

Radiological Habits Survey: Winfrith, 2003



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Radiological Habits Survey: Winfrith, 2003

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SUMMARY

This report presents the results of a survey conducted in 2003 into the habits and consumption patterns of people living, working and pursuing recreational activities in the vicinity of the Winfrith site. The site is owned by the United Kingdom Atomic Energy Authority and has been undergoing decommissioning since the main facility, the Steam Generating Heavy Water Reactor, was shutdown in September 1990. The company is licensed to operate the site under the Nuclear Installations Act, 1965. Under the Radioactive Substances Act, 1993 the company is authorised to discharge gaseous radioactive wastes to the atmosphere and liquid radioactive wastes to deep water in Weymouth Bay, offshore of Arish Mell. The site also contains sources of direct radiation.

Potential exposure pathways related to site include:

- consumption of locally sourced terrestrial and marine foods
- occupancy of buildings and the surrounding areas relating to direct radiation
- occupancy of intertidal areas
- occupancy in or on fresh and/or marine water in the survey areas
- handling commercial fishing gear and sediment
- activities relating to streams and rivers in the immediate area

The survey investigated all of these pathways. Individuals from the local population were interviewed and the data obtained are presented and discussed. Data for 1629 individuals were collected. Gamma dose rate measurements were taken to supplement those made in routine surveillance programmes.

High consumption rates were found in the following groups of locally produced foods: fish, crustaceans, molluscs, 'other' vegetables, root vegetables and honey. Other local foods consumed were green vegetables, potatoes, domestic fruit, milk, cattle meat, pig meat, sheep meat, goat meat, poultry, eggs, wild/free foods, honey, wild fungi, venison, freshwater fish and freshwater plants.

For the marine environment, the main activities relevant to occupancy included commercial fishing, commercial diving for shellfish, sport diving, surface water sports, dog walking and walking. In the terrestrial environment, up to 5 km from the site, the main activities included farming, gardening and allotment maintenance. The main activities relating to freshwater locations in the terrestrial area included recreational activities (angling, bathing, etc), a trout farm and a watercress farm. It was noted that ground water was consumed by livestock at several farms and by two individuals living in a property that did not have a mains water supply.

Within 1 km of the site perimeter, the main occupancies related to residents and employment.

The data from the survey are presented in full for each individual in order to assist in assessments of the additive effects of exposures from multiple pathways. The information recorded during interviews was processed in two different ways to identify high rates appropriate to the various aquatic and terrestrial pathways. One method estimated a representative figure for each pathway by selecting a group at the upper end of the distribution of observations. The other chose the 97.5 percentile rate from the distribution.

Comparisons have been made with the results from the previous aquatic survey.

Suggestions are made for changes to environmental monitoring programmes on the basis of the information collected during the survey.

1 INTRODUCTION

The public may be exposed to radiation as a result of the operations of the United Kingdom Atomic Energy Authority (UKAEA) site at Winfrith either from discharges of liquid or gaseous radioactive wastes into the local environment, or from radiation emanating directly from the site. This report provides information about activities members of the public carry out which may influence their radiation exposure. The study has been funded by the Environment Agency, the Food Standards Agency and the Health and Safety Executive in order to support their respective roles in protecting the public from the effects of radiation.

1.1 Regulatory framework

The Environment Agency regulates discharges of waste under the Radioactive Substances Act 1993 (RSA 93) (UK Parliament, 1993) as amended by the Environment Act 1995 (EA 95) (UK Parliament, 1995a) and by legislation implementing the European Union (EU) Basic Safety Standards (BSS) Directive 96/29/Euratom (CEC, 1996). This Directive takes account of Recommendations of the International Commission on Radiological Protection (ICRP), particularly ICRP 60 (ICRP, 1991). Authorisations under RSA 93 are issued by the Environment Agency after wide-ranging consultation, including the Food Standards Agency. As well as being a Statutory Consultee, the Food Standards Agency has responsibilities for ensuring that any radioactivity present in food does not compromise food safety and that authorised discharges of radioactivity do not result in unacceptable doses to consumers via the diet. The Food Standards Agency also ensures that public radiation exposure via the diet is within EU accepted limits. Consultation papers on Statutory Guidance to the Environment Agency on the regulation of radioactive waste discharges were issued by the Department for Environment, Food and Rural Affairs (Defra) in 2000 and the Welsh Assembly in 2002. These draft guidance documents include, *inter alia*, affirmation that protection of the critical groups of the public is the appropriate radiological protection methodology to use. This report provides information to support assessments of critical groups.

Operation of nuclear sites anywhere in the UK can only take place if they are licensed under the Nuclear Installations Act 1965 (NIA 65) (UK Parliament, 1965). The Nuclear Installations Inspectorate of the Health and Safety Executive implements this legislation and is also responsible for regulating, under the Ionising Radiations Regulations (IRR99) (UK Parliament, 1999), the restriction of exposure of the public to direct radiation from operations occurring on these sites.

1.2 Radiological protection framework

UK policy on the control of radiation exposure has long been based on the Recommendations of ICRP which embody the principles of justification of practices, optimisation of protection and dose limitation. Radiological protection of the public is based on the concept of a critical group of individuals. This group is defined as those people who, because of where they live and their habits, receive the highest radiation dose due to the operations of a site. It follows that, if the dose to this group is acceptable when compared to relevant dose limits and constraints, other members of the public will receive lower doses, and overall protection is provided for.

Dose standards for the public are embodied in national policy (UK Parliament, 1995b), in guidance from the International Atomic Energy Agency (IAEA) in the Basic Safety Standards for Radiation Protection (IAEA, 1996) and in EC legislation in the EU BSS Directive 96/29/Euratom. The public dose standards were incorporated into UK law in the IRR 99. In order to implement the Directive in England and Wales, the Environment Agency was issued with a direction by the Department of the Environment, Transport and the Regions (DETR) (now part of Defra) in 2000 (DETR, 2000). This includes the requirements that the Environment Agency ensure, wherever applicable,

- all public radiation exposures from radioactive waste disposal are kept As Low As Reasonably Achievable (ALARA);
- the sum of such exposures does not exceed the dose limit of 1 mSv a year;
- the dose received from any new source does not exceed 0.3 mSv a year;

- the dose received from any single site does not exceed 0.5 mSv a year.

Guidance on the principles underlying prospective assessments (i.e. assessments of potential future doses) has been provided by a group of UK public bodies (EA, SEPA, DoENI, NRPB and FSA, 2002). Where relevant, this guidance may also be applied to retrospective assessments (i.e. assessments of doses already received). A recent discussion paper (Camplin *et al*, 2002) has considered different ways in which data collected from habits surveys similar to this study may be used to carry out integrated (i.e. combined pathway) dose assessments.

2 THE SURVEY

2.1 Site activity

The Winfrith site is owned by the United Kingdom Atomic Energy Authority (UKAEA). It is situated on the south coast in the county of Dorset, 6 km north of West Lulworth between Portland Bill and St Alban's Head (Figures 1 and 2).

UKAEA is licensed to operate the site under NIA 65, and under RSA 93 it is authorised to discharge gaseous radioactive wastes to the atmosphere and liquid radioactive wastes to deep water in Weymouth Bay in the English Channel. Details of the amounts of radioactive waste discharged in 2002 have been published (EA, EHS, FSA and SEPA, 2003). Other tenant operators on the site (RWE NUKEM Ltd, the National Nuclear Corporation and the Atomic Energy Authority Technology (AEAT) also hold authorisations to discharge radionuclides to the atmosphere.

The Winfrith site was developed in the 1950s when it became necessary to assess the wide variety of different reactor types being developed in the UK. The site has been undergoing decommissioning since the shutdown of the Steam Generating Heavy Water Reactor (SGHWR) in 1990. Since then other activities have also been closed down which has resulted in part of the site becoming de-licensed. The site's commercial activities were transferred to a new private company, AEAT, in 1996. The Winfrith site should be mainly in use as a business centre by 2025, with only a small part remaining a licensed area.

2.2 Survey objectives

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) undertook the survey in 2003 on behalf of the Environment Agency, the Food Standards Agency, and the Health and Safety Executive. The aim of the survey was to obtain integrated habits data

related to public radiation exposure from the Winfrith site via aquatic, terrestrial and direct radiation pathways so that realistic assessments of critical group doses could be made.

The last full aquatic habits survey conducted by CEFAS in the Winfrith area was in 1985. An update of this survey was conducted in 1986/87. Data from these surveys are used for dose assessments for the Winfrith area (e.g. EA, EHS, FSA and SEPA, 2003). Consumption data from the surveys have been published (Smith and Hunt, 1989). No previous terrestrial or direct radiation habits surveys have been conducted around the site by CEFAS.

Fieldwork was undertaken in order to obtain site specific habits survey data. These data were used to establish exposure pathways for the local population and the characteristics of those most exposed. General habits survey information for the area was also obtained.

Investigations were carried out to ascertain the following:

- The production, use and destination of local produce
- The consumption rates of aquatic and terrestrial foods from within the survey areas
- The types, seasonality of and extent of consumption of wild foods in the area
- External exposure activities, including commercial fishing (potting, netting and diving), angling, bait digging, mollusc collection and recreational activities
- The extent of occupancy within 1 km of the site perimeter
- Uses of stream, river and ground water and activities occurring in and on water
- The extent of any unusual practices, which may be relevant, such as the use of seaweed as a fertiliser and the transfer of contamination by wildlife

2.3 Survey areas

Three main survey areas were defined to encompass the dominant activities expected for aquatic, terrestrial and direct radiation pathways respectively. Water courses and areas potentially containing contamination from gaseous washout alone are discussed in the

terrestrial sections of this report. Those containing contamination from liquid discharges or both gaseous and liquid discharges are discussed in the aquatic sections.

The aquatic survey area shown in Figure 1, extended from Portland Bill in the west to St Alban's Head in the east and included fisheries from the coastline out to a line drawn between these two headlands. Information on commercial fishing activities, but not habits data, in a secondary aquatic survey area, Poole Harbour, was also obtained during the survey. The harbour contains radioactivity from Winfrith's liquid discharges and there is potential washout of gaseous discharges entering via the River Frome. Earlier aquatic surveys used hydrographic survey information to define a survey area covering the coastline from Portland Bill in the west to Hengistbury Head in the east including Poole Harbour. However, discharges reduced considerably following the closure of SGHWR in 1990 and a smaller survey area is now considered appropriate.

The terrestrial survey area, shown in Figure 2, was defined as the circle to a radius of 5 km from the site centre (NGR SY 813 869), to encompass the main areas of potential deposition from gaseous discharges. Activities relating to streams, the River Frome and ground water in this area were also investigated.

For direct radiation, the survey area, also shown in Figure 2, was defined as the area within 1 km of the licensed site perimeter.

2.4 Conduct of the survey

The fieldwork component of the survey was carried out between 28th May and 6th June 2003, by a survey team of four people, according to techniques described by Leonard *et al.* (1982).

A programme of work was sent to the Environment Agency, the Food Standards Agency, and the Health and Safety Executive before the survey for comment. Pre-survey discussions between one of the survey team, UKAEA, the Environment Agency, the Food Standards

Agency and the Health and Safety Executive were held prior to the start of the fieldwork. These discussions provided an outline of the main aims of the survey and highlighted areas or items, which required special attention or effort by the team. On 2nd June a meeting was held between the survey team and UKAEA at the Winfrith site. This served to provide details about site operations, including waste disposal, and information about potential pathways and activities in the area. Further information was sought about wildlife studies and pest control measures in and immediately around the site. Animals could be vectors for transporting radioactive materials off-site and are also potential food items for some individuals.

People with a local knowledge of the survey area were contacted for information on any aspects relevant to the various exposure pathways. These included the local Defra fisheries officer, the local Sea Fisheries Committee officer, a sea fishing club representative, the local council, allotment association delegates, beekeeping representatives and the Tourist Information Office.

During the survey, individuals who were identified as having the potential to be exposed to radioactivity from the site were contacted and interviewed. Interviews were used to establish individuals' consumption rates of locally grown terrestrial foods and locally caught seafoods, their handling rates of intertidal sediments and commercial fishing gear, their occupancy rates relevant to external intertidal exposure and direct radiation and their occupancy rates in and on water. Any general information of possible use to the survey was also obtained. Using the information gained in the interviews, a list of occupations and activities was built up to produce a picture of potential exposure pathways. This then enabled emphasis to be placed on those individuals who were likely to be the most exposed and included boat owners, commercial divers, anglers, mollusc collectors, bait-diggers, allotment tenants, gardeners, beekeepers, farmers and individuals living and/or working close to the site.

The survey did not involve the whole population in the vicinity of Winfrith, but targeted subsets in order to identify the potentially most exposed individuals. Therefore, although the number of people in the terrestrial survey area was estimated to be 8000, information was obtained

for a significantly smaller number than this. To aid interpretation, the number of people interviewed in each group as a percentage of what we estimate to be complete coverage for that group has been calculated. It is possible that there may be people in each group that we did not identify at the time of the survey. The results are summarised in Table 1. The 'groups' are described and quantified, and the number of people interviewed given as percentages of the totals. It should be noted that for certain groups, such as anglers and divers, it can be virtually impossible to calculate the total number of people who undertake the activity in the survey area as many people visit from outside or only visit occasionally during the year. In other cases, may be necessary to estimate the number of individuals from the number of clubs for example. These cases are explained in Table 1.

The aquatic, terrestrial and direct radiation elements of the survey primarily targeted pathways relevant to those elements, for example people in the terrestrial survey were initially questioned because it was known that they grew a lot of terrestrial foodstuffs. However, where possible, every interviewee was asked about pathways in each of the three areas. During interviews with representatives from businesses based within the direct radiation survey area, it was not possible to collect data for all pathways (such as consumption of local foods), for each employee. In these cases, data were limited to those relating to the primary reason for the interview (i.e. occupancy rates within 1 km of the site perimeter). Such individuals only have data for this pathway in Annex 1.

Forty-five person-days were spent interviewing and observations for 1629 individuals were recorded. During the survey, some gamma dose rate measurements were taken to aid assessment of external exposure pathways.

3 METHODS FOR DATA ANALYSIS

3.1 Data recording

The 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. The raw data were entered into a habits survey database where each individual for whom information was obtained was given a unique identifier (the observation number) to assist in maintaining data quality.

During the interviews, people could not always provide consumption rates in kilograms per year for food or litres per year for milk. In these cases, 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. The database converted these data into consumption rates (kg/y for food and l/y for milk) using a variety of conversion factors. These included produce weights (Hessayon, 1990 and 1997 and Good Housekeeping, 1994), edible fraction data researched by CEFAS and information supplied by the Meat and Livestock Commission. For the purpose of data analysis, foodstuffs were aggregated into food groups as identified in Table 2. Specific food types relevant to this survey are presented in the tables.

All consumption and occupancy data in the text of this report are rounded to two significant figures to reflect 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 row totals to appear slightly erroneous (± 0.1). The exception is for consumption rates less than 0.05 kg/y, which are presented to two decimal places, in order to avoid them appearing as 0.0 kg/y. External exposure data are quoted as integers.

To ensure the quality of the data collected during the survey fieldwork and presented in the reports, the following procedures have been employed:

- Experienced scientific staff were used for fieldwork and data assessment. They had been trained in the techniques of interviewing and obtaining data for all pathways which were relevant to the survey being conducted. Where individuals offered information during interview which was unusual, they were questioned further in order to double check the validity of their claims.
- Where possible, interviewees were contacted again to confirm the results of the initial interview if, when final consumption rates were calculated, observations were found to be high in relation to our experience of other surveys, taking into account local factors.
- Data were stored in a database in order to minimise transcription and other errors.
- Draft reports and data tables were formally reviewed by senior CEFAS staff.
- Final reports were only issued when the Environment Agency, the Food Standards Agency and the Health and Safety Executive were entirely satisfied with the format and content of the draft.

The habits data are structured into groups of activities 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, for example, are grouped as 'crustaceans'. For external exposure over intertidal sediments, occupancy over a common substrate, (for example, sand) is chosen. The choice of a group of activities is made when it is reasonable to assume that consistent concentrations or dose rates would apply within the group. In addition to grouping of activities, ingestion 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. These age groups are from 0 to 1.0 y of age (called 3 months old); more than 1.0 y to 2.0 y (called 1 year old); more than 2.0 y to 7.0 y (called 5 year old); more than 7.0 y to 12.0 y (called 10 year old); more than 12.0 y to 17.0 y (called 15 year old). Individuals over 17 are treated as adults. These age groupings are consistent with those used in ICRP 72 (1996). For direct radiation pathways the data are grouped into distance zones from the site perimeter

as a coarse indication of the potential dose rate distribution due to this source of exposure. The bands used were: 0 – 0.25 km, 0.25 – 0.5 km and 0.5 – 1 km. These distance bands are also useful when assessing exposure to the atmospheric plume(s).

3.2 Data analysis

The main output of the study is the statement of individuals' consumption, handling and occupancy rates given in Annexes 1 and 2. These can be used by those undertaking radiological assessments of the effects of the operation of the Winfrith site – taking into account the concentration and/or dose rate distributions in space and time relevant to the assessment. It is only with the outcome of such an assessment that the critical group can strictly be defined as those most exposed.

In addition to providing the data in the annexes, we have also analysed them to provide estimates of rates of occupancy, handling and consumption which can be regarded as typical of those most exposed prior to a formal assessment being undertaken. Two approaches are used.

Firstly, the 97.5 percentile rate was calculated for each group using the Excel mathematical function for calculating percentiles. This method 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 MAFF and FSA (Byrom *et al*, 1995 and FSA, 2002), and these are referred to as generic rates in this report. Secondly, 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 rates observed within a factor of three of the maximum value (termed the lower threshold value). It accords with the principle expressed by ICRP (ICRP, 1984) that the critical group should be small enough to be reasonably homogeneous with respect to age, diet and those aspects of behaviour that affect the doses received. In this report, the term critical group rate is used to

represent the data derived by the 'cut-off' method for ease of presentation. A separate critical group rate was calculated for each food group or activity identified in the survey.

In exceptional cases the 'cut-off' method can result in only one member of the high rate group. In this case, judgement is used as to whether to include other individuals within the group.

In previous aquatic surveys (those undertaken prior to 2002) 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 as for consumption is used. The factor reflects variations in the doses likely to be received due to natural variations in the interactions of radiations with tissues caused by, for example, differences in anatomy.

For ingestion pathways, high rates for children have been calculated from the survey data. However because few child consumers were identified during the survey, shown in Table 1, the rates should be viewed with caution. For assessment purposes, an alternative, theoretical approach may be taken which involves scaling the critical group rates for adults by ratios. These ratios are given in Annex 3 and have been calculated using generic 97.5 percentile consumption rates.

Selection of 97.5 percentile and critical group rates for occupancy is not made for the direct radiation pathway. Such an analysis is of limited value without a detailed knowledge of the spatial extent of dose rates due to direct radiation.

For the purposes of assessing total dose integrated across all pathways, the data from the survey can be further analysed to take into account the degree of overlap of each pathway. This is discussed further in Section 7 and data to undertake a total dose assessment are provided in Annex 4.

4 AQUATIC RADIATION PATHWAYS

4.1 Aquatic survey area

The aquatic survey area covered all intertidal areas between Portland Bill and St Alban's Head (Figure 1). Seafood caught and collected inshore of a direct line between Portland Bill and St Alban's Head were included in the survey. Information on commercial fishing activities in Poole Harbour was also obtained during the survey however; no habits data was obtained for this area.

Portland Bill to Weymouth

Portland Bill is a large limestone outcrop which provides shelter against south-westerly winds. Many activities took place in the sheltered area of Weymouth Bay and in Portland Harbour. They included commercial fishing (potting, netting and diving), angling, surfing, sport diving and snorkelling for molluscs.

Portland Bill offered several diving facilities including diving schools, diving centres, dive boat charters and diving shops. This sheltered area was very popular with sport divers as it offered miles of coastline with extensive beaches, rocky areas, reefs and kelp forests. There were also several wrecks in the vicinity of Portland Harbour and in other areas of Weymouth Bay, with some being conveniently close to the shore. Some of the areas were too rough for commercial scallop dredging thereby conserving stocks of shellfish for divers to collect. The main shellfish which divers and snorkelers collected were scallops (*Pecten maximus*), razor fish (*Ensis arcuatus*), Manila clams (*Tapes philippinarum*), edible crabs (*Cancer pagurus*) and lobsters (*Homarus gammarus*) between May and September when weather conditions were favourable. Manila clams and razor fish were collected in shallow water and the other species were collected further offshore. Commercial scallop diving was also carried out further offshore on the Shambles Bank.

Portland Bill was a popular location for angling. The main species caught were mackerel (*Scomber scombrus*) and bass (*Dicentrarchus labrax*)

One fisherman dredged for juvenile mussels (*Mytilus edulis*) around Portland from January to March for re-laying in Poole Harbour.

Pacific oyster rearing was carried out at an oyster farm located at Wyke Regis in the Fleet Lagoon which was a natural estuary. The lagoon is tidal with seawater entering and leaving via Portland Harbour.

There was a surfing club based at Ferry Bridge that had approximately 80 club members who frequently windsurfed and kite surfed in Portland Harbour all year round.

Approximately 30 commercial fishing boats were based at Weymouth harbour together with several boats used for recreational activities.

Weymouth beach was a 1 km long stretch of sand and was very popular with beach-goers, especially children.

Weymouth to St Alban's Head

The South West Coast Path passes Osmington beach (anglers occasionally visited this location), Durdle Door and St Oswald's Bay, and, rounding the chalky cliffs of Lulworth Cove enters the Lulworth Ranges, a military firing range. The path through the Ranges is only accessible at certain times of the year. Boats from Lulworth and Kimmeridge, further east, set pots for crabs and lobsters in the Swanage Bay area. Scallops were also collected by commercial divers from rough ground on Lulworth Ledges.

Between Mupe Bay and Worbarrow the coastal path kept close to the edge of the cliffs where the path dropped down to the shingle beach at Arish Mell. The beach here was out-of-bounds

as it has not been cleared of explosives. Further east the Kimmeridge Ledges were made up of shale. Below the tower at Kimmeridge Bay there was an Information Centre for the Dorset Trust for Nature Conservation where guided walks were organised. Chapman's Pool was the last small bay before reaching St Alban's Head.

All the beaches and coves along this section of coastline, where public access was possible and permitted, were visited frequently by tourists and locals. Shore angling was also popular at these locations, with various species of rays and bass being the commoner species caught.

Poole Harbour

Poole Harbour is a large expanse of seawater forming a natural harbour. Except for a narrow opening to Poole Bay at Sandbanks, it is enclosed from the open sea providing ideal protection in rough weather for a variety of water sports and commercial fishing. The two main rivers which flow into Poole Harbour are the Frome and the Piddle.

4.2 Commercial fisheries

Approximately 30 registered boats (<10 metres) were based in Weymouth Harbour. Two boats were based in Lulworth Cove and two others in Kimmeridge Bay. Of these boats, some worked on a full-time basis while others worked part-time. Most were multi purpose, using whatever fishing methods were appropriate for the time of the year and conditions. In addition, there were some larger boats (>10 metres), which only fished in the survey area depending on tidal, seasonal and weather conditions.

The principal fishing effort was potting for crabs and lobsters by the smaller boats (<10 metres) who each set between 60 and 600 pots. The favoured areas were the Lulworth Banks, Kimmeridge Ledges and Bat's Head areas. Between March and December they were potting for edible crabs, spider crabs (*Maja squinado*) and lobsters and between August and October they were potting for prawns (*Palaemon serratus*). A small number of fishermen set

pots, which were especially designed for cuttlefish (*Sepia officinalis*) and whelks (*Buccinum undatum*) and nets for marketable fish and pot bait. However, netting in the area was restricted by strong tides. Netting mainly took place using trammel nets and bottom gill nets when crustacean stocks were low in the area. Favoured periods were February to May and again during October to December. Bass, grey mullet (*Cherlon labrosus*), Dover sole (*Solea solea*), brill (*Scophthalmus rhombus*), turbot (*Scophthalmus maximus*), plaice (*pleuronectes platessa*), cod (*Gadus morhua*), pollack (*Pollachius pollachius*) and various species of rays were the main species caught over these periods. In addition, two boats were noted to be otter trawling in the area.

There was an inshore scallop bed situated off Portland Bill although the area was currently being left to regenerate. Diving for scallops took place at Lulworth Banks on a commercial basis from May to November. There was an oyster farm in the natural estuary of the Fleet Lagoon near Wyke Regis, where approximately one million oysters were reared annually. Most of the stock were Pacific oysters (*Crassostrea gigas*). When the oysters had reached marketable size, they were purified in water treated with ultra violet light for 48 hours, and held in aerated holding tanks until sold.

In Poole Harbour, mussel rearing was the main commercial fishery since the extensive oyster fishery was decimated by *Bonamia* in the late 1980s. The immature mussels were dredged from the Portland area of Weymouth Bay and laid in beds (called layings) in the harbour and harvested when they had reached marketable size. Other mollusc species fished for commercially in the harbour included cockles (*Cerastoderma edule*), Manila clams and some oysters (*Ostrea edulis*). There was one licensed seine netsman operating in the joint estuary of the Frome and the Piddle, catching salmon (*Salmo salar*) and seatrout (*Salmo trutta*) from 1st June to 31st July.

4.3 Angling

The coastline in the survey area offered good shore fishing, with extensive beaches and rocky outcrops. Popular locations were Portland Bill, Weymouth, Lulworth Cove, Mupe Bay, Worbarrow Bay and Kimmeridge Bay. Bass, rays and mackerel were the main edible species being caught at the time of the survey. Private boat and charter boat angling were also carried out on a large scale in Weymouth Bay, particularly around the Portland area.

4.4 Seafood wholesalers and retailers

Seafood wholesalers and retailers were interviewed to ascertain whether the seafood sold locally was caught in the survey area. The majority of the fishing boats landed in Weymouth Harbour and the seafood was either sold directly to buyers in the area or transported to London or France depending on the market price. There were several wholesalers in the survey area based at Portland and Weymouth with one wholesaler buying approximately 90% of the crustaceans and 10% of wet fish landings. Most of the crabs were then sold to France, Spain, Portugal and Italy. Whelk landings were sold to a wholesaler based outside the area. Another wholesaler bought the majority of wet fish landings and a small amount of crustacean landings and exported both directly to Spain. The majority of the mollusc catch was also sold outside the survey area with scallops going to Billingsgate, Manila clams going to France and London, razor fish going to Japan and the whelks going to Korea.

Some retailers bought locally caught seafood including bass, mullet, cuttlefish, edible crabs, lobsters, plaice, turbot, prawns and scallops. The oyster company at Wyke Regis bought immature oysters from Whitstable, Kent, which were grown on for three years to a marketable size. Approximately 10 tonnes per year were sold to seafood bars and local restaurants.

4.5 Wildfowl

No wildfowling was noted within the survey area.

4.6 Other food pathways

The survey team were informed that one individual, who was a diver, consumed small quantities of a species of seaweed. Although the survey team attempted to contact this person both by a house visit and by letter, no response was obtained. No other marine pathways, such as the use of seaweed as fertiliser, were noted.

4.7 Internal exposure

Consumption data for locally caught aquatic foodstuffs are presented in Tables 3 to 5 for adults and Tables 6 to 8 for children. These tables include the mean consumption rates of the critical groups together with the observed 97.5 percentile rates calculated as described in Section 3.2. No adult or child consumers of marine plants and algae or wildfowl were observed. Furthermore, no children in the 3 month old age group were noted to be consuming any locally caught seafood. For purposes of comparison, the data are summarised, in Table 9 for adults, and Tables 10 to 13 for children (15 year olds, 10 year olds, 5 year olds and 1 year olds respectively). The summary tables also include mean rates and 97.5 percentile rates based on national data (referred to as 'generic' data in this report) for the groups where these data have been generated: adults, 15 year olds and 10 year olds.

Adult consumption rates

The people consuming the greatest quantities of seafood from the aquatic survey area were commercial fishermen (potting and netting) and commercial divers.

The predominant species of fish consumed by adults were plaice, bass and mackerel together with smaller quantities of pollack, cod, red gurnard (*Aspitrigla cuculus*) and salmon. A critical group of 10 individuals was identified with a maximum consumption rate of 74 kg/y and a mean of 40 kg/y. The observed 97.5 percentile rate based on 54 observations was 53 kg/y. This compares 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 species eaten by the critical group, rounded to the nearest 5%, was 35% plaice, 25% mackerel, 20% bass, 10% pollack, 5% cod and 5% red gurnard.

The predominant species of crustaceans consumed by adults were edible crabs and lobsters with small quantities of common prawns and spider crabs. A critical group of six individuals was identified with a maximum consumption rate of 23 kg/y and a mean of 15 kg/y. The observed 97.5 percentile rate based on 51 observations was 20 kg/y. This compares 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 species eaten by the critical group, rounded to the nearest 5%, was 55% lobsters, 40% edible crabs and 5% common prawns.

The predominant species of molluscs consumed by adults were scallops, Manila clams and whelks. A critical group of two individuals was identified with a maximum consumption rate of 14 kg/y and a mean of 14 kg/y. The observed 97.5 percentile rate based on 39 observations was 14 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for molluscs of 3.5 kg/y and 10 kg/y respectively. The percentage breakdown of species eaten by the critical group, rounded to the nearest 5%, was 75% scallops and 25% whelks.

Children's consumption rates

15 year old age group

For fish, a critical group of one individual was identified with a consumption rate of 15 kg/y. The observed 97.5 percentile rate based on two observations was 14 kg/y. This compares

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 two individuals was identified with a maximum consumption rate of 3.1 kg/y and a mean of 3.0 kg/y. The observed 97.5 percentile rate based on three observations was 3.1 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for crustaceans of 2.5 kg/y and 6 kg/y respectively.

For molluscs, a critical group of two individuals was identified with a maximum consumption rate of 0.86 kg/y and a mean of 0.86 kg/y. The observed 97.5 percentile rate based on four observations was 0.86 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for molluscs of 2.5 kg/y and 6 kg/y respectively.

10 year old age group

For fish, a critical group of four individuals was identified with a maximum consumption rate of 15 kg/y and a mean of 10 kg/y. The observed 97.5 percentile rate based on six observations was 14 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for fish of 6 kg/y and 20 kg/y respectively.

For crustaceans, a critical group of six individuals was identified with a maximum consumption rate of 8.4 kg/y and a mean of 6.0 kg/y. The observed 97.5 percentile rate based on seven observations was 8.4 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for crustaceans of 2.5 kg/y and 7 kg/y respectively.

For molluscs, a critical group of three individuals was identified with a maximum consumption rate of 14 kg/y and a mean of 14 kg/y. The observed 97.5 percentile rate based on 5 observations was 14 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for molluscs of 2.5 kg/y and 7 kg/y respectively.

5 year old age group

For fish, a most exposed group of one individual was identified with a consumption rate of 5.9 kg/y. No generic consumption rates have been derived for this age group.

For crustaceans, a critical group of two individuals was identified with a maximum consumption rate of 1.4 kg/y and a mean of 0.95 kg/y. The observed 97.5 percentile rate based on two observations was 1.4 kg/y. No generic consumption rates have been derived for this age group.

For molluscs, a most exposed group of one individual was identified with a consumption rate of 0.86 kg/y. No generic consumption rates have been derived for this age group.

1 year old age group

For fish, a most exposed group of one individual was identified with a consumption rate of 2.9 kg/y. No generic consumption rates have been derived for this age group.

For crustaceans, a most exposed group of one individual was identified with a consumption rate of 2.9 kg/y. No generic consumption rates have been derived for this age group.

No mollusc consumption was identified for this age group in the survey area.

4.8 External exposure

Intertidal occupancy

Table 14 shows the intertidal occupancy data recorded during the survey. The two types of intertidal sediment in the survey area, where public occupancy was identified, were sand and stones, and sand.

The maximum occupancy rate recorded over sand and stones was 400 h/y for an individual walking at Portland Harbour. Two other individuals (another walker and an angler) had occupancy rates within a factor of three of this giving a mean rate of 300 h/y.

The maximum occupancy rate recorded over sand was 210 h/y by an angler. Six walkers' occupancy rates came within a factor of three of this, which gives a mean rate for this group of 150 h/y.

Other intertidal activities noted to be taking place in the survey area were playing, dog walking, and bait digging.

Handling

Handling sediment, while bait digging or mollusc collecting, or handling commercial fishing gear, which has become entrained with fine sediment particles, 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).

Fishing gear can also be a source of whole body gamma exposure due to occupancy in the vicinity of the gear. However this pathway is minor compared with the same exposure

received during occupancy over intertidal areas and it has therefore been omitted from the report.

Table 15 shows the commercial fishing gear and intertidal sediment handling rates recorded during the survey.

The maximum fishing gear handling rate recorded was 1800 h/y for a commercial shellfish potter. Sixteen other commercial fishermen (mainly other shellfish potters but also some gill netters) had gear handling rates that came within a factor of three of this. This gives a mean handling rate for this group of 1200 h/y.

The maximum sediment handling rate recorded was 10 h/y for two bait diggers. No other sediment handling was observed. This gives a mean handling rate for this group of 10 h/y.

Gamma dose rate measurements

Representative gamma dose rate measurements at 1 m above the substrate were taken at locations where high occupancy rates were observed. These measurements (shown in Table 16) ranged from 0.045 to 0.059 $\mu\text{Gy/h}$ over sand and two measurements of 0.050 $\mu\text{Gy/h}$ were over sand and stones. These results compare with an expected natural background level of 0.05 $\mu\text{Gy/h}$ over sand.

4.9 Water based activities

Activities taking place in or on the water can lead to ingestion of seawater and/or inhalation of sea spray. These 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. Occupancy rates for activities taking place in or on the water around Winfrith are shown in Table 17 for adults and children. Table 17 indicates whether the observations are for fresh water or seawater.

The radionuclide content of fresh water in the survey area, such as the River Frome, comes from washout of gaseous discharges. Radionuclides in the marine environment originate from the site's liquid discharges.

Activities in the water

Activities taking place in water included commercial diving, sport diving, playing, water sports preparation and swimming. Fifty-six observations were recorded and the people with the highest occupancy rates in the water were two commercial shellfish divers with 190 h/y.

Activities on the water

Activities taking place on the water around Winfrith included commercial fishing, boating to and from dive sites, windsurfing and sea angling. Sixty-nine observations for people fishing, boating, surfing and angling were recorded and the person with the highest occupancy rate on the water was a commercial fisherman, with 3200 h/y.

5 TERRESTRIAL RADIATION PATHWAYS

5.1 Terrestrial survey area

The terrestrial survey area covered all land within 5 km of the site centre (NGR SY 813 869) as shown in Figure 2. It was characterised by a number of small villages. The eastern part encompassed the village of Wool, 2.5 km from the site centre. Winfrith Newburgh was situated 2.5 km south-west of the site centre and to the north-west the villages of Moreton and Crossways were 3 km and 5 km respectively from the site centre. Two hamlets, East Burton and East Knighton, were within 1 km of the site perimeter. An army camp at Bovington dominated the area to the north-east. The River Frome flowed from the north-west, past the north side of the Winfrith site, out to the east past Wool and eventually into Poole Harbour.

The predominant land use was farming, with information gained for 35 working farms. Some of these farms were worked by the same farmer. However, for the sake of this report, they have all been considered as individual farms. The 35 farms comprised:

- 1 freshwater fish farm
- 1 watercress farm
- 2 salad crop farms
- 10 dairy farms
- 1 lamb meat and sheep's milk farm
- 2 beef farms
- 5 beef and sheep farms
- 8 dairy, beef and sheep farms
- 1 dairy and beef farm
- 2 chicken-egg farms
- 2 pig and chicken-egg farms

In addition to the produce already mentioned, many farms also grew arable crops.

Dairies producing cow's milk sold to a number of national distributors such as Milk Link Limited, Milk Marque, Dairy Crest Group plc, Marks and Spencer (all outside the survey area) and to a local distributor. The sheep's milk was sold to a national company outside the area to be made into yoghurt.

Most of the cattle were sold to abattoirs in Oxford or Somerset but smaller numbers were sold to private farmers outside the survey area or through two outlets within the survey area. Sheep were sold to a variety of abattoirs outside the survey area. One pig farmer sold all the pork he produced to customers both locally and from outside the survey area. The other pig farmer sold pigs to one of three meat markets, all in the south west of England outside the area.

The arable crops grown in the survey area were wheat, grass, maize, barley, oats, oil seed rape, broad beans, linseed, salad crops and fruit and vegetables. In addition to arable crops, one farm cultivated water cress. The crops grown specifically for national sale were wheat, barley, oats, oil seed rape, broad beans, linseed, water cress and salad crops. The wheat and oats were used for milling purposes and the barley for the malting industry. The grass and some of the cereals were used to feed livestock during the winter months, either by the farm which produced the crops or by neighbouring farms. Fruit and vegetables were grown commercially at two places in the survey area – one smallholding, which sold produce from the door to local customers and one nursery, which sold approximately 20 varieties of young vegetable plants for customers to buy and finish growing in their gardens or allotments.

Both of the pig farms and the smallholding selling fruit and vegetables, sold chicken eggs to customers from the door. The amounts sold varied between three dozen per week and 33 dozen per day. One residential property also sold smaller quantities of eggs to local customers from the door.

A number of people were consuming food they produced themselves on a non-commercial basis. A wide variety of farm products such as beef, lamb, pork, cow's milk, sheep's milk, eggs, fruit, vegetables, water cress and salad crops were all consumed by people involved with their production. Three families kept livestock for meat (two had cattle and one had goats). Two families kept goats for milk and secondary products such as cheese, yoghurt and ice cream. At several locations chickens, ducks and geese were kept for eggs and meat and another household kept turkeys for meat.

On two farms livestock had access to water from the River Frome and on another farm they were supplied by water from a borehole. However, in all cases the animals were also supplied with mains water. One household was identified whose sole water supply was from a borehole, and two properties near the Winfrith site had capped or disused wells in their gardens.

Spring water was used in large quantities by a watercress farm, which had a water extraction license from the Environment Agency to irrigate the crop. A fish farm, fed by water from the River Frome, reared rainbow trout for sale to two wholesalers outside the survey area. The trout were not on sale directly to the public. Two people were noted angling for, and consuming small quantities of freshwater fish from the River Frome.

A ford on the River Frome at Moreton was a popular location for people, mainly children, to paddle and play during hot weather. On one occasion during the survey, up to 50 people were seen in or around the ford. Observations at this location have been included in Table 17 and the fact that they relate to fresh water has been highlighted.

There were two allotment sites (shown in Figure 2) within the survey area. The allotment site at Wool had approximately 30 tenants and the allotment site at East Burton had five tenants. A high percentage of the produce was consumed by the allotment tenants and their families. Any excess produce grown by the Wool allotment tenants was usually given away to family and friends or sold to a local market and the proceeds invested back into the allotment site.

Twenty properties where fruit and vegetables were being grown in gardens were identified. As with the allotment produce, these fruit and vegetables were mainly consumed by the people growing them and any excess was being given away to friends and family. No evidence of people using seaweed as a fertiliser either on allotment plots or in their own gardens was noted.

There were five shooting clubs in the survey area, namely Newland, Triggon, East Burton, Sherbourne and Moreton which shot pheasants, duck, geese, partridge and deer in season. Some of the game was sold to game dealers based outside the 5 km area but most was eaten by the club members and their families and friends. Most of the farmers shot game on their own farms or were part of a local organised shoot.

Five beekeepers were identified in the survey area. Three of these produced honey mainly for themselves and their friends and family and two were selling their honey in the local area – one to customers from the door and one through a local retail outlet. Production of honey varied between approximately 20 kg per year to approximately 500 kg per year per beekeeper.

Small quantities of wild foods such as blackberries, blackcurrants, sloes and mushrooms were collected in the surrounding areas of Wool, Winfrith Newburgh, East Burton and East Knighton. They were also collected from the allotment sites, in private gardens and on most of the local farms.

Rabbits and deer, which could potentially migrate off-site and become food items, were noted to inhabit the site which. No consumption of rabbit was noted but small amounts of venison were consumed.

5.2 Terrestrial food wholesalers and retailers

Retailers, (including greengrocers, butchers, bakers, convenience stores, local public houses, farm shops and nurseries) in Wool, Winfrith Newburgh, Crossways, Bovington, East Knighton and East Burton were interviewed in order to find out whether they were selling produce from within the survey area. A butcher in Wool sold some local beef. A public house, two convenience stores and a greengrocer were supplied by a local egg producer, and local honey was sold in a tea room in the survey area.

5.3 Internal exposure

Consumption data for locally produced terrestrial foodstuffs are presented in Tables 18 to 35 for adults and Tables 36 to 51 for children. These tables include the mean consumption rates of the critical groups together with the observed 97.5 percentile rates calculated as described in Section 3.2. For purposes of comparison, the data are summarised in Table 9 for adults, and Tables 10 to 12 for children (15 year olds, 10 year olds and 5 year olds respectively). No children in the 1 year old or 3 month old age groups were noted to be consuming locally produced terrestrial foods.

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. The data are summarised in Table 52. Those food types shown in bold and labelled with an asterisk were sampled as part of the 2002 Food Standards Agency monitoring programme (EA, EHS, FSA and SEPA, 2003).

Adult consumption rates

Consumption of terrestrial foods was identified in the following 18 food groups: green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, milk, cattle meat, pig meat, sheep meat, goat meat, poultry, eggs, wild/free foods, honey, wild fungi, venison,

freshwater fish and freshwater plants. No consumption of rabbits/hares or local cereals was identified.

Critical group mean consumption rates for all food groups were less than the generic 97.5 percentile consumption rates. Eleven critical group mean consumption rates exceeded the generic mean consumption rates. These were for green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, milk, cattle meat, pig meat, sheep meat, eggs and honey. Two observed 97.5 percentile consumption rates exceeded the generic 97.5 percentile consumption rates. These were for other vegetables and root vegetables.

Children's consumption rates

15 year old age group

Thirteen children in this age group were identified to be eating locally produced terrestrial food. Consumption of terrestrial foods was identified in the following 12 food groups: green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, milk, pig meat, poultry, eggs, wild/free food, honey and venison. No consumption was identified for the following food groups: cattle meat, sheep meat, rabbits/hares, wild fungi and local cereals. Honey was the only food group consumed at a critical group mean consumption rate higher than its generic 97.5 percentile consumption rate. In addition, the critical group mean consumption rates for green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, milk, pig meat, poultry and eggs were higher than their respective generic mean consumption rates. Only for root vegetables and honey did the observed 97.5 percentile consumption rates exceed the generic 97.5 percentile consumption rates.

10 year old age group

Twelve children in this age group were identified as eating locally produced food. Consumption of terrestrial foods was identified in the following 12 food groups: green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, milk, sheep meat, poultry, eggs, wild/free food, wild fungi and venison. No consumption was identified for the following food groups: cattle meat, pig meat, rabbits/hares, honey and local cereals. Critical group mean consumption rates for all food groups were less than the generic 97.5 percentile consumption rates. The critical group mean consumption rates for green vegetables, other vegetables, root vegetables, sheep meat and eggs were higher than their respective generic mean consumption rates. No food groups observed 97.5 percentile consumption rates exceeded the generic 97.5 percentile consumption rates.

5 year old age group

Three children in this age group were identified as eating locally produced food. Consumption of terrestrial foods was identified in the following nine food groups: green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, cattle meat, sheep meat, eggs and wild/free food. No consumption was identified for the following food groups: milk, pig meat, poultry, rabbits/hares, honey, wild fungi, venison and local cereals. No generic 97.5 percentile or generic mean consumption rates have been determined for this age group so no comparisons with the corresponding observed rates are possible.

6 DIRECT RADIATION PATHWAYS

6.1 Direct radiation survey area

The direct radiation survey area covered all land inside of, and within 1 km of, the UKAEA Winfrith nuclear licensed site perimeter (Figure 2). It included two hamlets – East Burton to the east and East Knighton to the south. The main A352 runs south of the site from east to west. A railway line transected the survey area running parallel to the perimeter fence to the north of the site.

The River Frome runs from the north of the survey area towards the site and then runs eastward along the northern boundary and to the north of East Burton. The survey area contained a significant amount of farmland, both livestock and arable, and there were six working farms. Areas to the south and west of the site were predominantly heathland incorporating Knighton Heath, Winfrith Heath and Whitcombe Vale. Winfrith Heath was owned and managed by the Dorset Wildlife Trust and was a Site of Special Scientific Interest covering an area of 255 acres.

The UKAEA nuclear licensed site covers the western part of a business centre called the Winfrith Technology Centre. Within the licensed site are the UKAEA buildings and also some unrelated businesses. The eastern part of the Winfrith Technology Centre used to be part of the UKAEA site but has now been de-licensed.

6.2 Residential activities

The majority of residents lived in East Burton and East Knighton and the rest lived at a few outlying properties, including some farms. The two hamlets consisted mainly of working couples and retired people and there were very few children.

6.3 Leisure activities

The heaths in the area had public access via footpaths or other permitted paths and many people visited each year. The Dorset Wildlife Trust offered special wildlife education days and guided walks and most heathland areas had visitor centres providing wildlife information.

Dog walkers frequently used the footpaths running along the site boundary.

The riparian rights for this stretch of the River Frome were privately owned so limited numbers of anglers fished there. Small shoots were also held on private land in the survey area.

Staff from the Winfrith Technology Centre used a football pitch in the de-licensed part of the Winfrith Technology Centre.

6.4 Commercial activities

Commercial activities included local businesses, farming, railway operations and conservation and management activities on the heaths. Six farms were located within 1 km of the site perimeter fence.

The Winfrith Technology Centre was the most densely populated part of the direct radiation survey area with approximately 1700 people working there (excluding UKAEA employees). Although this included about 40 businesses, many were comparable and people would be expected to have similar occupancy rates. As a result, only people from a representative cross section of both offices and laboratories were interviewed. Some businesses in the Centre were based inside the UKAEA licensed site and some were based in the de-licensed area. Employees from companies (other than UKAEA) in both areas were included in the survey. Observations for UKAEA employees were not investigated. Employees from only one of these companies spent a significant quantity of their time working outdoors.

6.5 Occupancy rates

Table 53 presents indoor, outdoor and total occupancy data for adults and children and includes distances from the site perimeter fence for where these occupancies took place. An analysis of the data by distance zones and occupancy rates is shown in Table 54. Non-UKAEA employees working on the licensed site are marked by an asterisk in Table 53 and have been assigned a distance of 0.0 metres from the licensed site perimeter.

0 - 0.25 km from the site perimeter fence

Six hundred and thirty six individuals were identified as spending time in the 0 to 0.25 km zone. The majority of observations in this zone were for people working at the Winfrith Technology Centre although the highest total occupancies were for people living in the hamlet of East Knighton. The highest total occupancy rate was for a local resident of 8700 h/y. The highest total occupancy rate for a group of 21 employees was 3900 h/y where 1300 h/y was spent outside.

0.25 – 0.5 km from the site perimeter fence

Six hundred and fifty nine people were identified as spending time in the 0.25 to 0.5 km zone. The majority of observations in this zone were for people at work, mainly at the Dorset Police Headquarters, although the highest total occupancy was for a retired elderly occupant at 8760 h/y. For work related activities, the highest occupancy was 1900 h/y (all spent indoors) for eight employees.

0.5 – 1.0 km from the site perimeter fence

Fifty-nine people were identified as spending time in the 0.5 to 1.0 km zone. All the observations were for residents (including farmers). The highest total occupancy rate was 8700 h/y for a farmer.

6.6 Gamma dose rate measurements

Table 55 presents gamma dose rate measurements in the Winfrith direct radiation survey area. Representative gamma dose rate measurements were taken both inside and outside a selection of residences and businesses and at background locations outside the area. It should be noted that the measurements have not been adjusted for natural background dose rates.

The outdoor measurements, which were taken approximately 2 to 20 metres from the nearest buildings, ranged from 0.047 to 0.067 $\mu\text{Gy/h}$. Outdoor measurements were taken over grass, soil and concrete. The indoor measurements ranged from 0.049 to 0.100 $\mu\text{Gy/h}$. Background gamma dose rate measurements were taken over grass between 3.7 and 6.4 km from the site perimeter fence and ranged from 0.052 to 0.062 $\mu\text{Gy/h}$.

Comprehensive studies of background radiation have been carried out on a national scale by the National Radiological Protection Board (NRPB), the most recent of these being a review conducted during 1999 (Hughes, 1999). The results from these could be used for comparison.

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 Table 56. These are based on information in Annex 1 and are derived irrespective of the magnitude of the rate observed for each pathway.

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.

The National Dose Assessments Working Group (NDAWG) has considered methods for calculating total dose from consumption and occupancy data provided by habits surveys. The relevant adult profiles for Winfrith are shown in Annex 4. Child profiles can be calculated by applying the ratios shown in Annex 3. Further discussion of the use of these data in assessments is given in *Radioactivity in Food and the Environment, 2003* (EA, EHS, FSA and SEPA, 2004).

8 CONCLUSIONS AND SUGGESTIONS

8.1 Survey findings

During the survey, team members interviewed numerous commercial fishermen and terrestrial food producers in the survey area. In addition allotment holders, anglers, beekeepers, game/rough shooters (people shooting deer, pheasants, pigeons, partridges etc), people collecting wild/free foods and wild fungi were identified and interviewed. All consumption rates recorded in this report include only locally produced or caught foods.

Exposure pathways were investigated for 1629 individuals. The survey found that pathways relating to each of the three potential sources of exposure from the UKAEA Winfrith site were present:

- Discharges of liquid radioactive waste to the Weymouth Bay area of the English Channel
- Discharges of gaseous radioactive waste to the atmosphere
- Direct radiation emitted from the site (sometimes called 'station shine')

The adult critical group rates (as defined in Section 3.2) for the separate local aquatic consumption pathways were:

- 40 kg/y for fish
- 15 kg/y for crustaceans
- 14 kg/y for molluscs

The predominant aquatic species consumed by the critical group were plaice, mackerel, bass, pollack, lobsters, edible crabs, scallops and whelks.

The critical group occupancy rates over the separate intertidal substrates were:

- 300 h/y for sand and stones
- 150 h/y for sand

The critical group rate for handling fishing gear was 1200 h/y and for handling of sediment was 10 h/y.

The maximum occupancy rate for time spent in water was 190 h/y for two divers. The maximum occupancy rate for time spent on water was 3200 h/y for a commercial fisherman.

The adult critical group rates for the separate local terrestrial consumption pathways were:

- 31 kg/y for green vegetables
- 32 kg/y for other vegetables
- 34 kg/y for root vegetables
- 90 kg/y for potatoes
- 43 kg/y for domestic fruit
- 120 l/y for milk
- 27 kg/y for cattle meat
- 17 kg/y for pig meat
- 8.5 kg/y for sheep meat
- 1.4 kg/y for goat meat
- 8.9 kg/y for poultry
- 12 kg/y for eggs
- 6.5 kg/y for wild/free foods
- 7.5 kg/y for honey
- 1.2 kg/y for wild fungi
- 4.3 kg/y for venison
- 0.5 kg/y for freshwater fish
- 10 kg/y for freshwater plants

No consumption of rabbits/hares or local cereals was identified. Consumption of foodstuffs by children was also recorded. Combinations of food groups (both aquatic and terrestrial) consumed at critical group rates by individuals, together with their external pathway exposures, are presented in bold type in Annexes 1 and 2.

For occupancy rates of members of the public within 1 km of the UKAEA Winfrith site perimeter, the highest rates (indoors plus outdoors) were:

- 8700 h/y for the 0 to 0.25 km zone
- 8760 h/y for the 0.25 to 0.5 km zone
- 8700 h/y for the 0.5 to 1.0 km zone

In each zone, the highest occupancy rates were due to residency.

8.2 Comparisons with previous surveys

No previous terrestrial or direct radiation surveys have been carried out by CEFAS, therefore comparisons for these exposure pathways cannot be made. However, comparisons can be made with the previous aquatic survey of 1986/87, which updated the 1985 survey. It should be noted that the previous surveys used weighting factors to convert children's consumption rates into adult-equivalent rates. Critical groups therefore included both adults and children, and were based on adult-equivalent consumption rates for the latter.

The 2003 aquatic consumption rate data have all decreased significantly in comparison to the 1986/87 survey. The critical group consumption rate for fish has decreased from 77 kg/y to 40 kg/y. Previously, the maximum consumption rate observed was 140 kg/y and 22 people were included in the critical group. In the 2003 survey, the maximum consumption rate observed was 74 kg/y and 10 people were included in the critical group.

The main species of fish consumed by the critical group in the 1986/87 aquatic survey were plaice, skate, sole, cod, whiting and mackerel. In 2003, the main species were plaice, bass, mackerel, pollack, cod and red gurnard.

The critical group consumption rate for crustaceans has decreased from 26 kg/y to 15 kg/y. Previously, the maximum consumption rate observed was 38 kg/y and 10 people were included in the critical group. In the 2003 survey, the maximum consumption rate observed

was 23 kg/y. Six people were included in the critical group. It should be noted that the previous survey used weighted crustacean consumption rates according to where the crustaceans came from. This was to reflect the wide range of concentrations at the time. Consumption rates for the critical group were therefore the equivalent rates for "Weymouth Bay" crabs. Without such weighting, the critical group consumption rate would have been 44 kg/y (Smith and Hunt, 1989).

The predominant species consumed by the critical group, edible crabs, lobsters and prawns have not changed since 1987.

The critical group consumption rate for molluscs has also significantly decreased from 39 kg/y to 14 kg/y. Previously, the maximum consumption rate observed was 51 kg/y. A total of three people were included in the critical group. In the 2003 survey, the maximum consumption rate observed was 14 kg/y and two people were included in the critical group. The weighting approach described for crustaceans was also used for mollusc, and rates were based on "Weymouth Bay" whelks. Without such weighting, the critical group consumption rates would have been 38 kg/y (Smith and Hunt, 1989).

The main species of molluscs consumed by the critical group in the 1986/87 aquatic survey were whelks, cockles, oysters, mussels, winkles and scallops. In 2003, the main species consumed were scallops and whelks.

Previously, critical group occupancy rates were noted over silt, sand and shingle. In the 2003 survey, these were for sand, and sand and stones. Comparisons are therefore drawn only for sand.

It should be noted that the methodology for determining the critical group has been altered since previous surveys so care is needed when comparing results. However, where the critical group rates for 2003 would have been different using the original methodology, a comment is made in the comparisons.

Occupancy rates over sand have decreased. In the previous surveys the highest rate was 570 h/y and the critical group rate was 520 h/y for two people. In 2003, the maximum rate was 210 h/y and the critical group rate was 150 h/y for seven people. Using the same methodology in 2003 as was used in 1987 would have given a critical group occupancy rate over sand of 160 h/y for five people. In 1987, the main activities noted for the critical group were for a warden and a bait digger. Although two bait diggers were interviewed in the 2003 survey, their occupancy rate was only 10 h/y. Wardens still spend time on the sand and stones at Kimmeridge, taking groups of school children onto the beach, although their occupancy rates have decreased since 1987. The main activities noted in the 2003 survey were angling and walking.

The previous surveys identified a critical group handling rate for commercial fishing gear of 1600 h/y for 13 fishermen and a maximum handling rate of 2100 h/y. The 2003 survey recorded a critical group handling rate of 1200 h/y for 17 people and a maximum handling rate of 1800 h/y. Using the same methodology as for 1987 would have given a critical group handling rate in 2003 of 1400 h/y for eight fishermen.

The previous surveys identified a critical group handling rate for sand/silt of 420 h/y and a maximum handling rate of 470 h/y. The 2003 survey recorded a critical group rate of only 10 h/y for two bait diggers and a maximum handling rate of 10 h/y.

In 1985, the highest occupancy rates in water were for a group of full-time divers associated with the naval base at Portland. Their occupancy in water was 750 h/y. Scallop divers, recreational divers, windsurfers and swimmers were also observed. The 2003 survey recorded a maximum occupancy of 190 h/y for a diver and 580 h/y for a surfer (in water for a percentage of this time). Other activities taking place in water were water sports preparation, swimming and playing. No comparisons can be made for occupancy on water as this was not considered in previous surveys.

Three gamma dose rate measurements were taken during this survey at the same locations where gamma dose rate measurements were taken in 1985. However, direct comparisons cannot be made as the substrate types differ as follows:

	1985 ($\mu\text{Gy/h}$)	2003 ($\mu\text{Gy/h}$)
• Ferry Bridge	0.064 over sand/silt	0.045 over sand
• Kimmeridge	0.073 over clay	0.055 over sand
• Lulworth	0.055 over shingle	0.054 over sand

8.3 Suggestions for environmental monitoring

The 2002 monitoring programmes operated by the Environment Agency and the Food Standards Agency included the following samples and measurements (EA, EHS, FSA and SEPA, 2003):

Aquatic surveillance

- Cod
- Plaice
- Ling
- Crabs
- Pacific oysters
- Cockles
- Whelks
- *Fucus serratus*
- Seaweed
- Seawater
- Gamma dose rate measurements over intertidal areas at Weymouth Bay, Osmington Mills, Ringstead Bay, Durdle Door, Lulworth Cove, Swanage Bay and Poole Harbour

Terrestrial surveillance

- Milk
- Apples

- Cabbage
- Carrots
- Gooseberries
- Honey
- Potatoes
- Grass
- Sediment from north of the site, R Frome (upstream and downstream), and R Win, east of the site
- Freshwater from north of the site, R Frome (upstream and downstream), and R Win, east of the site

It should be noted that the following suggestions put forward in this section for consideration are based solely on the findings of this survey. They are not the outcome of any form of assessment.

For the aquatic monitoring programme, consideration could be given to the following:

- Replace the monitoring of cod and ling with the monitoring of mackerel and bass as they were eaten in greater quantities
- Include the monitoring of lobsters from West Lulworth as they were the most commonly consumed species of crustaceans
- Include scallops from Lulworth Bay as they were eaten in the greatest quantity by critical group consumers.
- Include Manila clams from Portland Harbour as they were commonly consumed
- An additional gamma dose rate measurement over sand and stones at Portland Harbour

For the terrestrial monitoring programme, consideration could be given to the following:

- Monitor onions instead of carrots as they were consumed in greater quantities in the root vegetable group

- Introduce runner beans as they were the most commonly consumed species in the other vegetable group
- Add goats milk to the monitoring programme as it was consumed by members of the critical group for milk.
- Introduce a meat sample as many types of meat from the area were eaten but none are currently monitored. Cattle meat was consumed in the greatest quantities
- Chicken eggs could be monitored as they were eaten by a number of people
- Wild blackberries could be introduced as they were commonly consumed
- Water cress could be monitored as it was consumed in significant quantities

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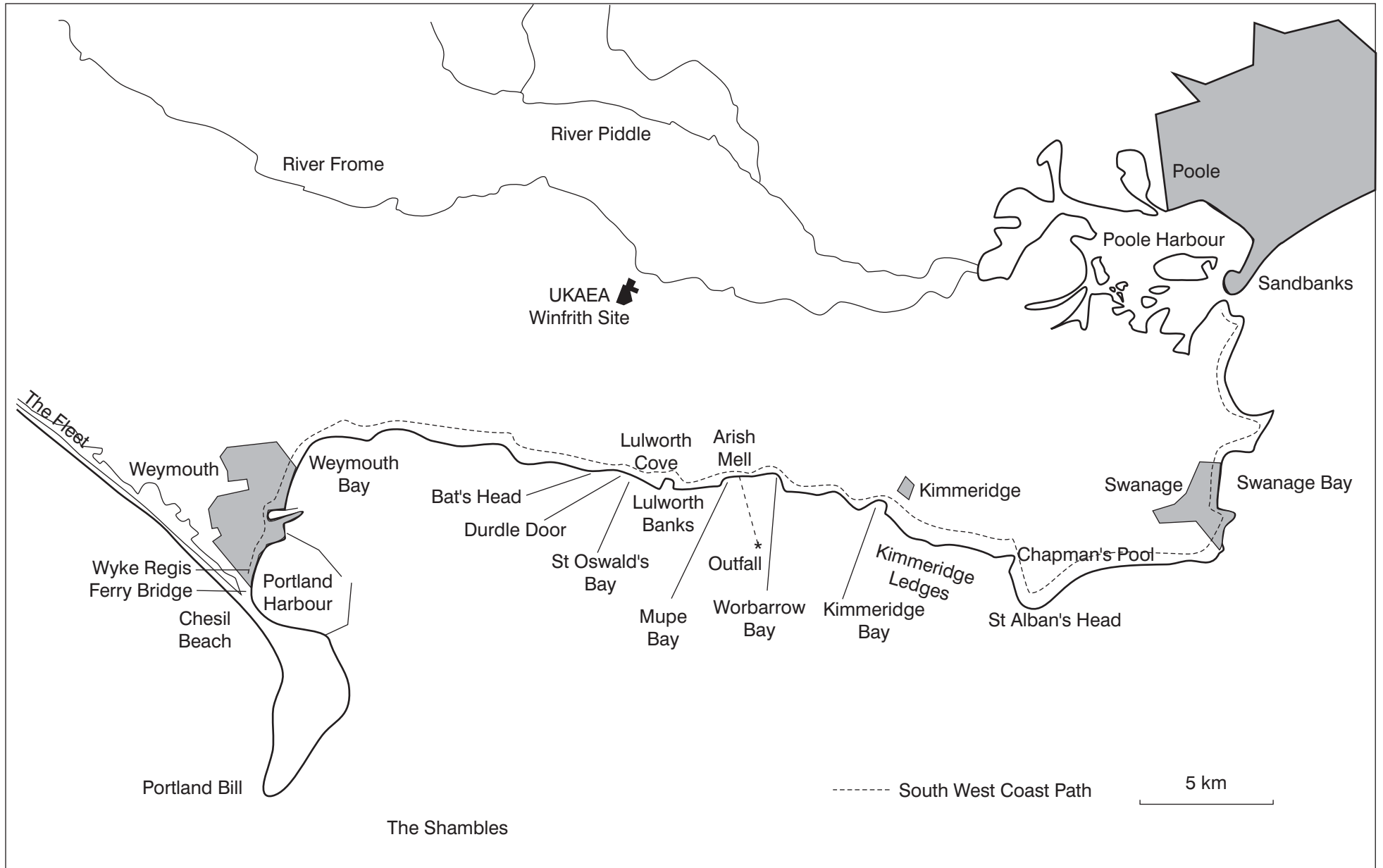


Figure 1. The Winfrith aquatic survey area



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

Key

1 = East Burton Allotments

2 = Wool Allotments

Table 1. Survey coverage

Group	Criteria	Estimate of complete coverage	Number for whom positive data was obtained	Coverage for positive observations	Notes
ALL PATHWAYS					
All potential people in Winfrith aquatic, terrestrial and direct radiation survey areas	Number of people resident in terrestrial survey area (excluding those in direct radiation)	7700 [^]	134 ^{^^}	*	Not all people resident in the 5 km area were interviewed. The survey targeted individuals who were potentially the most exposed (Section 2.4), mostly producers of local food (farmers and allotment tenants)
	Number of people resident in the direct radiation survey area	300	95	**	
	Number of employees in the direct radiation survey area	2230	1259	***	
	Number of people using the aquatic area	Unknown but more than 410	141 ^{^^}	U	Data obtained for people living outside the 5 km area affected by aquatic discharge
	Approximate total for aquatic, terrestrial and direct radiation survey areas	Unknown but more than 10,640	1629 ^{^^}	U	
AQUATIC PATHWAYS					
Commercial fishermen	Number of commercial fishermen actively fishing in survey area	35	21	****	
Boat anglers	Number seen or heard of during survey	20	5	**	
Regular beach users	Number seen in action or spoken to during survey	150	60	***	Mainly anglers and watersport enthusiasts setting up wind and kite boarding equipment
Bait diggers	Number seen in action, spoken to or heard of during survey	2	2	*****	Most anglers interviewed bought their bait
Commercial divers	Number seen in action, spoken to or heard of during survey	6	6	*****	Mollusc collectors
Sport divers	Members of clubs in survey area or people spoken to during survey	100	100	*****	Most data are generic and were provided by club representatives
Watersport participants (excl diving)	Members of clubs in survey area and people seen in action or spoken to during survey period	100	50	***	Most data are generic and were provided by club representatives

TERRESTRIAL PATHWAYS^{^^^}					
Farms	Number of farmers and their family members in the survey area	175	71	***	Estimate of 41 farms in the area, of which 35 farmers were interviewed
Shooting syndicates	Number of club members licensed to shoot in survey area	30	5	*	
Bee keepers	Number of people consuming honey in survey area	U	5	U	Estimate of 5 beekeepers in the area, all of which were interviewed
Allotments	Number of tenants and their family members in the survey area	175	50	**	Estimate of 35 plots in the area, of which 10 tenants were interviewed
DIRECT RADIATION PATHWAYS					
Occupancy of area	Number with occupancies > 100 hours (excluding site employees)	2530	1354	***	
Residences	Number of residents in the survey area	300	95	**	Observations obtained for approximately one third of the residences
Employees	Number of people predominantly based in survey area	2230	1259	***	
BREAKDOWN OF AGE GROUPS					
Adults	Individuals over 17	U	1530	U	
15 year old	More than 12.0 year old to 17.0 year old	U	25	U	
10 year old	More than 7.0 year old to 12.0 year old	U	22	U	
5 year old	More than 2.0 year old to 7.0 year old	U	38	U	
1 year old	More than 1.0 year old to 2.0 year old	U	10	U	
3 months old	From 0 to 1.0 year old	U	4	U	

Notes

[^] - Data from www.statistics.gov.uk were used to estimate this figure for people resident in the 5km survey area

^{^^} - The number of people for whom data was obtained for each pathway listed below, will not necessarily equal the approximate total

This is because some individuals, for example someone who fishes from a boat and the shore and digs their own bait will be counted three times, whereas others, such as the families of fishermen, will not be counted at all.

^{^^^} - four shops, a market garden, a garden nursery, a tearoom and a public house were visited during the survey

U - Unknown

Coverage

* = 1-20% ** = 20 - 40% *** = 40 - 60% **** = 60-80% ***** = 80-100%

Table 2. Typical food groups used in habits surveys

Green vegetables	Globe artichoke, asparagus, broccoli, brussel 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, kohlrabi, leek, onion, parsnip, radish, shallot, spring onion, swede, turnip
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	Milk, butter, cream, cheese, yoghurt, goats milk
Cattle meat †	
Pig meat †	
Sheep meat †	
Poultry	Chicken, duck, goose, grouse, guinea fowl, partridge, pheasant, pigeon, snipe, turkey, woodcock
Eggs	Chicken egg, duck egg, goose egg
Wild/free foods	Blackberry, blackcurrant, chestnut, crab apple, damson, dandelion root, elderberry, nettle, raspberry, rowanberry, samphire, sloe, strawberry, wild apple
Honey	
Wild Fungi	Mushrooms
Rabbits/Hare	Hare, rabbit
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 (fresh water)	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, queens, scallops, razor shell, whelks, winkles

Notes:

* Although squid and cuttlefish are molluscs, radiologically they are more akin to fish

† Including offal

Table 3. Adult consumption rates of fish in the Winfrith area (kg/y)

Observation number	Bass	Cod	Mackerel	Mixed fish	Plaice	Pollack	Red gurnard	Salmon	Total
3				73.7					73.7
4				59.0					59.0
98				41.3					41.3
73			17.7			17.7			35.4
64					35.4				35.4
65					35.4				35.4
79		11.8			11.8		11.8		35.4
86	14.7		14.7						29.5
87	14.7		14.7						29.5
88	14.7		14.7						29.5
100				23.6					23.6
14				17.7				2.6	20.3
13				17.7				1.3	19.0
1095					14.7				14.7
1097					14.7				14.7
1098					14.7				14.7
23				11.8					11.8
24				11.8					11.8
25				11.8					11.8
26				11.8					11.8
27				11.8					11.8
28				11.8					11.8
97				11.8					11.8
1014	10.7								10.7
1015	10.7								10.7
15				10.3					10.3
16				10.3					10.3
93	2.9		2.9			2.9			8.8
94	2.9		2.9			2.9			8.8
95	2.9		2.9			2.9			8.8
1082					7.5				7.5
302	6.4								6.4
74	2.7				2.7				5.4
75	2.7				2.7				5.4
76	2.7				2.7				5.4
77	2.7				2.7				5.4
1092					5.3				5.3
1093					5.3				5.3
1094					5.3				5.3
84	4.1								4.1
85	4.1								4.1
174			3.7						3.7
175			3.7						3.7
101	3.3								3.3
34	0.9		0.9						1.8
35	0.9		0.9						1.8
38	0.9		0.9						1.8
39	0.9		0.9						1.8
206	0.3		1.4						1.7
207	0.3		1.4						1.7
208	0.3		1.4						1.7
278					1.5				1.5
279					1.5				1.5
296	0.9				0.4				1.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the 10 highest adult consumers is 40.4 kg/y

The observed 97.5 percentile rate based on 54 observations is 53.2 kg/y

Table 4. Adult consumption rates of crustaceans in the Winfrith area (kg/y)

Observation number	Common prawn	Edible crab	Spider crab	Lobster	Total
25		9.0		13.7	22.6
26		9.0		13.7	22.6
64		4.5		8.2	12.7
65		4.5		8.2	12.7
296		7.6		2.8	10.4
19	2.8	1.0		4.6	8.4
15-16		3.7		3.7	7.4
93-95	4.5	1.3		0.9	6.7
79	2.8	3.9			6.7
74-77		5.6			5.6
27-28		2.7		2.7	5.4
73	5.3				5.3
13		4.3			4.3
280-281		3.2			3.2
34-35	1.1	1.0		1.1	3.1
38-39	1.1	1.0		1.1	3.1
99-100		3.1			3.1
80-81	2.8				2.8
97-98		2.6			2.6
292		1.3		0.9	2.2
206			2.2		2.2
293-295		1.3			1.3
278-279				1.2	1.2
1010-1011	1.0				1.0
1-2		0.7			0.7
86-87		0.6			0.6
1095		0.3		0.1	0.5
1097-1098		0.3		0.1	0.5
1092-1094		0.2		0.2	0.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 6 highest adult consumers is 14.9 kg/y

The observed 97.5 percentile rate based on 51 observations is 20.2 kg/y

Table 5. Adult consumption rates of molluscs in the Winfrith area (kg/y)

Observation number	Manila clam	Scallop	Razor fish	Whelk	Total
27		10.4		3.4	13.7
28		10.4		3.4	13.7
304		4.3			4.3
54-93	3.9				3.9
286-289		3.2			3.2
75		2.6			2.6
23-24		2.6			2.6
296		2.2			2.2
299-301		2.2			2.2
302		1.1	0.6		1.6
86-87		1.3			1.3
87		1.3			1.3
1097-1098		0.9			0.9
34-35		0.9			0.9
38-39		0.9			0.9
1092-1094		0.3			0.3
89-90		0.2			0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the 2 highest adult consumers is 13.7 kg/y

The observed 97.5 percentile rate based on 39 observations is 13.7 kg/y

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

15 year old age group

Observation number	Age	Bass	Mackerel	Mixed fish	Plaice	Total
1099	16				14.7	14.7
36	14	0.9	0.9			1.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the highest 15 year old consumer is 14.7 kg/y

The observed 97.5 percentile rate based on 2 observations is 14.4 kg/y

10 year old age group

Observation number	Age	Bass	Mackerel	Mixed fish	Plaice	Total
1100	8				14.7	14.7
29	11			8.8		8.8
30	9			8.8		8.8
31	7			8.8		8.8
176	10		3.7			3.7
37	11	0.9	0.9			1.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the 4 highest 10 year old consumers is 10.3 kg/y

The observed 97.5 percentile rate based on 6 observations is 14.0 kg/y

5 year old age group

Observation number	Age	Bass	Mackerel	Mixed fish	Plaice	Total
1101	2				5.9	5.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the highest 5 year old consumer is 5.9 kg/y

The observed 97.5 percentile is not applicable for 1 observation

1 year old age group

Observation number	Age	Bass	Mackerel	Mixed fish	Plaice	Total
18	1			2.9		2.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the highest 1 year old consumer is 2.9 kg/y

The observed 97.5 percentile is not applicable for 1 observation

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

15 year old age group

Observation number	Age	Common prawn	Edible crab	Lobster	Total
36	14	1.1	1.0	1.1	3.1
82	13	2.8			2.8
1099	16		0.3	0.1	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 2 highest 15 year old consumers is 3.0 kg/y

The observed 97.5 percentile rate based on 3 observations is 3.1 kg/y

10 year old age group

Observation number	Age	Common prawn	Edible crab	Lobster	Total
20	10	2.8	1.0	4.6	8.4
21	8	2.8	1.0	4.6	8.4
29	11		2.7	2.7	5.4
30	9		2.7	2.7	5.4
31	7		2.7	2.7	5.4
37	11	1.1	1.0	1.1	3.1
1100	8		0.3	0.1	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 6 highest 10 year old consumers is 6.0 kg/y

The observed 97.5 percentile rate based on 7 observations is 8.4 kg/y

5 year old age group

Observation number	Age	Common prawn	Edible crab	Lobster	Total
83	5	1.4			1.4
1101	2		0.3	0.1	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 2 highest 5 year old consumers is 0.9 kg/y

The observed 97.5 percentile rate based on 2 observations is 1.4 kg/y

1 year old age group

Observation number	Age	Common prawn	Edible crab	Lobster	Total
18	1		1.5	1.5	2.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the highest 1 year old consumer is 2.9 kg/y

The observed 97.5 percentile is not applicable for 1 observation

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

15 year old age group

Observation number	Age	Scallop	Whelk	Total
1099	16	0.9		0.9
36	14	0.9		0.9
91	15	0.2		0.2
92	15	0.2		0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the 2 highest 15 year old consumers is 0.9 kg/y

The observed 97.5 percentile rate based on 4 observations is 0.9 kg/y

10 year old age group

Observation number	Age	Scallop	Whelk	Total
29	11	10.4	3.4	13.7
30	9	10.4	3.4	13.7
31	7	10.4	3.4	13.7
1100	8	0.9		0.9
37	11	0.9		0.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the 3 highest 10 year old consumers is 13.7 kg/y

The observed 97.5 percentile rate based on 5 observations is 13.7 kg/y

5 year old age group

Observation number	Age	Scallop	Whelk	Total
1101	2	0.9		0.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the highest 5 year old consumer is 0.9 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 9. Summary of adults' consumption rates in the Winfrith area (kg/y or l/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	54	10	73.7	29.5	40.4	53.2	15	40
Crustaceans	51	6	22.6	8.4	14.9	20.2	3.5	10
Molluscs	39	2	13.7	13.7	13.7	13.7	3.5	10
Green vegetables	99	12	64.3	25.5	30.7	26.0	15	45
Other vegetables	122	34	57.0	19.1	32.4	55.3	20	50
Root vegetables	99	19	63.1	21.7	34.0	60.8	10	40
Potato	108	9	165.6	60.5	90.1	92.9	50	120
Domestic fruit	107	19	69.3	23.3	43.0	61.0	20	75
Milk	30	24	156.0	68.2	123.2	156.0	95	240
Cattle meat	24	21	31.5	21.0	26.8	31.5	15	45
Pig meat	16	12	20.2	12.6	16.8	20.2	15	40
Sheep meat	19	19	12.0	6.5	8.5	12.0	8	25
Goat meat	4	4	1.4	1.4	1.4	1.4	ND	ND
Poultry	26	15	14.5	5.2	8.9	14.5	10	30
Eggs	85	59	19.4	6.9	12.2	17.8	8.5	25
Wild/free foods	58	14	13.6	4.5	6.5	6.7	7	25
Rabbits/hares	NC	NC	NC	NC	NC	NC	6	15
Honey	40	12	9.1	4.5	7.5	9.1	2.5	9.5
Wild fungi	9	5	1.5	0.7	1.2	1.5	3	10
Venison	9	6	6.4	3.3	4.3	6.4	ND	ND
Fish (freshwater)	3	3	1.1	0.3	0.5	1.1	15	40
Plants (freshwater)	5	5	13.0	8.7	10.4	13.0	ND	ND

ND = not determined

NC = not consumed

Table 10. Summary of 15 year old children's consumption rates in the Winfrith area (kg/y or l/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	2	1	14.7	14.7	14.7	14.4	6.5	20
Crustaceans	3	2	3.1	2.8	3.0	3.1	2.5	6
Molluscs	4	2	0.9	0.9	0.9	0.9	2.5	6
Green vegetables	11	5	26.0	10.3	15.8	23.6	9	25
Other vegetables	11	6	27.7	9.4	17.0	27.7	10	30
Root vegetables	11	8	21.7	11.4	15.8	21.7	7.5	20
Potato	11	4	92.9	36.2	65.6	92.9	60	130
Domestic fruit	10	4	25.8	10.9	15.5	22.9	15	50
Milk	1	1	128.2	128.2	128.2	NA	110	260
Cattle meat	NC	NC	NC	NC	NC	NC	15	35
Pig meat	1	1	18.4	18.4	18.4	NA	10	30
Sheep meat	NC	NC	NC	NC	NC	NC	5.5	15
Poultry	1	1	9.9	9.9	9.9	NA	6.5	20
Eggs	3	3	11.9	9.6	11.1	11.9	7	25
Wild/free foods	5	2	1.5	0.9	1.2	1.5	3	13
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	4	3	7.4	4.5	5.5	7.2	2	5
Wild fungi	NC	NC	NC	NC	NC	NC	2	5.5
Venison	1	1	3.3	3.3	3.3	NA	ND	ND

ND = not determined

NC = not consumed

NA = not applicable

Table 11. Summary of 10 year old children’s consumption rates in the Winfrith area (kg/y or l/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	6	4	14.7	8.8	10.3	14.0	6	20
Crustaceans	7	6	8.4	3.1	6.0	8.4	2.5	7
Molluscs	5	3	13.7	13.7	13.7	13.7	2.5	7
Green vegetables	9	6	13.4	6.8	10.0	12.7	6	20
Other vegetables	10	6	19.1	7.5	10.7	17.7	8	25
Root vegetables	9	7	17.8	8.8	12.9	17.5	6	20
Potato	10	7	36.2	13.5	22.5	34.3	45	85
Domestic fruit	8	2	7.6	5.9	6.7	7.3	15	50
Milk	4	4	138.3	83.0	96.8	134.1	110	240
Cattle meat	NC	NC	NC	NC	NC	NC	15	30
Pig meat	NC	NC	NC	NC	NC	NC	8.5	25
Sheep meat	1	1	6.5	6.5	6.5	NA	4	10
Poultry	4	3	4.5	4.5	4.5	4.5	5.5	15
Eggs	9	6	11.9	5.2	8.4	11.9	6.5	20
Wild/free foods	4	3	0.7	0.7	0.7	0.7	3	11
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	2	7.5
Wild fungi	3	3	0.4	0.4	0.4	0.4	1.5	4.5
Venison	1	1	3.3	3.3	3.3	NA	ND	ND

ND = not determined
 NC = not consumed
 NA = not applicable

Table 12. Summary of 5 year old children’s consumption rates in the Winfrith 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	5.9	5.9	5.9	NA	ND	ND
Crustaceans	2	2	1.4	0.5	0.9	1.4	ND	ND
Molluscs	1	1	0.9	0.9	0.9	NA	ND	ND
Green vegetables	1	1	1.5	1.5	1.5	NA	ND	ND
Other vegetables	2	2	7.5	0.6	4.1	7.3	ND	ND
Root vegetables	1	1	1.3	1.3	1.3	NA	ND	ND
Potato	2	2	3.8	2.8	3.3	3.8	ND	ND
Domestic fruit	1	1	5.9	5.9	5.9	NA	ND	ND
Milk	NC	NC	NC	NC	NC	NC	ND	ND
Cattle meat	1	1	15.4	15.4	15.4	NA	ND	ND
Pig meat	NC	NC	NC	NC	NC	NC	ND	ND
Sheep meat	1	1	3.5	3.5	3.5	NA	ND	ND
Poultry	NC	NC	NC	NC	NC	NC	ND	ND
Eggs	2	2	5.2	3.2	4.2	5.2	ND	ND
Wild/free foods	1	1	0.1	0.1	0.1	NA	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

ND = not determined

NC = not consumed

NA = not applicable

Table 13. Summary of 1 year old children’s consumption rates in the Winfrith 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	2.9	2.9	2.9	NA	ND	ND
Crustaceans	1	1	2.9	2.9	2.9	NA	ND	ND
Molluscs	NC	NC	NC	NC	NC	NC	ND	ND

ND = not determined

NC = not consumed

NA = not applicable

Table 14. Intertidal occupancy rates in the Winfrith area (h/y)

Observation number	Location	Activity	Sand and stones	Sand
307	Portland Harbour	Walking	400	
308	Portland Harbour	Walking	288	
84	Local beaches	Angling		208
306	Portland Harbour	Walking	200	
220	Local beaches	Walking		148
221	Local beaches	Walking		148
222	Local beaches	Walking		148
223	Local beaches	Walking		148
312	Portland Harbour	Walking	120	
224	Lulworth Bay	Walking		108
225	Lulworth Bay	Walking		108
1630	Kimmeridge	Warden at Kimmeride Marine Centre	75	
1631	Kimmeridge	Warden at Kimmeride Marine Centre	75	
310	Portland Harbour	Walking	60	
101	Kimmeridge	Walking		52
102	Kimmeridge	Walking		52
273	Weymouth Bay	Walking		52
274	Weymouth Bay	Walking		52
275	Weymouth Bay	Walking		52
276	Weymouth Bay	Walking		52
277	Weymouth Bay	Walking		52
309	Portland Harbour	Walking	48	
311	Portland Harbour	Walking	38	
103	Local beaches	Playing on beach		24
104	Local beaches	Playing on beach		24
105	Local beaches	Playing on beach		24
206	Local beaches	Dog walking, swimming and walking		24
207	Local beaches	Dog walking, swimming and walking		24
212	Lulworth Bay	Walking	24	
213	Lulworth Bay	Walking	24	
141	Warborrow Bay	Walking	18	
142	Warborrow Bay	Walking	18	
290	Ferrybridge	Bait digging		10
291	Ferrybridge	Bait digging		10

Notes

Emboldened observations are the critical group

The critical group intertidal occupancy rate over sand and stones based on 3 observations is 296 h/y

The observed 97.5 percentile rate for occupancy over sand and stones based on 13 observations is 366 h/y

The critical group intertidal occupancy rate over sand based on 7 observations is 145 h/y

The observed 97.5 percentile rate for occupancy over sand based on 21 observations 178 h/y

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

Observation number	Location	Activity	Fishing gear	Sediment
296	Portland	Gear handling	1750	
297	Portland	Gear handling	1750	
298	Portland	Gear handling	1750	
6	Weymouth Bay	Gear handling	1289	
93	Weymouth Bay	Gear handling	1260	
19	Chatman's Pool	Gear handling	1250	
97	Weymouth Bay	Gear handling	1200	
27	Lulworth Bay	Gear handling	1176	
15	St Albans	Gear handling	1125	
17	Weymouth Bay	Gear handling	1125	
99	Weymouth Bay	Gear handling	1050	
79	Weymouth Bay	Gear handling	1045	
22	Chatman's Pool	Gear handling	938	
5	Weymouth Bay	Gear handling	933	
13	Kimmeridge	Gear handling	720	
23	Kimmeridge	Gear handling	700	
89	Weymouth Bay	Gear handling	675	
74	Weymouth Bay	Gear handling	546	
292	Weymouth Bay	Gear handling	390	
32	Lulworth Bay	Gear handling	385	
33	Lulworth Bay	Gear handling	385	
34	Bat's Head	Gear handling	350	
302	Weymouth Bay	Gear handling	256	
303	Weymouth Bay	Gear handling	256	
278	Weymouth Bay	Gear handling	50	
290	Ferrybridge	Bait digging		10
291	Ferrybridge	Bait digging		10

Notes

Emboldened observations are the critical group

The critical group fishing gear handling rate based on 17 observations is 1161 h/y

The observed 97.5 percentile rate for fishing gear based on 25 observations is 1750 h/y

The critical group sediment handling rate based on 2 observations is 10 h/y

The observed 97.5 percentile rate for sediment based on 2 observations for Sediment is 10 h/y

Table 16. Gamma dose rate measurements over intertidal substrates in the Winfrith area (micro Gy/h)

Location	NGR	Substrate	Gamma dose rate at 1 metre
Ferrybridge, Portland	SY 666 758	Sand	0.045
Portland Harbour beach	SY 668 759	Sand & stones	0.050
Kimmeridge	SY 907 791	Sand	0.055
Osmington Mills	SY 700 818	Sand & stones	0.050
Chapman's Pool	SY 955 772	Sand	0.059
Lulworth Cove	SY 824 799	Sand	0.054

Table 17. Occupancy rates in and on water in the Winfrith area (h/y)

Observation number	Location	Activity	In water	On water	F or S water ^
308	Portland Harbour	Surfing	576		S
42 - 52	Portland Harbour	Surfing	438		S
306	Portland Harbour	Surfing	200		S
307	Portland Harbour	Surfing	200		S
312	Portland Harbour	Surfing	200		S
302-303	Weymouth Bay	Commercial fishing and diving/boating	190	770	S
1095-1096	Lulworth Ledges	Diving/commercial fishing	180	596	S
40-42	Lulworth Bay	Diving/boating	152	60	S
64, 66	Weymouth Bay	Diving/boating	150	450	S
273-277	Weymouth Bay	Diving/boating	150	100	S
271, 272	Weymouth Bay	Diving	150		S
119 - 125*	R. Frome, Moreton	Playing	128		F
311	Portland Harbour	Surfing	113		S
53	Portland Harbour	Diving	110		S
305	Portland Harbour	Surfing	105		S
67-72	Weymouth Bay	Diving/boating	100	300	S
280	Portland	Diving	66		S
282 - 288	Portland	Diving/boating	60	180	S
289	Portland	Diving/boating	60	180	S
74	Weymouth Bay	Commercial fishing/diving	50	774	S
78	Weymouth Bay	Diving/boating	50	150	S
116*	R. Frome, Moreton	Playing	40		F
114*	R. Frome, Moreton	Playing	32		F
115*	R. Frome, Moreton	Playing	32		F
310	Portland Harbour	Surfing	30		S
309	Portland Harbour	Surfing	24		S
217	Unknown	Water sports preparation	20		S
304	Weymouth Bay	Diving/boating	12	12	S
117-118*	R. Frome, Moreton	Playing	10		F
212, 213	Lulworth Bay	Swimming	2		S
5	Weymouth Bay	Commercial fishing		3200	S
15	St Albans	Commercial fishing		2200	S
17	Weymouth Bay	Commercial fishing		2200	S
6	Weymouth Bay	Commercial fishing		1975	S
296 - 298	Portland	Commercial fishing		1750	S
27	Lulworth Bay	Commercial fishing		1512	S
19	Chatman's Pool	Commercial fishing		1500	S
93	Weymouth Bay	Boating		1440	S
97	Weymouth Bay	Boating		1400	S
23	Kimmeridge	Commercial fishing		1300	S
292	Weymouth Bay	Commercial fishing		1260	S
99	Weymouth Bay	Boating		1200	S
79	Weymouth Bay	Commercial fishing		1140	S
22	Chatman's Pool	Commercial fishing		1125	S
89	Weymouth Bay	Boating		1125	S
13	Kimmeridge	Commercial fishing		990	S
32, 33	Lulworth Bay	Commercial fishing		440	S
86	Weymouth Bay	Boating		416	S
34	Bat's Head	Commercial fishing		400	S
278	Weymouth Bay	Commercial fishing		240	S
1014	Kimmeridge	Boat angling		150	S
281	Portland	Angling		130	S

Notes

^ F= Fresh water S= Salt water

* These observations were for children.

114= Male, Age 8

120= Male, Age 9

115= Female, Age 6

121= Male, Age 14

116= Female, Age 9

122= Male, Age 14

117= Male, Age 12

123= Male, Age 14

118= Female, Age 15

124= Male, Age 13

119= Male, Age 8

125= Male, Age 15

Table 18. Adult consumption rates of green vegetables in the Winfrith area (kg/y)

Observation number	Asparagus	Broccoli	Brussel sprout	Cabbage	Cauliflower	Chard	Courgettes	Cucumber	Herbs	Kale	Lettuce	Marrow	Spinach	Squash	Total
239				18.3						32.0	14.1				64.4
1082		20.4		25.5											45.9
101-104	4.8	3.2	4.2	3.9	3.2		0.8	1.0			3.5			1.4	26.0
106-107	4.8	3.2	4.2	3.9	3.2		0.8	1.0			3.5			1.4	26.0
1036-1039	2.1	3.4	4.6	4.3	3.4		2.8	4.3			0.8				25.5
244-247				5.7			2.8			4.6	3.4				16.4
260-266	2.8			10.2							3.3				16.3
170-172		3.7		3.0	1.9		4.9				1.3				14.9
151-152		2.6	2.7	3.2				2.1			2.4		0.6		13.6
143-147		2.0	2.4	2.5	2.0		0.6	0.5		2.7	0.5				13.4
3-4								6.4			6.8				13.1
240-243			3.1	6.4			1.8				1.6				12.9
1087-1091				3.4	1.4			3.4		3.6					11.8
193-194			2.6	6.7	1.0										10.3
197-199			2.6	6.7	1.0										10.3
1016-1017			1.6	3.1			0.7				4.0		0.6		10.0
248-249		2.7		6.8											9.5
1085-1086							3.7	4.3					0.9		8.8
227-228							4.5				3.9				8.4
141-142							5.5		0.3		1.1				6.9
174-175	0.4	2.0		1.6			0.6	0.6			1.3		0.3		6.8
139-140								3.4			3.0				6.4
212-213							3.6				2.4				6.0
216-219		0.9					3.4				1.0				5.3
209							4.5				0.3				4.8
201			1.4					1.4			1.8				4.5
202-203						0.8					3.5				4.3
113											3.2				3.2
127											3.2				3.2
200								1.4			1.8				3.2
229												3.0			3.0
232-235												3.0			3.0
224-225											1.6				1.6
1003-1005											1.5				1.5
251-252				1.4											1.4
255-258				1.4											1.4
220-221							0.9								0.9
1092-1094											0.8				0.8
149-150									0.3						0.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the 12 highest adult consumers is 30.7 kg/y

The observed 97.5 percentile rate based on 99 observations is 26.0 kg/y

Table 19. Adult consumption rates of other vegetables in the Winfrith area (kg/y)

Observation number	Broad bean	Chilli pepper	French Bean	Mangetout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
3-4	10.2		4.1		6.8		30.6		5.4	57.0
216-219	1.1		11.3	1.1			38.3	2.3	1.1	55.3
1085-1086	6.4		1.4		2.7	4.4	2.3		30.6	47.8
1082	8.4						30.6			39.0
209	13.6						10.2		14.4	38.2
227	13.6						10.2		14.4	38.2
224-225	11.2		0.5				12.2		10.8	34.8
260-266	10.1				2.5		15.1			27.7
1014-1015							22.7			22.7
113, 127	2.0				10.0		10.0			22.0
170-172	2.3				6.8		10.0		3.0	22.0
139-140							10.2		10.8	21.0
143-147					3.2		14.3		1.6	19.1
212-213	1.1						11.3		3.6	16.1
1087-1091							7.3		8.6	16.0
1021	4.5				6.8		4.5			15.8
200	4.5	0.5				3.9			6.8	15.8
101-104	1.6		1.6		1.5	0.8	3.6	0.4	5.7	15.3
106-107	1.6		1.6		1.5	0.8	3.6	0.4	5.7	15.3
229,232-235	1.5						1.5		12.0	15.0
997-1000							12.2		2.7	14.9
240-243							10.0		4.5	14.5
228	7.3						7.3			14.5
141-142	5.0		6.8	1.1						12.9
220-221	1.7		2.3	1.4			4.6		2.7	12.6
1036-1039	1.1				1.1	0.7	2.3	1.2	5.4	11.8
201		0.5				3.9			6.8	11.2
1083-1084	7.3						3.4			10.7
151-152					2.3		7.1	0.3	0.9	10.7
239	9.1				0.8					9.8
202-203							5.1	0.7	3.6	9.4

Table 19. Adult consumption rates of other vegetables in the Winfrith area (kg/y)

Observation number	Broad bean	Chilli pepper	French Bean	Mangetout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
1016-1017	2.0		2.2		4.1					8.3
244-247	3.4				2.3		2.3			7.9
1003-1005	1.7						1.7		2.7	6.1
7-12	3.0								1.8	4.8
251-252	1.0				1.8		2.0			4.8
255-258	1.0				1.8		2.0			4.8
1012-1013							4.5			4.5
174-175			0.2				2.6		1.2	3.9
1092-1094	1.5								1.5	3.0
149-150							3.0			3.0
153-158	1.3									1.3
193-194							1.3			1.3
197-199							1.3			1.3
248-249					1.2					1.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of other vegetables based on the 34 highest adult consumers is 32.4 kg/y

The observed 97.5 percentile rate based on 122 observations is 55.3 kg/y

Table 20. Adult consumption rates of root vegetables in the Winfrith area (kg/y)

Observation number	Beetroot	Carrot	Garlic	Jerusalem artichoke	Leek	Onion	Parsnip	Radish	Shallot	Spring onion	Swede	Turnip	Total
3-4	5.1	10.1			10.1	9.5	8.1		0.9		15.3	4.1	63.1
201		11.3	0.9	11.3	5.7	22.7	6.8	1.8		0.2			60.8
200		11.3	0.9	11.3	5.7	22.7	6.8	1.8		0.2			60.8
1021	6.8	13.5				21.6							41.9
197-198		6.7			3.4	23.6	2.6				2.1		38.4
151-152	3.6	7.2				5.8		2.9	1.3	1.6	4.6		26.9
1082	4.5	8.5				6.6	5.4						25.0
227	2.3	6.8				12.5			2.8				24.3
209	2.3	5.6				12.5			3.4				23.8
260-266	2.5	7.5			1.3	5.0	4.0		0.9	0.6			21.7
239	0.6	0.8				17.6	0.9		0.5	0.3			20.6
220-221	17.8												17.8
1085-1086	1.1	2.3				10.8	2.7						16.9
174-175	1.4	3.8	0.4			8.9	0.5		1.7				16.6
193-194		6.7			3.4		2.6				2.1		14.8
199		6.7			3.4		2.6				2.1		14.8
216-219	0.6	6.8				4.4	1.8	0.6					14.1
170-172	2.3	2.3			2.3	5.4	1.8						14.0
251-252	2.3	1.4				4.3			0.7	0.4	3.0		12.1
255-258	2.3	1.4				4.3			0.7	0.4	3.0		12.1
1016-1017	0.5	5.4			1.4	2.2	2.2						11.6
101-104		2.1	0.2		1.7	1.6	0.8		0.5		4.6		11.4
106-107		2.1	0.2		1.7	1.6	0.8		0.5		4.6		11.4
113		2.5			7.2			0.3		0.3			10.4
127		2.5			7.2			0.3		0.3			10.4
212-213						9.1							9.1
143-147	1.6	1.6				2.6	0.6		2.3				8.8
1083-1084						8.6							8.6

Table 20. Adult consumption rates of root vegetables in the Winfrith area (kg/y)

Observation number	Beetroot	Carrot	Garlic	Jerusalem artichoke	Leek	Onion	Parsnip	Radish	Shallot	Spring onion	Swede	Turnip	Total
141-142	5.0					0.9			1.8				7.7
228						7.3							7.3
1036-1039		2.3			0.6	3.6							6.4
1003		3.8				1.7							5.4
1087-1091		2.7				2.6							5.3
244-247						2.3				2.3			4.5
1004-1005		1.7				1.7							3.4
139-140	2.7									0.6			3.3
1092-1094						3.0							3.0
248-249					0.8	2.2							3.0
240-243	1.6	1.1											2.7
229, 232-235		1.5				1.1							2.6
202-203								0.7					0.7
238						0.4							0.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of root vegetables based on the 19 highest adult consumers is 34.0 kg/y

The observed 97.5 percentile rate based on 99 observations is 60.8 kg/y

Table 21. Adult consumption rates of potato in the Winfrith area (kg/y)

Observation number	Potato
1021	165.6
193-194 197-199	92.9
1092-1094	60.5
209, 227	50.8
240-243	44.5
1083-1084	43.7
141-142	41.6
101-104 106-107	40.6
220-221	36.2
1082	30.3
143-147	27.9
1014-1015	25.4
260-266	25.3
202-203	22.0
1016-1017	21.8
151-152	21.0
224-225	19.7
244-247	19.1
3-4	18.2
229	16.8
232-235	16.8
216-219	16.6
251-252 255-258	14.7
248-249	13.5
113, 127	11.3
997-1000	10.1
174-175	10.0
1036-1039	9.1
170-172	9.1
7-12	8.5
153-158	5.6
149-150	5.0
239	4.6
1003-1005	3.4
1012-1013	1.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of potatoes based on the 9 highest adult consumers is 90.1 kg/y

The observed 97.5 percentile rate based on 108 observations is 92.9 kg/y

Table 22. Adult consumption rates of domestic fruit in the Winfrith area (kg/y)

Observation number	Apple	Black-berry	Black-currant	Cherry	Damson	Goose-berry	Grapes	Logan-berry	Melon	Pear	Plum	Pumpkin	Rasp-berry	Red-currant	Rhubarb	Straw-berry	Tay-berry	White-currant	Total
1021	37.5									13.6	13.6				4.6				69.3
1036-1039	18.8	6.1	2.8			2.0				3.4	9.1		2.6		1.7	8.5	6.0		61.0
1085-1086	18.8		2.8						1.7	13.6			8.1	4.5	1.2	5.7	4.0		60.4
1082	12.5		28.4								2.3		6.8						49.9
200-201	4.5		17.0	0.2	2.3	1.8	1.8	2.3	1.7				6.8	0.5		2.3	1.8	0.5	43.5
227	27.6							5.7							3.4				36.7
1014-1015	13.6									6.8	9.1								29.5
101-104	8.6		7.3			1.0			0.7	6.2			0.6		1.4				25.8
1083-1084	18.8										4.5								23.3
1012-1013	18.8																		18.8
106-107			7.3			1.0			0.7	6.2			0.6		1.4				17.2
3-4	16.3																		16.3
216	3.4		0.7			1.4		1.1			4.5		0.5	0.1	0.7	1.1			13.5
260-266		3.8											3.8		5.1				12.7
217-219	3.4		0.7			1.4		1.1			4.5		0.5	0.1	0.7				12.4
153-158			4.1			2.3							3.9			1.5			11.7
209								5.7			2.5				3.4				11.6
149-150	2.5		2.0	0.5		1.0							3.0		2.5				11.5
1003-1005															10.9				10.9
212-213	6.8												1.1		2.3				10.2
239															0.4		8.0		8.3
174-175						1.4							2.0	0.8		3.4			7.6
170-172						6.8													6.8
224-225	2.3	0.2								3.4									5.9
202-203	4.5															0.3			4.9
1092-1094	3.0	1.5																	4.5
1025-1026	4.2																		4.2
1087-1091			2.3			1.6													3.9
141-142													2.7			0.2			2.9
143-147		0.2													2.0	0.2			2.4
7-12															2.3				2.3

Table 22. Adult consumption rates of domestic fruit in the Winfrith area (kg/y)

Observation number	Apple	Black-berry	Black-currant	Cherry	Damson	Goose-berry	Grapes	Logan-berry	Melon	Pear	Plum	Pumpkin	Rasp-berry	Red-currant	Rhubarb	Straw-berry	Tay-berry	White-currant	Total
1022-1024			0.8			0.8								0.8					2.3
108-109													0.7			1.4			2.0
151-152															1.8				1.8
193-194	1.3																		1.3
197-199	1.3																		1.3
220-221													0.3		0.9				1.2
1-2		1.1																	1.1
1016-1017	0.5			0.3															0.8
248-249												0.3				0.5			0.8
997-1000													0.2						0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the 19 highest adult consumers is 43.0 kg/y

The observed 97.5 percentile rate based on 107 observations is 61.0 kg/y

Table 23. Adult consumption rates of milk in the Winfrith area (l/y)

Observation number	Cows milk	Goats milk	Sheep milk	Total
112	156.0			156.0
113	156.0			156.0
127	156.0			156.0
128	156.0			156.0
130	156.0			156.0
143	138.3			138.3
144	138.3			138.3
145	138.3			138.3
146	138.3			138.3
147	138.3			138.3
101		128.2		128.2
102		128.2		128.2
103		128.2		128.2
104		128.2		128.2
106		128.2		128.2
107		128.2		128.2
170	103.4			103.4
171	103.4			103.4
172	103.4			103.4
173	103.4			103.4
1016		83.0		83.0
1017		83.0		83.0
184	68.2			68.2
185	68.2			68.2
1014		25.6		25.6
1015		25.6		25.6
108			12.0	12.0
109			12.0	12.0
110			12.0	12.0
111			12.0	12.0

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of milk based on the 24 highest adult consumers is 123.2 l/y

The observed 97.5 percentile rate based on 30 observations is 156.0 l/y

Table 24. Adult consumption rates of cattle meat in the Winfrith area (kg/y)

Observation number	Cattle meat
7-12	31.5
177-178 180-183	30.8
184-192	21.0
1092-1094	7.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of cattle meat based on the 21 highest adult consumers is 26.8 kg/y

The observed 97.5 percentile rate based on 24 observations is 31.5 kg/y

Table 25. Adult consumption rates of pig meat in the Winfrith area (kg/y)

Observation number	Pig meat
1-2	20.2
101-104 106-107	18.4
1036-1039	12.7
1085-1086	4.5
184-185	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of pig meat based on the 12 highest adult consumers is 16.8 kg/y

The observed 97.5 percentile rate based on 16 observations is 20.2 kg/y

Table 26. Adult consumption rates of sheep meat in the Winfrith area (kg/y)

Observation number	Sheep meat
1092-1094	12.0
108-111	11.3
177-178 180-183	7.0
163-168	6.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of sheep meat based on the 19 highest adult consumers is 8.5 kg/y

The observed 97.5 percentile rate based on 19 observations is 12.0 kg/y

Table 27. Adult consumption rates of goat meat in the Winfrith area (kg/y)

Observation number	Goat meat
101-104	1.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of goat meat based on the 4 highest adult consumers is 1.4 kg/y

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

Table 28. Adult consumption rates of poultry in the Winfrith area (kg/y)

Observation number	Chicken	Duck	Goose	Partridge	Pheasant	Pigeon	Turkey	Total
200-201		2.7	2.2	1.1	8.5			14.5
184-185				3.5	6.8			10.3
101-104, 106-107	3.8	3.3	0.9				2.0	9.9
1092-1094				1.9	1.2	0.1	3.0	6.2
141-142		3.4			1.8			5.2
1016-1017	4.5							4.5
143-147					0.9			0.9
170-173		0.5			0.5			0.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of poultry based on the 15 highest adult consumers is 8.9 kg/y

The observed 97.5 percentile rate based on 26 observations is 14.5 kg/y

Table 29. Adult consumption rates of eggs in the Winfrith area (kg/y)

Observation number	Chicken egg	Duck egg	Goose egg	Total
1014-1015	17.8	1.4	0.3	19.4
108-111	17.8			17.8
141-142	17.8			17.8
161-164	17.8			17.8
184-185	17.8			17.8
228	17.8			17.8
1092-1094	17.8			17.8
143-147	11.9			11.9
251-252 255-258	11.9			11.9
229, 232-235	10.4			10.4
101-104 106-107	5.7	3.8	0.1	9.6
1-2, 1010-1011	8.9			8.9
1082-1086	8.9			8.9
1012-1013	8.2			8.2
240-243	7.4			7.4
1016-1017	7.1			7.1
3-4	6.9			6.9
153-158	6.4			6.4
1087-1091	4.7			4.7
151-152	4.1			4.1
1007-1008, 1021	4.1			4.1
7-12	3.0			3.0
174-175	2.7			2.7
248-249	0.2			0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of eggs based on the 59 highest adult consumers is 12.2 kg/y

The observed 97.5 percentile rate based on 85 observations is 17.8 kg/y

Table 30. Adult consumption rates of wild/free foods in the Winfrith area (kg/y)

Observation number	Blackberry	Blackcurrant	Sloe	Total
1082	4.5		9.1	13.6
153	6.7			6.7
154	6.7			6.7
155	6.7			6.7
156	6.7			6.7
157	6.7			6.7
158	6.7			6.7
241	3.4	2.7		6.1
242	3.4	2.7		6.1
243	3.4	2.7		6.1
240	3.4	1.8		5.2
1022	4.5			4.5
1023	4.5			4.5
1024	4.5			4.5
101	0.5		2.3	2.7
151	1.7		1.0	2.7
152	1.7		1.0	2.7
200	0.5		1.8	2.3
201	0.5		1.8	2.3
209	2.3			2.3
227	2.3			2.3
239	1.8			1.8
1021	1.8			1.8
1092			1.7	1.7
1093			1.7	1.7
1094			1.7	1.7
1025	1.5			1.5
1026	1.5			1.5
184	0.5		0.7	1.1
185	0.5		0.7	1.1
1083	1.1			1.1
1084	1.1			1.1
1003	0.9			0.9
1004	0.9			0.9
1005	0.9			0.9
141	0.7		0.1	0.8
142	0.7		0.1	0.8
1016-1017			0.7	0.7
997-1000	0.6			0.6
102-104	0.5			0.5
106-107	0.5			0.5
193-194	0.4			0.4
197-199	0.4			0.4
1087-1091	0.2			0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild/free foods based on the 14 highest adult consumers is 6.5 kg/y

The observed 97.5 percentile rate based on 58 observations is 6.7 kg/y

Table 31. Adult consumption rates of honey in the Winfrith area (kg/y)

Observation number	Honey
1036-1039	9.1
101-104	7.4
106-107	7.4
202-203	4.5
1-2	2.7
209	2.7
227	2.7
151	2.3
1085-1086	0.7
1092-1094	0.7
133-135	0.5
184-185	0.5
1007-1008	0.5
216-219	0.2
224-225	0.2
1003-1005	0.2
141-142	0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of honey based on the 12 highest adult consumers is 7.5 kg/y

The observed 97.5 percentile rate based on 40 observations is 9.1 kg/y

Table 32. Adult consumption rates (kg/y) of wild fungi in the Winfrith area

Observation number	Mushrooms
1092	1.5
1093	1.5
1094	1.5
184	0.7
185	0.7
1016	0.4
1017	0.4
224	0.2
225	0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild fungi based on the 5 highest adult consumers is 1.2 kg/y

The observed 97.5 percentile rate based on 9 observations is 1.5 kg/y

Table 33. Adult consumption rates of venison in the Winfrith area (kg/y)

Observation number	Venison
200	6.4
201	6.4
34	3.3
35	3.3
38	3.3
39	3.3
1092	0.6
1093	0.6
1094	0.6

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of venison based on the 6 highest adult consumers is 4.3 kg/y

The observed 97.5 percentile rate based on 9 observations is 6.4 kg/y

Table 34. Adult consumption rates of freshwater fish in the Winfrith area (kg/y)

Observation number	Brown Trout	Rainbow Trout	Total
96		1.1	1.1
141	0.3		0.3
142	0.3		0.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of freshwater fish based on the 3 highest adult consumers is 0.5 kg/y

The observed 97.5 percentile rate based on 3 observations is 1.1 kg/y

Table 35. Adult consumption rates of freshwater plants in the Winfrith area (kg/y)

Observation number	Watercress
210	13.0
211	13.0
206	8.7
207	8.7
208	8.7

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of freshwater plants based on the 5 highest adult consumers is 10.4 kg/y

The observed 97.5 percentile rate based on 5 observations is 13.0 kg/y

Table 36. Children's consumption rates of green vegetables in the Winfrith area (kg/y)

10 year old age group

Observation number	Age	Asparagus	Broccoli	Brussel sprout	Cabbage	Cauliflower	Chard	Courgettes	Cucumber	Kale	Lettuce	Marrow	Spinach	Squash	Total
176	10	0.4	2.0		1.6			0.6	0.6		1.3		0.3		6.8
237	8											1.5			1.5
259	10				1.4										1.4
223	11							0.9							0.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the 6 highest 10 year old consumers is 10.0 kg/y

The observed 97.5 percentile rate based on 9 observations is 12.7 kg/y

5 year old age group

Observation number	Age	Asparagus	Broccoli	Brussel sprout	Cabbage	Cauliflower	Chard	Courgettes	Cucumber	Kale	Lettuce	Marrow	Spinach	Squash	Total
236	6											1.5			1.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the highest 5 year old consumer is 1.5 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 37. Children's consumption rates of other vegetables in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Broad bean	French bean	Mangetout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
267	16	10.1			2.5		15.1			27.7
268	16	10.1			2.5		15.1			27.7
105	15	1.6	1.6		1.5	0.8	3.6	0.4	5.7	15.3
222	13	1.7	2.3	1.4			4.6		2.7	12.6
204	16						5.1	0.7	3.6	9.4
205	13						5.1	0.7	3.6	9.4
1006	14	1.7					1.7		2.7	6.1
253	16	1.0			1.8		2.0			4.8
254	16	1.0			1.8		2.0			4.8
195	14						1.3			1.3
196	13						1.3			1.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of other vegetables based on the 6 highest 15 year old consumers is 17.0 kg/y

The observed 97.5 percentile rate based on 11 observations is 27.7 kg/y

10 year old age group

Observation number	Age	Broad bean	French bean	Mangetout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
148	10				3.2		14.3		1.6	19.1
223	11	1.7	2.3	1.4			4.6		2.7	12.6
1018	9	2.0	2.2		4.1					8.3
1019	8	2.0	2.2		4.1					8.3
1020	8	2.0	2.2		4.1					8.3
237	8	0.8					0.8		6.0	7.5
259	10	1.0			1.8		2.0			4.8
176	10		0.2				2.6		1.2	3.9
250	9				1.2					1.2
159	7	0.7								0.7

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of other vegetables based on the 6 highest 10 year old consumers is 10.7 kg/y

The observed 97.5 percentile rate based on 10 observations is 17.7 kg/y

5 year old age group

Observation number	Age	Broad bean	French bean	Mangetout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
236	6	0.8					0.8		6.0	7.5
160	5	0.7								0.7

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of other vegetables based on the 2 highest 5 year old consumers is 4.1 kg/y

The observed 97.5 percentile rate based on 2 observations is 7.3 kg/y

Table 38. Children's consumption rates of root vegetables in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Beetroot	Carrot	Garlic	Leek	Onion	Parsnip	Radish	Shallot	Spring onion	Swede	Total
268	16	2.5	7.5		1.3	5.0	4.0		0.9	0.6		21.7
267	16	2.5	7.5		1.3	5.0	4.0		0.9	0.6		21.7
222	13	17.8										17.8
195	14		6.7		3.4		2.6				2.1	14.8
196	13		6.7		3.4		2.6				2.1	14.8
253	16	2.3	1.4			4.3			0.7	0.4	3.0	12.1
254	16	2.3	1.4			4.3			0.7	0.4	3.0	12.1
105	15		2.1	0.2	1.7	1.6	0.8		0.5		4.6	11.4
1006	14		1.7			1.7						3.4
204	16							0.7				0.7
205	13							0.7				0.7

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of root vegetables based on the 8 highest 15 year old consumers is 15.8 kg/y

The observed 97.5 percentile rate based on 11 observations is 21.7 kg/y

10 year old age group

Observation number	Age	Beetroot	Carrot	Garlic	Leek	Onion	Parsnip	Radish	Shallot	Spring onion	Swede	Total
223	11	17.8										17.8
176	10	1.4	3.8	0.4		8.9	0.5		1.7			16.6
259	10	2.3	1.4			4.3			0.7	0.4	3.0	12.1
1018	9	0.5	5.4		1.4	2.2	2.2					11.6
1019	8	0.5	5.4		1.4	2.2	2.2					11.6
1020	8	0.5	5.4		1.4	2.2	2.2					11.6
148	10	1.6	1.6			2.6	0.6		2.3			8.8
250	9				0.8	2.2						3.0
237	8		0.8			0.6						1.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of root vegetables based on the 7 highest 10 year old consumers is 12.9 kg/y

The observed 97.5 percentile rate based on 9 observations is 17.5 kg/y

5 year old age group

Observation number	Age	Beetroot	Carrot	Garlic	Leek	Onion	Parsnip	Radish	Shallot	Spring onion	Swede	Total
236	6		0.8			0.6						1.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of root vegetables based on the highest 5 year old consumer is 1.3 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 39. Children's consumption rates of potato in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Potato
195	14	92.9
196	13	92.9
105	15	40.6
222	13	36.2
267	16	25.3
268	16	25.3
204	16	22.0
205	13	22.0
253	16	14.7
254	16	14.7
1006	14	3.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of potatoes based on the 4 highest 15 year old consumers is 65.6 kg/y

The observed 97.5 percentile rate based on 11 observations is 92.9 kg/y

10 year old age group

Observation number	Age	Potato
223	11	36.2
148	10	27.9
1018	9	21.8
1019	8	21.8
1020	8	21.8
259	10	14.7
250	9	13.5
176	10	10.0
237	8	3.8
159	7	2.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of potatoes based on the 7 highest 10 year old consumers is 22.5 kg/y

The observed 97.5 percentile rate based on 10 observations is 34.3 kg/y

5 year old age group

Observation number	Age	Potato
236	6	3.8
160	5	2.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of potatoes based on the 2 highest 5 year old consumers is 3.3 kg/y

The observed 97.5 percentile rate based on 2 observations is 3.8 kg/y

Table 40. Children's consumption rates of domestic fruit in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Apple	Blackberry	Blackcurrant	Cherry	Gooseberry	Melon	Pear	Pumpkin	Raspberry	Redcurrants	Rhubarb	Strawberry	Total
105	15	8.6		7.3		1.0	0.7	6.2		0.6		1.4		25.8
268	16		3.8							3.8		5.1		12.7
267	16		3.8							3.8		5.1		12.7
1006	14											10.9		10.9
204	16	4.5											0.3	4.9
205	13	4.5											0.3	4.9
1027	14	4.2												4.2
222	13		0.1							0.3		0.9		1.4
195	14	1.3												1.3
196	13	1.3												1.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the 4 highest 15 year old consumers is 15.5 kg/y

The observed 97.5 percentile rate based on 10 observations is 22.9 kg/y

Table 40. Children's consumption rates of domestic fruit in the Winfrith area (kg/y)

10 year old age group

Observation number	Age	Apple	Blackberry	Blackcurrant	Cherry	Gooseberry	Melon	Pear	Pumpkin	Raspberry	Redcurrants	Rhubarb	Strawberry	Total
176	10					1.4				2.0	0.8		3.4	7.6
159	7			2.0		1.2				1.9			0.7	5.9
148	10		0.2									2.0	0.2	2.4
223	11		0.1							0.3		0.9		1.4
1018	9	0.5			0.3									0.8
1019	8	0.5			0.3									0.8
1020	8	0.5			0.3									0.8
250	9								0.3				0.5	0.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the 2 highest 10 year old consumers is 6.7 kg/y

The observed 97.5 percentile rate based on 8 observations is 7.3 kg/y

5 year old age group

Observation number	Age	Apple	Blackberry	Blackcurrant	Cherry	Gooseberry	Melon	Pear	Pumpkin	Raspberry	Redcurrants	Rhubarb	Strawberry	Total
160	5			2.0		1.2				1.9			0.7	5.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the highest 5 year old consumer is 5.9 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 41. Children's consumption rates of milk in the Winfrith area (l/y)

15 year old age group

Observation number	Age	Cows milk	Goats milk	Total
105	15		128.2	128.2

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of milk based on the highest 15 year old consumer is 128.2 l/y
The observed 97.5 percentile is not applicable for 1 observation

10 year old age group

Observation number	Age	Cows milk	Goats milk	Total
148	10	138.3		138.3
1018	9		83.0	83.0
1019-1020	8		83.0	83.0

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of milk based on the 4 highest 10 year old consumers is 96.8 l/y
The observed 97.5 percentile rate based on 4 observations is 134.1 l/y

Table 42. Children's consumption rates of cattle meat in the Winfrith area (kg/y)

5 year old age group

Observation number	Age	Cattle meat
179	5	15.4

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the highest 5 year old consumer is 15.4 kg/y
The observed 97.5 percentile is not applicable for 1 observation

Table 43. Children's consumption rates of pig meat in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Pig meat
105	15	18.4

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of pig meat based on the highest 15 year old consumer is 18.4 kg/y
The observed 97.5 percentile is not applicable for 1 observation

Table 44. Children's consumption rates of sheep meat in the Winfrith area (kg/y)

10 year old age group

Observation number	Age	Sheep meat
169	7	6.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of sheep meat based on the highest 10 year old consumer is 6.5 kg/y

The observed 97.5 percentile is not applicable for 1 observation

5 year old age group

Observation number	Age	Sheep meat
179	5	3.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of sheep meat based on the highest 5 year old consumer is 3.5 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 45. Children's consumption rates of goat meat in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Goat meat
105	15	1.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of goat meat based on the highest 15 year old consumer is 1.4 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 46. Children's consumption rates of poultry in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Chicken	Duck	Goose	Pheasant	Turkey	Total
105	15	3.8	3.3	0.9		2.0	9.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of poultry based on the highest 15 year old consumer is 9.9 kg/y

The observed 97.5 percentile is not applicable for 1 observation

10 year old age group

Observation number	Age	Chicken	Duck	Goose	Pheasant	Turkey	Total
1018	9	4.5					4.5
1019	8	4.5					4.5
1020	8	4.5					4.5
148	10				0.9		0.9

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of poultry based on the 3 highest 10 year old consumers is 4.5 kg/y

The observed 97.5 percentile rate based on 4 observations is 4.5 kg/y

Table 47. Children's consumption rates of eggs in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Chicken egg	Duck egg	Goose egg	Total
253	16	11.9			11.9
254	16	11.9			11.9
105	15	5.7	3.8	0.1	9.6

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of eggs based on the 3 highest 15 year old consumers is 11.1 kg/y

The observed 97.5 percentile rate based on 3 observations is 11.9 kg/y

10 year old age group

Observation number	Age	Chicken egg	Duck egg	Goose egg	Total
148	10	11.9			11.9
259	10	11.9			11.9
1018	9	7.1			7.1
1019	8	7.1			7.1
1020	8	7.1			7.1
237	8	5.2			5.2
159	7	3.2			3.2
176	10	2.7			2.7
250	9	0.2			0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of eggs based on the 6 highest 10 year old consumers is 8.4 kg/y

The observed 97.5 percentile rate based on 9 observations is 11.9 kg/y

5 year old age group

Observation number	Age	Chicken egg	Duck egg	Goose egg	Total
236	6	5.2			5.2
160	5	3.2			3.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of eggs based on the 2 highest 5 year old consumers is 4.2 kg/y

The observed 97.5 percentile rate based on 2 observations is 5.2 kg/y

Table 48. Children's consumption rates of wild/free foods in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Blackberry	Sloe	Total
1027	14	1.5		1.5
1006	14	0.9		0.9
105	15	0.5		0.5
195	14	0.4		0.4
196	13	0.4		0.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild/free foods based on the 2 highest 15 year old consumers is 1.2 kg/y

The observed 97.5 percentile rate based on 5 observations is 1.5 kg/y

10 year old age group

Observation number	Age	Blackberry	Sloe	Total
1018	9		0.7	0.7
1019	8		0.7	0.7
1020	8		0.7	0.7
159	7	0.1		0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild/free foods based on the 3 highest 10 year old consumers is 0.7 kg/y

The observed 97.5 percentile rate based on 4 observations is 0.7 kg/y

5 year old age group

Observation number	Age	Blackberry	Sloe	Total
160	5	0.1		0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild/free foods based on the highest 5 year old consumer is 0.1 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 49. Children's consumption rates of honey in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Honey
105	15	7.4
204	16	4.5
205	13	4.5
1006	14	0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of honey based on the 3 highest 15 year old consumers is 5.5 kg/y

The observed 97.5 percentile rate based on 4 observations is 7.2 kg/y

Table 50. Children's consumption rates of wild fungi in the Winfrith area (kg/y)

10 year old age group

Observation number	Age	Mushrooms
1018	9	0.4
1019	8	0.4
1020	8	0.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild fungi based on the 3 highest 10 year old consumers is 0.4 kg/y

The observed 97.5 percentile rate based on 3 observations is 0.4 kg/y

Table 51. Children's consumption rates of venison in the Winfrith area (kg/y)

15 year old age group

Observation number	Age	Venison
36	14	3.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of venison based on the highest 15 year old consumer is 3.3 kg/y

The observed 97.5 percentile is not applicable for 1 observation

10 year old age group

Observation number	Age	Venison
37	11	3.3

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of venison based on the highest 10 year old consumer is 3.3 kg/y

The observed 97.5 percentile is not applicable for 1 observation

Table 52. Percentage contribution each food type makes to its terrestrial food group for adults

Green vegetables		Domestic fruit		Wild/free foods	
*Cabbage	29.6 %	*Apple	31.7 %	Blackberry	74.6 %
Lettuce	15.3 %	Blackcurrant	12.1 %	Sloe	18.1 %
Courgettes	9.7 %	Rhubarb	10.1 %	Blackcurrant	7.2 %
Broccoli	8.5 %	Raspberry	8.9 %		
Brussel sprout	8.4 %	Pear	8.1 %	Freshwater plants	
Kale	7.6 %	Plum	7.2 %	Watercress	100.0 %
Cucumber	7.2 %	*Gooseberry	5.2 %		
Cauliflower	5.5 %	Strawberry	5.2 %		
Asparagus	5.3 %	Blackberry	4.3 %		
Marrow	1.4 %	Tayberry	3.1 %		
Other (4 varieties)	1.4 %	Loganberry	1.5 %		
		Redcurrants	1.0 %		
		Other (6 varieties)	1.6 %		
Other vegetables		Milk			
Runner bean	46.3 %	*Cows milk	66.1 %		
Tomato	21.8 %	Goats milk	32.3 %		
Broad bean	16.5 %	Sheep milk	1.6 %		
Pea	7.8 %				
French Bean	4.7 %	Poultry			
Pepper	1.3 %	Pheasant	29.3 %		
Other (3 varieties)	1.6 %	Chicken	23.5 %		
		Duck	18.0 %		
Root vegetables		Turkey	14.0 %		
Onion	34.7 %	Partridge	9.8 %		
*Carrot	23.4 %	Goose	5.3 %		
Beetroot	10.9 %	Pigeon	0.1 %		
Parsnip	8.2 %				
Swede	7.2 %	Eggs			
Leek	7.1 %	Chicken egg	96.8 %		
Shallot	3.2 %	Duck egg	3.1 %		
Artichoke	1.7 %	Goose egg	0.2 %		
Spring onion	1.6 %				
Other (3 varieties)	1.9 %				

NOTES

Food type asterisked and emboldened were monitored by FSA in 2002 (EA, EHS, FSA and SEPA, 2003)

Other food groups monitored were honey and potatoes

Percentages are based on the consumption of all adults in the survey consuming that particular food group

Table 53. Occupancy rates in the Winfrith direct radiation survey area for adults and children (h/y)

Observation Number	Sex (U if unknown)	Age (in years) (U if unknown)	Distance from site perimeter fence (km)	Indoor occupancy	Outdoor occupancy	Total occupancy
0 to 0.25 km zone						
1088	M	U	0.25	6608	2100	8708
1082	F	U	0.25	6466	2190	8656
1084	M	U	0.25	6674	1750	8424
1087	F	U	0.25	6296	2100	8396
1083	F	U	0.25	6574	1750	8324
1085	M	U	0.25	5256	1596	6852
1086	F	U	0.25	5256	1596	6852
1089-1091	M	U	0.25	5512	686	6198
370-389*	M	U	0.00	1460	730	2190
367-368	M	U	0.01	1815	206	2021
406-447*	M	U	0.00	1783	115	1898
448-450*	M	U	0.00	633	1265	1898
451-469*	F	U	0.00	1783	115	1898
922-924	M	U	0.01		1840	1840
926	M	U	0.01	1702	138	1840
471-605	F	U	0.10	1739		1739
606-921	M	U	0.10	1739		1739
927-954	M	U	0.05	1582	83	1665
955-967	F	U	0.05	1582	83	1665
369	F	U	0.01	1598		1598
968-987	M	U	0.05	1160	61	1221
988-995	F	U	0.05	1160	61	1221
391-392*	M	U	0.00	920		920
393-405*	F	U	0.00	920		920
0.25 to 0.5 km zone						
228	M	60	0.30	7031	1729	8760
1007	M	U	0.50	5184	3456	8640
1008	F	U	0.50	5184	3456	8640
1012	F	U	0.50	6516	1860	8376
1013	M	U	0.50	7911	465	8376
1011	F	U	0.50	7616	690	8306
3	M	56	0.50	4611	3646	8256
4	F	54	0.50	4611	3646	8256
112	M	53	0.50	6776	1436	8212
193	F	36	0.45	7314	884	8198
1009	F	U	0.50	6456	1620	8076
227	F	60	0.30	6492	1376	7868
239	M	72	0.50	6712	1092	7804
209	M	60	0.30	6300	1460	7760
1	M	63	0.30	5528	2080	7608
2	F	60	0.30	5528	2080	7608
197	F	74	0.45	7394	154	7548
198	M	72	0.45	6438	1110	7548
997	F	U	0.50	5268	1400	6668
1001	M	U	0.50	5826	750	6576
1002	F	U	0.50	5826	750	6576
194	M	39	0.45	5129	1351	6480
1043	M	U	0.45	3084	3084	6168
199	M	42	0.45	5624	312	5936
1000	M	U	0.50	5168	750	5918
1004	F	U	0.50	5222	690	5912
1005	F	U	0.50	5672	240	5912
1006	F	14	0.50	5672	240	5912
1041	F	U	0.45	2892	2892	5784

Table 53. Occupancy rates in the Winfrith direct radiation survey area for adults and children (h/y)

Observation Number	Sex (U if unknown)	Age (in years) (U if unknown)	Distance from site perimeter fence (km)	Indoor occupancy	Outdoor occupancy	Total occupancy
0.25 to 0.5 km zone						
1040	M	U	0.45	2870	2870	5740
195	F	14	0.45	5419	208	5627
196	M	13	0.45	5419	208	5627
1010	M	U	0.50	5205	276	5481
998	M	U	0.50	4718	200	4918
1042	F	U	0.45	914	2134	3048
999	M	U	0.50	2318	100	2418
321	M	4	0.40	1560	690	2250
322	M	3	0.40	1560	690	2250
323	M	3	0.40	1560	690	2250
324	F	3	0.40	1560	690	2250
325	M	2	0.40	1560	690	2250
326	F	3	0.40	1560	690	2250
327	M	2	0.40	1560	690	2250
328	F	2	0.40	1560	690	2250
329	M	1	0.40	1560	690	2250
330	F	1	0.40	1560	690	2250
331	F	0.6	0.40	1560	690	2250
1003	M	U	0.50	2140	92	2232
113	M	27	0.50	1200	960	2160
1044-1045	M	U	0.45	1920		1920
1046-1051	F	0.7	0.45	1920		1920
313	F	18	0.40	1150	690	1840
314	F	40	0.40	1150	690	1840
315-320	F	U	0.40	1150	690	1840
1102-1224	M	U	0.30	1800		1800
1225-1253	F	U	0.30	1800		1800
1260-1367	M	U	0.30	1665		1665
1368-1559	F	U	0.30	1665		1665
332	M	4	0.40	660	690	1350
333-342	M	3	0.40	660	690	1350
343-347	F	3	0.40	660	690	1350
348-354	M	2	0.40	660	690	1350
355	F	2	0.40	660	690	1350
356-360	M	1	0.40	660	690	1350
361-362	F	1	0.40	660	690	1350
363-364	M	0.5	0.40	660	690	1350
365	F	0.5	0.40	660	690	1350
1052-1071	F	U	0.45	1000		1000
1072-1081	M	U	0.45	1000		1000
1254-1258	M	U	0.30	900		900
1259	F	U	0.30	900		900
1560-1584	M	U	0.30	833		833
1585-1629	F	U	0.30	833		833
200	M	43	0.45	360	360	720
366	U	U	0.40	130		130
0.5 to 1.0 km zone						
1021	M	U	0.63	5856	2856	8712
238	F	U	0.80	7512	1092	8604
212	M	62	0.75	7172	1276	8448
135	F	83	0.80	8124	220	8344
217	F	50	0.75	6968	1260	8228
1037	F	U	0.60	7423	735	8158
161	F	40	0.60	6336	1664	8000

Table 53. Occupancy rates in the Winfrith direct radiation survey area for adults and children (h/y)

Observation Number	Sex (U if unknown)	Age (in years) (U if unknown)	Distance from site perimeter fence (km)	Indoor occupancy	Outdoor occupancy	Total occupancy
0.5 to 1.0 km zone						
1025	M	U	0.60	6096	1848	7944
132	F	88	0.90	7762	168	7930
213	F	62	0.75	6883	1045	7928
1023	M	U	0.75	6768	1152	7920
1026	F	U	0.60	6046	1848	7894
139	F	58	0.80	6655	1200	7855
1022	M	U	0.75	6396	1404	7800
141	M	65	0.60	5608	2190	7798
214	M	68	0.75	6316	1176	7492
215	F	67	0.75	6316	1176	7492
126	M	82	0.90	6128	1190	7318
129	F	81	0.90	6128	1190	7318
226	F	55	0.75	6228	1064	7292
150	F	58	0.90	7072	170	7242
149	M	60	0.90	6279	912	7191
224	M	59	0.75	6037	904	6941
225	M	23	0.75	6037	904	6941
140	F	17	0.80	6794	50	6844
142	F	61	0.60	5701	1095	6796
133	F	47	0.80	5770	850	6620
220	M	44	0.75	5305	1246	6551
216	M	53	0.75	5378	1120	6498
221	F	41	0.75	5250	1246	6496
222	F	13	0.75	5250	1246	6496
223	F	11	0.75	5250	1246	6496
1014	M	U	0.70	4533	1764	6297
137	F	53	0.70	5864	282	6146
1027	F	14	0.60	4274	1848	6122
134	M	49	0.80	5165	730	5895
162	M	41	0.60	4216	1664	5880
1036	M	U	0.60	5316	490	5806
1015	F	U	0.70	4042	1764	5806
1024	M	U	0.75	5008	564	5572
136	M	55	0.70	5264	196	5460
1016	F	50	0.63	1900	2856	4756
1017	M	59	0.63	2208	2184	4392
1018	M	9	0.63	2300	1860	4160
1019	F	8	0.63	2300	1860	4160
1020	F	8	0.63	2300	1860	4160
138	M	30	0.70	3862	52	3914
218	M	19	0.75	2460	1260	3720
219	M	22	0.75	2460	1260	3720
1038-1039	F	U	0.60	3216		3216
1028-1031	F	U	0.60	240	1680	1920
1032-1033	F	U	0.60	240	1394	1634
1034-1035	F	U	0.60	60	542	602

Notes

* Occupancy takes place inside the boundary of the nuclear licensed site

Table 54. Analysis of occupancy rates in the Winfrith direct radiation survey area

0 to 0.25 km zone	
Number of hours per year	Number of observations
8000 to 8760	5
7000 to 8000	0
6000 to 7000	5
5000 to 6000	0
4000 to 5000	0
3000 to 4000	0
2000 to 3000	22
1000 to 2000	589
0 to 1000	15

0.25 to 0.5 km zone	
Number of hours per year	Number of observations
8000 to 8760	11
7000 to 8000	7
6000 to 7000	5
5000 to 6000	10
4000 to 5000	1
3000 to 4000	1
2000 to 3000	14
1000 to 2000	532
0 to 1000	78

0.5 to 1 km zone	
Number of hours per year	Number of observations
8000 to 8760	7
7000 to 8000	15
6000 to 7000	13
5000 to 6000	6
4000 to 5000	5
3000 to 4000	5
2000 to 3000	0
1000 to 2000	6
0 to 1000	2

**Table 55. Gamma dose rate measurements for the Winfrith direct radiation survey
(micro Gy/h)**

Location	Distance from perimeter (km)	NGR	Ground type	Gamma dose rate at 1 metre
Police HQ - reception	0.03	SY 826 866	Concrete/indoors	0.055
Police HQ - carpark	0.03	SY 826 866	Tarmac	0.060
Police portacabin	0.015	SY 825 867	Inside-wood	0.050
Police portacabin	0.015	SY 825 868	Outside - grass	0.052
House 1, East Burton	0.70	SY 831 866	Grass	0.059
House 1, East Burton	0.70	SY 831 866	Concrete/indoors	0.073
House 2, East Burton	0.70	SY 831 865	Grass	0.057
House 2, East Burton	0.70	SY 831 865	Indoors	0.100
Farm 1, East Burton	0.70	SY 827 860	Grass	0.064
Farm 1, East Burton	0.70	SY 827 860	Indoors	0.058
Business 1, Winfrith	0.05	SY 819 869	Grass	0.067
Business 1, Winfrith	0.05	SY 819 869	Concrete/indoors	0.049
Business 2, Winfrith	0.13	SY 823 868	Grass	0.062
Business 2, Winfrith	0.13	SY 823 868	Concrete/indoors	0.054
Business 3, Winfrith	0.45	SY 827 864	Grass	0.064
Business 3, Winfrith	0.45	SY 827 864	Indoors	0.055
House 3, East Burton	0.80	SY 831 868	Grass	0.062
House 3, East Burton	0.80	SY 831 868	Indoors	0.075
House 4, East Burton	0.80	SY 831 867	Concrete	0.062
House 4, East Burton	0.80	SY 831 867	Indoors	0.065
House 5, East Burton	0.10	SY 813 862	Grass	0.050
House 6, East Burton	0.30	SY 808 862	Soil	0.053
House 7, East Burton	0.30	SY 812 863	Grass	0.047
House 7, East Burton	0.30	SY 812 860	Grass	0.052
East Burton	0.70	SY 830 868	Grass	0.058
East Burton	0.70	SY 830 869	Grass	0.053

Background 1 (East Stoke)	4.7	SY 890 868	Grass	0.052
Background 2 (Affpuddle)	6.4	SY 801 937	Grass	0.057
Background 3 (Crossways)	4.4	SY 765 880	Grass	0.062
Background 4 (Marley Wood)	3.7	SY 812 826	Grass	0.059

Annex 1. Summary of adult consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Winfrith area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance of residence from Winfrith site (km) (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potatoes	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Goat meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Venison	Fish (freshwater)	Plants (freshwater)	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 site perimeter fence	Outdoor occupancy within 1 km of site perimeter fence			
1	M	63	0.3		0.7						1.1			20.2				8.9		2.7										5528	2080				
2	F	60	0.3		0.7						1.1			20.2				8.9		2.7											5528	2080			
3	M	56	0.5	73.7			13.1	57.0	63.1	18.2	16.3							6.9												4611	3646				
4	F	54	0.5	59.0			13.1	57.0	63.1	18.2	16.3							6.9												4611	3646				
5	M	42	U																								933			3200					
6	M	34	U																								1289			1975					
7	F	45	3.0					4.8		8.5	2.3		31.5					3.0																	
8	F	18	3.0					4.8		8.5	2.3		31.5					3.0																	
9	M	U	3.0					4.8		8.5	2.3		31.5					3.0																	
10	M	U	3.0					4.8		8.5	2.3		31.5					3.0																	
11	M	U	3.0					4.8		8.5	2.3		31.5					3.0																	
12	M	U	3.0					4.8		8.5	2.3		31.5					3.0																	
13	M	51	15.0	19.0	4.3																						720			990					
14	F	U	15.0	20.3																															
15	M	46	15.0	10.3	7.4																							1125			2200				
16	F	U	15.0	10.3	7.4																														
17	M	U	15.0																										1125			2200			
19	M	48	15.0		8.4																								1250			1500			
22	M	U	U																										938			1125			
23	M	50	11.0	11.8		2.6																							700			1300			
24	F	50	11.0	11.8		2.6																													
25	M	83	7.0	11.8	22.6																														
26	F	80	7.0	11.8	22.6																														
27	M	40	8.0	11.8	5.4	13.7																							1176			1512			
28	F	38	8.0	11.8	5.4	13.7																													
32	M	U	8.0																											385			440		
33	M	U	8.0																											385			440		
34	M	56	9.5	1.8	3.1	0.9																	3.3						350			400			
35	F	U	9.5	1.8	3.1	0.9																	3.3												
38	M	U	U	1.8	3.1	0.9																	3.3												
39	F	U	U	1.8	3.1	0.9																	3.3												
40	M	40	U																												152		60		
41	M	40	U																												152		60		
42	M	30	U																												438				

Annex 1. Summary of adult consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Winfrith area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance of residence from Winfrith site (km) (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potatoes	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Goat meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Venison	Fish (freshwater)	Plants (freshwater)	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 site perimeter fence	Outdoor occupancy within 1 km of site perimeter fence
406-447	M	U	U																											1783	115	
448-450	M	U	U																											633	1265	
451-469	F	U	U																											1783	115	
471-605	F	U	U																											1739		
606-921	M	U	U																											1739		
922-924	M	U	U																												1840	
926	M	U	U																											1702	138	
927-954	M	U	U																											1582	83	
955-967	F	U	U																											1582	83	
968-987	M	U	U																											1160	61	
988-995	F	U	U																											1160	61	
997	F	U	0.5					14.9		10.1	0.2								0.6										5268	1400		
998	M	U	0.5					14.9		10.1	0.2								0.6										4718	200		
999	M	U	0.5					14.9		10.1	0.2								0.6										2318	100		
1000	M	U	0.5					14.9		10.1	0.2								0.6										5168	750		
1001	M	U	0.5																											5826	750	
1002	F	U	0.5																											5826	750	
1003	M	U	0.5				1.5	6.1	5.4	3.4	10.9								0.9	0.2									2140	92		
1004	F	U	0.5				1.5	6.1	3.4	3.4	10.9								0.9	0.2									5222	690		
1005	F	U	0.5				1.5	6.1	3.4	3.4	10.9								0.9	0.2									5672	240		
1007	M	U	0.5																4.1		0.5									5184	3456	
1008	F	U	0.5																4.1		0.5									5184	3456	
1009	F	U	0.5																											6456	1620	
1010	M	U	0.5		1.0																									5205	276	
1011	F	U	0.5		1.0																									7616	690	
1012	F	U	0.5					4.5		1.8	18.8																			6516	1860	
1013	M	U	0.5					4.5		1.8	18.8																			7911	465	
1014	M	U	0.7	10.7				22.7		25.4	29.5	25.6							19.4										150	4533	1764	
1015	F	U	0.7	10.7				22.7		25.4	29.5	25.6							19.4											4042	1764	
1016	F	50	0.6				10.0	8.3	11.6	21.8	0.8	83.0						4.5	7.1	0.7		0.4							1900	2856		
1017	M	59	0.6				10.0	8.3	11.6	21.8	0.8	83.0						4.5	7.1	0.7		0.4							2208	2184		
1021	M	U	0.6					15.8	41.9	165.6	69.3								4.1		1.8								5856	2856		
1022	M	U	0.8									2.3																		6396	1404	
1023	M	U	0.8									2.3																		6768	1152	

Annex 2. Summary of children's consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Winfrith area

Observation number	Sex (U if unknown)	Age in years	Distance of residence from Winfrith site (km) (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potatoes	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Goat meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Venison	Intertidal occupancy over sand	Handling sediment	Occupancy in water	Indoor occupancy within 1 km of site perimeter fence	Outdoor occupancy within 1 km of site perimeter fence	
15 year old age group																												
117	M	12	U																							10		
82	F	13	U		2.8																							
124	M	13	2.0																							128		
196	M	13	0.5				10.3	1.3	14.8	92.9	1.3							0.4								5419	208	
205	M	13	0.3				4.3	9.4	0.7	22.0	4.9									4.5								
222	F	13	0.8				0.9	12.6	17.8	36.2	1.4															5250	1246	
36	F	14	9.5	1.8	3.1	0.9																						
121	M	14	2.0																							128		
122	M	14	2.0																							128		
123	M	14	2.0																							128		
195	F	14	0.5				10.3	1.3	14.8	92.9	1.3							0.4								5419	208	
1006	F	14	0.5				1.5	6.1	3.4	3.4	10.9								0.9	0.2						5672	240	
1027	F	14	0.6								4.2								1.5							4274	1848	
91	F	15	U				0.2																					
92	F	15	U				0.2																					
105	F	15	0.3				26.0	15.3	11.4	40.6	25.8	128.2		18.4		1.4	9.9	9.6	0.5	7.4				24				
118	F	15	U																								10	
125	M	15	2.0																							128		
291	M	15	U																									
204	M	16	0.3				4.3	9.4	0.7	22.0	4.9									4.5								
253	F	16	U				1.4	4.8	12.1	14.7								11.9										
254	M	16	U				1.4	4.8	12.1	14.7								11.9										
267	M	16	U				16.3	27.7	21.7	25.3	12.7																	
268	M	16	U				16.3	27.7	21.7	25.3	12.7																	
1099	U	16	U	14.7	0.5	0.9																						
10 year old age group																												
31	M	7	8.0	8.8	5.4	13.7																						
159	M	7	2.0					0.7		2.8	5.9								3.2	0.1								
169	F	7	3.5												6.5													
21	M	8	15.0		8.4																							
114	M	8	2.0																								32	
119	M	8	2.0																								128	
237	M	8	0.8				1.5	7.5	1.3	3.8									5.2									
1019	F	8	0.6				10.0	8.3	11.6	21.8	0.8	83.0					4.5	7.1	0.7		0.4					2300	1860	

Annex 2. Summary of children's consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Winfrith area

Observation number	Sex (U if unknown)	Age in years	Distance of residence from Winfrith site (km) (U if unknown)	Fish	Crustaceans	Molluscs	Green vegetables	Other vegetables	Root vegetables	Potatoes	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Goat meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Venison	Intertidal occupancy over sand	Handling sediment	Occupancy in water	Indoor occupancy within 1 km of site perimeter fence	Outdoor occupancy within 1 km of site perimeter fence	
10 year old age group																												
1020	F	8	0.6				10.0	8.3	11.6	21.8	0.8	83.0					4.5	7.1	0.7		0.4						2300	1860
1100	U	8	U	14.7	0.5	0.9																						
30	F	9	8.0	8.8	5.4	13.7																						
116	F	9	U																							40		
120	M	9	2.0																						128			
250	M	9	U				9.5	1.2	3.0	13.5	0.8							0.2										
1018	M	9	0.6				10.0	8.3	11.6	21.8	0.8	83.0					4.5	7.1	0.7		0.4					2300	1860	
20	M	10	15.0		8.4																							
148	F	10	2.0				13.4	19.1	8.8	27.9	2.4	138.3					0.9	11.9										
176	M	10	2.0	3.7			6.8	3.9	16.6	10.0	7.6							2.7										
259	M	10	U				1.4	4.8	12.1	14.7								11.9										
29	F	11	8.0	8.8	5.4	13.7																						
37	F	11	9.5	1.8	3.1	0.9																3.3						
223	F	11	0.8				0.9	12.6	17.8	36.2	1.4											148			5250	1246		
5 year old age group																												
325	M	2	U																							1560	690	
327	M	2	U																							1560	690	
328	F	2	U																							1560	690	
348	M	2	U																							660	690	
349	M	2	U																							660	690	
350	M	2	U																							660	690	
351	M	2	U																							660	690	
352	M	2	U																							660	690	
353	M	2	U																							660	690	
354	M	2	U																							660	690	
355	F	2	U																							660	690	
1101	U	2	U	5.9	0.5	0.9																						
322	M	3	U																							1560	690	
323	M	3	U																							1560	690	
324	F	3	U																							1560	690	
326	F	3	U																							1560	690	
333	M	3	U																							660	690	
334	M	3	U																							660	690	
335	M	3	U																							660	690	
336	M	3	U																							660	690	

Annex 3. 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
Direct radiation	1.000	1.000
External exposure	0.500	0.030
Plume	1.000	1.000

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 data for wild fruit and nuts for infants and 10 yr old children.
4. Game includes rabbits/hares and venison

Annex 4. Summary of Winfrith profiled habits data

Profile Name	Pathway Name	Crustaceans	Direct radiation	Eggs	Freshwater fish	Sea fish	Domestic fruit	Wild/free foods	Exposure over sediment ¹	Honey	Cattle meat	Game meat ²	Pig meat	Poultry	Sheep meat	Milk	Molluscs	Wild fungi	Occupancy in water	Occupancy on water	Freshwater plants	Plume (IN; 0-0.25km) ³	Plume (MID; 0.25-0.5km) ³	Plume (OUT; 0.5-1km) ³	Green vegetables	Other vegetables	Potato	Root vegetables	
		kg	h	kg	kg	kg	kg	kg	h	kg	kg	kg	kg	kg	kg	l	kg	kg	h	h	kg	h	h	h	kg	kg	kg	kg	
Crustaceans		14.9				15.9											0.4		30	620									
Direct radiation			8760	0.2		0.1	0.7		0.5				0.1			0.4							890	870	240	0.4	0.9	1.0	0.6
Eggs		0.1	3270	12.2		3.1	8.9	0.9	3.2	0.9	1.2		2.7	2.0	1.6	31.6		0.1				660	1200	840	7.3	12.5	21.2	7.9	
Freshwater fish			5840	11.9	0.5		2.0	0.5	12.0	0.1			3.5											4860	4.6	8.6	27.7	5.1	
Sea fish		4.1	1750	1.4		40.4	3.3										0.3		20	200			1650		2.6	11.4	3.6	12.6	
Domestic fruit			6450	6.6		1.7	43.0	1.5	8.0	3.7	0.3	0.7	7.0	3.6		29.7				10		2060	450	2170	15.0	20.6	30.7	17.6	
Wild/free foods			2500	5.5		0.5	9.1	6.5														620		1520	7.0	7.5	17.3	2.6	
Exposure over sediment			2920			0.7	0.4		232.0										160					2170	0.3	4.2	12.1	5.9	
Honey			2920	4.8		0.3	32.6	0.4	12.7	7.5	0.5		13.4	4.6		64.1								1700	22.2	13.2	27.0	8.0	
Cattle meat				2.5			0.6	0.1			26.8			1.0	2.0	6.5		0.1								1.4	2.4		
Game meat		2.1	1460			1.2	14.5	0.8				4.3		4.8			0.6			70			120		1.3	4.5		20.3	
Pig meat		0.1	4380	6.3		0.3	32.0	0.4	12.7	7.2	0.5		16.8	4.6		64.1							1270	1700	21.5	11.6	23.3	7.8	
Poultry		0.1	1750	12.2		1.3	16.3	1.2	12.5	3.2	4.6	1.0	7.4	8.9	2.4	60.4	0.1	0.4					50	970	12.0	10.2	33.9	14.3	
Sheep meat		0.1		8.4		0.8	0.9	0.3		0.1	10.9	0.1		1.0	8.5	2.5		0.2								0.1	0.5	9.5	0.5
Milk			1460	7.0		0.1	7.2	0.4	6.3	1.9	2.0		4.6	3.9		123.2		0.1					430	380	12.3	13.1	19.8	8.3	
Molluscs		5.4				11.8											13.7			760									
Wild fungi		0.2		17.8		3.2	2.7	1.5		0.6	12.9	0.4	0.2	7.8	7.2	27.3	0.2	1.2								0.5	1.8	36.3	1.8
Occupancy in water									67.2										400										
Occupancy on water		3.1				5.4											1.1			1640									
Freshwater plants		0.4				1.0			9.6												10.4								
Plume pathways (inner area)			8760	6.8		0.7	23.7	1.7		0.1			0.9									7480				12.2	23.6	11.8	10.3
Plume pathways (middle area)		0.1	8760	2.9		4.1	4.9	0.4		0.4			1.3			4.9							7090			5.2	9.0	20.2	10.3
Plume pathways (outer area)			8760	2.9		0.5	11.2	0.5	13.2	0.9			1.1	0.4		4.8									6680	4.2	12.2	12.6	5.0
Green vegetables			4380	5.6		0.9	36.7	1.7	12.7	6.7	0.5		13.4	4.6		64.1						720	650	1700	30.7	15.7	26.2	11.6	
Other vegetables			4640	4.1		4.7	14.5	0.5	6.4	0.2			0.3	0.2		40.1						660	1010	1850	10.9	32.4	20.3	16.3	
Potato		0.1	5840	6.4		1.8	9.9	1.0		0.2	2.5	0.2		2.1	4.0		0.1	0.5					3970	970	6.0	3.5	90.1	19.1	
Root vegetables			4150	1.8		7.4	20.1	1.6		0.4		0.7		1.5								460	2520	460	13.4	25.8	38.9	34.0	

Notes

1. Sediment includes occupancy over sand and stones and sand only
2. Game meat includes rabbits/hares and venison
3. Plume times are the sums of individuals' indoor and outdoor times



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