



Irrigation Modernization and Design of Pipe Distribution Networks

PIPE SYSTEM DEVICES AND CONTROL STRUCTURES FOR FLOW CONTROL, FLOW MEASUREMENT, AND PROTECTION



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Devices required for Pipe Systems

- Needed for all systems:
 - Flow control (on/ off) isolation valves
 - Air valves
- Needed for most systems:
 - Flow and/ or volumetric meters
 - Flow control and/ or pressure reducing devices
 - Sediment removal devices
- Devices may be linked by a SCADA/ telemetry system for remote monitoring and/ or actuation.

Types of Devices

Air Valves

- **Combination air valves for:**
 - Release and intake of large volumes of air during pipe filling/ emptying
 - Release of small volumes of air during usual operation (from air pockets)
- **Located:** pumps, high points along pipelines, primary and distribution hubs, etc.

Air Valve size, mm	Main Pipe Size, mm
25ø (1 inch)	Up to 110ø
50ø (2 inch)	125 - 225ø
80ø (3 inch)	255 - 400ø
100ø (4 inch)	450 - 600ø

Glass reinforced nylon - Bermad



Flow control (on/ off) isolation valves – Butterfly valve

- A quarter-turn valve which is fully open or closed when the disc is rotated a quarter turn.
- Some head loss as disc always present in water flow.
- Cheaper than other (gate) valves of comparable size.
- Usually manufactured in cast iron/ ductile iron/ steel and in sizes from 200 mm to 4000 mm.



Flow control (on/ off) isolation valves – Gate (sluice) valve

- A valve that opens by lifting a barrier (gate). Usually used to shut off the flow, rather than for flow regulation.
- Head loss is minimal when the gate is fully opened.
- Smaller sizes usually rigid uPVC/ nylon with brass spindle, while larger sizes (350 to 2000 mm) usually cast iron/ ductile iron/ steel.



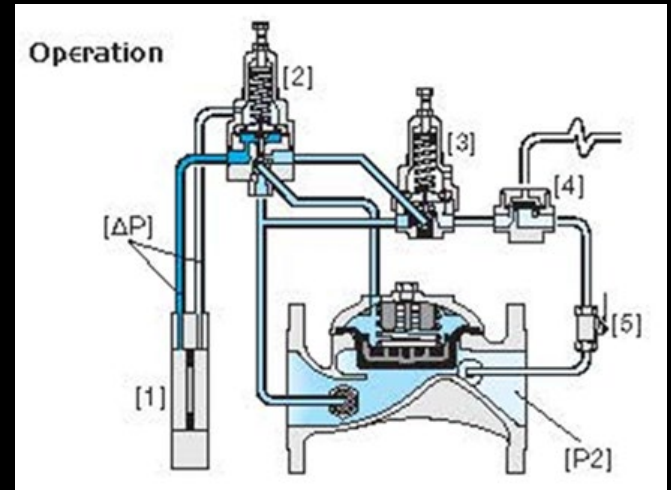
Flow control (on/ off) isolation valves – Ball valve

- A quarter-turn valve which is fully open or closed when the ball is rotated a quarter turn.
- Small sizes available, DN 20 – 90 mm
- Usually manufactured in uPVC and are cheap and durable
- Connection options include threaded, flanged, solvent welded, and so on.



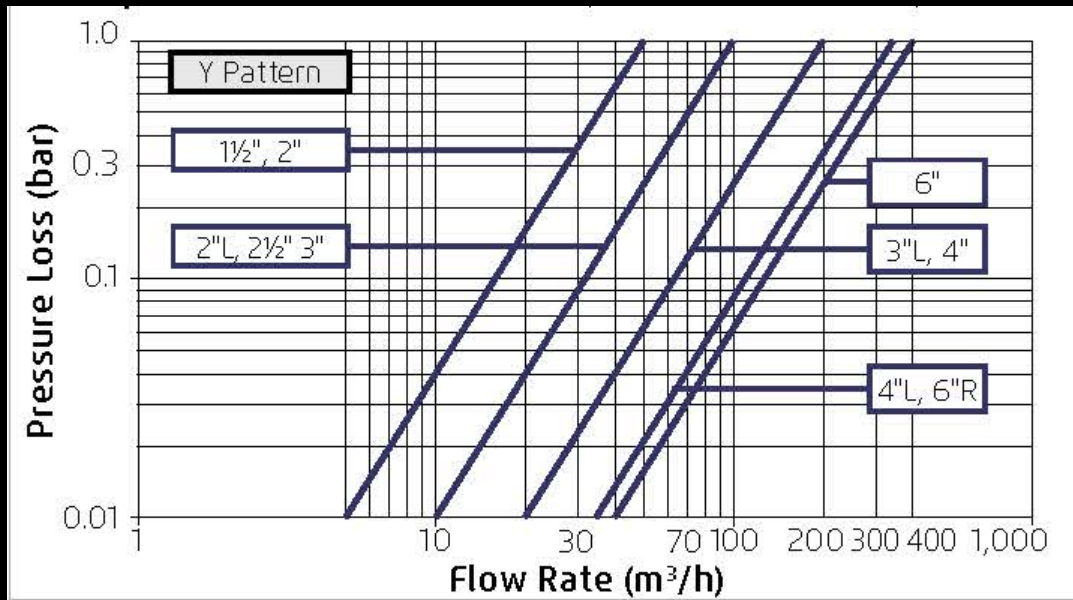
Hydraulic Diaphragm Control Valves

- Diaphragm valves (or membrane valves) consists of a valve body with a flexible diaphragm, and a "weir" or "saddle" or "seat" upon which the diaphragm closes the valve.
- Enable control of downstream pressure (with a single pilot), or both pressure and flow rate (2 pilots)
- Operate using line pressure, and head loss is significant
- Fitting a (solenoid) actuator enables remote as well as local operations
- Available sizes 1.5 to 16 inches, DN 40 to DN 400 mm. Plastic valve for sizes up to 6 inches, DN 150



Hydraulic Diaphragm Control Valves for both flow and d/s pressure control

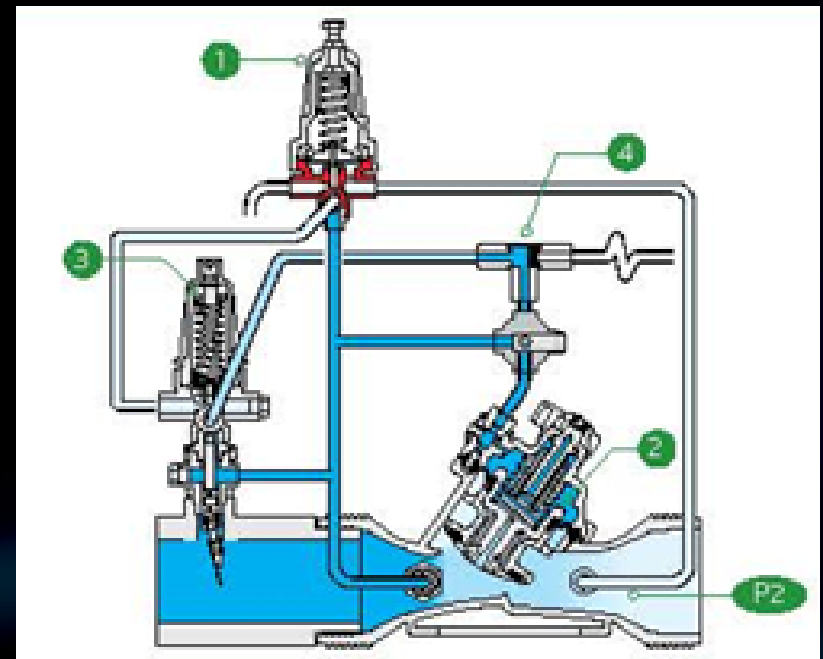
- 1.5 to 6 inch, DN40 to DN 150.
- Head loss:
 - E.G.: a 2L inch device has 0.5 m head-loss for flow of 25 m³/hr, 7 l/s



Dia			Flow Rate		Headloss	
inch	DN	Kv	m3/hr	l/s	bar	m
1.5	40	50	12.0	3.3	0.06	0.56
2	50	50	19.0	5.3	0.14	1.42
2L	50L	100	19.0	5.3	0.04	0.35
2.5	65	100	27.1	7.5	0.07	0.72
3	80	100	38.9	10.8	0.15	1.49
3L	80L	200	38.9	10.8	0.04	0.37
4	100	200	58.3	16.2	0.09	0.83
4L	100L	340	58.3	16.2	0.03	0.29
6L	150L	340	123.1	34.2	0.13	1.29
6	150	400	123.1	34.2	0.09	0.93

Operation:

The Pressure Reducing Pilot (PRP) ① is hydraulically connected to the control chamber ② through the Flow Control Pilot (FCP) ③. The PRP commands the valve to throttle closed should downstream pressure rise above setting and to fully open when downstream P_2 pressure drops below setting. The FCP commands the valve to throttle closed should demand rise above setting and to open fully when demand drops below setting. The Shuttle Valve ④ allows valve remote closing by introducing pressurized command to the control chamber, shutting the valve.



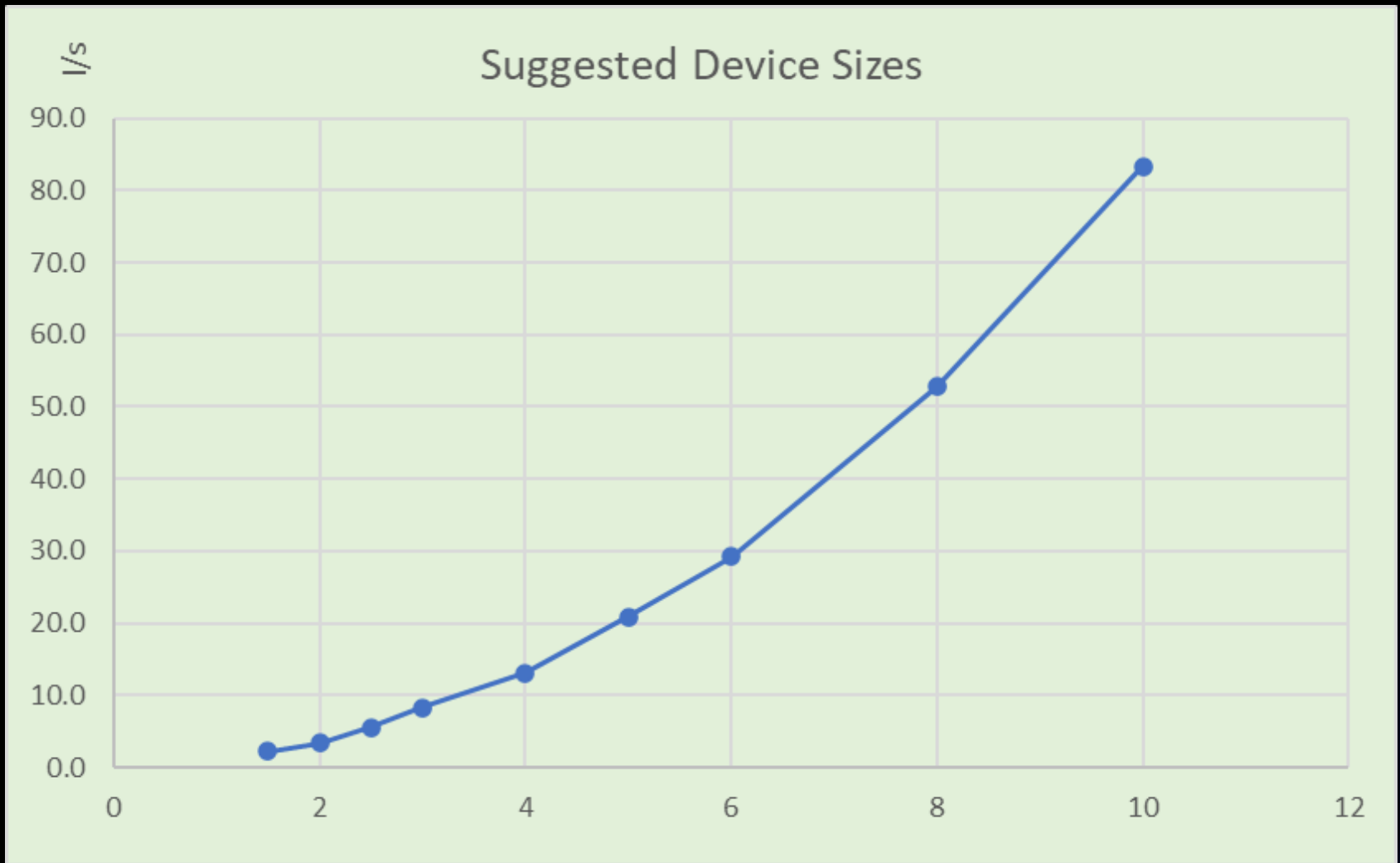
Flow and/ or volumetric meters

- Types and sizes:
 - mechanical, e.g., paddle mounted in top of meter
 - Ultrasonic (in line)
 - Ultrasonic (clamp on)
 - Electro-magnetic
- Most battery operated
- Most flow volume and rate
- Usually linked to SCADA system for remote monitoring of flows



Diameter		Min Flow		Permanent Flow		Flow for 0.5 m headloss	
inch	DN	m3/h	l/s	m3/h	l/s	m3/h	l/s
2	50	2.8	0.8	35	9.7	25	6.9
2.5	65	4	1.1	50	13.9	40	11.1
3	80	6	1.7	75	20.8	50	13.9
4	100	10	2.8	125	34.7	90	25.0
5	125	14	3.9	175	48.6	135	37.5
6	150	20	5.6	250	69.4	230	63.9
8	200	36	10.0	450	125.0	400	111.1
10	250	48	13.3	600	166.7	530	147.2
12	300	64	17.8	800	222.2	900	250.0
Ductile iron, Bermad							

Indicative device sizes

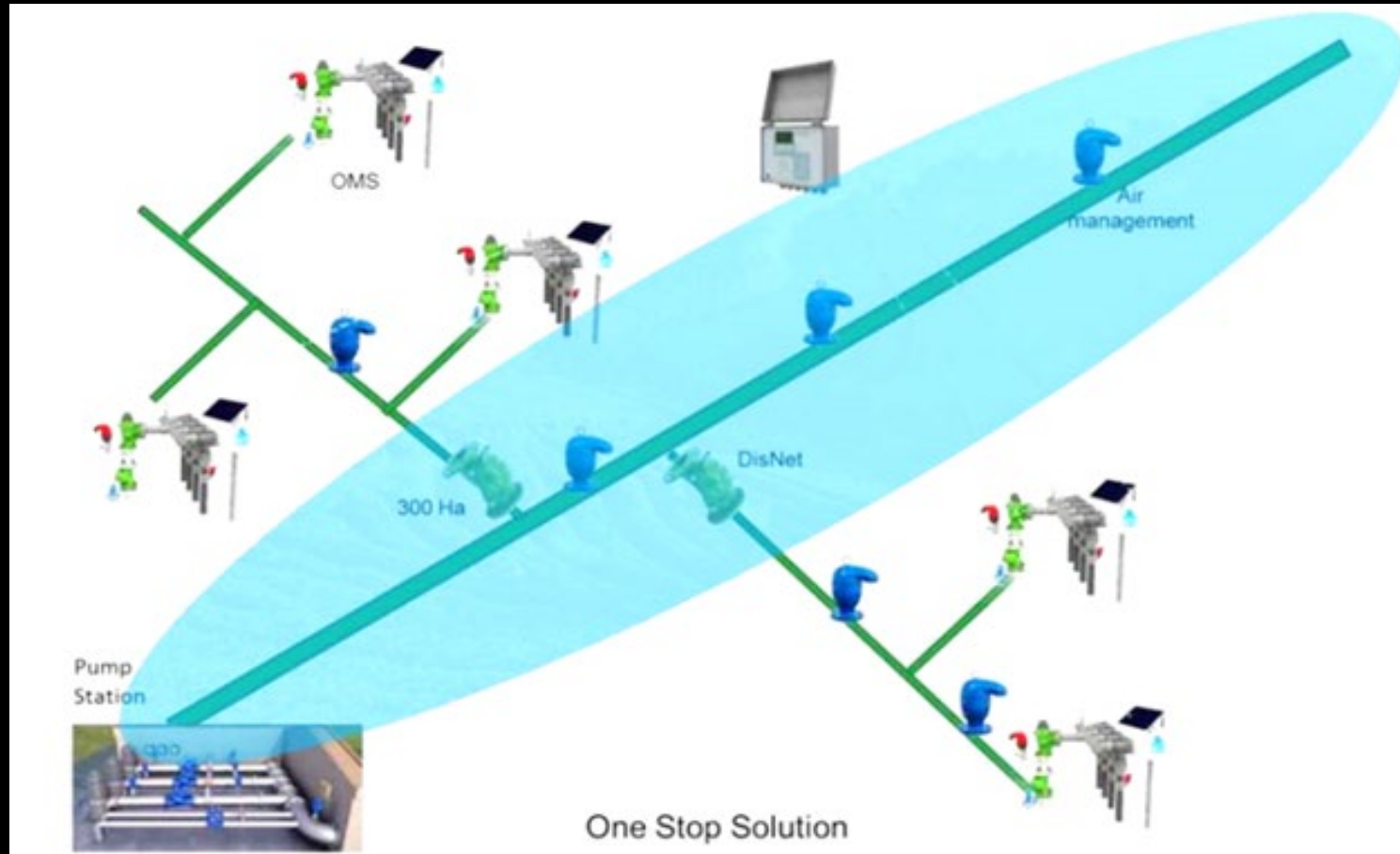


Filters and Strainers

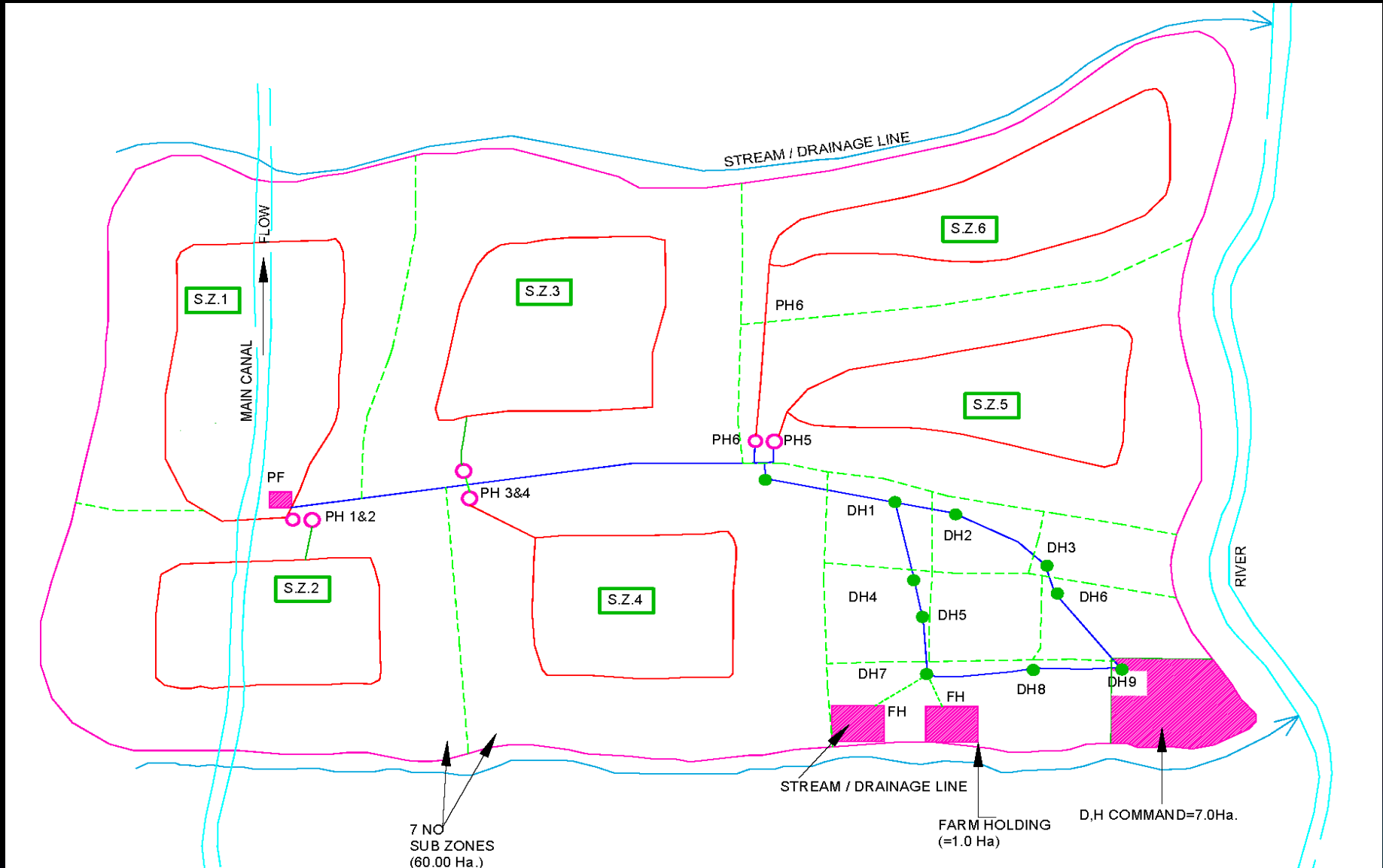
- Automatic filters typically have a coarse screen and a fine screen, a flushing valve, differential pressure switch, and a programmable logic controller. As sediments are filtered by the screens the pressure differential increases. Once the pressure reaches a certain point, typically about 7 psi, 0.5 bar, the trapped sediment is flushed out.
- Irrigation filters (screen) sizes typically 200-500 microns
- Sizes: 2 – 36 inch
- Stainless steel usual for larger filters, and plastic for smaller filters



Pipe Distribution Network System Control Structures



For a 3-tier system, most devices are located at the primary & distribution hubs



Devices at control hubs (primary, secondary)

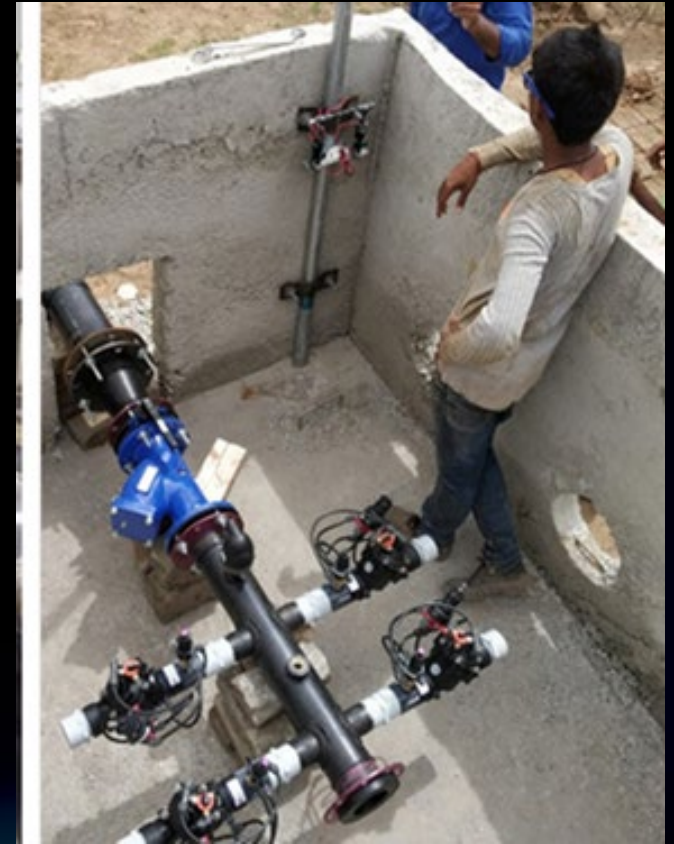
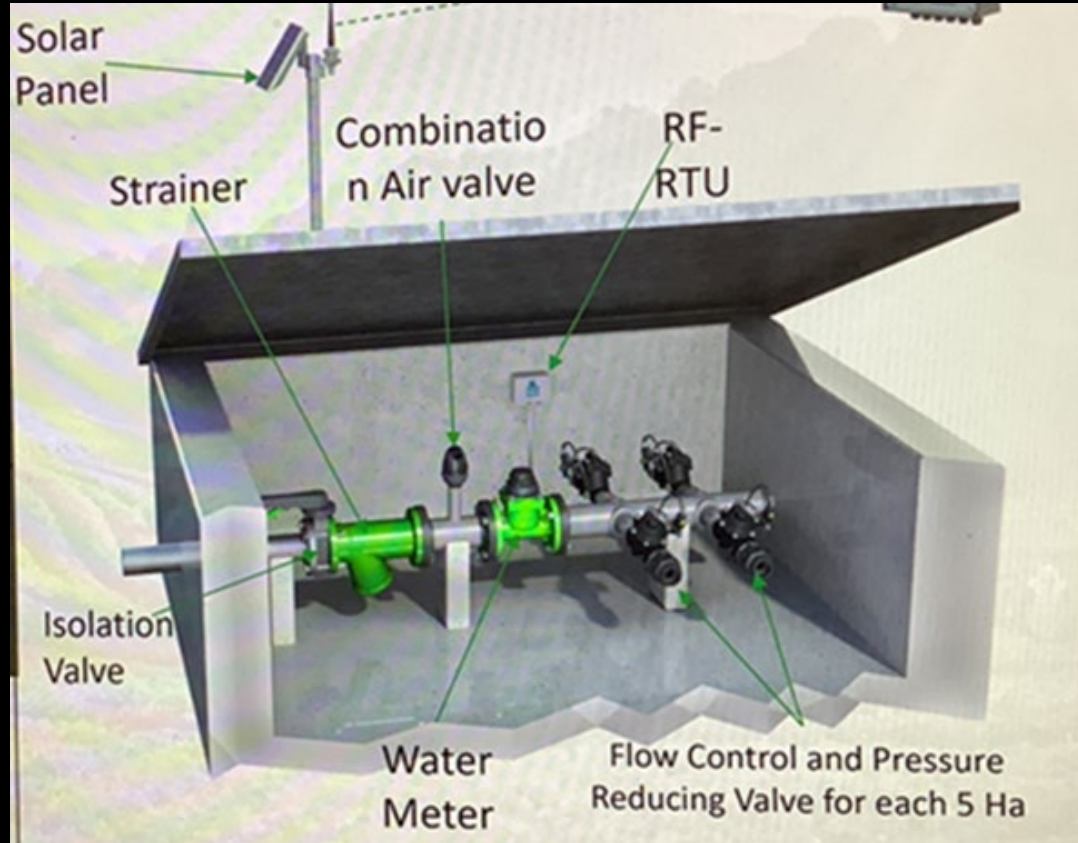


Control Hub: air valve and flow and pressure control to 75 ha units with remote SCADA monitoring & actuation

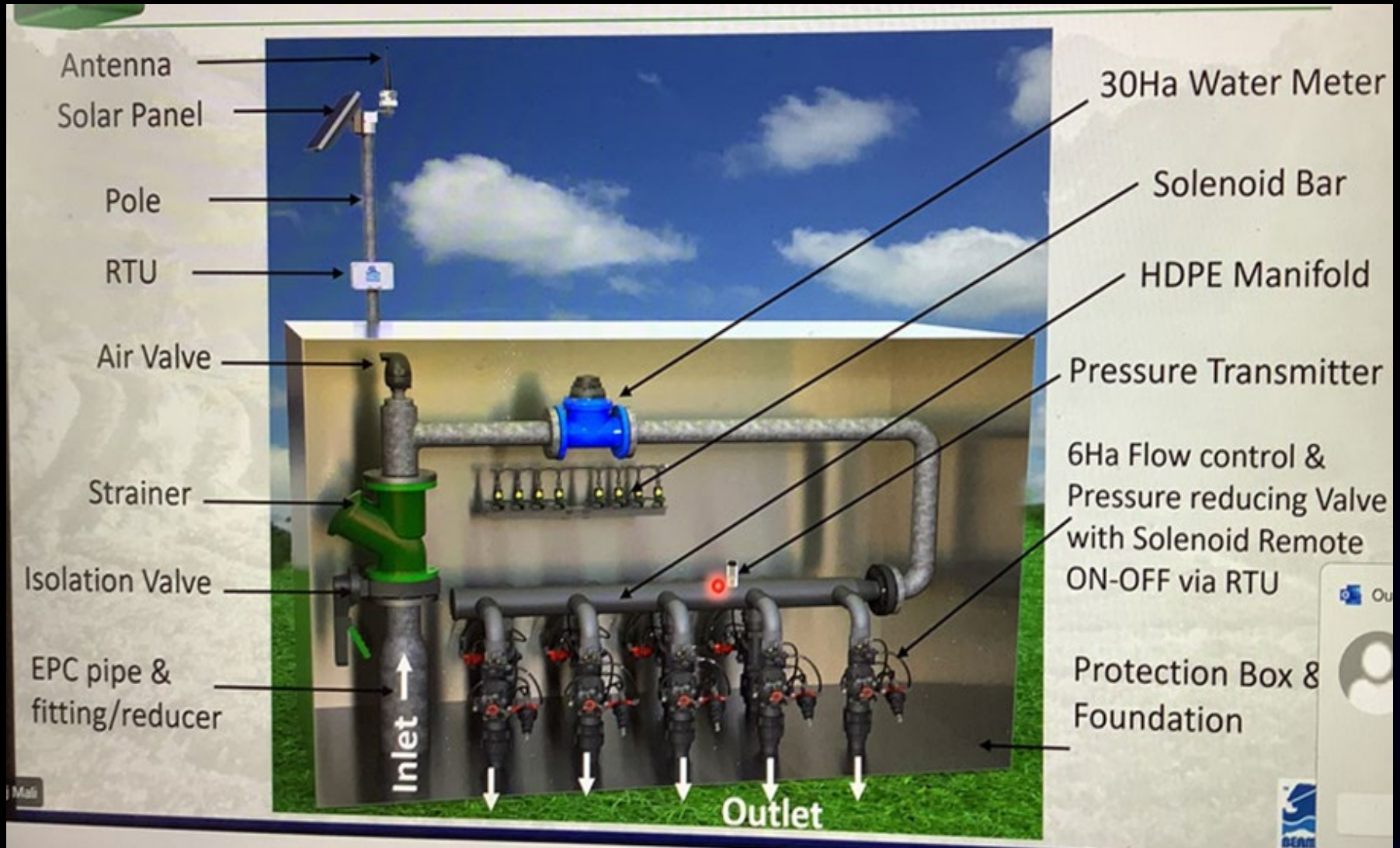


Control Hub (remote management system) with air valve, air flow and pressure control to 250-300 ha units with remote SCADA monitoring

Devices at Outlet (Flow Distribution) Hubs



Cont.



Cont.



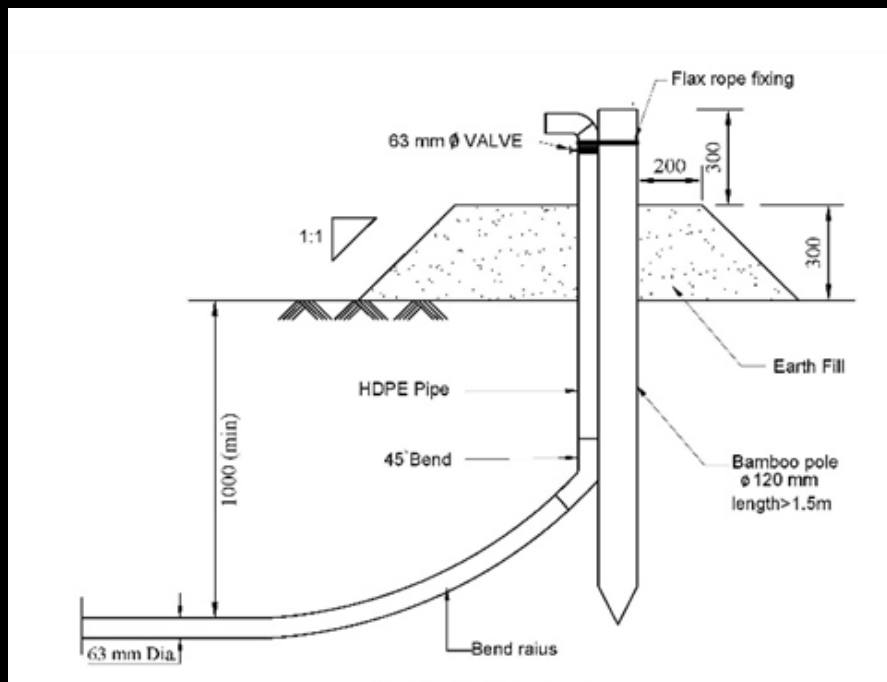
Distribution Hub – Wangana project

- Simple arrangement leaving farmer to connect their hoses
- Tank increases the cost of the outlet and is probably not justified
- For a high LoS area distance from (outlet) supply point to farmers fields ~150 m.



Farmer Field Hydrants

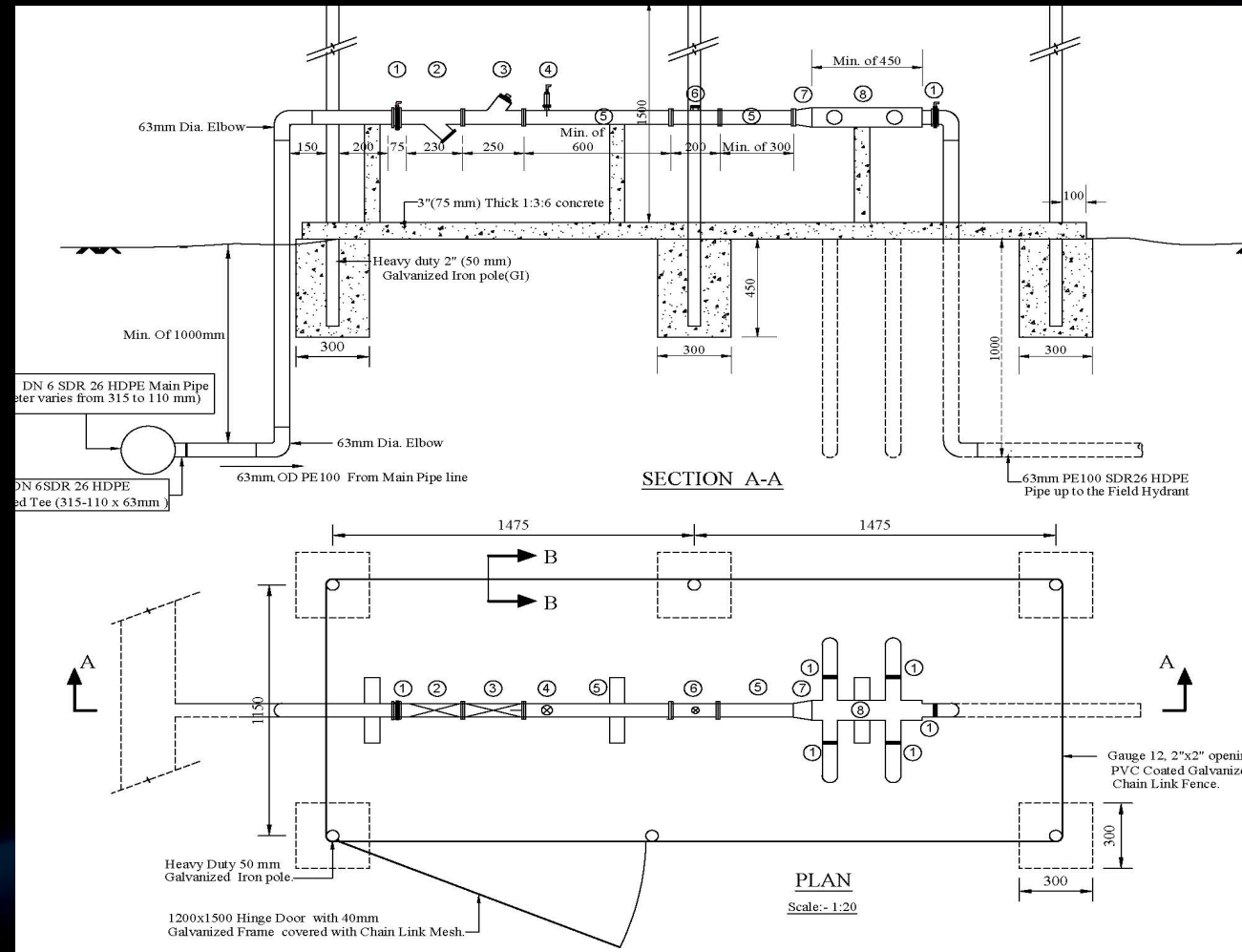
- For high LoS, one per farmer
- Given the large number of these the cost must be low – adopt uPVC ball valves





Thank you

- ①. DN 50 Wafer Type Ductile Iron(DI) Butterfly Valve
- ②. DN 50 Y -Type Ductile Iron Flange Strainer
- ③. DN 50 Hydraulically Controlled Flanged Flow Control & Pressure Reducing valve
- ④. DN 25 Combination Air Valve with Isolation valve (Tapping with Universal Tapping Saddle)
- ⑤. PE100 SDR17 HDPE Flanged Pipe.
- ⑥. DN 50 Ductile Iron Volumetric Flow Meter
- ⑦. PE100 SDR17 HDPE Taper - 63mmx90mm
- ⑧. PE100 SDR17 450mm length HDPE 90 mm Header/ Manifold with 63 mm Flanged Branch (05Nos) As shown.



Item	Size		Total all-	Remarks
	mm	inch	in rate \$	
Gate Valve - Rigid uPVC/ nylon with brass spindle (Jain/ Others)	50	1.5		
	63	2		
	75	2.5	15.76	ZHUJI HAMBER IMPORT
	90	3	18.47	AND EXPORT O.,LTD.
	110	4	26.16	Quotation on 31-03-2021
Ball Valve - plastic (Jain, others)	50	1.5		
	63	2	2.36	ZHEJIANG XIER PLASTIC VALVE LEAD CO.,LTD Quotation 31-03-2021
	75	2.5	4.52	
	90	3	9.38	
	110	4	15.75	
Isolation - Butterfly Valve (ductile iron, Bermad, others)	40	1.5		
	50	2	64.63	BERMAD, 2022
	65	2.5	69.53	BERMAD, 2022
	80	3	74.41	BERMAD, 2022
	100	4	96.61	BERMAD, 2022
	150	6	151.83	BERMAD, May 2022
	250	10	586.68	BERMAD, May 2022
300	12	651.31	BERMAD, May 2022	
Y-Strainer (ductile iron body)	40	1.5		
	50	2	157.89	BERMAD, 2022
	65	2.5	208.72	BERMAD, 2022
	80	3	259.54	BERMAD, 2022
	100	4	527.15	BERMAD, 2022
	125	5	644.66	Est
	150	6	747.09	BERMAD, May 2022

No	Item	Size		Total all-in rate \$	Remarks
		mm	inch		
	Combination Air valves, Model C10 (glass reinforced nylon, Bermad)	25	1	136.60	BERMAD, 2022
		50	2	183.01	BERMAD, May 2022
		80	3	278.49	BERMAD, May 2022
	Flow control and pressure reducing valve, (i) IR-172 (polyamid body, Bermad) - smaller dia., and (ii) 472 model (CI/ DI body)	40	1.5		
		50	2		
		50L	2L	778.46	BERMAD, 2022
		65	2.5		
		80	3		
		80L	3L	1,075.52	BERMAD, 2022
		100	4	2,613.86	BERMAD, May 2022
		100L	4L		
	150L	6L			
		150	6	4,445.20	BERMAD, May 2022
	Flow & Volumetric Meter, Turbo-IR-M (ductile iron, Bermad)	50	2	367.35	BERMAD, 2022
		65	2.5	376.63	BERMAD, 2022
		80	3	396.52	BERMAD, 2022
		100	4	436.31	BERMAD, 2022
		125	5	478.89	Est
		150	6	515.73	Est