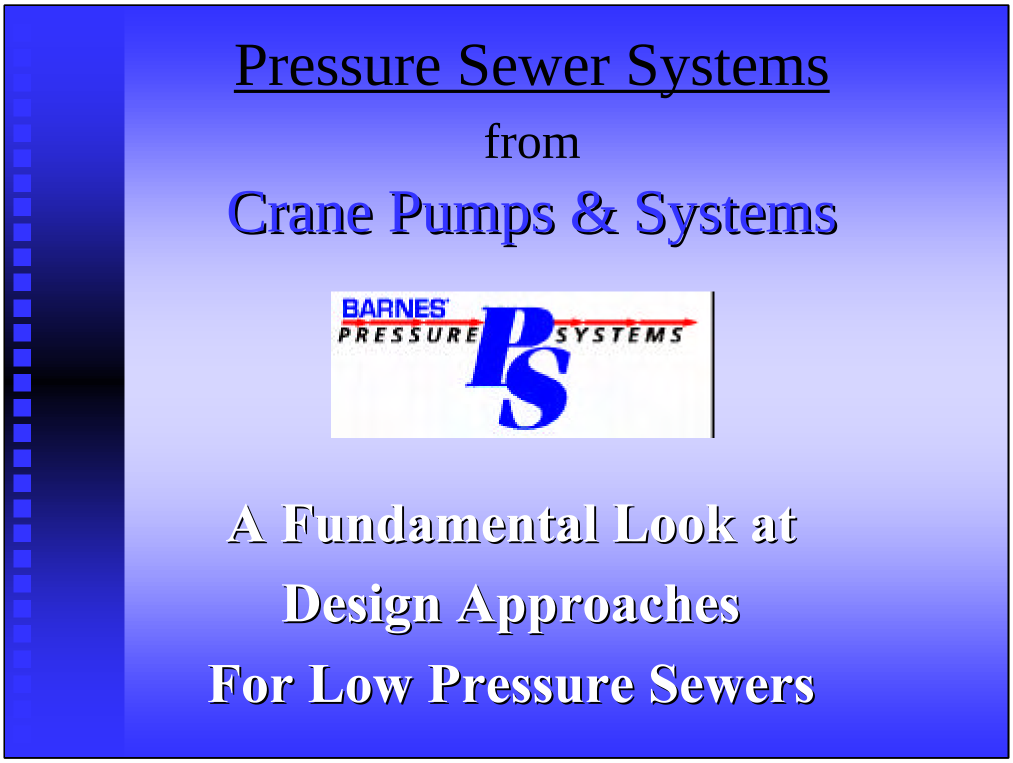
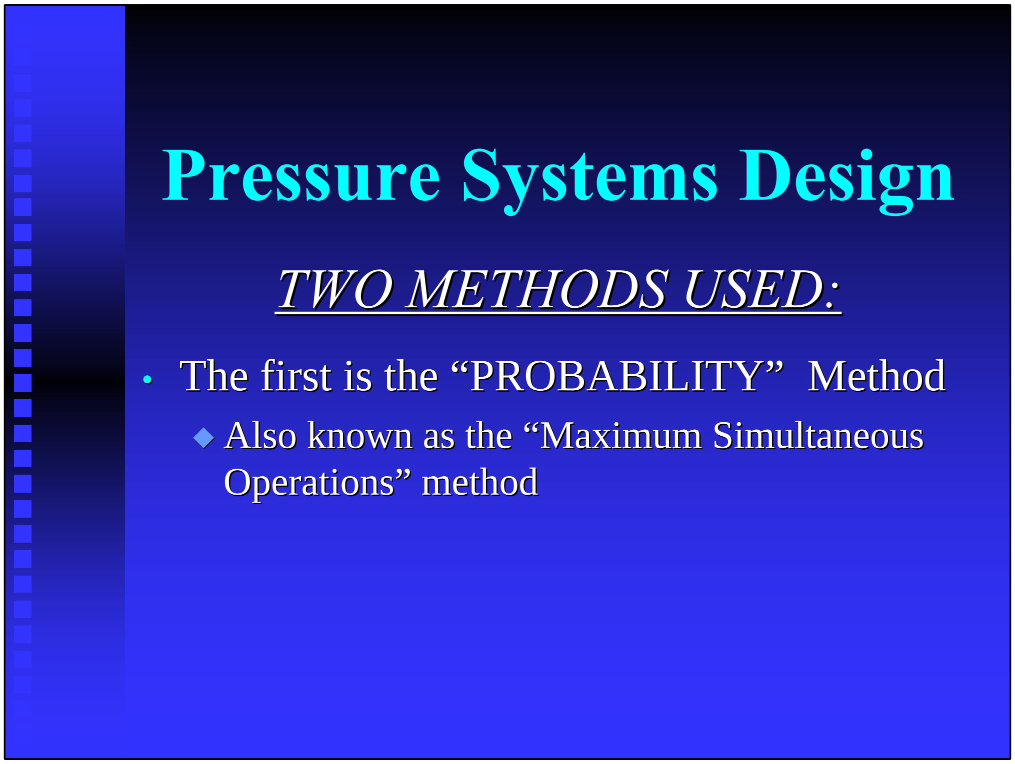


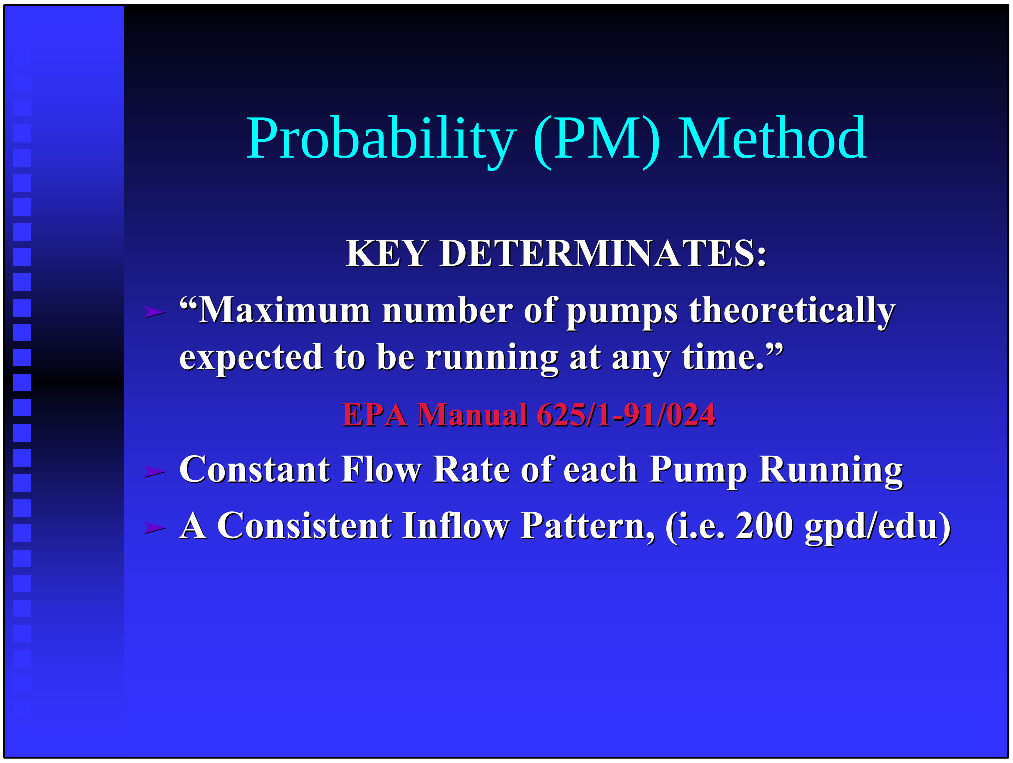
Welcome

Thanks for your effort to be here.

We appreciate it.



The Probability Method is more commonly known as the Maximum Simultaneous Operations Method. This method attempts to predict the maximum number of pumps that will run simultaneously, for any one minute in duration, during the operating day.



The Probability Method can only be applied correctly to a "Fixed Flow" or "Posititive Displacement" pump. That is, a pump that has a vertical head curve. (an example would be a piston type or a gear type pump) In the Pressure Sewer Industry, this method has been applied to "Semi-Positive Displacement" or Progressing Cavity pumps.

The method is based upon the assumption that each and every pump that is running simultaneously, will produce the same identical flow rate, irrespective of its head or location in the system.

The flow value used by one manufacturer as the "Constant Flow" is 11 GPM. This flow valueis then multiplied by the maximum number of pumps theoretically expected to be running at any time during the day.

The Probability Method also assumes a consistent flow pattern in the sewer system.

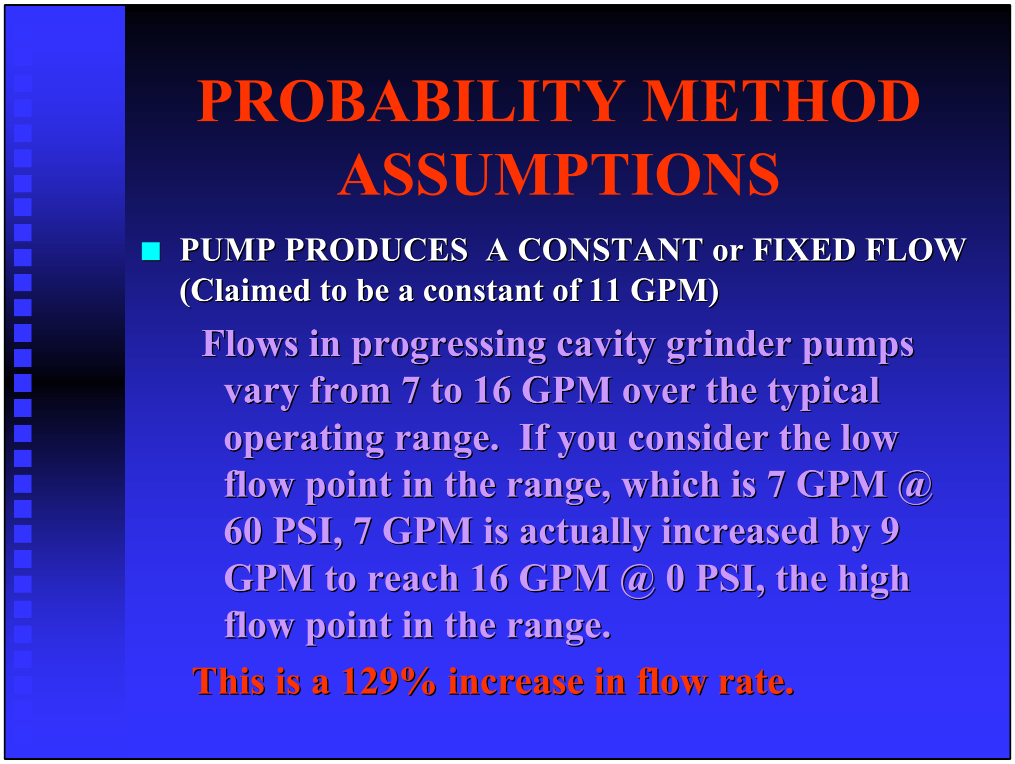
PM Method
Determining Peak Flow

Cores Connected	Simultaneous Operations	Flow Rate	Peak Flow
1	1	11	11
2-3	2	11	22
4-9	3	11	33
10-18	4	11	44
19-30	5	11	55
31-50	6	11	66

The table in this slide is based on the Environment One Corporation Design Handbook. The number of pumps or cores is counted. The accumulated number of pump cores in a given pipe run (column 1 above), in theory, has a positive correlation to a certain maximum number of simultaneous operations, shown in column 2 above.

Column 3 shows the claimed constant flow of 11 GPM. Column 2 is multiplied by Column 3 to predict the maximum flow that will occur in each pipe segment (Column 4 above).

Pipes are then sized to accommodate these flows.

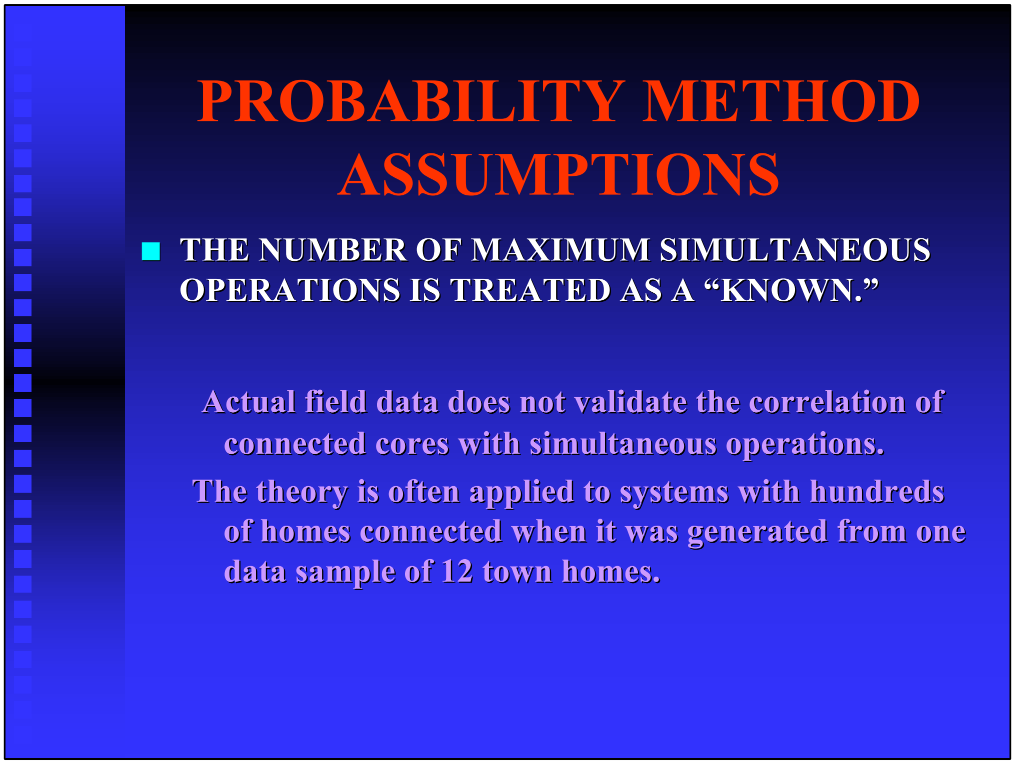


The Assumptions of the Probability Method involve:

1. A Constant Flow

Compared to most centrifugal sewage pumps, the progressing cavity pump curve is “relatively speaking” vertical. However, closer examination will reveal that the flow varies from 7 to 16 gallons per minute over the typical recommended operating range. The theory being applied has nothing to do with comparing one type of pump to another, but rather assumes a constant flow over the entire operating range.

If you consider the low flow point in the operating range, which is 7 GPM, the 7 GPM is actually increased by 9 GPM to reach the high flow point in the operating range, which is 16 GPM. The 16 GPM represents an 129% increase over the 7 GPM flow rate. Can one scientifically accept a 129% increase in flow as a constant?



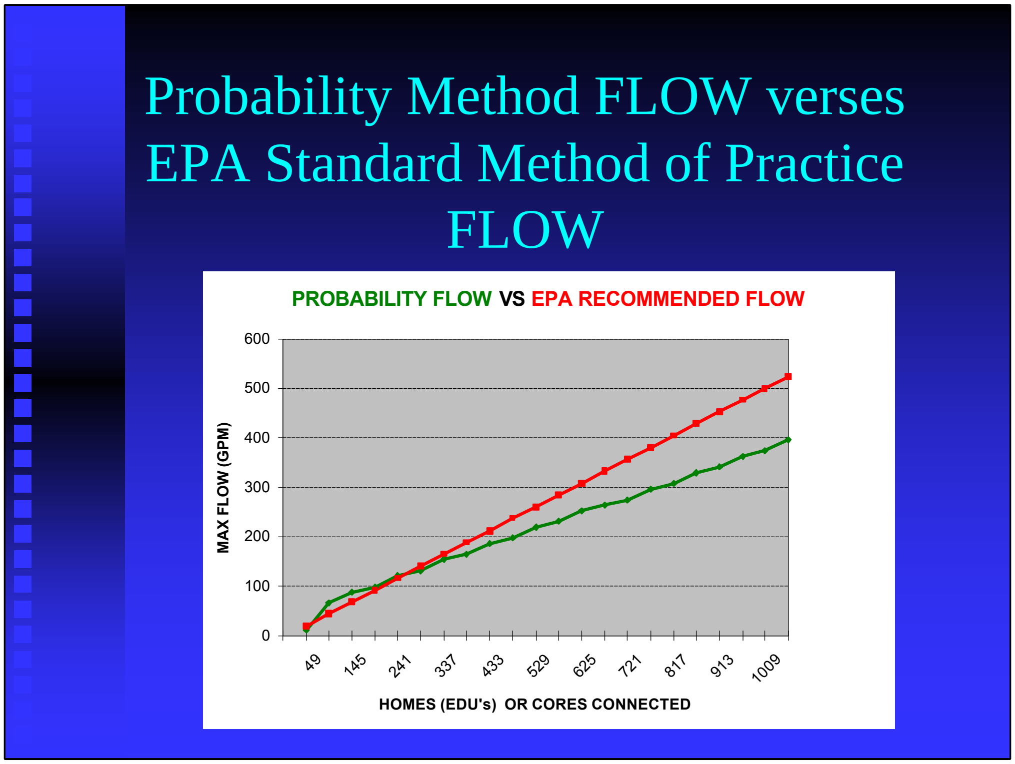
The Assumptions of the Probability Method (Con't):

Assumption 2. Maximum Simultaneous Operations is a "KNOWN"

You will note the quote from the EPA manual, (3 slides back), states, "the maximum number of pumps theoretically expected to be running at any time".

The facts are that there is precious little supporting data available. What data is available often contradicts the table. The data simply does not exist in sufficient sample size to establish a statistical degree of certainty in support of the table.

Additionally, those who know, understand that the table has been extrapolated from a sample size of 12 town homes in the famous Albany, NY study, published in the early 1970's by USEPA. The sampled town homes are likely not analogous in water consumption to the typical single family dwelling of today.



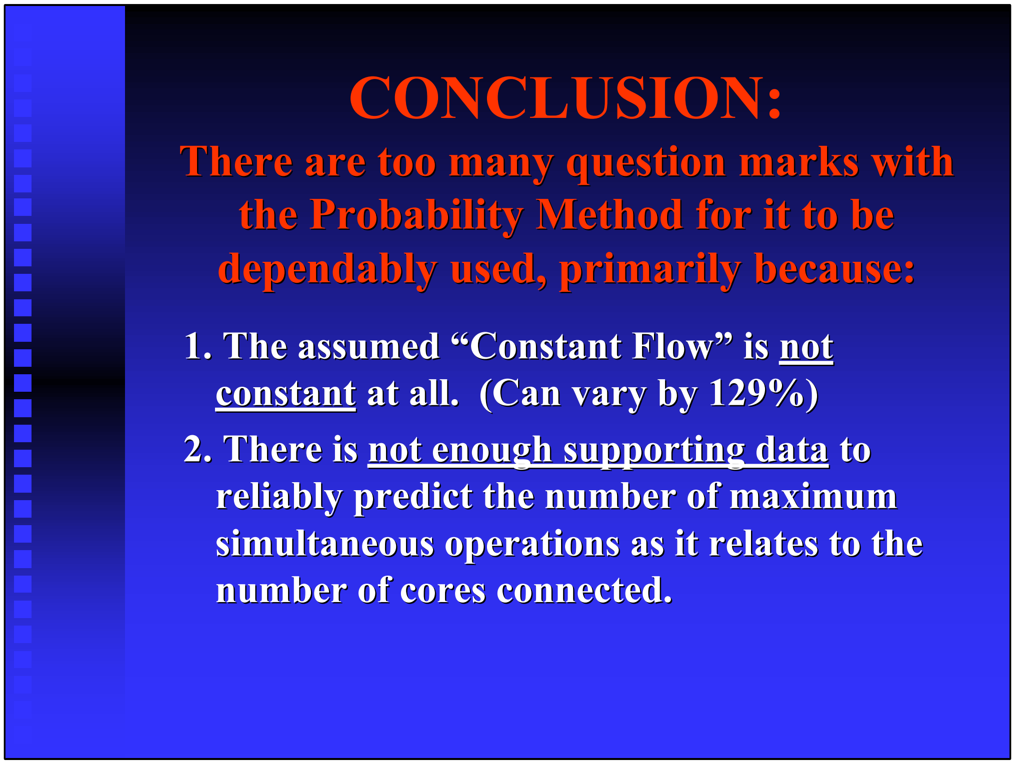
What can this comparison tell us?:

1. The flows predicted by the use of the Probability Method, vary both higher and lower from the flows predicted by the standard method of practice method recommended by EPA.

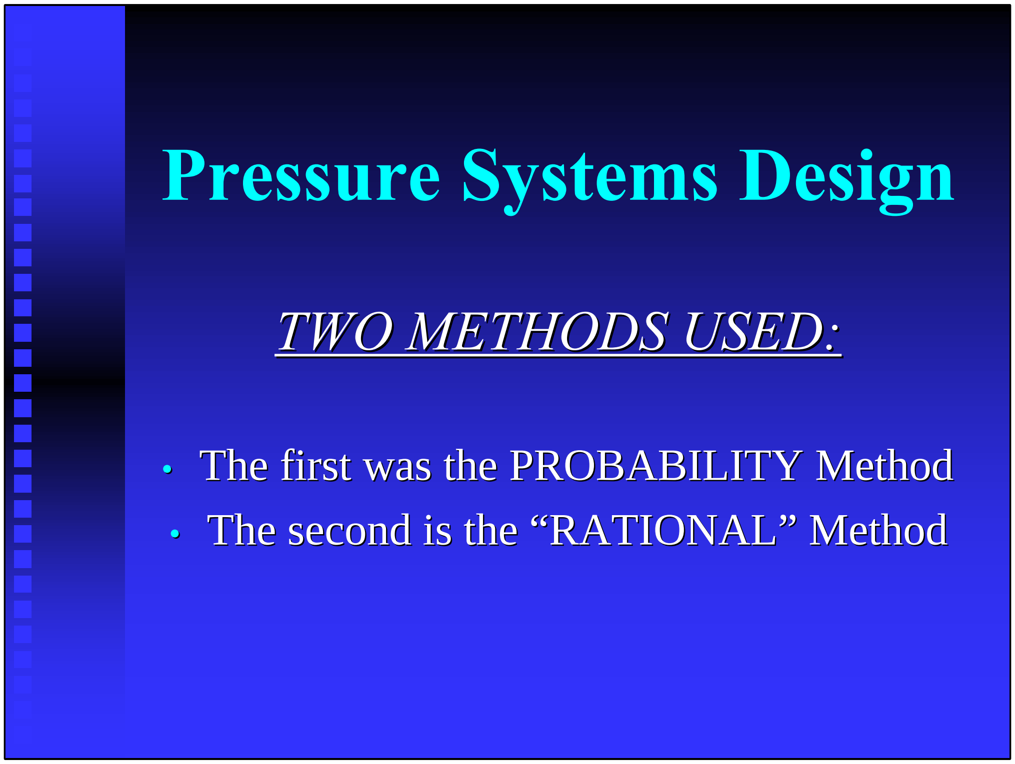
For the flows to vary both above and below the EPA line, one of two things must happen.

Issue "A". The flows from the homes in one part of the system are producing more flow than others. This cannot be statistically validated. (i.e. a random sample of 50 EDU's/homes from a system should produce the same flow as a second random sample of another 50 EDU's/homes.) This could not the case in the Probability Method model curve above.

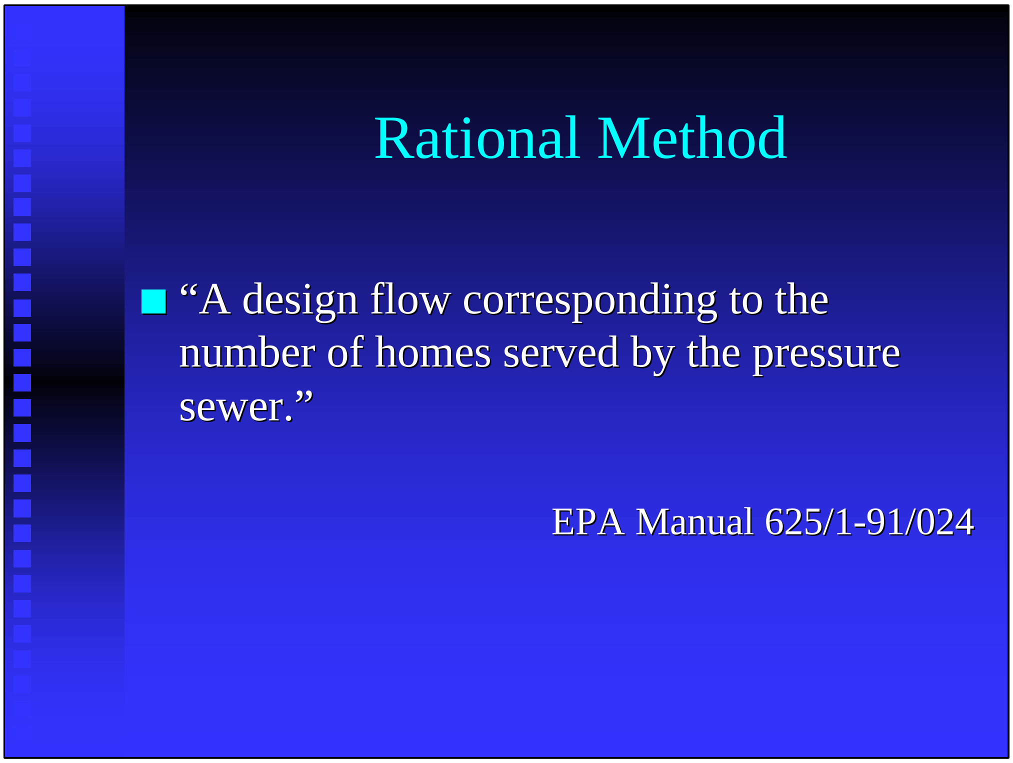
Issue "B". If "A". above were not true, then the flows from the pumps would have to be higher in one part of the system than in another. (The Probability Method, however, is based on a constant, like flow from each pump in the system (11 GPM).



Barnes does not recommend the use of the Probability Method.



The second method for predicting design flows in a pressure sewer is the Rational Method.



A design flow that corresponds to the number of homes or EDU’s being served.

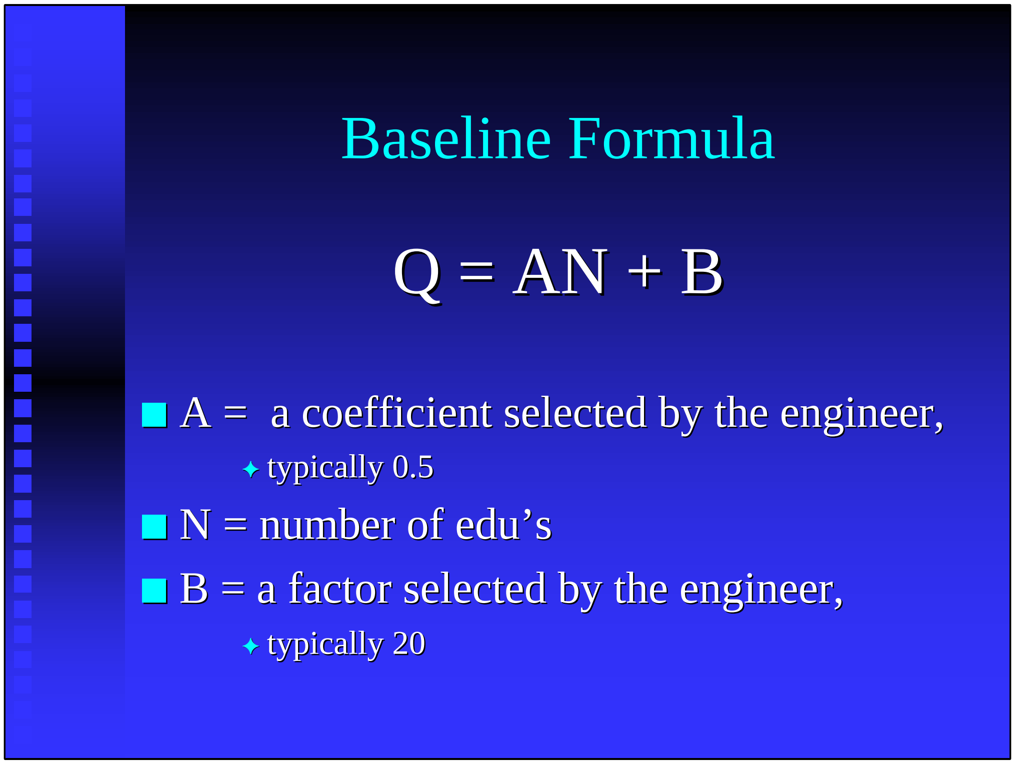
This flow is not dependent on the output from any pump being constant or the same as the others.

Rational Method

"The rational method can be logically applied when either centrifugal pumps or semi-positive displacement pumps are used."

"*The rational design has almost exclusively become the accepted method of practice*."

EPA Manual 625/1-91/024

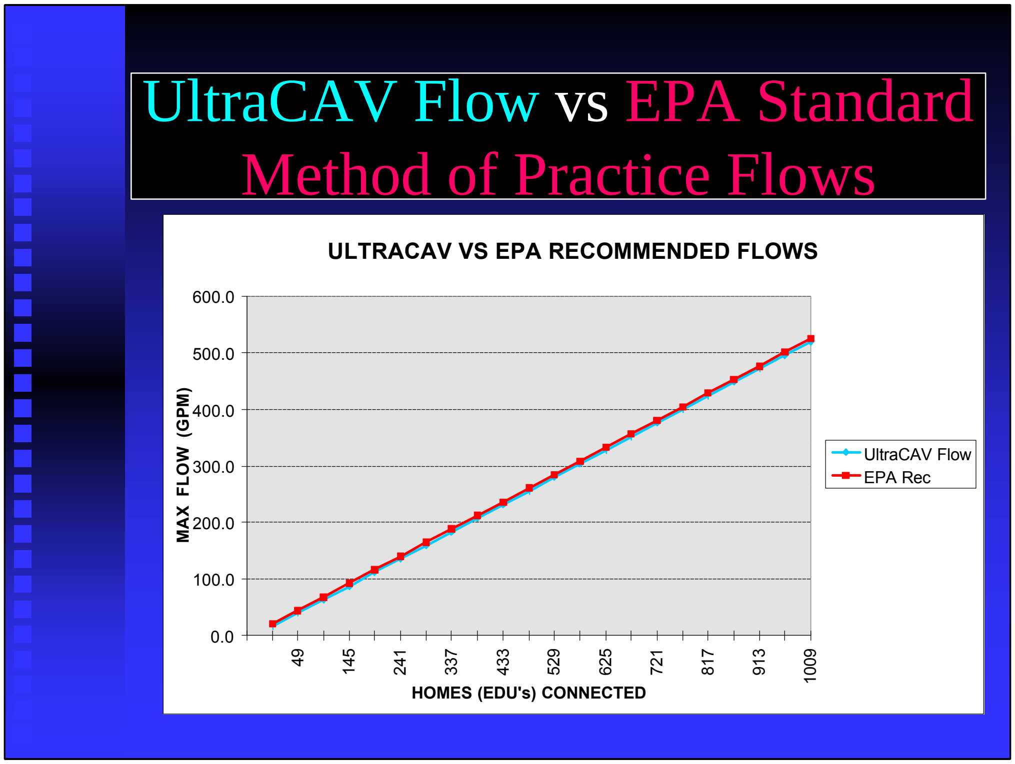


Q = the quantity or flow predicted X

One important factor in this method, (Rational), is that the flow contribution from each home is a constant, "A". This insures that the same flow contribution will result from any random sample of homes.

"B" is a baseline flow. Barnes recommend that the baseline flow, while suggested to be 20, not be any higher than the flow of any one pump, operating solo, in that respective grinder system. This will insure scouring of solids and greases in the system extremities.

It goes without saying that one does not want to predict a flow of 20 GPM or higher and then use a pump that cannot produce that much flow. Piping in such a case would accumulate debris and likely increase the likelihood of nuisance odors.

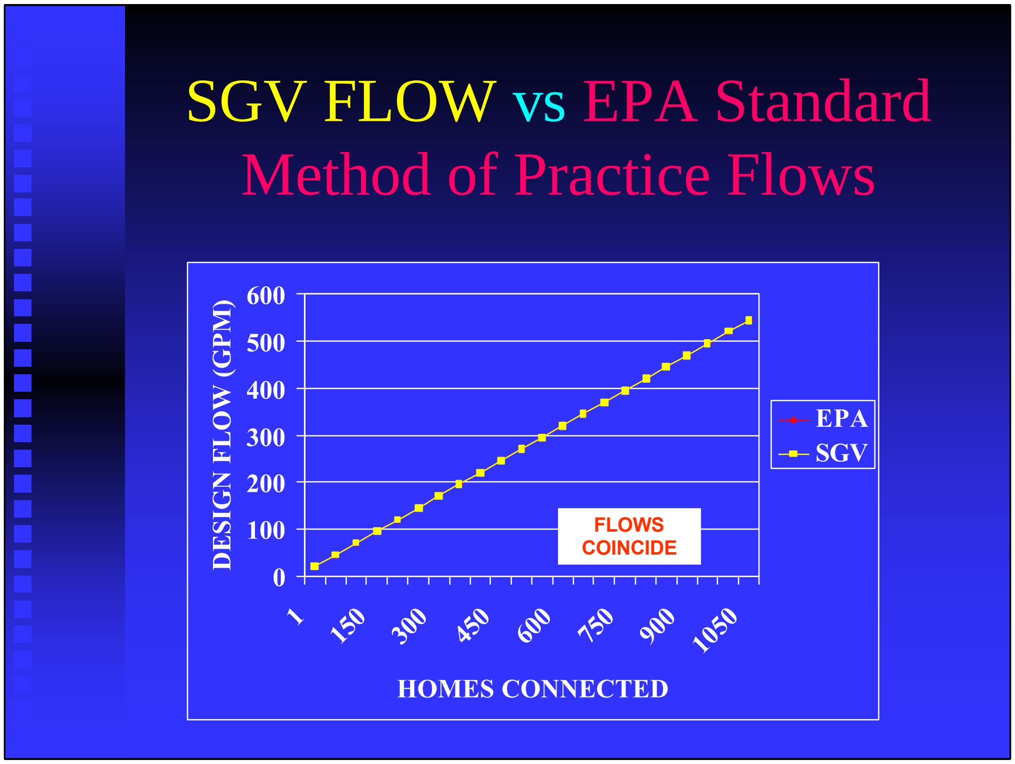


Note:

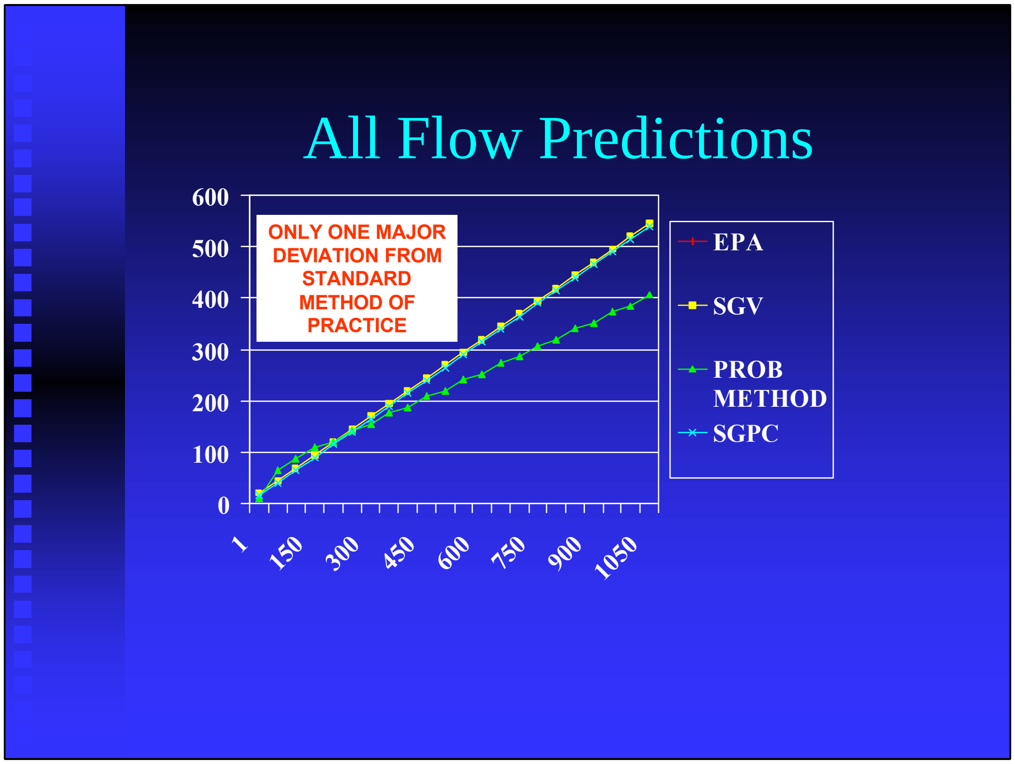
1. The flow does vary. ever so slightly, from the EPA recommendations utilizing 20 GPM as the B value.

2. This flow variation is due to the value of 15 GPM for B in the formula Q=AN+B. Thus, when one UltraCAV pump runs solo, the flow predicted will be 15.5 GPM. This is consistent with the respective pump curve.

3. The slope of the line is a straight line….meaning that the flow contribution per home is consistent.



1. The Barnes SGV flows perfectly coincide with the Standard Method of Practice flows suggested by EPA and WEF.

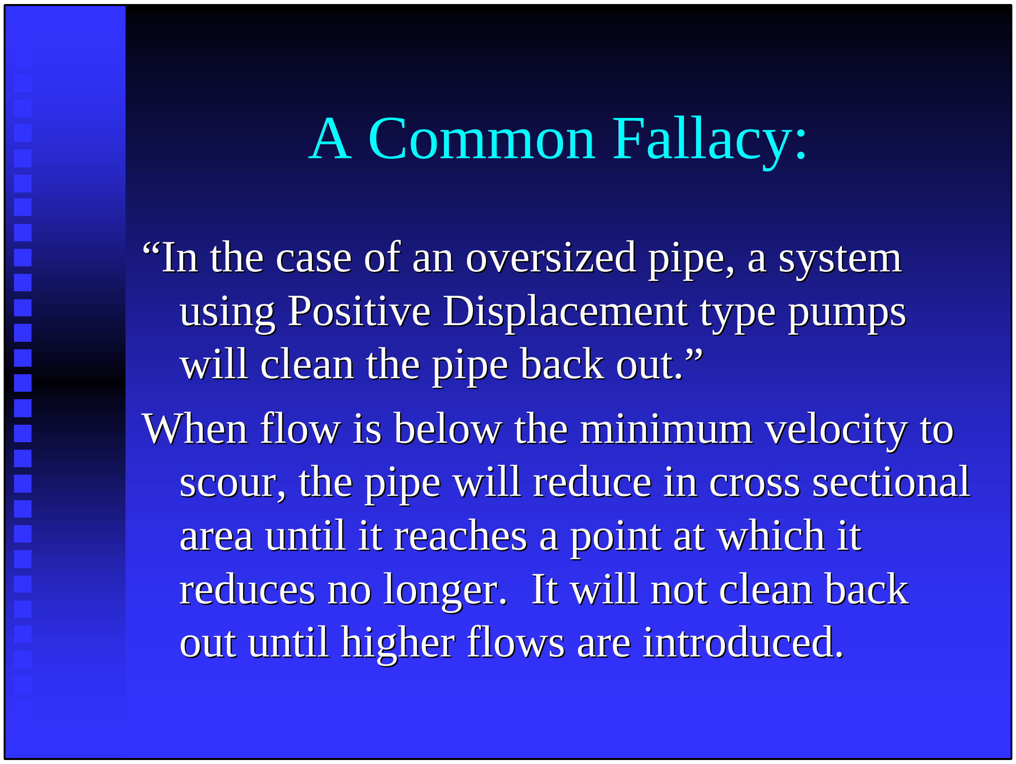


In this chart, the flow predictions by EPA, Barnes SGV, Barnes UltraCAV, and Probability Method are all plotted. The only significant deviation from the Standard Method of Practice is the Probability Method curve.

Choosing a Pipe Diameter

(APPLIES TO BOTH METHODS)

- Generally, for a given Design Flow, choose largest pipe diameter that still allows for a flow velocity of two feet per second or more.
- Project specific requirements can cause a choice of a smaller diameter pipe.
- Choosing larger diameters will require regular flushing in grinder systems.
- The 2 FPS requirement is waived in STEP systems

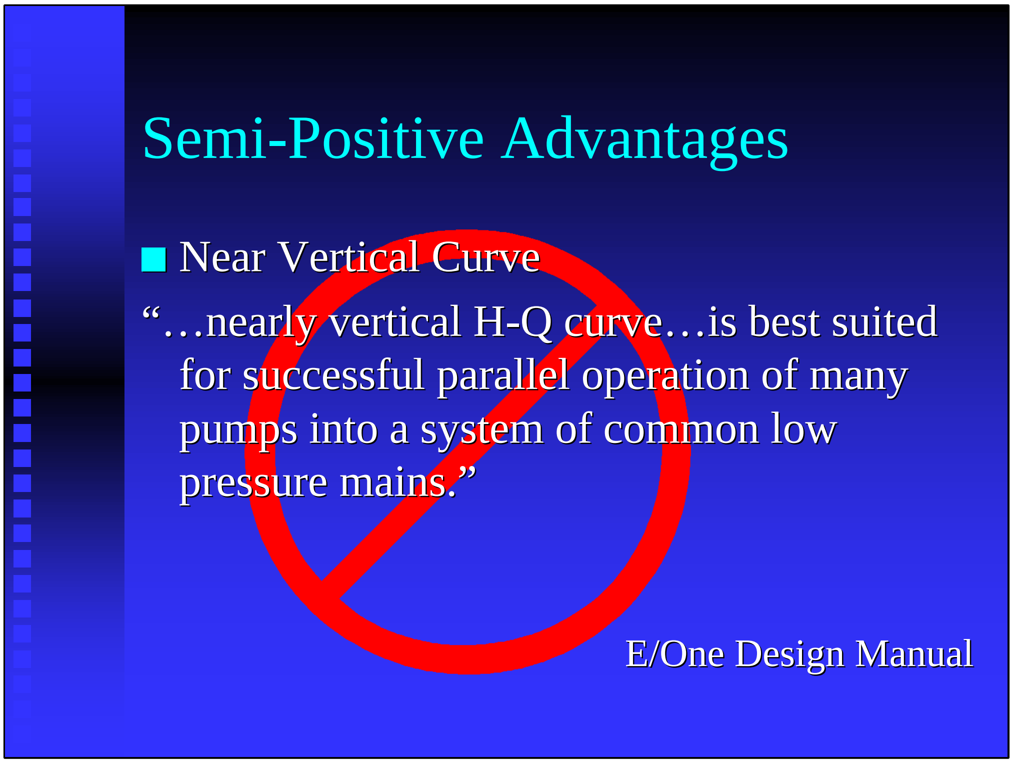


Fluid, including sewage is commonly caused to move through a pipe because of Gravity. A marble will roll down hill through a pipe for the same reason, gravity. As a slight slope increases to a deeper slope, the marble moves through the pipe with greater speed. In a given pipe with a given slope, however, the speed of the marble will be the same no matter how many times you release the marble into the pipe. The reason is that the force propelling the marble remains the same, Gravity.

Whatever pump(s) a particular pipe has connected to it, will result in a particular maximum flow potential. That maximum flow will not change without changes to the number or type of pumps being used.

In a low pressure sewer, any particular system will achieve a certain maximum flow. If the flow velocity is not sufficient to re-entrain solids when the maximum flow is reached, debris will begin to accumulate on the inside of the pipe. It will continue to accumulate until the inside cross sectional area of the pipe reduces to a point at which the velocity produced by the maximum flow begin to prohibit further accumulation. It will not be “cleaned back out” by same pumps that allowed the accumulation is the first place.

Cleaning of the pipe will occur when additional or different pumps cause additional flow at higher velocities in the pipe. No particular “type” of pump has an inherent advantage or disadvantage. Flow in a pipe is flow in a pipe, and the dynamics between the two will not care what force is the cause.



A given pressure system will have numerous operating conditions throughout the day. There will be a maximum head condition (at peak demand) and a minimum head condition (one pump running solo at lowest head required). Any pump that can properly operate at both of these conditions will work anywhere in that respective pressure system.

The shape of the curve is totally irrelevant.

A pump that meets all of the conditions demanded of a system….meets all of the conditions demanded of a system irrespective of the shape of its curve.

Pumps of varying types may be used in the same system as long both will meet the lowest and highest head conditions demanded by that particular system.

The obvious advantage of the progressing cavity pump is its head capacity.

Some feel that operation on 115volts is advantageous.

In some applications, its low flow characteristics can be a problem.

The centrifugal grinder needs to be a recessed vortex impeller design in order to operate way right on its curve. These pumps are virtually impossible to cavitate (unlike traditional semi-open impeller designs) and thus make a great choice for a pressure sewer and its varying head demands.

The Barnes SGV is more robust than a progressing cavity pump. The Barnes SGV series is a three bearing centrifugal grinder with oil filled motor and is considered a constant duty pump. This means it can be operated in applications in which it pumps 24 hours per day. Such application will not reduce the expected life. Such an application of a progressing cavity grinder pump will greatly reduce its life.

So, the bottom line is: The properly designed centrifugal grinder is more robust and should have a longer life expectancy, however, it cannot produce heads significantly over 100 feet.

The requirements of each pressure sewer project are different. Choose the pump that best meets the needs of the respective project.