Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

For the future of our environment

Radiological Habits Survey Hunterston 2024

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Radiological Habits Survey: Hunterston 2024

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List of abbreviations and definitions

AGR	Advanced Gas-Cooled Reactor
BSSD	Basic Safety Standards Directive
DORIS	Dispersion of Radionuclides into the Sea
EASR18	Environmental Authorisations (Scotland) Regulations 2018
EDF	Électricité de France
EIADR	Environmental Impact Assessment for Decommissioning Regulations
ERL	Environmental Radioactivity Laboratory, University of Stirling
EU	European Union
GSR	General Safety Requirements
GRANIS	Gamma Radiation above Nuclides in Soil
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ILB	In-shore Lifeboat
ILWS	Intermediate Level Waste Store
MET	Meteorological
MoGSS	Mobile Gamma Spectrometry System
NDA	Nuclear Decommissioning Authority
NDAWG	National Dose Assessment Working Group
NRS	Nuclear Restoration Services Limited
ONR	Office of Nuclear Regulation
PC-CREAM	Consequences of Releases to the Environment: Assessment Methodology
PLUME	Atmospheric dispersion model used within PC-CREAM
PPE	Personal Protective Clothing

RESUS	Resuspension of activity concentrations into air model used within PC-CREAM
RIFE	Radioactivity in Food and the Environment
RNLI	Royal National Lifeboat Institution
SEPA	Scottish Environment Protection Agency
SSG	Site Stakeholders Group
SIB	Small Inflatable Boat
SILWE	Solid Intermediate Level Waste Encapsulation plant
SSSI	Site of Special Scientific Interest
UK	United Kingdom
UKAS	United Kingdom Accreditation Service
WILWREP	Wet Intermediate Level Waste Retrieval and Encapsulation Plant

Units

Bq	Becquerel	M	Mega (one million, E^{6})
Gy	Gray	m	milli (one thousandth, E^{-3})
[H*(0.07)]	Directional dose equivalent at 0.07 mm skin depth	µ	micro (one millionth, E^{-6})
Sv	Sievert	%	percentage
mSv	milliSieverts	Ha	hectare
µSv	microSieverts	km	kilometre
nGy	nano Gray	m	metres
eV	electron-volt	cm	centimetre
keV	kiloelectron volt	y^{-1}	per year
L	Litres	h^{-1}	per hour

Summary

This report presents the findings of the 2024 Hunterston Habits Survey to determine the habits and consumption patterns of people living and undertaking recreational activities in the vicinity of the Hunterston nuclear site (encompassing two sub sites that run separately – Hunterston A and Hunterston B). Both sites are authorised by the Scottish Environment Protection Agency (SEPA) under Environmental Authorisations (Scotland) Regulations 2018 (EASR18). 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 the three areas that were likely to be affected by discharges from the site, defined as:

- An aquatic survey area; covering 30km stretching from Wemyss Bay to Saltcoats and extending 3km offshore including both Great and Little Cumbrae islands.
- A terrestrial survey area; 5km zone around Hunterston nuclear licensed site. The southern part of Great Cumbrae and Little Cumbrae Islands offshore of Largs, was also included.
- The direct radiation survey area; extending 1km from the site which relates to ionising radiation emanating directly from the site.

During the survey, several potential exposure pathways were investigated through methods including postal and face-to-face surveys and general observations. The survey was conducted in two parts: (i) Phase 1 - the face-to-face survey during the spring and summer of 2024, which was undertaken within and outwith the local school holiday period; and (ii) Phase 2 - a follow up survey during autumn/winter period of 2024.

Data obtained during the survey included the consumption of foods produced within the terrestrial survey area; occupancy of both terrestrial areas and within the direct radiation survey area; consumption of aquatic food from within the aquatic survey

area; occupancy of aquatic and intertidal areas; and the handling of equipment used within the aquatic survey area.

Interviews with members of the public were carried out over a period of 14 days and data for 352 individuals are presented and discussed for the face-to-face Phase 1 survey and a further nine individuals were re-surveyed within Phase 2. 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.

The aquatic survey area

Fish, crustaceans, molluscs and seaweed are all consumed by adults. The mean consumption rates for adult high-rate groups for each of these food groups were:

- 125kg y^{-1} for fish.
- 24kg y^{-1} for crustaceans.
- 52kg y^{-1} for molluscs.
- 0.75kg y^{-1} for seaweed.

Two children were found to consume fish (mackerel and pollock) with a mean high-rate consumption of 6.28kg y^{-1}. No aquatic consumption was determined for infants.

Aquatic activities for adults included jet skiing, outdoor swimming, stand-up paddle boarding, boat maintenance, canoeing, commuting via boat, kayaking, powerboating, Royal National Lifeboat Institution (RNLI) duties, sailing, sea angling, small inflatable boat (SIB) boating and working on a boat.

Intertidal activities for adults included bait digging, sitting/picnicking/BBQ, beachcombing, boat maintenance, collecting mussels, collecting razor clams, collecting seaweed, collecting shells, collecting winkles, crabbing, dog walking, drone flying, fishing, jogging, launching and recovery of dinghies, metal detecting, paddling, playing, preparation and deconstruction of paddle board, research/education, rock pooling, slipway cleaning, sunbathing and walking.

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

- 62.8h y^{-1} for activities in the water.
- 3149h y^{-1} activities on the water.
- 734h y^{-1} handling equipment.
- 369h y^{-1} handling sediment.

A total of 27 in-situ gamma dose rate measurements were made over intertidal surfaces during the survey period. One beta dose rate measurement was made over a boat keel.

The terrestrial survey area

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

- 20.9kg y^{-1} green vegetables.
- 10.5kg y^{-1} other vegetables.
- 18.9kg y^{-1} root vegetables.
- 66kg y^{-1} potatoes.
- 91.1kg y^{-1} domestic fruit.
- 8.16kg y^{-1} wild fruit.
- 1.75kg y^{-1} wild mushrooms.
- 15.6kg y^{-1} meat sheep.
- 24.8kg y^{-1} eggs.
- 6.3kg y^{-1} honey.

Occupancy living/working within 1km of Hunterston

The highest occupancy rates in 2024 within the direct radiation area were as follows (holidays were considered):

- 8396h y^{-1} for the total occupancy rate (for a resident).
- 6570h y^{-1} for the indoor occupancy rate (for a resident).
- 3650h y^{-1} for the outdoor occupancy rate (for a resident).

- 2555h y^{-1} for the working indoors occupancy rate (for a resident).
- 4015h y^{-1} for the working outdoors occupancy rate (for a resident).

Comparisons with previous surveys

The results of the Hunterston 2024 Habits Survey were compared with the last habits survey carried out at Hunterston in 2017.

In the aquatic survey area, the mean consumption rate for the adult high-rate group for fish in the face-to-face interviews increased in the 2024 survey compared to 2017. The main species of fish consumed by the adult high-rate group were bass, cod, mackerel, pollock, and salmon in 2024 compared to the main species of cod and mackerel in 2017.

The mean consumption rate for the adult high-rate group in the face-to-face interviews increased for molluscs in 2024 compared to 2017. In 2024 the main species consumed was mussels compared with 2017 when it was king scallops.

The mean consumption rate for the adult high-rate group in the face-to-face interviews for crustaceans was similar in 2017 and 2024. The main species of crustacean consumed in 2024 was langoustine compared with common lobster and brown crab in 2017.

The mean consumption for the adult high-rate group in the face-to-face interviews increased for seaweed to 0.75kg y^{-1}, compared to 0.45kg y^{-1} in 2017.

No adult consumption of wildfowl was determined in the 2024 survey while wildfowl were consumed in the 2017 survey.

The fish species consumed by children were mackerel and pollock in both 2017 and 2024. The mean consumption of fish within the children's high-rate group increased in 2024 compared to 2017.

No consumption of molluscs or wildfowl was determined for children in the 2024 survey, but it was found in 2017. No child consumption of crustacean was determined in either the 2017 or 2024 surveys.

No infant aquatic consumption was determined in 2024, but consumption of fish, molluscs and wildfowl was found in 2017.

For adults, there was a decrease in occupancy for in water, handling equipment and handling sediment in 2024 compared to 2017 while there was an increase for on water occupancy compared to 2017. The adult highest total intertidal occupancy in 2024 increased compared to 2017.

Adult consumption rates of locally produced food items increased in the 2024 survey for potatoes, domestic fruit, wild fungi and eggs in comparison to 2017. Adult consumption rates decreased in 2024 for green vegetables, other vegetables, root vegetables and wild fruit compared to 2017. No adult consumption for beef meat, game birds, game rabbit/hare, game venison, poultry, milk and private water was determined in 2024 compared to 2017.

The total occupancy was similar in 2024 compared to 2017. Indoor occupancy at home, indoor work occupancy and outdoor work occupancy all decreased in 2024 compared to 2017. Outdoor occupancy at home increased in 2024 compared to 2017.

Suggestions for changes to the monitoring programme

It is recommended that SEPA's routine environmental monitoring programme should consider sampling dulse seaweed from Portencross, different seaweed species and several edible plants near Hunterston, mushrooms from Hunterston Estate and Glentane Hill and pink purslane from the Hunterston area based on the findings of the 2024 survey.

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 Nuclear Restoration Services Limited (NRS), (which legally changed from Magnox Limited in April 2024) 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 consisted of two Advanced Gas Cooled Reactors (AGR). Station B stopped generating electricity in 2022 and is undergoing defueling (expected to be complete by 2025) with decommissioning to follow.

The current UK legislation, relating to radioactivity, provides uniform safety standards to protect the health of workers and members of the public. The UK's statutory obligation is now under the International Atomic Energy Agency (IAEA) Basic Safety Standard, (General Safety Requirements) Part 3, Schedule III.3 for the 1 mSv committed effective dose and 50mSv skin annual dose limit since leaving the EU (IAEA, 2014). This lays down basic safety standards for protecting people against the impact of exposure to ionising radiation. Following the United Kingdom's (UK) departure from the European Union (EU), the UK agreed a nuclear cooperation agreement with the European Commission (2021), ensuring both parties continue working together on civil nuclear matters including safeguards, safety, and security.

The site discharges radioactive effluent and gases into the environment that may result in the exposure of the public by two primary pathways:

(i) Discharges to the aquatic environment.

(ii) Discharges to the atmosphere.

From these pathways, members of the public may be exposed through inhalation, ingestion of locally sourced food and/or indirectly due to external exposure to contaminated materials (Smith and Jones, 2003). In addition, there may be a direct

exposure pathway (commonly referred to as shine) from the site which members of the public could be exposed to as they undertake their day-to-day activities.

It is also recognised that enhanced doses from external exposure due to authorised discharges and the consumption of locally sourced foods may occur because of contemporary and historical discharges accumulating in the environment (Dale et al., 2008; Tyler et al., 2013). It is the responsibility of SEPA to regulate the discharges from the site to ensure that the public are not exposed to doses more than the legal limits. Exposure to shine from nuclear radiation or waste facilities is the responsibility of the Office of Nuclear Regulation (ONR) within a nuclear licensed site, and the Health and Safety Executive (HSE) outside a nuclear licensed site, where any direct exposure impacts on facility workers.

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.

Within the scope of this report the information provided will assist SEPA in determining the representative person within the Hunterston area. The

representative person is established using environmental monitoring data in conjunction with habits survey data.

1.3 Dose limits and constraints

The system of dose limitation recommended by ICRP (2007), and subsequently in UK legislation, requires that: the retrospective maximum permissible dose limits do not exceed 1mSv y^{-1} from all anthropogenic sources. For prospective assessments, the maximum permissible doses or constraints used by SEPA are:

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

(ii) 0.5mSv 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 0.3mSv 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 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.

This report presents the findings for the 2024 habits survey of the Hunterston nuclear licensed site. All raw data can be found in Appendix A1. The previous survey was undertaken (fieldwork components) during the periods 1 – 7 April and the 17 – 23 June 2017 (Dale et al., 2018).

2 The survey

2.1 Introduction

This chapter describes the site characteristics including recent and prospective site activities, and the surrounding land cover characteristics. In preparation for the survey, a meeting was held with site operators and the SEPA site inspector in June 2024.

The survey team were unable to attend the Hunterston Site Stakeholders Group (SSG) however, SEPA brought the Hunterston Habits Survey to the attention of the SSG during an SSG meeting.

2.2 Hunterston site activity

2.2.1 Current on-site activity

The Hunterston A and B sites consists of Hunterston A and Hunterston B stations. Hunterston A is owned by the NDA and is being decommissioned by NRS - Hunterston A is currently still decommissioning. Nuclear Restoration Services are currently commissioning the Solid Intermediate Level Waste Encapsulation plant (SILWE). The Wet Intermediate Level Waste Retrieval and Encapsulation Plant (WILWREP) is undergoing modifications and underwent active commissioning in early 2017. The higher activity waste will be processed through SILWE or WILWREP, encapsulated in a grout mixture, and stored in the Intermediate Level Wase Store (ILWS). At time of writing, a permit variation submitted by Hunterston A site is currently being considered by SEPA. Hunterston A currently has a permit to release tritium; caesium137; plutonium-241; alpha and non-alpha waste as liquid discharges and tritium and carbon14 to the atmosphere. Full details are provided in the reports of Radioactivity in Food and the Environment (RIFE) (latest report used for this study was RIFE, 2023).

Hunterston B is owned by EDF Energy and was powered by two Advanced Gas-Cooled Reactors (AGR's) and is now undergoing defueling before it enters decommissioning. Hunterston B is authorised to discharge particulate beta, tritium, carbon-14, sulphur-35, iodine-131 and argon-41 to the atmosphere and alpha; non-

alpha, tritium; sulphur-35 and cobalt-60 as liquid discharges. Full details are provided in the 2023 RIFE report (RIFE, 2023).

Liquid discharges are made from the Hunterston A and B sites although they are much less frequent than when the sites were generating electricity, and these discharges are discharged within the tidal window. Hunterston A and B liquid discharges share a common discharge line but discharge separately.

Hunterston A staffing numbers remain consistent with the previous survey while Hunterston B staffing numbers are being reduced (by almost 50 % currently), however this does increase at times with contractor work. The visitor centre is now closed having stopped ad-hoc tours during the Covid pandemic and was not re-opened.

2.2.2 Off-site activity

Both Hunterston A and B operate their own 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.

The new Western Link Interconnector (high voltage direct current subsea electricity link) came ashore at Ardneil Bay following a 420km route underground and subsea. It was reported that during its construction, there was a notable increase in traffic in the area which may potentially have increased the population number within the construction period. The connection is to boost energy transmission and maximise renewable energy throughout the UK.

Within the grounds of the Hunterston Estate a renewable energy developer is developing a battery storage plant. This was due to become operational in April 2024, however, it is not yet operational.

Demolition of the old conveyor belt structure across the A78 occurred in August 2022. When the structure was built in the 1970’s it was used to provide supplies to the Ravenscraig steelworks. On closure of the steelworks, it was subsequently used to unload coal that was to be transported within Scotland and to England. The

removal of this structure is in part to make way for a new cable making factory which is anticipated to bring up to 900 jobs to the area.

An otter sanctuary is in place on the Peel Estate near Hunterston on Gill Burn and is reported to attract individuals to the area.

2.3 Estimated activity concentrations from licensed discharges from Hunterston A and Hunterston B

There has been no change to the permit limits for liquid and gaseous discharges from Hunterston since the previous survey.

Permitted limits of aqueous discharges from:

- Station A of tritium (3.0E+10Bq y^{-1}), caesium-137 (1.6E+11Bq y^{-1}), plutonium-241 (2.0E+09Bq y^{-1}), alpha (2.0E+09Bq y^{-1}, assessed as plutonium-239), and all other non-alpha (6.0E+10Bq y^{-1}, assessed as caesium-137) and
- Station B of tritium (7.0E+14Bq y^{-1}), sulfur-35 (6.0E+12Bq y^{-1}), cobalt-60 (1.0E+10Bq y^{-1}), alpha (1.0E+09Bq y^{-1}, assessed as plutonium-239), and all other non-alpha (1.5E+11Bq y^{-1}, assessed as caesium-137) (RIFE, 2023)

were used to calculate activity concentrations in water using the DORIS model within PC-CREAM 1.5.1.92 (database version 2.0.0) (Smith and Simmonds, 2009).

A continuous release was assumed when modelling unfiltered seawater, fish, seaweed, crustacean, and mollusc activity concentrations over a 50-year period. The default values for the Hunterston area in PC-CREAM were used for all element dependent parameters (e.g. sediment distribution coefficients, K_d, and concentration factors), local compartment details (e.g. depth, coastline length, volumetric exchange rate, suspended sediment load, sedimentation rate, sediment density and diffusion rate) and regional model information (e.g. volume, depth, suspended sediment load, sedimentation rate, sediment density, diffusion rate).

Activity concentration values reported at 50 years for unfiltered seawater in the immediate vicinity of Hunterston were estimated to be: 7.07E0 Bq l^{-1} for tritium, 5.25E-2Bq l^{-1} for sulfur-35, 7.09E-5Bq l^{-1} for cobalt-60, 1.65E-5Bq l^{-1} for plutonium-

241, 2.84E-5Bq l^{-1} for alpha, and 3.70E-3Bq l^{-1} for all other non-alpha and caesium-137.

Activity concentrations in different aquatic foodstuffs were estimated and are presented in Table 2.1.

Table 2.1. Estimated activity concentrations in foodstuffs

Radionuclide	Fish (Bq kg^{-1})	Crustaceans (Bq kg^{-1})	Molluscs (Bq kg^{-1})
Tritium	7.07E+00	7.07E+00	7.07E+00
Sulfur-35	1.05E-01	5.25E-02	2.10E-01
Cobalt-60	2.36E-02	2.36E-01	1.18E-01
Alpha	1.42E-03	2.84E-03	4.26E-02

Atmospheric activity concentrations were modelled using the PLUME model in PC-CREAM (Smith and Simmonds, 2009). The permitted gaseous discharges from Hunterston were modelled and included:

- Station A of tritium (2.0E+10Bq y^{-1}), carbon-14 (2.0E+09Bq y^{-1}), other radionuclides (3.0E+06Bq y^{-1}, modelled as caesium-137) and
- Station B of tritium (1.5E+13Bq y^{-1}), carbon-14 (4.5E+12Bq y^{-1}), sulfur-35 (5.0E+11Bq y^{-1}), argon-41 (1.5E+14Bq y^{-1}), iodine-131 (2.0E+09Bq y^{-1}), particulate beta (5.0E+08Bq y^{-1}, assessed as caesium-137) (RIFE 2023).

PLUME was set to calculate activity concentrations in air from a 67m stack height for both stations and are reported here over a range of distances from 500 to 25,000 metres. The meteorological (MET) stability scheme was applied using the default settings with data extracted based on the MET Pasquill D with rain category, selected by reviewing the local meteorological data. The estimated activity concentrations in air are presented in Table 2.2.

Table 2.2. Calculated activity concentrations in air (Bq m^{-3}) discharged from a stack height of 67m for both Hunterston A and B

Distance (m)	Argon-41	Carbon-14	Tritium	Iodine-131	Sulphur-35	Caesium-137*
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 total dose from atmospheric discharges at the same specified distances from the Hunterston A and B sites, using the data presented in Table 2.2. Table 2.3 reports the estimated external doses modelled from PC-CREAM for adults, children, and infants.

Table 2.3. Modelled total external doses (μSv) in the 50th year to Adults, Children, or Infants at specified distances from a 67m stack at Hunterston A and B 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

2.4 Survey areas

Low activity concentrations within the environment of Hunterston were demonstrated following the assessment of the radionuclide concentrations modelled by PC-CREAM. The 2024 Habits Survey was designed to encompass the 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 A and B nuclear licensed sites. These areas are consistent with the previous habits survey (2017) and are shown in Figures 2.1 and 2.2. These areas are also consistent with the Environmental Impact Assessment for Decommissioning Regulations (1999) (EIADR) where Graphic 5.2 in the EIADR report reflects a comparable survey area.

A Mobile Gamma Spectrometry System (MoGSS) (carborne and handheld) survey of the full survey area (roads and coastline) was also undertaken.

The 2024 survey areas focused on:

(i) A 1km 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.

(ii) The terrestrial survey areas included a 5km radial zone from the Hunterston nuclear licensed site boundary.

(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. Great Cumbrae Island and Little Cumbrae Island and offshore 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.

2.6 Soil data

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 A and B sites.

2.7 Topographic wetness index

Catchment hydrology can be important in the redistribution of radionuclides. For example, organic soils can allow radionuclides (e.g. caesium-137 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 50m resolution digital elevation model for Scotland using the OS Terrain 50 product, 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 pathways and highlights areas where radionuclides from atmospheric fallout might accumulate.

Figure 2.1 The terrestrial survey area for the 2024 Hunterston Habits Survey

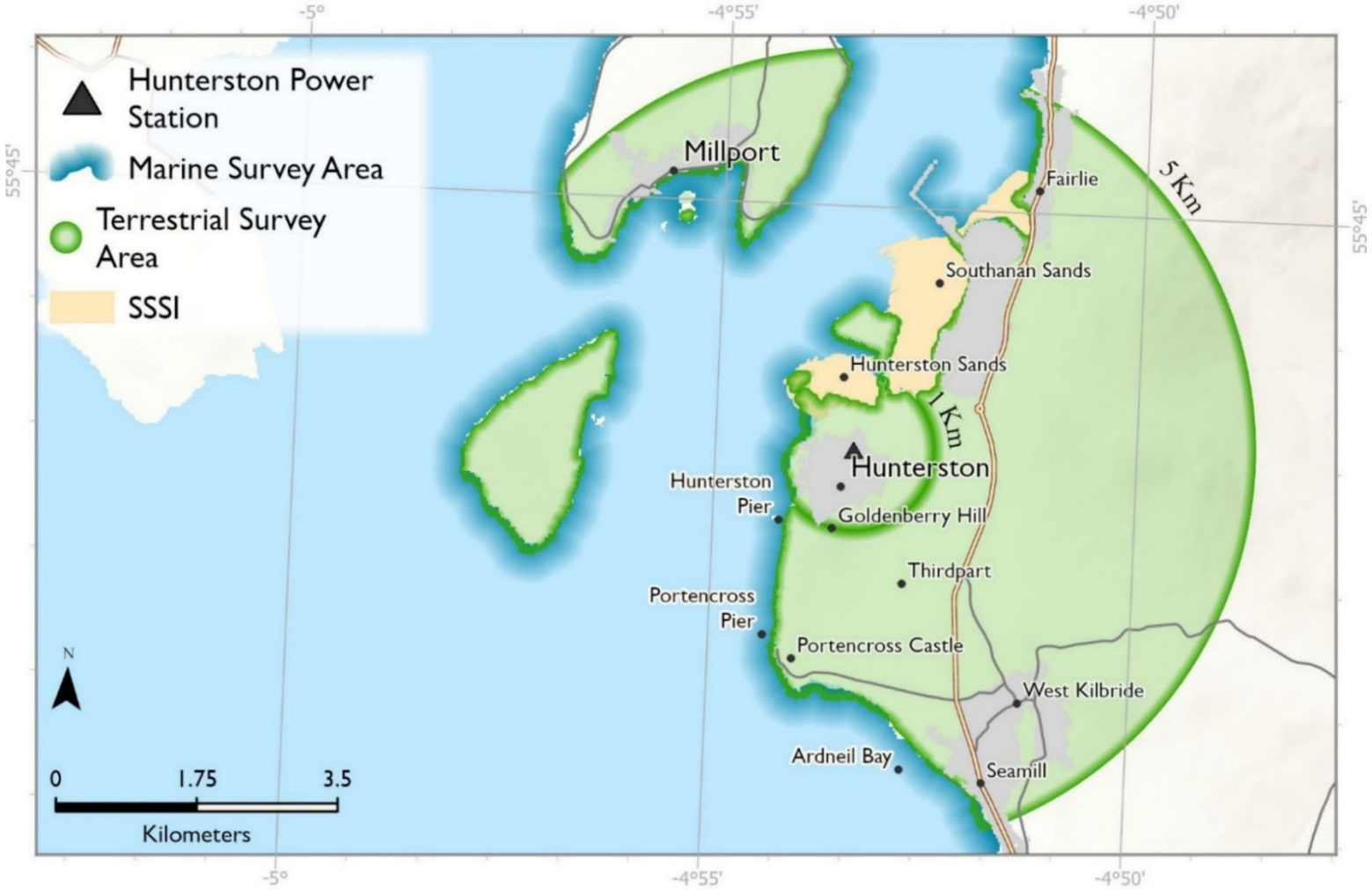


Figure 2.2 The marine survey area for the 2024 Hunterston Habits Survey

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

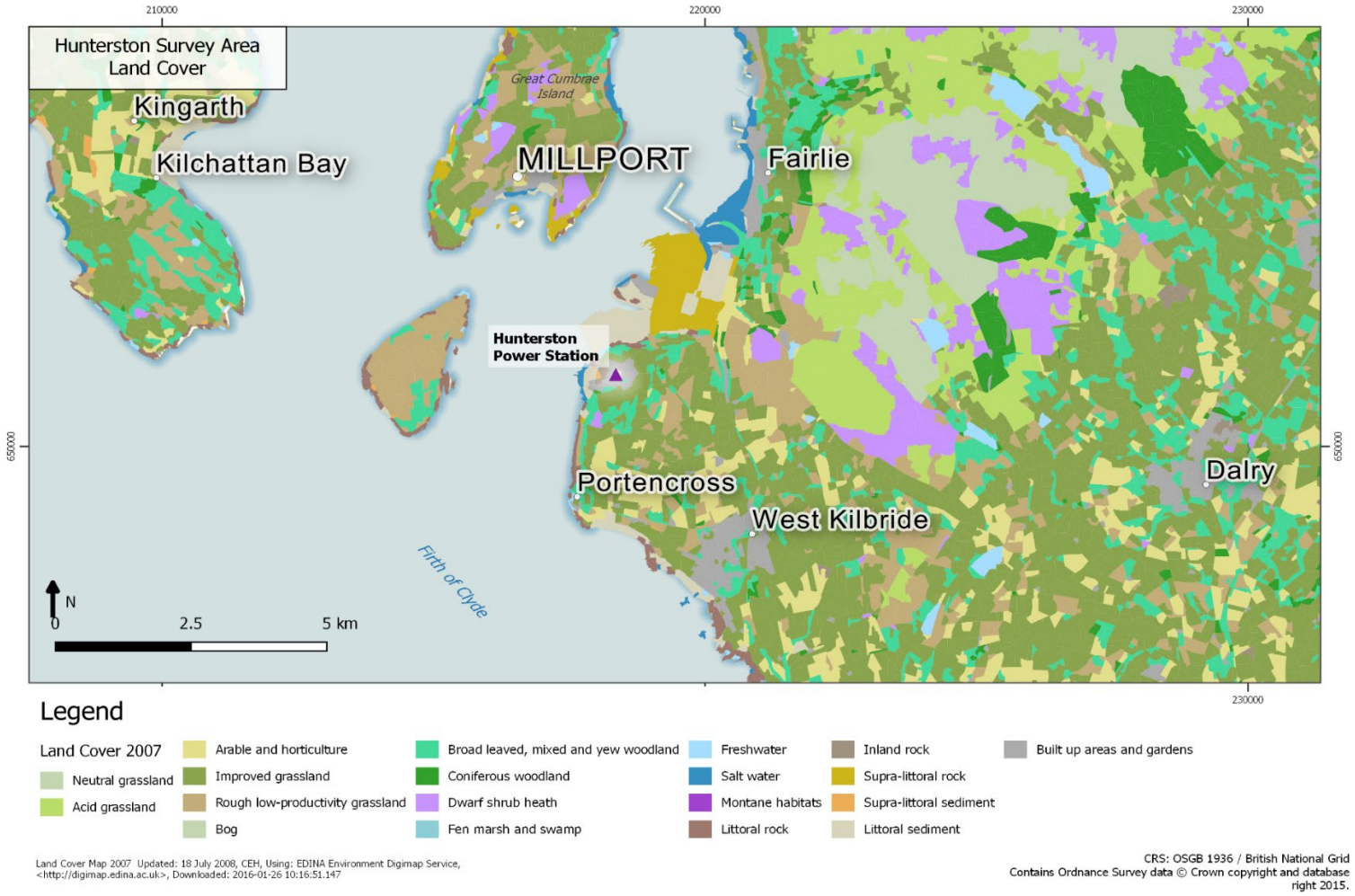


Figure 2.4 Soil types dominating the Hunterston survey area (The Macauley Institute for Soil Research, 2015)

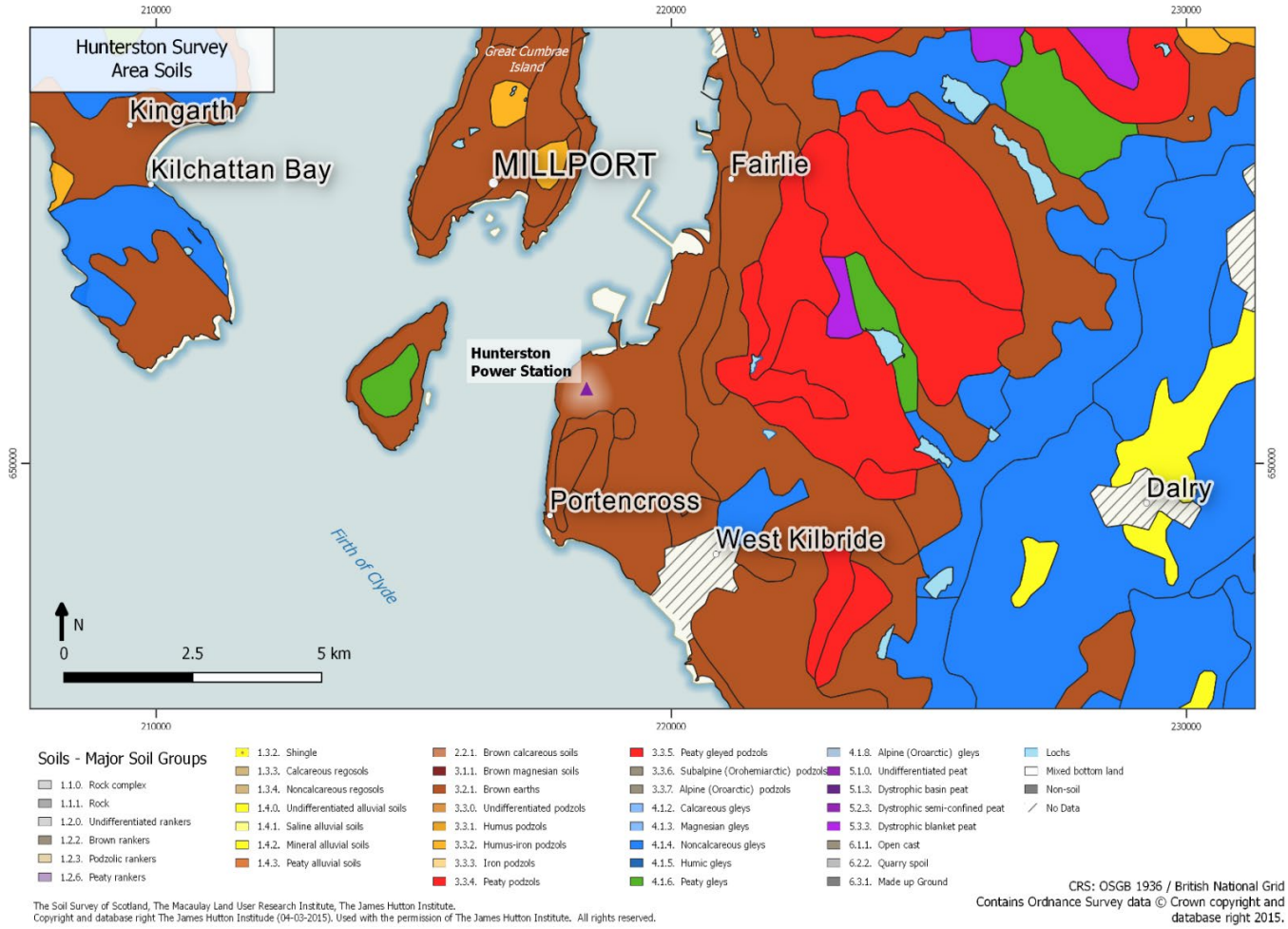
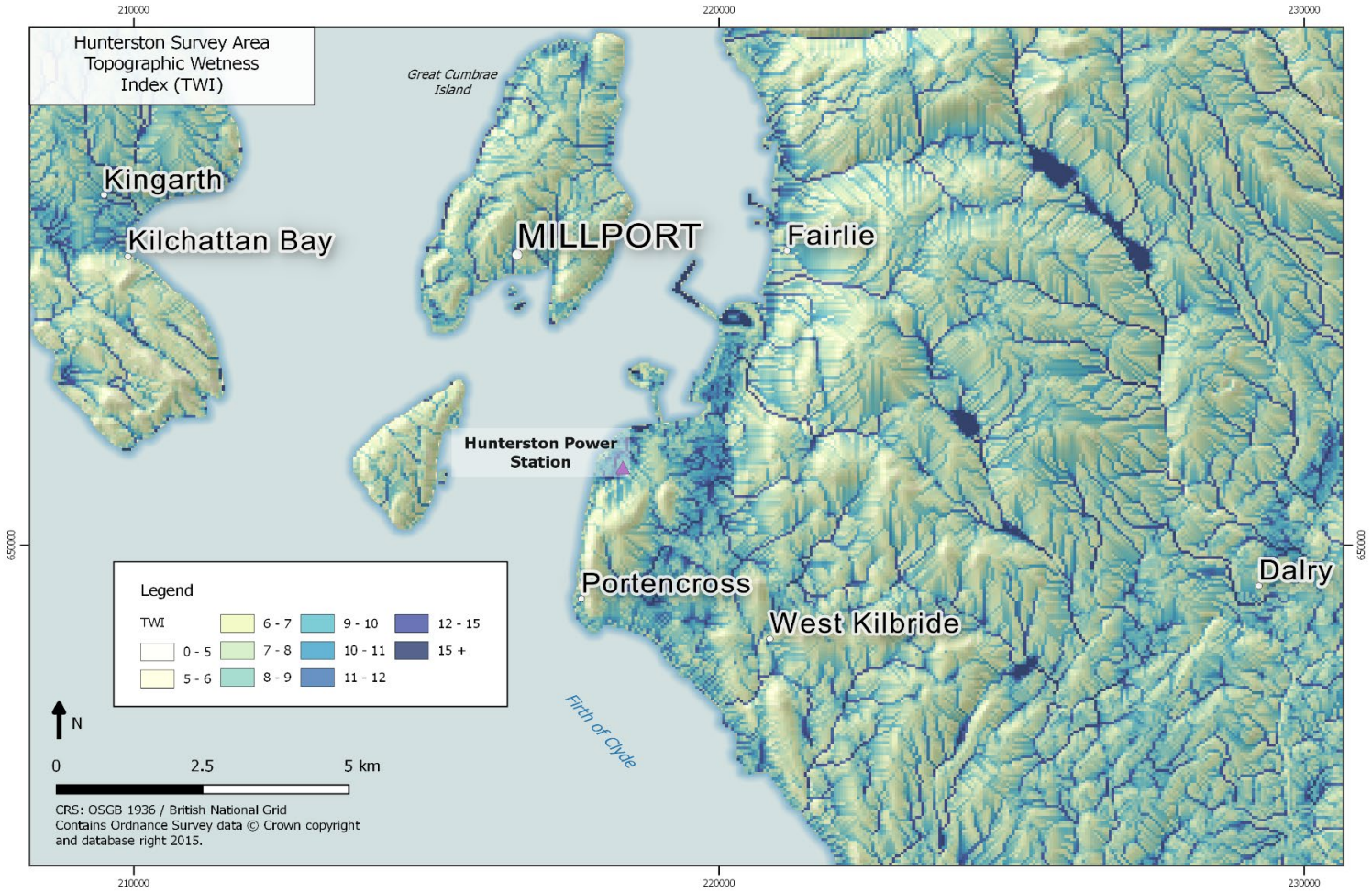


Figure 2.5 The topographic wetness index in the Hunterston survey area (Ordnance Survey, 2015)



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 of the Hunterston nuclear licensed site provided a useful frame of reference for undertaking this survey. Following the desktop study described in Chapter 2, the habit survey was defined and includes:

(i) An initial postal survey.
(ii) A mobile radiometric survey to characterise the heterogeneity of radiation in the environment surrounding the Hunterston A and B sites.
(iii) Face-to-face surveys and follow-up phone calls.
(iv) A series of informal meetings during and after the face-to-face surveys to validate the data and findings.

3.2 Postal survey

To obtain a provisional assessment of the activity and food consumption habits of the local community living within the survey area, a postal questionnaire was distributed to 2000 households. The households were selected using a random sampling method and numbers varied according to the number of households found within each area. While the survey was sent to a particular individual in the household, the survey questions were designed to collect information on the habits of the people living in that household. Only one individual per household was therefore selected to receive the postal survey. The selected households included individuals living in the following geographical areas (Figure 3.1):

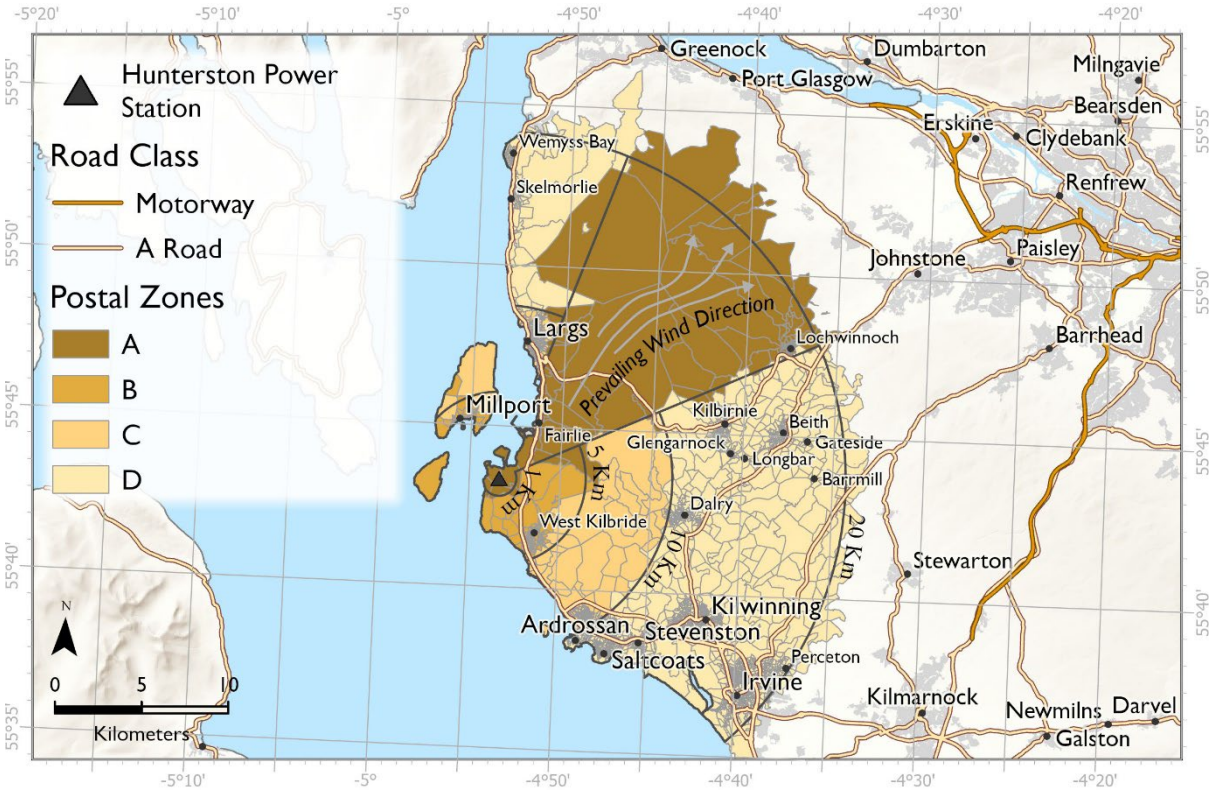
(i) Within the 1km radius surrounding the Hunterston A and B sites and the geographical area within the predicted plume (Zone A).

(ii) Between 1km and 5km from the Hunterston A and B sites outwith the predicted plume (Zone B).

(iii) Between 5km and 10km from the Hunterston A and B sites outwith the predicted plume (Zone C).

(iv) Between 10km and 20km from the Hunterston A and B sites outwith the predicted plume (Zone D).

Figure 3.1 Map showing the postal survey zones for the Hunterston survey



The open electoral register was used for each of the zones of interest and contact details for households were randomly selected. Considering the reduced number of households located under the modelled plume, surveys were randomly distributed to the houses. The following percentages reflect the total available postal addresses from the electoral roll for each zone, totalling 2000 households being randomly selected: Zone A 10%; Zone B 30%; Zone C 30% and Zone D 30%. 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 a useful focus to target during the face-to-face surveys or focus group discussions.

The postal survey included questions on food consumption, activities, and a map for identifying whereabouts the different activities were undertaken by household members. Further information can be found in Chapter 4 and Appendix A2.

3.3 Radiometric surveys

The radiometric surveys comprised a carborne and handheld gamma spectrometry survey (MoGSS), in-situ gamma dose rate and in-situ beta skin dose rate measurements.

3.3.1 In-situ dosimetry

The Environmental Radioactivity Laboratory (ERL) has ISO 17025:2017 accredited procedures for the deployment and recording of gamma dose rate in air using two Thermo Radeye instruments. Measurements were undertaken at all locations where occupancy or location may lead to potentially higher exposure to radioactivity because of Hunterston A and B 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 $\mu Sv\ h^{-1}$.

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 item(s) that were potentially exposed to the higher radioactivity concentrations within the survey area.

Further details of the beta skin dosimetry can be found in Appendix A4.

3.4 Conduct of the survey

The pre-survey preparations involved:

(i) Discussions with SEPA over the requirements for the Hunterston survey.
(ii) Reviewing past survey reports and maps to identify key information.
(iii) Compiling a directory of key groups involved in activities in the area from web searches and from people living in the survey area with relevant knowledge.
(iv) Agreeing the field survey programme with SEPA.
(v) University of Stirling staff conducting a carborne and handheld MoGSS survey.

3.5 Meetings and informal contacts

In the 2024 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 ‘standard’ face-to-face interviews. The multi-methods approach facilitated a means to ‘triangulate’ (verify) the data gathered through the different approaches: e.g. 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 types of local food such as honey and game. Such information also aided in the development of survey data collection with individual contacts within relevant groups providing additional contacts to follow-up. These groups were approached prior to, during and after the face-to-face interviews by telephone and email.

A directory of local groups, bodies and organisations that potentially undertake relevant activities within the survey area was compiled prior to the field surveys. 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 about 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.

3.6 Data conversion and analyses

During the face-to-face interviews, data on food consumption was 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. Data for each survey were transferred to a bespoke Microsoft Access database for analysis. The figures reported from individuals are utilised within this report after the percentage of any gifting or waste deducted from the final annual figure(s).

3.7 Data rounding and grouping

All data collected from the face-to-face and postal surveys are reported to two significant figures. For the food consumption data, the total annual consumption (kg y^{-1}) 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). These groups are like those used in previous survey reports but with a focus on the most commonly encountered food types. Individuals were given the option to add any additional food items using an ‘Other’ food category.

The time (h y^{-1}) individuals spent carrying out activities was calculated by multiplying frequency (occasions per year) and duration (hours), whilst considering seasonality where appropriate. Data reported are after any holidays and working hours within the survey replies were accounted for. A ‘liquid’ category was also added to the survey

for individuals who carry out aquatic activities that could result, e.g. in inadvertent ingestion of water through outdoor swimming/sailing.

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

Table 3.1 Food groups used in the Hunterston habits survey

Food group	Example of foods within 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 (legumes)	Broad beans, French beans, pea, runner beans
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, white currant
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

Food group	Example of foods within group
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

Table 3.2 ICRP age groups used in the dose assessment

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

3.8 Qualitative and quantitative observations

Whilst undertaking the face-to-face surveys, observational data were acquired on any 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, e.g. 20 minutes, with both onshore and offshore (including intertidal) activities noted. The number of individuals, their gender and their approximate age were noted for each activity witnessed. Where large groups of people were observed, the number of individuals was estimated. After the observation period, individuals were approached where possible and subsequent face-to-face surveys 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 of both day and seasons (e.g. within and outwith the period of the local school holidays).

One of the problems with this type of survey is being confident in a person's recollection of portion size/mass or occupancy/activity times. To address this, the survey team had information on what might be considered a reasonable range for consumption of different foods. Where a survey individual's response was outwith these ranges, the survey team challenged and verified the response. To achieve this, visual aids of, e.g. portions of vegetables or fruit, were shown to allow the individual to re-evaluate and confirm their data. With regards to occupancy, a similar approach was taken where all 'extreme' hours (again identified as being outwith reasonable ranges based on previous surveys' findings) were also challenged. It is not possible to visualise 'time' so the survey individual's initial times would be calculated to a per year basis to show how this might be compared with their other daily habits and work life. If the surveyed individual confirmed the 'extreme' value, then these were recorded as this is the information the survey team were given. While the survey team's approach should minimise inaccurate information from being collected, it remains possible that extreme results could still be reported and thus may be a potential source of error within the survey.

4 Postal survey

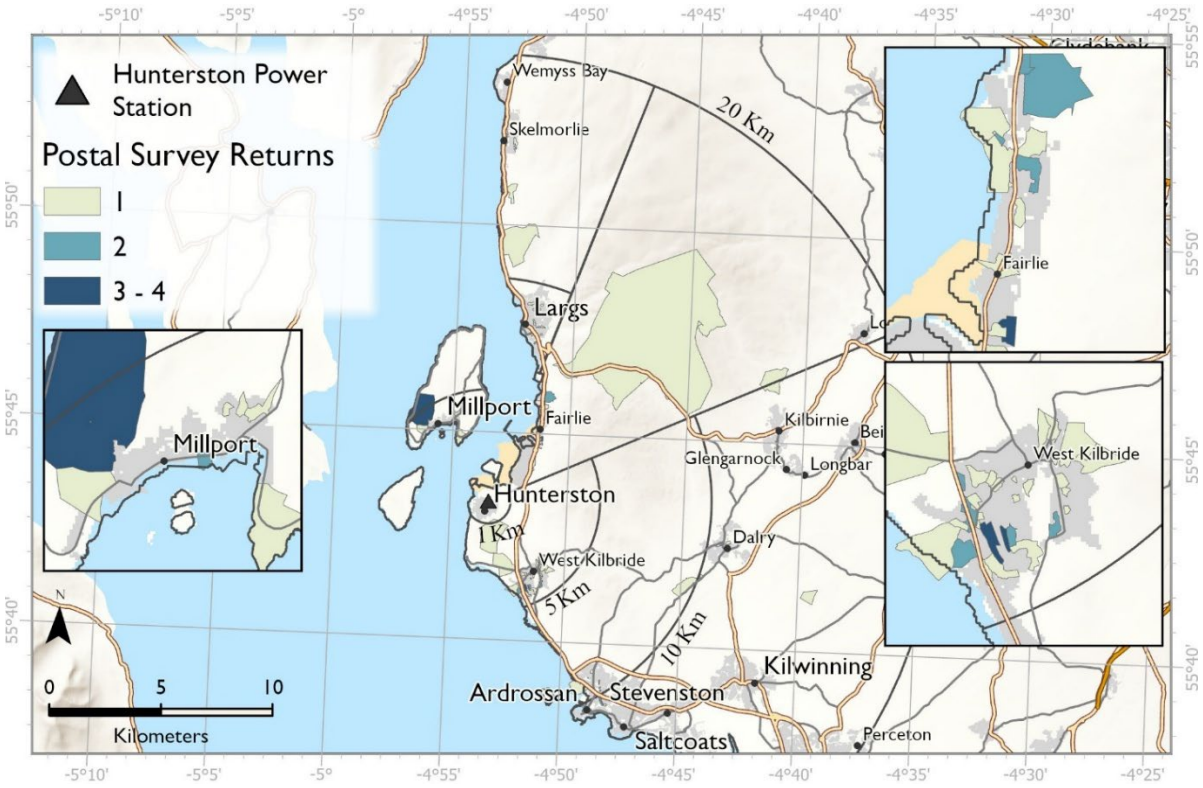
4.1 Introduction

The results from the postal survey provide an overview of the habits within an area of 20km radius centred on the Hunterston A and B nuclear licensed sites.

2000 postal surveys were sent out to households in the survey area and 123 postal returns were used in the analysis (Figure 4.1). This is comparable with previous habit postal surveys around the different nuclear sites across Scotland.

The postal survey proved useful for identifying where households undertook popular activities and the proximity of these activities to the Hunterston A and B sites. The survey was not designed to capture the length of time individuals spent doing these activities. The postal survey results are presented in detail in Appendix A2.

Figure 4.1. Postal survey returns density map



5 Aquatic radiation pathways

5.1 Introduction

Survey locations were established following the desktop review and to allow effective comparison with the previous Hunterston Habits Survey in 2017 (Dale et al., 2018). The survey locations were visited throughout the survey period and observations of offshore and onshore activities were undertaken. The survey schedule ensured that each location was visited at different times of the day, reflecting the different activities occurring at each location.

The survey locations were visited throughout two survey periods, the first outwith the school holiday period (22 to 28 June) and the second within the school holiday period (3 to 9 August) of 2024. Offshore and onshore observations were undertaken at each site.

5.2 Aquatic survey area descriptions

The aquatic survey area stretches from Wemyss Bay in the north to Ardrossan/Saltcoats in the south, including the southern part of Great Cumbrae Island and Little Cumbrae Island, offshore of Largs.

The survey locations are reported from Wemyss Bay in the north and Ardrossan in the south. See Appendix A5 for site descriptions and observations.

5.3 Commercial seafood operations

Commercial seafood operations operate within the survey area with the main fishing methods being trawling and creeling. Common lobster, Nephrops and prawn are landed at Largs Pier. It was reported there are around six trawlers that fish between Wemyss Bay and Saltcoats including Fairlie Roads (locally known as ‘The Castle’, meaning between Portencross Castle and Little Cumbrae Castle). It is reported that other boats from outwith the survey area do come in and land catch at the harbour. A small percentage of the catch stays local (being sold to local businesses) and some is sold within Scotland, but with most of the catch sold to Europe. There are three creel boats based in Ardrossan, landing lobster, with their catch reported to being

sold to a wholesaler outwith the survey area. There are also two razor clam boats that fish out of Ardrossan, and it is reported that their catch is sold to China and Japan.

One commercial fishing business operates a fishing vessel and oyster farm within the survey area with some of the catch being sold to local businesses.

One fish wholesaler was found to operate within the survey area. Contact was made with this business; however, no information was obtained. Local businesses from within the survey area were contacted and two sold produce that was sourced locally either from boats landing catch in Largs or caught by individuals working within the business. Produce sourced and sold locally was determined to be langoustine, squat lobsters, common lobsters, brown crab and oysters.

5.4 Non-commercial fishing and angling

Angling was a popular activity and the following text shows areas where non-commercial fishing, bait digging and collecting of molluscs & crustaceans occurred within the aquatic survey area. Catch and release was reported to be the popular practice with individuals, releasing most of their catch and consuming only a small percentage.

Bait Digging: Ardrossan south beach, Portencross, Fairlie sands and Hunterston sands

Fishing from shore/rocks/pier/kayak: Ardrossan to Portencross (cod, haddock, whiting, pollock) – from kayak, Ardrossan (pollock and mackerel) – from shore, Castle Bay (mackerel and pollock) – from shore, Hunterston (mackerel) – off rocks by car park, Portencross to Hunterston (Mackerel) – from kayak, Portencross (coley and mackerel) – from shore/rocks, Largs (mackerel and haddock) – from slip, Largs (bass, mackerel and sea trout) – from shore, Saltcoats (plaice) – from harbour

Mollusc/crustaceans picking (non-commercial): Hawkings Craig (crabbing -catch and release) – from pier, Castle Bay (cockles and razor clams), Kelburnfoot (mussels), Ardrossan north beach (winkles).

5.5 Wildfowling

No wildfowling was identified within the marine survey area. A local wildfowling club was contacted to obtain information, but no response was received. Wildfowling was identified in the previous 2017 habit survey.

5.6 Royal National Lifeboat Institute (RNLI)

The 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 to Rothesay (including Little Cumbrae and Great Cumbrae Islands) and continues north to Dunoon. There are 19 active volunteer crew 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. On average there are approximately 40 callouts annually with 12 callouts at the time of the interview. The RNLI reported that since the closure of the hyperbaric chamber there has been a decrease in diving related callouts. The RNLI have reported however an increase in paddleboard related callouts and also that there are three areas that are popular now with outdoor swimming groups within the survey area: Aubrey Point at Largs beach, The Pencil (the monument and outcrop between Far Bowencraig and Bowencraig) and Seamill beach. The RNLI also reported that there has been a dramatic increase in cruise ships on the Clyde.

The RNLI boat and personal protective equipment (PPE) and suits (if immersed in the water during callout) are all hosed with freshwater on return to base.

5.7 Sailing and rowing

The survey area is popular for sailing and there is a large active marina near Largs which provides sailing, training, moorings and boatyard and marine services. There are several aquatic activity clubs also within the survey area providing activities with adult and family memberships.

Sailing and aquatic activity clubs within the survey area were contacted with information provided by one club. Clubs generally have a large number of family and individual memberships with the main sailing taking place throughout the summer months within the survey area. Clubs provided different sectors including sailing, training, racing and keelboats. Safety boat cover is provided by the clubs and boats, and equipment are hosed down with fresh water after each time sailing. Individual members take their own personal kit/clothing home for washing/rinsing.

The Field Studies Centre, Isle of Cumbrae provides fieldwork experience for primary and secondary school children, universities and activity-filled family holidays. Group sizes vary from 2 to 100 with courses/activities provided for approximately five days. On 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 see an increase in 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.

Since the previous Hunterston Habit Survey, Scotland's National Watersports Centre based on the Isle of Cumbrae no longer operates and has closed.

5.8 Diving clubs

A diving club that reportedly dives within the survey area was contacted but no response was received. However, the RNLI reported that they have noticed a reduction of individuals diving in the Firth of Clyde which may be due to the closure of a nearby hyperbaric unit and a corresponding decrease in diving related RNLI callouts since its closure.

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 who walked dogs within the survey area were identified and interviewed. 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 along the Ayrshire Coastal Path which follows most of the survey area coastline. With the presence of the National Nature Reserve and Site of Special Scientific Interest (SSSI) within the survey area many walkers/bird watchers were noted.

5.11 Animals grazing

No cattle or sheep were observed grazing on seaweed or within intertidal areas anywhere within the survey area.

5.12 Seaweed and foraging

Five individuals interviewed collect seaweed from Ardrossan North Shore, Boydston, Fairlie, Seamill beach, Hunterston Sands and Portencross beach for use to grow vegetables and as a weed suppressant. Methods of application vary between individuals with some individuals hosing the seaweed down with fresh water before applying to the soil and then leaving it to compost before digging it in. Some individuals apply directly to the soil and then allow it to compost before digging it in.

One individual collects 0.75kg of Dulse seaweed (*Palmaria palmata*) to consume from Portencross. A second individual collected different seaweed species, sea arrowgrass, sea orache, sea aster and Scots lovage from intertidal areas commercially from within the survey area for consumption but was unable to provide quantities.

Individuals collected seaweed for use on garden/allotment plots from Boydston beach, Ardrossan North beach, Fairlie beach, Hunterston Sands and Portencross. The main species of seaweed collected is bladderwrack (*Fucus vesiculosus*) and sea kelp (*Laminariales*).

5.13 Internal exposure – phase 1

5.13.1 Adult consumption rates

Table 5.1 presents a summary of the consumption rates for aquatic food types including fish, crustaceans, molluscs, and seaweed. Mean adult consumption rates for the high-rate groups and the observed 97.5th percentile rates are included in Table 5.1. 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.

Table 5.1 Summary of adults' consumption rates of foods from the aquatic survey area

Food Group	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1})	Observed minimum for the high-rate group (kg y^{-1})	Observed mean for the high-rate group (kg y^{-1})	Observed 97.5th percentile for the high-rate group (kg y^{-1})	Full dataset – Observed mean (kg y^{-1})	Full dataset – 97.5th percentile (kg y^{-1})	National Data mean (kg y^{-1})	National data 97.5th percentile (kg y^{-1})
Fish	16	2	156	93.6	125	154	20.6	133	15.0	40.0
Crustaceans	4	1	24	24	24	NA	7.39	22.6	4	10
Molluscs	4	1	52	52	52	NA	13.8	48.3	4	10
Seaweed	1	1	0.75	0.75	0.75	NA	0.75	NA	ND	ND

ND – not determined

The generic mean and generic 97.5th percentile rates based on National Habit Data are also included (Smith and Jones, 2003). The national data 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 do 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, crustaceans, and molluscs (Table 5.1), which are 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 assessments.

Adults consumed bass (two individuals), cod (one individual), mackerel (11 individuals), pollock (four individuals), salmon (two individuals), sea trout (two individuals), haddock (one individuals), plaice (two individuals) and coley (two 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 multiplied by frequency) of fish was 156kg y^{-1} and this individual consumed mackerel (130kg y^{-1}) and pollock (26kg y^{-1}) all sourced from within the aquatic survey area. The mean fish consumption for the adult high-rate group was 125kg y^{-1}.

Adults consumed crustaceans, which consisted of shrimps (one individual) and langoustines (three individuals). The observed maximum consumption (quantity multiplied by frequency) of crustaceans was 24kg y^{-1} and this individual consumed langoustine from within the survey area. The mean crustacean consumption for the adult high-rate group was 24kg y^{-1}.

Adults consumed molluscs, which consisted of mussels (three individuals) and razor clams (one individual), scallops (one individual), winkles (one individual) and cockles (one individual). The observed maximum consumption (quantity multiplied by frequency) of molluscs was 52kg y^{-1} for one individual consuming mussels from within the survey area. The mean molluscs consumption for the adult high-rate group was 52kg y^{-1}.

One adult consumed 0.75kg y^{-1} seaweed (Dulse) which was sourced from within the survey area.

No adults were found to consume wildfowl from within the aquatic survey area, however, it should be noted that two individuals within the postal survey reported to consuming wildfowl that the individuals sourced from within the aquatic survey area.

5.13.2 Child and infant consumption rates

Table 5.2 presents a summary of children's consumption rates of fish from the aquatic survey area. Mean consumption rates for the high-rate groups and the observed 97.5th percentile rates are included in Table 5.2

Table 5.2 Summary of children's consumption rates of foods from the aquatic survey area

Food Group	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1})	Observed minimum for the high-rate group (kg y^{-1})	Observed mean for the high-rate group (kg y^{-1})	Observed 97.5th percentile for the high-rate group (kg y^{-1})	Full dataset – Observed mean (kg y^{-1})	Full dataset – 97.5th percentile (kg y^{-1})
Fish	2	2	6.65	5.9	6.28	6.63	6.28	6.63

The table also includes mean consumption rates and 97.5th percentile rates based on the full dataset. There was no aquatic consumption determined for the infant age group during the survey period.

For the child age group, fish was found to be consumed which comprised of mackerel (two individuals) and pollock (one individual). The observed maximum consumption was 6.65kg y^{-1} by one individual who consumed mackerel (5.9kg y^{-1}) and pollock (0.75kg y^{-1}) which was sourced from within the survey area.

No consumption of mollusc, crustacean or wildfowl was determined for the child age group.

No aquatic consumption was determined for the infant age group.

5.14 External exposure – phase 1

Occupancy rates for adult intertidal activities are presented in Table 5.3. Occupancy rates for adult aquatic (in water), aquatic (on water), handling rates of equipment and handling rates of sediment are presented in Table 5.4.

Intertidal activities for adults included bait digging, sitting/picnicking/BBQ, beachcombing, boat maintenance, collecting mussels, collecting razor clams, collecting seaweed, collecting shells, collecting winkles, crabbing, dog walking, flying drone, fishing, jogging, launching and recovery of dinghies, metal detecting, paddling, playing, preparation and deconstruction of paddle board, research/education, rock pooling, slipway cleaning, sunbathing and walking.

Table 5.3 Summary of adults' external exposure for intertidal activities over intertidal substrates

Intertidal Substrate	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (h y^{-1})	Observed minimum for the high-rate group (h y^{-1})	Observed mean for the high-rate group (h y^{-1})	Observed 97.5th percentile for the high-rate group (h y^{-1})	Full dataset – Observed mean (h y^{-1})	Full dataset – 97.5th percentile (h y^{-1})
Rock	25	4	312	117	215	312	48.2	312
Sand	141	7	1460	615.45	959	1405	96.4	885
Sand and stones	56	10	843	290	457	817	129	652
Stones	20	5	730	365	474	712	131	643

The activities undertaken by adults in the high-rate group over the following intertidal substrates included:

Rock: launching and recovery of dinghies at Bowencraig; rock pooling at Boydston and Fairlie sands; sitting/picnicking/BBQ at Farland Point and St Phillans; crabbing at Farland Point; dog walking at Portencross; fishing at Farland Point, Hawking Craig, Hunterston, St Phillans, Millport and Portencross; and playing at Farland Point.

Sand: bait digging at Ardrossan South beach, Fairlie Sands and Hunterston Sands; sitting/picnicking/BBQ at Ardneil Bay, Ardrossan north and south beach, Fairlie beach, Millport and Seamill beach; beachcombing at Ardneil Bay, Ardrossan north and south beach, Bowencraig, Fairlie beach, Fairlie sands and Seamill beach; boat maintenance at Fairlie beach; collecting seaweed at Ardrossan north beach, Boydston, Hunterston Sands and Portencross beach; collecting shells at Seamill beach; collecting winkles at Ardrossan north beach; crabbing at Newtown Bay; dog walking at Ardneil Bay, Ardrossan north and south beach; Boydston, Fairlie beach, Kelburnfoot, Newtown Bay, Saltcoats beach and Seamill beach; drone flying at Hunterston Sands; fishing at Fairlie beach, Millport and Ardrossan north and south beach; metal detecting at Ardrossan south beach; paddling at Ardneil Bay, Ardrossan north and south beach, Bowencraig, Fairlie beach, Fairlie Sands, Kelburnfoot, Newtown Bay, Portencross and Seamill; playing at Ardrossan north beach, Bell Bay, Bowencraig, Fairlie beach, Millport, Newtown Bay and Seamill beach; preparation and deconstruction of stand-up paddle board at Ardrossan north beach; research and education at Fairlie beach; rock pooling at Bell Bay; sunbathing at Ardrossan north beach; and, walking at Ardneil Bay, Ardrossan north and south beach, Bell Bay, Boydston, Fairlie beach, Fairlie Sands and Hunterston Sands.

Sand and stones: bait digging at Portencross beach; sitting/picnicking/BBQ at Castle Bay, Largs Bay, Millport (Kames beach) Portencross and Seamill beach; beachcombing at Seamill beach; boat maintenance at Portencross; collecting mussels at Kelburnfoot; collecting razor clams at Castle Bay; collecting seaweed at Fairlie beach and Portencross; collecting winkles at Castle Bay; dog walking at

Kelburnfoot, Portencross, Largs Bay, Castle Bay, Bowencraig, Pencil View, Ardrossan north beach, Seamill beach, Fairlie beach, Far Bowencraig, Hunterston Sands and Ardneil Bay; drone flying at Ardrossan north beach; fishing at Largs beach at Pencil View; paddling at Ardrossan north beach, Hunterston Sands, Kelburnfoot, Largs Bay and Portencross beach; playing at Ardrossan south beach, Largs Bay and Portencross beach; rock pooling at Bowencraig, Castle Bay, Hunterston Sands, Largs Bay and Portencross beach; and, walking at Ardrossan south beach, Largs Bay, Meigle Bay, Pencil View, Portencross, Seamill beach and Wemyss Bay.

Stones: beachcombing at Meigle Bay, Portencross and Skelmorlie; dog walking at Ardrossan north beach, Largs Bay and Portencross; fishing at Hunterston and Saltcoats harbour; playing at Wemyss Bay; slipway cleaning at Largs marina; and, walking at Largs Bay and Wemyss Bay.

The highest intertidal total occupancy rate was 1460h y^{-1} for an individual who spent time dog walking on a sand substrate within the survey area.

On a rock substrate, the highest occupancy was 312h y^{-1} for two individuals, one individual who spent time fishing at Portencross and a second individual who spent time sitting/picnicking/BBQ at St Phillans. On a sand substrate, the highest occupancy was 1460h y^{-1} for one individual who spent time dog walking at Ardrossan north beach and Seamill beach. On a sand and stone substrate, the highest occupancy was 843h y^{-1} for an individual who spent time collecting mussels (1h y^{-1}), collecting razor clams (1h y^{-1}), collecting winkles (1h y^{-1}), dog walking (730h y^{-1}), sitting/picnicking/BBQ (98h y^{-1}) and rock pooling (12h y^{-1}) at Castle Bay and Kelburnfoot. On a stone substrate the highest occupancy was 730h y^{-1} for an individual who spent time fishing at Saltcoats harbour.

Table 5.4 Summary of adults' external exposure for aquatic activities (in water and on water), handling of equipment and handling of sediment

Activity	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (h y^{-1})	Observed minimum for the high-rate group (h y^{-1})	Observed mean for the high-rate group (h y^{-1})	Observed 97.5th percentile for the high-rate group (h y^{-1})	Full dataset – Observed mean (h y^{-1})	Full dataset – 97.5th percentile (h y^{-1})
Aquatic (in water)	69	11	113	39	62.8	110	16.4	99.5
Aquatic (on water)	43	1	3149	3149	3149	NA	160	1011
Handling equipment	55	6	1139	482	734	1132	106	918
Handling sediment	130	7	780	260	369	718	42.3	301

Activities in water included jet skiing, outdoor swimming and stand-up paddle boarding. The highest occupancy rate for adults in the water was 113h y^{-1} for an individual who spent time jet skiing within the survey area. Activities on water included boat maintenance, canoeing, commuting via boat, kayaking, powerboating, RNLI duties, sailing, sea angling, SIB boating and working on a boat. The highest occupancy rate for adults on water was 3149h y^{-1} for an individual who spent time power boating (336h y^{-1}), sailing (213h y^{-1}) and working on a boat (2600h y^{-1}) within the survey area. The activities for adults involved handling boats and boating equipment, handling clothes and overalls and handling fishing gear. The highest level of handling equipment was 1139h y^{-1}, this individual spent time undertaking boat maintenance (676h y^{-1}), handling boats and boating equipment (449h y^{-1}) and handling fishing gear (14h y^{-1}) within the survey area. The highest level of handling sediment was 780h y^{-1}, and this is for an individual who spent time playing (260h y^{-1}) and sitting/picnicking/BBQ (520h y^{-1}) within the survey area. 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. Intertidal activities comprised: bait digging, sitting/picnicking/BBQ, beachcombing, collecting mussels, collecting razor clams, collecting seaweed, collecting shells, collecting winkles, crabbing, fishing, metal detecting, paddling, playing, research/education and rock pooling.

Occupancy rates for children and infant intertidal activities are presented in Table 5.5. Occupancy rates for children and infant aquatic (in water), aquatic (on water), handling rates of equipment and handling rates of sediment are presented in Table 5.6.

Intertidal activities for children were sitting/picnicking/BBQ, beach cleaning, beachcombing, crabbing, dog walking, fishing, paddling, playing, rock pooling, sunbathing and walking.

Table 5.5 Summary of children and infant external exposure for intertidal activities over intertidal substrates

Age Group	Intertidal substrate	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (h y^{-1})	Observed minimum for the high-rate group (h y^{-1})	Observed mean for the high-rate group (h y^{-1})	Observed 97.5th percentile for the high-rate group (h y^{-1})	Full dataset – Observed mean (h y^{-1})	Full dataset – 97.5th percentile (h y^{-1})
Child age group (6 to 15 years old)	Rock	8	1	312	312	312	NA	60.5	264
Child age group (6 to 15 years old)	Sand	32	3	365	165	232	355	34	210
Child age group (6 to 15 years old)	Sand and stones	20	8	156	58.5	105	156	47.6	156
Child age group (6 to 15 years old)	Stones	11	2	58	48	58	NA	12.8	55.5

Age Group	Intertidal substrate	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (h y^{-1})	Observed minimum for the high-rate group (h y^{-1})	Observed mean for the high-rate group (h y^{-1})	Observed 97.5th percentile for the high-rate group (h y^{-1})	Full dataset – Observed mean (h y^{-1})	Full dataset – 97.5th percentile (h y^{-1})
Infant age group (0 to 5 years old)	Rock	1	1	3.96	3.96	3.96	NA	3.96	NA
Infant age group (0 to 5 years old)	Sand	16	5	780	365	697	780	224	780
Infant age group (0 to 5 years old)	Sand and stones	2	2	120	120	120	120	120	120

The activities undertaken by children in the high-rate group over the following intertidal substrates included:

Rock: crabbing at Farland Point; fishing at St Phillans, Farland Point and Portencross; playing at Farland Point; and rock pooling at Fairlie Sands.

Sand: sitting/picnicking/BBQ at Seamill beach, Ardrossan north and south beach and Fairlie beach; beachcombing at Ardrossan north and south beach, Seamill beach, Ardneil Bay and Bowencraig; crabbing at Newtown Bay; dog walking at Ardneil Bay, Newtown Bay, Seamill beach and Ardrossan north beach; paddling at Ardrossan north and south beach, Portencross, Seamill beach, Newtown Bay and Bowencraig; playing at Ardrossan north and south beach; Seamill beach, Bell Bay, Newtown Bay, Bowencraig and Fairlie beach; rock pooling at Bell Bay; and, walking at Seamill beach, Bell Bay and Ardrossan north beach.

Sand and stone: sitting/picnicking/BBQ at Portencross and Largs Bay; beachcombing at Largs Bay; dog walking at Far Bowencraig and Largs Bay; paddling at Ardrossan south beach and Largs Bay; playing at Portencross, Largs Bay and Ardrossan south beach; rock pooling at Bowencraig and Largs Bay; and walking at Portencross.

Stones: beachcombing at Meigle Bay and Skelmorlie; beach cleaning at Meigle Bay; playing at Largs Bay and Wemyss Bay; and fishing at Saltcoats harbour.

The highest intertidal occupancy rate for a child was 365h y^{-1} for an individual who spent time dog walking (365h y^{-1}) on a sand substrate within the survey area.

On rock substrate, the highest occupancy was 312h y^{-1}, and this was for a child who spent time fishing within the survey area. On sand, the highest occupancy was 365h y^{-1}, and this was for a child who spent time dog walking within the survey area. On sand and stone substrate, the highest occupancy was 156h y^{-1} and this was for two children who spent time beachcombing (52h y^{-1}), playing (52h y^{-1}) and rock pooling (52h y^{-1}) within the survey area. On stone substrate, the highest occupancy

was 58h y^{-1}, and this was for a child who spent time beach cleaning (10h y^{-1}) and beachcombing (48h y^{-1}) within the survey area.

Intertidal activities for infants included sitting/picnicking/BBQ, beachcombing, crabbing, dog walking, paddling, playing rock pooling and walking.

The activities undertaken by infants in the high-rate group over the following intertidal substrates included:

Rocks: rock pooling at Boydston.

Sand: sitting/picnicking/BBQ at Seamill beach, Millport and Ardrossan south beach; beachcombing at Bowencraig and Seamill beach; crabbing at Newtown Bay; dog walking at Newtown Bay and Seamill; paddling at Bowencraig, Seamill beach, Fairlie beach, Newtown Bay and Ardrossan south beach; playing at Seamill beach, Fairlie beach, Millport, Newtown Bay and Ardrossan north beach; and walking at Seamill beach.

Sand and stone: paddling at Portencross; playing at Portencross; rock pooling at Portencross; and walking at Portencross.

The highest intertidal occupancy rate for an infant was 780h y^{-1} for four individuals who spent time sitting/picnicking/BBQ (260h y^{-1}) and time playing (520h y^{-1}) on a sand substrate within the survey area.

On rock substrate, the highest occupancy was 3.96h y^{-1} and this was for one infant who spent time rock pooling within the survey area. On sand substrate, the highest occupancy was 780h y^{-1}, and this was for four infants who spent time playing (520h y^{-1}) and sitting/picnicking/BBQ (260h y^{-1}) within the survey area. On sand and stone substrate, the highest occupancy was 120h y^{-1}, and this was for two infants who spent time paddling (12.5h y^{-1}), playing (23h y^{-1}), rock pooling (6.5h y^{-1}) and walking (78h y^{-1}) within the survey area.

Table 5.6 Summary of children and infant external exposure aquatic activities (in water and on water), handling of equipment and handling sediment

Age Group	Activity	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (h y^{-1})	Observed minimum for the high-rate group (h y^{-1})	Observed mean for the high-rate group (h y^{-1})	Observed 97.5th percentile for the high-rate group (h y^{-1})	Full dataset – Observed mean (h y^{-1})	Full dataset – 97.5th percentile (h y^{-1})
Child age group (6 to 15 years old)	Aquatic (in water)	21	5	52	18	33.2	52	9.89	52
Child age group (6 to 15 years old)	Aquatic (on water)	6	3	140	82.5	102	137	56.2	133
Child age group (6 to 15 years old)	Handling equipment	13	2	312	122	217	307	49.7	255
Child age group (6 to 15 years old)	Handling sediment	47	5	261	121	191	261	33	245

Age Group	Activity	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (h y^{-1})	Observed minimum for the high-rate group (h y^{-1})	Observed mean for the high-rate group (h y^{-1})	Observed 97.5th percentile for the high-rate group (h y^{-1})	Full dataset – Observed mean (h y^{-1})	Full dataset – 97.5th percentile (h y^{-1})
Infant age group (0 to 5 years old)	Aquatic (in water)	2	1	26	26	26	NA	15.4	26
Infant age group (0 to 5 years old)	Aquatic (on water)	1	1	26	26	26	NA	26	NA
Infant age group (0 to 5 years old)	Handling sediment	18	4	780	780	780	780	183	780

Child activities in the water included body boarding, outdoor swimming and stand-up paddle boarding. The highest occupancy rate for children in water was 52h y^{-1} for two individuals who spend time body boarding within the survey area. Activities on the water included commuting via boat, kayaking and fishing. The highest occupancy rate for children on water was 140h y^{-1}, this was for a child who spent time kayaking (70h y^{-1}) and fishing (70h y^{-1}) within the survey area. The activities for children involved handling boats and boating equipment and handling fishing gear. The highest level of handling equipment was 312h y^{-1} for a child who spent time fishing. The highest level of handling sediment was 261h y^{-1}, and this is for two individuals who spent time sitting/picnicking/BBQ (130.5h y^{-1}) and playing (130.5h y^{-1}) within the survey area. 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. Intertidal activities comprised: beachcombing, crabbing, paddling, playing, rock pooling, litter picking, sitting/picnicking/BBQ, fishing, and collecting sea glass.

Infant activities in the water included outdoor swimming and stand-up paddle boarding. The highest occupancy rate for an infant in water was 26h y^{-1} for an individual who spent time stand-up paddle boarding within the survey area. Infant activities on the water included bodyboarding and outdoor swimming. The highest occupancy rate for an infant on water was 26h y^{-1} for an individual kayaking within the survey area. The highest level for an infant handling sediment was 780h y^{-1} and this was for four individuals who spent time playing (520h y^{-1}) and sitting/picnicking/BBQ (260h y^{-1}) within the survey area. 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. Intertidal activities comprised: sitting/picnicking/BBQ, beachcombing, crabbing, paddling, playing and rock pooling.

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 A and B sites, coastal and intertidal areas (Figure 2.1). This chapter also details the production and consumption of private food, including the results from face-to-face discussions.

6.1.1 Terrestrial survey area

The terrestrial survey area stretches from the southern outskirts of Fairlie to West Kilbride and inland taking in all conurbations with communities ranging from as small as one house to villages. Much of the land within the survey area is agricultural, predominantly arable and livestock (mostly cattle and sheep).

6.2 Private food production

Three allotments were found within the 5km radius from the Hunterston A and B sites. One allotment has 181 raised bed plots and 169 members. The plots are made up of raised beds in polytunnels and outside. Members consist of individuals, couples and family groups. Each member is allocated one outdoor and one polytunnel raised bed plot. There are also four raised beds for the community where vegetables are grown, and produce is taken to individuals within the community through church and local authority contacts.

The second allotment has 18 plots and 14 members. Members grow a mixture of fruit and vegetables for consumption. Some members collect seaweed and apply it to their plot. One individual keeps chickens at the allotment.

The third allotment has 30 raised bed plots and growing space in polytunnels. Each of the 30 members are offered a plot and space in the polytunnel. The allotments have ‘friends’ of the garden who come in and help tend the plots. Approximately a quarter of the members use seaweed on their plots, which is applied on the beds in the Autumn. Some members wash the seaweed before digging into soil in the

Autumn and some apply directly on the beds after collecting, leaving it on top of the soil over the winter period.

Over the survey period, 21 people were interviewed who grew their own fruit and vegetables within their own home gardens and the food grown was consumed by their families and friends. These interviews yielded good quality data as many retained detailed records of the crop grown and their yields.

One family interviewed keep chickens and consume the eggs.

6.3 Commercial food production

Local butchers were contacted to determine where their produce was sourced. Of butchers contacted, one butcher sold meat that was sourced from within the 5km terrestrial survey area.

6.4 Wild foods

Within the terrestrial survey area wild food consumption was reported by 22 individuals. A breakdown of the foods, number of individuals, consumption and locations are detailed in Table 6.1.

One individual collected wild garlic and mushrooms from near the Hunterston A and B sites and Glentane Hill and pink purslane from the Hunterston area commercially for consumption but was unable to provide quantities.

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, however, if honey is to be sold commercially then a licence is required.

The local beekeeper's association was contacted but the survey team were unable to collect any information on beekeepers within the terrestrial survey area.

Three beekeepers who keep bees within the 5km survey area were interviewed during the survey period. Beekeepers were found to consume, sell, and gift honey

produced. Apiaries consisted of several hives with a total yield varying up to 45kg y^{-1}. This year, a low yield was reported due to poor weather and the inability for the bees to forage.

6.6 Farms

Within the Hunterston terrestrial survey area, 13 working farms were identified, however, only seven farms provided information. Farming included cattle, sheep, crops, and mixed farming (crops and animals). Three farms used water for human and animal consumption solely from the mains water while one farm consumed water via a private spring for humans and animals. One farm consumed water via the mains however during the summer months cattle had access to spring water. Another farm consumed water for humans via the mains water supply but provided ditch water for their animals. The last farm provided mains water supply for human and animal consumption but when the animals are in the fields, they have access to ditch and burn water.

No farms shot and consumed game. Crops produced within the 5km survey area were hay, silage, potatoes, turnips, spring barley, winter barley and wheat. No produce grown was consumed by the farm however some farms produced some of their own animal feed. Poultry (hens) were kept by one farm with eggs consumed by farm individuals only.

Table 6.1 Wild food summary of total number of individuals, highest annual consumption, and locations

Food type	Total number of individuals	Maximum individual consumption (kg y^{-1})	Location of maximum consumption foraged	Other locations of foraging
Apple	2	7.5	Around Thirdpart	-
Blackberry	17	4	Hedgerows around Thirdpart	Hunterston Estate, West Kilbride, Portencross
Elderberry	5	0.9	West Kilbride	-
Elderflower	3	0.5	West Kilbride	-
Garlic berries	2	0.75	West Kilbride	-
Garlic leaves	1	0.1	Within 5km terrestrial survey area	-
Hawthorn berries	3	3	West Kilbride	Hunterston
Mushrooms	2	1.75	West Kilbride	-
Nettle leaves	2	0.25	West Kilbride	-
Nettle seeds	2	0.05	West Kilbride	-
Raspberry	1	1	Hunterston - coastal path	-
Rosehips	1	2.7	Hunterston – coastal path	-
Watercress	1	0.1	Within 5km terrestrial survey area	-

Internal exposure – phase 1

6.7.1 Internal exposure adult consumption rate

Adult consumption data for locally produced foodstuffs potentially affected by atmospheric releases from Hunterston are presented in Table 6.2. The table presents the adult consumption rates summarising 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 consumption rate. The table contains the mean consumption rate for both the high-rate consumer group and the whole dataset collected from around Hunterston. The table also provides the mean and 97.5th percentile consumption rates from national data (Smith and Jones, 2003) for comparison. The national data 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 consumption data does not consider any extreme habits, and this may be an area for further research. For example, there may be regional or local differences in habits which may result in different rates of consumption, with many of the food groups showing greater consumption than the national mean and may represent an important local pathway. It may be necessary to consider that the national data (which is aggregated and is useful as a broad comparison) cannot capture local or regional variations in habits, which may have significance.

Consumption of locally produced foods was identified and are presented in Table 6.2.

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

Food type	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1}or l y^{-1})	Observed minimum for the high-rate group (kg y^{-1}or l y^{-1})	Observed mean for the high-rate group (kg y^{-1}or l y^{-1})	Observed 97.5th percentile for high-rate group (kg y^{-1}or l y^{-1})	Full dataset – Observed mean (kg y^{-1}or l y^{-1})	Full dataset – 97.5th percentile (kg y^{-1}or l y^{-1})	National mean (kg y^{-1}or l y^{-1})	National 97.5th percentile (kg y^{-1}or l y^{-1})
Green vegetables	18	10	27.5	11.7	20.9	27.5	13.5	27.5	15	45
Other vegetables	19	6	17.7	6.5	10.5	17	4.56	15.1	20	50
Root vegetables	21	10	34	11.6	18.9	32.4	11.23	30.3	10	40
Potatoes	22	5	100	40	66	97.5	20.5	86.9	50	120
Fruit domestic	24	5	144	49.8	91.1	144	30.4	144	20	75

Food type	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1}or l y^{-1})	Observed minimum for the high-rate group (kg y^{-1}or l y^{-1})	Observed mean for the high-rate group (kg y^{-1}or l y^{-1})	Observed 97.5th percentile for high-rate group (kg y^{-1}or l y^{-1})	Full dataset – Observed mean (kg y^{-1}or l y^{-1})	Full dataset – 97.5th percentile (kg y^{-1}or l y^{-1})	National mean (kg y^{-1}or l y^{-1})	National 97.5th percentile (kg y^{-1}or l y^{-1})
Fruit wild	17	6	10.9	4	8.16	10.7	3.3	10.3	7	25
Wild fungi	2	2	1.75	1.75	1.75	1.75	1.75	1.75	3	10
Meat sheep	4	1	15.6	15.6	15.6	NA	5.73	14.6	10	30
Eggs	19	11	36.2	15	24.8	36.2	16.4	36.2	8.5	25
Honey	6	5	9	3	6.3	9	5.35	9	2.5	9.5

One observed mean consumption rate for the high-rate consumer group was found to be greater than the national 97.5th percentile value, this was for domestic fruit. One observed mean consumption rate for the high-rate consumer group was found to be comparable to the national 97.5th percentile value, this was for eggs. All high figures were checked with individuals for verification. Eight of the observed mean consumption rates for the high-rate consumer group were found to exceed the national mean consumption rates. These were for green vegetables, root vegetables, potatoes, domestic fruit, wild fruit, sheep meat, eggs and honey.

6.7.2 Child consumption rates

Table 6.3 presents a summary of the child consumption rates. The table summarises the number of observations made, the number of individuals 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 consumption rate. 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 domestic fruit, wild fruit and eggs. Infant consumption of locally produced foods was identified for domestic fruit and wild fruit.

Table 6.3 Summary of children and infant consumption rates

Age Group	Food type	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1} or l y^{-1})	Observed minimum for the high-rate group (kg y^{-1} or l y^{-1})	Observed mean for the high-rate group (kg y^{-1} or l y^{-1})	Observed 97.5th percentile for high-rate group (kg y^{-1} or l y^{-1})	Full dataset – Observed mean (kg y^{-1} or l y^{-1})	Full dataset – 97.5th percentile (kg y^{-1} or l y^{-1})
Child age group (6 – 15 years old)	Fruit domestic	3	1	5.44	5.44	5.44	NA	2.48	5.22
Child age group (6 – 15 years old)	Eggs	2	2	3	3	3	3	3	3
Child age group (6 – 15 years old)	Fruit wild	3	3	0.9	0.5	0.63	0.88	0.63	0.88

Age Group	Food type	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1} or l y^{-1})	Observed minimum for the high-rate group (kg y^{-1} or l y^{-1})	Observed mean for the high-rate group (kg y^{-1} or l y^{-1})	Observed 97.5th percentile for high-rate group (kg y^{-1} or l y^{-1})	Full dataset – Observed mean (kg y^{-1} or l y^{-1})	Full dataset – 97.5th percentile (kg y^{-1} or l y^{-1})
Infant age group (0 – 5 years old)	Fruit domestic	1	1	4.72	4.72	4.72	NA	4.72	NA
Infant age group (0 – 5 years old)	Fruit wild	1	1	0.9	0.9	0.9	NA	0.9	NA

7 External exposure

7.1 Introduction

Gamma dose rates can vary markedly over short distances due to external factors e.g. geology, nearby buildings, trees etc., anthropogenic releases and shine from nuclear power plant activities. An understanding of the spatial variation in dose rate is important for determining the implications of the habits of the local population. A mobile (both handheld and carborne, Section 7.2) and in-situ gamma dose rate survey (Section 7.3) was therefore undertaken. To achieve large-scale coverage, a MoGSS was used to measure the dose rates for the natural occurring gamma emitting radionuclides (potassium-40 and the uranium-238 and thorium-232 decay series) alongside estimates for anthropogenic caesium-137. However, this approach is unable to assess the occurrence of the most abundant radionuclide released from Hunterston, namely tritium. Tritium can be measured by sampling and analysis in the environmental monitoring program.

In-situ beta dosimetry (Section 7.4) was undertaken on a boat in the Hunterston area to estimate the skin dose associated with radioactivity in the environment.

7.2 Mobile Gamma Spectrometry Survey (MoGSS)

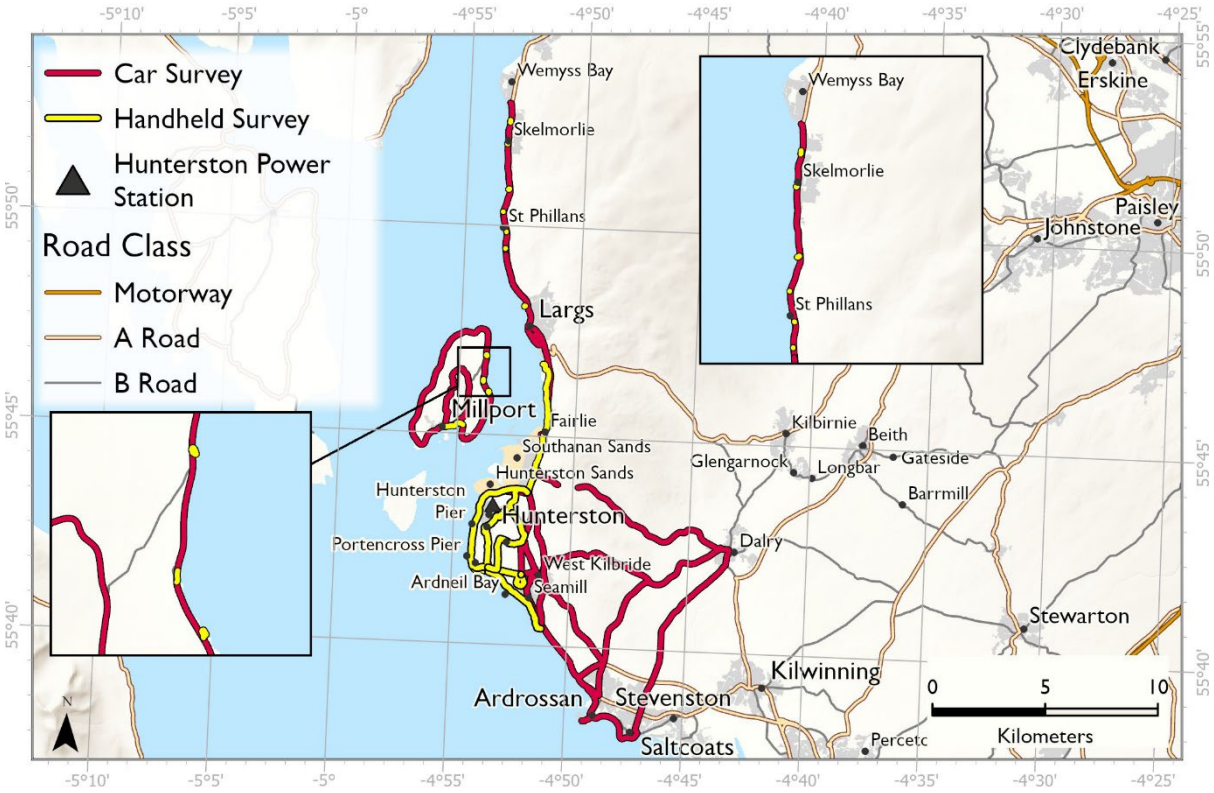
MoGSS was utilised to measure the differential dose estimations for the natural radioelements (potassium-40 and the uranium-238 and thorium-232 decay series) alongside estimates for anthropogenic caesium-137. The ability to separate dose contributors is especially important given that any potential contributions from caesium-137 could be identified from the spatially variable background element concentrations, particularly on beaches close to the site.

7.2.1 Survey area

A carborne gamma spectrometry survey of the study area was undertaken supplemented by a handheld gamma spectrometry system along some of the coastal sections (from Fairlie to Seamill). Areas of particular focus were within 5km radius of the Hunterston A and B sites and around intertidal areas that could be accessed by the public. The roads surveyed covered more than 50km.

To obtain as broad a spatial sample as possible and to investigate as many environments as possible, two systems operating MoGSS were deployed. Firstly, one large volume sodium iodide detector was mounted in a box on top of a car, which was driven along the roads within the area of interest (Varley et al., 2020). The system, with a combined detector volume of four litres, has high counting efficiency but was restricted to areas of vehicular access and thus could only be used on roads and carparks. Secondly, to focus in on smaller areas not accessible by vehicle and to cover accessible coastline areas, a handheld system comprising a 71 × 71 mm sodium iodide detector was used. All MoGSS units produced differential energy spectra recorded at one second integration time alongside high accuracy (<0.6 m) differential Global Positioning System (GPS) readings. Coverage of the handheld and carborne MoGSS are shown in Figure 7.1.

Figure 7.1 Coverage for handheld and carborne MoGSS



7.2.2. Carborne and handheld results

Overall, 33000 spectral measurements were made (~10291 – carborne; ~19125 – handheld).

Dose rates typically ranged from 0.001µGy h^{-1} (1nGy h^{-1}) to more than 0.1µGy h^{-1} (100nGy h^{-1}). Higher values between 0.1 and 0.59µGy h^{-1} may be attributable to elevated natural radiation, for example high concentrations of potassium-40 from road and building construction materials.

7.3 In-situ gamma dosimetry

The Environmental Radioactivity Laboratory (ERL) has ISO 17025:2017 accredited procedures for the deployment and recording of gamma dose rate in air, using ISO 17025:2017 accredited (UKAS) calibrations for two Thermo Radeye instruments. Measurements were taken at all locations where occupancy or location may lead to higher exposure to radioactivity or radiation because of site activities.

Twenty-seven in-situ gamma dose rate measurements were collected at intertidal sites during the survey. A UKAS accredited procedure was followed to estimate the terrestrial gamma dose rate. Since most of the dose contribution was thought to be from naturally occurring radionuclides, a radium-226 calibration was used to estimate dose rate for all gamma dose rate measurements. Radium-226 occurs naturally in the environment and emits several gamma-rays spanning the environmentally relevant energy spectrum (0-2204keV).

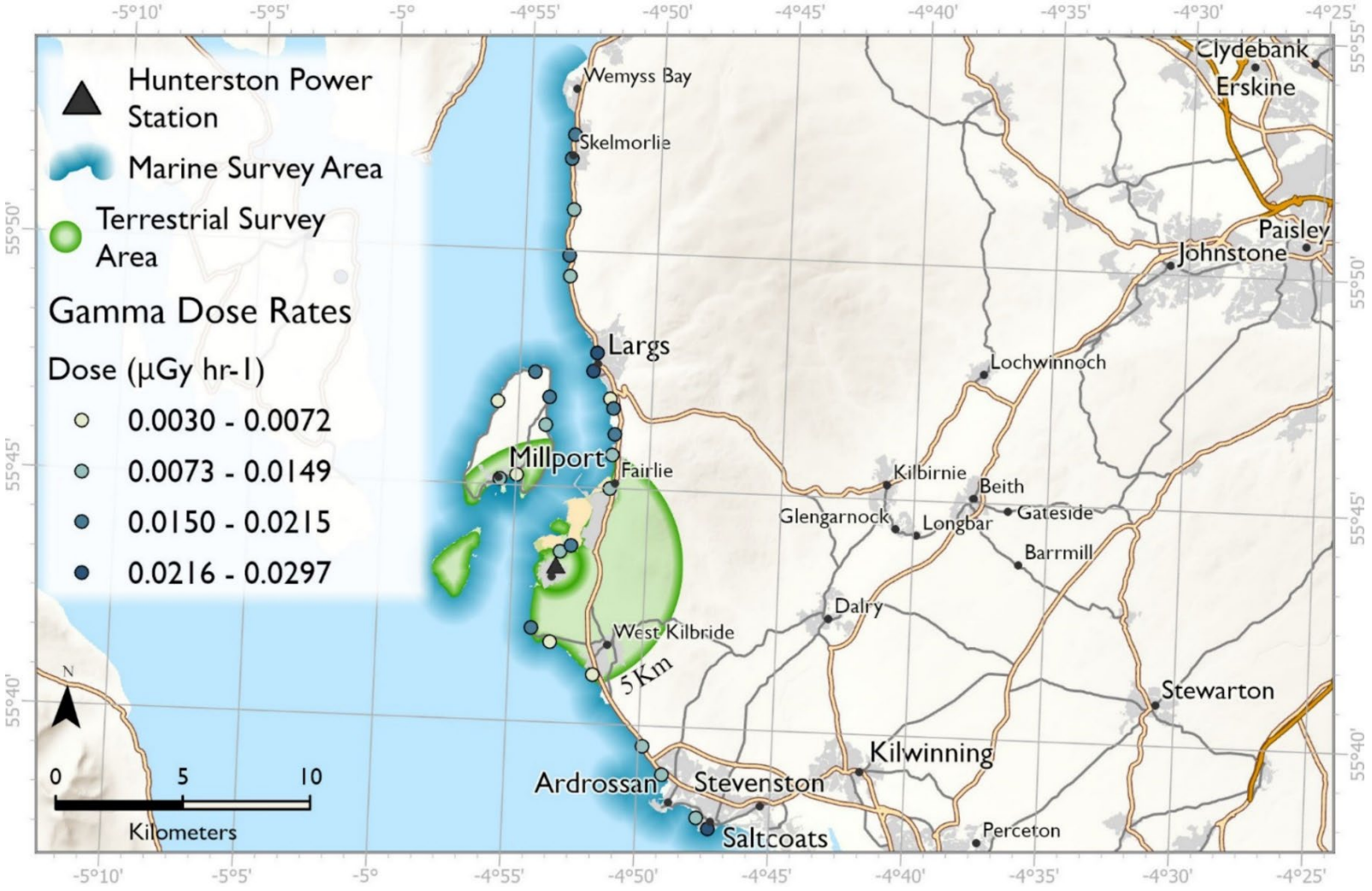
A summary of the dose rate measurements made across the survey area for terrestrial and intertidal areas can be found in Table 7.1. Note that most of the higher readings are made over mud and stone. Lower readings tended to be recorded on sandier areas. Spatially (Figure 7.2), there was little evidence to link patterns in dose rates to the Hunterston A and B sites.

Table 7.1 Summary of gamma dose rate measurements collected across the Hunterston survey area

Site	Surface	Eastings	Northings	Dose rate (μGy h^{-1})	2σ Uncertainty (μGy h^{-1})
Southanan Sands	Mud	2191	6522	0.020352	0.003595
Hunterston Sands	Mud and stone	2187	6520	0.014908	0.003463
Castle Bay	Rock	2200	6591	0.025796	0.003743
Saltcoats Harbour	Rock	2245	6411	0.029313	0.003846
Near Routenburn	Rock (large)	2191	6628	0.014070	0.003444
St Phillans	Rock and sand	2191	6636	0.018007	0.003536
Skelmorlie	Rock and stone	2192	6674	0.018174	0.003540
Ardneil Bay	Sand	2183	6484	0.003015	0.003234
Ardrossan North	Sand	2227	6432	0.009045	0.003339
Ardrossan South	Sand	2240	6415	0.009464	0.003347
Boydston	sand	2219	6443	0.009380	0.003345
Fairlie Sands North	Sand	2207	6558	0.011977	0.003398
Fairlie Sands South	Sand	2206	6544	0.008961	0.003337
Kames Bay	Sand	2170	6550	0.006533	0.003292
Newton Sands	Sand	2163	6549	0.012982	0.003420
Portencross (harbour)	Sand	2175	6490	0.017923	0.003534
Seamill	Sand	2199	6471	0.005444	0.003273

Site	Surface	Eastings	Northings	Dose rate (μGy h^{-1})	2σ Uncertainty (μGy h^{-1})
Bowencraig	Sand and shell	2207	6580	0.006198	0.003286
Kelburnfoot	Sand and shell	2208	6566	0.021524	0.003626
Ballochmartin Bay	Sand and stone	2181	6570	0.010134	0.003360
Jetty (by old watersports centre, Cumbrae)	Sand and stone	2183	6581	0.020352	0.003595
Little Skate Bay	Sand and stone	2162	6579	0.007203	0.003304
Meigle	Sand and stone	2192	6654	0.011725	0.003393
White Bay	Sand and stone	2177	6590	0.018174	0.003540
Largs	Stone	2202	6598	0.029732	0.003858
Wemyss Bay	Stone	2193	6684	0.019933	0.003584
Far Bowencraig	Stone and silt	2208	6576	0.019263	0.003567

Figure 7.2 Summary of the gamma dose rate measurements across the Hunterston survey area



7.4 In-situ beta dosimetry

One in situ beta dosimetry measurement of skin dose [H*(0.07)] equivalent was measured on a sailing boat that was situated close to the coast. The result was below the detection limit of 0.2μSv h^{-1} per cm^{-2}.

7.5 Occupancy rates

7.5.1. Occupancy data for the survey area

The Phase 1 interviews revealed that individuals take part in a range of terrestrial, aquatic, and intertidal activities within the survey area (Table 7.2). For terrestrial activities, the most popular activity was rambling/walking (48 individuals) and the terrestrial activity with the overall maximum occupancy was for an individual spending 4380h y^{-1} dog walking within the terrestrial survey area. For the intertidal activities, playing was the most popular (103 individuals) with the highest individual occupancy being 1560h y^{-1} for dog walking at Fairlie beach, Largs Bay and Kelburnfoot. For the aquatic activities, outdoor swimming was the most popular (70 individuals) and the aquatic activity with the overall maximum occupancy was for an individual working on a boat spending 2600h y^{-1} offshore of Largs.

Table7.2 Summary of the activities and total number of individuals that take part in the activities. The location of the maximum occupancy is also given

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y $^{-1}$)	Location of Maximum Occupancy
Terrestrial	Allotments	7	2190	Within 5km survey area
Terrestrial	Beekeeping	2	104	West Kilbride
Terrestrial	Bird/nature watching	8	585	Hunterston Estate and Portencross
Terrestrial	Boat maintenance	1	6	Portencross
Terrestrial	Camping	2	8	Portencross
Terrestrial	Collecting wild produce	9	456	Within 5km survey area
Terrestrial	Crofting	1	1460	Within 5km survey area
Terrestrial	Cycling	34	548	Within 5km survey area
Terrestrial	Dog walking	46	4380	Within 5km survey area
Terrestrial	Drone flying	1	78	Hunterston Sands
Terrestrial	Farming	6	3120	West Kilbride
Terrestrial	Fishing	1	9	Glenburn Reservoir
Terrestrial	Gardening	36	2008	Within 5km survey area
Terrestrial	Groundworks	1	540	Within 5km survey area

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y^{-1})	Location of Maximum Occupancy
Terrestrial	Horse riding	1	104	Within 5km survey area
Terrestrial	Invertebrate watching	1	195	Hunterston Estate and Portencross
Terrestrial	Jogging	5	365	Great Cumbrae Island
Terrestrial	Playing	8	548	Within 5km survey area
Terrestrial	Rambling/walking	48	520	Within 5km survey area
Terrestrial	Sitting/picnicking/BBQ	16	711	Within 5km survey area
Terrestrial	Small holding outdoor activities	3	3376	Within 5km survey area
Intertidal	Bait digging	6	260	Ardrossan South beach
Intertidal	Sitting/picnicking/BBQ	93	520	Newtown Bay
Intertidal	Beach clean	1	10	Meigle Bay
Intertidal	Beachcombing	7	234	Ardneil Bay
Intertidal	Boat maintenance	3	52	Portencross
Intertidal	Collecting mussels	1	1	Kelburnfoot
Intertidal	Collecting razor clams	1	1	Castle Bay

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y^{-1})	Location of Maximum Occupancy
Intertidal	Collecting seaweed	6	137	Fairlie
Intertidal	Collecting shells	1	52	Seamill
Intertidal	Collecting winkles	2	2	Ardrossan North beach
Intertidal	Crabbing	9	5	Farland Point
Intertidal	Dog walking	77	1560	Fairlie beach, Largs Bay, Kelburnfoot
Intertidal	Drone flying	2	39	Hunterston Sands
Intertidal	Fishing	34	1042	Saltcoats harbour and Portencross
Intertidal	Jogging	1	52	Ardneil Bay
Intertidal	Launching and recovery of dinghies	1	2	Bowen Craig
Intertidal	Launching and recovery of dinghies	1	2	Bowen Craig
Intertidal	Metal detecting	4	2.5	Ardrossan South beach
Intertidal	Paddling	67	39	Hunterston Sands
Intertidal	Preparation and deconstruction of paddle board	1	2	Ardrossan North beach

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y^{-1})	Location of Maximum Occupancy
Intertidal	Playing	103	520	Newtown Bay
Intertidal	Research/education	1	10	Fairlie beach
Intertidal	Rock pooling	24	120	Largs Bay
Intertidal	Slipway cleaning	1	39	Largs Marina
Intertidal	Sunbathing	3	1	Ardrossan North beach
Intertidal	Walking	58	1119	Seamill and Largs Bay
Aquatic	Boat maintenance	4	624	Largs Marina
Aquatic	Body boarding	2	52	Ardneil Bay
Aquatic	Canoeing	7	10	Portencross
Aquatic	Commute via boat	11	6	Fairlie Roads
Aquatic	Jet skiing	1	113	Largs Marina
Aquatic	Kayaking	13	104	Portencross
Aquatic	Outdoor swimming	70	39	Seamill beach
Aquatic	Power boating	5	390	Millport
Aquatic	RNLI duties	1	1.5	Largs Bay
Aquatic	Sailing	18	273	Off Largs Marina
Aquatic	Sea angling	10	560	Castle Bay

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y^{-1})	Location of Maximum Occupancy
Aquatic	Small inflatable boat	1	20	Fairlie
Aquatic	Stand-up paddle boarding	38	104	Seamill beach
Aquatic	Working on a boat	1	2600	Largs

7.5.2 Occupancy rates within 1km of Hunterston (inside/outside work or home)

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 7.3 show the time spent indoors and outdoors on an annual basis. Thirteen individuals interviewed worked within 1km of the Hunterston A and B nuclear licensed sites. The highest time spent indoors at work for one individual each was 2555h y^{-1} and the highest time spent outdoors at work for one individual was 4015h y^{-1}. The highest time spent indoors for one individual was 6570h y^{-1} indoors, and the highest time spent in the immediate area outside their house was 3650h y^{-1} for one individual. All figures consider any holiday period away from home with all figures checked and confirmed by the individuals. The highest total occupancy living within 1km of the Hunterston nuclear licensed site was 8396h y^{-1} for one individual.

Table 7.3 Occupancy rates of those individuals working or living within 1km 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 $^{-1}$)
171	3650	3650	-	-
441	3650	1825	-	-
442	2920	730	-	-
443	-	-	-	3200
83	6570	1095	-	-
82	3650	730	548	3468
480	3650	730	-	4015
80	5840	365	-	-
481	5840	-	2555	-
482	5840	730	-	-
483	5840	183	-	-
79	4015	-	-	-
139	-	-		3458

8 Phase 2 survey results

8.1 Introduction

There were three aims to the Phase 2 surveys conducted. These were to i) validate the Phase 1 face-to-face surveys; ii) identify any major changes to internal/external exposure pathways; and iii) identify any new pathways within a select group of individuals. To determine the individuals selected, the total dose from all exposure pathways for each survey participant was estimated. These data were then used to identify three individuals from different parts of the dose distribution (e.g. the top third, middle third and bottom third of the distribution). It was agreed with SEPA that the Phase 2 survey should target nine individuals. Additional considerations affecting selection were that some individuals (when asked during Phase 1) said they did not want to be contacted again, for some individuals we had incorrect contact details, or individuals did not respond to approaches made by the survey team during the Phase 2 surveys. For Hunterston, follow up surveys were made in November 2024. Seven individuals agreed to participate with the Phase 2 survey when contacted: two individuals from the high group (A and B), two individuals from the medium group (D and E) and three individuals from the low group (G, H and I) group.

8.2 Phase 2 internal exposure

8.2.1 Internal terrestrial

There was no terrestrial food group consumption (all locally sourced within 5km) reported by any individual selected within the medium group within Phase 1 of the survey. Within the high group two individuals consumed produce within the Phase 1 and Phase 2 surveys and data are provided in Table 8.1. Within the high group, there was no change in terrestrial food consumption for individual A however there was a change in terrestrial food consumption for individual B. This was due to some of the produce being consumed by one other individual and some of the produce not being successfully grown. Individual B also foraged for wild mushrooms since the Phase 1 survey, and this was included in the Phase 2 survey results.

Within the low group only individual I reported terrestrial food group consumption. Individual I consumed wild fruit (blackberries) within the Phase 2 survey which was not collected when undertaking the Phase 1 survey (Table 8.2).

Table 8.1 Survey comparison of terrestrial consumption for the high group (kg y^{-1})

Food type	A Phase 1 (kg y^{-1})	A Phase 2 (kg y^{-1})	B Phase 1 (kg y^{-1})	B Phase 2 (kg y^{-1})
Green leafy vegetables	19.2	19.2	24.2	13.2
Other vegetables	2	2	0.5	-
Root vegetables	14.6	14.6	8.8	2.7
Potatoes	40	40	100	25
Domestic fruit	15	15	53.5	48.5
Eggs	-	-	18	9
Wild fungi	-	-	-	0.45

Table 8.2 Survey comparison of terrestrial consumption for the low group (kg y^{-1})

Food type	I Phase 1 (kg y^{-1})	I Phase 2 (kg y^{-1})
Wild foods	-	2.7

8.2.2 Internal aquatic

There was no aquatic food group consumption (all locally sourced within the marine survey area) reported by any individual selected within the high, medium or low groups within Phase 1 of the survey. No aquatic food consumption was determined within the Phase 2 survey.

8.3 Phase 2 external exposure

8.3.1 External terrestrial

Terrestrial occupancy was reported within the high, medium and low groups (occupancy within 5km – terrestrial survey area). Within the high group both individual's A and B undertook terrestrial activities in both the Phase 1 and Phase 2 surveys, and the data are provided in Table 8.3. There was no change to individual A's activities and occupancy between the Phase 1 and Phase 2 surveys. Individual B however did have some changes within the Phase 2 survey. The time spent at the allotment in Phase 1 (494h y^{-1}) decreased within the Phase 2 survey. This was due to these hours being reported solely as occupancy at the allotment in Phase 1 whereas in the Phase 2 survey, the hours were reported as being at the allotment (52h y^{-1}) and occupancy gardening at home (338h y^{-1}). The total of 390h y^{-1} occupancy within the allotment and gardening was however less than the total occupancy for the allotment within the Phase 1 survey due to spending less time in late summer and the autumn months at the allotment. Individual B also reported to spending less time dog walking in the Phase 2 survey than was reported in the Phase 1 survey. This was due to some of that time being spent on intertidal substrate which is reflected in Table 8.6. Less occupancy was also reported for individual B whilst undertaking rambling/walking in the Phase 1 survey (325h y^{-1}) than was reported in the Phase 2 survey (169h y^{-1}). As is reflected in consumption in Table 8.1, individual B spent a small amount of time collecting wild produce in the Phase 2 survey which was a new activity and therefore not reported in the Phase 1 survey.

Within the medium group only one individual reported undertaking terrestrial activities within Phase 1 and Phase 2 surveys (Table 8.4). Individual E reported to

spending 1460h y^{-1} dog walking within the Phase 1 survey however, within the Phase 2 survey, it was felt this was overestimated and individual E reported to spending 548h y^{-1} dog walking within the terrestrial survey area.

Within the low group only one individual reported to undertaking terrestrial activities within Phase 1 and Phase 2 surveys (Table 8.5). There was a slight change between activity occupancy in the Phase 1 and Phase 2 surveys for individual I for cycling and dog walking. Individual I reported to spend 39h y^{-1} and 78h y^{-1} cycling and 156h y^{-1} and 104h y^{-1} dog walking within the Phase 1 and Phase 2 surveys respectively. There was no explanation for this. Both gardening and rambling/walking were comparable within the Phase 1 and Phase 2 surveys.

Table 8.3 Survey comparison of terrestrial occupancy for the high group (h y^{-1})

Terrestrial activities	A Phase 1 (h y^{-1})	A Phase 2 (h y^{-1})	B Phase 1 (h y^{-1})	B Phase 2 (h y^{-1})
Allotments	2190	2190	494	52
Bird/nature watching	2.5	2.5	-	-
Cycling	548	584	-	-
Dog walking	-	-	156	78
Gardening			-	338
Rambling/walking	-	-	325	169
Collecting wild produce	-	-	-	0.08
Sitting/picnicking/BBQ	-	-	-	-

Table 8.4 Survey comparison of occupancy for the medium group (h y^{-1})

Terrestrial activities	E Phase 1 (h y^{-1})	E Phase 2 (h y^{-1})
Dog walking	1460	548

Table 8.5 Survey comparison of terrestrial occupancy for the low group (h y^{-1})

Terrestrial activities	I Phase 1 (h y^{-1})	I Phase 2 (h y^{-1})
Cycling	39	78
Dog walking	156	104
Gardening	208	195
Rambling/walking	365	365

8.3.2 External aquatic

Intertidal and aquatic occupancy was reported within the high, medium and low groups within the marine survey area.

Within the high group both individual's A and B undertook marine activities in both Phase 1 and Phase 2 surveys, and the data are provided in Table 8.6. There was no change to individual A's activities and occupancy in both the Phase 1 and Phase 2 surveys. Individual B's Phase 1 and Phase 2 surveys were comparable for occupancy over sand and handling sediment, and they reported spending time on sand and stone substrate in Phase 2 (not reported in Phase 1).

Within the medium group both individuals D and E undertook marine activities in both Phase 1 and Phase 2 surveys, and the data are provided in Table 8.7. Individual D reported substantially less time walking on intertidal substrates in the Phase 2 survey than the Phase 1 survey with a substantial decrease in occupancy on sand substrate and an increase in occupancy on sand and stone substrate. Individual E reported more time spent sitting/picnicking/BBQ and beachcombing within the Phase 2 survey than in the Phase 1 survey due to visiting the beach more often. Outdoor swimming was reported within the Phase 1 survey for Individual E however this was not reported within the Phase 2 survey. Individual E reported to not having undertaken any outdoor swimming.

Within the low group individuals G, H and I undertook marine activities in both Phase 1 and Phase 2 surveys, and the data are provided in Table 8.8. Individual G reported to underestimating time spent walking within the Phase 1 survey in the Phase 2 survey. Individual G reported they had spent less time outdoor swimming (26h y^{-1} and 39h y^{-1} respectively) for their in water occupancy in the Phase 2 survey than in Phase 1. There was no change to individual H's activities and occupancy in both the Phase 1 and Phase 2 surveys. Individual I reported less time dog walking in the Phase 2 survey (52h y^{-1}) than in the Phase 1 survey (86h y^{-1}). There was no explanation for this.

Table 8.6 Survey comparison of intertidal and aquatic activity occupancy for the high group (h y^{-1})

Intertidal and aquatic occupancy	A Phase 1 (h y^{-1})	A Phase 2 (h y^{-1})	B Phase 1 (h y^{-1})	B Phase 2 (h y^{-1})
Occupancy over sand	401	401	4.5	3
Occupancy over sand and stones	137	137	-	78
Occupancy in water	1.87	1.87	-	-
Handling equipment	13	13	-	-
Handling sediment	342	342	4.5	3

Table 8.7 Survey comparison of intertidal and aquatic activity occupancy for the medium group (h y^{-1})

Intertidal and aquatic activities	D Phase 1 (h y^{-1})	D Phase 2 (h y^{-1})	E Phase 1 (h y^{-1})	E Phase 2 (h y^{-1})
Occupancy on sand	1095	128	20	50
Occupancy on sand and stone	24	208	-	-
Occupancy in water	-	-	2	-
Handling sediment	-	-	20	50

Table 8.8 Survey comparison of intertidal and aquatic activity occupancy for the low group (h y^{-1})

Intertidal and aquatic activities	G Phase 1 (h y^{-1})	G Phase 2 (h y^{-1})	H Phase 1 (h y^{-1})	H Phase 2 (h y^{-1})	I Phase 1 (h y^{-1})	I Phase 2 (h y^{-1})
Occupancy on sand	-	-	2	2	86	52
Occupancy on sand and stone	6	52	1	1	-	-
Occupancy on stone	-	-	3	3	-	-
Occupancy in water	39	26	-	-	-	-
Handling sediment	-	-	6	6	-	-

9 Post Covid-19 habit analysis

It was discussed with SEPA that due to the pandemic individuals' habits may have somewhat changed for different reasons. Individuals were asked if any of their habits (terrestrial, intertidal, and aquatic) had changed since the Covid19 pandemic. Within the survey 249 individuals provided a definitive answer to whether there had been any changes to their habits. Figures 9.1 to 9.4 show individuals' habits post Covid19.

Figure 9.1 shows that 133 individuals reported that there had been no changes to their habits, 58 individuals reported that they now spent more time outdoors (some individuals indicated that as a family they all spent more time outdoors), 12 individuals reported that they now spent less time outdoors and 46 individuals reported that their habits had changed due to 'other' reasons. Figures 9.2, 9.3 and 9.4 provide a breakdown of each category within Table 9.1.

Figure 9.1 Post Covid-19 changes identified from individuals surveyed

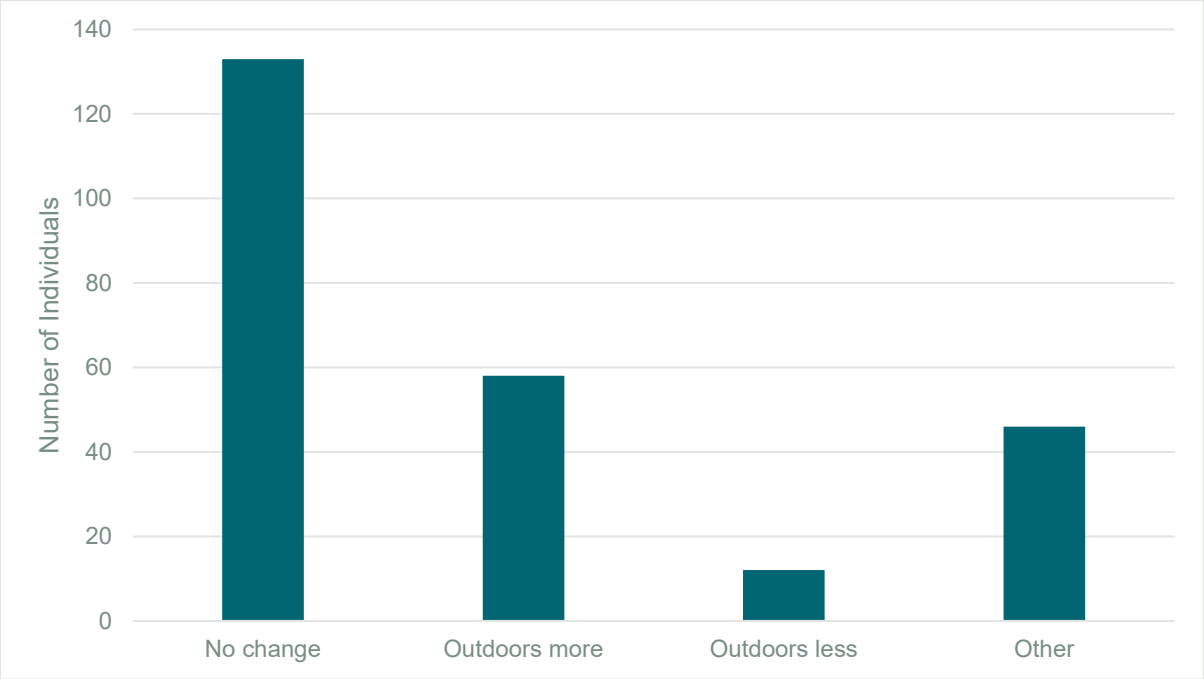


Figure 9.2 Breakdown of habits individuals reported post Covid-19 for those individuals reporting more time spent outdoors

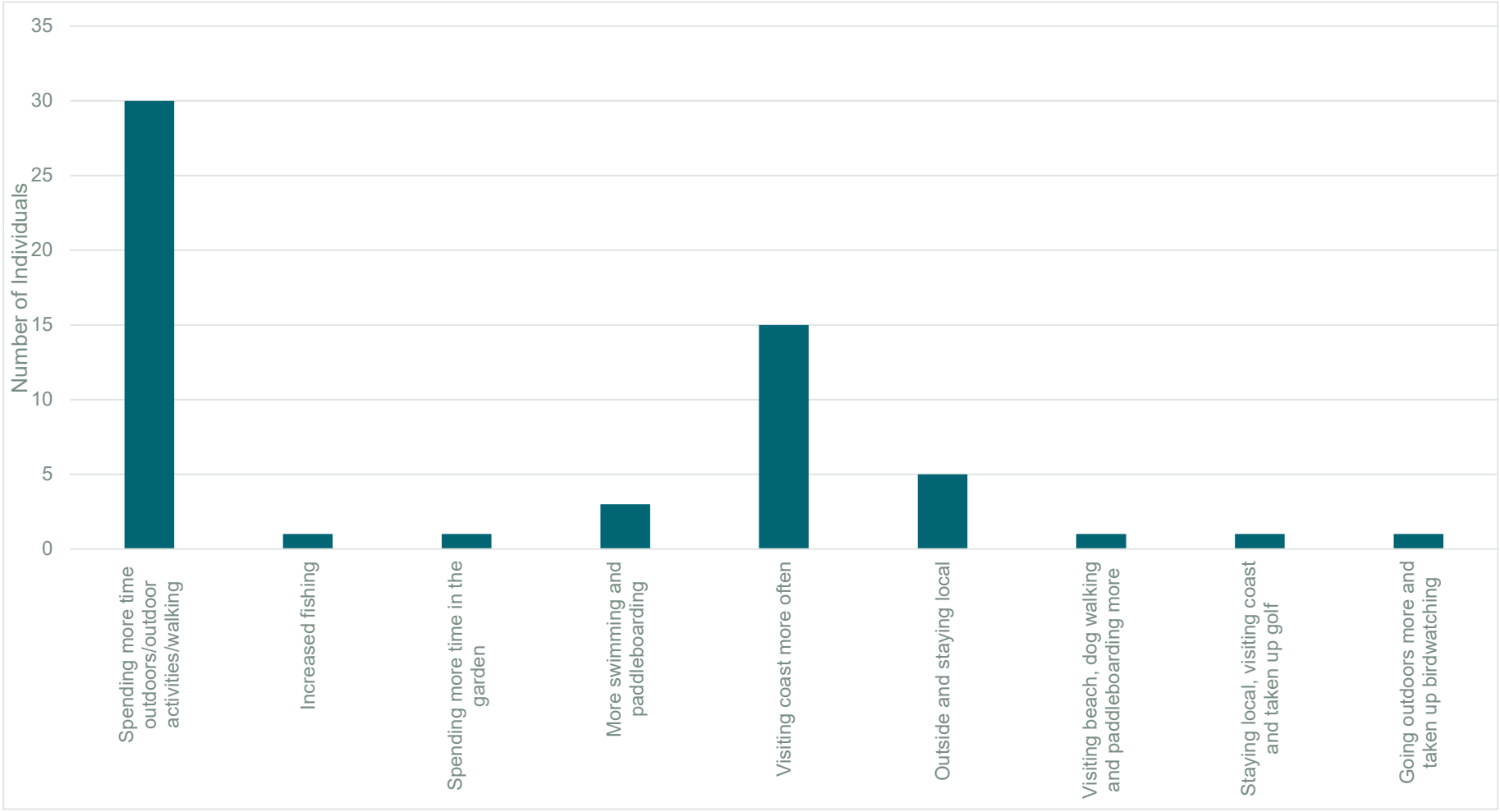


Figure 9.3 Breakdown of habits individuals reported post Covid-19 for those individuals reporting less time spent outdoors

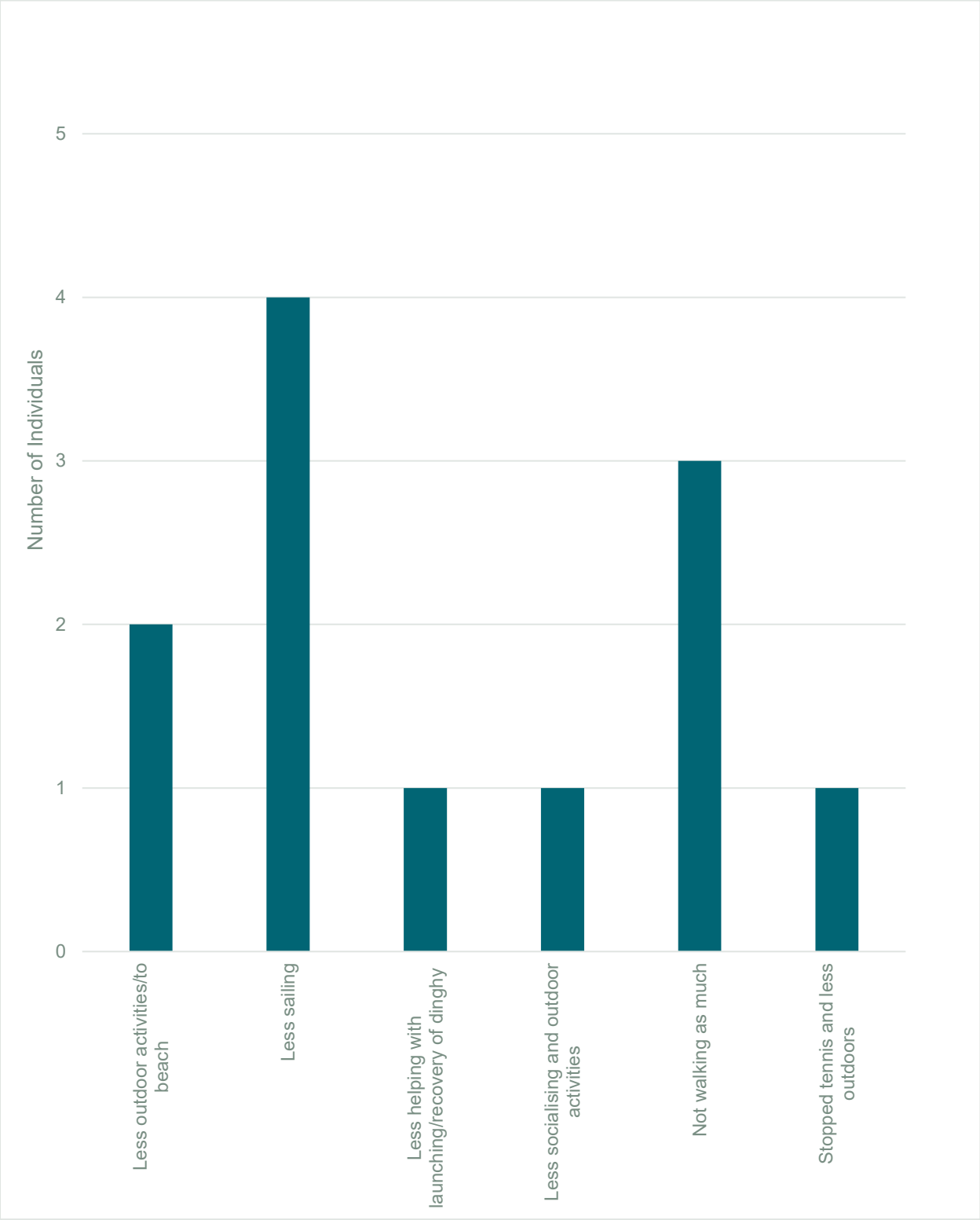
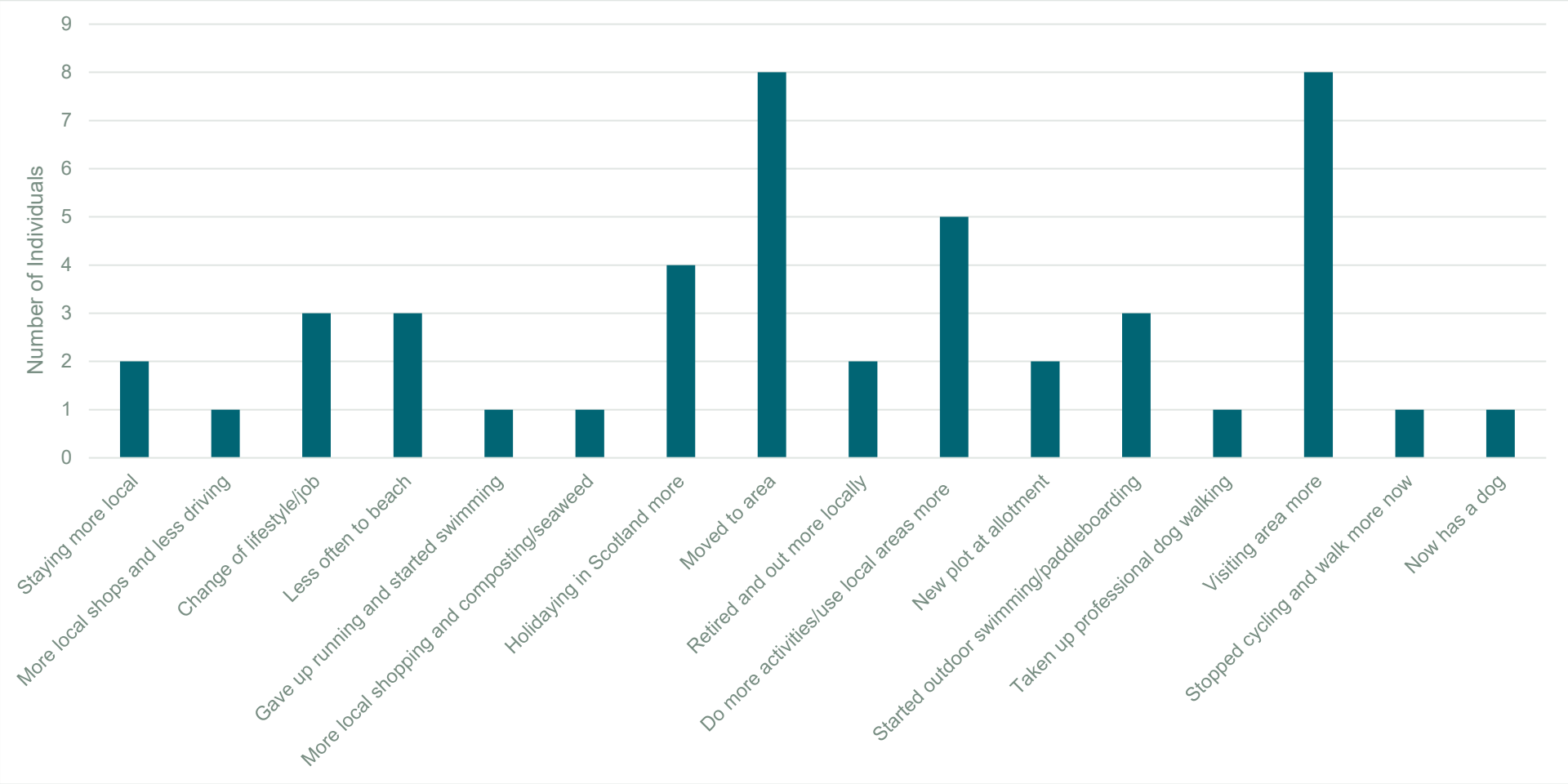


Figure 9.4 Breakdown of 'Other' contributors to post Covid-19 habit changes



10 Comparisons with the previous survey

10.1 Introduction

The results from the 2024 Hunterston Habits Survey have been reported in chapters 5-7 for both the postal survey and the face-to-face Phase 1 survey. These results can be compared with results from the previous habits survey, undertaken around Hunterston in 2017 by the University of Stirling.

The aquatic and terrestrial face-to-face survey area in the 2024 survey is consistent with the previous 2017 survey.

10.2 Aquatic survey

10.2.1 Phase 1 - adult consumption rates – internal exposure

A comparison between 2017 and 2024 adult consumption rates of aquatic foods in the face-to-face interviews is presented in Table 10.1. The table also provides the mean consumption rates from national data (Smith and Jones, 2003) for comparison.

Table 10.1 Comparison between 2017 and 2024 adult consumption rates of aquatic foods

Food Group	2017 Number of people in the high-rate group	2017 Maximum consumption rate (kg y^{-1})	2017 Mean consumption rate (kg y^{-1})	2024 Number of people in the high-rate group	2024 Maximum consumption rate (kg y^{-1})	2024 Mean consumption rate (kg y^{-1})	National - Mean (kg y^{-1})
Fish	1	94.1	94.1	2	156	125	15.0
Crustaceans	4	26	26	1	24	24	4.00
Molluscs	1	28.8	28.8	2	52	52	4.00
Seaweed	1	0.45	0.45	1	0.75	0.75	ND
Wildfowl	2	47.2	47.2	ND	ND	ND	ND

ND – not determined

In 2024 the mean consumption rate for the adult high-rate group increased from 94.1kg y^{-1} to 125kg y^{-1} for fish, from 28.8kg y^{-1} to 52kg y^{-1} for molluscs and was comparable for crustaceans (24kg y^{-1} and 26kg y^{-1}) compared with 2017. In 2024 the mean consumption of seaweed for the adult high-rate group increased to 0.75kg y^{-1}, from 0.45kg y^{-1} in 2017. No consumption of wildfowl was found in the 2024 survey in contrast with the 2017 survey. The main species of fish consumed by the adult high-rate group were bass, cod, mackerel pollock and salmon in 2024 compared to the main species being cod and mackerel in 2017. The main species of crustacean consumed by the adult high-rate group in 2024 was langoustine whereas in 2017 it was common lobster and brown crab. The main species of mollusc consumed by the adult high-rate group in 2024 and 2017 was mussels.

10.2.2 Phase 1 - children and infant consumption rates – internal exposure

A comparison between 2017 and 2024 of children's consumption rates of aquatic foods in the face-to-face interviews is presented in Table 10.2. No consumption was determined for infants in the 2024 survey.

Table 10.2 Comparison between 2017 and 2024 children's consumption rates of aquatic foods

Age Group	Food Group	2017 Number of people in the high-rate group	2017 Maximum consumption rate (kg y^{-1})	2017 Mean consumption rate (kg y^{-1})	2024 Number of people in the high-rate group	2024 Maximum consumption rate (kg y^{-1})	2024 Mean consumption rate (kg y^{-1})	National - Mean (kg y^{-1})
Child (6 to 15 years old)	Fish	4	0.26	0.26	2	6.65	6.28	15.0
Child (6 to 15 years old)	Crustaceans	ND	ND	ND	ND	ND	ND	4.00
Child (6 to 15 years old)	Molluscs	2	2	2	ND	ND	ND	4.00
Child (6 to 15 years old)	Wildfowl	1	0.10	0.10	ND	ND	ND	ND

The mean consumption of fish within the children's high-rate group increased in 2024 compared to 2017 (6.28kg y^{-1} and 0.26kg y^{-1} respectively). The children's high-rate group consumed mackerel and pollock in both 2024 and 2017. No consumption of crustacean was determined in either the 2024 or 2017 survey. In 2024, children did not consume molluscs or wildfowl which was observed in 2017.

10.2.3 Phase 1 - adult intertidal/aquatic occupancy – 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.

The highest total intertidal occupancy in 2024 was 1460h y^{-1} for an individual on a sand and stone substrate dog walking, which is increased compared to1278h y^{-1} in 2017 for an individual who spent time dog walking. Occupancy on a rock, stone and a sand and stone substrate decreased in 2024 compared with 2017. Occupancy on a sand substrate increased in 2024 compared with 2017.There was no occupancy determined on a mud substrate in 2024 compared with 2017. A comparison is shown in Table 10.3.

In 2024 there was a decrease in occupancy for in water, handling equipment and handling sediment (62.8h y^{-1}, 734h y^{-1} and 369h y^{-1} respectively), compared with the 2017 survey (156h y^{-1}, 3030h y^{-1} and 858h y^{-1} respectively). In 2024 on water occupancy increased compared with 2017 (3149h y^{-1} and 2730h y^{-1} respectively). A comparison is shown in Table 10.4.

Table 10.3 Comparison of the 2017 and 2024 intertidal external exposure pathways for adults

Intertidal substrate	2017 Number of people in the high-rate group	2017 Maximum occupancy for the high-rate group (h y^{-1})	2017 Mean occupancy for the high-rate group (h y^{-1})	2024 Number of people in the high-rate group	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})
Rock	ND	1248	ND	4	312	215
Sand	ND	938	ND	7	1460	959
Sand and stone	ND	1095	ND	10	843	457
Stone	ND	858	ND	5	730	474
Mud	ND	58.5	ND	ND	ND	ND

Table 10.4 Comparison of the 2017 and 2024 aquatic external exposure pathways for adults

Activity	2017 Number of people in the high-rate group	2017 Maximum occupancy for the high-rate group (h y^{-1})	2017 Mean occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})
Aquatic (in water)	1	156	156	11	113	62.8
Aquatic (on water)	1	2730	2730	1	3149	3149
Handling equipment	1	3030	3030	6	1139	734
Handling sediment	1	858	858	7	780	369

10.2.4 Phase 1 – children and infant intertidal/aquatic occupancy – 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 for both children and infant age groups.

The highest total intertidal occupancy in 2024 was 365h y^{-1} for a child on a sand substrate dog walking, which is lower when compared to 696h y^{-1} in 2017 for two children who spent time sitting/picnicking/BBQ, beachcombing, dog walking, paddling and playing. The highest total intertidal occupancy in 2024 was 780h y^{-1} for four infants who spent time sitting/picnicking/BBQ and playing on a sand substrate, which is increased compared to 208h y^{-1} in 2017 for an infant who spent time playing. For the child age group, occupancy on a rock and a sand and stone substrate decreased in 2024 compared with 2017. Occupancy on a sand substrate and a stone substrate increased in 2024 compared with 2017. For the infant age group, occupancy decreased on a rock substrate in 2024 compared with 2017. Occupancy on a sand substrate and a sand and stone substrate increased in 2014 compared with 2017. A comparison is shown in Table 10.5.

In 2024, for the child age group, there was a decrease in occupancy for on water, handling equipment and handling sediment (82.5h y^{-1}, 122h y^{-1} and 120.5h y^{-1} respectively), compared with the 2017 survey (612h y^{-1}, 416h y^{-1} and 540h y^{-1} respectively). In 2024, the child in water occupancy increased compared with 2017 (18h y^{-1} and 6.24h y^{-1} respectively). A comparison is shown in Table 10.6.

In 2024, for the infant age group, occupancy was determined for in water and on water (both of occupancy 26h y^{-1}) with no occupancy determined in 2017 for these water activities. Infant handling sediment activity increased in 2024 compared to 2017 (780h y^{-1} and 156h y^{-1} respectively) with no handling of equipment determined by infants in 2024 compared to 2017. A comparison is shown in Table 10.6.

Table 10.5 Comparison of the 2017 and 2024 intertidal external exposure pathways for children and infants

Age Group	Activity	2017 Number of people in the high-rate group	2017 Maximum occupancy for the high-rate group (h y^{-1})	2017 Mean occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})
Child (6 to 15 years old)	Rock	ND	416	ND	1	312	312
Child (6 to 15 years old)	Sand	ND	104	ND	3	365	232
Child (6 to 15 years old)	Sand and stone	ND	540	ND	8	156	105
Child (6 to 15 years old)	Stone	ND	6	ND	2	58	58
Infant (0 to 5 years old)	Rock	ND	52	ND	1	3.96	3.96
Infant (0 to 5 years old)	Sand	ND	156	ND	5	780	697
Infant (0 to 5 years old)	Sand and stone	ND	104	ND	2	120	120

ND – not determined

Table 10.6 Comparison of the 2017 and 2024 aquatic external exposure pathways for children and infants

Age Group	Activity	2017 Number of people in the high-rate group	2017 Maximum occupancy for the high-rate group (h y^{-1})	2017 Mean occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})
Child (6 to 15 years old)	Aquatic (in water)	1	6.24	6.24	5	52	18
Child (6 to 15 years old)	Aquatic (on water)	1	612	612	3	140	82.5
Child (6 to 15 years old)	Handling equipment	1	416	416	2	312	122
Child (6 to 15 years old)	Handling sediment	2	540	540	5	261	120.5
Infant (0 to 5 years old)	Aquatic (in water)	ND	ND	ND	1	26	26
Infant (0 to 5 years old)	Aquatic (on water)	ND	ND	ND	1	26	26
Infant (0 to 5 years old)	Handling equipment	1	1	1	ND	ND	ND

Age Group	Activity	2017 Number of people in the high-rate group	2017 Maximum occupancy for the high-rate group (h y^{-1})	2017 Mean occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy for the high-rate group (h y^{-1})
Infant (0 to 5 years old)	Handling sediment	1	156	156	4	780	780

ND – not determined

10.3 Terrestrial survey

10.3.1 Phase 1 – adult consumption rates – internal exposure

Consumption rates of locally produced food items have increased in the 2024 survey in the potatoes, domestic fruit and wild fungi food groups in comparison to the 2017 survey. Consumption rates decreased in the 2024 survey in the green vegetables, other vegetables, root vegetables, wild fruit, eggs, sheep meat and honey food groups in comparison to the 2017 survey. No consumption for beef meat, game birds, game rabbit/hare, game venison, poultry, milk and private water was determined in 2024 compared to the 2017 survey. A comparison between the 2017 and 2024 mean consumption rates for adult consumption of the terrestrial food groups is presented in Table 10.7. The table also provides the mean consumption rates from national data (Smith and Jones, 2003) for comparison.

Table 10.7 Comparison between 2017 and 2024 mean consumption rates of local terrestrial food groups for adults (kg y^{-1} or l y^{-1})

Food group	2017 Mean consumption rate for the high-rate group (kg y^{-1} or l y^{-1})	2024 Mean consumption rate for the high-rate group (kg y^{-1} or l y^{-1})	National mean
Green vegetables	53.2	20.9	15.0
Other vegetables	38	10.5	20.0
Root vegetables	43.9	18.9	10.0
Potatoes	44.1	66	50.0
Domestic fruit	49.4	91	20.0
Wild fruit	28.5	8.2	7
Wild fungi	1	1.75	3
Meat beef	28	ND	15.0
Meat game (birds)	10	ND	ND
Meat game (venison)	68.6	ND	ND
Meat game (rabbit/hare)	3	ND	ND
Meat poultry	2	ND	10.0
Meat sheep	24	15.6	8
Honey	8	6.3	2.50
Eggs	28.9	24.8	8.5
Milk	9	ND	95
Private water	365	ND	ND

ND – not determined

10.3.2 Phase 1 – children and infant consumption rates - internal exposure

Child consumption rates of locally produced food items in the 2024 survey were in domestic fruit, wild fruit and eggs food groups. Compared with 2017, consumption decreased for both domestic fruit and wild fruit in 2024 though eggs were consumed in 2024 and not found in 2017. For infants, consumption of domestic fruit increased in 2024 compared with 2017, and wild fruit consumption was determined in 2024 but not in 2017. The mean consumption rates for children and infants are presented in Table 10.8.

Table 10.8 Comparison between 2017 and 2024 mean consumption rates of local terrestrial food groups for children (kg y^{-1} or l y^{-1})

Age Group	Food group	2017 Mean consumption rate for the high-rate group (kg y^{-1} or l y^{-1})	2024 Mean consumption rate for the high-rate group (kg y^{-1} or l y^{-1})
Child (6 to 15 years old)	Green vegetables	29.3	ND
Child (6 to 15 years old)	Other vegetables	11.7	ND
Child (6 to 15 years old)	Root vegetables	40.4	ND
Child (6 to 15 years old)	Potatoes	38.1	ND
Child (6 to 15 years old)	Domestic fruit	17	5.44
Child (6 to 15 years old)	Wild fruit	2	0.63
Child (6 to 15 years old)	Wild fungi	1	ND
Child (6 to 15 years old)	Meat beef	0.45	ND

Age Group	Food group	2017 Mean consumption rate for the high-rate group (kg y^{-1} or l y^{-1})	2024 Mean consumption rate for the high-rate group (kg y^{-1} or l y^{-1})
Child (6 to 15 years old)	Meat game (birds)	1.25	ND
Child (6 to 15 years old)	Meat poultry	1	ND
Child (6 to 15 years old)	Eggs	ND	3
Infant (0 to 5 years old)	Domestic fruit	0.60	4.72
Infant (0 to 5 years old)	Wild fruit	ND	0.9

ND – not determined

10.4 Occupancy living/working within 1km of Hunterston

Table 10.9 presents the comparison between the 2017 and 2024 survey occupancy rates within the direct radiation survey area (h y^{-1}). The table displays the time spent indoors and outdoors of their home (living) and for those who work (spending time indoors and outdoors) within 1km of the Hunterston A and B nuclear licensed sites (Hunterston A and B site workers were not included in this survey). In 2024 the total occupancy was slightly lower compared with 2017. Indoor occupancy at home, indoor work occupancy and outdoor work occupancy all decreased. Outdoor occupancy at home increased in 2024 compared to 2017.

Table 10.9 Comparison between 2017 and 2024 occupancy rates for people living and working within the direct radiation area (h y^{-1})

Occupancy	2017 (h y^{-1})	2024 (h y^{-1})
Highest total	8395	8396
Highest indoor at home	7300	6570
Highest outdoor at home	1460	3650
Highest indoor at work	3257	2555
Highest outdoor at work	4380	4015

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 = 123); (ii) face-to-face surveys (n = 352); and (iii) several meetings and informal contacts. These data have been supplemented with radiometric surveys including: (i) a carborne and handheld gamma spectrometry survey (n = ~ 10291 (carborne); n = ~19125 (handheld)); (ii) in-situ gamma dose rate (n = 27 intertidal); and (iv) in-situ beta dose rate (n = 1).

11.2 Ongoing monitoring

The RIFE report (2023) demonstrates a comprehensive set of monitoring undertaken annually around the Hunterston A and B sites 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. Samples taken and reported by SEPA are provided within the RIFE reports (e.g. RIFE, 2023) and covered fish, crustaceans, molluscs, sediment, sand, seawater, seaweed *(Fucus vesiculosus)*, milk, apple, beef, carrots, cauliflower, honey, lamb, onions, potatoes, rosehips, turnips, venison, freshwater and grass.

11.3 Conclusions and recommendations

Information collected between Phase 1 and 2 surveys demonstrates that there can be differences in data due to a change in habits over the course of a year and/or there is an over or underestimating when reporting information on consumption and occupancy. This is despite extensive steps taken to check the validity of the results collected during the face-to-face questions.

In some cases, there are differences in the surveyed individual responses between Phases 1 and 2. These differences may be genuine, e.g. a real change in consumption or occupancy between the different parts of the year when the Phase 1 and 2 surveys were conducted, or they may be due to different estimates of their consumption/activities, e.g. Phase 2 surveys are conducted via pre-arranged telephone interviews and the survey individuals may be able to better prepare for the questions than when they are approached in the survey area at random.

Overall, for Hunterston, the results of the Phase 2 surveys largely demonstrate that they provide confidence in the representativeness of the data collected throughout the Phase 1 surveys. It is anticipated that some work can still be done to explain the differences between Phase 1 and 2 surveys e.g. by establishing whether they are due to seasonal/weather conditions, or an over/under-estimating on the part of the survey individual. The survey team will consider additional ways to evaluate this in further surveys.

It is recommended that SEPA's routine monitoring continues as is (i.e. as prior to the Covid19 pandemic). However, based on the findings of this habits survey, and taking into account the potential radiological significance of the various pathways that were identified, it is suggested that SEPA consider the following that:

(i) Dulse seaweed (*Palmaria palmata*) be sampled from Portencross beach bi-annually.
(ii) Either dulse (*Palmaria palmata*), sea lettuce (*Ulva lactuca*), sugar kelp (*Laminaria saccharina*) or kombu kelp (*Laminaria digitata*) seaweed be sampled bi-annually from near Hunterston Pier.
(iii) Sea arrowgrass, sea orache, sea aster and Scots lovage be sampled near Hunterston bi-annually.
(iv) Mushrooms be sampled from West Kilbride annually and pink purslane is sampled from the Hunterston area annually.

References

Dale, I., Smith, P., Tyler, T., Copplestone, D., Varley, A., Bradley, S., Bartie, P., Clarke, M., Blake, M. (2018). Hunterston Radiological Habit Survey. University of Stirling.

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

Environmental Authorisations (Scotland) Regulations 2018 (Scottish Government, 2018)

European Commission. (2013). Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom a. Official Journal of the European Commission L13 2014:1–73.

European Commission. (2021). Agreement between the government of the United Kingdom of Great Britain and Northern Ireland and the European atomic energy community for cooperation on the safe and peaceful uses of nuclear energy. Available at the Europa Website.

Garden Forum Horticulture, 2009.

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.

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.

IAEA (2014) Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. General Safety Requirements. IAEA Safety Standards Series No. GSR Part 3, Vienna, 2014.

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).

ICRP (2012). Compendium of Dose Coefficients based on ICRP Publication 60. ICRP Publication 119. Ann. ICRP 41(Suppl.).

Land Cover Map (2007). Updated in 2008 by the Centre for Ecology and Hydrology using EDINA environment digimap service.

Leonard, D.R.P., Hunt, G.J., Jones, P.G.W., (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.

NDAWG (2013). Use of Habits Data in Prospective Dose Assessments. NDAWG Guidance Note 7. Available from at the NDAWG website.

Ordnance Survey Great Britain (2015).

Punt, A; Tyler A; Saleh, S; Bradley S; & Copplestone D. (2011). Measurement and Assessment of External Radiation Dose Rates to People on Houseboats and using Riverbanks – using the Ribble Estuary as a case study. Environment Agency Report: SC060080/R4. ISBN: 978-1-84911-211-6.

Radioactivity in Food and the Environment (RIFE) Report, 2021 (published 2022).

Radioactivity in Food and the Environment (RIFE) Report, 2022 (published 2023).

Radioactivity in Food and the Environment (RIFE) Report, 2023 (published 2024).

Smith, J.G., Simmonds, J.R. (2009). The Methodology for Assessing the Radiological Consequences of Routine Releases of Radionuclides to the Environment Used in PC-CREAM 08, Health Protection Agency Report HPA-RPD-058.

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 (2015).

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.

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.

UK Government (1999). Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (as amended).

Varley, A., Tyler, A.N., Wilson, C. (2020) Near real-time soil erosion mapping through mobile gamma-ray spectroscopy. Journal of Environmental Radioactivity, 223-224, 106400.

Appendices

Appendix A

Appendix A1: Raw data

Table 1 Phase 1 adult fish consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
52	Bass	31.20
129	Bass	1.25
52	Cod	31.20
53	Mackerel	130.00
100	Mackerel	8.40
56	Mackerel	6.00
470	Mackerel	5.90
84	Mackerel	5.90
103	Mackerel	3.70
55	Mackerel	3.60
530	Mackerel	2.00
41	Mackerel	1.80
116	Mackerel	1.50
528	Mackerel	1.50
53	Pollock	26.00
100	Pollock	3.60
470	Pollock	0.75
84	Pollock	0.75
52	Salmon	31.20

Observation number	Food type	Sum of consumption (kg y^{-1})
71	Salmon	5.40
129	Sea trout	1.00
56	Trout (freshwater)	4.00
71	Haddock	21.60
158	Plaice	0.60
535	Plaice	0.60
535	Coley	0.08
158	Coley	0.08

Table A1.2 Phase 1 child fish consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
471	Mackerel	5.9
469	Mackerel	5.9
469	Pollock	0.75

Table A1.3 Phase 1 adult crustacean consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
71	Shrimps	5.40
77	Prawns (langoustines)	24.00
147	Prawns (langoustines)	0.08
12	Prawns (langoustines)	0.08

Table A1.4 Phase 1 adult mollusc consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
821	Mussels	52
53	Mussels	2
53	Razor clams	0.25
111	Scallops	0.25
95	Winkles	0.1
53	Cockles	0.5

Table A1.5 Phase 1 adult in water activities. Where observation numbers are listed more than once for same activity, this indicates that the activity is undertaken at more than one location, e.g. outdoors swimming at multiple beaches in the area

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
77	Jet skiing	112.5
133	Outdoor swimming	52
160	Outdoor swimming	39
44	Outdoor swimming	17.2
844	Outdoor swimming	13
843	Outdoor swimming	13
845	Outdoor swimming	13
846	Outdoor swimming	13
56	Outdoor swimming	13

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
78	Outdoor swimming	10
464	Outdoor swimming	10
465	Outdoor swimming	10
463	Outdoor swimming	10
24	Outdoor swimming	9
24	Outdoor swimming	9
24	Outdoor swimming	9
148	Outdoor swimming	7.5
847	Outdoor swimming	6.8
55	Outdoor swimming	6.8
159	Outdoor swimming	6.5
159	Outdoor swimming	6.5
17	Outdoor swimming	6
430	Outdoor swimming	6
842	Outdoor swimming	3.8
97	Outdoor swimming	2.08
81	Outdoor swimming	2
18	Outdoor swimming	2
109	Outdoor swimming	1.9
167	Outdoor swimming	1.5
487	Outdoor swimming	1.5
488	Outdoor swimming	1.5
52	Outdoor swimming	1.5

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
841	Outdoor swimming	1.3
840	Outdoor swimming	1.3
834	Outdoor swimming	1.3
817	Outdoor swimming	1.3
811	Outdoor swimming	1.3
810	Outdoor swimming	1.3
816	Outdoor swimming	1.3
818	Outdoor swimming	1.3
42	Outdoor swimming	1.3
831	Outdoor swimming	1
833	Outdoor swimming	1
836	Outdoor swimming	1
832	Outdoor swimming	1
837	Outdoor swimming	1
838	Outdoor swimming	1
839	Outdoor swimming	1
147	Outdoor swimming	0.75
614	Outdoor swimming	0.75
613	Outdoor swimming	0.75
830	Outdoor swimming	0.3
98	Outdoor swimming	0.3
835	Outdoor swimming	0.3
808	Outdoor swimming	0.3

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
36	Outdoor swimming	0.3
95	Outdoor swimming	0.3
161	Outdoor swimming	0.3
99	Stand-up paddle boarding	104
39	Stand-up paddle boarding	78
37	Stand-up paddle boarding	52
33	Stand-up paddle boarding	36
846	Stand-up paddle boarding	26
845	Stand-up paddle boarding	26
144	Stand-up paddle boarding	26
56	Stand-up paddle boarding	26
844	Stand-up paddle boarding	26
111	Stand-up paddle boarding	19.5
111	Stand-up paddle boarding	19.5
111	Stand-up paddle boarding	19.5
111	Stand-up paddle boarding	19.5

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
111	Stand-up paddle boarding	19.5
143	Stand-up paddle boarding	18
545	Stand-up paddle boarding	18
52	Stand-up paddle boarding	12
430	Stand-up paddle boarding	12
17	Stand-up paddle boarding	12
78	Stand-up paddle boarding	10
465	Stand-up paddle boarding	10
463	Stand-up paddle boarding	10
464	Stand-up paddle boarding	10
19	Stand-up paddle boarding	9
428	Stand-up paddle boarding	9
429	Stand-up paddle boarding	9
817	Stand-up paddle boarding	8
466	Stand-up paddle boarding	8

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
155	Stand-up paddle boarding	8
811	Stand-up paddle boarding	8
816	Stand-up paddle boarding	8
810	Stand-up paddle boarding	8
542	Stand-up paddle boarding	6
847	Stand-up paddle boarding	2
55	Stand-up paddle boarding	0.5

Table A1.6 Phase 1 children in water activities. Where observation numbers are listed more than once for same activity, this indicates that the activity is undertaken at more than one location, e.g. outdoors swimming at multiple beaches in the area

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
445	Body boarding	52
444	Body boarding	52
546	Outdoor swimming	9
547	Outdoor swimming	9
425	Outdoor swimming	4.8
450	Outdoor swimming	2.5

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
449	Outdoor swimming	2.5
448	Outdoor swimming	2.5
507	Outdoor swimming	2
507	Outdoor swimming	2
508	Outdoor swimming	2
508	Outdoor swimming	2
537	Outdoor swimming	1.6
536	Outdoor swimming	1.6
485	Outdoor swimming	1.5
486	Outdoor swimming	1.5
618	Outdoor swimming	0.75
617	Outdoor swimming	0.75
615	Outdoor swimming	0.75
616	Outdoor swimming	0.75
611	Stand-up paddle boarding	26
546	Stand-up paddle boarding	9
547	Stand-up paddle boarding	9
467	Stand-up paddle boarding	8
468	Stand-up paddle boarding	8
543	Stand-up paddle boarding	6

Table A1.7 Phase 1 infant in water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
426	Outdoor swimming	4.8
612	Stand-up paddle boarding	26

Table A1.8 Phase 1 adult on water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
845	Boat maintenance	624
157	Boat maintenance	32
76	Boat maintenance	20
135	Boat maintenance	2
161	Canoeing	10
78	Canoeing	10
463	Canoeing	10
464	Canoeing	10
465	Canoeing	10
55	Canoeing	1
847	Canoeing	0.25
846	Commute via boat	6
845	Commute via boat	6
844	Commute via boat	6
843	Commute via boat	6
56	Commute via boat	6
80	Commute via boat	3
481	Commute via boat	3

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
850	Commute via boat	0.5
71	Commute via boat	0.5
100	Kayaking	104
167	Kayaking	82.5
487	Kayaking	82.5
488	Kayaking	82.5
84	Kayaking	70
144	Kayaking	26
55	Kayaking	1
847	Kayaking	1
845	Power boating	390
844	Power boating	390
134	Power boating	320
32	Power boating	70
134	Power boating	16
135	Power boating	12
135	Sailing	234
149	Sailing	208
134	Sailing	117
134	Sailing	96
474	Sailing	40
76	Sailing	40
135	Sailing	39
475	Sailing	34

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
476	Sailing	34
157	Sailing	24
477	Sailing	24
155	Sailing	24
78	Sailing	20
156	Sailing	18
532	Sailing	13
122	Sailing	13
52	Sailing	6
24	Sailing	6
478	Sailing	2
66	Sailing	2
53	Sea angling	547.5
100	Sea angling	104
84	Sea angling	70
53	Sea angling	52
843	Sea angling	13
56	Sea angling	13
846	Sea angling	13
844	Sea angling	13
845	Sea angling	13
134	Working on a boat	2600
166	RNLI duties	1.5
109	SIB boating	20

Table A1.9 Phase 1 children on water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
483	Commute via boat	3
482	Commute via boat	3
486	Kayaking	82.5
485	Kayaking	82.5
469	Kayaking	70
611	Kayaking	26
469	Sea angling	70

Table A1.10 Phase 1 infant on water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
483	Commute via boat	3
482	Commute via boat	3
486	Kayaking	82.5
485	Kayaking	82.5
469	Kayaking	70
611	Kayaking	26
469	Sea angling	70

Table A1.11 Phase 1 adult intertidal activities. Where observation numbers are listed more than once for same activity, this indicates that the activity is undertaken at more than one location, e.g. beachcombing at multiple beaches in the area

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
53	Bait digging	4.5			
56	Bait digging		2.08		
100	Bait digging	6			
158	Bait digging	52			
520	Bait digging	26			
845	Bait digging		2.08		
7	Beachcombing			24	
7	Beachcombing			24	
14	Beachcombing	1			
23	Beachcombing			41.6	
23	Beachcombing	41.6			
42	Beachcombing		6		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
56	Beachcombing	234			
56	Beachcombing	78			
80	Beachcombing	6			
88	Beachcombing	1			
95	Beachcombing	18			
97	Beachcombing	13			
103	Beachcombing	3			
108	Beachcombing	8.32			
109	Beachcombing	182.5			
127	Beachcombing	0.5			
127	Beachcombing	0.5			
145	Beachcombing	2			
146	Beachcombing	0.5			
421	Beachcombing	1			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
481	Beachcombing	6			
515	Beachcombing	1			
609	Beachcombing	2			
656	Beachcombing	0.5			
656	Beachcombing	0.5			
828	Beachcombing	18			
842	Beachcombing		6		
861	Beachcombing	182.5			
109	Boat maintenance	13			
844	Boat maintenance		52		
845	Boat maintenance		52		
53	Collecting mussels		1		
53	Collecting razor clams		1		
38	Collecting seaweed	5			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
56	Collecting seaweed		13		
102	Collecting seaweed	26			
109	Collecting seaweed		136.875		
110	Collecting seaweed	4.5			
439	Collecting seaweed	4			
164	Collecting Shells	52			
53	Collecting winkles		1		
95	Collecting winkles	2			
168	Crabbing	0.33			
170	Crabbing				5
458	Crabbing				5
11	Dog walking			365	
12	Dog walking		58.4		
15	Dog walking	18			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
17	Dog walking	312			
23	Dog walking	41.6			
23	Dog walking			41.6	
24	Dog walking		520		
24	Dog walking	520			
24	Dog walking	520			
29	Dog walking			12	
29	Dog walking			15.96	
34	Dog walking	182.5			
34	Dog walking	182.5			
35	Dog walking		182.5		
35	Dog walking	182.5			
36	Dog walking	52			
36	Dog walking	6			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
37	Dog walking	485.45			
39	Dog walking	780			
44	Dog walking		52		
44	Dog walking		182.5		
44	Dog walking		45		
44	Dog walking		182.5		
50	Dog walking	15.96			
50	Dog walking	15.96			
50	Dog walking				15.96
52	Dog walking	730			
53	Dog walking		730		
56	Dog walking		234		
68	Dog walking	86.32			
69	Dog walking		17		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
71	Dog walking		104		
80	Dog walking	6			
89	Dog walking	730			
89	Dog walking	730			
91	Dog walking	0.2			
91	Dog walking	0.3			
91	Dog walking	0.4			
91	Dog walking				0.3
91	Dog walking	0.2			
99	Dog walking		10		
105	Dog walking	2			
108	Dog walking	365			
109	Dog walking	182.5			
112	Dog walking	6			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
121	Dog walking		730		
122	Dog walking		84		
122	Dog walking		84		
122	Dog walking		84		
125	Dog walking		24		
127	Dog walking	0.5			
127	Dog walking	0.5			
140	Dog walking		1		
142	Dog walking	4.5			
144	Dog walking	365			
147	Dog walking	3.75			
147	Dog walking		3		
150	Dog walking	156			
155	Dog walking	52			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
161	Dog walking		365		
161	Dog walking		6		
161	Dog walking		6		
168	Dog walking	0.89			
414	Dog walking			365	
415	Dog walking			365	
420	Dog walking		58.4		
424	Dog walking		182.5		
424	Dog walking	182.5			
427	Dog walking	182.5			
427	Dog walking	182.5			
430	Dog walking	312			
438	Dog walking			15.96	
438	Dog walking			12	

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
439	Dog walking	52			
466	Dog walking	52			
481	Dog walking	6			
524	Dog walking	6			
552	Dog walking	15.96			
613	Dog walking	3.75			
613	Dog walking		3		
614	Dog walking		3		
614	Dog walking	3.75			
656	Dog walking	0.5			
656	Dog walking	0.5			
820	Dog walking	2			
843	Dog walking		234		
844	Dog walking		234		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
845	Dog walking		234		
846	Dog walking		234		
850	Dog walking		104		
861	Dog walking	182.5			
102	Drone flying	39			
128	Drone flying		1		
8	Fishing				2
9	Fishing				117
45	Fishing				4
85	Fishing			4	
101	Fishing			468	
101	Fishing			78	
113	Fishing				4
116	Fishing				9

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
117	Fishing		12		
123	Fishing				0.5
129	Fishing		117		
158	Fishing			730	
158	Fishing				312
167	Fishing				2
170	Fishing				5
408	Fishing				6
411	Fishing				117
458	Fishing				5
528	Fishing				9
554	Fishing				39
555	Fishing				39
559	Fishing				4

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
559	Fishing	10			4
100	Fishing	182			
100	Fishing	52			
100	Fishing	104			
37	Jogging	52			
479	Launching and recovery of dinghies				2
86	Metal detecting	2			
96	Metal detecting	2.5			
509	Metal detecting	2			
822	Metal detecting	2.5			
12	Paddling		1		
14	Paddling	1			
23	Paddling	1.32			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
24	Paddling		1.32		
24	Paddling	1.32			
24	Paddling	1.32			
31	Paddling	5.25			
31	Paddling	5.25			
35	Paddling	4.8			
50	Paddling	0.25			
56	Paddling		39		
92	Paddling	0.25			
94	Paddling	4			
95	Paddling	0.5			
103	Paddling	0.87			
104	Paddling	0.67			
107	Paddling	2			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
108	Paddling	5			
109	Paddling	13			
142	Paddling		2		
142	Paddling	2			
145	Paddling	0.25			
147	Paddling	0.75			
150	Paddling	7			
159	Paddling		9.75		
162	Paddling	1.44			
168	Paddling	0.89			
420	Paddling		1		
421	Paddling	1			
424	Paddling	4.8			
433	Paddling	5.25			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
433	Paddling	5.25			
523	Paddling	0.25			
534	Paddling	1.44			
609	Paddling	0.25			
613	Paddling	0.75			
614	Paddling	0.75			
806	Paddling	0.67			
808	Paddling	2			
823	Paddling	4			
828	Paddling	0.5			
843	Paddling		39		
844	Paddling		39		
845	Paddling		39		
846	Paddling		39		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
847	Paddling		12.48		
14	Playing	1			
30	Playing	20			
31	Playing	5.25			
31	Playing	5.25			
95	Playing	6			
98	Playing	2			
106	Playing	0.64			
115	Playing		1		
115	Playing			3	
123	Playing	6			
124	Playing	4			
143	Playing	10			
146	Playing	0.5			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
159	Playing		48.75		
163	Playing		12		
167	Playing	75			
167	Playing		48		
168	Playing	0.89			
169	Playing	3.3			
170	Playing				5
421	Playing	1			
433	Playing	5.25			
433	Playing	5.25			
447	Playing	3.3			
456	Playing	4			
458	Playing				5
461	Playing	6			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
487	Playing	82.5			
487	Playing		48		
488	Playing		48		
488	Playing	82.5			
539	Playing		1		
545	Playing	10			
548	Playing		10		
549	Playing		10		
558	Playing	195			
559	Playing	104			
560	Playing	260			
810	Playing	0.64			
811	Playing	0.64			
812	Playing	0.64			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
813	Playing	0.64			
814	Playing	0.64			
815	Playing	0.64			
816	Playing	0.64			
817	Playing	0.64			
818	Playing	0.64			
819	Playing	0.64			
828	Playing	6			
830	Playing	2			
831	Playing	2			
832	Playing	2			
833	Playing	2			
834	Playing	2			
835	Playing	2			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
836	Playing	2			
837	Playing	2			
838	Playing	2			
839	Playing	2			
840	Playing	2			
841	Playing	2			
847	Playing		19.5		
847	Playing		3.25		
111	Preparation and deconstruction of paddle board	2			
109	Research/education	10			
44	Rock pooling		15		
53	Rock pooling		12		
56	Rock pooling		1.92		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
70	Rock pooling				3.96
114	Rock pooling				26
148	Rock pooling		120.45		
169	Rock pooling	3.3			
447	Rock pooling	3.3			
843	Rock pooling		1.92		
844	Rock pooling		1.92		
845	Rock pooling		1.92		
846	Rock pooling		1.92		
847	Rock pooling		6.5		
22	Sea Angling				36
22	Sea Angling				36
22	Sea Angling	36			
84	Sea Angling				36

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
19	Sitting/picnicking/BBQ	18			
37	Sitting/picnicking/BBQ	78			
39	Sitting/picnicking/BBQ	54			
42	Sitting/picnicking/BBQ		6		
45	Sitting/picnicking/BBQ		15		
46	Sitting/picnicking/BBQ				39
53	Sitting/picnicking/BBQ		97.5		
87	Sitting/picnicking/BBQ	2			
90	Sitting/picnicking/BBQ	1			
90	Sitting/picnicking/BBQ		1		
94	Sitting/picnicking/BBQ	12			
95	Sitting/picnicking/BBQ	96			
97	Sitting/picnicking/BBQ	7			
98	Sitting/picnicking/BBQ	3.5			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
106	Sitting/picnicking/BBQ	3			
107	Sitting/picnicking/BBQ	4			
115	Sitting/picnicking/BBQ	2			
118	Sitting/picnicking/BBQ	24			
127	Sitting/picnicking/BBQ	0.5			
127	Sitting/picnicking/BBQ	0.5			
133	Sitting/picnicking/BBQ	36			
143	Sitting/picnicking/BBQ	20			
145	Sitting/picnicking/BBQ	2			
146	Sitting/picnicking/BBQ	0.5			
147	Sitting/picnicking/BBQ	1.5			
148	Sitting/picnicking/BBQ		120.45		
163	Sitting/picnicking/BBQ		24		
167	Sitting/picnicking/BBQ		48		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
167	Sitting/picnicking/BBQ	82.5			
410	Sitting/picnicking/BBQ				312
428	Sitting/picnicking/BBQ	18			
429	Sitting/picnicking/BBQ	18			
487	Sitting/picnicking/BBQ		48		
487	Sitting/picnicking/BBQ	82.5			
488	Sitting/picnicking/BBQ	82.5			
488	Sitting/picnicking/BBQ		48		
511	Sitting/picnicking/BBQ	2			
545	Sitting/picnicking/BBQ	20			
548	Sitting/picnicking/BBQ		24		
549	Sitting/picnicking/BBQ		24		
558	Sitting/picnicking/BBQ		15		
559	Sitting/picnicking/BBQ	104			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
560	Sitting/picnicking/BBQ	520			
609	Sitting/picnicking/BBQ	2			
613	Sitting/picnicking/BBQ	1.5			
614	Sitting/picnicking/BBQ	1.5			
656	Sitting/picnicking/BBQ	0.5			
656	Sitting/picnicking/BBQ	0.5			
808	Sitting/picnicking/BBQ	4			
810	Sitting/picnicking/BBQ	3			
811	Sitting/picnicking/BBQ	3			
812	Sitting/picnicking/BBQ	3			
813	Sitting/picnicking/BBQ	3			
814	Sitting/picnicking/BBQ	3			
815	Sitting/picnicking/BBQ	3			
816	Sitting/picnicking/BBQ	3			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
817	Sitting/picnicking/BBQ	3			
818	Sitting/picnicking/BBQ	3			
819	Sitting/picnicking/BBQ	3			
821	Sitting/picnicking/BBQ	7			
823	Sitting/picnicking/BBQ	12			
828	Sitting/picnicking/BBQ	96			
830	Sitting/picnicking/BBQ	3.5			
831	Sitting/picnicking/BBQ	3.5			
832	Sitting/picnicking/BBQ	3.5			
833	Sitting/picnicking/BBQ	3.5			
834	Sitting/picnicking/BBQ	3.5			
835	Sitting/picnicking/BBQ	3.5			
836	Sitting/picnicking/BBQ	3.5			
837	Sitting/picnicking/BBQ	3.5			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
838	Sitting/picnicking/BBQ	3.5			
839	Sitting/picnicking/BBQ	3.5			
840	Sitting/picnicking/BBQ	3.5			
841	Sitting/picnicking/BBQ	3.5			
842	Sitting/picnicking/BBQ		6		
135	Slipway cleaning			39	
145	Sunbathing	1			
609	Sunbathing	1			
10	Walking			1	
16	Walking	54			
16	Walking	54			
20	Walking		2		
27	Walking			3	
27	Walking	30			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
28	Walking	1095			
28	Walking		24		
30	Walking		1.5		
30	Walking	3			
33	Walking		312		
39	Walking	156			
42	Walking		6		
51	Walking	12			
76	Walking	4			
76	Walking	4			
76	Walking		4		
83	Walking	26			
91	Walking	6			
93	Walking	0.5			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
99	Walking		10		
104	Walking	4			
114	Walking	4.29			
114	Walking	4.29			
114	Walking	4.29			
120	Walking		3		
120	Walking			1.5	
126	Walking	24			
134	Walking	1.16			
145	Walking	2			
146	Walking	0.5			
148	Walking		120.45		
160	Walking		6		
162	Walking	5.98			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
162	Walking	26			
162	Walking	5.98			
162	Walking	5.98			
162	Walking	13			
167	Walking		48		
169	Walking	3.3			
412	Walking			1	
413	Walking			1	
416	Walking			5	
417	Walking			5	
435	Walking			3	
435	Walking	3			
447	Walking	3.3			
474	Walking		4		

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
474	Walking	4			
474	Walking	4			
487	Walking		48		
488	Walking		48		
520	Walking	4.29			
520	Walking	4.29			
520	Walking	4.29			
522	Walking	0.5			
531	Walking	2			
534	Walking	5.98			
534	Walking	5.98			
534	Walking	26			
534	Walking	13			
534	Walking	5.98			

Observation number	Intertidal activity	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on stone (h y^{-1})	Occupancy on rock (h y^{-1})
538	Walking		6		
553	Walking	12			
607	Walking		2		
608	Walking		2		
609	Walking	2			
806	Walking	4			
842	Walking		6		
847	Walking		78		

Table A1.12 Phase 1 children intertidal activities. Where observation numbers are listed more than once for same activity, this indicates that the activity is undertaken at more than one location, e.g. outdoors swimming at multiple beaches in the area.

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
407	Beach Clean			10	
406	Beachcombing			24	
406	Beachcombing			24	
407	Beachcombing			24	
407	Beachcombing			24	
423	Beachcombing	1			
444	Beachcombing		52		
445	Beachcombing		52		
482	Beachcombing	6			
483	Beachcombing	6			
513	Beachcombing	0.5			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
514	Beachcombing	0.5			
610	Beachcombing	2			
619	Beachcombing	0.5			
829	Beachcombing	18			
453	Crabbing	0.33			
455	Crabbing	0.33			
459	Crabbing				5
460	Crabbing				5
453	Dog walking	0.89			
455	Dog walking	0.89			
472	Dog walking		45		
473	Dog walking		45		
482	Dog walking	6			
483	Dog walking	6			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
506	Dog walking	28			
506	Dog walking	28			
611	Dog walking	365			
615	Dog walking		3		
615	Dog walking	3.75			
616	Dog walking	3.75			
616	Dog walking		3		
617	Dog walking		3		
617	Dog walking	3.75			
618	Dog walking		3		
618	Dog walking	3.75			
409	Fishing				312
459	Fishing				5
460	Fishing				5

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
485	Fishing				2
516	Fishing			4	
517	Fishing			4	
518	Fishing			4	
519	Fishing			4	
556	Fishing				39
557	Fishing				39
423	Paddling	1			
434	Paddling	10			
453	Paddling	0.89			
455	Paddling	0.89			
507	Paddling	0.5			
507	Paddling	0.5			
508	Paddling	0.5			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
508	Paddling	0.5			
536	Paddling		9.75		
537	Paddling		9.75		
550	Paddling		12		
551	Paddling		12		
610	Paddling	0.25			
615	Paddling	0.75			
616	Paddling	0.75			
617	Paddling	0.75			
618	Paddling	0.75			
824	Paddling	4			
826	Paddling	4			
829	Paddling	0.5			
418	Playing			5	

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
419	Playing			5	
423	Playing	1			
434	Playing	10			
444	Playing		52		
445	Playing		52		
448	Playing	2.5			
449	Playing	2.5			
450	Playing	2.5			
453	Playing	0.89			
455	Playing	0.89			
459	Playing				5
460	Playing				5
485	Playing		48		
485	Playing	82.5			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
486	Playing	82.5			
486	Playing		48		
507	Playing		1		
507	Playing	1			
508	Playing		1		
508	Playing	1			
510	Playing	2			
512	Playing	2			
513	Playing	0.5			
514	Playing	0.5			
525	Playing			3	
525	Playing		1		
525	Playing	2			
526	Playing			3	

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
526	Playing	2			
526	Playing		1		
527	Playing			3	
527	Playing		1		
527	Playing	2			
536	Playing		48.75		
537	Playing		48.75		
540	Playing		1		
541	Playing		1		
546	Playing	20			
547	Playing	20			
550	Playing		24		
551	Playing		24		
619	Playing	0.5			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
829	Playing	6			
444	Rock pooling		52		
445	Rock pooling		52		
448	Rock pooling	2.5			
449	Rock pooling	2.5			
450	Rock pooling	2.5			
472	Rock pooling		15		
473	Rock pooling		15		
521	Rock pooling				26
469	Sea Angling				36
485	Sitting/picnicking/BBQ	82.5			
485	Sitting/picnicking/BBQ		48		
486	Sitting/picnicking/BBQ		48		
486	Sitting/picnicking/BBQ	82.5			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
507	Sitting/picnicking/BBQ	1			
507	Sitting/picnicking/BBQ		1		
508	Sitting/picnicking/BBQ		1		
508	Sitting/picnicking/BBQ	1			
546	Sitting/picnicking/BBQ	10			
547	Sitting/picnicking/BBQ	10			
550	Sitting/picnicking/BBQ		12		
551	Sitting/picnicking/BBQ		12		
610	Sitting/picnicking/BBQ	2			
615	Sitting/picnicking/BBQ	1.5			
616	Sitting/picnicking/BBQ	1.5			
617	Sitting/picnicking/BBQ	1.5			
618	Sitting/picnicking/BBQ	1.5			
619	Sitting/picnicking/BBQ	0.5			

Observation number	Intertidal activity	Sum of sand occupancy (h y^{-1})	Sum of sand and stone occupancy (h y^{-1})	Sum of stone occupancy (h y^{-1})	Sum of rock occupancy (h y^{-1})
824	Sitting/picnicking/BBQ	12			
826	Sitting/picnicking/BBQ	12			
829	Sitting/picnicking/BBQ	96			
610	Sunbathing	1			
448	Walking	2.5			
449	Walking	2.5			
450	Walking	2.5			
485	Walking		48		
486	Walking		48		
610	Walking	2			
619	Walking	0.5			

Table A1.13 Phase 1 infant intertidal activities. Where observation numbers are listed more than once for same activity, this indicates that the activity is undertaken at more than one location, e.g. playing at multiple beaches in the area.

Observation number	Intertidal activity	Sum of occupancy on sand (h y^{-1})	Sum of occupancy on sand and stone (h y^{-1})	Sum of occupancy on rock (h y^{-1})
561	Sitting/picnicking/BBQ	260		
562	Sitting/picnicking/BBQ	260		
563	Sitting/picnicking/BBQ	260		
564	Sitting/picnicking/BBQ	260		
620	Sitting/picnicking/BBQ	0.42		
809	Sitting/picnicking/BBQ	4		
825	Sitting/picnicking/BBQ	12		
827	Sitting/picnicking/BBQ	12		
422	Beachcombing	1		
620	Beachcombing	0.42		
452	Crabbing	0.33		
454	Crabbing	0.33		

Observation number	Intertidal activity	Sum of occupancy on sand (h y^{-1})	Sum of occupancy on sand and stone (h y^{-1})	Sum of occupancy on rock (h y^{-1})
452	Dog walking	0.89		
454	Dog walking	0.89		
612	Dog walking	365		
422	Paddling	1		
432	Paddling	5.25		
432	Paddling	5.25		
452	Paddling	0.89		
454	Paddling	0.89		
620	Paddling	0.33		
825	Paddling	4		
827	Paddling	4		
848	Paddling		12.48	
849	Paddling		12.48	
422	Playing	1		

Observation number	Intertidal activity	Sum of occupancy on sand (h y^{-1})	Sum of occupancy on sand and stone (h y^{-1})	Sum of occupancy on rock (h y^{-1})
431	Playing	10.5		
431	Playing	10.5		
432	Playing	5.25		
432	Playing	5.25		
452	Playing	0.89		
454	Playing	0.89		
457	Playing	4		
462	Playing	6		
561	Playing	520		
562	Playing	520		
563	Playing	520		
564	Playing	520		
620	Playing	0.42		
848	Playing		19.5	

Observation number	Intertidal activity	Sum of occupancy on sand (h y^{-1})	Sum of occupancy on sand and stone (h y^{-1})	Sum of occupancy on rock (h y^{-1})
848	Playing		3.25	
849	Playing		19.5	
849	Playing		3.25	
446	Rock pooling			3.96
848	Rock pooling		6.5	
849	Rock pooling		6.5	
620	Walking	0.42		
848	Walking		78	
849	Walking		78	

Table A1.14 Phase 1 adult handling sediment

Observation number	Sum of handling sediment (h y^{-1})
7	48.00
106	3.64
107	6.00
108	13.32
109	342.38
110	4.50
114	26.00
115	6.00
118	24.00
123	6.00
124	4.00
127	2.00
133	36.00
19	18.00
142	4.00
143	30.00
145	4.25
146	1.50
147	2.25
148	240.90
150	7.00
158	52.00

Observation number	Sum of handling sediment (h y^{-1})
159	58.50
162	1.44
163	36.00
164	52.00
167	253.50
168	2.11
169	6.60
170	10.00
23	84.52
24	3.96
30	20.00
31	21.00
35	4.80
37	78.00
38	5.00
39	54.00
42	12.00
44	15.00
45	15.00
46	39.00
410	312.00
420	1.00
421	3.00
424	4.80

Observation number	Sum of handling sediment (h y^{-1})
428	18.00
429	18.00
433	21.00
439	4.00
50	0.25
447	6.60
456	4.00
458	10.00
461	6.00
53	117.00
481	6.00
487	261.00
488	261.00
56	368.00
509	2.00
511	2.00
515	1.00
520	26.00
523	0.25
534	1.44
539	1.00
545	30.00
548	34.00
549	34.00

Observation number	Sum of handling sediment (h y^{-1})
558	210.00
559	208.00
560	780.00
12	1.00
609	4.25
613	2.25
614	2.25
70	3.96
656	2.00
80	6.00
14	3.00
86	2.00
806	0.67
808	6.00
810	3.64
811	3.64
812	3.64
813	3.64
814	3.64
815	3.64
87	2.00
816	3.64
817	3.64
818	3.64

Observation number	Sum of handling sediment (h y^{-1})
819	3.64
821	7.00
822	2.50
823	16.00
88	1.00
828	120.50
830	5.50
831	5.50
832	5.50
833	5.50
834	5.50
835	5.50
836	5.50
837	5.50
838	5.50
839	5.50
840	5.50
841	5.50
842	12.00
843	40.92
844	40.92
845	43.00
90	2.00
846	40.92

Observation number	Sum of handling sediment (h y^{-1})
847	41.73
861	182.50
92	0.25
94	16.00
95	122.50
96	2.50
97	20.00
98	5.50
100	6.00
102	26.00
103	3.87
104	0.67

Table A1.15 Phase 1 children handling sediment

Observation number	Sum of handling sediment (h y^{-1})
406	48
407	58
418	5
419	5
423	3
434	20
444	156
445	156

Observation number	Sum of handling sediment (h y^{-1})
448	5
449	5
450	5
453	2.11
455	2.11
459	10
460	10
472	15
473	15
482	6
483	6
485	261
486	261
507	5
508	5
510	2
512	2
513	1
514	1
521	26
525	6
526	6
527	6
536	58.5

Observation number	Sum of handling sediment (h y^{-1})
537	58.5
540	1
541	1
546	30
547	30
550	48
551	48
610	4.25
615	2.25
616	2.25
617	2.25
618	2.25
619	1.5
824	16
826	16
829	120.5

Table A1.16 Phase 1 infant handling sediment

Observation number	Sum of handling sediment (h y^{-1})
422	3
431	21
432	21
446	3.96
452	2.11

Observation number	Sum of handling sediment (h y^{-1})
454	2.11
457	4
462	6
561	780
562	780
563	780
564	780
620	1.59
809	4
825	16
827	16
848	29.25
849	41.73

Table A1.17 Phase 1 adult handling equipment

Observation number	Sum of handling equipment (h y^{-1})
109	13
111	7
113	4
116	10
117	12
122	8
123	1
129	117

Observation number	Sum of handling equipment (h y^{-1})
134	338
135	23
143	1
157	32
158	1086
161	10
22	111
167	16
170	5
8	2
32	70
33	10
9	119
45	4
408	6
411	117
458	5
463	10
464	10
465	10
52	1
53	607
478	0.4
55	1

Observation number	Sum of handling equipment (h y^{-1})
56	14
509	0.1
528	9
545	1
554	40
555	40
558	0.3
559	18
66	0.4
76	20
77	8
78	11
84	122
85	4
86	0.1
843	14
844	515
845	1139
846	14
847	1
99	43
100	482
101	575

Table A1.18 Phase 1 children handling equipment

Observation number	Sum of handling equipment (h y^{-1})
409	312
444	52
445	52
459	5
460	5
469	122
485	2
516	4
517	4
518	4
519	4
556	40
557	40

Table A1.19 Phase 1 adult terrestrial activities

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
13	Allotments	15
13	Allotments	274
38	Allotments	117
109	Allotments	2190
117	Allotments	234
118	Allotments	13
118	Allotments	390

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
529	Allotments	234
861	Allotments	2190
439	Bee keeping	104
498	Bee keeping	20
23	Bird/nature watching	120
102	Bird/nature watching	10
103	Bird/nature watching	84
103	Bird/nature watching	21
109	Bird/nature watching	3
137	Bird/nature watching	12
138	Bird/nature watching	293
138	Bird/nature watching	293
861	Bird/nature watching	3
78	Boat maintenance	6
92	Camping	8
523	Camping	8
24	Collecting wild produce	1
35	Collecting wild produce	8
56	Collecting wild produce	456
69	Collecting wild produce	3
149	Collecting wild produce	2

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
424	Collecting wild produce	8
439	Collecting wild produce	50
71	Crofting	1460
21	Cycling	12
35	Cycling	52
41	Cycling	104
46	Cycling	3
55	Cycling	26
68	Cycling	39
76	Cycling	15
83	Cycling	104
84	Cycling	6
109	Cycling	548
137	Cycling	6
137	Cycling	6
149	Cycling	52
155	Cycling	80
169	Cycling	3
170	Cycling	5
424	Cycling	52
447	Cycling	3
470	Cycling	6
606	Cycling	12

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
845	Cycling	832
847	Cycling	26
12	Dog walking	1
23	Dog walking	130
23	Dog walking	130
23	Dog walking	130
24	Dog walking	520
24	Dog walking	520
24	Dog walking	520
29	Dog walking	12
36	Dog walking	12
68	Dog walking	156
69	Dog walking	52
69	Dog walking	365
71	Dog walking	913
80	Dog walking	365
82	Dog walking	4380
92	Dog walking	5
92	Dog walking	4
97	Dog walking	1460
108	Dog walking	183
110	Dog walking	156
112	Dog walking	1
112	Dog walking	1

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
118	Dog walking	130
118	Dog walking	130
118	Dog walking	130
118	Dog walking	130
125	Dog walking	24
125	Dog walking	24
141	Dog walking	183
141	Dog walking	183
142	Dog walking	1
142	Dog walking	1
142	Dog walking	1
147	Dog walking	30
150	Dog walking	156
151	Dog walking	730
155	Dog walking	104
161	Dog walking	2
161	Dog walking	6
161	Dog walking	0.45
163	Dog walking	0.25
163	Dog walking	0.25
164	Dog walking	312
164	Dog walking	6
165	Dog walking	365
420	Dog walking	1

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
438	Dog walking	12
439	Dog walking	730
466	Dog walking	104
480	Dog walking	4380
481	Dog walking	365
523	Dog walking	4
523	Dog walking	5
524	Dog walking	1
524	Dog walking	1
533	Dog walking	183
533	Dog walking	183
544	Dog walking	1
544	Dog walking	1
544	Dog walking	1
613	Dog walking	3
614	Dog walking	3
821	Dog walking	1460
102	Drone flying	78
139	Farming	1278
139	Farming	2190
491	Farming	1560
492	Farming	3120
495	Farming	3120
496	Farming	730

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
497	Farming	3120
520	Fishing	9
13	Gardening	60
23	Gardening	274
35	Gardening	274
37	Gardening	78
38	Gardening	1369
55	Gardening	104
56	Gardening	351
56	Gardening	221
68	Gardening	208
69	Gardening	730
69	Gardening	91
71	Gardening	913
78	Gardening	90
79	Gardening	365
80	Gardening	208
83	Gardening	312
103	Gardening	14
108	Gardening	730
110	Gardening	468
110	Gardening	26
134	Gardening	390
149	Gardening	54

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
151	Gardening	78
151	Gardening	3
155	Gardening	104
164	Gardening	548
164	Gardening	13
165	Gardening	13
424	Gardening	274
439	Gardening	468
463	Gardening	90
466	Gardening	104
843	Gardening	776
843	Gardening	1232
844	Gardening	221
844	Gardening	351
845	Gardening	351
845	Gardening	221
847	Gardening	104
850	Gardening	913
81	Groundworks	540
71	Horse riding	104
138	Invertebrate watching	98
138	Invertebrate watching	98
55	Playing	548
847	Playing	548

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
13	Rambling/walking	365
16	Rambling/walking	3
21	Rambling/walking	144
21	Rambling/walking	144
24	Rambling/walking	234
27	Rambling/walking	5
31	Rambling/walking	156
35	Rambling/walking	274
40	Rambling/walking	4
45	Rambling/walking	7
50	Rambling/walking	2
55	Rambling/walking	312
56	Rambling/walking	520
68	Rambling/walking	365
78	Rambling/walking	20
102	Rambling/walking	42
103	Rambling/walking	31
110	Rambling/walking	33
110	Rambling/walking	293
117	Rambling/walking	100
126	Rambling/walking	8
135	Rambling/walking	1
137	Rambling/walking	3
137	Rambling/walking	3

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
162	Rambling/walking	7
168	Rambling/walking	21
424	Rambling/walking	274
435	Rambling/walking	5
436	Rambling/walking	2
437	Rambling/walking	2
451	Rambling/walking	21
489	Rambling/walking	4
529	Rambling/walking	12
529	Rambling/walking	12
529	Rambling/walking	12
531	Rambling/walking	8
534	Rambling/walking	7
552	Rambling/walking	2
558	Rambling/walking	7
606	Rambling/walking	144
606	Rambling/walking	144
843	Rambling/walking	520
844	Rambling/walking	520
845	Rambling/walking	520
846	Rambling/walking	520
847	Rambling/walking	312
55	Running	104
559	Running	156

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
560	Running	365
847	Running	104
23	Sitting/picnicking/BBQ	365
40	Sitting/picnicking/BBQ	2
55	Sitting/picnicking/BBQ	24
56	Sitting/picnicking/BBQ	702
56	Sitting/picnicking/BBQ	9
69	Sitting/picnicking/BBQ	274
71	Sitting/picnicking/BBQ	4
71	Sitting/picnicking/BBQ	365
78	Sitting/picnicking/BBQ	90
108	Sitting/picnicking/BBQ	3
463	Sitting/picnicking/BBQ	90
489	Sitting/picnicking/BBQ	2
843	Sitting/picnicking/BBQ	702
843	Sitting/picnicking/BBQ	9
844	Sitting/picnicking/BBQ	702
844	Sitting/picnicking/BBQ	9
845	Sitting/picnicking/BBQ	9
845	Sitting/picnicking/BBQ	702
846	Sitting/picnicking/BBQ	702
846	Sitting/picnicking/BBQ	9
847	Sitting/picnicking/BBQ	24
850	Sitting/picnicking/BBQ	365

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
67	Small holding outdoor activities	1460
171	Small holding outdoor activities	2738
171	Small holding outdoor activities	639
441	Small holding outdoor activities	2738
441	Small holding outdoor activities	639

Table A1.20 Phase 1 children terrestrial activities

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
425	Collecting wild produce	8
425	Cycling	52
448	Cycling	3
449	Cycling	3
450	Cycling	3
459	Cycling	5
460	Cycling	5
469	Cycling	6
471	Cycling	6
556	Cycling	3
557	Cycling	3
482	Dog walking	365
483	Dog walking	365

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
615	Dog walking	3
616	Dog walking	3
617	Dog walking	3
618	Dog walking	3
483	Jogging	52
425	Playing	274
482	Playing	390
483	Playing	390
425	Rambling/walking	137
453	Rambling/walking	21
455	Rambling/walking	21

Table A1.21 Phase 1 infant terrestrial activities

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
849	Cycling	26
848	Cycling	26
426	Cycling	52
849	Gardening	104
848	Gardening	104
849	Playing	548
848	Playing	548
426	Playing	274
849	Rambling/walking	312
848	Rambling/walking	312

Observation number	Terrestrial activity	Sum of occupancy (h y^{-1})
454	Rambling/walking	21
452	Rambling/walking	21
426	Rambling/walking	137
426	Collecting wild produce	8

Table A1.22 Phase 1 adult green vegetable consumption

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
38	Asparagus	0.23
109	Asparagus	0.25
490	Asparagus	0.23
861	Asparagus	0.25
71	Broccoli	0.23
109	Broccoli	2.50
110	Broccoli	7.70
118	Broccoli	1.40
439	Broccoli	3.40
440	Broccoli	3.40
850	Broccoli	0.23
861	Broccoli	2.50
56	Brussel sprouts	1.60
110	Brussel sprouts	11.00
439	Brussel sprouts	2.00
440	Brussel sprouts	2.00
13	Cabbage	1.50

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
109	Cabbage	1.00
118	Cabbage	4.00
439	Cabbage	5.00
440	Cabbage	5.00
861	Cabbage	1.00
38	Cauliflower	1.50
71	Cauliflower	1.00
110	Cauliflower	5.50
439	Cauliflower	0.50
440	Cauliflower	0.50
490	Cauliflower	1.50
850	Cauliflower	1.00
38	Celery	6.23
71	Celery	0.25
109	Celery	1.25
490	Celery	6.23
850	Celery	0.25
861	Celery	1.25
109	Chard	3.30
439	Chard	1.90
440	Chard	1.90
861	Chard	3.30
38	Herbs	0.75
71	Herbs	0.23

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
109	Herbs	0.50
118	Herbs	0.20
151	Herbs	0.05
490	Herbs	0.75
850	Herbs	0.23
861	Herbs	0.50
82	Kale	5.00
109	Kale	3.30
117	Kale	3.50
439	Kale	6.50
440	Kale	6.50
480	Kale	5.00
529	Kale	3.50
861	Kale	3.30
38	Kohl Rabi	2.72
490	Kohl Rabi	2.72
13	Lettuce	5.85
71	Lettuce	0.50
82	Lettuce	22.50
108	Lettuce	1.35
117	Lettuce	1.80
118	Lettuce	2.70
439	Lettuce	4.05
440	Lettuce	4.05

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
480	Lettuce	22.50
529	Lettuce	1.80
850	Lettuce	0.50
109	Lovage	1.25
861	Lovage	1.25
71	Rhubarb	0.50
108	Rhubarb	16.00
109	Rhubarb	2.50
850	Rhubarb	0.50
861	Rhubarb	2.50
38	Spinach	0.25
71	Spinach	0.25
109	Spinach	3.30
439	Spinach	1.90
440	Spinach	1.90
490	Spinach	0.25
850	Spinach	0.25
861	Spinach	3.30

Table A1.23 Phase 1 adult other vegetable consumption

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
69	Borlotti bean	0.20
82	Borlotti bean	0.10
480	Borlotti bean	0.10

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
38	Broad bean	4.50
56	Broad bean	2.40
83	Broad bean	0.50
109	Broad bean	1.00
118	Broad bean	4.80
439	Broad bean	1.00
440	Broad bean	1.00
490	Broad bean	4.50
861	Broad bean	1.00
13	French bean	0.66
38	French bean	1.00
69	French bean	1.33
71	French bean	0.50
82	French bean	1.00
439	French bean	0.50
440	French bean	0.50
480	French bean	1.00
490	French bean	1.00
850	French bean	0.50
110	Mushrooms	0.50
38	Pea	1.00
71	Pea	0.50
108	Pea	8.66
117	Pea	1.33

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
439	Pea	1.50
440	Pea	1.50
490	Pea	1.00
529	Pea	1.33
850	Pea	0.50
38	Runner Bean	5.40
69	Runner Bean	16.20
82	Runner Bean	5.40
109	Runner Bean	1.00
480	Runner Bean	5.40
490	Runner Bean	5.40
861	Runner Bean	1.00

Table A1.24 Phase 1 adult root vegetable consumption

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
56	Beetroot	1.04
71	Beetroot	1.50
82	Beetroot	5.20
108	Beetroot	1.10
109	Beetroot	5.00
110	Beetroot	1.20
439	Beetroot	5.00
440	Beetroot	5.00

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
480	Beetroot	5.20
850	Beetroot	1.50
861	Beetroot	5.00
37	Carrot	23.00
71	Carrot	1.50
83	Carrot	0.25
109	Carrot	1.00
117	Carrot	1.13
529	Carrot	1.13
850	Carrot	1.50
861	Carrot	1.00
38	Fennel	1.20
108	Fennel	0.23
490	Fennel	1.20
69	Garlic	0.38
71	Garlic	0.25
108	Garlic	0.40
109	Garlic	0.10
151	Garlic	0.30
439	Garlic	5.00
440	Garlic	5.00
850	Garlic	0.25
861	Garlic	0.10
38	Jerusalem artichoke	5.25

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
109	Jerusalem artichoke	0.50
490	Jerusalem artichoke	5.25
861	Jerusalem artichoke	0.50
13	Leek	4.76
37	Leek	11.00
38	Leek	4.76
56	Leek	0.95
69	Leek	7.14
71	Leek	0.25
82	Leek	11.90
109	Leek	5.00
118	Leek	9.52
480	Leek	11.90
490	Leek	4.76
850	Leek	0.25
861	Leek	5.00
13	Onion	3.99
38	Onion	9.98
56	Onion	1.20
71	Onion	0.70
109	Onion	3.00
110	Onion	2.00
117	Onion	0.67
118	Onion	5.32

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
439	Onion	1.60
440	Onion	1.60
490	Onion	9.98
529	Onion	0.67
850	Onion	0.70
861	Onion	3.00
38	Parsnip	2.25
490	Parsnip	2.25
71	Radish	0.50
850	Radish	0.50
13	Shallot	0.40
38	Shallot	0.24
71	Shallot	0.50
490	Shallot	0.24
850	Shallot	0.50
38	Swede	3.00
71	Swede	1.00
110	Swede	2.75
490	Swede	3.00
850	Swede	1.00
110	Turnip	2.94

Table A1.25 Phase 1 adult potato consumption

Observation number	Vegetable type	Sum of consumption (kg y^{-1})
109	Potatoes	40.00
110	Potatoes	100.00
117	Potatoes	2.31
118	Potatoes	3.85
134	Potatoes	3.15
151	Potatoes	3.85
164	Potatoes	4.00
171	Potatoes	21.00
37	Potatoes	23.00
38	Potatoes	3.47
439	Potatoes	75.00
440	Potatoes	75.00
441	Potatoes	21.00
52	Potatoes	18.00
490	Potatoes	3.47
56	Potatoes	1.54
529	Potatoes	2.31
71	Potatoes	2.50
83	Potatoes	0.50
850	Potatoes	2.50
861	Potatoes	40.00
100	Potatoes	4.67

Table A1.26 Phase 1 adult domestic fruit consumption

Observation number	Fruit type	Sum of consumption (kg y^{-1})
38	Apple	27.00
56	Apple	30.00
69	Apple	5.40
108	Apple	5.50
109	Apple	2.00
151	Apple	9.60
490	Apple	27.00
861	Apple	2.00
82	Aubergine	1.00
480	Aubergine	1.00
38	Blackberry	0.45
490	Blackberry	0.45
38	Blackcurrant	6.75
69	Blackcurrant	2.70
118	Blackcurrant	4.50
134	Blackcurrant	1.50
439	Blackcurrant	1.00
440	Blackcurrant	1.00
490	Blackcurrant	6.75
38	Blueberries	4.08
69	Blueberries	1.63
80	Blueberries	0.03

Observation number	Fruit type	Sum of consumption (kg y^{-1})
481	Blueberries	0.25
490	Blueberries	4.08
56	Cherries	0.16
38	Courgettes	5.76
56	Courgettes	11.52
69	Courgettes	2.30
71	Courgettes	0.50
82	Courgettes	6.05
109	Courgettes	2.50
117	Courgettes	4.32
118	Courgettes	11.52
144	Courgettes	3.60
480	Courgettes	6.05
490	Courgettes	5.76
529	Courgettes	4.32
850	Courgettes	0.50
861	Courgettes	2.50
38	Cucumber	2.50
56	Cucumber	2.00
69	Cucumber	1.00
71	Cucumber	2.00
83	Cucumber	1.20
118	Cucumber	5.00
490	Cucumber	2.50

Observation number	Fruit type	Sum of consumption (kg y^{-1})
850	Cucumber	2.00
56	Gooseberry	0.09
80	Gooseberry	0.25
109	Gooseberry	3.00
439	Gooseberry	2.25
440	Gooseberry	2.25
481	Gooseberry	0.25
861	Gooseberry	3.00
38	Grape	2.50
80	Grape	0.50
481	Grape	0.50
490	Grape	2.50
69	Loganberry	4.86
38	Pear	2.25
490	Pear	2.25
69	Pepper	4.00
71	Pepper	1.50
82	Pepper	14.00
108	Pepper	20.00
110	Pepper	12.00
118	Pepper	2.00
480	Pepper	14.00
850	Pepper	1.50
38	Plum	6.00

Observation number	Fruit type	Sum of consumption (kg y^{-1})
490	Plum	6.00
82	Pumpkin	5.00
480	Pumpkin	5.00
38	Raspberry	2.00
52	Raspberry	0.30
490	Raspberry	2.00
439	Redcurrant	0.50
440	Redcurrant	0.50
109	Squash	2.50
861	Squash	2.50
38	Strawberry	4.40
52	Strawberry	0.50
56	Strawberry	0.96
71	Strawberry	0.50
108	Strawberry	9.00
110	Strawberry	0.50
117	Strawberry	0.45
118	Strawberry	2.70
134	Strawberry	2.50
439	Strawberry	1.50
440	Strawberry	1.50
490	Strawberry	4.40
529	Strawberry	0.45
850	Strawberry	0.50

Observation number	Fruit type	Sum of consumption (kg y^{-1})
69	Sweetcorn	3.43
82	Sweetcorn	1.72
110	Sweetcorn	11.00
480	Sweetcorn	1.72
38	Tomato	80.00
56	Tomato	20.00
69	Tomato	8.00
71	Tomato	3.00
83	Tomato	0.50
109	Tomato	5.00
110	Tomato	30.00
117	Tomato	20.00
118	Tomato	24.00
144	Tomato	12.00
439	Tomato	6.00
440	Tomato	6.00
490	Tomato	80.00
529	Tomato	20.00
850	Tomato	3.00
861	Tomato	5.00
439	White currants	0.50
440	White currants	0.50

Table A1.27 Phase 1 child domestic fruit consumption

Observation number	Fruit type	Sum of consumption (kg y^{-1})
482	Grape	0.5
482	Gooseberry	0.25
482	Blueberries	0.25
483	Grape	0.5
483	Gooseberry	0.25
483	Blueberries	0.25
611	Tomato	4
611	Courgettes	1.44

Table A1.28 Phase 1 infant domestic fruit consumption

Observation number	Fruit type	Sum of consumption (kg y^{-1})
612	Tomato	4
612	Courgettes	0.72

Table A1.29 Phase 1 adult wild foods consumption

Observation number	Wild food type	Sum of consumption (kg y^{-1})
82	Apple	7.50
480	Apple	7.50
24	Blackberry	0.14
55	Blackberry	0.75

Observation number	Wild food type	Sum of consumption (kg y^{-1})
56	Blackberry	1.08
69	Blackberry	4.00
78	Blackberry	0.25
80	Blackberry	0.50
82	Blackberry	2.00
149	Blackberry	2.00
439	Blackberry	3.00
440	Blackberry	3.00
463	Blackberry	0.25
464	Blackberry	0.25
465	Blackberry	0.25
480	Blackberry	2.00
481	Blackberry	0.50
35	Elderberry	0.90
56	Elderberry	3.40
424	Elderberry	0.90
55	Elderflower	0.13
439	Elderflower	0.50
440	Elderflower	0.50
439	Garlic berries	0.75
440	Garlic berries	0.75
24	Garlic Leaves	0.10
56	Hawthorn berries	2.70
439	Hawthorn berries	3.00

Observation number	Wild food type	Sum of consumption (kg y^{-1})
440	Hawthorn berries	3.00
439	Mushrooms	1.75
440	Mushrooms	1.75
439	Nettle	0.25
440	Nettle	0.05
439	Nettle seeds	0.05
440	Nettle seeds	0.25
56	Raspberry	1.00
56	Rosehips	2.70
56	Seaweed	0.75
24	Water seacress	0.10

Table A1.30 Phase 1 child wild foods consumption

Observation number	Wild food type	Sum of consumption (kg y^{-1})
482	Blackberry	0.5
483	Blackberry	0.5
425	Elderberry	0.9

Table A1.31 Phase 1 infant wild foods consumption

Observation number	Wild food type	Sum of consumption (kg y^{-1})
426	Elderberry	0.9

Table A1.32 Phase 1 adult wild fungi consumption. Note this table reflects the mushroom data already presented as part of Table A1.29 and is included here for summary purposes only

Observation number	Wild fungi	Sum of consumption (kg y^{-1})
439	Mushrooms	1.75
440	Mushrooms	1.75

Table A1.33 Phase 1 adult sheep meat consumption

Observation number	Meat	Sum of consumption (kg y^{-1})
134	Lamb	2.7
139	Lamb	2.6
56	Lamb	2
69	Lamb	15.6

Table A1.34 Phase 1 adult egg consumption

Observation number	Eggs	Sum of consumption (kg y^{-1})
23	Eggs	2.09
52	Eggs	36.19
53	Eggs	36.19
56	Eggs	18.10
69	Eggs	27.14
71	Eggs	8.35
110	Eggs	18.10
117	Eggs	15.08

Observation number	Eggs	Sum of consumption (kg y^{-1})
171	Eggs	3.02
439	Eggs	9.05
440	Eggs	9.05
441	Eggs	3.02
442	Eggs	3.02
443	Eggs	3.02
491	Eggs	26.39
492	Eggs	26.39
493	Eggs	26.39
494	Eggs	26.39
529	Eggs	15.08

Table A1.35 Phase 1 children egg consumption

Observation number	Eggs	Sum of consumption (kg y^{-1})
444	Eggs	3.02
445	Eggs	3.02

Table A1.36 Phase 1 adult honey consumption

Observation number	Honey	Sum of consumption (kg y^{-1})
37	Honey	3
439	Honey	9
440	Honey	9
52	Honey	0.6

Observation number	Honey	Sum of consumption (kg y^{-1})
498	Honey	4.5
56	Honey	6

Appendix A2: Postal survey

The postal survey produces an independent data set from a broad cross section of the population living in the area potentially providing a means to identify new or modified habits to target during the face-to-face surveys or focus group discussions.

The postal survey helps refine and revise the face-to-face survey plans and identify optimal geographic areas to target during the face-to-face surveys. It provides additional information on potential sites for the collection of observational data and indicated the optimum timings to visit each survey location. Furthermore, the postal survey provides contacts for individuals and groups to follow up with and a wider list of activities that merit further investigation in the later face to face survey work. Follow up with contacts was only undertaken if specific permission was granted by the survey respondent(s).

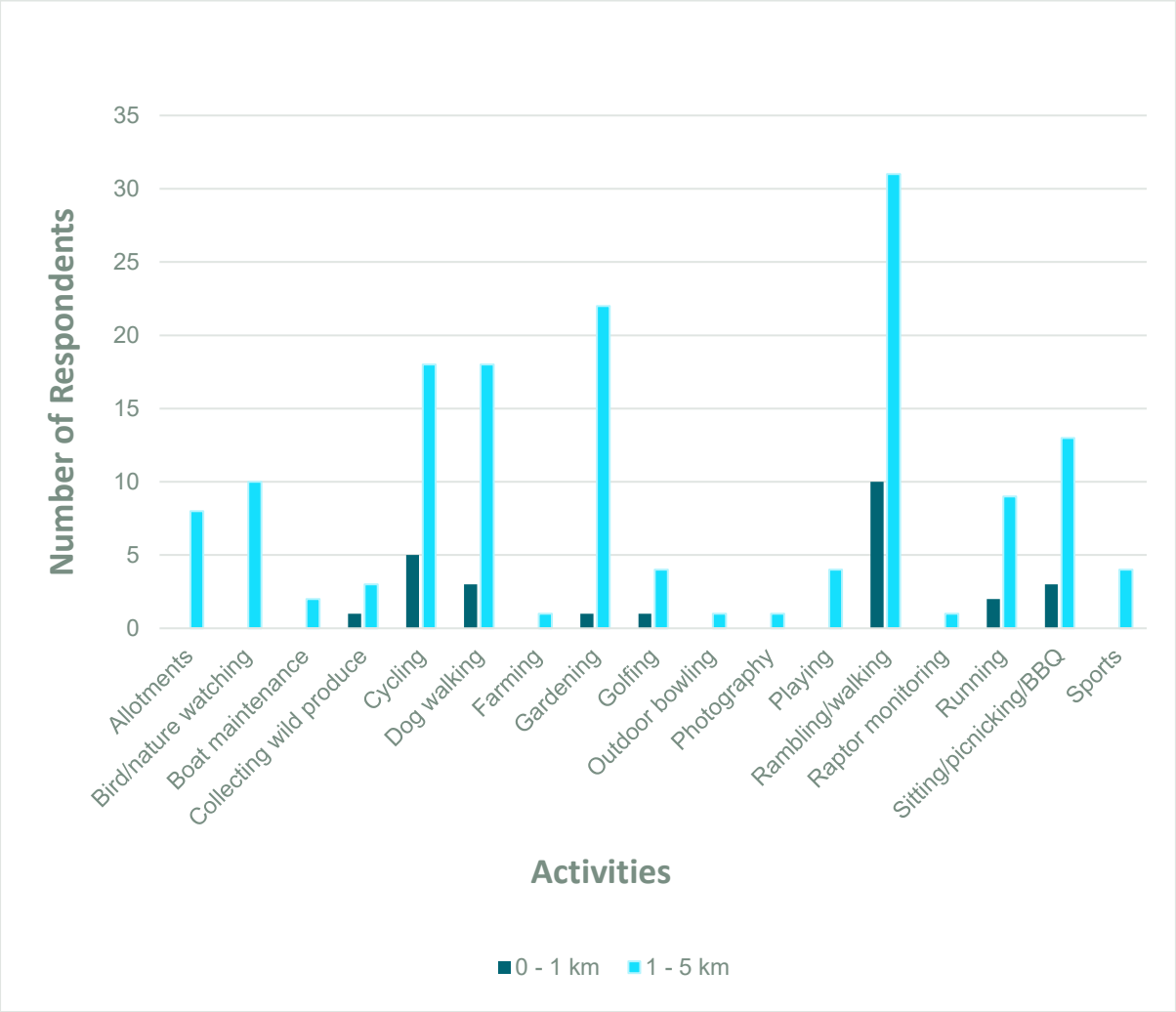
A2.1 Postal survey results

Several respondents report undertaking a range of terrestrial activities within 5km of the Hunterston A and B sites (Figure A2i).

Rambling/walking was the most popular activity within 1km of the site (10 respondents) followed by cycling (5 respondents).

Within 5km of the site rambling/walking was the most popular activity (31 respondents) followed by gardening (22 respondents), dog walking and cycling each with 18 respondents.

Figure A2i. Overview of the number of respondents participating in terrestrial activities in the 1km and 5km survey areas



The location where the range of activities within 5km are reported are listed below with Cumbrae and West Kilbride having the widest range of activities (13 different activities). Rambling/walking and cycling were the two activities undertaken at more sites than any other activity, 24 and 17 locations respectively.

Allotments: Cumbrae, Fairlie, Fairlie, West Kilbride.

Bird/Nature-Watching: Ardneil, Ardneil/Thirdpart, Construction yard - by Hunterston, Cumbrae, Fairlie, Kaim Hill, Millport, Near Portencross, Near Thirdpart, Portencross, Seamill, West Kilbride.

Boat maintenance: Cumbrae, Fairlie,

Collecting Wild Produce: Burn Gill near Hunterston access road, Fairlie, Little Cumbrae, West Kilbride.

Cycling: All over 5km, Ardneil, Crosbie area, Cumbrae, Fairlie, Following railway within 5 km, From West Kilbride to coast and north to Hunterston Gulls Walk, Hunterston, Hawking Craig, Irvine Road - A78, Little Cumbrae, Millport, Kilruskin Glen, Near Portencross, Portencross, West of Knockenden Reservoir, West Kilbride.

Dog Walking: Coastal path Portencross, Cumbrae, Deer Park, Fairlie, Fairlie Glen, Hunterston, Little Cumbrae, Near Lion Rock, Cumbrae, Near Portencross, Near Thirdpart, Portencross, Southannan Glen/Blackhill, The Three Sisters, West Kilbride.

Farming: Cumbrae.

Gardening: Cumbrae, Deer Park, Fairlie, East of Hunterston Sands and A78, Millport, near Kelburn, West Kilbride.

Golfing: Ardneil, Deer Park, East of Hunterston Sands and A78, Little and Great Cumbrae, West Kilbride.

Outdoor bowling: West Kilbride.

Playing: Cumbrae, Fairlie, Millport, Near Portencross, Portencross, West Kilbride.

Photography: Near Thirdpart.

Rambling/Walking: All over 5km, Between A78 and B782, Coastal path between Hawking Craig and Portencross, Cumbrae, Deer Park, East of Fairlie - Kairn Hill, East of Glenburn Reservoir, Fairlie, Fairlie Glen, From West Kilbride to coast and north to Hunterston Gulls Walk, Glentane Hill, Goldenberry, Hunterston, Hunterston, Hunterston Castle, Law Hill, Little Cumbrae, Little Cumbrae, Millport, Near Gulls Walk, Kilruskin Glen, Near Portencross, Near Thirdpart, North of Lion Rock, Cumbrae, Portencross, West Kilbride.

Raptor monitoring: Cumbrae.

Running/Jogging: Black Hill, Carlung, Bushglen and Lawoodhead, Cumbrae, Deer Park, East of Waterside Hill, Goldenberry, Kaim Hill, near Castle Knowe, Near Gulls Walk, Near Portencross, Portencross, Portencross on B7048 to WK, West Kilbride.

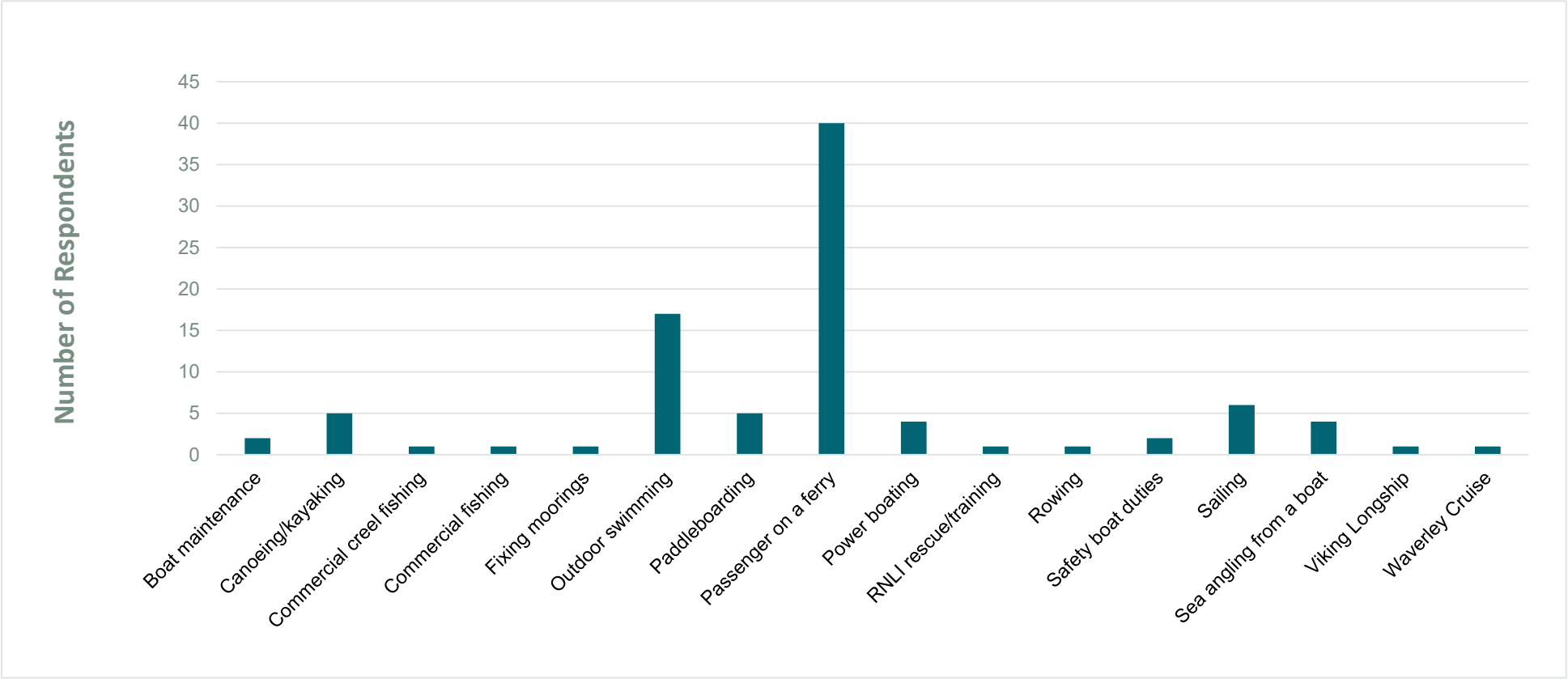
Sitting/Picnicking/BBQ: All over 5km, Carlung, Bushglen and Lawoodhead, Cumbrae, Deer Park, Fairlie, Hunterston, Little Cumbrae, Millport, Near Portencross, near WK Golf club, Portencross, West Kilbride.

Sports: Cumbrae, Little and Great Cumbrae, West of Glenburn fishery, West Kilbride.

A2.1.2 Aquatic external exposure

Several households reported they engaged in aquatic activities within the survey area. The total number of respondents undertaking each aquatic activity, either in or on the water are presented in Figure A2ii.

Figure A2ii Overview of the number of respondents participating in aquatic activities



Across the whole aquatic survey area, travelling as a passenger on the ferry (40 respondents) and outdoor swimming (17 respondents) were the most popular followed by sailing (six respondents), with canoeing/kayaking and paddle boarding each having five respondents.

In terms of activity locations, the Firth of Clyde had the highest range of activities (ten respondents) and specifically Fairlie Roads with eight respondents as listed below.

Boat maintenance: Firth of Clyde - between Ardrossan and Portencross, Firth of Clyde - between Largs and Wemyss Bay, Fairlie Roads.

Canoeing/kayaking: Ardneil Bay, Brither Rocks, Bell Stane, Fairlie, Fairlie/Fairlie Sands, Firth of Clyde, West Kilbride.

Commercial creel fishing: Firth of Clyde - between Ardrossan and Portencross.

Commercial fishing: Firth of Clyde - between Ardrossan and Portencross.

Fixing moorings: Fairlie Roads.

Outdoor swimming: Ardneil Bay, Brither Rocks, Ardrossan, Campburn Bay, Fairlie, Fairlie, Fairlie/Fairlie Sands, near Brither Rocks, Newtown Bay, Seamill, Off Cumbrae, Southannan Sands.

Paddleboarding: Ardneil Bay, Ardrossan, near yellow craigs (Ardrossan), Off Cumbrae, Saltcoats.

Passenger on a ferry: Fairlie Roads, Firth of Clyde, Firth of Clyde - to Little Cumbrae.

Power boating: Fairlie Roads, Firth of Clyde, Off Cumbrae.

Rowing: Off Cumbrae.

Safety boat duties: Fairlie Roads, Firth of Clyde.

Sailing: Around Cumbraes, Fairlie Roads, Firth of Clyde.

Sea-angling on a boat: Firth of Clyde - between Ardrossan and Portencross, Fairlie Roads, Off Cumbrae, Off Little Cumbrae.

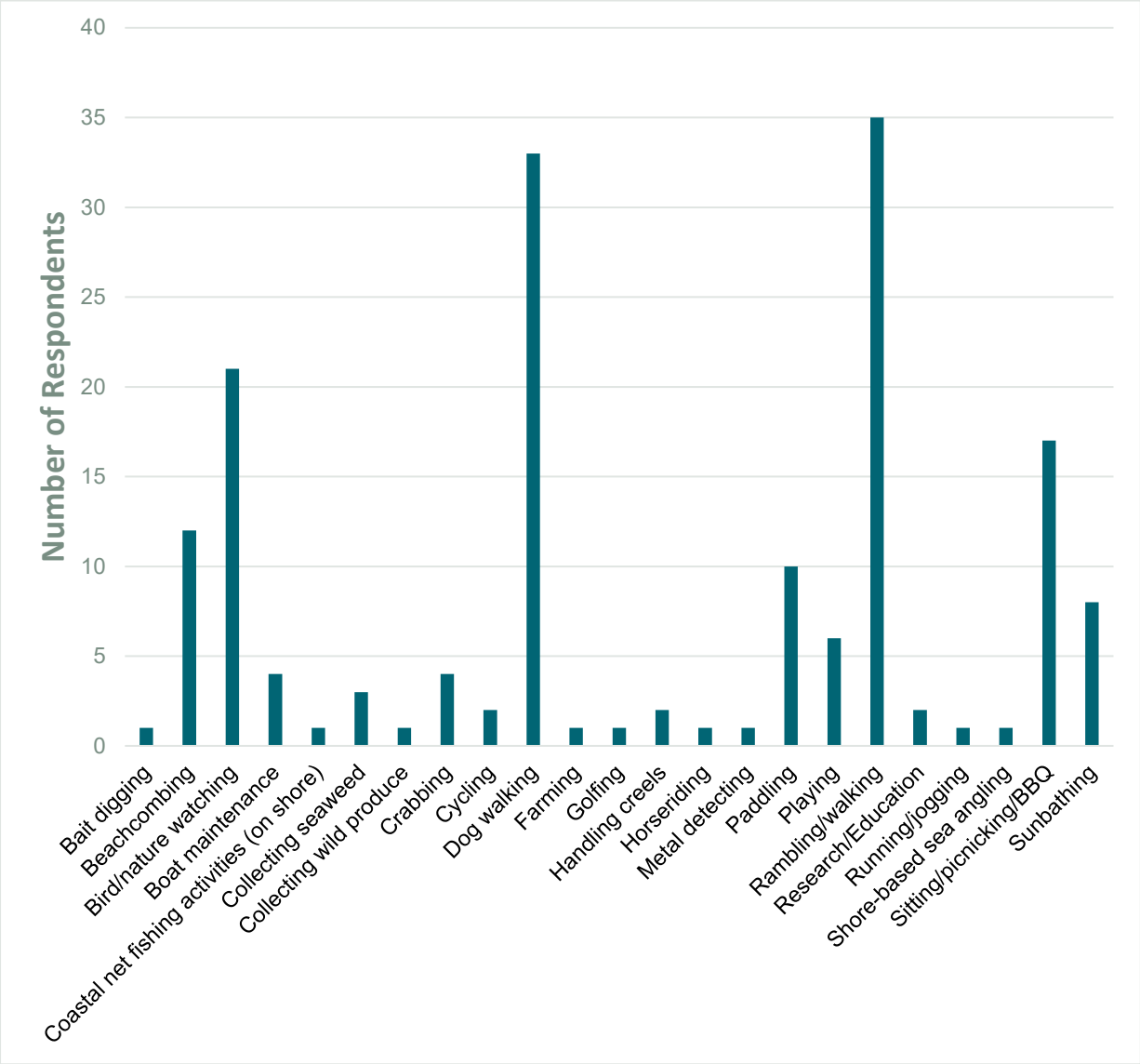
Viking Longship: Fairlie Roads.

Waverley Cruise: Firth of Clyde.

A2.1.3 External intertidal exposure

Several households carry out activities in the intertidal zone within the survey area. The number of respondents undertaking each intertidal activity are presented in Figure A2iii. The activity with the highest number of respondents was rambling/walking (35 respondents) followed by dog walking, bird/nature watching and sitting/picnicking/BBQ (33, 21 and17 respondents respectively).

Figure A2iii Overview of the number of respondents participating in intertidal activities



Intertidal activities were reported throughout the survey zone of 5km, as listed below. Fairlie Sands had the highest number of differing activities with Southanan Sands and Ardneil Bay intertidal areas also proving relatively popular.

Bait Digging: Fairlie.

Beachcombing: Ardrossan north beach/to Campburn Bay, Ardneil Bay, Fairlie, Fairlie, Far Bowens Craig, Farland Head, Hawking Craig, Hunterston Sands, Largs

Bay, Largs Bay, Little and Great Cumbrae, Meigle Bay, Newtown Bay, Portencross, Seamill, Southannan Sands.

Bird/Nature-Watching: All coastal area from Hunterston to Ardrossan, Ardrossan north beach, Ardneil Bay, Beach by Seaview caravan park, Bellstane/Boydston, Between Southannan Sands and St Fillan's Bridge, Brither Rocks, Doughead Hole, near Portachur Point, Fairlie, Far Bowens Craig, Gulls Walk - Southannan Sands, Farland Point, Hawking Craig, Hunterston Sands, Meigle Bay, Portencross, Seamill, Southannan Sands, West Kilbride.

Boat Maintenance: Between Fairlie and Largs, Fairlie, Firth of Clyde - between Largs and Wemyss Bay, Newtown Bay.

Coastal net fishing activities (on shore): Firth of Clyde - between Largs and Wemyss Bay.

Collecting seaweed: Ardrossan north beach/to Campburn Bay, Ardrossan South shore, Cumbrae, Southannan Sands.

Collecting wild produce: Ardneil Bay, Hunterston Sands.

Cycling: Southannan Sands.

Crabbing: Cumbrae, Fairlie, Firth of Clyde - between Largs and Wemyss Bay, Meigle Bay.

Dog walking: Ardrossan, Ardrossan Harbour, Ardrossan north beach, Ardneil Bay, Ardrossan South shore, Bellstane/Boydston, Between Southannan Sands and St Fillan's Bridge, Bowens Craig, Boydston, Brither Rocks, Coastal between Largs and Fairlie, Coastal near Routenburn, Cumbrae, Fairlie, Far Bowens Craig, Fintray Bay, Gulls Walk, Farland Point, Hawking Craig, Hunterston Sands, Kames Bay, Kelburn Foot, Largs Bay, Little Brigurd – Hunterston, Newtown Bay, Newtown Bay, Portencross, Saltcoats/Saltcoats harbour, Seamill, Southannan Sands.

Farming: Between Southannan Sands and St Fillan's Bridge.

Golfing: Ardneil Bay.

Handling creels: Fairlie, Firth of Clyde - between Largs and Wemyss Bay.

Horse riding: Ardneil Bay.

Metal detecting: Ardneil Bay, Fairlie, Farland Head, Hawking Craig, Hunterston Sands, Largs Bay.

Outdoor swimming: Ardrossan north beach/to Campburn Bay.

Paddleboarding: Ardrossan.

Paddling: Ardneil Bay, Ardrossan - Ponder beach, Boydston, Castle Bay, Cumbrae, Fairlie, Kames Bay, Meigle Bay, Sheriff's Port, Cumbrae, Skate Bay, Cumbrae, Southannan Sands.

Playing: Ardrossan north beach, Fairlie, Meigle Bay, Southannan Sands.

Rambling/walking: Ardrossan Harbour, Ardrossan north beach, Ardrossan - Ponder beach, Ardrossan South shore, Bellstane, Bowens Craig, Boydston, Brither Rocks, Cumbrae, Fairlie, Fintray Bay, Firth of Clyde - between Largs and Wemyss Bay, Farland Point, Hawking Craig, Hunterston Sands, Kames Bay, Largs Bay, Little and Great Cumbrae, Meigle Bay, Portencross, Saltcoats/Saltcoats harbour, Seamill, Southannan Sands, Yellowcraigs. West Kilbride.

Research/Education: Fairhaven, Cumbrae.

Running/Jogging: Ardneil Bay.

Sitting/Picnicking/BBQ: Ardrossan Harbour, Ardrossan north beach, Ardneil Bay, Boydston, Brither Rocks, Fairlie, Hunterston Sands, Kames Bay, Meigle Bay, Portencross, Seamill, Southannan Sands, West Kilbride.

Shore-Based Sea-Angling: Farland Point.

Sun-Bathing: Ardrossan north beach, Ardrossan north beach/to Campburn Bay, Ardrossan - Ponder beach, Bellstane. Cumbrae, Fairlie, Newtown Bay, Seamill, Southannan Sand.

A2.1.4 Internal exposure

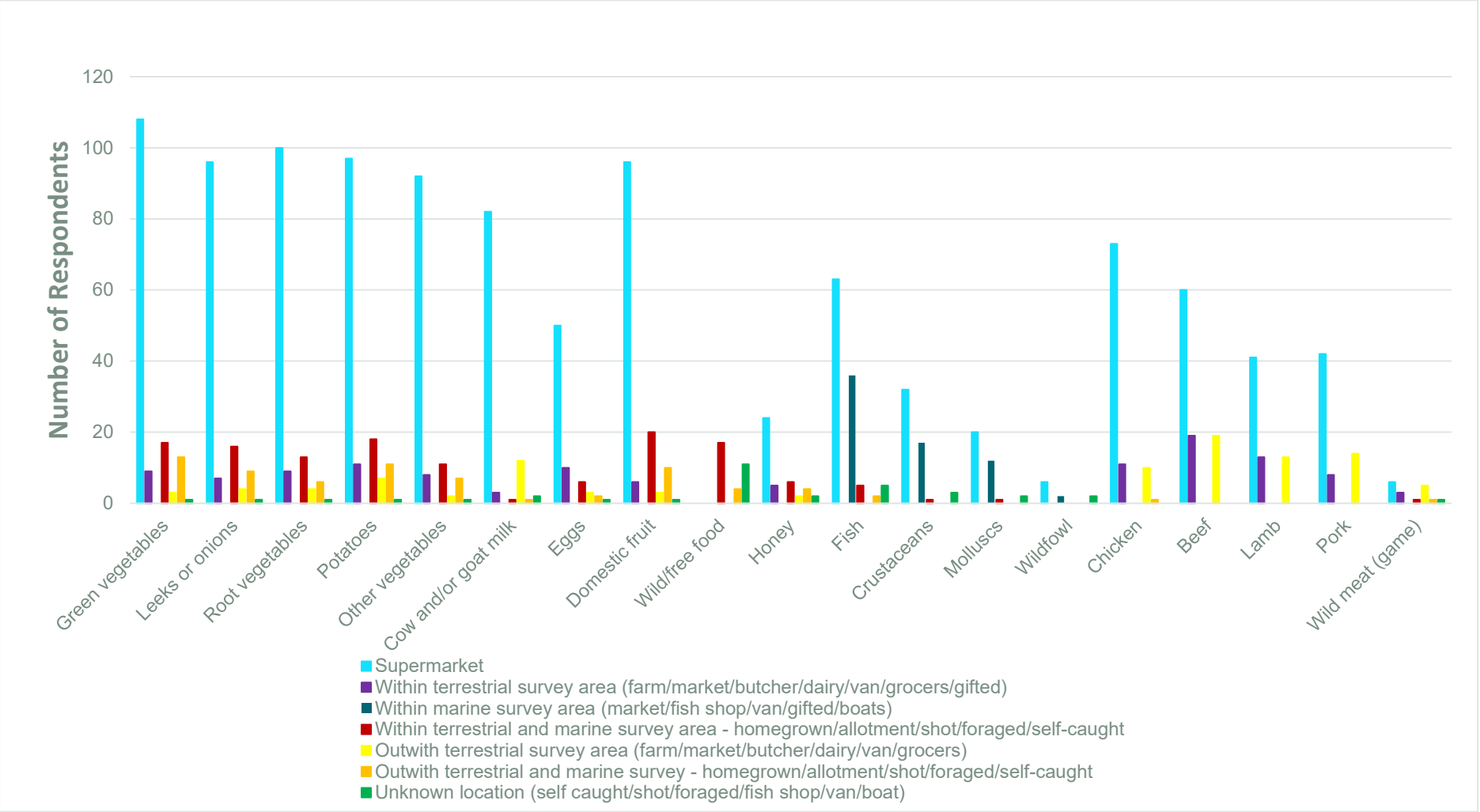
Respondents were asked to provide information on where they sourced their food. Figure A2i shows the number of respondents sourcing food locally for each food group. Results show that the respondents bought most of their food from local shops or supermarkets within and outwith the terrestrial (5km) and marine (30km) survey area. This was consistent across all food groups reflecting the low numbers of respondents that sourced local produce. Domestic fruit was the highest of locally sourced produce that was homegrown (20 respondents) whilst fish was the highest of locally sourced foods from a fish shop/van/market/gifted/boats (36 respondents).

Figure A2iv shows the number of respondents sourcing food from each food group locally sourced, homegrown/allotment/shot/foraged/self-caught and outwith the survey area. Food sourced from within the survey area showed the largest number of respondents (36) to source fish from within the survey area. Domestic fruit was sourced by 20 respondents from within the 5km terrestrial survey area. Beef was sourced by 19 respondents from within the 5km terrestrial survey area. A very small number of respondents shot wild meat (game) and wildfowl. Table A2i provides an overview of where local produce within the survey area was sourced.

Table A2i. Summary of locally produced food

Food Group	Number of respondents	Locally home grown/foraged/caught/shot
Green vegetables	17	West Kilbride, Fairlie and Millport
Leeks or onions	16	West Kilbride, Fairlie and Millport
Root vegetables	13	West Kilbride, Fairlie and Millport
Potatoes	18	West Kilbride, Fairlie and Millport
Other vegetables	11	West Kilbride, Fairlie and Millport
Cow and/or goat milk	1	Millport
Eggs	6	West Kilbride and Millport
Domestic fruit	20	West Kilbride, Fairlie and Millport
Wild/free food	17	Portencross, West Kilbride, Fairlie, Cumbrae and Hunterston
Honey	6	Fairlie and West Kilbride
Fish	5	Kames Bay, Fairlie, Largs, Cumbrae, Ardrossan
Crustaceans	1	Firth of Clyde – within the survey location
Molluscs	1	Self-caught Largs
Wildfowl	2	Self-caught - unknown location within survey area
Wild meat (game)	2	Within 5km of site - an unknown location within survey area

Figure A2iv Number of respondents sourcing food from food groups



Appendix A3: In-situ gamma dose rate measurements

The protocol requires the detector's probe to be positioned 1m above the surface and counts acquired over a 600 second integration time. The cosmic and intrinsic components to the measurement are then subtracted. The protocol also requires persons operating the detector to be at least 5m from the probe during the count. Both instruments are calibrated using radium-226 and caesium-137 sources (the calibration being chosen to reflect naturally occurring or anthropogenic radionuclide sources respectively). Here, gamma dose rates were dominated by the natural background, so all results are reported with the radium-226 calibration and reported as μGy h^1.

For the dose assessment tool, gamma dose rates were converted to Effective Dose (μSv h^{-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 as they have had the cosmic and intrinsic component subtracted.

Appendix A4: Beta skin dosimetry measurements

The instrument was calibrated under UKAS accreditation against strontium-90 and yttrium-90, chlorine-36 and carbon14 (and put inside a file poly-pocket to protect the system from the weather). A 12mm 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 12mm 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 0.2μSv h^1.

Appendix A5: Site descriptions and observations

A5.1 Aquatic survey area descriptions

The survey locations were visited throughout two survey periods, the first outwith the school holiday period (22 to 28 June) and the second within the school holiday period (3 to 9 August) of 2024. Onshore and offshore 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, all of Little Cumbrae Island and offshore of Largs were also included. 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 most of the length of the aquatic survey area and stays close to the coastline, routing along many beaches between Skelmorlie and Ardrossan.

A5.2 Wemyss Bay, Skelmorlie, Meigle Bay, Auchengarth, St Phillans and Routenburn

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 stone beach with a stone sea defence wall along the back of the bay. Within the school holiday period several families were playing and walking, and three individuals were observed dog walking on the intertidal substrate. Outwith the school holiday survey period two individuals were walking and one individual paddling in the intertidal area. One ferry and one submarine were observed outwith the school holiday survey period. A small sand and stone beach is located to the south of the ferry terminal and train station with individuals observed to be walking, dog walking, paddling and playing both within and outwith the school holiday period.

South from Wemyss Bay is Skelmorlie, Meigle Bay, Auchengarth/St Phillans and Routenburn (Figure A5.1) which is a rocky stretch of coastline with limited access from the main road. No onshore or offshore observations were observed at Skelmorlie site both within and outwith the school holiday period. One adult and two children were observed dog walking at Meigle with no other observations on or offshore outwith the school holiday period. Within the school holiday seven individuals were observed fishing off rocks at Meigle, no other onshore or offshore activities were observed.

Figure A5.1 Looking south from Skelmorlie (June 2024)

Continuing along the coastline to Auchengarth/St Phillans the substrate is stone with rocky outcrops with some sand apparent. Outwith the school holiday period two adults and one child were observed walking on the intertidal substrate, however no onshore or offshore observations were noted within the school holiday survey. Access along this stretch was limited with only a few parking bays allowing access to the beach area.

Continuing south towards Largs, the substrate is a mixture of large rock and stone to the roadside along the coast at Routenburn. At low tide the foreshore is interspersed with sandy patches and seaweed. Several individuals were observed fishing off the large rocks around Routenburn (five adults and one child) and one yacht sailing observed offshore.

No spume was observed at any of the sites between Skelmorlie and Largs within or outwith the school holiday survey period.

A5.3 Largs to Fairlie

Largs beach is a large sand and stone bay backed by a concrete promenade. At low tide seaweed covers a sandy substrate. The RNLI is situated in Largs. Section 5.5 provides further details.

On Largs beach, within the school holiday survey period, five dog walkers and four individuals walking were observed. Outwith the school holiday survey included 15 dog walkers, one adult and one infant beachcombing, three adults, five children and one infant playing (families), more than 20 individuals walking and two individuals sitting on rocks and two individuals sitting on the beach, six individuals swimming, three individuals fishing from the shore and one individual fishing from Aubrey Point.

Between Largs beach and Fairlie there are several little bays (Castle Bay, Far Bowencraig, Bowencraig 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.

Within the school holiday period two individuals were shore fishing from Castle Bay and one individual was dog walking on the intertidal substrate. No offshore activities were noted. Outwith the school holiday survey there were no intertidal activities observed at Castle Bay however four dinghies were resting on the intertidal substrate. Offshore seven sailing boats were noted and one ferry.

Within the school holiday survey period one individual was cleaning the slip to the south of the intertidal substrate, and three adults were preparing and launching a dinghy from the slip. On the intertidal substrate one adult and two children were beachcombing and rock pooling and one individual was dog walking. Outwith the school holiday survey period intertidal activities observed at Bowencraig were a family playing, two families sitting on the intertidal substrate, three individuals walking, one infant and one child paddling, two individuals windsurfing and two yachts sailing.

Continuing to Far Bowencraig, within the school holiday survey period two adults and two children were observed paddling, offshore one RIB and one sailing yacht were observed. No intertidal activities were noted at Far Bowencraig (Figure 5.2) outwith the school holiday survey period. Offshore, one powerboat, one yacht and one inshore lifeboat were observed.

There were no intertidal or offshore activities observed at Kelburnfoot within the school holiday survey period. Outwith the school holiday survey period, one photographer and seven dog walkers (one a professional dog walker) and three yachts sailing offshore were observed.

A RNLI station is situated at Largs (Section 5.5). Ferries operate between Largs and Great Cumbrae Island and are based at Largs ferry terminal with regular sailings throughout the day. Commercial fishing boats also land their catch on the Largs pier. 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 within or outwith the school holiday surveys.

Figure A5.2 Far Bowencraig (June 2024)

A5.4 Fairlie, Southanan Sands and Hunterston Sands

Fairlie Sands is a sand and stone 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 Southanan Sands (Figure A5.3), which is a large sandy bay with patches of seaweed interspersed throughout. An aquaculture farm is located at Southanan Sands. Continuing south is Hunterston Sands (Figure A5.4), a large sandy bay with stones and rocks interspersed towards the back of the bay. A manmade sea defence causeway to the turbines is situated at Hunterston Sands and a cycle and footpath runs from Fairlie to Hunterston.

Figure A5.3 Southanan Sands (June 2024)

Figure A5.4 Hunterston Sands (June 2024)

Within the school holiday survey period no activities were noted on the intertidal substrate at Fairlie beach to the north of Fairlie. Offshore, one dredger, one barge and one tug were observed. Outwith the school holiday survey period one individual was observed dog walking and approximately 20 sailing yachts were moored on the water alongside two RIB's, one dinghy, one rowing boat resting on the sand and several RIB's resting on the wall to the back of the beach.

Activities observed at Fairlie Sands (south of Fairlie viewpoint) within the school holiday survey period were three individuals dog walking, eight individuals walking, one birdwatcher and one yacht sailing offshore. Outwith the school holiday survey seven walkers, one dog walker and two individuals collecting/beachcombing were observed with two walkers on the peninsula path by the intertidal zone. Seven yachts were noted offshore sailing.

Outwith the school holiday survey period three dog walkers were observed on Southanan Sands and several walkers/dog walkers were observed on the footpath beside the intertidal zone. One sailing boat was observed offshore. There were no activities observed within the school holiday survey period at Southanan Sands.

Within the school holiday survey period, Hunterston Sands was relatively popular with four individuals walking by Hawkings Craig on the coastal path, three individuals dog walking on the coastal path, one cyclist on the coastal path and two cyclists, one dog walker and several individuals jogging and walking on the cycle/footpaths around Hunterston. One individual fishing from the pier and one individual fishing from the rocks were observed. No activities on the intertidal substrate were observed. One sailing boat was observed offshore.

Two dog walkers and one walker were observed on Hunterston Sands with several walkers, dog walkers and two individuals jogging on an adjoining road between the two Hunterston site roundabouts and one individual was foraging on Hunterston Sands outwith the school holiday survey period. No aquatic activities were observed. A carpark at Hawkins Craig (pier to the south of Hunterston sand) is accessible from the Hunterston nuclear site and one professional dog walker, one individual fishing off the rocks and many Hunterston workers were observed walking from the site along to Hawkings Craig during work breaks. No other activities were observed. The Ayrshire coastal footpath passes through this section of coastline with many walkers and dog walkers observed on this route towards Portencross.

No spume was noted at any of these sites outwith the school holiday survey period.

A5.5 Portencross and Ardneil Bay

Continuing south from Hunterston Sands the shoreline substrate is mainly rocky with a walled stone harbour at Portencross (Figure A5.5) situated near a small sand and stone beach beside Portencross Castle. Just north of the harbour is a wooden pier and since the previous habit survey in 2017, it has been sectioned off with a notice and barrier advising the public that the pier is unsafe and not for use. Despite this notice the survey team observed that many individuals (adults, children and infants) accessed the pier to fish from or to sit. The survey team were unable to interview any of the individuals on the pier due to the safety notice and barrier. South of the castle the shoreline continues to be rocky with a car park and picnic area situated behind the rocky shore.

Figure A5.5 Portencross Harbour, looking south to Portencross castle (June 2024)

Activities by Portencross Castle and Portencross harbour within the holiday survey were observed with more than 20 individuals walking along the coastal path around Portencross and one yacht and one pleasure boat were sailing offshore. Many individuals were observed fishing from and standing on the pier (more than 20 individuals) despite the safety notice. Six dog walkers and two children were playing on the rocks and one individual sitting on the rocks by the castle. Outwith the school holiday period three jet skis were offshore and came into moor at the harbour briefly before setting off out on the Firth of Clyde again. One speedboat was also

observed offshore and one individual was swimming near the pier. Moored in the harbour were two motorboats and one RIB. Several walkers and dog walkers were walking on the path between the pier, Portencross Castle and the carpark.

At the Portencross carpark within the school holiday survey period four individuals were camping on the grass, three dog walkers and four walkers and one photographer were observed by the carpark. Outwith the school holiday survey period two individuals were sitting/picnicking, several individuals were walking, one cyclist that was sitting picnicking and one group that were camping were observed on the terrestrial zone. One adult and one child were swimming accessed by a narrow sand and stone section between the rocks at the intertidal zone near the carpark. One sailing yacht and one fishing boat were observed offshore from the carpark.

South along the coast from Portencross is Ardneil Bay (Figure A5.6), which is now only accessible via a path from the road requiring a walk from parking facilities at Portencross Castle. It is a stone substrate bay with a sandy foreshore. The bay is backed by sea defence boulders and grass scrub behind which are agricultural fields. Towards the south end of Ardneil Bay part of the West Kilbride Golf Club lies behind the beach. No intertidal activities were observed within the school holiday survey period. Offshore, one sailing boat was observed. Activities observed outwith the school holiday survey period included three tents pitched on the grass area next to the intertidal zone, two walkers on the beach and one dog walker. Evidence of horse riding on the path to Ardneil Bay was observed. No aquatic activities were observed outwith the school holiday survey period.

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

Figure A5.6 Ardneil Bay looking south (June 2024)

A5.6 Seamill to Ardrossan North Beach

The sandy shore continues south from Ardneil Bay towards Seamill with a rocky promontory towards the north of Seamill beach. 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 at Boydston beach (Figure A5.7). The length of this is backed by long beach grasses; a coastal footpath and the main A78 road.

Figure A5.7 Boydston beach (June 2024)

Within the holiday survey period Seamill beach was relatively busy with 17 dog walkers, several families playing, 18 walkers, seven individuals sitting/picnicking, two individuals were camping on the beach, one adult and one child were using an SUP, four adults, six children and one infant were paddling, and four individuals were swimming. Outwith the school holiday survey period intertidal activities observed at Seamill beach comprised of many families sitting/picnicking and playing, nine dog walkers, seven walkers, nine individuals swimming, six individuals shore fishing, one adult, two children and one infant paddling and one individual stand-up paddle boarding.

Within the school holiday survey period at Boydston beach one adult and three children were paddling, one adult and one infant were rock pooling, three individuals were playing, and five individuals were walking. Offshore, one yacht was sailing. Outwith the school holiday survey period at Boydston beach, many individuals were observed dog walking, walking,

sitting/picnicking and playing, paddling, one individual metal detecting, one individual swimming, two individual undertaking lifeguard duties and one individual was collecting several buckets of winkles but declined to be interviewed. One sailing boat was observed offshore at Boydston.

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

A5.7 Ardrossan North Beach and Ardrossan South Beach

Continuing south from Boydston towards Ardrossan the substrate is sandy with rocky outcrops interspersed with stone and seaweed. Ardrossan comprises two sandy bays, Ardrossan North beach and Ardrossan South beach (Figure A5.8). Ardrossan has a harbour which is segregated into two areas, an outer and inner harbour. The inner harbour is a marina for mainly pleasure craft, but which also provides moorings for commercial fishing boats. The Ardrossan to Arran ferry is located at the ferry terminal at the outer harbour.

Towards the south of Ardrossan North beach large sea defence boulders are apparent and shells 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 have sea defence boulders present.

Figure A5.8 South Bay (Ardrossan South beach, June 2024)

Within the school holiday period at Ardrossan North beach, eleven individuals were observed dog walking intertidal activities observed with no other intertidal or offshore activities observed. At Ardrossan South beach, more than 20 dog walkers and 20 walkers, approximately 20 individuals playing, four individuals sitting/picnicking, one individual flying a kite and two individuals swimming were observed within the school holiday survey period.

Outwith the school holiday period the activities observed at Ardrossan North beach were approximately 20 dog walkers (including families), one family playing, six adults and two children walking one individual sitting/picnicking and one family camping on the beach. No aquatic activities were observed. Intertidal activities at Ardrossan South beach outwith the school holiday period comprised approximately 20 dog walkers, six adults, 12 children and two infants playing, 40+ individual (adults, children and infants) walking, six individuals sitting/picnicking and two individuals metal detecting. No aquatic activities were observed.

No spume was noted at these sites outwith the school holiday survey period.

A5.8 Great Cumbrae Island

Great Cumbrae Island, located approximately 2km offshore of Largs, is a small island with many small bays around the coastline of approximately 16km. Its main town is Millport located to the south of Great Cumbrae Island with a road traveling the extent of the island. A coastguard station is located at Millport. 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 now closed on the island. The Field Studies Centre is based to the southeastern side of Great Cumbrae Island and staff and students/visitors spend time on the intertidal substrate.

Within the school holiday survey period several activities were observed including five individuals walking and seven individuals dog walking on Kames Bay, four individuals dog walking, several families playing and seven individuals sitting/picnicking at Newtown Bay, one individual walking on West Bay, three children swimming and two adults flying a kite on Bell Bay, three adults and six children fishing off Farland Point and one adult and one child fishing off Stinking Bay. One fishing boat and four sailing boats were observed in Fairlie Roads (locally known as ‘The Castle’, meaning between Portencross Castle and Little Cumbrae Castle), and the Waverley Steamer was moored at the pier by the Field Studies Centre. At Newtown Bay, 28 sailing boats/yachts were moored on the water with and four dinghies, 11 SIBs and nine kayaks were resting on the shore. One adult and one child were walking on the slip at Newtown Bay. Many joggers, cyclists and walkers were observed around the island. No intertidal or aquatic activities observed around Millport Harbour during the period the survey team visited.

Outwith the school holiday survey period one individual was observed at Kames Bay. At Millport Harbour three RIBs and one jet-ski were resting on the intertidal substrate and at Newtown Bay (Figure A5.9) intertidal activities comprised one dinghy resting on the intertidal substrate, one individual jogging, one tent pitched on the beach with several individuals camping, eleven individuals walking and one individual dog walking. Five fishing boats, one yacht, three RIB’s, six dinghies and two motorboats were all observed offshore sailing at Millport Harbour. Aquatic activities observed offshore at Newtown Bay were fifteen sailing boats, seven motorboats, one RIB, one creel fishing boat and one rowing boat. More than 20 cyclists and walkers were observed on the road outwith the school holiday survey period, mainly between Millport and the

ferry terminal. One campervan was observed parked by one of the north bays on the Isle of Cumbrae, but no other intertidal or aquatic activity were observed outwith the school holiday period.

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

Figure A5.9 Newtown Bay, Isle of Cumbrae, Greater Cumbrae (June 2024)

A5.9 Little Cumbrae Island

Little Cumbrae Island is a small private island offshore of Hunterston and 1km 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.

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