



Sanitary Sewer - Pipe Flow Analysis

Project: GPI Industrial Wastewater Discharge Lateral Realignment
Project Scope: Realign GPI's Industrial Discharge to Industrial Diversion Chamber
Basis of Design: GPI Peak Flow Rate = 8.1 MGD = 5,600gpm
Project No.: wwr
Computed By: RSS **Date:** 12/14/22

Upstream Invert Elev.	754.5
Downstream Invert Elev.	750.28
Pipe Length (ft.)	658
Slope (ft/ft.)	0.00641
Slope (ft/100) (%)	0.641%

Manning's Equation for Partially Full Pipe

$$Q = \frac{1.49}{n} \cdot A \cdot R_h^{2/3} \cdot S^{1/2}$$

where :

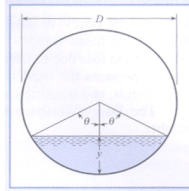
Q = Flow (Manning Equation)

n = 0.013 (Manning Roughness Coefficient)

$$R_h = \left(\frac{D}{4}\right) \cdot \left[1 - \frac{\sin\theta \cdot \cos\theta}{\pi \cdot (\theta/180^\circ)}\right] \text{ (Hydraulic Radius)}$$

$$A = \left[\left(\frac{\pi D^2}{4}\right) \cdot \left(\frac{2\theta}{360^\circ}\right) - \left(\frac{D}{2}\right)^2 (\sin\theta \cos\theta)\right] \text{ (Area of Flowing Water)}$$

$$y = \left(\frac{D}{2}\right) - \left[\frac{D}{2} \cos\theta\right] \text{ (Depth of Flow in Pipe)}$$



	Pipe Diameter	Pipe Diameter	Slope of Pipe	Area of Flow	θ	Wetted Perimeter	Hydraulic Radius	Q(manning)			V(manning)	% Full	Depth of Flow
	in	ft	%	ft ²	degrees	ft	ft	gpm	cfs	mgd	ft/s		v_in
	24	2.00	0.641%	0.028	20.0	0.698	0.040	13	0.0295	0.02	1.067	3.0	0.72
	24	2.00	0.641%	0.053	25.0	0.873	0.061	34	0.0759	0.05	1.424	4.7	1.12
	24	2.00	0.641%	0.091	30.0	1.047	0.087	73	0.1626	0.11	1.795	6.7	1.61
	24	2.00	0.641%	0.141	35.0	1.222	0.115	138	0.3069	0.20	2.176	9.0	2.17
Min	24	2.00	0.641%	0.206	40.0	1.396	0.147	236	0.5268	0.34	2.561	11.7	2.81
	24	2.00	0.641%	0.285	45.0	1.571	0.182	377	0.8403	0.54	2.944	14.6	3.51
	24	2.00	0.641%	0.380	50.0	1.745	0.218	567	1.2638	0.82	3.323	17.9	4.29
	24	2.00	0.641%	0.490	55.0	1.920	0.255	812	1.8102	1.17	3.694	21.3	5.12
Avg	24	2.00	0.641%	0.614	60.0	2.094	0.293	1117	2.4884	1.61	4.051	25.0	6.00
	24	2.00	0.641%	0.751	65.0	2.269	0.331	1482	3.3017	2.13	4.394	28.9	6.93
	24	2.00	0.641%	0.900	70.0	2.443	0.368	1906	4.2474	2.74	4.718	32.9	7.90
68.2 %	24	2.00	0.641%	1.059	75.0	2.618	0.405	2386	5.3166	3.44	5.020	37.1	8.89
	24	2.00	0.641%	1.225	80.0	2.793	0.439	2914	6.4938	4.20	5.300	41.3	9.92
95.5 %	24	2.00	0.641%	1.397	85.0	2.967	0.471	3482	7.7579	5.01	5.554	45.6	10.95
	24	2.00	0.641%	1.571	90.0	3.142	0.500	4076	9.0828	5.87	5.782	50.0	12.00
99.7 %	24	2.00	0.641%	1.745	95.0	3.316	0.526	4685	10.4387	6.75	5.982	54.4	13.05
	24	2.00	0.641%	1.916	100.0	3.491	0.549	5293	11.7933	7.62	6.154	58.7	14.08
Peak	24	2.00	0.641%	2.083	105.0	3.665	0.568	5885	13.1138	8.48	6.297	62.9	15.11
	24	2.00	0.641%	2.241	110.0	3.840	0.584	6448	14.3683	9.29	6.411	67.1	16.10
	24	2.00	0.641%	2.390	115.0	4.014	0.595	6969	15.5271	10.03	6.496	71.1	17.07
	24	2.00	0.641%	2.527	120.0	4.189	0.603	7434	16.5648	10.71	6.554	75.0	18.00
	24	2.00	0.641%	2.652	125.0	4.363	0.608	7836	17.4607	11.28	6.585	78.7	18.88
	24	2.00	0.641%	2.761	130.0	4.538	0.609	8168	18.2005	11.76	6.591	82.1	19.71
	24	2.00	0.641%	2.856	135.0	4.712	0.606	8427	18.7761	12.13	6.574	85.4	20.49
	24	2.00	0.641%	2.936	140.0	4.887	0.601	8611	19.1862	12.40	6.535	88.3	21.19
	24	2.00	0.641%	3.001	145.0	5.061	0.593	8723	19.4361	12.56	6.477	91.0	21.83
	24	2.00	0.641%	3.051	150.0	5.236	0.583	8768	19.5371	12.63	6.403	93.3	22.39
	24	2.00	0.641%	3.088	155.0	5.411	0.571	8754	19.5054	12.61	6.316	95.3	22.88
	24	2.00	0.641%	3.114	160.0	5.585	0.558	8690	19.3619	12.51	6.218	97.0	23.28
	24	2.00	0.641%	3.130	165.0	5.760	0.543	8586	19.1301	12.36	6.112	98.3	23.59
	24	2.00	0.641%	3.138	170.0	5.934	0.529	8454	18.8359	12.17	6.002	99.2	23.82
	24	2.00	0.641%	3.141	175.0	6.109	0.514	8305	18.5056	11.96	5.891	99.8	23.95
	24	2.00	0.641%	3.142	180.0	6.283	0.500	8153	18.1656	11.74	5.782	100.0	24.00