Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe

Technical review report for project VoGERA

This report is part of a project that has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement number 731166.

INTRODUCTION

Technical review report is part of GeoERA's Monitoring and evaluation process for co-funded projects (*hereinafter: project*). The aim of a technical review is to assess the work carried out under the project over a certain period and provide recommendations. Such technical review evaluates the project reports and deliverables, the proper use of resources, the management of the project and the expected impact.

Technical review report consists of four sections, each representing one level of monitoring and/or evaluation of the project:

Level	Monitor / Reviewer	Input	Aim
1 – Monitoring of progress indicators	Monitoring and reporting officer (GeoZS)	MPPR* FPPR**	Monitoring of the effectiveness of implementation of selected projects with respect to finance, time and administration.
2 – Scientific review	Reviewers (GeoZS)	Submitted deliverables MPPR FPPR	Quality review of the deliverables and review of achieving scientific and professional goals.
3 – Review of the theme progress	Theme coordinators	MPPR FPPR	Review of achieving theme objectives.
4 – GeoERA Progress evaluation	Stakeholder Council member(s)	Sections 1 and 2 of this report Review meetings	Overall project progress and general recommendations.

*MPPR = Midterm Project Progress Report (see PI doc no 2)
**FPPR = Final Project Progress Report (see PI doc no 2)

Monitoring and evaluation process:

M0 = End of reporting period
M1 = Submitted (Final) Project progress Report (MPPR / FPPR)
M2 = 1 – Monitoring & 2 – Evaluation
M3 = 3 – Evaluation of the theme progress
M3 = (Final) Review Meeting & 4 – Progress evaluation

Each project will be reviewed twice: for first project period M1-M18 – Technical review report, and second project period M19-M36 – Final review report.
Technical review report is based on Horizon 2020 templates but adopted to GeoERA needs. Technical reviews of projects shall be carried out on a confidential basis.

GENERAL INFORMATION

ERA-NET Cofund Grant Agreement:	731166
ERA-NET Cofund acronym:	GeoERA
Call identifier:	H2020-LCE-2016-2017/H2020-LCE-2016-ERA
Project full title:	Vulnerability of Shallow Groundwater Resources to Deep Sub-surface EnergyRelated Activities
Project acronym:	VoGERA
Project reference number:	GeoE171.015
Project topic:	Groundwater
Project specific topic:	GW4 – Contribute to Groundwater management and interactions with Energy and Mining in rural and urban areas
Lead partner:	NERC (UKRI) UK Research and Innovation (British Geological Survey)
Project website:	https://geoera.eu/projects/vogera1/

☐ Technical review report
☒ Final review report

Period covered	01/01/2020 – 31/10/2021
Review meeting date	30.11.2021; start at 13:00

Contributor:	Role:	Approved on:
Barbara Simić	Monitoring and reporting officer	2.12.2021
Aleksandra Trenchovska	Monitoring and reporting officer	2.12.2021
Andrej Lapanje	Scientific reviewer	6.12.2021
Jasna Šinigoj	Scientific reviewer	2.12.2021
Matija Krivic	Scientific reviewer	2.12.2021
Klaus Hinsby	Theme coordinator	4.1.2022
Marco Petitta	GeoERA Stakeholder	29.12.2021
Ad de Roo	GeoERA Stakeholder	/

1 LEVEL 1 – MONITORING OF PROGRESS INDICATORS

In this section the project is monitored "remotely" on the basis of the respective reports. This part is filled in by Monitoring and reporting officer with aim to monitor the effectiveness of implementation of the selected projects with respect to finance, time and administration, based on submited MPPR and FPPR.

	Yes	Partially (comment needed)	No
PROJECT MANAGEMENT			
Has the MPPR / FPPR report been submitted on time?	☒	See comment no. 1	☐
Have there been any changes in project partnership?	☒	See comment no. 2	☐
Has the project management been performed as required?	☒		☐
Has the collaboration between partners been effective?	☒		☐
Do you identify evidence of underperforming partners, lack of commitment or change of interest of any partners?	☐ (see comment)		☒
DELIVERABLES and MILESTONES			
Have the planned deliverables for the period been submitted on time according to timeline in Project Agreement?	☐	See comment no. 3	☒
Have the planned deliverables for the period been completed (from MPPR / FPPR, sheet 4)	☒		☐
Have any changes to deliverables occurred (type/ dissemination level)? (from MPPR / FPPR, sheet 4 and 5)	☒		☐
Have planned milestones been achieved for the reporting period? (from MPPR / FPPR, sheet 4)	☒		☐
Have the project partnership identify any difficulties achieving any of the deliverables / milestones?	☐		☒
DEVIATIONS (from MPPR / FPPR, sheet 5)			
Has the project partnership identify any deviations that will not affect projects outputs?	☒		☐
Have any deviations occur on the project, with impact on project outputs?	☐		☒
In case of deviations, have the project adopted corrective measures?	☒		☐

DISSEMINATION, COMMUNICATION			
Has the project adopted its dissemination plan?	☒		☐
Have the planned dissemination activities been completed for the reporting period? (from MPPR / FPPR, sheet 6)	☒		☐
Have the partners' disseminated project results and information adequately?	☒		☐
Is the project following dissemination plan?	☒		☐
Is the project interacting in a satisfactory manner with other GeoERA projects?	☒		☐
Is the project interacting in a satisfactory manner with national/international bodies?	☒		☐

FINANCE			
To the best of your estimate, have the resources used been utilised for achieving the project? (according to MPPR / FPPR, sheet 9)	☒		☐
To the best of your estimate, have the resources used been in a manner consisted with the principle of economy, efficiency and effectiveness?*	☒		☐
Are there any major deviations in the budget consumptions from the financial plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☒	See comment no. 4	☐
Are there any major deviations in the Person - Months consumptions from the plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☒		☐
Are any budget modifications for the project needed? (from MPPR / FPPR, sheet 5)	☐		☒

***The principles of economy, efficiency and effectiveness**: refers to the standard of "good housekeeping" in spending public money effectively. Economy can be understood as minimising the costs of resources used for an activity (input), having regard to the appropriate quality and can be linked to efficiency, which is the relationship between the outputs and the resources used to produce them. Effectiveness is concerned with measuring the extent to which the objectives have been achieved and the relationship between the intended impact and the actual impact of an activity. Cost effectiveness means the relationship between project costs and outcomes, expressed as costs per unit of outcome achieved.

Comments (highlighting the project progress) / deviations / recommendations:

The VoGERA project aimed to improve scientific understanding of the vulnerability of shallow groundwater to deep underground industrial energy activities, including geothermal energy extraction, unconventional oil and gas exploitation, sub-surface storage, and waste disposal. Human activities in the deep subsurface (the source) pose a threat to groundwater (the receptor), which is a fundamental natural resource for freshwater, economic development, and ecological diversity in the area. The project consortia focused on identifying pathways from source and recepient on 4 pilot areas, building on previously completed European projects and developing conceptual models. The main objectives of the projects were achieved when the models were used to develop the 3D Groundwater Vulnerability - 3D GWV methodology to quantify the intrinsic and specific vulnerability of groundwater resources to deep sub-surface energy related activities. The 3D Groundwater Vulnerability methodology was developed as a preliminary "qualitative" (Tier 1) groundwater risk screening tool during the planning phase or when assessing the impacts of new or hypothetical deep subsurface activities. The methodology has also been tested in the four pilot areas and has proven to be very efficient, reliable, and useful. We encourage the project consortia to formalize the methodology.

The Covid 19 epidemic had an impact on the progress of the VoGERA project. In December 2020, the project was extended by 4 months, from 30.6.2021 until 31.10.2021. The postponed project activities were appropriately communicated to the GeoERA Executive board, which has reviewed and approved the changes in terms of achieving the project outcomes. A detailed list of changes is part of the project documentation in the Project plan History of changes.

The project management structure of the smallest GeoERA Groundwater theme was well defined and efficient. The pandemic situation required a certain degree of flexibility on the part of the partnership and adaptability of its participation in the project activities. Overall, the budget has been underspent, but the Lead partner ensured that the objectives were fully met, and no under-performing partners were identified. Only one partner, GEOINFORM, ceased its activities in the second reporting period, with no impact on the project work. Their activities were finalized in the first reporting period and the unused budget was transferred to the project TACTIC.

The dissemination and communication activities of the project are adequate considering the small size of the project and the pandemic situation. Activities were mainly focused on events, e.g. congresses, webinars and workshops.

Comment no. 1: The Final Project Progress Report was submitted on time in draft form. Partners still have the opportunity to recalculate their financials by the end of the calendar year to include the final data, so minor variations can be expected. The changes will not affect the content of the project.

Comment no. 2: The project partner GEOINFORM was active during the first project period (1.7.2018 - 31.12.2019). With the beginning of the second period, it terminated its participation and reduced its budget. The remaining activities and budget have been transferred to the project TACTIC as the partner's activities in this project have been completed. The change has no impact on the project implementation or results.

Comment no. 3: Due to the pandemic situation, some activities were delayed, and results had to be submitted later than planned. The revised dates were communicated to the Monitoring team and the GeoERA Secretariat by amending the project plan. The changes in deliverables are:

The deliverable changes in the project implementation period are:

Reporting period 1:
D2.5 postponed from M5 (30.11.2018) → M40 (31.10.2021)

Reporting period 2:
D3.2 postponed from M24 (30.6.2020) → M40 (31.10.2021)
D4.2 postponed from M36 (30.6.2021) → M40 (31.10.2021)
D1.3 postponed from M38 (31.8.2021) → M40 (31.10.2021)
D1.5 postponed from M38 (31.8.2021) → M40 (31.10.2021)
D2.3 postponed from M38 (31.8.2021) → M40 (31.10.2021)
D2.6 postponed from M38 (31.8.2021) → M40 (31.10.2021)
Deliverables 3.2 (report on pilot characterization) and 3.3 (report on pilot vulnerability assessment) have been merged together.

Comment no. 4: Some project partners spent less than 80% than their planned budget. Partners that spent less than their planned budget are GEUS and NERC. The consumption of man-months followed the EUR consumption.

The project has coped well with the negative external factors and has overcome its challenges in such a way that it has achieved its planned objectives and project results. For this reason, the project is rated "excellent" at level 1 and thus receives a rating of 4 - Objectives and targets fully achieved.

Overall assessment of the project:

☐ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives)

Summary of dissemination activities:

	SCIENTIFIC COMMUNITY	GENERAL PUBLIC	POLICY MAKERS	EUROPEAN INSTITUTION	NATIONAL INSTITUTION	REGIONAL INSTITUTION	INTERNATIONAL INSTITUTION	LOCAL INSTITUTION	PRIVATE COMPANIES	OTHER	Total Target Group reach
EVENTS	64221			5							64226
MEETINGS	15			5							20
ONLINE_MEDIA	42810	5800	51	50	50	50	50	50	50	240	49201
PUBLICATIONS	5500		40		40	10	30				5620
Total	**112546**	**5800**	**91**	**60**	**90**	**60**	**80**	**50**	**50**	**240**	**119067**

	ABSTRACTS	BLOG	CONGRESS	FACEBOOK	LINKEDIN	MEETING	POSTER	RESEARCHGATE	TWITER	WEBINAR	WEBSITE	WORKSHOP	Total
EVENTS			6							4		2	12
MEETINGS						1							1
ONLINE_MEDIA		5		10	1			1	2		1		20
PUBLICATIONS	7						4						11
Total	**7**	**5**	**6**	**1**	**1**	**1**	**4**	**1**	**2**	**4**	**1**	**2**	**44**

Are the dissemination activities adequate?

☐ 5 - **Overachieved** (the projects dissemination activities have exceeded expectations)
☐ 4 - **Excellent** (the projects dissemination activities have fully achieved its expectations)
☒ 3 - **Good** (the projects dissemination activities are adequate)
☐ 2 - **Acceptable** (the projects dissemination activities are acceptable)
☐ 1 - **Unsatisfactory** (the project has failed to disseminate)

Cummulative financial statement:

	Person months	**Total eligible costs**	**Reimbursement rate**	**GeoERA contribution**	**In-kind contribution**
Plan	**50,26**	**422.523,61**	**29,7 %**	**125.489,52**	**297.034,09**
1st period consumption	16,54	124.119,82	29,7 %	36.863,59	87.256,23
2nd period consumption	31,56	243.912,43	29,7 %	72.441,99	171.470,44
TOTAL	**48,10**	**368.032,25**	**29,7 %**	**109.305,58**	**258.726,67**

2 LEVEL 2 – SCIENTIFIC REVIEW

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by reviewer with aim to review the quality of the deliverables and review of achieving scientific and professional goals. Scientific review is based on submitted deliverables and reported Impact statement in MPPR/FPPR.

Impact statement (from MPPR / FPPR, sheet 8):

The outcomes of the project have generated the following impact:

1) Research activities improved the cooperation and communication between national/regional sub-surface research institutes and European stakeholders that deal with groundwater resource management.

2) The deliverable 3.1 “Technical report on evidence for potential pathways for groundwater contamination from subsurface energy activities and investigation/ data collection plan technical report” improved knowledge-sharing across Europe, in particular in relation to intercalibration procedures and standards for geophysical and monitoring equipment used for sub-surface characterization and designing investigations to assess groundwater vulnerability to deep sub-surface industrial activities. The beneficiaries of this knowledge are sub-surface research institutes and other research communities, but also regional and local authorities and stakeholders such as drinking water supply companies can benefit from the increased understanding of the geology at the pilot sites.

3) The deliverable 4.1 “ Expanded diagrams of conceptual models identifying potential pathways for energy activity in the deep sub-surface and shallow groundwater vulnerability” presents conceptual models of groundwater vulnerability to deep sub-surface energy activities and possible contamination pathways. These models harmonized understanding and management of the groundwater vulnerability. The beneficiaries are Sub-surface research institutes and groundwater resource managers in relation to energy, Groundwater Directive and EU Energy Policy. Institutes may also benefit from a common understanding of groundwater vulnerability from deep sub-surface activities and will be able to use these in communication with the public.

4) The deliverable 3.2 presented for four pilot areas a common framework for investigating possible pathways of contamination from the deep subsurface. The resulting understanding could be used for evaluating the possible impacts of future deep subsurface activities in those areas. Again, the beneficiaries of this knowledge are regional and local authorities as well as stakeholders in the water industry.

5) The deliverable 4.2 presented a novel methodology called 3D Groundwater Vulnerability (3D GWV) for characterising the vulnerability of shallow groundwater resources to deep sub-surface energy related activities. The vulnerability method can

be applied using the spreadsheet tool accompanying the report. The tool is targeted at regional and local environment authorities and other stakeholders for being used as a “qualitative” (Tier 1) high-level groundwater risk screening tool when considering energy related activities in the deep sub-surface or as a complement to other established vulnerability and risk assessment tools.

Expected impact (from Project Agreement):

Due to the nature of the VoGERA project there are planned and expected to be multiple beneficiaries of the project resulting in the expected impacts mentioned in the Scientific Scope and those not mentioned in the Scientific Scope. The table below describes how the beneficiaries will use or benefit from the project and will have impact for them.

Improved sub-surface spatial planning by groundwater managers and decision-makers will depend on the applicability of conceptual models and vulnerability assessment approaches, therefore it will be vital to understand stakeholder needs. In addition, the impact will be sensitive to the current legislation and regulation regarding these technologies and use of the deep sub-surface for energy related activities and the necessity to take other factors into account when making decisions. Achieving the expected impacts will necessarily rely on the engagement of policy makers and regulators from a range of different countries and their willingness to implement any developed methodologies or conceptual understandings. Theoretically, a greater understanding of the issues at hand should provide decision-makers with the confidence to allow development of these industries under the right circumstances, however, there is a large amount of negative public opinion surrounding some of these activities and therefore this may have an influence on the achieved impacts of the project. By consulting with stakeholders during the project there is greater likelihood that the outcomes will meet their needs and be presented in a way that maximises use. In addition, WP2, and the responsibility for dissemination and communication will be led by VMM who perform a regulation role therefore there is guaranteed input and interaction with a stakeholder from at least one country.

Evaluation of deliverables

No.	Title	Status (Approve/ Reject)	Comments
D1.3	Final project review report	Approved	Level 1 MT
D1.4	Cumulative expenditure report	Approved	Level 1 MT
D1.5	Final financial report	Approved	Level 1 MT
D2.3	Prioritised data to GIP	Approved	
D2.5	Workshops for European and regional stakeholders (2)	Approved	
D3.2	Report on the characterization of pathways and vulnerability assessments for the pilot studies	Approved	
D4.2	Common methodology for characterizing the vulnerability of shallow groundwater to deep industrial activities.	Approved	

Has the quality as a whole been achieved according to the objectives? Has the project as a whole been making satisfactory progress?

☐ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives)

Comments (highlighting the project progress) / deviations / recommendations:

The technical reports, result of the project VoGERA, are clear and easy to understand. In the reports the ratio behind the developed tool for vulnerability of shallow groundwater resources GWW 3D is elaborated and tested at four pilot areas as ''exercise in style'' in Pannonian basin (HU), the valley of Pickering (UK), Noord-Brabant (NL) and Rauw fault (B). The evaluated vulnerability and risk assessment for all four pilot area will be uploaded to EGDI portal. The project fulfil all of its goals and the results are very promising.

At Geological Survey of Slovenia, we will surely use the developed tool GWW 3D in the beginning phase of any deep sub-surface project to evaluate the related risk for shallower groundwater bodies and check which information is still needed to reduce risk and increase level of confidence of the assessment.

I recommend the project team that start the initiative at EUROGEOSURVEYS level to promote this methodology for vulnerability assessment due to the deep sub-surface energy related activities in the European Commission in Brussels. I think the use of GWW 3D should be a part of any EIA for deep sub-surface Energy related activities in European Union.

3 LEVEL 3 – REVIEW OF THE THEME PROGRESS

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by Theme coordinator with aim to review the achieved scientific goals in accordance with theme objectives, on the basis of Sheet 3 in MPPR / FPPR – Project contribution to GeoERA project.

Project contribution to GeoERA project (from MPPR / FPPR, sheet 3):

The GeoERA groundwater projects respond to groundwater research needs described in the call for the ERA-NET on Applied Geoscience (LCE-26-2016), which was partly inspired by and elaborated based on a Concept Note on Groundwater Research Needs previously developed by the Water Resources Expert Group (WREG) of the EuroGeoSurveys in collaboration with science and policy officers of DG Research and DG Environment. The Concept Note intended to assist and realize climate proof and resilient groundwater management and contribute to bridging the gap between science and policy and sustainable use of the subsurface.
Competing uses of the subsurface are expected to increase as a result of secondary impacts of climate change such as CO2 storage, and exploitation of raw materials and geoenergy. Integrated and sustainable management of the subsurface is imperative for the success and implementation of the European Green Deal, the UN sustainable development goals, the UN Framework Classification (UNFC) for groundwater and the new UN Resources Management System (UNRMS). Sustainable management of natural resources requires FAIR and easy access to geodata including geological, physical, biogeochemical and ecological characteristics of groundwater bodies and their link to surface water and dependent terrestrial and associated aquatic ecosystems.
The four GeoERA groundwater projects: HOVER, RESOURCE, TACTIC and VoGERA all contribute with data and knowledge to build a geological service for Europe that via the European Geological Data Infrastructure provide easy access to geodata for all stakeholders. The groundwater data support implementation of the EU and UN policies mentioned above as well as the Water Framework and Groundwater directives according to associated guidance.

The main objective of GeoERA is to contribute to the optimal use and management of the subsurface. The VoGERA project helped achieve by delivering the following:
1) An improved understanding of the relationship between deep energy activities and shallow groundwater resources, and in particular the contaminant pathways in a range of different hydrogeological settings.
2) A series of conceptual models to characterize groundwater vulnerability and identify potential contaminant pathways between industrial activities in the deep sub-surface (and associated infrastructure) and shallow groundwater resources (potable water and/or water for other human uses, less than 400m below ground level).
3) A series of groundwater vulnerability assessments for four pilot areas across Europe, with maps or 3D models showing relevant geological factors, such as the

presence of faults and the vertical separation distance between shallow groundwater and targets for potential industrial activity in the sub-surface (e.g. hydrocarbon source rocks, geothermal sources).
4) A consistent and novel methodology for assessing the vulnerability of shallow groundwater from deep industrial activities that can be universally applied across Europe.

Theme objectives:

The main objective of the GeoERA groundwater theme is to provide data, information and decision-support tools for the long-term protection, sustainable management and improvement of groundwater resources across Europe, within the framework of societal challenges and EU policies. These include the European Green Deal, the Water Framework and Groundwater directives, and the UN Sustainable Development Goals. Innovative methodologies and digital map viewers and information products are developed to tackle the diversity of hydrogeological settings at a range of scales from points or boreholes to the whole of Europe; primarily visualized in two or three dimensions providing access to all the compiled data and information including 3D hydrogeological models. By jointly developing effective and harmonized tools and methodologies for monitoring, modelling, data management and visualization, in close collaboration with the other GeoERA themes, this work will improve our understanding of groundwater chemical and quantitative status across Europe and how this is affecting or affected by groundwater legitimate uses and nature. “Legitimate uses” include e.g. drinking water abstraction, irrigation, heating and cooling of buildings and mining; and “nature” include the ecological status and biodiversity of groundwater dependent terrestrial and associated aquatic ecosystems as well as groundwater ecosystems. The mission of the GeoERA groundwater projects is to contribute to and initiate the development of a world leading digital groundwater and subsurface information platform with free and easy access (FAIR data) to groundwater data across Europe relevant for assessing groundwater chemical and quantitative status according to EU directives and support sustainable management of groundwater and other subsurface resources in a changing climate.

Has the project as a whole achieved the objectives and expected impact of the theme?

☒ 5 - **Overachiever** (the project has achieved greater impact on project theme and/or other themes than expected)

☐ 4 - **Excellent progress** (the project has fully achieved its objectives and goals towards the theme as expected)

☐ 3 - **Good progress** (the project has achieved most of its impact towards the theme for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has minor impact)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or has no impact on the theme)

Comments / deviations / recommendations:

The VoGERA project has delivered what was promised in the original proposal, but in addition it also developed a decision support tool (DST), which can be accessed and downloaded from the map viewer of the VoGERA website. The DST can be applied by everybody in need of accessing the vulnerability of shallow groundwater resources to deep energy related activities such as exploitation of geothermal energy, shale gas or storage of CO2. The freely available DST is the main reason for the high rating of the impacts and outcome of the VoGERA project.

4 LEVEL 4 – GEOERA PROGRESS EVALUATION

In this section the project is reviewed on the Review meetings, where projects present their overall progress and achievements. This section relates to particular project, broader impact of GeoERA as a whole on policies will be covered at the Final Review meeting with questionnaire and interview with Evaluator.

Based on technical review summaries provided by Sections 1 – 3 of this report, and project presentation on the (Final) Review meeting:

Has the project as a whole been making satisfactory progress according to your own understanding and expectations of the GeoERA project?

☐ 5 - **Overachiever** (the project has exceeded expectations)
☒ 4 - **Excellent progress** (as expected)
☐ 3 - **Good progress** (minor recommendations given below)
☐ 2 - **Acceptable progress** (below expectations)
☐ 1 - **Unsatisfactory progress** (the project did not meet expectations)

Overall comments for the project (overall recommendations, modifications, corrective actions, or re-tuning the objectives to optimize the impact or keep up with the State of the Art, re-focusing, or a simple praise)

One of the Stakeholders informed the GeoERA Coordinator and the Monitoring team of their serious illness after the Review meeting was conducted. Due to the illness, they will not be able to provide an evaluation, and due to the late notification, no other stakeholder could be invited. This project is evaluated by one stakeholder.

The project has been developed correctly and in line with the initial program, using the available budget to reach the declared goals. Among other groundwater projects of GeoERA, VOGERA has the clearest consequences on the resource management, due to the scope of assess vulnerability of groundwater resources to deep investigations and extraction activities.
I found the final results, as shown by the deliverables, very significant with respect to the objectives, offering the requested improvement of the knowledge and of the research in the field of groundwater vulnerability and protection. Thus, the project provides excellent progress in line with initial expectations. Some short comments are listed below:

- The application of the developed methodology (and related tools) to the four study areas, respectively corresponding Pannonian basin (HU), the valley of Pickering (UK), Noord-Brabant (NL) and Rauw fault (B), offers a complete variety of shallow aquifers possibly impacted by deep investigations/extractions/energy production. Consequently, the methodological approach will be easily extended to other similar groundwater systems, testifying the effort in harmonization of data and procedures.

- As stated above, the project results have a direct application to policy development ad national and EU scale, offering several inputs to better manage the interference between shallow groundwater protection and deep investigations; I suggest the preparation of specific guidelines and/or policy briefs based on project results, according with the GREEN DEAL plan and consequent EC expectations.
- A very significant result of the project are the hydrogeological sections representing the "conceptual models", where competing uses of subsoil are classified and exposed, highlighting the potential impacts of industrial deep activities with respect to different hydrogeological conditions of shallow resources; I suggest promoting the use of these conceptual models in the international groups and activities working on the relationships between human requirements and environmental needs. Namely, a direct link can be established with the UN sustainable development goals, the UN Framework Classification (UNFC) for groundwater and the new UN Resources Management System (UNRMS).
- Considering the indirect impacts of the industrial activities in deep subsoil (e.g. CO_2 storage, raw material exploitation, geoenergy production) and related potential consequences also on climate change, I finally suggest to promote the diffusion of the results not only among the Geological Surveys and professional geologists, but also by the involvement of different stakeholders coming from the society, representing both the main users and the civil associations, not forgetting young generations/scholars; this is probably not an easy task, but produced data and models are still shared with the geological/engineering community by public database funded on FAIR principles; additional efforts are required, but potential relevant results can be achieved in the future by the "translation" of the produced "conceptual models" in leaflets and other dissemination materials to be distributed in the society; the raising attention to the climate and ecological topics would help to reach citizens better than in the past, promoting the awareness also of complex problems as those faced by VOGERA.

Annex 1: Review meeting list of participants

Name	Role	Organisation
Joop Hasselman	GeoERA coordinator	Netherlands Organisation for Applied Scientific Research
Barbara Simić	Monitoring and Reporting Officer	Geological Survey of Slovenia
Aleksandra Trenchovska	Monitoring and Reporting Officer	Geological Survey of Slovenia
Jasna Šinigoj	Scientific Reviewer	Geological Survey of Slovenia
Matija Krivic	Scientific Reviewer	Geological Survey of Slovenia
Andrej Lapanje	Scientific Reviewer	Geological Survey of Slovenia
Klaus Hinsby	Ground Water theme coordinator	Geological Survey of Denmark and Greenland
Marco Bianchi	VoGERA Project manager	British Geological Survey
Çis Slenter	Project member	Flanders Environment Agency
Willem Jan Zaadnoordijk	Project member	Netherlands Organisation for Applied Scientific Research
Koen Beerten	Project member	Belgian Nuclear Research Centre
Agnes Szalkai	Project member	Mining and Geological Survey of Hungary
Evaluation done through Review Meeting recording:		
Marco Petitta	GeoERA Stakeholder	Sapienza University of Rome, Department of the Earth Sciences, Italy
Ad de Roo	GeoERA Stakeholder	University of Utrecht and project JRC WEFE lead