Case Study

July 2012

elios 2 European Liability Insurance Organisation Schemes

NHBC

8. Rainwater Harvesting

incl. Catchment Basins and Grey Water Re-cycling

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8.1 Introduction to the technology

This case study covers both rainwater and grey water technologies in new build.

The main drivers behind the take up of these technologies are that there are changes in water costs, demand and supply of water (both for drinking and other domestic uses). There is an increasing demand for water.

- As population grows, and more properties are built.
- Individually, where there is increasing demand for water, for gardens, car washing and in the home for more showers, baths, washing machine and dish washers.

There is also a fear that rainwater patterns will alter due to climate change. Examples of these changes are the lower rainfall on Iberia in recent years and in the UK during 2010 and 2011. This will also increase water demand. Equally there may be heavier periods of rain, as on record in the UK in 2012. This requires management of excess water.

The increased demand for water requires more infrastructure to supply potable (i.e. drinkable, safe), water. This may be expensive and is provided centrally. By encouraging local conservation and recycling, the high costs of new reservoirs, pipelines and sewage systems for removal may be avoided.

Rainwater and grey water systems can help reduce the need for major infrastructure, manage demand and may help smooth out demand and supply.

At an installation or site level, rainwater harvesting (RWH) consists of taking rainwater from local catchment, e.g. house and garage roofs and car parks. This water can be used in the garden and for many purposes inside the house for services that do not require potable water, such as toilets and even (if cleaned further) washing machines.

Grey water recycling consists of taking waste water from rooms within a property such as bathrooms (sinks, baths and showers but not toilets) or kitchens (dishwaters, washing

machines, sinks) and re-using this water either inside the property, (e.g. in toilets) or outside on the garden or for washing the car.

In agricultural systems, rainwater may be used for animal water and crop irrigation. In industrial settings, both systems can be used for toilet flushing, cleaning and other processes once cleaned and purified as needed.

The number of installed systems is currently limited in the UK, though there is a market for both grey water and RWH systems in new build. They may also be retrofitted, although the market is still small. In Germany studies undertaken in 2009 showed that about 65,000 systems were installed that year, with over 100,000 across Europe.

8.2 Available types of this technology

There are seen to be three scales of rainwater harvesting (RWH) system:

- Local measures
- District measure
- Regional measures

This case study focuses on local measures only.

There are many varieties of systems. The simplest RWH systems consist of a tank on a down-pipe. The more complex can include some or all of the following components:

- Harvesting – from patios, roofs, internal drains, etc.
- Filtering – to remove certain objects that would cause blockage or decay.
- Storage - both a large tank and internal smaller tanks to feed parts of the house.
- Re-distribution - of the recycled water through the property.

Both rainwater and grey water harvesting systems fall into three main categories:

- Non-pressurised: where water is gravity fed, via a header tank, to its point of use.
- Pressurised: where the water is pumped directly from the storage tank to the point of use.
- Combination: which combines elements of both pressurised and non-pressurised systems by using an internal control unit to supply boosted water on demand to points of use. Units sometimes integrate a means of safely topping up with mains water.

For grey water harvesting, the relevant rooms in a property need separate water collection systems and the grey water is then fed into tanks.

Both grey water and rainwater require filtering and additionally UV filtering for more sterile water. For rainwater it may just be sufficient to have leaf guards - but usually also a particle filter at the entrance to the tank. Filters typically need cleaning or replacing every 3 months. There may need to be a calming inlet to minimise disturbance by the inflow into the storage tank, or by entering the inflow at the bottom of the tank, stagnation may be avoided. Systems must also have an overflow for times of heavy rain, and top-up from mains supply for when there is a shortage of rain/grey water. There must also be suitable valves to avoid backflow and cross-contamination.

Finally there must be a system to re-distribute the water back into the house or property. Some systems use PV for powering pumps, and some may need a computer based control system to manage water levels.

The simplest rainwater irrigation systems can be self-installed by a householder and can cost less than £50 (with no running costs). The price of a more complex RWH system for a

new-build house with an 80m2 roof ranges from £1,500 to £3,000 per unit (plus installation costs). It has been estimated that a grey water recycling system would add £5,000 to £6,000 onto the build cost of a new property.

Systems are claimed to save up to 50% of water consumption and sewerage costs. Grey water installers claim that their systems can use 40% less energy than using mains water.

8.3 Strengths, weaknesses, opportunities and threats

This section outlines a discussion of the key drivers effecting rainwater harvesting and grey water systems.

Strengths

- Increases the sustainability of a property.
- Established technology
- Low running costs after initial installation.
- Can reduce the cost of district or regional infrastructure for a new build estates or towns.
- Recycled water is likely to be "softer", i.e. have a lower mineral content.
- Recycled rainwater does not contain chlorine, so for gardens is less polluting.

Weaknesses

- Blocking due to poor maintenance of filters.
- Relatively high capital investment for retrofitting.
- Risk of environmental damage (frost, roots, etc.) , especially to tanks.
- Pumped systems can be noisy.
- Restricted to non-potable applications in small, household systems due to cost.

Opportunities

- Increased number of households and a growing population.
- Some EU member states (including the UK) are classified as having insufficient water for the current population.
- Changing water/rainfall patterns causing hosepipe bans.
- There is arguably a change in some rain patterns, with heavier bursts of rain. Local catchment can help to alleviate flooding by retaining rain water for some time.
- Costs are reducing and the number of experienced designers and installers is increasing, especially for new builds.

Threats

- Slight risk of contamination of potable water or recycled water if systems are badly maintained.
- Rainwater can contain a range of pollutants, from bird faeces, lichen, dust, pesticides and dissolved gases. In extremis this may include low-level radioactive waste.
- Water rights – for example, in Colorado, USA, water harvesting is seen as stealing water from other residents.

8.4 Building pathology, defects, and what can go wrong

8.4.1 Invitations to complete questionnaire

An invitation to complete the online version of the Elios II questionnaire was sent to 374 individuals in the following industry sectors:

TABLE 8.1 – Invitations to complete questionnaire

Sector	*Number sent*
Insurance	64
Certification Bodies	10
Accreditation Organisations	4
Builders/Installers	55
Manufacturers	74
Trade Associations	27
Professional Institutes	19
Architects	14
Quantity Surveyors	2
Other	4
Building Inspection Services	13
Government Organisation	22
Housing Associations/Commissioner	16
Consultancies	15
Merchant/retailer	5
Unknown	30
Total	374

In total 70 respondents completed some or all of the questionnaire. This is an 18% response rate.

8.4.2 Responses received

At the closing date of 1st October 2012, 11 responses had been received which related specifically to rainwater harvesting, including catchment basins and grey water re-cycling. This is 16% of the received questionnaires. The industry sectors of the respondents, as defined by the recipients, were as follows:

TABLE 8.2 – Responses

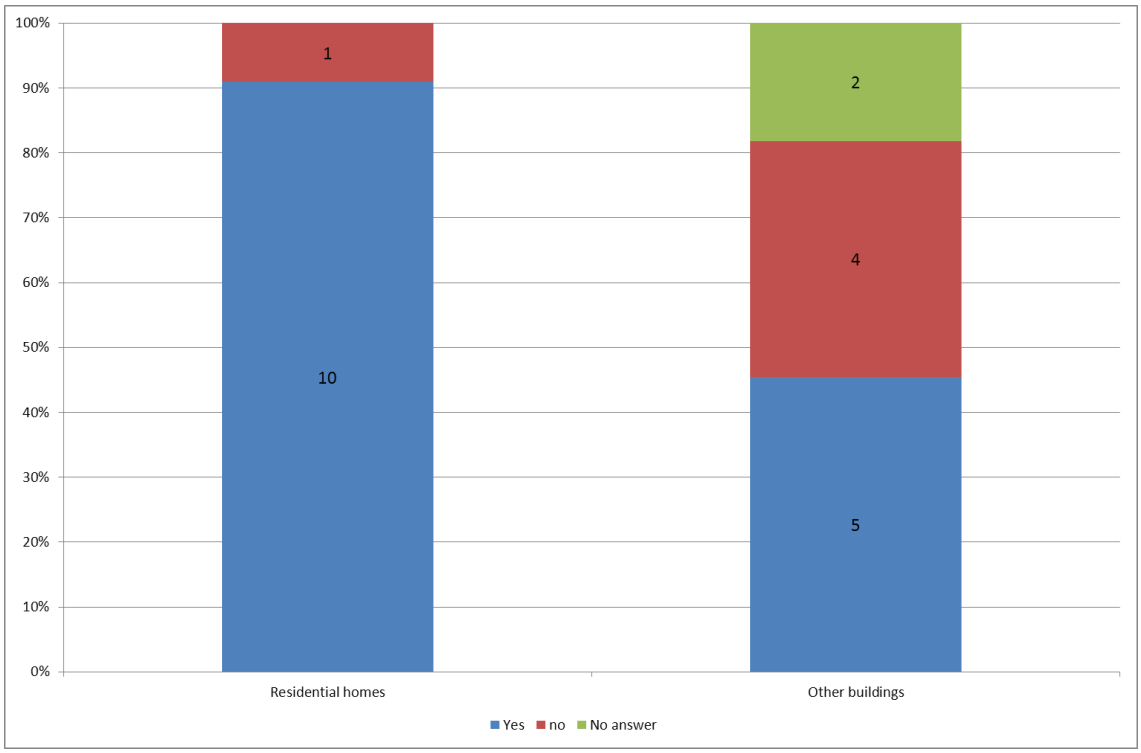
Sector	***Responses received***
Government organisation	1
Architectural practice	0
Housing organisation/Commissioner	4
Manufacturer	1
Retailer/merchant	1
Construction company	3
Installer	0
Building inspection service	1
Certification organisation	1
Insurance company	3
Trade association	0
Professional institution	0
Other (please specify)	1
Business in more than one	3
Total	***15***

Note that some businesses are in more than one sector. The respondents collectively claimed to have data relating to 183 installations of the technology, of which 13 (7%) were said to have experienced failures or defects.

The following graphs and charts only relate to the people who responded about this technology.

CHART 8.3

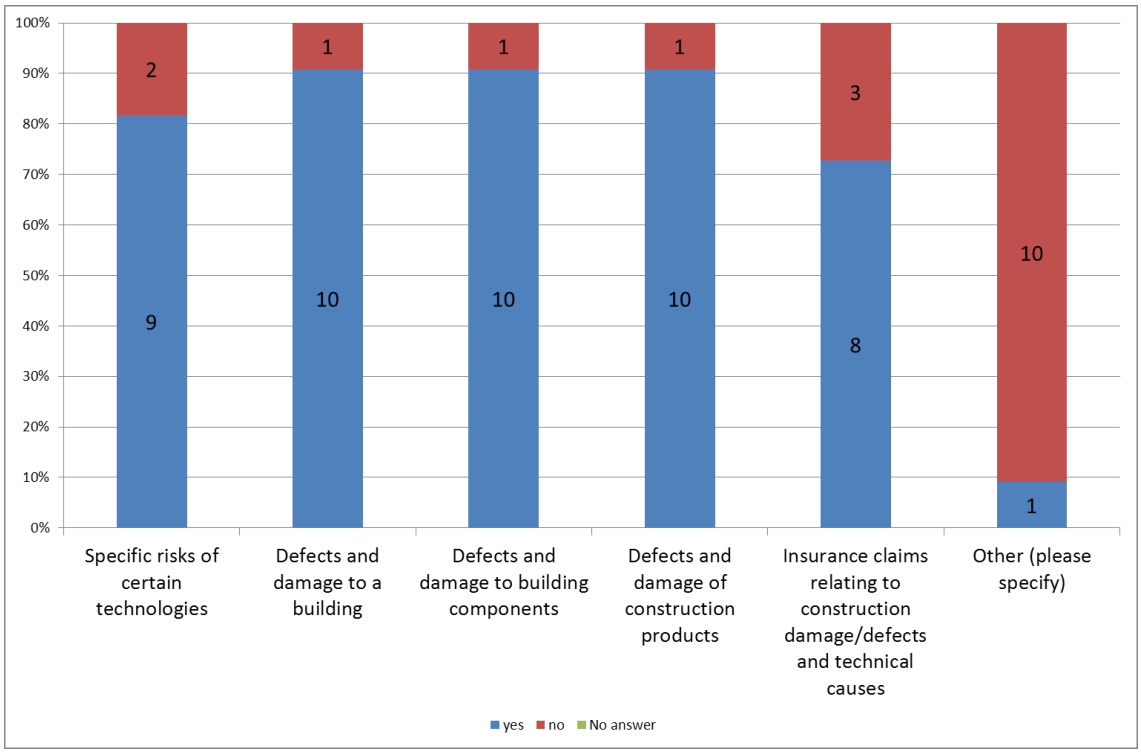
Question asked – *"Does your organisation collect or collate its own data on these types of buildings?"*



This chart shows the number of reporting organisations that collect data on each type of property. This is only for this eco-technology. Organisations may collect data on more than one type of property.

CHART 8.4

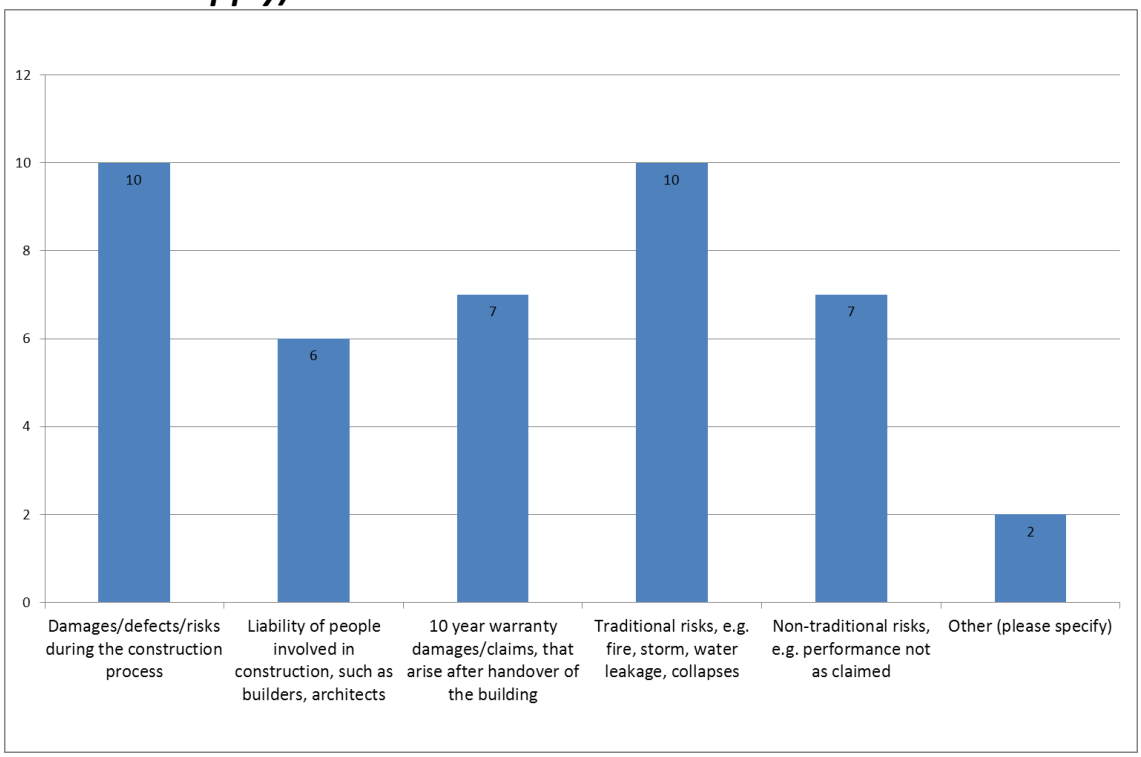
Question asked –*"Does your organisation collect its own data on these issues (please tick all that apply)?"*



This chart shows the various reasons that the reporting organisations collect data, and the number of organisations that gave each reason. This is only for this eco-technology, and not for all 10 technologies. Organisations may collect data for more than one reason.

CHART 8.5

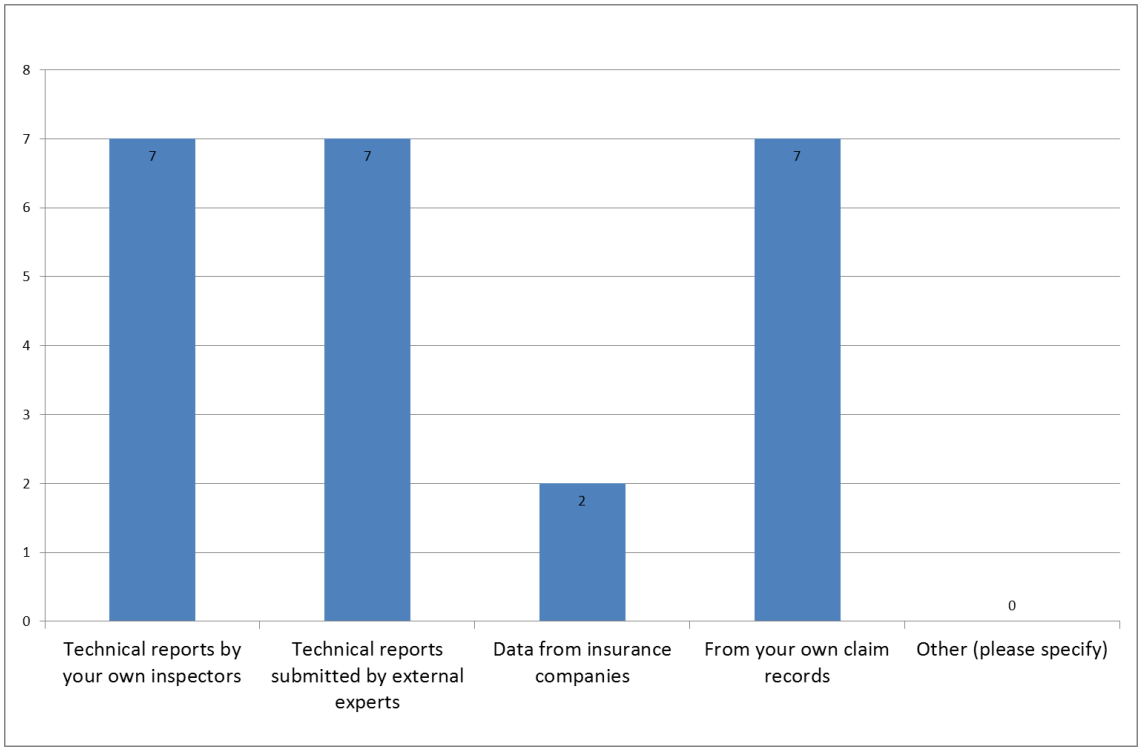
Question asked – *"What kind of damages/defects do the data refer to (please tick all that apply)?"*



This chart shows the number of organisations that reported each kind of damage on which they collect data. Each column represents a different type of damage. This is only for this specific eco-technology, not overall. Organisations may collect data for more than one reason.

CHART 8.6

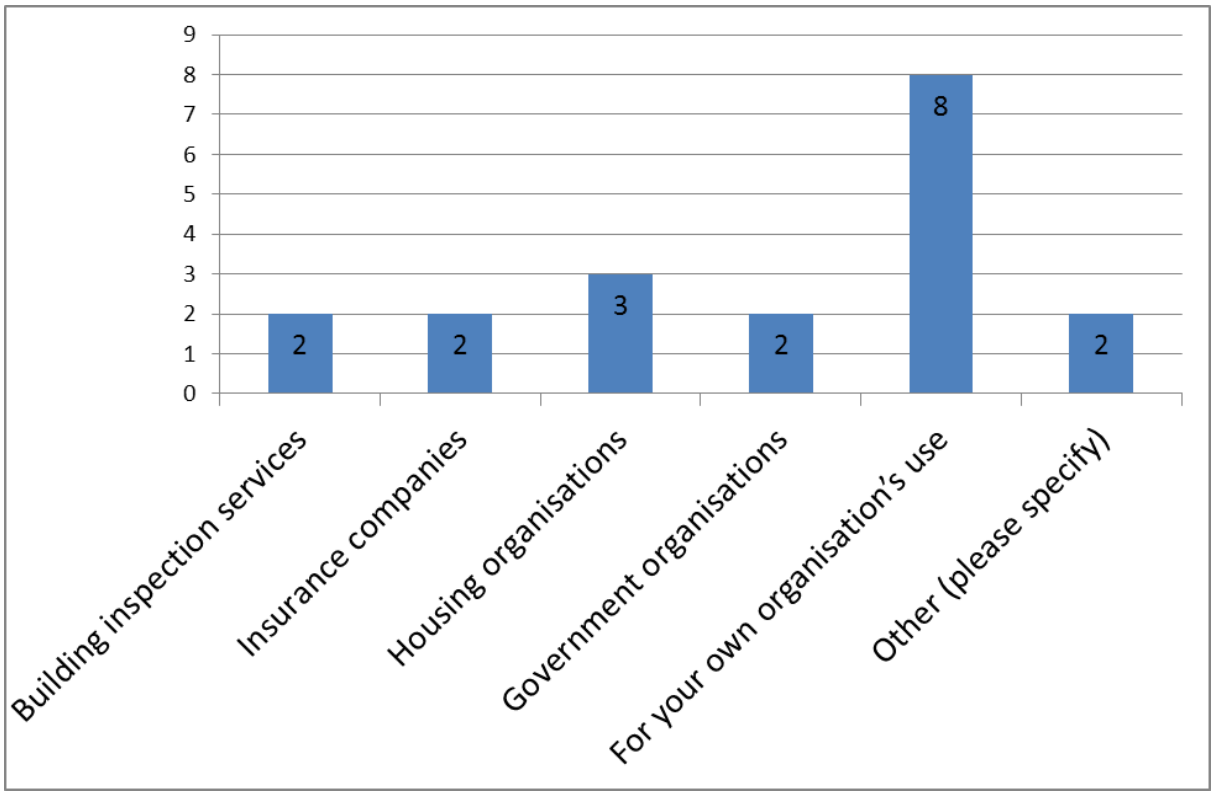
Question asked – *"How do you collect the data (please tick all that apply) ?"*



This chart shows the method by which each organisation collects data; each column represents a different method of data collection. This is only for this eco-technology, not overall. Organisations may collect data for more than one reason.

CHART 8.7

Question asked "*For whom do you collect the data (please tick all that apply)?*"



This chart shows the number and type of organisations that reported that they collect data about this eco-technology. Organisations may collect data for more than one type of organisation.

8.4.3 Summary of responses about databases

These statistics relate to people who responded about this technology.

About their database:

- 5 have a database, 1 did not respond;
- 4 provided a date when data collection started
  - the earliest in 1967
  - 1 in 2007
  - 2 in 1990
- 6 carry out statistical analysis of the data;

About data publication:

- 3 make data available on the web;
  None in newsletters;
- 2 in other publications;

About the availability of data, of these 9 respondents:

- 4 publish summary data only;
- 1 publish raw data;
- None publish raw data, even anonymously;

Two comments were passed, as follows:

- "Where we have research projects funded by third parties, there is often a requirement to disseminate findings, under controlled know-how and IP, with commercially sensitive information removed."
- "Only the results of research work."

Finally, note that this question was answered in general about all 10 eco-technologies and may not apply to the specific technology.

8.4.4 Reasons for failures and defects

The reported reasons for the failures and defects were as follows:

TABLE 8.8

Reason for failure/defect	Number	% of total
Requirement management		
Change in client's requirements	0	0.00%
Misunderstanding of the effectiveness of the technology	0	0.00%
Poor project management	2	1.09%
Inaccurate engineering or architectural data	0	0.00%
Delivery		
Late delivery	0	0.0%
Storage issues	0	0.0%
Awkward packaging	0	0.0%
Poor transport of product	0	0.0%
Installation		
Incorrect design for installation	2	1.09%
Incorrect installation documentation	0	0.00%
Failure in installation	1	0.55%
Commissioning failure	0	0.00%
Operational failure		
Product failure once installed	12	6.56%
Incorrect user documentation	0	0.0%
Misuse of product by end-user	0	0.0%
Performance not as claimed	0	0.0%
Other		
No other reasons were given for failure		
Total		

Note that an installation may have had more than one reason to fail.

8.4.5 Failures/defects commentary

The respondents offered the following general comments and suggestions on the ways in which the failures and defects might be avoided in future:

TABLE 8.9

Reason for failure/defect	Commentary
Requirement management	
Change in client's requirements	Changes during the design or execution phase, which could lead to inconvenience for the house buyers. For example a water chute that drains on open terrain.
Misunderstanding of the effectiveness of the technology	
Poor project management	
Inaccurate engineering or architectural data	
Delivery	
Late delivery	
Storage issues	
Awkward packaging	
Poor transport of product	

Installation	
Incorrect design for installation	Perhaps a not well thought or worked out design, which could lead to disadvantages for the end user. Where possible all systems should utilise a header tank with an auto-mains-refill to ensure water is still available during a power outage.
Incorrect installation documentation	
Failure in installation	
Commissioning failure	
Operational failure	
Product failure once installed	In the sense of ignorance and nuisance for house buyers. Pump failure, external pipework freezing due to inadequate insulation. Leak at monitoring meter.
Incorrect user documentation	
Misuse of product by end-user	Filter cleaning not picked up by maintenance teams.
Performance not as claimed	
Other (specified)	

Other comments included:

- A series of post-completion issues, mainly around poor performance of submersible pumps, dirty filters etc. The cost of installation far exceeded the financial benefits accruing to the household. SYHA will not be providing RWH on future schemes unless required to by Code for Sustainable Homes or Planning requirements.
- We have used the ECO-Play grey water recycling system. This seems to work reasonably well but cost is a real concern and not viable for the benefit being gained in water consumption. We feel restricting water use in the home is a negative thing and the messaging of re using grey water unclear when used on new homes. Seems ok for commercial applications. Water reduction is not a driver in new homes. However each development site has a SUDS design and often uses water mitigation and retention measures. The use of rainwater butts is commonplace and generally seen as a positive attribute.

- We are very concerned about RWH, the risks to occupants associated with stored water, the costs and the fact that consumers fail to limit or restrict their water use.

8.4.6 Key findings

In summary:

- There were no significant numerical counts of causes of failure beyond what one might expect for typical building projects.
- Product failure was most commonly cited as a cause of failure, for example pumps.
- There is a concern about maintenance due to poor maintenance of filters.
- No further detail was given about product failure in this survey.

Lessons:

- Further research might be carried out to identify the reasons for product failure – whether this is due to installation, filtering or other issues such as tree roots, etc.