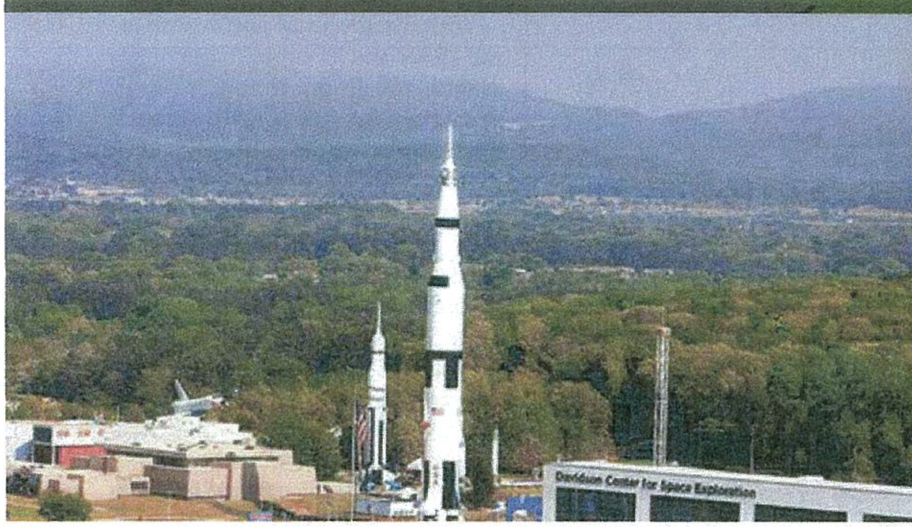


MAURY D. GASTON, CARSON SMITH, AND JAMES C. HOGELAND

Pipe inside diameter key to energy efficiency

DUCTILE IRON'S LARGER-THAN-NOMINAL INSIDE DIAMETER MAY YIELD GREATER ENERGY AND FINANCIAL SAVINGS THAN OTHER MATERIALS.

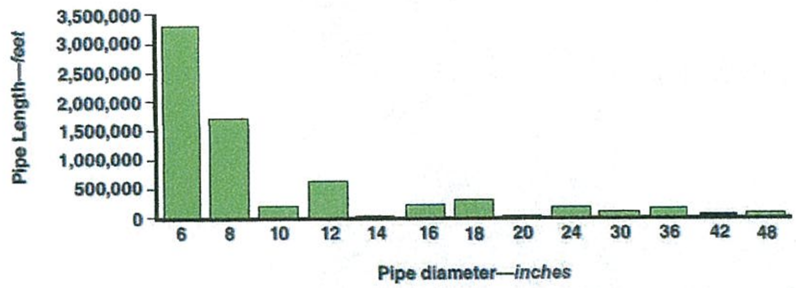
Huntsville, Alabama, came to national attention during the space race. The nearby Redstone Arsenal and George C. Marshall Space Flight Center were the home of missile development for the United States. Wernher von Braun, the genius behind the German V-2 rocket program, had relocated to Huntsville after World War II and led the development of rockets with the payloads necessary to lift a spacecraft and lunar module to orbit and beyond. The multistage Saturn V rocket used in the National Aeronautics and Space Administration's Apollo program that culminated in landing US astronauts on the moon and returning them safely to Earth was their crowning achievement.

This activity created a hotbed of technology, science, and engineering, which attracted thousands of progressive and intelligent men and women to Huntsville. Their legacy lives on today, with the Huntsville area being home to more than a half million residents and numerous cutting-edge industries specializing in technology, science, and engineering. The Huntsville Space and Rocket Center (see the photograph on this page) chronicles America's space exploration and is a permanent exhibit to showcase the hardware of the space program.

HUNTSVILLE HOME TO THE STATE'S FIRST PUBLIC WATER SYSTEM

Huntsville Utilities provides electricity, water, and natural gas to the area. Its roots date to 1823 when the first public water system in Alabama was built by John Hunt, the city's founder. That primitive system drew water from a

FIGURE 1 Nominal diameters and associated footages of pipe in the Huntsville, Ala., water system



spring simply known as Big Spring and used a wooden storage tank and hollowed cedar logs to deliver water to the city. In 1858 Huntsville purchased the water system, and in 1954 a board of directors was established to operate the utility. The primary water source today is the nearby Tennessee River. Each year 13 billion gallons of clean water are furnished to more than 89,000 metered residential and commercial customers. Huntsville Utilities also provides 6 billion cubic feet of natural gas and 4 billion kilowatt-hours of electricity annually (Huntsville Utilities, 2014).

In the past 33 years, Huntsville water treatment plants have received the "Best Operated Surface Water Treatment Plant" award 14 times and the "Best Operated Ground Water System in Alabama" on nine occasions from the Alabama Water Pollution Control Association. In 1992 and 2006, the US Environmental Protection Agency (USEPA) awarded Huntsville with its Safe Drinking Water Excellence award for Region IV (Huntsville Utilities, 2014).

Huntsville's water system is extensive, totaling 1,297 miles of pipe ranging from 6- through 48-inch diameters. Figure 1 and Table 1 show footages for each nominal diameter. Because of the significantly larger quantities of 6- and 8-inch pipe, the quantities of some larger-diameter pipes are not immediately noticeable on the bar graph (Figure 1). Specific footages for all pipe diameters are reported in Table 1.

Iron pipe is the predominant material used in the Huntsville distribution system, and it has provided dependable service through a variety of geographic conditions for more than 100 years. Nevertheless, alternate materials have been used from time to time, depending on soil conditions, flow, pH, and so on. Table 2 and Figures 2–3 show the footages for each type of pipe material in Huntsville's system.

SAME SIZE PIPE MAY HAVE DIFFERENT INSIDE DIAMETERS

The characteristics of various pipe materials differ. For instance, it would seem logical for two 12-inch pipes to have the same inside diameter regardless of their material composition. However, nominally same-sized pipe of different materials have different inside diameters. Here's why: The first national standard for water pipe was developed by AWWA in the early 1900s (AWWA, 1908), and it dealt with gray-iron pipe, commonly known as cast iron. Using a 12-inch diameter as an example, the internal diameter was sized at 12 inches, and wall thicknesses were calculated using the physical and metallurgical properties of gray iron. This resulted in a 13.20-inch outside diameter. The use of iron pipe became so widespread that the outside diameters of iron pipe were adopted as industry standards. Fittings, valves, hydrants, and other pipe joints were designed to mate with iron pipe outside diameters.

With the advent of ductile iron in the 1950s and its stronger and more robust metallurgical and physical properties, the wall could be reduced and the pipe would perform as well or better than gray iron. For the reasons described, the outside diameter was held constant, and the wall thickness was taken from the inside, resulting in an inside diameter that exceeded the nominal diameter. Later, other materials such as asbestos–cement and polyvinyl chloride (PVC) came to market. Those pipe materials' outside diameters were sized to match the existing industry standard established by cast iron. The physical strength of materials such as asbestos–cement and PVC are less than that of gray iron, so the

TABLE 1 As-built nominal diameters and associated footages of pipe in the Huntsville, Ala., water system

Diameter	Footage
6	3,328,505
8	1,709,729
10	211,670
12	624,651
14	6,630
16	198,252
18	303,027
20	5,243
24	172,130
30	70,757
36	154,703
42	1,011
48	64,299
54	NA
60	NA
64	NA

NA—not applicable

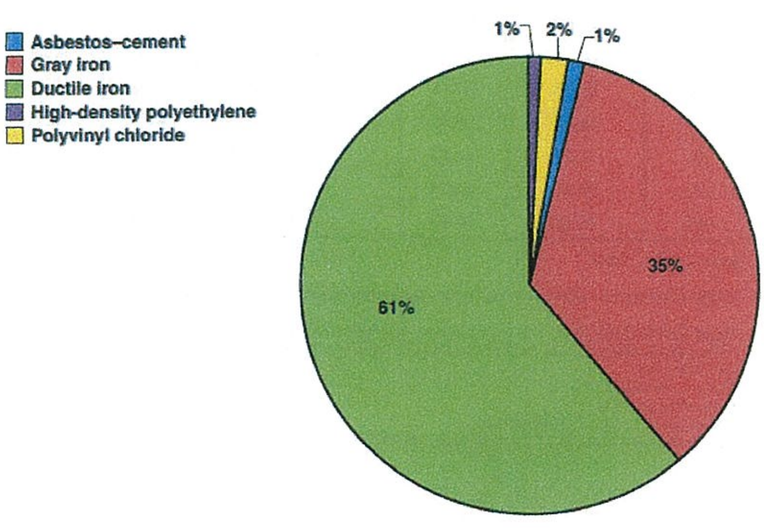
TABLE 2 As-built pipe material and associated footages in the Huntsville, Ala., water system

Pipe Material	Length of Pipe *feet*
Asbestos–cement	25,262
Gray iron	2,444,030
Ductile iron	4,217,625
HDPE	6,593
PVC	157,097

HDPE—high-density polyethylene, PVC-polyvinyl chloride

corresponding wall thicknesses were greater than gray iron. This yielded an inside diameter that is less than the nominal pipe size. Because it all started with an inside diameter equal to nominal and gray iron as a material, any material with physical and metallurgical properties less than gray iron will have a less-than-nominal inside diameter. Conversely, any material with physical and metallurgical properties exceeding gray iron (such as ductile iron) will have a greater-than-nominal inside diameter. Simply stated, because all standard pipe has the same outside diameter, stronger pipe materials allow for larger inside diameters. In the case of the 12-inch example, a class 350 cement mortar–lined ductile-iron pipe has an inside diameter of 12.52 inches, and a DR18 PVC pipe has an inside diameter of 11.65 inches. In the case of prestressed concrete cylinder pipe (PCCP), governed by AWWA Standard C301, the inside diameter is typically equal to nominal, and steel joint rings mate with whatever connection is present, often a flange. Steel pipe, governed by AWWA Standard C200 and sometimes used in the largest diameters, also generally carries the nominal diameter as the inside diameter and its bells, spigots, and flanges are sized as necessary. Table 3 compares the inside diameters of various pipe materials. Figure 4 shows the percentage difference in cross-sectional area of ductile-iron pipe compared with PVC pipe for 16-inch and smaller diameters and compared with PCCP or steel for 18-inch and larger diameters, based on the inside diameters noted previously.

FIGURE 2 Pipe material as percentage of system footage in the Huntsville, Ala., water system



WATER–ENERGY NEXUS

The water–energy nexus has been a big topic lately. In its 2012 State of the Industry Report, Black & Veatch notes that "energy accounts for as much as 30% of utility budgets and more than 85% of water utility greenhouse gas emissions" (Black & Veatch, 2012). To further examine this topic, this article models and estimates annual pumping costs for the Huntsville water system using its actual pipe materials and lengths. A second calculation of modeled annual pumping costs is then made using DR18 PVC for all diameters of 16-inch and smaller and PCCP or steel (nominal inside diameter) for all diameters 18 inches and larger. The modeled pumping costs and energy differences and their financial and environmental implications are then compared and contrasted.

Numerous papers, presentations, and studies are conducted related to pump selection and pump efficiencies as a means of reducing the significant energy required to deliver water. They all point to the importance of having pumps operate at their optimum efficiencies. Similarly, previously commonly overlooked consideration of the energy savings available through use of larger-than-nominal-inside-diameter pipe materials yields impressive results related to the electricity needed to pump water through them as compared with pipe materials with smaller inside diameters.

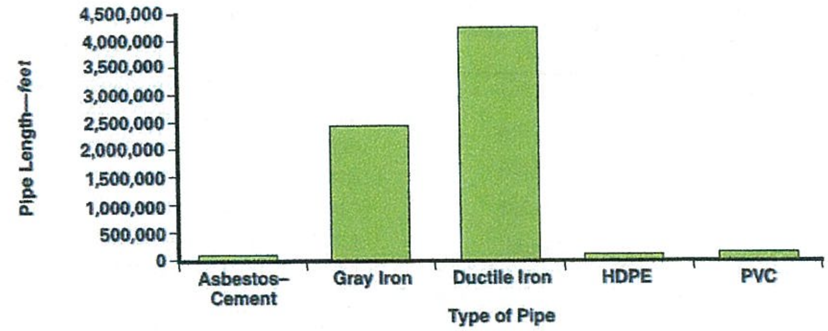
Pumping costs. Factors affecting the cost of pumping include cross-sectional area, coefficient of friction, power cost, and pump efficiency. The preceding paragraphs discussed differences in cross-sectional area. The next factor of interest is the coefficient of friction.

The cement-mortar lining for iron pipe, developed by AMERICAN Cast Iron Pipe in 1922, was first supplied as an in situ process at the Charleston (S.C.) Public Works (Miller, 1965). It was developed in response to tuberculation, a form of internal corrosion in which minerals in the water stick to the exposed bare iron. Engineers at AMERICAN discovered that tuberculation would not occur in iron pipe if it was lined with a cement–mortar surface. It was so successful so quickly that it soon became the norm for iron pipe, and a standard was developed. In 1929, the American Standards Association issued a tentative standard for cement–mortar linings. That standard is known today as ANSI/AWWA C104/A21.4, Cement–Mortar Lining for Ductile-Iron Pipe and Fittings (AWWA, 2013). The C Factor, or Hazen-Williams coefficient of friction, associated with cement–mortar linings is 140, a value resulting from field measurements of flow in operating systems of varying ages. The long-term consistency of 140 has been challenged from time to time, but in situ flow tests have repeatedly confirmed this value (AWWA, 2013). A number of studies confirming this have been published through the years in JOURNAL AWWA and other industry publications. Table 4 shows in-service flow tests of several new and older cement mortar–lined iron pipelines.

The Hazen-Williams coefficient for PVC pipe is generally accepted to be 150 and is also generally accepted to remain constant. The higher the C factor, the less friction between the fluid and the surface. To be clear, these energy comparisons credit a more efficient C factor value for PVC pipe than for iron pipe. Pumping cost calculations show, however, that the larger inside diameter of iron pipe more than offsets the higher C factor of PVC pipe. The C factor for mortar-lined PCCP is the same for mortar-lined iron pipe—140. The C factor for high-density polyethylene (HDPE) is 155, also a widely agreed upon value. Modeled pump efficiencies, power costs, and other values in the equations will be the same irrespective of the pipe materials.

Pumping costs for a given volume through a pipeline are a function of

FIGURE 3 Pipe material and associated footages in the Huntsville, Ala., water system



HDPE—high-density polyethylene, PVC—polyvinyl chloride

TABLE 3 Actual internal diameters of various distribution and transmission main pipe materials

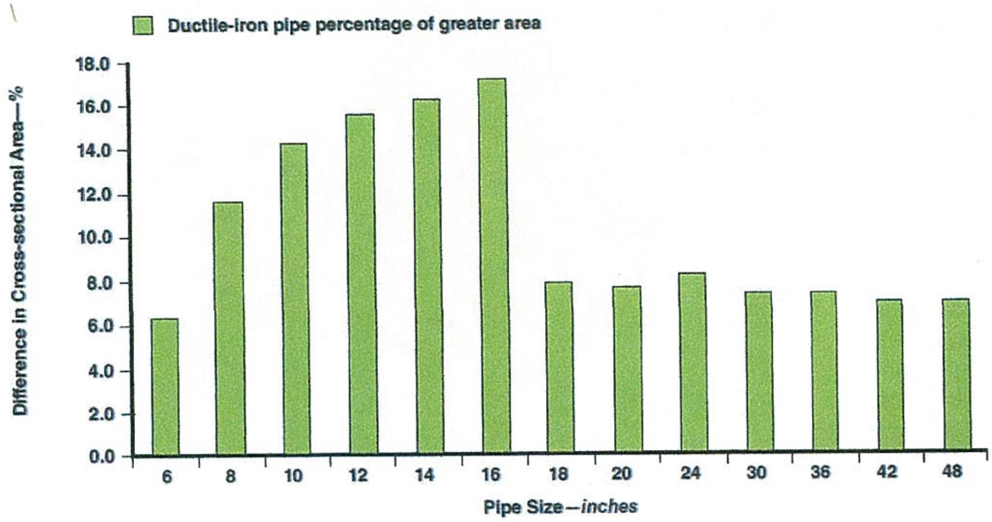
Nominal Size *Inches*	Ductile Iron* *Inches*	PVC† *Inches*	Asbestos–cement‡ *Inches*	PCCP§ *Inches*	Steel** *Inches*	HDPE†† *Inches*
6	6.28	6.09	5.85			5.57
8	8.43	7.98	7.85			7.31
10	10.46	9.79	10.00			8.96
12	12.52	11.65	12.00			10.66
14	14.55	13.50	14.00			12.35
16	16.61	15.35	16.00			14.05
18	18.69	17.20		18.00		15.74
20	20.75	19.06		20.00		17.44
24	24.95	22.76		24.00	24.00	20.83
30	31.07	28.77		30.00	30.00	25.83
36	37.29	34.43		36.00	36.00	32.29
42	43.43	40.73		42.00	42.00	38.41
48	49.63	46.49		48.00	48.00	44.47

Source: DIPRA, 2006

HDPE—high-density polyethylene, PCCP—prestressed concrete cylinder pipe

*From AWWA C150, Table 5; lowest pressure class with C104 cement mortar lining
†Iron outside diameter, AWWA C900 and C905; DR 18 for 6–24 inch; DR 21 for 30–36 inch, and DR 25 for 42–48 inch
‡From AWWA C400-93
§From AWWA C301
**From manufacturers' information
††From AWWA C906; DR 11 for 6–30 inch, DR 13.5 for 36 inch, DR 15.5 for 42 inch, and DR 17 for 48 inch

FIGURE 4 Percentage differences in cross-sectional area between ductile-iron pipe and PVC/PCCP or steel



PCCP—prestressed concrete cylinder pipe, PVC—polyvinyl chloride

power cost, pump efficiency, and head loss as reflected in Eq 1:

$$\text{Pumping Cost} = 1.65\ H_L \times Q \times (a/E) \quad (1)$$

in which H_L = head loss in feet per thousand feet of pipeline; Q = flow rate in gallons per minute, a constant reflective of demand; a = power cost in dollars per kilowatt-hour; and E = efficiency of pump system as a fraction of 1.

H_L is determined by

$$H_L = 1{,}000\left[\frac{V}{0.115C(d)^{0.63}}\right]^{1.852} \quad (2)$$

in which V = velocity in feet per second, C = flow coefficient (C factor), and d = actual internal diameter in inches.

Velocity can be used to determine flow rate, as shown by Eq 3:

$$Q = V \times 2.448 \times d^2 \quad (3)$$

Power costs vary across the United States. Many factors influence power costs, including regulatory requirements, the cost of fuel to generate the power, supply and demand, natural disasters, and so on. Power costs in Huntsville are \$0.09381/kW·h. Figure 5 shows commercial electric power costs by state as reported by the US Energy Information Administration (2014).

Pump efficiencies vary depending on manufacturer, condition, age, and other factors. A reasonable pump efficiency is 70%, and because the same efficiency is used across the board, it's a uniform variable, just as with power cost.

A reasonable modeling velocity is 4 fps. In a 6-inch ductile-iron line, that's 386 gpm. In a 42-inch transmission line that will feed many smaller distribution lines, that's 18,469 gpm. The variety of diameters in the Huntsville system and the production of 13 billion gallons per year are consistent with the 4-fps velocity.

Using the local Huntsville power cost of \$0.09381/kW·h, pump efficiency of 70%, and velocity of 4 fps, and applying Eqs 1–3 to the as-built transmission and distribution network of the Huntsville water system (Table 5), the annual pumping cost for the system is calculated to be \$7,529,528. Actual costs may vary given actual condi-

TABLE 4 Flow tests of in-service cement mortar–lined iron pipe

Location	Diameter *nominal inches*	Length *feet*	Age *years*	Hazen-Williams C Factor
Corder, Mo.	8	21,400	1	145
Bowling Green, Ohio	20	45,600	1	143
Chicago, Ill.	36	7,200	12	151
Safford, Ariz.	10	23,200	16	144
Tempe, Ariz.	6	1,235	24	144
Seattle, Wash.	8	2,686	29	139
Concord, N.H.	12	500	36	140

Source: DIPRA, 2006

tions, but proportional savings will be reflective nonetheless.

Energy values. Dividing by the power cost of $0.09381 yields a total annual kilowatt-hour value of 80,263,597. The USEPA website has a conversion feature that translates annual kilowatt-hours into equivalent tons of carbon dioxide emissions resulting from the generation of that energy. The calculated theoretical 80,263,597 kW·h used to pump Huntsville's water would result in the emission of 62.424 tons of carbon dioxide (USEPA, 2014).

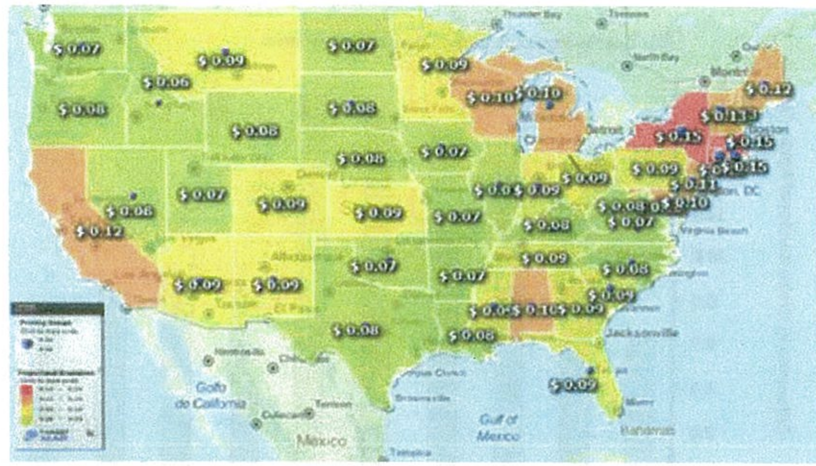
Table 6 shows the energy required to deliver the same volume of water through a modeled system constructed of PVC pipe (16-inch and smaller) and nominal-diameter PCCP or steel (18-inch and larger diameters). Differences occur in the modeled flow velocity compared with the baseline of 4 fps in the as-built model. In addition, 6-inch PVC is actually bigger than 6-inch gray cast iron, so an energy savings is realized with 6-inch PVC compared with 6-inch gray cast iron. With 27% of the pipe footage in the Huntsville system being 6-inch gray cast iron (that has an inside diameter smaller than that of PVC), iron pipe as a whole overcomes a substantial pre-existing disadvantage in this analysis.

Using the same power cost of $0.09381/kW·h, the same pump efficiency of 70%, the same flow volume, and applying the same equations to the actual as-built transmission and distribution network of the Huntsville water system as if it were not built of iron, as shown in Table 6, the annual modeled pumping cost for the system would be $8,196,527, a difference of $666,999 per year.

Dividing that difference by the power cost of $0.09381 yields a total annual kilowatt-hour difference of 7,110,105. This is the additional energy that would be required if the system were built of DR18 PVC and PCCP or steel.

Using the USEPA website conversion feature cited earlier shows that the difference in annual kilowatt-hours is equivalent to an additional 5.530 tons of carbon dioxide emissions. So, in Huntsville, pumping through cement mortar–lined iron pipe instead of PVC or nominal-inside-diameter PCCP or steel pipe saves the environment some 5.530 tons of carbon emissions each year.

FIGURE 5 Commercial electric power costs by state



Source: US Energy Information Administration, 2013

Impact of energy differences. The operational differences in cost and power have both environmental and financial impacts. Iron pipe is made of recycled ferrous products, a critical dimension in the sustainability equation. The Institute for Market Transformation to Sustainability has recognized ductile-iron pipe with its independent, third-party Sustainable Gold rating known as SMaRT (IMTS, 2012). This is based on public health and environmental safety, renewable energy and energy reduction, the use of recycled materials, reclamation and sustainability, manufacturing innovation, and a toxin-free environment. Iron pipe is the only pressure pipe to be certified by any independent sustainability organization.

Environmental impacts. According to the USEPA (2014), the 5.530 fewer tons of carbon dioxide annual emissions are equivalent to any of the following:

- 1,045 passenger vehicles on the road
- 562,392 gallons of gasoline
- 66 tanker trucks of gasoline
- 690 homes' electrical energy consumption
- 21.6 railcars of coal
- 11,666 barrels of oil

Financial impacts. According to the Black & Veatch report cited earlier, energy can be 30% of a utility's operating expenses. If that is true for Huntsville, the modeled annual power cost savings of $666,999 represent a 3% savings in total overall operational expenses. A 3% savings in total overall operational expenses is a significant achievement.

The present value of those future annual savings for just 30 years at 3% is $13,073,475; at 4% it is $11,533,769. The present values for 50 years, a reasonable expectation for iron pipe, are $17,161,727 and $14,328,596 at 3% and 4%, respectively. By using iron pipe, Huntsville has undoubtedly saved tens of millions of dollars throughout its history since the availability of smaller-than-nominal-diameter pipe materials such as asbestos–cement, PVC, and HDPE.

TABLE 5 Calculated pumping cost of as-built for Huntsville (Ala.) Utilities water network

Size *inches*	Material	Length *feet*	Pumping Cost Based On As-Built Piping Material (6-Inch Pipe and Larger)							
			Velocity *gpm*	Pipe ID	C Factor	Velocity *fps*	Head Loss *feet*	Pump hours/ day	$/kW·h	Yearly Pumping Cost—*$*
6	Asbestos	25,262	335	5.85	140	4.0	244	24	0.09381	18,078.93
6	Gray iron	1,851,995	357	6.04	140	4.0	17232	24	0.09381	1,361,165.88
6	Ductile iron	1,3273,03	386	6.28	140	4.0	11801	24	0.09381	1,007,724.91
6	HDPE	3,867	304	5.57	155	4.0	33	24	0.09381	2,200.22
6	PVC	120,078	363	6.09	150	4.0	974	24	0.09381	78,203.48
8	Gray iron	294,093	644	8.11	140	4.0	1940	24	0.09381	276,310.41
8	Ductile iron	1,393,135	696	8.43	140	4.0	8785	24	0.09381	1,351,791.77
8	HDPE	2,726	523	7.31	155	4.0	17	24	0.09381	1,945.32
8	PVC	19,775	624	7.98	150	4.0	117	24	0.09381	16,132.05
10	Gray iron	25,862	999	10.1	140	4.0	132	24	0.09381	29,173.12
10	Ductile iron	168,802	1,071	10.46	140	4.0	828	24	0.09381	196,052.41
10	PVC	17,006	939	9.79	150	4.0	79	24	0.09381	16,449.40
12	Gray iron	141,969	1,438	12.12	140	4.0	586	24	0.09381	186,419.47
12	Ductile iron	482,444	1,535	12.52	140	4.0	1918	24	0.09381	650,870.77
14	Gray iron	749	1,961	14.15	140	4.0	3	24	0.09381	1,118.97
14	Ductile iron	5,881	2,073	14.55	140	4.0	20	24	0.09381	8,992.39
16	Gray iron	21,495	2,573	16.21	140	4.0	63	24	0.09381	35,963.10
16	Ductile iron	176,757	2,702	16.61	140	4.0	505	24	0.09381	301,798.75
18	Gray iron	107,463	3,254	18.23	140	4.0	276	24	0.09381	198,279.07
18	Ductile iron	195,564	3,421	18.69	140	4.0	487	24	0.09381	368,404.28
20	Gray iron	404	4,023	20.27	140	4.0	1	24	0.09381	814.30
20	Ductile iron	4,839	4,216	20.75	140	4.0	11	24	0.09381	9,945.53
24	Ductile iron	172,130	6,096	24.95	140	4.0	306	24	0.09381	412,507.32
30	Ductile iron	70,757	9,453	31.07	140	4.0	97	24	0.09381	203,576.60
36	Ductile iron	154,703	13,616	37.29	140	4.0	172	24	0.09381	518,194.02
42	Ductile iron	1,011	18,469	43.43	140	4.0	1	24	0.09381	3,845.06
48	Ductile iron	64,299	24,119	49.63	140	4.0	51	24	0.09381	273,304.14
Totals		6,850,607								7,529,527.80

HDPE—high-density polyethylene, ID—inside diameter, PVC—polyvinyl chloride

*6,850,607 feet = 1,297 miles

TABLE 6 Pumping cost of modeled PVC/PCCP/steel for Huntsville (Ala.) Utilities water network

Size *inches*	Material	Length *feet*	Theoretical Pumping Cost if PVC Used for 6- Through 16-Inch and PCCP Used for 18-Inch and Larger						Difference *$*
			Pipe Material	Pipe ID	C Factor	Velocity *fps*	Head Loss *feet*	Yearly Pumping Cost—*$*	
6	Asbestos	25,262	PVC	6.09	150	3.7	176.5	13,080.68	4,998.25
6	Gray iron	1,851,995	PVC	6.09	150	3.9	14,568.0	1,150,747.71	210,418.17
6	Ductile iron	1,327,303	PVC	6.09	150	4.3	12,061.8	1,030,000.64	(22,275.73)
6	HDPE	3,867	PVC	6.09	150	3.3	22.5	1,513.69	686.52
6	PVC	120,078	PVC	6.09	150	4.0	973.8	78,203.48	0.00
8	Gray iron	294,093	PVC	7.98	150	4.1	1,847.3	263,080.21	13,230.21
8	Ductile iron	1,393,135	PVC	7.98	150	4.5	10,099.5	1,554,040.11	(202,248.34)
8	HDPE	2,726	PVC	7.98	150	3.4	11.7	1,348.53	596.80
8	PVC	19,775	PVC	7.98	150	4.0	117.0	16,132.05	0.00
10	Gray iron	25,862	PVC	9.79	150	4.3	135.3	29,883.72	(710.60)
10	Ductile iron	168,802	PVC	9.79	150	4.6	1,005.4	238,182.45	(42,130.03)
10	PVC	17,006	PVC	9.79	150	4.0	79.3	16,449.40	0.00
12	Gray iron	141,969	PVC	11.65	150	4.3	625.4	198,912.90	(12,493.42)
12	Ductile iron	482,444	PVC	11.65	150	4.6	2,396.8	813,490.48	(162,619.71)
12	PVC	238	PVC	11.65	150	4.0	0.9	266.12	0.00
14	Gray iron	749	PVC	13.5	150	4.4	2.9	1,238.23	(119.26)
14	Ductile iron	5,881	PVC	13.5	150	4.6	24.9	11,397.91	(2,405.52)
16	Gray iron	21,495	PVC	15.35	150	4.5	72.5	41,274.20	(5,311.10)
16	Ductile iron	176,757	PVC	15.35	150	4.7	652.9	390,035.28	(88,236.53)
18	Gray iron	107,463	PCCP	18	140	4.1	293.1	210,928.39	(12,649.32)
18	Ductile iron	195,564	PCCP	18	140	4.3	585.0	442,483.71	(74,079.42)
20	Gray iron	404	PCCP	20	140	4.1	1.0	869.26	(54.96)
20	Ductile iron	4,839	PCCP	20	140	4.3	12.8	11,898.77	(1,953.24)
24	Ductile iron	172,130	PCCP	24	140	4.3	369.7	498,367.03	(85,859.71)
30	Ductile iron	70,757	PCCP	30	140	4.3	115.5	241,468.69	(37,892.09)
36	Ductile iron	154,703	PCCP	36	140	4.3	204.3	615,128.36	(96,934.33)
42	Ductile iron	1,011	PCCP	42	140	4.3	1.1	4,526.13	(681.07)
48	Ductile iron	64,299	PCCP	48	140	4.3	60.3	321,578.51	(48,274.38)
Totals		6,850,607						8,196,526.62	(666,998.82)

HDPE—high-density polyethylene, ID—inside diameter, PCCP—prestressed concrete cylinder pipe, PVC—polyvinyl chloride

Four percent interest could be paid on bonds of $16,674,975 with those annual savings. Using a labor cost of $75,000 per person annually, that's a personnel head count of almost nine individuals. Irrespective of actual costs, which may vary from this model because of pump operations of fewer than 24 hours per day, gravity flow from tanks, or other variables not suitable for a model, it's a 9% savings in the second highest expense of the utility—energy.

CONCLUSION

Huntsville Utilities' decision to use iron pipe has not only resulted in long-term dependability, safe and reliable delivery of drinking water, and a tough product that protects the public water supply, but it has also resulted in significant annual cash savings of as much as $666,999 and energy savings of 7,110,105 kW·h, both of which contribute to the financial health of the utility and to the quality of life for those served in the area.

ABOUT THE AUTHORS

Maury D. Gaston is manager of marketing services for AMERICAN Ductile Iron Pipe, a division of AMERICAN Cast Iron Pipe Company, POB 2727, Birmingham, AL 35202 USA; mgaston@american-usa.com. A 32-year veteran of the water industry and a 30-year member of AWWA, Gaston serves as chair of subcommittee 1 of A21 and as a member of A21. He is also chair of the Auburn University Alumni Engineering Council and director of the State of Alabama Engineering Hall of Fame. Gaston is a mechanical engineering graduate of Auburn University. Carson Smith is engineering services project manager at Huntsville Utilities. James Hogeland is product engineer at AMERICAN Cast Iron Pipe Company in Birmingham.

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