



---

## ANNEX 2

### *Well Field Dravlje valley in Ljubljana (PA2.1)*

## SET-UP OF PILOT-SPECIFIC MANAGEMENT PRACTICES

### D.T2.1.2 Transnational case review of best management practices in pilot actions

# BEST MANAGEMENT PRACTICES REPORT IN PILOT ACTION

---

*“ WELL FIELD DRAVLJE VALLEY IN LJUBLJANA ”*

---

FINAL VERSION

09. 2017

---





Contributors, name and surname	Institution
Barbara Čenčur Curk	University of Ljubljana, NTF
Anja Torkar	University of Ljubljana, NTF
Jerca Praprotnik Kastelic	University of Ljubljana, NTF
Primož Banovec	University of Ljubljana, FGG
Ajda Cilenšek	University of Ljubljana, FGG
Matej Cerk	University of Ljubljana, FGG
Branka Bračič Železnik	Public Water Utility JP VO-KA



## Table of Contents

1. Introduction.....	3
2. Land use, drinking water and flood protection in the Pilot Action .....	4
2.1. Land use .....	4
2.2. Drinking water protection .....	5
2.3. Flooding issue .....	6
2.4. Other land restrictions .....	7
3. Best Management Practices .....	9
3.1. Forest.....	9
3.2. Grassland.....	9
3.3. Agriculture.....	10
3.4. Urban areas (settlements) .....	10
3.5. Industrial areas .....	12
3.6. Tourism .....	13
3.7. Transport units .....	13
3.8. Flood management.....	15
4. Conclusions .....	16
5. References .....	16

# 1. Introduction

In this report best management practices are presented on the level of Pilot Action Well field Dravlje valley in Ljubljana (Figure 1), regarding potential conflicts of interest between land use management and water protection.

The aim of this report is to provide the review of best practices regarding different types of land use (agriculture, grassland, forestry) respectively vegetation cover (wetland), aiming at water protection and mitigating floods in the Pilot Action.

For this, first of all human activities have to be identified, which are posing risk to water quality and quantity; flooding and consecutive to water management. Finally, review of best management practices in the Pilot Action is presented.

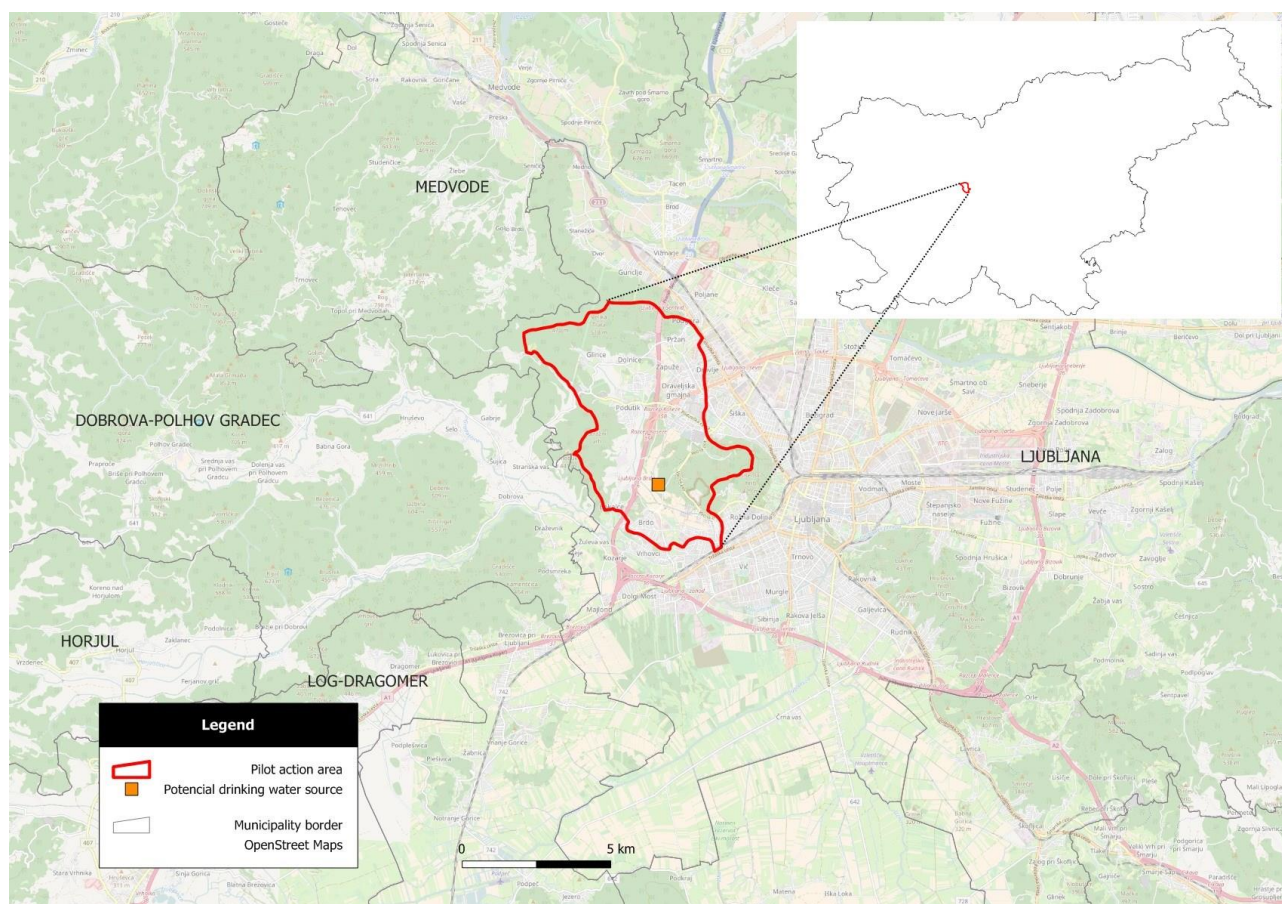


Figure 1: Pilot Action Well Field Dravlje valley

## 2. Land use, drinking water and flood protection in the Pilot Action

### 2.1. Land use

The Pilot Action (PA) area is situated in the central part of Slovenia, in the capital city of Ljubljana and it covers the area of 16.65 km<sup>2</sup>.

Figure 2 presents land use in PA Dravlje valley according to CLC 2012 map. Percentages of particular land use according to CLC level 1 and 3 are presented in Table 1 and Table 2. The largest percentage of surface is covered with forest and semi natural areas (45.3 %), following with artificial surfaces (30.6 %); the least of the surface belongs to agricultural areas (24.1%).

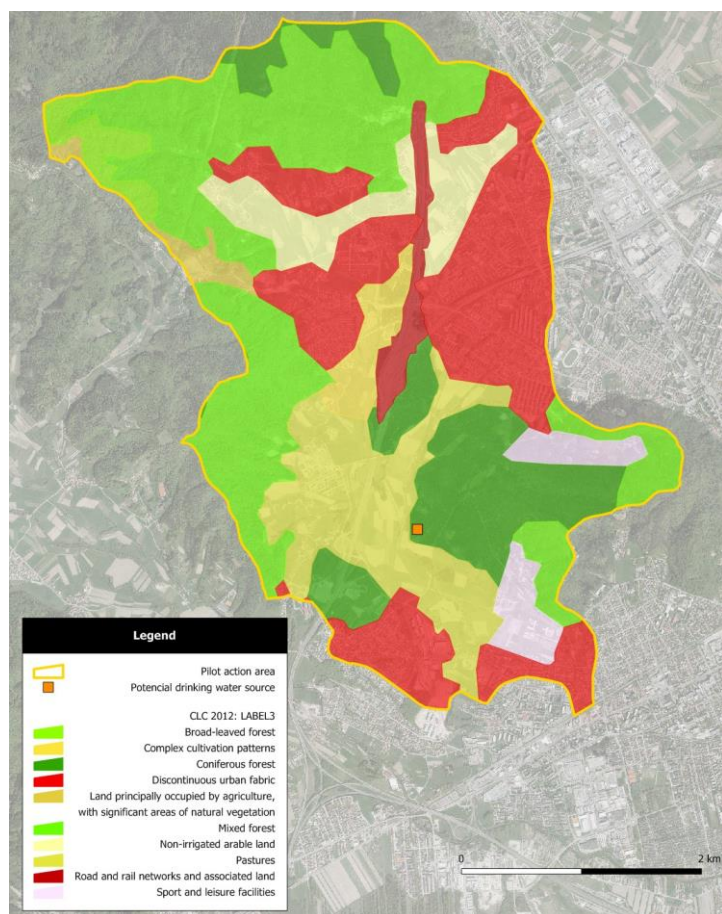


Figure 2: Corine land cover 2012 map (ARSO, 2017)

Table 1: Corine land cover 2012 - share of land use (level 1)

CLC code	LABEL1	Surface area (km2)	Share (%)
100	Artificial surfaces	5.099	30.6%
200	Agricultural areas	4.008	24.1%
300	Forest and semi natural areas	7.546	45.3%





Table 2: Corine land cover 2012 (level 3)

CLC code	LABEL1	LABEL3	Surface area (km2)
112	Artificial surfaces	Discontinuous urban fabric	4.118
122	Artificial surfaces	Road and rail networks and associated land	0.378
142	Artificial surfaces	Sport and leisure facilities	0.603
211	Agricultural areas	Non-irrigated arable land	1.102
231	Agricultural areas	Pastures	2.230
242	Agricultural areas	Complex cultivation patterns	0.445
243	Agricultural areas	Land principally occupied by agriculture, with significant areas of natural vegetation	0.231
311	Forest and semi natural areas	Broad-leaved forest	0.366
312	Forest and semi natural areas	Coniferous forest	2.307
313	Forest and semi natural areas	Mixed forest	4.873

## 2.2. Groundwater quantity and quality

In the PA Area only piezometer exists on west edge of Ljubljansko polje, therefore measurements are not completely reliable and more piezometers have to be set up in this area. Groundwater quantity of 100 l/s was determined in this piezometer OP-12/03. The Aquifer is completely covered with 12 m thick clay layer and protected from any pollution and the groundwater quality is good. Also Ljubljana's ring road does not present threat although it runs through the valley (PETAUER, 2003).

## 2.3. Drinking water protection

Drinking water protection zones (DWPZ) are established for the purpose of the protection of groundwater and surface water sources. The rules are described in the Rules on criteria for the designation of a water protection zone (Official Gazette of the Republic of Slovenia 64/2004, 5/2006, 58/2011, 15/2016). DWPZ are divided into inner areas due to different levels of protection:

wider area with the moderate protection regime (III)

- subzone with milder protection regime (IIIA)
- subzone with mild protection regime (IIIB)

narrow area with the rigorous (strict) protection of the water protection regime (II)

- subzone with strict protection regime (IIA)
- subzone with less strict protection regime (IIB)

the narrowest area with the most rigorous protection regime (I)

Pilot Action Dravlje valley lies at the border of two groundwater bodies (Figure 3): the Ljubljansko polje aquifer (pink border) and the Ljubljansko barje aquifer (blue border) and DWPZs for both aquifers.

Pilot Action Dravlje is a location for potential water well filed, which is for now only a reserved area in the Spatial plan of the Municipality of Ljubljana. DWPZs (Figure 3) of Ljubljansko polje aquifer and the Ljubljansko barje aquifer cover 71.7% (11.94 km<sup>2</sup>) of the Pilot Action area. DWPZs of the Ljubljansko polje aquifer in the northern part of the area are narrow areas with the rigorous protection regime (IIB) and wider area with moderate protection regime (IIIA and IIB). In the southern area DWPZ of the Ljubljansko barje are wider areas with moderate protection regime (III).

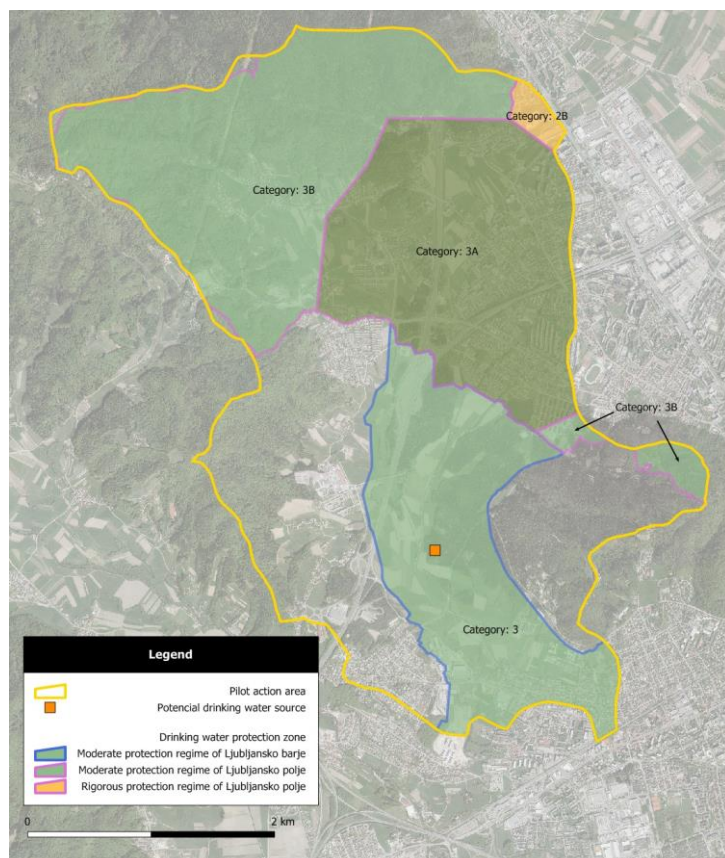


Figure 3: Drinking water protection zone map (ARSO, 2017)

## 2.4. Flooding issue

Floods are present in the PA area. In the last decade, two major flood events happened in the area: 18th - 20th September 2010 and 22nd October 2014. High water levels are caused by intensive rainfall and are the most critical due to the relatively small basin (16.6 km<sup>2</sup>). Glinščica stream (Figure 4) is regulated practically in its entire length. The riverbed is made from concrete and there are concrete panels on some parts of the bank.



Figure 4 displays the flood hazard map, which shows the potential adverse consequences associated with different flood hazard.

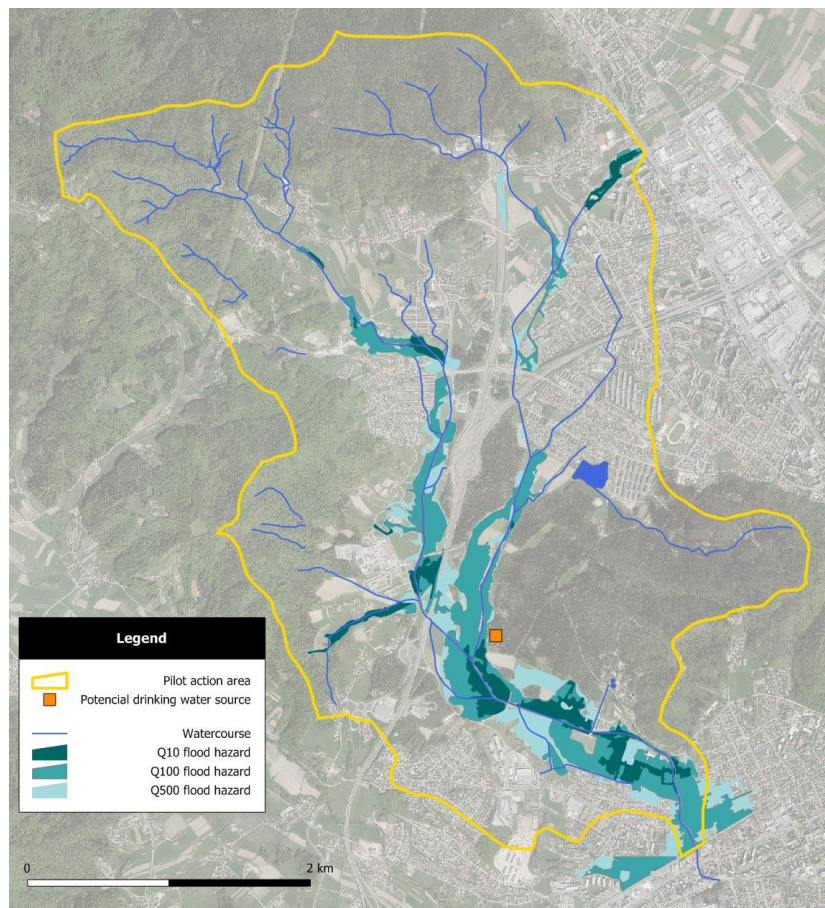


Figure 4: Flood hazard map (ARSO, 2017)

## 2.5. Other land restrictions

In the PA area there are also other areas with restrictions (Figure 5): two nature parks and several natural heritages locations.

In the PA area several water permits and water consents are issued (Figure 6). Water permits are for private groundwater use (mostly wells, also some springs); for the most of them water use is not defined. In cases where water use is defined it is for geothermal water use and own (private) water supply. Water consents are for interventions in space on water areas, such as crossings of road or other infrastructure (cables, sewage, pipeline...), auxiliary buildings, water course regulations, etc.

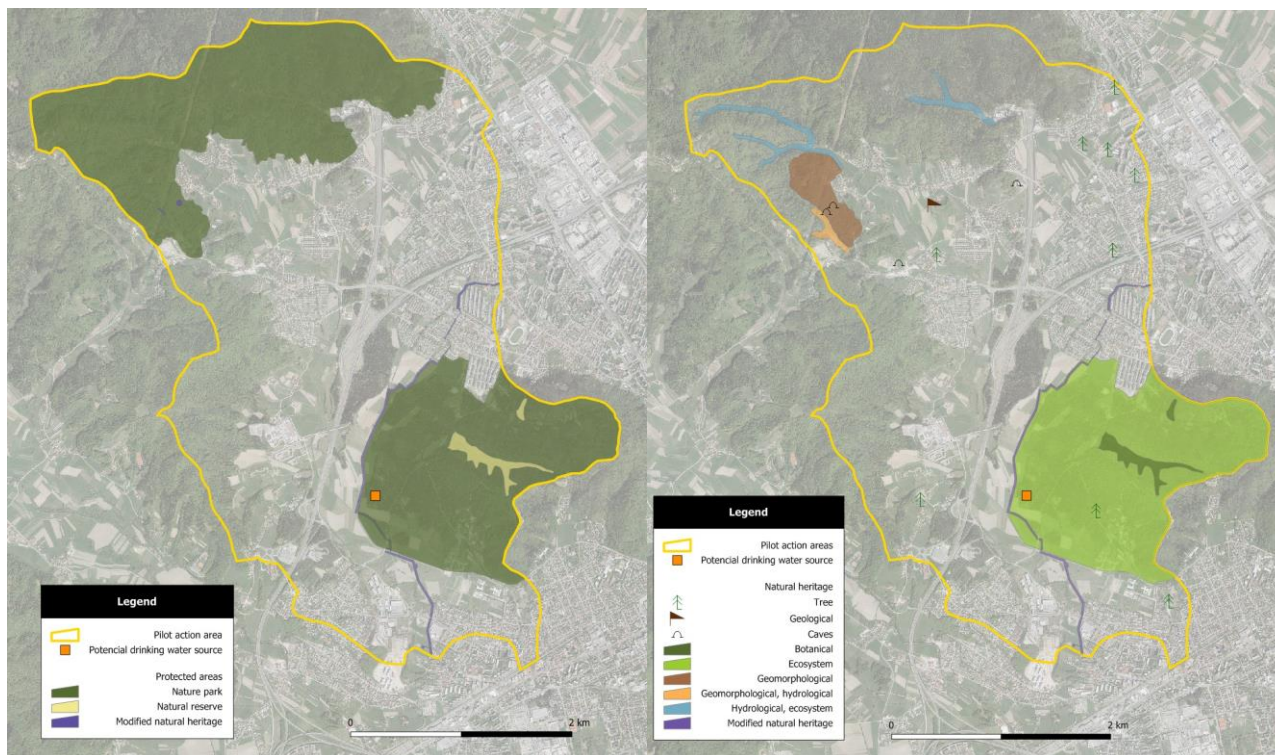


Figure 5: Protected areas map (left) and natural heritage map (right) (ARSO, 2017)

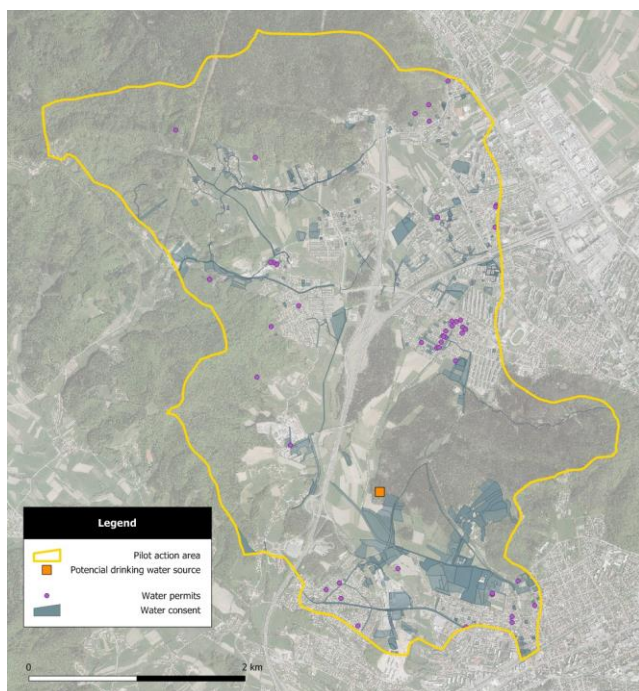


Figure 6: Map of water permits and water consent (ARSO, 2017)





## 3. Best Management Practices

### 3.1. Forest

In the PA area forests are divided into mixed forest (64.6%), coniferous forest (30.6%) and broad-leaved forests (4.9%); see Figure 2. Because the forests are within the city, they are called the urban forests, where the importance of two main production functions of the forest, timber production and hunting management, are not present. The main functions of the urban forests are environmental function (climatic, biological, hydrological), since they preserve biodiversity and protect valuable natural features (Smrekar et al., 2011). The social functions are also very important, such as hygienic health function and recreational function.

Fertilization with manure, liquid manure and slurry is forbidden in forests in all DWPZ.

#### Advantages:

- fertilization is not allowed due to DWPZ
- due to urban forest no clear cuts or timber productions are present

#### Challenges:

- dominance of tourism over forest protection

### 3.2. Grassland

According to the CLC, grassland covers less than 15% of the PA area (Table 2) and is mostly presented as pastures; some parts are areas of natural vegetation. Around half of the grassland is within DWPZ, where ploughing of permanent grassland is prohibited. From harvesting period in autumn until 1<sup>st</sup> March it is forbidden to use mineral fertilizers containing nitrogen and similar period starting one month later it is forbidden to use manure and slurry. Outside the time ban mineral fertilizers containing nitrogen can be used for permanent grassland where the maximum permitted amount of nitrogen must not exceed 50 kg N/ha for each mowing.

#### Advantages:

- enhancing and preserving drinking water sources

#### Challenges:

- diminishing applications of fertilizers in the period, when it is not allowed
- establishing control over the purchased and used quantity of fertilizers



### 3.3. Agriculture

Agriculture covers around 10% of the PA area and all is inside the DWPZ III (wider area with the moderate protection regime).

On such areas it is forbidden to fertilize without a fertilization plan, which has to be written and must be available to the competent inspector at the time of inspection, if requested. The fertilization plan must contain information on the type and amount of mineral or organic fertilizer used for each crop.

The manure and slurry storage must be large enough to storage manure and slurry for at least six months and must contain up to 170 kg/ha of nitrogen according to the fertilization plan.

#### Advantages:

- regular inspections and supervision carried out by the Inspectorate of the RS for Agriculture, Forestry, Food and the Environment
- subsidies for limitations for use of fertilizers

#### Challenges:

- establishing control on use of fertilizers in the time ban
- establishing control of the purchased and used quantity of fertilizers
- establishing control of storages of manure and slurry (sealing, quantities, etc.)

### 3.4. Urban areas (settlements)

Sewage system and individual small wastewater treatment plants (WWTP) are present in the PA area, but some septic tanks can still be found (Table 3). The sewage network must be regularly supervised because a leaking network may cause environmental pollution (VOKA, 2017a).

**Table 3: Type of households connections in the PAA**

Type of connection	No. of people	No. of households
Sewage system	20494	3250
Individual WWTP	84	23
Septic tank	1676	478
Total	22256	3751

Figure 7 shows sewage system in the Dravlje PA area and all associated technological facilities. Within Dravlje PA area is one small WWTP, called Smodinovec, with capacity 70 PE and secondary treatment - biological treatment with activated sludge (VOKA, 2017b).

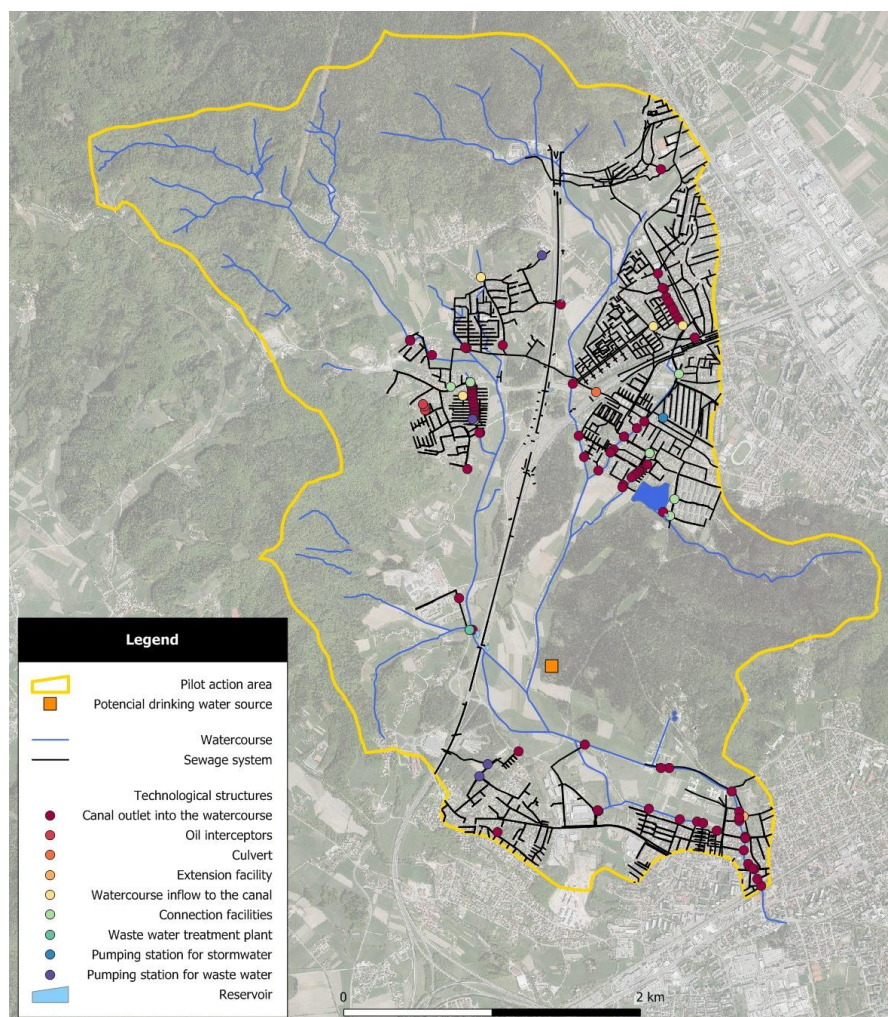


Figure 7: Sewage system with technological structures (GURS, GJI, 6.3.2017)

Efficiency of WWTP Smodinovec is shown in Table 4 and is in line with limit values on COD and BOD<sub>5</sub> defined in the Decree on the discharge and treatment of urban wastewater (Official gazette No. 98/15).

Table 4: Efficiency of WWTP Smodinovec for COD and BOD<sub>5</sub> (VOKA, 2017b)

Year	After COD [%]	After BOD <sub>5</sub> [%]
2016	79,06	81,63
2015	91,79	96,81
2014	72,45	81,89
2013	90,0	93,4

#### Advantages:

- existing local sewage system



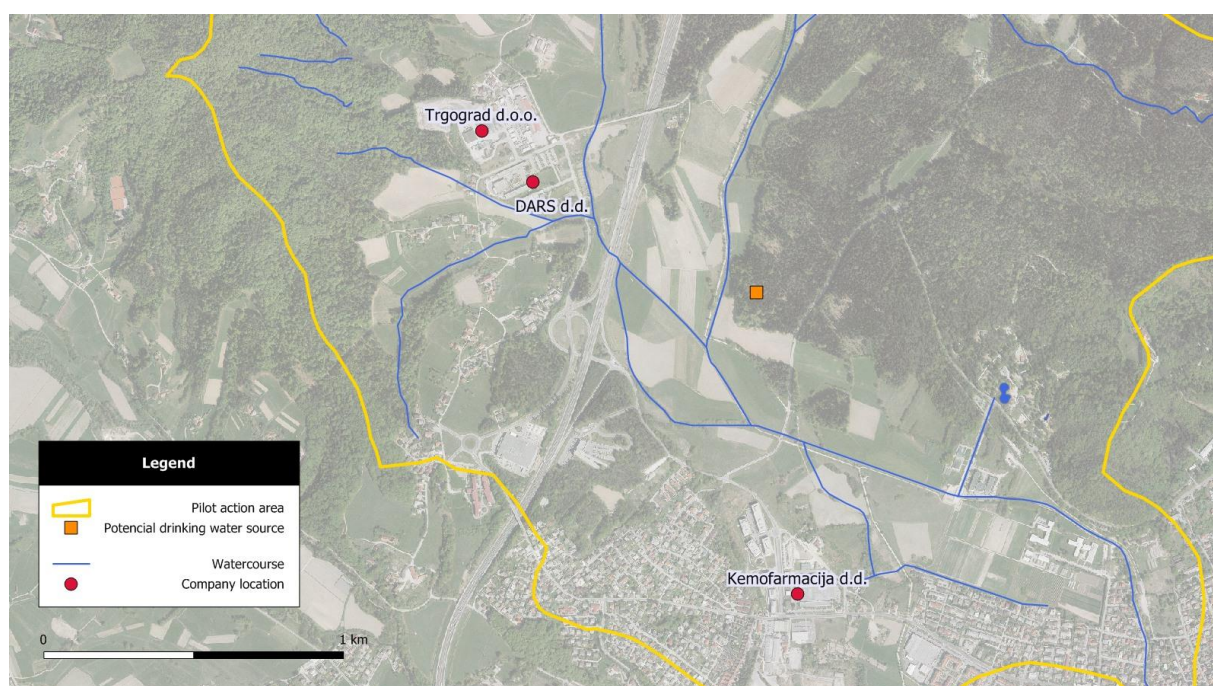
### Challenges:

- establishing of control of local sewage condition
- establishing of control of septic tanks (quantities, cleaning etc.)

## 3.5. Industrial areas

There are only few companies, which can impact on environment and waters in Dravljje valley pilot action area (Figure 8):

Kemofarmacija d.d. - In addition to medications and medical devices the sales program also includes cosmetics, dietary supplements, chemicals and a variety of services for customers and suppliers. Primary wholesaling business is based on the principles of existing European good distribution practices and legislative requirements. Besides authorization to sell medicinal products, they also have a license to produce medicines. This includes the manufacturing processes within the scope of secondary repackaging of registered medicinal products for human and veterinary use. Work in accordance with ISO 9001 has been established since 1998 and upgraded in accordance with new versions of the standard. Specific categories of products, such as chemicals, medications and cooled products are stored in a special, separate room (Kemofarmacija, 2017).



**Figure 8: Locations of the companies, which can impact on environment and waters**

Trgograd d.o.o. - Quality assurance is achieved by own control and laboratory, which monitors all phases of work, from production to the incorporation of asphalt mixture. The capacity of the asphalt plant Smodinovec is 180 tonnes of mixture per hour. They have a production of low temperature asphalt mixtures with the use of foamed bitumen and the use of recycled asphalt in the asphalt mixtures (Trgograd, 2017).



Figure 9: Asphalt production in business zone Smolinovec (Google maps, 2017)

DARS d.d. Avtocestna baza Ljubljana - grit material storage for the highway maintainance.

Advantage:

- internal control of waste and exhausts

Challenge:

- establishing of control of activities impacting on environment and waters

### 3.6. Tourism

In the PA area is the biggest zoo in Slovenia. Ljubljana zoo operates since 1949 and it occupies 19.6 ha with 6.5 km walking paths and over 200.000 visitors every year. There are also many walking paths in both natural parks. Toško Čelo hill (NW part of the PA area) is a very popular destination for hiking and cycling.

Advantage:

- natural areas

Challenge:

- establishing of control of runoff and sewage waters

### 3.7. Transport units

Motorways and roads are present in the Dravljje valley PA area (Figure 10). Through the entire PA area runs the Western part of Ljubljana's ring road, which is one of the busiest roads in Slovenia due to the strategically important position and the concentrated economic life in the capital city.



Waste water from roads is managed with Decree on the emission of substances in the discharge of meteoric water from public roads (Official Gazette of the Republic of Slovenia 47/2005), which define measures to reduce emissions due to discharge of meteoric waste water from public roads, limits of emissions into water and public sewer system for meteoric waste water from public roads and evaluation and measurement of emissions.

In winter freezing of road surfaces is prevented with solvents (salt) and sands. Environmentally unfriendly solvents are allowed to use only in the minimum necessary quantities. For solvents only such device should be used, that enables accurate dosing quantities. The dosing quantities of solvent should take into account the amount of solvent that it is already on the road.

Negative impact on water quality can have also the use of pesticides on the roadsides.

#### Advantages:

- arranged road rainwater discharge on motorway main roads and on majority of side roads

#### Challenges:

- to prevent excessive use of solvents in winter
- to prevent application of fertilizers on the roadsides
- to collect and to control road rainwater discharge, particularly in the area of planned Koseze

#### Waterworks

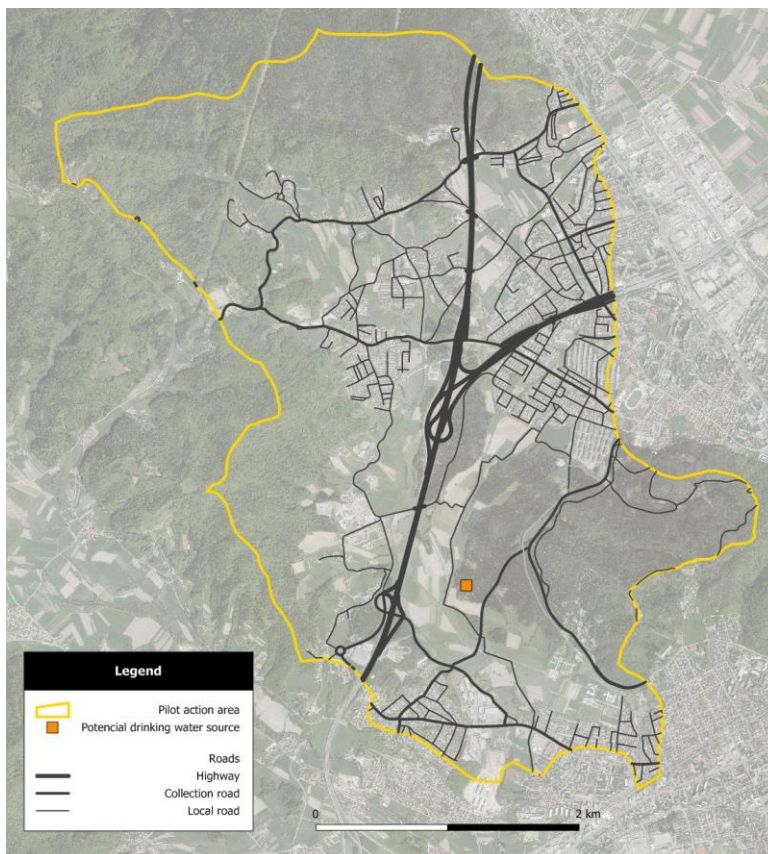


Figure 10: Map of roads in the PA Dravlje valley (GURS, GJI, 6.3.2017)

### 3.8. Flood management

Because floods are present in the Dravlje valley PA area, some measures have already been performed. Construction of dry reservoir Brdnikova (

Figure 11) and all associated functional structures will significantly reduce the risk of flooding of existing residential and other buildings downstream of the wider urbanized area of Rožna Dolina and the southwestern part of Ljubljana in Glinščica river basin. Road re-construction with the implementation of the dyke has started this spring (2017).

Other planned flood protection measures (Environmental report, 2011) are:

- small retention areas,
- drainage of rainwater into the closed channel,
- pipe culverts,
- flood protection walls,
- cant.

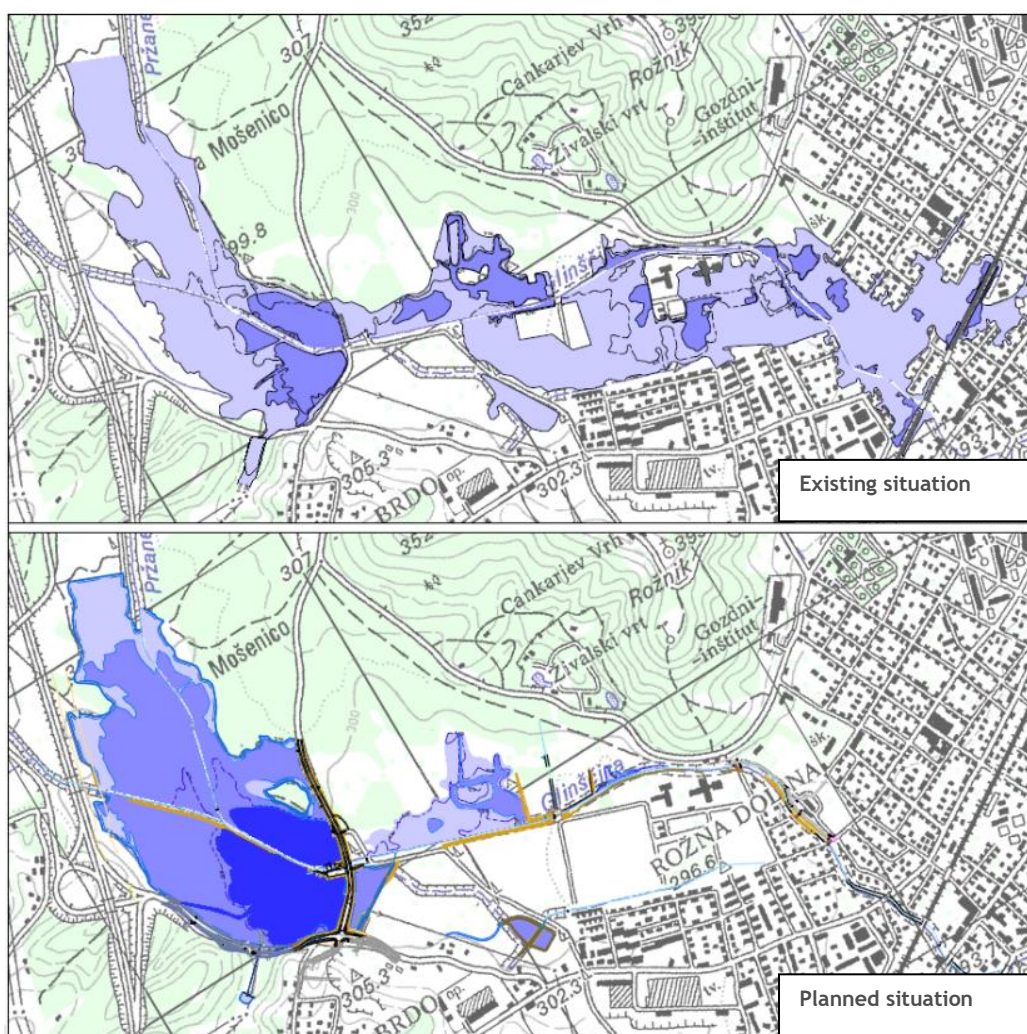


Figure 11: Existing and planned situation after construction of reservoir Brdnikova (Ordinance proposal, 2012).

Advantages:

- flood protection area with measures and limitations

Challenges:

- monitoring of flood events and permanent validation of flood hazard maps

### 3.9. Protected areas

In the PA there are two nature parks: Nature park Tivoli, Rožnik and Šišenski hill and also the natural park Polhograjski Dolomiti. In these parks activities are limited according to Ordinance for each Nature park in order to protect nature.

Advantages:

- limited activities in nature parks for the protection of nature

Challenges:

- inspection of activities in nature parks

## 4. Conclusions

In Slovenia, legislation regarding water and nature protection is very good. We can define many BMPs already from legislation, but the main problem is their implementation.

Challenges in supervision and inspection of implementation of best management practices will be studied in the continuation of the PROLINE-CE project. The biggest challenge to implement BMPs into daily operation and even more challenging is implementation of BMPs into legislation in order to become obligatory. For coping with these challenges several interactive workshops with key stakeholders are planned.

## 5. References

Decree, 2015. Decree on the discharge and treatment of urban wastewater (OG, no. 98/15). Available at: <http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED6951>

Environmental report, 2011. Okoljsko poročilo za občinski podrobni prostorski načrt za območje zadrževalnika Brdnikova. Municipality Ljubljana. Available at: [http://ppmol.org/urbanizem5/upload/documents/okoljsko-poroilo\\_zadrzevalnik\\_brdnikova.pdf](http://ppmol.org/urbanizem5/upload/documents/okoljsko-poroilo_zadrzevalnik_brdnikova.pdf)





Kemofarmacija, 2017. Quality. Kemofarmacija d.d. Available at:

<https://www.kemofarmacija.si/wps/wcm/connect/SL/Domov/O+nas/Kakovost/>

Ordinance proposal, 2012. Predlog Odloka o občinskem podrobnem prostorskem načrtu za območje zadrževalnika Brdnikova. Available at: [https://www.ljubljana.si/assets/Seje/15446/6.-](https://www.ljubljana.si/assets/Seje/15446/6.-toka---oppn---brdnikova.pdf)

[toka---oppn---brdnikova.pdf](https://www.ljubljana.si/assets/Seje/15446/6.-toka---oppn---brdnikova.pdf)

Petauer D. 2003. Piezometer OP-12/03, GEOKO, Ljubljana.

Smrekar, A., Erhartič, B. & Šmid Hribar, M., 2011. Krajinski Park Tivoli, Rožnik in Šišenski hrib. Georitem 16, Geografski inštitut Antona Melika ZRC SAZU, Ljubljana, 134 p. Available at: <http://giam.zrc-sazu.si/sites/default/files/9789612542917.pdf>

Trgograd, 2017. Activities / asphalt. Trgograd d.o.o. Available at:

<http://www.trgograd.net/dejavnosti/asfaltiranje.php>

VOKA, 2017a. How the sewage system functions. Public water facility Vodovod-Kanalizacija.

Available at: <http://www.vo-ka.si/en/about-company/drainage-and-treatment-waste-water/how-sewage-system-functions>

VOKA, 2017b. Čistilna naprava Smodinovec. Public water facility Vodovod-Kanalizacija. Available

at: <http://www.vo-ka.si/o-druzbi/odvajanje-ciscenje-odpadne-vode/cistilna-naprava-smodinovec>

ŽELEZNIK B., 2005. Potencialni novi viri pitne vode za mestno občino Ljubljana. Report for Public water facility Vodovod-Kanalizacija.