

# This presentation premiered at WaterSmart Innovations

[watersmartinnovations.com](http://watersmartinnovations.com)



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# CRITERIA FOR IMPROVED DRAINLINE CARRY PERFORMANCE FROM HIGH EFFICIENCY TOILETS



Dr Steve Cummings

## 19<sup>th</sup> Century WC test media – Thomas Crapper

Test media to demonstrate WC performance first established by 19<sup>th</sup> century designers

Thomas Crapper was a believer in quality control and simulation of user conditions



All Crapper's toilets had to pass simulated testing with a selection of test media that demonstrated overall toilet performance

Reyburn, W. 1969. 'Flushed with Pride - The Story of Thomas Crapper'. pp 11-14. Macdonald and Company Ltd: London.

## 19<sup>th</sup> Century WC test media – Crapper's test results

In a test using simulated waste, a two gallon flush completely removed from the bowl:

- 1 flat sponge  
(four-and-a-half inch diameter)



- 10 apples  
(one-and-a-half inch diameter)



- Plumber's smudge  
(coated over the pan)



- 3 air vessels  
(crumpled pieces of paper)



- Four pieces of paper  
(adhering closely to the soiled surface)



Allen, Jones & Kahn. 2000. The septic system owner's manual. Shelter Publication Inc, Canada.

## Test media development – Representative test criteria

- **US MaP Test – new approach**

- Research shows that average human waste is between 100g-200g yet MaP tests up to 1000g.
- Is a bowl that clears 1000g of waste a better performer to the user than a bowl that will clear 350g?



- **Gauley & Koeller Report**  
200g of Media  
+ 4 Balls of Toilet Paper



- **WaterSense**  
350g of Media  
+ 4x7 Sheets of Toilet Paper



- **MaP maximum**  
1000g of Media  
+ 4x7 Sheets of Toilet Paper

Gauley & Koeller. 2005. Evaluation of Low-Flush-Volume Toilet Technologies to Carry Waste in Drainlines – Final Report. A Canada Mortgage and Housing Corporation Project.

Kira, A. 1976.

The Bathroom Book – New and expanded edition.  
Penguin Books.

## Test media development – Varying media from International Standards



MaP media (uncased)



Modified MaP media (latex)



Aus/DIN media



Paper (choke test)



Paper (12 sheets)



Paper (6 sheets)



Paper (8 sheets)



Towel



Polypropylene balls



Sponge



Granules and Balls



Saw Dust



Golf ball

**To ensure consistency there is a need for more representative test media criteria to be internationally adopted**



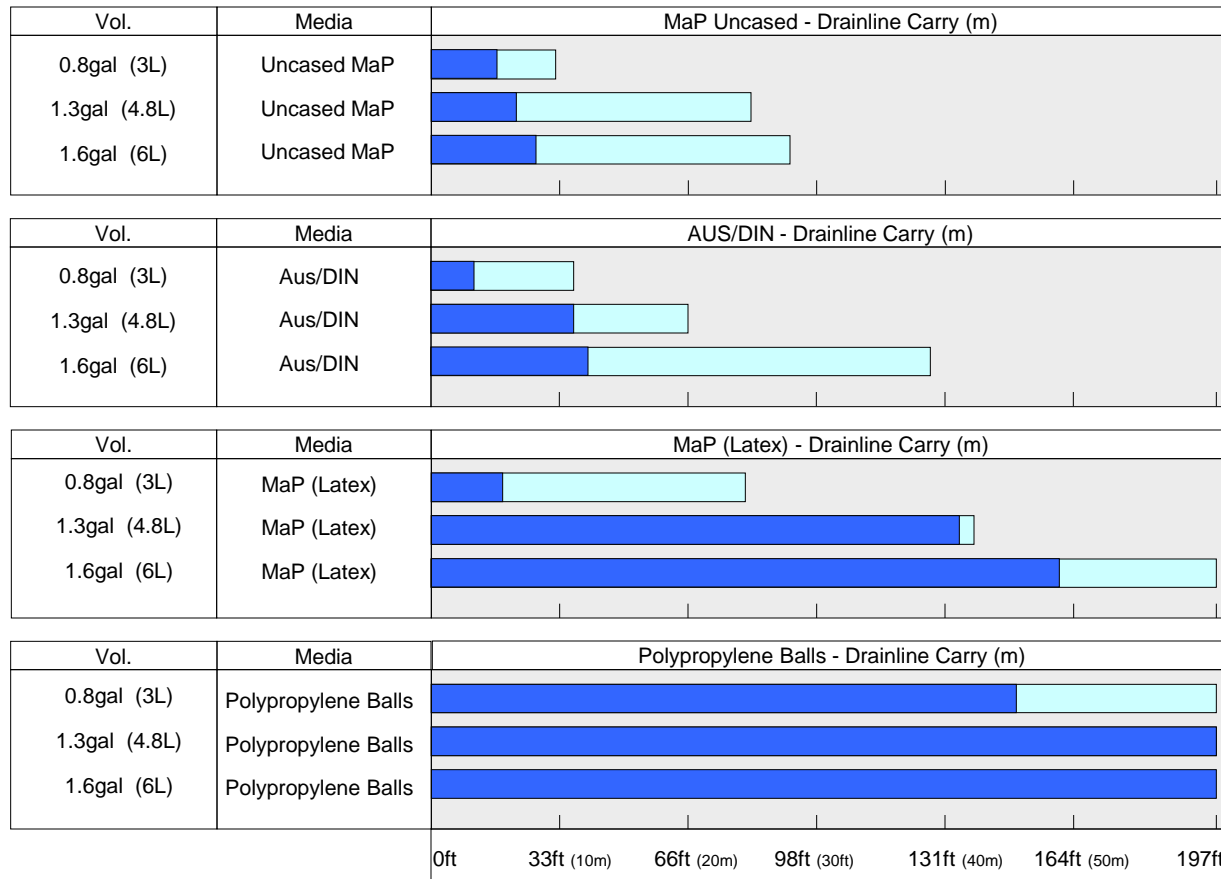
## Test Media – WC drainline transportation testing

Comprehensive drainline testing conducted on 197ft (60m) drainline testing rig





## Test Media – WC drainline transportation test results

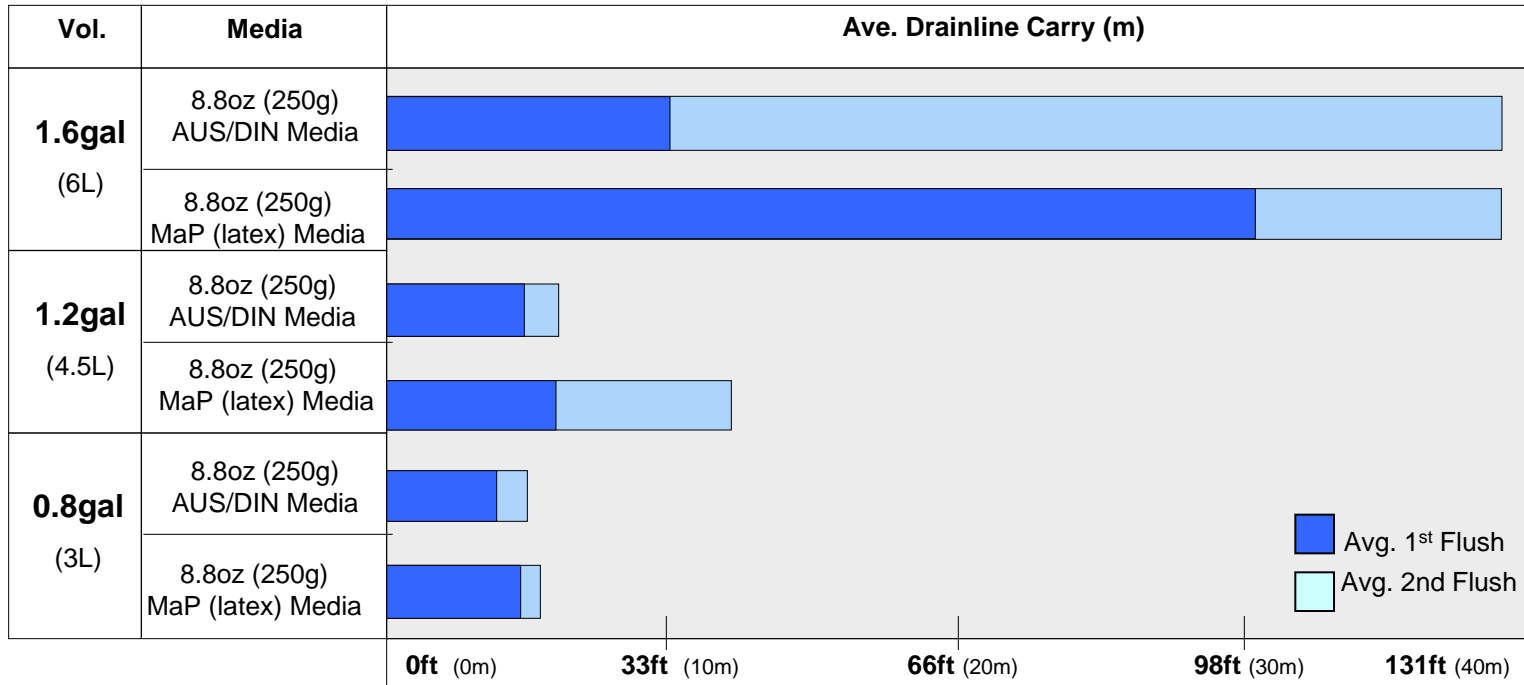


■ 1st Flush Cycle ■ 2nd Flush Cycle

Results show significant difference in drainline transportation between types of test media

## Test Media – WC drainline transportation test results

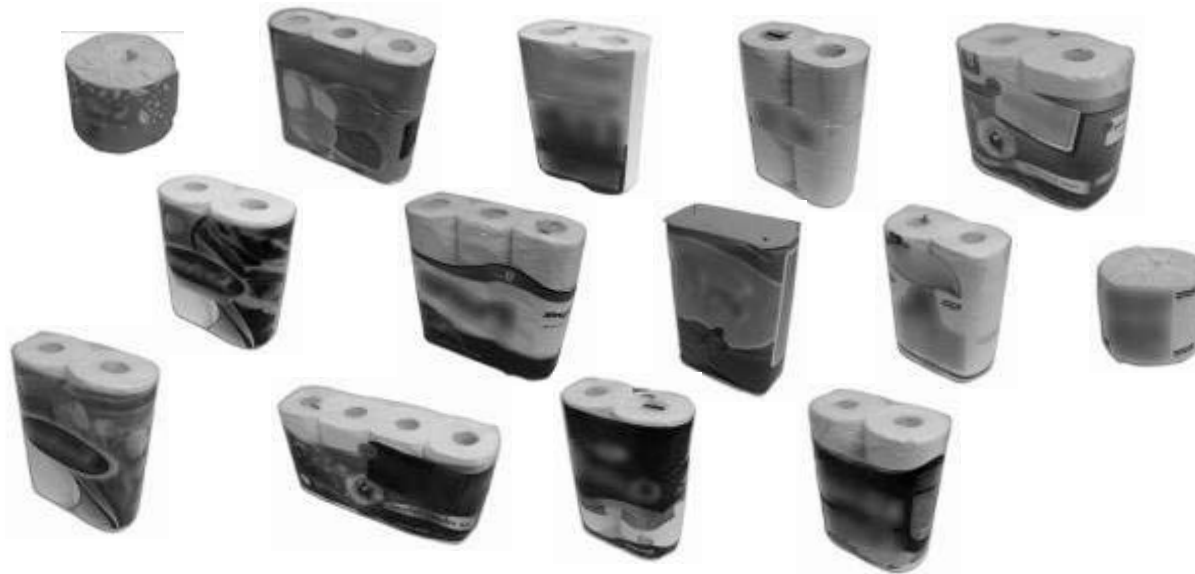
### Reductions in flush volume – **exponential reduction** in solid waste drainline transportation performance



Highlights the need for representative drainline transportation testing at ultra-low flush volumes

## Toilet Paper Test Media - Evaluation

Toilet drainline transportation evaluation of 14+ commercially available toilet paper brands



**ASFlow**

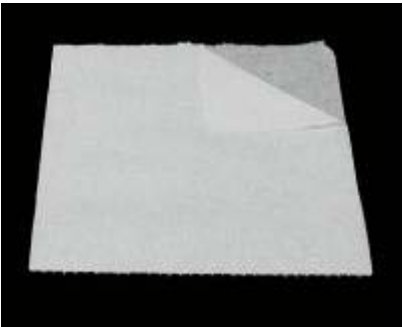
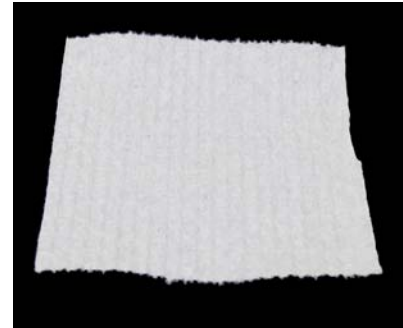
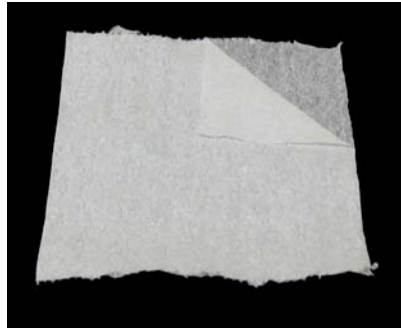
Australasian Scientific Review of Reduction of Flows on Plumbing and Drainage Systems

The ASFlow Committee is conducting research into the performance of toilet paper and the identification of appropriate test media.

## Toilet Paper Test Media - Evaluation

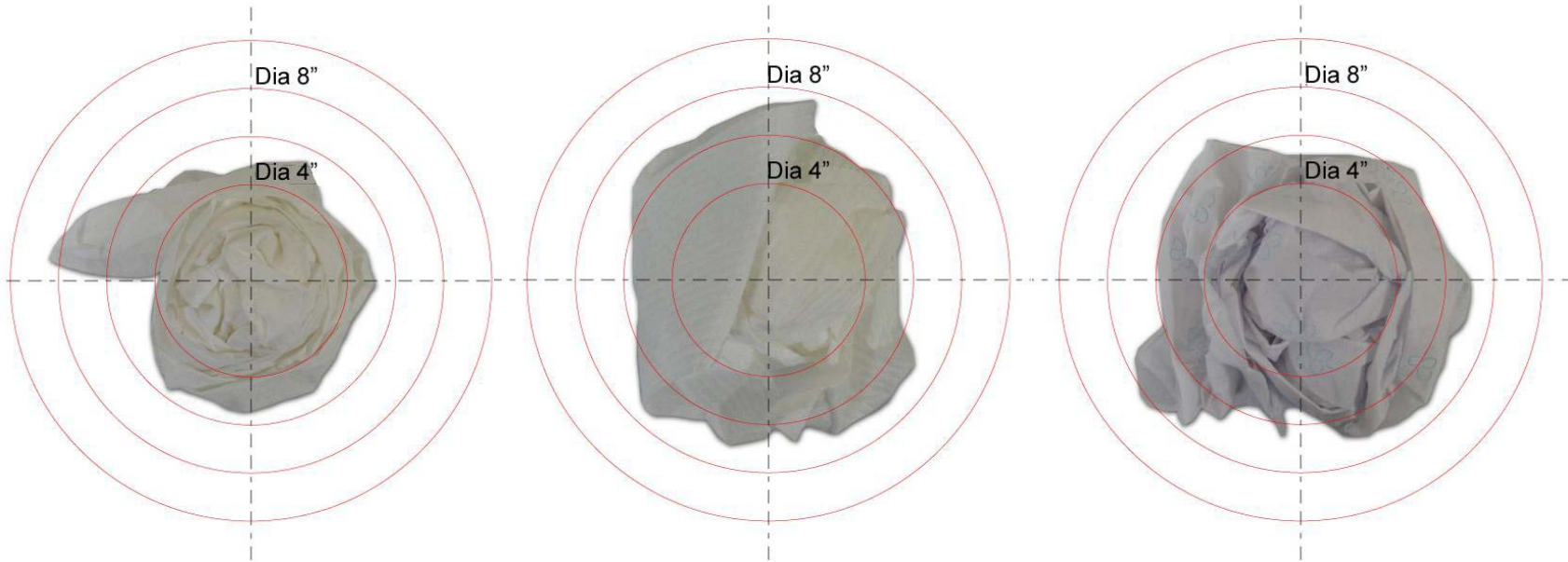
### Toilet paper characteristics varied by;

- Number of ply
- Weight
- Material



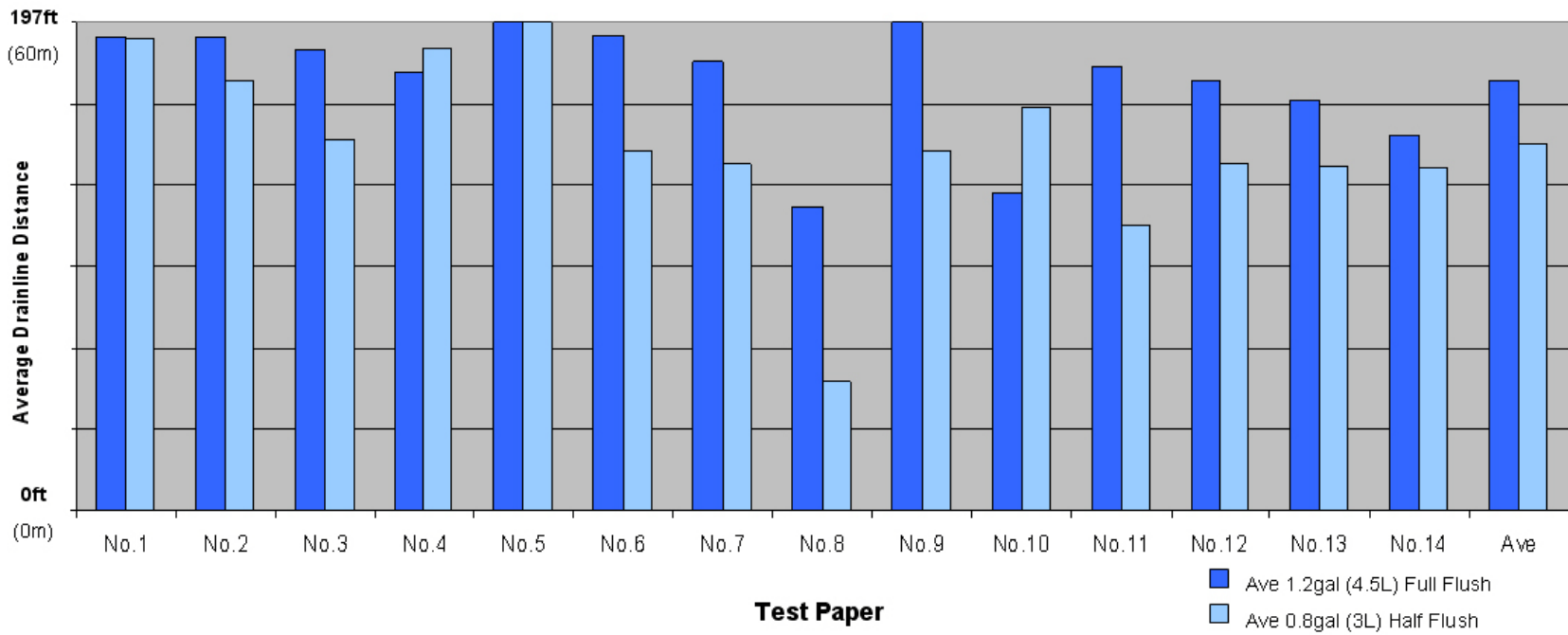
## Toilet Paper Test Media - Evaluation

Testing was carried on using 30 sheets of crumpled toilet paper.  
Each test paper produced varying diameters of bulk.



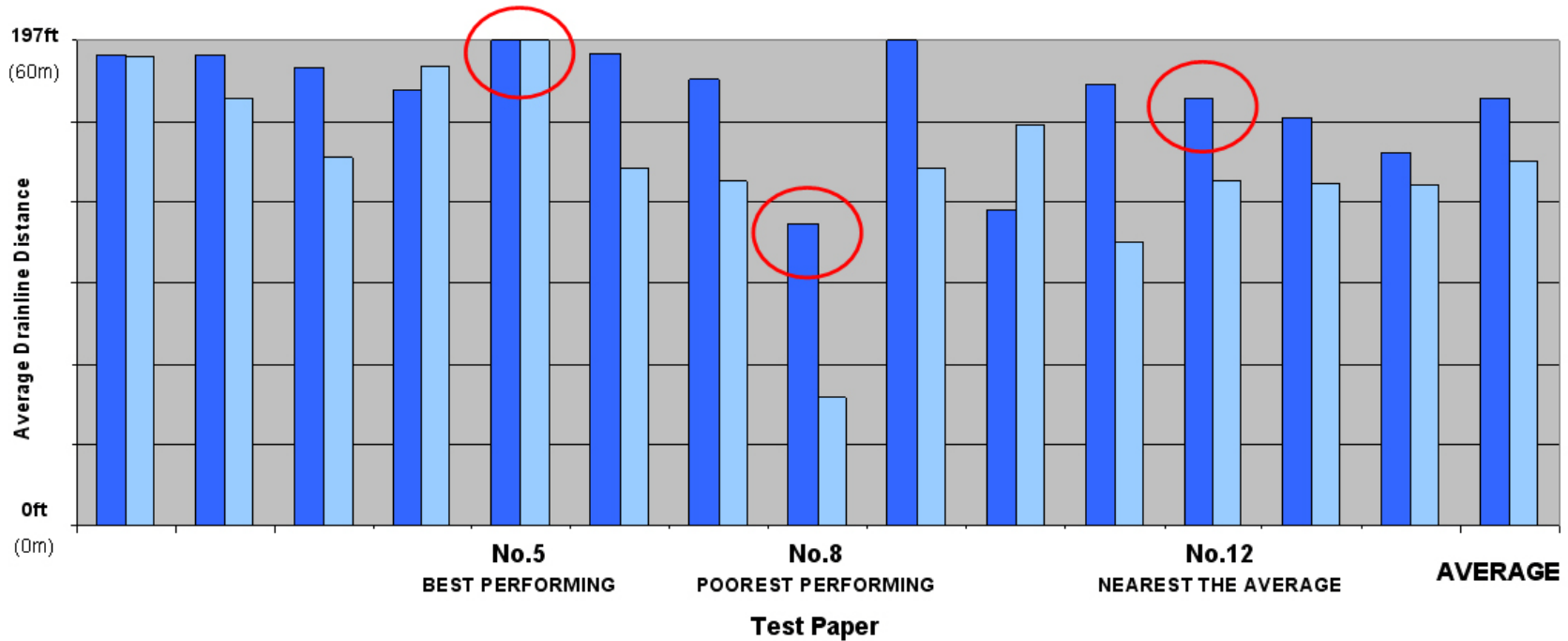
## Test Media – WC drainline transportation test results

Average Drainline Carry (ft) of Test Paper using 1.2gal (4.5L) Full Flush and 0.8gal (3L) Half Flush



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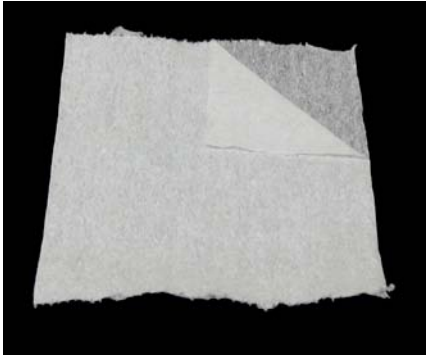
## Test Media – WC drainline transportation test results

**No.5**  
**Test Paper Characteristics**

Sheet Size: 11x10cm

Ply: **2**

Weight (g) of 10 sheets: **0.133oz**  
(3.758g)



**Best Performing**

**No.8**  
**Test Paper Characteristics**

Sheet Size: 11x10cm

Ply: **1**

Weight (g) of 10 sheets: **0.126oz**  
(3.568g)



**Poorest Performing**

**No.12**  
**Test Paper Characteristics**

Sheet Size: 11x10cm

Ply: **2**

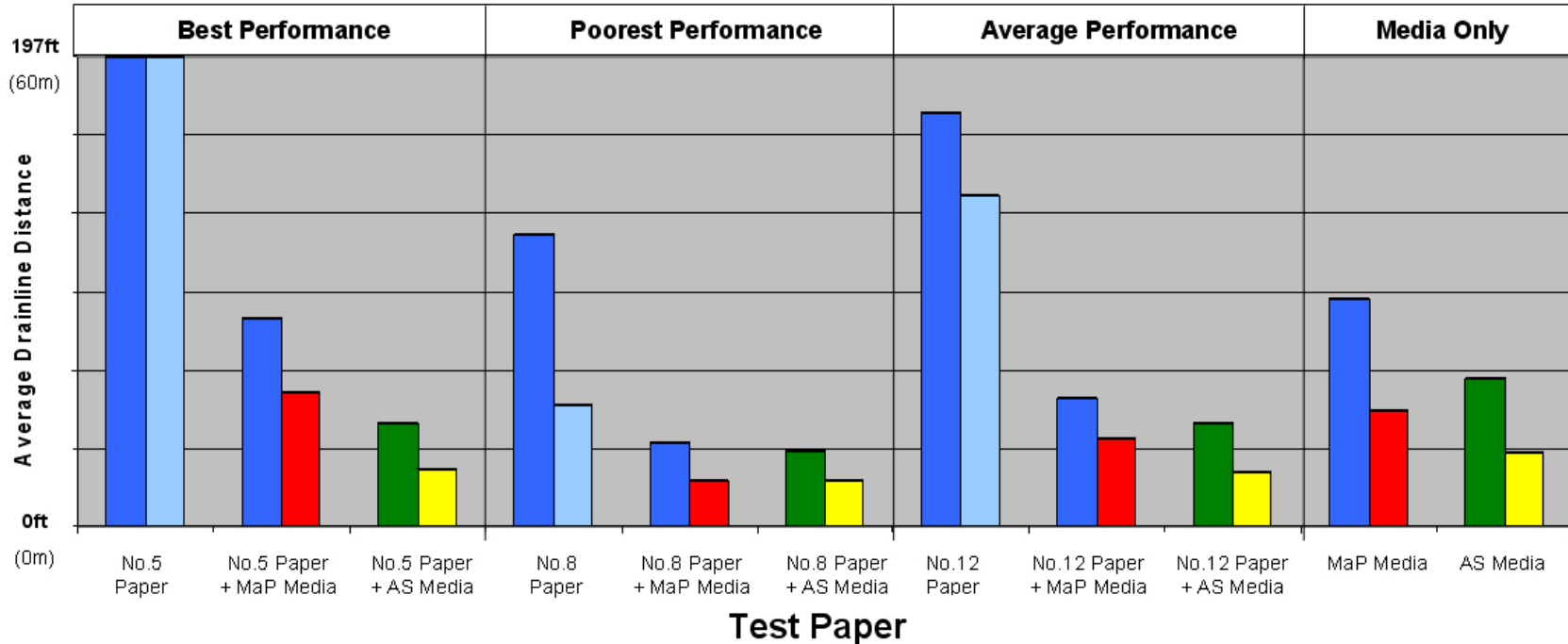
Weight (g) of 10 sheets: **0.180oz**  
(5.106g)



**Nearest the Average**

## Test Media – WC drainline transportation testing

Comparison of Ave Drainline Carry (ft) of Test Paper with MaP and AS Media using 1.2gal and 0.8gal Flush



Toilet paper was found to have a significant effect on test media drainline carry performance



## Research Summary –

- **Simulated performance testing with representative test media has been conducted since the early 19<sup>th</sup> century**
- **Numerous types of test solid media are used internationally with no consistency**
- **To provide the performance criteria for ultra-low flush systems a more representative universal test media is required**
- **Results show that the interaction of toilet paper and solids effects drainline transportation performance**
- **ASFlow is investigating the influence of toilet paper in actual toilet blockage situations in buildings**



## Drainline Transportation Performance – Future direction

The adoption of realistic test media universally will allow for the development of improved ultra-low flush fixtures and plumbing systems that operate effectively



Thank you