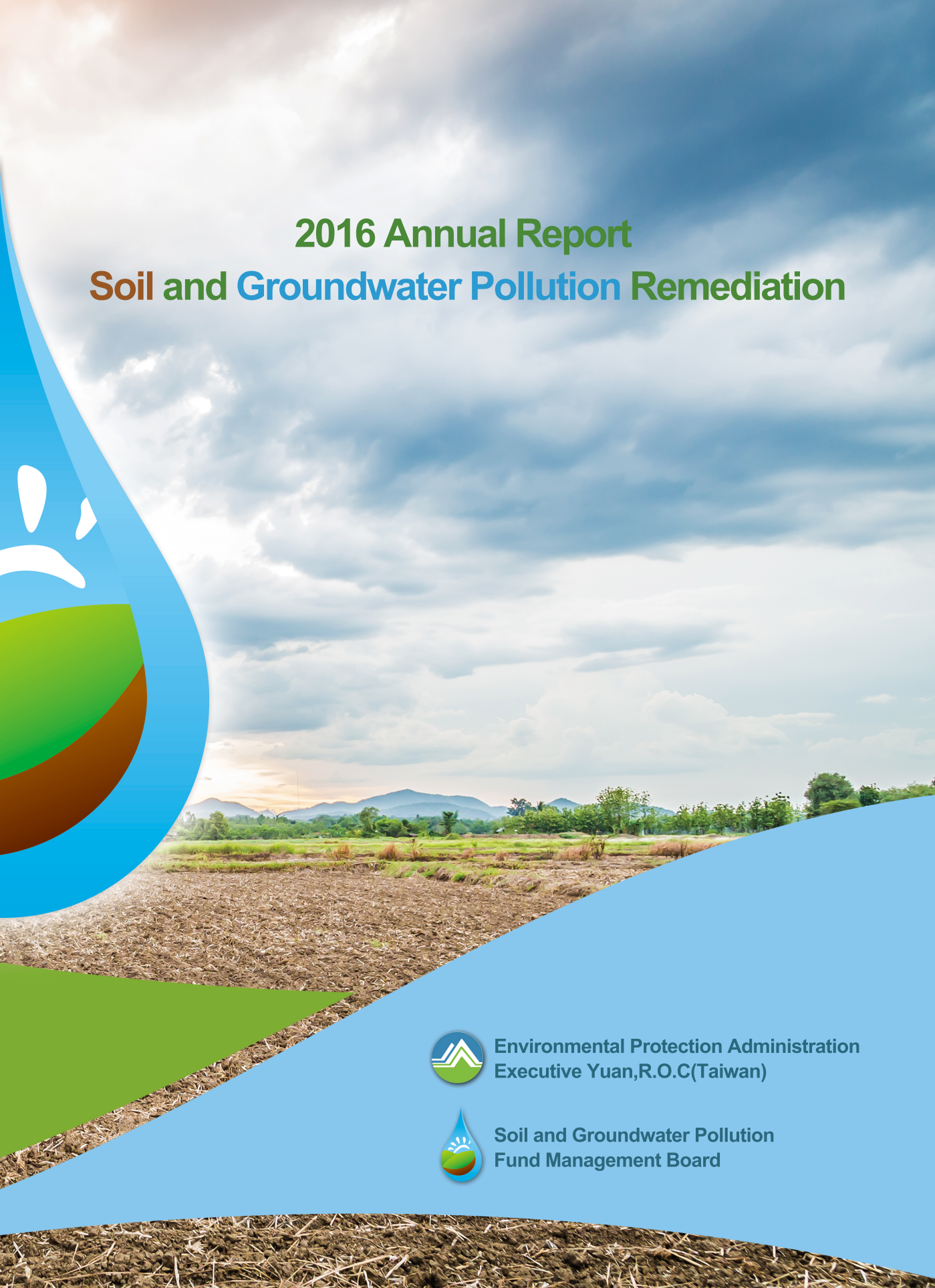
2016 Annual Report
Soil and Groundwater Pollution Remediation



Environmental Protection Administration
Executive Yuan,R.O.C(Taiwan)

Soil and Groundwater Pollution
Fund Management Board

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Ch1.Policies and Goals

1.1 2016 Policies

Taiwan Environmental Protection Administration (hereinafter referred to as EPA) has established 5 goals to improve the management performance of soil and groundwater. The 5 goals are described as follows:

1. Establishing comprehensive regulations to strengthen administrative management
2. Overview of fund income and expenditure to improve budget utilization
3. Continuing to identify potential pollution threats at early stage
4. Integrating different administrative sectors to promote remediation and restoration
5. Enhancing professional skills domestically for international collaboration

1.2 Accomplishments

The EPA has established projects for effective regulations on the investigation, remediation, and prevention on soil and groundwater pollution. The relevant policies and accomplishments are described below:

1. Overview of the Soil and Groundwater Pollution Remediation Fund Management Board (hereinafter referred to as the SGRFMB)'s income and expenditure to improve budget utilization

I. A comprehensive review had been conducted on the existing levying scheme, and revisions were made to the fee collection procedure on

December 30th, 2016.The officially announced chemical substances, enterprises, and levying rates were revised based on the SGRFMB's actual income and expenditure, on-site inspections, remediation and pollution control standards. (p.8)

2. Continuing to identify potential pollution threats at early stage

I. The EPA has requested industrial parks to file mandatory reports for future references pursuant to the Soil and Groundwater Remediation Act (hereinafter referred to as the Act) and review the work effectiveness of mandatory reporting. The reporting rate for future references has risen to 99.3%. (p.10)

II. The management on soil and groundwater in industrial parks has been categorized into 149 zones. Each zone is classified by 4 different colors to represent the actual pollution level and potential pollution. (p.12)

III. An analytical tool for measuring uncertainties was added to the Health Risk Assessment System. (Please refer to https://sgw.epa.gov.tw/Risksystem/Default.aspx). The new features include the probability distribution of parameters and sampling tools. Moreover, the search engine interface was also upgraded to strengthen the evaluation method and to meet the demand of establishing localized parameters.(p.15)

3. Integrating different administrative sectors to promote remediation and rehabilitation

I. The EPA supported local governments to manage polluted sites, such as verification work response measures, investigation, evaluation, and control of polluted sites to technically support response measures. (p.13)

II. The Ministry of Interior approved the "Two-year Solar Power Promotion Plan" proposed by the Ministry of Economic Affairs (MOEA) on October 27, 2016, and established the "Principles of

Concurrent Remediation: Setting Solar Powers on Remediation Sites". The Principles took effect on November 8, 2016 in all cities in Taiwan. (p.16)

III. With the promotion of remediation works, Taiwan EPA was able to remove 239 sites from regulatory listing of control sites and made announcement to the public.

4. Enhancing professional skills domestically for international collaboration

I. Training courses were held for the Working Group on Remediation for Soil and Groundwater Pollution of Asian and Pacific Region. The participants included members from Australia, Indonesia, Malaysia, New Zealand, the Philippines, Sri Lanka, Thailand, and Vietnam. Experts from local Taiwan institutions such as environmental consulting firms, environmental protection administrations also joined the training. The trainings provided an opportunity for communication and strengthened the bond between member countries. (p.25)

II. Taiwan and Korea has started the collaboration in soil and groundwater management since 2010. This year, Taiwan and Korea also signed a MOU during "The Seventh Steering Committee Meeting of MOU between Taiwan EPA and Korea MOE" and "2017 Taiwan-Korea Forum on Remediation of Soil and Groundwater Contamination" The purpose of the forum and meeting was to promote collaboration between private institutes in Korea and Taiwan to push forward the research and development of remediation works. (p.27)

III. Three sites have undergone green and sustainable remediation (GSR) with the help from the government in 2016. The GSR provides an opportunity for the SGRFMB to come up with optimal strategies on soil and groundwater management. Moreover, the GSR provides information for the authorities to establish a draft for the certification

system to ensure the system's rationality and fairness. In addition, investigators from the United States Geological Survey were invited to Taiwan for remediation technology transfer. The "Training Workshop on the Application of Phytoforensics for Contaminated Sites" was held concurrently. (p.29)

IV. Academic and relevant institutions were given subsidies to engage in research and development of soil and groundwater pollution remediation. A total of 28 research teams participated in the research in 2016. The qualifying rate was 59.6%, and among the qualified projects, 25 were research projects (89.3%), and the other 3 were pilot studies (10.7%). (p.32)

Ch2. Organizational Structure, Functions, and Financial Management of the Soil and Groundwater Pollution Remediation Fund

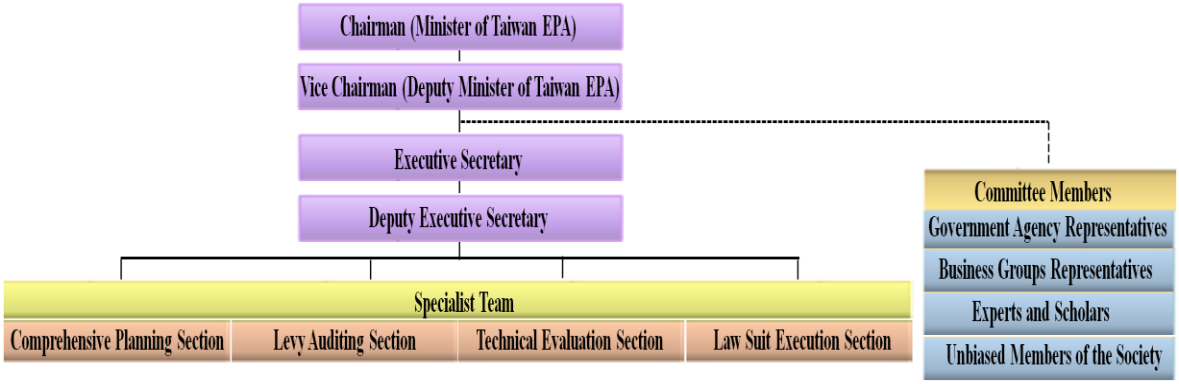
2.1 Organizational Structure and Functions

According to the Soil and Groundwater Pollution Remediation Act (hereinafter referred to as the Act), the central competent authority can impose levy on manufactures and importers for designated chemical substances. The Soil and Groundwater Pollution Remediation Fund Management Board (hereinafter referred to as the SGRFMB) was established to supervise and utilize the collected levy. The responsibilities of the SGRFMB include:

1. Review of fund income and expenditure, and utilization of the collected levy.
2. Review of annual budget and closing account
3. Review of fund utilization
4. Other relevant issues

The SGRFMB has established specialist teams based on the organizational structure of SGRFMB for the following tasks:

1. Review of remediation sites
2. Evaluating the cleanup priority of sites
3. Approval on the mandatory expenditure for response measures
4. Reviewing remediation plans or remediation goals
5. Other reviews related to the fund expenditure.



The organizational structure of the SGRFMB

2.2 Financial Management

The Soil and Groundwater Pollution Remediation Fund Management Board (hereinafter referred to as SGRFMB was founded to alleviate the consequences of soil and groundwater pollution. If ever an emergent situation occurs, it provides disbursement for the response measures and remediation. However, polluters are required to pay the compensation afterwards. Furthermore, a compensation procedure was established.

2.2.1 Fund Income and Expenditure

1. Sources of Fund Income

In accordance with the Act, the income of SGRFMB shall be derived from the following 8 sources:

I. Soil and groundwater pollution remediation fees

II. The compensation paid by polluters, persons potentially responsible for pollution, and interested parties of the polluted land pursuant to Article 43 and Article 44.

III. Payments from land developers pursuant to Paragraph 3 of Article 51.

IV. Accrued interest generated by the funds

V. Appropriation from the central competent authority through budget process

VI. Partial appropriation of relevant environmental protection funds

VII. Partial appropriation of criminal and administrative fines for environmental pollution

VIII. Other related income

2. Purposes of the Funds

The abovementioned funds shall be used for the following purposes:

I. In accordance with the Act, The funds are used for expenditures made by competent authorities at all levels for verification, adoption of response measures, supervision, and plan determination, review, investigation, assessment, implementation, and expenditures generated from changes of abovementioned plans

II. Legal expenses including claim for compensation

III. Personnel and administrative management expenses, personnel expense incurred by soil and groundwater pollution prevention and remediation work.

IV. Expense of soil and groundwater pollution control work performed by competent authorities at all levels.

V. Expense of audit of soil and groundwater pollution verification and implementation effectiveness

VI. Expense of international environmental protection work

VII. Expense of audits of soil and groundwater quality monitoring and implementation effectiveness

VIII. Expense of levying soil and groundwater pollution remediation fees

IX. Expense of soil and groundwater pollution health risk assessment and management.

X. Expense of researching, promoting, developing, and creating incentives for soil and groundwater pollution remediation technology.

XI. Subsidies for soil and groundwater pollution prevention

XII. To cover other costs in connection with soil pollution or groundwater pollution remediation approved by the central competent authority.

3. Utilization of the Funds

The total income in 2016 was NT 989.32 million, and 95% of the total income came from remediation fees.

The total expenditure in 2016 was NT 1.36886 billion, and remediation fees spent on soil and groundwater pollution remediation accounted for 97% of the total expenditure, which was around NT 1.32143 billion. The rest was spent on administrative management, infrastructure, and equipment. This part accounted for 3% of the total expenditure, which was around NT 47.43 million.

2.2.2 Strengthening the Online Reporting Platform

Majority of the fund income comes from remediation fees, which accounte for 95% of the total income. Remediation fees are reported online after the reporting system was established. This has significantly shortened the reporting time and increased data accuracy. Around 10,000 cases are being reported each year, and the online reporting rate has been around 99%.

2.2.3 Outlook for Fund Income and Expenses

Taiwan EPA revised the fee collection procedures on December 30, 2016 and conducted a comprehensive review on the existing levying system. In addition, the EPA has reviewed the designated chemical substances, enterprises, and levying rates based on the real income and expenses, on-site inspections, remediation, and pollution control standards of the SGRFMB.

Ch3. Prevention and Management of Soil and Groundwater Pollution

3.1 Pollution Prevention

Soil and groundwater pollution can be easily neglected. When contaminants continue to spread and accumulate in soil and groundwater, the negative impacts to human health and the environment becomes greater. As the level of contamination exacerbates, remediation works become more time-consuming and costly.

As the saying goes, “an ounce of prevention is worth a pound of cure”, Taiwan EPA proactively adopts 3 prevention methods to monitor the quality of the environment and prevent pollution. The key actions and results of 2016 are described as follows:

1. Pollution Testing by Enterprises Officially Announced by the Central Competent Authority

In order to implement justice and fairness, Taiwan EPA has formulated Article 8 and Article 9 of the Soil and Groundwater Remediation Act (hereinafter referred to as the Act) to ensure the security of land transactions. Land assignors and enterprises officially announced by the central competent authority shall provide assessment reports on soil pollution of the transferring land beforehand. Detecting potential threats as early as possible is helpful in clarifying the responsible persons of site pollutions.

Articles 8 and 9 of the Soil and Groundwater Remediation Act

The Act	Designated Subjects	Restrictions
Article 8	Land Assignor	Land transfer
Article 9	Enterprises Officially Announced by the Central Competent Authority	1. Acquisition of an enterprise establishment license or registration, or application for a business license, in accordance with the law 2. Change of business operator. 3. Change of industry category. However, enterprises whose industry category before and after the change is one which has been officially announced by the central competent authority shall be exempt from this requirement. 4. Change of scope of operating site. 5. Implementation, in accordance with the law, of termination of business, cancellation of operating permit or business license, termination of operation (shipping), plant (facility) closure, or discontinuation of production, manufacturing, or processing.

2. Soil and Groundwater Testing in Designated Zones

In accordance with the Act, the following places shall undergo soil and groundwater testing on a regular basis:

I. Industrial parks

II. Export processing zones

III. Science-based industrial parks

IV. Environmental technology parks

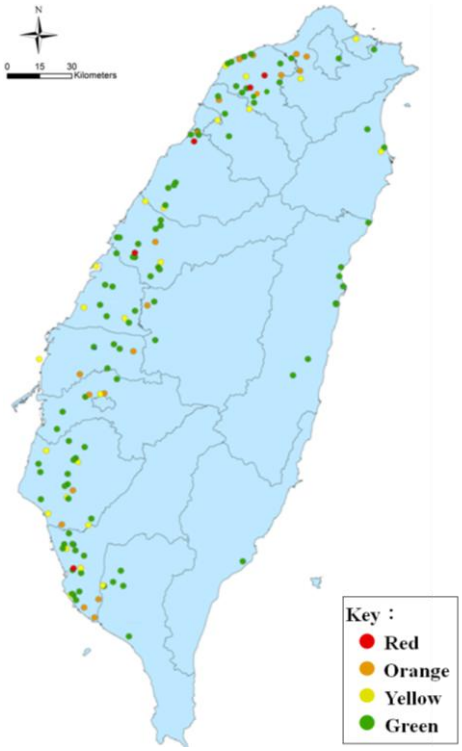
V. Agricultural technology parks

According to statistics recorded until December 2016, the reporting rate for future references of industrial parks had reached 99.3%.

Among them, Ministry of Economic Affairs (MOEA)-run industrial parks, local government-owned industrial parks, export processing zones, science-based technology parks, environmental technology parks, and agricultural technology parks have all completed their online reports, and only one private-run industrial park did not complete filing reports for future references.

3. Early-Warning System for Industrial Parks

To effectively prevent industrial pollution and safeguard people's health, the EPA has developed a monitoring scheme for industrial parks. The Lights Classification Management System is used to categorize industrial parks with red, orange, yellow, and green lights to indicate the level of pollution monitoring and administrative management. The EPA also investigates and announces the outcome when monitoring any abnormality. This is helpful in obtaining timely background quality of nationwide industrial parks. Additionally, the monitoring network provides efficient control of industrial parks with high potential pollution.



The Current Status of Nationwide Industrial Park Lights Classification

Industrial Park Lights Classification System

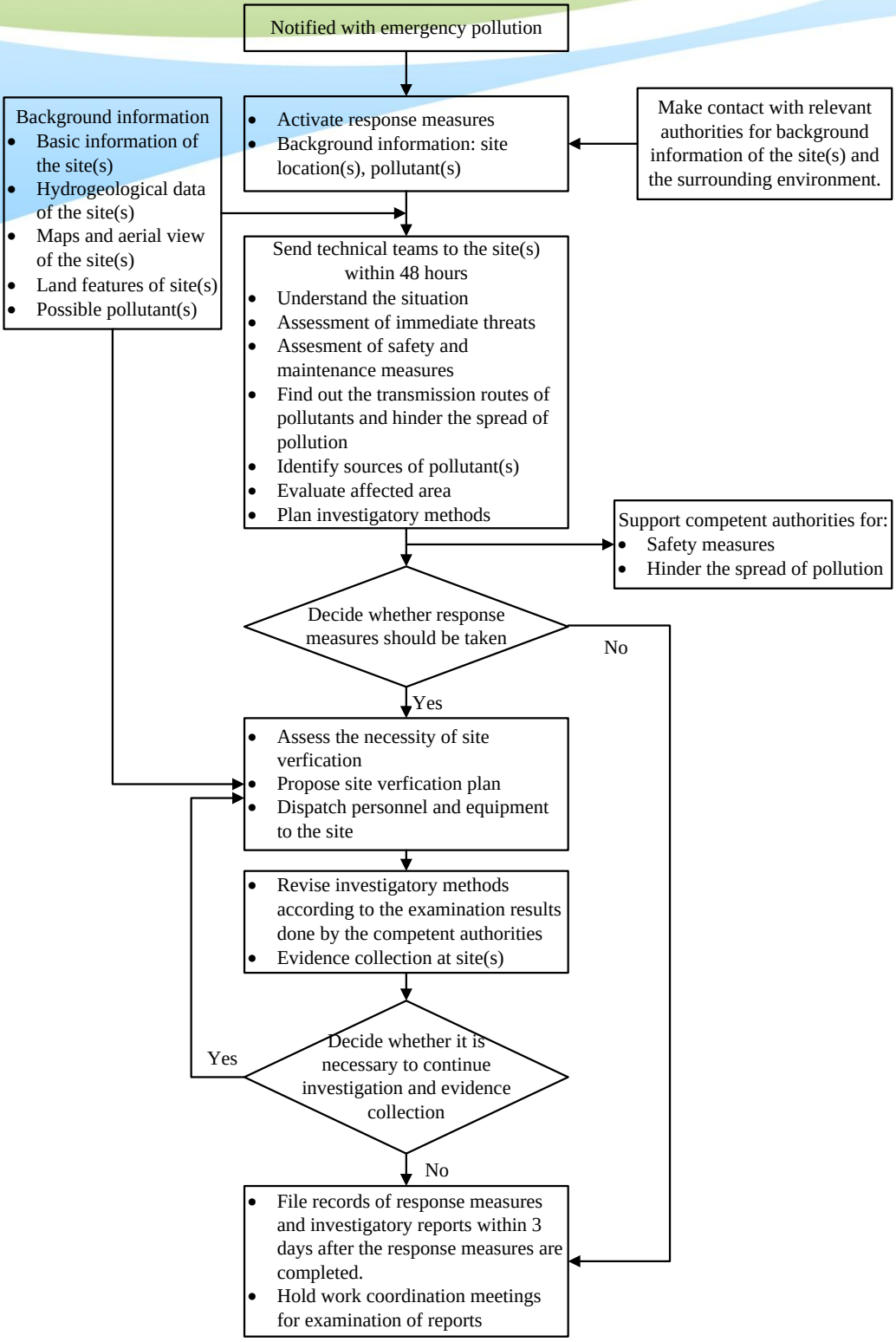
Light Classification	Definition	Goals	Actions
Red	Contamination found within the park and spread over the park's boundaries	Risk assessment and management	Pollution risk assessment and management strategies (within and outside the industrial park)
		To cut off pollutant sources	To track pollutant sources and execute response measures
		To set up early-warning lines	To complete the monitoring networks within and outside the industrial park
		To prevent the spread of pollution	To set up pollution isolation measures on boundaries
Orange	Contamination within the park	To strengthen the line of defense on boundaries	To complete the monitoring networks on boundaries or to restraint the scope of pollution
		Risk assessment and management	To perform risk assessment and management measures for the pollution which cannot be improved in the short-time
		To track the source of pollutants and alleviate the level of pollution	To clarify the scope of pollution and execute improvement measures
Yellow	Contamination has been regulatory listed and remediated	Accelerate remediation works	Give counseling advices and strengthen early-warning monitoring network
	Lower than limited concentration over the years but not in compliance with reporting procedure for reference	To complete pollution testing and report for reference	To complete the monitoring wells network within the park and boost the efficiency
Green	In compliance with reporting procedure for references and lower than limited concentration over the years; low polluting industry that are exempt from examinations	Potential pollutants management	Strengthen the audit and inspection of air , water, and toxic chemical waste management
		Geological background concentration management	Groundwater Management

3.2 Pollution Management

Taiwan EPA has established monitoring wells and preventative measures for the abovementioned potential pollution sites, and launched detailed investigation in all areas. In addition, the EPA has set up a complete managing network for polluted sites. The main tasks are described in the following:

1. Responsive Investigations, Verification Work , and Technical Support

The EPA has commissioned professional institutes as supporting units since 2000. These institutes support the EPA and local environmental protection bureaus on the investigation and verification work of pressing soil and groundwater pollution cases. In early stages of the pollution, these units will grasp the conditions of polluted sites and evaluate the level of contamination to determine if it is necessary to adopt emergency response measures.



Procedures of Pollution Emergency Plan

2. The Off-site Treatment, Disposal and Reuse of Contaminated soil

To effectively track the flow of off-site contaminated soil, the EPA has amended the Waste Disposal Act and added the responsibility for the handlers and transporters to report and manage off-site contaminated soil in accordance with the Waste Disposal Act. This has allowed EPA to adopt more effective management and regulation on the handlers of off-site contaminated soil.

3. Risk Assessment of Sites

When the Soil and Groundwater Remediation Act was first promulgated in 1999, the concept of risk assessment has been included into the decision making process of groundwater remediation. If remediation works have failed to meet the standard requirements due to factors such as geological conditions, pollutant characteristics, and remediation technology, the remediation targets can be changed according to the Health Risk Assessment System. The Act was revised again on February 2000, and the scope has been extended to remediation sites of soil and groundwater pollution.

Taiwan EPA has further established 2 online platforms, the “Preliminary Assessment and the Cleanup Priority of Sites” (please refer to https://sgw.epa.gov.tw/envsystem/index.aspx) and the “Health Risk Assessment System”

(please refer to https://sgw.epa.gov.tw/Risksystem/Default.aspx) to perform massive calculations and e-management. “The Risk Assessment Team of Polluted Sites” was also established to evaluate the planning and reports of the health risk assessment and influences to the environment. The team also makes reviews on the evaluation methods, parameters, and data updates of risk assessment.

4. Promoting the Reuse of Contaminated Land

The redevelopment of contaminated land is still at its early stage in Taiwan. Therefore, the EPA has combined the idea of risk assessment and risk

management and formulated an initial planning of reusing contaminated land exclusively for representative sites. Remediation works on such sites will speed up by integrating local environmental protection bureaus and responsible persons.

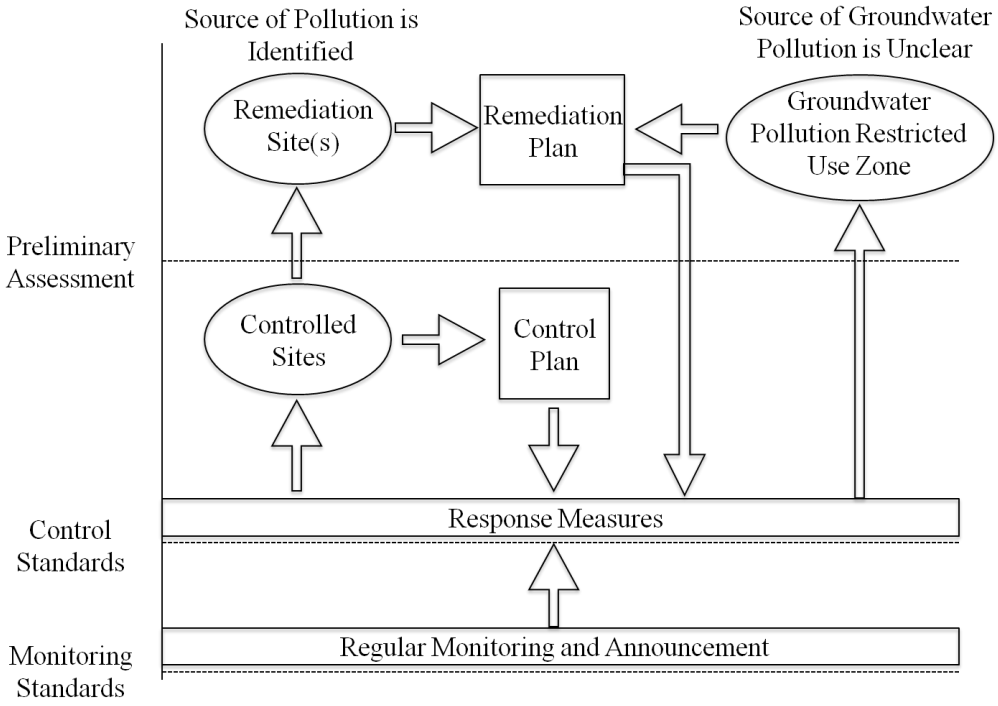
In addition, the EPA has launched the “Principles of Concurrent Remediation: Setting Solar Powers on Remediation Sites” in 2016 to set up solar power facilities on contaminated land.

Ch4.Statistics of Polluted Sites on Regulatory Listing

4.1 Statistics of Polluted Sites on Regulatory Listing

1. Procedure for Polluted Sites Announcement

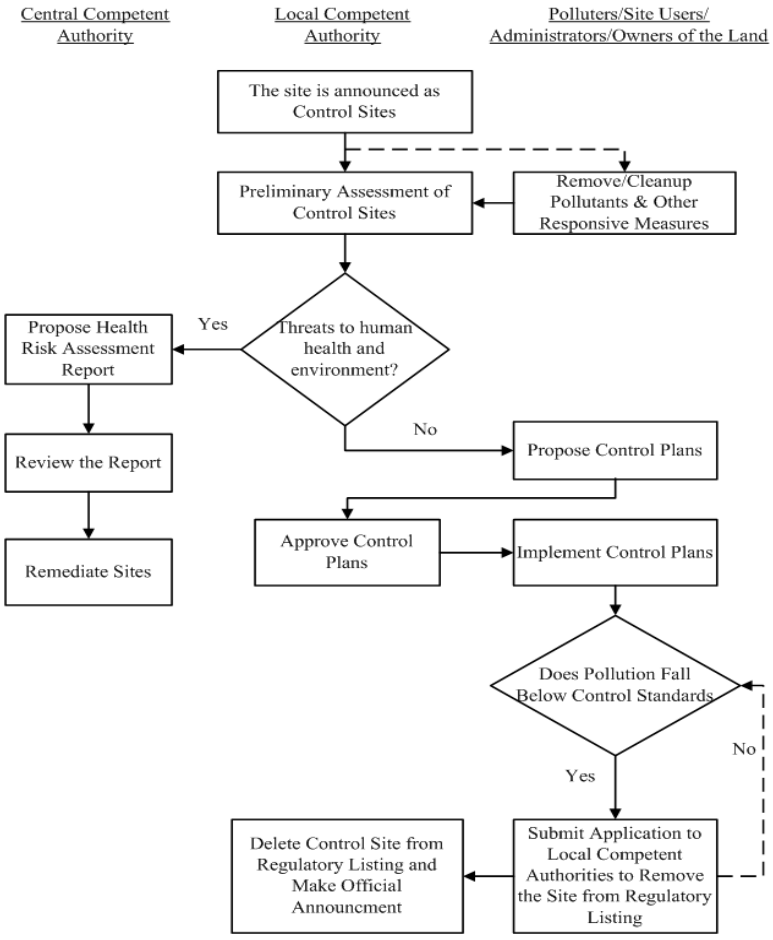
When the source of soil or groundwater pollution is identified, and the pollutant concentration reaches control standards, the competent authorities at all levels shall announce the site as Pollution Control Site (hereinafter referred to as control site). If the results of initial evaluation indicate that the pollution will pose serious threats to human health and the environment, the central competent authority shall announce the site as Pollution Remediation Sites (hereinafter referred to as remediation site)



Procedure for Polluted Sites Announcement

2. Procedure for Control Sites

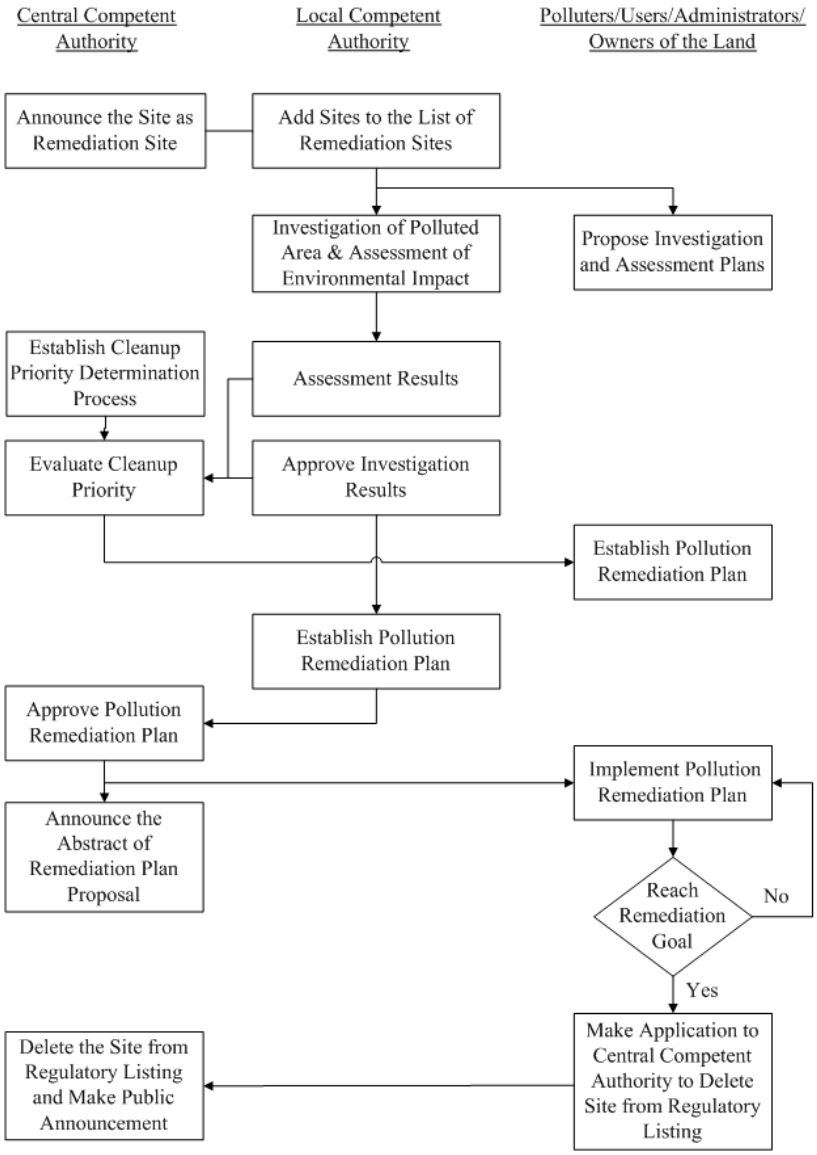
In accordance with Article 13 of the Act, local competent authorities shall order the polluter or person potentially responsible for pollution to complete investigation work within 6 months and draft a pollution control plan, which shall be implemented after being submitted to and receiving the approval of local competent authority. If the polluter or person potentially responsible for pollution is not identified or has failed to draft a pollution control plan, local competent authority may take appropriate measures to effect improvement in view of its financial status and actual site conditions. Once the monitoring statistics have met the control standards and there are no more signs showing threats to people's health and the environment, the site will be deleted from regulatory listing after the authorities have completed the verification.



Procedure for Control Sites

3. Procedure for Remediation Sites

In accordance with Article 14 of the Act, the polluter or potential polluters shall submit investigation and assessment plans within 3 months after receiving notification from local authorities. If monitoring statistics have reached the regulatory standard during remediation period, the polluter can apply for review works. The authorites will announce the cancellation of regulatory listing of the site when there are no more signs of pollution.

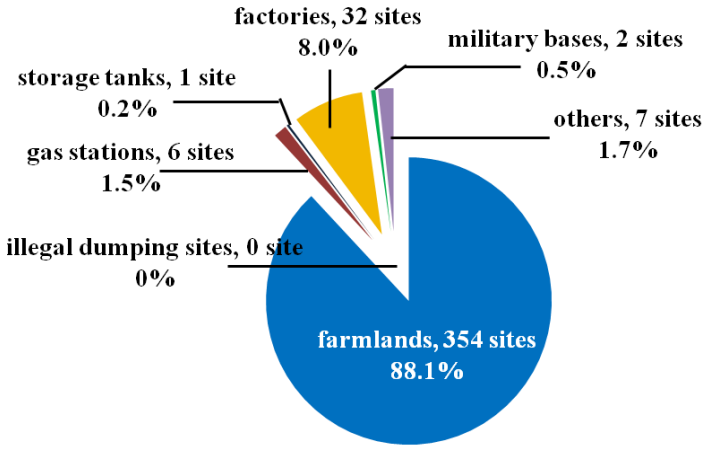


Procedure for Remediation Sites

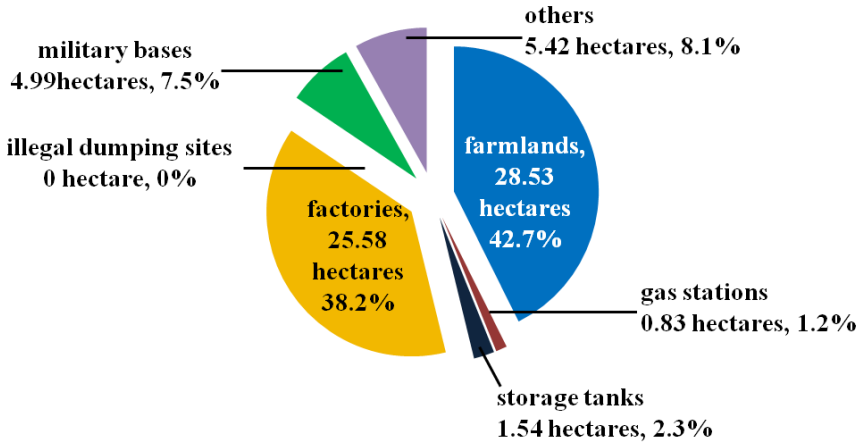
4.1.1 Control Sites

1. Sites on Regulatory Listing

In 2016, a total of 402 sites (around 66.9 hectares) were on regulatory listing as control sites. Among them, farmlands accounted for 354 sites (around 28.4 hectares), factories accounted for 32 sites (around 25.6 hectares), military bases accounted for 2 sites (around 5 hectares), gas stations accounted for 6 sites (around 0.8 hectares), and the 8 remaining sites (around 7 hectares) were illegal dumping sites, storage tanks, and other sites.



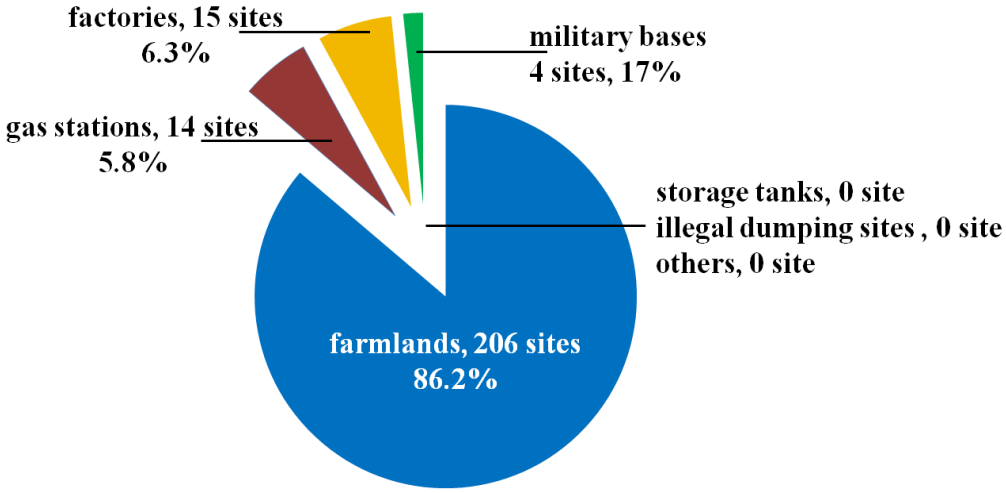
Types of Polluted Sites on Regulatory Listing in 2016



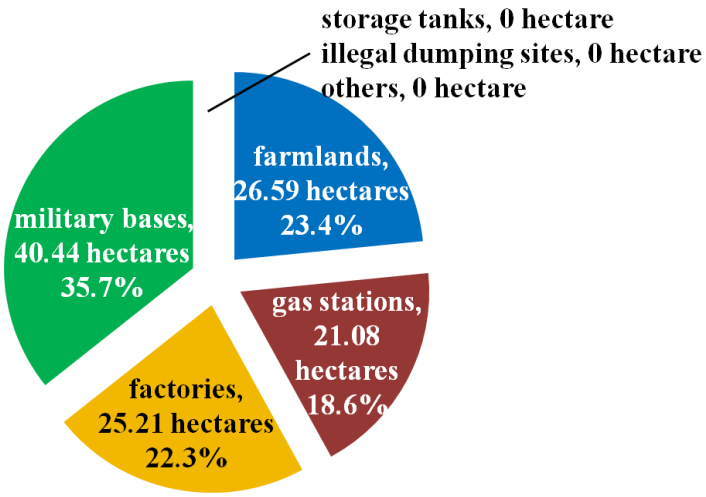
Areas of Polluted Sites on Regulatory Listing in 2016

2. Sites Deleted from Regulatory Listing

In 2016, 239 control sites (around 113.2 hectares) were deleted from regulatory listing. Among them, farmlands accounted for 206 sites (around 26.5 hectares), factories accounted for 15 sites (around 25.2 hectares), gas stations accounted for 14 sites (around 21.1 hectares), and military bases accounted for 4 sites (around 40.4 hectares). However, no illegal dumping sites or storage tanks were deleted from regulatory listing.



Types of Sites Deleted from Regulatory Listing in 2016



Areas of Sites Deleted from Regulatory Listing in 2016

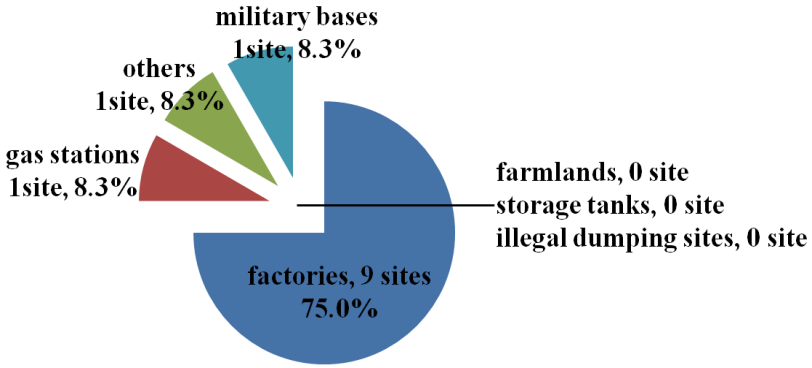
4.1.2 Remediation Sites

In 2016, 9 factory sites were publicly announced on regulatory listing as remediation sites; 1 gas station, 1 military bases and 1 other site were publicly announced on regulatory listing as remediation sites respectively.

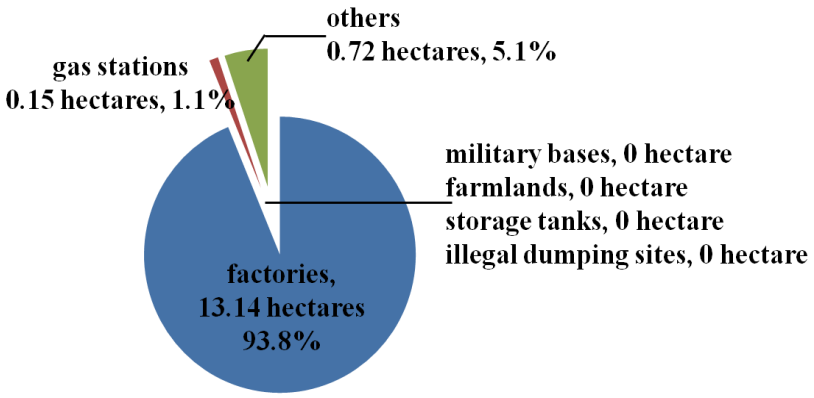
Distribution of remediation sites by administration districts:

1. Changhua County: 4 sites
2. Taoyuan City: 2 sites
3. Kaohsiung City: 2 sites
4. New Taipei City: 1 site
5. Tainan City: 1 site
6. Miaoli County: 1 site
7. Penghu County: 1 site

Taoyuan City had the largest regulated area (around 7.3 hectares), and the second largest was Miaoli County (around 3.2 hectares)



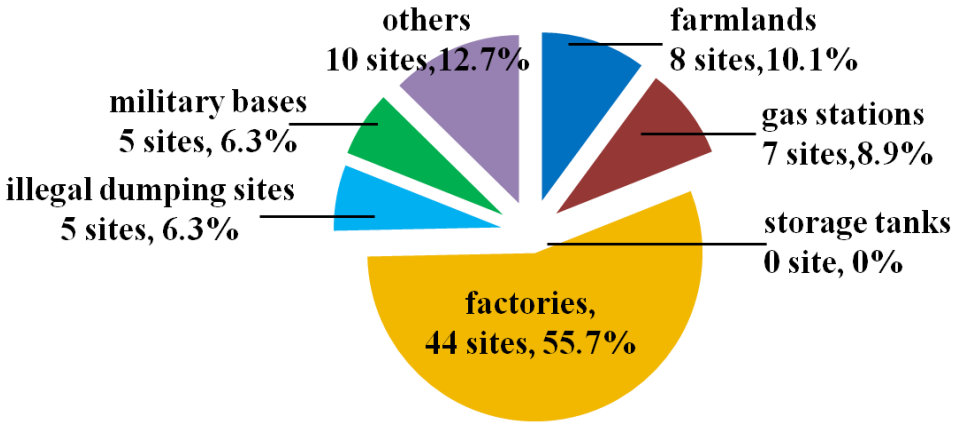
Types of Remediation Sites on Regulatory Listing in 2016



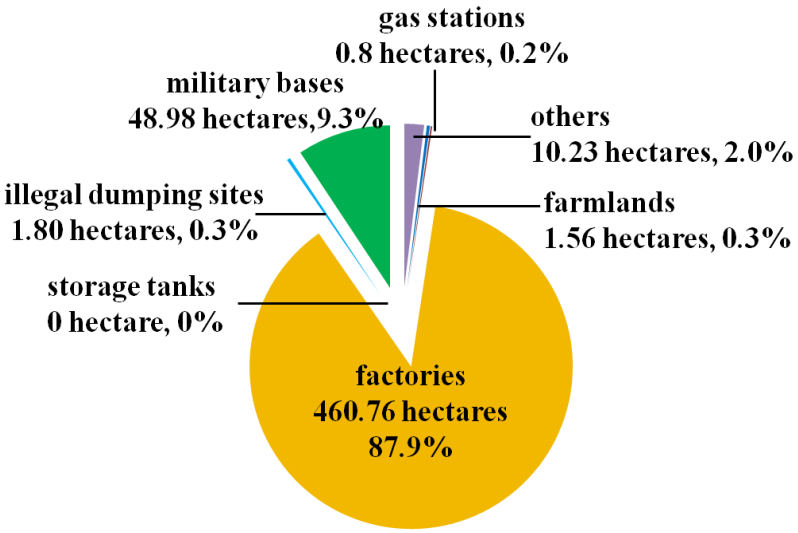
Areas of Remediation Sites on Regulatory Listing in 2016

4.1.3 Sites with Limited Correction Period

A total of 79 sites (around 524.1 hectares) were publicly announced as sites with limited correction period. Among them, farmlands accounted for 8 sites (around 1.5 hectares), gas stations accounted for 7 sites (around 0.8 hectares), factories accounted for 44 sites (around 460.8 hectares), illegal dumping sites accounted for 5 sites (around 1.8 hectares), military bases accounted for 5 sites (around 49 hectares), and the remaining 10 sites goes to others.



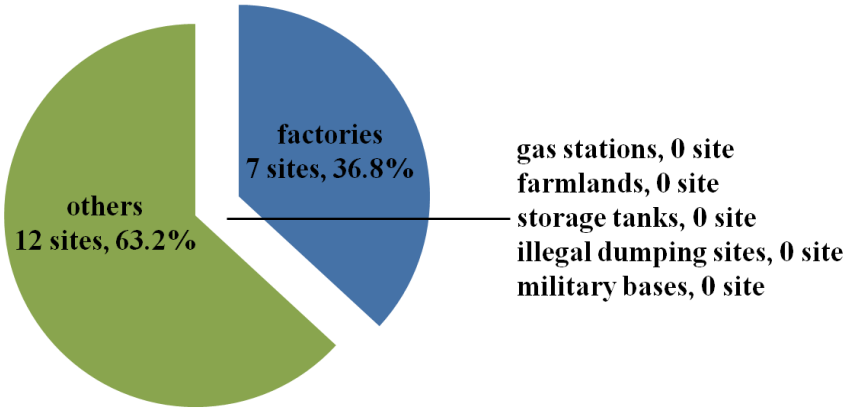
Types of Sites with Limited Correction Period in 2016



Areas of Sites with Limited Correction Period in 2016

4.1.4 Groundwater Pollution Use Restriction Zones

A total of 19 groundwater pollution use restriction zones were added into regulatory listing in 2016. Among them, factories accounted for 7 sites (around 3.5 hectares), and there were 12 other sites (around 147.6 hectares).



Types of Groundwater Pollution Use Restriction Zones in 2016

4.1.5 Accomplishments of Site Management

A total of 7148 sites were listed on regulatory listing by the end of 2016, including 605 factories, 335 gas stations, 60 illegal dumping sites, 70 military bases, 5911 farmlands, 19 storage tanks, and 148 other sites.

As for sites that were removed from regulatory listing, the total number recorded by the end of 2016 was 3706 sites. As for sites that were removed from regulatory listing, the total number recorded by the end of 2016 was 3706 sites: 3090 farmland sites (the highest number), followed by 286 factory sites, 177 gas station sites, 73 others, 41 military bases, 31 illegal dumping sites, and 8 storage tank sites.

Ch5. Promotion of Soil and Groundwater Works

5.1 International Collaboration

Taiwan EPA has been proactive in holding seminars to address soil and groundwater pollution remediation. Aside from the 2016 Training Courses on Survey and Remediation of Soil and Groundwater Contaminated Sites, the EPA has proactively promoted bilateral collaboration between Taiwan and Korea and sent delegates to participate the 7th committee meeting held in Korea. Taiwan EPA and Korea Ministry of Environment (hereinafter referred to as MOE) signed the 4-year "Memorandum of Understanding on Technical Cooperation in Soil and Groundwater Protection between the Taipei Mission in Korea and the Korean Mission in Taipei" during the meeting. All these activities demonstrated the government's effort and devotion in becoming the leader of soil and groundwater remediation in the Asia-Pacific region.

1. International Training Courses on Survey and Remediation of Soil and Groundwater Contaminated Sites

In order to continue experiences sharing with neighboring Asian countries and other non-diplomatic countries, Taiwan EPA has held 6 steering committee meeting of Working Group to address environmental protection issues. The 2016 Training Courses were held from March 21st to March 28th, 2016. A total of 8 member countries nominated representatives to join the training and a total of 9 representatives participated in the training courses. Domestic environmental consulting firms and local environmental protection bureaus to join the courses and share their experiences with guests from abroad.

2016 International Training Courses on Survey and Remediation of Soil and Groundwater Contaminated Sites Group Photo at the Opening Ceremony

Site Visiting and Remediation Technologies Demonstration at the site of Radio Corporation of America (RCA)

In-class Activities

After-class Discussion

2. The 7th Taiwan-Korea Steering Committee Meeting of MOU & Taiwan-Korea Forum on Remediation of Soil and Groundwater Contamination

Taiwan EPA and Korea MOE first signed a MOU on August 27th, 2012. A total of 7 steering meetings were held by the end of 2016.

To strengthen communication and discussions with other countries, a delegation consisted of 14 people was sent by Taiwan EPA to participate the 7th Steering Meeting in Korea. The meeting was held from August 29th to September 2nd, 2016. Taiwan and Korea also signed a second MOU on soil and groundwater remediation cooperation that will last for 4 years. The meeting provided an opportunity for both sides to exchange experiences and visit sites. This was also a great opportunity for Taiwan EPA to promote the key actions and results of soil and groundwater remediation works.

Group Photo, Taiwan and Korea Representatives

The 7th Taiwan-Korea Cooperation Committee Meeting on the Soil and Groundwater

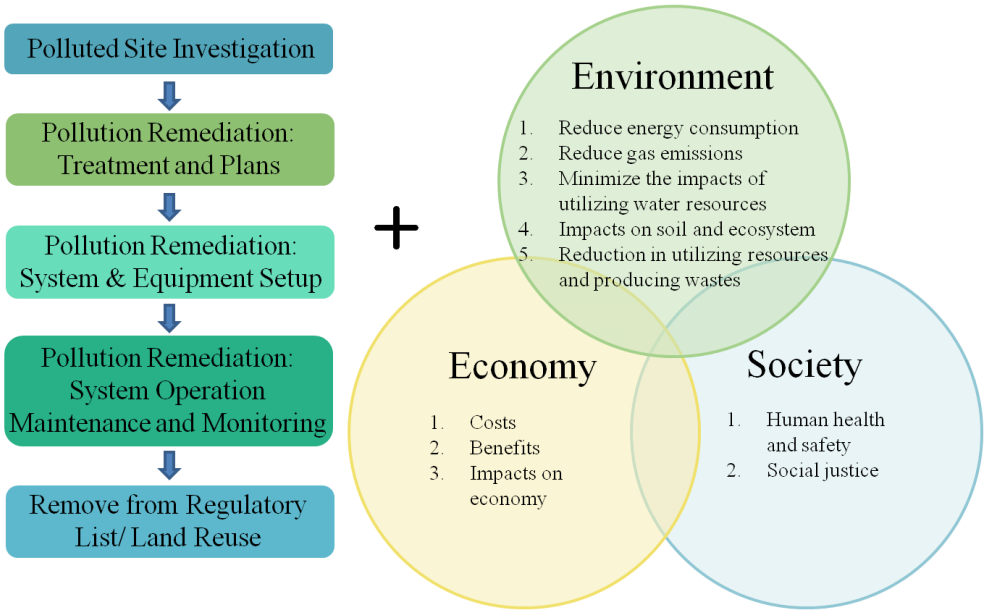
Taiwan and Korea Representatives signing the 4-year MOU

The Technology Forum at the 7th Taiwan-Korea Cooperation Committee Meeting on the Soil and Groundwater

5.2 Research Results and Accomplishments

5.2.1 Green and Sustainable Remediation and Promotional Works

The Soil and Groundwater Remediation Act was first published in 2000 in Taiwan. Over the past 17 years, the administrative management of polluted sites has become well-established. Remediation of polluted sites usually takes years to finish. As global community realizes that investigating and remediating polluted sites are costly, the Green and Sustainable Remediation (GSR) is being promoted to address pressing environmental issues sustainably. The concept of GSR also encourages competent authorities to consider the possible consequences of investigation and remediation and their impacts on the environment, society, and economy.



GSR Evaluation Diagram

To fully implement GSR, Taiwan EPA has assisted 3 sites to execute GSR assessment and suggested best management practices (BMPs) Meanwhile, Taiwan EPA proposed a draft on the certification system to ensure its rationality and fairness. In addition, the GSR Platform (please refer to: http://sgw.epa.gov.tw/greenremediation/) was set up to provide users strategies on environmental cleanup. The platform also provides counseling services on environment footprint, economic evaluation, societal evaluation, and BMPs. A total of 3 GSR workshops were held in 2016 to guide users to explore the system.

In recent years, Taiwan has been proactive in participating International Sustainable Remediation Forum (SuRF) to exchange experiences with other SuRF organizations from around the world. The SuRF-Taiwan organization was established in 2012. The international community has reached a consensus to establish an International Sustainable Remediation Alliance (ISRA), and Taiwan will be a key member in this alliance. To date, Taiwan has participated in 5 conference calls and addressed the key actions and results of GSR promotion. In addition, Taiwan has assisted SuRF-USA to write the whitepaper and reviewed documents of GSR standards for the International Organization for Standardization (ISO).

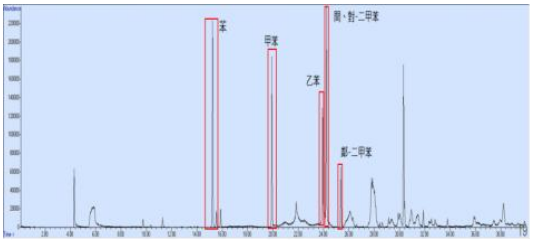
Taiwan EPA has introduced phyto-technologies, surface flux chamber sampling technique for vapor intrusion evaluation, sampling and analysis techniques for subsurface soil vapor to be in line with the latest investigatory approach and remediation technologies. Dr. Landmeyer from the US Geological Survey was invited to Taiwan for remediation technologies transfer. These technologies were demonstrated at 2 polluted sites in Taiwan, proving that they can truly reflect the level of underground pollution. Taiwan EPA also held a press conference to address core-sampling of plants to detect underground pollution, and held 2 sessions of the “Training Workshop on the

Application of Phytoforensics for Contaminated Sites". The EPA also finished a draft of the Phyto-technologies Guidelines.

Core-sampling

Outdoor Demonstrations

In-situ Core-sampling Analytic Tool



Core-sampling In-situ Analytic Spectrum

Training workshop on the application of phyto-technologies for polluted Sites

5.2.2 Soil and Groundwater Pollution Remediation Fund Subsidiary for Research and Pilot Study

Taiwan EPA has launched subsidy program since 2000 to promote investigation, assessment, sediment pollution investigation, and rehabilitation works of soil and groundwater. The subsidy program aims to encourage soil and groundwater remediation research units and academic institutions to engage in relevant research. The Regulations on the Soil and Groundwater Pollution Remediation Fund Subsidiary for Research and Pilot Study was announced on October 22nd, 2012 to enhance nationwide soil and groundwater remediation works and development.

Research topics are divided into 2 categories: research projects and pilot studies. The core of research is to integrate academics and industries. The outcome of research shall be practically feasible in remediating polluted sites. In 2016, research topics were broadened to four categories: remediation, assessment, prevention, and others. Details of research are tailored to the policies launched by Taiwan EPA.

Taiwan EPA has received a total of 293 applications from 2000 to 2016.There were 149 applications that passed the review (the average passing rate was 51.9%). In 2016, a total of 47 applications were submitted to EPA and 28 passed the review (with a passing rate of 59.6%). Among the 28 passed applications, 25 (89.3%) were research studies and 3 (10.7%) were pilot studies.

5.3 Promotional Activities of Land Quality

In order to raise the public's awareness on soil and groundwater protection, Taiwan EPA created a Facebook fan page (please refer to: https://zh-tw.facebook.com/sgwepa/) to promote the importance of land quality to the public and educate them the right way to protect the environment. Taiwan EPA frequently posts news, videos, and various activities to interact with followers on the fan page. The frequent posts have raised the page's visibility and attracted more audience, and the number of followers reached 15,000 in 2016. The fan page also provides a solid foundation for environmental education as it raises the public's awareness on soil and groundwater issues. The key accomplishments are described below:

1. Environmental Education at Schools

An education fair was launched by Taiwan EPA to introduce soil and groundwater protection to students. The purpose of the fair was to teach students the right way to protect the land. The fair was consisted of several activities, including campus environmental education, Popular Science Activities, and story-telling tour. The EPA hopes to raise students' awareness on environmental protection issues.

Campus Education Tour

Numbers	Promotional Activities	About the Event
1	Environmental Education	● Number of sessions: 6 ● Places: Keelung, Taoyuan, Hsinchu, Miaoli, Taichung, and Changhua
2	Popular Science Activities	● Number of sessions: 4 ● Places: Taoyuan, Miaoli, Tainan, and Changhua
3	Storytelling Tour	15 sessions at remote schools

Environmental Education-Quiz Contest

Environmental Education-Award Ceremony

Popular Science Activities – Teaching Materials (Lab Kits)

Popular Science Activities – Lab Experiment

Storytelling at Remote Schools-Quiz Contest

Storytelling at Remote Schools-Group Photo

2. Environmental Education Workshops and Promotional Activities at Local Communities

I. Integrating local cultures into promotional activities

Taiwan EPA held events at local communities in Changhua, Taoyuan, and Nantou to educate citizens about soil and groundwater protection. By concurrently holding promotional events during local festivals, Taiwan EPA was able to promote soil and groundwater issues and the Facebook page to local citizens.

Changhua Wang Kung Festival- Information and guidance

Taoyuan Tu Di Gong Festival- Photo-op with citizens

Nantou Global Tea Expo- Family photo at the event

II. Training Courses for Soil and Groundwater Education Speakers

Taiwan EPA held 2 training courses in order to nurture teachers for storytelling events. These teachers are sent to remote schools and educate children about how to protect soil and groundwater with stories.

3. Media Marketing

I. Media Coverage and Charity Broadcasting

Taiwan EPA has been utilizing the media to bring professional and accurate information to the public. Soil and groundwater information can reach the public via magazines, newspapers, and TV advertisements to attract more audiences and raise their awareness on soil and groundwater issues.

Another marketing strategy was to make non-profitable 30-second video clips for public welfare. Taiwan EPA applied for permit from the Department of Information Services of Executive Yuan to make 30-second video clips and broadcast them on TV to expand the depth and width of promotional works.

Media Coverage

Numbers	Types of Media Coverage	Views
1	Magazine Advertisement	1,517,000
2	Newspaper Advertisement	1,324,080
3	Broadcasting Advertisement	1,698,642
4	Non-profitable 30-second video clips for public welfare	4,826,836

II. Cross-industry Collaboration

Taiwan EPA collaborated with other industries to further promote soil and groundwater issues to the public. The approach was to post posters at theatres and shops. Apple Theatre, New Taipei City Books and Reading Association, and TKEC Electronics joined the campaign and put up posters at their stores. This cross-industry cooperation has boosted the efficiency in the promotional works.

Posters at Apple Theatre
(at Miaoli)

Posters at TKEC stores
(in Northern Part of Taiwan)

5.4 Seminars and Exhibition of Soil and Groundwater Pollution Prevention and Management of Industrial Sites

Taiwan EPA held seminars and exhibitions from July 19 to 20, 2016 to demonstrate the key actions and achievements on the soil and groundwater pollution prevention of industrial sites. The core of the events was to introduce the current status, prevention methods, and management of soil and groundwater pollution to enterprises and the public.

1. Seminars

Scholars and experts from the academia, government, and industries gathered together to address the following issues of soil and groundwater protection: investigatory and remediation approach, prevention management, tracking sources of pollutant, environment forensics, factory pollution liabilities and insurances, the Soil and Groundwater Pollution Remediation Act and land trading, land revitalization, and domestic soil and groundwater markets. A total of 386 participants joined the seminars, and it was a great opportunity for experts to share their experiences.

2. Call for papers

Taiwan EPA called for academic works from scholars, experts, and students. Posters of submitted works were posted on the seminar days for grading and the authors were invited to present their research outcome. A total of 23 papers joined the competition.

3. Exhibitions, Workshops, and Micro-Movie Awards

Videos, infographics, and models were used to promote the current status of Taiwan's soil and groundwater works, including investigation, management, and remediation accomplishments. Workshops were held regularly to encourage people to join the events and work together for soil and groundwater protection. An award ceremony was held to praise the 34 micro-movies that won the movie contest that lasted from December 2015 to May 2016. Over 750 people joined the 2-day micro-movie exhibition.

Opening Ceremony

Keynote Speech at Seminars

Dissertation Presentation

Dissertation Posters

Guided Tour

Seminars and Workshops

Ch6. Future Outlook

6.1 Mid and Long-Term Policies and Goals

The remediation of soil, groundwater, and sediments can be extensive. However, after years of implementation and review, remediation works have become more comprehensive in Taiwan. New investigatory approaches and remediation technologies are being utilized to manage soil and groundwater pollution. These achievements have brought positive influences and Taiwan EPA will keep promoting environmental protection works in the future. The developmental goals are described as follows:

1. Fully implement sediment management
2. All-round farmland management and strategies
3. Develop efficient screening investigation system
4. Continuous review of fee collecting procedure; build sustainable and feasible fee collection procedures
5. Comprehensive groundwater management and strategies
6. Enhance investigatory and remediation approaches
7. Develop tools for IT management and decision-making process
8. Optimize inspection system
9. Strengthen the nurturing of talent
10. Continue to establish feasible pollution forensics technologies
11. Promote and expand the reuse of off-site polluted soil
12. Establish a risk assessment platform
13. All-round management and strategies of operating factories

6.2 Future Planning and Goals

2016 marks the 16th anniversary since the Soil and Groundwater Pollution Remediation Act first launched in 2000. Taiwan EPA has been proactive in giving assistance to the soil and groundwater industry, as well as building technologies that are suitable for local utilizations. In addition, numerous international seminars and site visits were held to allow non-governmental and governmental units to exchange ideas and share their experiences. Taiwan EPA has also signed MOU with other countries to address soil and groundwater remediation works with the international community. Aside from accumulating past experiences and localizing remediation technologies to be in line with domestic needs, Taiwan EPA is also determined in helping local enterprises to expand soil and groundwater market overseas. Taiwan EPA has set 10 goals for future development:

1. Promote the reporting system for enterprise inspections
2. Systematic management of polluted off-site soil
3. Investigation on soil and groundwater pollution
4. Implement industrial zones ranking and management
5. Promote the reuse of polluted land
6. Develop soil and groundwater health risk maps
7. Expand industrial research and engage in remediation works
8. Strengthen the integration and application of environmental data on groundwater; stimulate groundwater quality potential and water quality indicator; continuous research on the cause of ammonia nitrogen in background water in domestic groundwater.
9. Monitor high-polluting industries and factories; encourage factories with high pollution potential to self-monitoring
10. Continuous promotion of international collaboration

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