

A pilot case study of inner-city high-density housing on brownfield in Chongqing, China

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Abstract

Chongqing is one of the largest and rapidly emerging property markets in China. To substance the development needs in the process of the economic transition, China has created major policies such as “suppress the 2nd industry and develop the 3rd industry” to assist its rapid urban economic structural change, which consequently weeded out a flood of polluting plants out of the inner-city, replaced by residential and commercial uses. This paper examines one of the former industrial sites existing in the inner-city area of Chongqing which has recently been developed into a large-scale high-density residential space. The site was formerly used for chemical industrial purpose during the planned economy era. This case study provides detailed (factual) evidence about the short- and long- term impact of property development projects that have changed the Highest and Best use of inner-city sites into residential or commercial uses in the changing social and economic setting. It identifies institutions, processes and practices in the reclamation of inner-city brownfield areas for high-density residential use in Chongqing and preliminarily yet critically evaluates its impact. Findings from this study are likely to stimulate policy debates and raise the awareness and the urgency to improve policy and industry practice standards in the building and property industry concerning inner-city brownfield development in China. This, in the future will lead to higher consumer satisfaction and confidence.

Key words

Brownfield; high-density apartment; inner-city; contamination; Chongqing; China

INTRODUCTION

The economic transition in China is reflected by the fundamental change of the property rights system from the predominantly centrally controlled state ownership of urban land and properties to a much more sophisticated mixture of public and private ownerships (Li, 1999, Zhu, 1999), and the rapid emergence of the world's largest urban commercial property markets which drives rapid changes of inner-city land use in inner-city areas of major Chinese cities from industrial to residential and commercial uses (Wu, 2009). Since the 1990s, a large number of urban industrial enterprises that were previously located in central areas of major cities have started to be relocated and replaced by non-industrial uses such as high-density housing and commercial spaces. This is generally known and termed "suppress the second industry and develop the third industry". For the potential scale of this process, table 1 shows an initial estimate of relocations in five major Chinese industrial cities. Less aware, however, is that many factories built during the planned economy era (1950-1978) have generated, in varying degrees, poisonous wastes or pollutants on the sites they occupied, which could lead to serious short-term and longer-term social, economic and political consequences, given the substantial size of the industrial base previously occupied urban cores and the scale and speed of their redeveloping into residential or commercial uses. The serious consequence is evidenced by incidences such as the recent (03-2009) explosion of a former chemical factory in Jiangsu Province that was used for temporary housing, causing eleven casualties and twenty injuries (MYL, 2009). In 2004, the chlorine leakage in the Tian-Yuan Chemical Factory in Chongqing caused nine casualties and forced the relocation of over 150,000 local residents (Enorth, 2004). This further demands safe and effective relocation and redevelopment processes, which require close government-market interactions.

Table 1 - Number of industrial property relocation in major industrial cities

City	Number of relocated factories	Time period
Chongqing	96*	2006 -
Guangzhou	427*	2005 -
Herbin	219	1995 – 2006
Beijing	200	2002 – 2008
Wuhan	193	By 2007

*: being relocated or to be relocated factories.

Source: authors

Given the high-density nature of inner-city configuration in China, this paper hopes to raise the awareness of potential environmental impact of brownfield development in the reshaping of China's inner-city built environment – critical for a sustainable property and construction industry. This paper aims to connect conceptually brownfield development and the actual problem that China faces by a discussion of basic but relevant concepts in the field. Based on this understanding, the study selects an inner-city high-density housing project in Chongqing which used to be an industrial site during the planned economy, as a pilot study to provide critical insights to the problem. The paper firstly reviews the definition of urban brownfield and the various aspects of brownfield development from an international perspective. The project selection criteria and the research approach to the case study are then displayed, followed by project background and detail analysis such as the land use history and key aspects of the development before the evaluation of project impact. Finally conclusive remarks are presented hoping to raise the awareness of and future research into this emerging research matter/topic.

BROWNFIELD DEVELOPMENT: AN INTERNATIONAL PERSPECTIVE

Internationally there has been a continuous discussion on the concept of *brownfield*. For example, Alker et al. (2000) proposed a robust definition of the term from a multidisciplinary perspective, stating that a brownfield site is “any land or premises which has previously been used or developed and is not currently fully in use, although it may be partially occupied or utilized. It may also be vacant, derelict or contaminated.” Dixon (2006, p241) defines *brownfield* in a broader sense as “any land, which has been previously developed, including derelict and vacant land, which may or may not be contaminated”. The Hazardous Substance Research Centers defines *brownfields* as abandoned or underused industrial and commercial facilities available for re-use (HSRC, 2006). The expansion or redevelopment of such a facility may be complicated by real or perceived environmental contaminations. The term *brownfield* also refers to previously developed land as defined by the Department of Environment, Transport and Regions (DETR) in the UK (Adams and Watkins, 2002,p18, Syms, 2004). More recently, it has become apparent that major cities in former planned economies such as China have started to face the challenge of reuse brownfield sites, and it is within this context that the existing definitions need to be confined to capture the underlying force that drives the urban redevelopment in China.

Increasingly, urban regeneration or urban brownfield development is becoming a research topic with international significance in cities or regions that are going through socio-economic changes and urban spatial reconfiguration at varying speeds (Adams and Watkins, 2002, Murray and Rogers, 1999, Syms and Weber, 2003), in particular, in West European nations and the North America. With specific interest are the investment performance and the development activities that are led by either the public or the private sector of varying scopes and emphases (Berry et al., 1993, Adair et al., 2003, Adair et al., 2005, Needham et al., 2003, Syms, 1997). Since the turn of the 21st century, urban regeneration has become a global concern in the studies of the urban built environment, from developed countries such as the UK and Germany, to modern city states such as Singapore and Hong Kong, and to emerging markets such as China. Though among them there are differences in terms of research emphasis and implications.

Hulsbergen and Stouten (2001) examines the problems surrounding urban regeneration policy using the Netherlands as a case study. Estates Gazette (2002) outlines the UK attempt to provide disincentive to develop in green field areas by enforcing ‘higher planning tariffs for greenfield developments will be used to revive derelict areas’. Evans (2008) brings to light the fact that urban regeneration policy in the UK is not being incorporated with general concepts of sustainability. In the North America the redevelopment of brownfield sites and its environmental consequences have been studied quite extensively, for example Meyer (2000), Jennings et al (2002), De Sousa (2003) and Jennings and Ma (2007). A recent study is focused on the regeneration of USA military sites, drawing on a number of international examples (Bagaeen, 2006). The need for urban regeneration has created the need as well as the major challenge in most high-density and developed cities around the world. A recent study in Hong Kong has considered the high density nature of the city state (Yau et al., 2008); the safety of such high density buildings has become an important issue. Among mature markets, there are various issues that have been identified and investigated regarding the broader conditions of urban regeneration and brownfield development, including its history, its making (the process) its techniques and its consequences (Journal of Planning Literature, 2008, van Herwijnen et al., 2007, Winson-Geideman et al., 2004, Bonomo et al., 2002).

Healey (1995) and Healey et al. (1992) contends that the regeneration of industrial sites has an important role to play in local economic development, but that realizing this role requires a fine-grained understanding of the dynamics of local conditions'. Nurden (2002) looks at a UK Scheme that is aimed to contribute to remediation costs of brownfield sites for residential purposes to stimulate such development in a competitive way. Clearly, without such stimulus, effective urban brownfield development into residential use will be very costly. In the UK, Prince Charles established a fund dedicated to urban regeneration and sustainable property (Building Design, 2008, p3) and one of the focuses of this fund is brownfield residential development. Raco and Henderson (2006) consider the roles, rationales and problems related of brownfield developments in planning policy based on an UK case study. Using Berlin as a case study, Moss (2003, p511) studies brownfield developments to 'explore(s) the interrelationships between urban land use, resource consumption, and utility service provision with a study of brownfield regeneration from a infrastructure perspective'. Similarly a comparison was conducted between the UK and Germany with an emphasis on planning provision (Ganser and Williams, 2007). More recently, the concept of sustainable brownfield development has started to emerge among developed countries such as Australia with large former military sites being developed into large residential districts in Melbourne (Hannink and Scott, 2009) and former light industrial suburbs redeveloped into sports/residential town in Sydney (Wu and Reed, 2004, Wu and Reed, 2006). A similar study of international comparison of redeveloping military sites was conducted by Bagaeen (2006). Over all brownfield development is proven to be a complex and challenging issue as suggested by major professional bodies (RICS, 1998) and by those who study urban brownfield within a broader social, economic and political context (Henderson et al., 2007, Raco et al., 2008, Healey et al., 1992, Healey and Nabarro, 1990).

CASE STUDY APPROACH TO TRANSITION-LED URBAN BROWNFIELD DEVELOPMENT

Transition-led urban brownfield development in China

However, existing theory does not cover, at least sufficiently insightfully, the area of inner-city brownfield development in cities that are being transformed within a relatively short period of time. In particular, China's case of being a transitional economy is one of the most typical examples of massive change of urban land use from industrial to residential or commercial uses in inner-city areas in major cities (Zhu, 1999, Wu, 2009, Cao and Guang, 2007). The authors believe that urban brownfield development in China can be understood by systematically studying carefully identified projects to reflect the change of land use being part of the socio-economic change. One of the key components is to identify, evaluate and estimate the conditions, costs and policies based on evidence found in China to gain insights. In this study, *urban brownfield land* is defined as inner-city sites with industry heritage from the planned economy era in China which have been or are being redeveloped or transformed into residential or commercial uses. The brownfield property development research in transitional economies such as China has shown unique features; for example its large scope and strong government intervention, which clearly differs as compared to mature markets. Given the short history of China's economic transition, this issue is not yet well investigated and understood. Thus specific questions such as "is it an important issue faced in China's rapid urban transformation?" and "how the issue is or is likely to be treated?" are examined through the selection and analysis of a high-density project in Chongqing.

Project identification, selection and analysis

The aim of this paper is to understand the conditions and the practice of the economic transition-led brownfield development in inner-city Chongqing, to identify key features and characteristics of the process to guide future research and practice. As Table 1 indicates earlier, being one of main industry bases of China for the past 50 years, the large number of relocated and relocating industrial entities from inner-city area and the strong demand for residential and commercial land use to replace them have qualified Chongqing as one of the cities suitable for the current enquiry. Compared to Guangzhou where the process was started relatively early, national policies concerning urban brownfields are more likely to affect recent brownfield projects in the Chongqing property development sector. This provides a further angle for cross-city comparison e.g. Guangzhou vs. Chongqing and historical examination e.g. earlier vs. more recent projects in one of the cities. However, this is outside the scope of this paper.

Specifically, the project site had been used for industrial purposes until the early 2000s and had been re-zoned and developed into high-density housing started in 2007. Through this case study, key research issues will be identified and clarified to assist identifying other projects as comparative cases for follow-on studies and to develop detailed and specific questions for a proposed nation-wide survey on awareness and practice among stakeholders in different places. A clear case study plan was formulated, containing data collection criteria, analysis and reporting procedures. It is anticipated that this will provide a clear set of rules to ensure the consistency in the case study and in turn ensures the validity and reliability of the methodology (Yin, 2002, Robson, 2002). The general project selection criteria identified by the authors include:

- The site had been formally used for industrial purposes in the planned economy era before its current use (i.e. before the mid-1990s);
- The site is located in inner-city area of Chongqing and is designated for high-density residential or commercial use;
- There is contamination issue involved based on the land use history;
- Planning appraisal and construction evaluation have been undertaken; and
- There is high potential that the yet to be treated contaminated land will affect current and/or future users;

Various aspects of the project are then studied and analysed, including:

- (1) the project's land use history;
- (2) its basic background being a redevelopment from industrial property to high-density residential;
- (3) Its associated planning policies, given a set of socio-economic background;
- (4) development attributes that are related to the land use history, focusing on how the developer view the problem (existing and potential) of site contamination in the development process, and government's attitude regarding the same issue for this specific project; and
- (5) government land supply policies to study the formal practices for inner-city brownfield (former industrial sites).

Through the analysis of the selected project case in Chongqing, this study examines: how well the concern is dealt with in specific high-density residential projects at specific locations. This study focuses on the planning and the project delivery stages. One of the main reasons for the current research being projects and supply side focused such as developers and government land

supply and planning policies is due to the relatively short history of China's inner-city redevelopment. Post-occupancy study of the social and economic costs being passed on from the previous industrial land use to the current and the future generations is not yet a mature construct, therefore are considered beyond the scope of this paper. It is expected that the selected case will act as a carrier for a holistic approach to the institutional and historical settings that affect brownfield development in Chongqing. As Yin (2002) puts it: "single case study would also apply to the study of an institution which remained at the level of the whole rather than seeking to look at and analyse the different functioning of separate sub-units within the institution."

Data sources/collection and limitations

Project history and relevant details regarding the treatment of contaminations are collected in 2008 with local research supports. Also collected are background information of government policies, land supply and planning particulars which are mainly obtained from public sources e.g. the Department of Land Management, Urban Planning Department and/or the Department of Environments. Wherever necessary, descriptive data are collected by the researchers through their research associates with key stakeholders especially in regard to information such as project or land use chronology.

CHONGQING AND TRANSITION-LED BROWNFIELD DEVELOPMENT

The Chongqing metropolitan area situates at the south-west region of China, with a total area of 82,400 sq.km and a total population of over 31 million. Being one of China's largest cities, Chongqing's property market remains relatively immature (Jones Lang LaSalle, 2008). Chongqing has been one of China's six industry bases during the planned economy era. Its industrial sector is represented by over 31,530 industry entities, most of which were located in inner-city areas, with industry types ranging from metallurgy to medicine and agriculture. Located within central city area and close to the Jia-ling River, there have been major environmental concerns. Relative to 2006, industry produced solid waste in 2007 had a 14.98% increase reaching 271.87 tons. The restructuring of the industrial sector aims to a healthier location pattern suitable for the socio-economic needs. For example, factories generate pollution are encouraged to relocate themselves from inner-city to industrial park.

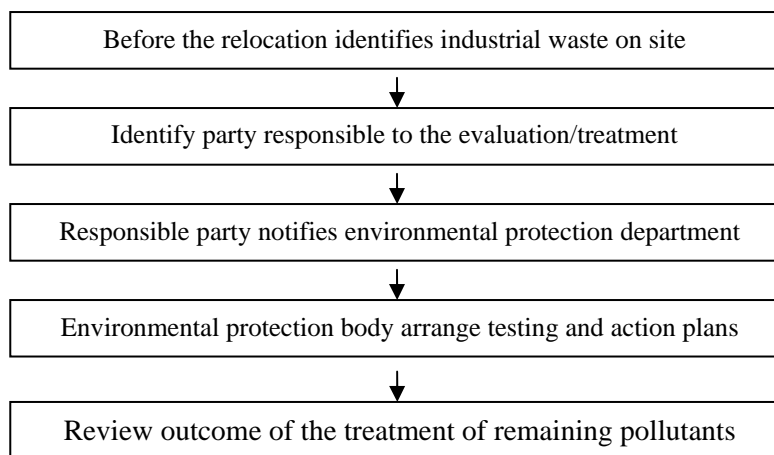
Since 2001 the city government compiled a relocation plan for polluting factories and plants, but it had not been effective given the high costs involved in the relocating process. Nonetheless in 2006, the city government evaluated 15 relocation entities against pollution risks. The outcome shows that the original sites of 5 enterprises have pollution problem. Regarding the impact of the relocation process on the supply of land in the city area, the 96 industrial bodies' moving out from the inner-city area has allowed over 1334 hectare inner-city land for alternative land use. This will substantially affect the inner-city land supply and land reserve [compiled by the city's planning authority] which in turn affects the supply of housing and commercial spaces. Regarding the environmental consequences, an early estimate suggests inner-city brownfield land due to the relocation of inner-city industry is 35.3 hectare, involving the treatment of 904 ton pollutants.

INNER-CITY BROWNFIELD TREATMENT PROCEDURES

The main concerns in the inner-city brownfield development process in Chongqing include the policies and regulations that are related to the transfer of inner-city sites, e.g., the Ministry of Land & Resource Order 11 (2002) on the transfer of state-owned land use rights, the project

financial control, e.g., the People’s Bank of China Order 121 (2003) on enhancing property financial control, and the Macroeconomic Regulation and Control (MRC) of urban land supply, e.g., the State Council’s Notice (2006) on the market approach to the transfer of industrial land and its pricing. Regarding the environmental concerns in the relation process of former industrial land in inner-city areas, the Ministry of Environmental Protection (MEP) Notice (2004) specifically addresses this concern. The MEP suggested that before the industrial entity is relocated, the site must be evaluated by provincial level environmental protection body and make necessary remedy arrangements. Figure 2 shows a general description of the procedure of treating remaining pollutant during the relocation of former industrial entities. This applies to the relocated factories (entities) that are either closed down or facing insolvency risks. Note that key stakeholders in the property industry such as developers appear to have little role played in this process because in most cases the process will occur before the development project starts where developers have not had full ownership or usership of the land.

Figure 2 – management process of industrial waste treatment in the relocation process



Source: authors

Similar to most major cities in China, Chongqing in recent years has experienced high-speed expansion. The high demand often requires site pollution treatment to be completed quickly. Some simple methods include covering, removing, burying or plant-treatment. Since 2007 Chongqing has started to organize soil pollution survey, aiming at a comprehensive, systematic and accurate knowledge of the city’s land/soil environment quality, e.g., the types, levels and cause(s) of soil pollution, evaluates the pollution risk of soil, and determines the level of safeness to raise the capacity of managing and monitoring urban land resources with new technology applied to soil treatment. Funding wise, the treatment of polluted site typically receive funding support from enterprise pollution treatment fund, post-treatment value increase of the site, environmental protection special supporting fund, land treatment special fund and international environmental protection or collaborative organization donations. Also increased is the number of industrial entities adopting site risk evaluation from around 15 in 2007 to over 40 till 2009.

Until the present time, relevant legislation and regulations suitable for development projects site (soil) quality standard have not been fully developed, not to mention their testing and refinement. Current practice is mainly based on *the Land Environment Quality Standard* which is however developed for agriculture land use therefore is considered too restrict to industrial or inner-city brownfield development projects. The lack of local level detailed standards and its enforcement both are worrying sighs for proper brownfield development practice. In addition, the way the

industrial legacy is treated in the actual development process seems to be commonly regarded as mainly the duty of the relocating entity or the responsible government body. The role of the property markets especially the role of developers and users remains unclear in the current institutional framework.

THE CASE STUDY: THE R&F MODERN SQUARE CHONGQING

Project background

As the change of inner-city land use pattern due to the economic transition did not speed-up until recent years, the selected case, the R&F Modern Square, is a large-scale high-density residential project that was recently completed in the inner-city area of Chongqing. Figure 3 shows the locality of the R&F project in the inner-city of Chongqing. The project is located in the current planned CBD area of Chongqing, underpinned by high investment potential and convenient housing with supporting facilities within walking distance. Product wise, the R&F brand name has received a good reputation in China's residential space markets.

Figure 3 – The locality map of R&F Modern Square, Chongqing



Source: Google map website and site-visit

The project includes two construction areas and two green/public space. Table 2 shows some basic statistics of the project. The project contains eight 33-levels high-rise apartments, two 31-levels high-rise apartments and two 18-levels apartments. Per unit area is ranged from 35 sqm (one bedroom), 68 sqm (two bedrooms) to 131 sqm (four bedrooms). The project also contains 15,000 sqm landscaping, including a 4000 sqm artificial lake. Supporting facilities include an over 4000 sqm supermarket, a 2000 sqm activity centre and a 1000 sqm childcare centre. Property management is regarded as of high quality.

Table 2 – Key features of the project

Project name	R&F Modern Square	Project address	59 New Road Southbank District
Developer	Chongqing R&F Properties Co. Ltd	Property management firm	Guangzhou Tianli Properties Co Ltd
Landscaping	Singapore Paking Landscape Design Co. Ltd	Building type	High-rise
Land area	78,000 sqm	Total built area	274,000 sqm
Residential area	186,000 sqm	Commercial space	84,000 sqm

Plot ratio	3.9	Green coverage	30%
Total number of units	1868	Finishing	Well-done detail
Building density	18%	Price per unit	400 to 830 k RMB
Current sales price average	6200 RMB/sqm	Total car parks	1321
Project commencement	27-Oct-2007	Hand-over date	15-Dec-2008

Source: authors

The developer

The property development industry in China has developed its unique features as it emerges and grows in the immature market environment with the heavy hand of the government due to the economic transition (Wu 2009). Developers naturally become one of the key elements to be studied if we want to evaluate and achieve effective brownfield projects. However perhaps due to the challenge in obtaining reliable information and cooperative observations, with only a few exceptions such as (Coiacetto, 2001, Coiacetto, 2007, Dair and Williams, 2006, Guy and Henneberry, 2002), this important force in any property market has surprisingly attracted relatively limited published research. To assist the current study, a basic review of the developer, the Chongqing R&F Properties Co, suggests that it is a full subsidiary company of the Guangzhou R&F Group as part of its recent national expansion process. The Guangzhou R&F Group was established in 1994 and is one of the largest domestic and privately-held property firms in China. In 2005 it was listed in the Hong Kong Stock Exchange (No. 2777) with a market value over 50 billion HK\$. It is also the first Chinese (mainland) property company joining the Hang Seng China Enterprise Index. The R&F Group has been involved in design, development, project management, agency (sales), property management and almost all facets of the property business in China. In 2006, the company had a total revenue of 12 billion RMB from sales (approximately 1.5 billion US\$), with land reserve exceeding 20 million sqm across the country.

During 2008 and 2009, the company has delivered over 40 projects in southern China region, with an expected floor space of over 5 million sqm. It had developed large-scale residential projects in major cities such as Beijing, Tianjin and Xi'an in the northern China region and currently it has established branch in Chongqing – a city with the population of over thirty million, Chengdu – the capital city of one of the most highly populated provinces in China, and Hainan – China's largest Special Economic Zone. Although a project that is undertaken by one of the leading listed development companies in China may not be typical to be generalized in the process of brownfield development in urban China, but it forms a basis for a conservative study, given the accumulative experience and expertise major domestic developers are able to provide in the past two decades in China. Moreover, a similar project that was completed earlier by the R&F Group was identified in Guangzhou – one of the major cities with a relatively longer history of brownfield projects and also developed, was selected and examined using a similar research approach (Wu and Chen, 2009). This again shows the accumulative nature in brownfield development in major Chinese cities by the market. Hence this research is not only a pilot study of inner-city brownfield development in China; it is also an attempt to understand Chinese domestic developer's perspective on brownfield projects. A theoretical framework is being developed based on detailed (micro) investigations of this nature to track emerging trends and draw a whole picture of the inner-city brownfield issue in China.

Land use history and its transfer process

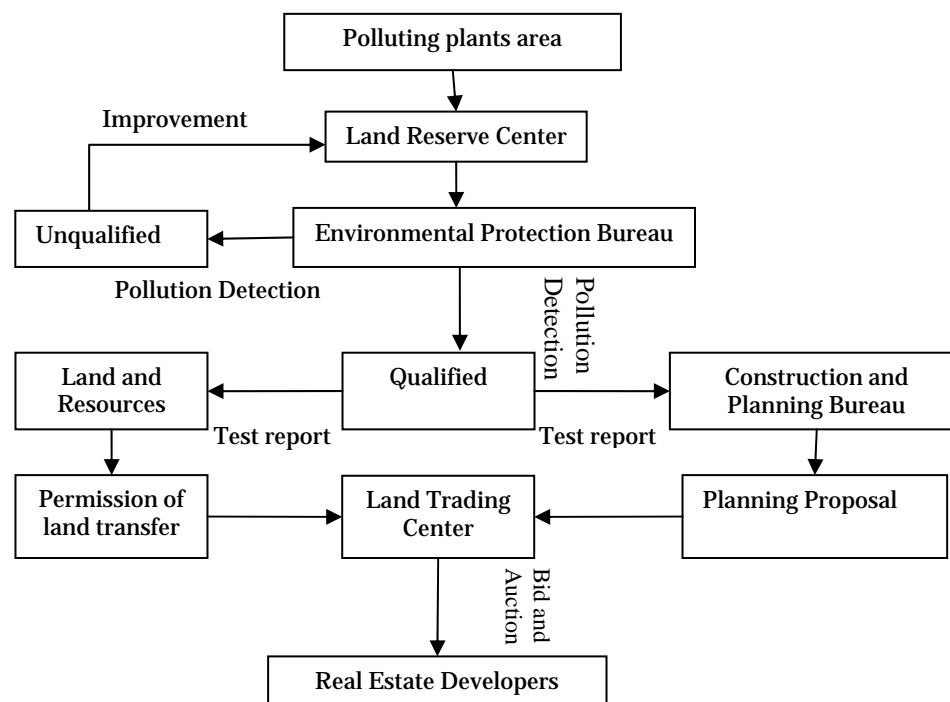
The previous land use, the Chongqing Southwest Pharmaceutical Factory No.2 is located at 59 New Road Southbank District of Chongqing city. It was established in 1958 occupying over 0.89 million sqm, combined chemical materials, pharmaceutical intermediates, botanical extracts, and

solid preparation has long-time generated pollutant-such as phenol, methyl and toluene- affecting the surrounding environment at a range of 2 to 3 kilometers. By 2005, the factory completed its relocation process and the site became vacant from its previous land use. After the site was inspected, it was found by the environmental agency, the Chongqing Environmental Protection Bureau, that the factory did not treat the remaining solid waste during the relocation i.e. no proper disposal of industrial solid waste and hazardous residues. In 10 January 2006, Chongqing R&F Properties bought the land use rights of the site (the original site of Southwest No.2 Pharmaceutical Lab) of 78,000 sqm at 160.47 million RMB (Table 3), using public announcing approach, one of the market approach of land transfer. (See the Ministry of Land Resources Order No.11 (2002) and the State Council Notice (2006) on state-owned urban land transfer methods.) The site is redeveloped into high-density residential project i.e. R&F Modern Square, supplying 0.24 million sqm of residential space. Table 3 captures some of the key parameters in the general land transfer process of the site. And figure 4 shows the general process of the land transfer for this project.

Table 3 The land transfer plan

Site location	Land use	Land area (sqm)	Max built area (sqm)	Max site coverage	Land category	Land transfer general price
59 New Road Southbank District	Commercial residential	78,404	Between 78,404 and 233,196	Not higher than 25%-45%	Commercial 4 Residential 5	160.47 million RMB
Additional notes:	1. Net land area is about 58,300 sqm 2. Planning parameters and requirements can be found in Chongqing Development Land Use Planning Notice (2005) No 0018 and attached maps.					

Figure 4 – The land transfer process



Source: authors

Treatment of pollutant from the previous land use

During the land transfer and the project development stages, the treatment of the contaminated site to suit the proposed residential use is the key focus of this study. The industrial waste was left unattended by the Chongqing Southwest Pharmaceutical Factory during its relocation in 2005. Due to practical constraints such as the lack of fund in treating the pollutants, the Chongqing Land Reserve Centre processed the site before the environmental issue was fully treated. In 2006 the site was sold to Chongqing R&F Properties, who was then responsible for the treatment of the pollutants. The developer did not obtain environmental protection permit prior to the commencement of the project. As the date of land transaction (1-Jan-2006) was before the dates of land transfer policies were published (e.g. the Ministry of Land Resources Order 1-August-2006), the R&F Properties was required to handle the site contamination. However it remains relatively ambiguous on who should be the responsible party in projects of this nature. 2006 was a year of major macro-economic policies to adjust the property industry in China, which seems to push the development sector to take more responsibility in brownfield land development related issues. However the direct cost of being the responsible party is often high. This makes stronger a tension between the restructuring of the urban economy, which facilitates the demand for inner-city brownfield development, and the regulation of the property market and especially the property development industry.

The actual treatment of the contaminated soils on the site was pushed by the environmental agency. The developer removed surface soil, replaced by newly shipped-in soil. The soil containing pollutants was shipped off-site to prevent it from being exposed. The on-site treatment is mainly through plants that may absorb or mitigate the pollutants. According to the environment regulations a project that is commenced before obtaining an Environmental Protection Permit will receive a penalty of maximum 100,000 RMB. However the government also failed to ensure the site is suitable for high-density development before handing it to the developer, therefore relies fully on the developer's capacity to handle any environment issues that is left by the previous land use which is state-owned activity by nature. It is obvious that the amount of penalty is an insignificant amount to developer given the level of profit from central city high-density housing projects. The authors believe if a payment of this nature will reduce or even exempt developer's responsibility to site environmental treatments, it is very likely that the regulation will actually act as a *disincentive* to the developers for their not performing certain roles such as site decontamination that are relevant to the general good of the society. Under this logic, it seems rare for the government in Chongqing to directly fine the developer in clearing up inner-city brownfields. Currently, three forms of control are normally used: (1) environmental evaluation upon project completion; (2) project suspension if pollution problem is found by the environmental agency through its random checking process; (3) the environmental agency has the rights to release land contamination conditions to the public.

Project evaluation and impact

Given the history of the treatment of brownfield site for residential development, the legacy from the previous industrial use has been treated by the developer; however it occurs in a way that the rights and the obligations involved in the process is somehow not fully justified. Regarding the impact of the treatment, property purchasers are likely to concern the potential consequences if the contaminant is aware for not being fully treated. As the land use history details are rarely known by the general public and action had been taken by the developer, buyers until recently have focused more on the quality and prices of the project itself.

Table 4 – Project sales conditions

Building	Sales rate (%)	Building	Sales rate (%)
1	100%	7	50%
2	100%	8	55%
3	100%	9	60%
4	100%	10	100%
5	100%	11	70%
6	60%	12	60%

Source: authors

In terms of sales, the R&F project sales prices at the time of this study has an average of RMB 6200/sqm which is similar to the average price in Chongqing city. The sales records shows a very high clearance rate with six out of the 12 buildings achieved 100% sales, given its recent completion (see table 4). Market demand in Chongqing is clearly evident by the overall 80% clearance rate at the time of this study. Preliminary investigation does not suggest a strong concern among purchasers about the environmental issue in this study. The authors speculate and discuss several possible reasons here:

- (1) the information transparency level is low. Chongqing's environmental effect/impact reports, register information and environmental auditing reports information are not sufficiently exposed to the market, therefore the awareness of the general public on the mentioned issue remains low;
- (2) the project is located in the CBD with high-quality finishing provided by developer which is very attractive in the market in both owner-occupying and investment sense;
- (3) the R&F Group is China's top developer and has 14 years experience in producing high-quality projects nation-wide. This earns the developer good reputation and trust among consumers.

Thus since the developer had openly announced its treatment to the site's industrial legacy, the market, with asymmetry information, believes the issue has been properly treated. The capacity of the developer to handle the public, administrative and financial challenges of projects of this nature seems to be a critical element in major residential projects built on inner-city brownfield sites, and indeed the inner-city regeneration process in China.

DISCUSSION AND CONCLUSIONS

This paper focuses on project, key players and the institutions that are directly relevant to the supply and the redevelopment of inner-city brownfield sites. Inner-city brownfields in China appears to develop unique characteristics that are closely linked to China's economic transition and its consequential industry and economic restructuring. The treatment of the legacy from previous industrial use and its impact on future generation is becoming an important and urgent research problem, given its potential impact on the healthy development of the urban economy and the wellbeing of home-owners and property users.

In recent years, Chongqing has started the process of relocating industrial entities that are no longer suitable to be located in inner-city areas, and are being rapidly replaced by uses that are consistent with current market demand. However, the remains of pollutants from the previous land use are not fully treated during the fast redevelopment process, which raises the potential of negative environmental consequences affecting the sustainable future of major Chinese cities. Through the general review and the case study, the paper shows the government has generated a series of policies relevant to the issue, followed by arranging associated scientific research and

site examination, auditing procedures, aiming at a better treatment of this important issue. Yet much remains to be improved upon e.g. the development of legislation and regulations that are specific to site contamination control and process. China has not had soil environment impact evaluation industry standards – substances such as contents, scope and detailed technical procedures of relevant investigation is not clearly specified. China has not established contaminated land evaluation standards specifically suitable for urban lands. It is also apparent that market and government administrative transparency are both required to be improved upon so that project evaluation, product pricing and policy making can be made more effective and fair.

China under the economic transition faces the relocation of inner-city degraded industry replaced by alternative uses; hence inner-city brownfield development for high-density residential or commercial uses and the pressure of maintaining a healthy urban property market environment are both in play. Previous land user and the government are generally considered the main stakeholders to arrange the relocation as they are the main parties to make and to follow the rules due to the structural change in the transition process. Commercial property developers and current end users are the main parties for the current land use. It remains controversial at the current stage for which party or parties should bear what cost(s) that is left from the previous land use – this tension seems to be reflected in the contrasting policies of the industry relocation and the planning/building standards and policies in the land and property development processes. Also noticed in this pilot study is the lack of fund and resources by the government to support the relocation and site contamination treatment. The pass-on cost(s) to the developers taking inner-city brownfield projects, which in turn fully or partially passed on to occupiers and investors, could potentially be a major issue to be faced in the near future in China's urban consolidation. The process is known to be complex, therefore it appears that not all practical constraints of the mentioned issue can be identified and explained in this paper, which raises the urgency for further questions to be investigated in future studies.

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