



D.T 2.8.1

Pilot Action: Parma Functional Urban Area

Version 1
03 2017



1. The City of Parma

1.1. Description of Parma's territory

Parma is located in northern Italy, in the region Emilia-Romagna between the Apennine Mountains and the Po Valley (Figure 1). The city covers an area of 260.8 km². The Apennine mountains are located about 15 km south. The city of Parma is bordered by the municipalities of Treccasali and Torrile in the north and by Langhirano, Felino, Sala Baganza and Collecchio in the south. All these municipalities are part of the FUA. The average altitude of the town is approximately 57 meters above sea level.

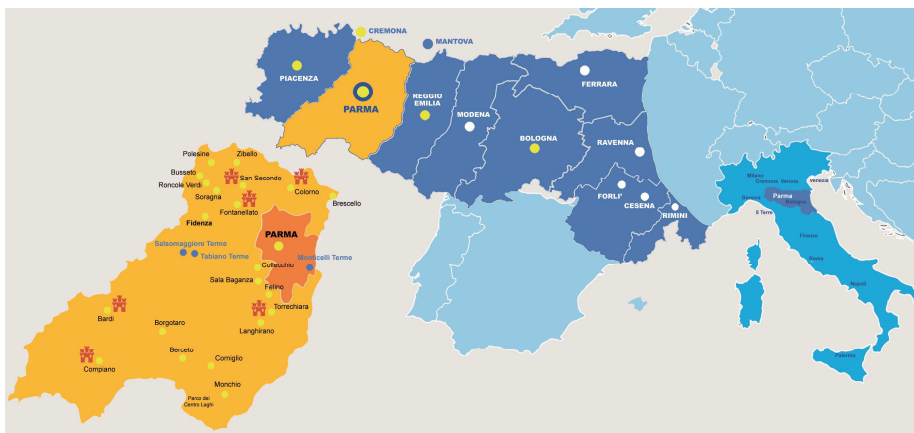


Figure 1 - Geographical framework

The municipal area is flat, the river Parma goes through the city centre and then flows into the Po, the longest Italian river; other two rivers delimit part of the boundaries, to the west the river Taro and to the east the river Enza (Figure 2).

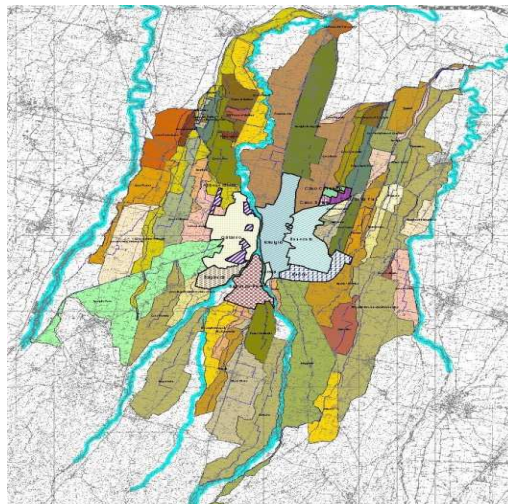


Figure 2 - Rivers in the city

The climate of Parma is typically continental: summers are hot and muggy with temperatures of about 30°C and winters are harsh, with temperatures often below zero.



On 30.9.2016 the inhabitants of the municipality were 194 563.



Figure 3: Parma Riverside “Lungoparma”

1.2. History of Parma

Parma was founded by the Romans in 183 b.C. and its Etruscan name was adapted by Romans to describe the round shield called Parma. It was the ancient capital of the Duchy of Parma and Piacenza (1545-1859), reigned by the Duchess Maria Luigia from 1814 to 1847 after the exile of her husband Napoleon.



Figure 4: Parma coat of arms

1.3. Monuments and places of interest

There are many religious monuments that characterize the town. The most famous are the Cathedral, consecrated in 1106, which is considered among the major works of Romanesque architecture in Italy, and the Baptistery of Antelami, consecrated in 1270.

The Palace of Pilotta is a set of buildings located in the historic centre; it hosts museums and the famous Farnese Theatre (Figure 5), the first European mobile theatre scene; it was destroyed by an air raid of May 1944 and rebuilt after World War II.



Figure 5: Farnese theatre

The city of Parma is universally known for the opera. The most representative building of this art is the neoclassical “Teatro Regio”, it was built in 1821 and is considered one of the most important traditional theatres in Italy (Figure 6).



Figure 6: Theater Regio



Figure 7: Garibaldi's square



Other places of interest in the city are the historic parks: the most important are the Ducal Park and the Cittadella.



Figure 8: The Ducal Park



Figure 9: Park of Cittadella

1.4. Curiosity about Parma

Since 2002 Parma is the seat of the European Authority for Food Safety Authority (EFSA). The city is seat of the Interregional Agency for the River Po (AIPO), since 1990 of the Po River Basin Authority (AdbPo) and since 1994 of the Department for Scientific Investigations (RIS) of the Police's corp with competences on the northern Italy.

In December 2015, Parma was designated "UNESCO Creative Cities for Gastronomy".



It is also the capital of the so-called “Food Valley”: it specializes in the food sector with products such as Prosciutto di Parma and Parmigiano-Reggiano (Figure 10), etc. and food-related industry such as Barilla, Parmalat.

It is the seat of the University of Parma, one of the oldest universities in the world. A part of the University, the oldest one, is located in the city centre, the other one, the Campus, is in the southern part of the city.

2. Pilot Action

The pilot area is located in the urbanized territory of the Municipality of Parma (Figure 11 and 12), and includes the historical downtown and recent settlements. The area is densely urbanized, with a concentration of residential buildings, trading and services. Historical gardens are the North boundary of the study area. The mean ground elevation is about 55 m above sea level.

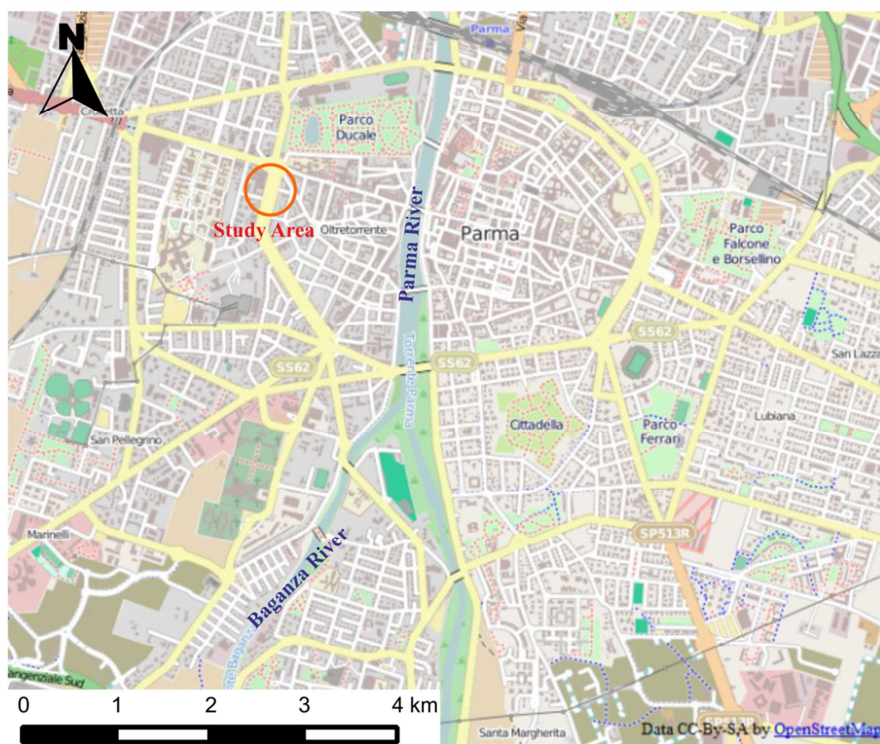


Figure 10 - City of Parma, the red circle is the pilot area



Figure 11: Pilot area, Santa Croce Square

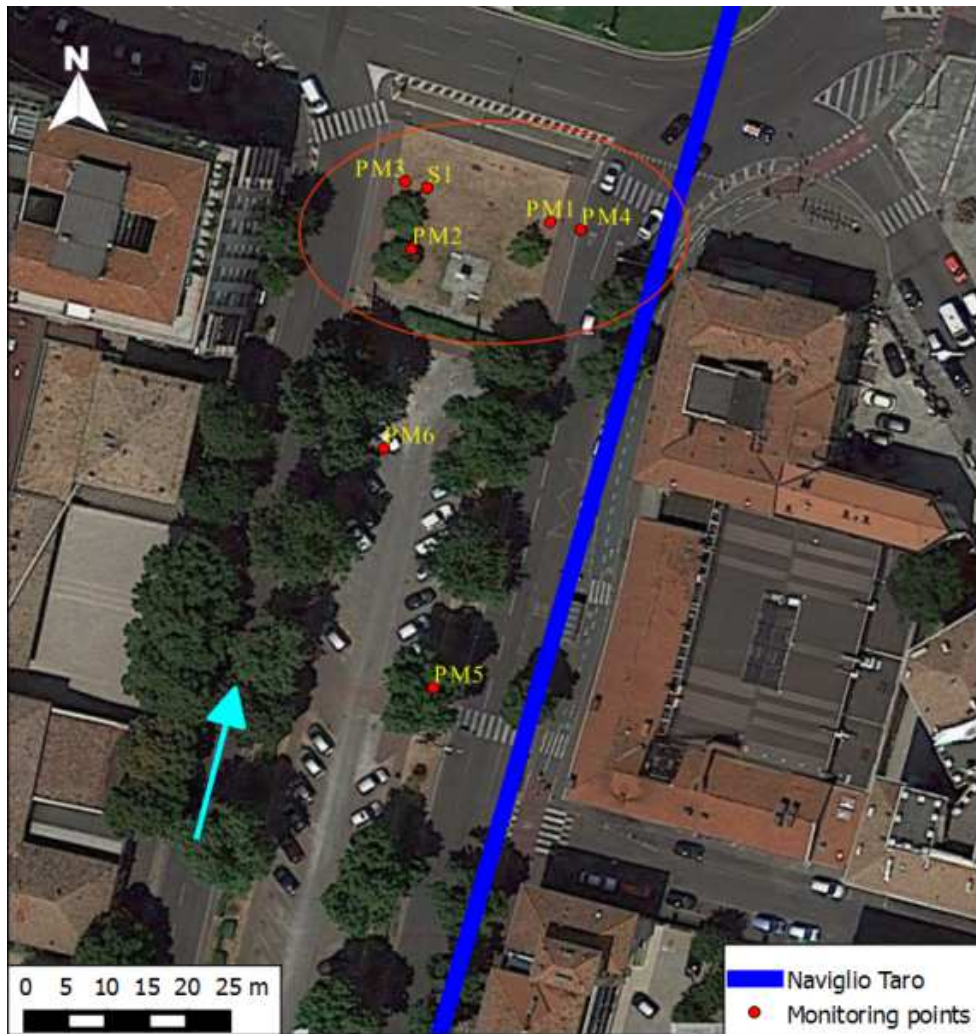


Figure 12 - Detail of the study area (red circle of Figure 1), PM are the monitoring wells, S1 is a borehole



2.1 Hydrogeology

The area presents a flat morphology softly sloping to N-NE, following the course of alluvial conoids that have been deposited by the Taro, Enza, Parma and Baganza Rivers (all the waterways flow through the municipal territory). The study area is located in hydrographic left of the Parma River (Figure 12).

The Quaternary drifts present ribbon-like and lens-like structures that lengthen following the stream that laid them down and that are mostly made of heterogeneous clastic sediments, from gravelly to clayey (with sudden spatial variations).

In detail the stratigraphic representation, based on few boreholes drilled at the site (see Figure 3), shows the following characteristics (see also Figure 13):

- 0.0 - 2.0/2.9 m Backfill
- 2.0/2.9 - 5.0 m silty clay
- 5.0 - 6.0 m silty sand
- 6.0 - 11.5 m silty clay
- 11.5 - 16.0 m gravel and sand.

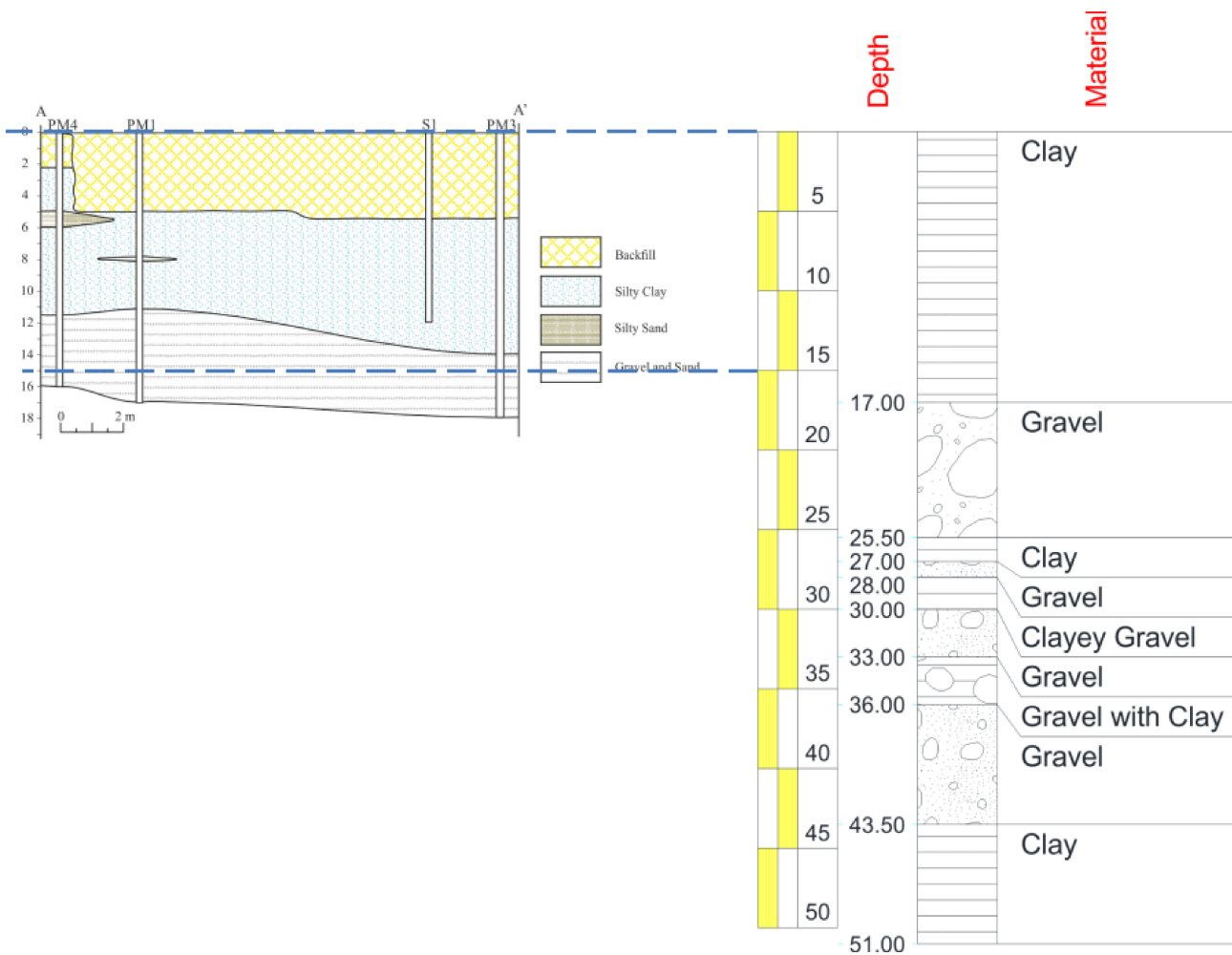


Figure 13 - Cross section of the study area

Locally the hydrostratigraphic system is composed of aquifer reservoirs, juxtapose and overlapping and partially or totally isolated by barriers of permeability made of sedimentary bodies whose predominant element is fine.

The first significant groundwater level, in the pilot area, is generally located around 10 m depth; it presents a direction in N-NE. According to the data, the groundwater interested by the pollution is between 9.0 to 12.0 m depth. The first aquifer that feeds the city aqueduct is 36.00 m deep the ground level.

2.2 Contamination

The first information about the groundwater pollution (presence of hydrocarbons, Methyl tert-butyl ether, BTEX) was collected in 2002 during a reclamation procedure on an area in which was located a gas station. At the end of the procedure the sampling analysis showed PCE concentrations in groundwater higher than the law limits, even in piezometers upstream the gas station.



During the last two years the PCE concentration values increase at 18-24 µg/l, see Table 1 and Figures 14-17. At the present state, the sources of the pollution are still unknown.

In February 2013 an historical analysis of the commercial activities, which potentially used PCE and were close to the pilot area in the 20-25 past years, has been carried out (no reported here for brevity).

Table 1 PCE concentration [µg/l] at monitoring points

DATE	PM1	PM2	PM3	PM4	PM5	PM6
30/06/05	2.8	9.30	0.11	0.82		
06/09/05	10	12.00	1.0	7.0		
27/10/05			6.0			
30/11/05	16.4	2.30	0.16	5.30		
28/02/06	4.3	13.50	1.75	10.70		
12/04/06					11.92	13.08
21/02/07	8.15	13.54	0.34	8.93	13.4	12.73
14/06/07	9.73	11.88	0	7.34	12.16	16.23
29/11/11	13.7		12.40		13.36	
26/03/12	10.12		1.63		12.40	
25/06/13	11.0		0.77		16.40	
24/03/15	18.84		6.98		24.48	

Actual knowledge doesn't allow to identify the source of the pollution and the extent of the plume; for this reason it is necessary to design and improve the environmental investigations.

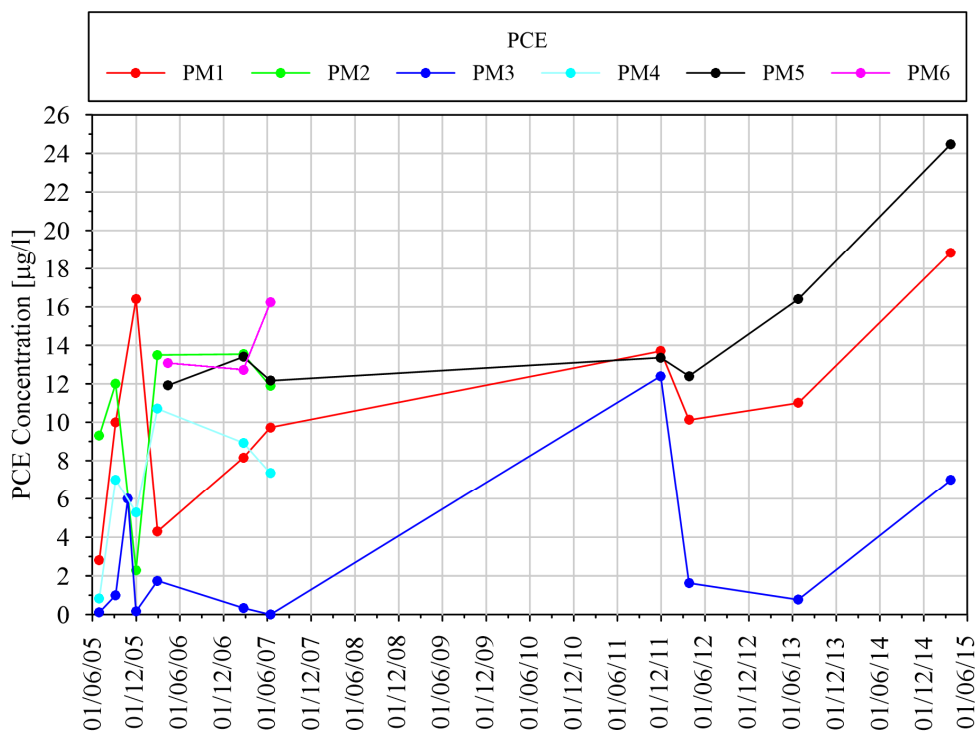




Figure 14 - PCE concentration at the monitoring wells

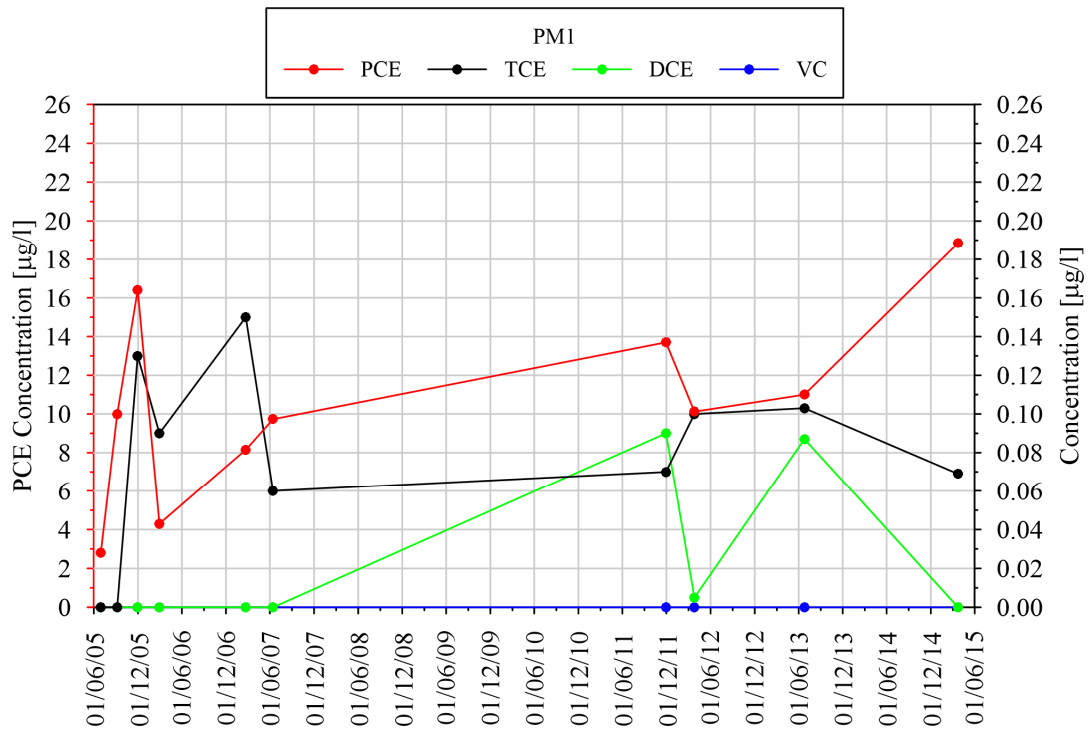


Figure 15 - PCE concentration at PM1

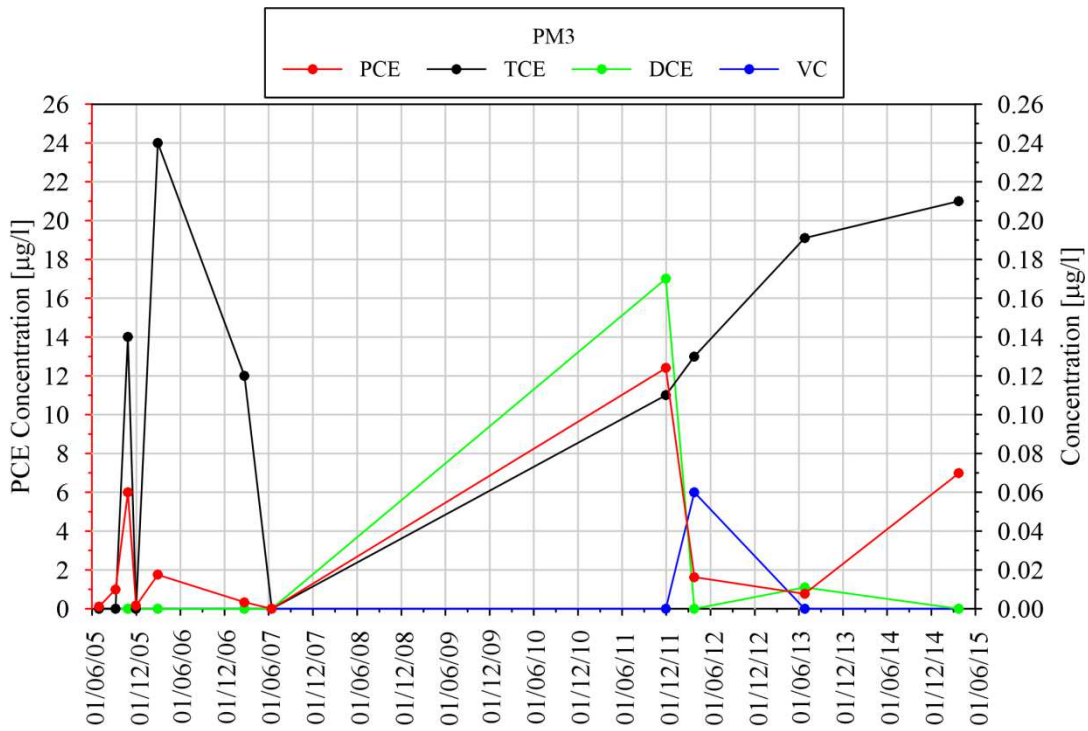


Figure 16 - PCE concentration at PM3

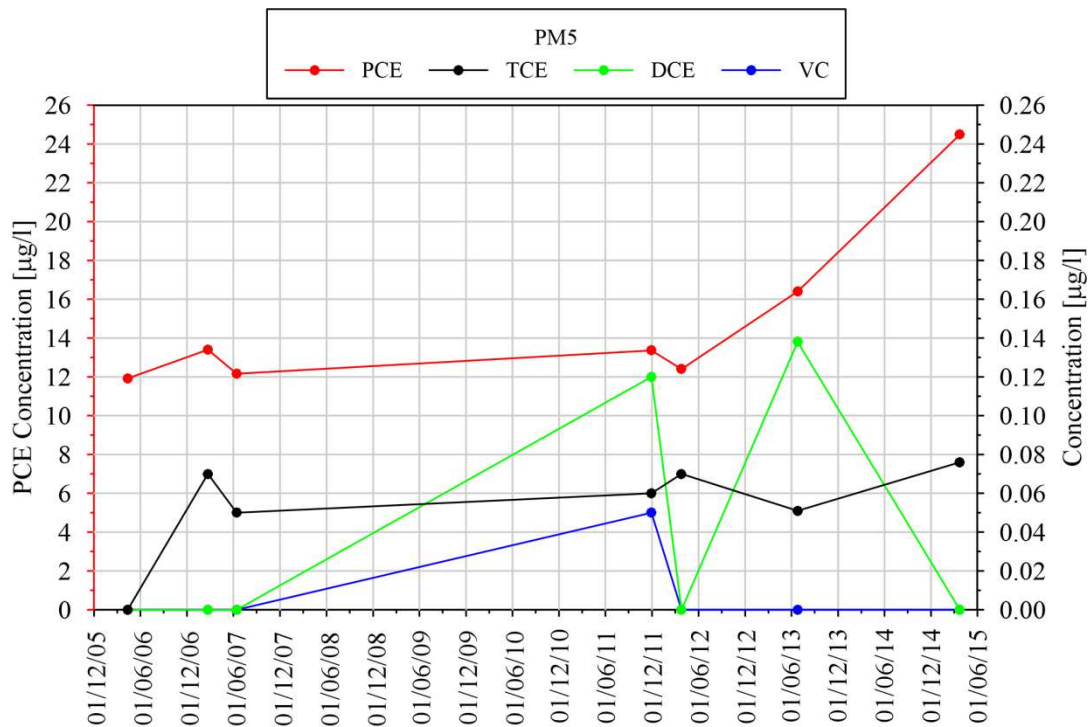


Figure 17 - PCE concentration at PM5

2.3 ACTIONS

According to the Italian laws (D.lgs. 152/06 e smi), at the present state it is impossible to find the responsible, the sources and the extent of the pollution. The Municipality of Parma has to schedule a campaign of environmental investigations with the aim to define the polluted site and the level of contaminations; then reclamation procedures should be designed.

3. Goals

The law in force indicates that PCE concentrations in groundwater should not exceed 1.1 µg/l. As said in the first paragraph the area is strongly urbanized, so that it will be necessary to bring back the PCE values to the limits allowed by the law or verify the possibility to isolate the source of pollution.

It is important to underline that there are many wells throughout the city, feeding the aqueduct; even if the groundwater pulled out are in a greater deep than the ones interested by the pollution phenomenon described here, it is absolutely important to verify the possibility of contamination between the shallow groundwater and the productive one.

The objectives of the project at the pilot site are:

- increase the knowledge on the contamination;



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- identify the plume spread;
 - monitor the plume evolution;
 - investigate non-invasive remediation technologies;
 - investigate the possibility to apply the Natural Attenuation.