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Baseline assessment and monitoring of water resources exposed to unconventional hydrocarbon exploration and extraction activities

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Comero Sara

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Baseline assessment and monitoring of water resources exposed to unconventional hydrocarbon exploration and extraction activities

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Abstract

The EU has potential reserves of natural gas and oil that is trapped in shale formations and some Member States are actively pursuing shale gas exploration. Extraction of oil and gas from shale formations necessitates the use of hydraulic fracturing. The impact of this technology on the environment and in particular on groundwater needs to be monitored in order assess the performance of wells that have been fractured. In this setting, contamination of groundwater from the use of fracturing technology is of great public concern and the public concerned of shale gas projects expects to be informed about releases of pollutants from shale oil and gas production. It is necessary to determine baseline parameters before fracturing takes place and to monitor these parameters during and after fracturing. There is no agreed methodology or use of standards for the measurement of the baseline and the monitoring of baseline parameters.

This technical workshop was organized with the aim to discuss the technical and scientific challenges of baseline assessment and subsequent monitoring of those water resources which may be exposed to unconventional hydrocarbon exploration and extraction activities.

1. Introduction

To set the scene, the existing framework on chemical monitoring of water was presented briefly. The workshop gave an overview on national experiences in the UK, Poland and Germany and provided an overview on the monitoring challenge as addressed by research consortia. Some 40 experts including colleagues from the JRC sites in Ispra and Seville (connected by video conferencing) discussed possible approaches and challenges for baseline assessment as well as surveillance/control monitoring. The discussions addressed also data infrastructure need to share such information while protecting intellectual property rights and sensitive information. In this context, the recently launched Information Platform for Chemical Monitoring Data was presented, too.

The discussion was mainly focused on highlighting the importance of the following anchor points, focusing in particular on the (ground)water impact:

- Establishment of a baseline assessment;
- Discussion about the organisation of monitoring campaigns
- Posing questions on the methodologies to be applied for the sampling/measurements.

The final agenda of the workshop as well as the list of the presentations is attached at the end of the report.

2. National Experiences and User Perspectives

The first part of the Workshop dealt with the National Experiences and User Perspectives.

The Shale gas baseline monitoring in the United Kingdom was discussed by Rob Ward, which provided a clear picture of characterisation of the natural quality of groundwater. Since the information on the methane concentration in groundwater was limited, in 2013 a methane survey has been started with the aim to focus on its provenience. Trace organics were also analysed for.

Concerning the shale gas potential on methane in in groundwater, the main issue is to understand the provenience of elevated methane concentrations, its behaviour in the sub-surface and the risks associated with it, limiting the number of measurements of methane in groundwater.

Preliminary results from the survey show that from drinking water abstractions and shallow (<100m deep) monitoring boreholes concentrations are low, ranging from below detection to 3.7 mg/l with a median of around 0.005mg/l.

The main outcomes were also discussed in terms of temporal variation, wondering if geographical point could influence the measured concentration value. It is then evidenced the importance of a baseline (monitoring of the concentration during years/months to understand the trend of the measured parameter). From these baseline, it resulted that the variation in the water level during months and years is correlated by the nitrate concentration. This reflect the anthropogenic factor determined by fertilisers.

The future is to extend toward a national baseline monitoring in order to establish an independent monitoring programme, and to provide high resolution data, both spatial and temporal. Results of this monitoring will be used to inform the public and industry, but also to assist regulation and help for the development of new technology.

The monitoring work package included the study of the following parameters: groundwater, ground motion (InSAR - satellite radar interferometry), induced seismicity and air quality (CH4, CO2, GHG)

The baseline monitoring comprise the evaluation of existing groundwater sampling points, as well new boreholes and included the laboratory analysis of: inorganic and organic chemistry, dissolved gases, stable isotopes, tracers and naturally occurring radioactive material.

The preliminary studies of inorganic chemistry show that in the examined groundwater, the natural concentration exceed the drinking water standard for Al, Cu, Fe and methane. In the case of organic chemistry, chemicals above the standard are mainly associated with an anthropogenic impact, excluding a natural origin.

The IWM Network & UK approach to establishing Environmental Baselines was discussed by Steve Thompsett. After the circulation of a discussion paper on Integrated Water Management to industry at the end of 2014, terms of references were established.

From the discussion it emerged the importance for establishing an environmental baseline. Guidelines for the establishment of environmental baselines for UK onshore oil and gas was published in January 2015. A conceptual site model was developed by the identification of all potential pathways keeping in mind that the key step is the monitoring phase

The Water user's point of view and concerns was discussed by Mark Mulcahy. He focused on the comparison between bottle water and the initial water, with the absence of any

substance in the bottle water (very low levels). The priority is the protection of water quality and the protection of groundwater.

The topic Groundwater Monitoring – Findings of the German Federal Environment Agency Study on Environmental Impacts of Hydraulic Fracturing was presented by Bernd Kirschbaum. The first study on environmental impact of fracking was released in 2012. The second study was terminated in 2014 with the aim to develop a first concept to detect possible impacts from different pathways in groundwater.

They reveal that potential impact pathways of hydraulic fracturing on groundwater resources could be due both to technical and artificial pathways such us the handling of fracking fluids, possible spills, and natural pathways (a common natural pass way is nitration).

Main topics treated in the studies are the number of locations for monitoring groundwater and the number of well. Regarding the first topic, four locations have been chosen:

1. Top groundwater horizon, which is not used for drinking water extraction;
2. Aquifer relevant for drinking-water extraction (drinking-water aquifer);
3. First aquifer below the last drinking-water aquifer;
4. Horizon up to approximately 200 m - 300 m above the frack horizon.

The proposed number for groundwater test well in the drilling area is:

1. 4 monitoring wells for top groundwater horizon;
2. 2 for drinking water aquifers.

Chemical parameters examined are based on EU fracking chemicals including additives and solvents, and reaction products occurring during fracking.

For groundwater monitoring the open questions are still many with concern on the number and location of well, the sampling intervals, the parameters to be measured as well as the selection between target vs. non-target screening.

Recommendations of the study were helpful for the implementation of a comprehensive groundwater monitoring before, during and after hydraulic fracturing operations in the new regulations in Germany.

The Polish experiences on environmental monitoring and groundwater management in the process of unconventional hydrocarbon exploration was presented by Monika Konieczyńska and Małgorzata Woźnicka. The study was published in 2010 and the second study on fracking would also include the drilling wells, the horizon drilling the closure of the wells and gases. However, the study does not include the waste water reuse giving the motivation that from a legislative point of view it is hard to follow the waste and moreover the frack agencies do not compete with it.

The monitored media were: air, ground surface, soil, surface water and groundwater.

What emerged from the monitoring study in terms of main issue related to the monitoring study is that every site is different (even in the production stage) and it is not possible to shift results from site to site.

In terms of main issue related to the monitoring study it emerged that it would be not possible to shift results from site to site because every site show different characteristic from the others in all the monitoring stages (including the production one). Another problem encountered was the adequate control of technical operations which was difficult to supervise due to unknown timetables of industry works.

In the case of the water media it is considered both the surface (first layer of the water surface) and the ground (main bottom of acquirers). It also emerged a difficulty in monitoring deeper aquifers because of their complicate detection.

It is moreover to be considered that what goes directly into the environment is the flow back concentration and not the fracking fluid.

The sampling design was built considering the following steps:

- Examination of the baseline: before the drill site construction
- Measurements during the preparation of the hydraulic fracture
- Studies during the hydraulic fracture for fluids control
- Examination of the status of the environment on completion of drill operations
- Monitoring the status of the environment one or two years after the completion of the operations.

After the presentation of the monitoring study, an open discussion generated the following questions and proposals:

- Proposal for the analysis of waste (with "waste" meaning that nothing is left on the site)
- Question on the path: is it considered a waste facility?
- The emission of methane from soil could both came from oil and gas exploration, and shale gas. This is a very site specific issue because depends on the underground;
- Recommendation of shale gas should suffice for regulation. No need of more regulation for UK since the status basic for controlling this process in terms of regulation is sufficient. Even in Europe the status of regulation is sufficient.

The discussion also focused on the following issues:

- The horizontal priority is the water monitoring and modelling. The issues to be resolved are related to the monitoring phase (which not always means costs) and to the training support for sharing and exchanging of the information.
- The water demand is rather low but there are no information on water protection and fate. In case of water demand, it is necessary to multiply by the number of well.
- Composition of fracking fluids: all Polish companies reveal the composition of the fluids they are using but the information on the concentration is only given in terms of minimum and maximum concentrations (range of concentration). The recipe (final composition of the fluids) is given.
- The time scale is much more important of the location for scenario hypothesis. It is important to observe the post production phase.
- The monitoring study is usually area specific and not site specific; during the organization phase for shale production, it is important to look at a geographical area and not at a specific site (area not in terms of region).

3. Research Projects

The second part of the workshop introduced the Research Projects.

The first discussed research project was the SHEER project and the strategy for groundwater monitoring by Peter Styles and Andrew Gunning. SHEER is the acronym of shale gas exploration induced risk. The objective of SHEER is to develop best practices for assessing and mitigating the environmental footprint of shale gas exploration and exploitation. In particular, assessing short and long-term risks associated with the groundwater and surface water contamination, air pollution and induced seismicity.

One of the main issue is the propagation of permeability during fracking (fracking cause a chance in permeability of the rocks).

In the case of groundwater, it is to be considered the impact of drinking aquifers potentially by abandoned well or mining near the well through stimulation; this pose an issue in terms of regulation.

Main questions derived from the project are:

- How long would be the baseline? Three years could be considered as minimum period.
- Which are the compound to be measured for the baseline? The literature could help, including coating gases.
- Methodology for fractures? Initially, a statistical estimation of fractures should be done.

An Overview of the M4ShaleGas project was given by Yvonne Schavemaker. The key words of the project acronym are: measuring, monitoring, mitigation and managing. Sub-programmes of the project include the impact on surface, the global climate and the public concern. This activities will be conducted through integration, recommendation and dissemination. The project started the 1st oh June 2015 with a duration of 12 months and half.

Main questions involved are:

- Are modelled compounds the same used for the baseline monitoring? Yes, they are.
- How to plan a collaboration bringing knowledge and data sharing for a correct management of waste resulted from fracking and EC mining techniques?
- How to interact with stakeholders for the dissemination of results? Web, reports, meetings could be useful.
- What's happens when the well is abandoned? Re-stimulation of the well including well design (fit for purpose approach and not a standard approach), looking at the integrity of abandoned well about and thinking to the future. Main issue are:
    - No data available for the abandoned stage
    - Exploratory stage well will never come into production

An overview at European scale is needed. Monitoring program plans should also consider the audience to be satisfied and not go further to research aspects because the public perceptions is very important.

Data and Data Sharing Systems was discussed by Alessandro Torello with a presentation on The NGS Facts System. The NGS Fact System is a web site on voluntary disclosure of HF components used by industries. It is also a complement to another initiative called OPPPW.

The web site supplies transparency perception and need to the public to understand industry; it also benefits from sharing policy.

The website provides a platform for transparency, with data start from 2011, divided by countries, and with only <5% chemicals listed as trade secret.

Main questions are:

- What goes up from the well is much dirtier? Need a mirror for flow back fluids. Anomalies comes from flow back fluids; it would be useful as a complementary information even if it is difficult to sample the flow back fluid (takes time for operation). 20% of this fluid flow back in the first 15 days but small amounts come back in times (maybe somewhere else) and at the end nothing remain. Also, it is to be considered the change of fluids from reactions with rocks.
- Degree of saturation? How much come back for modelling process.

Conclusion

The workshop provided a first input on key parameters to be considered for baseline assessment and monitoring, and possible technical challenges in the implementation. Participants

A great deal of information was shared among the participants, who appreciated the technical level of discussion in a constructive atmosphere between the various stakeholders from the European gas sector, the European water sector, water using industries, environmental authorities and the research community.

Participants agreed their interest to pursue the process of exchanging knowledge on baseline assessment and monitoring and the idea that JRC organizes a follow up event was generally accepted. In this context, the idea of a technical level meeting with the four H 2020 consortia on the monitoring aspects was brought into the discussion.

Further work would be necessary to coordinate and facilitate the technical discussions, working towards a better harmonization of methodologies for baseline

Workshop final agenda

30 June 2015

09:00-09:15 **Welcome and Objectives of the workshop**
(*Commission*)

09:15-09:30 **EU legislative framework on chemical monitoring of water**

- Presentation(s) (*Commission*)

09:30-10:45 **National Experiences and User Perspectives**

- Methane monitoring experience in the UK (*Rob Ward*)
- The IWM network and UK approach to the Establishment of Environmental Baselines (*Steve Thompsett*)
- Water user's point of view and concerns (*Mark Mulcahy*)
- Groundwater Monitoring – Findings of the German Federal Environment Agency Study on Environmental Impacts of Hydraulic Fracturing (*Bernd Kirschbaum*)
- Polish experiences on environmental monitoring and groundwater management in the process of unconventional hydrocarbon exploration (*Monika Konieczyńska & Małgorzata Woźnicka*)

Coffee break during session

10:45-12:00 **Discussion: Baseline Monitoring**

12:00-13:30 Lunch at the EC canteen

13:30-14:15 **Research Projects**

- An Overview of the SHEER project and the strategy for groundwater monitoring' (*Peter Styles & Andrew Gunning*)
- An Overview of the M4ShaleGas project (*Yvonne Schavemaker*)
- An Overview of the Shale4environment project (*Adrian Jones*)

14:15-15:30 **Discussion: Surveillance / Control Monitoring**

Coffee break during session

15:30-16:45 **Data and Data Sharing Systems**

- The NGS Facts System (*Alessandro Torello*)
- Lessons learnt from FracFocus1 in the US (NN)
- IPCHEM (*Bernd Gawlik*)

16:45-17:30 **Conclusions and next steps**

17:30 End of Workshop

List of presentations

Joint Research Centre

The European Commission's in-house science service

EC Technical Workshop
Brussels, 30th of June, 2015

Baseline assessment and monitoring of water resources exposed to unconventional hydrocarbon exploration and extraction activities

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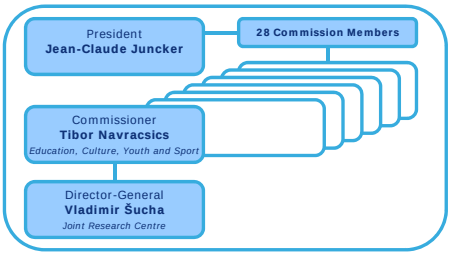
The JRC inside the European Commission



Overview

- Established 1957
- Only Commission Directorate General carrying out direct research
- 7 institutes in 5 countries
- 3,068 staff (35% short-term)
- 622 peer-reviewed scientific publications in 2013
- Budget 2013: €393.29 million, plus €73.9 million earned income

The Joint Research Centre (JRC)
the Commission's in-house science service

- Provides EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.
- Works in support of other Commission services, EU Institutions, and Member States, in close cooperation with industry, universities, and research organisations in the EU and worldwide.
- Is independent of industrial and national interests, has access to confidential information, and provides on-tap fast and flexible response.

Why this workshop?

- **EU has potential reserves of UHC in shale formations**
- **Some MS are pursuing shale gas exploration**
- **Impact in particular on (ground)water needs to be monitored:**
  - *Baseline assessment*
  - *Monitoring*
  - *Questions on methodologies*
- **Need for a scientific exchange on:**
  - *Key parameters to be considered*
  - *Technical challenges in implementation*
  - *Data sharing issues*

Agenda

09:00-09:15 **Welcome and Objectives**

09:15-09:30 **Chemical monitoring of water in the EU**

09:30-10:45 **National Experiences and User Perspectives**

- Methane monitoring experience in the UK (*Rob Ward*)
- The IWM network and UK approach to the Establishment of Environmental Baselines (*Steve Thompsett*)
- Water user's point of view and concerns (*Mark Mulcahy*)
- Groundwater Monitoring – Findings of the German Federal Environment Agency Study on Environmental Impacts of Hydraulic Fracturing (*Bernd Kirschbaum*)
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10:45-12:00 **Discussion: Baseline Monitoring**

13:30-14:15 **Research Projects**

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- An Overview of the **M4ShaleGas** project (*Yvonne Schavemaker*)
- An Overview of the **Shale4environment** project (*Adrian Jones*)

14:15-15:30 **Discussion: Monitoring**
Coffee break during session

15:30-16:45 **Data and Data Sharing Systems**

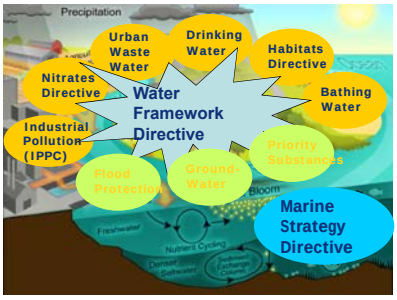
- The NGS Facts System (*Alessandro Torello*)
- Lessons learnt from FracFocus1 in the US (miscellaneous input from US EPA, GS and DoE)
- IPCHEM (*Bernd Gawlik*)

16:45-17:30 **Conclusions and next steps**

Chemical Monitoring of Water in the EU

European Union legislation provides for measures against chemical pollution of surface waters.

- **Inland and coastal waters**
  - Substances of EU-wide concern (**priority substances**)
  - Selection by Member States of substances of national or local concern (**river basin specific pollutants**) for control at the relevant level.
- **Groundwater**
  - pollution trend studies ("baseline level" data obtained in 2007-2008);
  - measures to prevent or limit inputs of pollutants into groundwater
  - Annexes I and II under reform
- **Marine waters**
  - Contaminants in water
  - Contaminants in fish and seafood
- **Legislation to be mentioned**
  - *Water Framework Directive*
  - *Groundwater Directive*
  - *Marine Strategy Framework Directive*
  - *QA/QC Directive*
  - *... and related ones*



The EU Framework for Water

Watershed drawing from Pearl (2005)

Arguments dealt with

- **Priority Substances**
  - Identification
  - EQS Setting
  - Monitoring
- **River-basin specific pollutants**
  - Selection
  - Monitoring
- **Watch List**
  - Purpose
  - Selection
- **And Exploratory Monitoring?**

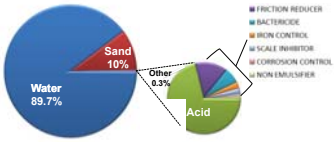
A vicious circle

"Emerging Pollutants – Compounds of emerging concern"

The "chemical" aspect

- Huge volumes
- Industrial grade
- No info about impurities
- Voluntary disclosure
- In Europe, strong controversy between Member States

Fluid Composition

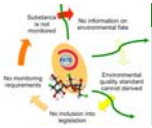


4 Million Gallons of Fluid Used
11,000 Gallons of Chemicals

Source: FracFocus – Hopson 5H well http://www.hydraulicfracturingdisclosure.org/

Pan-European Substance Scanning

To produce independent data on the occurrence of new and less-investigated contaminants in environmental media on a manageable sample set by sharing and synchronising available resources.



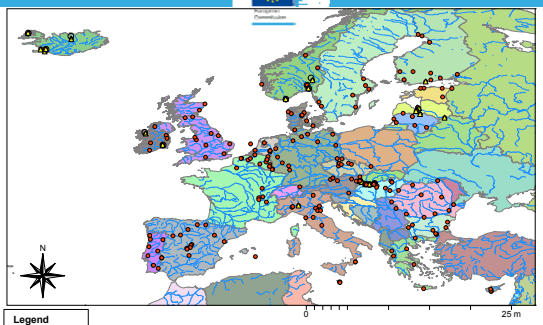
Chemistry-based Assessment
- Pesticides
- Pharmaceuticals
- Personal care products
- Nano-materials
- New chemicals
- ...

Effect-based Assessment
- Target organisms
- Biosensors
- Bioassays
- Transcriptogenomics
- ...

Risk-based Assessment
- Effect-direct analyses
- Emission loads
- Fate assessment
- ...

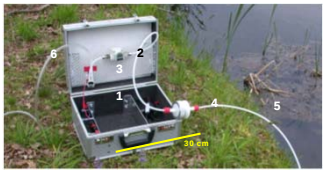
Characteristics:
- Concern-driven approach
- Integrative assessment
- Coordination of existing capacities
- Pan-regional assessment
- Known data quality
- Multi-parameter
- Few experts - same samples

Example: WWTP Effluents
- 91 WWTP effluents analyzed
- 168 organic chemicals and 20 trace elements
- 134 out of the 168 compounds were detected
- Effect-based:
  - Estrogenicity was detected in one third of the samples and
  - Dioxin-like toxicity was detected in a quarter of the samples.



Geographical distribution

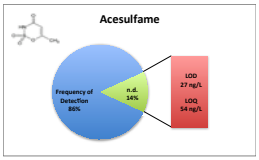
The Mariani Box

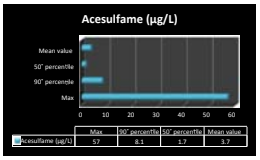


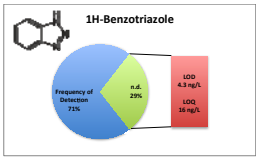
1. Battery 12 V
2. Flow-meter / Counter
3. Pump (Flow rate: 0.1-0.2 L / min)
4. Holder-SPE: adsorbent
5. Water Sampling line
6. Waste

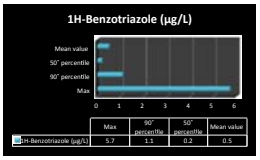
Cost prototype: 1500 Euro
Expected cost in production: 600 Euro
Patent: pending
Target volume: max. 10-20 L → 10 to 20 fold increase of LoQ

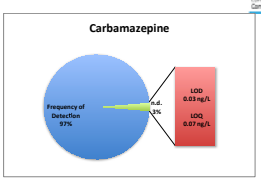
Water

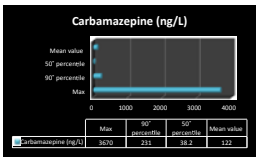


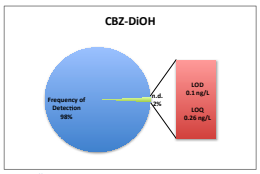


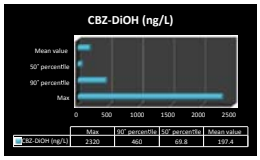












Core process

"Chemical Monitoring"

The most common sampling method applied for 1L of water.

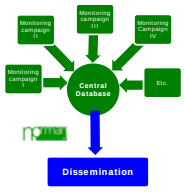
Extraction of Information
- Sampling
- Pre-treatment
- Analyses
- Quantification

Interpretation
- Statistics
- Mapping
- Concentration vs Effects

Communication
- Report
- Paper
- Poster
- Book
- Media

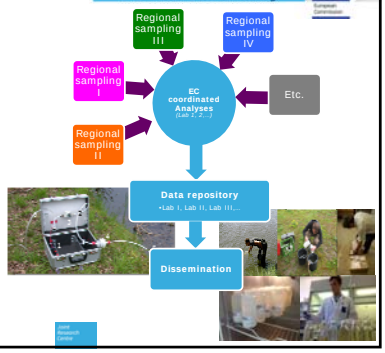
In case of chemicals, these steps are usually carried out by sectorial specialists and the risk of misinterpretation is high

Towards better approaches

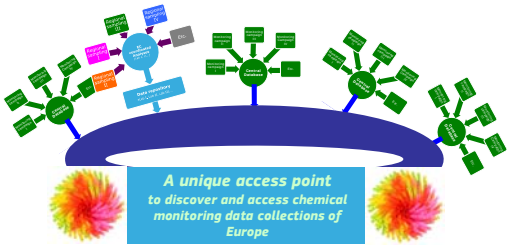


CENTRAL DATABASE

EU-Wide Monitoring and Watch List Monitoring



The idea of a "Chemical Information System" Service



A unique access point
to discover and access chemical monitoring data collections of Europe

Established through **COM(2012) 252 final**
COMMUNICATION FROM THE COMMISSION TO THE COUNCIL
The combination effects of chemicals - Chemical mixtures

Sharing data for better policy making

IPCheM is an initiative of the European Commission
- DG Environment (Chef de File)
- DG Joint Research Centre
- DG Health and Consumer Protection

Currently involved are in addition

European Food Safety Authority

European Environmental Agency

European Chemical Agency

Federal Environmental Agency – UBA (Germany)

Federal Public Service Health, Food Chain Safety and Environment (Belgium)

SOLUTIONS

NORMAN Association

Information Platform for Chemical Monitoring- IPCheM

British Geological Survey

Gateway to the Earth

Shale gas baseline monitoring in the UK

Professor Rob Ward
Director of Groundwater Science
British Geological Survey

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Outline

- National baseline monitoring
- Sub-regional integrated monitoring
- Preliminary results

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National baseline monitoring

- Widespread concern in N. America (and UK)
- RS/RAE report, PHE report, UK Shale Gas Task Force report…..
- Widespread recognition of importance and support for environmental baseline
- BGS – national geological survey takes leading role:
  - Resource estimation
  - Seismic investigation
  - Groundwater/aquifer protection
  - Methane baseline

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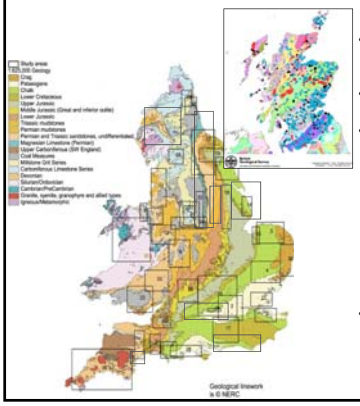
BGS/EA/SEPA Baseline Project



- 29 reports (England, Wales and Scotland) – BGS, EA, SEPA
- Broad range of aquifer types
- Common format:
  - geology/hydrogeology
  - environmental data
  - historical/current data
  - hydrochemistry plots
  - geochemical controls
  - evolution of chemistry
  - depth profiles
  - trends
- Currently used for WFD TVs, permit conditions, remedial targets, …….

Methane in sub-surface

Abbeystead, 1984
Lancashire Evening Post

Loscoe, 1986
Derby Evening Telegraph

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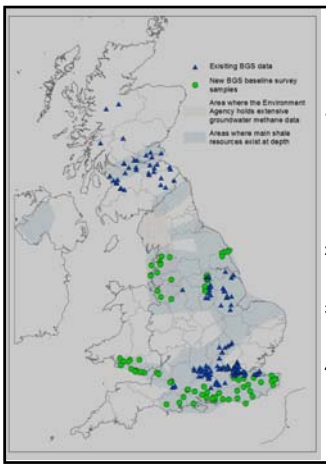


BGS baseline methane survey

1. Waters characterised using:
- Dissolved concentrations of CH_4 and CO_2 plus general water chemistry
- Stable isotopes of CH_4 and CO_2
- Trace organics
- Groundwater residence time indicators

2. Collation of other baseline data
- BGS/EA baseline studies

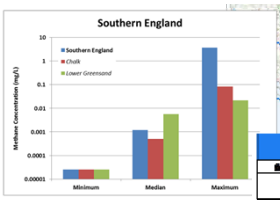
3. Temporal variation
- Quarterly sampling at selected sites

4. Publication
- Data summaries/statistics on BGS website

Environment Agency

Summary data and statistics

Area	CH4 Concentration (mg/L) Min	Median	Max	Number of Samples
Central Southern Scotland	[illegible]	[illegible]	[illegible]	[illegible]
Lancashire and Cheshire	[illegible]	[illegible]	[illegible]	[illegible]
Midlands & Yorkshire	[illegible]	[illegible]	[illegible]	[illegible]
Southern England	[illegible]	[illegible]	[illegible]	[illegible]
South Wales	[illegible]	[illegible]	[illegible]	[illegible]
Carlisle and Niland	[illegible]	[illegible]	[illegible]	[illegible]



Area	Concentration (mg/l) Minimum	Median	Maximum	Number of Samples
Southern England	[illegible]	[illegible]	[illegible]	[illegible]
Chalk	[illegible]	[illegible]	[illegible]	[illegible]
Lower Greensand	[illegible]	[illegible]	[illegible]	[illegible]

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Temporal methane monitoring

Region	Aquifer	Concentration range (µg/l)
Southern England	Chalk	0.6 - 1.1
	Lwr Greensand	<0.2 - 1.9
	Tunbridge Wells Sands	8.1 - 14
	Ashdown Beds	31 - 57
	Hampshire Tertiaries	12 - 19
Bristol/Bath	Keuper Sandstone	0.4 -3.1
	Carb Limestone	0.4 - 300
	Dolomitic Limestone	>0.2 - 2.5
S. Wales	Coal Measures	0.4 - 132
	Coal Measures	2.1 - 220
	Carb Limestone	0.5 - 483
Midalnds/Yorks	Chalk	0.1 - 0.2
	Chalk	0.4 - 1.0
	Lwr Magnesian Lst	0.3
	Sherwood Sandstone	0.1 - 0.2
	Sherwood Sandstone	0.1
North West	Drift	6.5-15.5

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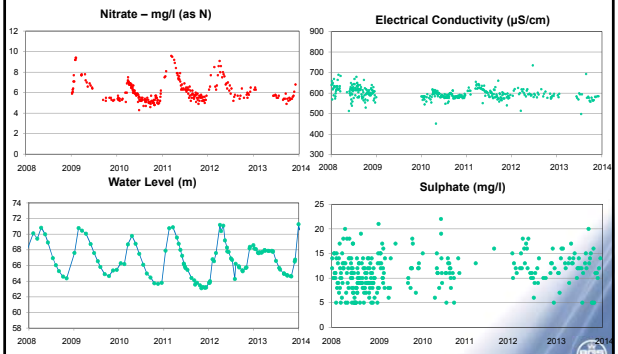
Importance of baseline



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Lancashire monitoring

- Extend national baseline monitoring
- Establish **independent** monitoring programme
- Provide high resolution (spatial and temporal) data - information and scientific results on the web and in scientific literature:
  - Inform public, industry, regulators of environmental baselines and their natural variability
  - Assist in shaping regulatory monitoring and good practice
  - Improve understanding of sub-surface in the context of UGEE (avoid issues encountered in NA)
  - Develop new technology/sensors
  - Establish effective partnership to build capability

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Monitoring work packages

- Groundwater
- Ground motion
- Induced seismicity
- Air quality and fugitive emissions

- Flowback fluid

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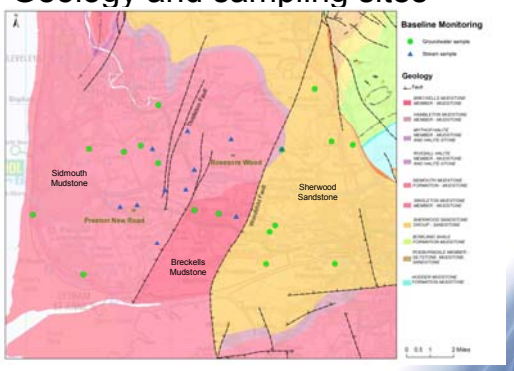
Geology and sampling sites



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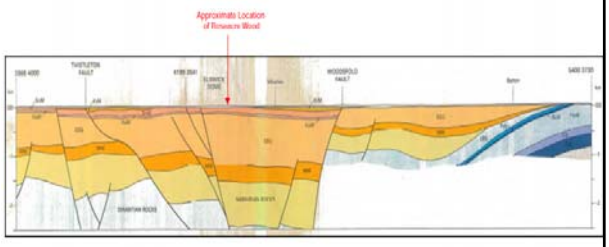
Geological X-section



W E

BGS (1990): 1:50k Solid Geology, Sheet 67 Garstang
© Crown copyright and database rights 1990 Ordnance Survey 100021290.

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Baseline groundwater monitoring

- Existing groundwater sampling points
  - Unstable parameters (on-site)
  - Inorganic and organic chemistry (VOCs, SVOCs, TPH, broad screening for range of organic compounds)
  - Dissolved gases (incl. CH_4, noble gases)
  - Stable isotopes ($\delta^{18}O$, $\delta^{2}H$, $\delta^{13}C$ DIC/CH_4)
  - Tracers: CFCs, SF_6
  - NORM (Rn, Ra, U)
- New boreholes
  - 6 pairs of shallow BHs – Quaternary (10-40 m depth)
  - 1 deep borehole – Sherwood Sandstone (500 m depth)
  - Real-time in situ monitoring : pH, T, DO, EC, water level
  - Laboratory analysis of groundwater - as above

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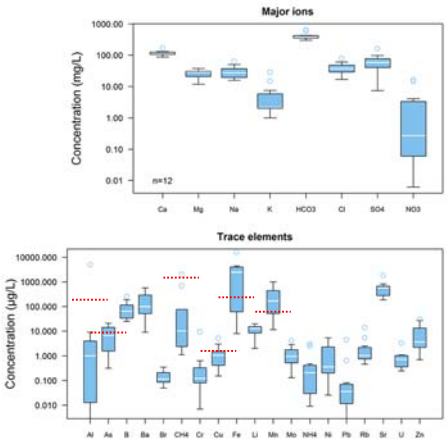
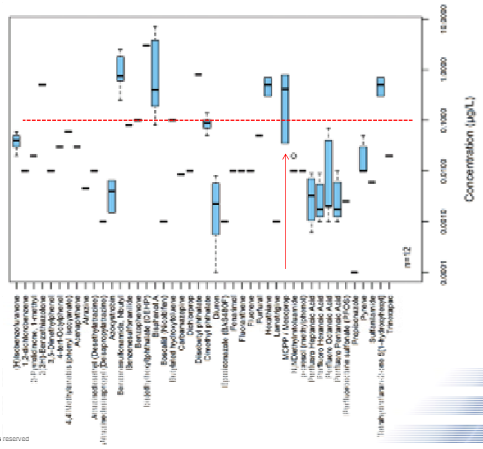


Preliminary results – inorganic chemistry



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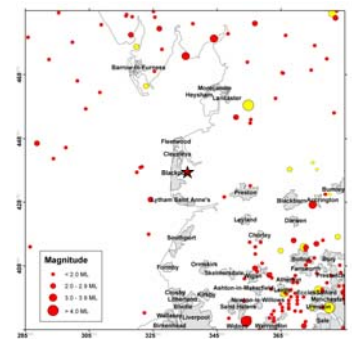
Seismicity



- Instrumentally recorded earthquakes (red circles): 1970 to present
- Historical earthquakes (yellow circles): <1970
- Epicentre of the 1 April 2011 earthquake (red star)

- Seismically quiet area
- Significant background noise

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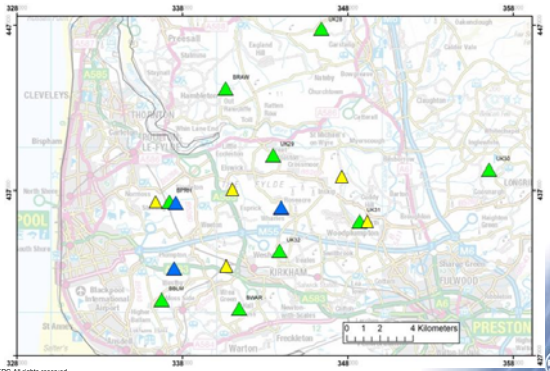
New seismometers



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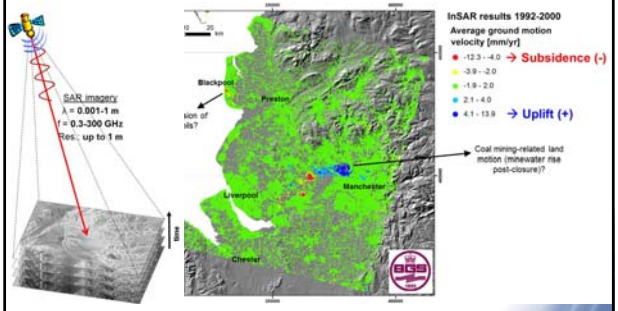
Satellite radar interferometry (InSAR)



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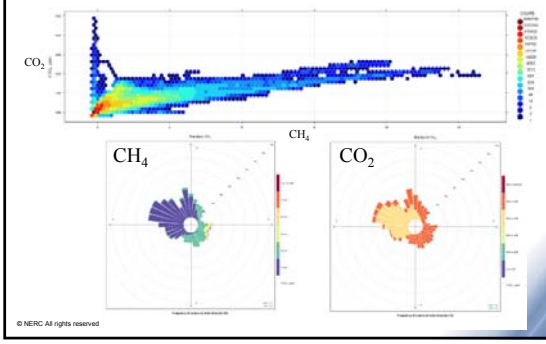
Air quality (CH_4 and CO_2)



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Thank you

www.bgs.ac.uk/research/groundwater

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UKOOG United Kingdom Onshore Oil and Gas

The UK voice for onshore oil and gas exploration

IWM Network &
UK approach to establishing Environmental Baselines

Technical Workshop on Monitoring

Tuesday 30th June 2015

Steve Thompsett
UKOOG – Executive Director

UKOOG United Kingdom Onshore Oil and Gas

Agenda

Integrated Water Management
- Water across regulation!
- Water and the Supply/Demand Chain
- An Integrated Approach to Water

Establishing Environmental Baselines
- Establishing Environmental Baselines Drivers
- Guidelines for UK Industry
- CSM
- Whole life approach to Monitoring

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IWM Network

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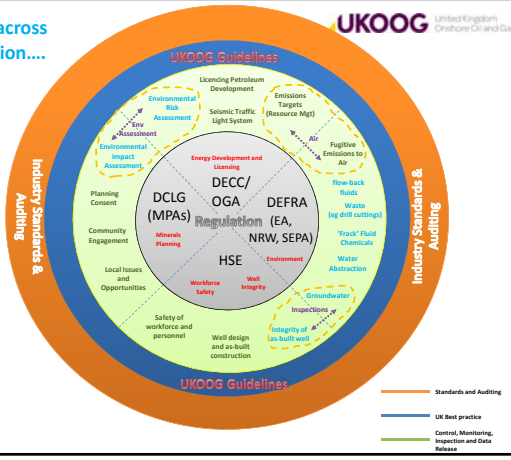
Water across regulation….



Water is Key in operational terms!

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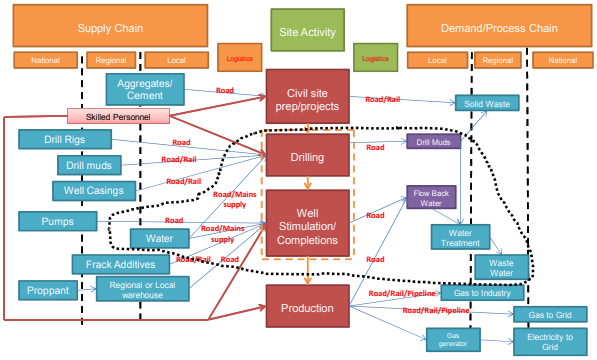
Onshore O&G – Demand/Supply Chain



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What are we doing?

UKOOG United Kingdom Onshore Oil and Gas

Environment and Process Safety Working Group initiative

Governance
- UKOOG led Steering Board: twice a year
  - O&G Operators
  - Academics
  - O&G Supply Chain
  - Water and O&G 'Technical' Experts
  - Water Industry
  - Next Board Autumn 15

Current Position
- Discussion Paper circulated – Autumn 14
- Initial meeting hosted – early December 14
- Terms of Reference established
- Sub-groups identified and 6 month plan formulated

Priorities
- Cross-cutting quick wins – eg analysis suites, BAT for Monitoring …
- 'Sectoral' groups to be established – networks/leadership
  - 1. Supply; 2. Site Mgt; 3. Operational Use and Re-use; 4. Waste Management
- Task and Finish activities by 'sectoral' area

Integrated Water Management for Onshore Oil and Gas

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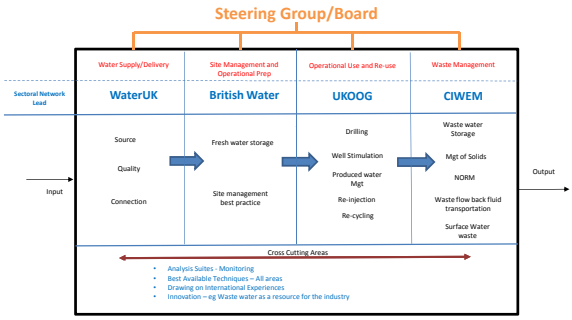

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Integrated Water Management - Next Steps

- This is a long term initiative - circa 5 years!
- Qtr 1 & 2 2015
  - Shape a priority programme!
  - Form 'Sectoral' task groups
- Qtr 3 to 4 2015
  - Realising the Quick Win Cross-cutting opportunities
  - Linking with other initiatives –Innovate – EA BAT projects
  - Capturing Learning from EU and other geographies
    - MWD BREF

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Establishing Environmental Baselines

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Establishing Environmental Baselines - Drivers!

- Building the Social Licence to Operate in the UK
- Supporting Permitting & Consenting
- Laying Foundations - Culture of Transparency and Disclosure
- Facilitating the Reinstatement of sites
- Managing Politics!
- Addressing Future Challenges

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Establishing Environmental Baselines

Context

- Risk Based – Science led
- Conceptual Site Model
- Source – Pathway - Receptor
- Draws on Best Practice from other sectors
- Avoid a 'blanket approaches'
- Covers all Onshore Oil and Gas
- Covers Exploration and Production
- Aimed for 12 pages – got 25!

Receptors

In Scope –

- Groundwater, Surface water, Soil, Air, Ground Gases, NORM and Ecology

Outside Scope –

- Nuisance (Dust, Noise etc)

Baseline Guidance - Published on 7th January 2015 | www.ukoog.org.uk

Conceptual Site Model

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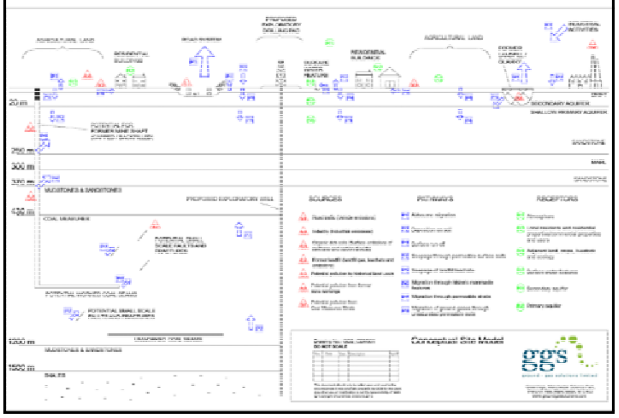
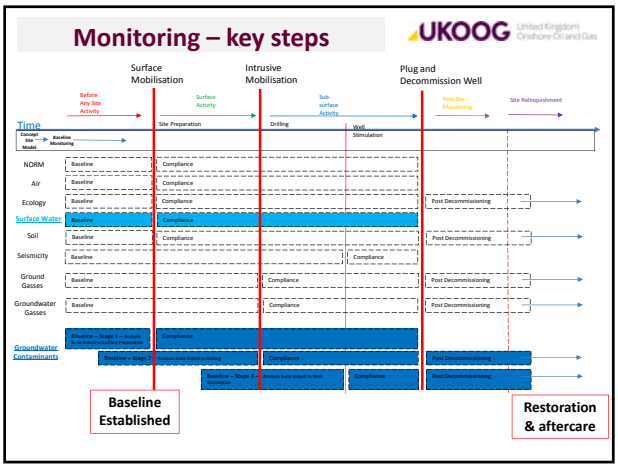



Monitoring – key steps
UKOOG
United Kingdom Onshore Oil and Gas
Surface Mobilisation
Intrusive Mobilisation
Plug and Decommission Well
Before Any Site Activity
Surface Activity
Sub-surface Activity
Post Site Monitoring
Site Relinquishment
Time
Concept Site Model
Baseline Monitoring
Site Preparation
Drilling
Well Stimulation
NORM
Air
Ecology
Surface Water
Soil
Seismicity
Ground Gasses
Groundwater Gasses
Groundwater Contaminants
Baseline
Compliance
Post Decommissioning
Baseline – Stage 1 – Analysis Suite Inherent to Surface Preparation
Baseline – Stage 2 – Analysis Suite Inherent to Drilling
Baseline – Stage 3 – Analysis Suite Inherent to Well Stimulation
Baseline Established
Restoration & aftercare

For our Environment

Umwelt Bundesamt

Technical Workshop

Groundwater Monitoring – Findings of the German Federal Environment Agency Study on Environmental Impacts of Hydraulic Fracturing

Bernd Kirschbaum
Federal Environment Agency
Section II 2.1 General Aspects of Water & Soil Protection

Studies of the Federal Environment Agency on Environmental Impacts of Fracking

First study - released September 2012

- Risk Assessment of Potential Impacts on Groundwater
- Fracturing Fluids , Flowback and Produced Water
- Legal Regulations and administrative Structures
- Recommendations for action and procedures
- http://www.umweltbundesamt.de/publikationen/environmental-impacts-of-fracking-related-to

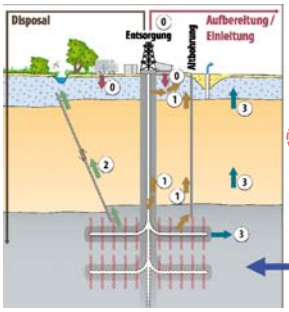
Second study - released July 2014

WP 1 - Monitoring Concept Groundwater
WP 2 - Fracturing Fluids Registry
WP 3 - Treatment and Disposal of Flowback and Produced Water

WP 4 - GHG emissions – Compilation of Scientific Knowledge
WP 5 - Induced Seismicity
WP 6 - Competing Uses and Environmental Protection
WP 7 - Recommendations

- http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_53_2014_summary.pdf

Potential Impact Pathways of Hydraulic Fracturing on Groundwater Resources



- Above surface pathways
- Technical/artificial pathways
- Natural pathways, e.g. deep-reaching faults
- Migration through high permeability pathways
- Disposal of flowback/production water in injection wells

Source: ahu, 2012

Risks for well integrity failure

Production well
- Zementation failure
- pipe failure

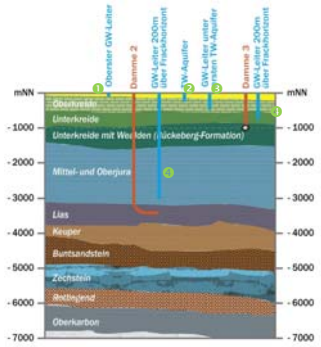
Lack of data
- Geology
- Hydrogeology
- Geomechanic
- Tension
- Pressure
- Hydrochemistry

Human error
- Design of frac operation
- Well construction
- Performance

External vulnerability
- Abandoned wells
- Boreholes for seismic and hydrological equipment

Source: RiskCom, 2014

Overview of the aquifers to be monitored



Source: RiskCom, 2014

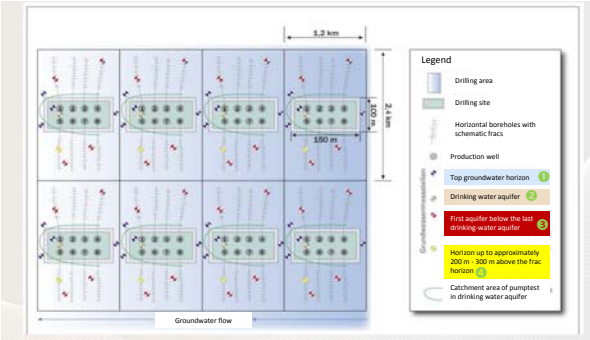
1. Top groundwater horizon (no drinking-water extraction)
2. Aquifer relevant for drinking-water extraction (drinking-water aquifer)
3. First aquifer below the last drinking-water aquifer
4. Horizon up to approximately 200 m - 300 m above the frac horizon

Overview of the aquifers to be monitored for prospecting, extraction and injection

Aquifer	Prospecting and extraction		Injection
	Baseline monitoring	Surveillance monitoring	
1 Top groundwater horizon (no drinking-water extraction)	X	X	X
2 Aquifer relevant for drinking-water extraction (drinking-water aquifer)	X	X	X
3 First aquifer below the last drinking-water aquifer	only intended for R&D and demonstration projects.	X	X
4 Horizon up to approximately 200 m - 300 m above the frac horizon	only intended for R&D and demonstration projects.	X	Only for pressure monitoring

Source: RiskCom, 2014

Number and allocation of groundwater test wells – R&D Projects



Source: RiskCom, 2014

Chemical Parameters

- Selection of chemical parameters for monitoring based on:
  - Fracking Chemicals (Quality, quantity and percentage of additives in der frac fluid)
  - Formation water (hydrocarbons, inorganic elements and ions, NORM)
  - Reaction Products formed from additives during fracking process
  - Mobilised solutes and solid products from the shale play
  - Disolved gases (e.g. ethane, methane, H_2S, CO_2)
- Exact Catalogue of Chemical Parameters that has to be analyzed requires sample

Source: C&EN, March 2015

Current situation Germany - Regulations on Fracking

Change of the following laws and ordinances

- Federal Water Act (WHG)
- Federal Nature Conservation Act (BNatschG)
- Federal Mining Act(BBergG)
- Ordinance on Environmental Impact Assessment of mining projects (UVP-V Bergbau)
- General Federal Mining Ordinance (ABBergV)
- Affected Burden Mining Ordinance (EinwBV)

New Monitoring Regulation mentioned in the Draft Law

Law	Regulations	Application
Ordinance on EIA of mining projects;	**Baseline study** according to EU COM 2014/70/EU	- Shale gas - CBM - Tight gas - Deep geothermal Energy (HDR)
Federal Water Act	Groundwater and surface water **monitoring during operation and closure;** Monitoring and quantitative + qualitative balance study of **flowback and produced water** for each well Monitoring of **well integrity** Monitoring of **air emissions** (methane, etc.) and of **induced seismicity**	- Shale gas - CBM - Tight gas - Deep geothermal Energy (HDR)

Groundwater Monitoring

Summary and Outlook

- Recommendations of the study were helpful for implementation groundwater monitoring in the new regulations (before, during and after hydraulic fracturing operations)
- Still many open questions:
  - Number, location and depth of groundwater test wells
  - Sampling intervalls
  - Exact Catalogue of Chemical Parameters that have to be analyzed
  - Screening methods for groundwater monitoring
  - Assesment of findings

Umwelt Bundesamt

Thank you for attention

Bernd Kirschbaum
bernd.kirschbaum@uba.de

Country Update - Germany

Basic Elements of the Draft Law

1. Ban of Fracking

Ban of Fracking	Law	Regulation	Application
Sensitive Areas	- Federal Water Act - Federal Nature Conservation Act	- Ban of fracking and subsurface disposal of produced water in water protection areas (drinking water and spa) and in catchment areas of dams and lakes for drinking water abstraction; - Ban of fracking and subsurface disposal of produced water nature protection areas, national parks and natura 2000-areas (partial)	- Shale gas - CBM - Tight gas - Deep geothermal Energy (HDR)
Shale gas and CBM	- Federal Water Act	**R+D Projects may be permitted** to explore and assess environmental impacts under certain conditions : • Fracking Fluids: only **non** water hazardous mixtures; • independent expert commission to accompany and evaluate R+D Projects	- Shale gas - CBM

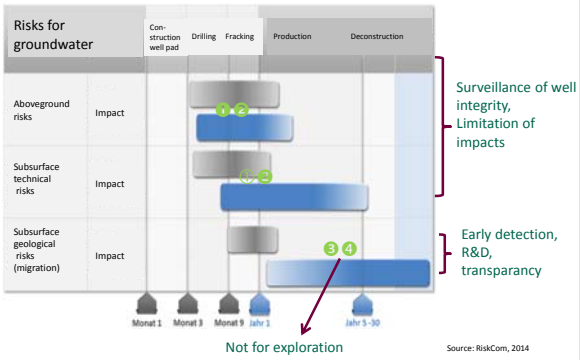
Country Update - Germany

Basic Elements of the Draft Law

2. Strict criteria

Strict criteria	Law	Regulation	Application
Induced Seismicity	- General Federal Mining Ordinance	- seismological baseline report - measures for controlled operation	- Shale gas - CBM - Tight gas - Deep geothermal Energy (HDR)
Frac-Fluid Registry	- Federal Water Act	- power to issue statutory instruments;	- Shale gas - CBM - Tight gas
Environmental Impact Assessment	- Ordinance on EIA of mining projects	- EIA for exploration and exploitation of natural gas, oil and geothermia using hydraulic fracturing.	- Shale gas - CBM - Tight gas - Deep geothermal Energy (HDR)
Liability - Burden of proof in damages	- Federal Mining Act; - Affected Burden Mining Ordinance	- Application of mining damage presumption also on borehole mining	- Shale gas - CBM - Tight gas - Deep geothermal Energy (HDR)

Temporal effects of risks



Source: RiskCom, 2014

Outline

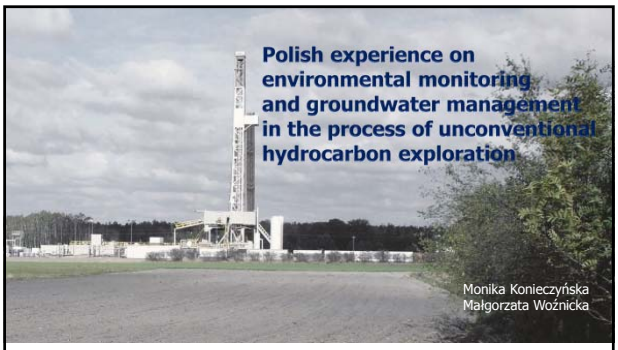
1 GROUNDWATER MONITORING CONCEPT FOR HYDRAULIC FRACTURING, IN PARTICULAR SHALE GAS

1.1 Context and objective of WP1 - groundwater monitoring concept
1.2 Assessment of potential impacts
1.3 Recommendations for further procedures – monitoring concept

2 SITUATION IN GERMANY

2.1 Current status of implementing new regulation on fracking
2.2 Foreseen monitoring activities

3



Polish Geological Institute
National Research Institute

FULL REPORTS

Exploration stage:

1. US Environmental Protection Agency (June 2015 draft); http://www2.epa.gov/hfstudy
2. Polish Report of General Directorate for Environmental Protection (2015) (Polish Geological Institute/AGH University of Sci. & Tech./Gdańsk University of Tech.); http://www.gdos.gov.pl/shale-gas-reports

Production stage:

1. US Environmental Protection Agency (June 2015 draft); http://www2.epa.gov/hfstudy

Research done by governmental agencies (in real conditions)

		USA	Poland*
1	Water acquisition	x	x
2	Water composition (background)	x	x
3	Flowback chemistry	x	x
4	Seismicity & earthquakes	x	x
5	Acoustic climate	x	x
6	Wellbore integrity	x	x
7	Soil protection	x	x
8	Drilling cuts managment	x	x
9	Wastewater reuse	x	
10	Surface water protection	x	x
11	Drinking water aquifers protection (methane pollution?)	x	x
12	Drinking water aquifers protection (chemical pollution)	x	x
13	Methane (e.g. co2) emission	x	x
14	Direct impact on human health	x	x

* Only for exploration

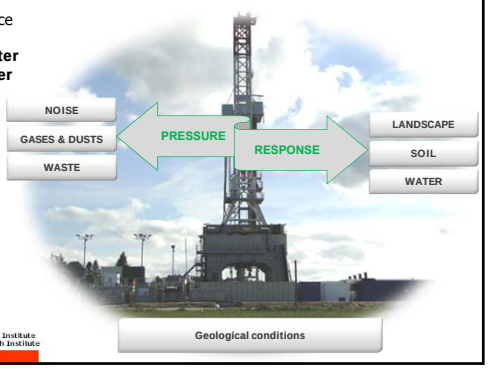
Test site locations in Poland

1 - Lubocino
2 - Stare Miasto
3 - Syczyn
4 - Wysin
5 - Zawada
6 - Łebień
7 - Gapowo

The aim of the project

Environmental impact on:

1. air
2. ground surface
3. soil
4. **surface water**
5. **groundwater**



The full cycle of research

1. Identification of the local conditions and field work planning.
2. Examination of the baseline status of the environment prior to the commencement of exploration.
3. Measurements while drilling vertical/directional wells.
4. Studies during hydraulic fracture stimulation and gas flow testing.
5. Examination of the status of the environment on completion of drill site operations.
6. Monitoring of the status of the environment after the completion of downhole operations.

The survey of water

Surface and groundwater resources assessment, sampling and analysis on several technological stages starting from well pad commencement, via drilling, HF and gas testing.

Quantitative status
water balance

Chemical status
assessment of water status

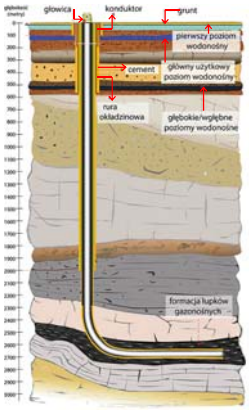
The scope of research

Water contamination risk:

- detailed natural confinement study
- possible migration pathways
- water quality assessment

Water needs:

- definition
- possible water supply sources



Research methodology

Assessment of hydrogeological conditions
Hydrogeological mapping | Hydrodynamic modeling

Assessment of chemical water status
Natural resistance to contamination | Sampling and laboratory tests

Assessment of quantitative water status
Analyzing of available water resources | Water balance

Long-term research monitoring
Sampling of control monitoring sites | Additional studies

Hydrogeological mapping and modeling

Test site	Surveyed area - estimated size in km²	Number of groundwater monitoring sites	Number of surface water monitoring sites
Lubocino	12.5	14	5
Stare Miasto	78.5	17	4
Syczyn	78.5	28	-
Wysin	28.0	16	2
Zawada	78.5	15	2
Łebień	12.5	-	-
Gapowo	28.0	16	1

Sampling

Test rounds:

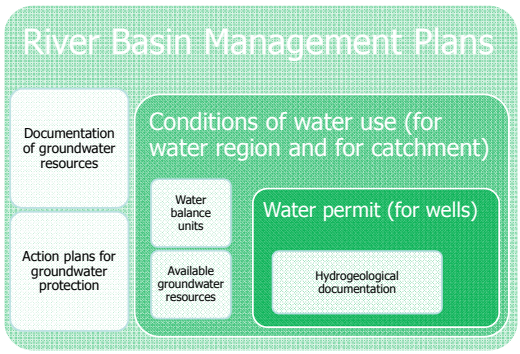
I. Initial status (before drill site construction) or as-found status (drill site in operation)
II. Prior to hydraulic fracture stimulation
III. During hydraulic fracturing
IV. On completion of Operator's activity
V. 1-2 years after well stimulation and gas tests

Test round	Monitoring sites sampled						
	Lubocino	Stare Miasto	Syczyn	Wysin	Zawada	Łebień	Gapowo
I	19	15	13	12	13	-	12
II	10	8	3	-	2	-	12
III	10	9	2	-	15	-	-
IV	-	12	13	-	2	-	12
V	-	12	4	-	-	5	-

Groundwater reserves versus water consumption for fracturing purposes

Test site	Available groundwater resources	Reserve groundwater resources	Fracturing water withdrawal	% of available groundwater resources used for fracturing purposes	% of reserve groundwater resources used for fracturing purposes
	(as of 2012)				
	10^3 m³/year	10^3 m³/year	10^3 m³	%	%
Lubocino	110 650	56 161	7.967	0.007	0.014
Stare Miasto	111 930	103 737	3.212	0.003	0.00319
Syczyn	79 034	66 476	37.849	0.05	0.057
Wysin	119 951	107 375	No fracturing		
Zawada	256 792	213 472	1.284	0.0005	0.0006
Łebień	208 828	190 539	17.322	0.008	0.009
Gapowo	110 650	56 161	25.360	0.023	0.045

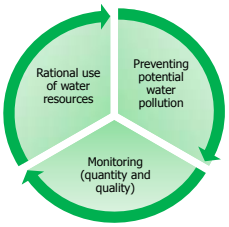
Groundwater management in Poland



Recommendations for water management

Water management recommendations address the following shale gas exploration and/or appraisal issues:

- to minimize the risk of top aquifer and surface water contamination by ground surface operations,
- to minimize the risk of deeper aquifer contamination by underground drilling operations (the vertical well),
- to minimize impacts on the quantitative status of waters (protection of surface and groundwater resources),
- to monitor water resources in terms of q & q.

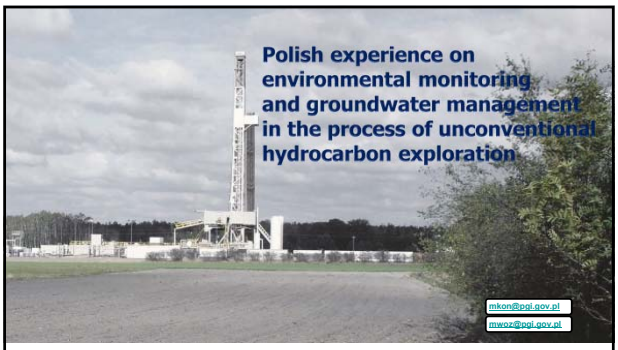


Conclusions

- The study showed no negative impact of exploration on the surface and groundwater chemistry in the observed period of time.
- There was no contamination of the groundwater as a result of well stimulation, neither any significant changes in test site impact indices were found in two years after hydraulic fracture stimulation
- No indirect impact on water-dependent ecosystems was detected.
- Due to the scale of operations, in terms of water requirements, **the stage of shale gas production** will differ significantly from the current exploration stage in Poland.

Conclusions (cont)

- Further exploratory/production operations should be preceded by:
  - site specific water supply study (incl. alternative water sources)
  - baseline status of surface and groundwater (quality and quantity),
  - background concentrations of methane in groundwater,
  - baseline concentrations of methane in soil gas.
- Special concern should be put on waste management, as high quantities of drilling wastes, flowback and produced water might pose hazards to natural environment on site and elsewhere.
- Ensuring safety of the environment and sufficient public perception and safety in production areas will require an adequate control of technical operations and **the establishment of uniform monitoring system,** with special regard to water supply reservoirs q & q.



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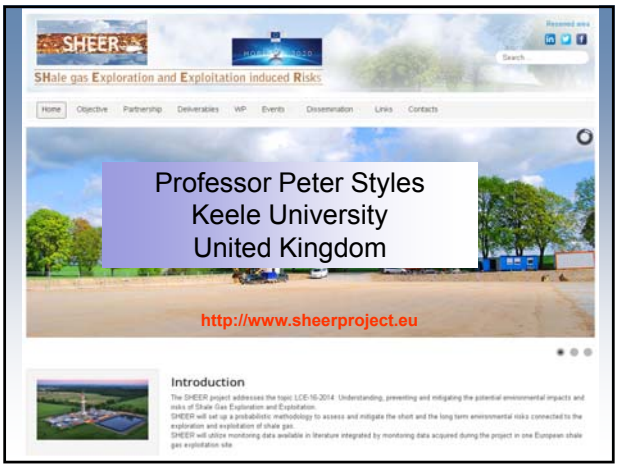
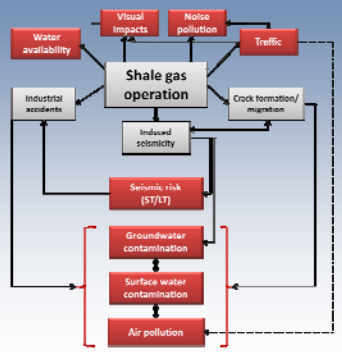


Potential hazards of shale gas operations



Fracking in the UK: as decided by Lancashire Planning Authority Yesterday!

Council Rejects Both Proposed Sites on Traffic and Noise (not on geological grounds!)

Work Packages

1. AMRA Analisi e Monitoraggio del Rischio Ambientale, Italy P. Gasparini (PI)	5. KNMI Royal Netherlands Meteorological Institute, Netherland B. Dost (PI)
2. IGF PAS Institute of Geophysics, Polish Academy of Sciences, Poland S. Lasocki (PI)	6. RSK RSK M Ltd, United Kingdom A. Gunning (PI)
3. KeU Keele University, United Kingdom P. Styles (PI)	7. UGL University of Glasgow, United Kingdom P.Younger (PI)
4. GFZ Helmholtz-Zentrum Potsdam Deutsches Geoforschungszentrum, Germany T. Dahm (PI)	8. UW University of Wyoming, United States M. Cheadle (PI)

WP Number	WP Title	Scientific coordinator
WP1	Project Management and Coordination	AMRA
WP2	Compilation of the SHEER Database	IGF PAS
WP3	On Site Monitoring	IGF PAS
WP4	Assessment of Induced Seismicity	GFZ
WP5	Assessment Of Groundwater Chemistry	RSK W Ltd
WP6	Assessment of the air quality impact	IGF PAS
WP7	Multi-Hazard And Multi-Risk Analysis	AMRA
WP8	Guidelines For Best Practice and Dissemination	KeU

DESCRIPTION

The **objective** of **SHEER** is to develop best practices for assessing and mitigating the environmental footprint of shale gas exploration and exploitation.

SHEER will develop a probabilistic procedure for assessing short and long-term risks associated with:

- ***Groundwater contamination***
  By chemicals contained in the flow back, formation, produced and waste waters;
- ***Air pollution***
  By migration of fugitive methane through induced and natural fractures and mobilization of radioactive particles and gases from the underground
- ***Induced seismicity***
  From fracking and injection of waste water

SHEER DISTINCTIVE FEATURES

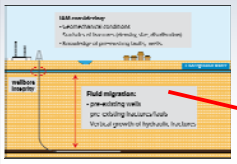
- **To develop procedures to assess time-dependent vulnerability of infrastructures, life-lines, and socio-economic assets to different possible hazards, to perform a multi-risk analysis.**
- To implement the developed framework for one of the case-studies.
- To carry out a comparative analysis between the impacts of shale gas operations and impacts related to exploitation of alternative energy sources.

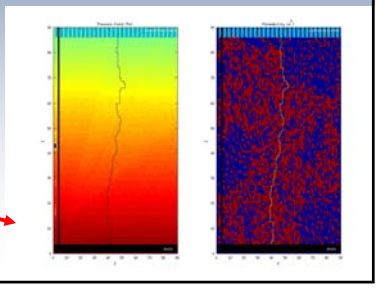
DESCRIPTION

The severity of each hazard depends strongly on the

unexpected enhanced permeability pattern

which may develop as an unwanted by-product of the fracking processes and may become pathways for gas and fluid migration towards underground water reservoirs or the surface.





DESCRIPTION

- **An important part of SHEER will be devoted to monitoring and understanding how far this enhanced permeability pattern can develop in space and time as a consequence of shale gas exploitation.**
- **The hazards may be at least partially inter-related as they all depend on this enhanced permeability pattern. Therefore they will be approached from a**
  - ***multi-hazard* and *multi risk perspective*.**

SHEER DISTINCTIVE FEATURES

MULTI-RISK ANALYSIS

Probabilistic methodology for assessing short and long-term risks

To implement an effective mechanism to identify and structure scenarios of risk interactions and cascading effects, taking into account the phase of development of the project:

- **Drilling, Hydraulic stimulation, Production, Abandonment**
  - To develop and implement physically-based, probabilistic tools for the assessment of the likelihood of occurrence of interrelated risk scenarios with regard to:
- **Induced seismicity**
- **Ground water pollution**
- **Air pollution**

SHEER

Shale gas **E**xploration and **E**xploitation induced **R**isks

WP 3.3.
Monitoring of groundwater condition

WP5
Assessment of Groundwater Chemistry

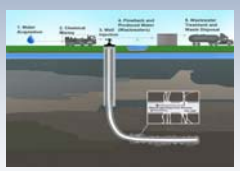
Andrew Gunning
RSK W Ltd

Groundwater Research work programme

- **TASK 3.3 - Onsite monitoring**
  IGF PAS,RSKW
- **TASK 5.1 - Develop Generic Settings:**
  RSKW, UGL
- **TASK 5.2 - Detailed Hydrogeological modelling:**
  RSKW, UGL
- **TASK 5.3 - Recommendations for best practice:**
  UGL, RSKW

Impact on drinking water aquifers is a key issue in shale oil and gas

An assessment of potential impacts of shale gas/tight oil exploration and development on groundwater resources, in terms of possible pollution or resource impairment, requires an investigation of three possible scenarios, as shown in Figure 1, in which groundwater could be impacted:



- At surface : spills of pollutants &/or contaminants; disposal of flowback;
- Around the well-bore as a result of a failure in well integrity in which drilling fluids or flow back is allowed to escape into surrounding strata;
- Through groundwater flow arising from fracture stimulation

Risks associated with the transfer of contaminants through surface activity such as spills of contaminants are not included within the research proposal.

Research Objectives

WP5 - Assessment Of Groundwater Chemistry [Months: 1-36]
RSK W Ltd, IGF PAS, KeU, UNIVERSITY OF GLASGOW

WP5 will characterise baseline conditions and potential impacts on drinking water supplies in shale gas plays within Europe. Assessment of potential impacts of shale gas exploration and development on groundwater resources, in terms of possible pollution or resource impairment, requires investigation of three scenarios in which groundwater could be impacted:

- Well integrity
- Abandoned well legacies.
- Fracture simulation eg changes in ground water flow and the potential for enhanced gas or fluid migration through high permeability pathways.

Task 5.1 . Develop Generic Settings (Task Leader: Andrew Gunning – RSK; UGL

Task 5.2. Detailed Hydrogeological modelling (Task Leader: Andrew Gunning – RSK; UGL

Task 5.3. Recommendation for best practice (Task Leader: Paul Younger – UGL; RSK)

Research Objectives

WP3.3 - Assessment Of Groundwater Chemistry [Months: 1-36]
RSK W Ltd, IGF PAS, KeU

A groundwater flow and chemistry monitoring will consist of at least one deep test well during a fracture stimulation to establish hydrogeological baseline condition and design a groundwater monitoring regime to sample specific zones.

This information will then be used to assess the impact of:

• Anthropogenic influences – existing/abandoned wells for surface spill of pollutants
• Well integrity failure;
•Groundwater flow arising from fracture stimulation.

Long–term hydro-chemical sampling will include the analysis of methane within groundwater.

•Piezometric data testing modifications in groundwater flow caused by fracture stimulation .

•Basic hydrogeological data using hand held field equipment

•Pump tests will be carried out to determine of hydrogeological parameters of the test zone.

•Equipment will be installed once the well is case with intensive sampling following installation and fracture stimulation but at other at intervals sufficient to identify trends.

SHEER DISTINCTIVE FEATURES

DATA GATHERING

Opportunity to monitor the site and collect whole-life-cycle data from the site preparation phase to the production phase

Polish shale gas site
Municipality: Gmina Lniewo

GW Monitoring Plan

At a site in Poland:

•1 hydrometric network – objective recharge

•4 boreholes to collect and analyse samples for a range of determinants including CH_4 with piezo's installed to monitor groundwater pressures.

Geology

▪Quaternary glacial and fluvio-glacial deposits, silts, sands, peat, overlying eroded Tertiary (Miocene) – very eroded, buried valleys

▪Mesozoic bedrock at depth.

The Wysin groundwater monitoring wells consist of at least 4 wells >200mm diameter, drilled to c 75 metres (mbgl).

The well locations are as follows:

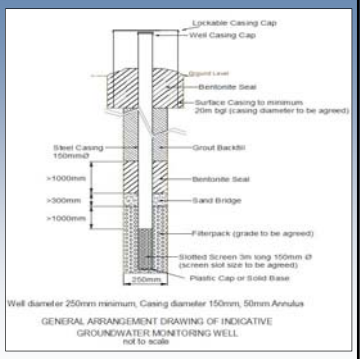
•GW1 – Upstream of direction of groundwater flow relative to the main drilling pad

•GW2 – Midway (800m) above lateral of Wysin 2H

•GW3 - Midway (800m) above lateral from Wysin 3H

•GW4 - Downstream of direction of groundwater flow relative to the main drilling pad

•GW5 – if required.



Thanks
Any questions

International Association of Oil & Gas Producers

Introducing NGS FACTS: public disclosure of hydraulic fracturing chemicals

Alessandro Torello, IOGP
June 30, 2015

www.ngsfacts.org responds to a transparency need

- EU may have significant shale potential
- Industry benefits from knowledge sharing
- Public is concerned by chemicals

IOGP: Producing Half of the World's Oil, a Third of the Natural Gas

Our main objective: **promote safe, responsible and sustainable operations**

Chemicals disclosure for the public

- Energy Community since 1st Jan 2011
- By country, well on a map
- <5% of chemicals listed as trade secrets
- IOGP hosts the data

All well data have been submitted by the relevant well operator and whilst IOGP has taken care to publish these accurately on the website neither IOGP nor the well operator shall be liable for any use of or reliance on such data by any third party or member of the public.

www.ngsfacts.org is… a website!

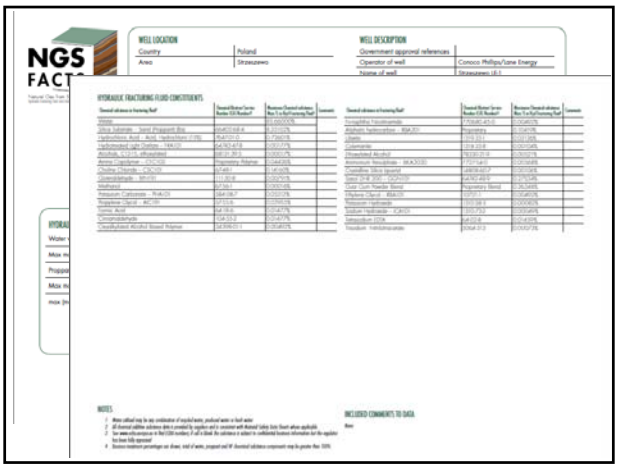
Natural **G**as from **S**hale **F**luid and **A**dditive **C**omponent **T**ransparency **S**ervice

- Anadarko Petroleum Corporation
- Baker Hughes Incorporated
- BG Group
- BP plc
- Chevron Corporation
- ConocoPhillips
- eni SpA
- Euromelaux
- ExxonMobil
- ODF SUEZ
- International Association of Drilling Contractors (IADC)
- International Gas Union (IGU)
- Maersk Oie og Gas AS
- Marathon Oil Company
- Norwegian Oil and Gas
- Oil & Gas UK
- OMV Group
- Repsol
- RWE Dea AG
- Schlumberger
- Shale Gas Europe (SGE)
- Shell International Exploration & Production BV
- Statoil
- Total
- Wintershall Holding GmbH

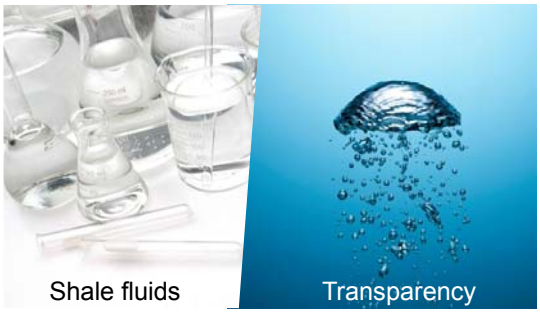
- Voluntary disclosure of HF components
- Open to all operators
- Complement to other initiatives (OPPPW*)

* See: http://www.opppw.pl/en/fracturing_fluid_composition/23

Fracturing fluids are typically composed of: >90% water, 9% sand, <1% chemicals



In conclusion, www.ngsfacts.org is about…



International Association of Oil & Gas Producers

Thank you!

For more information please contact:

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8

IPCheM

The European Commission
Information Platform for Chemical Monitoring

EU Monitoring programmes

MATRICES

- Food and Feed monitoring
- Environmental monitoring
- Human bio-monitoring
- Product & indoor air monitoring

REASONS

EU legislation/initiatives
WFD, MSFD, Air quality directive, Drinking water directive, MRLs in food/feed, REACH, Market surveillance regulation, etc.

International obligations/initiatives
OSPAR, HELCOM, Stockholm Convention, EMEP, AMAP, WHO, UNEP, etc.

National legislation/initiatives
Surveys, etc.

Scientific curiosity

DATA PROVIDERS

- MSs Authorities
- Research Institutes
- Universities
- JRC
- Industry

Why IPCheM?

The lack of information on the chemical exposure and burden on the humans and the environment **is a major gap** in knowledge base for the European chemical policies.

➔ It is **not possible to assess the real impact of chemicals and their mixtures**

➔ It is **difficult to assess effectiveness of policies**

➔ Ad-hoc **collections are very time demanding and inefficient**

IPCheM requested by:

COM/2012/0252 final: The combination effects of chemicals – Chemical mixtures

7th Environment Action Programme. Priority objective 5: to improve the knowledge and evidence base for Union environment policy

Data collection, management & assessment

Food and Feed monitoring	**Collection of data well established (EFSA)** **Specific calls for data** **RASFF (SANCO)**
Environmental monitoring	**No systematic collection exists** **Good initiatives but limited – WISE, AIRBASE (EEA)**
Human bio-monitoring	**No systematic collection exists** **COPHES, DEMOCOPHES – EU projects**
Product & indoor air monitoring	**No systematic collection exists** **Some data in RAPEX (SANCO)**

No inter-linkages

Background

COM/2012/0252 final: The combination effects of chemicals – Chemical mixtures

"Support improved understanding of the chemical mixtures to which human populations and the natural environment are actually exposed"… "through the creation of a platform for chemical monitoring data. This would help identify links between exposure and epidemiological data in order to explore potential biological effects and lead to improved health outcomes."

7th Environment Action Programme

Priority objective 5: to improve the knowledge and evidence base for Union environment policy

This requires "*developing a comprehensive chemical exposure and toxicity knowledge base which draws on data generated without animal testing where possible. Continuing the Union's coordinated approach to human and environmental biomonitoring including, where appropriate, standardisation of research protocols and assessment criteria*

Definition and background

Scope statement for IPCheM

IPCheM is a single access point for discovering and retrieving chemical monitoring data

IPCheM is design as

- a distributed infrastructure
- avoiding data duplication and information systems replication
- respecting any condition of data access and use defined by Data Providers

Objectives

- Facilitate access to chemical monitoring data
- Provide hosting facilities for data currently not properly stored
- Promote and improve data quality and comparability
- Facilitate assessment

Scope statement for IPCheM

- **It covers only chemical monitoring data;** other data (e.g. hazard, emissions, physicochemical properties) are not integrated to IPCheM but can be linked to it
- **Data providers:** Commission Services, EU Agencies, EU Member States, international and national organisations, researchers
- **Users:** Commission Services, EU Agencies, MSs, international and national organisations, researchers and public, respecting existing access and use conditions

Project approach

Scientific challenge→ climb the "data comparability" ladder

"IPCheM should further strive to improve comparability of the data by promoting standardisation of data and metadata and improvement of quality assurance standards"
(IPCheM Scoping Paper)

Benefits in chemical monitoring domain:

- evaluate multi-media and multi - pathway exposure for human risk assessment
- evaluate time trends in the levels of chemicals in the environment and in humans
- evaluate the efficacy of policy measures for reducing exposures in the environment and in humans
- prioritise further research, monitoring and policy measured for protecting the environment and human health from chemical exposure threaths

Project management and governance

Structure

Environmental monitoring data	EEA
Human Biomonitoring	EEA
Food and feed	EFSA
Indoor air and products	IHCP JRC

PROJECT GOVERNANCE

4 thematic modules

Approach

1ST level: metadata page

Information about data collection, e.g.:
- Spatial and temporal coverage
- media
- Chemicals and related UoM
- Conditions of data access and use
- Responsible Body and PoC
- Links (home page, db app.)

Unique search interface

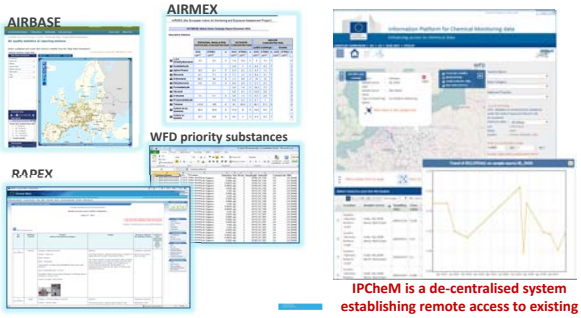
- Chemical name
- CAS number
- Module
- Media
- Spatial coverage
- Temporal coverage (V2)

2ND level: page of results

- Visualisation of data values (concentrations) into the **Master Table**
- Additional specific filters based on data structure
- Sample site/station info
- Temporal trends
- Spatial search and query refinement
- Possibility to save the results into the

The **Master table** was originally based on **the simple identification of the minimum set of information domain-related and common to all data collections to be integrated in IPCheM**:
- *concentration measurements of 1-n substances*
- *with declared UoMs*
- *collected in different matrices/media*
- *in a certain "period"*
- *in a certain "location"*

Scientific challenge→ handle heterogeneity in a transparent way



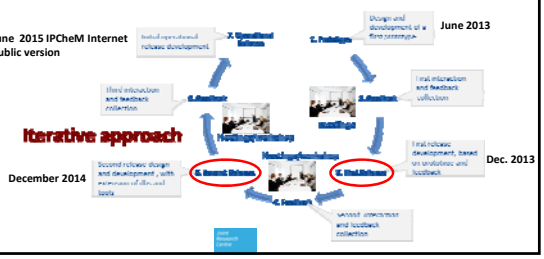
IPCheM is a de-centralised system establishing remote access to existing data collections

Status of Development

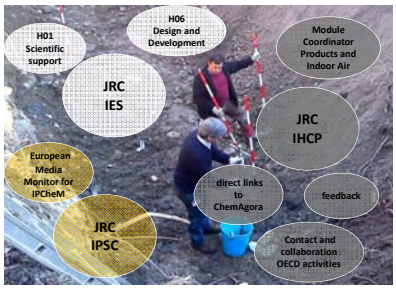
Status of development

- Current version: First release open to European Commission and European Agencies

Feb. 2013Start of IPCheM development – 3 year project



IPCheM is an initiative involving the active participation of a large number of partners.



External partners

6 DGs, 3 EU Agencies, Member States, Research Consortia

Vision for the future

→ **Fitting IPCheM into the International knowledge framework (e.g. OECD)**

→ **IPCheM the official repository of the outcomes of relevant research projects (already in line with RDA principles)**

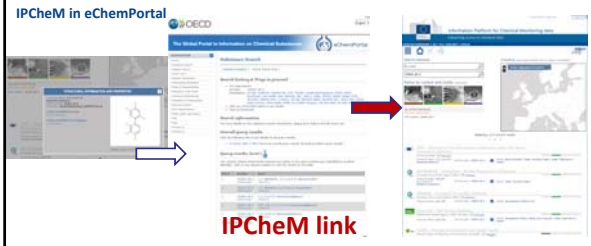
→ **IPCheM a 'two-way alert' system between environmental and food monitoring (to flag up contamination)**

→ **IPCheM a support system for knowledge on exposure-dose-response relationships (correlation of health with exposure threats)**

Next step of the project

Enhancement of interoperability with information systems of the same domain to enlarge the knowledge framework of effects on chemicals and mixtures

IPCheM in eChemPortal



http://rdsi-portal-dev.jrc.it/RDSIdiscovery/ipchem/index.html#discovery/35065-28-2

Next steps of development

- **IPCheM Internet public Version (for the IPCheM Conference, 19th June 2015)**
- Implementation of the authentication and authorization tool to allow different levels of data accessibility to different groups of user
- Upgraded version for **download options** (formats, metadata info, quality flag)
- **Map-viewer** version 2
- **Statistic tool - advanced** version 1
- Feasibility and pilot version for **sub-structure search**

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