fundamental series 10

The Continuing Professional Development Programme, produced in association with energy INSTITUTE

Current thinking on...

Water Management

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Water is a precious resource.

One of the key messages from the UK Climate Change Risk Assessment 2012 (CCRA) is that UK water resources are projected to come under increased pressure as a potential consequence of climate-driven changes in hydrological conditions, as well as population growth and the desire to improve the ecological status of rivers. By the 2050s, between 27m and 59m people in the UK may be living in areas affected by water supply-demand deficits[1].

There is also increasing awareness that growth in water demand is becoming unsustainable. The average consumption of water per person in England and Wales in 1992/93 was around 140 litres per person per day (l/p/d) and by 2005/06 this had increased to around 150 l/p/d. This growth in water use has been largely attributed to an increase in the number and range of appliances in buildings and increases in the frequency of their use, and changes in household size. This is demonstrated by the proportion of households with washing machines and dishwashers increasing, with ownership in 2007 at 95 per cent and 33 per cent respectively[2]. The increased popularity of water-hungry power showers has also had an impact on water use.

Balance supply & demand

If we are to maintain the balance of water supply and demand and secure sustainable supplies into the future, then our buildings must play a part in helping to reduce the demand for water. The UK Government has set a target of 130l/p/d by 2030 to help promote water efficiency. While Part G (amended 2009) of the Building Regulations has set us on the right path for improving water efficiency in new homes, there are also direct cost benefits and Government financial incentives for retrofitting water efficient equipment to buildings.

In order for water management to be effective it must integrate water efficiency with hygiene control and safety.

The source of water used and the type of wastewater generated by the activities in a building will determine how much is paid for water supply and wastewater disposal. While a number of buildings are turning to alternative water sources, the reality is the majority of buildings currently depend on the UK mains water supply network for their water source.

Alternative water sources include:

- groundwater (abstracted from boreholes);
- surface water (abstracted from rivers, lakes, etc.);
- grey or recycled water; and
- rainwater harvested from roofs.

Wastewater types include:

- foul or domestic sewage;
- trade effluent; and
- surface and highway drainage.

There is a number of mains water charging schemes for water and wastewater in the UK with the amount being paid depending on:

- the service provider;
- the size of the meter or supply pipe; and
- the tariff structure agreed with your service provider.

Differences in charges

The standard water and wastewater charge in the UK for non-domestic premises can vary dramatically between service provider. For example, Business Stream charges £0.7951 per m^2 of water whereas Wessex Water is £2.05 per m^2 of water (2012/13 charging schemes)[3]. Companies currently have different approaches to charging for surface water and highway drainage.

Under the Water Industry Act 1991, any wastewater produced on trade premises (and in pursuit of a trade or business) is defined as 'trade effluent'. However, this definition does not include domestic sewage which is defined as wastewater produced as a result of domestic usage such as washing, food and drink-related activities or using the toilet. Trade effluent covers wastewater from processes such as: industrial production, washing and cooling plant, machinery or vehicles.

The charging structure for trade effluent is based on the volume and strength of an effluent using the Modgen formula which was agreed between the water industry and the

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Confederation of British Industry. This formula takes into account the level of trade effluent treatment needed for each business using the following cost elements for:

- collection;
- primary treatment;
- biological treatment;
- treatment and disposal into the sea;
- biological oxidation of settled sewage; and
- treatment and disposal of primary sludge.

The use of the Mogden formula is based on one of the core principles of sustainable development, the Polluter Pays Principle.

This means that businesses pay less for wastewater that is less contaminated and more for wastewater that is more contaminated.

The Mogden formula is generally: C = R + V + (Ot/Os)B + (St/Ss)S

C - unit charge for the trade effluent discharge (p/m^2).

R - unit cost of reception and conveyance of sewage (p/m^2).

V - unit cost of the volumetric and primary treatment (p/m^2).

B - unit cost of the biological treatment (p/m^2).

Ot - chemical oxygen demand of settled sewage trade effluent (mg/l).

Os - chemical oxygen demand of settled sewage standard strength (mg/l).

St - suspended solids of trade effluent (mg/l).

Ss - suspended solids of crude sewage standard strength (mg/l).

S - unit cost of treatment and disposal of primary sludge (p/m^2).

Water companies will publish their charging data for use in the mogden formula on an annual basis. The Waste and Resources Action Programme (WRAP) has developed a Mogden formula tool[4] to assist businesses in England and Wales, Scotland and Northern Ireland to calculate their trade effluent costs. The tool allows the user to investigate the impact of modifying specific aspects of the effluent to understand the related variation in discharge cost.

While the direct costs of water and wastewater are easily identified, there are many hidden costs associated with water use and disposal of wastewater. These hidden costs can include:

- water treatment costs prior to water use (e.g. the use of ion exchange technology to treat water prior to use in a boiler);
- the energy costs associated with pumping, heating and cooling water for particular applications;
- the cost of lost product or raw materials in wastewater; and
- wastewater treatment prior to its reuse or discharge.

These hidden costs are entirely dependant on the water using activities on a particular site and the site-specific situation. However, the hidden costs of water may be more than three times the total direct cost of water and wastewater[5].

As a simple example, consider the hidden cost of heating water to 43ºC for domestic service using gas, electricity or oil as the heating method using the DECC Quarterly Energy Figures[6].

Heating Method	Unit Price (£/kWh)	Assumed Heating Efficiency	Cost of Heating (£/m^3 of water)
Natural Gas	£0.0293	80 per cent	£1.41
Electricity	£0.1064	100 per cent	£4.10
Gas Oil	£0.065	80 per cent	£3.13

Detect and diagnose

Monitoring and targeting (M&T) is a management technique designed to detect and diagnose the wasteful use of water. Other benefits can include: increased resource efficiency, better environmental performance and more accurate resource budgeting. M&T comprises the following elements:

- the measurement of water consumption and any underlying influencing factors by constructing a water mass balance (a numerical account used to show where water enters and leaves a business, and where it is used within a business);
- the calculation of water efficiency key performance indicators (the metrics deemed essential to understanding operational health of a building or site) to establish baseline performance and track changes;
- the comparison of those ratios with expected values or targets (benchmarking);
- communicating the results to the responsible person(s); and
- the responsible person(s) taking action to manage water efficiency.

A robust M&T system will assist a building or site work towards optimal water efficiency. Simple checks such as investigating the water use baseload during unoccupied hours can often help identify the wasteful use of water. Taking a water meter reading at close and start of business or during a period when the building is unoccupied will quickly identify if water is being wasted. Water could be wasted by a cistern passing, no or timed urinal flush control or a leak. All these issues can be simply improved by low cost water efficiency solutions.

The importance of monitoring is further demonstrated by the UK Water Sustainability Indicators 2010/11 which show that customers living in properties with a water meter typically use about 18 per cent less than customers who live in properties which do not have a water meter[7].

Once a building or site has an understanding of its water use the next stage of water management is to improve water efficiency by using the Water Management Hierarchy (WMH). The WMH is a hierarchy of water conservation priorities which include a number of levels with the highest being the most preferred:

- **eimination:** stop all leaks, spills and eliminate water use where unnecessary;
- **reduction:** consider if water could be used more efficiently or if there is an alternative process available.
- **reuse:** consider if the water could be treated/filtered and re-used within the process or activity.
- **recycle:** consider if the water could be recycled for use elsewhere in the building or site.

The water efficiency opportunities from the WMH can be realised by using appropriate water-saving products and practices in buildings and industry.

Labelling scheme

To assist water users compare products for water efficiency the Bathroom Manufacturers Association has developed a Water Efficiency Product Labelling Scheme[8]. The Water Efficiency Product Labelling Scheme provides easy access to a database of bathroom products which, when installed and used correctly will use less water, save energy and save money. The label contains information on: category of the product, type of measurement, performance band and actual capacity/performance of the manufacturer's product.

Examples of water-saving products and practices that can be used in buildings and industry include:

- **waterless urinals:** Operating at the highest level on the WMH, waterless urinals eliminate the need for water. There are generally two types of waterless urinal: the siphonic trap and deodorising pad. The siphonic trap uses a low-density barrier fluid which allows urine to pass through it to sewer while maintaining hygiene. A deodorising pad is impregnated with a deodorising chemical to maintain hygiene which is fitted in a modified S-bend. While waterless urinals eliminate water use completely this benefit must be weighed against the installation costs and ongoing cleaning costs. The fastfood chain McDonalds has implemented waterless urinals in over 700 of their restaurants.
- **urinal flush control:** Urinals are often set to flush on a time basis regardless of the building or site operating hours. This frequently leads to a high waste of water (e.g. a typical office may operate 40 hours a week but a urinal may flush regularly throughout 168 hours). While urinal flush control will reduce unnecessary water use a minimum frequency

is required for them to remain hygienic. There are generally two types of urinal flush control: passive infrared (PIR) sensor and hydraulic valve. A PIR sensor can be used to detect the use of the urinal (via area occupancy) and control a solenoid valve fitted to the inlet pipework to allow a pre-set amount of water into the cistern per use. When the cistern is full it will discharge into the urinal. The hydraulic valve is similarly fitted to the inlet pipework and operates by detecting pressure changes through water being used elsewhere in the toilet (e.g. hand washing).

• **toilet cisterns:** Traditional cisterns would have used 9 or 11 litres of water per flush. To improve their water efficiency cistern volume adjusters (small displacement devices) can be inserted to reduce the effective flush volume. For new builds or existing building refurbishments new water efficient alternatives include 6 litre single flush or 6 and 4 litre dual flush and more recently highly efficient 4.5/2.6 litre dual flush systems.

• **wash hand basin control:** The traditional wash hand basin and tap design is a water waster in today's modern commercial plumbing systems. Options to improve water efficiency at the wash hand basin include: specifying smaller wash bowls, use of foam soaps or water efficient taps. Smaller wash bowls can reduce the volume of water used per use and foam soap uses less water to rinse hands than standard liquid soap.

Water-efficient taps generally include: percussion/push taps, spray taps or PIR sensor controlled taps. Automatic taps (often referred to as percussion or push taps) contain a self-closing mechanism which closes the tap after a preset time and can save ~50 per cent of water use versus a conventional tap. Spray taps operate by forcing water through small holes in the tap outlet producing a spray to increase the surface area covered by the volume of water used and can save ~60 per cent of water use versus a conventional tap. PIR sensors operate in much the same way as the PIR sensors for urinal flush control by automatically starting and stopping the flow from the tap.

• **showers:** It is often considered that showers are more water efficient than baths, however, that is not always the case. While a conventional shower may use 12 litres per minute a power shower may use up to 20 litres per minute. Based on a 5-minute use the showers will use 60 litres and 100 litres respectively, while a bath may use 70 litres. In the past, water efficient shower heads contained a flow restrictor and often disappointed by providing a less pleasurable shower. Newer versions generally aerate or pulse water to give a similar sensation to a conventional shower while reducing water use by up to 60 per cent of a conventional shower head.

• **pressure-reducing valves:** High water pressure can result in excessive water consumption and exacerbate leakage. The use of pressure-reducing valves can control the water pressure in a building. Typically a 10 per cent reduction in water pressure will provide a 5 per cent reduction in water use at point of use.

The UK Government has established an Enhanced Capital Allowance (ECA) water scheme that encourages businesses to invest in technologies that save water and improve water quality. The ECA water scheme is managed by the Department for Environment, Food and Rural Affairs and HM Revenue and Customs. It offers 100 per cent first-year allowances (tax relief) on investments in eligible water efficient technologies and products which can be found on the Water Technology List[9].

Eligible technologies

Eligible water-efficient technologies and products include, but are not limited to: water efficient showers, taps, toilets and washing machines; monitoring and leakage detection equipment; rainwater harvesting equipment; water efficient industrial cleaning equipment; slurry and sludge dewatering equipment; vehicle-wash water reclaim units; water management equipment for mechanical seals and water reuse systems.

While UK water resources are projected to come under increased pressure through climate change, population growth and societies appetite for water hungry equipment there is reason to be optimistic. Government legislation, environmental programmes such as WRAP and financial incentives through ECA's all encourage society to become more water efficient. Businesses can implement water efficiency initiatives to improve water management and realise tangible benefits such as a reduced environmental impact and improved bottom line.

Through water users and Government working together there is an opportunity to reduce water use and protect this precious and increasingly scarce resource for future generations. The issues are real but through effective water management they can and must be addressed.

References

1. http://www.defra.gov.uk/publications/2012/01/26/pb13698-climatechange-riskassessment/

2. http://www.communities.gov.uk/documents/planningandbuilding/pdf/WaterEfficiencyNewBuildings.pdf

3. http://www.business-stream.co.uk/sites/default/files/120405FullchargingstatementI2-13v3b.pdf; and http://www.wessexwater.co.uk/customers/threecol.aspx?id=222&linkidentifier=id&itemid=222 for further information.

4. http://www.wrap.org.uk/content/mogden-formula-tool-2

5. See GG152R Tracking water use to cut costs for further information.

6. http://www.decc.gov.uk/en/content/cms/statistics/publications/prices/prices.aspx

7. http://www.water.org.uk/home/news/press-releases/indicators2010-11/water-uk---sustainability-report-2010-11.pdf

8. http://www.water-efficiencylabel.org.uk/

9. http://wtl.defra.gov.uk/browse_criteria.asp?section=54&itemTitle=Eligibility+-+Which+products per cent2Fsystem+are+supported per cent3F

Further Reading

• HM Government: Water for Life. See http://www.defra.gov.uk/environment/quality/water/legislation/whitepaper/ for further information.

• Water Efficiency in New Buildings: A Joint DEFRA and Communities and Local Government Policy Statement. See http://www.communities.gov.uk/documents/planningandbuilding/pdf/WaterEfficiencyNewBuildings.pdf for further information.

• WRAP is a Government programme that offers free, independent and practical advice to UK businesses to minimise resource use and divert priority materials from landfill. See http://www.wrap.org.uk/ for further information.

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SERIES 10 MODULE 1: QUESTIONS

Water Management

Please mark your answers on the sheet below by placing a cross in the box next to the correct answer. Only mark one box for each question. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet in ink, return it to the address below. Photocopies are acceptable.

1. How many people in the UK may be living in areas affected by water supply-demand deficits by the 2050's?

- ☐ Between 0.27 and 0.59m
- ☐ Between 2.7 and 5.9m
- ☐ Between 27 and 59m
- ☐ Between 270 and 590m

2. What is the UK Government target for individual water consumption by 2030?

- ☐ 1.3 litres/person/day
- ☐ 13 litres/person/day
- ☐ 130 litres/person/day
- ☐ 1300 litres/person/day

3. Customers living in properties with a water meter typically use how much less water compared to those without a water meter?

- ☐ 0 per cent
- ☐ 5 per cent
- ☐ 18 per cent
- ☐ 90 per cent

4. The Mogden formula trade effluent charging scheme was agreed between the water industry and...

- ☐ Carbon Trust
- ☐ Bathroom Manufacturers Association
- ☐ Waste and Resources Action Programme
- ☐ Confederation of British Industry

5. Roughly, what is the cost of heating a cubic metre of water using electricity?

- ☐ £4,100.
- ☐ £410.
- ☐ £41.
- ☐ £4.10

6. Roughly, how much water can a waterless urinal save?

- ☐ 10 per cent
- ☐ 50 per cent
- ☐ 90 per cent
- ☐ 100 per cent

7. Which of the following products is a type of urinal flush control?

- ☐ Hydraulic valve
- ☐ Automatic tap
- ☐ Aerated shower head
- ☐ Dual flush cistern

8. Which of the following is NOT a method of improving water efficiency at the wash hand basin?

- ☐ Increasing water supply pressure
- ☐ Using a smaller wash bowl
- ☐ Using foam soap
- ☐ Using water-efficient taps

9. Roughly, what per cent reduction in water pressure will provide a 5 per cent reduction in water use?

- ☐ 1 per cent
- ☐ 5 per cent
- ☐ 10 per cent
- ☐ 50 per cent

10. Which of the following products are included on the Water Technology List?

- ☐ Pipe insulation
- ☐ Copper pipe
- ☐ Water efficient taps
- ☐ Tap washers