Introduction
As a group which I lead, based at the James Hutton Institute, Dundee and Aberdeen, working in both research and the direct delivery of forensic work to police, forensic institutions and lawyers across the UK and globally, our primary aims related to this enquiry are to: (1) advance the study and understanding of forensic soil science; (2) review, communicate and share knowledge in this area; (3) train students and fellow scientists in the skills necessary in this area; (4) disseminate knowledge and information in the area of forensic geoscience and (5) deliver a service in the Forensic Ecological and Environmental disciplines (soil science, geology, mineralogy, botany, soil and plant DNA, microbiology).

We have worked on over 150 cases in the UK and several overseas. We are an accredited laboratory (ISO17025 and ISO9001) and share in the aims of the FSR. All our work is covered by ISO9001. Most of the analytical methods we use in forensic applications are additionally accredited to ISO17025, and any exclusions are always highlighted. We are happy therefore to address this enquiry to help answer the stated questions posed from this perspective and position of skills, expertise and knowledge. Our responses are itemised below:

1. Is forensic science contributing to the delivery of justice in the UK?
1.1 Reliable Forensic Science (FS) provision is and should be fundamental to the delivery of justice in the UK and globally and it is hard to see how the Criminal Justice System (CJS) could function without forensic science (FS). Physical evidence is present in most cases. In comparison witness evidence is at times subjective and flawed by imperfect memories and compromised positions of incomplete information and is often therefore flawed or biased.

1.2 Evidence-based forensic science of physical materials most often uses quantitative, scientifically valid analysis to establish facts and the true nature of evidence. It is essential to a well-functioning CJS. However, forensic science spans a wide range of different methods and approaches for different physical and biological materials, each with their own complex nature. Forensic studies of ecological and environmental materials are essential to interpret physical evidence in both the investigative (intelligence) stage of a police enquiry and the evaluative phase (evidential), to potentially be presented in court. Forensic science is essential to the safe delivery of justice in the UK.

2. What are the current strengths and weaknesses of forensic science in support of justice?
2.1 Strengths: There are a wide range of scientifically valid and well tested methods for almost all types of physical evidence and an increasing range of methods that test smaller and smaller samples in a reliable manner. All science is/should be based on impartial theory, experimentation, observation and analysis by specialists in that sub-field, which has been tested, evaluated against context
and which should then give confidence in their evaluation/evidence. Good, reliable scientific data can give a statistically robust argument for the defense or the prosecution.

2.2 Weaknesses: Not all organisations are accredited, something the Forensic Science Regulator (FSR) is working to resolve. Accreditation gives assurance of confidence in any related datasets. There are missing reference databases; missing methods; un-reliable methods in some areas or only qualitative techniques available and evaluative methods are not consistent. More research is required in these areas.

3. What is the scientific evidence base for the use of forensic techniques in the investigation and prosecution of crimes?

3.1 There is a considerable knowledge base currently available; high quality peer reviewed publications; validated and comprehensive databases. However, more knowledge is required on issues such as transference and persistence of the wide range of potential physical materials and conditions to allow activity level interpretations to be made. In addition, data on issues such as mixtures and potential contamination of physical evidence is an inevitable consequence of people and matter interacting with each other. and increasingly advanced instrumentation and methods are proven to be able to quantify and trace the origin and amounts of trace materials in such situations.

4. How can the Criminal Justice System be equipped with robust, accurate and transparent forensic science?

4.1 There is a wide range of models for the effective delivery of forensic science depending upon the particular evidence type, ranging from being delivered from within the police to from an external specialist provider with appropriate related credentials and accreditation.

4.2 There is however a low level of funded R&D currently available in the area of forensic science. In order to further increase robustness, there should be encouragement to push for more laboratory analysis to be covered by accreditation and be based on peer reviewed published scientific papers. This requires investment also by the laboratory. Impartial and independent quality control serves the court, not the market. The duty of an expert is to serve the court, not the person who pays the fee.

4.3 The National Crime Agency (NCA) does have an Expert Advisors database, where I am registered, which provides an annual independent quality check of practitioners undertaking cases/outcomes etc. This is in addition to that assurance carried out by the individual’s Professional body (e.g. British Society of Soil Science, Geological Society, etc.). In addition, the Chartered Scientist status option is a good way of showing some of the credentials necessary to carry out the work to a certain professional standard. Also, there are excellent courses being run to train scientists in the legal process (e.g. Expert Witness training courses) in which our staff have been trained. Modification of these to improve their direct relevance has been implemented in Scotland and should be encouraged through justice/law/policing collaborations.
5. **What is the level of understanding of forensic science within the Criminal Justice System amongst lawyers, judges and juries? How can it be improved?**

5.1 In our area and experience, Forensic Geoscience, it is generally very limited. However, we have always found Barristers and lawyers very receptive and welcoming of well communicated science in an easily understood manner.

5.2 Currently there is a range of abilities in communication across the practitioners in the field of forensic geoscience (from crime scene to court). Recently PowerPoint summary presentations describing the science and results found have been welcomed by Counsel. This can be either in discussions prior to the case, at a meeting of experts, or as a submitted PowerPoint for court. Increasingly the use of multimedia is being permitted in court. Papers on communication of evidence have been produced (30-Second Forensic Science) and the publication of Primers in forensic ecology should be encouraged and financed by the courts, similar to the one produced on DNA.

6. **Is the current training available for practitioners, lawyers and the judiciary appropriate?**

6.1 There is no bespoke training available for the ecological sciences aspect of FS. This could be further developed if funds were made available. In England and Wales forensic practitioners carry out awareness training sessions for Senior Investigating Officers (SIO), Scene Examiners (SE) and Crime Scene Managers (CSM).

6.2 In Scotland this also takes place at least annually (time and resource dependent) for SIOs and SPA forensic staff, carried out by ourselves at the James Hutton Institute. If funding was made available, such courses could be more integral to the CPD of related staff.

7. **Is the current market for forensic services in England and Wales sustainable?**

7.1 There are two main commercial forensic providers practicing ecological evidence in England & Wales, Alecto Forensic Services and Cellmark Forensic Services, both with extremely high-quality standards and reputations, being legacy companies from LGC and Cellmark and to whom we at the James Hutton Institute provide many of the ecological service provisions (soil, botany, diatom investigations, etc.).

8. **Is the system of accreditation working successfully to ensure standardised results and the highest quality analysis and interpretation of significance of evidence?**

8.1 The FSR is discussing and developing a system of accreditation starting with the mainstream types of Forensic methods such as DNA. Later the FSR will consider also forensic ecology and the geosciences. However, since there are already considerable levels of accreditation for the individual laboratories carrying out Forensic geoscience, under UKAS accreditation, these ensure standardisation and delivery of high quality results.

8.2 By its very nature accreditation relies upon documented, well established, methods with significant statistically valid quality control and an established training program for the analysts. The best fit for accreditation is thus for
quantitative analysis. New methodology requires time to produce validation data and this is then examined by an external body (in the case of the UK UKAS) before it can be accredited. This can however take months and is an expensive process. Accreditation of methods and labs is an important progressive step in ensuring good and repeatable practice. Here at the James Hutton Institute and James Hutton Limited we are accredited to ISO9001 for all the work we carry out and for specific analytical methods to ISO17025. These methods can be found [here](#). All analytical methods, whether accredited or not, have strict quality control and meticulous documentation. However, areas such as application of search methodology, interpretation and evaluation of data do not have such accreditation.

9. **What role should the Forensic Science Regulator have? If the Forensic Science Regulator is to have statutory powers, what should these be?**

9.1 We believe that there is a place for the FSR to fulfill the role required under Question 4 above: this would help ensure that the same high standards be used by both prosecution and defence experts, as should be the case, to avoid wasting valuable court time.

9.2 Statutory powers would need to be carefully thought over and fully discussed with each group of expert types, especially for niche disciplines such as in the forensic geosciences.

10. **What lessons can be learned from the use of forensic science in Scotland and Northern Ireland? What can be learned from the use of forensic science overseas?**

10.1 In Scotland the “mid model” has been adopted where the SPA Forensic Services (main Forensic providers) run as a separate, but related organisation to Police Scotland. For mainstream forensic work they are called to attend the scene and provide expert or fact statements. It allows impartiality and independence of the police while allowing true integration in any forensic case strategy meetings and is highly effective and offers an integrated approach.

10.2 For Geoscience the James Hutton Institute (JHI) provides scene attendance, survey, etc. as and if required, or advice, training and bespoke analytical labs with related databases for Scotland. The JHI work closely with SPA and jointly run training courses. JHI also brings in recognised external providers (e.g. Queens University for GPR; RBGE for wood and garden plant DNA) where the expertise is not held in house. Various models exist globally but of note is ENFSI, the Netherlands with NFI and police linkages, US (various models across states) and Australia (again variable models across states) for forensic Geoscience integration with policing and the CJS.

11. **Is the 'Forensic Science Strategy' produced by the Home Office in 2016 suitable?**

11.1 This is a very helpful document. As stated at point 70, research is carried out in a wide range of locations, but due to the breadth of the forensic science disciplines this creates a complex landscape in which collaboration between organisations is vital.

12. **How should further research funding for forensic science be justified? What should be the focus of such research?**
12.1 It is suggested that there should be a dedicated funding call for evidence-based research in Forensic Science which is currently lacking. The science base has to be reproducible, able to work with varying size and quality of trace material and appropriate databases, and excellent systems of evaluation and of quality assurance have to be in place and made available. The pursuit of justice is limited at times by not having enough resources to carry out bespoke case relevant research. Reduced time and costs will be possible through the development of improved search models.

12.2 More work is required to enable the testing and use of new enabling technologies; to fill the gaps in knowledge of variation; to build better and more case relevant reference databases; to enable smaller sample sizes to be considered and to deliver robust evaluation of the often complex datasets, including spatial data.

13. Where are the gaps in research and understanding of forensic science? How and by whom should the research questions be articulated to fill these gaps?

13.1 The variability of soils and sediments (databases) and the lack of a dedicated research council, or dedicated place within the research councils for FS (soils in NERC, materials analysis/geophysics in EPSRC, psychology/behavioral analysis in AHRC) are areas which could be populated. Now with the RCUK combined funding source, there may be an opportunity to provide an integrated bespoke call for the forensic sciences. The EPSRC did provide this for a short time, with the ‘Think Crime’ funding call initiative, when the SoilFit and GIMI projects were run and led by ourselves at the James Hutton Institute in partnership with the NCA and the then FSS. Based on this period of dedicated geoscience bespoke research, the Macaulay/James Hutton Institutes were then able to accelerate and strengthen the soil forensic science base and helped raise awareness across the CJS as to what Forensic Geoscience/ Ecology can and cannot deliver. The outcome is that we now have well-resourced, integrated, accredited and dedicated (dedicated forensic labs used only for case work) labs that carry out analytical Geoscience/Ecology FS in the UK. This has only been possible as a result of the ability to utilise match funding and long term strategic funding of research and construction of relevant databases from Scottish Government related projects. Prior to this time much of the Geoscience work was ad hoc and lacked quality standards. After this period UCL have also been successful in securing funds from EPSRC for their SECRET projects, training post-doctoral students in the wider forensic sciences including evaluation and interpretation. More dedicated research funding for forensic science would secure the staff and platform for the range of forensic sciences across the UK.

14. How can a culture of innovation in forensic science be developed and sustained?

14.1 A culture of innovation in forensic science can be further developed by ensuring forensic services and Research institutions have R&D funds and capacity to keep on innovating; ensuring R&D funds encourage research institutions to develop new approaches, evidenced-based research, ranging from long-term and focused controlled, targeted experimentation, to communicating results of search (both successes/failures) to inform future search/improved research capacities. This is being undertaken by some researchers in UK Universities and research institutes but is currently piecemeal by a lack of funding to allow integration. This
area of research requires a considerable amount of investment. For forensic geology to become sustainable this requires considerable investment in research, training, teaching, communication, professionalisation and appropriate regulation and accreditation.

15. Are there current or anticipated skills gaps? Who should have responsibility for and/or Have oversight of training?
15.1 In our area, there is a lack of eager minds entering forensic ecological disciplines. They can carry out related projects as part of BSc/MSc studies, but obtaining PhD or Post Doctorate level funding remains challenging. There should be training set up for both Police Force personnel, young researchers and the judiciary. For Police Force personnel, it could be undertaken as part of the NCA training programme. For the judiciary, secondments could be considered as a way to share knowledge and improve approaches. There will be different models most suitable for the range of forensic disciplines. Consideration as to how this is overseen by the FSR requires much consideration.

16. Are there gaps in the current evidence base for digital evidence detection, recovery, integrity, storage and interpretation? No comment.

17. Is enough being done to prepare for the increasing role that digital forensics will have in the future? Does the Criminal Justice System have the capacity to deal with the increased evidence load that digital forensics generates? No comment.

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