw, Cove, St Abbs and Eyemouth. Larger fishing boats also operated from Eyemouth Harbour, trawling for *Nephrops*, but these all fished outside of the survey area. During the 2001 survey, *Nephrops* were being caught within 3 km of the shore in the survey area, however, this was not the case during this survey.

The commercial collection of winkles (*Littorina littorea*) was identified along the rocky shoreline in the Cove Harbour area and between Dunbar Harbour and Skateraw. The collectors were locals and visitors to the area. Some of these people were also consuming winkles.

4.3 Seafood wholesalers and retailers

Seafood wholesalers were based in Dunbar, Eyemouth and Berwick. Most of the landed crabs and lobsters were sold to the Eyemouth and Dunbar wholesalers and the winkles were sold to the Berwick wholesaler. Most of the brown crabs were sold for the local or UK market and approximately 35% were exported to France, Spain and Italy. Most of the lobsters and all of the velvet crabs and winkles were also exported to these countries.

Three retailers in Eyemouth were selling lobsters and brown crabs from the survey area and some commercial fishermen were selling brown crabs and lobsters directly to the public from their boats.

4.4 Angling and hobby fishing

Shore angling was popular in the survey area, particularly near the Torness pipe outfall where anglers fished for bass (*Dicentrarchus labrax*) in the warm water discharged from the Torness site. Two anglers reported that they could both catch as many as 2000 bass per year at this location. It was also reported that the majority of bass caught at Torness were sold to Chinese restaurants in Berwick. Bass were consumed by the anglers and their family and friends. Shore angling was also identified along other sections of coastline of the survey area including North Berwick, Dunbar, Skateraw and St Abb's Head.

Boat angling was also popular and occurred offshore of North Berwick, Dunbar, St Abbs, Eyemouth and Thorntonloch. Angling charter boats operated out of North Berwick Harbour and Eyemouth Harbour. The angling parties were predominantly groups of visiting anglers or tourists and some were local anglers.

In this report, the term 'hobby fishing' is used to describe recreational fishing on a small scale with creels, which is usually carried out from boats that do not have commercial fishing licences, and therefore, it is illegal to offer the catch for sale. A number of hobby fishermen were creeling from boats for crabs and lobsters within the survey area. One person was also identified setting creels from the shore between Barns Ness and Torness. The catches of crab and lobster were consumed by the fishermen and their families and friends.

4.5 Wildfowling

Wildfowling was identified on the shores of the River Tyne estuary in the John Muir Country Park and it was reported that wildfowl were being consumed. However, the survey team were unable to contact any wildfowlers during the survey and therefore no quantitative data could be obtained. Wildfowling permits were issued by the East Lothian Council who provided the following information regarding the number of wildfowlers shooting in the area and their bag returns. For the season commencing on the 1st September 2005 and closing on the 20th February 2006, the salt marsh areas were visited by 108 wildfowlers who made a total of 627 visits. The bag returns indicated that 70 wildfowlers shot a total of 122 geese (predominantly graylag goose, with smaller numbers of pink-footed goose and Canada goose) and 365 ducks (predominantly wigeon, with smaller numbers of teal, mallard and goldeneye).

4.6 The use of seaweed as a fertiliser

One keen gardener collected an estimated 1500 litres bladderwrack (*Fucus vesiculosus*) per year from Skateraw and White Sands beaches, which was used as a fertiliser on a vegetable garden. A farmer was identified who used to apply kelp (*Laminaria saccharina*) to arable crops used for livestock feed, but had ceased 2 years ago. The kelp had been obtained from the East Lothian Council who collected it mainly from Dunbar beach during their beach cleaning operations. The farmer reported that an estimated 400 tonnes (40 lorry loads) had been used per year, and also indicated that it was possible that this practice might resume in the future.

4.7 Internal exposure

Adults' consumption rates

Adults' consumption rates of fish, crustaceans and molluscs are presented in Tables 3, 4 and 5 respectively and are summarised in Table 9. It was reported that wildfowl were being consumed but no quantitative data could be obtained. No consumption of marine plants/algae by adults was identified during the survey.

The main consumers of fish were anglers and their families. The main species of fish consumed by adults were mackerel (*Scomber scombrus*), bass and cod (*Gadus morhua*) with smaller amounts of pollack (*Pollachius pollachius*), saithe (*Pollachius virens*) and flounder (*Platichthys flesus*). A critical group of 17 individuals was identified with a maximum consumption rate of 64 kg/y and a mean rate of 29 kg/y. The observed 97.5 percentile rate based on 111 observations was 29 kg/y. These rates compare with the adult generic mean and 97.5 percentile consumption rates for fish of 15 kg/y and 40 kg/y respectively. The percentage breakdown of fish species consumed by the critical group,

rounded to the nearest 5%, consisted of, mackerel 40%, bass 30%, cod 20%, pollack 5% and saithe and flounder together 5%.

The main consumers of crustaceans were commercial fishermen, hobby fishermen and families of these people. The species of crustaceans consumed by adults were brown crab and lobster. A critical group of nine individuals was identified with a maximum consumption rate of 43 kg/y and a mean rate of 22 kg/y. The observed 97.5 percentile rate based on 58 observations was 32 kg/y. These rates compare with the adult generic mean and 97.5 percentile consumption rates for crustaceans of 3.5 kg/y and 10 kg/y respectively. The percentage breakdown of crustacean species consumed by the critical group, rounded to the nearest 5%, consisted of lobster 75% and brown crab 25%.

The main consumers of molluscs were non-commercial winkle collectors and their families. The main species of molluscs consumed by adults were winkles and small amounts of mussels (*Mytilus edulis*). A critical group of nine individuals was identified with a maximum consumption rate of 9.0 kg/y and a mean rate of 7.8 kg/y. The observed 97.5 percentile rate based on 15 observations was 9.0 kg/y. These rates compare with the adult generic mean and 97.5 percentile consumption rates for molluscs of 3.5 kg/y and 10 kg/y respectively. The only mollusc species consumed by the critical group was winkles.

Wildfowling was identified in the survey area and the following species were being shot; graylag goose, pink-footed goose, Canada goose, wigeon, teal, mallard and goldeneye. It was reported that wildfowl were being shot in the survey area and were being consumed; however, no quantitative data could be obtained (see Section 4.5). Consumption rates of wildfowl have been obtained during other habits surveys in Scotland and the critical group mean rates ranged from 11 kg/y to 22 kg/y. Generic consumption rates for wildfowl have not been determined.

Children's consumption rates

Children's consumption rates for fish, crustaceans and molluscs are shown in Tables 6 to 8 respectively and are summarised in Tables 10 to 12. No children in the 1 year old and 3 month old age groups were noted to be consuming locally caught seafood. No children in the 15 year old and 10 year old age groups were identified consuming molluscs. No children were identified who consumed wildfowl or marine plants.

15 year old age group

For fish, a critical group of two individuals was identified, with a maximum consumption rate of 24 kg/y and a mean rate of 24 kg/y. The observed 97.5 percentile rate based on nine observations was 24 kg/y. These rates compare with the generic mean and 97.5 percentile consumption rates for fish of 6.5 kg/y and 20 kg/y respectively.

For crustaceans, a critical group of one individual was identified with a consumption rate of 12 kg/y. The observed 97.5 percentile rate based on three observations was 12 kg/y. These rates compare with the generic mean and 97.5 percentile consumption rates for crustaceans of 2.5 kg/y and 6 kg/y respectively.

10 year old age group

For fish, a critical group of one individual was identified with a consumption rate of 29 kg/y. The observed 97.5 percentile rate based on nine observations was 25 kg/y. These rates compare with the generic mean and 97.5 percentile consumption rates for fish of 6.0 kg/y and 20 kg/y respectively.

For crustaceans, a critical group of one individual was identified with a consumption rate of 12 kg/y. The 97.5 percentile rate is not applicable for one observation. This compares with the generic mean and 97.5 percentile consumption rates for crustaceans of 2.5 kg/y and 7 kg/y respectively.

5 year old age group

For fish, a critical group of one individual was identified with a consumption rate of 0.5 kg/y. The 97.5 percentile rate is not applicable for one observation. No generic data have been derived for this age group.

For crustaceans, a critical group of one individual was identified with a consumption rate of 13 kg/y. The 97.5 percentile rate is not applicable for one observation. No generic data have been derived for this age group.

For molluscs, a critical group of one individual was identified with a consumption rate of 8.4 kg/y. The 97.5 percentile rate is not applicable for one observation. No generic data have been derived for this age group.

4.8 External exposure

Intertidal occupancy

External exposure from artificial radiation to members of the public who frequent intertidal areas depends on the occupancy rate and dose rate after subtraction of an appropriate value for natural background radiation. Dose rates over mud and salt marsh can be higher than those over coarser substrates due to fine grain size and consequent ability to adsorb more radioactivity. Consequently, occupancy rates over these substrates are considered to be radiologically more important than similar rates over other substrates. Estimates of natural backgrounds used by Cefas for assessing doses to individuals (EA, EHS, FSA and SEPA, 2006) are 0.05 µGy/h for sandy substrates, 0.07 µGy/h for mud and salt marsh and 0.06 µGy/h for all other substrates.

Activities were observed taking place over three intertidal substrates in the survey area, which were over rock, over sand and over sand and stones. The activities included angling, bait digging, collecting winkles, collecting mussels, collecting seaweed, dog walking, sunbathing, horse riding, beach cleaning, beach warden activities and life guard activities.

Table 13 presents the intertidal occupancy rates, grouped by substrate (rock, sand, and sand and stones). For intertidal occupancy over rock, the maximum rate was 1600 h/y for an individual who was walking, angling and collecting winkles, and the critical group mean rate was 980 h/y for 10 individuals who were anglers and commercial winkle collectors. For intertidal occupancy over sand, the maximum rate was 1100 h/y for a beach cleaner, and the critical group mean rate was 470 h/y for one individual who was beach cleaning and 12 dog walkers. For intertidal occupancy over sand and stones, the maximum rate and the critical group mean rate was 500 h/y for two dog walkers.

Gamma dose rate measurements were taken at selected locations, shown in Table 14, to supplement those of SEPA's routine monitoring programme.

Handling

Handling sediment while bait digging, mollusc collecting or handling commercial fishing gear can give rise to skin exposure from beta radiation. This needs consideration even though the annual dose limit for skin is a factor of 50 times higher than that for effective dose. There is also a contribution to effective dose due to skin exposure (ICRP, 1991).

Table 15 presents the handling rates of fishing gear and sediment. For handling fishing gear, the maximum rate was 1500 h/y and the critical group mean rate was 1100 h/y for 18 fishermen. For handling sediment, the maximum rate was 1000 h/y and the critical group mean rate was 700 h/y for

six commercial winkle collectors. One individual was a member of both critical groups (observation number 69), who was handling fishing gear for 620 h/y and handling sediment for 560 h/y.

Handling of angling equipment was not considered to be a significant pathway. Therefore, as in previous surveys, data for this pathway were not collected.

4.9 Water based activities

Activities taking place in or on the water can lead to ingestion of water and/or inhalation of spray. These pathways are generally considered to be minor in comparison with other exposure pathways such as the ingestion of foods produced in the vicinity of a nuclear site. However, in order to allow for their assessment, relevant data have been collected. Activities where there is a high potential of an individual's face going under the water have been classified as activities 'in water' since they are likely to lead to ingestion of water. All other activities have been classified as activities 'on water'.

Occupancy rates for activities taking place in or on seawater around Torness are shown in Table 16. No further manipulation of the data (for example, calculating critical group mean rates) has been carried out. It should be noted that some of the data was gained through interviews with representatives from a diving club and water sports clubs who provided occupancy rates for their club members.

Activities in the water

Activities in the water around Torness included diving, swimming and kayaking. The maximum occupancy rate in the water was 210 h/y for a diver.

Activities on the water

Activities on the water around Torness included commercial fishing, operating charter boats, boat angling, canoeing, jet skiing and pleasure boating. The maximum occupancy rate on the water was 2200 h/y for a commercial creel fisherman.

5. TERRESTRIAL RADIATION PATHWAYS

5.1 Terrestrial survey area

The terrestrial survey area covered all land within 5 km of the centre of the Torness site, as shown in Figure 2. The main villages in the terrestrial survey area were Cockburnspath, which was located to the south-east of the Torness site and Innerwick, which was located to the south-west.

Farms in the survey area produced lamb, beef and arable crops (wheat, barley, hay, silage, beans, kale, potatoes, swedes, Brussels sprouts and turnips). Interviews were conducted at 12 farms, seven of which produced lamb, beef and arable crops, three produced lamb and arable crops, and two produced arable crops. No dairy farms were identified within the survey area. Most of the lambs and beef cattle were sold at auctions in Stirling and Perth, and some were sold to an abattoir in Wales. Potatoes, swedes, Brussels sprouts and turnips were sold to supermarkets for human consumption. Barley was sold for malting and wheat was sold for milling and for distilling. Arable crops were also used for winter livestock feed. Many of the farmers kept lamb, beef and vegetables from their own farms for their household's consumption. Several farmers also kept chickens for chicken eggs for their household's consumption. A mineral water company was identified that extracted approximately 5.5 million litres of water per year from boreholes in the survey area. The water was bottled and was predominantly distributed throughout Scotland.

A smallholding was identified in the survey area, where a small number of pigs were reared, chickens were kept for eggs and a large amount of vegetables were grown. The smallholders and their families consumed a large amount of their own produce, the chicken eggs were also sold privately and the vegetables were also sold to a shop in the area. No allotment sites were identified within the survey area. However, several gardeners were identified in Innerwick, Barns Ness and Dunglass who grew fruit and vegetables for their household's consumption.

Three beekeepers were identified who kept hives in the survey area near Thurston, Dunglass and Cockburnspath. The honey was consumed by the individuals' families and the remainder sold locally either from their houses or to retailers in the survey area.

The availability of wild foods was limited in the survey area and only small amounts of blackberries, crab apples, hazel nuts and mushrooms were consumed. Some of the farmers shot game on their land or permitted private shoots on their land. The consumption of game including pheasant, partridge and a small amount of venison was identified. No consumption of freshwater fish was identified.

Local shops were visited to establish whether they were selling produce from within the survey area. Two shops in the local area sold fruit and vegetables on a small scale that were produced in the

survey area. A butcher sold beef which was produced in the survey area. However, only a small percentage of the beef sold at the butcher's shop came from farms within the survey area.

5.2 Land cover

Figure 3 shows the land cover in the terrestrial survey area. The figure was reproduced from a land cover map produced by Macaulay Land Use Research Institute (Macaulay Institute For Soil Research, 1988), with their consent.

A large proportion of the survey area was arable land with small areas of improved grassland and smooth grassland. There were also small areas of coniferous and non-coniferous plantations bordering the minor waterways in the area and areas of coppiced wood south of the village of Innerwick.

There was a large cement works located approximately 3 km north-west of the Torness site close to what had been an old landfill site. This landfill site had been used for the disposal of non-radioactive, site construction material, but was now farmland.

5.3 Novel radiation pathways

The transfer of contamination off the Torness site by wildlife was investigated as radionuclides could enter the food chain or contaminate the environment through this pathway. A representative from the Torness site reported that pigeons and rabbits were observed on the site and that they were regularly culled to keep the numbers low. The consumption of rabbits from Innerwick, Blackcastle, Cocklaw and Thurston was noted. The consumption of pigeons was not identified.

5.4 Internal exposure

Consumption data for locally produced foodstuffs potentially affected by gaseous discharges are presented in Tables 17 to 31 for adults and Tables 32 to 41 for children. These tables include the critical group mean consumption rates and the observed 97.5 percentile rates calculated as described in Section 3.4. For purposes of comparison, the data are summarised in Table 9 for adults and in Tables 10 and 11 for children (15 year olds and 10 year olds respectively). No children in the 5 year old, 1 year old and 3 month old age groups were noted to be consuming foods from the terrestrial survey area.

In order to provide information relevant to surveillance and assessments studies, the consumption rate data collected during the survey were analysed to indicate which food types most commonly contributed to each food group for adults. The data are summarised in Table 42. Those food types

shown in emboldened italics were sampled as part of SEPA's monitoring programme during 2005 (EA, EHS, FSA and SEPA, 2006).

Adults' consumption rates

Consumption of locally produced foods was identified in the following 15 food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, cattle meat, pig meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi and venison. No consumption of milk, freshwater fish and local cereals was identified.

The critical group mean consumption rate exceeded the generic 97.5 percentile consumption rate for root vegetables and honey and was equal to it for other vegetables. A further six critical group mean consumption rates exceeded the generic mean consumption rates. These were for potato, domestic fruit, cattle meat, pig meat, sheep meat and eggs. Five observed 97.5 percentile consumption rates exceeded the generic 97.5 percentile consumption rates. These were for other vegetables, root vegetables, potato, pig meat and honey.

Children's consumption rates

15 year old age group

Five children in the 15 year old age group were identified to be eating locally produced food. Consumption was identified in the following nine food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, cattle meat, sheep meat, eggs and wild fungi. No consumption was identified for milk, pig meat, poultry, wild/free foods, rabbits/hares, honey, venison, freshwater fish and local cereals. No critical group mean consumption rates exceeded the respective generic 97.5 percentile consumption rates. Three critical group mean consumption rates exceeded the generic mean consumption rates. These were for root vegetables, cattle meat and sheep meat. No observed 97.5 percentile consumption rates exceeded the respective generic 97.5 percentile consumption rates.

10 year old age group

Two children in the 10 year old age group were identified consuming food from only one food group, which was pig meat. No consumption was identified for the following 17 food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, cattle meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi, venison, freshwater fish and local cereals. The critical group mean consumption rate for pig meat did not exceed the generic 97.5 percentile or generic mean consumption rates. The observed 97.5 percentile consumption rate did not exceed the generic 97.5 percentile consumption rate.

6. DIRECT RADIATION

The direct radiation survey area, shown in Figure 2 extended up to 1 km from the centre of the Torness site. The activities of the Torness site employees and contractors while at work were not considered in the direct radiation survey.

6.1 Direct radiation survey area

Immediately in front of the Torness site to the north and north-east was a concrete sea wall which was part of the coastal walkway that linked Skateraw Harbour to Thorntonloch. A man-made embankment of large rocks formed a sea defence in front of the sea wall. There was a small wharf to the north of the power station where a lifeboat base was located. Two boats were observed moored in the sea in front of the wharf. Beyond an area of farmland to the east of the site, the shore was shelving rocks and this was a popular area for anglers near the Torness site pipe outfall. The small hamlet of Thorntonloch and a caravan park were located to the south-east of the site. Farmland covered the area to the south and west of the site and this bordered the site perimeter fence. Several residences were also located in this area. To the north-west of the site was Skateraw Harbour, which comprised a rocky shore with a sandy beach.

6.2 Occupancy within direct radiation survey area

Local residents and individuals were interviewed and their occupancy rates within the direct radiation survey area are presented Table 43. Data were obtained for residents living to the south-east and south of the site, people staying in caravans for significant periods of the summer, farmers, shore anglers who spent significant time angling near the Torness site pipe outfall, and people working on the lifeboat. Six adults had occupancy rates greater than 7000 h/y. The highest total occupancy rate (indoor plus outdoor) was 8600 h/y for a resident. The highest indoor occupancy rate was 8500 h/y for a resident and the highest outdoor occupancy rate was 1800 h/y for a person who was working in the area.

6.3 Gamma dose rate measurements

Gamma dose rate measurements taken at residences in the direct radiation survey area are also presented in Table 44. Gamma dose rate measurements were taken both indoors and outdoors of most residences where interviews were conducted. Outdoor measurements were taken approximately 5 to 10 metres from the nearest building. Background gamma dose rate measurements taken at locations remote from the site for comparison are also presented in Table 44. All measurements were taken at a height of 1 metre above the substrate. It should be noted that these measurements have not been adjusted for natural background dose rates.

The gamma dose rate measurements taken outdoors ranged from 0.055 µGy/h to 0.080 µGy/h and those taken indoors ranged from 0.053 µGy/h (inside a caravan) to 0.111 µGy/h (in a house). For comparison, the background measurements ranged from 0.066 µGy/h to 0.090 µGy/h.

7. COMBINED PATHWAYS

In determining habits data for the purposes of assessing radiological doses to the public, it may be necessary to consider a combination of pathways. Data are provided in Annexes 1 and 2 so that the full effect of combining pathways can be assessed for individual observations, given the concentrations and dose rates for a particular assessment. In some circumstances, it will be possible to make simplifying assumptions and define the consumption and external exposure rates appropriate to a series of potential critical groups. Such assumptions will depend on the assessment in question but some initial observations are provided here as a starting point for those undertaking assessments.

The most extensive combinations of pathways for adult dose assessment are shown in Annex 3. Each of the 17 combinations shown in this annex represents an actual individual (or individuals) from Annex 1 who has positive data (irrespective of the magnitude), for each pathway marked with an asterisk. It should be noted that combination numbers in Annex 3 do not correlate directly with observation numbers in Annex 1. Other individuals from Annex 1 have combinations that are not listed in Annex 3 because they have fewer pathways and a dose assessment for them would be adequately covered by one of the 17 listed combinations.

Combinations of pathways at critical group rates may be achieved by considering the data in Annexes 1 and 2. Although critical group rates are not given in the annexes, the rates for individuals making up the groups are shown emboldened. Possible combinations of pathways and their associated critical group rates are therefore apparent.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Survey findings

The survey investigated three potential sources of public radiation exposure from the Torness site, which were:

- Discharges of liquid radioactive waste to the North Sea
- Discharges of gaseous radioactive waste to the atmosphere
- Emissions of direct radiation

Data were collected for 341 adults and 42 children including commercial fishermen, anglers, shellfish collectors, farmers, gardeners, beekeepers and people living and spending time within the direct radiation area.

Aquatic survey area

The adult critical group mean consumption rates of aquatic foods were:

- 29 kg/y for fish
- 22 kg/y for crustaceans
- 7.8 kg/y for molluscs

The main species consumed by the adult critical groups for fish were mackerel, bass and cod, for crustaceans were lobster and crab, and for molluscs was winkles.

Wildfowling was identified in the survey area and it was reported that wildfowl were being consumed but no quantitative data could be obtained (see Section 4.5). No consumption of marine plants/algae was identified.

The critical group mean occupancy rates over intertidal areas were:

- 980 h/y for rock
- 470 h/y for sand
- 500 h/y for sand and stones

The critical group mean handling rates were:

- 1100 h/y for handling fishing gear
- 700 h/y for handling sediment

The maximum occupancy rates for individuals spending time in water and on water were 210 h/y and 2200 h/y respectively.

Terrestrial survey area

The adult critical group mean consumption rates of foods from the terrestrial survey area were:

- 15 kg/y for green vegetables
- 50 kg/y for other vegetables
- 50 kg/y for root vegetables
- 88 kg/y for potatoes
- 22 kg/y for domestic fruit
- 23 kg/y for cattle meat
- 37 kg/y for pig meat
- 14 kg/y for sheep meat
- 2.4 kg/y for poultry
- 10 kg/y for eggs
- 2.9 kg/y for wild/free foods
- 1.4 kg/y for rabbits/hares
- 11 kg/y for honey
- 1.2 kg/y for wild fungi
- 4.0 kg/y for venison

No individuals were identified consuming milk, freshwater fish or local cereals from the terrestrial survey area.

Direct radiation survey area

The highest occupancy rate (indoors plus outdoors) of a member of the public within 1 km of the site centre was 8600 h/y. The highest indoor occupancy rate was 8500 h/y for a resident and the highest outdoor occupancy rate was 1800 h/y for a person who was working in the area.

8.2 Comparisons with the previous survey

The results from this 2006 survey can be compared with results from the last habits survey undertaken at Torness in 2001.

Aquatic survey area

In 2006, the adult critical group mean consumption rates had decreased for fish and had increased for crustaceans and molluscs, when compared to the results from the 2001 survey. The adult critical group mean consumption rates in 2001 were 41 kg/y for fish, 17 kg/y for crustaceans and 5.9 kg/y for molluscs, and in 2006 were 29 kg/y for fish and 22 kg/y for crustaceans and 7.8 kg/y for molluscs.

The main fish species consumed in 2006 were mackerel, bass and cod compared to haddock and bass in the 2001 survey. The main crustacean species consumed in the 2006 survey were lobster and crab compared to crab, *Nephrops* and lobster in the 2001 survey (no inshore *Nephrops* were noted during the 2006 survey). The main mollusc species consumed in the 2006 survey was winkles compared to mussels in the 2001 survey. In addition, the consumption of wildfowl was reported in 2006 but not in 2001.

For external pathways, it should be noted that the methodology used for determining critical groups in 2006 (see Section 3.4) has changed since the 2001 survey so care is needed when comparing results. In previous surveys a factor of 1.5, instead of 3, was used to define the cut-off value for intertidal occupancy and handling. However, it is now considered appropriate that the same factor of 3 as for consumption is used. The factor reflects variations in the doses likely to be received due to natural variations in the interactions of radiation with tissues caused by, for example, differences in anatomy.

In 2001, occupancy over the following five substrates was identified: mussel beds; mud and sand; rock; sand; sand and stones. In 2006, occupancy over the following three substrates was identified: rock; sand; and sand and stones. Therefore occupancy over rock, over sand and over sand and stones can be compared.

In 2001, the critical group mean occupancy rate over rock was 1700 h/y for one angler (no change using the current methodology), compared to a critical group mean rate in 2006 of 980 h/y for 10 individuals, who were anglers and winkle collectors. In 2001, the critical group mean occupancy rate over sand was 490 h/y for six individuals who were walkers, dog walkers and an angler and walker (360 h/y using the current methodology for 12 individuals engaged in the same activities) compared to a critical group mean rate in 2006 of 470 h/y for 13 individuals, one was a beach cleaner and the rest were dog walkers. In 2001, the critical group mean occupancy rate over sand and stones was 310 h/y for six individuals who were walkers, dog walkers, an angler and a shellfish collector (260 h/y using the current methodology for nine individuals engaged in the same activities), compared to a critical group mean rate in 2006 of 500 h/y for two individuals who were dog walkers.

In 2001, the critical group mean rate for handling fishing gear was 1800 h/y for seven commercial fishermen (1500 h/y using the current methodology for twelve commercial fishermen and a net repairer), compared to a critical group mean rate in 2006 of 1100 h/y for 18 commercial fishermen. In 2001, the critical group mean rate for handling sediment was 360 h/y for a shellfish collector (no change using the current methodology), compared to a critical group mean rate in 2006 of 700 h/y for six winkle collectors.

Terrestrial survey area

A comparison between the 2001 and 2006 adult critical group mean consumption rates (kg/y) for terrestrial foods from the Torness area is listed below.

	2001	2006
• Green vegetables	30	15
• Other vegetables	38	50
• Root vegetables	32	50
• Potatoes	100	88
• Domestic fruit	22	22
• Cattle meat	Nil	23
• Pig meat	Nil	37
• Sheep meat	5.7	14
• Poultry	5.9	2.4
• Eggs	13	10
• Wild/free foods	1.8	2.9
• Rabbits/hares	7.1	1.4
• Honey	Nil	11
• Wild fungi	0.3	1.2
• Venison	9.5	4.0
• Freshwater fish	Nil	Nil
• Cereals	Nil	Nil

Compared to the previous survey, consumption rates had increased in the following food groups: other vegetables, root vegetables, cattle meat, pig meat, sheep meat, wild/free foods, honey and wild fungi. Consumption rates had decreased in the following food groups: green vegetables, potatoes, poultry, eggs, rabbits/hares and venison. The consumption rate for domestic fruit remained unchanged. No consumption of milk, freshwater fish and cereals was noted in either survey.

The food groups that showed significant increases in consumption rates since 2001 were cattle meat, pig meat, sheet meat and honey, all of which were not consumed in 2001. The most significant decreases in consumption rates were noted for the green vegetables, poultry, rabbits/hares and venison food groups.

Direct radiation survey area

In common with the 2001 direct radiation survey, this survey identified individuals living in the Torness area who spent more than 8000 h/y within 1 km of the site.

8.3 Current environmental monitoring programmes

The 2005 SEPA aquatic and terrestrial monitoring programmes around the Torness site comprised the following samples and measurements (EA, EHS, FSA and SEPA, 2007).

- Sediments, seawater, seaweed and various seafoods (cod, brown crabs, lobsters, *Nephrops* and winkles)
- Gamma dose rate measurements were taken at Heckies Hole, Dunbar Inner Harbour, Belhaven Bay, Barns Ness, Skateraw, Thorntonloch, Pease Bay, St Abb's Head, Coldingham Bay and Eyemouth.
- Beta dose rate measurements were taken over creels (lobster pots) at Cove and nets at Dunbar Harbour.
- Cows' milk, blackberries, cabbage, cheese, courgettes, eggs, elderberries, goats' milk, plums, potatoes, rowanberries, spring greens, turnips, wheat, grass and soil.
- Air monitoring was undertaken near Innerwick and Cockburnspath.

During the 2006 Torness habits survey, Cefas attempted to identify a suitable location for a 3rd medium volume air sampler, however, nowhere was identified.

8.4 Recommendations for environmental monitoring

It is considered that SEPA's current monitoring programme provides adequate coverage for the aquatic and terrestrial environments. However, based on the findings of this habits survey, the following suggestions are presented for consideration:

Aquatic monitoring

- A sample of wildfowl from the John Muir Country Park could be included, as although consumption rates were not obtained during the survey, it was reported that large numbers of ducks and geese were being consumed. Wigeon would be recommended, since this was reported to be the most commonly consumed species.
- The biannual sample of crab and the annual sample of lobster could be changed from those caught offshore of Cove to crab and lobster caught offshore of the Torness site outfall.
- The sample of cod taken from White Sands could be changed to a sample of bass taken from near the Torness outfall as bass were consumed in larger quantities.
- A sample of bladderwrack from Skateraw Harbour could be added as it was used as a fertiliser on vegetables.
- A sample of soil from land that has been fertilised with bladderwrack could be added.
- The beta dose rate measurements taken over creels could be changed from creels set at Cove to creels set offshore of the Torness outfall.

Terrestrial monitoring

- An annual sample of cattle meat or pig meat could be introduced. The consumption of pig meat and cattle meat was not identified in 2001 but was noted in 2006.
- The current sample of plums could be replaced by a sample of apples, as apples were consumed in greater quantities within the food group domestic fruit.
- The current sample of turnips could be replaced by a sample of onions, as onions were consumed in greater quantities within the food group root vegetables.

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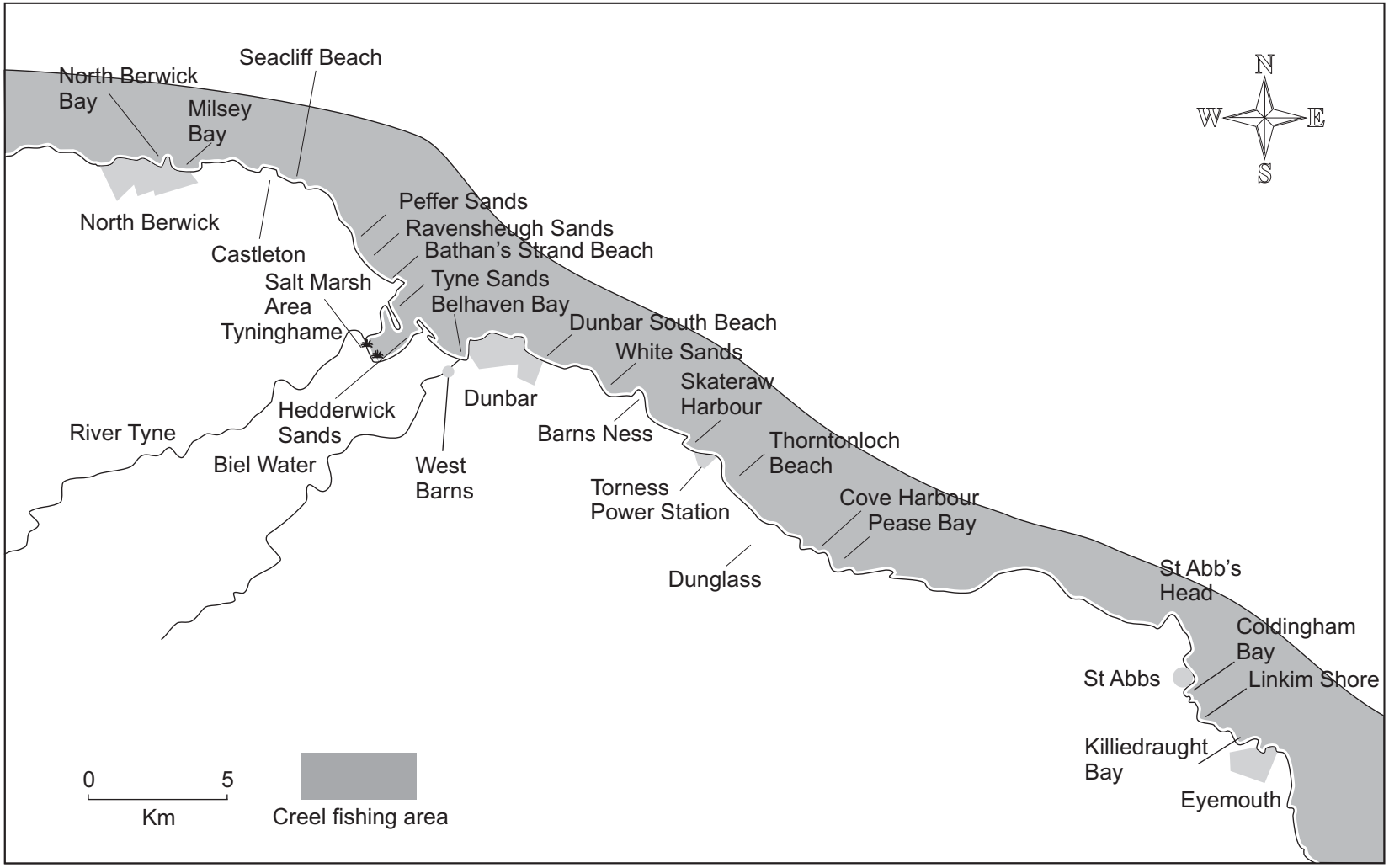

Figure 1. The Torness aquatic survey area

Figure 2. The Torness terrestrial (outer ring) and direct radiation (inner ring) survey areas

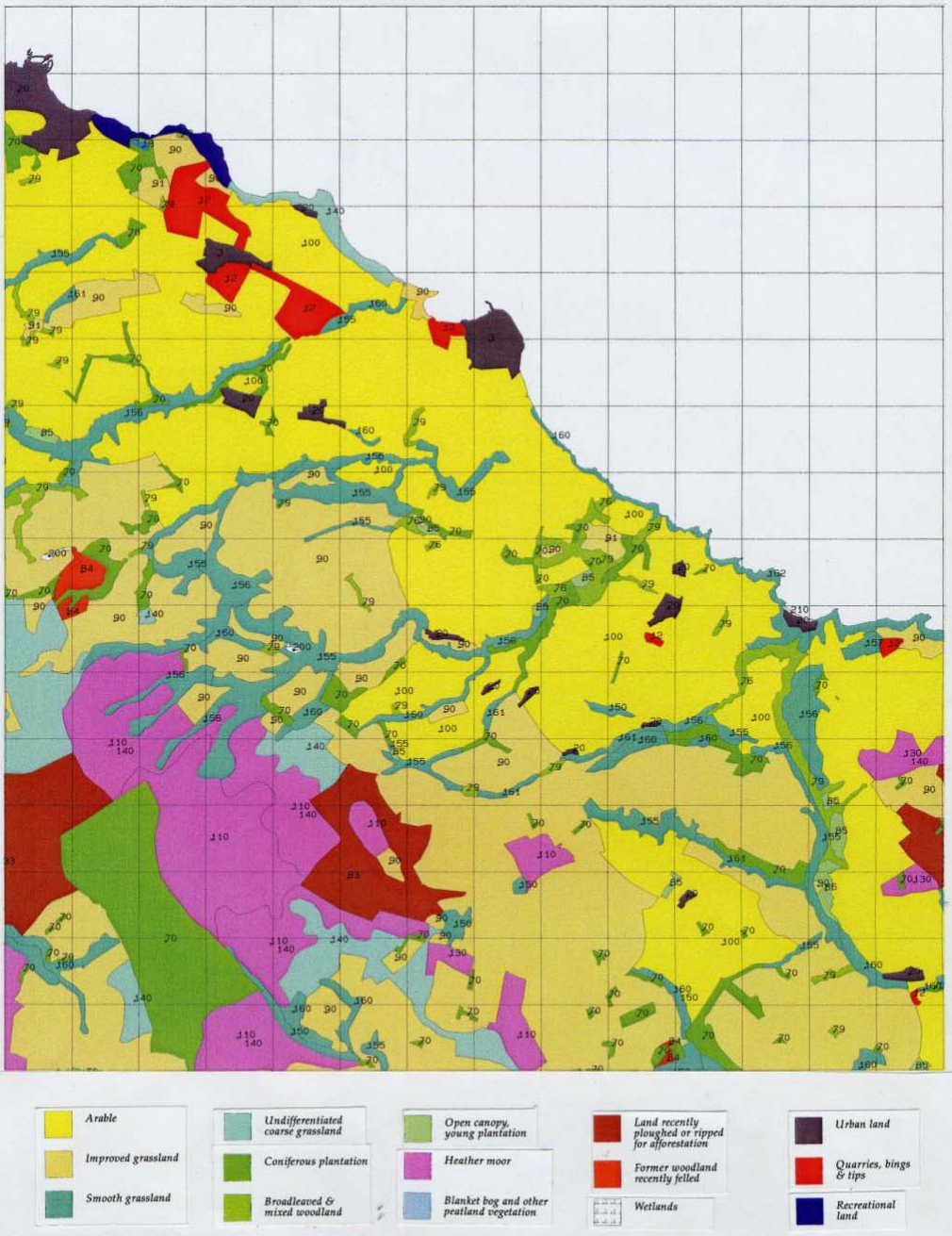

Figure 3. Land cover around Torness .

Number codes on the figure relate to point and line features not shown in the key.
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Base Scale is 1:50000

Table 2. Typical food groups used in habits surveys

Food group	Typical foods within the food groups
Green vegetables	Globe artichoke, asparagus, broccoli, Brussels sprout, cabbage, calabrese, cauliflower, chard, courgettes, cucumber, gherkin, herbs, kale, leaf beet, lettuce, marrow, spinach
Other vegetables	Aubergine, broad bean, chilli pepper, french bean, mangetout, pea, pepper, runner bean, sweetcorn, tomato
Root vegetables	Jerusalem artichoke, beetroot, carrot, celeriac, celery, chicory, fennel, garlic, kohl rabi, leek, onion, parsnip, radish, shallot, spring onion, swede, turnip
Potato	Potato
Domestic fruit	Apple, apricot, blackberry, blackcurrant, boysenberry, cherry, damson, fig, gooseberry, grapes, greengages, huckleberry, loganberry, melon, nectarines, peach, pear, plum, pumpkin, raspberry, redcurrants, rhubarb, rowanberry, strawberry, tayberry, whitecurrant
Milk	Cow's milk, cream, yoghurt, goat's milk
Solid milk products	Butter, cheese
Cattle meat[b]	Beef
Pig meat[b]	Pork
Sheep meat[b]	Lamb, mutton
Poultry	Chicken, duck, goose, grouse, guinea fowl, partridge, pheasant, pigeon, snipe, turkey, woodcock
Eggs	Chicken egg, duck egg, goose egg
Wild/free foods	Blackberry, chestnut, crab apple, damson, dandelion root, elderberry, nettle, raspberry, rowanberry, sloe, strawberry,
Honey	Honey
Wild Fungi	Mushrooms, other edible fungi
Rabbits/Hares	Rabbit, hare
Venison[b]	Venison
Fish (sea)	Bass, brill, cod, common ling, dab, Dover sole, flounder, gurnard, haddock, hake, herring, lemon sole, mackerel, monkfish, mullet, plaice, pollack, witch saithe, salmon, sea trout, squid*, cuttlefish*, rays, turbot, whitebait, whiting
Fish (freshwater)	Brown trout, rainbow trout, perch, pike, salmon (river), eels
Crustaceans	Brown crab, spider crab, crawfish, lobster, *Nephrops* , squat lobster, prawn, shrimp
Molluscs	Cockles, limpets, mussels, oysters, king scallops, queen scallops, razor shells, whelks, winkles

Notes

[a] Although squid and cuttlefish are molluscs, radiologically they are more akin to fish

[b] Including offal

Table 2. Ratios for determining consumption rates for children

Food group	Ratio child/adult[1]	
	1 yr old	10 yr old
Fish[2]	0.050	0.200
Crustaceans[2]	0.050	0.250
Molluscs[2]	0.050	0.250
Green vegetables	0.222	0.444
Other vegetables	0.200	0.500
Root vegetables	0.375	0.500
Potatoes	0.292	0.708
Domestic fruit	0.467	0.667
Milk	1.333	1.000
Cattle meat	0.222	0.667
Pig meat	0.138	0.625
Sheep meat	0.120	0.400
Poultry	0.183	0.500
Eggs	0.600	0.800
Wild/free foods[3]	0.110	0.490
Game[4]	0.140	0.500
Honey	0.789	0.789
Wild fungi	0.150	0.450
Freshwater fish[2]	0.050	0.250

Notes

[1] The age groups suggested for assessment in this table are those relating to dose coefficients representing 1 to 2 yr olds (labelled 1 yr old) and 7 to 12 yr olds (labelled 10 yr old). Excepting notes 2 and 3, ratios were derived from Byrom et al., (1995) for 1yr old (6 - 12 months) and 10 yr old children (10 - 11 yrs).

[2] Ratios were derived from Smith and Jones, (2003) which presented data for infants and children.

[3] Ratios were derived from FSA, (2002) data for wild fruit and nuts for infants and 10 yr old children.

[4] Game includes rabbits/hares and venison.

Table 3. Adults' consumption rates of fish in the Torness area (kg/y)

Observation number	Bass	Bream	Cod	Ling	Flounder	Grey mullet	Mackerel	Pollack	Saithe	Total
313	**5.1**		**41.9**		**4.1**		**12.5**			**63.6**
135			**15.7**				**15.7**	**15.7**		**47.2**
162-167			**3.1**				**22.8**	**2.9**		**28.7**
191-194	**24.5**									**24.5**
181	**12.4**		**2.4**						**9.4**	**24.2**
16-17	**22.6**									**22.6**
195			**1.8**				**20.8**			**22.5**
213			**11.4**				**10.0**			**21.3**
338			13.5				6.2			19.7
200	12.8		4.5							17.3
228-230			16.8							16.8
21	2.6							12.4		15.0
116-121			5.3				8.1			13.4
235,241	12.8									12.8
23-24							3.7	7.4		11.1
136							10.6			10.6
220-221	1.1						9.0			10.1
71-72			5.0					5.0		9.9
323-324			4.8	1.9			1.7	1.2		9.6
104-105	2.1				0.5	1.1	5.5			9.2
174-177							9.0			9.0
84		5.6					3.1			8.7
81	8.5									8.5
297-301	8.0									8.0
304-305,307	8.0									8.0
178-179	3.7		3.8							7.6
311	6.8									6.8
360-361	6.4									6.4
310			6.3							6.3
49	4.3									4.3
356-357							4.2			4.2
331-335			1.9	0.8			0.7	0.5		3.8
317-322			1.6	0.6			0.6	0.4		3.2
325-326,328			1.6	0.6			0.6	0.4		3.2
346	2.7									2.7
276-277	2.6									2.6
284	2.1									2.1
278-279	1.9									1.9
187-188,190	1.3									1.3
358-359	1.3									1.3
314-316	0.9									0.9
92-94	0.7									0.7
184-185	0.7									0.7
201-202	0.7									0.7
100-102	0.5									0.5
253-254							0.5			0.5
95-99	0.4									0.4
280	0.3									0.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the 17 highest adult consumers is 29.1 kg/y

The observed 97.5 percentile rate based on 111 observations is 28.7 kg/y

Table 4. Adults' consumption rates of crustaceans in the Torness area (kg/y)

Observation number	Brown crab	Lobster	Total
197-198	**15.9**	**27.4**	**43.3**
220-221	**9.9**	**5.7**	**15.6**
85-89		**15.5**	**15.5**
195	1.0	11.9	12.9
69		12.9	12.9
128	6.6	5.7	12.3
228-230	7.7	2.5	10.2
219	7.5		7.5
160-161		5.6	5.6
63	5.4		5.4
64	1.6	2.6	4.2
205-207	4.0		4.0
104-105	2.1	1.1	3.1
149		2.6	2.6
41-42	0.8	1.3	2.1
136		1.9	1.9
354-355	1.6	0.2	1.9
116	1.4	0.4	1.8
349-350	0.4	1.3	1.7
132-133	1.0	0.6	1.6
235	1.4	0.1	1.4
122-123	0.8		0.8
284-295		0.4	0.4
135		0.2	0.2
278	0.1		0.1
236-238		0.1	0.1
240-241		0.1	0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 9 highest adult consumers is 21.7 kg/y

The observed 97.5 percentile rate based on 58 observations is 31.6 kg/y

Table 5. Adults' consumption rates of molluscs in the Torness area (kg/y)

Observation number	Mussel	Winkle	Total
73-78		**9.0**	**9.0**
213		**7.4**	**7.4**
211-212		**4.5**	**4.5**
16-17		2.7	2.7
358-359		0.1	0.1
104-105	0.1		0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the 9 highest adult consumers is 7.8 kg/y

The observed 97.5 percentile rate based on 15 observations is 9.0 kg/y

Table 6. Children's consumption rates of fish in the Torness area (kg/y)

15 year old age group

Observation number	Age	Bass	Cod	Ling	Mackerel	Pollack	Saithe	Total
182	**14**	**12.4**	**2.4**				**9.4**	**24.2**
183	**12**	**12.4**	**2.4**				**9.4**	**24.2**
302	16	8.0						8.0
303	14	8.0						8.0
348	16				4.5			4.5
327	15		1.6	0.6	0.6	0.4		3.2
189	14	1.3						1.3
186	12	0.7						0.7
103	15	0.5						0.5

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the 2 highest 15 year old age group consumers is 24.2 kg/y
The observed 97.5 percentile rate based on 9 observations is 24.2 kg/y

10 year old age group

Observation number	Age	Bass	Cod	Ling	Mackerel	Pollack	Saithe	Total
168	**10**		**3.1**		**22.8**	**2.9**		**28.7**
309	11	8.0						8.0
308	9	8.0						8.0
306	8	8.0						8.0
180	7	1.9	1.9					3.8
329	11		1.6	0.6	0.6	0.4		3.2
330	7		1.6	0.6	0.6	0.4		3.2
203	10	0.7						0.7
255	9				0.5			0.5

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the highest 10 year old age group consumer is 28.7 kg/y
The observed 97.5 percentile rate based on 9 observations is 24.6 kg/y

5 year old age group

Observation number	Age	Bass	Cod	Ling	Mackerel	Pollack	Saithe	Total
256	**5**				**0.5**			**0.5**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the only 5 year old age group consumer is 0.5 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 7. Children's consumption rates of crustaceans in the Torness area (kg/y)

15 year old age group

Observation number	Age	Crab	Lobster	Total
129	**12**	**6.6**	**5.7**	**12.3**
348	16		0.9	0.9
239	14		0.1	0.1

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of crustaceans based on the highest 15 year old age group consumer is 12.3 kg/y
The observed 97.5 percentile rate based on 3 observations is 11.8 kg/y

10 year old age group

Observation number	Age	Crab	Lobster	Total
130	**10**	**6.6**	**5.7**	**12.3**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of crustaceans based on the only 10 year old age group consumer is 12.3 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

5 year old age group

Observation number	Age	Crab	Lobster	Total
70	**6**		**12.9**	**12.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of crustaceans based on the only 5 year old age group consumer is 12.9 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 8. Children's consumption rates of molluscs in the Torness area (kg/y)

5 year old age group

Observation number	Age	Mussel	Winkle	Total
70	**6**	**2.4**	**6.0**	**8.4**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of molluscs based on the only 5 year old age group consumer is 8.4 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 9. Summary of adults' consumption rates in the Torness area (kg/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical group consumption rate	Observed minimum critical group consumption rate	Observed mean critical group consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Fish	111	17	63.6	21.3	29.1	28.7	15.0	40.0
Crustaceans	58	9	43.3	15.5	21.7	31.6	3.5	10.0
Molluscs	15	9	9.0	4.5	7.8	9.0	3.5	10.0
Green vegetables	40	17	23.4	9.3	14.9	23.4	15.0	45.0
Other vegetables	36	12	86.3	35.0	50.0	86.3	20.0	50.0
Root vegetables	53	4	73.7	26.4	50.0	59.5	10.0	40.0
Potato	57	21	150.0	59.2	87.7	150.0	50.0	120.0
Domestic fruit	38	21	36.6	12.9	22.3	36.6	20.0	75.0
Milk	NC	NC	NC	NC	NC	NC	95.0	240.0
Cattle meat	6	6	31.5	18.9	23.1	31.5	15.0	45.0
Pig meat	8	6	50.6	30.0	36.9	50.6	15.0	40.0
Sheep meat	17	8	22.6	11.3	14.1	22.6	8.0	25.0
Poultry	18	9	4.5	1.6	2.4	3.7	10.0	30.0
Eggs	24	10	17.8	8.1	10.4	17.8	8.5	25.0
Wild/free foods	25	7	6.0	2.3	2.9	3.9	7.0	25.0
Rabbits/hares	4	2	1.4	1.4	1.4	1.4	6.0	15.0
Honey	12	6	11.8	8.2	10.6	11.8	2.5	9.5
Wild fungi	20	6	2.0	0.7	1.2	1.7	3.0	10.0
Venison	8	3	4.0	4.0	4.0	4.0	ND	ND
Freshwater fish	NC	NC	NC	NC	NC	NC	15.0	40.0

Notes
ND = not determined
NC = not consumed

Table 10. Summary of 15 year old children's consumption rates in the Torness area (kg/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical group consumption rate	Observed minimum critical group consumption rate	Observed mean critical group consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Fish	9	2	24.2	24.2	24.2	24.2	6.5	20.0
Crustaceans	3	1	12.3	12.3	12.3	11.8	2.5	6.0
Molluscs	NC	NC	NC	NC	NC	NC	2.5	6.0
Green vegetables	3	3	9.3	3.4	5.3	9.0	9.0	25.0
Other vegetables	3	1	7.3	7.3	7.3	7.0	10.0	30.0
Root vegetables	3	3	15.6	9.5	11.5	15.3	7.5	20.0
Potato	3	1	29.5	29.5	29.5	28.3	60.0	130.0
Domestic fruit	4	2	6.4	3.2	4.8	6.1	15.0	50.0
Milk	NC	NC	NC	NC	NC	NC	110.0	260.0
Cattle meat	1	1	18.9	18.9	18.9	NA	15.0	35.0
Pig meat	NC	NC	NC	NC	NC	NC	10.0	30.0
Sheep meat	1	1	11.3	11.3	11.3	NA	5.5	15.0
Poultry	NC	NC	NC	NC	NC	NC	6.5	20.0
Eggs	1	1	5.1	5.1	5.1	NA	7.0	25.0
Wild/free foods	NC	NC	NC	NC	NC	NC	3.0	13.0
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	2.0	5.0
Wild fungi	1	1	0.2	0.2	0.2	NA	2.0	5.5
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Freshwater fish	NC	NC	NC	NC	NC	NC	6.5	20.0

Notes

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 11. Summary of 10 year old children's consumption rates in the Torness area (kg/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical group consumption rate	Observed minimum critical group consumption rate	Observed mean critical group consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Fish	9	1	28.7	28.7	28.7	24.6	6.0	20.0
Crustaceans	1	1	12.3	12.3	12.3	NA	2.5	7.0
Molluscs	NC	NC	NC	NC	NC	NC	2.5	7.0
Green vegetables	NC	NC	NC	NC	NC	NC	6.0	20.0
Other vegetables	NC	NC	NC	NC	NC	NC	8.0	25.0
Root vegetables	NC	NC	NC	NC	NC	NC	6.0	20.0
Potato	NC	NC	NC	NC	NC	NC	45.0	85.0
Domestic fruit	NC	NC	NC	NC	NC	NC	15.0	50.0
Milk	NC	NC	NC	NC	NC	NC	110.0	240.0
Cattle meat	NC	NC	NC	NC	NC	NC	15.0	30.0
Pig meat	2	2	7.5	7.5	7.5	7.5	8.5	25.0
Sheep meat	NC	NC	NC	NC	NC	NC	4.0	10.0
Poultry	NC	NC	NC	NC	NC	NC	5.5	15.0
Eggs	NC	NC	NC	NC	NC	NC	6.5	20.0
Wild/free foods	NC	NC	NC	NC	NC	NC	3.0	11.0
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	2.0	7.5
Wild fungi	NC	NC	NC	NC	NC	NC	1.5	4.5
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Freshwater fish	NC	NC	NC	NC	NC	NC	6.0	20.0

Notes

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 12. Summary of 5 year old children's consumption rates in the Torness area (kg/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical group consumption rate	Observed minimum critical group consumption rate	Observed mean critical group consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Fish	1	1	0.5	0.5	0.5	NA	ND	ND
Crustaceans	1	1	12.9	12.9	12.9	NA	ND	ND
Molluscs	1	1	8.4	8.4	8.4	NA	ND	ND
Green vegetables	NC	NC	NC	NC	NC	NC	ND	ND
Other vegetables	NC	NC	NC	NC	NC	NC	ND	ND
Root vegetables	NC	NC	NC	NC	NC	NC	ND	ND
Potato	NC	NC	NC	NC	NC	NC	ND	ND
Domestic fruit	NC	NC	NC	NC	NC	NC	ND	ND
Milk	NC	NC	NC	NC	NC	NC	ND	ND
Cattle meat	NC	NC	NC	NC	NC	NC	ND	ND
Pig meat	NC	NC	NC	NC	NC	NC	ND	ND
Sheep meat	NC	NC	NC	NC	NC	NC	ND	ND
Poultry	NC	NC	NC	NC	NC	NC	ND	ND
Eggs	NC	NC	NC	NC	NC	NC	ND	ND
Wild/free foods	NC	NC	NC	NC	NC	NC	ND	ND
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	ND	ND
Wild fungi	NC	NC	NC	NC	NC	NC	ND	ND
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Freshwater fish	NC	NC	NC	NC	NC	NC	ND	ND

Notes

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 13. Intertidal occupancy rates in the Torness area (h/y)

Observation number	Location*	Activity*	Rock	Sand	Sand and stones
69	**Torness outfall and Barns Ness to Torness**	**Angling, collecting winkles and walking**	**1570**		
18	**Torness outfall**	**Angling**	**1320**		
213-214	**Dunbar**	**Collecting winkles**	**1040**		
16	**Torness outfall**	**Angling and collecting winkles**	**1000**		
181	**St Abb's Head and Torness outfall**	**Angling**	**945**		
297	**Torness outfall**	**Angling**	**728**		
284	**Torness outfall/**Thorntonloch beach	**Angling**	**720**	240	
178	**St Abb's Head and Torness outfall**	**Angling**	**720**		
215	**Dunbar lighthouse**	**Collecting winkles**	**690**		
49-50	Torness outfall	Angling	500		
85	Barns Ness	Walking/Angling	456		
217-218	Cove	Collecting winkles	437		
84	Skateraw and Torness/Skateraw	Angling/Bait digging	380	84	
201	Torness outfall	Angling	312		
353	Barns Ness to Dunbar	Collecting winkles	260		
79	North Berwick and Barns Ness	Collecting winkles	240		
200	Torness outfall and Dunbar	Angling	208		
311-312	Torness outfall	Angling	160		
278	Thorntonloch beach	Angling	156		
21	Torness and Dunbar	Angling	140		
191	Torness outfall	Angling	140		
73	North Berwick and Barns Ness	Collecting winkles	120		
80	Torness outfall, Cove and Pease Bay	Angling	120		
208-210	Torness outfall	Angling	113		
235	Torness outfall	Angling	108		
174	Dunbar beach	Angling	91		
360	Thorntonloch beach	Angling	90		
184	Torness outfall	Angling	80		
336	Skateraw and Torness	Angling	80		
187	Torness outfall	Angling	72		
296	Torness outfall and Thorntonloch beach	Angling	70	70	
22	Torness outfall	Angling	70		

Table 13. Intertidal occupancy rates in the Torness area (h/y)

Observation number	Location*	Activity*	Rock	Sand	Sand and stones
277	Thorntonloch beach	Angling/Walking	60	40	
348	Dunbar Harbour	Angling	60		
104	Various locations	Collecting mussels, angling, sunbathing, dog walking	32	136	
105	Skateraw and Torness outfall/Thorntonloch beach	Collecting mussels and angling/Sunbathing	32	6	
253	Skateraw/White Sands	Angling/Walking	30	32	
282	Torness outfall	Angling	24		
313	Torness outfall and Eyemouth	Angling	18	12	
92,95,100	Torness outfall	Angling	8		
283	Torness outfall	Angling	6		
358-359	Torness outfall	Collecting winkles	6		
310	Torness outfall	Angling	4		
216	**North Berwick to Dunbar beaches**	**Beach cleaning**		**1070**	
342-345	**Belhaven Bay**	**Dog walking**		**490**	
228	**Bellhaven, White Sands, Skateraw and Torness beach**	**Dog walking**		**480**	
169-173	**Dunbar Beach**	**Dog walking**		**365**	
356-357	**North Berwick to Dunbar beaches**	**Dog walking**		**365**	
90	Barns Ness, Skateraw and Thorntonloch	Dog walking		350	
314-316	Thorntonloch beach	Walking		162	
339-341	Skateraw, Dunbar and Thorntonloch beaches	Dog walking		156	
36-37	Skateraw and Thorntonloch beach	Dog walking		144	
44	Thorntonloch beach	Dog walking		120	
43	Thorntonloch beach	Dog walking		120	
114	Coldingham beach/Linkim beach	Beach warden and lifeguard duties/Dog walking		100	6
7	Thorntonloch beach	Walking		100	
19-20	Eyemouth	Dog walking		100	
91	Barns Ness, Skateraw and Thorntonloch	Dog walking		100	
115	Coldingham beach	Beach warden and lifeguard duties/Dog walking		100	
47-48	Thorntonloch beach	Walking		90	
109-110	Coldingham beach	Sunbathing		90	
111-113	Coldingham beach	Sunbathing		72	
274-275	Thorntonloch beach	Walking		70	

Table 13. Intertidal occupancy rates in the Torness area (h/y)

Observation number	Location*	Activity*	Rock	Sand	Sand and stones
254-256	Skateraw and White Sands	Walking		64	
369-370	White Sands	Dog walking		52	
276	Thorntonloch beach	Walking		40	
71-72	White Sands	Bait digging		20	
107-108	Thorntonloch beach	Horse riding		5	
242	Thorntonloch beach/Barns Ness to Skateraw	Walking/Collecting seaweed for fertiliser		4	20
243	Skateraw and Thorntonloch beach	Walking		4	
123	Skateraw and Thorntonloch beach	Walking		3	
222	**Barns Ness, Skateraw and Thorntonloch**	**Dog walking**			**504**
223	**Barns Ness, Skateraw and Thorntonloch**	**Dog walking**			**494**
281	Thorntonloch beach	Walking			84
236	Skateraw Harbour	Dog walking			78

Notes

Emboldened observations are the critical group members

The critical group intertidal occupancy rate over rock based on 10 observations is 977 h/y

The observed 97.5 percentile rate based on 52 observations for rock is 1243 h/y

The critical group intertidal occupancy rate over sand based on 13 observations is 467 h/y

The observed 97.5 percentile rate based on 60 observations for sand is 490 h/y

The critical group intertidal occupancy rate over sand and stones based on 2 observations is 499 h/y

The observed 97.5 percentile rate based on 6 observations for sand and stones is 503 h/y

*The forward slash (/), separates the locations of, and activities taking place on, the separate substrates for that individual

Table 14. Gamma dose rate measurements over intertidal substrates in the Torness area (µGy/h)

Location	NGR	Substrate	Gamma dose rate at 1 metre
North Berwick Harbour	NT 553 856	Mud	0.087
North Berwick beach	NT 553 855	Sand	0.069
Dunbar winkle area	NT 685 787	Rock	0.076
Skateraw beach	NT 738 755	Mud and sand	0.056
Skateraw beach	NT 738 756	Sand	0.054
Torness outfall	NT 754 750	Rock	0.075
Thorntonlock beach	NT 755 745	Sand	0.054
Coldingham beach	NT 918 665	Sand	0.055

Table 15. Handling rates of fishing gear and sediment in the Torness area (h/y)

Observation number	Location*	Activity*	Fishing gear	Sediment
40	**Offshore of St Abbs**	**Creeling**	**1450**	
64	**Offshore of St Abbs**	**Creeling**	**1450**	
132	**Offshore of North Berwick**	**Creeling**	**1408**	
134	**Offshore of North Berwick**	**Creeling**	**1408**	
219	**Offshore of Cove**	**Creeling**	**1404**	
220	**Offshore of Cove**	**Creeling**	**1404**	
347	**Offshore of the coast between Eyemouth and North Berwick**	**Creeling**	**1378**	
349	**Several locations**	**Creeling**	**1375**	
204	**Offshore of Dunbar**	**Creeling**	**1300**	
354	**Several locations**	**Creeling**	**1155**	
355	**Several locations**	**Creeling**	**1155**	
197	**Torness area**	**Creeling**	**858**	
128	**Dunbar**	**Creeling**	**817**	
131	**Dunbar**	**Creeling**	**817**	
351	**Several locations**	**Creeling**	**715**	
352	**Several locations**	**Creeling**	**715**	
196	**Offshore of Torness**	**Creeling**	**630**	
69	**Barns Ness to Torness/Barns Ness**	**Creeling/Collecting winkles**	**620**	**560**
68	Offshore of St Abbs	Creeling	432	
63	Offshore of St Abbs	Creeling	360	
228	Offshore of Dunbar	Creeling	360	
231	Offshore of Dunbar	Creeling	360	
195	Offshore of Dunbar	Creeling	132	
85	Barns Ness	Creeling	110	
213	**Dunbar**	**Collecting winkles**		**1040**
214	**Dunbar**	**Collecting winkles**		**1040**
215	**Near Dunbar lighthouse**	**Collecting winkles**		**690**
217	**Cove foreshore**	**Collecting winkles**		**437**
218	**Cove foreshore**	**Collecting winkles**		**437**
353	Barns Ness to Dunbar	Collecting winkles		260
79	North Berwick and Barns Ness	Collecting winkles		240
73	North Berwick and Barns Ness	Collecting winkles		120
84	Skateraw	Bait digging		84
242	Skateraw	Collecting seaweed		20
16	Thorntonloch beach	Collecting winkles		20
71	White Sands	Bait digging		20
72	White Sands	Bait digging		20
358	Torness outfall and jetty	Collecting winkles		6
359	Torness outfall and jetty	Collecting winkles		6
104	Skateraw	Collecting mussel		2
105	Skateraw	Collecting mussel		2

Notes

Emboldened observations are the critical group members

The critical group fishing gear handling rate based on 18 observations is 1114 h/y

The observed 97.5 percentile rate based on 24 observations for fishing gear is 1450 h/y

The critical group sediment handling rate based on 6 observations is 701 h/y

The observed 97.5 percentile rate based on 17 observations for sediment is 1040 h/y

*The forward slash (/), separates the locations of and activities taking place for that individual

Table 16. Occupancy rates in and on water in the Torness area (h/y)

Observation number	Location	Activity*	In water	On water
39	Eyemouth to St Abb's Head	Diving	210	
160	North Berwick	Diving/Water sports	117	195
26-35	St Abb's Head	Diving	96	
149-159	North Berwick	Diving/Water sports	81	135
348	Dunbar	Swimming/Angling and boating	30	368
114	Coldingham	Kayaking	12	
47	Thorntonloch	Swimming	10	
91	Barns Ness, Skateraw and Thorntonloch	Swimming	6	
115	Coldingham	Kayaking	5	
116	North Berwick	Diving/Working on a boat and angling	5	112
105	Thorntonloch/Dunglass, Eyemouth to Dunbar	Swimming/Creeling on the rocks and bird watching boat trips	1	16
104	Thorntonloch/Eyemouth to Dunbar	Swimming/Bird watching boat trips	1	12
228, 231	Offshore of Dunbar	Creeling		2206
347	Offshore of coast between Eyemouth and North Berwick	Creeling		1950
40, 64	Offshore of St Abbs	Creeling		1848
354-355	Offshore of various locations	Creeling/Charter boat skipper		1685
219-220	Offshore of Cove	Creeling		1638
349	Offshore of various locations	Creeling		1625
204	Offshore of Dunbar	Creeling		1560
132, 134	Offshore of North Berwick	Creeling		1408
196	Offshore of Torness	Working on a boat/Creeling		1144
41	Offshore of St Abb's Head	Charter boat skipper		960
197	Offshore of Torness	Creeling		858
351-352	Offshore of various locations	Creeling		845
128, 131	Offshore of Dunbar	Creeling		817
63, 68	Offshore of St Abbs	Creeling		720
25	Offshore of St Abbs	Charter boat skipper		680
69	Barns Ness to Torness	Wading		620
136	Offshore of North Berwick	Angling		382
135	Offshore of North Berwick	Charter boat skipper		300

Table 16. Occupancy rates in and on water in the Torness area (h/y)

Observation number	Location	Activity*	In water	On water
195	Offshore of Dunbar	Angling		264
374-383	Offshore of North Berwick	Sailing		260
85	Barns Ness	Wading		220
65-67	Offshore of St Abbs	Angling		200
23	Offshore of St Abbs	Angling		160
313	Offshore of various locations	Angling		156
137	North Berwick	Canoeing		150
163-164	Pease Bay/Dunbar	Jet skiing/Angling		116
138	North Berwick	Canoeing		100
336, 337	Offshore of the coast between Skateraw and Dunbar	Angling		96
162	Offshore of Dunbar	Angling		60
38	Offshore of the coast between Eyemouth and Dunbar	Sailing		50
139-148	North Berwick	Canoeing		50
71, 72	Offshore of Eyemouth	Angling		40
310	Offshore of North Berwick	Angling		40
317, 323	Offshore of Thorntonloch	Angling		40
325, 331	Offshore of Thorntonloch	Angling		40
111-113	Coldingham	Wading		18
283	Offshore of Dunbar	Angling		6
356-357	Offshore of North Berwick	Sailing		6

*The forward slash (/), separates the locations of, and activities taking place in or on water for that individual

Table 17. Adults' consumption rates of green vegetables in the Torness area (kg/y)

Observation number	Artichoke	Asparagus	Broccoli	Brussel sprout	Cabbage	Cauliflower	Courgettes	Cucumber	Herbs	Lettuce	Pak choi	Spinach	Total
122-123				**5.5**	**8.5**	**4.1**		**5.1**		**0.3**			**23.4**
104-105			**2.0**				**11.0**	**8.5**		**0.1**			**21.7**
59-62		**1.3**	**1.0**	**2.5**		**2.5**	**2.5**			**1.3**		**2.0**	**13.0**
242-243				**6.8**	**4.6**	**5.6**				**4.5**			**21.5**
91	**7.2**						**5.5**						**12.8**
235-238			**1.5**	**0.3**	**2.4**	**1.9**	**1.1**	**1.2**		**0.8**			**9.3**
240-241			**1.5**	**0.3**	**2.4**	**1.9**	**1.1**	**1.2**		**0.8**			**9.3**
3-6					6.1								6.1
90							5.5						5.5
1-2				1.5				4.0					5.5
224						0.7		3.0					3.7
225						0.7		3.0					3.7
226						0.7		3.0					3.7
227						0.7		3.0					3.7
247											2.5	0.9	3.4
248											2.5	0.9	3.4
222							1.8						1.8
223							1.8						1.8
10				1.7									1.7
11				1.7									1.7
12				1.7									1.7
13				1.7									1.7
14				1.7									1.7
15				1.7									1.7
82									0.2				0.2
83									0.2				0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the 17 highest adult consumers is 14.9 kg/y

The observed 97.5 percentile rate based on 40 observations is 23.4 kg/y

Table 18. Adults' consumption rates of other vegetables in the Torness area (kg/y)

Observation number	Broad bean	Chilli pepper	French bean	Mange tout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
242-243	**13.7**				**20.3**		**32.6**		**19.8**	**86.3**
122-123									**59.0**	**59.0**
90-91	**2.3**		**1.8**				**6.8**	**2.3**	**32.4**	**45.6**
104-105		**1.8**	**1.4**	**0.2**				**1.8**	**34.2**	**39.4**
59-62	**10.0**		**10.0**		**5.0**		**10.0**			**35.0**
224-227	2.5				2.5		7.5		3.4	15.9
235-238	0.9		0.9		1.4		0.9	1.0	2.3	7.3
240-241	0.9		0.9		1.4		0.9	1.0	2.3	7.3
1-2						1.0			5.0	6.0
3-6									5.4	5.4
222-223	1.5						1.5			2.9
55-58	1.7									1.7
247-248					0.02					0.02

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of other vegetables based on the 12 highest adult consumers is 50.0 kg/y

The observed 97.5 percentile rate based on 36 observations is 86.3 kg/y

Table 19. Adults' consumption rates of root vegetables in the Torness area (kg/y)

Observation number	Artichoke	Beetroot	Carrot	Celery	Fennel	Garlic	Leek	Onion	Parsnip	Shallot	Spring onion	Swede	Turnip	Total
242		**6.2**	**13.5**	**0.8**			**10.1**	**28.8**	**5.4**	**4.8**			**4.1**	**73.7**
243		**6.2**	**13.5**	**0.8**			**10.1**	**28.8**	**5.4**	**4.8**			**4.1**	**73.7**
104	**10.9**	**0.5**	**4.5**		**1.4**	**2.2**	**3.0**	**2.2**	**1.8**					**26.4**
105	**10.9**	**0.5**	**4.5**		**1.4**	**2.2**	**3.0**	**2.2**	**1.8**					**26.4**
224-227		4.5	5.0				5.0	6.6	1.3				2.0	24.5
55-58		3.1						13.5	5.4		0.8			22.7
122-123							5.0	16.5						21.5
59-62			8.0				5.0	5.0		2.5				20.5
235-238		1.1	1.3			0.1	5.6	4.5	0.2			1.6	1.2	15.6
240-241		1.1	1.3			0.1	5.6	4.5	0.2			1.6	1.2	15.6
3-6			4.5					7.2				2.5		14.2
222-223								1.4	2.6				6.8	10.8
247-248			3.4		0.6			5.5						9.5
261-263													8.3	8.3
90-91								7.0						7.0
364-368												4.6		4.6
1-2													2.5	2.5
10-15													1.7	1.7
232-234								1.5						1.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of root vegetables based on the 4 highest adult consumers is 50.0 kg/y

The observed 97.5 percentile rate based on 53 observations is 59.5 kg/y

Table 20. Adults' consumption rates of potato in the Torness area (kg/y)

Observation number	Potato
261	**150.0**
262	**150.0**
263	**150.0**
259	**101.6**
260	**101.6**
59	**100.0**
60	**100.0**
61	**100.0**
62	**100.0**
51	**75.0**
54	**75.0**
90	**74.6**
91	**74.6**
223	**70.8**
364	**60.0**
365	**60.0**
366	**60.0**
367	**60.0**
368	**60.0**
104	**59.2**
105	**59.2**
224-227	44.5
52-53	37.5
55-58	36.4
235-238	29.5
240-241	29.5
242-243	27.3
232	24.3
233	24.3
234	24.3
3-6	18.2
246	12.1
247	5.1
248	5.1
10-15	3.3
1	2.5
2	2.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of potato based on the 21 highest adult consumers is 87.7 kg/y

The observed 97.5 percentile rate based on 57 observations is 150.0 kg/y

Table 21. Adults' consumption rates of domestic fruit in the Torness area (kg/y)

Observation number	Apple	Blackberry	Blackcurrant	Cherry	Gooseberry	Grapes	Loganberry	Melon	Peach	Pear	Plum	Raspberry	Redcurrant	Rhubarb	Strawberry	Tayberry	Total
104	**2.7**		**7.9**	**0.5**				**1.5**		**3.2**		**4.5**		**2.7**	**13.6**		**36.6**
105	**2.7**		**7.9**	**0.5**				**1.5**		**3.2**		**4.5**		**2.7**	**13.6**		**36.6**
59	**12.5**	**2.5**					**0.6**			**2.0**	**2.5**	**3.8**		**1.5**	**3.8**	**0.6**	**29.6**
60	**12.5**	**2.5**					**0.6**			**2.0**	**2.5**	**3.8**		**1.5**	**3.8**	**0.6**	**29.6**
61	**12.5**	**2.5**					**0.6**			**2.0**	**2.5**	**3.8**		**1.5**	**3.8**	**0.6**	**29.6**
62	**12.5**	**2.5**					**0.6**			**2.0**	**2.5**	**3.8**		**1.5**	**3.8**	**0.6**	**29.6**
122	**9.1**										**9.1**	**11.3**					**29.5**
123	**9.1**										**9.1**	**11.3**					**29.5**
223														**27.4**			**27.4**
82	**13.6**										**8.5**						**22.1**
83	**13.6**										**8.5**						**22.1**
90	**0.7**										**0.7**	**5.4**		**1.1**	**8.2**		**16.1**
91	**0.7**										**0.7**	**5.4**		**1.1**	**8.2**		**16.1**
224	**4.5**		**2.1**		**1.0**						**1.1**	**2.0**	**1.1**	**0.1**	**2.4**		**14.5**
225	**4.5**		**2.1**		**1.0**						**1.1**	**2.0**	**1.1**	**0.1**	**2.4**		**14.5**
226	**4.5**		**2.1**		**1.0**						**1.1**	**2.0**	**1.1**	**0.1**	**2.4**		**14.5**
227	**4.5**		**2.1**		**1.0**						**1.1**	**2.0**	**1.1**	**0.1**	**2.4**		**14.5**
1	**5.0**					**1.0**		**2.5**		**3.5**					**2.5**		**14.5**
2	**5.0**					**1.0**		**2.5**		**3.5**					**2.5**		**14.5**
264												**12.9**					**12.9**
265												**12.9**					**12.9**
106-107	3.8									0.2	2.3						6.4
261-263	3.0										1.5			0.8			5.3
240-241	0.4		0.1	0.4		1.3			0.1		0.3			0.1	0.4		3.2
235-238	0.4		0.1	0.4		1.3			0.1		0.3			0.1	0.4		3.2
362-363			0.7												0.7		1.4
247-248														1.2			1.2
242-243	0.2																0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the 21 highest adult consumers is 22.3 kg/y

The observed 97.5 percentile rate based on 38 observations is 36.6 kg/y

Table 22. Adults' consumption rates of cattle meat in the Torness area (kg/y)

Observation number	Beef
251-252	**31.5**
369-372	**18.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the 6 highest adult consumers is 23.1 kg/y
The observed 97.5 percentile rate based on 6 observations is 31.5 kg/y

Table 23. Adults' consumption rates of pig meat in the Torness area (kg/y)

Observation number	Pork
264-265	**50.6**
270-273	**30.0**
266-267	7.5

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of pig meat based on the 6 highest adult consumers is 36.9 kg/y
The observed 97.5 percentile rate based on 8 observations is 50.6 kg/y

Table 24. Adults' consumption rates of sheep meat in the Torness area (kg/y)

Observation number	Lamb
251-252	**22.6**
104-105	**11.3**
369-372	**11.3**
261-263	3.8
10-15	1.9

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the 8 highest adult consumers is 14.1 kg/y
The observed 97.5 percentile rate based on 17 observations is 22.6 kg/y

Table 25. Adults' consumption rates of poultry in the Torness area (kg/y)

Observation number	Partridge	Pheasant	Total
59	**1.8**	**2.7**	**4.5**
261-262	**0.3**	**2.3**	**2.6**
364-365		**2.3**	**2.3**
367-368		**2.3**	**2.3**
235, 241	**0.9**	**0.7**	**1.6**
52-53		1.4	1.4
106		1.4	1.4
242-243		0.9	0.9
1-2		0.45	0.45
264-265		0.5	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of poultry based on the 9 highest adult consumers is 2.4 kg/y

The observed 97.5 percentile rate based on 18 observations is 3.7 kg/y

Table 26. Adults' consumption rates of eggs in the Torness area (kg/y)

Observation number	Chicken egg	Duck egg	Total
264-265	**17.8**		**17.8**
104-105	**8.9**		**8.9**
3-6	**8.6**		**8.6**
82-83		**8.1**	**8.1**
235-238	5.1		5.1
240-241	5.1		5.1
55-58	4.1		4.1
59-60	3.1		3.1
1-2	1.0		1.0

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of eggs based on the 10 highest adult consumers is 10.4 kg/y

The observed 97.5 percentile rate based on 24 observations is 17.8 kg/y

Table 27. Adults' consumption rates of wild/free foods in the Torness area (kg/y)

Observation number	Blackberry	Crab apple	Hazel nuts	Total
364	**2.3**		**3.8**	**6.0**
51, 54	**2.5**			**2.5**
365-368	**2.3**			**2.3**
52-53	1.5			1.5
104-105	1.4			1.4
82-83		1.1		1.1
222-223	1.1			1.1
242-243	1.1			1.1
1-2	0.5			0.5
224-227	0.5			0.5
90-91	0.2			0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild/free foods based on the 7 highest adult consumers is 2.9 kg/y

The observed 97.5 percentile rate based on 25 observations is 3.9 kg/y

Table 28. Adults' consumption rates of rabbits/hares in the Torness area (kg/y)

Observation number	Rabbit
235-236	**1.4**
264-265	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of rabbits/hares based on the 2 highest adult consumers is 1.4 kg/y

The observed 97.5 percentile rate based on 4 observations is 1.4 kg/y

Table 29. Adults' consumption rates of honey in the Torness area (kg/y)

Observation number	Honey
122-125	**11.8**
82-83	**8.2**
126-127	2.7
1-2	0.5
104-105	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of honey based on the 6 highest adult consumers is 10.6 kg/y

The observed 97.5 percentile rate based on 12 observations is 11.8 kg/y

Table 30. Adults' consumption rates of wild fungi in the Torness area (kg/y)

Observation number	Mushrooms
364	**2.0**
104-105	**1.4**
59	**0.9**
261-262	**0.7**
264-265	0.5
1-2	0.2
242-243	0.2
235-238	0.2
240-241	0.2
222-223	0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild fungi based on the 6 highest adult consumers is 1.2 kg/y

The observed 97.5 percentile rate based on 20 observations is 1.7 kg/y

Table 31. Adults' consumption rates of venison in the Torness area (kg/y)

Observation number	Venison
261-263	**4.0**
59	0.9
235-237	0.5
241	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of venison based on the 3 highest adult consumers is 4.0 kg/y

The observed 97.5 percentile rate based on 8 observations is 4.0 kg/y

Table 32. Children's consumption rates of green vegetables in the Torness area (kg/y)

15 year old age group

Observation number	Age	Broccoli	Brussel sprout	Cabbage	Cauliflower	Courgette	Cucumber	Lettuce	Pak choi	Spinach	Total
239	**14**	**1.5**	**0.3**	**2.4**	**1.9**	**1.1**	**1.2**	**0.8**			**9.3**
249	**16**								**2.5**	**0.9**	**3.4**
250	**14**								**2.5**	**0.9**	**3.4**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of green vegetables based on the 3 highest 15 year old age group consumers is 5.3 kg/y
The observed 97.5 percentile rate based on 3 observations is 9.0 kg/y

Table 33. Children's consumption rates of other vegetables in the Torness area (kg/y)

15 year old age group

Observation number	Age	Broad bean	French bean	Pea	Runner bean	Sweetcorn	Tomato	Total
239	**14**	**0.9**	**0.9**	**1.4**	**0.9**	**1.0**	**2.3**	**7.3**
249	16			0.02				0.02
250	14			0.02				0.02

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of other vegetables based on the highest 15 year old age group consumer is 7.3 kg/y
The observed 97.5 percentile rate based on 3 observations is 7.0 kg/y

Table 34. Children's consumption rates of root vegetables in the Torness area (kg/y)

15 year old age group

Observation number	Age	Beetroot	Carrot	Fennel	Garlic	Leek	Onion	Parsnip	Swede	Turnip	Total
239	**14**	**1.1**	**1.3**		**0.1**	**5.6**	**4.5**	**0.2**	**1.6**	**1.2**	**15.6**
249	**16**		**3.4**	**0.6**			**5.5**				**9.5**
250	**14**		**3.4**	**0.6**			**5.5**				**9.5**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of root vegetables based on the 3 highest 15 year old age group consumers is 11.5 kg/y
The observed 97.5 percentile rate based on 3 observations is 15.3 kg/y

Table 35. Children's consumption rates of potato in the Torness area (kg/y)

15 year old age group

Observation number	Age	Potato
239	**14**	**29.5**
249	16	5.1
250	14	5.1

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of potato based on the highest 15 year old age group consumer is 29.5 kg/y
The observed 97.5 percentile rate based on 3 observations is 28.3 kg/y

Table 36. Children's consumption rates of domestic fruit in the Torness area (kg/y)

15 year old age group

Observation number	Age	Apple	Blackcurrant	Cherry	Grapes	Peach	Pear	Plum	Rhubarb	Strawberry	Total
108	**16**	**3.8**					**0.2**	**2.3**			**6.4**
239	**14**	**0.4**	**0.1**	**0.4**	**1.3**	**0.1**		**0.3**	**0.1**	**0.4**	**3.2**
249	16								1.2		1.2
250	14								1.2		1.2

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of domestic fruit based on the 2 highest 15 year old age group consumers is 4.8 kg/y
The observed 97.5 percentile rate based on 4 observations is 6.1 kg/y

Table 37. Children's consumption rates of cattle meat in the Torness area (kg/y)

15 year old age group

Observation number	Age	Beef
373	**14**	**18.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the only 15 year old age group consumer is 18.9 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 38. Children's consumption rates of pig meat in the Torness area (kg/y)

10 year old age group

Observation number	Age	Pork
268	**10**	**7.5**
269	**7**	**7.5**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of pig meat based on the 2 highest 10 year old age group consumers is 7.5 kg/y
The observed 97.5 percentile rate based on 2 observations is 7.5 kg/y

Table 39. Children's consumption rates of sheep meat in the Torness area (kg/y)

15 year old age group

Observation number	Age	Lamb
373	**14**	**11.3**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the only 15 year old age group consumer is 11.3 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 40. Children's consumption rates of eggs in the Torness area (kg/y)

15 year old age group

Observation number	Age	Chicken egg
239	**14**	**5.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of eggs based on the only 15 year old age group consumer is 5.1 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 41. Children's consumption rates of wild fungi in the Torness area (kg/y)

15 year old age group

Observation number	Age	Mushrooms
239	**14**	**0.2**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild fungi based on the only 15 year old age group consumer is 0.2 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 42. Percentage contribution each food type makes to its terrestrial food group for adults

Domestic fruit		**Root vegetables**		**Eggs**	
Apple	28.8 %	Onion	36.1 %	***Chicken egg***	89.8 %
Raspberry	17.6 %	Carrot	15.3 %	Duck egg	10.2 %
Strawberry	14.7 %	Leek	14.0 %		
Plum	12.0 %	***Turnip***	9.8 %	**Wild/free foods**	
Rhubarb	9.0 %	Beetroot	6.4 %		
Blackcurrant	5.1 %	Parsnip	6.1 %	***Blackberry***	83.2 %
Pear	4.2 %	Swede	5.4 %	Hazel nuts	10.5 %
Blackberry	1.9 %	Artichoke	2.8 %	Crab apple	6.3 %
Grapes	1.9 %	Shallot	2.5 %		
Melon	1.5 %	Garlic	0.6 %	**Poultry**	
Redcurrants	0.9 %	Fennel	0.5 %		
Gooseberry	0.8 %	Spring onion	0.4 %	Pheasant	85.7 %
Cherry	0.6 %	Celery	0.2 %	Partridge	14.3 %
Tayberry	0.4 %				
Loganberry	0.4 %	**Green vegetables**		**Rabbits/hares**	
Peach	0.1 %				
		Cabbage	19.7 %	Rabbit	100.0 %
Other vegetables		Cucumber	16.5 %		
		Courgettes	16.1 %		
Tomato	46.3 %	Brussel sprout	15.0 %	**Wild fungi**	
Runner bean	20.9 %	Cauliflower	13.3 %		
Broad bean	12.9 %	Lettuce	6.0 %	Mushrooms	100.0 %
Pea	10.4 %	Broccoli	5.2 %		
French bean	6.9 %	Spinach	2.9 %		
Sweetcorn	1.9 %	Artichoke	2.2 %		
Chilli pepper	0.5 %	Asparagus	1.5 %		
Pepper	0.3 %	Pak choi	1.5 %		
Mangetout	0.1 %	Herbs	0.1 %		

Notes

Food types in emboldened italics were monitored by FSA in 2005 (EA, EHS, FSA and SEPA, 2006).
Other foods monitored were cows' milk, goats' milk, potatoes, cheese, elderberry, rowanberry, spring greens and wheat.
Percentages are based on the consumption of all adults in the survey consuming that particular food group.

Table 43. Occupancy rates in the Torness direct radiation survey area (h/y)

Observation number	Sex	Age in years (U if unknown)	Indoor occupancy (h/y)	Outdoor occupancy (h/y)	Total occupancy (h/y)
Adult observations					
362	F	78	8500	104	8604
246	F	86	7489	915	8404
46	F	49	7387	645	8032
363	F	55	7598	104	7702
90	M	60	6128	1360	7488
223	F	56	6425	987	7412
91	F	59	5188	820	6008
222	M	50	4764	1008	5772
7	F	83	4610	640	5250
45	F	U	4000	440	4440
276	F	63	2700	560	3260
277	M	69	2700	560	3260
280	F	U	2700	560	3260
8	M	U	2900	200	3100
9	F	U	2260	840	3100
43	F	U	2280	360	2640
44	M	U	2280	360	2640
274	F	64	1954	684	2638
278	M	56	1554	630	2184
279	F	60	1804	380	2184
197	M	66		1840	1840
317	M	59	1083	285	1368
318	F	58	1083	285	1368
323	M	60	1083	285	1368
324	F	U	1083	285	1368
325	M	58	1083	285	1368
326	F	U	1083	285	1368
331	M	64	1083	285	1368
332	F	U	1083	285	1368
18	M	U		1320	1320
16	M	58		1000	1000
284	M	48		960	960
244	M	U		936	936
245	F	U		936	936
196	M	45		920	920
199	M	U		920	920
257	M	U		915	915
258	M	U		915	915
297	M	50		728	728
69	M	38		700	700
360	M	56	476	100	576
361	F	60	440	100	540
49	M	33		500	500
50	M	30		500	500
314	M	49		432	432
315	M	21		432	432

Table 43. Occupancy rates in the Torness direct radiation survey area (h/y)

Observation number	Sex	Age in years (U if unknown)	Indoor occupancy (h/y)	Outdoor occupancy (h/y)	Total occupancy (h/y)
316	M	18		432	432
311	M	44		160	160
123	F	58		156	156
36	M	42		144	144
296	M	41		140	140
104	F	47		112	112
235	M	59		108	108
236	F	45		78	78
21	M	38		70	70
22	M	42		70	70
105	M	42		60	60
80	M	U		40	40
282	M	32		24	24
313	M	54		18	18
364	M	U		12	12
92	M	53		8	8
95	M	52		8	8
100	M	47		8	8
283	M	44		6	6
358	M	35		6	6
359	M	35		6	6
107	F	40		5	5
242	M	71		4	4
243	F	71		4	4
310	M	54		4	4
Child observations					
47	F	16	6095	150	6245
48	F	15	6095	150	6245
275	F	9	1080	360	1440
281	F	15	808	200	1008
312	M	14		160	160
37	M	10		144	144
108	F	16		5	5

Table 44. Gamma dose rate measurements (µGy/h)

Residences

Location	Indoor substrate	µGy/h	Outdoor substrate	µGy/h
Residence 1	Concrete	0.073	Grass	0.078
Residence 2	Inside caravan	0.061	N/M	N/M
Residence 3	Inside caravan	0.054	Grass	0.055
Residence 4	Inside caravan	0.053	N/M	N/M
Residence 5	Inside caravan	0.054	N/M	N/M
Residence 6	Wood	0.076	Grass	0.071
Residence 7	Concrete	0.110	Grass	0.080
Residence 8	Tiles	0.095	Grass	0.080
Residence 9	Concrete	0.111	Grass	0.067

Comparison background gamma dose rates

Location	NGR	Substrate	µGy/h
North Berwick golf course	NT 568 854	Rough grass	0.066
Near Innerwick Village	NT 697 735	Grass	0.090
Ecclaw Hill	NT 759 682	Grass	0.070

N/M = Not measured

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
1	M	U				5.5	6.0	2.5	2.5	**14.5**				0.5	1.0	0.5		0.5	0.2										
2	F	U				5.5	6.0	2.5	2.5	**14.5**				0.5	1.0	0.5		0.5	0.2										
3	M	52				6.1	5.4	14.2	18.2						**8.6**														
4	F	50				6.1	5.4	14.2	18.2						**8.6**														
5	M	25				6.1	5.4	14.2	18.2						**8.6**														
6	M	23				6.1	5.4	14.2	18.2						**8.6**														
7	F	83																				100						4610	640
8	M	U																										2900	200
9	F	U																										2260	840
10	F	U				1.7		1.7	3.3				1.9																
11-15	U	U				1.7		1.7	3.3				1.9																
16	M	58	**22.6**		2.7																**1000**				20				1000
17	M	34	**22.6**		2.7																								
18	M	U																			**1320**								1320
19	M	56																				100							
20	F	55																				100							
21	M	38	15.0																		140								70
22	M	42																			70								70
23	M	62	11.1																								160		
24	F	U	11.1																										
25	M	U																									680		
26	U	U																								96			
27-35	M	U																								96			
36	M	42																				144							144
38	M	62																									50		
39	M	U																								210			
40	M	U																						**1450**			1848		
41	M	U		2.1																							960		
42	F	U		2.1																									

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
43	F	U																				120						2280	360
44	M	U																				120						2280	360
45	F	U																										4000	440
46	F	49																										7387	645
49	M	33	4.3																		500								500
50	M	30																			500								500
51	M	62							**75.0**							**2.5**													
52	M	56							37.5					1.4		1.5													
53	F	51							37.5					1.4		1.5													
54	F	61							**75.0**							**2.5**													
55	M	U					1.7	22.7	36.4						4.1														
56	F	U					1.7	22.7	36.4						4.1														
57	M	U					1.7	22.7	36.4						4.1														
58	M	U					1.7	22.7	36.4						4.1														
59	M	U				**13.0**	**35.0**	20.5	**100.0**	**29.6**				**4.5**	3.1				**0.9**	0.9									
60	F	U				**13.0**	**35.0**	20.5	**100.0**	**29.6**					3.1														
61	M	70				**13.0**	**35.0**	20.5	**100.0**	**29.6**																			
62	F	68				**13.0**	**35.0**	20.5	**100.0**	**29.6**																			
63	M	U		5.4																				360			720		
64	M	U		4.2																				**1450**			1848		
65-67	M	U																									200		
68	M	U																						432			720		
69	M	38		12.9																	**1570**			**620**	**560**		620		700
71	M	45	9.9																			20			20		40		
72	M	45	9.9																			20			20		40		
73	M	25			**9.0**																120				120				
74-78	U	U			**9.0**																								
79	M	U																			240				240				
80	M	U																			120								40

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
81	F	U	8.5																										
82	M	U				0.2				**22.1**					**8.1**	1.1		**8.2**											
83	F	U				0.2				**22.1**					**8.1**	1.1		**8.2**											
84	M	58	8.7																		380	84			84				
85	M	U		**15.5**																	456			110			220		
86-89	U	U		**15.5**																									
90	M	60				5.5	**45.6**	7.0	**74.6**	**16.1**						0.2						350						6128	1360
91	F	59				**12.8**	**45.6**	7.0	**74.6**	**16.1**						0.2						100				6		5188	820
92	M	53	0.7																		8								8
93	F	51	0.7																										
94	F	25	0.7																										
95	M	52	0.4																		8								8
96	F	42	0.4																										
97	F	32	0.4																										
98	F	26	0.4																										
99	F	22	0.4																										
100	M	47	0.5																		8								8
101	F	47	0.5																										
102	M	17	0.5																										
104	F	47	9.2	3.1	0.1	**21.7**	**39.4**	**26.4**	**59.2**	**36.6**			**11.3**		**8.9**	1.4		0.5	**1.4**		32	136			2	1	12		112
105	M	42	9.2	3.1	0.1	**21.7**	**39.4**	**26.4**	**59.2**	**36.6**			**11.3**		**8.9**	1.4		0.5	**1.4**		32	6			2	1	16		60
106	M	41								6.4				1.4															
107	F	40								6.4												5							5
109	F	19																				90							
111	F	30																				72					18		
114	M	19																				100	6			12			
115	M	20																				100				5			
116	M	U	13.4	1.8																						5	112		
117-118	M	U	13.4																										

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
119-121	F	U	13.4																										
122	M	59		0.8		**23.4**	**59.0**	21.5		**29.5**								**11.8**											
123	F	58		0.8		**23.4**	**59.0**	21.5		**29.5**								**11.8**				3						156	
124	F	31																**11.8**											
125	M	33																**11.8**											
126	F	35																2.7											
127	M	38																2.7											
128	M	41		12.3																				**817**			817		
131	M	38																						**817**			817		
132	M	65		1.6																				**1408**			1408		
133	F	65		1.6																									
134	M	68																						**1408**			1408		
135	M	55	**47.2**	0.2																							300		
136	M	64	10.6	1.9																							382		
137	M	U																									150		
138	M	U																									100		
139-143	M	U																									50		
144-148	F	U																									50		
149	M	36		2.6																						81	135		
150-154	M	U																								81	135		
155-159	F	U																								81	135		
160	M	U		5.6																						117	195		
161	F	U		5.6																									
162	M	50	**28.7**																								60		
163	M	45	**28.7**																								116		
164	M	28	**28.7**																								116		
165	F	28	**28.7**																										
166	F	50	**28.7**																										
167	F	45	**28.7**																										

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
169-171	M	U																				**365**							
172-173	F	U																				**365**							
174	M	19	9.0																		91								
175	M	18	9.0																										
176	M	U	9.0																										
177	F	U	9.0																										
178	M	43	7.6																		**720**								
179	F	43	7.6																										
181	M	47	**24.2**																		**945**								
184	M	49	0.7																		80								
185	F	49	0.7																										
187	M	41	1.3																		72								
188	F	40	1.3																										
190	M	U	1.3																										
191	M	54	**24.5**																		140								
192	F	52	**24.5**																										
193	M	U	**24.5**																										
194	F	U	**24.5**																										
195	M	55	**22.5**	12.9																				132			264		
196	M	45																						**630**			1144		920
197	M	66		**43.3**																				**858**			858		1840
198	F	64		**43.3**																									
199	M	U																											920
200	M	29	17.3																		208								
201	M	42	0.7																		312								
202	F	42	0.7																										
204	M	30																						**1300**			1560		
205	M	52		4.0																									
206	F	51		4.0																									

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
207	M	32		4.0																									
208	M	43																			113								
209	M	39																			113								
210	M	22																			113								
211	M	56			**4.5**																								
212	F	55			**4.5**																								
213	M	61	**21.3**		**7.4**																**1040**				**1040**				
214	M	28																			**1040**				**1040**				
215	M	67																			**690**				**690**				
216	M	57																				**1070**							
217	M	40																			437				**437**				
218	F	40																			437				**437**				
219	M	65		7.5																				**1404**			1638		
220	M	38	10.1	**15.6**																				**1404**			1638		
221	F	38	10.1	**15.6**																									
222	M	50				1.8	2.9	10.8								1.1			0.1				**504**					4764	1008
223	F	56				1.8	2.9	10.8	**70.8**	**27.4**						1.1			0.1				**494**					6425	987
224	M	64				3.7	15.9	24.5	44.5	**14.5**						0.5													
225	F	60				3.7	15.9	24.5	44.5	**14.5**						0.5													
226	M	40				3.7	15.9	24.5	44.5	**14.5**						0.5													
227	M	39				3.7	15.9	24.5	44.5	**14.5**						0.5													
228	M	51	16.8	10.2																		**480**		360			2206		
229	F	50	16.8	10.2																									
230	F	23	16.8	10.2																									
231	M	27																						360			2206		
232	M	63						1.5	24.3																				
233	F	59						1.5	24.3																				
234	M	30						1.5	24.3																				
235	M	59	12.8	1.4		**9.3**	7.3	15.6	29.5	3.2				**1.6**	5.1		**1.4**		0.2	0.5	108								108

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
236	F	45		0.1		**9.3**	7.3	15.6	29.5	3.2					5.1		**1.4**		0.2	0.5			78						78
237	F	19		0.1		**9.3**	7.3	15.6	29.5	3.2					5.1				0.2	0.5									
238	F	17		0.1		**9.3**	7.3	15.6	29.5	3.2					5.1				0.2										
240	M	20		0.1		**9.3**	7.3	15.6	29.5	3.2					5.1				0.2										
241	M	25	12.8	0.1		**9.3**	7.3	15.6	29.5	3.2				**1.6**	5.1				0.2	0.5									
242	M	71				**21.5**	**86.3**	**73.7**	27.3	0.2				0.9		1.1			0.2			4	20		20				4
243	F	71				**21.5**	**86.3**	**73.7**	27.3	0.2				0.9		1.1			0.2			4							4
244	M	U																											936
245	F	U																											936
246	F	86							12.1																			7489	915
247	M	43				3.4	0.02	9.5	5.1	1.2																			
248	F	41				3.4	0.02	9.5	5.1	1.2																			
251	M	U									**31.5**		**22.6**																
252	F	U									**31.5**		**22.6**																
253	M	U	0.5																		30	32							
254	F	U	0.5																			64							
257	M	U																											915
258	M	U																											915
259	M	80							**101.6**																				
260	F	75							**101.6**																				
261	M	52						8.3	**150.0**	5.3			3.8	**2.6**					**0.7**	**4.0**									
262	F	48						8.3	**150.0**	5.3			3.8	**2.6**					**0.7**	**4.0**									
263	M	22						8.3	**150.0**	5.3			3.8							**4.0**									
264	M	37								**12.9**		**50.6**		0.5	**17.8**		0.5		0.5										
265	M	33								**12.9**		**50.6**		0.5	**17.8**		0.5		0.5										
266	M	40										7.5																	
267	F	40										7.5																	
270	F	U										**30.0**																	
271	F	U										**30.0**																	

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
272	F	U										**30.0**																	
273	M	33										**30.0**																	
274	F	64																				70						1954	684
276	F	63	2.6																			40						2700	560
277	M	69	2.6																		60	40						2700	560
278	M	56	1.9	0.1																	156							1554	630
279	F	60	1.9																									1804	380
280	F	U	0.3																									2700	560
282	M	32																			24								24
283	M	44																			6						6		6
284	M	48	2.1	0.4																	**720**	240							960
285-289	M	U		0.4																									
290-295	F	U		0.4																									
296	M	41																			70	70							140
297	M	50	8.0																		**728**								728
298	F	U	8.0																										
299	F	U	8.0																										
300	M	U	8.0																										
301	F	U	8.0																										
304	M	U	8.0																										
305	F	U	8.0																										
307	F	U	8.0																										
310	M	54	6.3																		4						40		4
311	M	44	6.8																		160								160
313	M	54	**63.6**																		18	12					156		18
314	M	49	0.9																			162							432
315	M	21	0.9																			162							432
316	M	18	0.9																			162							432
317	M	59	3.2																								40	1083	285

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
318	F	58	3.2																									1083	285
319	M	38	3.2																										
320	M	27	3.2																										
321	F	23	3.2																										
322	M	26	3.2																										
323	M	60	9.6																								40	1083	285
324	F	U	9.6																									1083	285
325	M	58	3.2																								40	1083	285
326	F	U	3.2																									1083	285
328	F	U	3.2																										
331	M	64	3.8																								40	1083	285
332	F	U	3.8																									1083	285
333	M	40	3.8																										
334	F	34	3.8																										
335	M	32	3.8																										
336	M	42																			80						96		
338	F	85	19.7																										
339	M	42																				156							
340	F	40																				156							
342	F	42																				**490**							
343	F	37																				**490**							
346	M	65	2.7																										
347	M	53																						**1378**			1950		
349	M	55		1.7																				**1375**			1625		
350	F	52		1.7																									
351	M	55																						**715**			845		
352	M	18																						**715**			845		
353	M	40																			260				260				
354	M	58		1.9																				**1155**			1685		

Annex 1. Adults' consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
355	M	51		1.9																				**1155**			1685		
356	M	U	4.2																			**365**					6		
357	F	U	4.2																			**365**					6		
358	M	35	1.3		0.1																6				6				6
359	M	35	1.3		0.1																6				6				6
360	M	56	6.4																		90							476	100
361	F	60	6.4																									440	100
362	F	78								1.4																		8500	104
363	F	55								1.4																		7598	104
364	M	U						4.6	**60.0**					**2.3**		**6.0**			**2.0**										12
365	F	U						4.6	**60.0**					**2.3**		**2.3**													
366	M	27						4.6	**60.0**							**2.3**													
367	F	26						4.6	**60.0**					**2.3**		**2.3**													
368	M	22						4.6	**60.0**					**2.3**		**2.3**													
369	M	45									**18.9**		**11.3**									52							
370	F	48									**18.9**		**11.3**									52							
371	M	21									**18.9**		**11.3**																
372	M	19									**18.9**		**11.3**																
374-383	U	U																									260		

Notes

Emboldened observations are rates included in the critical groups.

Annex 2. Children's consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex	Age in years	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Eggs	Wild fungi	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
15 year old age group																						
47	F	16															90		10		6095	150
48	F	15															90				6095	150
103	F	15	0.5																			
108	F	16								**6.4**							5					5
129	M	12		**12.3**																		
182	F	14	**24.2**																			
183	F	12	**24.2**																			
186	F	12	0.7																			
189	M	14	1.3																			
239	F	14		0.1		**9.3**	**7.3**	**15.6**	**29.5**	**3.2**				**5.1**	**0.2**							
249	M	16				**3.4**	0.02	**9.5**	5.1	1.2												
250	M	14				**3.4**	0.02	**9.5**	5.1	1.2												
281	F	15																84			808	200
302	M	16	8.0																			
303	M	14	8.0																			
312	M	14														160						160
327	M	15	3.2																			
337	M	16																		96		
344	M	13															**490**					
348	M	16	4.5	0.9												60			30	368		
373	M	14									**18.9**		**11.3**									

Annex 2. Children's consumption rates (kg/y) and occupancy rates (h/y) in the Torness area

Observation number	Sex	Age in years	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Eggs	Wild fungi	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
10 year old age group																						
37	M	10															144					144
110	F	9															90					
130	M	10		**12.3**																		
168	M	10	**28.7**																			
180	F	7	3.8																			
203	M	10	0.7																			
255	M	9	0.5														64					
268	M	10										**7.5**										
269	M	7										**7.5**										
275	F	9															70				1080	360
306	F	8	8.0																			
308	M	9	8.0																			
309	F	11	8.0																			
329	M	11	3.2																			
330	M	7	3.2																			
5 year old age group																						
70	M	6		**12.9**	**8.4**																	
112	F	6															72			18		
113	M	2															72			18		
256	F	5	**0.5**														64					
341	M	4															156					
345	F	6															**490**					

Notes

Emboldened observations are rates included in the critical groups.

Annex 3. Combinations of adults' pathways for consideration in dose assessments

Combination number	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of the site centre	Outdoor occupancy within 1 km of the site centre
1				*	*	*	*	*				*	*	*		*	*										
2				*	*	*	*	*						*						*				*		*	*
3	*	*	*	*	*	*	*	*			*		*	*		*	*		*	*			*	*	*		*
4		*																	*			*	*	*			*
5	*	*																		*		*			*		
6	*	*		*	*	*	*	*				*	*		*		*	*	*								*
7																				*	*			*			
8		*																				*			*		*
9				*	*	*	*	*						*			*				*					*	*
10		*		*	*	*	*	*					*		*		*	*			*						*
11				*	*	*	*	*				*		*			*			*	*						*
12									*		*									*							
13						*	*	*			*	*					*	*									
14								*		*		*	*		*		*										
15	*																		*	*						*	*
16	*	*																	*							*	*
17	*																								*	*	*

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