



OVERVIEW OF THE CURRENT SITUATION ON BROWNFIELD REMEDIATION AND REDEVELOPMENT IN CHINA

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ACRONYMS AND ABBREVIATION

AAI	All Appropriate Inquiries
BEPB	Beijing Environmental Protection Bureau
BHC	Hexachlorocyclohexane
BLCRC	Beijing Land Consolidation and Reserve Center
BMEIC	Beijing Municipal Economic and Information Commission
BMUPC	Beijing Municipal Urban Planning Commission
DDT	Dichlorodiphenyltrichloroethane
EIA	Environmental Impact Assessment
ERA	Environmental Risk Assessment
ESA	Environmental Site Assessment
GDP	Gross Domestic Product
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
DRC	Development and Reform Commission
MEP	Ministry of Environmental Protection
MEPB	Municipal Environmental Protection Bureau
MIIT	Ministry of Industry and Information Technology
MLR	Ministry of Land and Resources
MOHURD	Ministry of Housing and Urban-Rural Development
MWR	Ministry of Water Resources
NAPL	Non-Aqueous Phase Liquids
NDRC	National Development and Reform Commission
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
POP	Persistent Organic Pollutant
SEPA	State Environmental Protection Administration (MEP at present)
WLRC	Wuhan Land Reserve Center

FOREWORD

Land contamination is a serious problem in China. In recent years, many old and polluting industries are being relocated away from urban centers due to rapid urban growth in China. As a result, a large number of contaminated land sites (often referred to as ‘brownfields’) are emerging. These brownfields pose a dual problem: on the one hand, they pose an environmental and health hazard in China’s most densely populated areas. On the other hand, as brownfields cannot be developed usefully, they pose an obstacle to urban and economic development. The most straightforward solution to the brownfield problem is site remediation. However, the policy, regulatory and technical frameworks for site remediation remain relatively underdeveloped in China and many challenges remain for adequate site remediation.

This review of the current situation with regards to brownfield site remediation highlights the fragmentation of the legal framework for site contamination. At the same time, many different stakeholders are involved with brownfields, including former exploiting enterprise(s), governments at all levels, local communities and the public, as well as new developers. Responsibilities and interactions between these stakeholders are often not clearly defined, which leads to confusion and dodging of responsibility. A strengthened and comprehensive legal system covering all aspects of brownfield remediation and redevelopment is necessary. Additionally, national standards and guidelines are crucial for a consistent approach to site management across the country.

We hope the challenges identified in this study and the recommendations and suggested solutions will be able to contribute to awareness of the importance of effectively addressing land contamination, and to accelerating the remediation and redevelopment of brownfield site in China.

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EXECUTIVE SUMMARY

Poor industrial planning and inadequate pollution management in the past have made land contamination a serious issue in China. Rapid urbanization in recent years has resulted in the need to redevelop industrial land once occupied – and contaminated – by old industries, which have helped bring the issue of the remediation and redevelopment of contaminated lands (often referred to as brownfields) to the forefront. Brownfields pose two problems: an environmental and public health risk and an obstacle to urban and local economy development as they remain unused. Both the Chinese national government and the local governments in some Chinese cities have begun to take action to control land contamination, mainly emphasizing the remediation of polluted lands for the purpose of urban development. The actions taken to date in some cities, such as Beijing and Chongqing, demonstrate the viability of such programs.

This report provides an overview of the current situation of brownfield management in China in order to help raise awareness of land contamination and help develop remediation activities. It reviews the institutional arrangements and stakeholders of brownfield site management in the country, examines the weaknesses and challenges of the current systems, and offers some suggestions and recommendations.

As a newcomer in the area of brownfield management, China has wide room for

improvement. The key conclusions and recommendations of this report are summarized below.

The report first highlights the fragmentation of the legal framework for site contamination. It concludes that a comprehensive legal and regulatory framework including a national law covering site contamination is needed to clearly define the responsibilities and liabilities regarding land contamination and remediation, and provide clear and concise guidance for all stakeholders.

Secondly, due to the many different actors involved in site contamination –including various local and national governments, previous exploiters, local residents and potential investors– confusion between actors and authorities is a major problem. An example is that the relationship between land use planning (deciding the type of land use) and brownfield management (specifying remediation standards and requirements) is not clearly defined. The government should therefore strengthen inter- and intra-coordination and cooperation between various government agencies on issues including in site investigation, assessment, land ownership transfer, design and implementation, remediation standards and completion acceptance and reuse.

Thirdly, China needs to speed up its work to officially approve, release and implement a system of national standards and technical

guidelines for the prevention and treatment of land contamination. Local authorities should also be encouraged to issue tougher standards based on local situations.

Fourthly, economic and financial instruments, such as environmental taxes, cleanup subsidies, loans, guarantees and market licenses, are necessary for establishing an effective management system to address the incentive and funding issues of brownfield management. Better and practical application of the “polluter pays” principle and clearly defined rules and funding channels between known stakeholders (namely the governments, previous or current land owners, and developers) for the remediation and redevelopment of brownfield sites should be carefully analyzed in order to develop an effective system brownfield management. China can learn from the U.S. experience in the evolution of contaminated site remediation from the Superfund Act to the Brownfield Act.

Fifthly, China’s urgent need for urban land requires that efficient soil remediation be completed in a short period of time. Selection of suitable and cost-effective remediation technologies is a high priority. Soil remediation objectives should be considered in the selection of technology and remediation plans, and be specifically designed for each site according to its intended use and other specific circumstances. The country urgently needs

to increase its R&D capacity, especially advanced software and hardware equipment in the fields of contaminated site monitoring, assessment and remediation. International exchange and training can help increase the talent pool.

Last but not the least, public awareness and participation are always one of the important elements in effective governance and administration of brownfield site management. As the first step, information should be made available to the public, in order to raise awareness and facilitate public participation in brownfield management.

In summary, as brownfield remediation and redevelopment is becoming a pressing environmental and development issue, China needs to strengthen its legal, organizational, and institutional framework for brownfield management, build its implementation capacity, raise public awareness and participation, and be innovative in financial and technical solutions. In addition, China should draw from the land remediation and redevelopment experiences accumulated by developed countries for contaminated soil, and adopt those best practices and lessons to improve its own system. A companion study to this one reviews these lessons and experiences (see *International Experience in Policy And Regulatory Frameworks For Brownfield Site Management*, World Bank, 2010).

1. INTRODUCTION

Poor industrial planning and inadequate past pollution management have helped make land contamination in China a serious problem. However, rapid urbanization in recent years has resulted in the need to redevelop industrial land once occupied – and contaminated – by old industries, which has resulted in several high-profile pollution-related incidents that have helped bring the issue of the remediation and redevelopment of contaminated lands to the forefront. Both the Chinese national government and local governments in some Chinese cities have begun to take action to control land contamination, emphasizing the remediation of polluted lands for the purpose of urban development.

The purpose of this report is to provide an overview of the current situation of brownfield management in China for World

Bank staff and relevant government officials in order to help raise awareness of land contamination and help develop remediation activities. After the introductory section, Section 2 explores the environmental and development pressures of land. Section 3 reviews government plans, targets and actions. Section 4 discusses the regulatory framework for brownfield remediation and redevelopment in China. Section 5 analyzes organizational setup and management procedures, as well as the stakeholders in brownfield management. Section 6 offers a brief review of the status of brownfield remediation technologies in China. Section 7 looks at the cases of Beijing and Chongqing. Section 8 evaluates Chinese practices, discusses areas for improvement, offers recommendations, and concludes the brief.

2. ENVIRONMENTAL AND DEVELOPMENT PRESSURES OF LAND CONTAMINATION IN CHINA

2.1 MAGNITUDE AND HISTORICAL ROOTS OF LAND CONTAMINATION

Land contamination has become a serious problem in both rural and urban areas of China. In urban areas, China's industrialization and modernization process, which started in the 1950s, has left a legacy of vast polluted industrial and commercial areas (often called 'brownfields' in Western literature)¹, however overall statistics are not yet available.

Brownfields in China often date back some 50 years to the era of highly polluting industries built during the Great Leap Forward. Most of these industrial factories were initially located on the perimeter of Chinese cities. Many were state-owned enterprises that were initially located on the perimeter of cities, and they often have a long history of using antiquated equipment and a legacy of poor management and inadequate environmental services. Soil pollution is often serious at these sites. In some cases, the concentration of pollutants in the soil can be up to hundreds of times higher than regulations permit. In some places pollution has been documented to have penetrated the soil by as much as 10

meters. Some underground organic pollutants have aggregated in the form of non-aqueous phase liquids (NAPL) which, if not dissolved in water, can become a new source of pollution. Contaminants also can migrate to groundwater, leading to widespread dispersal of pollutants.

2.2 TYPES OF BROWNFIELD SITES

Industrial brownfield sites in China's urban areas can be divided into four groups by type of main pollutant:

1. Heavy metal contaminated sites. Mainly from steel, iron and smelting plants, ore tailings and chemical solid waste piles; typical contaminants are arsenic, lead, cadmium, mercury, and chrome.
2. Persistent Organic Pollutant (POP) contaminated sites. China produces, and widely uses, pesticides such as DDT, HCB, Chlordane and Mirex. Although certain pesticides haven't been used for many years, some remain in the soil. New pesticide-contaminated sites continue to be discovered in China, in addition to other types of POP-contaminated sites, such as PCB capacitor dismantling and burial sites.
3. Organic contaminated sites such as petrochemical, coking etc. Substances include organic solvents, benzene and hydrocarbons, often mixed with other contaminants such as heavy metals.
4. Electronic waste sites. Incorrect disposal of electronic waste can affect human

1 The definition of brownfields is "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant". See <http://www.epa.gov/brownfields/about.htm>. In this report, contaminated sites and brownfield sites are used inter-exchangeably.

health. The main contaminants are heavy metals and POPs (bromination flame retardants and dioxin).

2.3 URBAN DEVELOPMENT PRESSURE AND EMERGING BROWNFIELD CONCERN

Little public attention was paid to land contamination in the past due to the difficulties in identifying and measuring land pollution, as well as soil pollution hysteresis (the effects of pollution experienced with a lagged effect, or delay in time). In recent years, however, the process of relocating old and polluting industrial enterprises away from urban areas has been accelerated due to rapid urban development. This relocation of industrial enterprises has intensified greatly in major urban areas in

China – such as Beijing and Tianjin in the Hai River Basin, the old industrial belt in northeastern China, the Yangtze River Delta, and the Pearl River Delta. It has recently been reported that there are more than 200 polluting enterprises being relocated from inside the Fourth Ring Road in Beijing, 56 being relocated in Shenyang, and 147 large industrial enterprises being shut down, suspended and relocated in Guangzhou. The environmental issue of brownfields has become a barrier in the process of land redevelopment. Today, many old industrial sites located inside cities cannot be redeveloped due to contamination concerns. They become a roadblock to urban development owing to both environmental contamination (groundwater,

Table 1. Examples of Industrial Enterprise Relocation in Major Chinese Cities

Beijing	Over one hundred polluting enterprises inside the Fourth Ring Road have been relocated, leaving eight million square meters of industrial land to be redeveloped
Chongqing	Over one hundred polluting enterprises from the city center will be relocated by 2010
Guangzhou	Over one hundred large industrial enterprises have been shut down, suspended, or relocated since 2007
Shanghai	Several dozens of old industrial enterprises were relocated from downtown areas
Shenyang	Several dozens of polluting enterprises were relocated in 2008; all the heavily polluting enterprises in the city centre would be relocated from 2009 onward
Cities in Jiangsu Province	Over one hundred chemical enterprises have been relocated, and many small chemical companies were closed
Cities in Zhejiang Province	Several dozens of large industrial enterprises have been relocated or closed since 2005

soil, surface hazardous and non-hazardous waste, ongoing dumping) and liability concerns for both owners and developers. The abandoned or delayed redevelopment of brownfield sites in urban areas also has a profound social impact on local communities such as poor living conditions, lack of employment opportunities, and even social instability.

2.4 BEGINNING OF BROWNFIELD REMEDICATION AND CONTROL

A series of land contamination incidents has occurred in recent years during the process of rapid urban sprawl and redevelopment. Some of these incidents (Box 1) have been reported in the media, and have caught the public's attention. For instance, the pollution poisoning incident of construction workers in the construction site of Songjiazhuang Subway Station in Beijing marks the beginning of brownfield acknowledgement and remediation. Immediately following this incident, the State Environmental Protection Administration (now MEP) issued the "Notice on Effective Prevention and Control of Environmental Pollution for Industrial Enterprise Relocations" in 2004. The notice requires that all local environmental protection bureaus satisfactorily carry out pollution prevention and control during the relocation process. As soon as a case of soil pollution is found, it should immediately be reported to SEPA, and pollution control countermeasures must be implemented.

When Shanghai began site preparations for the 2010 Expo in 2004, the city government established a soil pollution remediation center in 2005 to carry out the remediation effort. The remediation of several contaminated sites has been successfully completed in Beijing as well, including at the Beijing No. 3 Chemical Plant, Red Lion Paint Factory, Beijing Coking Plant (South area) and Beijing Dyestuffs Plant. These cases have helped build technical and management experience on brownfield remediation and redevelopment in China. During the remediation and redevelopment of old industrial sites, industrial landmarks are protected, reused and gradually recycled. For example, the main structure of Shanghai Nanqu Power Plant was successfully preserved and converted into an exhibition hall for the Shanghai Expo. Based on the recommendations and proposals of 50 representatives of the city's congress in 2007, Beijing decided to stop the demolition of the Beijing Coking Plant and instead launched a global competition for ideas on reusing the plant's industrial buildings.

Box 1 Examples of Pollution Incidents on Contaminated Sites in Chinese Cities

A. Songjiazhuang Poisoning Accident in Beijing

On April 28th, 2004, a poisoning incident took place during the construction of Songjiazhuang Metro Station in Beijing. The Songjiazhuang site had previously housed a 1970s-era pesticide plant. Though the plant had been removed many years earlier, large quantities of residual poisonous gases remained trapped underground. Three workers collapsed when the drilling operation reached 5 meters. They were sent to the hospital, and the site was closed. Consequently, the Beijing Environmental Protection Bureau conducted site monitoring and took remediation measures. Contaminated soil at the site was later evacuated, transported, and incinerated. The incident marks the beginning of the remediation and redevelopment of industrial contaminated land in China.

Source: Outlook Weekly, Xinhua News Agency, 2009

B. Sanjiang Housing Development Project (Hanyang Pesticide Factory) Site in Wuhan City

In 2006, an 18.7 hectare (280mu) parcel of land in Wuhan, the largest industrial city in central China, was sold to Sanjiang Real Estate for residential development. The land is on the water front of the Han River, near the confluence of the Yangtze and Han Rivers, and was deemed very valuable for residential development. Four years later, however, the land remains vacant, devoid of any of the planned development, as shortly after construction began, the soil was found to contain large amounts of pesticide residuals due to the fact that the area used to be occupied by Hanyang Pesticide Factory. Several construction workers were poisoned and had to be hospitalized. The vendor, Wuhan Land Reserve Center, had to compensate 120 million RMB to Sanjiang Real Estate as it had failed to perform an adequate site assessment and information disclosure before the transaction. It is estimated that remediation of this site could cost at least 500 million RMB.

Source: Times Weekly, 2010

2.5 CHALLENGES AHEAD

Currently, brownfield remediation and redevelopment is a big challenge to governments, business owners, developers, and local societies. Consequently, environmental supervision and management of contaminated sites has gradually become an essential responsibility of environmental authorities.

However, the effective regulatory and institutional framework for brownfield management has yet to be established, and many of these issues must be resolved. Suitable, cost-effective remediation technologies in China are still in the pilot stages. Major land contamination problems and management challenges have been

highlighted by MEP (2008) and are summarized below:

1. There is serious land pollution in some areas of China. Abandoned land – a result of the relocation of industrial enterprises – is one of the main manifestations of soil pollution;
2. Various types of land contamination exist, including the coexistence of old and new pollutants, mixes of both organic and inorganic compounds;
3. Food quality and safety incidents associated with contaminated land have increased rapidly in recent years, becoming an important threat to people’s health and social stability;
4. The causes of land contamination are often complex and difficult to control;
5. A supervision and management system for land pollution is not fully formed, for example there is a lack of awareness;
6. The question of risk and “exposure,” is an important unresolved issue in need of attention.

There are numerous reasons for cleaning up brownfield sites: removing a public health hazard, improving the general environment, and making new land available for development. However, unlike many Super Fund sites in the US where contaminated lands, once remediated, are usually not developed for other economic activities, there is always pressure in China to find new land suitable for development. Therefore, an important remaining issue is the liability of the new developer after a “cleaned” site has been purchased and developed. What is the extent of their future liability (exposure) if the site is found to remain contaminated, or if pollution standards become more stringent? This question of liability—both to past polluters and future developers of brownfield sites—needs to be clarified and resolved. The answers to these questions will have an important impact on both the development and the pricing of “cleaned” brownfield sites. Without clarification, developers will be reluctant to make major investments in previous brownfield sites.

3. GOVERNMENT PLANS, TARGETS AND ACTIONS

Due to the pressure of industrial relocation and brownfield remediation and redevelopment in many Chinese cities, governments at the national and local levels have begun paying attention to brownfield issues and have started preparing plans for brownfield remediation and redevelopment.

To investigate the current situation of land contamination, the MEP and the Ministry of Land and Resources (MLR) have, since 2006, jointly carried out a national survey on the environmental conditions of soil and on pollution prevention, primarily in farmlands. The project, budgeted at one billion yuan RMB, is planned to be completed in 2010. The soil pollution survey aims to establish an inventory of contaminated sites, identify the type, scope, extent and spatial distribution of heavily polluted areas, analyze the causes of pollution, and propose environmental management measures. The scope of the national survey covers most provinces and municipalities in China, focusing on the Yangtze River Delta, the Pearl River Delta, the Bohai Bay Economic Belt, and the old North East China industrial belt. The results of this investigation are currently being analyzed and processed.

In June 2008, MEP issued an official document entitled "Recommendations on Strengthening Soil Contamination Prevention and Remediation." It pointed out the severe problem of soil pollution, specified government requirements, laid out a plan, and called for action. The

proposed action plan includes completing the national survey of soil contamination, establishing a basic framework for a Soil Environmental Monitoring Network, developing national and local soil pollution prevention plans, and forming a preliminary regulatory and policy framework for the prevention of soil pollution.

The 2008 MEP document set the following working targets for soil pollution control in China by 2015: install a supervision and management system for soil pollution prevention; develop a series of policies, laws and regulations on soil pollution prevention and control; improve the standard system on soil pollution prevention and control and the soil environmental monitoring network; establish an oil pollution emergency response system; enhance soil environment protection efforts by significantly increasing public awareness of the issue; implement soil pollution prevention planning, develop new soil pollution prevention and control technologies, and demonstrate significant results. The document also calls for local authorities to urgently and fully understand the importance of, and contribute to, strengthening soil pollution prevention and control.

On the local level, some provincial or municipal governments such as Shanghai, Beijing, Chongqing, Wuhan, Shenyang and Zhejiang have also begun to take action in brownfield remediation. For example,

Shanghai issued soil cleanup standards for the Shanghai World Expo 2010 site, which was the first of its kind in China. In 2007, Beijing's Environmental Protection Bureau (EPB) issued "Guidelines on Site Environment Assessment (SEA)", and "Notice on SEA of Industrial Wasteland after Relocation" which will be discussed in depth below. Chongqing EPB has carried out an initial SEA for its industrial lands and is drafting a document titled "Methodology on Soil Contamination Prevention and Remediation." Zhejiang

EPB is working on documents titled "Management Framework on Land Contamination Prevention and Remediation," and is carrying out a risk assessment system and demonstrations on remediation technology. The EPB, Planning Bureau, and Land and Resources Bureau of Shenyang City have jointly issued the "Administrative Methods for Cleanup and Remediation of Contaminated Lands in Shenyang (for trial use)." Shenyang has completed the clean-up of the area where the old Shenyang Smelter Plant was located.

4. REGULATORY FRAMEWORK FOR BROWNFIELD MANAGEMENT

China's legal and regulatory system for soil pollution prevention and control is in its infancy. There is no national law encompassing land contamination and brownfield remediation and redevelopment. Legal requirements related to soil pollution and liability are scattered in the provisions of several existing national laws or regulations, such as the Constitution, Criminal Law, Environmental Protection Law, Land Management Law, Solid Waste Pollution Prevention Law, Hazardous Chemical Waste Pollution Prevention and Control Methods, Law of Water and Soil Conservation, Land Reclamation Ordinance, and the Urban Real Estate Development and Management Regulations.

4.1 REGULATORY FRAMEWORK

In principle the Constitution requires the rational use of land and the prevention of soil pollution; Criminal Law specifies the criminal nature of soil pollution; the Solid Waste Pollution Prevention Law regulates solid waste, municipal waste and industrial solid waste, but does not specify brownfields; the Land Management Law states that "governments at all levels should take measures to maintain irrigation and drainage facilities, improve soil quality, improve soil fertility, and prevent land desertification, salination, soil erosion and soil pollution"; and the Land Reclamation Ordinance requires that damage caused during construction work—including digging, excavating, pressing and other

activities should be compensated, and the soil remediated. Article 35 of The Solid Waste Pollution Prevention Law requires that entities producing solid waste take preventive measures for storage and treatment facilities and sites of solid waste, and the article also specifies their obligation and financial liabilities.

These relevant legal provisions, however, are not systematic or consistent, and none of them are focused on land contamination. They also are too general, and lack operational details and accountability deterrence provisions. Control and prevention requirements, and measures pertaining specifically to land pollution, are largely missing. It is therefore necessary to develop a specific law for prevention and control of land contamination. MEP is lobbying for including the "Soil Pollution Prevention and Control Law" in the legislation plan of the national congress.

Currently, brownfield management in China is guided by an ad-hoc set of documents, rules and guidance issued by the government over the past several years, such as "Notices on Effective Prevention and Control of Environmental Pollution for Industrial Enterprise Relocations" and "Recommendations on Strengthening Soil Contamination Prevention and Remediation (MEP [2008] No. 48)," issued by MEP (formerly SEPA), in 2004 and 2008 respectively.

The 2004 Notice is not a mandatory rule and does not give many details, but it began to promote pollution control and management of contaminated sites in cases where industrial enterprises were relocated. MEP's "Recommendations on Strengthening Soil Contamination Prevention and Remediation" in 2008 further requires that all relevant departments and units fully understand the importance of strengthening soil pollution prevention and control, of establishing guiding principles and goals, and of setting priority areas of remediation. The document places a heavy emphasis on the need to establish and improve relevant laws, regulations and the standard system of soil pollution control. However, given the magnitude brownfield problems in the context of development, these documents which lack legal status are no substitute for a national law.

4.2 TECHNICAL STANDARDS

Technical standards for soil pollution control are also in urgent need of improvement. There are no comprehensive technical guidelines or standards on soil pollution monitoring, environmental risk assessment and soil remediation techniques officially issued at a national level. However, a series of provisional site management standards and technical guidelines are being prepared and trials used, such as:

- "Soil Environmental Quality Assessment and Remediation Standards for Exhibition Site (Provisional for Shanghai Expo)" (HJ350-2007)

- Testing Standards: "Soil Environmental Monitoring Technical Specifications" (HJ/T166-2004); "Groundwater Monitoring Technical Specifications" (HJ/T164-2004); and "Water Environment Monitoring Specifications" (SL219-98) issued by the Ministry of Water Resources; and
- Monitoring Standards: "Groundwater Quality Standards" (GB/T14848-93); "Soil Environmental Quality Standards" (GB15618-1995); and "Soil Environmental Quality of Industrial Enterprises" (HJ/T25-1999), although the latter is very rarely used.

In addition, MEP has commissioned research institutes to draft or revise a series of contaminated site management standards and guidance, including the "Soil Environmental Quality Standard," "Interim Measures for Soil Environmental Management of Contaminated Sites,"(2009) "Guidelines for Contaminated Sites Environmental Monitoring,"(2010) "Guidelines for Contaminated Site Risk Assessment,"(2009) and "Guidelines for Contaminated Site Soil Remediation," (2009). They are currently under review and revision.

Establishing local regulations or standards is essential to accommodate the regional and local differences in China in terms of economic development, soil types, and natural conditions. Some Chinese cities with a fast development pace and stronger economic capacities have started their own research, and prepared local regulations and technical standards, in response to the

need for soil remediation and environmental management for land redevelopment. The following are a few examples:

- In March 2006, Zhejiang Province issued “Zhejiang Province Solid Waste Pollution Prevention Regulation,” which requires an environmental risk assessment to be carried out for contaminated soil.
- In January 2007, the Beijing Environmental Protection Bureau (EPB) issued “Site Environmental Assessment Guidelines,” which stipulate work procedures and technical methods for site environmental assessments within Beijing.
- In May 2007, Chongqing Municipality dispersed “Chongqing Environmental Protection Regulations,” which stipulated that before industrial enterprises may relocate, they must first clean up remaining hazardous materials and wastes, as well as remediate any contaminated soil.
- In 2007, Shenyang EPB, Shenyang Municipal Planning Bureau, and Shenyang Municipal Land Resources Bureau jointly issued “Shenyang Municipal Environmental Management Measures on Contaminated Site Treatment and Remediation (trial implementation),” Shenyang Environmental [2007] No. 87, which stipulates the evaluation and identification of contaminated sites.
- In June 2008, Chongqing Municipal Government issued the “Notice on Strengthening Industrial Contaminated Sites Treatment and Remediation,” which details requirements for meticulous conduct on contaminated site risk assessments.

5. ORGANIZATIONAL SETUP, MANAGEMENT PROCEDURES AND STAKEHOLDERS

5.1 RELEVANT AGENCIES AT THE NATIONAL LEVEL

In China, as land is owned by the state, the government is the main body in charge of land use. In particular, the Ministry of Land and Resources (MLR), on behalf of the State Council, is responsible for the uniform management of land according to national laws and regulations. The State Land Administration, under the supervision of MLR, is directly in charge of land management, including implementing land management law or regulations; land surveys, statistics, registering and issuing land titles and certificates; developing land use master plans; managing land acquisitions and allocations; reviewing and submitting land use change applications that require State Council approval; researching major land management issues; supervising local land bureaus; coordinating with other ministries to resolve land disputes, and investigating major land use violation cases.

Besides MLR, a number of ministries are involved in different aspects of land management. For example:

1. Ministry of Environmental Protection (MEP): Responsible for supervising and managing environmental pollution prevention; developing and implementing management rules for the prevention of water, air, soil and solid waste pollution;
2. National Development and Reform Commission (NDRC): Contributes to the drafting of environmental protection planning; coordinates major problems in ecological development, saving energy and resources, the comprehensive utilization of resources (promotion of resource efficiency); overall coordination of environmental industries and the promotion of cleaner production.
3. Ministry of Housing and Urban-Rural Development (MOHURD): Responsible for city planning, endorsing plans submitted by provincial, municipal or township level administrative departments and the supervision of their implementation; participating in land use planning framework review; developing housing and urban construction planning and economic development policies; developing and monitoring the implementation of regulatory policies in the real estate market jointly with relevant departments; guiding urban land transfer and commercial development, and issuing real estate industry sector development plans and policies.

MLR needs to communicate with other ministries on strengthening land management. For example, in March 2010, MLR held a forum attended by representatives from 16 ministry-level organizations, including NDRC, Ministry of

Industry and Information Technology (MIIT), MOHURD, etc., to discuss priority land management issues, and ensure that the work of inventorying and redeveloping contaminated sites is listed as a priority task in the agenda of the central government in 2010.

The management of industrial contaminated sites is divided over several ministries (MLR, MEP, NDRC and MOHURD). Although there is a definition of each ministry's responsibilities and duties there are problems with overlap and absence in management procedures especially on contaminated sites which have not yet been streamlined due to the lack of applicable laws and regulations. Methods are usually considered on a case-by-case basis, and the redevelopment of the first few sites was a process of "learning by doing."

As an authority for pollution management, MEP plans to issue the "Management Method of Contaminated Sites" (in June 2010 this document was in the comments collection stage). It stipulates methods of site investigation and environmental risk assessment, including guidelines under which the investigation and assessment of conditions must be carried out, what content should be included and what procedures should be followed. The method also stipulates a management system for the remediation, inventory, and recording of contaminated sites, including the conditions under which remediation should be started, specific requirements for the remediation plan and its implementation, how to deal with the results of remediation, and the

qualifications of the companies involved. This document is expected to significantly contribute to further clarifying the management procedures on urban brownfield sites.

5.2 ORGANIZATIONAL ARRANGEMENT AT THE LOCAL LEVEL

At the local level (county, municipal and provincial), the land bureau within local governments is in charge of uniform management of land resources and the urban planning bureau is in charge of urban planning. Taking Beijing as an example, industrial relocation needs to be approved by four municipal agencies before a parcel of industrial land can be transferred to other use. These agencies are the Beijing Municipal Economic and Information Commission (BMEIC), Municipal Development and Reform Commission (BDRC), Municipal Urban Planning Commission (BUPC), and the Municipal City Administration and Sanitation Commission (BCASC). The roles of each agency breakdown as follows:

1. The Beijing Municipal Economic and Information Commission (BMEIC) is responsible for researching and drafting the development plan and policies for the local industry, software and information sector, as well as the application and promotion of structural adjustment and upgrading of the industrial structure.
2. The Municipal Development and Reform Commission (BDRC) is responsible for planning major construction projects and the geographic

layout of economic productivity; promotion of a sustainable development strategy, helping to draft general land use, ecological construction, and environmental protection planning.

3. The Municipal Urban Planning Commission (hereinafter referred to as BUPC) is responsible for the organization and compilation of overall urban plans, city districts and planning of new urban districts, urban design guidelines, and specific district planning; urban construction land use, planning and management of construction projects; site selection of major urban/rural development projects; research and review of land reserves and land supply planning; licensing of construction land and construction project planning; urban planning, construction project planning and its implementation, supervision and management.
4. The Beijing Municipal City Administration and Sanitation Commission is responsible for the organization, management and supervision of the environment and hygiene; coordination of municipal waste disposal facilities, site closure and dismantling of facilities; development and implementation regulations for solid waste disposal.

Figure 1 below shows the working procedures in Beijing for the relocation of polluting enterprises which affect local residents.

Notice in Figure 1 that the Beijing Municipal Environmental Protection Bureau (BEPB) has not been listed as one of the authorities in the approval process.

In 2007, the BMEPB issued the "Notice Regarding Implementation of Soil Environmental Assessment after Enterprise Relocation," which requires that soil environmental assessment be conducted before a site is reused after enterprise relocation. This notice has had a positive effect on contaminated site treatment and remediation.

Figure 2 represents the administrative process for land redevelopment in Beijing. The process is split into two phases. The first phase covers land acquisition and reservation, consisting of four steps: land acquisition, consolidation, reservation and transfer. The second phase covers land auction and development. In this system, the government controls the primary land market, with the land being supplied to the market through the reserve and auction system.

Figure 1. Review and Approval Procedure of Industrial Relocation in Beijing

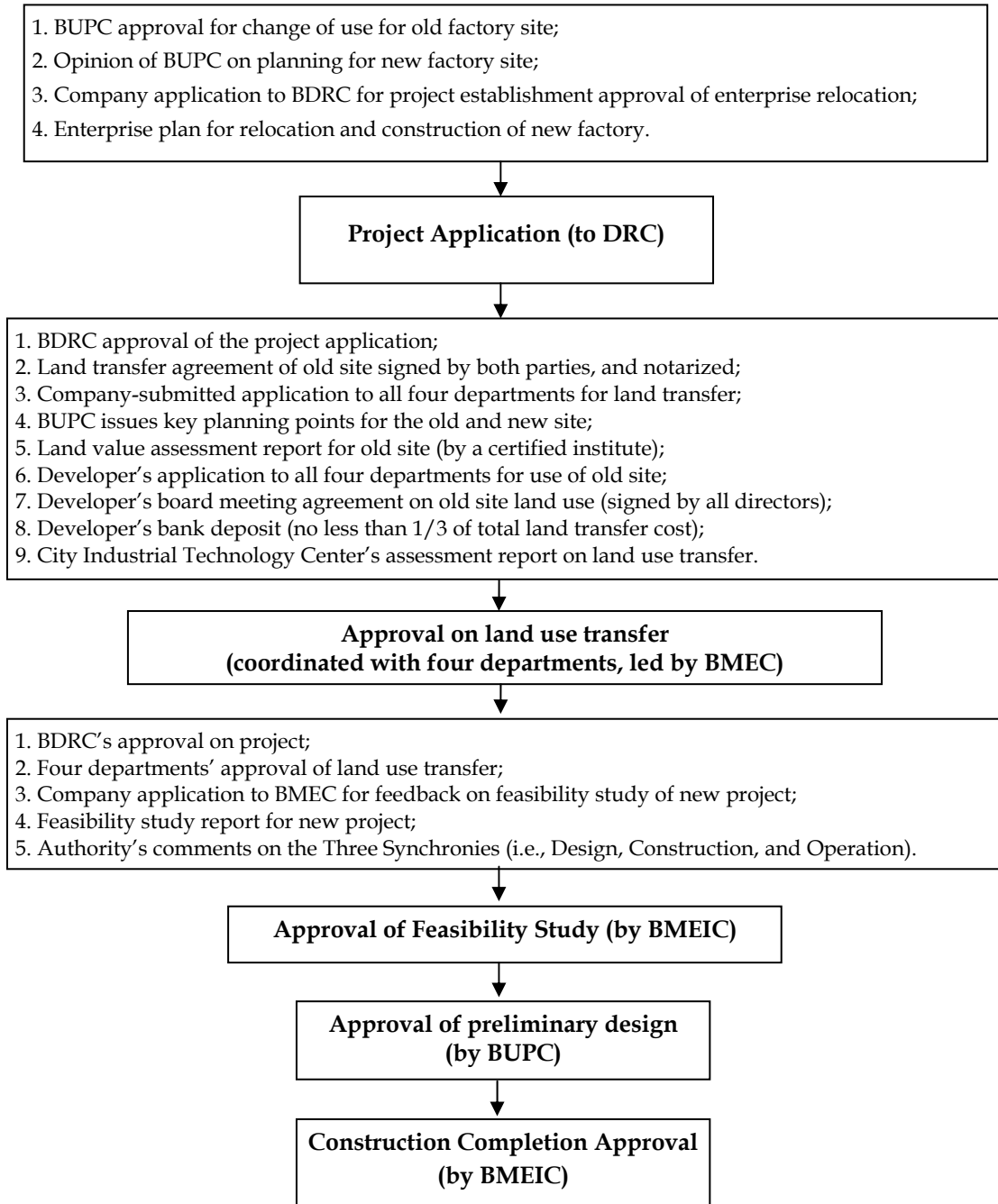
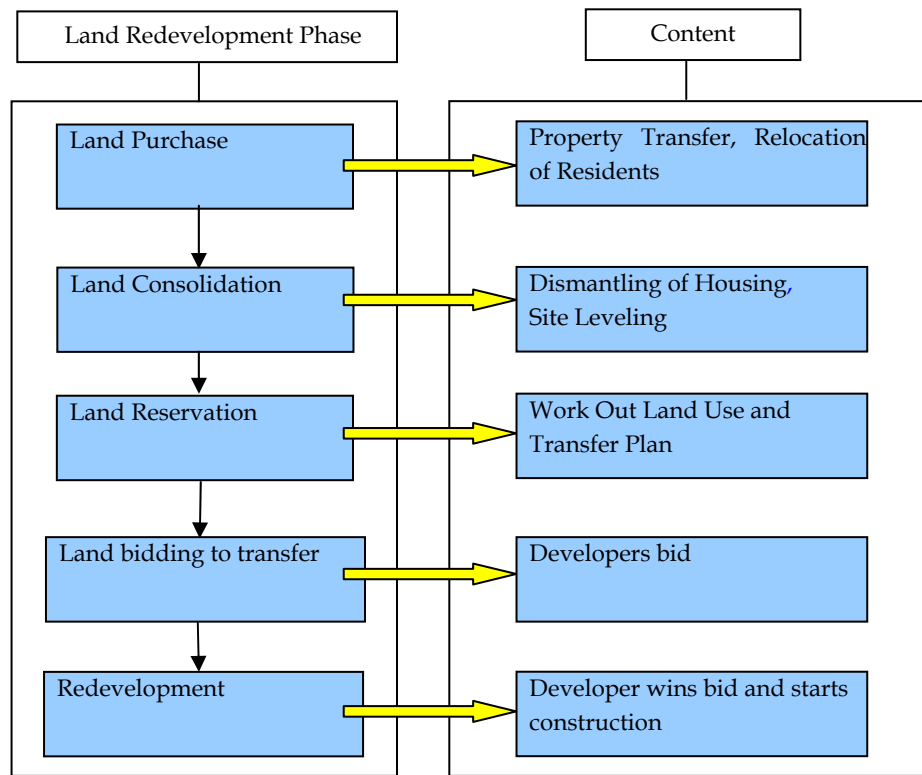


Figure 2. Land Redevelopment Process



5.3 STAKEHOLDERS AND THEIR RESPECTIVE ROLES

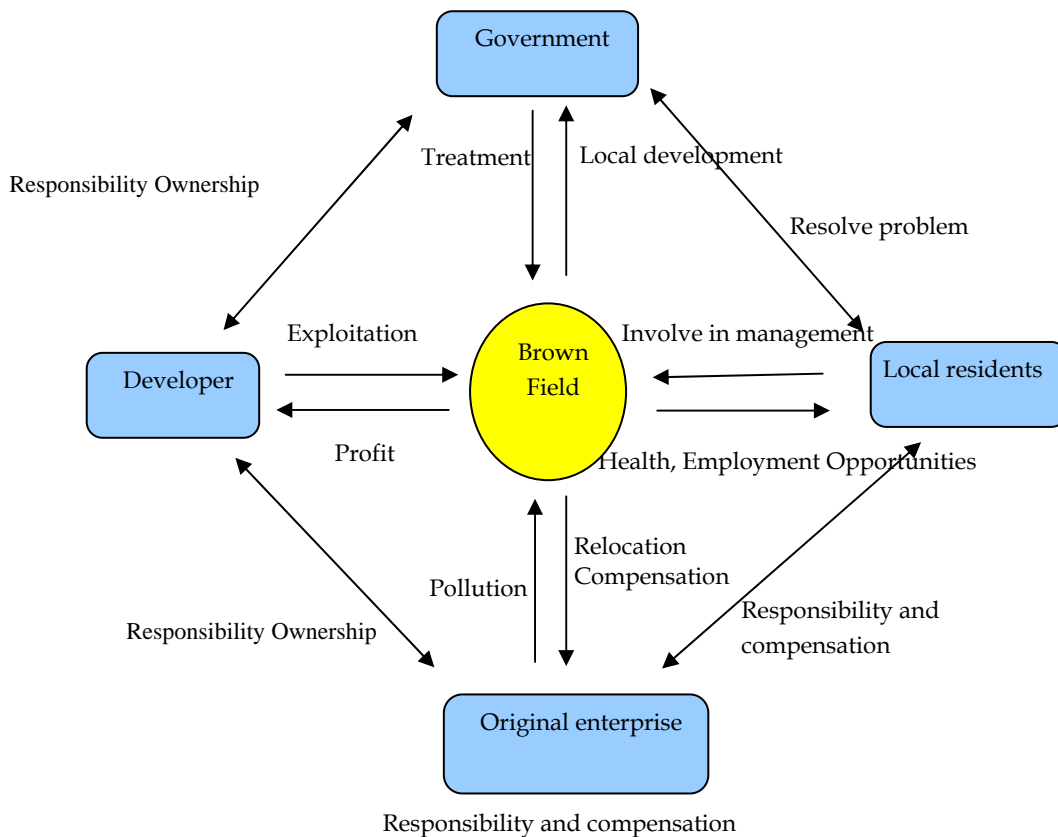
The process of land redevelopment includes direct and indirect stakeholders. Direct stakeholders include the local government, community residents, enterprises and developers. Indirect stakeholders include financial institutions, research institutions, arbitration or litigation organizations, the media, the public, future generations, biodiversity advocates, and local non-governmental organizations. Figure 3 shows crossover interests and relationships among direct stakeholders. Take, for example, the relationship between the local government and developers. Brownfields are often located in the city center, occupying an area of high commercial value

with developed infrastructure. Although China did not make detailed regulations on brownfield redevelopment, the government has actively encouraged the redevelopment of wasteland in order to promote densification (more concentrated use of land resources), and provided policies that reduced risk to developers' investments. Brownfield redevelopment can create new employment opportunities, stimulate community activity and reduce health threats, all of which are conducive to building a harmonious and stable society. Therefore, the redevelopment of brownfields, if pollution issues are appropriately handled, is of great significance for regional and urban economic development, as well as for residents' living conditions.

However, the redevelopment of brownfields can be costly and time consuming as the results of remediation must meet the pollution control standards of the environmental protection bureau. Brownfield redevelopment also brings potential risks from pollutants that remain after cleanup and redevelopment. Developers want to get good returns from

brownfield redevelopment, but are worried about these risks. As the caretaker of public lands, the government should provide incentive policies to attract developers and encourage effective use of land resources. Setting these incentive policies and dividing the costs and responsibilities of remediation will be a critical task for both the government and the developers.

Figure 3. Stakeholders in brownfield remediation and reuse



6. REMEDIATION TECHNOLOGIES AND MARKET IN CHINA

In recent years, government funding has helped develop remediation technologies and equipment for selected types of contaminated sites. Although various soil and groundwater remediation technologies exist, only a few are both practical and economical. In China, the most commonly used remediation practice is excavation followed by ex-situ treatment, such as depositing contaminated soil in an off-site landfill, and or neutralizing with kiln treatment. In-situ remediation technologies are still in the early stage of research and piloting.

A few pilot and demonstration projects for soil remediation and land reuse have been implemented in China (see Table 2). Most draw on relevant foreign experience, and were jointly executed with foreign environmental protection companies and

research institutes, and their respective domestic counterparts. The completed soil remediation and land reuse projects cover most types of contaminated sites, including chemical engineering plants, mining and metallurgy sites, petroleum-polluted sites, pesticide-contaminated sites, and e-waste sites. Remediation technologies currently used in China are predominantly off-site (ex-situ) disposal technologies, such as excavation and co-incineration in cement kilns. Other technologies, including bio-remediation and vapor extraction, are currently under development; most on-site (in-situ) remediation technologies remain in the experimentation and demonstration stages (refer to section 2.3). Pilot and demonstration site remediation projects have been implemented in Beijing, Shanghai, Chongqing, Zhejiang, Jiangsu and Shenyang, and other cities.

Table 2. Pilot and Demonstration Remediation Projects in China

Year	Soil type	Major pollutants	Major technologies	Scale	Reuse purpose
2005	Heavy metal contaminated soil	Lead and other heavy metals	Induction of plant extraction, chemical fixation, chemical leaching methods, electrokinetic remediation	Pilot	Exhibition space
2007	Polluted soil Chemical engineering plants	Tetrabutyl tin, dioctyl phthalate, DDT, lead, etc.	Solidification by cement kiln incineration technology, landfill	65,000 m ³	Residential land
2007	Soil in pesticide plants	DDT, BHC and other organic pollutants	Solidification by cement kiln incineration	140,000 m ³	Residential land

Year	Soil type	Major pollutants	Major technologies	Scale	Reuse purpose
2008	Soil contaminated by paint	Heavy metals, semi-volatile organic chemicals	Thermal desorption and Solidification by cement kiln incineration	52,000 m ³	Residential land
2008	Petroleum contaminated soil	Benzene and nitrobenzene	Landfill	8,000 m ³	Eliminate potential environmental risks
2008	Coal Chemical contaminated soil	Phenol, sulfide and polycyclic aromatic hydrocarbons	Landfill	2,000 m ³	Commercial development
2008	Petroleum contaminated soil	Oil Sludge	Plant - microbial remediation	Pilot	Eliminate pollutants
2009	Polluted soil Chemical engineering plants	Volatile, semi-volatile organic compounds	Biological reactor and ventilation repair techniques	Pilot	Residential land
2005	PCBs demonstration project	PCBs wastes, PCBs contaminated soil and water	Cleanup of storage sites, thermal desorption of low-density PCBs waste, disposal, online transformer PCBs oil dechlorination storage facility long-distance transport of high concentration waste	demonstration	

China's soil remediation market remains in the experimental and cultivation stages with some domestic enterprises and joint ventures carrying out environmental remediation engineering practices and cultivating soil remediation markets. The soil remediation industry in developed countries has already been established for several decades. Therefore these countries have developed much valuable experience

and mature technologies. China should take advantage of advanced technologies and equipment and cooperate with the international soil remediation industry on technical activities in order to promote technological advancement and learn from international experience, which will help accelerate the maturation of its soil remediation market.

7. CASE STUDIES: BEIJING AND CHONGQING

7.1 CITY CASE ONE - BEIJING

7.1.1 Industrial Relocation and Land Contamination

In order to improve environmental conditions and restructure industrial areas, the Beijing government began shutting down and relocating old and polluting industries from the center of Beijing in the 1980s. As Beijing's rapid urban expansion requires a substantial amount of land for public, residential and commercial purposes, the remediation and redevelopment of former industrial lands is necessary. During the period from 2001 to 2005, 142 plants were relocated, making 8.78 million m² of land available for reuse. According to another statistics, some 300 factories have been moved out of Beijing's urban area, freeing up some 9 million square meters of land for redevelopment. These relocations involved several mega-plants, including Capital Steel, relocation of which began in 2005, and the Beijing Coking Chemical Plant in 2006.

These efforts proved successful because:

1. industrial pollution sources in urban area have been largely removed;
2. urban land use efficiency and industrial structure improved; and
3. relocated industries recover capital from land transfers, which provides the enterprises with funds that can be reinvested in the business, thus facilitating the companies to become

local economic engines of new development areas.

Despite the achievements, the large-scale industry relocation left behind many contaminated sites throughout Beijing's urban area, which sometimes contain multiple pollutants on site and serious soil and groundwater pollution. Currently, Beijing is facing administrative, technical and financial challenges to effectively tackle the issue.

7.1.2 Local Regulation Development

The poisoning incident of Songjiazhuang Subway Station in 2004 was a turning point regarding the public opinion and environmental management of industrial contaminated sites. Following the Songjiazhuang incident, a series of local regulations and administrative rules were issued, and actions were taken by the municipal government (Box 2).

To date, Beijing Municipal Government has established an initial regulatory framework for environmental assessment and management planning for sites vacated by relocated industries. Among these, two brownfield management documents, namely *Site Environmental Assessment Guidelines (January 2007)* and *Notice on Implementing Soil Environmental Assessment for Sites Left from Industry Relocation (July 2007)*, are of particular importance.

The *Site Environmental Assessment Guidelines* are intended to identify potential contamination at a site, to conduct a risk assessment based on the current situation or future land utilization requirements, to determine site remediation requirements and recommend remediation methods, and to provide a basis for decisions on land utilization in the future. It also stipulates a stepwise procedure for site environmental assessment.

- Step 1 Contamination Identification: Identify potential contaminated sites using desk reviews, field visits and interviews with land owners and operators, as well as environmental agencies. The assessment practitioner will then use professional judgment to conclude whether the examined site has been contaminated, and prepare a site investigation list (annex 2 to the Guidelines).
- Step 2 Contamination Verification: Carry out preliminary soil and groundwater sampling and laboratorial analysis. Based on the results of the analysis, the assessment practitioner will verify the location, type and level of site contamination, and conduct an initial risk assessment regarding human health and environmental quality. At this stage, an initial remediation plan should be developed and assessed.
- Step 3 Risk Assessment and Remediation Measures: Conduct a risk assessment and develop soil cleanup and remediation measures. At this stage, more intensive soil and ground water sampling and analysis is needed, to

specify the level and geographic boundaries of the contamination, and when appropriate to conduct further quantitative risk assessment, including exposure and toxicity analysis. Meanwhile, future land utilization such as residential, farmland, industrial and commercial purposes needs to be taken into account in the risk assessment. As a result, remediation objectives, measures and cost estimates need to be developed.

The *Notice on Implementing Soil Environmental Assessment for Sites Left from Industry Relocation* essentially reiterates the principles set forth by SEPA on industrial contaminated site management, such as the “polluter pays principle”. It also helps reinforce the *Site Environmental Assessment Guidelines* presented above. It stipulates that, prior to redevelopment:

- The environmental situation of such sites must be assessed;
- A soil remediation plan must be prepared for the contaminated site;
- Remediation costs of the contaminated sites should be paid by the factories which caused the pollution; and
- The site cannot be redeveloped until the remediation reaches the environmental targets agreed.

The development of a regulatory framework regarding contaminated site management in Beijing has focused on the identification of liability and stakeholder responsibilities. The “polluter pays principle” has been clarified, and the roles of respective government agencies have

been set. Another achievement is the development of the Site Environmental Assessment Guidelines to regulate methodology and procedure for soil assessment, which effectively helps contain risks of existing sites. However, given the particular complexity and risks associated with the brownfield redevelopment lifecycle – from site identification to reuse – of brownfield management, the role played by regulations and the environmental agency needs to be further expanded.

7.1.3 Remediation Efforts

Environmental consideration and requirements have been incorporated into regulations regarding land ownership transfer and the redevelopment of contaminated industrial sites. Since 2007, environmental assessments have been conducted on nearly 50 contaminated sites in Beijing, involving steel making, coking, chemical, dye, textile, automotive, and pesticide industries. The assessment results show that some of the sites are contaminated and cannot meet the environmental criteria for planned usage without soil remediation. Among those sites, some are so severely contaminated that pollutants extend to 20 meters underground. So far, several sites have been cleaned up, and the soil was disposed of using ex-situ remediation technologies. These technologies, including separation and landfill, as well as cement kiln incineration, have been applied to different contamination situations, including Beijing No.3 Chemical Plant, Beijing Hongshi Paint Plant, Beijing Tire Plant and Beijing Dye

Plant. Several hundred thousand cubic meters of polluted soil have been treated.

Beijing Hongshi Paint Plant site housed a pesticide plant in the 1950s, which was transformed into a paint plant in the 1980s. Site assessment results indicated that the main contaminants were Hexachlorocyclohexane (C₆H₆Cl₆) and DDT. It is estimated that the contaminated soil in the site amounts to 140,000 m³. The bidding document of the land auction specified that the winning bidder should prepare and implement an action plan to avoid secondary soil pollution in accordance with the contaminated soil disposal plan formulated by BEPB. As a result, the developer spent tens of millions (RMB) of private capital on soil remediation, and has met the commitment to clean up the contaminated soil, which was disposed of using cement kiln incineration. The entire remediation process was supervised by BEPB. Upon completion of the disposal, land monitoring was conducted and the results recorded by BEPB. Further development of the land proceeded with the inspection approval issued by BEPB.

This case shows that, firstly, in involvement of environmental authority into the entire brownfield redevelopment process ensures proper site cleanup and risk control; secondly, Beijing is in an advantageous position as soil remediation costs can be recovered from high land transfer revenue. As long as this is the case, and appropriate site and soil analysis are carried out, such as a site assessment prior to land auction, this approach will remain viable.

7.1.4 Challenges Ahead

Brownfield remediation and reuse in Beijing is urgent because of the shortage of urban land for development. Beijing needs to further develop its institutional and regulatory framework, establish an effective brownfield management system, and use market mechanisms raise adequate funding for financing brownfield remediation.

7.2 CITY CASE TWO – CHONGQING

7.2.1 Industrial Relocation and Land Contamination Problems

Chongqing is an industrial mega-city in southwestern China. Its industrial sectors cover bulk and fine chemicals, metallurgy, machinery, and instrumentation among others. Since 2002, the city has been relocating old and polluting industries from central urban areas, for environmental management and urban development purposes. There were 137 factories on the relocation plan list set forth by the Chongqing Municipal Government, posing great challenges to the city in terms of management, technology and financing. Most of these former industrial lands would be reused for urban development. However, long-term accumulation of contaminants resulting from industrial production and operation has polluted large amounts of soil and groundwater. Based on past studies, it is estimated that contaminated soil amounts to several million cubic meters in Chongqing City. In addition, land contamination is often complex, comprised of heavy metals, volatile organic compounds (VOCs) and semi-VOCs.

The city has recognized the importance and urgency of brownfield management. It has introduced various policies and regulations, clarified main institutional responsibilities, conducted a baseline study on brownfield management, and piloted several demonstration projects. The city has also developed strategic action plans, including establishing a city-wide prevention and response system by 2015, and a specialized fund for contaminated land cleanup and remediation.

7.2.2 Local Regulation Development

Chongqing municipal government has clarified the principles regarding liability for brownfield management, based on Chinese environmental protection law, civil law and land law. Three key principles include:

- the “Polluter Pays Principle”;
- the “Investor Benefits Principle”; and
- the “Land Owner Takes Responsibility Principle”.

Since 2004, various government bodies have issued a series of brownfield management policies and regulations, as listed in Box 2.

Box 2 Local Policies and Regulations on Contaminated Site Management in Chongqing

(1) City People's Congress: "Chongqing City Environmental Protection Regulations", 2007

- Article 47: Before switching production or relocation, factories should conduct brownfield treatment;
- Article 104: have not conducted treatment of the contaminated soils must make a correction under supervision of environmental administrative authorities...and be fined up to RMB 100,000.

(2) Municipal Government Documents:

- "Recommendations on Speeding up the Relocation of Key Polluting and Unsafe Factories in the Core Urban Areas", 2004
- "Notification on Strengthening the Remediation of Contaminated Former Industrial Sites", 2008

(3) Municipal EPB Documents:

- "Forwarding SEPA Notification on Implementing Pollution Control during Factory Relocation", 2004
- "Notification on Implementing Soil Contamination Control and Treatment after Factory Relocation", 2005
- "Notification on Strengthening the Management of Solid Waste Left from Closed, Shut-down, Bankrupt and Relocated Factories", 2006
- "Request for Further Regulating and Strengthening the Supervision of Contaminated Sites Left from Closed, Stopped, Bankrupted and Relocated Factories", 2008

These regulations show that the municipal government attaches great importance to the issue of brownfields. It considers addressing brownfields as an integral part of realizing the city's development objective: to build a livable and ecological Chongqing. Unlike Beijing, which has formulated dedicated *Site Environmental Assessment Guidelines*, Chongqing requires that site environmental assessment should be incorporated into the existing general environmental assessment mechanism. It also stipulates that priority should be given to prevention, that remediation should be

combined with prevention, that new contamination should be avoided, and that remediation of existing contaminated sites should be conducted gradually.

At the institutional level, Chongqing Environmental Protection Bureau (CEPB) plays a leading role in supervising baseline surveys of the contaminated sites of relocated factories. The city also provides policy explanations and publications to factories on a regular basis, and gradually strengthens the enforcement of its regulations.

As a result of these regulations and guidelines, the remediation and redevelopment of contaminated sites in Chongqing City has made substantial progress. Meanwhile, the municipal government has provided a specialized subsidy fund for contaminated site environmental risk assessment, which has been significantly increasing during the past years. In 2007, 200 million RMB was spent on 15 sites, while by 2009 the figures rose to 800 million yuan RMB spent on 45 sites. So far, 5 demonstration projects have been launched, among which the demonstration of excavation and cement kiln disposal methods on chemical plant contaminated soils is almost completed.

7.2.3 Local Government Strategy and Actions Plans

Based on the above work, the CEPB proposed the following strategic action plans for future brownfield management in 2008.

1. Set forth a timetable for developing a city-wide Early Warning and Prevention and Control (EWPC) system for soil and groundwater pollution:
 - 2008: preparatory work;
 - 2009: pilot industrial soil and groundwater EWPC system set up in 5 factories;
 - 2010: scale up to 10 factories;

- 2011–2014: incorporate environmental simultaneous (design, construction, and operation) into the site control and prevention system of all newly built factories;
 - 2015: the city's industrial factories conduct soil and groundwater pollution EWPC system in a stepwise manner.
2. Build a diverse financing mechanism for site cleanup and remediation. According to the “polluter pays principle”, the “investor benefits principle”, and the “land owner takes responsibility principle”, it is anticipated that future financial resources for contaminated site remediation will consist of a revolving fund to finance cleanup and redevelopment activities of enterprises, and an earmarked fund to provide grants for the cleanup and remediation of contaminated land with unclear ownership or responsibility and other financial sources (Box 3).

7.2.4 Challenges Ahead

It is estimated that at least 2 billion USD is needed for site cleanup and remediation in Chongqing. The city, however, is facing a huge financing gap. The city is looking for technically suitable and cost-effective remediation technologies and appropriate site remediation standard.

Box 3 Financial Resources for Brownfield Remediation

1. Revolving Fund for cleanup and redevelopment of enterprise contaminated sites

- utilize the loans of international financing institutions and other sources to establish a fund to finance the cleanup and relocation of polluting enterprises;
- provide loans to the enterprises to be relocated for site remediation;
- repay the loans with revenues received from remediated land use rights transfer for other commercial use

2. Earmarked Fund to Subsidize Brownfield Remediation

- establish Fund with part of the fees collected from the transfer of remediated land use rights (coordinate with the Bureaus of Finance, Land and Resources)
- prepare operational manual of the Fund in coordination with the Bureau of Land and Resources
- Provide subsidies earmarked for the cleanup and remediation of contaminated lands which's ownership or pollution responsibility is unclear, which is not intended for development in the short term, or which will be used for public purposes.

Source: Chongqing Environmental Protection Bureau

8. AREAS FOR IMPROVEMENT, RECOMMENDATIONS, AND CONCLUSIONS

As a newcomer in the area of brownfield management, China has wide room for improvement and is facing an opportunity in brownfield prevention, control and remediation of contaminated land. As outlined here, the nation is lacking in many areas: a comprehensive regulatory framework (including both ex-ante and ex-posed liability and risks for brownfield sites); uniform national standards on site assessment, clean-up and remediation; proven technologies for investigating and remediating contaminated sites; and effective funding or financing mechanisms. China also needs to improve its information disclosure on brownfield sites and strengthen its national and local capacity and the participation of stakeholders.

Regulatory framework. Analysis shows that China's legal systems for the prevention and remediation of contaminated lands and brownfield redevelopment at both national and local levels is weak. Existing legal provisions on the prevention and control of land pollution in Chinese laws and regulations are scattered, and too general to specify legal responsibilities and obligations among stakeholders. A comprehensive legal system is desperately needed to clearly define the responsibility and liability of land contamination and remediation, and provide clear and concise guidance for all stakeholders.

National soil pollution standards and technical guidelines for brownfield cleanup and remediation. Despite some local practices and provisional standards and guidelines issued at the national level, government agencies and research institutes have been using or referring to different methods and standards of contaminated soil risk assessment used in other countries; the result has been inconsistent and incomparable assessment results and conclusions. The lack of unified standards also complicates efforts to develop a regulatory framework. China needs to speed up its work to officially approve, release and implement a system of national standards and technical guidelines for the prevention and treatment of land contamination. Local authorities should also be encouraged to issue tougher standards based on local situations.

Financing instruments and mechanisms. Remediating and treating contaminated sites for redevelopment is expensive, therefore financial issues are often a major obstacle. An appropriate financing mechanism—one that includes economic incentives and funds—is important to the remediation and redevelopment of contaminated sites. Economic and financial instruments, such as environmental taxes, cleanup subsidies, loans, guarantees and market licenses, are necessary for establishing an effective management system to address the incentive and funding

issues of brownfield management. In China, no specific funds exist for contaminated site remediation (like the Superfund or the Brownfield Remediation Fund in the US) at either national or local levels. No clearly defined rules and funding channels exist between known stakeholders (namely the governments, previous or current land owners, and developers) for the remediation and redevelopment of brownfield sites. This is an urgent area for improvement. Better and practical application of the “polluter pays” principle should be carefully studied in order to develop a reasonable and manageable system of implementation for brownfield management. China can learn from the U.S. experience in the evolution of contaminated site remediation from Superfund Act to Brownfield Act.

Cleanup technologies. Moreover, China needs efficient and practical technologies for remediating contaminated soil. Brownfield remediation technical aspects, such as practical procedures, standards, technically suitable and cost-effective remediation technologies are either yet to be established, or are still in a pilot stage. China’s urgent need for land in urban construction requires that efficient soil remediation be completed in a short period of time. Therefore, requirements for selecting remediation technologies are high. However, the lack of advanced, efficient and practical technologies is a significant barrier in the redevelopment process of contaminated land. It is also necessary for soil remediation objectives, as well as the selection of technology and remediation program plans, to be specifically designed

for each site according to its intended use and other specific circumstances. Such detail requires experienced and highly trained experts with relevant skills, but at present China lacks such expertise.

Government coordination. The planning, remediation and redevelopment of contaminated sites requires inter-departmental, multi-partner, interdisciplinary, and cross-boundary cooperation in order to be carried out successfully. In China, management responsibility for urban land at both the local and national levels is allocated between two different administrative systems: urban planning and land management, both of which have independent functions. Currently, however, the functions of these two government departments are not clearly defined, causing confusion and managerial difficulties regarding contaminated land remediation and development. The role of environmental authorities (as well as the role of different divisions within environmental authorities) in prevention and control of contaminated land both in urban and rural areas is not well specified. The relationship between land use planning (deciding the type of land use) and brownfield management (specifying remediation standards and requirements) is not clearly defined. The government should therefore strengthen inter- and intra-coordination and cooperation between various government agencies on issues including in site investigation, assessment, land ownership transfer, design and implementation, remediation standards and in completion acceptance and reuse.

Corresponding policies and regulations should be developed.

Public awareness and participation.

Redevelopment of contaminated land can have an effect on public health and other vital interests, but public awareness of such risks remains low in China. Many cities currently focus too much on local economic development and profit from urban land sales. They tend to overlook pollution health, problems and environmental security associated with industrial and urban development. Investors and local residents of brownfield redevelopment projects have low awareness of the risks of previous soil contamination, and lack adequate means and resources to investigate and participate in such matters. Information should be made available to the public, in order to raise awareness and facilitate public participation in brownfield management.

Capacity building. The capacity of environmental monitoring and supervision in contaminated sites is in urgent need of improvement. Although China is making an effort to develop its R&D sector and enforce intellectual property rights, it still predominantly relies on the assimilation of foreign experience and technologies. Therefore, the country urgently needs to increase its R&D capacity, especially advanced software and hardware equipment in the fields of contaminated site monitoring, assessment and remediation. International exchange and training can help increase the talent pool.

Implications of city case studies. The actions taken to date in the cities of Beijing and Chongqing demonstrate the viability of such programs. Beijing has established an initial regulatory framework for brownfield management. In particular, it has developed specific *Site Environmental Assessment Guidelines* for contaminated site investigation, impact and risk assessment. Significant progress has been made relative to other cities in China. The Hongshi Paint Plant site cleanup and redevelopment experience shows that appropriate prior assessment, involvement of environmental authority into the entire redevelopment process and transparent processes are crucial. In addition, the financing mechanism used in this project—recovering cleanup costs from land transfer revenues—proved to be viable.

Chongqing has also made an effort in formulating policies, a regulatory framework and strategic action plans for brownfield management. Chongqing bases brownfield remediation financing mechanisms on the “polluter pays”, the “investor benefits”, and the “land owner takes responsibility” principles. These principles allow flexibility in balancing between liability and implementation efficiency, and as such, are commendable. In addition, Chongqing’s proposal to build a diversified financing mechanism is a good start and worth further exploring.

International experience in risk-based and brownfield site prioritization.

Based on the review of international experience in brownfield management (see *International Experience in Policy And Regulatory*

Frameworks For Brownfield Site Management, World Bank, 2010, prepared by the same World Bank program), prioritization and risk-based approaches can be highlighted and applied in China. In setting remediation objectives, industrialized countries have learned some lessons the hard way. The U.S. Superfund is a case in point. Very large amounts of money and effort were spent on a relatively small number of sites, leading to very high costs to society. In the Netherlands, previous environmental laws required that all contaminated soil be remediated to meet certain environmental quality targets, but the system proved difficult to operate, and was very costly.

International experience has shown that it is more effective to establish a suitable contaminated soil remediation standard system that takes future land use and site features into consideration. Such systems are known as 'risk-based,' because the level of remediation required depends on the level of risk sites pose to society and the environment. This system of remediation usually requires less work overall than full remediation, significantly reducing costs.

Given the large number of contaminated sites in China and the limited availability of funds for remediation, an important issue is the order in which sites get remediated. Some developed countries have adopted contaminated land risk level assessments, with a national priority list that ascertains

the risk of land pollution, classifies contaminated land risk levels, and determines the priorities of remediation. On the human health and environmental safety premise, funds should first be allocated to sites that pose the greatest threat to society and the environment, as identified through contaminated sites surveys and assessments. It is necessary to establish a similar risk assessment system in China, taking into consideration and combined with the actual situation of contaminated land in China.

In summation, brownfield remediation and redevelopment is becoming a pressing environmental and development issue in China. As plans exist to reuse most old industrial sites for residential and commercial purposes after industrial relocation, land contamination and environmental risks are a crucial issue. To cope with the challenge, China needs to strengthen its legal, organizational, and institutional framework for brownfield management, build its implementation capacity, raise public awareness and participation, and be innovative in financial and technical solutions. In addition, China should try its best to tap into the rich land remediation and redevelopment experiences accumulated by developed countries for contaminated soil, and learn from best practices and lessons to improve its own system.

REFERENCES

- Beijing Municipal Environmental Protection Bureau, Site Environmental Assessment Guidelines, 2007
- Chongqing Municipal Environment Protection Bureau, "Industrial Site Contamination Status and Strategy of Chongqing" 2010 (A presentation prepared for a World Bank mission)
- Chen, H.J., "Relocated chemical plant in Suzhou left behind toxic land with the water in the core area likes soy sauce." *Modern Express (Xiandai Kuaibo)*, January 12, 2010
- Ding, D., "Environmental security is the first when changing land use to residential use." *China Environment News*, February 6, 2006
- Gu, Q.B., Guo G.LL, Li F.S., 2008, "Classification, Application and Selection of Contaminated Site Remediation Technology: An Overview." *Environmental Sciences*, 21(2):197-202
- Guo, X.M., 2008, "Plight of inner city renewal restricted by present land redevelopment mechanism." *City Planning Review*, 32(10):42-49
- Li, F., 2010. "Current Status Review on Remediation and Redevelopment of Contaminated Land in China," Background report submitted to the World Bank Program "China Brownfield Remediation and Redevelopment."
- Liu, D.T., 2009, "About 1/5 of land in our country is contaminated, foreign enterprises are optimistic in the soil remediation market," *China Environmental News*, April 14, 2009
- Liu, Wei, 2009, "Beijing: After the fall of subway workers," *Outlook Magazine (Liaowang Zhoukan)*, Xinhua News Agency, Issue No.9, 2009
- MEP (formerly SEPA), 2004, "Notice of Doing Business on the Effective Prevention and Control of Environmental Pollution during the Relocation Process," (SEPA Administrative Office [2004] No. 47).
- MEP, 2008, "Recommendations on Strengthening Soil Contamination Prevention and Remediation," a MEP document (MEP [2008] No. 48).
- The State Council of China, "Implementing the Scientific Concept of Development and Strengthening Environmental Protection," the State Council document (State Council [2005] No. 39).
- Sun, Z.Y., Xie H.S., Yang Y.W., "Preliminary Study of the Environmental Conflicts and Their Coordinating Countermeasures Among Brownfield Stakeholders, *Environmental Science and Management*," 2009,34(10):1-5
- Tian J.Y., Liu G., 2003, "A Primary Probe into Technical Outfit for Restoring Soil Contamination Projects." *Mechanical Engineering*, 34(12): 33-37
- Wang, J.X., "Industrial enterprises moving out of Downtown." *People's Daily*, June 3, 2002
- Wang, W.M., "The 'incident of transferring poisoning land for redevelopment' hasn't ended." *China Real Estate Newspaper*, August 21, 2007
- Wu, X., 2006, "Deployed the investigation work of soil pollution nationwide." *Ecology and Rural Environment Studies*, 22 (3): III-IV
- Yao, H.Y., 2010, "280 acres of most valuable land laid waste, the truth behind the returning of the country's largest land contamination incident," *Time weekly (Shidai Zhoubo)*, No.10

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