

# Description of Rimini water supply system

## 1. Study area

The Romagna region is a portion of the administrative Italian region called Emilia-Romagna and it is identified by the three provinces of Ravenna, Forlì-Cesena and Rimini (Figure 1). It is located in northern Italy, framed between the Apennines mountain chain in the south-west and the Adriatic Sea in the east. The climate on the Romagna coast is warm and temperate, with annual rainfall between 550 and 750 mm and a mean annual temperature between 12 and 14 °C, summer months are warm but not necessarily dry. Average annual rainfall increases substantially in the more humid Apennine region, reaching values up to 1850 mm/year, mainly due to the orographic lift.



Figure 1. Location of the study area in the administrative region of Emilia-Romagna. Red line delimitates the three Romagna provinces.

## 2. Regional water supply system

### 2.1 Regional water supplier: Romagna acque società delle Fonti S.p.a.

All the drinking water supply in the Romagna provinces is provided by “Romagna Acque – Società delle Fonti Spa”. The company provides wholesale water to the main retail water companies (99% Hera S.p.A) in the three provinces, which include more than one million permanent resident and millions of tourists.

Romagna Acque owns and manages all drinking water sources for civil use in Romagna: the company deals with water collection/abstraction, subsequent treatment (purification or other intermediate process) and delivery to the integrated water service provider (in some cases via transit in water holding tanks).

Around half of water for the Romagna region is drawn from the Ridracoli reservoir, but all Romagna provinces have other surface and subsurface sources. Such water is treated in various purification plants, which provide the mains supply of “Acquedotto della Romagna” (Romagna Aqueduct), water network covering more than 600 km (Figure 2). It starts at the Capaccio water treatment plant, which treats water coming from the Ridracoli Dam, and connects the majority of the municipalities in the region.

Depending on the case, local water sources (as wellfields and other purification plants) can deliver water directly to the distribution networks of the retail water companies or release it into the Romagna Aqueduct.

Table 1 reports the entire amount of water delivered to the retail water companies in the past years in the Romagna region.



Figure 2. “Acquedotto della Romagna” (Romagna Aqueduct) water network, which link the Ridracoli reservoir to the majority of the municipalities in the Romagna region.

Table 1. Total annual volume delivered to the water retail companies by Romagna Acque – Società delle Fonti Spa

	Volume (m <sup>3</sup> )
2009	108'675'833
2010	106'639'574
2011	111'865'370
2012	112'746'041
2013	107'764'245
2014	106'524'558
2015	110'726'173
2016	110'977'560
2017	115'428'870
2018	113'571'724

## 2.2 The Ridracoli reservoir

The most important source is the artificial reservoir of the Ridracoli Dam (south-west in Figure 2), located in the Apennines, which meets about 50% of the total regional water requirement (about 60 Mm<sup>3</sup>/year). It has a capacity of 33 Mm<sup>3</sup>.

As explained in Figure 3, water can reach the reservoir:

- directly from the hydrographic basin closed at the dam itself (delimited by the orange contour).
- through four diversion watersheds linked to the reservoir through a system of weirs (blue circles) and underground water channels (red line).

Thus, the reservoir is able to collect water from a total drainage area covering 85.1 km<sup>2</sup> approximately (38.9 km<sup>2</sup> of the direct basin, and 46.2 km<sup>2</sup> of the additional diversion watersheds). The water withdrawn from the reservoir is treated few kilometres downstream at the Capaccio water treatment plant, from which the main pipeline of the Romagna Aqueduct starts. It has a maximum flow capacity of 2.2 m<sup>3</sup>/s. Table 2 reports the annual volume of water withdrawn and treated from the reservoir.



Figure 3. Ridracoli reservoir system: orange contour refers to the hydrographic basin closed at the dam, blue circles to the weirs in the diversion watersheds and red line to the underground channel.

*Table 2. Annual volume of water withdrawn from the Ridracoli reservoir*

	<b>Treated volume (m<sup>3</sup>)</b>
1996	53'708'660
1997	58'650'720
1998	57'630'230
1999	56'024'410
2000	54'936'000
2001	56'031'850
2002	43'994'820
2003	56'471'310
2004	57'883'120
2005	60'631'340
2006	56'225'040
2007	39'828'785
2008	51'753'846
2009	54'928'104
2010	61'828'456
2011	50'905'669
2012	40'105'498
2013	58'930'388
2014	56'433'666
2015	54'696'437
2016	54'004'839
2017	44'960'769
2018	58'468'155

### **3. Rimini water supply**

The province of Rimini, as can be observed in Figure 2, is fed by multiple water sources:

- water coming from the Ridracoli reservoir through the Romagna Aqueduct
- wellfields extracting groundwater from the alluvial fan of Marecchia river, which goes through the city of Rimini itself. The maximum annual volume that can be extracted from the whole fan is fixed to 24 Mm<sup>3</sup> by license.
- Wellfields extracting groundwater from the alluvial fan of Conca river (south of Rimini). The maximum annual volume that can be extracted from the whole fan is fixed to 3.7 Mm<sup>3</sup> by license.
- Conca reservoir: a little reservoir with a capacity of 1.5 Mm<sup>3</sup> for drinking water use, located between the municipality of Rimini and Riccione. It can be used only in summer months (for a maximum of 3 Mm<sup>3</sup>), but in the last years it has not been activated, due to water quality issues.

As anticipated, all the above-mentioned water sources are managed by Romagna Acque, who sell the water to Hera Spa that is the only retail water company in the Province. Hera manages the water distribution network from the Romagna Acque input points to the customers. Customers pay the water to Hera, who bills the

customers based on traditional, mechanical water meters with reading that should be made once per year. On the other hand, Romagna Acque bills Hera monthly, allowing a finer metering of the delivered water. However, the municipality of Rimini is hydraulically connected through Hera water distribution network to the neighbouring municipalities of Santarcangelo (not touristic little city uphill) and Riccione (another very touristic village on the coast immediately south of Rimini). For this reason, it is not possible (as far as we know) to divide the water delivered by Romagna Acque to Hera between these municipalities, and thus any consideration on the source and the origin of the delivered water has to be made referring to the three cities together.

During summer months, less than 20% of water distributed usually comes from the Ridracoli Dam (Romagna Aqueduct) while all the rest comes mainly from groundwater wellfields (in the past there was also some marginal contribute of the Conca reservoir); during the other months of the year, Ridracoli may supply up to the 40/50% of the water volumes. Table 3 reports the annual volume of water delivered from Romagna Acque in the last years through the Romagna Aqueduct and through the local sources (mainly groundwater from wellfields). Similarly, Figure 4 shows the monthly water volume distributed in the same period: the blue portion of the bar refers to local sources while the red one to the Ridracoli Aqueduct.

Except for the years 2009 and 2010, when the company was still not managing all water sources, it can be noticed that in drier years the portion of water coming from local sources increases. In fact, dry years as 2011, 2012 and 2017 present a higher contribute of the local wellfields, due to the fact that surface water is scanty and water coming from Ridracoli feeds other municipalities in the region, which have no availability of local water sources. On the other hand, in wet years as 2013 and 2016 Ridracoli dam is able to supply great part of the regional demand and so, also in Rimini, the company gives priority to such water, which is of better quality, more sustainable (less water is extracted from the alluvial fans) and cheaper (no need of pumping cost).

*Table 3. Annual volume of water delivered by Romagna Acque to the three municipalities of Rimini, Riccione and Santarcangelo*

	Volume (m <sup>3</sup> )		
	Romagna Aqueduct	Local sources	Total
2009	2'914'929	26'030'359	28'945'288
2010	4'479'039	22'571'862	27'050'901
2011	4'607'591	22'640'450	27'248'041
2012	3'579'074	24'236'421	27'815'495
2013	6'687'403	19'500'450	26'187'853
2014	5'960'254	20'684'549	26'644'803
2015	5'537'304	21'891'406	27'428'710
2016	7'502'980	19'777'994	27'280'974
2017	5'163'533	23'069'336	28'232'869
2018	6'612'159	20'455'923	27'068'082
2019	4'560'050	22'147'804	26'707'854

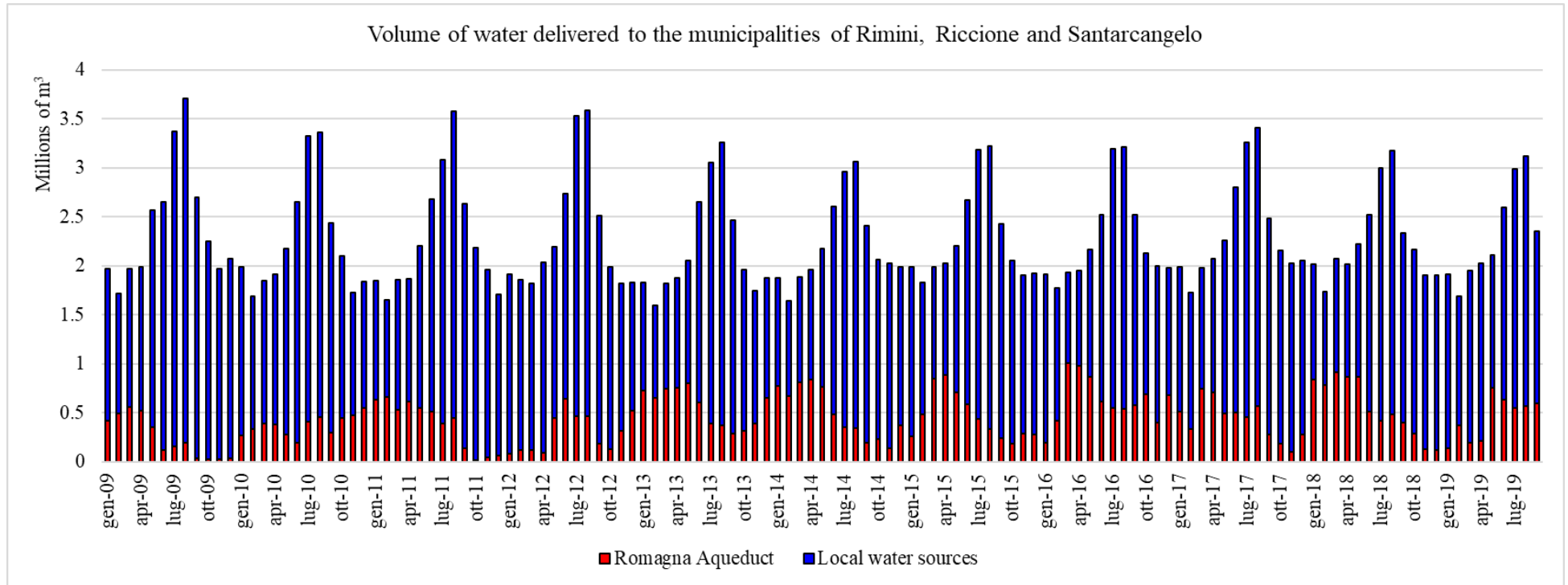


Table 3. Monthly volume of water delivered by Romagna Acque to the three municipalities of Rimini, Riccione and Santarcangelo from different sources.