

Scottish Water Best Practice Guidance

Prepared for: Scottish Water



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**Scottish
Water**
Always serving Scotland

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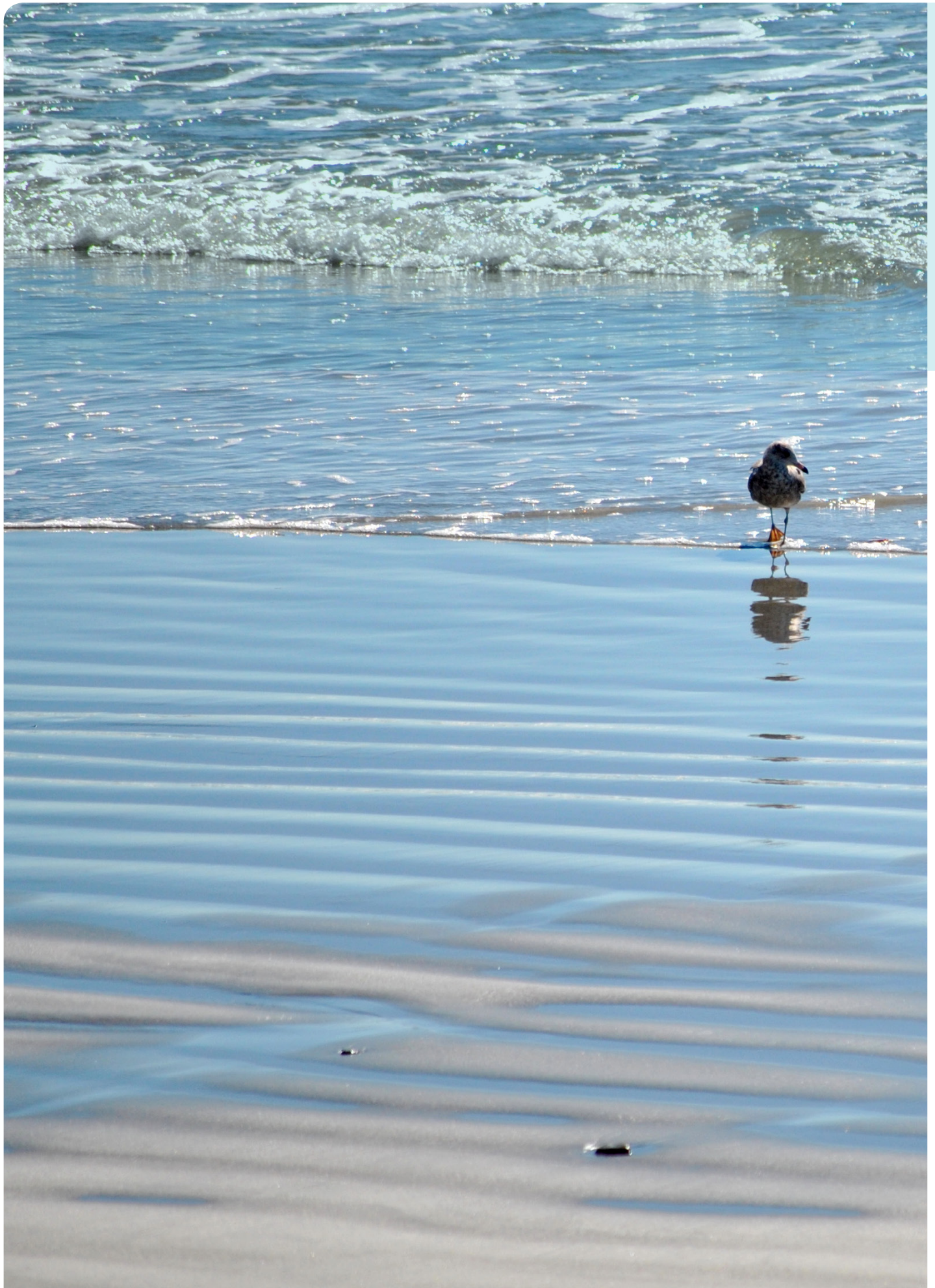
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1 Introduction

1.1 Strategic aims and objectives for Scottish Water

Scottish Water has a mandate from the Water Industry Commission, to encourage the specification of improved water efficiency measures within dwellings. This is intended to encourage and facilitate the minimisation of water usage in new build and refurbished homes.

Scottish Water commissioned BRE to support the delivery of their water efficiency agenda as a result of BRE's expertise and knowledge in developing tools and methodologies, such as Ecohomes and 'Code for Sustainable Homes' that address water efficiency.

BRE devised a four stage programme of activity as follows:

- Stage 1 Market Intelligence Report
- Stage 2 Section 7 Consultation Response Recommendations
- Stage 3 Stakeholder Workshop
- Stage 4 Production of Best Practice Guidance.

Initial discussions focused on what drivers exist to incentivise developers to specify water efficient technologies. Discussion also focused on the energy and carbon emissions associated with the processing of potable water. It was noted by Scottish Water that even in Scotland, water shortage is an issue as often there is insufficient levels of rainfall. These drivers were noted as being important as plans to further develop Scotland's housing stock will put additional pressure on the available infrastructure. The outcomes from this process are timely in influencing future

policy on water efficiency within new and refurbished housing development.

In addition to the environmental conditions that restrict water use there is also the causal impact to the environment in making our water safe to drink and wash with as a result of the processing stage. It is this processing stage that accounts for approximately 1% of the UK's total carbon emissions, around 5 million tonnes of greenhouse gases (CO₂ equivalent) per annum, and its associated cost to public funds as a result of the energy required to make the water fit for purpose. It must also be noted that water is a finite resource that requires careful management due to global, national and local issues as follows.

1.1.1 Global Water Scarcity issues

Water scarcity is a widespread issue that affects many countries throughout the world, ranging from third world countries to major economic powers. Approximately 80%* of the world's population live with the threat of water scarcity, with waterborne diseases and the absence of sanitised water one of the leading causes of death globally. Water scarcity becomes an issue when the available water in a region is less than the demand, and is not only influenced by the volume of precipitation, but by density of population, infrastructure, sanitising processes and storage.

While oceans cover the majority of the Earth's surface area, this is primary saline (salt) water. To convert saline water to potable water requires energy intensive processes, and as such only a small percentage of potable water

is captured this way. The Earth's fresh water comes from aquifers, surface water and the atmosphere (primarily precipitation), and is decidedly limited.

1.1.2 National Water Scarcity Issues

In the UK a drought can be defined as 'a period of at least 15 consecutive days or more where there is less than 0.2 mm of rainfall'[†]. Drought is a regular occurrence in UK during the hot summer months. The South East and East of England is historically the worst affected area. With a particularly high density of population and lowest level of precipitation in the UK, this area can become vulnerable during periods without rain.

The impact of a prolonged drought in the UK can be extensive, with the ecosystem, agriculture, quality of life and, in the case of widespread drought, the economy all negatively impacted on as a result.

1.1.3 Local Water Scarcity Issues

While Scotland has always been considered as a 'wet' country, there are areas that have suffered from water scarcity in recent years. Reservoirs have a limited storage capacity in Scotland, and in a period of as little as 3 weeks without rainfall, water shortage can become an issue.

For example, in the summer of 2010, Dumfries and Galloway experienced prolonged periods with little or no rainfall, leading to depleted reservoir water levels (around 63% of normal capacity). It was suggested that if this situation had escalated then a 'drought order' may

* Nature (Journal)
<http://www.nature.com/nature/index.html>

† <http://www.weatheronline.co.uk/reports/wxfacts/Drought.htm>

have been enforced. Also, within the summer months of 2010, tankers carrying 80,000 gallons of fresh water were transported to the Isle of Mull to meet the shortfall in potable water on the island. The water scarcity in this instance forced hotels on the island to close accommodation and cancel bookings.

Scottish Water are committed to ensuring that they operate in a responsible and efficient way, acknowledging the wider sustainability and environmental issues that they can positively influence and that in turn they encourage and support their customers to do the same. Through research projects and awareness raising campaigns Scottish Water seeks to examine the barriers to implementing water efficiency and successfully address these, particularly as common responses and conceptions are “but it rains all the time in Scotland...” and “people don’t like their water use being restricted...”. As there is no financial incentive, such as paying water rates based on usage (Scottish Water has no desire to implement this policy), changing homeowners attitude to reducing water consumption is a challenge that must be addressed during the design and specification stages of construction projects. Scottish Water also recognises the importance of working with the future building owners to help them understand the reason for these specifications.

1.2 Generating awareness and taking responsibility

The development of Scottish Building Standards Division (BSD) Section 7: Sustainability Technical Standard in May 2010 was seen as an opportunity to increase water use awareness, improve the minimum dwelling specifications and ultimately reduce water consumption. Through consultation and discussion, it has been commented that Section 7 in its present state, could be more ambitious in an attempt to drive the industry towards more water efficient dwellings. The outcome of the research from this publication will inform future development of this Standard relevant to water efficiency.

Through discussions with a range of stakeholders, including house builders and developers, the challenge of achieving co-operation and approval to install these measures was discussed. Feedback provided was that at present the construction industry does not perceive that there is market demand for such technologies for the reasons stated previously around the amount of rainfall Scotland experiences.

There are a number of considerations and restraints when approaching the task of reducing water consumption or implementing water efficient specifications, including cost, product availability, product performance and user satisfaction that

are discussed throughout this publication. However, the need to reduce water consumption in Scotland is important to Scottish Water, Scottish Government and a range of stakeholders within and related to the construction of dwellings and steps must be taken to facilitate this.

Every building user leaves an impact or a ‘footprint’ on the environment, that at times can be negative and may be irreversible. On a wider scale, individual action or inaction can contribute to global warming, climate change and pollution levels. However, there is an opportunity through increased water efficiency to have a positive effect on the planet. Whether the motivation is to help the UK meet specific targets, for financial benefit or simply to leave the world in a stable condition for their children, the positive choices that individuals make in their homes, in their place of work and in their lives in general can have a significant impact.

Building users and home owners are responsible for and can significantly influence their individual carbon footprint and their impact on the environment. Unfortunately, at present even those who are willing to act positively do not always have the required tools or knowledge to do so effectively. This publication will provide a guide to all stakeholders on how to achieve water efficiency, where the benefits are qualified and quantified.

2 Range of water efficient technologies

Research delivered at Stage 1 of this project identified there are a number of water efficient technologies already established and readily available in the market place for use in domestic buildings. Environmental performance standards have encouraged and supported a market for more water efficient technologies. The Code for Sustainable Homes has been a driver for new technology to the market place at a cost that is comparable with existing fittings that offer no marked improvement on the level of operational efficiency.

Below are examples of some of the water efficient technologies that are available at present for use in domestic buildings.



Figure 1 Low flow taps

2.1 Low flow taps

Low flow taps can assist in the reduction of water consumption as the flow rate dictates the amount of water used. The price of supplying low flow taps is around the same as traditional taps however if flow restrictors or aeration fittings are added the unit price can increase by around £5 to £10.

Aerated taps add air to the water coming from taps to reduce water use, while still giving the perception of a higher flow rate. They are cost competitive, easy to install and can help to save water in the kitchen and bathroom (Figure 1).

2.2 Low volume flush WCs

Low volume flush WCs (water closets) reduce water consumption by providing the user with the option of a short flush to clear liquids or long flush for solids. Dual flush WCs (eg 6/4 litre) are now commonly being specified in most developments as they are of a comparable cost to a standard system. (Figure 2).

A system that has been made available in countries such as Japan, USA, Australia and in the Scandinavian region is the WC with integrated wash hand basin. The system is designed so that the waste water from the hand basin supplies the cistern below. The product not only has water efficiency features but also has the added benefit of reducing space requirements as the sink is positioned on top of the cistern. However, care has to be taken to reduce the risk of microbiological and biological growth in the system; this can be managed by sanitising the cistern block.



Figure 2 Dual flush WC

2.3 Lower volume baths

A range of lower volume baths are also available and resemble the shape of the more traditional bath. The restricted depth and slim styling reduces the maximum water capacity required to fill the bath, helping to assist in water use reduction. The aesthetics and practicality of this design appears to be the preferred option for the majority of users and developers at present, compared with other low volume bath styles and designs, such as those which require the user to sit upright. (Figure 3).

2.4 Low flow showers

Low flow rates in showers are usually achieved by substituting the conventional showerhead with a water efficient one. These are available as complete units that are the same or similar cost to non-water efficient units. Low flow showers may reduce consumption by modulating the flow rapidly or by aeration, simple low cost showerheads are also available that provide a good area of spray and impact sensation by optimising the faceplate design.

Aerated showerheads use a mixture of air and water to create an illusion and feel of more water and can reduce water consumption by up to 30%. The benefit of this system is that the user experience is not diminished as the desired performance is still being achieved by the showerhead. (Figure 4).



Figure 3 Lower volume bath



Figure 4 Low flow shower

2.5 Rainwater harvesting systems

Rainwater harvesting is an alternative supply of non-potable water. This can include the use of water butts for collection of rainwater to irrigate garden areas, or tanks for a range of uses that includes flushing of toilets, washing cars and to use in washing machines assuming the water has been suitably treated. Rainwater is usually collected a roof area of at least 50m² for most single dwellings.

Rainwater harvesting systems should be properly designed, installed and regularly maintained to prevent cross contamination between potable water and non-potable water and to manage health and safety risks. There is also likely to be an ongoing additional maintenance cost for either the developer or building user for this type of system, however, due to the lack of domestic rainwater harvesting system installations the level of cost is undefined. In addition to this, the energy cost associated with certain installations of these systems must also be evaluated to weigh up the potential benefits. (Figure 5).

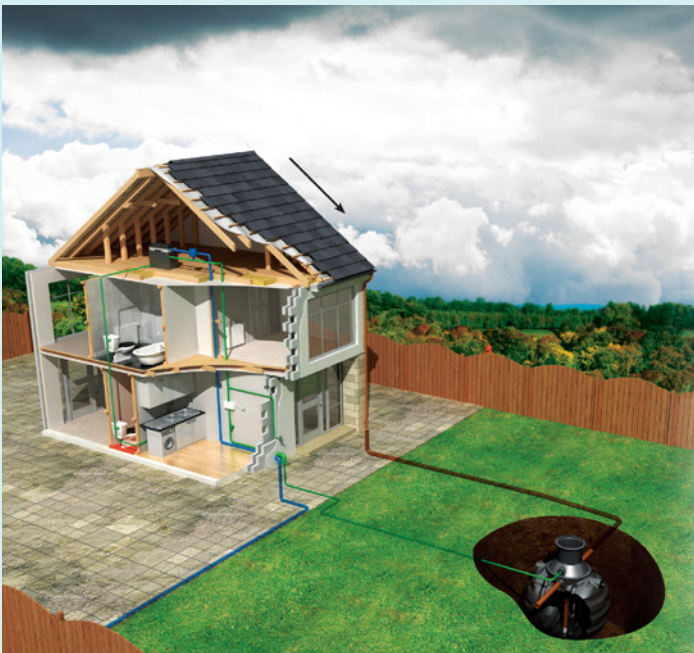


Figure 5 Rainwater harvesting system

2.6 Greywater recycling systems

Greywater is defined as waste water without faecal matter, however, for the context of domestic water recycling it is defined as waste water from baths and showers. The systems vary in size and complexity and price at typically twice the cost of rainwater harvesting systems.

Untreated greywater is normally stored for no more than 24 hours before use or discharge due to the rapid breakdown of contaminants that occur and the build up of bacteria. As the dwelling occupants generate greywater, supply is linked to demand. The greywater is generally used for toilet flushing. The system needs to be designed, installed and maintained to avoid cross contamination of potable and non-potable water. Similarly to rainwater harvesting, ongoing maintenance costs must be given consideration when specifying the installation of the system.

2.7 Other domestic appliances

There are a number of domestic appliances available that also offer water saving features including dishwashers and washing machines. These appliances can make a significant contribution to the overall water consumption in a domestic building as well as offering significant operational energy savings.

The size of the appliance as well as the operating features impacts on the energy and water requirements. Washing machines and dishwashers that save the rinse water of the last wash for the pre-wash requirement in the next load are an example of this. High energy rated products can also help to make significant operational energy savings over the product lifetime.



Figure 6 Greywater recycling system (www.watersavetech.com)

2.8 Awareness raising products

There are also awareness raising products currently on the market to help occupants understand and mitigate the impact that their water use has. This includes items such as shower timers. (Figure 7). These can come in the form of waterproof electronic clocks, water use measuring devices and sand timers which are easy to install. These types of products can be useful in terms of raising user awareness, however, this report is focussing more on the water consumption and performance of fixtures and fittings.

There are a range of 'Water Efficient' products and measures on the market. Some of these also offer a potential energy saving as a direct result. For this research project Scottish Water are specifically interested in

the water efficiency and performance of the more permanent fixtures and fittings and will therefore not look to influence a performance standard for domestic white goods as a result of this project. However, Scottish Water does recognise that this is an area that end users should be encouraged to consider when purchasing these goods.

Examples of readily available 'water efficient' products are detailed in Table 1.

It should be noted that generally the product cost appears to vary greatly based on the brand and quality of finish, rather than the level of water consumption for fixtures and fittings. For kitchen appliances there is a noted increase in cost for energy and water efficient models.



Figure 7 Showerdrop timer

Table 1: Current standards and range of available technologies to meet requirements

	Units	Section 7 – 'Gold'	Example 'Water Efficient' Products on Market	Additional Cost* for 'Water Efficient' Products?	Potential Significant Energy Saving?
WC Litres per flush		3.5	5/3 litres dual flush (3.66 litre flush) Or 4/2.6 dual flush (3 litre flush)	Approx. £11 increase	N
WHB (Wash Hand Basin) Taps	Litres/min	4	1.7 – 6 (flow restrictor)	Approx £5 per set of two restrictors	N
Showers	Litres/min	6	4.5 – 12 (flow restrictor)	Flow Restrictor – Approx £5	Y
			4.5 – 12	Aerated Head – No significant additional cost	Y
Baths	Litres	–	67 to 150	No additional cost – small baths available at reduced cost	Y
Bidet	Litres per use	–	–	–	N
Sink Taps	Litres/min	6	3 – 12 (flow restrictor)	Approx £5 per set of two	N
Dishwasher	Litres per use	–	6	'A+++' version an additional expense of approx £400	Y
Washing Machine	Litres per use	–	Below 40	'A+++' version an additional expense of approx £300	Y
Watt butt	No. of	1 per household	Various	Various dependent upon size, type and location	N
Rain Water Harvesting	% of WC use	20% of WC use	Various	Various dependent upon size, type and location	N
Grey Water Harvesting	% of WC use	20% of WC use	Various	Various dependent upon size, type and location	N

* Additional cost above 'standard' products and fittings taken from a sample range during BRE's product research

3 Overview of construction market drivers

The existence of environmental performance standards and the introduction of new legislation have undoubtedly acted as drivers for the construction sector to consider and encourage water efficiency standards. The drive towards greater water efficiency standards in the domestic sector is further supported by the aspirations of Scottish Water who seek to encourage and support the specification of improved water efficiency measures within dwellings.

3.1 Scottish Building Standards and Environmental Assessment Methods

3.1.1 Section 7 – Sustainability

'Section 7 – Sustainability' was introduced in May 2010 as a part of the Technical Standards of the Scottish Building Regulations for new build domestic properties. Section 7 benchmarks building performance specifications in five categories: 'Bronze' (mandatory) and 'Bronze +', 'Silver', 'Gold' and 'Platinum' (all

voluntary). Highlighted below (in Table 2) is the product specification for water use under each stated category.

As can be seen in Table 2, Section 7 guidance refers to Watt Butts, WCs, Wash Hand Basin Taps, Kitchen Taps, Shower Heads, Rainwater/Greywater Harvesting and Water Meters. There is no reference within the standard to a specification for Baths, or to water and energy use for the major kitchen appliances (Washing Machines and Dishwashers) as this is not an area that Scottish Building Standards influence as part of their role.

Table 2: Section 7 Water Use Standards

	Section 7 Categories – Water Use			
	'Bronze' or 'Bronze +'	'Silver'	'Gold'	'Platinum'
WC	No specific water use or product specification requirements	≤ 4.5l/m	≤ 3.5l/m	No requirements additional to 'Gold' standard
Wash Hand Basin Taps		≤ 6l/m	≤ 4l/m	
Kitchen Taps		-	≤ 6l/m	
Shower Head		≤ 8l/m	≤ 6l/m	
Rainwater/Greywater Harvesting		-	≥ 20% for toilet flushing	
Water Meter		-	Yes	
Water Butt		1 per dwelling	1 per dwelling	
≤ Less than or equal to ≥ Greater than or equal to				

3.1.2 Code for Sustainable Homes

The recognised environmental assessment method for domestic properties in Scotland is EcoHomes, however, this standard has not been embraced in the same way as Code for Sustainable Homes has in other parts of the United Kingdom and as a result has not been revised since 2006. As environmental guidance and sustainability targets have progressed significantly since 2006, the Code for Sustainable Homes (2010), which is used widely by developers and house builders in England, Wales and Northern Ireland, was considered as a relevant comparable standard.

Within the Code for Sustainable Homes (The Code), the objective is similar to that of Section 7 in that it attempts to promote water efficiency, however the targets for water use are approached in a different manner. Instead of specifying individual performance standards for water consuming items, the focus is upon the overall water consumption in litres per person per day. This gives designers and developers more freedom to focus upon specific areas of water use within the project. With an overall target to be met there is scope to vary the performance of specific items,

provided the final target is met, rather than being given performance requirements for each product. A calculation methodology and tool is used to determine the consumption figures, and 'credits' within the scheme are awarded as highlighted in Table 3.

Within the water use calculation tool, the following items are considered:

- WC
- Wash Hand Basin
- Shower
- Bath
- Kitchen Sink
- Washing Machine
- Dishwasher
- Water Softener
- Bidet

While Section 7 gives a performance standard for individual items, the Code for Sustainable Homes allows the focus to be on the overall reduction of water use, and also includes Baths, Washing Machines and Dishwashers. Bidets and Water Softeners are not commonplace in Scotland and as such have not been considered throughout the course of this study.

Table 3: Code for Sustainable Homes Water Use Standards

Water Consumption	Credits	Mandatory Levels
≤120 litres per person per day	1	Level 1 and 2
≤110 litres per person per day	2	
≤105 litres per person per day	3	Level 3 and 4
≤90 litres per person per day	4	
≤80 litres per person per day	5	Level 5 and 6

In order to quantify a notional volume of water use in litres per person per day, and to allow a degree of comparison with other domestic properties within the UK and Northern Ireland, the Section 7 ‘Gold’ Standard has been used as a benchmark in the Code calculator. The results are in Table 4 as follows.

As highlighted in Table 4, based on Section 7’s most onerous requirements for water use, the ‘Gold’ Standard equates to approximately 141 litres per person per day. As no values have been given under Section 7 for baths, washing machines or dishwashers, default values from the Code for Sustainable Homes manual have been applied.

Based on the ‘Gold’ standard specification, zero credits out of a possible of six credits would be awarded based on the Code credit criteria under the ‘Wat 1 – Internal Potable

Water Use’ category. Under the ‘Wat 2 – External Potable Water Use’ category, one credit could be awarded based on the use of a water butt.

As Water Efficiency is a mandatory credit in the Code, achieving zero credits under this criterion would mean that certification would not be achieved. Therefore, Section 7 Gold Standard for Water Efficiency would not achieve compliance with the Code. There have been in the region of 55,000 Code for Sustainable Homes assessments accredited in the UK to date, at Code for Sustainable Homes Level 3 thus achieving water efficiency of around 105 litres per person per day. This demonstrates that it is achievable to promote much higher levels of water efficiency as technology is available on the market to accredit the stated number of assessments at around 105 litres per person per day.

Table 4: Section 7 Standards applied to Code for Sustainable Homes Calculator

Installation Type	Unit	Capacity/Flow	Litres per person per day
WC	Flush	3.5 litres	16.8–20% for RWH = 13.44
Wash Hand Basin	Litres/min	4 l/min	21.17
Shower	Litres/min	6 l/min	18
Bath	Litres	225 litres	36
Kitchen Sink	Litres/min	6 l/min	31.758
Washing Machine	Typical Use	49 litres	16.66
Dishwasher	Typical use	13 litres	3.9
Water Softener	Litres per use	-	0
Bidet	Litres Per Use	-	0
			140.928

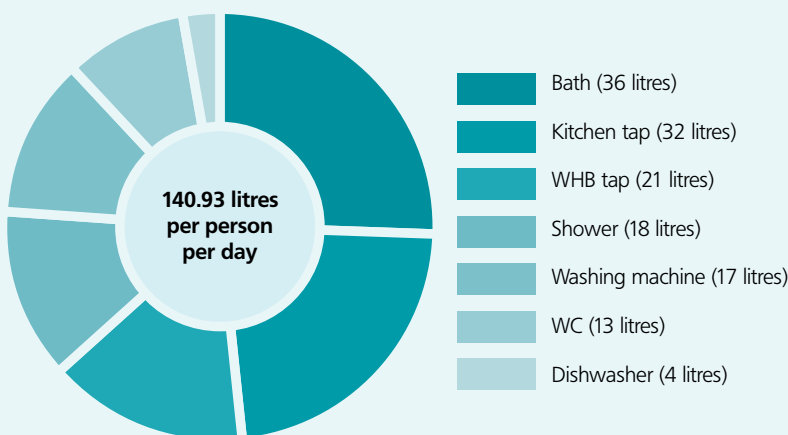


Figure 8 Section 7: Gold Standard Water Usage

4 Implementing water efficiency

4.1 Challenges to implementing water efficiency

Through BRE Scotland's product research and stakeholder sessions, it was concluded there are a number of challenges and perceived barriers to implementing water efficiency measures and standards.

Perceived challenges can be categorised as follows:

Lack of legislative drivers

- The need for a more ambitious water efficiency standard within the Section 7 guidance, or other equivalent standards, to act as real driver towards a 'low water use' design.

Impact on marketability of dwelling

- Saleability risk of 'low water use' homes;
- Perceived additional cost for developers;
- Cost vs. Benefit argument, particularly around 'supplementary' technology systems for domestic properties; and
- Possible additional maintenance costs for landlord/developers/owners.

Product performance

- Lack of availability of suitable 'supplementary' products (such as Rain Water Harvesting suitable for all dwelling types); and
- 'Fear factor' of unknown or untested products.

Based upon the stakeholder sessions, the key issue for developers appears to be the increased cost for low water use fixtures and fittings, and low water and energy use appliances. However, while items such as rainwater harvesting, or high performing white goods, can be expensive, there are a range of products that are widely available to help lower water use in a domestic environment significantly below typical baseline consumption figures at a relatively small additional expense.

The suitability of specific systems is also an important consideration. Rainwater harvesting for example, can be effective given the correct circumstances, however, for a high apartment building the amount of energy required to pump the harvested water upwards (as generally, due to space restrictions the storage tanks are concealed and installed underground) it is not always conducive to a 'sustainable' building. The ongoing maintenance costs are also prohibitive to developers.

For building occupants and users there are additional challenges that require to be addressed in order to progress towards becoming a 'low water use' nation. These have been summarised as follows:

Awareness raising

- Lack of motivation and understanding of the need to reduce water use as Scotland is generally considered to have a high rainfall rate; and
- Lack of understanding and education of building users in relation to operation and performance of installed products and systems.

Product performance

- Reduced user satisfaction through low water use fixtures and fittings (e.g. low shower flow rate).

The key occupant challenge relates to the knowledge of the building users. There appears to be a lack of understanding as to why users would want to reduce their individual water consumption, particularly as most consider Scotland to be a 'wet' country with high levels of rainfall and therefore do not perceive there to be any water scarcity issues or the need for a focus on reduction techniques.

4.2 Opportunities from Implementing water efficiency

This research has also demonstrated that there are a number of opportunities and associated benefits for the industry and the end user as a result of successfully incorporating water efficiency measures into the domestic market. These have been summarised under the following Environmental, Economic and Collaboration and Innovation themes:

4.2.1 Environmental

Demonstrating compliance with legislation

The introduction of Section 7 – Sustainability is the next step for the Building Standards Division in encouraging the sustainable design and construction of all new buildings within a broader context of sustainable development.

The measures of sustainability are broadly related to the built form. The scope of the measures can be divided into two sets, extracted from the Technical Guidance as follows:

- **Climate change, energy and water resources.** Promote the more efficient use of energy, fuel and water in buildings. Reducing water use will reduce the energy consumed and the carbon emissions associated with distributing, processing and heating of water. It is also important that building occupants have the opportunity to understand how their behaviour can reduce use of these resources.
- **Quality of life; material use and waste.** Homes should be designed to accommodate flexible living, working and studying patterns for individuals, groups and families. More aspects of designing for well-being, such as daylighting rooms more effectively and protecting from noise from adjacent buildings, should be promoted for all new home occupants.

The labelling system in Section 7 rewards new buildings that meet the 2010 building standards with a Bronze level label. Further optional upper levels are defined by Silver, Gold and Platinum. The system can be used by developers or planners who may wish to demonstrate their environmental commitment by referring to the sustainability labels.

Formally adopting some of the water efficiency measures and specifications discussed in this project for all new homes will help developers in demonstrating compliance with the Section 7 standard, beyond the minimum Bronze label. This should encourage home owners that measures have been incorporated to ensure that the design and installations fully take account of current legislation and where progressing beyond the minimum Bronze standard and are going some way in helping to 'future proof' current designs.

Legislation is continuously evolving with the purpose of furthering the achievement of sustainable development and what is considered today's best practice may well be tomorrow's minimum standard in an attempt to drive the built environment towards a low carbon future. Developers should be aware of this and should be encouraged to set high performance benchmarks, delivering beyond minimum standards and demonstrating that they are responding to legislation to help us deliver our low carbon future.

Improving the environmental impact

The overall environmental impact of a dwelling is something that is being targeted, measured and reported within Scotland and throughout the UK. There are many drivers for considering the environmental impact of a dwelling including legislation, such as a requirement for Code for Sustainable Homes, Section 7 and EPCs (Energy Performance Certificate), a growing public awareness regarding environmental issues and the developers own Corporate Social Responsibility and image.

Tools and standards such as Code for Sustainable Homes and Section 7 both have dedicated categories that address water efficiency in dwellings. Incorporating water efficiency measures will help to ensure that the dwelling performs favourably under the water categories which make a significant contribution to the overall environmental performance of a dwelling. In addition to this, reduced water consumption will result in a smaller demand in terms of water resource, which will in turn help to reduce the carbon footprint associated with water use.

4.2.2 Economic

Improving marketability

The operational performance of dwellings, including financial and environmental, is a consideration that is increasingly factored in to the purchase decision of any dwelling, particularly in today's climate. Occupiers are becoming more aware of the increasing energy and heating costs associated with their homes and a number of buyers and occupiers are starting to consider the operational cost prior to committing to a new home.

The installation of water efficient measures in a dwelling will ultimately reduce water use which in turn will contribute to the reduction in energy consumed and the carbon emissions associated with distributing, processing and heating of water. Therefore, water efficiency measures can be promoted to help improve the marketability of a dwelling by demonstrating lower operational costs and environmental impact.

There is an additional benefit here also for the developer who can market the 'Green' dwellings in a way that can help to improve their own image with public and private investors.

Funding opportunities

Scottish Water are committed to improving water efficiency standards throughout Scotland and is supporting research and development projects to understand how best to make this happen. For this project, Scottish Water is specifically interested in improving water efficiency measures within the Scottish domestic market. Scottish Water has allocated resource and budget to research this topic and support the domestic market in a move towards water efficient standards. Funding opportunities have been made available to support efficiency measures in new build and refurbishment homes. This is an attractive incentive for developers and occupiers who can promote and enjoy these measures without a significant increase in capital cost provided consideration has been given to the specification referenced later in this document. For further information Scottish Water should be contacted directly.

4.2.3 Collaborations and innovation

Benefiting from research and development

Scottish Water is in support of encouraging, and where possible assisting, innovation in relation to water efficiency. BRE Scotland's Innovation Park is an example of this, where Scottish Water are contributing towards the specification of water efficiency measures in one of the buildings. The Innovation Park is a demonstration ground where products, specifications and a range of materials and products and innovative design features are being piloted in an attempt to inform and shape our future built environment, working towards a low carbon, more sustainable future.

Research and development that is supported by Scottish Water, such as the Innovation Park, provides a learning, testing and visual platform for specifiers, manufacturers and developers allowing them to interact and learn from new designs, products and technologies. These demonstration projects help to mitigate the risk of the unknown and help to breed confidence for developers who are looking to incorporate and deliver against more efficient standards and specifications. They also provide an unbiased testing ground for products, where performance can be monitored and examined and the results shared with all interested groups. This provides useful feedback to manufactures on product performance and user satisfaction and can help to influence future specifications.

5 Recommended specification

Through extensive market and product research and practical product selection exercises, including the delivery of a workshop with the relevant stakeholders, it was clear that when producing a 'low water use' specification that the 'one size fits all' approach is not appropriate. Dwelling types of varying

size (and assumed occupancy) have differing requirements and as such may require a different specification. During the delivery of the workshop stakeholders discussed what would be considered to be acceptable maximum consumption levels for each fixture and fitting, as referenced in Appendix A.

Stakeholders also proposed the following specifications for the 'typical' property types listed below:

5.1 One or two bedroom property

Table 5: Water Efficiency Measure Specification – One or two bedroom

	Units	Section 7 'Gold' or 'Platinum' Standard	Product Specification (max. values)
WC	Litres per flush	3.5	5/3 (dual flush) or 3.5 (single flush)
WHB (Wash Hand Basin) Taps	Litres/min	4	1.7
Showers	Litres/min	6	6
Baths	Litres	-	160
Sink Taps	Litres/min	-	4
Dishwasher	Litres per use	-	9
Washing Machine	Litres per use	-	45
Building User Guide	-	-	Explaining any water efficiency measures and their purpose

5.2 Three, four or five bedroom properties

Table 6: Water Efficiency Measure Specification – Three, four or five bedroom property

	Units	Section 7 'Gold' or 'Platinum' Standard	Product Specification (max. values)
WC (Main Bathroom)	Litres per flush	3.5	6/4 (dual flush) or 4.5 (single flush)
WC (En Suite or additional bathrooms)	Litres per flush	-	5/3 litres (dual flush) or 3.5 litres (single)
WHB (Wash Hand Basin) Taps	Litres/min	4	1.7
Showers	Litres/min	6	6
Baths	Litres	-	170
Sink Taps	Litres/min	-	4
Dishwasher	Litres per use	-	9+ (dependent upon occupancy)
Washing Machine	Litres per use	-	45+ (dependent upon occupancy)
Building User Guide	-	-	Explaining any water efficiency measures and their purpose

While the specifications are similar there are several key differences that should be highlighted.

Dual flush

Our research suggested that users and specifiers were comfortable with a dual flush option. However they were concerned with the performance of a 5/3 litre dual flush system, yet comfortable with a 6/4 litre, particularly for the main bathroom of a house likely to be occupied by a number of younger children. The option of a single reduced flush and not a dual flush may be the optimum solution in this instance. This could be specified as a single 3.5 litre flush volume, so as to comply with the Section 7 'Gold' standard without dropping to as low as a 3 litre flush option.

En suite or additional bathrooms

These are in addition to a main bathroom and in a family home would likely to be used less frequently than the main bathroom and less likely to be the primary bathroom for younger children. Therefore, further reduced flush volumes in a supplementary en suite or bathroom would be recommended.

Baths

Three and four bedroom houses are more likely to accommodate families (as compared with the two bedroom flat) with children and therefore slightly larger volume baths with a wider base, for multiple children to sit in, would be recommended.

Dishwashers

When using low water use appliances it is important to specify the appropriate capacity of machine for each particular dwellings individual requirement. Full size dishwashers may not be appropriate for a two bedroom flat as it is unlikely to be filled for each use. Therefore, the specification of a compact dishwasher was considered to be the best option for the dwellings with a lower occupancy. Each dwelling type has varying dishwasher size.

Washing machines

For three and four bedroom houses a washing machine with a higher load capacity may be more suitable as there would be a higher number of occupants, resulting in a larger volume of washing. If the washing machine was limited in size multiple washes may be required, which would not be considered to be energy or water efficient.



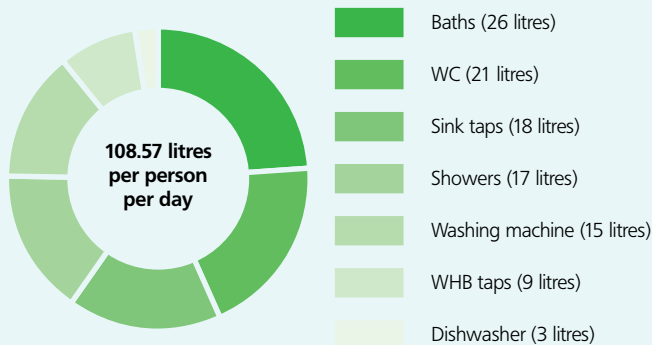


Figure 9 One or two bedroom specification

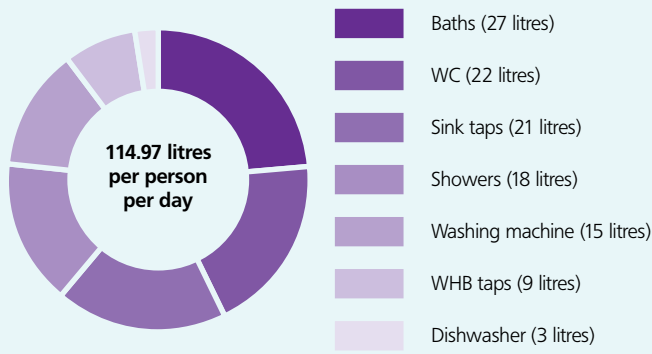


Figure 10 Three, four or five bedroom specification

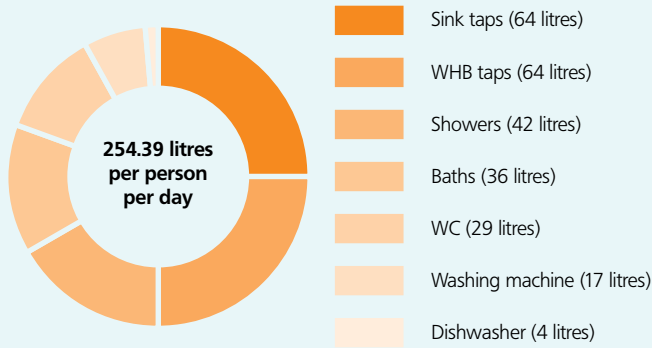


Figure 11 Code for Sustainable Homes – Default values

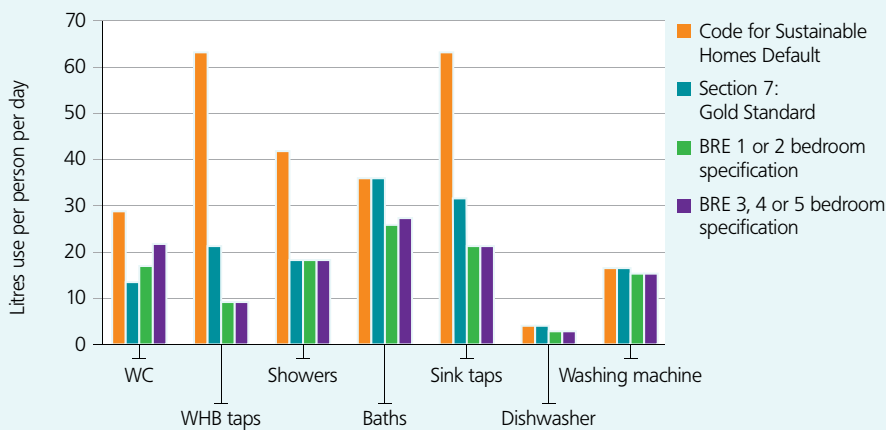


Figure 12 Water usage comparison

Please note that there is a mandatory 20% contribution from RWH for WC flushing for Section 7: Gold Standard.

5.3 Specification performance

The Code for Sustainable Homes water calculation tool was used as a comparator with the above specifications. For the one or two bedroom property the estimated consumption is 108.56 litres per person per day (2 credits under the Code for Sustainable Homes) and for the three, four or five bedroom property the consumption is estimated to be 115.72 litres per person per day (1 credit). This is significantly lower than the 140.928 litres per person per day that is estimated for demonstrating compliance with the requirements for Section 7 'Gold' label.

The product specifications and the overall consumption are represented in the pie charts below for the 1 or 2 bedroom property and the 3, 4 or 5 bedroom property. A third pie chart is also provided using the default values from the Code for Sustainable Homes calculator to act as a comparator.

The product specifications can greatly influence the overall water consumption in a domestic property. The graph below helps to demonstrate the difference in consumption levels for each individual item and compares standard default values (commonly available in the market place), with products that demonstrate compliance with Section 7 Gold Standard and also with the two water efficiency specifications for the flat and house types mentioned above.

6 Energy considerations

6.1 Energy intensive treatment processes

In the UK, the water industry abstracts approximately 19 billion litres of water per day from boreholes, reservoirs and river abstraction points. To produce and supply clean drinkable water to homes in the UK requires approximately 600 kWh of energy per million litres of water. The energy used for water supply and sewage treatment processes equates to approximately 1% of the UK's total emissions, around 5 million tonnes of greenhouse gases (CO₂ equivalent) per annum. It is clear that conserving and making efficient use of water is not only important in terms of water scarcity, but also in terms of the impact that this has upon the UK's energy use and associated carbon emissions.

6.2 Associated energy consumption

For all items that make use of hot water, the energy use associated with raising the temperature of the water should also be considered, particularly with wash hand basins, showers and baths. Assuming the hot water generator is efficient, reducing water use is the key to reducing energy use. Energy savings should be realised through the 'low water use' specifications detailed previously.

To realise a reduction in water, and therefore in energy consumption, specifying and installing 'low flow' products is key, however, it is important that the flow rates are not reduced to a level where user satisfaction and operational use is compromised. For example, if the flow rate of a shower is too low to wash and rinse effectively, this will result in the user spending longer in the shower in order to complete this task and could mean a higher water and energy use.

6.3 Water saving techniques vs additional energy consumption

For 'supplementary' technologies, such as rainwater harvesting, energy use must also be considered. When specifying rainwater harvesting the appropriateness of the system for the property and potential energy use must be assessed. While perhaps appropriate for detached or semi-detached homes with ample storage space for the tank at height (e.g. loft space), properties such as flats will find the availability of space for a storage tank sized accordingly for a rainwater harvesting system to be a challenge, particularly at height and therefore creates an increased transportation distance between the tank and the end use. In this situation an underground storage tank with a pump would often be required to transport the rainwater to the WC. This energy requirement and use can often be significant and opens the debate of efficiency in relation to water savings versus energy consumption.

7 Conclusions

Water scarcity is a real issue in the UK, with water shortages regularly resulting in hosepipe bans in certain areas of the country. Within Scotland, reservoirs have a limited storage capacity, and in a period as little as 3 weeks without rainfall, water shortage is problematic. There is also an energy intensive process that is required to ensure water is treated and transported in such a way to make it safe for the consumer. Therefore, it is important to minimise usage through specification where possible and to generate end user awareness to assist them in making more informed, more efficient and more sustainable choices.

The development of the Scottish Building Standards through the Section 7: Sustainability guidance was seen as an opportunity to increase awareness by improving water specifications and ultimately reducing water consumption. Through consultation and discussion, it has been commented that Section 7 could be more ambitious in terms of requiring a more ambitious water efficiency specification that will help to drive the industry towards water efficient dwellings. Scottish Water is currently working with the Scottish Building Standards Division to address this issue based on conclusions from this research.

There is currently no formal requirement to meet any of the Section 7: Sustainability targets as this is a voluntary scheme, the Code for Sustainable Homes is only applicable to England, Wales and Northern Ireland and EcoHomes has not been adopted as a formal standard in Scotland. As such, there is no mandatory legislative driver to encourage developers towards the uptake of water

efficiency measures. In addition to this, there are also several other concerns and restrictions that some developers consider to be a barrier to effectively managing water use. This includes the 'saleability' of 'low water use' properties, the additional (perceived) capital cost of the items and any maintenance costs associated with implementing water efficiency measures, the 'Cost vs. Benefit' argument and the reluctance to install products that are not yet widely accepted in the market.

In terms of the building user, it is clear that there can often be a lack of understanding as to why water consumption should be reduced and as such there is a lack of motivation to attempt to save water. However, based on occupant feedback from multiple case studies, 'low water use' products are generally accepted provided there is no reduction in the expected performance of these products. The key barrier for the building user is the possibility of reduced occupant satisfaction through water efficiency measures.

It became apparent that any 'water efficiency' specification would have to consider all of the above concerns and still allow the dwelling and its occupants to better manage water use. It is appreciated that each property has varying numbers of fixtures/fittings, size, locations and occupancy. With such differing circumstances for each dwelling, it is clear that one specification is not appropriate for all properties, and as such multiple recommended specifications were developed for various dwelling types to encourage developers to work towards a 'low water use' design and to help to encourage the

specification of improved water efficiency measures.

Scottish Water is currently conducting water efficiency trials within the domestic market to help promote water efficiency measures and trial emerging technologies, without the risk of compromising user experience. Scottish Water has a desire to encourage developers to work towards achieving 'interim' and 'aspirational' water efficiency levels through the specification of low water consuming fixtures and fittings in domestic properties. The Scottish Water 'interim' and 'aspirational' targets have been set at 120 and 105 litres per person per day respectively. These are included within Appendix A and example product specifications have been provided. The specifications for the 'interim' and 'aspirational' targets have been derived as a result of the stakeholder workshop session, product research and post occupancy feedback that has been collated, analysed and documented over the life of this research project. The specifications in Appendix A demonstrate that consumption rates of 115 litres per person per day can be achieved, comfortably below the maximum desirable Scottish Water 'interim' target of 120 litres and without overly compromising the end user experience or expected product performance. The specification also details what consumption levels would be required to align with Scottish Water's 'aspirational' target. The consumption levels specified in Appendix A indicate that the consumption rate would be 105 litres per person per day, in-line with Scottish Water's 'aspirational' target.

8 References

Code for Sustainable Homes
<http://www.breeam.org/page.jsp?id=86>

Homes for Scotland
<http://www.homesforscotland.com/>

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<http://www.scotland.gov.uk/Topics/BuiltEnvironment/Building/Building-standards>

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<http://www.watercommission.co.uk/>

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<http://www.weatheronline.co.uk/reports/wxfacts/Drought.htm>

Appendix A

Table A1 summarises an example of the maximum flow rates, flush volumes, capacities and litres per cycle that could be specified for various water consuming appliances within a domestic property in order to help achieve the desired 'Interim' and 'Aspirational' water saving targets that have been set by Scottish Water. The table also provides the expected consumption rates (in litres/per person/day) for 'Typical Existing Usage' and the Section 7 'Gold' standard as a comparator.

There are many water efficient technologies, fixtures and fittings widely available on the market at present, many at competitive prices that can help to achieve the water efficiency targets that have been set by Scottish Water. These technologies, fixtures and fittings have been discussed in detail within the Stage 1 and Stage 2 reports for this project. Example of these technologies, fixtures and fittings, which can help to demonstrate compliance with the Scottish Water 'Interim' and 'Aspirational' targets, include the following:

Water Closet (WC)

There are many dual flush and reduced flush WC options available for the domestic market at present which are cost competitive and that are generally accepted by the end user. The more efficient options can help to significantly reduce the overall water consumption levels within a property. The 6/4 litre or 5/3 litre flush options would help to demonstrate compliance.

Wash Hand Basin and Sink Taps

Low flow taps are also widely available on the domestic market and are again price competitive when compared with traditional products. Another option is to install flow restrictors or aeration fittings to reduce the flow rate. Different flow restrictors can be specified for varying flow rates and aeration fittings are used to add air to the water coming from the tap to reduce water use, while still giving a full-bodied flow. Both are simple enough to install at fairly low cost.

The flow rates would generally be higher for kitchen sink taps as these are generally used for a purpose i.e. to fill a kettle or pot and the restricted flow rate would not impact on the volume of water required. Restricting the flow rates for WHB (Wash Hand Basin) taps and sink taps to 1.7 litres per minute and 4 litres per minute retrospectively would help to demonstrate compliance.

Showers

Low flow rates in showers are usually achieved by substituting the conventional showerhead with a water efficient one, which are also cost competitive. Low flow showers may reduce consumption by modulating the flow rapidly or by aeration. Aerated showerheads use a mixture of air and water to create an illusion and feel of more water and can reduce water consumption by up to 30% without diminishing performance or user comfort. Reducing the flow rate to 6litres per minute or down to 5 litres per minute would help to demonstrate compliance.

Baths

A range of lower volume baths are also available, with restricted depth and slim styling that reduces the maximum water capacity required to fill the bath. These resemble the shape of the more traditional bath and are cost competitive in the market place. Ensuring that the bath's water capacity is no more than 170 litres will help to demonstrate compliance.

Dishwasher and washing machine

Domestic appliances can make a significant contribution to the overall water consumption in a property as well as offering significant operational energy savings. The size of the appliance as well as the operating features impacts on the energy and water requirements. Washing machines and dishwashers that save the rinse water of the last wash for the pre-wash requirement in the next load are an example of this. High energy rated products can also help to make significant operational energy savings over the product lifetime. There are a number of options available on the market and prices can vary depending on the specification and manufacturer. Dishwasher and washing machines which consume a maximum 9 litres per cycle and 45 litres per cycle retrospectively would help to demonstrate compliance.

Table A1

	Units	Typical Existing Usage – as defined by Scottish Water	Section 7 – 'Gold' standard	Scottish Water – 'Interim' Target	Scottish Water – 'Aspirational' Target*
WC	Litres per flush	-	3.5	4.5 or 6/4	3.5 or 5/3
WHB (Wash Hand Basin) Taps	Litres per min	-	4	1.7	1.7
Showers	Litres per min	-	6	6	5
Baths	Litres	-	225 (assumed)	170	160
Sink Taps	Litres per min	-	6	4	4
Dishwasher	Litre per cycle	-	>9 (assumed)	9	9
Washing Machines	Litres per cycle	-	>45 (assumed)	45	45
Total consumption**	Litres per person per day	150	141	≤120	≤105
Compliance with Scottish Water Target	Litres per person per day	Non-compliance	Non-compliance	Compliant with 'Interim' Target	Compliant with 'Aspirational' Target

* Example specifications have been detailed to demonstrate how the 'interim' or 'aspirational' targets could be reached.

** The Code for Sustainable Homes calculator has been utilised to provide an indication of consumption levels, in litres per person per day, in accordance with Scottish Water's targets.



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