THE IDENTITY OF A MARE

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RESEARCH OF A NEW RELATION BETWEEN HUMAN AND NON-HUMAIN

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Travail de fin d'études de : *SUIN Julien*

Copromoteur-expert : *PLEWINSKI Bertrand*
Copromoteurs : *DE VISSCHER Jean-Philippe*
CAVALIERI Chiara
DESCHEEMAEKER Basil

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RÉSUMÉ

If rivers have always been of great use for the development of man, it is now a question of no longer considering them as an object but as a subject. Indeed, in recent years, the legal personality of rivers raises a general question. We can cite the case of the Whanganui in New Zealand and in Europe the case of the Mar Menor lagoon in Spain, both have recently acquired this status. If the Sambre was the first canalized river in Belgium, it could again be a precursor in the re qualification of Belgian rivers thanks to the Sambre 2030 betting. In this thesis, it will be a question of identifying the Sambre via a thorough analysis. This led to the selection of a territory, the Haute-Sambre en Aval de Thuin, responding best to the desire to reconnect Human and non-Humain by altering the banks. Finally, the proposal focuses on two areas: The village of Hourpes on the edge of Sambre in the Forêt des Waibbes and the former site of the thermal power station of Jambes-de-Bois in Monceau-sur-Sambre.

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«Le culte de l'eau pure fut le premier culte des hommes, car c'était celui de la vie et de la santé».
Louis-Claude Vincent

0. FOREWORD

0.1 THE RESEARCH INTENTION

The aim of this research consist in trying to renew the links between the Human and Non-Human to redefine an identity to the Vallée de la Sambre. The main subject that is going to be analyzed is the water thematic but also its environment, which has been through these past centuries strongly modified with the industrialisation.

The choices of the subject came by discussions with the International Master of Architecture. During these two years we have been aware of the current questions of architecture and landscape and the water quality was a thematic that I wanted to explore. I choose Sambre as a subject because I was born in the region called «Le Pays Noir». This area represent Charleroi and its surrounding, located in the middle of the outline of the river.

I used to go along the RAVel when I was younger for running with my high school or sometimes I was riding bicycle until Thuin. Reminding those times, I asked myself some questions about the memories that marked my mind when I was there and it finally became the question of my work.

0.2 LANDSCAPE IDENTITY

Many Occidental cities since the 18th century industrial era had built a powerful image linked to that activity. From now on «L'héritage n'est plus qu'une image de structure et production de villes polluantes». The lifestyle of nowadays has well changed and the requests are not the same.

The territorial identity is based on experience. The principal feature that we find is the temporality. It must be from a long time in a way to let it live through a memory anchoring which is given by cultural transmissions. Before talking about the factors that are influencing the territorial identity and the uses of it in our society, we need to know the difference between territorial identity, identity and identification. The identity is the «construction sense process from cultural attributions receiving priority on all the other sources». When we refer to a space, we conceptualize the consciousness of a collective singularity. territorial identity can be seen as the term describing the relationship between an individual or a group and a given territory that allows them to compose their own social identity. It is based on symbolisations via myths, stories, centre and limits. Finally, the identity of territory requires being objective so that the studied space is defined simply as a spatial object. This difference between the identity of a region and the identity consciousness of individuals must be distinguished.

Secondly, territorial identity is a component of many issues and that is why we can classify them according to 3 factors: Politics, collective, utilitarian and economic mobilization (Fourny 2008 : 4). Although it changes form, politics is helped by territorial identity to be legitimate. If for the political function the territory is a medium of identity, the unity of the territory justifies the political unity. Identity has a function and variant nature, it is in a logic of validation of a public action. The second factor concerning collective mobility applies in territorial management by using territorial identity in its symbolic and rational dimensions. The creation of a territory project requires alliances, sometimes between public and private actors. This collective adhesion is essential to realize a project. The third factor, utilitarian and economic, highlights the territory through a global trading economy. A commercial value is attributed to the attestation of authenticity and the affirmation of the existence of a territory. Thus, these 3 factors transform the established identity into an instituting identity. The territory is determined by the latter which makes it a recognized object integrated into a system of principles and standards.

Thirdly, a factor in its own right is identifiable: the socio-anthropological factor. In this perspective, if we find a social relationship of communication in a space it will be territory as an object becomes heritage. When we talk about territorial identity, it is easy to tie it to a sentimental hook. These hooks are elements from places related to childhood, they are of the order of small scale. But when these areas are enlarged by treating larger territories, the personal and collective dimensions collide.

0.3 IDENTITY OF THE SAMBRE

Over the centuries, this area has undergone many changes following industrial development. Indeed, before being known for its usefulness to maritime transport, the Sambre followed its minor bed by commonly creating overflows now called floods following its channeling. It was at the end of the 17th century that the Sambre began to industrialize, mainly around the Charleroi region. 3 centuries later, with the wars and the oil shock as main causes, the industrial era collapsed and left this artificialized space abandoned (Prouff 2018: 20). However, there are still active sites near Jemeppe-sur-Sambre. Despite the decrease in activities leading to a decrease in the percentage of pollution, it persists and still leaves the quality of surface water and groundwater to be desired (CRSA 2022: 50).

On the other hand, the aspect of the river in the south of the valley has a completely different connotation: around Thuin and the French border industries are scarce and the maintenance of biodiversity is already committed by the Natura2000 network. The issue of pollution always lies in agricultural development and the impact on the subsoil.

If we now look at the societal aspect of this territory, indeed there has been a demographic upheaval following the mining boom in the northern part of the Sambre sub-basin. As early as 1822, the demand for employment in this context brought families from all horizon, having as common membership the terrils and social cities built at that time. Many generations have passed since then and we can question social identity. On the one hand remains this sentimental hook, on the other hand there is this a new quest for meaning where the desire to make socio-economic history coexist with a return to the natural environment is felt in political discourses and through project proposals (Guermond 2006: 293).

The question of territorial identity of the Sambre Valley then takes its meaning. It is for this reason that this work will try to discern the different ways of dealing with the return of biodiversity in the context of the rehabilitation of waterways. The objective will first be to identify the importance of the identity of a territory, to find a relationship between the human and the non-human and finally to apply it to the case of the Sambre.

1. TO THE SOURCE

Sambre is a Franco-Belgian river begining in France in the wood of La Haie-Equiverlesse in the township of Fontenelle located in the department of Aisne in Haute France. It travels 87 kilometers then meets the Belgian border at Erquelinnes to continue its path for 103 kilometers before flowing into the Meuse at the edge of the citadel of Namur. Along the way it crosses 45 municipalities including 15 Belgian (CRSA 2022: 42).

1.1 THE HISTORY OF THE SAMBRE

1.1.1 THE RIVER BEFORE THE INDUSTRIAL AREA

The Sambre is one of the oldest rivers used for river activity. It was first mentioned in 57 BC by Julius Caesar in his book II of «Commentaries on the Gallic War». Therefore the name can come from the battle of Sabis because the fleet of the Roman army located around Maubeuge was called «Classis Sambrica». It was in 840 that the hypothesis was

confirmed because it appeared under the name of «Samera», meaning quiet and running water in Latin.

Its appearance was quite different from that of today. Sambre did not look like the river that we know today but rather a river of the Ardennes such as the Lesse. Indeed, it was natural and wild with jolts letting it overflow on its major bed in times of heavy rains. The height of the water was already shallow and its bed included many islets, rocks, sandbanks causing problems of the river transport. As a result, navigation was intermittent, from 4 to 6 months a year. Wooden dams, as rudimentary as they were, were built around the 11th-12th century to provide the necessary driving force for hydraulic mills. These dams were built to create a «water hole» that created an increase of the water draught or a decrease of the speed of the flow during periods of flooding (Maigre M. 2023: 10).

During the 13th century, the appearance of the «pertuis», ancestors of the locks, equipped with gates and dams allowed the development of the navigation on the Basse-Sambre on the Namur side between Moignelée and Auvelais. In 1328, a charter granted by the city of Namur deals with a navigation to the upstream of Floreffe to Labuisière. It was not until the 16th century that all the locks were equipped with gates allowing boats to cross the Sambre in 5 days downhill and 14 days upstream (Maigre M. 2023: 11).

Although Sambre had already been modified by the inhabitants of the villages along its edge, the movement of boats remained difficult and dangerous. An analysis to undertake work to re-qualify the quality of the Sambre for navigation had been undertaken but did not emerge. It was only between 1692, when Louis XIV was at the siege of Namur, and 1747 that Sambre was cut into several works with irregular plans often in the interest of the factories and at the cost of the navigation.

This map is a zoom in the section called «La Thudinie» with Thuin and Lobbes in its center. We can already see that in the 18th century the city of Thuin is well developed. Concerning the river, an island was present and Sambre was already crossed by a bridge. The meanders seemed irregular and wavy.

In this second zoom, we see the old outline of Sambre separating Charleroy in the «Ville Basse» and «Ville Haute» which was a fortification made by Vauban during Louis XIV reign.

In the Namur county, oldly appartening at the bishopric of Liège, meanders were more sinuous, longer and deviating.

At the end, there were 18 dams along Sambre. Unfortunately these were rudimentary and made it even more difficult to navigate for the boats being loaded with only 500 kilograms (Maigre M. 2023: 11).

During this French period, the military engineers had then decided to modify Sambre's junction to the Oise. The first canalisation sketches dates from 1780 and it is 9 years later, under the hand of Mr. Deveau, Commissioner of the States of Hainaut and Mr. De Cryseul, Commissioner of the States of Hainaut, that the importance of channelling took shape. The goal was to widen, narrow, straighten over certain areas, to deepen all of it and create a towpath. In order to not prioritise mill workers and other mill users, the direction of navigation was entrusted to the Administration des Ponts et Chaussées in 1806. Therefore, the boats crossing the Sambre measured 21.50 meters long, 3.20 meters wide for a load of 46,500 tons of coal, hay, wood or stones against a fifth in low water (Maigre M. 2023: 12).

1.1.2 THE RIVER DURING THE INDUSTRIAL AREA

In 1820-1830, the industrial revolution took a turn in Wallonia with the development of mining and steel (La fonderie 2020: 4). Shortly before, under the Dutch regime which started after the defeat of Napoleon on June 18, 1815, the Sambre began to undergo more

significant changes. After several requests of the Municipal Council of Thuin and similar request for regularization in the memory of the chief engineer De Behr, it is in 1824 that the government of King Guillaume made the decision to visit in situ the river Sambre. Following this analysis, the choice of the canalisation was chosen in *view* of the multiple possible benefits for the country.

According to the specifications, the difference in height of 42.17 meters between the border and Namur would be reduced thanks to the presence of 22 locks with a fall of 1 or 2.50 meters. Thanks to this Franco-Dutch agreement, this new pipeline brought a uniform anchorage in all seasons which allowed to go from 5-6 months of use to 10 months a year.The resumption of navigation after the works in January 1829 was inaugurated at Thuin by Guillaume d'Orange by boat. He travelled Sambre to Charleroy, stopping at the Bonehill factories in Hourpes (Maigre M. 2023: 16).

However, despite these first installations, renovations had to be made regarding the specifications such as the length of 12 locks located between Charleroi and Namur. These were 42 meters and were lengthened by 8 meters for larger boats. These locks were made of bricks and fault stones with a lock drop wall. The dams vary from 4 to 6 meters wide and consist of abutments and masonry piles. The bridges are in piled framework and abutments in masonry with a drawbridge. The towpath was either backfilled on natural land or excavated. The railway line built along the Sambre surpassed it 29 times via 9 fixed bridges in masonry and 20 others in wooden arch resting on piles and abutments in masonry. The draft had also been revised to reach 1.50 meters but it turned out that it was only 1.20 meters deep (Maigre M. 2023: 18). Following a lawsuit concerning the defects of the project, the government took over the contract in November 1835. Engineers have drawn up the list of works to be carried out to have a minimum anchorage of 2 meters on Belgian territory. After 5 years of work, from 1834 to 1839, the Sambre and the Oise were finally connected which allowed a junction between Paris and Charleroi.

In the 19th century, Thuin as slightly changed in terms of demography. Looking at Sambre, we can now see the first structures allowing the gestion of the water and its flows.

Charleroi knew a huge changement in less then one century. As we can see, the city is know developped and the surrounding where the hamlets were are bonded. Sambre has become a navigated river from Marchienne La Providence to its other side Couillet. As we can see, many diversions of water are now existing as harbours. Sambre have been linked to the new canal Charleroi-Bruxelles. The old meanders are crossing the new outline drawn by Armand Caulier and the previous drafts.

Concerning Basse-Sambre on the side of Jemeppe-sur-Sambre, the city is slowly expanding itself. Only two changes are notable : the island after Auvelais and the one after Ham-sur-Sambre. Both are used as dams and locks.

Unfortunately, these changes executed on the minor bed facilitated the overflows of the Sambre. Among the most affected cities is the one of Charleroi which experienced devastating floods, including the one in 1850 that wiped out 5 masonry bridges. The water that still passed through the current Boulevard Tirou had reached an overtaking of 2 to 3 meters more causing a flood of the entire Ville-Basse. This was also a real danger for the mining galleries. Since then, new studies had been undertaken in 1851 to find out the causes of flooding. With this work, the Belgian Sambre had obtained a draft of 2.10 meters and a sink of 1.80 meters for barges (Maigre M. 2023: 23).

The problem of sambre and its flooding came from the fact that its minor bed is winding and has a limited capacity to evacuate volumes as during heavy rains. This is why the Sambre valley still experienced overflows more than a dozen times until 1995. In 1919, the "Commission nationale des grands travaux" wrote a report on the decision to dam and divert loops in flood zones:

« La rivière doit être élargie et approfondie entre l'écluse de la Jambe-de-Bois à Monceau et Namur; en outre, de nombreux coudes doivent être adoucis. Les barrages à poutrelles sont à remplacer par des vannes Stoney. L'exécution de ce programme préviendra les débordements, tant que le débit de la Sambre ne dépasse pas les 235 m3/sec ».

The modernization program of Basse-Sambre was created 7 years later by Armand Caulier. It was after the validation of Minister Henri Baels in 1929 that King Albert and Queen Elisabeth were able to inaugurate the major works of Charleroi on June 22, 1930 (Maigre M. 2023: 26).

1.1.3 THE RIVER AFTER THE INDUSTRIAL AREA

1.1.3.1 THE VISUAL CHANGES

The end of the industrial era in the Sambre basin came around 1960-1970. Since then, factories and companies have slowly disappeared to make way for empty areas called SAR (sites à réaménager). This period left behind a river with a dark image, with the inhabitants who live on the bank turning their backs on it.

On the other hand, the activities on the banks of Sambre were able to persist in particular thanks to the creation of the Autonomous Port of Charleroi (PAC) in February 1971. The main mission of the PAC is to participate in the development of economic activities related to those of the waterway. The autonomous port of Charleroi has 29 port sites spread over 500 hectares (SPWallonie 2024: /).

The whole part of Haute-Sambre is used only for Sunday navigation unlike the Basse-Sambre which is connected to the Brussels-Charleroi canal. The RAVel, formerly used for pulling boats by horses, is now used by cyclists or walkers doing hiking. Even if it remains largely unchanged on its outline, 10 centimeters were added on the Haute-Sambre by raising the water level of the reaches to reach 2.20 meters of sinking. Apart from these modifications, works have had the chance to experience a second life on the side of the Haute-Sambre now intended mainly for river tourism.The example of the Erquelinnes dock is one of them: It existed since 1865 and served as an industrial space for coal processing. 120 years later, she was found abandoned by passers-by. They have taken steps to transform the dock into a marina to revive this space (Municipality of Erquelinnes 2024). Other bays of the Haute-Sambre have also experienced the development of Yachting Club to welcome river tourism (Maigre M. 2023: 110).

Since the Depot de guerre, La Thudinie didn't change much more. We can only notice the urbanism spreading in Lobbes and Waibes.

A lot of modification have been done in the Charleroi area. Firstly, now the Canal Charleroi-Bruxelles is simplified but so is all Sambre. We can see that the river doesn't pass anymore by the Boulevard Tirou in the city center and neither by the center of Couillet. A harbour area exist now in Marchienne-au-Pont.

The Basse Sambre situation has quiet changed, all the meanders have been shorten to improve the quality of the navigation. These old stretch of the river are now surrounding Factories and industrial zoning.

On the Basse-Sambre side, the government declared on 9 March 1957 the passage to the 1350 tons law in order to integrate the national network into the European river scheme. Between 1966 and 1969, sailing conditions were improved by increasing the draught from 1.80 meters to 2.60 meters (Maigre 2023: 186). During the same years, the 1825 infrastructures were replaced by lock dams allowing more substantial falls. This change reduced the number of falls from 13 to 8 between Charleroi and Namur (Maigre 2023: 222). Several bridges have also been removed and others have been replaced to accommodate these larger boats.

On this part, Sambre didn't have a change since then except for Charleroi where the Quai de Sambre had a makeover in one of the Phoenix project dating from 2010-2014. From

the Pont de la Résistance to the Pont de la rue de l'Ecluse, the banks surface has been changed from parking spaces and the road to a pedestrian and seating area. This step allowed to create a first approach towards the return to a link between Human and Sambre. We are now in 2024 and Sambre is still the main element of the new figure of the Carolorégian basin. Indeed, Charleroi Bouwmeester proposed, as part of the masterplan «RIVES DE CHARLEROI», a more radical approach : creating a marina in the city center at the place of the current finance building at the opposite of the central station.

1.1.3.2 THE PERCEPTION CHANGES

« L'eau n'est pas un bien comme les autres: elle est indispensable à la vie humaine et à la vie en général. Ceci entraine une responsabilité particulière des pouvoirs publics, de tous les acteurs et des citoyens. C'est d'autant plus vrai depuis que l'homme est en « capacité », par certaines de ses activités, de mettre ce patrimoine hydrique en péril, en dérégulant son cycle de façon parfois irréversible » (Eco Karst 108 : 1).

As we have seen so far, the Human looked at Sambre first to feed his land, produce his food. Very quickly, it became an interesting subject for the industrial development of Wallonia. But when the industrial period fell, the Charleroi region tried to turn to tourism and the economy. Even if it is still the case today, we find a new facet which is not less important: its ecosystem and the quality of its water mass. Indeed, river contracts were created at the beginning of this 21st century following the government's decree of November 13, 2008. Thanks to it, the Contrat Rivière Sambre & Affluents appeared and undertook the implementation of different objectives. These objectives are carried out by many local actors and users of Sambre. The River Contract evolves on the scale of the entire Sambre sub-watershed thus grouping the pre-existing dynamics of the Contrat Rivière de Haute-Sambre, the Contrat Rivière de Sambre Centre, of the Contrats des Lacs de l'Eau d'Heure and the Contrats de Rivière du Ry de Fosses. In 2020-2022, 34 municipalities were partners in the Contrat Rivière Sambre & Affluents (CRSA 2022: 30).

In the working methodology, the CRSA has determinated and renamed areas for each part of the river. For this study, the working area is limited to Sambre which has been divided into two parts namely SA25R and SA27R. The reflection of the work focuses on two areas of reflection, pollution, related to industries and agriculture, biodiversity, related to sensitive habitats and species. These areas will be studied in the next points of this first chapter.

As noted in this illustration, none of the water masses associated with the Sambre sub-basin are responding to the assessed requests. Some sources of pollution often come back during the analyses. Among those, we find the discharge of wastewater into the stream, lost wells, oil and waste accidents, contamination of nitrate and pesticides from agriculture, industrial pollution (CRSA 2022: 45).

Looking more precisely, Sambre is mostly affected by nitrogen substances and phosphates. At the Belgian-French border, it has a good quality of water but over its course it deteriorates more and more at the level of the Basse-Sambre. However, the first signs of deterioration already arrive in Haute-Sambre when the Hantes flows in it at Labuissière. In the northern basin, the quality is poor when the river is meeting its tributaries (CRSA 2022 : 53). Contamination with phosphorous substances is also more present in the north of Sambre because of wastewater (CRSA 2022 : 54).

Fortunately, the percentage of the good condition of water masses increases over the years. Indeed, 36% were in good or very good ecological condition in 2007-2008 against 44% over the period 2013-2018 (SPW Environment - DEE 2020). Looking at these statistics and the water quality map of Wallonia, we can notice that the south has a fairly clean quality and that the Sambre-Meuse basin seems to be the barrier to this ecological continuity. We will try to understand what are the causes of this rupture in the next points with the industrial development and the biodiversity present on the banks of Sambre.

1.2 THE HUMAN : INDUSTRIAL DEVELOPMENT

1.2.1 THE REVOLUTIONS

Coal mining had already begun in the 12th century. Four centuries later, coal was used as a household fuel in the mining regions. However, industries used coal as fuel later. They tended to settle in the countryside around villages and hamlets to benefit from a larger space and their primary resource: wood (Charleroi Discovery 2007). It was at the end of the 17th century that Belgium became one of the first industrial powers to have Europe with coal mining on the surface as the site of Bois-du-Luc created in 1685 (Numeric Landscape 2023). It was not until the 18th century that its use became widespread in the brickworks, breweries, distilleries, glassworks, etc. (Clerbois D. 2006: 9).

At the end of the 19th century, the second industrial revolution began. New means of production came to upset the mores and the companies then thought of the development of foreign markets. All the factories are located on the banks of the river to answer to the new technologies. On the other side, a large number of so-called «home-based industries» companies are born (Clerbois D. 2006: 39).

Turning the page in the next century, industrial production is impacted by the First World War. After that, the evolution didn't take place, the factories remain in the same production patterns with the production of transport equipments, raw and semi-finished products. In addition, the aim is to expand industrial areas in less cramped spaces through electric energy and industrial transport. After the Second World War, the Belgian economy faced a structural crisis in the 1950s. No equipment was renewed while the other countries became competitors.

However, the landscape changed. The unusable materials of the mines piled up and formed the landfills, the open extractions left vast calcareous gaps, the rivers became a navigable water line with as we have seen, the suppressions of many meanders. The development of the railways also flatten the ground, leaving a topographical mark today. Industries became vast complexes interrupting the horizon line.

From the second half of the 20th century until the beginning of our current century, zoning industries are developed. These business parks are located outside of cities, near traffic hubs and airports. Meanwhile, deindustrialization was beginning and the causes of it were the energy competition of coal and new locations.

1.2.2 INDUSTRIALISATION'S IMPACT AND ACTIONS

Sambre's biological activity has been significantly impacted by this industrial past. As shown by two studies of the Institute of Zoology of Liège made in the 70, Basse-Sambre saw living organisms disappear almost entirely. Haute-Sambre has been relatively unaffected. Although industrial activity in the Sambre sub-basin has declined, its impact is still visible. It appears second in the classement for the responsibilities in the Meuse District.

197 industries in the Sambre sub-basin are taxed on the discharge of their industrial waters. 21 are classified in the IPPC (Integrated Pollution Prevention and Control) while 18 are taken up as SEVESO (companies that could potentially be the cause of major accidents). 3,696 sites are listed as potentially polluted.

Yet, of the total water pollution, industries account for only 10% of discharges. During the period 2005-2010, the Sambre sub-basin has seen a 50% reduction in pollutant emissions (CRSA 2022: 51).

1.3 THE NON-HUMAN : THE PlACE OF THE BIODIVERSITY

1.3.1 GEOLOGY

It is important to pay attention to geology since soil functioning and water quality are closely related.

The Sambre sub-basin is included in the Walloon coalfield. The Carboniferous Sandstone and Schist form a band in this area. The Sambrien coal of shale nature consists of two superimposed layers: the Namurien, older and the Westphalien.

A cenozoic blanket, towards the Hennuyers and Brabant plateaus, is present in the north of the coal strip. The grounds are mostly sandy-clayey loose that lays in discordance on the Paleozoic base.The trays are covered with a large silty cover. The valley bottoms are composed of quaternary alluvial materials carried by rivers (CRSA 2022 : 43).

In the south, 3 sets are presented: First the Condroz de l'Entre-Sambre-et-Meuse. Synclinals are constitutive of notorious shale-sandstone levels, anticlinals of limestone and frasnian and Givetian shales. The « Depression » of the Fagne the formations are silto-clay detrital lithologies and to a lower extent clay-carbonate of the Famennien. The Calestienne on the southern edge of the Dinant synclinorium is in the form of a 2 to 4 km wide strip predominantly composed of calcareous but also sandstone shale of the Lower Devonian, middle Devonian, Superior Devonian.

It's among these layers that the groundwater is exploited for abstraction used for the public distribution of water, by private, farmers, individuals. However, as we have seen in the points dealing with current sambre and industries, pollution influences the water quality of these catchments. A vulnerable zone has been defined according to the protection of groundwater and surface water against nitrates of agricultural origin. In these areas, measures are requested from farmers such as the condition of storage of organic nitrogen on the farm, maximum spreadable quantities, permitted periods and conditions (CRSA 2022 : 45).

Although there is a tendency to think that the subsoil and the underground environment are stable as a result of their environment of their own, it's quite the opposite. Indeed, its ecosystem is intimately linked to the activities and phenomena that take place on the surface.

The main element linking the surface to the subsoil is water which can enter by infiltration or percolation via karst sites such as sinkholes, chasms, collapses… This phenomenon plays a major role in the quality of our basements. It can be likened to a series of nested steps influencing the smallest of materials up to a whole hydro-geological basin (Eco Karst 100: 30).

This is where the importance of treating our soils, rainwater runoff and discharging pollutants related to human activities appears. Therefore, as we have seen before, guidelines are written for good agricultural practices, soil waterproofing and water purification.

The remediation of a polluted site can be carried out in two ways: ex situ or in situ. In Wallonia the ex situ method is generally used. It works by excavating contaminated soil and transporting it to a treatment centre. In situ offers the pumping and treatment of contaminated water, thermal desorption or bio remediation. Thanks to fungi and mold, nature can treat itself pollutants such as hydrocarbons but this natural attenuation remains slow and incomplete (Exo Karst 108: 26). If human activities influence this environment, karst influences the development of the territory. In Wallonia, karst hazard is recognized as a major natural hazard on the same scale as floods, storms, etc. (Exo Karst 100: 32).

The Sambrien basin is subject to several strips of limestone in which karst formations are developed. The axis Fontaine l'Evèque-Bouffioux-Châtelet-Presles-Floreffe is the most

important of all and the most remarkable karst phenomenon is the great lapiaz of Leernes-Landelies (CRSA 2022 : 46).

1.3.2 THE AGRICULTURE LAND

In Wallonia we have 14 agricultural regions. The Sambrien basin is included in 3 of these regions: the Condroz in its center and south, the Fagnes in the south, the silty region in the north and east (EAW 1 2023 : 1).

The utilized agricultural area (UAA) occupies 44% of the Walloon territory. Cattle farming is predominant with 46% of the UAA while exports of field crops occupy 35% of this area. Forage production (all crops for animal feed) accounts for 55% of the UAA. The largest UAA covers a third of the UAA Wallonia. In second and third place are Condroz and Ardenne. Hainaut is the largest province with over 210,000 hectares.

With 60% of the land, agriculture is mainly present in the Sambre sub-basin. Agricultural activity in the Thudinie region, between Sambre and Meuse, the North (CRSA 2022: 51).

As we can see, it's mainly the south of Sambre, at the bottom of the Condroz, that we find the higher concentration of all the productions shown in the fig. 40. There is also a fairly concentrated area in the Limoneuse area to the north.

As we can see, it's mainly in the south of Sambre, at the bottom of the Condroz region that we find the maximum concentration of all the productions shown in ill. 40. There is also a fairly concentrated area in the silty area to the north.

In this second part concerning agriculture, we will see the harmful aspects to the good health of the soils of the sub-basin. Environmental degradation changes according to the types of agricultural production, their use of chemicals, etc.

In Wallonia, 90% of the area under cultivation had insufficient levels of organic matter causing the fertility of biodiversity, soil structures, water circulation, carbon storage and immobilization of certain pollutants. About the erosion, 57% of the area under cultivation exceeded the erosion threshold from 2017 to 2021.

Water pollution by nitrate and pesticides from cultivated soils exceeded the water pollution criterion by 11% in Walloon territory (EEW 7 2024: 10). This excess takes place in areas of arable crops, especially in the silty region. In the Cambrian sub-basin, we can notice a peak of NO3 concentration in the west between the Thudinie and Beaumont. The cause is the rate of nitrogen used in the cultivation of corn, vegetables and potatoes in these regions. However, soil pollution toward water decreases thanks to water contracts and agro-environmental methods such as managed strips. This factor remains difficult to address as drought and heavy rains influence it (EEW5 2022: 4).

The use of fertilizers and nitrogen in Walloon agricultural soils is no longer the current major pollutant. Indeed, its use has decreased compared to the previous century and it stagnated since 2009. Nevertheless, the use of mineral nitrogen increased by 1.5% between 2019 and 2020 following budgetary changes. (EEW4 2022: 4)

The use of plant protection products (PPP) are used to protect plants from pests, regulate their growth, fight against unwanted plants. Nonetheless, it remains an agent with risks to human and environmental health. That is why national action plans have been imposed to reduce these risks. In 2020, the total quantity of PPP active substances amounted to 5518 tonnes, almost twice as much as in 1995-2010. The reason comes from improved product efficiency, farmer awareness, milder weather and restrictions. In 2020, the use of mancozeb in potato cultivation was the best-selling fungicide before sulphur and captan.

The potato crop has the highest use rate with 15.3 kg s.a./ha followed by sugar beet and winter wheat against 0.03 kg/ha for permanent grassland. When these data are mixed with the area of the different crops, we found out that it's in the silty, sand-silty and Condroz

regions that the average dose of use of PPP products is highest. This observation can be explained by the type of production found in northern Wallonia: cereal, beet and potato crops (EEW2 2023: 6).

Eutrophication of rivers in the Sambre basin is decreasing. This is due to the reduction of phosphate fertilizer inputs, the reduction of domestic pollutant loads and the compliance of wastewater treatment plants for tertiary treatment. In addition, district management plans were also involved (EEW4 2019: 2).

Another aspect unfavourable to groundwater quality is the compaction of agricultural soils because of the machinery. As a whole, the eastern basin of the Sambre is little subject to soil sensitivity except the south of the Charleroi region, from west to east at Hourpes, Landelies, Jamioulx, Gerpinnes, etc. But also north and south of Fosse-la-Ville (EEW6 2019: 2).

Even if the impact of agriculture has many negative consequences, the trend indicates an improvement compared to previous decades. Furthermore, 15.9% of agriculture was organic in 2022. By the end of our decade, the objective will be to reach 30% organic production in the Walloon SAU (DEW 2024: 11). Different European strategies are implemented such as the «Farm to fork strategy» aiming to reduce at least 50% of nutrient losses without affecting soil fertility by 2030. New EU 'fertilizer' regulation implemented in 2022 also seeks to incentivise the use of recycled and organic fertilisers (EEW2 2022: 4).

1.3.3 BIODIVERSITY

1.3.3.1 SITE AND ENVIRONMENT

The Sambre Valley is at a very specific place in terms of biodiversity because it is at the junction of two regions: the Atlantic and the continental zone.

The continental region covers more than a quarter of the European Union. It extends over 13 countries in a strip from west to east from central France, southern Belgium to Romania. It continues on the Asian continent to the Ural mountains. This vast area was covered with deciduous beech plains dotted with swamp and bog floodplains. As a result of massive agricultural production and the use of lumber, these forests were cleared. Moreover, as we have seen in the case of Sambre, most European rivers have been channelled for river transport, which has seriously impacted the biodiversity of these valleys. (Natura 2000 région continentale: 3)

The Atlantic region extends from the northern part of the United Kingdom, two thirds of Belgium and the coast of the North Sea but also to the north of Spain. Biodiversity over the centuries has been more degraded than the continental region. Forests were also cleared in the Middle Ages. Natural deciduous trees were now replaced by coniferous plantations occupying 13% of the region (Natura 2000 région Atlantique : 3)

Wallonia has a great lithological diversity with a wide range of soil chemical richness. North of the Sillon Sambre-et-Meuse lies deposits of lossèique silt bringing the agricultural wealth of the region. In the south, geological bases made up of calcareous rocks, micaceous sandstone and shale have generated soils of variable fertility (D-2022-11802-141: 25).

In the silty region, small valleys with wetter soils are provided with hybrid poplars marking the openfield. The remaining forest parts are made of beech and oak forests.The Sambre-et-Meuse furrow of Condroz has long been domesticated as we have seen by the artificalization of Sambre and wood production. Few natural environments remain in the bottom of the valley. However, the slopes are adorned with remarkable forest massifs and rocky escarpment. Among this biologically rich sector, brownfield sites participated with waste heaps and quarries (D-2022-11802-141: 26).

The forest area of Wallonia occupies 32.8% of the territory with its 500,000 hectares including 480,000 hectares of productive forest (D-2022-11802-141: 44). It is distributed irregularly with a concentration in the south of the sambro-mosan furrow and in the Ardennes.

40.3% of this forest area consists of softwood: 73% spruce, 9% douglas fir and 6% pine. This situation is explained by the era of the reforestation that European forests experienced in the 19th and 20th centuries for economic purposes. The structure of these afforestation doesn't look like a natural forest at all in view of the simplified structure. Fortunately, changes in natural regeneration and irregular stand patterns have recently emerged in resinous silviculture practices but their exploitation far exceeds forest production with more than 120% (D-2022-11802-141: 46).

Hardwood forests have undergone changes long ago before those of softwood. The oak was replaced by the regimes of the coppice and coppice under forest. As a result, 40% of the deciduous forests are still coppice under forest, 6% of coppice but oak remains the first species (D-2022-11802-141: 45). These are composed of oak, beech, oak-beech and noble hardwoods.

As shown in the diagram, the north of the Sambre-et-meuse furrow is weakly wooded (8% of the Walloon wooded area) and the Condroz, cradling the south of Sambre is a little more abundant. Of the 430,000 hectares of deciduous forest area estimated by the Ferraris map, only 180,000 hectares remain, a decrease of 56%. The cause is deforestation for agricultural areas and the cultivation of the conifers mentioned above (D-2022-11802-142: 26).

As Wallonia know a varierty of geological ground and has many biological region, Sambre valley has around 10 natural habitats with specific spacies of trees, shrubs or flowerbed.

1.3.3.2. HABITATS OF SAMBRE'S VALLEY

Habitat 9110

Among them, we find the presence of habitat 9110, beech with white alfalfa, in the continental region. Present on soils poor in mineral elements and acidic substrates as in loam and loam-sandy soils. This habitat is however not the most developed because the substrates of the furrow in the Condroz is rich (D-2022-11802-142: 118). These are forests dominated by beech coexisting with other species from silvicultural practices such as oak and more rarely maple. The shrubby undergrowth is also dominated by beech and oak. The herbaceous layer is defined by the germandree Scorodoine et myrtille commune (D-2022-11802-142: 108).

Habitat 9120

Habitat 9120 is that of Atlantic acidiphilic beech. It is present in the Atlantic region and in the Entre Sambre-et-Meuse. This vegetation is represented by the beech and oak from the treatment in coppice or coppice under forest and recolonization forests. They are divided into two close phytosociological associations distinguished by the nuance of acidity and texture of the soils: Fago-Quercetum and Milio-Fagetum.

The Atlantic acidiphilic beech is found in sandy areas of Brabant and Hainaut to the Entre-Sambre-et-Meuse. Here, beech tends to dominate with sessile oak and pedunculate oak. One can find more rarely the birch and the mountain ash of the birds.

Atlantic acidicline beech appears preferably in thicker silty blankets with brown loam and denatured soils with imperfect drainage. It's found in the Atlantic region of Hainaut and in the Entre-Sambre-et-Meuse. Beech is still the main essence with oak but we can see the maple sycormore and a shrub layer composed of hazel and elder charm (D-2022-11802-142: 128).

Habitat 9130

Neutrophils are found in the continental and Atlantic regions. It holds a significant proportion of oak, ash, oak-charmaies, oak-ash from the coppice and coppice treatment.

Mid-European neutrophil beech trees occupy a well-ventilated and fertile soil, rich in mineral elements. Present in plateau as in slopes it is characterized by the abundance of yellow lamier and aspérule odorous and nitrocline.

Atlantic neutrophil beech groves develop in draining and silty soil of good fertility. The old afforestation is covered with vast vernal beaches of hyacinth (D-2022-11802-142: 143).

Habitat 9150

Beech ash is mainly found in continental areas. Calcicultural forests are rare in the silty region, in the Condroz the peaks and sunny slopes of the valleys are the areas of predilection as for those in Fagne-Famenne (D-2022-11802-142: 169). This habitat is dominated by charm and oak. It is also home to rare species protected by la Loi de la Conservation de la Nature.

Calcium beech forests are thermophilic forests developing on superficial and stony calcareous brown soils. The hour dominates with the sessile and pedunculate oak, charm, country maple, ash, cherry, Torminal alis, large-leaved lime. Floristic diversity remains very high.

The oak-charmaies are the most frequent habitat 1150 following treatment in coppice or coppice under smart. There are oaks, charms, country maple in predominance and these species are supplemented with ash, beech, larch, mulberry and lime. The shrub flora has many bushy cullet species such as male dogwood, purgative buckthorn, troine, etc. The herbaceous layer has extensive beaches of perennial mercurial and orchid species (D-2022-11802-142: 162).

Other types of habitats, such as the climacic Molinie and Subatlantic Ash Forests, are present but in too small a minority to be assessed in the study.

1.3.3.3 DIRECTIVE AND ORGANISATION TOWARD THE BIODIVERSITY

In order to protect and re densify the quality of biodiversity, several directives and nature reserves have emerged. Let's first go back to the beginnings with the consideration of the environmental issue:

We must first take a broader view in order to understand the current state of research. The whole issue of nature management came into being on 12 July 1973, when the Belgian Nature Conservation Act was passed. Attention is therefore focused solely on measures to protect endangered species, nature reserves and natural parks. It was not until the 1990s that the importance of territorial management was mentioned (Fautsch & Dufrene 2008: 16).

At that time, the Natura2000 network was created to focus attention on the need to manage and protect nature from invasive species. In 1992, the Member States of Europe must designate sites of Community importance following the adoption of the Habitats Directive. Then in 2001, European heads of state aim to put an end to the decline in biodiversity by 2010. The Walloon government has selected sites to meet European criteria. If in June 1996 we had 57 sites, in March 2005 we had 240 sites, forming an area of 13.12% of the Walloon territory with 220,000 hectares (Fautsch & Dufrene 2008: 36).

We can see on this map that the powland and permanent culture are taking the main place of the Sambre basin scenery. The agricultural production is always nearby rivers and its

more concentrated on the sa25R side. The forest are localised in the south of Sambre in the Condroz and separate the urban landscape of the Condroz landscape.

1.4 CONCLUSION : THE DUALITY BETWEEN HUMAN & NON-HUMAN

« La récurrence des inondations a conduit à développer une culture du risque poussée chez les habitants du quartier y résidant depuis quelques années. Le risque a renforcé le lien social au sein de la population. La solidarité au moment des crues et le sentiment d'appartenance à une entité géographique et sociale à défendre sont des éléments marquants lorsque l'on s'entretient avec des habitants du quartier. »
(Guézo et Verrhiest, 2008 mentioned by Richard-Ferroudji, Dupont, Durand, Grelot 2014 : 11).

After having analyzed the territory of Sambre entirely it seems wise to target a more precise study area in order to issue a proposal for upgrading of the watercourse on the given area.

Preferably, it would be better to find a space that is not the most deteriorated to propose a plausible solution and serve as a starting point for the new identity of Sambre and the awareness of Humans in relation to the environment surrounding it.

To do this, we will in the next pages analyzed the main themes cited in this first chapter by composing summary maps to deduce the space most subject to research.

The first synthesis concerns the history of the Sambre pipeline. As we can see, it has undergone considerable changes over the last four centuries.

If we first look at the Haute-Sambre, it does not change much overall. Only 2 arms were transformed into a lake/ marsh to make way for a straight pipe in order to trace the railways.

Further from the lock of Monceau Jambe-de-Bois Sambre takes another turn. Man modified his arms, sometimes to protect the inhabitants from floods or diversions for industrial purposes such as the island of La Providence or the 2 arms of Jemeppe and Ham-sur-Sambre.

In the end, Sambre keeps two facets, the one of pleasure boating in Haute-Sambre and the one of fonctionality linking the different basins via the Charleroi-Brussels canal.

Through the superimposition of these 3 maps, we can understand the functioning of the land occupations taking place along the Sambre valley.

Indeed, we can notice that Charleroi is the heart of the Sambre basin. The city and its peri-urban fabric separate the river into 3 zones: Haute-Sambre, Basse-Sambre in the Carolorégienne region and finally the Basse-Sambre in the province of Namur. Although the landscape surrounding the former mining town seems similar, the Haute-Sambre has a greener territory, especially with the forest massif bordering the top of the Condroz. In addition, we can see a difference in density of the urban mesh between the two territories: The South has kept a rural aspect while the East of Charleroi keeps an urban canvas with cities like Châtelet, Farciennes or Jemeppe-sur-Sambre an its industrial zoning on the edge of the old Sambre's riverbanks.

Thus, this second map already draws an answer concerning the spaces that can be favorable to the redefinition of the identity of Sambre: La Haute-Sambre.

In this third summary map, we see the soil and water quality of the Sambre sub-basin.

On the one hand, the soil has an average quality ranging from medium to poor. The healthiest part appears in the southern region, in Famenne. The region of Charleroi is

also of better quality but it is not so correct in view of the coating of the mineral floor. That's why the area is hatched.

The quality is impoverished when one moves away from the urban center and enters the plowed land in the North of the city as in the South in the boot of the Limoneuse region in the South West of Thuin.

The overall water quality was made on the basis of data on the presence of phosphate and nitrates. An average was established to restore the water quality according to the 5 molecules of fig. 30. We obviously notice a relatively good quality at the French border and a quality that decreases from Merbes-le-Chateau to Charleroi. In the north the quality is severely degraded due to the density of housing and runoff.

This third map shows an interesting place to deal with which is that between Erquelinnes and Charleroi, more precisely the area of the Haute-Sambre downstream of Thuin. Indeed this space has an average to poor water quality but could be the first step of a revalorization of Sambre.

This last map shows the vegetation in two aspects: one controlled by man, that of agriculture. We note that the distribution of field use is quite concentrated on the peri-urban edge of Charleroi in the Condroz. The area extends from west to east of the Thudinie to Fosses-la-Ville. The map also allows to locate karst phenomena. We realize that areas with a low percentage of agricultural production also have karst.

As for forests, the Sambre sub-basin has more trees in the south, particularly the Ardennes than the north. A suburban massif is visible just above the area with higher agricultural production.
Along Sambre, Natura2000 areas are visible after Lobbes including the reserves of Merbes-le-Chateau.

This map concludes the validation of the Haute-Sambre downstream of Thuin to continue the study. Indeed, this area is the space between the city and more natural areas. We can also see that this region has a vast typologies of tree spicies with the habtiats 9110, 9120 and 9130. In addition, there are karst phenomena and agricultural production that can form a study point for the intervention areas.

2. HAUTE-SAMBRE EN AVAL DE THUIN

The Haute-Sambre en Aval de Thuin is a 13,87 kilometers sub-part of the Haute-Sambre located between Thuin and the Jambe de Bois in Marchienne-au-Pont/ Monceau-sur-Sambre. Sambre crosses the municipalities of Lobbes Thuin, Montigny-le-Tilleul and Fontaine l'Evêque before becoming the Basse Sambre in Marchienne-au-Pont.

2.1 APPROACH OF THE PROJECT

2.1.1 AN UPSTREAM & DOWNSTREAM RESEARCH

*2.1.1.1 THE ALLUVIAL PLAIN : RAIN FOLLOW RIVER*S

If we look at the world's water reserves, water stocks represent 1.4 billion m3. However, seas and oceans account for 97.5% of this volume, leaving only 2.5% fresh water remaining. Among these 2/3 freshwater include glaciers. This leaves only 1% of total water as groundwater and 0.01% surface water. Only this minus 1% is actually usable for our various activities (SPWARNE 02 2024: 6).

In Belgium, the freshwater capital amounts to 13 billion m3 per year with about 7 billion m3 of rainwater taking into account evapotranspiration. Groundwater reserves are estimated at 1.9 billion m3 per year. In Wallonia, the rainfall ratio is relatively high with around 160 to 200 days of rain over the year. Wallonia has an important groundwater resource, partly due to the porous subsoil. Water flows more abundantly in loose rocks and coherent rocks such as limestone, which have cracks. Representing 79% of the water

in Walloon distribution, groundwater is one of the most important issues regarding environmental quality (SPWARNE 02 2024: 8).

When we look at the Haute Sambre downstream of Thuin, we see a high presence of agricultural land around Sambre and on its major bed. If this field is one of the first users of water resources, it is also decisive for the genesis and distribution of water resources. Indeed, it participates directly in the water cycle since it is influenced by rainwater and the share of runoff or drained to aquifers (LeenhardtD. , Voltz M. 2020: 1).

For more than half a century, agricultural activity has been recognized as one of the anthropogenic activities causing the degradation of these waters (LeenhardtD. , Voltz M. 2020: 24). It is true, as we have seen from the summary map 3 of the first chapter, that the obvious cause of this observation lies in the use of chemicals which are in direct and indirect contact with the water masses of agricultural territories.

As a result, several laws have been created via European standards such as the « REGULATION (EU) 2021/2115 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) ».

In addition, there is an agri-environmental and climate approach (ACAM) to encourage farmers to implement practices that improve the environment and climate outside of the legislative requirement. To motivate the voluntary commitment of a period of 5 years, farmers then receive remuneration.

In 2022, 48% of producers (6,071) were engaged in a CMAM. The increase in percentage over the last 5 years is due to an increase in remuneration for some of the MCEAs, but also to the introduction of new variants in 2018. If we look at the trend of the last 10 years, it remains undetermined in view of its clear decline in 2012-2017 and the slight increase known until 2022 (EEW agri-environment 2023: 4).
In the CAP 2023-2027, MEFAs are one of the three pillars that allow agricultural practices to evolve towards environmental issues. These MCEAs include 5 basic methods, 3 targeted methods and 1 result-oriented method.

In addition to these proposals, measures have been issued by the Walloon agriculture to protect agricultural soils from water erosion :

The principles of struggles vary, such as
- protection of the soil against the erosive impact of raindrops,
- the increase in the resistance of the ground to detachment,
- increasing infiltration capacity,
- increasing the soil infiltration capacity,
- The increase in surface water retention at the soil surface
- Reducing runoff volumes by limiting slope lengths
- Slow down runoff
- Conduct runoff without causing erosion

2.1.1.2 THE FLOOD PLAIN : TOWARDS A RETURN TO THE WATER BANKS

« Dans ce contexte, la présence et la circulation de l'eau peuvent apparaître comme un élément salutaire pour créer ce lien et recoudre le tissu urbain riverain, ne serait-ce qu'en permettant une lecture vectorisée des paysages urbains, c'est-à-dire en créant un fil directeur qui permette au sujet de lire et de lier le paysage »
(Roullet-Sureau C. 2008 : 4).

As we were preparing to close our last mining concessions that required a Sambre pipeline some 60 years ago, the redevelopment of the banks was already a reflection in urban and landscape planning in the United States to enhance the spaces of closed shipyards on the outskirts of historic centres (Gravari-Barbas M. 1998: 262).

In Europe, the value of rivers and their banks was taken into account from the 1980s to the 1990s. Through various projects, rivers see proposals for a new look, only it is not always for a purely environmental purpose: it is often a question of answering political issues, water management such as floods or economic issues.

We can see that cities undertaking projects of equipment development and green spaces. For example, the city of Lyon planned to build a real estate complex, shopping center, multiplex and a seat for the regional council instead of 5 kilometers of parking along the quays. Nantes wants to turn to the Garonne where 800,000 m2 are transformed into housing, offices and public facilities. We can see that the mission here remains in the revaluation of heritage where the river's role is to activate the question of space. « La dimension écologique de la relation fleuve-ville n'est pas dans les préoccupations : l'eau [...], l'énergie, les matériaux en relation avec le fleuve ne sont pas intégrés » (Bonin 2007 : 25). Ecology and uses are two elements difficult to harmonize. Between growth, construction, leisure developed in specific areas, the consideration of the river remains ultimately secondary (Bonin 2007: 26).

The last angle of approach is that of floods. Let's take the case of Béziers to best illustrate the point of view of the possible relationship between man and water : a city located in the south of France, it is crossed by the Orb and also by the Canal du Midi, separating the Faubourg district from those on the hill. This neighborhood is constantly facing floods and floods. What defines the strength of this district is its rich heritage, environmental and tourism. The suburb is composed of locks, a canal bridge classified as a UNESCO World Heritage Site (Richard-Ferroudji, Dupont, Durand, Grelot 2014: 8).

This risk of flooding has strengthened the social bond of the inhabitants through "living with" linked to the "risk culture". Water is ultimately the element that gives the neighbourhood its identity. In "The Orb constitutes "its backbone" by indicating "Everything that touches the Orb touches us""(Echoes of Faubourg No. 1 quoted by Richard-Ferroudji, Dupont, Durand, Grelot 2014: 11). Here we are not talking about having a fatalistic vision of keeping the floods. Nevertheless, they point to the possibility of coping with the floods. But these words do not unanimity: for the neighbouring commune, floods can disappear. In conclusion, we note that the views are rambling. An investigation was therefore conducted in order to question the floods and the defence of the inhabitants on the subject and the "institutionalized vigilance".

At the end of the analysis, it is the option of the restoration of the riparian that has been validated with the redevelopment of the banks and the improvement of the hydraulic capacity of the works. Improving security and biodiversity is achieved through improved access to water. A flood post is still present and is held by the "Groupement du Faubourg" in case of alert (Richard-Ferroudji, Dupont, Durand, Grelot 2014: 22).

2.1.2 SAMBRE : AN EMERGING CHALLENGE

This risk of flooding has strengthened the social bond of the inhabitants through "living with" linked to the "risk culture". Water is ultimately the element that gives the neighbourhood its identity. In "The Orb constitutes "its backbone" by indicating "Everything that touches the Orb touches us""(Echoes of Faubourg No. 1 quoted by Richard-Ferroudji, Dupont, Durand, Grelot 2014: 11). Here we are not talking about having a fatalistic vision of keeping the floods. Nevertheless, they point to the possibility of coping with the floods. But these words do not unanimity: for the neighbouring commune, floods can disappear. In conclusion, we note that the views are rambling. An investigation was therefore conducted in order to question the floods and the defence of the inhabitants on the subject and the "institutionalized vigilance".

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Sambre is a field of study taken into account in the multiple challenges undertaken by the actors. The Charleroi region remains the main one to undertake plans for the future territory with the Strategic Development Committee «Charleroi Metropolises». It proposes a lot of challenges among which are cited the points of the development of the waterway but also of the ecological transition with the fight of urban sprawl and preservation of biodiversity resources, the strengthening of a green and blue network etc… (PMCM Challenges 2024)

In a more demanding vision Sambre 2030 is another association is not negligible in the projects of consideration of Sambre. This project realized by Olivier Pestiaux wants to change the negative points of view that we have of the river and to no longer consider it as an object or a sewer but an entity in its own right.

The approach of his research is based on legal foundations in order to bring to Sambre a right like the Man has. To do this, it projects 4 axes: a transversal legal axis and three sectoral axes - cultural and artistic, environmental and socio-economic (Sambre 2030).

2.1.3 PROJECT DEVELOPMENT AND NEW IDENTITY

Sambre is a field of study taken into account in the multiple challenges undertaken by the actors. The Charleroi region remains the main one to undertake plans for the future territory with the Strategic Development Committee «Charleroi Metropolises». It proposes a lot of challenges among which are cited the points of the development of the waterway but also of the ecological transition with the fight of urban sprawl and preservation of biodiversity resources, the strengthening of a green and blue network etc… (PMCM Challenges 2024)

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The approach of his research is based on legal foundations in order to bring to Sambre a right like the Man has. To do this, it projects 4 axes: a transversal legal axis and three sectoral axes - cultural and artistic, environmental and socio-economic (Sambre 2030).

Finally, proposals made at this scale may be proposed in similar places to continue the naturalization and consideration of Sambre throughout its territory. The sixth chapter closes the occasional interventions of the major bed and the minor bed to unify the interventions in order to create a real ecological corridor transcending imaginary borders.

2.2 DESCRIPTION OF THE HAUTE-SAMBRE EN AVAL DE THUIN

2.2.1 THE URBAN FABRIC

If we look through this peri-urban landscape, the city of Thuin is the first apparent city if we take the direction of the current of Sambre. Vast commune, it is the least greedy in artificial territory per capita. It has 14,600 inhabitants for an area of 76 km2. Its historic centre has developed on the right bank of the valley but on the other side of Sambre, the city extends over a residential area called Les Waibes. Thuin is the only city to have developed along the border with Lobbes. In its continuity and on the edge of the reach of Thuin in Long-courant, the hamlet of Hourpes appears in full forest halfway of the historical site founded in 657 of the Abbey of Aulne.

The villages grouped around its urban core extend along the roads by a ribbon urbanization along these roads connecting them to the center of Charleroi (CM 2018: 15).

We can see that this typology is present on the top of the Sambre valley, mainly on the right bank with Montigny-le-Tilleul 1 or 2 km from the edge of Sambre. The commune founded in 1977 extends on the left bank with the village of Landelies known for its multiple limestone quarries. Indeed, we can see the «Sambre limestone» quarry east of the hamlet that was developed in 1821 shortly after the Battle of Waterloo (2022 Sambre limestone). Further to Monceau, the Dullière quarry also extends along the edge. Both produced an exhaler of more than one million m3 (Habils F., Roland S., Rorive A. 2014: 38).

All these places weave in canvas main roads enclosing Sambre. We can see here the national 53 linking Charleroi, Montigny-le-Tilleul and Beaumont, the national 59 crosses the N53 and the N54 by connecting Seneffe to Gozée crossing Sambre by Thuin. Suburban areas develop around these axes. Road transport is undoubtedly the most used although there is the 130a train line between Charleroi and Erquelinnes. The latter has 4 stops on the Haute-Sambre en aval de Thuin.

2.2.2 THE BIODIVERSITY

The percentage of green space remains dominant. As can be seen, although there is an urban fabric designed around Sambre, it is first landlocked by a vast forest area. It extends to the border between the Condroz plateau and the urban plateau: It comes to the west border a district of Fontaine l'Evêque and to the east it extends to Montigny-le-Tilleul and then continue to be present to the south of Fosses-la-Ville.

As we have seen in the analysis of chapter 1, several habitats are present among this massif. In this mixed region of Haute-Sambre, we find 3 kinds of habitats, 9120, 9130 and 9150, making this space a real ecological issue with more than forty species of trees and flower beds. In order to preserve this area in a stable state, Natura 2000 has listed several areas including Lobbes wood, Waibbes wood and Leernes wood. These green lungs on the edge of the black country consist of varied forest habitats of quality: Atlantic acidophilic beech groves at Houx, neutrophil beech grove, hillside forests, alluvial forests. These are paced by Sunday joggers thanks to routes offered by the city of Thuin and Lobbes.

Around this forest, agriculture occupies the soil to the south and north. Commercial agricultural production and grasslands are found mainly along towns and villages. These plots touch the major bed, are present on the alluvial terrace and mainly on the slightly undulating plateaus.

2.2.3 SAMBRE

Sambre has a length of 13,870 metres divided into 5 biefs for a cumulative fall of 10.84 metres thanks to the 5 beam locks. (Maigre M. 2022: 34). It meets through its course other watercourses not navigable of second order such as the stream of Notre-Dame aux charmes in Hourpes, the rau of the hermitage in the Abbey of alder, the island ri in front of the dead arm west of Landelies.

Although there is a slight flood hazard at Hourpes, Aulne and Landelies, the 2021 floods did not cause large overflows along the Haute-Sambre downstream of Thuin. However, runoff axes from the top of the valley begin for most fields and roads, which is part of the poor quality of the Sambre basin.

2.3 DIAGNOSTIC OF THE ALLUVIAL PLAIN

The diagnosis of the major bed and alluvial terraces aim to deal with fields that are part of low-anthropic spaces. This topic is determined because the field of agriculture is the most polluting field for groundwater and can however be an inevitable lever for the maintenance and development of a healthier groundwater body.

Several areas will be identified as potential threats due to erosion and karst phenomena, the good water quality of Sambre and agricultural soils.

2.3.1 SECTION A-A

This section perfectly demonstrates the consequence of a non-herbaceous earth for a longer or shorter period. Agricultural surface in alluvial terrace, soils are highly sensitive to erosion. It is again near the banks that sensitivity decreases but this is from the artificial ground.

2.3.2 SECTION B-B

The section shows a preponderance of diffuse erosion mainly on the low-grade plateau and on the hardwood woodland areas. The meadows and fields along the Sambre seem to be more resistant to erosion because they are not covered all year round. The two places with strong erosion sensitivity are those with steep slopes in a wood or grove.

2.3.3 SECTION C-C

Here we see that erosion is still present in the middle of agricultural plots whether it is herbaceous all year round or not. A second erosion is visible at the more pronounced gradients of the major bed due to diffuse runoff.

2.3.4 SECTION D-D

The fields around the Marchienne area appear to be sensitive to erosion concentrated in flat areas. At the Ring Bridge, soils are affected by diffuse erosion.

2.4 DIAGNOSTIC OF THE FLOOD PLAIN

2.4.1 THE RIVER BANKS

Looking at the banks of the Haute-Sambre downstream of Thuin, several types of banks remain present. We will analyze them and make an inventory with a catalog to list the different places where typologies will repeat. This tool will be used to locate the most favorable places for a healthy environment and those that arouse interest in enhancing the spine of this landscape.

*2.4.1.1 THE WILD B ANK**S***

These banks are those that have not been affected by man and whose ecological status is the most respected of all types of banks. We find it mainly along the reach between Thuin-Hourpes, Hourpes-Abbaye d'Aulne.

As we can see, the river side is made of mud covered of foams and the bank fulled by trees are not structured but let free. This type is part of the Natura2000 areas excepted for Landelies's part.

This natural wetland can be devided in 3 zones : the full pool, the riparian vegetation and the upland vegetation.

2.4.1.2 THE LAWNS RIVER BANKS

These shore are still consiedered as appartening to the natural side but they are the product of human modification. This type is localised on the right side bewteen the career of Landelies and the village itself.

As we can see, the river side is made of dirt and lawns. Sometimes this type meet rove as on the picture but otherwise it can be a lawns separating Sambre from agricutlure plots.

This bank is can be devided in 2 zones : the river and the ground

2.4.1.3 THE GRASS RIVER BANKS

This third river front is no longer considered as natural. As a matter of fact, the thin layer of grass is hiding concrete that we can sometimes see as a part is uncovered. This typology is the most common of the Haute-Sambre en aval de Thuin.

It can be seperated in 3 parts : the river the slopes made of grass and the RAVeL of concrete slabs.

2.4.1.4 THE STONE RIVER BANKS

The stone banks are unatural and it have been made in the 19th century during the canalisation of 1834-1839 under Guillaume d'Orange. We can find it surrounding the islets of the locks.

It can be seperated in 3 parts : the stone slope overgrown by plants and the brown ground.

2.4.1.5 THE VERTICAL CONCRETE RIVER BANKS

The only two places where this type is encountered are the reach of Thuin and the career of Landelies.

The only part is a concrete wall diving into water.

2.4.1.6 THE SLOPED CONCRETE RIVER BANKS

This last side is a steep banked which is higher and larger than the other. Located after the last lock of the section, It marks the beginning of the Basse-Sambre.

It can also be devided in 2 parts, the slopes going into the water and the bank made of grass.

Looking at this summary map of the banks, we can see that the left bank is more artificialized than the right bank. However, most of the banks are more prone to encountering curbs made of concrete or wall stones with a layer of grass on them. Agricultural and natural areas remain mainly present from the lock of Thuin to that of Landelies. Fully mineralized surfaces remain present on the outskirts of Thuin and on the edges of industrial plots.

2.4.2 THE FRACTURES

The term « fracture » here mean any urban element produced by man and interrupting the environmental continuity of Sambre. The study of fractures seems important to be able to combine them with riverbank typologies in order to find interesting study spaces at the first stage of Sambre's identity. Although they are also of several kinds, they will also be listed on the Haute-Sambre at the end of the typological catalogue.

8 types of fractures have been recorded across the Haute-Sambre en aval de Thuin. Since the fractures are rarely isolated, the descriptions of these will be done rather by exemplifying interesting areas that combine them.

2.4.2.1 FRACTURE IN THUIN

The first invoice is that grouping the meeting with a city on the side of the two banks and a bridge crossing it. Here in the case of Thuin, the difference in level and densification are

two interesting markers of the fracture. In addition, the Anderlues Street Bridge is a strong national footprint. We find some greenery east of the railway line. The high point of interest are undoubtedly the Jardins suspedus being listed as a UNESCO World Heritage Site. They are on the other side of the ridge located on the right bank in the direction of descent of Sambre.

2.4.2.2 FRACTURE IN HOURPES

The Hourpes fracture is probably the one with the least impact. Indeed, the place presents a hamlet with some houses on the edge of Sambre with a railway passing a little further. The interest to note here is therefore the possibility of creating an ecological corridor in view of the areas surrounding Hourpes: the wood of Leernes, the wood of the Waibes listed as Natura2000 and finally opposite the other side of the shore, a marshy area during heavy rains. It is home to a multitude of insects and plants.

2.4.2.3 FRACTURE IN LANDELIES

The Landelies fracture is one of the most complex to treat. Indeed, Sambre meets a multitude of changes first with the lock and the spillway but also by the activity and development of the village. It has its centre at the level of the lock bridge to reach Montigny-le-Tilleul and also extends north along the left bank of Sambre. In addition to being relatively mineralized, a railway bridge overlooks the river to continue its path in the fields. Here the only probable connection is the portion of forests after the fall of the spillway with these fields.

2.4.2.4 FRACTURE IN JAMBE-DE-BOIS

This fracture comes from a mix between a lock area and an old abandoned industrial space. This lock is the only lock and outlet contemporary Haute Sambre. We can see that a fairly wide site can be proposed on the right bank, undeveloped space of the SNCB. On the other side, a factory and the Dullière quarry mark the horizon of the surroundings. The quarry is a place of interest given the karst problems and the ecological impoverishment caused by this activity. Little natural green space surrounds the place but green spaces occupy the grounds further south and at the bottom of the quarry.

2.5 CONCLUSION : THE RIVER BANK OPPORTUNITIES

In the first place, the analysis of the Sambre basin and its low anthropic lands to be carried out on the option not to work on a specific location but rather on proposals for actions that can or should be implemented to limit the transfer of phito pharmaceuticals and other pollutants in the soil and by direct runoff to Sambre.

In a second time, after analyzing the bank typologies as well as the fracture spaces, it is necessary to choose two fracture sites to meet the desire to recreate on the one hand a link between Human and Sambre taking into account the Non-Human and vice versa a space for Non-human and Sambre.

Based on the 4 fractures analyzed, the ones from Jambe-de-Bois seem to be the most convincing:

The locality of La Jambe-de-Bois is interesting it is because it is near Charleroi and it is also the passage from Haute-Sambre to Basse Sambre. In addition, this site is completely abandoned and offers a beautiful axis to let develop wildlife and cultural projects as the tourist office Carolo with the black loop or the urban safari.

Furthermore, this choice is also interesting because of its topography so that we can project concrete ideas from the next chapter.

3. LA CLE DES CHAMPS

This chapter deals with a set of fields bordering Sambre between Thuin and Marchienne-zone. The desire not to issue specific projects for a specific area is based on the fact that it is more useful to propose a broad action plan than a one-off intervention in order to hope to recover a better quality of the low anthropized soils.

3.1 A PROPOSAL FOR EVERYONE BY EVERYONE

«Si, en tant que pays, ou en tant que réseau mondial de communautés, nous sommes vraiment acquis à la durabilité, dans tous les domaines, alors l'agriculture doit figurer tout en haut de notre liste de priorités, constituer le premier repas du nouveau jour.»
Janine Benyus 2011

3.1.1 THE FARMER, A MULTI CAP-CRAFT ?

Over time, the role of the farmer playing an important role in the survival of humanity and the maintenance of lands has died out with the socio-economic, environmental and landscape situations of today's agricultural world (Gruit E. 2018: 1).

Today, the landscape that is perceived as a collective heritage is influenced by different actors acting only on their plots, causing global impact on this territory. "The landscape must be seen and lived" and agriculture must become a conscious component in the construction of urban space.

This is why it is now time to rethink agriculture and provide solutions taking into account the knowledge of each of the stakeholders involved in this subject.

3.1.2 IMPROVEMENT OF AGRICULTURAL LAND STRUCTURE

If the aim is to improve soil quality and reduce the problem of karstic phenomena and erosion, the restructuring of agricultural parcels has some favourable solutions. Indeed, landscape designers and farmers are two actors who can, after various analyses, find action plans in the short and long term.

First, farmers come to integrate the suggestions proposed by MAEC such as grass strips dividing the field, adding hedges and slopes on the edge of fields, crop change...

In a second step, the landscape designer analyses the site and proposes solutions by renewing the landscape richness of the territory.

4. LA JAMBE DE BOIS

The lock of La jambe de bois is a space defining a disused industrial wasteland in its center. The site lies on the border between the town of Marchienne-au-Pont, Monceau-sur-Sambre and the town of Montigny-le-Tilleul and is divided into a large and flat space bordered by an elevation difference of 30 meters to the south and east. The railway line towards Erquelinnes crosses twice the Sambre road and runs along the quarry on the other side of the shore.

4.1 INTRODUCTION

4.1.1 DESCRIPTION

If a few decades ago Marchienne-au-pont was a hub of European wealth with industrial development, it is now a whole other story. Indeed, the town of Marchienne has not been able to restore its image with time and the wastelands have long been left unhealthy

before becoming, as for La Providence, a space of great economic interest for the future of Charleroi Metropole.

Looking at the site of the Jambe-de-Bois, we see in its center the lock and weir number 10. Before being positioned at this location, the lock at Sas de la Jambe-de-Bois separated Sambre in two at the Upstream turn from the existing one. It was the device that contributed to the transformation of the waterways of Sambre because it made it possible to solve this problem of water level differences. Reconstruction of the new lock was carried out following land subsidence caused by mining (Maigre M. 2023: 117). On the image of Figure 79 we can see the beginning of the renaturalized arm that led to the old spillway.

Only electric dam-lock of the Haute-Sambre, it has 2 pertuis of 12.50 meters wide operating with rolling valves of the Stoney system. The 111.90-metre lock can be divided into two 55-metre semi-airlocks with wing doors built in 1961 (Lean M. 2023: 119). More than half a century later, it underwent a modification in 2017 in order to become a hydroelectric dam. Thanks to its fall of almost 5 meters, which makes it the largest fall of the Belgian Sambre, it can produce 1800 Mwh per year to power 600 average homes. It is not linked to any CO2 emissions in addition to being ecological thanks to the respect of fish taken into account in the operation of the machine (Duchene N. Quoted in Télésambre).

Speaking of energy production, it is not insignificant that an electric dam is located on this site. Indeed, the site of La Jambe-de-bois is near Saint-Martin, a locality that has experienced a strong mining production. It is in 1824 that the creation of 3 wells saw the day then it was bought by the S.A Monceau-Fontaine in 1908, the well No. 19 of the Bas Long Prés is the deepest in Europe with 1370 meters of depth. A power plant, a sorting workshop and a brickworks were also on site.

The remnant of the cooling tower known as the «Power plant» remains right next to the lock. It was created in the 1950s following an extension of the Société des Charbonnages de Monceau-Fontaine installed since 1921. This structure was bought in 1990 by ENGIE and closed its activity in 1997 (SPAQuE 2012). It is thus the other part of the factory formerly using coal that appears on the left bank of Sambre.

The concession closed in 1979 and was dismantled in 1984 which explains the large slab between the edge of Sambre and the 4 football fields. In 2010, SPAQuE planned to begin dismantling all buried constructions in 2016 to carry out a soil investigation (SPAQuE 2010).

All this industrial activity is the explanatory cause of the presence of the station of Marchienne-zone with a vast empty area. Line 130A originated under the North Railway and had a building commissioned in 1881 (Demeur R 1860:23). In 1942, S.N.C.B obtained Marchienne zone and the Saint-Martin site had a workshop to repair the locomotives. This explains why such a vast space around the single railway exists (Dambly P. 2011: 2).

Currently, the Dullière quarry is still in operation via the SAGREX company and the former site of Saint-Martin will be operated by the Porte Ouest project of Charleroi Bouwemeester and the Paola Vigano office.

*4.1.2 POTENTIA*L

The treatment of this space is quite interesting because it is the intermediary between the city with a higher density and between a remaining portion of the suburban forest after all these known mutations. In addition, the north of the site is bordered by the presence of the Hamlet's Dirt which, with its 200 meters high, is a real ecological treasure.

This dump can be visited through two hikes organized by the city of Charleroi. The black loop along Sambre by its right bank from Charleroi to explore the remaining industrial reinforcement along 22 kilometers of walk and that of the Grande Dérive. It is 54 kilometres long and runs along the water road from Montigny-le-Tilleul to pass in front of the station at Marchienne-Zone. As it doesn't have a direct access to the site of Jambes-de-Bois, it continues its path along the future project of Charleroi Porte-Ouest.

A little further south of the Terrarium, the Dullière quarry remains a significant location up to minus 30 meters below the altitude of Sambre. Atypical landscape, it also has an ecosystem and influences the subsoil and groundwater.

The entrance to the site can be made through the station of marchienne-zone which is currently in poor condition. The industrial remains are already emerging with the gas pipeline coming out of the ground to trace a path for the more adventurous wanting to discover the past of the site of Saint Martin. Indeed, we can still see a large open space that served as a garage to renovate the trains of the time. Apart from this, the Engie nuclear power plant remains the construction that overshadows the rubble because of its height and its European reputation as an abandoned place.

From a cultural point of view, we can see that the old concession no. 19 is part of the masterplan for Charleroi West Gate. The space will host crop areas and vegetable garden for local development but also the new football field of Sporting de Charleroi. Drawing a new dynamic around the Jambe-de-bois is also a message to visitors and future workers by inviting them to discover a natural space that holds many riches equal to the industrial heritage.

Looking further, renaturalising the right bank of Sambre also means that the ridge or the road to Marchienne and Gozée could be an axis where the quality of life would be better. Knowing that there's on the other side of the ridge the smaller valley of Eau d'Heure, this neighborhood could be a component of a green grid to connect the two rivers for a curtain of greenery. Moreover, by increasing the quality of the Eau d'Heure, it increase the quality of the Basse Sambre since it flows in next to La Providence.

4.2 THE PROJECT

4.2.1 MASTERPLAN

The project aims to revitalize the south of Marchienne-au-pont by taking care of Sambre to create the connection between human and non-human. To do so, three keys are identified in order to draw the best compromise between the environment and its stakes in the face of a historical wealth.

The first is to protect soils from erosion and bursting, the second is to create a better water quality by creating a freshwater circuit that acts as an artifact for walkers and curious people to raise awareness of the importance of water and finally, propose interventions to activate the hooks of the place. This is done in particular by the renovation of the platforms of the station of Marchienne zone with an additional access to the district of the city of the North. On the other hand, a walk will connect this new access to urban hiking trails through industrial buildings repurposed in various activities.

4.2.2 THE PLATEAU OF SAINT-MARTIN
A sectioned topography

The site of the Jambe-de-bois is topographically a space with many facets. If we look at the map of potential, the site is naturally valloné by Sambre on the left bank with in addition a striking opposition between the quarry and the Hameau's dirt. On the right bank of the Saint-Martin area, there is a very clear division in the topography. This rapid drop in elevation is not natural and is due to the work carried out by the railway company Nord in 1881. Before that, the ridge on the road to Gozée and Marchienne was 40 meters lower than the shoreline.

To prevent erosion caused by water runoff, rolling the terrain softens the drop amplitude to slow down the flow rate causing concentrated erosion. The slope is configured to guide the flows to the outlet through natural vegetation acting as a second skin against the effects of battante.

However, changing the difference in altitude also led to removing any mineral surface from the plateau so that water could be absorbed as best as possible.

Two techniques are used:

The first is the ditch with a leaking embankment down the valley near Sambre. This technique is the most concretising choice in view of the strong difference in height with respect to the surface laid before meeting the layout of the railways.

The second is a parabolic ditch leading water to a floodable meadow. It consists of the creation of a dike allowing a retention of water to reach the floodable meadow with a shallow depth and a wider space to capture several runoff.

4.2.3 THE WATER MEMORY
An artefact serving the environment

4.2.3.1 Water treatment

Remediation Plans by Sub-basin

The Jambe-de-bois site can be divided into 2 parts for the water treatment topic. On one side, when looking at the right bank facing the direction of water displacement, the plot of Saint-Martin is connected to the public sanitation system. On the other side of the bank, the decommissioned power plant of Engie and part of the houses in the district of Hameau are not connected to it and must then have a separate sanitation.

The remediation methodology.

Now that the site has better soil absorption during floods, these treatments will be exploited to reuse rainwater to supply the site with drinking water.

To do this, the site must be equipped with a water treatment system. Several types of treatment exist, including the conventional sewage system, sceptic pits or biological treatment of waste water by high-pressure oxygenation. Although the latter is acceptable as a method reducing environmental impact, it remains in the field of machinery with large installations requiring the casting of a concrete screed and compliance with other standards.

A third solution, that of phyto-purification seems to be the most feasible if we want to stay as much as possible in the environmental respect of Sambre. It also seems to be a good compromise given the natural water reserves created by the new elevation of the shore.

Operation

Phyto-purification is a type of 100% ecological purification using the ability of a living plant with bacteria, to absorb, fix and degrade certain pollutants in the air, water and soil. Study is required to make this useful because it is not just about putting a puddle and placing the plants in the vicinity. For photo-purification to work, it is necessary to work together macrophytes and micro-organisms in a properly calculated set to eliminate nitrates, phosphates metals and other infectious biological agents. System requiring a certain surface of soil, it is more used for treatments of large areas such as agricultural or industrial plots but also collective groupings rather than an individual device (Fosseseptique.net 2024 : phytoépuration).

The device is carried out in 3 cycles:

- The pre-treatment: it is a filter substrate made of gravel, sand, reeds that filter and send the macro particles to the surface of the water.
- Chemical treatment: The roots of plants suck out the polluting components.

An artifact serving water

The site is relatively well suited to this type of system, but its infrastructure is equally well suited. Indeed, the cooling thermal power plant and pipeline pipes are already infrastructures that can accommodate certain stages of phyto-purification.

The weirs allow to collect water before arriving in a marsh and at the foot of the hill to then be conducted with the work of escape to the lagoon. Rainwater from flat roofs of the Engie building would also be stored and depolluted in it. These volumes of water would symbolically pass through the old open-air pipelines before arriving, thanks to the descent of the pipe, at the space created by Marchienne Meadow.

Then, after the second phase of horizontal flow treatment, water would pass into the interior of the decommissioned thermal power plant now serving as a terminal pond.

This technique combined with the new land use, would raise awareness of visitors and residents around the site through awareness by seeing the entire process and life cycle of water.

4.2.3.2 Banks treatment

Now that the water has been treated as best as possible on site through this long process, it’s now a question of focusing on the types of banks.

La Jambe-de-Bois is a heavily mineralized lock. Although it is eco friendly thanks to its electric spillway and the fish pass, concrete banks don’t promote the flowering of fauna & flora. By creating natural banks, a new space opens up to biodiversity to link the two sides of the bank.

Furthermore, the revalorisation of this segment of the RAVeL will bring a new dynamic that will be more welcoming for adopters of strolls and sports.

4.2.4 LES BAS LONGS PRÉS
A rooted history

Once the site has been fully treated, various interventions show that the Jambe-de-bois is the door open to a new connection with Sambre and its industrial terroir.

To do this, the Marchienne-zone station, currently the only access road at the east of the site, is restored in a better conditions. The platform is renovated to make way for a light structure and it is going to be accompanied by a new canopy pointing towards the thermal power plant. The stop is accessible through the existing entrance of Max Lambert Street

and the second platform of the station is accessible through its new entrance. This allows to link the district of the Cité Nord to La Jambe-de-Bois.

At the entrance of the docks, a sign explains the history of this old station and the past linked to that of miners and the development of the site of Saint-Martins. Further on, the walk can be done in a didactic way with walks leading into old buildings such as the car shed dating from the mid-19th century. This one now merges into the new shape of the valley which allows it to become a terrace to contemplate the view. The interior of this vast space can occasionally receive events of big crowds.

Finally, the project also took into account the many possible hikes and was therefore designed so that a new route could be created to reach on the one hand the black loop and on the other the great drift. Indeed, the creation of the new bank allows to pass from the cooling tower to the Engie plant thanks to the remains of the pipeline bridge. Then it is possible to continue its way towards Landelies and the South or to follow the direction of the current to reach the future space of Porte Ouest.

5. ECOLOGICL CORRIDOR

This chapter is the final stage and concludes with an overall map of the entire Sambre the search for revitalization of Sambre by selecting plausible areas for similar transformation of the phases mentioned for the fractures in chapter 2.

Indeed, the goal was to start with modifications on specific areas allowing a first approach and awareness of the importance of Sambre in his daily life. Nevertheless, if we want a concrete impact, then these phases must continue through all the major fractures and then link each of them together to develop a real ecological corridor.

The areas of interest were listed in 4 different degrees, from weak to highly anthropogenic. It was possible to list them by using the data of the summary maps in Chapter 1, which are compiled in a data table below.

6. CONCLUSION

The study of the Sambre Valley has shown how much man has influenced the environment in which he lives. Indeed, the historical study of the Sambre shows that the Human has a great interest in the water and the rivers beside which it came to settle for centuries.

With regard to water quality, the subject is vast and doesn’t concern only the industrial sectors as one might think. Indeed we had seen that a series of phenomena interfered with the good quality of the waters. From the mineralization of a bank to the discharge of industrial water through the simple runoff of rainwater that cannot be absorbed as much in urban areas as in rural areas, erosion phenomena influenced surface water just as karst phenomena influence groundwater which is so useful for catchment for distribution.

Fortunately through this study we find that many actors are involved in the re-qualification of rivers. I will quote for the case of the Sambre the Contrat de Rivière Sambre & Affluents which does a remarkable job to treat the sub-basins encompassing its 34 municipalities with the help of the databases of the Service Public de Wallonie Agriculture, Ressources naturelles et Environnementsmaller actors.

Finally, the work made it possible to show that it is possible to enhance a territory culturally and therefore economically by finding an answer in a procedure of environmental and ecological will by putting water as a fundamental actor.

It is high time in our present time where Man doesn’t stop and risks to run at full throttle to his loss, to stop and look up to take the time to meet the needs of nature without what Victor Hugo evoked:

« Il est une triste chose de songer que la nature parle et que le genre humain n'écoute pas ».

7. BIBLIOGRAPHY

7.1 REFERENCES

- Charleroi Découverte (2007). «Histoires & patrimoine de Charleroi». URL : https://www.charleroi-decouverte.be/pages/index.php?id=1
- Clerbois D. (2006). «L'espace industriel : le cas du bassin Sambre et Meuse». Travail de fin d'études, Master de spécialisation en urbanisme et aménagement du territoire [bibliothèque de l'Uclouvain].
- Commune d'Erquelinnes (2024). «Le port de plaisance». URL : https://www.erquelinnes.be/loisirs/tourisme/syndicat-dinitiative/patrimoine-et-visites/port-de-plaisance
- CRSA (2020-2022). «Protocole d'Accord 2020-2022 du Contrat de Rivière Sambre et Affluents asbl». URL : https://www.crsambre.be/wp-content/uploads/2017/12/Introduction.pdf
- CWEPSS (2015). «Eco Karst 100». URL : https://www.cwepss.org/download/ecoKarst/Ecokarst100'.pdf [En ligne], consulté le 19 juin 2024.
- Developpement Durable de Wallonie (2023). «Où en est la Wallonie par rapport aux objectifs de développement durables ?» URL : https://developpementdurable.wallonie.be/sites/default/files/resources/SPW%20-%20Rapport%20indicateurs%20ODD%202023-%20version%20longue.pdf
- EDIWAL : EDIWAL (2023). «Les habitats d'interet communautaire de Wallonie». URL : [En ligne], consulté le 12 juin 2023.
- EAW 1 : Etat de l'Agriculture Wallon (2022). «Superficie agricole utilisée». URL : https://etat-agriculture.wallonie.be/contents/indicatorsheets/EAW-1.html[En ligne], consulté le 12 juin 2023.
- EAW 2 : Etat de l'Agriculture Wallon (2023). «Production végétale». URL : https://etat-agriculture.wallonie.be/contents/indicatorsheets/EAW2.html [En ligne], consulté le 12 juin 2023.
- EEW 1 : Etat de l'Environnement Wallon (2020). « État des masses d'eau». URL : http://etat.environnement.wallonie.be/contents/indicatorsheets/EAU%201.html[Online], searched the 1st June 2024.
- EEW 2 : Etat de l'Environnement Wallon (2022). « Consommation d'engrais en agriculture ». URL : http://etat.environnement.wallonie.be/contents/indicatorsheets/AGRI%205.html [online] searched the 13th June 2024.
- EEW 3 : Etat de l'Environnement Wallon (2023). « Utilisation de produits phytopharmaceutiques ». URL : http://etat.environnement.wallonie.be/contents/indicatorsheets/AGRI%206.html [online] searched the 13th June 2024.
- EEW 4 : Etat de l'Environnement Wallon (2019). « Eutrophisation des cours d'eau ». URL : http://etat.environnement.wallonie.be/contents/indicatorsheets/EAU%205.html?thematic=8b021b82-dfa7-4dc4-9550-cddb9f0760f2 [online] searched the 13th June 2024.
- EEW 5 : Etat environnement Wallonie (2022). « Bilan d'azote en agriculture et flux d'azote des sols vers les eaux ». URL : http://etat.environnement.wallonie.be/contents/indicatorsheets/SOLS%204.html?thematic=8b021b82-dfa7-4dc4-9550-cddb9f0760f2 [online] searched the 13th June 2024.
- EEW 6 : Etat environnement Wallonie (2018). « Compaction des sols agricoles et forestiers ». URL : http://etat.environnement.wallonie.be/contents/indicatorsheets/SOLS%20Focus%202.html?thematic=8b021b82-dfa7-4dc4-9550-cddb9f0760f2 [online] searched the 13th June 2024
- EEW 7 : Etat environnement Wallonie « Sols». URL : http://etat.environnement.wallonie.be/home/diagnostic/sols-1.html#:~:text=Les%20concentrations%20en%20nitrate%20dans,de%20la%20période%202017%20%2D%202021. [online] searched the 14th June 2024
- Fautsch & Dufrene (2008). «Natura 2000». URL : http://biodiversite.wallonie.be/fr/publications.includehtml?IDC=3705 [online] searched the 15th June 2024.

-Gravari-Barbas M. (June 1998) «La « festival market place » ou le tourisme sur le front d'eau. Un modèle urbain américain à exporter». URL : https://doi.org/10.3406/noroi.1998.6868 [En ligne], consulté le 19 juin 2024.
- Guermond Y. (2006). "L'identité territoriale : l'ambiguïté d'un concept géographique". Université de Rouen, L'Espace géographique 2006/4 (Tome 35), pp 291-297. [En ligne], consulté le 27 décembre 2023.
URL : https://www.cairn.info/revue-espace-geographique-2006-4-page-291.htm
- La Fonderie (2020). «La révolution industrielle dossier pédagogique». URL : https://www.lafonderie.be/wp-content/uploads/2020/05/La-révolution-industrielle-Dossier_pedagogique_complet.pdf
- La biodiversité en Wallonie (2010). « Région continentale». URL : http://biodiversite.wallonie.be/servlet/Repository/nat2000-frcontinentale.pdf?ID=20986&saveFile=true
- La biodiversité en Wallonie (2010). « Région atlantique». URL : http://biodiversite.wallonie.be/servlet/Repository/nat2000-fratlantique.pdf?ID=20987&saveFile=true
- Maigre M. (2020). «La Sambre Belge Première Rivière Canalisée».
- Numéric Landscape (2023). «RN54 :penser différemment les choses». URL : https://numericlandscape.org/2023/08/29/rn-54-penser-differemment-les-choses-au-dela-du-dogme-politique/
- Prouff V. (2018). "La Sambre inaccessible ? : De Charleroi à Farciennes". (Thèse de Master)
[bibliothèque de l'Uclouvain].
- Wallonie Port de Charleroi (2019). «le port en quelques chiffres». URL : https://www.portcharleroi.be/fr/nous-connaître/le-port-en-quelques-chiffres#situation
- RAVeL Wallonie (2024). «Le RAVeL». URL : https://ravel.wallonie.be/home.html
- Le Blanc A. ,Piermay J-L. et Daviet S. ««« Éditorial », Territoire en mouvement Revue de géographie et aménagement». URL : http://journals.openedition.org/tem/2522 [ONline], searched the 27 décembre 2023.
- Richard-Ferroudji A., Dupont N., Durand S. et Grelot F. (2014). "Une politique du « vivre avec » un fleuve et ses débordements". Vertigo, volume 14 n°2. [Online], searched the 28 december 2023.
-Roullet-Sureau C. (2008). «Quelles réponses au « désordre urbain» en vallée de l'Orge ?». URL : http:// journals.openedition.org/strates/6182 [Online], searched the 19 june 2024.
- Charleroi Metropole (2024). «Plan de Mobilité de Charleroi Métropole et Centrale Locale de Mobilité» URL : https://territoire.charleroi-metropole.be/espace-ressources/documentation-et-inspiration/mobilite-info-pmcm-et-clm [Online], searched the 20th june 2024.
- Sambre 2030 (2024). «Vision». URL : https://www.sambre2030.org [Online], searched the 20th june 2024.
-Calcaire de Sambre (2022). «Historique» URL : https://www.calcairesdelasambre.be/historique [Online], searched the 20th june 2024.
-Habils F., Roland S., Rorive A. (2014). « CARTE HYDROGÉOLOGIQUE DE WALLONIE - FONTAINE-L'EVÊQUE - CHARLEROI». URL : http://environnement.wallonie.be/cartosig/cartehydrogeo/document/Notices/4678.pdf [Online], searched the 21th june 2024.
-Duchêne M. quoted by a Télésambre report (2022). «Découverte du barrage-écluse hydroélectrique de Monceau» URL : https://www.telesambre.be/info/decouverte-du-barrage-ecluse-hydroelectrique-de-monceau/49581 [Online], searched the 23th june 2024.
- SPAQuE (2010). «Charbonnage n°19 Bas Longs Prés» URL : https://spaque.be/realisations/charbonnage-n19-bas-longs-pres/ [Online], searched the 22th june 2024.
- SPAQuE (2012). «Charleroi : Réhabilitation des sols pollués du site « centrale électrique de Marchienne-au-Pont». URL : https://spaque.be/charleroi-rehabilitation-des-sols-pollues-du-site-centrale-electrique-de-marchienne-au-pont/ $ [Online], searched the 22th june 2024.
- CHARLEROI NOUWMEESTER (2019). «Sambre Ouest» URL : http://www.charleroi-bouwmeester.be/sambre-ouest [Online], searched the 24th june 2024.
- Lost ground (2018). « La Société des haut-fourneaux Forges et Fonderies N. Waroqué et Cie». URL : http://www.nicau.be/hourpes.html [Online], searched the 25th june 2024.

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