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Dissemination Level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	
EU-RES	Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)	
EU-CON	Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)	
EU-SEC	Classified Information: SECRET UE (Commission Decision 2005/444/EC)	



## **Note about contributors**

The following organizations contributed to the work described in this deliverable:

### **Lead partner responsible for the deliverable:**

AMRA

*Deliverable prepared by:*

Raffaella Russo

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## **1. Introduction**

The SHEER Second annual meeting was held in Blackpool on June 5-8, 2017. This deliverable represents a summary report of the main discussions and outcomes of the meeting.

## 2. Agenda

### 2.1 MONDAY – June 5

#### **SHEER – Review of the last year – Reports from WP leaders**

Attendees: SHEER Consortium

#### **10:15 – 11:00 Registration & Coffee**

#### **11:00 – 11:15 Welcome** by Paolo Capuano, AMRA, Project Co-ordinator

- Introductions and objectives of the meeting
- Tribute to Paolo Gasparini
- The SHEER Project after Year 2

#### **Reports from Work Package Leaders**

Discussion includes:

- Lessons so far - What have we learnt
- Where now?
- What's left to do?
- Next steps
- What are we going to recommend? – Recommendations for best practice

#### **11:15 – 11:45 WP2 – The SHEER Database** (Beata Orlecka-Sikora, IGF-PAS)

#### **11:45 – 12:15 WP3 – On Site Monitoring** (Stanisław Lasocki, IGF-PAS)

#### **12:15 – 13:00 WP6 – Assessment of Air Quality Impact** (Janusz Jarosławski, IGF-PAS)

#### **13:00 – 14:00 Lunch**

#### **14:00 – 15:15 WP5 – Assessment of Groundwater Chemistry** (Andrew Gunning, RSKW)

**14:00 – 14:15** *A Summary of WP5* – Andrew Gunning

**14:15 – 14:35** *Baseline and post frac data* – Nelly Montcoudiol

**14:35 – 14:50** *The Geological and Hydrogeological Model* – Catherine Isherwood

**14:50 – 15:10** *Next steps and inputs to WP5.3* – Neil Burnside

**15:10 – 15:15** *Discussion* – Andrew Gunning

#### **15:15 – 15:45 Coffee**

#### **15:45 – 17:15 WP7 – Multi-Hazard and Multi-Risk Analysis.** (Alexander Garcia, AMRA)

**15:45 – 15:55** *Introduction – Overview of WP7 Activities* – Alexander Garcia

**15:55 – 16:15** *Multi-hazard risk assessment of shale gas operations* – Alexander Garcia

**16:15 – 16:35** *Assessing socio-economic impact for unconventional hydrocarbons exploitation* - Raffaella Russo

**16:35 – 16:55** *Assessing risk pathway scenarios for groundwater pollution: the case of abandoned wellbores* – Andrew Gunning

**16:55 – 17:15** *Towards the development of a “virtual site” for testing MR modelling capacities* – Paolo Capuano

#### **17:15 – 17:45 Concluding remarks** by Paolo Capuano, Project Co-ordinator

## 2.2 TUESDAY – June 6

### **SHEER – Review of the last year – Reports from WP leaders**

Attendees: SHEER Consortia

**9:00 - 9:15** Welcome and outline of Day 2 (Paolo Capuano, AMRA, Project Co-ordinator)

### **Continuation of Reports from Work Package Leaders**

**9:15 - 10:45 WP4 – Assessment of Induced Seismicity (Part 1)** (Simone Cesca, GFZ)

**09:15 - 09:30** *Assessment of the detection performance of the SHEER seismic monitoring network at the Wysin site, NE Poland.* - Jose Angel Lopez Comino

**09:45 – 10:00** *Network optimization for monitoring induced seismicity in noisy sedimentary basins.* - Elmer Ruigrok

**10:00 – 10:15** *Detection, location and migration of AEs induced by hydraulic fracturing: the Aspö mine (Sweden) experiment.* - Simone Cesca

**10:15 – 10:30** *Estimation of seismic source parameters of induced seismicity: application to The Geysers geothermal area, California.* - Matteo Picozzi

**10:30 – 10:45** *Investigation for correlation patterns among seismic and operational parameters in the North-western The Geysers Geothermal Field.* - Kostas Leptokaropoulos

**10:45 – 11:15** Coffee

**11:15 – 12:45 WP4 – Assessment of Induced Seismicity (Part 2)** (Simone Cesca, GFZ)

**11:15 – 11:30** *Temporal static stress drop variations in relation to technological activity at The Geysers geothermal field, California.* - Monika Staszek

**11:30 – 11:45** *Probabilistic properties of seismicity from Oklahoma and The Geysers geothermal field and their implications for the seismic hazard analysis.* - Stan Lasocki

**11:45 – 12:00** *Seismic hazard assessment considering fluid-induced seismicity.* - Alexander Garcia

**12:00 – 12:15** *Using interferometry method for velocity changes Assessment, in Wysin Site, NE Poland.* - Henryk Marcak

**12:15 – 12:30** *Parametric Modelling of Hydraulic Fracturing for Shale Gas.* - Sam Toon

**12:30 – 12:45 Discussion**

**12:45 – 13:45** Lunch

**13:45 - 15:15 WP8 – Guidelines for Best Practice and Dissemination** (Glenda Jones, Keele)

**13:45 – 14:15** *WP3 & WP8 Co-operation* - Raffaella Russo

**14:15 – 14:45** *Do we need environmental monitoring? A cost-benefit analysis of the Wysin site.* - Tom Kelly

**14:45 – 15:00** *Community Building, Stakeholder Engagement & Dissemination.* - Glenda Jones

**15:00 – 15:30** Coffee

**15:30 – 16:00** **Reports from other Horizon 2020 projects (Chair: Paolo Capuano, AMRA)**

- M4ShaleGas (Ed Hough, BGS)



- FracRisk (Chris McDermott, University of Edinburgh)

**16:00 – 16:15 Final remarks** (Paolo Capuano, AMRA)

**16:15 – 17:30** Advisory Board meeting & PMT meeting

**17:30 – 18:00** Advisory Board report and discussion

**8 pm Conference dinner**



## 2.3 WEDNESDAY – June 7

### Conference on SHEER: Shale Oil & Gas - Risk Management and Mitigation

Attendees: SHEER Consortium plus external guests from industry, academia, regulators and government

- 8:30 – 9:30** Registration for stakeholder delegates
- 9:30 – 9:40** Welcome Address – Rob Green (Blackpool, Fylde and Wyre Economic Development Company, SHEER Advisory Board)
- 9:40 – 10:00** Opening Remarks and an Overview of the SHEER Project – CHAIR Prof Paolo Capuano (AMRA, SHEER Project Coordinator)
- 10:00 – 10:30** Risk management in the development of shale oil and gas (Ruth Allen, RSKW Ltd)

**10:30 – 11:00** Coffee

#### Theme 1 Water

- 11:00 – 11:30** Review of shale impacts for the water industry (Jim Marshall, Policy and Business Adviser, Water UK)
- 11:30 – 12:00** Risk assessment and environmental monitoring related to shale oil and gas with particular reference to groundwater (Andrew Gunning, RSKW Ltd)

#### Theme 2 Induced Seismicity

- 12:00 – 12:30** Science for Managing the Hazard of Induced Earthquakes: Lessons from Oklahoma (Prof Bill Ellsworth, Stanford University)
- 12:30 – 13:00** Challenges in monitoring, discrimination and management of seismicity induced by underground industrial activities: a European perspective (Simone Cesca, GFZ)

**13:00 – 14:00** Lunch

**14:00 – 14:20** The Cuadrilla e-Portal (Sam Schofield, Cuadrilla)

#### Theme 3 Air Quality

- 14:20 – 14:50** The impact of shale gas exploration/exploitation activities on the quality of ambient air - Wysin, Poland case study (Prof Janusz Jarosławsky, IGF-PAS)
- 14:50 – 15:20** Air Quality research to support shale-gas regulation by the Environment Agency (Prof Roger Timmis, Environment Agency, England)

**15:20 – 15:35** Coffee

#### Theme 4 Risk Management

- 15:35 – 16:05** Assessing risks associated with shale gas operations (Alexander Garcia, AMRA)
- 16:05 – 16:20** Reducing the risk of induced seismicity during Shale Gas operations (Sam Toon/ Rachel Westwood, Keele University)



**Theme 5 SHEER – the next steps**

**16:20 – 16:30** The SHEER Project, Next Steps. (Prof Paolo Capuano, AMRA, SHEER Project Coordinator)

**16:30** Close

**2.4 THURSDAY – June 8**

Due to inclement weather, the planned field trip to the Cuadrilla drill site and outcrops of the Bowland Shale scheduled for June 8 was cancelled.

### **3. List of participants**

The list of participants is in Annex 1.

### **4. Report**

All of the above mentioned presentations are available on the SHEER webpage (<http://www.sheerproject.eu/>).

During the second day, the Project Management Team and the Advisory Board meetings were held. The minutes of those meetings are reported in the following paragraphs.

On the second day, also two representatives of other LCE16-2014 projects (M4Shale & FracRisk) attended the meeting.

During the third day a stakeholders meeting event took place. The list of participants to this event is available in the Annex 2.

## 5. Minutes of the Project Management Team

### Agenda

1. Activities for the last year
2. Database completion and data availability at 1<sup>st</sup> May 2018
3. EGU 2018 participation
4. Sheer publications
5. Project dissemination for the third year
6. Final meeting
7. AOI

### Activities for the last year

One of the most important issue is the preparation of the final guidelines. Those guidelines should be prepared as soon as possible. Andrew Gunning will ask all WP leaders for inputs by the end of September.

### Database completion and data availability at 1<sup>st</sup> May 2018

Beata Orlecka-Sikora, WP2 leader, will prepare some documents in which each provider will ensure the authorization to data use, so that all data will be available by the end of April 2018. Another problem is the possible bad quality of the Oklahoma data. AMRA will investigate on this issue, contacting Keele Univeristy (Oklahoma data provider) in order to ensure the good quality of data included in the SHEER database.

### EGU 2018 participation

It was stated the importance of having a session at the EGU in 2018. Alexander Garcia (AMRA) have been invited to be co-convenor at a session of Energy, Resources & the Environment. In September, the SHEER consortium will propose a session at the EGU, possibly with all the other LCE16-2014 winning projects.

### Sheer publications

The SHEER project will be presented in a special issue “Acta Geophysica” of Springer (co-editor in chief for the Antropogenic Seismicity section is P. Styles). The idea is to have the volume available before the project ends.

This issue will contain a general paper with the project description, and other more specific papers. All WP leaders will be contacted by middle of September, in order to have all papers ready by the middle of December.

### Project dissemination for the third year

Due to the difficulties of the EU Commission in recognizing the reporting of the participation to extra EU meetings, IGF-PAS asked Paolo Capuano for a formal letter, stating the importance for the SHEER project to be represented at the IASPEI conference, which will be held in Kobe from 30<sup>th</sup> July to 4<sup>th</sup> August 2017.

A possible joint event with the ShaleXenvironment (SXT) team will be probably organized for the last year. P. Capuano will participate to the Second annual meeting of SXT in Florence

## Final meeting

The final meeting will be held in Krakow, from 26 to 28 April 2018.

## 6. Advisory Board Minutes

The Second Annual Meeting of the SHale Gas Exploration and Exploitation Induced Risks (SHEER) project was held on June 5-6, 2017 in Blackpool, U.K.. The purpose of the meeting was to review progress made in the second year of the SHEER project, present plans for the completion of the project in April 2018, share knowledge and experience among project members and with representatives of other Horizon 2020 shale-gas projects. A one-day public conference on "Shale Oil & Gas - Risk Management and Mitigation" followed on June 7 for external guests from industry, academia, regulators and government. Due to inclement weather, the planned field trip to the Cuadrilla drill site and outcrops of the Bowland Shale scheduled for June 8 was cancelled.

The Advisory Board (AB) provides the SHEER management with advice on the overall direction of the project, monitors progress in meeting milestones, and offers solutions to problems that it identifies or are referred to it by management. This report on the Annual Meeting covers both presentations made at the meeting, observations from the AB about the status and direction of the project, and feedback from external participants in the public conference.

The past year presented unexpected challenges due to the death of SHEER project coordinator and beloved leader Paolo Gasperini in July 2016. It is very fortunate that Professor Paolo Capuano has taken on the leadership of SHEER and under his guidance the project is currently on track to meet all of its commitments in the next 10 months.

The overall goal of the SHEER project is to develop a scientific understanding of potential environmental impacts of shale gas development and the associated risks to society, and to develop options for preventing and mitigating those hazards. The SHEER work plan is divided into eight work packages, all of which were reviewed and discussed in detail during the course of the Annual Meeting. We report below our review comments and suggestions as well as some recommendations for the conclusion of the project.

WP1. Project Management and Coordination: Project coordinator Paolo Capuano presented the mid-term report on the status of the project at the end of the second year. Milestones are being met and there is every expectation that the project will be 100% completed at the end of April, 2017 as scheduled. He emphasized the importance of publication in open access journals (green or gold), as otherwise reports would not be credited.

He also reported that the INEA review of the SHEER project particularly emphasized the importance of enhancing cooperation with the three other Horizon 2020 projects on unconventional hydrocarbon development. The AB endorses this goal and urges the Program Management Team to explore joint activities with the three other projects such as technical meetings, stakeholder forums and summary publications. The latter could be particularly important (and hopefully effective) for best practice guidelines.

Meeting milestones and deliverables was also emphasized by the INEA. The AB strongly encourages the management team to closely track the deliverables and suggests keeping the status updated in a place accessible to all project members (i.e. internal webpage). Tracking should include: who is responsible; when is it due; and links to the product when delivered.

The AB also notes that its report from the first annual meeting in June 2016 was not widely shared with the project, understandably following the death of Paolo Gasperini. We trust that this report will go to all participants in a timely manner.

WP2. Compilation of SHEER Database: Significant progress toward the on-time completion of the database is being made. Both “raw” and “harmonized” data are now online in various stages of completion. Integration of the harmonized data into the IS-EPOS platform remains a work in progress. An important, and largely unresolved issue, is the need to gain permission from the original data owner to redistribute data through IS-EPOS.

The AB recognizes that gaining permission to distribute may be a problem for certain data sets, and encourages the SHEER participants to work with their external colleagues to arrive at an acceptable solution. Situations have already arisen when a data set acquired and analyzed by the project is no longer authoritative due to updating by the original data provider. This is essentially unavoidable for seismic catalog data, for example. Solutions such as providing clear instructions and caveats to users and/or instructions for retrieving current data from the original source should be explored.

WP3. On Site Monitoring: The signature accomplishment of SHEER this past year was the successful monitoring of the hydrofrac operations at the Wysin well site in Poland. Two extended reach horizontal wells were fracked by the Polish National Oil Company. Well 2H was fracked on June 8-18, 2016 and well 3H on July 19-29, 2016. Monitoring result from WP4, WP5 and WP6 will be discussed below. The fracking was only partially successful and in the end, the company decided that production of the wells would not be economical to pursue. The wells are currently shut-in.

In addition to the Wysin monitoring, a temporary seismic array deployment was conducted in the Groningen gas field of the Netherlands in July-August 2016. The deployment was testing array designs in the midst of this heavily instrumented gas field and was successful in recording microearthquakes with magnitudes up to M 1.7.

WP4. Assessment of Induced Seismicity: This work package contains a large number of individual tasks, including but not limited to monitoring of the Wysin test site. The diversity of investigations provides a wealth of information for development of best practice guidelines. Although the Wysin monitoring was successful, almost no microseismic activity occurred, and consequently guidelines will need to be developed from experience reported in the literature and analysis by the SHEER team of data collected in North America and computational modeling studies. From a scientific standpoint, the AB has no serious concerns about any of the individual projects. We would, however, encourage the seismologists to begin drafting best practice guidelines soon. If a “traffic light” protocol is recommended, assessing the case-specifics of the social license to operate must be done in parallel with seismological estimates of the actual seismic hazard to people and property. A high-level goal should be harmonization of the guidelines among the four Horizon 2020 projects.

WP5. Assessment of Groundwater Chemistry: Impressive results have been obtained at Wysin in this work package, particularly in collecting the pre-frac baseline and related development of a hydrogeologic model. In developing best practice guidance, consideration should be given to the balance between best available science and cost versus benefit for an industrial scale development. In other words, how might guidance adjust when the scale changes from a few wells to hundreds or even thousands of production completions? Consider also how the scope of best practice for groundwater monitoring would evolve from pre-development through abandonment of a site.

WP6. Assessment of Air Quality Impacts: Monitoring results from Wysin produces a number of interesting results. The brief increase in methane detected in September may be associated with unusual seismic signals that appear to emanate from close to the wellhead at shallow depth. It is disappointing that the oil company is unable or unwilling to discuss this observation. Despite this serious handicap, the AB encourages the team members from both WP4 and WP6 to consider potential scenarios for how this might have occurred in the context of best practice guidance.

## WP7. Multi-Hazard and Multi-Risk Analysis:

WP8. Guidelines for Best Practice and Dissemination: As the AB report from 2016 stated, communication presents both a huge challenge and critical opportunity for the project. Progress is clearly being made on this front, but as the work package that brings the analysis and recommendations from the entire project into focus much remains to be done in the remaining months of the project.

The one-day public conference on “Shale Oil & Gas - Risk Management and Mitigation” on June 7 proved to be a tremendous success. The event reached a broad technical audience that eagerly absorbed the presentations and responded with numerous probing and insightful questions. How can this experience be shared more broadly? Are there other key stakeholder groups to approach? For example, the U.K. Onshore Operators group would be one.

The AB views the guidelines and best practice guidance as the key deliverable of SHEER. It brings the entire project together. We strongly recommend that an internal draft (or even just outline) be written soon (before the end of summer) and circulated among all the project participants (and AB). This will provide a framework for all to see how their specific recommendations fits into the larger picture. There will also be multiple audiences to consider, including regulators, industry, general public, residence of areas considered for drilling, and even opponents of development. On one level, the document will contain technical recommendations supported by SHEER original and literature research. On another level, it should focus on key issues and provide information resources needed by decision-makers when addressing them. At the same time, it should avoid the temptation to lay-out policy prescriptions.

One Final Thought: The June 7<sup>th</sup> public conference confirmed the high level of interest in unconventional oil and gas development. The many thoughtful questions asked by the audience of resource managers, engineers and scientists revealed a need for an informed, high-level policy-oriented document that synthesizes the scientifically based understanding of the risks of shale oil and gas development in the European context. The SHEER project is in an excellent position to write this paper. The lessons learned at Wysin are directly relevant, as are the understandings gained from projects in North America and elsewhere. The AB strongly encourages the SHEER PMT to make a plan to produce this paper and aim for a high-impact journal. If you are successful, this will be a fitting capstone to SHEER.

**ANNEX I**

**LIST OF PARTICIPANTS**



LIST OF PARTICIPANTS		
SECOND ANNUAL MEETING - BLACKPOOL - 2015,5-8 JUNE		
N°	SURNAME	NAME
<b>P. N° 1 - AMRA - ANALISI E MONITARAGGIO DEL RISCHIO AMBIENTALE SCARL</b>		
1	CAPUANO	PAOLO
2	GARCIA	ALEXANDER
3	PICOZZI	MATTEO
4	RUSSO	RAFFAELLA
<b>P. N° 2 – IGF- PAS- INSTITUTE OF GEOPHYSICS, POLISH ACADEMY OF SCIENCES</b>		
1	JAROSLAWSKI	JANUSZ
2	LASOCKI	STANISLAW
3	LEPTOKAROPOULOS	KONSTANTINOS
4	LISOWSKA	ANNA
5	MARCAK	HENRYK
6	ORLECKA-SIKORA	BEATA
7	STASZEK	MONIKA
<b>P. N°3 KeU - UNIVERSITY OF KEELE</b>		
1	JONES	GLENDIA
2	TOON	SAM
3	WESTWOOD	RACHEL
<b>P. N°4 - GEOFORSCHUNGSZENTRUM POTSDAM</b>		
1	CESCA	SIMONE
2	LOPEZ-COMINO	JOSE
<b>P. N°5 – KNMI - KONINKLIJK NEDERLANDS METEOROLOGISCH INSTITUUT</b>		
1	RUIGROK	ELMER
<b>P. N°6 – RSK - RSK W Ltd</b>		
1	ALLEN	RUTH
2	GUNNING	ANDREW
3	ISHERWOOD	CATHERINE
4	KELLY	THOMAS
<b>P. N° 7 – UGL - UNIVERSITY OF GLASGOW</b>		
1	BANKS	DAVID
2	BURNSIDE	NEIL
3	MONTCOUDIOL	NELLY

OTHER PROJECTS PARTICIPANTS		
1	HOUGH (M4SHALE PROJECT)	ED
2	MCDERMOTT (FRACRISK PROJECT)	CHRISTOPHER

ADVISORY BOARD		
1	CLARKE	HUW
2	DI BUCCI	DANIELA
3	ELLSWORTH	WILLIAM
4	GREEN	ROB

## **ANNEX II**

### **STAKEHOLDERS MEETING LIST OF PARTICIPANTS**

<b>Name</b>	<b>Last name</b>	<b>Email address</b>	<b>Position held</b>	<b>Institution</b>
Paul	Bradley	paul.bradley@hse.gov.uk	Operations Manager	Health & Safety Executive
Chris	Breislin	chris.breislin@aecom.com	Hydrogeologist	AECOM
Chris	Browitt	cbrowitt@staffmail.ed.ac.uk	Geophysicist	Edinburgh University
Steve	Brown	steve.brown@environment-agency.gov.uk	Technical Specialist Hydrogeologist	Environment Agency
Siobhan	Browne	siobhan.browne@beis.gov.uk	Senior Climate and Energy Science Advisor	Department for Business, Energy and Industrial Strategy
Mark-Paul	Buckingham	mp@xiengineering.com	Managing Director	Xi Engineering Consultants
Ruth	Buckley	ruth.buckley@environment-agency.gov.uk	Hydrogeologist	Environment Agency
Zuansi	Cai	z.cai@napier.ac.uk	Lecturer in Energy and Environmental Engineering	Edinburgh Napier University
Roseanne	Clement	r.clement@ed.ac.uk	PhD Student	University of Edinburgh
Caroline	Crawford	carolinecrawfordcasc@hotmail.com	Masters Student	RSKW/University of Strathclyde
Stephen	Danton	stephen.danton@atkinsglobal.com	Associate Director	Atkins Limited
Simon	Dawson	simon.dawson@environment-agency.gov.uk	Technical Specialist	Environment Agency
Chris	Dilley	cdilley@anglianwater.co.uk	Water Resources Specialist	Anglian Water Services Limited
Laurance	Donnelly	laurance.donnelly@arup.com	Geologist	Arup
Alistair	Duncan	a.duncan@halletec.co.uk	Director	Halletec Environmental Ltd
Ben	Edwards	edwardsb@liverpool.ac.uk	Senior Lecturer	University of Liverpool
Aidan	Foley	aidan.foley@eggconsult.co.uk	Director	EnvGeoGeo
Christopher	Ford	christopher.ford@strath.ac.uk	Researcher	Strathclyde University
Gina	Geffers	zcfbgge@ucl.ac.uk	PhD Student	The University of Edinburgh
Antonio	Gennarini	antonio.gennarini@severntrent.co.uk	Hydrogeologist	Severn Trent Water Ltd.
Sam	Grainger	S.grainger395@yahoo.co.uk	Doctoral Researcher	University of Strathclyde
Chris	Hitches	christopherhitches@hydrock.com	Hydrogeologist	Hydrock
Melinda	Lewis	mlewis@bgs.ac.uk	Senior Hydrogeologist	British Geological Survey

Christophe	Maisons	christophe.maisons@magnititude-geo.com	Managing Director	Magnitude SAS	
Jim	Marshall	jmarshall@water.org.uk	Senior Policy Adviser	Water UK	
Phil	Merrin	phil.merrin@uuplc.co.uk	Groundwater Manager	United Utilities Water Ltd	
John	Midgley	jmidg@bgs.ac.uk	UK Geoenergy Observatories, Technical Manager	British Geological Survey	
Olivia	Milton-Thompson	olivia.miltonthompson@gmail.com	PhD Researcher	Exeter University	
Laura	Mitchem	laura.mitchem@phe.gov.uk	Specialist Environmental Public Health Scientist	Public Health England	
Mark	Morton	mark.morton@yorkshirewater.co.uk	Senior Hydrogeologist	Yorkshire Water	
Hamid Reza	Nasriani	hrnasriani@uclan.ac.uk	Senior Lecturer in oil & gas engineering	University of Central Lancashire	
Megan	O'Donnell	megan.odonnell@ed.ac.uk	PhD Student	University of Edinburgh	
Damian	Pawson	damian.pawson@mouchel.com	Principal Air Quality Consultant	WSP (Mouchel)	
Leo	Phillips	l.phillips@enitial.co.uk	Business Development Manager	enitial	
Richard	Phillips	richard.phillips@defra.gsi.gov.uk	Inspector	Drinking Water Inspectorate	
Kathryn	Richardson	kathryn.richardson@environment-agency.gov.uk	Regulatory Specialist	Environment Agency	
Nick	Riley	carboniferouslimited@gmail.com	Director	Carboniferous Ltd	
Steve	Roberts	stevenj.roberts@environment-agency.gov.uk	Geoscience Team	Environment Agency	
Martin	Shannon	martin.a.shannon@nationalgrid.com	Regulation and External Affairs	National Grid	
Aaron	Sheehan	aaron.sheehan@atkinsglobal.com	Oil Gas Environmental Consultant	Atkins	
Philip	Silk	philip.silk@mdc.co.uk	Project Manager	Moorhouse Drilling and Completions	
Tony	Smith	tsmith@peel.co.uk	Commercial Strategy Manager	Peel Gas and Oil	
Joanna	Thorp	jo.thorp@atkinsglobal.com	Hydrogeologist	Atkins Global	
Roger	Timmis	roger.timmis@environment-agency.gov.uk	Lead Scientist	Environment Agency	
Philip	Usher	philip.usher@itasca-image.com	Software Developer/Geophysicist	Itasca-IMaGE	
Alice	Walker	alicewalkereq@gmail.com	Geophysicist	ABConsulting	

Leon	Warrington	leonwarrington@hydrock.com	Senior Hydrogeologist	Hydrock	
Glynn	Williams	glynn.williams@drilling-products.com	Chairman	Clear Solutions International Limited	
Weimu	Xu	weimu.xu@beis.gov.uk	Higher Scientific Office	Department for Business, Energy and Industrial Strategy	
Jim	Cross	jim.cross@environment-agency.gov.uk		Environment Agency	
Katherine	O'Connor		NW Government Office Representative	Department for Business, Energy and Industrial Strategy	