
The Allegheny City Water Works, 1840-1907

by Bruce W. Jordan

Introduction

THE development of urban infrastructure was considered a critical factor in city growth during the nineteenth century. Among the most important elements in this infrastructure was the provision of an ample and potable supply of water to meet the domestic, industrial, sanitary, and fire-fighting needs of urban society. Between 1802 and 1914, the number of water works in American cities increased from one (Philadelphia) to 9,850; and by 1914, 41 percent of urban Americans had filtered piped-in water from water works.¹

This paper focuses on the history of the Allegheny City water supply system from 1840, when the city was chartered, to 1907, when it was annexed by Pittsburgh. During this period, the water supply system was designed, constructed, and improved to keep pace with the city's growth. By the end of the period, the increasing demand for water surpassed the system's design capacity. In order to better illustrate the growth and development of the water supply system, the paper is divided into four sections. The first section describes the early years of Allegheny water supply prior to the construction of the water works. This section also compares the early water supply systems of Allegheny and Pittsburgh. The second section explains the engineering aspects of the Allegheny water supply system — its design, system problems, and improvements. The third section covers the administrative and financial matters concerning the water supply system. The last section looks into the changes the Pittsburgh Department of Public Works made in the Allegheny Water Works in the first few years after the 1907 annexation.

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1 Joel A. Tarr, "Building the Urban Infrastructure in the Nineteenth Century: An Introduction," *Infrastructure and Urban Growth in the Nineteenth Century, Essays in Public Works History* 14 (Public Works Society, 1985): 65, 71, 73.

Early Beginnings 1781-1847

At the end of the Revolutionary War, the Pennsylvania legislature set aside three thousand acres opposite Fort Pitt for veterans who would take land as payment for their war services. The three thousand acres, known as the Reserve Tract, lay on the northern floodplain of the Allegheny and Ohio Rivers and became the site for the city of Allegheny. A 1788 act authorized a surveyor to lay out a town site from part of the Reserve Tract and incorporated the town of Allegheny. Gradually people and industries moved into the new town. In 1828, Allegheny became a borough and in 1840 a third-class city with 10,090 inhabitants.²

Allegheny's water supply came from several sources. One source consisted of small creeks or streams from the hill surrounding the settlement, but they did not provide a steady sufficient flow. Another source was local natural springs and public and private wells. The largest water source, however, was the nearby Allegheny River. People either got the river water themselves or relied on water carriers. The water carriers loaded their wagons with barrels of river water and then drove through the city streets selling water at three cents a tubful and six cents a barrel. Most homeowners kept a water tank, usually in their backyard, which either the water carriers or homeowners filled. Supposedly, between forty and fifty water carriers plied their trade prior to the construction of the water works.³

Across the river, Pittsburgh inhabitants initially obtained their water in the same manner; but, in 1826, they began construction of a water works. Completed in September 1828, the water works consisted of a pumping station at the bottom of Cecil Alley drawing water from the Allegheny River and pumping it through a fifteen-inch pipe 2,439 feet to a distribution reservoir on top of Grant's Hill. The reservoir, which was eleven feet deep and held approximately one million gallons, was above the city and distributed the water by gravity flow.⁴

2 Pittsburgh was not much larger with 21,000 people. Leland D. Baldwin, *Pittsburgh: The Story of a City, 1750-1865* (Pittsburgh, 1937), 241-42; Allegheny Centennial Committee, *Story of Old Allegheny City* (Pittsburgh, 1941), 8-33; A. Warner & Co., *History of Allegheny County, Pa.* 1 (Evansville: Unigraphic Reproduction, 1978), 515-19.

3 The most famous spring, near the corner of Ridge Avenue and Marion Street, was used to brew "Spring Water Ale." Baldwin, 206; *Old Allegheny City*, 36; Charles W. Dahlinger, "Old Allegheny," *Western Pennsylvania Historical Magazine* 1 (1918): 205-06; William M. Rimmel, *The Allegheny Story* (Pittsburgh, 1981), 2.

4 John Duffy, "Smoke, Smog, and Health in Early Pittsburgh," *Western Pennsylvania Historical Magazine* 44 (1962): 102-05.

The successful operation of the Pittsburgh water works caused the citizens of Allegheny to press their government to build a municipal water system. In 1837, the Allegheny borough council appointed a committee to report on possible sites, machinery, and costs for a water works. Although the committee prepared a report, a combination of insufficient borough funds and the protests of the water carriers prevented any immediate action. When Allegheny became a city in 1840, the new city charter stated:

Councils shall have the power to provide for a supply of water by the construction and regulation of wells, pumps, cisterns, reservoirs or water works; to prevent and punish injuries to the works, and waste or pollution of the waters; and for the purposes of establishing water works, or for supplying the same with pure water, the corporation may go beyond its territorial limits, and its jurisdiction to prevent or punish any injury to the water works or pollution to the stream or source of water shall extend beyond its corporate limits.⁵

From this section of the charter came the legal basis for many of Allegheny's water supply decisions. More importantly, it legally established the idea of a water works.

Pittsburgh's water system proved incapable of meeting the needs of the city's rising population. The city expanded into areas that were equal to or higher than the reservoir, and these areas could not be supplied by the gravity method of distribution. With the growth of the downtown area, part of Grant's Hill was cut away, leaving the reservoir dangerously exposed. Sewage was often dumped into the river upstream of the intake pipes, reducing the system's water quality. During the 1840s, Pittsburgh officials built a new system for about \$240,000. The pumping station was moved upstream to Twelfth Street and the reservoir was placed on top of Quarry Hill. By the end of 1850, over twenty-one miles of water pipes had been laid, servicing 6,630 homes, stores, and shops.⁶

While the city of Pittsburgh constructed its second water works, the people of Allegheny again demanded their own system. Important arguments cited the convenience of having water come directly into homes and shops, as well as the city's competition with Pittsburgh. With a good supply of water, Allegheny could attract a larger share of

5 Prepared by John C. McCombs, *The Charter of the City of Allegheny: A Collection of Special Acts of Assembly and Ordinances of the City* (City of Allegheny, 1870), Chap. 3, Sec. 10.

6 Duffy, 102-05; James H. Thompson, "Pittsburgh Finance, 1816-1865," *Western Pennsylvania Historical Magazine* 32 (1950): 44-45; *Old Allegheny City*, 623-24.

inhabitants and businesses. Taverns, breweries, mills, and tanneries all required large amounts of clean water. Industries using steam power needed abundant and clear water for their boilers. The co-existence of jobs and plenty of water would attract people. An adequate supply of water throughout the city would make it possible for firemen to fight fires effectively, thereby reducing fire insurance costs. A water works could provide a lucrative source of revenue to the city. Pittsburgh, for instance, derived 21 percent of its total revenues from water rents.⁷

The Committee on Water prepared another report in 1845. Like the previous report, it suggested possible sites for the water works and potential costs. In June and July 1847, the city government purchased sites for the water works and authorized \$115,000 in bonds to pay for the sites and construction.⁸

System Engineering 1847-1907

The Initial System: The Committee on Water adopted a water supply system very similar to Pittsburgh's. The system was a typical mid-nineteenth-century water works and had no startling innovations. Troy Hill, in the adjoining borough of Duquesne, was considered the best site for a distributing reservoir. On June 3, 1847, the Committee on Water purchased seven acres there from Nicholas Voegtly, Sr., for \$12,000. At the same time, the committee purchased a lot one hundred feet wide on Bank Cove running back to the river for an engine-house. The committee selected the Allegheny River as the water source for reasons of quantity and quality. The river was the only consistent major water source close to the city. In addition, its quality was better than that of the spring and well water which came up through the coal layers underlying the city, containing "bituminous and sulphurous particles."⁹

According to the construction plan, two twenty-four-inch diameter intake pipes were laid on the bottom of the Allegheny River opposite 22nd Street in Pittsburgh (ten blocks upstream of Pittsburgh's intake pipes). Approximately 550 feet in length, 350 feet of the intakes

7 Thompson, 57; Dahlinger, 205-06.

8 Select Council of Allegheny, *Minutes*, Apr. 8, June 10, July 15, 1847; Common Council of Allegheny, *Minutes*, June 3, 10, July 8, 1847.

9 Baldwin, 243; Select Council of Allegheny, *Minutes*, Apr. 8, June 10, July 15, 1847; Duffy, 103; Nelson Blake, *Water for the Cities: A History of the Urban Water Supply Problem in the United States* (Syracuse, 1956), 1-247.

went underground from the engine house to the river bank and then extended two hundred feet into the river. The downstream intake pipe extended approximately one hundred feet farther into the river channel than the upstream pipe did. Each intake pipe supplied a pumping engine in the engine house. Both the steam engines and the pumps were designed by Robert Moore, who was a member of the city council and became the first superintendent of the water works. Water flowed into the system by a combination of suction from the pumps and gravity, since the water intake pipe was lower at the engine house end than at the river end. From the pumping well, the engines pumped the water through a thirty-six-inch diameter pipe 570 feet to the reservoir on top of Troy Hill. The 7,500,000 gallon reservoir was 222 feet above the pumping well. The reservoir formed a rectangle 412.5 feet long, 225 feet wide, and about fifteen feet deep and was split down the middle by a wall. The bottom and sides of the reservoir were paved with brick covered with either concrete or clay puddling. Water was distributed by gravity flow throughout the eleven mile distribution system. The initial distribution system used narrow diameter pipe — four inches on most streets — which became a major problem later on. Until plumbers could attach home service pipes to the system, people obtained their water from the nearest hydrant.¹⁰

Construction began in 1848 and was finished by fall of 1849. On September 15, 1849, the engines began to fill the reservoir. Eight days later water was released into the distribution pipes. Allegheny now had a water supply system.¹¹

System Changes and Problems: Immediately after its completion, new demands for better service and more water appeared. Between 1850 and 1907, Allegheny's population grew almost sevenfold.

¹⁰ Each year the city officials of Allegheny published the *Annual Reports of the Various Officers and Standing Committees of the City of Allegheny for the Fiscal Year* (hereafter cited AR). This paper is based on the following sections of the AR: The Controller's Report (hereafter cited CR), the Report of the Water Committee (hereafter RWC), and the Report of the Superintendent of the Water Works (hereafter RSWW). In order to keep the notes from becoming too cumbersome, specific page references have been eliminated where information has been combined from many years. The elaborate indexing of the *Annual Reports* will make the retrieval of the data relatively simple for interested researchers. AR: 1876, the map at the front of the book and Plate B; *The Pittsburgh Gazette*, Dec. 10, 1849, Jan. 17, Feb. 22, 1850; *Atlas of Pittsburgh, Allegheny, and the Adjoining Boroughs* (Philadelphia, 1872).

¹¹ *The Pittsburgh Gazette*, Sept. 17 and 21, 1849; Select Council of Allegheny, *Minutes*, June 10, 1847.

TABLE 1
Allegheny's Population Growth

1840	10,090
1850	21,262
1860	28,702
1870	53,180
1880	78,682
1890	105,287
1900	129,896
1905	140,000+

Allegheny also became an industrial city. The city's growth forced the settlement of hilly areas behind the floodplain and water officials had to supply increasingly large populations and higher areas. Up to 1907, Allegheny's water officials sought to keep up with demand by expanding and improving the distribution system, increasing pumpage, improving water quality, and trying to plan ways of staying ahead of demand.¹²

After the initial eleven-mile distribution system was laid, another 160 miles of pipe were added over time. The first major addition was a 127,121-foot burst of pipe laying between 1867 and 1872. The rapid expansion of the distribution system in these years was a result of the annexation of the adjoining boroughs of Duquesne and Manchester and the need to provide them with water. Between 1888 and 1903, as Allegheny grew from approximately 80,000 inhabitants in 1880 to 130,000 in 1900, a second great expansion of the distribution system occurred with the installation of over 434,360 feet of pipe.¹³

As the distribution system continued to expand, the combination of numerous water users and small distribution pipes caused some sections of the city to begin to lose water pressure. When a section of the city became densely populated, its inhabitants used so much water that the local water pressure dropped, making it difficult to obtain water. Industrial water users could also create pressure problems in a ward by excess usage. As a result, demands for larger distribution pipes began in city wards with heavy water use. For example, in 1866, people in the city's First and Second Wards, where much of the city's

12 *Old Allegheny City*, 621; Pennsylvania General Assembly, *Legislative Handbook* (Harrisburg, 1900), 303; *ibid.*, 1902, 260.

13 AR: RSWW, 1856-1874, 1876-1907. Each year usually had charts detailing the amount of each diameter pipe laid and where it was laid.

industries were located, suffered the first pressure problems and asked for larger pipes. In 1880 and again in 1886, fire department officials complained that the distribution system's pressure was too weak to fight fires effectively and that the fire plugs were improperly placed.¹⁴

Demands for water service from newly developed and acquired areas of the city conflicted with the demands for improved service from the city's older areas. The superintendent maintained that the city's policy was to extend service to the new areas prior to expanding service to the older areas. The rationale for this policy was the expectation of higher revenues. Newly-supplied areas produced revenues to match expenses, whereas improvements to older areas produced higher expenses without any additional revenues. The superintendent proposed a plan where city funds would annually be set aside for the extension of the distribution system, thereby freeing some of his funds for the improvement of older service areas; but his idea was never accepted. Demand consistently outstripped efforts to upgrade the distribution system.¹⁵

Besides the lack of pressure and inadequately-sized pipes in the distribution system, the Allegheny water supply system suffered from other problems. In the severe winters of the late 1850s, for instance, thousands of feet of pipe froze, burst, and had to be replaced. The pipes were unevenly placed underground and in many cases were too close to the surface. This problem was reduced when the city streets were paved and a legal street grade was set. Another problem of the system during this early period was that the water in the end pipes would stagnate and become smelly and dark red in color from the dirt and rust in the pipes. The correction of this problem finally began in 1880 when twenty dead-end pipes were connected by an outer circuit of connecting pipes.¹⁶

The reservoir was a continuous problem throughout the sixty-seven-year period. Given the city's high water demand and the reservoir's small size, the reservoir was filled and emptied several times a day. The flowing water rapidly wore away the reservoir's lining, causing increased seepage and eventual deterioration of the slopes supporting the reservoir. Water system officials had to repair basin leaks, rebuild basin slopes, and repuddle (and after 1894, re-asphalt) the basin lining

14 AR: RSWW, RWC, 1856-1874, 1876-1907; for the Fire Department, AR 1880, 257-59 and AR 1886, 238.

15 Ibid. The superintendent's statement of policy is found in his 1876 report.

16 Ibid. In 1857 alone, over 4,000 feet of pipe had to be replaced and another 7,000 feet had to be lowered below the frost line.

almost every other year. Improper repairs often compounded the problem by reducing the safety level of the basin's holding capacity; hence, the basin's reduced capacity accelerated the deterioration process. Considering the high cost of basin repairs, it is interesting that, unlike other cities, Allegheny's water officials never built a reservoir by-pass pipe so that the reservoir could properly be repaired without interrupting water service to the city. In 1904, the system had to be shut down twice because of reservoir problems that could not be quickly repaired.¹⁷

The reservoir also created other problems. It had two basic functions — to supply pressure to operate the distribution system and to provide a place for sediment to settle and reduce turbidity. However, since the reservoir was filled and emptied several times each day, the water had little chance to settle. Much of the sediment was deposited in the distribution pipes, reducing their effectiveness. Sediment in the pipes also prevented the city from installing a water meter system.¹⁸

The first call for a meter system came in 1872, and it recurred many times over the years. By 1902, the per capita daily water use was over three hundred gallons and pleas for reduced water consumption from the city government went unheard. Reduced demand might increase repair bills and reduce the cost of system improvements. A water metering system could not be used because the sediment prevented the meter's piston from moving and recording the amount of water consumed.¹⁹

Since these problems prevented the reservoir from being used at full capacity, the pumping engines had to be worked overtime to maintain sufficient levels in the reservoir to meet demand. As a result, the pumps and engines wore out faster than anticipated and needed frequent repairs. Existing engines were reworked to pump larger amounts until either new engines were purchased or a new water

17 By 1893, the reservoir was filled and emptied three times daily. By 1898, it was drained almost five times daily and by 1905, six times daily. AR: RSWW, 1856-1874, 1876-1907, and the Report of the Director of the Department of Public Works (hereafter RDDPW), 1891-1907. Citizens living below the reservoir worried that a reservoir collapse would release its contents into Spring Garden Run, and recreate the terrible rain storm and subsequent flood of July 1874, which killed seventy people. John E. Parker, *Recollections of Seventy Years and Historical Gleanings of Allegheny, Pa.* (Boston, 1886), 96-102. The city of Milwaukee, Wisc., put in a by-pass pipe when their initial reservoir was constructed. Bruce W. Jordan, "Origins of the Milwaukee Water Works," *Milwaukee History* 9 (Spring 1986).

18 AR: RSWW, 1856-1874, 1876-1907.

19 Ibid. In 1902, the superintendent cited an example of sediment affecting water meter piston movement where one city meter recorded less than 25 cents in water consumption for a three-month period.

works could be planned and built. The water committee, who oversaw the operations of the water works, stated in their 1872 report that both the new engine and the reworked older engines were "viewed as temporary relief" until a new water works was built. Once engine repairs became too costly, city officials purchased larger pumping engines. For example, from 1879 to 1881, they spent over \$25,000 repairing the existing pumping engines. In 1883, two larger (six million gallon per day) pumping engines were purchased.²⁰

Several lesser problems troubled the water supply system. Besides water, the river intake pipes drew in river mud and small debris. The pumping wells had to be periodically cleaned out by hand before the mud and debris affected the pumps. Ice chunks also blocked the intakes and had to be cleared away. Another problem occurred during low river flows. The pumps had to be slowed down before they sucked air into the system. Trapped air bubbles in the pipes could cause the pipes to burst. During the late 1870s and early 1880s, the distribution system suffered from a series of bursting pipes. Forty-four pipes burst in 1879 and 1880. Thirty-two pipes burst in 1882 alone. This was due to old pipes with low tensile strength, obstructions, and corrosion. Although better pipe was later used for the distribution system, there was an average of sixty-five water main leaks, 562 service pipe leaks, and 348 hydrant leaks annually until 1907.²¹

Planning for a New Water Works: When the water committee built the water works at the end of the 1840s, they forecasted the need for a new water works in approximately twenty years. Their forecast was based upon the interval of construction between the two Pittsburgh water works and a projection of Allegheny City's growth. Allegheny had grown rapidly since its incorporation in 1840 (see Table 1). By 1865, when the city's population had almost doubled since the water works was completed, a movement began urging the building of a larger system. The state legislature authorized an enlargement, but, during the next year's session, rescinded the authorization. During the same year, the water committee in Allegheny resisted expansion of the distribution system outside the city limits because of a perceived difficulty in collecting water rents. The inescapable fact remained — the forecasts were faulty and Allegheny needed more water.²²

From 1865 until construction actually began in 1894, many ideas

²⁰ Ibid.

²¹ Ibid. Private companies took advantage of pipe obstructions in 1887 and 1907 by obtaining city contracts to clean out the pipes.

²² AR: RWC, 1856-1866.

and plans for a new water works were considered. Complete plans were drawn up in 1870, 1876, and 1886. These plans addressed the questions of improved water quality, increased pumping capacity, and a larger reservoir. The city continued to make modifications to the existing system — primarily adding pumps and tanks to supply the areas above the reservoir — throughout the years from 1865 to 1907. In both the new plans and modifications, the best available technology was used, but it was borrowed from other systems.²³

Several ideas dominated these plans. By the 1870s, the combination of upstream cities dumping their sewage into the river and the local expansion of Pittsburgh and Allegheny upstream of Allegheny's intakes made the water too polluted for safe continued use. By the 1870s, Pittsburgh had the nation's highest typhoid fever mortality rate — a disease transmitted by sewage-polluted water. Because it was using the same water source, Allegheny's typhoid death rate was as bad! When the water works were initially constructed, popular theory held that running water purified itself. City officials thought that by moving the intakes above local expansion they could avoid local pollution and that normal stream flow would clean the upstream pollution. Therefore, new intakes and a new pumping station dominated all plans. Since the reservoir was the most expensive part of the new plans, it was considered optional. Although it would allow time for the turbidity to settle and provide an emergency supply, the costs outweighed the advantages. Instead of an expensive reservoir, city officials chose to build a series of less expensive tanks in the high areas of the city. The problem with these tanks was that they did not provide much of a reserve; they were emptied as fast as they were filled. Another option was to reduce demand through either the use of a metering system or adjustment of water rates. For previously mentioned reasons, the metering system was rejected, and the city government did not dramatically increase water prices as a means to pay for the increased water usage.²⁴

23 For the 1870 plan, Engineers' Society of Western Pennsylvania, "The Water Supply of Allegheny," *Proceedings* 3 (Pittsburgh, 1887), 97-99. For the 1876 plan, AR: Report of the City Engineer, 1876-1880. For the 1886 plan, AR: 1886, 327-35.

24 The average annual typhoid death rate per 10,000 citizens in Pittsburgh was 10.44 in the 1870s; 10.56 in the 1880s; in Allegheny it was 6.99 in the 1870s; 10.33 in the 1880s. For filtration and typhoid mortality rates, Mark J. Tierno, "The Search for Pure Water in Pittsburgh: The Urban Response to Water Pollution, 1893-1914," *Western Pennsylvania Historical Magazine* 60 (Jan. 1977): 23-36; Engineers' Society of Western Pennsylvania, "Interpretations of Analysis of Allegheny River Water as Supplied to Pittsburgh," *Proceedings* 9 (1893), 180-83; Blake, 248-64.

In all three plans, water quality would be improved by placing the intake pipes ten miles upstream at Huling's Eddy. Turbidity would be reduced because the river was deep and fast flowing at the eddy. The lack of either residential or industrial development near the eddy also would reduce water pollution at the intakes. The pumphouse would be built on the river bank next to the eddy. Its capacity was increased with each plan, reaching thirty million gallons per day in the 1886 plan. The 100,000,000-gallon reservoir was to be placed on the hills above the eddy, 260 to 280 feet above the pumphouse. From the new reservoir, the water would flow downhill to the existing reservoir and then to the rest of the city. In the areas of the city above the old reservoir, separate pumping stations would pull the water up to the higher areas.²⁵

The 1870 plan was never implemented. The rapid expansion of the city's population and industries forced revenues to be used to increase the size of the distribution system and the diameter of its pipes. Future revenues were mortgaged through the sale of bonds to finance the distribution system improvements, the new pumping engine, and reservoir repairs. The city government could not use other revenues for the plan, since those revenues were being used to build other components of the city's infrastructure, such as the sewer system and gas light system. The only portion of the plan used was the construction of a separate pumping station for the higher portions of Troy Hill in 1872. A small pumping engine pulled the water from the reservoir uphill to a 100,000-gallon tank. From the tank, the water was distributed by gravity to sections of the city's Seventh Ward above the reservoir.²⁶

Shortly after Allegheny's 1870 plan was drawn up, Pittsburgh city officials began construction of a new pumping and reservoir system — its third system to provide water for its citizens. Completed in 1874, the pumping station was on the eastern boundary of the city, near the Brilliant Station. The water was pumped uphill to the Hiland Reservoir, which supplied the lower and main portions of the city directly. From the Hiland Reservoir, some of the water was pumped uphill a second time to the Herron's Hill Reservoir — which supplied water to the highest parts of the city. The drawback to the new water works was that Pittsburgh's typhoid death rates remained at their high levels, in spite of the fact that it obtained water from above the

²⁵ *Ibid.*

²⁶ AR: CR and RSWW, 1870-1872; "Analysis of Allegheny River Water," 180-83.

city's boundaries. It soon became evident that running water did not purify itself.²⁷

Trying to follow Pittsburgh's example, in 1876 the Allegheny City engineer drew up a new plan for a larger water works, but the unavailability of funds prevented any action. Instead, because the city's new population in the hilly areas behind the already occupied flood-plain needed water, additional pumping capacity was necessary. The Howard Street Pumping Station, completed in 1881, pumped water from the reservoir to metal holding tanks on Montgomery Hill. These and subsequent tanks supplied the city's new population. Additional tanks were built on Montgomery Hill in 1889 and 1893, on Spring Hill in 1886 and 1897, and on Nunnery Hill in 1893 and 1894. By pumping water to all of these tanks, the Howard Street Station became crucial for the water supply of the newer sections of the city.²⁸

These tanks drained as fast as they were filled. For example, by 1893, the Montgomery Hill tanks had a capacity of 240,000 gallons and a daily demand of 1,250,000 gallons. At the Howard Street Station, daily average pumping rose from 1,477,330 gallons in 1889 to 11,238,854 gallons in 1907. To meet the demand, water works engineers either ran the engines above design capacity or purchased increasingly larger pumps. Problems resulted from the former. Excessive use of the engines strained their capacity and in 1890 and 1899 boilers exploded, causing property damage and loss of life.²⁹

In 1886, the city engineer and the superintendent of the water works drew up a plan for a new city water works — a plan very similar to that of 1870. The main components of this plan included a supply drawn at Huling's Eddy with thirty-million-gallon-daily pumping capacity and a 105,472,388-gallon reservoir above the eddy at a cost of \$2,309,742.05. In an effort to reduce typhoid mortality, a combined mechanical and chemical filter was proposed to improve water quality. (The superintendent believed small domestic filters would do a better job than a city filter — both in filtering quality and in cost effectiveness.) The following year the superintendent of the water works proposed a modified plan — adding a filter crib and omitting the reservoir. Since most of the debris and sediment flowed in the main channel, water was to be taken through the clean gravel bed in the smaller channel between Nine Mile Island and the right bank of the Allegheny River. A crib built above the intakes would

27 *Old Allegheny City*, 624.

28 AR: RSWW and CR, 1876-1907.

29 AR: RSWW, 1881-1907.

serve as an icebreaker, partial filter, and debris strainer. Instead of building a new reservoir, his plan pumped water directly to the old River Avenue Station and from there to the existing reservoir. This plan had an estimated cost of \$731,418.60.³⁰

City officials hired D. M. Greene as a consulting engineer to review both plans and advise the officials on what was best. Greene agreed on the same intake site as the other plans, but advised that the water be filtered through at least three feet of gravel before entering the intakes. He added that the pumps should have a daily capacity of at least thirty million gallons. Also, the delivery main should be heavier and stronger than the superintendent's plan so that it would become a permanent part of the distribution system. Greene wanted these parts to be built immediately, and he left the reservoir to be constructed when time and city funds permitted. The cost of his plan was \$1,514,060.40 which included approximately \$100,000 for contingencies the other plans had omitted.³¹

Construction began in 1894 and the new system was operational by the fall of 1896. Greene's plan was used with two exceptions. First, pumping capacity was increased to 36,000,000 gallons daily. Second, the delivery main was connected to the old Troy Hill reservoir, instead of the River Street Station. The River Street Station was kept operational as the emergency back-up to the new station, known as the Montrose Pumping Station. The drawback to the new system was the same as Pittsburgh's 1874 system — typhoid death rates remained at their high levels. Allegheny's new intakes were upstream of Pittsburgh's. The crib protecting the intakes acted as a partial filter, but the typhoid deaths persisted.³²

Between the completion of the new additions in 1896 and the annexation in 1907, several changes were either made or contemplated. Demand for water kept increasing. In 1907, two new fifteen-million-gallon pumps were added to the Montrose Pumping Station. In 1904, to relieve some of the demand at the Howard Street Station (then pumping over ten million gallons daily), the superintendent proposed

30 AR: RSWW, 1886: 327-35, 1887: 341-43; Engineers' Society of Western Pennsylvania, *Proceedings* 3, 94.

31 AR: RSWW, 345-52.

32 After the Montrose Plant opened, Allegheny averaged 128 typhoid deaths annually. During the last few years before the annexation, Allegheny's typhoid death rate per 10,000 citizens was over twelve. One note of perspective is that pneumonia killed far more people annually than typhoid. AR: RSWW, 1888-1897; RDDPW, 1894-1897; Mayor's Report, 1894; Report of the City Physician, 1894-1907.

to build a new pumping station at the other end of Troy Hill which would take its water directly from the main line supplying the reservoir. No action was ever taken on this idea. To serve the city's highest areas, a pumping station and tanks were built in 1905 on Green Tree Hill — the highest point in the city. The Green Tree Pumping Station was unique within the system in that it used electricity instead of coal to power its pumps. In 1906, bonds were authorized to build a new reservoir, but the annexation by Pittsburgh cancelled their issuance. Little action was taken to improve the filtering of water at the intakes.³³

Administration and Finance 1849-1907

Administration: There were three levels of administration for water supply matters in Allegheny. The highest level was the Committee on Water. The committee was made up of two or three members each of the city's Select Council and Common Council. Though in charge of water matters, the committee members acted as middlemen. They passed the needs and requests of the water managers on to the city government and the appropriated funds and the political considerations of city government on to the water managers. The second level consisted of two water supply professionals: the superintendent of the water works and the assessor of water rents. The superintendent not only operated the water supply system, but also designed its improvements. The qualifications for the job were the skills of a competent engineer (the water committee hoped he would be college-trained) and the ability to post a two thousand dollar bond before assuming the job. The assessor of water rents assessed each building using city water a water rent based either on the number of people and rooms or on the type of business carried on inside. New buildings were assessed a water rent based on the materials used in construction. Each type of building material was assigned a water rent based on the amount of water believed necessary to complete the construction. Rents were initially collected by city collectors in each ward, but excessive delinquencies forced the city treasurer to assume collection responsibilities during the early 1860s. The third level included the employees of the water works.³⁴

33 AR: RSWW and RDDPW, 1897-1907.

34 AR: RWC, CR, and Report of the Assessor of Water Rents (hereafter RAWR), 1856-1870; *The Pittsburgh Gazette*, Feb. 22, 1850; *The Charter of the City of Allegheny*, 108-11. In 1856, the city assessed the water users

Further changes occurred during the 1890s. In 1891, the water works became part of the new Department of Public Works. Now known as the Bureau of Water, it was still headed by the superintendent under his new title of the superintendent of water supply and distribution. The assessor of water rents became the superintendent of water assessments for the Bureau of Assessment of Water Rents, and reported to both the director of public works and the city treasurer. In 1893, the city was split into five service districts.³⁵

TABLE 2
City Service Districts

A	supplied by the Troy Hill Reservoir
B	supplied by the Nunnery Hill tanks*
C	supplied by the Montgomery Hill tanks*
D	supplied by the Spring Hill tanks*
E	supplied by Troy Hill direct pumping

*Water came from the Howard Street Pumping Station

District F, added in 1903, was the high hill area supplied by the Green Tree tanks.³⁶

Finance: Lacking cash in 1847, city officials used bonds to pay for the immediate costs. They hoped the profits from the water rents would pay off the bonds, as was the case in Pittsburgh. (Initially city officials wanted to sell Allegheny citizens shares of water works stock at twenty-five dollars per share, but this idea was rejected.) Although officials used a combination of cash down payments and bonds to purchase the sites for the pumphouse and the reservoir, they paid for the rest of the construction with city bonds. Except for \$49,553 of city bonds which were issued directly to suppliers, the city's bonds were sold and the cash used to pay for the construction costs which totaled \$263,985.23.³⁷

\$29,179.12 in water rents. By the end of the city's fiscal year (Apr. 1857), only \$13,910.35 (or 47.7 percent) had been collected. A year later, \$38,755.18 had been assessed the water users, and only \$19,351.88 (49.9 percent) had been collected.

³⁵ AR: Ordinance, 1891, 597; RSWW, 1893.

³⁶ AR: RSWW, 1903.

³⁷ Select Council of Allegheny, *Minutes*, Apr. 8, June 10, July 15, 1874; Mar. 1, Apr. 5, 1849; Jan. 10, 1850; Thompson, 56-57; AR: RSWW, 1891. Originally valued at \$263,985.23 in 1850, the assets of the water works increased to \$1,814,060.00 by 1891 (the last time assets were reported).

As Allegheny continued to grow and demand more water, the city government issued more bonds to pay for the water service expansion. Initially the bonds paid for the distribution system expansion and upgrading, but during the 1870s, bonds were also used for reservoir improvements and general expenses. Thereafter, any major improvements, such as pumping engines, holding tanks, pipe, and the new 1894 system, were paid for from bond proceeds. Interest rates rose from 5 percent to 7 percent during the 1870s, but fell to 4 percent during the 1880s and remained there until 1907. In 1874, a sinking fund was legally established for bond retirement; however, prior bonds were issued "provided that 5% of the amount of the bonds issued in any 1 year shall be set apart out of the proceeds of water rents, plus the interest for the redemption of said bonds."³⁸ Bonds continued to be issued in periodic clusters (1884 to 1896, 1901, and 1905 to 1907) to pay for new pumps, pipes, tanks, and the new facilities of 1894. The high point of water works' debt came in 1901 at \$2,647,000 (compared to overall city debt of \$6,460,233 that year). However, one million dollars of city bonds were authorized in 1906 to build a new reservoir, but the annexation cancelled both their issuance and a new debt high point.³⁹

Like many cities, Allegheny city officials had trouble collecting assessments and determining the proper water rate. Just as they had surfaced in the 1850s, collection problems began again in the mid-1880s. Samuel C. Grier left the job of assessor of water rents in 1885 and became the new delinquent tax collector in 1888. By 1892, delinquent payments of water taxes rose to 28.9 percent of what was assessed that year. From then up to 1907, annual delinquency averaged 30.42 percent with a high point of 34.47 percent in 1897 (\$109,793 of \$318,494). Most of the delinquencies were collected during the city's next fiscal year.⁴⁰

38 Water pipe, hydrants, fire plugs, etc.	\$1,251,593.00
Engines and pumps-River Avenue works	270,582.00
Buildings and Foundations-River Avenue works	83,000.00
Reservoir and improvements	78,279.00
Water works property	50,000.00
Howard Street Building, pumps, etc.	30,356.00
Troy Hill facilities	15,000.00
Montgomery Hill-Tanks and Property	15,000.00
Spring Hill-Tanks and Property	10,000.00
Stock on hand	10,000.00
Scales at the Works	250.00

39 AR: 1869, 101. AR: CR and Report of the City Treasurer, 1856-1874, 1876-1907.

40 AR: CR and Report of the City Treasurer, 1883-1907. One interesting note is that the 1874 and 1875 bonds had their interest paid in gold.

The city of Allegheny borrowed Pittsburgh's system of water rents informally from the completion of the initial system up to April 1857, when the state legislature passed an Act of Assembly authorizing Allegheny's city councils to levy water rates. The Act of Assembly merely formalized the procedures that had been used for the last eight years. Water rents were a flat annual charge based upon the number of rooms in each residence. Additional rents were charged for water-using extras such as sinks, bathtubs, water-closets, and lawn sprinklers. Businesses were assessed different rents based upon the type of business and its water usage. Some of Allegheny's water rates were:

1 room and 1 person	\$2.00 annually
2 rooms and 2 people	3.25 "
3 rooms and 3 people	4.50 "
4 rooms and 4 people	5.75 "
5 rooms and 5 people	7.00 "
6 rooms and 6 people	8.25 " *
over 6 rooms and 6 people	1.25 per room and .75 per person
schools	2.00-5.00 annually
blacksmith shops	2.00 per forge
barber shops	4.00 for the first chair and 2.50 for each additional chair
bakeries	.01 for each barrel of flour baked
slaughter houses	3.00-15.00 annually
horses	1.25 each
cows	.50 each
public bathes	8.00 each annually
private bathes (cold water)	1.50 " "
private bathes (hot water)	2.50 " "

*Each person over 10 years of age was an additional seventy-five cents.⁴¹

The larger business establishments that used steam, such as hotels, drinking saloons, breweries, tanneries, and cotton factories, were to be charged a special rate determined by the city's Water Committee. Any establishment supplied by water measure, usually larger businesses and manufacturers, was to be charged a rate of fifteen cents per thousand gallons.⁴²

41 W. B. Rodgers, *A Digest of the Arts of Assembly Relating to General Ordinances of the City of Allegheny, 1840-1897* (Pittsburgh, 1897), 250-51, 476-77; AR: City Ordinances, 1867, 109-10.

42 Ibid.

These rates changed several times. In 1864, a minimal second assessment on water users began. In 1866, the water meter rates were reduced from fifteen cents per thousand gallons to twelve cents. One reason was to promote business growth. Another reason was that some businesses were building their own water supply systems, which cost the city water revenues. These business establishments had trouble obtaining water because the distribution system had not yet reached their area or the distribution pipe size could not provide enough water. The flat rates were adjusted upward by 25 percent in 1871 and again in 1876. The major reason for these rate increases was that the city of Allegheny had grown rapidly through annexation and had issued several series of water bonds to pay for the distribution system to be expanded into these new areas of the city. Another reason for the increase in nonmetered rates was that water consumption had also grown rapidly in just a few years.⁴³

TABLE 3
Allegheny's Water Consumption

Year	Annual Water Consumption*	Average Daily Consumption*
1858	641,884,000	1,758,476
1863	972,804,000	2,665,205
1869	1,004,601,600	3,081,600
1878	2,669,441,200	7,250,000
1887	6,505,579,649	17,823,506
1903	14,630,881,909	39,764,895
1907	15,283,217,917	41,871,829

*in gallons

In forty-nine years of recorded water consumption, the demand for water grew over 2,281 percent while the city's population grew only 558 percent. The per capita consumption of water also grew at a rapid rate (see Table 4). One of the major reasons for the huge consumption was intensive industrial water use. Allegheny's steam-using firms as well as its many tanneries, steel and cloth mills, dyeing establishments, soap factories, breweries, slaughteryards, and one very large food processing company all required large amounts of water.⁴⁴

⁴³ AR: CR, RSWW and City Ordinances, 1864-1874, 1876-1907. Table 3 used the RSWW for the years cited.

⁴⁴ The figures were calculated from Tables 1 and 3. Table 4 came from the RSWW for the years cited. While industrial water amounts are not listed, the types and numbers of water users can be found in the RAWR.

TABLE 4
Daily Per Capita Water Consumption

1869	44 gallons
1878	100 gallons
1882	115 gallons
1900	300 gallons

Observing the rapid increase of per capita water consumption and realizing there were no immediate plans for a larger water works, the superintendents had to do something to reduce demand and its wear and tear on the system. Beginning in 1872, various superintendents proposed that city-wide metering systems be installed in an effort to reduce water wastage. In 1878, the superintendent calculated that forty out of every hundred gallons were wasted daily. The director of the Department of Public Works in 1902 calculated there were twenty-six cities in the United States with a population greater than Allegheny's, but none of them used more water per capita. The city of Milwaukee, twice the size of Allegheny, used over 31,000 meters to keep daily per capita consumption about eighty gallons. (Allegheny's was over three hundred gallons.) While part of the problem was technical (the water was too muddy for the meters to work accurately), another part was psychological. Residential users did not want meters. In 1903, the director of the Department of Public Works stated more could be saved if meters were installed in factories and large consumers than if meters were installed residentially, as in Milwaukee. In 1906, the same director stated that, unless a metering system was made mandatory, residential users preferred paying some of the water costs of the heavy users because it kept overall rates lower.⁴⁵

The water works provided the city of Allegheny with significant amounts of revenue. In 1856, water assessments were \$28,972. In 1871, water assessments passed \$100,000; \$200,000 in 1887; and \$300,000 in 1896. When the annexation occurred in 1907, water assessments were \$387,455.⁴⁶ The percentage of average assessed water rents to city revenues is displayed in Table 5:

45 AR: RDDPW and RSWW, 1870-1874, 1876-1907.

46 AR: RAWR and CR, 1856-1874, 1876-1907.

TABLE 5
*The Percentage of Water Revenues to Total City Revenues*⁴⁷

1850s	46.34%
1860s	39.10%
1870s	20.63%
1880s	16.24%
1890s	11.31%
1900s	11.86%

These percentages would have been much higher if the revenues from the delinquent water rent collections were part of water revenues instead of being a separate category. The revenues from bond sales were not included in the city revenue figures. During the early years of this period, the water works provided almost half of the city's revenue. After 1880, when Allegheny's growth increased the revenue from other sources, like the property tax, the water works' revenue became an increasingly small portion of the city's revenues.⁴⁸

Although the water works provided Allegheny's government with a steady surplus of funds, the exact net income of the water works is difficult to obtain. The superintendents used different accounting methods every year or so, especially in the areas of operating costs, repairs, and expansion of the system. For example, expansion of the distribution system was part of operating costs in some annual statements and separate from operating costs in others. After 1880, however, they were always part of operating costs. Only two superintendents calculated the annual net income, but they each did it only once (the city controller never tried to figure out the works' net income). William D. Faulkner in 1863 figured the annual net income as \$30,940. George N. Miller in 1866 figured an annual net income of \$50,773. Those two years were not the most profitable according to the records available. Two examples of estimated higher profits are \$106,075 in 1880 and \$146,841 in 1891.⁴⁹

Most of the operating expenses were a result of expenditures for coal and salaries. Up to the 1880s, the price of coal accounted for 44 percent of the water works' operating costs, making it the largest

⁴⁷ Table 5 was calculated by dividing water revenues into total city revenues for the years cited from the CR.

⁴⁸ AR: RAWR and CR, 1856-1874, 1876-1907.

⁴⁹ AR: RSWW, 1856-1874, 1876-1907. This does not include the 1850-1855 era when few of the costs are known. The total operating expenses (the operating expenses plus the expenses of permanent improvements) are deducted from the total water assessments.

single expense item. In order to reduce this expense, engineers attempted to improve the efficiency of boilers and pumps. As the overall operating expenses rose during the 1880s, both the cost of coal and its percentage of the operating costs dropped dramatically. By 1884, coal was only 12.56 percent of the operating costs. During the decade of the 1890s, coal averaged 20.5 percent of the operating costs. Coal average costs rose again in the 1900s to 27.56 percent of operating costs. In 1907, the department spent over \$100,000 on coal — the most ever for one year.⁵⁰

Salaries, the other major expense, were initially about half the expense of coal. In 1872, salaries were 26 percent of total operating expenses (coal was 61 percent) and gradually rose to 37 percent (\$8,015) in 1880. From the 1880s until the annexation in 1907, salaries were approximately double that of coal. In 1897, salaries for the Bureau of Water were \$112,143. This was the first time salaries were over \$100,000. By 1907, salaries were \$179,125 and 55.24 percent of total operating expenses.⁵¹

The operating costs themselves were, on the average, under ten thousand dollars annually until the early 1860s, under twenty thousand dollars annually until 1876, and under twenty-two thousand dollars annually up to 1880. After 1880, the permanent improvements were included in the total operating expenses. As a result, operating expenses jumped dramatically. During the 1890s, operating costs were averaging slightly over \$200,000 annually (\$205,532). During the 1900s, average annual operating costs were slightly over \$300,000 (\$311,106).⁵²

Beyond 1907

In 1907, Pittsburgh annexed the city of Allegheny. Allegheny's water works became part of the Pittsburgh Department of Public Works (DPW). J. L. Brown, the superintendent in Allegheny, became the assistant superintendent in charge of the Allegheny portion of Pittsburgh's water works. In his 1908 report, Brown proposed that, if no large new reservoir was built, two smaller reservoirs of four-to-

⁵⁰ Ibid. Engineers added new grate bars for improved combustion, altered cam arrangements to reduce the pump stroke, and increased the size of the pump cylinders to push more water per stroke.

⁵¹ Ibid.

⁵² Ibid. This does not include the 1850-1855 era when few of the costs are known.

five-million gallons apiece should be built. One would be at the head of Lafayette Avenue and the other on Spring Hill. The size of these reservoirs would be large enough to cover the repair time in case of a breakdown at the Howard Street Pumping Station. Brown had proposed these reservoirs before, but insufficient funds prevented their construction.⁵³

In 1909, Pittsburgh's DPW acquired the plant of the Monongahela Water Company, a private water company which served the South Side. In order to make operations more economically efficient, plans were drawn up in 1912 to merge the three separate systems into one system. Under the new plan, all water came from the Allegheny River through the Ross Pumping Station (the pumping station for Pittsburgh before the reorganization and three miles downstream from the Montrose Station) and its attendant filtering basins. The Montrose Pumping Station was dismantled and moved to Aspinwall. The new Aspinwall Pumping Station pumped the filtered water to the North Side and its new reservoir. Completed in 1914, the new 151,000,000-gallon reservoir, located in Shaler Township, replaced the old Troy Hill Reservoir. Construction of the Aspinwall Pumping Station eliminated the need to retain the old River Avenue Pumping Station as a backup to the Montrose Station. Pipes were laid underneath the Allegheny River to connect the low service areas of both cities and to give elasticity of operations. Deemed economically inefficient, the Troy Hill Pumping Station was abandoned. Service to that area was then provided by a new pipe from the Spring Hill tanks.⁵⁴

Water quality was improved through the use of slow sand filters. These filters were first tested in 1895 in the basement of Pittsburgh's First Unitarian Church and dramatically improved the water quality. Unfortunately ten years of political power struggles and engineering and cost revisions delayed the filtration plant construction. In 1905 construction began at the Ross Pumping Station. As soon as sections of the filtration plant were completed, water was filtered and sent to the city. Beginning in December 1907, Pittsburgh citizens used partially filtered, partially "raw" water and had totally filtered water by October 3, 1908. In 1908, 1,082 people died in Pittsburgh from typhoid fever; in 1909, 326 people died from typhoid fever. Allegheny

53 *Annual Report of Pittsburgh's Department of Public Works, 1908, 1909; Department of Public Works, The City of Pittsburgh and Its Public Works* (Pittsburgh, 1916), 48-53, 56-57, 60-64; AR: RSWW and RDDPW, 1900-1907.

54 *Ibid.*

received filtered water when the Aspinwall Pumping Station was completed in 1914. In 1906, 6.8 percent of all deaths in Pittsburgh were from typhoid fever, and by 1915 only 0.43 percent of all deaths were from typhoid fever.⁵⁵

Summary and Conclusions

The water works which the city of Allegheny constructed was a typical mid-nineteenth-century water works. It used the largest and cleanest local water supply, in this case the Allegheny River. Steam-powered pumps pulled the water from the river and then pushed it uphill to a large holding and distributing reservoir. Using a combination of gravity and water pressure from the weight of the water held in the reservoir, water was distributed through over eleven miles of iron pipe. There was very little innovative engineering in both the original water works and the subsequent modifications. All of the ideas and technology used came from elsewhere, especially from Pittsburgh, whose system the Allegheny Water Works' builders loosely copied.

Likewise, the problems encountered by the Allegheny Water Works were the typical problems faced by most nineteenth-century water works. Rapid urban and industrial expansion forced a similar rapid expansion of the distribution system. As the newer pipes were added to the distribution system, they caused a loss of water pressure in parts of the older system. The older pipes were also installed with a smaller system in mind; hence many of the major initial distributing mains were too small to handle the water demands of a larger city. Given the city's policy of providing water to the new areas of the city over instituting system improvements, capital for upgrading the pumps and reservoirs was used instead to expand the distribution system. The water works' managers relied on patchwork maintenance to keep the whole system operating until enough capital could be raised to finance upgrading the system. The water works' managers could not borrow from general city funds as those funds were being used to build other components of Allegheny's infrastructure, such as a sewer system and a street system.

The rising national concern over the quality and purity of water became a concern in Allegheny during the 1870s. Evidence of this concern was the placement of the new Montrose Pumping Station ten

⁵⁵ Ibid.; Tierno, 27-36.

miles upstream — above the urban development of both Allegheny and Pittsburgh. Filtration of the water was handled in a primitive manner as the river water was drawn through a sand bed into the intake pipes. Allegheny water officials still viewed the reservoir as a settling basin to reduce the water's turbidity.

Like all cities providing water to their citizens, Allegheny officials faced a dilemma — whether to continue expensive expansion of their system or to reduce water demand. They chose the former, beginning a race with demand with which they barely broke even. While turbidity prevented extensive use of water meters, little was done to juggle water rates in order to reduce water demand. By meeting demand, long-term improvements such as a larger reservoir and a filtering system were cast aside for more and larger pumps and a better distribution system. The long-term improvements had to wait until after the city's annexation by Pittsburgh in 1907. Complaints of excessive demand were also passed on to Pittsburgh officials. In view of the present concern for local water supply systems, Allegheny's water supply system provides some interesting "lessons." Local conditions affecting water demand can change faster than projected system adequacy, creating difficult water policy decisions. Reducing water demand can extend a system's adequacy. Any major system changes were very expensive. In a financial sense, water has historically been a cheap service a city has provided its citizens, but in a public health sense, the cost of water has been high. In spite of its problems, the provision of water by Allegheny to its citizens and industries boosted the city's size and finances. Without the water works, it is doubtful that much of this would have occurred. ■