A Laboratory Study into a Novel, Retrofittable Rainwater Harvesting (RWH) System

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Summary

1. **RWH for UK houses**
2. **Laboratory assessment**
3. **Results**
4. **Discussion**

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Threat or Resource?

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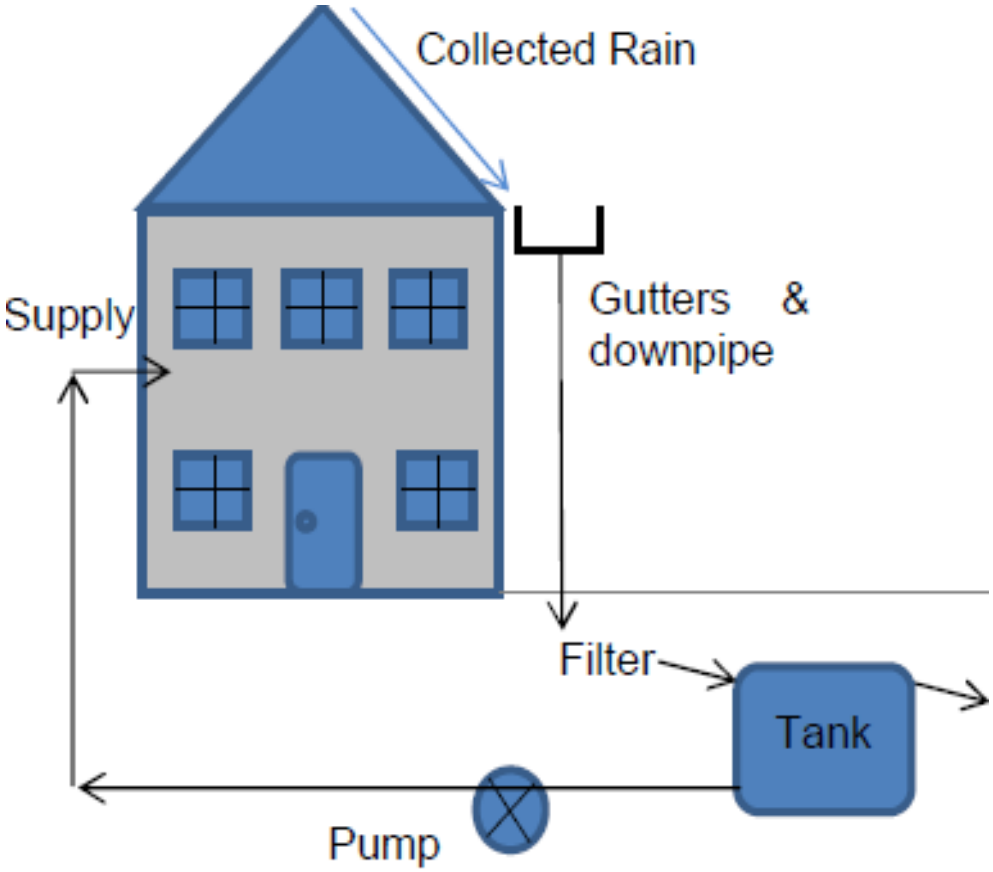
RWH for UK houses



Existing residential RWH has long payback periods. TOTEX and OPEX is high (Roebuck, 2012).

Retrofit costs are high ~£5k?

High energy use?

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Literature Review: FlushRain

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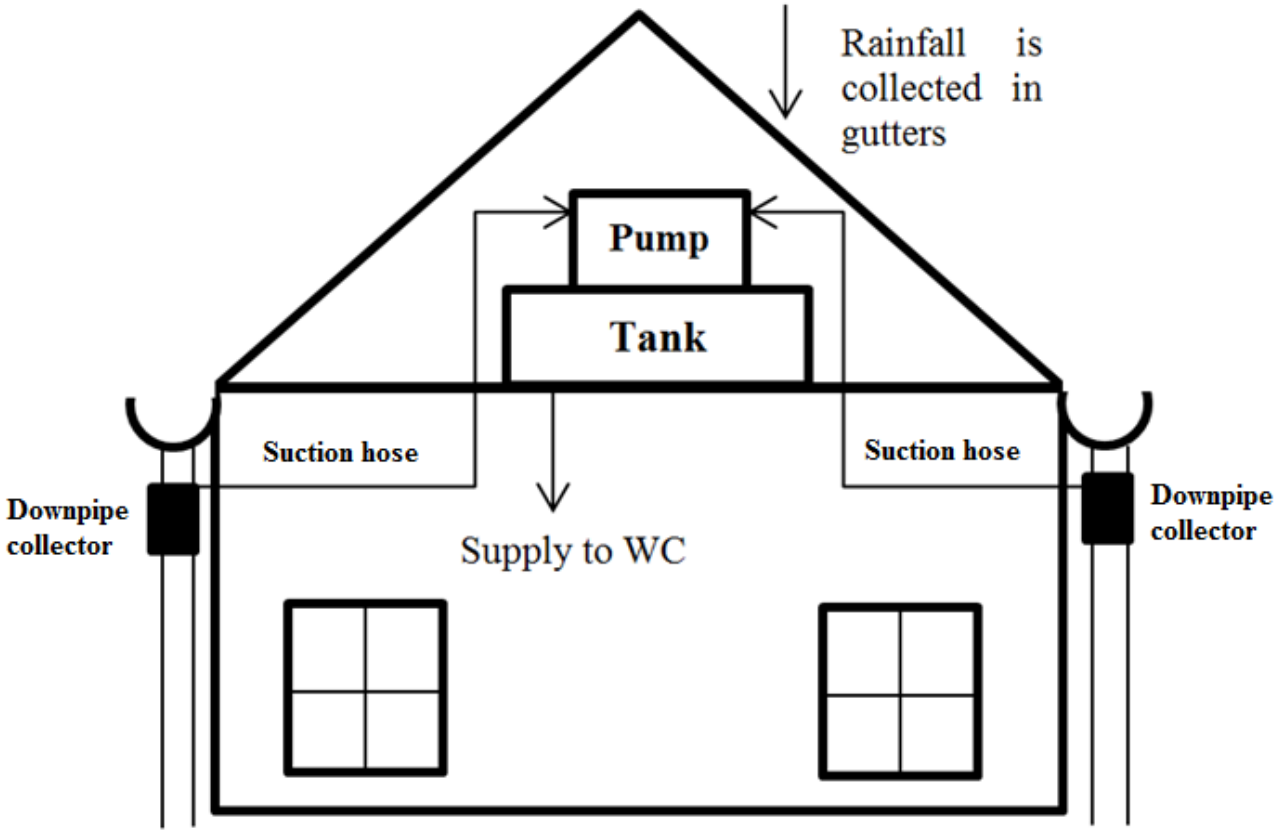
Retrofittable RWH: FlushRain



~£1k installed

Small tanks = less benefit?

Low energy use?

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Retrofittable RWH with low energy use:

The Energy Efficiency Driver

Environment Agency

and are typically more energy and carbon intensive than alternative water supply and efficiency measures.

The use of rainwater harvesting systems

..... in some circumstances, rainwater harvesting systems can be expensive and have long pay-back periods. Systems with a small tank, installed in high density, urban areas (such as single domestic systems) can be costly and the volume of rainwater collected and used can be low. They also require ongoing maintenance in order to maintain effectiveness and are typically more energy and carbon intensive than alternative water supply and efficiency measures.

Research Questions

RQ1) Can the system function with either one or two downpipes connected?

RQ2) How does the system function when static head is increased?

RQ3) What is the electricity consumption of the system in comparison with alternative RWH systems and municipal supplies?

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Laboratory Test Rig 1

Assess Head-flow relationships

- System can be operated at a range of different heads with 1 or two collectors.
- Water collected in a vessel and mass/unit time used for flow rate.

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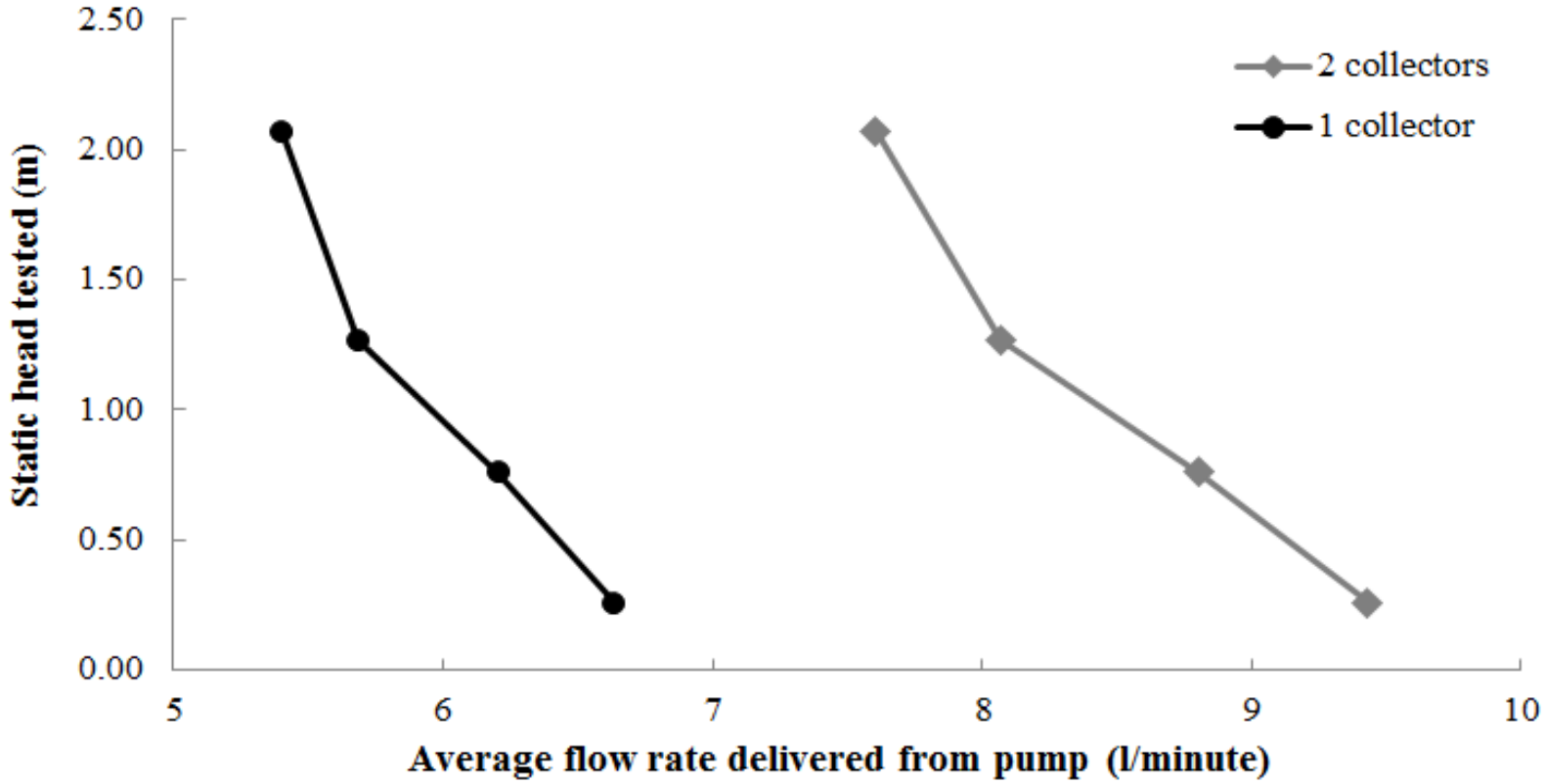
Laboratory Test Rig 1 - Results

Assess Head-flow relationships



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Laboratory Test Rig 2

Assess Electrical Consumption

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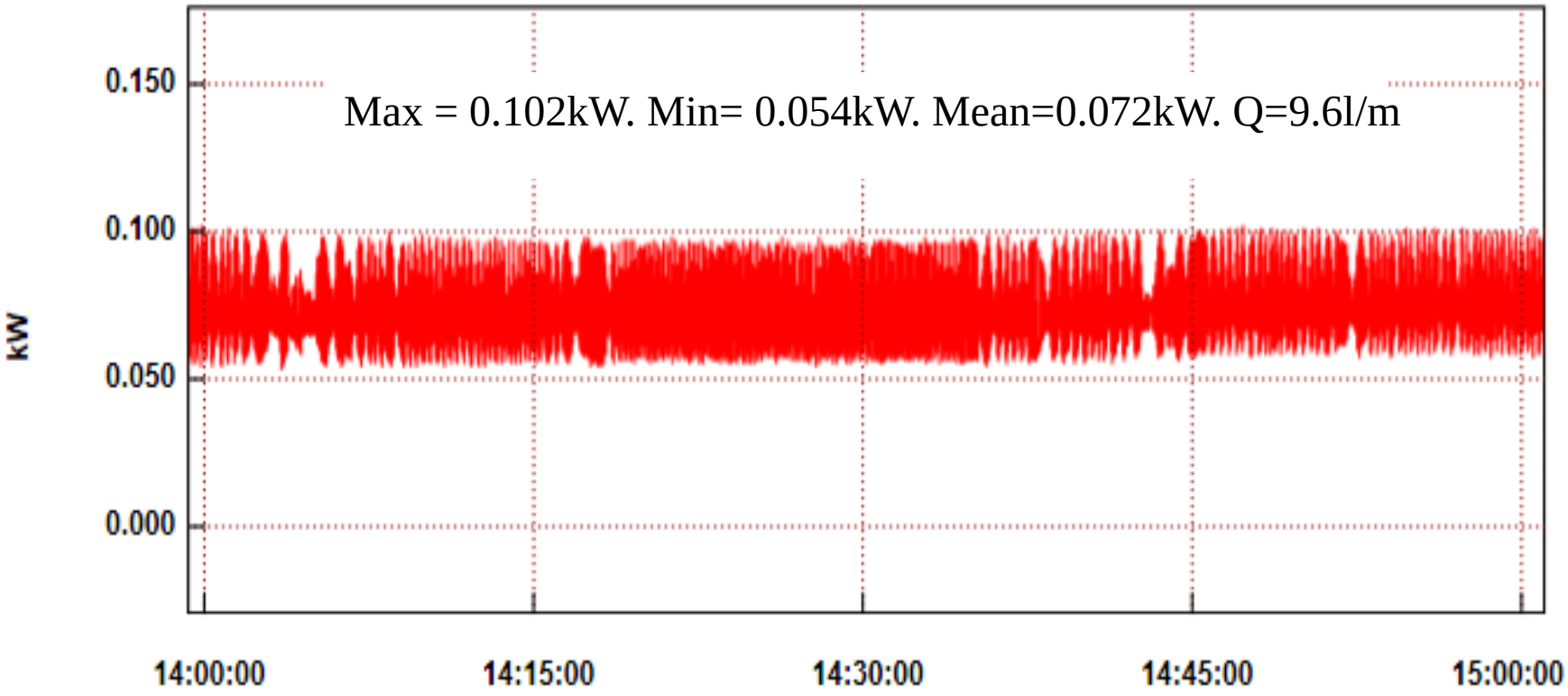
Laboratory Test Rig 2 - Results

Assess Electrical Consumption – 2 collectors



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Discussion – Power Consumption

System	Consumption	Source
FlushRain	0.12kWh/m^3	This study*
Commercial RWH	0.54kWh/m^3	Ward et al.
Market Leader - RainDirector	0.68kWh/m^3	RWH ltd
Municipal supply	0.60kWh/m^3	Ward et al.
Median of 10 RWH studies	1.40kWh/m^3	Vieira et al.
Global desalination	3.60kWh/m^3	Vieira et al.

*attributed to; 1) the low power consumption for the pump (~50-100W), the low operating head.

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Discussion Cont.

- Electricity costs for pumping projected <£1/annum.
- South West Water = £61.50 (rate of £2.05/m^3).
- However, electronics had **standby power consumption** of 11W adding £13.41/annum.
- Assuming 30m^3/annum, total electricity usage =3.34kWh/m^3. 5x higher than municipal supplies.
- Reduction in standby power to be investigated.

Further work

- Reduce standby power consumption to achieve lower electricity use per m^3 than existing water supplies.

- Real-world pilot trials are underway.

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Further work: Real-world Installations

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Key Messages

- RWH can come in many guises.
- If low electricity consumption is needed then the system studied will need further development.
- If it can be retrofitted for ~£1500 / house, then it will be ~3x cheaper than existing systems.
- 70% of UK houses that will exist in 2050 have already been constructed.

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