

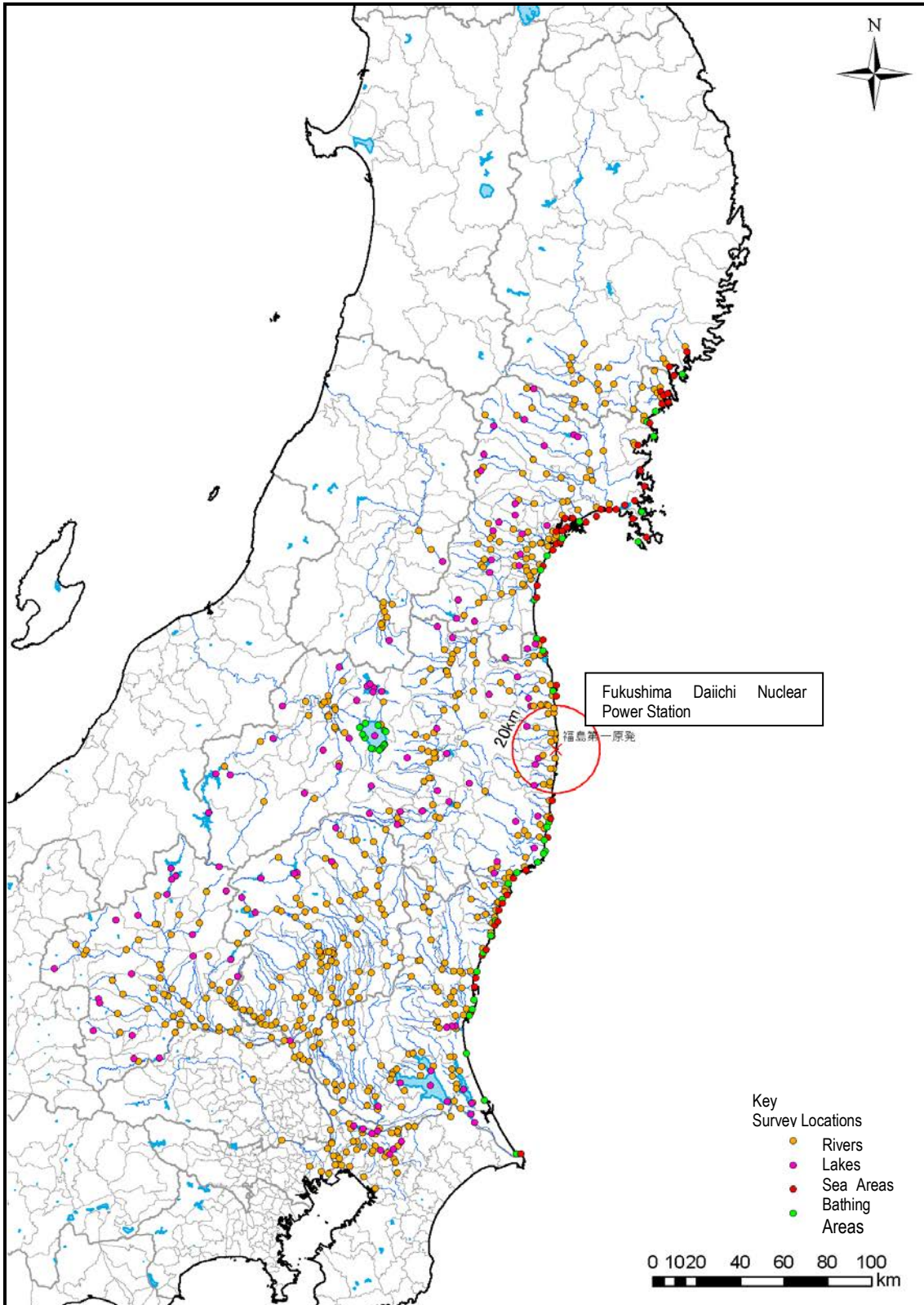
## FY2011 Radioactive Material Monitoring Surveys of the Water Environment

### 1. Survey Overview

Surveys of the concentration of radioactive material (radioactive iodine, radioactive cesium, and radiostrontium) in water, sediment and the surrounding environment (soil and herbaceous plants on river terraces and the shores of lakes) were carried out in water environments (surface water bodies (rivers, lakes and headwaters, coasts, etc.)) in the prefectures of Iwate, Miyagi, Yamagata, Fukushima, Ibaraki, Tochigi, Gunma, Saitama, Chiba, and Tokyo from August 2011 (surveys of the surrounding environment also included measurement of the air dose).

### 2. Number of Survey Locations

Survey	Prefecture	Survey Period	Rivers	Lakes and Headwaters	Sea Areas	Bathing Areas	Total
1 <sup>st</sup> time	Iwate	2011.12.21 - 2012. 1. 6	18	–	2	1	21
	Miyagi	2011.10. 3 - 11. 7	77	21	30	10	138
	Yamagata	2011.10.24 - 10.27	10	2	–	–	12
	Fukushima	2011. 9.15 - 10.14	113	46	9	25	193
	Ibaraki	2011. 8.30 - 10. 8	93	12	12	11	128
	Tochigi	2011.10. 5 - 10.24	107	8	–	–	115
	Gunma	2011.11.30 - 12.16	50	19	–	–	69
	Chiba	2011.10.31 - 11. 4	41	8	–	–	49
2 <sup>nd</sup> time	Miyagi	2012. 1.23 - 2.24	37	4	12	–	53
	Fukushima	2011.11.15 - 11.29	113	46	9	25	193
	Ibaraki	2012. 2.17 – 2.25	35	12	5	–	52
	Tochigi	2012. 2.20 – 2.29	54	4	–	–	58
	Gunma	2012. 2.23 - 3. 2	40	7	–	–	47
	Chiba(*)	2012. 2.13 - 2.17	46	8	–	–	54
3 <sup>rd</sup> time	Fukushima	2012. 1. 5 - 1.27	113	32	9	25	179
4th time	Fukushima	2012. 2.25 – 3.14	113	25	9	24	171
Total			1060	254	97	124	1532



Survey Locations (All)

### 3. Outline of Results

#### (1) Water

Of the 700 or so locations (1,532 specimens) at which surveys were carried out in FY2011, levels of 1Bq/L or more were detected at 21 river locations (29 specimens) and 11 lake locations (12 specimens). The highest reading obtained was 20Bq/L (cesium-134 and cesium-137) during the first survey in Fukushima Prefecture (location: Murohara Bridge (Nemiecho), Ukedo River, Fukushima Prefecture; collection date: September 26).

The results of the final survey carried out in FY2011 (end of January-March) showed that levels of 1Bq/L or more were detected at 6 locations (all rivers) and the highest reading obtained was 2Bq/L.

#### (2) Sediment

##### [Rivers, Lakes]

In the case of both rivers and lakes, high readings were seen at a limited number of locations, such as those within the 20km zone, but at the majority of locations, the figures were generally no higher than around 2,000Bq/kg.

As far as rivers are concerned, increases have been seen at some locations, such as estuaries, but levels generally fell or remained constant overall.

In terms of the trend among lakes, although there was some variation, substantial rises were seen at a limited number of locations, such as those within the 20km zone. No major increases were seen overall.

##### [Coasts (1-2km)]

Overall, levels were lower than in rivers and lakes, generally being no higher than 400-600Bq/kg.

In terms of the trend, although there was some variation, levels generally remained constant or fell overall.

Locations Where Radioactive Cesium was Detected (Water)

Category	Prefecture	Water Body	Location	Municipality	Sampling Date	Radioactive Cesium (Bq/L)	
						Cs-134	Cs-137
Rivers	Fukushima	Jizogawa River	Hamahatabashi Bridge	Shinchimachi Town	Sept. 19	<1	1
		Niidagawa River	Kidouchibashi Bridge	Minamisomashi City	Sept. 15	<1	1
			Sakekawabashi Bridge	Minamisomashi City	Sept. 16	1	<1
		Otagawa River	Ishiwatadobashi Bridge	Minamisomashi City	Sept. 16	1	3
			Kaminouchihashi Bridge	Minamisomashi City	Sept. 15	2	2
				Minamisomashi City	Nov. 29	<1	1
			Masudabashi Bridge	Minamisomashi City	Sept. 16	1	1
			JR Tetsudobashi Bridge	Minamisomashi City	Sept. 16	<1	1
			Maruyamabashi Bridge	Minamisomashi City	Sept. 26	1	<1
		Ukedogawa River	Muroharabashi Bridge	Namiemachi Town	Sept. 26	9	11
				Namiemachi Town	Nov. 21	<1	1
			Ukedobashi Bridge	Namiemachi Town	Sept. 26	7	8
		Takasegawa River	Keiobashi Bridge	Namiemachi Town	Sept. 26	<1	1
		Maedagawa River	National Route 6, west	Futabamachi Town	Sept. 26	3	3
				Futabamachi Town	Nov. 21	1	2
				Futabamachi Town	March 4	<1	1
			Nakahamabashi Bridge	Namiemachi Town	Sept. 26	4	4
				Namiemachi Town	Nov. 21	1	1
				Namiemachi Town	March 4	<1	1
		Kumagawa River	National Route 6, west	Okumamachi Town	Sept. 26	1	1
			Mikumabashi Bridge	Okumamachi Town	Sept. 26	1	<1
		Tomiokagawa River	Kobamabashi Bridge	Tomiokamachi Town	Sept. 26	1	1
					Jan. 6	1	1
		Ogunigawa River	Before the confluence with Hirosegawa River	Dateshi City	Sept. 18	<1	1
					March 4	<1	1
		Utsushigawa River	Osegawabashi Bridge	Nihonmatsushi City	Nov. 26	3	4
		Hirosegawa River	Jizogawarabashi Bridge	Dateshi City	Jan. 19	3	5
		Nigorigawa River	Before the confluence with Omorigawa River	Fukushimashi City	March 1	1	1
	Tochigi	Kurokawa River	Shindenbashi Bridge	Nasumachi Town	Oct. 5	<1	1
	Lakes	Fukushima	Soso (farm pond)Uchizawa		Somashi City	Somashi City	1
Matsugabo Dam (Utagawako Lake)			Somashi City	Somashi City	<1	1	
Mano Dam (1 m from the bottom)			Itatemura Village	Sept. 30	10	12	
Ganbe Dam Reservoir			Itatemura Village	Sept. 20	<1	1	
Yokokawa Dam Reservoir			Minamisomashi City	Sept. 16	2	3	

		Ogaki Dam		Namiemachi Town	Sept. 26	12	15
		Sakashita Dam		Okumamachi Town	Sept. 26	1	1
		Takikawa Dam		Kawauchimura Village	Sept. 26	<1	1
				Kawauchimura Village	March 4	<1	1
		Kenhoku (farm pond) Handanuma Lake		Korimachi Town	Sept. 20	2	3
		Kenchu (farm pond) Hounokusa		Koriyamashi City	March 1	1	1
Miyagi	Bagyunuma Lake	Lake exit	—	Oct. 24	1	2	

## [Survey Method]

### (1) Overview

Samples of water from the surface layer and bottom layer, samples of mud from the sediment at the river/lake/sea, and samples of soil and herbaceous plants from the surrounding environments (river terrace, lake shore, and beach) were collected at each site and analyzed for radioactive materials (radioactive iodine I-131, and radioactive cesium Cs-134 and Cs-137). In addition, the air dose was measured at the time the samples were collected. Tables 1-3 show the field survey methods used. Table 4 shows the method used to measure radioactive material, while Table 5 shows the methods used to analyze other items.

Filtration and other forms of pretreatment were not used when measuring radioactive materials in water.

Moreover, both sediment and soil were left in their wet state when measuring radioactive materials in such samples, with values for dried mud being obtained by converting the figures using the mud content (1-loss on drying) measured separately for each sample. Herbaceous plants were also measured in their wet state and the figures shown are the moist unit weight.

Table 1 Field Survey Methods (Water)

Item	Survey Method	Survey Subject			
		Rivers	Lakes and Headwaters	Coasts	Bathing Areas
Weather	Visual evaluation	○	○	○	○
Air temperature	Measured using a mercury-in-glass thermometer graduated in 0.1°C increments	○	○	○	○
Full depth	Measured using a measuring rope with red markings	○	○	○	○
Sampling depth	Measured using a measuring rope with red markings	○	○	○	○
Water temperature	Measured using a mercury-in-glass thermometer graduated in 0.1°C increments	○	○	○	○
Color	Evaluation using the Japan Color Research Institute color chart	○	○	○	○
Odor	Human olfactory evaluation	○	○	○	○
Transparency	Measurement using a transparency meter	○	—	—	—
Secchi disk depth	Measurement using a 30cm white Secchi disk	—	○	○	○
Conductivity	Measurement using an electrical conductivity meter (DKK-TOA Corporation WM-32EP)	○	○	—	○
Salinity	Measurement using a salinometer (JFE Advantech Co., Ltd. AAQ1183 (AAQ-RINKO))	—	—	○	—

Table 2 Field Survey Methods (Sediment)

Item	Survey Method	Survey Subject			
		Rivers	Lakes and Headwaters	Coasts	Bathing Areas
Sampling depth	Visual evaluation	○	○	○	○
Properties	Visual evaluation	○	○	○	○
Color	Evaluation using the Japan Color Research Institute Color Chart	○	○	○	○
Mud temperature	Measured using a mercury-in-glass thermometer graduated in 0.1°C increments	○	○	○	○
Odor	Human olfactory evaluation	○	○	○	○

Table 3 Field Survey Methods (Surrounding Environment)

Item	Survey Method	Survey Subject			
		Rivers	Lakes and Headwaters	Coasts	Bathing Areas
Properties	Visual evaluation	○	○	—	○
Color	Evaluation using the Japan Color Research Institute Color Chart	○	○	—	○
Odor	Human olfactory evaluation	○	○	—	○
Air dose	See "(2) Survey details" for method used	○	○	—	○

Table 4 Radioactive Material Analysis Methods and Lower Determination Limits

Item	Method of Analysis	Lower Determination Limit		
		Water	Sediment	Surrounding Environment (Soil and Herbaceous Plants)
Radioactive iodine (I-131)	<ul style="list-style-type: none"> <li>Measurement of gamma radiation using a germanium (Ge) semiconductor detector</li> <li>Gamma-ray Spectrum Analysis in a Radiological Emergency (2004 MEXT Radiation Measurement Method Series No.29)</li> </ul>	1	*	30
Radioactive cesium (Cs-134)		1	*	10
Radioactive cesium (Cs-137)		1	*	10
Radiostrontium (Sr-89)	Radiostrontium Analysis (2003 MEXT Radiation Measurement Method Series No.2)	—	2	—
Radiostrontium (Sr-90)		—	2	—

\* No lower determination limit was set for sediment, and each specimen was measured within the extent possible.

Table 5 Method of Analyzing Other Items and Number of Specimens

Item		Method of Analysis	Unit	Lower Determination Limit
Water	Suspended solids (SS)	Method given in Annex Table 9 in Environment Agency Notice No.59, December 1971 (Environmental Quality Standards for Water Pollution)	mg/L	1

	Turbidity	Japan Industrial Standard K 0101 9.4	degree	0.1
Sediment	Mechanical composition	Japan Industrial Standard A 1204	%	0.1
	Moisture content (mud content)	Japan Industrial Standard A 1203	%	—
	Soil particle density	Japan Industrial Standard A 1202	g/cm <sup>3</sup>	—

## (2) Survey details

### (Rivers)

#### Water

The following were observed at each survey location and surface layer water samples were collected using a water sampler from a bridge or the river bank at the survey location in question. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc.

- Field observation items: Full depth, sampling depth, water temperature, color, odor, Secchi disk depth, conductivity
- Items analyzed:
  - Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137)
  - Other items: Suspended solids (SS), turbidity



Water Sampler (Example: Van Dorn Sampler)

#### Sediment

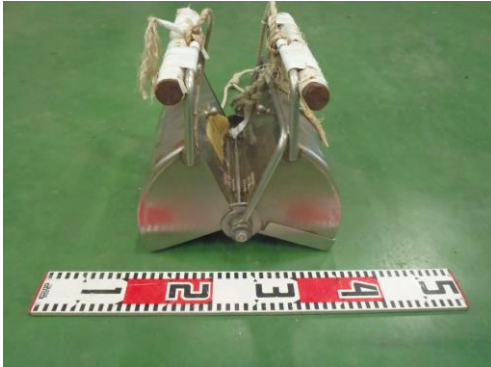
The field observation items listed below were taken at each survey location and then, while on a bridge or the river bank at the survey location in question, a sample of mud from the surface layer of sediment (surface layer to around 10cm) was collected from an area of 15cm×15cm square (or 20cm×20cm square) at least 3 times using a bottom sampler (Smith-McIntyre grab sampler or Ekman-Birge bottom sampler) and mixed well. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc.

- Field observation items: Sampling depth, properties, color, mud temperature, odor
- Items analyzed:
  - Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137), strontium\* (Sr-89, Sr-90)
  - Other items: Mechanical composition, moisture content (mud content)

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\*If analysis results revealed high concentrations of radioactive iodine and radioactive cesium in samples from a particular location, samples from that location were then analyzed for radiostrontium.

Smith-McIntyre Grab Sampler (simplified)



Ekman-Birge Bottom Sampler



Bottom samplers

### Surrounding environment (river terraces)

#### (i) Soil/herbaceous plants

Soil, and any weeds or other herbaceous plants growing abundantly in the environment (basically, the flood plain) surrounding each water and sediment survey location were collected and the concentration of radioactive substances therein was measured.

As a general rule, soil (including any short weeds, etc. growing on that soil) was collected from 1 place on the river terrace, etc. on both the left and right banks (2 places in total) at each survey location.

Moreover, as shown in the diagram below, soil samples were generally collected from 5 points within an area of 3-5m square (generally 4 points diagonally opposite each other and 1 point where the diagonals intersected).

The places within which the aforementioned samples were collected (3-5m square) and the layout of the collection points (5 points) were adjusted as necessary, according to the situation at the site. For example, in some cases, the 5 points chosen ran in row parallel with the river.

When collecting the samples, a soil sampler (5cm in diameter), etc. was used to collect soil from the surface layer down to a depth of 5cm, along with any short weeds, etc. growing on the soil. If the ground was hard, a trowel or similar tools were used as required. The soil collected from different collection points was put into different plastic bags.

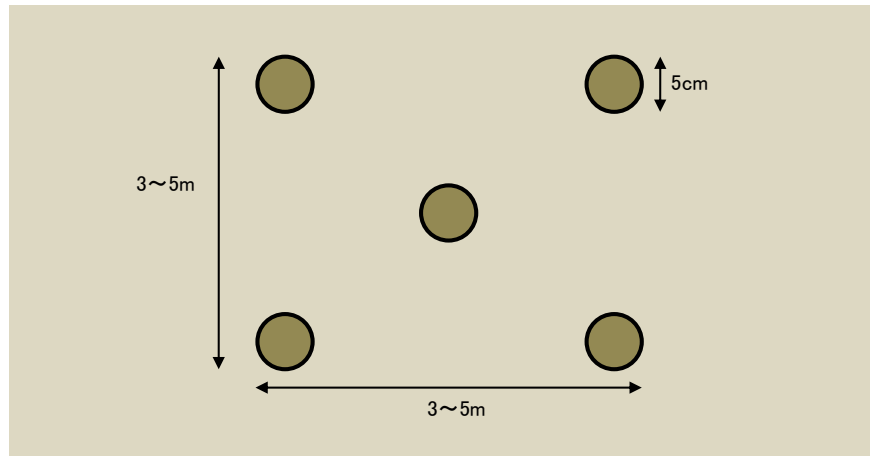
The requirements when collecting the samples were as follows.

- When selecting a site for soil collection, choose as flat a place as possible.
  - The soil collected should have fine particles and little gravel mixed in.
  - Any bulky pieces of plant material or splinters of wood scattered on the surface should be removed.
  - The root system layer should also be included as part of the soil collected.
  - Any short weeds or other herbaceous plants growing there should also be collected.
- Sample collection is focused on riverside land (the side of the river enclosed by an embankment), and samples are not collected in the following cases.
- If soil on the flood plain on both the left and right banks beside the survey location (within an area of around 50m) is not exposed due to the presence of a three-sided concrete culvert or similar structure
  - If soil is not exposed because of snow having accumulated

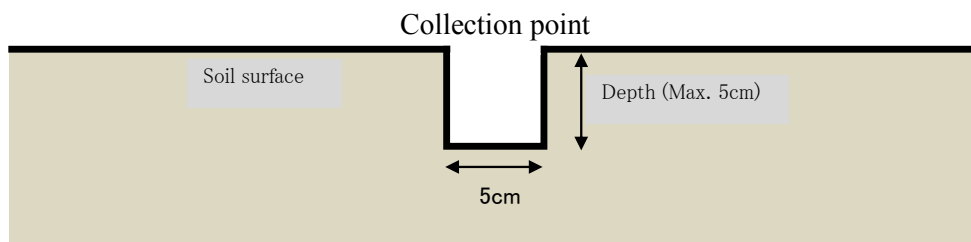


The samples collected (soil and herbaceous plants) from all five points were mixed together well on site to create a single specimen, and after returning to the laboratory, the soil and herbaceous plants were analyzed.

- Field observation: Properties, color, odor
- Items analyzed: • Radioactive materials: Iodine (I-131), cesium (Cs-134, Cs-137)



Layout of Soil Collection Points (5 points at each location)



Cross-section of a Soil Collection Point



Stainless steel pipe and hammer used for soil collection

(ii) Air dose

A survey meter (NaI scintillation survey meter, etc.) was slowly moved around the survey location from which soil had been collected, to check that there were no specific

areas where the dose equivalent rate spiked; once this had been confirmed, the air dose was measured.

If soil was not to be collected from that site, measurement was carried out at a point chosen at will near the location at which the water and mud samples had been collected. Measurement was not carried out if the soil was covered with snow.

The requirements when selecting the location where measurements would be taken were as follows.

- A flat, open area without any major obstacles (buildings, cars, etc.) within around 5m from the point in question.
- A site with as little vegetation as possible.
- A site that is on soil, wherever possible, and not on asphalt or concrete.

<Measurement method>

Measurement height: About 1m above the ground

Time constant: Set at around 10 seconds on devices that allow the constant to be adjusted

Measurement: After the survey meter stabilized, measurements were taken 5 times (the detector was held in place for a duration equivalent to 3 times the time constant and the indicated value was then read; if the needle fluctuated considerably, the time constant was increased) at 1-minute intervals (around 30 seconds in some cases), and the mean value was taken as the figure for that location.

The following four types of survey meter were used to measure air dose this time. Figures measured with a Model 3 or Model 5000 had a tendency to be a little higher than those measured with a TCS-172 or TCS-161 (about 1.6 times higher).

The remarks column in the survey results table shows which type of meter was used at each survey location.

Type of Survey Meter

Manufacturer	Model, etc.
Hitachi-Aloka Medical, Ltd.	TCS-172, TCS-161
Ludlum Measurement Inc.	MODEL 3
Health Physics Instruments	Model 5000



Source: Hitachi-Aloka Medical, Ltd. website  
Survey Meter (Example: Manufactured by Hitachi-Aloka Medical, Ltd.)

(Lakes and headwaters)

Water

The following were observed at each survey location and surface layer water samples were collected using a water sampler from a boat or the lake shore, taking the samples from the surface layer at a depth of 0.5m and from the bottom layer at a height of 1m from the lake bottom. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc. The survey was not carried out if the surface of the water was frozen.

- Field observation items: Full depth, water temperature, Secchi disk depth
- Items analyzed: • Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137)
  - Other items: Suspended solids (SS), turbidity

Sediment

The field observation items listed below were taken at each survey location and then, while on a boat or the lake shore at the survey location in question, a sample of mud from the surface layer (surface layer to around 10cm) was collected from an area of 15cm×15cm square (or 20cm×20cm square) at least 3 times using a bottom sampler (Smith-McIntyre grab sampler or Ekman-Birge bottom sampler, etc.) and mixed well. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc. The survey was not carried out if the surface of the water was frozen.

- Field observation items: Sampling depth, properties, color, mud temperature, odor, contaminants
- Items analyzed: • Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137), strontium (Sr-89, Sr-90)
  - Other items: Mechanical composition, moisture content (mud content)

Surrounding environment (lake shore)

(i) Soil

At lakes and headwaters, a sample was collected from one location where the soil was exposed on the lake shore or its margin. No sample was collected if this was not possible due to the whole circumference being covered with a concrete revetment or similar.

The survey method used was as detailed in "Surrounding environment (river terraces)" in "Rivers" above.

(ii) Air dose

Air dose surveys were carried out around each survey location from which soil was collected. If soil was not to be collected, the air dose was measured at a point chosen at will.

The survey method used was as detailed in "Surrounding environment (river terraces)" in "Rivers" above.

(Coast)

Water

The following were observed at each survey location and water samples were collected using a water sampler from a boat, taking the samples from the surface layer at a depth of 0.5m and from the bottom layer at a height of 1m from the sea floor. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc.

- Field observation items: Full depth, water temperature/salinity, Secchi disk depth
- Items analyzed: • Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137)
  - Other items: Suspended solids (SS), turbidity

### Sediment

The following were observed at each survey location and sediment samples were collected while on a boat. When collecting the mud, a sample from the surface layer of sediment (surface layer to around 10cm) was collected from an area of 15cm×15cm square (or 20cm×20cm square) at least 3 times using a bottom sampler (Smith-McIntyre grab sampler or Ekman-Birge bottom sampler) and mixed well. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc.

- Field observation items: Sampling depth, properties, color, mud temperature, odor
- Items analyzed: • Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137)
  - Other items: Mechanical composition, moisture content (mud content)

### (Bathing areas)

#### Water

A water sampler was used to collect water from the surface layer from the water's edge to a point where the water was 1-1.5m deep, in one area at each bathing area being surveyed. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc. The survey was not carried out if the surface of the water was frozen.

- Field observation items: Full depth, water temperature/salinity
- Items analyzed: • Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137)
  - Other items: Suspended solids (SS), turbidity

### Sediment

Sediment was collected from the water's edge to a point where the water was 1-1.5m deep, in one area at each bathing area being surveyed. When collecting the mud, a sample from the surface layer of sediment (surface layer to around 10cm) was collected from an area of 15cm×15cm square (or 20cm×20cm square) at least 3 times using a bottom sampler, etc. and mixed well. The samples collected were taken back to the laboratory for analysis of radioactive materials, etc. The survey was not carried out if the surface of the water was frozen.

- Field observation items: Sampling depth, properties, color, mud temperature, odor
- Items analyzed: • Radioactive material: Iodine (I-131), cesium (Cs-134, Cs-137)
  - Other items: Mechanical composition, moisture content (mud content)

### Surrounding environment (beaches)

#### (i) Soil

Sand, etc. was collected from one area near the middle of the beach at each bathing area being surveyed. Samples were not collected from the mountain/forest side of the hinterland.

The survey method used was as detailed in "Surrounding environment (river terraces)" in "Rivers" above.

#### (ii) Air dose

Air dose surveys were carried out around each survey location from which soil was collected.

The survey method used was as detailed in "Surrounding environment (river terraces)" in "Rivers" above.

\*Reference Materials

- Measurement of radioactive iodine and radioactive cesium
  - Measurement of Gamma Radiation Using a Germanium (Ge) Semiconductor Detector and Gamma-ray Spectrum Analysis in a Radiological Emergency (2004 MEXT Radiation Measurement Method Series No.29)  
<http://www.jcac.or.jp/series.html>  
<http://www.kankyo-hoshano.go.jp/series/lib/No29.pdf> (in Japanese)
- Measurement of radiostrontium
  - Measurement of Gamma Radiation Using a Germanium (Ge) Semiconductor Detector and Radiostrontium Analysis (2003 MEXT Radiation Measurement Method Series No.2)  
<http://www.jcac.or.jp/series.html>  
<http://www.kankyo-hoshano.go.jp/series/lib/No2.pdf> (in Japanese)
- Soil collection method for surveys of surrounding environments
  - MEXT Materials distributed at the 1st meeting of the Radiation Dose Distribution Map Advisory Committee (Document 1-4-2-2 Method of Collecting Soil Samples in Order to Create a Map of Soil Concentrations (Draft))  
[http://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/017/shiryo/1306566.htm](http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/017/shiryo/1306566.htm)  
[http://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/017/shiryo/\\_\\_\\_icsFiles/afieldfile/2011/05/30/1306566\\_2.pdf](http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/017/shiryo/___icsFiles/afieldfile/2011/05/30/1306566_2.pdf) (in Japanese)
  - MEXT Materials distributed at the 1st meeting of the Radiation Dose Distribution Map Advisory Committee (Document 1-5-2 Method of Collecting Data in Order to Measure Radioactivity Concentrations in Soil)  
[http://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/017/shiryo/1306566.htm](http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/017/shiryo/1306566.htm)  
[http://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/017/shiryo/\\_\\_\\_icsFiles/afieldfile/2011/05/30/1306566\\_4.pdf](http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/017/shiryo/___icsFiles/afieldfile/2011/05/30/1306566_4.pdf) (in Japanese)
- Spatial dose-rate measurement method
  - MEXT Materials distributed at the 1st meeting of the Radiation Dose Distribution Map Advisory Committee (Document 1-7 Guidelines on the Measurement of Spatial Dose-Rate (Dose Equivalent Rate per Centimeter) and the Collection of Soil Samples (Draft))  
[http://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/017/shiryo/1306566.htm](http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/017/shiryo/1306566.htm)  
[http://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/017/shiryo/\\_\\_\\_icsFiles/afieldfile/2011/05/30/1306566\\_7.pdf](http://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/017/shiryo/___icsFiles/afieldfile/2011/05/30/1306566_7.pdf) (in Japanese)