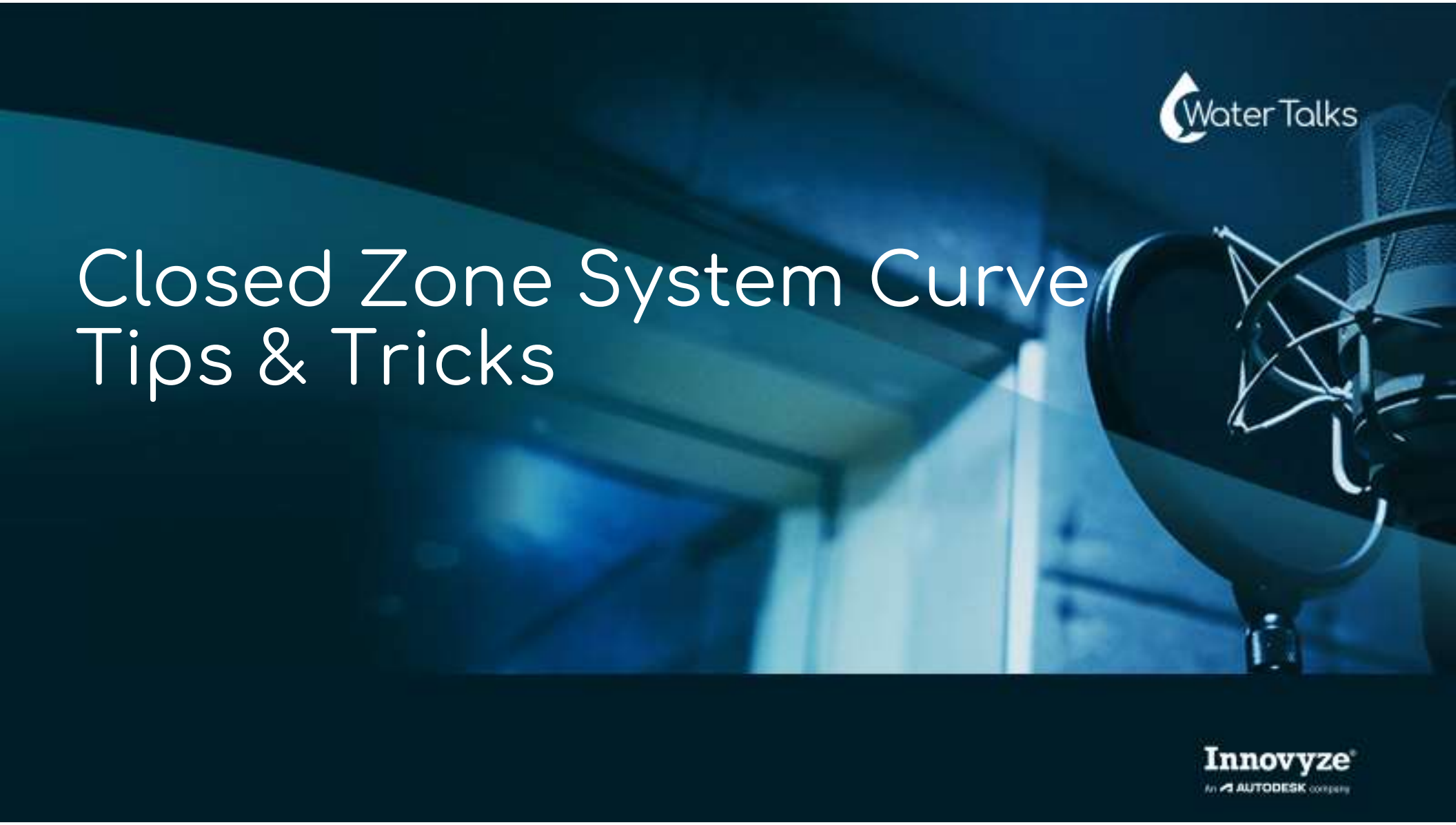


Closed Zone System Curve Tips & Tricks

Closed Zone (pumped only) Special Case

- Will cause errors using the System Curve tool. Must run these *manually*
  - Zero Flow disconnection using the automated tool
  - Supply must ***exactly*** equal demand to get correct values
- **Make all pumps inactive or off.**
- Select two points: one on *suction side* and one on *discharge side* of PS
- Need to add a dummy tank for model requirements to solve the head equations
  - Set tank elevation at HGL goal – 10 ft.; Max Height at 20 ft., initial level at 10 ft. Locate Tank at far end of system or at high point or at the PS discharge. Diameter of 10 ft. (***May want to check several points***)
  - Can also use a fixed head reservoir set at the goal HGL
- Best to set pump station positive and negative demands equal to total closed zone system base demand
- Use a pattern to get flows from near zero to maximum
  - Note: Can't use a zero multiplier. Make 0.01 for 1st point multiplier to make it as small as possible
  - Assign pattern to *all demand nodes* in the closed zone
  - Assign the created pattern to positive and negative demand nodes

Special Case System Curves

- Closed Zone (pumped only)
  - Check for static lift changes on suction side
    - Set up boundary conditions appropriately
  - Run as EPS analysis
    - Recommended Time Settings ---------->
    - Duration = #pattern values -1
  - System Curve
    - For each flow, calculate the difference in head between the suction & discharge node. Use results for the Head vs Flow curve
  - Checks – Make sure ***no flow to tank*** for each hour of the run
  - Other Notes: - User may need to adjust patterns for the remaining system to constant (value of 1) to keep the demands for the rest of the system at a constant value for the entire run.

Category	Unit	Decimal Time	Clock Time
Duration	Minutes	14.0000	
Hydraulic Timestep	Minutes	1.0000	
Pattern Timestep	Minutes	1.0000	
Quality Timestep	Minutes	0.1000	
Report Timestep	Minutes	1.0000	
Rule Timestep	Minutes	0.1000	
Pattern Start	Hours	0.0000	
Report Start	Hours	0.0000	
Start Clocktime	Clock Time		00:00:00

Other Notes on Closed Zones System Curves

- These are often an ***Iterative*** Process
  - Location of the Dummy Tank at Critical Point May not be clear
    - May need to run a few options to be sure what is truly critical
  - System Curve with Dummy Tank Remote will ID Discharge Pressure at Max Flow at the Pump Station (*i.e. Find HGL needed at Max Flow at station*)
  - Most Pump Stations will often be Variable Speed Discharge
    - Use this to set the pressure there and maintain your critical pressure for your key points
  - Can Rerun w/ Tank at discharge using HGL found (Curve will be Flat)

Other Notes on Closed Zones System Curves

- **Make Sure all other Demands outside the zone remain Constant**
- **Spreadsheet for developing the patterns is available "*as is*"**
  - **NOTE: it is your responsibility to verify the calculations etc.**
- **No Zero Flow point but very close**
- **Dummy Tank needed for the math and to set the desired HGL**
- **Always Verify *no flow* goes in or out of the Dummy Tank**

Other Notes on Closed Zones System Curves

Patrick Moore:
This is the highest flow desired for the system curve

Patrick Moore:
This should be the sum of all closed zone node demands in Demand1 through Demand10

	Base Demand
	432.48

Max Demand	Max Pattern value
2000	4.624491

# of Intervals	14
Interval	142.8571

Instructions

1) Calculate the total demand in the closed zone (in the Demand1 - Demand 10 fields) for all junctions in the closed zone. Enter in the "Base Demand" field (cell d3)
2) Identify what maximum flow you wish to run the system curve out to. Enter in the "Max Demand" field (cell D6)
3) Identify the total number of intervals to run (enter in cell D8) - Note you may have to add rows or delete rows if other than 14
4) Copy the Demand Pattern highlighteds in cells A11-A27 to the model and create a new pattern (i.e System_Curve or something else)
5) Set up the EPS run as specified in the System Curve presentation and run it
6) Copy the suction node results to cells K13-N27
7) Copy the Discharge node results to cells Q13 to T27
8) Add your specific pump curve to cells B32-C40
9) The system curve will be calculated in cells Y13 - AB27 and graphed below around N30

Demand Pattern

Time	Value
0	0.01
1	0.33
2	0.66
3	0.99
4	1.32
5	1.65
6	1.98
7	2.31
8	2.64
9	2.97
10	3.3
11	3.63
12	3.96
13	4.29
14	4.62

Flow		
0	0.01	4.3248
142.8571	0.330321	142.8571
285.7143	0.660642	285.7143
428.5714	0.990962	428.5714
571.4286	1.321283	571.4286
714.2857	1.651604	714.2857
857.1429	1.981925	857.1429
1000	2.312246	1000
1142.857	2.642566	1142.857
1285.714	2.972887	1285.714
1428.571	3.303208	1428.571
1571.429	3.633529	1571.429
1714.286	3.96385	1714.286
1857.143	4.29417	1857.143
2000	4.624491	2000

Pump Curve:

Flow	Head
0	170
200	165
400	155
600	140

Suction Node

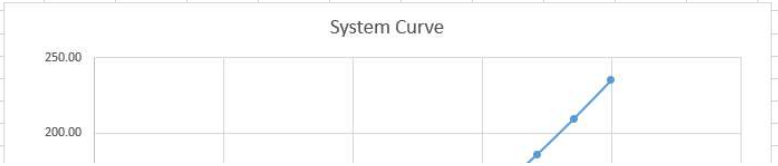
Time	Demand (	Head (ft)	Pressure (psi)
00:00 hrs	4.32	1,790.00	10.16
01:00 hrs	142.72	1,789.98	10.15
02:00 hrs	285.44	1,789.94	10.13
03:00 hrs	428.16	1,789.88	10.1
04:00 hrs	570.87	1,789.79	10.07
05:00 hrs	713.59	1,789.69	10.02
06:00 hrs	856.31	1,789.56	9.97
07:00 hrs	999.03	1,789.42	9.9
08:00 hrs	1,141.75	1,789.25	9.83
09:00 hrs	1,284.47	1,789.07	9.75
10:00 hrs	1,427.18	1,788.87	9.67
11:00 hrs	1,569.90	1,788.66	9.57
12:00 hrs	1,712.62	1,788.42	9.47
13:00 hrs	1,855.34	1,788.17	9.36
14:00 hrs	1,998.06	1,787.90	9.25

Discharge Node

Time	Demand (	Head (ft)	Pressure (psi)
00:00 hrs	-4.32	1,819.28	22.84
01:00 hrs	-142.72	1,822.39	24.19
02:00 hrs	-285.44	1,827.41	26.37
03:00 hrs	-428.16	1,834.40	29.39
04:00 hrs	-570.87	1,843.22	33.22
05:00 hrs	-713.59	1,853.81	37.81
06:00 hrs	-856.31	1,866.16	43.16
07:00 hrs	-999.03	1,880.19	49.24
08:00 hrs	-1,141.75	1,895.89	56.04
09:00 hrs	-1,284.47	1,913.21	63.54
10:00 hrs	-1,427.18	1,932.03	71.70
11:00 hrs	-1,569.90	1,952.47	80.55
12:00 hrs	-1,712.62	1,974.46	90.08
13:00 hrs	-1,855.34	1,997.99	100.28
14:00 hrs	-1,998.06	2,023.09	111.15

System Curve Calculation

Time	Flow (gpm	Head Diff (ft)
00:00 hrs	4.32	29.28
01:00 hrs	142.72	32.41
02:00 hrs	285.44	37.47
03:00 hrs	428.16	44.52
04:00 hrs	570.87	53.43
05:00 hrs	713.59	64.12
06:00 hrs	856.31	76.6
07:00 hrs	999.03	90.77
08:00 hrs	1141.75	106.64
09:00 hrs	1284.47	124.14
10:00 hrs	1427.18	143.16
11:00 hrs	1569.9	163.81
12:00 hrs	1712.62	186.04
13:00 hrs	1855.34	209.82
14:00 hrs	1998.06	235.19



Innovyze
An AUTODESK company

AUTODESK
WATER TALKS

Other Notes on Closed Zones System Curves

1. You will need to create a new demand pattern to use in the closed zone (see spreadsheet)
2. You should consider making a new scenario with a new demand set & control set for this analysis.
3. Identify a suction node and discharge node on the pump station
4. Suction node will have positive demand equal to the total with the new pattern
5. Discharge node will have negative total demand with the new pattern
6. All patterns in the closed zone will need the new pattern
7. You need to put the dummy tank somewhere in the closed zone. If it is too close to the station the system curve will be very flat. I often put it at the highest customer point using the min pressure needed for the zone to set the HGL needed. Recall HGL = elevation plus pressure head so HGL = elevation plus pressure _psi * 2.31 ft/psi (if needed) Use this to guide tank setup. . If HGL = X then elevation of the tank should be X- 10 ft, Max height would be 20 ft and initial level would be 10 ft. Diameter should be 20 ft. Connect with a 100 ft diameter 10 ft line to the node in question to minimize headloss.
8. Make sure to set all demand patterns outside the zone to Constant . This is a new pattern you make with 1 value equal to 1.0 This will keep these demands consistent outside the closed zone.

Other Notes on Closed Zones System Curves

9. Set the time options as noted.

Category	Unit	Decimal Time	Clock Time
Duration	Minutes	14.0000	
Hydraulic Timestep	Minutes	1.0000	
Pattern Timestep	Minutes	1.0000	
Quality Timestep	Minutes	0.1000	
Report Timestep	Minutes	1.0000	
Rule Timestep	Minutes	0.1000	
Pattern Start	Hours	0.0000	
Report Start	Hours	0.0000	
Start Clocktime	Clock Time		00:00:00

10. Make sure all pumps at the station feeding the closed zone are off and controls for them will not turn them on.
11. Make sure to set the boundary conditions outside the zone for tank levels that may change. You may need to run more than one system curve run to get you full system curve min and max curves. (see system curve presentation)
12. Complete the system curve run
13. Make sure to check the line connected to the dummy tank and graph it. There should be no flow in this line during the run if all demands are perfectly balanced. If there are flows in this line investigate and resolve the flow imbalance and rerun.
14. Graph the suction node and discharge node
15. Switch to the report for each of the graphs and copy the run data to the excel sheet for each in the area shown
16. Copy in your proposed pump curve and run for all min and max boundary conditions and you are all set.