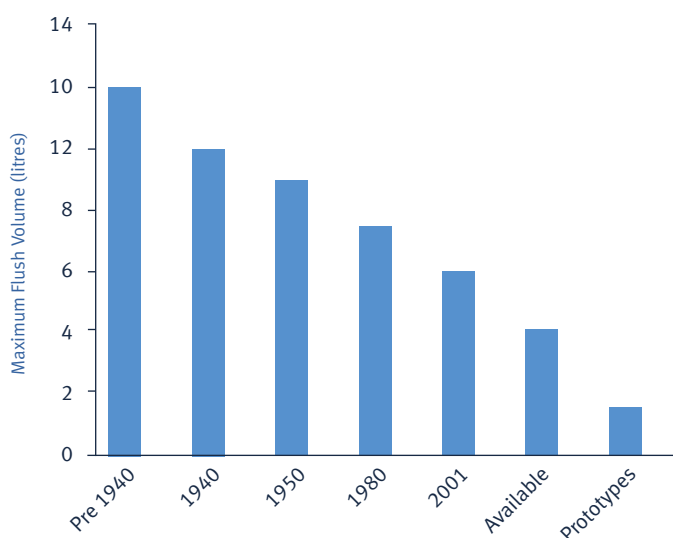


1 toilets



It is essential that toilets flush effectively to maintain standards of hygiene, but designs are now available that use significantly less water than was required in the past. In older properties, flushing the toilet represents the largest proportion of water used in the home. An average household¹ with a nine litre toilet flushes around 110 litres down the pan – that’s 30 per cent its total water consumption per day. This should reduce as older toilets are replaced with newer ones with lower flush volumes. Toilets in offices, schools and public conveniences account for an even greater proportion of total water use although the exact percentage will depend on factors such as whether urinals are available.

Figure 2: Toilet full flush volumes have reduced and continue to fall



Valves and siphons

Before January 2001, all domestic toilets in the UK had to use a siphon flush, which was originally developed to prevent water wastage. When we pull the handle, a piston lifts water to start a siphon, which empties the cistern into the toilet bowl. When the cistern is empty the siphon is broken and the cistern refills ready for the next flush.

Since January 2001 approved drop valves and flap valves have been permitted. These allow a button operated flush and more obvious two-button dual-flush operation. But sooner or later, unlike the siphon, they will leak. The Water Regulations require endurance testing of 200,000 flushes under laboratory conditions, but mechanisms can be incorrectly installed and debris can enter the cistern during installation, causing immediate leaks. Evidence from water companies shows that leakage from valves is already becoming a serious problem².

From a sample of over 500 properties that were investigated due to unusually high water bills, Bournemouth and West Hampshire Water identified 31 properties where the cause of the high water use was leaking drop valve operated toilets. On average, six month water bills for these properties were over £370 more than the bill for the six month period before the leak.

¹ Average occupancy 2.4 people.

² Data supplied by Bournemouth and West Hampshire Water for the period July 05 to Jan 07.

Table 1: Comparisons of toilet flushing mechanisms.

Flush mechanism	Advantages	Disadvantages
Siphon flush (all UK toilets prior to 2001)	<ul style="list-style-type: none"> • No leakage • Fail-safe • Robust • Familiar technology in UK 	<ul style="list-style-type: none"> • Lever rather than button(s) • Dual flush operation less obvious to the user • Gives a lower flow rate than a drop valve toilet
Drop valve	<ul style="list-style-type: none"> • Can be button operated • Dual flush operation is more easily understood by user • Allows lower flush volumes by giving a higher flow rate 	<ul style="list-style-type: none"> • Will eventually leak which can be hard to detect • Poor installation or DIY intervention can cause valve to stick • Seals are vulnerable in hard water areas

Detecting a leaking flush valve

Small leaks are likely to go unnoticed but should be detected by the following test:

If the toilet has been flushed recently, allow the water under the rim to drain for about a minute. Wearing rubber gloves, dry the back of the pan below the rim with toilet paper. Any leak should be obvious. If you can't see a leak, hold a sheet of toilet paper against the back of the pan for about 30 seconds and check that it stays dry. Since most cisterns with valves have an internal overflow that discharges into the pan, a leak could be due to either the inlet or the flush valve. If turning off the water to the toilet quickly stops the leak, check the inlet valve.

Dual flush

Dual flush siphon and valve flush toilets both offer potential savings, particularly in the home. For commercial and public toilets, the savings are likely to be less, as users may not know how to use the system and will often have no financial incentive to save water.

Typically the effective flush volume has been calculated as the average of one full flush and three reduced flushes. Therefore a 6/4 dual flush toilet should average 4.5 litres per flush, but this figure can vary depending on who is using it.

When specifying water efficient toilets, check the Water Technology List for approved products at: www.eca-water.gov.uk

Low-cost retrofit options

One of the most cost effective domestic water efficiency measures³ is to convert an existing toilet to variable flush and/or to optimise the full flush volume. Retaining the original siphon avoids the problem of leaking valves.

Effective flushing volumes

An effective flush volume is the volume of water needed to clear the toilet pan and transport solids far enough to avoid blocking the drain. In reality, few toilets when fitted flush with the optimum volume of water. Too little water will lead to double flushing and increased risk of the drain blocking, whilst too much will waste water. Many devices are available to avoid wasting water. Some displace a volume of water in the cistern and so reduce each flush by an equivalent amount, typically one litre. Before and after you fit this type of device check that the flush works well, that the inlet valve does not leak and that it is adjusted so that the water is up to the level marked in the cistern. Lowering the water level will reduce the flush volume, but may also make the flush less efficient. Cistern displacement devices are often available free of charge from local water companies, or a suitable plastic bottle filled with water can be placed in the cistern.

If double flushing is needed to clear the pan, the amount of water used could actually increase. If there are problems with flushing, remove the cistern displacement device immediately.

Variable flush devices

These devices allow the user to choose how much water is used for each flush. Some allow a flush to be interrupted once the pan is clear and some allow one of several pre-determined flush volumes to be selected before flushing. Fitting variable flush retrofit devices resulted in an 8.5 per cent reduction in total domestic water use in trials by water companies and the Environment Agency⁴.

³ *The Economics of Water Efficient Products in the Household*, Environment Agency 2003

⁴ *Retrofitting variable flush mechanism to existing toilets*, Environment Agency 2005.

Individual households have achieved even greater savings with no evidence of double flushing. Many older toilets are already fitted with dual flush siphons, but with the dual flush function disabled by adding a small plug. Removing this plug converts a nine litre toilet into a 9/4 dual flush and requires the flush lever to be held down to achieve a full flush.

Retrofit devices that follow the same ‘pull and hold for full flush’ are available. This seems logical but people will need to be told what to do. Whilst instruction stickers are supplied, these are often not fitted for aesthetic reasons.

The Thomas Dudley Duo siphon is designed so that it defaults to full flush. Whilst there is a risk that users may never discover the part flush function, visitors will be spared embarrassment and repeated flushing.

Delayed action inlet valves

As a toilet flushes, it immediately starts to refill so the actual flush can be significantly greater than expected. In a simple test, Portsmouth Water researchers found that a 5.8 litre flush increased to 6.8 litres with the inlet valve left on during the flush – a 17 per cent increase. This problem is solved by the Torbec Ecofill inlet valve which stays shut until the flush has stopped.

Do low flush toilets cause drain blockage?

Properly designed and correctly installed toilets with flush volumes as low as four litres can be connected to conventional drains without fear that the drains will become blocked⁶. When the existing nine litre toilets at St Leonard’s Middle School, Hastings were replaced with four litre water efficient models, the previous problems of bad smells and blockages disappeared⁷. For flush volumes lower than four litres care may be needed with the design of the drain.

As the amount of water we use has increased considerably since most of the UK’s sewers were built, sewers (mains drains) are no more likely to become blocked due to less water being used to flush the toilet or indeed due to any other water efficiency measures.

Regulations

Toilets that are to be connected to the mains water supply must meet the Government’s performance specification⁸. Water Regulations Advisory Scheme (WRAS) approval is the best way to demonstrate that a product complies, but there is no legal requirement to independently test and verify products.

Table 2: Low cost retrofit devices that retain the leak-free siphon. The cheapest of these devices can be obtained free of charge and the most expensive will cost up to £20 to buy plus installation costs.

Device	Saving per flush ⁵	Advantages	Disadvantages	Cost
Cistern displacement devices	0.5 to 2.5 litres	<ul style="list-style-type: none"> • Low cost or DIY labour only 	<ul style="list-style-type: none"> • Only beneficial if the existing full flush is excessive 	£
Interruptible flush – user releases lever or pushes a button when the pan is clear	30%	<ul style="list-style-type: none"> • Low flush default forces regular user to learn the operation • Accurate control of flush volume possible 	<ul style="list-style-type: none"> • First time users may assume the flush is ineffective unless instructions are provided • Potential for double flushing 	££
Variable flush – knob rotated for high, medium and low flush	30%	<ul style="list-style-type: none"> • Obvious operation without instructions 	<ul style="list-style-type: none"> • Might not appeal visually to all users • Requires two operations, adjust and flush • Potential for double flushing 	££
Dual flush retrofit or replacement siphon – default to part flush	30%	<ul style="list-style-type: none"> • Low flush default forces regular user to learn the operation 	<ul style="list-style-type: none"> • First time users may assume the flush is ineffective unless instructions are provided • Potential for double flushing 	£££
Dual flush retrofit or replacement siphon – default to full flush	30%	<ul style="list-style-type: none"> • Pan should always be cleared 	<ul style="list-style-type: none"> • Without instructions, users might never discover the part flush function 	£££

⁵ This will vary depending on the toilet performance, existing flush volume and user awareness.

⁶ Lillywhite, MST, Webster, CJD and Griggs, JC. 1987. Low-water-use washdown WCs. BRE.

⁷ Keating and Styles. 2004. Performance Assessment of Low Volume Flush Toilets; St Leonards Middle School, Hastings. Southern Water.

⁸ Water Supply (water fittings) Regulations 1999: WC Suite Performance Specifications.

WRAS approved toilets will have been tested for flush performance including a trailing-volume test, which is an indicator of drain line carry.

The future

Some technologies exist or are being developed to achieve even lower flush volumes, but the currently available four-litre (full flush) and two-three litre reduced flush approaches the lower limit for conventional drains. Using smaller diameter drains or boosters that collect a number of flushes before discharging them all at once, could allow flush volumes to be reduced further for new developments in the future.

A prototype currently undergoing independent trials is claimed to work effectively with only 1.5 litres of water per flush. This frugal performance is achieved by using air pressure to help clear the pan.

Alternative technology

Vacuum and compressed air toilets

Vacuum drainage is used in trains, boats and aircraft where it is necessary to use the minimum amount of water. It is not currently cost-effective or practical for houses or flats.

Macerating toilets

Marine toilets using compressed air and low-flush macerating toilets are a lower-cost option, and have been used in houses, particularly where cesspool-emptying charges make them very cost-effective. Compressed air can be used to increase the force of the flush, allowing less water to be used. Macerators can be used to break down solids to make them easier to flush away and reduce the volume of water required. You would need to make sure that the installation complies with the Water Regulations if the toilet has a direct mains water connection, as some designs have to be modified to comply. Macerating toilets are an especially useful technology in properties with long drains or in basement flats.

Compost toilets

Composting and other dry toilets do not need water at all, but are not currently suitable for general use in the UK. However, for sites without a reliable water supply or drainage, they can be an excellent solution.

Further information

Water Conservation: a guide for installation and maintenance of low-flush WCs, BRE 1997, Published by CRC.

Lifting the Lid, Harper and Halestrap, Centre for Alternative Technology 1999

Waterwise: www.waterwise.org.uk