

OUTPUT FACT SHEET

Pilot actions (including investment, if applicable)

Version 2

Project index number and acronym	CE32 AMIIGA
Lead partner	Główny Instytut Górnictwa
Output number and title	Output O.I6.1.1; Treatment and restoring of natural conditions of groundwaters in Novy Bydzov FUA
Investment number and title (if applicable)	O.I6.1 Treatment and restoring of natural conditions of groundwaters in Novy Bydzov FUA (CZ)
Responsible partner (PP name and number)	Technical University of Liberec / PP5
Project website	http://www.interreg-central.eu/Content.Node/AMIIGA.html
Delivery date	03.2019

Summary description of the pilot action (including investment, if applicable) explaining its experimental nature and demonstration character

The investment consists of five new monitoring wells and 3 multi-level monitoring systems (more details concerning this work can be found in the uploaded deliverable evidence D.T2.5.1). The drilling works were performed by the contractor of Technical University of Liberec - DEKONTA a.s; the work was monitored by project partner 4 (PP4; Novy Bydzov city and Forsapi company). The partner PP4 has supported also activities of Technical University of Liberec via mutual cooperation in site infrastructure preparation, external expert of PP4 and project team assistance - communication with properties owners, entrance on private properties for Technical University of Liberec experts and their technics and equipment. Installation and drilling of the wells was carried out using the HVS 144 drilling rig. Five monitoring wells with the depth of approx. 6 - 8 m were built. Monitoring wells were dug by direct push (vibration drilling) with a diameter of 63 mm. The wells were equipped with a polypropylene (PP) casing with an outside diameter of 32 mm and an internal diameter of 25 mm.

The second part of the Investement 6 consisted of purchasing and injection of the biomaterial (cheese whey) in three rounds. According to the project, the application of cheese whey was carried out by a direct-push pressure method into narrow-profile, provisionally equipped boreholes. For injection there were used the Geoprobe 7822DT drilling rig and the Wanner G10 injection pump.

First application was performed from 3.10.2017 to 6.10.2017. Container (15 cubic meters (7.5 undiluted)) was installed at the site and a diluted cheese whey (taken from "Polabské mlékárny") at a temperature of about 40 °C was pumped into it on 3.10.2017. To this container there was added 12 kg NaOH for the pH adjustment and during 3.10.2017 and 4.10.2017 this mixture was applied to 5 probes. Subsequently, an additional 15 cubic meters (7.5 undiluted) of cheese whey was taken on 5.10.2017, again 12 kg of NaOH was added, and during the 5.10 and 6.10 the mixture was pumped into the remaining 5 probes.

Second cheese whey application round was performed from 5.12.2017 to 7.12.2017. Cheese whey (15 cubic meters (7.5 undiluted)) was again taken from "Polabské mlékárny" with the temperature of about 40 °C. Again NaOH was added (20 kg) in order to adjust the pH and the mixture was applied to 5 wells. Subsequently, additional 15 cubic meters (7.5 undiluted) of cheese whey were transported 6.12, again supplemented with 20kg of NaOH, and within 6-7.12 mixture was pumped to the remaining 5 wells.

Third application of cheese whey was performed 24 - 25.5.2018. Container (15 cubic meters (7.5 undiluted)) was installed at the site and a diluted cheese whey (taken from "Polabské mlékárny") at a temperature of about 40 °C was pumped into it on 24 and 25.10.2017. To this container there was added 15 kg NaOH for the pH adjustment and during 24.5.2018 and 25.5.2018 this mixture was applied to 4 probes (overall there were 10 injection points). The flow of cheese whey during the application was around 25 to 30 L/min. It was noted that previous applications of cheese whey did not sufficiently influence probes MR-4 and MR-5, therefore the 3rd cheese whey application was performed near to this area. Thanks to the invented by Technical University of Liberec - BMT tools as well as chemical analyses it was possible to assure the effective and sustainable remediation (in addition to performed by PP4 - 5 monitoring rounds of the whole Novy Bydzov FUA, additional operational 15 monitoring rounds at the locality during the treatment were performed; samples were taken for chemical, BMT and isotopic analyses; more details can be found in the uploaded deliverable evidences D.T2.5.5, D.T2.5.6 and D.T2.5.7). The innovative BMT tool was developed in WP1 by Technical University of Liberec and was continuously tested and successfully validated *in situ* in the frames of WP2 and Investement 6.

NUTS region(s) concerned by the pilot action (relevant NUTS level)

Nuts0: CZ, CZECH REPUBLIC
 Nuts1: CZ0, Česká Republika
 Nuts2: CZ05, Severovýchod
 Nuts3: CZ052, Královéhradecký kraj

Investment costs (EUR), if applicable

35 298,43 Euro

Budget article	Sum, Euro
BL.5 Equipment PP5: Consumables and chemicals for analysis and testing within I.6: tubes for solution mixing, tips for qPCR analysis, pipettes for solution preparation, plastic bottles for groundwater sampling, isolation kits, standards for analysis, kits for measurement of DNA concentration from environmental samples, cuvette tests for measurement of physico-chemical parameters of water, etc.	13 347,92 Euro
BL6 Infrastructure and works PP5: Works and services within the Investment 6 at the pilot site of Novy Bydzov carried out by Dekonta company: <ul style="list-style-type: none"> - drilling, installation of monitoring wells and installation of micropumps; - selection of the most appropriate reagents (in cooperation with TUL and Photonwater) on the basis of the laboratory test; - application of the reagents with the help of direct push technology using temporary wells (3 rounds); - presentation of the carried out works. PP4: Works and services within the Investment 6 at the pilot site of Novy Bydzov carried out by the city of Novy Bydzov: <ul style="list-style-type: none"> - preparation of the site; - renting and restoring the land (localities) for the implementation of pilot activities; - maintenance of newly built monitoring boreholes. 	16 419,51 Euro 5 531 Euro
Total costs spent within I.6. (incl. VAT)	35 298,43 Euro

Expected impact and benefits of the pilot action for the concerned territory and target groups and leverage of additional funds (if applicable)

The implementation of an investment contributes to improvement of groundwater quality at FUA Novy Bydzov as well as EU capacity to select cost-effective & appropriate remedial options for groundwater body management. The major social benefit of investment is the improvement of groundwater quality in Novy Bydzov in a very sustainable (green) process. Due to the fact that the treatment was made on a site located at many private properties, one of the main beneficiaries of this biotreatment are people to which these properties belong. The quality of water in the water wells on these properties has been improved. The major beneficiary of scientific results is Technical University of Liberec (PP5) and water authorities as well as remediation and engineering companies that provided and supervised the remediation processes (Dekonta / Photon Water Technology). Thanks to the results obtained within the AMIGA project, Technical University of Liberec enlarged the knowledge base on the sustainable control of the *in situ* attenuated bioremediation process and this will result in scientific publications as well as sharing the knowledge on various national and international conferences. The greatest benefit of the AMIGA project for the state of the environment in FUA Nový Bydžov was the refinement of information for the solution of remedial measures, which led to the design of the Management Plan for the removal of groundwater pollution. This effort was crowned with the approval of MP by the Czech Ministry of Environment, which allocates 3.2 million euros for the removal of pollution in FUA Nový Bydžov for next period (2019-2023). The demonstrated remedial technology (Biologically enhanced Reductive Dehalogenation) will be applied as the main remedial technology in the full scale remediation in the next period (2019-2023) in the FUA Novy Bydzov.

Sustainability of the pilot action results and transferability to other territories and stakeholders.

The results of the Novy Bydzov pilot action have scientific (one scientific publication will be created from herein obtained results) and practical benefit related to evaluation of treatment results. We have demonstrated that the BMT results, generated for such locality, can be very reliable, and conclusions drawn from them, can be correlated very well with the chemical analyses.

Moreover, the BMT tool that was developed in the frame of WP1 and validated in the frame of WP2 can be used by different institutions at different territories. We have demonstrated that the use of controlled biotreatment process can bring great value to site treatment in FUA and the results were shared and distributed as a good practice to all partners and stakeholders. The demonstrated remedial technology (Biologically enhanced Reductive Dehalogenation) will be applied as the main remedial technology in the full scale remediation in the next period (2019-2023) in the FUA Novy Bydzov

Lessons learned and added value of transnational cooperation of the pilot action implementation (including investment, if applicable)

The pilot action was well planned, and we gained satisfying results. The transnational cooperation of Technical University of Liberec (Czech Republic) with Polytechnic University of Milan, PoliMi (PP7) within the AMIGA project can be considered as a great success. Polytechnic University of Milan have a very well equipped laboratory and expert scientists/technicians, thanks to which, we were able to perform Compound-Specific Isotope Analysis (CSIA) on the Novy Bydzov groundwater samples and by this understand better the conducted bioremediation process on site. Thus collaborative results can help us in publishing valuable results, where both BMT and CSIA are used. Pilot Action 2.5 was discussed in detail during each Partner Meetings and in Expert Panel workshops. Experts of other partners contributed to improving knowledge about the hydrogeological aspects, sources and transport of pollution in the FUA NB and helped to solve how to mitigate groundwater pollution. The special Expert Panel workshop was dedicated to Pilot action 2.5 in February 2019 in Milan. All lessons learned from the pilot action 2.5 are publicly available to all partners who can benefit from the lessons learned.

Contribution to/ compliance with:

- relevant regulatory requirements
- sustainable development - environmental effects. In case of risk of negative effects, mitigation measures introduced
- horizontal principles such as equal opportunities and non-discrimination

- The biotreatment is considered as very effective and sustainable way of remediation. Also during the pilot action in Novy Bydzov we have demonstrated how toxic substances can be eliminated from the environment without the use of often dangerous chemical remediation agents (for example hydrogen peroxide or ozone).
- Within the AMIGA project, both women and men amazingly contributed to the project outputs, and we believe that we had promoted equality between women and men. Moreover, during the project duration, we did not observe any discrimination on the grounds of racial or ethnic origin, religion or belief, disability, age or sexual orientation.

References to relevant deliverables (e.g. pilot action report, studies), investment factsheet and web-links

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

For further details see the website of Novy Bydzov City, which informed about AMIIGA activities in Novy Bydzov: <https://www.novybydzov.cz/projekt-amiiga/gs-1358>, and the Deliverables (D.T2.5.1 - D.T2.5.7):

- D.T2.5.1 Report on drilling of remedial application and remedial monitoring wells
- D.T2.5.2 Field sampling and laboratory analyses protocols from the initial groundwater sampling and laboratory campaign
- D.T2.5.3 Report on identification and specification of groundwater and dissolved pollution transport pathways
- D.T2.5.4 Report on the remedial laboratory test
- D.T2.5.5 Technical protocols from field remediation action
- D.T2.5.6 Report on testing of BMT tools to monitor remediation progress, efficiency and sustainability
- D.T2.5.7 Report on Pilot Action In-situ biologically enhanced attenuation

All mentioned deliverables have been uploaded to the eMS and can be requested at: stanislaw.waclawek@tul.cz e-mail. Moreover they are all available at this link: <https://drive.google.com/open?id=1epplupxHZE-p4E5JfqzTdne33qLmxoyn>