2009

Title: Glade Irrigation District Low Water Pressure Investigate

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L2E Project: 912

585/115 homes ≈ ~5 gal/min
1040/115 homes ≈ ~9 gal/min
range of H_2O av per ho if 115 conn

Summary of project:

L2 Engineering was retained in May 2009 by the Glade Irrigation District to assist in determining the causes of low pressure in the Glade Irrigation District water supply piping, and analyze several proposed solutions for increasing the pressure.

The low water pressure occurs during the summer / irrigation months in the 3" and 4" supply lines which are near the end of the water system. The water pressure drops to approximately 40 PSI or lower at times. This is in contrast to supply just after the pressure reducing station, which is at 90 PSI 90 PSI is the practical limit to how high the regulator can be set without causing problems due to excessive pressure at the services near the pressure regulating station. The water supply to the pressure reducing station is approximately 140 PSI.

The system was designed and installed in 1974 to for/60 services. As of this time there are 109 services attached to the system. The water source is Glade creek and is chlorinated. The existing pressure regulator station has rated capacity of 585 GPM (37 liters/sec), however, due to the high head / large pressure differential, is capable of supplying up to 1040 GPM at 90 PSI.

The goal is to maintain approximately 55 PSI minimum and 90 PSI maximum main pipe pressures throughout the system.

Results

1. To obtain water pressure similar to what the system was originally designed for, water restrictions and/ or considerable upgrades to the piping are required. The current system is servicing about twice as many residences and is not able to supply water at the desired pressures.

   The original system under the same worst assumed summer loads would see a minimum mai pipe pressure of 55 PSI, this is the target for improvements to the system.

2. The recommendation for improving pressure in the 3" and 4" piping in the short term is to go t reduced flows by restricting water use age.

   The amount of pressure increase this will provide depends on the existing water pattern vs. th restricted water use age pattern. If many services already already use water for irrigation on every other day, the effect will be minimal. If most services use water every day the effect will be significant.

   For the model, the water flow is estimated to drop to 67% of the current value by going to watering every 2cnd day for each service.

   Because the system is limited by pipe capacity and has no storage capability, the maximum irrigation volume flow would be achieved by irrigating 24 hours a day, even with high evaporation losses. If water is not used during the day, it does not make any more water available at night.

3. The recommendation for improving pressure in the 3" and 4" piping in the long term is to replace and up size the piping in the following order, 4", 3", 6", 8".

   Both the 3" and 4" will need to be upgraded to achieve significant pressure increases in those areas. Doing so will result in lower pressures in the 6" piping as that section will see more flov and pressure drop.

   The regulator station will also require larger capacity valve(s), since the system will be able to deliver more volume as the piping is upgraded, and to lessen the risk of water hammer damage.

   The runs were based on increasing the pipe sizes, from 3" to 4", 4" to 6", 6" to 8", and 8" to 10". This results in a similar system pressure with 110 houses to what the present system had with 55 houses on it. If considerable additional future services are anticipated to be added, it may be worth considering increasing each pipe by 1 additional size, or leaving the existing piping in and looping the new pipe to tie into the old in several places.

4. The current pressure regulators have enough capacity to supply approximately 1040 GPM at 90 PSI outlet pressure. Flowing more than this will result in supply pressures at the outlet of less than 90 PSI. At 1100 GPM, the regulator outlet pressure will be approximately 81 PSI when set at 90 PSI, and at 1200 GPM this would drop to 67 PSI.

   The current pressure regulators are operating in higher than recommended flow and pipe velocity ranges. The max recommended flow for both valves is 585 GPM. The max recommended flow is 20 ft/sec to limit pipe and valve velocities to prevent potential water hammer problems if large valves are turned off quickly. This may be more of a concern for large commercial or industrial loads than a residential system.

   Two different size valves are used to get get better (smoother) dynamic pressure valve response. Normally the smaller valve is setup at several PSI above the larger valve, so that it operates alone at low flows.

   Increasing the capacity of the pressure reducing station could be done by increasing the valve sizes, or adding an additional valve in parallel with the existing 2.

5. Adding a booster pump at the start of the 4" pipe would increase flow rates downstream of the booster pump, thereby increasing the flow rate and pressure drop in the 6" piping. The result would be significantly decreased pressure near the end of the 6" piping. The pressure at the end of the 3" pipe would also be quite low. 3 booster pump stations would be required to achieve a pressure profile similar to the original design.

   The piping is restrictive for the amount of water flowing, so any attempts to increase the flow rates with booster pumps results in pipe velocities in excess of the recommended 5 to 7 ft/sec, range, and large pressure drops. The higher than recommended pipe velocities would make the system more susceptible to water hammer problems.

6. There is a considerable amount of excess capacity in the pipe running from the intake to the pressure reducing station. If the line were T'd and a run of the river turbine installed, the turbine could act as the pressure reducing valve by increasing the flow rate to the point where the pipe friction is equal to the excess head pressure available. The total power available is in the range of 25 kW. If sufficient water is available all year, it would generate about $16,000/ year at $0.07 /kWh The chlorination system would need to be changed. There are a number of other possibilities including an inline turbine, an open tank/ reservoir, or a stand-alone system.

Don Scarlett of Kaslo is a local Engineer with expertise in micro hydro systems. His tel # is (250) 353-2563. He has expressed interest in looking at the system for power generation.

7. Graphical output follows showing the effects of each change on the system.

   P is the pipe pressure at the main pipe, beginning at the outlet of the pressure reducing statior and showing the start and end of each pipe and location.

   Qs is the theoretical flow to each service at the start and end of each location.

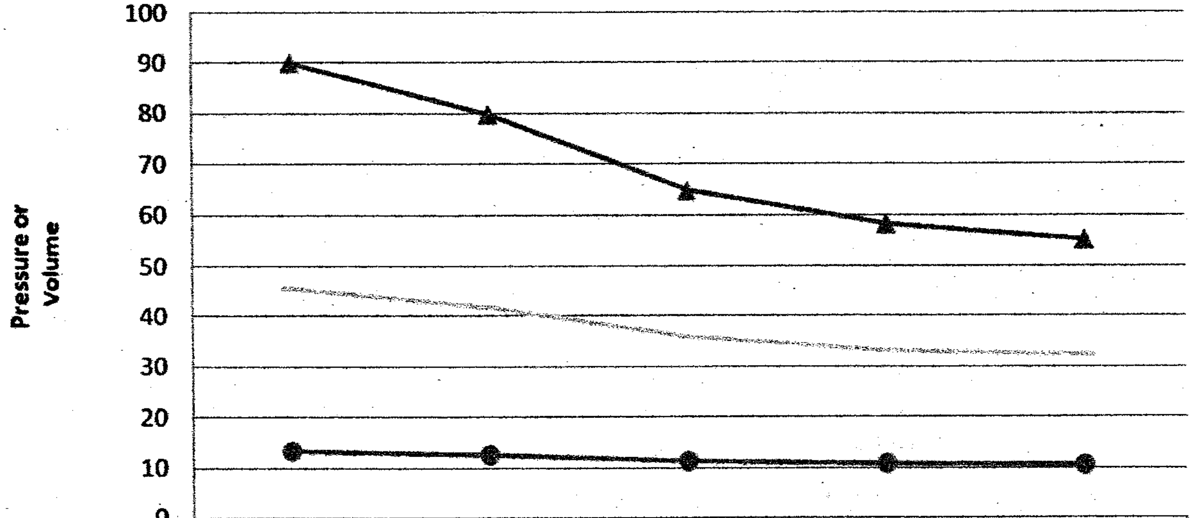
   Throw(ft) is an estimated typical sprinkler horizontal throw which would result at each pressure location. Its significance is not in the absolute value, but in the difference in values at various locations.

   The calculations were done using a spreadsheet to create a model of the Glade Irrigation District system. Runs are approximate, using following assumptions:

   - Each service is equally spaced along the pipe service for that pipe size and # of services.
   - Each service has the same connected load. Each run is modeled with a fixed restriction (k factor) and equivalent nozzle opening for each service. The system flow rate is iterated until the estimated and calculated system flow values match.
   - Services are equally spaced along each section of pipe.
   - The elevation change is equally divided along each service within each main pipe size. Elevations are input at the start and end of each pipe run only.
   - The elevations and pressures are at the location of the pipe along the road, some houses, particularly in the London road area are considerably higher than the pipe and will have lower pressures due to this height where the water is being used.
   - Elevations were taken using an average of 2 GPS and 2 altimeter readings and are approximate:

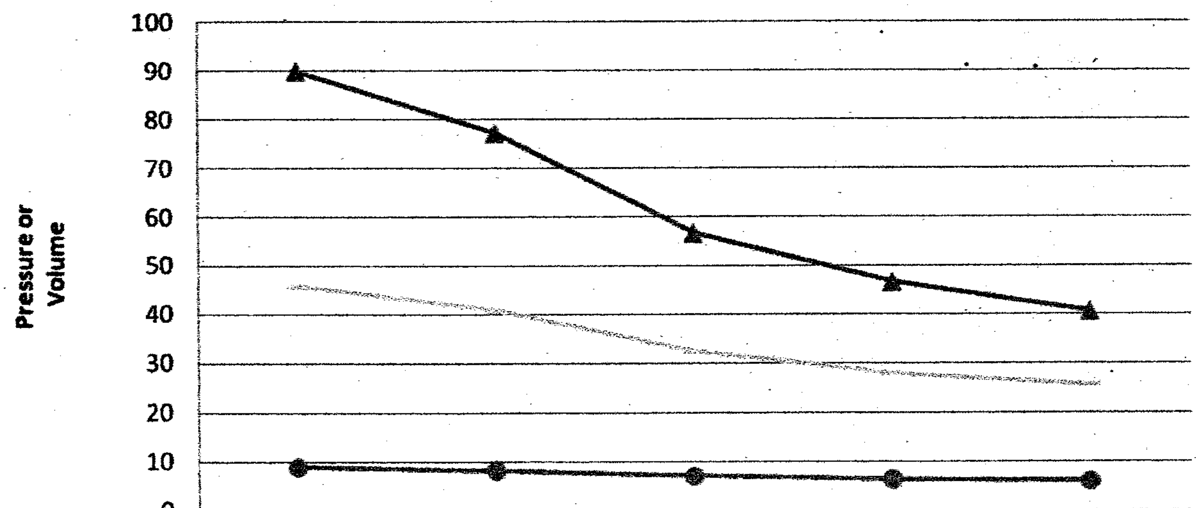
location	Street	height	Pipe	Ele
Intake			8"	5
P red stn			8"	4
8-6 transition	Antler Johns place 2120/2122	high spot	8"-6"	4
6" pipe	Glade	high area	6"	4
6" pipe	Glade & Division	high area	6"	4
6"-4" near	Glade Hall	high area - start P problems after hall just before downhill and road over pipe	6"	4
4"-3" near	Morain Rd	x-ing	4"	4
3"	London Rd	down hill and below road	3"	4
3"	Leeside Rd	low area	3"	4
3"	Zwicks place 2309	nearing end	3"	4
3"	Denison Rd.	end of pipe	3"	4

Original system, worst summer days, 620 GPM



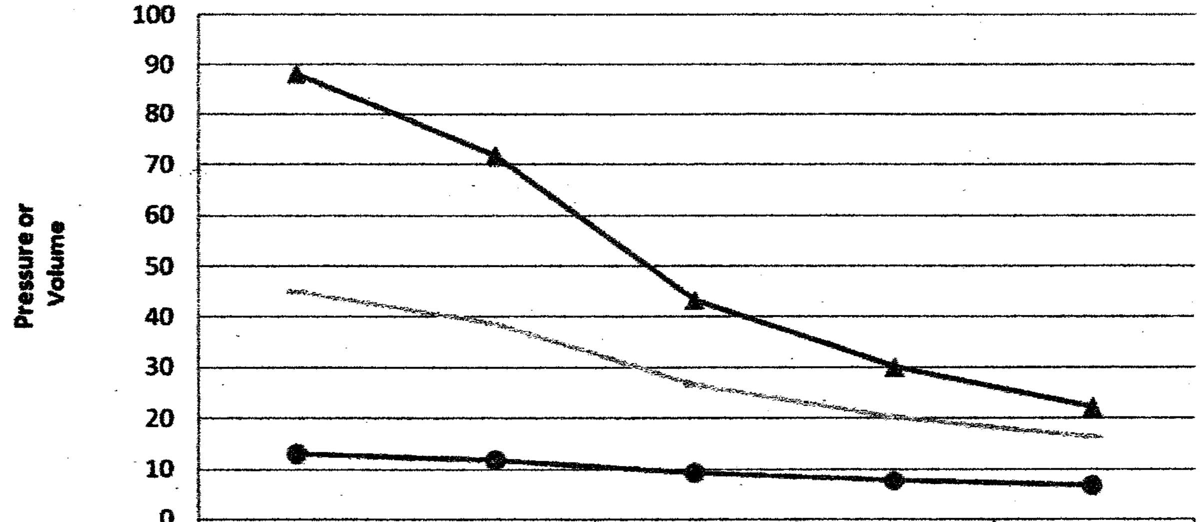
	Pr stn	8" pipe	6" pipe	4" pipe	3" pipe
P (PSI)	90	80	65	58	55
Qs (GPM)	13.2	12.4	11.2	10.6	10.5
Throw (ft)	45.6	41.7	35.8	33.1	32.3

Exist system, normal summer days, 790 GPM



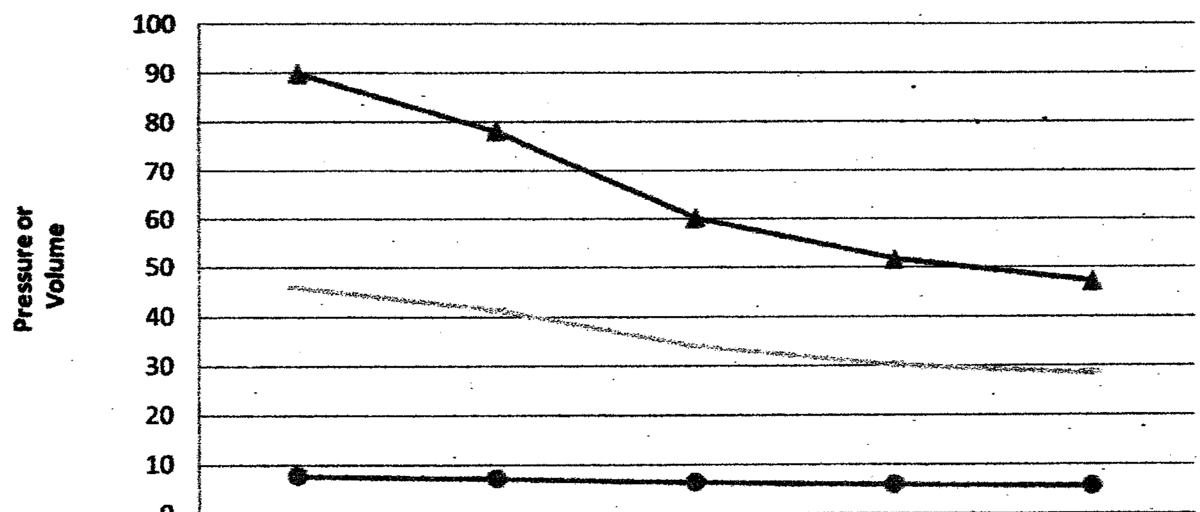
	Pr stn	8" pipe	6" pipe	4" pipe	3" pipe
P (PSI)	90	77	57	47	41
Qs (GPM)	8.8	8.2	7.0	6.4	6.0
Throw (ft)	45.7	40.8	32.4	28.0	25.5

Exist system, worst summer days, 1050 GPM



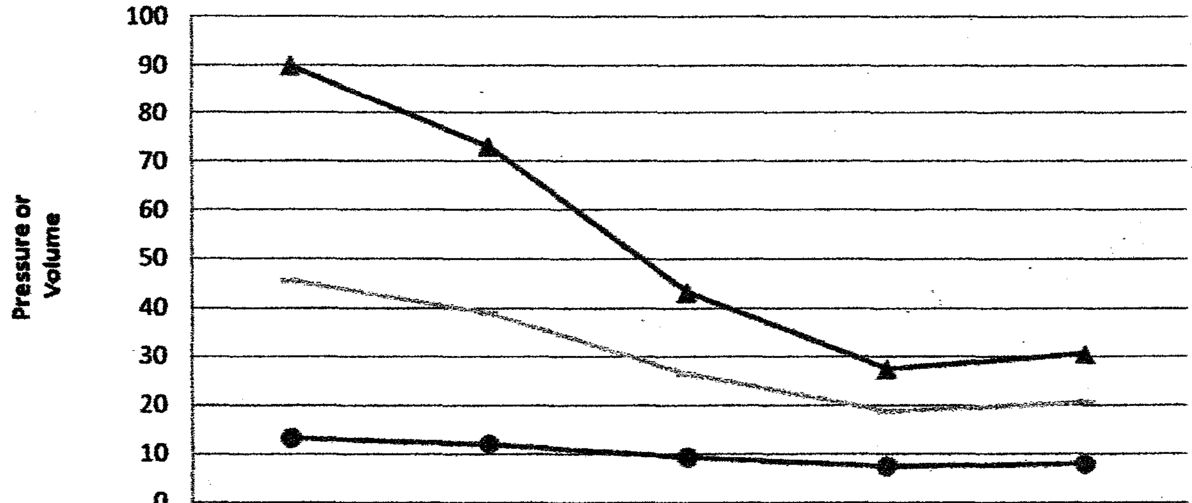
	Pr stn	8" pipe	6" pipe	4" pipe	3" pipe
P (PSI)	88	72	43	30	22
Qs (GPM)	13.1	11.8	9.2	7.6	6.7
Throw (ft)	45.0	38.6	26.5	20.1	16.4

Exist system with water restrictions, 710 GPM



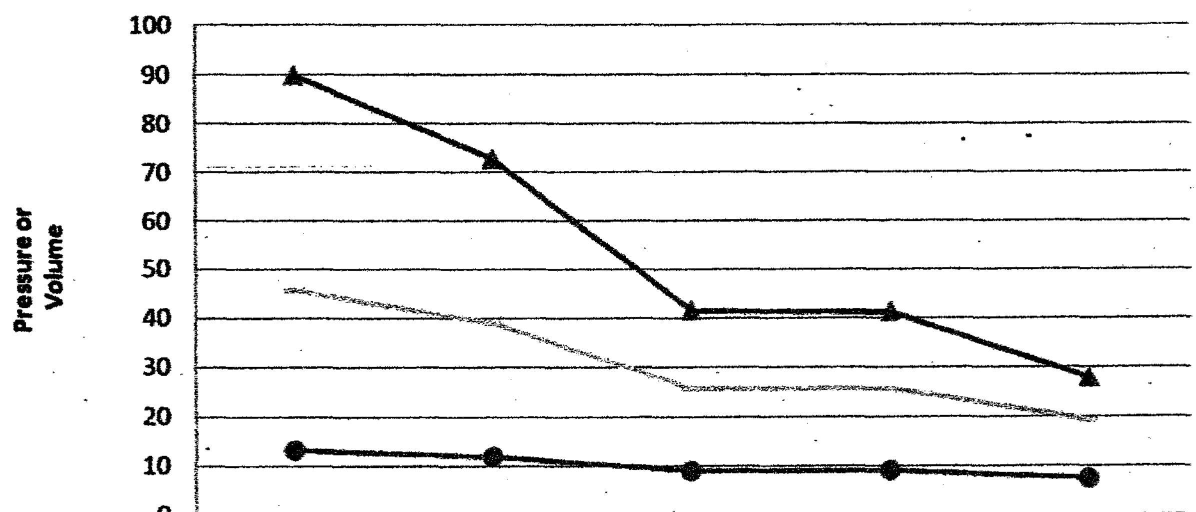
	Pr stn	8" pipe	6" pipe	4" pipe	3" pipe
P (PSI)	90	78	60	52	47
Qs (GPM)	7.7	7.2	6.3	5.9	5.6
Throw (ft)	45.8	41.2	34.0	30.3	28.6

3" & Preducer upgraded, 1070 GPM



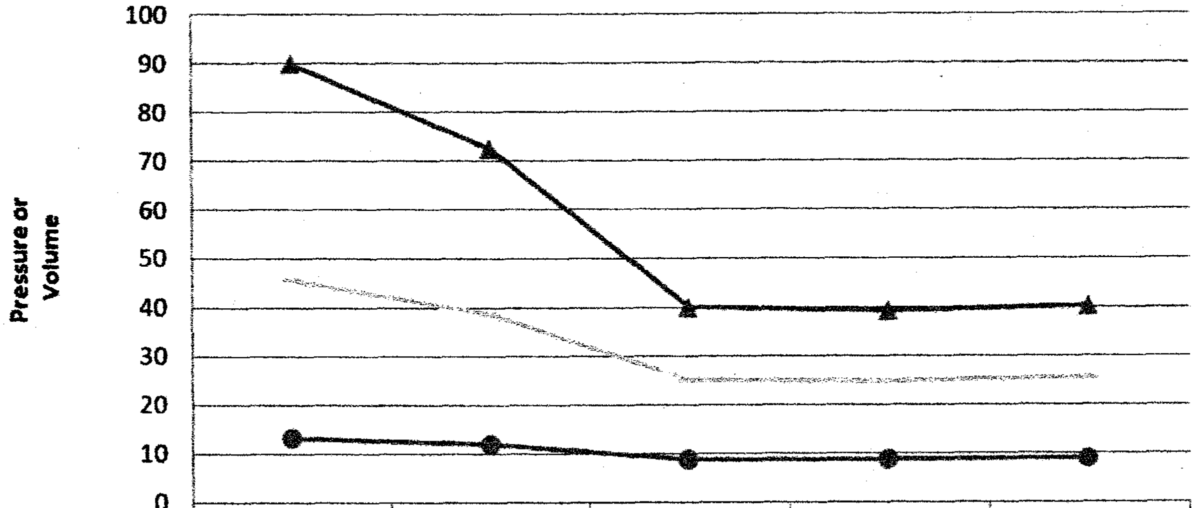
	Pr stn	8" pipe	6" pipe	4" pipe	4" pipe
P (PSI)	90	73	43	27	31
Qs (GPM)	13.2	11.9	9.2	7.3	7.8
Throw (ft)	45.6	39.1	26.5	18.7	20.7

4" & Preducer upgraded, 1080 GPM



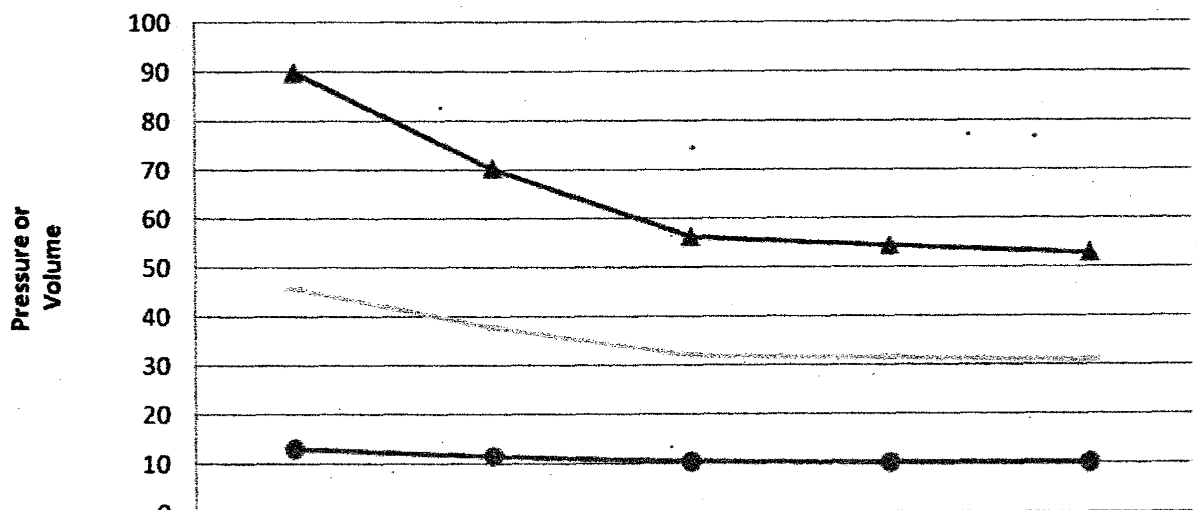
	Pr stn	8" pipe	6" pipe	6" pipe	3" pipe
P (PSI)	90	73	42	41	28
Qs (GPM)	13.2	11.9	9.0	9.0	7.4
Throw (ft)	45.6	39.0	25.7	25.7	19.3

3", 4" & Preducer upgraded, 1100 GPM



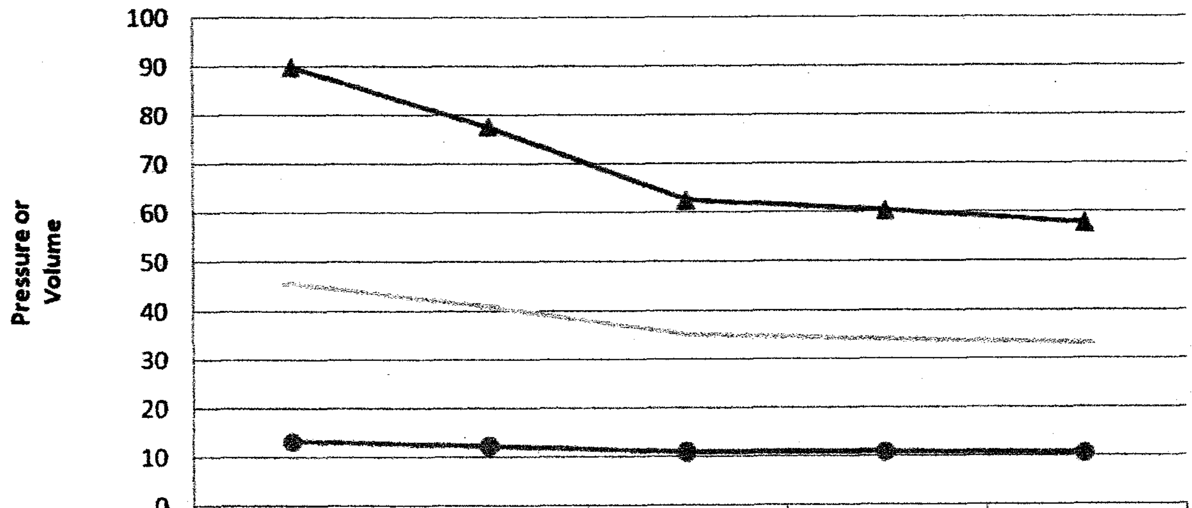
	Pr stn	8" pipe	6" pipe	6" pipe	4" pipe
P (PSI)	90	72	40	39	40
Qs (GPM)	13.2	11.8	8.8	8.8	8.9
Throw (ft)	45.6	38.8	24.9	24.7	25.4

3", 4", 6" & Pred upgraded, 1200 GPM



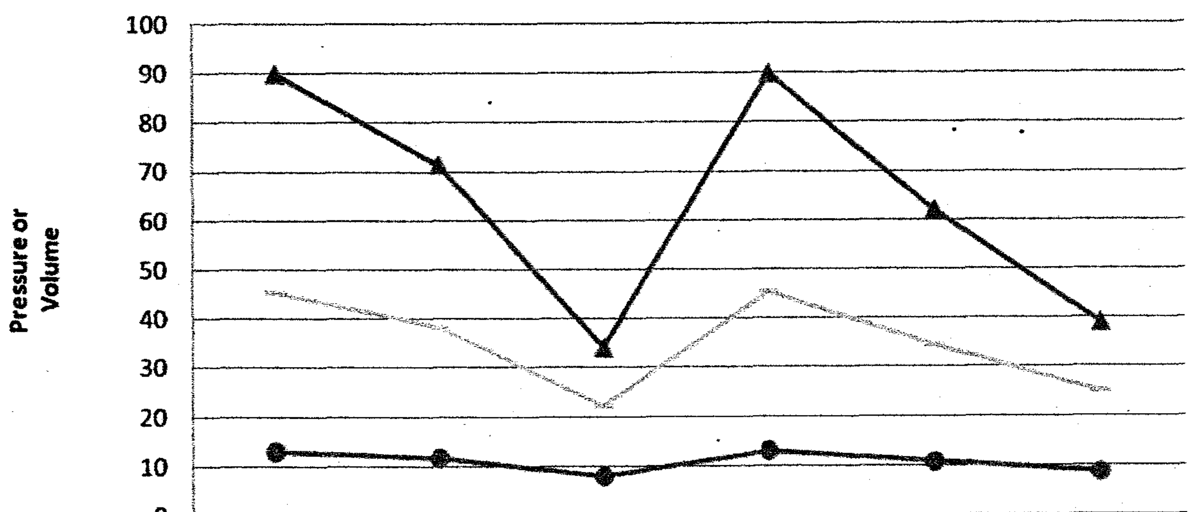
	Pr stn	8" pipe	8" pipe	6" pipe	4" pipe
P (PSI)	90	70	56	54	53
Qs (GPM)	13.2	11.7	10.5	10.3	10.2
Throw (ft)	45.6	37.9	32.3	31.6	31.1

all pipe & Pred upgraded, 1250 GPM



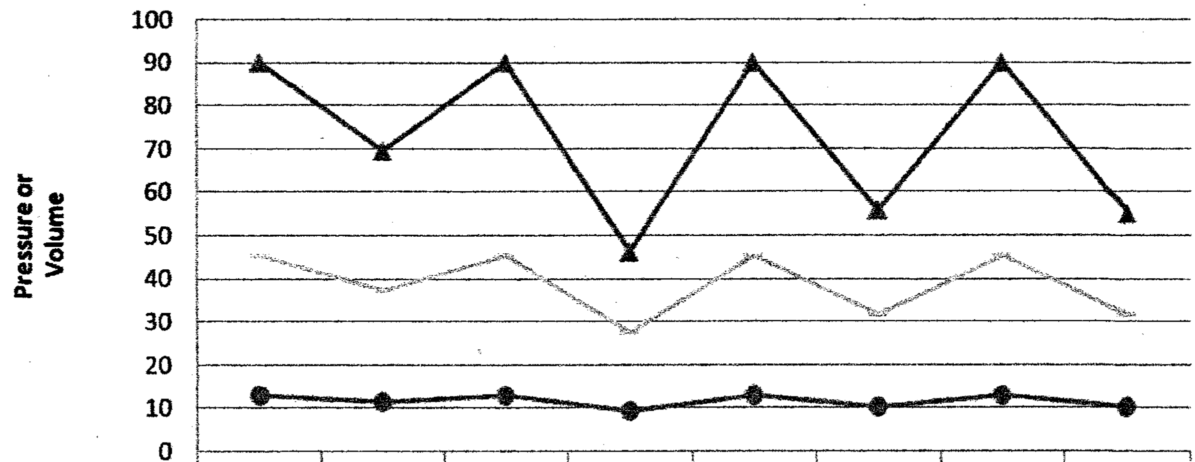
	Pr stn	10" pipe	8" pipe	6" pipe	4" pipe
P (PSI)	90	78	63	60	58
Qs (GPM)	13.2	12.3	11.1	10.9	10.7
Throw (ft)	45.8	41.0	35.0	34.1	33.2

Add Booster Pump, upgrade Preducer, 1140 GPM



	Pr stn	8" pipe	6" pipe	Booster	4" pipe	3" pipe
P (PSI)	90	72	34	90	62	39
Qs (GPM)	13.2	11.8	8.1	13.2	11.0	8.8
Throw (ft)	45.6	38.4	22.1	45.6	34.6	24.9

Add 3 Booster Pumps, upgrade Preducer, 1230 GPM



	Pr stn	8" pipe	Booster	6" pipe	Booster	4" pipe	Booster	3" pipe
P (PSI)	90	69	90	46	90	56	90	55
Qs (GPM)	13.2	11.6	13.2	9.5	13.2	10.4	13.2	10.4
Throw (ft)	45.6	37.5	45.6	27.7	45.6	31.8	45.6	32.0