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Radiological Habits Survey: Dumfries and Galloway Coast 2024

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List of abbreviations and definitions

BBQ	Barbeque
BSS	Basic Safety Standards
DC	Dose Coefficient
EASR18	Environmental Authorisations (Scotland) Regulations 2018
ERL	Environmental Radioactivity Laboratory, University of Stirling
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
MET	Meteorological
MoGSS	Mobile Gamma Spectrometry System
NDAWG	National Dose Assessment Working Group
RIB	Rigid Inflatable Boat
RIFE	Radioactivity in Food and the Environment
RNLI	Royal National Lifeboat Institution
RSPB	Royal Society for the Protection of Birds
SEPA	Scottish Environment Protection Agency
UK	United Kingdom
UKAS	United Kingdom Accreditation Service
UNESCO	United Nations Educational, Scientific and Cultural Organisation

Units

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

Summary

This report presents the results of the 2024 radiological habits survey to determine the habits and consumption patterns of people living, working and/or undertaking recreational activities along the northern coast of the Solway Firth that may be subjected to long-range effects of permitted radioactive liquid discharges into the Irish Sea, primarily from the Sellafield nuclear licensed site in Cumbria. The aquatic and intertidal coastal survey targeted approximately 140km of coastline, extending from the Isle of Whithorn in the west to Glencaple in the east. During the survey, several potential exposure pathways were investigated through various methods, including face-to-face surveys and direct observations.

Interviews with members of the public were carried out over a period of 14 days (Phase 1 survey) and were conducted between 22 to 28 June and 20 to 26 July 2024 at coastal sites. A total of 337 individuals were surveyed, and their results are presented and discussed. Part of the survey is to identify individuals who may be considered as high-rate consumers or have high-rate occupancies in particular areas. These high-rate individuals were identified using established method (i.e. using a 'cut-off' to define those in a "high-rate" group) and to identify 97.5th percentiles for each exposure pathway. In discussion with SEPA, nine face-to-face surveys were followed up in November 2024 (Phase 2 survey) as a means of validation and are discussed within the report.

The aquatic survey area

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

- 104kg y^{-1} for fish.
- 30.8kg y^{-1} for crustaceans.
- 1.34kg y^{-1} for molluscs.
- 113kg y^{-1} for wildfowl.
- 11kg y^{-1} for saltmarsh grazed lamb.

Children consumed fish, crustaceans and wildfowl with a mean high-rate consumption of 32.7kg y^{-1}, 0.9kg y^{-1} and 37.5kg y^{-1} respectively. For aquatic infant consumption, only fish was determined with a mean high-rate consumption of 16.5kg y^{-1}.

Aquatic activities for adults included body boarding, outdoor swimming, snorkelling, stand-up paddle boarding, windsurfing, boat maintenance, canoeing, commercial fishing/creeling, kayaking, powerboating, sailing, sea angling and sport fishing.

Intertidal activities for adults included bait digging, sitting/picnicking/barbeque (BBQ), beachcombing, bird/nature watching, bouldering, collecting cockles, collecting mussels, collecting razor clams, collecting seaweed, collecting winkles, collecting wood, crabbing, dog walking, farming, fishing, fixing moorings, paddling, playing; research/education, rock pooling, sunbathing, walking and wildfowling.

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

- 94.7h y^{-1} for activities in water.
- 1955h y^{-1} for activities on water.
- 2013h y^{-1} for handling sediment.
- 492h y^{-1} for handling equipment.

Thirty-seven in-situ gamma dose rate measurements were made over intertidal surfaces during the survey period. Two beta dose rate measurements were made over boat keels.

Comparisons with previous surveys

The results of the 2024 Dumfries & Galloway Coastal habits survey were compared with the previous habits survey carried out in 2017.

In 2024 the mean consumption rate for the adult high-rate group in the face-to-face interviews was substantially higher for fish and wildfowl compared with 2017. The main species of fish consumed were bass, cod, and whiting in 2024 compared to the main species of salmon, cod, plaice, and mackerel in 2017. The main species of

wildfowl consumed by the adult high-rate group in 2024 was mallard, pink-footed goose, greylag goose, widgeon, pintail, and teal while in 2017 they were mallard, pink-footed goose, greylag goose, widgeon, and teal.

The mean consumption for the high-rate group for crustacean and mollusc substantially decreased in 2024 compared with 2017. The main species of crustacean consumed in 2024 were brown crab, common lobster and langoustines which were the same species as consumed in 2017. The main species of mollusc consumed by the adult high-rate group in 2024 were scallops compared with mussels and scallops in 2017.

The mean consumption for the adult high-rate group for saltmarsh grazed lamb consumption increased in 2024 compared with the 2017 survey.

The mean consumption of fish within the children's high-rate group substantially increased in 2024 compared to 2017. The children's high-rate group consumed bass, cod, and whiting in 2024 compared with flounder, salmon, Dover sole, mackerel, pollock, and bass in 2017. The mean consumption of crustacean within the children's high-rate group increased in 2024 compared with 2017. The children's high-rate group consumed common lobster in 2024 compared with common lobster and shrimps in 2017. Molluscs were consumed in the 2017 within the children's high-rate group compared with no consumption determined in 2024.

Wildfowl was consumed in 2024 within the children's high-rate group compared with no consumption determined in 2017.

The mean consumption of fish within the infant high-rate group substantially increased in 2024 compared to 2017. The infant high-rate group consumed cod and bass in 2024 compared with mackerel, pollock, bass, and flounder in 2017. Crustaceans were consumed in the 2017 survey with no crustacean consumption determined for the infant age group in 2024. Mollusc consumption for the infant high-rate group was determined in 2024 with no mollusc consumption being determined in 2017.

The 2024 mean of the adult high-rate group for in water activities substantially decreased compared to the previous 2017 survey. On water activities and handling equipment for the adult high-rate group increased in 2024 compared with 2017. The mean occupancy times for the adult high-rate group for handling sediment was comparable in 2024 to the 2017 survey. The highest total intertidal occupancy for adults decreased in 2024 compared with 2017.

The mean of the children's high-rate group for in water and on water activities decreased in 2024 compared to the 2017 survey. The children's high-rate group increased in 2024 compared with 2017. Children's intertidal occupancy increased in 2024 compared to 2017.

Infant in water occupancy and handling sediment increased in 2024 compared with 2017. On water occupancy and handling equipment was determined in 2024 compared with not being determined in 2017. Infant intertidal occupancy increased in 2024 compared with 2017.

Suggestions for changes to the monitoring programme

The SEPA current monitoring programme provides adequate coverage of the different foodstuffs identified in this survey. However, it is suggested that SEPA also sample common lobster and langoustine from Wigtown Bay.

1 Introduction

1.1 Regulatory context

Radionuclides from permitted discharges of liquid radioactive waste into the Irish Sea, primarily from the Sellafield Nuclear site in Cumbria, have been recorded at locations around the Irish Sea including along the Dumfries and Galloway coastline. These radionuclides are transported to the coastline in a liquid phase and in particulate form, largely associated with sediment transport. It is recognised that doses from external exposure along the coastline and the consumption of locally sourced foods, either directly or indirectly (e.g., use of seaweed as a soil conditioner) from the coastal environment, may be higher as a result of contemporary and historical discharges being concentrated through natural processes leading to environments with elevated concentrations of anthropogenic radioactivity (Dale et al., 2008; Tyler et al., 2013; Tyler et al., 2010; Tyler, 1999; Hunt 1998; McDonald et al., 1990).

Discharges from Sellafield are regulated by the Environment Agency and authorisations are granted under the Environmental Permitting (England and Wales) Regulations 2010, which set limits on the activities of specified radionuclides that are released from the site.

This survey, conducted along the Dumfries and Galloway coastline in Scotland, considers the effects of permitted liquid discharges into the Irish Sea from the Sellafield nuclear site in Cumbria. Any potential effect of these wastes is monitored in the Solway Firth, which has its northern coastline in Scotland and southern coastline in England.

SEPA's role in this case is directed at its general duty to protect the public from radiation exposure. In support of this role, SEPA undertakes routine monitoring of the environment and reports the results through the Radioactivity in Food and the Environment (RIFE) series.

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, e.g., 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 Dumfries and Galloway 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 the United Kingdom (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 habit survey takes the form of an initial postal survey, a face-to-face survey (Phase 1) and follow-up surveys (Phase 2). The survey aims to collect data on the consumption rates of locally sourced foods that might be impacted by the marine and intertidal environments, and occupancy times along the coastline to identify the doses to the 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 marine, intertidal or near shore terrestrial environment that might lead to exposure to radioactivity from any licensed liquid discharges from Sellafield.

(ii) Collecting information on consumption of marine or food caught or produced (including wild and free foods and any novel pathway) that may be related directly or indirectly (e.g., use of seaweed or salt marsh grazed animals) to the Solway and determine an annual rate of consumption for everyone surveyed and household members of all ages.

This report presents the findings for the 2024 habits survey of the Dumfries and Galloway coast. All raw data can be found in Appendix A1. The previous habits

survey fieldwork was undertaken during the period 6 – 12 March and 1 – 7 July 2017 (Smith et al., 2018).

2 The survey

2.1 Introduction

This chapter describes the characteristics that define the area and the potential routes of radioactivity or radiation exposure to the public from anthropogenic sources, such as the Sellafield nuclear site.

2.2 Defining the survey area

2.2.1 The fate of radioactivity in the coastal area of Dumfries and Galloway

The fate of radionuclides released from the Sellafield (Windscale) nuclear site has been the focus of much research. Early investigations utilised caesium-137 as a tracer for water and sediment transport in the Irish Sea and West Coast of Scotland (Baxter et al., 1979; McKinley et al. 1981 a, b; McKay and Baxter 1985; McKay et al., 1986). McDonald et al., (1990) demonstrated the importance of sediment transfer mechanisms of radionuclides, including americium-241 and plutonium-241, to intertidal and saltmarsh sediments. Further investigations by McKenzie et al., (1994) suggested that about 90% of the caesium-137 discharged along with plutonium remained in solution and migrated out of the Irish Sea. The remaining caesium-137; plutonium and americium-241 was incorporated into fine sediments, detailed further by McKenzie et al., (1999). McKenzie and Scott (1993) also highlighted that, although radionuclide discharges from Sellafield had decreased by two orders of magnitude, the legacy of the longer-lived radionuclides discharged to the environment had resulted in only one order of magnitude reduction in dose rates to critical groups (now termed representative person(s)).

Shallow coastal environments, saltmarshes and intertidal environments represent important areas, due to the deposition of sediment bound radionuclides and therefore represent potentially important routes of exposure. Allan and Pye (1992) describe factors that control the dynamics of these environmental systems, which can exhibit continual natural intra- and inter- annual change in depositional/erosional

cycles (erosion and accretion of fine intertidal sediments, erosion and growth of salt marshes).

Harvey and Allan (1998) provide a good description of the Solway Saltmarshes, which represent the largest single expanse of saltmarshes in the UK (*ca.* 200 ha). Detailed mapping of sedimentation rates across these environments by Tyler (1999) showed how they vary greatly and systematically within saltmarshes, depending on proximity to the channel edge and creek with surface roughness (vegetation) and local microtopography (levees and terraces). This largely controls grain size distribution and sedimentation rate resulting in a complex balance between higher clay content (higher caesium-137 and americium-241 activity concentrations) but lower sedimentation rates (<0.1cm y^{-1}) towards the back of the salt marsh, to greater sand content (lower radionuclide activity concentrations) and higher sedimentation rates (>1cm y^{-1}) towards the intertidal edge of the saltmarsh. The balance between clay content and sedimentation rate tends to result in higher total activity deposition towards the centre of the saltmarshes (Tyler, 1999). The legacy of the caesium-137 peak discharges from Sellafield in the 1970s remains the dominant anthropogenic contributor to external exposure (Tyler, 1999). However, increasing burial by more recent lower activity sediments and radioactive decay is progressively reducing the external measured doses. The exact dose varies, however, as temporal and spatial heterogeneity is expected over intertidal surfaces depending on whether there is ongoing erosion (to a potentially pre-Sellafield level) or accretion (bearing well-mixed Sellafield radionuclides).

Technetium-99 discharges peaked in the mid-1990s. The biogeochemical behaviour of technetium-99 is largely controlled by its oxidation state (Leonard et al., 2004), with low adsorption to oxic sediments and higher adsorption to reducing anoxic sediments. There is a significant desorption potential when sediments are mixed in oxic environments, resulting in generally low radionuclide concentrations in sediment, particularly those found in the Solway. Leonard et al. (2004) also indicated from experimental work, that the primary uptake mechanism of technetium-99 by marine biota is probably directly from surrounding seawater. Importantly, the bioaccumulation factor for technetium-99 can be very high in some marine species,

including up to and greater than 1000 for Crustacea (2000 for Norwegian lobster) and consequently understanding the consumption rates of different marine seafood species may be important.

Tidal current data for the Solway from the UK Hydrographic Office (1992) were reviewed. Both these sources show accelerating currents during the flood tide between the area immediately south of the Wigtown peninsula (Figure 2.1) and north of the Isle of Man funnelling and forcing the tide into the inner Solway, supported by currents moving up from the south along the Cumbrian coastline. This is likely to have the effect of moving contaminated sediment off the Cumbrian coastline into the inner Solway. As the tide turns, the currents flow to the west and to the south with the result of potentially dispersing sediment around the Irish Sea. However, the overall result is for the inner Solway to be a net recipient of Sellafield-contaminated sediment.

Of the remaining Solway coastline, the current flow appears to be insignificant into the northern reaches of Luce Bay. This is confirmed by several reports where samples have been collected offshore showing that the bed sediments to the west of Wigtown peninsula reflect higher energy currents with >80% gravel content phasing towards 80% sand content towards Glen Luce, whilst Wigtown and Kirkcudbright has >15% mud. The data suggest that sediment entering Luce Bay are dominated by material derived from the west coast of Scotland with limited mixing with radionuclide contaminated sediments from Sellafield. Published data from airborne gamma ray survey results (Sanderson et al., 1992; 1993; 2004) confirm that the intertidal and saltmarsh environments of the inner Solway east of Wigtown have enhanced caesium-137 signatures compared to adjacent terrestrial areas. Sampling and ground based in-situ investigations onshore and offshore have also confirmed broad systematic associations between caesium-137 with plutonium-241, amercium-241 and with the finer sediment fractions (Mackenzie et al., 1999; Tyler, 1999).

McCubbin et al. (2006) showed that the technetium-99 activity concentrations associated with the muddier sediments in the Scottish coast are higher (20Bq kg^{-1}) in the inner Solway than towards the southwest of Wigtown (0.3Bq kg^{-1}) and North Channel (0.1Bq kg^{-1}). These lower activity concentrations reflect the higher energy

environment and coarser bed sediments of this western sector of the Solway. Furthermore, technetium-99 activity concentrations in water have also tended to be lower in areas to the west of the Wigtown peninsula (Leonard et al., 2004). RIFE (2023) reported very low levels of technetium-99 in seaweed at Auchencairn and around 0.17Bq kg^{-1} in plaice (Kirkcudbright) which is similar to previous years.

In 2009, 60 wind turbines were installed in Scottish Territorial Waters off the coast of Dumfries in the Solway, making the Robin Rigg windfarm the largest offshore in Scotland. The footings of the turbines are protected to minimize sediment scour (Cassie, 2016).

Based on the available monitoring data and expected current-driven sediment movements, the primary focus for the habits survey should be the coastal environment between Wigtown peninsula and the western side of the Nith Estuary. The area to the east of the Nith Estuary has been surveyed as part of the habits survey in the environs of the Chapelcross nuclear licensed site (Tyler et al., 2017) and is therefore not considered further in this report.

This habit survey therefore focuses on key areas of potential external exposure within the saltmarshes and intertidal areas including: Wigtown Bay, Fleet Bay; Brighouse Bay; Kirkcudbright Bay; Port Mary; Rascarrel Bay; Auchencairn Bay; Needles eye; and Kirkconnell (west side of River Nith).

2.3 The survey area

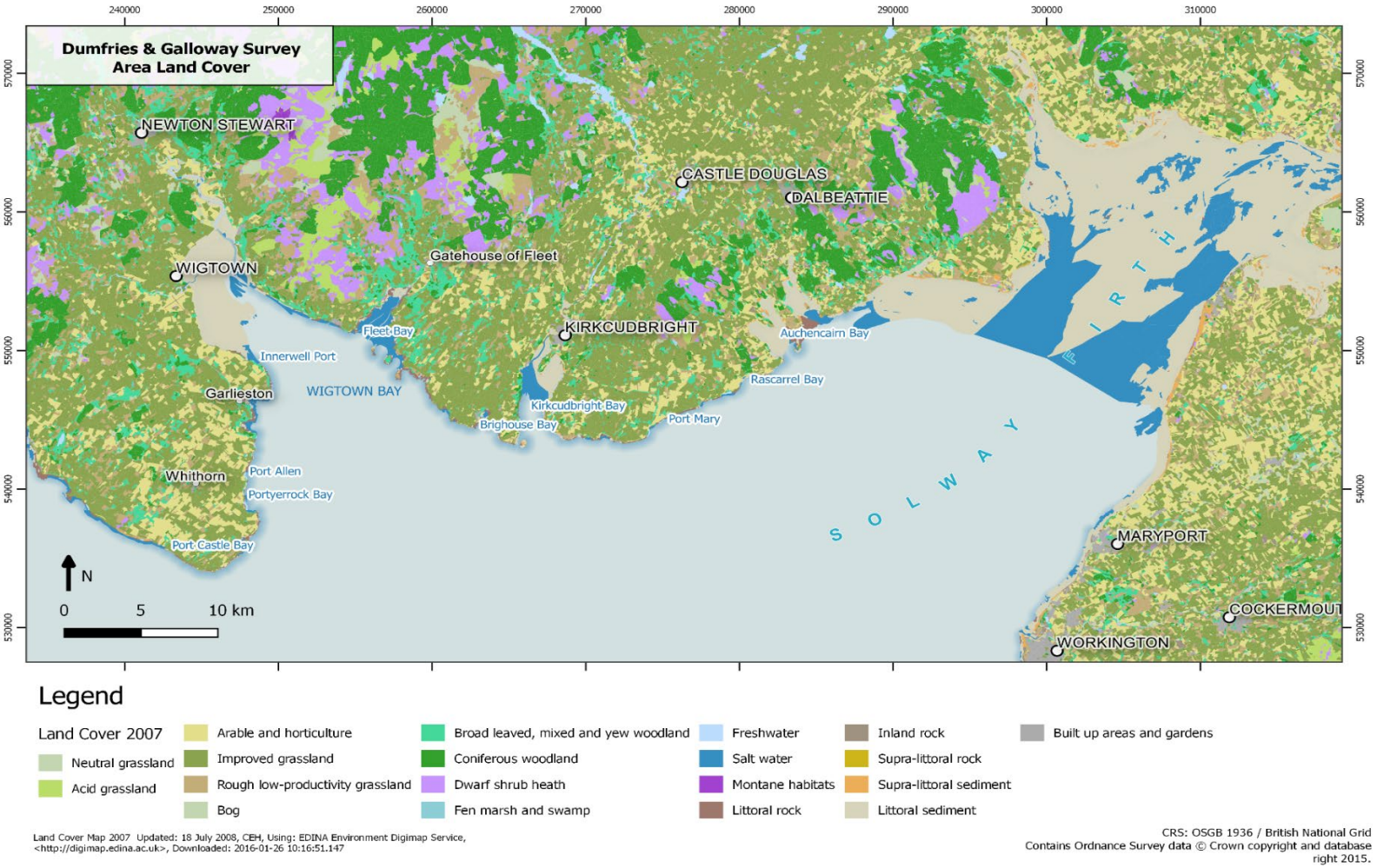
The marine survey area (Figure 2.1) extends from the west of Caerlaverock National Nature Reserve to the Isle of Whithorn representing the locations where current and historic discharges from Sellafield are likely to be found as described in Section 2.2.1. The survey area for the 2024 habits survey is consistent with previous habit surveys (Garrod et al., 2013, Smith et al., 2018). The survey area is defined by a series of larger bays interspersed with rocky headlands and small bays. The heads of the larger bay areas are characterised by mudflats and salt marshes of varying size whilst the smaller bays are predominantly sandy. Between Southerness and Sandyhills the coastline differs, consisting of large areas of sandy beaches.

2.4 Land cover data

The area represented by saltmarshes within the survey area is 1306ha. Land cover data for the survey area and further inland are presented in Figure 2.2.

Figure 2.1 Coastal survey area extending from the Isle of Whithorn to Glencaple (Contains Ordnance Survey data © Crown copyright and database right [2025])

Figure 2.2 Land cover of coastal survey and inland areas (Land Cover Map, 2007)



2.5 Soil data

Soil data for the surrounding inland area of the coastal survey area are presented in Figure 2.3. Along coastal margins, the dominant soil type is brown earth with smaller localised areas of humic gleys.

2.6 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 2.4 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 2.3 Soil map of coastal and inland areas (The Macauley Institute for Soil Research)

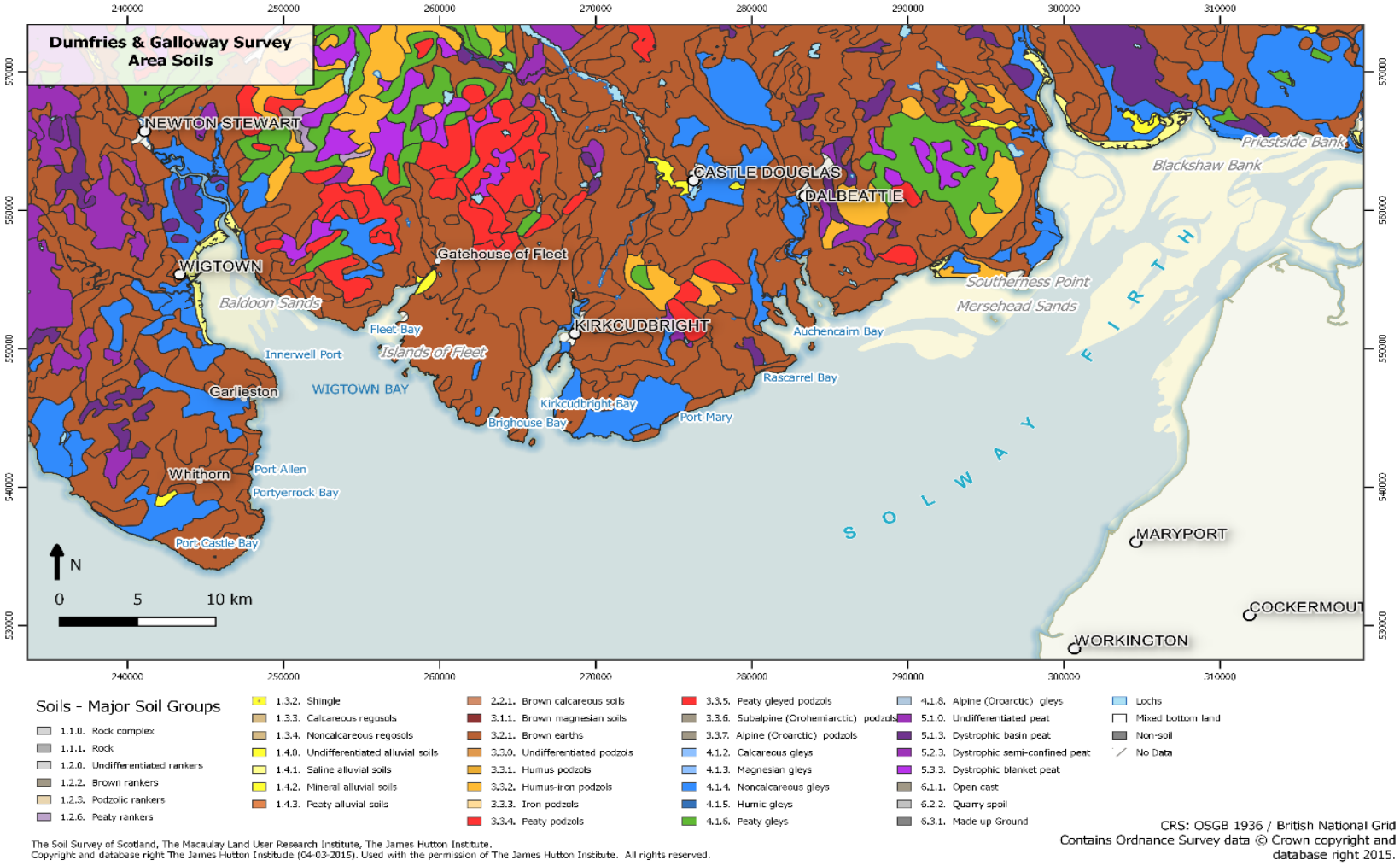
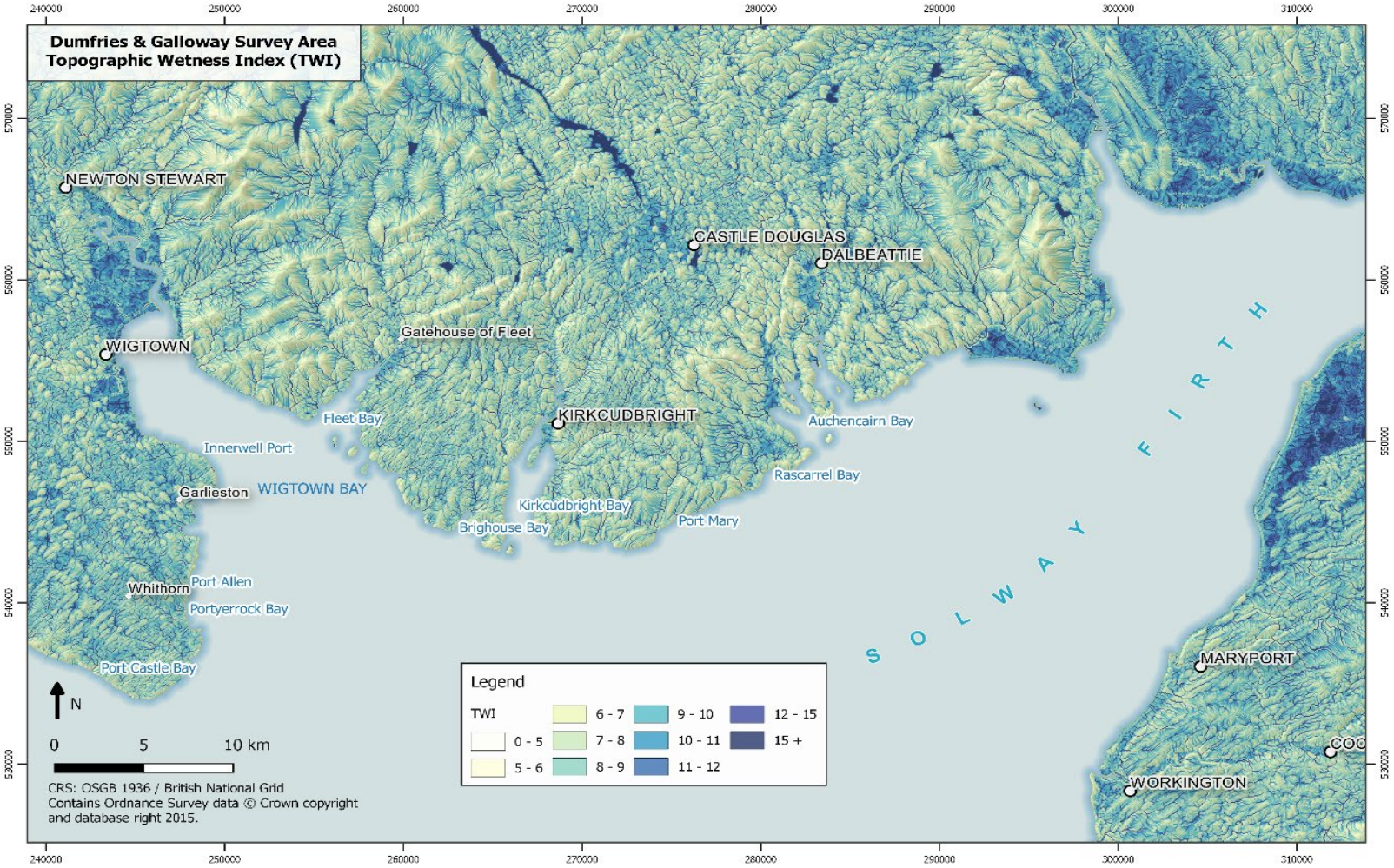


Figure 2.4 The topographic wetness index in the Solway Firth area (Edina, Ordnance Survey Great Britain, 2018)



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). Previous habit surveys (e.g. Garrod et al., 2013, Smith et al., 2018) provided a useful frame of reference for undertaking this survey of the Dumfries and Galloway site. The survey team undertakes desktop studies (Chapter 2) and a postal survey to define the survey area for Phase 1 face to face activities. Other sources of information were used to understand and characterise the area, including:

(i) A brief overview of Sellafield site activities.

(ii) A review of the distribution of Sellafield radionuclides.

(iii) A mobile radiometric survey to characterise the heterogeneity of radiation in the environment surrounding the Dumfries and Galloway Coast.

(iv) A series of informal meetings during and after the face-to-face surveys to validate the data and findings.

3.2 Radiometric surveys

The radiometric surveys comprised a carborne and handheld gamma spectrometry survey, Mobile Gamma Spectrometry System (MoGSS), in-situ gamma dosimetry and in-situ beta skin dosimetry. Further details are provided in Appendices A2 and A3.

3.2.1 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 higher exposure to radioactivity. These included

areas that may have elevated radionuclide concentrations from authorised anthropogenic discharges, or where fine sediment is known to accumulate (e.g., salt marshes and mudflats). The effective dose from terrestrial gamma radiation was calculated and reported in μSv h^{-1}. Further details of the in-situ methodology can be found in Appendix A2.

3.2.2 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 (100cm^2) and was used to monitor item(s) that were used in the Solway and potentially exposed to the higher radioactivity concentrations. Further details of the beta skin dosimetry can be found in Appendix A3.

3.3 Conduct of the survey

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

3.4 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 a ‘standard’ face-to-face interview schedule. 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 survey. 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 that 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.

3.5 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. 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 or quantity of any gifting or waste was deducted from the final annual figure(s).

3.6 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 their 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 in Table 3.2.

Table 3.1 Food groups used in the Dumfries and Galloway Coast Habits Survey

Food Group	Example of Foods Within Group
Eggs	Duck eggs, goose eggs, hen eggs
Wild/free foods	Blackberry, garlic, nettle, raspberry, rowanberry, sloe, strawberry
Honey	Honey
Fish	Bass, cod, Dover sole, flounder, kipper (herring), mackerel, plaice, pollock, salmon, sea trout, thornback-ray, tope, trout (freshwater)
Crustaceans	Brown crab, common lobster, shrimps, prawns (langoustines)
Molluscs	Cockles, mussels, oysters, razor clams, scallops, winkles, whelks
Wildfowl	Greylag & pink-footed goose, mallard, teal, widgeon
Saltmarsh grazed cattle meat	Beef
Saltmarsh grazed sheep meat	Lamb

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

3.7 Qualitative and quantitative observations

Whilst undertaking the face-to-face surveys, observational data were acquired on any obvious changes to each location that may influence the number of people present or their level of exposure (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 (Table 3.2) 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/quantity 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’ figures (identified as values outwith reasonable ranges identified from previous surveys) 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 incorrect 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 Aquatic radiation pathways

4.1 Introduction

Survey locations were established following the desktop review (Chapter 2) and to allow effective comparison with the previous Dumfries & Galloway habits survey undertaken in 2017 (Smith et al., 2018). The survey locations were visited throughout the survey periods 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. Two survey periods were used, the first outwith the school holiday period 18 to 24 May 2024 and the second during the school holiday period 20 to 26 July of 2024. Focus groups with local activity groups were arranged, as part of the survey.

4.2. Aquatic survey area descriptions

The survey area covered approximately 140km of coastline, including intertidal areas and waters along the northern shore of the Solway Firth between the Isle of Whithorn in the west and Glencaple in the East (Figure 2.1). Kirkconnell Merse is the last survey point, opposite Glencaple, and therefore provides continuity with the Chapelcross habits survey (Dale et al., in press). The Admiralty charts show fast flowing tides in the main channel beyond the bay areas. Overall, the coastline is dominated by a series of rocky peninsulas, which may or may not be accessible, interspersed with four large sandy bays: Wigtown, Fleet, Kirkcudbright and Auchencairn Bays, and a series of much smaller bays. At low tide these larger bays expose a large expanse of sand and mud. The eastern end of the survey area is bounded by the western side of the Caerlaverock National Nature Reserve, which extends across to the opposite side of the Nith estuary between Carse Bay and Airds Merse. Across the survey area, six main rivers enter the Solway Firth. From west to east these are: the Rivers Bladnoch; Cree; Water of Fleet; Dee; Urr Water; and Nith.

Site descriptions and observations can be found in Appendix A4.

4.3 Commercial seafood operations

Information obtained from local harbour masters showed there to be nine commercial creel boats that fish within the Solway. Many more boats land produce, however their catch is sourced from outwith the survey area.

Garlieston Harbour has three working creel boats that source their produce from the Solway and land their catch at the harbour. Two of the boats fish for common lobster and brown crab and one boat fishes for whelks. It is reported that 80% of the three boats catch is sold to go abroad and 20% is sold for use within the UK. Some produce is sold locally with one fishmonger within the Kirkcudbright area being known to buy a small amount of produce and one local business buys all the brown crab and some common lobster from one of the boats.

Isle of Whithorn has four working creel boats that source their produce from the Solway and land their catch at the harbour. All four boats fish for common lobster and brown crab. It is reported that 80% of the three boats catch is sold to go abroad and 20% is sold for use within the UK. No produce was reported to be sold locally.

Kirkcudbright has one creel boat that fishes for common lobster and brown crab in the area of the Solway west of Kirkcudbright to Fleet Bay and east of Kirkcudbright to Kippford. A second creel boat fishing from Kirkcudbright harbour is reported to fish for razor clams from the harbour towards Fleet Bay. It is reported that 100% of the catch is sold to buyers outwith the survey area with the razor clams thought to be exported to China.

Fishing for Queen Scallops was reported however this was undertaken in the Irish Sea during the winter months and in the English Channel and off the East coast of Scotland in the summer months. All scallop fishing undertaken was therefore outwith the survey area.

It was reported that there is one commercial winkle picking business that operates out of Garlieston with the business organising pickers to collect winkles from within the survey area and then it buys the winkles from them. No further information was obtained.

Two businesses within the survey area fish and sell their own produce which is sourced from within the Solway. One of the businesses fishes using net and cobble and declined to provide information. One wholesaler within the survey area that buys locally landed produce and sells the produce within the United Kingdom and Europe was contacted but declined to provide information.

Stake net or haaf net fishing is not undertaken within the survey area and has not been practiced for several years.

4.4 Non-commercial fishing and angling

Angling was a popular activity and listed below are the areas where non-commercial fishing, bait digging and collecting of molluscs and crustaceans occurred within the aquatic survey area. Catch and release was reported within the survey area.

Bait Digging: Carrick Bay, Brighouse Bay, Southerness

Fishing from shore/rocks/pier/kayak: Wigtown Bay (Mackerel, bass) – from kayak, Garlieston bay (pollock) – from kayak, Isle of Whithorn (whiting and flounder) – off harbour wall, Garlieston (dog fish) – off rocks, Garlieston (gurnard and tope) – catch and release from kayak, Carsluith (grey mullet) – from boat, Brighouse Bay (whiting, pollock, cole fish (coley), dog fish – all catch and release) – from boat, Brighouse Bay (mackerel – consume) – from boat, Carsethorn, Kirkandrews Bay, Mossyard Bay, Wigtown Bay (Smooth-hound, Thornback Ray, Bass – all catch and release) – from shore

Mollusc/crustaceans picking (non-commercial): Carrick Bay – collecting mussels, razor clams, cockles and winkles to use as bait, Carsluith (crab and lobster) – from boat, Sandyhills Bay, Powilliemount beach, Southerness, Isle of Whithorn (harbour) and Carrick beach (crabbing)

4.5 Wildfowling

Wildfowling takes place in Wigtown Bay with the season between 1 September and 20 February. There are two wildfowling clubs within the survey area, both are based in Wigtown Bay accessing Wigtown Bay Merse and Creetown Merse. It was reported

that some members are based locally but most members are from outwith the Dumfries and Galloway area. Contact with wildfowlers indicate the following wildfowl were shot and consumed: Canadian goose, greylag goose, mallard, pink-footed goose, pintail duck, teal, and widgeon.

4.6 Royal National Lifeboat Institute (RNLI)

The RNLI are based at Kirkcudbright and at Kippford. Kirkcudbright have a lifeboat which is launched on the eastern side of Manxman's lake, with access south of Mutehill. It is launched at the request of the coastguard for emergency rescue incidents. The area covered stretches from Southerness to the Isle of Whithorn. There are twelve active crew and six shore crew with crew training fortnightly for four hours each session. To date this year (November 2024), the Kirkcudbright RNLI have received six to eight callouts which is reported to be lower than previous years. All boating equipment and the lifeboat are hosed down with fresh water after each time in the water. Kirkcudbright RNLI reported an increase in open water swimming within the survey area. There are plans to upgrade the boathouse based at Mutehill.

Kippford RNLI have a lifeboat which is launched on the Urr Water. It is launched at the request of the coastguard for emergency rescue incidents. The area covered from Kippford is west to Barlocco Bay and east to Southerness. There are twelve active and shore crew, with crew training being weekly for approximately two hours. To date this year (November 2024), there have been eight callouts reported. All boating equipment and the lifeboat are hosed down with fresh water after each launch.

The Nith Rescue is an independent lifeboat station and has a significant inland rescue area but within the Solway it operates throughout the upper east area from Sandyhills to the mouth of the River Esk. The lifeboat is launched at the request of the coastguard for emergency rescue incidents. There are 21 boat crew and one shore crew member who train fortnightly for approximately four to five hours. To date this year (December 2024), the Nith Rescue have received 16 callouts which is reported to be lower than their average number of callouts. All boating equipment and boats are hosed down with fresh water after each launch.

4.7 Sailing and aquatic activities

Within the coastal survey area there are many local water activities clubs consisting of sailing, canoeing, kayaking, sea cadets and diving. Wigtown Bay and the coastal waters by Kirkcudbright were popular areas for water sports with some clubs having their own slipways and providing access to sailing dinghies, kayaks, canoes, and Rigid Inflatable Boats (RIB's).

Six clubs within the survey area were contacted to provide information with three responses. Information provided showed the popularity of the coastline within the survey area and how well used it was for aquatic sports and activities. Boats and boating equipment were hosed down after each time in the water and individuals usually take their own personal kit and equipment home to wash. There are memberships for individuals and families, however the majority of club members are adults. However, there is a representation of children throughout with child membership, within family memberships and the sea cadets.

4.8 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. The length of time walking varied with the seasons with more frequent visits to the coastline during spring and summer. During the survey period the survey team did not observe any dog walkers.

4.9 Animals grazing

Cows and sheep were observed grazing on saltmarsh and merse within the coastal survey area specifically along the Solway coastline near Garlieston, Creetown Merse, Kirkcudbright (near the Dhoon), near Kippford and the Merse south of Glencaple. Six farmers grazed cattle on the saltmarsh with three farms producing beef and three farms producing lamb within the survey area. One farm consumes their own lamb.

4.10 Seaweed and foraging

One individual collected a small amount of seaweed from within the survey area however this was used as bait for hobby fishing.

4.11 Nature reserve

The RSPB Crook of Baldoon has undergone some changes since the previous habits survey. In the last 10 years RSPB Crook of Baldoon has set a target of requiring any event that is financially viable to run. A management plan ensures all events and the way the rangers work are reviewed to ensure all work is economically viable along with good time management. Changes have therefore now been incorporated into the way it is run. As a result, there are guided walks only occasionally. For example, there has been just one guided walk in the last two years. The Royal Society for the Protection of Birds (RSPB) Crook of Baldoon is now collaborating with the Galloway and Ayrshire Biosphere programme in collaboration with the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and it is reported that there will be more contact with the UNESCO Biosphere over the next couple of years which may introduce guided walks over the winter period in partnership with the UNESCO Biosphere. The aim is to enhance appreciation of the biosphere culturally, environmentally and educationally.

Currently, it is reported that the main use of the saltmarsh is for wildfowling and used by wildfowlers, with two main wildfowling groups. The biosphere reserve has most contact with one of the wildfowl groups. The wildfowling bylaws are currently in the process of changing to new bylaws requiring individuals to have a permit and shoot within designated areas. Currently, this is voluntary, but it was recognised that many wildfowlers respect the rules that are issued with the current permits.

4.12 Internal exposure – phase 1

This section provides the results from the face-to-face surveys on consumption levels of aquatic produce (internal exposure) and the aquatic and intertidal activities undertaken (external exposure).

4.12.1 Adult consumption rates

Table 4.1 presents a summary of the consumption rates for aquatic food types including fish, crustacean, mollusc and wildfowl. Mean adult consumption rates for the high-rate groups and the observed 97.5th percentile rates are included in Table 4.1. 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 4.1 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 for the high-rate group (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	32	2	104.2	104.2	104.2	104.2	10.9	104.2	15.0	40.0
Crustaceans	7	3	37.5	27.5	30.8	37	15.6	36	4	10
Molluscs	8	5	1.68	1.2	1.34	1.64	0.87	1.61	4	10
Wildfowl	6	3	114	113	113	114	63.5	114	ND	ND
Sheep meat	4	4	11	11	11	11	11	11	10	30

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 Dumfries and Galloway 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 that may result in very different rates of consumption, e.g., fish and wildfowl (Table 4.1) and may represent an important local pathway. There is no national mean available, but the local consumption of wildfowl full dataset mean is significantly lower than that of the high-rate group. 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 (nine individuals), brill (one individuals), cod (two individuals), dog fish (three individuals), flounder (three individuals), grey mullet (three individuals), hake (two individuals), mackerel (21 individuals), pollock (three individuals) and whiting (four 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 104.2kg y^{-1} by two individuals (who consumed the same amount) and they consumed cod (91kg y^{-1}), bass (13kg y^{-1}) and whiting (0.2kg y^{-1}) all sourced from within the survey area. The mean fish consumption for the adult high-rate group was 104.2kg y^{-1}.

Adults consumed crustaceans, which consisted of brown crab (four individuals), common lobster (six individuals) and langoustine (two individuals) all sourced from within the survey area. The observed maximum consumption of crustacean was 37.5kg y^{-1} and this individual consumed common lobster (12.5kg y^{-1}) and brown crab (25kg y^{-1}) all sourced from within the survey area. The mean crustacean consumption for the adult high-rate group was 30.8kg y^{-1}.

Adults consumed molluscs, which consisted of mussels (one individuals), scallop (seven individuals) and whelks (one individual) all sourced from within the survey

area. The observed maximum consumption of mollusc was 1.68kg y^{-1} and this individual consumed scallop sourced from within the survey area. The mean mollusc consumption for the adult high-rate group was 1.34kg y^{-1}.

Adults consumed wildfowl, which consisted of Canadian goose (two individuals), greylag goose (two individuals), widgeon (four individuals), pink-footed goose (seven individuals) and greylag goose (two individuals), mallard (three individuals), pintail (one individual), teal (one individual) and widgeon (three individuals) all sourced from within the aquatic survey area. It should be noted that some adults consumed more than one type of wildfowl. The observed maximum consumption of wildfowl was 114kg y^{-1} and this individual consumed mallard (3kg y^{-1}), pink-footed goose (90kg y^{-1}), pintail (3kg y^{-1}), teal (2kg y^{-1}) and widgeon (16kg y^{-1}) (it is noted that this is a high consumption therefore this figure was highlighted and has been validated with the individual). The mean wildfowl consumption for the adult high-rate group was 113kg y^{-1}.

Adults consumed saltmarsh grazed sheep (meat), which consisted of sheep meat (four individuals) all sourced from within the survey area. The observed maximum consumption of sheep meat was 11kg y^{-1} and was consumed by four individuals, each consuming 11kg y^{-1} sourced from within the survey area. The mean sheep meat consumption for the adult high-rate group was 11kg y^{-1}.

4.12.2 Child and infant consumption rates

Table 4.2 presents a summary of children and infant consumption rates of fish, crustacean, molluscs and wildfowl from the aquatic survey area. Mean consumption rates for the high-rate groups and the observed 97.5th percentile rates are included in Table 4.2.

Table 4.2 Summary of children and infant consumption rates of foods from the aquatic survey area

Age Group	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})
Child (6 to 15 years old)	Fish	5	2	32.7	32.7	32.7	32.7	13.14	32.7
Child (6 to 15 years old)	Crustaceans	1	1	0.9	0.9	0.9	NA	0.9	NA
Child (6 to 15 years old)	Wildfowl	1	1	37.5	37.5	37.5	NA	37.5	NA
Infant (0 to 6 years old)	Fish	4	2	16.5	16.5	16.5	16.5	8.26	16.5
Infant (0 to 6 years old)	Molluscs	1	1	0.07	0.07	0.07	NA	0.07	NA

The table also includes mean consumption rates and 97.5th percentile rates based on the full dataset.

For the child age group bass (two individuals), cod (two individuals), mackerel (three individuals) and whiting (two individuals) was consumed. It should be noted that some children consumed more than one fish type (flat and/or round). The observed maximum consumption of fish was 32.7kg y^{-1} by two individuals who consumed bass (6.5kg y^{-1}), mackerel (26kg y^{-1}) and whiting (0.2kg y^{-1}) which was all sourced from within the survey area. The mean fish consumption for the child high-rate group was 32.7kg y^{-1}.

Children consumed crustacean with one individual only consuming 0.9kg y^{-1} of common lobster sourced from within the survey area.

Children consumed wildfowl with one individual only consuming 37.5kg y^{-1} of pink-footed goose sourced from within the survey area.

No consumption of mollusc was found for the child age group.

Infants consumed bass (two individuals), cod (two individuals), mackerel (one individuals), pollock (one individuals) and whiting (two individuals) all sourced from within the aquatic survey area. It should be noted that some infants consumed more than one fish type (flat and/or round). The observed maximum consumption of fish was 16.45kg y^{-1} by two individuals and they consumed bass (3.25kg y^{-1}), cod (13kg y^{-1}) and whiting (0.2kg y^{-1}) which was all sourced from within the survey area. The mean fish consumption for the infant high-rate group was 16.45kg y^{-1}.

Infants consumed molluscs with one individual only consuming 0.07kg y^{-1} of mussels sourced from within the survey area.

No consumption of crustacean or wildfowl was found for the infant age group.

4.13 External exposure – phase 1

Occupancy rates for adults in intertidal, aquatic (in water), aquatic (on water), handling rates of equipment and handling rates of sediment can be found in Tables 4.3 and 4.4.

Table 4.3 Summary of adults' external exposure for aquatic, 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})	Observed mean for the full dataset (h y^{-1})	Observed 97.5th percentile for the full dataset (h y^{-1})
Aquatic (in water)	56	8	117	58.4	94.7	117	19	117
Aquatic (on water)	51	4	2160	1500	1955	2154	213	2080
Handling equipment	47	4	2190	1700	2013	2182	219	2080
Handling sediment	146	5	677	338	492	657.54	38.6	392

Activities in water included body boarding, outdoor swimming, snorkelling, stand-up paddle boarding and windsurfing. The highest occupancy rate for adults in the water was 117h y^{-1} for an individual who spends time bodyboarding (19.5h y^{-1}) and outdoor swimming (78h y^{-1}) and stand-up paddle boarding (19.5h y^{-1}) at Mossyard Bay. Activities on water included boat maintenance, canoeing, commercial fishing/creeling, kayaking, powerboating, sailing, sea angling and sport fishing. The highest occupancy rate for adults on water was 2160h y^{-1} for an individual who spends time commercial fishing/creeling within the survey area. Adults were also found to handle equipment within the survey area, the activities for adults involved handling boats and boating equipment, handling clothes and overalls and fishing gear. The highest level of handling equipment was 2190h y^{-1}, this individual spent time undertaking commercial fishing/creeling (2160h y^{-1}) and boat maintenance/boating equipment (30h y^{-1}). The highest level of handling sediment was 677h y^{-1}, and this is for an individual who spends time beachcombing (650h y^{-1}) and sitting/picnicking/BBQ (27h y^{-1}) at Abbey Burnfoot.

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, bouldering, collecting cockles, collecting mussels, collecting razor clams, collecting seaweed, collecting winkles, collecting wood, crabbing, dog walking, fishing, fixing moorings, paddling, playing; research/education, rock pooling, sunbathing and wildfowling.

Table 4.4 presents adult intertidal substrate occupancy. Intertidal activities for adults included bait digging, sitting/picnicking/BBQ, beachcombing, bird/nature watching, bouldering, collecting cockles, collecting mussels, collecting razor clams, collecting seaweed, collecting winkles, collecting wood, crabbing, dog walking, farming, fishing, fixing moorings, paddling, playing; research/education, rock pooling, sunbathing, walking and wildfowling.

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

Mud: wildfowling at Wigtown Bay and fixing moorings at Kirkcudbright.

Rock: sitting/picnicking/BBQ at Mossyard Bay and Southerness; bird/nature watching at Kippford; bouldering at Thirlstone Arch; crabbing at Isle of Whithorn; dog walking at Powilliemount; fishing at Auchenlarie beach, Carrick Bay, Isle of Whithorn, Kirkandrews Bay, Kirkcudbright, Mossyard Bay, Southerness and Sandyhills; paddling at Southerness, playing at Southerness; rock pooling at Sandyhills; and, walking at Southerness.

Table 4.4 Summary of adults' external exposure for intertidal occupancy

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 of the high-rate group (h y^{-1})	Observed mean for the full dataset (h y^{-1})	Observed 97.5th percentile for the full dataset (h y^{-1})
Mud	2	1	69	69	69	NA	37	67.4
Rock	23	4	84	36	52.8	81.6	14.2	66.4
Saltmarsh	14	2	206	93	150	203	35.6	169
Sand	163	15	548	204	382	525	61	427
Sand and stones	55	5	677	252	418	649	56.1	398
Stones	1	1	1095	1095	1095	NA	1095	NA

NA – not applicable

Saltmarsh: beachcombing at Sandyhills; bird/nature watching at RSPB Mersehead, dog walking at Sandyhills and Wigtown Bay; farming at Creetown Merse and Kippford Merse; paddling at Sandyhills Bay, research/education at Baldoon Merse; fishing at Gartshore Park and Kirkcudbright; walking at RSPB Mersehead; and wildfowling at Auchencairn Bay, Carsluith, Kirkconnell merse and Wigtown Bay.

Sand: bait digging at Carrick beach, Brighouse Bay and Southerness; sitting/picnicking/BBQ Balcary Bay, Brighouse Bay, Carrick Bay, Carrick beach, Kippford, Mossyard Bay, Powilliemount, Rascarrel Bay, Rockcliffe, Rough Island, Sandgreen, Southerness, the Dhoon.

Sand and stones: sitting/picnicking/BBQ at Abbey Burnfoot, Brighouse Bay, Isle of Whithorn, Kippford, Rascarrel Bay, Rockcliffe and Southerness; beachcombing at Abbey Burnfoot, Balcary Bay, Brighouse Bay, Isle of Whithorn, Rascarrel Bay, Southerness; bird/nature watching at Brighouse Bay and Southerness; collecting wood at Southerness; crabbing at Southerness; dog walking at Balcary Bay, Brighouse Bay, Garlieston, Isle of Whithorn, Kippford, Rascarrel Bay, Rigg Bay, Rockcliffe and Wigtown Bay; fishing at Carsethorn and Wigtown Bay; paddling at Rockcliffe and Southerness; playing at Mossyard Bay; rock pooling at Balcary Bay, Brighouse Bay, Isle of Whithorn, Mossyard Bay, Rascarrel Bay and Southerness; sunbathing at Brighouse Bay; walking at Auchenlarie beach, Balcary Bay, Brighouse Bay, Isle of Whithorn, Kippford, Rockcliffe and Southerness.

Stones: dog walking at Mutehill. The highest intertidal occupancy for an adult was 1095h y^{-1} for an individual who spent time dog walking at Mutehill on a stone substrate.

Tables 4.5 and 4.6 presents a summary of the children and infants' intertidal, aquatic (in water), aquatic (on water) occupancy rates, handling rates of equipment and handling rates of sediment. Intertidal activities for children and infants included sitting/picnicking/BBQ; beachcombing; crabbing; dog walking; fishing; paddling; playing; rock pooling; sunbathing; and walking.

Children's activities in the water included body boarding, outdoor swimming and stand-up paddle boarding. The highest in water occupancy was 13h y^{-1} for two individuals who spent time outdoor swimming at Mossyard. Children's activities on the water consisted of kayaking and sea angling. The highest on water occupancy was 54 h y^{-1} for two individuals who spent time kayaking (18h y^{-1}) and sea angling (36h y^{-1}) at the Dhoon.

Infant activities in water consisted of body boarding, outdoor swimming and stand-up paddle boarding. The highest occupancy was 10h y^{-1} for two individuals who spent time outdoor swimming (6h y^{-1}) and stand-up paddle boarding (4h y^{-1}) at Sandyhills Bay and Rockcliffe. Infant activities on water consisted of canoeing and sea angling. The highest on water occupancy was 1h y^{-1} for an individual who spent time canoeing at Carrick Bay.

The highest level of handling of equipment for children was 36h y^{-1} for two individuals who spent time handling fishing equipment at the Dhoon. The highest level of handling equipment for infants was 2h y^{-1} for one individual who spent time handling a body board at the Dhoon.

Table 4.5 Summary of children's and infants' external exposure for aquatic, 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})	Observed mean for the full dataset (h y^{-1})	Observed 97.5th percentile for the full dataset (h y^{-1})
Child (6 to 15 years old)	Aquatic (in water)	21	6	13	5	11.2	13	3.81	13
Child (6 to 15 years old)	Aquatic (on water)	10	3	54	18	42	54	12.8	54
Child (6 to 15 years old)	Handling equipment	7	2	36	36	36	36	11.5	36
Child (6 to 15 years old)	Handling sediment	40	6	677	228	420	677	78.8	677
Infant (0 to 5 years old)	Aquatic (in water)	6	3	10	5	8.33	10	4.96	10
Infant (0 to 5 years old)	Aquatic (on water)	2	1	1	1	1	NA	0.67	0.98

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})	Observed mean for the full dataset (h y^{-1})	Observed 97.5th percentile for the full dataset (h y^{-1})
Infant (0 to 5 years old)	Handling equipment	3	2	2	1	1.5	1.96	1.11	1.95
Infant (0 to 5 years old)	Handling sediment	23	3	677	482	612	677	105	677

NA – not applicable

Table 4.6 Summary of children's and infants' external exposure for intertidal occupancy

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})	Observed mean for the full dataset (h y^{-1})	97.5th percentile for the full dataset (h y^{-1})
Child (6 to 15 years old)	Rock	8	5	9	3	5.4	9	4	9
Child (6 to 15 years old)	Sand	39	5	482	228	284	460	64.4	267
Child (6 to 15 years old)	Sand and stones	5	2	677	677	677	677	677	677
Infant (0 to 5 years old)	Rock	1	1	9	9	9	NA	9	9
Infant (0 to 5 years old)	Sand	20	3	482	256	331	471	63.8	381

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})	Observed mean for the full dataset (h y^{-1})	97.5th percentile for the full dataset (h y^{-1})
Infant (0 to 5 years old)	Sand and stones	6	3	677	252	535	677	274	677

NA – not applicable

The highest level of handling sediment for children was 677h y^{-1} for two individuals who spent time sitting/picnicking/BBQ (27h y^{-1}) and beachcombing (650h y^{-1}) at Abbey Burnfoot. The highest level of handling sediment was two infants was 677h y^{-1} who spent time sitting/picnicking/BBQ (27h y^{-1}) and beachcombing (650h y^{-1}) at Abbey Burnfoot. 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; dog walking; fishing; paddling; playing; rock pooling; and sunbathing.

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

Rock: sitting/picnicking/BBQ Balcary Bay, Sandyhills Bay, Southerness and The Dhoon; crabbing at Isle of Whithorn; fishing at Isle of Whithorn, Mossyard Bay and Southerness; paddling at Balcary Bay, Sandyhills Bay, Southerness and The Dhoon; playing at Balcary Bay, Sandyhills Bay, Southerness and The Dhoon; rock pooling at Sandyhills Bay; and, walking at Southerness.

Sand: sitting/picnicking/BBQ at Brighouse Bay, the Dhoon, Balcary Bay, Sandyhills Bay, Southerness, Powilliemount, Carrick beach and Mossyard Bay; beachcombing at Skyreburn Bay, Mossyard Bay, Powilliemount, Sandyhills Bay, the Dhoon and Carrick beach, bird/nature watching at Sandyhills Bay; crabbing at Powilliemount and Southerness; dog walking at the Dhoon, Powilliemount, Sandyhills Bay, Garlieston, Rigg Bay, Southerness and Kirkcudbright; paddling at the Dhoon, Carrick beach, Powilliemount, Southerness, Sandyhills Bay, Mossyard Bay, Auchenlarie beach, Balcary Bay, Brighouse Bay, Rigg Bay and Garlieston; playing at the Dhoon, Mossyard Bay, Auchenlarie beach, Southerness, Carrick beach, Sandyhills Bay, Balcary Bay, Brighouse Bay, Garlieston and Rigg Bay; rock pooling at Powilliemount, Southerness and Mossyard Bay; sunbathing at Carrick beach ; and, walking at Carrick beach, the Dhoon, Sandyhills Bay, Powilliemount, Mossyard Bay, Southerness and Ardwell.

Sand and Stones: sitting/picnicking/BBQ at Abbey Burnfoot; beachcombing at Southerness and Abbey Burnfoot; crabbing at Southerness; paddling at Powilliemount, Sandyhills and Southerness; rock pooling at Powilliemount and Southerness; and, walking at Powilliemount, Sandyhills and Southerness.

The highest intertidal occupancy for a child was 677h y^{-1} for two individuals who spent time beachcombing (650h y^{-1}) and sitting/picnicking/BBQ (27h y^{-1}) on a sand and stone substrate.

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

Rock: paddling, sitting/picnicking/BBQ and playing at Southerness.

Sand: sitting/picnicking/BBQ at Carrick Bay, Rough Island, Rockcliffe, Sandyhills Bay, Powilliemount, Sandgreen Mossyard Bay, Balcary Bay, the Dhoon and Southerness, Brighouse Bay; beachcombing at Kippford, Sandyhills Bay, Rockcliffe, Powilliemount and Skyreburn Bay; dog walking at Powilliemount, Sandyhills Bay, Garlieston and Rigg Bay; paddling at Auchenlarie beach, Balcary Bay, Brighouse Bay, Carrick Bay, Garlieston, Mossyard Bay, Powilliemount, Rigg Bay, Rockcliffe, Sandgreen, Sandyhills Bay, Southerness and the Dhoon; playing at Auchenlarie beach, Balcary Bay, Brighouse Bay, Carrick Bay, Garlieston, Kippford, Mossyard Bay, Rigg Bay, Rockcliffe, Sandgreen, Sandyhills Bay, Southerness and the Dhoon; sunbathing at Carrick beach, Balcary Bay and Rockcliffe; and, walking at Sandyhills Bay, Kippford, Rockcliffe and Carrick beach.

Sand and stones: sitting/picnicking/BBQ at Abbey Burnfoot; beachcombing at Abbey Burnfoot and Balcary Bay; dog walking at Rockcliffe; Playing at Mossyard Bay; rock pooling at Balcary Bay and Mossyard Bay; and, walking at Balcary Bay and Rockcliffe.

The highest intertidal occupancy for an infant was 677h y^{-1} for two individuals who spent time beachcombing (650h y^{-1}) and sitting/picnicking/BBQ (27h y^{-1}) on a sand and stone substrate.

Gamma dose rate measurements over different substrates within the survey area can be found in Chapter 5.

5 External exposure

5.1 Introduction

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, see section 5.2) and in-situ gamma dose rate survey (section 5.3) 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.

In-situ beta dosimetry (section 5.4) was undertaken on boat and sailing equipment in the Solway Firth area to estimate the skin dose associated with radioactivity in the environment.

5.2 Mobile Gamma Spectrometry Survey (MoGSS)

MoGSS was utilised to measure the differential dose estimations for the natural radio elements (potassium-40 and the uranium-238 and thorium-232 series) alongside estimates for anthropogenic caesium-137. The ability to separate dose contributors is especially important given that any potential contribution from caesium-137 could be identified from the spatially variable background element concentrations, particularly on beaches and other intertidal areas that may be impacted by Sellafield discharges.

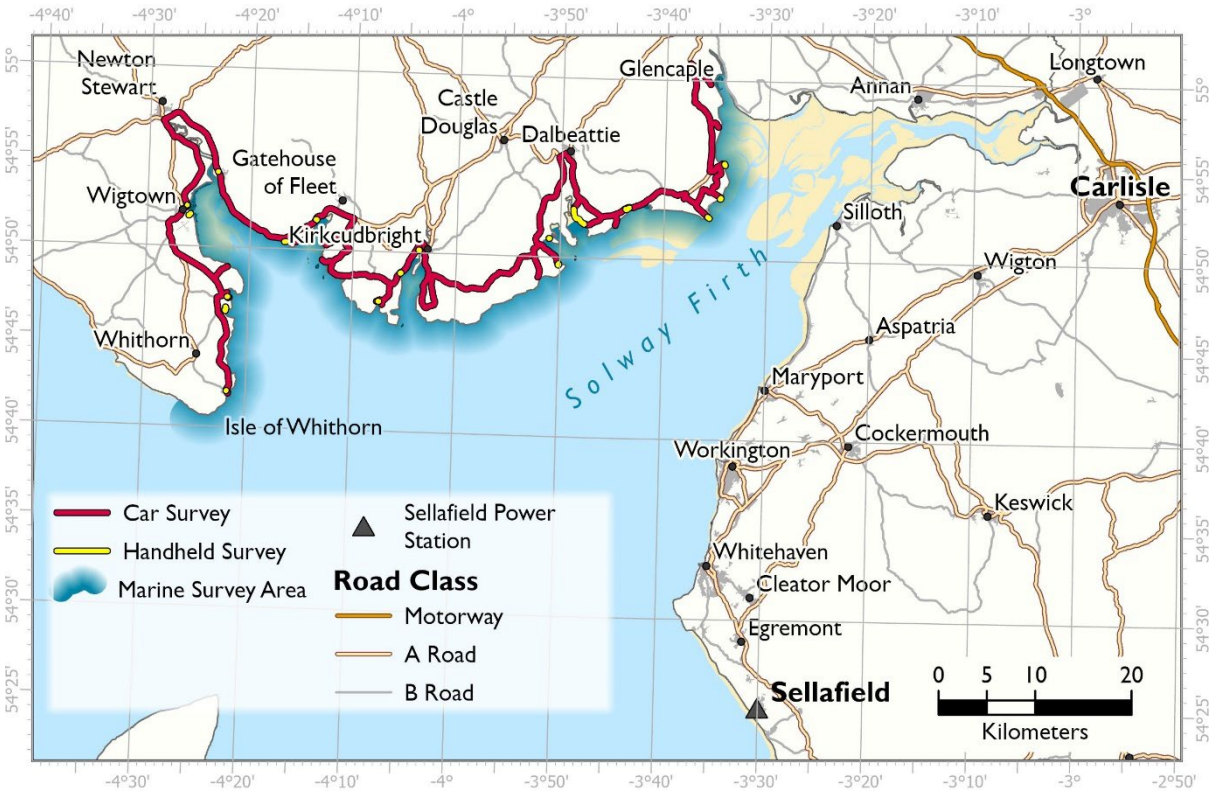
5.2.1 Survey area

A carborne gamma spectrometry survey of the study area was undertaken supplemented by a handheld gamma spectrometry system along the coastline. The roads surveyed covered more than 50km (see Figure 5.1).

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 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 a vehicle and to cover accessible coastline areas, a handheld system comprising a 71 × 71 mm sodium iodide detector was used. Both MoGSS units produced a differential energy spectra recorded at one second integration times alongside high accuracy (<0.6 m) differential GPS readings. Coverage of the handheld and carborne MoGSS are shown in Figure 5.1.

Figure 5.1 Coverage for handheld and carborne MoGSS (Contains Ordnance Survey data © Crown copyright and database right [2025])



5.2.2 Carborne and handheld results

Overall, 23000 spectral measurements were made (~14822 – carborne; ~8523 - handheld).

Dose rates typically ranged from 0.003μGy h^1 (3nGy h^1) to more than 0.08μGy h^1 (80nGy h^1). Higher values between 0.08 and 0.27μGy h^1 may be attributable to

elevated natural radiation, for example high concentrations of potassium-40 from road and building construction materials.

5.3 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 arising from the authorised discharges from Sellafield.

Thirty-seven in-situ gamma dose rate measurements were collected on intertidal sites during the survey (Figure 5.2). A UKAS accredited procedure was followed to estimate the terrestrial gamma dose rate. Since most of the dose contribution was thought to be from the natural radionuclides a radium-226 calibration was used to estimate dose rate for all gamma dose rate measurements given that radium-226 occurs naturally in the environment and emits a number of gamma-rays spanning the entire environmentally relevant 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 5.1. Note that most of the higher readings are made over mud and stone. Lower readings tended to be recorded on sandier areas.

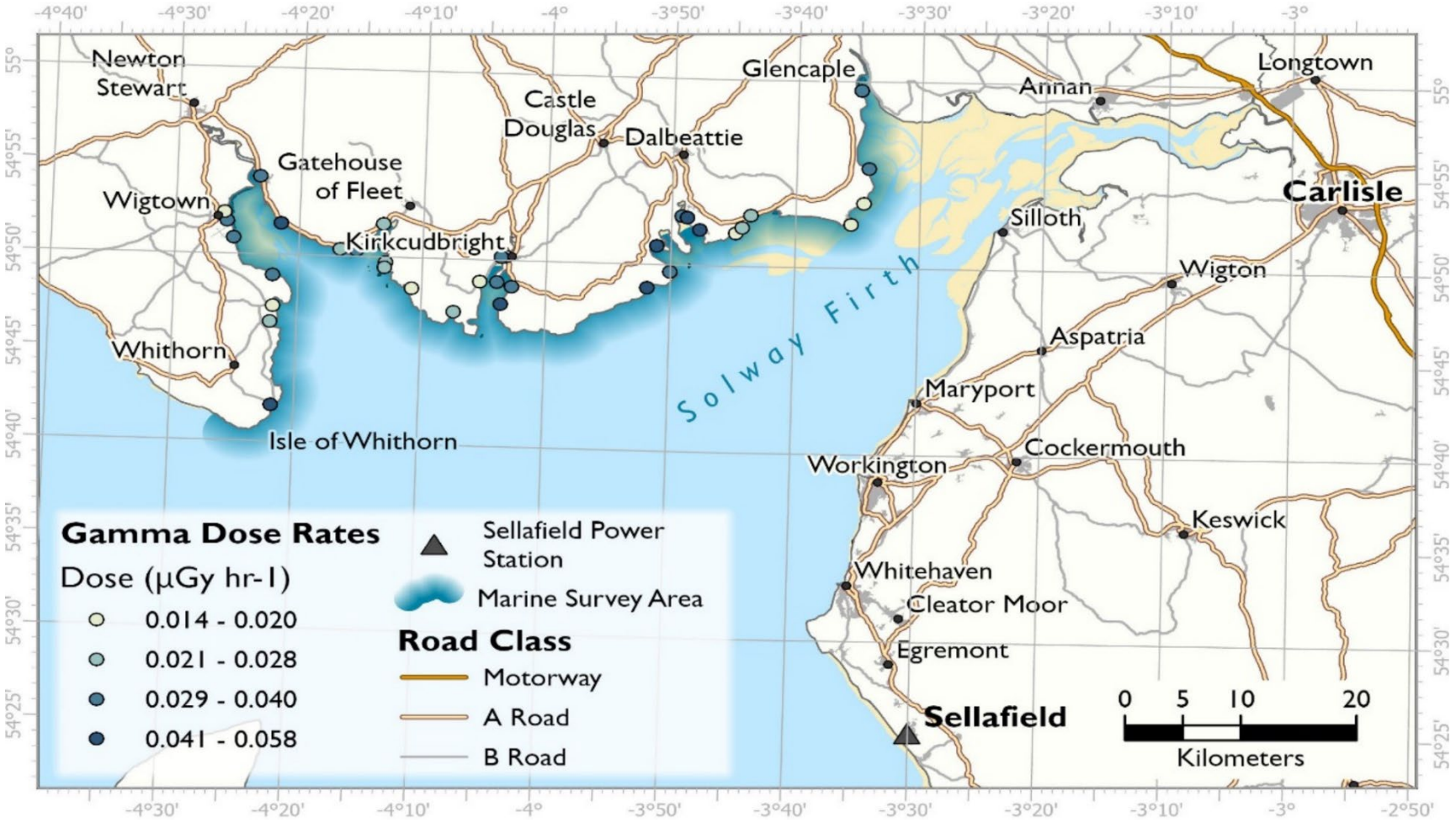
Table 5.1 Summary of gamma dose rate measurements collected across the Dumfries and Galloway survey area

Site	Surface	Eastings	Northings	Dose rate (μGy h^{-1})	2σ Uncertainty (μGy h^{-1})
Rascarrel Bay	Grass	2802	5480	0.047152	0.004438
Wigtown, by harbour	Grass/merse	2440	5547	0.034171	0.003996
Kirkcudbright Marina	Grass/mud	2680	5511	0.023116	0.003668
Creetown merse	Merse	2468	5591	0.034171	0.003996
Kirkconnell merse	Merse	2987	5676	0.036013	0.004055
Carsluith	Mud	2486	5544	0.042462	0.004272
Garlieston Bay	Mud	2478	5463	0.016667	0.003504
Gartshore Park	Mud	2676	5510	0.037688	0.00411
Innerwell Fishery	Mud	2478	5493	0.030318	0.003876
Mutehill	Mud	2685	5481	0.03995	0.004186
Martyrs Stake	Mud/merse	2437	5556	0.019598	0.003576
Abbey Burnfoot	Rock/sand	2680	5511	0.023116	0.003668
RNLI, near Mutehill	Rock/shingle	2675	5464	0.043635	0.004313
Crook of Baldoon	Saltmarsh	2445	5531	0.038275	0.00413

Site	Surface	Eastings	Northings	Dose rate (μGy h^{-1})	2σ Uncertainty (μGy h^{-1})
Glen Isle saltmarsh	Ssaltmarsh	2832	5551	0.038191	0.004127
Skyreburn	Saltmarsh	2574	5543	0.028057	0.003808
Old Torr	Saltmarsh/grass	2810	5521	0.046734	0.004423
St Mary's Isle	Saltmarsh/ merse	2672	5485	0.03593	0.004052
Auchenlarie beach	Sand	2537	5519	0.025042	0.003722
Balcary Bay	Sand	2822	5495	0.036013	0.004055
Brighouse Bay	Sand	2635	5456	0.022781	0.003659
Carrick Bay	Sand	2576	5505	0.021608	0.003628
Carrick beach	Sand	2575	5500	0.022027	0.003639
Port O Warren	Sand	2878	5534	0.013987	0.003442
Powilliemount	Sand	2989	5563	0.014489	0.003453
Rigg Bay	Sand	2476	5447	0.021608	0.003628
Rockcliffe	Sand	2847	5537	0.046315	0.004408
Sandgreen	Sand	2575	5522	0.023953	0.003691
Sandyhills	Sand	2892	5552	0.026549	0.003764
Southerness	Sand	2978	5543	0.013987	0.003442
The Dhoon (Nun Mill Bay)	Sand	2657	5486	0.017337	0.00352
Portling Bay	Sand and rock	2884	5540	0.023451	0.003677
Mossyard beach	Sand and shell	2551	5518	0.03191	0.003925

Site	Surface	Eastings	Northings	Dose rate (μGy h^{-1})	2σ Uncertainty (μGy h^{-1})
Carsethorn	Sand and stone	2994	5598	0.033585	0.003977
Kirkandrews Bay	Sand and stone	2598	5479	0.018007	0.003536
Kippford	Sand/mud/stone	2837	5550	0.058291	0.004854
Isle of Whithorn Bay	Stoney	2477	5364	0.043635	0.004313

Figure 5.3 Summary of the gamma dose rate measurements across the Dumfries and Galloway survey area (Contains Ordnance Survey data © Crown copyright and database right [2025])



5.4 In-situ beta dosimetry

Beta dosimetry of skin dose [H*(0.07)] was measured. One in-situ beta dose measurement was collected on a boat keel at two intertidal sites during the survey with measurement values of 0.83 and 0.88μSv h^{-1} per cm^{-2}. The mean beta dose value was 0.85μSv h^{-1} per cm^{-2}.

5.5 Occupancy rates for the survey area

The Phase 1 interviews revealed that individuals take part in a range of aquatic and intertidal activities within the survey area (Table 5.2). For aquatic activities, outdoor swimming was the most popular (75 individuals) and the activity with the highest occupancy was commercial fishing/creeling (2160h y^{-1}) at Kirkcudbright. For the intertidal activities, walking was the most popular (115 individuals) and the intertidal activity with the overall maximum occupancy was dog walking (1095h y^{-1}) at Mutehill.

Table 5.2. Summary of the activities and total number of individuals that take part in the activities.

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y^{-1})	Location of Maximum Occupancy (if provided)
Intertidal	Bait digging	3	39	Southerness
Intertidal	Sitting/picnicking/BBQ	113	196	Rockcliffe and Kippford
Intertidal	Beachcombing	88	650	Abbey Burnfoot
Intertidal	Bird/nature watching	11	10.5	Kippford
Intertidal	Bouldering	2	4	Thirlston Arch
Intertidal	Collecting cockles	1	0.66	Carrick beach
Intertidal	Collecting mussels	1	0.66	Carrick beach
Intertidal	Collecting razor clams	1	0.66	Carrick beach
Intertidal	Collecting seaweed	1	0.66	Carrick
Intertidal	Collecting winkles	1	0.66	Carrick beach
Intertidal	Collecting wood	13	2	Southerness
Intertidal	Crabbing	9	52	Carrick beach
Intertidal	Dog walking	74	1095	Mutehill
Intertidal	Farming	2	52	Within the survey area
Intertidal	Fishing	20	195	Ross Bay and Carrick beach
Intertidal	Fixing moorings	1	5	Kirkcudbright Marina
Intertidal	Paddling	113	161	Brighouse Bay and the Dhoon
Intertidal	Playing	92	161	Brighouse Bay and the Dhoon
Intertidal	Research/education	1	12	Baldoon Merse

Activity type	Activity	Number of Individuals	Maximum Occupancy (h y^{-1})	Location of Maximum Occupancy (if provided)
Intertidal	Rock pooling	32	24	Sandyhills Bay, Rockcliffe and Kippford
Intertidal	Sunbathing	22	17.5	Balcary Bay and Carrick beach
Intertidal	Walking	115	365	Rockcliffe and Sandgreen
Intertidal	Wildfowling	2	162	Wigtown Bay and Kirkconnell Merse
Aquatic	Boat maintenance	5	26	Kirkcudbright
Aquatic	Body boarding	5	19.5	Mossyard Bay
Aquatic	Canoeing	3	1	Carrick Bay
Aquatic	Commercial fishing/creeling	4	2160	Kirkcudbright Bay
Aquatic	Kayaking	34	416	Kirkcudbright Bay and Fleet Bay
Aquatic	Outdoor swimming	75	78	Mossyard Bay
Aquatic	Power boating	1	52	Off Kirkcudbright
Aquatic	Sailing	19	225	Sandgreen
Aquatic	Sea angling	17	208	Powilliemount
Aquatic	Snorkelling	1	0.5	Carrick Bay
Aquatic	Sports fishing	1	35	Off Kirkcudbright
Aquatic	Stand-up paddle boarding	26	26	Sandgreen
Aquatic	Windsurfing	4	29	Sandgreen

6 Phase 2 survey results

6.1 Introduction

There were three aims of 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 individual was estimated. This was 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 Dumfries and Galloway, follow up surveys were made in November 2024. Of the individuals contacted within each part of the distribution, follow up surveys were completed for three individuals from the high (A, B and C), medium (D, E and F) and low (G, H and I) groups (nine individuals).

6.2 Phase 2 internal exposure

6.2.1 Internal aquatic

Tables 6.1 and 6.2 summarise the findings and any changes in aquatic food consumption. Individuals B and C from the high group reported consuming crustaceans within the Phase 1 survey with comparable consumption reported in Phase 2. Both B and C however reported consuming fish in the Phase 2 survey. Both individuals B and C reported that they had forgotten to mention the consumption of fish in the Phase 1 survey. Individual D from the medium group reported to consuming fish in the Phase 1 survey however none was reported to be consumed within the Phase 2 survey due to the individual now not sourcing local produce (as the individual fishing for produce does not currently fish in the Solway).

Table 6.1 Survey comparison of aquatic consumption for the high group (kg y^{-1})

Food type	B Phase 1 (kg y^{-1})	B Phase 2 (kg y^{-1})	C Phase 1 (kg y^{-1})	C Phase 2 (kg y^{-1})
Crustacean	27.5	30	27.5	30
Fish	-	60	-	60

Table 6.2 Survey comparison of aquatic consumption for the medium group (kg y^{-1})

Food type	D Phase 1	D Phase 2
Fish	5	-

6.3 Phase 2 external exposure

6.3.1 Intertidal and aquatic activities

Within the high occupancy group (Table 6.3), Individual A reported no change in the Phase 2 survey with occupancy spent fishing and handling equipment. Individual B reported the same occupancy spent fishing but reported to spend a little more time handling equipment due to spending more time on boat maintenance.

Within the medium occupancy group (Table 6.4), Individual F reported no change between the Phase 1 and 2 surveys. Individual E reported no change in the time spent on the intertidal substrate (sand) dog walking however reported to now spending no time on rock substrate fishing as the individual now fishes more regularly on the river from saltmarsh substrate (39h y^{-1} and 104h y^{-1} respectively). Individual E reported an increase in handling equipment in Phase 2 compared with Phase 1 due to spending more time cleaning fishing gear as a result of more time spent fishing.

Within the low occupancy group (Table 6.5), Individual G reported occupancy on sand (108h y^{-1}) and handling sediment (12h y^{-1}) within the Phase 1 survey. Within the Phase 2 survey Individual G reported an increase occupancy on sand (340h y^{-1}) and handling sediment (50h y^{-1}) due to spending more time walking and beachcombing/playing than was reported within the Phase 1 survey. Within the Phase 1 and 2 surveys, Individual's H and I reported comparable occupancy on sand substrate dog walking (28h y^{-1} and 25h y^{-1} respectively). However, in the Phase 1 survey both individuals H and I reported to spending time sitting/picnicking/BBQ (14h y^{-1}). This was not reported in the Phase 2 survey.

Table 6.3 Survey comparison of aquatic activity occupancy for the high group (h y^{-1})

Intertidal and aquatic 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})
Occupancy on water	2160	2160	1500	1500
Handling equipment	2190	2238	1700	1700

Table 6.4 Survey comparison of intertidal and aquatic activity occupancy for the medium group (h y^{-1})

Intertidal and aquatic activities	E Phase 1 (h y^{-1})	E Phase 2 (h y^{-1})	F Phase 1 (h y^{-1})	F Phase 2 (h y^{-1})
Occupancy on rock	39	-	-	-
Occupancy on saltmarsh	-	96	-	-
Occupancy on sand	548	548	74	74
Handling sediment	-	-	43	43
Handling equipment	41	104	-	-

Table 6.5 Survey comparison of intertidal 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 rock	-	-	-	-	-	-
Occupancy on saltmarsh	-	-	-	-	-	-
Occupancy on sand	108	340	28	25	28	25
Handling sediment	12	50	14	-	14	-

7 Post Covid-19 habit analysis

It was discussed with SEPA that, due to Covid-19 individual's habits may have somewhat changed for different reasons. Within the face-to-face survey (Phase 1) individuals were asked if any of their habits (intertidal and aquatic) had changed since Covid-19. Within the survey, 222 individuals provided a definitive answer to whether there had been any changes to habits. Figures 7.1 to 7.4 show individual's habits post Covid-19.

Figure 7.1 shows that 178 individuals reported that there had been no changes to their habits, 26 individuals reported that they now spent more time outdoors (some individuals indicated that as a family they all spent more time outdoors), four individuals reported that they now spent more time indoors and 14 individuals reported that their habits had changed due to 'other' reasons. Figures 7.2, 7.3 and 7.4 provide a breakdown of each category within Table 7.1. Only four individuals reported that they spend more time indoors now which may reflect the time passed since Covid-19.

Figure 7.1 Post Covid-19 changes identified from individuals surveyed

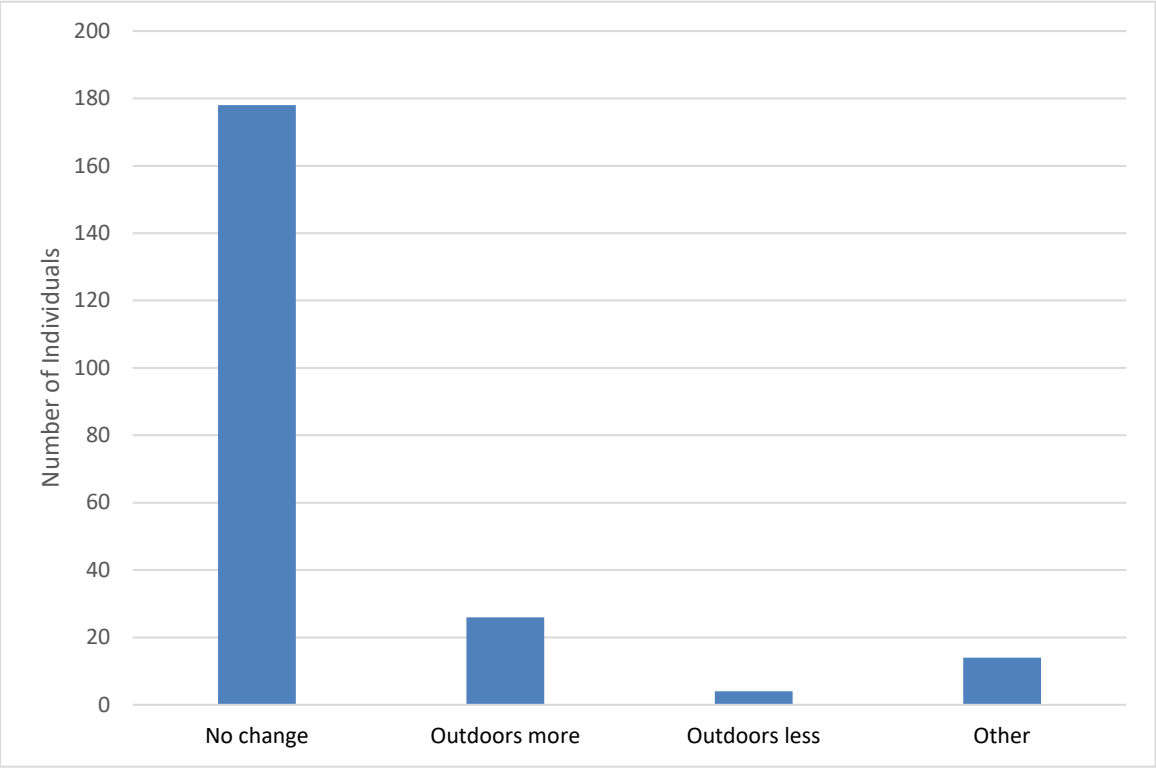


Figure 7.2 Breakdown of habits individuals reported post Covid-19 for those individuals reporting more time spent outdoors

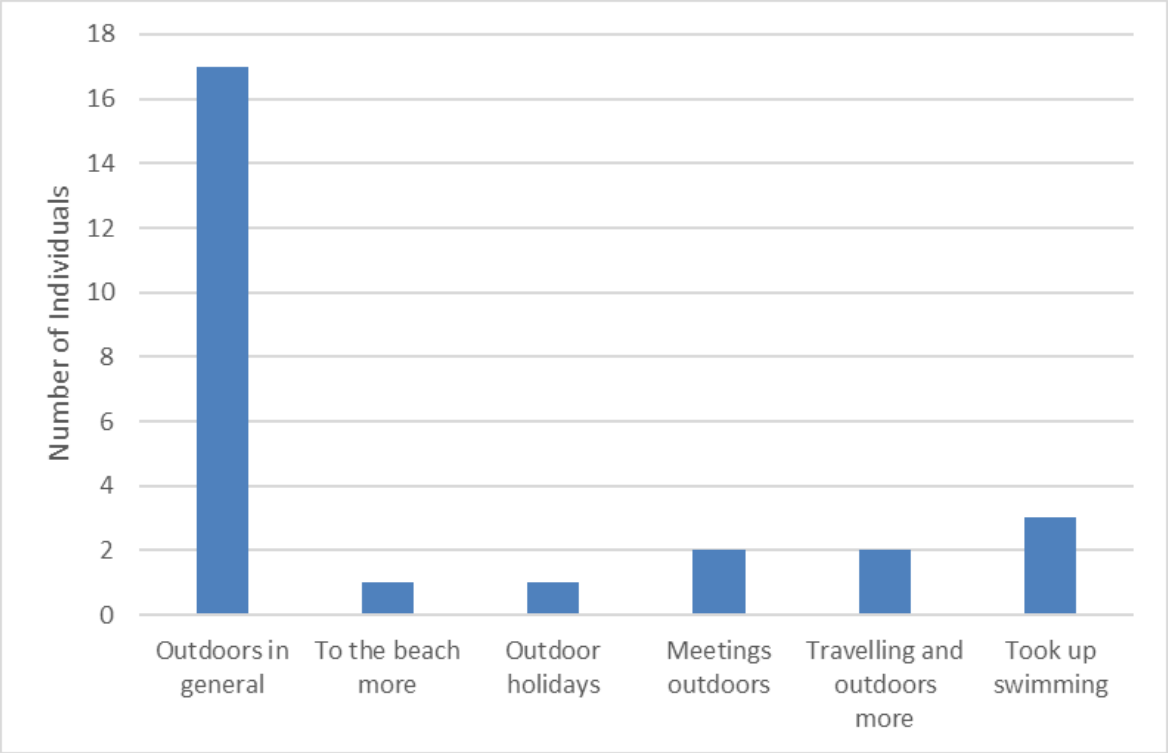


Figure 7.3 Breakdown of habits individuals reported post Covid-19 for those individuals reporting less time spent outdoors

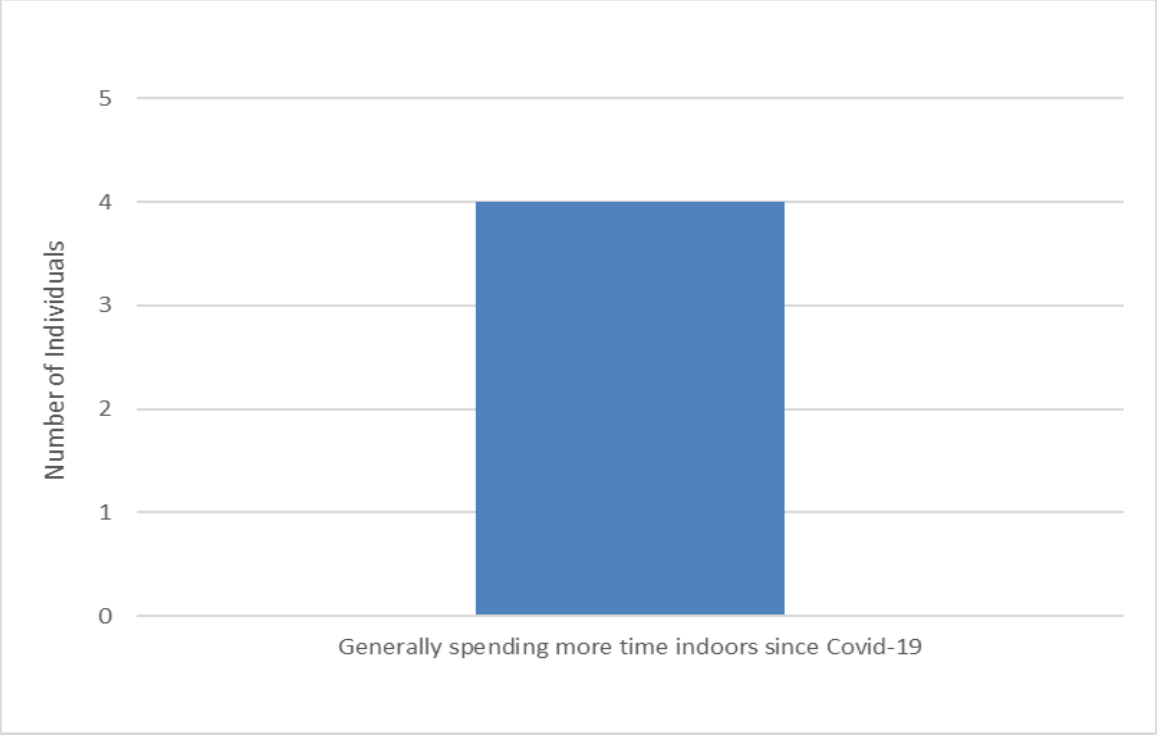
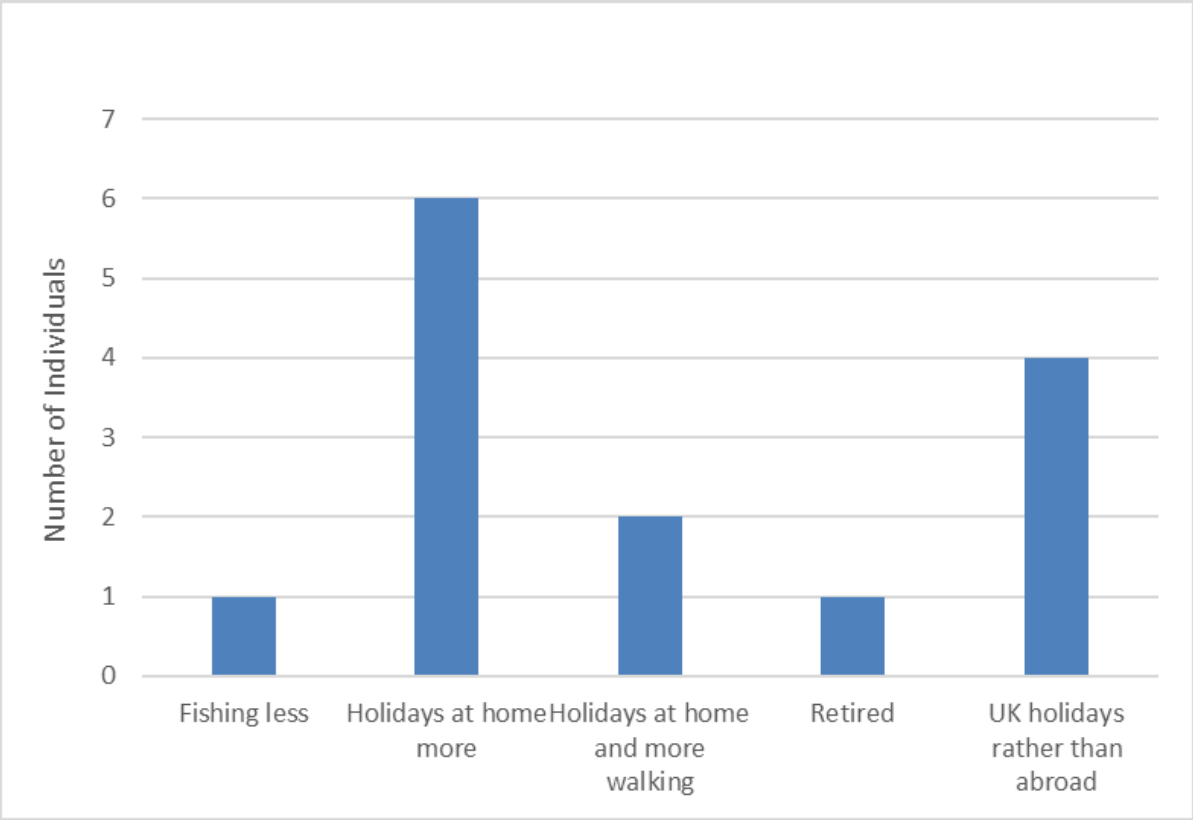


Figure 7.4 Breakdown of 'Other' contributors to post Covid-19 habit changes



8 Comparisons with the previous survey

8.1 Introduction

The results from the 2024 Dumfries and Galloway habits survey have been reported in chapter 4 for the face-to-face Phase 1 survey. These results can be compared with results from the previous habits survey, undertaken in 2017 by the University of Stirling (Smith et al., 2018).

The aquatic face-to-face survey area in the 2024 survey extended from intertidal areas and waters of the Solway from Isle of Whithorn to Glencaple in the east.

8.2 Aquatic survey

8.2.1 Phase 1 - adult consumption rates – internal exposure

A comparison between the 2017 and 2024 adult consumption rates of aquatic foods in the face-to-face interviews is presented in Table 8.1. The table also provides the mean consumption rates from national data (Smith and Jones, 2003) for comparison.

In 2024, the mean consumption rate for the adult high-rate group substantially increased for fish and wildfowl (104kg y^{-1} and 113kg y^{-1}) compared with 2017 (31.2kg y^{-1} and 27.7kg y^{-1}) respectively. The mean consumption for the high-rate group for crustacean and mollusc substantially decreased in 2024 (30.8kg y^{-1} and 1.34kg y^{-1}) compared with 2017 (62.9kg y^{-1} and 27.7kg y^{-1}) respectively. The mean consumption rate for the high-rate group for saltmarsh grazed lamb increased in 2024 compared with 2017 (11kg y^{-1} and 9.83kg y^{-1}) respectively.

The main species of fish consumed by the adult high-rate group were bass, cod, and whiting in 2024 compared to the main species of salmon, cod, plaice, and mackerel in 2017.

The main species of wildfowl consumed by the adult high-rate group in 2024 were mallard, pink-footed goose, greylag goose, widgeon, pintail and teal. In 2017 the main species were mallard, pink-footed goose, greylag goose, widgeon and teal.

Table 8.1 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	6	53.4	31.2	2	104	104	15.0
Crustaceans	3	72.8	62.9	3	37.5	30.8	4.00
Molluscs	4	27.6	15.6	5	1.68	1.34	4.00
Wildfowl	3	41.5	27.7	3	114	113	ND
Saltmarsh lamb	6	10	9.83	4	11	11	ND

The main species of crustacean consumed by the adult high-rate group in 2024 were brown crab, common lobster and langoustines which are the same as those consumed in 2017. The main species of mollusc consumed by the adult high-rate group in 2024 was scallops compared with mussels and scallops in 2017.

8.2.2 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 8.2.

Table 8.2 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 for the high-rate group (kg y^{-1})	2017 Mean consumption for the high-rate group (kg y^{-1})	2024 Number of people in the high-rate group	2024 Maximum consumption for the high-rate group (kg y^{-1})	2024 Mean consumption rate for the high-rate group (kg y^{-1})
Child (6 to 15 years old)	Fish	4	4	2.88	2	32.7	32.7
Child (6 to 15 years old)	Crustaceans	4	0.5	0.33	1	0.9	0.9
Child (6 to 15 years old)	Molluscs	2	2.1	1.4	-	-	-
Child (6 to 15 years old)	Wildfowl	-	-	-	1	37.5	37.5
Infant (0 to 5 years old)	Fish	2	2.64	2.07	2	16.5	16.5
Infant (0 to 5 years old)	Crustacean	1	0.24	0.24	-	-	-
Infant (0 to 5 years old)	Mollusc	-	-	-	1	0.07	0.07

The mean consumption of fish within the children's high-rate group substantially increased in 2024 compared to 2017 (32.7kg y^{-1} and 2.88kg y^{-1} respectively). The children's high-rate group consumed bass, cod and whiting in 2024 compared with flounder, salmon, Dover sole, mackerel, pollock and bass in 2017.

The mean consumption of crustacean within the children's high-rate group increased slightly in 2024 compared with 2017 (0.9kg y^{-1} and 0.33kg y^{-1} respectively). The children's high-rate group consumed common lobster in 2024 compared with common lobster and shrimps in 2017. Molluscs were consumed in the 2017 survey with the mean consumption rate for the children's high-rate group of 1.4kg y^{-1} (mussels, razor clams and cockles). No mollusc consumption was determined for the children's age group in 2024.

The mean wildfowl consumption for the children's high-rate group in 2024 was 37.5kg y^{-1} compared with no wildfowl consumption in 2017. Wildfowl consumed by the high-rate group was pink-footed goose.

The mean consumption of fish within the infant high-rate group substantially increased in 2024 compared to 2017 (16.5kg y^{-1} and 2.07kg y^{-1} respectively). The infant high-rate group consumed cod and bass in 2024 compared with mackerel, pollock, bass and flounder in 2017.

Crustaceans were consumed in the 2017 survey with the mean consumption rate for the infant high-rate group of 0.24kg y^{-1} (brown crab and common lobster). No crustacean consumption was determined in 2024.

The mean mollusc consumption for the infant high-rate group in 2024 was 0.07kg y^{-1} compared with no mollusc consumption being determined in 2017. Molluscs consumed by the high-rate group were mussels and whelks.

8.2.3 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 1095h y^{-1} for an adult dog walking on a stone substrate which is decreased compared 2054h y^{-1} in 2017 for an individual who spent time on sand and stone substrate, rock substrate and saltmarsh.

In 2024 there was a substantial decrease in occupancy for in water compared with the 2015 survey, 94.7h y^{-1} and 1346h y^{-1} respectively. In 2024, on water occupancy and handling equipment increased, 1955h y^{-1} and 2013h y^{-1} respectively, compared with 1495h y^{-1} and 1398h y^{-1} in 2017. Handling sediment in 2024 was comparable with the 2017 survey, 492h y^{-1} and 555h y^{-1} respectively. A comparison is shown in Table 8.3.

Table 8.3 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 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})
Aquatic (in water)	2	1762	1346	8	117	94.7
Aquatic (on water)	6	2099	1495	4	2160	1955
Handling equipment	7	1776	1398	4	2190	2013
Handling sediment	6	650	555	5	677	492

8.2.4 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.

The highest total intertidal occupancy in 2024 was 677h y^{-1} for two children who spent time beachcombing and sitting/picnicking/BBQ on a sand and stone substrate compared with 136h y^{-1} for a child playing (48h y^{-1}), crabbing (10h y^{-1}) and dog walking (78h y^{-1}) in 2017. The highest total intertidal occupancy in 2024 was 677h y^{-1} for two infants who spent time beachcombing and sitting/picnicking/BBQ on a sand and stone substrate compared with and infant who spent 208h y^{-1} horse riding in 2017.

In 2024, child in water and on water occupancy decreased (11.2h y^{-1} and 42h y^{-1} respectively) compared with 48h y^{-1} and 98.4h y^{-1} respectively in 2017. In 2024, child handling equipment and handling sediment increased (36h y^{-1} and 420h y^{-1}) compared with 24.8h y^{-1} and 54.5h y^{-1} respectively in 2017.

In 2024, infant in water occupancy increased to 8.3h y^{-1} compared with 2.88h y^{-1} in 2017. In 2024, infant occupancy for on water activities and handling equipment was determined however, this was not determined in 2017. In 2024, infants handling sediment increased (612h y^{-1}) compared to 2017 (55.5h y^{-1}).

A comparison is shown in Table 8.4.

Table 8.4 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 Number of people in the high-rate group	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy rate for the high-rate group (h y^{-1})
Child (6 to 15 years old)	Aquatic (in water)	1	48	48	6	13	11.2
Child (6 to 15 years old)	Aquatic (on water)	2	142	98.4	3	54	42
Child (6 to 15 years old)	Handling equipment	1	24.8	24.8	2	36	36
Child (6 to 15 years old)	Handling sediment	12	96	54.5	6	677	420
Infant (0 to 5 years old)	Aquatic (in water)	4	4	2.88	3	10	8.3
Infant (0 to 5 years old)	Aquatic (on water)	ND	ND	ND	1	1	1
Infant (0 to 5 years old)	Handling equipment	ND	ND	ND	2	2	1.5

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 Number of people in the high-rate group	2024 Maximum occupancy for the high-rate group (h y^{-1})	2024 Mean occupancy rate for the high-rate group (h y^{-1})
Infant (0 to 5 years old)	Handling sediment	10	96	55.5	3	677	612

ND – not determined

9 Recommendations and suggestions for monitoring programme changes.

9.1 Introduction

The habits survey results for occupancy, activity and food consumption arise from two main sources of community engagement: (i) face-to-face surveys (n = 338); and (ii) several meetings and informal contacts. These data have been supplemented with radiometric surveys: (i) a carborne and handheld gamma spectrometry survey (n = ~14822 (carborne); n = ~8523 (handheld)); (ii) in-situ gamma dose rate (n = 37 intertidal); and (iii) in-situ beta dose rate (n = 2).

9.2 Ongoing monitoring

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

9.3 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 of 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 Dumfries and Galloway 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 mostly as is however based on the 2024 survey results, which show differences in some food groups between this and previous surveys, it is recommended that consideration be given to the following within future monitoring programmes:

- The sampling of common lobster from Wigtown Bay annually.
- The sampling of langoustine from Wigtown Bay annually.

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Appendices

Appendix A

Appendix A1: Raw data

Table A1.1. Phase 1 adult fish consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
36	Bass	13.6
740	Bass	13
131	Bass	13
200	Bass	6
508	Bass	6
537	Bass	4
453	Bass	3.2
454	Bass	3.2
197	Bass	2.5
131	Cod	91
740	Cod	91
36	Mackerel	9.1
190	Mackerel	3
530	Mackerel	1.5
529	Mackerel	1.5
145	Mackerel	1.25
722	Mackerel	1.25
446	Mackerel	0.9
447	Mackerel	0.9

Observation number	Food type	Sum of consumption (kg y^{-1})
448	Mackerel	0.9
454	Mackerel	0.75
453	Mackerel	0.75
1017	Mackerel	0.45
12	Mackerel	0.45
726	Mackerel	0.125
725	Mackerel	0.125
724	Mackerel	0.125
54	Mackerel	0.125
421	Mackerel	0.1
425	Mackerel	0.1
64	Mackerel	0.1
422	Mackerel	0.1
454	Pollock	5
453	Pollock	5
411	Pollock	0.125
453	Dogfish	0.5
454	Dogfish	0.5
537	Flounder	1
453	Flounder	0.25
454	Flounder	0.25
716	Grey Mullet	13.6
129	Grey Mullet	13.6
459	Grey Mullet	6

Observation number	Food type	Sum of consumption (kg y^{-1})
118	Brill	1
453	Whiting	2.5
454	Whiting	2.5
131	Whiting	0.2
740	Whiting	0.2
716	Hake	13.6
129	Hake	13.6

Table 1.2 Phase 1 child fish consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
743	Bass	6.5
741	Bass	6.5
743	Cod	26
741	Cod	26
432	Mackerel	0.1
427	Mackerel	0.1
426	Mackerel	0.1
743	Whiting	0.2
741	Whiting	0.2

Table A1.3 Phase 1 infant fish consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
742	Bass	3.25
744	Cod	13.00
742	Cod	13.00
433	Mackerel	0.10
414	Pollock	0.05
744	Whiting	0.20
742	Whiting	0.20

Table A1.4 Phase 1 adult crustacean consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
202	Brown crab	4.2
464	Brown crab	2.5
463	Brown crab	2.5
459	Common lobster	12.5
462	Common lobster	9
464	Common lobster	5
463	Common lobster	5
526	Common lobster	0.9
191	Common lobster	0.9
464	Prawns (langoustines)	20
463	Prawns (langoustines)	20
459	Crab	25

Table A1.5 Phase 1 child crustacean consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
738	Common lobster	0.9

Table A1.6 Phase 1 adult mollusc consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
411	Mussels	0.05
202	Scallops	1.68
716	Scallops	1.3
129	Scallops	1.3
508	Scallops	1.2
200	Scallops	1.2
528	Scallops	0.1
527	Scallops	0.1
411	Whelks	0.02

Table A1.7 Phase 1 infant molluscs consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
414	Mussels	0.05
414	Whelks	0.02

Table A1.8 Phase 1 adult wildfowl consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
453	Mallard	2.3
454	Mallard	2.3
457	Mallard	1.25
457	Mallard	1.25
453	Pink-Footed Goose	84.4
454	Pink-Footed Goose	84.4
457	Pink-Footed Goose	45
457	Pink-Footed Goose	45
455	Pink-Footed Goose	37.5
466	Pink-Footed Goose	2.25
465	Pink-Footed Goose	2.25
457	Teal	1.15
457	Teal	1.15
454	Widgeon	9
453	Widgeon	9
457	Widgeon	8
457	Widgeon	8
453	Greylag goose	11.3
454	Greylag goose	11.3
454	Canadian Goose	5.6
453	Canadian Goose	5.6
457	Pintail	1.55
457	Pintail	1.55

Table A1.9 Phase 1 child wildfowl consumption

Observation number	Food type	Sum of consumption (kg y^{-1})
460	Pink-Footed Goose	37.5

Table A1.10 Phase 1 adult in water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
55	Body boarding	19.5
727	Body boarding	19.5
728	Body boarding	19.5
727	Outdoor swimming	78
55	Outdoor swimming	78
728	Outdoor swimming	78
24	Outdoor swimming	58.4
54	Outdoor swimming	26
725	Outdoor swimming	26
726	Outdoor swimming	26
724	Outdoor swimming	26
205	Outdoor swimming	15
57	Outdoor swimming	13
736	Outdoor swimming	12
132	Outdoor swimming	12
199	Outdoor swimming	9.75
199	Outdoor swimming	9.75

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
515	Outdoor swimming	9.75
515	Outdoor swimming	9.75
68	Outdoor swimming	8.58
435	Outdoor swimming	8.58
436	Outdoor swimming	8.58
1007	Outdoor swimming	5
23	Outdoor swimming	5
7	Outdoor swimming	5
623	Outdoor swimming	4.5
173	Outdoor swimming	4.5
15	Outdoor swimming	4
535	Outdoor swimming	4
536	Outdoor swimming	4
147	Outdoor swimming	3.96
147	Outdoor swimming	3.96
147	Outdoor swimming	3.96
436	Outdoor swimming	3.96
200	Outdoor swimming	3.25
660	Outdoor swimming	3
39	Outdoor swimming	3
659	Outdoor swimming	3
659	Outdoor swimming	3
39	Outdoor swimming	3
660	Outdoor swimming	3

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
661	Outdoor swimming	3
661	Outdoor swimming	3
54	Outdoor swimming	3
725	Outdoor swimming	3
726	Outdoor swimming	3
724	Outdoor swimming	3
37	Outdoor swimming	2.64
513	Outdoor swimming	2.5
1016	Outdoor swimming	1.5
10	Outdoor swimming	1.5
23	Outdoor swimming	1.5
188	Outdoor swimming	1
188	Outdoor swimming	1
193	Outdoor swimming	1
507	Outdoor swimming	1
194	Outdoor swimming	1
148	Outdoor swimming	0.62
718	Outdoor swimming	0.62
9	Outdoor swimming	0.5
425	Outdoor swimming	0.5
64	Outdoor swimming	0.5
424	Outdoor swimming	0.5
422	Outdoor swimming	0.5
421	Outdoor swimming	0.5

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
423	Outdoor swimming	0.5
2228	Outdoor swimming	0.33
8	Outdoor swimming	0.33
147	Outdoor swimming	0.3
147	Outdoor swimming	0.3
147	Outdoor swimming	0.3
144	Outdoor swimming	0.2
196	Outdoor swimming	0.1875
65	Snorkelling	0.5
724	Stand-up paddle boarding	26
725	Stand-up paddle boarding	26
726	Stand-up paddle boarding	26
54	Stand-up paddle boarding	26
728	Stand-up paddle boarding	19.5
727	Stand-up paddle boarding	19.5
55	Stand-up paddle boarding	19.5
23	Stand-up paddle boarding	14
1017	Stand-up paddle boarding	14
12	Stand-up paddle boarding	14

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
148	Stand-up paddle boarding	6.25
718	Stand-up paddle boarding	6.25
515	Stand-up paddle boarding	6
199	Stand-up paddle boarding	6
205	Stand-up paddle boarding	5
726	Stand-up paddle boarding	3
725	Stand-up paddle boarding	3
724	Stand-up paddle boarding	3
54	Stand-up paddle boarding	3
660	Stand-up paddle boarding	2
660	Stand-up paddle boarding	2
659	Stand-up paddle boarding	2
39	Stand-up paddle boarding	2
39	Stand-up paddle boarding	2
661	Stand-up paddle boarding	2

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
659	Stand-up paddle boarding	2
661	Stand-up paddle boarding	2
147	Stand-up paddle boarding	0.5
37	Stand-up paddle boarding	0.32
11	Stand-up paddle boarding	0.25
724	Windsurfing	26
726	Windsurfing	26
725	Windsurfing	26
54	Windsurfing	26
726	Windsurfing	3
725	Windsurfing	3
54	Windsurfing	3
724	Windsurfing	3

Table A1.11 Phase 1 child in water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
413	Body boarding	2
406	Outdoor swimming	13
407	Outdoor swimming	13
738	Outdoor swimming	12
737	Outdoor swimming	12

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
739	Outdoor swimming	12
1008	Outdoor swimming	5
417	Outdoor swimming	1
418	Outdoor swimming	1
719	Outdoor swimming	0.62
674	Outdoor swimming	0.5
426	Outdoor swimming	0.5
427	Outdoor swimming	0.5
428	Outdoor swimming	0.5
429	Outdoor swimming	0.5
431	Outdoor swimming	0.5
675	Outdoor swimming	0.5
676	Outdoor swimming	0.5
674	Outdoor swimming	0.5
675	Outdoor swimming	0.5
676	Outdoor swimming	0.5
674	Outdoor swimming	0.5
675	Outdoor swimming	0.5
676	Outdoor swimming	0.5
430	Outdoor swimming	0.5
2229	Outdoor swimming	0.33
1012	Stand-up paddle boarding	0.5

Table A1.12 Phase 1 infant in water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
414	Body boarding	2
1009	Outdoor swimming	5
663	Outdoor swimming	3
662	Outdoor swimming	3
663	Outdoor swimming	3
662	Outdoor swimming	3
514	Outdoor swimming	2.5
663	Stand-up paddle boarding	2
662	Stand-up paddle boarding	2
663	Stand-up paddle boarding	2
662	Stand-up paddle boarding	2
1013	Stand-up paddle boarding	0.25

Table A1.13 Phase 1 adult on water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
70	Boat maintenance	26
724	Boat maintenance	8.58
54	Boat maintenance	8.58
725	Boat maintenance	8.58
726	Boat maintenance	8.58

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
726	Boat maintenance	2
725	Boat maintenance	2
724	Boat maintenance	2
54	Boat maintenance	2
724	Boat maintenance	0.48
725	Boat maintenance	0.48
54	Boat maintenance	0.48
726	Boat maintenance	0.48
444	Canoeing	1
65	Canoeing	1
191	Commercial fishing/creeling	2080
526	Commercial fishing/creeling	2080
461	Creel fishing/Handling	2160
463	Creel fishing/Handling	1500
188	Kayaking	208
188	Kayaking	208
724	Kayaking	26
726	Kayaking	26
725	Kayaking	26
54	Kayaking	26
736	Kayaking	18
132	Kayaking	18
1018	Kayaking	16
1021	Kayaking	16

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
1019	Kayaking	16
1017	Kayaking	16
12	Kayaking	16
1022	Kayaking	16
1020	Kayaking	16
1023	Kayaking	16
723	Kayaking	5
39	Kayaking	3
724	Kayaking	3
725	Kayaking	3
726	Kayaking	3
54	Kayaking	3
68	Kayaking	1
425	Kayaking	0.33
424	Kayaking	0.33
423	Kayaking	0.33
422	Kayaking	0.33
64	Kayaking	0.33
421	Kayaking	0.33
37	Kayaking	0.165
188	Power boating	52
726	Sailing	195
724	Sailing	195
725	Sailing	195

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
54	Sailing	195
894	Sailing	70
14	Sailing	35
726	Sailing	30
54	Sailing	30
725	Sailing	30
724	Sailing	30
188	Sailing	13
188	Sailing	13
535	Sailing	9
534	Sailing	9
203	Sailing	9
536	Sailing	9
448	Sailing	3.5
447	Sailing	3.5
446	Sailing	3.5
70	Sailing	3.5
124	Sailing	2
10	Sailing	1
131	Sea angling	312
740	Sea angling	312
130	Sea angling	208
459	Sea angling	125
722	Sea angling	90

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
720	Sea angling	17.5
721	Sea angling	17.5
146	Sea angling	17.5
448	Sea angling	3.5
70	Sea angling	3.5
447	Sea angling	3.5
446	Sea angling	3.5
64	Sea angling	0.33
14	Sport fishing	35

Table A1.14 Phase 1 child on water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
739	Kayaking	18
738	Kayaking	18
737	Kayaking	18
431	Kayaking	0.33
430	Kayaking	0.33
429	Kayaking	0.33
428	Kayaking	0.33
427	Kayaking	0.33
426	Kayaking	0.33
739	Sea angling	36
738	Sea angling	36

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
432	Sea angling	0.33

Table A1.15 Phase 1 infant on water activities

Observation number	Aquatic activity	Sum of occupancy (h y^{-1})
442	Canoeing	1
433	Sea angling	0.33

Table A1.16 Phase 1 adult intertidal activities

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
7	Bait digging	0	0	26	0	0	0
7	Bait digging	0	0	39	0	0	0
7	Bait digging	0	0	13	0	0	0
7	Beachcombing	0	0	0	0.32	0	0
7	Beachcombing	0	0	0	0.32	0	0
7	Beachcombing	0	0	0	1	0	0
16	Beachcombing	0	0	0.66	0	0	0
16	Beachcombing	0	0	0.66	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
16	Beachcombing	0	0	15	0	0	0
1007	Beachcombing	0	0	15	0	0	0
1007	Beachcombing	0	0	0.5	0	0	0
1007	Beachcombing	0	0	0.5	0	0	0
1007	Beachcombing	0	0	4	0	0	0
1007	Beachcombing	0	0	26	0	0	0
1007	Beachcombing	0	0	0.66	0	0	0
1011	Beachcombing	0	0	8	0	0	0
1011	Beachcombing	0	0	12	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
1011	Beachcombing	0	0	0	192	0	0
1014	Beachcombing	0	0	1.25	0	0	0
1014	Beachcombing	0	0	0.5	0	0	0
1015	Beachcombing	0	0	0.5	0	0	0
1015	Beachcombing	0	0	0.5	0	0	0
1016	Beachcombing	0	0	0	2.31	0	0
1017	Beachcombing	0	0	2.31	0	0	0
1017	Beachcombing	0	0	2.31	0	0	0
114	Beachcombing	0	0	2.31	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
114	Beachcombing	0	0	2.31	0	0	0
1087	Beachcombing	0	0	0	2.31	0	0
1087	Beachcombing	0	0	8	0	0	0
115	Beachcombing	0	0	6	0	0	0
115	Beachcombing	0	0	6	0	0	0
1097	Beachcombing	0	0	6	0	0	0
1097	Beachcombing	0	0	3	0	0	0
1098	Beachcombing	0	0	0	0.32	0	0
1098	Beachcombing	0	0	1	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
1099	Beachcombing	0	0.88	0.88	0	0	0
1099	Beachcombing	0	0	5	0	0	0
17	Beachcombing	0	0	2.31	0	0	0
17	Beachcombing	0	0	2.31	0	0	0
116	Beachcombing	0	0	0	2.31	0	0
117	Beachcombing	0	0	338	0	0	0
1117	Beachcombing	0	0	0	455	0	0
1117	Beachcombing	0	0	0	195	0	0
118	Beachcombing	0	0	36	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
118	Beachcombing	0	0	0.5	0	0	0
123	Beachcombing	0	0	0	1.5	0	0
123	Beachcombing	0	0	2	0	0	0
123	Beachcombing	0	0	4	0	0	0
123	Beachcombing	0	0	4	0	0	0
124	Beachcombing	0	0	4	0	0	0
124	Beachcombing	0	0	4	0	0	0
124	Beachcombing	0	0	4	0	0	0
125	Beachcombing	0	0	2	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
125	Beachcombing	0	0	0	1.5	0	0
125	Beachcombing	0	0	5	0	0	0
125	Beachcombing	0	0	5	0	0	0
125	Beachcombing	0	0	5	0	0	0
125	Beachcombing	0	0	3	0	0	0
125	Beachcombing	0	0	3	0	0	0
125	Beachcombing	0	0	0.5	0	0	0
125	Beachcombing	0	0	0.5	0	0	0
125	Beachcombing	0	0	0	1	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
125	Beachcombing	0	0	0.66	0	0	0
125	Beachcombing	0	0	0.66	0	0	0
125	Beachcombing	0	0	0.5	0	0	0
125	Beachcombing	0	0	0.5	0	0	0
18	Beachcombing	0	0	0.5	0	0	0
126	Beachcombing	0	0	18	0	0	0
126	Beachcombing	0	0	18	0	0	0
126	Beachcombing	0	0	18	0	0	0
126	Beachcombing	0	0	18	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
126	Beachcombing	0	0	6	0	0	0
127	Beachcombing	0	0.88	0.88	0	0	0
127	Beachcombing	0	0.88	0.88	0	0	0
128	Beachcombing	0	0.88	0.88	0	0	0
128	Beachcombing	0	0.88	0.88	0	0	0
128	Beachcombing	0	0	0	0	0	0
128	Beachcombing	0	0	1.25	0	0	0
128	Beachcombing	0	0	12	0	0	0
128	Beachcombing	0	0	36	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
129	Beachcombing	0	0	0.66	0	0	0
129	Beachcombing	0	0	1	0	0	0
130	Bird/Nature watching	0	7	0	0	0	0
130	Bird/Nature watching	0	7	0	0	0	0
130	Bird/Nature watching	0	7	0	0	0	0
130	Bird/Nature watching	0	0	1	0	0	0
130	Bird/Nature watching	0	0	0	0.66	0	0
130	Bird/Nature watching	0	0	0	0	0	5.25
130	Bird/Nature watching	0	0	0	0	0	5.25

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
130	Bird/Nature watching	0	0	0	0.66	0	0
131	Bird/Nature watching	0	0	0	1.5	0	0
131	Bird/Nature watching	0	0	1	0	0	0
131	Bird/Nature watching	0	7	0	0	0	0
132	Bird/Nature watching	0	0	0	1.5	0	0
132	Bouldering	0	0	0	0	0	4
132	Bouldering	0	0	0	0	0	4
133	Collecting cockles	0	0	0.66	0	0	0
133	Collecting mussels	0	0	0.66	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
133	Collecting razor clams	0	0	0.66	0	0	0
19	Collecting seaweed	0	0	0.66	0	0	0
19	Collecting winkles	0	0	0.66	0	0	0
1306	Collecting wood	0	0	0	2	0	0
1306	Collecting wood	0	0	0.5	0	0	0
1307	Collecting wood	0	0	0.5	0	0	0
1307	Crabbing	0	0	0.77	0	0	0
1308	Crabbing	0	0	52	0	0	0
1308	Crabbing	0	0	0	0.77	0	0
144	Crabbing	0	0	0.77	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
145	Crabbing	0	0	0.77	0	0	0
145	Crabbing	0	0	0	0	0	0
145	Crabbing	0	0	0	0.77	0	0
20	Crabbing	0	0	0.77	0	0	0
20	Crabbing	0	0	0.77	0	0	0
20	Crabbing	0	0	0	0.77	0	0
20	Crabbing	0	0	0.77	0	0	0
20	Dog walking	0	0	14	0	0	0
146	Dog walking	0	0	104	0	0	0
147	Dog walking	0	0	104	0	0	0
147	Dog walking	0	0	0.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
147	Dog walking	0	0	14	0	0	0
147	Dog walking	0	0	0.5	0	0	0
147	Dog walking	0	0	9	0	0	0
148	Dog walking	0	0	16	0	0	0
148	Dog walking	0	0	16	0	0	0
148	Dog walking	0	0	16	0	0	0
148	Dog walking	0	0	1.5	0	0	0
21	Dog walking	0	0	2	0	0	0
21	Dog walking	0	0	0	0	1095	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
21	Dog walking	0	0	1.5	0	0	0
21	Dog walking	0	0	0	0	0	0
21	Dog walking	0	0	0	1.5	0	0
21	Dog walking	0	0	0	294	0	0
21	Dog walking	0	0	0	3	0	0
21	Dog walking	0	0	0	3	0	0
22	Dog walking	0	0	0	3	0	0
22	Dog walking	0	0	0	1	0	0
22	Dog walking	0	0	0	1	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
22	Dog walking	0	0	1	0	0	0
173	Dog walking	0	0	0	3	0	0
174	Dog walking	0	0	0	3	0	0
174	Dog walking	0	0	6	0	0	0
174	Dog walking	0	0	1	0	0	0
175	Dog walking	0	0	26	0	0	0
175	Dog walking	0	0	4	0	0	0
23	Dog walking	0	0	7.5	0	0	7.5
183	Dog walking	0	0	0	10.5	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
183	Dog walking	0	1.75	1.75	0	0	0
185	Dog walking	0	0	0	2	0	0
185	Dog walking	0	0	2	0	0	0
185	Dog walking	0	0	8	0	0	0
24	Dog walking	0	0	0.5	0	0	0
24	Dog walking	0	0	10.5	0	0	0
24	Dog walking	0	0	12.5	0	0	0
186	Dog walking	0	0	7	0	0	0
186	Dog walking	0	0	0	7	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
187	Dog walking	0	0	78	0	0	0
187	Dog walking	0	0	1	0	0	0
187	Dog walking	0	0	77.5	0	0	0
187	Dog walking	0	0	77.5	0	0	0
188	Dog walking	0	0	365	0	0	0
189	Dog walking	0	0	0	365	0	0
190	Dog walking	0	0	0	7	0	0
190	Dog walking	0	0	208	0	0	0
190	Dog walking	0	0	208	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
190	Dog walking	0	0	104	0	0	0
190	Dog walking	0	0	26	0	0	0
192	Dog walking	0	0	3	0	0	0
193	Dog walking	0	0	3	0	0	0
193	Dog walking	0	0	1	0	0	0
193	Dog walking	0	0	6	0	0	0
193	Dog walking	0	0	9	0	0	0
193	Dog walking	0	0	7.5	0	0	7.5
194	Dog walking	0	0	4	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
194	Dog walking	0	104	0	0	0	0
195	Dog walking	0	0	0	7	0	0
25	Dog walking	0	0	104	0	0	0
25	Dog walking	0	0	1	0	0	0
25	Dog walking	0	0	0	7	0	0
25	Dog walking	0	0	7	0	0	0
25	Dog walking	0	0	3	0	0	0
25	Dog walking	0	0	0	0	0	0
25	Dog walking	0	0	0	3	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
25	Dog walking	0	0	0	0	0	0
25	Dog walking	0	0	0	3	0	0
25	Dog walking	0	0	3	0	0	0
25	Dog walking	0	0	0	0	0	0
25	Dog walking	0	0	0	1.5	0	0
25	Dog walking	0	0	1.5	0	0	0
196	Dog walking	0	0	0	0	0	0
196	Dog walking	0	0	0	1.5	0	0
196	Dog walking	0	0	1.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
197	Dog walking	0	0	0	294	0	0
198	Dog walking	0	0	12.5	0	0	0
198	Dog walking	0	0	0.5	0	0	0
198	Dog walking	0	0	0.5	0	0	0
199	Dog walking	0	0	0	3	0	0
199	Dog walking	0	0	0	3	0	0
200	Dog walking	0	0	0	3	0	0
200	Dog walking	0	0	2	0	0	0
200	Dog walking	0	0	0	2	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
201	Dog walking	0	0	0	2	0	0
201	Dog walking	0	0	2	0	0	0
202	Dog walking	0	0	8	0	0	0
203	Dog walking	0	0	0	1	0	0
203	Dog walking	0	0	0	1	0	0
205	Dog walking	0	0	1	0	0	0
205	Dog walking	0	1.75	1.75	0	0	0
205	Dog walking	0	1.75	1.75	0	0	0
8	Dog walking	0	1.75	1.75	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
8	Dog walking	0	1.75	1.75	0	0	0
8	Dog walking	0	0	14	0	0	0
8	Dog walking	0	0	14	0	0	0
26	Dog walking	0	0	0	10.5	0	0
26	Dog walking	0	0	10.5	0	0	0
26	Dog walking	0	0	36	0	0	0
2228	Dog walking	0	0	36	0	0	0
2228	Dog walking	0	0	104	0	0	0
2228	Dog walking	0	0	104	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
2228	Dog walking	0	0	14	0	0	0
2231	Dog walking	0	0	14	0	0	0
2231	Dog walking	0	0	0.5	0	0	0
2232	Dog walking	0	0	2	0	0	0
2232	Dog walking	0	0	1.5	0	0	0
35	Farming	0	52	0	0	0	0
35	Farming	0	26	0	0	0	0
35	Fishing	0	0	0	42	0	0
35	Fishing	0	0	0	0	0	42
35	Fishing	0	0	1	0	0	1
35	Fishing	0	0	0	0	0	2

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
35	Fishing	0	0	8	0	0	0
35	Fishing	0	0	1	0	0	1
35	Fishing	0	0	0	0	0	1
35	Fishing	0	0	0	0	0	6
35	Fishing	0	0	0	0	0	6
35	Fishing	0	0	39	0	0	0
9	Fishing	0	0	156	0	0	0
36	Fishing	0	0	0	0	0	3
36	Fishing	0	0	0	42	0	0
36	Fishing	0	0	42	0	0	0
36	Fishing	0	0	24	0	0	0
37	Fishing from shore	0	0	0	0	0	42

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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	Fishing from shore	0	0	0	0	0	39
37	Fishing from shore	0	0	0	0	0	4
37	Fishing from shore	0	0	0	0	0	52
37	Fixing moorings	5	0	0	0	0	0
37	Paddling	0	0	2	0	0	0
37	Paddling	0	0	2	0	0	0
37	Paddling	0	0	3.5	0	0	0
38	Paddling	0	0	1.5	0	0	0
38	Paddling	0	0	1.5	0	0	0
38	Paddling	0	0	12	0	0	0
38	Paddling	0	0	12	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
38	Paddling	0	0	5	0	0	0
38	Paddling	0	0	3	0	0	0
38	Paddling	0	0	0	6	0	0
39	Paddling	0	0	3.5	0	0	0
39	Paddling	0	0	1.5	0	0	0
39	Paddling	0	0	3	0	0	0
39	Paddling	0	0	0.25	0	0	0
39	Paddling	0	0	1	0	0	0
39	Paddling	0	0	0.25	0	0	0
39	Paddling	0	0	2	0	0	0
39	Paddling	0	0	1.66	0	0	0
39	Paddling	0	0	1.33	0	0	0
39	Paddling	0	0	1.33	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
10	Paddling	0	0	2	0	0	0
408	Paddling	0	0	0.25	0	0	0
408	Paddling	0	0	0.25	0	0	0
409	Paddling	0	0	0.25	0	0	0
411	Paddling	0	0	0.25	0	0	0
411	Paddling	0	0	13	0	0	0
411	Paddling	0	0	1	0	0	0
411	Paddling	0	0	0.33	0	0	0
411	Paddling	0	0	0.33	0	0	0
411	Paddling	0	0	0.33	0	0	0
412	Paddling	0	0	3	0	0	0
412	Paddling	0	0	3	0	0	0
412	Paddling	0	0	3	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
412	Paddling	0	0	0	6	0	0
412	Paddling	0	0	2	0	0	0
412	Paddling	0	0	6.5	0	0	0
415	Paddling	0	0	6.5	0	0	0
415	Paddling	0	0	1.5	0	0	0
416	Paddling	0	0	1.5	0	0	0
416	Paddling	0	0	1.5	0	0	0
416	Paddling	0	0	1.12	0	0	0
416	Paddling	0	0	0	1.12	0	0
416	Paddling	0	0	1.12	0	0	0
416	Paddling	0	0	0	1.12	0	0
416	Paddling	0	0	1.12	0	0	0
416	Paddling	0	0	0.48	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
416	Paddling	0	0	1.5	0	0	0
416	Paddling	0	0	1.5	0	0	0
416	Paddling	0	0	1.5	0	0	0
416	Paddling	0	0	1.5	0	0	0
420	Paddling	0	0	1.5	0	0	0
421	Paddling	0	0	1.5	0	0	0
421	Paddling	0	0	6.5	0	0	0
421	Paddling	0	0	6.5	0	0	0
422	Paddling	0	0	5	0	0	0
422	Paddling	0	0	0	5	0	0
422	Paddling	0	0	0	13	0	0
423	Paddling	0	0	13	0	0	0
423	Paddling	0	0	6	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
423	Paddling	0	0	7.98	0	0	0
424	Paddling	0	0	3	0	0	3
424	Paddling	0	0	6	0	0	0
424	Paddling	0	0	80.4	0	0	0
425	Paddling	0	0	80.4	0	0	0
425	Paddling	0	0	1.33	0	0	0
425	Paddling	0	0	1.16	0	0	0
436	Paddling	0	0	3.5	0	0	0
436	Paddling	0	0	3	0	0	0
436	Paddling	0	0	3	0	0	0
436	Paddling	0	0	3	0	0	0
436	Paddling	0	0	0.33	0	0	0
437	Paddling	0	0	0.25	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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	Paddling	0	0	1.12	0	0	0
439	Paddling	0	0	1.12	0	0	0
439	Paddling	0	0	0	1.12	0	0
439	Paddling	0	0	0.48	0	0	0
439	Paddling	0	0	24	0	0	0
439	Paddling	0	0	0.25	0	0	0
440	Paddling	0	0	0.17	0	0	0
440	Paddling	0	0	1.5	0	0	0
440	Paddling	0	0	3.25	0	0	0
440	Paddling	0	0	80.4	0	0	0
440	Paddling	0	0	80.4	0	0	0
440	Paddling	0	0	80.4	0	0	0
441	Paddling	0	0	80.4	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
441	Paddling	0	0	6	0	0	0
441	Paddling	0	0	6	0	0	0
441	Paddling	0	0	3	0	0	3
441	Paddling	0	0	7.98	0	0	0
441	Paddling	0	0	1.33	0	0	0
444	Paddling	0	0	1.33	0	0	0
444	Paddling	0	0	3.5	0	0	0
444	Paddling	0	0	1.5	0	0	0
444	Paddling	0	0	0.25	0	0	0
445	Paddling	0	0	0.25	0	0	0
445	Paddling	0	0	0	5	0	0
450	Paddling	0	0	0	13	0	0
451	Paddling	0	0	5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
451	Paddling	0	0	13	0	0	0
451	Paddling	0	0	0.17	0	0	0
451	Paddling	0	0	0.5	0	0	0
453	Paddling	0	0	1	0	0	0
453	Paddling	0	0	2	0	0	0
453	Paddling	0	0	1.5	0	0	0
453	Paddling	0	0	0.25	0	0	0
51	Paddling	0	0	0.25	0	0	0
51	Paddling	0	0	1.12	0	0	0
457	Paddling	0	0	1.5	0	0	0
457	Paddling	0	3.5	3.5	0	0	0
458	Paddling	0	3.5	3.5	0	0	0
52	Paddling	0	0	0.25	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
52	Paddling	0	0	9.75	0	0	0
52	Paddling	0	0	9.75	0	0	0
52	Paddling	0	0	24	0	0	0
52	Paddling	0	0	12	0	0	0
52	Paddling	0	0	12	0	0	0
52	Paddling	0	0	5	0	0	0
52	Playing	0	0	4	0	0	0
467	Playing	0	0	4	0	0	0
471	Playing	0	0	4	0	0	0
53	Playing	0	0	4	0	0	0
53	Playing	0	0	1	0	0	0
53	Playing	0	0	7	0	0	0
53	Playing	0	0	7	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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	Playing	0	0	12	0	0	0
53	Playing	0	0	12	0	0	0
11	Playing	0	0	1	0	0	0
11	Playing	0	0	12	0	0	0
11	Playing	0	0	5	0	0	0
56	Playing	0	0	7	0	0	0
56	Playing	0	0	2	0	0	0
506	Playing	0	0	2	0	0	0
507	Playing	0	0	3.5	0	0	0
507	Playing	0	0	3.5	0	0	0
507	Playing	0	0	1.5	0	0	0
507	Playing	0	0	1.5	0	0	0
507	Playing	0	0	7.98	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
509	Playing	0	0	6	0	0	0
509	Playing	0	0	3	0	0	3
509	Playing	0	0	6	0	0	0
510	Playing	0	0	80.4	0	0	0
510	Playing	0	0	80.4	0	0	0
510	Playing	0	0	4	0	0	0
513	Playing	0	0	1.33	0	0	0
513	Playing	0	0	1.16	0	0	0
513	Playing	0	0	6	0	0	0
57	Playing	0	0	1	0	0	0
516	Playing	0	0	3.5	0	0	0
516	Playing	0	0	1	0	0	0
517	Playing	0	0	0.66	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
517	Playing	0	0	70	0	0	0
518	Playing	0	0	5	0	0	0
518	Playing	0	0	19.5	0	0	0
519	Playing	0	0	0	6	0	0
519	Playing	0	0	0	24	0	0
523	Playing	0	0	80.4	0	0	0
523	Playing	0	0	80.4	0	0	0
524	Playing	0	0	80.4	0	0	0
524	Playing	0	0	80.4	0	0	0
524	Playing	0	0	6	0	0	0
58	Playing	0	0	6	0	0	0
58	Playing	0	0	7.98	0	0	0
58	Playing	0	0	3	0	0	3

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
527	Playing	0	0	4	0	0	0
527	Playing	0	0	6	0	0	0
527	Playing	0	0	2	0	0	0
527	Playing	0	0	1.33	0	0	0
531	Playing	0	0	1.66	0	0	0
532	Playing	0	0	1.33	0	0	0
534	Playing	0	0	1.33	0	0	0
534	Playing	0	0	2	0	0	0
535	Playing	0	0	1.33	0	0	0
535	Playing	0	0	3.5	0	0	0
59	Playing	0	0	70	0	0	0
59	Playing	0	0	19.5	0	0	0
59	Playing	0	0	19.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
59	Playing	0	0	0	24	0	0
59	Playing	0	0	0	6	0	0
536	Playing	0	0	5	0	0	0
536	Playing	0	0	5	0	0	0
538	Playing	0	0	5	0	0	0
538	Playing	0	0	5	0	0	0
538	Playing	0	0	7	0	0	0
60	Playing	0	0	7	0	0	0
61	Playing	0	0	2	0	0	0
61	Playing	0	0	2	0	0	0
61	Playing	0	0	1.5	0	0	0
61	Playing	0	0	1.5	0	0	0
61	Playing	0	0	1.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
61	Playing	0	0	1.5	0	0	0
61	Playing	0	0	1.5	0	0	0
61	Playing	0	0	1.5	0	0	0
61	Playing	0	0	0.66	0	0	0
61	Playing	0	0	1	0	0	0
61	Playing	0	0	12	0	0	0
61	Playing	0	0	12	0	0	0
564	Playing	0	0	5	0	0	0
564	Playing	0	0	12	0	0	0
564	Playing	0	0	1	0	0	0
564	Playing	0	0	1	0	0	0
565	Playing	0	0	1	0	0	0
565	Research/ education	0	12	0	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
565	Rock pooling	0	0	0	3.2	0	0
565	Rock pooling	0	0	0	0.32	0	0
62	Rock pooling	0	0	0	0.32	0	0
62	Rock pooling	0	0	0.66	0	0	0
62	Rock pooling	0	0	0.66	0	0	0
62	Rock pooling	0	0	7.92	0	0	0
62	Rock pooling	0	0	7.92	0	0	0
62	Rock pooling	0	0	7.92	0	0	0
566	Rock pooling	0	0	0.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
566	Rock pooling	0	0	0	1.12	0	0
566	Rock pooling	0	0	1.12	0	0	0
566	Rock pooling	0	0	14	0	0	0
63	Rock pooling	0	0	0	12	0	0
64	Rock pooling	0	0	0	0	0	1
64	Rock pooling	0	0	2	0	0	0
64	Rock pooling	0	0	0	3	0	0
65	Rock pooling	0	0	0	3	0	0
65	Rock pooling	0	0	2	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
65	Rock pooling	0	0	0	0	0	1
65	Rock pooling	0	0	0.5	0	0	0
65	Rock pooling	0	0	0.5	0	0	0
65	Rock pooling	0	0	0.5	0	0	0
65	Rock pooling	0	0	7.92	0	0	0
12	Rock pooling	0	0	7.92	0	0	0
12	Rock pooling	0	0	7.92	0	0	0
66	Rock pooling	0	0	0	0.32	0	0
606	Rock pooling	0	0	0	0.32	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
606	Rock pooling	0	0	0	0.32	0	0
607	Rock pooling	0	0	0.66	0	0	0
607	Rock pooling	0	0	0.66	0	0	0
607	Rock pooling	0	0	0	1.12	0	0
607	Rock pooling	0	0	1.12	0	0	0
607	Rock pooling	0	0	1.12	0	0	0
607	Rock pooling	0	0	0	1.12	0	0
607	Rock pooling	0	0	14	0	0	0
608	Sea Angling	0	30	0	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
608	Sea Angling	0	0	30	0	0	0
608	Sea Angling	0	0	0	0	0	12
608	Sea Angling	0	0	0	0	0	12
608	Sea Angling	0	0	0	0	0	12
608	Sea Angling	0	3	0	0	0	0
608	Sitting/picnicking/BBQ	0	0	1	0	0	0
609	Sitting/picnicking/BBQ	0	0	12	0	0	0
609	Sitting/picnicking/BBQ	0	0	5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
609	Sitting/picnicking/BBQ	0	0	14	0	0	0
609	Sitting/picnicking/BBQ	0	0	3	0	0	0
609	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
609	Sitting/picnicking/BBQ	0	0	60	0	0	0
609	Sitting/picnicking/BBQ	0	0	3	0	0	0
609	Sitting/picnicking/BBQ	0	0	18	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
611	Sitting/picnicking/BBQ	0	0	0	1	0	0
611	Sitting/picnicking/BBQ	0	0	1	0	0	0
611	Sitting/picnicking/BBQ	0	0	14	0	0	0
611	Sitting/picnicking/BBQ	0	0	14	0	0	0
611	Sitting/picnicking/BBQ	0	0	4	0	0	0
611	Sitting/picnicking/BBQ	0	0	12	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
612	Sitting/picnicking/BBQ	0	0	12	0	0	0
612	Sitting/picnicking/BBQ	0	0	3	0	0	3
612	Sitting/picnicking/BBQ	0	0	80.4	0	0	0
612	Sitting/picnicking/BBQ	0	0	1.16	0	0	0
612	Sitting/picnicking/BBQ	0	0	1.34	0	0	0
613	Sitting/picnicking/BBQ	0	0	30	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
613	Sitting/picnicking/BBQ	0	0	1.5	0	0	0
613	Sitting/picnicking/BBQ	0	0	0	0	0	0
613	Sitting/picnicking/BBQ	0	0	31.2	0	0	0
614	Sitting/picnicking/BBQ	0	0	31.2	0	0	
614	Sitting/picnicking/BBQ	0	0	12	0	0	0
614	Sitting/picnicking/BBQ	0	0	18	0	0	18

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
614	Sitting/picnicking/BBQ	0	0	10	0	0	0
614	Sitting/picnicking/BBQ	0	0	13	0	0	0
614	Sitting/picnicking/BBQ	0	0	1.5	0	0	0
614	Sitting/picnicking/BBQ	0	0	80.4	0	0	0
614	Sitting/picnicking/BBQ	0	0	80.4	0	0	0
615	Sitting/picnicking/BBQ	0	0	80.4	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
615	Sitting/picnicking/BBQ	0	0	80.4	0	0	0
615	Sitting/picnicking/BBQ	0	0	7.98	0	0	0
67	Sitting/picnicking/BBQ	0	0	6	0	0	0
67	Sitting/picnicking/BBQ	0	0	6	0	0	0
67	Sitting/picnicking/BBQ	0	0	3	0	0	3
67	Sitting/picnicking/BBQ	0	0	1.34	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
67	Sitting/picnicking/BBQ	0	0	2	0	0	0
616	Sitting/picnicking/BBQ	0	0	1.66	0	0	0
616	Sitting/picnicking/BBQ	0	0	1.34	0	0	0
616	Sitting/picnicking/BBQ	0	0	1.34	0	0	0
617	Sitting/picnicking/BBQ	0	0	2	0	0	0
617	Sitting/picnicking/BBQ	0	0	1.33	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
617	Sitting/picnicking/BBQ	0	0	13	0	0	0
620	Sitting/picnicking/BBQ	0	0	13	0	0	0
620	Sitting/picnicking/BBQ	0	0	10	0	0	0
620	Sitting/picnicking/BBQ	0	0	2.4	0	0	0
621	Sitting/picnicking/BBQ	0	0	3	0	0	0
621	Sitting/picnicking/BBQ	0	0	2.4	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
621	Sitting/picnicking/BBQ	0	0	2.4	0	0	0
622	Sitting/picnicking/BBQ	0	0	1	0	0	0
622	Sitting/picnicking/BBQ	0	0	1	0	0	0
622	Sitting/picnicking/BBQ	0	0	1	0	0	0
622	Sitting/picnicking/BBQ	0	0	3	0	0	0
622	Sitting/picnicking/BBQ	0	0	0	6	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
622	Sitting/picnicking/BBQ	0	0	0	98	0	0
623	Sitting/picnicking/BBQ	0	0	98	0	0	0
68	Sitting/picnicking/BBQ	0	0	2	0	0	0
68	Sitting/picnicking/BBQ	0	0	3	0	0	0
656	Sitting/picnicking/BBQ	0	0	3	0	0	0
656	Sitting/picnicking/BBQ	0	0	1	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
656	Sitting/picnicking/BBQ	0	0	1	0	0	0
656	Sitting/picnicking/BBQ	0	0	6	0	0	0
656	Sitting/picnicking/BBQ	0	0	0	0.32	0	0
656	Sitting/picnicking/BBQ	0	0	0	0.32	0	0
656	Sitting/picnicking/BBQ	0	0	0	0.32	0	0
656	Sitting/picnicking/BBQ	0	0	4.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
656	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
656	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
657	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
657	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
657	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
658	Sitting/picnicking/BBQ	0	0	0.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
658	Sitting/picnicking/BBQ	0	0	0	0.5	0	0
658	Sitting/picnicking/BBQ	0	0	2.24	0	0	0
658	Sitting/picnicking/BBQ	0	0	5	0	0	0
658	Sitting/picnicking/BBQ	0	0	60	0	0	0
658	Sitting/picnicking/BBQ	0	0	0	27	0	0
658	Sitting/picnicking/BBQ	0	0	5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
658	Sitting/picnicking/BBQ	0	0	4	0	0	0
658	Sitting/picnicking/BBQ	0	0	4	0	0	0
658	Sitting/picnicking/BBQ	0	0	12	0	0	0
658	Sitting/picnicking/BBQ	0	0	3	0	0	0
658	Sitting/picnicking/BBQ	0	0	12	0	0	0
659	Sitting/picnicking/BBQ	0	0	1	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
659	Sitting/picnicking/BBQ	0	0	1	0	0	0
659	Sitting/picnicking/BBQ	0	0	1	0	0	0
659	Sitting/picnicking/BBQ	0	0	0	6	0	0
659	Sitting/picnicking/BBQ	0	0	1	0	0	0
659	Sitting/picnicking/BBQ	0	0	0	98	0	0
659	Sitting/picnicking/BBQ	0	0	98	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
659	Sitting/picnicking/BBQ	0	0	0	0.32	0	0
659	Sitting/picnicking/BBQ	0	0	0	0.32	0	0
659	Sitting/picnicking/BBQ	0	0	0	0.32	0	0
660	Sitting/picnicking/BBQ	0	0	1	0	0	0
660	Sitting/picnicking/BBQ	0	0	0	1	0	0
660	Sitting/picnicking/BBQ	0	0	0	1	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
660	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
660	Sitting/picnicking/BBQ	0	0	4.5	0	0	0
660	Sitting/picnicking/BBQ	0	0	1	0	0	0
660	Sitting/picnicking/BBQ	0	0	6	0	0	0
660	Sitting/picnicking/BBQ	0	0	6	0	0	0
660	Sitting/picnicking/BBQ	0	0	7.98	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
660	Sitting/picnicking/BBQ	0	0	80.4	0	0	0
661	Sitting/picnicking/BBQ	0	0	1.5	0	0	0
661	Sitting/picnicking/BBQ	0	0	4	0	0	0
661	Sitting/picnicking/BBQ	0	0	12	0	0	0
661	Sitting/picnicking/BBQ	0	0	0.5	0	0	0
661	Sitting/picnicking/BBQ	0	0	0	0.5	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
661	Sitting/picnicking/BBQ	0	0	2.24	0	0	0
661	Sitting/picnicking/BBQ	0	0	0	27	0	0
661	Sitting/picnicking/BBQ	0	0	6	0	0	0
661	Sitting/picnicking/BBQ	0	0	2	0	0	0
661	Sitting/picnicking/BBQ	0	0	0	1	0	0
670	Sitting/picnicking/BBQ	0	0	30	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
670	Sitting/picnicking/BBQ	0	0	3	0	0	0
670	Sitting/picnicking/BBQ	0	0	3	0	0	0
671	Sitting/picnicking/BBQ	0	0	3	0	0	0
671	Sitting/picnicking/BBQ	0	0	5	0	0	0
671	Sunbathing	0	0	2	0	0	0
672	Sunbathing	0	0	2	0	0	0
672	Sunbathing	0	0	8	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
672	Sunbathing	0	0	0	0.5	0	0
672	Sunbathing	0	0	1	0	0	0
672	Sunbathing	0	0	1	0	0	0
672	Sunbathing	0	0	1.98	0	0	0
672	Sunbathing	0	0	2	0	0	0
672	Sunbathing	0	0	2	0	0	0
672	Sunbathing	0	0	2	0	0	0
672	Sunbathing	0	0	0	0.5	0	0
672	Sunbathing	0	0	1	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
672	Sunbathing	0	0	1	0	0	0
672	Sunbathing	0	0	17.5	0	0	0
672	Sunbathing	0	0	17.5	0	0	0
673	Walking	0	0	0.5	0	0	0
673	Walking	0	0	5	0	0	0
673	Walking	0	0	36	0	0	0
673	Walking	0	0	90	90	0	0
673	Walking	0	0	36	0	0	0
673	Walking	0	0	365	0	0	0
673	Walking	0	0	48	0	0	0
673	Walking	0	0	15	0	0	0
673	Walking	0	0	26	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
673	Walking	0	0	26	0	0	0
673	Walking	0	0	36	0	0	0
673	Walking	0	0	0.5	0	0	0
673	Walking	0	0	0	70	0	0
673	Walking	0	0	48	0	0	0
73	Walking	0	0	365	0	0	0
73	Walking	0	0	48	0	0	0
73	Walking	0	0	365	0	0	0
677	Walking	0	0	52	0	0	0
677	Walking	0	0	52	0	0	0
677	Walking	0	0	0.5	0	0	0
677	Walking	0	0	4.5	0	0	0
677	Walking	0	0	4.5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
678	Walking	0	0	4.5	0	0	0
678	Walking	0	0	104	0	0	0
678	Walking	0	0	6	0	0	0
678	Walking	0	0	6	0	0	0
678	Walking	0	0	26	0	0	0
678	Walking	0	0	0	1.5	0	0
679	Walking	0	0	1.5	0	0	0
679	Walking	0	0	1.5	0	0	0
679	Walking	0	0	1.5	0	0	0
679	Walking	0	0	13	0	0	0
679	Walking	0	0	13	0	0	0
679	Walking	0	0	0	1	0	0
679	Walking	0	0	2	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
74	Walking	0	0	2	0	0	0
74	Walking	0	0	15	0	0	0
13	Walking	0	0	2	0	0	0
13	Walking	0	0	0	22.5	0	0
707	Walking	0	0	78	0	0	0
707	Walking	0	0	0	78	0	0
708	Walking	0	0	22.5	0	0	0
708	Walking	0	0	24	0	0	0
709	Walking	0	0	24	0	0	0
709	Walking	0	0	24	0	0	0
709	Walking	0	0	0	1.5	0	0
709	Walking	0	0	4	0	0	0
709	Walking	0	0	1	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
709	Walking	0	0	20	0	0	20
709	Walking	0	0	0	3	0	0
709	Walking	0	0	0.66	0	0	0
709	Walking	0	0	1	0	0	0
709	Walking	0	0	12	0	0	0
709	Walking	0	0	12	0	0	0
709	Walking	0	0	36	0	0	0
709	Walking	0	0	2.31	0	0	0
709	Walking	0	0	2.31	0	0	0
709	Walking	0	0	0	2.31	0	0
709	Walking	0	0	2	0	0	0
709	Walking	0	0	0	2	0	0
709	Walking	0	0	2	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
710	Walking	0	0	14	0	0	0
710	Walking	0	0	90	90	0	0
710	Walking	0	0	104	0	0	0
710	Walking	0	0	0	0.5	0	0
710	Walking	0	0	36	0	0	0
710	Walking	0	0	0	70	0	0
710	Walking	0	0	0	48	0	0
710	Walking	0	0	7	0	0	0
710	Walking	0	0	0	1	0	0
710	Walking	0	0	6	0	0	0
710	Walking	0	7	0	0	0	0
710	Walking	0	0	0	1.5	0	0
710	Walking	0	0	4	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
710	Walking	0	0	4	0	0	0
710	Walking	0	0	4	0	0	0
710	Walking	0	0	4	0	0	0
711	Walking	0	0	4	0	0	0
711	Walking	0	0	1	0	0	0
711	Walking	0	0	2	0	0	0
711	Walking	0	0	0	0	0	0
711	Walking	0	0	6	0	0	0
711	Walking	0	0	0	1	0	0
711	Walking	0	7	0	0	0	0
711	Walking	0	7	0	0	0	0
712	Walking	0	7	0	0	0	0
712	Walking	0	0	5	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
712	Walking	0	0	5	0	0	0
712	Walking	0	0	5	0	0	0
714	Walking	0	0	0	1.5	0	0
714	Walking	0	0	1.5	0	0	0
715	Walking	0	0	1.5	0	0	0
716	Walking	0	0	1.5	0	0	0
716	Walking	0	0	0	78	0	0
718	Walking	0	0	78	0	0	0
718	Walking	0	0	0	22.5	0	0
718	Walking	0	0	22.5	0	0	0
718	Walking	0	0	1.5	0	0	0
720	Walking	0	0	1.5	0	0	0
721	Walking	0	0	24	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
722	Walking	0	0	24	0	0	0
722	Walking	0	0	24	0	0	0
722	Walking	0	0	0	1	0	0
724	Walking	0	0	2	0	0	0
724	Walking	0	0	2	0	0	0
724	Walking	0	0	1	0	0	0
725	Walking	0	0	1	0	0	0
725	Walking	0	0	1	0	0	0
725	Walking	0	0	1	0	0	0
726	Walking	0	0	1	0	0	0
726	Walking	0	0	1	0	0	0
726	Walking	0	0	2.31	0	0	0
727	Walking	0	0	0	2.31	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
727	Walking	0	0	2.31	0	0	0
727	Walking	0	0	2.31	0	0	0
727	Walking	0	0	2.31	0	0	0
727	Walking	0	0	0	2.31	0	0
728	Walking	0	0	0	2	0	0
728	Walking	0	0	2	0	0	0
728	Walking	0	0	2	0	0	0
728	Walking	0	0	14	0	0	0
728	Walking	0	0	0	3	0	0
736	Walking	0	0	0	3	0	0
736	Walking	0	0	0	3	0	0
736	Walking	0	0	0	3	0	0
740	Walking	0	0	0	3	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
14	Walking	0	0	36	0	0	0
14	Walking	0	0	12	0	0	0
894	Walking	0	0	36	0	0	0
894	Walking	0	0	12	0	0	0
95	Walking	0	0	12	0	0	0
15	Walking	0	0	36	0	0	0
15	Walking	0	0	0	3	0	0
15	Walking	0	0	12	0	0	0
96	Walking	0	0	36	0	0	0
96	Walking	0	0	36	0	0	0
96	Walking	0	0	36	0	0	0
96	Walking	0	0	12	0	0	0
96	Walking	0	0	12	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
96	Walking	0	0	12	0	0	0
906	Walking	0	0	12	0	0	0
906	Walking	0	0	36	0	0	0
906	Walking	0	0	7	0	0	0
906	Walking	0	0	0	70	0	0
906	Walking	0	0	6	0	0	0
906	Walking	0	0	6	0	0	0
97	Walking	0	0	0.66	0	0	0
97	Walking	0	0	1	0	0	0
97	Walking	0	0	2	0	0	0
97	Walking	0	0	0.5	0	0	0
97	Wildfowling	0	86	0	0	0	0

Observation number	Intertidal activities	Occupancy on mud (h y^{-1})	Occupancy on saltmarsh (h y^{-1})	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})
97	Wildfowling	0	8	0	0	0	0
97	Wildfowling	0	8	0	0	0	0
97	Wildfowling	0	24	0	0	0	0
1005	Wildfowling	69	69	0	0	0	0

Table A1.17 Phase 1 child intertidal activities

Observation number	Intertidal activities	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})
675	Beachcombing	5	0	0	0
733	Beachcombing	36	0	0	0
732	Beachcombing	0	195	0	0
731	Beachcombing	0	195	0	0

Observation number	Intertidal activities	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})
730	Beachcombing	2.31	0	0	0
719	Beachcombing	4	0	0	0
569	Beachcombing	17.16	0	0	0
568	Beachcombing	5	0	0	0
567	Beachcombing	0	2.31	0	0
676	Beachcombing	2.31	0	0	0
676	Beachcombing	2.31	0	0	0
734	Beachcombing	0	2.31	0	0
675	Beachcombing	2.31	0	0	0
674	Beachcombing	0	455	0	0
675	Beachcombing	0	455	0	0
674	Beachcombing	5	0	0	0
674	Beachcombing	0.5	0	0	0
432	Beachcombing	2.31	0	0	0

Observation number	Intertidal activities	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})
431	Beachcombing	17.16	0	0	0
430	Beachcombing	17.16	0	0	0
429	Beachcombing	36	0	0	0
428	Beachcombing	2.31	0	0	0
427	Beachcombing	4	0	0	0
426	Beachcombing	4	0	0	0
676	Beachcombing	36	0	0	0
737	Beachcombing	4	0	0	0
741	Beachcombing	4	0	0	0
739	Beachcombing	4	0	0	0
738	Beachcombing	4	0	0	0
743	Beachcombing	0	2.31	0	0
743	Beachcombing	17.16	0	0	0
741	Beachcombing	17.16	0	0	0

Observation number	Intertidal activities	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})
619	Beachcombing	1.25	0	0	0
735	Beachcombing	17.16	0	0	0
674	Bird/Nature watching	1	0	0	0
676	Crabbing	0	0.77	0	0
407	Crabbing	0	0.77	0	0
676	Crabbing	0.77	0	0	0
676	Crabbing	0.77	0	0	0
674	Crabbing	0	0.77	0	0
675	Crabbing	0	0	0	3
675	Crabbing	0.77	0	0	0
674	Crabbing	0.77	0	0	0
675	Crabbing	0.77	0	0	0
1006	Crabbing	0.77	0	0	0
719	Dog walking	16	0	0	0

Observation number	Intertidal activities	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})
539	Dog walking	104	0	0	0
1008	Dog walking	104	0	0	0
1006	Dog walking	0.5	0	0	0
619	Dog walking	1	0	0	0
1008	Dog walking	10.5	0	0	0
1006	Dog walking	16	0	0	0
676	Dog walking	16	0	0	0
676	Fishing	0	0	0	1
738	Fishing	0	0	0	3
413	Fishing	0	0	0	2
676	Paddling	1.12	0	0	0
675	Paddling	9.75	0	0	0
452	Paddling	7.98	0	0	0
413	Paddling	3	0	0	3

Observation number	Intertidal activities	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})
675	Paddling	3.5	0	0	0
525	Paddling	0.25	0	0	0
449	Paddling	24	0	0	0
674	Paddling	12	0	0	0
675	Paddling	0.33	0	0	0
417	Paddling	0.33	0	0	0
418	Paddling	0	1.12	0	0
418	Paddling	0	1.12	0	0
418	Paddling	1.12	0	0	0
417	Paddling	1.12	0	0	0
732	Paddling	1.12	0	0	0
1008	Paddling	0.5	0	0	0
733	Paddling	0.33	0	0	0
731	Paddling	1	0	0	0

Observation number	Intertidal activities	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})
737	Paddling	1.12	0	0	0
1008	Paddling	0.25	0	0	0
1012	Paddling	3.5	0	0	0
520	Paddling	1.12	0	0	0
567	Paddling	0	1.12	0	0
521	Paddling	9.75	0	0	0
674	Paddling	3	0	0	3
719	Paddling	80.4	0	0	0
418	Paddling	6	0	0	0
735	Paddling	6	0	0	0
569	Paddling	6	0	0	0
619	Paddling	6	0	0	0
734	Paddling	80.4	0	0	0
568	Paddling	9.75	0	0	0

Observation number	Intertidal activities	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})
417	Paddling	9.75	0	0	0
674	Paddling	7.98	0	0	0
739	Paddling	12	0	0	0
417	Paddling	9.75	0	0	0
730	Paddling	9.75	0	0	0
452	Paddling	0.25	0	0	0
417	Paddling	24	0	0	0
417	Paddling	5	0	0	0
449	Paddling	24	0	0	0
431	Playing	5	0	0	0
418	Playing	1	0	0	0
430	Playing	4	0	0	0
418	Playing	6	0	0	0
429	Playing	7.98	0	0	0

Observation number	Intertidal activities	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})
428	Playing	10	0	0	0
427	Playing	3	0	0	3
418	Playing	4	0	0	0
418	Playing	80.4	0	0	0
432	Playing	108	0	0	0
426	Playing	6	0	0	0
413	Playing	4	0	0	0
521	Playing	4	0	0	0
520	Playing	5	0	0	0
1012	Playing	6	0	0	0
1008	Playing	6	0	0	0
1008	Playing	4	0	0	0
737	Playing	8	0	0	0
738	Playing	3.5	0	0	0

Observation number	Intertidal activities	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})
525	Playing	7.98	0	0	0
413	Playing	3	0	0	3
2230	Playing	3.5	0	0	0
2229	Playing	108	0	0	0
417	Playing	12	0	0	0
739	Playing	108	0	0	0
417	Playing	12	0	0	0
2229	Playing	12	0	0	0
2230	Playing	5	0	0	0
569	Playing	1	0	0	0
568	Playing	12	0	0	0
674	Playing	80.4	0	0	0
539	Playing	4	0	0	0
567	Rock pooling	1.12	0	0	0

Observation number	Intertidal activities	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})
676	Rock pooling	0.5	0	0	0
676	Rock pooling	0	1.12	0	0
675	Rock pooling	2	0	0	0
675	Rock pooling	1.12	0	0	0
674	Rock pooling	0.5	0	0	0
525	Rock pooling	0	0	0	1
4450	Rock pooling	1.12	0	0	0
568	Rock pooling	0	1.12	0	0
674	Rock pooling	0.5	0	0	0
675	Rock pooling	0	1.12	0	0
675	Sitting/picnicking/BBQ	1	0	0	0
675	Sitting/picnicking/BBQ	5	0	0	0
676	Sitting/picnicking/BBQ	0	27	0	0
426	Sitting/picnicking/BBQ	0	27	0	0

Observation number	Intertidal activities	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})
674	Sitting/picnicking/BBQ	60	0	0	0
567	Sitting/picnicking/BBQ	60	0	0	0
676	Sitting/picnicking/BBQ	60	0	0	0
569	Sitting/picnicking/BBQ	3	0	0	3
719	Sitting/picnicking/BBQ	6	0	0	0
730	Sitting/picnicking/BBQ	7.98	0	0	0
731	Sitting/picnicking/BBQ	5	0	0	0
732	Sitting/picnicking/BBQ	5	0	0	0
733	Sitting/picnicking/BBQ	5	0	0	0
734	Sitting/picnicking/BBQ	80.4	0	0	0
676	Sitting/picnicking/BBQ	5	0	0	0
429	Sitting/picnicking/BBQ	5	0	0	0
430	Sitting/picnicking/BBQ	6	0	0	0
452	Sitting/picnicking/BBQ	2.5	0	0	0

Observation number	Intertidal activities	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})
427	Sitting/picnicking/BBQ	12	0	0	0
735	Sitting/picnicking/BBQ	3	0	0	3
449	Sitting/picnicking/BBQ	6	0	0	0
428	Sitting/picnicking/BBQ	7.98	0	0	0
674	Sitting/picnicking/BBQ	6	0	0	0
431	Sitting/picnicking/BBQ	80.4	0	0	0
733	Sitting/picnicking/BBQ	5	0	0	0
1012	Sitting/picnicking/BBQ	1	0	0	0
418	Sitting/picnicking/BBQ	12	0	0	0
731	Sunbathing	17.5	0	0	0
732	Sunbathing	17.5	0	0	0
418	Sunbathing	17.5	0	0	0
2230	Sunbathing	17.5	0	0	0
730	Sunbathing	17.5	0	0	0

Observation number	Intertidal activities	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})
2230	Sunbathing	17.5	0	0	0
2229	Walking	7	0	0	0
2229	Walking	2.31	0	0	0
734	Walking	2.31	0	0	0
735	Walking	2	0	0	2
619	Walking	2	0	0	2
418	Walking	5	0	0	0
417	Walking	5	0	0	0
417	Walking	4	0	0	0
417	Walking	2.31	0	0	0
741	Walking	2.31	0	0	0
417	Walking	0	2.31	0	0
413	Walking	52	0	0	0
739	Walking	4	0	0	0

Observation number	Intertidal activities	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})
413	Walking	52	0	0	0
737	Walking	52	0	0	0
738	Walking	52	0	0	0
418	Walking	2	0	0	0
743	Walking	4	0	0	0
438	Walking	52	0	0	0
452	Walking	4	0	0	0
406	Walking	52	0	0	0
539	Walking	2.31	0	0	0
732	Walking	0	2.31	0	0
730	Walking	0	2.31	0	0
735	Walking	5	0	0	0
731	Walking	2.31	0	0	0
734	Walking	4	0	0	0

Observation number	Intertidal activities	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})
733	Walking	4	0	0	0

Table A1.18 Phase 1 infant intertidal activities

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
1009	Beachcombing	4	0	0
1009	Beachcombing	3	0	0
1009	Beachcombing	0.5	0	0
1009	Beachcombing	0.5	0	0
1009	Beachcombing	0.5	0	0
1009	Beachcombing	0.5	0	0
1010	Beachcombing	0.5	0	0
1010	Beachcombing	0	192	0
1010	Beachcombing	0	195	0
1010	Beachcombing	0	455	0
1010	Beachcombing	0	195	0
1010	Beachcombing	0	455	0
1013	Beachcombing	0.66	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
1013	Beachcombing	1	0	0
1013	Beachcombing	0.66	0	0
410	Beachcombing	1	0	0
414	Dog walking	1.5	0	0
414	Dog walking	0	1.5	0
414	Dog walking	0	0	0
414	Dog walking	0.5	0	0
414	Dog walking	104	0	0
414	Dog walking	104	0	0
419	Dog walking	104	0	0
419	Dog walking	104	0	0
419	Paddling	80.4	0	0
419	Paddling	80.4	0	0
419	Paddling	6	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
419	Paddling	6	0	0
419	Paddling	3	0	3
419	Paddling	7.98	0	0
419	Paddling	1.66	0	0
419	Paddling	1.33	0	0
419	Paddling	1.33	0	0
419	Paddling	2	0	0
433	Paddling	0.25	0	0
433	Paddling	0.25	0	0
442	Paddling	0.25	0	0
442	Paddling	3	0	0
442	Paddling	0.5	0	0
442	Paddling	1.5	0	0
442	Paddling	1.5	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
442	Paddling	1.5	0	0
443	Paddling	1.5	0	0
443	Paddling	12	0	0
443	Paddling	12	0	0
443	Paddling	12	0	0
443	Paddling	12	0	0
443	Paddling	5	0	0
511	Playing	80.4	0	0
511	Playing	80.4	0	0
511	Playing	6	0	0
512	Playing	3	0	3
512	Playing	6	0	0
512	Playing	7.98	0	0
514	Playing	1.66	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
514	Playing	1.33	0	0
514	Playing	2	0	0
522	Playing	1.33	0	0
522	Playing	19.5	0	0
533	Playing	19.5	0	0
610	Playing	0	24	0
610	Playing	0	6	0
610	Playing	5	0	0
610	Playing	7	0	0
610	Playing	1.5	0	0
610	Playing	1.5	0	0
610	Playing	1.5	0	0
610	Playing	1.5	0	0
618	Playing	1.5	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
618	Playing	0.66	0	0
618	Playing	1	0	0
618	Playing	1	0	0
662	Playing	0.66	0	0
662	Playing	12	0	0
662	Playing	12	0	0
662	Playing	12	0	0
662	Playing	12	0	0
662	Playing	5	0	0
662	Rock pooling	0	3	0
662	Rock pooling	0	12	0
662	Sitting/picnicking/BBQ	4.5	0	0
662	Sitting/picnicking/BBQ	4.5	0	0
663	Sitting/picnicking/BBQ	4.5	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
663	Sitting/picnicking/BBQ	4.5	0	0
663	Sitting/picnicking/BBQ	1.5	0	0
663	Sitting/picnicking/BBQ	5	0	0
663	Sitting/picnicking/BBQ	0	27	0
663	Sitting/picnicking/BBQ	0	27	0
663	Sitting/picnicking/BBQ	5	0	0
663	Sitting/picnicking/BBQ	1.5	0	0
663	Sitting/picnicking/BBQ	80.4	0	0
663	Sitting/picnicking/BBQ	80.4	0	0
663	Sitting/picnicking/BBQ	6	0	0
717	Sitting/picnicking/BBQ	7.98	0	0
717	Sitting/picnicking/BBQ	3	0	3
717	Sitting/picnicking/BBQ	6	0	0
717	Sitting/picnicking/BBQ	1.66	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
717	Sitting/picnicking/BBQ	1.34	0	0
729	Sitting/picnicking/BBQ	2	0	0
729	Sitting/picnicking/BBQ	1.33	0	0
742	Sitting/picnicking/BBQ	13	0	0
742	Sitting/picnicking/BBQ	13	0	0
742	Sitting/picnicking/BBQ	1	0	0
744	Sitting/picnicking/BBQ	2.5	0	0
744	Sunbathing	2	0	0
744	Sunbathing	2	0	0
907	Sunbathing	17.5	0	0
907	Walking	8	0	0
907	Walking	0	1	0
907	Walking	1	0	0
907	Walking	1	0	0

Observation number	Intertidal activities	Occupancy on sand (h y^{-1})	Occupancy on sand and stone (h y^{-1})	Occupancy on rock (h y^{-1})
907	Walking	1	0	0
908	Walking	1	0	0
908	Walking	0	48	0
908	Walking	0.66	0	0
908	Walking	1	0	0
908	Walking	1	0	0
908	Walking	0.66	0	0

Table A1.19 Phase 1 adult handling sediment

Observation number	Sum of occupancy (h y^{-1})
7	48
1007	48
1011	15
1014	14
1015	14
1017	0.5
115	16
1097	16
1098	16
1099	16
118	1.75
123	5.83
124	0.25
125	14.8
126	1
128	24.7
129	338
130	42.3
131	677
132	120
133	3.5
19	7.5
1306	3

Observation number	Sum of occupancy (h y^{-1})
1307	4
1308	4
145	42
20	6
147	206
148	1.5
21	14
22	202
173	6
174	2.17
185	1
187	43.2
190	13
192	1.5
193	110
25	5.76
196	5.25
198	13
200	32.8
201	3.25
205	33
8	26
26	1
2228	26

Observation number	Sum of occupancy (h y^{-1})
2231	2
2232	2
35	10.7
36	78
37	44
38	4.5
39	26
409	1.5
411	482
412	482
416	77.9
421	8
422	8
423	8
424	8
425	8
436	7
439	10
440	8.98
441	10
444	3.99
451	7
453	102
51	1

Observation number	Sum of occupancy (h y^{-1})
457	162
458	12
52	36
53	23.8
11	15
507	91.5
509	32.8
510	32.8
513	33
516	5.25
517	5.25
518	5.25
519	5.25
523	13
524	13
58	2
527	10.2
531	1.5
538	1
61	77.9
564	5.83
565	5.83
62	482
566	5.83

Observation number	Sum of occupancy (h y^{-1})
63	1.5
64	8
65	7.48
12	0.5
607	11
608	11
609	14
611	13
612	6
613	202
614	36
615	2.17
67	7
616	3.5
617	3.5
620	1.5
621	2
622	23.8
623	6
68	26
656	1.92
657	1
658	10.7
659	26

Observation number	Sum of occupancy (h y^{-1})
660	16
661	16
670	0.25
671	0.25
672	14.8
673	14.8
73	7
677	1
678	24.7
679	4.5
13	14
709	96
710	12
711	17.5
712	3.5
716	0
718	1.5
722	42
724	3
725	3
726	3
727	14.8
728	14.8
736	120

Observation number	Sum of occupancy (h y^{-1})
740	27
96	3.32
906	3.32
97	12

Table A1.20 Phase 1 child handling sediment

Observation number	Sum of occupancy (h y^{-1})
1008	48
1012	15
2229	26
2230	26
407	3
413	482
417	77.9
418	77.9
426	8
427	8
428	8
429	8
430	8
431	8
432	12
449	7
452	7
520	5.25
521	5.25
525	13
539	1
567	5.83
568	5.83

Observation number	Sum of occupancy (h y^{-1})
569	5.83
619	3.5
674	14.8
675	14.8
676	14.8
719	1.5
730	31.9
731	31.9
732	31.9
733	31.9
734	31.9
735	31.9
737	228
738	228
739	228
741	677
743	677

Table A1.21 Phase 1 infant handling sediment

Observation number	Sum of occupancy (h y^{-1})
1009	48
1010	48
1013	15
410	1.5

Observation number	Sum of occupancy (h y^{-1})
414	482
419	77.9
433	4
442	8.98
443	9.99
511	32.8
512	32.8
514	33
522	5.25
610	14
618	3.5
662	16
663	17.5
717	206
729	5
742	677
744	677
907	3.32
908	3.32

Table A1.22 Phase 1 adult handling equipment

Observation number	Sum of occupancy (h y^{-1})
1016	6
127	63.8
130	221
131	312
146	17.5
23	6
183	41
188	61
190	46.8
191	2080
196	5
197	52
199	1
205	0.5
36	195
420	8.25
444	3
446	3.5
447	3.5
448	3.5
451	1
453	3
459	155

Observation number	Sum of occupancy (h y^{-1})
461	2190
463	1700
465	1
54	11.1
55	19.5
515	1
57	3.25
526	2080
59	370
60	24.8
64	0.33
65	3.75
66	2
70	29.6
720	17.5
721	17.5
722	90
724	11.1
725	11.1
726	11.1
727	19.5
728	19.5
740	312
14	77

Table A1.23 Phase 1 child handling equipment

Observation number	Sum of occupancy (h y^{-1})
406	3.25
413	2
432	0.33
438	2
452	1
738	36
739	36

Table A1.24 Phase 1 infant handling equipment

Observation number	Sum of occupancy (h y^{-1})
414	2
433	0.33
442	1

Appendix A2: 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 no persons operating the detector to be within 5m of 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 $\mu Gy\ h^{-1}$.

For the dose assessment tool, gamma dose rates were converted to Effective Dose ($\mu Sv\ h^{-1}$) 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 A3: Beta skin dosimetry 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 no persons operating the detector to be within 5m of 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: Site descriptions and observations

A4.1 Site descriptions and observations

A4.1.1 Isle of Whithorn to Innerwell

The Isle of Whithorn is a small village situated on a rocky peninsula, based around the harbour (Figure A4.1). The lower intertidal substrate is mud, whilst the upper substrate is rocky with small rocks, seaweed, pebbles and shingle. A slipway is located to the left of the harbour with access via a public car park. A children's play area is located on the coastline beyond the car park and is subject to sea spray.

Figure A4.1 Isle of Whithorn harbour

The harbour is used by both commercial fisherman and leisure craft. Both a sailing and a diving club use a building on the harbour side for equipment storage and function room. Club sailing boats are stored on a hard standing area on the beach area behind the harbour opposite the

club house. Sailing and kayaking takes place in Wigtown Bay off the harbour and several wrecks provide interest for divers. A charter boat launches from the harbour offering fishing and wildlife trips in Wigtown Bay and outwith the survey area.

Within the school holiday survey period, one adult and five children were observed playing/walking, and several boats were resting on the intertidal substrate at Isle of Whithorn Bay. At the Isle of Whithorn harbour, two individuals were fishing off the pier, five adults and one child were fishing off the harbour, one child was crabbing off the harbour, two individuals were fishing off the rocks of the headland and six fishing boats, one tourist boat, four RIB's, four sailing boats and seven motorboats were moored at the harbour.

Outwith the school holiday survey, five fishing boats, four yachts, two motorboats and two RIB's were moored at the Isle of Whithorn harbour. No offshore activity was observed outwith the school holidays. On the Isle of Whithorn Bay two dog walkers and two individuals beachcombing were observed.

Between the Isle of Whithorn and Rigg Bay, access to the shoreline is limited due to rocky cliffs, except for Portyerrock Bay, which provided easy access to a foreshore consisting of rocky and shingle substrates. Rigg Bay is accessible, and the bay consists of a large area of sand with pebbles and small rocks, and the beach is backed with trees. A path follows the coastline from here round towards Garlieston Bay. Within and outwith the school holiday survey periods no activities on or offshore at Portyerrock Bay were observed.

Within the school holiday survey period, one adult and one child were dog walking, and three individuals were using stand-up paddle boards at Rigg Bay. Fifteen individuals were observed walking, playing, paddling, and sunbathing at Rigg Bay however no offshore activities were noted outwith the school holiday survey period. Cows were observed grazing on the saltmarsh at this site.

Continuing to Garlieston Bay, this features a rocky headland on the north side and a working harbour to the south. Around the harbour and town, the lower intertidal substrate is sandy with mud towards the low tide zone, whilst the upper zone consists of sand, pebbles, shingle and vegetation. The shoreline is backed by a stone wall that goes around the town. The harbour is used by both commercial fishers and leisure craft.

Within the school holiday survey period the following were observed: one individual working on a fishing boat, two fishing boats, two kayakers, three sailing boats and five motorboats were moored at Garlieston harbour. Activities observed at Garlieston bay were six adults and two children walking, two adults dog walking, one adult and one infant sitting/picnicking, two stand-up paddle boarders and one individual shore fishing.

Outwith the school holiday survey period Garlieston, harbour (Figure A4.2) observations included three fishing boats and one small yacht moored at the harbour and two dog walkers, five individuals walking and one individual sitting on rocks at Garlieston Bay.

Figure A4.2 Garlieston harbour

Northwards, along the coastline from the town, as far as q Isle, the lower intertidal zone is characterised by sand, stones, and mud. The upper intertidal area is sand, and pebbles backed with grass up to roadside and a seawall with two areas of marshland vegetation. The northern end of the bay is a rocky headland with a coastal path to Innerwell, however there is no easy

access to the shore. No activities were observed onshore or offshore within or outwith the school holiday period at Innerwell.

No spume was observed at any of the sites within this section of coast either within or outwith the school holiday period.

A4.1.2 Innerwell to Carsluith

The coastline between Innerwell to Carsluith consists predominantly of the Crook of Wigtown Bay Local Nature Reserve. Beyond Innerwell, no access to the shore is possible, due to enclosed farmland, until the RSPB Crook of Baldoon reserve. The reserve forms part of the Wigtown Bay local nature reserve which extends around Bladnoch sands, the River Bladnoch, Wigtown Sands, and the Cree estuary.

Figure A4.3 Crook of Baldoon with grazing cows in distance

The coastal section consists of a large area of established saltmarsh closer to the landward side and mudflats on the seaward side (Figure A4.3). There are several well-defined access points to

the nature reserve, including from the car park at RSPB Crook of Baldoon reserve which is reported to be popular with nature watchers, walkers, and dog walkers. However, during the time of the visit, both within and outwith the school holiday period, no activities were observed. Cattle were observed grazing on the saltmarsh at the Crook of Baldoon and towards Creetown Merse, and sheep were observed grazing on Wigtown Merse (Figure A4.4), the merse at Martyrs Stake and Creetown Merse.

Figure A4.4 Section of Wigtown Merse with grazing sheep

At Wigtown harbour, there is a public car park with footpaths leading onto the wetlands behind the coastline. The area around the harbour has been known to flood on very high tides. The harbour has mooring posts for boats and there are two slipways allowing boats to be launched. Steep mud banks do not allow safe access onto the riverbank. Wigtown harbour is not a working harbour, and no boats were observed in the harbour when visited within and outwith the school holiday survey. However, the nearby carpark with access to the Wigtown bird hide via a short

path, was popular with campervans outwith the school holiday period. Access to the saltmarsh beyond the bird hide is restricted due to farmland fencing and drainage channels.

Behind the harbour area, a public footpath along the old railway line allows access to Martyr's Stake and the wider saltmarsh (Figure A4.5), with additional access from a public car park to the Martyr's Stake via a boarded footpath. The coastal path behind Martyr's Stake and the wider saltmarsh was quiet with no activities observed within the school holiday survey period, however the coastal path proved to be popular with dog walkers outwith the school holiday period. Sheep were observed grazing on the saltmarsh near Martyr's Stake during this period.

Figure A4.5 The Merse from Martyr's Stake

Access to the northern section of the reserve, close to the western bank of the River Cree, is restricted due to farmland and drainage channels. No activities were observed offshore in this northern section.

On the eastern bank of the River Cree (south on the A75 past Creetown) no activities were observed within or outwith the school holiday period however sheep were observed grazing on the Creetown Merse outwith the school holiday period.

The coastline from the end of the Creetown saltmarsh to Creetown Old Quay is characterised by mudflats on the lower intertidal areas alongside the river channel, which are covered by high tides. The upper intertidal zone is mud, sand, seaweed, and stones with large boulders closest to the road acting as sea defences in places. Access down to the shore is limited in places due to dense vegetation cover.

Continuing southeast on this section of coast, access to the shore near Carsluith (Figure A4.6), is via a footpath. The intertidal zone consists of mudflats below the low watermark combined with mudflats, sands, pebbles, and seaweed on the upper intertidal area backed with vegetation to the A75. No activities onshore or offshore were observed within or outwith the school holiday survey period.

Between Innerwell and Carsluith, Wigtown Bay forms part of the Wigtown Bay Local Nature Reserve. Wildfowling was reported to occur in this area.

No spume was observed at any of the sites within this section of coast either within or outwith the school holiday period.

Figure A4.6 The Merse at Carsluith

A4.1.3 Carsluith to Islands of Fleet and Carrick Bay

Extending from Carsluith, access is fairly restricted until Mossyard where two holiday parks are located and separated by a rocky headland known as Ringdoo Point. Access to the beach is through the holiday parks either via footpaths or a slipway. The coastline is rocky with a couple of sandy bays. Auchenlarie beach is accessible via the holiday park whilst Ringdoo Point and Mossyard Bay can be accessed via a side road off the A75 and farm track which leads to a public car park behind a sandy bay.

Within the school holiday period, observations were one dog walker on the intertidal substrate, one family playing and walking on the intertidal substrate and one individual swimming. Outwith the school holiday survey period five fishing boats were observed off the rocks by the slip at Auchenlarie beach along with two individuals observed swimming and two individuals kayaking.

Continuing southeast, observations within the school holiday period were three individuals dog walking, one child playing, seven individuals walking and two adults and two children walking on the rocks, four adults and two children sitting and playing and six individuals sitting on the intertidal substrate, and one adult and one child fishing off the rocks. One RIB was offshore. Mossyard beach was very popular outwith the school holiday period with many families sitting/picnicking/BBQ and paddling. One leisure boat was observed offshore.

Fleet Bay is mostly a sandy expanse with mudflats at the head of the bay from Skyreburn Bay (Figure A4.7). The outer area of the bay is a popular holiday destination with several holiday caravan sites. These caravan sites tend to cluster around smaller sandy bays divided by rocky promontories and stretches of inaccessible rocky coastline. At the north end of the bay, two further roadside lay-bys are ringed with mature trees and enable access to the shoreline area. Here, the upper intertidal zone is sandy with a marked boundary of mud and sand where reeds and saltmarsh grasses grow in the mid-intertidal zone. The lower intertidal zone is mud. Large rocks are also present in the area.

Beyond the caravan sites lies Skyreburn Bay, within the school holiday period a large group of three families (six adults, two children and six infants) were beachcombing, two individuals were dog walking, one motorboat sailing offshore and one motorboat (with two adults) was resting on the substrate. No on or offshore activities were observed outwith the school holiday period.

The central part of Skyreburn Bay is bisected by a wide stream with an extensive area of coastal grasses close to the road which gives way to saltmarsh vegetation and then more mudflats.

There is no access around the head of the bay on either sides of the estuary of the River Fleet, with fields being fenced off. The shoreline consists of saltmarsh vegetation and improved grassland up to where the A75 crosses the River Fleet. On the eastern side of the bay, the shoreline is also characterised by a thin saltmarsh extending past Rough Point, behind which there is a thin strip of unimproved grasslands, shrubs and one section of woodland. No farms have been identified that graze animals on the saltmarsh areas. There is no access along the eastern side of Fleet Bay until Airds Bay, Sandgreen. The substrate at Airds Bay and Sandgreen is sandy.

Figure A4.7 Skyreburn Bay

Within the school holiday survey period, Airds Bay was very popular with more than 40 individuals observed sitting/picnicking/BBQ, four individuals walking on the intertidal substrate and rocks, five adults and one child swimming, five adults, two children and one infant paddling, ten children playing, nine dinghies sailing, 14 individuals kayaking, one individual bodyboarding, three adults and two children using stand-up paddle boards, one individual cleaning their boat, and three sailing boats and four motorboats sailing offshore.

Outwith the school holiday survey period, eight dog walkers, nine walkers, and six individuals sitting on rocks were observed at Airds Bay with one individual was launching a boat in the water at Airds Bay.

From Airds Bay the shore is rocky with headlands and sandy bays which can be accessed by foot. Offshore, three small islands (Murray's Isles, Ardwall Isle and Barlocco Isle) are known as the Islands of Fleet.

Figure A4.8 Ardwall Isle

It is possible to walk to Ardwall Isle (Figure A4.8) at low tide. Within the school holiday survey period, several individuals were observed on the island, outwith the school holiday survey period the island was observed to have 20 plus individuals walking on it.

Carrick Bay is a secluded sandy bay with Carrick Point, a rocky promontory, extending out to sea (Figure A4.9). Holiday homes surround the beach area allowing easy access onto the intertidal area. Outwith the school holiday period, a family of five were observed paddling, two adults and four children were sitting/picnicking/BBQ, and two individuals were walking. Three kayaks were resting on the intertidal substrate of the foreshore and two kayakers and four paddleboarders were observed offshore. Within the school holiday period, one sailboat was sailing offshore, one sailboat was moored offshore, and two RIBs were resting on the substrate.

Figure A4.9 Carrick Bay

Extending along the coastline is Carrick beach (Figure A4.10) which is a small sandy beach. The lower intertidal zone extends out to Ardwall Isle and around to Barlocco Isle. A road sign warned that cattle grazed on the coastline but not during July and August. Outwith the school holiday survey period, many families were observed sitting/picnicking/BBQ, two individuals were dog walking, one adult and one infant were playing and a family of five were paddling. Within the school holiday survey period, one sailboat, one RIB, nine kayaks, three dinghies and one boat trailer were resting on the substrate at Carrick beach. No individuals were observed undertaking any activities within the holiday period.

No spume was observed at any of the sites within this section of coast, either within or outwith the school holiday period.

Figure A4.10 Carrick beach

A4.1.4Carrick Bay to Kirkcudbright

The coastline extends from Carrick Bay to Kirkandrews Bay and is relatively rocky with access via fields and open scrubland. Kirkandrews Bay (Figure A4.11) is enclosed by rocky headlands with the lower intertidal zone consisting of several large rocky outcrops, sand, and seaweed. The upper intertidal zone comprises shingle, sand, crushed shells, and seaweed.

The shoreline backs onto scrub and grass with agricultural land behind. Within and outwith the school holiday survey period, no on or offshore activities were observed.

Figure A4.11 Kirkandrews Bay

The following five kilometres of coastline to Brighouse Bay is rocky with no obvious access points due to enclosed farmland. Brighouse Bay is an enclosed sandy bay with rocky headlands and rocky strips along the sides of the bay. The lower intertidal zone is sand whilst closer to the high tide line the shoreline is more shingle with a stream entering the central area of the bay. Close to the caravan site, public toilets and a car park allow easy access to the central sandy area of the bay whilst another footpath follows the coastline before turning inland through a wooded area to the caravan site. The eastern side of the bay has a narrow coastal zone of grasses and scrubland with some houses close to the shoreline. Within the school holiday survey period, seven individuals dog walking, two adults and two children were playing, six individuals walking and one family sitting/picnicking/BBQ were observed. Outwith the school holiday survey period nine dog walkers, four individuals sitting/picnicking/BBQ and two individuals walking were observed on Brighouse Bay.

From Brighouse Bay to the headland at Fox Craig, the coastline continues to be rocky with scrub dominating behind the high tide zone with access to this area limited. While not observed, anglers were reported to walk over farmland to access fishing points in the western coastal area. Ross Bay forms part of the larger Kirkcudbright Bay with a public road allowing easy access and onto the intertidal zone. The lower intertidal zone is sand and mud whilst the upper area consists of rocks with some saltmarsh present. Large boulders have been deposited on the shore in front of the houses to function as sea defences. The head of the bay is covered by saltmarsh vegetation with shrub and farmland behind. No activities were observed within or outwith the school holiday period.

Continuing north from Ross Bay there is no access until reaching Nun Mill Bay (the Dhoon) (Figure A4.12), is situated opposite the tip of St Mary's Isle on the west side. The coastline at Nun Mill Bay forms a small sandy bay with a rocky headland. The bay is easily accessible and outwith the school holiday period three dog walkers and cows on the shore were observed. A large car park and grassy picnic area are immediately behind the beach allowing easy access directly onto the shore. Within the school holiday survey period Nun Mill Bay was popular with more than 100 individuals sitting, playing, walking, dog walking, paddling, swimming and individuals kayaking, bodyboarding and using a RIB.

Figure A4.12 Nun Mill Bay (the Dhoon)

Extending north along the coast there is a holiday caravan site situated behind Jock's Bay. This bay is very rocky and there were no marine observations within or outwith the school holiday period. Continuing along from Jock's Bay is the River Dee channel which is mud flats on the lower intertidal zone and stones and rocks on the upper intertidal zone. This is backed by a grassy strip towards the road. Access to the bay on the west was restricted by farmland and saltmarsh which extends round to the bridge over the A75 linking both sides of Kirkcudbright.

A line of trees screens the beach from the road in places. No activities onshore or offshore were observed either within or outwith the school holiday period.

Kirkcudbright harbour is the main fishing port of the survey area with four fishing boats moored during the survey periods. Scallop fishing is the main focus however most of the scallop boats fish outwith the survey area. It was reported that Kirkcudbright harbour is dredged once a year by a consulting company. Two individuals were fishing off the harbour within the school holiday survey period

The RNLI have an in-shore lifeboat stationed nearby on Manxman's Lake, with a training centre on Dee Walk in the centre of Kirkcudbright from where team members initially meet for a rescue before driving to the lifeboat station.

Along the coast from the main harbour area, Kirkcudbright marina has a floating pontoon (Figure A4.13). Seventeen yachts, nine cruisers and three sea cadet boats were moored on the pontoon with a further nine sailing boats moored on the water near the shore.

There is a slipway for launching boats from Kirkcudbright Bay Sailing Club whose club house and storage yard are located here, the slipway is for members use only.

Figure A4.13 Kirkcudbright Marina

From the marina, the coastline forms a bend in the river where Gartshore Park is located. The lower intertidal zone is mud flats, with seaweed and pebbles on the upper zone. A stepped bank separates a coastal vegetation strip of unimproved grasses from the pebbled and seaweed area. Easy access to this area is through the park at various points with a footpath leading along the coastline. Within the school holiday survey period no activities were observed on or offshore. Two walkers and one individual fishing were observed outwith the school holiday survey period.

Spume was only observed at Kirkcudbright marina outwith the school holiday period within this section of coast.

A4.1.5Kirkcudbright to Palnackie

Along the stretch from Gartshore, the intertidal zone changes to saltmarsh which stretches over 100m out into the river channel and south towards St Mary's Isle (a narrow peninsula into Kirkcudbright Bay). Access to the western shoreline of the isle is via a road. The intertidal zone consists of mud flats with pebbles and seaweed higher up the beach backed with saltmarsh vegetation. A raised bank of pebbles is behind the saltmarsh vegetation. A footpath enables walking around the isle with various access points onto a rocky shoreline round the tip of the isle (The Point).

The Point is rocky with access onto an area sheltered by a small, wooded island. The lower intertidal zone comprises a substrate of mudflats in the wider bay, with sand, mud, rocks, seaweed in the mid intertidal zone with saltmarsh vegetation and pebbles across the upper zone. From the Point, a rough track follows the coastline back towards Kirkcudbright. Despite dog walkers and individuals being on the Isle, there were no marine observations within or outwith the school holiday survey period.

East of St Mary's Isle is a bay called Manxman's Lake, consisting of exposed mudflats at low tide. The northern end of the bay is dominated by saltmarsh with no access readily identified until near the A711 on the eastern side. No activities were observed onshore or offshore in the bay within or outwith the school holiday survey period.

Continuing south, the intertidal zone consists of mudflats forming the lower zone with sand and saltmarsh in the upper zone. From the lake, the coastline becomes rocky with no access to the shoreline. A rough track leads to the RNLI lifeboat station (Figure A4.14) from which a footpath leads onto Torr Point, the rocky shores around the lifeboat station and Torr Point are reported to be popular fishing areas although no marine activity on or offshore was observed within or outwith the school holiday survey period at these locations.

Figure A4.14 RNLI - Mutehill lifeboat station

The next section of coastline is not readily accessible, being very rocky but also forms part of the MoD Dundrennan. Access to Torr Point at the eastern end of the range is not permitted

during live firing exercises. Access to Abbey Burnfoot and Port Mary Bay is possible outwith live firing exercises, both locations are small rocky bays with access via a path alongside a field. Within the school holiday survey period one dog walker was observed at Abbey Burnfoot. Outwith the school holiday period, a family of six were beachcombing.

Continuing along the coastline, no public access is possible until Rascarrel Bay. New holiday cabins have been built near the shore since the 2017 habits survey. The lower intertidal zone at Rascarrel Bay is rocky with an uneven surface of saltmarsh vegetation incised with narrow channels in the upper zone. Beyond the bay the coastline continues to be rocky with no access onto the shoreline. No activities were observed on or offshore within the school holiday survey period. Only two individuals walking on the intertidal zone were observed outwith the school holiday survey period.

Balcary Bay (Figure A4.15) is on the western edge of Auchencairn Bay and is a sheltered bay. The lower intertidal zone is sandy with a rocky outcrop near the tower on the southeastern edge of the bay. The mid zone is comprised of small stones and larger pebbles whilst the upper zone is stone and sand with some larger rocks, behind which large boulders and a stone wall function as sea defences. Within the school holiday survey period intertidal activities of individuals walking, playing, dog walking and sitting/picnicking/BBQ were seen. Outwith the school holiday survey period, three individuals walking and three individuals sitting/picnicking/BBQ were observed.

Figure A4.15 Balcary Bay

Access northwest along the coastline was restricted from Balcary Bay until the saltmarsh at the head of Auchencairn Bay. The substrate in the upper zone of Auchencairn Bay was saltmarsh and reed bed where a bird hide was publicly accessible. The lower intertidal zone is sand and mudflats. The footpath passes through the reed bed with boarded sections laid where the ground is too wet. No activities were observed within or outwith the school holidays.

East of Auchencairn Bay is Orchardton Bay which has no public access.

Palnackie is located inland on the estuary of the Urr Water with a small harbour. The river channel has steep muddy banks with no safe access possible. Several old and in disrepair boats of varying sizes were tied up at the harbour. No activities were observed within or outwith the holiday period.

No spume was observed at any of the sites within this section of coast within the school holiday period. Outwith the holiday survey period, spume was observed only at Kirkcudbright Marina.

A4.6 Palnackie to Southerness Point

Separating Auchencairn Bay from Rough Firth is a peninsula, South Glen. There is a hard standing area for cars for use by the public at the south end of Glen Isle. Glen Isle is accessible via a track for vehicles or by foot which provides access to the intertidal zone and also for

holiday homes that are situated on Glen Isle (Figure A4.16). The intertidal substrate is rocky with extensive mudflats extending across the bay on either side of the isle. No marine activities were observed on the eastern side however five boats were moored on the Urr Water. On the western side of Glen Isle no public access is possible onto the salt marsh due to fenced farmland.

Figure A4.16 Glen Isle looking to Kippford

Northeast of Glen Isle, a saltmarsh extends towards Kippford near a bend on the Urr Water. The saltmarsh is incised with deep muddy channels flooded at high tide. Faint footpaths provide evidence of public access. The main river channel consists of steep muddy banks and is navigable up to at least the harbour at Palnackie. No more access to the coastline was possible until Kippford.

Kippford is a small coastal settlement and is located where the Urr Water enters the eastern side of Auchencairn Bay. A sailing club have a club house near to a stone jetty slipway and floating pontoon with boat storage facilities on the riverside.

Outwith the school holiday survey period, sheep were grazing on the saltmarsh by Kippford, new houses were being built next to the hardstanding for boat storage over winter and one fishing boat, 14 sailing boats and six motorboats were moored at Kippford stone jetty. No other observations were noted during this period. Within the school holiday survey period, four

individuals were dog walking on the intertidal substrate and the pontoon, five adults and eight children were crabbing off the pontoon, seven sailing boats and one motorboat were moored at the harbour by the club and ten adults, and two children were on the pontoon.

A public car park is located next to the boat storage area with access onto the intertidal zone possible from the end of the grassy area which leads to a small area of saltmarsh and grass. The lower intertidal zone forms the mudflats along the river with the upper zone being stone up to a sea wall. Further access onto the upper intertidal zone is also possible from a gap in the sea wall accessing two slipways.

During the school holiday survey period, a creel boat was lying on the upper beach area near the slipway. The creel fishing boat no longer operates in contrast to the 2017 survey.

A RNLI station is located in the village. A shop forms part of the lifeboat station to raise funds. Within the school holiday survey period families were crabbing from the slipway and the floating pontoon, two dog walkers, ten adults and two children playing by the sailing club. Seven sailing boats and one motorboat were resting on the substrate at low tide. Outwith the school holiday survey period, one working boat, 14 sailboats and six motorboats were moored on the water. Sheep were observed grazing on the saltmarsh up-river north of Kippford.

Rough Island is located in the centre of the bay and at low tide there is an access causeway however this is restricted during May and June due to birds nesting.

Port Donnel, a rocky headland, marks the coastline at the small village of Rockcliffe. The coastline forms a small bay, and its intertidal substrate is mud and sand which extends for over one kilometre out to the end of the bay (Figure A4.17).

Figure A4.17 Rockcliffe bay and lower intertidal zone

The upper intertidal substrate comprises rocky outcrops and sand and crushed shells. Large rocks form a sloping sea defence with a road behind with a small car park area at the north end of the bay. Easy access onto the beach is possible from along the road. Within the school holiday survey period activities observed were dog walking, walking, individuals playing, individuals sitting/picnicking/BBQ and individuals paddling. Offshore one sailing yacht and four motorboats were observed. Outwith the school holiday survey period there were six dog walkers, two individuals playing on rocks, several families (with children and infants) walking, beachcombing and rock pooling and four individuals sitting/picnicking/BBQ.

Steep cliffs make the intertidal substrate inaccessible from Rockcliffe to Port O' Warren Bay. Port O' Warren Bay (Figure A4.18) is a sandy beach extending out into the Solway Firth with

rock outcrops, pebbles, and sand with small areas of saltmarsh vegetation in the upper intertidal zone.

Figure A4.18 Port O Warren Bay

Continuing along the coast from Port O' Warren Bay is a large sandy bay, Portling Bay (Figure A4.19), with large rocky outcrops on the eastern side of the bay and smaller rocky outcrops on the western side. The bay is accessed via a coastal path from the west or via a slipway from the village. Within the school holiday survey period, one individual was fishing at Portling Bay, no other on or offshore activities were observed at Portling Bay or at Port O Warren Bay. Outwith the school holiday period, no marine activities were observed at either of these two sites.

Figure A4.19 Portling Bay

From Portling Bay it is possible to walk on a coastal path above the cliffs but no access down to the shoreline is possible from this path. Access along the sandy shoreline from Portling Bay to Sandyhills, passing the Needle's Eye cliff archway, is possible.

At Sandyhills (Figure A4.20) a public car park with toilets, enable visitors easy access onto an extensive sandy beach substrate. Net fishing posts were observed offshore. Saltmarsh vegetation and reeds cover a small corner of the bay to the east of the bay. Across most of the bay the upper intertidal zone is a sandy substrate which extends to a small rocky outcrop on the western side of the bay.

Outwith the school holiday period, there were 13 dog walkers, several families walking and several families sitting/picnicking/BBQ and two individuals sitting on rocks. Within the school holiday survey period, more than 100 individuals were observed walking, dog walking, sitting/picnicking/BBQ, and playing and a further 20+ individuals swimming and paddling.

Figure A4.20 Sandyhills beach

Southwick Coast Nature Reserve is located west from Sandyhills and is managed by the Scottish Wildlife Trust and is accessed from the A710. The reserve is a mixture of coastal substrates, with sand and mud at the western side. Saltmarsh and the estuary are on the eastern edge and forms the western boundary of the Merse Sands area and RSPB Mersehead Reserve. Within the school holiday survey period there were no observations noted. Outwith the school holiday survey period, several individuals were walking on the beach. Several staff were present at the RSPB Reserve inland.

Figure A4.21 Southerness lighthouse and beach

Southerness has several large caravan sites, some of which are open all year. A hotel, golf course, public toilets and a car park are nearby. Southerness Point (Figure A4.21) extended into the Solway Firth and is a rocky outcrop accessed via a pathway from the village leading directly to the lighthouse (which is now occasionally open during the summer period to visitors) around which the beach area is formed of rocky wave cut platforms interspersed with sand. Outwith the school holiday survey period, two dog walkers, and six adults and two infants walking were observed.

Within the school holiday survey period, more than 100 individuals were noted undertaking activities which included dog walking, walking, playing, sitting, picnicking, paddling and rock pooling.

No spume was observed at any of the sites within this section of coast either within or outwith the school holiday period.

A4.1.7 Southerness to Glencaple

To the east of Southerness, access to the intertidal substrate is from caravan sites onto Gillfoot Bay and onto the bay at Powilliemount (Figure A4.22) via a car park. The intertidal substrate is of a sandy lower intertidal zone with a large area of rocky outcrops on the upper intertidal zone. Outwith the school holiday period, there were seven individuals walking and two individuals playing on rocks at Powilliemount. Within the school holiday survey period, observations on the intertidal substrate were one cyclist, one family rock pooling, six individuals dog walking, eight individuals walking, four individuals sitting, seven children and infants playing, one family beachcombing, seven individuals fishing from the rocks and two camping groups camping on the beach. Accessible from the Powilliemount public car park there is a small area that individuals climb and boulder from (Thirlston Arch).

Figure A4.22 Powilliemount

Continuing north along the coast is Carsethorn (Figure 4.23) which comprises of a muddy lower intertidal zone with sand and stone on the upper intertidal zone. Four groynes leading up to the high tide mark at southern end of the hamlet are apparent though quite inundated with sand. Access to the intertidal area is at several points along the road where car parking and picnicking are available. Outwith the school holiday survey period, there were five individuals walking. No other marine observations were observed. Within the school holiday survey period, three individuals were observed fishing from the shore.

Figure A4.23 Carsethorn

Continuing north from Carsethorn, the next access point to the shoreline is at Burnfoot where mudflats dominate the intertidal zone. This section of mudflats also forms the western edge of the Wildfowl and Wetlands Trust's (WWT) Caerlaverock National Nature Reserve up to Airds Point.

Kirkconnell merse forms part of a large saltmarsh on the west bank of the Nith estuary, from Airds Point in the south to where Cargen Pow stream enters the river in the north. Access to the southern end of the merse is from the end of a metalled road where a rough track follows the edge of the saltmarsh through Banks Wood. A padlocked gate, half-way down the track prevents any further progress by vehicle. Access onto the saltmarsh is limited due to a fence, however, a path from a padlocked gate allows access onto the merse.

While not observed, wildfowling was reported at this section of merse and said to be popular in the winter months. Access is limited towards the northern end of the merse. From the northern end of the merse there is no further public access until Glencaple.

No activities were observed on Kirkconnell merse when visited both within and outwith the school holiday survey period. No spume was observed at any of the sites within this section of coast either within or outwith the school holiday period.

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