Special Research Study

Comparison of Water Pipe Installation Lengths and Costs in Wisconsin: Madison, Milwaukee, Kenosha, and Waukesha

Client: American Chemistry Council

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EXECUTIVE SUMMARY

The American Chemistry Council (ACC) retained BCC Research to investigate and compare municipal water supply pipe (i.e., pressure main) costs in four communities in Wisconsin. Target communities included the cities of Madison and Milwaukee, that use a closed competition bid process for pipe and pipeline projects, as well as Kenosha and Waukesha, that permit open competition for pipeline projects and pipe procurement.[1] BCC Research collected pipe installation, pipe cost, and pipe material data in each of these communities to compare cost and cost differential among the communities.

BCC Research collected publicly available data from bid documentation, city data, council meeting minutes, contracts, and other data sources. Primary data collection methods, including phone and/or email interviews, were used as needed to fill gaps or to verify and benchmark available data.

Key project findings indicate that communities with open competition enjoy lower pipe cost, on average, for water main installation or replacement projects, reaching average savings of 19% for 6-inch pipe, 29% for 12-inch pipe, 22% for 16-inch pipe, 29% for 20-inch pipe, and 19% for 24-inch pipe, in comparison to municipalities employing closed competition practices. Cities with closed competition achieved cost parity, on average, with open competition cities for 8-inch pipe. Based on these data, for a hypothetical one-mile installation of 12-inch water main pipe, a municipality using a closed competition pipe material selection process would pay approximately $262,658 (for pipe only; does not consider installation costs). In contrast, a municipality using an open competition pipe material selection process would pay approximately $187,573, for a **cost savings of $75,085 per mile of 12-inch water main purchased**. Figure ES-1 summarizes the closed and open competition pipe cost results shown in Table ES-1.

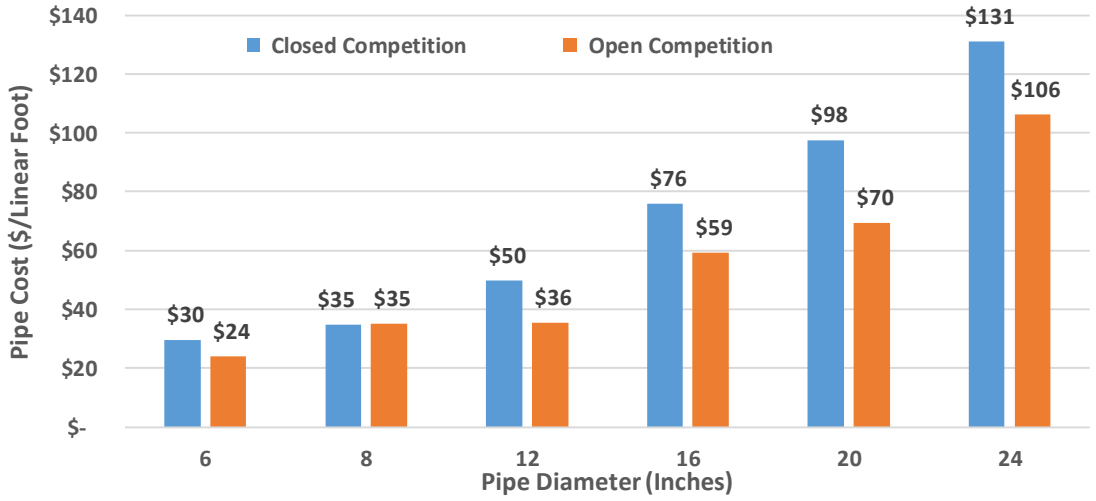

Figure ES-1: Average Pipe Capital Cost ($/Foot) by Pipe Diameter for Closed (Madison, Milwaukee) and Open Competition (Kenosha, Waukesha), 2015 to 2018

[1] Closed competition indicates that a city has standard specifications that limit the material options prior to bidding; Open competition indicates that some competition between materials is allowed based on project performance requirements.

Table ES-1: Average Pipe Capital Cost ($/Foot) by Pipe Diameter (6-inch to 24-inch), for Closed Competition (Madison, Milwaukee) and Open Competition (Kenosha, Waukesha) Municipalities, 2015 to 2018

Pipe diameter (inches)	Closed Competition	Open Competition	Percent Savings from Open Competition
6	$29.6	$23.9	19.1%
8	$34.8	$35.2	-1.1%*
12	$49.7	$35.5	28.6%
16	$75.9	$59.1	22.0%
20	$97.6	$69.5	28.7%
24	$131.0	$106.2	18.9%

*Open competition costs were 1.1% higher for 8” pipe, on average. Source: BCC Research.

INTRODUCTION

PURPOSE

The primary objective of this study was to develop a comparison of municipal water (pressurized) pipe installation and costs in four communities in Wisconsin, for open competition and closed competition bid processes. The analysis included detailed data collection and analysis for the following closed competition cities—Madison and Milwaukee—and the following open competition cities—Kenosha and Waukesha. Data were gathered to highlight differences between open and closed competition bidding options for the following:

- How much pipe is installed each year
- Pipe sizing
- Pipe material, where data were available
- Compare cost and cost differential in the selected communities that follow different options for bidding

METHODOLOGY

Information collected in support of this study was collected through a combination of primary and secondary research methods. For these cities, secondary research methods, include city data, bid documentation, council meeting minutes, contracts, planning documents, water master plans, capital improvement plans, and other available data proved effective as reliable data sources. Primary data sources (phone and/or email-based interviews with City staff) were used as needed to fill gaps or verify/benchmark pipe data.

Public data were collected that included pipe lengths, materials, diameter and published costs. However, some data sources also included extraneous information and costs, beyond simple pipe cost. For example, some pipeline projects are bid out as a cost for construction and completion of the entire project, including pipe as well as appurtenances (vaults, manholes, etc.) and sometimes roadwork and earthwork (pavement, fill, sidewalks, etc.), without breaking out pipe costs explicitly. Data collected for these cities were of high quality. Nonetheless, in some instances, pipe costs were not available. In these cases, average cost per foot was estimated based on average cost for the same diameter pipe in that city during the same year.

Pipe cost, length, and diameter data were available for at least 80% of the data points used and summarized for this study. No complete or otherwise usable data were excluded. In total, 804 individual pipe installations were considered, from 2015 through 2018, in support of the project.

CITY OF MADISON (CLOSED COMPETITION) PIPE INSTALLATION AND COST DATA

The City of Madison operates the Madison Water Utility, which is responsible for water system operation as well as water main installation and upkeep in Madison, Wisconsin. Madison follows a closed competition process for bids on water pipeline projects, and specifies the use of ductile iron (DI) pipe for all pressurized water transmission and distribution applications relevant to this study. For new subdivisions, City policy dictates that the City provides water service but the developer is responsible for installation of all pipe infrastructure. The City also releases bids directly to complete upgrade and repair projects. The focus of this study is on City projects, not on those initiated by a private developer. Data were collected for 2015 through 2018, and a total of 175 pipe cost data points were included in the analysis from that time period.

Based on data collected in support of this study, the City purchased over 156,000 feet of pipe during 2015 through 2018, at a total purchase price of nearly $5.4 million. The City purchased pipe fabricated from DI, plus small amounts of pipe fabricated from steel (used primarily for casing) and other metals. However, this study tracks cost for DI and plastic pipe only. Bid-level data indicated that no plastic pipe was installed during 2015 to 2018; therefore 100% of installed pipe tracked by the study was composed of DI. LWC operates more than 4,200 miles of water pipe within its service area.

Data for City pipe procurement costs were collected primarily based on filed bid responses and awarded contracts for pipe purchase and installation by the City. These bid responses were publicly available through public meeting documentation, contract documentation, bid documentation, and/or through direct information request by BCC Research. Data collected were benchmarked against municipal water system data, including total length of in-ground pipe installed each year. Pipeline diameter, length and cost data were available for the City for all identified projects. During the Study period, the City installed pipe ranging in size from 6 to 20 inches in diameter.

Table 1 summarizes the length and diameter of pipe installed in Madison during 2015 through 2018. Similarly, Table 2 summarizes total pipe costs by diameter and year, while Table 3 summarizes pipeline cost per foot, and Table 4 summarizes pipe *materials* by length of pipe installed. Finally, we summarized average pipe costs for Madison over the study period by diameter. These are shown in Table 5.

Table 1: Madison: Linear Feet of Pipe Installed, 2015-2018

Pipe Diameter (inches)	Pipe Length (feet)			
	2015	**2016**	**2017**	**2018**
6	2,490	1,975	2,755	2,455
8	32,965	12,415	22,833	19,095
12	3,830	21,365	14,270	6,275
16	4,220	1,010	4,255	3,240
20	880	-	75	-
24	-	-	-	-
TOTAL	44,385	36,765	44,188	31,065

Source: BCC Research.

Table 2: Madison: Pipe Cost, 2015-2018

Pipe Diameter (inches)	Pipe Cost ($/Year)			
	2015	**2016**	**2017**	**2018**
6	$75,246	$60,060	$104,480	$86,406
8	$960,568	$391,092	$880,226	$564,400
12	$131,892	$678,498	$579,704	$187,891
16	$204,586	$47,497	$224,231	$133,229
20	$64,064	N/A	$7,276	N/A
24	N/A	N/A	N/A	N/A
TOTAL	$1,436,355	$1,177,147	$1,795,917	$971,926

Source: BCC Research.

Table 3: Madison: Pipe Cost per Foot

Pipe Diameter (inches)	Pipe Cost ($/Foot)			
	2015	**2016**	**2017**	**2018**
6	$30.22	$30.41	$37.92	$35.20
8	$29.14	$31.50	$38.55	$29.56
12	$34.44	$31.76	$40.62	$29.94
16	$48.48	$47.03	$52.70	$41.12
20	$72.80	N/A	$97.01	N/A
24	N/A	N/A	N/A	N/A

Source: BCC Research.

Table 4: Madison: Pipe Materials (Percent of Annual Total)

Pipe Materials	Percent of Total Annual Pipe Length Installed			
	2015	**2016**	**2017**	**2018**
Ductile Iron	100.0%	100.0%	100.0%	100.0%
Plastic	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Source: BCC Research.

Table 5: Madison: Average Pipe Cost, by Pipe Diameter

Pipe Diameter (inches)	Average Pipe Cost ($/ft), 2015-2017
6	$33.44
8	$32.19
12	$34.19
16	$69.08
20	$84.90
24	N/A

Source: BCC Research.

CITY OF MILWAUKEE (CLOSED COMPETITION) PIPE INSTALLATION AND COST DATA

Milwaukee, Wisconsin allows closed competition for water pipeline projects. Based on data collected in support of this study, the City installed only DI pipe for water transmission and distribution during the 2015 to 2018 period: The City operates an active water main replacement program, which was active during the time period covered by this Study. The City is currently investing heavily in the replacement of ageing water mains within its service area, and most expenditures summarized here were for replacement of existing pipe, according to City documentation and staff. The City has set goals of replacing at least 15 miles of water mains in 2015 to 2017, at least 18 miles in 2018 to 2019, and 20 miles in 2020.

Data for the City were collected primarily based on filed bid responses and awarded contracts for City pipeline projects, which were publicly available through City Council meeting documentation, contract documentation, bid documentation, and as data made available to BCC Research. Data collected were benchmarked against city municipal water system data, including total length of in-ground pipe each year. Pipeline diameter, length and cost data were available for Milwaukee for all identified projects. During the Study period, the City primarily installed 8-inch diameter pipe, but also installed pipe having diameters ranging from 6 to 24 inches.

During 2015 through 2018, the City installed nearly 243,000 linear feet of pipe, totaling over $8.8 million in pipe procurement cost. Table 6 summarizes the length and diameter of pipe installed in Milwaukee during 2015, 2016, 2017, and 2018. Similarly, Table 7 summarizes total pipe costs by diameter and year, while Table 8 summarizes pipeline cost per foot, and Table 9 summarizes pipe *materials* by length of pipe installed. Finally, we summarized average pipe costs for Milwaukee over the study period by diameter. These are shown in Table 10.

Table 6: Milwaukee: Linear Feet of Pipe Installed, 2015-2018

	Pipe Length (feet)			
Pipe Diameter (inches)	**2015**	**2016**	**2017**	**2018**
6	-	4,455	2,697	1,239
8	7,619	67,288	63,145	83,233
12	69	2,332	4,452	3,797
16	-	54	1,767	366
20	214	6	6	-
24	-	-	24	4
TOTAL	7,902	74,135	72,091	88,639

Source: BCC Research.

Table 7: Milwaukee: Pipe Cost, 2015-2018

Pipe Diameter (inches)	Pipe Cost ($/Year)			
	2015	2016	2017	2018
6	N/A	$111,215	$69,831	$32,673
8	$353,347	$2,219,203	$2,179,742	$2,969,102
12	$5,864	$125,050	$279,665	$227,001
16	N/A	$5,389	$163,368	$44,241
20	$26,398	$516	$728	N/A
24	N/A	N/A	$3,240	$508
TOTAL	$385,609	$2,461,373	$2,696,574	$3,273,525

Source: BCC Research.

Table 8: Milwaukee: Pipe Cost per Foot

Pipe Diameter (inches)	Pipe Cost ($/Foot)			
	2015	2016	2017	2018
6	N/A	$24.96	$25.89	$26.37
8	$46.38	$32.98	$34.52	$35.67
12	$84.98	$53.62	$62.82	$59.78
16	N/A	$99.81	$92.46	$120.88
20	$123.35	$86.00	$121.32	N/A
24	N/A	N/A	$135.00	$127.00

Source: BCC Research.

Table 9: Milwaukee: Pipe Materials (Percent of Annual Total)

Pipe Materials	Percent of Total Annual Pipe Length Installed			
	2015	2016	2017	2018
Ductile Iron	100.0%	100.0%	100.0%	100.0%
Plastic	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Source: BCC Research.

Table 10: Milwaukee: Average Pipe Cost, by Pipe Diameter

Pipe Diameter (inches)	Average Pipe Cost ($/ft), 2015-2018
6	$25.74
8	$37.39
12	$65.30
16	$104.38
20	$110.22
24	$131.00

Source: BCC Research.

CITY OF KENOSHA (OPEN COMPETITION) PIPE INSTALLATION AND COST DATA

Kenosha, Wisconsin follows an open competition process for water pipeline projects. Pipe material data were available for all pipe installed during the study period. These data indicate that 90% of all pipe installed in 2015, 96% installed in 2016, and 96% installed in 2017 was plastic, with the remainder being ductile iron. Note that very limited pipe installation data were available for 2018, and what was available did not include pipe material information. Therefore, 2018 data were not included.

Data for the City were collected primarily based on filed bid responses and awarded contracts for City pipeline projects, which were publicly available through City Council meeting documentation, contract documentation, bid documentation, and as data made available to BCC Research. Data collected were benchmarked against city municipal water system data, including total length of in-ground pipe each year. Pipeline diameter, length and cost data were available for Kenosha for all identified projects. During the Study period, the City installed pipe having the following diameters: 6-inch, 8-inch, 12-inch, 16-inch, and 24-inch.

In total, the City installed over 74,000 linear feet of pipe during 2015 through 2017, for a total cost of nearly $2.7 million. Table 11 summarizes the length and diameter of pipe installed in Kenosha during 2015, 2016, and 2017. Similarly, Table 12 summarizes total pipe costs by diameter and year, while Table 13 summarizes pipeline cost per foot, and Table 14 summarizes pipe *materials* by length of pipe installed. Finally, we summarized average pipe costs for Kenosha over the study period by diameter. These are shown in Table 15.

Table 11: Kenosha: Linear Feet of Pipe Installed, 2015-2018

Pipe Diameter (inches)	Pipe Length (feet)			
	2015	2016	2017	2018
6	14	-	-	N/A
8	17,315	21,091	3,826	N/A
12	7,335	5,415	111	N/A
16	5,262	5,160	8,144	N/A
20	-	-	-	N/A
24	-	-	521	N/A
TOTAL	29,926	31,666	12,601	N/A

Source: BCC Research.

Table 12: Kenosha: Pipe Cost, 2015-2018

Pipe Diameter (inches)	Pipe Cost ($/Year)			
	2015	2016	2017	2018
6	$302	N/A	N/A	N/A
8	$426,382	$690,877	$192,010	N/A
12	$309,073	$175,201	$1,982	N/A
16	$202,836	$316,217	$349,853	N/A
20	N/A	N/A	N/A	N/A
24	N/A	N/A	$28,046	N/A
TOTAL	$938,594	$1,182,295	$571,890	N/A

Source: BCC Research.

Table 13: Kenosha: Pipe Cost per Foot

Pipe Diameter (inches)	Pipe Cost ($/Foot)			
	2015	2016	2017	2018
6	$21.59	N/A	N/A	N/A
8	$24.63	$32.76	$50.19	N/A
12	$42.14	$32.35	$17.93	N/A
16	$38.55	$61.28	$42.96	N/A
20	N/A	N/A	N/A	N/A
24	N/A	N/A	$53.83	N/A

Source: BCC Research.

Table 14: Kenosha: Pipe Materials (Percent of Annual Total)

Pipe Materials	Percent of Total Annual Pipe Length Installed			
	2015	2016	2017	2018
Ductile Iron	10.0%	4.2%	4.1%	N/A
Plastic	90.0%	95.8%	95.9%	N/A
Total	100.0%	100.0%	100.0%	N/A

Source: BCC Research.

Table 15: Kenosha: Average Pipe Cost, by Pipe Diameter

Pipe Diameter (inches)	Average Pipe Cost ($/ft), 2015-2018
6	$21.59
8	$35.86
12	$30.81
16	$47.60
20	N/A
24	N/A

Source: BCC Research.

CITY OF WAUKESHA (OPEN COMPETITION) PIPE INSTALLATION AND COST DATA

Waukesha, Wisconsin follows an open competition process for water pipeline projects. Pipe material and project cost data were available for all identified projects during 2015 through 2018. For certain projects, pipe cost data were not available. Pipe costs for these select datapoints were therefore estimated by averaging available pipe cost data for the same material, size and year. These estimates were then benchmarked against total project cost data and the materials and activities included in the project, based on bid documents (i.e., to separate out costs for fittings). The City relies on a combination of PVC and DI pipe, with limited high density polyethylene (HDPE) applications. The percentage of DI versus plastic pipe installed varied from year to year, ranging from 39% DI and 61% plastic in 2015 to 69% DI and 31% plastic in 2016.

Data for the City were collected based on filed bid responses and awarded contracts for City pipeline projects, which were publicly available through City Council meeting documentation, contract documentation, bid documentation, and as data made available to BCC Research. Data collected were benchmarked against city municipal water system data including total system length and typical replacement rates. During the Study period, the City installed pipe of various sizes; however, 8-inch and 12-inch pipe were the most commonly installed diameters.

In total, the City installed over 88,000 linear feet of pipe during 2015 through 2018, for a total cost of nearly $4.9 million. Table 16 summarizes the length and diameter of pipe installed in Waukesha during 2015, 2016, 2017, and 2018. Similarly, Table 17 summarizes total pipe costs by diameter and year, while Table 18 summarizes pipeline cost per foot, and Table 19 summarizes pipe *materials* by length of pipe installed. Finally, we summarized average pipe costs for Waukesha over the study period by diameter. These are shown in Table 20.

Table 16: Waukesha: Linear Feet of Pipe Installed, 2015-2018

Pipe Diameter (inches)	Pipe Length (feet)			
	2015	2016	2017	2018
6	37	250	32	-
8	6,283	9,015	7,748	2,902
12	8,062	20,957	5,060	2,344
16	3,014	1,489	116	1,662
20	-	267	254	1,060
24	5,895	8,534	3,730	-
TOTAL	23,289	40,511	16,940	7,968

Source: BCC Research.

Table 17: Waukesha: Pipe Cost, 2015-2018

Pipe Diameter (inches)	Pipe Cost ($/Year)			
	2015	2016	2017	2018
6	$925	$7,120	$789	N/A
8	$210,242	$336,331	$267,545	$94,373
12	$303,702	$977,113	$199,821	$87,151
16	$228,393	$107,031	$7,562	$116,154
20	N/A	$19,568	$19,756	$60,971
24	$616,046	$805,562	$446,449	N/A
TOTAL	$1,359,308	$2,252,726	$941,922	$358,650

Source: BCC Research.

Table 18: Waukesha: Pipe Cost per Foot

Pipe Diameter (inches)	Pipe Cost ($/Foot)			
	2015	2016	2017	2018
6	$25.34	$28.54	$25.06	N/A
8	$33.46	$37.31	$34.53	$32.52
12	$37.67	$46.62	$39.49	$37.18
16	$75.79	$71.88	$65.19	$69.89
20	N/A	$73.29	$77.78	$57.52
24	$104.51	$94.40	$119.68	N/A

Source: BCC Research.

Table 19: Waukesha: Pipe Materials (Percent of Annual Total)

Pipe Materials	Percent of Total Annual Pipe Length Installed			
	2015	2016	2017	2018
Ductile Iron	38.6%	69.1%	39.8%	46.7%
Plastic	61.4%	30.9%	60.2%	53.3%
Total	100.0%	100.0%	100.0%	100.0%

Source: BCC Research.

Table 20: Waukesha: Average Pipe Cost, by Pipe Diameter

Pipe Diameter (inches)	Average Pipe Cost ($/ft), 2015-2018
6	$26.31
8	$34.46
12	$40.24
16	$70.69
20	$69.53
24	$106.20

Source: BCC Research.

SUMMARY FINDINGS AND CONCLUSIONS

Key findings of this project indicate that municipalities employing open competition practices for the selection of municipal water pipe (force main) materials drive lower pipe cost, on average, for the majority of water main projects. As shown in Table 21, open competition resulted in a pipe cost savings for 6-inch, 12-inch, 16-inch, 20-inch, and 24-inch pipe diameters, with average savings of 19% for 6-inch 29% for 12-inch pipe, 22% for 16-inch pipe, 29% for 20-inch pipe, and 19% for 24-inch diameter pipe. Pipe costs for 8-inch diameter pipe were near parity for closed and open competition, with closed competition showing a 1% savings over open. 8-inch pipe costs for closed competition cities were pulled downward, on average, thanks to large purchases of 8-inch DI pipe. Milwaukee purchased more over 16 miles of 8-inch DI pipe during the study period—more than all other pipe diameters combined, which may have contributed to lower cost due to large bulk purchases. Nonetheless, all other pipe diameters showed a strong cost-benefit to open competition: based on these data, for a hypothetical one-mile installation of 12-inch municipal water force main pipe, a municipality utilizing a closed competition bid selection process would pay approximately $262,658 in pipe capital costs. In contrast, a municipality utilizing an open competition bid selection process would pay only $187,573, for a cost savings of $75,084 per mile of 12-inch water pipe purchased. Figure 1 visually summarizes the closed and open competition pipe cost results shown in Table 21.

Table 21: Average Pipe Capital Cost ($/Foot) by Pipe Diameter (6-inch to 24-inch), for Closed Competition (Madison and Milwaukee) and Open Competition (Kenosha and Waukesha) Municipalities, 2015 to 2018

Pipe diameter (inches)	Closed Competition	Open Competition	Percent Savings from Open Competition
6	$29.6	$23.9	19.1%
8	$34.8	$35.2	-1.1%
12	$49.7	$35.5	28.6%
16	$75.9	$59.1	22.0%
20	$97.6	$69.5	28.7%
24	$131.0	$106.2	18.9%

Source: BCC Research.

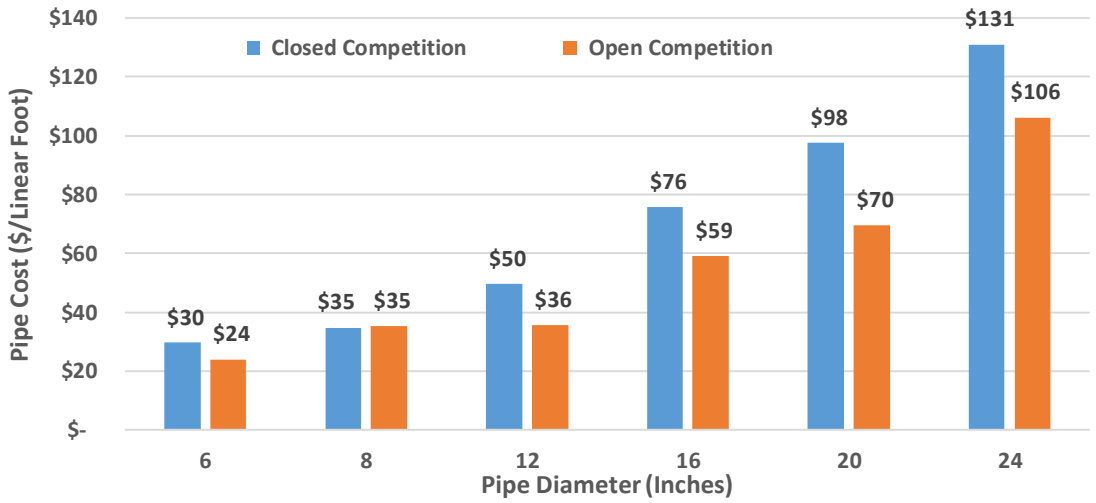

Figure 1: Average Pipe Capital Cost ($/Foot) by Pipe Diameter for Closed (Madison and Milwaukee) and Open Competition (Kenosha and Waukesha), 2015 to 2018