Institution: Brunel University

Unit of Assessment: 7 Earth Systems and Environmental Sciences

a. Overview

Formed in 2004, the Institute for the Environment (IfE) is a Specialist Research Institute focused on research and postgraduate education in the area of environmental hazards. The recent award of the Queen's Anniversary Prize (2011), and our performance in RAE2008, herald a period of rapid growth, and set the stage for the Institute to become a leading UK environmental research institute, particularly in the area of chemical hazards, stemming from the well-established reputation of Brunel ecotoxicologists, built over 2 decades. Under the management of the newly appointed Head (2011), changes to both the shape and size of the Institute include two landmark appointments of highly productive senior scholars and substantial increases in research staff numbers (from 8.6 to 18) and research grants awarded (from £3.5 million to £5.6 million). Catalysed by increased research income (6-10% of University annual research income), the Institute has expanded its international research capacity in human toxicology, ecotoxicology, chemical risk assessment, and environmental chemistry, whilst laying the foundations for new research capacity in climate and past environments and environmental health. The Institute is a vibrant scholarly environment which attracts high quality postgraduates and researchers and prepares them for a career in science through its unique internship programmes for research students and bid-writing fellowships for postdoctoral scientists. Accordingly, PhD student and Masters student numbers studying within the Institute have doubled compared to 2008, and we host around 4 international scientists each year who come to the Institute to conduct short sabbaticals in collaboration with our permanent staff. Institute research is exceptionally highly cited (273 papers published between 2008 and 2013 cited 2093 times; collective H index 92). Added to this, around half our staff hold editorial positions in leading international journals in relevant fields. The Institute is an exemplar of impact and for the translation of research into societal impact, making significant contributions to some of the most important environmental issues facing society.

b. Research strategy

The Institute research strategy is inspired by its vision: To become a highly visible global leader in knowledge generation and translation to protect people and wildlife (individuals and populations) from environmental hazards. Our mission statement is: To develop and deliver knowledge to enable society to protect life on earth from environmental hazards; To translate knowledge into useful advice and products for industries, decision makers and consumers; To empower/motivate individuals and stakeholders to accelerate movement towards local, national and global sustainability. Important strategic goals for targeted efforts that support the Institute's mission and vision include: *a) Improving knowledge of environmental hazards and their consequences for people and wildlife (individuals and populations), b) Improving knowledge of the environmental hazards themselves including metrics of exposures, c) Finding ways to mitigate and/or manage environmental hazards, d) Training of a cadre of top-notch scientists and professionals from across a wide range of disciplines, in order to meet the mission.* The four strategic goals integrate the five core areas of our research capacity and reflect its interdisciplinary nature. To realise these goals, we strive to (i) retain and recruit researchers of the highest quality into our key research areas (ii) attract excellent research students nationally and internationally, (iii) provide a supportive and effective research environment and infrastructure to facilitate research excellence and knowledge transfer (iv) build collaborations and effective partnerships both within the University, but also regionally, nationally and internationally with other research institutions, research agencies, funding bodies/sponsors, and (v) encourage translation and exploitation of our research activities for the benefit of society.

ACHIEVEMENTS SINCE 2008

a) Increased research capacity through recruitment and retention of world leading researchers – Since RAE2008, research capacity has increased from 8.6 academic researchers (with a total of 121 outputs during the period covered by the 2008 RAE) to 17 in 2013 (with a total of 273 outputs; see section c of this document "People"). Appointments include human toxicologists (Kortenkamp, Silva and team) and industrial chemist (Kanda), both of whom are world-leading (Kortenkamp's H index is 31 and Kanda, appointed for his industrial experience, has written over 90 industrial reports and several research papers). Russell was recruited to the climate hazards group in 2010 to replace Dodson, who left in 2007. Three academic staff have been

promoted since and Jobling was appointed as Head in 2011, replacing Sumpter.

b) Increased support for research and knowledge transfer resulting in increased grant submissions and income: Following the appointment of the new Head, an ambitious training and mentoring programme for improved support to academics and PDRFs was instigated. Biannual academic retreats, one-to-one research mentoring, increased internal peer review and mentoring of grant writing and a revised appraisal system (2010) now ensure a greater emphasis on research. The progress towards success of these relatively new measures is currently evidenced by a) an increase in the quality of grants and papers submitted, particularly by the ECRs (steadily increasing research income and better scores on failed grants; e.g. ERC classification), b) an increase in the number and value of grant submissions (increased from £4.3 million in 2011 to almost £10 million in each of 2012 and 2013), c) an increased number of researchers, including PDRAs, actively writing grants, d) a doubling in PI spend from almost £2.5 million(RAE 2008) to almost £6 million (REF 2014) in a more competitive research climate e) Two staff members won Brunel Research Innovation and Enterprise Funds (BRIEF Awards) through an annual competition to pump-prime their research (Zeka 2008, Russell 2012). Six staff have received funds for travel to build research collaborations. Notable presence at conferences due to BRIEF activities include e.g. the International Society for Environmental Epidemiology 2011 presentations where Zeka presented 7 abstracts.

c) Increased support for career progression of research students and postdoctoral researchers through TWO in-house schemes that are now part of the Institute brand – In 2011 Institute introduced a) the ASPIRE career development scheme for PhD students and b) the MINT (Monthly Internship) postdoctoral grant and fellowship-writing scheme (elaborated in section C "people" below). These schemes are a deliberate move to further attract and retain high quality postgraduates and researchers by ensuring career enhancement, progression (e.g. see Lopez-Merino Section C, People) and opportunities for their continued employment within and outside the Institute and to establish a new Brunel brand in postgraduate training and employability.

d) Increased the number of collaborative research partnerships – The Institute has *built new collaborations* across the University (e.g. with the School of Engineering and Design, the Business and Law schools and the department of Biological Sciences), and with strategically selected industrial partners(e.g. Pfizer, Johnson and Johnson, Novartis, BP, Martek Marine, Severn Trent Water, Thames Water) and developed longer term relationships with end users, *evidenced by 8 studentships and 15 grants totalling £1.482 million.* In 2011, the Institute took leadership of the University's Environment and Energy collaborative research network (90 members across the University) to further facilitate interdisciplinary collaborative research across the University (two workshops hosted in on Energy and Water in 2010 and 2011 respectively). We have worked to ***raise the profile of Brunel in water research*** *through* a new University research centre on water sustainability and as members of the European Water Supply and Sanitation Technology Platform.

The institute has a global strategy to actively partner with a small number of international Universities to complement its research and expand its reach. Partnerships formed during the period include - with **Carnegie Mellon USA (Green Chemistry)** and with **BTH University, Sweden (world leaders in Sustainability)**. Through the latter, the Institute and the University is now (2012) a member of a Global Alliance (http://www.alliance-ssd.org), aimed at conducting research and education to contribute to real societal change towards sustainability.

e) Gained royal recognition and reward for outstanding success in translating research into socioeconomic impact – The Institute competed and *won a* ***prestigious Queen's Anniversary Trust Prize at the end of 2011*** for the socioeconomic impact of two decades of excellent research on hormonally active chemicals in the aquatic environment and for the transformational contribution of this work to the field of toxicology. The translation of research into impact is now embedded in the Institute's mission (2012-2015) and has been actively encouraged through the target setting in the annual appraisal process since 2011. Brunel Research Support and Development Office (RSDO) supports all staff in completing the impact requirements of their grant submissions (RSDO are invited to the bi-annual retreats and integrated with the Institute as much as possible). The Institute has re-developed its website (www.brunel.ac.uk/ife/) and has produced a colour brochure, distributed on memory sticks, to promote research opportunities and research achievements to potential partners and end-users. Impact is promoted through interaction with the University PR company and through direct contact with the public (Russell is winner of the Phillip Hunt Prize for public communication from The Royal Meteorological Society 2013).

FUTURE STRATEGIC GOALS/AIMS

The Institute's strategic plan to 2015 builds on the University plan to place us in the upper quartile of UK higher education institutions. Responsibility for the research strategy (see REF3a section C) rests with the Institute Academic Research Committee (ARC), chaired by the Deputy Head of Research. The plan to 2015 includes: ***Increasing and diversifying research funding*** - Increasing the contract value won by 10% each year by improving the quality of grants with concomitant changes in success rate and by diversifying research income streams. We will also **build on and nurture our established collaborations in order to increase the number of collaborative grants.** We will **increase the number and quality of postgraduate students -** (*double the number of students by 2015 and an increased proportion with IELTS greater than 6.0 and upper second class and 1st degrees*) by securing funding for EU doctoral training centres as well as cohort based doctoral training centres (e.g. our recently successful London Doctoral Training Partnership funded by NERC will support 36 PhD studentships per year for the next five years). **Further enhancing research quality** – through a) Enhancement of research skills e.g. statistical research workshops for staff and research students organised by newly appointed statistician, Martin Scholze b) Continued internal peer review of grants and publications for high quality journals c) Mentoring and appraisal of staff. **Restructuring our research activities** - In order to understand and solve the increasingly complex problems that exist at the intersection between people, wildlife and our increasingly complex environment, the Institute will expand to form a larger institute of Environment, Health and Societies with two to three times as many staff as it has currently. The disciplines represented will span traditional basic biological, medical, and population sciences, such as toxicology and epidemiology, but also translational sciences, data and information sciences, chemistry, bioengineering, synthetic biology, biostatistics, health economics, anthropology, bioethics, risk communication, behavioural sciences, and others. We will work with other research groups to form new integrated research themes e.g. ageing societies in an ageing world and future planetary sustainability.

c. People, including

i. Staffing strategy and staff development

Institute staffing policies and strategies are underpinned by the University policy to promote world-leading research. As part of our forward plan to ensure that the Institute is of a size and shape that can be responsive to global environmental issues and to the educational and business needs of a sustainable society, ***we have strategically enhanced our research capacity from 9 staff in RAE2008 to 17 staff in 2013***. Kortenkamp and Kanda (ECR) were appointed as Research Professors, Russell and Silva are Research Lecturers and Martin (ECR), Scholze (ECR), Lockyer (ECR) and Lopez-Merino (ECR) are independent Research Fellows. As our mission also includes an aim to increase the extent of interaction with external partners, and to promote the transfer and translation of knowledge between the university, government and industry, both Professors were intentionally appointed because they are actively engaged in communication and translation activities, at the research environment policy interface (Kortenkamp) and at the academia/industry interface (Kanda has spent his entire career until his appointment in 2012 working within industry). The appointment of Lockyer and Scholze will increase research quality across the Institute through the improvement of experimental design and data analysis and through the increased application of molecular biology to our research. Lockyer brings an additional benefit of enhancing the Institute's growing research interests in the biology of molluscs, both as vectors for human and animal diseases (biological hazards) and as possible sensors for chemical pollution. The appointment of the entire human toxicology group from the London School of Pharmacy (Kortenkamp, Silva, Scholze, Martin and team) has added a whole new dimension to the Institute's world famous toxicological research, allowing it to better address and integrate both human and wildlife toxicology. The appointment of Kanda, as an industrial professorial fellow with extensive experience and connections in the chemicals and water industries, has provided necessary bolstering of the Institute's environmental chemistry group and additional support for our world-leading toxicology team.

Support for equality and diversity - The University has achieved an Athena SWAN Bronze award for its efforts to promote the equal opportunity of women in science-related subjects and is embedding the policy and practices across all disciplines. The Institute particularly excels in this area through a tailored work plan for female staff with children that enables an appropriate work-life balance by assessing and managing teaching loads prior to and after maternity leave. Indeed,

three postdoctoral scientists and three academics/research fellows currently work flexible hours due to their child commitments and four academic staff members have had maternity/paternity leave since 2008. We also strive to ensure that recruitment of female staff and students supports the attainment of a 50:50 gender ratio within the Institute. We encourage this by displaying the Athena SWAN logo when we advertise positions. The Institute currently has 19 female staff (including the Head) and 13 male staff in total, including the temporary research staff and technical staff; of the 17 academics and research staff returned (15.7 FTE), seven are women. Ethnic diversity is also well-represented in our staff. Our dedicated health and safety officer ensures staff with disabilities, temporary or permanent, are catered for. All staff are required to attend equality and diversity training sessions provided by the University.

Support for research career development - We provide **individualised staff development** opportunities appropriate to the career stage of our staff. Staff development of academics is closely managed by mentoring and by annual appraisal carried out by the Head plus one to two brief progress meetings throughout the year to encourage the development of high quality and high impact research portfolios and to ensure allocation of teaching and administrative duties are commensurate with individual research targets as far as possible. Appraisal of PDRFs and research assistants is carried out by the PIs and appraisal of technical staff and administrative staff by the Institute Manager. *Newly appointed ECRs* (5 in the period under assessment) have reduced teaching and administrative load for the three years of their probationary term and are assigned a research mentor who assists them with the development of their research portfolio. They are also given priority access to funds from the Institute's budget to attend conferences and for collaboration. Early career researchers represent the next generation of research leaders and as such they are encouraged to be involved in research management. E.g. Martin (ECR), attended the University 2012 leadership and management course, ASPIRE. Research staff also access opportunities through staff development and have attended and benefitted from a wide range of these courses. Biannual academic retreats (each 3-4 days in length), and internal peer review and mentoring of grant and paper writing ensures a great emphasis on research for ECRs as well as ALL other academics and PDRFs. The retreats focus on increasing the number and quality of grants and academic papers written by Institute researchers through intense scrutiny, **peer review and examination by external experts**. Retreats also serve as a forum for collaborative proposal writing and interaction with staff from other Brunel departments and external institutions. To further support these efforts, **all papers and grants are internally peer reviewed in a more formal process prior to submission by at least 2 members of staff through our Academic Research Committee.** Other activities aimed at enhancing the vitality of the research environment for all staff include: research coffee times, research 'speed-dating' between the members of the Institute and members of other departments, and a research grant deadline whiteboard kept up to date by postdoctoral researchers. *All research staff* are encouraged to participate in development opportunities provided by Vitae and have attended and benefitted from a wide range courses offered by Brunel Staff Development. The Institute and/or the University cover these costs. The researchers are also supported by a team of full-time technicians a number of which (Beresford, Pash) have co-authored papers. One of our senior technicians (Beresford) has recently registered to do a part-time PhD and another (Losty) an MPhil; we actively encourage researcher development of technical staff. **The Institute supports mid and senior staff to embrace research leadership and mentoring roles and tailored staff development is available to support staff in this role.** These staff are expected to take leadership roles in the wider University and disciplinary community by participating in research grant awarding bodies, organising national/international conferences and editing key research journals (see section e). In 2011, the Institute modified its organizational structure in order to optimize its ability to support the strategic priorities and objectives of the organization and in order to empower key staff by providing opportunities for greater responsibility and progression. A Deputy Head for Postgraduate Research and a Deputy Head for Postgraduate Taught programmes were appointed, both from the existing staff pool (following the appraisal process). Key administrative and technical staff were also promoted into line management roles so that the offices and laboratories could be managed more efficiently.

The University was awarded the European Commission's 'HR Excellence in Research' badging in 2011 in recognition of its commitment to the recommendations of the **Concordat to support the career development of researchers.** The University has a Concordat Action Plan and a

Concordat Working Group. With a strong base of postdoctoral fellows and research assistants (we have employed 13 post-doctoral research fellows since 2008, 9 of which are still employed), the Institute supports and develops these staff along the lines of the Concordat; they are managed by the research grant PIs via annual review at which their subject, methodological and generic/transferable skills needs are evaluated using the 4 domains of the Researcher Development Framework and their future career aims discussed. This is further complemented centrally by a dedicated programme for researchers run by the Graduate School. The tiered structure of the Institute means that young scientists gain specific skills training from more senior researchers (PhDs from postdocs and postdocs from more senior postdocs and academics), through attendance of specialised workshops, and by doing research within our collaborators' labs. **Bespoke activities** include **"*shadow" peer reviewing grant applications and papers and leading on the writing of grants and papers***. The Institute invites all postdoctoral researchers on the bi-annual research writing retreats and began its **own in-house postdoctoral grant writing fellowship scheme (MINT) in 2011** that provides an extended period of employment, with in-house funding, within which to write grants and fellowships with training and mentorship from academics. The success of this scheme is already proving to be exemplary: **Four postdoctoral MINT fellowships were awarded in 2011-2012, resulting in the submission of 6 additional grants by the staff.** One of these (awarded to Lopez-Merino) resulted in her winning a three year personal research fellowship from the Leverhulme Trust (2013), and a further (Margiotta-Casaluci, a star researcher developing independence) won pump priming funding from the Japanese GEN foundation for his research. Two further postdoctoral researchers are currently participating in bid writing; owing to its success, the scheme will be continued throughout 2014-2015 and is supported by a business plan for its continuation beyond 2015. All PDRFs publish and present their work at national/international conferences and have access to the academic networks of the senior staff. All PDRFs are first authors on research papers describing their work conducted as part of grants awarded to PIs. Our PDRFs have presented a substantial number of papers (42 in total) at national and international conferences since 2008.

The Institute actively rewards success through the annual promotional exercise. Scrimshaw to Reader (2009), Chaudhary to Senior Lecturer (2010), and Jobling to Chair in 2010. The needs of fixed-term and part-time staff are fully integrated into these procedures. As part of the promotions process, the University organises workshops, led by the University Equality Champion, to support women intending to apply for promotion. The success of the staff development and support activities of the Institute is indicated by the retention rate of staff; all but 1 of the staff submitted in the 2008 RAE have been retained. 4 academic staff have been promoted (3 centrally and 1 internally) together with 3 technical staff. Chris Skelly moved to New Zealand and is now in Australia at the School of Population Health, The University of Queensland, having published several important papers from his work at Brunel. PDRF Bannister went to Pfizer, Ribe is self-employed. Hala is a senior PDRA at the University of Texas, Orton is at Exeter University, Jones is studying for an MSc at London Veterinary College. The Institute has a high retention rate of all staff. Several PDRAs (e.g. Runnalls, Harries, Baynes, Margiotta-Casalucci) have been at the Institute between 5 and 10 years and many move from PhD to PDRF whilst within the Institute. Indeed both the Head and the Deputy were previously Brunel PhD students.

ii. Research students

The Institute's policies and procedures concerning doctoral students are underpinned by the University strategy and our Deputy Head of Research, Routledge sits on the University sub-committee with responsibility for this. We are committed to the academic and professional development of our students, and actively manage these from induction (where training and professional needs are identified) and evaluate progress against agreed targets regularly throughout their time in the Institute. Expert supervision of research students is often from internationally renowned scholars, and we are also committed to giving postdoctoral researchers experience in co-supervision of doctoral students. Students have 2 supervisors (and sometimes an additional external supervisor). Formal elements of progress were revised during the period of assessment to ensure doctoral students are on a trajectory to successfully completing their studies within the established registration duration, and now include: an induction week, practical courses, transferable skills workshops, formally recorded progress meetings every six weeks (in line with the University policy) with a progress review after 6 months (introduced in 2011), progression from

MPhil to PhD after 1 year (upon presentation and discussion of a report with the Deputy Head of Research and supervisors), 2nd and 3rd year reports, plus annual student/supervisor reports to the University. The additional review meeting at 6 months, rather than 1 year, was introduced as a driver to improve the quality of PhD supervision and to better advise the students of the likelihood that they will succeed in obtaining a PhD earlier in their programme of study, than otherwise advised by the University. The PGR recruitment strategy, advised by the University and QAA guidelines, was also revised in order to ensure a better selection of students with respect to their academic ability and in line with the research interests of the Institute. A more rigorous process has also been introduced to ensure better matching of students to supervisors. Taken together, these improvements in selection and assessment of PhD students have increased completion rates to 98% within 4 years and reduced the time to completion in line with the RCUK timeframe. Throughout their study, research students reside within the Institute in dedicated research areas complete with individual workspaces and computers. There is also a dedicated coffee room. They are supported centrally by the Graduate School, providing advice and support and a range of facilities such as a common room, networked computer kiosks, kitchen and quiet study room. Located next door to the Institute, the Graduate School building has a space set aside exclusively for postgraduate students, which is accessible 24/7. The Postgraduate Study Centre is a computer room only accessible to postgraduates. Internally, the students are supported by internal workshops on topics such as paper and thesis writing. The students also organise and are regular presenters at the Institute's weekly seminar series and conferences which feature both external speakers and experienced researchers from the Institute. These seminars are used as a forum at which students and postdocs alike can practice and hone their presentation skills. All research students are encouraged to publish their PhD research in peer-reviewed high impact journals. Most students graduate with at least 2 papers from their PhD thesis and all students are first authors on the papers that arise from their thesis. During the period of assessment, more than 30% of papers were published with PhD students as authors. Recent graduates have been appointed to Pfizer, AstraZeneca, Atkins, and the Water Research Centre and at leading universities in Europe, North America and the East of Asia. Others now shape national and international policy environments through their work in government agencies, research institutes and NGOs.

Activities and Awards for PG students: All students are provided with funds to attend at least one external conference and must participate in the Brunel SRI conference and Graduate School Poster competition held annually. Three students won the Vice Chancellor's Prize for the best poster in 2009/10, 2011/12 and 2012/2013. Many enter the annual Brunel competition for travel funds from the Vice Chancellor's Travel Prizes fund (£500) and two prizes were awarded to Institute students during the period of assessment. Two of our current students won full scholarships through the Isambard Scholarship scheme. The Institute runs its own "in house" "PhD-plus" programme called "ASPIRE which (through a competitive process) helps support work experience with one of our many government and industrial collaborators, or to travel to an international lab to conduct a novel piece of research. **Support for supervisors** – The Institute provides support for PhD supervisors through its mentoring system. Central support for supervision training is provided by the Graduate School in collaboration with Staff development.

d. Income, infrastructure and facilities

Research Funds: Since RAE2008, 37 grants of various sizes have been awarded with a value of £5.6 million as principal and co-investigators. Two large EU consortia grants were led and coordinated by Institute scientists (PHARMAS by Sumpter and CONTAMED by Kortenkamp). Research funding is mainly from EC, DEFRA and the NERC, with an increasing proportion from BBSRC, EPSRC, NC3Rs, the Leverhulme Trust, charitable foundations and the pharmaceutical and water industries. Our portfolio includes awards to staff as sole PI, Co-I and as part of large research consortia. Looking forward to 2015 and beyond, the Institute seeks to further increase research funding won and to diversify income sources, particularly in collaboration with industry and government. Priority areas for funding in the next 5 years are Europe (through Horizon 2020), MRC, EPSRC, NERC and the Bill and Melinda Gates Foundation. To achieve this, we will continue to drive up the quality and quantity of research applications, maintain our academic retreat programme to support and develop grant-writing by our staff with the support of RSDO, invite ECRs and PDRFs to participate in or develop their own grant applications, and maintain pump priming funding and support for collaborative meetings to discuss new ideas. *Infrastructure and facilities:* The Institute has continued to benefit considerably from this emphasis on strengthening

research, with the University providing significant central funds to support the Institute as it grows. This includes a £112,000 investment in the Institute's new laboratory facilities to accommodate human toxicology and a £66,000 investment to create two new research student and postdoctoral offices complete with workstations and cupboard space for each researcher installed in 2011. We have also increased the technical team supporting laboratory research by employing a junior biological technician (2012) and a chemistry technician (2008). Some restructuring of the technical and administrative staff (2012) has also provided a dedicated health and safety officer, ensuring health and safety is a strategic focus. The University is also committed to significant investment in the Institute's animal facilities. There are three technical staff dedicated to maintaining these facilities, where the *in vivo* experiments are conducted. They provide vital support for toxicological research that the Institute undertakes and are encouraged to participate in the planning and running of the experiments carried out in this facility. The Institute also charges out some space in the animal facility for mammalian research carried out by other parts of the University. The University has invested £6 million and has obtained planning permission to expand these facilities, the planning of which began in 2012. At University level, the Computer Centre provides a comprehensive set of networked software, data services and a collection of 570,000 books and e-journals to support our research. Since 2008, Institute staff have performed over £400k worth of consultancy for DEFRA, ChemTrust, Lloyds Register, the UK Water Industry and Melbourne Water.

e. Collaboration or contribution to the discipline or research base

Building links with collaborative partners to carry out interdisciplinary research is something that is in the DNA of the Institute's scientists and of Brunel University as a whole. The Institute is proactive in providing support for establishment of research collaborations through provision of funds for travel (e.g. Zeka 2008 for setting up a collaborative network with Albania), for grant writing workshops and round table discussions (six new collaborators) with other universities and end users. Indeed Zeka's visit to Albania resulted in participation in a public health network on air pollution (APHEKOM, noted as one of the top 20 projects with high impact funded by the EC, www.aphekom.org/web/aphekom.org/. For PhD students and PDRFs, travel funds are awarded through the PhD plus ASPIRE scheme (described in the section on staff). 30 of the 37 projects funded during the period of assessment are leveraged using resources of Brunel's other schools, research institutes, and through our intimate connections with end-users built up over many years. Evidence of the success of our collaborations is evident in the large number of collaborative grants and in 154 out of 273 collaborative papers during the period of assessment. The contribution we have made to the discipline is evidenced by the many citations of our papers (1433 citations of the 154 collaborative research papers published since 2008). The number of citations of science per year has steadily risen from 238 in 2008 to 409 citations per year in 2012. **Exemplar collaborations** include - *With* ***Exeter University*** (Tyler) ***and the Environment Agency*** on biological effects of estrogenic pollution on fish populations. Since 2008, we have secured two collaborative grants from the NERC to continue our joint research in this area which began over two decades ago when Tyler was based at Brunel - *With* ***NERC hydrologists*** (Johnson and Williams) ***at CEH Wallingford*** combining hydrological mapping and modelling with ecotoxicology to predict exposure and effects of pollution - *With* ***Water Industries*** on better treatment processes to remove chemicals so that lower amounts are released into rivers. This involves a new research strategy and international collaboration with world leading **Carnegie Mellon University Green Chemist Terry Collins** (UKWIR pilot study awarded to Jobling 2011-2012) **-** With **pharmaceutical industries** to conduct industrially relevant research on the biological effects of pharmaceuticals, a field initiated by institute researchers (35 papers published since 01/01/2008 cited more than 400 times to date) We are collaborators in a large Swedish programme of research (MistraPHARMA) on this topic. – *With* ***Cranfield University***, ***Atkins and the Water industry*** *on fate and behaviour of hazardous substances in wastewater treatment processes* resulting in 17 joint Brunel-Cranfield publications since 2008, including two with colleagues at Atkins, the UK water industry and regulators in the Chemical Investigation Programme, a large multimillion pound national programme on chemicals in wastewaters. The forward research strategy is to research optimisation of the operating conditions in sewage plants to facilitate removal of hazardous substances. By working closely with the UK water industry (and an EPSRC studentship based at Cranfield), the team are able to ensure that decision makers remain informed about options for improving effluent quality. - *With* the ***Technical University of Denmark and Erasmus MC***

University Netherlands - pioneering toxicological research in rodent models suggests that chemical risk assessments that ignore the possibility of combination effects of mixtures may lead to considerable underestimations of risks associated with human exposures to cocktails of chemicals that disrupt male sexual differentiation (4 key publications since December 2007 with 150 citations). This will have great impact on the significance of epidemiological research which does not currently account for combined exposures. - *With* ***BP petroleum,*** **INIO, Geological Survey, INCO and Tehran University in Iran and with Shirshov Institute of Oceanography in Russia** - *Collaboration on reconstructing past Caspian sea level and climate changes in Iran (*9 publications since 2008 with 61 citations)*.* Leroy and collaborators are investigating rapid sea level changes in the Caspian sea providing scope for making forecasts of sea level change to help mitigation of societal impact and also to provide stratigraphic information of benefit to petroleum companies (BP have funded one postdoc and two PhDs since 2008). The University of Ghent, CNRS, University of Strasbourg, University of Paris-Sud and CEREGE are also involved in parts of this collaboration. *With* **Max Planck Institute of Meteorology and various other collaborators in Spain, China and Turkey –** *Leroy's research* explores relationships between climate changes and vegetation, fauna, and human evolutionary dynamics using palynology as a main tool (*10 publication 97 cites)*. The high profile collaborations of the Institute have been instrumental in attracting high-quality students to the institution, many of whom have ended up working in the industries and government offices who funded the research because of the reputation the Institute has established. This sort of triangulation between science, business and policy is an area where the Institute excels leading to other research projects, informed dissertation topics and contacts being formed with other researchers in the University. The Institute is also a leader in disseminating research tools and methodologies across the globe. Mapping techniques pioneered by the Institute to illustrate impacts of pollution on UK river systems have been applied to a similar project in Australia (Jobling's research with CSIRO). Sharing of bioassays developed in collaboration with Glaxo (Routledge) with over 200 laboratories worldwide have led to a range of studies, to the considerable benefit of environmental science (publishing over 500 research papers to date; more than 70 papers in the period of assessment). A patented Virtual Fish tool (Jobling) enables visualisation of potential outcomes of pollution for fish populations using a traffic light approach. This science epitomises the Institute's sense of mission and its understanding of the global need for universal tools with which to detect threats of chemicals in the environment.

The Institute is home to some world-leading scientists (e.g. Sumpter H index 78, Kortenkamp H index 31, Jobling H index 30, and Scrimshaw H index 27). **Sumpter has won a number of awards, two since 2008:** the **2009 Toxicity Award from the Royal Society of Chemistry, and an Honorary doctorate from ETH Zurich**. **Kortenkamp** is champion in regulatory toxicology; providing scientific input to the EU process of defining criteria for the identification of endocrine disrupting substances and key member of the USA Consumer Health Advisory Panel on phthalates, currently banning phthalates in children's toys and personal care products. **Jobling and Kortenkamp** served on a working group for producing a WHO/UNEP Global Assessment of Endocrine Disrupters (2010-2012); **Jobling** is a main editor. Jobling will chair the 2014 Gordon conference on endocrine disruptors, elected in 2010, whilst Kortenkamp was chair in 2009. **Leading palynologist Leroy** (H index 18) has acted as Intergovernmental Panel on Climate Change expert reviewer, international focus group leader for The International Union for Quaternary Science (INQUA; http://www.terpro.org.ar/hazards.htm) , European Union Marie Curie evaluator, European Science Foundation Reviewer (2011-2012) and evaluator for the Romanian RAE in summer 2011 (55 Romanian universities, 20,000 researchers). Kershaw is one of the few leading experts on the paleoecology of stromatoporoid sponges. In general Institute staff take on tasks such as journal editorship, seminar series and conferences at a level appropriate to their career stage e.g. Quaternary International (Leroy), Environmental Science and Technology (Sumpter), Chemosphere (Jobling), Current Pharmaceutical Analysis (Kanda), Guest co-editor on a thematic set of papers published in Geobiology (Kershaw). Atmospheric Science Letters (Russell), Lead Guest Editor (Zeka) and Evaluator for the Portuguese Science Foundation. Five staff are members of NERC peer-review college. Lopez-Merino (H index 7, 23 publications since 2006, 151 citations) recently joined the group and will lead her own research programme through a fellowship awarded to her by the Leverhulme Trust (2013).