Water Distribution System Planning Values and Design Guidelines

The water system information utilized to develop these design guidelines is from the City's most recent Water Facility Plan Update (WFPU), City Standards, and Montana DEQ guidelines. **Table 1** provides planning values to estimate water demands. The planning values are calculated from historical water consumption; it's the design engineer's responsibility to ensure the planning values are sensible for the development being constructed. Additionally, it's recommended to check that the infrastructure being implemented aligns with the calibrated water system model. **Table 2** provides water distribution system design guidelines including pressure, velocity, headloss, and fire flow requirements.

Table 1. Water Demand Planning Values for Sizing Infrastructure[1]

Water Demand Planning Values	
Average Daily Demand (ADD)	
Land Use Type	Recommended Planning Value
Single Dwelling Residential	350 gpd
Multiple Dwelling Residential	240 gpd/DU
General Commercial	870 gpd/acre
Neighborhood Office	330 gpd/acre
Industrial	470 gpd/acre
Light Industrial	160 gpd/acre
Public Institutional	150 gpd/acre
Peaking Factors to Calculate Maximum Daily Demand (MDD) and Peak Hourly Demand (PHD)	
Description	Peaking Factor
MDD Peaking Factor[2]	3.00
PHD Peaking Factor[3]	1.85

1 Abbreviations: gpd = gallons per day | DU = dwelling unit
2 Use to convert ADD to MDD. Multiply this peaking factor by the ADD to calculate MDD.
3 Use to convert MDD to PHD. Multiply this peaking factor by the MDD to calculate PHD.

Table 2. Water Distribution System Design Guidelines[1]

Water Distribution System Design Guidelines	
Pressure Requirements	
Parameter	Pressure (psi)
Recommended Operating Pressure Range	50 – 80
Maximum Pressure	100
Minimum Pressure during Peak Hourly Demand	50
Minimum Pressure during Fire Flow	20
Velocity Requirements	
Parameter	Velocity (fps)
Transmission Pipelines (12-inch and larger)	Less than 3
Distribution Pipelines (10-inch and smaller)	Less than 5

Table 2. Water Distribution System Design Guidelines (Continued)[1]

Water Distribution System Design Guidelines		
Headloss Requirements		
Parameter	Headloss (feet per 1,000 feet)	
Transmission Pipelines (12-inch and larger)	Less than 2	
Distribution Pipelines (10-inch and smaller)	Less than 5	
Fire Flow Requirements[2]		
Land Use Type	Flow Rate (gpm)	Duration (hours)
Residential	1,500	3
Commercial	4,000	4
Industrial	4,000	4

1 Abbreviations: psi = pounds per square inch | fps = feet per second | gpm = gallons per minute

2 The City Fire Department follows the International Fire Code to determine needed fire flow. These are general requirements for planning purposes and may not be indicative of the requirements for specific developments or buildings.

Wastewater Collection System Planning Values and Design Guidelines

The wastewater system information utilized to develop these design guidelines is from the City's most recent Wastewater Facility Plan Update (WWFPU), City Standards, and Montana DEQ guidelines. **Table 3** provides planning values to estimate wastewater flows. The planning values are calculated from historical wastewater generated; it's the design engineer's responsibility to ensure the planning values are sensible for the development being constructed. Additionally, it's recommended to check that the infrastructure being implemented aligns with the collection system model. **Table 4** provides wastewater collection system design guidelines for both force mains and gravity mains.

Table 3. Wastewater Flow Planning Values for Sizing Infrastructure[1]

Wastewater Flow Planning Values	
Average Daily Flow (ADF)	
Land Use Type	Planning Value
Single Dwelling Residential = 1 ERU	200 gpd = 1ERU
Multiple Dwelling Residential = 0.8 ERU/DU	160 gpd/DU = 0.8 ERU
General Commercial	540 gpd/acre
Neighborhood Office	200 gpd/acre
Industrial	260 gpd/acre
Light Industrial	90 gpd/acre
Public Institutional	60 gpd/acre
Peaking Factors to Calculate Peak Hourly Flow (PHF)	
Description	Peaking Factor
PHF Peaking Factor (From Montana DEQ Design Standards)[2]	$PHF\ Peaking\ Factor = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$ $(P = population\ in\ thousands)$

1 Abbreviations: gpd = gallons per day | DU = dwelling unit

2 Fair, G.M. and Geyer, J.C. "Water Supply and Waste-water Disposal" 1st Ed. John Wiley & Sons, Inc. New York, (1954), P. 13

3 If I/I is anticipated, a planning value of 250 gpd per ERU shall be used

Table 4. Wastewater Collection System Design Guidelines

Wastewater Collection System Design Guidelines	
FORCE MAINS	
General Design Guidelines	
Parameter	Value
Minimum Velocity	4 fps
Maximum Velocity	8 fps
Minimum Diameter	4-inch
Design C-Factor (Hazen Williams)[1]	120
GRAVITY MAINS	
Minimum Slope Requirements	
Diameter	Minimum Slope (feet / 100 feet)
8-inch	0.400
10-inch	0.280
12-inch	0.220
14-inch	0.170
15-inch	0.150
16-inch	0.140
18-inch	0.120
21-inch	0.100
24-inch	0.080
27-inch	0.067
30-inch	0.058
33-inch	0.052
36-inch	0.046
39-inch	0.041
42-inch	0.037
General Design Guidelines	
Parameter	Value
Minimum Velocity	2.5 fps
Maximum Velocity	15 fps
Minimum Diameter	8-inch
Design Roughness Coefficient (Manning's)[2]	0.011
Minimum Bury Depth (Top of Pipe)	4 feet

1 This design C-Factor is for new and/or smooth pipe (i.e. PVC). If utilizing a pipe with a rough interior, utilize a lower C-Factor (refer to textbook values).

2 This design roughness coefficient is for new and/or smooth pipe (i.e. PVC). If utilizing a pipe with a rough interior, utilize a higher roughness coefficient (refer to textbook values).