



**UST**  
FACULTAT DE CIÈNCIES  
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**UVIC-UCC**

## **Degree Final Project**

# *Identification of socio-ecological connection in Rete ZUB*

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**Degree in Environmental Science**

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Vic, 6<sup>th</sup> June 2018

## **Degree final project summary**

### **Degree in Environmental Science**

**Title:** Identification of socio-ecological connection in Rete ZUB

**Key words:** Rete ZUB, socio-ecological connection, interactive map

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**Date:** 6<sup>th</sup> June 2018

Rete ZUB is a non-profit public-private partnership (Borromeo Wetland Network – Rete *Zona Umida Borromeo*). It aims to extend a successful initiative a broader geographical area. This initiative was carried out in Peschiera Borromeo, south-east of Milan in Lombardy, within the Watermill project and focused on increasing agricultural productivity, environmental sustainability and social solidarity.

The identification of socio-ecological connectors between wetlands in this area was performed through an agreement between *Antico Mulino ltd* and *Universitat de Vic-Universitat Central de Catalunya*. The project is based on an interactive map which allows us to understand new possibilities for connecting high points of biodiversity, mitigating the effects of climate change in Mediterranean regions.

Social and ecological values are featured to determine the connection between the existing wetlands and management advice for improving the worst socio-ecological connectors. Finally, some new potential wetlands have been identified to become reservoirs for excessive rainfall waters and new research projects.

## **Resum del projecte de final de grau**

### **Grau en Ciències Ambientals**

**Títol:** Identificació de la connexió socio-ecològica en Rete ZUB

**Key words:** Rete ZUB, connexió socio-ecològica, mapa interactiu

**Author:** Lluís Bertrams Tubau

**Tutor/s:** Roger Arquimbau Cano (UVIC- UCC) i Francesco Cavazza (Antico Mulino ltd)

**Date:** 6 juny 2018

Rete ZUB és una associació públic-privada sense ànim de lucre, formant l'anomenada Xarxa d'Aiguamolls Borromeo. El seu objectiu és estendre el projecte realitzat en una àrea geogràfica més àmplia. Aquesta iniciativa s'ha dut a terme a Peschiera Borromeo, al sud-est de Milà a Lombardia, emmarcat en el projecte de *Antico Mulino*, centrant-se en augmentar la productivitat agrícola, la sostenibilitat ambiental i la solidaritat social.

La identificació socio-ecològica dels connectors entre els aiguamolls d'aquesta àrea s'ha realitzat a través d'un acord entre *Antico Mulino ltd* i la *Universitat de Vic-Universitat Central de Catalunya*. El projecte es basa en un mapa interactiu que permet entendre noves possibilitats per connectar alts punts de biodiversitat, mitigant els efectes del canvi climàtic en les regions mediterrànies.

Els valors socials i ecològics es caracteritzen per determinar la connexió entre els aiguamolls existents i la corresponent gestió per millorar els pitjors connectors identificats. Finalment, alguns aiguamolls potencials s'han identificat podent ser reservoris per a l'excés d'aigua en fortes precipitacions i per a nous projectes de recerca científica.

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# 1. Background

## 1.1. Antico Mulino and Rete ZUB

*Antico Mulino Ltd* is the promoter and leader of a non-profit public-private partnership named Rete ZUB (Borromeo Wetland Network). The aim of this wetland network is to extend the successful experiences in Peschiera Borromeo with the *Progetto del Mulino* initiative or Watermill project, to a broader geographical area. It is a philanthropic private initiative based in Peschiera Borromeo (Milan) and focused on increasing agricultural productivity, environmental sustainability and social solidarity.

*Progetto del Mulino* or Watermill project is a philanthropic private initiative based on Peschiera Borromeo and focused on increasing agricultural productivity, environmental sustainability and social solidarity. The project consists in achieving ecological agricultural uses of the land with irrigation agriculture, with the mark of proximity and ecological products. *Progetto del Mulino* is supported by *Antico Mulino Ltd*, owned by a member of the Borromeo family, which settled in the area in the 15<sup>th</sup> century.

Rete ZUB is formed by:

- *Antico Mulino Ltd*: promoter and leader of the Rete ZUB, owning an experimental wetland of about 5 hectares located in Peschiera Borromeo, where several social and research activities are carried out.
- *Società Agricola GAB Ltd*: certified organic farm located in Peschiera Borromeo, owning 19 hectares of arable land (wheat, spell and horticulture grown with permaculture techniques).
- *Azienda Agricola Giancarlo Borromeo Ltd*: sustainable farm located in Corneliano Bertario, owning 220 hectares out of which 50 hectares have been re-naturalized through agro-environmental schemes and 8 hectares are covered by wetlands.

Environmental interest areas such as Carengione forest, Antico Mulino wetland (Peschiera Borromeo wetland), Lica wetland (Corneliano Bertario wetland) and Isola wetland (Cassano d'Adda wetland) are the ecological element of Rete ZUB. These areas are both private and public owned and built to improve the ecological value of the landscape in the east province of Milan.

### 1.1.1. Geographical area of Rete ZUB

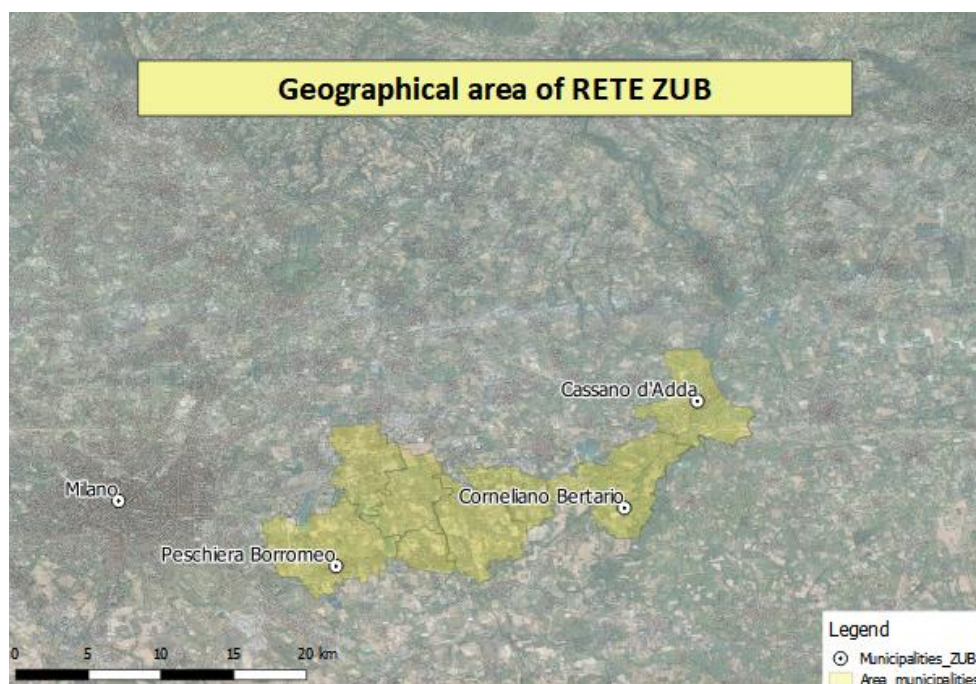
Rete ZUB is located in the south-east of Milan, in Lombardy (a region in the north of Italy). Lombardy is an area of *Pianura Padana*, which covers about 650 kilometers in

the north of Italy, following the Po River. This is one of the most developed areas in Italy. There are plenty fertile lands, where intensive agricultural and industrial activities take place. Few and fragmented wetlands and ecological areas are recognizable. Between these, *fontanile* are traditional elements of the area, artificially created by collecting in canals and wetlands water coming from natural springs.

The landscape of the eastern province of Milan is sprinkled with irrigation fields, canals and a few wooded areas, a kind of mosaic landscape. Intensive farming activities take place in the area around the private wetlands and regional parks that have great environmental and tourist potential. This is shown in the Rete ZUB wetlands which have demonstrated how a properly managed ecosystem, can not only enhance the environmental quality of the landscape, but also increase the public use of it. Moreover, there are two regional parks in this area: *Parco Naturale Adda Sud* (South Adda River Regional) and *Parco Agricolo Sud Milano* (South Milan Agricultural Park).

Three castles of historical interest in Cassano d'Adda, Corneliano Bertario and Peschiera Borromeo provide a potential source of cultural tourism for the area.

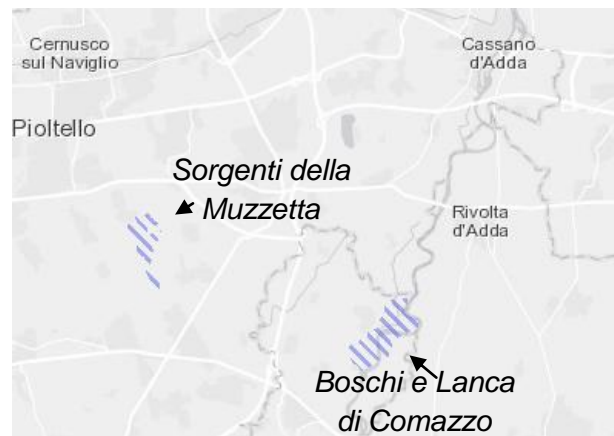
The geographical area of Rete ZUB with its main cities of Peschiera Borromeo, Corneliano Bertario (Truccazzano municipality) and Cassano d'Adda are shown in Figure 1.



**Figure 1 Geographical area of Rete ZUB.**

Peschiera Borromeo and Cassano d'Adda are at the extremes of Rete ZUB. Peschiera Borromeo is a small town in the neighbourhood of Milan, 10 km from city centre. Corneliano Bertario is a rural village, near the most important and biggest wetland of Rete ZUB, Corneliano Bertario, 23 km from Milan. Finally, Cassano d'Adda is a town near Adda River (26 kms from Milan).

Natura 2000 network, the European Union of preservation natural net, has established two protected areas in Rete ZUB which are fragile habitats: "*Sorgenti della Muzzetta*" and "*Boschi e Lanca di Comazzo*". They are shown in Figure 2.



**Figure 2** *Sorgenti della Muzzetta* and *Boschi e Lanca di Comazzo* (Natura 2000, 2017a, 2017b).

*Parco Agricolo Sud Milano* is a rural park located in the south-west area of Rete ZUB (Figure 3):



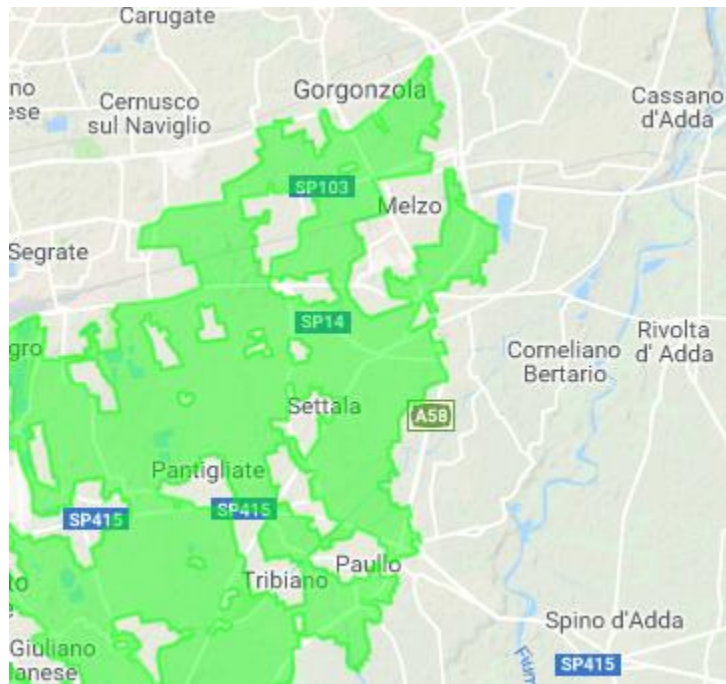


Figure 3 Protected area in green color of Parco Agricolo Sud Milano (Parco Agricolo Sud Milano, 2018)

### 1.1.2. Wetlands in Rete ZUB

Rete ZUB has particular wetlands in the region with important environmental features. The most important wetlands are shown in Figure 4:

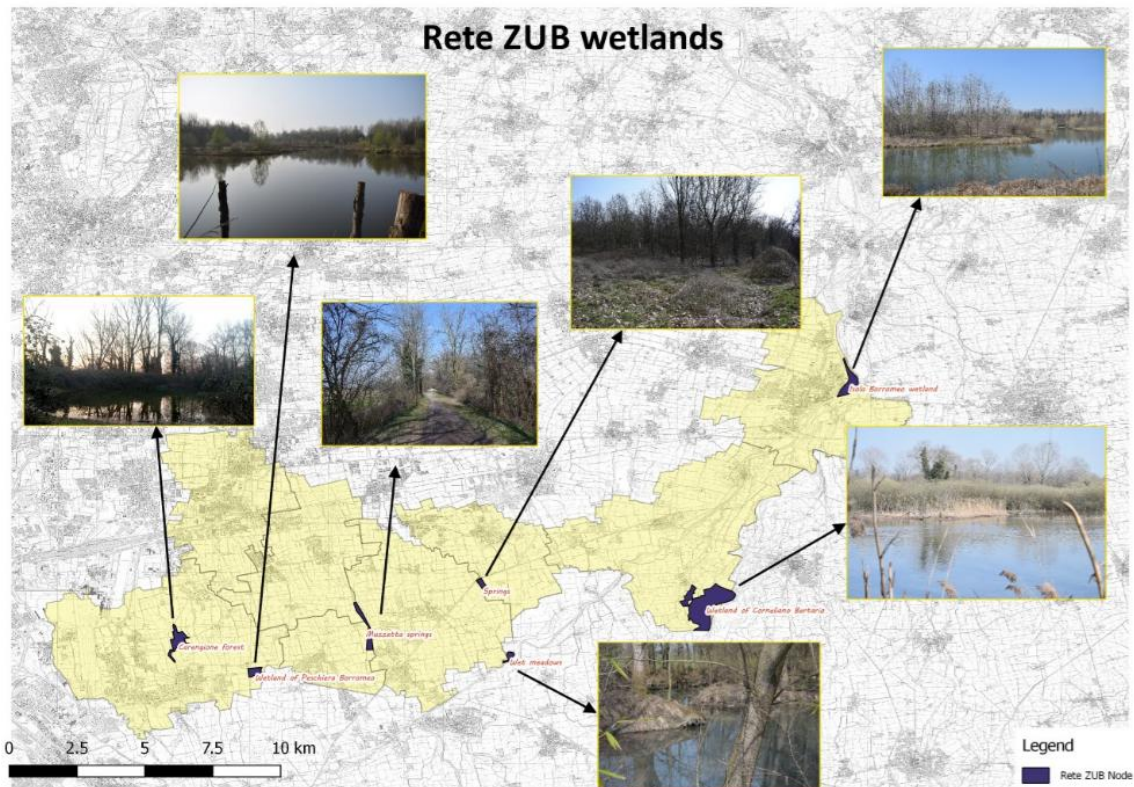


Figure 4 Rete ZUB of existing wetlands

The existing wetlands in Rete ZUB are shown in different photos (link in the title):

- [Carengione forest:](#)

The Carengione forest is located between the north and north-east of urban area of Pescara Borromeo. The main ecological feature is a wooded area of autochthon trees like *Quercus robur*, *Ulmus minor*, *Alnus glutinosaa*, *Acer sp.*, *Prunus sp.*, *Sambucus sp.* and *Salix sp.* with some shrub species and some little swamps inside. The great variety of plant species attracts all kinds of wildlife, typically *Anas platyrhincchos* (mallards), wrens, *Gallinula chloropus* (moorhens) and rabbits (“Parco Agricolo Sud Milano,” n.d.).

This is a particular point of interest as a wetland with a forest within it, like a forest island between irrigation fields appropriate as a refuge for wildlife. This kind of wetland is rare in the Mediterranean region and exceptional in *Parco Agricolo Sud Milano*.

The proximity of the area to the nearby town means that there is public access with some itineraries promoted to go for a walk, cycling or horse riding.

- **Antico Mulino wetland (Peschiera Borromeo wetland):**

This ecological area was created in 2008 with a plantation of autochthonous trees. A few years later a wetland was built with the aim of favoring the quality of the ecosystem. The wetland itself is divided into three areas: a water flooded area that seems natural, but in fact is artificially created with environmental value; wet meadows close to the swamp and a tree plantation area. In addition, there are some little islands in the wetlands appropriate for bird nesting.

The presence of an antique water mill will be a potential tourist point and a hub for natural scientists, environmentalists and biologists. In addition, a biological farm with permaculture system (Solà, 2015) cultivates wheat, spelt and grasses.

Permaculture is an agriculture technique that consists of growing different plant species together using only water and weed, without implantation of chemical products (Solà, 2015).

The global threat to biodiversity from air and water pollution, deforestation, overbuilding urban areas and fragmentation of territories disrupts the biological cycles of flora and fauna. It causes difficulties to find food and carry out reproduction. Therefore, this area provides a shelter for wildlife, especially migratory birds and has become a scientific and educational area of study for young students and researchers. It also focuses attention and awareness on the threat to biodiversity threat and its possible solutions (Alboran cooperativa sociale, n.d.).

- **Muzzetta springs:**

This ecological area is a protected area of *Parco Agricolo Sud Milano* and the Natura 2000 network, considered as a partial regional reserve. It is located in the middle of an urban, industrial and agricultural landscape. The main feature is the presence of a *fontanile* with hygrophilous vegetation such as *Alnus glutinosa* and *Fraxinus excelsior* creating a hydrophilic forested linear system. The combination of oligotrophic and eutrophic water with benthic vegetation of *Chara sp.* and vegetation of *Magnopotamion* or *Hydrocharition* respectively creates a sheltering system for autochthonous amphibians such as the Lataste frog (*Rana latastei*), birds and some mammals, typically weasels and hazel mice (Fasola, 2010).

- **Springs:**

This small ecological area is near a road between Settala and Liscate urban areas and surrounded by agricultural landscape. It is featured by a plantation of autochthonous vegetation which creates a shelter for wildlife as an island forest.

- **Wet meadows:**

This ecological area is beside an affluent of Adda River, next to a poplar plantation. This humid area is a great ecosystem for aquatic and migratory birds and amphibians because it creates a good shelter for their feeding and reproduction. The area is quiet and far from urban and industrial areas, making it an ideal environment for them.

- **Lica wetland (Corneliano Bertario wetland):**

It is the biggest complex of wetland and forested areas in Rete ZUB. It is located in Corneliano Beratrio, an area with low vehicle traffic and low density of humans compared with other wetlands in Rete ZUB. This wetland is close to Adda River and represents the highest point of biodiversity of wildlife, vegetation, typical forests of *Populus alba* and *Fraxinus excelsior*, and landscape over the other wetlands. In this area there is an important value of agricultural cultivation of corn, wheat, barley, meadows and soy.

This ecological area is formed by four wetlands with different environmental features. Two of them are artificial with old woods surrounding them. One is created for wader birds with shallow waters, like the black-winged stilt (*Himantopus himantopus*), and another with deeper waters for ducks. It is managed by a manual bulkhead, regulating the natural flow of the incoming water from Adda River. This important feature is the key to improve in other wetlands of Rete ZUB. The area is also a private hunting reserve that increases its economic funding.

- **Isola Borromeo wetland (Cassano d'Adda wetland):**

It is an important wetland in Cassano d'Adda municipality, located on a small island within the Adda River. It is an artificial wetland created to improve the biodiversity and the ecological value of an area close to the town, combined with agricultural fields and wet meadows.

Its aim is to restore an area from human degradation. However, it is related to create a shelter for wildlife, the same as in the other wetlands of Rete ZUB with autochthonous

tree and shrubs plantation. The great achievement is to protect the area from public use, with environmental education plans to raise awareness from the society.

Its management is conducted by *Alboran Social Cooperative* (Isola Borromeo, n.d.).

More details of each wetland are exposed in Table 1 and Annex.2. Socio-ecological connectors:

Name	Area	Municipalities
Carengione forest	36,54 ha	Peschiera Borromeo
Antico Mulino wetland	14,70 ha	Peschiera Borromeo
Muzzetta springs	23,88 ha	Pantigliate and Rodano
Wet meadows	7,28 ha	Comazzo and Settala
Springs	9,67 ha	Liscate
Lica wetland	156,62 ha	Trucazzano
Isola Borromeo wetland	37,06 ha	Cassano d'Adda

Table 1 Rete ZUB nodes with their surface and municipalities

### 1.1.3. The role of wetlands in Rete ZUB

Wetlands have a high importance according to the UE law. They keep an important part of the global biodiversity. They provide ideal conditions for a vast diversity of habitats and species, especially for birds, providing vital nesting and migratory flyway areas, as well as for other fauna species, such as amphibians and mammals.

Wetlands support a wide range of public services like providing biodiversity recreational and tourism opportunities. In addition, they act as a carbon sink to reduce levels of greenhouse gases into the atmosphere.

However, despite their importance, wetlands are disappearing or being polluted at an alarming rate and are among Europe's most threatened ecosystems.

The Habitats (92/43/EEC), Birds (2009/147/EC) and the Water Framework (2000/60/EC) Directives are the main pieces of legislation ensuring the protection of Europe's ecosystem including the wetlands.

The huge amount of flora and fauna species that inhabit wetlands make them the most ecologically diversified ecosystem in the world. Furthermore, the vegetation in wetlands helps to control water erosion. The most common wetland species of fauna include many amphibians and reptiles, some species of fishes, but also a huge range of

insects and water invertebrates. Specially, an extensive range of birds of all shapes and sizes, either all year-round or only briefly as they pass through during migration routes. It plays a key role as a bioindicator of good environmental conditions. In addition, some mammals like rabbits or nutria (*Myocastor coypus*), an invasive species, inhabit in the region (*Annex.1. Wildlife and flora species in Rete ZUB*). They are another problem to improve for the ecological services.

Rete ZUB is in a Mediterranean region, affected by Mediterranean climate with two different situations:

- Winter season (October- April): there is a lot of water. It rains frequently. There is no problem of regulation in water uses.
- Summer season (May- September): water uses can be regulated because in this period as there could be lack of water and temporary drought.

Rete ZUB wetlands have a great potential for phytoremediation process to store and remediate polluted water coming from excessive rainfalls. Nowadays, heavy rainfall causes a saturation of the system and can damage the environment throwing away the residual waste water without any treatment. Wetlands have a natural potential to stock and purify polluted waters. Specifically, through a properly managed network of canals and wetlands, the dangerous impact of excessive rainfall water can be mitigated. The slow water flow within wetlands achieves a neutralization of pollutants by the vegetation. In a mixed landscape of urban and agricultural land, wetlands can act as a sink of heavy rainfall. This process has the ability to change a potential threat into a valuable resource(Zhang, Zheng, & Sharp, 2010).

Urban areas would discharge the water of rainfalls through irrigation canals until the existing and new potential wetlands. This process is important to mitigate climate change, especially during excessive rainfalls. In addition, it helps prevent wind, rain, and groundwater from carrying pollution away to other areas. The microbial reactions can attenuate and reduce these charges of pollutants. Wetlands provide a substrate of roots, stems, and leaves, where microorganisms can grow and break down organic materials and uptake heavy metals.

The most used phytoremediation technology is the horizontal submerged flow system, where the water level is slightly below the surface and the environment inside the beds is predominantly anaerobic. A well-defined oxygenated micro zone is developed around the rhizomes of vegetation, which determines the development of the aerobic bacterial film. The alternation of aerobic and anaerobic areas involves the development

of several microorganisms. The process of degrading organic matter, nitrogenous substances, phosphorus compounds and heavy metals of microbial activities and the absorption from plants in wetlands are being researched by scientists all over the world (Riggio et al., 2018). The constant water flow, the major quantity circulates underground, maintains it purified while passing through the rocks like a process of filtration.

Another type of potential wetlands is gravel pit lakes. Nowadays, they are exploited for industrial uses restoring of a lot of water.

#### **1.1.4. Points of cultural interest**

Rete ZUB has different points of cultural interest related to the Christian religion and buildings of medieval age within a unique landscape in Italy that it boosts an important heritage to protect.

Churches and little sanctuaries make an important religious and traditional heritage in Italy because they are featuring each city, town and village.

There are three historic castles of the Borromeo family that make another point of cultural interest, explained below:

- *Peschiera Borromeo castle* is the oldest property from the Borromeo family who develop commercial and financial activities in Lombardy until 1435. This castle is one of the few surrounded by a moat full of water excavated in 15<sup>th</sup> century, dated in 1432.

- *Corneliano Bertario castle* is a medieval castle located in Corneliano Bertario village, in the south-east of Milan, beside Adda river. The castle, dated in 1158, was a mansion of the Borromeo family. Nowadays, this mansion combines history, culture and medieval architecture with ceremonies and weddings.

- *Cassano d'Adda castle*, named as the Visconti castle. Adjacent to the Duchy of Milan, beside Adda River, this building belonging to the 12<sup>th</sup> century, was the residence of the Visconti family.

The building served as a political representation, a center for parties and a scene of battles; it was also the place where Leonardo Da Vinci started to work on human portraits.

Nowadays, this castle is a historical place restored and opened to public and private ceremonies and weddings.



## **1.2. Research project**

The identification of socio-ecological connectors in Rete ZUB is a non-profit public-private partnership allowing the creation of a natural network between important wetlands in the area. The project consists in defining socio-ecological connectivity between these places to improve their management and preservation status.

Some existing and potential wetlands can become the storage of water for a new kind of wastewater treatment of urban areas, performing a phytoremediation process and, at the same time, to achieve a major water use for farmers.

After that, the social vision should be the solution to keep and continue this project, for a good social, cultural and natural use of the area. This project in Mediterranean regions will be considered a pioneering initiative of phytoremediation process, as a sink of drought effects aggravated by climate change.

The project will be carried out with the involvement of the student Lluís Bertrams Tubau in his master dissertation for the Environmental Sciences degree at *Universitat de Vic – Universitat Central de Catalunya (UVIC-UCC)*. It is based on a three-week stay by *Antico Mulino*, with an agreement of extracurricular practicum between *Antico Mulino Ltd* and *UVIC- UCC*. After that, a final report and interactive map are shown. The funding of the project was halfway: airline tickets, accommodation and tutor expenses were a contribution of *Antico Mulino Ltd* and the student financed food and transport during his stay.

The supervisors of the project will guarantee the accomplishment of the project, field and office work, and its redefinition (*Annex.5. Timeline, supervisors and budget*).

## **1.3. Socio-ecological connection**

Rete ZUB aims to associate and aggregate local farmers of the east Milan area to increase their market power and have access to a larger share of the neighbouring and attractive growing market of the Milan's metropolitan area. In parallel, Rete ZUB aims at promoting with public authorities and regional parks a sustainable tourism, both local and international, based on an effective common environmental and landscape preservation.

The identification of socio-ecological connectors between different wetlands in Rete ZUB is explained in the following sections while in *Annex.2. Socio-ecological connectors* some features about connectors and each node are exposed.



### **1.3.1. The role of ecological connection between wetlands**

Ecological connectors are important to maintain a high value of biodiversity in each wetland because the connectivity between wetlands is essential to preserve the different kinds of habitat, such as riverside vegetation wetlands, wet meadows, springs, *fontanile*, and species of flora and fauna (*Annex.1. Wildlife and flora species in Rete ZUB*).

The environmental values over the world, especially with climate and global change, create another vision from the society to improve and protect different kinds of habitats, like wetlands, before its probable disappearance. Wetlands provide an important ecological value of *Pianura Padana*. They need more protection from human impact and its pollution. Some important habitats are: riverside vegetation, wetlands, wet meadows, springs and *fontanile*. The best way to connect the wetlands of Rete ZUB is irrigation canals with a good environmental status with riverside trees, without invasive vegetation and rubbish and clear water.

However, to mitigate climate change a phytoremediation process is able to improve the life of the nearby population. During storms, the heavy rainfall can cause several damage in urban areas, even deaths (Meloni, 2017; Rinaldi, 2016). If the drainage of water had gone across irrigation canals until existing and potential wetlands, some problems of water would have been less dangerous.

### **1.3.2. The role of social connection between wetlands for public use**

The social connection of Rete ZUB between wetlands for public uses plays a very important role for tourism, for population of near urban areas, for farmers and also for industrial activities. These activities are important to give a potential value for the territory and for the society of the area. Their harmony with environmental values improves the social and ecological features of the connectors.

A track or path next to the irrigation canal, the potential and the existing wetland and *fontanile* achieves a good connector for social and public uses.

Different activities which help to define the social uses of Rete ZUB connectors can be carried out in the region:

- Sportive activities such as walking, running, riding a bike or horse riding.
- Natural routes to learn ecological interests of the area related with wildlife and vegetation.

- Historical routes to identify and learn the history of the three castles and the territory.
- Agricultural activities for tourists to learn agricultural values as well as taste ecological products of the area.
- Ecotourism. Some farmhouses with historical heritage develop their value for tourism, as a rural hotel, weddings and other ceremonies. They create different landmarks around the region and their activities to attract customers. Also, restaurants and local shops offer fresh and proximity food which can improve the economy of the region.

Finally, the potential participants who can interact in the project have an important role to understand Rete ZUB and define its network:

- *Town councils*: they can protect the area with their legislative tools of municipality regulation, especially urbanism. They can explain to the population the benefits to protect the area, referenced by economic progress based on tourism and agricultural eco-products.
- *Population of urban areas*: they must be aware of the area with natural values. It is essential to explain to them the situation and the importance of their territory.
- *Farmers*: they are involved with a bottom-up approach to create a common ecologically sustainable area with an improvement of the agriculture profitability, the enhancement of environmental and landscape characteristics, and the environmental and landscape social fruition. In addition, they are the pioneers to achieve this project with land stewardships which can be established to protect different parts of their properties.
- *Tourism*: cultural, natural, ornithologist, botanical tourism and sportive tourism have the potentiality to increase the economic benefits in the area.
- *Wastewater*: existing and potential new wetlands can store wastewater from urban, industrial and commercial areas through the connectors of irrigation canals.
- *Climatology*: rainfalls are important to maintain springs, *fontanile*, irrigation canals and wetlands. Droughts should also be taken into account when defining potential wetlands in agricultural areas.

## 2. Objectives

The objective of the project is to identify new and existing socio-ecological connections between wetlands being part of Rete ZUB and other ecosystems potentially included in this wetland network. Furthermore, geographical and territorial obstacles to the connectivity will be highlighted and strategies to overcome them advised. Such connections will improve the ecological value of the wetlands, their usability for social purposes (research, education and tourism) and the potential excessive rainfall water phytoremediation treatment. The study will define a socio-ecological management plan for the connections and the wetlands themselves.

## 3. Methodology

The different areas of the study, such as Carengione forest, Peschiera Borromeo wetland, Muzzetta springs, other springs and wet meadows, Corneliano Bertario wetland and Cassano d'Adda wetland are mapped and the related management planning identified.

Irrigation canals, agricultural fields, wetlands, natural springs and potential areas in Rete ZUB are studied to collect data during the field work. It is identified and presented in an interactive map, by QGIS software (OSGeo Project & OGIS trademark, 2018), with facilities to transfer to GPS or mobile phones to use in future management schemes. An interactive map has been drawn specifically, per each socio-ecological connection and wetland, current status, interest and critical points to develop improvement actions and its future management.

### 3.1. Field cards

The field work is based on the calculation of ecological and social values of homogeneous connectors (Annex.3. Card 1), both as a transect and a particular code.

The code is based on capital letters of different nodes or villages and towns (Figure 5):

- **BC\_AM.number** is between Carengione forest (*Bosco dil Carengione*) and the wetland of Peschiera Borromeo (*Antico Mulino wetland*):
  - **BC**: Carengione forest.
  - **AM**: Wetland of Peschiera Borromeo.
- **AM\_SM.number** is between the wetland of Peschiera Borromeo (*Antico Mulino wetland*) and Muzzetta springs (*Sorgenti della Muzzetta*).

- **AM:** Wetland of Peschiera Borromeo.
  - **SM:** Muzzetta springs.
- **SM\_S.number** is between the wetland of Muzzetta springs and the node of springs.
  - **SM:** Muzzetta springs.
  - **S:** Springs.
- **S\_W.number** is between the nodes of springs and wet meadows.
  - **S:** Springs.
  - **W:** Wet meadows.
- **W\_L.number** is between the node of wet meadows and the village of Lavagna.
  - **W:** Wet meadows.
  - **L:** Lavagna.
- **L\_C.number** is between the village of Lavagna and the wetland of Corneliano Bertario.
  - **L:** Lavagna.
  - **C:** wetland of Corneliano Bertario.
- **C\_C.number** is between the wetland of Corneliano Bertario and the wetland of Cassano d'Adda (*Isola Borromeo wetland*).
  - **C:** Corneliano Bertario.
  - **C:** Cassano d'Adda.

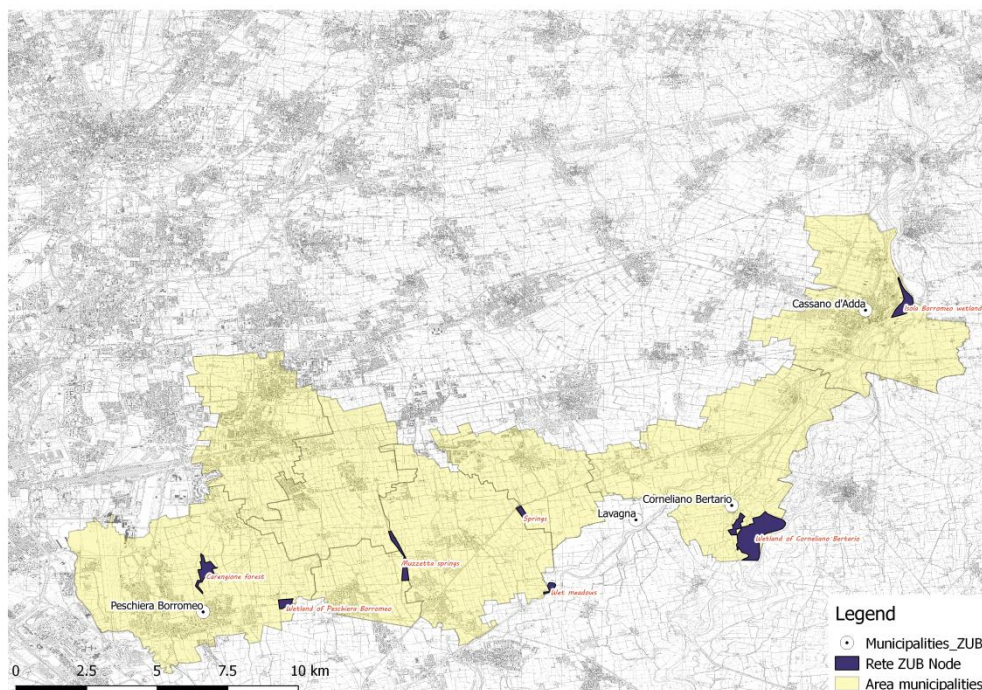


Figure 5 Map with areas of methodology codes.

These codes are simply to ease the field work with a GIS application of Oruxmaps ("Oruxmaps," 2018).

The values of ecological connectors are divided into different points and each point is also subdivided into others which are explained below:

- **Quality of the connector**

- *Irrigation canal features*: related to water turbidity, rubbish presence, lateral concrete walls, small preys and natural talus.

- Water turbidity: determines the potential feature to be a fontanile or not.

- Rubbish presence: determines a human impact in the irrigation canal.

- Lateral concrete walls: the presence of this artificial structure in the lateral of the irrigation canal reduces the final ecological value.

- Small preys: the presence of small preys in the middle of the irrigation canal can stop the connectivity and reduce the final ecological value.

- Natural talus: a good irrigation canal must have a natural talus in its lateral.

- **Quality of the area**

- *Features until 10-25 meters next to the irrigation canal*: side vegetation, invasive vegetation, presence of rubbish, presence of wetland, conservation state of the area, access of water in the possible reservoir, agricultural uses near the connector, pasture-livestock, arable land, meadows, orchard and forest plantation must be evaluated to determine an important score of final ecological value.

- Side vegetation: a high presence of side vegetation is important to become a refuge for wildlife, a high point of biodiversity. But it depends on the coating of invasive species of vegetation.

- Invasive vegetation: a high presence of side vegetation and invasive species can cause a high problem with the loss of autochthonous species.

- Rubbish presence: it is the same case as in the irrigation canal features.

- Wetland presence: if the connector is close to a wetland or the observer finds out an existing wetland, some evaluation points must be done such as vegetation presence, distance from irrigation canal and temporal ponds presence. All of them with a positive ecological value if there is presence of vegetation, temporal ponds and are located in a short distance from the connector.
- Conservation state of the area: divided in good, regular or bad status according to the observer's point of view.
- Access of water in the possible reservoir: it can be in a good optimal access or not. It is based on the status of the irrigation canal and the high presence of vegetation acting as a dam.
- Agricultural uses near the connector: near the connector with agricultural uses or not, a simple observation of the surroundings.
- Pasture-livestock, arable land, meadows, orchard: if near the connector there are pasture-livestock, arable land, meadows, or orchard. Different options which improve and diversify the landscape of the area.
- Forest plantation: a forest plantation is a negative score because it determines an area without trees some time before. If there is a forest plantation and it is with autochthonous tree species, it will be better than with invasive species.

- **Obstacles**

- *Presence of obstacles*: different kind of obstacles that can have an important impact on ecological values, stopping the connection for wildlife.
- Minor roads: its main feature is low traffic of motorized vehicles.
- Highway: an important visual and ecological impact for the vegetation and wildlife, it can also stop the connection.
- Bridges: an important impact for wildlife and vegetation, it can stop the connection but with an implementable step of wildlife it can be improved.
- Railroad: the same case as the highway.

- Buildings: a little building near the connector that causes an environmental impact. For example an electrical tower that can involve a danger for birds.
- Industrial: presence of industries that can cause an important impact for wildlife and vegetation as well as for the environment.
- Residential: an urban area near the connector.
- Commercial: if there is a commercial center near the connector.
- Steps for wildlife: if there is an obstacle, it can be a step of wildlife or not. If there is no obstacle, it will not input in the final score. Nevertheless, if there is an obstacle and there is not a step of wildlife, the observer should say if it can be implementable or not.

- **Proximity to a historical element of the landscape:**

If there is a historical element near the connector, the observer should mention it with some description. The final score is exposed in the point of obstacles.

- **Potentially characteristic landscape to be preserved:**

If there is a potentially characteristic landscape such as agricultural fields, near Adda River, or near a fontanile the observer should mention it with some description. The final score is also exposed in the point of obstacles.

To evaluate each ecological connector status it should be a good option to expose a personal evaluation. In addition, the final score of ecological connectors for the interactive map in the final results is classified in:

- Bad ecological connector (red label): 0-52 points
- Average ecological connector (purple label): 52-103 points
- Good ecological connector (green label): 103-155 points

The values of social connectors are divided into different points and each point also divided into others which are explained below:

- *Social connector features* (agricultural road or path)
  - Follow the ecological connector: if the road or path is following the ecological connector, it will mean an optimal public use of the connector.

- Parallel route to irrigation canal: also related to the previous case, if a route is going parallel to an irrigation canal, its public use increases.
- Proximity of water's reservoir: if the social connector is near a water reservoir, it will pollute this place. For this reason the score is negative if the social connector is near a water reservoir.
- *Road or track features*:
  - Track/road presence: it is a positive score if there is a track or road presence.
  - Rubbish on the sides and/or in the middle: if there is some rubbish it can be a problem for public uses and ecological features.
  - Suitable use for bicycles and walkers: if a road or track is present, it may be suitable for both bicycles and walkers, or only for one of them.

If there is an informative panel in the connector the observer must input the location, coordinates and features that it includes.

In the same way as the ecological connector determination, the observer should expose a personal evaluation. In addition, the final score of social connectors for the interactive map in the final results is classified in:

- Bad social connector (red label): 0-12 points
- Average social connector (purple label): 12-23 points
- Good social connector (green label): 23-35 points

Finally, management proposals are exposed by the observer about connector improvements in ecological and social uses, its management, infrastructures needed as well as wildlife and flora management.

Another field card is done in previous field work: a survey for population of near urban areas and tourism (*Annex.4. Card 2*). This field card makes different kind of questions related with the social uses of the area, the ecological conservation state, the possibility of selling local products from farmers in the area and to know some improvement proposals from the respondents.



### 3.2. Field work and data collection

Field work is based on three weeks of transects following a previous Rete ZUB network designed (*Annex.6. Previous map Rete ZUB connection*). The schedule is shown in *Annex.5. Timeline, supervisors and budget*.

During the days of field work, evaluating the socio-ecological status of each transect, the existing and potential new wetlands, the critical and interest points in the area with ecological and social features are also evaluated. Every afternoon is defined to do office work with the creation of the interactive map and the classification of the data in a data base and all the photos of each transect and wetland.

The criteria to define possible areas for potential new wetlands are the nearby of towns and villages in flooded areas and the slope ("Acquereflue," n.d.). It is also related with outstanding municipalities holding three historical castles of Peschiera Borromeo, Corneliano Bertario and Cassano d'Adda.

The field work is based on Oruxmaps, an app for mobile phones and tablets, which is based on GPS signal where transects are recorded. In each interest and critical point is recorded a point with a photo called *waypoint*, which is an essential part of the final project to be identified in an interactive map.

Finally, each transect has a different kind of management proposals depending on the final score of socio-ecological characteristics.

### 3.3. Building up the interactive map

The interactive map is built up by GIS software of QGIS. Different layers are created with some photos opening by a link in Google Drive account, their classification is shown below:

- **Connectors** (line layer)
  - Code (related with photos linked)
  - Social score
  - Ecological/environmental score
  - Comments (related with management advice)
  - Length
- **Interest point** (point layer)
  - Code (related with photos linked)
  - Description (define different labels)
    - Cultural interest

- Farm
  - Point of high ecological value
  - Points for public use
- **Critical point** (point layer)
  - Code (related with photos linked)
  - Description (define different labels)
    - Ecological obstacle
    - Obstacle for public use
    - Rubbish
- **Potential node** (polygon layer)
  - Code
  - Name
  - Existing (in previous field work it was defined some potential areas of wetland)
  - Checked (observer checks them)
  - Comments (description and management advice)
  - Area

In this layer there are different labels classified:

- Artificial lake / Gravel pit (related with industrial extraction of gravel)
- Fontanile
- Potential new wetland

Other layers are used to define the final map (Geoportale della Lombardia, n.d.):

- *Rilevanze\_Rete\_irrigua*: it is related with a layer of irrigation canal.
- *Rilevanze\_Fontanili\_attivi*: it is related with the most important *fontanile* in the region.
- *Rete\_ZUB\_Conessioni*: previous connector which was created before field work.
- *Fontanili\_della\_Lombardia*: it is related with all *fontanile* in the region of Lombardia.
- *Rete\_ZUB\_Node*: layer of nodes based on existing wetland which is used to connect Rete ZUB network.
- *Dati\_statistici\_popolazione*: information about municipalities.

These layers are mixed and composed in different ways to create different kinds of maps with socio-ecological values of connectors between existing wetlands, with potential nodes defined. In addition, interest and critical points are exposed to achieve a complete map.

## **4. Results**

The identification of socio-ecological connection in Rete ZUB to create an interactive map is based on ecological and social connectors between existing wetlands and potential new ones, with interest and critical points exposed in the following sections. Finally, management advice is exposed to benefit the preservation of Rete ZUB.

The data base of each connector is shown in *Annex.7. Data base*.

### **4.1. Ecological connection**

The enlarged images in Figure 6 show in a better resolution the different ecological values of connectors between the important wetlands, with the potential nodes included in the artificial lake, the same as the gravel pit, the *fontanile* and the potential new wetlands.

An important result is the division of the ecological and social connector near Isola Borromeo wetland in Cassano d'Adda because the best option for ecological characteristics is going through next to Adda River.

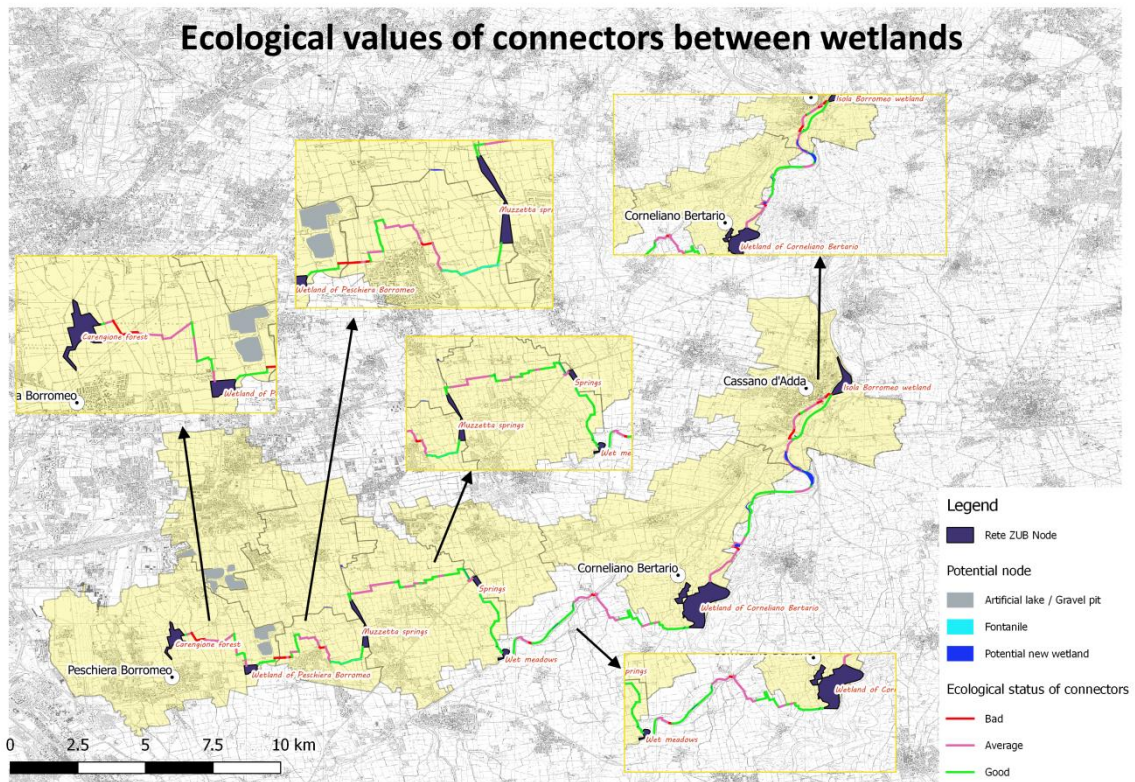


Figure 6 Ecological values of connectors between wetlands

The different kind of ecological connectors are shown in (Figure 7):

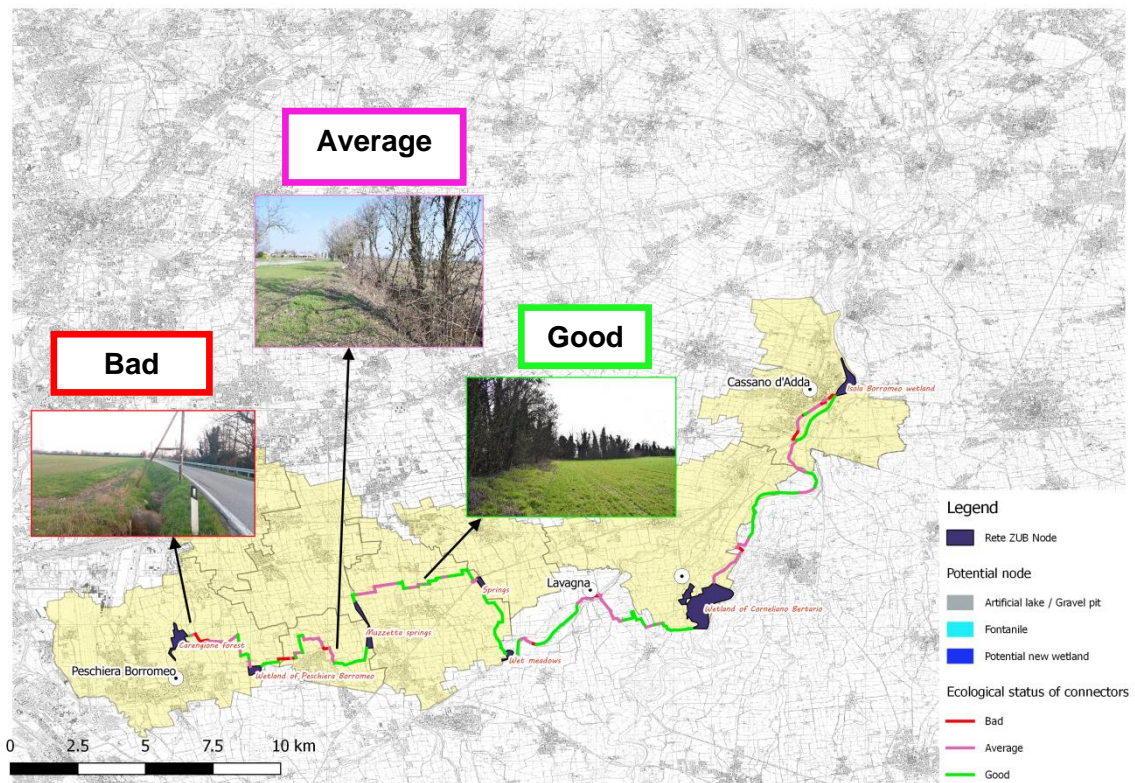


Figure 7 Examples of ecological connectors

The good ecological connector is defined with the code [SM S.14](#), the average ecological connector with the code [AM SM.23](#) and the bad ecological connector with the code [BC AM.3](#) (see *Annex.7. Data base* and *Annex.11. Layers of interactive map*)

Some problems related with ecological features are:

- [Code AM SM.12](#): invasive species of reed (*Arundo donax*) in the irrigation canal.
- [Code AM SM.13](#), [BC AM.14](#), [BC AM.17](#): it needs an implementable step of wildlife and drainage of the soil to continue the irrigation canal.
- [Code L C.3](#): there is a concrete wall that increases the velocity of water.
- [Code L C.5](#), [S W.4](#): there is a bridge in this connector that increases the velocity of water with a concrete wall, and it also impoverishes the ecological value of the connector.
- [Code L C.13](#), [SM S.11](#): it needs to implement an irrigation canal with a good ecological connector. This place is really necessary to improve the connectivity to join the Rete ZUB.
- [Code SM S.5](#): an artificial stop of the connector that needs to create an irrigation canal.
- [Code SM S.22](#): a step of wildlife full of invasive vegetation.
- [Code W L.6](#): there is no step of wildlife, as there is an obstacle (a highway bridge) with little invasive vegetation.
- [Code W L.14](#): there is not an irrigation canal with an important amount of invasive vegetation, near an affluent of Adda River.
- [Code W L.16](#): an important bridge to connect the public use between the village of Lavagna and the connection to the wetland of Corneliano Bertario.

## 4.2. Social connection

The enlarged images in Figure 8 show in a better resolution the different social values of connectors between the important wetlands, with the potential node included.



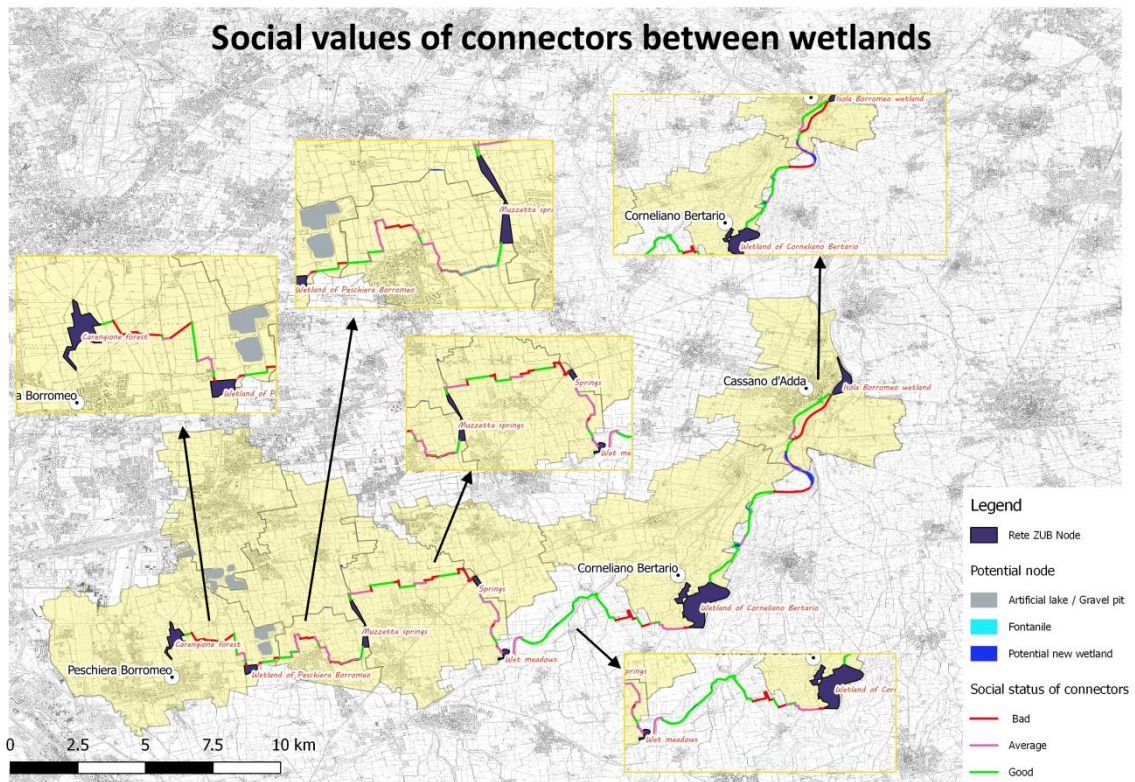


Figure 8 Social values of connectors between wetlands

The different kind of social connectors are shown in (Figure 9):

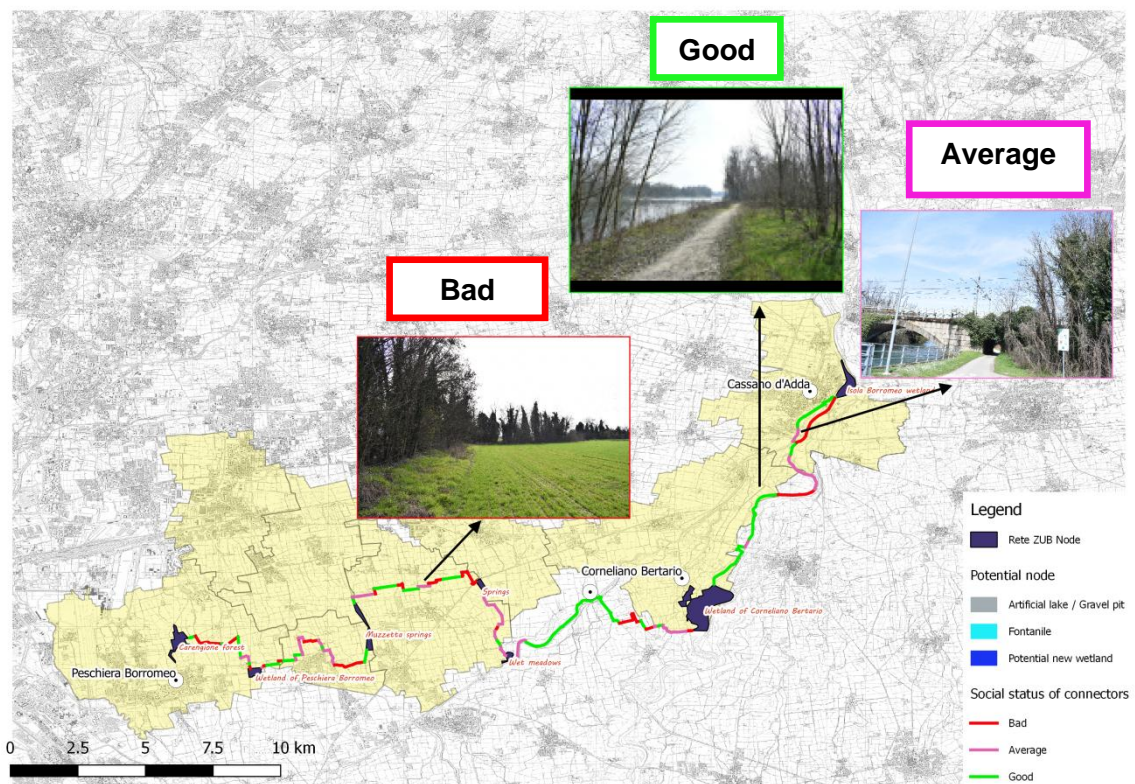


Figure 9 Examples of social connectors

The good social connector is defined with the code [C C.5](#), the average social connector with the code [C C.17](#) and the bad social connector example with the code [SM S.13](#) (see *Annex.7. Data base* and *Annex.11. Layers of interactive map*).

Sportive activities such as walking, running, riding a bike or riding a horse can be frequent. The distance measure between each important node of Rete ZUB is shown in Table 2.

Transect	Distance (km)
Carengione forest to the wetland of Peschiera Borromeo	3,7
The wetland of Peschiera Borromeo to Muzzetta springs	6,3
Muzzetta springs to springs	6,3
Springs to wet meadows	3,1
Wet meadows to Lavagna	4,9
Lavagna to the wetland of Corneliano Bertario	5,0
The wetland of Corneliano Bertario to Isola Borromeo wetland	11,8
<b>Total</b>	<b>41,1</b>

Table 2 Distances of different transects

### 4.3. Points of interest

Table 3 shows the most important social and ecological interest point of Rete ZUB:

- **Ecological interest point:**
  - Point of high ecological value: related with potential connectors to evaluate in the following 5 to 10 years and an example of good environmental and preservation connector with a good social use.
- **Social interest point:**
  - Cultural interest: related with historical bridges for irrigation canals or for people to cross them, an example of step of water, different important castles of the Rete ZUB, historical churches and a hermitage.
  - Farm
  - Points for public use: example of social use related to rest areas, examples of social, environmental, legislation and sanctions signals, and an example of phytoremediation process in a private property.

Code	Classification	Comments
<a href="#">IP_1</a>	Point of high ecological value	Potential connector to evaluate in a 5-10 years
<a href="#">IP_2</a>	Point of high ecological value	Good environmental connector with a public path
<a href="#">IP_3</a>	Cultural interest	Bridge of an irrigation canal. An example of good conservation

<a href="#">IP_4</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_7</a>	Cultural interest	Historical bridge in an irrigation canal
<a href="#">IP_9</a>	Cultural interest	Castello Borromeo. Important cultural interest point
<a href="#">IP_10</a>	Cultural interest	Example of a step of water in an irrigation canal near Muzzetta springs
<a href="#">IP_11</a>	Cultural interest	Cascina Castello
<a href="#">IP_13</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
IP_19	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_24</a>	Cultural interest	Cascina Rossate with a historical church
<a href="#">IP_26</a>	Points for public use	Example of social use. Picnic area without barbecues
<a href="#">IP_29</a>	Points for public use	Social signal. An example of public use signal
IP_30	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_31</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_33</a>	Points for public use	An important signal about legislation and sanctions
<a href="#">IP_34</a>	Points for public use	An example of an environmental signal
<a href="#">IP_36</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_37</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_40</a>	Cultural interest	An important cultural and historical religious point
<a href="#">IP_41</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_43</a>	Farm	A farm is an important cultural and interest point of Rete ZUB
<a href="#">IP_44</a>	Cultural interest	Church of Cassano d'Adda
<a href="#">IP_45</a>	Cultural interest	Villa Maggi Ponti. A "rural hotel" and restaurant next to a cultural castle wall
<a href="#">IP_46</a>	Cultural interest	Hermitage. It needs to be open for public use. Near Isola Borromeo wetland
<a href="#">IP_47</a>	Cultural interest	Castello Visconteo. An important cultural interest point of 12 <sup>th</sup> century
<a href="#">IP_50</a>	Cultural interest	Antico Mulino. A cultural interest point about the history of the landscape. Nowadays, it is being reformed for ecological tourism uses
<a href="#">IP_56</a>	Cultural interest	Castello Borromeo in Corneliano Bertario
<a href="#">IP_57</a>	Cultural interest	Church of Corneliano Bertario
<a href="#">IP_59</a>	Points for public use	Example of little phytoremediation process

Table 3 Points of ecological and social interest in Rete ZUB

The ecological and social values of connectors between wetlands in Rete ZUB with interest points are shown in Figure 10 and Figure 11:



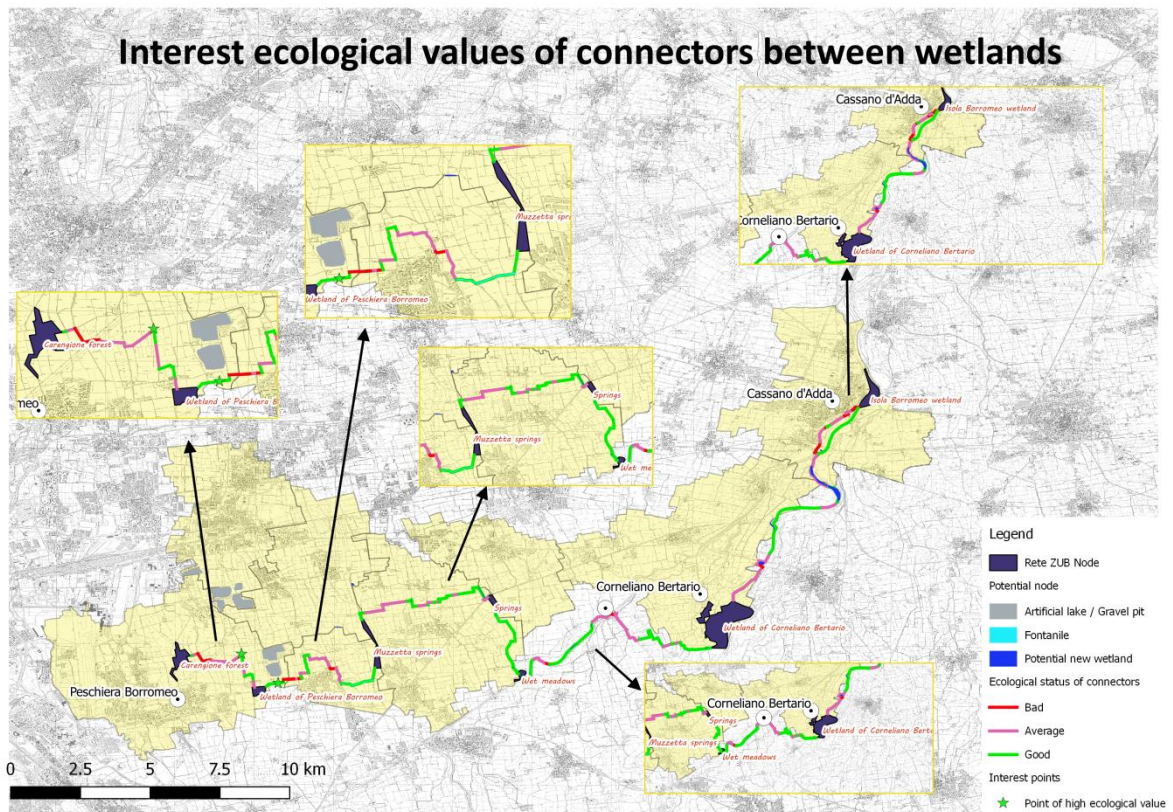


Figure 10 Ecological values of connectors between wetlands with ecological interest points

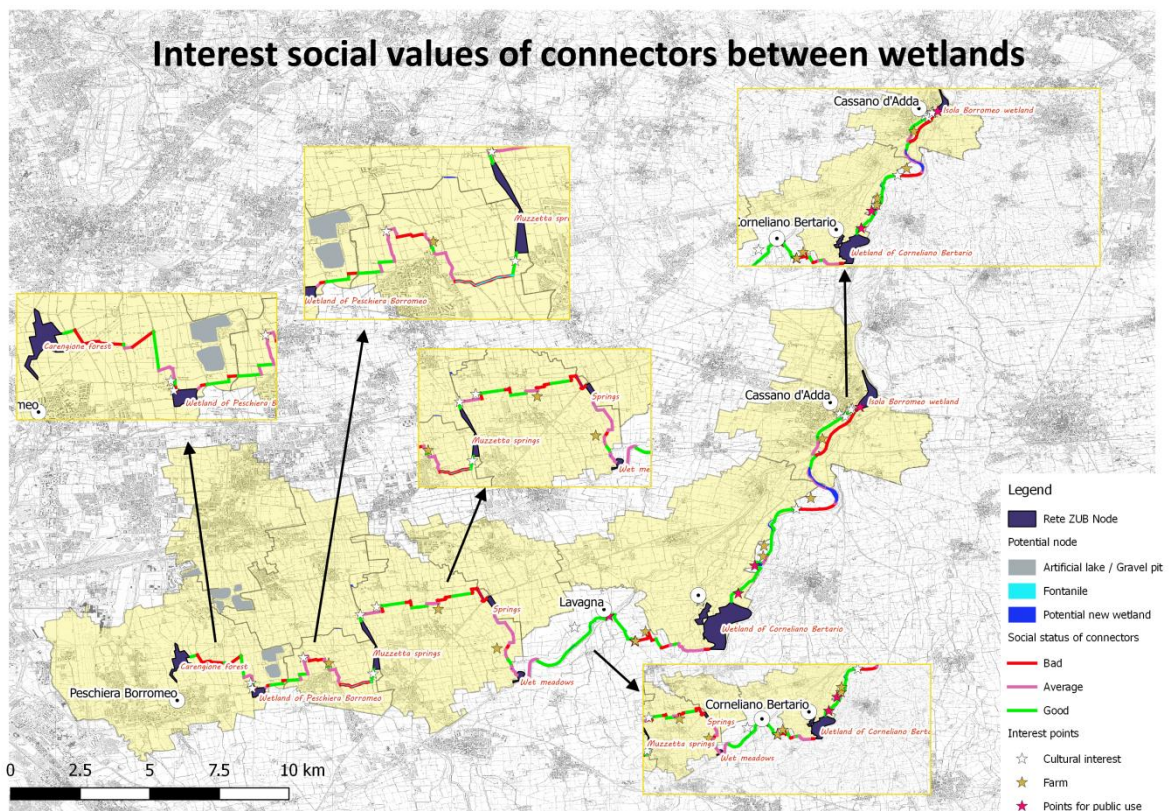


Figure 11 Social values of connectors between wetlands with social interest points

*Sorgenti della Muzzetta* access is closed to the public to improve the natural preservation status.

#### 4.4. Critical points

In Table 4 shows the most important social and ecological critical points of Rete ZUB:

- **Ecological critical point:**
  - Ecological obstacle: related to the step of wildlife closed by an artificial object: electrical towers that can harm birds, industrial areas, railroads and highways cause disruption in the landscape and to the wildlife. Also, an artificial construction for a step of water without step of fishes.
  - Rubbish: the presence of rubbish causes a disruption in wildlife, flora and landscape.
- **Social interest point:**
  - Obstacle for public use: related to the presence of a road, difficult to cross for the people and also to maintain the ecological connector. In different connectors near Cassano d’Adda there is no bridge to connect the social use. Finally, bars and barbecues without control can cause a disruption area with a high presence of rubbish.
  - Rubbish: the presence of rubbish can cause a visual and esthetical impact to the people.

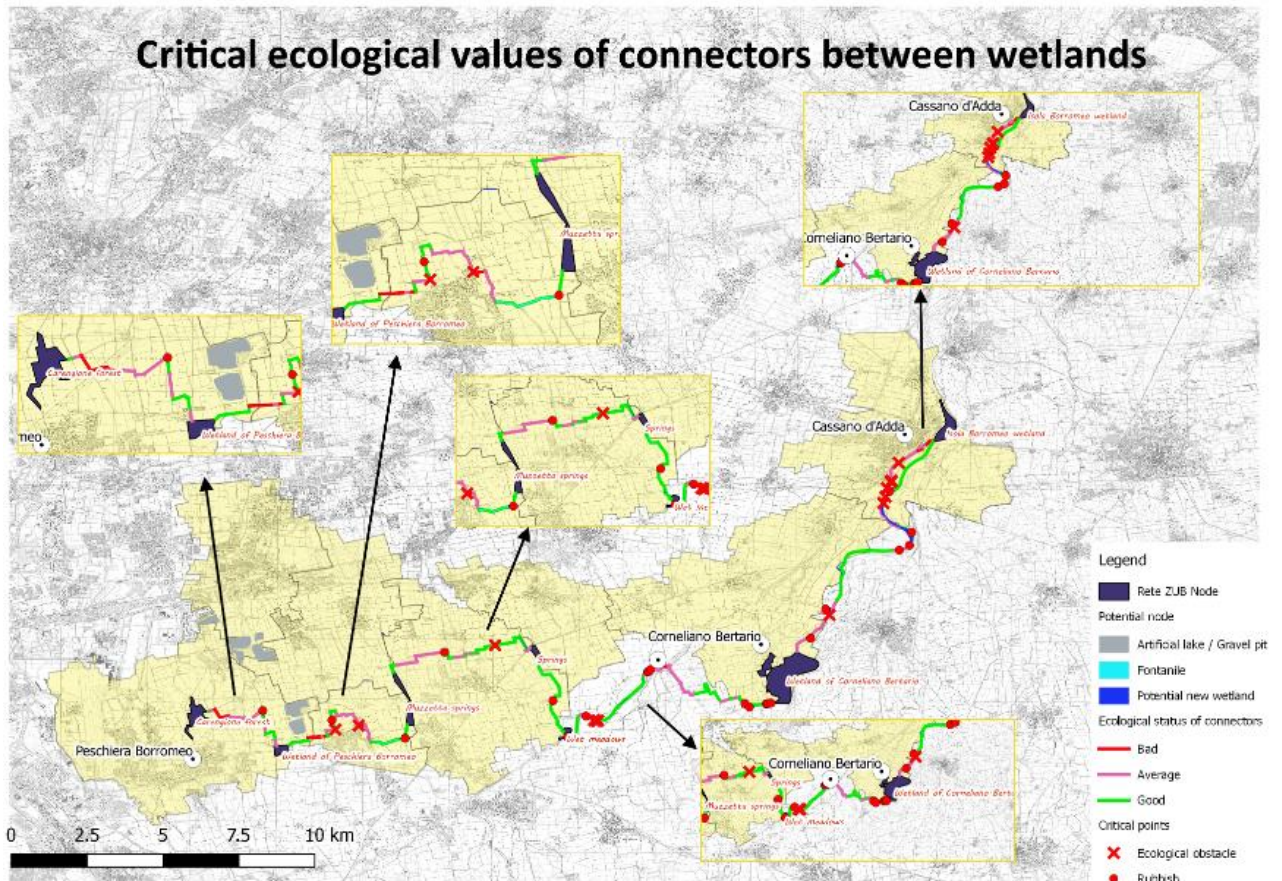
Code	Classification	Description
<a href="#">CPT_1</a>	Obstacle for public use	Presence of a road. There is an ecological step, but not a social one. People need to cross the road to go to the Carengione forest.
<a href="#">CPT_2</a>	Rubbish	A lot of rubbish next to the social path.
<a href="#">CPT_3</a>	Obstacle for public use	Presence of a road. The irrigation canal is stopped before.
<a href="#">CPT_4</a>	Ecological obstacle	Step of wildlife closed by an artificial object.
<a href="#">CPT_5</a>	Rubbish	Some rubbish in the irrigation canal.
<a href="#">CPT_6</a>	Obstacle for public use	Presence of a road. Difficult to connect environmental connector. It needs a step of wildlife.
<a href="#">CPT_7</a>	Ecological obstacle	A step of wildlife closed means a cut connector.
CPT_12	Rubbish	Need cleaning.
<a href="#">CPT_14</a>	Rubbish	Rubbish next to the road from Premenugo to Settala.
<a href="#">CPT_16</a>	Ecological obstacle	An electrical tower that can harm birds and disrupt the landscape.
<a href="#">CPT_17</a>	Obstacle for public use	An important road that cuts the ecological and social connector.
<a href="#">CPT_20</a>	Rubbish	Rubbish from the farm near the connector.
<a href="#">CPT_21</a>	Rubbish	An abandoned house near the node and the



		river.
<a href="#">CPT 22</a>	Obstacle for public use	There is no social path for public use. It needs a simple bridge.
<a href="#">CPT 23</a>	Rubbish	A lot of rubbish next to the path. It needs cleaning.
<a href="#">CPT 24</a>	Ecological obstacle	An electrical tower that can harm birds and disrupt the landscape.
<a href="#">CPT 25</a>	Ecological obstacle	Presence of a highway bridge.
<a href="#">CPT 27</a>	Ecological obstacle	An electrical tower that can harm birds and disrupt the landscape.
<a href="#">CPT 29</a>	Rubbish	No comments.
<a href="#">CPT 30</a>	Rubbish	No comments.
<a href="#">CPT 31</a>	Rubbish	Presence of a reed. The invasive vegetation needs cleaning.
<a href="#">CPT 36</a>	Obstacle for public use	Road from Comazzo to Corneliano Bertario
<a href="#">CPT 37</a>	Rubbish	A tyre in the irrigation canal
<a href="#">CPT 38</a>	Rubbish	No comments.
<a href="#">CPT 39</a>	Rubbish	No comments.
<a href="#">CPT 40</a>	Rubbish	No comments.
<a href="#">CPT 41</a>	Rubbish	No comments.
<a href="#">CPT 42</a>	Rubbish	Ashes from some barbecues. More restrictions are needed on some barbecues and picnic areas.
<a href="#">CPT 43</a>	Ecological obstacle	Stop the ecological connection. It is an artificial building.
<a href="#">CPT 44</a>	Rubbish	No comments.
<a href="#">CPT 46</a>	Obstacle for public use	There is no bridge. A bridge is needed to connect social uses.
<a href="#">CPT 47</a>	Rubbish	No comments.
<a href="#">CPT 48</a>	Rubbish	No comments.
<a href="#">CPT 49</a>	Rubbish	No comments.
<a href="#">CPT 51</a>	Ecological obstacle	Rail road and highway presence. There is a step of wildlife and step for social use.
<a href="#">CPT 52</a>	Ecological obstacle	There is an important industrial area near Rete ZUB and an electrical tower.
<a href="#">CPT 53</a>	Rubbish	Presence of gravel
<a href="#">CPT 54</a>	Obstacle for public use	No bridge. A bridge is needed to connect social uses and stops ecological connector. I decided to connect social uses until Isola Borromeo wetland and ecological connectors next to Adda River.
<a href="#">CPT 55</a>	Obstacle for public use	Road and forbidden step
<a href="#">CPT 56</a>	Ecological obstacle	Artificial step of water. Step for fishes is needed.
<a href="#">CPT 57</a>	Ecological obstacle	Railroad
<a href="#">CPT 58</a>	Ecological obstacle	Bridge for a highway in construction.
<a href="#">CPT 59</a>	Ecological obstacle	Bridge that needs a step for fishes. It stops ecological connector.
<a href="#">CPT 60</a>	Obstacle for public use	An artificial prey to save the overflow of the river.
<a href="#">CPT 61</a>	Obstacle for public use	Bar and barbecues. It might be located in a flooded area. It needs more maintenance to avoid the rubbish created by the people.

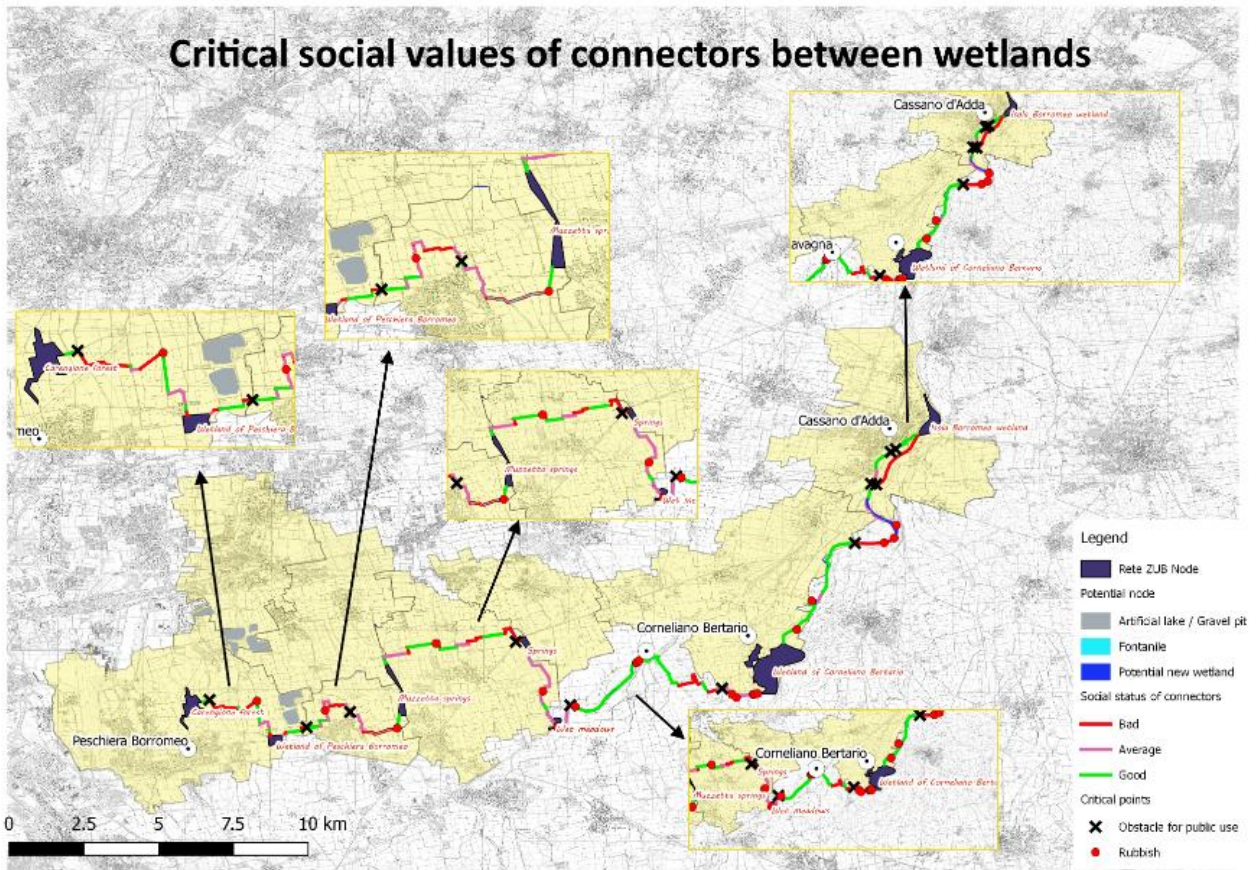
**Table 4 Critical points with their code, classification and description**

The ecological and social values of connectors between wetlands in Rete ZUB with critical points are shown in Figure 12 and Figure 13:



**Figure 12 Critical ecological values of connectors between wetlands in Rete ZUB**





**Figure 13 Critical social values of connectors between wetlands in Rete ZUB**

Ecological and social connectors are divided in CPT\_54 (see Table 4 and Figure 14) where the public use goes next to the Adda River affluent until Isola Borromeo wetland, whereas the ecological connector goes next to the Adda River until its wetland. However, when the last connectors arrive in the urban area of Cassano d'Adda, walkers can go next to the Adda River until Isola Borromeo wetland, and cyclists can go inside Cassano d'Adda town until its wetland.



Figure 14 Image of critical point with the code CPT\_54

#### 4.5. Potential new wetlands

Potential new wetlands are classified with their area in artificial lake, which is a kind of gravel pit for industrial uses, in *fontanile* in some connectors and in potential new wetlands, areas of some existing wetlands and others with a high potential to become a new one. In Table 5 and Figure 15 are shown them:

Code	Class	Area (m <sup>2</sup> )	Existing	Description
<u>1</u>	Artificial lake / Gravel pit	253.071,71	Yes	Industrial lake to extract minerals
<u>2</u>	Artificial lake / Gravel pit	102.056,38	Yes	Industrial lake to extract minerals
3	Artificial lake / Gravel pit	67.025,96	Yes	Industrial lake to extract minerals
4	Artificial lake / Gravel pit	265.665,22	Yes	Industrial lake to extract minerals
<u>5</u>	Artificial lake / Gravel pit	119.003,72	Yes	Lago di Malaspina, an artificial lake in an urban area of San Bovio, near Milano.
<u>6</u>	Artificial lake / Gravel pit	213.463,70	Yes	Industrial lake to extract minerals
<u>7</u>	Potential new wetland	5.585,53	Yes	-
<u>8</u>	Potential new wetland	1.084, 29	Yes	Near connector SM_S.6 and SM_S.7
<u>9</u>	Potential new wetland	9.080,29	Yes	Near connector SM_S.21

<a href="#">10</a>	Potential new wetland	331,55	Yes	Near connector S_W.1
11	Potential new wetland	3.322,40	Yes	Potential node near to C_C.17 connector
<a href="#">12</a>	Potential new wetland	5.822,11	Yes	<i>Sorgenti della Muzzeta</i>
<a href="#">13</a>	Fontanile	31.006,24	Yes	Important to be considered as a potential node.
<a href="#">14</a>	Potential new wetland	89.310, 95	No	Potential node next to Adda River
<a href="#">15</a>	Potential new wetland	32.385,82	No	A potential node in some years, to be evaluated
<a href="#">16</a>	Potential new wetland	33.423,58	No	A potential node in some years, to be evaluated
<a href="#">17</a>	Fontanile	4.299,78	Yes	A potential node in some years, to be evaluated
<a href="#">18</a>	Potential new wetland	626,85	No	A tree plantation considered as a potential node.
<a href="#">19</a>	Potential new wetland	435,04	Yes	A potential node near connector S_W.9
<a href="#">20</a>	Potential new wetland	1.402,80	No	A potential node makes for a little meander in the irrigation canal next to S_W.11 connector
<a href="#">21</a>	Potential new wetland	6.144,32	No	A potential node to be considered
<a href="#">22</a>	Potential new wetland	2.690,51	No	A potential node in the future next to W_L.13 connector
<a href="#">23</a>	Potential new wetland	2.157,54	Yes	A potential node near Carengione forest
<a href="#">24</a>	Potential new wetland	19.717,67	Yes	A potential node near C_C.3 connector
<a href="#">25</a>	Potential new wetland	18.182,27	Yes	A potential important node near Adda River, near C_C.5 connector

Table 5 Potential nodes code, classification, area and description.



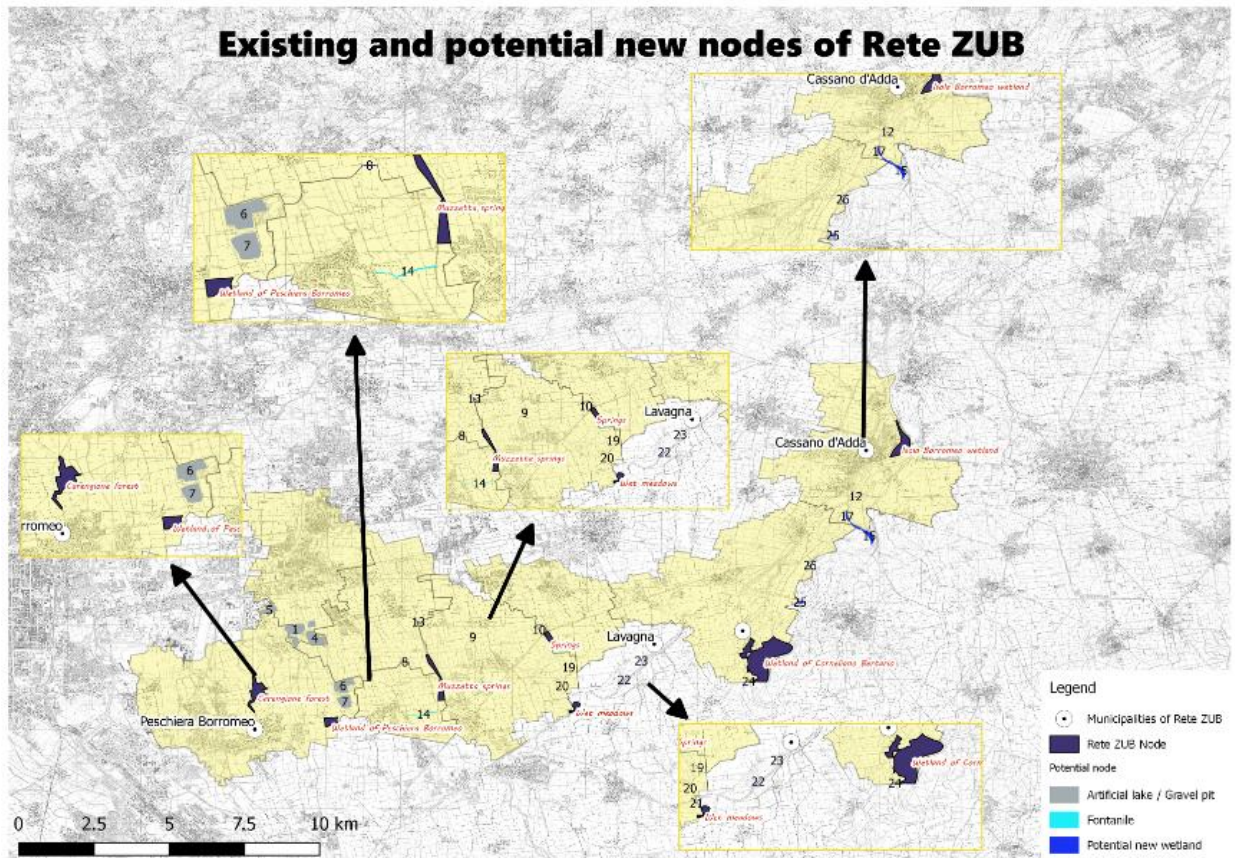


Figure 15 Potential and Rete ZUB nodes

## 5. Discussion of results

Three examples of ecological and social connectors are chosen to improve Rete ZUB and understand the three labels of classification: good, average and bad.

- Good ecological connector (SM S.14): a great amount of autochthonous vegetation with trees, shrub and herbaceous with correct ratio related to 20% of herbaceous, 30% of shrub, and 50% of trees vegetation. The water turbidity is low, but it is important not to confuse with *fontanile* (potential node).
- Good social connector (C C.5): a correct track for walkers and bicycles without a pass for motorized vehicles between a natural place close to an irrigation canal, affluent of the Adda River or the Adda River.
- Average ecological connector (AM SM.23): the ratio of vegetation is less than the one of the good ecological connector. The water turbidity is high or without step of water.
- Average social connector (C C.17): the features are similar to the good social connector but with more obstacles and artificial buildings close to the connector.



- Bad ecological connector (BC AM.3): a connector without trees, with some obstacles. The water turbidity is high or there is no water to evaluate it. This kind of connector can be near roads, bridges, highways and railroads with an important natural impact.
- Bad social connector (SM S.13): a connector without a track or road that nobody can cross because it is a private property.

Some important bridges that connect different urban areas by a secondary road are shown in code W L.16 (bridge that connects Lavagna to Comazzo) and code C C.25 (bridge that connects Corneliano Bertario to Cassano d'Adda). These two bridges are not complemented with management cards because it is very difficult to improve their ecological and social use.

The same case as in the field card (*Annex.3. Card 1*) for ecological and social connector status, if the results are: *acceptable, good or very good, you can accept the ecological or social connector; regular, you have to give a critical evaluation to accept them and bad, you cannot accept the ecological or social connector.*

The distance between Rete ZUB nodes (Table 2) are important to implant rest areas, shown in Figure 16:

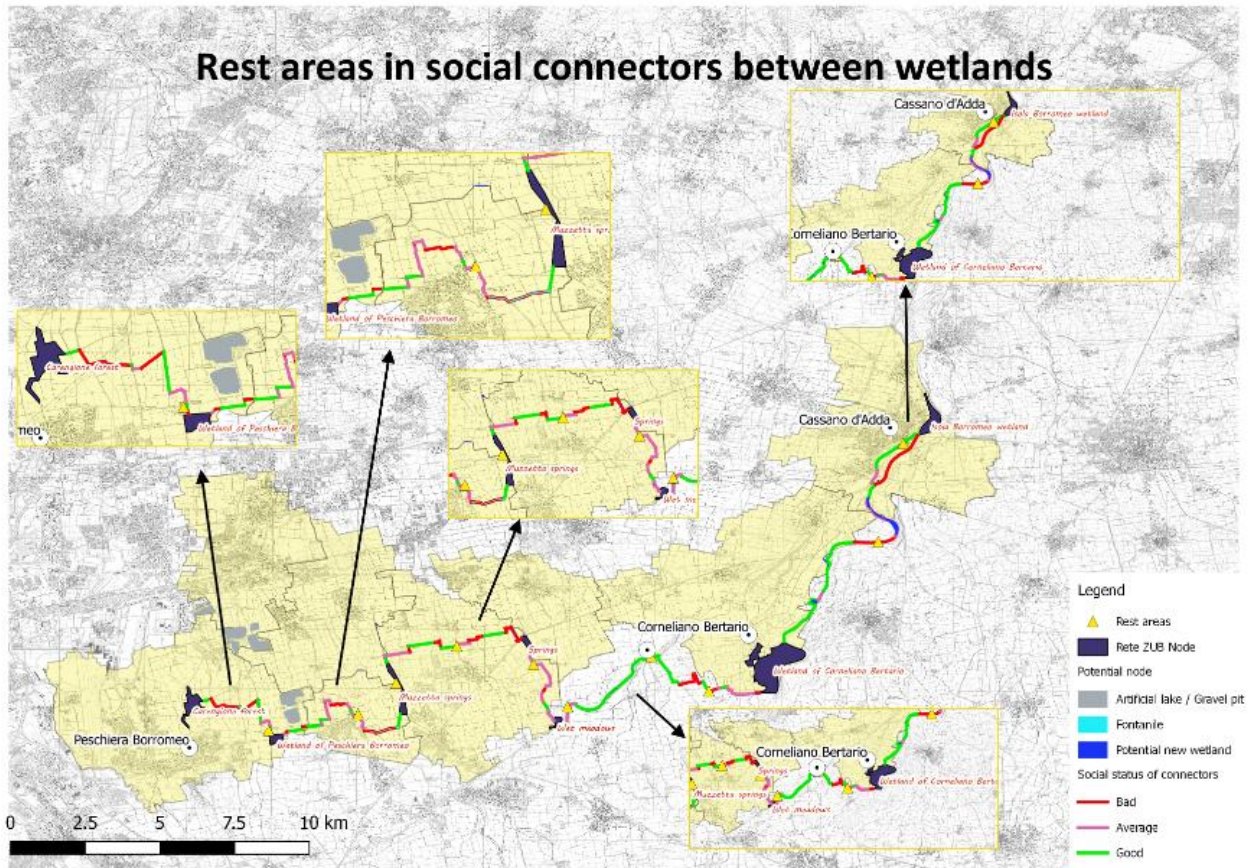


Figure 16 Rest areas in Rete ZUB

The rest areas are important to concentrate people in some places near urban areas and social paths to diffuse them from a high ecological interest point. An example of them is shown in Figure 17.



Figure 17 Image of a rest area example with the code IP\_26

On the other hand, different activities can be carried out in the area related to social uses of Rete ZUB:

- Sportive activities such as walking, running and cycling.
- Natural routes for learning ecological interests of the area related to wildlife and vegetation.
- Historical routes to identify and learn the history of the three castles and the territory.
- Agricultural activities for tourists to learn agricultural values and taste ecological products of the area.

The Eurosite Toolkit for the management of natural areas provides a flexible framework plan to take care of private states management. The basic standards that have to be followed to create a management plan for a private state are three: preliminary evaluation, description of the land, evolution.

A better management plan consists in volunteer performances to achieve our aims, specially focused on psychical disabilities, mainly replanting autochthonous vegetation to preserve the ecosystem. In addition, in temporary or permanent flooded areas, some footpaths can be built to make the step of people more comfortable. Some bird watching cabins can be built to attract ornithologist tourism, a kind of ecotourism.

Another important aspect is land stewardships agreement to achieve more areas of territory with protective ideas written up with contracts. It will be essential to create a landmark to boost the territory with a high level of environmental preservation.

Considering the results of the field work and as wetland maintenance is concerned, there can be an agreement with a social cooperative that is responsible for seeking jobs for disabled or socially problematic people. They check on the humid zone once or twice a week. They would be on the humid zone once or twice a week to check the water level, clear the paths, clean the invasive vegetation and rubbish, and make sure the canal is not blocked. Nowadays, *Alboran social cooperative* performs this kind of activities.

Each connector is associated with generic management cards that are exposed in Annex.8. They are related to some frequent ecological and social problems in Rete ZUB. The management team could choose them to solve the connection between the wetlands. The relation between each code of transects and its number of management card is shown in *Annex.10. Relation of connectors with management cards.*

Another important aspect is the management of existing and new potential wetlands with the following features:

- Botanic management:

Three times a year the grass will be cut manually on the sides of the wetland.

- Water and infrastructure management:

The water level regulation in the wetland should be done by using manual bulkheads upstream and downstream the natural flow of the incoming water, both during the summer period (April - September) and winter period (October - March). The rainwater flow will constantly be checked and eventually the exceeding water disposal will be managed. Therefore, the whole year regular inspections will be arranged to regulate water levels and check embankments stability.

Water enters through a lead situated in the top of the wetland and exits through another lead in the opposite side. The management team of Rete ZUB will be able to change the size of the lead in order to get out more or less water. For this reason the ideal way is two different situations: when water is fixed and when water is circulating. In summer it often circulates just once a week.

Another aspect is the water level in wetlands whose deepest part is 2 meters and the lowest is just 5 centimeters. The existence of two different environments in the same place is allowed so that they can provide the conditions for a vast diversity of species.

- Educational research projects

Water mill project aims to become a replicable benchmark and virtuous example for local communities and attract specifically students of both primary schools and universities to build their future in agricultural and environmental sectors.

- Eco-tourism

Management advice is the key to improve Rete ZUB connection, also creating a potential new tourism in the region for its high preservation value.

Finally, some particular aspects are identified to establish informative panels in Rete ZUB (see *Annex.9. Design of informative panel*).

## **6. Conclusions**

The identification of socio-ecological connectors in Rete ZUB is based on its ecological and social importance in a high urban region in Italy, increasing its biodiversity and landscape with management cards whose finality is performing new environmental and social projects. The area of the project is located in private properties with agricultural uses and a few wetlands.

Climate change causes several damages in Mediterranean regions, especially in Lombardy, during excessive rainfalls. The discharge of water in towns causes a real problem difficult to solve. The interest of existing and new wetlands in the region plays an important role to mitigate these effects. After the rainfalls, potential wetlands should clean the water up in some days throwing it away through the irrigation canals for agricultural and farming uses. It is a solution to flooding problems in the region to avoid damages for the society that it will provide a new potential urban wastewater treatment. Accordingly, historical heritages characterizing the landscape with Middle Age castles in Peschiera Borromeo, Corneliano Bertario and Cassano d'Adda will be essential to achieve the landmark of the territory. In addition, new potential wetland areas are found complementing the present network. Another type of potential wetlands are gravel pit lakes for industrial uses. Nowadays, they are exploited restoring a lot of water. If this activity is stopped, they will become an environmental way to purify water and store it.

The definitive implantation of the project will be the use of the land to connect ecological, historical and social features with the aim of achieving better preservation and proper use for nearby inhabitants and tourists. Possible creation of new work places in restaurants, museums and bed and breakfasts from rural hotels will improve the economic sustainability in the area. Public institutions should promote educational activities to achieve a better use of the area.

The social vision will be the solution to keep and improve the project, achieving cultural and natural high values of all the connections to improve their heritage richness.

Private properties and public institutions should do divulgation and educational tasks to enhance the region and Rete ZUB.

Finally, this project in Mediterranean regions will be considered a pioneering initiative, as a sink for the effects of drought and excessive rainfall water aggravated by climate change, reducing the flow from waste water treatment plants and its associated damages.

Nature and humans could live together if humans would respect the natural order(Stone, 2014).

## **7. Acknowledgments**

I thank the support of the supervisors (*Annex.5. Timeline, supervisors and budget*) for the previous work, specially to search funding from CAP Holding, for the assistance in the staying in Italy, for the improvement of the project and for providing a perfect structure and organization on the final report.

Finally, funding for the project was provided halfway by *Antico Mulino ltd* and the student.

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## **Annexes**

## **Annex.1. Wildlife and flora species in Rete ZUB**

### **Wildlife biodiversity**

#### Insects:

- *Calopteryx splendens*
- *Libellula depressa*
- *Anax imperator*

#### Amphibians:

- *Rana sync. Esculenta* (green frog)
- *Rana latastei* (Lataste frog)
- *Bufo viridis* (common toad)

#### Reptiles:

- *Natrice dal collare*
- *Hierophis viridiflavus*

#### Mammals:

- *Talpa europaeus* (European mole)
- *Erinaceus europaeus*
- *Pipistrellus pipistrellus*
- *Ratus feliceus* (spiny ceram rat)
- *Myocastor coypus* (nutria)
- *Lepus europaeus* (hare)
- *Vulpes vulpes* (red fox)
- *Dama dama* (deer)

#### Birds

- *Podiceps cristatus* (aquatic specie)
- *Ardea cinerea*
- *Nycticorax nycticorax*
- *Anas platyrhynchos*
- *Vanellus vanellus*
- *Gallinula chloropus*
- *Fulica atra*
- *Streptopelia decaocto*
- *Buteo buteo*
- *Falco tinnunculus*
- *Strix aluco*
- *Athene noctua*
- *Phasianus colchicus*
- *Alcedo atthis*
- *Picus viridis*
- *Dendrocopos major*
- *Alauda arvensis*
- *Hirundo rustica*
- *Delichon urbica*
- *Lanius collurio*
- *Pica pica*
- *Sturnus vulgaris*
- *Carduelis carduelis*
- *Passer domesticus italiae* (typical in Italy of *Passer domesticus* specie)

**Flora biodiversity:**

- *Juglans regia*
- *Quercus robur*
- *Cornus sanguine*
- *Alnus glutinosa*
- *Corylus avellana*
- *Acer campestre*
- *Euonymus europaeus*
- *Salix alba*
- *Convallaria majalis*
- *Sambucus nigra*
- *Scilla bifolia*
- *Crataegus monogyna*
- *Anemone nemorosa*
- *Fraxinus ornus*
- *Urtica dioica*
- *Parietaria officinalis*
- *Rubus ulmifolius*
- *Rosa canina*

## Annex.2. Socio-ecological connectors

Node	Connector	Irrigation canal (number of irrigation canals between nodes)	Location	Interest point (fontaine)
Carengione forest and Antico Mulino	Carengione forest to Antico Mulino	Three (historical and landscape value)	Peschiera- Borromeo and Pioltello	-Mirazzano fontaine (natural and landscape value) -Ceriano fontaine -Ponti or Folli I -Gambarone (San Bovio) (natural and landscape value) -Pestazzo (nord di c.na Pestazza) -Testa Vecchia fontaine -Gambarone fontaine -Borsani fontaine
Antico Mulino and Muzzeta springs	Antico Mulino to Muzzeta springs	Seven (historical and landscape values)	Peschiera- Borromeo (east), Rodano (north),Pantigliate (center)	-Testone di Vaianello -Fontana Alta or Fontanone -Malspina or dei Campi -Mombretto or Monzese -Roverbella I -Cassigne'i -Palazzolo -Fontana Marcia I -Fontana nuova II

				<ul style="list-style-type: none"> <li>-Roverbella or Vicorbella</li> <li>-Dell'esse or Della Ferrovia</li> <li>-Fontanile Busca I</li> <li>-Crosina</li> <li>-Schienone</li> <li>-Pantigliate fontanie (natural and landscape value) related with Crosina</li> <li>-Settala fontaine (natural and landscape value) related with Shienone</li> </ul>
Muzzeta springs and springs	Muzzeta springs to springs	Nine (historical and landscape values)	Settala (south), Rodano (north-west), Vignate (north), Liscate (est)	<ul style="list-style-type: none"> <li>-Sorgenti della Muzzetta (Sud Est di Lucino)-(natural and landscape value)</li> <li>-Boscana (ovest di c.na Castello) - (natural and landscape value)</li> <li>-Calandrone (Nord Est di c.na Brazzuto) – (natural and landscape value)</li> <li>- Sud di Liscate (natural and landscape value)</li> <li>- Bocca d'Oro (Vignate) - (natural and landscape value)</li> <li>-Gardina (Liscate)- (natural and</li> </ul>

				landscape value) (not pass of the path) -Castellazo (Liscate) -(natural and landscape value) (not pass of the path) -Vedano (Vignate)- (natural and landscape value) -Boscana I -Gaitina or Gaitino or Ganitina -Dell'oca -Calandrone or Cerca II -Catanino or Castanino -Bisolo II -Sorgenti Si San Pietro -Sighizzone -Masnadora or Bocca d'Oro -Cavetto-Testa Quadra- Violina -Roadello or Raffaello -Fontaninello -Testa di Chiodo or Vedanino -Castello or Molina -Regelada
Muzzeta springs, springs and wet	Muzzeta springs to wet meadows	Five (historical and landscape values)	Settala	-Schienone (natural and landscape value)

meadows				<ul style="list-style-type: none"> <li>-Boscana (natural and landscape value)</li> <li>-Castelletto (natural and landscape value)</li> <li>-Dugnani (sud di c.na Conigo) – (natural and landscape value)</li> <li>-Rile (est di Settala) - (natural and landscape value)</li> <li>-Calandrone (natural and landscape value)</li> <li>-4 Ponti (nord di c.na Baialupo)</li> <li>-Boscana I</li> <li>-Ranino or di Cna Castelletto</li> <li>-Gaitina, Gaitino or Ganitina</li> <li>-Dell’oca</li> <li>-Quattro ponti</li> <li>-Carlotto</li> <li>-Rile</li> </ul>
Wet meadows and Lica wetland	Wet meadows to Lica wetland	Eleven (an important fluent of Adda River)	<p>Liscate (west), Lombardia (south), Truccazzano (east)</p> <p>Important place near node of Lica Wetland is Corneliano Bertario.</p>	<ul style="list-style-type: none"> <li>-4 Ponti (natural and landscape value)</li> <li>- Cerca (nord di c.na di Mezzo)- (natural and landscape value)</li> <li>-Cavo Marocco</li> </ul>



				<ul style="list-style-type: none"> <li>-Di Rossate (nord ovest di c.na Rossate) -(natural and landscape value)</li> <li>-Di Comazzo</li> <li>-Molino delle Chiare</li> <li>-Molgorino</li> <li>-Addetta (natural and landscape value)</li> </ul>
	Springs to Lica wetland	Thirteen	Liscate (west), Truccazzano (east), Melzo (north-west), Pozzuolo Martesana (north-east)	<ul style="list-style-type: none"> <li>-Castellazzo (Liscate)- (natural and landscape value)</li> <li>-Galanta (Nord Est di c.na Rosa)- (natural and landscape value)</li> <li>-Del Dosso di Santo Stefano</li> <li>-Serraglio</li> <li>-Ghisalberti</li> <li>-Senza nome</li> <li>-Pantano</li> <li>-Galanta o Bellaviti</li> <li>-Fulvia</li> </ul>
Lica wetland and Isola Borromeo wetland	Lica wetland to Isola Borromeo wetland	Three, near Adda river	Truccazzano (south), Cassano d'Adda (north)	<ul style="list-style-type: none"> <li>-Truccazzano (Molina II) -- (natural and landscape value)</li> <li>-Cassano d'Adda (c.na Seriole) -- (natural and landscape value)</li> <li>-Molina 2</li> </ul>

				-Rosina -Fontana bassa -Lancon -Del Portone
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**Annex.3. Card 1**

## Ecological connector

Observer: \_\_\_\_\_

Coordinates: \_\_\_\_\_

Location: \_\_\_\_\_

(Transect to determine ecological connector (homogeneous transect))  
Code \_\_\_\_\_Irrigation canal features (*Quality of the connector*):

- Water turbidity HIGH (-5) | HALF (5) | LOW (5)
- Rubbish YES (-5) | NO (5)
- Lateral concrete walls YES (-5) | NO (5)
- Preys (small) YES (-5) | NO (5)
- Natural talus YES (5) | NO (-5)

Features until 10-25 meters next to the irrigation canal (*Quality of the area*):

- Side vegetation 100-75% (5) /75-50% (5) /50-25% (0) /25-0% (-5)
- Invasive vegetation 100-75% (-5) /75-50% (-5) /50-25% (0) /25-0% (+5)
- Rubbish presence YES (-5) | NO (5)
- Wetland presence YES (5) | NO (0)
- If the answer before is YES, you can answer the next sections:
  - Wetland extension: \_\_\_\_\_ meters
  - Vegetation presence HIGH (5) | HALF (0) | LOW (-5)
  - Distance from irrigation canal >100m (5) | 100-50m (0) | <50 m (-5)
  - Temporal ponds presence YES (5) | NO (0)
- Conservation state of the area: GOOD (10) | REGULAR (0) | BAD (-10)
- Access of water in the possible reservoir GOOD (5) | BAD (-5)
- Agricultural uses near the connector YES (5) | NO (0)
- Pasture- livestock YES (5) | NO (0)
- Arable land YES (5) | NO (0)
- Meadows YES (5) | NO (0)

- Orchard YES (5) | NO (0)

- Forest plantation YES (-5) | NO (5)

If the answer before is YES:

- Invasive species YES (-5) | NO (5)

Presence of obstacles (Obstacles):

- Minor roads YES (-5) | NO (5)

- Highway YES (-10) | NO (10)

- Bridges YES (-5) | NO (5)

- Railroad YES (-5) | NO (5)

- Buildings YES (-5) | NO (5)

- Industrial YES (-10) | NO (10)

- Residential YES (-10) | NO (10)

- Commercial YES (-10) | NO (10)

- Steps for wildlife (in the presence of obstacles) YES (5) | NO (-5)

If response is NO:

- Un-implementable

- Implementable

- Proximity to an historical element of the landscape YES (5) | NO (0)

Description:

- Potentially characteristic landscape to be preserved YES (5) | NO (0)

Description:

Personal evaluation:

Evaluation of ecological connector (adding values between parenthesis, minimum value can be 0) (*Ecological total*):

Ecological connector status
Very good – 185 - 140
Good – 140 - 100
Regular – 100 - 75
Acceptable – 75 - 50
Bad – 50 - 0

*If the result is acceptable, good or very good, you accept ecological connector. If it is regular, you have to give a critical evaluation to accept it. If it is bad, you can't accept the ecological connector.*

(Transect to determine ecological connector (homogeneous transect))

Features of road or path:

Social connector features (agricultural road or path):

- Follow the ecological connector YES (5) | NO (0)
- Parallel route to irrigation canal YES (5) | NO (0)
- Proximity of water's reservoir YES (-5) | NO (5)

Road or track features:

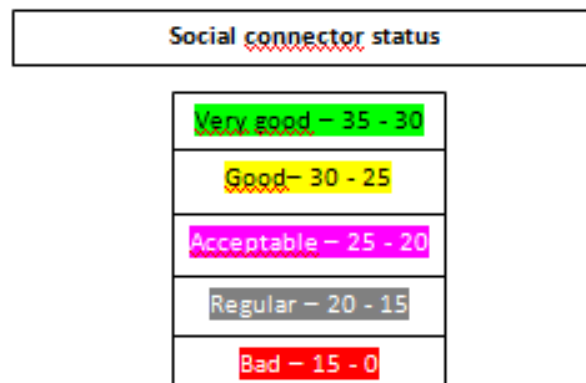
- Track/road presence YES (5) | NO (0)
- Rubbish on the sides and/or in the middle YES (-5) | NO (5)
- Suitable use for bicycles YES (5) | NO (0)
- Suitable use for walkers YES (5) | NO (0)

Informative panel establishing:

- Location:
- Coordinates:
- Features have to include:

Personal evaluation:

Calculation the evaluation social connector (adding parenthesis values, value minimum will be 0) (*Social total*):



*If social connector state is acceptable, good or very good, it will choose the connector (previously accepting ecological connector). If it is regular, you will have to give a correct evaluation. If it is bad, it won't accept.*

- Connector improvements:

- Ecological uses:

- Social uses:

- Infrastructures needed:

- Wildlife and flora management:

- Connector management:



## **Annex.4. Card 2**

## Implantation of natural spaces net in Antico Mulino

Pollster: \_\_\_\_\_

Location of pollster: \_\_\_\_\_

- 1) Week frequentation in the area, by bike or on foot?
  
- 2) Are you using the area? On foot, by bike? / with family, friends, alone,etc.?
  
- 3) Are informative panels suitable?
  
- 4) Is conservation state good?
  
- 5) Would you buy local products from farmers if sold in the area?
  
- 6) Would you be willing to know more about the area (environment, agricultural systems, birds,..)
  
- 7) Do you think in some improvement proposals?

## Annex.5. Timeline, supervisors and budget

This section presents a timeline to understand the planning before, during and after the field study. In January and February 2018, a preview study of the area and planning of the project will be carried out to prepare and execute the project between March and April 2018 (Table 6). Finally in May 2018, the project will be written up and presented in two sessions, one in Italy, with the network's stakeholders and the other in UVIC-UCC within the final degree dissertation defense.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 0						<b>17<sup>th</sup> March</b> Arrival to Malpensa Airport (Milano) and visit the area	Staying in the place and visiting Peschiera-Borromeo
Week 1	Transect to determine socio-ecological values (Bosco di Carengione to Peschiera Borromeo and going to the North)	Transect to determine socio-ecological values (Wetland of Peschiera Borromeo to the North)	Transect to determine socio-ecological values (Wetland of Peschiera Borromeo to Muzzetta springs)	Transect to determine socio-ecological values (Wetland of Peschiera Borromeo to Muzzetta springs)	Staying with Francesco Cavazza. Working in the project. Visiting Cornelian Bertario and Cassano d'Adda wetlands	Rest day	Transect to determine socio-ecological values (Muzzetta springs to wet meadows)
Week 2	Transect to determine socio-ecological values (Wet meadows to Lavagna)	Transect to determine time and distance between Carengione Forest to Muzzetta Springs	Transect to determine socio-ecological values (Lavagna to the wetland of Cornelian Bertario)	Transect to determine socio-ecological values (Cornelian Bertario to nearby area of Albignano d'Adda)	Office day work	Rest day	Rest day
Week 3	Transect to determine socio-ecological values (Nearby area of Albignano)	Office work. Finishing interactive map for a possible meeting with CAP	Meeting with Mr. Borromeo to comment about the meeting with CAP Holding. Setting up the meeting in the	Meeting with CAP Holding (postponed) Meeting with Francesco Cavazza for	Work in the wetland of Peschiera Borromeo for possible future management advice	Rest day (setting up the material and baggage and clean up the accommodation)	<b>8<sup>th</sup> April</b> Return

	d'Adda to Cassano d'Adda)	Holding	afternoon	the final and definitive interactive map and report			
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Table 6 Field work during the stay in Peschiera Borromeo

The preview study consists in scientific research about socio-ecological connections in similar places, phytoremediation process in wetlands, and other important aspects related to the legislation, actor mapping and usability of the territory. The project planning is based on defining the potential socio-ecological network for public and private uses with GIS software. The project execution to define the definitive socio-ecological connections between new and existing wetlands will be carried out during the three-week stay in Italy between March and April. The activities in the area would be studying of network and company mission and vision, studying of ecological and social connectors, identification of interest points and potential water reservoirs, and talking with owners, town councils and nearby inhabitants to achieve the objectives. Writing up the project consists in a final report which will be explained in the different presentations in UVIC-UCC and Italy (Table 7).

Activity	January	February	March	April	May	June
Preview study						
Project planning						
Project execution						
Project write up						
Project presentation						

Table 7 Project timeline

The budget of the project in Peschiera-Borromeo for about three weeks is presented in Table 8, based on:

- Accommodation in-situ, in Cascina Renata (building owned by *Antico Mulino Ltd*).
- Transport between Barcelona Airport and Milan Airport by plane and car rental in Italy to move around the area with more freedom. Car rental includes fuel price.
- Living expenses.

- Professional private translator to achieve a perfect English report for the scientific community.

- Supervisors:

- *Local supervisor:* Francesco Cavazza from *Antico Mulino srl Unipersonale* will be the local supervisor with knowledge about the territory, its uses and its public and private owners. He will give the potential to carry out this project and to achieve a great improvement in the area.
- *Academic supervisor:* Roger Arquimbau, as a professor of Management of the Natural Environment from Universitat de Vic-Universitat Central de Catalunya, will be the academic supervisor. He will provide the key instruments to improve and define the management of the area of the study.
- *Form and English supervisor:* professional translator from Catalan to improve a perfect report for the scientific community.

All supervisors will contribute to the final report.

Item	Price
Accommodation	1200€
Flight	150€
Car rental	280€
Living expenses	250€
Internet connection	100€
Translator	300€
Supervision	1500€
Total	3780€

Table 8 Budget for the project

## Annex.6. Previous map Rete ZUB connection

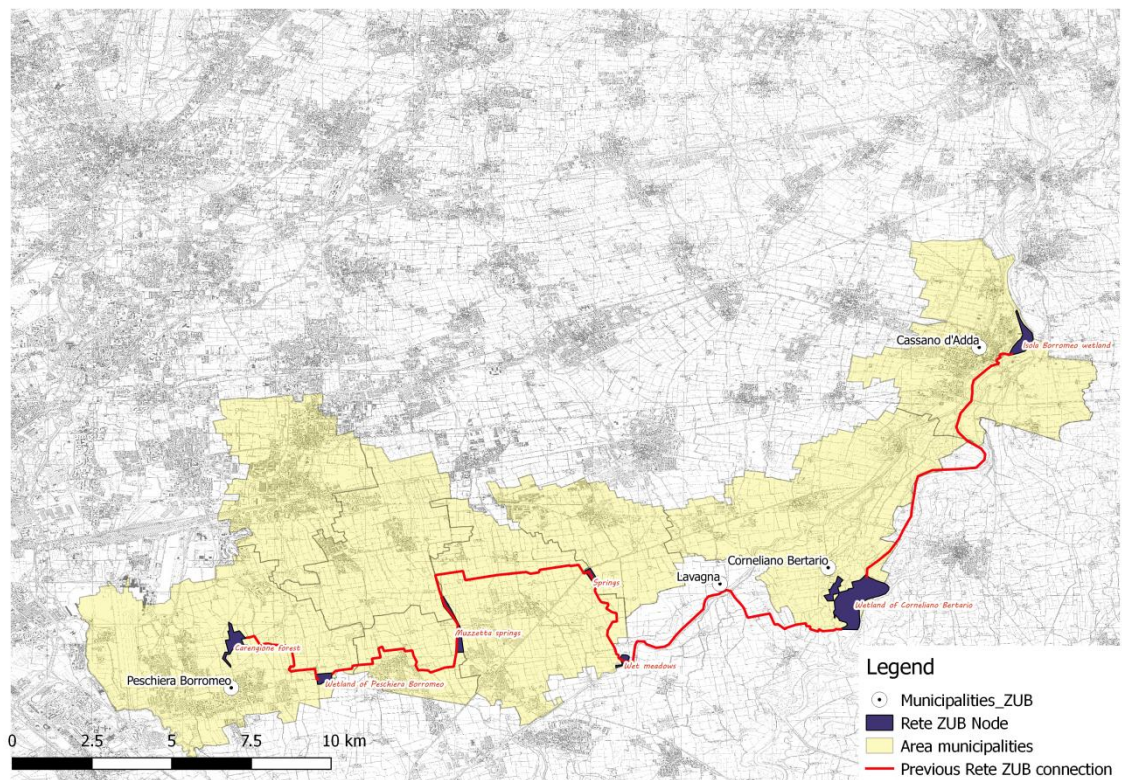


Figure 18 Map of previous Rete ZUB connection

## Annex.7. Data base

Transect	Lenght (m)	Eco.	Soc.	Comments
<a href="#">BC AM.1</a>	82	115	35	Clean invasive vegetation. Indicators for social uses.
<a href="#">BC AM.2</a>	149	60	35	Clean invasive vegetation in the irrigation canal. Indicators for social uses. Drainage of irrigation canal to the next transect (fontanile)
<a href="#">BC AM.3</a>	305	40	10	Clean invasive vegetation and irrigation canal. No path and difficult to pass, need it. Indicators for bike pass. Informative panel.
<a href="#">BC AM.4</a>	27	40	10	Plantation of autochthonous trees. No path and difficult to pass. Clean step of wildlife.
<a href="#">BC AM.5</a>	356	45	10	Clean invasive vegetation and irrigation canal. No path and difficult to pass, need it.
<a href="#">BC AM.6</a>	479	80	10	Plantation of autochthonous trees. Not path and difficult to pass. Clean step of wildlife.
<a href="#">BC AM.7</a>	72	90	35	Plantation of autochthonous trees. Not path and difficult to pass. Clean step of wildlife. Informative panel.
<a href="#">BC AM.8</a>	162	85	15	Clean invasive vegetation and rubbish. Need some autochthonous trees. Need a path and indicators.
<a href="#">BC AM.9</a>	517	90	5	Clean invasive vegetation and rubbish. Need a path and indicators.
<a href="#">BC AM.10</a>	151	105	35	Clean the irrigation canal (lot of rubbish), the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel and indicators.
<a href="#">BC AM.11</a>	163	105	35	Clean the irrigation canal, the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel and indicators.
<a href="#">BC AM.12</a>	253	90	35	Clean the irrigation canal and adequate pass of water, the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel and indicators
<a href="#">BC AM.13</a>	221	90	35	Clean the irrigation canal, the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel and indicators.
<a href="#">BC AM.14</a>	325	115	20	Clean the irrigation canal, the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel and indicators
<a href="#">BC AM.15</a>	249	105	15	Clean the irrigation canal, the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel, indicators and path for walkers.
<a href="#">BC AM.16</a>	127	90	35	Clean the irrigation canal, the step of wildlife and need plantation of autochthonous trees and "ornithoboxes". Need informative panel and indicators.

<a href="#">BC AM.17</a>	60	70	5	Near Borromeo Castel. Clean the invasive vegetation and rubbish. Need some autochthonous trees.
<a href="#">AM SM.1</a>	91	125	15	Near the wetland of Peschiera Borromeo. Need a step of wildlife. Need a path, indicators and an informative panel, also in the wetland.
<a href="#">AM SM.2</a>	111	130	10	Near of the wetland of Peschiera Borromeo. Need plantation of autochthonous trees and ornithoboxes. Need a path, indicators and an informative panel, also in the wetland. It is a private part
<a href="#">AM SM.3</a>	430	125	25	Plantation of autochthonous trees did it. Need time to evaluate their ecological state. Need a path, indicators and an informative panel, also in the wetland. It is a private property.
<a href="#">AM SM.4</a>	103	130	25	Plantation of autochthonous trees did it. Need time to evaluate their ecological state. Need a path, indicators and an informative panel, also in the wetland.
<a href="#">AM SM.5</a>	194	50	10	Need clean of invasive vegetation. Need a path, indicators and an informative panel, also in the wetland.
<a href="#">AM SM.6</a>	134	50	25	Need clean of invasive vegetation and clean rubbish, indicators and informative panel about the importance of orchard.
<a href="#">AM SM.7</a>	33	40	25	Need clean of invasive vegetation and clean rubbish. Need to create a step of wildlife. Need indicators and informative panel about the importance of orchard.
<a href="#">AM SM.8</a>	40	35	25	Need clean of invasive vegetation, rubbish and the step of wildlife. Need indicators and informative panel.
<a href="#">AM SM.9</a>	65	30	25	Need clean of invasive vegetation and clean rubbish and the step of wildlife, also to adjust. Need indicators and informative panel.
<a href="#">AM SM.10</a>	95	55	25	Interest point of orchard. Clean invasive vegetation of irrigation canal and plantation of autochthonous trees and ornithoboxes.
<a href="#">AM SM.11</a>	87	35	25	Interest point of orchard. Clean invasive vegetation of irrigation canal and plantation of autochthonous trees and ornithoboxes.
<a href="#">AM SM.12</a>	182	110	15	Clean invasive vegetation of irrigation canal. Need plantation of autochthonous trees and ornithoboxes. Need path, indicators and informative panel.
<a href="#">AM SM.13</a>	299	85	25	Implementable step of wildlife (need it). Need path, indicators and informative panel.
<a href="#">AM SM.14</a>	613	110	20	Interest point of irrigation canal. Need a step of wildlife and plantation of trees. Need path, indicators and informative panel.
<a href="#">AM SM.15</a>	22	65	10	Interest point of irrigation canal. Need plantation of autochthonous trees and ornithoboxes. Need path, indicators and informative panel.
<a href="#">AM SM.16</a>	160	105	15	Need plantation of autochthonous trees and ornithoboxes, adjust pass of water. Need path, indicators and informative panel.
<a href="#">AM SM.17</a>	120	105	15	Clean invasive vegetation and plantation of trees and ornithoboxes. Need indicators for social uses.



<a href="#">AM SM.18</a>	58	90	15	Implementable step of wildlife. Clean invasive vegetation. Need a path, informative panel and indicators.
<a href="#">AM SM.19</a>	578	100	10	Clean invasive vegetation, plantation of autochthonous trees and ornithoboxes. Need a path and indicators near a road.
<a href="#">AM SM.20</a>	289	55	20	There is a farm. Clean invasive vegetation, plantation of trees and ornithoboxes. Next to the road (without path) and need indicators.
<a href="#">AM SM.21</a>	140	55	25	Farmer point. Clean the step of wildlife and rubbish. Need some indicators and one informative panel.
<a href="#">AM SM.22</a>	229	30	20	Implementable step of wildlife (need it). Very bad ecological connector (need an irrigation canal), drainage the soil to pass the water, need plantation of trees and ornithoboxes.
<a href="#">AM SM.23</a>	122	85	20	Clean invasive vegetation and rubbish. Need indicators and informative panel.
<a href="#">AM SM.24</a>	80	75	20	Clean invasive vegetation and rubbish. Need indicators and informative panel. Need plantation of autochthonous trees and ornithoboxes.
<a href="#">AM SM.25</a>	137	95	15	Orchard uses but next to industrial area. Need a path and indicators.
<a href="#">AM SM.26</a>	87	95	15	Orchard uses but next to industrial area. Need a path and indicators.
<a href="#">AM SM.27</a>	192	95	15	Orchard uses but next to industrial area. Need a path and indicators. Need plantation of autochthonous trees.
<a href="#">AM SM.28</a>	736	135	10	Fontanile. Clean some invasive vegetation. Need a path.
<a href="#">AM SM.29</a>	254	125	10	Fontanile. Clean some invasive vegetation. Need a path.
<a href="#">AM SM.30</a>	174	115	10	Fontanile. Clean some invasive vegetation. Need an informative panel (in the path) and indicators.
<a href="#">AM SM.31</a>	285	120	35	Near Muzzetta springs. Need panel and indicators. Need plantation of autochthonous trees and ornithoboxes.
<a href="#">AM SM.32</a>	157	125	35	Near Muzzetta springs. Need panel and indicators. Need plantation of autochthonous trees and ornithoboxes
<a href="#">SM S.1</a>	238	145	35	Need plantation of autochthonous trees.
<a href="#">SM S.2</a>	220	110	15	Need plantation of autochthonous trees and ornithoboxes, adjust pass of water. Need path, indicators and informative panel.
<a href="#">SM S.3</a>	648	95	15	Need plantation of autochthonous trees and ornithoboxes, adjust pass of water. Need path, indicators and informative panel.
<a href="#">SM S.4</a>	206	70	5	Need plantation of autochthonous trees and ornithoboxes, adjust pass of water. Need path, indicators and informative panel.
<a href="#">SM S.5</a>	911	80	25	Implementable step of wildlife. Interest point (Cascina Castello). Need indicators and informative panel. Really necessary for the interest point.
<a href="#">SM S.6</a>	157	105	0	Near a potential wetland. Next to road. Need pass of water. Clean the rubbish.
<a href="#">SM S.7</a>	252	120	5	Near a potential wetland. Clean the rubbish. Need a path, indicators and informative panel.

<a href="#">SM_S.8</a>	215	110	30	Need plantation of autochthonous trees and ornithoboxes. Adjust pass of water. Need indicators and informative panel.
<a href="#">SM_S.9</a>	336	100	30	Need plantation of autochthonous trees and ornithoboxes. Adjust pass of water. Need indicators and informative panel.
<a href="#">SM_S.10</a>	77	105	30	Need plantation of autochthonous trees and ornithoboxes. Adjust pass of water. Need indicators and informative panel.
<a href="#">SM_S.11</a>	223	90	20	Implementable step of wildlife. Need pass of water.
<a href="#">SM_S.12</a>	130	110	15	Need pass of water and clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">SM_S.13</a>	82	75	15	Implementable step of wildlife. Need plantation of autochthonous trees and ornithoboxes. Need a path, indicators and informative panel.
<a href="#">SM_S.14</a>	115	110	15	Very good connector for its high biodiversity. Clean invasive vegetation and adjust for the pass of water. Need a path, indicators and informative panel.
<a href="#">SM_S.15</a>	375	125	10	Good environmental connector. Need a path, indicator and informative panel.
<a href="#">SM_S.16</a>	259	120	10	Good environmental connector. Need a path, indicator and informative panel.
<a href="#">SM_S.17</a>	207	90	25	Electrical tower. There is a path. Need indicators and informative panel.
<a href="#">SM_S.18</a>	505	115	25	Good environmental connector. There is a path. Need indicator and informative panel.
<a href="#">SM_S.19</a>	178	110	5	Clean invasive vegetation. Need a path, indicators for social uses and informative panel.
<a href="#">SM_S.20</a>	202	110	5	Clean invasive vegetation. Need a path, indicators for social uses and informative panel.
<a href="#">SM_S.21</a>	525	145	5	Road that stop the environmental connector. Need to adjust the step of wildlife and clean it. Need a path, indicators and informative panel.
<a href="#">SM_S.22</a>	200	85	5	Near a potential wetland (node). Need to clean the step of wildlife. Need a path, indicators and informative panel.
<a href="#">S_W.1</a>	237	155	15	Near a wetland(springs). Fontanile. Need a path, indicators and informative panel
<a href="#">S_W.2</a>	491	150	20	Fontanile. Need indicators and informative panel.
<a href="#">S_W.3</a>	383	130	15	Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">S_W.4</a>	97	115	20	Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">S_W.5</a>	315	130	15	Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">S_W.6</a>	138	130	15	Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">S_W.7</a>	140	125	15	Need to clean rubbish. Need a path, indicators and informative panel.
<a href="#">S_W.8</a>	155	115	5	Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">S_W.9</a>	370	130	15	Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">S_W.10</a>	279	115	35	Good environmental connector. Need time to evaluate the tree plantation. Need indicators and informative panel.

<a href="#">S_W.11</a>	481	130	15	Good environmental connector. Clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">W_L.1</a>	983	105	20	Near wet meadows (wetland area). Plantation of poplars next to the connector. There is a path. Need indicators and informative panel.
<a href="#">W_L.2</a>	162	85	15	Near wet meadows (wetland area). Clean rubbish and invasive vegetation. Stop for irrigation canal. Need a path.
<a href="#">W_L.3</a>	75	65	20	Implementable step of wildlife. Drainage irrigation canal. Clean rubbish and invasive vegetation. Need indicators and informative panel.
<a href="#">W_L.4</a>	287	90	35	Next to affluent Adda river. Drain the irrigation canal, clean invasive vegetation and adjust the step of wildlife. Need indicators and informative panel.
<a href="#">W_L.5</a>	123	30	25	Next to affluent Adda river. Drain the irrigation canal, adjust the step of wildlife. Need indicators and informative panel.
<a href="#">W_L.6</a>	579	110	30	Next to affluent Adda river. Drain the irrigation canal, adjust the step of wildlife. Need indicators and informative panel.
<a href="#">W_L.7</a>	145	110	30	Next to affluent Adda river. Drain the irrigation canal, clean the invasive vegetation and adjust the step of wildlife. Need indicators and informative panel.
W_L.8	145	110	30	Implementable step of wildlife and need to drain irrigation canal. Need informative panel and indicators.
<a href="#">W_L.9</a>	279	115	25	Clean invasive vegetation. Need informative panel and indicators.
<a href="#">W_L.10</a>	133	125	25	Clean invasive vegetation. Need informative panel and indicators.
<a href="#">W_L.11</a>	418	115	25	Clean invasive vegetation. Need informative panel and indicators.
<a href="#">W_L.12</a>	245	110	35	Good environmental and social connector. Need evaluation in some years. Need informative panel and indicators.
<a href="#">W_L.13</a>	363	110	35	Good environmental and social connector. Need evaluation in some years. Need informative panel and indicators.
<a href="#">W_L.14</a>	162	60	25	Implementable step of wildlife. Clean rubbish and invasive vegetation. Need drainage (adjust pass of water). Need informative panel and indicators.
<a href="#">W_L.15</a>	627	85	30	Good environmental and social connector. Need evaluation in some years and drainage irrigation canal. Need informative panel and indicators.
<a href="#">W_L.16</a>	154	30	35	Bridge to cross the river. Bad environmental and social connector. Need an advertise panel.
<a href="#">L_C.1</a>	277	55	30	Clean invasive vegetation and invasive rubbish. There is a path. Need an informative panel.
<a href="#">L_C.2</a>	528	100	30	Clean invasive vegetation and invasive rubbish. There is a path. Need an informative panel.
<a href="#">L_C.3</a>	217	75	30	Clean invasive vegetation and invasive rubbish. There is a path. Need an informative panel.
<a href="#">L_C.4</a>	109	55	30	Bad location. Next to a house. Need an informative panel.
<a href="#">L_C.5</a>	276	80	35	Need plantation of autochthonous trees and ornithoboxes. Need informative panel.

<a href="#">L_C.6</a>	164	55	10	A farm next to the connector. Bad connector. Need plantation of autochthonous trees and ornithoboxes. Need a path, indicators and informative panel.
<a href="#">L_C.7</a>	676	125	10	Need plantation of autochthonous trees and ornithoboxes. Need a path, informative panel and indicators.
<a href="#">L_C.8</a>	333	125	10	There is a farm. Need a path, indicators and informative panel.
<a href="#">L_C.9</a>	162	120	10	Need connection to the other connector. Needs a path, indicators and informative panel.
<a href="#">L_C.10</a>	107	130	35	Need plantation of autochthonous trees and ornithoboxes. Need indicators and informative panel (there is a path).
<a href="#">L_C.11</a>	69	135	35	Need plantation of autochthonous trees and ornithoboxes. But there are also trees. Need indicators and informative panel (there is a path).
<a href="#">L_C.12</a>	180	120	35	There is a farm. Need indicators and informative panel (there is a path).
<a href="#">L_C.13</a>	332	80	10	Need a path, indicators and informative panel.
L_C.14	102	115	15	Implementable step of wildlife, need to drain an irrigation canal. Need to create a pass of water (drain irrigation canal) to the other connector. Need path, indicators and informative panel.
<a href="#">L_C.15</a>	52	110	20	Need a plantation of autochthonous trees and ornithoboxes. Need a path, indicators and informative panel.
<a href="#">L_C.16</a>	195	90	30	Fontanile. Need time to evaluate plantation of trees (10-15 years). Need a path, indicators and informative panel.
<a href="#">L_C.17</a>	145	130	15	Fontanile. Need to clean invasive vegetation and rubbish of a tire. Need a path, indicators and informative panel.
<a href="#">L_C.18</a>	299	130	15	Fontanile. Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">L_C.19</a>	77	130	15	Fontanile. Need plantation of autochthonous trees and ornithoboxes. Need a path, indicators and informative panel.
<a href="#">L_C.20</a>	576	125	15	Fontanile. Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">L_C.21</a>	38	125	15	Fontanile. Need to clean invasive vegetation. Need a path, indicators and informative panel.
<a href="#">L_C.22</a>	109	125	5	Fontanile. Good environmental connector. Need a path, indicators and informative panel.
<a href="#">C_C.1</a>	1670	90	25	Clean rubbish and invasive vegetation. There is a path. Need indicators and informative panel.
<a href="#">C_C.2</a>	241	30	25	Un-implementable step of wildlife. Clean rubbish and invasive vegetation. Bad environmental connector.
<a href="#">C_C.3</a>	438	80	25	Next to Adda River. Clean rubbish and invasive vegetation. There is a path. Need indicators and informative panel.
<a href="#">C_C.4</a>	354	60	15	There is a farm. Next to Adda River. Clean rubbish and invasive vegetation. There is a path. Need indicators and informative panel. Also it needs to clean the path of invasive vegetation.
<a href="#">C_C.5</a>	1872	130	30	Next to Adda River. Clean invasive vegetation. There is a path. Need indicators and informative panel. It needs to clean the path of invasive vegetation.
<a href="#">C_C.6</a>	394	110	30	Next to Adda River. Clean invasive vegetation. There is a path. Needs indicators and informative panel. It needs to clean

				the path of invasive vegetation.
<a href="#">C C.7</a>	139	110	30	Next to Adda River. Need plantation of autochthonous trees and ornithoboxes. There is a path. Need indicators (specially indicator to Albignano d'Adda) and informative panel. It needs to clean the path of invasive vegetation.
<a href="#">C C.8</a>	802	105	0	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. Need path, indicators and informative panel.
<a href="#">C C.9</a>	450	95	0	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. Need a path, indicators and informative panel.
<a href="#">C C.10</a>	175	100	0	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. Need a path, indicators and informative panel.
<a href="#">C C.11</a>	874	105	15	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. A potential wetland. There is a path, need indicators and informative panel.
<a href="#">C C.12</a>	553	100	15	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. A potential wetland. There is a path, need indicators and informative panel.
<a href="#">C C.13</a>	506	95	20	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. A potential wetland. There is a path, need indicators and informative panel.
<a href="#">C C.14</a>	237	55	30	Next to Adda River. Clean invasive vegetation, rubbish and plant different types of trees. There is a highway and railroad. Passes FrecciaRossa. There is a path, need indicators and informative panel.
<a href="#">C C.15</a>	263	100	25	Next to Adda River. Clean invasive vegetation and plant different types of trees. There is a path, need indicators and informative panel.
<a href="#">C C.16</a>	147	55	25	Next to Adda River and industrial area. Clean invasive vegetation and plant different types of trees. There is a path, need indicators and informative panel. Need open to public use.
<a href="#">C C.17</a>	452	0	20	Implementable step of wildlife. Need a pass of fishes. Needs a better environmental connector next to Adda River, but with not social connector there. Need indicators and informative panel.
<a href="#">C C.18</a>	168	65	20	Need a better environmental connector next to Adda River, but with not social connector there. Need indicators and informative panel.
<a href="#">C C.19</a>	94	85	25	Need a better environmental connector next to Adda River, but without social connector there. Need a plantation of trees. Needs indicators and informative panel.
<a href="#">C C.20</a>	346	90	25	Need a better environmental connector next to Adda River, but without social connector there. Need indicators and informative panel.
<a href="#">C C.21</a>	52	30	35	Implementable step of wildlife. There is a bridge, needs a step for fishes. Also it needs a plantation of autochthonous

				trees and clean rubbish. Needs indicators and informative panel.
<a href="#">C_C.22</a>	198	110	35	Clean invasive vegetation and adjust pass of water. Need indicators and informative panel.
<a href="#">C_C.23</a>	251	65	35	Adjust a natural environmental step for wildlife with natural talus and autochthonous trees. Bad social use because it is in a flooded area.
<a href="#">C_C.24</a>	289	60	25	Implementable step of wildlife. Interest point of Cassano d'Adda church and castle. There is a bar with barbecues. Need to clean rubbish and invasive vegetation. Need indicators and informative panel.
<a href="#">C_C.25</a>	301	5	30	Interest point of Cassano d'Adda church and castle. There is an important bridge. Bad environmental connector. There are steps for people. Need signals of danger for traffic.
<a href="#">C_C.26</a>	262	55	25	Interest point of castle and near Isola Borromeo wetland. Need plantation of autochthonous trees. Need indicators and informative panel. Also informative panel about Isola Borromeo wetland.
<a href="#">C_C.27</a>	268	35	25	Bad environmental and acceptable social connector. It needs plantation of autochthonous trees. In the bridge is difficult to maintain environmental connector. It needs indicators, specially how to arrive to Isola Borromeo wetland.



## **Annex.8**

## **Annex.8.1. Management card 1**

Connector code:

Choose the problem with the corresponding management advice.

### Problems:

- 1) Invasive reed (*Arundo donax*) causes a stopping step of water in the irrigation canal.
- 2) Without riverside autochthonous trees.



Figure 19 Example of connector with code AM\_SM.12

### Management advices:

- 1) Clean the invasive species and drainage the soil to avoid another time the apparition of them.
- 2) Plantation of autochthonous trees with high biodiversity. It needs to plant different species of hydrophilic characteristics between 5 meters of distance, like a mosaic landscape next to 1,5 meters of the irrigation canal until 20 meters. The main kind of autochthonous trees are:

- *Populus nigra*
- *Populus alba*
- *Fraxinus excelsior*
- *Alnus glutinosa*

In five years, the trees need *ornithoboxes* for birds to improve its biodiversity.

Shrub vegetation needs to increase like a *Corylus avellana* specie.

## **Annex.8.2. Management card 2**

Connector code:

Choose the problem with the corresponding management advice.

**Problems (choose one option):**

	Without step of wildlife	Without irrigation canal	Without autochthonous trees
Management advice 1	x	X	X
Management advice 2		X	X
Management advice 3			X
Management advice 4		X	
Management advice 5	x	X	



Figure 20 Example of connector with code AM\_SM.13 to improve with management advice 1

**Management advices (choose one option):**

1) It needs an implementable step of wildlife with a drainage of the soil to continue the irrigation canal.

The drainage of the soil can be made by an artificial way with a light excavator or by a manual way with shovel and more workers to hire.

The plantation of autochthonous trees with high biodiversity needs to plant different species of hydrophilic characteristics between 5 meters of distance, like a mosaic landscape next to 1,5 meters of the irrigation canal until 20 meters. The main kind of autochthonous trees are:

- *Populus nigra*
- *Populus alba*
- *Fraxinus excelsior*
- *Alnus glutinosa*

2) It needs an implementable step of wildlife with a drainage of the soil to continue the irrigation canal.

The drainage of the soil can be made by an artificial way with a light excavator or by a manual way with shovel and more workers to hire.

The plantation of autochthonous trees with high biodiversity. It needs to plant different species of hydrophilic characteristics between 5 meters of distance, like a mosaic landscape next to 1,5 meters of the irrigation canal until 20 meters. The main kind of autochthonous trees are:

- *Populus nigra*
- *Populus alba*
- *Fraxinus excelsior*
- *Alnus glutinosa*

In five years, the trees need *ornithoboxes* for birds to improve its biodiversity.

Shrub vegetation needs to increase like a *Corylus avellana* specie.

3) It needs a plantation of autochthonous trees with high biodiversity. It needs to plant different species of hydrophilic characteristics between 5 meters of distance, like a mosaic landscape next to 1,5 meters of the irrigation canal until 20 meters. The main kind of autochthonous trees are:

- *Populus nigra*
- *Populus alba*
- *Fraxinus excelsior*
- *Alnus glutinosa*

In five years, the trees need *ornithoboxes* for birds to improve its biodiversity.

Shrub vegetation needs to increase like a *Corylus avellana* specie.

4) The drainage of the soil can be made by an artificial way with a light excavator or by a manual way with shovel and more workers to hire.

5) It needs an implementable step of wildlife with a drainage of the soil to continue the irrigation canal.

The drainage of the soil can be made by an artificial way with a light excavator or by a manual way with shovel and more workers to hire.

### **Annex.8.3. Management card 3**



Connector code:

*Choose the problem with the corresponding management advice.*

## Problems:

1) An artificial bridge with concrete wall.



Figure 21 Example of connector with code L\_C.5

## Management advices:

1) It needs to naturalize the concrete wall to become a natural talus with a vegetable mesh of herbaceous species, with a plantation of autochthonous trees with high biodiversity next to the irrigation canal. It needs to plant different species of hydrophilic characteristics between 5 meters of distance, like a mosaic landscape next to 1,5 meters of the irrigation canal until 20 meters. The main kind of autochthonous trees are:

- *Populus nigra*
- *Populus alba*
- *Fraxinus excelsior*
- *Alnus glutinosa*

In five years, the trees need *ornithoboxes* for birds to improve its biodiversity.

Shrub vegetation needs to increase like a *Corylus avellana* specie.

#### **Annex.8.4. Management card 4**

Connector code:

*Choose the problem with the corresponding management advice.*

### **Problems:**

1) A step of wildlife full of invasive vegetation causes a not step of wildlife and also of water.



Figure 22 Example of connector with code SM\_S.22.

### **Management advices:**

1) It needs to clean the step of wildlife by manual activity of human worker. It is difficult to clean all the connectors, but at least the step of wildlife in every 5 years.

When the nearby of step of wildlife will be cleaned, it needs to protect the area without any entry of people and animals, like a protective mesh over the step of wildlife, only with the pass of the water.

## **Annex.8.5. Management card 5**

Connector code:

**Problems:**

- 1) Presence of a concrete wall.



Figure 23 Example of connector with code L\_C.3

**Management advices:**

- 1) The only solution is destroy this wall with an artificial light machinery when the irrigation canal is drought. Then, it needs to naturalize the talus:
  - Compact the soil to grew up autochthonous herbaceous vegetation.

## **Annex.8.6. Management card 6**



Connector code:

*Choose the problem with the corresponding management advice.*

### Problems:

- 1) Presence of shrub invasive vegetation in the irrigation canal or in the 5-10 meters next to it.



Figure 24 Example of connector with code W\_L.14

### Management advices:

- 1) The only solution is to clean this invasive vegetation with garden tools and transport them to an organic treatment plant to make fertilizer. It needs to do it every 5 years.



## **Annex.8.7. Management card 7**

Connector code:

Choose the problem with the corresponding management advice.

### Problems:

- 1) Without autochthonous trees.
- 2) Full of invasive species in the irrigation canal and/or in the step of wildlife, especially shrub species.



Figure 25 Example of a connector with code BC\_AM.4

### Management advices:

1) Plantation of autochthonous trees with high biodiversity. It needs to plant different species of hydrophilic characteristics between 5 meters of distance, like a mosaic landscape next to 1,5 meters of the irrigation canal until 20 meters. The main kind of autochthonous trees are:

- *Populus nigra*
- *Populus alba*
- *Fraxinus excelsior*
- *Alnus glutinosa*

In five years, the trees need *ornithoboxes* for birds to improve its biodiversity.

Shrub vegetation needs to increase like a *Corylus avellana* specie.

2) The only solution is to clean this invasive vegetation with garden tools and transport them to an organic treatment plant to make fertilizer. It needs to do it every 5 years.

### **Annex.8.8. Management card 8**

Connector code:

*Choose the problem with the corresponding management advice.*

### Problems:

- 1) Without track for public use.
- 2) Presence of rubbish in the irrigation canal and the edges of it.



Figure 26. An example of connector with code L\_C.20

### Management advices:

1) Arrange a track for walkers and bicycles, not for motorized vehicles. It is important to preserve the environmental area with a high ecological value. If it is necessary a little ecological mesh to avoid the entry of people in a potential node should be built it.

In addition, when a track is created, it needs to implant indicators and an informative panel depending on:

- Near existing wetland.
- Near potential node: potential wetland, fontanile activity or artificial lake.
- Near good ecological connector.
- Near an interest point.

2) Clean the rubbish with people from social organizations of the important wetlands in Rete ZUB. It needs a garbage bag and a transport to a treatment plant.

**Annex.8.9. Management card 9**

Connector code:

*Choose the problem with the corresponding management advice.*

### Problems:

- 1) A track and/or road without indicators and informative panel.
- 2) Presence of rubbish in the irrigation canal and the edges of it.



Figure 27 Example of connector with code AM\_SM.21

### Management advices:

1) If there are some homogeneous connectors for public use with the same social classification of connector, they can implant an informative panel in an intersection of different roads or in each 5 kms of distance. However, if there aren't homogeneous connectors it is important to evaluate the importance of the connector.

How can evaluated them?

- Near existing wetland.
- Near potential node: potential wetland, fontanile activity or artificial lake.
- Near good ecological connector.
- Near an interest point.

Indicators are important for public use, to show the track or advertise dangers and also nearby roads for motorized vehicles to advertise the pass of walkers and bicycles.

2) Clean the rubbish with people from social organizations of the important wetlands in Rete ZUB. It needs a garbage bag and a transport to a treatment plant.

## **Annex.9. Design of informative panel**

Each informative panel has to include:

- Introduction about the area
- Ecological aspects of the area in the social track:
  - Flora
  - Wildlife (especially avifauna)
  - Wetlands / springs / wet meadows
  - Irrigation canals
- Cultural aspects (include castles and water fountains)
- Prohibitions of the area, such as not motorized vehicles, respect the area and dog tied
- Recommended activities (ornithology, cultural visiting, wildlife fauna, etc.) to do on foot, by bike or/and ride a horse
- Name of the social track to give a common and particular name in the region for its knowledge.

## Annex.10. Relation of connectors with management cards

Code of the transect	Number of the management card
BC_AM.1, AM_SM.5, AM_SM.6, AM_SM.7, AM_SM.23, SM_S.6, W_L.9, W_L.10, W_L.11, L_C.1, L_C.2, L_C.3, C_C.1, C_C.3, C_C.4, C_C.5, C_C.6, C_C.22	<u>6,9</u>
BC_AM.2, AM_SM.8, AM_SM.9, AM_SM.21	<u>4,9</u>
BC_AM.3, BC_AM.6, BC_AM.7, SM_S.22	<u>4,8</u>
BC_AM.4, BC_AM.8, AM_SM.12, AM_SM.19, AM_SM.20	<u>7,8</u>
BC_AM.5, BC_AM.9, AM_SM.28, AM_SM.29, AM_SM.30, SM_S.12, SM_S.14, SM_S.19, SM_S.20, S_W.3, S_W.5, S_W.6, S_W.8, S_W.9, S_W.11, W_L.2, L_C.20, L_C.21	<u>6,8</u>
BC_AM.10, BC_AM.11, BC_AM.12, BC_AM.13, BC_AM.14, BC_AM.15, BC_AM.16, BC_AM.17, AM_SM.10, AM_SM.11, AM_SM.17, AM_SM.24, SM_S.8, SM_S.9, SM_S.10, C_C.23	<u>7,9</u>
AM_SM.1, AM_SM.2, AM_SM.13, AM_SM.14, AM_SM.15, AM_SM.16, AM_SM.27, SM_S.2, SM_S.3, SM_S.4, SM_S.5, SM_S.13, SM_S.21, L_C.10, L_C.11, L_C.15, L_C.17, L_C.18, L_C.19	<u>2,8</u>
AM_SM.3, AM_SM.4, AM_SM.25, AM_SM.26, SM_S.7, SM_S.15, SM_S.16, SM_S.18, S_W.1, S_W.7, L_C.13, L_C.16, L_C.22	<u>8</u>
AM_SM.18, C_C.8, C_C.9, C_C.10, C_C.16	<u>2,6,8</u>
AM_SM.22, AM_SM.31, AM_SM.32, W_L.3, W_L.5, W_L.6, W_L.8, W_L.15, L_C.5, L_C.7, L_C.9, L_C.14, C_C.17, C_C.19, C_C.21, C_C.26, C_C.27	<u>2,9</u>
L_C.5	<u>2,3,9</u>
S_W.4	<u>3,6,8</u>
SM_S.1, SM_S.11	<u>2</u>
SM_S.17, S_W.2, S_W.10, W_L.1, W_L.12, W_L.13, W_L.16, L_C.8, L_C.12, C_C.18, C_C.20	<u>9</u>
W_L.4, W_L.7, W_L.14, C_C.2, C_C.7, C_C.11, C_C.12, C_C.13, C_C.14, C_C.15, C_C.24	<u>2,6,9</u>
L_C.4	<u>5,9</u>
L_C.6	<u>2,5,8</u>

Table 9 Relation of code of each transect with the number of the management card



## Annex.11. Layers of interactive map

In the following link is shown in a better resolution the layers of the interactive map and the final Rete ZUB connection in QGIS software:

<https://drive.google.com/drive/u/0/folders/16UxoE9nuxfhniir3OCxLSorxU3i-9hJp>

In the folder of “Layers initial” is shown:

- Area of municipalities (*Dati\_statistici\_popolazione\_2011\_2014.shp*)
- Fontanile of Lombardy (*Fontanili\_della\_Lombardia.shp*)
- Important fontanile (*Rilevanze\_Fontanili\_attivi.shp*)
- Point layer of municipalities (*Municipalities\_ZUB.shp*)
- Previous connection of Rete ZUB (*Rete\_ZUB\_Conessioni.shp*)
- Previous node of Rete ZUB (*Rete\_ZUB\_Nodi.shp*)
- Important irrigation canal in Rete ZUB (*Rilevanze\_Rete\_irrigua.shp*)

In the folder of “Layers Rete ZUB” is shown:

- Connection of Rete ZUB (*Connectors.shp*)
- Critical points of Rete ZUB (*Critical\_points.shp*)
- Interest points of Rete ZUB (*Interest\_points.shp*)
- Potential node of Rete ZUB (*Potential\_node.shp*)
- Rest areas (*Rest\_areas.shp*)