

BROWNFIELD REPORT MAGDEBURG-ROTHENSEE

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1 Magdeburg Functional Urban Area: General Context and Mapping of Brownfield Sites

1.1 Location and Structural Characteristics

In terms of the area it encompasses, Saxony-Anhalt is not one of the smaller German states. However, with a population of just 2.2 Million (3 % of the population of Germany) and a population density of 109 people per km², it is one of the most rural and sparsely populated regions in Germany. The Halle (Saale) region in the southern part of the state and the Magdeburg region to the north are the only two more densely populated urban centres. Saxony-Anhalt's economic indicators are significantly lower than the federal average. Unemployment in 2015 was 9,0 % in December 2016 (Germany: 5,8 %), and the gross domestic product (GDP) per capita in 2014 was just 24,650 EUR (Germany: 36,450 EUR).

Magdeburg, the state capital of Saxony-Anhalt, lies approximately 150 km away from the conurbations of Hanover-Braunschweig-Wolfsburg to the west, Berlin-Potsdam to the east and Leipzig-Halle to the south. The Magdeburg region or functional urban area (FUA) comprises the city of Magdeburg itself, which is the state capital and the three adjacent districts of Börde, Jerichower Land and Salzland. Figure 1 shows the position of the Magdeburg FUA (yellow outline) within the state of Saxony-Anhalt. The region is centred on the state capital. In December 2015, the region was home to some 700,000 residents (31% of the population of Saxony-Anhalt) of which around 240,000 lived in the city of Magdeburg. The average population density within the FUA is 86 people per km².



Fig. 1: Rural and urban districts of Saxony-Anhalt

Source: Ministry of Regional Development and Transport, Saxony-Anhalt



In the largely rural surrounding region, around two thirds of the area are used for agriculture and a further 20 per cent are forested. Magdeburg Bay, also known as Magdeburger Börde, is a fertile landscape that has always had a pronounced agricultural character. In addition, the Magdeburg FUA developed into a machine and plant engineering centre during the 19th and 20th centuries. In the wake of economic structural transformation over the past few decades, the current industrial focus has shifted more towards service provision and logistics operations. In this context, the region benefits from good connectivity to the main road, rail and waterway transportation networks (Figure 2)

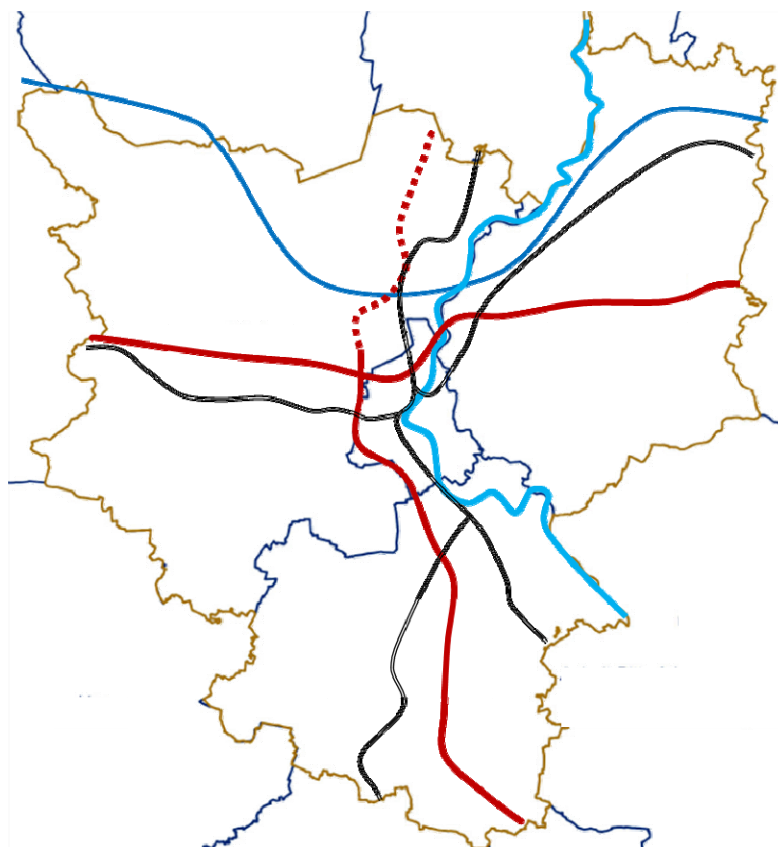


Fig. 2: Main transport networks of Magdeburg FUA (Red: Motorway, Blue: Waterway, Black: Railway)

Quelle: Ministerium für Landesentwicklung und Verkehr Sachsen-Anhalt

As a legacy of industrial and military activities in the area, there are currently some 4549 suspected contamination sites within the Magdeburg region, none of which has been thoroughly investigated. Whilst this figure appears to be extremely high, it includes a large number of small sites. Risk analyses have already been undertaken at a further 804 sites of suspected contamination. Dangerous levels of contamination were indeed discovered at 331 locations, whereas the suspicions about the remaining 473 sites were not confirmed. Of the confirmed contaminated sites, 184 have already been cleaned up, 45 are still undergoing remediation and 102 are still heavily polluted. Figure 3 provides an overview of the confirmed and suspected contaminated sites of in the Magdeburg FUA.

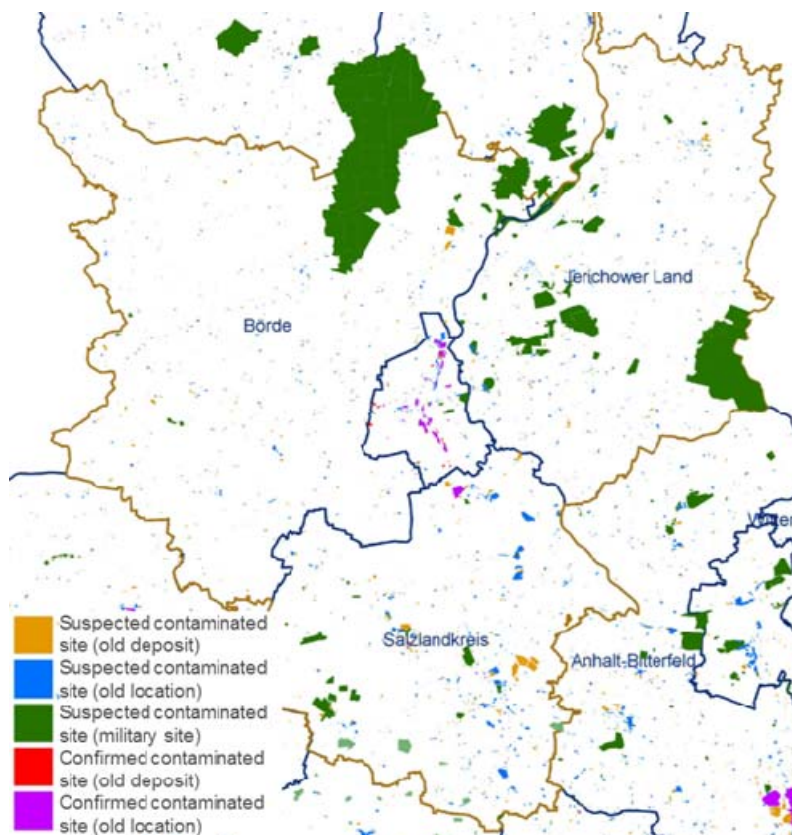


Fig. 3: Confirmed and suspected contaminated sites in the FUA

Source: Image based on data from the Saxony-Anhalt State Office for the Environment (Datei schädlicher Bodenveränderungen und Altlasten)

1.2 Economic Structure and Contaminated Sites

1.2.1 Börde District

The Börde district is situated to the north west of Magdeburg. With a resident population of around 170,000 and an area of about 2400 km², the population density is 73 people per km² (2015). The unemployment rate in December 2016 was 6,5 %, which represents the lowest rate of all districts in Saxony-Anhalt. The GDP per capita for 2014 was 25,829 EUR. As such, the Börde district has the highest economic force per resident out of all three surrounding districts. In addition to agriculture, the most important sectors of the economy are potash mining as well as machine and plant engineering.

Important firms and businesses:

- AWH Armaturenwerk Hötensleben GmbH: Manufacturers of stainless steel components for the food, chemical and pharmaceutical industries (located at this site since 1900)
- IFA Rotorion - Holding GmbH, Haldensleben: Manufacturers of articulated parts and shafts for the automotive industry
- K+S Kali GmbH, Kaliwerk Zielitz: The largest potash mining operation in Germany (1700 employees)
- WILO SE, Oschersleben: Producers of pumps and pumping systems (located at this site since 1897)

There are 1217 suspected contaminated sites within the Börde district, none of which has been investigated as yet. Out of the 16 suspected sites that have already been analysed, 10 of them were found to be clean and safe. Of the 6 sites that were found to harbour dangerous contaminants, five have already been decontaminated and only one has not yet been sanitised.



1.2.2 Jerichower Land District

The Jerichower Land administrative district is situated to the north west of Magdeburg. With a resident population of around 90,000 and an area of about 1,600 km², the population density is just 58 people per km² (2015). This is the lowest level in any of the three districts. Unemployment in December 2016 was 8,4 %. The GDP per capita for 2014 was 23,118 EUR. Due to the area's propitious agricultural conditions, several food industry corporations have been established there. Moreover, Jerichower Land district is well connected to the River Elbe, the Elbe-Havel-Canal und Mittellandkanal waterways, which was beneficial for the shipbuilding industry. Other sectors represented within the district are the metalworking industry as well as machine and plant engineering.

Important firms and businesses:

- Burger Knäcke GmbH + Co. KG: The first ever German crisp bread factory (located at this site since 1931)
- Schiffswerft Bolle GmbH Derben: Shipbuilders (located at this site since 1861)
- Schiffswerft Hermann Barthel GmbH: Shipbuilders (located at this site since 1799)
- Stahl- und Apparatebau Genthin (STAG GmbH): Manufacturers of liquid gas containers
- STREICHER Drilling Technology GmbH, Gommern: Drilling technology
- Walzwerk Burg GmbH: Manufacturers of stainless steel sheeting

There are currently 1728 suspected contaminated sites within the Jerichower Land district. Out of the 49 suspected sites that have already been analysed, 8 of them were found to be clean and safe. All 41 sites that were found to be contaminated have already undergone remediation.

1.2.3 Salzland District

The Salzland Administrative District is situated to the south of Magdeburg. With a resident population of around 200,000 and an area of about 1,400 km², the population density is 138 people per km² (2015). This represents the highest population density level among the three districts. The unemployment rate in December 2016 was 10,7 %, which represents the highest rate within the Magdeburg region. With a GDP per capita of just 22,196 EUR (2014) the Salzland district has the lowest economic power per capita within the region. In addition to agriculture and the food industry, the economic structure is also dominated by the mining and extraction of raw materials as well as production and processing firms. Nevertheless, a number of industrial firms that had been rich in tradition failed to survive the transition to the market economy following the reunification of Germany.

Important firms and businesses:

- Cargill Deutschland GmbH, Barby: Producers of glucose syrup, wheat starch, wheat gluten as well as alcohol
- Chiech SA, Sodawerk Staßfurt: Soda production (located at this site since 1882)
- European Salt Company GmbH & Co. KG, Steinsalzbergwerk Bernburg: Food-grade salt extraction
- Landmaschinen Roschwitz GmbH: Manufacturers of agricultural machinery (located at this site since 1897)
- SK Schönebeck - Lapua GmbH, Schönebeck: Producers of sport and hunting munition
- Solvay Chemicals GmbH, Sodawerk Bernburg: Soda production (located at this site since 1883)

The Salzland district is home to 1441 sites of suspected contamination which have not yet been investigated, and a further 404 which have been examined. Remediation work has already been completed at 47 sites with dangerous levels of contamination. Seven sites are currently undergoing decontamination, and 14 sites remain polluted. In the case of 336 locations, the relevant investigations revealed no dangerous contamination.



1.2.4 Magdeburg, State Capital of Saxony-Anhalt

Initially, the economic development of Magdeburg benefited from the favourable agricultural conditions in the Börde region as well as the intersection of important long-distance roads and waterways (the river Elbe). As a result, Magdeburg came to occupy a significant position in the European grain trade. Magdeburg's position as a transport hub was reinforced through the expansion of the waterway network in the 18th century (first the Elbe-Havel-Canal and later the Mittellandkanal) and again following the introduction of the railway in the 19th century. Magdeburg developed into an inland staging port for the main seaport port in Hamburg, whose functions entailed cargo handling and warehousing.

As a location it also played a role in early industrialisation becoming a major centre for machine engineering and the food industry. During the Third Reich era, the economy was increasingly adapted to the production of armaments. Among other things produced at this time were aircraft engines (Junkers), armoured vehicles (Krupp-Gruson), munitions (Polte), and synthetic fuel (BRABAG). Allied carpet bombing during the Second World War wrought great destruction in Magdeburg. During the post-war/GDR (German Democratic Republic) era, Magdeburg returned to the machine engineering tradition but refocused on the production of heavy plant. The lion's share of the gross value added by Magdeburg-based industrial enterprises in 1975 was generated by machine and automotive engineering (42 %), the food industry (29 %), and the chemical industry (8 %). However, industrial production during the Socialist era resulted in significant environmental damage. The market economy transition, which began in 1990, was accompanied by heavy job losses followed by the closure of many companies.

With a resident population of around 240,000 and an area of about 200 km², the population density of Magdeburg is 1,173 people per km² (2015). Unemployment in December 2016 was 9,7 %. The per capita GDP for 2014 was 23,118 EUR. As an economic location, Magdeburg continues to be dominated by the machine engineering tradition. Employing a total workforce in excess of 11,000 spread over some 60 businesses, machine and plant engineering is Magdeburg's biggest economic sector. Other important sectors are logistics and services.

Important firms and businesses:

- Enercon GmbH: Manufacturer of wind power turbines (over 5000 employees)
- FAM Magdeburger Förderanlagen und Baumaschinen GmbH: Manufacturer of conveyor systems and construction plant (1900 employees)
- GETEC Energie Holding GmbH: Energy services provider (1000 employees)
- Nordlam GmbH: Timber processing industry
- Regiocom GmbH: IT services provision
- Rothenseer Rotorblattfertigung GmbH: Manufacturer of wind power turbines

Within the environs of the city of Magdeburg, there are still 163 suspected contamination sites that have not yet been investigated. Out of 335 suspected contamination cases, 216 sites were found to be harbouring dangerous contaminants. 91 locations have already been cleaned up, 38 others are currently undergoing remediation, and 87 are still polluted. No legacy contamination was discovered at any of the remaining 119 sites that have been scrutinised.



1.3 Remediation of Contaminated Sites in Saxony-Anhalt

Founded in 2000, the Brownfield Authority Saxony-Anhalt (LAF), a state office for the remediation of contaminated sites, is responsible for environmental decontamination and remediation in Saxony-Anhalt. The foundation of the LAF represented the creation of a specialised institution whose objective is the bundling of complex tasks associated with the elimination of legacy contaminated sites so as to provide targeted support for potential investors. The LAF is responsible for decisions pertaining to exemption applications pursuant to environmental framework legislation, for the implementation of all tasks associated with the approvals as well as for settling the costs following the completion of these tasks. The exemption indemnifies the investor, partially or in full, against the risk of a heavy cost burden resulting from legacy ecological liabilities incurred prior to 1.7.1990.

The most important of the LAF's objectives is the removal of barriers to investment due to the presence of legacy contamination, the implementation of urgent hazard prevention measures as well as decontamination and remediation in the context of the revitalisation of landscapes damaged by industrial activities and/or extraction (mining) operations. As a matter of principle, the order in which the locations in question are processed depends upon the latent hazard potential. However, whenever investment measures are imminent, the processing of the affected area is prioritised, whereby the development plans for the site in question are coordinated with the potential investor. The objective is the short-term provision of cleaned up sites for economic utilisation.

The LAF's most important tasks include:

- The preparation of exemption certificates
- The preparation of remediation plans
- Decisions pertaining to the necessary decontamination measures
- The provision of consultancy services and support during tendering processes and the supervision and implementation of remediation measures
- Approval and acceptance of the completed remediation measures
- Cost reimbursements to exempted companies

Since 1992, the costs of site contamination indemnification have been shared between the federal and state governments pursuant to a relevant administrative agreement. The federal government's financial liabilities towards the state of Saxony-Anhalt arising from this administrative agreement have been satisfied by a one-off flat rate payment pursuant to the so-called "General Contract", which was concluded in the autumn of 2001. With that, sole responsibility for the costs of financing the remediation of contaminated sites devolved to the state of Saxony-Anhalt. The monies associated with the General Contract are currently managed via a special fund. Any funds not yet required for immediate use, are profitably invested on the capital markets, securing the long-term financial resources required for legacy contamination remediation measures in Saxony-Anhalt. Since being founded in 2000, the LAF has paid over a billion euros to investors for remediation measures.

2 The Magdeburg-Rothensee Pilot site: Detailed Assessment

2.1 Historical Background

The Magdeburg-Rothensee port and industrial complex is situated on the banks of the river Elbe to the north of Magdeburg. The industrial and commercial utilisation of this area began even before the construction of the port complex in connection with the Magdeburg-Stendal rail link, which was completed in 1849. The *Old Gas Works* began operations as early as 1853. The origin of the modern Port of Magdeburg goes back to 1888 when construction began on the Commercial Port (German: *Handelshafen*). The harbour basin, which is one kilometre long and between 45 and 65 metres wide (Figure 4) was completed in 1893, after which the commercial port was able to begin operations as Germany's, at the time, most modern inland port. Transshipment loads primarily included grain, sugar, salt, coffee, animal fodder, fertilisers, coal and timber. By 1906, the Commercial Port was already operating at full capacity, and had to be extended. The incorporation of the neighbouring village Rothensee took place in this context and to this end.



Fig. 4: Port basin of the historic commercial port, today known as Magdeburg Science Port (photo: Steven Klein)

The Industrial Port (German: *Industriehafen*) was then constructed between 1908 and 1911, whose port basin is 1670 m long and 62 m wide (Figure 5). In addition, its draught depth is 30 cm more than that of the Elbe both at low and mean water levels. In the following years a number of industrial firms and storage facilities were erected there, which not only gave the port its name, but were also responsible for the current contamination of the soil and ground water at the site. Trading and processing coal and petroleum-based products emerged as focal points. In 1923, for example, a wood impregnation plant began operations, which made use of creosote among other things. Beginning in 1930, the so-called Großgaserei (Main Gas Works) was producing gas for local and nationwide distribution as well as processing coke. Several major storage tanks depots also appeared for petroleum, diesel fuel, and lubricant oils.

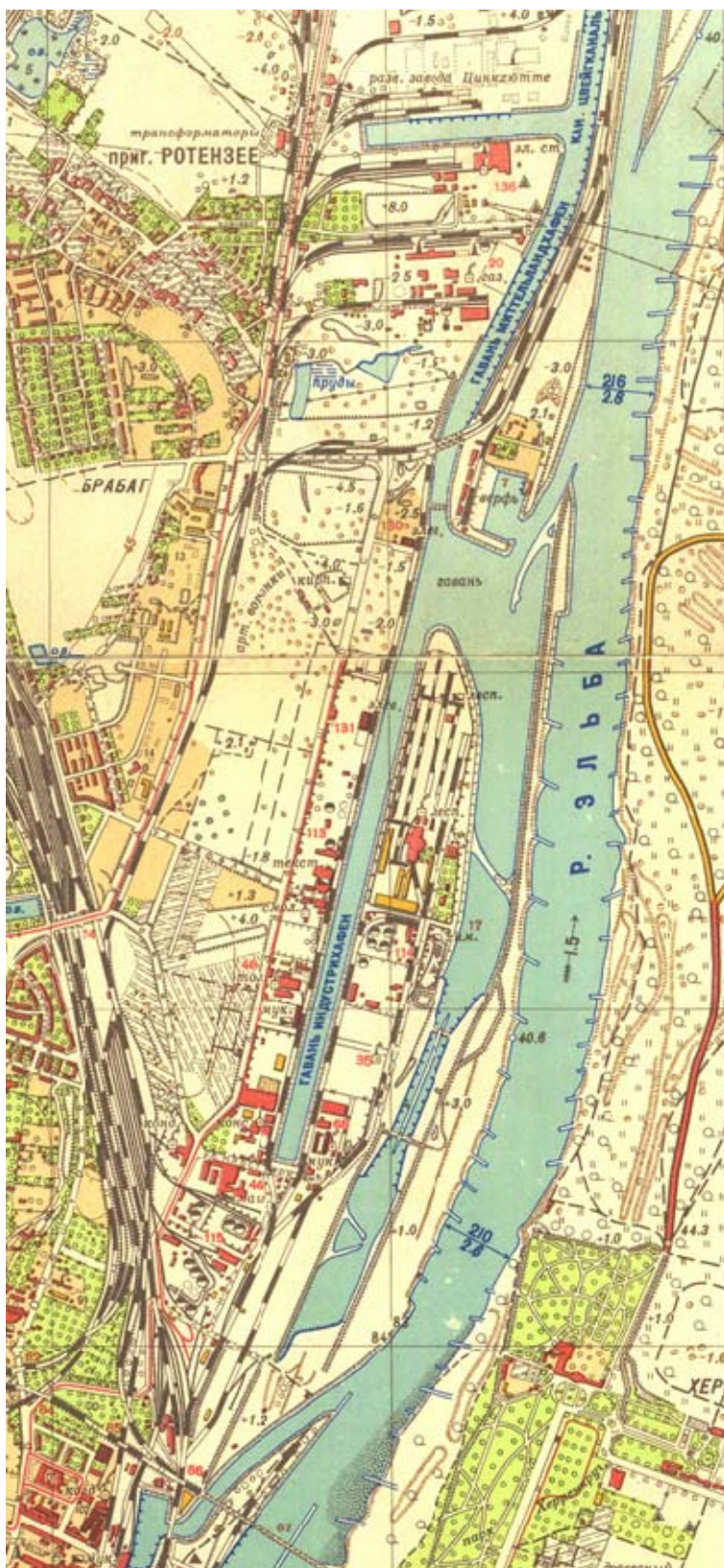


Fig. 5: Excerpt from a 1947 Red Army map showing the Rothensee industrial zone, the *Industriehafen* and Port Basin I of the *Kanalhafen*

Source: Cadastral Office, City of Magdeburg

The next port expansion took place between 1929 and 1932. Encompassing a total area of around 80 hectares, the Canal Port (German: *Kanalhafen*) is the biggest port to have been constructed in Magdeburg to date (Fig. 6). Since the completion of the Rothensee boat lift in 1938, it has been accommodating the shipping traffic coming in from the Midland Canal. The boat lift bridges a height differential of between 11 and 18 metres depending on the water level to provide a link between the Midland Canal and the Rothensee Link Canal, which provides access to both the Elbe and the Port of Magdeburg. The Canal Port comprises of two port basins with a total quay length of some 1560 metres. An approximately 100 metre wide dam separates the Canal Port from the Elbe. Located there is the Dam Terminal, which encompasses a 4570 metre long quayside. A zinc works began sulphidic zinc ores smelting operations in the vicinity of the Canal Port in 1930. The Braunkohle-Benzin-AG (BRABAG), a hydrogenation plant specialising in the production of synthetic petroleum from lignite opened to the west of the August-Bebel-Causeway in 1937.



Fig. 6: A view of the waste incineration power plant at the Canal Port (photo: Steven Klein)

Much of the production plant at the Rothensee industrial zone were destroyed in enemy air raids in the final stages of World War Two. During the GDR era, the Port of Magdeburg was incorporated in the Central Elbe Region Inland Ports People's Enterprise (VEB Binnenhäfen MittelElbe). It was privatised following the reunification of Germany and currently operates as Magdeburger Hafen GmbH, a 100 per cent owned subsidiary of the City of Magdeburg. In 2001, the Rothensee Lock took over from the outdated boat lift from 1938. The Magdeburg Waterway Junction was completed in 2003 with the inauguration of the *Mittellandkanal* canal bridge across the River Elbe. The so-called Hanse Port (German: *Hansehafen*) which was constructed between 2004 and 2008, was the last of Magdeburg's four ports to be completed. The Hanse Port zone encompasses a total area of 40 hectares. Single loads weighing up to 50 tonnes can be transhipped in the container port with the aid of a gantry crane.

2.2 Socio-economic Status

The Magdeburg-Rothensee pilot site encompasses an area of 945 hectares (Fig. 7). The area primarily comprises commercial zones and port areas as well as, in north western sector, a few remaining green spaces and agriculturally used land. The special harbour zone includes areas covering a total of 380 hectares.



Fig. 7: Aerial view showing the limits of the Rothensee pilot site

Source: Planning Department, City of Magdeburg,

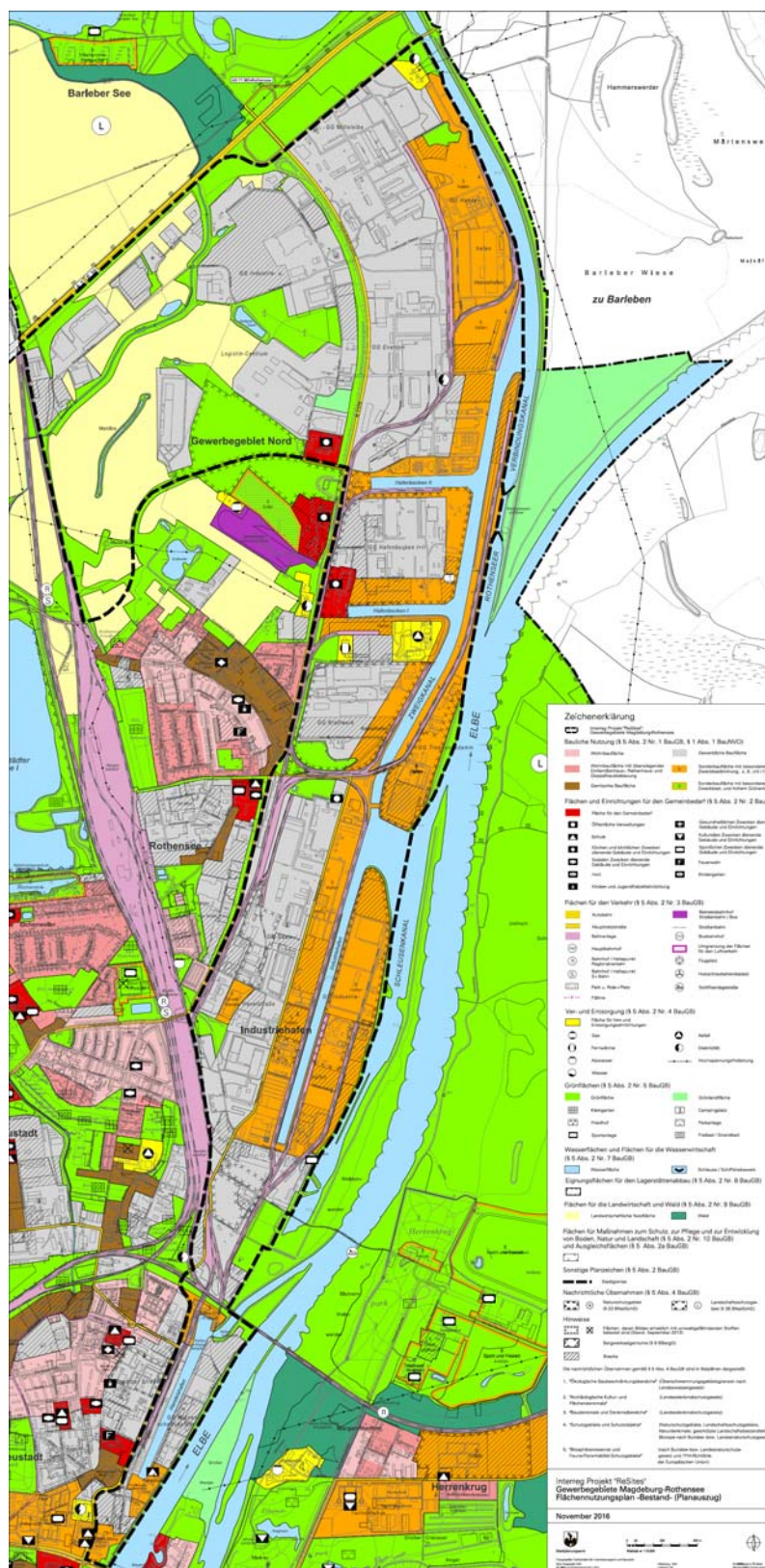


Fig. 8: Land-use plan showing the limits of the Rothensee pilot site (Orange: Port, Grey: Industry, Light green: Green space, Yellow: Agriculture)

Source: Planning Department, City of Magdeburg



Because there are no residential zones within the boundaries of the pilot site, the number of residents is extremely low. However, the number of residents within the zone has increased from 198 in 2000 to 403 in 2015. The Rothensee neighbourhood immediately adjacent to the pilot site is home to around 2800 residents (2014) and has a population density of 1300 residents per km² (13 residents per hectare). Yet, the number of residents has diminished by 17 per cent since 2000 and a further reduction of 10 per cent by 2025 is predicted. By contrast, the city as a whole has experienced a slight increase of 1.5 percent in the number of residents since 2000, and a further increase of 0.5 percent is expected by 2025. 18 percent of all domestic accommodation in the Rothensee neighbourhood have been vacant at the end of 2014, whereas the vacancy rate for the city as a whole was just 11 percent. The unemployment rate in late 2015 was around 8 percent, which was slightly lower than for the city as a whole. The number of small workshops within the pilot site area increased from 52 to 66 between 2007 and 2015 (year ends), which represent a healthy growth rate of 27 percent.

Important firms and businesses operating within the Magdeburg-Rothensee pilot site:

- Enercon GmbH: Manufacturer of wind power turbines (3000 employees at the Rothensee site)
- Glencore Magdeburg GmbH: Production and trade of raw materials
- Magdeburger Hafen GmbH: Port and logistics services provider
- Nordlam GmbH: Timber processing industry
- Rothenseer Rotorblattfertigung GmbH: Manufacturer of wind power turbines

2.3 Infrastructure and Urban Development

The Rothensee pilot site has a trimodal cargo transportation network. The Port of Magdeburg and the harbour railway as well as the adjacent A2 motorway provide for excellent links to the intraregional road, rail and waterway transportation networks (see Fig. 2). The Magdeburg Rothensee Industrial and Logistics Centre (ILC) is situated between the Hanse Port and the motorway at the northern end of the zone. The only designated freight centre in Saxony-Anhalt is integrated within the ILC. The total area of the Port of Magdeburg, including waterway surfaces, is around 625 hectares, and the total quayside length is 6750 metres. The available storage capacity comprises 40,000 m² of covered warehousing and 200,000 m² of outdoor storage. The harbour railway, which covers 55 km of rail network and a number of railway traction vehicles forms part of the port. Around 1 million tonnes of crude oil are transshipped every year alongside other bulk goods and freight, individually packaged goods and containers. More than 3.4 million tonnes of freight were turned over in 2015 alone. Since the low water lock became operational in 2011, the continuity of port operations at the Hanse Port and Canal Port has been guaranteed even when the Elbe is at a low ebb. Future plans include the integration of the Industrial Port into the water-level independent zone, however, this will require the prior extension of the separation levy as far as the *Steinkopfsinsel* (an island in the river Elbe).

The A2 and A14 motorways as well as railway links to Hanover, Berlin and Halle/Leipzig are all available for personal transportation, whereby the A14 motorway is scheduled for extension in a northerly direction in the coming years. The closest international airports at Berlin, Hanover and Leipzig-Halle are all about 150 km away.

The Rothensee waste incineration power plant, whose steam turbines generate a total gross power output of almost 70 MW, represents a significant component of the technical infrastructure. The facility has a residual waste thermal exploitation capacity of up to 65,000 tonnes per annum, whereby it generates an average of 370 GWh of electrical power and supplies the district heating network with 350 GWh per year (see Fig. 6).

The ownership structures within the pilot site area are heterogeneous. At 54 percent of the total area, most of it is in private hands. At over 42 percent, the City of Magdeburg owns the second biggest share in conjunction with its Magdeburger Hafen GmbH subsidiary. The remaining 4 percent belongs to the state of Saxony-Anhalt and/or the Federal Republic of Germany. In the Science Port area, however, the proportions

deviate significantly from the overall average values. In relation to these, the City of Magdeburg is the largest proprietor with real estate holdings in excess of 71 percent. Ownership of the remaining portions is divided evenly between the Federal Republic of Germany and the state of Saxony-Anhalt (15 %) and private landlords (14 %).

The City of Magdeburg employs various planning instruments in order to direct land development initiatives. In 2014, for example, “Magdeburg 2025”, an integrated urban development concept, was signed off. In addition a land-use plan (See Fig.8), a series of master plans, project and land development plans have been produced for various lots, and a number of urban development measures have already been implemented.



Fig. 9: A view of the “Denkfabrik”, an innovation and business incubation centre at the Magdeburg Port of Science (photo by: Goodway)

Source: taken unaltered from WIKIMEDIA COMMONS

https://upload.wikimedia.org/wikipedia/commons/a/a5/Hafenbecken_mit_Denkfabrik.jpg

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The historic Commercial Port is currently undergoing redevelopment as a new urban district. The port operations have been stopped and the location will now be transformed to serve a new mixed function as a residential and commercial district to be known as *Magdeburg Science Port*. The Science Port concept entails drawing upon from nearby scientific institutions such as the university, the Experimental Factory (*Experimentelle Fabrik*) and various research institutes for inspiration and to catalyse the emergence of new innovative and technology-oriented enterprises. The “Denkfabrik” (literally “Think Tank”), an innovation and business incubation centre has been operating within a former granary building since 2007 (Fig. 9). Despite some positive developments, a number of sub-zones are still not being used or are being utilised for inferior, low value purposes. Even the majority of the former granaries and silos at the Magdeburg Port of Science, which enjoy listed building or protected monument status, are currently still vacant (see Fig. 4). Re-purposing the granaries as residential spaces is being hampered by the noise emissions from the surrounding industrial and commercial facilities.



2.4 Environmental Status and Remediation

Since the early 1990s, the pilot site has been thoroughly investigated for soil and ground water contamination. In addition to several hundred localised investigations, large-area ground water studies have been carried out and the results have been transferred to a systematic inter sub-area ground water monitoring system. A groundwater model for Rothensee is being built up since 2006 and is being continually updated with data from the groundwater monitoring activities as well as from investigative measures. The model is used to clarify hydrological issues, as a basis for remediation scenario calculations, and for the identification of contaminant freights. Beyond this, the model is used by Magdeburger Hafen GmbH and the City of Magdeburg to predict flood events and for flood protection concepts.

A total of 96 pollutant contaminated areas have been identified within the Rothensee pilot site. Essentially, the soil has been penetrated by aliphatic and aromatic hydrocarbons, phenols, polycyclic aromatic hydrocarbon and heavy metals such as zinc, cadmium, chrome, arsenic and mercury. Because the alluvial loam layer, which covers extensive areas within the pilot site, has been destroyed by the impacts of war and construction projects in many places, contaminants have been able to penetrate right through to the groundwater in these areas. Thus, many product phase lenticular structures of tar and mineral oils have formed on the surface of the ground water. The most important abandoned industrial sites or contaminated brownfield sites along with an indication of the former usage and main pollutants are listed here and shown in Figure 10, and are briefly described below.

1. Old gas works (tar)
2. "WGT" fuel depot (fuel)
3. "MINOL" fuel depot I (fuel)
4. "MINOL" fuel depot II (fuel)
5. Wood impregnation works (tar oil, heavy metals)
6. "BEMA" heap (deposit containing lindane)
7. Main gas works (tar ponds, cyanides, benzene, etc.)
8. Zinc smelter (zinc, cadmium)
9. "BRABAG" Hydrogenation plant (synthetic petroleum products)

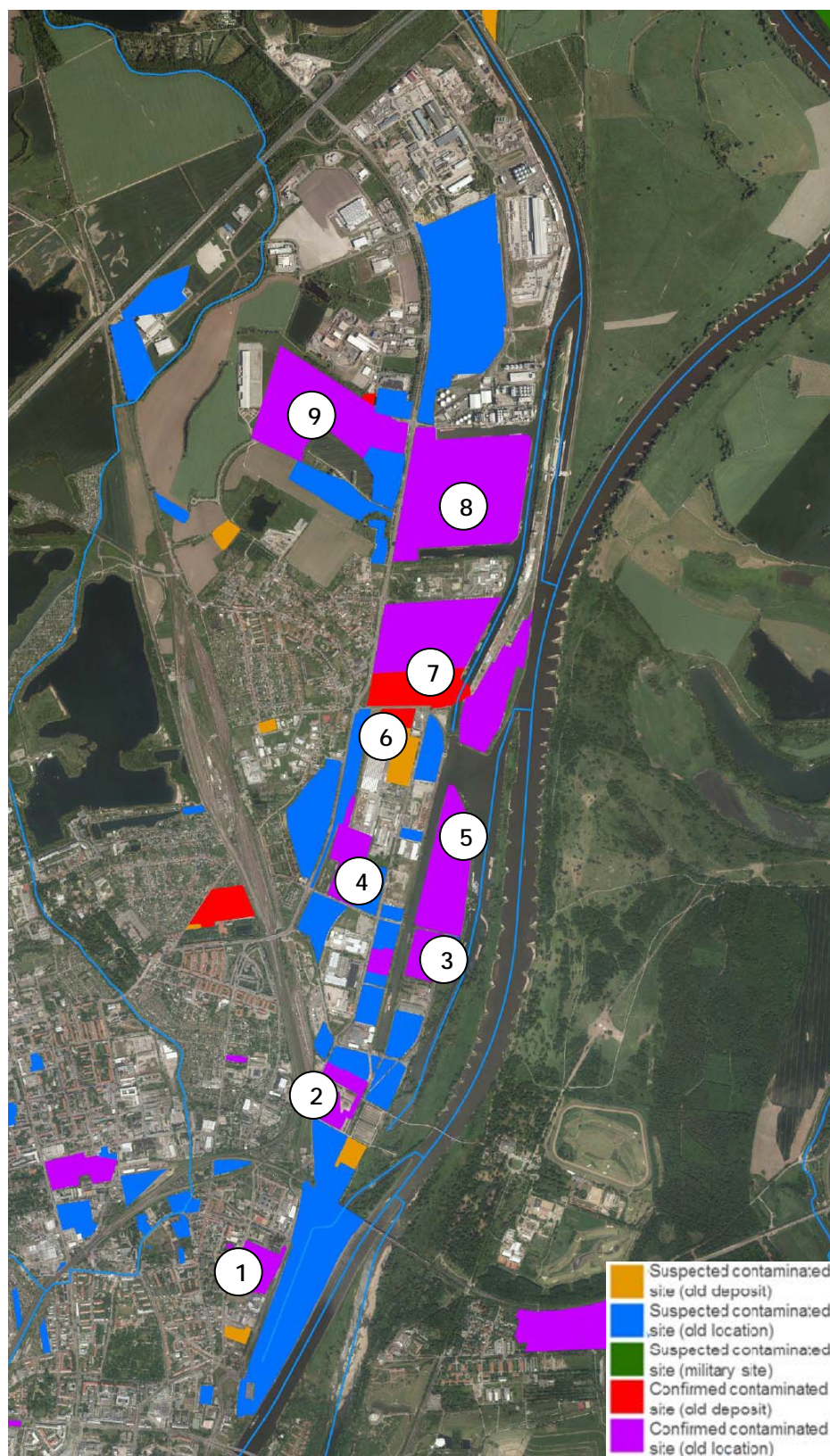


Fig. 10: Confirmed and suspected contaminated sites at Magdeburg-Rothensee

Source: Image based on data from the Saxony-Anhalt State Office for the Environment (Datei schädlicher Bodenveränderungen und Altlasten)

Old Gasworks

The Old Gasworks on Rogätzer Straße (near the Science Port) operated from 1853 to 1940 (Fig. 11). There are currently no structural remains visible above ground. In the course of a raft investment preparation and support remediation measures a number of soil contamination sites and 16 tar pits were cleaned up between 2004 and 2008. The site is currently being used by the Magdeburg Municipal Utilities and a Discounter.



Fig. 11: Historic photograph of the Old Gasworks, Rogätzer Strasse, Magdeburg

Source: Urban Planning Office of Magdeburg, State Capital of Saxony Anhalt (Ed.): *Magdeburgs Aufbruch in die Moderne*, p. 54

Fuel depots

Between 1938 and 1990 several sites in the vicinity of the Industrial Port were used as civilian and military tank storage depots. Soils and groundwater in this area are, in some cases, severely contaminated as a result of the effects of war, handling losses and especially in the wake of an accident that occurred in the 1970s. Benzene and petroleum-derived hydrocarbons are the main contaminants. Soil contamination in the unsaturated soil zone has been removed in the course of construction preparation and support measures carried out since 2009 in order to revitalise the terrain and prepare it for re-utilisation. 70 tonnes of soil were removed during these operations. These measures were followed by a ground water clean up project based on *Air Sparging*, which achieved good results (Fig. 12). Air sparging is an *in situ* subsurface contaminant remediation technology that involves the injection of pressurised oxygen into contaminated ground water enabling the hydrocarbons to transform from a dissolved to a vaporous state. The air is then sent to vacuum extraction systems to remove the contaminants. The action was completed in 2015.

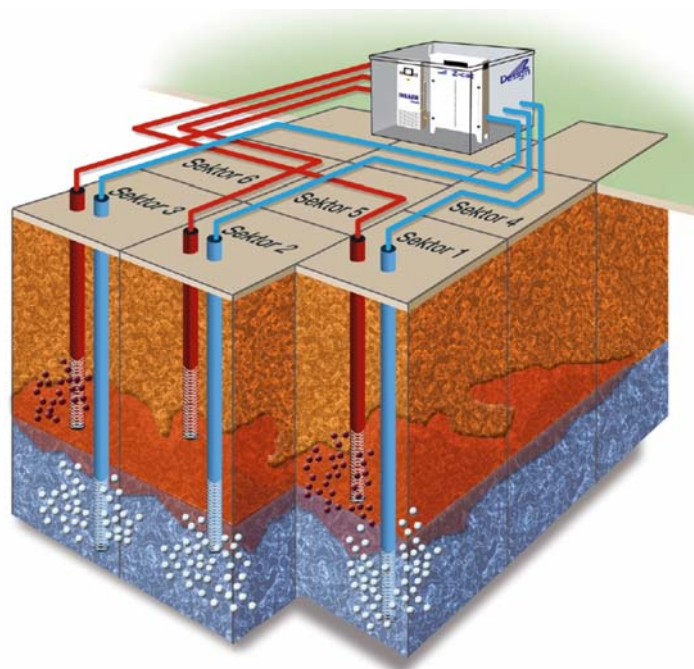


Fig. 12: Visualisation of the Air Sparging remediation technique
Quelle: LAF

“BEMA” heap

Beton- und Metallbau GmbH or “BEMA” was the successor to a GDR-era company and specialised in the production of concrete paving and garden and landscape construction products. Lindane production by-products were deposited in a 4 metre high heap covering 35,000 m² within the BEMA premises which were situated at the northern end of the Industrial Port industrial zone. Around 3800 tonnes of hexachlorocyclohexane (HCH) contaminated soil was removed. In order to prevent the formation of dust drifts and to interrupt the soil to human transmission pathway, the BEMA heap was secured with a surface covering during 2008-2009. The largest citizens’ solar power plant in the state of Saxony-Anhalt has been operating on the heap since 2016.

Wood impregnation works

A wood impregnation works operated within the Industrial Port (Industriestraße No. 7) between 1923 and 1991. The buildings were demolished in 1999. Timber was treated with salt, chrome salts and creosote at this site. During the course of remediation works that began in 2003, a number of previously unknown subterranean structures and serious creosote and heavy metal contaminations were discovered. The remediation activities were completed in 2005. Today the site is home to a wind power turbine rotor blade production plant.

Main Gasworks

The grounds of the former Main Gasworks, from which no architectural structures remain, are located at the southern end of the Canal Port. The grounds are subdivided between the north end, within which the production facilities had been operated, and the south end where large volumes of production waste from the gas works were dumped in unsecured deposits. Gas for the municipal grid and coke were produced at the site from 1930 to 1993. By-products of processing operations were around 10,000 tonnes of tar and some 12,000 tonnes of benzene among other things per year. Some of these pollutants were sluiced into the grounds or were left in unmonitored deposits. The large volumes of contaminants in the soils and groundwater represented a serious hazard for natural resources and an obstacle to the re-use of the site.

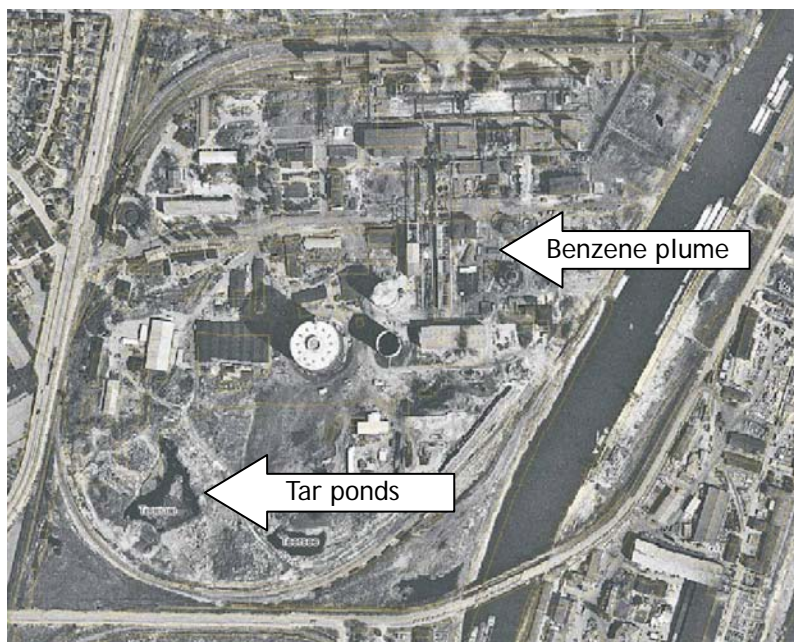


Fig. 13: Aerial photograph from 1979 showing the Großgaserei premises with tar ponds and benzene plant

Source: LAF

Due to their significant disadvantages and inconvenience to people and the environment, the open tar ponds, which reached depths of up to seven metres, were drained and remediated between 2001 and 2004. Around 76,000 tonnes of liquid to solid tars and other waste were evacuated from seven tar ponds then removed and treated for disposal at licensed facilities. The residual contamination at priority remediation locations have been secured for the long term through landscape structuring (Fig. 14-17).



Fig. 14: Tar pond (Source Fig. 14-17: LAF)



Fig. 15: Liquid tar was pumped out



Fig. 16: Pasty tar was solidified with calcium carbonate and excavated



Fig. 17: Former tar ponds get filled up and covered

Even following the completion of the hazard removal measures involving the removal of the tar ponds from the south end of the premises and remediation measures carried out at the north end, significant deposits of contaminants are still present in both the saturated and unsaturated soil zones. These are the result of decades of industrial utilisation and the associated unregulated dumping and movement of waste materials from gas production operations through migration and leaching. Nevertheless, further soil remediation measures in the sense of a source reduction were not deemed to be proportionate. Instead, direct contact with the contaminated subsoil has been prevented through the installation of sealing membranes (Fig. 18).

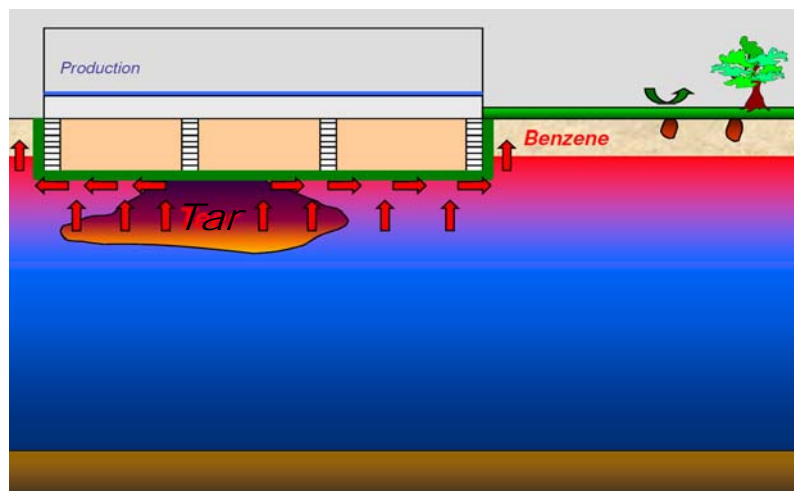


Fig. 18: Schematic view of surface sealing of contaminated subsoil

Source: LAF

In addition, the first part of the steel piling wall was constructed in 2010, which prevents polluted groundwater from draining into the port and the River Elbe. At the same time, the steel piling was used for the construction of a shipping pier, thereby contributing to the economic re-utilisation of the site. In order to absolutely ensure that the groundwater cannot drain off, the existing steel piling walls need to be extended and supplemented with sealing walls. Thereby most of the contaminated groundwater should be retained within the seal wall system and the unpolluted groundwater stream will be redirected along the outside of the sealing walls (Fig. 19). In addition, action must be taken to dispose of or treat the residual contamination within the sealing wall system circulation system. To this end, an *ENA-project* (*Enhanced Natural Attenuation*) is planned whose objective is the in-situ biodegradation of heterocyclic hydrocarbons. The prerequisite safety system is scheduled for completion in 2018.

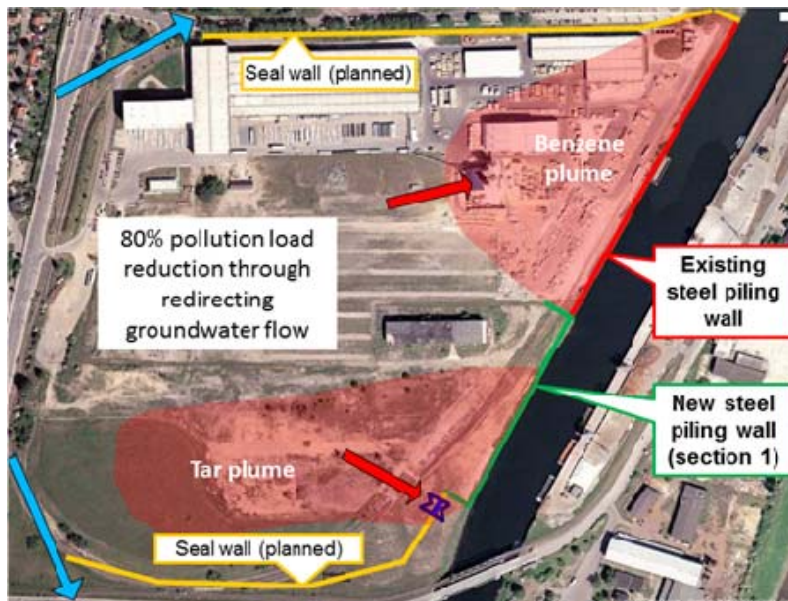


Fig. 19: Existing steel piling walls and planned seal walls

Source: LAF

Zinc smelter

No structural traces of the zinc smelting plant remain. The polluted operating premises are located between the two port basins of the Canal Port. The long-term contaminant influx during the zinc smelting plant's operational phase, which lasted from 1930 to 1945, has resulted in several major contaminant pools in the soil and groundwater. For historical reasons, the soil contamination is primarily characterised by materials that are typical for the location, primarily zinc and cadmium. In addition, there is widespread ground water contamination in the vicinity of the grounds. The results of the risk analysis have shown that hazard prevention measures are necessary due to the extent of the contaminated area and the presence of high-risk pollutants in the deeper soil layers. However, with due consideration to questions of the proportionality of remediation measures, the use of surface sealing technologies to contain the contaminants in-situ is the preferred course of action. Plans are currently afoot to re-use the grounds for commercial enterprise.

„BRABAG“ Hydrogenation plant

The Magdeburg-Rothensee hydrogenation plant which was operated by Braunkohle-Benzol-AG (BRABAG) began operations in 1937 in the north-west sector of the Pilot Project Zone. The Bergius-Pier hydrogenation process was used at the site to convert bituminous tar into synthetic petroleum, which was primarily used to secure the army and air force's vehicle and aircraft fuel supplies. Towards the end of the Second World War, more than 2000 forced labourers, mostly Hungarian Jews, were employed at the hydration works. The prisoners were accommodated at *Lager Magda*, a satellite camp of the Buchenwald concentration camp. By the end of the war, some 550 prisoners had lost their lives. The works were dismantled for reparations in 1946 so that no visible physical remains have been preserved. No remediation work has been carried out at the site to date, which is currently planted with greenery and lies within a protected conservation zone.



2.5 Conclusion

The task of cleaning up the contaminated areas within the Magdeburg-Rothensee pilot site is one of the largest remediation projects in Saxony-Anhalt. About 50 million euros from federal and state funds have been spent on pollution remediation since the 1990s, as a result of which it has been possible to re-use many of the affected sites. Some significant commercial zones have been established in this context, for example in the field of wind turbine production. However, not all remediation measures have been completed, and some former industrial sites have not as yet been decontaminated at all. The number of sites still not being used or which are being used for inferior, low value purposes is not insignificant. Many industrial buildings and granaries, some of which enjoy listed building or protected monument status, are currently unoccupied or are not being adequately utilised. Therefore, the remediation and redevelopment of brownfield sites and the renovation and upgrading of existing building stocks continue to be important objectives in terms of environmental rehabilitation and urban development.

A number of different public and private bodies, some of whom are pursuing different strategies and objectives, are currently involved in urban development and urban land-use planning, remediation and safe-making of real estate, as well as the revitalisation and marketing of the respective sites. A close and well coordinated collaboration between these different stakeholders is essential for a successful and efficient land development programme. Web-based solutions offer a method of simplifying cross-disciplinary agreements and collaboration between the authorities and other stakeholders in the field of site remediation and brownfield redevelopment. In this way, data, plans and documents can be exchanged and shared in a rapid and uncomplicated manner. Information about the various sites and risk statuses can be accessed online at any time. Using the pilot site as an example, and within the framework of the ReSites project, a pilot action will be conducted using web-GIS-supported collaboration between the participating local stakeholders.