water

Impact of Self-cleansing Criteria Choice on the Optimal Design of Sewer Networks in South America—Supplementary Data

Table S1. Data for Mini-Chicó sewer network.

Pipe	Ground Elevation [m]		Length [m]	Flow [m³/s]
	Upstream	Downstream		
1	2587.34	2575.50	167.53	0.27
2	2575.50	2569.69	91.03	0.35
3	2569.69	2564.91	93.21	0.61
4	2564.91	2561.06	188.01	0.78
5	2561.06	2558.33	203.91	1.24
6	2558.33	2557.98	113.06	1.80
7	2557.98	2555.82	81.84	1.95
8	2555.82	2555.07	187.38	2.16
9	2555.07	2551.68	169.13	2.70
10	2551.68	2551.68	100.56	3.20
11	2551.68	2551.50	180.50	3.68
12	2551.50	2551.42	90.42	6.43
13	2551.42	2551.50	337.42	6.43
14	2590.20	2570.32	277.80	0.48
15	2570.32	2569.25	85.81	0.73
16	2569.25	2564.21	194.62	0.93
17	2564.21	2559.98	201.17	1.94
18	2559.98	2555.32	187.18	2.18
19	2555.32	2551.50	273.83	2.48
20	2570.03	2566.68	95.17	0.34
21	2566.68	2564.21	197.90	0.91
22	2572.91	2571.62	63.83	0.06
23	2571.62	2569.25	81.45	0.21
24	2573.46	2573.93	83.43	0.12
25	2573.93	2570.32	200.02	0.15
26	2570.84	2564.91	180.32	0.12
27	2566.15	2561.06	85.58	0.29
28	2561.96	2558.33	85.65	0.32
29	2559.96	2557.98	63.32	0.10
30	2558.70	2555.82	80.11	0.15
31	2556.39	2555.07	80.01	0.30
32	2555.41	2551.68	84.84	0.22
33	2573.97	2571.62	52.93	0.13
34	2559.91	2559.98	87.31	0.22
35	2554.26	2551.50	62.00	0.20

Table S2. Data for Mays and Wenzel [13] network.

Pipe	Ground Elevation [m]		Length [m]	Flow [m³/s]
	Upstream	Downstream		
1	152.40	150.87	106.68	0.1132
2	150.87	148.43	121.92	0.1982
3	148.43	146.30	106.68	0.2548
4	146.30	143.25	167.67	0.6229
5	143.25	141.73	152.40	1.2459
6	141.73	138.68	172.21	2.0104
7	138.68	137.46	121.92	2.4635
8	137.46	136.55	152.40	2.5201
9	136.55	135.63	186.53	2.6617
10	149.35	147.82	121.92	0.1132
11	147.82	146.30	131.07	0.2265
12	149.35	147.82	147.63	0.2265
13	147.82	144.78	137.16	0.3398
14	144.78	143.25	106.68	0.423
15	147.82	144.78	152.40	0.2548
16	144.78	143.25	106.68	0.453
17	143.25	141.73	106.68	0.5663
18	142.64	141.42	121.92	0.1132
19	141.42	140.20	91.44	0.1699
20	140.20	138.68	105.22	0.2548

Table S3. Data for 'Kerman' city network. Taken from Afshar et al. [34].

Pipe	Ground Elevation [m]		Length [m]	Flow [m³/s]
	Upstream	Downstream		
1	74.59	73.66	260	0.0279
2	70.70	69.90	300	0.0549
3	73.00	71.50	400	0.0211
4	73.66	72.10	460	0.0304
5	72.10	71.19	260	0.0324
6	71.19	69.85	300	0.0340
7	69.85	68.24	450	0.0366
8	68.24	67.28	400	0.0387
9	69.90	69.30	270	0.0562
10	69.30	68.40	310	0.0580
11	68.40	67.28	440	0.0596
12	67.28	66.22	470	0.0967
13	66.22	65.82	350	0.1012
14	65.82	65.42	340	0.1047
15	71.50	70.10	400	0.0264
16	70.10	68.60	400	0.0300
17	68.60	66.80	500	0.0319
18	66.80	66.10	400	0.0403
19	66.10	65.42	590	0.0446
20	65.42	64.50	320	0.1659

Table S4. First simulation scenario for the sensitivity analysis.

		Ground Elevation [m]									
Pipe	**Flow[1] [L/s]**	**Scenario 1 (100%)**		**Scenario 2 (50%)**		**Scenario 3 (30%)**		**Scenario 4 (10%)**		**Scenario 5 (5%)**	
		Up	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**
1	1.0	2587.34	2575.50	1293.67	1287.75	776.20	772.65	258.73	257.55	129.37	128.77
2	2.0	2575.50	2569.69	1287.75	1284.85	772.65	770.91	257.55	256.97	128.78	128.48
3	3.0	2569.69	2564.91	1284.85	1282.45	770.91	769.47	256.97	256.49	128.49	128.24
4	4.0	2564.91	2561.06	1282.45	1280.53	769.47	768.32	256.49	256.11	128.24	128.05
5	5.0	2561.06	2558.33	1280.53	1279.16	768.32	767.50	256.11	255.83	128.05	127.91
6	6.0	2558.33	2557.98	1279.16	1278.99	767.50	767.39	255.83	255.80	127.91	127.89
7	7.0	2557.98	2555.82	1278.99	1277.91	767.39	766.75	255.80	255.58	127.89	127.79
8	8.0	2555.82	2555.07	1277.91	1277.55	766.75	766.52	255.58	255.51	127.79	127.75
9	9.0	2555.07	2551.68	1277.55	1275.84	766.52	765.50	255.51	255.16	127.75	127.58
10	10.0	2551.68	2551.68	1275.84	1275.84	765.50	765.50	255.17	255.17	127.58	127.58
11	11.0	2551.68	2551.50	1275.84	1275.75	765.50	765.45	255.17	255.15	127.58	127.57
12	12.0	2551.50	2551.42	1275.75	1275.71	765.45	765.43	255.15	255.14	127.57	127.57
13	13.0	2551.42	2551.50	1275.71	1275.75	765.43	765.45	255.14	255.15	127.57	127.57
Mean Terrain Slope [%][2]		1.79		0.89		0.54		0.18		0.09	

[1]All scenarios have the same flow rate.

[2]Calculated as: $Mean\ terrain\ slope\ [\%] = \frac{Up\ Ground\ Elevation_{Pipe\ 1} - Dow\ Ground\ Elevation_{Pipe\ 13}}{Total\ length\ of\ the\ path = 2004\ m} \times 100$

Table S5. Second simulation scenario for the sensitivity analysis.

		Ground Elevation [m]									
Pipe	**Flow[1] [L/s]**	**Scenario 1 (100%)**		**Scenario 2 (50%)**		**Scenario 3 (30%)**		**Scenario 4 (10%)**		**Scenario 5 (5%)**	
		Up	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**
1	2.0	2587.34	2575.50	1293.67	1287.75	776.20	772.65	258.73	257.55	129.37	128.77
2	4.0	2575.50	2569.69	1287.75	1284.85	772.65	770.91	257.55	256.97	128.78	128.48
3	6.0	2569.69	2564.91	1284.85	1282.45	770.91	769.47	256.97	256.49	128.49	128.24
4	8.0	2564.91	2561.06	1282.45	1280.53	769.47	768.32	256.49	256.11	128.24	128.05
5	10.0	2561.06	2558.33	1280.53	1279.16	768.32	767.50	256.11	255.83	128.05	127.91
6	12.0	2558.33	2557.98	1279.16	1278.99	767.50	767.39	255.83	255.80	127.91	127.89
7	14.0	2557.98	2555.82	1278.99	1277.91	767.39	766.75	255.80	255.58	127.89	127.79
8	16.0	2555.82	2555.07	1277.91	1277.55	766.75	766.52	255.58	255.51	127.79	127.75
9	18.0	2555.07	2551.68	1277.55	1275.84	766.52	765.50	255.51	255.16	127.75	127.58
10	20.0	2551.68	2551.68	1275.84	1275.84	765.50	765.50	255.17	255.17	127.58	127.58
11	22.0	2551.68	2551.50	1275.84	1275.75	765.50	765.45	255.17	255.15	127.58	127.57
12	24.0	2551.50	2551.42	1275.75	1275.71	765.45	765.43	255.15	255.14	127.57	127.57
13	26.0	2551.42	2551.50	1275.71	1275.75	765.43	765.45	255.14	255.15	127.57	127.57
Mean Terrain Slope [%][2]		1.79		0.89		0.54		0.18		0.09	

[1]All scenarios have the same flow rate.

[2]Calculated as: $Mean\ terrain\ slope\ [\%] = \frac{Up\ Ground\ Elevation_{Pipe\ 1} - Dow\ Ground\ Elevation_{Pipe\ 13}}{Total\ length\ of\ the\ path = 2004\ m} \times 100$

Table S6. Third simulation scenario for the sensitivity analysis.

		Ground Elevation [m]									
Pipe	**Flow[1] [L/s]**	**Scenario 1 (100%)**		**Scenario 2 (50%)**		**Scenario 3 (30%)**		**Scenario 4 (10%)**		**Scenario 5 (5%)**	
		Up	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**
1	3.0	2587.34	2575.50	1293.67	1287.75	776.20	772.65	258.73	257.55	129.37	128.77
2	6.0	2575.50	2569.69	1287.75	1284.85	772.65	770.91	257.55	256.97	128.78	128.48
3	9.0	2569.69	2564.91	1284.85	1282.45	770.91	769.47	256.97	256.49	128.49	128.24
4	12.0	2564.91	2561.06	1282.45	1280.53	769.47	768.32	256.49	256.11	128.24	128.05
5	15.0	2561.06	2558.33	1280.53	1279.16	768.32	767.50	256.11	255.83	128.05	127.91
6	18.0	2558.33	2557.98	1279.16	1278.99	767.50	767.39	255.83	255.80	127.91	127.89
7	21.0	2557.98	2555.82	1278.99	1277.91	767.39	766.75	255.80	255.58	127.89	127.79
8	24.0	2555.82	2555.07	1277.91	1277.55	766.75	766.52	255.58	255.51	127.79	127.75
9	27.0	2555.07	2551.68	1277.55	1275.84	766.52	765.50	255.51	255.16	127.75	127.58
10	30.0	2551.68	2551.68	1275.84	1275.84	765.50	765.50	255.17	255.17	127.58	127.58
11	33.0	2551.68	2551.50	1275.84	1275.75	765.50	765.45	255.17	255.15	127.58	127.57
12	36.0	2551.50	2551.42	1275.75	1275.71	765.45	765.43	255.15	255.14	127.57	127.57
13	39.0	2551.42	2551.50	1275.71	1275.75	765.43	765.45	255.14	255.15	127.57	127.57
Mean Terrain Slope [%][2]		1.79		0.89		0.54		0.18		0.09	

[1]All scenarios have the same flow rate.

[2]Calculated as: $Mean\ terrain\ slope\ [\%] = \frac{Up\ Ground\ Elevation_{Pipe\ 1} - Dow\ Ground\ Elevation_{Pipe\ 13}}{Total\ length\ of\ the\ path = 2004\ m} \times 100$

Table S7. Fourth simulation scenario for the sensitivity analysis.

		Ground Elevation [m]									
Pipe	**Flow[1] [L/s]**	**Scenario 1 (100%)**		**Scenario 2 (50%)**		**Scenario 3 (30%)**		**Scenario 4 (10%)**		**Scenario 5 (5%)**	
		Up	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**
1	5.0	2587.34	2575.50	1293.67	1287.75	776.20	772.65	258.73	257.55	129.37	128.77
2	10.0	2575.50	2569.69	1287.75	1284.85	772.65	770.91	257.55	256.97	128.78	128.48
3	15.0	2569.69	2564.91	1284.85	1282.45	770.91	769.47	256.97	256.49	128.49	128.24
4	20.0	2564.91	2561.06	1282.45	1280.53	769.47	768.32	256.49	256.11	128.24	128.05
5	25.0	2561.06	2558.33	1280.53	1279.16	768.32	767.50	256.11	255.83	128.05	127.91
6	30.0	2558.33	2557.98	1279.16	1278.99	767.50	767.39	255.83	255.80	127.91	127.89
7	35.0	2557.98	2555.82	1278.99	1277.91	767.39	766.75	255.80	255.58	127.89	127.79
8	40.0	2555.82	2555.07	1277.91	1277.55	766.75	766.52	255.58	255.51	127.79	127.75
9	45.0	2555.07	2551.68	1277.55	1275.84	766.52	765.50	255.51	255.16	127.75	127.58
10	50.0	2551.68	2551.68	1275.84	1275.84	765.50	765.50	255.17	255.17	127.58	127.58
11	55.0	2551.68	2551.50	1275.84	1275.75	765.50	765.45	255.17	255.15	127.58	127.57
12	60.0	2551.50	2551.42	1275.75	1275.71	765.45	765.43	255.15	255.14	127.57	127.57
13	65.0	2551.42	2551.50	1275.71	1275.75	765.43	765.45	255.14	255.15	127.57	127.57
Mean Terrain Slope [%][2]		1.79		0.89		0.54		0.18		0.09	

[1]All scenarios have the same flow rate.

[2]Calculated as: $Mean\ terrain\ slope\ [\%] = \frac{Up\ Ground\ Elevation_{Pipe\ 1} - Dow\ Ground\ Elevation_{Pipe\ 13}}{Total\ length\ of\ the\ path = 2004\ m} \times 100$

Table S8. Fifth simulation scenario for the sensitivity analysis.

		Ground Elevation [m]									
Pipe	**Flow[1] [L/s]**	**Scenario 1 (100%)**		**Scenario 2 (50%)**		**Scenario 3 (30%)**		**Scenario 4 (10%)**		**Scenario 5 (5%)**	
		Up	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**	**Up**	**Down**
1	10.0	2587.34	2575.50	1293.67	1287.75	776.20	772.65	258.73	257.55	129.37	128.77
2	20.0	2575.50	2569.69	1287.75	1284.85	772.65	770.91	257.55	256.97	128.78	128.48
3	30.0	2569.69	2564.91	1284.85	1282.45	770.91	769.47	256.97	256.49	128.49	128.24
4	40.0	2564.91	2561.06	1282.45	1280.53	769.47	768.32	256.49	256.11	128.24	128.05
5	50.0	2561.06	2558.33	1280.53	1279.16	768.32	767.50	256.11	255.83	128.05	127.91
6	60.0	2558.33	2557.98	1279.16	1278.99	767.50	767.39	255.83	255.80	127.91	127.89
7	70.0	2557.98	2555.82	1278.99	1277.91	767.39	766.75	255.80	255.58	127.89	127.79
8	80.0	2555.82	2555.07	1277.91	1277.55	766.75	766.52	255.58	255.51	127.79	127.75
9	90.0	2555.07	2551.68	1277.55	1275.84	766.52	765.50	255.51	255.16	127.75	127.58
10	100.0	2551.68	2551.68	1275.84	1275.84	765.50	765.50	255.17	255.17	127.58	127.58
11	110.0	2551.68	2551.50	1275.84	1275.75	765.50	765.45	255.17	255.15	127.58	127.57
12	120.0	2551.50	2551.42	1275.75	1275.71	765.45	765.43	255.15	255.14	127.57	127.57
13	130.0	2551.42	2551.50	1275.71	1275.75	765.43	765.45	255.14	255.15	127.57	127.57
Mean Terrain Slope [%][2]		1.79		0.89		0.54		0.18		0.09	

[1]All scenarios have the same flow rate.

[2]Calculated as: $Mean\ terrain\ slope\ [\%] = \frac{Up\ Ground\ Elevation_{Pipe\ 1} - Dow\ Ground\ Elevation_{Pipe\ 13}}{Total\ length\ of\ the\ path = 2004\ m} \times 100$