

## When constraints become assets in the design of blue-green infrastructures: an insight from two cases in the Western part of France (Loire River Basin)

Marie Fournier<sup>1</sup>, Mathieu Bonnefond<sup>2</sup>,

<sup>1</sup>*Conservatoire National des Arts et Métiers (CNAM), HESAM, Laboratoire Géomatique et Foncier (GeF), Zone Atelier Loire, Marie.fournier@lecnam.net*

<sup>2</sup>*Conservatoire National des Arts et Métiers (CNAM), HESAM, Laboratoire Géomatique et Foncier (GeF), Zone Atelier Loire, Mathieu.bonnefond@lecnam.net*

**Abstract:** Our presentation focuses on two recent projects of blue-green infrastructures located in the very heart of French middle-size cities in the Western part of France, in the Loire river basin (the Ile aux Planches in Le Mans and the Parc Balzac in Angers). They constitute good illustrations of recent and innovative approaches in the design of blue-green infrastructures. In the two cases, it is interesting to point out the major challenges that planners had to face. First, innovative solutions have been found to overcome technical difficulties (flood-prone areas, brownfield sites, heavy pollution and so on). Second, planners also had to address local conflicts during the definition and implementation of those projects. At last, we point out how those various constraints have been mainly turned into assets and synergies to design multifunctional blue-green infrastructures.

**Keywords:** multifunctionality; blue-green infrastructures; Loire river basin (France); middle-size cities

### Introduction

Since a few years, green infrastructures have become a cornerstone in the urban projects of most major cities. Locally, they improve the quality of life and may contribute to the image of metropolis worldwide. Some cities such as Berlin, London or Toronto are at the forefront and provide great case studies (Kazmierczak, Carter, 2010) but we believe it is also interesting to explore smaller scale projects in medium-size cities, which are less invested but might be more easily replicated in most urban areas. In this context, our presentation focuses on two recent projects of green infrastructures in French middle-size cities, located in the Loire river basin (Western part of France). As stated by the European Commission (2013), those two cases are examples of “strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem series”. More specifically, they can be defined as blue-green infrastructures as they consist of a network of wetlands and associated open spaces along rivers (Ghofrani *et al.*, 2017). The “Ile aux Planches” in Le Mans and the “Parc de Balzac” in Angers are blue-green infrastructures which have been planned and designed around the years 2000. Those two cases are interesting to study together as they share



similarities and constitute good illustrations of recent and innovative approaches in the design of multifunctional blue-green infrastructures. The two of them are former urbanized or industrial areas, close to city centers. Planners had to face similar challenges: high-flood risk, heavy pollution but also the involvement of local inhabitants. In this presentation, we describe how planners turned those challenges and constraints into assets and found solutions to build synergies in their projects. In the two cases, water retention is the first objective, but multifunctionality is at the roots of those projects. Indeed, as often defined (Ahern, 2011; Hansen and Pauleit, 2014), the objectives of planners were to combine different functions (ecological, social but also economic) in limited space, also leading to various services for local inhabitants (before all flood protection).

All along this presentation, we mainly focus on the case of the “Ile aux Planches” (Le Mans, Sarthe) which we have studied extensively during the last 4 years (Gatien-Tournat *et al.*, 2016, Fournier *et al.*, 2017a, Thaler *et al.*, 2019) and we compare it with the “Parc Balzac” case (Angers, Maine-et-Loire).

## **Background**

This presentation is mainly based on the results of the empirical phase of the TRANS-ADAPT project. TRANS-ADAPT is a JPI Climate Project (2014-2017) which examined bottom-up and community initiatives within flood risk management policies in four European countries: Austria, France, Ireland and the Netherlands. In France, it has received funding from the French National Research Agency (ANR). Three cases were carried out in the Loire River basin, in Le Mans, Angers and Blois. The case of the “Ile aux Planches”, in Le Mans, was one of them.

The “Ile aux Planches” is an urban park located on the Sarthe River. It is a 3-hectare island. Formerly it was a frequently flooded wide pasture which became an island in 1831 when a 680 meters canal was dug to make the Sarthe River navigable to boats. Several industries settled on the canal banks, including a gas plant in 1842. Owner of the site, the French Electricity Company (EDF) operated an electricity plant on the island until 1945. Then, it was used as a repair center and to store material and vehicles. The company progressively started to relocate its activities to another district in the late 1980s and until 1993. They decided to get rid of the site and make it profitable. In agreement with the city council, a housing project was launched. However, residents were vigorously opposed to this project. Instead, there were claims to turn the island into a public park. After several years of conflict, all parties reached an agreement and the park opened in 2008. Today, the “Ile aux Planches” is a multifunctional blue-green infrastructure, combining a recreational area, a flood risk mitigation area and a residential estate. Both flood issue and bottom-up pressure from local populations for more green urban spaces led to the planning and design of this multifunctional infrastructure.

## **Methods used**

The empirical phase of the TRANS-ADAPT project was based on extensive desk-based analysis of academic and grey literature. It was accompanied by several semi-structured interviews with key actors involved in the implementation of those projects (more than 10 interviews for the “Ile aux Planches” case). These interviewees were mainly stakeholders of flood risk management initiatives at local level. They were representatives of different types of organization related to public authorities

(at regional or local level), market or civil society (Non-Governmental-Organizations (NGOs), land users and so on). Participants were questioned on the design and implementation of the project, their personal contribution and the integration of bottom-up initiatives at both definition and implementation phases.

## Results

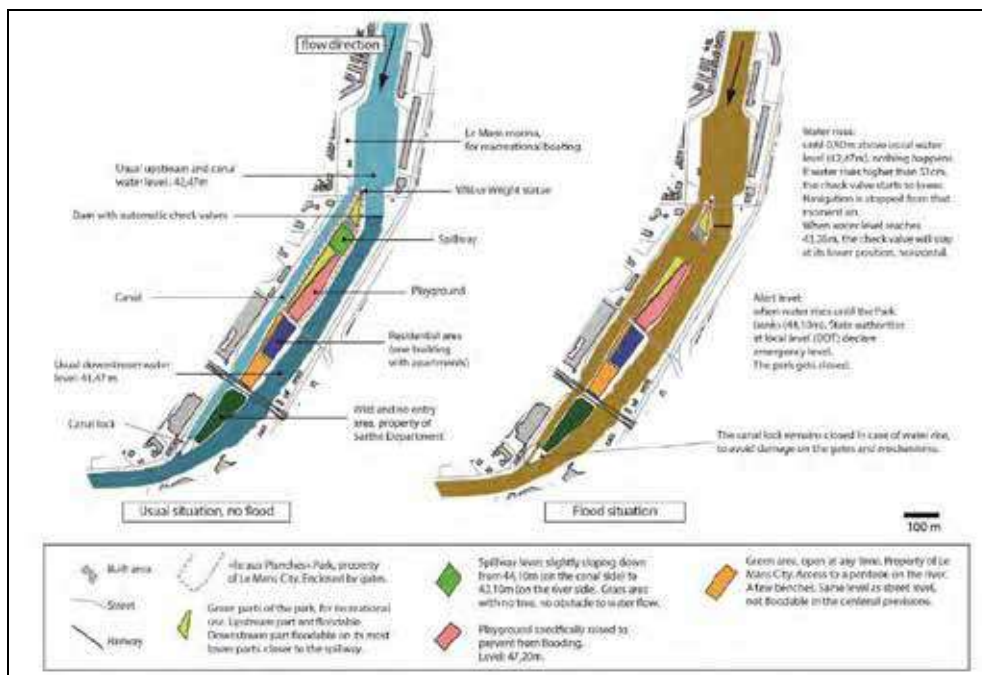
The two cases in Le Mans (“Ile aux Planches”) and Angers (“Parc Balzac”) share several similarities. Both sites are really close to the city center, along the main local river (Sarthe in Le Mans, Maine in Angers). The “Ile aux Planches” is a 3-hectare blue-green infrastructure, while the “Parc Balzac” is about 50 hectares. In the mid-1990s, they were still brownfield sites, heavily polluted. In Angers, 50% of the area was covered with alluvial meadows and 50% was a former controlled landfill. As described above, industries on the “Ile aux Planches” were derelict and most grounds were polluted. However, both sites were identified by local municipalities as potential areas for new urban projects. Their location is interesting. The “Ile aux Planches” is close to the train station and the city center of Le Mans. The “Parc Balzac” is located next to very recent urban estates. However, the 1995 flood strongly hit the two cities and solutions needed to be found to better deal with the risk. Local authorities decided to define and design mitigation projects on those sites. Since 2007, mitigation is identified by the Floods Directive as a key strategy within Flood Risk Management policies. As defined by Hegger *et al.* (2016), “*Flood risk mitigation focuses on decreasing the consequences of floods through measures inside the vulnerable area. Consequences can be mitigated by a smart design of the flood-prone area. Measures include spatial order, water retention within the protected area, or (regulations for) flood-proof building*”. In a nutshell, most flood risk mitigation projects include measures to retain water in the flood-prone area. If mitigation projects are quite common in several North-western European countries since the 1990s, it remains quite an innovative strategy in France (Fournier *et al.*, 2016). However, more and more French local authorities start to launch such mitigation projects (Fournier *et al.*, 2017b). Indeed, if central government authorities do prohibit building in the most exposed zones or limit this in moderate-hazard flood-prone areas that can remain constructible, developers, in these places, must consider various “necessities” and make sure they do not increase flood exposure either locally or at the level of the overall urban system. In this context, blue-green infrastructures constitute great potentials towards a “resilient urban planning” (Liao, 2012, Barroca and Serre, 2012, Barroca and Hubert, 2008) thanks to those “flood expansion areas”.

In our cases, the need to deal with those constraints had a great impact on the design of the two blue-green infrastructures.

First, both parks follow a gradient of several levels. The “Ile aux Planches” is a hydraulic system. A discharge channel is at low level on the island. It is about 50 meters wide and is covered by lawns which cannot be planted, so that water can run easily from the canal to the river. However, other uses have been defined and organized. A playground has been settled much higher. It is not accessible in case of flooding and several gates prevent children from running towards water. Tiered seats have also been installed on the side of the discharge channel, so that concerts, plays or any other public events can take place on open space. Seats are straight and not designed in curves, to facilitate the water flow. Extra costs were invested as the whole structure had to be reinforced with poles to sustain

walls at one end of the park. The southern part of the island is occupied by a residential building and a small patch of land remains non-accessible because of ground pollution. If the “Ile aux Planches” has become a key hydraulic infrastructure to mitigate the flood risk in the city center of Le Mans, the project was designed as a multifunctional blue-green project to meet other services (leisure and housing mainly). The objective of creating an urban park and the reduction of flood risk has been achieved. Multifunctional use is at operation but in case of flooding, the flood risk management function takes it all and no other use of the park is allowed.

Below, the illustration indicates the general organization of the site, when flooded (right side) or not (left side).



**Illustration 1. The “Ile aux Planches” in Le Mans: no flood/flood situation (Gatien-Tournat, 2015)**

The design of the “Parc Balzac” infrastructure in Angers is based on the same principle and makes the best out of local constraints. The whole project valorizes height differences to meet several objectives (environmental, social, safety). At low level, a network of ditches and channels has been dug and organized to restore a wide marsh/wetland (instead of the landfill). This wetland is flooded regularly in winter and spring. More than 1000 trees were planted on about 12 hectares (poplar trees, willows, alders and so on). The water level can be controlled with hydraulic works in this low wetland. This is particularly important in spring time as this network of ditches has also been restored to provide spawning grounds for fish. Higher in altitude, wet meadows were kept and cattle graze there. Planners chose rustic races (Highland cattle, donkeys (baudets du Poitou, ânes du Cotentin)) for extensive grazing, adapted to wetlands and able to stay outside for several days with little care. Thanks to cattle grazing, the whole area is kept as prairies, which is also interesting for biodiversity. Indeed, some protected bird species nest in those meadows (such as corncrakes protected by the Birds European Directive). More than 60 bird species have been identified in the park. Meadows are flooded when the river Maine is high (about once or twice a year) but most of the time, they remain out of water. In

some meadows, a landscape of “green dunes” has been created and vegetation varies depending on the altitude. When flooded, we can see waves from above. Information for the public is provided on several spots about various environmental issues (biodiversity, floods, landscape) and it is possible to walk all through the area (even in case of flooding). Higher in altitude, orchards with fruit trees but also bushes were planted so that a variety of birds may nest. About 120 family gardens were also organized and managed by a local association. This area is only flooded in case of major flood events.

Those two cases illustrate well planners’ current strategies in French cities to create synergies between various uses and services in blue-green infrastructures (Scarwell *et al.*, 2014). The need to give room back to rivers, even at the very heart of cities, has led to flood mitigation innovative projects. Safety is the key issue but planners design projects within which water flows and water retention areas are used to address other objectives (biodiversity protection, landscape, leisure and so on). Some synergies between the different functions of those infrastructures may appear. In the case of the “Ile aux Planches”, complementarities between functions are still limited. Most of the time, there is no water on the “Ile aux Planches”; when not flooded, there is no evidence of the hydraulic role of the site. The “Parc Balzac” project is much more integrated. Wetlands, prairies and water courses are at the core of the infrastructure. Water is always present in the landscape and the various uses and services of the area are regularly explained on site. As such, the project really can be described as a multifunctional blue-green infrastructure. However, to conclude on that aspect, it is important to remind that the “Ile aux Planches” project has also led to positive loops. Locally, aldermen acknowledged river banks in Le Mans were under-exploited and some projects have been launched to improve this situation.

Second, if those projects may seem quite innovative, it is important to point out that multifunctionality must not be taken for granted. It may be at the roots of projects, but it can also be the result of local negotiations during the definition and implementation phases.

In our two cases (“Ile aux Planches” and “Parc Balzac”), it is important to point out that there has been a strong involvement of residents and associations. In Angers, local inhabitants’ involvement was granted from the start. A first public inquiry was launched in 1992 to identify some potential uses for this derelict land. The municipality of Angers launched the definition and design phases of the “Parc Balzac” with local NGOs. The Ligue for the Protection of Birds (LPO) took an active part in the design of the orchards as well as in the definition of maintenance practices for the prairies. A local fishing association was involved in the design of the ditches’ network. Local gardeners’ associations (*Fédération des Jardins Familiaux Angevins* and *Association des jardiniers de Belle-Beille*) contributed to the organization of the family gardens. Today, those associations are still strongly involved in the management of the park. The LPO monitors bird populations and the fishing association participates in the maintenance and monitoring of the network of ditches as they are potential spawning grounds for fish (pikes). In spring time, the water level is controlled in this water network for fish reproduction. A gardeners’ association (*L’Amicale des Jardiniers de la Douvre*) is also responsible for the management of the family gardens. At last, biologists from the University of Angers are involved to monitor oak trees. Therefore, a variety of actors has been involved from the start in the decision-making process and the design of “Parc Balzac”. Today it proves to be quite successful thanks to this collaborative local governance. As already stated and discussed in literature,

this case is a good example of an inclusive governance leading to environmental and social benefits (Buijs *et al.*, 2016).

In the “Ile aux Planches” case, public participation started from a conflictual situation. By nature, planning projects often prove to be conflictual (Subra, 2014) as they transform local land uses and activities. Several authors also point out the various outcomes of those conflicts on planning projects (Melé *et al.*, 2004; Melé, 2013). In the case of the “Ile aux Planches”, it is interesting to see that the conflict between the municipality and local inhabitants contributed to the transformation of the initial residential project promoted by local authorities into the “Ile aux Planches” blue-green infrastructure as we know it today. In this case, we can speak of active citizenship, as defined by Moro (2012, quoted by Buijs *et al.*, 2016), that is to say, “*citizens’ ability to organize themselves in a multiform manner, to mobilize resources and to act in the public (...) in order to protect rights and take care of common goods*”. The conflict started during the 1990s, when the municipality of Le Mans decided to launch a housing project on this island which had been recently bought from EDF. Two public inquiries were carried out in 1996 and 1997. The commissioner came to the conclusions that the housing project was not beneficial to the ‘general interest’ and showed how vigorously residents were opposed to such a project on the island. Claims were written down to turn the island into a public park. A petition was initiated by a resident who had lived in the district his whole life, Mr. Marcel Bréjou. He went door to door for several weeks in 1998 and collected 800 residents’ signatures. After 2 years of failed negotiations with the municipality and EDF, the “Ile aux Planches” association was created to defend the project of an urban park. Active members were present every Saturday on the district market to inform residents and to collect ideas. Several press articles were published between 2000 and 2003. The members of the association were district residents, made of diverse socio-professional profiles. Aldermen and Department representatives also supported them. In the end, in 2003, the City Council approved the creation of a park. The safety issue and the need to build a protection system was a priority but local authorities and members of the association reached an agreement so that the area would be designed as a green park. After the project was completed, the island association began to lose members. However, some active members wanted it to continue and started to diversify its activities (towards leisure, entertainment and cultural activities). Today, the association is still active and carries out various educational and social projects. Every year, the association participates in several social events which take place on the “Ile aux Planches” and its members organize educational activities.

## **Discussion**

If many French middle-size cities still lack public urban green spaces in the very heart of city centers, it is interesting to see how the flood risk issue and growing uncertainties about our capacities to deal with major floods lead to the definition of innovative projects in flood-prone areas. Today, the “Ile aux Planches” and “Parc Balzac” are key blue-green infrastructures in middle-size cities with few parks in their inner urban area.

The design of those blue-green infrastructures has been very much influenced by the various constraints that planners had to face, but those latter have succeeded to overcome them and even turn them into assets in their final projects. This is mainly the case in “Parc Balzac”, in Angers. Flood retention is the first objective, but the presence of water is also crucial for other functions (especially

biodiversity). In this case, the flood risk has been really changed from a constraint to an opportunity. If such a planning strategy is already quite frequent in other European countries like Germany or the Netherlands (Kerr, 2017), this remains very new in France. In Le Mans, in the case of “Île aux Planches”, all other uses still stop when a flood occurs.

Eventually, those two projects have been successful thanks to the great involvement of local inhabitants, various associations and the setting up of arrangements between all users. Such involvement is mainly explained by the variety of functions and services which have been identified in those projects. On that aspect, it is possible to compare with other similar projects in neighboring middle-size cities (for instance Blois (Morisseau, 2012, Bonnefond *et al.*, 2017)) where safety issue has clearly prevented support and involvement from residents.

It is also interesting to point out that both parks are now part of the networks of green infrastructures at the city scale. Even more, they constitute a connection between the river in the heart of the city and larger green areas at the outskirts of the urban area. As such, it is a major challenge for local authorities to integrate those blue-green infrastructures in a larger strategy.

To conclude, it would be interesting to analyse more how neighbourhood experts' techniques and know-how could be harnessed to great benefit in the very process of urban design, to better assess the risks, reduce vulnerability and enhance resilience in those projects. To successfully reduce vulnerability and enhance resilience at the scale of the city, urban, hydraulic, landscape and ecological issues must be articulated in a coherent manner. For this purpose, these projects must go beyond the current range of regulatory technical solutions and articulate urban project with blue-green infrastructures. On that aspect, there are different other examples or attempts in the Loire basin, as Matra Fluvial City project in Romorantin-Lanthenay (Rode *et al.*, 2018, Bonnefond, 2018). In this case, flood mitigation and blue-green infrastructure are central in this project which combines hydraulic modelling, urban, landscape and architectural conceptions.

## References

- Ahern, J., 2011, From fail-safe to safe-to-fail. Sustainability and resilience in the new urban world. *Landscape and Urban Planning*, 100, 341-343.
- Bonnefond, M., Fournier, M., Servain, S., Gralépois, M., 2017, La transaction foncière comme mode de régulation en matière de protection contre les inondations. Analyse à partir de deux zones d'expansions de crue: l'Île Saint Aubin (Angers) et le déversoir de la Bouillie (Blois). *Risques Urbains*, 17(1).
- DOI : 10.21494/ISTE.OP.2018.0218
- Bonnefond, M., 2018, La modélisation hydraulique comme condition de la résilience des projets d'aménagement urbain en zone inondable?. *La Houille Blanche*, 3, 25-33.
- Barroca, B., Hubert, G., 2008, Urbaniser les zones inondables, est-ce concevable?. *Développement durable et territoires*, <http://developpementdurable.revues.org/7413>.
- Barroca, B., Serre, D., 2012, De la ville qui sépare à la ville qui intègre. *Travaux*, 886, 32–35.
- Buijs, A.E., Mattijssen, T. J. M., Van der Jagt, A. P. N., Ambrose-Oji, B., Andersson, E., Elands, B. H. M., Steen Moller, M., 2016, Active citizenship for urban green infrastructure: fostering the diversity and dynamics of citizen contributions through mosaic governance. *Current Opinion in Environmental Sustainability*, 22:1-6.
- Ghofrani, Z., Sposito, V., Faggian, R., 2017, A Comprehensive Review of Blue-Green Infrastructure Concepts. *International Journal of Environment and Sustainability*, 6(1), 15-36.

- Hansen, R., Pauleit, S., 2014, From Multifunctionality to Multiple Ecosystem Services? A Conceptual Framework for Multifunctionality in Green Infrastructure Planning for Urban Areas. *Ambio*, 43, 516-529.
- European Commission, 2013, Communication from the Commission to the European Parliament, The Council, the European Economic and Social Committee and the Committee of the Regions. Green Infrastructure (GI) – Enhancing Europe’s Natural Capital.
- Fournier M., Bonnefond M., Gralepois M., Servain S., 2017a, Planning land uses in flood-prone areas: when conflicts contribute to the definition and implementation of urban projects. Two examples from the Loire River basin (Blois, Le Mans – France). Zones Ateliers and Critical Zone observatory Networks (LTER-France) Conference, Nantes, France, October.
- Fournier, M., Larrue, C., Alexander, M., Hegger, D., Bakker, M., Pettersson, M., Crabbé, A. Mees, H. and Chorynski, A., 2016, Flood risk mitigation in Europe: how far away are we from the aspired forms of adaptive governance?. *Ecology and Society*, 21(4): 49. <https://doi.org/10.5751/ES-08991-210449>
- Fournier, M., Larrue, C., Schellenberger, T., 2017b, Changes in flood risk governance in France: a David and Goliath story?. *Journal of Flood Risk Management*, <https://doi.org/10.1111/jfr3.12314>.
- Gatien-Tournat, A., Fournier, M., Gralepois, M., Bonnefond, M., Servain, S., 2016, Societal transformation and adaptation necessary to manage dynamics in flood hazard and risk mitigation (TRANS-ADAPT): France country report. JPI Climate Program.
- Hegger, D. L. T., Driessen, P.P.J., Wiering, M., Van Rijswijk, H. F. M. W., Kundzewicz, Z. W., Matczak, P., Crabbé, A., Raadgever, G.T., Bakker, M. H. N., Priest, S. J., Larrue, C. and Ek, K., 2016, Toward more flood resilience: Is a diversification of flood risk management strategies the way forward?. *Ecology and Society* 21(4):52. <https://doi.org/10.5751/ES-08854-210452>
- Kazmierczak, A., Carter, J., 2010, Adaptation to climate change using green and blue infrastructure. A database of case studies. Interreg IVC GRaBS project.
- Kerr, L., 2017, A tale of two green cities. Exploring the role of visions in the development of green infrastructure in two European Green Capital cities. Master’s Thesis for the Environment and Society Studies programme, Radboud University, Nijmegen.
- Liao, K., 2012, A theory on urban resilience to floods: a basis for alternative planning practices’. *Ecology and Society*, 4, <http://dx.doi.org/10.5751/ES-05231-170448>
- Meaujean, F., 2007, La gestion durable d’un espace public: le parc Balzac à Angers. *Nature et Paysage. Ressources durables du Val de Loire*, « Imaginer le Val de Loire » Colloquium, CAUE Loire-Atlantique, pp. 60-63.
- Melé, P., Larrue, C., Rosemberg, M., 2004, *Conflits et territoires* (Tours, France: PUF).
- Melé, P., 2013. « Conflit d’usage », in Casillo, I., Barbier, R., Blondiaux, L., Chateauraynaud, D., Fourniau, J-M., Neveu, C., Salles, D. (dir.), *Dictionnaire critique et interdisciplinaire de la participation*, Paris, GIS Démocratie et Participation, ISSN : 2268-5863. URL: <http://www.dicopart.fr/fr/dico/conflit-dusage>.
- Morisseau, G., 2012, Le quartier périurbain de la Bouillie (Blois). Les nouveaux paysages du risque. *Projets de paysage*, 4, <https://www.projetsdepaysage.fr/editpdf.php?texte=741>.
- Rode, S., Guevara, S., Bonnefond M., 2018. Resilience in urban development projects in flood-prone areas: a challenge to urban design professionals. *Town Planning Review TPR*, 89 (2). <https://doi.org/10.3828/tpr.2018.10>
- Scarwell, H-J., Schmitt, G., Salvador, P-G., 2014. *Urbanisme et inondation: outils de réconciliation et de valorisation* (Villeneuve-d’Ascq, France : Presses universitaires du Septentrion).
- Subra, P., 2014. *Géopolitique de l’aménagement du territoire* (Paris, France : Armand Colin).
- Thaler, T., Attems, M-S., Bonnefond, M., Clarke, D., Gatien-Tournat, A., Gralepois, M., Fournier, M., Murphy, C., Rauter, M., Papatoma-Köhle, M., Servain, S., Fuchs, S., 2019. Drivers and barriers of adaptation initiatives – how societal transformation affects natural hazard management and risk mitigation in Europe. *Science of the Total Environment*, 650, 1073-1082
- Ville d’Angers, Le parc de Balzac. Paysage et développement durable.
- Ville d’Angers, Le Parc de Balzac, espace naturel, Date of access: 27/05/2019.
- <http://www.angers.fr/vivre-a-angers/la-nature-a-angers/les-parcs-et-jardins-publics/patrimoine/espaces-naturels/le-parc-de-balzac-espace-naturel/index.html>