Engagement and Impact 2018

University of South Australia

USA05 (HLS) - Impact

Overview

Title

(Title of the impact study)

Saving lives, saving soil, saving sites: transforming the way the world deals with contaminated environments

Unit of Assessment

05 - Environmental Sciences

Additional FoR codes

(Identify up to two additional two-digit FoRs that relate to the overall content of the impact study.)

03 - Chemical Sciences
06 - Biological Sciences

Socio-Economic Objective (SEO) Codes

(Choose from the list of two-digit SEO codes that are relevant to the impact study.)

96 - Environment
92 - Health

Australian and New Zealand Standard Industrial Classification (ANZSIC) Codes

(Choose from the list of two-digit ANZSIC codes that are relevant to the impact study.)

32 - Construction Services

Keywords

(List up to 10 keywords related to the impact described in Part A.)

Bioavailability

Contamination

Cost reduction

Health

Lead

Productivity

Regulation

Remediation

Soil

Waste

Sensitivities

Commercially sensitive

No

Culturally sensitive

No

Sensitivities description

(Please describe any sensitivities in relation to the impact study that need to be considered, including any particular instructions for ARC staff or assessors, or for the impact study to be made publicly available after EI 2018.)

Aboriginal and Torres Strait Islander research flag

(Is this impact study associated with Aboriginal and Torres Strait Islander content?
NOTE - institutions may identify impact studies where the impact, associated research and/or approach to impact relates to Aboriginal and Torres Strait Islander peoples, nations, communities, language, place, culture and

knowledges and/or is undertaken with Aboriginal and Torres Strait Islander peoples, nations, and/or communities.)

No

Science and Research Priorities

(Does this impact study fall within one or more of the Science and Research Priorities?)

Yes

Science and Research Priority	Practical Research Challenge
Health	Improved prediction, identification, tracking, prevention and management of emerging local and regional health threats.
Environmental change	Improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors.
Environmental change	Options for responding and adapting to the impacts of environmental change on biological systems, urban and rural communities and industry.

Impact

Summary of the impact

(Briefly describe the specific impact in simple, clear English. This will enable the general community to understand the impact of the research.)

Remediating land used for mining, industry, agriculture, urban development and waste disposal costs Australia over $2 billion a year. University of South Australia (UniSA) research in collaboration with industry has led governments globally to modify soil assessment policies. Previously there was no accurate way to measure site contamination and risk to humans through soil contact (contaminant bioavailability). Every site was assumed to have 100 percent likelihood to cause harm. UniSA's accurate and reliable assessment tools have given environmental agencies better solutions for managing and/or remediating soils without compromising human health and safety. Benefits include improved health and safety through reduced exposure to hazards and remediation cost savings of $749 million.

Beneficiaries

(List up to 10 beneficiaries related to the impact study)

Land owners seeking to redevelop contaminated sites (e.g. Lend Lease, Renewal SA.) or reinstate impacted land (e.g. mining organisations)

Risk consultants and auditors

Australian Government

Environmental Protection Agencies in Australia

Environmental Protection Agencies in New Zealand

Environmental Protection Agencies in United States

Environmental Protection Agencies in Canada

Steel manufacturers in the province of Zhuhang, China

Health Agencies in South Australia (SA Health and Women's and Children's Hospital)

Industry associations including the Australasian Land and Groundwater Association, Australian Contaminated

Land Consultants Association and WasteMINZ

Countries in which the impact occurred

(Search the list of countries and add as many as relate to the location of the impact)

Australia
United States of America
New Zealand
China (excludes SARs and Taiwan)
Canada

Details of the impact

(Provide a narrative that clearly outlines the research impact. The narrative should explain the relationship between the associated research and the impact. It should also identify the contribution the research has made beyond academia, including:
- who or what has benefitted from the results of the research (this should identify relevant research end-users, or beneficiaries from industry, the community, government, wider public etc.)
- the nature or type of impact and how the research made a social, economic, cultural, and/or environmental impact
- the extent of the impact (with specific references to appropriate evidence, such as cost-benefit-analysis, quantity of those affected, reported benefits etc.)
- the dates and time period in which the impact occurred.

NOTE - the narrative must describe only impact that has occurred within the reference period, and must not make aspirational claims.)

Outcomes from the University of South Australia's (UniSA) human health exposure assessment research have been pivotal for environmental policy refinement in Australia for quantifying exposure to environmental contaminants (National Environmental Protection Measure (NEPM) for the Assessment of Site Contamination, EnHealth Australian Exposure Factor Guidance Guidelines for Assessing Human Health Risks from Environmental Hazards). New knowledge and assessment techniques allow a greater understanding of the risk posed by environmental contaminants to communities and individuals with flow-on benefits for health and wellbeing, and associated economic savings including better and more tailored management of sites and their remediation and policy development and refinement.

Exposure assessment amendments to the NEPM, governing contamination management practices in Australia, achieve sector-wide impact on landowners, risk assessors, auditors, regulators, local government authorities and communities. The EnHealth Guidelines, a document prepared by the government for risk assessors, details the relationship between bioavailability and bioaccessibility, and the appropriateness of using in vitro assays as surrogates for exposure refinement.

New bioavailability approaches to site assessment and management have had major impacts leading to savings through reduced volume of hazardous waste sent to landfill, treatment of soil for disposal in lower category landfills (lowering disposal costs), and reducing remediation and removal requirements (soil safe to remain on-site).

This resulted in direct commercial benefits as well as wider economic benefits to Australia. For example, 30 environmental consulting companies have saved their clients an estimated $749 million in remediation costs over the last six years as a result of exposure assessment refinement undertaken at UniSA. The impact has occurred across 60 land developments in VIC, NSW, TAS, SA, WA and ACT.

With regulatory frameworks supporting the application of bioavailability assessment for the refinement of exposure, and with increasing demonstrated value to industry in Australia, there is a growing demand for services by state and local governments seeking to better understand contaminant exposure in their communities. UniSA's work has directly informed development of a targeted strategy by SA Health to reduce blood lead levels in Port Pirie residents, through provision of service (2013-2014) which determined the bioavailability of lead in soil. A related project supported by the SA Women's and Children's Hospital is in progress, seeking to determine the importance of the inhalation exposure pathway for lead, with a view to understanding whether this pathway is a

critical component of lead exposure in Port Pirie's dusty environment (through inhalation of air-borne lead-containing dust). UniSA commenced exposure assessment research with the Broken Hill Environmental Lead Program aiming to quantify lead bioavailability, understand factors influencing bioavailability and target strategies for minimising exposure to reduce population blood lead levels. Assoc Prof Albert Juhasz (Exposure Assessment Research Leader) says, "Providing services to these communities is the culmination of years of research leading to regulatory changes that have created a supportive framework to give authorities the confidence to invest in better understanding bioavailability and bioaccessibility in their communities. The opportunity to benefit communities like Port Pirie and Broken Hill is a major driver and reward for me."

Outcomes from UniSA's exposure assessment research have directly impacted international regulatory guidance in Canada (Health Canada, 2011), the US (US Environmental Protection Agency (USEPA), 2013; Hawai'i Department of Health, 2012-2015) and NZ. Collaboration with Bioaccessibility Research Canada led to the development of a decision framework for the use of contaminant bioaccessibility data in human health risk assessment at contaminated sites, which has been adopted by environmental practitioners in Canada. Outcomes of the arsenic bioavailability project with the Hawai`i Department of Health, Hazard Evaluation and Emergency Response Office, identified that many land parcels within former sugar cane plantations may not require remediation or engineered controls as arsenic bioavailability was intrinsically low due to the soil's physicochemical properties. The exposure refinement approach developed was incorporated into Hawai'i Department of Health guidance for the 'Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater' and is now used as the standard methodology for assessment of risk for arsenic-contaminated land (>200,000 acres). Engagement with the USEPA National Risk Management Research Laboratory, USEPA National Exposure Research Laboratory, USEPA Office of Superfund Remediation and Technology Innovation, Science Policy Branch, and EPA National Health and Environmental Effects Research Laboratory (via provision of UniSA's arsenic bioavailability database from 2004-2014) resulted in the development of guidance on in vitro bioaccessibility assays for predicting oral relative bioavailability of arsenic in soil. The document has been presented to the USEPA Technical Review Workgroup Bioavailability Committee and is currently under review for regulatory guidance. The NZ Ministry for the Environment commissioned UniSA researchers to review guidance on 'Accounting for bioavailability in contaminated land site specific risk assessment' and 'Methodology for deriving standards for contaminants in soil to protect human health'. Outcomes from the review were incorporated into draft environmental guidance documents for ministerial consideration. Development of international guidance has sector-wide impact on landowners, risk assessors, auditors, regulators, local government authorities and the communities they serve and protect.

Associated research

(Briefly describe the research that led to the impact presented for the UoA. The research must meet the definition of research in Section 1.9 of the EI 2018 Submission Guidelines. The description should include details of:
- what was researched
- when the research occurred
- who conducted the research and what is the association with the institution)

Inspired by challenges facing end-users in managing contaminated sites, in 2003, University of South Australia (UniSA) researchers commenced development of in vivo and in vitro methodologies for measurement/prediction of contaminant bioavailability in soil, initially focused on arsenic. and later driven by end-user input for priority pollutants (e.g. lead, cadmium, polyaromatic hydrocarbons (PAHs), organochlorines, and per- and poly-fluoroalkyl substances (PFAS). UniSA secured a $590,000 ARC Linkage grant (2003-2006) and $1.1 million through the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) (2006-2009). Further research was funded from USEPA, NZ Ministry for the Environment, Hawai'i Department of Health, SA Health, Broken Hill Environmental Lead Program and other end-users (30 from the environmental sector). Refinement and publication of the arsenic in vivo-in vitro relationship began in 2006 with validation of lead and cadmium relationships in 2009-2010. This research informed the National Environmental Protection Measure statutory review. Global impact is exemplified by 65 site-specific bioavailability assessments in Australia (from 2010), quantification of arsenic bioavailability in Hawaiian soil impacted by historical herbicide usage (2013-2015), UniSA being the only non-US contributor to bioavailability guidance by USEPA (2015-), and a technique utilising lead signature combined with bioavailability assessment, in Zhuhang, China (2015).

FoR of associated research

(Up to three two-digit FoRs that best describe the associated research)

05 - Environmental Sciences

03 - Chemical Sciences
06 - Biological Sciences

References (up to 10 references, 350 characters per reference)

(This section should include a list of up to 10 of the most relevant research outputs associated with the impact)

Diamond, G. L., K. D. Bradham, W. J. Brattin, M. Burgess, J. W. Drexler, S. Griffin, C. A. Hawkins, A.L. Juhasz, J.M. Klotzbach, C. Nelson, Y.W. Lowney, K.G. Scheckel, David J. Thomas (2016). Predicting oral relative bioavailability of arsenic in soil from in vitro bioaccessibility. Journal of Toxicology and Environmental Health Part A 79: 165-173.

Juhasz, A. L., Tang, W., Smith, E. (2016). Using in vitro bioaccessibility to refine estimates of human exposure to PAHs via incidental soil ingestion. Environmental Research 145: 145-153

Li, H-B., Chen,K., Juhasz, A., Lei, H. and Ma, L. (2015). Childhood Lead Exposure in an Industrial Town in China: Coupling Stable Isotope Ratios with Bioaccessible Lead; Environmental Science and Technology, 49, 50805087.

Estimate of the cost of hazardous waste in Australia: Final Report, July 2014. Report prepared for the Department of the Environment by Marsden Jacob Associates.

Australian Exposure Factor Guide (2012). Environmental Health Standing Committee (enHealth); Commonwealth of Australia; Section 4.1, pp. 42-45.

Juhasz A. L., J. Weber and E. Smith (2011). Impact of soil particle size and bioaccessibility on children and adult lead exposure in peri-urban contaminated soils. Journal of Hazardous Materials 186: 1870-1879.

Smith, E., I. M. Kempson, A. L. Juhasz, J. Weber, A. Rofe, D. Gancarz, R. Naidu, R. G. McLaren and M. Grafe (2011). In vivo - in vitro and XANES spectroscopy assessments of lead bioavailability in contaminated peri-urban soils. Environmental Science and Technology 45: 6145-6152.

Juhasz A. L., J. Weber, R. Naidu, D. Gancarz, A. Rofe, D. Todor and E. Smith (2010). Determination of relative cadmium bioavailability in contaminated soils and it prediction using in vitro methodologies. Environmental Science and Technology 44: 5240-5247.

J.C. Ng, A.L. Juhasz, E. Smith and R. Naidu (2009). Contaminant bioavailability and bioaccessibility Part 2: Guidance for industry. Technical Report no. 14; CRC for Contamination Assessment and Remediation of the Environment.

National Environment Protection (Assessment of Site Contamination) Measure, (1999 as amended 2013). Federal

Register of Legislative Instruments, F2013C00288. Schedule B7, Appendix 1.

Additional impact indicator information

Additional impact indicator information

(Provide information about any indicators not captured above that are relevant to the impact study, for example return on investment, jobs created, improvements in quality of life years (QALYs). Additional indicators should be quantitative in nature and include:
- name of indicator (100 characters)
- data for indicator (200 characters)
- brief description of indicator and how it is calculated (300 characters).)