Fukushima Daiichi Nuclear Power Station Measures Pertaining to the Fish inside the Port (Seawater and Seabed Soil Investigation Results from inside the Port)

＜Reference document＞
March 19, 2025
Tokyo Electric Power Company Holdings, Inc.
Fukushima Daiichi Decontamination & Decommissioning Engineering Company

■ At the Fukushima Daiichi Nuclear Power Station, to prevent fish containing high cesium concentrations from escaping outside of the port, TEPCO has been implementing the following multilayered measures pertaining to the fish inside the port.

- ✓ Improving environment of the port: covering the seabed soil inside the port and reducing the amount of cesium flowing into the port (by removing rubble, paving, additional silt fence installation, etc.)
- ✓ Catching the fish in addition to keeping them in place : Along with installing multiple nets for preventing fish from leaving and gill nets, etc. inside the port to prevent fish from leaving that area, we have also been catching fish.
- ✓ Monitoring: We continue to measure the cesium concentrations in fish caught inside the port and monitor its trends.

■ The following countermeasures have also been completed in addition to those mentioned above

① Re-covering of the seabed of the Unit 1-4 open intake channel (started on October 16, 2023 and completed on June 13, 2024)

② Reduction of the mesh size of the fish migration prevention net at the exit of the Unit 1-4 open intake channel (Started on July 31, 2023 and completed on September 1 of the same year)

③ Replacement of the fish migration prevention net for the east wave embankment that surrounds the Unit 1-4 open intake channel (started on July 26, 2023 and completed on March 4, 2024)

<The above information was announced by June 13, 2024>

■ **The concentrations of cesium 137** in seawater and seabed soil from inside the port ※ were investigated as part of port fish countermeasures.

■ Results of the cesium 137 concentration investigation found that **cesium in the seawater was below detectable levels for the most part**. **The concentration of cesium 137 in the seabed soil was two digits lower than that from the Unit 1-4 open intake channel (before re-covering the seabed), and even seabed soil with high concentrations was approximately the same as the soil around the Unit 5, 6 open intake channel. The seabed soil was found to have no impact on the seawater**. (Refer to pages 2 and 3)

■ Furthermore, **the chemical attributes of the cesium 137 adhered to the seabed soil make it, for the most part, difficult for fish to ingest**. (Refer to page 4)

■ Although no fish have been caught with cesium concentrations exceeding 100 Bq/kg while catching the fish being strengthened in FY2024, we will continue to improve the port environment (reduce the amount of cesium flowing into the port) and engage in port fish countermeasures such as the monitoring of fish inside the port, etc.

※: Inside the port excluding from inside the Unit 1-4 open intake channel and in the vicinity of the Unit 5, 6 open intake channel

1. Summary of conditions inside the port and the details of investigation performed outside the open intake channels, etc.

- The concentrations of cesium 137 in the seabed soil (sediment) from the vicinity of the Unit 5, 6 open intake channel and from inside the Unit 1-4 open intake channel have been measured.
- Maintenance dredging is performed in the vicinity of the Unit 5, 6 open intake channel, which serves as the intake channel for seawater used to dilute ALPS treated water, and we've completed the re-covering of the seabed inside the Unit 1-4 open intake channel into which rain drainage from drainage channel K flows.
- In September 2024, we performed an investigation outside the open intake channels during which seawater and seabed soil were taken from the 10 locations shown in Figure 1 from the various layers and the seabed shown in Figure 2 (near the water surface, mid layer, near the seabed), and analyzed the chemical attributes of cesium 137 adhered to the seabed soil as well as the cesium 137 concentrations measured to date.

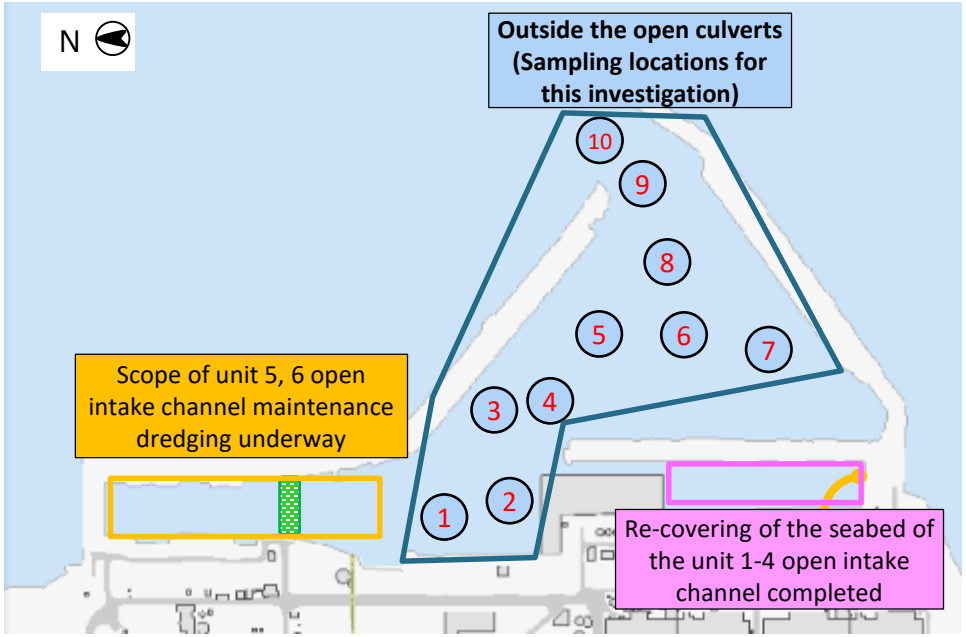


Figure 1. Investigation sampling locations

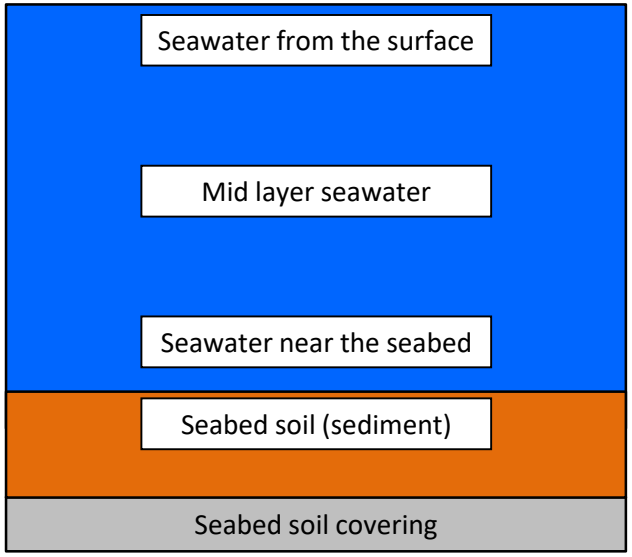


Figure 2. Sampling depths (Diagram of sampling positions)

2. Results of the investigation into cesium 137 concentrations in seawater and seabed soil from inside the port

- In September 2024, seawater (near the water surface, mid layer, near the seabed) and seabed soil were sampled from 10 locations inside the port (outside the open intake channels) to analyze cesium 137 concentrations.
- Seawater analysis results found that cesium concentrations were below detectable levels (approximately 0.4Bq/liter) in 28 out of the 30 samples.
- Cesium concentrations in seabed soil were between 183.0 (location ⑤)~4,575 (location ②) Bq/kg. In regards to the concentration distribution, cesium levels increased as we moved from the mouth of the port into the back of the port, but were two digits lower than the cesium concentrations in the seabed soil from inside the Unit 1-4 open intake channel (maximum: 150,000Bq/kg prior to re-covering), and approximately the same as in the vicinity of the Unit 5, 6 open intake channel. Furthermore, cesium concentrations near the mouth of the port (location ⑩) were approximately the same as those outside the port (north side of the Unit 5, 6 discharge outlet).
- While cesium 137 was detected in the seabed soil, concentrations were below detectable levels for the most part in seawater thereby indicating that the cesium 137 in the seabed soil is not eluting into the sea water.

【Reference】
Inside the Unit 1-4 open intake channel:
19,000~150,000Bq/kg
Near the Unit 5, 6 open intake channel:
227~5,140Bq/kg
North side of the Unit 5, 6 discharge outlet:
112~280Bq/kg
(Results for inside the unit 1-4 open intake channel are from 2023, and all other measurements are from 2024)

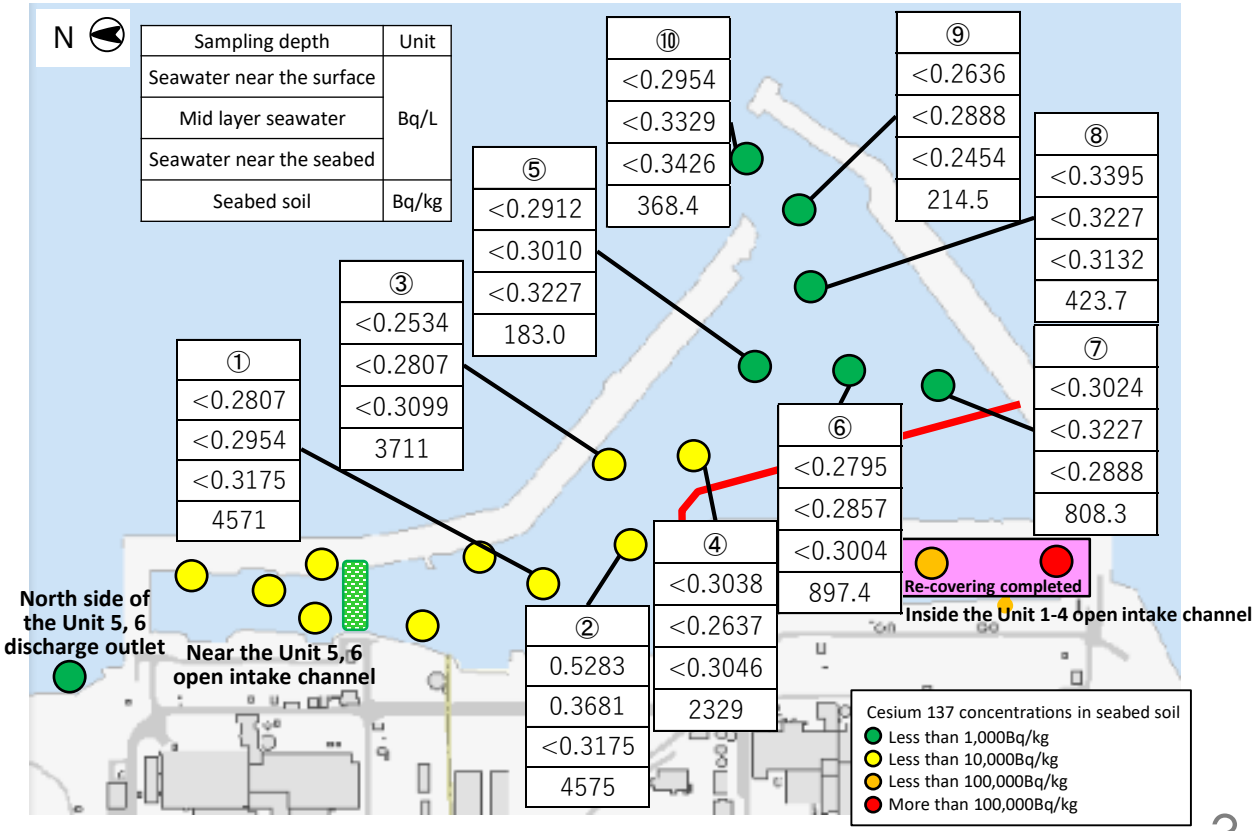


Figure 1. Concentrations of cesium 137 in seawater and seabed soil for each investigation location

3. Analysis results of the chemical attributes of cesium 137 adhered to seabed soil from inside the port

- Chemical attributes of cesium 137 adhered to seabed soil sampled from 10 locations inside the port (outside the open intake channels) were analyzed.
- Investigation results found that the chemical attributes of cesium 137 make it, for the most part, difficult for fish to ingest.
- In addition, as noted on page 3, the cesium 137 in the seabed soil was not found to be eluting into the sea water, and we evaluate that the seabed soil inside the port (outside the open intake channels) is having little impact on fish.

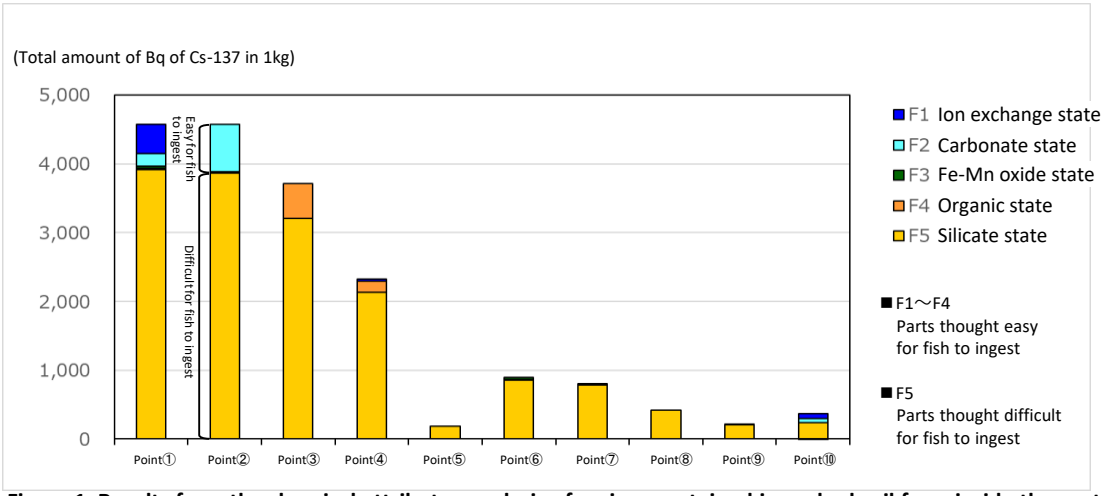


Figure 1. Results from the chemical attributes analysis of cesium contained in seabed soil from inside the port (outside the open intake channels)

F1: (1M Acetic acid Na) extracted → Ion exchange state (surface adhesions)
F2: (1M Acetic acid Na + acetic acid) extracted → Carbonate state
F3: (0.04M Hydroxyl amine) extracted → Fe-Mn Oxide state
F4: (0.02M Nitric acid + 30% Hydrogen peroxide) extracted → Organics
F5: (Residue) → Silicate state

Cesium found to exist in the following forms using Tessier et al. (1979) sequential sampling method

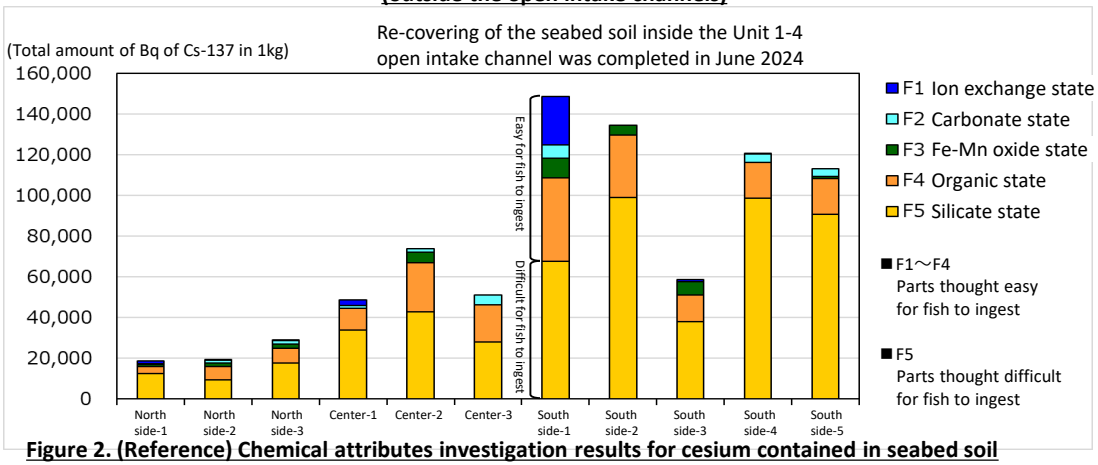


Figure 2. (Reference) Chemical attributes investigation results for cesium contained in seabed soil from inside the Unit 1-4 open intake channel

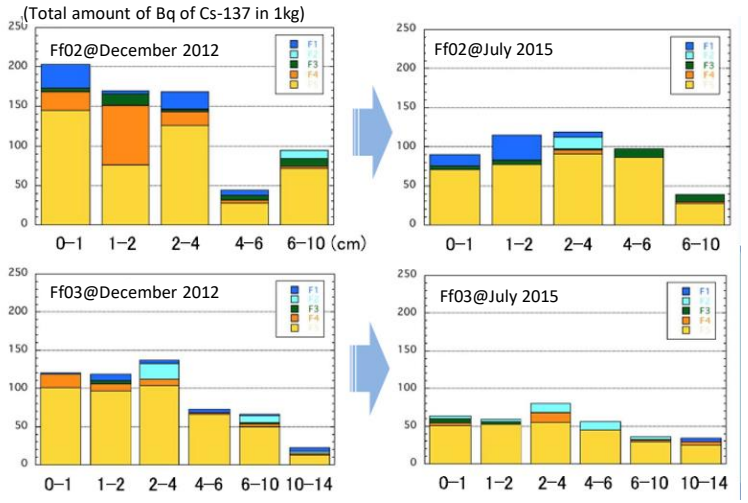
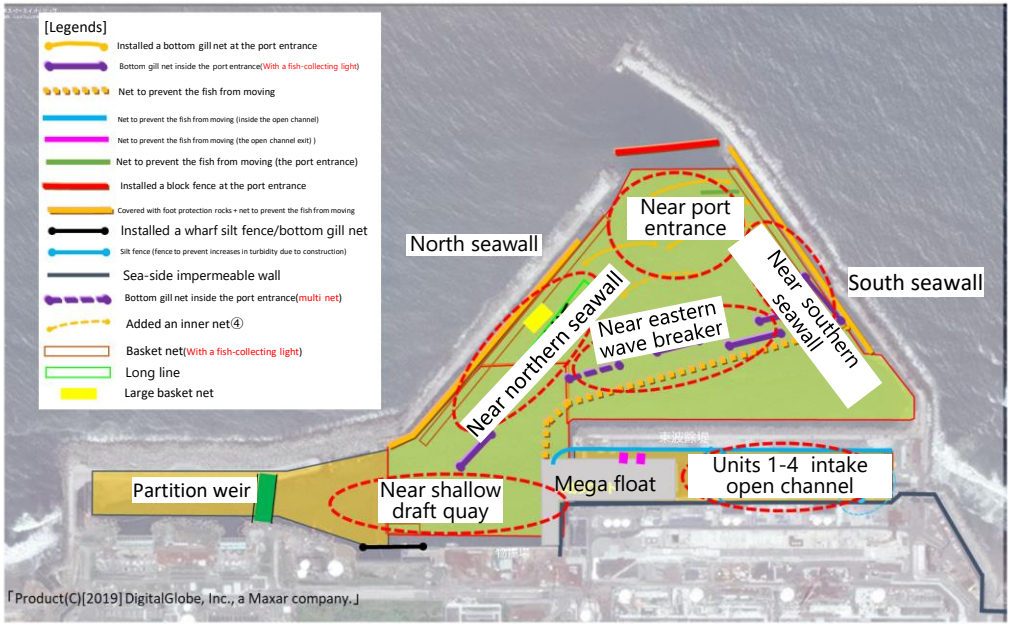


Figure 3. (Reference) Investigation results for seabed soil from off the coast of Fukushima※

※Quoted from "FY2016 Primary Results of Investigative Research to Address the TEPCO Fukushima Daiichi Nuclear Power Station Accident" (March 2017, Japan Fisheries Research and Education Agency) Chapter 7. Assessment of the impact of Radioactive Cesium in Seabed Soil on Marine Products

【Reference】Status of fish monitoring inside the power station port

- Port fish countermeasures, such as catching fish inside the port, etc., have been strengthened since February 2022.
- In September 2023, the mesh size of the fish migration prevention net at the Unit 1-4 open intake channel outlet was reduced, and in March 2024 the fish migration prevention net for the east wave embankment was replaced. Furthermore, in June 2024 we completed re-covering the seabed of the Unit 1-4 open intake channel.
- In FY2024 we continued to strengthen catching fish but to date, we have yet to catch any fish with cesium concentrations exceeding 100 Bq/kg.
- We will continue to engage in port fish countermeasures, such as monitoring the fish inside the port, etc.



Area demarcations for catching fish inside the port

Chart: Analysis values for each area and number of specimens which had concentrations that exceeded 100Bq/kg

catchment area	FY2021			FY2022			FY2023			FY2024（April 2024 - January 2025）		
	analytic number	exceeded 100Bq/kg	overcuts	analytic number	exceeded 100Bq/kg	overcuts	analytic number	exceeded 100Bq/kg	overcuts	analytic number	exceeded 100Bq/kg	overcuts
Near port entrance	12	0	0%	108	3	3%	67	4	6%	3	0	0%
Near south seawall	9	1	11%	35	0	0%	15	1	7%	5	0	0%
Near north seawall	41	0	0%	134	8	6%	82	6	7%	17	0	0%
Near eastern wave breaker	23	5	22%	119	14	12%	51	2	4%	12	0	0%
Units 1~4 intake open channel				12	12	100%	13	11	85%	0	0	0%
Near shallow draft quay	3	1	33%	7	0	0%	45	2	4%	3	0	0%
Total	88	7	8%	415	37	9%	273	26	10%	40	0	0%

【Reference】Confirming the chemical attributes of cesium adhered to seabed soil

- During this investigation we also confirmed the chemical attributes of cesium adhered to seabed soil taken from inside the Unit 1-4 open intake channel.
- Analysis was performed using Tessier et al.'s (1979) sequential extraction method that was used to assess the impact of radioactive cesium in seabed soil on marine products as noted in Chapter 7. of the "FY2016 Primary Results of Investigative Research to Address the TEPCO Fukushima Daiichi Nuclear Power Station Accident (March 2017, Japan Fisheries Research and Education Agency)
- The cesium in the seabed soil offshore of Fukushima that was analyzed during the aforementioned investigative research and the cesium found in the seabed soil of the Unit 1-4 open intake channel both exist mainly as silicate, which is difficult for fish to ingest.
- However, seabed soil taken from inside the Unit 1-4 open intake channel showed great discrepancies in cesium attributes, and at some locations (north side-2, south side-1) approximately 50% of the cesium exists in a form that is easy for fish to ingest (F1-F4).

F1: (1M Acetic acid Na) extracted → Ion exchange state (surface adhesions)

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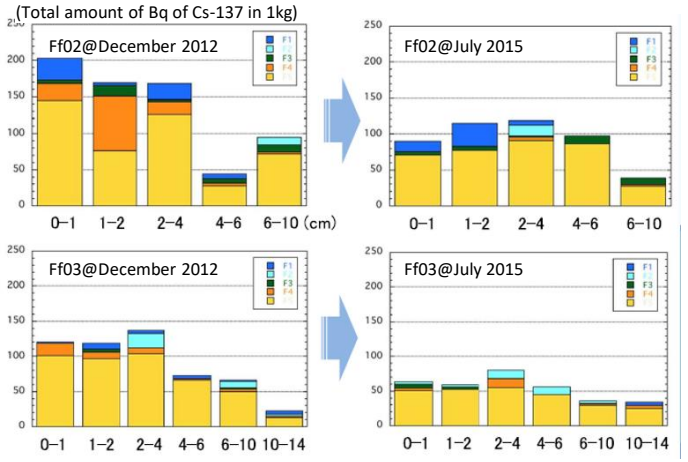


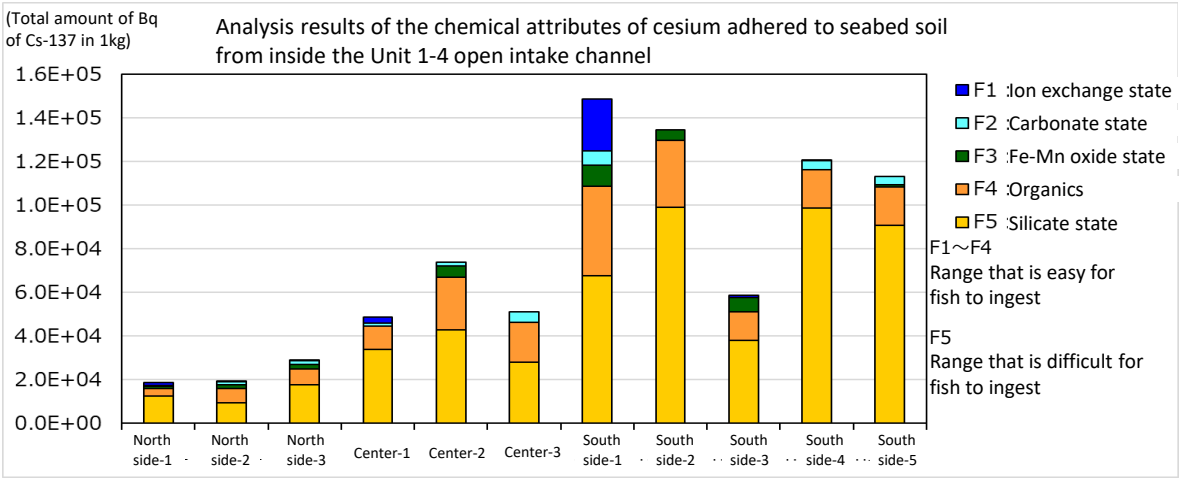


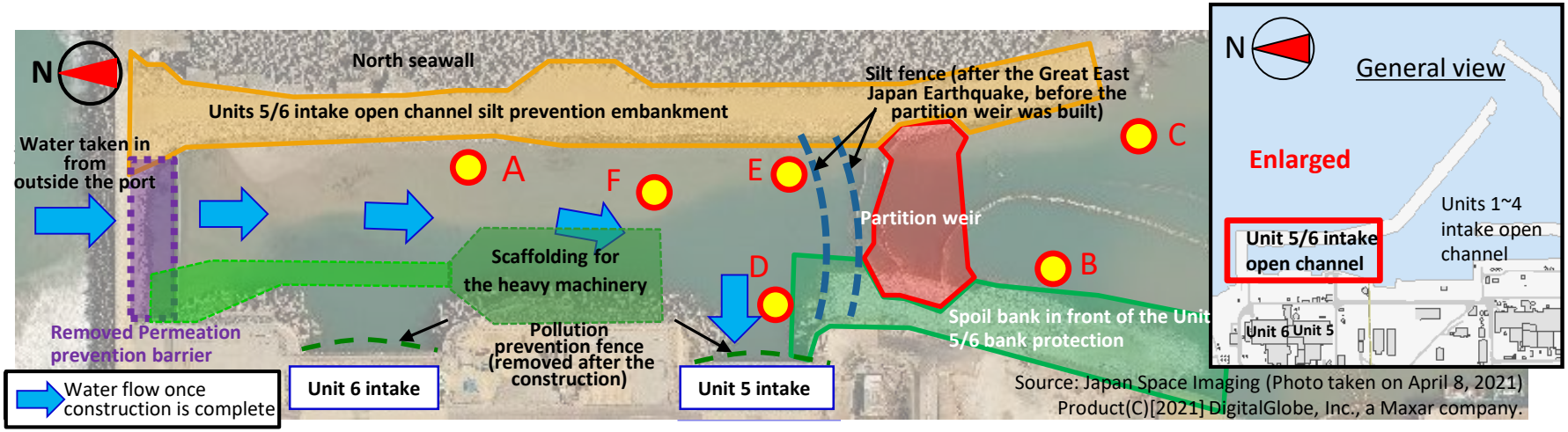
Figure 15. Investigation Results for seabed soil from off the coast of Fukushima※

※Quoted from "FY2016 Primary Results of Investigative Research to Address the TEPCO Fukushima Daiichi Nuclear Power Station Accident" (March 2017, Japan Fisheries Research and Education Agency) Chapter 7. Assessment of the impact of Radioactive Cesium in Seabed Soil on Marine Products

Figure 14. Chemical attributes of cesium in seabed soil from inside the Unit 1-4 open intake channel

【Reference】Monitoring results for seabed soil inside the Unit 5/6 intake open channel

- The following shows monitoring results for seabed soil inside the unit 5/6 intake open channel from August 2022 to February 2025.



Sampling points		Before construction 2017 to July 2021	FY2022 Aug. ~ Mar.	2023 Apr. ~ Dec.	2024 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	2025 Jan.	Feb.
A-1 North side of the Unit 5/6 open channel (North side of the silt fence (GL±0m))	Cs-134	4.4～52.3	31.5～39.8	32.0～69.5	44.5	51.1	34.6	34.4	34.8	53.6	51.4	40.4	59.0	64.5	38.1	57.6	37.4	45.4
	Cs-137	163.6～678.6	303.2～468.1	216.7～2975.0	1,210.0	1,270.0	195.2	510.4	461.7	1,169.0	2,107.0	1,337.0	1,135.0	826.2	922.9	725.1	615.9	1,079.0
A-2 North side of the Unit 5/6 open channel (North side of the silt fence (GL-0.5m))	Cs-134	14.4～58.5	32.5～38.3	－	※Only sampled from the surface (GL±0m) since sand was removed during dredging													
	Cs-137	310.0～689.8	299.1～404.0	－														
B South side of the partition weir (① (South side of the silt fence))	Cs-134	723.0	34.5～65.6	48.8～97.1	75.2	38.2	52.8	35.1	50.6	48.1	39.7	58.2	55.7	64.5	42.5	57.6	39.4	38.9
	Cs-137	6,475.0	412.8～3,331.0	323.8～4943.0	2,868.0	353.9	1,205.0	613.8	1,125.0	2,086.0	1,308.0	1,342.0	1,638.0	1,622.0	1,190.0	1,863.0	1,006.0	1,185.0
C South side of the partition weir (② (South side of the silt fence))	Cs-134	183.0	30.9～68.7	37.1～234.8	153.3	115.8	42.4	26.5	36.9	39.2	29.5	41.4	38.1	48.6	31.0	29.8	33.8	28.9
	Cs-137	1,893.0	360.8～2,671.0	295.9～9519.0	9,737.0	3,345.0	723.9	348.9	257.0	253.0	409.7	419.6	361.7	356.2	227.4	246.4	258.6	252.8
D Unit 5 intake	Cs-134	－	101.6～3,546.0	50.2～690.7	61.8	50.3	177.8	114.8	79.6	50.3	40.3	64.9	69.3	83.5	52.0	50.7	35.9	35.9
	Cs-137	－	3,301.0～144,000.0	951.7～26400.0	3,981.0	2,069.0	8,661.0	5,140.0	1,970.0	2,305.0	2,166.0	1,763.0	1,834.0	1,866.0	1,563.0	1,773.0	1,656.0	1,898.0
E North side of the partition weir	Cs-134	－		35.6～147.0	64.4	161.2	46.4	40.4	38.3	37.0	41.6	55.0	50.1	55.7	33.1	42.7	38.4	59.7
	Cs-137	－		437.1～5795.0	3,145.0	8,371.0	829.4	2,427.0	1,551.0	764.6	1,066.0	3,371.0	4,154.0	1,191.0	1,460.0	2,118.0	1,060.0	1,878.0
F East side of scaffolding for the heavy machinery	Cs-134	－		40.2～166.1	58.6	31.3	55.3	37.8	87.1	34.1	40.7	49.1	74.8	58.6	48.2	63.2	40.0	42.8
	Cs-137	－		592.4～8303.0	630.9	178.7	3,446.0	1,694.0	1,148.0	891.0	1,884.0	1,020.0	1,654.0	1,606.0	955.9	1,392.0	1,332.0	1,447.0

※Unit: Bq/liter, Figures in gray were below the detection limit