

## Watermark Lift Station

Town of Howey-In-The-Hills, *Lake* County, Florida

### Lift Station Calculations

Prepared by:

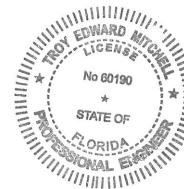


902 N. Sinclair Avenue • Tavares, Florida 32778 • Phone (352) 343-8481

Halff Project No. 045548.003

***June 11, 2025***

*Revised July 22, 2025*



Digitally signed by  
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Date: \_\_\_\_\_

## LIFT STATION CALCULATIONS

### Watermark Lift Station

#### I. Design Flow Rates:

##### A. Residential

| Parcel ID         | Type Description                      | Unit Description | Units | Unit Flow (GPD/Unit) | Average Daily Flow (GPD) | Average Daily Flow (GPM) | Minimum Daily Flow (GPM) | Maximum Daily Flow (GPM) | Peak Daily Flow (GPM) |
|-------------------|---------------------------------------|------------------|-------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------|
| 1                 | Residential - SF (detached 3 Bedroom) | dwelling unit    | 118   | 300                  | 35,400                   | 25                       | 12                       | 49                       | 98                    |
| 2                 | Residential - SF (detached 3 Bedroom) | dwelling unit    | 84    | 300                  | 25,200                   | 18                       | 9                        | 35                       | 70                    |
| 3                 | Residential - SF (detached 3 Bedroom) | dwelling unit    | 88    | 300                  | 26,400                   | 18                       | 9                        | 37                       | 73                    |
| 4                 | N/A                                   | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| 5                 | N/A                                   | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| Total Residential |                                       |                  |       |                      | 87,000                   | 60                       | 30                       | 121                      | 242                   |

| Residential Design Peaking Factors: | F <sub>min</sub> | F <sub>max</sub> | F <sub>peak</sub> |
|-------------------------------------|------------------|------------------|-------------------|
|                                     | 0.50             | 2.00             | 4.00              |

##### B. Non-Residential

| Parcel ID             | Non-Residential Land Use Description | Unit Description | Units | Unit Flow (GPD/Unit) | Average Daily Flow (GPD) | Average Daily Flow (GPM) | Minimum Daily Flow (GPM) | Maximum Daily Flow (GPM) | Peak Daily Flow (GPM) |
|-----------------------|--------------------------------------|------------------|-------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------|
| 1                     | N/A                                  | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| 2                     | N/A                                  | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| 3                     | N/A                                  | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| 4                     | N/A                                  | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| 5                     | N/A                                  | ---              |       | ---                  | 0                        | 0                        | 0                        | 0                        | 0                     |
| Total Non-Residential |                                      |                  |       |                      | 0                        | 0                        | 0                        | 0                        | 0                     |

| Non-Residential Design Peaking Factors: | F <sub>min</sub> | F <sub>max</sub> | F <sub>peak</sub> |
|-----------------------------------------|------------------|------------------|-------------------|
|                                         | 0.50             | 2.00             | 4.00              |

Equivalent Residential Unit, ERU: 300 gpd/du

Total Project ERU's = 290

|              | Daily Flow (GPD) | Daily Flow (GPM) | Daily Flow (GPM) | Daily Flow (GPM) | Daily Flow (GPM) |
|--------------|------------------|------------------|------------------|------------------|------------------|
| Total Design | 87,000           | 60               | 30               | 121              | 242              |

## LIFT STATION CALCULATIONS

### Watermark Lift Station

#### II. Wet Well Dimensions:

##### Wetwell Information:

|                                         |                |       |                 |
|-----------------------------------------|----------------|-------|-----------------|
| 1. Wet Well Layout:                     | Duplex         | Input | Units           |
| 2. No. of Wet Wells:                    | 1              |       |                 |
| 3. Wet Well Configuration:              | Circular       |       |                 |
| 4. Inside Diameter =                    | D              | 8     | ft              |
| 5. Wetwell Inside Length =              | L              |       | ft              |
| 6. Wetwell Inside Width =               | W              |       | ft              |
| 7. Influent Sewer Elevation =           |                | 89.00 | ft              |
| 8. Grade Elevation =                    |                | 97.75 | ft              |
| 9. Maintenance Pad height above grade = |                | 0.50  | ft              |
| 10. Cross-Sectional Area =              | A <sub>c</sub> | 50.27 | ft <sup>2</sup> |

##### Inflow Information:

|                            |                |     |     |
|----------------------------|----------------|-----|-----|
| 1. Design Average Inflow = | Q <sub>a</sub> | 60  | gpm |
| 2. Design Peak Inflow =    | Q <sub>p</sub> | 242 | gpm |

##### Pump Flow Information:

|                       |                |     |     |
|-----------------------|----------------|-----|-----|
| 1. Design Pump Flow = | Q              | 330 | gpm |
| 2. Total Pump Flow =  | Q <sub>T</sub> | 330 | gpm |

#### IV. Wet Well Control Levels:

##### Design Operational Elevations:

|                               |         |       |       |
|-------------------------------|---------|-------|-------|
| 1. Top of Structure =         | Input A | Input | Units |
| 2. Influent Sewer Main =      |         | 98.25 | ft    |
| 3. High Water Alarm =         | 0.00    | 89.00 | ft    |
| 4. Lag Pump No. 3 On =        | 0.00    | N/A   | ft    |
| 5. Lag Pump No. 2 On =        | 0.00    | N/A   | ft    |
| 6. Lag Pump No. 1 On =        | 0.50    | 88.50 | ft    |
| 7. Lead Pump On =             | 1.00    | 87.50 | ft    |
| 8. Pumps Off =                |         | 85.50 | ft    |
| 9. Highest Wetwell Bottom =   | 3.00    | 82.50 | ft    |
| 10. Selected Wetwell Bottom = |         | 82.50 | ft    |
| 11. Selected Wetwell Depth =  |         | 15.25 | ft    |

##### Minimum Site Dimensions:

|                                           |       |    |
|-------------------------------------------|-------|----|
| 1. Total Depth of Wet Well =              | 15.25 | ft |
| 2. Station Yard Finish Grade Elevation =  | 97.75 | ft |
| 3. Minimum Station Yard Width =           | 15.25 | ft |
| 4. Min. Station Easement Length & Width = | 38.50 | ft |

#### III. Wet Well Operating Depth:

##### Actual Working Depth and Volume:

|                                       |       |        |                                                                                                                 |
|---------------------------------------|-------|--------|-----------------------------------------------------------------------------------------------------------------|
| 1. Minimum Allowable Cycle Time =     | 10    | min    | T <sub>c</sub> = [V <sub>r</sub> / (Q <sub>out</sub> - Q <sub>in</sub> )] + (V <sub>r</sub> / Q <sub>in</sub> ) |
| 2. Wetwell Volume per Foot of Depth = | 376   | gal/ft | V <sub>R</sub> = A <sub>c</sub> * 7.481                                                                         |
| 3. Flow Rate Ratio (Peak) =           | 1.37  |        | R = Q <sub>r</sub> / Q <sub>p</sub>                                                                             |
| 4. Required Minimum Working Volume =  | 647   | gal    | V <sub>r</sub> = [Q <sub>out</sub> * T <sub>c</sub> * (R-1)] / R <sup>2</sup>                                   |
| 5. Required Minimum Working Depth =   | 1.720 | ft     | d <sub>r</sub> = V <sub>r</sub> / (V <sub>R</sub> )                                                             |
| 6. Selected Working Depth =           | 2.00  | ft     | d <sub>a</sub>                                                                                                  |
| 7. Actual Working Volume =            | 752   | gal    | V <sub>a</sub> = A <sub>c</sub> * 7.48 * d <sub>a</sub>                                                         |

#### V. Static Head Loss

##### Station Discharge Valve Assembly:

|                                    |        |              |       |                                        |
|------------------------------------|--------|--------------|-------|----------------------------------------|
| 1. Valve Assembly Above Grade:     | Yes    | Input/Result | Units | Design Equations                       |
| 2. Valve Assembly Elevation =      | 101.75 |              | ft    |                                        |
| 3. Wet Well High Water Elevation = | 89.00  |              | ft    | E <sub>HW</sub>                        |
| 3. Wet Well Low Water Elevation =  | 85.50  |              | ft    | E <sub>LW</sub>                        |
| 4. Static Head Loss (min) =        | 12.75  |              | ft    | LS = E <sub>HP</sub> - E <sub>HW</sub> |
| 5. Static Head Loss (max) =        | 16.25  |              | ft    | LS = E <sub>HP</sub> - E <sub>LW</sub> |

##### Force Main Elevation Information:

|                                    |       |  |    |                                        |
|------------------------------------|-------|--|----|----------------------------------------|
| 1. Grade Elevation at High Point = | 94.50 |  | ft |                                        |
| 2. Cover at High Point =           | 3.00  |  | ft |                                        |
| 3. Elevation at High Point =       | 91.50 |  | ft | E <sub>HP</sub>                        |
| 4. High Water Elevation =          | 89.00 |  | ft | E <sub>HW</sub>                        |
| 5. Low Water Elevation =           | 85.50 |  | ft | E <sub>LW</sub>                        |
| 6. Static Head Loss (min) =        | 2.50  |  | ft | LS = E <sub>HP</sub> - E <sub>HW</sub> |
| 7. Static Head Loss (max) =        | 6.00  |  | ft | LS = E <sub>HP</sub> - E <sub>LW</sub> |

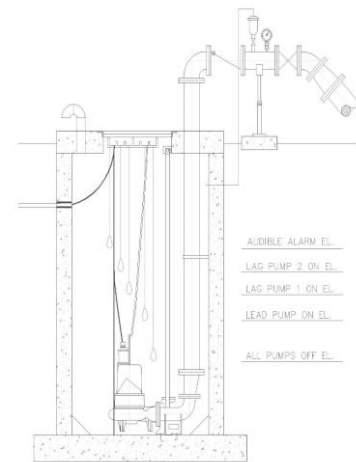
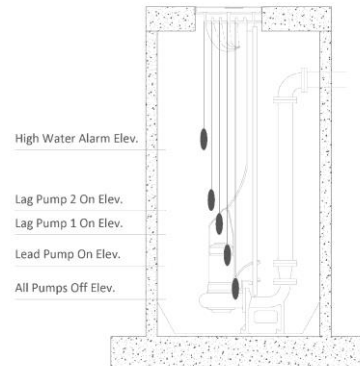
##### Connection Pressure Information:

|                                          |       |  |     |                                             |
|------------------------------------------|-------|--|-----|---------------------------------------------|
| 1. Grade Elevation at Connection Point = | 86.10 |  | ft  |                                             |
| 2. Cover at Connection Point =           | 3.00  |  | ft  |                                             |
| 3. Elevation at Connection =             | 83.10 |  | ft  | E <sub>c</sub>                              |
| 4. Connecting Pressure (Max.) =          | 14.15 |  | psi |                                             |
| 5. Connecting Pressure (Min.) =          | 7.57  |  | psi |                                             |
| 6. Connecting Head (Max.) =              | 32.64 |  | ft  | P                                           |
| 7. Connecting Head (Min.) =              | 17.46 |  | ft  | P                                           |
| 8. High Water Elevation =                | 89.00 |  | ft  | E <sub>HW</sub>                             |
| 9. Low Water Elevation =                 | 85.50 |  | ft  | E <sub>LW</sub>                             |
| 10. Static Head Loss (min) =             | 11.56 |  | ft  | LS = (E <sub>c</sub> + P) - E <sub>HW</sub> |
| 11. Static Head Loss (max) =             | 30.24 |  | ft  | LS = (E <sub>c</sub> + P) - E <sub>LW</sub> |

**Total Static Head Loss (Min) = 12.75 feet**

**Total Static Head Loss (Max) = 30.24 feet**

Notes: Connecting pressures provided by Connelly & Wicker, Inc.'s WaterCAD Model for the Hillside Grove Development - dated 10/27/2022.



## LIFT STATION CALCULATIONS

### Watermark Lift Station

#### VI. Buoyancy Calculation:

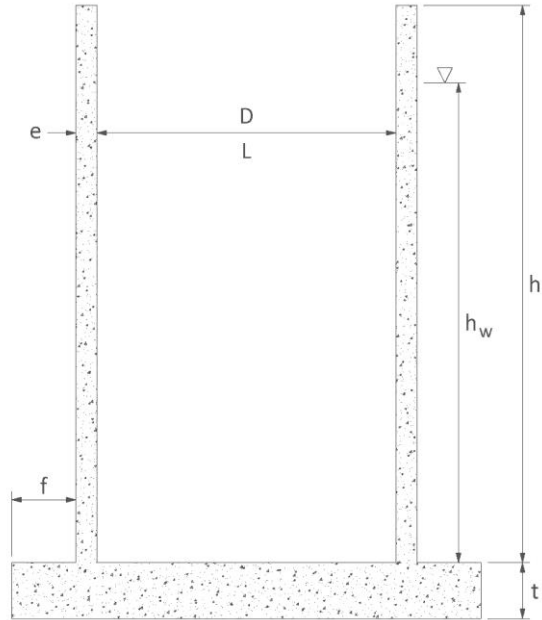
##### Wetwell Information:

|                              |                | Input/Result    | Units           |
|------------------------------|----------------|-----------------|-----------------|
| 1. Wet Well Configuration:   |                | <b>Circular</b> |                 |
| 2. Wetwell Inside Diameter = | D              | 8.0             | ft              |
| 3. Wetwell Inside Length =   | L              | 0.0             | ft              |
| 4. Wetwell Inside Width =    | W              | 0.0             | ft              |
| 5. Wetwell Depth =           | h              | 15.25           | ft              |
| 6. Base Slab Thickness =     | t              | 12              | in              |
| 7. Wall Edge Thickness =     | e              | 8               | in              |
| 8. Flange Extension =        | f              | 12              | in              |
| 9. Wetwell Inside Area =     | A <sub>i</sub> | 50.27           | ft <sup>2</sup> |
| 10. Wetwell Outside Area =   | A <sub>o</sub> | 68.42           | ft <sup>2</sup> |
| 11. Base Slab Area =         | A <sub>b</sub> | 100.88          | ft <sup>2</sup> |

##### Materials Information:

###### *Wet Well Material:*

|                                    |                                            |                 |                    |
|------------------------------------|--------------------------------------------|-----------------|--------------------|
|                                    |                                            | <b>Concrete</b> |                    |
| 1. Unit Weight of Water =          | Y <sub>water</sub>                         | 62.4            | lb/ft <sup>3</sup> |
| 2. Unit Weight of Wall =           | Y <sub>wall</sub>                          | 150.0           | lb/ft <sup>3</sup> |
| 3. Unit Weight of Base =           | Y <sub>base</sub>                          | 150.0           | lb/ft <sup>3</sup> |
| 4. Unit Weight of Saturated Soil = | Y <sub>sat</sub>                           | 110.0           | lb/ft <sup>3</sup> |
| 5. Percent Saturation =            |                                            | 100%            |                    |
| 6. Submerged Unit Weight =         | Y' = Y <sub>sat</sub> - Y <sub>water</sub> | 47.6            | lb/ft <sup>3</sup> |



###### *For Fiberglass Wet Wells:*

|                                 |            |         |
|---------------------------------|------------|---------|
| 7. Basin Diameter x Depth =     | <b>N/A</b> |         |
| 8. Volume of Fiberglass Basin = | N/A        | gallons |
| 9. Weight of Fiberglass =       | N/A        | lbs.    |

##### Assumptions:

1. Assume groundwater surface 1 to 3 feet below finished grade.
2. Ignore weight of wetwell above grade, top slab and equipment/materials in wetwell.
3. Ignore soil cohesion and additional soil weight exerted on wetwell base due to soil repose effect.

|                                          | Input/Result | Units | Design Equations                 |
|------------------------------------------|--------------|-------|----------------------------------|
| <u>Wetwell Buoyant Force:</u>            |              |       |                                  |
| 1. Depth to Groundwater                  | 3.00         | ft    |                                  |
| 2. Water Displaced by Wetwell Cylinder = | 52,298       | lbs   | $F_w = A_o * h_w * Y_{water}$    |
| 3. Water Displaced by Base =             | 6,295        | lbs   | $F_b = A_b * (t/12) * Y_{water}$ |
| 4. Total Bouyant Force =                 | 58,593       | lbs   | $F_B = F_b + F_w$                |

##### Downward Forces:

|                                       |        |     |                                                                  |
|---------------------------------------|--------|-----|------------------------------------------------------------------|
| 1. Downward Force of Concrete =       | 56,653 | lbs | $F_c = [(A_o) - (A_i)] * h * Y_{wall} + A_b * (t/12) * Y_{base}$ |
| 2. Downward Force of Saturated Soil = | 23,565 | lbs | $F_s = [(A_b) - (A_o)] * h * (Y_{sat} - Y_{water})$              |
| 3. Total Downward Force =             | 80,218 | lbs | $F_D = F_c + F_s$                                                |

##### Factor of Safety Against Buoyant Uplift:

|                                              |        |     |                  |
|----------------------------------------------|--------|-----|------------------|
| 1. Wetwell Buoyant Force =                   | 58,593 | lbs | $F_B$            |
| 2. Downward Force =                          | 80,218 | lbs | $F_D$            |
| 3. Factor of Safety Against Buoyant Uplift = | 1.37   |     | $FS = F_D / F_B$ |

# **LIFT STATION CALCULATIONS (Cont'd)** **Watermark Lift Station**

## **VII. Calculation of System Head Curve:**

Total Static Head (Min) = 12.75 Feet  
Total Static Head (Max) = 30.24 Feet

|                           | Station Piping |     |       | Force Main Piping |     |       | Force Main Piping |     |       |
|---------------------------|----------------|-----|-------|-------------------|-----|-------|-------------------|-----|-------|
|                           | New            |     |       | New               |     |       | New               |     |       |
| Pipe Length (feet)        | 29             |     |       | 1,568             |     |       | 100               |     |       |
| Pipe Diameter (inches)    | 6              |     |       | 6                 |     |       | 10                |     |       |
| Pipe Inside Dia. (inches) | 5.349          |     |       | 6.090             |     |       | 8.219             |     |       |
| Pipe Area (Sq.-Ft.)       | 0.156          |     |       | 0.202             |     |       | 0.368             |     |       |
| Pipe Material             | HDPE           |     |       | PVC               |     |       | HDPE              |     |       |
| Pressure Class            | DR-11          |     |       | DR-18             |     |       | DR-9              |     |       |
| Roughness C               | 120            |     |       | 120               |     |       | 120               |     |       |
| Fittings:                 | K-Value        | No. | Tot K | K-Value           | No. | Tot K | K-Value           | No. | Tot K |
| 90° Bend                  | 0.45           | 2   | 0.9   | 0.45              | 1   | 0.5   | 0.42              | 0   | 0.0   |
| 45° Bend                  | 0.24           | 2   | 0.48  | 0.24              | 4   | 1.0   | 0.22              | 0   | 0.0   |
| Tee (straight)            | 0.3            | 0   | 0.0   | 0.3               | 0   | 0.0   | 0.28              | 0   | 0.0   |
| Tee (branch)              | 0.9            | 1   | 0.9   | 0.9               | 0   | 0.0   | 0.84              | 0   | 0.0   |
| Plug Valve                | 0.27           | 1   | 0.27  | 0.27              | 2   | 0.5   | 0.25              | 0   | 0.0   |
| Check Valve               | 0.75           | 1   | 0.75  | 0.75              | 0   | 0.0   | 0.7               | 0   | 0.0   |
| Gate Valve                | 0.12           | 0   | 0     | 0.12              | 0   | 0.0   | 0.11              | 0   | 0.0   |
| Total K-Value             |                |     | 3.3   |                   |     | 2.0   |                   |     | 0.0   |

Add. Manifold Flows (gpm): 0 0 340  
Step Interval = 20 gpm  
Station Layout = Duplex  
No. of Pumps = 1 in operation

| System Head Curve | Total Q (gpm) | Pump Q (gpm) | Pipe & Fitting Friction Losses in Feet - Velocity in Feet per Second |                 |                |           |                 |                |           |                  |                |           |                  |                |                      | TDH        |            |
|-------------------|---------------|--------------|----------------------------------------------------------------------|-----------------|----------------|-----------|-----------------|----------------|-----------|------------------|----------------|-----------|------------------|----------------|----------------------|------------|------------|
|                   |               |              | Pipe (ft)                                                            | 6 Fittings (ft) | Velocity (fps) | Pipe (ft) | 6 Fittings (ft) | Velocity (fps) | Pipe (ft) | 10 Fittings (ft) | Velocity (fps) | Pipe (ft) | 10 Fittings (ft) | Velocity (fps) | Friction Head (feet) | Min (feet) | Max (feet) |
|                   | 0             | 0            | 0.00                                                                 | 0.00            | 0.0            | 0.00      | 0.00            | 0.0            | 0.00      | 0.00             | 0.0            | 1.62      | 0.04             | 1.4            | 1.66                 | 14.41      | 31.90      |
|                   | 20            | 20           | 0.00                                                                 | 0.00            | 0.3            | 0.09      | 0.00            | 0.2            | 0.00      | 0.00             | 0.1            | 1.80      | 0.04             | 1.5            | 1.94                 | 14.69      | 32.18      |
|                   | 40            | 40           | 0.01                                                                 | 0.02            | 0.6            | 0.33      | 0.01            | 0.4            | 0.00      | 0.00             | 0.2            | 1.99      | 0.05             | 1.6            | 2.40                 | 15.15      | 32.64      |
|                   | 60            | 60           | 0.02                                                                 | 0.04            | 0.9            | 0.69      | 0.01            | 0.7            | 0.01      | 0.00             | 0.4            | 2.19      | 0.05             | 1.7            | 3.02                 | 15.77      | 33.26      |
|                   | 80            | 80           | 0.04                                                                 | 0.07            | 1.1            | 1.18      | 0.02            | 0.9            | 0.02      | 0.00             | 0.5            | 2.40      | 0.06             | 1.8            | 3.78                 | 16.53      | 34.02      |
|                   | 100           | 100          | 0.06                                                                 | 0.10            | 1.4            | 1.78      | 0.04            | 1.1            | 0.03      | 0.00             | 0.6            | 2.61      | 0.06             | 1.9            | 4.68                 | 17.43      | 34.92      |
|                   | 120           | 120          | 0.09                                                                 | 0.15            | 1.7            | 2.49      | 0.05            | 1.3            | 0.04      | 0.00             | 0.7            | 2.84      | 0.07             | 2.0            | 5.72                 | 18.47      | 35.96      |
|                   | 140           | 140          | 0.11                                                                 | 0.20            | 2.0            | 3.31      | 0.07            | 1.5            | 0.05      | 0.00             | 0.8            | 3.07      | 0.07             | 2.0            | 6.90                 | 19.65      | 37.14      |
| 160               | 160           | 0.15         | 0.27                                                                 | 2.3             | 4.24           | 0.09      | 1.8             | 0.06           | 0.00      | 1.0              | 3.31           | 0.08      | 2.1              | 8.20           | 20.95                | 38.44      |            |
| 180               | 180           | 0.18         | 0.34                                                                 | 2.6             | 5.28           | 0.12      | 2.0             | 0.08           | 0.00      | 1.1              | 3.56           | 0.08      | 2.2              | 9.64           | 22.39                | 39.88      |            |
| 200               | 200           | 0.22         | 0.42                                                                 | 2.9             | 6.41           | 0.15      | 2.2             | 0.10           | 0.00      | 1.2              | 3.82           | 0.09      | 2.3              | 11.20          | 23.95                | 41.44      |            |
| 220               | 220           | 0.26         | 0.51                                                                 | 3.1             | 7.65           | 0.18      | 2.4             | 0.11           | 0.00      | 1.3              | 4.08           | 0.10      | 2.4              | 12.89          | 25.64                | 43.13      |            |
| 240               | 240           | 0.31         | 0.60                                                                 | 3.4             | 8.98           | 0.21      | 2.6             | 0.13           | 0.00      | 1.5              | 4.36           | 0.11      | 2.5              | 14.70          | 27.45                | 44.94      |            |
| 260               | 260           | 0.36         | 0.71                                                                 | 3.7             | 10.42          | 0.25      | 2.9             | 0.15           | 0.00      | 1.6              | 4.64           | 0.11      | 2.6              | 16.63          | 29.38                | 46.87      |            |
| 280               | 280           | 0.41         | 0.82                                                                 | 4.0             | 11.95          | 0.29      | 3.1             | 0.18           | 0.00      | 1.7              | 4.93           | 0.12      | 2.6              | 18.69          | 31.44                | 48.93      |            |
| 300               | 300           | 0.47         | 0.94                                                                 | 4.3             | 13.57          | 0.33      | 3.3             | 0.20           | 0.00      | 1.8              | 5.23           | 0.13      | 2.7              | 20.87          | 33.62                | 51.11      |            |
| 320               | 320           | 0.53         | 1.07                                                                 | 4.6             | 15.29          | 0.38      | 3.5             | 0.23           | 0.00      | 1.9              | 5.53           | 0.14      | 2.8              | 23.16          | 35.91                | 53.40      |            |
| 330               | 330           | 0.56         | 1.14                                                                 | 4.7             | 16.19          | 0.40      | 3.6             | 0.24           | 0.00      | 2.0              | 5.69           | 0.14      | 2.9              | 24.36          | 37.11                | 54.60      |            |
| 340               | 340           | 0.59         | 1.21                                                                 | 4.9             | 17.11          | 0.42      | 3.7             | 0.25           | 0.00      | 2.1              | 5.85           | 0.14      | 2.9              | 25.58          | 38.33                | 55.82      |            |
| 360               | 360           | 0.66         | 1.35                                                                 | 5.1             | 19.02          | 0.48      | 4.0             | 0.28           | 0.00      | 2.2              | 6.17           | 0.15      | 3.0              | 28.11          | 40.86                | 58.35      |            |
| 380               | 380           | 0.72         | 1.51                                                                 | 5.4             | 21.02          | 0.53      | 4.2             | 0.31           | 0.00      | 2.3              | 6.50           | 0.16      | 3.1              | 30.75          | 43.50                | 60.99      |            |
| 400               | 400           | 0.80         | 1.67                                                                 | 5.7             | 23.11          | 0.59      | 4.4             | 0.34           | 0.00      | 2.4              | 6.84           | 0.17      | 3.2              | 33.52          | 46.27                | 63.76      |            |
| 420               | 420           | 0.87         | 1.84                                                                 | 6.0             | 25.29          | 0.65      | 4.6             | 0.38           | 0.00      | 2.5              | 7.18           | 0.18      | 3.2              | 36.39          | 49.14                | 66.63      |            |
| 440               | 440           | 0.95         | 2.02                                                                 | 6.3             | 27.57          | 0.71      | 4.8             | 0.41           | 0.00      | 2.7              | 7.54           | 0.19      | 3.3              | 39.39          | 52.14                | 69.63      |            |
| 460               | 460           | 1.03         | 2.21                                                                 | 6.6             | 29.93          | 0.78      | 5.1             | 0.44           | 0.00      | 2.8              | 7.90           | 0.20      | 3.4              | 42.49          | 55.24                | 72.73      |            |
| 480               | 480           | 1.12         | 2.41                                                                 | 6.9             | 32.38          | 0.85      | 5.3             | 0.48           | 0.00      | 2.9              | 8.27           | 0.21      | 3.5              | 45.71          | 58.46                | 75.95      |            |
| 500               | 500           | 1.20         | 2.61                                                                 | 7.1             | 34.92          | 0.92      | 5.5             | 0.52           | 0.00      | 3.0              | 8.64           | 0.22      | 3.6              | 49.04          | 61.79                | 79.28      |            |
| 520               | 520           | 1.29         | 2.82                                                                 | 7.4             | 37.55          | 0.99      | 5.7             | 0.56           | 0.00      | 3.1              | 9.03           | 0.23      | 3.7              | 52.48          | 65.23                | 82.72      |            |
| 540               | 540           | 1.39         | 3.05                                                                 | 7.7             | 40.27          | 1.07      | 5.9             | 0.60           | 0.00      | 3.3              | 9.42           | 0.24      | 3.8              | 56.03          | 68.78                | 86.27      |            |
| 560               | 560           | 1.48         | 3.28                                                                 | 8.0             | 43.07          | 1.15      | 6.2             | 0.64           | 0.00      | 3.4              | 9.82           | 0.25      | 3.8              | 59.69          | 72.44                | 89.93      |            |
| 580               | 580           | 1.58         | 3.51                                                                 | 8.3             | 45.96          | 1.24      | 6.4             | 0.68           | 0.00      | 3.5              | 10.23          | 0.26      | 3.9              | 63.46          | 76.21                | 93.70      |            |
| 600               | 600           | 1.69         | 3.76                                                                 | 8.6             | 48.93          | 1.32      | 6.6             | 0.73           | 0.00      | 3.6              | 10.64          | 0.28      | 4.0              | 67.35          | 80.10                | 97.59      |            |

## **VIII. Equations**

### Friction Losses:

Piping:  $h_f = [(10.44 \times L \times Q^{1.85}) \div (C^{1.85} \times d^{4.8655})]$

Fittings:  $h_f = K \times (v^2 \div 2g)$

Velocity:  $v = Q \div A$

L = Pipe Length (feet)  
d = Pipe Diameter (inches)  
A = Pipe Cross-Section Area (sq ft)  
Q = Flow Rate (gpm)  
v = Velocity (fps)  
C = Roughness Coefficient

### **K Coefficients**

|                | Pipe Diameter |      |      |      |      |      |      |      |      |      |      |      |
|----------------|---------------|------|------|------|------|------|------|------|------|------|------|------|
| Fittings:      | 1.25          | 1.5  | 2    | 3    | 4    | 6    | 8    | 10   | 12   | 14   | 16   | 18   |
| 90° Bend       | 0.66          | 0.63 | 0.57 | 0.54 | 0.51 | 0.45 | 0.42 | 0.42 | 0.39 | 0.39 | 0.39 | 0.36 |
| 45° Bend       | 0.35          | 0.34 | 0.30 | 0.29 | 0.27 | 0.24 | 0.22 | 0.22 | 0.21 | 0.21 | 0.21 | 0.19 |
| Tee (straight) | 0.44          | 0.42 | 0.38 | 0.36 | 0.34 | 0.30 | 0.28 | 0.28 | 0.26 | 0.26 | 0.26 | 0.24 |
| Tee (branch)   | 1.32          | 1.26 | 1.14 | 1.08 | 1.02 | 0.90 | 0.84 | 0.84 | 0.78 | 0.78 | 0.78 | 0.72 |
| Plug Valve     | 0.40          | 0.38 | 0.34 | 0.33 | 0.31 | 0.27 | 0.25 | 0.25 | 0.23 | 0.23 | 0.23 | 0.22 |
| Check Valve    | 1.10          | 1.10 | 1.00 | 0.95 | 0.90 | 0.75 | 0.70 | 0.70 | 0.65 | 0.65 | 0.65 | 0.60 |
| Gate Valve     | 0.18          | 0.15 | 0.15 | 0.14 | 0.14 | 0.12 | 0.11 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 |

## LIFT STATION CALCULATIONS (Cont'd)

### Watermark Lift Station

#### VIII. Calculation of System Head Curve:

##### Pump Information:

1. Pump Manufacturer: **Hydromatic**
2. Pump Model: **Submersible**
3. Curve: **H4H** **Standard Efficiency**
4. Impeller Diameter: **8.75** inches
5. Horsepower: **10** hp
6. Speed: **1750** rpm

|  | Input | Units | Equations |
|--|-------|-------|-----------|
|--|-------|-------|-----------|

##### Assumed Efficiency Information:

- |                             |        |     |             |
|-----------------------------|--------|-----|-------------|
| 1. Design Pump Flow =       | 330.00 | gpm | Q           |
| 2. Pump Efficiency =        | 68%    |     | $\eta_p$    |
| 3. Drive Motor Efficiency = | 75%    |     | $\eta_{DM}$ |
| 4. Specific Gravity =       | 1.00   |     | SG          |

##### Required Horsepower for Minimum Headloss:

- |                           |       |    |                                       |
|---------------------------|-------|----|---------------------------------------|
| 1. Total Discharge Head = | 48.00 | ft | H                                     |
| 2. Required Horsepower =  | 5.88  | HP | $HP = (Q * H * SG) / (3960 * \eta_p)$ |
| 3. Kilowatt Input =       | 5.85  | KW | $KW = (HP * 0.7457) / \eta_{DM}$      |

##### Required Horsepower for Maximum Headloss:

- |                           |       |    |                                       |
|---------------------------|-------|----|---------------------------------------|
| 1. Total Discharge Head = | 55.00 | ft | H                                     |
| 2. Required Horsepower =  | 6.74  | HP | $HP = (Q * H * SG) / (3960 * \eta_p)$ |
| 3. Kilowatt Input =       | 6.70  | KW | $KW = (HP * 0.7457) / \eta_{DM}$      |

#### IX. Cycle Time:

##### Flow Information:

- |                                              | Input | Units | Equations |
|----------------------------------------------|-------|-------|-----------|
| 1. Design Pumping Capacity (Min Head Case) = | 435   | gpm   | $Q_{min}$ |
| 2. Design Pumping Capacity (Max Head Case) = | 330   | gpm   | $Q_{max}$ |
| 3. Design Average Inflow =                   | 60    | gpm   | $Q_a$     |
| 4. Design Peak Inflow =                      | 242   | gpm   | $Q_p$     |
| 5. Actual Working Volume =                   | 752   | gal   | $V_a$     |
| 6. Minimum Allowable Cycle Time =            | 10    | min   |           |

##### Cycle Times for Design Average Inflow:

- |                                            |       |     |                               |
|--------------------------------------------|-------|-----|-------------------------------|
| 1. Time to Fill (Design Average Inflow) =  | 12.45 | min | $t_f = V_a / Q_a$             |
| 2. Time to Empty (Design Average Inflow) = | 2.79  | min | $t_e = V_a / (Q_{min} - Q_a)$ |
| 3. Cycle Time (Design Average Inflow) =    | 15.24 | min | $t_c = t_f + t_e$             |

##### Cycle Times for Design Peak Inflow:

- |                                         |       |     |                               |
|-----------------------------------------|-------|-----|-------------------------------|
| 1. Time to Fill (Design Peak Inflow) =  | 3.11  | min | $t_f = V_a / Q_p$             |
| 2. Time to Empty (Design Peak Inflow) = | 8.51  | min | $t_e = V_a / (Q_{max} - Q_p)$ |
| 3. Cycle Time (Design Peak Inflow) =    | 11.63 | min | $t_c = t_f + t_e$             |

##### Note:

1. If cycle time is insufficient, iteratively increase **selected working depth** in the **Wetwell Sizing** tab or select a different pump and input new specifications in the **Curve Data** tab until sufficient.
2. Cycle time should not be less than 5 minutes (10 minutes is preferred).

#### X. Water Hammer:

##### Wave Velocity Calculation:

- |                               | Input    | Units | Equations                                  |
|-------------------------------|----------|-------|--------------------------------------------|
| 1. Fluid Bulk Modulus =       | 300,000  | psi   | k                                          |
| 2. Pipe Material =            | PVC      |       |                                            |
| 3. Modulus of Elasticity =    | 400,000  | psi   | E                                          |
| 4. Pipe Outside Diameter =    | 6.90     | in    | OD                                         |
| 5. Pipe Wall Thickness =      | 0.383    | in    | T                                          |
| 6. Standard Dimension Ratio = | 18.02    |       | $SDR = OD / T$                             |
| 7. Wave Velocity =            | 1,291.87 | ft/s  | $a = 4,660 / \sqrt{1 + (k*(SDR - 2)) / E}$ |

##### Water Hammer Calculation:

- |                                  |        |                   |                                  |
|----------------------------------|--------|-------------------|----------------------------------|
| 1. Max. Change in Velocity =     | 3.60   | ft/s              | $\Delta v$                       |
| 2. Acceleration Due to Gravity = | 32.2   | ft/s <sup>2</sup> | g                                |
| 3. Maximum Surge Pressure =      | 62.61  | psi               | $P = a * \Delta v / (2.307 * g)$ |
| 4. Water Hammer Head =           | 144.43 | ft                | $h_{wh} = P * 2.307$             |

##### Peak Hoop Stress Calculation:

- |                             |        |     |                           |
|-----------------------------|--------|-----|---------------------------|
| 1. Maximum Surge Pressure = | 62.61  | psi | P                         |
| 2. Peak Hoop Stress =       | 532.64 | psi | $S = (P * (SDR - 1)) / 2$ |

#### XI. System Curve:

##### Pump Manufacturers' Websites

##### Hydromatic:

Wastewater Pump Selection Software: <https://www.pentair.com/en-us/brands/hydromatic.html>

##### Wastewater Pump Electronic Catalog:

<http://pentairoec.pvcomm.net/login.asp>

##### FLYGT:

Wastewater Pump Selection Software: <https://www.xylect.com>

FLYGT Submersible Pump: N 3000 Series

FLYGT Grinder Pump: M 3000 Series

##### ABS:

Wastewater Pump Selection Software: <https://absel.sulzer.com/StartMain.aspx>

#### XII. Travel Time and Distance:

Pump Run Time (peak): 8.51 minutes

| Pipe ID | Diameter (inches) | Area (ft <sup>2</sup> ) | Length (ft) | Pump Flow Rate |       | Pipe Velocity (fps) | Travel Time        |                  | Travel Distance (ft) |
|---------|-------------------|-------------------------|-------------|----------------|-------|---------------------|--------------------|------------------|----------------------|
|         |                   |                         |             | Maximum (gpm)  | (cfs) |                     | Required (minutes) | Actual (minutes) |                      |
| P-1     | 6.09              | 0.202                   | 1,568       | 330            | 0.735 | 3.63                | 7.19               | 7.19             | 1568                 |
| P-2     | 8.22              | 0.368                   | 100         | 330            | 0.735 | 2.00                | 0.84               | 1.32             | 158                  |
| P-3     | 9.79              | 0.523                   | 1497        | 330            | 0.735 | 1.41                | 17.74              | 0.00             | 0                    |
| P-4     | 6.09              | 0.202                   | 0           | 330            | 0.735 | 3.63                | 0.00               | 0.00             | 0                    |
| P-5     | 6.09              | 0.202                   | 0           | 330            | 0.735 | 3.63                | 0.00               | 0.00             | 0                    |
| P-6     | 6.09              | 0.202                   | 0           | 330            | 0.735 | 3.63                | 0.00               | 0.00             | 0                    |
| P-7     | 6.09              | 0.202                   | 0           | 330            | 0.735 | 3.63                | 0.00               | 0.00             | 0                    |
| P-8     | 6.09              | 0.202                   | 0           | 330            | 0.735 | 3.63                | 0.00               | 0.00             | 0                    |
|         |                   |                         |             |                |       |                     | 25.77              | 8.51             | 1,726                |

|                    |           |                       |                            |
|--------------------|-----------|-----------------------|----------------------------|
| Item Number / Tags | : Default | Size                  | : Hydromatic - H4H         |
| Service            | :         | Stages                | : 1                        |
| Quantity           | : 1       | Based on curve number | : SUB_S_E_AH_00021_B_4 Rev |
| Quote number       | :         |                       | 2012-03-23                 |
|                    |           | Date last saved       | : 22 Jul 2025 2:01 PM      |

**Operating Conditions**

|                               |                     |
|-------------------------------|---------------------|
| Flow, rated                   | : 330.0 USgpm       |
| Head, rated (requested)       | : 55.00 ft          |
| Head, rated (actual)          | : 56.24 ft          |
| Suction pressure, rated / max | : 0.00 / 0.00 psi.g |
| NPSH available                | : Ample             |
| Site Supply Frequency         | : 60 Hz             |

**Performance**

|                                        |                             |
|----------------------------------------|-----------------------------|
| Speed criteria                         | : Synchronous               |
| Speed                                  | : 1750 rpm                  |
| Impeller dia.                          | : 8.75 in                   |
| Impeller diameter, maximum             | : 10.00 in                  |
| Impeller diameter, minimum             | : 8.00 in                   |
| Efficiency                             | : 61.36 %                   |
| NPSH required / margin required        | : - / 0.00 ft               |
| nq (imp. eye flow) / S (imp. eye flow) | : 34 / - Metric units       |
| Minimum Continuous Stable Flow         | : 100.0 USgpm               |
| Head max.                              | : 90.14 ft                  |
| Head rise to shutoff                   | : 63.88 %                   |
| Flow, best eff. point                  | : 444.2 USgpm               |
| Flow ratio, rated / BEP                | : 74.29 %                   |
| Diameter ratio (rated / max)           | : 87.50 %                   |
| Head ratio (rated dia / max dia)       | : 65.16 %                   |
| Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]       | : 1.00 / 1.00 / 1.00 / 1.00 |
| Selection status                       | : Acceptable                |

**Liquid**

|                                 |                    |
|---------------------------------|--------------------|
| Liquid type                     | : Water            |
| Additional liquid description   | :                  |
| Solids diameter, max            | : 0.00 in          |
| Solids size limit               | : 3.00 in          |
| Solids concentration, by volume | : 0.00 %           |
| Temperature                     | : 68.00 deg F      |
| Fluid density                   | : 1.000 / 1.000 SG |
| Viscosity                       | : 1.00 cP          |
| Vapor pressure, rated           | : 0.34 psi.a       |

**Material**

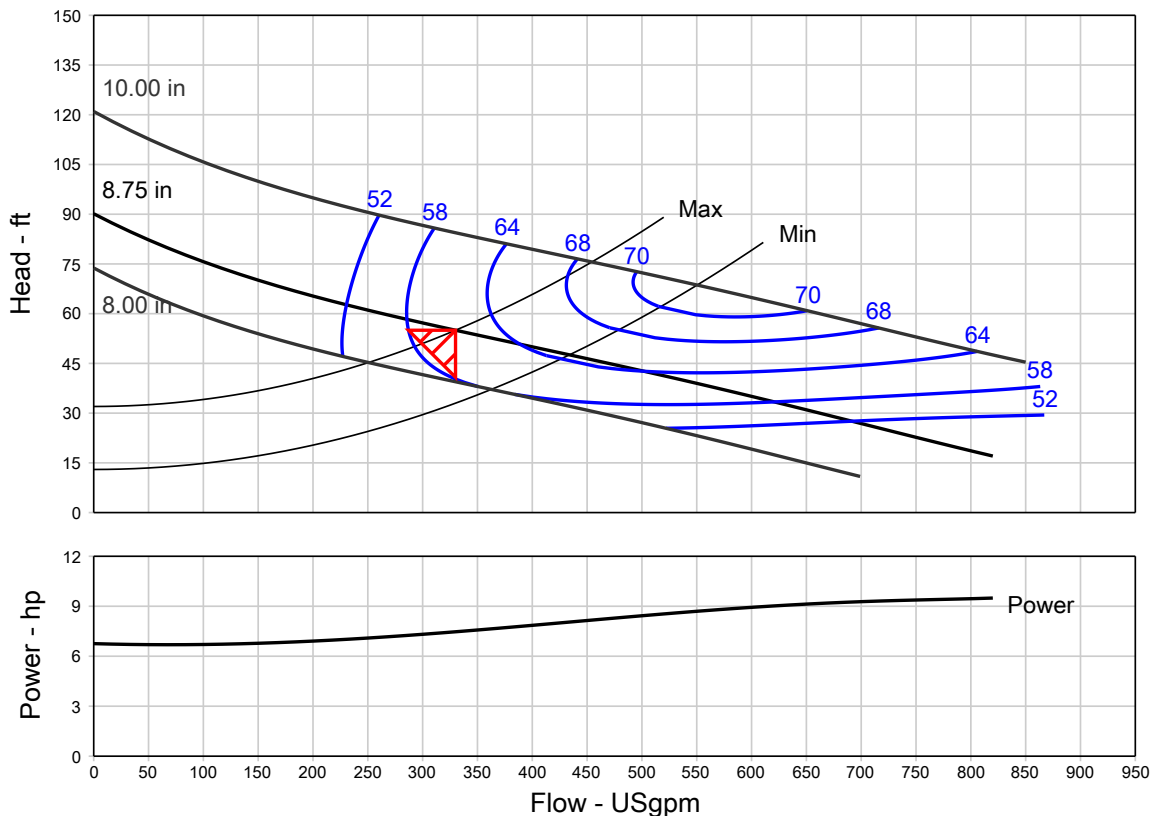
|                   |            |
|-------------------|------------|
| Material selected | : Standard |
|-------------------|------------|

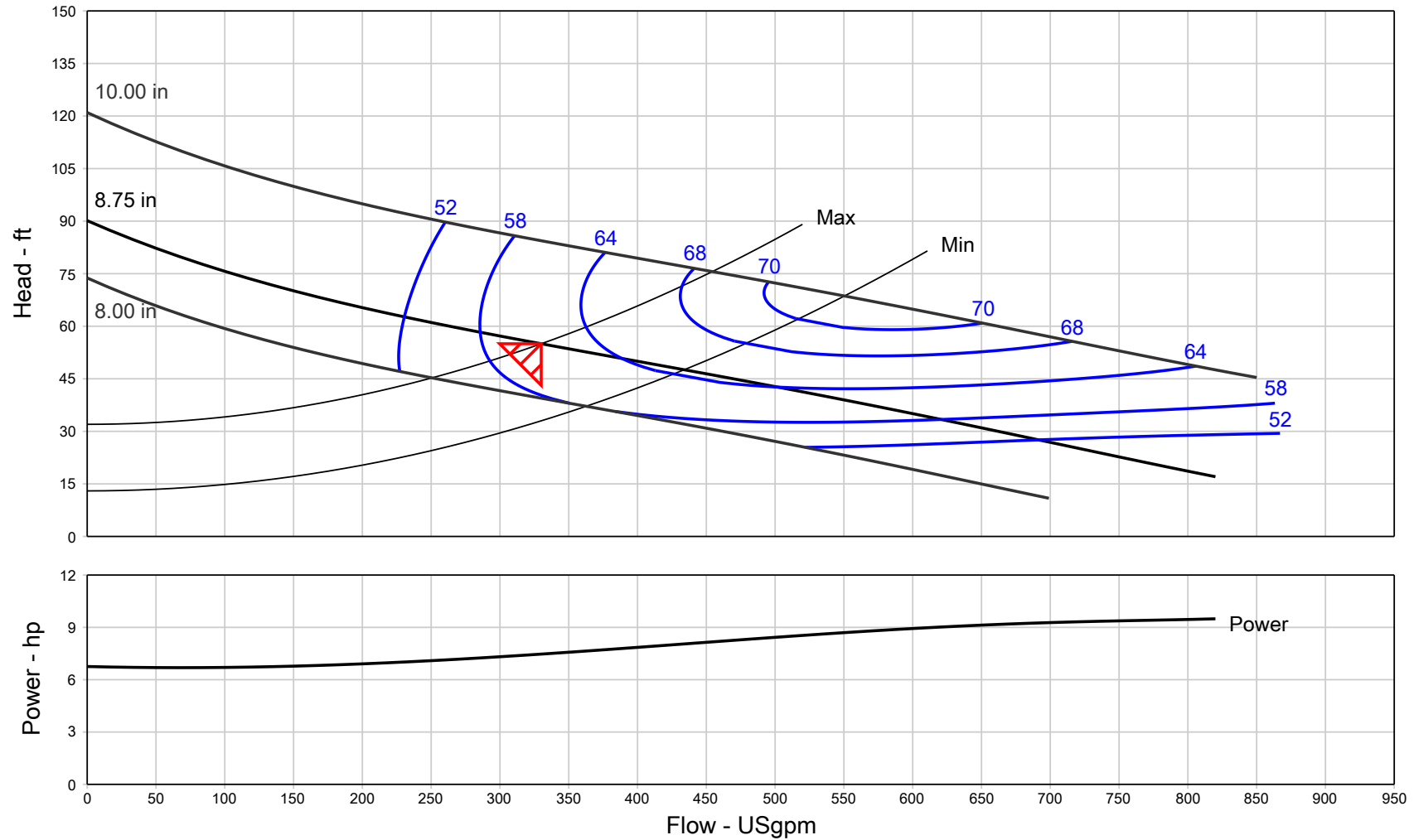
**Pressure Data**

|                                    |               |
|------------------------------------|---------------|
| Maximum working pressure           | : 39.01 psi.g |
| Maximum allowable working pressure | : N/A         |
| Maximum allowable suction pressure | : N/A         |
| Hydrostatic test pressure          | : N/A         |

**Driver & Power Data (@Max density)**

|                             |                      |
|-----------------------------|----------------------|
| Driver sizing specification | : Max Power          |
| Margin over specification   | : 0.00 %             |
| Service factor              | : 1.00               |
| Power, hydraulic            | : 4.58 hp            |
| Power, rated                | : 7.47 hp            |
| Power, maximum              | : 9.49 hp            |
| Motor rating                | : 10.00 hp / 7.46 kW |




Item Number / Tags : Default  
Service :  
Quantity : 1  
Quote number :  
Date last saved : 22 Jul 2025 2:01 PM

Size : Hydromatic - H4H  
Stages : 1  
Speed : 1750 rpm  
Based on curve number : SUB\_S\_E\_AH\_00021\_B\_4  
Rev 2012-03-23  
Efficiency : 61.36 %  
Power, rated : 7.47 hp

Flow, rated : 330.0 USgpm  
Head, rated : 55.00 ft  
NPSH required : -  
Fluid density : 1.000 / 1.000 SG  
Viscosity : 1.00 cP  
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010] : 1.00 / 1.00 / 1.00 / 1.00



|                    |           |                 |                       |
|--------------------|-----------|-----------------|-----------------------|
| Item Number / Tags | : Default | Size            | : Hydromatic - H4H    |
| Service            | :         | Stages          | : 1                   |
| Quantity           | : 1       | Speed           | : 1750 rpm            |
| Quote number       | :         | Frame size      | :                     |
|                    |           | Date last saved | : 22 Jul 2025 2:01 PM |

**Performance Data**

|                                               |            |
|-----------------------------------------------|------------|
| Head, maximum diameter, rated flow            | : 84.41 ft |
| Head, minimum diameter, rated flow            | : 39.46 ft |
| Head max.                                     | : 90.14 ft |
| Efficiency adjustment factor, total           | : 1.00     |
| Power adjustment, total                       | : 0.00 hp  |
| Head adjustment factor, total                 | : 1.00     |
| Flow adjustment factor, total                 | : 1.00     |
| NPSH3 adjustment factor, total                | : 1.00     |
| NPSH margin dictated by pump supplier         | : 0.00 ft  |
| NPSH margin dictated by user                  | : 0.00 ft  |
| NPSH margin used (added to 'required' values) | : 0.00 ft  |

**Mechanical Limits**

|                                       |                    |
|---------------------------------------|--------------------|
| Torque, rated power, rated speed      | : 0.43 hp/100 rpm  |
| Torque, maximum power, rated speed    | : 0.54 hp/100 rpm  |
| Torque, driver power, full load speed | : 0.57 hp/100 rpm  |
| Torque, driver power, rated speed     | : 0.57 hp/100 rpm  |
| Torque, pump shaft limit              | : 1,000 hp/100 rpm |
| Radial load, worst case               | : -                |
| Radial load limit                     | : -                |
| Impeller peripheral speed, rated      | : -                |
| Impeller peripheral speed limit       | : -                |

**Various Performance Data**

|                                | Flow (USgpm) | Head (ft) | Efficiency (%) | NPSH3 (ft) | Power (hp) |
|--------------------------------|--------------|-----------|----------------|------------|------------|
| Shutoff, rated                 | 0.00         | 90.14     | -              | -          | 6.76       |
| Shutoff, maximum               | 0.00         | 121.0     | -              | -          | 11.33      |
| Minimum Continuous Stable Flow | 100.0        | 75.68     | 28.50          | -          | 6.70       |
| Rated flow, minimum            | 330.0        | 39.46     | 57.69          | -          | 5.70       |
| Rated flow, maximum            | 330.0        | 84.41     | 59.98          | -          | 11.72      |
| BEP flow, rated                | 444.2        | 46.84     | 64.78          | -          | 8.11       |
| 120% rated flow, rated         | 396.0        | 50.28     | 64.19          | -          | 7.83       |
| End of curve, rated            | 820.0        | 17.05     | 37.19          | -          | 9.49       |
| End of curve, minimum          | 699.0        | 10.90     | 27.84          | -          | 6.91       |
| End of curve, maximum          | 850.0        | 45.37     | 61.72          | -          | 15.77      |
| Maximum value, rated           | -            | 90.14     | 64.78          | -          | 9.49       |
| Maximum value, maximum         | -            | -         | 70.96          | -          | 15.77      |

**System differential pressure**

|                                                |  |
|------------------------------------------------|--|
| Differential pressure, rated flow, rated (psi) |  |
| Differential pressure, shutoff, rated (psi)    |  |
| Differential pressure, shutoff, maximum (psi)  |  |

**Discharge pressure**

|                                               |  |
|-----------------------------------------------|--|
| Discharge pressure, rated flow, rated (psi.g) |  |
| Discharge pressure, shutoff, rated (psi.g)    |  |
| Discharge pressure, shutoff, maximum (psi.g)  |  |

**Ratios**

|                                  |            |                                                         |            |
|----------------------------------|------------|---------------------------------------------------------|------------|
| Maximum flow / rated flow, rated | : 248.50 % | Head rated diameter / head minimum diameter, rated flow | : 139.39 % |
|----------------------------------|------------|---------------------------------------------------------|------------|

**Stage, Speed and Solids Limits**

|                               |            |
|-------------------------------|------------|
| Stages, maximum               | : 1        |
| Stages, minimum               | : 1        |
| Pump speed limit, maximum     | : 1750 rpm |
| Pump speed limit, minimum     | : 1170 rpm |
| Curve speed limit, maximum    | : 1750 rpm |
| Curve speed limit, minimum    | : 1170 rpm |
| Variable speed limit, maximum | : -        |
| Variable speed limit, minimum | : 880 rpm  |
| Solids size limit             | : 3.00 in  |

**Typical Driver Data**

|                              |            |
|------------------------------|------------|
| Driver speed, full load      | : 1760 rpm |
| Driver speed, rated load     | : 1770 rpm |
| Driver efficiency, 100% load | : 89.50 %  |
| Driver efficiency, 75% load  | : 90.00 %  |
| Driver efficiency, 50% load  | : 89.50 %  |

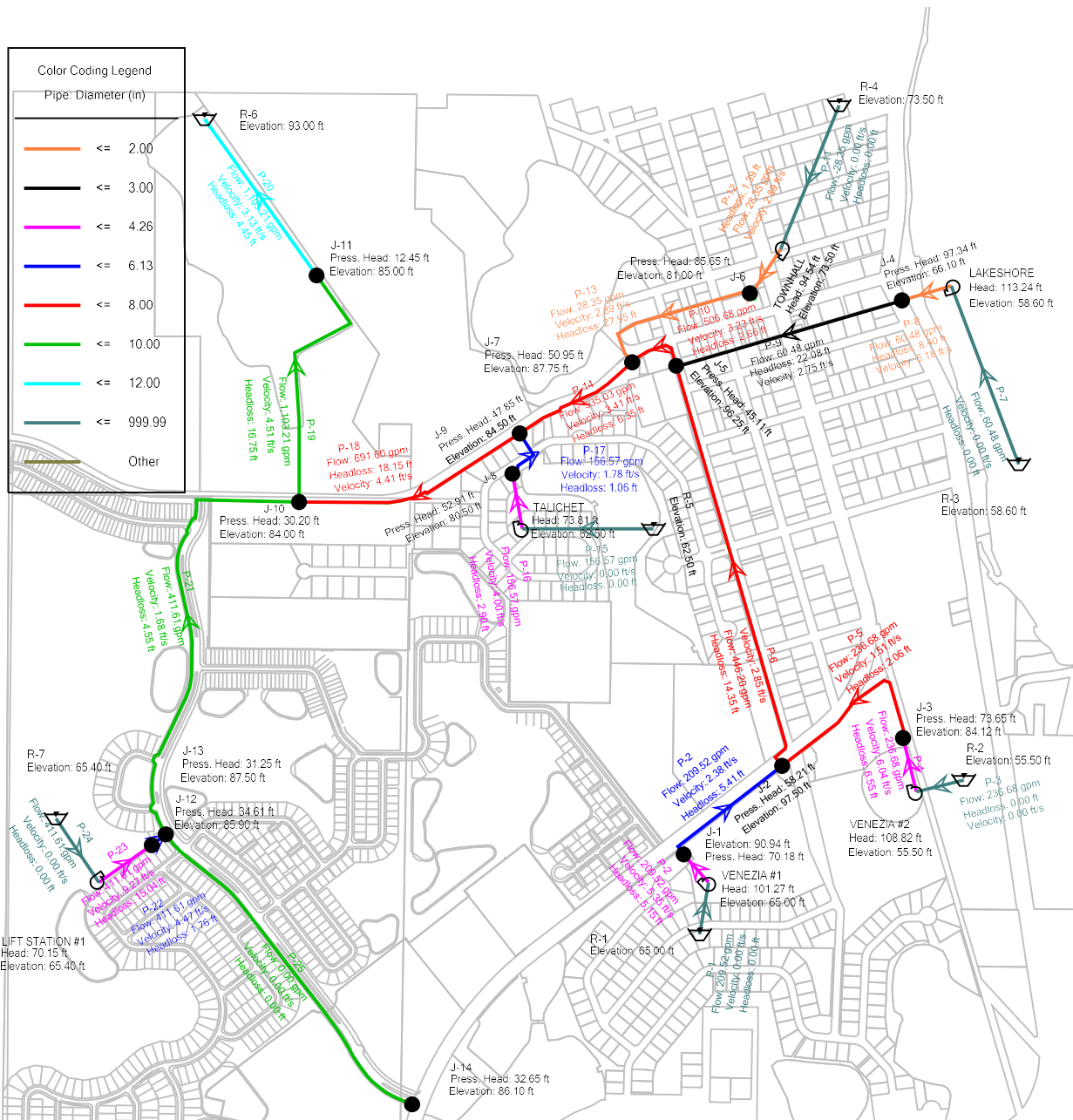
**@ Density, rated**
**@ Density, max**

|       |       |
|-------|-------|
| 23.80 | 23.80 |
| 39.01 | 39.01 |
| 52.36 | 52.36 |

| @ Suction pressure, rated | @ Suction pressure, max | @ Suction pressure, rated | @ Suction pressure, max |
|---------------------------|-------------------------|---------------------------|-------------------------|
|---------------------------|-------------------------|---------------------------|-------------------------|

|       |       |       |       |
|-------|-------|-------|-------|
| 23.80 | 23.80 | 23.80 | 23.80 |
| 39.01 | 39.01 | 39.01 | 39.01 |
| 52.36 | 52.36 | 52.36 | 52.36 |

## Scenario: Base (MANIFOLD CONDITION)



Scenario: Base (EXISTING NETWORK CONDITIONS)

