Welcome

On behalf of the REMEDIATE consortium, welcome to our conference at Queen's University Belfast. I hope you have an enjoyable and informative two days of presentations and workshops. This conference would not have been possible without the dedication and performance of our Early Stage Researchers across seven universities, their supervisors, and without the input of our industrial and public sector partners. We also thank our speakers, session chairs, and workshop organisers.

There are 4 themes to the conference presentations: Contaminated Land Biology; Site Modelling, Risk Assessment and Risk Communication; Chemical Analysis, Monitoring and Prediction; and Advances in Land Management and Resource Recovery, with 30 presentations and 6 posters presenting the latest developments from international leaders in the contaminated land sector.

We are also delighted to facilitate two workshops geared specifically towards the brownfield industry: The Ireland Brownfield Network will deliver 'Asbestos in Soil – A Magic Number'; and the British Geological Survey along with the Geological Survey of Northern Ireland will deliver a workshop on 'Using Science to Manage the Sub-Surface'.

We hope that you have a great time, learn a lot, make new friends and meet up with old ones.

Best wishes,

Rory Doherty
REMEDIATE Coordinator
Queen's University Belfast

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Programme summary

Wednesday 19th September 2018

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1240 - 1340	Lunch (Isdell Courtyard)
1340 - 1520	Sessions B1 & B2 (Conference Rooms)
1520 - 1730	IBN Workshop (Isdell Courtyard)
1900 - 2300	Conference Dinner at the Ulster Museum

Thursday 20th September 2018

0830	Registration open (Block 2 entrance)
0830 - 0930	Networking Breakfast (Isdell Courtyard)
0930 - 1110	Sessions C1 & C2 (Conference Rooms)
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1700 - 1730	Closing Session (Isdell Courtyard)

Wednesday 19th September 2018

0800 Registration open (Block 2 entrance)
0845 - 1030 Opening Session (Isdell Courtyard)

Chair
Rory Doherty
REMEDIATE Coordinator
Queen's University Belfast

Speakers
Paul Bardos
University of Brighton
Director, r3 Environmental Technology Ltd
Using Risk Assessment and Sustainability to make the most Cost-Effective Contaminated Land Management Decisions

Richard Clayton
Director
WSP in the UK
A Remediation Practitioners Framework for Effective Remediation

Dietmar Müller-Grabbher
General Secretary
EU Common Forum on Contaminated Land
Towards Improving Solutions in Contaminated Land Management

1030 – 1100 Tea/Coffee (Lower Glass Corridor)

1100 – 1240 Sessions A1 and A2

Session A1 Chemical Analysis, Monitoring, and Prediction I (Conference Room 1)

Chairs

Fred Coulon
Professor of Environmental Chemistry & Microbiology Cranfield University (UK)

Alex Lee
Director
WSP in the UK

Presentations

CAMP11
Coren Pulleyblank
Dublin City University
Detecting degradation products of polycyclic aromatic hydrocarbons (PAH) in aqueous and soil environmental matrices: recent progress in the field.

CAMP10
Peter Brennan
Dublin City University
Distribution and sources of PAHs and trace metals in Bull Island, Dublin Bay

CAMP3
Diego Corcho-Sanchez
Envirotecnics Global Service
Laboratory evaluation of mixed surfactants solutions to mobilise hexachlorocyclohexane (DNAPL) from Sardas landfill (Aragón, Spain)

CAMP7
Mark Cave
British Geological Survey
Prediction and mapping of the human ingestion bioaccessibility of arsenic from soils in the South West of England

Session A2 Advances in Land Management and Resource Recovery (Conference Room 2)

Chairs

Giovanna Dino
Environmental Engineer
University of Turin

Tommi Kaartinen
Senior Scientist
VTT (Technical Research Centre of Finland)

Presentations

ALMRR1
Neha Mehta
University of Turin
Reuse of extractive waste from abandoned mine site to restore land sustainability: A case study from Campello Monti, NW Italy

ALMRR2
Zoltan Sas
Queen's University Belfast
Radiological characterisation of recyclable industrial by-products for concrete production point of view

ALMRR4
Silvia Contessi
University of Padova
The High Performance Solidification/Stabilization process: a case study of Pb immobilization through recycling of contaminated soil

ALMRR5
Lorena Zichella
Polytechnic University of Turin
Environmental impacts, management and potential recovery of residual sludge from stone industry: the Piedmont case

1240 – 1340 Lunch (Isdell Courtyard)

1340 – 1520 Sessions B1 and B2

Session B1 Contaminated Land Biology I (Conference Room 1)

Chairs

Kristian Brandt
Associate Professor
University of Copenhagen

Mike Larkin
Emeritus Professor
Queen's University Belfast

Presentations

CLB7
Stacie Tardif
University of Copenhagen
Evaluation of soil microbiological community attributes for future integration into site-specific ecological risk assessments

CLB8
Yi Zhao
University of Copenhagen
Evidence for metal-induced co-selection of antibiotic resistance genes in urban soils from the Tellus Survey in Belfast, Northern Ireland

CLB6
Christine Switzer
University of Strathclyde, Glasgow
Rehabilitation of soil after aggressive high temperature remediation

CLB1
Caroline Gauchotte-Lindsay
University of Glasgow
Towards a rational design for PAHs bioremediation- combination of advanced analytical and molecular tools

Session B2 Site Modelling, Risk Assessment, and Risk Communication I (Conference Room 2)

Chairs

Torsten Schmidt
Chair of Instrumental Analytical Chemistry
University of Duisburg-Essen

Mike Spence
Environmental Geoscientist
Shell

Presentations

SMRARC7
Tatiana Cocerva
Queen's University Belfast
How can oral bioaccessibility improve the human health risk assessment of inorganic contaminants? Case study: metropolitan area of Belfast

SMRARC1
Darren Beriro
British Geological Survey
Measuring polycyclic aromatic hydrocarbons release from soil in artificial sebum – steps toward a physiologically based in vitro dermal bioavailability test

SMRARC5
Russell Thomas
WSP
Assessing the environmental legacy of the manufactured gas industry in the UK and Europe

SMRARC6
Steve Owen
RSK Ltd
Non-intrusive advances in site characterisation to maximise value during land management

1520 – 1730 Ireland Brownfield Network (Isdell Courtyard)

Asbestos in Soil - A Magic Number?

The Ireland Brownfield Network (IBN) will host a workshop to discuss the key issues regarding the investigation, analysis and assessment of asbestos in soils (AiS), and the subsequent management of risks through remediation and management of waste.

Asbestos poses significant financial, legal and reputational risks for the management and redevelopment of brownfield land. IBN will produce a guidance document to support an all-Ireland approach for the investigation, assessment, and management of AiS through referencing existing legislation and industry-led guidance and best practice. The overall aim of this document will be to provide developers and their advisors with a refence guide to explain their legal requirements and identify appropriate mitigation measures to support the safe management and development of brownfield land.

Panel

Siobhan Cox (Chair)
Senior Lecturer, Remediate ESR supervisor
Queen's University Belfast

Anne Marie Casey
Chairperson of the Ireland Brownfield Network
Senior Specialist,
ESB International

Olivia Holmes
Senior Environmental Consultant
Malachy Walsh & Partners

Claire Clifford
Technical Director
Enviroguide Consulting

David Kerr
Senior Environmental Consultant
White Young Green Limited

Owen Williams
Environmental advisor
Brownfield Development Services

Simon Cole
Executive Committee member of SoBRA
Technical Director,
Aecomm

1930 - 2330 Conference Dinner at the Ulster Museum

Thursday 20th September

0830 – 0930 Registration (Block 2 entrance)
0830 – 0930 Networking Breakfast (Isdell Courtyard)

0930 - 1110 Conference Sessions C1 and C2
Session C1 Chemical Analysis, Monitoring, and Prediction II (Conference Room 1)

Chairs

Fred Coulon
Professor of Environmental Chemistry & Microbiology Cranfield University (UK)

Alex Lee
Director
WSP in the UK

Presentations

CAMP4
Tom Henman
RSK Ltd
Maximising site conceptualisation for coal tar NAPL in fractured bedrock through UV fluorescence testing, downhole geophysics, NAPL physico-chemical testing and in situ remedial pilot trials

CAMP5
Panagiotis Kirmizakis
Queen's University Belfast
Bioelectrical systems to investigate and monitor remediation

CAMP2
David Holmes
Ecologia Environmental Solutions Limited
Advances in in-situ automatous LNAPL and water level monitoring by guided wire radar: detailed analysis of LNAPL behaviour and improved site understanding

CAMP8
Matthias Metzger
Dublin City University
Development of analytical methods for the determination of polycyclic aromatic hydrocarbons and phthalate acid esters contamination in soil to assist remediation processes

CAMP9
Nenad Stojanović
University of Duisburg-Essen
Development of PAL SPME Arrow-GC-IRMS method for compound-specific stable isotope analysis of groundwater contaminants

Session C2 Contaminated Land Biology II (Conference Room 2)

Chairs

Kristian Brandt
Associate Professor
University of Copenhagen

Mike Larkin
Emeritus Professor
Queen's University Belfast

Presentations

CLB5
Ricardo Costeira
Queen's University Belfast
Exploratory metagenomic characterization of bacterial and viral communities in groundwater of contaminated land

CLB2
Chris Allen
Queen's University Belfast
Can we measure the age of oil pollution using molecular microbiology?

CLB3
Heather De-Quincey
Swansea University
The use of a biochar enhanced artificial soil for mine reclamation

CLB4
Hussein Ibrahim
Queen's University Belfast
Functionally active naphthalene-degrading bacterial community in hydrocarbon-contaminated groundwater from an old gasworks site

CLB9
Elio Padoan
University of Turin
The suitability of short rotation forestry for phytoremediation of urban soil, development of a protocol for urban areas

1110 – 1130 Tea/Coffee (Lower Glass Corridor)

1130 – 1250 Session D1

Site Modelling, Risk Assessment, and Risk Communication II (Conference Room 1)

Chairs

Torsten Schmidt
Chair of Instrumental Analytical Chemistry
University of Duisburg-Essen

Mike Spence
Environmental Geoscientist
Shell

Presentations

SMRARC2
Darren Beriro
British Geological Survey
Ground Risk Prioritisation Tool for brownfield redevelopment projects

SMRARC3
Sabrina Cipullo
Cranfield University
Linking bioavailability of complex mixture to toxicity changes to assess recovery of contaminated soil

SMRARC4
Neha Mehta
University of Turin
Linking bioaccessibility and solid-phase distribution of heavy metals in soils and extractive waste from abandoned mine site: A case study from Campello Monti, NW Italy

SMRARC8
Jack Lort
British Geological Survey
Dermal Bioavailability of PAHs: The Route Forward

1250 – 1350 Lunch (Lower Glass Corridor)

1350 – 1700 British Geological Survey and Geological Survey of Northern Ireland Workshop

Geoscience and Brownfields - Using Science to Manage the Soil Sub-Surface

This workshop will provide attendees with an enhanced understanding of BGS geoscience used to develop conceptual sites models for risk-based management of brownfield land. Examples will range from accessing BGS digital geology maps to free geological software for drawing accurate cross-sections and borehole logs to bioaccessibility science. GSNI will provide a local perspective on the use of information to guide decision making, including the Tellus project. Group discussions will focus on what BGS and GSNI might do differently to enhance the benefits of its science within the brownfield redevelopment process and how we could adapt and respond better to end-user need. We will also discuss new ideas that may perhaps form the basis of collaborative projects and ventures that satisfy defined industry requirements. The results of the workshop will be used to plan future geoscience activities.

Presenters

Darren Beriro
British Geological Survey (BGS)

Alex Donald
Northern Ireland Geological Survey (GSNI)

1700 – 1730 Closing Session

Closing remarks from Rory Doherty, Coordinator of Remediate
Presentations of awards
Acknowledgements

Conference Abstracts

Advances in Land Management and Resource Recovery (ALMRR)

ALMRR1

Neha Mehta
University of Turin

Reuse of extractive waste from abandoned mine site to restore land sustainability: A case study from Campello Monti, NW Italy

Extractive waste dumps present at abandoned mine sites are high in volume and present an environmental hazard as the heavy metals get released. Challenges linked with extractive waste makes it imperative to apply methodologies to restore land sustainability. Reusing extractive waste and recovering minerals can be important intervention strategy. The present study is structured on three sections: 1) risk analysis to quantify environmental impacts; 2) using waste as additive to pure soil; 3) dressing activity to exploit minerals. The study was done in abandoned mine site of Campello Monti located in the basement of Southern Italian Alps and composed of mafic rocks, used for Ni exploitation from 1863 to 1940s To determine need of intervention strategies, risk analysis approach using Risk based Corrective Action (RBCA) guidelines was used. Impacts on human health and groundwater were measured. Results showed that there was carcinogenic risk to human beings due to arsenic. There was risk to groundwater due to Ni. In fact, groundwater was found to be contaminated with Ni during sampling campaigns. pH dependence batch leaching test was performed to study release aspect of contaminants in water, to further analyse impacts of waste. Experiments were conducted to analyse the use of fine fraction (< 2 mm particle size) of waste rocks as additive to pure soil. Plant growth experiments were conducted after mixing waste rocks with pristine sand and a compost mixture. No major negative impacts were observed. To recover minerals and to exploit raw materials (Ni, Cu, Co) and potential critical raw materials, platinum group elements (PGE) coarse fraction of extractive waste was grinded, sieved and dressed through shaking table and magnetic separation. Results showed that up to 25 % of the waste was separated using magnetic separation. This study, thus, provided evidence towards using extractive waste as economic opportunities.

ALMRR2

Zoltan Sas
Queen's University Belfast

Radiological characterisation of recyclable industrial by-products for concrete production point of view

To promote the circular economy and avoid the contamination of land due to disposal practice, the reuse of mine wastes and industrial by products is becoming popular. The specific problem for the use of industrial by-products is that they may contain, elevated concentration of Naturally Occurring Radionuclides (NOR). This study focusses on three different geopolymer sample series made with activated slag; GGBFS/fly ash; GGBFS/red mud with various mixing proportions. The NOR content of the components and the geopolymers were determined with gamma spectrometry. The final NOR content was also calculated from the components. The compressive strengths were tested, the radon exhalation of the components and the samples were determined with closed accumulation chamber techniques. The calculated NOR content was close to the measured ones which prove that the calculation of the final NOR content from the components is a reliable method to predict the products NOR content. The obtained results were used to classify the final products according to international standards. The radon exhalation results showed that the increased fly ash content results in elevated radon exhalation owing to the opening of a spherical matrix of the fly ash particles which makes possible the release of the formerly enclosed Rn-222 in the particles. The red mud content owing to its elevated NOR content significantly increased the NOR content of the final products, but it had an unbeneficial effect on the compressive strength. It can be concluded that the alkali activation of the fly ash is an important factor on the radon exhalation which requires attention to produce safe geopolymers. The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 701932.

ALMRR4

Silvia Contessi
University of Padova

The High Performance Solidification/Stabilization process: a case study of Pb immobilization through recycling of contaminated soil

Remediation of contaminated land is usually realised with techniques generating large volumes of waste. From the end-of-waste perspective, it is necessary to develop techniques enabling recycling, to provide environmental protection and economic benefits. The High Performance Solidification/Stabilization (HPSS) process is an eco-improved technology for treating contaminated soil, which has been recently engineered and applied to several large remediated sites, including the case study reported. The HPSS process follows the principles of traditional solidification/stabilization (S/S) techniques, with the innovation of including a granulation step at the end of the process and using superplasticizing and hydrophobizing additives to produce cementitious granular materials. These pellets, characterized by low porosity and reduced leaching, could be reused as filling materials directly in the reclaimed area. The case study deals with the remediation of a former agriculture supply cooperative from the beginning of the 20th century, located in Bagnolo Mella (BS, Italy). There, soil is affected by heavy metals contamination. Pb is posing special concerns for its high concentration and mobility, the latter enhanced in the alkaline conditions induced by the binder. This study aims to understand at the molecular and microstructural level the immobilization mechanisms controlling the retention of Pb, using advanced techniques as XAS, in addition to routine techniques as XRD, SEM/EDS and leaching tests. The results indicate that Pb-containing soil minerals dissolve during the S/S process, leaving Pb dispersed within the cementitious matrix. By curing pellets in water with CO2 addition, the leaching of Pb is dramatically lowered, thanks to the lower pH and to the precipitation of an external layer of calcium carbonate, covering the pellet. An additional step of water conditioning was proposed to improve the binder maturation during the HPSS process. This provides for a wider range of elements treated, including also amphoteric elements as Pb.

ALMRR5

Lorena Zichella
Polytechnic University of Turin

Environmental impacts, management and potential recovery of residual sludge from stone industry: the Piedmont case

Residual sludge (EWC 010413, according with Commission Decision 2000/532/EC and its Italian implementation Legislative Decree 152/2006 Annex D Part IV) produced during dimension stone working activities still represent a big concern for Stone industry. Even if in the last 10-12 years (from 2006 up to now) the total production, at national and local level, has been decreasing, due to the global market crisis which negatively influenced both building industry and infrastructure realization their management still represent a problem (in term of economic, environmental and social impacts) for the companies interested in slabs, tiles and manufactured production (from dimension stones' blocks), and for the citizen at large. The main challenges to deal with for their correct management are: the huge volume produced in quite limited areas (eg. Ossola Valley or Pietra di Luserna quarry basin, considering Piedmont Region – object of the present research); the very fine particles distribution of the sludge (leads to a behaviour similar to the silt clay; it is to say low permeability and conditions that make it not completely suitable for the production of substrates; the chemical properties of the waste due to the presence of heavy metal and TPH contents, sometimes over the threshold values, which can polluted water and soil if residual sludge are not properly managed.

The present research investigates several aspects connected to residual sludge: from the estimation of the volumes at Piedmont Region scale, to its chemical and physical characterization, to the impacts potentially connected to its management. Moreover, at laboratory scale the treatments to separate heavy metals and/or to decrement the TPH content, up to the potential reuses of treated sludge are tested. Its potential recover is in line with the circular economy approach, which can lead, on the one side, to the decrement of costs for its disposal in dumps, and, on the other side, to the quality improvement of the material (and of its environmental characteristics).

Chemical Analysis, Monitoring, and Prediction (CAMP)

CAMP2

David Holmes
Ecologia Environmental Solutions Limited

Advances in in-situ automatous LNAPL and water level monitoring by guided wire radar: detailed analysis of LNAPL behaviour and improved site understanding

Recovery of hydrocarbons that are present as Light Non-Aqueous Phase Liquids (LNAPL) in soils is an established remedial process and its success lies on a sound understanding of LNAPL behaviour. LNAPL baildown tests are used to understand the LNAPL mobility and provide important information about soil conditions. These data can then be understood using concepts informed by theories of multiphase flow in porous media. In particular, baildown tests can provide a measurement of the LNAPL mobility, expressed as transmissivity. Baildown are conceptually simple, but active sites, viscous LNAPL and discontinuous measurements pose risks to personnel and hinder site understanding. A guided-wire radar sensor provides a safer, more reliable and accurate measurement technique for baildown testing that can also be used to create long-term, high-resolution hydrographs to assist in better defining LNAPL behaviour. A sensor was used to monitor the interface levels based on time-domain reflectometry. These devices are commonly found in very controlled environments which differ significantly from those associated with LNAPL recovery wells. The sensor was modified to allow its operation in LNAPL monitoring wells on site. The quality of the data collected by Ecologia during laboratory and field trials is greater than could be obtained by following the current ASTM standard for baildown or skimming tests: the accuracy and precision of the system exceeds the physical possibilities of an interface probe. The system can also be used to create hydrographs of far greater utility than can be currently made and provide near real-time data via remote access. In addition, the system removes the need for a continuous site operator presence, freeing up site personnel for other work, and more importantly, minimising any health and safety concerns associated with monitoring LNAPL-extraction or monitoring wells.

CAMP3

Diego Corcho-Sanchez
Envirotecnics Global Service

Laboratory evaluation of mixed surfactants solutions to mobilise hexachlorocyclohexane (DNAPL) from Sardas landfill (Aragón, Spain)

A laboratory study was conducted to evaluate the suitability of a mixed surfactant solution for removal by DNAPL of hexachlorocyclohexane (HCH) and different organochlorinated compounds from a landfill site at Sardas (Aragón, Spain). The commercial surfactants used for making mixed surfactant solutions were Span 80, Tween 80), Triton X-100, Aerosol OT, Aerosol MA80, Envirosurf and Envirosurf CC. Based on the properties of individual and mixed surfactants, the preferred composition for an aqueous mixed surfactant solution was Span 80 (65%)/Tween 80 (35%). The HLB (Hydrophilic-Lipophilic Balance) for HCH DNAPL was calculated and corresponds to a value of 8.0 (lipophilic compound). Emulsion stability tests have shown that mobilisation of free product through micellar solubilisation (stable emulsion) was higher with mix surfactants than with individual surfactants. In addition, we concluded that the best surfactant composition candidates to mobilise HCH DNAPL (higher emulsifying capacity and absence of free product) were Envirosurf CC, Aerosol OT (25%) - Triton X-100 (75%); Span 80 (65%) - Tween 80 (35%). Bath experiments have shown that the sequence of DNAPL removal efficiency was Span 80 (65%) - Tween 80 (35%) > Envirosurf CC and Aerosol OT (25%) - Triton X-100 (75%) > water. The ability of aqueous surfactant solutions to recover DNAPL leachate entrapped in silica soil matrix was evaluated in column experiments. The column studies involved the injection of: a) 5% solution of (Span 80 (65%) – Tween 80 (35%); b) 5% solution of Aerosol OT (25%)-Triton X-100 (75%); c) clean water (Control). Treatment with Aerosol OT (25%)-Triton X-100 (75%) showed high washing efficiency (water solubilisation) after passing 5 volumes of solution though the column. On the other hand, treatment with the surfactant mixture Span 80 (65%) – Tween 80 (35%) mobilise DNAPL in a highly stable emulsion form (micellar solubilisation), although free phase removal was not as effective. Micellar solubilisation of organochlorinated DNAPL is the chosen recovery system for the test trial to be carried out at the Sardas landfill.

CAMP4

Tom Henman
RSK Ltd

Maximising site conceptualisation for coal tar NAPL in fractured bedrock through UV fluorescence testing, downhole geophysics, NAPL physico-chemical testing and in situ remedial pilot trials

This project applies integrated high quality site investigation, product analysis and pilot scale trials to investigate sources of coal tar non-aqueous phase liquids (NAPL) underlying a former gasworks site. The site was characterised by multiple NAPL sources and complex geology with interdigitation of extrusive igneous and sedimentary rock, both extensive fractured. NAPL source areas were evaluated using a multiple lines of evidence approach in the site investigation and refined further through pilot trials including: detailed examination of rock cores during logging and using UV fluorescence and PID testing; assessment of soil and groundwater results from current and previous investigations using effective solubility calculations; laboratory physical and chemical testing of NAPL samples; extensive NAPL monitoring including baildown/product recovery tests; in situ pilot trials for NAPL removal.

RSK worked with a specialist laboratory to apply suitable methods for coal tars to determine contact angles in air and water and surface/interfacial tension, used in assessing NAPL mobility. NAPL viscosity was tested over a range of temperatures to inform the optimal range for thermal treatment during the subsequent pilot trials. A key finding was significant differences in the properties of NAPL present by source area, e.g. higher viscosity and surface tension correlating with higher proportions of heavy end TPH fractions being present. This was crucially important for updating the CSM in terms of NAPL sources and differing behaviour as well as informing the scope of the trials. The pilot trials then enabled estimates to be made of recoverable NAPL versus total mass in the matrix under ambient and optimal thermally-enhanced conditions. The presence of residual NAPL in bedrock following previous source remediation works is an emerging theme on many gasworks sites, and this project provides a valuable case study of NAPL assessment for a highly complex fractured bedrock environment.

CAMP5

Panagiotis Kirmizakis
Queen's University Belfast

Bioelectrical systems to investigate and monitor remediation

Electrochemical half-cell reactions occurring at different redox states electronically connected drived by microbial processes at landfills and contaminated sites results changes to the physical and chemical properties of the subsurface environment and can be measured using geophysical and bioelectrical methods. The geophysical responses in such cases require the presence of naturally occurring electronic conductors such as bio-precipitates or a combination of extracellular microbial mechanisms and interactions with mineral surfaces. By passing the existing subsurface electronic conductor with a series of large graphite electrodes modifies such cases into 'Bioelectrical Systems' (BES). BES are systems that combine wastewater treatment with energy production and resource recovery by converting chemical energy into electrical while employing microbes as catalysts. The engineered BES can be used in real time monitoring and clean-up of contaminants. Here show the applicability and efficiency of such systems in the remediation process by a series of lab studies and how they can be developed in large scales around water and wastewater treatment systems. Current production monitoring used as a real-time view of the process. For further understanding of the results, further geochemical analysis was performed to provide additional insight on the process.

CAMP7

Mark Cave
British Geological Survey

Prediction and mapping of the human ingestion bioaccessibility of arsenic from soils in the South West of England

Bioaccessibility of potentially harmful elements in soil is an important parameter for local authorities and planners for assessing the risk to human health. In the South west of England the total As in soil reaches concentrations which are of the order of 30 times higher than the C4SL for England (37 mg/kg). It is important to know how much of the As in these soils is available for human uptake (the bioaccessible fraction). Ideally the Unified Barge Method (UBM) bioaccessibility test would have been applied to all 1154 soil samples collected for the GBASE survey of the South West of England, however, due to financial constraints it was only possible to analyse 50 for their bioaccessible content. In order to predict and produce a map of As bioaccessibility over the whole area we developed the following strategy:

i) Model the overall geochemistry of all the 1154 GBASE soils as a mixture of geochemical components.

ii) Use these geochemical components combined with the original element geochemistry and the xy locations of the samples as predictor variables for a machine learning model with bioaccessible As as the dependant variable.

iii) Use the machine learning model to predict bioaccessible As in all the GBASE soils where bioaccessible As has not been measured.

iv) Interpolate the bioaccessible As values with a machine learning spatial modelling approach on a 10000 point grid using a combination of inverse distance weighted predictions combined with geological domains to produce a map of As bioaccessibility.

The map clearly shows greater bioaccessibility around the mineralised halos of the granite intrusions clearly showing the Devon Great Consols mining area to the west of Dartmoor. Interestingly the bioaccessibility of As in this area is mostly below the C4SL (37 mg/kg As) despite the high totals found in the soils.

CAMP8

Matthias Metzger
Dublin City University

Development of analytical methods for the determination of polycyclic aromatic hydrocarbons and phthalate acid esters contamination in soil to assist remediation processes

Two of the most prominent current pollutants are polycyclic aromatic hydrocarbons (PAHs) and phthalate acid esters (PAEs). Both pollutants originate mainly form anthropogenic sources and can have a devastating impact on the environment. PAHs are classified as persistent organic pollutants (POPs) and their carcinogenic potential is well established as is their adverse effect on plant and wildlife. Once absorbed by an organism, PAEs act as endocrine disrupting compounds, due to the respective similarity to estrogens. This project aims to harness current know-how from many sources including peer reviewed journals and environmental institutes, and adapting these to generate quick and simple methods for soil analysis. Since PAEs are used in all types of plastics, they are ubiquitous in the environment and laboratory. Therefore, samples and extracts are prone to contamination at all steps from sampling to injection into the analytical system. In this study we will demonstrate how to reduce PAE blank values and to efficiently prevent sample contamination. Additionally we show how sample extraction and enrichment throughput can be increased by use of sonication and nitrogen dry down instead of soxhlet and rotary evaporation. Furthermore we present how both PAHs and PEAs can be quantified with a single run. Finally, a site study is conducted on Bull Island in Dublin Bay, Ireland, to test these methods under real sample conditions. In conclusion we will illustrate how much time and solvent can be saved by using sonication and nitrogen dry down as well as being able to quantify both types of pollutants in the same extract and run.

CAMP9

Nenad Stojanović
University of Duisburg-Essen

Development of PAL SPME Arrow-GC-IRMS method for compound-specific stable isotope analysis of groundwater contaminants

Compound-specific stable isotope analysis (CSIA) is well established technique for studying environmental fate of pollution. Carbon measurements are already regularly being used in site assessment studies in low $\mu g \cdot L^{-1}$ range. Dual-isotope analysis of hydrogen and carbon can give much more information, but limits of precise isotope analysis for hydrogen are usually much higher, which means that often real samples must be somehow enriched. The aim of the presented work was to investigate suitability of using recently developed PAL SPME Arrow fibers for extraction/enrichment prior to carbon and hydrogen stable isotope analysis of groundwater contaminants. By measuring the extraction profiles, it was determined that out of all tested phases, CWR/PDMS gives the highest extraction yields and the most accurate δ-values. Investigation of the desorption profiles helped to uncover that the optimal desorption conditions are 0.8 mL/min He flow and 4 min long injection, while using 1.2 mm ID straight, self-made liner. By performing more than one extraction/desorption cycle, more equal and greater sensitivity of different classes of analytes is achieved. Finally, the proposed method was put to the test by analysing groundwater samples taken from the Belfast Gasworks site. Data gathered during this work demonstrates how important thorough adjustment of a wide range of parameters is for achieving desired precision and sensitivity of the chosen microextraction technique.

CAMP10

Peter Brennan
Dublin City University

Distribution and sources of PAHs and trace metals in Bull Island, Dublin Bay

Tidal wetlands and coastal vegetated habitats respond to natural and anthropogenic forces that pose significant threats to society such as climate change and sea level rise. They also have a very high capacity for the uptake and long-term storage of carbon ("blue carbon"). Assessment and prediction of coastal vulnerability can only be achieved by the systematic and sustained monitoring of the physical, chemical and biological processes that occur in coastal zones. Here we conduct a spatial characterisation of soils and sediments from Bull Island, a UNESCO declared biosphere. The objective is to provide a coordinated, chemical and physical characterisation of the sediments and soils of Bull Island and its intertidal area. Data on organic pollutants and on characteristics such as particle size, metal content, pH and percentage organic matter has been recorded and mapped for future use. This data will now act as a baseline for future studies that investigate environmental change over time. Source and distribution of polycyclic aromatic hydrocarbons (PAHs) and metals including iron, chromium, calcium, aluminium and lead were analysed to further understand anthropogenic influence on the area. A range of methods were utilised to quantitatively assess the organic and inorganic input into the bay. Statistical analysis was carried out to determine relationships between variables tested and similarities between samples. Results show that PAHs present in the bay had a common source of combustion, indicating anthropogenic input. Organic matter content and C:N showed that terrestrial material has a large influence on pollution concentration in the area. Principal component analysis (PCA) indicated strong linear relationships between PAH content and total organic carbon (TOC), and also a strong linear trend between lead and TOC.

CAMP11

Coren Pulleyblank
Dublin City University

Detecting degradation products of polycyclic aromatic hydrocarbons (PAH) in aqueous and soil environmental matrices: recent progress in the field

Over the past 20 years, the oxygenated degradation products of priority pollutant polycyclic aromatic hydrocarbon (PAH) have received increasing attention in environmental literature due to their role in the well-documented toxicity and carcinogeneity of parent PAH. Despite growing interest and increasing evidence of their importance, significant challenges remain in the establishment of analytical techniques which are able to address the broad range of potential target compounds as well as the complexity of soil and aqueous environmental matrices. This research reviews current approaches to the analysis of oxygenated PAH in contaminated soil and aqueous environmental samples. We present key findings from our own research to improve sample handling, evaluate the use of aminopropylsilica as a sorbent for the fractionation and clean-up of soil extracts for these analyses, and compare the development of oxygenated PAH degradation products under three remediation treatment scenarios.

Contaminated Land Biology (CLB)

CLB1

Caroline Gauchotte-Lindsay
University of Glasgow

Towards a rational design for PAHs bioremediation- combination of advanced analytical and molecular tools

Rational design of bioremediation technologies will only be achieved by using a "systems biology" approach to elucidate the mechanisms underlying microbial degradation in complex mixtures. In simultaneously regarding the environment, the microbial communities, the pollutants and the metabolites as an integrated system, then complex data from each component need to be linked and interpreted to reduce the degrees of freedom and highlight the most important synergies and pathways. Through the example of polycyclic aromatic hydrocarbons (PAHs), we are currently developing the tools to achieve this. The biodegradation of PAHs has been characterised in environmental contaminated samples but mostly *in vitro* in microcosms and usually for a single PAH compound or a very limited number of compounds often using single strain of microorganisms. We aim to ultimately be able to decipher and predict the biodegradation of complex PAHs mixtures *in situ* in contaminated soils such as those found at former manufactured gas plants (FMGPs) sites by combining molecular biology approaches with unique high-resolution analytical methods such as comprehensive two-dimensional gas chromatography (GCxGC). Here we present the first part of our research, where we investigated PAHs-contaminated soils from 3 FMPGs and established statistical correlations between microbial ecology, quantitative PCR of selected PAH-degrading genes and concentrations of the 16 USEPA PAHs. We also demonstrate the potential of GCxGC for elucidation of PAHs biodegradation mechanisms beyond the 16 USEPA PAHs due to high-resolution separation of alkylated isomers and possible separation and identification of metabolites.

CLB2

Chris Allen
Queen's University Belfast

Can we measure the age of oil pollution using molecular microbiology?

The use of mass spectrometry techniques for the analysis of oil pollution age is well established. It is essentially based on comparing the relative levels of kerosene and PAHs, with older pollutants having less kerosene present. A limitation of this approach is that in older pollution spills, the amount of kerosene present is so low the methods becomes inaccurate. Further there can be sensitivity issues at very low pollutant levels. In this study we show that a novel approach, based on studying the presence of functional genes from related soil bacteria, can be used with similar and perhaps greater application.

CLB3

Heather De-Quincey
Swansea University

The use of a biochar enhanced artificial soil for mine reclamation

Steep-sided, heavily contaminated and metal(loid)-enriched mine tailings are common among post-mining landscapes. Tailings are affected by severe erosion, causing multi-elemental contamination of nearby areas, and their remediation remains challenging and costly due to their extreme toxicity. The phytostabilisation of these sites has proven to be a low-cost, soft-engineering method of improving surface stability and lessening the spread of contamination. Phytoremediation typically involves integrating organic matter into the surface of the tailings, whereas this research explores a novel in-situ method of phytostabilisation, creating an overlaying cap of a biochar-enhanced artificial soil (technosol) on the surface of Pb-Zn-rich mine tailings. A 14 week outdoor pot trial using 21 replicated treatments was conducted to develop a suitable soil amendment. The technosol was composed of an ~8cm deep sustainable greenwaste/foodwaste municipal compost, basalt fines, waste ground cockleshells and a sustainably produced coniferous biochar. The technosol was seeded with metal-tolerant grass species native to the UK. Biochar was demonstrated to substantially aid the establishment of healthy grass cover and an extensive root network, whilst significantly reducing Pb uptake into above-ground biomass, 3.3x less Pb than the control. A treatment of compost, 5% (v/v) biochar and small amounts of basalt fines and ground cockleshell (~1% v/v) produced the most favourable plant growth in all measured areas. These treatments produced more substantial root growth and, on average, a 1200% increase in biomass when compared to the unamended mine tailings, and a 54% increase when compared to the unamended compost. Compared to the treatments without biochar, a 5% biochar addition produced, on average, 25% more biomass growth, 54mm taller grass and an increased C uptake (+25%) and N uptake (+46%) in plant biomass. This study demonstrated the potential for a sustainably produced biochar and mineral-enhanced technosol for the phytomanagement of contaminated mine tailings.

CLB4

Hussein Ibrahim
Queen's University Belfast

Functionally active naphthalene-degrading bacterial community in hydrocarbon-contaminated groundwater from an old gasworks site

Environmental pollution is a global issue as most industrial sites release harmful hydrocarbon compounds and xenobiotics into the environment mostly from natural and anthropogenic sources. Studies have implicated diverse microorganisms responsible for the breakdown of these hydrocarbons in soil and water environment. In this study, we applied DNA stable-isotope probing technique and naphthalene dioxygenase gene (*nahAc*) probe to study active naphthalene degradation by indigenous microbes in hydrocarbon-contaminated groundwater from an old gasworks site. Laboratory-based microcosm was set up for 25 days incubation with freshly sampled groundwater using ^{13}C-naphthalene as labelled substrate and ^{12}C-substrates for control microcosm. Digital Spectrofluorometer was used to monitor naphthalene available in the microcosms for the period of incubation. The nucleic acid extracted from the incubations was subjected to isopycnic ultracentrifugation to separate both ''heavy'' and ''light '' DNA for downstream analysis. Labelled DNA biomarkers were obtained at 25 days incubation, this implies assimilation of the ^{13}C-naphthalene substrates into the biomass of microbial community in the heavy fraction while no yield in the controls. The NDO functional gene probe was achieved by PCR amplification of naphthalene dioxygenase genes (*nahAc* genes) encoding for naphthalene dioxygenase using robust NDO-specific primers that target the *nahAc* genes, this produced band of a 482-bp fragment of the *nahAc* genes which signifies the presence of naphthalene dioxygenase in the labelled fraction and confirmed the presence of functionally active naphthalene degraders in the gasworks. The heavy and light DNA were further subjected to shotgun metagenome sequencing to identify the active naphthalene-degrading bacterial community responsible for naphthalene breakdown. This study reveals an active naphthalene degradation in the old gasworks principally by the indigenous microbes in the hydrocarbon-contaminated groundwater, mostly using the *nah*Ac genes of naphthalene dioxygenase.

CLB5

Ricardo Costeira
Queen's University Belfast

Exploratory metagenomic characterization of bacterial and viral communities in groundwater of contaminated land

Studying the behaviour of microbial communities and their shared gene pool is becoming key in site remediation strategy development. Nonetheless, the analysis of bacteriophages and their interactions with xenobiotic degraders has been widely overlooked to date.

Here, we aimed to conduct an integrative and comparative analysis of bacterial and viral communities found in groundwater of hydrocarbon-contaminated land. Environmental samples were collected from 6 sampling stations from an old gasworks site in Northern Ireland. Two of the sampling points were monitored for a full year (May 2016 – May 2017). A set of 14 viromes and 14 total metagenomes were shotgun-sequenced using the Illumina® HiSeq 2500/4000 Systems. A complete and advanced characterization of these metagenomes was accomplished using state of the art bioinformatic tools. In this study, discrete temporal and spatial variations in bacterial and viral community structures were found. Variations were particularly pronounced between sampling stations. Discrete functional profiles and discrete biodegradation capacities were also found for the bacterial communities. We hypothesise that this may be due to pH changes and other chemical variations occurring at the site of study. Sub-populations of bacteria involved in putative local bioremediation processes were identified via binning of genomes and sub-populations of bacteria interacting with bacteriophages were identified via host assignment of the sequenced viral communities. Several viral generalists were identified at the site of study. These may have a pronounced role in prokaryotic production at the site. Biodegradative genes were also found in the contigs of sequenced viromes. This exposes the importance that bacteriophages may have in the horizontal gene transfer of catabolic genes via specialized/generalized transduction mechanisms. Ongoing works aims to further evaluate the relations between bacterial and viral communities at contaminated sites. Furthermore, we hope that these findings may help to advance the tailoring of bioremediation strategies of polluted environments.

CLB6

Christine Switzer
University of Strathclyde, Glasgow

Rehabilitation of soil after aggressive high temperature remediation

Smouldering remediation is capable of removing 99.9+% of heavy hydrocarbon contamination from soil using self-sustaining flameless combustion. As a result of contamination and smouldering remediation, soil experiences physical, chemical, and biologically-relevant changes, including texture, geochemistry, and losses of essential nutrients. Adapting to and overcoming these changes is essential to biological restoration of soil and/or engineering reuse. Smouldering subjects soil to temperatures of 500-1100°C for periods of minutes to hours while destroying contaminants in soil pores. Heating and chemical reactions change soil-surface properties and how soil interacts with water, nutrients, and potentially toxic elements. Nitrogen and total organic carbon become lost around 500°C followed by phosphorus around 1000°C. Simple clays become fired around 500°C, reducing soil cation exchange capacity and its ability to retain water. Because of these changes, supplementation is required to support plant growth in soils. Amendments derived from natural materials offer some benefit but yield inconsistent results.

A series of laboratory and small field experiments involving plants and microbes investigated the potential for soil restoration after smouldering. Addition of stoichiometrically-balanced nutrients accelerated microbial colonisation and growth of healthy emergent plants. Further additions became wasteful with no observed improvements in successional development. Phytoremediation plants and microbes capable of bioremediation grew well with balanced nutrients. Leguminous plants also grew well but did not develop root nodules while nitrogen was abundant. Limiting nitrogen resulted in improved nodulation, though results were inconsistent. In microbe-only experiments, conditions in post-remediation soils favoured gram negative species and fungi colonisation. Similarly, soils in a two-year rooftop field experiment had extensive colonisation by bryophytes and the diversity of species was limited in smouldered soils. In all experiments, soils recovered well in stoichiometrically balanced conditions, but more research is needed to support restoration to fully functional ecosystems similar to before contamination and remediation.

CLB7

Stacie Tardif
University of Copenhagen

Evaluation of soil microbiological community attributes for future integration into site-specific ecological risk assessments

Multi-element contaminated sites are complex and heterogeneous in nature making it challenging to elucidate the specific impacts of contamination on key ecosystem processes. Currently, total metal concentrations in combination with standard ecotoxicological assays are being used to evaluate ecological risks in contaminated soils, but there is a need for soil quality assessment methods that can causally link soil remediation to ecological recovery of indigenous soil biota. Microorganisms are the first responders to environmental change and provide several key ecosystem services potentially serving as specific protection goals for site-specific ecological risk assessment of remediated sites. This study investigated the use of several microbial community indicators in evaluating risk along a long-term multi-metal contamination gradient in Denmark. Top soil samples were collected at an old wood impregnation site contaminated with chromated copper arsenic (CCA) and extensive soil physicochemical characterization was performed. Microbial community parameters such as bacterial community composition, function and metal resistance were targeted with a combination of molecular and microbiological tools such as next-generation Illumina sequencing of the 16S rRNA gene, high throughput qPCR array targeting microbial biogeochemical cycling genes and pollution-induced community tolerance (PICT) assays. These microbial parameters correlated strongly with soil quality along the contamination gradient. Bacterial community diversity and growth decreased with increasing contamination, while bacterial community resistance increased with increasing contamination. Bacterial community structure and genes related to biogeochemical cycling of key nutrients were significantly impacted by metal contamination. Importantly, this paper identifies several microbial community parameters that show potential for directly evaluating the impact of remediation strategies on the recovery of key ecosystem services provided by microorganisms.

CLB8

Yi Zhao
University of Copenhagen

Evidence for metal-induced co-selection of antibiotic resistance genes in urban soils from the Tellus Survey in Belfast, Northern Ireland

Antibiotic resistance genes (ARGs) constitute emerging environmental pollutants and pose risks to public health. Toxic metals are known to select for metal-resistant bacteria in metal-contaminated soils, but there is growing concern that metal contaminants can also act as co-selective agents thereby causing environmental proliferation of antibiotic resistance. In this study, we quantified ARGs and selected mobile genetic elements known to constitute potential ARG hosts in 50 archived soils from the Tellus Survey of the Belfast area using a high-throughput qPCR based ARG chip. The ARG prevalence was linked to concentrations of individual metals and a soil metal toxicity index calculated based on the relative toxicity of different metals to soil microbial processes. A total of 164 ARGs were detected in all analyzed soils with an average absolute abundance of 3.4 x 107 ARG gene copies per gram of soil. A significant correlation between ARGs and mobile genetic elements (MGEs) was observed, suggesting the importance of horizontal gene transfer in ARG dissemination. Network analysis revealed the co-occurrence pattern between specific metals (Zn, Cu, Ni, Cr, Co, Cd, Hg, and As) and corresponding ARGs. Path analysis showed that soil metal toxicity index significantly correlated to the number of detected ARGs ($\lambda = 0.32$, $P < 0.001$) and to the abundance of co-occurring ARGs ($\lambda = 0.61$, $P < 0.001$) via MGEs. Collectively, our results indicate a role of soil metals for co-selection of ARGs in urban and semi-urban soils from the Belfast area and also suggest a risk for environmental ARG dissemination via horizontal gene transfer. In conclusion, we propose that ARGs are of direct relevance to the management and remediation of metal-polluted sites.

CLB9

Elio Padoan
University of Turin

The suitability of short rotation forestry for phytoremediation of urban soil, development of a protocol for urban areas

This field work was conducted to verify the effectiveness of phytoremediation on a former industrial Zn-contaminated soil within the city of Torino. The aims were: to verify the suitability of applying phytoremediation in urban settings; to assess the viability of Short Rotation Forestry for soil remediation; to determine the heavy metal uptake of different plant species and to establish an operational protocol for planting and agronomic maintenance of the parcels. For the experiment, nine different plants well adapted to the Piedmont area with rapid growth and large biomass production were selected: Populus xcanadensis Mönch, Populus deltoides Marsh, Populus alba L., Salix alba L., S. viminalis L., S. matsudana Koidz and three Robinia pseudoacacia L. genotypes. Parallel field and greenhouse experiments were conducted were plants were grown for two years. In field experiment, Short Rotation Forestry technique was adopted, with a plant density of 10000 plants per hectare. Biomass growth and soil were monitored throughout the trial to compare the plant response and metal uptake rates in all plant tissues (roots, stem and leaves). In the urban contaminated soil, Salix resulted to be the best accumulator with regard to Zn, with a maximum uptake in stem and leaves, although the produced biomass was low. After two years, no change in soil total metal content was observed, while bioavailable fraction of Zn and Cu decreased significantly using all species, from the 26% of Robinia to the 36% decrease using Salix. In the pedoclimatic conditions of the urban site, the most productive species was Robinia, leading to higher extraction rate per hectare and giving promising results also in pot experiments, suggesting the possibility to increase plant density to 16000 plants per hectare, to increase the phytoextraction and limit the access to the contaminated area.

Site Modelling, Risk Assessment, and Risk Communication (SMRARC)

SMRARC1

Darren Beriro
British Geological Survey

Measuring polycyclic aromatic hydrocarbons release from soil in artificial sebum – steps toward a physiologically based in vitro dermal bioavailability test

British Geological Survey has developed a new method for measuring the release of polycyclic aromatic hydrocarbons (PAH) from real-world former gasworks soils. The research forms part of a National Grid funded project to minimise uncertainties associated with the dermal exposure pathway in human health risk assessments of post-industrial brownfields. Freeze-dried and sieved soil samples were added to artificial sebum and end-over-end rotated for 4 hrs at skin surface temperature. The sebum/soil mixture was centrifuged and the sebum fraction subject to solid phase extraction and subsequent gas chromatography mass spectrometry / mass spectrometry. Preliminary results are presented in the context of methodological and analytical uncertainties. These results form part of the ongoing development of a physiologically based *in vitro* dermal bioaccessibility test for risk-based land management.

SMRARC2

Darren Beriro
British Geological Survey

Ground Risk Prioritisation Tool for brownfield redevelopment projects

The British Geological Survey has developed a new spatial Ground Risk Prioritisation Tool for planners, land-owners and managers responsible for portfolios of brownfield sites. Ground conditions form one of the most costly delays for the redevelopment of brownfield sites in the UK. Assessing the risk and potential costs of remediating contamination or designing suitable development platforms at an early stage can help keep projects on time and to budget. The Ground Risk Prioritisation Tool uses multi-criteria decision analysis and raster processing methods to produce risk scores that can be compared between sites. Data used within the decision-support tool includes previous landuse, the sensitivity of controlled waters and geohazards. The datasets can be visualised with the calculated risk scores to gain an understanding of site and area based potential ground conditions at an early stage of the brownfield redevelopment lifecycle.

SMRARC3

Sabrina Cipullo
Cranfield University

Linking bioavailability of complex mixture to toxicity changes to assess recovery of contaminated soil

A six month laboratory scale study was carried out to compare biochar and compost techniques for the remediation of soil contaminated with tar. Two soil samples, Soil 1 (high contamination) and Soil 2 (low contamination) were collected from two brownfield sites occupied by former Gasworks sites in UK, and amended with 15% w/w commercial compost and wood shavings (C), 5% w/w biochar (B), or left with no amendment (NT). The hydrocarbons and heavy metals total and bioavailable concentrations were monitored throughout 180 days incubation. In order to define end point remediation and link bioavailability to toxicity changes, a different range of biological indicators for hazard assessment have been taken into account such as; bacteria count, soil respiration, microbial biomass, microbial community fingerprint, seeds germination (Rye grass, mustard, and pea), earthworms lethality (*E. fetida)*, and bioluminescent bacteria (*Vibrio fischeri*) with Microtox® assay. The treatments applied were able to enhance the changes in TPHs bioavailable concentration. Both treatment ($P < 0.004$) and incubation time ($P < 0.005$) were found to be significantly affecting the bioavailability. In particular, mesocosms treated with compost displayed the most significant reduction in toxicity for both Soil 1 and Soil 2. An increase in soil respiration rate (up to 8 times the compared to NT soil), along with a more stable microbial fingerprint were recorded, in compost amended soils, across the four time points analysed (onset, 30 days, 90 days, and 180 days). Additionally, compost amended soils showed the highest percentage of seeds germinated (> 90%) for both soil samples across multiple seeds types, and a net decrease (over 14 times lower than NT) in toxicity for the bioluminescent bacteria. Ultimately, the bioavailable concentration was found to be strongly correlated with the toxicity responses in model organisms, providing a better assessment of the relative sensitivity of receptor-based end-points.

SMRARC4

Neha Mehta
University of Turin

Linking bioaccessibility and solid-phase distribution of heavy metals in soils and extractive waste from abandoned mine site: A case study from Campello Monti, NW Italy

Mining activities have led to the introduction of high levels of heavy metal (HM) concentrations in soils. This has attracted governmental and public attention due to their non-biodegradable nature and hazards posed to human health and the environment. However, total concentrations of HM are poor indicators of actual risk hazard to human health and can lead to overestimation of risk. In this study, oral bioaccessibility (the fraction available for absorption via oral ingestion), was used to refine human health risk assessment. Solid phase distribution of the HM was also investigated to characterize HM distribution and behavior in the extractive waste streams and impacted soil. The study was undertaken at an abandoned mine site from Campello Monti, in the Southern Italian Alps used for Ni exploitation from 1863 to 1940s. The results showed that total concentrations of HM were high and reached upto 7400 mg/kg for Ni due to parent material, however, only 11% was bioaccessible. Detailed analysis showed that the bioaccessible fraction (BAF) of Ni, Cu and As varied from 0.5 to 21%, 2 to 47%, and 7 to 28%, respectively. The variation can be attributed to the difference in pH, organic matter content and mineralogical composition of the samples. Results of non-specific sequential extraction showed that non-mobile forms of the elements were associated with the residual and Fe-oxides components of the matrix. The present study highlights that including bioaccessibility and solid phase distribution can refine and inform risk assessment of abandoned mine sites.

SMRARC5

Russell Thomas
WSP

Assessing the environmental legacy of the manufactured gas industry in the UK and Europe

The manufactured gas industry was one of the great technological innovations of the industrial revolution. It developed in England but required the input of engineers, scientists and entrepreneurs from across the British Isles and Europe to succeed. Gas was initially used for lighting, but later found new markets in heat and power, it also spawned a separate chemical industry which utilised the by-products such as coal-tar and spent oxide it produced. These by-products have also left an environmental legacy due to their carcinogenic and toxic properties. The scale of the industry was considerable with up to 4000 gasworks constructed in the British Isles alone and in excess of 10,000 in the rest of Europe. The development of gasworks in Europe initially spread to it nearest continental neighbours, generally supported by British Engineers and sometimes the financial might of big companies such as Imperial Continental Gas Association. European gasworks originally used imported British technologies and coal to manufacture gas, however, as British coal became harder and more expensive to obtain, different technologies were developed suited to continental coals or feedstock. The vertical and horizontal retorts favoured in Britain, started to diverge from the chamber and oven based processes which were more suited to the continental coals. To add to the complexity, oil based gas manufacturing processes became popular in the late 19th and 20th century, which led to a change in the properties of the by-products formed. Whilst these gas manufacturing process all produced a tar by-product, their chemical and physical properties were different, which can affect their mobility and hazardous properties. All these changes have had an impact on the environmental legacy left by the gas industry across the British Isles and Europe, which this paper will describe and quantify, using historic and recent data from industry and academic sources.

SMRARC6

Steve Owen
RSK Ltd

Non-intrusive advances in site characterisation to maximise value during land management

Brownfield sites undergoing redevelopment contain a significant number of ground conditions such as buried foundations, contaminant plumes and structures that can be unknown to a developer or purchaser. With the government proposing to build over 1 million homes in the UK, effective ground investigation using geophysical technologies can localise anomalies on site that highlight these features and enable targeted intrusive investigation. This presentation will use 2 case studies to demonstrate: How a site wide geophysical survey used in conjunction with standard intrusive methods was used to robustly evaluate quantities of buried structures at a brownfield site. This was important not only for the potential to encounter obstructions in the ground, but also with respect to the quantities of concrete that would be generated during the groundworks and available for re-use during the redevelopment. How geophysical surveys were used to inform landfill gas/leachate migration and thus inform the conceptual site model with respect to which nearby residential properties were at the greatest risk of landfill gas ingress. No amount of intrusive investigation can map ground gas migration and account for preferential migration pathways such as utilities but with the addition of geophysics supported by the intrusive investigation it is easy to see the edge of the landfill and also areas where potential higher areas of gas may be located and thus target the investigation accordingly.

SMRARC7

Tatiana Cocerva
Queen's University Belfast

How can oral bioaccessibility improve the human health risk assessment of inorganic contaminants? Case study: metropolitan area of Belfast

Urban environments have been contaminated significantly during the industrial revolution with many Potentially Toxic Elements (PTEs) accumulated in the topsoils. Belfast, the largest city in Northern Ireland, has encountered an intensive process of industrialisation in 18th and 19th century, being known worldwide for linen production and shipbuilding activities.

Previous research by McIlwaine et al. (2017) identified elevated concentrations of PTEs (As, Cr, Cu, Ni, Pb, V, and Zn) in Belfast soils that may pose a risk to the human health. However only the bioaccessible fraction of PTEs is available to be taken up by the human body and enter in the systemic circulation causing further toxic effects. In this study, the Unified BARGE Method (UBM) an in-vitro test which mimics the human gastrointestinal tract has been used to measure the oral bioaccessibility of PTEs in 103 soil samples collected from the metropolitan area of Belfast during Tellus project 2004 and 2007. The UBM test showed low bioaccessible fraction (BAF) for Cr (0.5 to 5.7%), V (3.3 to 23.4%), and Ni (1 to 45.7%) which are associated with soil parent materials in Antrim Basalt. In contrast, higher BAF values were registered for Cu (0.4 to 68.1%), Zn (5 to 78.2%), As (6.8 to 82.9%), and Pb (8.8 to 100%) that might be associated with anthropogenic sources within Belfast.

The outcomes of this research suggest that the source of contamination is an important factor to be considered when bioaccessibility testing is applied in human health risk assessment. This is the first study undertaken in Belfast metropolitan area where oral bioaccessibility of PTEs is considered and it has potential applications for policymakers, urban developers, and risk assessors of contaminated land.

SMRARC8

Jack Lort
British Geological Survey

Dermal Bioavailability of PAHs: The Route Forward

Dermal absorption is a significant exposure route to PAHs (Polycyclic Aromatic Hydrocarbons), as the skin contributes to 10% of total body weight and on average covers 1.8m^2 of body surface area. At present, there are no recommended values provided by the Environment Agency (UK) for the dermally absorbed fraction of PAHs from soils. The Wester et al (1990) *in vivo* study using *Rhesus* monkeys, calculated a PAH dermal absorption value of 13%, which is currently used in the CLEA model designed by the Environment Agency (UK) to produce generic assessment criteria (GAC) to assess whether a site is suitable for domestic or industrial use. This dermal bioavailability figure is disputable, and it could be argued to be overly conservative or even an underestimate of the true absorption value. It is evident that a much better understanding of the dermal bioavailability of these compounds is needed to enable decisions on brownfield redevelopment to be better informed. To do this an improved *in vitro* method must be developed. For this to be achieved, artificial membranes could be used in place of human/animal skin in *in vitro* diffusion studies, to remove inter-individual differences of *ex vivo* skin. It should also be noted that the aging process in soils has a great impact on the release of PAHs, and as a consequence many studies that have used artificially spiked soils have overestimated dermal absorption. To prevent this, naturally weathered contaminated soils should be used, as these will have undergone these aging processes which binds the PAHs to the soil. Also, for method validation, solvent spiking the membrane with a known PAH concentration and the same solvent, will allow for direct comparison between methods, as this removes the effect of the soil and differing soils of different studies.

Poster presentations

Posters were invited from all presenters, and will be on display in the Isdell Courtyard throughout the conference. In addition, the following posters can also be seen:

ALMRR3
Zoltan Sas
Queen's University Belfast
Radiological characterisation of geopolymers containing various mixtures of activated slag, red mud, fly ash and ground granulated blast-furnace slag

CAMP1
Sabrina Cipullo
Cranfield University
Prediction of fate, persistence, and bioavailability of complex chemical mixtures through machine learning models

CAMP6
Manuela Lasagna
University of Turin
Nitrate in groundwater of Piedmont plain (NW Italy): distribution and origin

CAMP12
Morteza Seyedpour
Technical University of Dortmund
Theory of Porous Media approach to simulation of contaminant transport in groundwater: verifying the numerical results with sandbox experiment

CAMP13
Morteza Seyedpour
Technical University of Dortmund
Simulation of contaminant transport in vadoes zone: continuum mechanics approach in frame work of Theory of Porous Media

CAMP14
Morteza Seyedpour
Technical University of Dortmund
Modelling contaminant transport in groundwater using coupled Theory of Porous Media and Monte Carlo simulation

Conference Speaker & Session Chair Profiles

Chris Allen

Chris is Professor of Microbiology at Queen's University Belfast. He has been involved with aromatic hydrocarbon microbiology research for over 25 years, and has published over 100 papers in related fields.

Paul Bardos

Paul is an international authority on risk assessment and risk management, remediation option appraisal, technical approaches to remediation, sustainable and "green" remediation, low input approaches; development and delivery of training; re-use of materials; international approaches and state of the art for contaminated land management. He has extensive experience with Public and Private Sector projects, and has worked on similar technical assessment and support projects for public bodies in the UK, USA, Australia, Japan, Belgium, Germany, Netherlands and China, and a wide range of internationally supported projects. He is Managing Director of r3 environmental technology ltd, Adjunct Professor at the School of Environment and Technology, University of Brighton (UK) and a Visiting Professor at the University of Reading. He also works as an independent expert for the European Commission and agencies in the UK and several countries, including FECO-MEP in China.

Darren Beriro

Darren is a Geoscientist at British Geological Survey where he has been working for the past 4 years. Darren has been award a NERC Knowledge Exchange Fellowship with a focus on the redevelopment of brownfield land in the UK. Darren's research interests include human exposure to soil contaminants, predictive modelling of geochemical data and spatial multi-criteria analysis for decision-making. Prior to BGS, Darren worked for 10 years in environmental consultancy, specialising in risk-based land management and environmental assessments for construction projects. Positions held included company Director and Principal Consultant for regional firms in Yorkshire and Lincolnshire.

Kristian Brandt

Kristian acquired his PhD degree (1998) in Microbial Ecology from Aarhus University and currently is an associate professor and head of the Environmental Microbiology Research Group at University of Copenhagen (UCPH) and a faculty member at the Sino-Danish Centre for Education and Research in Beijing, China. Currently, he is also the UCPH scientist-in-charge for the REMEDIATE Marie Skłodowska-Curie Action (MSCA) funded Innovative Training Network (ITN). His main research interests focus on microbe-pollutant interactions, nutrient/greenhouse gas dynamics in soils, and the environmental dimensions of antibiotic resistance. He has published more than 50 papers in peer-reviewed scientific journals (H factor; 22).

Peter Brennan

Peter is a REMEDIATE Early Stage Researcher in Dublin City University. His research interests are focused on optimising chemical and biological remediation treatments of contaminated land. Peter is developing wireless microbial fuel cell sensors to monitor remediation activities online in real-time.

Anne Marie Casey

Anne Marie is the Chairperson of the Ireland Brownfield Network. She is a Senior Specialist with ESB International with over 17 years' experience having worked as an environmental specialist in Ireland, Northern Ireland, UK, Azerbaijan and America. Anne Marie is a Chartered Environmentalist and a Chartered Scientist in the UK and Ireland (CIWEM). She holds an honours B.Sc. (Geol) degree from the UCC, M.Sc. in Environmental Engineering from Trinity College Dublin. Her areas of expertise include waste management and environmental liability assessment in relation to soil, ground-gas, air quality, construction noise, surface water and groundwater risk assessment and remediation.

Mark Cave

Mark has extensive experience in the analysis and interpretation of environmental chemical data with particular reference to geochemistry and human health. Key interests include working on the bioaccessibility of polyaromatic hydrocarbons in soils, investigating the geological controls on the bioaccessibility of As and Pb in the UK,

and interpretation of geochemical data sets with reference to geogenic, anthropogenic and socio-economic influences. Key achievements include the developed a novel sequential extraction methodology for identification of the solid phase speciation of potentially harmful elements in soils and the development of *in vitro* bioaccessibility testing procedures for potentially harmful substances in soils.

Sabrina Cipullo

Sabrina is a REMEDIATE Early Stage Researcher at Cranfield University. Her experience includes research in: environmental and analytical chemistry, microbial and bioassay toxicity testing, environmental modelling, and ecological and human health risk assessment.

Her role within REMEDIATE focuses on Environmental Chemistry and toxicological approaches to site assessments. She is an associate member of the Royal Society of Chemistry, a committee member East Anglia Region of the Analytical Division (RSC), as well as an active member of the Society of Brownfield Risk Assessment (SoBRA).

Richard Clayton

Richard is WSP's UK Head of Ground Risk and Remediation, one of the largest contaminated land teams in the UK and uniquely incorporating a specialist remediation design and contracting division, WSP Remediation Limited.

Richard is based in Birmingham and has extensive experience successfully dealing with land quality issues for corporate organisations, landowners, developers and local government. He is currently leading the remediation design for the HS2 Enabling Works contracts on the Birmingham Spur.

Richard is a member of the steering committee and the Secretary of RemSoc, a recently established remediation society focussed on supporting remediation professionals.

Claire Clifford

Claire is Technical Director of Enviroguide Consulting, where she manages the contaminated land group. Claire's experience includes work in Ireland, UK and Canada on a range of brownfield sites for clients in the industrial, property development, petroleum, pharmaceutical, and waste sectors. Her areas of expertise include contaminated land and hydrogeology assessments in particular human

health and environmental risk assessments and remediation of brownfield sites as well as site investigation, waste classification and project management. Claire has a BSc in Geology from the University College Cork and an MSc in Environmental Sciences from Trinity College Dublin. Claire is a Professional Geologist (PGeo) with the Institute of Geologists of Ireland (IGI) and is listed on the IGI Register of Competent Persons for Unregulated Waste Disposal/Contaminated Land Assessments.

Tatiana Cocerva

Tatiana is a REMEDIATE Early Stage Researcher at Queen's University Belfast. Tatiana received a B.Sc. in Environmental Sciences from the University of Bucharest in Romania and a M.Sc. degree in Geomaterials & Environment from the University Paris-EST, France. Her international experience included research collaborations in areas such air, water and soil pollution, with Italy, Denmark, France, Romania, Moldova, Russia and USA. Tatiana's current research and interests are focused on the use of bioaccessibility testing to refine human health risk assessment of contaminated land and understanding the controlling factors over contaminant bioaccessibility.

Simon Cole

Simon is the Technical Lead for AECOM's UK&I ELS team and Practice Leader for Quantitative Risk Assessment. Simon was a national technical advisor to the Environment Agency for eight years, was formerly a member of the UK Government's Expert Panel on risk assessment under Part 2A and a member of the Welsh Government Advisory Group on Land Contamination. Simon currently sits on the executive committee of SoBRA and the Joint Industry Working Group on Asbestos in Soil, and chairs the SoBRA sub-group on asbestos in soil, and the NICOLE European Working Group on asbestos in soil.

Silvia Contessi

Silvia is a PhD student in her first year at the University of Padova – Department of Geosciences. She deals with heavy metals contamination of soil and binder-based remediation techniques, since she graduated in Environmental Sciences. She also collaborates in the study and development of low impact binders, obtained by industrial

by-products, as a way for lowering CO2 emissions due to construction industry.

Diego Corcho-Sánchez

Diego has a BSc in Biology and PhD in Environmental Engineering and more than 10 years of experience in biotechnology and environmental microbiology applied to the management of contaminated soil and groundwater. He is specialised in the technical and economic direction of consulting projects, R & D projects and remediation projects. Recently he was involved in lab studies analysing the effect of commercial surfactants and chemical oxidation reagents for the treatment of groundwater and contaminated soil.

Ricardo Costeira

Ricardo is a REMEDIATE Early Stage Researcher at Queen's University of Belfast, where he is enrolled as a final year PhD student. Throughout his career, Ricardo has developed advanced bioinformatic skills towards the (meta)genomic analysis of complex communities of microbes. As a trained microbiologist turned bioinformatician, Ricardo aims to progress in his career in the new booming field of bioinformatics.

Fred Coulon

Frederic holds a chair in Environmental Chemistry & Microbiology at Cranfield University (UK) and is recognised for his internationally leading contribution on water, soil and wastewater treatment, resource recovery and environment, and public communication of environmental science and engineering. His work is premised on the understanding that environmental resources are inextricably intertwined and therefore there is a need of advancing a nexus approach to enable integrated and sustainable management of water, soil and waste systems.

Siobhan Cox

Siobhan is a Senior Lecturer at Queen's University Belfast. Her research interests include risk assessment of contaminated sites including human health risk assessment, the use of bio-accessibility testing and differentiating between geogenic and anthropogenic sources of contamination. Dr Cox has also considerable industrial experience of leading the assessment and management of

contaminated land, successfully delivering multi-million pound construction projects as a contaminated land consultant, before entering academia in 2003. She is currently a project leader on the €3.7M REMEDIATE Marie Curie ETN and a work package leader on the £550k InnovateUK funded LowCoPreCon project.

Heather De-Quincey

Heather is a PhD student at Swansea University and a member of the Swansea Biochar Research Team. Heather will be presenting her recent MSc research detailing the successful phytostabilisation of Pb-Zn contaminated mine tailings through the creation of a biochar-enhanced technosol. The application of the technosol substantially improved biomass (+1200%), significantly reduced Pb uptake into biomass (3.3x less Pb than the control), and created an extensive plant root network. Her current PhD aims to develop this method of phytostabilisation into one suitable for field-scale application on the inaccessible steep slopes typical of mine wastes.

Giovanna Dino

Graduated in Environmental Engineering – Georesources specialisation (Politecnico di Torino) and qualified as mining engineer since 2001. PhD course in Environmental Geoengineering (Politecnico di Torino) ended in 2004. From 2008 she has been working at University of Torino (Earth Sciences Department) as research assistant and responsible for the *mineral dressing and sampling* laboratory, interested in research connected to quarrying and mining activities (geomaterials sampling and characterisation, dressing activities, sustainable mining, circular economy approach to recover raw material – secondary and critical – from waste, impacts connected to waste management).

Involved from 2001 in European, national and local projects which deals with the management, the impacts, and the potential reuse of waste.

From 2001 she published more than 100 scientific papers and abstracts, presented at National and International Conferences or published in scientific journals.

Rory Doherty

Rory is a senior lecturer in the school of the Natural and Built environment at Queen's University Belfast. He has over 20 years'

experience as an academic and remediation contractor. Rory has worked on several contaminated land projects with industrial partners that include Biological Permeable Reactive Barriers, Ex Situ and In Situ Chemical Oxidation, Ex Situ and In Situ Bioremediation, Groundwater Modelling, the Reuse of Materials and Environmental Forensics. He applies chemistry, geophysics and microbiology to environmental problems to produce viable engineering solutions. Rory's research interests are: The Circular Economy, Reuse & Recovery of Hazardous & Valuable Materials, Restoration of Peatlands, Sustainable Remediation of Pollution, Identification and apportionment of Potentially Toxic Elements.

Alex Donald

Alex is a geology graduate from Queen's University Belfast and has been working for the Geological Survey of Northern Ireland for 15 years. He was a member of the Tellus Project team and now works in Information and Infrastructure dealing with data delivery, data management and information products.
He has compiled GSNI publications including 'A Guide to the Tellus Data' and 'Unearthed'. He has a particular interest in urban geology and has been involved in the European Co-operation on Science and Technology (COST) Action "Sub-Urban".

Caroline Gauchotte-Lindsay

Caroline is a Lecturer in Environmental Engineering in the School of Engineering at the University of Glasgow. Her research is funded by the EU, EPSRC, Royal Society, the Royal Society of Edinburgh and recently Scottish Water. An analytical chemist by training, she has built a successful track record in developing high-resolution environmental analytical methods (such as novel stable isotope mass spectrometry and comprehensive two-dimensional gas chromatography (GCxGC)) coupled with advanced data mining to monitor and elucidate the fate of organic contaminants in natural and engineered environments.

Tom Henman

Tom is Director at RSK Environmental. He is a Fellow of the Royal Society of Chemistry, a Chartered Chemist/Scientist, SiLC and Suitably Qualified Person under the NQMS. He has worked on diverse projects ranging from major infrastructure and development to legacy

industrial sites. Tom is a chemist by background but leads multi-disciplinary teams to develop solutions to contaminated land issues. He has worked on collaborative research projects with universities relating to contaminated land and brownfield related subjects and co-authored literature papers. Tom would be supported by Felipe Couto, the managing director of the RSK remediation contracting business.

David Holmes

David is the Technical Manager for Ecologia. He was awarded a PhD in Civil Engineering from Southampton University in 2013, looking at multiphase flow in landfills, and joined Ecologia in 2014. He is involved with LNAPL recovery work and has used LNAPL mobility as a metric for regulatory closure/acceptance in the UK, Ireland and Europe. He won the 2017 Brownfield Briefing Best Science Award for guided-wire measurement of LNAPL.
His current role is to look after R&D efforts and the laboratory, with involvement in numerous ongoing remediation projects. Areas of current research include chemical dosimetry in support of ISCO, per- and polyfluoroalkyl substances, metals fixation and thermal technologies.

Olivia Holmes

Olivia is a Senior Environmental Consultant at Malachy Walsh & Partners, with over eighteen years' experience in Environmental Engineering, focussing primarily on contaminated land assessment and remediation, waste management, and Environmental Impact Assessment (EIA) and planning. Olivia is a chartered engineer with Engineers Ireland and a chartered member of CIWEM. She is recognised by Engineers Ireland as being suitably qualified and experienced to carry out risk-based assessment certifications of historic landfill sites and contaminated land sites.

Hussein Ibrahim

Hussein is currently a late stage research student in the School of Biological Sciences with research specialty in Environmental microbiology and Biodegradation. After his first degree in Applied Microbiology, he obtained an MSc in Environmental Microbiology with commendation from University of Aberdeen where he applied bacterial biosensor and bioreporters for the diagnostic determination of hydrocarbon pollutants in contaminated groundwater for

environmental relevance. He has attended several academic conferences of high value including the recently concluded Microbiology Society Annual Conference 2018 held in Birmingham. He has attended REMEDIATE research meetings in Copenhagen and the Summer school hosted in Belfast.

Tommi Kaartinen

Tommi works as a Senior Scientist at VTT Technical Research Centre of Finland Ltd. He has 15 years professional experience in waste characterisation, processing and management, material recyclability, water treatment and recycling technology development and environmental impact assessments. He has been active in landfill mining research since 2011, and has managed national and international research projects in the field. He is also Finland's representative in EURELCO, European Enhanced Landfill Mining Consortium, where he also worked as a leader in a working group dedicated for science and technology in landfill mining. Tommi has also written and evaluated several peer-reviewed articles regarding landfill mining

David Kerr

David is a Senior Environmental Consultant with White Young Green Limited, an award multi-disciplinary consultancy based throughout the UK and Ireland. David provides advice to a wide range of public and private sector client's on the management of land contamination and environmental risks associated with owning, managing and developing brownfield sites. Before joining WYG, David had gained experience as an independent Environmental Advisor and Environmental Scientist involved in the assessment, management and remediation of pollution incidents. David has professional experience in contaminated land surveys and assessment, human health risk assessment, environmental impact assessment, waste classification and invasive species.

Panagiotis Kirmizakis

Panagiotis is a REMEDIATE Early Stage Researcher at Queen's University Belfast. Prior to arriving at QUB, he earned a master's degree in geoenvironmental resources and a bachelor's degree in environmental engineering in Greece. His research involves biogeophysical approaches in site assessments.

Mike Larkin

Mike is Emeritus Professor of Microbial Biochemistry at Queen's University of Belfast. He retired at the end of 2016 after 36 years at the university. His main research interest was the fate of organic chemicals in the environment and the role of microorganisms in their degradation. His interests spanned their evolution, genetics and biochemistry. He is former chair of the Questor Centre Research Committee.

Alex Lee

Technical Director at WSP with over 20 years' experience. Alexander has accountability for providing advice, support and technical guidance across all our UK offices. His remit encompasses: business improvement; growth of our people; and the cultivation of a shared culture of "best in class". Alexander has previously been employed by WSP Remediation Ltd, Environmental Resources Management (ERM), GeoDelft and British Nuclear Fuels (BNFL). He is a Chartered Geologist, Chartered Scientist and European Geologist together with Accredited Risk Assessor including accreditation for human health, gas, vapour and groundwater risk assessments. He is elected Chair of The Society of Brownfield Risk Assessors (SoBRA). He has completed projects encompassing problem holder legislative responsibilities, divestiture and audit together with strategy development and resource assessment.

Jack Lort

Jack is a PhD student at the British Geological Survey and the University of Nottingham. Jack's project is titled: "Measurement and modelling human dermal bioavailability of potentially harmful organic soil contaminants". The project aims are:

- To optimise an *in vitro* method to quantify the human dermal bioavailability of PAHs in soil
- To validate results using publicly available in vivo study data
- To use measured physico-chemical soil properties to develop, test and evaluate numerical models to predict dermal bioavailability, explaining which factors might be responsible for the release of contaminants from soil into and through human skin

Neha Mehta

Neha a REMEDIATE Early Stage Researcher in the Department of Earth Sciences at the University of Torino. Her work applies separation engineering aspects to recover minerals from waste. Her work also includes assessment of risks associated with contaminants at site. Her research interests are waste management and risk analysis due to contaminants at site.

Matthias Metzger

Matthais is a REMEDIATE Early Stage Researcher at Dublin City University. He studied biomedical chemistry to the level of M. Sc. at the Johannes –Gutenberg University in Mainz, Germany. Having specialised in instrumental analysis during my master studies and completing my master thesis on surface water analysis, he looked for a challenge in environmental analytics and for the past year he has been working on the quantification of micro pollutants in soil and sediment via GC/MS.

Dietmar Müller-Grabbher

Dietmar is Deputy Head of the Contaminated Sites Department at Environment Agency Austria (EAA). He holds an MSc in civil engineering & water management from University of Natural Resources & Applied Life Sciences, Vienna (Austria). Working with the EAA's Contaminated Sites Department since 1989 (Deputy head since 2009) his main responsibilities include supervising the national program, chairing the national working group "Risk assessment of contaminated sites" at the Austrian Standards Institute, & acting as associated expert to the Austrian parliaments Commission on the Remediation of Contaminated Sites. During the period from 1998 until 2014 he was regularly involved to European R&D activities focused to land management and remediation. Since September 2017 he is General Secretary to COMMON FORUM (www.commonforum.eu) & ICCL (www.iccl.ch), the European and the global network of policy advisors & regulators in contaminated land management.

Steve Owen

Steve is a chartered geologist with 12 years' experience. Steve has worked on oilfields in Iraq in addition to redevelopment projects in

the UK and currently leads RSK's northern geophysics team. Routinely working with geoscience colleagues, Steve promotes the use of geophysics to maximise the value of site investigation to redevelopment and oil & gas clients. Steve is heavily involved the development of rapid collection and integration techniques of geophysical data with application to detection of near surface targets. Steve recently had a paper published in the Quarterly Journal of Engineering Geology and Hydrogeology

Elio Padoan

Elio has recently completed his doctorate in soil chemistry. His interests are in soil elemental chemistry of urban areas, with regard to the elemental translocation from soil to different environmental compartments and to the soil contribution to urban pollution, as source and sink of heavy metals.

Coren Pulleyblank

Coren is a REMEDIATE Early Stage Researcher at Dublin City University. Hailing from Canada, she completed her Bachelors of Arts degree in the History of Science and Technology and Classics, and her Bachelors of Science degree in Geography. Interested in environmental processes, she has conducted fieldwork in the Rouge River Valley, the Canadian Arctic and French Alps. Her current work focuses on emerging contaminants in soils, in particular the degradation products of polycyclic aromatic hydrocarbons in soils.

Zoltan Sas

Zoltan worked at Queen's University Belfast (QUB) as a Marie Curie research fellow (By-BM Project, H2020-MSCA-IF ID: 701932). The secondment institute is Hasselt University, Nuclear Technological Centre (NuTeC), Diepenbeek, Belgium. My primary interest is the NOR (naturally occurring radioactivity) in the built environment. The By-BM Project focuses on the screening and radon exhalation properties of various industrial by-products used in the Geopolymer Team of QUB. The By-BM project is developing innovative, environmentally-safe geopolymers – which integrate waste materials yet comply with necessary safety standards.

Torsten Schmidt

Torsten obtained his PhD degree in Analytical Chemistry in 1997 in Marburg (D). After postdoctoral and senior scientist positions at EAWAG/ETH Zurich (CH) and in Tuebingen (D), he became full professor for Instrumental Analytical Chemistry at the University of Duisburg-Essen (D) and scientific director at the IWW Water Centre in Muelheim an der Ruhr in 2006. He is currently president of the German Water Chemistry Society. In 2013, he received the Fresenius Award of the German Chemical Society. His main research interests include the development and application of analytical methods with focus on separation techniques (GC, LC), sample preparation and compound-specific isotope analysis, process-oriented environmental chemistry and oxidation processes in water technology.

Seyed Morteza Seyedpour

Morteza is a REMEDIATE Early Stage Researcher at TU Dortmund University. His work focuses on contaminant transport in groundwater and soil. His background is mechanical engineering. He earned his BSc in heat and fluid mechanics from Urmia University and his MSc in biomechanics at Iran University of Science and Technology. Before PhD, he worked as a researcher at Medical Nanotechnology and Tissue Engineering Research Centre of Shahid Beheshti University and Motor and Propulsion Laboratory of Tarbiat Modares University.

Mike Spence

Mike is a geochemist and environmental engineer with 13 years of industry experience in refinery water use, environmental fate assessment and the risk- based management of soil and groundwater. He has recently returned to Shell from a 4 year secondment to Concawe in Brussels, where (as Science Executive for Water, Soil, Waste and Oil Pipelines) he coordinated research at sector level to improve the environmental performance of EU refineries. Mike has a degree in Natural Sciences (Geology) from Cambridge, an MSc in Geochemistry from the University of Leeds, and completed his PhD on the use of stable isotope fractionation to assess subsurface biodegradation rates at the University of Sheffield.

Nenad Stojanović

Nenad is a REMEDIATE Early Stage Researcher at the University of Duisburg-Essen in the workgroup of Prof Dr Torsten Schmidt. He gained his M.Sc. degree in Chemistry in 2014 and has worked at the Institute of Field and Vegetable Crops in Novi Sad, Serbia. Previously gathered experience in the field of gas chromatography he is now combining with microextraction techniques in order to simplify and improve sensitivity of compound-specific stable isotope measurements. His skills in making illustrations and technical drawings allow him to precisely transfer his ideas to the mechanical engineers that help him to modify and improve existing measurement equipment.

Christine Switzer

Christine is a Lecturer in Environmental Engineering at the University of Strathclyde. Broadly, her research interests lie in the areas of contaminant fate, transport, and remediation as well as rehabilitation of post-remediation soils. She is co-inventor of the patented smouldering remediation process that has been deployed successfully at contaminated sites all over the world. She and her co-inventors were presented with the Lord Ezra Award for innovation in combustion engineering in 2009 and the commercial team was awarded the American Academy of Environmental Engineers and Scientists Superior Achievement Award in 2017.

Stacie Tardif

Stacie is a REMEDIATE Early Stage Researcher at the University of Copenhagen. Her main research interests lie in the effect of soil metal contamination on soil microbial community parameters such as composition and function. She is working to develop and apply relevant and scalable green monitoring and remediation tools for the decontamination of metal polluted sites. She acquired her MSc graduate degree in Environmental Microbiology, through which she developed extensive analytical and problem-solving skills particularly relating to the processing of very large datasets and extensive multivariate statistical analyses.

Russell Thomas

Russell has spent much of his career working on the investigation, assessment and remediation of former gasworks sites. Russell manages a variety of university innovation projects on behalf of WSP and clients, ranging from environmental forensics to bioaccessability testing. He is currently a Technical Director for the Engineering Consultancy WSP and holds visiting academic positions at the University of Strathclyde and the University of Manchester.
He is a member of the Institute of Gas Engineers and Managers History Panel, Co-editor of Historic Gas Times and has written numerous papers on different aspects of the gas industry.

Owen Williams

Owen is a freelance environmental advisor working with clients who acquire and develop brownfield sites throughout Ireland. Owen is the founding Chair of the Ireland Brownfield Network and is a former environmental insurance broker, consultant and regulator. His 20 years' experience and expertise in quantifying and managing environmental liabilities has earned him a reputation as being a pragmatic problem solver dedicated to the appropriate and sustainable redevelopment of brownfield sites.

Yi Zhao

Yi is a REMEDIATE Early Stage Researcher at the University of Copenhagen. Her main research interests lie in the relationship between metal contamination and antibiotic resistance/arsenic biogeochemical cycling genes using high-throughput qPCR (HT-qPCR) based chips. She is working to develop and apply a novel HT-qPCR smart chip for comprehensively profiling of microbial arsenic genes in the contaminated and remediated soils. She worked at Institute of Urban Environment, Chinese Academy of Sciences, through which she developed extensive analytical and lab skills on molecular microbial ecology and environmental microbiology.

Lorena Zichella

Lorena works at the Politecnico of Turin. Currently working for a PhD in Environmental Engineering and Territory with the topic thesis: "Natural stone sludge as secondary raw materials: towards a new sustainable recovery process."

About Remediate

REMEDIATE is a Marie Skłodowska-Curie Action (MSCA) funded Innovative Training Network (ITN). The network is a multidisciplinary collaboration between internationally renowned groups from academia and industry with complementary expertise in a wide range of site investigation and risk assessment technologies. The network is made up of from five EU member states (UK, Ireland, Germany, Denmark, and Italy) hosting post-graduate students, and who lend facilities, expertise, and industry knowledge to the project. All project participants are committed to the goal of providing innovative research and training to develop cost effective, sustainable remediation of contaminated land.

Early Stage Researchers (ESRs) have taken part in an integrated research and training programme to provide them with technical and transferable skills for future employment. Each research project was designed to benefit the contaminated land sector through the development of techniques and tools across a range of disciplines relating to site investigation and risk assessment, to provide better informed solutions for remediation. The researchers received joint supervision from academic and industry mentors to enhance their career prospects.

REMEDIATE will produce creative, innovative researchers with skill sets to address the technical, economic, and social challenges facing the contaminated land sector in Europe and throughout the world.

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REMEDIATE