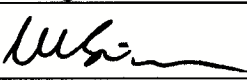
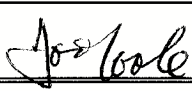
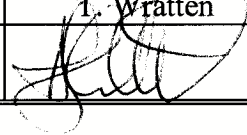


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SUMMARY

UKAEA has reviewed the programme of monitoring of the local beaches for the first half of year 2005. The finds for this period are summarised and analysed. The total number of beach surveys in this period was twenty-nine plus a single strandline on Sandside beach in April. Three of the beach surveys were carried out on Sandside beach, one on Dunnet beach, sixteen on Dounreay foreshore and the rest on other beaches. Considering all the beaches and foreshores, an area in excess of 2 million square metres has been monitored for fragments of irradiated fuel and a total of 6,488,898 Gamma readings were taken. The denial of access to Sandside beach from the beginning of April has impacted on the programme as has a period of severe weather coupled with technical difficulties during January. However future surveys will enable UKAEA to comply with the yearly targets for area coverage and number of surveys. The survey on Dunnet beach resulted in the detection of a DFR type particle, this being the first time a particle is detected on a public beach apart from Sandside and Dounreay foreshore. Also, a fragment of contaminated plastic was detected, recovered and analysed. These finds caused further enquiries and investigations, still ongoing when this report was being prepared. No particles were detected in any of the surveys of Thurso, Scrabster, Brims Ness and Crosskirk.

Issue	Date	Author Name Signature	Checked by Name Signature	Issue Approved Name Signature
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Distribution

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1 INTRODUCTION

1.1 Background

In 1983, a routine radiological survey at predetermined locations on the Dounreay beach discovered a particle of irradiated Material Testing Reactor (MTR) fuel. The particle was primarily composed of aluminium and contained a small amount of uranium as well as fission products. Since the 1983 discovery, routine monitoring for particles has been carried out at selected locations distributed over some 25 kilometres of coastline, centred on the Dounreay Foreshore and the public beaches at Sandside Bay. Other local beaches from Melvich in the West to Thurso in the East have been checked. Particles have also been found in the seabed sediments offshore of Dounreay.

Ten particles were found on the Dounreay Foreshore during the first surveys in January 1984. Since then, particles have been found on the Dounreay Foreshore at a variable rate during the routine surveys. Most particles identified originate from MTR fuel, but particles have also been found which can be associated with the Dounreay Fast Reactor DFR. A few particles of activated steel have also been recovered.

Sandside, three kilometres West from Dounreay, was the only public beach on which particles have been found, until the particle detected on Dunnet beach on March 26th 2005. One particle was discovered on Sandside beach in 1984 and since that time a routine programme of beach monitoring has been conducted. A second particle was discovered on Sandside beach in May 1997. The radiological monitoring of the local coastline and, in particular, Sandside Beach, has been progressively increased since May 1997. The development of the monitoring regime is fully described in previous reports.

1.2 Current Statutory Monitoring Requirements

UKAEA Dounreay's Authorisation conditions for the Disposal of Liquid Radioactive Waste require the implementation of a regime of environmental monitoring. In particular, the current environmental programme associated with liquid discharges, as defined in the latest issue of Technical Implementation Documents (TIDs) related to Liquid Radioactive Waste Disposals dated October 2004, includes, among other investigations, beach monitoring in accordance with Table 1-1.

The radiological target has been removed in the current version of the TID. The requirement is to deploy Groundhog Evolution operated at an average velocity not greater than 1 m/s and discarding for area coverage purposes any reading taken when velocity is greater than 1.2 m/s. The coverage requirement for Sandside beach (in excess of 0.25 square kilometres per month) and its limitations is still in force.

The following table 1-1 summarises the current monitoring regime.

Beach	Extent of monitoring	Grid references (GRs)	Frequency of monitoring
Sandside Bay	All of the sandy areas that can be accessed by a vehicle from MHWS to low water* between GRs in column 3	295700, 966280 & 296690, 965780	Monthly
Sandside Bay	Accessible sandy areas which do not permit vehicle access including North beach, harbour, sandy areas below Fresgoe House, bands of sand Northeast of the beach below the public lavatories and the sandy areas North of Isauld Burn	295700, 966280 & 296690, 965780	Monthly
Sandside Bay	Strandline that can be accessed by vehicle between GR's in column 3	295700, 966280 & 296690, 965780	Fortnightly
Thurso Bay	All sandy areas that can be accessed by a vehicle from MHWS to low water* between GRs in column 3	311360, 968960 & 312070, 968850	Three times per year
Scrabster Bay	All sandy areas that can be accessed by a vehicle from MHWS to low water* between GRs in column 3	310040, 970180 & 310605, 969170	Three times per year
Crosskirk Bay	All accessible sandy areas from MHWS to low water* between GRs in column 3	302860, 969900 & 302970, 970250	Six times per year
Brims Ness	All accessible sandy areas from MHWS to low water* between GRs in column 3	304250, 971270 & 304410, 971030	Six times per year
Dounreay East Foreshore	All accessible sandy areas from MHWS to low water* between GRs in column 3	298650, 967410 & 299020, 967670	Fortnightly except during the period 1 May to 31 August
Dounreay West Foreshore	All accessible sandy areas from MHWS to low water* between GRs in column 3	298190, 967029 & 298340, 967095	Fortnightly except during the period 1 May to 31 August
Melvich Bay	All accessible sandy areas from MHWS to low water* between GRs in column 3	288246, 965662 & 289109, 965028	Once during 2004
Dunnet Bay Beach	All accessible sandy areas from MHWS to low water* between GRs in column 3	320336, 968460 & 321440, 970870	Once during 2005

* Low water means as reasonably practicable to low water springs, but at least to neap low water

Table 1-1: Statutory Beach monitoring requirements

2 SUMMARY OF THE SURVEYS

The total number of complete beach surveys in the first half of 2005 is 28. Two of them were carried out on Sandside beach, sixteen on the Dounreay foreshore and ten on the other beaches, as summarised in Table 2-1.

Furthermore, one partial survey and a strandline were carried out on Sandside beach in January and April.

	Sandside	West Foreshore	East Foreshore	Crosskirk	Brims Ness	Scrabster	Thurso	Dunnet
Jan 2005	✓ *	✓	✓					✓
Feb 2005	✓	✓	✓	✓			✓	
Mar 2005	✓	✓	✓		✓	✓		
Apr 2005	✓ *	✓	✓	✓	✓			
May 2005								
Jun 2005				✓	✓		✓	

* partial or strandline survey only carried out

Table 2-1: Survey summary with dates

In the next sections a summary is given for each beach.

2.1 Sandside Beach

Permission to access the beach was withdrawn from the beginning of April. The January survey did not cover the required 250,000 square metres because of a combination of technical and environmental reasons. The withdrawal of access prevented the April (apart from one strandline), May and June surveys being carried out. Severe storms hit the north coast of Scotland in January. The high winds prevented safe conditions for surveying. In addition, the damage the storms caused to the access paths to the beach made access very difficult and indeed is thought to have caused vibrational damage to the electronics when access was attempted. Repairs were carried out by the landowner at UKAEA expense, and February and March surveys were carried out successfully. See Appendix B for pictures of the access path.

	area [m ²]	Gamma readings [number]
January 2005	31,375	101,360
February 2005	318,502	993,790
March 2005	288,854	872,553
April 2005	7,878	23,569

Table 2-2: Sandside surveys details

The area covered in January does not fulfil the statutory requirements. However, future surveys can be in excess of the statutory value and therefore counterbalance the low January coverage in order to achieve a satisfactory calendar year average.

A total of four particles on three different days was detected and recovered from Sandside beach.

2.2 Thurso and Scrabster Beaches

A total of three surveys were carried out on Thurso and Scrabster during the period considered. A summary with area covered and number of sensor readings acquired is reported in Table 2-3 for the two beaches. No particles were detected during the surveys.

	area [m ²]	Gamma readings [number]
Thurso - February 2005	86,492	252,030
Scrabster - March 2005	47,799	134,118
Thurso - June 2005	119,669	345,531

Table 2-3: Thurso and Scrabster surveys details

The chart in Figure 2-1 shows the relationship between gamma readings and area coverage for Sandside, Scrabster and Thurso surveys.

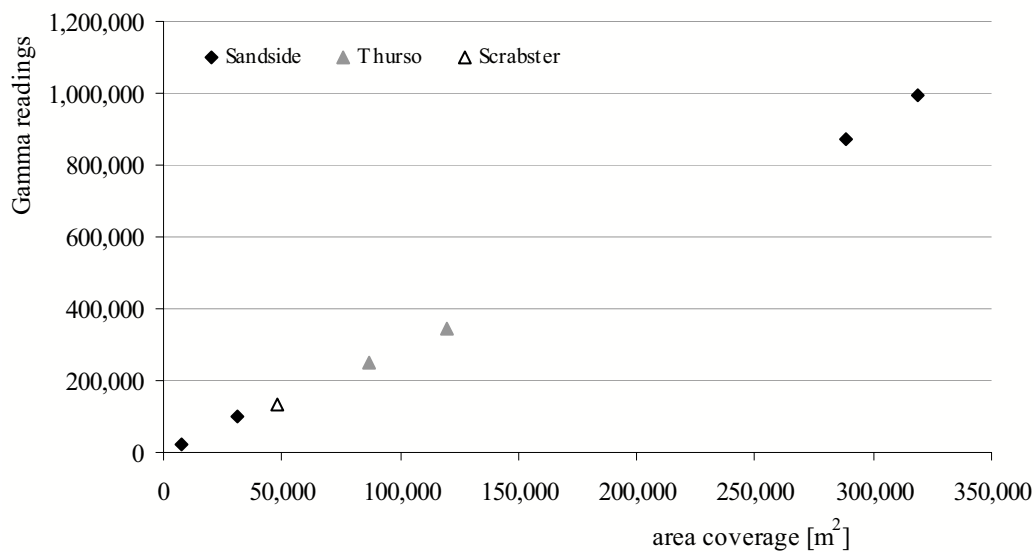


Figure 2-1: Area - counts scatterplot for Sandside, Scrabster and Thurso

The chart above, as its counterparts for the other beaches below reported, gives a graphical description of the relationship between number of readings and area coverage. With the new speed limitations introduced in the TID in October 2004, a higher number of readings is needed in order to survey the same areas covered when a higher speed was used. All the surveys are laying approximately on the same line which slope is an indication of the area covered with a single reading.

2.3 Brims Ness

In the first half of 2005 a total of three surveys were carried out on Brims Ness. A summary with area covered and number of points acquired is reported in Table 2-4.

	area [m ²]	Gamma readings [number]
March 2005	363	1,408
April 2005	623	4,307
June 2005	2,517	15,529

Table 2-4: Brims Ness surveys details

The sandy areas available for monitoring varied considerably. No particles were detected during any of these surveys.

2.4 Crosskirk

The number of surveys carried out on Crosskirk during the period considered in this report is three. Table 2-5 summarises the area covered and number of points acquired for each survey. No particles were detected during any of these surveys.

	area [m ²]	Gamma readings [number]
February 2005	574	2,535
April 2005	817	3,440
June 2005	576	2,106

Table 2-5: Crosskirk surveys details

The chart in Figure 2-2 shows the relationship between gamma readings and area coverage for Crosskirk and Brims Ness surveys.

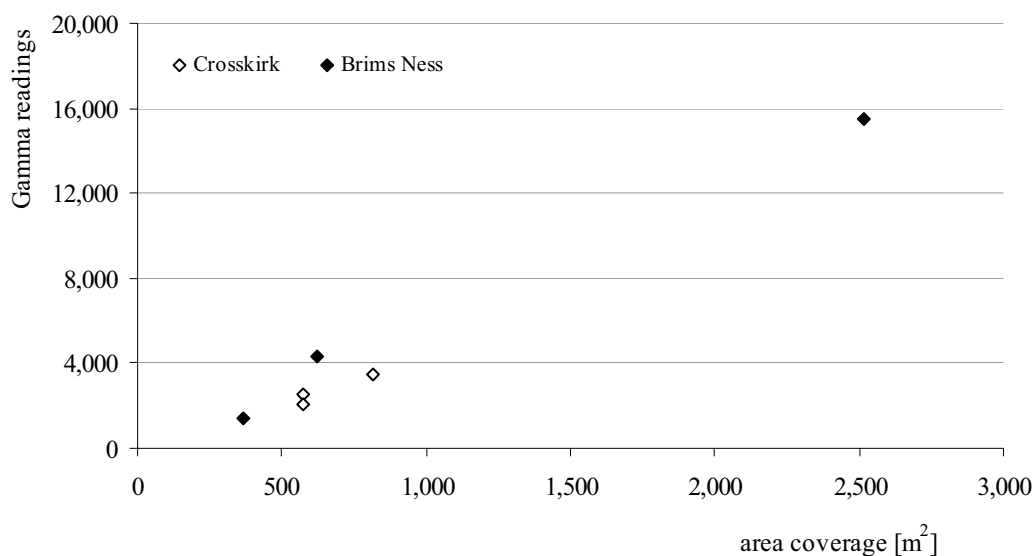


Figure 2-2: Area - counts scatterplot for Crosskirk and Brims Ness

2.5 Dounreay Foreshore

The number of surveys carried out on the Dounreay foreshore in the first half of 2005 is sixteen. All of them were carried out on the West foreshore. Lack of sand on the eastern foreshore prevented the execution of any survey. Table 2-6 summarises the area covered and number of points acquired for each survey. A total of seven particles were detected during the surveys.

One West foreshore survey scheduled for the last week in March was cancelled under SEPA instruction in order to maximise the resources deployment on Dunnet beach.

A series of images related to the planned East foreshore surveys is reported in Appendix C. They illustrate the absence of accessible sandy areas for monitoring.

	area [m ²]	Gamma readings [number]
January 2005 I	7,762	35,717
January 2005 II	6,020	20,638
February 2005 I	8,504	32,158
February 2005 II	9,434	47,547
March 2005 I	8,952	33,507
March 2005 II	12,130	44,116
April 2005 I	14,094	59,997
April 2005 II	14,484	66,817

Table 2-6: Dounreay foreshore surveys details

The chart in Figure 2-3 shows the relationship between gamma readings and area coverage for the surveys carried out on Dounreay foreshore.

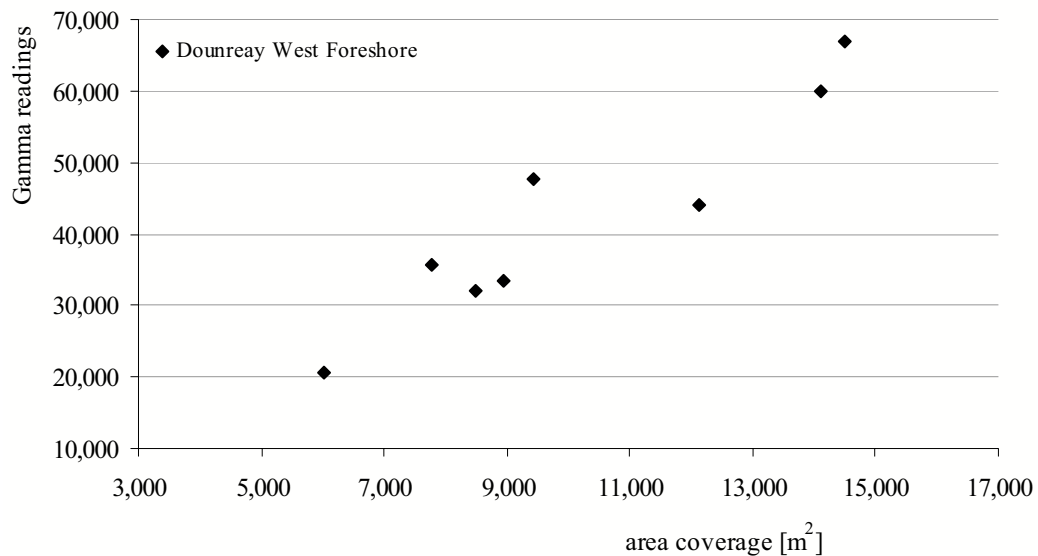


Figure 2-3: Area - counts scatterplot for Dounreay foreshore

2.6 Dunnet

During early 2005 a one-off survey of Dunnet beach was carried out. The survey spanned over almost four months, for a total of 33 days of effort and a total of almost 194 hours of surveying.

	area [m ²]	Gamma readings [number]
January to May 2005	1,087,092	3,396,125

Table 2-7: Dunnet survey details

The start of the survey was delayed by technical issues with the monitoring equipment and by particularly inclement weather. Table 2-8 summarises the days in which monitoring has taken place. The survey was completed earlier than scheduled by using out-of-hours working, weekend working and by permission from SEPA to divert effort from Sandside beach.

	Days of surveying in each month
January	31
March	1, 2, 17, 18, 19, 22, 23, 24, 25, 26, 29, 30, 31
April	1, 4, 5, 6, 7, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22
May	17, 18, 19, 20

Table 2-8: Dunnet survey days

During the survey a particle, a contaminated fragment of plastic and a number of stones with natural radiological signature were detected and recovered.

The figure below summarises the relationship between gamma readings and area coverage for the surveys carried out in all the beaches. It should be noted that scale is bi-logarithmic.

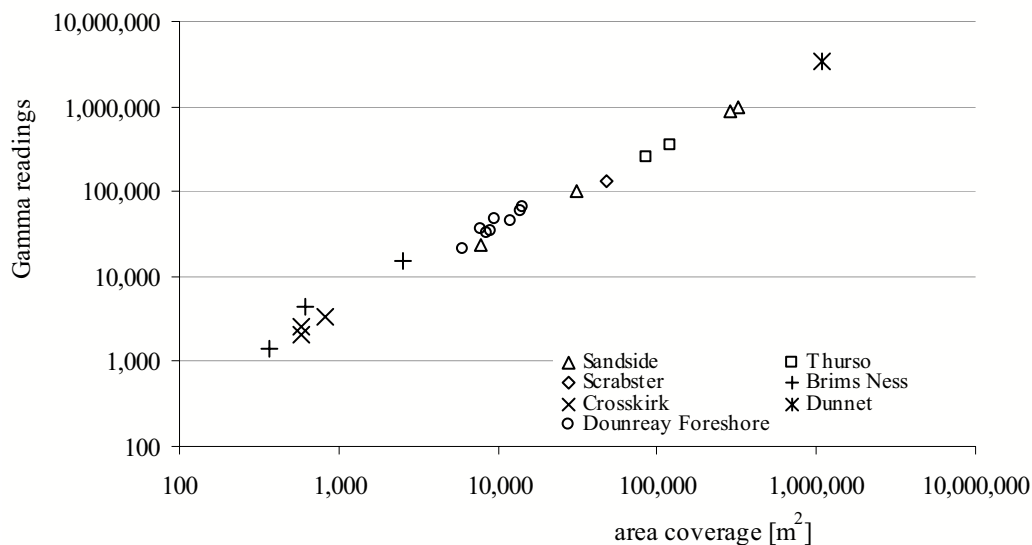


Figure 2-4: Area - counts scatterplot for all the surveys

3 SUMMARY OF THE FINDS

In this section a list of particle finds for the first half of 2005 is given along with considerations about their activity distribution and their geographical location.

3.1 List of Finds

The following Table 3-1 summarises the finds on Dounreay foreshore and on the public beaches for the first half of year 2005, along with the corresponding data for the previous years.

	prior to 2003	2004	2005 I	total
Sandside Beach	46	5	4	55
Dounreay Foreshore	217	9	7	235
Other Beaches	0	0	1	1

Table 3-1: Particle finds

Along with the particles listed above, a series of items has been detected on Dunnet beach. One is a fragment of contaminated plastic contaminated with ^{137}Cs ; the remaining items are stones whose elevated content of naturally occurring radioisotopes triggered the alarm on the surveying equipment.

3.2 Sandside Finds

The number of particles detected in the first half of 2005 is similar to the number of finds in year 2004. This might be explained by the fact that only four surveys were carried out during 2004 and three surveys (plus a single strandline) were carried out during the period covered by this report, assuming also that the rate of arising of particles on the beach is constant.

The summary of the finds is reported in Table 3-2 below. EFSN is the Environmental Field Sample Number assigned.

Date of recovery	Easting	Northing	depth [mm]	^{137}Cs activity [Bq]	EFSN
19-Feb-05	296317	965351	50	1.50E+04	SS/05/01
21-Feb-05	296399	965382	150	4.70E+04	SS/05/02
21-Feb-05	296206	965391	70	1.10E+04	SS/05/03
16-Mar-05	295905	965517	50	3.18E+04	SS/05/04

Table 3-2: Groundhog Evolution particle summary data for Sandside

Particle SS/05/04 found on March 16th also showed 379 Bq of ^{94}Nb activity.

3.3 Spatial Distribution on Sandside

The image of Figure 3-1 shows the locations where the four particles were detected and recovered from during the period covered by this report (in green), along with the particles found in previous years (in yellow).

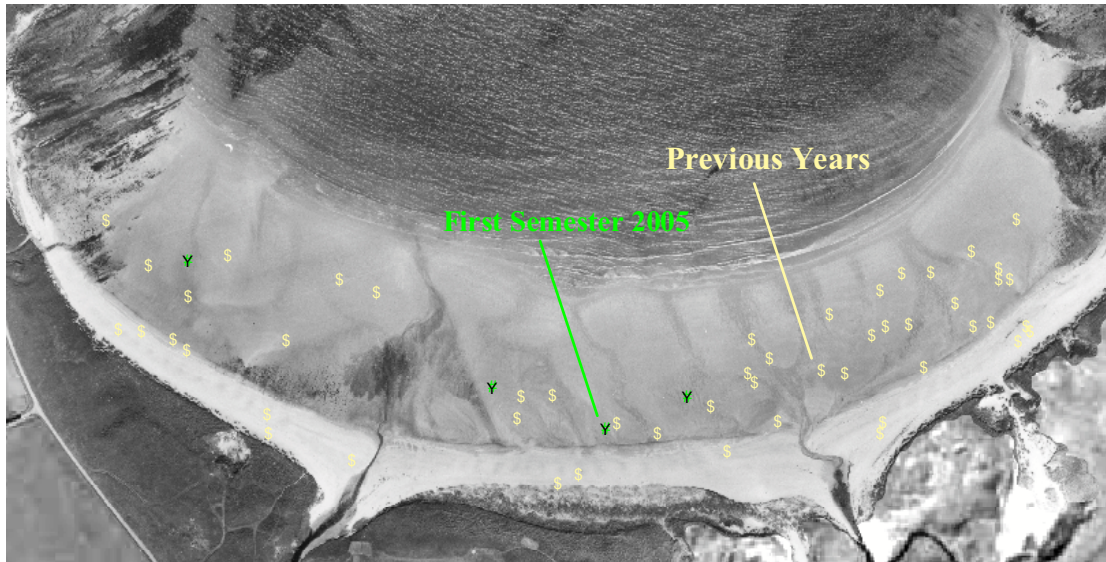


Figure 3-1: Georeferenced particle finds on Sandside beach

By observing the spatial distribution of the recent finds, it is possible to see that there are less finds on the Eastern side of the beach than in the previous years. None of the recent finds are in fact on the Eastern side of the beach: three of them are in a central position and the latest find is in the Western side.

This trend seems to be the opposite of the trends observed in 2003 and 2004. The low number of surveys in a half year hampers the efforts to find further information useful in highlighting possible trends.

3.4 Space-temporal Distribution on Sandside

The chart in Figure 3-2 summarises the above description of find locations in time. Particles are plotted chronologically with their Easting as abscissa. By projecting vertically on the image, it is also possible to find out the area of the beach whence the particle was recovered.

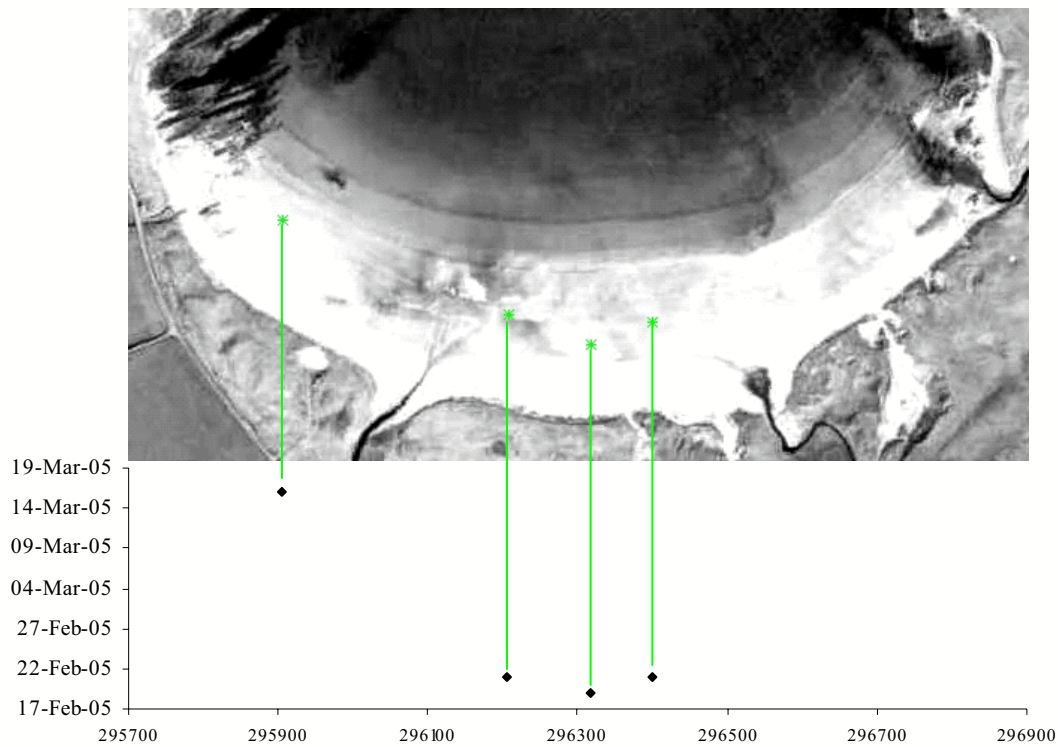


Figure 3-2: Easting - date scatterplot for Sandside finds

The first three particles (19 to 21 February) were detected in the central area of the beach. The latest find was detected in the Western area of the beach.

3.5 Dounreay Foreshore Finds

The following table summarises the finds of particles on Dounreay foreshore

Date of recovery	Easting	Northing	depth [mm]	¹³⁷ Cs activity [Bq]	EFSN
06-Jan-05	298356	967004	50	4.30E+04	DF/05/01
07-Jan-05	298363	967051	50	1.90E+05	DF/05/02
07-Jan-05	298376	967046	100	9.60E+05	DF/05/03
01-Feb-05	298341	967018	100	9.60E+05	DF/05/04
17-Feb-05	298353	967048	100	1.60E+06	DF/05/05
17-Feb-05	298343	967013	150	5.90E+06	DF/05/06
17-Feb-05	298251	966959	50	2.30E+05	DF/05/07

Table 3-3: Groundhog Evolution particle summary data for Dounreay foreshore

The number of finds has not significantly changed when compared with the results for the last three months of the previous year. The average activity for the first half of 2005 is four times higher than the average activity for the finds of 2004.

3.6 Spatial Distribution on Dounreay Foreshore

Figure 3-3 below reported shows the location of the Dounreay foreshore finds detected with Groundhog Evolution since October 2004.

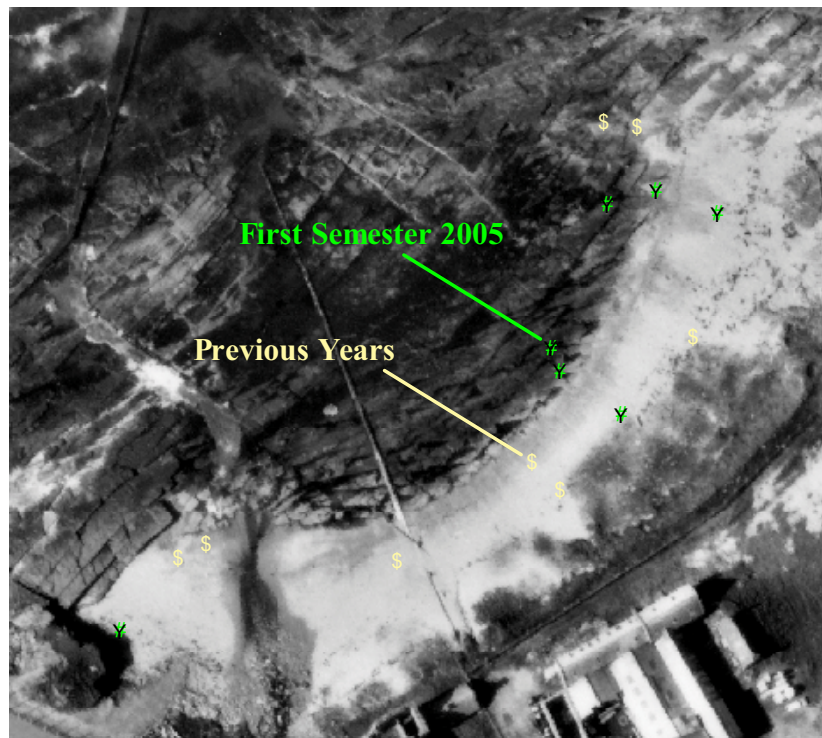


Figure 3-3: Georeferenced particle finds on Dounreay foreshore

Only one find (one of the most recent) is located in the Western area of the Dounreay beach. The rest of the particles were detected in the Eastern or central zones.

3.7 Space-temporal Distribution on Dounreay Foreshore

The chart in Figure 3-4 summarises the locations of particle finds related to time - in a similar fashion to the one reported for Sandside beach in Section 3.4. Particles are plotted chronologically with their Easting as abscissa and date of recovery as ordinate. By projecting vertically on the georeferenced image it is also possible to find out the location of the beach whence each particle was recovered.

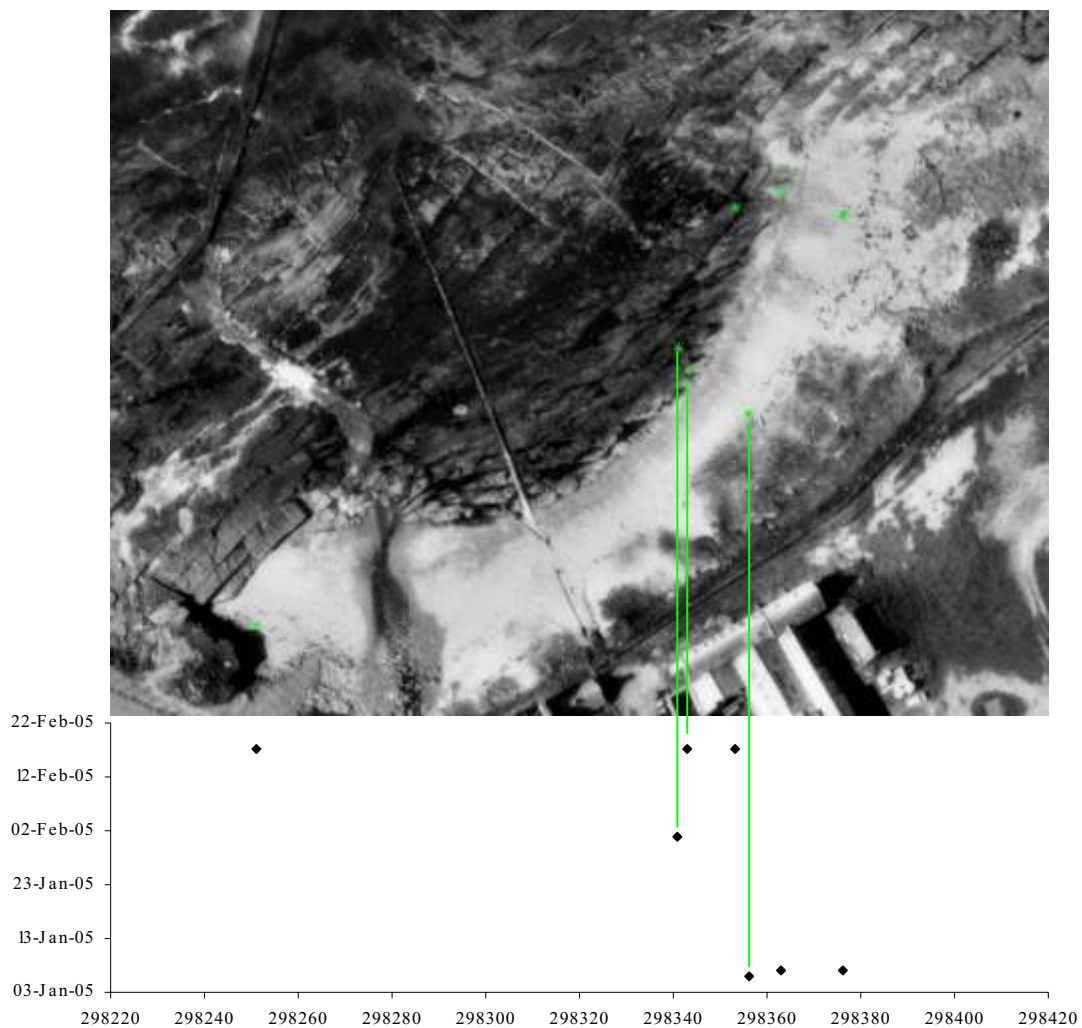


Figure 3-4: Easting - date scatterplot for Dounreay foreshore

3.8 Dunnet Finds

The survey of Dunnet beach resulted in the detection of a single DFR particle and a plastic fragment with ^{137}Cs contamination. Also, a number of stones triggered the survey equipment alarm. Those five stones were recovered and underwent laboratory analyses in order to ascertain the nature of the activity detected.

In all the cases the stones' activity was due to natural radioisotopes.

The tables below summarise the main information of the different finds.

Date of recovery	Easting	Northing	depth [mm]	^{137}Cs activity [Bq]	EFSN
26-Mar-05	321283	968943	70	8.90E+03	DB/05/01

Table 3-4: particle summary for Dunnet

Date of recovery	Easting	Northing	description	activity	EFSN
02-Mar-05	321869	970232	plastic fragment	$\sim 2\text{E}+04$ Bq ^{137}Cs	DB/05/01S
31-Mar-05	320582	968275	stone	natural series	DB/05/02S
01-Apr-05	320551	968280	stone	natural series	DB/05/03S
05-Apr-05	320437	968204	stone	natural series	DB/05/04S
06-Apr-05	320483	968269	stone	natural series	DB/05/05S
22-Apr-05	320189	968183	stone	natural series	DB/05/06S

Table 3-5: detected items summary for Dunnet

Further investigations are currently being carried out by SEPA in order to gather more information about the nature and, possibly, the origin of the contaminated plastic fragment.

3.9 Activity Comparison

The following bar chart in Figure 3-5 shows a comparison between the activities of the particles recovered on Dunnet beach, Sandside beach and Dounreay foreshore in the present reporting period.

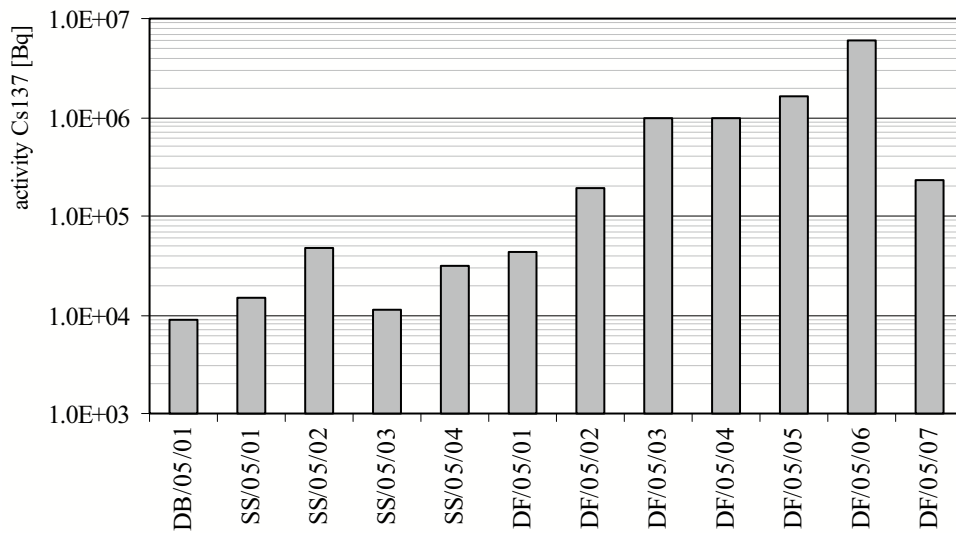


Figure 3-5: Activity of the detected particles

The lowest activity is the one of the particle recovered from Dunnet beach, at less than 1.0×10^4 Bq ^{137}Cs .

The particles recovered from Sandside have an average activity around 2.6×10^4 . The particles from Dounreay foreshore average around 1.4×10^6 .

3.10 Activity and Depth of Recovery

The following chart in Figure 3-6 shows the activity and depth scatterplot of the finds during the first half of 2005.

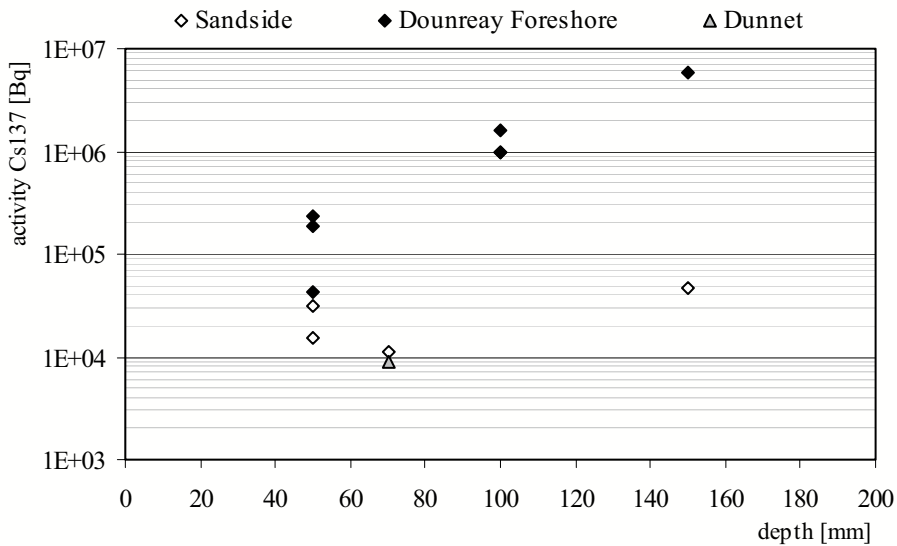


Figure 3-6: Depth - activity scatterplot for all finds

While it is easy to see how the activities of Dounreay foreshore finds are on average higher than the activities of particles found on the other beaches, the depth of recovery does not appear to be related to the beach upon which the particles were detected.

In other terms, both Sandside and Dounreay foreshore finds range from a minimum of 50 mm to a maximum of 150 mm of depth.

4 ANALYSIS OF SURVEY SPEED

Since the beginning of October 2004, SEPA enforced a new regime of monitoring in the latest issue of the TID related to the liquid discharges: the average survey velocity must not be greater than 1 m/s and no reading acquired at velocity in excess of 1.2 m/s can be used for the determination of the area covered.

The following charts in Figures 4-1 and 4-2 summarise the maximum and average speed for all the surveys carried out during the present reporting period.

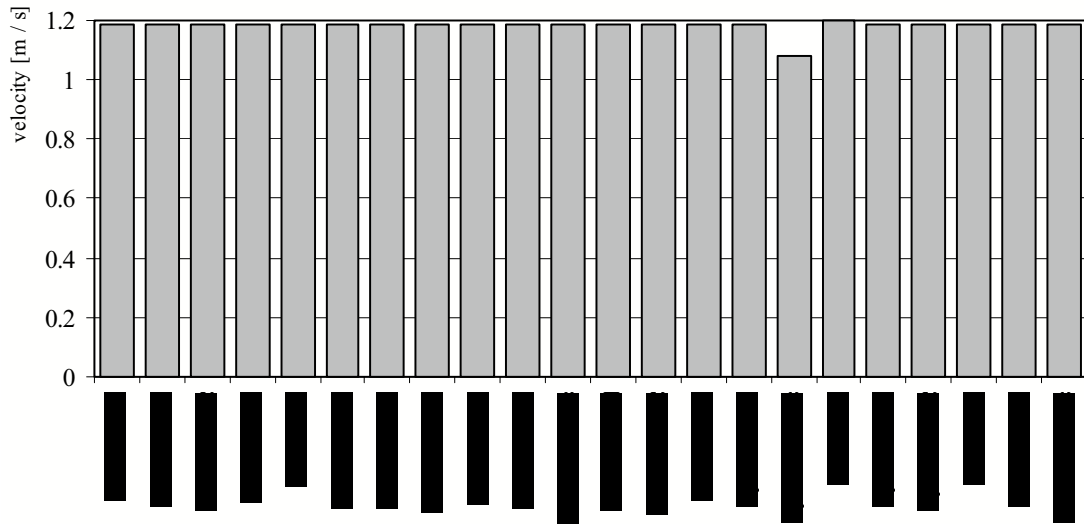


Figure 4-1: Maximum survey velocities

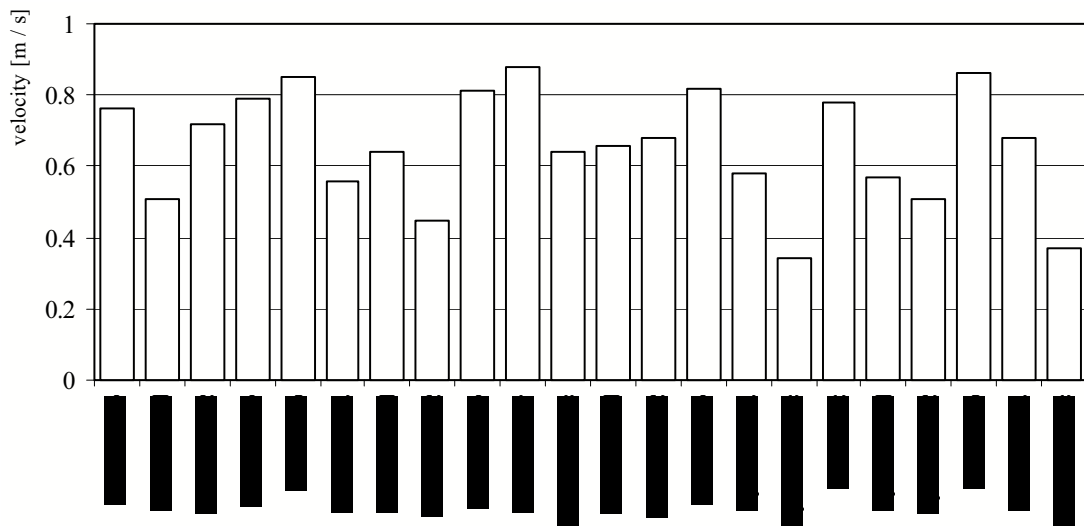


Figure 4-2: Average survey velocities

The following tables (Table 4-1 to Table 4-3) report the numerical values of average and maximum velocity used for each survey.

	velocity [m/s]	
	average	maximum
Jan Sandside	0.76	1.19
Feb Sandside	0.79	1.19
Feb Thurso	0.85	1.19
Mar Sandside	0.81	1.19
Mar Scrabster	0.88	1.19
Apr Sandside	0.82	1.19
Jun Thurso	0.86	1.19
Jan - May Dunnet	0.78	1.2

Table 4-1: Velocity summary data for the main beaches

	velocity [m/s]	
	average	maximum
Feb Crosskirk	0.56	1.19
Mar Brims Ness	0.64	1.19
Apr Brims Ness	0.34	1.08
Apr Crosskirk	0.58	1.19
Jun Brims Ness	0.37	1.19
Jun Crosskirk	0.68	1.19

Table 4-2: Velocity summary data for the minor beaches

	velocity [m/s]	
	average	maximum
Jan DF West 1	0.51	1.19
Jan DF West 2	0.72	1.19
Feb DF West 1	0.64	1.19
Feb DF West 2	0.45	1.19
Mar DF West 1	0.66	1.19
Mar DF West 2	0.68	1.19
Apr DF West 1	0.57	1.19
Apr DF West 2	0.51	1.19

Table 4-3: Velocity summary data for Dounreay foreshore

All the velocity limitations required by the TID (average velocity not greater than 1 m/s and no readings considered with velocity in excess of 1.2 m/s) are in every respect fulfilled.

The average velocity on the minor beaches is consistently lower than on the main beaches in order to compensate for the higher background.

5 REPORTING AND PUBLICATION OF THE RESULTS

The current arrangements for reporting the results of the surveys involve notifying SEPA, both orally and in writing, whenever a particle is found. As soon as the Survey Team reports a contact, the UKAEA Project Manager contacts SEPA and notifies them of the find. The field data gathered by the team once the particle is separated and packaged for transport are then fed to SEPA through the UKAEA Project Manager.

Once the accurate positional data and the results of high resolution gamma spectrometry are available, generally not later than the day following the find, a formal letter is sent to SEPA.

SEPA are also able to review the survey reports and to request specific processing of the data in electronic format whenever they consider appropriate. The results of the surveys (the particles found) are summarised in the annual report to SEPA on Radioactivity Levels outside the Dounreay Site.

Although the above arrangements appear to satisfactorily convey the necessary information to SEPA, in light of the very large scale of the beach monitoring project, the significant cost to the public, and public interest in the ongoing investigation of the Dounreay particles, it was concluded by SEPA that a six-monthly review of beach monitoring should be undertaken. This report has been produced in response to this requirement, and is the first report on this time frequency to be submitted.

It is also recognised that relatively wide public interest has been shown in local beach monitoring. The simplest and most accessible route by which information can be made available to the public is via the UKAEA website. The latest issued annual review and summary details of particle finds on public beaches are currently published on the UKAEA web site.

6 CONCLUSIONS

UKAEA has successfully implemented the statutory monitoring schedule with the following exceptions:

- Sandside January survey: insufficient area coverage;
- Dounreay West foreshore: one survey missing owing to redeployment on Dunnet.

These will be addressed as follows:

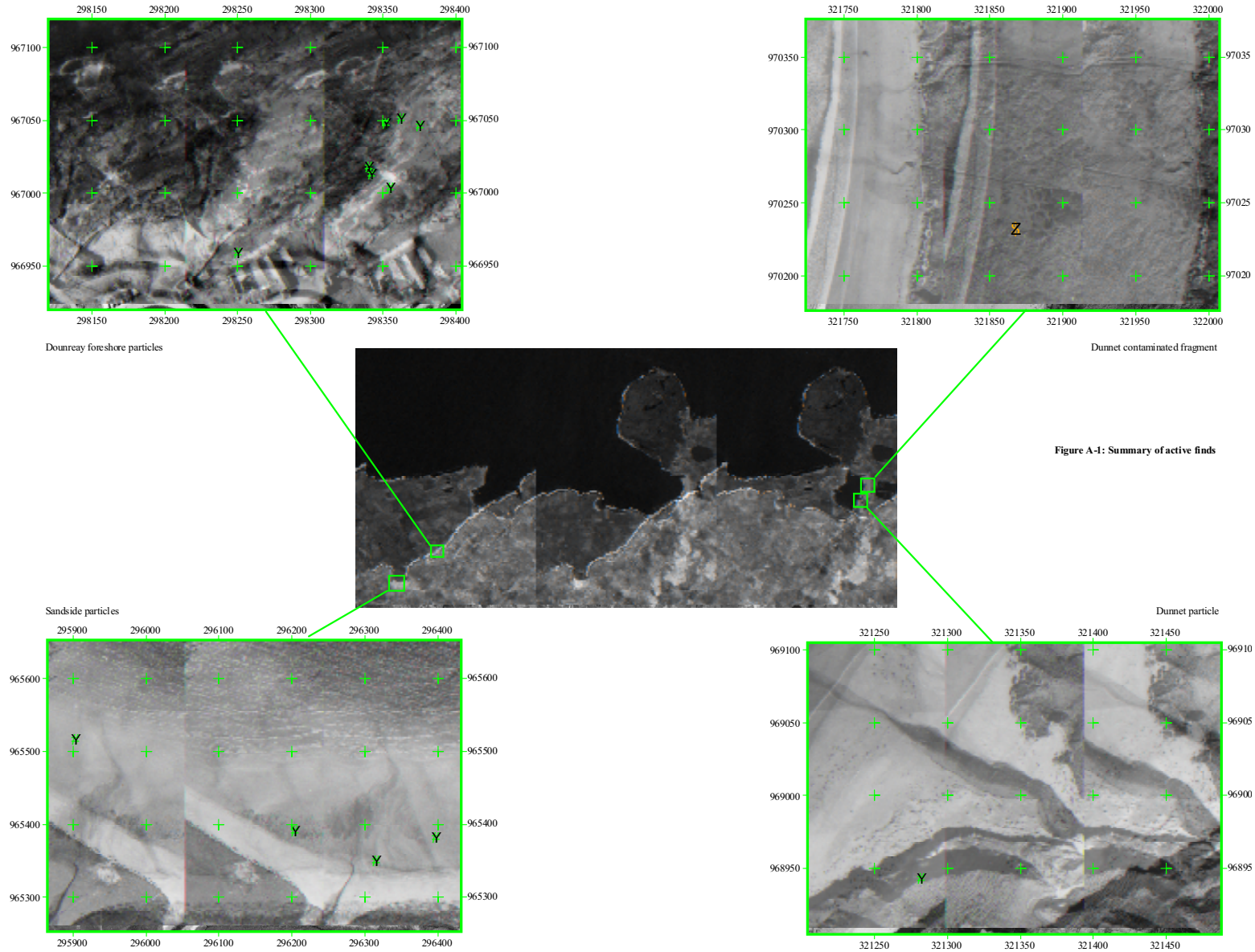
- more extensive coverage in future surveys to readdress the yearly average and take it back to at least the value of 250,000 square metres per month;
- one additional Dounreay West foreshore survey to be carried out later during the year.

The remaining aspects of the statutory requirements are fulfilled.

Investigations are currently ongoing to gain more knowledge about the Dunnet beach find in particular.

APPENDIX A

The following Figure A-1 shows a summary of the particles and the contaminated plastic fragment finds on a wide area map covering the area where surveys have taken place.



APPENDIX B

The following pictures show the extent of damage sustained by the Sandside access path during the spell of bad weather of early January and the status after the repairs.

Figure B-1 shows the very broken nature of the path, with large stones and very uneven track surface. Figure B-2 shows the path repaired with coarse gravel and sand.



Figure B-1: Storm damage to Sandside path



Figure B-2: Repaired Sandside path

APPENDIX C

The Eastern foreshore has been accessed as per planned schedule but on no occasion was sand available to be surveyed. In the following pages, a set of photographs is presented for the days in which a survey was planned.

Date of survey	Number of photographs
11-Jan-05	3
29-Jan-05	3
11-Feb-05	4
28-Feb-05	4
10-Mar-05	3
23-Mar-05	4
08-Apr-05	3
21-Apr-05	3



East foreshore 11th Jan 2004
Photograph 1



East foreshore 11th Jan 2004
Photograph 2



East foreshore 11th Jan 2004
Photograph 3



East foreshore 29th Jan 2005
Photograph 1



East foreshore 29th Jan 2005
Photograph 2



East foreshore 29th Jan 2005
Photograph 3



East foreshore 11th February 2006
Photograph 1



East foreshore 11th February 2006
Photograph 2



East foreshore 11th February 2006
Photograph 3





23rd March 2005
East foreshore 8th Apr 2005
Photograph 1



23rd March 2005
East foreshore 8th Apr 2005
Photograph 2



23rd March 2005
Friday 8th April 2005



East foreshore 21st Apr 2005
Photograph 1



East foreshore 21st Apr 2005
Photograph 2



East foreshore 21st Apr 2005
Photograph 3

