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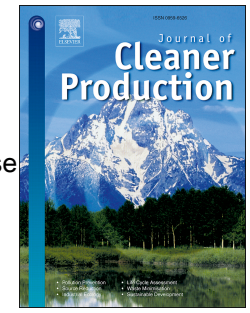

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PII: S0959-6526(16)00055-X

DOI: 10.1016/j.jclepro.2016.01.029

Reference: JCLP 6617

To appear in: *Journal of Cleaner Production*

Received Date: 3 March 2015

Revised Date: 6 January 2016

Accepted Date: 12 January 2016

Please cite this article as: Martinat S, Dvorak P, Frantal B, Klusacek P, Kunc J, Navratil J, Osman R, Tureckova K, Reed M, Sustainable urban development in a city affected by heavy industry and mining? Case study of brownfields in Karvina, Czech Republic, *Journal of Cleaner Production* (2016), doi: 10.1016/j.jclepro.2016.01.029.

wordcount: 9246

Sustainable urban development in a city affected by heavy industry and mining? Case study of brownfields in Karvina, Czech Republic

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Abstract

Due to recent societal changes ‘brownfield’ sites have gradually become a significant element in planning urban development. Brownfields can occur as a barrier and obstacle to the development of the urban organism but simultaneously they also represent unrealized potential. Brownfields, ex-industrial sites, are greater in those cities whose development was based on heavy industry or mining. In the first part of this paper theoretical concepts linked to the regeneration of brownfields are discussed, the second part is devoted to a case study of Karvina, in the Czech Republic, where the driving forces behind the occurrence of brownfields, their spatial distribution, and their prospects for regeneration are analysed. It was found that 28 brownfield sites on 121 hectares are located in surveyed city with the majority having industrial and mining origins. Majority of local brownfields are owned by a local mining company. The perception of individual sites by the local population was ascertained via a questionnaire survey (n=150). This found that awareness about problems connected to brownfields is quite limited and that local population perceive post-mining brownfields,

located in more distant locations, as an opportunity for new industries to create job opportunities in city with significant unemployment problems.

Highlights

Brownfield sites and associated impacts on the urban development of post-industrial cities.
The popularity of industrial usage for post-mining brownfields.
That post-mining landscapes are frequently not perceived as brownfield.
Brownfields located in the peripheral locations are usually disregarded.
The central role of public administration in brownfields regeneration projects.

Keywords

Brownfields; Human Geography; Spatial analysis; Karvina; Czech Republic

1. Introduction

According to official statistics, the Czech Republic has experienced an enormous growth in built-up areas in the last two decades. Almost 4 700 hectares of land have newly been covered by different types of constructions, meaning that the same amount of green space has also been irrecoverably lost. Simultaneously, many abandoned sites of various original uses have appeared as a result of recent societal and economic transitions, in both urban and rural areas. The questions arise whether such ‘wild’ building development at the expense of open landscapes is in line with the proclaimed 'sustainable' development strategies of cities and villages, and whether this form of development threatens the future use of land-based resources. This near-future threat is consistently emphasized by scientists and international organisations, which propose solutions based on more environmentally friendly uses of the landscape. One such direction that could help to reduce such negative development is a systematic and well-planned policy for the regeneration of abandoned sites, for which the term 'brownfields' is usually used. The problem of brownfields has recently raised public debates among representatives of the public administration, private companies, and academia. This issue is increasingly becoming a part of the research agenda of not only geographers (Osman et al., 2015, Frantál et al., 2015a, Kunc et al., 2014a, Hercik et al., 2014) but also of economists (Bartke and Schwarze, 2015, Bartke, 2011; Rydvalová and Žižka, 2006), sociologists (Alexandrescu et al., 2014a, Alexandrescu et al., 2014b), urban planners (Raco and Henderson, 2006), environmental scientists (Carlon et al., 2008), and scientists in technical fields (e.g. Morio et al., 2013). If we focus more on socio-spatially oriented research into brownfields, the following research directions may be stressed: 1) the development of databases with various social, economic, and environmental data on brownfields (e.g., Leigh and Coffin, 2000, Vojvodíková et al., 2011); 2) studies analysing the process of brownfields regeneration and approaches of the public administration in different regions or countries (e.g., Klusáček et al., 2011); 3) studies reacting to the limited financial sources available for the regeneration of brownfields through the development of prioritisations and classifications of these sites (Chrysochoou et al., 2009; Doleželová et al., 2014; Pizzol et al., 2016); 4) studies on the specificities of the spatial development of brownfields within cities (Kunc 2014b, Frantál and Nováková, 2014; Novosák et al., 2013); 5) application of GIS tools to brownfields research (e.g. Sun and Jones, 2013); and 6) studies focusing on analyses of specific types of brownfields according to their original use (agricultural – Krejčí et al., 2014, Klusáček et al., 2013, Klusáček 2014, Skála et al., 2013; military - Hercik et al., 2014; cultural – Andres and Grésillon, 2013, Slach et al., 2013 etc.). From the geographer's point of view, it can be stated that the discipline significantly contributes its expertise in spatial coherences and relations between natural and socioeconomic components of the landscape to deepening knowledge of the various spatial aspects of brownfields. Although the significance

locational context of brownfields has often been underestimated as it is dynamically reshaped by other driving forces, it can be stated that the spatial dimensions of brownfields and their regeneration are of crucial importance (Frantál, et al. 2013).

This paper deals with the issue of brownfields in the city of Karvina, a city where due to its mining and industrial history during the last one and a half centuries, and to dynamic socioeconomic changes in the last two decades, many relicts of industrial and mining activities can be found. In the first part of the paper theoretical concepts linked to the regeneration of brownfields are discussed, while the second part is devoted to the case study of Karvina, where the driving forces behind the occurrence of its brownfields, their spatial distribution, and their regeneration prospects are analysed. Attention has also been paid to the perception of individual sites by the local population, as ascertained in a questionnaire survey. Examples of regeneration projects are then presented. In the third part of the paper, selected results of the questionnaire survey focused on the perception of brownfields and regeneration preferences are analysed. The research questions of the paper were defined as 1) what is structure, distribution, specificities and driving forces of occurrence of brownfields in Karvina, and 2) how brownfields in Karvina are perceived by local population.

2. Theoretical remarks on the problem of brownfields

The National Strategy for Brownfield Regeneration (CzechInvest, 2008) defines brownfields as properties (lands, buildings) that are underused, neglected, and potentially contaminated. They usually occur as the relicts of former industrial, agricultural, residential, military, or other such activities. The above-mentioned strategy also draws attention to the fact that brownfields cannot be appropriately or effectively used until remediation has been carried out. In spite of the fact that brownfields are defined differently in different EU countries (Alker et al., 2000, Oliver et al., 2005, Thornton et al., 2007, Frantál et al. 2012), there is a common agreement in the Czech Republic over the definition of the term. Nevertheless, this methodological variation regularly gives rise to misunderstandings when cross-national analyses of brownfields are conducted (see Frantál et al., 2015b). As stated in the Search Study for the Location of Brownfields in the Czech Republic developed by the CzechInvest Agency in the period 2005-2007 (CzechInvest, 2008), within the territory of the Czech Republic there are 2 355 brownfields covering 10 326 hectares in total. Based on qualified estimations we propose that the number of sites and associated hectares of land is circa 11 700 sites with an area of 38 000 hectares, almost four times higher than the previous estimate. The distribution of these sites within the districts and regions of the Czech Republic is uneven, owing to the different historical and economic developments of individual areas. However, the driving forces behind the occurrence of brownfields in the Czech context are essentially the same across the country. The key processes driving these changes stem from economic transition from central planning towards a market economy at the beginning of the 1990s. Alongside this process, is the shift of the societal paradigm towards a globalised (or Europeanised) post-industrial economy based on a service sector (Dorsey 2003) along highly specialized manufacturing sectors (Turečková, 2014, Domalewski and Baxa, 2015), leaving traditional industrial sites unused. This shift brings increased social risks (Keller, 2011) that have a significant spatial expression, predominantly in densely populated urban areas (Mulíček, et al., 2014) – especially in post-communist cities, where the intensity of the changes is multiplied (Sýkora and Bouzarovski, 2012) - resulting in the displacement and spatial segregation of certain social groups within cities.

It is obvious that consequences of brownfields are not isolated within, or to, given sites. As stated by Kunc et al. (2014), it is indisputable that the wider hinterland of brownfield sites is

notably influenced by such abandoned, neglected, and devastated places, and they interfere with the functioning of the wider urban organism. As evidenced in many studies, the hinterlands of brownfields show greater occurrences of social (e.g., anti-social behaviour, unemployment), economic (decreased market values of land and properties – see Sun and Jones, 2013), environmental (real or perceived contamination), and even psychological (social stigmatisation, fear of crime) impacts. All these coherences strongly affect both local inhabitants and tourists (Navrátil et al., 2013), which make the perception of brownfields quite specific. As Kunc et al. (2011, 2014) demonstrated in their studies on the perception of urban brownfields, differences in the perceptions of brownfields in individual cities in the post-communist context is driven both by the success of the socio-economic transition of given cities in the past two decades and by the educational level of the local population. Kunc et al. (2014) also stress the differing preferences of the population concerning the possibilities for the future use of specific brownfield sites. In cities where a successful economic transition has taken place, housing or green space regeneration is more popular, whilst in cities with economic problems, public support for regeneration projects are focused on new employment possibilities. Specific cases are discussed by Martinat and colleagues (2014, 2015), who focused on the perception of regeneration options for brownfields in cities heavily affected by mining. They point to the vital role of flagship regeneration projects undertaken by the public sector, predominantly in regions with structural problems. The importance of flagship regeneration projects is also discussed by Temelová (2007) in the case of Prague, and in the case of Vienna by De Frantz (2005).

Another approach to brownfield research is represented by Klusáček et al. (2011), who focused their attention on the attitudes of representatives of the public administration towards the regeneration of brownfields. As illustrated by their research, mayors see the position of local administration in the brownfield regeneration process as being negotiators between the clashing interests of different groups of stakeholders, rather than as initiators. Mayors also emphasized the necessity of involving stakeholders in the regeneration process from its earliest stages and of the close cooperation of individual levels of the public administration. A slightly different approach has been employed by Alexandrescu et al. (2014a), who based their research on an investigation of individual brownfield regeneration projects in the Czech Republic, Poland, and Romania. They pointed to the crucial importance of local sociocultural conditions and to the importance of the organisational embeddedness of institutions engaged in the brownfield regeneration process. Barriers to urban brownfield regeneration from the point of view of the city officials are studied by Tintera et al. (2014) in the case of Estonia, stressing the lack of local knowledge of regeneration possibilities and the absence of brownfield regeneration tools as crucial factors, accompanied by the public opinion that brownfields should be regenerated primarily using private funds.

3. Methods and material

The research questions of the paper were defined as 1) what is structure, distribution, specificities and driving forces of occurrence of brownfields in Karvina, and 2) how brownfields in Karvina are perceived by local population.

The step that has to precede any analysis of the spatial consequences of the occurrence and regeneration of brownfields is the development of databases of these sites. In the absence of a centrally administered database for the city of Karvina, it was necessary to create this database from multiple sources. The above-mentioned CzechInvest Agency database of brownfields was an important source of data. The database was developed by the regional administration of the Moravian-Silesian Region and the Regional Development Agency in

Ostrava. Other sources of data included the Integrated Plan for Development of the City of Karvina (2008) and internal materials of the Karvina city administration. The current state of individual sites in this database was verified by field research conducted in early 2014.

Information on the extent, ownership, and former and future uses of all identified brownfields was gathered from multiple sources and verified during an interview with a city representative. For general information about the history and recent development of sites the local press was used. Sites were also classified according to the neighbourhoods in which they are located. Selected socioeconomic data of the individual neighbourhoods was also collected and analysed in the context of existing brownfields. In the second research phase, a questionnaire survey was carried out in order to learn more about the opinions of local people concerning brownfields and to identify their preferences for their regeneration and possible future use. During February and March of 2014, residents of Karvina older than 18 were approached in the city streets, and by means of semi-structured interviews 150 completed questionnaires (comprising 16 questions each) were gathered. During this latter research stage, the educational and gender structure of respondents were kept in reasonable balance (see Table 7). As a consequence of directly approaching respondents, there was a very high success rate for questionnaire completion – circa 90 %. To enable deeper insight into individual sites, the identification of pre-conditions and driving forces behind the occurrence of brownfields in Karvina, local publications focusing on specifics of industrial development in the region were utilized (Dohnal 1968, Kijonka a Rebrova 2005, Chmiel 2010).

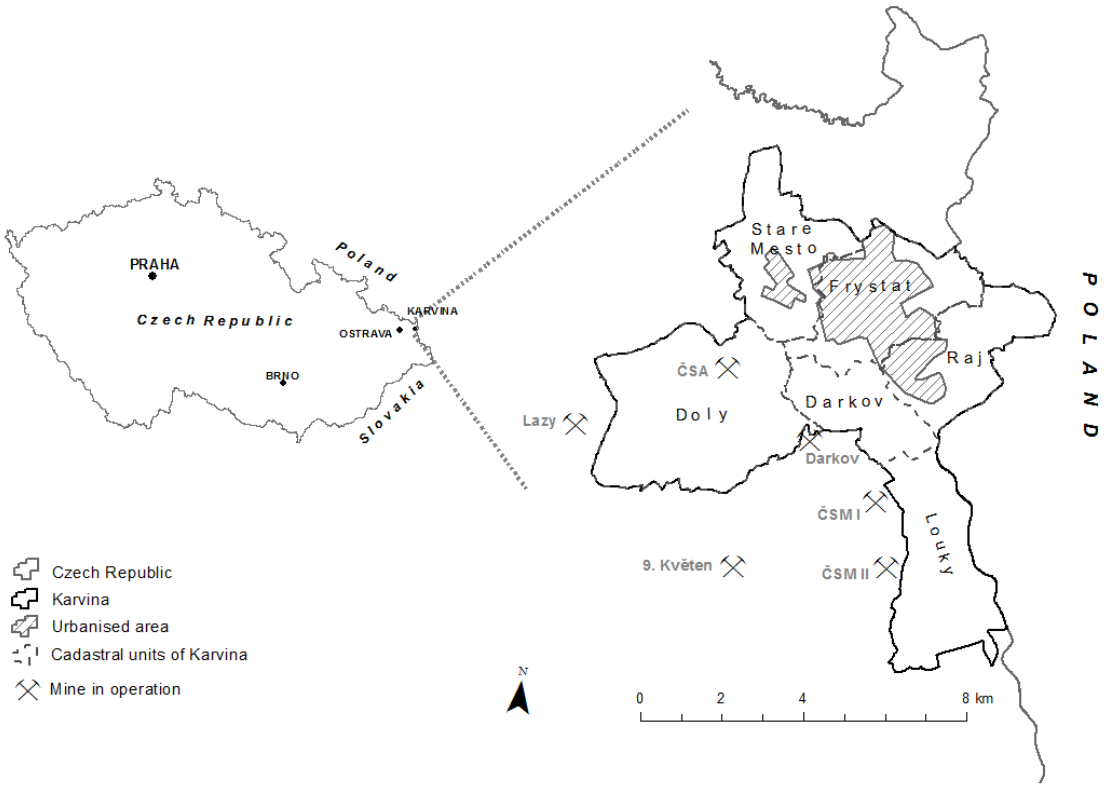
4. Reasons for the occurrence of brownfields in Karvina

Karvina is a city located in Silesia in the eastern part of the Czech Republic, in the immediate vicinity of the Polish border (see Figure 1). The area of the city is 57.5 hectares, with a population of almost 57 000 inhabitants (2014) and the long-term development of mining and heavy industry is the crucial element in the city's urban development. These sectors of the local economy have been configuring the urban structures of the city for more than 150 years. They have influenced the demographic, educational, and social structure and the forms of mass housing such as historical dormitories for miners and later panel housing estates from the 1960-80s, where currently more than 90 % of the city population live. This long-term co-existence of city structures and alongside heavy industries is mirrored in recurring dynamic population expansions and waves of mass migration during mining booms. The peak population was reached in early 1980s at 78 000 people. Relics of urban structures in Karvina can be found dating from the very beginnings of industrialisation at the end of the first half of 19th century but the central impulse for urbanisation has been driven by the local mines and factories. Yet the most intense impacts on urban forms date to the socialist period and the massive support for mining and heavy industries from the state. The most radical effects on the urban landscape can be found in the Doly ('Mines') neighbourhood in the western part of the city, where the original city centre of Karvina was once located. This area was heavily undermined and cleared in the 1950s and 1960s, with its population was moved to the east in the area of Frystat, which became the new city centre of Karvina. Significant impacts from mining can be also found in the neighbourhoods of Louky and Darkov in the southern part of the contemporary city of Karvina, where due to undermining many houses were demolished and artificial lakes created.

After the political changes of 1989 mining activity in the former Czechoslovakia was sharply reduced; mining in the Ostrava-Karvina mining area was affected by these changes. While in the western part of this mining area (Ostrava) the activity had completely disappeared by the middle 1990s. The core of local mining, the only place where black coal has been mined

down to the present, shifted eastward to the Karvina area. Currently the mining company (OKD) operates two mines – Karvina Mine (locality CSA in the western part of the city) and Darkov Mine (in the southern part of the city). The two other mines in operation (ČSM Mine and Karvina Mine in the locality of Lazy) are located within neighbouring cities and municipalities (Orlova, Stonava), yet the mining fields are partly located within Karvina as well. Annual production of coal is here around 8,6 million tons (2014) and is consistently decreasing. On the other hand, the OKD mining company has recently attempted to widen its mining fields to areas with better natural conditions for mining, which is happening at the expense of one neighbourhood of Karvina (Stare Mesto). The mining company has been the most important employer not only in Karvina, with circa 11 000 employees, but in the whole Moravian-Silesian Region. Employment in this sector illustrates the importance of industrial activities for the development of the city. In the early 1990s employment in industry formed 50,3 % of the economically active population, while according to the last available data from 2011, the this has decreased by a half (to 26,5 %), yet the industry still plays an important part in employing the local population. As a consequence of the lack of other employment opportunities in the city, a very high unemployment rate has emerged (14.2 % at the beginning of 2015). The lack of jobs, the high unemployment rate and increased environmental pollution in combination have created the preconditions for outmigration from the city to other cities and regions in the Czech Republic, in the last three decades the population in Karvina has decreased by 27 % in total. Alongside mining metallurgy, metal industry, and engineering have been significant employers in Karvina (the Kavoz, Kovona, Jäkl companies) in the past 100 years, and as recently as the 1990s provided thousands of local people with employment. Today the number of employees in successor companies is much reduced but the sector is still an important employer in the city. Recently lighter industrial activities are gradually arising outside of the traditional industrial areas, in development zones built on greenfields in the northeast part of the city (Stare Mesto), an area which, as already mentioned above, is paradoxically endangered by the further expansion of coal mining (Martinát et al., 2014).

Figure 1. Location of Karvina in the context of the Czech Republic



Source: authors' own processing

5. Spatial patterns of brownfields in Karvina

Within the city of Karvina, the research phase of this article identified 28 sites occupying a total area of 121 hectares that could be called brownfields. Within the Karvina area effects of coal mining such as terrain decreases as a consequence of undermining, hydrological changes in the area, artificial lakes, slag heaps and other impacts have created wider devastated areas that are not taken into consideration in the set of analysed sites because of their specifics. Such wider devastated sites are located in the neighbourhoods of Doly, Darkov, and Louky, and are much larger than the brownfields identified. Nevertheless, for the purposes of this research, due unclear delineation, they have not been taken into account. If we accept this presumption, then the above-mentioned 28 brownfields cover in total 2.1 % of the area of the city. As is clearly illustrated in Table 1, the distribution of brownfields within the individual neighbourhoods of Karvina is strongly uneven.

Table 1. Brownfields in individual neighbourhoods of the city of Karvina

neighbourhood	number of brownfields (2014)	area of brownfields (2014, ha)	share of area of neighbourhood (%)	share of total brownfield area in the city (%)	area and population (2011) (population; km^2)	
Darkov	1	3	0.6	2.5	301	541.8
Doly	8	50.78	3.1	42.0	325	1643.4
Frystat	2	0.7	0.3	0.6	1547	256.1
Hranice	5	13.21	5.1	10.9	8152	259.5
Louky	3	3.43	0.3	2.8	407	991.7
Nove Mesto	4	26.1	10.9	21.6	17163	240.1

Raj	2	18.8	2.4	15.5	16088	771.3
Stare Mesto	3	4.97	0.6	4.1	810	849.9
Mizerov	0	0	0	0	12077	198.3

Source: brownfield database of the CzechInvest Agency; brownfield database of the Moravian-Silesian Region; Integrated Plan for Development of the City of Karvina (2008); internal materials of the city of Karvina; authors' own field research

Brownfields within the city of Karvina can predominantly be found in the neighbourhood Doly, which is located in the western part of the studied area. The neighbourhood is typified by wide post-mining areas with a small population remaining, and covers the former, now demolished, city centre of the original historical settlement of Karvina. Within the Doly neighbourhood brownfields occupy an area of almost 51 hectares. The majority of these sites are post-industrial either former coal mines or a similar use, with a rich history going back to the middle 19th century. Here are the areas of former mines (Jindrich, Gabriela, Barbora and others), former dormitories for miners (U Frantisky, U Barbory), and facilities of mines still in operation, whose functionality is limited or completely abandoned for example the bus station by the CSA Mines and the coking plant located by the CSA Mine). As is apparent from Table 2, in this neighbourhood the population (325 in 2011) has recently, as a consequence of its peripherality and desolation, been reduced by 75 % in the last two decades. The remaining population are mainly socially marginalized and poor, whilst the mining company (OKD) is the largest owner of land and buildings. The area is typical of mining landscapes in its surface manifestations of mining activities as well as in its decreases of terrain as a result of undermining, the occurrence of many artificial lakes, and general changes to hydrological conditions.

Another neighbourhood of Karvina with a strong brownfield presence, covering more than one fifth of the total area of brownfields in the city, is the area of Nove Mesto. As the name indicates (Nove Mesto = New City), this neighbourhood was formed from built-up areas developed in the second half of the 20th century, mainly by prefabricated housing estates. Almost one third of the total population of Karvina (approx. 17 000 people) is concentrated in Nove Mesto, this being the largest section of Karvina by population. The Kovona company with its substantial industrial operations focusing on metal industries used to be located here during the communist era. After the privatization of the Kovona national company keeping the same name in the 1990s, many industrial operations were limited and several buildings abandoned. One part of the area called the Industrial Park, on Zavodni Street, is the only part of this facility presently used. Other examples of brownfields in Nove Mesto are a former concrete mixing plant and a plant for producing prefabricated panels dating from the development of the local housing estates. Yet another example of a brownfield is the former House of Culture, where social events for the local population were formerly organized but which is now abandoned.

More than ten percent of the total area of brownfields in Karvina is located in the Raj (18.8 hectares) and Hranice (13.3 hectares) neighbourhoods. Within Hranice are several post-industrial sites that were part of the Jäkl Company and a former district construction company. Other brownfields are left over from housing; Vagonka, originally villas for officials from the Jäkl iron works in the 1920s, later housing for poor people, were demolished in 2011. Other types of brownfields can be found in Raj, located in the south-eastern part of the city. The largest registered brownfield within Karvina (at 15.5 hectares) was identified here; it is the premises of a former military air defence base named Cerny les and several farms. In the central part of present-day Karvina, thus the Frystat neighbourhood,

there are also some abandoned buildings with specific historical and architectural value such as Janackuv mlyn a mill and, Larischovy konirny formerly stables.

Table 2. Selected demographic characteristics of city parts of Karvina

neighbourhood	population density (2011, population /km^2)	population change (2001-2011, in %)	population change (1991-2011, in %)	change in the number of houses (2001-2011, in %)	age index (2011, 65+/0-14)	economically active population (2011, in %)
Darkov	56	-25.9	-74.8	-19.0	191.7	45.2
Doly	20	-59.9	-75.0	-54.0	84.9	37.2
Frystat	604	8.5	13.0	9.8	169.0	43.8
Hranice	3 141	-9.4	-18.8	17.8	125.4	45.9
Louky	41	-10.2	-39.1	-6.2	204.8	46.9
Nove Mesto	7 150	-11.6	-11.4	1.0	111.6	41.9
Raj	2 086	-14.1	-14.5	7.6	153.5	46.7
Stare Mesto	95	-5.3	0.0	6.8	142.7	45.7
Mizerov	6 090	-14.0	-18.5	0.4	137.8	47.1
Karvina	**989**	**-12.7**	**-16.9**	**1.2**	**132.0**	**45.1**

Source: Czech Statistical Office (Census 1991, 2001, 2011 – www.czso.cz)

Brownfield regeneration projects will always be closely linked to the needs of the local population. As visible in Table 2 and noted above, Karvina is a city that has experienced sharp population decreases in last two decades, losing 13 % of population in the last decade. Despite these population decreases, the number of houses is consistently rising; except in neighbourhoods heavily affected by ongoing mining Doly, Darkov, Louky. It is obvious that the distribution of demographic features among individual city parts also strongly differs. The exception to this trend is in the central part of the city (Frystat), where the population is growing, if we focus more on the age structure using an age index (see Table 2), we can clearly see that the very old, small neighbourhoods heavily affected by mining are populated by elderly people (Darkov, Louky) while the relatively younger city parts (Nove Mesto, Hranice) have a dominance of housing estates from the time of communism. Such a demographic development poses huge problems for the future as concerns services and facilities for elderly people. It seems that this trend should be considered in thinking about regeneration projects, especially in cities with such demographic profiles.

Tables 3-6 provide details on the different aspects of the Karvina brownfields according to a range of criteria. As emerged from the analyses conducted regarding the size of brownfields, the most frequent size category is between 1-3 hectares, whilst the largest total area, more than 20% is covered by brownfields sized between 5-10 hectares. The most frequent previous use of present-day brownfields both by number and by area is industrial (Table 4). Such a result is not very surprising although due to the absence of undermined areas within the database noted above, post-mining brownfields form about one third of the total area of Karvina brownfields, in particular in the Darkov and Doly neighbourhoods. In the context of the recent dramatic decline in agricultural activity in the Czech Republic it is not surprising that agricultural brownfields also form an important part of the database. In the case of Karvina, we refer to former farms in the Louky and Raj neighbourhoods and to abandoned greenhouses in Stare Mesto. The architecturally valuable Larischovy konirny (stables) in

Frystat fall into the same category. A former use in the service sector was identified in four cases (Table 4), nevertheless the classification of several sites is uncertain and some specific sites are hard to classify, such as the bus station by CSA Mine, an abandoned church of St. Barbora in the undermined part of Louky, or an abandoned water tower in Hranice. Whilst the previous use of the brownfields may remain uncertain that same cannot be said for questions of ownership. The majority of sites are owned by private owners, in the case of ex-mining areas and buildings, this is predominantly the mining company OKD itself. Those brownfields under public ownership were identified in just two cases, the Larischovy konirny stables in Frystat and the Vagonka estate in Hranice. A mixed type of brownfield ownership was identified only in the areas around the former Barbora Mine in Doly.

Table 3. Brownfields in Karvina according to their size

size	< 1 ha	1-3 ha	3-5 ha	5-10 ha	> 10 ha
number of sites	3	11	6	5	4
area of sites (ha)	1.5	20.5	21.9	25.7	51.4
share of total area (%)	1.2	16.9	18.1	21.2	42.5

Source: authors' own research and processing

Table 4. Categories of brownfields in Karvina according to previous use

previous use	culture	housing	mining	industry	services	military	agriculture
number of sites	1	3	5	9	5	1	4
area of sites (ha)	1	9.7	37.9	42.2	7.14	15.5	7.6
share of total area (%)	0.8	8.0	31.3	34.9	5.9	12.8	6.3

Source: authors' own research and processing

Table 5. Categories of brownfields in Karvina according to ownership

type of ownership	mixed	private	public
number of sites	3	23	2
area of sites (ha)	19.9	97.1	4
share of total area (%)	16.4	80.2	3.4

Source: authors' own research and processing

The categories of brownfields in Karvina according to the intensity of their contemporary use are shown in Table 6. It can be observed that a partial use of studied sites was identified in one third of brownfields. This type of site was previously used for activities other than solely mining activities, for example other industries or agriculture. It can be observed that the reuse of post-mining brownfields is highly specific and problematic regarding both environmental risks such as undermining, contamination, hydrological changes and their peripheral location. This assumption about environmental problems is supported by analyses of the database. It is in post-mining brownfields in Karvina where contamination is most frequently supposed (see Table 6).

Table 6. Categories of brownfields in Karvina according to contemporary use and contamination

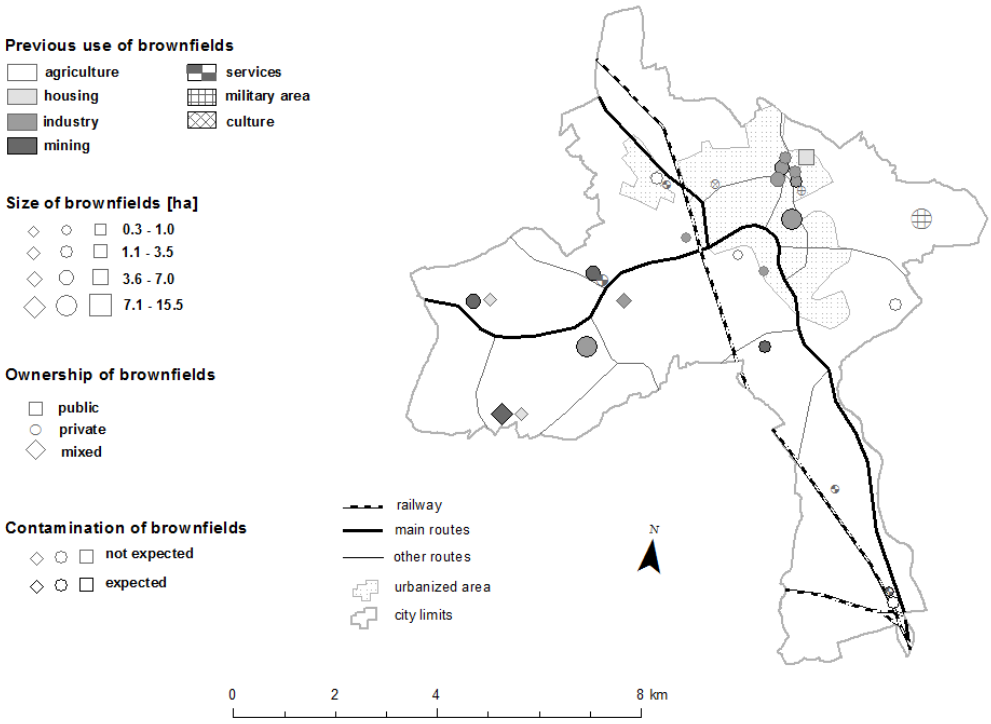
contemporary use	partially used	unused	contamination	supposed	not supposed
number of sites	9	19	number of sites	10	18
area of sites	36.9	84.1	area of sites	60.3	60.7

(ha)			(ha)		
share of total area of sites (%)	30.5	69.5	share of total area of sites (%)	49.8	51.2

Source: authors' own research and processing

Figure 2 presents the spatial distribution of individual types of brownfields in Karvina, as regards their location within the city, size, previous use, type of ownership, and contamination status. It might be observed that while in the built-up areas of Karvina sites of industrial origin prevail such as engineering, metal industry, metallurgy, food industry, the post-mining brownfields are located in the western part of the city (Doly), where settled areas are highly limited. Agricultural brownfields can primarily be found on the outskirts of the city.

Figure 2. Location and basic characteristics of brownfields identified in Karvina



Source: authors' own research and processing

6. Perception of brownfields

An integral part of efforts to make brownfields viable parts of cities again is to customise regeneration plans to the needs of the local population. Such tailored solutions can have a better chance of attracting the population to reuse sites brownfields that that been neglected or abandoned for years or even decades. Surveys of the perceptions of brownfields and on preferences for individual regeneration plans create a suitable platform for deepening our knowledge of regeneration options, possibilities, and their acceptance by groups of stakeholders. Bearing in mind the limited space of this paper, only the key results from the larger survey are presented. The basic segmentation of groups of respondents (n=150) can be seen in Table 7.

Table 7. Basic segmentation criteria of respondents

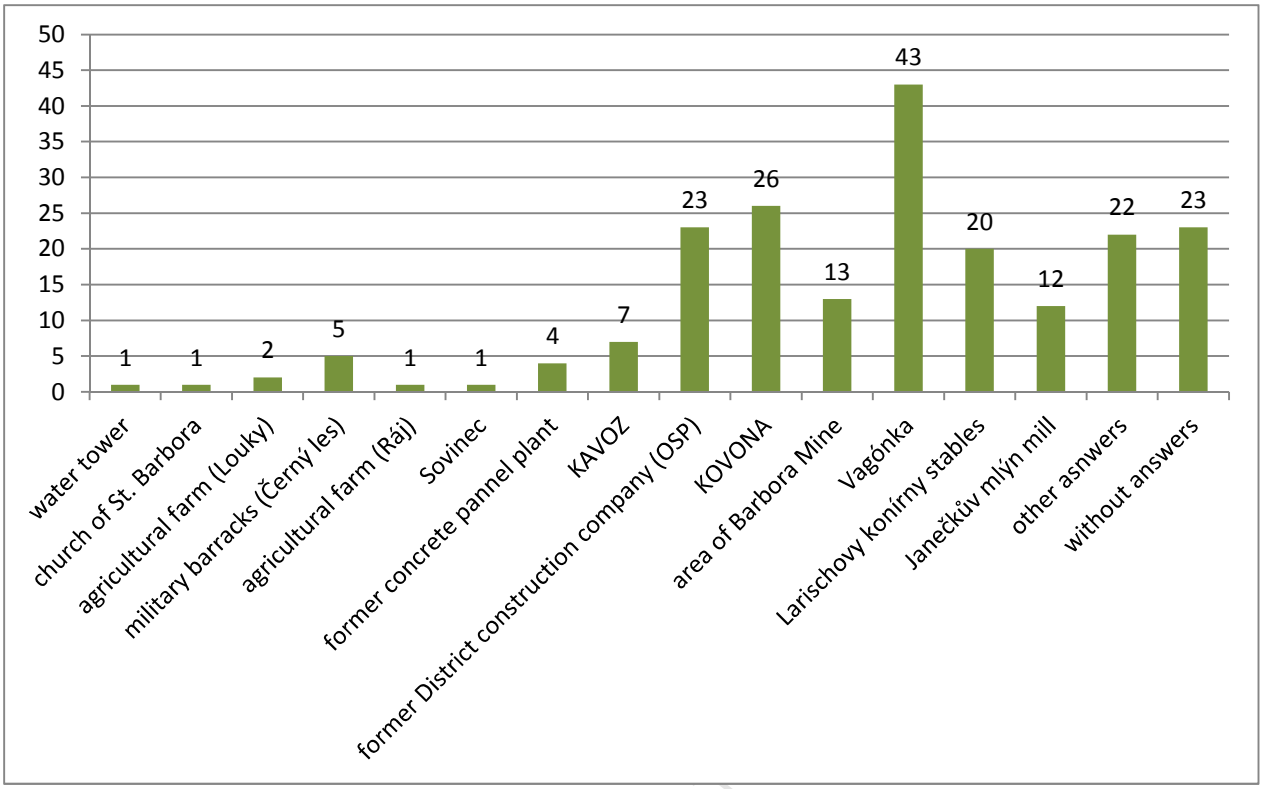
	gender
male	27 %
female	73 %
	age
18-29 years	24 %
30-44 years	28 %
45-59 years	42 %
60-70 years	3 %
above 71 years	3 %
	education
elementary	8 %
secondary without final graduation	33 %
secondary with final graduation	45 %
university	14 %

Source: authors' own processing (n=150)

The first question of the survey was to discern familiarity of the local population with the term 'brownfield' which is quite limited, with just one third (32 %) of respondents answering affirmatively. Almost half the respondents were unable to find the proper answer. This might be caused by the poor educational structure of the Karvina population, according to 2011 census data only 7.4 % of the local population has attained a university education. Yet in comparison to analyses carried out on this topic in 2010 (Kunc et al., 2011) nearby city Ostrava with a comparable relationship with industry less than one fifth of respondents were able to answer positively. Increasing awareness among the population of the term brownfield may be linked with gradually growing discussions in mainstream media on this topic in recent years, when several flagship regeneration projects have been completed such as Vaňkovka shopping mall in Brno, Karolina shopping mall in Ostrava and the Golden Angel project in Prague.

The second question aimed at identifying the specific localities within the city of Karvina that respondents associate with brownfields. The correct definition of the term had been provided after the first question. The question was formulated as an open one and the results were surprising (see Figure 3). Respondents noted fourteen different sites in total. One third mentioned Vagonka, a presently demolished site formerly used as housing for the poor; one fifth of respondents named the premises of the former Kovona Company (metal industries) and the building of the former District Construction Company. Post-mining sites were not mentioned despite the heritage of the industry in the city, only 9 % of all respondents mentioned former mines (the Barbora Mine in Doly) and other post-mining brownfields were not mentioned at all. The large frequency of mentions of the Vagonka site is probably due to the fact of its recent (2011) demolition and former status as a residence for disadvantaged people; it had become a 'hot' issue in Karvina’s media. The other factors explaining the popularity of Vagonka is the location of the post-mining brownfields outside of settled areas of the city in the western and southern parts of the city. This wider area is scarcely inhabited and thus largely out of sight of the inhabitants of Karvina, making the urgency of regeneration for these sites much less, in contrast to the two most frequently referenced localities.

Figure 3. Overview of answers to the question: "Which location comes to your mind in Karvina in connection with the term brownfield?"



Source: authors' own research and processing (n=150)

The next question focused on options for reusing post-mining brownfields, which were supposed to be the most known between respondents. This was partly confounded by the lack of awareness of post-mining brownfields as discussed above. Individual regeneration options were shown and explained to respondents in the form of a list. Respondents then evaluated individual options (see Table 8) with the numbers 1 to 5 (1 = the highest importance and 5 = the lowest importance). For every proposed possibility the average was calculated as the arithmetic mean. The closer the final value of each choice was to 1, the more preferred the given regeneration option was. As is clearly visible in Table 8, the most preferred option for regeneration of post-mining brownfields was new areas for industry. This result can be explained in the context of current social problems, high unemployment, and a lack of jobs that are typical for contemporary Karvina. People would like to see industrial activities in those locations where they were used to commute for work for decades, in locations with good transport accessibility but at a distance from settled areas. The second best option for people was to regenerate post-mining brownfields into green space, which would seem to be the easiest solution. The least preferred option was housing, not surprising, since cities like Karvina are experiencing strong declines in their population and face problems with unoccupied flats rather than a shortage.

Table 8. Potential regeneration options for post-mining brownfields in Karvina as stated by local population

regeneration options	evaluation
for industry	2.12
for urban greenery	2.4
for leisure time and sport activities	2.67
for services	3.55
for housing	3.98

Source: authors' own research and processing (n=150), (1 = the highest importance and 5 = the lowest importance)

It seems that majority of the population of Karvina have adapted to life in proximity of mining activities and the resulting terrain to certain extent. Although the landscape in the western and southern parts of the city is heavily affected by mining, almost two thirds of respondents of our survey agreed with opinion that further expansion of 'mining can´t worsen the current situation'. This might also be expression of resignation of local population who have lost their confidence that the situation might be improved in near future. Lack of other job opportunities for less qualified people means that mining is perceived as the most stable job regardless of the anticipated exhaustion of the reserves in the next two decades. Environmental and health consequences are underestimated or are not seriously taken into account. Representatives of local city administration are supporters of further expansion of mining in the area, even at the expense of residential areas.

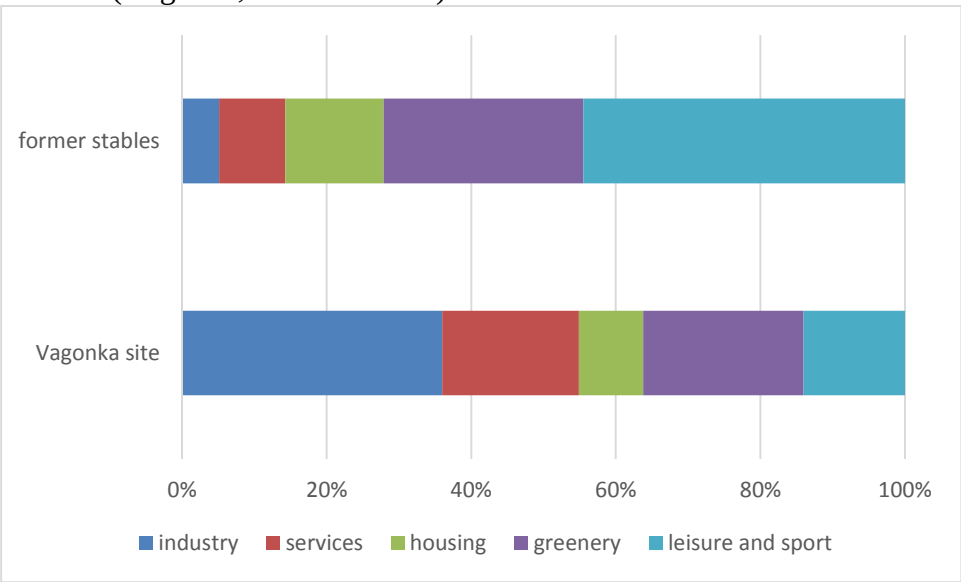
Questions regarding the urgency of regeneration of local brownfields showed a different set of possibilities. It is apparent that the population of Karvina perceives the existence of brownfields within the area of the city as an issue that poses problems for future urban development if not regenerated. Two thirds of respondents consider brownfields a problem of at least medium importance. The same share of respondents (65 %) regard the existence of brownfields as a sign of the decline of the city. This result perhaps reflects that industrial (and mining) activities have significantly influenced all elements of life in city for decades and it is this period which is usually connected in the minds of local residents to the times when the city had the greatest renown and the brownfields highlight is decline.

Moving to the survey results connected to financial sources for brownfield regeneration projects, it can be confidently stated that a majority of respondents (77 %) are convinced that a mix of private and public money is the most suitable way to accelerate brownfield regeneration. Such opinion reflects that the majority of brownfields in Karvina are owned by private companies, only two sites are owned by the public administration, and it seems that the local population believe public bodies should be significantly involved in brownfield regeneration projects. The assumption of the necessity of private money taking a role in the regeneration process supports the results of a question focusing on the satisfaction of the population with the policy of local officials regarding brownfields. A majority of respondents (57 %) consider this policy to be insufficient. An interview with a representative of the city revealed that the possibilities for the public administration to invest money in regenerations are quite limited and also possibilities to interventions in case of private properties is strongly reduced due to legislation settings. This suggests both a gap between the expectations that citizens have of the local state and its capabilities, as well as a failure to communicate those limitations effectively.

A comparison of the results regarding perceptions of possible alternative re-use options for two contrasting sites in the city is revealing. One site located on the margins of city, Vagonka, and one site located in central parts of the city, a former stable. In the case of the Vagonka site re-use for industry and the creation of new jobs, is the most popular, whilst in the case of former stables other functions such as leisure and sport attract more support. Such results correspond to specific functions of different parts of city. This suggestions limitations to re-purposing sites, as it hard for the local population to imagine alternative re-uses of given sites, since they have been used to certain functions from these sites for decades. Public bodies and NGOs will have to work at educational activities to change the attitudes of the

local population concerning alternative re-use, or even interim use, of brownfields. In part this is because there is only a limited tradition of public participation in planning decisions, which perhaps limits the citizen's imagination of their own city.

Figure 4. Comparison of perceptions of individual re-use options of two brownfield sites in Karvina (Vagonka, former stables)



Source: authors' own research and processing (n=150)

7. Concluding remarks

This paper aimed to spatially analyse brownfields in the area of the city of Karvina as an example of city heavily affected by coal mining and industry, and thereby discuss the perceptions of the local population about their city. A database of brownfields with 28 individual brownfields covering 121 hectares in total was developed based on various secondary sources and on field research. An analysis of the developed database was carried out and the whole set of brownfields were categorized and evaluated in relation to their status regarding; previous use, contemporary use, size, ownership, and supposed contamination status. Due to natural and historical conditions post-mining brownfields are primarily located in peripheral locations within the western and southern parts of the city (the Doly, Louky and Darkov neighbourhoods), whilst industrial brownfields can be more found in proximity to a belt of housing estates built up during the socialist era (the Nove Mesto and Hranice neighbourhoods). Specific to the centrally located parts of Karvina (Frystat) are brownfields with historical and architectural value (the Janackuv mlyn mill, the Larischovy konirny stables) about which specific re-use options were formulated by respondents of survey.

The database and survey evidence signals the relevance of the assumption that urban brownfields significantly influence urban development and city structures in a given city. Such sites are of intense interest to local people. Geographical proximity plays crucial role in the perception of the urgency of regeneration of any given brownfield. This finding is the mostly visible in case of post-mining brownfields in Karvina. Karvina is city which is predominantly known in relation to the mining industry but since these sites are located in distant locations from the residential areas of the city, the urgency of their regeneration is perceived as being reduced. Post-mining brownfields are here traditionally perceived as places for production activities as reflected by this being the most preferred option for their use by respondents surveyed, which complicates their alternative re-use. The probability of using these sites for industrial activities is, despite extensive plans, is very low in light of the

existence of other available space in other zones within the city limits and the environmental risks present. The combined efforts of the owners, the state and the residents will be needed to find ways to re-use these sites. This could be through incentives from the local state and the increased activities of the local resident to support such a process. Alternatively, an indirect approach is to showcase those examples that considered to be the best practice of regeneration and gather public support through such a route.

Currently knowledge about the environmental benefits of brownfield regeneration is at a relatively low level. What is lacking is awareness of the social and environmental problems associated with brownfield sites. Policies at the national, regional, and local levels regarding brownfields also show large gaps in how they conceptualise the problem. International experiences, such as with the provisional use of brownfields in cases where hygienic and environmental conditions are not in contradiction, could be also useful (Haase and Rall, 2011; Martinat et al., 2014). In this regard several regeneration projects that have already been executed within the area of the city of Karvina could also be mentioned. Some of them have increased public discussion about their usefulness. While the project focusing on the development of the industrial zone Nova Pole in the Stare Mesto neighbourhood is perceived by the population positively, because of its creation of new jobs, whilst the development of a golf resort on undermined areas in Lipiny (Frystat neighbourhood) has raised debates about whether public support should be used in this kind of project. Among other projects currently in their preparatory phase the Darkov lake project is illustrative. The aim is to build a leisure zone around an artificial lake in the Darkov neighbourhood, which was heavily affected by undermining. As another beneficial project is the "Footprints of Original Karvina", which aims at building educational trails and cycle paths in areas in the Doly neighbourhood heavily affected by mining, which is enabling at least the partial use of this area. Another project in preparation is the planned industrial zone Nad Barborou, also in Doly. It is necessary to add that in some post-mining brownfield sites with significant environmental issues re-naturalisation is the only option.

Finally, in the planning, preparation, implementation, and subsequent operation of a regeneration project, is it necessary to provide for the participation of the local community, whose opinion is crucial to the success of any project. New re-use options should be acceptable to the local population in order to make new developments and sites truly viable again.

Acknowledgement

Research was kindly supported by the project with title New methods for the more effective regeneration of brownfields to enable optimizing of the decision making processes (TD020259) that is funded by the Technology Agency of the Czech Republic, by the Ministry of Education, Youth and Sports within the Institutional Support for Long-term Development of a Research Organization in 2015 (School of Business Administration in Karvina, Silesian university in Opava) and by project with title Multifunctionality as an approach to the development of differentiated rural areas, which was funded by the Internal Grant Agency (IGA) of the Faculty of Regional Development and International Studies Mendel University in Brno (2014).

References

Alexandrescu, F., Martinát, S., Klusáček, P., Bartke, S., 2014a. The Path From Passivity Toward Entrepreneurship: Public Sector Actors in Brownfield Regeneration Processes in

Central and Eastern Europe. Organization & Environment, 27(2), 181-201. doi:10.1177/1086026614529436.

Alexandrescu, F., Bleicher, A., Weiss, V., 2014b. Transdisciplinarity in Practice: The Emergence and Resolution of Dissonances in Collaborative Research on Brownfield Regeneration, Interdisciplinary Science Reviews, 39(4), 307-322.

Andres, L., Grésillon, B., 2013. Cultural brownfields in European cities: a new mainstream object for cultural and urban policies. International Journal of Cultural policy, 19(1), 40-62.

Alker, S., Joy, V., Roberts, P., Smith, N., 2000. The definition of brownfield. Journal of Environmental Planning and Management, 43(1), 49-69.

Bartke, S., 2011. Valuation of market uncertainties for contaminated land. International Journal of Strategic Property Management, 15(4), 356-378. Doi: 10.3846/1648715X.2011.633771.

Bartke, S., Schwarze, R., 2015. No perfect tools: Trade-offs of sustainability principles and user requirements in designing support tools for land-use decisions between greenfields and brownfields. Journal of Environmental Management, 153, 11-24. Doi: 10.1016/j.jenvman.2015.01.040

Carlon, C., Pizzol, L., Critto, A., Marcomini, A., 2008. A spatial risk assessment methodology to support the remediation of contaminated land. Environment international, 34(3), 397-411.

CZECHINVEST. Národní strategie regenerace brownfieldů. Praha: Ministerstvo průmyslu a obchodu. 2008, 12 pp.

De Frantz, M., 2005. From cultural regeneration to discursive governance: constructing the flagship of the 'Museumsquartier Vienna'as a plural symbol of change. International Journal of Urban and Regional Research, 29(1), 50-66.

Dohnal, M., 1968. Sborník příspěvků k dějinám a výstavbě města. Karviná: Městský národní výbor, 1968, 326 pp.

Doleželová, L., Hadlač, M., Kadlecová, M., Martinát, S., Polednik, M., 2014. Redevelopment potential of brownfields: A-B-C model and its practical application. E+M Ekonomie a management. 2014, 18(2), 33-44.

Domalewski, P., Baxa, J., 2015. The development of regional differentiation of office construction in the Czech Republic: 1990–2010. Moravian Geographical Reports, 23(1), 21-33.

Dorsey, J.W., 2003. Brownfields and greenfields: the intersection of sustainable development and environmental stewardship. Environmental Practice, 5(1), 69-76.

Integrovaný plán rozvoje města Karviná. Změnová verze. [online]. 2008 [cit. 2014-4-13]. Available from <http://www.karvina.cz/portal/page/portal/uvodni_stranka/magistrat/zakladni_dokumenty/rozvoj_mesta/INTEGROVAN%C3%9D%20PL%C3%81N%20ROZVOJE%20M%C4%9ASTA%20KARVIN%C3%81.pdf>.

Databáze brownfields Moravskoslezského kraje. [online]. 2012 [cit. 2014-4-14]. Available from: <http://podnikatel.kr-moravskoslezsky.cz/databaze_brownfields.html>.

Frantál, B., Greer-Wooten, B., Klusáček, P., Krejčí, T., Kunc, J., Martinát, S., 2015a. Exploring spatial patterns of urban brownfields regeneration: The case of Brno, Czech Republic. Cities, 44, 9-18. Doi:10.1016/j.cities.2014.12.007.

Frantál, B., Kunc, J., Klusáček, P., Martinát, S., 2015b. Assessing Success Factors of Brownfields Regeneration: Inter-national and Inter-stakeholder Perspective. Transylvanian Review of Administrative Sciences, 44E, 91-107.

Frantál, B., Klusáček, P., Kunc, J., Martinát, S., 2012. Report on results of survey on brownfield regeneration and statistical analysis. Deliverable D3.1 of the TIMBRE FP7 project no. 265364 - Tailored Improvement of brownfields regeneration in Europe - www.timbre-project.eu.

675 Frantál, B., Nováková, E., 2014. A curse of coal? Exploring unintended regional
676 consequences of coal energy in the Czech Republic. Moravian Geographical Reports, 22(2),
677 55-65.Frantál, B., Kunc, J., Nováková, E., Klusáček, P., Martinát, S., Osman, R., 2013.
678 Location Matters Exploring Brownfields Regeneration in a Spatial Context (A Case Study of
679 the South Moravian Region, Czech Republic). Moravian Geographical Reports, 21(2), 5-19.
680 Haase, D., Rall, E.L., 2011. Creative intervention in a dynamic city: A sustainability
681 assessment of an interim use strategy for brownfields in Leipzig, Germany. Landscape and
682 Urban Planning, 100(3), 189-201.
683 Hercik, J., Šimáček, P., Szczyrba, Z., Smolová, I., 2014. Military brownfields in the Czech
684 Republic and the potential for their revitalisation, focused on their residential function.
685 Quaestiones Geographicae, 33(2), 127-138.
686 Chmiel, J., 2010. Karviná – Darkov. Český Těšín: Pro Print, 2010.
687 Keller, J., 2011. Koncept postindustriální společnosti a jeho slabiny. Sociológia, 43, 323-337
688 Kijonka, E., Rebrová, A., 2005. Karviná: město v kráse památek. Karviná: Magistrát města
689 Karviné, 2005.
690 Krzysztofik, R., Kantor-Pietraga, I., Spórna, T. 2013. A dynamic approach to the typology of
691 functional derelict areas (Sosnowiec, Poland). Moravian Geographical Reports, 21(2), 20 –
692 35.
693 Klusáček, P., Krejčí, T., Martinát, S., Kunc, J., Osman, R., Frantál, B., 2013. Regeneration of
694 agricultural brownfields in the Czech Republic – case study of the Czech Republic. Acta
695 Universitatis Agriculturae et Silviculturae Mendelulianae Brunensis, 61(2), 549-561.
696 Klusáček, P., Havlíček, M., Dvořák, P., Kunc, J., Martinát, S., Tonev, P., 2014. From Wasted
697 Land to Megawatts: How to Convert Brownfields Into Solar Power Plants (the Case of the
698 Czech Republic). Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,
699 62(3), 517-528.
700 Klusáček, P., Krejčí, P., Kunc, J., Martinát, S., Nováková, E., 2011. The post-industrial
701 landscape in relation to local self-government in the Czech Republic. Moravian Geographical
702 Reports, 19(4), 8-28.
703 Kunc, J., Klusáček, P., Martinát, S., 2011. Percepce a lokalizace urbánních brownfields:
704 podobnosti a rozdíly na příkladu Brna a Ostravy. Urbanismus a územní rozvoj, 14(1), 13-17.
705 Kunc, J., Navrátil, J., Tonev, P., Frantál, B., Klusáček, P., Martinát, S., Havlíček, M., Černík,
706 J., 2014b. Perception of urban renewal: Reflexions and coherences of socio-spatial patterns
707 (Brno, Czech Republic). Geographia Technica, 9(1), 66 - 77.
708 Kunc, J., Martinát, S., Tonev, P., Frantál, B., 2014a. Destiny of urban brownfields: Spatial
709 patterns and perceived consequences of post-socialistic deindustrialization. Transylvanian
710 Review of Administrative Sciences. 41E, 109–128.
711 Leigh, N. G., Coffin, S. L., 2000. How many brownfields are there? Building an industrial
712 legacy database. Journal of Urban Technology, 7(3), 1-18.
713 Krejčí, T., Klusáček, P., Martinát, S., & Havlíček, M., 2014. Úvodní poznámky k výzkumu
714 osudu cukrovarnických brownfields v České republice. Listy Cukrovarnicke a Reparske,
715 130(12), 406-411.
716 Martinát, S., Navrátil, J., Dvořák, P., Klusáček, P., Kulla, M., Kunc, J., Havlíček, M., 2014.
717 The expansion of coal mining in the depression areas – a way to develoment? Human
718 Geographies, 8 (1), 5-15. Doi: 10.5719/hgeo.2014.81.5
719 Martinát, S., Krejčí, T., Klusáček, P., Dohnal, T., Kunc, J., 2014. Brownfields and tourism:
720 contributions and barriers from the point of view of tourists. Proceedings of conference Public
721 recreation and landscape protection - with man hand in hand? (RaOP 2014), Brno: Mendel
722 University, Brno, 59-65.

Martinát, S., Kunc, J., Klusáček, P., Krejčí, T., Navrátil, J., Vnenková, J., Černík, J., 2015. Spatial relations and perception of brownfields in old industrial region: case study of Svinov (Ostrava, Czech Republic). Geographia Technica, 10(2), 66-77

Morio, M.,Schädler, S., Finkel, M., 2013, Applying a multi-criteria genetic algorithm framework for brownfield reuse optimization: Improving redevelopment options based on stakeholder preferences. Journal of Enviromental Management, 130, 331–346.

Mulíček, O., Osman, R., Seidenglanz, D., 2014. Urban rhythms: A chronotopic approach to urban timespace. Time & Society, Doi:10.1177/0961463X14535905.

Navrátil, J., Pícha, K., Martinát, S., Knotek, J., Kučera, T., Balounová, Z., White Baravalle Gilliam, Švec, R., Rajchard, J., 2013. A Model for the Identification of Areas Favourable for the Development of Tourism: A Case Study of the Šumava Mts. and South Bohemia Tourist Regions (Czech Republic). Moravian Geographical Reports, 21(1), 25-40.

Novosák, J., Hájek, O., Nekolová, J., Bednář, P., 2013. The spatial pattern of brownfields and characteristics of redeveloped sites in the Ostrava metropolitan area (Czech Republic). Moravian Geographical Reports, 21(2), 36–45.

Oliver, L., Ferber, U., Grimski, D., Millar, K., Nathanail, P., 2005. The scale and nature of European brownfields. CABERNET 2005 - International Conference on Managing Urban Land. LQM Ltd, Nottingham, UK, Belfast, Northern Ireland, UK.

Osman, R., Frantál, B., Klusáček, P., Kunc, J., Martinát, S., 2015. Factors affecting brownfield regeneration in post-socialist space: The case of the Czech Republic. Land Use Policy, 48, 309-316.

Pizzol, L., Zabeo, A., Klusáček, P., Giubilato, E., Critto, A., Frantál, B., Martinát, S, Kunc, J., Osman, R., Bartke, S., 2016. Timbre Brownfield Prioritization Tool to support effective brownfield regeneration. Journal of environmental management, 166, 178-192.

Raco, M., Henderson, S., 2006. Sustainable urban planning and the brownfield development process in the United Kingdom: Lessons from the Thames Gateway. Local Environment, 11(5), 499-513.

Rydvalová, P., Žižka, M., 2006. Ekonomické souvislosti revitalizace brownfields. Politická ekonomie, 5, 632-644.

Skála, J., Vácha, R., Čechmánková, J., Horváthová, V., 2013, Various Aspects of the Genesis and Perspectives on Agricultural Brownfields in the Czech Republic. Moravian Geographical Reports, 21(2), 46-55.

Slach, O., Boruta, T., Koutský, J., Bednář, P., 2013. Stodolní ulice à Ostrava: un exemple de régénération du centre d'une ville post-socialiste en République tchèque. Naissance d'un quartier culturel ou d'un espace de consommation? Territoire en Mouvement, 17, 52-72.

Sun, W., Jones, B., 2013. Using multi-scale spatial and statistical analysis to assess the effects of brownfield redevelopment on surrounding residential property values in Milwaukee county, USA. Moravian Geographical Reports, 21(2), 56-64.

Temelová, J., 2007. Flagship developments and the physical upgrading of the post-socialist inner city: the Golden Angel project in Prague. Geografiska Annaler: Series B, Human Geography, 89(2), 169-181.

Tintěra, J., Ruus, A., Tohvri, E., Kotval, Z., 2014. Urban Brownfields in Estonia: Scope, Consequences and Redevelopment Barriers as Perceived by Local Governments/Urbánní brownfieldy v Estonsku: rozsah, dopady a revitalizační bariéry z pohledu městských samospráv. Moravian Geographical Reports, 22(4), 25-38.

Thornton, G. J., Nathanail, C. P., Franz, M., Pahlen, G., 2007. The development of a brownfield-specific sustainability and indicator framework for regenerating sites: proposing a new definition of'sustainable brownfield regeneration. Land Contamination & Reclamation, 15(1), 41-54.

772 Turečková, K., 2014. Quaternary Sector as a Source of Growth and Competitiveness in the
773 EU. Proceedings of the 2nd international konference on European integration 2014 (ICEI
774 2014). Technical University of Ostrava, Ostrava, 723-730.
775 Vojvodíková, B., Potužník, M., Bürgermeisterová, R., 2011. The database on brownfields in
776 Ostrava (Czech Republic): Some approaches to categorization. Moravian Geographical
777 Reports, 19(4), 50-60.