

ISAR RIVER

Title		Isar River Plan. Neues Leben für die Isar! (New life for the Isar!)	
Organization		Joint venture/Cooperation of Bavarian State Water Management Agency together with Munich City Hall and Bavarian State Government	
Start	End	2000	2011
Length		8 km	
River typology		Braided in origin, channelized	
Q mean		90 m ³ /s	
Contact		Daniela Schaufuß, Dept. of Public Construction, City of Munich, daniela.schaufuss@muenchen.de	

Table of contents:

Location	2
Context	3
Pressures & Impacts	5
Objectives	5
Target species/Habitats.....	5
Restoration actions.....	7
Budget.....	11
Achievements	12
Social impact.....	12
Websites	14
Bibliography.....	14



LOCATION

The Isar River in the upper part of the Danube basin is a tributary from its right side with its source in the Alps (Figure 1).

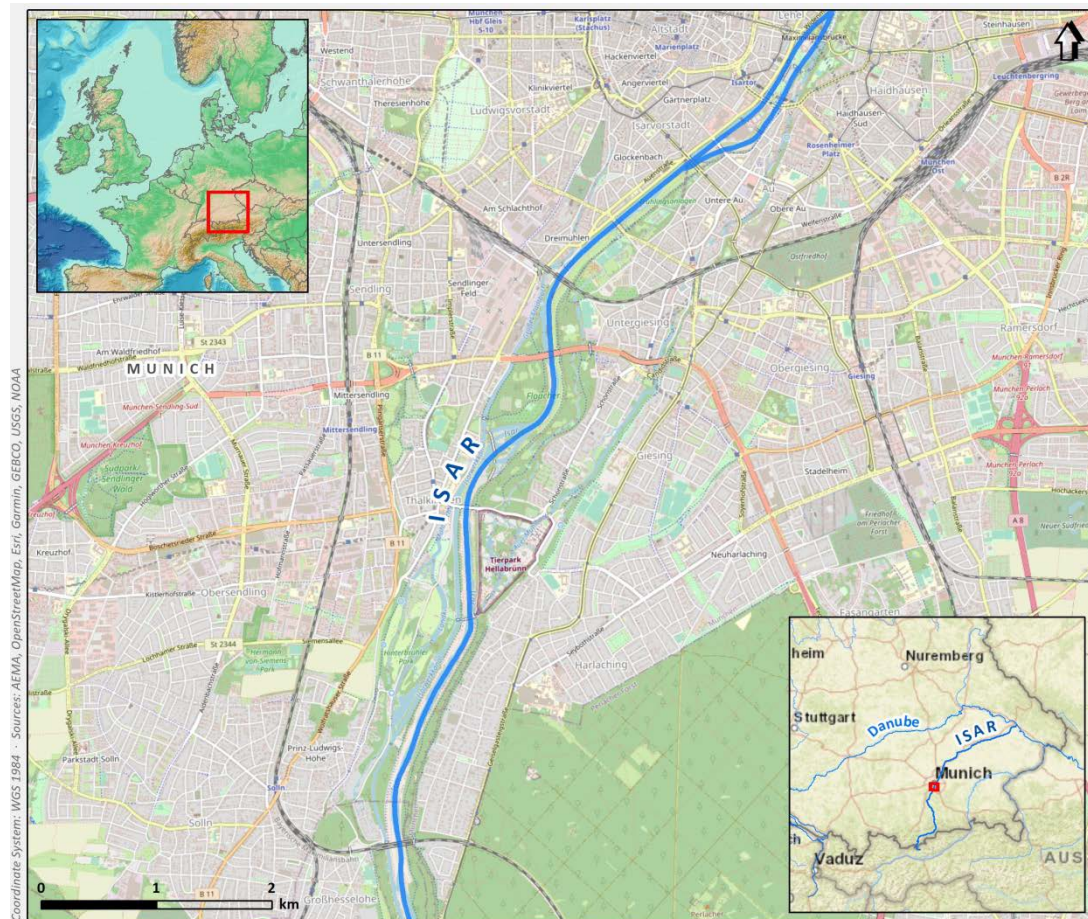


Figure 1. Location of the Isar River's restored reach and its basin

The project comprises the restoration of 8 km of the Isar River in the urban area of Munich, from the southern periphery, upstream, to the island in the city centre where the *Deutsches Museum* is located (Figures 1 and 2). The project was developed in five sections (the fifth subdivided into three sectors).

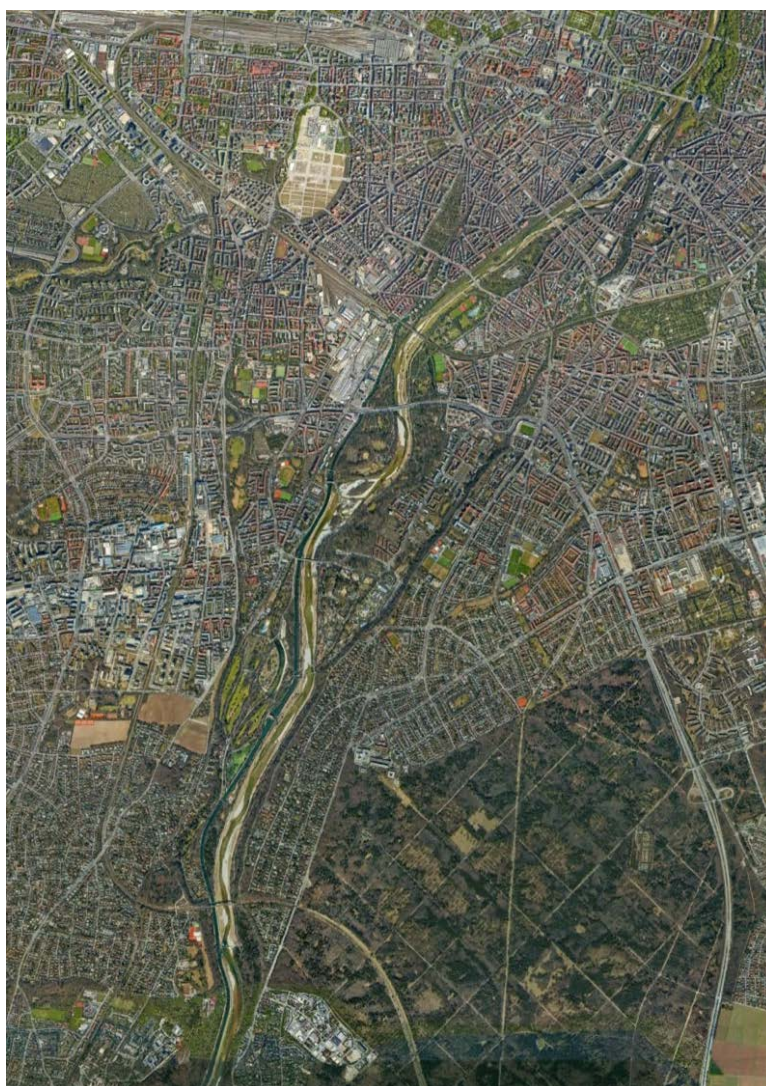


Figure 2. Location of the Isar River's restored reach within the city of Munich

CONTEXT

The Isar River is born in the Karwendel mountain range in the Alps and flows into the Danube River near Deggendorf after traveling 270 km. Due to its torrential regime, due to the thaw in spring or the abundant storms in summer, it was already called the "Torrent" by the Celts. It crossed Munich in a very dynamic braided gravel channel, whose arms and islands were modified in each great flood. The river regularly flooded the city and its surroundings. The city's relationship with the river was mainly a story of defence against the floods. In the 19th century, the urban section was channelized. In 1959 the construction of the Sylvenstein dam and reservoir, 80 km upstream of the city, was completed. With this dam, in addition to water storage, it was possible to reduce the flow of the ordinary flood.

At the turn of the XX-XXI century, the state of Bavaria has been an international reference in fluvial renaturation with numerous actions. The one on the Isar river is

emblematic for being a pioneer in the restoration of an urban environment. For the channelized Isar River, a return to a naturalized image of channel and banks was sought, with the objectives of guaranteeing and improving protection against floods, the recovery of good ecological condition of the river, the recovery of the riverbanks for leisure and recreational activities and the improvement of water quality.



Figure 3. Munich and the Isar River around 1724 (Sopena, 2013; from Bauferat LHM Munich)



Figure 4. Destruction of Ludwigs Bridge in 1813 (Sopena, 2013)

PRESSURES & IMPACTS

- 1) Lateral defences and embankments
- 2) Weirs and bridges
- 3) Narrowing
- 4) Incision

OBJECTIVES

The project has 6 main objectives:

- **Reduce flood risk**
- **Recovery of the riparian landscape**
- **Restoration of biodiversity**
- **Improvement of water quality**
- **Adequacy of riparian areas for leisure and recreation**
- **Citizen awareness of the entire process and its results**

Target species/habitats

Hydromorphology, alluvial forest

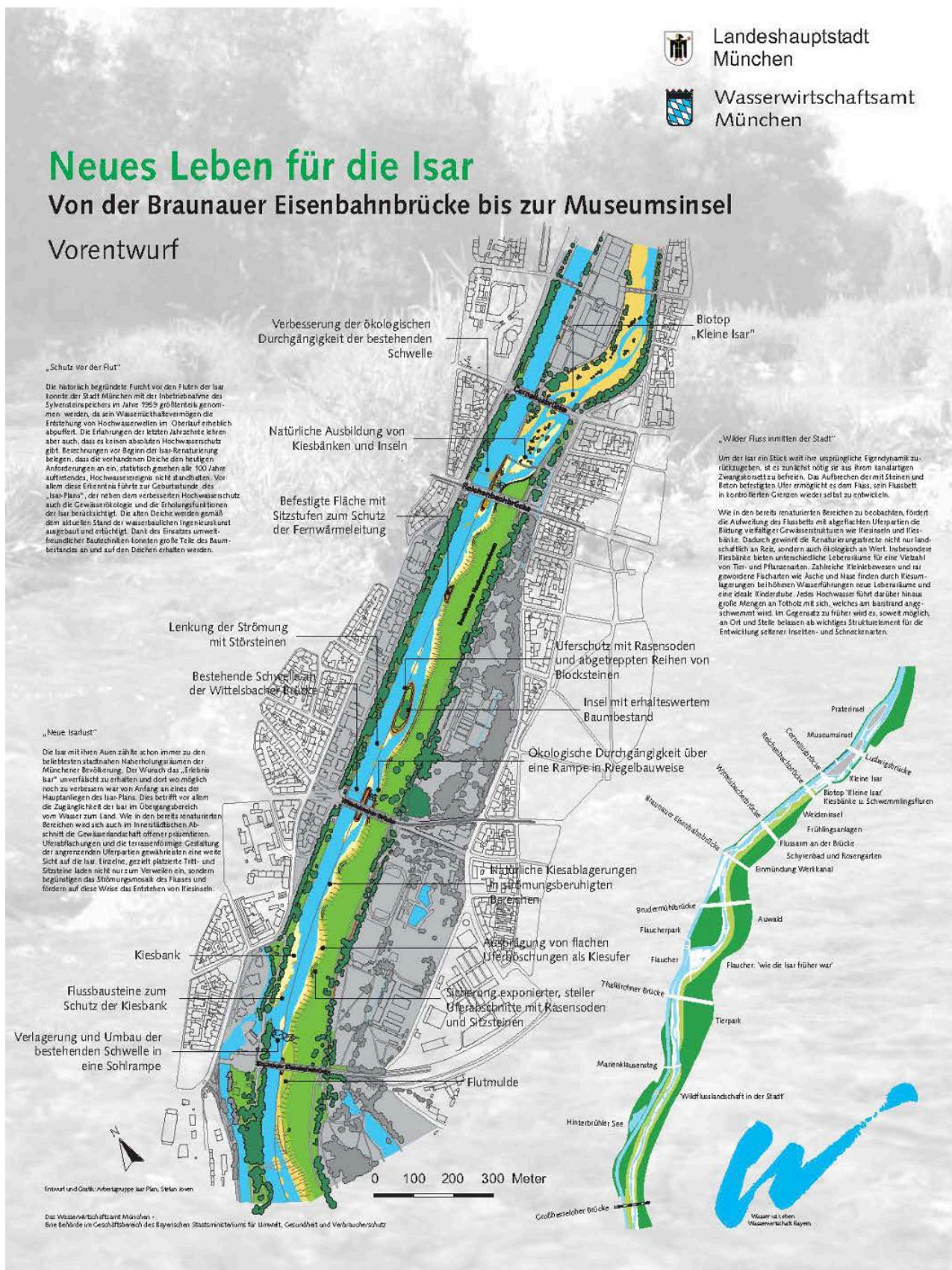


Figure 5. New life for the Isar! project

RESTORATION ACTIONS

With the initial objective of improving water quality and flood control, at the end of the 1980s, ideas began to be conceived in Munich for an integral development of the urban river. These ideas were consolidated in 1995 in the Isar-River-Project under the motto: New life for the Isar River! by founding the working group consisting of members of the Bavarian State Water Management Agency as well as of the Municipality of Munich.

After a period of consultations, both technical and public, construction work began in 2000 from the section upstream, between the pedestrian walkway Marienklausesteg and the Grosshesseloher Weir, continuing in the following years with successive sections towards the centre of the city.



Figure 6. Before and after restoration in the Wittelsbacher area

In the first phase, the following measures were adopted, also serving as a pattern for the following sections:

- The steep concrete and stone banks of the channel were removed, and the river channel widened. Gravel was mobilized and islands and bars formed out of it as there was a need of much more space within the river bed for improving flood protection we needed much more space within the river bed. Therefore, the river was widened and opened it and the water level during flood could be decreased.

As the Isar river has a huge deficit of gravel - the transport capacity is much higher than the available movable sediments - we put the mobilised gravel back into the Isar river bed. So the Isar was able to transport its (new) sediments again and forming new islands by itself.



Figure 7. Bank erosion and gravel feeding from the exposed bank

- Some of the riparian meadows were gently terraced and designed in such a way that the height difference between the floodplain and the channel was reduced, providing greater capacity for the channel and improving the accessibility of people to the water.

It was also necessary to adopt a series of additional measures such as:

- Limit the changes of the banks in this new natural dynamics.
- Reinforce the dikes of earth that in some areas had been damaged, when the oldest trees fell during floods.
- The old lamination weirs every two hundred metres, which made it difficult for fish passage, were replaced by a smooth staggering of jumps built with stone blocks in the shape of cells that make up small rapids.
- The river's ecological functioning was improved by incorporating logs and tree stumps on the banks. This allowed, with the accumulation of wood, the creation of habitats for invertebrates and fry, passage for aquatic creatures as well as the rooting of plants whose seeds have been dragged from upstream.

The improvement works were carried out section by section to downstream, each sector being completed approximately every year. The banks and the redesigned floodplain were planted with seeds of native plants, attracting insects of different species. The construction scars quickly faded, and the new naturalized landscape became popular areas for jogging, cycling, walking, barbequing and sunbathing and in winter for skiing. At the same time that the works were carried out, the water quality was radically improved. In September 2000 the first ultraviolet treatment plant began work in Bad Tölz, 48 km upstream from Munich. Progressively all treatment plants upstream and including of Munich have been upgraded with this disinfection treatment, allowing safe bathing in the river.

Therefore, in order to improve the protection measures and, in turn, the transformation to more natural dynamics and image of the river, it was verified that widening the main channel and renewing the landscape of the floodplain would achieve the additional capacity necessary to meet the safety design conditions without the need to raise the protection slopes. A competition was held in 2003 for the last section (2 km) between the Braunauer Railway bridge and the Museum Island, in the area of the historic city centre. Many bridges, memorials, pipelines, cables, and contaminated material within the floodplain were within this reach. An additional complication was the "Kleine Isar" (little Isar), a side channel around Museum Island.



Figure 8. Fork area of the Little Isar

The contest was won, among 50 proposals, by the team led by Irene Burkhard, landscape-designer. Public opinion harshly rejected the solution, especially for the use of concrete, as too "modernist" and not "natural" enough. This strong public response to the selected project would entail that the development for its execution be carried out jointly with the second selected team and with the participation of the contracting agencies. The renaturation works of this part, the most urban, were carried out between 2007 and 2011.

In the first two sectors, that linked to the areas already renaturalized more to the south, the solutions were similar to those already tested upstream of the river. At gravel shores and at the change in the profile of the floodable riverbank, some more architectural elements were added as built remains that emerge from the water as a reference to the city: steps, as grandstands made of large ashlar that appear and disappear on the banks, with the function of connecting with the wild meadows and accessing the water. Another singular element of these first two sections, which was very popular even

during the construction process itself, was the *Salix's* island (Figure 9), created in 2009. Originally it was a grove of trees in the old floodplain that the community wanted to maintain. Therefore, an arm of the main channel was built around the willows creating an island. To prevent its erosion, 400 tons of stone blocks were arranged on the sides and in front of the current, located so that they are generally hidden under the water level. In addition, with the collaboration of citizens, willow shoots were introduced which, together with gravel and wood, helped protect against erosion. Large and visible protection structures had to be built around the old bridges, because they were not designed for a wider and deeper riverbed. The abutments and piers therefore required new structural reinforcements.

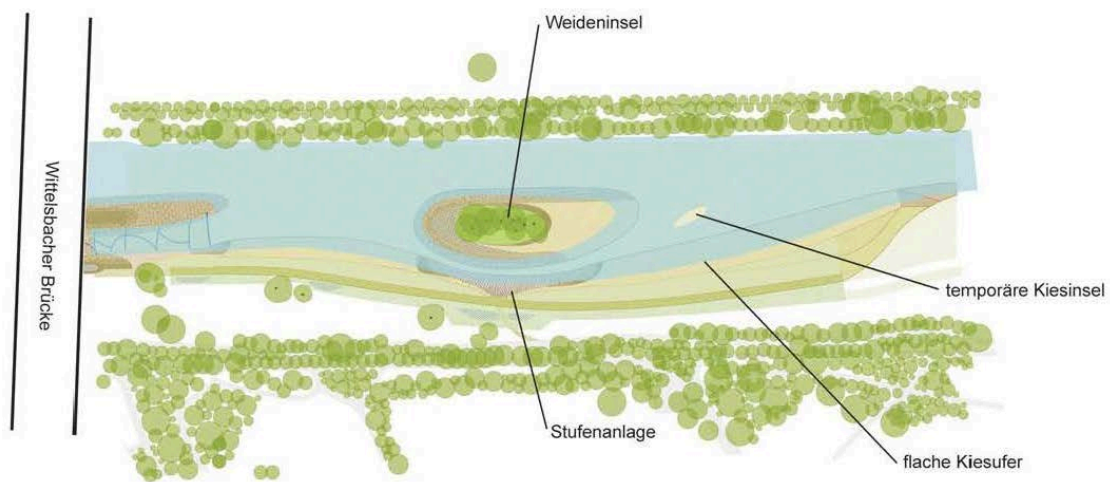


Figure 9. The *Salix's* island



Figure 8. Isar River in Munich after restoration works. Foto FrauHau (flickr).

The last sector of the project, between the Reichenbach bridge and the Museum Island, had a unique and complex challenge, which was the distribution of the flow between the main river, “Große Isar”, and the smaller “Kleine Isar”, improving the connection between the two, which entailed great difficulty in hydraulic calculation. The result of the modeling (a 1:20 model) helped to know the final details of the design before the works on the ground began in November 2009. These finished in June 2011 with a cost in this last phase of 4.4 million euros.

BUDGET

The total cost of the project was approximately 35 million euros. The city of Munich contributed 45%, while the State of Bavaria contributed 55%.

ACHIEVEMENTS

The results were excellent, achieving all the expected objectives. Overall, it was possible to give more space to the river, gravel sediments were mobilized and islands were designed, old concrete defences were removed and dikes and pipes were hidden and buried, old elements were dismantled, ramps were naturalized and stone block plans were established. The river began the movement of materials in a natural way, modifying the channel, many islands disappeared after a flood, generating the sensation in the citizen of being in the middle of nature even when close to the nerve centre of the city. The gravel banks have been replaced every time there is a significant flood, as happened in 2005 and 2012, in which many of the small structures executed did not resist and were repaired and rebuilt.

The floods deposit wood remains in the floodplain and on the banks and form pools and rafts. Some remain connected to the river providing excellent habitat for fry and invertebrates. The following year the floodplain flourished with a rich variety of species.

In short, it is the most emblematic urban river rehabilitation project in Europe. The applicability of its entire methodological process stands out, in which there were testing phases and several revisions. In addition, everything started from a citizen consensus and therefore from a collective awareness. Work was done with the community to define which spaces to preserve in traditional conditions and which to change in order to merge with the idea of fluvial rehabilitation. The fact that the river is fully integrated into the city is very interesting, there are no gaps or intermediate spaces.

A monitoring was done until 5 years after the works.

SOCIAL IMPACT

The social impact of the Isar River restoration has been enormously positive. The Isar has become the most important and popular green space in Munich, just outside the main gate of the historic city. Daily activities of walking, eating, reading, bathing, cycling, walking the dog, etc. are developed. Time and vegetation have managed to integrate the entire action into a new attractive and picturesque river landscape, renaturalized and representing nature. The process and its evolution was quickly accepted by the population.



Figure 9. Isar River in Munich after restoration works. Source: Foto FrauHau (flickr) and City of Munich

WEBSITES

https://www.wwa-m.bayern.de/fluesse_seen/massnahmen/isarplan/#

https://urban-waters.org/sites/default/files/uploads/docs/isar_plan_munich.pdf

https://climate-adapt.eea.europa.eu/en/metadata/case-studies/isar-plan-2013-water-management-plan-and-restoration-of-the-isar-river-munich-germany?set_language=en

BIBLIOGRAPHY

Arzet, K., Joven, S. (2008) *The Isar experience. Urban river restoration in Munich*. Isar Plan (https://www.wwa-m.bayern.de/fluesse_seen/massnahmen/isarplan/)

Binder, W. (2004) Restoration of rivers and floodplains in Bavaria. *3rd European Conference on River Restoration*, 27-32, Zagreb.

Espinosa, P. (2012) *Perspectivas del diseño urbano a partir de la rehabilitación fluvial en las ciudades en el ámbito de los países desarrollados*. Trabajo fin de master en Ordenación Territorial y Medioambiental, Universidad de Zaragoza.

Heckmann, T., Haas, F., Abel, J., Rimböck, A., Becht, M. (2017) Feeding the hungry river: fluvial morphodynamics and the entrainment of artificially inserted sediment at the dammed river Isar, Eastern Alps, Germany. *Geomorphology*, 291: 128-142.

Rädlinger, C. (2012) *Geschichte der Isar in München*. Stadtarchiv München, München.

Sopena, M.P. (2013) *Recuperación del paisaje en la ciudad: las riberas urbanas en las cuencas de los ríos Garona e Isar*. Trabajo Fin de Máster en Estudios Avanzados en Historia del Arte. Universidad de Zaragoza, 131 p.

Zinsser, T. (2003) Neues Leben für die Isar. Mit dem Isar-Plan verfolgen die Stadt München und das Land Bayern ehrgeizige Ziele. *Garten+Landschaft*, 12/2003: 12-21.