FY2014

Results of the Radioactive Material Monitoring in the Water Environment

March 2016

Ministry of the Environment

Contents

Outline

The following show the outline of the results of the FY2014 Monitoring of Radioactive Materials based on the Water Pollution Control Act.

Monitoring locations are as shown in Figure 1 and Figure 2.

1. National Radioactive Material Monitoring in the Water Environment in the Whole of Japan (FY2014)

○ Monitoring that was commenced in FY2014 at 110 locations for both public water areas and groundwater in 47 prefectures for the purpose of clarifying the distribution of radioactive materials in those areas nationwide (hereinafter referred to as the “Nationwide Monitoring”)

○ The total β radioactivity and detected γ-ray emitting radionuclides were within the past measurement trends except for one location where a relatively higher value than past records was measured in the sediment. Detection limits vary by radioactive material and monitoring location but were around 0.001 to 0.1 Bq/L for water and around 1 to 100 Bq/kg for sediments[1].

○ There were locations where the value of K-40 was rather high in public water areas and groundwater, but this was considered to have been caused by the influence of seawater.

○ Naturally occurring radionuclides that have not been included in nationwide surveys so far or have not been detectable in past surveys were detected but they were considered to be all thorium series radionuclides or uranium series radionuclides that are generally contained in natural soils and rocks, etc.

○ At some monitoring locations for public water areas, artificial radionuclides, Cs-134 and Cs-137, exceeding their detection limits were detected, but their values were within the past measurement trends[2].

○ It is appropriate to continue this monitoring the following fiscal year onward in order to clarify the distribution of radioactive materials in the water environment.

2. Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture (FY2011 to FY2014)

○ Monitoring that has been conducted continuously since August 2011 in response to the accident at the Tokyo Electric Power Company’s Fukushima Daiichi NPS (hereinafter referred to as the “Fukushima NPS Accident”), at around 600 locations for public water areas and around 400 locations for groundwater in and around Fukushima Prefecture for the purpose of clarifying the distribution of the accident-derived radioactive materials in the water environment (hereinafter referred to as the “Post-Earthquake Monitoring”)

○ The outline of the results of the measurement of radioactive cesium after the commencement of the FY2011 monitoring up to FY2014 is as follows.

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1 See Table 3-1-1, Table 3-1-2, and Table 3-1-3 of the report for the details of detection limits.

2 “Within the past measurement trends” means that the results of the latest monitoring survey are evaluated from a technical perspective as not displaying extreme deviation from the results of past similar monitoring surveys (such as the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted by the Nuclear Regulation Authority, and the Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture).

< Public water areas >

1) Water (detection limit: 1 Bq/L)

・Detection rates (number of detections/number of samples) were generally decreasing for rivers and lakes in all surveyed prefectures, and radioactive materials have not been detected in prefectures other than Fukushima Prefecture since FY2013.

・Radioactive materials were not detectable at any surveyed locations in coastal areas.

2) Sediments (detection limit: 10 Bq/kg)

a) Concentration distribution

・Rivers: There were some locations in Hamadori and Aizu in Fukushima Prefecture and in Ibaraki and Chiba Prefectures where activity concentrations were at relatively high levels. In other prefectures, concentrations were mostly at relatively low levels, although some locations showed relatively high concentrations.

・Lakes: There were some locations in Hamadori in Fukushima Prefecture where activity concentrations were at relatively high levels. In other prefectures, concentrations were mostly at relatively low levels, although some locations showed relatively high concentrations.

・Coastal areas: There were some locations in Miyagi and Fukushima Prefectures where activity concentrations were at relatively high levels. In other prefectures, concentrations were mostly at relatively low levels.

b) Changes in activity concentrations

・Rivers: A decreasing trend was observed in concentration levels at most locations.

・Lakes: Activity concentrations were generally decreasing or unchanged at most locations with some locations showing fluctuations. There were also a few locations where an increasing trend was observed.

・Coastal areas: Activity concentrations were generally decreasing at most locations with some locations showing fluctuations.

< Groundwater >

・Radioactive materials were not detectable in groundwater at any surveyed locations except for the two locations where they were detected in FY2011 (detection limit: 1 Bq/L).

○ The results concerning radionuclides other than radioactive cesium were as follows.

・I-131: Not detectable at any surveyed locations for public water areas and groundwater

・Sr-89: Not detectable at any surveyed locations for groundwater

・Sr-90: Detectable in sediment collected at several locations for public water areas, but activity concentrations were generally decreasing; Not detectable at any surveyed locations for groundwater

○ As measured activity concentrations are considered to fluctuate at some locations due to slight changes in sampling locations and properties, it is appropriate to continue this monitoring in the following fiscal years on an ongoing basis.

3. Other Radioactive Material Monitoring Conducted Nationwide (FY2014)

○ The results of the Monitoring of Environmental Radioactivity Levels, which has been conducted by the

Nuclear Regulation Authority for the purpose of clarifying the existence or nonexistence of the influence of nuclear facilities, etc. nationwide, were all within the past measurement trends.

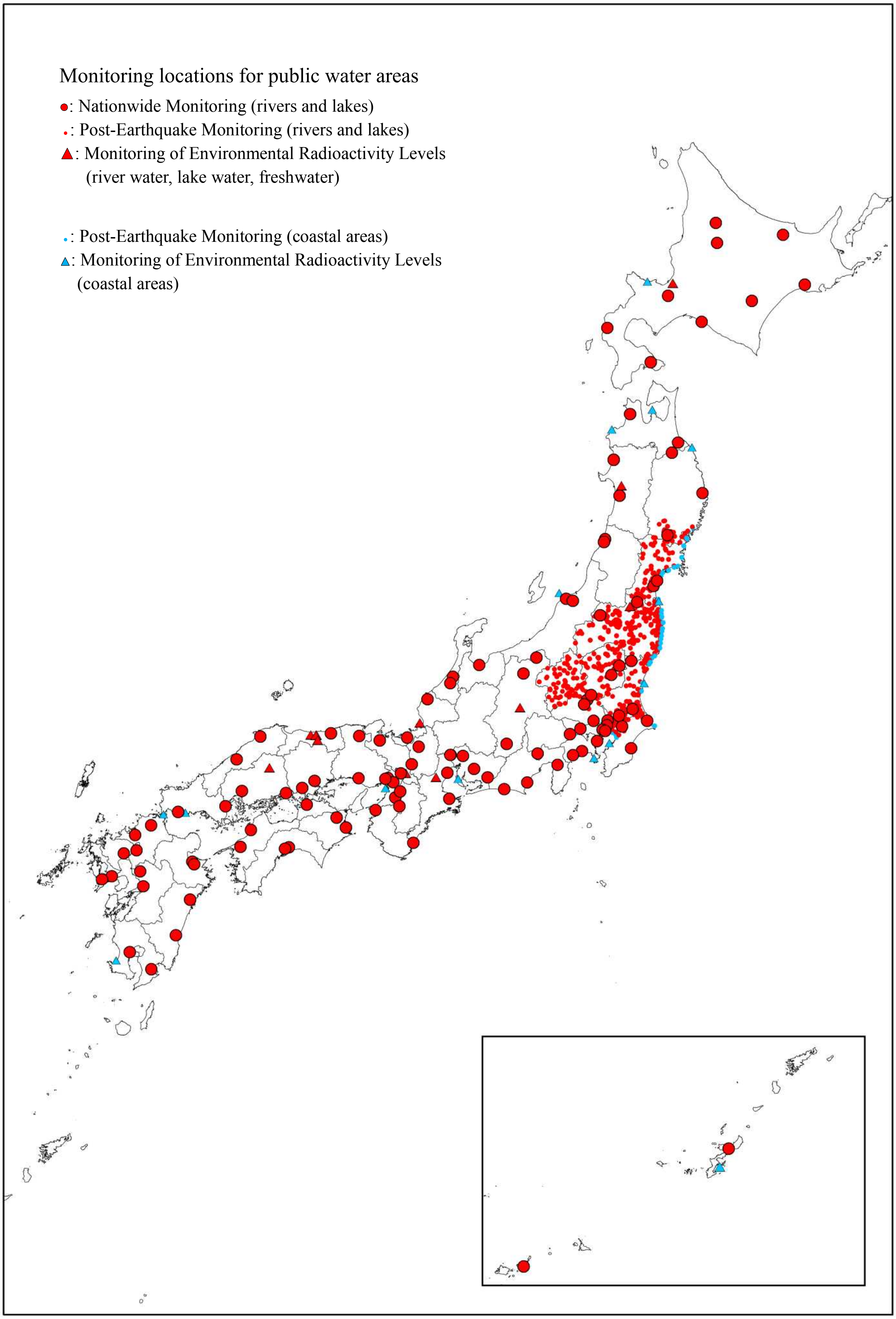


Figure 1 Locations for monitoring of radioactive materials based on the Water Pollution Control Act (public water areas)

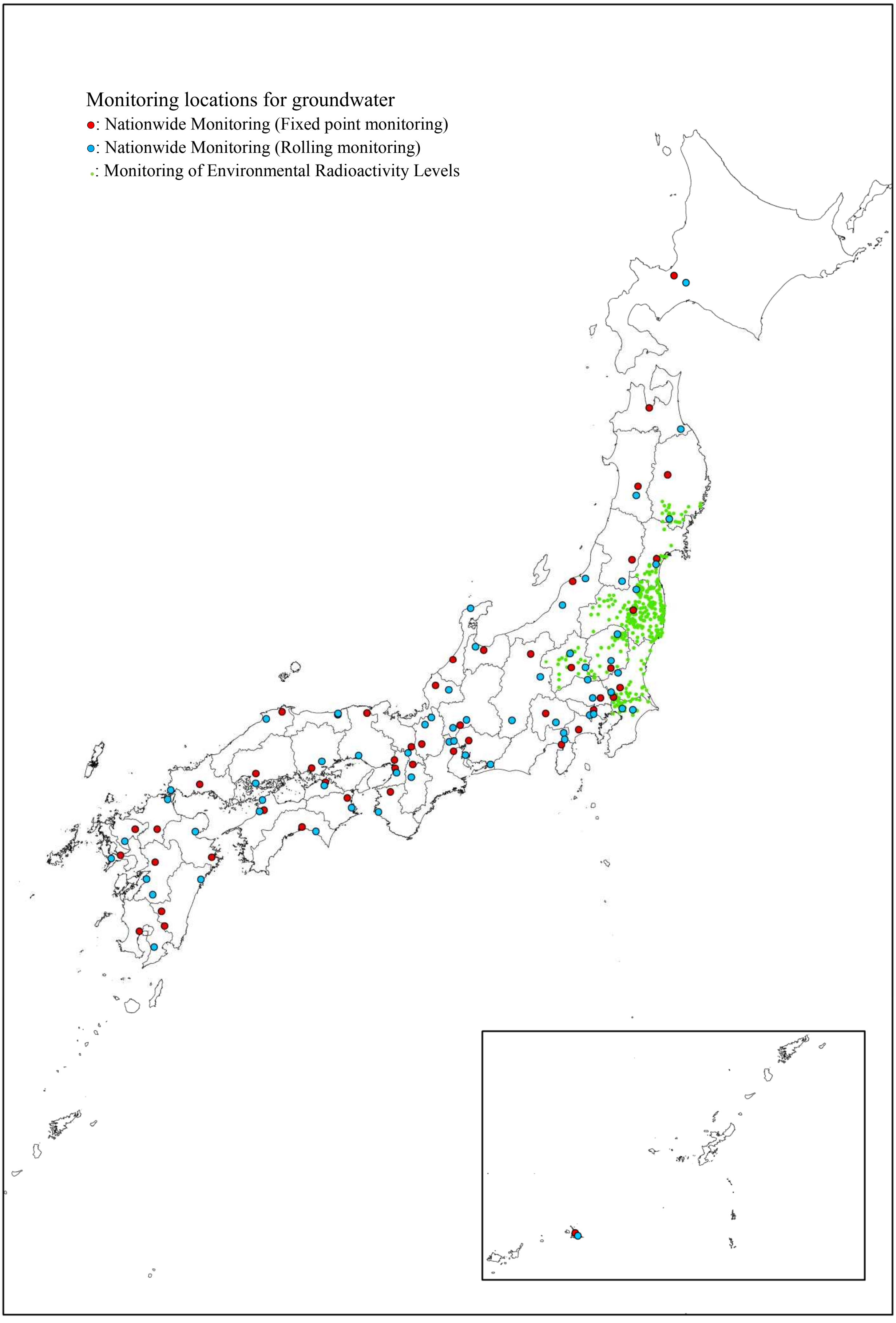


Figure 2 Locations for monitoring of radioactive materials based on the Water Pollution Control Act (groundwater)

Part 1: National Radioactive Material Monitoring in the Water Environment in the Whole of Japan (FY2014)

1. Objective and Details

1.1 Objective

The Fukushima NPS Accident discharged radioactive materials and caused environmental pollution. In response, the Water Pollution Control Act was amended and it was decided that the Minister of the Environment should monitor pollution caused by radioactive materials for public water areas and groundwater and release the results from the perspective of preserving the health and living environment of the people.

Under such circumstances, this monitoring aims to clarify the distribution of radioactive materials in public water areas and groundwater nationwide.

1.2 Details

(1) Monitoring locations

・Public water areas: 110 locations (rivers: 107 locations; lakes: 3 locations)

・Groundwater: 110 locations

Locations were selected based on the following thinking from the viewpoint of ensuring balanced nationwide monitoring (specific locations are as shown in Tables 1.2-2 and 1.2-3 and Figures 1.2-1 and 1.2-2).

(i) Public water areas

・The number of locations per prefecture was decided depending on the area and population, while securing at least one location in each prefecture, from the viewpoint of ensuring balanced nationwide monitoring.

・Locations within each prefecture were selected based on the following thinking:

a) Select representative rivers (including lakes) within each prefecture in the same numbers as those of the aforementioned locations in consideration of the area and population in their basins.

b) Regarding rivers selected as explained in a), select locations from among those for the monitoring of hazardous materials, etc. conducted under the Water Pollution Control Act, which are selected in consideration of water utilization points. For an individual river, prioritize locations in the lower sections (including lakes located downstream).

c) As this monitoring does not aim to clarify the influence of a specific source, exclude locations close to those subject to the Environmental Monitoring around Nuclear Facilities, etc. (Radiation Monitoring Grants), in principle.

(ii) Groundwater

・Two locations were chosen for each prefecture from the viewpoint of ensuring balanced nationwide monitoring, and one more location was added for each prefecture where the amount of groundwater utilized had been large in past several years.

・Locations within each prefecture were selected mainly from those for monitoring of environmental standard items for groundwater, based on the following conditions:

a) Select regional representative wells (such as wells built for monitoring or major wells with especially high frequency of use) in consideration of the utilization amount of groundwater from respective groundwater basins and water veins (hereinafter referred to as “groundwater basins, etc.”).

b) Prioritize wells owned or managed by local governments, etc. in consideration of the convenience of coordination in case an additional survey is required.

c) Select one location for continuous fixed point monitoring from among the locations selected in the manner above, while taking into account the utilization amount and representativeness in a broader area of the relevant groundwater basin, etc. Other locations are for rolling monitoring (for five years in principle).

d) As this monitoring does not aim to clarify the influence of a specific source, exclude locations close to those subject to the Environmental Monitoring around Nuclear Facilities, etc. (Radiation Monitoring Grants), in principle.

(2) Targets

・Public water areas: Water and sediments (for lakes, survey water both at the surface and bottom layers)
(Additionally, radioactive concentrations in soil and ambient dose rates are to be measured in the surrounding environment (river beds, etc.) near the sampling locations as reference.)

・Groundwater: Water
(Additionally, ambient dose rates are to be measured near the sampling locations as reference.)

(3) Frequencies and periods

・Public water areas: Once a year
However, monitoring was conducted four times a year at two locations (one location in eastern and western Japan, respectively) in order to check any annual variation.

・Groundwater: Fixed point monitoring was conducted once a year, and rolling monitoring was conducted once every five years in principle.

Periods for FY2014 monitoring are as shown in Table 1.2-4.

(4) Conducted analyses

The following analyses were conducted for collected samples.

・Measurement of total β radioactivity concentrations

・γ-ray spectrometry measurement using a germanium semiconductor detector (all detectable radionuclides, including naturally occurring radionuclides and artificial radionuclides, were surveyed in principle)

(5) Comparison with the past measurement trends

Obtained values were compared with the past measurement trends, and if any deviation was suspected, the validity of the measured values was rechecked (possibilities of transcription errors or insufficient adjustments of equipment, etc.).

This monitoring was just commenced and there are no accumulated data for the same locations. Therefore, the results of similar environmental monitoring conducted so far are to be used for comparison for the time being. Specifically, the results of the Monitoring of Environmental Radioactivity Levels and Monitoring of the Surrounding Environment conducted by the Nuclear Regulation Authority, as well as the results of the Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture conducted by the Ministry of the Environment were utilized. When making comparisons, due consideration was given to the possibility that the values of Cs-137 and other accident-derived radionuclides would have increased after the Fukushima NPS Accident.

Basically, nationwide data for the last two decades, which have become relatively free from the influence of nuclear tests in the atmosphere, were used. Also, with regard to the influence of the Fukushima NPS Accident, considering the influence immediately after it and based on actual measurement, “one year after the accident” was assumed to be a steady state, and therefore, the period from March 11, 2011 to March 10, 2012 was excluded.

(6) Measures to be taken when a value deviating from the past measurement trends was detected

The following measures are to be taken when a value deviating from the past measurement trends was detected (see Figure 1.2-3).

(6)-1 Release of preliminary values

Any value that is suspected to deviate from the past measurement trends should be immediately evaluated professionally by the chair and the deputy chair, and if it is judged highly urgent (when it has been confirmed that the value is highly likely to deviate from the past measurement trends, and additional detailed analyses are considered to be necessary), a preliminary report should be released as promptly as possible.

In such a case, the following related data should be compiled as basic data for professional evaluation. Members of the Evaluation Committee other than the chair and the deputy chair should be informed of the relevant information together with the professional evaluation by the chair and the deputy chair (see Table 1.2-1 for the chair and other committee members).

(i) Results of the measurement concerning water, sediments and ambient dose rates (results of the measurement of total β radioactivity concentrations and γ-ray spectrometry measurement)

(ii) Sampling dates, sampling locations (maps, water depth, river width, etc.), sampling methods, and sampling circumstances (photos)

(iii) Weather data for about one week near the measuring date (the amount of precipitation, in particular)

(iv) Ambient dose rates measured for the last one month or so in neighboring points

(v) Changes in past detected values of the relevant radionuclide

(6)-2 Detailed analyses and release of the results

For data for which the preliminary report was released as explained in (6)-1 above, the following detailed analyses are to be conducted and the results should be released.

・Concrete analysis to identify radionuclides (including measurement of individual radionuclides through a radiochemical analysis)

・Additional measurement in the surrounding areas of the relevant surveyed location

Table 1.2-1 List of members of the Evaluation Committee on Radioactive Material Monitoring in the Water Environment

IIMOTO Takeshi (Deputy chair)	Associate professor, Division for Environment, Health and Safety, the University of Tokyo
ISHII Nobuyoshi	Senior Researcher, Research Center for Radiation Protection, National Institute of Radiological Sciences
TOKUNAGA Tomochika	Professor, Department of Environment Systems, Graduate School of Frontier Sciences, the University of Tokyo
HAYASHI Seiji	Head, Center for Regional Environmental Research (Soil Environment Section), National Institute for Environmental Studies
FUKUSHIMA Takehiko (Chair)	Professor, Doctoral Program in Integrative Environment and Biomass Sciences, Graduate School, University of Tsukuba

Table 1.2-2 List of locations for the FY2014 Nationwide Monitoring (public water areas) (No. 1)

No.	Prefecture	Property	Sampling location		
			Water area	Location	Municipality
1	Hokkaido Prefecture	River	Ishikari River	Clean water intake at Ishikari River in Asahikawa City	Asahikawa City
2		River	Ishikari River	Intake at the Shirakawa water purification plant in Sapporo City	Sapporo City
3		River	Teshio River	Nakashibetsu Bridge (Intake at the Higashiyama water purification plant in Shibetsu City)	Shibetsu City
4		River	Tokoro River	Tadashi Bridge	Kitami City
5		River	Kushiro River	Intake at the Aikoku water purification plant in Kushiro City	Kushiro City
6		River	Tokachi River	Nantai Bridge	Obihiro City
7		River	Sarugawa River	Sarugawa Bridge (Tomigawa)	Hidaka Town
8		River	Matsukura River	Mitsumori Bridge (Before the confluence with Torasawa River)	Hakodate City
9		River	Shiribeshi-toshibetsu River	Intake at the Kitahiyama simple water plant in Kitahiyama Town	Setana Town
10	Aomori Prefecture	River	Iwaki River	Tsugaru-ohashi Bridge	Nakadomari Town
11		River	Mabechi River	Shiriuchi Bridge	Hachinohe City
12	Iwate Prefecture	River	Mabechi River	Fugane Bridge	Ninohe City
13		River	Heigawa River	Miyako Bridge	Miyako City
14		River	Kitakami River	Chitose Bridge	Ichinoseki City
15	Miyagi Prefecture	River	Abukuma River	Iwanuma (Abukuma Bridge)	Iwanuma City
16		River	Natori River	Yuriage-ohashi Bridge	Natori City
17	Akita Prefecture	River	Yoneshiro River	Noshiro Bridge	Noshiro City
18		River	Omono River	Kurose Bridge	Akita City
19	Yamagata Prefecture	River	Mogami River	Ryou Bridge	Sakata City
20		River	Akagawa River	Shinkawa Bridge	Sakata City
21	Fukushima Prefecture	River	Agano River	Shingo Dam	Kitakata City
22		River	Abukuma River	Taisho Bridge (Fushiguro)	Date City
23		River	Kujigawa River	Takachihara Bridge	Yamatsuri Town
24	Ibaraki Prefecture	Lake	Lake Kasumigaura	Center of the lake	Miho Village
25		River	Kokai River	Fumimaki Bridge	Toride City
26	Tochigi Prefecture	River	Nakagawa River	Shinnaka Bridge	Nakagawa Town
27		River	Kinugawa River	Kinugawa Bridge (Hoshakuji Temple)	Utsunomiya City
28	Gunma Prefecture	River	Tonegawa River	Toneozeki Weir	Chiyoda Town
29		River	Watarase River	Watarase-ohashi Bridge	Tatebayashi City
30	Saitama Prefecture	River	Arakawa River	Kuge Bridge	Kumagaya City
31		River	Arakawa River	Akigase Intake Weir	Saitama City/ Shiki City
32		River	Edogawa River	Nagareyama Bridge	Nagareyama City (Chiba Prefecture) / Misato City
33	Chiba Prefecture	River	Tonegawa River	Kakozeki Weir	Tonosho Town
34		River	Ichinomiya River	Nakanobashi Bridge	Ichinomiya Town
35		Lake	Lake Inbanuma	Lower area of clean water intake	Sakura City
36	Tokyo Metoroporis	River	Edogawa River	Shinkatsushika Bridge	Katsushika City
37		River	Tamagawa River	Haijima raw water supply point	Akishima City
38		River	Sumida River	Ryogoku Bridge	Chuo City / Sumida City
39		River	Arakawa River	Kasai Bridge	Koto City / Edogawa City
40	Kanagawa Prefecture	River	Tsurumi River	Rinko Tsurumi Bridge	Yokohama City
41		River	Sagami River	Banyu Bridge	Hiratsuka City
42		River	Sakawa River	Sakawa Bridge	Odawara City
43	Niigata Prefecture	River	Shinano River	Heisei-ohashi Bridge	Niigata City
44		River	Agano River	Oun Bridge	Niigata City
45	Toyama Prefecture	River	Jinzu River	Hagiura Bridge	Toyama City
46	Ishikawa Prefecture	River	Saigawa River	Okuwa Bridge	Kanazawa City
47		River	Tedori River	Hakusangoguchi Dike	Hakusan City
48	Fukui Prefecture	River	Kuzuryu River	Fuseda Bridge	Fukui City
49		River	Kitagawa River	Takatsuka Bridge	Obama City
50	Yamanashi Prefecture	River	Sagami River	Katsuragawa Bridge	Uenohara City
51		River	Fujikawa River	Manbu Bridge	Nanbu Town
52	Nagano Prefecture	River	Shinano River	Ozeki Bridge	Iiyama City
53		River	Saigawa River	Koichi Bridge	Nagano City
54		River	Tenryu River	Tsutsuji Bridge	Iida City

Table 1.2-2 List of locations for the FY2014 Nationwide Monitoring (public water areas) (No. 2)

No.	Prefecture	Property	Sampling location		
			Water area	Location	Municipality
55	Gifu Prefecture	River	Kisogawa River	Tokai-ohashi Bridge (Naruto)	Kaizu City
56		River	Nagara River	Tokai-ohashi Bridge	Kaizu City
57	Shizuoka Prefecture	River	Kanogawa River	Kurose Bridge	Numazu City
58		River	Ooi River	Fujimi Bridge	Yaizu City / Yoshida Town
59		River	Tenryu River	Kaketsuka Bridge	Iwata City / Hamamatsu City
60	Aichi Prefecture	River	Shonai River	Miwakare Bridge	Nagoya City
61		River	Yahagi River	Iwazutenjin Bridge	Okazaki City / Toyota City
62		River	Toyogawa River	Eshima Bridge	Toyokawa City
63	Mie Prefecture	River	Suzuka River	Ogura Bridge	Yokkaichi City
64		River	Miyakawa River	Watarai Bridge	Ise City
65	Shiga Prefecture	River	Adogawa River	Joan Bridge	Takashima City
66		Lake	Lake Biwako	Karasakioki-Chuo	—
67	Kyoto Prefecture	River	Yuragawa River	Yuragawa Bridge	Maizuru City
68		River	Katsura River	Before the confluence of three tributaries of Katsura River	Oyamazaki Town
69	Osaka Prefecture	River	Inagawa River	Gunko Bridge	Itami City (Hyogo prefecture)
70		River	Yodogawa River	Sugaharashirokita-ohashi Bridge	Osaka City
71		River	Ishikawa River	Takahashi	Tondabayashi City
72	Hyogo Prefecture	River	Kakogawa River	Kakogawa Bridge	Kakogawa City
73		River	Mukogawa River	Hyakkenbi	Takarazuka City
74		River	Maruyama River	Kaminogo Bridge	Toyooka City
75	Nara Prefecture	River	Yamato River	Fujii	Oji Town
76		River	Kinokawa River	Okura Bridge	Gojo City
77	Wakayama Prefecture	River	Kinokawa River	Shinrokkaizeki Weir	Wakayama City
78		River	Kumano River	Kumano-ohashi Bridge	Shingu City
79	Tottori Prefecture	River	Sendai River	Gyotoku	Tottori City
80	Shimane Prefecture	River	Hiikawa River	Kandatsu Bridge	Izumo City
81		River	Gonokawa River	Sakurae-ohashi Bridge	Gotsu City
82	Okayama Prefecture	River	Asahikawa River	Otoite Weir	Okayama City
83		River	Takahashi River	Kasumi Bridge	Kurashiki City
84	Hiroshima Prefecture	River	Ota River	Clean water intake in Hesaka	Hiroshima City
85		River	Ashida River	Kominomi Bridge	Fukuyama City
86	Yamaguchi Prefecture	River	Nishiki River	Clean water intake for the city	Iwakuni City
87		River	Koto River	Suenobu Bridge	Ube City
88	Tokushima Prefecture	River	Yoshino River	Takase Bridge	Ishii Town
89		River	Nakagawa River	Nakagawa Bridge	Anan City
90	Kagawa Prefecture	River	Dokigawa River	Marugame Bridge	Marugame City
91	Ehime Prefecture	River	Shigenobu River	Deai Bridge	Matsuyama City
92		River	Hijikawa River	Hijikawa Bridge	Ozu City
93	Kochi Prefecture	River	Kagami River	Kachuzeki Weir	Kochi City
94		River	Niyodo River	Hatazeki Weir (1) Center of flow	Ino Town
95	Fukuoka Prefecture	River	Onga River	Hinode Bridge	Nogata City
96		River	Nakagawa River	Shiobara Bridge	Fukuoka City
97		River	Chikugo River	Senoshita	Kurume City
98	Saga Prefecture	River	Kasegawa River	Kase Bridge	Saga City
99	Nagasaki Prefecture	River	Honmyo River	In front of Tenma Park	Isahaya City
100		River	Uragami River	Ohashizeki Weir	Nagasaki City
101	Kumamoto Prefecture	River	Kikuchi River	Shiroishi	Nagomi Town
102		River	Midori River	Uesugizeki Weir	Kumamoto City
103	Oita Prefecture	River	Oita River	Funaichi-ohashi Bridge	Oita City
104		River	Oono River	Shirataki Bridge	Oita City
105	Miyazaki Prefecture	River	Gokase River	Miwa	Nobeoka City
106		River	Oyodo River	Aioi Bridge	Miyazaki City
107	Kagoshima Prefecture	River	Kotsuki River	Iwasaki Bridge	Kagoshima City
108		River	Kimotsuki River	Matase Bridge	Kanoya City
109	Okinawa Prefecture	River	Genka River	Water intake	Nago City
110		River	Miyara River	Omoto water intake	Ishigaki City

Table 1.2-3 List of locations for the FY2014 Nationwide Monitoring (groundwater) (No. 1)

No.	Prefecture	Property	Location		
			Municipality	District	Monitoring method
1	Hokkaido Prefecture	Groundwater	Sapporo City	Kita Sanjo-Nishi, Chuo Ward	Fixed point monitoring
2		Groundwater	Eniwa City	Izaributo	Rolling monitoring
3	Aomori Prefecture	Groundwater	Aomori City	Shin Town	Fixed point monitoring
4		Groundwater	Hachinohe City	Kushihiki Aza Toriageishi	Rolling monitoring
5	Iwate Prefecture	Groundwater	Morioka City	Motomiya	Fixed point monitoring
6		Groundwater	Ichinoseki City	Nakasato Aza Shinkawara	Rolling monitoring
7	Miyagi Prefecture	Groundwater	Sendai City	Hon Town, Aoba Ward	Fixed point monitoring
8		Groundwater	Natori City	Takadatekawakami Higashikongoji	Rolling monitoring
9	Akita Prefecture	Groundwater	Daisen City	Niiyachi Aza Shimokawara	Fixed point monitoring
10		Groundwater	Yokote City	Omori Town Aza Onakajima	Rolling monitoring
11	Yamagata Prefecture	Groundwater	Yamagata City	Hatago Town	Fixed point monitoring
12		Groundwater	Yonezawa City	Tori Town	Rolling monitoring
13	Fukushima Prefecture	Groundwater	Koriyama City	Asahi	Fixed point monitoring
14		Groundwater	Fukushima City	Niida	Rolling monitoring
15	Ibaraki Prefecture	Groundwater	Tsukuba City	Karima	Fixed point monitoring
16		Groundwater	Chikusei City	Isami	Rolling monitoring
17		Groundwater	Bando City	Oyama	Rolling monitoring
18	Tochigi Prefecture	Groundwater	Shimotsuke City	Machida	Fixed point monitoring
19		Groundwater	Utsunomiya City	Yanaze Town	Rolling monitoring
20		Groundwater	Nasushiobara City	Torinome	Rolling monitoring
21	Gunma Prefecture	Groundwater	Maeba City	Shikishima Town	Fixed point monitoring
22		Groundwater	Kiryu City	Tenjin Town	Rolling monitoring
23		Groundwater	Numata City	Idoue Town	Rolling monitoring
24	Saitama Prefecture	Groundwater	Saitama City	Mikura, Minuma Ward	Fixed point monitoring
25		Groundwater	Kumagaya City	Yatsukuchi	Rolling monitoring
26		Groundwater	Kawagoe City	Minamitajima	Rolling monitoring
27	Chiba Prefecture	Groundwater	Kashiwa City	Funato	Fixed point monitoring
28		Groundwater	Yachiyo City	Murakami	Rolling monitoring
29		Groundwater	Tomisato City	Tokura	Rolling monitoring
30	Tokyo Metoroporis	Groundwater	Koganei City	Kajino Town	Fixed point monitoring
31		Groundwater	Tama City	Nagayama	Rolling monitoring
32	Kanagawa Prefecture	Groundwater	Hadano City	Imaizumi	Fixed point monitoring
33		Groundwater	Kawasaki City	Suge, Tama City	Rolling monitoring
34	Niigata Prefecture	Groundwater	Niigata City	Nagata, Chuo Ward	Fixed point monitoring
35		Groundwater	Shibata City	Yukata Town	Rolling monitoring
36		Groundwater	Joetsu City	Minato Town	Rolling monitoring
37	Toyama Prefecture	Groundwater	Toyama City	Hunahashikita Town	Fixed point monitoring
38		Groundwater	Takaoka City	Nakagawasono Town	Rolling monitoring
39	Ishikawa Prefecture	Groundwater	Hakusan City	Kuramitsu	Fixed point monitoring
40		Groundwater	Wajima City	Kawai Town, 2-bu	Rolling monitoring
41	Fukui Prefecture	Groundwater	Fukui City	Ote	Fixed point monitoring
42		Groundwater	Ono City	Tomoe	Rolling monitoring
43	Yamanashi Prefecture	Groundwater	Showa Town	Nishijo Shinden	Fixed point monitoring
44		Groundwater	Fujikawaguchiko Town	Odachi	Rolling monitoring
45	Nagano Prefecture	Groundwater	Nagano City	Tsurugamidori Town	Fixed point monitoring
46		Groundwater	Saku City	Ko aza Kamisairenji	Rolling monitoring
47		Groundwater	Iida City	Ote Town	Rolling monitoring
48	Gifu Prefecture	Groundwater	Gifu City	Kanoshimizu Town	Fixed point monitoring
49		Groundwater	Ogaki City	Marunouchi	Rolling monitoring
50		Groundwater	Seki City	Kose	Rolling monitoring
51	Shizuoka Prefecture	Groundwater	Numazu City	Izumi Town	Fixed point monitoring
52		Groundwater	Gotenba City	Higashitanaka	Rolling monitoring
53		Groundwater	Susono City	Mishuku	Rolling monitoring
54	Aichi Prefecture	Groundwater	Nagoya City	Kawaharatori, Showa Ward	Fixed point monitoring
55		Groundwater	Toyoha City	Mukaiyamaoike Town	Rolling monitoring
56		Groundwater	Handa City	Ikeda Town	Rolling monitoring

Table 1.2-3 List of locations for the FY2014 Nationwide Monitoring (groundwater) (No. 2)

No.	Prefecture	Property	Location		
			Municipality	District	Monitoring method
57	Mie Prefecture	Groundwater	Yokkaichi City	Daikyo Town	Fixed point monitoring
58		Groundwater	Inabe City	Inabe Town Kamikasada	Rolling monitoring
59		Groundwater	Kuwana City	Tado Town Yui	Rolling monitoring
60	Shiga Prefecture	Groundwater	Moriyama City	Miyake Town	Fixed point monitoring
61		Groundwater	Nagahama City	Nishiazai Town Yanokuma	Rolling monitoring
62		Groundwater	Takashima City	Imazu Town	Rolling monitoring
63	Kyoto Prefecture	Groundwater	Kyoto City	Kamihonnojimae Town, Nakagyo Ward	Fixed point monitoring
64		Groundwater	Oyamazaki Town	Shimoueno	Rolling monitoring
65	Osaka Prefecture	Groundwater	Osaka City	Tsuru Town, Taisho Ward	Fixed point monitoring
66		Groundwater	Sakai City	Daisennaka Town, Sakai Ward	Rolling monitoring
67	Hyogo Prefecture	Groundwater	Itami City	Kuchisakai	Fixed point monitoring
68		Groundwater	Toyooka City	Saiwai Town	Fixed point monitoring
69		Groundwater	Himeji City	Hojo	Rolling monitoring
70	Nara Prefecture	Groundwater	Nara City	Sakyo	Fixed point monitoring
71		Groundwater	Kashihara City	Okubo Town	Rolling monitoring
72	Wakayama Prefecture	Groundwater	Kinokawa City	Takano	Fixed point monitoring
73		Groundwater	Gobo City	Sono	Rolling monitoring
74	Tottori Prefecture	Groundwater	Tottori City	Saiwai Town	Fixed point monitoring
75		Groundwater	Tottori City	Denen Town	Rolling monitoring
76	Shimane Prefecture	Groundwater	Matsue City	Nishikawatsu Town	Fixed point monitoring
77		Groundwater	Izumo City	Enya Town	Rolling monitoring
78	Okayama Prefecture	Groundwater	Kurashiki City	Fukui	Fixed point monitoring
79		Groundwater	Okayama City	Imazaike, Naka Ward	Rolling monitoring
80	Hiroshima Prefecture	Groundwater	Hiroshima City	Ushiroyamako, Kamiseno Town, Aki Ward	Fixed point monitoring
81		Groundwater	Kure City	Hirobentenbashi Town	Rolling monitoring
82	Yamaguchi Prefecture	Groundwater	Yamaguchi City	Ouchimihori	Fixed point monitoring
83		Groundwater	Shimonoseki City	Tomito Town	Rolling monitoring
84	Tokushima Prefecture	Groundwater	Tokushima City	Fudohoncho Town	Fixed point monitoring
85		Groundwater	Anan City		Rolling monitoring
86	Kagawa Prefecture	Groundwater	Takamatsu City	Bancho Town	Fixed point monitoring
87		Groundwater	Takamatsu City	Ichinomiya Town	Rolling monitoring
88	Ehime Prefecture	Groundwater	Matsuyama City	Hirai Town	Fixed point monitoring
89		Groundwater	Matsuyama City	Nakanishiuchi	Rolling monitoring
90		Groundwater	Iyo City	Ueno	Rolling monitoring
91	Kochi Prefecture	Groundwater	Kochi City	Kerako	Fixed point monitoring
92		Groundwater	Aki City	Yanomaru	Rolling monitoring
93	Fukuoka Prefecture	Groundwater	Kurume City	Tanushimaru Town Akinari	Fixed point monitoring
94		Groundwater	Kitakyushu City	Fujimi, Kokuraminami Ward	Rolling monitoring
95	Saga Prefecture	Groundwater	Saga City	Yamato Town Niji	Fixed point monitoring
96		Groundwater	Kashima City	Nodomibunbaba	Rolling monitoring
97	Nagasaki Prefecture	Groundwater	Isahaya City	Sakaeda Town	Fixed point monitoring
98		Groundwater	Nagasaki City	Ohashi	Rolling monitoring
99	Kumamoto Prefecture	Groundwater	Kumamoto City	Suizenji, Chuo Ward	Fixed point monitoring
100		Groundwater	Yatsushiro City	Furujo Town	Rolling monitoring
101		Groundwater	Hitoyoshi City	Inoguchinoso	Rolling monitoring
102	Oita Prefecture	Groundwater	Saiki City	Kamioka	Fixed point monitoring
103		Groundwater	Hiji Town	Toyoka	Rolling monitoring
104	Miyazaki Prefecture	Groundwater	Miyakonojo City	Minamiyokoichi Town	Fixed point monitoring
105		Groundwater	Kobayashi City	Minaminishikata	Fixed point monitoring
106		Groundwater	Nobeoka City	Byumachi Town	Rolling monitoring
107	Kagoshima Prefecture	Groundwater	Kagoshima City	Tamazato Town	Fixed point monitoring
108		Groundwater	Kanoya City	Tasaki Town	Rolling monitoring
109	Okinawa Prefecture	Groundwater	Miyakojima City	Hirahigashinakasonezoe	Fixed point monitoring
110		Groundwater	Miyakojima City	Gusukube	Rolling monitoring

(*) For Location 65 in Osaka City, Osaka, measurement was not conducted as a sufficient amount of water could not be collected due to water shortage. The location will be changed for FY2015 onward.

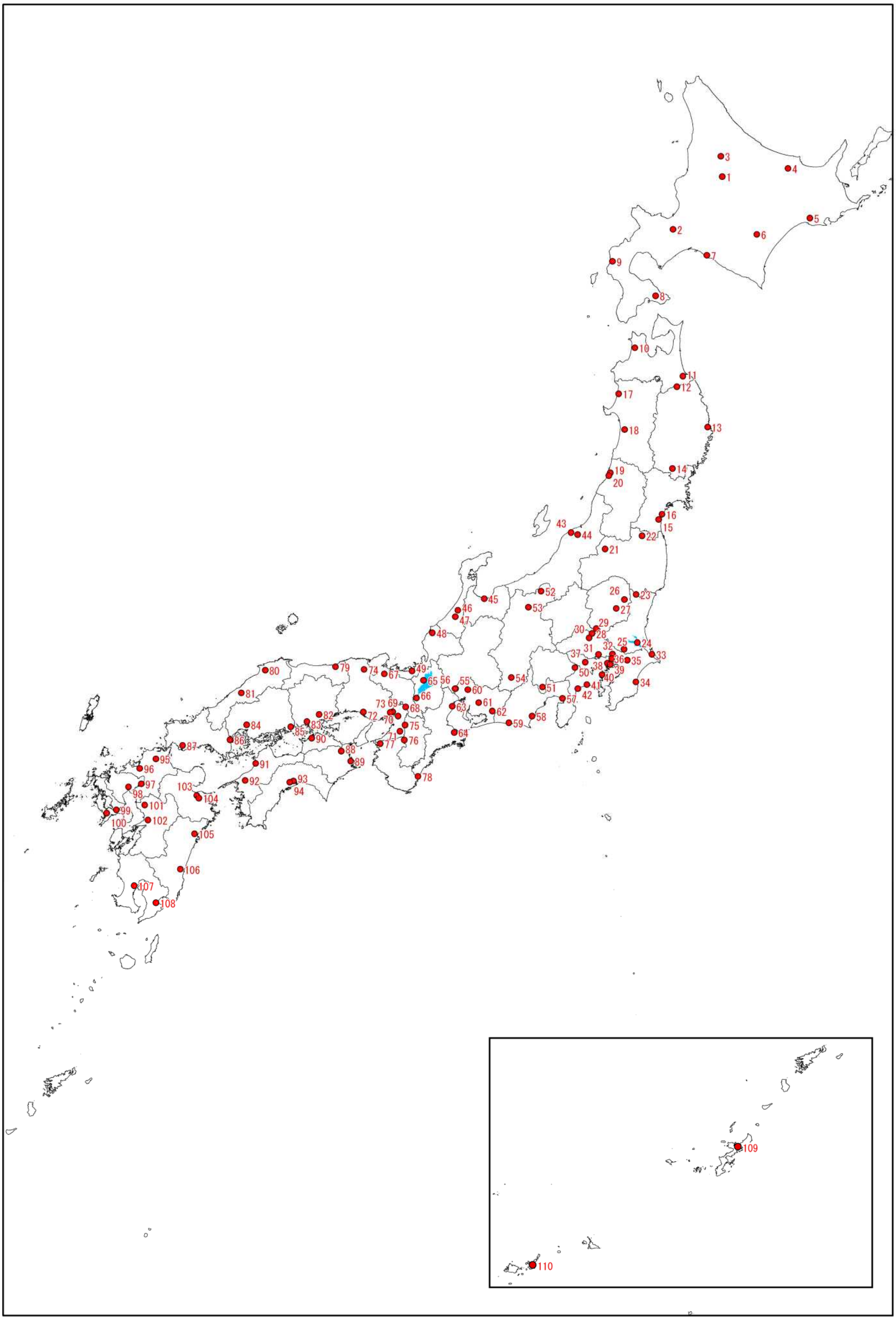


Figure 1.2-1 Map showing locations for the FY2014 Nationwide Monitoring (public water areas)

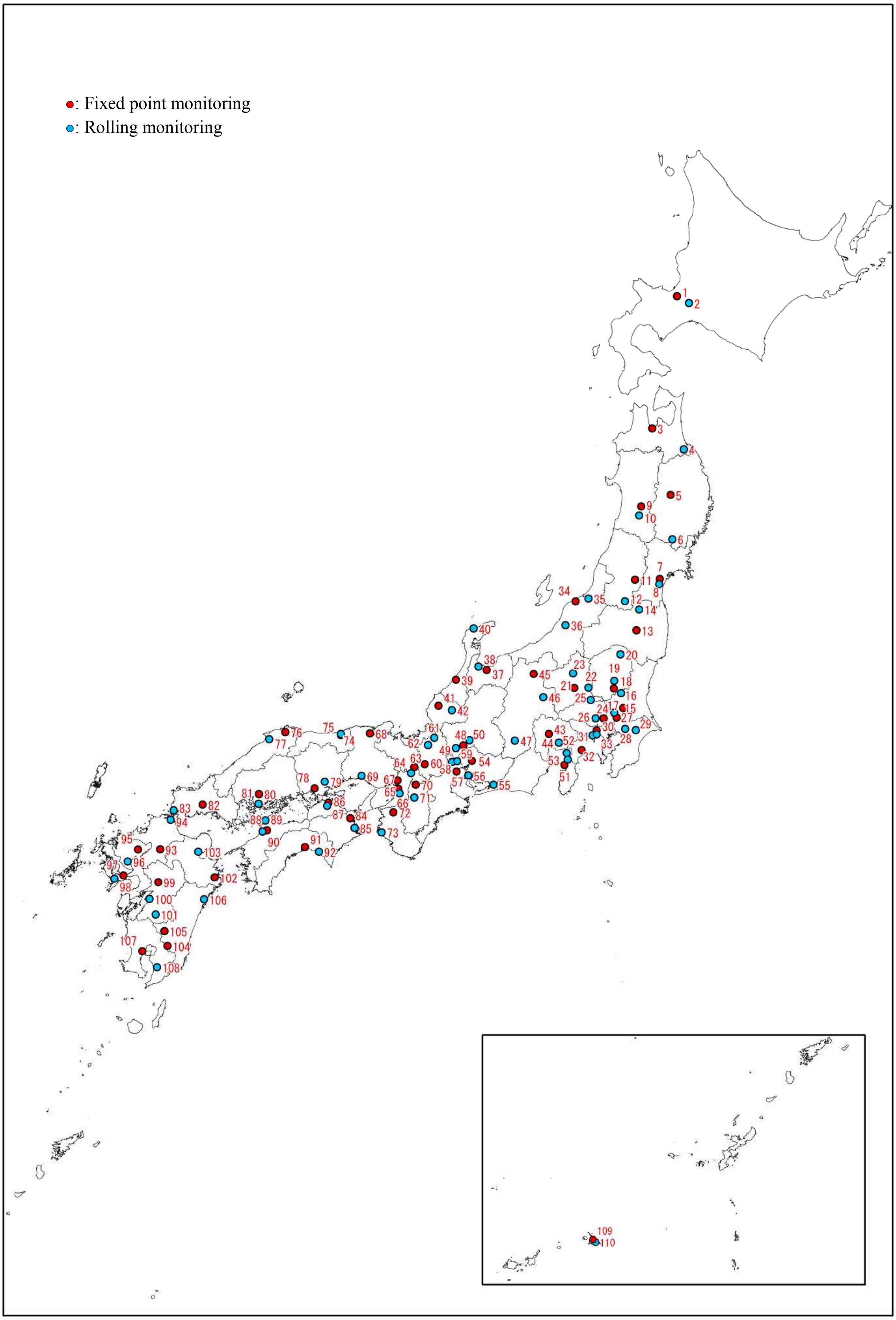


Figure 1.2-2 Map showing locations for the FY2014 Nationwide Monitoring (groundwater)

Table 1.2-4 Monitoring points and period by block (FY2014)

Block	Prefectures	Public water areas		Groundwater	
		Number of locations (*1)	Period	Number of locations	Period
Hokkaido block	Hokkaido	9	Aug. 26 to Oct. 24	2	Aug. 25 to Aug. 27
Tohoku block	Aomori, Iwate, Miyagi, Akita, Yamagata, and Fukushima	14	Sept. 1 to Sept. 18	12	Aug. 26 to Sept. 11
Kanto block	Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Niigata, Yamanashi, and Shizuoka	26 (2)	Aug. 25 to Sept. 18	27	Aug. 25 to Oct. 21
Chubu block	Toyama, Ishikawa, Fukui, Nagano, Gifu, Aichi, and Mie	15	Sept. 3 to Sept. 19	18	Sept. 1 to Sept. 19
Kinki block	Shiga, Kyoto, Osaka, Hyogo, Nara, and Wakayama	14 (1)	Sept. 3 to Sept. 18	13	Sept. 3 to Sept. 19
Chugoku-Shikoku block	Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime, and Kochi	16	Aug. 28 to Sept. 17	19	Aug. 25 to Sept. 18
Kyushu and Okinawa block	Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, and Okinawa	16	Aug. 25 to Sept. 17	18	Aug. 25 to Sept. 16
Survey to check annual variation	Gunma and Okayama	2	Aug. 25 to Jan. 26	-	-

(*1) Numbers in parentheses are those of monitoring locations for lakes and other numbers are those of monitoring locations for rivers.

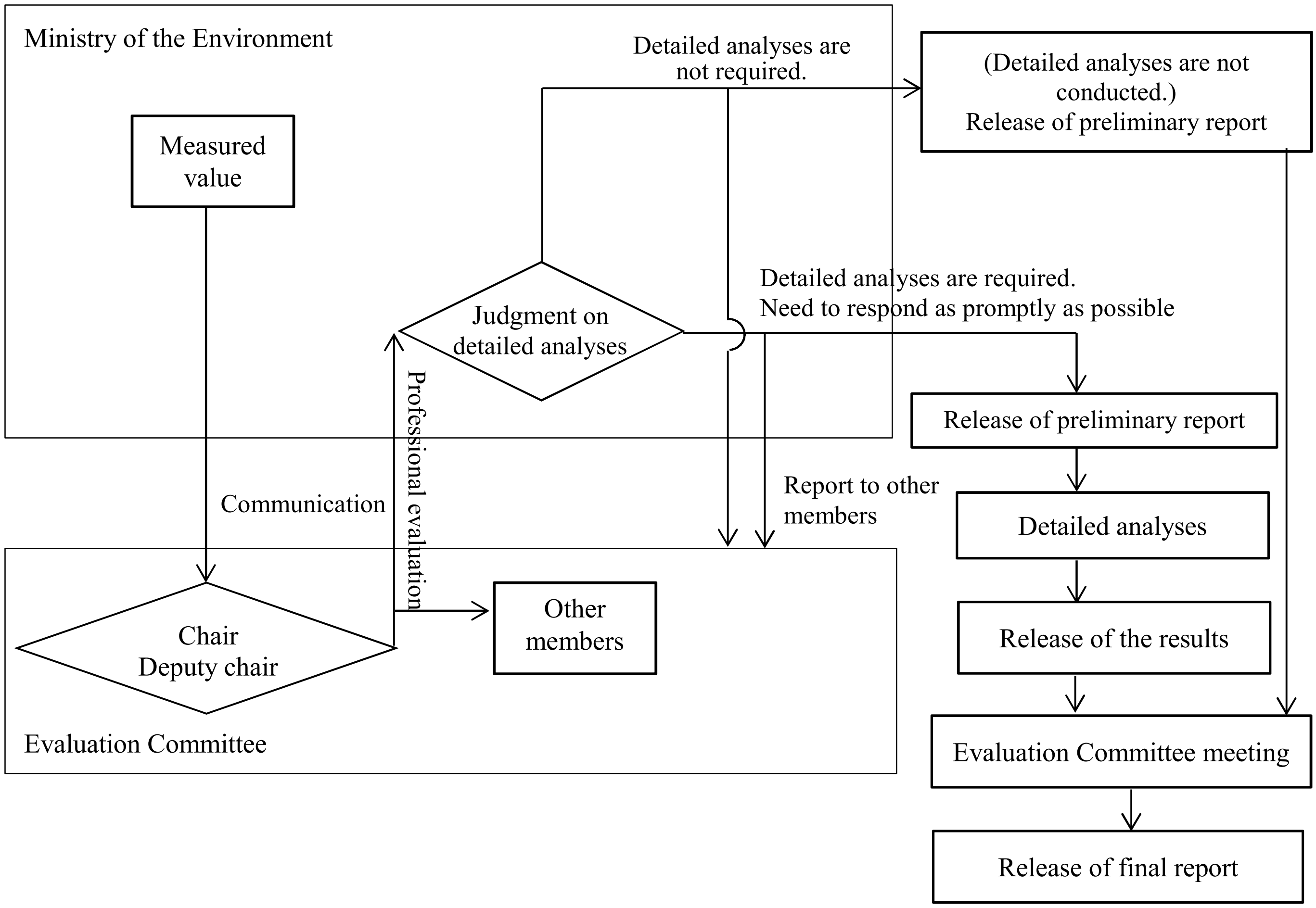


Figure 1.2-3 Procedures for professional evaluation of the results of the Nationwide Monitoring

2. Survey Methods and Analysis Methods

2.1 Survey methods

Samples were collected based on the following guidelines in principle, as outlined below.

- Water Quality Survey Method (September 30, 1971; Notice Kansuikan No. 30 issued by the Director of the Water Quality Preservation Bureau, Ministry of the Environment)
- Sediment Survey Method (August 8, 2012; Notice Kansuitaisuihatsu No. 120725002 issued by the Director of the Environmental Management Bureau, Ministry of the Environment)
- Groundwater Quality Survey Method (September 14, 1989; Notice Kansuikan No. 189 issued by the Director of the Water Quality Preservation Bureau, Ministry of the Environment)
- Environmental Sample Collection Method (1983, MEXT's Radioactivity Measurement Method Series)
- Sample Pretreatment for Instrumental Analysis Using Germanium Semiconductor Detectors (1982, MEXT's Radioactivity Measurement Method Series)

(1) Public water areas

- Water:

  Water samples of around 160 L (hydrochloric acid added) and around 2 L (nitric acid added) were collected at the predetermined points. Out of the 160 L (hydrochloric acid added), 80 L was used for the γ-ray spectrometry measurement and the remaining 80 L was preserved for possible detailed analyses. Out of the 2 L (nitric acid added), 1 L was used for the measurement of total β radioactivity concentrations. Additionally, the transparency (or Secchi disk depth) was measured upon collecting water samples, and if any influence of rainwater was suspected as a result of a comparison with past data or when there seems to be an influence of rainwater in light of the circumstances at locations without any past data where the transparency (or Secchi disk depth) was 50 cm or less, sampling at such locations was judged to be inappropriate.

- Sediments:

  Bottom sediment samples of around 6L were collected at the predetermined points at a depth of around 10 cm from the surface layer by using an Ekman-Birge grab sampler, and 3L out of the 6 L was used for the γ-ray spectrometry measurement.

- Soil:

  Soil samples (around 5 cm in diameter) were collected at a depth of around 5cm at five points within a 3 to 5 meter square (four vertexes and the diagonal intersection point), or when it is difficult to find an appropriate square to determine such five sampling points, at five points with 3 to 5 meter intervals along a river, and were brought back separately. Samples thus collected at the five points were mixed in equal amounts respectively and were used for analyses.

- Ambient dose rates (soil sampling locations):

  Ambient dose rates were measured by installing NaI (Tl) scintillation survey meters at a height of 1m from the ground surface on both banks of a river (or in the case of a lake, installing a NaI (Tl) scintillation survey meter at one point on lake side) in a manner to face the sampling point of river water (or lake water).

(2) Groundwater

・Water:

Groundwater samples of around 160 L (hydrochloric acid added) and around 2 L (nitric acid added) were collected at the predetermined wells, etc. 80 L of the 160 L (hydrochloric acid added) was used for the γ-ray spectrometry measurement and the remaining 80 L was preserved for possible detailed analyses. 1 L of the 2 L (nitric acid added) was used for the measurement of total β radioactivity concentrations.

When collecting water samples, it was confirmed that water temperature, transparency, pH, and electrical conductivity remained constant by letting the water pass for several minutes, and changes in the transparency, etc. thereafter were recorded as notes.

・Ambient dose rates (soil sampling locations):

Ambient dose rates were measured by installing NaI (Tl) scintillation survey meters at a height of 1 m from the ground surface near the relevant wells, etc. in a manner to face the sampling point of groundwater (or the groundwater layer).

2.2 Analysis methods

The measurement of total β radioactivity concentrations and γ-ray spectrometry measurement using a germanium semiconductor detector were conducted by the following methods for public water areas (water, sediments and soil) and groundwater (water). The γ-ray spectrometry measurement covered all detectable radionuclides (including naturally occurring radionuclides and artificial radionuclides) in principle. Detected values were indicated with two significant digits in the unit of "Bq/L" in the case of water samples from public water areas and groundwater samples, and in the unit of "Bq/kg (dry)" in the case of sediment samples from public water areas.

Adopted analysis methods were basically in line with the MEXT's Radioactivity Measurement Method Series, and detection limits were set at around 0.001 to 0.01 Bq/L for water samples and around 1 to 30 Bq/kg (dry) for sediment samples (however, these detection limits do not apply for I-131 or other radionuclides volatilized in pretreatment process for measurement analyses).

・Measurement of total β radioactivity concentrations: Concentrate and dry up samples, and then conduct measurement using a low-background gas-flow proportional counter.

・γ-ray spectrometry measurement: After proper pretreatment, put samples in a U-8 container or a 2L-Marinelli beaker and conduct measurement using a germanium semiconductor detector; The following 62 types of γ-ray emitting radionuclides (18 naturally occurring radionuclides and 44 artificial radionuclides) were surveyed. The measurement results of γ-ray emitting radionuclides were corrected for attenuation, and reported figures were activity concentrations as of the time of completing sampling.

Table 2.2-1 Surveyed γ-ray emitting radionuclides

Naturally occurring radionuclides (18 radionuclides)		Artificial radionuclides (44 radionuclides)				
Ac-228	Ra-224	Ag-108m	Co-58	I-131	Np-239	Te-129m
Be-7	Ra-226	Ag-110m	Co-60	I-132	Ru-103	Te-132
Bi-212	Th-227	Am-241	Cr-51	La-140	Ru-106	Y-91
Bi-214	Th-228	As-74	Cs-134	Mn-54	Sb-124	Y-93
K-40	Th-231	Ba-140	Cs-136	Mn-56	Sb-125	Zn-63
Pa-234m	Th-234	Bi-207	Cs-137	Mo-99	Sb-127	Zn-65
Pb-210	Tl-206	Ce-141	Fe-59	Nb-95	Sr-91	Zr-95
Pb-212	Tl-208	Ce-143	Ga-74	Nb-97	Tc-99m	Zr-97
Pb-214	U-235	Ce-144	Ge-75	Nd-147	Te-129	

3. Results

The outline of detectable radioactive materials at each monitoring location is as follows.

3.1 Detection of total β radioactivity and γ-ray emitting radionuclides

(1) Public water areas

1) Water

The results of the measurement of total β radioactivity and γ-ray emitting radionuclides are as shown in Table 3.1-1 and Figure 3.1-1.

a) Total β radioactivity

The detection rate for total β radioactivity was approximately 73%, with detected values ranging from not detectable to 1.1 Bq/L: all of which were within the past measurement trends.

b) γ-ray emitting radionuclides

Nine types of γ-ray emitting radionuclides (seven naturally occurring radionuclides and two artificial radionuclides) as shown in Table 3.1-1 and Figure 3.1-1 were detected, while other types of γ-ray emitting radionuclides were not detectable at any of the locations surveyed.

The detection rates of naturally occurring radionuclides were approximately 5% or less except for K-40, for which the detection rate was approximately 90%. K-40 was detected at some locations with the highest concentrations being, at the maximum, three times higher than the range of past measurement records but such high concentrations were considered to have been caused by the influence of seawater (explained later). Measured values of other naturally occurring radionuclides were within the past measurement trends except for those which had not been surveyed in the past.

Bi-212, Pb-210, and Pb-214 have not been included in nationwide surveys so far, but they are all thorium or uranium series naturally occurring radionuclides that are generally contained in natural soils and rocks, etc.

Regarding artificial radionuclides, the detection rates of Cs-134 and Cs-137 were around 16 to 23%, but detected values were 0.022 Bq/L or lower for Cs-134 and 0.065 Bq/L or lower for Cs-137: all of which were within the past measurement trends.

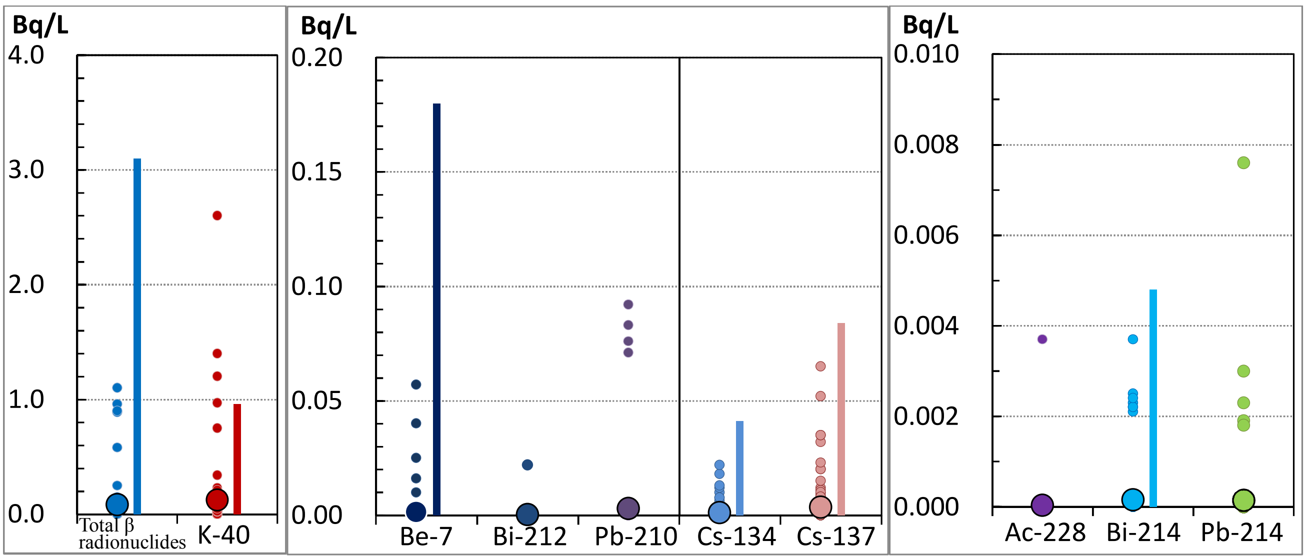
Table 3.1-1 Detection of total β radioactivity and γ-ray emitting radionuclides in water samples from public water areas

Radionuclides			Number of samples [A]	Number of detections [B]	Detection rate (B/A) [%]	Measured value [Bq/L]		Range of past measurement records(*1) [Bq/L]
						Range	Detection limit	
Total β radioactivity			113	82	72.6	ND - 1.1	0.019 - 0.46	ND - 3.1
γ-ray emitting radionuclides	Naturally-occurring	Ac-228	113	1	0.9	ND - 0.0037	0.0029 - 0.021	ND
		Be-7	113	5	4.4	ND - 0.057	0.0084 - 0.052	ND - 0.18
		Bi-212	113	1	0.9	ND - 0.022	0.0094 - 0.061	No data
		Bi-214	113	7	6.2	ND - 0.0037	0.0012 - 0.011	ND - 0.0048
		K-40	113	101	89.4	ND - 2.6	0.015 - 0.092	ND - 0.96
		Pb-210	113	4	3.5	ND - 0.092	0.043 - 1.2	No data
		Pb-214	113	5	4.4	ND - 0.0076	0.0017 - 0.0091	No data
	Artificial	Cs-134	113	18	15.9	ND - 0.022	0.00071 - 0.0043	ND - 0.041
		Cs-137	113	26	23.0	ND - 0.065	0.0007 - 0.0044	ND - 0.084

ND: Not detectable

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1995 to FY2014 (excluding data for March 11, 2011 to March 10, 2012)

* ● : Detected value
● : Average (arithmetic average; calculated by assuming ND to be zero)
| : Range of past measurement records (not indicated in the case of ND or where there are no past data)



(*) Vertical scales are different in the respective figures because detected values vary by radionuclide.

Figure 3.1-1 Detection of total β radioactivity and γ-ray emitting radionuclides in water samples from public water areas

2) Sediments

The results of the measurement of total β radioactivity and γ-ray emitting radionuclides in sediment samples from public water areas are as shown in Table 3.1-2 and Figure 3.1-2.

a) Total β radioactivity

Total β radioactivity was detected at all locations surveyed, with detected values ranging from 160 to 1,300 Bq/kg (dry): all of which were within the past measurement trends.

b) γ-ray emitting radionuclides

12 types of γ-ray emitting radionuclides (ten naturally occurring radionuclides and two artificial radionuclides) as shown in Table 3.1-2 and Figure 3.1-2 were detected, while no other types of γ-ray emitting radionuclides were detectable.

The detection rates of naturally occurring radionuclides exceeded 50% except for Be-7 and Th-234.

Measured values of Be-7, Bi-214, K-40, and Ra-226 exceeded the range of past measurement records.

Bi-214 was detected at Location No. 53 (Koichi Bridge, Saigawa River, Nagano City, Nagano) at a relatively higher level than past measurement records, but other radionuclides such as Pb-214, Ra-226, and Th-234, which are radionuclides of the same uranium series as Bi-214, were also detected at the same location at relatively higher levels compared with other locations, which suggests that the relevant sampling point is located in an area where concentrations of naturally occurring radionuclides derived from natural soils and rocks, etc. are relatively high (explained later).

K-40 and Be-7, which are radionuclides commonly found in the environment (K-40 was first incorporated at the time of the formation of the earth and Be-7 is generated by cosmic rays in the atmosphere), were detected but their measured values were considered to be within the past measurement trends.

Ra-226 is a uranium series naturally occurring radionuclide existing widely within the earth's crust. In light of the fact that the past data were based on the survey results for limited areas (Bi-214 was detected only in Aomori Prefecture and Ra-226 in Okayama Prefecture in the past), measured values of Bi-214 and Ra-226 in the latest monitoring were considered to be within the past measurement trends.

Ac-228, Bi-212, Pb-212, Pb-214, Th-234, and Tl-208 are radionuclides that have not been included in nationwide surveys so far or have not been detectable in past surveys. They are all thorium or uranium series naturally occurring radionuclides that are generally contained in natural soils and rocks, etc.

As shown in the margin of Table 3.1-2 and Figure 3.1-2, internationally detected concentration levels have been reported as 0 to 1,800 Bq/kg for K-40 and 0 to 900 Bq/kg for Ra-226 (both for soil).[3] In comparison with such levels, measured values were all within these levels.

Values of Cs-134 and Cs-137, which are artificial radionuclides, contained in sediment samples collected at the following locations exceeded the range of past measurement records.

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[3] Radiation Sources and Effects: 2000 Report of the United Nations Scientific Committee on the Effects of Atomic Radiation to the General Assembly; ANNEX B; Exposures from natural radiation sources

- No.13: Heigawa River, Iwate
- No.15: Abukuma River, Miyagi
- No.16: Natori River, Miyagi
- No.21: Agano River, Fukushima
- No.22: Abukuma River, Fukushima
- No.24: Lake Kasumigaura, Ibaraki
- No.25: Kokai River, Ibaraki
- No.28: Tonegawa River, Gunma
- No.32: Edogawa River, Saitama
- No.33: Tonegawa River, Chiba
- No.35: Lake Inbanuma, Chiba
- No.36: Edogawa River, Tokyo
- No.38: Sumida River, Tokyo
- No.39: Arakawa River, Tokyo
- No.40: Tsurumi River, Kanagawa

These locations were all in the Tohoku and Kanto blocks. Therefore, it was considered appropriate to compare detected values for samples collected at these locations with the results of the monitoring that the Ministry of the Environment has been conducting in and around Fukushima Prefecture after the Fukushima NPS Accident (hereinafter referred to as the "Post-Earthquake Monitoring"), separately with the results of the monitoring surveys conducted in the whole of Japan (Monitoring of Environmental Radioactivity Levels, etc.). Detailed comparison results, which are explained later, showed that detected values of Cs-134 and Cs-137 were also within the past measurement trends.

Table 3.1-2 Detection of total β radioactivity and γ-ray emitting radionuclides in sediment samples from public water areas

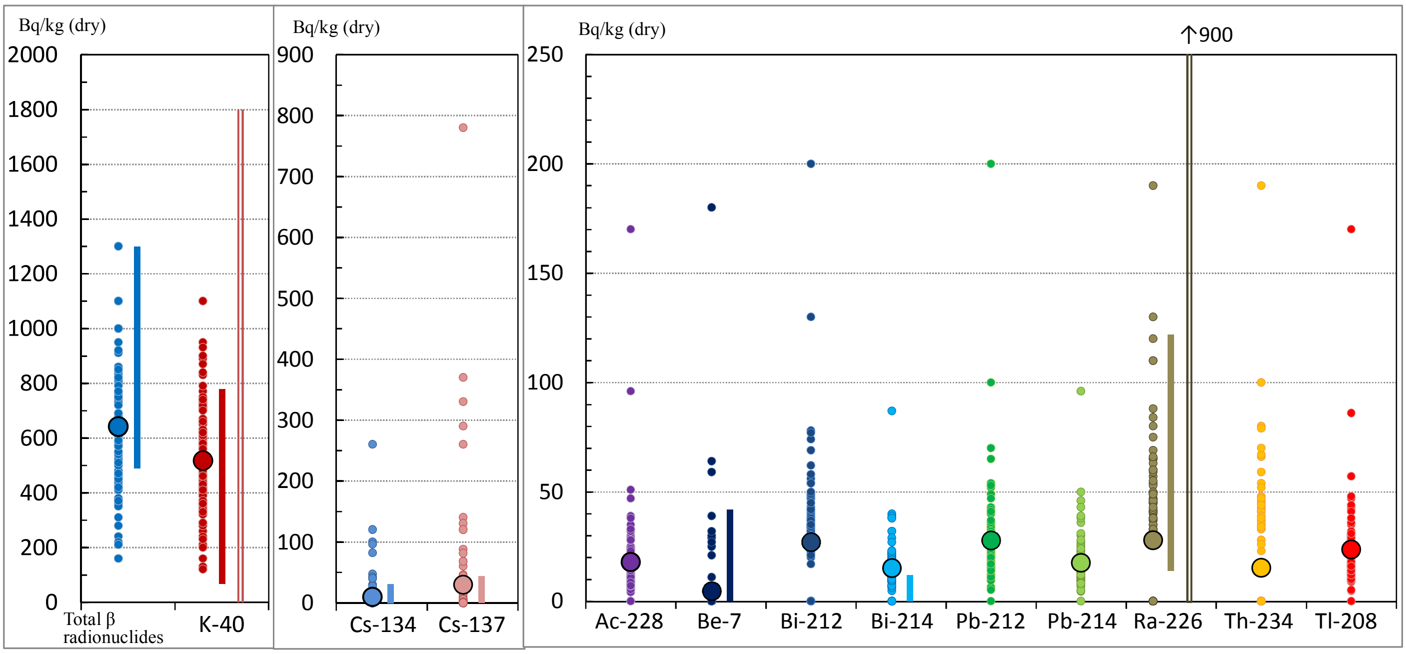
Radionuclides			Number of samples [A]	Number of detections [B]	Detection rate (B/A) [%]	Measured value [Bq/kg (dry)] Range	Measured value [Bq/kg (dry)] Detection limit	Range of past measurement records(*1) [Bq/kg (dry)]
Total β radioactivity			110	110	100.0	160 - 1,300	16 - 44	490 - 1,300
γ-ray emitting radionuclides	Naturally occurring	Ac-228	110	106	96.4	ND - 170	3.6 - 12	ND
		Be-7	110	11	10.0	ND - 180	8.5 - 69	ND - 42
		Bi-212	110	75	68.2	ND - 200	14 - 49	No data
		Bi-214	110	99	90.0	ND - 87	1.8 - 27	ND - 12
		K-40	110	110	100.0	120 - 1,100	13 - 82	69 - 780
		Pb-212	110	109	99.1	ND - 200	1.9 - 8.5	No data
		Pb-214	110	109	99.1	ND - 96	2.1 - 12	No data
		Ra-226	110	55	50.0	ND - 190	21 - 98	14 - 122
		Th-234	110	33	30.0	ND - 190	17 - 83	No data
		Tl-208	110	108	98.2	ND - 170	2.8 - 16	No data
	Artificial	Cs-134	110	27	24.5	ND - 260	1.0 - 5.3	ND - 31
		Cs-137	110	43	39.1	ND - 780	1.0 - 5.1	ND - 44

ND: Not detectable

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1995 to FY2014 (excluding data for March 11, 2011 to March 10, 2012)

(Note) Internationally detected concentration levels have been reported as 0 to 1,800 Bq/kg for K-40 and 0 to 900 Bq/kg for Ra-226 (both for soil) (see the main text).

* : Detected value
: Average (arithmetic average; calculated by assuming ND to be zero)
: Range of past measurement records (not indicated in the case of ND or where there are no past data)
: Range of past measurement records (internationally detected concentration levels)



(*) Details of the detection of Cs-134 and Cs-137 are explained later.
(*) Vertical scales are different in the respective figures because detected values vary by radionuclide.
(*) See the note in the margin of Table 3.1-2 and the main text for internationally detected concentration levels.

Figure 3.1-2 Detection of total β radioactivity and γ-ray emitting radionuclides in sediment samples from public water areas

(2) Groundwater

The results of the measurement of total β radioactivity and γ-ray emitting radionuclides in groundwater samples are as shown in Table 3.1-3 and Figure 3.1-3.

a) Total β radioactivity

The detection rate for total β radioactivity was approximately 80%, with detected values ranging from not detectable to 0.44 Bq/L: all of which were within the past measurement trends.

b) γ-ray emitting radionuclides

Ten types of γ-ray emitting radionuclides (all naturally occurring radionuclides) as shown in Table 3.1-3 and Figure 3.1-3 were detected, while no other types of γ-ray emitting radionuclides were detectable. Out of these detected γ-ray emitting radionuclides, K-40 was detected at concentration levels slightly exceeding the range of past measurement records but this is a radionuclide generally contained in natural soils and rocks, etc. (explained later). The measured value of Ra-226 also exceeded the range of past measurement records but could be considered to be within the past measurement trends, in light of the fact that Ra-226 was only detected in a limited area (only in Okayama Prefecture) in the past, that this is a uranium series radionuclide existing widely within the earth's crust, and that the value was much lower than the range of the internationally detected concentration levels.

Ac-228, Bi-212, Pb-212, Pb-214, Th-234, and U-235 are radionuclides that have not been included in nationwide surveys so far or have not been detectable in past surveys. They are all thorium or uranium series naturally occurring radionuclides that are generally contained in natural soils and rocks, etc.

Table 3.1-3 Detection of total β radioactivity and γ-ray emitting radionuclides in groundwater samples

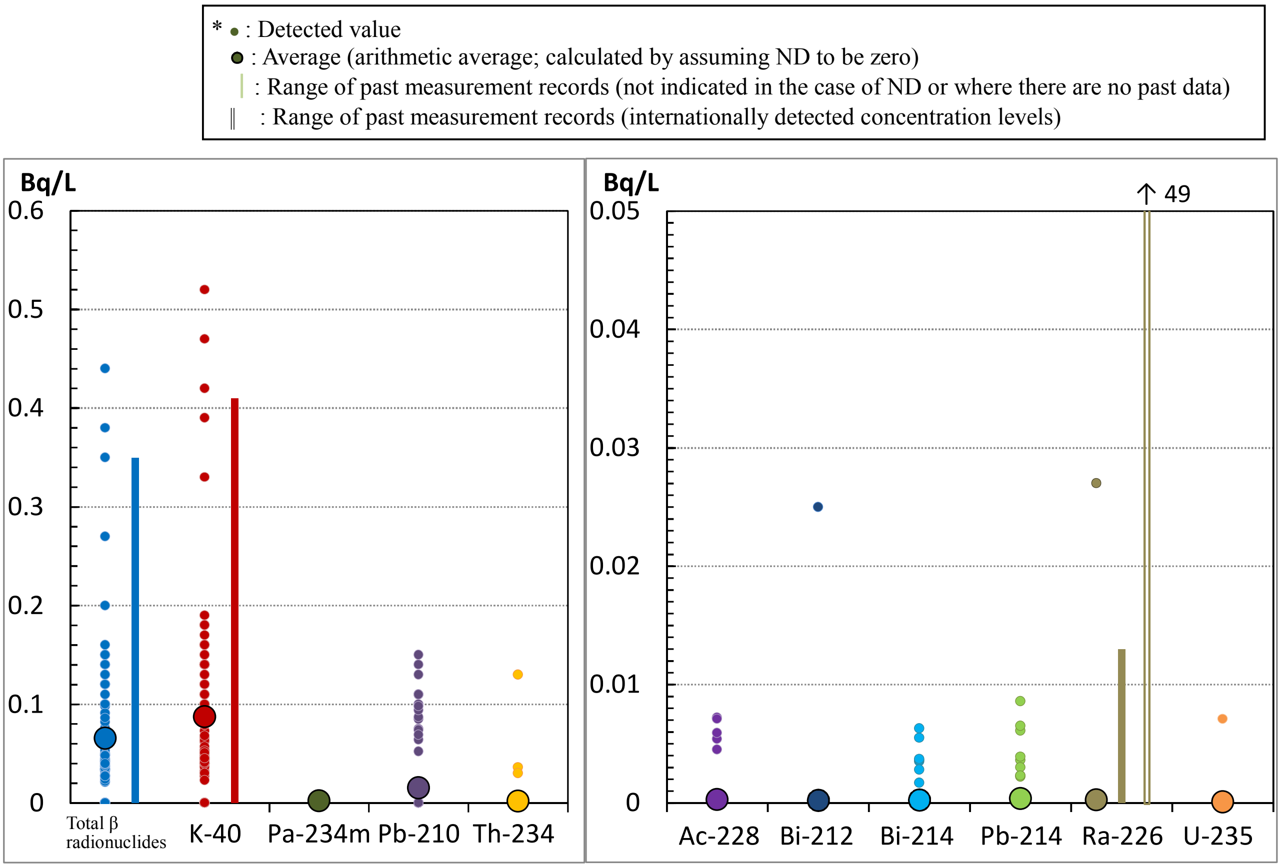
Radionuclides			Number of samples [A]	Number of detections [B]	Detection rate (B/A) [%]	Measured value [Bq/L]		Range of past measurement records(*1) [Bq/L]
						Range	Detection limit	
Total β radioactivity			109	87	79.8	ND - 0.44	0.019 - 0.040	ND - 0.35
γ-ray emitting radionuclides	Naturally occurring	Ac-228	109	5	4.6	ND - 0.0072	0.0028 - 0.0095	No data
		Bi-212	109	1	0.9	ND - 0.025	0.010 - 0.036	No data
		Bi-214	109	7	6.4	ND - 0.0063	0.0017 - 0.0054	No data
		K-40	109	88	80.7	ND - 0.52	0.017 - 0.061	ND - 0.41
		Pa-234m	109	1	0.9	ND - 0.22	0.12 - 0.45	No data
		Pb-210	109	17	15.6	ND - 0.15	0.044 - 0.30	No data
		Pb-214	109	9	8.3	ND - 0.0086	0.0018 - 0.0055	No data
		Ra-226	109	1	0.9	ND - 0.027	0.019 - 0.13	ND - 0.013
		Th-234	109	3	2.8	ND - 0.13	0.013 - 0.034	No data
		U-235	109	1	0.9	ND - 0.0071	0.0030 - 0.027	No data

ND: Not detectable

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1995 to FY2014 (excluding data for March 11, 2011 to March 10, 2012)

(*2) Internationally detected concentration levels have been reported as 0 to 49 Bq/L for Ra-226 (for drinking water).[4]

[4] Radiation Sources and Effects: 2000 Report of the United Nations Scientific Committee on the Effects of Atomic Radiation to the General Assembly; ANNEX B; Exposures from natural radiation sources



(*) Vertical scales are different in the respective figures because detected values vary by radionuclide.
(*) See the note in the margin of Table 3.1-3 for internationally detected concentration levels.

Figure 3.1-3 Detection of total β radioactivity and γ-ray emitting radionuclides in groundwater samples

3.2 Consideration regarding detected radionuclides

(1) Detection of naturally occurring radionuclides

1) Correlation between activity concentrations of K-40 and salinity

As explained in 3.1 above, activity concentrations of K-40 were at levels exceeding the range of past measurement records (0.96 Bq/L at the maximum) in water samples collected at some locations in public water areas.

Locations where activity concentrations of K-40 were at high levels showed high electrical conductivity (EC) (1,360 mS/m at the maximum) and this suggests the influence of the intrusion of seawater. Therefore, a comparison was made using all available data to clarify the correlation between activity concentrations of K-40 and EC (see Figure 3.2-1).

As shown in Figure 3.2-1, a positive correlation was found between them.

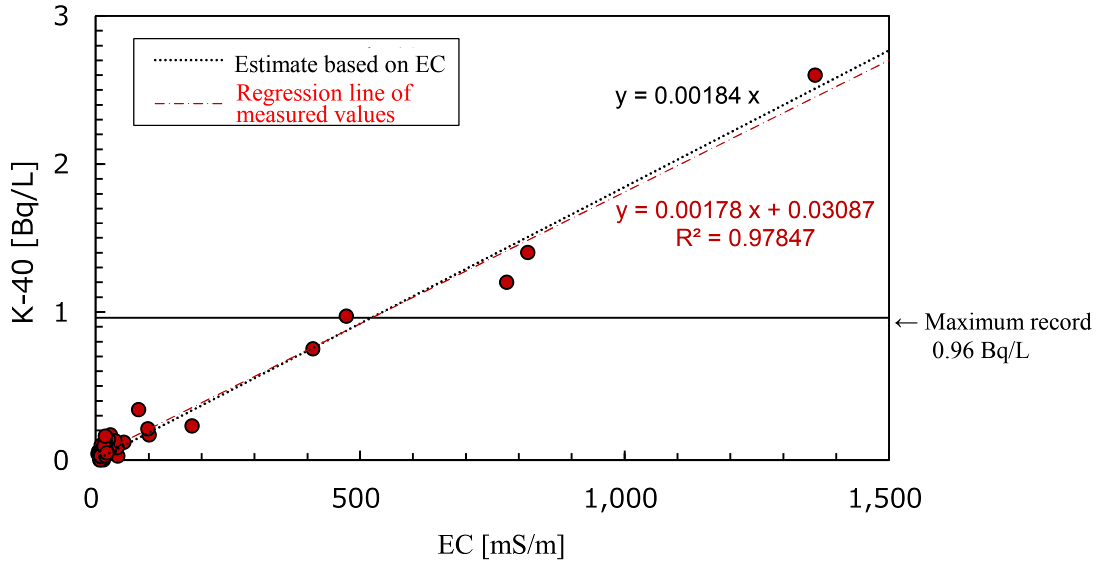


Figure 3.2-1 Correlation between the K-40 concentration and electrical conductivity in water samples from public water areas

In the meantime, according to the results of the Monitoring of Environmental Radioactivity Levels, conducted for the 20 years from FY1995 to FY2014 (monitoring of 465 samples collected from 18 prefectures), the average concentration (average) of K-40 was approximately 8.3 Bq/L and the maximum concentration was 14 Bq/L (see Table 3.2-1).

Table 3.2-1 Results of the Monitoring of Environmental Radioactivity Levels, etc. concerning K-40 in seawater(*1)

Number of surveys	Number of detections	Detection rate [%]	Average [Bq/L]	Maximum [Bq/L]
465	439	94.40%	8.3	14

(*1) Results of the Monitoring of Environmental Radioactivity Levels and the Monitoring of the Surrounding Environment conducted in Japan nationwide from FY1995 to FY2014

EC in seawater is generally around 4,500 mS/m, and the estimated activity concentrations of K-40 with possible influence of seawater were obtained by using the following formula based on the measurement results of EC for the relevant river water.

$$\text{(Activity concentration of K-40in river water)} = \text{(Average activity concentration of K-40 in seawater)} \times \frac{\text{(Measured EC for the river water)}}{\text{(Ordinary values of EC in seawater)}}$$

The estimated activity concentrations of K-40 in the river water are indicated with a dashed line in Figure 3.2-1, and the estimate values were very close to the measured activity concentrations of K-40. Therefore, relatively high activity levels of K-40 measured in the latest monitoring are considered to have been caused by the intrusion of seawater and fall within the past measurement trends.

In the same manner, the correlation between the K-40 concentration and EC was also checked with regard to groundwater samples (see Figure 3.2-2; scales of the vertical and horizontal axes differ from those for Figure 3.2-1). However, no clear correlation was found for groundwater samples. The measured values slightly exceeded the range of past measurement records (0.41 Bq/L at the maximum) for samples collected at Location No. 66 (Daisennaka Town, Sakai Ward, Sakai City, Osaka; 0.47 Bq/L), Location No. 68 (Saiwai Town, Toyooka City, Hyogo; 0.52 Bq/L), and Location No. 75 (Fukui, Kurashiki City, Okayama; 0.42 Bq/L). These locations are within areas where the potassium concentration in soil is relatively high (Figure 3.2-3), and relatively high activity levels of K-40 are considered to reflect the geological property of respective areas. Accordingly, the K-40 concentration for groundwater samples in the latest monitoring is considered to fall within the past measurement trends.

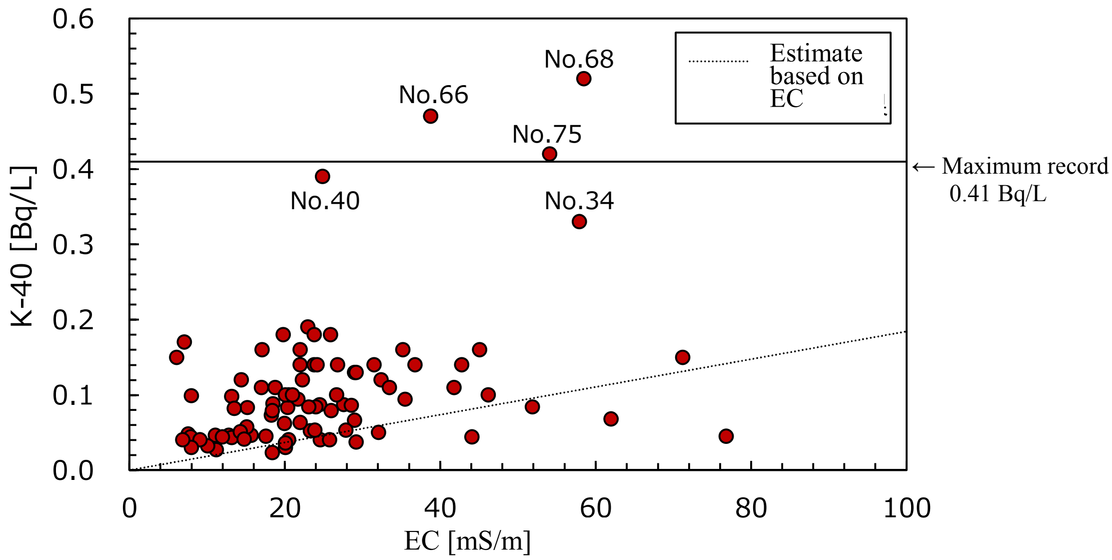


Figure 3.2-2 Correlation between the K-40 concentration and electrical conductivity in groundwater samples

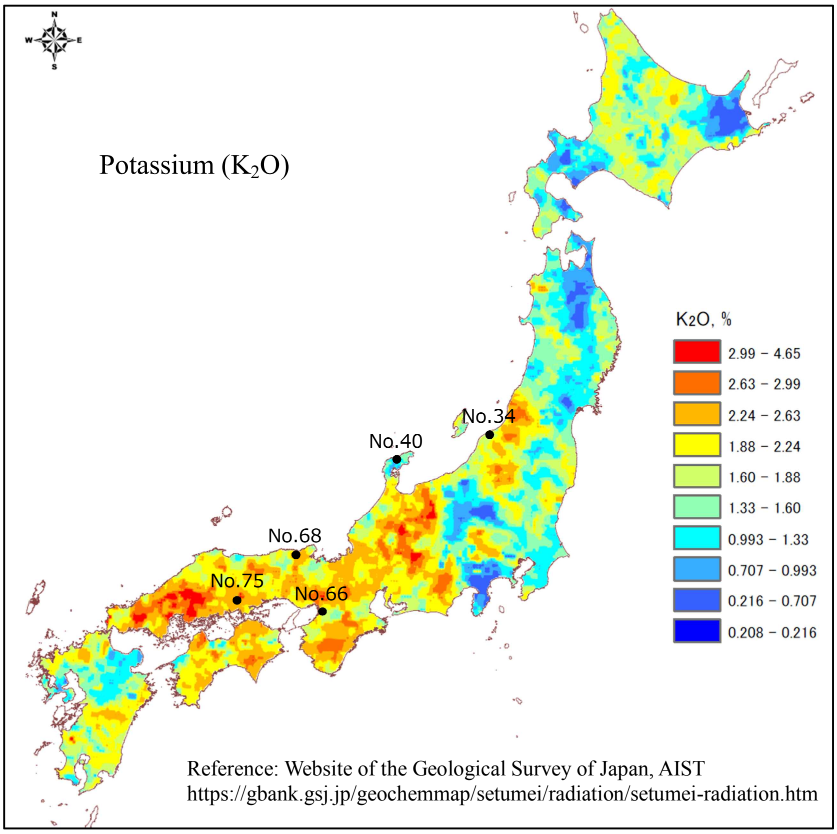


Figure 3.2-3 Distribution of potassium (K_2O) in soil in Japan

2) Uranium and thorium series radionuclides

As explained in 3.1 above, uranium and thorium series radionuclides were detected at relatively high concentration levels in sediment samples from public water areas.

Such radionuclides were detected as shown in Table 3.2-2.

These naturally occurring radionuclides exist widely within the earth's crust and belong to the same decay series, which implies the existence of some correlations among detected values.

Table 3.2-2 Detection of uranium and thorium series naturally occurring radionuclides

Radionuclides			Number of samples [A]	Number of detections [B]	Detection rate (B/A) [%]	Measured value [Bq/kg (dry)] Range	Measured value [Bq/kg (dry)] Detection limit
γ-ray emitting radionuclides	Uranium series	Th-234	110	33	30.0	ND - 190	17 - 83
		Ra-226	110	55	50.0	ND - 190	21 - 98
		Pb-214	110	109	99.1	ND - 96	2.1 - 12
		Bi-214	110	99	90.0	ND - 87	1.8 - 27
	Thorium series	Ac-228	110	106	96.4	ND - 170	3.6 - 12
		Pb-212	110	109	99.1	ND - 200	1.9 - 8.5
		Bi-212	110	75	68.2	ND - 200	14 - 49
		Tl-208	110	108	98.2	ND - 170	2.8 - 16

ND: Not detectable

Figure 3.2-4 and Figure 3.2-5 show correlations among detected values of radionuclides belonging to respective series (excluding data for radionuclides not detectable).

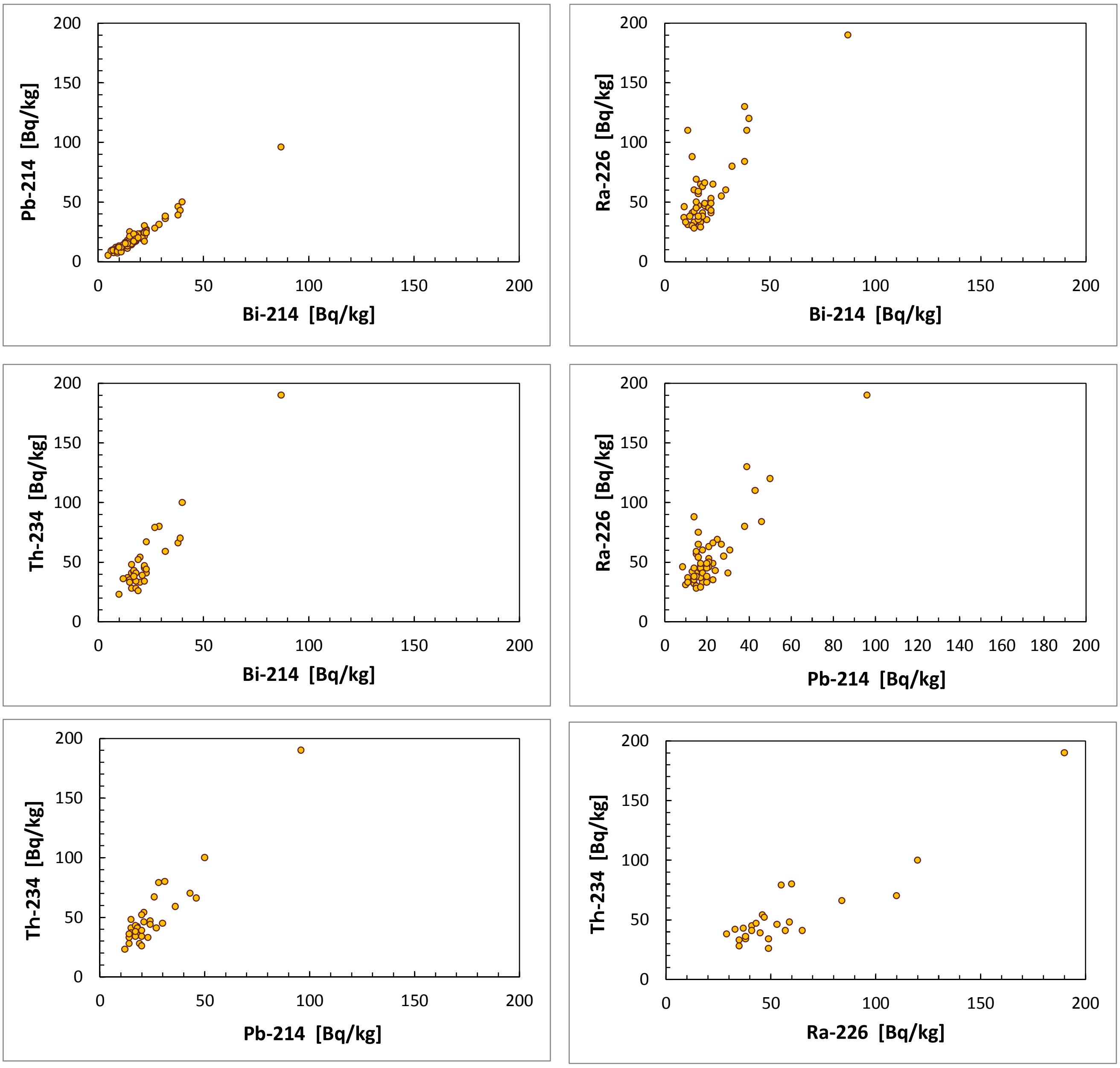
As is clear from these figures, high correlations were observed among uranium series radionuclides or thorium series radionuclides, respectively.

Given these facts, radionuclides belonging to these two series are considered to show geological characteristics of their respective sampling locations.

Locations where detected values of uranium and thorium series naturally occurring radionuclides were high include Location No. 45 (Hagiura Bridge, Jinzu River, Toyama City, Toyama), Location No. 53 (Koichi Bridge, Saigawa River, Nagano City, Nagano), Location No. 66 (Karasakioki-Chuo, Lake Biwako, Shiga), Location No. 84 (Intake for water supply in Hesaka, Ota River, Hiroshima City, Hiroshima), and Location No. 87 (Suenobu Bridge, Kotogawa River, Ube City, Yamaguchi), all of which are in areas where granite is widely distributed in neighboring areas or in upstream parts (see Figure 3.2-6). Generally, "granite contains naturally occurring radionuclides in relatively larger amounts than other types of rocks" (Geological Society of Japan, etc.), and measured values for these locations are considered to reflect such geological property of respective areas.

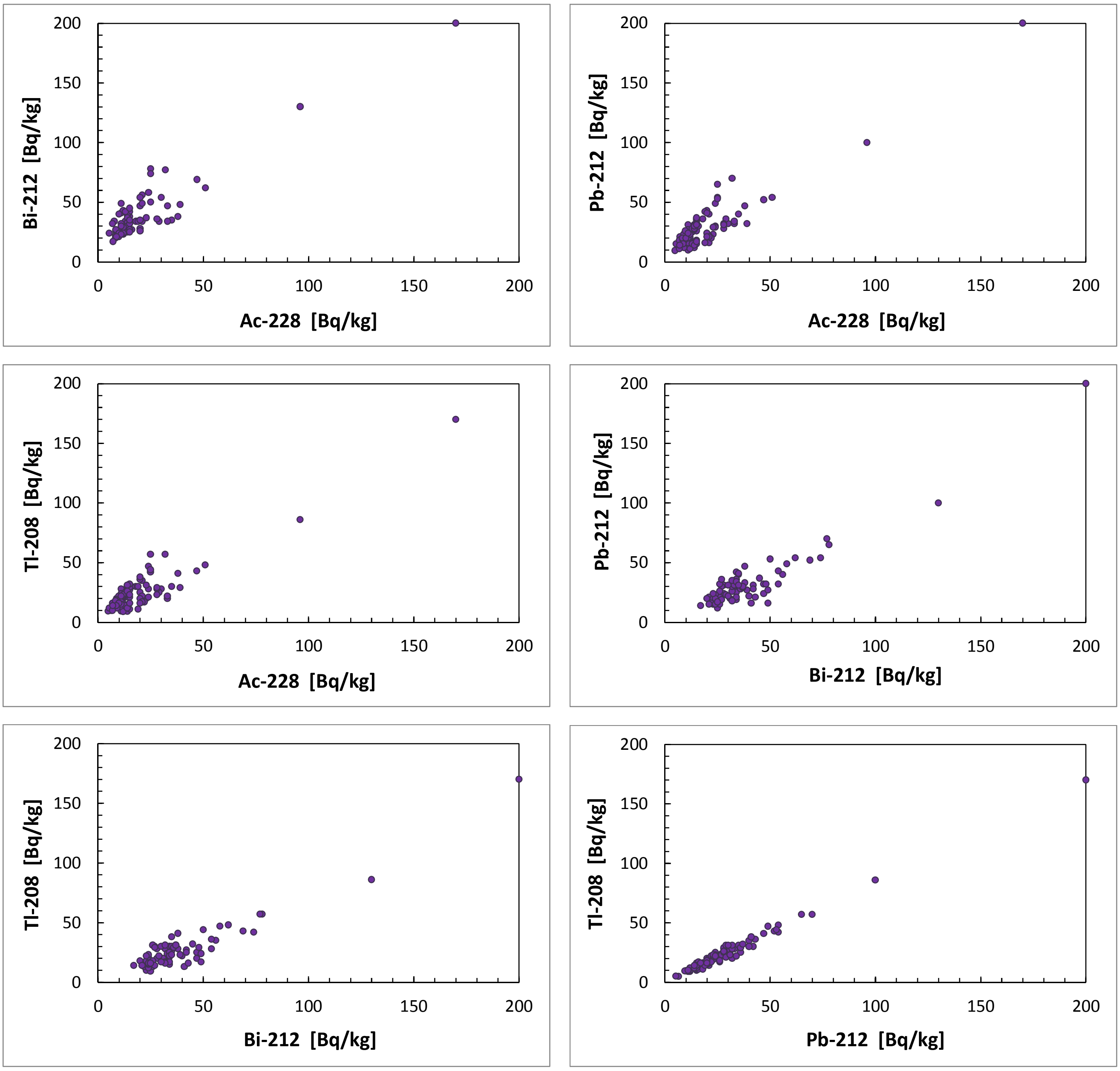
According to the Geological Society of Japan, etc.,[5] "natural radiation doses have certain correlation with uranium and thorium series radionuclides." Natural radiation doses in Japan are as shown in Figure 3.2-7.

5 http://www.geosociety.jp/hazard/content0058.html



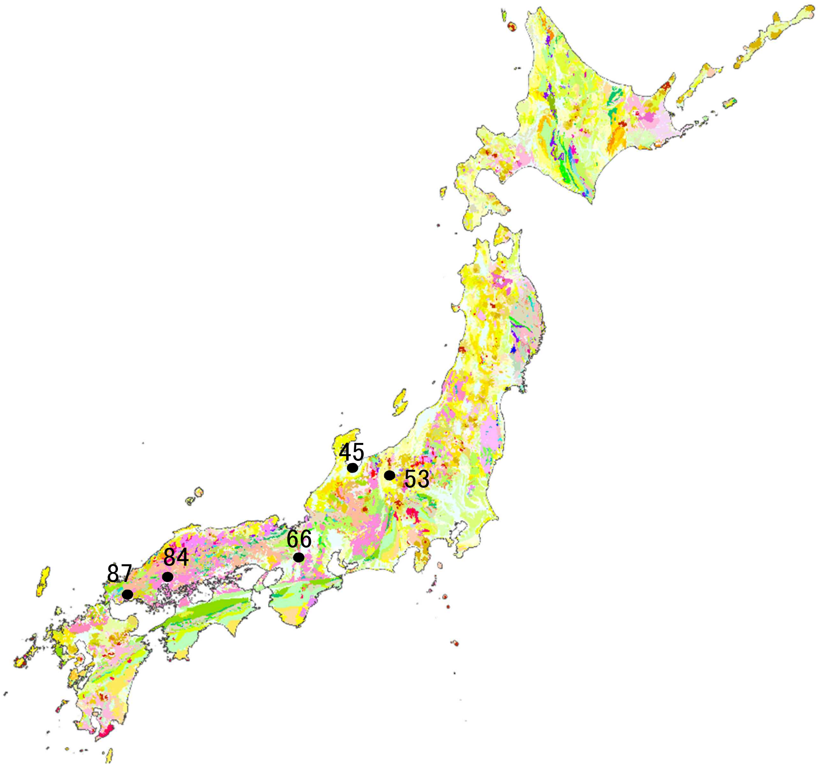
Correlation coefficient	Bi-214	Pb-214	Ra-226	Th-234
Bi-214		0.979	0.809	0.943
Pb-214			0.863	0.933
Ra-226				0.913

Figure 3.2-4 Correlations among uranium series radionuclides



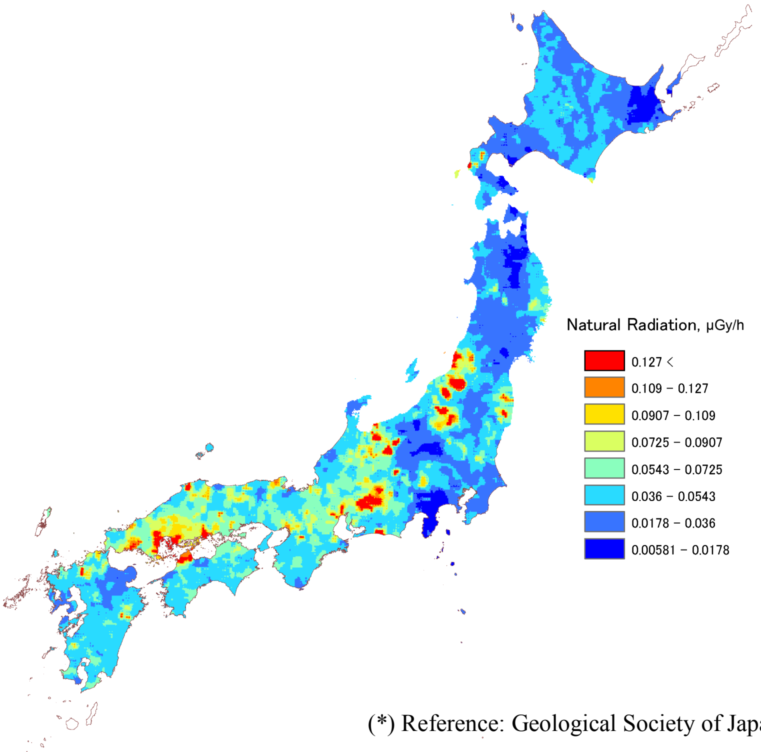
Correlation coefficient	Ac−228	Bi−212	Pb−212	Tl−208
Ac−228		0.914	0.918	0.907
Bi−212			0.938	0.934
Pb−212				0.984

Figure 3.2-5 Correlations among thorium series radionuclides



(*) Reference: Seamless Digital Geological Map of Japan (1:200,000) ® ; AIST website[6]
(*) Numbers in the figure indicate monitoring locations.

Figure 3.2-6 Distribution of granite in Japan
(parts highlighted in pink in the Figure are locations where granite exists)



(*) Reference: Geological Society of Japan website[7]

Figure 3.2-7 Natural radiation doses in Japan (Gy = Sv for γ-rays and β-rays)

6 https://gbank.gsj.jp/seamless/
7 http://www.geosociety.jp/hazard/content0058.html

(2) Detection of artificial radionuclides

1) Cs-134 and Cs-137 in sediments

As explained in 3.1 above, radioactive cesium was detected in sediment samples from public water areas in the Hokkaido, Tohoku, Kanto, Chubu, Kinki, and Kyushu blocks (43 locations in total; both Cs-134 and Cs-137 were detected at 27 locations (all in the Tohoku and Kanto blocks), and only Cs-137 was detected at 16 locations). At some of these locations, Cs-134 and Cs-137 were detected at concentration levels exceeding the range of past measurement records.

As locations where detected values exceeded the range of past measurement records were all in the Tohoku and Kanto blocks, the influence of the Fukushima NPS Accident was suspected. Therefore, a comparison was made as follows by using available data, including the results of the Post-Earthquake Monitoring being conducted at present.

(i) Regarding locations also surveyed in the Post-Earthquake Monitoring, a direct comparison with the data for the relevant locations obtained through said monitoring

(ii) Regarding locations that do not fall under the category of (i) above but are in Tokyo Metropolis or other prefectures where the Post-Earthquake Monitoring is conducted, a comparison with data for other locations in said prefectures

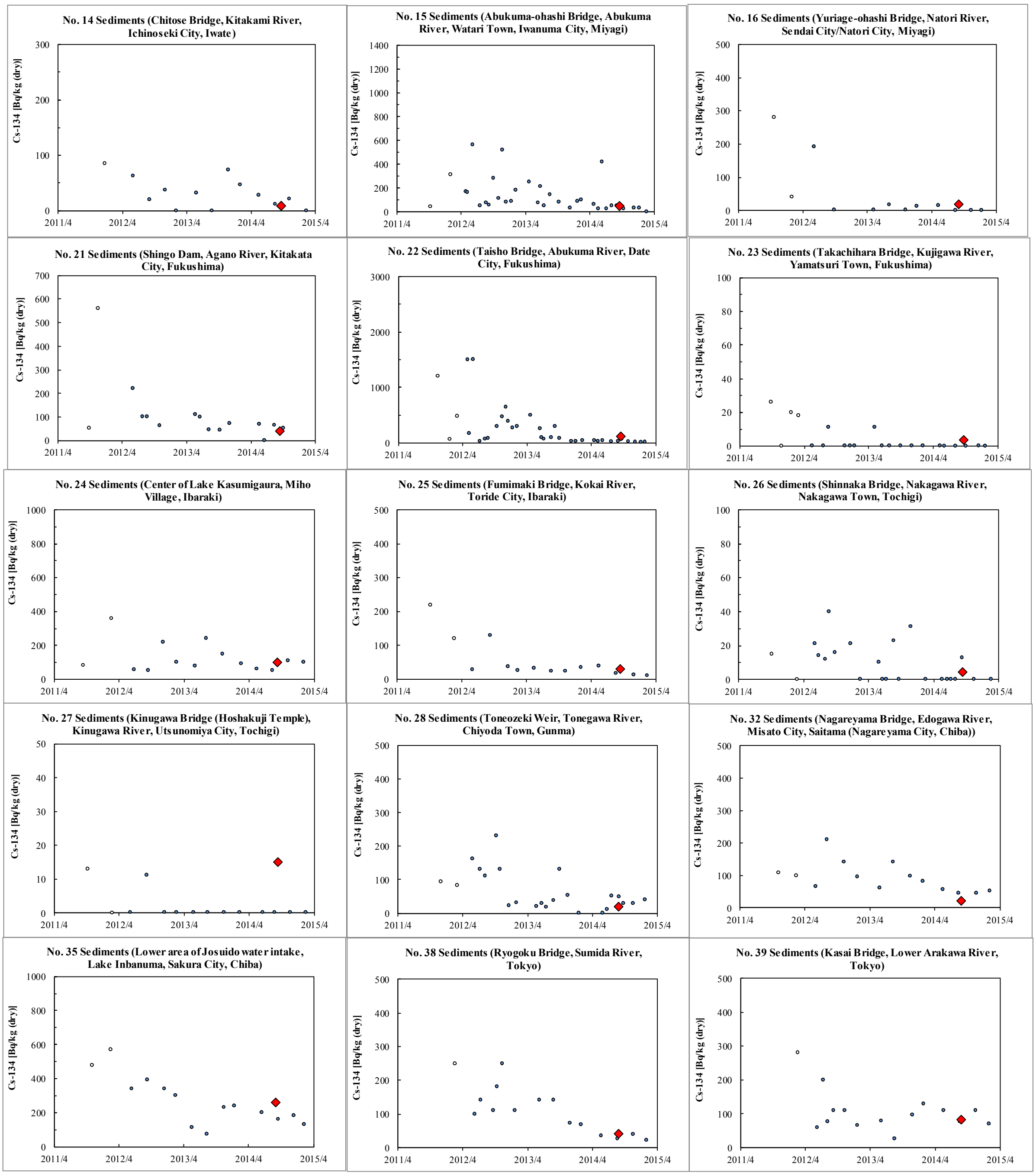
(iii) Regarding locations that do not fall under the categories of (i) and (ii) above, a comparison with the data for areas around the relevant locations obtained through the Post-Earthquake Monitoring

(iv) Regarding locations where measured values did not exceed the range of past measurement records, a comparison with data obtained through the Monitoring of Environmental Radioactivity Levels, etc.

(i) Comparison with the past Post-Earthquake Monitoring results for the same locations

Regarding locations also surveyed in the Post-Earthquake Monitoring, the measured values in the latest monitoring were compared with the past measurement records for the same locations (see Figure 3.2-8).

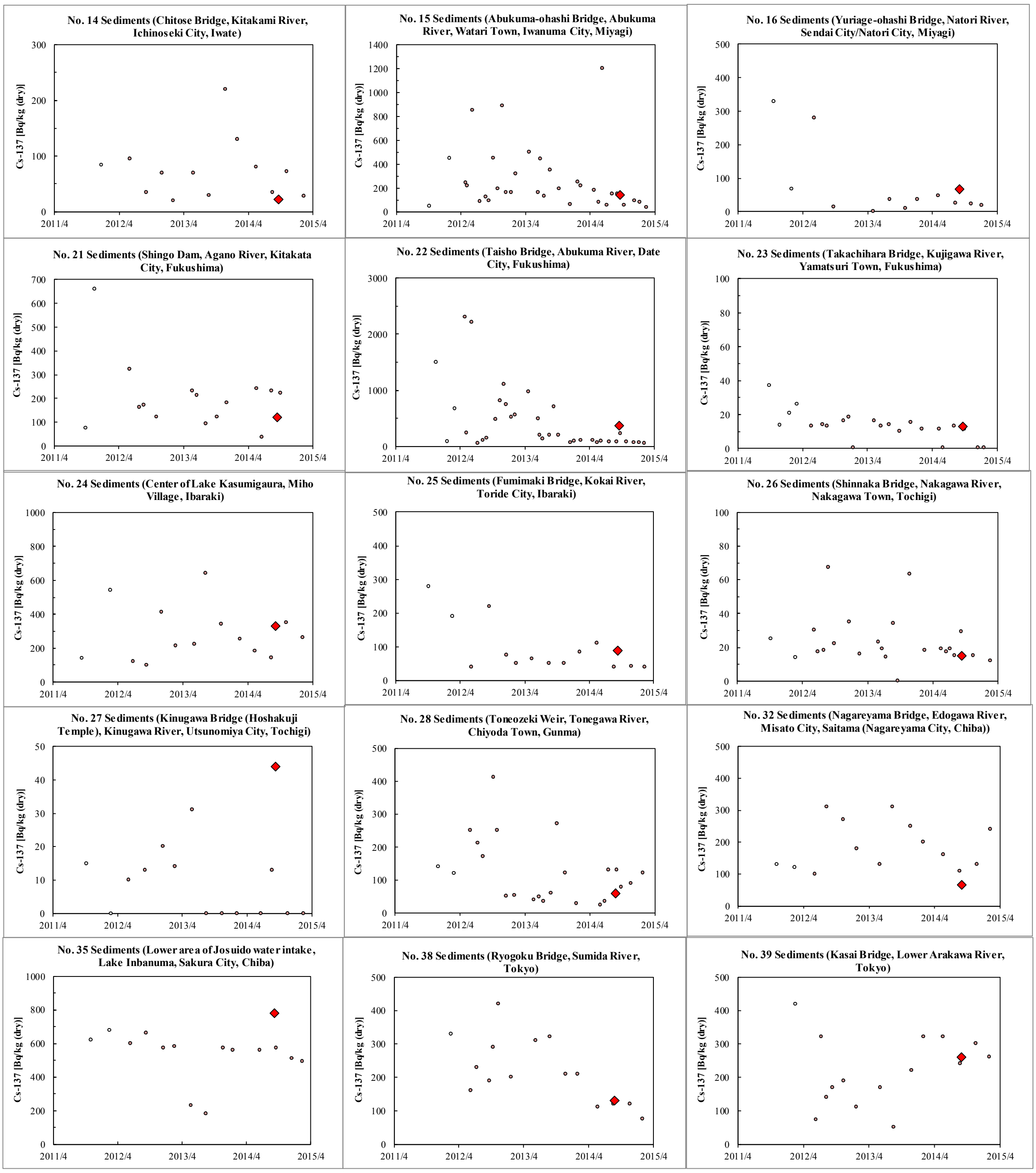
At Locations No. 27 and No. 35, measured values were larger than the range of past measurement records, but such deviations were considered to be within minor fluctuations in light of the past similar monitoring results, and the results of the latest monitoring were found to be within the past measurement trends.



(*) ◆ in figures shows the latest monitoring results.

(*) White small circles show the measurement results for March 11, 2011 to March 10, 2012, which were excluded from the past measurement records used as reference.

Figure 3.2-8(1) (i) Comparison with the past Post-Earthquake Monitoring results for the same locations [Cs-134]



(*) ◆ in figures shows the latest monitoring results.

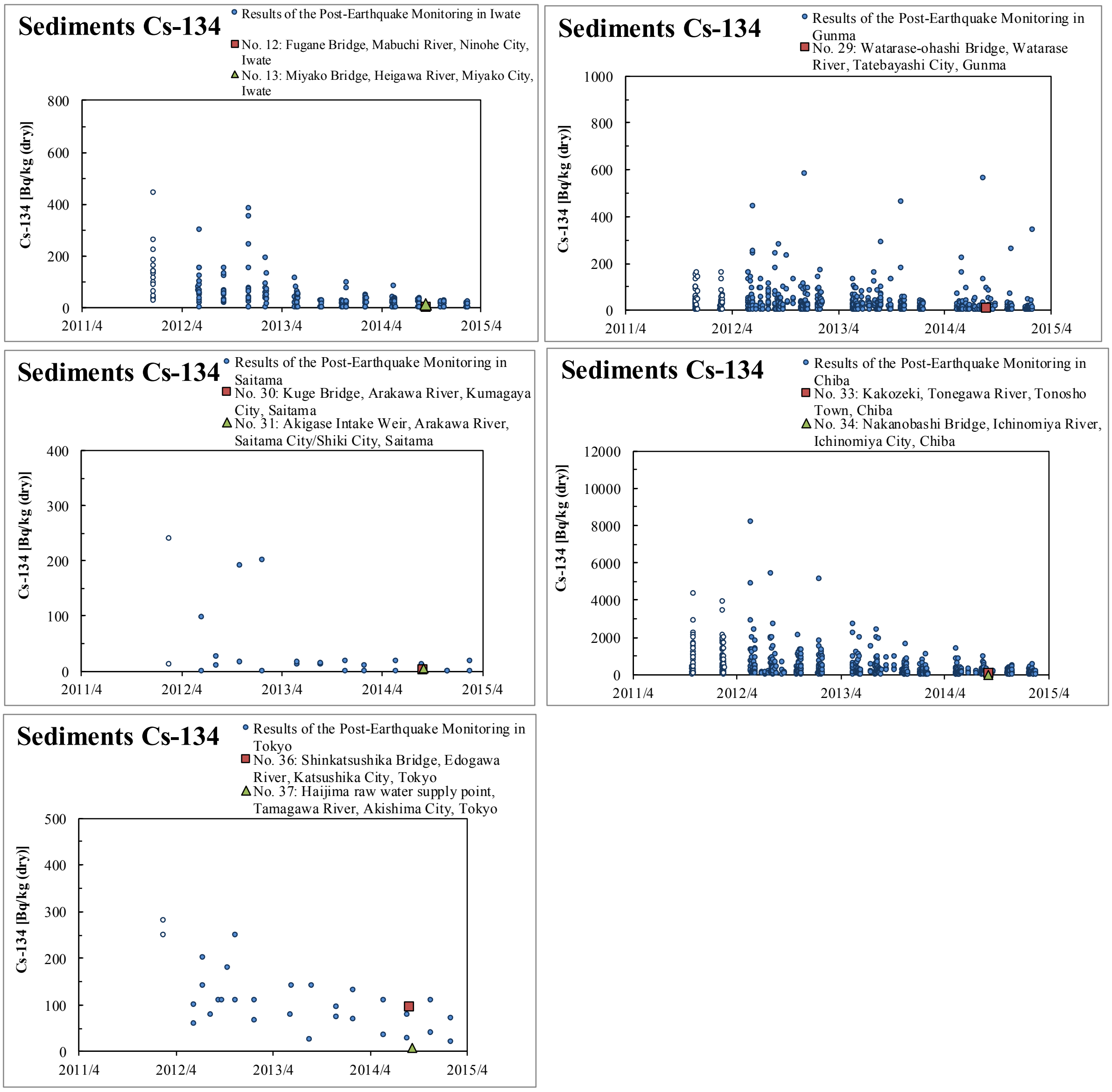
(*) White small circles show the measurement results for March 11, 2011 to March 10, 2012, which were excluded from the past measurement records used as reference.

Figure 3.2-8(2) (i) Comparison with the past Post-Earthquake Monitoring results for the same locations [Cs-137]

(ii) Comparison with the past Post-Earthquake Monitoring results in the same prefectures

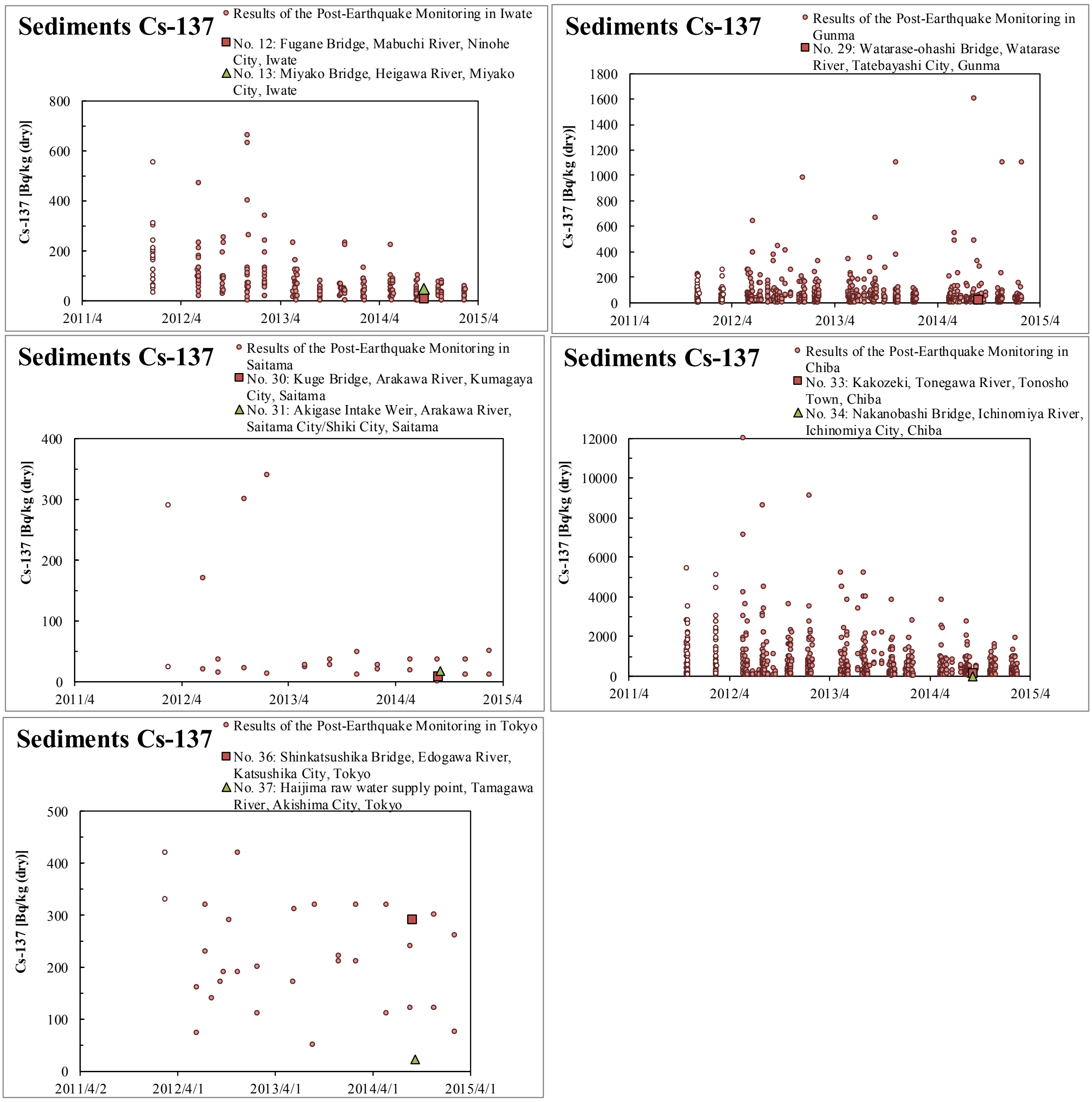
Regarding locations that have not been surveyed in the Post-Earthquake Monitoring, the measured values in the latest monitoring were compared with the past Post-Earthquake Monitoring results for locations in the same prefectures (see Figure 3.2-9).

The measured values in the latest monitoring were found to be all within the past measurement trends.



(*) White small circles show the measurement results for March 11, 2011 to March 10, 2012, which were excluded from the past measurement records used as reference.

Figure 3.2-9(1) (ii) Comparison with the past Post-Earthquake Monitoring results in the same prefectures [Cs-134]

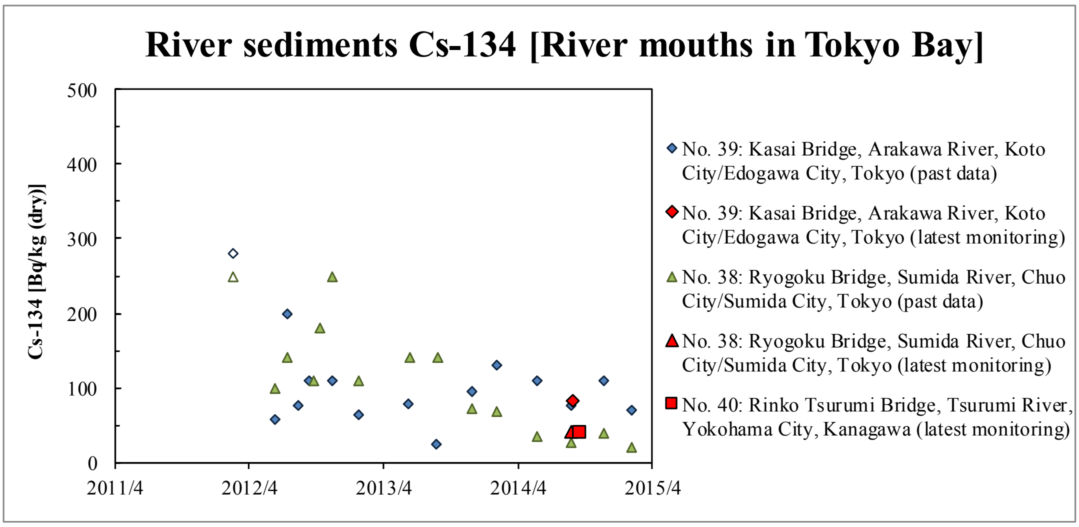


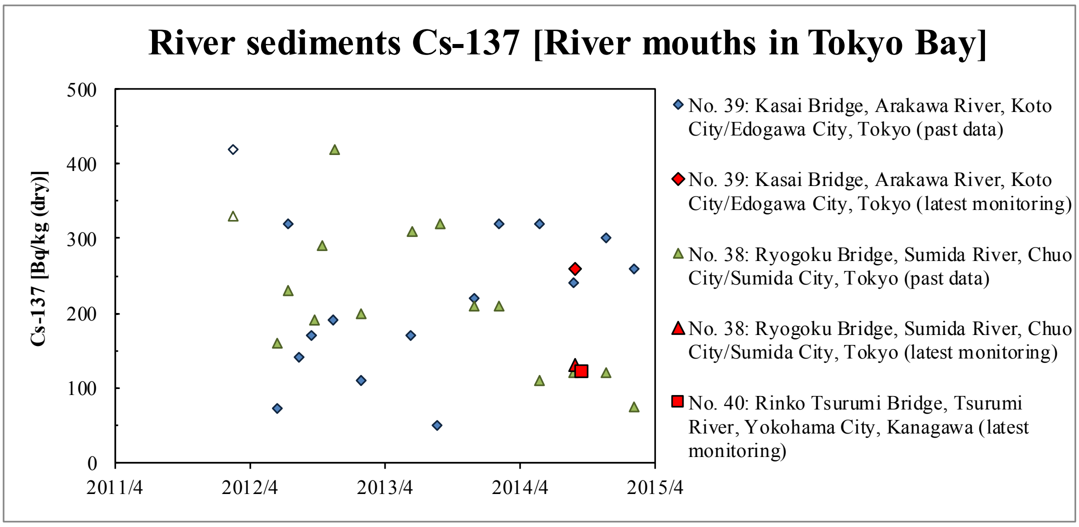
(*) White small circles show the measurement results for March 11, 2011 to March 10, 2012, which were excluded from the past measurement records used as reference.

Figure 3.2-9(2) (ii) Comparison with the past Post-Earthquake Monitoring results in the same prefectures [Cs-137]

(iii) Comparison with the past Post-Earthquake Monitoring results for nearby locations

Regarding Location No. 40 (Rinko Tsurumi Bridge, Tsurumi River, Yokohama City, Kanagawa Prefecture), it was considered to be appropriate to make a comparison with the past data for nearby locations although the Post-Earthquake Monitoring had not been conducted in Kanagawa Prefecture. Therefore, a comparison was made with the past data for Location No. 38 (Ryogoku Bridge, Sumida River, Chuo City/Sumida City, Tokyo Metropolis) and Location No. 39 (Kasai Bridge, Arakawa River, Koto City/Edogawa City, Tokyo Metropolis), both of which are located at the mouths of the Sumida River and the Arakawa River to Tokyo Bay (see Figure 3.2-10). As a result, it was found that the measured values for Location No. 40 were within the past measurement trends.





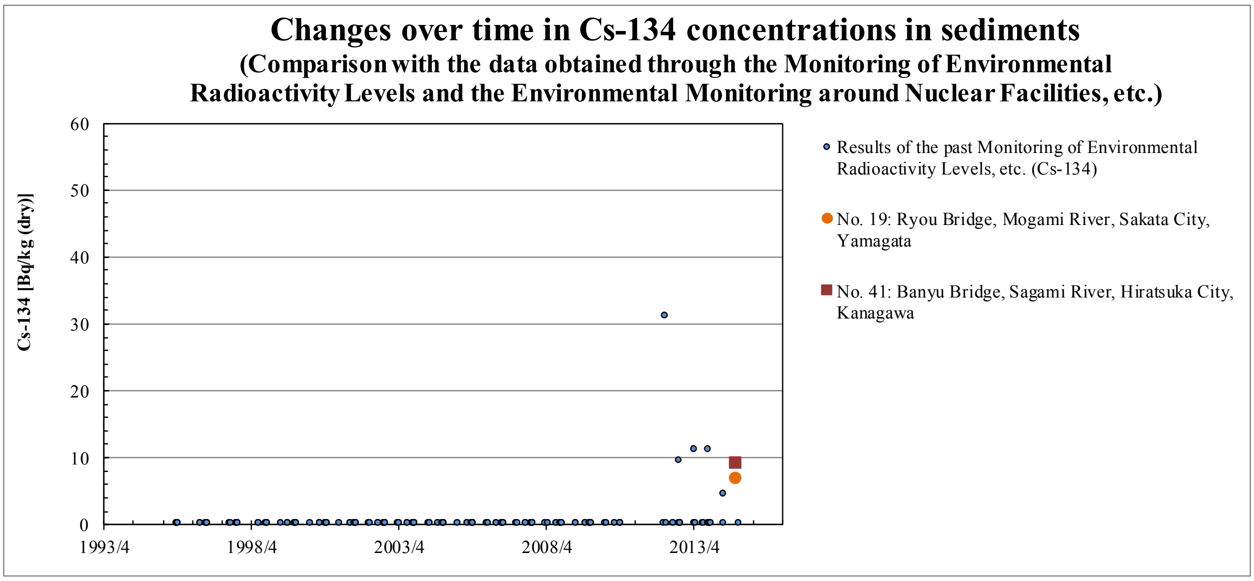
(*) White small circles show the measurement results for March 11, 2011 to March 10, 2012, which were excluded from the past measurement records used as reference.

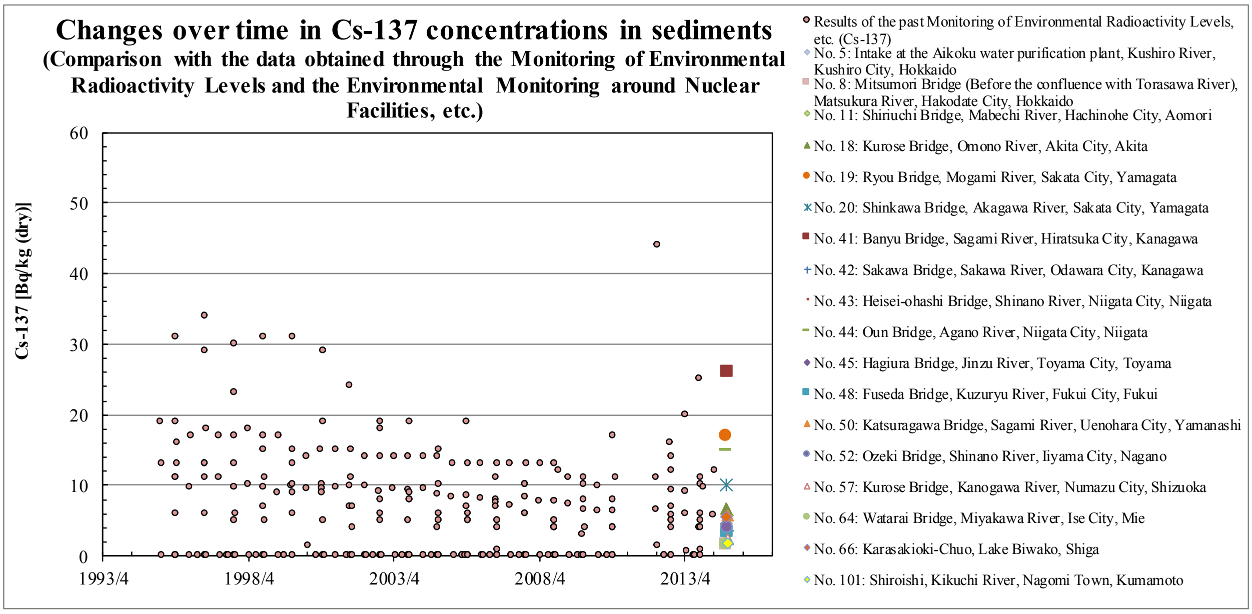
Figure 3.2-10 (iii) Comparison with the past Post-Earthquake Monitoring results for nearby locations

(iv) Comparison with the data obtained through the Monitoring of Environmental Radioactivity Levels, etc.

Regarding locations where measured values did not exceed the range of past measurement records, the measured values in the latest monitoring were compared with the data obtained through the Monitoring of Environmental Radioactivity Levels, etc. to check the concentration levels (see Figure 3.2-11).

Cs-134 and Cs-137 were detected at Location No.19 (Ryou Bridge, Mogami River, Sakata City, Yamagata Prefecture) and Location No. 41 (Banyu Bridge, Sagami River, Hiratsuka City, Kanagawa Prefecture), but measured values were all within the measurement trends after the Fukushima NPS Accident. In Hokkaido, Chubu, Kinki, and Kyushu blocks, only Cs-137 was detected at concentration levels within the measurement trends after the Fukushima NPS Accident.



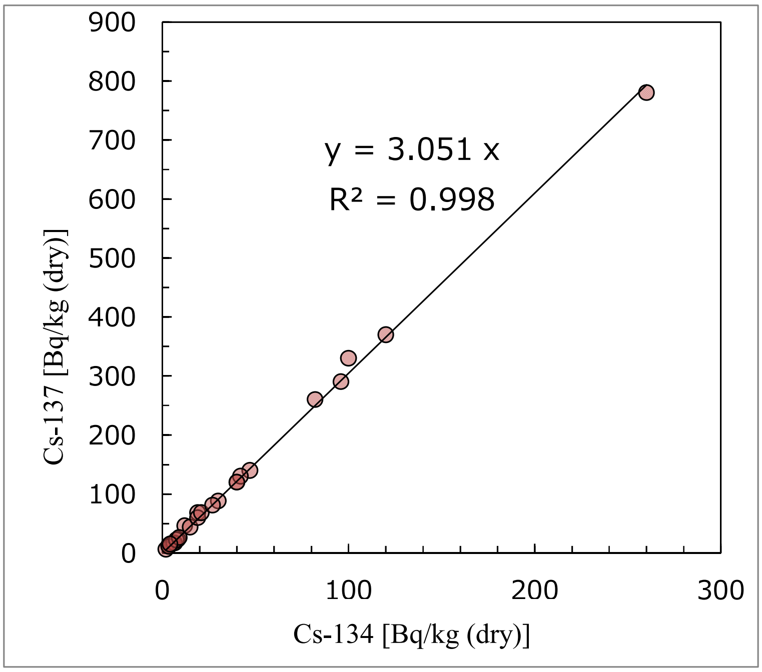


(*) Upper: Cs-134; Lower: Cs-137

(*) The measurement results for March 11, 2011 to March 10, 2012, which were excluded from the past measurement records used as reference, are not indicated.

Figure 3.2-11 (iv) Comparison with the data obtained through the Monitoring of Environmental Radioactivity Levels, etc.

Regarding locations where both Cs-134 and Cs-137 were detected (all in the Tohoku and Kanto blocks), a good correlation was observed in the activity concentration ratios of Cs-137 and Cs-134. The calculated activity concentration ratio was 3.1. When assuming that detected Cs-134 and Cs-137 are those discharged due to the Fukushima NPS Accident, this ratio could be found to be close to the theoretical ratio (approx. 3) as of September 2014 after the discharge in March 2011 (see Figure 3.2-12). This suggests that Cs-134 and Cs-137 detected in sediment samples collected in the Tohoku and Kanto blocks were derived from the Fukushima NPS Accident.



Radionuclide	Half-life (year)	Mar. 2011	Sep. 2011	Mar. 2012	Sept. 2012	Mar. 2013	Sept. 2013	Mar. 2014	Sept. 2014
Cs-134 (relative concentration)	2.062	1	0.85	0.71	0.60	0.51	0.43	0.36	0.31
Cs-137 (relative concentration)	30.07	1	0.99	0.98	0.97	0.95	0.94	0.93	0.92
Cs-137/Cs-134		1	1.17	1.37	1.60	1.87	2.19	2.56	2.99

Figure 3.2-12 Concentration ratio (Cs-137/Cs-134) [Sediments (public water areas)]

(Note: Changes over the years in concentration ratios (Cs-137/Cs-134) in consideration of half-life periods)

(*) The concentration ratio at the time of the latest monitoring (around September 2014) is estimated to be approximately 3 (highlighted in yellow in the table above).

Given these facts, Cs-134 and Cs-137 detected in sediment samples from public water areas were mostly derived from the Fukushima NPS Accident, except for some locations for which causal relations were unclear, but detected values were all within the measurement trends of the Post-Earthquake Monitoring being conducted at present.

2) Cs-134 and Cs-137 in water

Cs-134 or Cs-137 were detected at 26 out of the 110 locations where water samples from public water areas were collected (a total of 26 locations: both Cs-134 and Cs-137 were detected at 18 locations (all in the Tohoku and Kanto blocks) and only Cs-137 was detected at eight locations). However, the maximum values were 0.022 Bq/L for Cs-134 and 0.065 Bq/L for Cs-137, both of which were smaller by one digit or more than the lower detection limit (1 Bq/L) applied for the Post-Earthquake Monitoring and were below the range of past measurement records obtained through the Monitoring of Environmental Radioactivity Levels, which were used for comparison, (0.041 Bq/L for Cs-134 and 0.084 Bq/L for Cs-137).

Regarding the 18 locations (all in the Tohoku and Kanto blocks) where both Cs-134 and Cs-137 were detected, the concentration ratio (Cs-137/Cs-134) calculated in the same manner as in the case of sediment samples also showed a good correlation. The obtained concentration ratio was 2.9. When assuming that detected Cs-134 and Cs-137 were those discharged due to the Fukushima NPS Accident, this ratio was found to be close to the theoretical ratio (approx. 3) as of September 2014 after the discharge in March 2011 (see Figure 3.2-13). This suggests that Cs-134 and Cs-137 detected in water samples collected in the Tohoku and Kanto blocks were derived from the Fukushima NPS Accident.

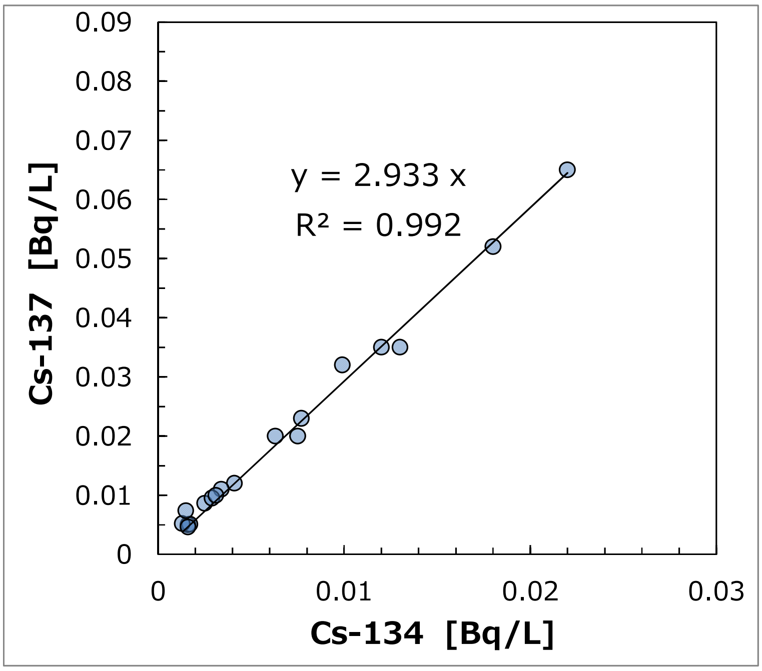


Figure 3.2-13 Concentration ratio (Cs-137/Cs-134) [Water (public water areas)]

3) Cs-134 and Cs-137 in groundwater

Cs-134 and Cs-137 were not detectable in groundwater samples collected at any of the 109 locations (detection limit: approx. 0.001 to 0.002 Bq/L).

3.3 Survey to check annual variation

At two locations[8] (both in rivers), namely, Location No.28 (Toneozeki Weir, Tonegawa River, Chiyoda Town, Gunma Prefecture) and Location No. 83 (Kasumi Bridge, Takahashi River, Kurashiki City, Okayama Prefecture), surveys were conducted four times during the period from August 25, 2014 to January 26, 2015.

Radionuclides were detected as shown in Table 3.3-1 and Table 3.3-2. Changes in concentration levels of radionuclides that were detected on all four occasions are shown in Figure 3.3-1 and Figure 3.3-2. No significant variation was observed for uranium and thorium series naturally occurring radionuclides as a whole (Ac-228, Pb-212, Pb-214, Tl-208, Bi-212, and Bi-214), nor for total β radioactivity and K-40 in particular.

Coefficients of variation[9] (sample standard deviation/average) are also indicated in Table 3.3-1 and Table 3.3-2 to show the dispersion of detected values. Regarding total β radioactivity and K-40, coefficients of variation were below 10% for sediment samples and were around 10 to 30% for water samples, while regarding radioactive cesium, they were around 20% both for sediment samples and water samples. The Radioactive Material Monitoring in the Water Environment conducted in FY2012[10] revealed that the variations in radioactive cesium concentration levels in river sediment samples (nine samples collected around the same time) were around 12% to 16%. The results of the latest monitoring for sediment samples were close to these figures although the survey period was different, and this suggests that variations depending on survey periods are of the same level as those depending on locations.

Table 3.3-1 Detection of radioactive materials in four surveys conducted at the same location [water]

Location	Radionuclide	Water [Bq/L]				Coefficient of variation [%]
		First	Second	Third	Fourth	
No.28	Survey date	Aug. 25, 2014	Oct. 27, 2014	Dec. 15, 2014	Jan. 26, 2015	
	K-40	0.097	0.11	0.078	0.094	13.9
	Cs-134	0.0015	0.0020	<0.0010	0.0018	14.2
	Cs-137	0.0074	0.0072	0.0048	0.0049	23.3
	Total β radioactivity	0.068	0.12	0.12	0.11	23.7

Location	Radionuclide	Water [Bq/L]				Coefficient of variation [%]
		First	Second	Third	Fourth	
No.83	Survey date	Aug. 30, 2014	Oct. 28, 2014	Dec. 15, 2014	Jan. 26, 2015	
	Be-7	<0.024	0.012	<0.0073	<0.0073	-
	K-40	0.034	0.045	<0.028	0.034	16.9
	Pb-212	<0.0019	<0.0021	<0.0019	0.0013	-
	Total β radioactivity	0.046	0.064	0.037	0.038	27.0

(*) Coefficients of variation are indicated only for radionuclides that were detected three times or more.

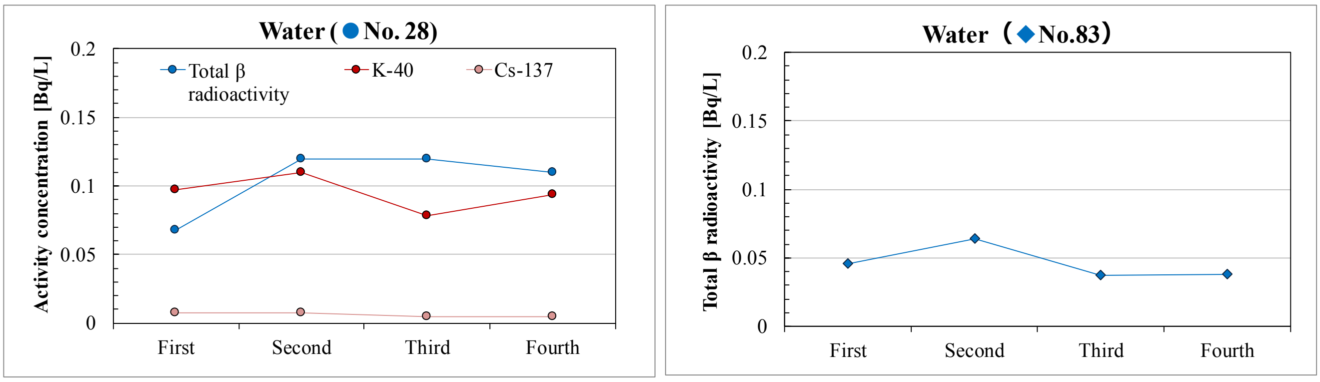


Figure 3.3-1 Detection of radioactive materials in four surveys conducted at the same location [water]

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[8] It was decided to select one location each in eastern and western Japan. All 110 locations were first divided into two for convenience (Locations No. 1 to No. 55 were classified as eastern Japan and Locations No. 51 to No. 110 were classified as western Japan) and the two locations of the median number in respective categories were selected.

[9] In the report of March 2015, a coefficient of deviation was calculated by dividing the population standard deviation with the average. However, in light of the fact that samples for the latest monitoring were collected from the natural environment (population), a coefficient of deviation in this report was calculated by dividing the sample standard deviation by the average. The same applies hereinafter.

[10] Review on methods of the FY2012 Radioactive Material Monitoring in the Water Environment (March 2013)

Table 3.3-2 Detection of radioactive materials in four surveys conducted at the same location [sediments]

Location	Radionuclide	Sediments [Bq/kg (dry)]				Coefficient of variation [%]
		First	Second	Third	Fourth	
No.28	**Survey date**	**Aug. 25, 2014**	**Oct. 27, 2014**	**Dec. 15, 2014**	**Jan. 26, 2015**	
	Ac-228	15	9.8	12	15	19.6
	Bi-214	<12	11	13	13	9.4
	K-40	290	330	280	280	8.1
	Pb-212	18	16	21	16	13.3
	Pb-214	11	11	16	11	20.4
	Tl-208	16	12	13	14	12.4
	Cs-134	19	13	21	17	19.5
	Cs-137	60	44	76	61	21.7
	Total β radioactivity	410	350	350	380	7.7

Location	Radionuclide	Sediments [Bq/kg (dry)]				Coefficient of variation [%]
		First	Second	Third	Fourth	
No.83	**Survey date**	**Aug. 30, 2014**	**Oct. 28, 2014**	**Dec. 15, 2014**	**Jan. 26, 2015**	
	Ac-228	13	25	12	19	34.9
	Bi-212	42	34	23	28	25.8
	Bi-214	15	21	17	17	14.4
	K-40	870	830	910	770	7.1
	Pb-212	28	28	24	27	7.1
	Pb-214	21	23	19	15	17.5
	Ra-226	50	<42	36	<39	-
	Th-234	<30	<41	30	42	-
	Tl-208	25	20	21	25	11.6
	Total β radioactivity	1000	980	890	920	5.4

(*) Coefficients of variation are indicated only for radionuclides that were detected three times or more.

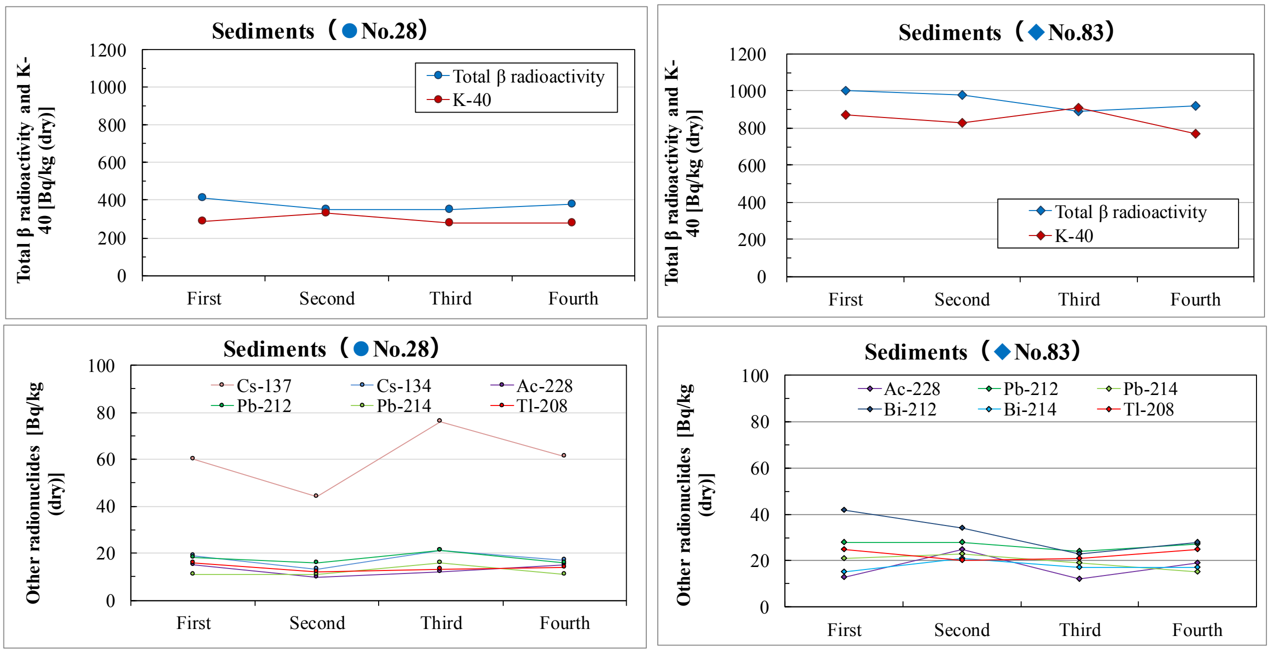


Figure 3.3-2 Detection of radioactive materials in four surveys conducted at the same location [sediments]

Part 2: Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture (FY2011 to FY2014)

1. Objective and Details

1.1 Objective

This monitoring was conducted in response to the Fukushima NPS Accident for the purpose of clarifying the distribution of the accident-derived radioactive materials in the water environment.

1.2 Details

(1) Locations

The survey was conducted mainly in the Tohoku and Kanto districts at around 600 locations for public water areas and at around 400 locations for groundwater. Specific locations are as shown in Figure 1.2-1.

(2) Targets

For public water areas (rivers, lakes, and coastal areas), water and sediments were surveyed. Additionally, radioactive concentrations in soil were measured in the surrounding environment (river beds, etc.) near the sampling locations as reference.

Radioactive concentrations in groundwater were also measured.

(3) Frequencies and periods

The monitoring for public water areas was conducted 2 to 10 times a year (varying by location) since August 2011.

The monitoring for groundwater was conducted 1 to 4 times a year (varying by location) since October 2011.

(4) Conducted analyses

Primarily, analyses targeting Cs-134 and Cs-137 were conducted.

Additionally, analyses on I-131, Sr-89, Sr-90 and other artificial radionuclides were also conducted for some of the collected samples.

(5) Compilation and evaluation of results

The results of the measurement are compiled and released sequentially as preliminary reports on the website of the Ministry of the Environment.

This report is the compilation of the overall monitoring results, and the details of individual monitoring surveys are available on the following webpages.

Public water areas: http://www.env.go.jp/jishin/monitoring/results_r-pw.html

Groundwater: http://www.env.go.jp/jishin/monitoring/results_r-gw.html

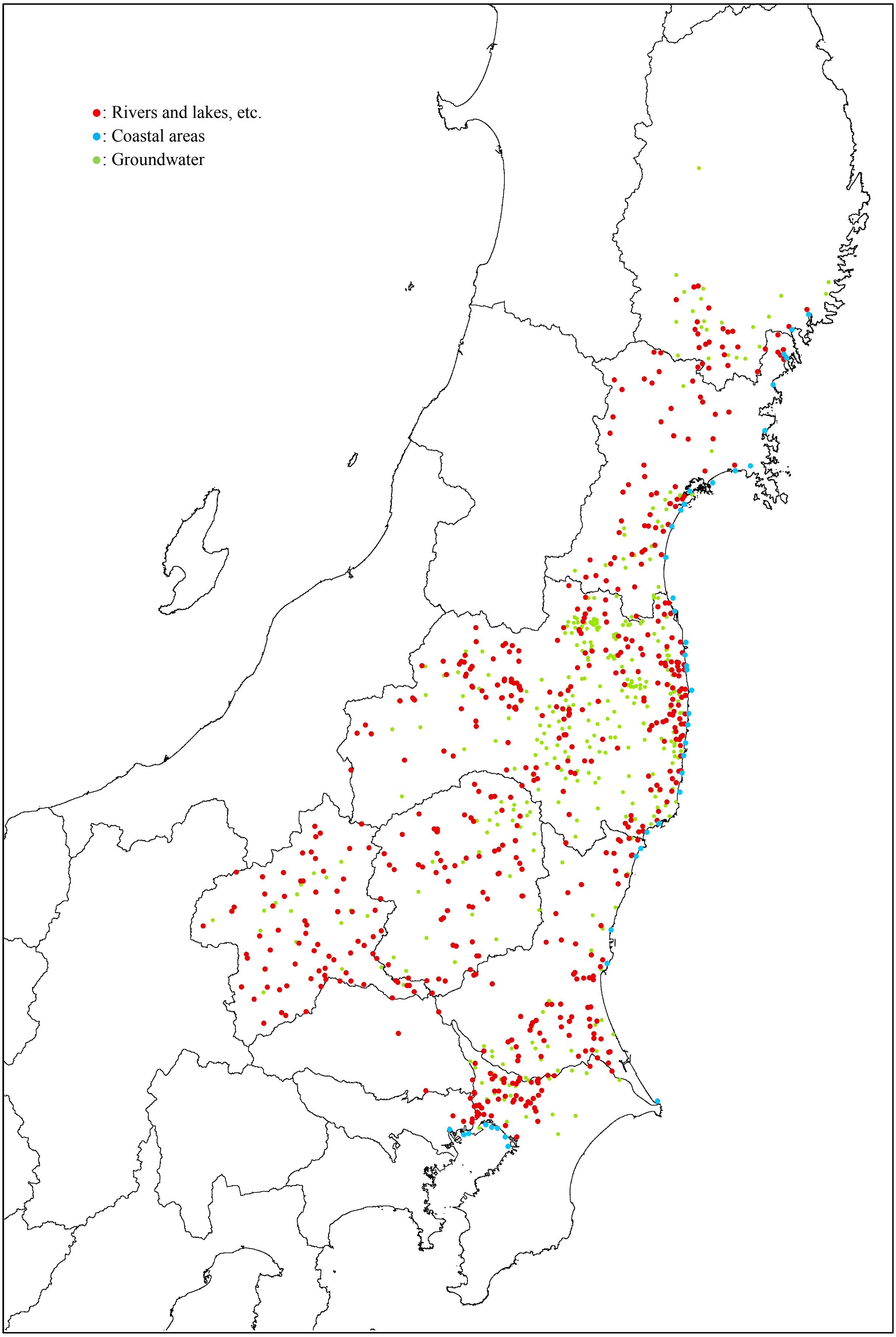


Figure 1.2-1 Map showing locations for the Post-Earthquake Monitoring

2. Survey Methods and Analysis Methods

2.1 Survey methods

Samples were collected at predetermined locations (for public water areas and groundwater) and the following analyses of radioactive materials are conducted at chemical laboratories.

Samples were collected based on the following guidelines in principle, as outlined below.

- Water Quality Survey Method (September 30, 1971; Notice Kansuikan No. 30 issued by the Director of the Water Quality Preservation Bureau, Ministry of the Environment)
- Sediment Survey Method (August 8, 2012; Notice Kansuitaisuihatsu No. 120725002 issued by the Director of the Environmental Management Bureau, Ministry of the Environment)
- Groundwater Quality Survey Method (September 14, 1989; Notice Kansuikan No. 189 issued by the Director of the Water Quality Preservation Bureau, Ministry of the Environment)
- Environmental Sample Collection Method (1983, MEXT's Radioactivity Measurement Method Series)
- Sample Pretreatment for Instrumental Analysis Using Germanium Semiconductor Detectors (1982, MEXT's Radioactivity Measurement Method Series)

2.2 Analysis methods

The γ-ray spectrometry measurement using a germanium semiconductor detector was conducted for water samples and sediment samples from public water areas and for groundwater samples, primarily targeting Cs-134 and Cs-137.

Additionally, analyses on I-131, Sr-89, Sr-90 and other artificial radionuclides were also conducted for some of the collected samples. Detected values were indicated with two significant digits in the unit of "Bq/L" in the case of water samples from public water areas and groundwater samples, and in the unit of "Bq/kg (dry)" in the case of sediment samples from public water areas. The measurement results were corrected for attenuation, and reported figures were activity concentrations as of the time of completing sampling.

Adopted analysis methods were basically in line with the MEXT's Radioactivity Measurement Method Series, and detection limits were as shown in the table below.

Table 2.2-1 Detection limit targets for radionuclides for the radioactive material-related environmental monitoring in areas afflicted by the Great East Japan Earthquake

Radionuclide		Public water areas (water)	Public water areas (sediments)	Groundwater
Radioactive cesium (Cs-134 and Cs-137)		Approx. 1 Bq/L	Approx.10 Bq/kg (dry)	Approx.1 Bq/L
Radioactive iodine (I-131)		Approx.1 Bq/L	Approx.10 Bq/kg (dry)	Approx.1 Bq/L
Radioactive strontium	Sr-90	—	Approx.1 Bq/kg (dry) (0.18 to 2.9 Bq/kg (dry))	Approx.1 Bq/L (*1)
	Sr-89	—	Approx.2 Bq/kg (dry)	Approx.1 Bq/L (*2)
Other artificial radionuclides (*3)		—	Ag-110m: 7 to 180 Bq/kg (dry) Sb-125: 130 to 330 Bq/kg (dry)	

*1: 0.0002 Bq/L for the FY2011 monitoring
*2: 0.001 Bq/L for the FY2011 monitoring
*3: Vary by type of radionuclides; The above table shows detection limit targets for Ag-110m and Sb-125, which were detected in the monitoring (see Chapter 5.3 of the main text).

3. Outline of the Results

The results of the Post-Earthquake Monitoring conducted in Tokyo Metropolis and other nine prefectures during the period from August 2011 to December 2014 were as outlined below.

3.1 Detection of radioactive cesium

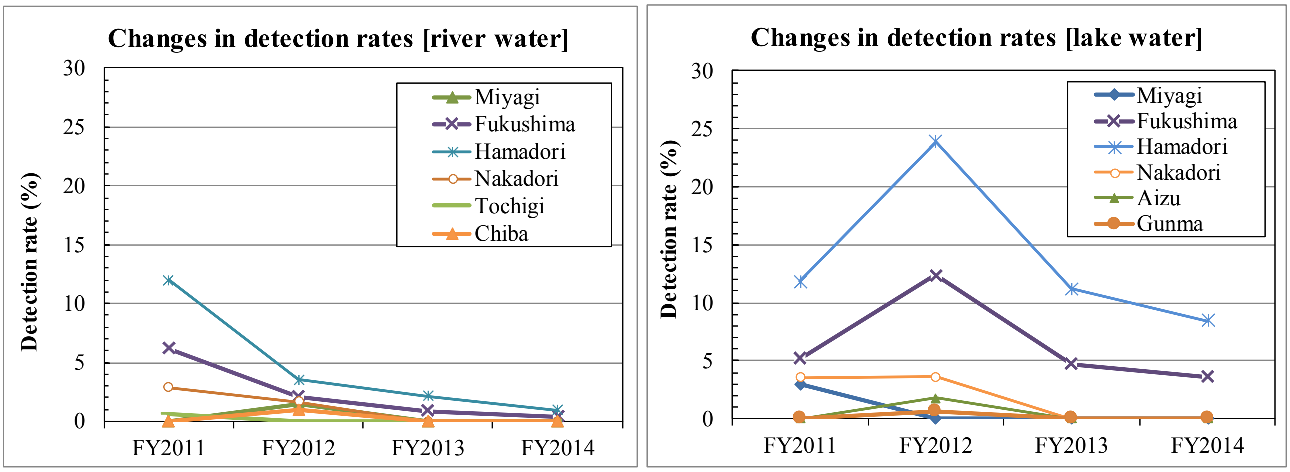
Radioactive cesium (the total of Cs-134 and Cs-137) was detected as follows.

(1) Public water areas (water)

Detection rates of radioactive cesium were generally decreasing for river water samples (7,000 or more in total) and lake water samples (4,100 or more in total) collected in all surveyed prefectures. Radioactive cesium has not been detected in prefectures other than Fukushima Prefecture since FY2013 (see Figure 3.1-1).

The maximum concentration levels in the FY2014 monitoring was 1.6 Bq/L for river water samples (detection rate: 0.9%) and 34 Bq/L for lake water samples (detection rate: 8.5%).

Radioactive cesium was not detectable in any of the samples collected at coastal areas (1,700 or more in total).



(*) Data for Fukushima Prefecture are the total of those for Hamadori, Nakadori, and Aizu. The same applies in other figures below.

Figure 3.1-1 Changes in detection rates of radioactive cesium in water samples from public water areas (left: rivers; right: lakes)

(2) Groundwater

Radioactive cesium was not detectable in groundwater samples (2,600 or more in total) collected in any of the surveyed prefectures, except for the two samples collected in Fukushima Prefecture wherein radioactive cesium was detected at 2 Bq/L and 1 Bq/L, respectively, in 2011.

(3) Public water areas (sediments)

1) Overall trends

Radioactive cesium was detected at the rate of over 80% in river sediment samples (7,000 or more in total), at over 90% in lake sediment samples (2,400 or more in total), and at over 50% in sediment samples collected in coastal areas.

Concentration levels were generally decreasing for all of the samples collected in rivers, lakes, and coastal areas, and the decreasing trend was especially notable in samples collected in rivers.

2) Situation by location

As radioactive cesium was detected at many locations, the situations in respective locations were compared and detected concentration levels and their changes were statistically compiled as shown in "4.3 Detection of radioactive materials in sediment samples by sampling location."

Detected concentration levels were compiled as shown in Table 3.1-1.

Locations where concentration levels were relatively high (Category A or B: upper 10 percentile) were found in Hamadori in Fukushima Prefecture, as well as in Nakadori and Aizu in Fukushima Prefecture, and also in Miyagi, Chiba, and Ibaraki Prefectures.

Table 3.1-1 Categorization of detected concentration levels for sediment samples from public water areas (rivers, lakes, and coastal areas)

<Rivers>

Category	Percentile (see Figure 4.3-1))	[River sediments] Range [Bq/kg (dry)]	Number of locations												
			Iwate	Miyagi	Fukushima Prefecture			Ibaraki	Tochigi	Gunma	Chiba	Saitama	Tokyo	Total	
					Hamadori Area	Nakadori Area	Aizu							Number of locations	Percentage
A	Upper 5 percentile	2,613 or more	0	0	15	0	0	1	0	0	3	0	0	19	4.8
B	Upper 5 to 10 percentile	1,326 ～ 2,613	0	1	2	3	1	2	0	0	11	0	0	20	5.1
C	Upper 10 to 25 percentile	522 ～ 1,326	0	7	13	15	1	9	0	1	14	0	0	60	15.2
D	Upper 25 to 50 percentile	188 ～ 522	2	15	10	10	6	27	11	4	12	0	2	99	25.0
E	Lower 50 percentile	188 or less	20	20	13	16	18	14	45	43	7	2	0	198	50.0
Total			22	43	53	44	26	53	56	48	47	2	2	396	100.0

<Lakes>

Category	Percentile (see Figure 4.3-1))	Range [Lake sediments] [Bq/kg (dry)]	Number of locations									
			Miyagi Prefecture	Fukushima Prefecture			Ibaraki	Tochigi	Gunma	Chiba	Total	
				Hamadori Area	Nakadori Area	Aizu					Number of locations	Percentage
A	Upper 5 percentile	26,707 or more	0	8	0	0	0	0	0	0	8	4.9
B	Upper 5 to 10 percentile	20,599 ～ 26,707	0	8	0	0	0	0	0	0	8	4.9
C	Upper 10 to 25 percentile	2,913 ～ 20,599	0	16	6	0	1	1	0	1	25	15.2
D	Upper 25 to 50 percentile	803 ～ 2,913	6	6	4	8	4	1	11	1	41	25.0
E	Lower 50 percentile	803 or less	15	3	2	23	14	6	13	6	82	50.0
Total			21	41	12	31	19	8	24	8	164	100.0

<Coastal areas>

Category	Percentile (see Figure 4.3-1))	Range [coastal area sediments] [Bq/kg (dry)]	Number of locations							
			Iwate	Miyagi	Fukushima	Ibaraki	Chiba	Tokyo	Total	
									Number of locations	Percentage
A	Upper 5 percentile	533 or more	0	1	1	0	0	0	2	4.8
B	Upper 5 to 10 percentile	462 ～ 533	0	0	2	0	0	0	2	4.8
C	Upper 10 to 25 percentile	276 ～ 462	0	1	3	0	0	2	6	14.3
D	Upper 25 to 50 percentile	79 ～ 276	0	5	5	0	0	0	10	23.8
E	Lower 50 percentile	79 or less	2	5	4	5	5	1	22	52.4
Total			2	12	15	5	5	3	42	100.0

Changes in detected concentration levels were compiled as shown in Figure 3.1-2, which shows Table 4.3-45 graphically.

At most monitoring locations for rivers, a decreasing trend was observed. For lakes, concentration levels were generally decreasing or unchanged at most locations with some locations showing fluctuations. There were also some locations where an increasing trend was observed. For coastal areas, a decreasing trend was observed at most locations with some locations showing fluctuations.

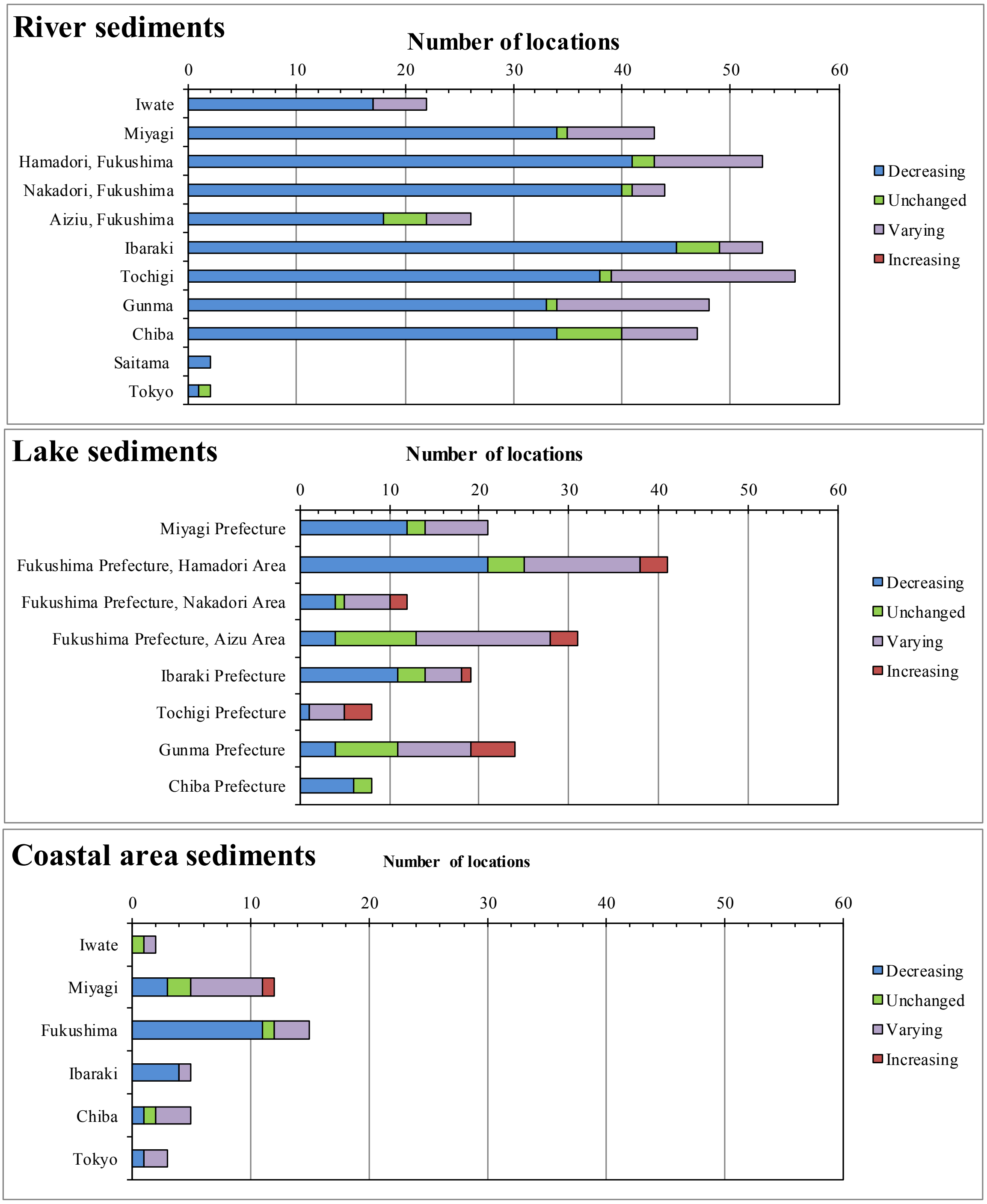


Figure 3.1-2 Changes in detected concentration levels of radioactive materials in sediment samples from public water areas (rivers, lakes, and coastal areas)

3.2 Detection of radionuclides other than radioactive cesium

(1) I-131

I-131 was not detectable in any of the monitoring surveys conducted from FY2011 to FY2012 for water samples from public water areas (approx. 3,000 samples from rivers, approx. 1,400 samples from lakes, and approx. 700 samples from coastal areas) and sediment samples from public water areas (approx. 3,000 samples from rivers, approx. 900 samples from lakes, and approx. 400 samples from coastal areas) as well as in any of the monitoring surveys conducted from FY2011 to FY2014 for groundwater samples (approx. 3,800 samples) (detection limit: 1 Bq/L for water and 10 Bq/kg for sediments).

(2) Sr-89 and Sr-90

Sr-90 was surveyed in the monitoring surveys conducted from FY2011 to FY2012 for sediment samples from public water areas (rivers, lakes, and coastal areas) (approx. 300 samples in total) and for groundwater samples (approx. 190 samples in total). As a result, Sr-90 was detected in some of the sediment samples from public water areas, but concentration levels were generally decreasing (see Figure 3.2-1).

Sr-89 was not detectable in any of the monitoring surveys conducted for sediment samples from public water areas (a total of 22 samples collected from rivers and lakes in FY2011) and for groundwater samples (a total of approx. 190 samples surveyed from FY2011 to FY2014) (detection limit: 1 Bq/L for water and 2 Bq/kg for bottom sediments).

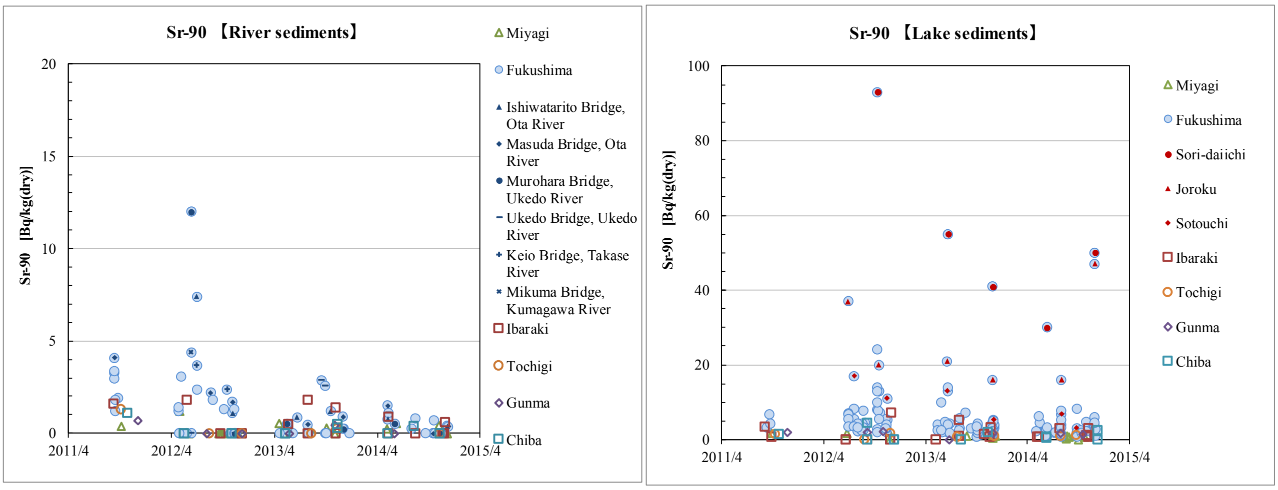


Figure 3.2-1 Detection of Sr-90 in sediment samples from public water areas (left: rivers; right: lakes)

(3) Other radionuclides

Ag-110m and Sb-125 were detected in FY2011 and FY2012 at detection rates below 1% within a total of over 10,000 samples surveyed from FY2011 to FY2014. They were detected near the Fukushima Daiichi NPS. Since FY2013, neither Ag-110m nor Sb-125 has been detectable.

4. Results (Radioactive Cesium (Cs-134 and Cs-137))

4.1 Water

(1) Public water areas

1) Rivers

Detection of radioactive cesium (Cs-134 and Cs-137) in river water samples was as shown in Table 4.1-1 and Figure 4.1-1.

Detection rates as a whole were generally decreasing since FY2011, and radioactive cesium was not detectable in FY2014 except in Hamadori in Fukushima Prefecture.

Detected values (the total of Cs-134 and Cs-137) were also in decline since FY2011. Radioactive cesium was detected in Hamadori in Fukushima Prefecture at a level of 1.6 Bq/L at the maximum in FY2014 but was not detectable in other locations (detection limit: 1 Bq/L for both Cs-134 and Cs-137).

2) Lakes

Detection of radioactive cesium (Cs-134 and Cs-137) in lake water samples was as shown in Table 4.1-2 and Figure 4.1-2.

Detection rates as a whole were decreasing since FY2012, and radioactive cesium was not detectable since FY2013 except in Hamadori in Fukushima Prefecture.

Detected values (the total of Cs-134 and Cs-137) were also in decline since FY2012. Radioactive cesium was detected in Hamadori in Fukushima Prefecture at a level of 34 Bq/L at the maximum in FY2014 but was not detectable in other locations (detection limit: 1 Bq/L for both Cs-134 and Cs-137).

3) Coastal areas

Detection of radioactive cesium (Cs-134 and Cs-137) in coastal area water samples was as shown in Table 4.1-3.

Radioactive cesium was not detectable at any surveyed locations (detection limit: 1 Bq/L for both Cs-134 and Cs-137).

(2) Groundwater

Detection of radioactive cesium (Cs-134 and Cs-137) in groundwater samples was as shown in Table 4.1-4.

The monitoring surveys were conducted for approx. 2,600 samples collected in eight prefectures. In FY2011, Cs-134 and Cs-137 were detected only at one location and two locations (all in Fukushima Prefecture), respectively, at a level of 1 Bq/L, which is the detection limit for radioactive cesium. In FY2012 onward, radioactive cesium was not detectable at any surveyed locations for groundwater.

<Note>

・Specification and Standards for Food, Food Additives, etc. in Accordance with the Food Sanitation Act (Drinking Water) (Ministry of Health, Labour and Welfare Public Notice No.130, March 15, 2012)

Radioactive cesium (total for Cs-134+Cs-137): 10 Bq/kg

・Reference Values for Radioactive Materials in Tap Water (Management Target for Water Supply Facilities) (March

5, 2012; 0305 Notice No.1 from the Director of the Water Supply Division, Health Service Bureau, Ministry of Health, Labour and Welfare)

Radioactive cesium (total for Cs-134+Cs-137): 10 Bq/kg

Table 4.1-1 Detection of radioactive cesium in river water samples (by fiscal year)

Prefecture	FY2011				FY2012				FY2013				FY2014				Total			
	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)
Iwate	18	0	0.0	-	64	0	0.0	-	80	0	0.0	-	80	0	0.0	-	242	0	0.0	-
Yamagata	10	0	0.0	-	0	0	-	-	0	0	-	-	0	0	-	-	10	0	0.0	-
Miyagi	114	0	0.0	-	204	3	1.5	ND - 6.3	193	0	0.0	-	196	0	0.0	-	707	3	0.4	ND - 6.3
Fukushima	452	28	6.2	ND − 20	854	18	2.1	ND - 4.6	801	7	0.9	ND - 5.5	770	3	0.4	ND - 1.6	2877	56	1.9	ND - 20
Hamadori Area	192	23	12.0	ND - 20	342	12	3.5	ND - 4.6	325	7	2.2	ND - 5.5	326	3	0.9	ND - 1.6	1185	45	3.8	ND - 20
Nakadori Area	176	5	2.8	ND - 8.0	355	6	1.7	ND - 1.9	322	0	0.0	-	324	0	0.0	-	1177	11	0.9	ND - 8.0
Aizu	84	0	0.0	-	157	0	0.0	-	154	0	0.0	-	120	0	0.0	-	515	0	0.0	-
Ibaraki	128	0	0.0	-	214	0	0.0	-	212	0	0.0	-	212	0	0.0	-	766	0	0.0	-
Tochigi	161	1	0.6	ND - 1.0	277	0	0.0	-	276	0	0.0	-	274	0	0.0	-	988	1	0.1	ND - 1.0
Gunma	90	0	0.0	-	216	0	0.0	-	214	0	0.0	-	210	0	0.0	-	730	0	0.0	-
Saitama	2	0	0.0	-	8	0	0.0	-	8	0	0.0	-	8	0	0.0	-	26	0	0.0	-
Chiba	82	0	0.0	-	202	2	1.0	ND - 1.3	200	0	0.0	-	200	0	0.0	-	684	2	0.3	ND - 1.3
Tokyo	3	0	0.0	-	12	0	0.0	-	8	0	0.0	-	8	0	0.0	-	31	0	0.0	-
Total	1060	29	2.7	ND - 20	2051	23	1.1	ND - 6.3	1992	7	0.4	ND - 5.5	1958	3	0.2	ND - 1.6	7061	59	0.8	ND - 20

ND: Not detectable

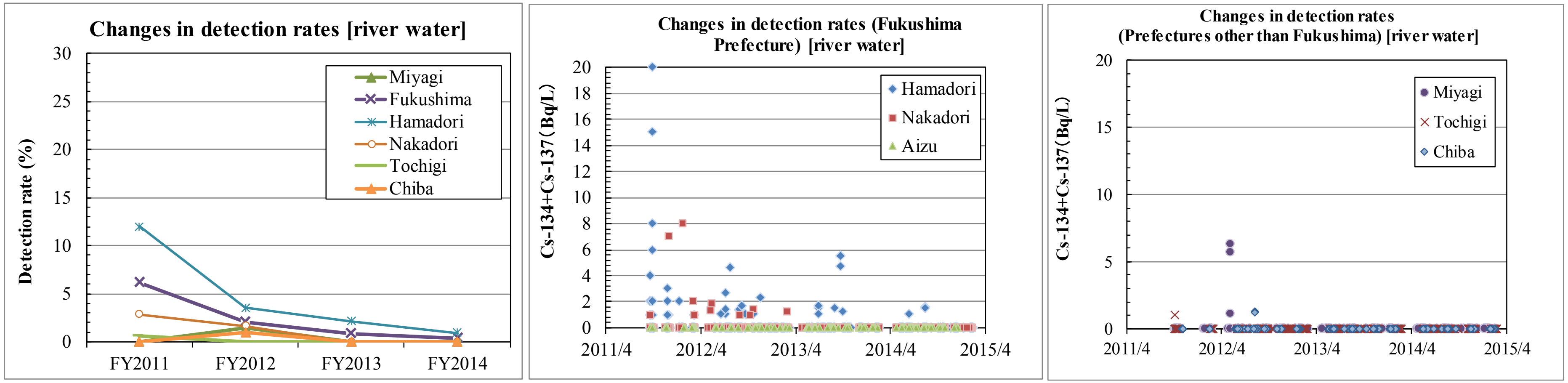


Figure 4.1-1 Detection rates of radioactive cesium in river water samples (left) and changes in detected values (center and right)

Table 4.1-2 Detection of radioactive cesium in lake water samples (by fiscal year)

Prefecture	FY2011				FY2012				FY2013				FY2014				Total			
	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)
Yamagata	4	0	0.0	-	0	0	-	-	0	0	-	-	0	0	-	-	4	0	0.0	-
Miyagi	34	1	2.9	ND - 3.0	90	0	0.0	-	118	0	0.0	-	114	0	0.0	-	356	1	0.3	ND - 3.0
Fukushima	211	11	5.2	ND - 27	581	72	12.4	ND - 100	761	36	4.7	ND - 47	799	29	3.6	ND - 33.8	2352	148	6.3	ND - 100
Hamadori Area	76	9	11.8	ND - 27	272	65	23.9	ND - 100	321	36	11.2	ND - 47	342	29	8.5	ND - 33.8	1011	139	13.7	ND - 100
Nakadori Area	56	2	3.6	ND - 5.0	83	3	3.6	ND - 1.2	109	0	0.0	-	113	0	0.0	-	361	5	1.4	ND - 5.0
Aizu	79	0	0.0	-	226	4	1.8	ND - 5.1	331	0	0.0	-	344	0	0.0	-	980	4	0.4	ND - 5.1
Ibaraki	48	0	0.0	-	93	0	0.0	-	152	0	0.0	-	152	0	0.0	-	445	0	0.0	-
Tochigi	24	0	0.0	-	54	0	0.0	-	62	0	0.0	-	64	0	0.0	-	204	0	0.0	-
Gunma	51	0	0.0	-	144	1	0.7	ND - 1.0	188	0	0.0	-	187	0	0.0	-	570	1	0.2	ND - 1.0
Chiba	32	0	0.0	-	50	0	0.0	-	53	0	0.0	-	50	0	0.0	-	185	0	0.0	-
Total	404	12	3.0	ND - 27	1012	73	7.2	ND - 100	1334	36	2.7	ND - 47	1366	29	2.1	ND - 33.8	4116	150	3.6	ND - 100

ND: Not detectable

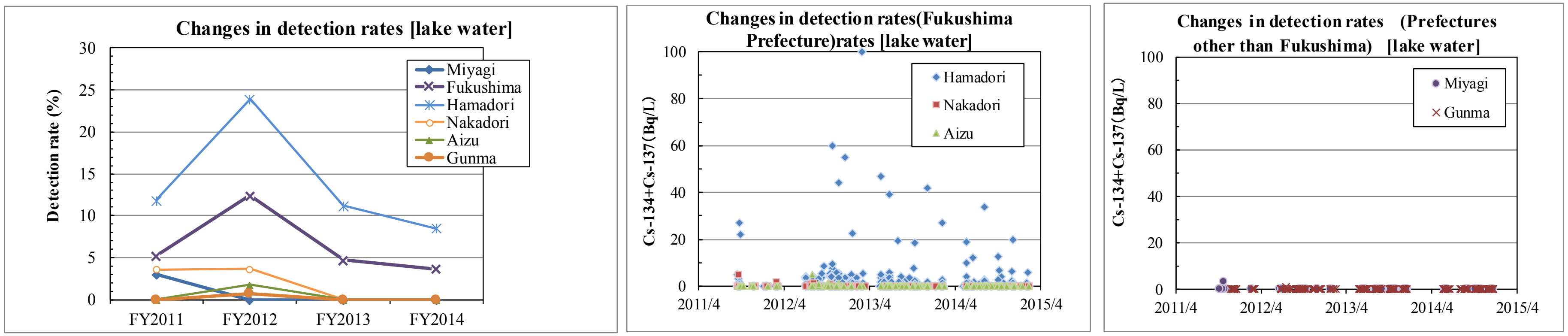


Figure 4.1-2 Detection rates of radioactive cesium in lake water samples (left) and changes in detected values (center and right)

Table 4.1-3 Detection of radioactive cesium in coastal area water samples (by fiscal year)

Prefecture	FY2011				FY2012				FY2013				FY2014				Total			
	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)
Iwate	5	0	0.0	-	8	0	0.0	-	8	0	0.0	-	8	0	0.0	-	29	0	0.0	-
Miyagi	94	0	0.0	-	96	0	0.0	-	102	0	0.0	-	104	0	0.0	-	396	0	0.0	-
Fukushima	116	0	0.0	-	189	0	0.0	-	300	0	0.0	-	300	0	0.0	-	905	0	0.0	-
Ibaraki	45	0	0.0	-	62	0	0.0	-	40	0	0.0	-	40	0	0.0	-	187	0	0.0	-
Chiba	0	0	-	-	62	0	0.0	-	46	0	0.0	-	46	0	0.0	-	154	0	0.0	-
Tokyo	0	0	-	-	38	0	0.0	-	36	0	0.0	-	36	0	0.0	-	110	0	0.0	-
Total	260	0	0.0	-	455	0	0.0	-	532	0	0.0	-	534	0	0.0	-	1781	0	0.0	-

Table 4.1-4 Detection of radioactive cesium in groundwater samples (by fiscal year)

Prefecture	FY2011				FY2012				FY2013				FY2014				Total			
	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)	Number of samples [A]	Number of detections [B]	Detection rate (B/A) (%)	Range of measured values (Bq/L)
Iwate	42	0	0.0	-	44	0	0.0	-	44	0	0.0	-	22	0	0.0	-	152	0	0.0	-
Miyagi	79	0	0.0	-	44	0	0.0	-	48	0	0.0	-	24	0	0.0	-	195	0	0.0	-
Yamagata	79	0	0.0	-	0	0	-	-	0	0	-	-	0	0	-	-	79	0	0.0	-
Fukushima	540	2	0.4	ND - 2.0	543	0	0.0	-	766	0	0.0	-	771	0	0.0	-	2620	2	0.1	ND − 2.0
Ibaraki	89	0	0.0	-	54	0	0.0	-	54	0	0.0	-	27	0	0.0	-	224	0	0.0	-
Tochigi	76	0	0.0	-	54	0	0.0	-	54	0	0.0	-	27	0	0.0	-	211	0	0.0	-
Gunma	40	0	0.0	-	40	0	0.0	-	42	0	0.0	-	21	0	0.0	-	143	0	0.0	-
Chiba	54	0	0.0	-	46	0	0.0	-	46	0	0.0	-	23	0	0.0	-	169	0	0.0	-
Total	999	2	0.2	ND - 2.0	825	0	0.0	-	1054	0	0.0	-	915	0	0.0	-	2620	2	0.1	ND - 2.0

ND: Not detectable

(*) In FY2011, both Cs-134 and Cs-137 were detected at one location and only Cs-137 was detected at one location at a level of 1 Bq/L (detection limit), respectively (see the main text).

4.2 Sediments

Detection of radioactive cesium (Cs-134 and Cs-137) in sediment samples from pubic water areas (rivers, lakes, and coastal areas) were as outlined below (detection limit was set at 10 Bq/kg).

(1) Public water areas (rivers)

Radioactive cesium (Cs-134 and Cs-137) detected in river sediment samples was as shown in Table 4.2-1 and Figure 4.2-1.

Detection rates varied between 60% and 100% with a slight decreasing trend observed over years. Detection rates remained over 80% in many of the surveyed prefectures in FY2014.

In the meantime, locations where detected values (the total activity concentrations of Cs-134 and Cs-137) were high were decreasing while the number of locations with low detected values was increasing. It was observed that detected values were generally decreasing over years.

(2) Public water areas (lakes)

Detection of radioactive cesium (Cs-134 and Cs-137) in lake sediment samples was as shown in Table 4.2-2 and Figure 4.2-2.

Detection rates varied between 83% and 100% and remained over 90% in all surveyed prefectures in FY2014 as well.

As a whole, locations where detected values (the total of Cs-134 and Cs-137) were high were decreasing and the number of locations with low detected values was increasing, although such trend was not as clear as in the case of river sediment samples.

In Hamadori in Fukushima Prefecture, high values exceeding 100,000 Bq/kg were observed even in FY2014.

(3) Public water areas (coastal areas)

Detection of radioactive cesium (Cs-134 and Cs-137) in coastal area sediment samples was as shown in Table 4.2-3 and Figure 4.2-3.

Detection rates varied between 50% and 100% and were over 50% in FY2014 in all surveyed prefectures except for those where only a small number of samples were collected.

A decrease in the number of locations where detected values (the total of Cs-134 and Cs-137) were high was not as clear for prefectures where only a small number of samples were collected, but in Fukushima and Miyagi Prefectures, the number of locations where detected values continued to be low was increasing, and detected values were thus decreasing over the years as a whole. However, in Miyagi Prefecture, there were locations where detected values exceeded 1,000 Bq/kg even in FY2014.