

Activities of GEPC and Regulatory Measures against Groundwater Pollution and Soil Contamination in Japan

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Teruyoshi HAYAMIZU

Vice Chair

Geo-Environmental Protection Center (GEPC), Japan

(Note) Materials for this presentation are prepared by the speaker and GEPC, or based on those provided from MOE Japan and modified by the speaker as appropriate.

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一般社団法人
土壤環境センター

Geo-Environmental Protection Center

1. Activities of Geo-Environmental Protection Center (GEPC)

About GEPC

The **Geo-Environmental Protection Center** of Japan (GEPC) was established in April 1996 to promote remediation of contaminated soil and groundwater and contribute to protecting human health and conserving the living environment. The GEPC is Japan's sole non-government public service corporation involved in the issue of soil and groundwater contamination.

Activities of GEPC

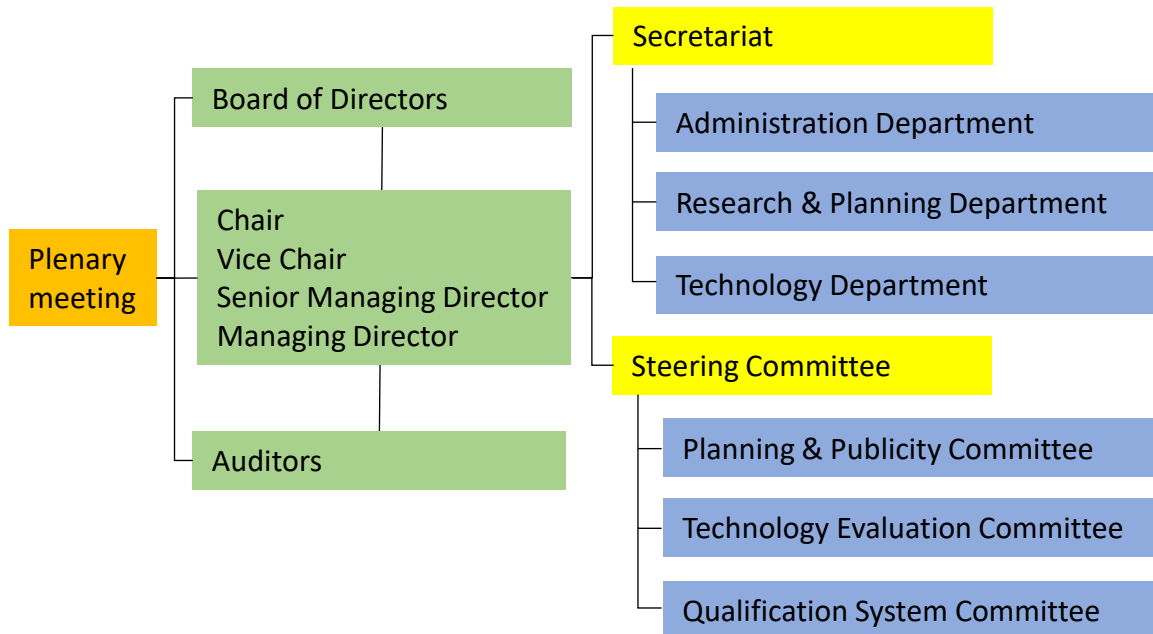
1. Improves Investigation & Countermeasure Techniques and Evaluation & Control Methods

2. Performs Study and Research in Japan and Overseas

3. Conducts Awareness-Raising and PR Activities

4. Implements a Qualification System

Organization of GEPC



Member companies of GEPC

A total of 100 companies are member of GEPC. The main industries of the member companies are Civil Engineering and Construction, Consulting Service, Investigation and Analysis, and Processing. They are leading companies in soil and groundwater contamination control in Japan.

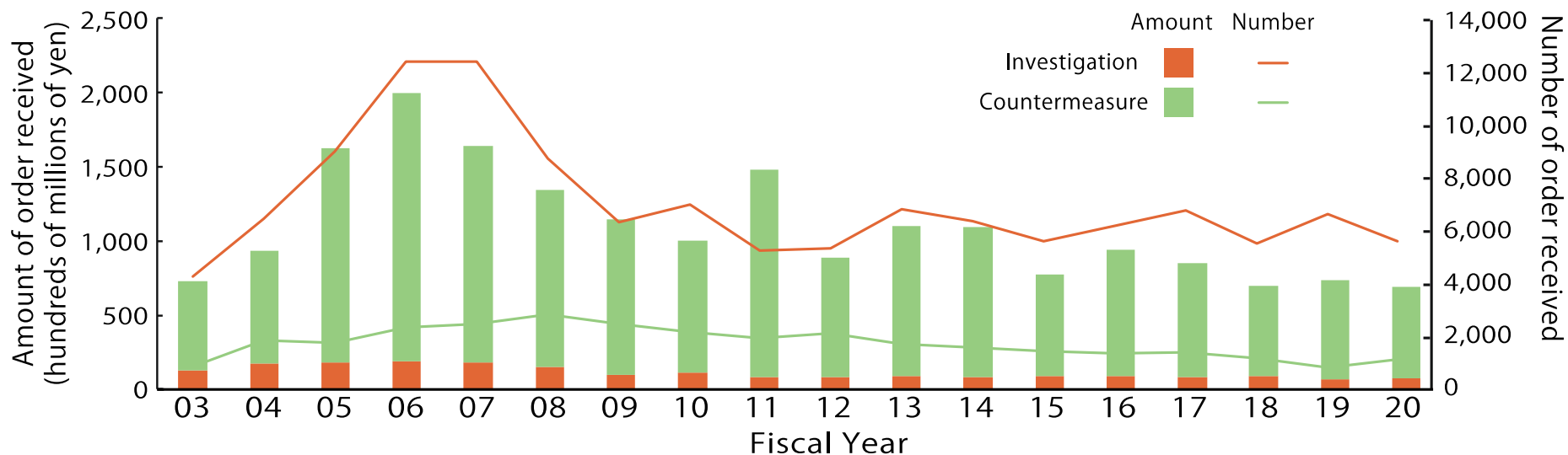


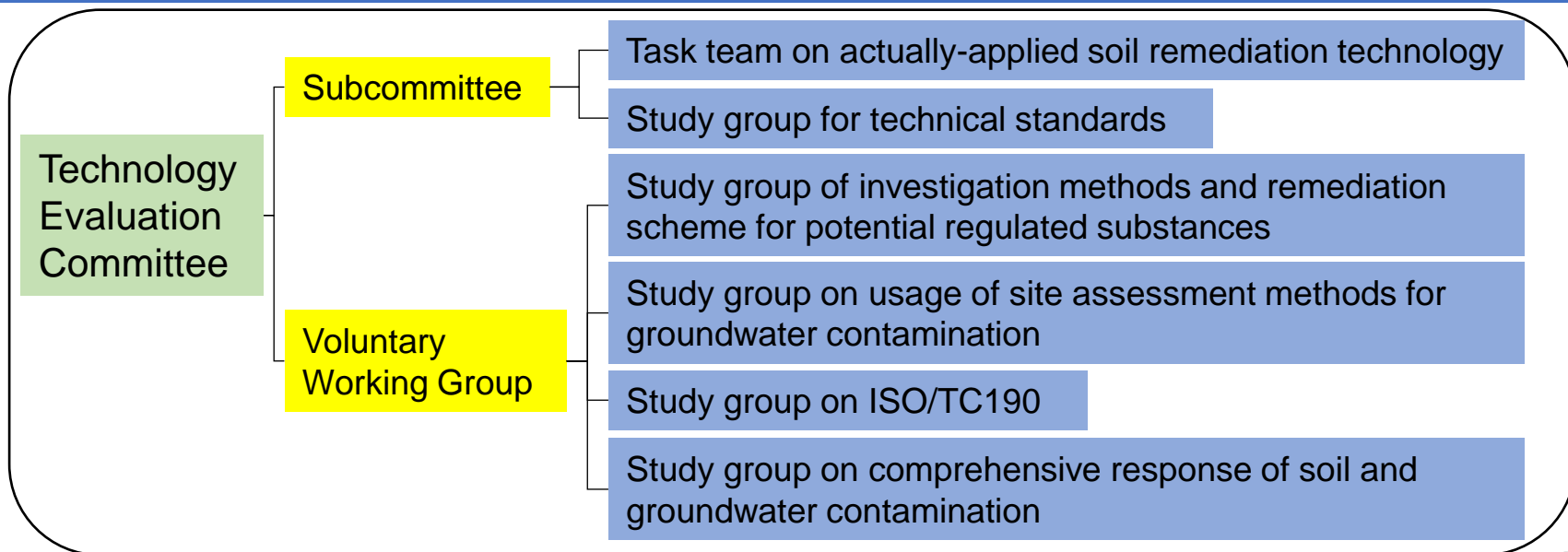
Fig. The results of orders received by member companies for investigation and countermeasure to soil contamination.



Activities of GEPC

1. Improves Investigation & Countermeasure Techniques and Evaluation & Control Methods
2. Performs Study and Research in Japan and Overseas

The Technology Evaluation Committee is active in resolving technical issues related to the investigation and remediation of soil and groundwater contamination by harmful chemical substances. The committee also studies solutions to various issues related to the review of the Soil Contamination Countermeasures Act and Environmental Quality Standards, and conducts research on risk assessment, remediation methodologies for a sustainable society, and harmonization of national and international standards.



Activities of GEPC

3. Conducts Awareness-Raising and PR Activities

The GEPC holds study meetings, seminars, academic symposiums and exhibitions for the purpose of disseminating knowledge and techniques on soil and groundwater contamination and their remediation. The GEPC also publishes reports that introduce the above activities and their outcomes, as well as a mail magazine.

1) Publication of Books and Reports

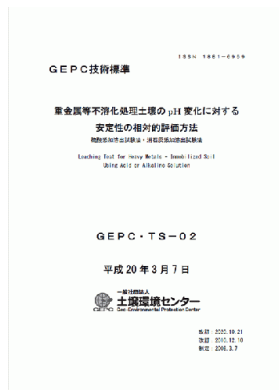
2) Seminar (Twice a year)

3) Field trip (Once a year)

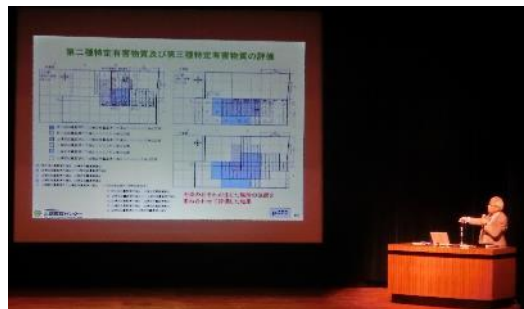
4) GEPC mail magazine (Several times a month)

5) Soil and Groundwater Remediation Technology Expo (biannually, Joint sponsorship)

6) Symposium on Soil and Groundwater Contamination and Remediation (annually, Joint sponsorship)



1) GEPC technical Standard



2) GEPC seminar



3) Field trip



6) Symposium

Activities of GEPC: 4. Implements a Qualification System

The GEPC carries out the following work of granting **qualifications** to engineers and managers to help improve the reliability of investigation into soil and groundwater contamination and its remediation work.

- 1) **Authorized Geo-Environmental Senior Engineer (Dojyo-kankyo kanri-shi)**
This qualification is granted to reliable senior engineers who have appropriate knowledge and judgment ability with respect to performing investigation and remediation of soil and groundwater contamination. *(Eligible persons: 534 as of March 2021)*
- 2) **Authorized Geo-Environmental Engineer for Safety of Field Work (Dojyo-kankyo hozen-shi)**
This qualification is granted to reliable engineers who have the required skills for (1) Work safety, (2) Consideration for the environment (e.g., preventing dispersion of contamination), and (3) Quality control (ensuring the quality of field work). *(Eligible persons: 2,536)*
- 3) **Authorized Geo-Environmental Manager for risk management (Dojyo-kankyo risuku kanri-sya)**
This qualification is granted to land managers who have basic knowledge for determining the state of contamination around a factory site in order to prevent soil and groundwater contamination and maintain and improve the asset value of land. *(Eligible persons: 5,091)*

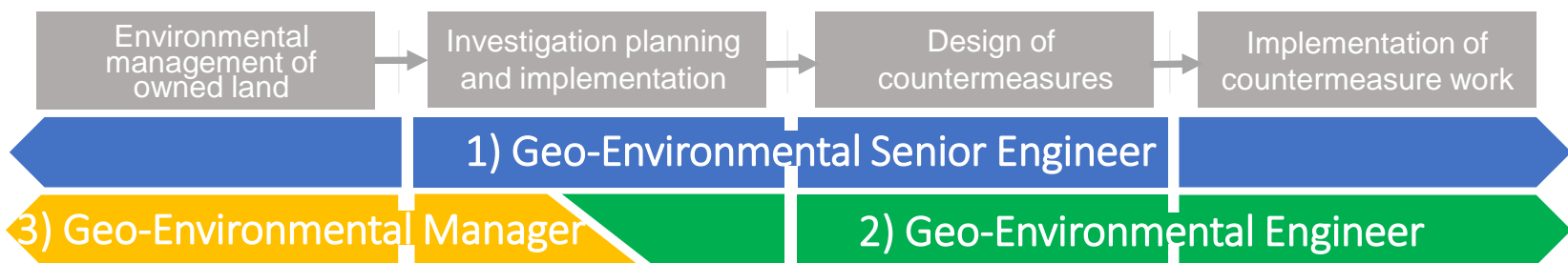
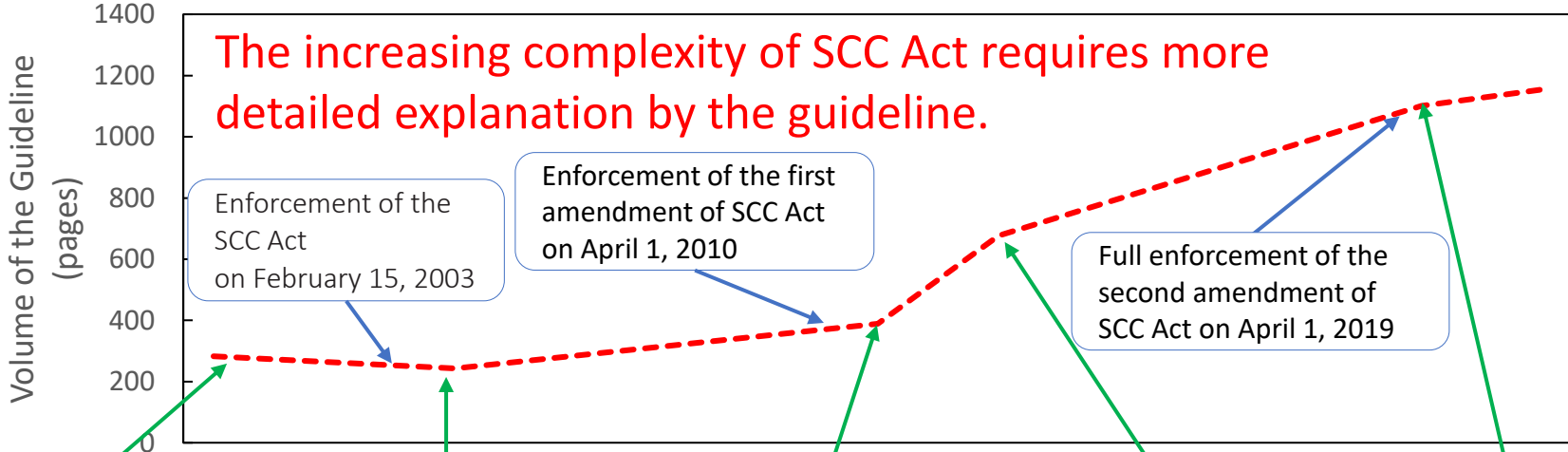


Fig. Coverage of each qualification

Activities of GEPC: Contracted work with the Government

GEPC has been contracted by the Ministry of the Environment to develop guidelines for the Soil Contamination Countermeasure Act (SCC Act) and examine the Environmental Quality Standards for soil, which contribute to the establishment and operation of the legal system.



January 1999



September 2003



July 2010



August 2012

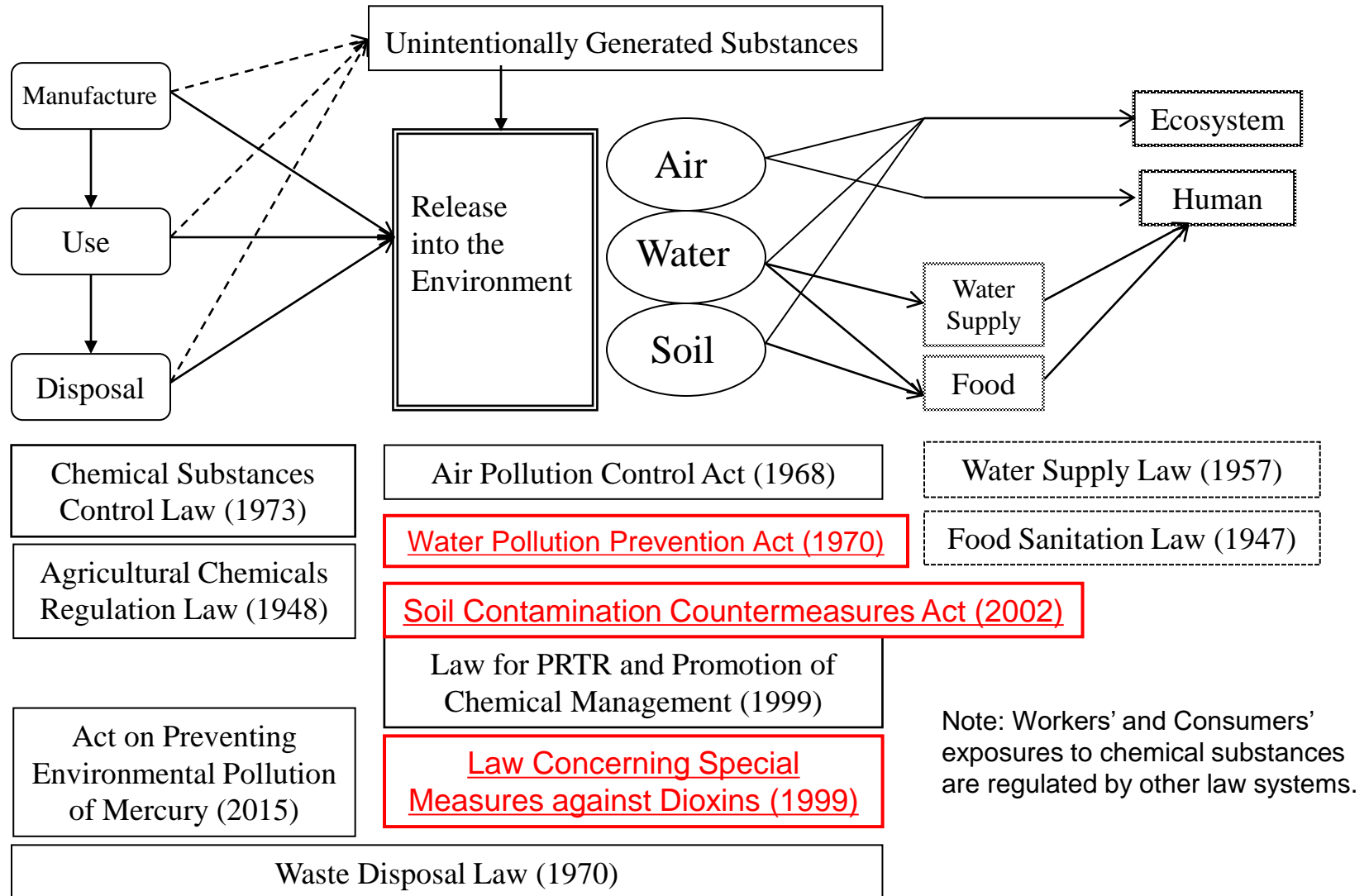


May 2019

2. Measures against groundwater pollution

3. Measures against soil contamination

Regulatory Framework for Environmental Risk Management of Hazardous Substances



Environmental Quality Standards (EQSs) for Groundwater

(Health Items only, as of Oct. 7, 2021)

Items	Standard
Cadmium	0.003mg/l or below
Total Cyanogens	Not-detected
Lead	0.01mg/l or below
Hexavalent Chromium	0.02mg/l or below
Arsenic	0.01mg/l or below
Total Mercury	0.0005mg/l or below
Alkyl Mercury	Not-detected
PCB	Not-detected
Dichloromethane	0.02mg/l or below
Carbon tetrachloride	0.002mg/l or below
Chloroethylene*	0.002mg/or below
1,2-Dichloroethane	0.004mg/l or below
1,1-Dichloroethylene	0.1mg/l or below
1,2-Dichloroethylene*	0.04mg/l or below

Items	Standard
1,1,1- Trichloroethane	1mg/l or below
1,1,2- Trichloroethane	0.006mg/l or below
Trichloroethylene	0.01mg/l or below
Tetrachloroethylene	0.01mg/l or below
1,3-Dichloropropene	0.002mg/l or below
Thiuram	0.006mg/l or below
Simazine	0.003mg/l or below
Thiobencarb	0.02mg/l or below
Benzene	0.01mg/l or below
Selenium	0.01mg/l or below
Nitrate-Nitrogen/ Nitrite-Nitrogen	10mg/l or below
Fluorine	0.8mg/l or below
Boron	1mg/l or below
1,4-dioxane	0.05mg/l or below
Dioxins	1 pg-TEQ/l or below

* Different from the EQS items for surface water

Causes of groundwater pollution (FY 2019)

Number of cases*

Total: 6,352

3,500

3,000

2,500

2,000

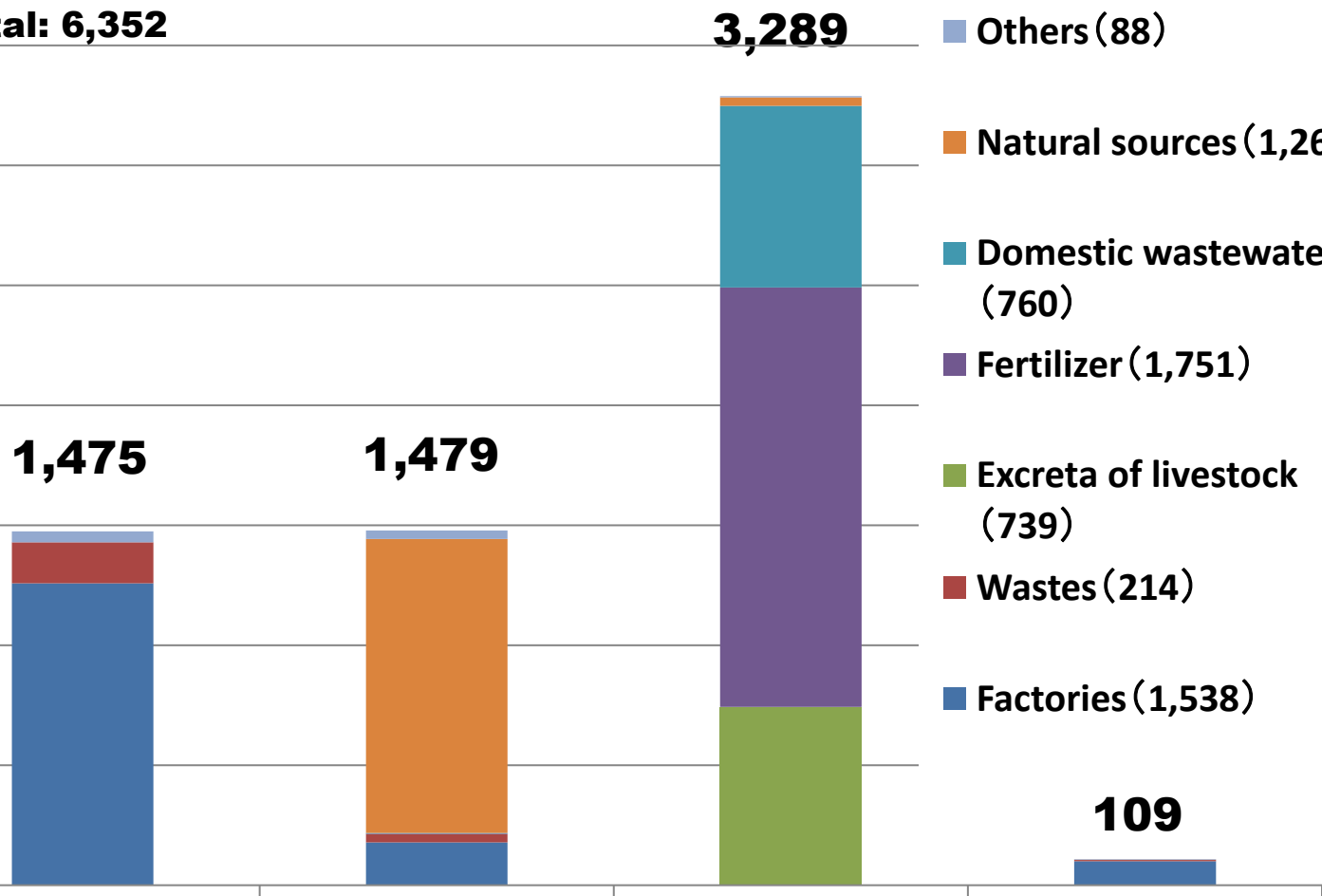
1,500

1,000

500

0

- Others (88)
- Natural sources (1,262)
- Domestic wastewater (760)
- Fertilizer (1,751)
- Excreta of livestock (739)
- Wastes (214)
- Factories (1,538)



VOC Heavy metals Nitrate nitrogen and nitrite nitrogen Combined pollution

Number of Wells*
Total: 4,782

1,332

1,468

1,879

103

*The total number of cases and wells are different because plural causes may be considered.
(Results of questionnaire survey on groundwater pollution conducted and summarized by MOE in 2021)

Measures against groundwater pollution

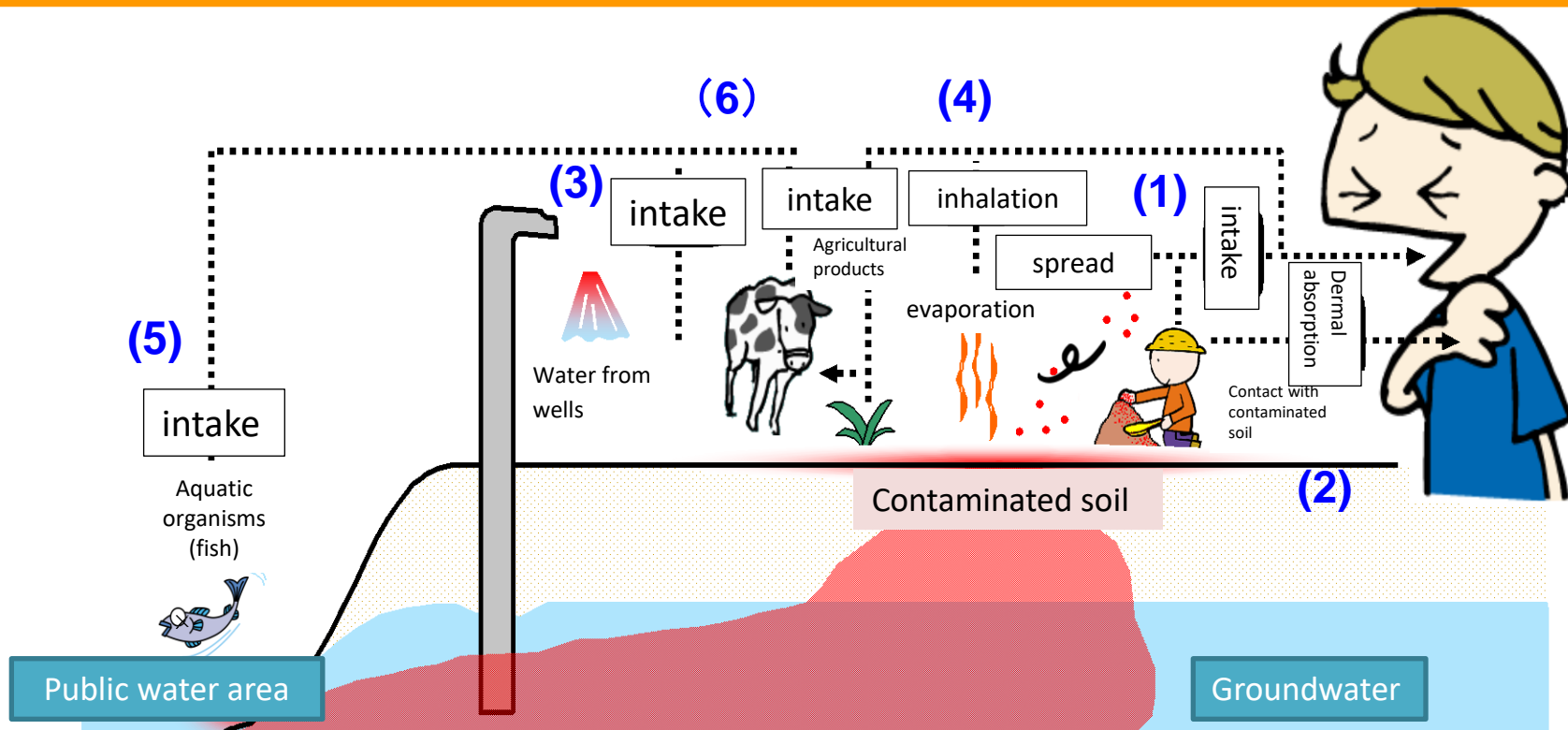
- Regulations stipulated in the Water Pollution Prevention Act (First introduced in 1989, added in 1996 and 2011)
 - Restrictions of permeation of harmful substances into groundwater (from facilities where hazardous substances are used, almost prohibition) and monitoring
 - Provisions of order for purification
 - Provisions of measures against accidental releases
 - Obligation to comply structural standards and to conduct regular examination to prevent groundwater pollution (from storage facilities of hazardous substances)
- Other measures
 - Guideline developed summarizing comprehensive measures to be taken against nitrate nitrogen and nitrite nitrogen
 - Stop using contaminated groundwater for drinking

Measures against soil contamination

EQSs for soil are set based on the Basic Environment Act and three laws have been implemented to recover soil contamination

- Law Concerning the Control of Soil Contamination in Agricultural Land (1970)
 - Designate the agricultural area polluted by specific hazardous substances (Cd, Cu, As) and promote its remediation.
- Law Concerning Special Measures against Dioxins (1999)
 - Set the TDI and EQSs for dioxins and stipulates comprehensive measures to reduce the emission, release and contamination by dioxins.
- Soil Contamination Countermeasures Act (2002) (To be explained later)
 - Conduct the investigation of soil contamination, designate the area in cities polluted by specific hazardous substances and promote its risk management

How does soil contamination cause health issues?



- 1. Ingestion of contaminated soil (including soil particulates in the atmosphere)** } Risk of direct ingestion
- 2. Dermal absorption from direct contact with contaminated soil** }
- 3. Ingestion of groundwater contaminated by hazardous substances eluted from contaminated soil**
→ Risk of ingestion through groundwater
- 4. Inhalation of hazardous substances emitted from contaminated soil into the atmosphere**
- 5. Discharge of soil containing hazardous substances into the public water area → accumulation in aquatic organisms → human ingestion**
- 6. Accumulation of hazardous substances in crops and livestock raised in contaminated land**
→ human ingestion – risk of indirect ingestion through agricultural products

History of Soil Contamination and Measures in Urban areas

- 1975 Soil contamination caused by Hexavalent chromium compounds was found in the site of a closed chemical factory
- 1980's Groundwater contamination caused by organochlorine compounds (trichloroethylene, etc.) becomes a social issue
- 1991 Establishment of "Environmental Quality Standards for Soil "
- 1980's and 90's Drawing up of several administrative guidance

Various difficulties in proceeding the legislation

- Land (=private property) contamination
- Soil contamination: negative legacy of the past, stock-type contamination
- Depending on the type of land-use, there is no adverse effect on health

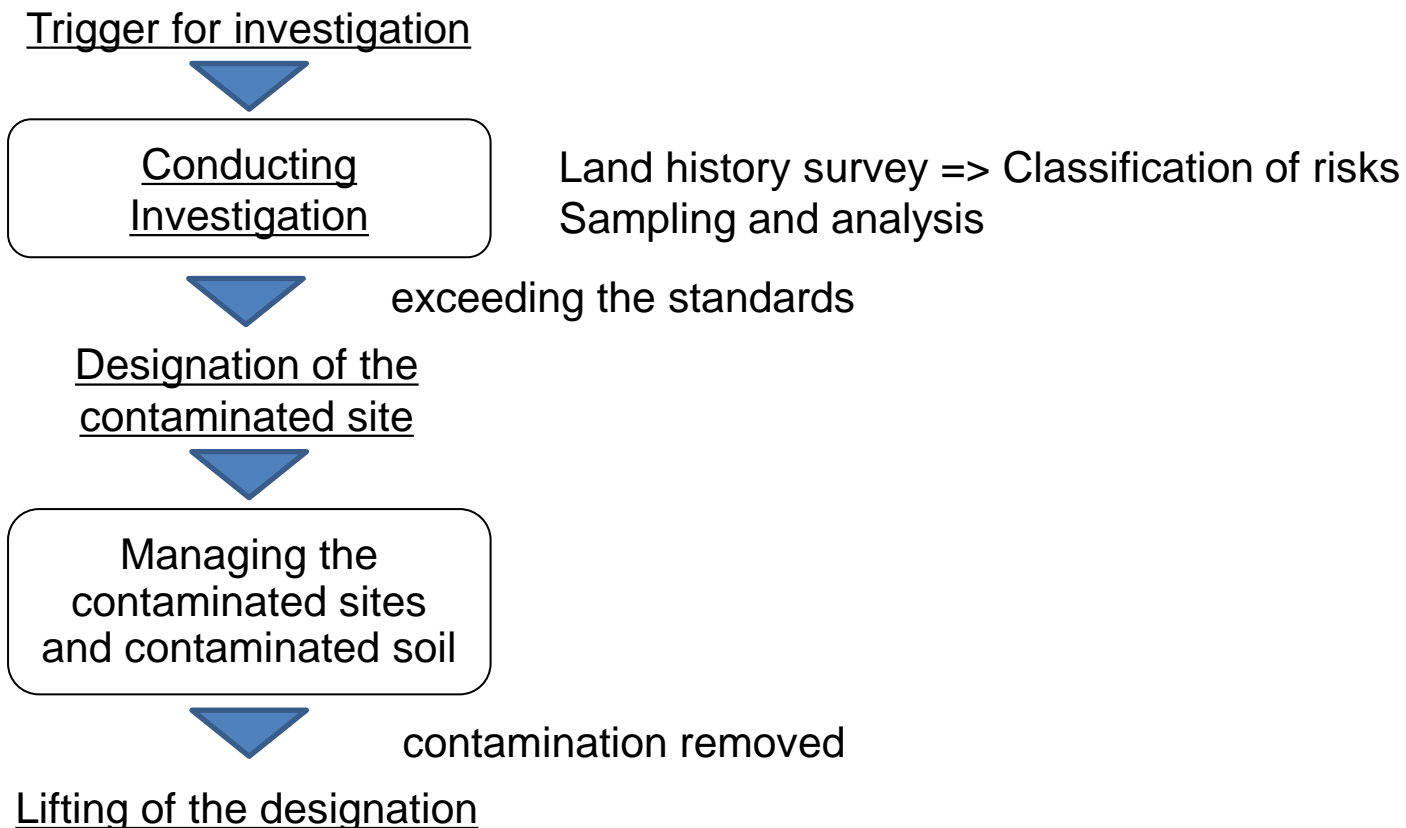
Finally, however, it was agreed that a rule-based approach be necessary to conduct investigation and promote countermeasures, due to the increasing cases of soil contamination and health concerns



Soil Contamination Countermeasures Act enacted (2002)

Outline of Soil Contamination Countermeasures Act

- Soil Contamination Countermeasures Act was enacted in 2002 (Amended in 2009 and 2017).
- The Act stimulates procedures for countermeasures mainly consisting of investigation and management of contaminated sites.



Types of Designated Hazardous Substances

Class 1*

(Volatile Organic Compounds)

- Chloroethylene
- Carbon tetrachloride
- 1,2—Dichloroethane
- 1,1—Dichloroethylene
- 1,2—Dichloroethylene
- 1,3—Dichloropropene
- Dichloromethane
- Tetrachloroethylene
- 1,1,1—Trichloroethane
- 1,1,2—Trichloroethane
- Trichloroethylene
- Benzene

Class 2**

(Heavy Metals)

- Cadmium and its compounds
- Hexavalent Chromium compounds
- Cyanides compounds
- Mercury and its compounds
- Selenium and its compounds
- Lead and its compounds
- Arsenic and its compounds
- Fluorine and its compounds
- Boron and its compounds

Direct Ingestion Risk (9 items)

Class 3*

(Agrochemicals and PCBs)

- Simazine
- Thiuram
- Thiobencarb
- PCB
- Organic phosphorus compounds

* Soil Leachate Standard (mg/L) is set as Designation Standard to prevent risks of ingestion through groundwater.

** Soil Leachate Standard (mg/L) and Soil Content Standard (mg/kg) are set to prevent risks of ingestion through groundwater and direct ingestion of soil.

Note: In addition, Soil Content Standard on dioxins is set under the Law Concerning Special Measures against Dioxins.

Investigating Soil Contamination

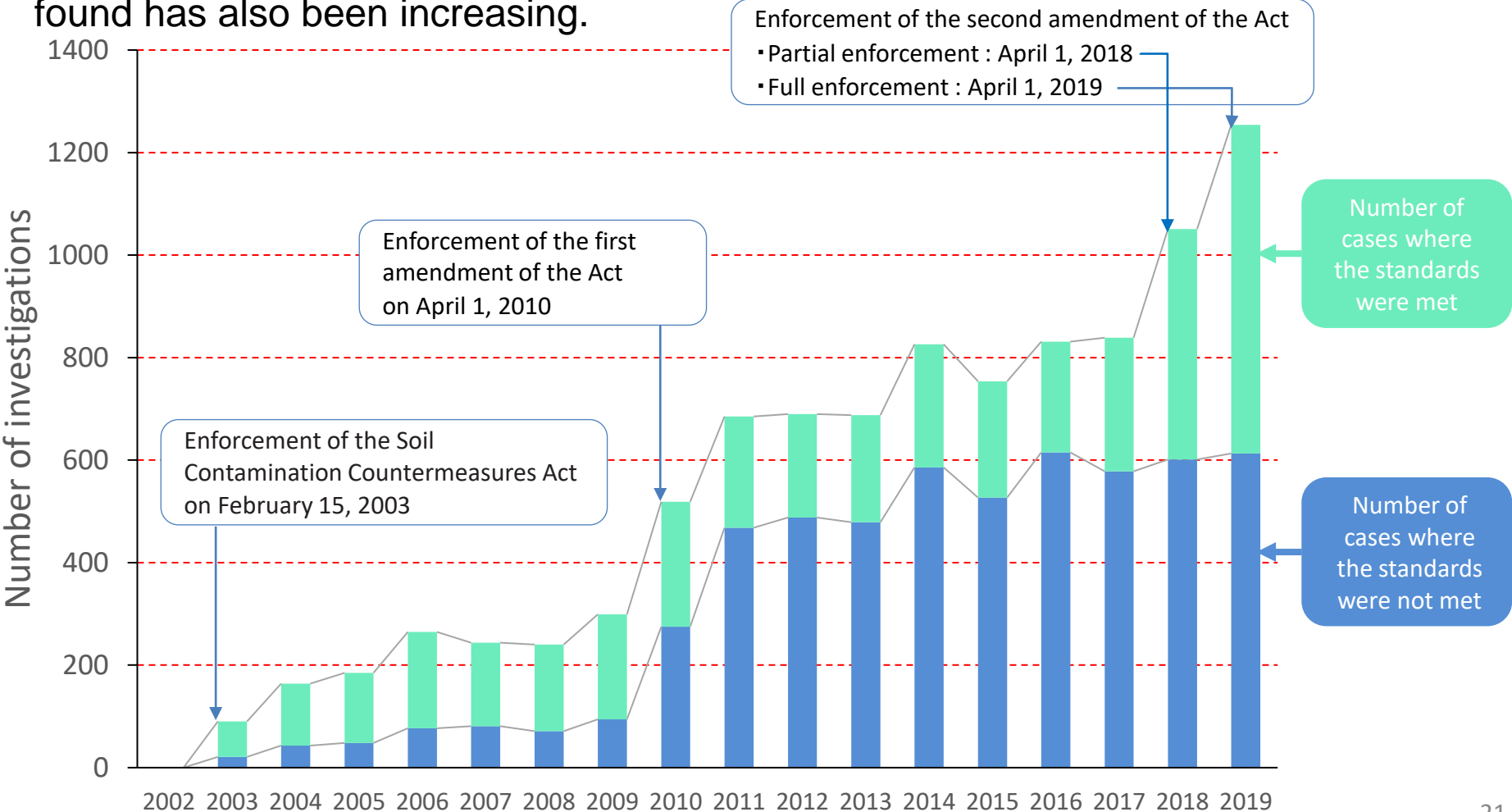
The owner, etc.* of the land shall have authorized institutions conduct investigation on soil contamination in the following situation.

(*owner, manager or occupier)

- When the use of specified facilities using hazardous substances is terminated (Art. 3)
- When the prefectural governor, having received notification of changes to the form or nature of land of a certain size or more ($\geq 3,000 \text{ m}^2$, or $\geq 900 \text{ m}^2$ where a specified facility using hazardous substances is currently located), finds that the land has possible soil contamination (Art. 4)
- When the prefectural governor finds that land is suspected to cause any harm to human health, due to soil contamination (Art. 5)
- If voluntary investigations reveal soil contamination, the owner, etc. of the land may file an application for designation of areas with the prefectural governor (Art. 14)

Number of cases where soil contamination was found by year (from FY 2002 to FY 2019)

The number of investigations into soil contamination grasped by prefectural governments, etc. under the Soil Contamination Countermeasure Act has been increasing year by year. The number of cases where soil contamination was found has also been increasing.



Designation of Contaminated Sites

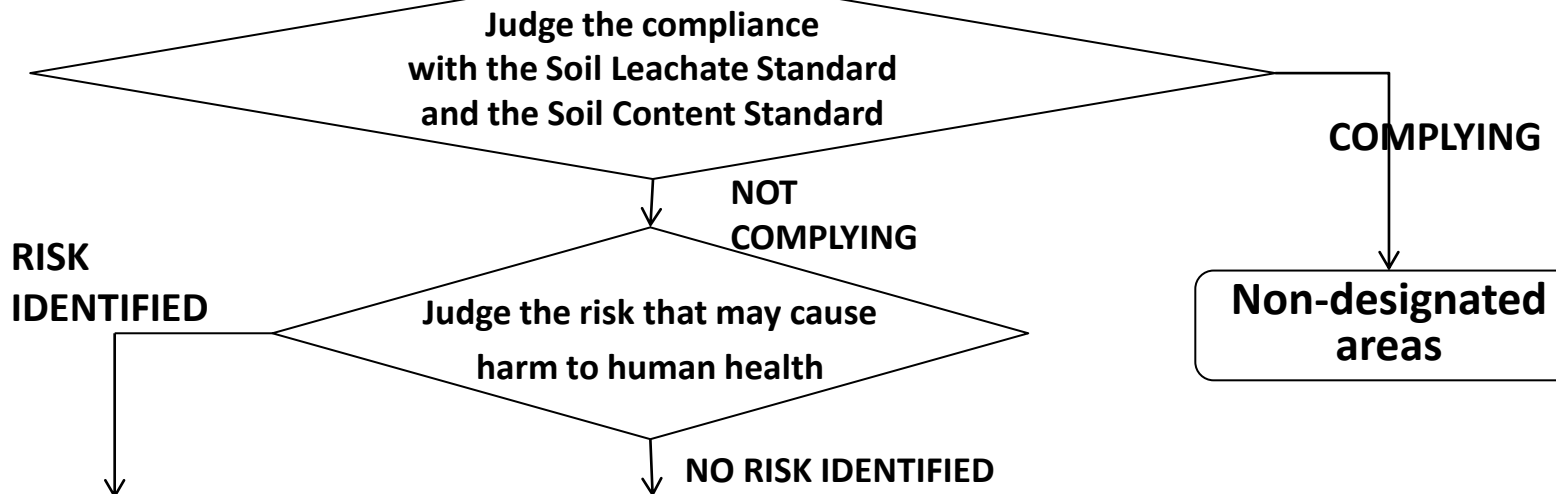
- Prefectural governor judges the compatibility with standards (soil leachate standards and soil content standards)
- If not complying, prefectural governor judges the risk that may cause harm to human health.
- If risk that may cause harm to human health is identified, the site shall be designated as an area which requires measures to block the intake routes of contamination.
- If risk that may cause harm to human health is not identified, the site shall be designated as an area which does not require immediate measures but requires advance notification on changing land form or nature.
- Contaminated soil in the areas cannot be brought out in principle. The soil can be brought only to processing facilities*. And when the soil is transported, it is necessary to obey the regulation of the Act.

(*with some exception)

The Designation Process of Contaminated Areas

Report investigation results to the prefectural governors (or city mayors*)

(*Those identified by Cabinet Order)



Non-designated areas

The identification process of risk that may cause harm to human health

- (1) Where in the surrounding areas people have access to drinking groundwater
- (2) Where it is accessible to the general public

Area for which changes to form or nature require notification (Article 11)

Area not requiring measures for contamination removal, etc. since there are no intake routes of contamination and no risk that may cause harm to human health (including areas where intake routes have been blocked)
 → Any person who intends to make changes to the form or nature of land shall notify the prefectural governor of the changes. (Article 12)

The owner, etc. may claim the cost of the plan and measures to be implemented against the person that caused the contamination (Article 8)

Area which requires measures (Article 6)

Area requiring measures for contamination removal, etc. since the existence of intake routes of contamination have risk that may cause harm to human health.
 → The owner, etc. of the land shall prepare a plan for contamination removal, etc. concerning the instruction of the prefectural governor, receive confirmation, implement measures for contamination removal, etc. pursuant to the confirmed plan, and make a report. (Article 7)
 → In general, it is prohibited to change the form or nature of land. (Article 9)

※When the contamination is removed, designation of areas is cancelled.

※There is an official announcement when each prefecture designates or cancels areas.

Countermeasures stated in the Act

Concept of the Act

- Managing environmental risk (Risk = hazard x exposure (intake))
- Blocking the ingestion pathway (Removing contaminated soil is not the emphasis of the Act)

Ingestion from drinking groundwater

In cases where not complying with the soil leachate standard, and groundwater is used for drinking



- **Monitoring** when there is no groundwater contamination
- **Containment** when there is groundwater contamination

Ingestion from physical contact with soil

In cases where not complying with the soil content standard, and the site is accessible to the general public



Embankment

- * Complete removal of contaminated soil may be required in limited cases (e.g., when there are possibilities of the effects of embankment being lost due to frequent changes to the land characteristics at sandpit for babies and infants)

Countermeasures for soil not complying with the soil standards

Countermeasures for risks caused by groundwater ingestion	In-situ containment, measurement of groundwater quality, containment by water sealing, prevention of the expansion of contaminated groundwater, removal by excavation, in-situ remediation, containment by shielding, insolubilization (in-situ insolubilization, backfilling of insolubilized soil)
Countermeasures for risks caused by direct ingestion of soil	Embankment, pavement, prohibiting intrusion into the site, replacement of soil, removal of contaminated soil (removal by excavation, in-situ remediation)

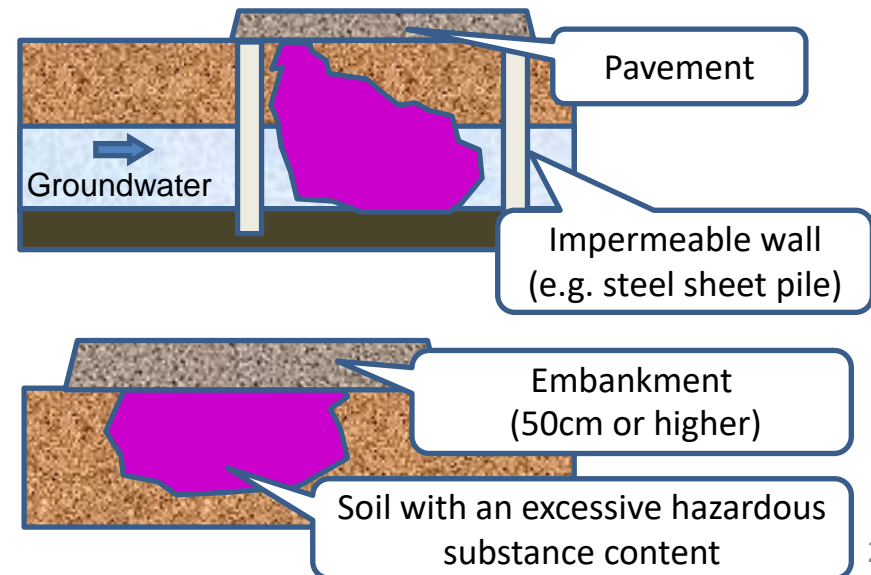
■ EXAMPLE

In-situ containment

Hazardous substances (e.g., mercury) are contained in an artificial (impermeable) wall and an impermeable geological stratum

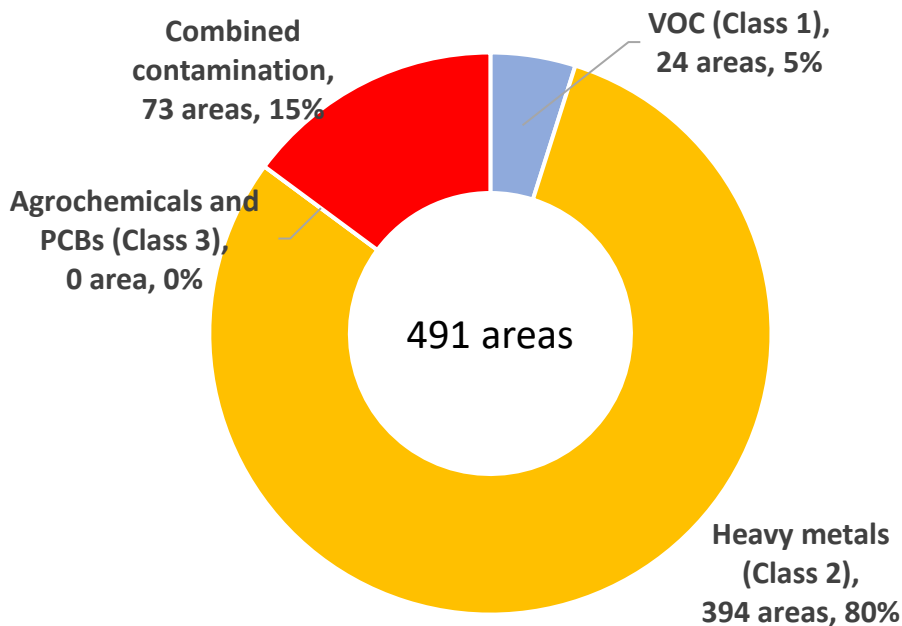
Embankment

Soil exceeding the hazardous substance concentration tent standard is covered by embankment to prevent exposure.



Designated areas (by Designated Hazardous Substances) (FY2019)

- The largest number of areas were designated due to the **contamination by heavy metals (80%)** in FY2019.
- Combined contamination was 15%.



Actions taken in designated areas (FY2019)

- **Removal by excavation occupies a large proportion (about 80%)** of the actions taken in Areas which Require Measures, etc.

		Number of actions implemented at Area which Requires Measures (2003-2019)	Number of actions implemented at Area which Requires Notification* (2003-2019)	Total (2003-2019)	
Risk by direct ingestion	Pavement	19	165	184	
	Keep out	20	66	86	
	Soil replacement	in the area	5	39	44
		outside the area	3	14	17
	Embankment	4	76	80	
Risk by ingestion of groundwater	Measurement of groundwater quality	233	261	494	
	In-situ containment	10	10	20	
	Containment by water sealing	4	8	12	
	Prevention of the expansion in the area of contaminated groundwater	22	20	42	
	Containment by shielding	0	2	2	
	Insolubilization	In-situ insolubilization	9	4	13
		Back filling of insolubilized soil	7	17	24
Removal of contaminated soil	Removal by excavation (percentage)	659 (75.5%)	2,694 (81.4%)	3,353 (80.2%)	
	In-situ remediation	132	102	234	
Others		9	165	174	
Number of answers		873	3,308	4,181	

*Area for which changes to form or nature require notification

Regulations concerning carrying-out, etc. of contaminated soil

- Regulations concerning carrying-out of soil within areas which require measures and areas for which changes to form or nature require notification (Articles 16, 17 and 18) (prior notification, order to revise plan, conformity to standards for transport), with some exception for the soil of areas contaminated by nature.
- Obligations to deliver and preserve control manifests concerning contaminated soil (Article 20)
- License system of contaminated soil processing business (Article 22)

Other Measures

- Improvement of the reliability of designated (i.e., authorized) investigation institutions (renewal of designation, appointment of a technical manager, etc.) (Articles 32 & 33)
- Subsidies by the fund for soil contamination countermeasures (granting subsidies for measures for contamination removal, etc. if a person responsible for contamination is unclear or does not exist, and the ability of the owner etc. to bear cost is low) (Articles 45&46)

Disposal process of contaminated soil

- Contaminated soil carried out from the designated areas shall be processed at licensed facilities (119 facilities as of July 2021)
- 1.8 million tons of contaminated soil were processed based on the Act. (4.48 million tons including the soil outside the scope of the Act)



Remediation facilities (60)



Cement factories (20)

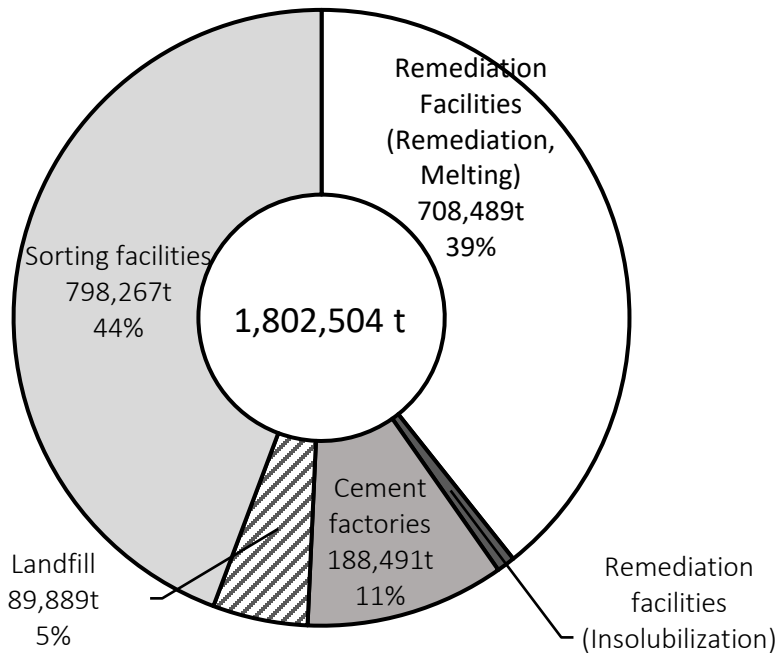


Landfill (40)

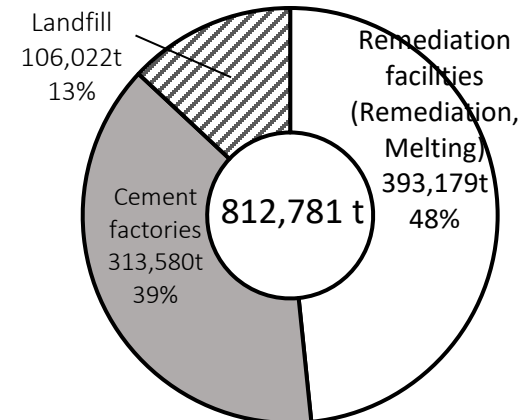


Sorting facilities (49)

Note: In addition, one "Facility for the use of soil contaminated by nature" is licensed.



Amount of contaminated soil processed at licensed processing facilities (FY2019, Primary processing)



Amount of contaminated soil processed at licensed processing facilities (FY2019, Re-processing)

※ If the contaminated soil after primary processing does not meet the standards, additional processing is required.

Thank you for your attention!

(Homepage)(in English)

Geo-Environmental Protection Center (GEPC)

<http://www.gepc.or.jp/english/eindex.html>

Ministry of the Environment (MOE)

<http://www.env.go.jp/en/water/index.html>