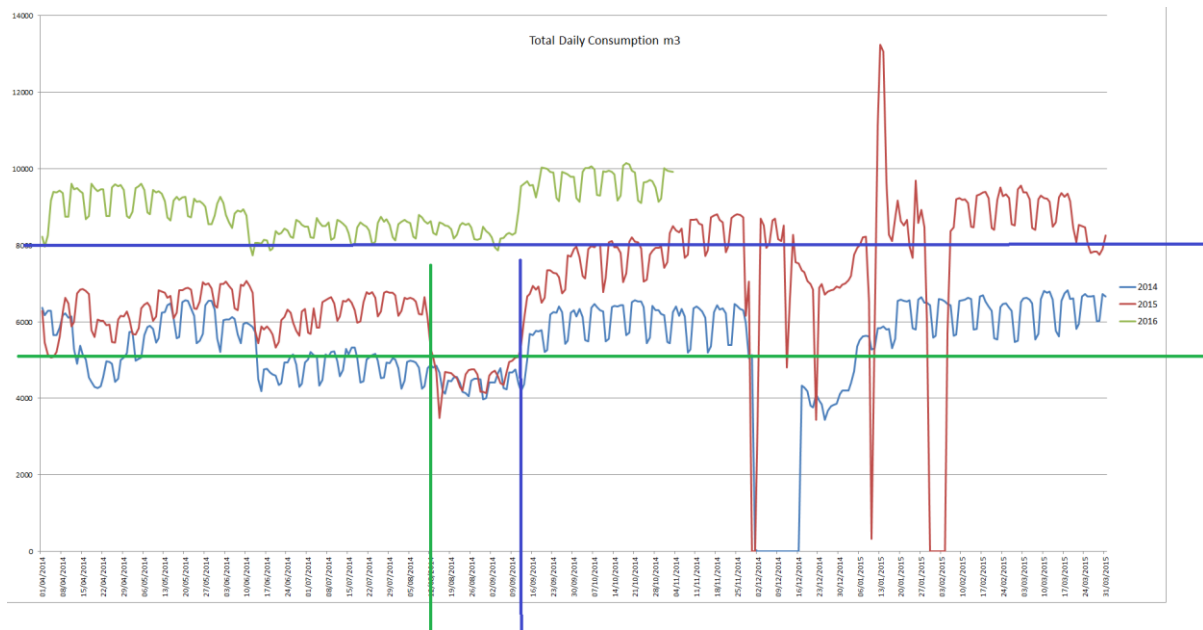


Water Leak Project

Background

We have been fortunate to date with free access to water flow data, provided by Southern Water. This data is the instantaneous water flow every 15mins, which has been turned into a volumetric scale and presented below. On this graph I have overlaid the last 3 years of water usage from 2014 to date, which clearly shows an increase in usage.



Note: The green vertical line is the moment that the last sizable water leak broke ground at Aisin Seiki and the horizontal green line is the historic baseline consumption, during term time. The blue vertical line, whilst being the start of the academic year, it also shows the signs of increased leaks on the system. The blue horizontal line is the current baseline and the potentials for savings (potentially 3,000m3).

Initial Site Leakage review Costs £5,500 + VAT.

Awaiting final approved report

We instructed the support of Celtic Surveys, through 1st Clear Flow to review/survey the campus, which commenced on the 19th September and continued until the 23rd September. Verbal feedback along with site meetings were undertaken daily during the investigation.

The work was undertaken in liaison with our onsite maintenance team, and their assistance was essential for Celtic to piece together the information they initially had and later received.

Celtic utilised the electronic format drawing 'University of Sussex Campus plan – Eco campus – Water Services' (drawn 28/05/2009) which proved useful, but not completely accurate information.

Following initial discussions, access to approximately half the water mains on site was not practicable due to ongoing analysis of asbestos within the duct areas.

The initial investigations have therefore been concentrated to the area North of Arts Road / Boiler House Hill where the water mains are mainly in the ground and not in duct and hence accessible.

This area is predominantly the Residences for the campus and some support buildings (Health Centre and Main refectory / Offices etc).

Investigation approach

Using the latest drawing 'University of Sussex Campus plan – Eco campus – Water Services (drawn 28/05/2009), helped identify sub meter locations for eventually each of the Residences in the area. Data logging was initially reviewed on the 21st September and one of the loggers (Northfield meter) was moved due to lack of available pulse units to suit the meters found on site.

These have been data logged to obtain flow profiles which helps in understanding where site water use, especially at night is occurring. Flow graphs from these loggers are attached in Appendix B.

In parallel with this a leak noise sounding (acoustic) survey on available fittings was undertaken, this provided areas of interest in relation to the night flows recorded at the Main incoming meter. A flow graph from this meter is included in Appendix A.

Following on from the acoustic survey, Leak noise correlations were undertaken on the Refectory Road area and subsequently the East slope area adjacent to the East Slope Bar.

One of the sub meter loggers was moved to the East slope residence meter, although this does show some night use, this is not the significant leakage that is occurring on site. This was in response to significant continuous flows observed in the drainage close to the meter location.

The data logger on the main revenue meter (Southern Water meter) records a significant night flow for the whole site, and there are potentially significant savings to be made if these can be reduced to previously observed levels. A lot of effort has been in proving the 'accuracy' of the latest drawing which overall is reasonably accurate but does need further updating from the information gathered to date. Several valves were 'found' during this exercise and the current maintenance team shown these locations.

Initial Investigation outcomes Costs £12,580+VAT

Works were undertaken to find and repairs were made where possible. Is there the potential to recoup some of this money back from Celtic Surveys (indemnities Insurance), as we actioned digging work, based on there request?

From the leakage investigations undertaken these culminating in the leak noise correlations, a leak was discovered on the water main in the eastern verge of Refectory Road / East Slope car park and up to the East Slope residence meter.

This main is shown in different locations (under the East slope bar (not normal practice), alongside the bar to the southern side and in the East Slope car park). Following the attempted repair of this leak, it has been subsequently determined that the main is under the East Slope bar.

To provide volumetric scale of the East Slope water leak, the supply would need closing off to that feeds East slope residences. In turning off this supply, with the volume of the leak suspected there would be a potential for the main to collapse in on itself and/or suck back ground water into the system and contaminating it. Hence this has not been undertaken at present.

Initial tracing of the East Slope main using cable avoidance tools and signal generator, indicated the main location to the south of the bar in a strip previously excavated.

Re-excavation in this area to a greater depth confirmed that the main and location of the leak is underneath the East Slope bar and thus cannot be repaired in the conventional manner. Relaying of the section of the main from valve chamber at the East Slope bar up to the current residences meter location is required to repair this main.

The relocation of the meter on this main should also be made to the bar area to allow complete monitoring of this leg for future system management.

At the time of the recent excavations there was an ongoing geotechnical investigation being undertaken in the East Slope Car Park, which we now believe is complete.

This will now allow the Mains relaying work to commence as soon as possible and the new end connections to be made during the Christmas period, ie after 10th December 2016 to 2nd January 2017.

Photographs of this area are shown in appendix C

Another water leak, which was on the fire main system, was found through sounding equipment and thorough investigation under manhole covers. The located of this leak was at the edge of a chamber housing valves between Lancaster House and the Health Centre, adjacent to a recently replaced Fire Hydrant. This leak was found to be at a shallow depth (approximately 1m) and a conventional leak repair clamp was attached to affect the repair, Photographs are attached in appendix D. The repair to this leak was undertaken on the 11/12th October 2016 and was completed on a live supply because the valves leading up to the leak couldn't be isolated.

Investigation of the water main from the pump house to the Freeman Building was hampered as the sub meter on this main (located in the pump house) is not working and requires replacement. Acoustic sounding led to location of a constantly flushing Urinal in the Thermo Fluid mechanics research building. This will need a Urinal controller fitted to stop constant use.

Further work

Northern Campus System

From investigation of the system predominantly north of Arts Road/ Boiler house road should be revisited after the repairs to the East Slope main. The areas of residence have lower levels of leakage

/ usage and these can be investigated to help minimise night use and hence bench mark the areas for future management and threshold warning settings.

Further inter system flow meters have been suggested, some are new installations, but some are the replacement of pre-existing meters that are not working. See attached plan in Appendix E

Due to the age and water quality the accuracy and competence of the existing mechanical sub meters is suspect. A good suggest could be the full bore fixed Ultra sonic (Arad Octave units) for the inter system flow meters as they are less susceptible to fouling than mechanical meters.

Fire Main System

As part of the initial investigations a review of the new fire main meter has been undertaken. This is a full bore fixed Ultrasonic meter, this gives an instantaneous flow reading and has pulsed output. Permission to data log this meter has now been obtained. This should be done as part of a leakage review on this system. Part of which will include a flow profiling exercise on the Snail House meter.

We would expect this to take 3-4 working days.

Southern Campus area

Complete system leakage / usage review required once access to the ducts / fittings and sub meters are available

It is expected that this will take 5 working days and 2 days for the final reporting.

Recommendations

The following summarises recommended further work:

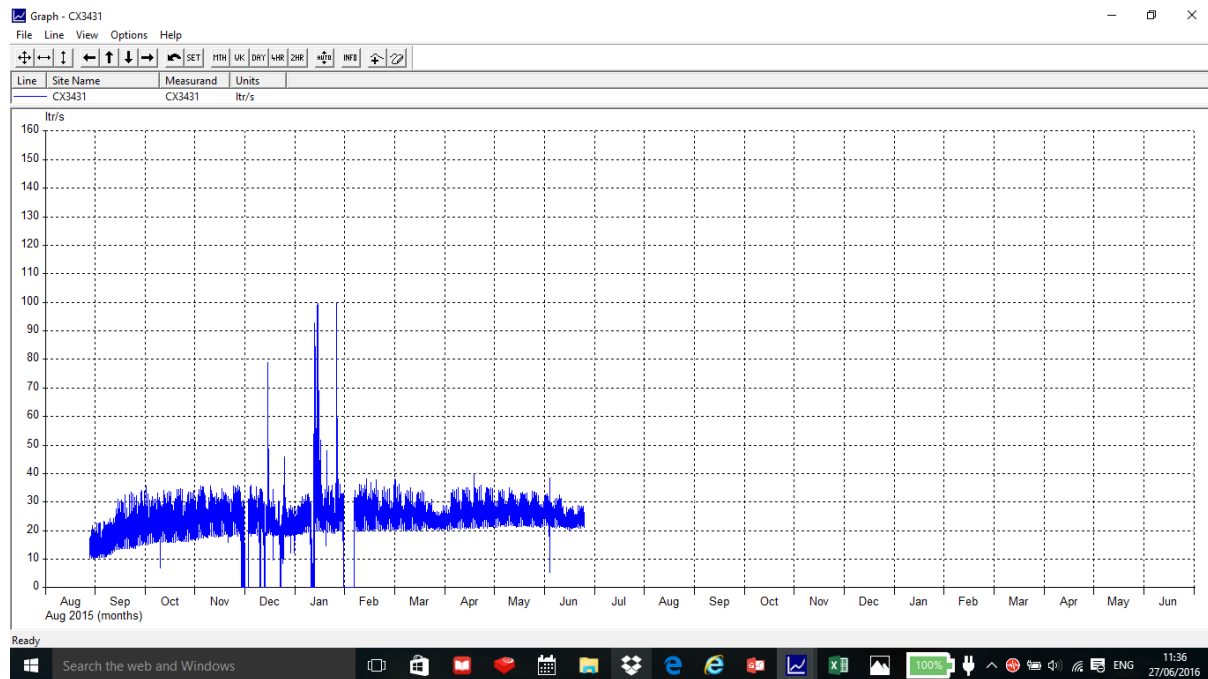
- Relay the East Slope main to remove leakage on this leg.
- Relocate the meter on this main to the bottom of the hill (East Slope bar area) to improve system flow monitoring.
- Re sweep the feeder mains system to current sub meters to confirm no further leakage on these elements.
- Undertake Leakage control within the residence areas served by the various sub meters to further reduce known leakage - link these to the new installed monitoring system to allow flow balancing. Refer plan in appendix E.
- Undertake flow monitoring on the Fire main system and Snail house meter followed by Leakage detection of the fire main to locate areas of interest and subsequently localise/pinpoint any leakage for repair. Part of this work will consider current sub metering and as in the Northern Campus potential inter system meter locations.
- Investigate Southern campus water mains when asbestos removed from ducts
- Connection of new meters, (including the fire main meters) to the new monitoring system to allow consistent reporting throughout the water and fire supply on site.

- Consideration of a flow surveys on the existing building specific sub meters and the building specific water use within these to investigate any potential for Water efficiency within each building.

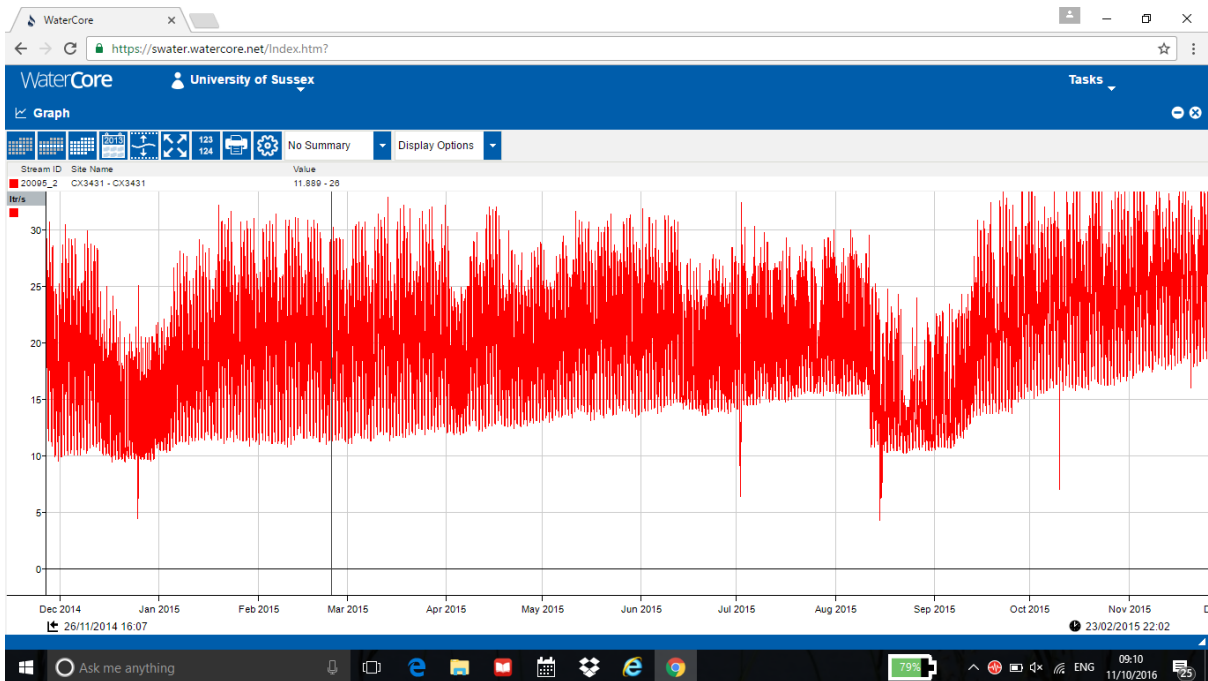
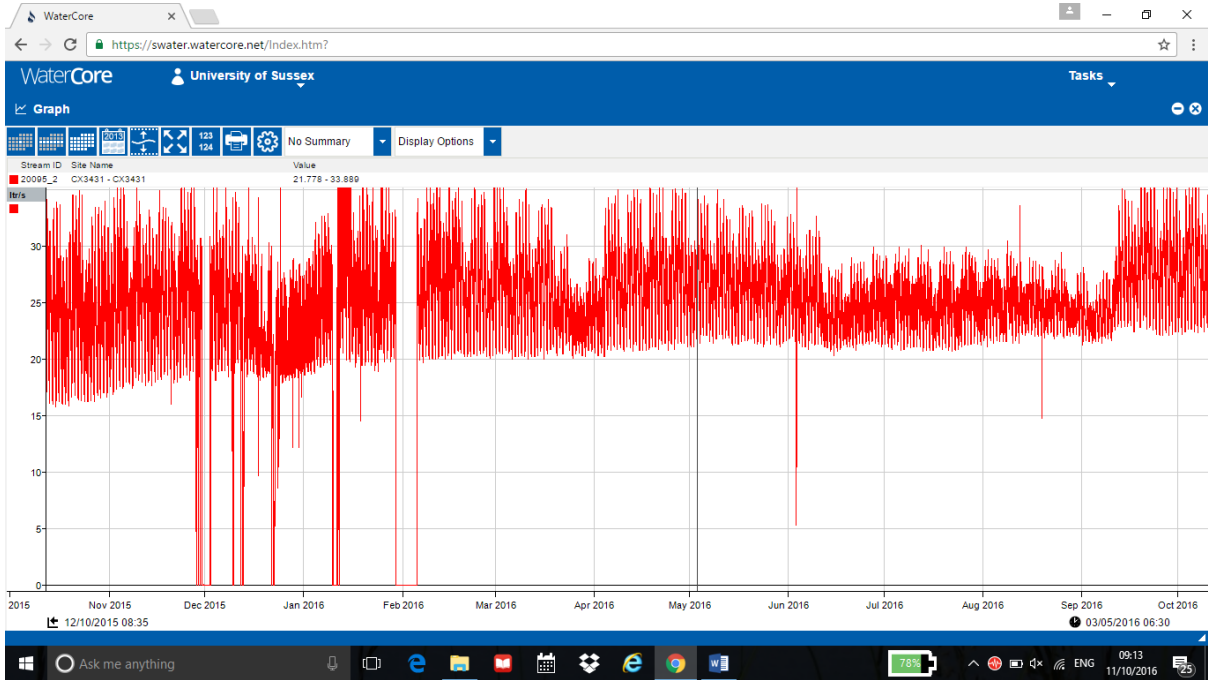
Appendix A – Flow graph from Southern Water (Revenue) meter.

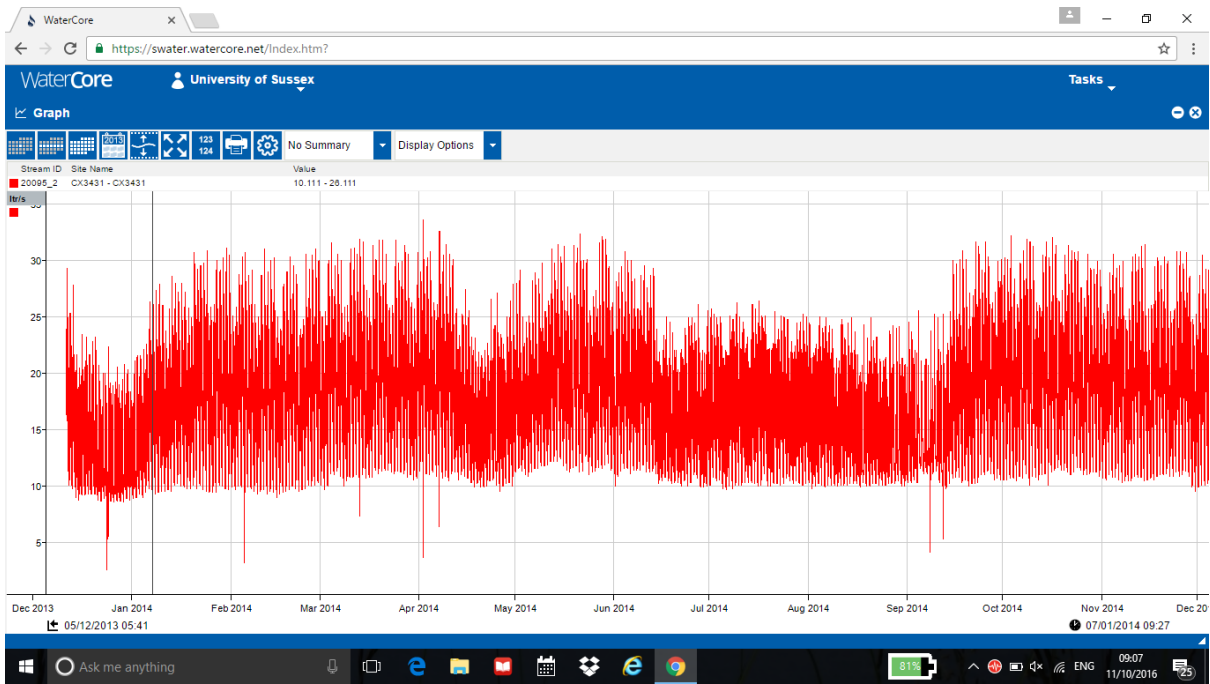
University of Sussex – Revenue flow meter – Graph of current flows (Litres / second) - 24th June 2016

This flow graph shows the growth in water use from August 2015 to the initial download in June 2016.



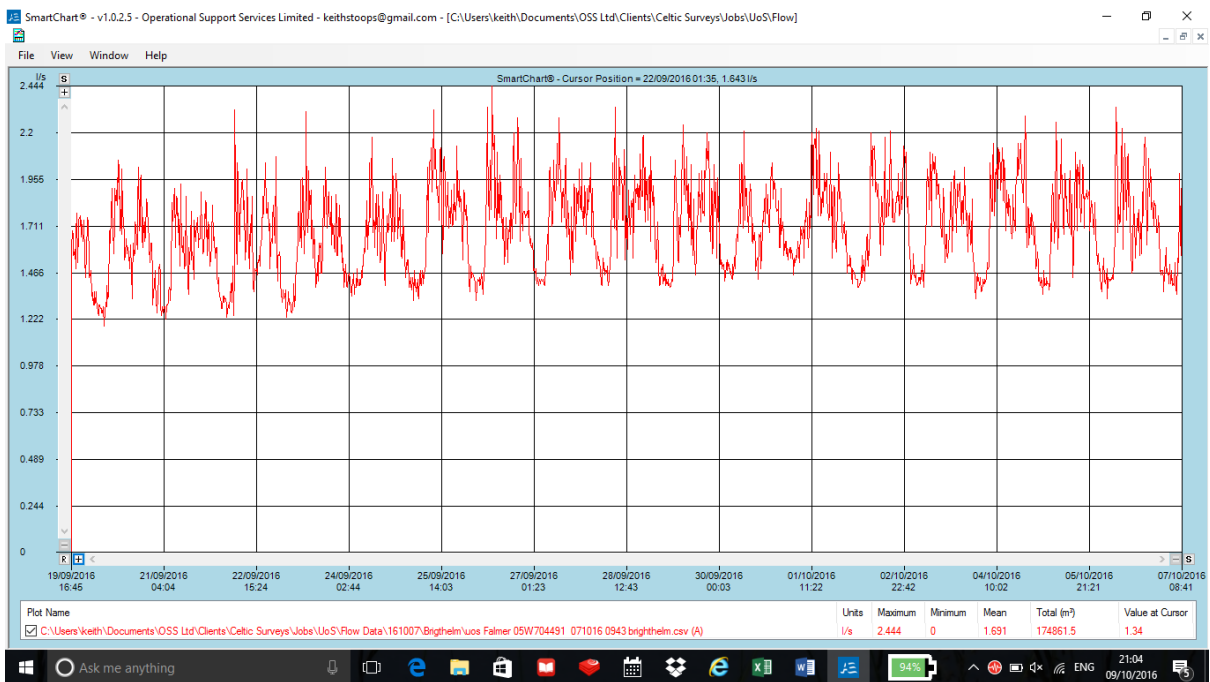
The graphs below show the data from the Cello logger on the Revenue meter since December 2013.



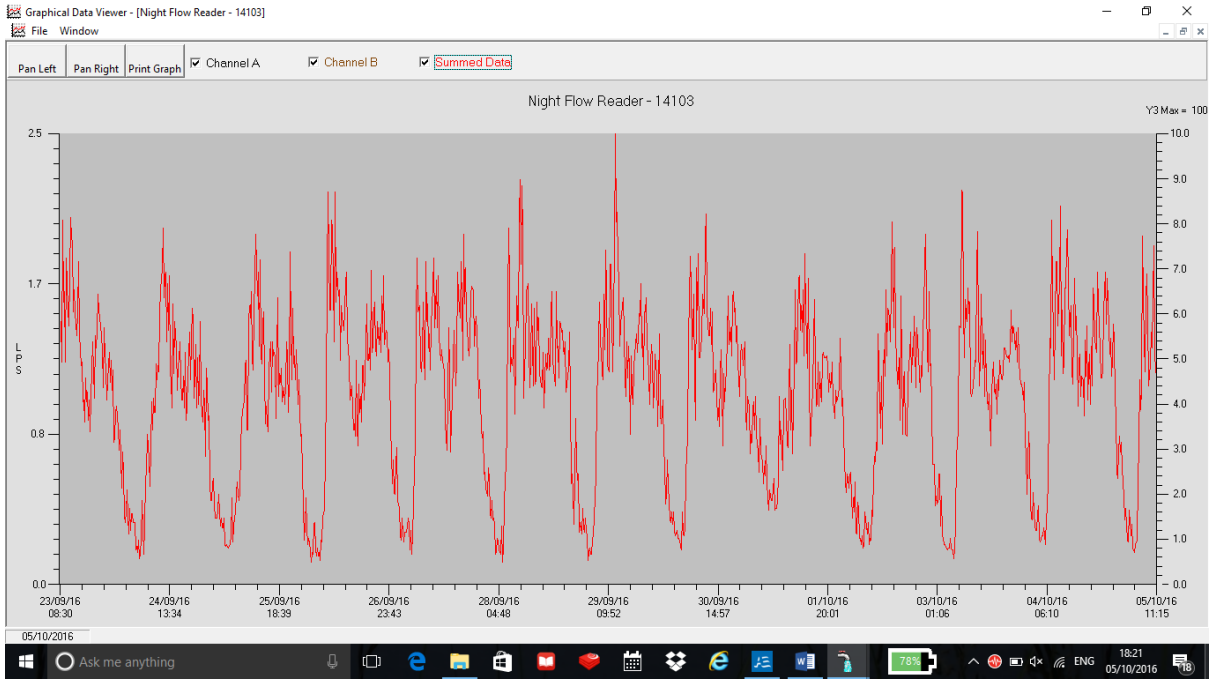


Appendix B – Flow graphs from Residence areas

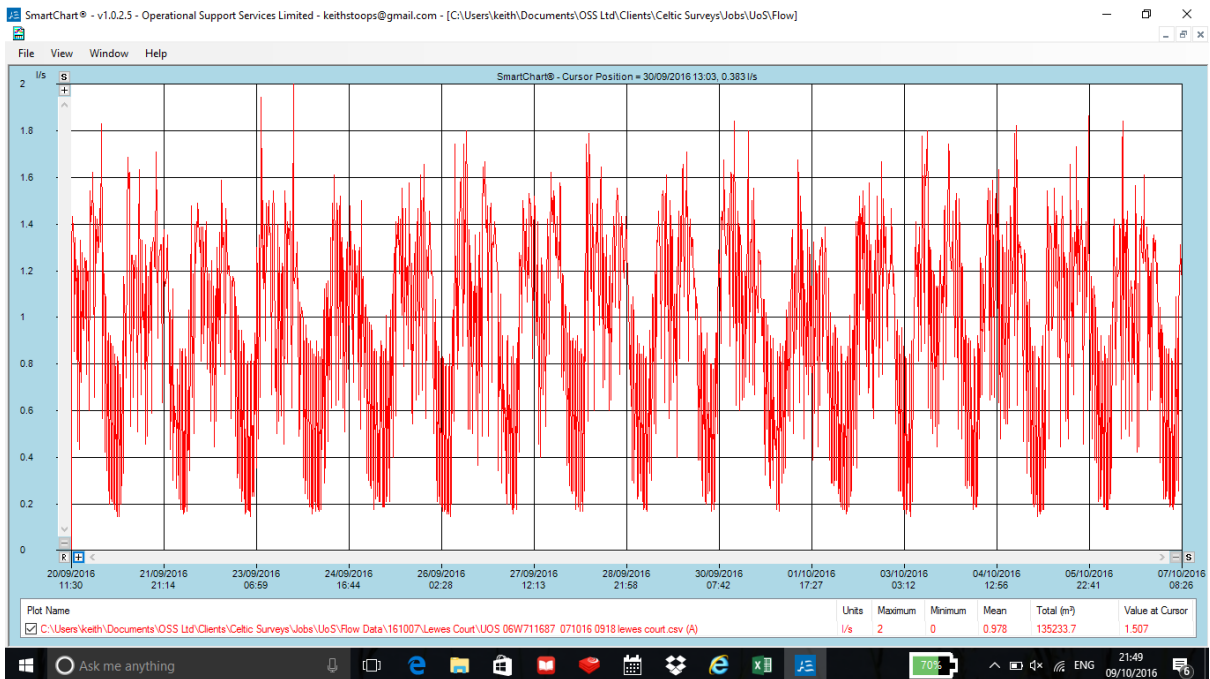
Brighthelm flow meter



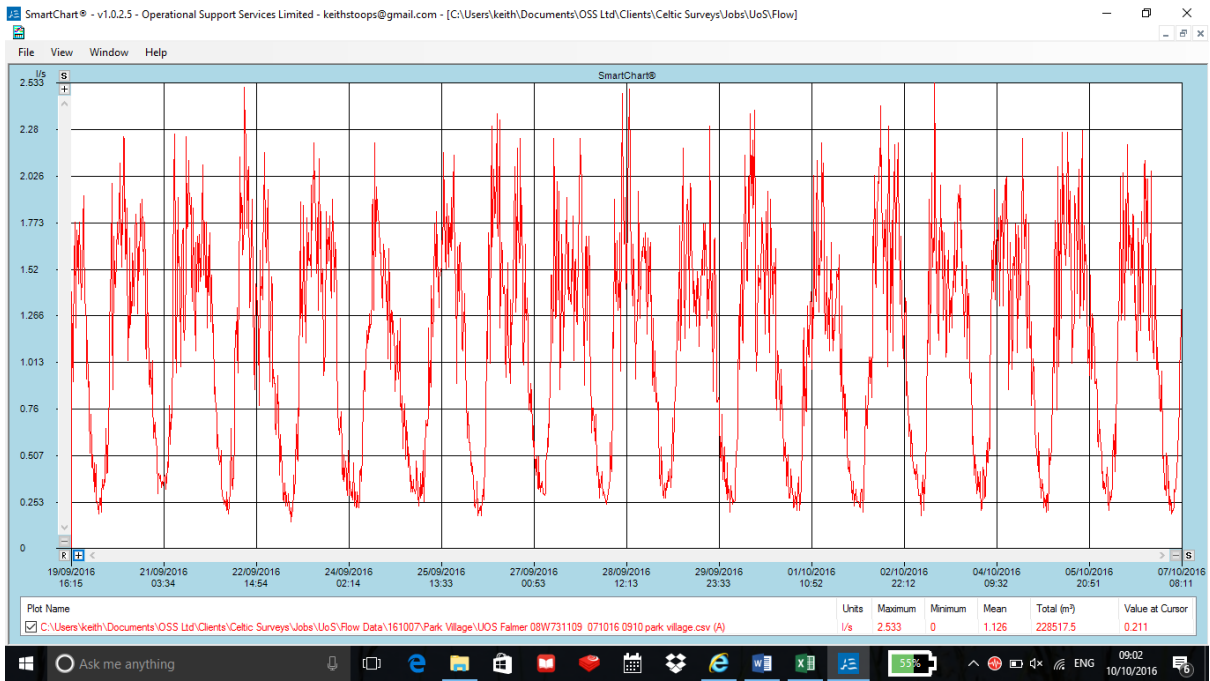
East Slope Residence Flow meter



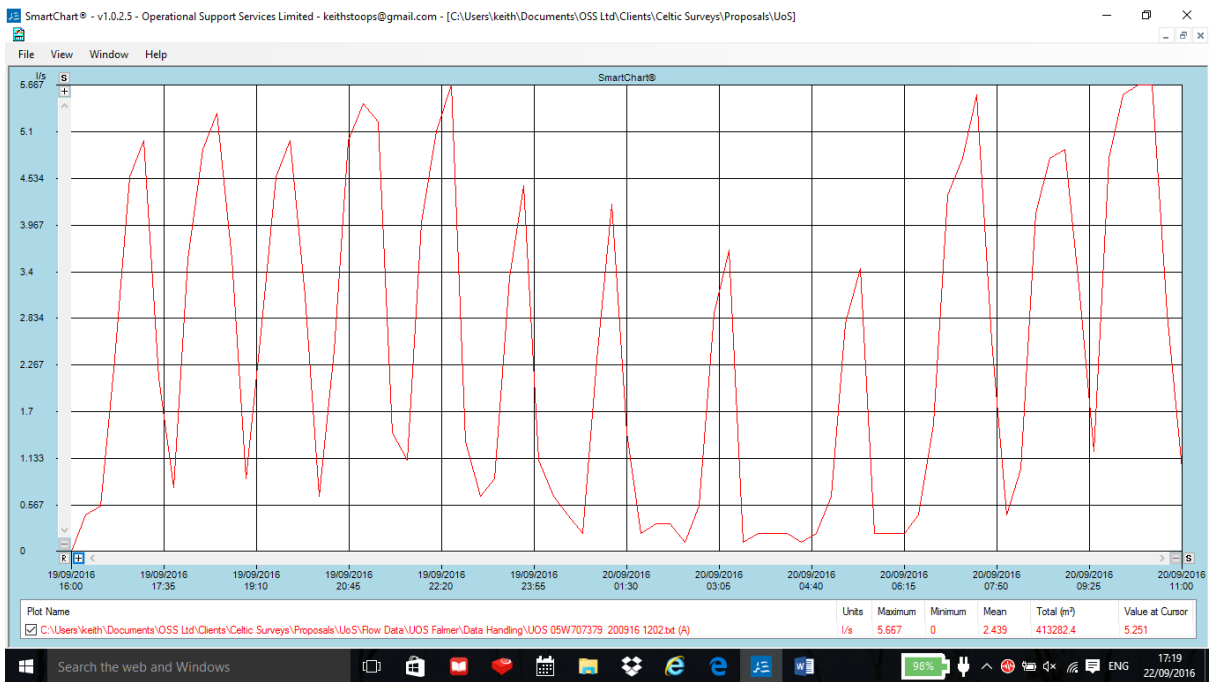
Lewes Court Flow Graph



Park Village Flow Graph



Northfield Flow Graph – only 1 day



Appendix C – East slope mains leak location Photographs





Appendix D – Lancaster House/ Health centre Leak Photographs





Appendix E – Inter system flow meter locations

University of Sussex – Falmer Campus – Location of existing meters and proposed meter locations

