This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

watersmart
INNOVATIONS

2013 Water Smart Innovations

Phase 2
Understanding the Implications of Reduced Flows in Building Drains

What is PERC ?

- Formed in December of 2008
- MoU Signed at EPA HQ
- First Project: Drainline Transport
- MoU with AS-Flow in 2010
- Funding struggles

Phase 1 Review
Why Drainline Transport?

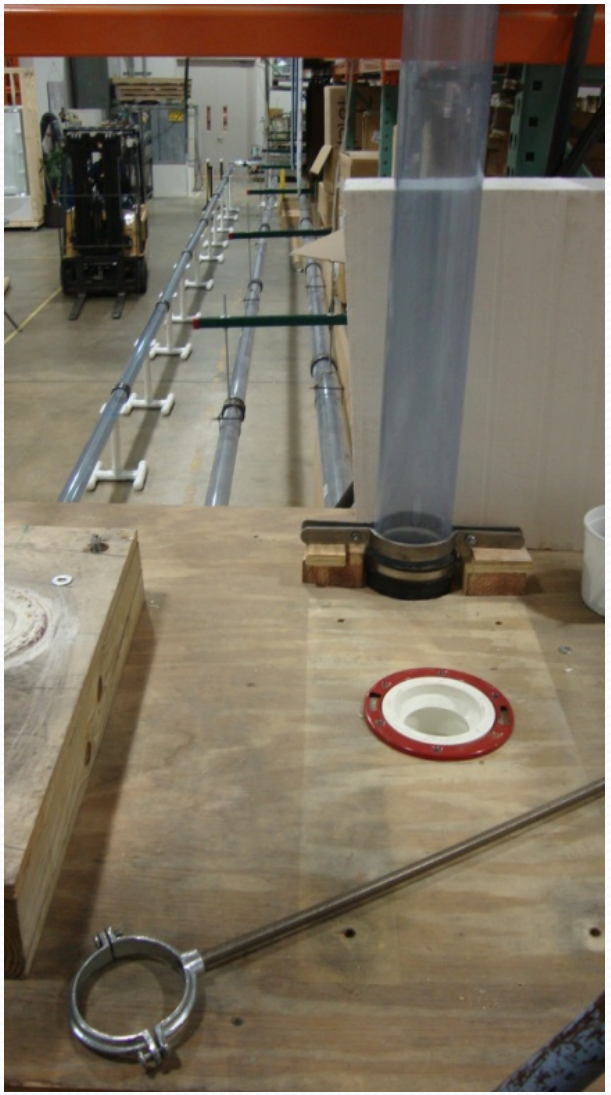
- Toilet consumption reduced 3.5 gpf → 1.6 gpf →1.28 gpf → ?
- Commercial installations
  - Isolated bathrooms
  - Long horizontal run building drains
  - Reduced supplemental flows
    - Non-water consuming urinals, ultra low flow faucets (0.5 gpm)
    - Proliferation of other water efficient technologies; medical, food service, industrial and commercial processes
  - Toilets increasingly stressed
- Domestic installations
  - Reduced flow showerheads and appliances
  - Graywater reuse systems – long term potential to eliminate long duration flows

The PERC Approach

- PERC Design of Experiment
  - The "Real World": Too Variable to Duplicate / Characterize
  - Need to Understand What's Really Important
  - Build a Perfect Drainline
- The Test Apparatus
  - 4" Clear PVC
  - 135 feet long (~41 M)
  - Slope Adjustable
- Why only 4-inch diameter? $
- **Clearing Flush: Low Cost Solution?**
  - Past research (Swaffield) cited potential
  - Low cost solution using flushometer-valves?

The PERC Approach

Test Apparatus viewed from Flush Stand

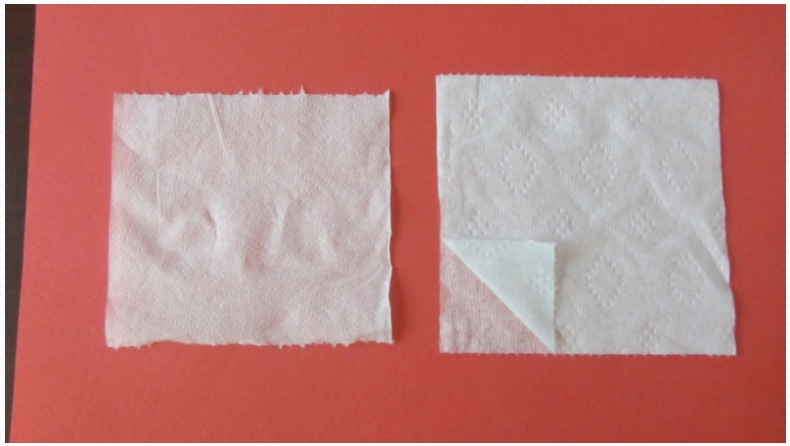


Two 90° Wide Sweep Bends at Far End

Test Media

- Uncased “MaP” Test Media
  - Proven “Realistic” in Toilet Testing
  - Deformable, “breaks down”

- Toilet Paper
  - Two US Brands
    - Low Tensile Strength
    - High Tensile Strength

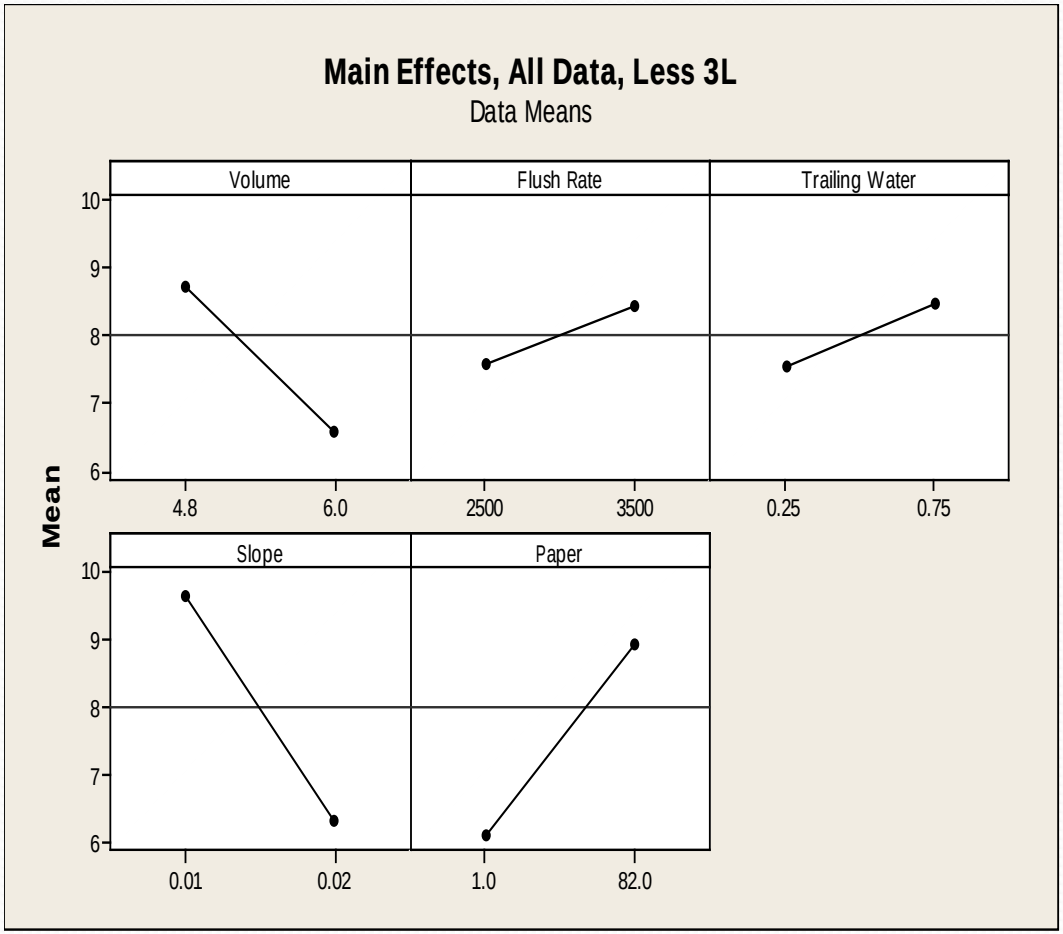


Phase 1 Deliverables

- Deliverables
  1. Clearing flush at the end of each Test Run
     - Is this a reliable low cost solution?

  2. Ranking of test variables
     - ✓ *1 Pipe Diameter: 4-inch / ~100* mm
     - ✓ *2 Pipe Slopes/Pitches: 1.00%; 2.00%*
     - ✓ *3 Flush Volumes: 6.0/1.6; 4.8/1.3; 3.0/0.8 (Lpf / gpf)*
     - ✓ *2 Flush Rates: 3500; 2500 (ml/sec –peak flow)*
     - ✓ *2 Percent Trailing Water Levels: 75%; 25%*
     - ✓ *2 Toilet Paper Tensile Strengths: High; Low*

Data Review



Factor	Type	Levels	Values
Volume	fixed	2	4.8, 6.0
Flush Rate	fixed	2	2500, 3500
Trailing Water	fixed	2	0.25, 0.75
Slope	fixed	2	0.01, 0.02
Paper	fixed	2	1, 82

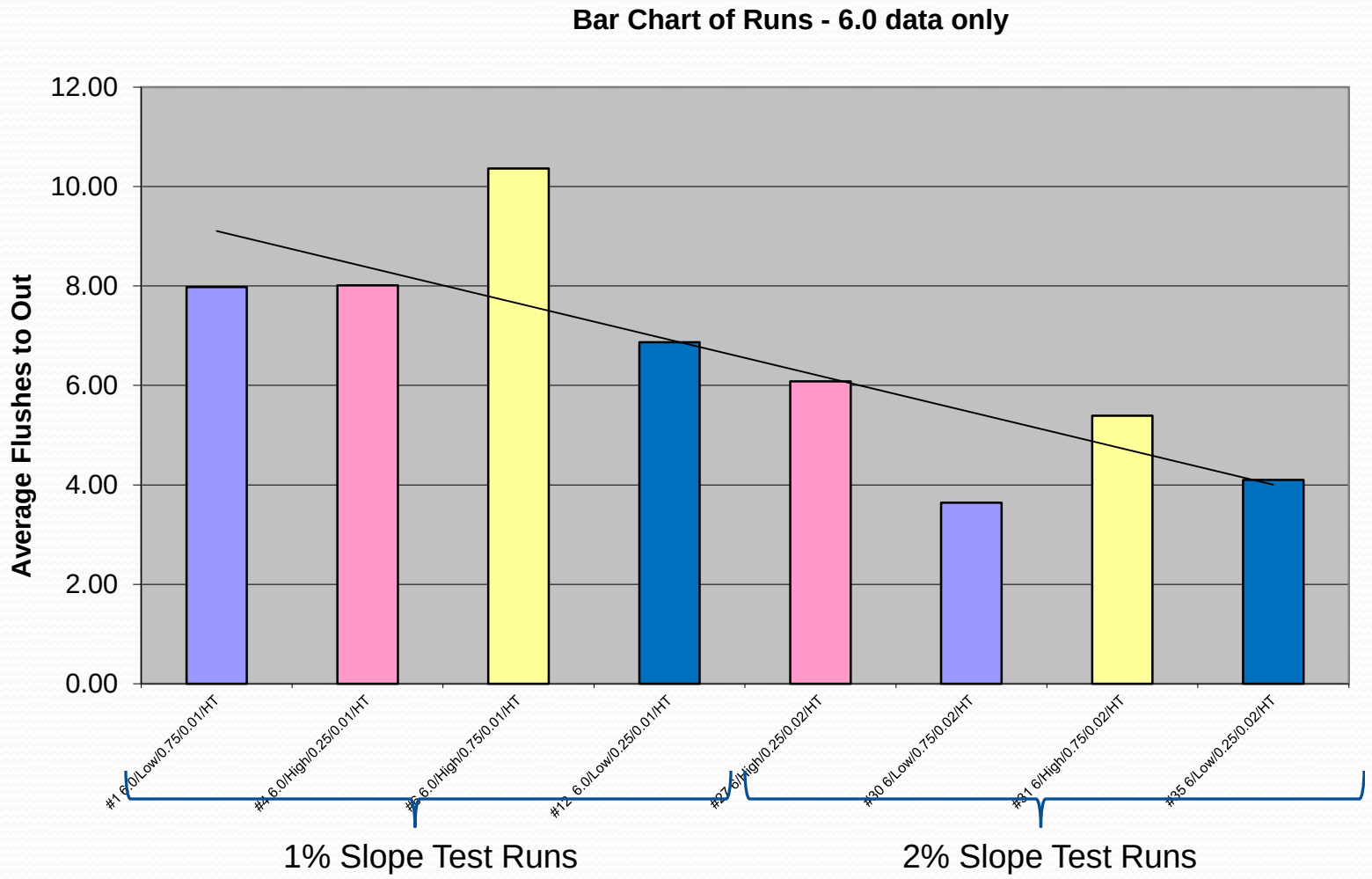
Variable	P Value
Volume	0.000*
Flush Rate	0.216
Trailing Water	0.185
Slope	0.000*
Paper	0.000*

* P-values below 0.05 indicate significance of the test variable

R-Sq = 81.61percent

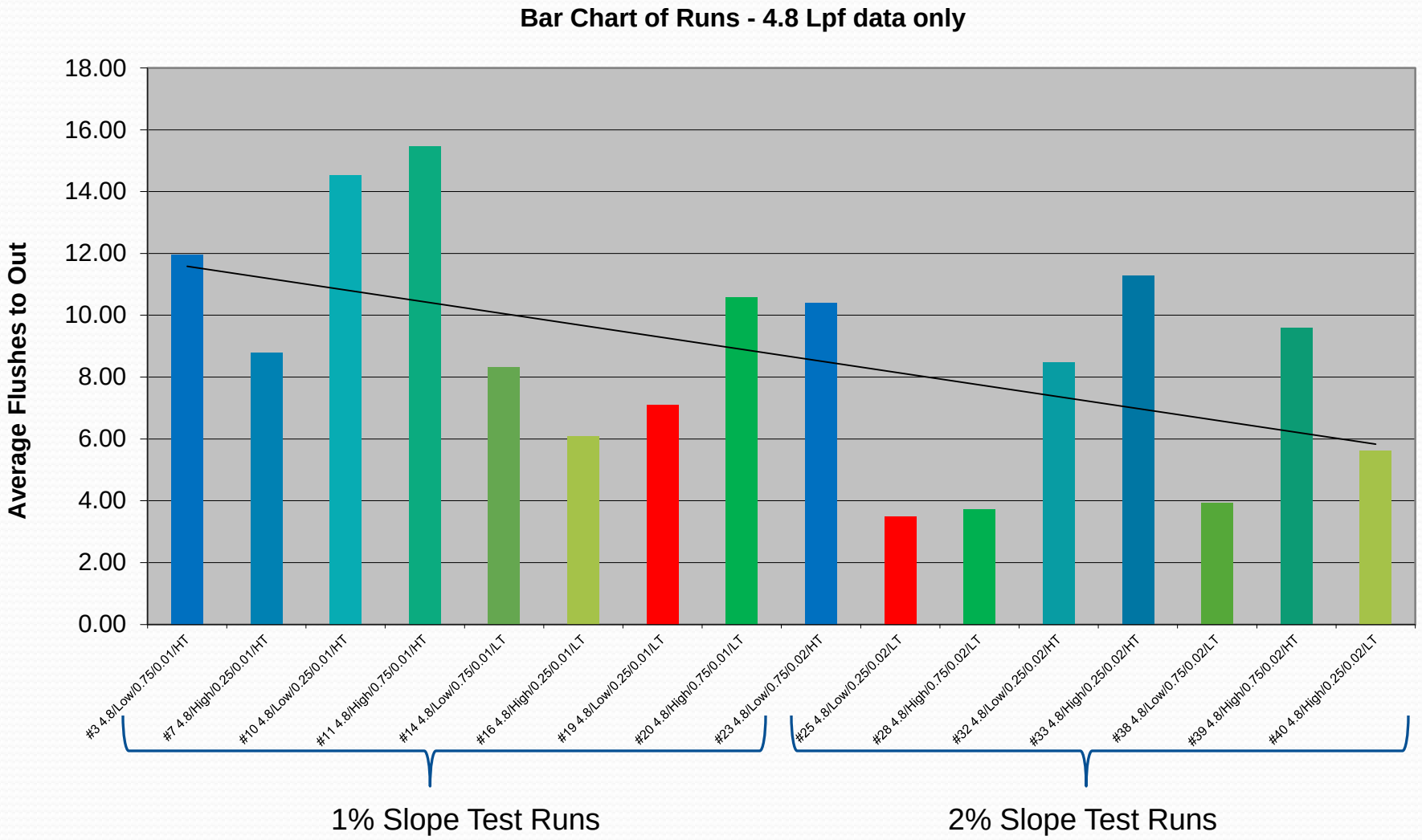
Data Review

- How can we tell if the statistical model is telling us the right answers? Let's look at traditional charts!



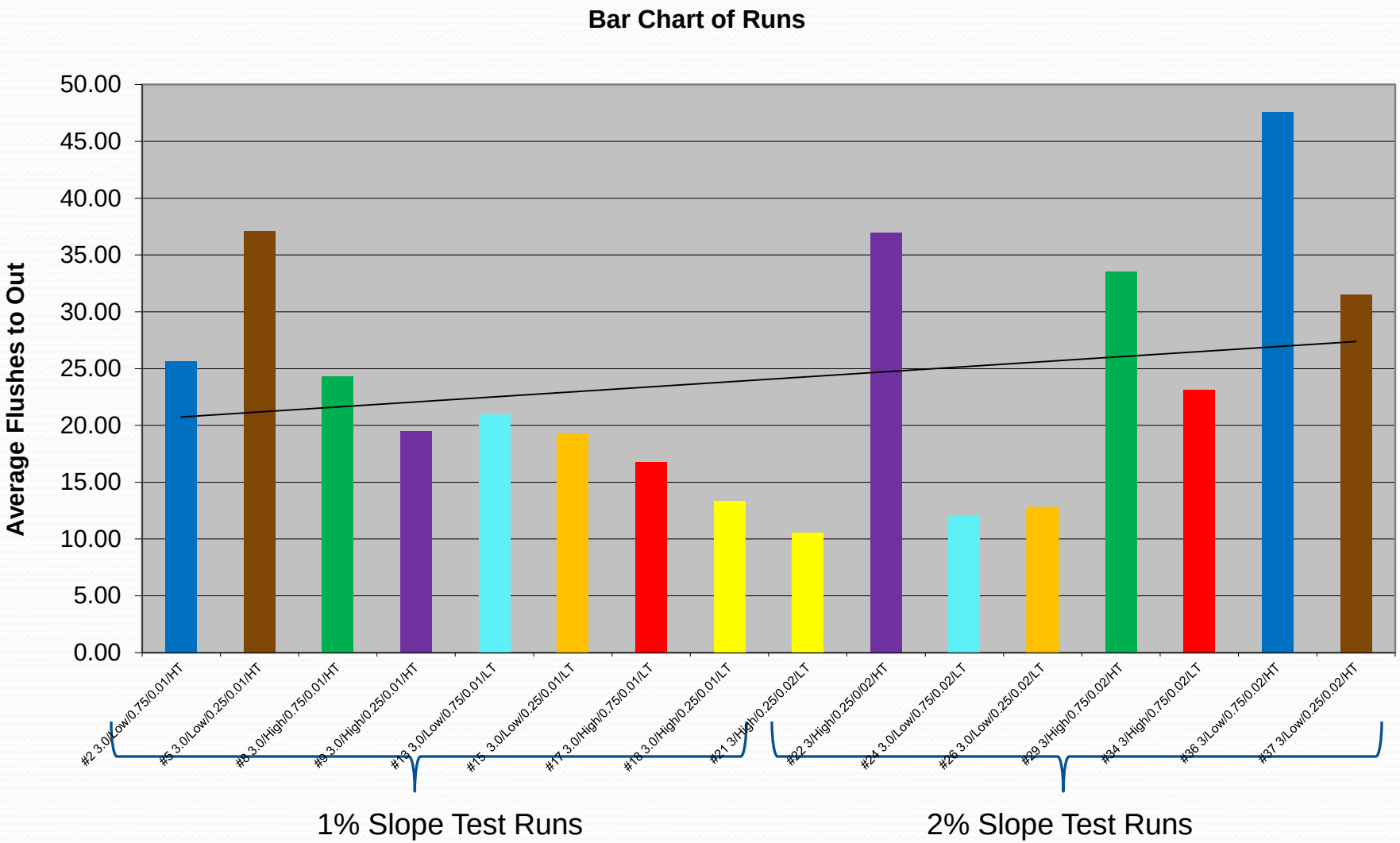
Data Review

- 4.8 L (1.28 gal) data only by slope



Data Review

- 3.0 L (0.8 gal) data only by slope



- Deliverables
  1. Clearing flush at the end of each Test Run
     - Reliable solution? **No**
     - 5 gallon clearing flush failed to clear line in 7 of 39 trials
     - Further study warranted
       - Shorter intervals
       - Requires separate experiment
  2. Ranking of test variables

Significant Variables	**Non-significant Variables**
Slope > Paper > Volume >	**% Trailing Water > Flush Rate**

Additional Findings

- 0.8 gpf / 3.0 Lpf Toilets: *Chaotic conditions resulted in the test apparatus at this discharge volume*
- 1.28 gpf / 4.8 Lpf HET's: *The behavior of the Test Apparatus at this volume level indicates satisfactory performance at this discharge volume*
  - *Phase 1 Report resulted in the U.S. EPA issuing a Notice of Intent for the development of a Commercial HET specification*
- Impact of Toilet Flush Characteristics: *Not significant factors in drain line performance in this study (further study req'd)*
  - Will present finding to ASME / CSA Standards Committees
  - Is there a need for a DLT test in the industry toilet standards?
  - Good news regarding future long term research needs

Phase 2 Focus Areas

- **Pipe Size Reduction** – Long a topic of debate at code hearings, the potential for reduced pipe size to improve drainline transport distances will be studied
  - A 3-inch test apparatus will be used in addition to the 4-inch diameter apparatus employed in Phase 1 to determine impact of reducing the pipe size
- **Additional Flush Volume Level –** Phase 1 results indicated a behavioral shift and a chaotic drainline performance condition resulted at the 3.0 Lpf / 0.8 gpf consumption level.
  - Phase 2 will investigate drainline transport performance at the 3.8 Lpf (1.0 gpf) volume level.
  - Many U.S. manufacturers are already producing toilets that flush at this consumption level for both commercial and residential applications.

Phase 2 Focus Areas

- **Toilet Paper Characteristics**
  - Phase 1 indicated a very strong significance for the wet tensile strength of toilet paper to impact drainline transport performance
  - We cannot assume the results achieved related to toilet paper when using the 3-inch diameter pipe.
- **Toilet Flush Characteristics**
  - Phase 1 results indicated non-significance of the toilet flush characteristics Percent Trailing Water and Flush Rate
  - Before these characteristics can be dismissed, results must be confirmed in Phase 2

It will be critical to study these variables at the 3-inch diameter pipe size

Phase 2 - Deliverables

- **Deliverable 1 – Pipe Size Reduction**
  - Phase 2 of the PERC study will show how a commonly suggested pipe size reduction (going from 4-inch diameter pipe to 3-inch pipe) will impact drainline transport in a long horizontal run.
  - Further, it will rank the significance of reducing pipe diameter to flush consumption level reductions, slope, toilet paper wet tensile strength, and toilet discharge characteristics of flush rate and percent trailing water.
  - The results from Phase 2 will provide needed data in understanding the implications of pipe size reductions and may advise future considerations of pipe sizing requirements.

Phase 2 - Deliverables

- **Deliverable 2 – Added 1.0 gpf discharge level**
  - Evaluating a new flush discharge level at 3.8 Lpf (1.0 gpf) will provide for a better understanding of how the drainline performs at the critical consumption level between 4.8 Lpf (1.28 gpf) and 3.0 Lpf (0.8 gpf), where drainline performance in Phase 1 became chaotic.
  - This will provide additional insight into the “tipping point” flush volume level, below which chronic blockage problems are more likely to occur.

Phase 2 - Deliverables

- Considering the two deliverables together, Phase 2 will evaluate how pipe size reduction in a building drain might allow for the successful use of lower consumption toilets in new installations that employ smaller diameter drains.
- Phase 2 will also provide data to help illustrate if we are indeed reaching a tipping point where further toilet consumption level reductions are risky in installations that do not provide for significant additional flows into the building drain.

Phase 2 - Budget

- Phase 2 of this research study will cost approximately $160,000.00
- A significant increase over the approximately $70,000.00 used to complete Phase 1.
- ~90% of the cost is related to labor.
- Phase 2 will be a 35 week testing program
- We need financial support from all stakeholders!
  - Water utilities, Manufacturers, Contractors, Plumbing Engineers, other NGO's , **YOU!**

If you agree this work is important, please help and show your support!

International Emerging Technology Symposium

APRIL 23 – 24, 2014

CRYSTAL GATEWAY MARRIOTT • ARLINGTON VIRGINIA

The 2014 International Emerging Technology Symposium (ETS), to be held April 23-24, 2014, at the Crystal Gateway Marriott in Arlington, Va., will be the most comprehensive and informative plumbing and mechanical event since the ETS debuted in 2008.

Building upon a highly successful and universally acclaimed formula refined during three previous symposiums (Chicago, 2008; Ontario, Calif., 2010; Washington, D.C., 2012), the event will gather plumbers, contractors, engineers, manufacturers, and water efficiency experts to introduce new technologies for the plumbing and mechanical industries, and discuss how policy initiatives can drive the introduction of these technologies to market and advance the cause of water and energy efficiency. The ETS is designed to provide a portal for the host organizations' partners in the manufacturing, engineering, and trade industries to display and demonstrate their innovative solutions to legislative and regulatory developments that often alter industry landscapes.

An unprecedented number of organizations, representing the foremost leaders in the plumbing and mechanical industries, have signed on to present the symposium as co-conveners. They are: the American Society of Plumbing Engineers (ASPE), the Canadian Institute of Plumbing & Heating (CIPH), the International Association of Plumbing and Mechanical Officials (IAPMO®), the Mechanical Contractors Association of America (MCAA), the Plumbing-Heating-Cooling Contractors National Association (PHCC), Plumbing Manufacturers International (PMI), the United Association (UA), and the World Plumbing Council (WPC).

THANK YOU

QUESTIONS?

Plumbing Efficiency Research Coalition

Presenter:

Peter DeMarco – IAPMO, pete.demarco@iapmo.org