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IMPLEMENTATION COMPLETION AND RESULTS REPORT

TF0A0193

ON A

GRANT

IN THE AMOUNT OF US$15 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR THE

China Contaminated Site Management Project

June 6, 2024

Environment, Natural Resources & The Blue Economy Global Practice

East Asia & Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective November 30, 2023)

Currency Unit =	Chinese Yuan (CNY)
CNY 7.0853 =	US$1

FISCAL YEAR
July 1–June 30

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ABBREVIATIONS AND ACRONYMS

CEPB	Chongqing Environmental Protection Bureau
EIRR	Economic internal rates of return
ESF	Environmental and Social Framework
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
FECO	Foreign Economic Cooperation Office
FYP	China's Five-Year Plan(s) for Economic and Social Development (2011–15, 2016–2020, 2021–25)
GA	Grant Agreement
GEF	Global Environment Facility
GoC	Government of China
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion and Results Report
IRI	Intermediate Results Indicator
ISR	Implementation Status and Results Reports
LEPD	Liaoning Environmental Protection Department
M&E	monitoring and evaluation
MEE	Ministry of Ecology and Environment (formerly known as Ministry of Environmental Protection or MEP)
MTR	Mid-Term Review
NIP	National Implementation Plan (of the Stockholm Convention)
PAD	Project Appraisal Document
PDO	Project Development Objective
PMU	Project Management Unit
POPs	persistent organic pollutants
RMB	renminbi, the Chinese currency
SDG	Sustainable Development Goal
ToC	Theory of Change
ToRs	terms of reference
VSL	value of statistical life

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DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P145533	China Contaminated Site Management Project
Country	**Financing Instrument**
China	Investment Project Financing
Original EA Category	**Revised EA Category**
Full Assessment (A)	Full Assessment (A)

Organizations

Borrower	Implementing Agency
PEOPLE'S REPUBLIC OF CHINA	Foreign Environmental Cooperation Center of Ministry of Ecology and Environment

Project Development Objective (PDO)

Original PDO

The project development objective is to improve the country's capacity for managing site contamination, and demonstrate environmentally sound identification and cleanup of sites contaminated with POPs and other hazardous chemicals.

FINANCING

	Original Amount (US$)	Revised Amount (US$)	Actual Disbursed (US$)
World Bank Financing			
TF-A0193	15,000,000	14,280,852	14,280,852
Total	**15,000,000**	**14,280,852**	**14,280,852**
Non-World Bank Financing			
Borrower/Recipient	60,000,000	0	0
Total	**60,000,000**	**0**	**0**
Total Project Cost	**75,000,000**	**14,280,852**	**14,280,852**

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
30-Apr-2015	18-Sep-2015	29-Oct-2018	31-Dec-2021	30-Nov-2023

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US$M)	Key Revisions
03-Dec-2021	9.33	Change in Loan Closing Date(s)
30-Mar-2023	11.05	Change in Results Framework Change in Components and Cost Change in Loan Closing Date(s) Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Highly Satisfactory	Satisfactory	Substantial

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US$M)
01	27-Aug-2015	Satisfactory	Satisfactory	.29
02	04-May-2016	Satisfactory	Moderately Satisfactory	.30
03	03-Dec-2016	Satisfactory	Moderately Satisfactory	2.30
04	21-Jun-2017	Satisfactory	Moderately Satisfactory	2.54
05	22-Dec-2017	Satisfactory	Moderately Satisfactory	3.15
06	25-Jun-2018	Satisfactory	Moderately Satisfactory	3.32
07	31-Dec-2018	Satisfactory	Moderately Satisfactory	5.14
08	20-Jun-2019	Satisfactory	Moderately Satisfactory	5.73
09	30-Dec-2019	Moderately Satisfactory	Moderately Satisfactory	5.99
10	18-Jun-2020	Moderately Satisfactory	Moderately Satisfactory	6.68
11	18-Dec-2020	Moderately Satisfactory	Moderately Satisfactory	7.18
12	15-Mar-2021	Moderately Satisfactory	Moderately Satisfactory	7.66
13	23-Sep-2021	Moderately Unsatisfactory	Moderately Unsatisfactory	8.76
14	18-May-2022	Moderately Satisfactory	Moderately Satisfactory	10.20
15	14-Dec-2022	Moderately Satisfactory	Moderately Satisfactory	10.61
16	09-Jun-2023	Satisfactory	Moderately Satisfactory	11.53

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Public Administration	**60**
Central Government (Central Agencies)	60

Industry, Trade and Services	**40**
Other Industry, Trade and Services	40

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Environment and Natural Resource Management	**99**
Environmental Health and Pollution Management	42
Air quality management	14
Water Pollution	14
Soil Pollution	14
Environmental policies and institutions	57

ADM STAFF

Role	At Approval	At ICR
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I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Context

1. **China's rapid growth over the past four decades has generated many economic benefits while at the same time contributing to environmental pollution and degradation.** The country's industrial transformation has impacted the quality of soil, air, and water, with soil pollution posing not only serious public health and environmental risks, but also being an obstacle to further urban and rural economic development. By the early 2000s, soil pollution had begun contaminating the food chain with heavy metals, persistent organic pollutants (POPs), solvents, fertilizers, pesticides, and other organic contaminants, which were also polluting groundwater and surface waters. According to China's First National Soil Survey (2014), which covered about 6.3 million square kilometers[1] of land area, 16.1 percent of the sampling sites showed signs of pollution exceeding the country's environmental quality limits at that time.

2. **Recognizing the importance of reducing environmental pollutants such as POPs, which are highly toxic and difficult to degrade, in 2001 China signed onto the Stockholm Convention on the elimination of POPs.** China had affirmed its commitment to the Convention by ratifying it early and officially enacting it in November 2004. The National Implementation Plan (NIP) for POPs Reduction and Elimination was subsequently developed and released by the Government of China (GoC) in 2007 to support its implementation. The NIP included a set of objectives for improving the legal and regulatory framework, and prioritized the development of remediation technologies for contaminated sites.

3. **In the years leading up to the project design, a series of national policies and programs[2] was launched to promote soil protection and environmentally sound management of contaminated sites.** By 2013,[3] the GoC had established short-term working targets for treatment and cleanup demonstrations of soil pollution in select areas. In the longer term, the GoC's vision was to have a national management system in place for soil protection by 2020, along with localized action on contaminated site management that would lead to a marked improvement in the country's soil quality. Following the launch of China's 12th Five-Year Plan (FYP) for National Economic and Social Development (2011–2015), an amendment to the country's Environmental Protection Law was passed in 2015, establishing environmental protection as a top national priority, with a focus on local government enforcement.

4. **Despite this progress, several factors were hindering widespread effective management of contaminated sites in China:** (i) *legal and regulatory framework*: there was an absence of a comprehensive national law focused on the prevention and control of soil pollution; (ii) *data and information constraints*: there was insufficient publicly available relevant data on soil pollution to enable localized and nationally coordinated action on soil pollution; (iii) *management capacity*: technical and institutional capacity for risk management and remediation of contaminated

[1] Including all arable land, partial forestland, grassland, unused land, and construction land.
[2] Notice on Effective Prevention and Control of Environmental Pollution for Industrial Enterprise Relocation (2004), Notice on Strengthening Soil Pollution Prevention and Control (2008), Opinions on Strengthening Key Tasks on Environmental Protection (2011), Opinions on Strengthening Key Tasks on Environmental Protection (2012), Work Arrangement on Soil Protection and Comprehensive Treatment in Near Future (2013), and China's 12th Five-Year Plan (2011–2015).
[3] Work Arrangement on Soil Protection and Comprehensive Treatment in Near Future (2013).

sites, particularly through a risk-based approach, was nascent at the time; (iv) *technology constraints:* although some soil and groundwater remediation technologies existed and had been tested in China, only a few were both practical and economical, as explained in the next paragraph; and (v) *funding constraints*: China did not have dedicated or specialized funds for management of contaminated sites.

5. **The China Contaminated Site Management Project was designed at a critical juncture and in a rapidly evolving national context, seeking to introduce international experience on a risk-based approach to demonstrate an environmentally and socially sound management process for the cleanup of sites contaminated with POPs and other toxic chemicals.** The most commonly used – but relatively expensive – remediation practice in China at the time was excavation, followed by ex-situ treatment, which involved the depositing of contaminated soil in an off-site landfill and/or neutralizing it with cement kiln treatment. Risk-based cleanup methods were often less costly, though lengthier, and still in the early stages of research and piloting in the country at that time. Under the risk-based remediation approach, an environmental and human health risk assessment would be carried out to determine the need for removal and/or remedial action, to what extent, and in which locations (depending on the future use of the site) or, conversely, whether the site might not need further action. Such remediation methods were widely adopted in many countries for their innovative approach of integrating human health risk assessment practices with the site's anticipated future use. Importantly, the project was designed with built-in flexibility based on the total land area to be remediated rather than the number of sites targeted (as described in the Key Factors section).

6. **The project was the first operation in the country to develop a framework for the risk-based management of contaminated sites, from technical guidelines and standards to a demonstration of the whole process in a few pilots.** The framework would draw on international good practices and include all the necessary steps to inform decisions for the management of the site: site identification, investigation, risk assessment, selection of remediation options depending on the level of initial and residual risks (before and after remediation), the future use of the site, remedial design and possible actions, remediation validation, and post-cleanup monitoring. It would also consider remediation technologies that had been successfully used internationally and had great potential for scale-up in China. The intent was for the technical and managerial experience gained from the identification and cleanup demonstrations of POPs-contaminated sites to be disseminated nationwide, thereby contributing to the country's ongoing efforts to address site contamination and comply with the Stockholm Convention.

Rationale for World Bank Support

7. **As Implementing Agency of the Global Environment Facility (GEF), the World Bank plays an important role in supporting its client countries in taking an integrated approach to sustainable development.** With the GEF serving as a financial mechanism to the Stockholm Convention, this project was intended to contribute to the GEF's chemicals program for reducing and eliminating the release of persistent organic pollutants (POPs). The project would contribute to promoting the sound management of chemicals throughout their life cycle in ways that lead to the minimization of significant adverse effects on human health and the global environment.

8. **The China Contaminated Site Management Project was aligned with the World Bank Country Partnership Strategy for China (FY2013–2016, Report No. 67566-CN),** contributing under Strategic Theme One: "Supporting Greener Growth of China" toward Outcome 1.6: "Demonstrating Pollution Management Measures." The Bank's China Systematic Country Diagnostic (Report No. 113092-CN, 2017) reiterated, as the project envisaged at appraisal, that soil contamination is an important threat to human health and the environment. Efforts to address soil contamination at the time of appraisal were still in their early stages, facing numerous legal, institutional,

technological, financial, and information challenges, including information about the type and volume of contaminants. The World Bank was uniquely positioned to assist China in addressing such complex environmental challenges by leveraging its experience, technical expertise, and local presence for support with the technical demonstrations, while also helping to reinforce the country's policy framework.

9. **The high-level project objectives were aligned with the World Bank Group's twin goals and international conventions.** The project intended to contribute to the World Bank Group's twin goals of ending extreme poverty by 2030 and boosting shared prosperity by improving health conditions through reduced exposure to pollution and increased access to reliable and accurate environmental information. In addition, the project responded to the country's priorities laid out in the National Implementation Plan for the Stockholm Convention on POPs and was aligned with national efforts around the development of the new national Law on the Prevention and Control of Soil Contamination (otherwise referred to as the Soil Pollution Prevention and Control Law).

Theory of Change (Results Chain)

10. **Given the growing need to manage the health and environmental risks of contaminated industrial sites and agricultural land, China was stepping up efforts to establish a management system and improve its technical and institutional capacity.** According to site data gathered by industry associations and local government institutions, over 700 sites were identified as having been contaminated with the POPs listed in the Stockholm Convention: over 600 production factories showed some form of contamination from (12) pesticides, and 122 producers were facing pollution from (10) industrial chemicals or by-products, all of which were using outdated technologies and improper means of waste disposal.

11. **The China Contaminated Site Management Project was to help the Chinese government manage contaminated sites in a sustainable way and strengthen the country's management capacity for prevention and control of soil pollution, and, in the longer term, reduce associated environmental and health risks and contribute to sustainable urban development and China's green growth trajectory.** It was designed to achieve this through a twofold approach: (i) improving the country's capacity for managing site contamination; and (ii) demonstrating risk-based, cost-effective approaches to remediation within a shortlist of contaminated sites. Although the project was not required to have a Theory of Change (ToC) at the time of project preparation, Figure 1 illustrates a ToC derived from the Project Appraisal Document (PAD, Report. No. PAD 938) at entry, as well as well as a draft Theory of Change prepared during the MTR (AM Seq 07, Annex 5).

12. **This ToC is predicated on the underlying assumptions that** (i) addressing soil pollution would continue to be a key priority for China; (ii) landowners would remain committed to working with the implementation agency until completion of the cleanup works; (iii) some of the more complex POPs sites could require additional investigation and possible pivoting if pollution levels are found to be greater than originally estimated; and (iv) there would be no other unforeseen conditions to prevent the piloting of the cleanup works from being conducted.

Project Development Objective: to improve the country's capacity for managing site contamination, and demonstrate environmentally sound identification and cleanup of sites contaminated with persistent organic pollutants (POPs) and other hazardous chemicals.

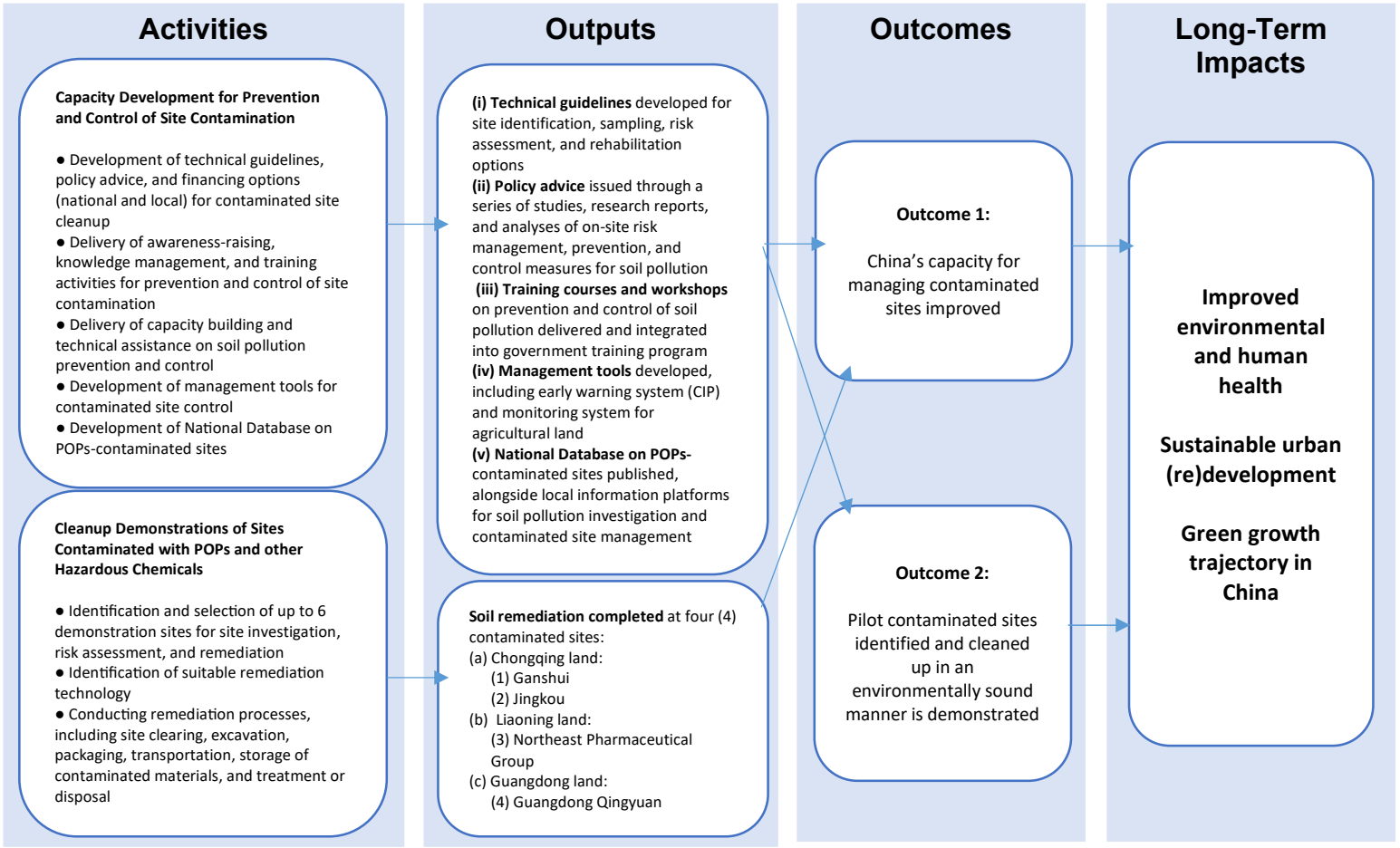

Figure 1: Theory of Change for the China Contaminated Site Management Project

Project Development Objectives (PDOs)

13. The Project Development Objective (PDO), as stated in the Project Appraisal Document (PAD) and the Grant Agreement (GA), was "to improve the country's capacity for managing site contamination, and demonstrate environmentally sound identification and cleanup of sites contaminated with persistent organic pollutants (POPs) and other hazardous chemicals."

Key Expected Outcomes and Outcome Indicators

14. The key expected outcomes were to improve the country's capacity for managing site contamination (introduce and transfer knowledge on environmental and human health, a risk-based approach in remediation), and to demonstrate a cost-effective and risk-based approach for soil pollution management (that would help the country effectively prioritize an inventory of POPs- contaminated sites according to impacts on the environment and human health). These were planned to be measured through the following four outcome indicators:

i. Selected priority technical guidelines and policy recommendations for prevention and control of site contamination at the national and local levels developed or issued (text)
ii. Training materials published and online training courses integrated into the Ministry of Ecology and Environment staff training system (text)
iii. Contaminated land managed or dump sites closed under the project (hectares)
iv. National database of POPs-contaminated sites established (text).

Components

15. **Component 1: Capacity Development for Prevention and Control of Site Contamination** (Total cost at appraisal: US$22.136 million including a US$8.22 million GEF grant; Actual cost: US$24.04 million, of which US$10.42 million GEF grant). This component supported activities related to (i) the development of technical guidelines, policy recommendations, and financing options for contaminated site cleanup; (ii) knowledge sharing events, and training and awareness raising activities in support of prevention and control of site contamination; (iii) development of management tools, such as a national database of POPs-contaminated sites, feasibility studies, and environmental warning systems; and (iv) other technical assistance activities.

16. **Component 2: Cleanup Demonstrations of Sites Contaminated with POPs and Other Hazardous Chemicals** (Total cost at appraisal: US$49.70 million including a US$6.03 million GEF grant; Actual cost: US$24.91 million, of which US$3.73 million GEF grant). This component supported activities related to the cleanup of four sites contaminated with POPs and other hazardous chemicals located in the provinces of Chongqing (Ganshui and Jingkou), Liaoning (Northeast Pharmaceutical Group), and Guangdong (Qingyuan), as described in detail in Annex 7. This was carried out through a series of site investigations, risk assessments to determine remediation goals, tailored remediation programs, Environmental and Social Management Plans, and public consultations and information disclosure.

17. **Component 3: Project Management** (*Total cost at appraisal: US$3.16 million including a US$0.75 million GEF grant; Actual cost: US$3.26 million, of which US$0.85 million GEF grant).* This component supported incremental operating costs associated with project management, including day-to-day project implementation, procurement and financial management, and environmental and social safeguards functions carried out by the Project Management Units (PMU), including coordination and collaboration among national and local government agencies, nongovernmental agencies, and private sector actors (such as site owners, polluters, or site redevelopers).

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)

18. **The project underwent two Level-II restructurings.** The first one was completed in December 2021 (Restructuring Paper No. RES48719) and the second restructuring was completed in March 2023 (Restructuring Paper No. RES54834).

Revised PDOs and Outcome Targets

19. The PDO and PDO-level indicator targets, as defined at appraisal and in the Grant Agreement, did not change throughout the project.

Revised PDO Indicators

20. The PDO-level indicators were not revised throughout the project.

Revised Components

21. **Components and Cost.** As part of the second restructuring, new activities were added to the first two components and the cost allocations were revised accordingly, as illustrated in Table 1 and detailed in paragraphs 22 and 23.

Table 1: Revised Components and Costs

Component	New Activities	Original Cost	Revised Cost	Actual Cost at ICR
Component 1: Capacity Development for Prevention and Control of Site Contamination	New activities on contaminated site management, soil pollution prevention, and knowledge sharing	US$22.14 million [of which US$8.22 million GEF grant]	US$24.04 million [of which US$10.42 million GEF grant]	US$32.34 million [of which US$10.3 million GEF grant]
Component 2: Cleanup Demonstrations of Sites Contaminated with POPs and other Hazardous Chemicals	Enhanced cleanup activities at one of the four project contaminated sites (Jingkou)	US$49.7 million [of which US$6.03 million GEF grant]	US$24.91 million [of which US$3.73 million GEF grant]	US$23.34 million [of which US$3.18 million GEF grant]
Component 3: Project Management	No new activities, only cost reallocation	US$3.16 million [of which US$0.75 million GEF grant]	US$3.26 million [of which US$0.85 million GEF grant]	US$5.8 million [of which US$0.8 million GEF grant]
Total Project Cost		**US$75 million** [US$15 million GEF grant]	**US$52.21 million** [US$14.28 million GEF grant]	**US$47.2 million [US$14.28 million]**

Other Changes

22. **Extension of grant closing date.** Through the first restructuring in December 2021, the closing date was extended by 15 months from December 31, 2021, to March 31, 2023. The second restructuring, completed in March 2023, extended the closing date by six months, from March 31 to November 30, 2023. The Implementation Schedule was revised accordingly.

23. **Reallocation of grant savings.** US$3 million in grant savings was reallocated to new capacity building and technical assistance activities that were introduced through the second project restructuring (March 2023). Under Component 1, these comprised the following: (i) contaminated site management: a risk management action plan and a cross-sectoral information platform to facilitate decision-making; a study on investigation, risk assessment,

and remediation techniques for sites contaminated with chlorinated paraffin; a study on odor investigation and control in contaminated sites; and technical guidelines for using specialized methods to screen dioxins in soil; (ii) soil pollution prevention: a study on protection and safe use of contaminated agricultural land; a study on design and application of risk management and control technology for land reclamation; and (iii) knowledge sharing: project summary and publication services. New activities under Component 2 involved additional measures in support of cleanup at the Chongqing Jingkou site. The disbursement estimates for the remaining grant amount as well as the Grant Agreement were revised accordingly.

24. **Results Framework:** As part of the second restructuring in March 2023, one additional intermediate outcome indicator was added to the Results Framework, namely an "Information platform for contaminated site management and redevelopment at the local level," with an end-target of having the platform established and functional by project closing.

Rationale for Changes and Their Implication on the Original Theory of Change

25. **Changes to closing date and components.** During the initial stage of project preparation, the Implementing Agency – the Foreign Environmental Cooperation Center (FECO) of the Ministry of Ecology and Environment (MEE) – conducted surveys and consultations to identify gaps and ensure that the project design and objectives aligned with the prevailing situation at the time. As project implementation progressed, there were several factors that affected the advancement of project activities, the most important being the emergence of a more detailed understanding of the extent of POPs pollution. This led to two extensions of the closing date and a restructuring of the project in March 2023. While the PDO indicators remained unchanged throughout the project implementation, some minor adjustments were made to the components during the March 2023 restructuring.

26. **The complexity of site conditions resulted in either delays in the implementation of remediation works at select demonstration sites or withdrawals from the project.** The initial understanding of the concentrations and extent of POPs soil contamination at some of the selected project sites turned out to be insufficient during the actual site remediation process. Further investigations were needed at these sites, requiring a more detailed diagnostic and additional time for completion. This is not uncommon in the remediation of contaminated sites, particularly for POPs and heavy metal mixed contamination, where site diagnostics before remediation require more detailed monitoring to accurately assess the extent of the contamination that would inform more accurate remediation strategies and technologies. Two sites[4] were withdrawn from the project because the contamination turned out to be too complex to be remediated within the project timeline.

27. **Delays resulting from the COVID-19 pandemic.** The outbreak of the COVID-19 pandemic in early 2020 prompted the Chinese government to adopt people-centered epidemic prevention policies, such as restrictions on physical gatherings of people. This led to the temporary suspension of certain project activities, delays in the restoration works for select project sites, and one demonstration site – Shandong Dacheng Agrochemicals – withdrawing from the project on the realization that remediation activities could not be completed on schedule and would put the project objectives at risk.

28. **Maximizing the effective use of grant funds.** Due to the withdrawal of two of the six demonstration sites from the project, approximately US$3 million in grant savings became available for reprogramming. A second closing date extension along with a project restructuring was sought in March 2023 to reallocate these grant savings to new

[4] Shenyang Chemical Plant site (2020) and Shandong Dacheng Agrochemicals site (2022).

technical assistance activities. These were designed to better reflect and support the emerging demands of the Chinese government in a dynamic policy and regulatory environment and to enhance their technical capacity for the management of the other selected contaminated sites.

29. **Results framework:** As part of the second restructuring in March 2023, one additional intermediate outcome indicator was added to the Results Framework, namely an "Information platform for contaminated site management and redevelopment at the local level," to reflect the enhanced impact of newly added activities on supporting local-level contaminated site management and to facilitate decision-making on redevelopment options for the remediated sites.

30. **Theory of Change.** The above changes did not impact the Theory of Change.

II. OUTCOME

A. RELEVANCE OF PDOs

Rating: High

Assessment of Relevance of PDOs and Rating

31. **The project is highly relevant to the World Bank Group's country strategy and other global goals.** By supporting the development of technical guidelines, standards, tools, and policy recommendations for risk-based contaminated site management in conjunction with cost-effective land remediation demonstrations drawing on international good practice, the project objectives remain highly relevant to the World Bank Country Partnership Framework for China (FY 2020–25, Report No. 117875-CN). The project's efforts to reduce hazardous waste while strengthening the country's management capacity for prevention and control of soil pollution in the long run contributes under Engagement Area 2: "Promoting greener development," namely Objective 2.2: "Reducing Air, Soil, Water, and Marine Plastic Pollution." Furthermore, by materially reducing China's public exposure to contaminated land and increasing access to reliable and accurate environmental information, the project also remains consistent with the World Bank Group's mission of ending extreme poverty and boosting prosperity on a livable planet, and the UN Sustainable Development Goals, namely SDG 15 – Life on Land, SDG 9 – Sustainable Industrialization, and SDG 3 – Good Health and Well-being.

32. **The project's design and intended outcomes were highly relevant to the 12th Five-Year Plan (FYP 2011–2015) at the time of project approval, and remain equally relevant to China's latest FYP for National Economic and Social Development (2021–2025).** The 12th FYP focused on addressing salient environmental problems, such as unsafe drinking water, and air and soil pollution negatively impacting public health. Chapter 38 of the 14th FYP asserts the country's intentions to promote the management, control, and restoration of contaminated farmland and construction land, and emphasizes precise and systematic pollution management, coordination in reducing pollution and carbon emissions, continuous improvement to air and water quality, and effective management of soil pollution risks.[5]

33. **The PDO remained highly pertinent and responsive to the rapidly evolving policy context in China.** Aligned with the efforts already underway during project preparation, the GoC continued to develop, enact, and implement

[5] Government of China 2021. *The 14th FYP for Economic and Social Development and Long-term Objectives through the Year 2035*.

laws and regulations for the management of contaminated sites, informed in large part by key findings of the project. In 2015, the State Council had introduced an "Action Plan for Prevention and Control of Soil Contamination," and in 2016, during the second year of project implementation, the GoC released an ambitious Soil Pollution Prevention and Control Action Plan (known as "Soil Ten"), which mandated the cleanup of hundreds of thousands of hectares of contaminated land across China. In 2019, a national law on "Soil Pollution Prevention and Control" was issued, representing the first comprehensive legal framework in China to address soil pollution – placing a legal obligation on private entities (that is, land-use right holders, manufacturers, operators) to implement risk control and remediation measures and cover costs associated with investigating, remediating, and managing soil contamination. Along with the concept of "risk-based contaminated site management," the project introduced relevant research and put forward systematic policy recommendations, guidelines, tools, and awareness-raising activities (on risk-based approaches) that not only contributed to the enactment of the country's Soil Pollution Prevention and Control Law but also supported its implementation and were integrated into the country's national guidelines.[6]

34. **The PDO remained relevant to local needs, thanks to a project structure with a national-level component including activities targeting central and local government officials, and a local component focusing on demonstration sites.** Under the first component, knowledge management activities were developed and made available to government officials and cleanup practitioners from both central and local governments to ensure cohesion and sustainability. The second component allowed for the entire risk-based remediation process to be carried out as an empirical and effective way to locally test out the process and its outputs, learn from it, and replicate it in other economic zones facing similar issues. It also served as an incentive for municipalities to take the necessary steps for the management of the site following a risk-based approach.

35. **Catalytic impact of the project.** Even with the withdrawal of select demonstration sites, this GEF grant leveraged more than double in private sector participation and counterpart funds, and the objectives remained achievable thanks to the project's flexible design and ability to pivot. The project restructurings ensured continued alignment with evolving conditions and policies without compromising the PDO. The experience and knowledge gained through these cleanup demonstrations can have a multiplier effect in terms of environmental, social, and economic benefits.

B. ACHIEVEMENT OF PDOs (EFFICACY)

Rating: High

Assessment of Achievement of Each Objective/Outcome

36. **Project outcomes.** The PDO can be unpacked into two outcomes: (a) China's improved capacity for managing site contamination; and (b) demonstration of environmentally sound identification and cleanup of sites contaminated with POPs and other hazardous chemicals. Both outcomes were fully achieved by the time the project was completed, with some results indicators exceeding their end-target values. The Results Framework with all key targets and results is included in Annex 1. Table 2 presents a summary of the results indicators. All data presented in this section, unless otherwise indicated, were gathered and validated throughout regular field visits and monitoring missions and have been drawn from official records including aide-mémoires, Implementation Status and Results Reports (ISRs), and the Borrower's completion report.

[6] For example, the Technical Guidelines for Site Environmental Investigation (HJ 25.1-2019), Guidelines for Hidden Soil Contamination Investigation in Key Supervised Units, Regulations on the Management of Soil Environment of Polluted Sites (2017), and Interim Measures for the Identification of Responsible Persons for Soil Contamination of Construction Land (2021).

Table 2: Achievement of PDO-level Results Indicators

	PDO Indicator	Baseline	Original End-Target (PAD)	End-Target Achievement	Comment
1	Selected priority technical guidelines and policy recommendations for prevention and control of site contamination at the national and local levels developed or issued (Text)	Existing technical guidelines for site cleanup (control of site contamination) at the national and local levels	Technical guidelines and policy recommendations for prevention and control of site contamination at the national level and in Chongqing and Liaoning developed or issued	25 standards and policy recommendations were produced from 10 research areas	Target achieved
2	Training materials published and online training courses integrated into Ministry of Environmental Protection staff training system (Text)	No training system for prevention and control of site contamination	Training materials published and online training courses integrated into the staff training system of the Ministry of Ecology and Environment (MEE)	Training materials were developed based on the Law for Soil Pollution Prevention and Control, published and incorporated into the internal training system of MEE	Target achieved
3	Contaminated land managed or dump sites closed under the project (hectare [ha])	0	5.2	8.6471 ha, of which: - Chongqing Ganshui: 0.0667 ha - Chongqing Jingkou: 0.7904 ha - Guangdong Qingyuan: 4.99 ha - Liaoning Northeast Pharmaceutical: 2.8 ha	Target exceeded
4	National database of POPs-contaminated sites established (Text)	No database for contaminated sites	The national database is operational	The database is operational, accessible, and has been integrated into the national contaminated land management database	Target achieved

37. **Outcome 1: China's capacity for managing contaminated sites improved.** PDO indicators 1, 2 and 3 measured this project outcome and their targets were achieved at both the national and local levels. These are discussed in detail below.

38. **Twenty-five standards or technical guidelines for prevention and control of site contamination at the national and local levels were developed to inform decision-making on environmental protection and land-use planning (*PDO Indicator 1*).** Of these, 15 were drafted at the national level, covering a range of priorities from pollution prevention to site investigation, risk assessment, remediation scheme, and implementation and post-remediation management; and 10 were drafted at the local level, namely for the Chongqing municipality and for Liaoning and Shandong provinces, including a study on financing options (see paragraph 53). Among them, two (2)

technical guidelines informed two national governmental guidelines[7], and eight (8) standards or technical guidelines were issued at the provincial level. Policy research areas were nimble among the different levels of government, demonstrating the project's ability to pivot to address local needs as well as to build on the experience gained from the provinces and municipalities. For example, two of the technical guidelines that were added with the second restructuring[8] further enhanced project impact, leading to the issuance of additional policy recommendations on new pollutants and land reclamation that were not envisioned at the time of project appraisal. This supported local-level contaminated site management and facilitated decision-making on redevelopment. The PDO indicator did not have a specific number-target since the project at appraisal identified the broad areas of focus that the project would cover, but the exact number of guidelines was not known at the time, allowing the addition of new guidelines, depending on the needs of the project during implementation. These key technical guidelines and policy recommendations for site pollution prevention and control were developed or issued and embedded into government planning, thereby facilitating implementation of the Law on the Prevention and Control of Soil Contamination.

39. **A number of training and awareness-raising activities on risk-based soil pollution management were carried out to nationwide subnational governments and the public, many of which have been incorporated into the MEE's staff training system for continued use beyond the life of the project as well as at the municipality level, where remediation pilots were carried out.** In terms of knowledge sharing and awareness raising, 27 training sessions (*PDO Indicator 2*) were delivered at the national and local levels. Overall, the project trained 22,518 participants, whose management abilities and technical skills on contaminated site management have been enhanced (See Annex 1, with cross-reference to Table 2.4 of the client's completion report).[9] These training materials were further uploaded and incorporated into MEE's online staff training system based on the 16 sessions delivered at the national level (of which five were delivered online); four (4) in Liaoning province; and seven (7) in Chongqing province (of which two were delivered online). A similar course system was developed for government managers, production enterprise personnel, and survey and remediation practitioners, which are publicly accessible.[10] In addition, the project supported the establishment of soil pollution cleanup science demonstration centers, such as the Soil Environmental Protection Education Museum in Beijing; production of promotional materials and videos, public participation and awareness campaigns on soil pollution prevention and control (for example, using social media platform WeChat) (*Intermediate Results Indicator (IRI) 6*); and development of early warning systems in Chongqing Changshou Industrial Park (*IRI 8*). By improving public knowledge and awareness, the project equipped local populations, alongside government policymakers and planners, with the enhanced ability and knowledge to protect the local soil and supervise pollution incidents.

40. **The project also developed tools to assist with the management of contaminated sites, such as a national database of POPs-contaminated sites (*PDO Indicator 4*), and an information platform for contaminated site management and redevelopment at the local level (*IRI 11*).** The establishment of the database was expected to precede a broader national information system, and it was in fact incorporated into the "National Information System for Soil Environment Management of Polluted Sites" developed by MEE starting in 2017 and which is

[7] The two national guidelines are Technical Guidelines for Risk Assessment of Soil Contamination on Construction Land (HJ 25.3-2019) and Technical Guideline for Risk Control and Soil Remediation - Effectiveness Assessment (HJ 25.5-2019)

[8] Technical Guidelines for Hazard Investigation in Key Supervised Industries and Technical Guidelines for Pollution Investigation, Risk Assessment, and Risk Management of Key Supervised Soil Contamination Units, both in Shandong Province.

[9] According to the training evaluation materials, the course arrangements were assessed as "reasonable," and the instructors as "well prepared." For example, the first training session held by FECO in 2023 was rated 98.80 out of 100 points.

[10] http://www.china-pops.org/zxpxkc/.

publicly available.[11] The development of a POPs sites database has been integrated into this national information system to optimize use of resources and existing initiatives in China. Currently, the national information system covers information on identified POPs-contaminated sites, with possible prioritization based on key criteria such as environmental and health risks, including site location, environment, geology and hydrogeology, present/future land use, contamination pathways, number/sensitivity of receptors, contaminant concentrations, dispersion, and toxicity. At the provincial level, the regional system allowed for site classification based on level of risk to ultimately trigger management measures adapted to that specific context.

41. **Outcome 2: Demonstration of contaminated sites identification and cleaned up in an environmentally sound manner.** All related indicators were achieved or, in a few cases, exceeded. A total of 8.6471 hectares of contaminated land across all four project sites was successfully remediated following a risk-based approach, in line with the project design (*PDO Indicator 3*) – **exceeding** the original end-target of 5.2 hectares. The project benefited 191,575 people who were positively affected by the site cleanups (*IRI 10*) – exceeding the original end-target of 8,100. The difference between the original and end-targets can be partially explained by the fact that these targets were conservative estimates at the time of project preparation and more accurate figures were expected during implementation based on more detailed site investigations. As the project envisaged "up to six" demonstration sites, a total decontaminated area was estimated for the project indicator, which was exceeded because the four sites that were actually remediated covered a larger area than expected, despite the two sites dropped.

42. **The four demonstration sites provide a good representation of contexts, sources, and levels of pollution and, correspondingly, different remediation plans and technologies adopted to generate lessons learned and replicability.** As illustrated in Annex 7 (which offers a detailed representation of the main characteristics of the contamination and remediation at these four sites), two of the sites were used for agricultural chemical production or storage, generating contamination with heavy metals, pesticides, and fertilizers. One site was a pharmaceutical chemical production site, where the contamination was the most diverse, including from heavy metals and metalloids to POPs and volatile compounds like benzene and chloroform. The fourth site corresponds to three areas within a broader district that have been affected by electronic waste dismantling and recycling, and where the contamination is typical from such activities, with heavy metals, metalloids, and several POPs polluting the air, soil, and water. The first three sites focused on soil pollution, while the fourth site had to assess how to minimize the flow of contaminants outside of the perimeter of the site. All four sites presented high concentrations of contaminants that required detailed investigations and health risk assessments, and, as a consequence, advanced planning for the remediation, including testing. Remediation technologies varied, from in situ bioremediation to ex situ thermal desorption treatment, according to the timeline possible for the remediation and/or the levels of pollution in the soil. This variety of contexts allowed lessons to be learned from the demonstration sites and informed capacity building as planned. In addition, it should be noted that the sites dropped from the project still implemented appropriate measures such as surface covering, fencing, ground hardening and institutional control measures for risk control.

43. **Remediation plans and technologies were adjusted based on the residual level of contamination after treatment, timeline required to achieve remediation targets, and the land used for the treatment facilities.** For example, the first pilot (Ganshui) was developed for the treatment of soils in two microbiological pools, but the residual concentrations remained too high, and the final treatment plan was adjusted to redirect contaminated soil for storage and treatment in cement kilns. For the same site, a specific treatment for soil with high levels of arsenic was initially planned through a biological process (treating the soils in a pond with a plant known to absorb

[11] https://sthjj.cq.gov.cn/zwgk_249/zfxxgkml/hjgl/trhjgl/jsydtrwrfxgkhxfml/202404/W020240408569425755941.pdf.

arsenic), but because it was too slow and inefficient, it was eventually replaced by treatment in the cement kiln plant. The treatment facilities' locations were closely monitored, in line with environmental and social assessments and related criteria, and in one instance, the treatment site was rejected because it was located in the catchment area of the Yangtze River.

44. **For each site, a comprehensive process was followed step by step, reflecting the technical guidelines developed for the province or municipality and the national government.** It included detailed investigations, health risk assessments, possible remediation technologies and plans, environmental and social assessments of the remediation plans, trials and testing, operations, and control of residual concentrations after remediation, third-party monitoring as relevant, and a completion report. In each province, the local Project Management Unit (PMU) or FECO (central PMU) supervised the process, and remediation supervision teams had the mandate to check the trials and accept the final remediation results. The variability and combination of contamination, pollutants, and choice of technology have enabled the generation of multiple lessons that were further reflected in the technical guidelines through a feedback loop.

Justification of Overall Efficacy Rating

45. **Given that all Outcome and Intermediate Results Indicators were 100 percent achieved or, in some cases, exceeded, the Overall Efficacy is rated High against the project's outcome targets and its overall impact on contaminated site management in China.** The project activities were in lockstep with China's efforts to strengthen its soil pollution regulatory framework. It contributed to the adoption of the new law, produced and adapted policy instruments to facilitate its implementation, and generated a scalable model for contaminated site management, drawing on international best practices. Consequently, China's capacity to manage contaminated sites has been improved through the combination of technical guidelines, trainings, and tools, with the knowledge and experience gained at the four remediation sites, bringing it on par with the contaminated site management approach of peers such as the United States and the European Union. Technical guidelines designed for national and provincial soil pollution regulatory authorities were mutually reinforcing, based on and informed by the ongoing pilot remediation, testing, and treatment process. The guidelines designed for enterprises helped them identify and address potential soil and groundwater risks and generate a list of screening and control values for relevant POP substances. In addition, the database for POPs-contaminated sites within the National Information System has become an essential tool for the government to inventory, manage, and continue to remediate contaminated sites, thereby improving human health and the environment in China.

46. **The project managed and controlled the treatment of a combined total of 10.0792 hectares spanning land parcels at four project sites (including about 2 hectares of adjacent land), and cleared 434,949 tons of related waste that directly reduced environmental risks in the vicinity of these parcels.** Due to the long-range migration of POPs substances, and the risks they pose to human health, the cleanup of these contaminated sites following a risk-based approach effectively minimizes the global environmental risks posed by the presence of POPs in the environment. This further contributes to the reduction of soil and groundwater pollution and the environmental risks associated with site contamination.

C. EFFICIENCY

Rating: Substantial

Assessment of Efficiency and Rating

47. **Economic Analysis.** Following the approach adopted at appraisal, a cost-benefit analysis was conducted to assess the project impacts in terms of health benefits, life value benefits, and land value enhancement derived from the

investment in cleanup of contaminated sites, with updated projections for project benefits and actual project costs. An end-of-project cost-benefit analysis was conducted only on Component 2, as Components 1 and 3 did not directly generate site-specific benefits. Rather, they have supported activities under Component 2 and will have much broader impacts nationwide for capacity development for prevention and control of site contamination, for which the benefits are difficult to quantify. The site-specific health benefits were presented by the value of statistical life, based on the Bank policy research working paper no. WPS 5421.[12] The results show that the project interventions at three of the sites are economically viable, with economic internal rates of return (EIRRs) of 14 percent, 43 percent, and 67 percent, respectively, as illustrated in Annex 4.

48. **A financial analysis was not conducted at appraisal.** The main reason is that the project would not generate financial revenues from direct and immediate land sales, but would potentially generate revenues stemming from site redevelopment, which is beyond the scope of this project.

49. **Implementation efficiency.** Cost-effective identification and cleanup of POPs-contaminated sites (that is, through a competitive bidding process and full involvement of site owners, for example) contributed to the implementation efficiency. Grant savings were promptly reprogrammed for new activities that amplified achievement of the PDO, with GEF funding fully disbursed. Even with the reduced counterpart funding, the project still achieved the PDO. Timely adjustments during restructuring avoided the loss or ineffective use of project funds, particularly for some of the more complex sites, and pivoted to address the immediate needs of the Chinese government.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

Rating: Highly Satisfactory

50. **The Overall Outcome is rated Highly Satisfactory, taking into consideration high relevance, high efficacy, and substantial efficiency:** (i) all Outcome and Intermediate Results Indicators were fully achieved or, in some cases, exceeded – even after the withdrawal of the two demonstration sites and despite the unforeseen delays, such as the COVID-19 pandemic; (ii) the continued high relevance of the project to the World Bank and GoC's priorities; and (iii) the project impact on contaminated site management in China.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

Gender

51. **The project has improved the living environment of 191,575 people across the provinces where the demonstration sites were located, among which 49 percent are women.** The project set out to measure the number of women (sex-disaggregated data) positively affected by the site cleanup works (Outcome 2, IRI #10). Benefits come from the removal of the sources of pollution and the resulting minimization of human exposure to pollutants that have potential carcinogenic or noncarcinogenic risks to human health.

Institutional Strengthening

52. **The management of contaminated sites is by nature a complex environmental issue that involves multiple management departments and stakeholders at each stage of the process, from investigations to post-remediation**

[12] Wang, Hua, and Jie He. 2010. "The Value of Statistical Life: A Contingent Investigation in China." Policy Research working paper no. WPS 5421. World Bank, Washington, DC. http://hdl.handle.net/10986/3905.

controls. The stakeholders involved depend, for example, on the industry sectors and activities where the pollution is coming from, the services and ministries involved in health risks assessments, those in charge of civil and/or public works for remediation, and monitoring and enforcement of works completed. At the time of project appraisal, the departments involved in the management of contaminated sites in China were decentralized, and there was some inadequacy in management capability. The responsibility for managing industrial and agricultural polluted sites or land was at times overlapping, although individually assigned to institutions such as the Ministry of Ecology and Environment (MEE), the Ministry of Land and Resources, the Ministry of Housing and Urban-Rural Development, the Ministry of Agriculture, and the National Development and Reform Commission. The project has increased the institutional capacity in China, thanks to the capacity building activities at FECO, within different services of the MEE, and in the two provinces in Chongqing and Liaoning. The project's research, technical guidelines, and trainings, coupled with the POPs database (as a part of the national information system on polluted sites) have directly increased knowledge and reinforced the management capability of MEE and in the provinces.

Mobilizing Private Sector Financing

53. **The project involved the private sector in the remediation process by way of the remediation technology – pilots, testing, and implementation – and redevelopment of the sites.** Examples of private sector interventions include the piloting of treatment technologies in Chongqing real estate for the new residential development at Northeast Pharmaceutical Group in Liaoning province. Through the project's risk-based approach to remediation and development of screening values and targets, the project indirectly contributed to de-risking investments in land redevelopment, thereby mobilizing private finance for the remediation process. The project has also enabled planning for development under a public-private partnership of a knowledge and remediation center in Chongqing, and supported research on potential financing options (including public-private partnerships) and market incentive measures for remediation.

Poverty Reduction and Shared Prosperity

54. **Pollution is a major cause of death and disability globally, with poor and vulnerable communities living generally closer to degraded or contaminated areas than higher-income population groups, therefore having higher exposure to contamination.** By reducing the exposure to contaminants in soils and water, the project contributed to improving people's living environment and thus to the World Bank Group's corporate goals and the vision of ending extreme poverty and boosting shared prosperity on a livable planet.

Other Unintended Outcomes and Impacts

55. **The project paved the way for broader World Bank support in China on soil/land pollution management.** The project was followed by (i) the Zhuzhou Brownfield Remediation Project – a US$150 million IBRD[13] loan that was approved in 2016 and closed in 2022, with a similar objective of supporting site remediation and reducing soil pollution at other industrial areas in China; (ii) the Hunan Integrated Agricultural Land Pollution Management Project – a US$100 million IBRD loan that was approved in 2017 and closed in 2023, with the objective of demonstrating a risk-based integrated approach to managing heavy metal pollution in agricultural land for safety of agricultural production areas in selected counties in Hunan; and (iii) the Sustainable Soil Pollution Management Project in Guangdong – a proposed US$300 million IBRD loan that is expected to be approved in 2025, with the objective of sustainably reducing heavy metal pollution and improving carbon sequestration in arable land in Shaoguan City,

[13] IBRD = International Bank for Reconstruction and Development.

Guangdong Province. Together, these projects have contributed to increasing China's capacity to manage contaminated sites or polluted arable land, and successfully and progressively introduced a risk-based approach for the management of soil pollution.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

56. **Evolving legislative and regulatory framework.** Although soil pollution management was becoming an emerging priority for China at the time of project preparation, it was not yet mainstreamed into the country's legislative and regulatory framework for contaminated site management. The Soil Ten (2016) and the Soil Pollution Prevention and Control Law (2019) – the driving force behind the country's accelerated efforts on soil pollution prevention and control – had not yet been issued. In addition, stakeholder coordination on soil pollution was fragmented and generally localized, new remediation technologies were not widely adopted, and technical capacity for implementation was lacking. The project introduced the risk-based management approach for contaminated sites based on their potential risks to human health, and carried out multiple supporting activities such as pollution prevention, risk control, and public participation. By communicating these experiences with legislative bodies in a timely manner throughout implementation, the project eventually provided effective support for the establishment of the Soil Pollution Prevention and Control Law and establishment of a database of polluted sites, a demonstration information management platform, and technical standards to support implementation of the new law.

57. **Innovative project design.** The project design was based on a thorough needs assessment and lessons drawn from the World Bank's growing body of knowledge and experience with contaminated site programs in other countries, including through other similar GEF projects. It was designed to demonstrate the "how to" of the management of POPs-contaminated sites, reflecting good international practices in the sector, starting with several sites and provinces, and bringing the newly gained experience at the national level. The project featured three areas that were a first in the country: (i) the demonstration of the entire process from investigations to the cleanup and redevelopment of a contaminated site; (ii) the selection of technologies that can be used, with their benefits and challenges; and (iii) the risk-based approach for remediation, considering the future use of the site and the potential risks for human health.

58. **Flexibility and responsiveness to local needs.** The design of the project aimed at addressing specific local needs identified in Chongqing Municipality and Liaoning province. A preliminary screening conducted during preparation identified 160 potential sites contaminated with POPs, among which only a few would be selected depending on their readiness (see PAD, p. 39 for the selection standards). Of these, only one was shortlisted during preparation, and the others were to be selected during implementation based on criteria defined and agreed with the implementing agencies.

59. **Risk management.** At the time of project preparation, three main risk categories were considered "Substantial": Stakeholders, Institutional Capacity, and Environmental and Social, resulting in a "Substantial" Overall Risk Rating. This was due to the complexity among potentially overlapping or unclear roles and responsibilities across

departments, complexity of site cleanup, and handling of hazardous waste during remediation. Planned mitigation strategies included close and regular coordination between national and provincial actors, delivery of the necessary technical trainings, and preparation of Environmental and Social Management Plans under the Bank's Environmental and Social Management Framework. The risk of site complexity cleanup was not meant to mitigated but to be managed during implementation as new information became available.

B. KEY FACTORS DURING IMPLEMENTATION

60. **During implementation, the project faced challenges with the selection of demonstration sites and implementation of remediation plans, mostly because of site contamination complexity.** There were several factors affecting the choice of demonstration sites for the project: the level of contamination, the timeline for the remediation, and associated environmental and social risks. Two sites were dropped because of either the complex contamination, which would necessitate a longer timeline for the cleanup process, or the discovery of contamination at the remediation-completed plots (which were not financed by the project) that were adjacent to the project site plots. As an example of the timeline challenges, the Shangdong Dacheng location was split into six sections, of which only three were within the project's scope, while the other three were remediated and validated earlier by the local government. When provincial authorities conducted a sampling of the remediated plots and found that the remediation targets were not met, a series of corrective measures were imposed. The MEE imposed further and even stricter demands following a site visit in September 2021, requesting that the site owner restart the entire remediation process, beginning with site investigation. As a result, this site subsequently withdrew from the project in 2022.

61. **The remediation at the four sites required evolving understanding of the level and extent of the contamination during the site investigation stage.** Understanding the detailed levels of contamination proved to be essential for the smooth remediation to take place as planned – the lack of which has the potential to significantly delay the remediation process. This was the case, for example, in the Northeast Pharmaceutical Group site in Liaoning Province and the Ganshui site in Chongqing. For the Ganshui site, bioremediation was selected as one of the technologies for demonstration purposes. During remediation, this technology was adjusted after several tests and trials of biological treatment with insufficient abatement of contaminant concentrations in soils. The final plan shifted to an excavation and ex-situ remediation of the soil by biological degradation of the pollutants in the soils, combined with treatment and storage in a cement kiln plant.

62. **Close coordination by an experienced PMU.** The central PMU (FECO) has extensive experience with the implementation of international cooperation projects. Housed directly under MEE and serving as the National Coordination Group for the Implementation of the Stockholm Convention, it maintained close contact with the MEE, the provincial and local PMUs, other ministries and commissions, as well as the World Bank throughout project implementation. This was crucial in the implementation of project activities, particularly given that institutional capacity was identified as a risk during preparation due to the lack of experience of the two local PMUs. The project was able to cross-pollinate between the national and provincial levels, as reflected by the training sessions and the way in which some of the technical guidelines developed in one province would inform the national guidelines.

63. **The policy and regulatory context in China required the project to pivot in accordance with the Chinese government's management approach and emerging priorities for contaminated sites.** Throughout implementation, project outputs were validated and incorporated by the MEE and other regulatory authorities into

their regular planning and training activities. In addition, and as previously mentioned, the international experience and risk-based site management concept introduced by the project were adopted by the Chinese government and incorporated into the implementation of the 2019 law. The Soil Ten (2016) and the Soil Pollution Prevention and Control Law (2019) were enacted during project implementation, building on the project's outputs and requiring the project to be responsive and adaptive. The Chinese government has also recognized the importance of controlling pollution at the source for the protection of soil and groundwater.

64. **Unforeseen delays occurred at one site related to land access and public impact.** The land clearing activities carried out in Qingyuan, Guangdong were stalled because of lengthier consultations with local villagers, despite the consultations that were conducted prior to the construction start. In fact, during the project site investigation and environmental and social impact assessment, consultations were already conducted with the local government, village committees, and others, and relevant opinions had been incorporated into the project's restoration/risk control plan. However, prior to the commencement of construction, some villagers expressed new and differing opinions. Although the above-mentioned issue was resolved through further negotiations among the project team, local government, and villagers, the construction progress was still affected, emphasizing the importance of fully assessing the impact of social issues on the project implementation before carrying out work involving land rights in polluted sites, as well as the importance of raising awareness around risk-based approaches to remediation. Such issues are not unusual around rehabilitation projects where public concerns around health impacts are high, and which justify the use of risk-based approaches for determining rehabilitation strategies.

65. **Mid-Term Review (MTR). During the MTR in October 2018, the PDO was found to have remained highly relevant to the country's site contamination prevention and cleanup goals.** However, the project was experiencing ongoing implementation delays due to earlier financial and procurement issues and slow progress with identification of demonstration sites and disbursements. The MTR undertook a technical review of the problematic sites at that time and directed attention toward the confirmation of the remaining two (of six) sites for cleanup demonstrations. The environmental and social safeguard performance at the confirmed sites was found to be Satisfactory.

66. **Other external factors.** The COVID-19 pandemic and unforeseen climate conditions (rainy season) led to delays in the project site management work.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

67. **The PDO was clearly defined and captured the project intent and ambition.** The ToC defined in Figure 1 along with the Results Framework presented in Annex 1 confirms that the project identified adequate results indicators and had sound M&E arrangements in place for tracking and monitoring implementation progress. The project's M&E system included (a) Annual Work Plans and Budgets; (b) periodic on-site inspections and verification by the implementing agency and PMU staff; (c) consolidated semiannual progress reports and semiannual unaudited Interim Financial Reports (IFRs) on the use of funds; (d) completion reports for each of the four cleanup subprojects under Component 2; (e) individual completion reports at the provincial level and a consolidated project completion report at the national level; and (f) annual financial audits of the sole project account established in the Ministry of Finance.

M&E Implementation

68. **Throughout M&E implementation, the Bank and the central and provincial/local PMUs worked closely together in conducting regular M&E of project implementation, identifying and addressing issues, and formulating corrective actions.** The Bank provided the necessary training in procurement, financial management, and environmental and social management to facilitate smooth oversight, monitoring, and reporting. Data on the results indicators were regularly collected by the PMUs from beneficiaries, stakeholders, and contractors, and validated by third parties. In addition, a technical support and management team was established with domestic and international experts to support the PMUs with the design of activities, quality review of results, and environmental and social aspects. The Bank participated in these technical discussions, and brought in additional international experience, as required.

M&E Utilization

69. **The M&E system was adequately utilized to track project progress and results in different stages, and to identify outstanding or potential issues.** The project M&E had tracked progress in the implementation of the remediation, a key indicator in the demonstration of the management of the contaminated sites. The Chongqing and Liaoning project offices collaborated with the central PMU to address issues and formulate next steps. This process was embedded in the project design, given the need to adjust remediation plans depending on successes or challenges of the remediation testing and trials.

Justification of Overall Rating of Quality of M&E

70. **The overall M&E quality is rated Substantial.** The design and implementation of the M&E system enabled the project to track progress toward achieving the PDO, respond to emerging issues, and take corrective actions as needed.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

71. **The project complied with environmental and social safeguards.** The project was considered Category A – Full Assessment due to the complexity of the targeted contaminated sites and the potential environmental and health risks, thereby triggering the Environmental Assessment (OP/BP 4.01) and Physical Cultural Resources (OP/BP 4.11) policies (due to the possibility of chance findings at the treated sites during excavation). The Indigenous Peoples (OP/BP 4.10) and Involuntary Resettlement (OP/BP 4.12) policies were also triggered provisionally, since not all project sites were known at the time. During implementation, the project did not identify any ethnic minorities, cultural or historical sites, either within or in the vicinity of the project sites. However, Involuntary Resettlement was triggered, as land acquisition was involved at one of the project sites during project implementation (Chongqing Jingkou[14]). To ensure the land acquisition was compliant with the relevant national and municipal regulations, under the ESMF, the local PMU conducted a due diligence on land use of the site, particularly to resolve the land rights issues. A Resettlement Due Diligence Report was prepared as well as an Involuntary Resettlement Action Plan, both of which were satisfactory to the Bank. Throughout project implementation, particular attention was paid to the prevention and control of secondary pollution during the remediation process, in accordance with the Environmental and Social Management Framework (ESMF). Specialized agencies were hired to conduct environmental and social impact assessments during site remediation, as well as detailed analysis of potential environmental and health risks

[14] Chongqing Material of Agriculture Production (Group) Limited Company had signed a state-owned land acquisition and compensation agreement with the Shapingba District Housing and Urban-rural Development Committee, which led to the change of site ownership (during the project implementation).

during construction processes, and based on this, an Environmental and Social Management Plan (ESMP) was formulated. A process was developed to screen the locations of remediation sites based on environmental and social criteria. The measures identified in the ESMP have a certain demonstration significance, and the monitoring and reporting system required in the environmental and social management plan also had a strong reference value for professionals in China's Contaminated Site remediation field. The full assessment was disclosed on May 31, 2014, the executive summary of the environmental assessment was disclosed on October, 15, 2014, and volumes dedicated to specific sites were disclosed during the life of the project and before works began.[15]

72. **The World Bank's rich experience in identifying and mitigating environmental and social risks and well-established ESMF provided valuable insights for the Chinese government in preventing and mitigating environmental and social problems caused by the remediation of contaminated sites.** The project enabled the development of guidelines to consider the potential impacts of the remediation on neighboring communities, and for the remediation sites to be located in suitable locations accordingly.

73. **Following the project restructuring in March 2023 and the introduction of 10 new capacity building activities for on-site pollution prevention, the project engaged a third-party expert.** Guided by the Bank's Environmental and Social Framework (ESF), General Guidelines on Environmental Health and Safety, the Office of Export and Secure Research Compliance Advisory Note Technical Assistance, and the ESMF for this project, terms of reference were developed for the new activities, environmental and social risks were identified, and environmental and social impact assessments were conducted to eliminate or mitigate any negative impacts.

74. **Procurement activities were carried out in accordance with World Bank requirements.** The central PMU had prior experience managing World Bank-financed projects and, thus, developed procurement plans in accordance with the Bank's relevant policies and procedures. The provincial and local PMUs had more limited capacity and experience, which resulted in procurement delays during the first few years of the project. The World Bank provided specialized management training during project initiation and throughout implementation, and technical experts were enlisted by the PMUs to enhance their capacity in procurement and contract management. This led to accelerated procurement performance in the later stages of implementation. There were no instances of misprocurement throughout project implementation.

75. **Overall, financial management arrangements were adequate**. The project maintained a stable financial management team that was well versed with the use and methods of grant-based funding and managed it in accordance with World Bank requirements. Initial delays in disbursement caused by limited capacity at the provincial and local PMUs were overcome through the establishment of a daily coordination mechanism with the central PMU. Audit reports were issued annually and found to be compliant, with unqualified opinions. The required Interim Financial Reports were generally submitted on time and no unusual activity was identified.

C. BANK PERFORMANCE

Quality at Entry

76. **The project design was timely, well-structured, and informed by key priorities of the GoC.** It also drew on the Bank's growing body of knowledge and experience with contaminated site management programs in other countries

[15] Disclosure dates: October 28 (Volume 3, Qijang district); December 23, 2014 (Volume 2, Environmental and Social Framework); August 5, 2018 (Northeast Pharmaceutical plant contaminated sites); April 27, 2021 (Shandong Dasheng Agrochem Company Limited); December 2, 2021 (Qingcheng district, Qingyuan city); February 21, 2021 (Jingkou warehouse).

and lessons learned from China's prior collaboration with the GEF on other chemical and waste demonstration projects. A thorough needs assessment was carried out and the choice of timing was critical to the success of the project, taking into account China's determination and key focus on ecological and environmental protection. These were reflected in the project components and implementation arrangements, which would facilitate achievement of the PDO. Risks and mitigation measures were appropriately identified and managed. The Results Framework was thought through and the chosen indicators were appropriate for tracking the project's impact and achievements. The composition of the established World Bank Task Team was commensurate with the complexity of the project. The project took nearly two years (22 months) from concept to board approval, with the Grant Agreement being signed within the first two months and the project becoming effective three months later.

Quality of Supervision

77. **The World Bank provided adequate support from the start and throughout implementation.** The Implementation Progress (IP) was downgraded within the first year of the project, owing to delays caused by weak management capacity and slow disbursement procedures. The Bank reacted swiftly by encouraging the recruitment of technical experts to support the PMU; inviting monthly updates to keep the project on track; offering relevant trainings (safeguards, an Environmental and Social Management System, financial management, and procurement); and providing general support with review of key activity outputs/reports, feasibility studies, and terms of reference. At the same time, the central PMU demonstrated commitment and autonomy getting the project up and running, from hiring of consultants/international experts to playing a key role in integration and collaboration with and between the two provincial PMUs and the Bank.

78. **Implementation support missions were held twice a year throughout the project life, with the exception of the first and last year of implementation.** This is standard practice and consistent with corporate requirements. Implementation Progress remained Moderately Satisfactory throughout most of the project life on account of delays in procurement and other activities – mainly related to Component 2, slow disbursement, and limited institutional capacity. There was a notable drop in ratings in 2021 when it became clear that there was insufficient time remaining to finalize the demonstration sites within the remaining project life. The restructuring was processed swiftly to extend the project life and allow for those activities to be completed toward achievement of the PDO.

Justification of Overall Rating of Bank Performance

79. Based on the above assessment of Quality at Entry and Quality of Supervision, overall Bank performance is rated Satisfactory.

D. RISK TO DEVELOPMENT OUTCOME

80. **The risks to the project outcomes considered both the policy dimension and technical aspects.** During the life of the project, China has continuously strengthened and improved its capacity to manage contaminated sites, as reflected by the several regulations enacted in parallel with the project and building on the technical guidelines delivered thanks to the project. Management of contaminated sites remains a priority, as reflected in the 14th Five-Year Plan (2021–2025) for Economic and Social Development. On the technical side, there are two dimensions that can affect the long-term outcome of the project: first, whether the sites encounter new sources of contamination,

which is a low risk given the redevelopments at some of the sites; and second, cleanup operations are suitable when there are prevention measures in place. Regarding the latter, the risk is low given the GoC's commitment reflected in the 14th FYP that includes reducing pollution and carbon emissions.

V. LESSONS AND RECOMMENDATIONS

81. **Balancing technical, economic, and social dimensions.** The remediation of contaminated sites is a complex environmental issue that requires the consideration of the trade-offs between technical and economic considerations, as well as social aspects of the remediation and other factors beyond technical and economic considerations. This requires consultations and stakeholder and citizen engagement to raise awareness about risk-based approaches to remediation. The implementation of stakeholder engagement, including disclosure and extensive consultations, appeared essential to ensure timely remediation and build trust within the population toward the remediation plan (see examples on how it affected this project in paragraph 64). Similarly, the formulation of an ESMP during the environmental impact assessment phase, which clearly specified potential environmental and social impact mitigation measures, as well as specific responsibilities and monitoring frequency for these measures, has proven an efficient instrument to effectively avoid or mitigate potential social conflicts.

82. **Design balancing piloting and regulatory strengthening promotes scale-up and replicability as a global public good.** The project acted as a demonstration project, leveraging GEF resources to inform follow-up of IBRD projects (two projects totaling US$250 million followed this project, and a third, US$300 million, project is under preparation) and further interventions for remediation of contaminated sites in China. The flexible design of the project and the combination of two complementary sets of activities focusing on building the national and local capacity, and using demonstration sites to reinforce the development of technical guidelines, have proved successful to inform China's management of contaminated sites in the longer term, thereby contributing to the global public good.

83. **Adaptive management allowed for further learning.** There are two lessons that can be drawn from dropping sites under this project. First, it demonstrated that there was a functioning system of checks and balances on the counterpart side. The example of the Dachend site, where issues were found during the MEE inspection and action was taken as a follow-up, including because the contamination levels were higher than what was expected after remediation, demonstrate the importance of audits and controls, and of processes and monitoring established along the development of a remediation plan. Second, from the technical perspective, the demonstration sites played their role of pilots for the choice of technologies depending on level of contamination and the timeline they require; that is, whether bioremediation is time-consuming and may not be suitable under tight remediation schedules is not a lesson from this project as it was the first time that it was implemented in China and therefore required adjustments, which is relevant to bringing new remediation technologies in IBRD countries. Similarly, the fact that detailed site investigation assessments are critical to successful site remediation efforts was not new to the sector, but there is often a discrepancy between the level of detail in the diagnostics before and during remediation that can cause delays in the implementation. These adjustments and delays demonstrate that the investigation and assessment of contaminated sites underpin the effectiveness of the remediation works. Only by scientifically and accurately delineating the extent and scope of the pollutants can the scientific and effective treatment of the site be assured, particularly for complex pollutants such as POPs.

ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: To improve the country's capacity for managing site contamination

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1. Selected priority technical guidelines (TG) and policy recommendations (PRs) for prevention and control of site contamination at the national and local levels developed or issued	Text	Existing TG for site cleanup (control of site contamination) at the national and local levels (see Annex 2) 01-Jan-2015	TG and PRs for prevention and control of site contamination at the national level and in Chongqing and Liaoning developed or issued 31-Dec-2021		100% achieved 30-Nov-2023

Comments (achievements against targets):
Target achieved (100%). The result was achieved by developing 25 technical guidelines – 15 at national level and 10 at province / municipality level - and policy recommendations from 10 research areas.

Source: Borrower's completion report, Chapter IV Table 4.1 and Annex 1 Table 2.1. FECO, November 2023.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
2. Training materials published and on-line training courses integrated into MEP staff training system	Text	No training system for prevention and control of site contamination 01-Jan-2015	Training materials published and online training courses integrated into the staff training system of MEP 31-Dec-2021		100% achieved 30-Nov-2023

Comments (achievements against targets):
Target achieved (100%). The result was achieved by developing 27 training sessions. Training materials have been developed and made available online.

Source: Borrower's completion report, Annex 1 Table 2.4. FECO, November 2023.

Objective/Outcome: To demonstrate environmentally sound identification and cleanup of contaminated sites

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
3. Contaminated land managed or dump sites closed under the project	Hectare(Ha)	0.00 01-Jan-2015	5.20 31-Dec-2021		100.00 30-Nov-2023

Comments (achievements against targets):
Target exceeded at 8.6471ha.

Source: Source: Borrower's completion report, Chapter IV Table 4.1 and details in Annex 1. FECO, November 2023.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. National database of POPs contaminated sites established	Text	No database for contaminated sites 01-Jan-2015	The national database is operational 31-Dec-2021		100% achieved 30-Nov-2023

Comments (achievements against targets):
Target achieved (100%). The National Database has been integrated in the national information system hosted and managed by MEE.

Source: Borrower's completion report, Chapter IV Table 4.1. FECO, November 2023.

A.2 Intermediate Results Indicators

Component: Component 1: Capacity Development for Prevention and Control of Site Contamination

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
5. Number of people trained on prevention and control of	Text	0.00	As per annual training		22,518, including 400 (Liaoning) new people

site contamination		31-Dec-2014	plans 31-Dec-2021		trained in early 2023. 30-Nov-2023

Comments (achievements against targets):
Target achieved (100%). The result was achieved by developing 27 training sessions. Training materials have been developed and made available online.

Source: Borrower's completion report, Annex 1 Table 2.4. FECO, November 2023.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
6. Public Awareness activities implemented	Text	0.00 31-Dec-2014	Public awareness campaign successfully implemented 31-Dec-2021		1. Public participation was conducted for all project site cleanup demonstrations 2. FECO constructed a science education base, and the three project offices produced six science films and promotional videos and several promotional materials. 30-Nov-2023

Comments (achievements against targets):

Awareness campaigns have been conducted at national level (e.g., social media) and at the demonstration sites.

Source: Borrower's completion report, chapter V project benefits assessment. FECO, November 2023

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
7. Feasibility Study for Knowledge and Remediation Center in Chongqing prepared	Text	No feasibility study 01-Jan-2015	Feasibility study completed 31-Dec-2021		100% completed. 30-Nov-2023

Comments (achievements against targets):
The study has been conducted.

Source: Borrower's completion report, chapter V project benefits assessment. FECO, November 2023

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
8. Regional Soil and Groundwater Contamination Prevention and Warning System at the Changshou Industrial Park established	Text	No warning system 01-Jan-2015	Warning system established and functional 31-Dec-2021		100% Completed - Warning system established and functional 30-Nov-2023

Comments (achievements against targets):
Warning system.

Source: Borrower's completion report. FECO, November 2023

Component: Component 2: Cleanup Demonstrations of Sites Contaminated with POPs and Other Hazardous Chemicals

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
9. POPs&pops waste destroyed, disposed or contained in environmentally sound manner	Metric ton	0.00 01-Jan-2015	79,000.00 31-Dec-2021		423,388.00 30-Nov-2023

Comments (achievements against targets):
423,388 metric tons were destroyed, disposed or contained, of which 8,500 in Chongqing, 45,000 in Liaoning and 370,000 in Qingyuan.

Source: Borrower's completion report. FECO, November 2023

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
10. Number of people positively affected by site cleanups	Text	0.00 01-Jan-2015	8,100.00 31-Dec-2021		191,575 30-Nov-2023

- Of which female	Text	0.00 01-Jan-2015	To be based on site investigation results 31-Dec-2021		95,787 30-Nov-2023

Comments (achievements against targets):
Source: Borrower's completion report. FECO, November 2023

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Information platform for contaminated site management and redevelopment at the local level	Text	No related information platform in Tongzhou District, Beijing 01-Jan-2015	Platform established and functional 30-Nov-2023		Completed 30-Nov-2023

Comments (achievements against targets):
The platform is integrated in the national information system.

Source: Borrower's completion report. FECO, November 2023

B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: **To improve the country's capacity for managing site contamination.**	
Outcome Indicators	1. Selected priority technical guidelines and policy recommendations for prevention and control of site contamination at the national and local levels developed or issued 2. Training materials published and online training courses integrated into Ministry of Environmental Protection staff training system
Intermediate Results Indicators	3. Number of people trained on prevention and control of site contamination 4. Public Awareness activities implemented 5. Feasibility Study for Knowledge and Remediation Center in Chongqing prepared 6. Regional Soil and Groundwater Contamination Prevention and Warning System at the Changshou Industrial Park established
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	1. 25 standards or technical guidelines and 10 policy recommendations for the prevention and control of site contamination at the national and local levels developed. Of these, 2 technical guidelines informed national guidelines, and 8 standards or guidelines were issued at local level. 2. Training materials compiled, published, and incorporated into the internal training system of the Ministry of Ecology and Environment 3. 22,518 people trained on prevention and control of site contamination, of which 20,550 within the central government, 470 in Liaoning, and 1,498 in Chongqing 4. Public Awareness activities implemented, including public participation for all project site cleanup demonstrations, establishment of a science education center, and production of six science films and other promotional videos and materials 5. Feasibility Study for Knowledge and Remediation Center in Chongqing completed 6. Regional Soil and Groundwater Contamination Prevention and Warning System at the Changshou Industrial Park established

Objective/Outcome 2: To demonstrate environmentally sound identification and cleanup of contaminated sites.	
Outcome Indicators	1. Contaminated land managed or dump sites closed under the project 2. National database of POPs-contaminated sites
Intermediate Results Indicators	3. POPs & POPs waste destroyed, disposed of, or contained in an environmentally sound manner 4. Number of people positively affected by site cleanups (with sex-disaggregated data) 5. Information platform for contaminated site management and redevelopment at the local level
Key Outputs by Component (linked to the achievement of the Objective/Outcome 2)	1. 8.6471 hectares (ha) of contaminated land cleaned up under the project, of which 0.067 ha in Chongqing Ganshui, 0.7904 ha in Chongqing Jingkou, 4.99 ha in Guangdong Qingyuan, and 2.8 ha in Liaoning Northeast Pharmaceutical 2. The database is integrated into the national contaminated land management database, which is fully operational 3. 423,388.04 metric tons of POPs & POPs waste were destroyed, disposed of, or contained, of which 8,500 in Chongqing, 45,000 in Liaoning, and 370,000 in Qingyuan 4. 191,575 people were positively affected by the site cleanups, of which 8,660 in Chongqing (4,330 or 50% females), 155,800 in Liaoning (77,900 or 50% females), and 27,115 in Qingyuan (13,557 or 50% females) 5. Information platform for contaminated site established, accepted, and operationalized

ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Qing Wang	Task Team Leader(s)
Laurent Granier	Senior Environmental Specialist
Frank Van Woerden	Senior Environmental Engineer
Guoping Yu	Procurement Specialist
Fang Zhang	Financial Management Specialist
Solvita Klapare	Team Member
Pei Shen Wang	Social Specialist
Xieli Bai	Team Member
Ning Yang	Senior Environmental Specialist
Meixiang Zhou	Social Specialist
Aristeidis Panou	Counsel
Supervision/ICR	
Qing Wang	Task Team Leader(s)
Yuan Wang	Procurement Specialist(s)
Fang Zhang	Financial Management Specialist
Yan Zhang	Procurement Team
Yongli Wang	Environmental Specialist
Xieli Bai	Team Member
Daniel Mira-Salama	Team Member
Delphine Arri	Team Member

Shuang Zhou	Social Specialist
Xiaonan Bai	Team Member
Min Hou	Team Member

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US$ (including travel and consultant costs)
Preparation		
FY13	6.900	39,243.00
FY14	19.172	125,884.11
FY15	13.245	74,999.87
FY16	0	0.00
Total	**39.32**	**240,126.98**
Supervision/ICR		
FY16	5.900	53,836.14
FY17	11.213	59,575.55
FY18	8.768	64,827.79
FY19	6.926	79,388.42
FY20	6.364	64,425.14
FY21	10.750	81,336.98
FY22	10.788	62,510.71
FY23	14.100	92,586.92
FY24	10.247	76,485.86
Total	**85.06**	**634,973.51**

ANNEX 3. PROJECT COST BY COMPONENT

NUMBERS WILL BE UPDATED IN FINAL VERSION

Components	Amount at Approval (GEF, US$M)	Actual at Project Closing (GEF, US$M)	Percentage of Approval (US$M)	Amount at Approval (Counterpart, US$M)	Actual at Project Closing (Counterpart, US$M)	Percentage of Approval (US$M)
Component 1: Capacity Development for Prevention and Control of Site Contamination	8.22	10.3	127	13.92	13.62	98
Component 2: Cleanup Demonstrations of Sites Contaminated with POPs and Other Hazardous Chemicals	6.03	3.18	62	43.67	21.18	49
Component 3: Project Management	0.75	0.8	113	2.41	2.41	100
Total	**15**	**14.28**	**100**	**60**	**52.21**	**87**

ANNEX 4. EFFICIENCY ANALYSIS

ECONOMIC AND FINANCIAL ANALYSIS

1. For the ICR, an economic analysis was reconducted to assess the economic viability of the proposed project. The analysis adopted the same approach (a cost-benefit analysis) at appraisal, with updated projections for project benefits and actual project costs. A cost-benefit analysis was therefore reconducted only on Component 2, as Components 1 and 3 did not directly generate site-specific benefits, but have supported activities under Component 2 and will have much broader impacts nationwide for capacity development for prevention and control of site contamination, for which the benefits are difficult to quantify.

2. At appraisal, four prospective sites – two in Chongqing and two in Shenyang – were evaluated based on information up to the project appraisal. However, during implementation, one site (Shenyang Chemical Plant) was dropped and Qingyuan Electronic Waste Disassembly Site added.

3. The project costs used in the economic analysis included the actual remediation costs only. After the cleanup and remediation, the land will be used for residential and commercial areas, assuming there will be no need for any operation and maintenance.

4. The project benefits used in the economic analysis included health benefits and incremental land value. The beneficiaries of the health benefits are the people exposed to soil contamination. Most of the beneficiaries are the residents living within 200 meters of the contaminated site. A few of the beneficiaries are workers still working at the sites, although normal production at the sites has stopped. The beneficiaries of land value increases are the local government, the owners of these sites, or both. The health benefits were presented as the value of statistical life (VSL) and avoided medical costs.

5. The economic analysis of the project was therefore carried out based on the following assumptions:
   - The lifespan of economic analysis is 25 years, including the period of site cleanup.
   - The investment costs actually occurred by year during the project implementation.
   - No operating and maintenance costs were considered.
   - The VSL used in the economic analysis came from Bank policy research working paper WPS 5421.[16] However, "the survey was conducted in the year of 2000, and the VSL should have changed significantly as the income of Chinese families has significantly changed." Therefore, the VSL was scaled up following each year's Consumer Price Index from 2001 to 2013. The VSL in 2000 was RMB 795,000 and in 2013 was RMB 800,856, and was continuously updated thereafter.
   - No avoided medical costs are considered, as there is a lack of statistical data on the medical costs relating to the contaminated site.
   - The people affected (beneficiaries) will increase by the average population growth rates of Chongqing and Shenyang. The 2013 statistical data show that the population growth rate is 0.36 percent in Chongqing and 0.35 percent in Shenyang, and that population in the two cities peaked in 2022.

[16] Wang, Hua, and Jie He. 2010. "The Value of Statistical Life: A Contingent Investigation in China." Policy Research working paper no. WPS 5421. World Bank, Washington, DC. http://hdl.handle.net/10986/3905.

- The land value of sites substantially appreciated after completion of the site cleanup; it is conservatively estimated that the value increased at least 30 percent at the Northeast Pharmaceutical Group Co. Ltd. (NEPHARM) site, and an estimated 80 percent in Chongqing.
- The land value is to increase 3 percent each year starting from one year after the completion of site cleanup.
- The social discount rate of 8 percent is used as a benchmark of the economic analysis.

6. However, the cost-benefit analysis does not apply to the Qingyuan Electronic Waste Disassembly Site as it does not generate much health benefit (few people live close by), and the treated land value is difficult to quantify for its possible use as a public park.

7. The results of the economic analysis of these three sites at the ICR show that the additional value of the land resulting from site cleanup made a significant contribution to the sustainability of the project. Tables A4.1 and A4.2 present more detailed information about the results at project completion compared to the values at appraisal.

Table A4.1: Results of the Economic Analysis at Project Completion

Name of site	Chongqing		Shenyang
	Ganshui Site	Jingkou Site (cement kiln)	NEPHARM Site
EIRR with health benefit only	n.a.	25.5%	n.a.
EIRR with incremental land value only	42.6%	29.1%	13.6%
EIRR with both above	42.7%	67.0%	13.9%

Note: EIRR = economic internal rates of return. n.a. = not available.

Table A4.2: Results of the Economic Analysis at Appraisal

Name of site	Chongqing		Shenyang
	Ganshui Site	Jingkou Site (cement kiln)	NEPHARM Site
EIRR with health benefit only	n.a.	17.7%	n.a.
EIRR with incremental land value only	35.5%	19.0%	8.5%
EIRR with both above	35.6%	55.2%	8.7%

Note: EIRR = economic internal rate of return. n.a. = not available.

8. The EIRRs at the ICR of the three sites are noticeably higher than those at appraisal, mainly reflecting the reduced cost of treatment and increased areas, which more than offset the negative impact of the population peak in 2022. Detailed calculations at the ICR are available on file.

9. The project would not generate financial revenues from direct and immediate land sales; however, it would potentially generate revenues stemming from site redevelopment. For example, it is most likely that the sites will be redeveloped as commercial and residential areas, which will enable the generation of income from the sale or rent of housing. At present, the exact nature of redevelopment is not known (site redevelopment is not part of the project), therefore assumptions on revenues would not be accurate and a financial analysis of the project was not carried out.

ANNEX 5. BORROWER, CO-FINANCIER, AND OTHER PARTNER/STAKEHOLDER COMMENTS

Comments from FECO were received on May 30th, 2024 and are reproduced below:

Dear Qing,

Specific opinions are marked in the report. The overall comments on the report are as follows:

We have carefully reviewed the ICR of the China Contaminated Site Management Project (the ICR) prepared by the World Bank team. We believes that the ICR has conducted a comprehensive assessment of the Project's preparation, implementation, achievements, and lessons learned from the Project implementation. In the ICR, the quoted project information is comprehensive the data used are clear and accurate, and the evaluation results are objective and impartial. We hereby fully recognize this high quality ICR

We would like to take this opportunity to express our sincere gratitude to the World Bank team headed by Ms. Qing Wang for their strong support and significant contributions to the success of this project. The professional, practical, and rigorous work attitude of the World Bank team has been highly recognized and praised by the project organizations and implementing units. Your support and assistance have enabled us to successfully complete this project.

The China Contaminated Site Management Project demonstrates the whole-process management through site remediation, including site identification, investigation, risk assessment, selection of remediation options, remedial design and action, verification of remediation, post-cleanup monitoring, etc. The technical and management experience gained from it has been promoted nationwide, helping our government manage contaminated sites in a sustainable way and reduce related environmental and health risks.

We are honored to have worked together with colleagues from the World Bank on the project. Although we encountered many difficulties during the implementation of the project, with the joint efforts of the World Bank team, the Chongqing Project Office, and the Liaoning Project Office, we successfully completed the relevant tasks. In this process, the management experience of the World Bank team played an irreplaceable role. We once again express our heartfelt gratitude to the team members, including Qing Wang, Min Hou, Yongli Wang, and Fang Zhang.

We look forward to further cooperation with the World Bank team in the field of new pollutant contaminated site management and other areas in the future.

With best regards,

Zhang Yang (Project Leader in FECO)

ANNEX 6. SUPPORTING DOCUMENTS

Client Project documents:

- Implementation Completion Report of the China contaminated Site Management Project (P145533)

World Bank documents:

- Project Appraisal Document: China contaminated Site Management Project (*link*)
- Integrated Safeguards Datasheet: China contaminated Site Management Project (2023) (*link*)
- Implementation Status and Results Reports (ISRs) (Seq. 1 Sept. 2015–Seq. 16 March 2023) (*link*)
- Aide Memoires (Sept. 2015–March 2023)
- World Bank Group (2012) Country Partnership Strategy (CPS) for China, 2013–16 (*link*)
- World Bank Group (2019) China Country Partnership Framework (CPF), 2020–25 (*link*)

Other literature is referenced in footnotes throughout this report.

ANNEX 7. PROJECT MAP AND DESCRIPTION OF PROJECT SITES AND REMEDIATION WORKS

1. Map of Sites Supported by the Project

2. Description of Sites Supported by the Project

(i) Northeast Pharmaceutical Group in Tiexi District, Liaoning Province. Northeast Pharmaceutical Group was founded in 1946 as a state-owned, large-scale pharmaceutical enterprise responsible for producing chemical raw materials and pharmaceutical intermediates and preparations, such as antibiotics, vitamins, and other health care products and drugs. Considering the characteristics of the site's pollution and the conditions in the surrounding sensitive areas, a comprehensive remediation plan was undertaken using a combination of in-situ and off-site methods, including on-site soil cleaning, on-site remediation for small earthwork volume/low secondary impact, off-site remediation for large earthwork volume/high secondary impact, and phased effectiveness evaluation.

(ii) Ganshui Agricultural Warehouse in Qijiang District, Chongqing Municipality. With an area of approximately 667 square meters, this warehouse was built in the early 1960s and was used primarily for storing pesticides, fertilizers, seeds, and agricultural tools. Based on a previous assessment of the site that had revealed arsenic and hexachlorocyclohexane (HCH) contamination in the soil,[10] a soil remediation and transfer project was conducted at the site, during which 148.04 tons of contaminated soil and construction debris were excavated and transferred to a hazardous waste warehouse, where it was temporarily stored. Following several assessments and on-site surveys, the polluted soil was transferred to a bioremediation test site for

treatment.

(iii) The Chongqing Agricultural Production Materials Group on Jingkou Street, in Shapingba District of Chongqing. The Chongqing Agricultural Production Materials Group, otherwise referred to as the Jingkou contaminated site, was built in 1968 over an estimated area of 7,904 square meters and had housed a warehouse that was primarily used for the storage, allocation, and distribution of pesticide products. According to a site investigation and evaluation, the soil in this area was found to be contaminated with benzene, heptachlor, aldrin, dieldrin, HCH, and various other pollutants. An ex-situ indirect thermal desorption technology was proposed to meet the remediation requirements for the selected site.

(iv) Qingyuan Electronic Waste Disassembly Site in Guangdong Province. One of the largest electronic waste dismantling and recycling centers in the country, Qingyuan City was home to 25 national designated processing and utilization enterprises for scrap metal. This resulted in a large amount of dismantled waste that had accumulated and was polluting the local environment and affecting the health of local residents. It was determined that environmental remediation works at this site would be most effectively carried out in stages and in batches using the in-situ horizontal barrier technology.

3. Summary of Remediation Works at the Project Sites

	Northeast Pharmaceutical Group in Tiexi District, Liaoning Province	**Ganshui Agricultural Warehouse in Qijiang District, Chongqing Municipality**	**Chongqing Jingkou Site**	**Qingyuan Electronic Waste Disassembly Site**
Previous Activity On-Site	Producing chemical raw materials and pharmaceutical intermediates and preparations, such as antibiotics, vitamins, and other health care products and drugs.	Agricultural warehouse for storage of pesticides and fertilizers (and other “dry” materials).	Pesticide production and storage. Products: DDT, HCH, DDVP, dipterex, Dimethoate, Methamidophos, Malathion, Acephate, Dimehypo, Chlordimeform Hydrochloride, and Isocarbophos.	The project specifically focused on remediation of three areas (identified as B1, M1, M2) in the city of Qingyuan (the largest electronic waste dismantling and recycling centers in China).
Contamination	Soil and groundwater: (i) heavy metals (arsenic, copper, zinc, nickel, lead, total chromium, mercury), (ii) volatile compounds such as VOCs (benzene, chloroform), SVOCs (PAHs, aniline), and (ii) heavy organic hydrocarbon pollutants such as TPH, and POPs (DDT and β-HCH).	Soil: arsenic and HCH (hexachlorocyclohexane, a pesticide).	Soil: benzene, heptachlor, Aldrin, Dieldrin, α-HCH, β-HCH, γ- HCH, δ- HCH, p, p'-DDE, p, p'-DDD, DDT, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene, Dibenz[a,h]anthracene, and other pollutants.	Typical chemicals from e-waste include heavy metals and metaloids (Ni, Pb, As, Cr) and several POPs, some of them volatiles that can impact air quality. Pollution in the district in air, soil, and water.

Remediation Plan	Includes detailed testing plan for soil and groundwater in 2 areas ("Core pollution" and "general pollution"). Risk assessment concluded that the groundwater contamination and associated human health risks levels were considered acceptable for nonexploitation conditions.	Included excavation and transport outside for temporary storage at a hazardous waste warehouse in cement plant, pending development of pilots for bioremediation (plants/ microorganisms). Biological treatment of the soil. After multiple pilots and trials, and a site screening process aligned with the elements identified in the environmental and social documents, a final site was designated near the cement plant.	Two plans were prepared – one for the management of soil and contamination, and one for the management of demolition materials. The remediation plan includes trials and a testing phase, including on-site testing of the possible treatment, before final adoption of the best appropriate technology.	Entails investigations and risk assessments at the district level, then remediation objectives would be reached with a combination of incineration, in situ containment, and water treatment. The final plan includes a combination of removal of the source, controlling residual levels to acceptable levels for receptors. Will be followed with environmental monitoring around the remediated sites (particularly in groundwater).
Remediation Technologies	(i) Heavy metal contamination: either stabilization in situ or excavation and disposal in landfill. (ii) Organic compound contamination: chemical oxidation or thermal desorption on-site, then discharged or reused depending on residual levels of contamination.	Final remediation adjusted after testing and trials: excavation and ex-situ remediation of the soil by biological degradation of the pollutants in soils, combined with treatment and storage in cement kiln plant.	Ex-situ indirect thermal desorption technology plus on-site temporary storage area.	(i) Water: pretreatment of wastewater to reach acceptable levels in sewage plants; then treatment in sewage plants. (ii) Soil: containment by installing an in-situ barrier.
Monitoring	On-site, concentration levels of key pollutants.	Third party and/or supervision unit.	Third party and/or supervision unit.	On-site concentration levels of key pollutants.
Redevelopment	Residential land and municipal land. No use planned for groundwater (no exploitation).	Not specified (warehouse still in use?).	Industrial use (mechanical parts processing, wood processing, and cultural product storage and other production and business activities).	Not specified – possibly green areas.