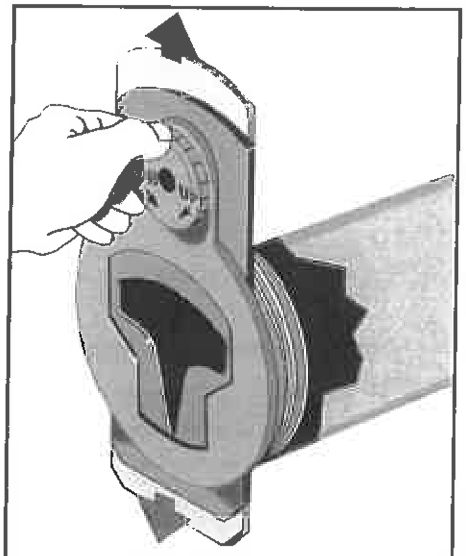
More Information On EQUALIZERS

DISTRIBUTION BOXES DON'T WORK WITHOUT EQUALIZERS!

That is the conclusion of many researchers, but is also obvious if one examines how a septic system functions.

THE PROBLEMS OF DISTRIBUTION BOXES



EQUALIZER

Because of the very large size of the usual 1000 gallon septic tank, the flow velocity out of the tank is very slow. You may flush 2 1/2 gallons into the tank in a rush, but this will only raise the level in the tank by about an eighth of an inch. This means that only a long, slow trickle will be coming out of the tank. One eighth of an inch provides a flow rate of roughly 0.25 gallons per minute (GPM). Divide this into two or more parts by a distribution box, and the flow to each pipe will usually be less than .1 GPM—a very low flow. Even this low flow is not the average from flushing. After half of the 2 1/2 gallons has flowed out of the tank, the rate is down to less than .04 GPM for each pipe! For four pipes, it's about 1/50 of a gallon per minute each-a fast drip. Since toilet flushing is the most common single source of effluent, that is what you have to design for.

At these very low flows, a distribution box must be set in the ground almost perfectly level. In fact, to divide this low flow rate with no more than 30% error in flow division, one would have to align all the pipes in the box to within one thirty second of an inch! ONE THIRTY SECOND OF AN INCH! In real life, most installers are happy to achieve an accuracy of 3/16 ths of an inch. In real life, in distribution boxes without *EQUALIZERs*, nearly all of the effluent from toilet flushes will be going to the lowest pipe. Of course this can lead to premature system failure.

The basic problem is that the flow rate is too small compared to the size of the holes, or pipes. You could either increase the flow rate (by pumping or dosing), or decrease the size of the opening. The *EQUALIZER* has a specially designed opening (*a cusp shaped weir*) that is narrower at the bottom and thus is able to divide even these very low flows with some accuracy. Clearl, the addition of *EQUALIZERs* is absolutely necessary for a distribution box to work properly.

SOME USE SERIAL DISTRIBUTION

Because of the problems with distribution boxes, alternatives have been tried. If you have several trenches, you can run the overflow from the highest into the next highest (called "serial distribution"). Unfortunately for this simple solution, more recent research seems to indicate that more uniform distribution means longer system life. Serial distribution depends entirely on anaerobic respiration for breakdown of the solids in the effluent, and anaerobic respiration is about ten times slower than aerobic respiration.

Serial distribution also inherently overloads the upper trenches causing premature failure there. It is only a matter of time before the other lines fail in turn, and sewage runs out on the ground. If, on the other hand, the effluent is distributed uniformly, this favors the more efficient aerobic respiration. Then the biomat is oxidized away as fast as it is built up by the incoming effluent, and the system can last indefinitely.

PARALLEL DISTRIBUTION IS BETTER

Current design practice uses either distribution boxes, or pressure distribution in order to achieve the desired uniform, or parallel, distribution. Since pressure distribution systems are quite failure prone, that only leaves distribution boxes as a good design choice. But distribution boxes also have some inherent problems.
THESE PROBLEMS ARE SOLVED BY USING EQUALIZERS!

A POSSIBLE SOLUTION?

There are proprietary devices on the market that have adjustable 2" round hole, an improvement on non-adjustable open pipes. Surely these devices will solve the problem? Unfortunately—no. They won't, for two reasons. First, they must be placed with extreme accuracy because, like the open pipes, it takes a large change in flow to raise the water level to a slightly higher pipe. Like a plain distribution box, they too must be placed with unattainable precision or low flows will simply not feed a pipe that is even minutely higher.

Second, it is all well and good to talk about adjusting the box or the 2" adjustable holes to these precise numbers. Then the installer has to bury the box without moving it at all! Later, people walk or mow over the buried pipes and box, the ground settles, and there are frost heaves. All of these things make such attempted accuracy pointless and futile. Within two years, it is doubtful that even 3/16ths of an inch of accuracy remains. Thus both open pipes and adjustable 2" holes are equaly destined to fail under normal installation conditions.

The graph in *Figure 1* shows the head of water built up behind an opening for a given flow rate. The comparison shows that the *EQUALIZER* has over three times as great a buildup (because the opening is narrow). We can see how important this is when we compare flow error rates *(Figure 2)*.

THE ONLY REAL SOLUTION ; EQUALIZERS !

The adjustable *EQUALIZER* is the only device that avoids the problems of imperfect installation and/or later movement of the distribution box. While the box might not be set quite perfectly, the final adjustments of the *EQUALIZERs* will make the openings exactly even compared to the water level in the box.

EQUALIZERs are very easy to install and use. The installer just pushes them into the open pipe ends in the distribution box. After installation, water is added to the bottom of the highest *EQUALIZER*. The rest of the *EQUALIZERs* are then dialed up to this exact level using the built-in adjustment knob. Easy, accurate, and best of all, – permanent! The patented shaped weir immediately improves accuracy enormously. But the improvements don't end there. *EQUALIZERS* are also self-adjusting over time! Even though the box or pipes move a little, flow division will remain excellent— indefinitely.

A LIVING ADJUSTMENT MECHANISM

EQUALIZERs have been installed in working systems for the past six years. Tests have proven that their patented shape takes full advantage of a remarkable characteristic. After a few months, the naturally occurring living slime that forms over everything in a distribution box will also form on the *EQUALIZERs*. In fact, this slime will plug the narrow lower 1/3 or so of the *EQUALIZER* weir. It will gather there right up to, but not above, the water line in the box. This means that even if one of the pipes and its *EQUALIZER* becomes slightly lower or higher than the others, this slime will form a slime dam across the *EQUALIZER* weir just at the average water line. Since all the dams will be at the same level, even at very low flows, division will still be very nearly equal. Even if the box continues to shift, this living adjustment mechanism will continue to compensate. The slime will build up on weirs lower than the water line, and will rot away if above the water line, thereby keeping flow division accurate.

The range of this compensation is not infinite, of course. Full compensation has a range of misalignment of roughly 3/8". But even for boxes worse than that, *EQUALIZERs* are always <u>much</u> better than either open pipes or the 2" holes.

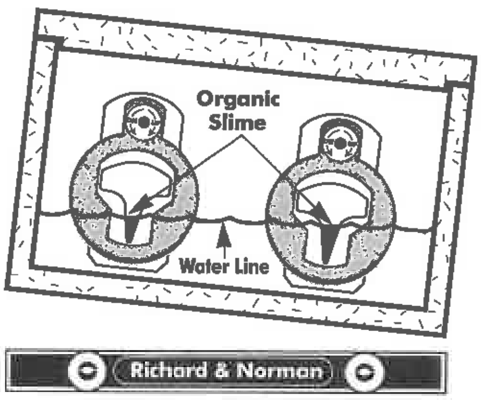


FIGURE 1. The organic slime fills the weirs up to the water line, but not above it.

USING EQUALIZERS IN PUMPED SYSTEM

Surprisingly, even pumped systems need adjustable *EQUALIZERs*. Obviously this is not because of low flow rates. Rather, the swirling and eddies caused by the rush of water into the box can cause a difference in water level of as much as 1/2" at the various outlet pipes. This will cause dramatically unequal flows. With *EQUALIZERs*, these high flows can be equalized. The *EQUALIZERs* must simply be adjusted so that they are at the same height compared to the water level with the pump running.

The question is often asked, "what is the maximum flow through each *EQUALIZER*?" The answer depends upon the total allowable head of effluent behind each *EQUALIZER*. The maximum flows are:

13 GPM each with the water level at the top of the *EQUALIZER* opening.
16 GPM each with the water level one inch above the top of the *EQUALIZER* opening.
19 GPM each with the water two inches above the top of the *EQUALIZER* opening.

THE BOTTOM LINE

EQUALIZERs cause the flows out of a d-box to be close to equal. In doing so they certainly help tremendously and never do harm. Installing them amounts to a kind of "insurance" against problems which could lead to premature system failure. If you are a Site Evaluator, a Designer, an Installer, a seller of distribution boxes, Plumbing Inspector or a Sanitarian, you really should insist on the use of distribution boxes with adjustable, easy to use *EQUALIZERs*.

Lifetime Warranty on Equalizer

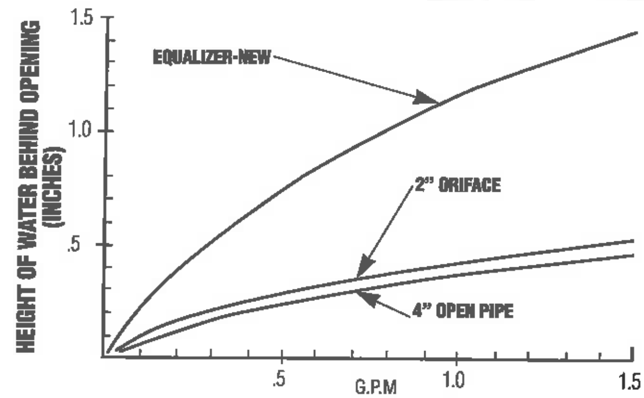


FIGURE 2. BUILD UP (HEIGHT) OF WATER BEHIND OPENINGS AS WE INCREASE THE FLOW. COMPARES 4" PIPE AND 2" ORIFICE WITH EQUALIZER.

0% ERROR WOULD MEAN FLOW WAS PERFECTLY SPLIT **100%** ERROR MEANS <u>ALL</u> FLOW TO LOWER PIPE, <u>NONE</u> TO HIGHER PIPE

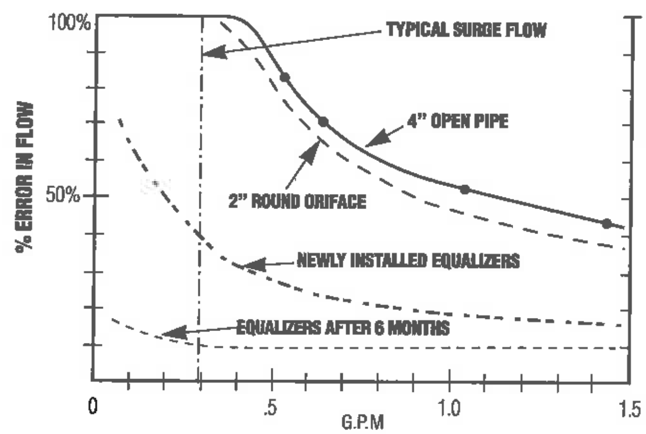


FIGURE 3. % FLOW ERROR VS GALLONS PER MINUTE. THIS GRAPH IS FOR **2** OUTLETS, ONE **3/16"** HIGHER THAN THE OTHER. (ALL HAVE LESS ERROR AT HIGH FLOW RATES)

(G.P.M = GALLONS PER MINUTE)

TO ORDER EQUALIZERS:

Distributed BY:

In Maine and New Hampshire (only) call:
SSI, Inc. at 1-800-762-6009
Fax: 1-207-562-8033
Brown Hill Road
West Peru, Maine 07290

Other U.S. and in Canada call:

POLYLOK™ Inc
173 Church Street, Yalesville, CT 06492
(203) 269-3119-Ext.20 Fax(203) 265-4941
1-800-234-3119-Ext.20

Patent Numbers 5,154353 – 5,107892
Other Patents Pending

CERTIFIED NATIONAL PRECAST CONCRETE ASSOCIATION PLANT

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Donald C. Hoxie, PE
18 Greenwood Street
Augusta, ME 04330
(207) 662- 7445

March 17, 1996

Norman Gavin, President
Polylok Inc.
173 Church Street
Yalesville, CT 06492

Phase I Report on the Field Study of Polylok's New Adjustable "Equalizer"

Dear Mr. Gavin:

INTRODUCTION

To reintroduce myself, between 1972 and 1994 I was the Director of the Division of Health Engineering in the State of Maine. This included regulatory responsibility for all the surface wastewater disposal systems installed in the State of Maine. Since retiring, I find myself providing part time consulting services to my former division and others. In the latter capacity, I was retained to review and evaluate the field study of your new adjustable "Equalizer." This is a report on Phase I of that field study.

STUDY PURPOSE

The study was designed by Richard Plachy, SSI Inc., West Peru, Maine to evaluate the new adjustable equalizer's ability to equally distribute domestic wastewater from a septic tank serving a three unit apartment house with four occupants.

STUDY DESIGN

The study was designed so that each of 16 equalizers should divert one quarter of 25% of the total wastewater stream leaving the structure. The study was also designed to evaluate equalizer performance during high, low and total flows. In Phase I the wastewater flowed from the septic tank by gravity into a carefully leveled distribution box that was fitted with an equalizer in each of four outlets. Each equalizer was adjusted so that their weirs were all at the same elevation. The flow from each outlet pipe was metered by a calibrated dipper tray and an accumulating counter that recorded each time the tray dumped. The flows leaving the four dipper tray boxes were recombined into a collection box and then piped to the next distribution box in the series. This was repeated four times in an attempt to provide better statistics and provide a means of checking the calibration of the dippers and the performance of their counters. **Appendix 1** shows a schematic of the test array used for this study. Richard Plachy installed all the field test equipment and conducted the field tests while I did the data reduction, analysis and presentation.

FIELD MEASUREMENTS

Upon arriving at the study site the counter readings were recorded. The differences in the counter readings from the previous site visit were used to determine low flow performance. During many visits several faucet's were turned on in the structure and left running for a half an hour or more. The counter readings were again recorded and the differences in the counter readings at the beginning of the site visit and when the faucets were shut off were used to determine high flow performance. The differences in the beginning counter readings taken at each site visit were used to determine total flow performance. During the study, three of the dripper counters malfunctioned making it impossible to accurately evaluate 8 of the 16 equalizers for all of Phase I. It also should be noted that high flow measurements were not made during each site visit.

SUMMARY OF FINDINGS

The average total wastewater flow from the structure was 158 gallons per day with average low flows of 86 gallons per day. The typical high flow ranged between 2 and 4 gallons per minute. **Appendix 2** summarizes equalizer total flows based on the assumption that each of the 16 dippers should have received 25% of each sampling period's flow. The numbers in ( )s represents the number of sampling periods used for calculating the averages.

Appendix 3 shows the statistical variability of the equalizers for all the sampling periods used to summarize the equalizers performance.

Appendix 4 shows the sampling period variations in the performance of the equalizers in graph format.

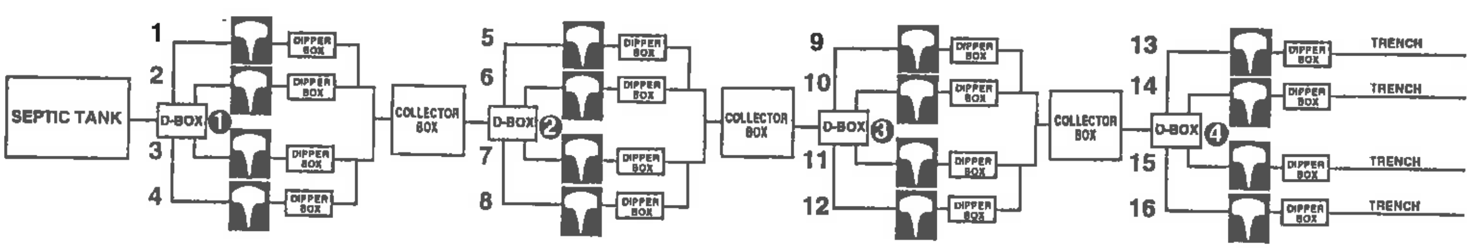
CONCLUSION

- Appendix 4 shows that the performance of any one equalizer can vary significantly from day to day.This is believed to be due to the rapid development of and periodic sloughing off of a biological matte that bridges the lower portion of the weir. Visual observations founded that the weirs periodically trap large suspended solids. These solids in turn are broken loose and swept away.
- Appendixes 2 and 3 show that equalizers perform slightly better at higher flows. This is believed to be related to greater hydraulic heads in the distribution boxes during higher flows. This also suggests that distribution boxes with small foot prints may further improve the performance of equalizers.
- Appendixes 2 and 3 show that equalizers seem to perform better in each succeeding distribution box.This is believed to be the result of larger solids settling out in the collection boxes resulting in less solids to be trapped by the weirs. This also suggests that the use of septic tank filters may further improve the performance of equalizers.
- The average of individual total flow for all 16 equalizers is 25.0% with a standard deviation of ± 4.9% and a 95% confidence limit of ± 9.9%.
- The equalizer's biologically adjusting weir appears to offer an inexpensive, non- mechanical way of dividing domestic wastewater flows into at least four relatively equal parts.

Under separate cover, I previously provided you with the raw field data and all my calculations which you may wish to provide o any customers, regulators, or design engineers who would like additional detailed information.
Please feel free to call me at (207) 622-7445.

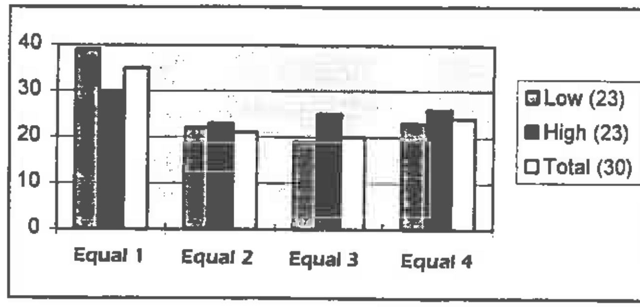
Donald C. Hoxie

APPENDIX 1

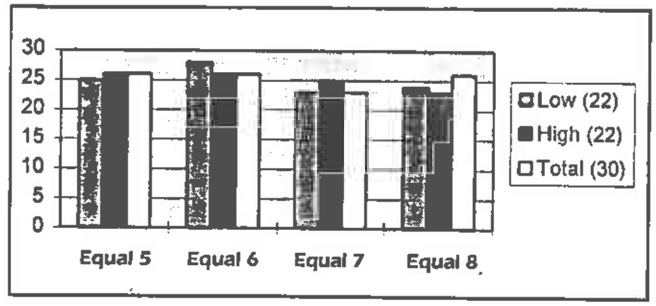


APPENDIX 2

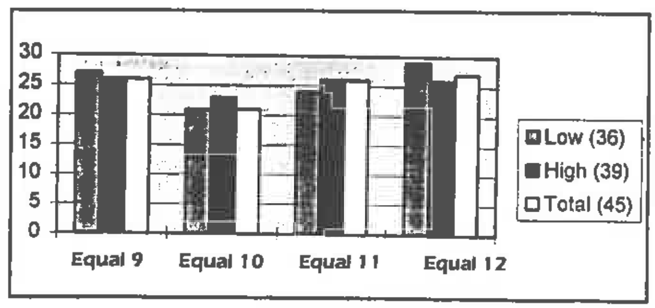
	Low (23)	High (23)	Total (30)
Equal 1	39	30	35
Equal 2	22	23	21
Equal 3	19	25	20
Equal 4	23	26	24



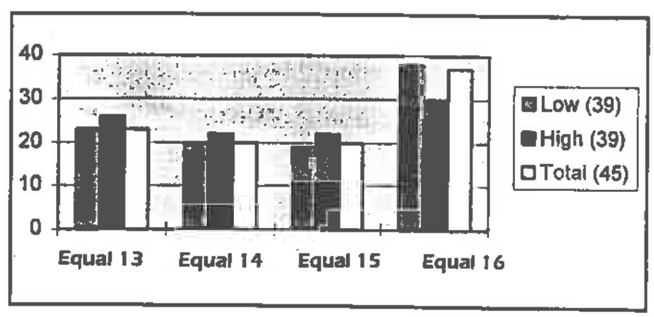
	Low (39)	High (39)	Total (45)
Equal 5	23	26	23
Equal 6	20	22	20
Equal 7	19	22	20
Equal 8	38	30	37



	Low (36)	High (39)	Total (45)
Equal 9	27	26	26
Equal 10	21	23	21
Equal 11	24	26	26
Equal 12	29	26	27



	Low (22)	High (22)	Total (30)
Equal 13	25	26	26
Equal 14	28	26	26
Equal 15	23	25	23
Equal 16	24	23	26



The numbers in the ( ) represent the number of days used to determine the averages

APPENDIX 3

DISTRIBUTION BOX 1 WITH EQUALIZERS 1 THROUGH 4 UNTIL COUNTER FAILURE 11/21/96

	Total Flow				Low Flow				High Flow			
	Equal 1	Equal 2	Equal 3	Equal 4	Equal 1	Equal 2	Equal 3	Equal 4	Equal 1	Equal 2	Equal 3	Equal 4
Median	36.0%	20.2%	16.8%	22.5%	35.4%	22.0%	16.5%	16.0%	28.5%	24.9%	23.4%	23.5%
Average	35.2%	20.8%	19.6%	24.4%	37.6%	22.3%	18.1%	22.0%	29.2%	22.3%	23.7%	24.9 %
Std/Dev	6.3%	10.0%	4.4%	8.1%	9.0%	13.8%	5.1%	9.2%	3.2%	7.5%	2.9%	4.5%

DISTRIBUTION BOX 2 WITH EQUALIZERS 5 THROUGH 8 UNTIL 1/3/96

	Total Flow				Low Flow				High Flow			
	Equal 5	Equal 6	Equal 7	Equal 8	Equal 5	Equal 6	Equal 7	Equal 8	Equal 5	Equal 6	Equal 7	Equal 8
Median	21.4%	19.5%	20.8%	38.2%	21.1%	19.7%	19.6%	40.7%	24.5%	22.7%	22.3%	31.4%
Average	23.1%	19.8%	20.5%	36.6%	23.3%	19.8%	18.7%	38.2%	25.6%	22.1%	21.8%	30.5%
Std/Dev.	5.7%	6.3%	4.7%	8.6%	7.7%	7.8%	5.3%	10.3%	3.4%	4.2%	4.3%	5.2%

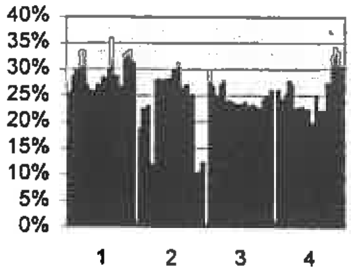
DISTRIBUTION BOX 3 WITH EQUALIZERS 9 THROUGH 12 UNTIL 1/3/96

	Total Flow				Low Flow				High Flow			
	Equal 9	Equal 10	Equal 11	Equal 12	Equal 9	Equal10	Equal 11	Equal 12	Equal 9	Equal 10	Equal 11	Equal 12
Median	26.8%	20.6%	26.0%	26.4%	26.8%	19.7%	22.8%	28.4%	25.8%	22.7%	24.4%	25.9%
Average	26.4%	20.8%	25.9%	26.9%	28.7%	20.7%	23.9%	28.8%	25.8%	22.7%	25.8%	25.7%
Std/Dev.	4.7%	3.1%	6.2%	4.4%	4.7%	3.6%	7.3%	5.9%	2.2%	3.7%	5.4%	2.8%

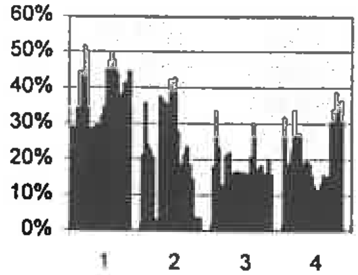
DISTRIBUTION BOX 4 WITH EQUALIZERS 13 THROUGH 16 UNTIL COUNTER FAILURE ON 11/21/95

	Total Flow				Low Flow				High Flow			
	Equal 13	Equal 14	Equal 15	Equal 16	Equal 13	Equal 14	Equal 15	Equal 16	Equal 13	Equal 14	Equal 15	Equal 16
Median	26.6%	25.5%	23.3%	25.6%	24.3%	26.3%	23.4%	25.6%	26.1%	25.8%	25.5%	24.1%
Average	25.9%	25.5%	22.8%	25.7%	24.9%	27.6%	23.1%	24.4%	25.7%	25.8%	25.4%	23.1%
Std/Dev.	4.0%	5.9%	3.1%	5.9%	5.9%	7.6%	3.1%	5.8%	1.9%	2.9%	2.1%	5.0%

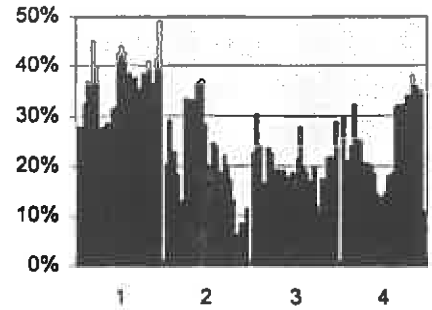
APPENDIX 4



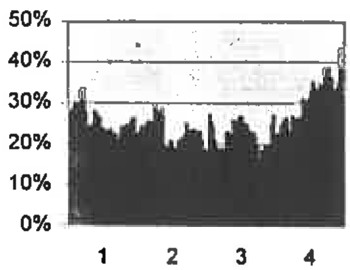
Distribution Box 1 High Flow



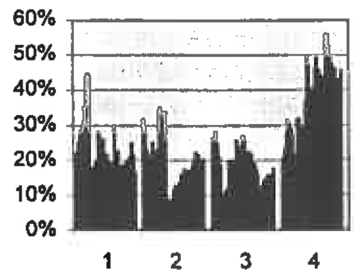
Distribution Box 1 Low Flow



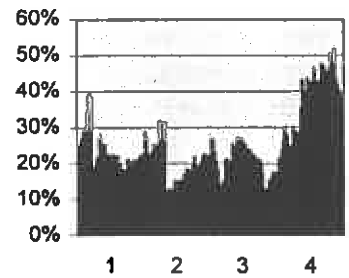
Distribution Box 1 Total Flow



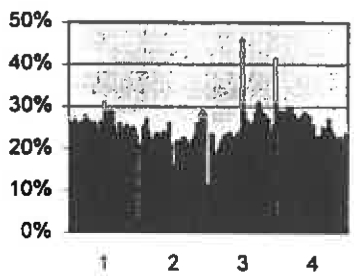
Distribution Box 2 High Flow



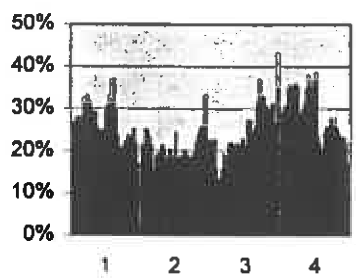
Distribution Box 2 Low Flow



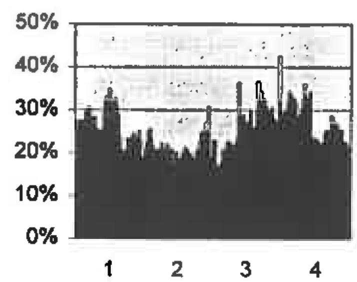
Distribution Box 2 Total Flow



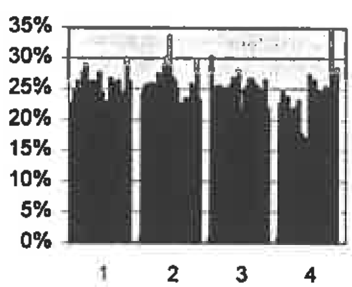
Distribution Box 3 High Flow



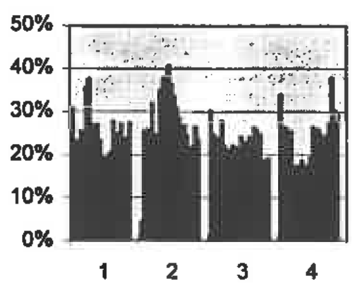
Distribution Box 3 Low Flow



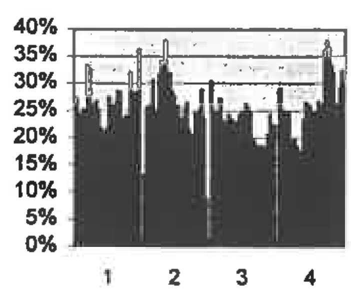
Distribution Box 3 Total Flow



Distribution Box 4 High Flow



Distribution Box 4 Low Flow



Distribution Box 4 Total Flow