GIS management of abandoned colliery in the Mons basin (Belgium): a case study at Levant de Mons

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Abstract: In 1860 the first company to obtain the concession of Levant de Mons began the digging of two exploratory shafts, which were unfortunately abandoned in 1863 due to a financial bankruptcy. Following the indications provided by some boreholes carried out in 1911-1912, between 1920 and 1925 another company undertook the construction of a new main mining site near the village of Estinnes-au-Val, located to the south of the road connecting the cities of Mons and Binche in the Walloon Region, southwest Belgium.

The underground workings and the coal extraction were started in 1924 and abandoned in December 1932. The main coal-mining site of the concession remained active until the closure of the colliery and contained two shafts. The digging of the two main shafts encountered the problem of crossing an aquitard layer 117.4 metres thick related to Cretaceous chalk. The first shaft, used for hoisting materials, with a diameter of 5.5m was 896.20m deep and the second shaft (for ventilation) was 889.45m deep.

Seventy six mine documents stored at the Geological Survey of Belgium have been used to create a GIS management tool. The project has two related objectives: it aims to locate at the surface the deep underground workings, galleries and haulage of the colliery as well as the surface infrastructure that has now disappeared.

The GIS application with MapInfo is a utility tool for country planners as the underground workings and surface infrastructure are superimposed on aerial photography with a very high precision. This makes it possible to highlight the limits of the extension of underground workings, to locate the main galleries and the shafts as well as the estimation of potential zones of pollution.

Résumé: En 1858, la première compagnie à obtenir la concession du Levant de Mons commenca à creuser 2 puits d'exploration en 1860 sur le territoire d'Harmignies (sud-ouest de la Belgique) mais elle abandonna malheureusement en 1863 suite à l'épuisement du capital. D'après les indications fournies par des sondages réalisés entre 1911 et 1912, une autre compagnie fondée en 1920 entrepris la construction d'un nouveau siège minier entre 1920 et 1925 sur le territoire d'Estinne-au-Val au sud de la route reliant les villes de Mons et de Binche.

Les travaux souterrains et l'extraction du charbon, démarrés en 1924, seront abandonnés en décembre 1932. Le creusement des 2 principaux puits a rencontré la difficulté de recouper une couche aquifère liée aux craies du Crétacé (dont l'épaisseur est de 117,4 m). Le principal site minier d'extraction du charbon de la concession resta en activité jusqu'à la fin de l'activité du charbonnage et comprenait deux puits. Le premier puits (pour la circulation du matériel) avec un diamètre de 5,5 m a atteint la profondeur de 896,20 m et le second puits (pour l'aérage) celle de 889,45 m.

Septante six documents miniers archivés au Service Géologique de Belgique ont été utilisés pour créer un outil de gestion SIG. Le projet a deux objectifs : il souhaite localiser en surface les travaux souterrains, les galeries, les bouveaux du charbonnage ainsi que les infrastructures de surface qui ont aujourd'hui disparues.

L'application SIG réalisée avec le logiciel MapInfo est un outil pour car les tracés vectoriels des travaux souterrains et des infrastructures de surface sont maintenant superposables avec grande précision à des photographies aériennes. Ceci permet de mettre en évidence les limites de l'extension des travaux souterrains, de localiser les galeries principales et les puits ainsi que les zones potentielles de pollution.

Keywords: coal mines, geographic information systems, planning, abandoned mines.

INTRODUCTION

The coal heritage is visible in the field as the coal industry has left its imprint on the landscape. More than three hundred slagheaps (formed from dumped barren shales) up to 100 m high are known to be related to the coal mining activities in Wallonia. This type of old surface infrastructure remains as witnesses of their glorious past. Development of new economic activities on disaffected mining sites and sustainable urbanization requires awareness of the coal heritage.

The present paper deals with an abandoned underground coal mine located close to the village of Estinnes-au-Val in the Walloon Region, Belgium. The project has two related objectives: it aims to locate at the surface the deep underground workings, galleries and haulage of the colliery as well as the surface infrastructure that has disappeared, through the development of a GIS tool.

GEOGRAPHIC AND GEOLOGICAL SETTINGS

All the collieries in the Walloon Region are located along an area with an SW-NE axis, 200 km in length and 5 km wide, that extends from the French border to the east of the city of Liege. The most eastern colliery is situated 13km from Germany.

The coal mining concession of Levant de Mons is located 10km to the southeast of the Mons city in the western part of the Walloon Region (Figure 1). The limits of the concession are located in the Mons, Estinnes and Binche communes. The concession covers a surface of 3773 hectares including the villages of Estinnes-au-Val, Villers-St-Ghislain and Vellereille-le-Sec.

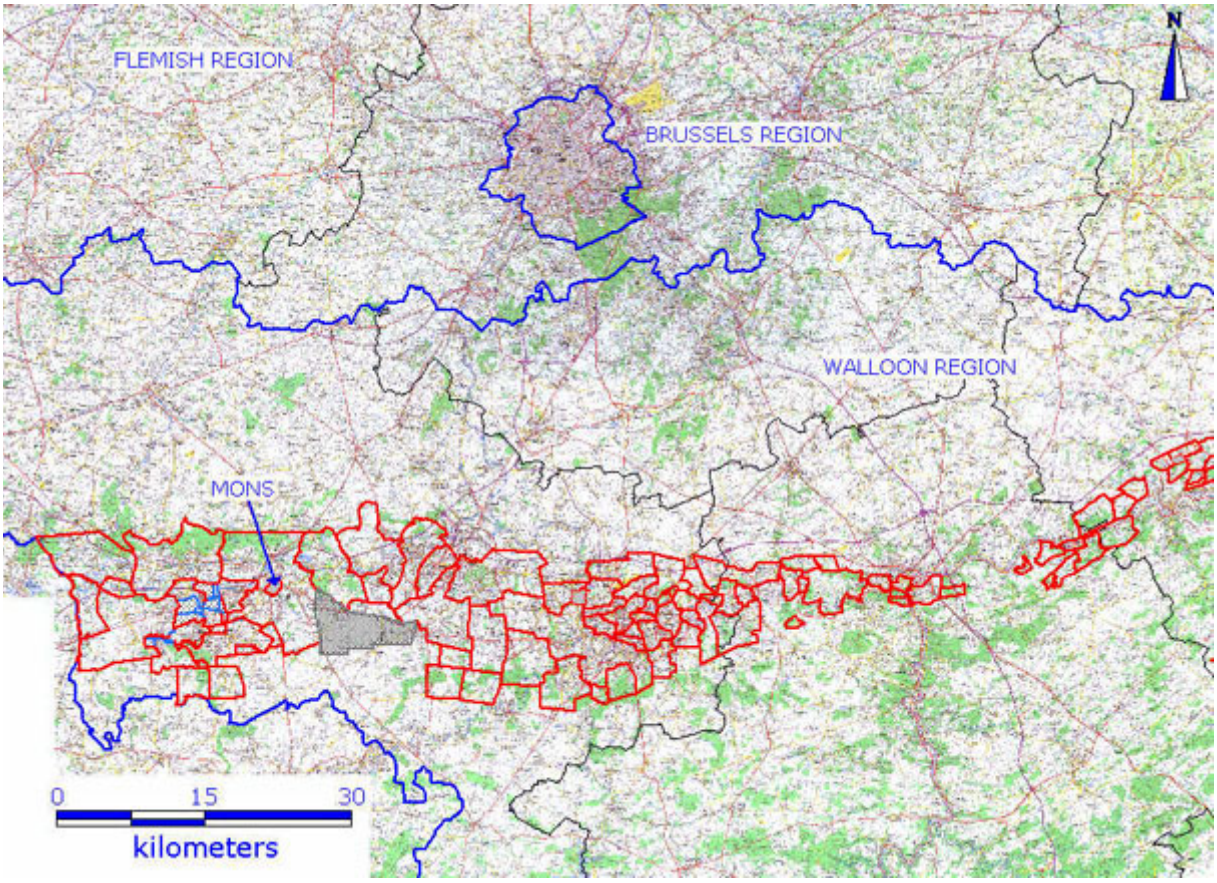

Figure 1. The coal concessions are superimposed on topographical maps in red (1:100.000 scale-map, Copyright @ National Geographic Institute). Blue lines delineate the Flemish, Brussels and Walloon Regions of Belgium and thin black lines indicate the limits of Belgian provinces. The area covered by the concession of Levant-de-Mons is in grey.

The economical coal resources of Belgium are restricted to the Upper Carboniferous Westphalian Coal Measures (Delmer, Dusar and Delcambre 2001). Flysch sedimentation took place in paralic basins, in the context of the Variscan Rhenohercynian fold and thrust belt. Extensive coal mining activities have been located in the Campine basin and in the Namur basin, extending respectively to the northeastern and southern flanks of the Caledonian Brabant Massif.

The local geology can be depicted from the stratigraphic series of the main mineshafts and drill holes realized on the concession. The Quaternary deposits have an average thickness of 14m and comprise soils of loam and sand. The Cretaceous series is relatively thick (Schellinck, 1921-22) and shows a strong thickness increase from south to north and from west to east due to the development of a large bowl corresponding to the Haine depression. The stratigraphic thickness ranges from 15m at Harmignies to more than 100m in Waudrez. In the northwestern part of the concession, Carboniferous strata composed of coal seams are overlain by a series hundreds of metres thick of Carboniferous limestone. In the southern part of the concession, a Devonian series 400-600 m thick has been described above the Coal Measures. The Coal Measures contain at least 13 exploited coal seams as indicated by the two mineshafts and are listed here with their thicknesses: S (1.05m), R (0.49m), N (0.71m), E (1.60m), D (1.19m), C (0.80m), n°1 (0.73m), n°5 (0.53m), n°7 (0.70m), n°10 (1.25m), n°11 (0.80m), n°16 (1.21m) and n°18 (1.39m). A total thickness of 12.45m characterizes the exploited coal seams in this part of the coal basin. The coal basin is limited to the east by the Binche anticline, to the south by the Midi fault and to the northwest by the Saint-Symphorien fault. The coal seams are regularly faulted and folded and present a range of nearly vertical to horizontal dip measurements.

HISTORY OF THE LEVANT DE MONS COLLIERY

In 1860 the first company to obtain the concession of Levant de Mons began the digging of two exploratory shafts which were unfortunately abandoned in 1863 due to a financial bankruptcy. A second company, formed in 1875, undertook the extension of the two abandoned exploratory shafts. Finally the shafts were abandoned at a depth of 444m and 47.5m, shafts n°1 and n°2 respectively.

Following the indications provided by some boreholes carried out in 1911-1912, between 1920 and 1925, another company undertook the construction of a new main mining site near the village of Estinnes-au-Val to the south of the road connecting the cities of Mons and Binche in the Walloon Region, southwest Belgium.

The underground workings and the coal extraction started in 1924 and were abandoned in December 1932. The digging of the two main shafts encountered the problem of crossing an aquitard layer 117.4m thick (Capiau, 1924) related to Cretaceous chalk. The main coal-mining site of the concession remained active until the closure of the colliery and contained two shafts (Figure 2) on the territory of the village of Estinnes-au-Val. The first shaft, used for hoisting materials, with a diameter of 5.5m was 896.2m deep and the second shaft (for ventilation) was 889.45m deep. The two shafts were extended to 900m deep during 1933-1934 and exploratory galleries were dug at a depth of 885m.

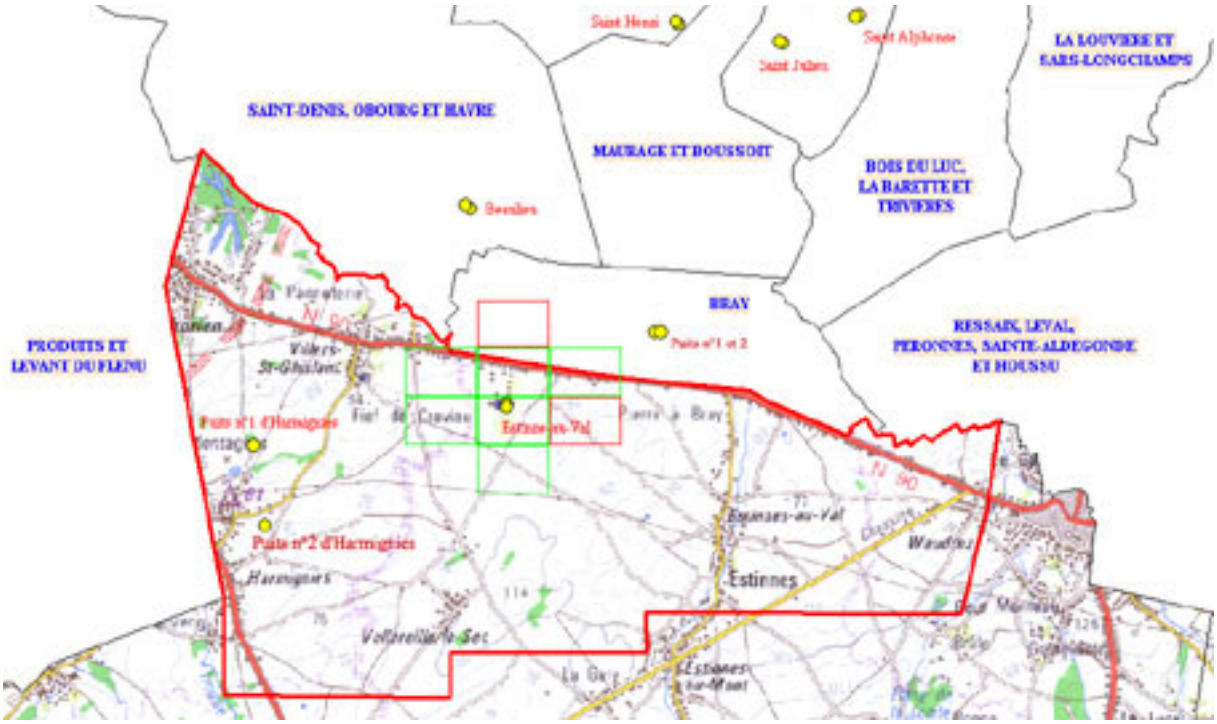

Figure 2. Relation of the limits of the neighbouring coal concessions (white surface and black borders) to the "Levant-de-Mons" concession (red line) superimposed onto the topographical map (1:100,000 scale, Copyright © National Geographic Institute). Yellow points represent the main mineshafts. Red and green rectangles (900x600m) correspond to the geo-referenced mine documents and plans, both for surface infrastructure and underground coal exploitation.

The concession of the Levant de Mons colliery and its limits (Figure 2) are clearly present on the three official maps drawn by the Mine Administration in 1906, 1922 and 1946. The concession had a surface area of 2536ha and was created by royal decree on the 3rd November 1834. After an extension of 837ha to the south allowed in July 1931, the total surface of the concession totalled 3373ha. Since February 1933, the coal exploitation activity ceased and the renunciation of the colliery was established by royal decree on the 1st December 1966.

DATABASE AND GIS DEVELOPMENT

The source documents are the last official maps of coal concessions, established by the Mine Administration in 1946 at 1:40,000 scale. These maps have been scanned, georeferenced and put into vector format in the GIS to serve as reference maps for the last administrative situation of the coal concessions. The data was last updated in 2003 for the Walloon Region. Before scanning, most of these documents are cleaned using special gum powder and partially restored.

The Geological Survey of Belgium holds 76 mine documents available for the Levant-de-Mons concession: 56 exploitation plans in horizontal projection, 9 exploitation plans in vertical projection, 3 vertical cross-sections and 8 plans of the surface mining infrastructure (Figure 3). The exploitation plans were controlled by the Mine Administration and hence can be considered as official documents. At scale of 1:1,000 they provide detailed information of the coal seams exploited in the underground galleries and panels. They provide the spatial and historical evolution of the exploitation of each coal seam. The concession limits, exploited panels, mine extents and geological elements such as faults, folds, natural wells and thicknesses of the coal seams are indicated on the plans.

The plans of the surface mining infrastructure at a of scale 1:100 give the precise location at the surface and include the mineshafts and all the buildings related directly to the exploitation and to the treatment of the coal and those used by the miners and workmen on the site.

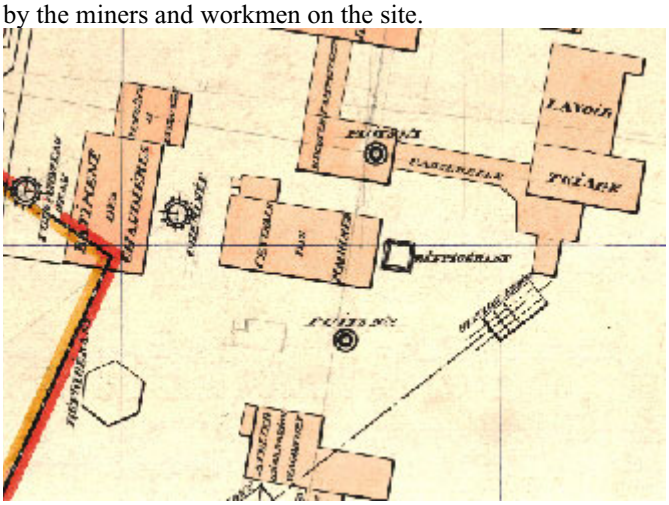

Figure 3. Extract of a mine plan giving the location of the infrastructure (buildings, mineshafts, workshops, etc.) of the colliery at the surface. The position of the two main mineshafts are precisely drawn: "puits n°1" inside a building and "puits n°2" 50 m to the south.

All the documents are entered into a mine plan database that has been developed for each concession. More detailed information about the databases for the collieries in Wallonia is presented in several papers (Devleeschouwer *et al.*, 2000, 2002). Technically, this GIS application is based on the creation of two complementary modules: a relational database management system under Microsoft Access 2000 (Copyright © 1992-1999 Microsoft Corporation) for the descriptive data and a cartographic management system under MapInfo 7.0® (Copyright © 2002 MapInfo Corporation) for the raster and geographic vector data.

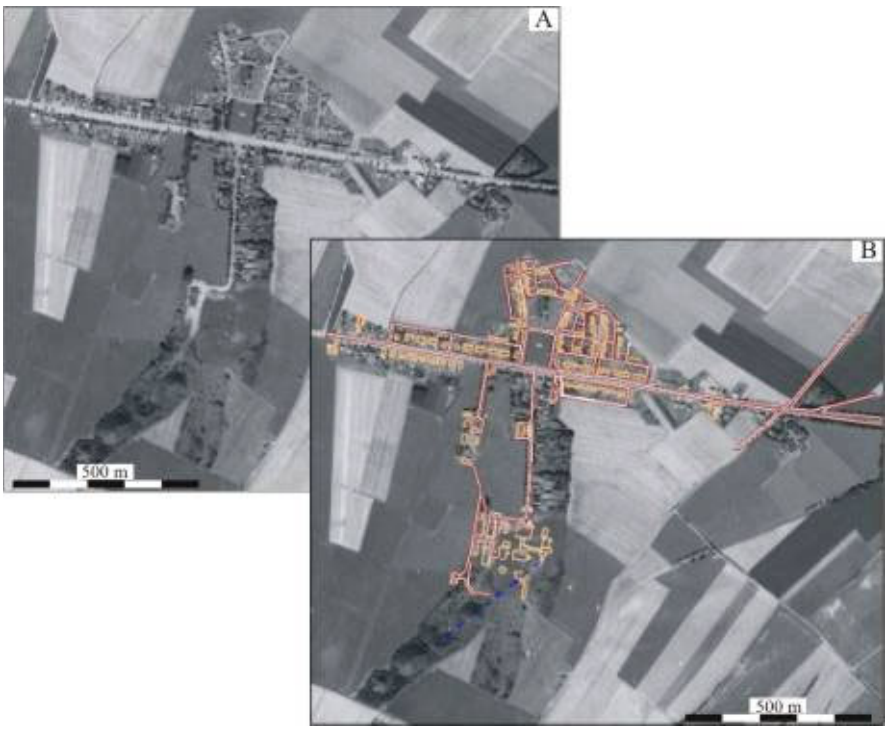

Figure 4. The digital orthophoto (upper left) is centred on the small miner's cottage in the village of Estinnes-au-Val. Infrastructure such as the buildings and houses of the colliery, drawn on the mine plans, are given vector coordinates and superimposed perfectly on the digital orthophoto (lower right). Background image corresponds to a digital orthophoto (Copyright © National Geographic Institute).

The mining coordinates and map grid, referenced to the Mons belfry, are present on the documents. The first step to georeference these documents is the conversion from mining coordinates to Lambert 72/50 coordinates through the use of two equations commonly used by the mine engineers. Mine coordinates at the four corners of each document are thus converted into the Belgian Lambert system. The georeferencing procedure is thus straightforward for the most recent mine plans. For older mine plans, the system is more complicated and requires the selection of a local reference point (usually the main mineshaft of the concession). Using only this reference point, the mine plans are not yet

correctly placed on the map grid. The procedure to obtain good geographic coordinates necessitates a work of comparison and careful checking of some physical objects (such as roads, crossroads and buildings) drawn on the mine document and also present on recent topographical maps. The next step involves creating vector coordinates for all the objects drawn on the mine plans. The following pictures illustrate the results of the work done using the mine documents with the software applications.

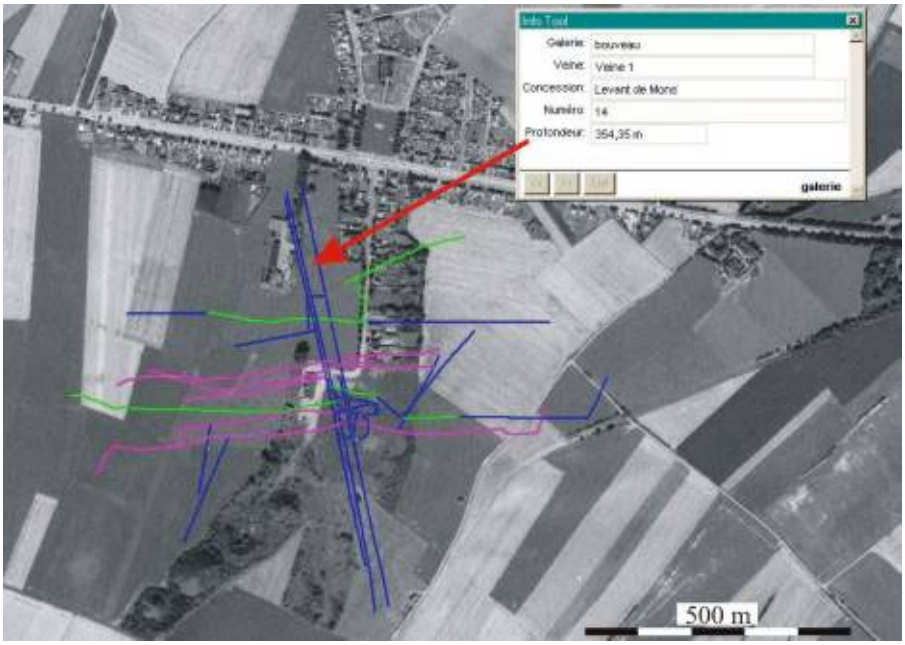

Figure 5. Coloured vector polylines represent the different galleries drawn in the GIS from the geo-referenced mine plans. Each vector polyline contains several fields of information such as the type, name and depth of the gallery and the name and the number of the concession. Background image corresponds to a digital orthophoto (Copyright © National Geographic Institute).

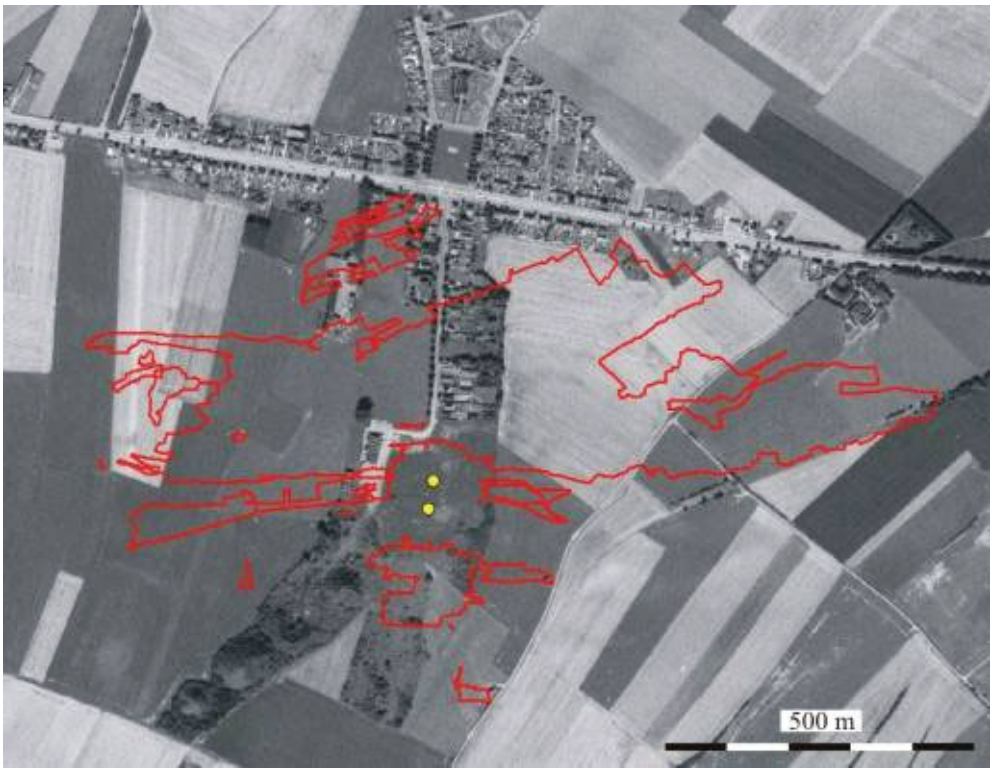

Figure 6. Limits on the surface of all the coal seams exploited between 300 and 500m deep from the two mineshafts (yellow points in the centre of the image). Background image corresponds to a digital orthophoto (Copyright © National Geographic Institute).

Once converted into vector format the village, with the streets, miners' cottages, the roads and the entire colliery infrastructure is perfectly superimposed onto the digital aerial photography (Figure 4).

Figure 5 shows the results of the vector formatting procedure realized on the geo-referenced mine documents. The different types of galleries are drawn and superimposed to digital orthophotos. The underground workings between

300 and 500m deep are converted into vector format. All this data permits the delineation of the maximal extension at the surface of these underground workings (Figure 6, in red). These data are superimposed to topographical or digital aerial photos allowing the detection of houses and infrastructure above exploited coal panels and galleries. Figure 6 shows that most of the zone corresponds to agricultural fields, only few residential houses in the northern part (southern side of the miner's cottage) are in the exploited underground area. The GIS application could be used to estimate potential zones of pollution related to the site of the previous colliery infrastructure.

Figure 7. Pictures taken in the field in 2002: 1- view of the abandoned colliery site, the red arrow on the field indicates the position of the mineshaft n°1, 2- concrete disc sealing one of the mineshafts, 3- the first slag heap (view to the north), 4- the second slag heap (view to the south from the first slag heap), 5- two preserved colliery buildings: shop on the right and a garage on the left, 6- another preserved building located at the colliery entrance. The house was the administrative office of the colliery.

Pictures taken in the field (Figure 7) depict the last preserved buildings of the colliery. The shop of the colliery is used today as a deposit and sale shop of drinks and beer. The owner of the building explains that during and after rainy days, a very strong odour is detected and moisture appears on the walls of the building. It appears that the surface waters originate from the field directly to the east of the building where a mud basin of fine coal particles was present, as indicated in the GIS.

CONCLUSIONS

The GIS application developed with MapInfo is a utility tool for country planners as the underground workings and surface infrastructures are now in vector format and can be superimposed on aerial photography with a very high precision.

This GIS application highlights the limits of the extension of the underground workings, the location of the main galleries and mineshafts and could be used to estimate potential zones of pollution related to the site of the previous colliery infrastructure.

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