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Urban Water Security - 6

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Domestic Water Consumption in England– defining the research problem

Water policy in England is based on a number of commonly-held assumptions:

- that pcc is around 150 lppd
- that ppc has been rising since 1970 (but....)
- Based on a combination of “old” studies (Isle of Wight, Sodcon, etc. going back to early 1990s) and newer work (e.g. Wessex Water, Southern Water)
- *Future Water* (2008) and related gov’t policy suggest that lppd should be reduced to 120 – but how.....and why “120”?

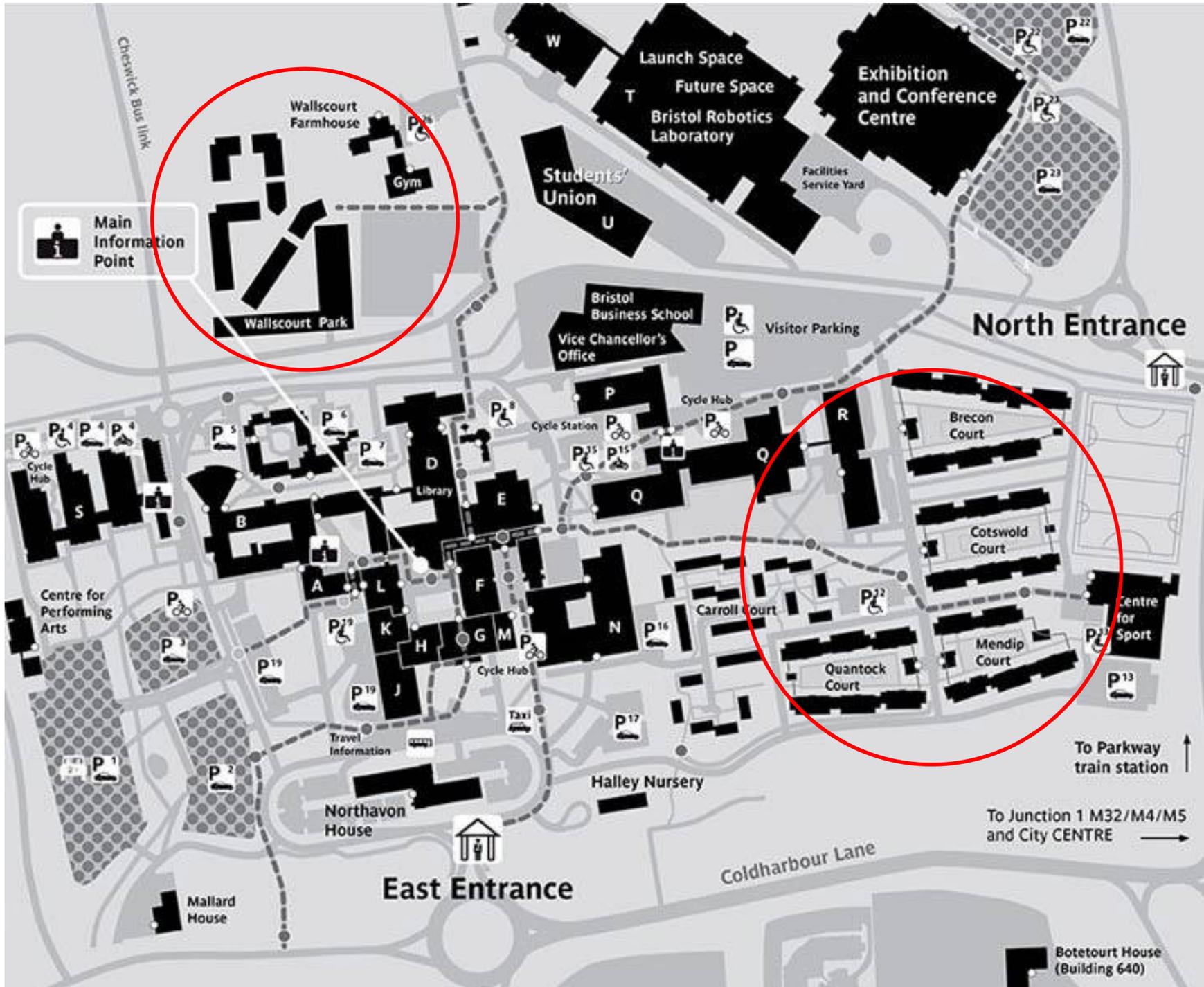
But these assumptions have a number of built-in difficulties:

- great variety of dwelling types - *no robust datasets on this*
- great variety of metrology strategies (and telemetry) yields *data of variable quality and comparability*
- *little knowledge about resident populations* (do two people live there.....or five....orten?)
- *no possibility of repeatable experimentation* – the “Holy Grail” for water conservation research!

What if it was possible to organise a long-term truly experimental study of water consumption?

- where metrology and telemetry were robust and reliable
- where there is high quality data about residents and accommodations?
- where there is an opportunity to test water behaviour interventions at scale because we can “reset” the experiment at intervals
- where it is possible to link with energy and other consumption data

In 2012, UWE and Bristol Water signed an MoU establishing the **Student Village Water Behaviours Study** as a long-term joint venture to add to the knowledge base about domestic water use and the potential efficacy of conservation measures (‘hard’ and ‘soft’ measures)



Cherwick Bus link

Main Information Point

Wallscourt Farmhouse

Gym

Wallscourt Park

Students' Union

Launch Space

Future Space

Bristol Robotics Laboratory

Exhibition and Conference Centre

Facilities Service Yard

Bristol Business School

Vice Chancellor's Office

Visitor Parking

North Entrance

Centre for Performing Arts

Library

Cycle Station

Cycle Hub

Brecon Court

Cotswold Court

Carroll Court

Quantock Court

Mendip Court

Centre for Sport

To Parkway train station

To Junction 1 M32/M4/M5 and City CENTRE

Northavon House

Halley Nursery

East Entrance

Coldharbour Lane

Mallard House

Botetourt House (Building 640)



Wallscourt Park

- Two phases, with first occupancy in 2015
- 975 beds in about 70 flats (each flat metered – 1:8/12 resolution)
- Not just first year students



Student Village

- First occupancy in 2006
- 1930 beds in four “courts”, each with 5 to 7 “blocks” (our “dmas”, with 1:68/84 resolution)
- Only first year students (mostly!)

Initial Study Assumptions/Design (first and second cycles)

- Informed by student accommodation that students were randomly allocated to blocks (*turned out not to be the case!*)
- No 'opt-in bias' (common problem with panel-type studies)
- Mendip (400 rooms) was assigned to be the control courtyard against which effect of interventions would be measured
- Ecoperl flow restricting tap inserts were installed in all hand basins in Brecon Courtyard (564 rooms).
- Tap inserts and low flow showerheads were installed in Cotswold Courtyard (476 rooms).
- In Quantock Courtyard (468 rooms) soft measures including shower timers and paper posters promoting water conservation were installed.
- All toilets fitted with Siamp thru the wall dual flush units.

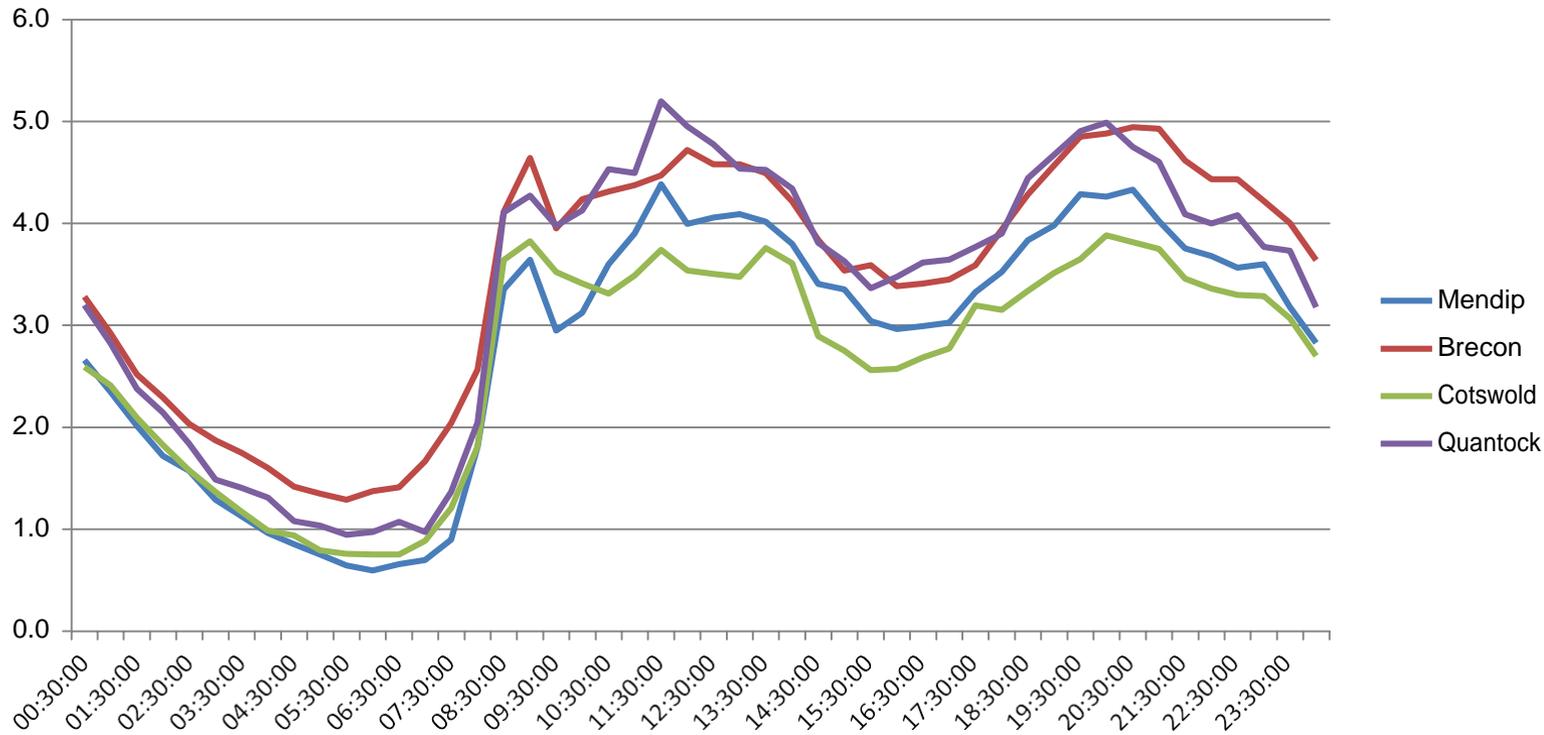
- 2012 – 2013 Initial installations and commissioning phase
- 2013 – 2014 **first** cycle (first experiment started)
- 2014 – 2015 **second** cycle (second experiment completed)
- 2015 – 2016 **third** cycle (focus on facilities mgmt, leakage & Wallscourt Park)
- 2016 – 2017 **fourth** cycle (hot water and pressure added as variables)
- 2017 – 2018 **fifth** cycle (segmentation and showering, SV and WP, following a “panel” of students into more normal accoms)

With the available data (since 2013), we were able to pose several research questions:

- ***What is baseline (personal) water use in this highly standardised context– without confounding factors of house type, modifications, gardening, car washing, etc.)***
- Are there differences in water use by gender, student origin (UK/EU versus international)
- Does involvement in sporting activities increase/decrease showering (at home)? (proximity of Sport Centre)
- ***Can we identify the difference that different “hard” and “soft” interventions make in water use, quantitatively, and qualitatively?***
- Also of interest was the life-span of the fixtures used in the study and associated maintenance issues (e.g. “leaky loos”)

What is Baseline Water Consumption?

2014-2015 Average LPPD (using only October & November, Tues-Thurs)



- Cotswold = 120 lppd & Brecon = 165 lppd (differences in this cycle linked to demographics and games-based engagement trial)
- Effect of lifecycle dynamics and greater occupancy during workday
- If we include weekends and holiday periods and calculate inter-block lppd, we can pick out blocks with higher non-UK and (in WPR) older student proportions

What effect of 'hard' and 'soft' interventions?

Mendip = no interventions

Cotswold, Brecon and Quantock with a progressive range of interventions

Posters



Fig. 1. Communal area notice board

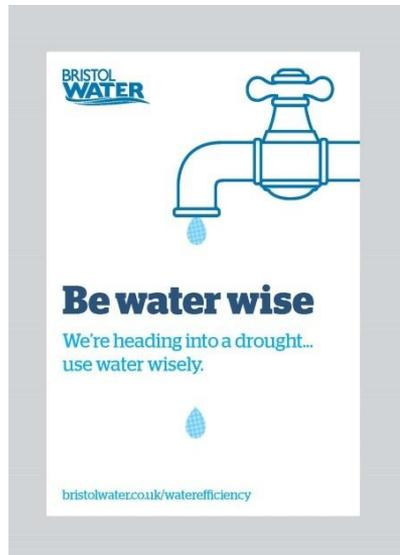


Fig. 2. Downstairs WC



Fig. 3. Shower room door (House 29/C)

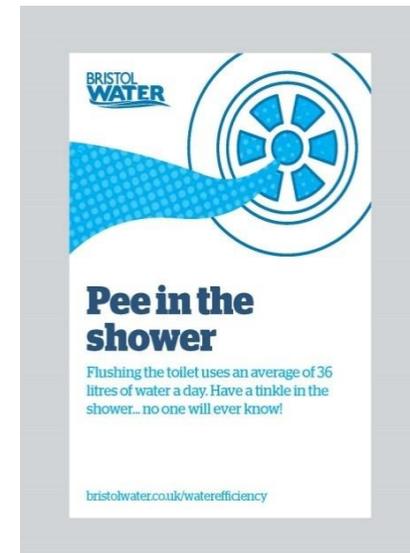


Fig. 4. Shower room door (House 30/D)

Showertimers & Amphiro a1 smart meter



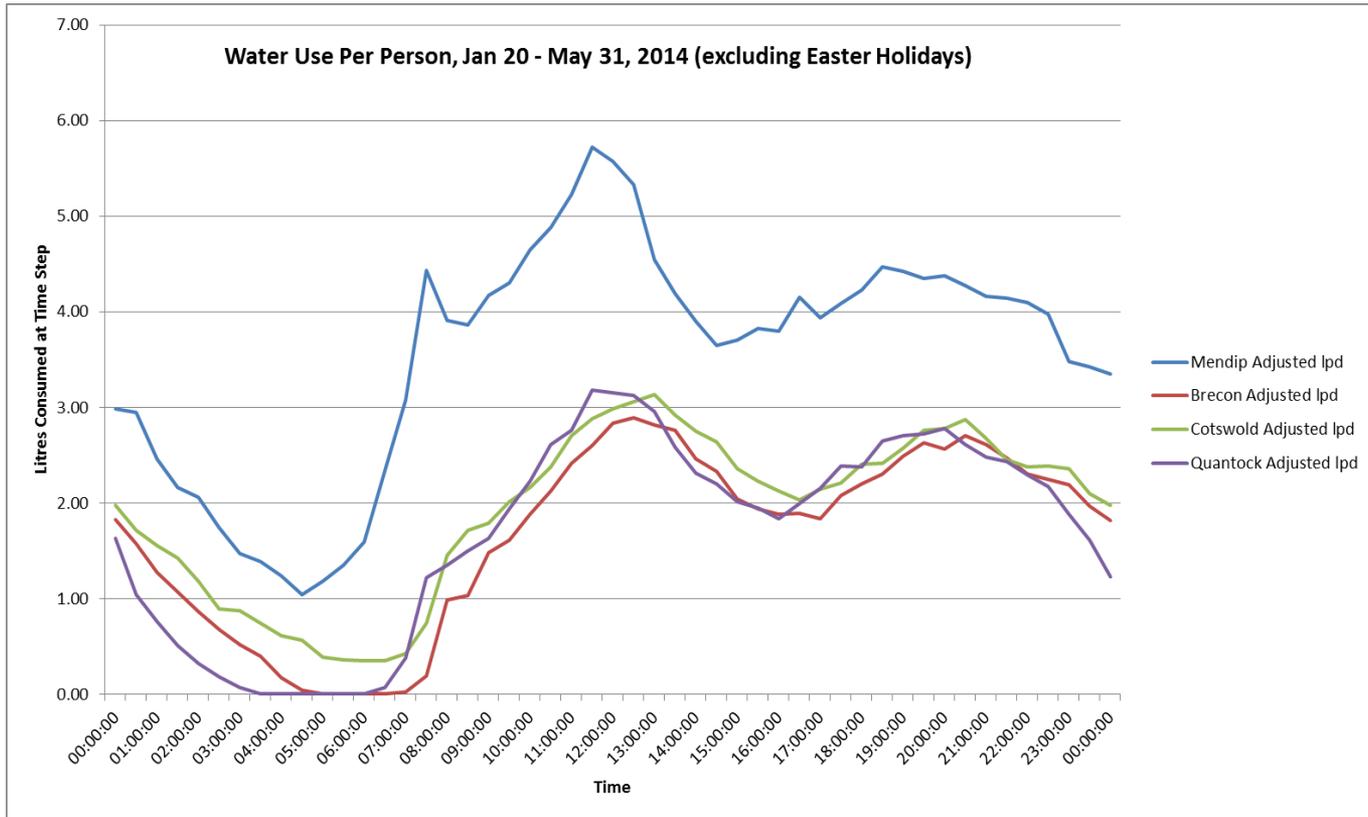
Fig. 5. Free 4 minute shower timer (Houses 31/32)



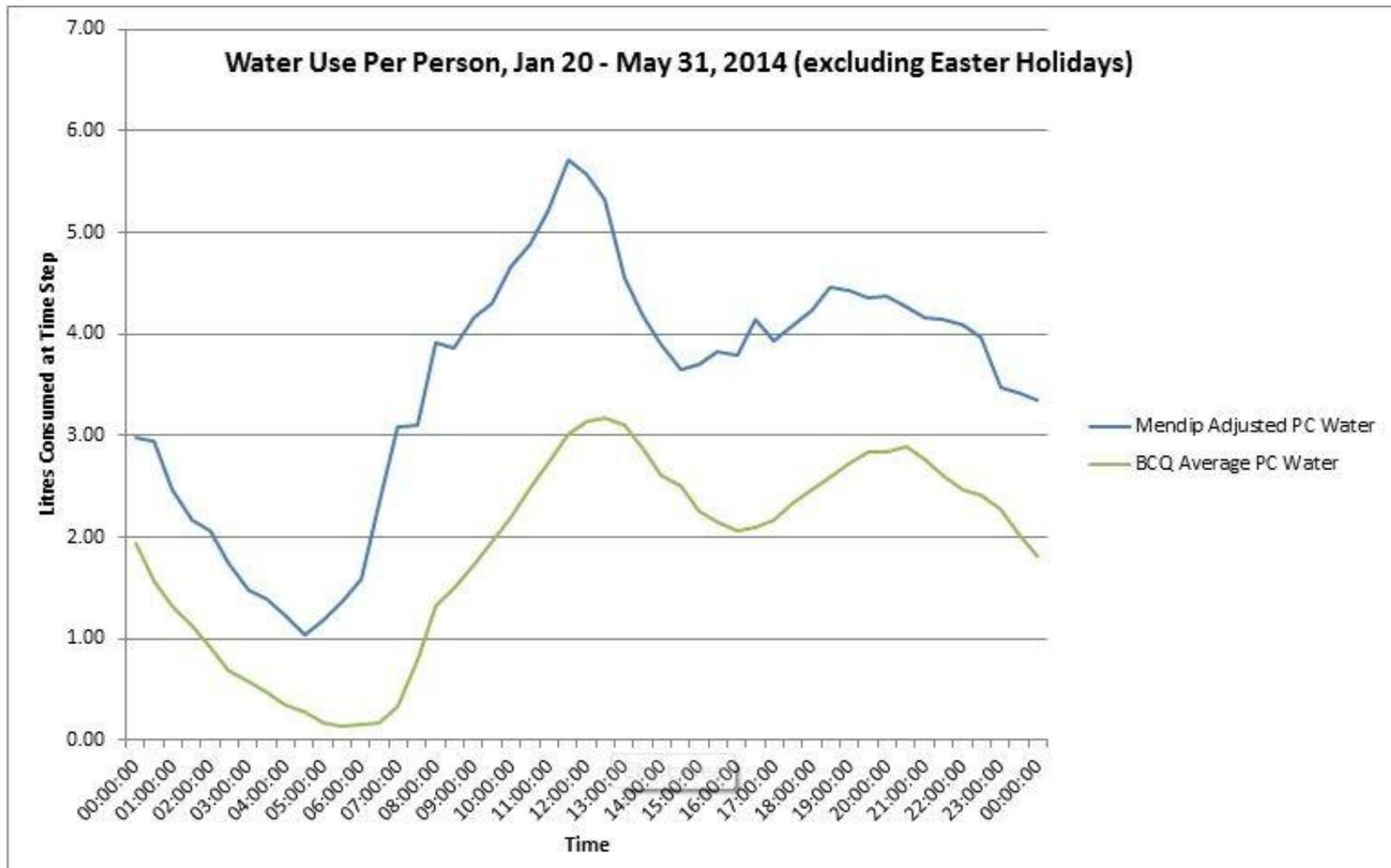
Fig. 6. Amphiro a1 smart shower meter (Houses 33/34)

Data collection - Household measurement v individual actions

Data source	When	What
Water fixtures audit	Aug 2017	5 houses, flow rates
BMS	Jan-Mar 2018	30 minute consumption
Siloette loggers	18 Dec-28 Mar	1 litre pulses for shower micro-components
Shower diaries	21 Feb-7 Mar	26 participants Date, time, location, duration, (litres)*, in-shower activities & products used, thoughts or emotions
Focus groups	28 Feb, 7 Mar, 14 Mar (x2), 21 Mar	22 participants Individual-Social-Material toolkit*
Online survey	7 Mar-21 Mar	19 responses Environmental attitudes, water-using behaviours (home and UWE), shower frequency/duration/products

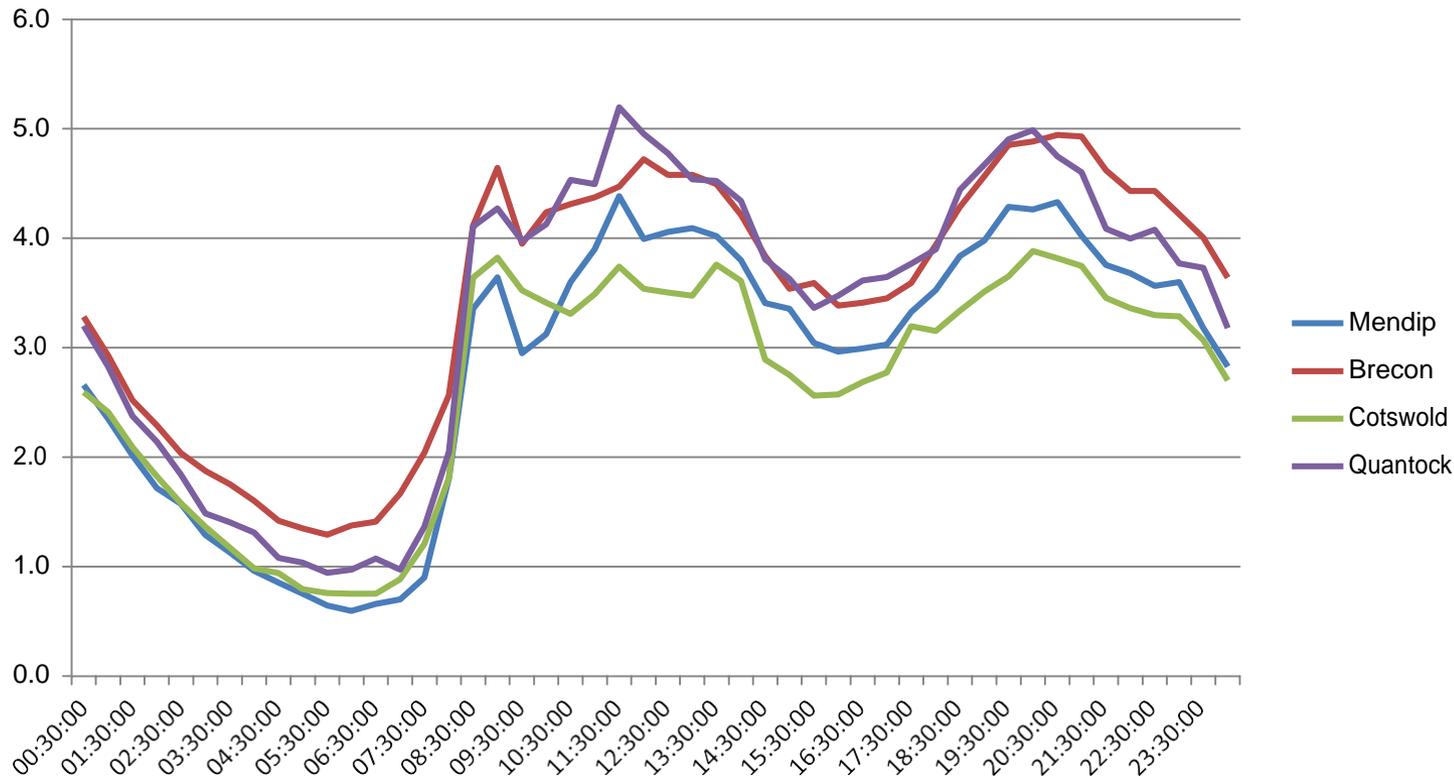


Good news – our interventions make about a 30% difference
 “Bad” news – hard to tell which works best!



Mendip = 180 lppd; others = 140 lppd – a 22% reduction
 Interestingly, the interventions' impact is fairly uniform across the day

2014-2015 - one year later



- But not sustainable.....a year later average lppd is **UP**, to between 135 – 150 lppd
- Qualitative research suggests some “bounceback” occurred even as early as the second week of the 2013-2014 trial
- Facilities programme for legionella control necessitated re-design of study (cannot “leave study running” during periods of void occupancy)

What have we learned so far?

- Huge benefits of the experimental design....but it has taken considerable time to get there – ***wenowhaveoneofthelargeststudiesofitskindanywhere!***
- Our study has become as interested/involved with facilities management as water behaviour/conservation - *poor water infrastructure management in large estates as important for conservation as behaviour change!*
- Conservation from “hard” interventions often easily cancelled out by behaviour modification (e.g. showerheads)
- Pressure matters as much as flow for some users
- Demographics are quite important, but in complex interacting ways
- Lifecourse dynamics effect significant and underappreciated - *student users really do use a lot of water!*
- Potential to LOTS of money...and CO₂ by being more water-efficient



“Continuous Improvement: Institutional Change” Award , 2017

“Student Engagement” Award, 2017 (joint award with Bristol University)

Influencing behaviour: “Individual-Social-Material” toolkit



The plan for 2017-2018 and beyond:

1. A limited number of blocks targeted with 100% fixtures change as follows:
 - a) New Neoperl flow restricting tap inserts
 - b) Audit/standardisation of shower and toilet fixtures (Fluidmasters)
 - c) Rigid schedule of fixtures audit and replacement (“like for like. same time each time step”)
 - d) RoI usually less than 102 years.
 - e) Legionella regime optimised



2. Wallcourt Park Study (Feb & Oct 2018)
 - a) Taking advantage of better meter resolution
 - b) Siloette loggers for data segmentation
 - c) Mixed quant-qual methodology

3. UWE Water Management Plan- 2013-2020
 - a) Water Systems Engineering support – Alan Co
 - b) Roll-out across Estate (Bower Ashton, non-accommodation, etc.)
 - a) Data management and analysis (with AI and “Games” Groups)





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Thanks very much!

www.watersecuritynetwork.org
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