

INVESTMENT FACT SHEET

I2 Installation of integral monitoring wells in Stuttgart FUA (DE) to achieve efficient monitoring of remediation activities

Project index number and acronym	CE32 AMIIGA
Responsible partner (PP name and number)	PP3 State Capital of Stuttgart
Linked to pilot action (number and title)	Pilot action 7: Integral monitoring of remedial measures efficiency in Stuttgart FUA (DE)
Project website	www.interreg-central.eu/Content.Node/AMIIGA.html
Delivery date	06.2019

Description and technical characteristics of the investment

Three additional monitoring wells were constructed:

- (i) AMIIGA 1 with a depth of 32 m in order to check the vertical percolation of CHCs in the area of depression, built in the major groundwater aquifer BH,
- (ii) AMIIGA 2 with a depth of 94 m in order to extend the monitoring network in deep mineral water aquifer, built in the mineral water aquifer Upper Muschelkalk and
- (iii) AMIIGA 3 with a depth of 22 m to capture the northeastern gradient and to describe, evaluate and quantify a possible vertical transfer of CHCs to deeper aquifers, built in the major groundwater aquifer BH.

The proposal for the Investment I2 included a drilling of six wells in Stuttgart-Feuerbach to optimize and improve the existing monitoring network. According to the Application Form, it was planned to drill:

- (i) four wells in shallow aquifers with a depth of approximately 20 m and
- (ii) two wells in deep aquifers with a depth up to 40 m.

The exact location of the wells had to be defined by means of hydrogeological and numerical models (A.T2.7). At the project begin, an extensive data acquisition, field measurements and the first evaluation of the flow and contaminant situation in Feuerbach were performed (D.T2.7.1-D.T2.7.5). The results showed the significant change in flow conditions compared with the previous knowledge about the upper aquifer system and the lack of data for the deep aquifer system. On the expert panel conducted in Ljubljana in May 2017, these issues were thoroughly discussed. As a result, it was decided to split the drilling into two campaigns:

- × Campaign 1: One shallow and one deep monitoring well (AMIIGA 1 and AMIIGA 2) drilled ahead of schedule to provide the necessary data for the development of the numerical model. The locations of the wells were defined by the results of the conceptual models (D.T2.7.5 and D.T2.7.9).
- × Campaign 2: One shallow monitoring well located according to more targeted definition by simulating different scenarios with the numerical models (D.T2.7.6 and D.T2.7.7).

The drilling of the well AMIIGA 1 was performed in November 2017. The well was drilled up to 31.9 m depth in aquifer "Grenzdolomit". The screening section was built in the upper aquifer "Bochinger Horizont" (from 15.3 m to 21.3 m depth), since the highest CHC contamination was detected at this level. The lower part was up to 21.3 m depth filled with appropriate cement mixture. The diameter of the well is 5".

The drilling of the well AMIIGA 2 was performed from November 2017 until January 2018. The well was firstly drilled up to 84 m depth in the aquifer "Upper Muschelkalk". The water level measurement of the new well indicated that there might not be enough water in this part of the aquifer. Therefore, it was necessary to further drill the well up to 94 m depth. Drilling such a deep well is a benefit to the project, since the knowledge about the deep aquifer and the understanding of flow situation considerably increased. In order to decide on screening sections of the well, flowmeter measurements were performed. Two screening sections were built (from 72 m to 82 m depth and from 85 m to 94 m depth), both in aquifer "Upper Muschelkalk". The diameter of the well is 6".

AMIIGA 3 was drilled and built from March to April 2019. The well was positioned according to the results of the numerical modelling in the northeast direction of AMIIGA 1. The drilling depth was 22 m with a drilling diameter of 324 mm. The screening section was built with a diameter of 5" in the "Bochinger Horizont" as main aquifer of the upper aquifer system from 18.10 to 21.10 m depth.

The deviations from planned activities and proposed schedule of the Investment I2 are listed below:

- × Significant change in flow conditions compared to the previous knowledge (decrease of groundwater levels for up to more than 8 m) caused several deviations from the work plan:
 - (i) Existing numerical models for flow and transport could not be applied. Therefore, a new numerical model had to be developed to properly and reliably simulate the flow and contaminant situation. Since there was a lack of data for the main aquifers of the upper (Bochinger Horizont) and the deep (Upper Muschelkalk) system that had to be tackled for the development of the numerical model, one shallow and one deep monitoring well (AMIIGA 1 and 2) had to be drilled ahead of schedule.
 - (ii) Positioning of new shallow well AMIIGA 3 required additional evaluation. The exact location of this well was based on updated hydrogeological and new numerical model due to significant differences in hydrogeological conditions. Using the numerical model for positioning the new well AMIIGA 3 is a great advantage, for the location could be selected reliably and goal-oriented determined. Since the development of the numerical model requires more time than planned, the drilling of the well was postponed.
- × In the Application Form, the depth of deep wells was estimated to 40 m. The depth of a well is dependent on the position (on a hill or in the valley). The well AMIIGA 2 had to be positioned in a location that required a drilling depth of 94 m. Due to this depth the local water authority had additional requirements regarding drilling technique protecting the mineral water aquifer "Upper Muschelkalk". The drilling of the deep monitoring well AMIIGA 2 was much more complex and costly as planned. All this caused considerable additional costs for drilling, consultant activities and flowmeter measurements.
- × Consequently, the available budget for drilling of four planned shallow wells is decreased. Therefore, at most one shallow well could be drilled in the second drilling campaign in order to stick to the proposed budget.

The reduction of number of wells didn't cause any significant disadvantage for defining the integral monitoring network, since in the past years many additional wells were drilled in Stuttgart-Feuerbach and can be used for

AMIIGA purposes. Furthermore, positioning of wells by means of numerical model gave a goal-oriented and reliable location. The goal of the Pilot Action to establish an integral monitoring network could only be achieved by adapting the action plan according to the field situation. The total drilling meters of all new wells (148 m) remained approximately the same as planned (160 m).

Investment costs (EUR) including a break-down of main cost items

The municipality of Stuttgart spent for the investment 136,990.05 EUR.

Drilling of well AMIIGA 1: total costs 30,047.62 EUR

- Site facilities (set up, maintain and removal of the construction site): 5,057.50 EUR
- Operational safety (Traffic signs, fences): 2,945.25 EUR
- Pavement works and disposal of soil material: 862.75 EUR
- Warfare material investigation: 1,285.20 EUR
- Drilling 32 m: 7,796.88 EUR
- Construction of the well: 4,309.70 EUR
- Pump tests: 6,307.00 EUR
- Sampling: 379,61 EUR
- Additional measures: 1,103.73 EUR

Drilling of well AMIIGA 2: total costs 68,425.89 EUR

- Site facilities (set up, maintain and removal of the construction site): 8,240.75 EUR
- Operational safety (Traffic signs, fences): 2,861.95 EUR
- Pavement works and disposal of soil material: 2,025.98 EUR
- Warfare material investigation: 273.70 EUR
- Drilling 94 m: 33,599.06 EUR
- Construction of the well: 12,872.23 EUR
- Sampling: 1.122,17 EUR
- Additional measures: 7,430.06 EUR

Drilling of well AMIIGA 3: total costs 38,516.54 EUR

- Site facilities (set up, maintain and removal of the construction site): 20,051.50 EUR
- Operational safety (Traffic signs, fences): 2,320.50 EUR
- Pavement works and disposal of soil material: 2,929.35 EUR
- Warfare material investigation: 199.92 EUR
- Drilling 22 m: 4,362.54 EUR
- Construction of the well: 3,383.88 EUR
- Pump tests: 2,142.00 EUR
- Additional measures: 3,126.84 EUR

Investment location

NUTS 3	Address (Street, house number, postal code, city, country)	GPS coordinates
DE111 Stuttgart - city region	AMIIGA 1: Sankt-Pöltener-Straße 29, 70469 Stuttgart, Germany AMIIGA 2: Krailenshaldenstraße, 70469 Stuttgart, Germany AMIIGA 3: Wiener Straße 42, 70469 Stuttgart, Germany	AMIIGA 1: 511818.4; 5406438.42 AMIIGA 2: 513182.2; 5407224.75 AMIIGA 3: 512020.45; 5406683.67

Duration and process of investment implementation

Start date	End date
11.2017	04.2019

Major milestones of investment implementation

AMIIGA 1: 11/2017
 AMIIGA 2: 01/2018
 AMIIGA 3: 04/2019

Ownership and durability of the investment (e.g. maintenance, financing)

The three monitoring wells belong to the municipality, department for environmental protection.

References to related pilot action (output fact sheet) and relevant deliverables (e.g. pilot action report, studies) and web-links.

If applicable, additional documentation, pictures or images to be provided as annex

- O.T2.7.1 Integral monitoring of remedial measures efficiency in Stuttgart FUA (DE)
- Documentation on procurement procedure for new GW-wells (DT2.7.10)
- Report on installation of shallow wells (DT2.7.11)
- Report on installation of deep wells (DT2.7.12)
- Final brochure (DC5.2) [Download](#)

All mentioned deliverables have been uploaded to the eMS and can be requested at: sandra.vasin@stuttgart.de



Figure 1: Drilled well AMIIGA 1



Figure 2: Drilled well AMIIGA 2



Figure 3: Drilled well AMIIGA 3