SBRI End of Phase Report Form

This report is the company's opportunity to describe the work undertaken during the contract. Describe what work was completed during the project and why this was important. If the work was part of a two phased programme this report will form part of the assessment for Phase 2, it is therefore important that applicants complete the form as completely as possible.

This report must be submitted within 14 days of the completion, or termination, date. The successful contractor should be well motivated to complete this report as completion of this report forms part of the contract.

The report should be submitted to Defra's Climate Ready team at Nobel House, 17 Smith Square, Westminster, SW1P 3JR.

The objectives of reporting:

- to report on the work undertaken, its success in meeting the project's agreed objectives and to provide information on the work so that this can be used in the assessment of further applications (if required and appropriate);
- to explain and prove expenditure; and,
- also provides the company with a comprehensive report to share with stakeholders and those that may help further commercialisation.

The report should be completed by the lead contractor, with input from any sub-contractors or project partners as appropriate. Please answer, wherever possible, on behalf of the business units, divisions, or companies which were involved in the work. If this is not possible (as a result of merger or acquisition, for example), please specify the organisation to which your answers refer.

Please answer the questions in the spaces provided. Try to answer fully, but keep your answers succinct and no longer than necessary to clearly explain them. When describing technical solutions, please regard your audience as being someone familiar with the technology, but not an expert. The report may be done in narrative alone, however diagrams or pictures may be added where these aid clarity within the restriction on the page limit of a total of eight sides of A4.

Because the true impact of an R&D project often takes several years to emerge, Defra or the Technology Strategy Board may approach you for up to six years after project completion to follow up on the questions in this report. Your co-operation with any such follow up work is greatly valued.

1. Details

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Project Reference: SBRI	Infrastructure/ built environment climate resilient sector designs
Report Type:	Final Report
Total Contract Cost: (£s)	59,625

Start Date: 23/12/13 End Date: 31/03/14

2. At the outset of this piece of work what were your aims and objectives?

At the outset of this project the aim was to develop a Sustainable Drainage Systems (SuDS) Retrofit Feasibility Tool will facilitate the rapid assessment of where these SuDS techniques are appropriate and which of the techniques could be used.

The key aspects of the tool were intended to be as follows:

- Identification of areas where SuDS retrofit will be justified and the impact of installing the measures.
- Identifying which types of SUDS are most appropriate to the areas identified.
- Guidance on the implementation of appropriate retrofit SuDS measures.
- Use of an innovative visual user interface and illustrative reporting outputs.

The software based tool would enable those responsible for management of surface water flood risk and drainage provision such as local authorities, water companies, major landowners, developers and infrastructure owner to evaluate where retrofit SuDS could be implemented to increase resilience of the urban environment.

The tool would enable a rapid high level assessment of where it is most appropriate to pursue the implementation of retrofit SuDS through the use of spatial data analysis techniques. The key inputs would be spatial data for land-use and land-cover, topographic data, surface water flood risk mapping, available information on known water pollution vulnerability issues, geology and environmental data.

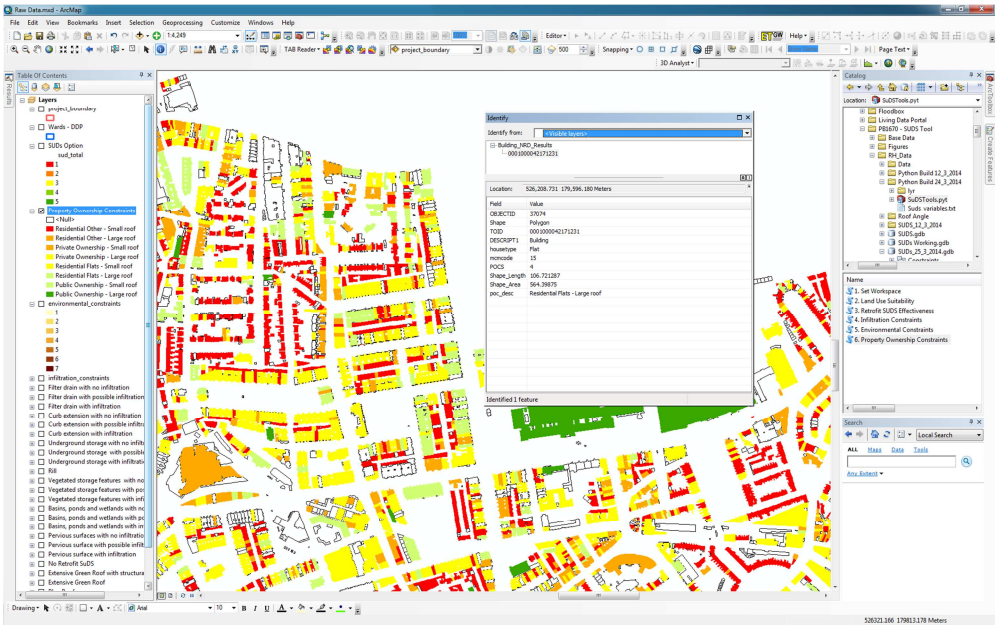
3. Please provide a summary of the outputs of this project and relate these to the original objectives. How do the outputs address the requirements of this competition?

A comprehensive review of the available datasets that the tool could possibly use has been undertaken. The aim here has been to ensure that we develop a tool which uses readily available data that is produced in a consistent format at a national scale. This will enable the tool to be easily applied to any location. Local datasets that are not available at a national scale have not been formally included within the scope of the tool. It is intended that these would be used to validate and improve the initial outputs and results of the tool. The tool provides guidance on how this may be done, however the tool has been designed so that it is not too prescriptive. This will encourage best use of local datasets to improve the quality of the analysis.

Discussions and consultation has been undertaken with SuDS industry practitioners and the academic community to gain their opinion on the scope of the tool and ensure buy-in. This included a workshop held on the 6th February 2014 to present the initial structure of the tool and test the tool philosophy. It led to some refinement to our tool structure and gave additional ideas for datasets that could be used to establish the feasibility for retrofit SuDS. Through these discussions we received wide support for the tool with many potential users seeing the potential of its application.

Following the workshop the tool structure has been finalised and an initial pilot study using the Royal Borough of Kensington and Chelsea was undertaken. This has confirmed that the structure and methodology is appropriate.

Following this the theoretical tool has been translated into a tool developed in the ARC GIS software environment. This automates the data analysis processes and enables the user to rapidly undertake an initial retrofit SuDS feasibility assessment. Once again this version of the tool has been piloted using the Royal Borough of Kensington and Chelsea as a study site. A screen shot showing an example result from the tool is shown below:



4. Describe any changes to the original project. What was the reason for these changes? Please include any circumstances that aided or impeded the progress of the project and the actions taken to overcome them.

The tool has largely been developed in line with the overall vision presented in our proposal. The exact scope of the datasets being used and how these are being analysed has evolved as the tool has been developed, with any opportunities for use of additional datasets taken where appropriate.

The main constraint on progress has been access to spatial datasets. We have been supported in development of our tool by the Royal Borough of Kensington and Chelsea and Thames Water and they have both been very helpful in sourcing data. However this has taken time as the relevant license agreements need to be complete before data is released and with the tight timescales of this commission this has been a challenge.

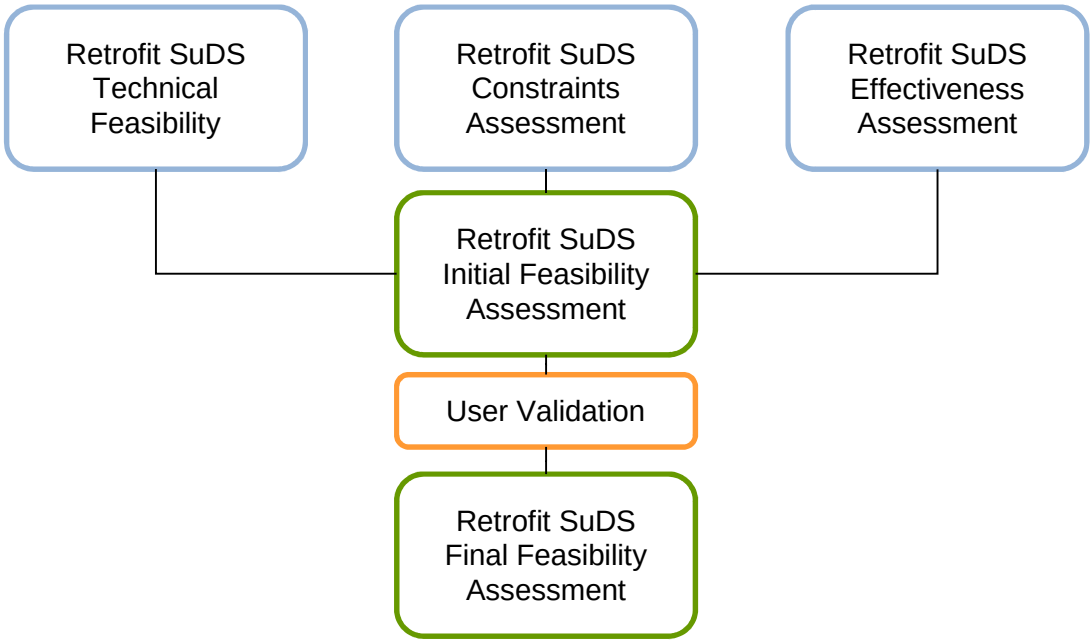
A key dataset that we had significant challenges to obtain was a digital surface model showing the elevation of structures that we planned to use to analyse roof slopes. We used our contacts within the Environment Agency to progress this and we finally received this dataset following approval of the licence agreement by Defra on 20th February 2014. The same has been the case for Water Framework Directive data, which has been supplied directly by Defra. Use of both of these datasets has significantly improved the quality of the tool we have produced, and the effort taken to acquire them has been fully justified.

Beyond these issues with availability of data to test the tool, progress has been good and we have been able to produce a completed first version of the automated tool in line with our initial programme by 31st March 2014. We are currently refining the specifics of the tool so that it is ready to be marketed to other potential users following this project.

5. Please provide a short factual summary of the most significant outcomes of your work.

The main outcomes of the work are as follows:

- Development of tool structure and methodology following review of literature and guidance, and consultation with industry experts. The flow chart below shows the final structure of the tool.



- Presentation and user testing of our initial tool structure at workshop on 6th February 2014.
- Initial piloting of tool using data for the Royal Borough of Kensington and Chelsea.
- Development of an automated version of the tool for use in the ARC GIS software environment to enable rapid assessment of retrofit SuDS feasibility.
- Final piloting of the automated tool using data for the Royal Borough of Kensington and Chelsea. Example outputs from this piloting are included as an appendix to this report.

6. Describe the innovative aspects of the work including any new findings or techniques.

The key aspects of the tool which are new and innovative are outlined below. These aspects of the tool are unique and have not been included in other tools that have been developed for similar purposes:

- Analysis of road width to assess the suitability of a road for curb extension SuDS retrofit measures.
- Analysis of property type data to assess the constraint upon SuDS retrofit measures due to differences in property ownership
- Analysis of roof slope for green roof suitability analysis using LiDAR Digital Surface Model data.
- Analysis of WFD waterbody assessment data to indicate areas where water quality improvements could be achieved through retrofit SuDS

7. Please give a description of how funds were spent with reference to the original budget and explain any significant variations.

The funds have largely been spent in accordance with our budget. For development of the automated version of the tool we have used specialist resources within Royal HaskoningDHV from the Netherland and India to complement our UK based expertise. This has significantly improved the quality of the tool that we have been able to produce.

Although we had originally intended to use data that is freely available to local authorities we have chosen to purchase one dataset under licence for our pilot area in the Royal Borough of Kensington and Chelsea. This is the British Geological Survey's Infiltration SuDS Map, which is only available on a commercial basis. This gives the best information on the ability of the ground to allow infiltration and it is felt by our project team that this data is the best available for the tool to use. The cost of this data was £400.

8. Describe any potential long-term collaborations/partnerships entered into. Please list the company and the role they played in the project.

We have not entered into any formal long term collaborations or partnerships. However through development of the tool we have been able to engage with both the professional and academic SuDS communities. This has improved our reputation in this area and enabled us to make connections with potential clients and partners for future work beyond this tool.

This project has enabled us develop working relationships with academia who are active in SuDS and their research programmes. These include the following:

- Professor Colin Thorne, University of Nottingham – Lead for the EPSRC Funded research project "Delivering and evaluating multiple flood risk benefits in blue-green cities"
- Professor Richard Ashley, University of Sheffield
- Dr Christophe Viavattene, Flood Hazard research Centre, Middlesex University
- Dr Scott Arthur, Heriot-Watt University,

We will continue with the knowledge interchange and close working with these universities as part of future development and use of the developed tool.

9. Please describe how your company has gained from this project. What new business opportunities have been created? Do you expect your company to grow as a result of this project?

It has enabled us to combine expertise from various parts of our company to develop a tool which has the potential to help with adaptation to climate change. Through this we are able to deliver our mission statement **Enhancing Society Together**.

This project has enabled Royal HaskoningDHV to raise our profile with regards to retrofit sustainable drainage with prospective clients and well as open up the opportunity for them to commission us to use the tool once it is complete on their area. This will primarily be local authorities looking to reduce surface water flood risk issues and water companies looking to reduce the strain on their surface water and combined sewer systems, and reduce pollutions caused by CSO spills.

As a result of this project, we are now able to broaden Royal HaskoningDHV's offer within the area of climate change adaptation and developing water sensitive communities. Ultimately we expect this to improve our growth in this sector and help us enhance society together with our clients and communities in the UK. We also plan to export this UK developed product internationally thereby enhancing the status of Royal HaskoningDHV and the UK as leaders in this area.

10. Describe the potential for exploiting the work. Please identify any new IP which has been filed or for which filing is anticipated.

Following completion of the SuDS retrofit tool we will market its application as a Royal HaskiningDHV service to existing and new clients. As outlined in our tender we would expect this to be water companies and local authorities.

We will be promoting the outcomes of the research project and tool development through offers of journal papers and presentations at major conferences and publications to increase awareness of the outputs within scientific and user communities.

11. Please insert additional information that may be pertinent. This may be in the form of text, pictures, diagrams, data, graphs that support the work.

Please see attached as an appendix to this report sample outputs from the tool.

- Environment Constraints – shows the results of the Environment Constraints scoring analysis. Higher values indicate greater numbers of constraints and constraints of greater importance that will make it harder to implement retrofit SuDS. These include historic environmental designations and natural environment designations.
- Infiltration Constraints – shows the results of the Infiltration Constraints scoring analysis. Higher values indicate areas where infiltration SuDS will be harder to implement.
- Property Ownership Constraints - shows the results of the Property Ownership Constraints scoring analysis. Ed properties are considered less suitable than green properties for retrofit SuDS.
- Effectiveness - shows the results of the Effectiveness scoring analysis. Higher scores indicate greater potential benefit through impacts on flood risk and water quality.
- SuDS Opportunities – shows the total number of SuDS types that could be potentially be implemented at any one location.
- Constraints and Effectiveness – Abingdon – shows a zoomed in summary of the four constraints and effectiveness outputs for an electoral ward.
- SuDS Opportunities – Abingdon – shows a zoomed in summary of the SuDS Opportunities output for an electoral ward.