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Scottish Environment Protection Agency
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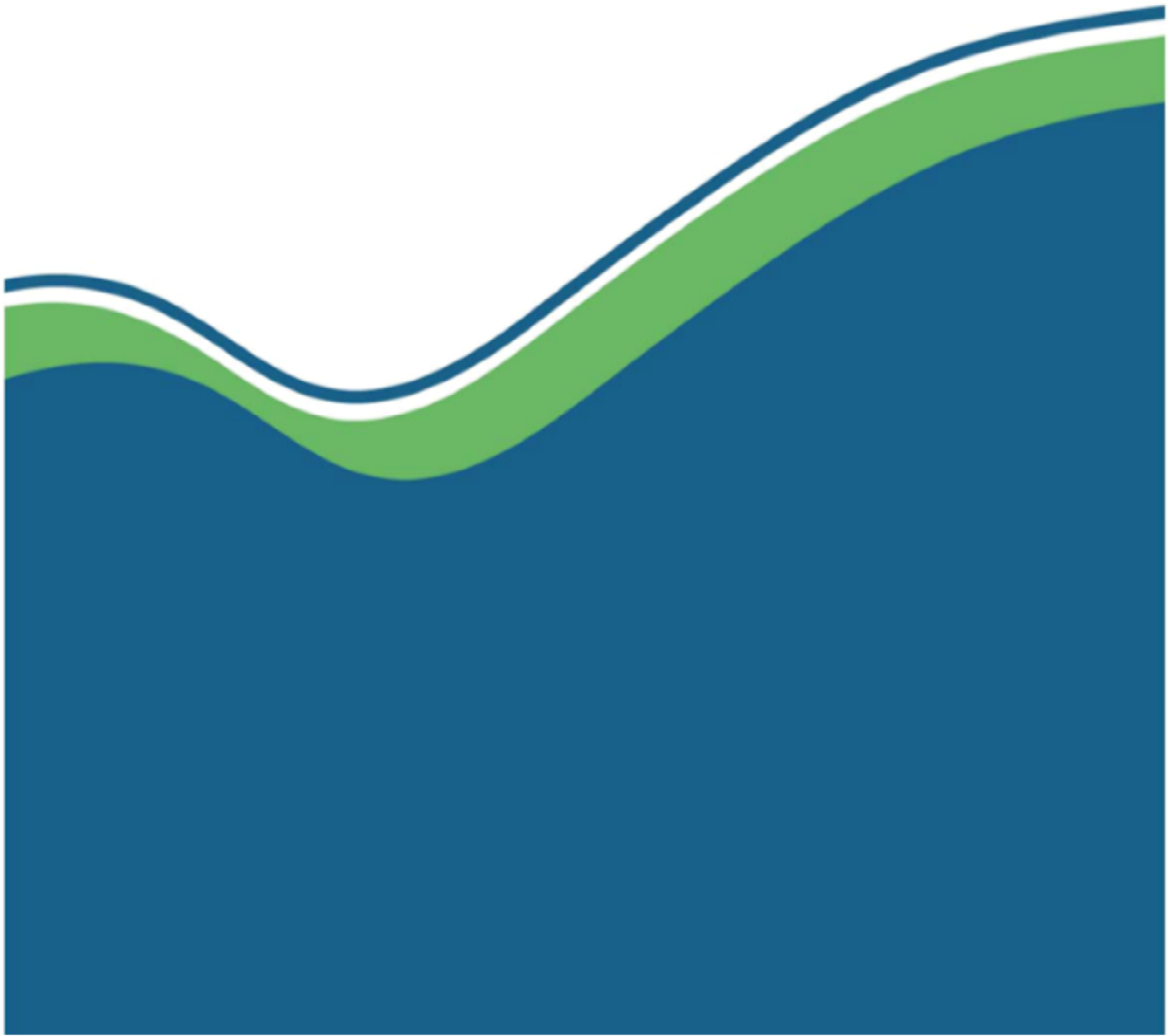
Radiological Habits Survey: Hunterston 2017



Radiological Habits Survey: Hunterston 2017

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List of Abbreviations and Definitions

AGRs	Advanced Gas-Cooled Reactors
BSS	Basic Safety Standards
CEFAS	Centre for Environment, Fisheries and Aquaculture
DCC	Dose conversion coefficient
DORIS	Dispersion of Radionuclides into the Sea
ERL	Environmental Radioactivity Laboratory, University of Stirling
GPS	Global positioning system
GRANIS	Gamma Radiation above Nuclides in Soil
HSE	Health and Safety Executive
ICRP	International Commission on Radiological Protection
ILB	In-shore lifeboat
ILW	Intermediate Level Waste
LOD	Limit of Detection
MoGSS	Mobile Gamma Spectrometry System
NDA	Nuclear Decommissioning Authority
NDAWG	National Dose Assessment Working Group
ONR	Office of Nuclear Regulation
PC-CREAM	Consequences of Releases to the Environment: Assessment. Methodology
RESUS	The Re-suspension Model
RIB	Rigid Inflatable Boats
RIFE	Radioactivity in Food and the Environment
RNLI	Royal National Lifeboat Institute
RSA	Radioactive Substances Act 1993
SEPA	Scottish Environment Protection Agency
SSSI	Site of Special Scientific Interest
UKAS	United Kingdom Accreditation Service

Units

Bq	Becquerel	k	kilo (thousand, E^{3})
Gy	gray	m	milli (one thousandth, E^{-3})
[H'(0.07)]	Directional dose equivalent at 0.07 mm depth	µ	micro (one millionth, E^{-6})
Sv	Sievert	ha	hectare
eV	electron-volt	m	metre
t	ton	cm	centimetre
g	gram	y	year
l	litre	d	day
%	percentage	per	$^{-1}$
T	Tera (E^{12})	K_d	sediment distribution coefficient
M	Mega (one million, E^{6})		

Summary

This report presents the results of the 2017 radiological Habits survey to determine the habits, occupancy and consumption patterns of people living and undertaking activities in the vicinity of the Hunterston nuclear licensed site (encompassing two sub sites that run separately – Hunterston A and Hunterston B). Both sites are authorised to discharge liquid radioactive wastes into the Firth of Clyde via one outfall. Authorised gaseous radioactive wastes are discharged from both sites via separate stacks. Sources of direct radiation are also present.

The survey targeted three areas that were determined to be affected by discharges from the site, defined as:

- An aquatic survey area; which covered the 20 km radial distance from the Hunterston nuclear licensed site stretching from Wemyss Bay to Saltcoats 3 km off-shore including both Great and Little Cumbrae islands;
- A terrestrial survey area; 5 km zone around Hunterston nuclear licensed site. The southern part of Great Cumbrae Island and all of Little Cumbrae Island off-shore of Largs, were also included; and
- The direct radiation survey area; extending 1 km from the site which relates to ionising radiation emanating directly from the site.

During the survey, a number of potential exposure pathways were investigated through various methods including postal and face-to-face surveys, focus groups and direct observations.

Interviews with members of the public were carried out over a period of 14 days (Phase 1 survey) and conducted between April 1st – 7th and the June 17th – 23rd at terrestrial and coastal sites. A total of 417 individuals were surveyed and their results are presented and discussed. Those high-rate individuals are identified using established methods comprising a ‘cut-off’ to define the high-rate group and 97.5th percentiles for dose assessment analysis. Nine face-to-face surveys were followed up in the October of 2017 (Phase 2 survey) as a means of validation and are discussed within the report.

The aquatic survey area

Fish; crustaceans; molluscs and wildfowl are consumed by adults within the survey area. The mean consumption rates for adult high-rate groups for each of these food groups were:

- 94.1 kg y^{-1} for fish (cod; Dover sole; mackerel; haddock; plaice; flounder; monk fish and dab)
- 26 kg y^{-1} for crustaceans (brown crab; common lobster and prawns)
- 28.8 kg y^{-1} for molluscs (mussels; razor clams; scallops; winkles; oysters and whelks)
- 47.2 kg y^{-1} for wildfowl (mallard; pink-footed goose; teal; widgeon; greylag goose; Canadian goose and woodcock)
- 0.45 kg y^{-1} for seaweed consumed

It is reported that ten individuals collect seaweed from Seamill; Fairlie Sands; Kames Bay (Great Cumbrae Island) and Portencross for use as a fertiliser on their gardens (for vegetables). Of those collecting the seaweed, two reported consuming seaweed which was collected from Seamill and Kames Bay (Great Cumbrae Island). Shore fishing was popular at Portencross and Farland Head.

The mean occupancy rates for the adult high-rate group within the aquatic survey area were:

- 978 h y^{-1} Intertidal activities
- 156 h y^{-1} In water activities
- 2 730 h y^{-1} On water activities
- 858 h y^{-1} Handling sediment
- 3 030 h y^{-1} Handling equipment

The terrestrial survey area

The mean consumption rates for the high-rate group for terrestrial foods were:

- 53.2 kg y^{-1} for green vegetables
- 38.0 kg y^{-1} for other vegetables
- 43.9 kg y^{-1} for root vegetables
- 44.1 kg y^{-1} for potatoes
- 49.4 kg y^{-1} for domestic fruit
- 28.5 kg y^{-1} for wild fruit
- 1.00 kg y^{-1} for wild fungi
- 28.0 kg y^{-1} for beef
- 3.00 kg y^{-1} for game
- 2.00 kg y^{-1} for poultry
- 24.0 kg y^{-1} for sheep
- 28.9 kg y^{-1} for eggs
- 8.00 kg y^{-1} for honey
- 365 l y^{-1} for water

The direct radiation survey area

The highest occupancy rates in the direct radiation area were as follows (holidays taken into account):

- 8 395 h y^{-1} for the total occupancy rate for a resident;
- 7 300 h y^{-1} for the indoor occupancy rate for a resident; and
- 1 460 h y^{-1} for the outdoor occupancy rate for a resident.

A significant portion of the direct radiation survey area was surveyed by car-borne gamma spectrometry.

Comparisons with previous survey

The results of the 2017 Hunterston Habits Survey were compared with the previous habits survey carried out at Hunterston in 2012.

In the aquatic survey area, the overall mean consumption rate for the adult high-rate group for fish, crustaceans, molluscs and wildfowl substantially increased in 2017 compared to 2012. Seaweed consumption was identified in both 2017 and in 2012. For children, fish consumption decreased in 2017 compared to 2012. Molluscs and wildfowl were consumed in 2017 and none consumed in 2012. No consumption of crustacean was identified in 2017 compared to consumption identified in 2012. For infants, fish and mollusc no consumption was identified in 2017 compared to 2012. No infants were found to consume crustaceans and wildfowl in either 2017 or in 2012.

The 2017 survey reported a decrease in maximum values for in-water and on-water occupancy rates compared to those in 2012. Maximum in-water activity occupancies were similar in value for both surveys although associated activities differed. No in- or on-water activities for infants were reported in 2017. Therefore, no comparison could be made with the 2012 survey.

The adult group handling aquatic equipment was found to be lower in 2012 compared to 2017 and activities included boat maintenance; handling clothes and overalls; diving gear and fishing gear.

Adult consumption rates of locally produced terrestrial food items increased in the 2017 survey in comparison to 2012 in the following food groups: vegetables (green); vegetables (other); fruit (domestic); fruit (wild); fungi (wild); beef; game (venison and birds); and, sheep meat. Consumption rates decreased in the 2017 survey in comparison to 2012 in the following food groups: vegetables (root); vegetable (potatoes); game (rabbit and hare); poultry; eggs; honey; and milk.

In 2017 the total occupancy decreased, the highest indoor occupancy decreased and the highest outdoor occupancy decreased from 2012.

Suggestions for changes to the monitoring programme

The following suggestions for changes to the current environmental monitoring programme are provided for consideration:

(i) A significant quantity of venison consumption, shot on a local estate, was identified in this report. As such, an annual sampling of deer could be incorporated as part of the monitoring strategy; and

(ii) The sampling of mushrooms (*Cantherellus and Boletus*) was identified in this survey. Consideration of sampling mushrooms from West Kilbride once per annum when in season.

1. Introduction

1.1 Regulatory Context

The Hunterston nuclear licensed site is situated on the coast of Ayrshire and encompasses two sub sites that are run separately. Since 2008, Hunterston A operated by Magnox Ltd on behalf of the Nuclear Decommissioning Authority (NDA) has been undergoing decommissioning while the second site is Hunterston B, which is operated by EDF Energy Generation and encompasses two Advanced Gas Cooled Reactors (AGRS) with an extended operating lifetime extension to 2023. Both sites hold authorisations under the Radioactive Substances Act 1993 (RSA '93) for the disposal of radioactive wastes. The Environmental Authorisations (Scotland) Regulations 2018 (EASR 18) will come into effect from 1st September 2018 and replaces the Radioactive Substances Act 1993. Both nuclear power stations are authorised by the Scottish Environment Protection Agency (SEPA) to discharge liquid radioactive wastes into the Firth of Clyde via one outfall. Authorised gaseous radioactive wastes are discharged from both sites via separate stacks. The impact of the waste produced is monitored under the requirements of Article 35 of the Basic Safety Standards (BSS) 96/29 Euratom to ensure that the doses to the representative person (Section 1.2) are below both the 1 mSv committed effective and the 50 mSv skin annual dose limit.

Both sites generate and discharge radioactivity into the environment that may result in the exposure of the public. The three primary sources of potential exposure to the public are:

(i) discharges to the aquatic environment;
(ii) discharges to the atmosphere; and
(iii) direct exposure from the site.

From these sources, members of the public may be exposed directly to radiation shine from the licensed site or through inhalation and/or indirectly due to exposure to contaminated materials and ingestion of foodstuffs (Smith and Jones, 2003). It is also recognised that enhanced doses from external exposure due to regulated discharges and the consumption of locally sourced foods may occur as a result of contemporary and historical discharges being concentrated through natural processes leading to

environments with elevated concentrations of anthropogenic and technologically enhanced radioactivity (Dale *et al.,* 2008; Tyler *et al*., 2013; Tyler and Heal*,* 2000).

It is the responsibility of SEPA to regulate the discharges from the site to ensure that the public are not exposed to doses in excess of legal limits. Exposure to direct shine from nuclear, radiation or waste facilities is the responsibility of the Office of Nuclear Regulation (within a nuclear licenced site), and the Health and Safety Executive (HSE), (outside a nuclear licensed site) where any direct exposure impacts on facility workers. Direct shine is considered as part of the 1 mSv y^{-1} threshold to the public. The dose to a worker on a nuclear licensed site is not considered under this public dose limit.

To support SEPA's role, this report, provides an assessment of public habits around the Hunterston site and to assist with future environmental monitoring programmes. The Habits survey, along with other factors such as modelling, can also confirm if the current programme is fit for purpose.

1.2 Definition of the Representative Person

The optimal approach for assessing doses to the public is through a combination of site-specific habit data and an environmental monitoring programme to determine ambient dose rates and concentrations in foodstuffs. In addition to the various interactions an individual may have with exposure routes, the actual doses received are also dependent upon age, size and metabolism. Thus, the standard approach is to identify and consider these sources of variability in appropriate groups. The concept of the *representative person* was introduced by the International Commission on Radiological Protection, (ICRP), (2006) and recommended to replace the previously used concept of the *critical group* in 2007 (ICRP, 2007). The *representative person* is the individual that represents the more highly exposed members of the public and is typically defined by a cut-off, for example the top 97.5% of the dose distribution within one or more routes of exposure. Within this concept, if the dose received by the *representative person(s)* can be demonstrated to be within the accepted dose limits and constraints, then the public are considered to be protected.

1.3 Dose Limits and Constraints

The system of dose limitation recommended by ICRP (2007), and subsequently by the Radioactive Substances BSS, requires that dose equivalents received by individuals shall not exceed the limits set out in Article 13 of Council Directive 96/29/Euratom (CEC, 1996).

The *retrospective* maximum permissible dose limits are set out as 1 mSv y^{-1}. For *prospective* assessments, the maximum permissible doses or constraints used by SEPA are:

(i) 0.3 mSv y^{-1} for any single source of radioactivity; and

(ii) 0.5 mSv y^{1} for a single site from which radioactive discharges are made.

It is also accepted by the UK Government that it should be possible to operate existing nuclear facilities without exceeding the 0.3 mSv y^{-1} constraint (Hunt *et al.,* 1982; Leonard *et al.,* 1982). It is therefore incumbent upon SEPA to ensure that these dose limits/constraints are not exceeded for all authorised discharges of ionising radiation to the environment.

1.4 Habits Survey Aim

The aim of the habits survey is to collect site-specific data to allow a bespoke assessment to be made that identifies the representative individual(s). The identification of the representative person is a result of combining known information on the consumption of local foods and occupancy times with data from SEPA's routine environmental monitoring programme. The survey aims to collect data on the consumption rates of locally grown foods and occupancy times to identify the doses to the most representative person(s). The survey also aims to identify any habits which the routine programme does not currently adequately cover and may recommend the adoption of new monitoring due to new or changing habits or the removal of monitoring that is no longer required. The survey does this by:

(i) Collecting data on a range of habits/activities by the general public in the environment immediately surrounding the nuclear site and surrounding areas that might lead to exposure to radioactivity or radiation from any

combination of licensed liquid or gaseous discharges, or direct radiation from on-site activities at Hunterston;

(ii) Collecting information on consumption of food grown or produced (including wild & free foods) in the survey area and determining an annual rate of consumption for each individual surveyed and household members of all ages; and

(iii) Quantifying the amounts of radioactivity, radiation and subsequent doses to individual members of the general public as a result of the discharges or operations of the nuclear site.

This report presents the findings for the 2017 habits survey of the Hunterston nuclear site. The previous survey was undertaken (fieldwork components) during the period 27th June to 10th July 2012 (Rumney *et al*., 2013).

2 The Survey

2.1 Introduction

This chapter describes the site characteristics including recent and prospective site activities, a dose assessment from licensed discharges to air and sea and the surrounding land cover characteristics. In preparation for the survey, a visit to the site and a meeting with the site operators was held in March 2017. A meeting organised by an existing stakeholder group with the site management in early March was also attended which helped to raise the profile of the planned postal survey; face-to-face surveys; and focus groups within the local community.

2.2 Site Activity

2.2.1 Current On-Site Activity

The Hunterston site consists of Hunterston A and Hunterston B. Hunterston A is operated by Magnox and is being decommissioned by the Nuclear Decommissioning Authority (NDA). The decommissioning process is currently focussing on the fuel ponds, work which is due for completion in 2017. This has resulted in increased liquid discharges of ^{137}Cs; ^{241}Pu; ^{241}Am and ^{90}Sr since 2015 when the work on the fuel ponds started. Liquid discharges from this process will be on-going but will decline. Two types of Intermediate Level Waste (ILW) encapsulation plants are being developed: (i) The wet ILW encapsulation plant which handles wet waste was commissioned in November of 2016 and is responsible for increases in discharges of ^{3}H, ^{14}C and other radionuclides including ^{60}Co and ^{137}Cs, of which ^{137}Cs is most abundant; and (ii) The dry ILW encapsulation plant, which will be commissioned in 2018. These two new developments will increase the atmospheric and marine discharges until 2022.

Hunterston B is owned by EDF Energy and is powered by two Advanced Gas-Cooled Reactors (AGR's), with its now estimated decommissioning date of 2023. The site generates 1000 MW of electricity and is operating at only 80% of its full capacity due to issues related to boiler tubes a number of years ago. Otherwise site B has undergone no major changes in recent years and none are planned for the near future. The two AGRs are on a regular three yearly operating cycle with no expected change to this. The main change in the vicinity of the Hunterston nuclear licensed site is the

building of a new electricity sub-station to accommodate the linking of renewable electricity generation methods to the National Grid.

Liquid discharges are made from the site at specific times to match with tidal flow to maximise dispersion and to ensure that the currents take the discharges away from the shore. Both Hunterston A and B share the same discharge point. Hunterston A has a permit to release ^{3}H; ^{137}Cs; ^{241}Pu; alpha and non-alpha waste as liquid discharges and ^{3}H; ^{14}C to the atmosphere. Hunterston B has a permit to release particulate beta, ^{3}H; ^{14}C and ^{35}S as liquid discharges and alpha; non-alpha, ^{3}H; ^{35}S and ^{60}Co to the atmosphere. Full details are provided in the 2016 report of Radioactivity in Food and the Environment (RIFE). An increase in the gaseous discharges of ^{14}C was noted from Hunterston B in 2015 but this increase is still well within the permitted level.

2.2.2 Off-Site Activity

Hunterston operates an environmental monitoring programme in the local district. This monitoring programme considers the effects of the liquid and aerial discharges from both sites A and B together.

2.3 Estimated Activity Concentrations from Licensed Discharges from Hunterston A and Hunterston B

Using permitted discharge data from Hunterston A and B, aquatic activity concentrations were modelled using the DORIS model within PC-CREAM (Public Health England, 2008), were modelled using default values to calculate aquatic activity concentrations in water (Table 2.1).

Assuming an effectively continuous release, activity concentrations were modelled in unfiltered seawater, fish, seaweed, crustaceans and molluscs, with outputs at 1; 5; 50; 500; 10 000 and 100 000 000 years. For all element dependent parameters (sediment distribution coefficients, K_d and deep water) local compartment details (depth; coastline length; volumetric exchange rate; suspended sediment load; sedimentation rate; sediment density and diffusion rate) and regional model information (volume; depth; suspended sediment load; sedimentation rate; sediment density; diffusion rate) the default values of the Hunterston area on PC-CREAM were used.

Table 2.1 Modelled aquatic activity concentrations from permitted discharges from Hunterston A and B using PC-Cream

Radionuclide	A Station (Bq y^{-1})	B Station (Bq y^{-1})
^{3}H	3.00E+10	7.00E+14
Alpha*	2.00E+09	1.00E+09
All other non-alpha^	6.00E+10	1.50E+11
137Cs	1.60E+11	
^{241}Pu	2.00E+09	
^{35}S		6.00E+12
^{60}Co		1.00E+10

*Assessed as ^{239}Pu. ^Assessed as ^{137}Cs

Activity concentration values at 50 years for unfiltered seawater in the survey area of Hunterston and estimated activity concentrations in food groups are reported (Table 2.2).

Table 2.2 Estimated activity concentrations from licensed discharges from Hunterston A and B. for unfiltered seawater and aquatic food groups.

	Activity Concentration			
Radionuclide	**Unfiltered seaweed (Bq l^{-1})**	**Fish (Bq kg^{-1})**	**Crustaceans (Bq kg^{-1})**	**Molluscs (Bq kg^{-1})**
^{3}H	7.07E+00	7.07E+00	7.07E+00	7.07E+00
^{35}S	5.25E-02	1.05E-01	5.25E-02	2.10E-01
^{60}Co	7.09E-05	2.36E-02	2.36E-01	1.18E-01
Alpha	2.84E-05	1.42E-03	2.84E-03	4.26E-02
^{241}Pu	1.65E-05	8.26E-04	1.65E-03	2.48E-02
All non-alpha & ^{137}Cs	3.70E-03	3.59E-01	1.08E-01	1.08E-01

Atmospheric activity concentrations from permitted discharges were also modelled using the PLUME model in PC-CREAM (Table 2.3)

PLUME was set to calculate activity concentrations released for a range of stack heights. The activity concentrations in air for discharges from both stations have been modelled using a 67 m stack are reported here over a range of distances from 500 m to 25 km.

Table 2.3 Atmospheric activity concentrations modelled for Hunterston A and B stations.

Radionuclide	A Station Bq y^{-1}	B Station Bq y^{-1}
^{3}H	2.00E+10	1.50E+13
^{14}C	2.00E+09	4.50E+12
Particulate beta*		5.00E+08
^{35}S		5.00E+11
^{41}Ar		1.50E+14
^{131}I		2.00E+09
Other*	3.00E+06	

The MET sampling scheme was applied using the default settings. However, the data extracted for the dose rates were based on the MET Pasquill D with rain category as being most typical of the UK weather and checked against the Largs Met Office data and World Weather Online. The calculated activity concentrations in air are presented in Table 2.4.

Table 2.4 Calculated combined activity concentrations (Bq y^{-1}) in air for permitted discharges from Hunterston A and B. Discharged from stack height of 67 m for both stations

Distance (m)	^{41}Ar	^{14}C	^{3}H	^{131}I	^{35}S	^{137}Cs*
500	2.41E-01	7.28E-03	2.43E-02	3.22E-06	8.04E-04	8.04E-07
1,000	5.51E-01	1.67E-02	5.58E-02	7.33E-06	1.84E-03	1.84E-06
5,000	8.73E-02	2.80E-03	9.32E-03	1.13E-06	2.91E-04	2.91E-07
10,000	2.86E-02	9.78E-04	3.26E-03	3.62E-07	9.55E-05	9.55E-08
15,000	1.46E-02	5.32E-04	1.77E-03	1.81E-07	4.87E-05	4.87E-08
20,000	8.94E-03	3.47E-04	1.16E-03	1.10E-07	2.99E-05	2.99E-08
25,000	6.05E-03	2.51E-04	8.37E-04	7.33E-08	2.03E-05	2.03E-08

*Assessed as all other radionuclides for station A (and particulate beta for station B)

The GRANIS (external exposure model) and RESUS (resuspension model) modules in PC-CREAM were used to estimate the external dose rates at the same specified distances from the Hunterston site, using the data presented in Table 2.4.

Table 2.5 Modelled Total External Doses (µSv) to adults, children or infants at the specified distances from 67 m stacks at Hunterston A and B Stations after 50 years of release.

Distance (m)	Adult	Child	Infant
500	8.72E-01	8.63E-01	8.08E-01
1,000	6.23E-01	6.13E-01	5.51E-01
5,000	1.06E-01	1.04E-01	9.18E-02
10,000	4.40E-02	4.32E-02	3.79E-02
15,000	2.61E-02	2.55E-02	2.22E-02
20,000	1.79E-02	1.75E-02	1.51E-02
25,000	1.33E-02	1.30E-02	1.11E-02

Table 2.5 reports the estimated external doses modelled from PC-CREAM (default settings) for adults; children and infants using ^{137}Csas the analogue for the “all other nuclides”.

2.4 Survey Areas

The survey area for the 2017 habits survey was designed to encompass these marine and terrestrial environments likely to be affected by discharges, including the area of potential direct radiation shine from ionising radiation emanating directly from the Hunterston nuclear site. These areas are consistent with the previous habits survey and are shown in Figure 2.1 and Figure 2.2.

The survey areas focus on:

(i) The 1 km zone from the boundary of the nuclear licensed site (covering housing and land-use close to the site) which relates to the ionising radiation directly from the site (direct shine);

(ii) The terrestrial survey areas included the 5 km radial zone from the Hunterston nuclear site, the southern part of Great Cumbrae Island and all of Little Cumbrae Island. This included an assessment of terrestrial habits within the area of prevailing wind and areas of higher occupancy; and

(iii) The aquatic survey areas include the intertidal areas and waters of the Firth of Clyde extending from Wemyss Bay in the north to Saltcoats in the south.

All of Great Cumbrae Island and all of Little Cumbrae Island and off-shore of Largs, was also included.

2.5 Land Cover Data

The land cover is presented in Figure 2.3. Hunterston is immediately surrounded by improved grassland with pockets of arable and horticultural land. Broad leaved, mixed and yew woodland is interspersed throughout this area with villages and single isolated buildings apparent towards the north, south and east of Hunterston. North to Fairlie the inland area is predominantly acid grassland with some dwarf shrub heath. South to Seafield the inland area is a mixture of arable and horticultural land and mixed grassland interspersed with broad-leaved, mixed and yew woodland. The proportions of land cover types within the different survey zones are summarised in Table 2.6. The results illustrate how improved grassland is the dominant land cover type across the survey area and beyond.

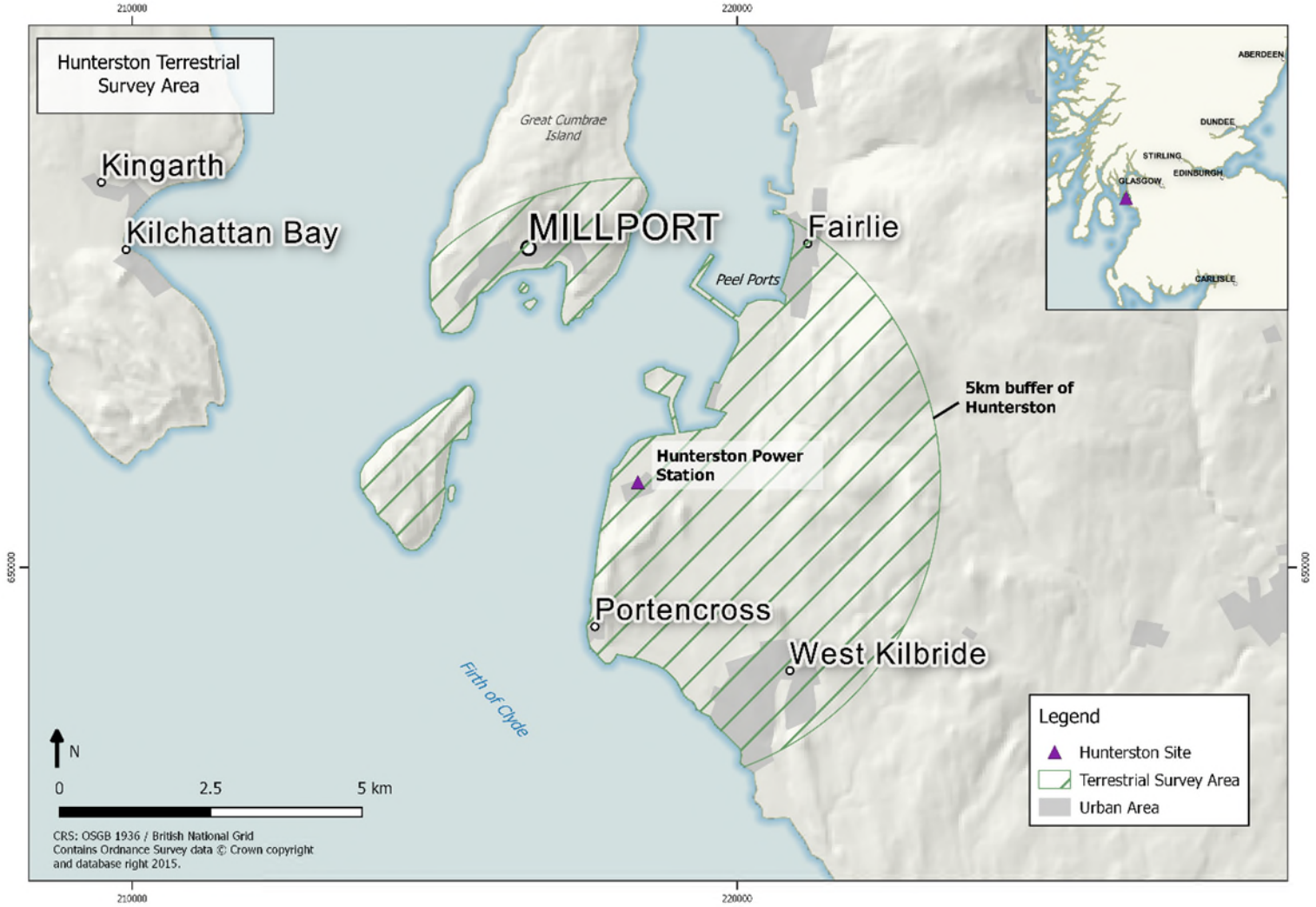

Figure 2.1 The terrestrial survey area for the 2017 Hunterston Habits Survey.

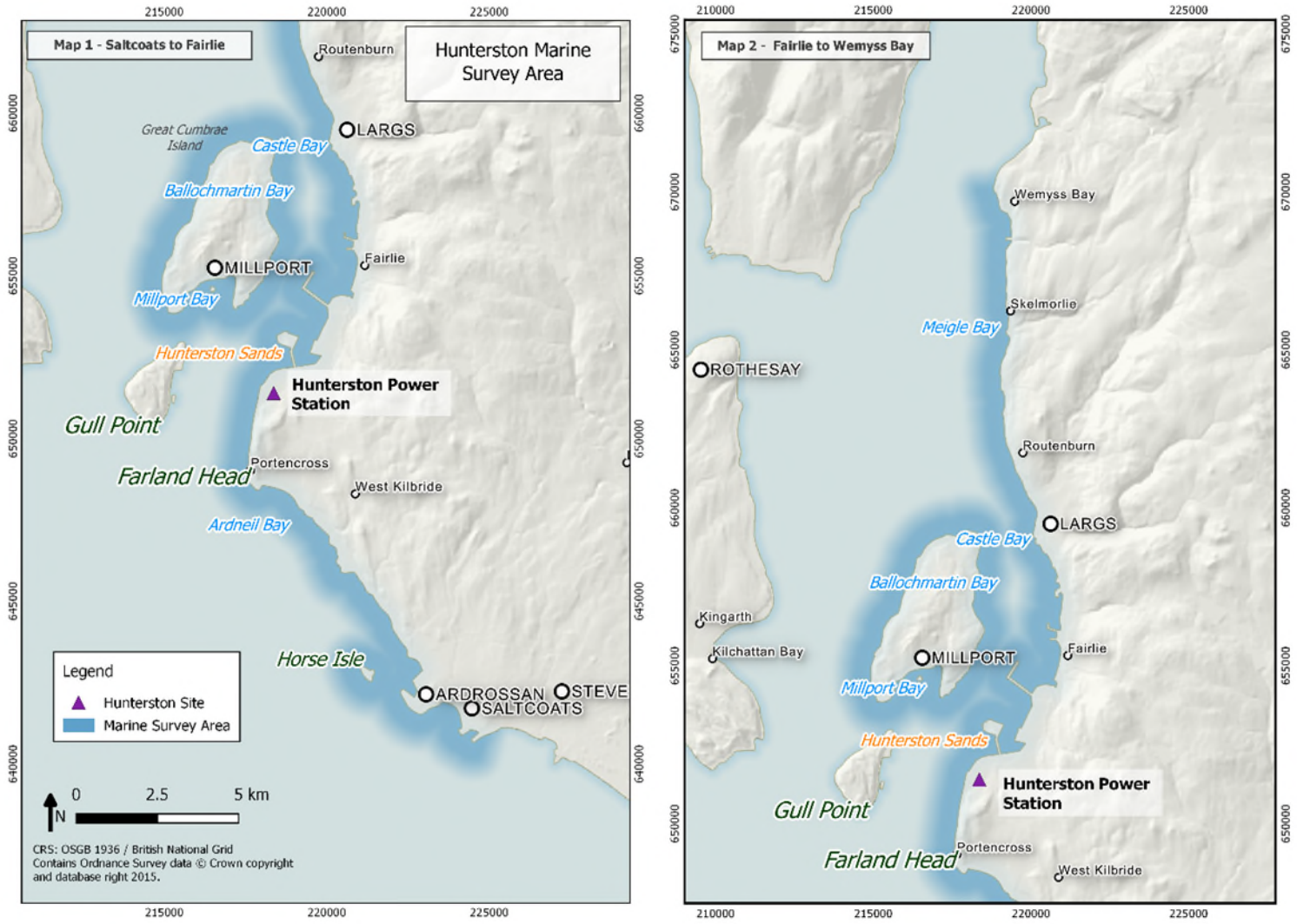

Figure 2.2 Map 1 and Map 2 showing the marine survey area for the 2017 Hunterston Habits Survey.

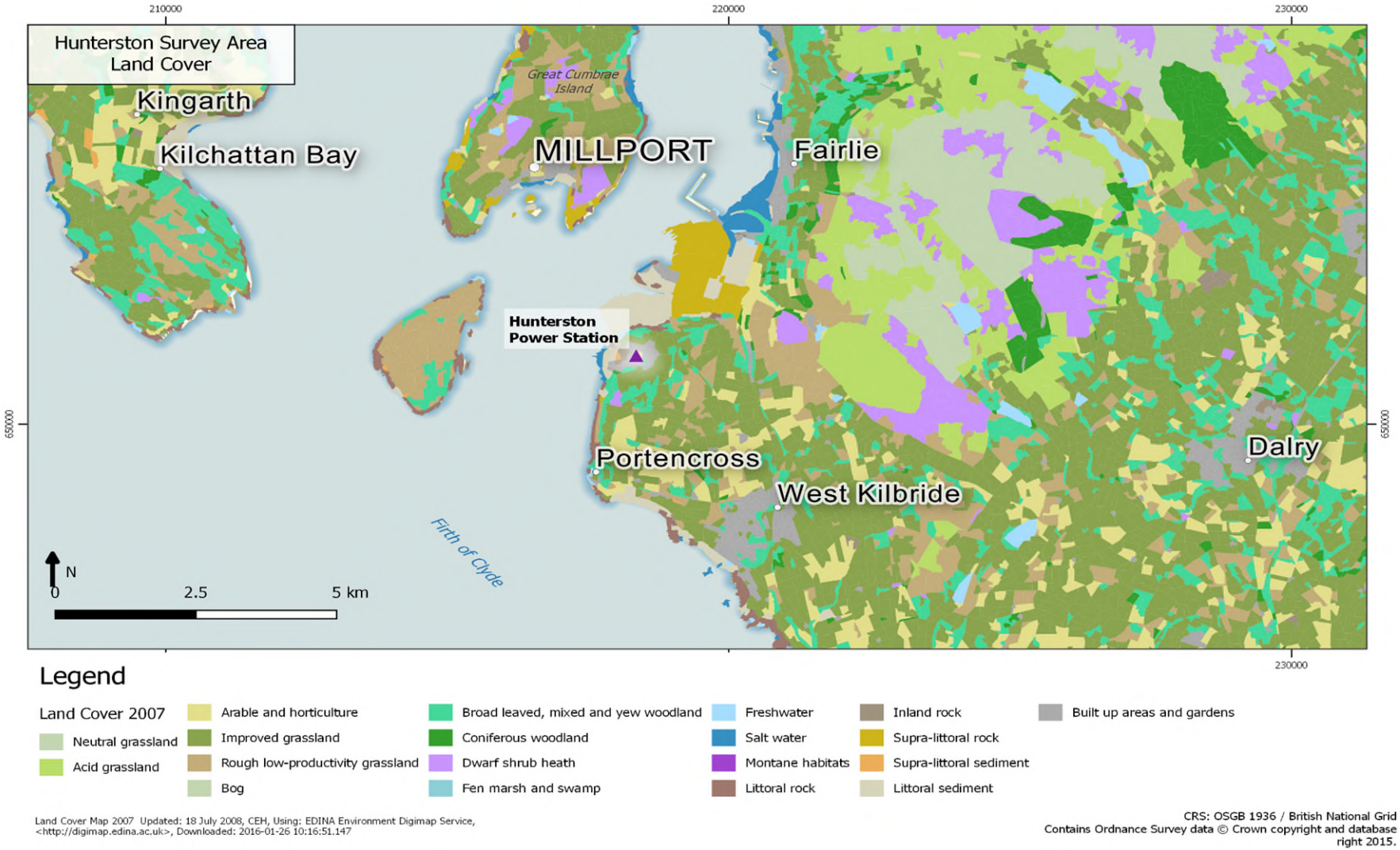

Figure 2.3 The land cover characterising the Hunterston survey area and surrounds (Land Cover Map, 2007)

2.6 Soil Data

Table 2.6 Quantitative estimates for land cover types within the terrestrial survey areas of increasing distance from the Hunterston site (1; 5; 10 and 20 km)

	Zonal Area (km^2)			
Broad Habitat	**1 km**	**5 km**	**10 km**	**20 km**
Acid grassland	0.00	4.19	18.9	41.7
Arable and horticulture	0.01	3.36	12.2	35.5
Bog	0.00	0.78	10.2	71.6
Broad leaved, mixed & yew woodland	0.51	3.37	13.8	59.2
Built up areas and gardens	0.29	2.99	8.04	37.5
Coniferous woodland	0.02	0.56	3.84	26.6
Dwarf shrub heath	0.03	1.50	9.36	67.3
Fen marsh and swamp	0.00	0.00	0.00	0.04
Freshwater	0.02	0.20	2.20	9.21
Improved grassland	0.93	12.4	48.6	199
Inland rock	0.05	0.11	0.22	1.43
Littoral rock	0.08	1.02	2.31	5.03
Littoral sediment	0.59	2.24	3.78	6.34
Montane habitats	0.00	0.00	0.00	0.12
Neutral grassland	0.00	0.00	0.00	0.45
Rough low-productivity grassland	0.08	7.48	16.6	61.0
Salt water	0.07	0.88	1.59	3.03
Supra-littoral rock	0.00	2.19	2.40	2.40
Supra-littoral sediment	0.01	0.03	0.06	0.34

The soil data are presented in Figure 2.4. The topographically low-lying parts of the survey are dominated by brown earths and a large area of peaty podzols around Hunterston with a small pocket of peaty gleys and undifferentiated peat. With increasing altitude the soil type becomes increasingly dominated by non-calcareous gleys and peaty gleyed podzols immediately behind the Hunterston site.

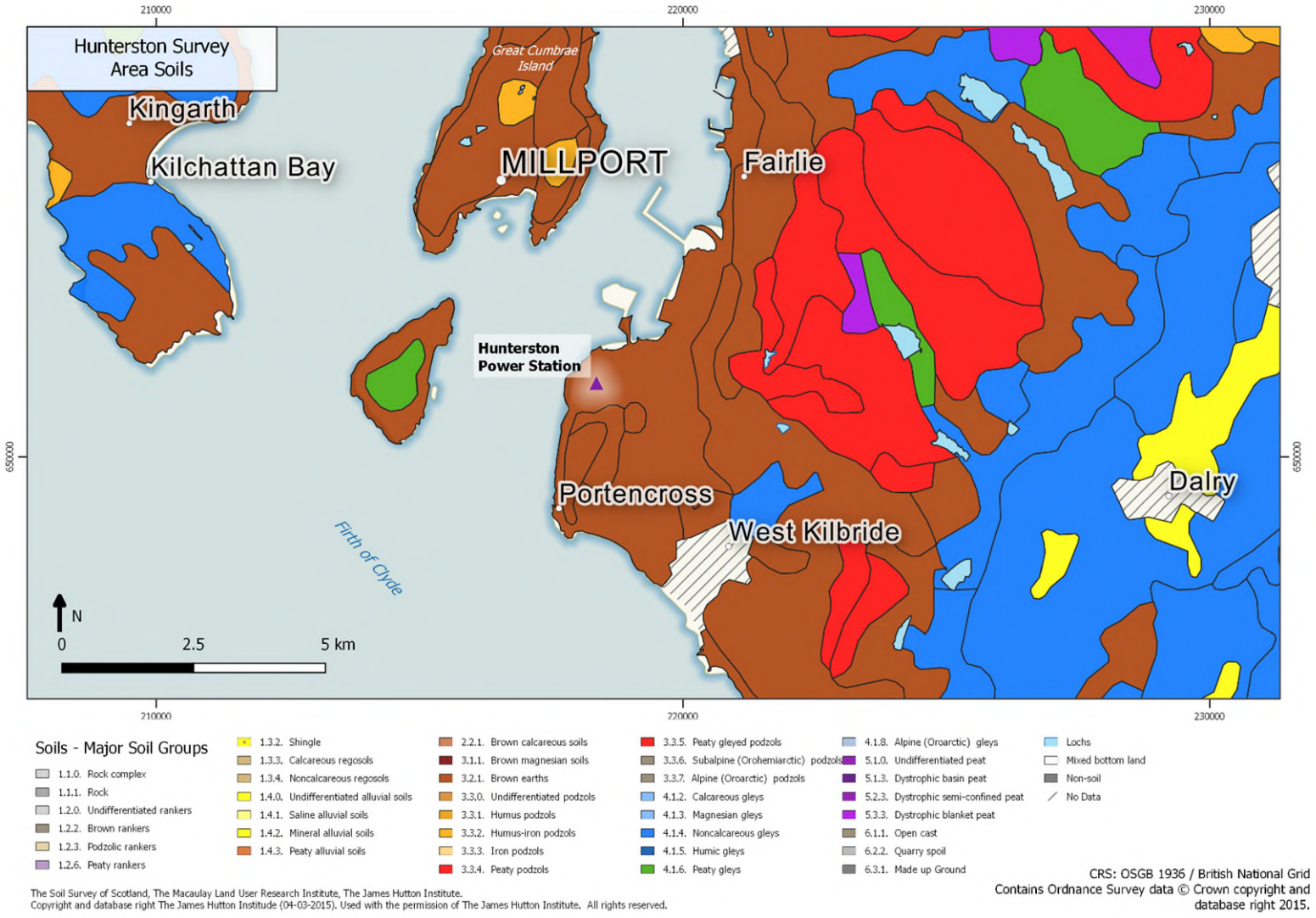

Figure 2.4 Soil types dominating the Hunterston survey area (The Macauley Institute for Soil Research).

2.7 Topographic Wetness Index

Catchment hydrology can be important in the redistribution of radionuclides. For example, organic soils can allow radionuclides (e.g. ^{137}Cs from fallout) to be transported in solution as well as in particulate form. When these hydrological flow paths cross from organic to mineral rich soils, the radionuclides can become bound to clays and oxides within the soil matrices. In extreme conditions, these areas have been shown to result in elevated concentrations of radioactivity (Tyler and Heal, 2000). Building on the soil and 50 m resolution digital elevation model for Scotland using the OS Terrain 50 product (https://www.ordnancesurvey.co.uk/business-and-government/products/terrain-50.html). Figure 2.5 shows details of the hydrological flow paths within the survey area. The lighter area indicates low flow, water flowing away, whilst areas of increasing blueness represent wetter areas. This provides more detail of hydrological flow paths than would otherwise be possible from standard maps and highlights areas where radionuclides from atmospheric fallout might accumulate especially when combined with maps of soil type.

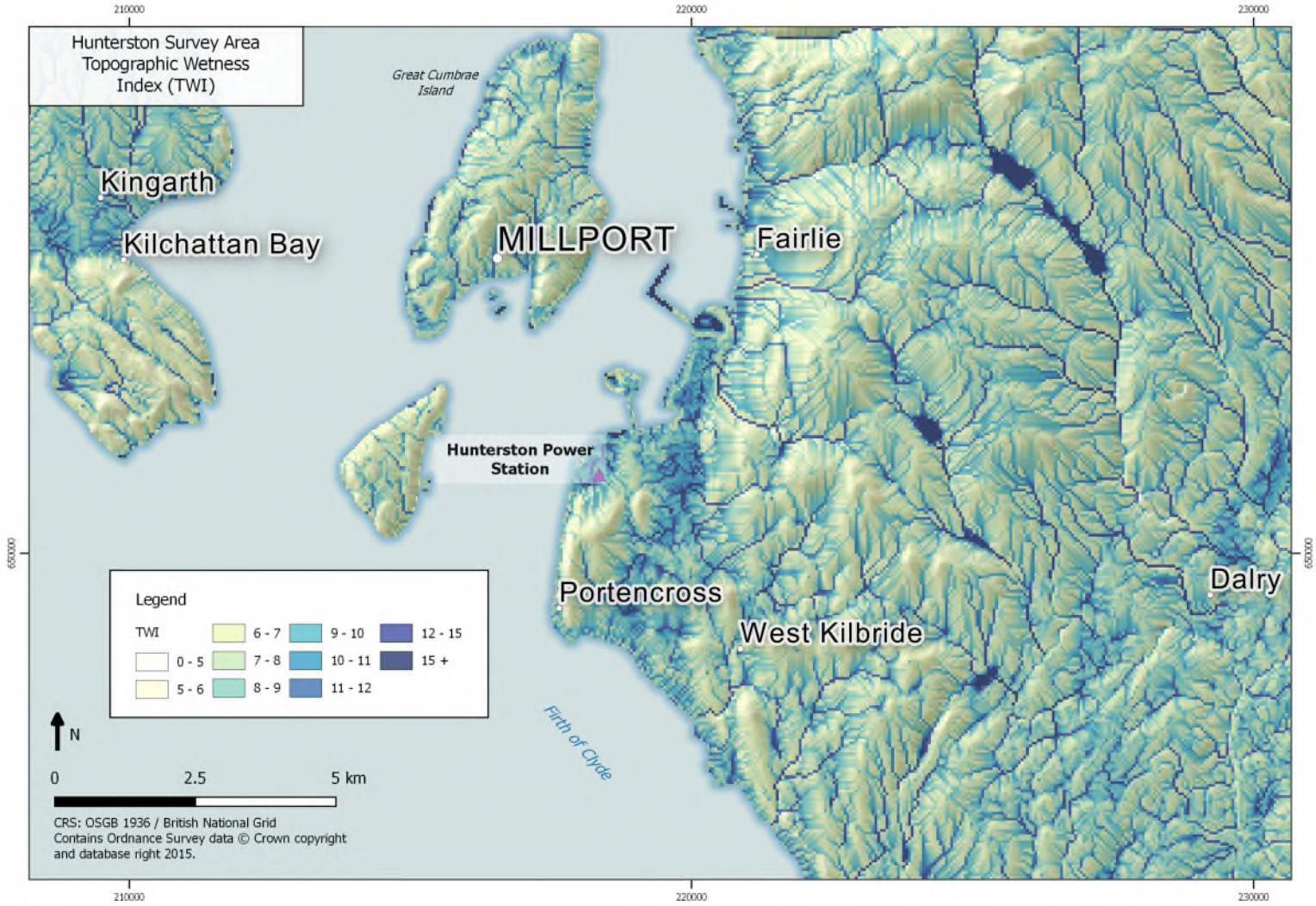

Figure 2.5 The Topographic Wetness Index in the Hunterston survey area.

2.8 Agricultural Production

The Scottish Agricultural Census 2016 data for the parishes (defined by postcodes as used by the Scottish Government; Dalry; Largs and West Kilbride) surrounding the Hunterston site have been assessed and are summarised in Table 2.7. A little over 2% of the total agricultural area is used for crops (18 000 hectares) whilst nearly 90% of the agricultural area is used for grass and grazing.

Table 2.7 Summarises the crop and grass production and land-use figures from census data, June 2016. Statistics prepared by Scottish Government RESAS Statistics (Agriculture)

Crops and fallow land	Number of holdings	Area (ha)	Estimated Yield (t y^{-1})
Winter barley	-	-	-
Spring barley	13	243	1 321
Total barley	13	243	1 379
Other crops (wheat, oats, triticale and mixed grain, seed potatoes and ware potatoes, stock-feeding crops, vegetables for human consumption and all other crops	19	120	-
Fallow land	11	45	-
Total crops, fallow and set-aside	23	426	-
	-	-	
Grass under 5 years old	30	225	-
Grass 5 years and older	154	6 570	-
Rough grazing	84	9 202	-
Common grazing land	-	-	-
Total grass and rough grazing	190	15 997	-
	-	-	
Utilised agricultural area (crops, grass and grazing land)	195	16 423	-
	-	-	
Woodland	77	1 283	-
Other land	97	366	-
Total agricultural area	**203**	**18 072**	**-**

Table 2.8 presents the summary data for the livestock census statistics for the same three parishes surrounding the Hunterston site. In addition to the data presented, there are a limited number of holdings with pigs and camelids in the survey area.

Table 2.8 Summary of the livestock production in the Hunterston area, June 2016. Statistics prepared by Scottish Government RESAS Statistics (Agriculture)

Animal Groups	**No. Holdings**	**No. Head per ha^{-1}**
Total female dairy cattle	10	1 249
Total female beef cattle	48	3 246
Total male cattle	47	1 303
Total calves	46	2 346
Total Cattle	**51**	**8 144**
Lambs	42	17 443
Total Sheep	**47**	**37 071**
Fowls for producing eggs	26	86 449
Fowls for breeding	9	43
Broilers and other table birds	-	-
Total Poultry	**28**	**86 782**
Goats and kids	7	37
Total horses and donkeys	41	350
Deer	-	-
Beehives	5	23

3 Methods

3.1 Introduction

To provide consistency and traceability to previous habit surveys, the methods employed and described in this chapter are largely based on the approach outlined in Leonard *et al.* (1982), Green *et al.* (2001) and National Dose Assessment Working Group (NDAWG) (2013). The previous habit surveys provided a useful frame of reference for undertaking this survey of the Hunterston nuclear site.

Chapter 2 described the desktop study undertaken to characterise and define the Habits Survey, including:

(i) A review of site activities;
(ii) The modelling of the atmospheric and marine discharges from the site to define the survey area boundary; and
(iii) An assessment of the land cover and agricultural activity.

The 2017 Habits Survey of Hunterston covers activities and food consumption. The survey introduced the following methods:

(i) A mobile radiometric survey to characterise the heterogeneity of radiation in the environment surrounding the Hunterston nuclear site;
(ii) GPS tracking on a limited number of volunteers to better understand the time spent by individuals as they interact with the environment; and
(iii) Information meetings during and after the face-to-face surveys to validate the data and findings.

The nature and timing of the fieldwork programme was discussed with SEPA prior to the start of the survey. The fieldwork component of the survey was conducted between April 1st – 7th and June 19th – 23rd at terrestrial and coastal sites. Information was gathered from informal meetings with groups and information collated from the past reports, web searches and local people. Five members of staff from the University of Stirling conducted the face-to-face interviews, observations and gamma dose rate measurements.

3.2 Postal Survey

To obtain a provisional assessment of the activity and food consumption habits of the local community living within the study area through the survey, a postal questionnaire for households was designed, piloted and distributed to 2 000 households. The survey included questions on food consumption, activities and a map for identifying the range of activities undertaken by household members. The sample included populations living within 20 km of the site. The protocol for the postal survey can be found in Appendix A1

The postal survey produced a data set from a broader cross section of the population living in the area potentially providing the means to identify new or missed habits that might provide useful focus to target some of the face-to-face surveys or meetings with local groups. Results of the survey can be found in Appendix A5.

3.3 Radiometric Surveys

The radiometric surveys comprised a car-borne gamma spectrometry survey, *in-situ* gamma dosimetry and beta skin dosimetry. Further details of the car-borne survey is described in Appendix A2.

3.3.1 In-Situ Dosimetry

The Environmental Radioactivity Laboratory (ERL) has ISO 17025:2005 accredited procedures for the deployment and recording of gamma dose rate in air, using ISO 17025:2005 accredited (UKAS) calibrations for two Thermo Radeye instruments. Measurements were undertaken at all locations where occupancy or location may lead to higher exposure to radioactivity or radiations as a result of site activities. These included areas that may have elevated radionuclide concentrations, where fine sediment is known to accumulate (e.g. salt marshes and mudflats). The effective dose from terrestrial gamma radiation was calculated and reported in μSv h^{-1}. Further details of the *in-situ* methodology can be found in Appendix A3.

3.3.2 Beta Dosimetry

A ruggedized Thermo BP19RD /Electra instrument was deployed to assess the Beta dosimetry of skin dose [H'(0.07)]. The BP19RD provided a wide area monitor

instrument (100 cm^2) and was used to monitor items that were potentially exposed to the higher radioactivity concentrations, i.e. close to licensed discharge points. Items monitored included boats and fishing equipment. Further details of the beta skin dosimetry can be found in Appendix 4.

3.4 GPS Tracking

GPS tracking units were provided to a number of individuals to provide empirical data on areas visited and duration. Individuals were required to wear the trackers for a minimum of five days. To ensure consistency in data a wearable GPS tracking device was considered the most suitable device for the Hunterston Habits Survey.

3.5 Conduct of the Survey

The pre-survey preparations involved a range of investigations with SEPA being contacted to discuss the requirements for the Hunterston survey. Past survey reports and maps for this site were investigated giving substantial and vital information. A directory of key groups involved in activities in the area was compiled from web searches and from contacting people within the local area with relevant knowledge pertaining to the survey. A proposed programme for the fieldwork being undertaken was then established and passed to SEPA for their view.

3.6 Meetings and Informal Contacts

In the 2017 survey, habits data and information were collected through a variety of approaches. This included contacting relevant parties and individuals for potential focus groups as well as a ‘standard’ face-to-face interview schedule. The multi-methods approach provided a means to ‘triangulate’ (verify) the data gathered through the different approaches: for example to check occupancy and activity data against the ‘snapshot’ observations recorded over a limited number of days in one season acquired from the individual face-to-face interviews. It also provided some additional information about local produce grown and consumed by householders, garden clubs, horticulturalists and farmers and consumption of particular types of local food such as honey and game. Such information also facilitated some snowballing of the survey

because the individual contact with relevant parties provided additional contacts to follow-up. These groups were approached prior to, during and after the face-to-face interviews by telephone and email.

Prior to the survey a directory of local groups, bodies and organisations relevant to the survey was compiled. The directory proved an invaluable resource through the survey period both for contacting groups and for use as a checklist against which responses and non-responses from potentially important groups with regard to activity, occupancy, exposure and local food consumption could be recorded. For future surveys, the directory will provide a useful starting point and a means of monitoring any changes in group/business or other activity in the area. The directory development required extensive web searches, follow-up telephone calls and use of earlier contacts across organisations and businesses.

3.7 Data Conversion & Analyses

During the face-to-face interviews, data on food consumption were recorded in units provided by respondents (e.g. pounds, grams, and ounces) and later converted into kilograms per year. The weights provided are for the fresh weight prepared and consumed. In some cases, respondents were unable to estimate food consumption in kilograms per year and instead gave the number of plants grown or the length and number of rows. These data were converted into consumption rates using conversion weights where possible e.g. one broccoli plant yields 700g (Garden Forum Horticulture, 2009; Hessayon, 2014) so that all consumption figures were reported in kilograms per year. Some individuals however were extremely specific with the weight of some foods consumed with these figures mainly given as an annual consumption. Data from the paper copies of each survey were transferred to a bespoke database for analyses. The figures reported from individuals were utilised within the report with the percentage of any gifting or waste deducted from the final figure. Phase 1 and Phase 2 raw data from the database can be found in Appendix A8 and A9 respectively.

3.8 Data Rounding and Grouping

All data collected from the face-to-face and postal surveys were reported to two significant figures. For the food consumption data the total annual consumption (kg) of different food types were calculated by multiplying the quantity (kg) and frequency

(times per year). The food items were placed into groups with similar attributes (Table 3.1).

Table 3.1 Food groups used in the Hunterston Habits Survey.

Food group	Example of foods within this group
Green leafy vegetables	asparagus, broccoli, brussel sprouts, cabbage, calabrese, cauliflower, celery, chard, herbs, kale, kohl rabi, lettuce, pak choi, rhubarb, marrow, spinach
Other domestic vegetables	broad bean, French bean, pea, runner bean
Root vegetables	beetroot, carrot, celeriac, fennel, garlic, Jerusalem artichoke, leek, onion, parsnip, radish, shallot, spring onion, swede, turnip
Potato	potato
Domestic fruit	apple, blackberry, blackcurrant, blueberries, corn, courgette, cucumber, gooseberry, grape, pear, pepper, plum, raspberry, redcurrant, strawberry, tayberry, tomato
Milk	milk, yoghurt, cheese
Cattle meat	beef, buffalo
Pig meat	pork
Sheep meat	lamb, mutton
Poultry	chicken, duck, goose, turkey
Eggs	eggs
Wild/free foods	blackberry, chestnuts, crab apples, damson, dandelion root, garlic, elderberry, elderflower, nettle, raspberry, rowanberry, sloe, strawberry
Honey	honey
Venison	venison
Fish	bass, cod, Dover sole, kipper (herring), mackerel, pollock, salmon, sea trout, trout (freshwater)
Crustaceans	brown crab, common lobster, shrimps
Molluscs	mussels, razor clams, scallops, winkles
Wildfowl	mallard, pink-footed goose, teal, widgeon
Game - bird	partridge, pheasant, quail

These groups are similar to those used in previous survey reports but focussed on the most common food items. Individuals were given the option to add any additional food items in the 'Other' food category.

The time individuals spent carrying out activities was calculated by multiplying frequency (occasions per year) and duration (hours), whilst taking into account seasonality where appropriate. Although individuals reported growing foods in season, consumption values were determined as annual totals.

Individuals accounted for any holidays and working hours within their survey replies. In addition to food consumption a 'liquid' category was also added and individuals who carried out aquatic activities that could result in the inadvertent ingestion of water, e.g. outdoor swimming/sailing, were identified to account for this pathway.

The age groupings used in this report are based on ICRP recommendations and are listed below in Table 3.2.

Table 3.2 ICRP age groups used in the dose assessment.

Name of age group	Age range
Group 1 - Infant	0-5 year old
Group 2 - Child	6-15 year old
Group 3 - Adult	16 year old and over

3.9 Qualitative and Quantitative Observations

Whilst undertaking the face-to-face surveys, observational data were acquired on obvious changes to each location such as new build housing, along with information on site usage and numbers of individuals undertaking specific habits. Observations were acquired over a specified time period, e.g. 20 minutes, and on-shore and off-shore (including intertidal) activities were noted. The number of individuals, their gender and their approximate age group undertaking each activity were also noted or estimated where large numbers were observed, e.g. beach activities. Some individuals were approached where possible and subsequent face-to-face surveys were conducted. Contact with individuals during face-to-face interviews frequently allowed the accuracy of observations to be checked and sometimes to be expanded, e.g. dog walkers might also engage in beachcombing and sailing at other times. Along with noting the weather conditions at the time of survey, this approach provided a basis for making a comparison with habits at different times and within and outwith the period of the local school holidays.

3.10 Dose Assessment Tool

The Habits Dose Assessment Spreadsheet Tool collated the data from the face-to-face survey for Hunterston and then used the consumption rates and habits data to calculate the retrospective dose to each interviewed member of the public, covering the total exposure from all pathways. It should be noted that only the consumption of locally produced food has been included in the retrospective dose assessment (i.e. food from outwith the survey area is not included within the assessment). Dose assessment was carried out following the guidance in NDAWG and ICRP for the *Representative Person*.

Activity concentration values came from modelling Dounreay discharges for 2016 using the default settings in PC-CREAM 08 (Public Health England, 2008). Dose coefficients for different age groups are described by ICRP (2012). As described in Section 3.8, data for the 2018 Dounreay Habits Survey were collected in three age groups. The dose conversion coefficients (DCCs) for each age group were taken from ICRP: Group 1 for infants; Group 2 for 10 year olds; and Group 3 for adults.

The tool analyses four general exposure pathways:

(i) *Internal terrestrial*, which includes the consumption of locally produced meat, fruit and vegetables;
(ii) *External terrestrial,* which determines the external doses from exposure to radiation present in the terrestrial environment as a result of deposition from atmospheric discharges and direct exposure through shine from on-site activities with radioactive materials;
(iii) *Internal aquatic*, which includes consumption of fish, crustaceans, molluscs and inadvertent ingestion of seawater. A proxy for inadvertent drinking of water was calculated by multiplying the time spent on aquatic activities by the known average of water ingested in such activities as described in Leonard *et al.,* (2015) and Stone *et al.,* (2008); and
(iv) *External aquatic,* which estimates the dose from external exposure through aquatic activities e.g. from radionuclides present in the aquatic environment (in water and sediments in saltmarshes or intertidal areas).

The direct exposure to shine from on-site activities was included in the analysis using *in-situ* measurements. These data were used to calculate direct exposure to members of the public that regularly travelled, worked or lived near the site.

The representative person was calculated independently for the total consumption and habits first and then by each exposure pathway. To identify the representative person, the 97.5th percentile rate cut off method was applied (Chapter 1). The representative person was calculated separately for external terrestrial and external marine exposure, internal terrestrial and internal marine consumption related exposure. The combined calculated total integrated all routes of exposure.

4 Postal Survey

4.1 Introduction

The results from the postal survey provide an overview of the habits within the area centred on the Hunterston site extending approximately 30 km from north to south for the aquatic and intertidal areas and 5 km for the terrestrial area.

Of the 2 000 postal surveys that were sent out to households in the survey area, 176 households returned their surveys, of which, 57 were either incomplete or illegible of which, 45 providing yielded some useful information. A total of 164 postal returns were used in the analyses. Postal return densities were plotted onto a heat map Figure 4.1).

The postal survey proved useful for identifying where households undertook popular activities and the proximity of these activities to the Hunterston site. The survey was not designed to capture the length of time individuals spent doing these activities. The postal survey results can be found in Appendix A5.

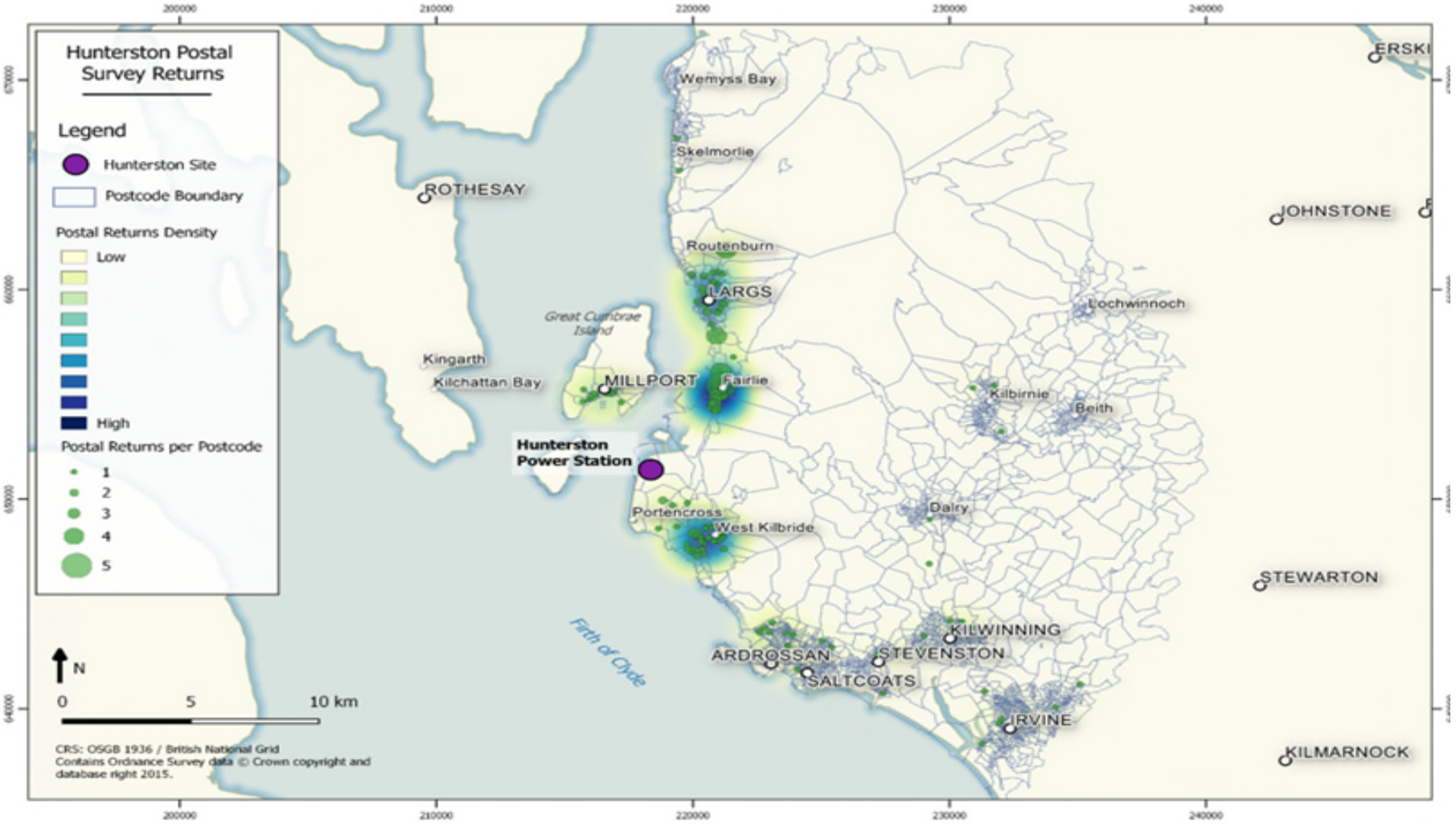

Figure 4.1 Postal survey return density map

5 Aquatic Radiation Pathways

5.1 Introduction

The survey locations were established following the desktop review of the site characteristics and presented in Chapter 2 to allow effective comparison with the previous Hunterston Habits Survey undertaken in 2012 (Rumney *et al*., 2013). The sites were visited throughout the survey period and observations of off-shore and on-shore activities were undertaken at each site. Each site was visited at different times of the day according to the survey schedule, which reflected the activities occurring at each site and proximity to the Hunterston site.

5.2 Aquatic Survey Area Descriptions

The survey locations were visited throughout two survey periods, the first during the schools' Easter break (1st April to 6th April) and the second outwith the school holiday period (17th June to 23rd June) of 2017. Off-shore and on-shore observations were undertaken at each site.

The survey area included the intertidal areas and waters of the Firth of Clyde extending from Wemyss Bay in the north to Saltcoats in the south. The southern part of Great Cumbrae Island and all of Little Cumbrae Island, off-shore of Largs, were also included, (Figure 2.2). Part of the survey area forms a National Nature Reserve and Scottish Site of Special Scientific Interest, which attract bird watchers and wildlife enthusiasts to the area to observe the intertidal birdlife. The Ayrshire Coastal Path runs the majority of the length of the aquatic survey area and stays close to the coastline, routing along many beaches between Ardrossan and Skelmorlie.

The survey sites are reported from Wemyss Bay in the north to Ardrossan South. Site descriptions and observations are located in Appendix A6.

5.2 Commercial Seafood Operations

Commercial seafood operations operate within the survey area with the main fishing methods being trawling and creeling. Lobster, crab (brown and velvet) and prawn are landed at Largs Pier. It was reported there are 8 – 10 regular trawlers that fish in the Fairlie Roads (locally known as 'The Castle', meaning between Portencross Castle

and Wee Cumbrae Castle). It is reported that other boats 'dip in and out' of the area throughout the years with Irish boats known to come in too. The boats fishing regularly in the survey area come from Troon, Rothesay (Isle of Bute), Campbeltown, Carradale and Tarbert. It is reported that the large fishing boats export approximately 85% of their catch to Europe with some going to two chains of UK restaurants. The remaining 15% remains in the UK with a very small percentage of catch staying within Scotland. The smaller fishing boats land all their catch and sell to a processor based in Motherwell. This fish has a lucrative Scottish market. Two creel boats are based in Ardrossan, landing crab and lobster, with their catch reaching both a local market within North Ayrshire and a market overseas. The survey team were unable to contact any fishing boat in Millport. Two boats (pair team), reported to be based in Tarbert fish in the Fairlie Roads for herring and spratt. Details are as follows:

One creel fishing boat is based in Ardrossan. Brown crab and common lobster are the main catch with approximately 80% of the catch going to the fish market in Troon and sold overseas. The remaining 20% is sold to local restaurants within the survey area. It is reported that a second creel fishing boat based at Ardrossan, is not fishing at present. The survey team were unable to determine any further details.

A prawn fishing boat is reported to land its catch at Largs Pier with a by-catch of plaice; Dover sole; cod; haddock; hake and herring. The by-catch is distributed and consumed by the crew and their families. The catch landed from this boat and a reported further three boats is sold to a fish wholesaler in Ayr. The survey team were unable to obtain any further information.

An aquaculture farm, located at Southannan Sands growing and harvesting oysters. The oysters are all for human consumption with 75% being sold domestically. Of this 75%, 1% stays within North Ayrshire, 25% is bound for the Far East and the Middle East and the remainder stays within the UK. The oysters are sold through a Glasgow merchant with one local outlet selling oysters.

Three fish wholesalers operate within the survey area. A fishmonger in Largs source all of their produce from Peterhead though they do sell locally caught Langoustines all year from within the survey area. A shop and restaurant located near Fairlie source most of the shellfish (crab; lobster & langoustine) locally using their own boat moored at Largs. Some of the cod sold is sourced from Largs fishing boats but mostly sourced

from outwith the survey area. No individuals within or outwith the school holiday period survey were identified winkle picking commercially.

5.3 Non-Commercial Fishing and Angling

Table 5.1 Locations associated with hobby fishing activities

Bait Digging	Fishing from shore/rocks/pier/kayak	Mollusc/crustaceans picking (non-commercial)
Fairlie Sands	Auchengarth (rocks)	Oysters (Southannan Sands)
Ardrossan North Beach	West of Portencross Castle (rocks)	Whelks (Southannan Sands)
	Portencross Pier	Razor clams (Seamill)
	Portencross (from kayak)	Scallops (Fairlie Roads)
	Wemyss Bay (shore)	Scallops (around both Cumbraes)
	Castle Bay (shore)	Mussels& Winkles (Fairlie Sands)
	Ardrossan Pier	
	Grey Craigs & Farland Point (Great Cumbrae Island (from dinghy)	
	Farland Head (rocks)	
	Seamill (rocks)	
	Millport (off harbour and rocks)	
	Ardneil Bay (shore)	
	Largs Bay (shore)	

Angling was a popular activity and Table 5.1 shows areas where non-commercial fishing; bait digging and collecting of molluscs & crustaceans occurred within the aquatic survey area.

5.5 Wildfowling

Wildfowling was identified on several estates within the survey area with three wildfowlers surveyed. Greylag geese; pink-footed geese; Canadian geese; teal;

widgeon and mallard duck were shot and consumed. Wildfowling was not identified within the survey area during the 2012 habits survey.

5.6 Royal National Lifeboat Institute

Royal National Lifeboat Institute has one in-shore lifeboat (ILB) for approximately four people which is based and stored indoors at Largs. It is launched at the request of the coastguard for emergency rescue incidents. The ILB covers the area from Ardrossan to Lunderston Bay on the North Ayrshire Coast and over the Firth of Clyde west to Garroch Head, on the southern tip of the Isle of Bute. The area stretches (including Little Cumbrae and Great Cumbrae Islands) to Rothesay and continues north to Dunoon. There are 18 volunteer members based at Largs and the crew train twice weekly for approximately three hours each session. The crew are required to attend 12 of these training sessions annually. Last year in 2016 there were 31 ILB call outs for rescue and 100% of the rescues were from the boat only with no crew members entering the water.

5.7 Sailing and Rowing

Castle Craig Kayak Club have approximately 36 members with an additional 20 individuals taking part in club activities. Within the 36 members there are four junior members (under 16 years old) and additional five junior individuals occasionally participating within the kayak club. Guests occasionally also participate with the club. The club operates during the summer months (May to September) and formally meet weekly at Largs slipway with individuals kayaking for approximately six to eight hours. Approximately 10 members kayak twice weekly. During the winter months (October to April) approximately eight members meet and kayak twice weekly for four to five hours. The areas that members mostly kayak are: from Ardrossan South Beach; from Largs and around the Cumbrae Islands; from Largs to Fairlie; Clyde Port and Hunterston; from Seamill beach to the Cumbraes and Bute; from Portencross to Little Cumbrae; and the south of the Isle of Bute. All kayaks, boats and clothing are washed down at home. The club supply the safety boat cover for the Gillian Saltire Appeal annual sponsored swim from Largs to Cumbrae. The club provide a 'come and try' taster session at Cumbrae Water Sports Centre and Largs Sailing Club and they also provide demonstration events for potential buyers of kayaks annually (sometimes

twice annually, in winter and spring) where suppliers provide kayaks and Castle Craig Kayak Club provide demonstrations.

Largs Sailing Club has around 700 members and is based within Largs Yacht Haven. Of these members there are approximately 400 individuals actively sailing which comprising 200 children and 200 dinghy sailors (including family memberships). Within these groups there are six days of sailing weekly with safety cover and a family night sailing is to commence this year (2017) which will provide a support boat. Within the 200 children there are 100 active cadets who sail within the group (including shore-based training) for approximately 2.5 hours weekly for 20 weeks annually. Clothing used can be rinsed in shower facilities on site with many children taking them home to wash. The Sailing Club organise approximately 12 regattas (racing events) throughout the year.

Scotland's National Watersports Centre based on the Isle of Cumbrae provides water-based sports including: paddle sports; dinghy sailing; windsurfing; power-boating; and yachting. There are six full time instructors and 50 associate instructors that may be called upon as required. The centre provide introductory and experienced courses with 80% of the activities based within the survey area and 20% outwith the survey area. The activities provided consist of three hours in the morning and three hours in the afternoon.

A one week sailing course is provided every six weeks. Accommodation is provided within the centre and groups range from primary school children to adult groups. The National Water Sports Centre is also the training venue for the national laser squad (seven squad members) and this training is undertaken throughout the winter months. Information provided by the centre indicated that a total 9 527 individuals undertook courses or made use of the facilities for training purposes for the period 2016/2017.

The Field Studies Centre, Isle of Cumbrae provides field work experiences for primary and secondary school children, universities and activity filled family holidays. Group sizes vary from 2 – 100 with courses/activities provided for approximately five days – four out of the five days a mixture of beach and boat-based activities are provided. Coastline activities on different substrates are approximately two to three hours in length with boat trip activities approximately 1.5 hours in length. September to November however see an increase of demand due to schools Advanced Higher

Courses with December and January being the quietest months. All boat and clothing gear is washed down by students at the Field Studies Centre. The centre generally closes for one to two weeks over Christmas and New Year.

5.8 Diving Clubs

A diving club that regularly meet within the aquatic survey area and undertake sub-aqua diving were contacted. Three members of the group were interviewed. The group have approximately 35 members with 12 being regular divers. There are no child members. The club meets every Tuesday evening throughout the year and training is available at that time. In addition to the Tuesday evening, diving takes place every Friday and Sunday with occasional Friday night dives, Saturdays and weekends. Diving routinely takes place, weather dependant, between Ayr Bay and Gourock, most commonly out of Largs to the various wrecks. Dives also take place outwith the aquatic survey area. Equipment is generally rinsed after each use, depending on facilities at the launch site and serviced annually. Suits get hosed down but most members take their regulators and own equipment home for thorough rinsing. Additionally, scallops and lobsters would be collected for personal consumption by some members.

5.9 Professional Dog Walkers

Professional dog walkers operate within the survey area. These groups will be active along the coastal strip for much longer periods. As dogs can enter the sea and the route of walks often encompasses muddy and sandy areas, the group may potentially have greater exposure to intertidal substrates. Two professional dog walkers were identified and interviewed. They reported to regularly walk on the intertidal areas around Fairlie; Hunterston, Portencross; Seamill and Ardrossan. The length of time walking varied with the seasons with more frequent visits to the coastline during spring and summer.

5.10 Ramblers/Walking

The survey area is popular with ramblers and walkers, especially with the Ayrshire Coastal Path which follows most of the survey area coastline. The survey team however were unsuccessful in contacting any local rambling or walking groups. With

the presence of the National Nature Reserve and SSSI within the survey area many walkers/bird watchers were noted.

5.11 Animals Grazing

Cows were observed grazing in several fields within and around the survey area. No cattle or sheep were observed grazing on seaweed or within intertidal areas anywhere within the survey area.

5.12 Seaweed and Foraging

Individuals interviewed reported collecting seaweed from Seamill beach, Fairlie Sands for use to grow vegetables. The amounts of seaweed collected by all individuals (checked and confirmed by individuals) are detailed as follows:

- One individual interviewed collects 225 kg of seaweed from Seamill beach. The seaweed is used in the individual's allotment, West Kilbride Allotment Association (the seaweed is collected towards the end of the year, put on top of the soil and left to mulch down ready for planting on the following Spring), to grow vegetables for their own and one other individual's consumption. This individual is also hoping to source seaweed from within the survey area for their own consumption;
- A second individual collected 320 kg annually from Fairlie Sands to use as fertiliser on their allotment (Fairlie organic growers) and providing seaweed that was distributed on all plots within the allotment;
- A third individual collected 15 kg of seaweed annually from Fairlie Sands. The seaweed was used on their allotment at Fairlie organic growers to grow vegetables for consumption by themselves and their family. The seaweed was collected and hung up to dry out over a period of a few weeks then distributed on top of the soil at the end of the year (November). This is left to mulch down ready for the following years growing season;
- A fourth individual collected approximately 180 kg of seaweed annually from Seamill beach for distribution on their allotment. The fruit and vegetables grown were for their own and their family's consumption. The seaweed is collected and then applied on top of the soil at the end of the year (November)

and left to mulch ready for planting on in the spring. Any larger bits of seaweed are chopped down and dug into the soil. Some rotted seaweed left in water is also used for watering and feeding growing plants;

- A fifth individual collected 120 kg of seaweed annually from within the survey area. The seaweed was used on their allotment and the fruit and vegetables grown were consumed by the individual. The seaweed is collected and put on top of the soil towards the end of the year (November). It is then left to mulch down and for the worms to pull it into the soil. The soil is used the following spring for planting;
- A sixth individual collected 45 kg of seaweed annually from within the survey area. The seaweed was used on their allotment and in the community garden in West Kilbride. The fruit and vegetables were consumed by the individual and other community garden individuals. The seaweed is collected and put on top of the soil towards the end of the year (November). It is then left to mulch down and for the worms to pull it into the soil. The soil is used the following spring for planting;
- A seventh individual collected 150 kg of seaweed annually from Seamill beach and Ardrossan North beach. The seaweed was used on the individual's allotment and produce grown was consumed by the individual;
- An eighth individual collected 10 kg of seaweed from Kames Bay on Greater Cumbrae which was used on raised beds in their allotment. This individual also consumes 0.45 kg seaweed annually that was collected from Kames Bay;
- A ninth individual collected 30 kg of seaweed annually from Fairlie Sands which was used on their allotment; and
- A tenth individual collected 2 tonnes of seaweed annually from Portencross for use in their own garden as compost. All vegetables and fruit were consumed by the individual and family. Some of the seaweed was processed in the individuals' garden in containers to be used as liquid fertiliser and the remainder was laid on top of the empty soil beds and left for approximately three to four weeks allowing it to start to break down and for the worms to pull it down. It was then dug into the soil and left until spring ready for planting on.

5.13 Phase 1 Survey Results: Internal Exposure

5.13.1 Introduction

A total of 417 face-to-face surveys were completed during the two fieldwork periods in 2017. Following each phase of fieldwork, data from the face-to-face surveys were entered into a database by each respective surveyor.

5.13.2 Adult Consumption Rates

Table 5.2 presents a summary of the consumption rates for aquatic food types including; fish, crustaceans, molluscs and wildfowl. Mean adult consumption rates for the high-rate groups and the observed 97.5th percentile rates are included in Table 5.2. The high-rate group was determined using a 'cut-off' method described by Hunt *et al*., (1982). This 'cut-off' method calculates the high-rate value by taking the mean of the values between the maximum observed rate and one third of the maximum observed rate. Therefore, the 'cut-off' method within this report is represented as the individuals derived to obtain the 'high-rate group'. The table also includes mean consumption rates and 97.5th percentile rates based on the full dataset. The generic mean and generic 97.5th percentile rates based on National Habit Data is also included (Smith and Jones, 2003).

The national data values are used to compare the high-rate mean and high-rate maximum consumers within the habits survey. During the Hunterston habits survey it became apparent that the national data does not consider any extreme habits of consumption. For example, there may be regional or local differences in habits which may result in very different rates of consumption for fish; crustacean and molluscs (Table 5.2), which is vastly greater than the national mean and may represent an important local pathway. It may be necessary to consider that the national data cannot capture local or regional variations in habits, which may have local significance within habits-based assessment.

Table 5.2 Summary of adult consumption rates of foods from the aquatic survey area.

Food Group	Number of observations in full dataset	Number of observations in high rate group	Observed maximum for high rate group (kg y^{-1})	Observed minimum for high rate group (kgy^{-1})	Observed mean for high rate group (kg y^{-1})	Observed 97.5th percentile for high group (kg y^{-1})	Observed mean for full dataset (kg y^{-1})	Observed 97.5th percentile for full dataset(kg y^{-1})	National data mean (kg y^{-1})	National data 97.5th percentile (kg y^{-1})
Fish	46	1	94.1	94.1	94.1	94.1	11.4	54.3	15.0	40.0
Crustaceans	13	4	26.0	26.0	26.0	26.0	13.3	26.0	4.00	10.0
Molluscs	10	1	28.8	28.8	28.8	28.8	6.46	25.6	4.00	10.0
Seaweed	1	1	0.45	0.45	0.45	0.45	0.45	0.45		
Wildfowl	11	2	47.2	47.2	47.2	47.2	9.71	47.5	ND	ND

Adults consumed cod (11 individuals); Dover sole (three individuals); mackerel (40 individuals); pollock (15 individuals); haddock (four individuals); plaice (eight individuals); flounder (eight individuals); monkfish (four individuals); and dab (eight individuals) all sourced from within the aquatic survey area. It should be noted that some adults consumed more than one fish type (flat and/or round). The observed maximum consumption (quantity x frequency) of fish was 94.1 kg y^{-1} and this individual consumed mackerel, sourced locally in the Firth of Clyde, whom fished on a regular basis.

Crustacean consumption consisted of brown crab (nine individuals); common lobster (nine individuals); and prawns (five individuals). The highest consumption was by four individuals each consuming 26 kg y^{-1} of prawns which were all locally sourced and self-caught by one individual fishing in the Fairlie Roads. It should be noted that some adults consumed more than one crustacean type.

Mollusc consumption consisted of mussels (two individuals); razor clams (one individual); scallops (nine individuals); winkles (one individual); oysters (two individual); and whelks (one individual). The observed maximum consumption was 28.8 kg y^{-1}, this individual consumed mussels (24 kg y^{-1}) and scallops (4.8 kg y^{-1}) purchased at a restaurant where both mussels and scallops are sourced from within the aquatic survey area. It should be noted that some adults consumed more than one crustacean type.

One adult surveyed consumed seaweed which was picked from Kames Bay on Great Cumbrae. Wildfowl consumption consisted of mallard (two individuals); pink-footed goose (two individuals); teal (two individuals); widgeon (two individuals); grey lag goose (six individuals); Canadian goose (two individuals); and woodcock (five individuals). The highest consumption was 47.2 kg y^{-1} by two individuals who consumed mallard (5.67 kg y^{-1}); pink-footed goose (3.1 kg y^{-1}); teal (0.9 kg y^{-1}); widgeon (1.1 kg y^{-1}); grey lag goose (34.5 kg y^{-1}); and Canadian goose (2 kg y^{-1}) which were all self-caught from within the aquatic survey area. These figures have been checked and confirmed by the individual.

5.13.3 Children and Infant Consumption Rates

Table 5.3 presents a summary of children's consumption rates for aquatic food types: fish, molluscs and wildfowl from the aquatic survey area. Mean consumption rates for both the high-rate groups and full dataset and the observed 97.5th percentile rates are included in Table 5.3. No children were identified in the survey who consumed crustaceans. There was no consumption of fish: crustaceans; molluscs or wildfowl noted for the infant age group.

Children consumed: mackerel (four individuals) and pollock (four individuals). The observed maximum consumption was 0.26 kg y^{-1} and this individual consumed mackerel (0.15 kg y^{-1}) and pollock (0.11 kg y^{-1}) caught off Farland Head.

Child mollusc consumption consisted of scallops consumed by two children. The highest consumption was 2 kg y^{-1} and this was sourced from Fairlie Roads. Wildfowl consumption consisted of woodcock consumed by one individual (0.1 kg y^{-1}) and this was sourced from a local estate. It should be noted that some children consumed more than one fish type.

Table 5.3 Summary of children's consumption rates of foods from the aquatic survey area.

Food Group	Number of observations in full dataset t	Number of observations in high rate group	Observed maximum for high rate group (kg y^{-1})	Observed minimum for high rate group (kg y^{-1})	Observed mean for high rate group (kg y^{-1})	Observed 97.5th percentile for high group (kg y^{-1})	Observed mean for full dataset (kg y^{-1})	Observed 97.5th percentile for full dataset (kg y^{-1})
Fish	4	4	0.26	0.26	0.26	0.26	0.26	0.26
Molluscs	2	2	2.00	2.00	2.00	2.00	2.00	2.00
Wildfowl	1	1	0.10	0.10	0.10	0.10	0.10	0.10

5.14 Phase 1 Survey Results: External Exposure

5.14.1 Adult External Exposure

Table 5.4 represents a summary of adult intertidal; aquatic (in-water); aquatic (on-water) occupancy rates; handling rates of equipment; and sediment. These activities are described in more detail below.

Intertidal activities for adults included: bait digging; bbq/sitting/picnicking; beach cleaning; beach football; beachcombing; bird/nature watching; boat maintenance; collecting mussels; collecting oysters; collecting razor clams; collecting sea coal; collecting seaweed; collecting whelks; collecting winkles; dog walking; fishing; fixing moorings; horse riding; kite flying; paddling; playing; slipway cleaning; walking; wildfowling; and working on an oyster farm. The highest intertidal occupancy rate by an adult was 1 278 h y^{-1} dog-walking at Fairlie Sands.

Table 5.4 Summary of adults' external exposure for intertidal, aquatic, handling of equipment and handling of sediment

Activity	Number of observations in full dataset	Number of observations in high rate group	Observed maximum for high rate group (h y^{-1})	Observed minimum for high rate group (h y^{-1})	Observed mean for high rate group (h y^{-1})	Observed 97.5th percentile for high group (h y^{-1})	Observed mean for full dataset (hr y^{-1})	Observed 97.5th percentile for full dataset (hr y^{-1})
Intertidal	221	12	1 278	792	978	1 269	181	916
Aquatic (In water)	20	1	156	156	156	156	18.4	119
Aquatic (On water)	61	1	2 730	2 730	2 730	2 730	253	1 344
Handling equipment	82	1	3 030	3 030	3 030	3 030	186	1 036
Handling sediment	73	1	858	858	858	858	55.5	355

Activities in the water included: sub-aqua diving; diving; stand-up paddle boarding (SUP-boarding); RNLI duties; coasteering; outdoor swimming; and capsizing when racing. Outdoor swimming was the most popular activity (seven individuals) whilst sub-aqua diving was the most popular in water activity with an individual reporting the highest occupancy (156 h y^{-1}), diving in the waters off both Cumbrae islands approximately 3 hours per week, all year round. These figures have been checked and confirmed. An individual adult reported spending time (2 h y^{-1}) in the water as a result of their boat capsizing when sailing. SUP-boarding is a relatively new sport in the UK and two individuals reported paddle-boarding or spending time in the water from Ardneil Bay along the coast to Largs Bay.

Activities on the water by adults included: being on a dive boat; boat maintenance; canoeing; commercial fishing/creeling; commuting by ferry; creel handling; dinghy

sailing; kayaking; power boating; RNLI duties; rowing; sailing; sail racing; sea angling; SIB boating; SUP-boarding; safety boat duties; and working on a boat. One individual reported freshwater angling in a loch within the survey area. The highest occupancy rate for adults on the water was 2 730 h y^{-1} for an individual who undertook commercial fishing/creeling activity. Freshwater angling was reported by one individual at a freshwater loch near West Kilbride within the 5 km zone.

The highest level of handling equipment by an adult was 3 030 h y^{-1} reported by a commercial fisherman handling fishing equipment (2 730 h y^{-1}) plus boat and boating equipment (300 h y^{-1}). These figures have been checked and confirmed by the individual. The highest level for handling sediment was 858 h y^{-1} by an individual who worked at an oyster farm. The occupancy data for intertidal activities were used for estimating the external gamma dose rate. Selected relevant intertidal activity occupancy data were also used to derive the handling sediment category which was then used for estimating the beta skin dose rate.

5.14.2 Children and Infants External Exposure

Table 5.5 represents a summary of children and infants' intertidal; aquatic (in-water); aquatic (on-water) occupancy rates; and handling rates of equipment and sediment.

Intertidal activities for children included: bbq/sitting/picnicking; beachcombing; beach football; dog walking; fishing; kite flying; paddling; playing; and walking. The highest intertidal occupancy rate for was 696 h y^{-1} by two children who spent time bbq/sitting/picnicking (72 h y^{-1}) at Millport; beachcombing (156 h y^{-1}); dog walking (156 h $^{y-1}$); paddling 156 (h y^{-1}); and playing on the beach (156 h y^{-1}) at Skelmorlie where they live.

Intertidal activities for infants included: bbq/sitting/picnicking; collecting razor clams; dog walking; fishing; paddling; playing and walking. The highest intertidal occupancy was 208 h y^{-1} for an infant who spent time playing on the beach at Ardrossan north beach.

The highest occupancy for handling equipment for children was 416 h y^{-1} who fished at Auchengarth. The highest level for handling of equipment for infants was 1 h y^{-1} for one infant who fished at Ardneil Bay, Great Cumbrae.

Table 5.5 Summary of children's and infant's external exposure for intertidal, aquatic and handling of equipment (rounded to three significant figures).

Activity	Number of observations in full dataset	Number of observations in high rate group	Observed maximum for high rate group (h y^{-1})	Observed minimum for high rate group (h y^{-1})	Observed mean for high rate group (h y^{-1})	Observed 97.5th percentile for high rate group (h y^{-1})	Observed mean for full dataset (hr y^{-1})	Observed 97.5th percentile for full dataset (hr y^{-1})
Children (6 - 15 years old)								
Intertidal	45	2	696	696	696	696	73.2	684
Aquatic (In-water)	5	1	6.24	6.24	6.24	6.24	2.25	5.82
Aquatic (On-water)	14	1	612	612	612	612	58.1	438
Handling equipment	19	1	416	416	416	416	33.3	262
Handling sediment	34	2	540	540	540	540	60.9	540
Infants (0 - 5 years old)								
Intertidal	20	2	208	156	182	207	36.1	183
Handling equipment	1	1	1.00	1.00	1.00	1.00	1.00	1.00
Handling sediment	18	1	156	156	156	156	27.7	134

The highest occupancy for handling of sediment by a child was 540 h y^{-1} who lived at Skelmorlie and spent time playing and sitting on a beach; beachcombing and paddling in the sea; either at Millport or at Skelmorlie on a frequent basis. The highest occupancy for handling of sediment by an infant was 156 h y^{-1} playing on the beach at Ardrossan north beach. The occupancy data for intertidal activities were used for estimating the external gamma dose rate. Selected relevant intertidal activity occupancy data were also used to derive the handling sediment category which was then used for estimating the beta skin dose rate.

Gamma dose rate measurements over different substrates within the survey area can be found in Chapter 7.

6. Terrestrial Radiation Pathways

6.1 Introduction

Chapter 6 reports on inland routes of exposure immediately adjacent to the Hunterston site, coastal and intertidal areas (Chapter 2, Figure 2.1). The observations made at each site are also presented. This chapter reports private food production details and the results from the face-to-face survey for consumption levels for privately produced food stuffs and occupancy rates within 5 km.

6.2 Terrestrial Survey Area

The terrestrial survey area extends 5 km radial from the Fairlie to Seamill and includes the southern end of Great Cumbrae Island and Little Cumbrae Island. Much of the land within the survey area is agricultural, predominantly arable and livestock (mostly cattle and sheep).

6.3 Private Food Production

Three allotments were found within the 5 km radius from the Hunterston site: West Kilbride Allotments Association; Organic Growers of Fairlie and Cumbrae Community Garden. A focus group was arranged with members of the West Kilbride Allotments Association with four individuals interviewed providing details of fruit and vegetable consumption data. The West Kilbride Allotments Association has 12 members at present with those members actively using the plots to grow and consume vegetables and fruit. Three of these individuals sourced seaweed from within the aquatic survey area for use on their allotment.

The survey team arranged a focus group with the Organic Growers of Fairlie and eleven members were interviewed providing details of fruit and vegetable consumption data. The organisation started with less than 20 people in 2008 and now has approximately 200 members, which includes some families, growing fruit and vegetables on the site. Each member maintains approximately two outdoor raised beds and one raised bed within a polytunnel, this however varies. Rainwater is collected on site which is used to irrigate the raised bed plots. Nine of the members

interviewed collected seaweed from within the aquatic survey area for use on their allotment.

The Cumbrae Organic Growers is a community-based guard and seven members were interviewed providing details of fruit and vegetable consumption data. Of the seven members interviewed one individual collected seaweed from within the aquatic survey area for use on their allotment. The Cumbrae Organic Growers have 30 members and each member is allocated one outdoor raised bed and one polytunnel bed. The Cumbrae Organic Growers have approximately 50 friends of the garden which support the gardens and can be called upon for helping out with planting baskets. The local primary school has a bed donated to them from the Cumbrae Organic Growers where Primary six children attend a gardening club once weekly in the spring. There is no consumption of produce as this is primarily a learning experience. The Cumbrae Organic Growers are also involved with a local care home for adults with learning difficulties. Once weekly over the summer period individuals help with gardening at the allotment in which vegetables are then taken back to the care home and consumed by the residents.

During the survey period, both within and outwith the school holidays, many individuals were found to produce a wide variety of fruit and vegetables. Of those individuals interviewed, some were specific with the yield of their products, many of whom maintained detailed records of the crop grown and the respective yield.

Face-to-face interviews indicated that 51 individuals grew their own fruit and vegetables within their home gardens and/or allotments with many growing a range of produce on the survey list and which were consumed by their family and friends. These individuals yielded data of sufficient quality for quantitative estimates of food quantities grown and consumed.

A total of three individuals surveyed reported keeping chickens, two individuals keep ducks and one individual keeping geese.

6.3 Commercial Food Production

Two butchers were identified within the survey area. One reported to source some lamb and beef 2 farms and also potatoes and carrots from within the 5 km survey area. The other butcher sources all their meat products from the abattoir in Paisley.

Game was shot on several farms and estates within the terrestrial survey area. The game (Roe deer – both buck and doe, pigeon and pheasant) was consumed by the individuals and their families.

6.4 Wild Foods

Table 6.1. Summary of wild food consumption by adults, total number of individuals, highest annual consumption and locations where wild food picked

Food Type	Number of observations in full dataset	Observed maximum for Full dataset (kg y^{-1})	Location of highest Consumption foraged	All other foraging locations
Apples	4	25.0	Millport	West Kilbride gardens
Blackberries	35	4.00	Millport, Millport Cathedral, Hunterston Estate,	West Kilbride gardens, West Kilbride Glen, Fairlie, Seamill, Hunterston nuclear site, Thirdpart
Elderflower	6	1.00	West Kilbride Glen	Hunterston nuclear site, Millport, West Kilbride Glen
Garlic Leaves	1	0.10	Millport	-
Mushrooms	8	1.00	West Kilbride allotments	West Kilbride Allotments, Fairlie
Nettle	1	2.00	Millport	-
Raspberries	6	5.00	Hunterston nuclear site	Fairlie Castle, Fairlie
Rosehips	1	1.00	Seamill	-
Seaweed	1	0.45	Kames Bay	-
Slow	4	4.00	Portachur Point	Millport
Sticky Willy	1	0.20	Farland Point	-
Wild Garlic	4	0.50	Hunterston nuclear site	Fairlie

Within the terrestrial survey area wild food foraging was reported by 21 individuals. A breakdown of the foods, number of individuals, consumption and locations are detailed in Table 6.1.

Blackberries were the most popular wild food picked with 35 individuals doing so, whilst apples yielded the highest quantity (25 kg y^{-1}). A total of eight individuals were identified as picking wild mushrooms with *Cantherellus and Boletus* species collected from allotments in West Kilbride. Small quantities of rose hips and sticky-willy were two new wild foods identified as been collected.

6.5 Production of Honey

Beekeepers are not required to be a member of a bee keeping association or to be registered therefore the precise numbers in the survey area are unknown. The North Ayrshire Beekeepers group was contacted and reported that there are approximately 33 members within North Ayrshire though only 10 - 12 members keep bees. Approximately two thirds of the members are new. The North Ayrshire Beekeepers group covers the area from Irvine to North Ayrshire and Inverclyde. A focus group was arranged with the North Ayrshire Beekeepers and two individuals were interviewed. During the survey period beekeepers interviewed kept bees around West Kilbride and Hunterston. Details of beekeeping are as follows:

- One beekeeper identified within the survey area at West Kilbride breeds and sells bees thus the quantity of hives varies throughout the year. The individual reported that during the summer they keep 12 hives and during the winter this is reduced to five hives. Most of the bees kept are sold (sold between Arran and into Dumfries and Galloway). Of the hives producing honey, a total of 46 kg is produced annually of which 16 kg is consumed by the beekeeper and one other individual (8 kg each), 7 kg is gifted to friends and family within the local area and 23 kg is sold within the local area, though some is sold outwith in Irvine and Ayr. During different seasons the bees forage on different pollen. The main honey flow produced is from trees and clover (fruit trees, sycamore and lime tree blossom) with foraging also from heather, dandelion, rosemary, willow herb and from snowdrop and crocus in the spring. The bees are found

to travel approximately 2.4 km. This individual has taken pollen samples from the bees to determine where it comes from,

- A second beekeeper keeps two active hives in West Kilbride producing 8 kg of honey annually. Of the honey produced 4 kg is consumed by the beekeeper and one other individual (2 kg each) and the remaining 4 kg is gifted to family and friends within the terrestrial survey area. During different seasons the bees forage on different pollen. The main honey flow is produced from sycamore and ivy blossom, heather and Himalayan balsam. The bees also forage clover, bramble, willow herb, snowdrop and crocus. The bees are found to travel approximately 2.4 km;
- A third individual reported to keep seven active hives near Hunterston. The individual was unable to provide details of quantities consumed and sold but indicated that some of the honey was sold locally within the survey area and some of the honey was consumed by the individual and family members. The hives however are mainly kept for breeding and selling of bees; and
- A fourth individual keeps beehives. The individual interviewed stated that any hives kept were within 5 km of the Hunterston site. Of the hives kept 3 kg of honey was consumed by the individual annually. Family members within the survey area also consume the honey.

6.6 Poultry

One individual interviewed keeps chickens, geese and ducks within the terrestrial survey area. Eggs from all birds are consumed by the individual, but the majority were either sold, gifted or traded within the local West Kilbride. The individual will be adding a further 20 rescue chickens at the end of March 2017.

Details of egg production and sales are as follows at the time of interview:

- Twenty chickens are kept free range with six-dozen eggs sold weekly for ten months of the year;
- Four geese are kept free range with eight eggs weekly either gifted or traded with individuals from the neighbouring allotment association; and
- Fourteen ducks are kept free range with the majority of two dozen eggs sold mostly to order. Any remaining eggs are gifted.

A second individual interviewed keeps a small number of chickens and eggs produced consumed by the individual and family. Two dozen eggs are also gifted weekly for most of the year.

A third individual interviewed keeps a small number of chickens and ducks. Eggs are consumed by this individual and one other family member. One dozen eggs (both chicken and duck) are gifted monthly to family and friends locally.

6.7 Farms

Within the Hunterston terrestrial survey area 15 working farms were identified. Farming included lamb, cattle, potatoes and cattle/sheep feed. Some of the farms reported that beef and lamb was consumed by the farmer and/or family members. From the postal survey, milk was consumed at one farm within the survey area by the farmer and their family. Farm water supply for human consumption was provided by mains water supply, one farm consumed water from a private water supply with animal (cow and sheep) water consumption being provided by mains water supply. Some animal water was provided by a private water supply and burn/ditch water. It should be noted that all farmhouses are situated within the 5 km terrestrial zone, though for a few farms, some of their land lies outwith the 5 km terrestrial zone.

6.8 Other Pathways

As part of the survey, other terrestrial and aquatic based pathways that maybe pertinent to the Habits survey were explored.

The Largs and District Angling Club have approximately 100 members. Within the terrestrial survey area, the club fishes at Crosbie Mains, West Kilbride – a brown trout fishery. It is reported that most of the club members practice catch and release fishing, however, a few do catch and take them home to consume.

Within West Kilbride an initiative to re-generate the village commenced in 1998. As part of this initiative an environmental group was formed starting with a community garden.

The group is now associated with 12 environmental projects around West Kilbride and from these activities a Green Gym was developed. The Green Gym currently has 17 regular volunteers with a further four or five people helping on occasions. Each

volunteer gives approximately three hours weekly to help. Based in a quarry (a nature reserve) they are currently planting a meadow; orchard and managing a wood. Within the group they provide hanging baskets; an edible area; wildflowers and an expert on mushroom foraging. In the meadow nuts; pears; apples and plum trees are grown. At the quarry rhubarb; gooseberries; blackcurrants; courgette; leek; kale and apple trees are grown. The Green Gym has connections with the local primary school where two Primary six classes (approximately 60 children) help one afternoon a week from Easter to summer and from the new term in summer to autumn. The children learn about the environment and partake in a hands-on experience of growing plants (flowers as well as edible plants) and generally have one input each year (before summer) to harvest the edible plants for them to consume. An annual beach clean-up is organised by the Green Gym, assisted by other organisations such as the Boys Brigade; the Brownies and church groups involved. They spend approximately six hours in spring collecting litter from the coastline from West Kilbride to Portencross.

The Argyll Fungi Group undertake species recording within the terrestrial survey area and although on occasions foraging is participated in (whether within or outwith the survey area), the purpose is to record where species are in order to identify these areas on a map. The group cover the Clyde and Argyll areas therefore the terrestrial survey area is only visited on a few occasions. Although the group have approximately 100 members, approximately 12 individuals (not always the same individuals) meet every weekend between August and November to record, and on occasions, forage fungi.

One individual interviewed produces and sells liqueurs from produce foraged within the terrestrial survey area. The liqueurs are sold in one local shop as well as farmers' markets and further afield. A very small amount of the liqueurs produced is consumed by the individual, however, no quantity was provided by the individual.

No quarries were identified during this survey which currently undertake any aggregate or stone extractions.

6.9 Internal Exposure - Phase 1

6.9.1 Adult Internal Exposure

Table 6.2 Summary of adult consumption of foods from the terrestrial survey area.

Food Type	Number of observations in full dataset	Number of observations in high rate group	Observed maximum for high-rate group (kg y^{-1} or l y^{-1})	Observed minimum for high-rate group (kg y^{-1} or l y^{-1})	Observed mean for high-rate group (kg y^{-1} or l y^{-1})	Observed 97.5th percentile for high group (kg y^{-1} or l y^{-1})	Full dataset-Observed mean (kg y^{-1} or l y^{-1})	Full dataset-Hypothetical 97.5th percentile (kg y^{-1} or l y^{-1})	National mean (kg y-1 or l y^{-1})	National 97.5t^{h} percentile (kg y^{-1} or l y^{-1})
Vegetables-Green	37	3	55.6	51.9	53.2	55.4	15.2	52.5	15.0	45.0
Vegetables-Other	31	3	43.6	35.2	38.0	43.2	8.6	37.3	20.0	50.0
Vegetables-Roots	32	3	46.5	39.4	43.9	46.5	14.7	46.5	10.0	40.0
Vegetables-Potatoes	44	4	50.0	38.1	44.1	50.0	14.9	49.1	50.0	120
Fruit-Domestic	41	6	74.5	38.8	49.4	71.3	22.0	49.2	20.0	75.0
Fruit-Wild	38	1	28.5	28.5	28.5	28.5	28.5	15.1	7.00	25.0
Wild Fungi	7	4	1.00	1.00	1.00	1.00	0.74	1.00	3.00	10.0
Meat- Beef	8	1	28.0	28.0	28.0	28.0	6.28	24.7	15.0	45.0
Meat - Game	5	2	3.00	3.00	3.00	3.00	1.95	3.00	ND	ND
Meat - Game Birds	11	2	10.3	10.3	10.3	10.3	4.49	10.3	ND	ND
Meat - Poultry	5	2	2.00	2.00	2.00	2.00	1.40	2.00	10.0	30.0
Meat - Sheep	9	1	24.0	24.0	24.0	24.0	10.0	21.6	8.00	25.0
Meat - Pork	-	-	-	-	-	-	-	-	15.0	40.0
Eggs	29	8	37.2	24.1	28.9	37.2	14.7	37.2	8.50	25.0
Milk	-	-	-	-	-	-	-	-	95.0	240
Honey	11	2	8.00	8.00	8.00	8.00	2.89	8.00	2.50	9.50
Drinking Water	1	1	365	365	365	365	365	365	ND	ND

ND – not determined

Consumption data for locally grown foodstuffs potentially affected by atmospheric releases from Hunterston are presented in Table 6.2 for adults.

The table summarises the number of observations made, the number of people in the high-rate consumer group, the minimum and maximum observed consumption rates

for the high-rate consumer group and the observed 97.5th percentile value. The table also provides the mean and 97.5th percentile consumption rates from national data (Smith and Jones, 2003) for comparison. Consumption of locally produced foods was identified for all food groups with the exception of pork and milk.

The mean consumption rates of the high-rate consumer group were found to exceed the national 97.5th percentile value for five food groups. These were for green vegetables, root vegetables, wild fruit, game and eggs.

The mean consumption rate of the high-rate consumer group were found to exceed the national mean consumption. These were for green vegetables, other vegetables, root vegetables, domestic fruit, wild fruit, beef meat, sheep meat and eggs. One farmer reports to drinking 1 l per day of water from their own private spring water supply.

6.9.2 Children and Infant Internal Exposure

Table 6.3 represents a summary of the children and infant's consumption rates for terrestrial food groups. The table summarises the number of observations made, the number of people in the high-rate consumer group, the minimum and maximum observed consumption rates for the high-rate consumer group and the observed 97.5th percentile value. The table also contains the mean consumption rate for both the high-rate consumer group and the whole dataset collected from around Hunterston.

Child consumption of locally produced foods was identified for all food groups with the exception of sheep meat; pork; eggs; honey; milk and water. Only one food group consumed by infants was identified and this was for domestic fruit.

Table 6.3 Summary of children's and infant consumption rates.

Food Type	Number of observations in full dataset	Number of observations in high rate group	Observed maximum for high-rate group (kg y^{-1})	Observed minimum for high-rate group (kg y^{-1})	Observed mean for high-rate group (kg y^{-1})	Observed 97.5th percentile for high group (kg y^{-1})	Observed mean for full dataset (kg yr^{-1} or l y^{-1})	Hypothetical 97.5th percentile for full dataset (kg y^{-1})
Children (6 - 15 years old)								
Vegetables-Green	1	1	29.3	29.3	29.3	29.3	29.3	29.3
Vegetables-Other	1	1	11.7	11.7	11.7	11.7	11.7	11.7
Vegetables-Roots	1	1	40.4	40.4	40.4	40.4	40.4	40.4
Vegetables-Potatoes	1	1	38.1	38.1	38.1	38.1	38.1	38.1
Fruit-Domestic	1	1	17.0	17.0	17.0	17.0	17.0	17.0
Fruit-Wild	3	1	2.00	2.00	2.00	2.00	1.33	1.98
Wild Fungi	1	1	1.00	1.00	1.00	1.00	1.00	1.00
Meat- Beef	2	2	0.45	0.45	0.45	0.45	0.45	0.45
Meat - Game	1	1	1.25	1.25	1.25	1.25	1.25	1.25
Meat - Game Birds	1	1	5.10	5.10	5.10	5.10	5.10	5.10
Meat - Poultry	1	1	1.00	1.00	1.00	1.00	1.00	1.00
Infants (0 - 5 years old)								
Fruit-Domestic	2	2	0.60	0.60	0.60	0.60	0.60	0.60

6.9.3 GPS Survey Results

No individual was willing to wear a GPS tracker when approached by members of the survey team during the face-to-face surveys. However, on board GPS tracking

information was provided by one commercial fishing vessel over a seven-day period confirming fishing occupancy.

7 Direct Radiation Exposure

7.1 Introduction

A gamma-ray spectrometry survey was undertaken to estimate the dose received by the general public around the Hunterston Power Stations A and B. Areas of particular focus were within 1 km radius of the facility and any potential access points to intertidal areas (Nine individuals were surveyed who lived within 1 km, with two of those individuals also working within 1 km of the site). Nevertheless, all major roads and a large section of the coastal path surrounding the power station were also surveyed covering more than 70 km.

MoGSS data were used to help target follow-up *in-situ* terrestrial air kerma measurements, which were undertaken at all face-to-face survey locations, access point to intertidal area or at any location where an apparent anomaly was observed. Beta dosimetry was undertaken over intertidal environments to estimate the skin dose associated with the anthropogenic radioactivity in the environment. Measurements were conducted in intertidal areas spanning from Wemyss Bay to Ardrossan South Beach. Measurements in these areas were made on fishing equipment and boats that were frequently immersed in the waters surrounding the Hunterston facility.

7.2 Mobile Gamma Spectrometry Survey

7.2.1 Survey Area

Two systems operating MoGSS were deployed in order to cover the area in sufficient spatial detail. A car-bourne system covered all major roads, whilst a back-pack system was able to survey areas not accessible by vehicle. Figure 7.1 displays the areas that the MoGGS survey covered.

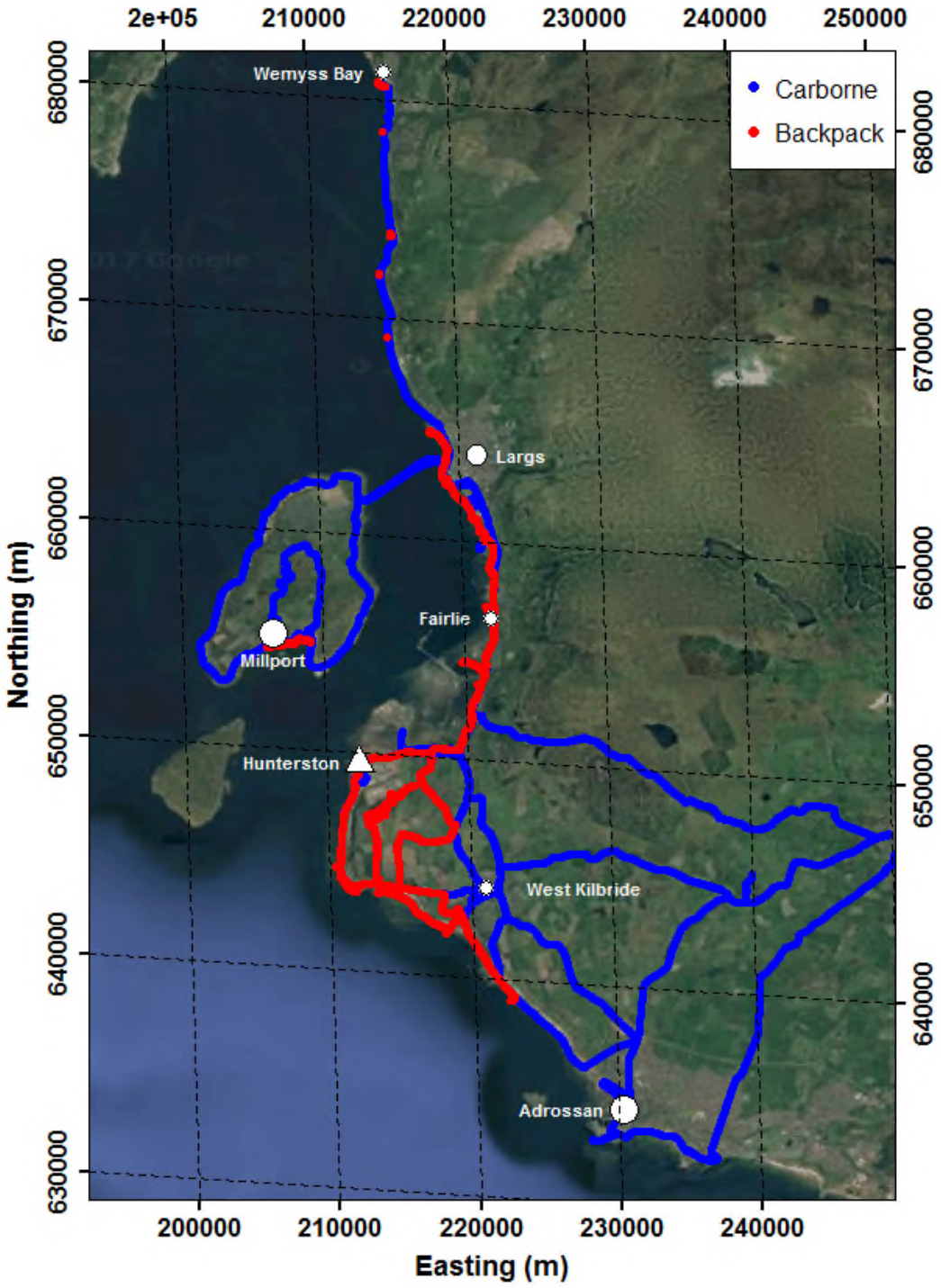

Figure 7.1 MoGSS coverage of Hunterston survey area. Red points demonstrate the area covered using the backpack system and blue points represent roads covered by the car-borne system

7.2.2 Mobile Gamma Survey Results

In total, over nine hours of data were captured encompassing 33 371 spectral measurements. (18 664 – road survey; 14 707– backpack).

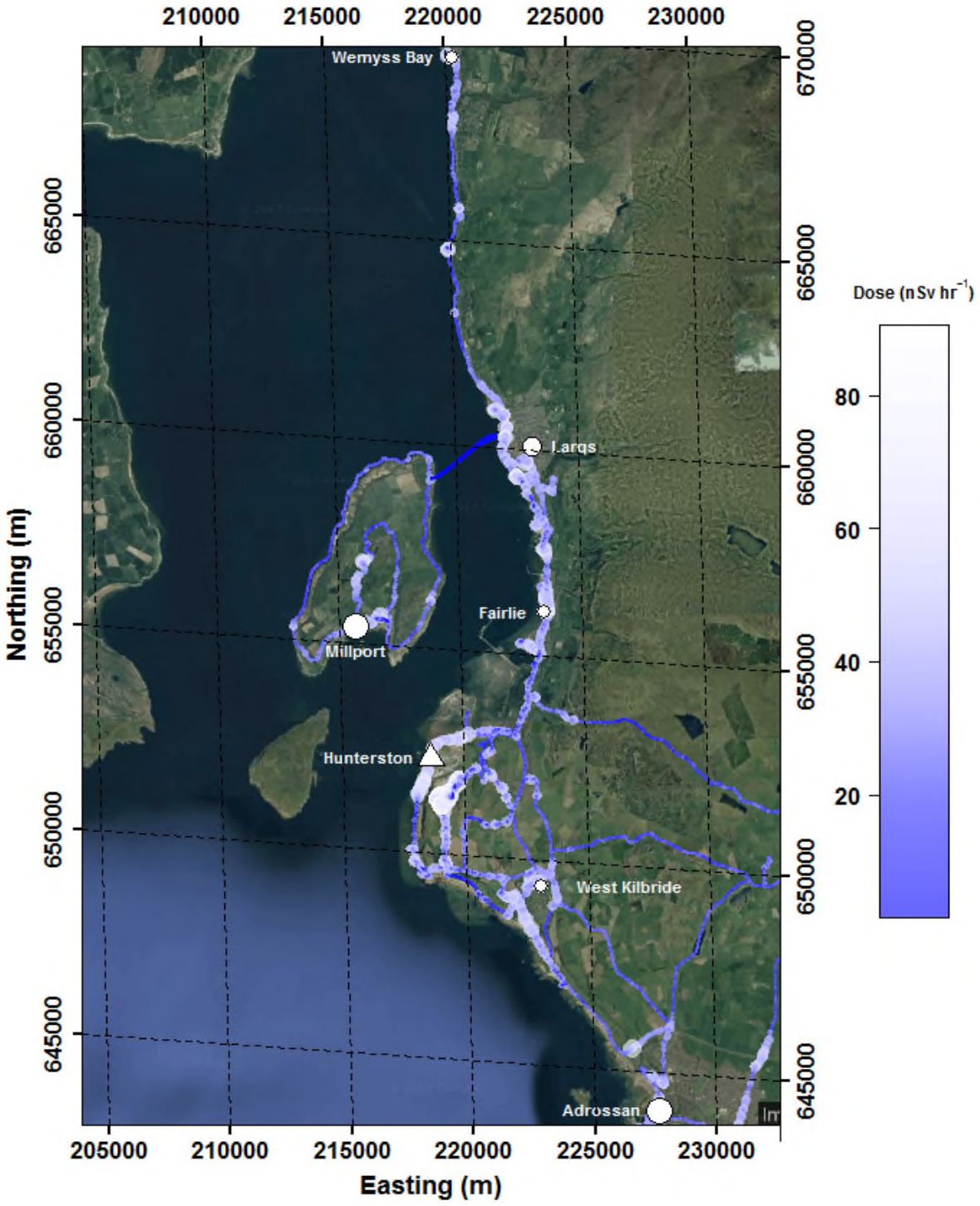

Figure 7.2 Total dose rate across the survey area

In terms of general spatial patterns in dose rate, much of the dose rate can be attributed to ^{40}K contributions and further contributions from the ^{238}U and ^{232}Th series (Figure 7.2). Elevated areas of dose are found in the major towns as a result of the higher density of building materials and road surfaces containing large proportions of the natural radioelements.

Large sections of the A78 (the major coastal road), particularly in built up areas such as through much of Largs, Ardrossan and Fairlie, reveal an elevated dose rate (> 60 nGy hr^{-1}). Comparing this dose rate to the hills surrounding the area where there is significantly less dose rate (~20 nGy hr^{-1}) due to the lack of buildings. This effect is commonly observed from buildings in mobile gamma-ray spectrometry.

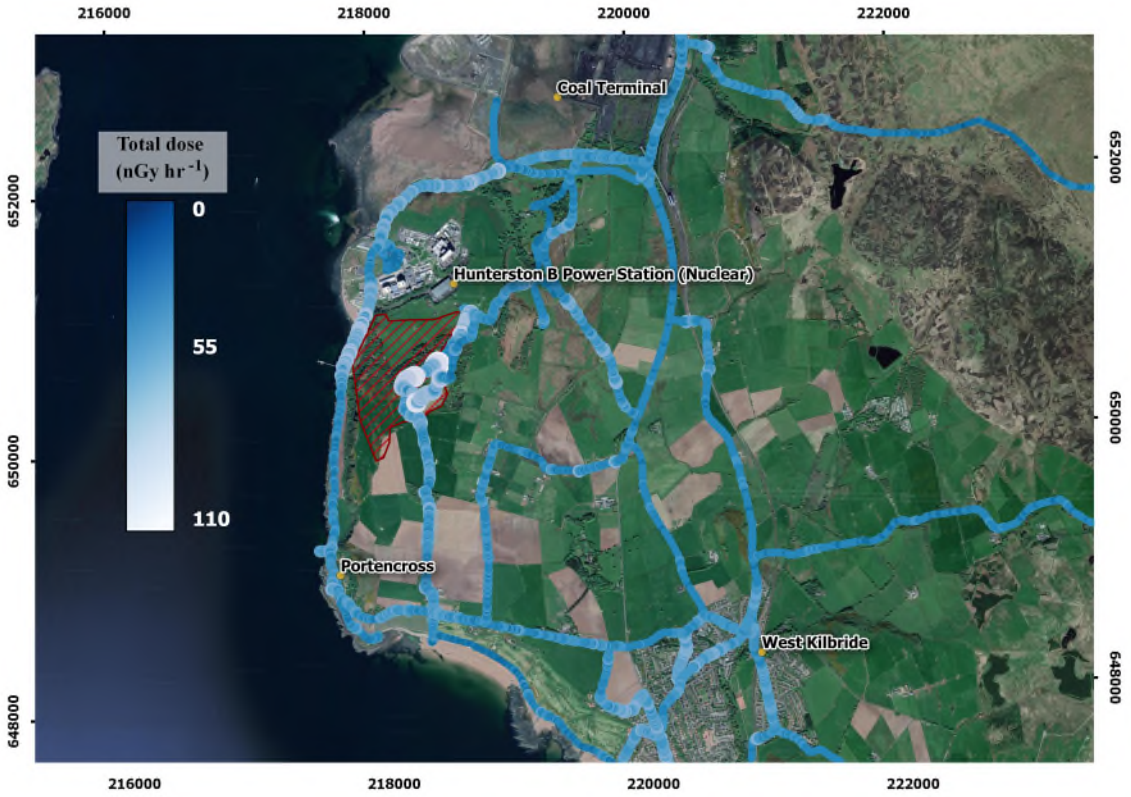

Figure 7.3 Total dose rates close to the Hunterston site alongside igneous intrusion

In close proximity to the Hunterston site, the dose rate would appear to be relatively high in terms of the entire survey area (Figure 7.3). This dose rate is dominated by an acid igneous intrusion, which forms the basis of the hill shadowing the site to the east (Figure 7.4-7.6). The elevated dose rate can be seen in both the ^{40}K (Figure 7.4) and ^{238}U (Figure 7.5) results at the top of the hill where results are recorded within the

boundary of the intrusion itself. Furthermore, elevated areas associated with the main road going into the site can be seen.

Overall, there are low contributions from ^{137}Cs (<15 nGr hr^{-1}) around the site and this could be also be an artefact from slight over stripping from the U window as there is a good correlation with ^{238}U dose rate (Figure 7.6). Further data measurements provided by the MoGGS system is in Appendix A7. These include: Estimated soil activities (Figure A7.1) and dose rates distributions from the car-borne measurements (Figure A7.2). Estimated concentrations for ^{40}K; ^{137}Cs plus the ^{238}U and ^{232}Th series are plotted for car-borne data in Figure A7.3).

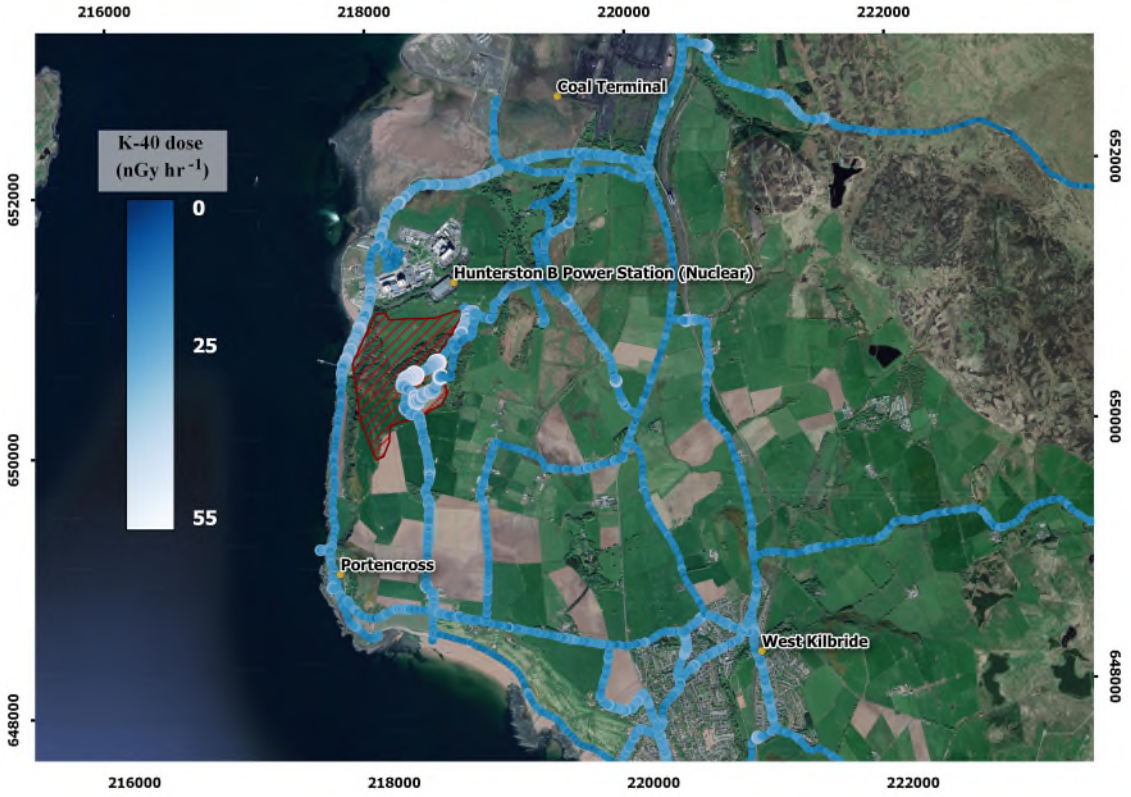

Figure 7.4 ^{40}K dose rate in the vicinity of the Hunterston site alongside igneous intrusion

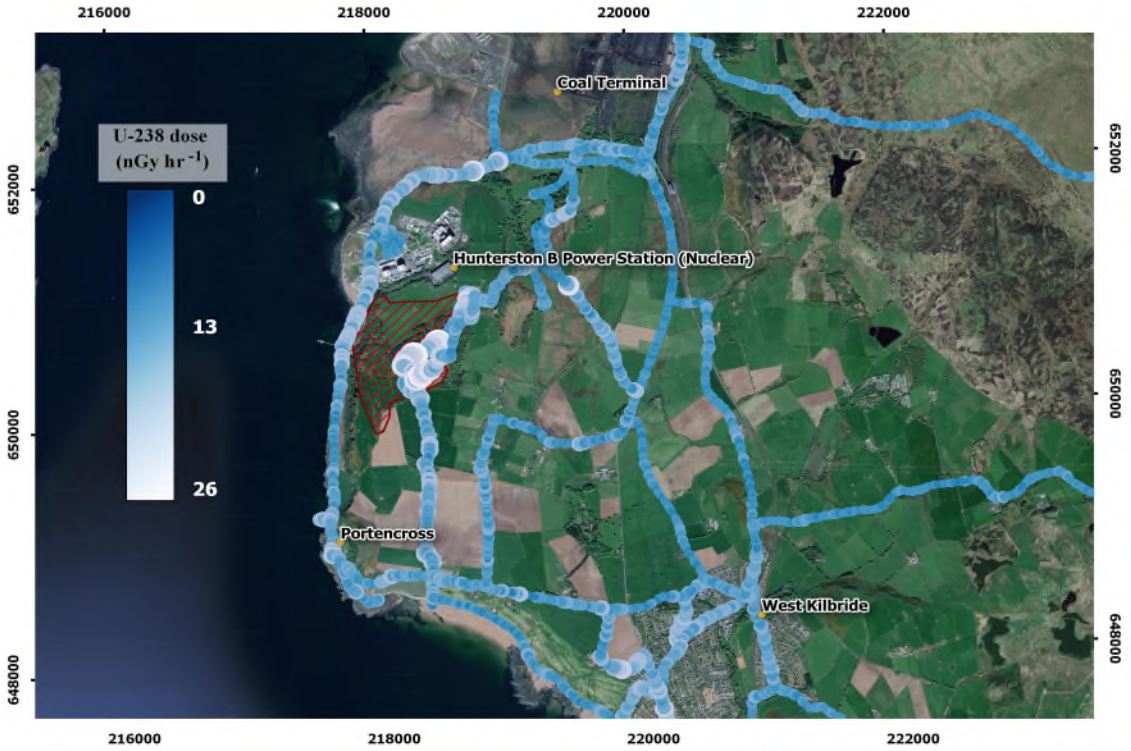

Figure 7.5 ^{238}U dose rate in the vicinity of the Hunterston site alongside igneous intrusion

Figure 7.6 ^{137}Cs dose rate in the vicinity of the Hunterston site alongside an igneous intrusion

7.3 *In-Situ* Gamma Dosimetry

A total of 37 *in-situ* air kerma (dose rate in air) measurements were collected at both terrestrial and intertidal sites during the survey (Figure 7.7). A UKAS accredited procedure was followed to estimate the terrestrial gamma dose rate. Since the vast majority of dose contribution was thought to be from the natural radionuclides a ^{226}Ra calibration was used to estimate dose rate for all air kerma measurements given that ^{226}Ra occurs naturally in the environment and emits a number of gamma-rays spanning the entire environmentally relevant spectrum. A summary of the dose rate measurements made across the site for terrestrial areas can be found in Table 7.1.

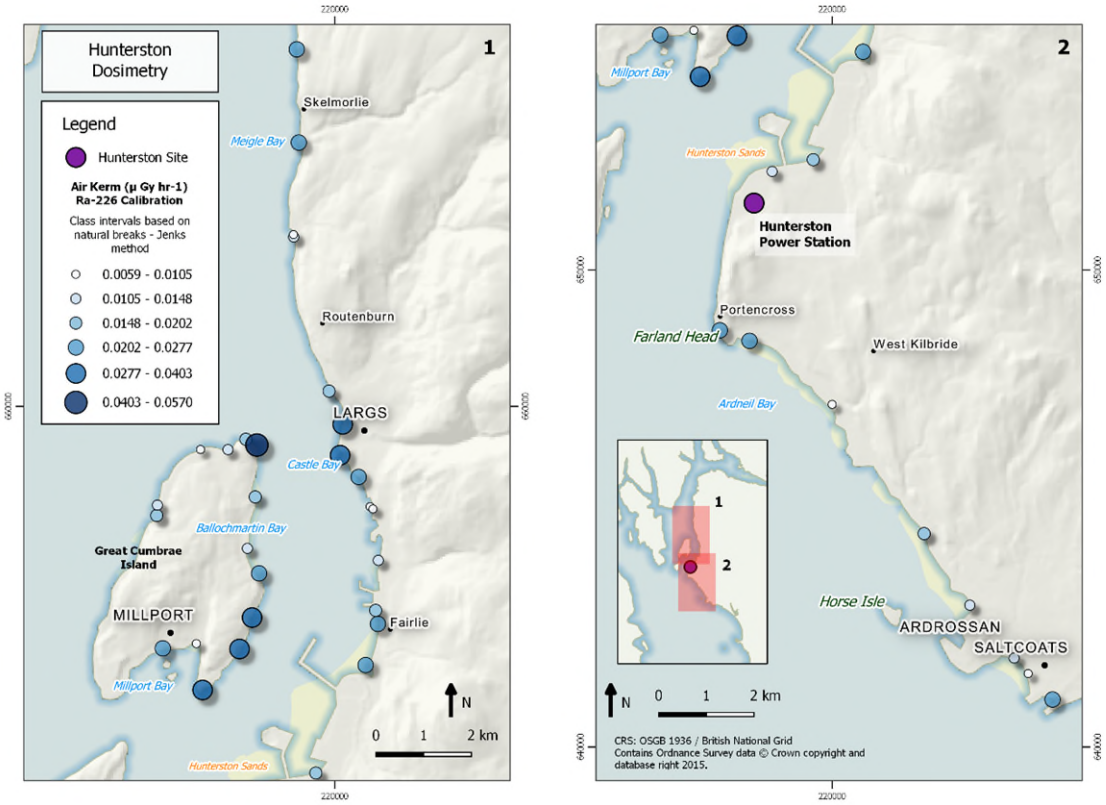

Figure 7.7 Summary of the gamma dose rate measurements across the Hunterston site.

Table 7.1 Summary of gamma dose rate measurements collected across the Hunterston site.

Site	Surface	Eastings	Northings	Dose (μGy hr^{-1})	2σ Uncertainty (μGy hr^{-1})
Ardrossan beach N	Sand	222889	642971	0.0145	0.0035
Ardrossan beach S	Sand	223966	641699.5	0.0102	0.0034
Ardneil Bay	Stones	218263	648513	0.0256	0.0037
Ballochmartin Bay	Rocks	218409	656497	0.0236	0.0037
Ballochmartin Bay	Sand	218164	657020	0.0122	0.0034
Bowens Craig	Sand	220741	657895	0.0099	0.0034
Boydston	Sand	221929	644471	0.0175	0.0035
Cairnies Quay	Sand	220500	658518	0.0259	0.0037
Castle Bay	Stones	220111	658974	0.0403	0.0042
Clashfarland Point (Butter Lump)	Rock	218263	655570	0.0401	0.004191
Fairlie Sands	Rock	220904	655437	0.023	0.0037
Fairlie Sands	Sand	220857	655721	0.0176	0.003526
Fairlie Sands	Sand & stones	220646	654574	0.0259	0.0037
Far Bowens Craig	Sand	220800	657847	0.0095	0.0033
Farland Point	Grass	217225	654051	0.0375	0.004105
Holms Bay	Grass	218364	659187	0.0570	0.004802
Hunterston Sands	Sand	218738	652064	0.0122	0.0034
Kames Bay	Sand	217093	655024	0.00963	0.00335
Kelburnfoot	Sand	220913	656770	0.0143	0.0034
Largs Bay - Headland	Sand	220166	659621	0.0316	0.003914
Largs Head	Stones	219879	660318	0.0202	0.0036
Little Skate Bay	Sand	216261	657710	0.0191	0.0036
Meigle Bay	Stones	219244	665529	0.0239	0.0037
Newtown Bay, Millport	Sand & stones	216388	654925	0.0233	0.003673
Portencross	Stones	217641	648734	0.0267	0.0038
Saltcoats harbour	Rocks	224625	640993	0.0265	0.0038
Seamill	Sand	219998	647180	0.006	0.0033
Skate Bay	Sand	216276	657928	0.0145	0.0035
Skelmorlie	Rock	219201	667484	0.0241	0.003696
Southannan Sands	Sand	219601	652311	0.0189	0.0036
St Phillian's	Rock	219136	663549	0.0148	0.003461
St Phillian's	Sand	219132	663600	0.0105	0.0034
The Lion	Grass	217999	654911	0.0335	0.004
Tomont Point	Rock	218133	659309	0.0169	0.00351
Watersports Centre	Stones	218329	658099	0.0176	0.0035
Wemyss Bay	Stones	219269	668895	0.0249	0.00372
White Bay Cumbrae	Sand	217468	659092	0.0121	0.0034

7.4 *In-Situ* Beta Dosimetry

Beta dosimetry of skin dose [H*(0.07)] was measured over intertidal areas (stones, mud, sand and seaweed) and fishing equipment such as creel pots that were stored close to the coast (Figure 7.8).

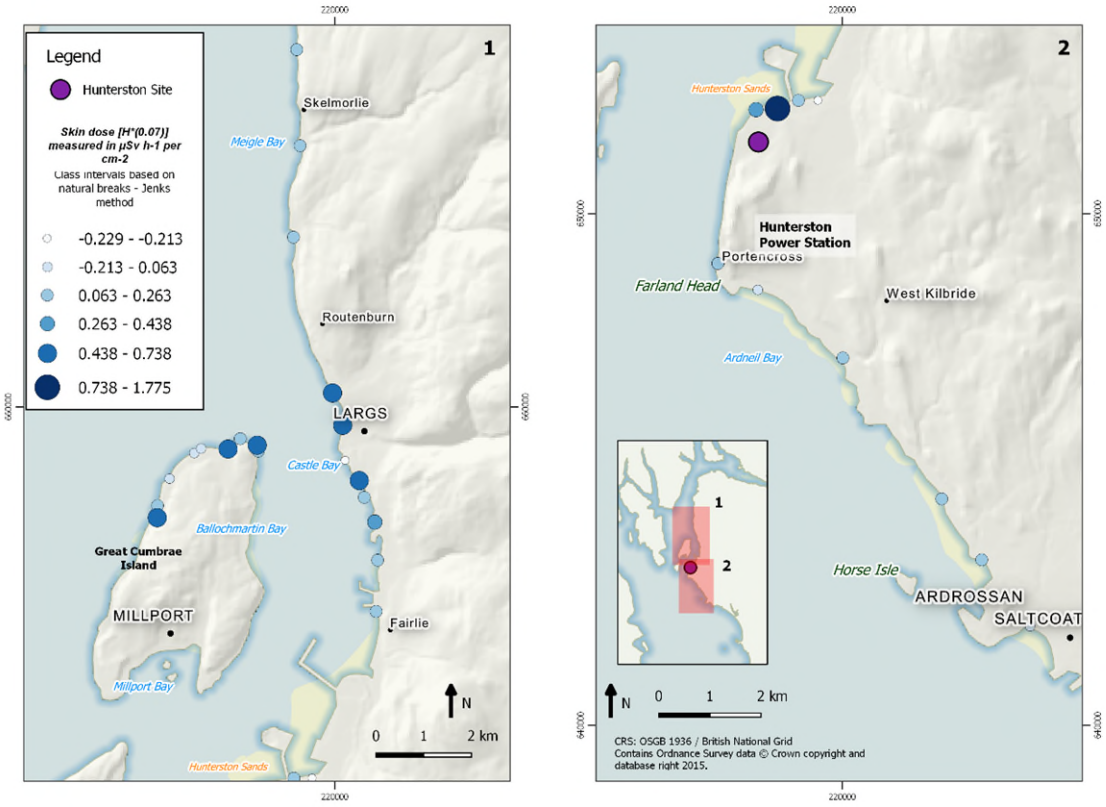

Figure 7.8 Summary of the gamma dose rate measurements across the Hunterston site.

A total of 38 measurements were made, the majority of which were below the 0.2 µSv h^{-1} per cm^{-2} detection limit and thus are not summarized in Table 7.2. A total of 16 readings were found to be above this detection limit, beta doses and locations of these measurements are summarized in Table 7.2. Notice the highest dose rate registered by the beta probe occurred over sand at Hunterston Sands next to the power station. Additionally, the higher dose rates were observed north of the site around Largs and north of Cumbrae.

Table 7.2 Estimated beta dose rates for Hunterston survey area

Site	Surface	Eastings	Northings	Dose (μSv hr^{-1})	2σ Uncertainty (μSv hr^{-1})
Bell Bay	Sand	216271	657676	0.500	0.106
Castle bay	Shell/stones/sand	220513	658455	0.675	0.084
Far Bowens Craig	Sandstone	220839	657583	0.425	0.121
Far Bowens Craig	Sand & small stones	220838	657587	0.438	0.093
Hunterston Sands	Sand & small stones	218312	652034	0.388	0.078
Hunterston Sands	Sand	218731	652056	1.775	0.123
Ladies Bay	Rocks	218370	659196	0.738	0.094
Largs Bay - Abbey Crescent	Stones	219951	660291	0.534	0.072
Largs Bay - Headland	Sand	220165	659613	0.513	0.089
Little Skate Bay	Sand	216278	657931	0.263	0.103
Meigle Bay	Seaweed	219270	665477	0.221	0.066
Portencross Harbour	Boat hull	217565	649027	0.203	0.056
St Phillian's	Seaweed on rocks	219132	663558	0.200	0.085
Tomont End	Rocks	218014	659332	0.200	0.077
Wemyss Bay	Stones & gravel	219196	669388	0.346	0.07
White Bay	Sand	217759	659117	0.563	0.093

7.5 Occupancy Rates

7.5.1 Occupancy Data for Survey Area

The Phase 1 surveys revealed that individuals take part in a range of terrestrial, aquatic and intertidal activities within the survey area (Table 7.3). The most popular terrestrial activity was rambling/walking (67 individuals) with the highest occupancy by any one individual of 1 095 h y^{-1} at Fairlie and Millport. Farming reported the highest overall occupancy times for any one category by a dairy farmer (5 600 h y^{-1}) at West Kilbride. Willow-weaving and roller-hockey were two new activities identified in the survey. Outdoor swimming (12 individuals) was the most popular in water activity. The highest occupancy was reported by a sub-aqua diver off both Cumbrae islands (156 h y^{-1}). A commercial fishman/creeler working along the Fairlie Roads reported the highest on-water activity (2 710 h y^{-1}) whilst sailing was the most popular activity (30 individuals). Dog walking was the most popular activity (113 individuals) within the intertidal zone along with the highest occupancy (1 278 h y^{-1}) of any activity reported

Table 7.3 Summary of the activities, maximum occupancy (h y^{-1}) and total number of individuals that take part in the activities. The location(s) of the maximum occupancy is also given.

Activity type	Activity	Number Individuals	Maximum Occupancy	Location of Maxim Occupancy (If provided)
Terrestrial	Farming	7	5 600	West Kilbride
Terrestrial	Allotments	19	2 190	Fairlie
Terrestrial	Bird/nature watching	7	1 095	Millport
Terrestrial	Gardening	27	1 095	Thirdpart
Terrestrial	Playing	7	1 095	Hunterston
Terrestrial	Rambling/walking	67	1 095	Fairlie & Millport
Terrestrial	Running	1	913	Portencross, Hawkir Craig, Hunterston nuclear site
Terrestrial	Dog walking	41	730	Millport & Thirdpart
Terrestrial	Looking after hens	1	728	West Kilbride
Terrestrial	Bee keeping	8	416	Great Cumbrae Islar
Terrestrial	BBQ/Sitting/picnicking	16	312	Millport
Terrestrial	Collect wild produce	22	274	Millport
Terrestrial	Bowling (outdoors)	3	234	West Kilbride
Terrestrial	Cycling	33	208	Fairlie
Terrestrial	Horse riding	2	208	Yonderfield
Terrestrial	Shooting/Wildfowling	2	208	Fairlie & Millport
Terrestrial	Croquet	3	104	Millport Cathedral
Terrestrial	Willow weaving	2	60.0	Millport
Terrestrial	Roller hockey	1	52.0	Portencross
Terrestrial	Education/Research	2	32.0	Hunterston nuclear s
Terrestrial	Golfing	1	4.29	Millport
Aquatic	Sub-aqua diving	5	156	Off both Cumbrae islands
Aquatic	Stand-up paddle boarding	2	39.0	Ardneil Bay; Largs B & Portencross
Aquatic	RNLI duties	3	12.0	Largs Bay
Aquatic	Outdoor swimming	12	6.24	Skelmorlie
Aquatic	Coasteering	1	4.50	White Bay & Little Cumbrae
Aquatic	Capsize when racing	1	2.00	Largs channel
Aquatic	Diving	1	0.25	Seamill beach
Aquatic	Commercial fishing/creeling	4	2 710	Fairlie Roads
Aquatic	Sailing	30	1 248	Fairlie Roads
Aquatic	Sailing race	1	750	Largs Channel
Aquatic	Kayaking	16	468	Around both Cumbra islands
Aquatic	Power boating	3	416	Largs Channel

Activity Type	Activity	Number Individuals	Maximum Occupancy	Location of Maximu Occupancy (If provided)
Aquatic	Being on a dive boat	3	364	Firth of Clyde
Aquatic	Working on a boat	2	300	Around both Cumbra islands
Aquatic	Rowing	2	234	Newtown Bay
Aquatic	RNLI duties	4	192	Largs Bay
Aquatic	Canoeing	15	187	Largs Bay; Millport & Portencross
Aquatic	Boat maintenance	12	160	Ardrossan
Aquatic	Stand-up paddle boarding	1	105	Farland Point; Cumbrae & Kames Bay
Aquatic	Commute via boat	6	104	Largs Channel
Aquatic	Sea angling	7	97.5	Portencross
Aquatic	SIB boating	2	78.0	Firth of Clyde
Aquatic	Safety boat duties	2	72.0	Around both Cumbra islands
Aquatic	Freshwater angling	1	24.0	West Kilbride
Aquatic	Dinghy sailing	1	12.0	Fairlie Roads
Aquatic	Creel fishing/handling	1	7.50	Portencross
Intertidal	Dog walking	113	1 278	Fairlie Sands
Intertidal	Fishing	43	1 248	Auchengarth
Intertidal	Work on oyster farm	1	858	Southannan Sands
Intertidal	Walking	63	728	Ardneil Bay, Kame Bay, Fairlie Sands & Portencross
Intertidal	Beachcombing	16	365	Kames Bay
Intertidal	Research/education	2	351	Great Cumbrae Islar
Intertidal	Collecting seaweed	6	208	Fairlie Sands
Intertidal	Playing	77	156	Ardrossan North Bea
Intertidal	Paddling	33	156	Bowen Craigs
Intertidal	Fixing moorings	1	117	Millport
Intertidal	Kite flying	5	104	Seamill Beach
Intertidal	BBQ/Picnicking/Sitting	17	72.0	Millport
Intertidal	Collecting razor clams	2	51.0	Largs Bay
Intertidal	Wildfowling	1	30.0	Portencross
Intertidal	Slipway cleaning	1	24.0	Largs Marina
Intertidal	Collecting oysters	1	18.0	Southannan Sands
Intertidal	Collecting whelks	1	18.0	Southannan Sands
Intertidal	Bird/Nature watching	1	13.0	Ardneil Bay
Intertidal	Bait digging	2	12.0	Fairlie Sands & Ardrossan South Beach
Intertidal	Collecting mussels	1	12.0	Fairlie Sands
Intertidal	Collecting winkles	1	12.0	Fairlie Sands
Intertidal	Horse riding	1	12.0	Ardneil Bay

Activity Type	Activity	Number Individuals	Maximum Occupancy	Location of Maximum Occupancy (If provided)
Intertidal	Collecting Sea coal	1	10.5	Portencross & Seam
Intertidal	Boat maintenance	1	8.00	Millport
Intertidal	Beach Clean	3	6.00	Portencross
Intertidal	Rock pooling	6	6.00	Seamill
Intertidal	Beach football	4	1.50	Seamill Beach

7.5.2 Occupancy Rates Within One Kilometre of Hunterston (Inside/outside home or work)

Individuals living or working within the immediate area of Hunterston were asked to estimate how much time they spend inside and outside their home or workplace. The results presented in Table 7.4 show the time spent indoors and outdoors on an annual basis.

Table 7.4 Occupancy rates of those individuals working or living within 1 km of Hunterston

Survey ID	Indoors at home (h y^{-1})	Outdoors at home (h y^{-1})	Indoors at work (h y^{-1})	Outdoors at work (h y^{-1})
415	5 475	1 460	-	-
416	3 650	365	-	4 380
417	4 380	1 460	-	-
418	4 380	1 460	-	-
419	7 300	1 095	-	-
420	3 650	1 095	-	-
431	4 390	1 095	-	-
432	4 390	1 095	-	-
440	3 159	702	3 159	351

Two individuals interviewed worked within 1 km of Hunterston. The highest amount of time spent working indoors for one individual was 3 159 h y^{-1} and the highest amount of time spent working outdoors for a second individual was 4 380 h y^{-1}. A total of nine individuals were interviewed who lived within 1 km of Hunterston, seven adults and two infants. The highest amount of time spent indoors at home for any one individual was an adult (7 300 h y^{-1}) and the highest amount of time spent in the immediate area

outside their home was 1 460 h $y^{-1}$by one adult and two infants. All figures take into account any holiday period away from home.

8. Phase 2 Survey Results

8.1 Introduction

The aim of the Phase 2 surveys was to validate the phase one face-to-face surveys; identify any major changes to internal/external exposure paths and to identify any new pathways within a select group of participants. Discussion with SEPA determined that nine individuals (three from the high exposure medium exposure group and low exposure group) should be contacted for the Phase survey (Table 8.1). These groups were determined according to the total dose received as calculated from the dose assessment tool and based on a percentage of the highest dose rate with the highest value being 100%. Dose assessment utilises data from all pathways (terrestrial and aquatic) and where appropriate includes shine.

Table 8.1 Phase 2 survey groups based upon dose assessments.

Dose Rate Group	Unique ID
High	A
High	B
High	C
Total in high group*:	**7**
Medium	D
Medium	E
Medium	F
Total in medium group*:	**39**
Low	H
Low	I
Low	J
Total in low group*:	**327**

*Number of surveys from phase 1 with corresponding dose rate value

Contact was made with individuals in each group. Sampling individuals in the phase two surveys was restricted by some people not wishing to be contacted again (when asked during the face-to-face surveys), incorrect follow-up details, or individuals not responding to approaches made by the survey team. A total of seven individuals were identified in the high-rate group all of which provided contact information.

8.2 Phase 2 Internal Exposure

8.2.1 Internal Terrestrial

All nine individuals contacted indicated that they had not changed their terrestrial consumption rate when re-surveyed. This included all food groups: vegetables; fruit; meat; wild foods; and other foods types such as eggs.

8.2.2 Internal Aquatic

All nine individuals reported they had not changed their consumption pattern or quantities of aquatic food types when re-surveyed. This applied to all aquatic food groups: crustaceans; fish; molluscs and wildfowl.

8.3 Phase 2 External Exposure

8.3.1 Terrestrial Activities

Only two individuals completing the Phase 2 surveys reported changes relating to terrestrial activities (Table 8.2). Individual B reported minor changes in their activity time in phase two stating they walked past the site for 2 h y^{-1} compared to no such activity in Phase 1.

Table 8.2 Survey comparison of terrestrial activity times

			OCCUPANCY CHANGES:	
Survey ID	**Category**	**Activity**	**Phase 1**	**Phase 2**
HIGH GROUP			**(h y^{-1})**	**(h y^{-1})**
B	Site travel	Walking	0.00	2.00
C	Site travel	Walking	365	2.00

Individual C reported a significant reduction in time walking past the site in Phase 2. Initially, individual C reported walking past the site on a daily basis. In the Phase 2 survey they stated they only walked to the entrance roundabout and back from Fairlie twice a year. Individual C also reported walking past the site entrance as a new location for dog-walking in Phase 2. However, this did not result in any change in activity time.

8.3.2 Aquatic/Intertidal Activities

Five individuals reported changes in aquatic or intertidal activities (Table 8.3). In the Phase 2 survey, individual D reported an increase in the amount of seaweed they collected compared to the quantity reported in the phase one survey. In addition to collecting seaweed to put on their garden, they used seaweed for decoration of pottery they made increasing collecting time from 2 h y^{-1} to 4 h y^{-1}.

Table 8.3 Survey comparison of aquatic and intertidal activity times

Survey ID	Category	Activity	OCCUPANCY CHANGES: Phase 1	Phase 2
LOW GROUP			**(h y^{-1})**	**(h y^{-1})**
I	Intertidal	Fishing	96.0	18.0
MEDIUM GROUP				
D	On water	Canoeing	4.00	0.00
F	In water	Outdoor swimming	0.25	0.00
D	Intertidal	Collect seaweed	2.00	4.00
E	Intertidal	Beachcombing	52.0	13.0

Changes were reported for on water activity. Individual D initially stated they went canoeing for at least 4 h y^{-1}. During the Phase 2 survey individual D stated they had not canoed at all this year. Individual E reported in the Phase 2 survey beachcombing once every two weeks for 30 minutes each time instead of on a weekly basis for one hour as initially stated. Individual F initially stated they swam outdoors for approximately 15 minutes in the summer per year. In Phase 2 survey they reported they hadn't been swimming this summer at all. There were changes reported in the low dose rate group by individual I who initially reported fishing all year round which then changed to between May and September in the phase two survey and so less time spent fishing.

8.3.1 Handling Equipment

In the Phase 2 survey, changes were reported for handling equipment by two individuals and two individuals also reported changes that resulted in coming into contact with sediment (Table 8.4).

Table 8.4 Changes to handling equipment occupancy times

		Handling Equipment	
Survey ID	**Activity**	**Phase 1**	**Phase 2**
LOW GROUP		**(h y^{-1})**	**(h y^{-1})**
I	Fishing	96.0	18.0
MEDIUM GROUP			
D	Canoeing	4.00	0.00

For handling equipment, individual D initially reported handling equipment for 4 h y^{-1} associated with canoeing. However, in phase two survey they stated they had not canoed this year. Individual I, initially reported fishing for 96 h y^{-1} in the phase one survey. This changed to only 18 h y^{-1} in the phase two survey.

8.3.2 Handling Sediment

Two individuals also reported changes in the Phase 2 survey that resulted in changes in the length of time they came into contact with sediment (Table 8.5).

Table 8.5 Changes to handling equipment occupancy times

		Handling Sediment	
Survey ID	**Activity**	**Phase 1**	**Phase 2**
MEDIUM GROUP		**(h y^{-1})**	**(h y^{-1})**
E	Beachcombing	52.0	13.0
D	Handling seaweed	2.00	4.00

Changes associated with handling sediment was reported by individuals D and E (Table 8.5). The former initially reported collecting seaweed for 2 h y^{-1} to be used for fertiliser. In the Phase 2 survey they reported an increase in time handling seaweed due to using it to decorate pottery they made.

Individual E reported beachcombing 1 hour per week all year in the Phase 1 survey. When re-surveyed, this beachcombing habit was reported to have changed to 30 mins once every 2 weeks, all year. As such the amount of time handling sediment fell from 52 h y^{-1} to 13 h y^{-1}. The differences in occupancy times reflect the answers given at the time of each survey.

Changes in activities reported by the other individuals re-surveyed did not result in any change in the length of time in contact with sediment.

8.4 Living and working within 1km

No individual completing a phase two survey lived or worked within 1 km of nuclear licensed site.

9 Dose Assessment

9.1 Phase 1 Survey Aquatic Radiation Pathways

9.1.1 Internal Exposure

The retrospective dose arising from internal exposure (via food sources from the aquatic environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 1.2E-3 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 1.2E-3 mSv y^{-1}. In the case of the most exposed person the dose arises from the consumption of locally obtained fish (94 kg y^{-1}).

9.1.2 External Exposure

The retrospective dose arising from external exposure (via people's habit activities in and on the aquatic environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 4.2E-3 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 4.1E-3 mSv y^{-1}. In the case of the most exposed person the dose arises from the handling of fishing gear (3 030 h y^{-1}).

9.2 Phase 1 Survey Terrestrial Radiation Pathways

9.2.1 Internal Exposure

The retrospective dose arising from internal exposure (via food sources from the terrestrial environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 5.9E-3 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 5.8E-3 mSv y^{-1}. In the case of the most exposed person the dose arises from the consumption of green leafy vegetables (30 kg y^{-1}); root vegetables (18.5 kg y^{-1}); potato (50 kg y^{-1}); fruit (37 kg y^{-1}); wild foods (28.5 kg y^{-1}); game (venison (3 kg y^{-1}); and eggs (6.7 kg y^{-1}).

9.2.1 External Exposure

The retrospective dose arising from external exposure (via people's habit activities in the terrestrial environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 3.9E-3 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 3.8E-3 mSv y^{-1}. The most exposed person's external terrestrial dose was dominated from direct shine (151 h y^{-1}).

9.2.2 Overall Combined Radiation Exposure

The retrospective dose arising from all exposure pathways (e.g. via people's habit activities in and on the aquatic, intertidal or terrestrial environments and the consumption of all foodstuffs derived locally from the aquatic or terrestrial environments) has been used to determine the representative person. The dose rate to the most exposed person from all exposure pathways is 7.5E-3 mSv y^{-1}. The retrospective dose to the representative person (97.5%) is 7.3E-3 mSv y^{-1}. In the case of the most exposed person, the dose was dominated by the direct shine (151 h y^{-1}). These doses are all very small in comparison with the 1 mSv public dose limit. Table 9.1 contains some summarised dose information based on the average doses to different people based on age profile.

Table 9.1 Average dose estimates (mSv y^{-1}) to stylised people averaged by age (phase 1 survey).

Age Category	Dose (mSv)
Infant	3.4E-6
Child	2.6E-5
Adult	3.3E-4
All Average	**3.6E-4**

9.3 Phase 2 Survey Dose Assessment

9.3.1 Introduction

The phase two surveys were undertaken in the November of 2017 and were re-analysed to determine the dose from each radiation exposure pathway using the same approach and data groups as for the original survey to allow comparisons to be drawn between the two survey periods. The results are described below.

9.4 Phase 2 Survey Aquatic Radiation Pathways

9.4.1 Internal Exposure

The retrospective dose arising from internal exposure (via food sources from the aquatic environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 1.1E-4 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 1.1E-4 mSv y^{-1}. In the case of the most exposed person, the dose arises from the consumption of locally obtained molluscs (29 kg y^{-1}).

9.4.2 External Exposure

The retrospective dose arising from external exposure (via people's habit activities in and on the aquatic environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 1.1E-3 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 1.0E-3 mSv y^{-1}. In the case of the most exposed person, the dose arises from the handling of sediment, fishing gear and spending time doing activities on the water (373; 4; and 4 h y^{-1} respectively).

9.5 Phase 2 Survey Terrestrial Radiation Pathways

9.5.1 Internal Exposure

The retrospective dose arising from internal exposure (via food sources from the terrestrial environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 5.9E-3 mSv y^{-1}. The dose to the (hypothetical) representative person

(97.5%) is 5.8E-3 mSv y^{-1}. In the case of the most exposed person, the dose arises from the consumption of green leafy vegetables (30 kg y^{-1}); root vegetables (18.5 kg y^{-1}); potatoes (50 kg y^{-1}); other vegetables (18.5 kg y^{-1}); domestic fruit (37 kg y^{-1}); honey (8 kg y^{-1}); eggs (6.8 kg y^{-1}); wild fungi (1 kg y^{-1}); wild/free foods (28.5 kg y^{-1}); and venison (3 kg y^{-1}).

9.5.2 External Exposure

The retrospective dose arising from external exposure (via people's habit activities in the terrestrial environment) was used to determine the representative person from this pathway. The retrospective dose to the most exposed person from this exposure pathway is 2.8E-4 mSv y^{-1}. The dose to the (hypothetical) representative person (97.5%) is 2.8E-4 mSv y^{-1}. The most exposed person's external terrestrial dose was dominated by intertidal activities over sand and stones and direct shine from the site (938 h y^{-1} and 4.5 h y^{-1} respectively).

9.5.3 Overall Combined Radiation Exposure

The retrospective dose arising from all exposure pathways (e.g. via people's habit activities in and on the aquatic, intertidal or terrestrial environments and the consumption of all foodstuffs derived locally from the aquatic or terrestrial environments) has been used to determine the representative person. The dose rate to the most exposed person from all exposure pathways is 5.9E-3 mSv y^{-1}. The retrospective dose to the (hypothetical) representative person (97.5%) is 5.8E-3 mSv y^{-1}. In the case of the most exposed person, the dose arises from the consumption of green leafy vegetables (30 kg y^{-1}); root vegetables (18.5 kg y^{-1}); potatoes (50 kg y^{-1}); other vegetables (18.5 kg y^{-1}); domestic fruit (37 kg y^{-1}); eggs (6.8 kg y^{-1}); honey (8 kg y^{-1}); wild fungi (1 kg y^{-1}); wild/free foods (28.5 kg y^{-1}); and venison (3 kg y^{-1}). Average dose estimates are compiled in Table 9.2.

Table 9.2 Average dose estimates (mSv y^{-1}) to stylised people averaged by age (phase 2 survey).

Age Category	Dose (mSv)
Infant	0.0E-0
Child	0.0E-0
Adult	4.9E-5
All Average	**4.9E-5**

These doses are all very small in comparison with the 1 mSv public dose limit.

9.6 Dose Comparison of Phase 1 and Phase 1 Surveys

The doses calculated for the different exposure pathways from data in the Phase 1 (during March and July) and Phase 2 (during November) surveys are provided in Table 9.3. For all pathways, and the total from all pathways, the doses for the Phase 1 survey are slightly higher than or the same as those for Phase 2. All doses are still well within the 1 mSv public dose limit.

Table 9.3 Comparison of doses calculated from the Phase 1 and Phase 2 survey data

	Phase 1 Survey		**Phase 2 Survey**	
Pathway	**97.5th Percentile Dose mSv y^{-1}**	**Maximum Dose mSv y^{-1}**	**97.5th Percentile Dose mSv y^{-1}**	**Maximum Dose mSv y^{-1}**
Internal Aquatic	1.2E-03	1.2E-03	1.1E-04	1.1E-04
External Aquatic	4.1E-03	4.2E-03	1.0E-03	1.1E-03
Internal Terrestrial	5.8E-03	5.9E-03	5.8E-03	5.9E-03
External Terrestrial	3.8E-03	3.9E-03	2.8E-04	2.8E-04
All pathways	**7.3E-03**	**7.5E-03**	**5.8E-03**	**5.9E-03**

The Phase 2 surveys provide significant added value in either validating or refining dose estimates attributable to more extreme habits and any changes in individual's habits following the phase one surveys.

10 Comparisons with the Previous Survey

10.1 Introduction

The results for the 2017 face-to-face surveys have been reported in chapters 5 and 6 and can be compared with results from the previous habits survey undertaken in Hunterston in 2012 by the Centre for Environment Fisheries and Aquaculture Science (CEFAS). The aquatic and terrestrial face-to-face survey area in the 2017 survey extended (for the aquatic survey) from Wemyss Bay to Saltcoats, including Great Cumbrae Island and Little Cumbrae Island, and (for the terrestrial survey) the area 5 km radius from the Hunterston site, including the southern part of Great Cumbrae Island and Little Cumbrae Island. This is consistent with the 2012 survey undertaken by CEFAS.

10.2 Aquatic Survey Comparisons

10.2.1 Adult Internal Exposure

A comparison between the 2012 and 2017 surveys for adult consumption rates of aquatic foods in the face-to-face interviews is presented in Table 10.1.

In 2017, the mean consumption rate for the adult high-rate group in the face-to-face surveys increased for: fish; crustaceans; molluscs and wildfowl compared with 2012. In both 2012 and 2017 surveys, the main species of fish consumed by adults in the high-rate group were cod and mackerel. The increase in fish consumption reported by an individual in 2017 was a keen sea angler who fished all year round. In 2012, the predominant species of crustaceans consumed were *Nephrops* and in 2017 the main crustacean species consumed by adults in the high-rate group were the common lobster and brown crab. The 2017 surveyed identified four family members who consumed the crustaceans, one of whom was a commercial fisherman/creeler. In 2012, the main species of molluscs consumed were king scallops compared to mussels in 2017.

In 2012, no species of wildfowl was found to be consumed. In 2017, the species of wildfowl consumed were mallard; pink-footed goose; teal; widgeon; greylag goose, Canadian goose and woodcock. The high quantities of wildfowl consumed were shot

on two local estates. In 2012, sea lettuce was consumed but not in the 2017 survey. Seaweed was reported to be consumed in the 2017 survey.

Table 10.1 Comparison between the 2012 and 2017 surveys for adult consumption rates of aquatic foods.

	2012			2017			
Food Group	**Number of observations in high rate group**	**Observed maximum in high rate group (kg y^{-1})**	**Observed mean in high rate group (kg y^{-1})**	**Number of observations in high rate group**	**Observed maximum in high rate group (kg y^{-1})**	**Observed mean in high rate group (kg y^{-1})**	**National Mean (kg y^{-1})**
Fish	23	22.2	11.2	1	94.1	94.1	15.0
Crustaceans	9	20.9	12.3	4	26.0	26.0	4.00
Molluscs	1	10.9	10.9	1	28.8	28.8	4.00
Marine plants/algae	3	0.20	0.20	-	-	-	-
Seaweed	-	-	-	1	0.45	0.45	-
Wildfowl	-	-	-	2	47.2	47.2	-

10.2.2 Children and Infant Internal Exposure

A comparison between the 2012 and 2017 surveys for consumption rates by children and infants of aquatic foods is presented in Table 10.2.

In 2017, child fish consumption decreased compared to 2012. No consumption of crustaceans was found in the 2017 survey compared to consumption in 2012. Consumption of wildfowl and molluscs was identified in 2017, with none reported in the 2012 report.

No consumption of fish; crustaceans; molluscs or wildfowl was identified for infants in 2017 compared to fish and crustaceans being identified in 2012.

Table 10.2 Comparison between the 2012 and 2017 surveys for children and infant's consumption rates of aquatic foods.

	2012			2017		
Food Group	**Number of observations in high rate group**	**Observed maximum in high rate group (kg y^{-1})**	**Observed mean in high rate group (kg y^{-1})**	**Number of observations in high rate group**	**Observed maximum in high rate group (kg y^{-1})**	**Observed mean in high rate group (kg y^{-1})**
Children (6 - 15 years old)						
Fish	8	10.7	7.10	4	0.26	0.26
Crustaceans	1	0.20	0.20	-	-	-
Molluscs	-	-	-	2	2.00	2.00
Wildfowl	-	-	-	1	0.10	0.10
Infants (0 - 5 years old)						
Fish	4	1.90	1.10	-	-	-
Crustaceans	1	0.10	0.10	-	-	-

10.2.3 Adult External Exposure

External exposure was divided into five groups: intertidal activities; aquatic in water activities; aquatic on water activities; handling of equipment; and handling of sediment. In 2017 the highest total intertidal occupancy for adults was determined as 1 095 h y^{-1} (on sand and stones substrate only).

The highest occupancy on sand in 2017 was 938 h y^{-1} which was slightly increased from 730 h y^{-1} in 2012. The highest occupancy on rock in 2017 was 1 248 h y^{-1} which greatly increased from 265 h y^{-1} in 2012. The highest occupancy on sand and stones in 2017 was 1 095 h y^{-1} (two individuals) which greatly increased from 400 h y^{-1} in 2012. The highest occupancy on stones in 2017 was 858 h y^{-1} which was an increase from 235 h y^{-1} in 2012. The highest occupancy on mud in 2017 was 58.5 h y^{-1} which increased from 12 h y^{-1} in 2012.

Decreases in activities were reported in both in- and on-water occupancy times in the 2017 survey compared to the previous survey. In 2012, the highest in-water occupancy by an adult was 446 h y^{-1} wind-surfing and kayaking. In 2017, the highest in-water occupancy by an adult was 156 h y^{-1} sub-aqua diving. In 2012, the highest on water occupancy by adult was 3 500 h y^{-1} by a commercial fisherman, compared to 2 730 h y^{-1} also reported by a commercial fisherman in 2017.

10.2.4 Children & Infant External Exposure

As with the adult intertidal/aquatic occupancy, external exposure was divided into five groups: intertidal activities; aquatic in water activities; aquatic on water activities; handling of equipment; and handling of sediment. In 2017 the highest total intertidal occupancy for children and infants was determined. The highest total intertidal occupancy for two children was 696 h y^{-1} (on rocks substrate and on sand and stones substrate). The highest total intertidal occupancy for an infant was 208 h y^{-1} (on sand substrate and on sand and stones substrate).

The highest occupancy on sand for a child in 2017 was 104 h y^{-1} which was decreased from 156 h y^{-1} in 2012. The highest occupancy on rock for a child in 2017 was 416 h y^{-1} which increased from 144 h y^{-1} in 2012. The highest occupancy on sand and stones for a child in 2017 was 540 h y^{-1} (two individuals) which greatly increased from 27 h y^{-1} in 2012. The highest occupancy on stones for a child in 2017 was 6 h y^{-1} which was a slight increase from 1 h y^{-1} in 2012.

The highest occupancy on sand for an infant in 2017 was 156 h y^{-1} which was an increase from 90 h y^{-1} in 2012. The highest occupancy on rocks for an infant in 2017 was 52 h y^{-1} which was a decrease from 84 h y^{-1} in 2012.The highest occupancy on sand and stones for an infant in 2017 was 104 h y^{-1} which was an increase from 27 h y^{-1} in 2012.

In 2012, the highest in water occupancy by a child was paddling (8 h y^{-1}). In 2017, the highest in water occupancy by a child reported swimming in the sea (6.23 h y^{-1}). In 2012, the highest on water occupancy by a child was 3 h y^{-1} rowing. In 2017, the

highest on water occupancy by a child was significantly higher who reported sailing and kayaking (612 h y^{-1}).

No activities were reported in the 2017 survey for in- and on-water activities by an infant and as such no comparisons could be made.

10.2.5 Adult Handling Equipment and Handling Sediment

Handling of sediment and equipment was compared with the previous report. In 2017, the mean occupancy time for the adult high-rate group was 3 030 h y^{-1}, by a commercial fisherman (fishing 2 730 h y^{-1} and boat handling 300 h y^{-1}. This was significantly higher than that reported in 2012 (1 460 h y^{-1}). The 2017 figures were checked and confirmed with the individual. The increase in 2017 rates may be attributed to handling fishing gear and boating equipment.

In 2017, the mean occupancy time for the adult high-rate group handling sediment was 858 h y^{-1}. By comparison, in 2012, mean occupancy time for the adults handling sediment was 548 h y^{-1}.

10.2.6 Children and Infants Handling Equipment and Handling Sediment

The 2012 survey did not report any children undertaking activities that involved handling equipment. Therefore, it is not possible to make any comparison with the 2017 survey.

In 2017, the mean occupancy time for the child high-rate group handling sediment was 540 h y^{-1} compared to only 2 h y^{-1} in 2012.

The 2012 survey did not report any activities by infants that involved handling equipment or sediment. Therefore, it is not possible to make any comparison with the 2017 survey.

10.3 Terrestrial Survey

10.3.1 Adult Internal Exposure

A comparison between the 2012 and 2017 surveys for mean consumption rates for adult of terrestrial food groups is presented in Table 10.3. The table also provides the mean consumption rates from national data (Smith and Jones, 2003) for comparison.

Table 10.3 Comparison between the 2012 and 2017 surveys for mean consumption rates of local terrestrial food groups for adults (kg y^{-1} or l y^{-1}).

Food group	2012 Observed mean in high rate group (kg y^{-1})	2017 Observed mean in high rate group (kg y^{-1})	National mean (kg y^{-1} or l y^{-1})
Vegetables – Green	19.7	53.2	15.0
Vegetables – Other	10.1	38.0	20.0
Vegetables – Root	50.7	43.9	10.0
Vegetables - Potatoes	77.3	44.1	50.0
Fruit - Domestic	44.3	49.4	20.0
Fruit - Wild	7.9	28.5	7.00
Fungi - Wild	0.80	1.00	-
Meat – Beef	23.7	28.0	15.0
Meat – Sheep	4.80	24.0	8.00
Meat - Poultry	5.00	2.00	10.0
Meat – Pork	-	-	15.0
Meat-Venison	-	68.6	-
Game Birds	-	10.0	-
Rabbits/Hare	9.6	3.00	-
Squirrel	0.80	-	-
Eggs	29.3	28.9	8.50
Milk	487	9.00	95.0
Honey	8.8	8.00	2.50
Freshwater fish	30.3	-	-
Freshwater plants	0.50	-	-
Private Water	-	365	-

Consumption rates of locally grown/reared food items increased in the 2017 survey compared to 2012 for the following food groups: vegetables (green); vegetables (other); fruit (domestic); fruit (wild); fungi (wild); beef; game; and sheep meat. Of these, green-; root-; other-vegetables, domestic fruit wild fruits; beef and sheep were above the national average. Egg consumption quantities were similar in both surveys with both values much higher than the national average.

Mean consumption rates decreased in the 2017 survey in comparison to 2012 in the following food groups: vegetables (root), vegetable (potatoes), game, poultry, eggs; and honey. Consumption of squirrels, freshwater fish and freshwater plants was identified in 2012 but not identified in 2017. New Food groups identified in the 2017 survey and not identified in the 2012 survey include: venison and game birds plus an individual who had their own private water supply.

10.3.2 Children Internal Exposure

A comparison between the 2012 and 2017 surveys for mean consumption rates for children consumption of the terrestrial food groups is presented in Table 10.4. Children were identified as consuming vegetables (green), vegetables (other), vegetables (root), domestic fruit, wild fruit, wild fungi; and beef in 2017, but this was not identified in 2012.

Table 10.4 Comparison between the 2012 and 2017 surveys for mean consumption rates of local terrestrial food groups for children (kg y^{-1}).

Food group	2012 Observed mean in high rate group (kg y^{-1})	2017 Observed mean in high rate group (kg y^{-1})
Vegetables – Green	-	29.3
Vegetables – Other	-	11.7
Vegetables – Root	-	40.4
Vegetables - Potatoes	10.0	38.1
Fruit - Domestic	-	17.0
Fruit-Wild	-	2.00
Wild Fungi	-	1.00
Meat- Beef	-	0.45
Meat - Game	-	1.25
Meat - Game Birds	-	5.10
Meat - Poultry	1.60	1.00
Eggs	1.40	-
Rabbits/Hare	0.90	-
Honey	1.60	-
Freshwater fish	1.60	-

Consumption of potatoes and game increased in 2017 compared to 2012. Consumption of eggs, honey and freshwater fish were identified in 2012 but not in 2017.

10.3.3 Infant Internal Exposure

A comparison between the 2012 and 2017 mean consumption rates for infant consumption of the terrestrial food groups is presented in Table 10.5. In the infant age group only domestic fruit was identified in 2017. Consumption of domestic fruit decreased in 2017 compared to 2012.

Table 10.5 Comparison between 2012 and 2017 mean consumption rates of local terrestrial food groups for infants (kg y^{-1}).

	2012	2017
Food group	**Observed mean in high rate group (kg y^{-1})**	**Observed mean in high rate group (kg y^{-1})**
Vegetables – Green	0.80	-
Vegetables – Other	1.00	-
Vegetables – Root	0.30	-
Fruit - Domestic	10.7	0.60
Meat - Poultry	0.60	-
Rabbits/Hare	0.10	-
Squirrel	0.30	-
Eggs	1.10	-
Honey	0.20	-

10.4 Direct Radiation Survey

The indoor and outdoor occupancy was assessed for individuals within 1 km of the site and compared with the 2012 survey results. Table 10.6 presents the comparison between the 2012 and 2017 survey occupancy rates (h y^{-1}) within the 1 km survey zone.

In 2017, the highest total occupancy was similar in value to that reported in 2012. In 2017, the highest indoor occupancy was similar in value to that reported in 2012. In 2017, the highest outdoor occupancy decreased significantly when compared 2012. No individual reported working within 1 km in the 2012 report. As such, no comparison could be made.

Table 10.6 Comparison between the 2012 and 2017 surveys for occupancy rates for people living and working within the direct radiation area (h y^{-1}).

Occupancy	2012	2017
Highest total	8 534	8 395
Highest indoor at home	7 668	7 300
Highest outdoor at home	3 402	1 460
Highest indoor at work	-	3 257
Highest outdoor at work	-	4 380

11 Recommendations and Suggestions for Monitoring Programme Changes.

11.1 Introduction

The Habits Survey presents results for occupancy, activity and food consumption from three main sources of community engagement: (i) Postal questionnaire (n = 164); (ii) face-to-face surveys (n = 417); and (iii) a number of meetings and informal contacts. These data have been supplemented with radiometric surveys including: (i) a car-borne gamma spectrometry survey (n = 18 664) and back-pack (n=14 707) were performed within the survey area; (ii) *in-situ* gamma dose rate (n = 37 intertidal and terrestrial), and (iii) Beta skin dose assessments (n = 38).

11.2 Ongoing Monitoring

The Radioactivity in Food and the Environment (RIFE) report demonstrates a comprehensive set of monitoring undertaken annually around the Hunterston site encompassing a range of food types and environmental substrates. The gamma dose rates reported by RIFE are generally higher than those reported here because the RIFE data include the cosmic contribution to dose. This assessment reports the terrestrial gamma dose rate only. When taking this into account, the results are similar. The RIFE report also samples a range of food types as well as grass and sediment types.

11.3 Conclusions and Recommendations

11.3.1 Conclusions

The postal survey provided limited information, given the relatively low numbers returned, on where individuals undertook activities and where they bought their food. Activity information was, on the whole, confirmed by the face-to-face surveys. However, such information was less useful for consumption purposes. Rather it provided evidence that most food consumed locally was shop bought and sourced from outside the survey area.

Of all the pathways identified and considered, the highest retrospective dose for all exposure pathways was 5.5E-2 mSv y^{-1} for both survey data. Between the Phase 1 survey and Phase 2 survey the only pathway to change was that for the external aquatic which dropped from 4.5E-3 to 4.0E-3 mSv y^{-1}. These are very small compared with the 1 mSv annual public dose limit.

11.3.2 Recommendations

Based on the findings of this habits survey, and also taking into account the potential radiological significance of the various pathways that were identified, the following suggestions for future surveys are presented for consideration:

(i) A significant quantity of venison consumption, shot on a local estate, was identified in this report. As such, an annual sampling of deer could be incorporated as part of the monitoring strategy.

(ii) The sampling of mushrooms (*Cantherellus and Boletus*) was identified in this survey. Consideration of sampling mushrooms from West Kilbride once per annum when in season.

References

CEC (1996). Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation. Official Journal of the European Community, 39, 1114.

Article 35 of the Basic Safety Standards (BSS) 96/29 Euratom

Dale, P., Robertson, I., Toner, M. (2008). Radioactive Particles in Dose Assessments. Journal of Environmental Radioactivity. 99, pp. 1589-1595

Garden Forum Horticulture, 2009. http://www.gardenforumhorticulture.co.uk/gyo/Square-Foot-Gardening.pdf.

Hessayon D. G. (2014). The New Vegetable & Herb Expert. Transworld Publications Ltd 2014, London.

Hunt, G. J., Hewett, C. J. and Shepherd, J. G., (1982). The identification of critical groups and its application to fish and shellfish consumers in the coastal area of the north-east Irish Sea. Health Physics, Vol. 43, No 6, pp. 875-889.

ICRP (2006). Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public. ICRP Publication 101a. Ann. ICRP 36 (3).

ICRP (2007). The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4).

Leonard AFC, Zhang L, Balfour AJ, Garside R, Gaze WH. (2015) Human recreational exposure to antibiotic resistant bacteria in coastal bathing waters. Environment International. 82, 92-100.

Leonard DRP, Hunt GJ, Jones PGW, (1982). Investigations of individual radiation exposures from discharges to the aquatic environment: the technique of habit surveys. pp. 512-517 In: 'Proceedings of the Third International Symposium on Radiological Protection - Advances in Theory and Practice', Inverness, 6-11 June 1982, Volume 2. *The Society of Radiological Protection*.

Green N, Wilkins B.T., Hammond D.J, Davidson M.F, Richmond S, Brooker S, (2001). Foods found in the wild around nuclear sites: An evaluation of radiological impact. Radiation Protection Dosimetry. 93(1), 67-73.

NDAWG (2013). Use of Habits Data in Prospective Dose Assessments. NDAWG Guidance Note 7. Available from http://ndawg.org/.

PC-CREAM Public Health England 2008

Radioactive Substances Act 1993 (RSA ’93)

Rumney, P., Ly V., Clyne, F.J. (2012) Radiological Habits Survey: Hunterston 2012. SEPA Report.

Smith, K.R., Jones, A.L. (2003). Generalised habit data for radiological assessments. NRPB-W41. NRPB, Chiltern.

Soils of Scotland. The Macauley Institute for Soil Research

Stone DL, Harding AK, Hope BK, Slaughter-Mason S (2008). Exposure assessment and risk of gastrointestinal illness among surfers. Journal of Toxicology and Environmental Health - Part A: Current Issues. 71(24): 1603-1615

Tyler, A.N. Dale, P., Copplestone, D., Bradley, S., Ewen, H., McGuire, C., Scott, E.M. (2013). The radium legacy: contaminated land and the committed effective dose from the ingestion of radium contaminated materials. *Environment International*, 59, 449-455

Tyler, A.N. and Heal, K.V. (2000). Predicting areas of Cs-137 loss and accumulation in upland catchments, Water, Air, and Soil Pollution, 121 (1-4): 271-288.

Appendices

Appendix A1 Postal Survey Protocol

The postal survey produced an independent data set from a broader cross section of the population living in the area potentially providing the means to identify new or missed habits that might provide useful focus to target some of the face-to-face surveys or meetings with local groups.

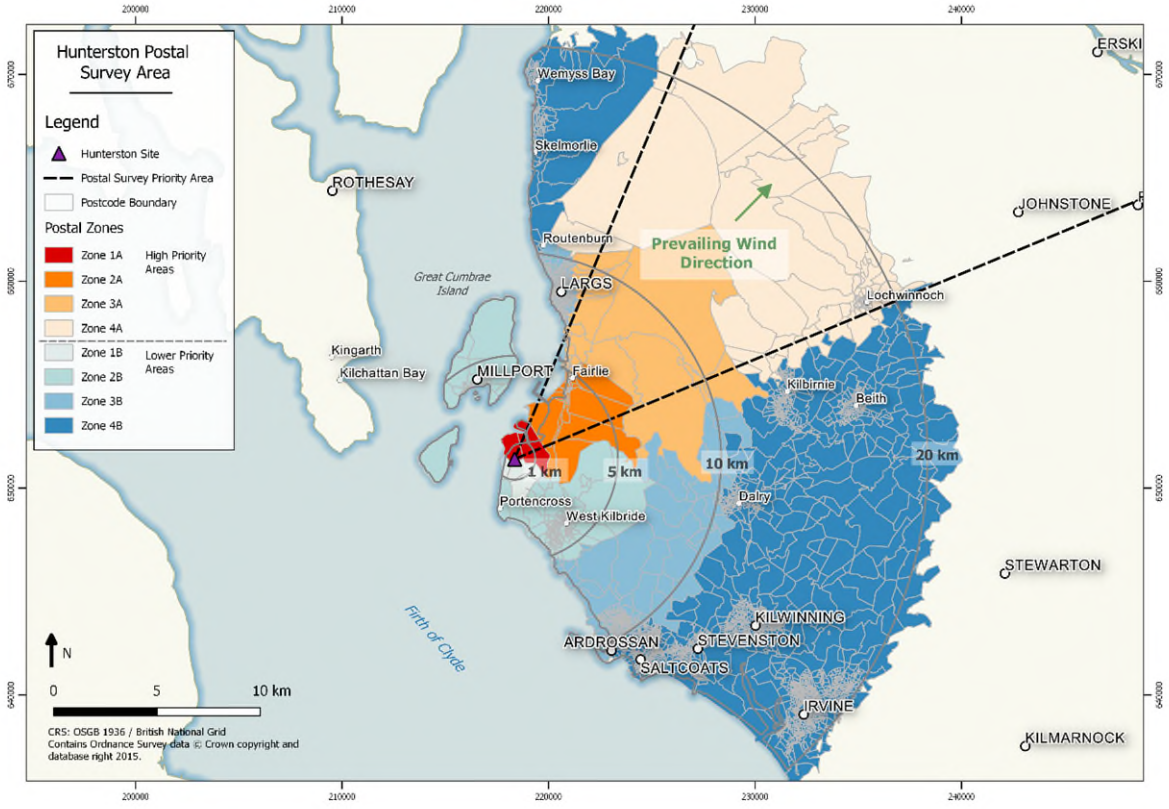

Figure A.1. The postal survey zones for the Hunterston area centred from the site boundary

The survey included a map (Figure A1) for identifying the range of activities undertaken by household members. The sample included populations living in the following geographical areas:

(ii) Within 1 km from the site boundary (zone 1A)

(iii) Between 1 km and 5 km from the site (zone 2A)

(iv) Between 5 km and 10 km from the site (zone 3A)

(v) Between 10 km and 20 km from the site (zone 4A)

These zones (zone 1A – 4A) were governed by the prevailing wind direction. Zones 1B - 4B were repeated outwith the plume area.

The postal survey was based upon postcodes, combined with the electoral role within the terrestrial survey area. Using data from the electoral role and grouped according to the zones in Figure A.1, people living with the postcode zones were randomly selected to provide a demographic cross-section of the population. Considering the reduced number of houses located under the modelled plume, the number of surveys were divided to each zone as follows: Zone 1A – 2 (0.15%); Zone 2A – 385 (19.25%); Zone 3A – 247 (12.35%); and, Zone 4A – 74 (3.7%). Outside of the plume the surveys were divided to each zone as follows: Zone 1B – 12 (0.6%); Zone 2B – 427 (21.35%); Zone 3 B – 426 (21.3%); and, Zone 4B – 426 (21.3%). Sampling and surveying at different distances from the site enabled exploration of the relationship between distance and habits and provided a means of producing additional potentially useful data. The postal survey produced an independent data set from a broader cross section of the population living in the area, again potentially providing the means to identify new or missed habits that might provide useful focus to target some of the face-to-face surveys or information groups.

The postal survey helped refine and revise the face-to-face survey tools and identify the optimal areas to target the face-to-face surveys. It also provided additional information on sites for the collection of observation data and indicated at what times the areas might be busy and supplied additional information and contacts with regard to both individuals and a wider range of activities that might merit further investigation in the later survey work. Results of the postal survey can be found in Appendix A5.

Appendix A2. The Mobile Gamma Spectrometry System

To measure such an extensive area, a Mobile Gamma-ray Spectrometry System (MoGSS) was utilised to measure the differential dose estimations for the natural radioelements (^{40}K and the ^{238}U and ^{232}Th series) alongside estimates for anthropogenic ^{137}Cs. The ability to separate the contributors is especially important given that any potential contributions from Hunterston ^{137}Cs could potentially be singled out from the spatially variable background element concentrations. This type of capability is not possible using conventional air-kerma measurements.

Two systems operating MoGSS were deployed in order to cover the area in sufficient spatial detail:

(i) Car-borne: Two large volume sodium iodide detectors were mounted in a box on top of a car, which was driven along all the major roads within the area of interest. The system, owing to the size of detectors, produced high efficiency and data, although data could only be collected from roads; and

(ii) Back-pack system: To survey smaller areas not accessible by vehicle, and to crucially cover the coastline and measure the dose at relevant access points, two separate backpack systems were used. To encompass many of the access points, a large section of the Ayrshire Coastal path was covered using this backpack system, extending from just north of Ardrossan to Largs (Figure 7.1). Each backpack system comprised of a 71 × 71 mm sodium iodide detector.

All MoGSS units produced a differential energy spectra recorded at 1 second integration times alongside high accuracy (<0.6 m) differential GPS readings.

Conversion of detector count rate (counts s^{-1}) to activity (Bq kq^{-1}) was performed using Monte Carlo calibrations and a conventional window stripping routine derived from concrete calibration pads. Cosmic background was measured on Loch Lomond and stripped from all spectral data. Prior to stripping, the Maximum Noise Fraction algorithm (Green *et al*, 1988) was used on individual instruments to smooth window counts using counts above 400 keV. A spatial Gaussian kernel was then used to further smooth the data. Finally, dose (nGy hr^{-1}) was calculated using ICRU conversion factors (ICRU, 1994)

The Mobile Gamma Spectrometry System (*MoGSS*) deploys 76mm x 76 mm and large volume (4 or 8 litre) NaI(Tl) detectors for real time data acquisition gamma ray spectra. One second spectra were acquired whilst driving with the detector mounted in the roof box of the survey vehicle to characterise the heterogeneity in the radiation environment around the Hunterston Site and further afield to identify exposure pathways that might otherwise be missed through conventional point measurements. Acquisition rate is limited by road and traffic conditions but aims to achieve better than one measurement per 20 km. *MoGSS* comprises a real time differential GPS system providing < 0.6 m positional accuracy, controlled by bespoke software through a tablet computer. Spectra were collected with 1 second integration times and data are

presented as counts per second (gross counts or counts in the window >350 keV). *MoGSS* was deployed to identify anomalies in the radiation field to help target follow-up *in-situ* dosimetry surveys and identify the likely source of the radioactive anomaly and spatially extrapolate any anomalous observations identified.

This approach provided a better understanding of the underlying natural background and any anthropogenic contribution to the radiation environment. The *MoGSS* system was deployed in vehicular mode to undertake a car-borne survey along the road network and in hand-held mode to map the site perimeter and the spillway.

Appendix A3 *In-Situ* Gamma Dose Rate Measurements

The protocol requires the detector to be maintained at 1 m above the surface and counts acquired over a 600 second integration time and the cosmic and intrinsic component to the measurement subtracted. The protocol also requires no persons operating the detector to be within 5 m of the probe during the count. Both instruments are calibrated with ^{226}Ra and ^{137}Cs. Here, gamma dose rates were dominated by the natural background so all results are reported with the ^{226}Ra calibration and reported as μGy h^{-1}.

For the dose assessment tool, gamma dose rates were converted to Effective Dose (μSv hr^{-1}) using a conversion factor of 0.85, which assumes an individual is standing and exposed to terrestrial derived gamma radiation. This conversion factor is used for most statutory monitoring programmes (Punt *et al*., 2011). All survey measurements are reported as terrestrial gamma dose measurements and have had the cosmic and intrinsic component subtracted.

Appendix A4 Beta Skin Dosimetry Measurements

The instrument was calibrated under UKAS accreditation against: strontium-90 (^{90}Sr) and yttrium-90 (^{90}Y); chlorine-36 (^{36}Cl) and carbon-14 (^{14}C) (and put inside a file poly-pocket to protect the system from the weather). A 12 mm Perspex shield was used to shield out any beta emissions and so enable the gamma contribution to the instrument to be established. All measurements were made with a 20 second integration time and in duplicate, with and without the 12 mm Perspex shield, enabling the net beta contribution to skin dose rate to be estimated (effective dose, or ambient dose

equivalent) and reported in μSv h^{-1}. The system is estimated to have a detection limit of around 0.2 μSv h^{-1}.

Appendix A5 Postal Survey Results

The postal survey proved useful for identifying popular activities and where households took part in these activities, as respondents were asked to mark down where they carry out their activities on a map of the survey area. This information was mapped onto a heat map[1] covering the survey area around the Hunterston site. These areas were later factored into the schedule for the face-to-face surveys. The survey was not designed to capture the length of time individuals spent doing these activities.

A5.1 Terrestrial External Exposure

A number of households reported undertaking a range of terrestrial activities with 5 km of the Hunterston site (Figure A5.1). Within one km of the site these included: bird watching (3 respondents); cycling (6); dog walking (5); rambling/walking (6); running (1); and sitting or picnicking (3).

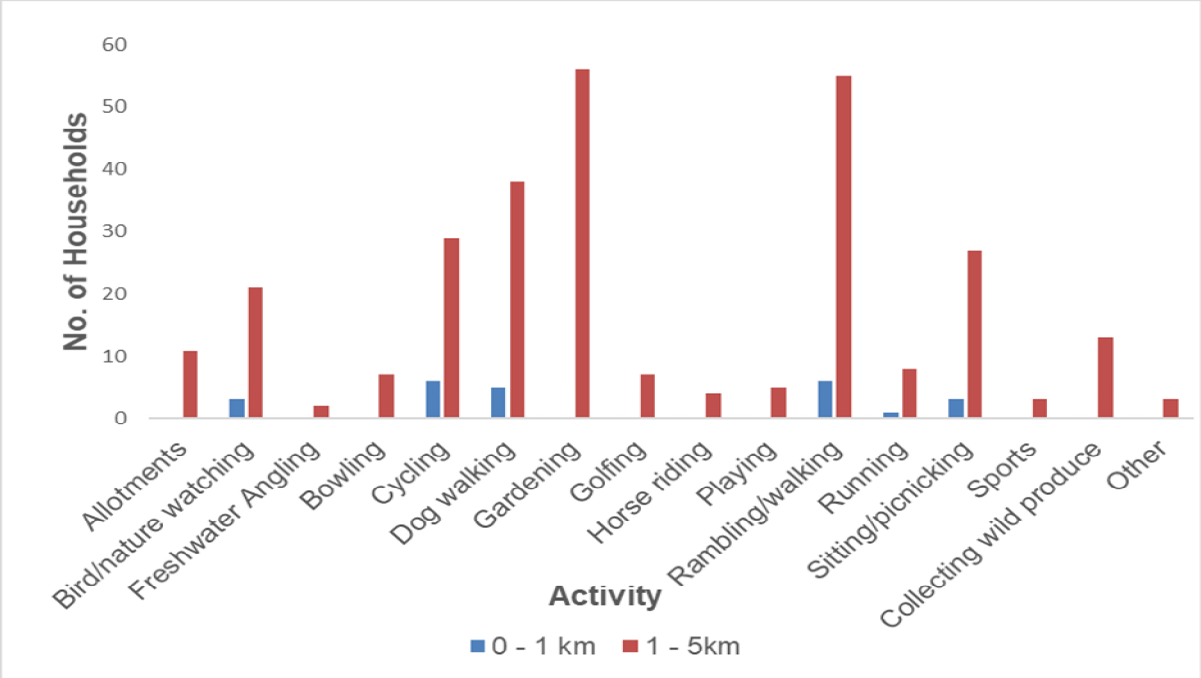

Figure A5.1. Overview of the number of households participating in terrestrial activities in the 1 km and 5 km survey areas.

Within 5 km of the site, gardening was the most popular activity (56 respondents) followed by: rambling/walking (55) and dog walking (38). Sports and other activities

were the least reported but included: in-line skating; photography; and dog training classes. Two respondents reported freshwater fishing within 5 km. No respondents reported bee keeping as an activity. In-line skating on the Hunterston estate was a new activity identified (other activity).

The location where the range of activities were reported are listed in Table A5.1. The greatest number of activities were reported at: Fairlie (10); Portencross (8); Ardneil Bay (8); and Thirdport (8).

Table A5.1 Summary of where respondents undertook terrestrial activities

No Specific Location Given	**No Location Given**	**Fairlie**	**Portencross**
Bird/nature watching	Bird/nature watching	Allotments	Bird/nature watching
Cycling	Bowling	Bird/nature watching	Cycling
Dog-walking	Cycling	Bowling	Dog-walking
Gardening	Dog-walking	Cycling	Gardening
Horse-riding	Gardening	Dog-walking	Rambling/walking
Playing	Golfing	Gardening	Running
Rambling/walking	Playing	Golfing	Sitting/picnicking
Running	Rambling/walking	Playing	Collect wild produce
Sitting/picnicking	Sitting/picnicking	Rambling/walking	
Collect wild produce	Sports	Running	
	Collect wild produce		
Hunterston Estate	**Peel Port Lagoon**	**Peel Port Path**	**Seamill**
Cycling	Bird/nature watching	Dog-walking	Allotments
Dog-walking	Cycling	Rambling/walking	Cycling
Rambling/walking	Rambling/walking	Running	Dog-walking
Collect wild produce	Sitting/picnicking		
Hunterston Site	**West Kilbride**	**West Kilbride Bay**	**Hawking Craig**
Bird/nature watching	Bird/nature watching	Bird/nature watching	Bird/nature watching
Cycling	Bowling	Dog-walking	Cycling
Dog-walking	Cycling	Gardening	Dog-walking
Rambling/walking	Dog-walking	Rambling/walking	Rambling/walking
Running	Gardening	Running	Collect wild produce
Sitting/picnicking	Sports	Sitting/picnicking	

Table A5.1 Summary of where respondents undertook terrestrial activities (continued)

Thirdport	Ardneil Bay	Millport	Cumbrae
Bird/nature watching	Bird/nature watching	Allotments	Cycling
Cycling	Cycling	Bird/nature watching	Dog-walking
Dog-walking	Dog-walking	Bowling	Horse-riding
Gardening	Golfing	Cycling	Rambling/walking
Horse-riding	Rambling/walking	Dog-walking	Sitting/picnicking
Rambling/walking	Running	Playing	Sports
Running	Sitting/picnicking	Collect wild produce	Collect wild produce
Collect wild produce	Collect wild produce		
Southannan Sands	**Southannan Estate**	**Fairlie Glen**	**Carlung farm (A78)**
Bird/nature watching	Cycling	Dog-walking	Cycling
Dog-walking	Rambling/walking	Rambling/walking	In-line skating
Kaim Hill	**Glentane Hill**	**Black Hill**	**Peel Port Pier**
Dog-walking Rambling/walking	Rambling/walking	Sitting/picnicking	Rambling/walking

Some activities were more widespread than others and reflected the ease of access to those locations and population centres. These included: dog-walking; rambling; or walking; and cycling. Other locations reported fewer activities and reflected the difficulty

Two people reported freshwater fishing at separate reservoirs within the five km survey area. Some correspondents reported terrestrial activities without providing a location. Information is listed in table A5.1 for completeness.

A5.2 Aquatic External Exposure

A number of households engaged in aquatic activities within the survey area. The total number of people undertaking each aquatic activity, either in or on the water and the distance from the Hunterston site are presented in Figure A5.2.

The highest number of respondents took part in outdoor swimming (11), followed by sailing (9) and commuting by boat (9). Most activities undertaken were reported between one and five km from the nuclear site, although one person reported rowing outside 5 km from the Hunterston site. No people reported undertaking the following

activities: boat maintenance; being on a dive boat; canoeing; jet skiing; sports fishing; net and cobble fishing.

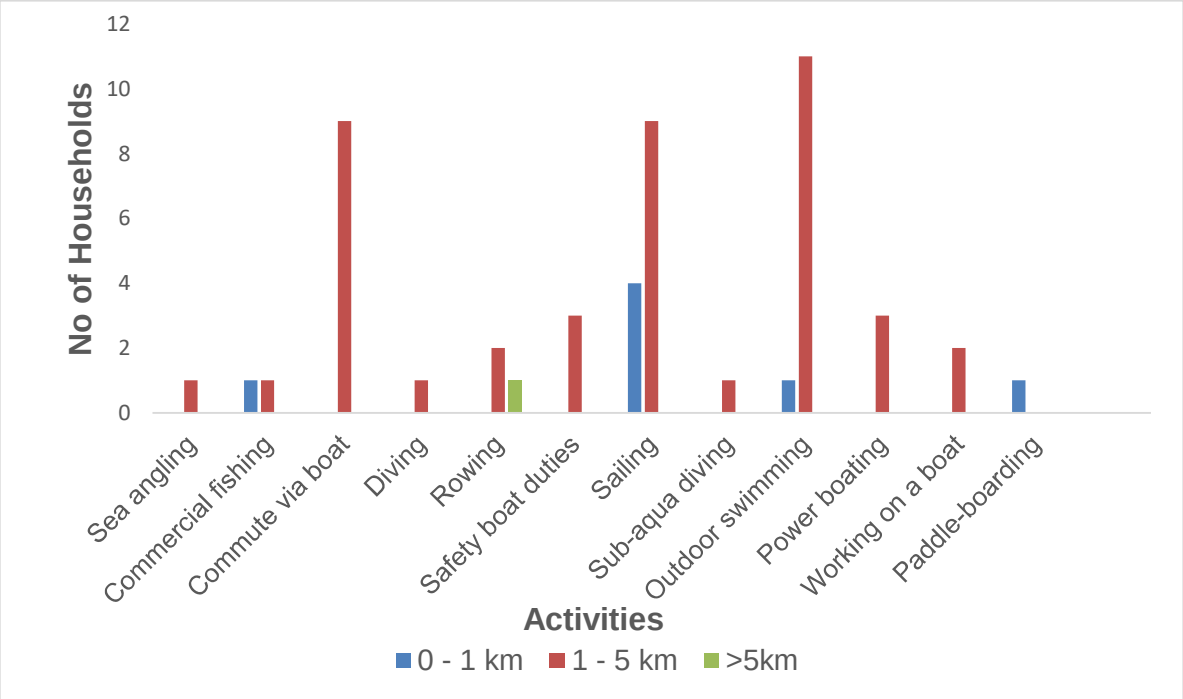

Figure A5.2. Summary of the number of households undertaking aquatic activities

In terms of activity locations, respondents reported undertaking higher numbers of activities around Great Cumbrae; Little Cumbrae; Fairlie; and off the coast at Hunterston (Table A5.2). Some respondents did not provide specific locations within the survey area for the range of aquatic activities they engaged in.

Table A5.2 Summary of where respondents undertook aquatic activities

Wemyss Bay	**Skelmorlie**	**Largs**	**Largs to Cumbrae**
Sailing	Sailing	Jet Skiing	Commute via boat
		Sailing	
Fairlie	**Fairlie Sands**	**Fairlie Marina**	**Peel Port**
Sailing	Safety boat duties	Safety boat duties	Rowing
Rowing	Outdoor swimming		
Outdoor swimming	Working on a boat		

Table A5.2 Summary of where respondents undertook aquatic activities (continued)

Great Cumbrae	Little Cumbrae	Millport	Hunterston Sands	No Specific Location Given
Sea angling	Sailing	Outdoor swimming	Power boating	Commercial fishing
Safety boat duties	Sea angling	Power boating	Sailing	Sailing
Outdoor swimming	Power boating	Rowing	Outdoor swimming	Sub-aqua diving
Power boating				Diving
Rowing				Working on a boat
Sailing				

Hawkings Craig	Ardneil Bay	West Kilbride Beach	Portencross
Sailing	Sailing	Outdoor swimming	Sailing

A5.3. External Intertidal Exposure

A number of households carry out activities in the intertidal zone within the survey area. The total number of people undertaking each intertidal activity and the distance from the Hunterston site are presented in Figure A5.3 with the highest number of respondents taking part in playing or walking (55); followed by dog walking (32); beachcombing (23); and rock pooling (17) with most activities undertaken between one and five km from the nuclear site. No person reported undertaking the following activities: crabbing; dredging; fixing moorings; handling creels; stake netting; or net and cobble fishing.

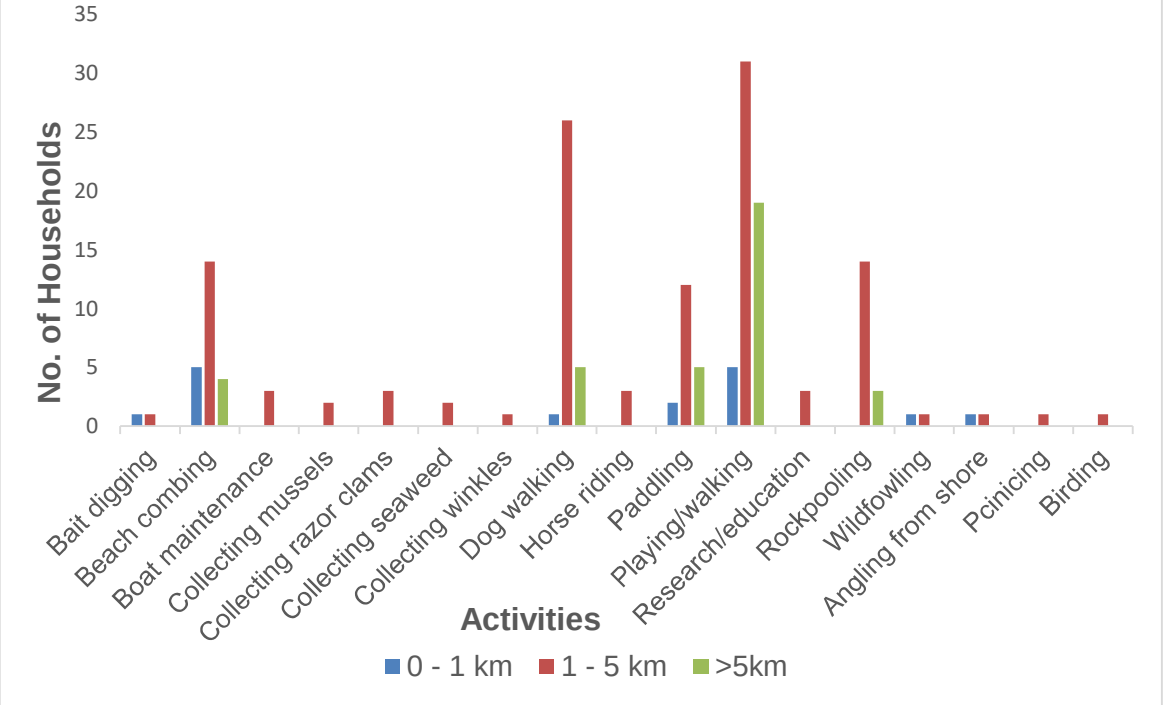

Figure A5.3. Summary of number of households undertaking intertidal activities

Intertidal activities were reported to be undertaken throughout the survey zone (Table A5.3). Respondents reported undertaking higher numbers of activities at Fairlie Sands; Portencross; Ardneil Bay and West Kilbride beach. Activities undertaken closest to the Hunterston site include: Bait digging; beach combing; playing; walking; paddling; and sea angling.

Table A5.3. Summary of where respondents undertook Intertidal activities

Kelburnfoot Beach	**Great Cumbrae**	**Skelmorlie**	**Routenburn**
Dog walking	Dog walking	Beachcombing	Playing/walking
Playing/walking	Research/education		
North Inch	**South Inch**	**Millport Bay**	**Fintry Bay**
Playing/walking	Playing/walking	Collect razor clams	Rock pooling
Portencross	**Ardneil Bay**	**Ardrossan: North Bay Beach**	**Ardrossan: South Bay Beach**
Beachcombing	Beachcombing	Beachcombing	Beachcombing
Dog walking	Dog walking	Playing/walking	Playing/walking
Paddling	Horse riding	Dog walking	Dog walking
Playing/walking	Paddling	Paddling	Paddling
Rock pooling	Playing/walking	Rock pooling	Rock pooling
Rock pooling	Rock pooling		
Picnicking	Picnicking		

Table A5.3. Summary of where respondents undertook Intertidal activities (continued)

Fairlie Sands	West Kilbride Beach	No Specific Location Given	Largs: Castle Bay Beach
Bait digging	Beachcombing	Beachcombing	Dog walking
Beachcombing	Dog walking	Boat maintenance	Paddling
Collect razor clams	Horse riding	Collect mussels	Rock pooling
Collect mussels	Paddling	Dog walking	Beachcombing
Collect seaweed	Playing/walking	Horse riding	Playing/walking
Dog walking	Rock pooling	Paddling	
Paddling	Picnicking		
Playing/walking			
Rock pooling			
Angling from shore			
Birding			

Millport	Southannan Sands	Hunterston Sands	Location Not Given
Beachcombing	Bait digging	Bait digging	Dog walking
Paddling	Beachcombing	Beachcombing	Paddling
Research/education	Dog walking	Paddling	Playing/walking
Rock pooling	Paddling	Playing/walking	Rock pooling
Picnicking	Research/education	Angling from shore	

Some respondents did not provide specific locations on the map within the survey area for a range of intertidal activities (no specific location given) whilst some reported intertidal activities but no locations were marked on the maps (no location given).

A5.4 Internal Exposure

Household respondents were asked to provide information on where they sourced their food. A summary of the results (Figure A5.4) shows the origins of where respondents sourced their food as a percentage. Results show that respondents bought most of their food sourced from outwith the zoned areas. This was consistent across all food groups.

Most food was bought from a local shop. The exception to this was for wild fowl whereby 50% was self-caught compared to 37.5% bought from a local shop. Respondents indicated that less than 20% of fruit and vegetables were home grown.

The range of food items reportedly consumed in the postal survey is shown in Table A5.4. The data represents a percentage of the total number of individuals consuming food items from each food group.

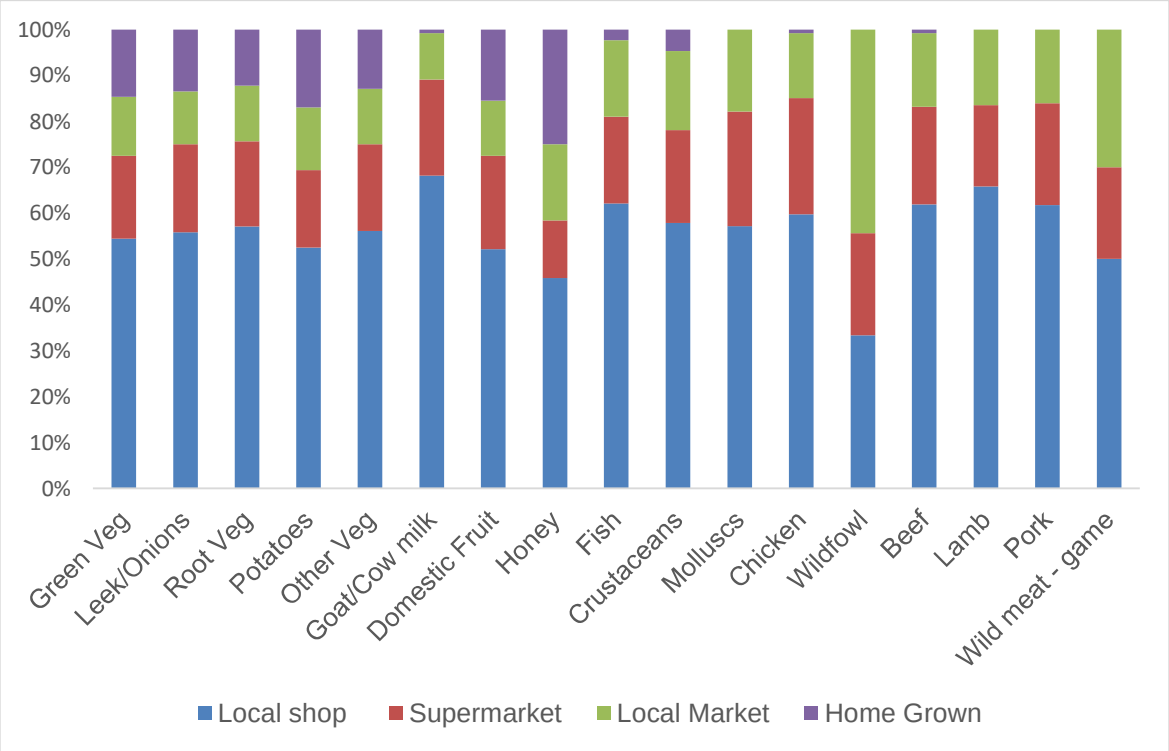

Figure A5.4. Source of food consumed by postal survey respondents

21 individuals stated they consumed honey, with six individuals (28.6%) stating they produced their own honey. One person stated they drank milk from their own herd as did one person for poultry and beef. Aquatic food groups tended to be shop bought. Three individuals consumed fish (2.52%) and crustaceans (5.66%) they had caught themselves. A total of 23 individuals reported they foraged for wild foods.

Table A5.4. Summary of the number of households, the food types they consumed and where they bought such food types. Includes number of people who foraged for wild foods

Food Group	Total No. Individuals	Local Shop (%)	Supermarket (%)	Local Market (%)	Home Grown/ Self-Caught (%)
Green vegetables	139	66.9	22.3	15.8	18.0
Root vegetables	132	67.4	22.0	14.4	14.4
Leeks/onion	128	68.0	23.4	14.1	16.4
Other vegetables	95	68.4	23.2	14.7	15.8
Potatoes	147	65.3	21.1	17.0	21.1
Domestic fruit	119	62.2	24.4	14.3	18.5
Wild Foods	23	-	-	-	-
Mushrooms	-	-	-	-	-
Cattle meat	120	67.5	23.3	17.5	0.83
Sheep meat	76	68.4	18.4	17.1	
Poultry	122	65.6	27.9	15.6	0.82
Pig meat	76	65.8	23.7	17.1	-
Wildfowl	8	37.5	-	25.0	50.0
Game	11	45.5	-	18.2	27.3
Milk	119	73.9	22.7	10.9	0.84
Fish	119	68.9	21.0	18.5	2.52
Crustaceans	53	69.8	24.5	20.8	5.66
Molluscs	25	64.0	28.0	20.0	-
Honey	21	52.4	14.3	19.0	28.6

Appendix A6 Site Descriptions and Observations.

A6.1 Aquatic Survey Area Descriptions

The survey locations were visited throughout two survey periods, the first during the schools' Easter break (1st April to 6th April) and the second outwith the school holiday period (17th June to 23rd June) of 2017. On-shore and off-shore observations were undertaken at each site.

The survey area included the intertidal areas and waters of the Firth of Clyde extending from Wemyss Bay in the north to Saltcoats in the south. The southern part of Great Cumbrae Island and all of Little Cumbrae Island, off-shore of Largs, were also included, (Chapter 5, Figure 5.1). Part of the survey area forms a National Nature Reserve and Scottish Site of Special Scientific Interest, which attract bird watchers and wildlife enthusiasts to the area to observe the intertidal birdlife. The Ayrshire Coastal Path runs the majority of the length of the aquatic survey area and stays close to the coastline, routing along many beaches between Ardrossan and Skelmorlie.

A6.2 Wemyss Bay, Skelmorlie, Meigle Bay, Auchengarth and St Phillan's

Wemyss Bay is the most northerly site within the survey area. The beach is located to the north of the ferry terminal and train station. It is a sand and stony beach with a stone sea defence wall along the back of the bay. Within the school holiday period two families were observed dog walking on the intertidal area. Outwith the school holiday period there were three individuals fishing; four dog walkers; six individuals playing; and one child cycling on the intertidal area. No aquatic activities were observed outwith or during the school holiday survey.

South from Wemyss Bay is Skelmorlie and Meigle Bay (Figure A6.1) which is a rocky stretch of coastline with limited access from the main road. No intertidal or aquatic activities were observed outwith or during the school holiday survey at these sites.

Figure A6.1 Looking north to Skelmorlie from Miegle (June, 2017)

Continuing along the coastline to Auchengarth the substrate is stony with rocky outcrops with some sand apparent. Three individuals were observed fishing from the rocks at Auchengarth within the school holiday survey. Outwith the school holiday period, three individuals were observed fishing from rocks. No aquatic activities were observed at Auchengarth outwith the school holiday survey. Access along this stretch was limited with only a few parking bays allowing access to beach area.

Continuing south towards Largs the substrate is a mixture of rock and stone backed with sand and shells along the coast at St Phillan's. The foreshore is interspersed with sandy patches and seaweed. One individual was observed walking over the rocks at St Phillan's within the school holiday survey. Outwith the school holiday survey two dog walkers were observed on the beach at St Phillan's. No aquatic activities were observed outwith or during the school holiday survey.

Spume was observed at St Phillan's within the school holiday period. No spume was observed at any sites within the section of coastline outwith the school holiday period.

A6.3 Largs to Fairlie

Largs beach is a large sand and stony beach bay backed by a concrete promenade. At low tide seaweed was covering sandy substrate. Largs is a seaside town and within

the school holiday survey one individual dog walking; one family playing; and one walker were observed on the intertidal area. The promenade was busy with both walkers and dog walkers. The Royal National Lifeboat Institute (RNLI) is situated in Largs (Figure A6.2). Section 5.6 provides further details.

Figure A6.2 Launching of the RNLI lifeboat at Largs (April, 2017)

Observations on Largs beach, outwith the school holiday survey included: nine dog walkers; 11 individuals playing (families); and two individuals sitting on the sand and stones. Aquatic activities observed included: three fishing boats and eight sailing yachts.

Between Largs beach and Fairlie there are several little bays: Castle Bay; Carnies Quay; Bowens Craig; Far Bowens Craig; and Kelburnfoot. The substrate is generally sandy with some stone/rocks and large sea defence boulders in areas. Access is available via slipways, coastal path and rocks. It was reported by an individual that at Bowens Craig the coastline has changed from a rocky substrate to a sandy substrate since 2016. During the school holiday survey no activities were observed on Castle Bay beach though families were playing at the play park on the grassy area behind the bay. Activities observed at Cairnies Quay included: three dog walkers; two walkers; and two yachts moored in the water. Individuals were observed walking and

cycling on the promenade. At Bowens Craig the intertidal observations were: a family playing on the sand and three dog walkers. Only one dog walker was observed on the intertidal substrate at Far Bowens Craig. Off-shore aquatic activities observed were nine yachts and one jet-ski. A coastal path stretching between Bowens Craig and Kelburnfoot was popular with seven cyclists; six individuals sitting on benches; 18 dog walkers; and 23 walkers. Activities at Kelburnfoot during the school holiday survey were two dog walkers.

Outwith the school holiday survey, activities observed at Castle Bay and Carnies Quay were: 11 dog walkers; six individuals playing and walking on the sand; and one individual shore fishing. Aquatic observations were: 11 sailing yachts; three cruisers; one speed boat; two yachts; and one speed boat were moored with a sail yacht and motorboat launching from the slip at Carnies Quay. Activities observed at Bowens Craig were three individuals sitting picnicking on the rocky outcrop; 11 dog walkers; three walkers; three individuals (two adults and one child) paddling; and one family of four playing on the rocks and sand. Observations at Far Bowens Craig were: two individuals playing on the rocks and one individual beachcombing. Aquatic activities observed were: one sail yacht and the launching of a soft inflatable boat. Activities observed at Kelburnfoot were: five dog walkers; two children cycling on the sand; and one individual sitting on the sand. Aquatic activities observed were seven sailing yachts.

A Royal National Lifeboat Institute (RNLI) station is situated at Largs (Section 5.6). The ferries operating between Largs and Great Cumbrae Island are based at Largs ferry terminal. Commercial fishing boats also land their catch on the Largs pier (Section 5.2). Largs Marina is situated south of the pier and houses a yacht haven with moorings for 700 pleasure craft, a sailing club, the Ellen McArthur Cancer Trust and commercial diving.

No spume was noted at any of these sites during or outwith the school holiday surveys.

A6.4 Fairlie, Southannan Sands and Hunterston Sands

Fairlie Sands is a sand and stony beach with rocks and seaweed apparent. A sea defence wall and large rocky outcrops are situated to the back of the beach. South of Fairlie Sands is Southannan Sands (Figure A6.3), which is a large sandy bay with patches of seaweed interspersed throughout. The bay is backed by bushes, some of

them brambles, and grass. An aquaculture farm is located at Southannan Sands. Continuing south, Hunterston Sands is a large sandy bay with stones and rocks interspersed towards the back of the bay. Behind the stones and rocks are grasses and bushes of gorse and whin. A manmade sea defence causeway to the turbines is situated at Hunterston Sands. A cycle path and footpath runs from Fairlie to Hunterston.

Figure A6.3 Southannan Sands (April, 2017)

Activities observed at Fairlie Sands within the school holiday survey were: five individuals walking and three individual dog walking. Two individuals were recovering a dinghy after being sailing, nine yachts were moored on the water and two kayaks along with a total of 12 dinghies and rowing boats were resting on the hard standing by the slipway. One trailer containing a sailboat was situated on the beach. One individual was observed collecting oysters at Southannan Sands and one sailing boat was observed on the water. No intertidal activities were observed at Hunterston Sands however four sailing yachts were observed on the water.

Outwith the school holiday survey activities observed at Fairlie Sands were: five dog walkers; seven walkers; two individuals sitting and picnicking; two bait diggers; one jogger; and two individuals recovering a rowing boat from the water. Aquatic activities

observed were four kayakers. Approximately 40 sailing yachts were moored on the water with rowing boats, canoe and dinghies on the hard standing beside the slip. Activities observed at Hunterston Sands were four dog walkers and one cyclist on the cycle and foot path. No aquatic activities were observed. One dog walker was observed on the saltmarsh area at Southannan Sands. No other activities were observed. A carpark at Hawkins Craig is accessible from the Hunterston nuclear site. Activities noted at this site outwith the school holiday period were: dog walkers and fishermen. The Ayrshire coastal footpath passes through this section of coastline.

No spume was noted at any of these sites during the holiday survey. Outwith the school holiday survey spume was observed at Fairlie Sands only.

A6.5 Portencross and Ardneil Bay

Continuing south from Hunterston Sands the shorline substrate is mainly rocky with a pier, a walled stony and seaweed harbour at low tide (Figure A6.4) and a small stony and sandy beach beside Portencross Castle.

South of the castle the shorline continues to be rocky with a car park and picnic area situated behind the rocky shore. One small fishing boat was observed moored at the harbour. During the holiday survey, activities observed included: one angler fishing from the pier; two adults & two children walking/playing on the rocks; two dog walkers; one photographer; four individuals picnicking; one walker; and seven visitors to Portencross Castle. Two workmen were also observed undertaking upgrading of the castle during the school holiday survey. One RIB (Rigid Inflatable Boat) was out on the water from the carpark and further south of Portencross two individuals were fishing from the rocks.

Figure A6.4 Portencross Harbour looking south to Portencross Castle (June, 2017)

South along the coast from Portencross, is Ardneil Bay, it is accessible via a path from the road and is a stony bay with a sandy foreshore. The bay is backed by sea defence boulders and grass scrub behind which are agricultural fields. Cattle were observed grazing in fields with no access to the beach. Towards the south end of Ardneil Bay part of the West Kilbride Golf Club lies behind the beach. Activities observed during the school holiday survey were five dog walkers and six walkers. No aquatic activities were observed during the school holiday survey.

Outwith the school holiday period activities observed at Portencross were: eight dog walkers; 19 walkers; 10 individuals fishing from the pier; three cyclists; one jogger; five individuals sitting; two photographers; one birdwatcher; and one individual preparing to kayak and fish. Aquatic activities observed were: four kayakers; one sailing yacht. A total of five boats (three motor boats and two fishing boats) were observed moored in the harbour. Activities observed at Ardneil Bay were: five dog walkers; seven walkers; a family of three playing in the sand; and a large party of approximately 30

individuals (adults and children) having a barbeque on the sand. Aquatic activities observed were: two sailing yachts and one fishing boat.

Brambles were present beside the carpark at Portencross and on the path towards Ardneil Bay. A beach clean-up was being organised by the Scottish Wildlife Trust undertaken at the end of April at Portencross.

No spume was observed during or outwith the school holiday survey at any of the sites.

A6.6 Seamill and Boydstone

The sandy shore continues south from Ardneil Bay towards Seamill with a rocky promontory towards the north of Seamill beach (Figure A6.5). The beach at Seamill is sandy with rocky outcrops the length of the beach southwards. Continuing south the coastline continued to be interspersed with rocky outcrops and a sandy beach with patches of stones and seaweed. The length of this is backed by long beach grasses; a coastal footpath and the main A78 road.

Figure A6.5 Boydstone beach (June 2017)

Seamill beach was busy during the school holiday survey. Intertidal activities observed comprised: ten dog walkers; 12 walkers; a family of four picnicking; eight

individuals playing & flying a kite; three children playing on rocks; and three individuals playing on the sand. Within the school holiday period intertidal activities observed at Boydstone comprised 12 dog walkers; 14 individuals (families) playing on the sand; and four individuals playing on the rocks. One sailing yacht was observed on the water offshore of Boydstone.

Outwith the school holiday survey, activities observed at Seamill beach were: four dog walkers; eight walkers; two individuals sitting on the rocks; and three individuals paddling and playing. Three kayakers were observed offshore. Activities observed at Boydstone were two individuals sitting on the beach at a bonfire; two dog walkers and two individuals lying on the sand. A fishing boat putting out creels was observed offshore.

No spume was observed at either site during or outwith the school holiday survey.

A6.7 Ardrossan North Beach and Ardrossan South Beach

Ardrossan is characterised by a harbour area segregated into two areas: an outer and inner area. The inner harbour is a marina for mainly pleasure craft, which also provides moorings for commercial fishing boats. The Ardrossan to Arran ferry is located at the ferry terminal at the outer harbour. Continuing south from Boydstone towards Ardrossan the substrate continues to be sandy beaches with rocky outcrops interspersed with stone and seaweed. Ardrossan comprises two sandy bays: Ardrossan North beach (Figure A6.6) and Ardrossan South beach.

Towards the south of Ardrossan North Beach large sea defence boulders are apparent and seashells and seaweed stretch the length of the back of Ardrossan North beach with grass, a road and residential housing behind. Ardrossan South beach (the south part of this being Saltcoats beach) is backed by a seawall onto a promenade. Both north and south of Ardrossan South beach sea defence boulders are present. No commercial winkle picking, mussel collecting or bait digging was noted within the school holiday period in contrast to the 2012 previous habits survey.

Figure A6.6 North Bay (Ardrossan North Beach. June 2017)

Within the school holiday period the intertidal activities observed comprised: 12 dog walkers and one walker at Ardrossan North beach and 25 dog walkers; 18 walkers; 27 individuals (families) playing on the sand; and 11 individuals sitting and picnicking at Ardrossan South beach.

Outwith the school holiday period the activities observed at Ardrossan North Beach were: eight dog walkers; two individuals walking; one jogger; three children playing on the rocks; one individual bait digging; and one individual fishing from Ardrossan Pier. Aquatic activities observed were: three sailing yachts; one RIB; two fishing boats; and one individual jet skiing. Activities observed at Ardrossan South Beach were: 24 dog walkers; seven walkers; one jogger; three individuals playing; and five individuals paddling. The only aquatic activity observed was one individual launching a jet-ski.

No spume was noted at these sites within the school holiday survey. Ouwith the school holiday survey, spume was noted at the Ardrossan South Beach site.

A6.8 Great Cumbrae Island

Great Cumbrae Island, located approximately 2 km off-shore of Largs, is a small island with many small bays around the coastline of approximately 16 km. Its main town is Millport located on the south of Great Cumbrae Island and is at its most busy in the

holiday periods. A coastguard station is located at Millport and commercial fishing boats are based here. A road travels the extent of the island. The coastline is mostly rocky and access to the shore is most often via parking laybys. The small bays around the island are a mixture of stone, sand and shell with rocky outcrops. The National Water Sports Centre of Scotland is located in the north eastern side of Great Cumbrae Island (Section 5.7). The Field Studies Centre is based to the south eastern side of Great Cumbrae Island and staff and students/visitors spend time on the intertidal substrate (Section 5.7). Outwith the school holiday survey period Intertidal activities were observed at Kames Bay (playing on the sand); Newtown Bay (families playing on the sand and dog walkers) and Little Skate Bay (dog walking). Aquatic activities observed comprised: one sailing yacht at Meigle Bay; two sailing yachts moored at Castle Bay; one kayaker at White Bay; and seven ribs moored at Cumbrae National Water Sports Centre. A group of children (approximately ten) were observed launching laser sailing dinghies at the time within the school holiday period. Joggers; cyclists; and walkers were observed on the road within the school holiday period. Millport was busy within the school holiday survey with many individuals walking around town.

Outwith the school holiday survey intertidal activities observed around Millport included: seven dog walkers; six walkers; 11 individuals paddling; 18 individuals sitting and picnicking/barbeque; 26 individuals playing on the sand; 17 individuals playing on the rocks; 10 individuals picnicking on the grass and; many individuals walking on the promenade area. Two individuals were noted camping on the grassy area at Deadmans Bay and two families with campervans were camping at Bells Bay. At Farland Point four individuals were observed sitting on the rocks, two individuals sitting and picnicking and one cyclist. Outwith the school holiday survey, approximately 60 individuals (adults and children) were participating in a cycling race around Great Cumbrae Island.

Aquatic activities observed around Great Cumbrae Island were: three sailing yachts; and one speed boat off Tomont End, two sailing yachts off White Bay, three sailing yachts off Holmes Bay; six sailing yachts off Ladies Bay; one dinghy with one individual fishing off Grey Craigs; and one sailing yacht off Clashfarland Point. Aquatic activities observed off Farland Point were two cruisers; one sailing yacht; one fishing boat; one individual fishing from a dinghy; and two motorboats. Kames and Newtown Bay at

Millport were also busy with aquatic activities observed included: 11 kayakers; one rowboat with three persons; three canoes; and the launching and recovering of RIB's. Approximately 16 cruisers were noted moored on the water in the Newtown Bay.

No spume was observed at any site around Great Cumbrae Island during or outwith the school holiday survey.

A6.9 Little Cumbrae Island

Little Cumbrae Island is a small private island offshore of Hunterston and 1 km south of Great Cumbrae Island. Its coastline is mainly rocky with steep cliffs in areas. Trips to Little Cumbrae Island are available via Largs. The survey team did not visit Little Cumbrae Island due to limited opportunity to access the island during the survey periods.

Appendix A7 MoGGS: Estimated Dose Rates

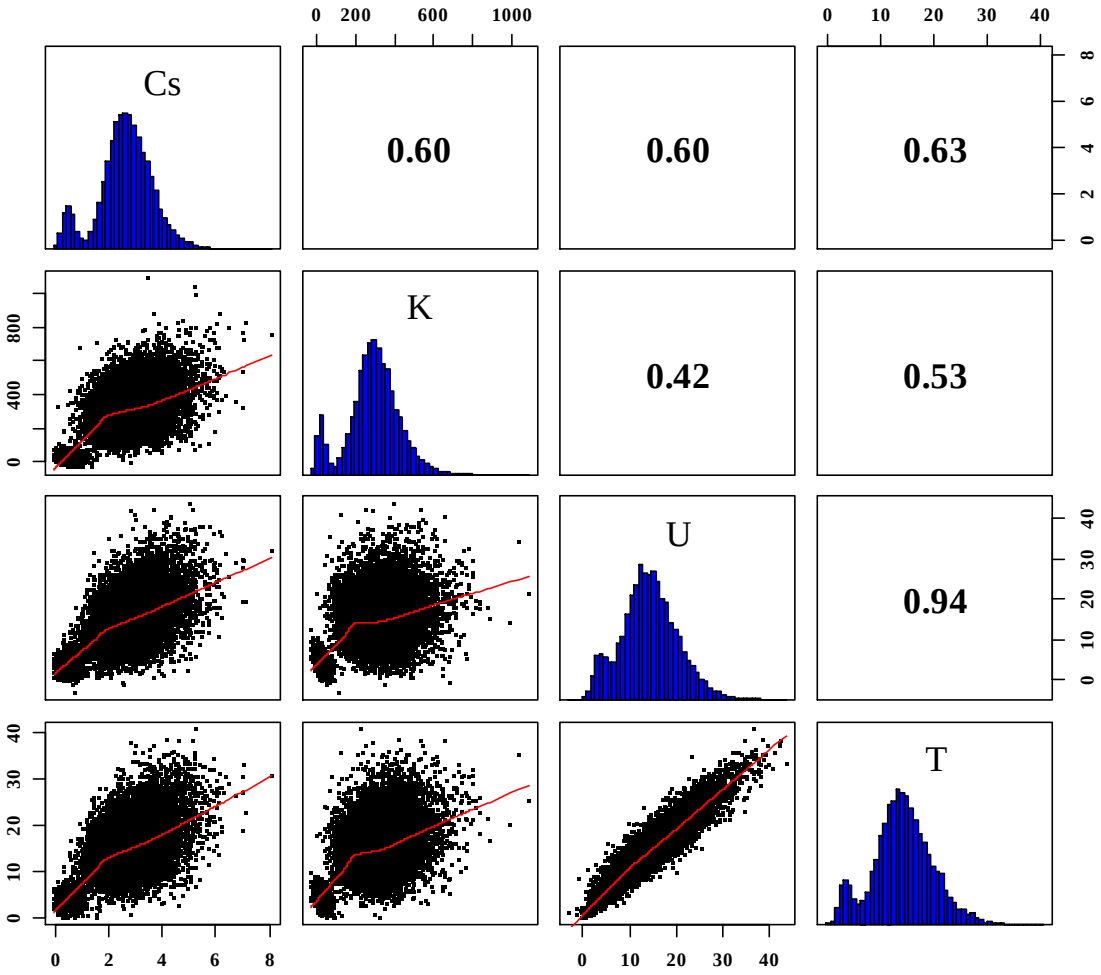

Figure A7.1. Estimated soil activity values (Bq kg^{-1}) derived from car-borne data. Shows spectral correlations between windows.

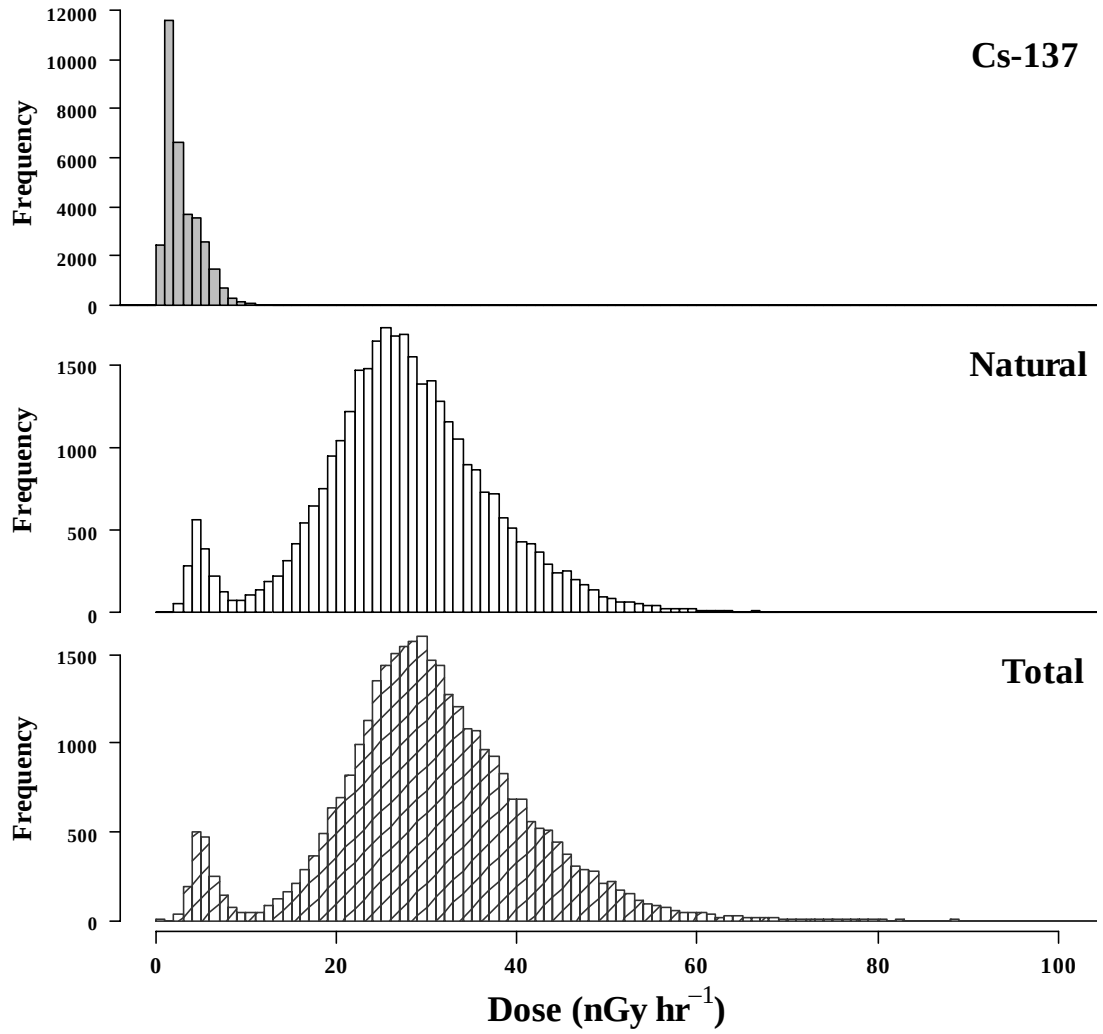

Figure A7.2 Estimated dose rates (nGy hr^{-1}) for the entire survey area. Doses are separated into ^{137}Cs, natural and the combined total.

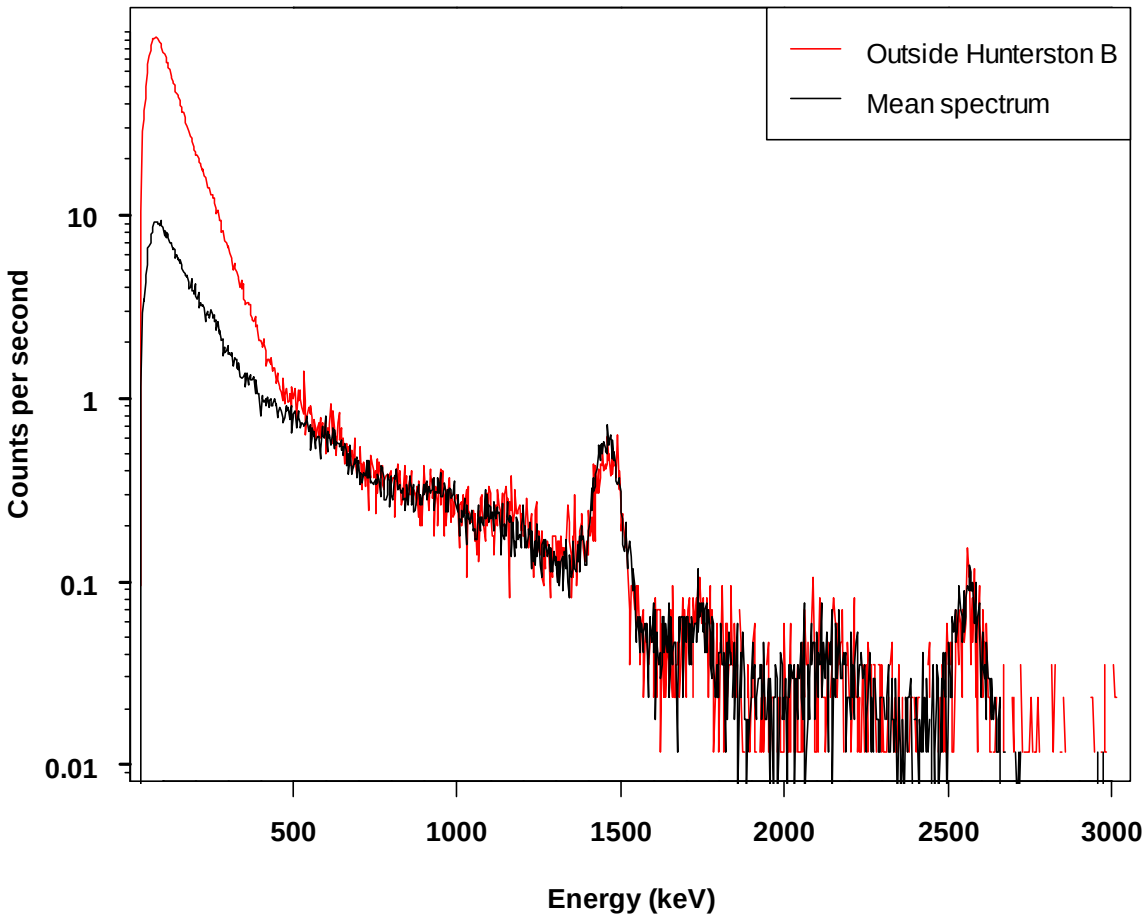

Figure A7.3 Spectral response in the carpark of Hunterston B and a “typical” mean spectral response across the survey area.

Appendix A8 Phase 1: Raw Data

Table A8.1 Phase One Adult Crustacean Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
323	Brown crab	7.80
320	Brown crab	7.80
332	Brown crab	7.80
333	Brown crab	7.80
321	Brown crab	7.80
162	Brown crab	2.75
204	Brown crab	1.20
237	Brown crab	1.20
100	Brown crab	0.20
162	Common lobster	4.34
333	Common lobster	3.60
320	Common lobster	3.60
321	Common lobster	3.60
332	Common lobster	3.60
323	Common lobster	3.60
100	Common lobster	1.36
204	Common lobster	0.45
237	Common lobster	0.45
254	Prawns (langoustines)	26.0
310	Prawns (langoustines)	26.0
305	Prawns (langoustines)	26.0
289	Prawns (langoustines)	26.0
162	Prawns (langoustines)	0.20

Table A8.2 Phase One Adult Fish Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
218	Cod	5.40
225	Cod	4.00
238	Cod	4.00
320	Cod	1.80
321	Cod	1.80
322	Cod	1.80
323	Cod	1.80
332	Cod	1.80
333	Cod	1.80

Unique ID	Food Type	Consumption Rate (kg y^{-1})
334	Cod	1.80
208	Cod	0.22
289	Dover sole	6.00
305	Dover sole	6.00
254	Dover sole	6.00
310	Dover sole	6.00
48	Mackerel	94.1
49	Mackerel	47.3
218	Mackerel	18.7
8	Mackerel	10.0
14	Mackerel	10.0
323	Mackerel	7.80
334	Mackerel	7.80
320	Mackerel	7.80
322	Mackerel	7.80
332	Mackerel	7.80
333	Mackerel	7.80
321	Mackerel	7.80
237	Mackerel	6.75
204	Mackerel	6.75
81	Mackerel	5.00
86	Mackerel	4.56
87	Mackerel	4.56
90	Mackerel	4.56
151	Mackerel	4.56
295	Mackerel	4.50
176	Mackerel	4.40
248	Mackerel	4.40
257	Mackerel	3.00
262	Mackerel	3.00
261	Mackerel	3.00
260	Mackerel	3.00
259	Mackerel	3.00
208	Mackerel	3.00
258	Mackerel	3.00
263	Mackerel	3.00
121	Mackerel	2.73
132	Mackerel	2.73
221	Mackerel	2.09
230	Mackerel	2.05

Unique ID	Food Type	Consumption Rate (kg y^{-1})
74	Mackerel	2.00
161	Mackerel	0.88
197	Mackerel	0.35
256	Mackerel	0.35
105	Mackerel	0.15
106	Mackerel	0.15
218	Pollock	31.2
322	Pollock	7.80
320	Pollock	7.80
333	Pollock	7.80
334	Pollock	7.80
321	Pollock	7.80
332	Pollock	7.80
323	Pollock	7.80
81	Pollock	7.00
208	Pollock	3.00
74	Pollock	1.00
104	Pollock	0.11
105	Pollock	0.11
197	Pollock	0.11
256	Pollock	0.11
305	Haddock	6.00
254	Haddock	6.00
310	Haddock	6.00
289	Haddock	6.00
208	Plaice	0.45
261	Plaice	0.45
257	Plaice	0.45
263	Plaice	0.45
260	Plaice	0.45
259	Plaice	0.45
258	Plaice	0.45
262	Plaice	0.45
262	Flounder	0.30
257	Flounder	0.30
263	Flounder	0.30
261	Flounder	0.30
259	Flounder	0.30
258	Flounder	0.30
208	Flounder	0.30

Unique ID	Food Type	Consumption Rate (kg y^{-1})
260	Flounder	0.30
310	Monk fish	6.00
289	Monk fish	6.00
305	Monk fish	6.00
254	Monk fish	6.00
262	Dab	0.30
261	Dab	0.30
260	Dab	0.30
259	Dab	0.30
258	Dab	0.30
208	Dab	0.30
263	Dab	0.30
257	Dab	0.30

Table A8.3 Phase One Adult Mollusc Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
187	Mussels	24.0
208	Mussels	1.80
319	Razor clams	12.0
100	Scallops	6.24
187	Scallops	4.80
23	Scallops	3.00
287	Scallops	3.00
72	Scallops	1.20
62	Scallops	1.20
62	Scallops	1.20
72	Scallops	1.20
161	Scallops	0.10
208	Winkles	1.50
319	Oysters	2.40
58	Oysters	0.72
319	Whelks	0.25

Table A8.4 Phase One Adult Wildfowl Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
16	Mallard	5.68
25	Mallard	5.68
16	Pink-Footed Goose	3.18

Unique ID	Food Type	Consumption Rate (kg y^{-1})
25	Pink-Footed Goose	3.18
25	Teal	0.91
16	Teal	0.91
16	Widgeon	1.14
25	Widgeon	1.14
16	Greylag goose	34.55
25	Greylag goose	34.55
18	Greylag goose	5.45
26	Greylag goose	5.45
176	Greylag goose	0.20
248	Greylag goose	0.20
25	Canadian Goose	2.05
16	Canadian Goose	2.05
30	Woodcock	0.10
312	Woodcock	0.10
27	Woodcock	0.10
28	Woodcock	0.10
29	Woodcock	0.10

Table A8.5 Phase One Children Fish Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
373	Mackerel	0.154
372	Mackerel	0.15
371	Mackerel	0.15
370	Mackerel	0.15
373	Pollock	0.11
372	Pollock	0.11
371	Pollock	0.11
370	Pollock	0.11

Table A8.6 Phase One Children Mollusc Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
359	Scallops	2.00
358	Scallops	2.00

Table A8.7 Phase One Children Wildfowl Consumption Rate

Unique ID	Food Type	Consumption Rate (kg y^{-1})
360	Woodcock	0.10

Table A8.8 Phase One Adult Terrestrial Activities

Unique ID	Terrestrial Activity	Total (h y^{-1})
156	Allotments	156
155	Allotments	821
156	Allotments	78.0
89	Allotments	156
79	Allotments	364
111	Allotments	585
4	Allotments	2190
6	Allotments	1825
67	Allotments	117
157	Allotments	78.0
78	Allotments	260
76	Allotments	260
11	Allotments	78.0
13	Allotments	520
5	Allotments	520
67	Allotments	13.0
434	Allotments	390
155	Allotments	156
57	Allotments	78
139	Allotments	312
138	Allotments	312
7	Allotments	78.0
222	Bee keeping	26.0
121	Bee keeping	19.5
111	Bee keeping	156
231	Bee keeping	26.0
434	Bee keeping	390
297	Bee keeping	90.0
78	Bird/nature watching	365
157	Bird/nature watching	104
19	Bird/nature watching	183
209	Bird/nature watching	13.0
209	Bird/nature watching	13.0
209	Bird/nature watching	13.0
209	Bird/nature watching	13.0
15	Bird/nature watching	183
209	Bird/nature watching	13.0
76	Bird/nature watching	1095

Unique ID	Terrestrial Activity	Total (h y^{-1})
207	Bowling (outdoors)	97.5
223	Bowling (outdoors)	104
279	Bowling (outdoors)	234
78	Collecting wild produce	2.00
157	Collecting wild produce	6.00
434	Collecting wild produce	6.00
278	Collecting wild produce	2.00
297	Collecting wild produce	4.00
15	Collecting wild produce	1.50
7	Collecting wild produce	3.00
6	Collecting wild produce	2.00
279	Collecting wild produce	2.00
19	Collecting wild produce	1.50
8	Collecting wild produce	5.00
156	Collecting wild produce	24.0
311	Collecting wild produce	3.00
129	Collecting wild produce	2.50
129	Collecting wild produce	2.50
239	Collecting wild produce	4.00
79	Collecting wild produce	36.0
111	Collecting wild produce	117
147	Collecting wild produce	44.0
155	Collecting wild produce	274
295	Collecting wild produce	2.50
76	Croquet	104
79	Croquet	104
78	Croquet	52.0
73	Cycling	2.00
4	Cycling	120
52	Cycling	26.0
85	Cycling	100
57	Cycling	26.0
121	Cycling	52.0
156	Cycling	156
176	Cycling	13.0
176	Cycling	13.0
176	Cycling	13.0
176	Cycling	13.0
85	Cycling	100
79	Cycling	104

Unique ID	Terrestrial Activity	Total (h y^{-1})
212	Cycling	6.00
222	Cycling	104
176	Cycling	13.0
102	Cycling	4.00
319	Cycling	13.0
280	Cycling	34.3
280	Cycling	17.7
280	Cycling	34.3
280	Cycling	17.7
116	Cycling	18.0
23	Cycling	0.50
117	Cycling	4.00
167	Cycling	4.00
152	Cycling	26.0
8	Cycling	208
287	Cycling	0.50
279	Cycling	58.5
265	Cycling	6.00
212	Cycling	6.00
78	Cycling	12.0
219	Cycling	26.0
219	Cycling	26.0
219	Cycling	26.0
219	Cycling	26.0
219	Cycling	26.0
265	Cycling	6.00
265	Cycling	6.00
212	Cycling	6.00
212	Cycling	6.00
265	Cycling	6.00
231	Dog walking	78.0
227	Dog walking	300
111	Dog walking	365
279	Dog walking	183
233	Dog walking	300
80	Dog walking	26.0
78	Dog walking	730
222	Dog walking	260
96	Dog walking	208
226	Dog walking	274

Unique ID	Terrestrial Activity	Total (h y^{-1})
6	Dog walking	104
295	Dog walking	416
70	Dog walking	26.0
15	Dog walking	274
275	Dog walking	365
214	Dog walking	0.99
278	Dog walking	183
214	Dog walking	0.99
108	Dog walking	6.00
109	Dog walking	6.00
22	Dog walking	208
22	Dog walking	208
285	Dog walking	365
434	Dog walking	548
214	Dog walking	0.99
270	Dog walking	183
256	Dog walking	52.0
270	Dog walking	78.0
271	Dog walking	183
197	Dog walking	52.0
312	Dog walking	365
271	Dog walking	78.0
273	Dog walking	730
204	Dog walking	241
26	Dog walking	365
198	Dog walking	26.0
173	Dog walking	26.0
171	Dog walking	6.00
276	Dog walking	26.0
276	Dog walking	365
198	Dog walking	17.2
4	Dog walking	104
198	Dog walking	19.5
171	Dog walking	6.00
198	Dog walking	39.0
275	Dog walking	26.0
19	Dog walking	274
134	Education/Research	32.0
137	Education/Research	32.0
269	Farming	4380

Unique ID	Terrestrial Activity	Total (h y^{-1})
2	Farming	5600
17	Farming	3430
291	Farming	2693
327	Farming	2400
317	Farming	3640
291	Farming	673
24	Farming	2550
140	Gardening	208
78	Gardening	52.0
156	Gardening	260
271	Gardening	274
89	Gardening	72.0
67	Gardening	156
256	Gardening	52.0
111	Gardening	156
22	Gardening	468
226	Gardening	52.0
98	Gardening	78.0
197	Gardening	52.0
270	Gardening	45.6
4	Gardening	730
271	Gardening	45.6
273	Gardening	1095
276	Gardening	156
278	Gardening	274
279	Gardening	274
280	Gardening	144
281	Gardening	144
285	Gardening	8.00
270	Gardening	274
121	Gardening	39.0
176	Gardening	91.3
161	Gardening	208
176	Gardening	26.0
169	Gardening	13.0
79	Gardening	26.0
75	Gardening	65.0
311	Golfing	4.29
147	Horse riding	208
153	Horse riding	208

Unique ID	Terrestrial Activity	Total (h y^{-1})
147	Looking after hens	728
278	Playing	104
278	Playing	156
279	Playing	104
279	Playing	156
268	Playing	1095
7	Rambling/walking	117
87	Rambling/walking	24.0
86	Rambling/walking	24.0
107	Rambling/walking	27.5
287	Rambling/walking	6.00
9	Rambling/walking	3.00
146	Rambling/walking	27.5
11	Rambling/walking	52.0
48	Rambling/walking	26.0
103	Rambling/walking	10.0
46	Rambling/walking	6.00
121	Rambling/walking	104
224	Rambling/walking	18.0
57	Rambling/walking	26.0
154	Rambling/walking	40.0
36	Rambling/walking	12.0
85	Rambling/walking	188
33	Rambling/walking	78.0
324	Rambling/walking	9.00
328	Rambling/walking	78.0
85	Rambling/walking	188
89	Rambling/walking	365
217	Rambling/walking	120
331	Rambling/walking	2.00
23	Rambling/walking	6.00
44	Rambling/walking	6.00
79	Rambling/walking	78.0
235	Rambling/walking	3.00
251	Rambling/walking	6.00
177	Rambling/walking	6.00
95	Rambling/walking	26.0
95	Rambling/walking	26.0
91	Rambling/walking	0.30
192	Rambling/walking	4.50

Unique ID	Terrestrial Activity	Total (h y^{-1})
152	Rambling/walking	520
192	Rambling/walking	4.50
79	Rambling/walking	312
187	Rambling/walking	72.0
75	Rambling/walking	365
72	Rambling/walking	5.20
209	Rambling/walking	13.0
72	Rambling/walking	5.20
235	Rambling/walking	3.00
91	Rambling/walking	0.30
91	Rambling/walking	0.30
209	Rambling/walking	13.0
209	Rambling/walking	13.0
209	Rambling/walking	13.0
209	Rambling/walking	13.0
267	Rambling/walking	2.00
210	Rambling/walking	2.00
252	Rambling/walking	6.00
266	Rambling/walking	7.00
71	Rambling/walking	548
211	Rambling/walking	7.00
256	Rambling/walking	1.44
256	Rambling/walking	1.44
256	Rambling/walking	1.44
197	Rambling/walking	1.44
197	Rambling/walking	1.44
197	Rambling/walking	1.44
91	Rambling/walking	0.30
129	Rambling/walking	1095
196	Rambling/walking	18.0
234	Rambling/walking	3.00
155	Rambling/walking	1095
72	Rambling/walking	5.20
78	Rambling/walking	104
200	Rambling/walking	18.0
156	Rambling/walking	312
196	Rambling/walking	18.0
280	Rambling/walking	274
135	Rambling/walking	0.75
280	Rambling/walking	45.6

Unique ID	Terrestrial Activity	Total (h y^{-1})
128	Rambling/walking	0.75
117	Rambling/walking	4.00
167	Rambling/walking	4.00
272	Rambling/walking	68.6
205	Rambling/walking	4.50
224	Rambling/walking	18.0
224	Rambling/walking	4.50
205	Rambling/walking	4.50
200	Rambling/walking	18.0
205	Rambling/walking	18.0
224	Rambling/walking	4.50
268	Rambling/walking	51.5
269	Rambling/walking	51.5
230	Rambling/walking	12.0
230	Rambling/walking	12.0
221	Rambling/walking	52.0
234	Rambling/walking	3.00
221	Rambling/walking	52.0
205	Rambling/walking	18.0
212	Roller hockey	52.0
265	Running	183
265	Running	183
265	Running	183
265	Running	183
265	Running	183
312	Shooting	208
312	Shooting	208
18	Shooting	30.0
271	Sitting/picnicking	156
270	Sitting/picnicking	156
79	Sitting/picnicking	312
266	Sitting/picnicking	1.00
211	Sitting/picnicking	1.00
232	Sitting/picnicking	52.0
171	Sitting/picnicking	2.00
76	Sitting/picnicking	52.0
228	Sitting/picnicking	52.0
226	Sitting/picnicking	1.50
78	Sitting/picnicking	52.0
157	Sitting/picnicking	104

Unique ID	Terrestrial Activity	Total (h y^{-1})
156	Sitting/picnicking	156
135	Sitting/picnicking	1.00
128	Sitting/picnicking	1.00
171	Sitting/picnicking	2.00
78	Willow weaving	60.0
156	Willow weaving	60.0

Table A8.9 Phase One Adult In Water Activities

Unique ID	In Water Activity	Total (h y^{-1})
318	Capsize when racing	2.00
154	Coasteering	4.50
154	Coasteering	4.50
192	Diving	0.25
109	Outdoor swimming	6.24
84	Outdoor swimming	2.00
168	Outdoor swimming	1.00
316	Outdoor swimming	0.50
34	Outdoor swimming	0.50
165	Outdoor swimming	0.50
279	Outdoor swimming	0.25
288	RNLI duties	12.0
287	RNLI duties	2.50
290	RNLI duties	1.00
212	Stand-up paddle boarding	13.0
265	Stand-up paddle boarding	13.0
265	Stand-up paddle boarding	13.0
212	Stand-up paddle boarding	13.0
265	Stand-up paddle boarding	13.0
212	Stand-up paddle boarding	13.0
100	Sub-aqua diving	78.0
72	Sub-aqua diving	78.0
72	Sub-aqua diving	78.0
101	Sub-aqua diving	7.50
197	Sub-aqua diving	1.80
197	Sub-aqua diving	1.80
197	Sub-aqua diving	1.80
256	Sub-aqua diving	1.80
256	Sub-aqua diving	1.80
256	Sub-aqua diving	1.80

Table A8.10 Phase One Adult On Water Activities

Unique ID	On Water Activity	Total (h y^{-1})
101	Being on a dive boat	35.0
100	Being on a dive boat	364
72	Being on a dive boat	52.0
72	Being on a dive boat	52.0
230	Boat maintenance	100
86	Boat maintenance	84.0
45	Boat maintenance	100
45	Boat maintenance	5.00
161	Boat maintenance	104
333	Boat maintenance	160
151	Boat maintenance	12.0
226	Boat maintenance	26.0
8	Boat maintenance	120
320	Boat maintenance	26.0
313	Boat maintenance	25.0
311	Boat maintenance	30.0
318	Boat maintenance	105
218	Canoeing	62.4
218	Canoeing	62.4
56	Canoeing	12.0
98	Canoeing	3.00
218	Canoeing	62.4
78	Canoeing	4.00
231	Canoeing	78.0
222	Canoeing	78.0
333	Commercial fishing/creeling	312
254	Commercial fishing/creeling	1040
254	Commercial fishing/creeling	1690
320	Commercial fishing/creeling	624
332	Commercial fishing/creeling	624
76	Commute via boat	9.00
79	Commute via boat	9.00
157	Commute via boat	104
154	Commute via boat	2.50
161	Commute via boat	62.4
192	Commute via boat	4.00
204	Creel fishing/Handling	7.50
129	Dinghy sailing	12.0

Unique ID	On Water Activity	Total (h y^{-1})
16	Freshwater angling	24.0
152	kayaking	3.00
154	kayaking	468
48	kayaking	208
148	kayaking	3.00
175	kayaking	195
175	kayaking	15.0
247	kayaking	195
247	kayaking	15.0
197	kayaking	104
256	kayaking	104
295	kayaking	6.00
48	kayaking	200
154	Power boating	234
318	Power boating	416
226	Power boating	48.0
288	RNLI duties	156
290	RNLI duties	192
294	RNLI duties	52.0
287	RNLI duties	2.50
4	Rowing	52.0
150	Rowing	234
154	Safety boat duties	72.0
52	Safety boat duties	5.00
162	Sailing	26.0
129	Sailing	96.0
162	Sailing	26.0
154	Sailing	234
164	Sailing	30.0
168	Sailing	12.0
168	Sailing	12.0
175	Sailing	24.0
313	Sailing	80.0
318	Sailing	48.0
52	Sailing	65.0
312	Sailing	156
8	Sailing	1248
121	Sailing	52.0
308	Sailing	48.0
247	Sailing	24.0

Unique ID	On Water Activity	Total (h y^{-1})
151	Sailing	140
164	Sailing	30.0
68	Sailing	234
161	Sailing	20.0
60	Sailing	234
47	Sailing	36.0
68	Sailing	234
60	Sailing	234
61	Sailing	234
86	Sailing	128
61	Sailing	234
226	Sailing	52.0
46	Sailing	24.0
44	Sailing	24.0
230	Sailing	260.
79	Sailing	5.00
45	Sailing	36.0
318	Sailing race	70.
55	Sea angling	6.00
204	Sea angling	97.5
48	Sea angling	11.0
197	Sea angling	12.0
320	Sea angling	36.0
332	Sea angling	36.0
333	Sea angling	24.0
48	Sea angling	11.0
48	Sea angling	11.0
42	SIB boating	78.0
43	SIB boating	78.0
295	Stand-up paddle boarding	34.8
295	Stand-up paddle boarding	34.8
295	Stand-up paddle boarding	34.8
311	Working on a boat	300
312	Working on a boat	300

Table A8.11 Phase One Adult Intertidal Activities

Unique ID	Intertidal Activity	Total (h y^{-1})
208	Bait digging	6.00
208	Bait digging	6.00
264	Bait digging	6.00
264	Bait digging	6.00
3	BBQ/Picnicking/Sitting	4.00
9	BBQ/Picnicking/Sitting	4.00
64	BBQ/Picnicking/Sitting	2.00
108	BBQ/Picnicking/Sitting	72.0
109	BBQ/Picnicking/Sitting	72.0
172	BBQ/Picnicking/Sitting	2.00
192	BBQ/Picnicking/Sitting	4.00
197	BBQ/Picnicking/Sitting	2.00
246	BBQ/Picnicking/Sitting	2.00
256	BBQ/Picnicking/Sitting	2.00
31	Beach Clean	2.00
140	Beach Clean	6.00
329	Beach Clean	2.00
197	Beach football	1.50
256	Beach football	1.50
69	Beachcombing	91.3
69	Beachcombing	91.3
76	Beachcombing	48.0
78	Beachcombing	365
94	Beachcombing	0.20
94	Beachcombing	0.20
94	Beachcombing	0.20
96	Beachcombing	41.6
108	Beachcombing	156
109	Beachcombing	156
154	Beachcombing	52.0
161	Beachcombing	78.0
226	Beachcombing	3.00
250	Beachcombing	0.20
250	Beachcombing	0.20
250	Beachcombing	0.20
209	Bird/Nature watching	13.0
162	Boat maintenance	8.00
208	Collecting mussels	12.0

Unique ID	Intertidal Activity	Total (h y^{-1})
319	Collecting oysters	18.0
318	Collecting razor clams	51.0
319	Collecting razor clams	24.0
147	Collecting Sea coal	5.25
147	Collecting Sea coal	5.25
4	Collecting seaweed	208
13	Collecting seaweed	2.04
14	Collecting seaweed	2.04
78	Collecting seaweed	2.00
138	Collecting seaweed	4.00
139	Collecting seaweed	4.00
319	Collecting whelks	18.00
208	Collecting winkles	12.0
4	Dog walking	730
6	Dog walking	365
8	Dog walking	894
15	Dog walking	117
19	Dog walking	117
20	Dog walking	0.50
22	Dog walking	312
31	Dog walking	78.0
31	Dog walking	104
34	Dog walking	9.00
36	Dog walking	183
37	Dog walking	120
37	Dog walking	365
38	Dog walking	350
39	Dog walking	91.3
41	Dog walking	91.3
51	Dog walking	18.0
55	Dog walking	730
56	Dog walking	365
60	Dog walking	52.0
60	Dog walking	52.0
64	Dog walking	274
64	Dog walking	274
68	Dog walking	52.0
68	Dog walking	52.0
70	Dog walking	208
78	Dog walking	91.3

Unique ID	Intertidal Activity	Total (h y^{-1})
80	Dog walking	365
80	Dog walking	26.0
82	Dog walking	183
84	Dog walking	18.0
88	Dog walking	26.0
88	Dog walking	130
92	Dog walking	365
96	Dog walking	41.6
97	Dog walking	400
99	Dog walking	821
106	Dog walking	400
107	Dog walking	3.30
108	Dog walking	156
109	Dog walking	156
114	Dog walking	1.00
115	Dog walking	12.0
119	Dog walking	730
120	Dog walking	31.0
123	Dog walking	365
124	Dog walking	456
124	Dog walking	365
125	Dog walking	241
126	Dog walking	52.0
126	Dog walking	52.0
127	Dog walking	156
127	Dog walking	208
130	Dog walking	183
131	Dog walking	365
131	Dog walking	3.00
144	Dog walking	1.00
145	Dog walking	365
145	Dog walking	183
146	Dog walking	3.30
147	Dog walking	6.00
163	Dog walking	120
165	Dog walking	183
168	Dog walking	183
173	Dog walking	26.0
173	Dog walking	78.0
173	Dog walking	26.0

Unique ID	Intertidal Activity	Total (h y^{-1})
173	Dog walking	130
173	Dog walking	480
173	Dog walking	52.0
174	Dog walking	274
177	Dog walking	20.8
177	Dog walking	20.8
177	Dog walking	20.8
179	Dog walking	475
180	Dog walking	1095
182	Dog walking	183
183	Dog walking	548
183	Dog walking	548
184	Dog walking	0.50
186	Dog walking	548
188	Dog walking	38.2
188	Dog walking	152
1889	Dog walking	48.0
190	Dog walking	52.0
191	Dog walking	1278
194	Dog walking	2.00
195	Dog walking	365
196	Dog walking	42.0
197	Dog walking	365
198	Dog walking	274
199	Dog walking	104
200	Dog walking	42.0
201	Dog walking	274
214	Dog walking	0.80
214	Dog walking	8.80
214	Dog walking	0.80
214	Dog walking	0.80
214	Dog walking	8.80
214	Dog walking	0.80
219	Dog walking	104
226	Dog walking	274
227	Dog walking	468
233	Dog walking	468
242	Dog walking	144
251	Dog walking	10.4
251	Dog walking	10.4

Unique ID	Intertidal Activity	Total (h y^{-1})
251	Dog walking	10.4
253	Dog walking	43.8
253	Dog walking	43.8
256	Dog walking	365
270	Dog walking	78.0
271	Dog walking	78.0
275	Dog walking	26.0
276	Dog walking	26.0
278	Dog walking	13.0
279	Dog walking	13.0
285	Dog walking	3.00
295	Dog walking	208
300	Dog walking	252
303	Dog walking	6.00
309	Dog walking	6.00
315	Dog walking	312
316	Dog walking	9.00
320	Dog walking	274
324	Dog walking	390
325	Dog walking	548
326	Dog walking	104
329	Dog walking	78.0
329	Dog walking	104
330	Dog walking	730
10	Fishing	1040
51	Fishing	20.0
53	Fishing	4.00
54	Fishing	36.0
54	Fishing	36.0
74	Fishing	6.00
76	Fishing	24.0
81	Fishing	104
86	Fishing	30.0
93	Fishing	1.00
104	Fishing	24.0
105	Fishing	8.00
107	Fishing	1.50
110	Fishing	1.00
116	Fishing	195
116	Fishing	234

Unique ID	Intertidal Activity	Total (h y^{-1})
116	Fishing	195
116	Fishing	234
146	Fishing	1.50
160	Fishing	0.25
178	Fishing	208
178	Fishing	208
178	Fishing	208
181	Fishing	208
181	Fishing	208
187	Fishing	48.0
187	Fishing	48.0
202	Fishing	60.0
203	Fishing	26.0
206	Fishing	39.0
208	Fishing	96.0
208	Fishing	96.0
213	Fishing	36.0
220	Fishing	12.0
225	Fishing	5.00
225	Fishing	5.00
225	Fishing	5.00
225	Fishing	5.00
229	Fishing	390
229	Fishing	10.0
232	Fishing	3.00
232	Fishing	3.00
236	Fishing	293
236	Fishing	293
264	Fishing	96.0
286	Fishing	36.0
286	Fishing	36.0
302	Fishing	1248
307	Fishing	416
161	Fixing moorings	117
277	Horse riding	12.0
197	Kite flying	2.0
201	Kite flying	104
256	Kite flying	2.00
301	Looking for razor clams	9.00
306	Looking for razor clams	9.00

Unique ID	Intertidal Activity	Total (h y^{-1})
34	Paddling	1.25
54	Paddling	2.50
54	Paddling	2.50
65	Paddling	6.50
69	Paddling	1.80
78	Paddling	4.00
84	Paddling	1.50
158	Paddling	0.50
158	Paddling	0.50
177	Paddling	1.50
177	Paddling	1.50
200	Paddling	6.00
215	Paddling	6.50
216	Paddling	6.50
243	Paddling	0.50
243	Paddling	0.50
251	Paddling	1.50
251	Paddling	1.50
278	Paddling	0.75
279	Paddling	0.75
286	Paddling	2.50
286	Paddling	2.50
316	Paddling	1.25
34	Playing	12.0
54	Playing	2.50
54	Playing	2.50
63	Playing	13.0
65	Playing	19.5
65	Playing	3.00
79	Playing	8.00
83	Playing	13.0
93	Playing	3.00
102	Playing	1.00
110	Playing	3.00
112	Playing	26.0
113	Playing	4.50
115	Playing	104
118	Playing	26.0
142	Playing	104
143	Playing	4.50

Unique ID	Intertidal Activity	Total (h y^{-1})
158	Playing	2.00
158	Playing	2.00
166	Playing	36.0
172	Playing	6.00
185	Playing	36.0
193	Playing	2.00
194	Playing	156
215	Playing	19.5
215	Playing	3.00
216	Playing	19.5
216	Playing	3.00
243	Playing	2.00
243	Playing	2.00
246	Playing	6.00
278	Playing	3.00
279	Playing	3.00
286	Playing	2.50
286	Playing	2.50
299	Playing	12.0
304	Playing	12.0
316	Playing	12.0
329	Playing	26.0
311	Research/education	351
312	Research/education	351
15	Rock pooling	6.00
19	Rock pooling	6.00
79	Rock pooling	1.00
93	Rock pooling	2.00
110	Rock pooling	2.00
52	Slipway cleaning	24.0
21	Walking	91.3
21	Walking	91.3
33	Walking	3.25
44	Walking	52.0
44	Walking	13.0
46	Walking	13.0
46	Walking	52.0
59	Walking	43.8
66	Walking	43.8
67	Walking	234

Unique ID	Intertidal Activity	Total (h y^{-1})
69	Walking	91.3
69	Walking	91.3
71	Walking	3.00
72	Walking	5.20
75	Walking	3.00
91	Walking	0.30
91	Walking	0.30
91	Walking	0.30
91	Walking	0.30
94	Walking	0.20
94	Walking	0.20
94	Walking	0.20
95	Walking	26.0
95	Walking	26.0
115	Walking	104
117	Walking	0.33
121	Walking	26.0
121	Walking	26.0
121	Walking	26.0
121	Walking	26.0
126	Walking	312
129	Walking	182
129	Walking	182
129	Walking	182
129	Walking	182
133	Walking	0.50
133	Walking	7.50
133	Walking	2.50
136	Walking	2.50
136	Walking	0.50
140	Walking	24.0
141	Walking	7.50
152	Walking	156
157	Walking	104
159	Walking	2.00
167	Walking	0.33
169	Walking	13.00
170	Walking	1.50
192	Walking	13.0
197	Walking	3.00

Unique ID	Intertidal Activity	Total (h y^{-1})
197	Walking	3.00
205	Walking	9.00
209	Walking	13.0
210	Walking	4.00
210	Walking	4.00
211	Walking	2.00
217	Walking	120
221	Walking	48.0
224	Walking	9.00
230	Walking	48.0
232	Walking	1.00
241	Walking	2.00
244	Walking	10.5
245	Walking	1.50
249	Walking	0.25
249	Walking	0.25
249	Walking	0.25
249	Walking	0.25
250	Walking	0.20
250	Walking	0.20
250	Walking	0.20
255	Walking	10.5
256	Walking	3.00
256	Walking	3.00
266	Walking	2.00
267	Walking	2.00
267	Walking	2.00
284	Walking	2.00
325	Walking	104
328	Walking	3.25
331	Walking	260
335	Walking	104
336	Walking	12.0
337	Walking	12.0
16	Wildfowling	30.0
58	Working on an oyster farm	234
58	Working on an oyster farm	624

Table A8.13 Phase One Children Terrestrial Activities

Unique ID	Terrestrial Activity	Total (h y^{-1})
393	Bee keeping	6.50
394	Bee keeping	6.50
396	Cycling	26.0
359	Cycling	0.50
369	Cycling	4.00
393	Cycling	17.2
394	Cycling	17.2
395	Cycling	17.2
358	Cycling	0.50
375	Dog walking	6.00
374	Dog walking	6.00
376	Dog walking	6.00
365	Dog walking	52.0
366	Dog walking	52.0
401	Playing	104
401	Playing	156
402	Playing	104
402	Playing	156
359	Rambling/walking	6.00
358	Rambling/walking	6.00
397	Sitting/picnicking	1.50
402	Collecting wild produce	2.00
401	Collecting wild produce	2.00

Table A8.14 Phase One Children In Water Activities

Unique ID	In Water Activity	Total (h y^{-1})
374	Outdoor swimming	6.24
392	Outdoor swimming	2.00
391	Outdoor swimming	2.00
362	Outdoor swimming	0.50
361	Outdoor swimming	0.50

Table A8.15 Phase One Children On Water Activities

Unique ID	On Water Activity	Total (h y^{-1})
367	Canoeing	3.00
395	Canoeing	1.30
394	Canoeing	1.30

Unique ID	On Water Activity	Total (h y^{-1})
393	Canoeing	1.30
368	Canoeing	1.00
364	kayaking	468
399	kayaking	13.0
398	kayaking	13.0
385	kayaking	3.00
384	kayaking	3.00
383	kayaking	3.00
382	kayaking	3.00
364	Sailing	144
359	Sailing	78.0
358	Sailing	78.0

Table A8.16 Phase One Children Intertidal Activities

Unique ID	Intertidal Activity	Total (h y^{-1})
399	BBQ/Picnicking/Sitting	2.00
354	BBQ/Picnicking/Sitting	4.00
354	BBQ/Picnicking/Sitting	4.00
398	BBQ/Picnicking/Sitting	2.00
375	BBQ/Picnicking/Sitting	72.0
374	BBQ/Picnicking/Sitting	72.0
376	BBQ/Picnicking/Sitting	72.0
398	Beach football	1.50
399	Beach football	1.50
374	Beachcombing	156
375	Beachcombing	156
376	Beachcombing	156
366	Beachcombing	5.20
365	Beachcombing	5.20
376	Dog walking	156
411	Dog walking	6.00
410	Dog walking	6.00
375	Dog walking	156
366	Dog walking	5.20
374	Dog walking	156
366	Dog walking	5.20
362	Dog walking	9.00
386	Dog walking	3.30
381	Dog walking	3.30

Unique ID	Intertidal Activity	Total (h y^{-1})
361	Dog walking	9.00
356	Fishing	36.0
357	Fishing	36.0
371	Fishing	8.00
409	Fishing	416
356	Fishing	36.0
372	Fishing	8.00
357	Fishing	36.0
370	Fishing	8.00
386	Fishing	1.50
381	Fishing	1.50
373	Fishing	8.00
399	Kite flying	2.00
398	Kite flying	2.00
356	Paddling	2.50
362	Paddling	1.25
356	Paddling	2.50
361	Paddling	1.25
366	Paddling	0.40
391	Paddling	0.75
392	Paddling	0.75
402	Paddling	0.75
365	Paddling	0.40
357	Paddling	2.50
376	Paddling	156
401	Paddling	0.75
390	Paddling	6.50
374	Paddling	39.0
375	Paddling	156
357	Paddling	2.50
396	Playing	12.0
369	Playing	1.00
357	Playing	2.50
356	Playing	2.50
356	Playing	2.50
400	Playing	10.5
362	Playing	12.0
361	Playing	12.0
357	Playing	2.50
397	Playing	12.0

Unique ID	Intertidal Activity	Total (h y^{-1})
402	Playing	3.00
401	Playing	3.00
368	Playing	0.90
367	Playing	0.90
376	Playing	156
374	Playing	156
375	Playing	156
392	Playing	0.75
391	Playing	0.75
377	Playing	104
390	Playing	19.5
382	Playing	6.00
389	Playing	104
380	Playing	4.50
394	Playing	4.50
378	Playing	36.0
388	Playing	26.0
387	Playing	26.0
385	Playing	52.0
384	Playing	52.0
383	Playing	6.00
390	Playing	3.00
405	Walking	2.00
377	Walking	104
404	Walking	2.00

Table A8.17 Phase 1 Infant Terrestrial Activities

Unique ID	Terrestrial Activity	Total (h y^{-1})
417	Cycling	4.00
428	Playing	1095
427	Playing	1095
428	Rambling/walking	51.5
427	Rambling/walking	51.5

Table A8.18 Phase One Infant Intertidal Activities

Unique ID	Intertidal Activity	Total (h y^{-1})
426	BBQ/Picnicking/Sitting	2.00
423	Dog walking	104

Unique ID	Intertidal Activity	Total (h y^{-1})
418	Fishing	1.00
432	Looking for razor clams	9.00
432	Looking for razor clams	9.00
424	Paddling	0.50
424	Paddling	0.50
425	Paddling	0.50
425	Paddling	0.50
422	Playing	156
419	Playing	104
421	Playing	104
420	Playing	26.0
414	Playing	13.0
415	Playing	13.0
431	Playing	12.0
429	Playing	10.5
412	Playing	6.00
413	Playing	6.00
416	Playing	6.00
426	Playing	6.00
418	Playing	3.00
424	Playing	2.00
424	Playing	2.00
425	Playing	2.00
425	Playing	2.00
417	Playing	1.00
418	Rock pooling	2.00
419	Walking	104
412	Walking	6.00
413	Walking	6.00
430	Walking	2.00

Table A8.19 Phase 1 Adult Handling Sediment Activities

Unique ID	Intertidal Activities	Total (h y^{-1})
264	Bait digging	12.0
208	Bait digging	12.0
192	BBQ/Picnicking/Sitting	4.00
3	BBQ/Picnicking/Sitting	4.00
256	BBQ/Picnicking/Sitting	2.00
108	BBQ/Picnicking/Sitting	72.0

Unique ID	Intertidal Activities	Total (h y^{-1})
246	BBQ/Picnicking/Sitting	2.00
109	BBQ/Picnicking/Sitting	72.0
64	BBQ/Picnicking/Sitting	2.00
197	BBQ/Picnicking/Sitting	2.00
9	BBQ/Picnicking/Sitting	4.00
172	BBQ/Picnicking/Sitting	2.00
31	Beach Clean	2.00
140	Beach Clean	6.00
329	Beach Clean	2.00
250	Beachcombing	0.60
161	Beachcombing	78.0
226	Beachcombing	3.00
108	Beachcombing	156
155	Beachcombing	52.0
96	Beachcombing	41.6
94	Beachcombing	0.60
78	Beachcombing	365
76	Beachcombing	48.0
69	Beachcombing	183
109	Beachcombing	156
208	Collecting mussels	12.0
319	Collecting oysters	18.0
318	Collecting razor clams	51.0
319	Collecting razor clams	24.0
147	Collecting Sea coal	10.5
13	Collecting seaweed	2.04
139	Collecting seaweed	4.00
138	Collecting seaweed	4.00
14	Collecting seaweed	2.04
4	Collecting seaweed	208
78	Collecting seaweed	2.00
319	Collecting whelks	18.0
208	Collecting winkles	12.0
301	Looking for razor clams	9.00
306	Looking for razor clams	9.00
84	Paddling	1.50
78	Paddling	4.00
278	Paddling	0.75
286	Paddling	5.00
69	Paddling	1.80

Unique ID	Intertidal Activities	Total (h y^{-1})
158	Paddling	1.00
279	Paddling	0.75
65	Paddling	6.50
177	Paddling	3.00
215	Paddling	6.50
216	Paddling	6.50
200	Paddling	6.00
243	Paddling	1.00
316	Paddling	1.25
34	Paddling	1.25
54	Paddling	5.00
251	Paddling	3.00
34	Playing	12.0
63	Playing	13.0
79	Playing	8.00
83	Playing	13.0
65	Playing	22.5
54	Playing	5.00
93	Playing	3.00
304	Playing	12.0
286	Playing	5.00
316	Playing	12.0
143	Playing	4.50
216	Playing	22.5
194	Playing	156
193	Playing	2.00
243	Playing	4.00
185	Playing	36.0
172	Playing	6.00
246	Playing	6.00
166	Playing	36.0
158	Playing	4.00
102	Playing	1.00
278	Playing	3.00
299	Playing	12.0
118	Playing	26.0
115	Playing	104
113	Playing	4.50
112	Playing	26.0
142	Playing	104

Unique ID	Intertidal Activities	Total (h y^{-1})
215	Playing	22.5
329	Playing	26.0
279	Playing	3.00
110	Playing	3.00
312	Research/education	351
311	Research/education	351
110	Rock pooling	2.00
93	Rock pooling	2.00
15	Rock pooling	6.00
78	Rock pooling	1.00
19	Rock pooling	6.00
16	Wildfowling	30.0
58	Working on an oyster farm	858

Table A8.20 Adult Handling Equipment Activities

Unique ID	Handling Activities	Total (h y^{-1})
72	Being on a dive boat	104
100	Being on a dive boat	364
101	Being on a dive boat	35.0
230	Boat maintenance	100
162	Boat maintenance	8.00
311	Boat maintenance	30.0
313	Boat maintenance	25.0
45	Boat maintenance	105
318	Boat maintenance	105
8	Boat maintenance	120
226	Boat maintenance	26.0
320	Boat maintenance	26.0
86	Boat maintenance	84.0
151	Boat maintenance	12.0
333	Boat maintenance	160
161	Boat maintenance	104
175	Boats and boating equipment	141
265	Boats and boating equipment	3.25
256	Boats and boating equipment	6.24
254	Boats and boating equipment	300
247	Boats and boating equipment	75.5
48	Boats and boating equipment	0.13
204	Boats and boating equipment	56.0

Unique ID	Handling Activities	Total (h y^{-1})
46	Boats and boating equipment	0.50
52	Boats and boating equipment	52.0
212	Boats and boating equipment	3.25
197	Boats and boating equipment	6.24
162	Boats and boating equipment	40.0
312	Boats and boating equipment	7.00
72	Boats and boating equipment	26.0
318	Boats and boating equipment	130
308	Boats and boating equipment	6.00
161	Boats and boating equipment	104
298	Boats and boating equipment	2.50
44	Boats and boating equipment	0.50
287	Boats and boating equipment	15.0
231	Canoeing	78.0
98	Canoeing	3.00
222	Canoeing	78.0
218	Canoeing	187
56	Canoeing	12.0
78	Canoeing	4.00
52	Clothes and overalls	0.50
169	Clothes and overalls	1.00
197	Clothes and overalls	13.0
161	Clothes and overalls	0.25
61	Clothes and overalls	35.1
181	Clothes and overalls	6.24
68	Clothes and overalls	35.1
175	Clothes and overalls	13.0
60	Clothes and overalls	35.1
287	Clothes and overalls	7.50
318	Clothes and overalls	20.0
313	Clothes and overalls	1.00
312	Clothes and overalls	12.5
311	Clothes and overalls	12.5
308	Clothes and overalls	1.00
298	Clothes and overalls	1.25
222	Clothes and overalls	1.00
256	Clothes and overalls	13.0
247	Clothes and overalls	10.5
236	Clothes and overalls	0.66
230	Clothes and overalls	3.90

Unique ID	Handling Activities	Total (h y^{-1})
48	Clothes and overalls	0.13
154	Coasteering	9.00
333	Commercial fishing/creeling	312
332	Commercial fishing/creeling	624
320	Commercial fishing/creeling	624
254	Commercial fishing/creeling	2730
204	Creel fishing/Handling	7.50
129	Dinghy sailing	12.0
256	Diving gear	3.00
72	Diving gear	12.5
197	Diving gear	3.00
225	Fishing	20.0
146	Fishing	1.50
74	Fishing	6.00
116	Fishing	858
110	Fishing	1.00
105	Fishing	8.00
104	Fishing	24.0
10	Fishing	1040
93	Fishing	1.00
86	Fishing	30.0
76	Fishing	24.0
81	Fishing	104
107	Fishing	1.50
53	Fishing	4.00
54	Fishing	72.0
203	Fishing	26.0
202	Fishing	60.0
232	Fishing	6.00
236	Fishing	585
206	Fishing	39.0
160	Fishing	0.25
181	Fishing	416
286	Fishing	72.0
178	Fishing	624
264	Fishing	96.0
208	Fishing	192
229	Fishing	400
220	Fishing	12.0
302	Fishing	1248

Unique ID	Handling Activities	Total (h y^{-1})
307	Fishing	416
213	Fishing	36.0
51	Fishing	20.0
187	Fishing	96.0
53	Fishing gear	0.25
54	Fishing gear	1.00
206	Fishing gear	1.63
289	Fishing gear	1.00
236	Fishing gear	176
225	Fishing gear	3.33
220	Fishing gear	0.25
213	Fishing gear	0.75
81	Fishing gear	13.0
203	Fishing gear	9.75
116	Fishing gear	39.0
181	Fishing gear	15.6
178	Fishing gear	15.6
197	Fishing gear	0.90
161	Fixing moorings	117
16	Freshwater angling	24.0
154	Power boating	234
318	Power boating	416
226	Power boating	48.0
150	Rowing	234
4	Rowing	52.0
197	Sea angling	12.0
204	Sea angling	97.5
333	Sea angling	24.0
55	Sea angling	6.00
320	Sea angling	36.0
332	Sea angling	36.0
48	Sea angling	33.0
295	Stand-up paddle boarding	105

Table A8.21 Phase 1 Children Handling Sediment Activities

Unique ID	Handling Activities	Total (h y^{-1})
374	BBQ/Picnicking/Sitting	72.0
354	BBQ/Picnicking/Sitting	8.00
376	BBQ/Picnicking/Sitting	72.0

Unique ID	Handling Activities	Total (h y^{-1})
375	BBQ/Picnicking/Sitting	72.0
399	BBQ/Picnicking/Sitting	2.00
398	BBQ/Picnicking/Sitting	2.00
375	Beachcombing	156
374	Beachcombing	156
366	Beachcombing	5.20
376	Beachcombing	156
365	Beachcombing	5.20
365	Paddling	0.40
376	Paddling	156
374	Paddling	39.0
362	Paddling	1.25
361	Paddling	1.25
375	Paddling	156
357	Paddling	5.00
356	Paddling	5.00
366	Paddling	0.40
402	Paddling	0.75
390	Paddling	6.50
401	Paddling	0.75
392	Paddling	0.75
391	Paddling	0.75
400	Playing	10.5
368	Playing	0.90
367	Playing	0.90
392	Playing	0.75
396	Playing	12.0
376	Playing	156
362	Playing	12.0
361	Playing	12.0
357	Playing	5.00
401	Playing	3.00
356	Playing	5.00
397	Playing	12.0
387	Playing	26.0
382	Playing	6.00
380	Playing	4.50
379	Playing	4.50
378	Playing	36.0
377	Playing	104

Unique ID	Handling Activities	Total (h y^{-1})
402	Playing	3.00
369	Playing	1.00
385	Playing	52.0
391	Playing	0.75
375	Playing	156
388	Playing	26.0
389	Playing	104
374	Playing	156
390	Playing	22.5
383	Playing	6.00
384	Playing	52.0

Table A8.22 Phase One Children Handling Equipment Activities

Unique ID	Handling Activities	Total (h y^{-1})
364	Boats and boating equipment	2.40
399	Boats and boating equipment	1.56
398	Boats and boating equipment	1.56
367	Canoeing	3.00
393	Canoeing	1.30
395	Canoeing	1.30
394	Canoeing	1.30
368	Canoeing	1.00
364	Clothes and overalls	15.7
359	Clothes and overalls	2.00
358	Clothes and overalls	2.00
398	Clothes and overalls	1.56
399	Clothes and overalls	1.56
409	Fishing	416
356	Fishing	72.0
357	Fishing	72.0
372	Fishing	8.00
371	Fishing	8.00
373	Fishing	8.00
370	Fishing	8.00
381	Fishing	1.50
386	Fishing	1.50
357	Fishing gear	1.00
356	Fishing gear	1.00

Table A8.23 Phase One Infants Handling Sediment Activities

Unique ID	Handling Activities	Total (h y^{-1})
426	BBQ/Picnicking/Sitting	2.00
432	Looking for razor clams	9.00
433	Looking for razor clams	9.00
424	Paddling	1.00
425	Paddling	1.00
422	Playing	156
419	Playing	104
421	Playing	104
420	Playing	26.0
415	Playing	13.0
414	Playing	13.0
431	Playing	12.0
429	Playing	10.5
426	Playing	6.00
412	Playing	6.00
416	Playing	6.00
413	Playing	6.00
424	Playing	4.00
425	Playing	4.00
418	Playing	3.00
417	Playing	1.00
418	Rock pooling	2.00

Table A8.24 Phase One Infants Handling Equipment Activities

Unique ID	Handling Activities	Total (h y^{-1})
418	Fishing	1.00

Appendix A9. Phase 2: Raw Data

Table A9.1 Phase Two Adult Mollusc Consumption

Unique ID	Food type	Consumption Rate (kg y^{-1})
532	Mussels	24.0
532	Scallops	4.80

Table A9.2 Phase Two Adult Green Leafy Vegetable Consumption

Unique ID	Vegetable	Consumption Rate (kg y^{-1})
526	Herbs	1.66
526	Asparagus	0.60
526	Celery	3.33
526	Kale	6.66
526	Spinach	3.33
526	Lettuce	3.33
526	Chard	6.66
526	Cauliflower	6.66
526	Calabrese	3.33
526	Cabbage	6.66
526	Brussel sprouts	1.66
526	Broccoli	6.66
526	Pak choi	1.66
527	Broccoli	6.60
527	Cabbage	6.66
527	Asparagus	0.60
527	Brussel sprouts	1.60
527	Pak choi	1.60
527	Kale	6.66
527	Celery	3.33
527	Spinach	3.30
527	Calabrese	3.33
527	Chard	6.66
527	Cauliflower	6.66
527	Lettuce	3.33
527	Herbs	1.60
528	Pak choi	0.50
528	Rhubarb	4.00
528	Kale	3.00
528	Spinach	1.00

Unique ID	Vegetable	Consumption Rate (kg y^{-1})
525	Rhubarb	1.50
525	Kale	2.50
525	Celery	1.50
525	Chard	3.00
525	Spinach	4.00
525	Herbs	1.00
525	Cabbage	2.50
525	Broccoli	14.0
529	Broccoli	2.80
529	Pak choi	25.2
530	Broccoli	1.05

Table A9.3 Phase Two Adult Other Vegetable Consumption

Unique ID	Vegetable	Consumption Rate (kg y^{-1})
526	French bean	3.33
526	Pea	1.60
526	Runner Bean	3.30
526	Broad bean	3.33
527	French bean	3.30
527	Broad bean	3.30
527	Pea	1.60
527	Runner Bean	3.33
528	Broad bean	1.00
528	Pea	1.00
525	Broad bean	10.0
525	Pumpkin	8.00
525	French bean	0.50
529	Runner Bean	18.0
529	Broad bean	15.6
529	Pea	9.99

Table A9.4 Phase Two Adult Root Vegetable Consumption

Unique ID	Vegetable	Consumption Rate (kg y^{-1})
526	Parsnip	1.66
526	Beetroot	6.66
526	Turnip	1.66
526	Swede	1.66
526	Shallot	1.66

Unique ID	Vegetable	Consumption Rate (kg y^{-1})
526	Onion	6.66
526	Leek	16.6
526	Jerusalem artichoke	1.66
526	Garlic	1.66
526	Fennel	1.66
526	Carrot	3.33
526	Spring Onion	1.66
527	Garlic	1.66
527	Jerusalem artichoke	1.66
527	Beetroot	6.66
527	Fennel	1.66
527	Swede	1.66
527	Carrot	3.33
527	Turnip	1.66
527	Leek	16.6
527	Shallot	1.66
527	Spring Onion	1.66
527	Onion	6.66
527	Parsnip	1.66
528	Beetroot	4
528	Spring Onion	0.18
525	Beetroot	15
525	Carrot	0.5
525	Garlic	2.5
525	Leek	0.5
529	Beetroot	7.8
529	Carrot	3
529	Leek	4.76
529	Onion	3.99
	Carrot	4.5
530	Carrot	4.5

Table A9.5 Phase Two Adult Potato Consumption

Unique ID	Vegetable	Consumption Rate (kg y^{-1})
526	Potatoes	16.6
527	Potatoes	16.6
528	Potatoes	1.00
525	Potatoes	50.0
530	Potatoes	13.86

Table A9.5 Phase Two Adult Domestic Fruit Consumption

Unique ID	Fruit	Consumption Rate (kg y^{-1})
526	Courgettes	6.66
526	Cucumber	6.66
526	Marrow	1.6
526	Squash	3.33
526	Tomato	16.6
527	Marrow	1.6
527	Squash	3.33
527	Courgettes	6.66
527	Tomato	6.66
527	Cucumber	1.675
528	Gooseberry	4
528	Cucumber	3
528	Courgettes	5
528	Strawberry	2.7
528	Raspberry	1
525	Blackcurrant	7.5
525	Courgettes	2
525	Strawberry	2.5
525	Gooseberry	2.5
525	Blackberry	2.5
525	Apple	5
525	Squash	15
529	Pepper	4
529	Courgettes	5.76
529	Tomato	24
529	Cucumber	5
530	Squash	1.80
530	Courgettes	2.88
530	Raspberry	5.00
530	Blueberries	0.68
530	Tomato	8.00
530	Blackcurrant	2.25
530	Loganberry	2.70
530	Pepper	3.00
530	Apple	13.5
530	Cucumber	1.25
530	Strawberry	8.10
533	Redcurrant	2.00

Unique ID	Fruit	Consumption Rate (kg y^{-1})
533	Raspberry	2.50

Table A9.6 Phase Two Adult Wild Fungi Consumption

Unique ID	Wild Food	Consumption Rate (kg y^{-1})
525	Mushrooms	1.00

Table A9.7 Phase Two Adult Wild Foods Consumption

Unique ID	Wild Foods	Consumption Rate (kg y^{-1})
533	Blackberry	4.00
530	Blackberry	1.00
528	Blackberry	4.00
525	Blackberry	2.50
525	Elderflower	0.50
528	Sloe	4.00
525	Mushrooms	1.00
525	Wild Garlic	0.50
528	Apple	6.00
525	Apple	25.0

Table A9.8 Phase Two Adult Wild Venison Consumption

Unique ID	Meat	Consumption Rate (kg y^{-1})
525	Wild venison	3.00

Table A9.9 Phase Two Adult Egg Consumption

Unique ID	Other produce	Consumption Rate (kg y^{-1})
528	Eggs	18.1
525	Eggs	6.79
529	Eggs	4.18
530	Eggs	27.1
533	Eggs	0.35

Table A9.9 Phase Two Adult Honey Consumption

Unique ID	Other produce	Consumption Rate (kg y^{-1})
526	Honey	1.35
527	Honey	1.35
525	Honey	8.00
533	Honey	3.00