The Water Works of the City of Philadelphia
The Story of their Development Engineering Specifications

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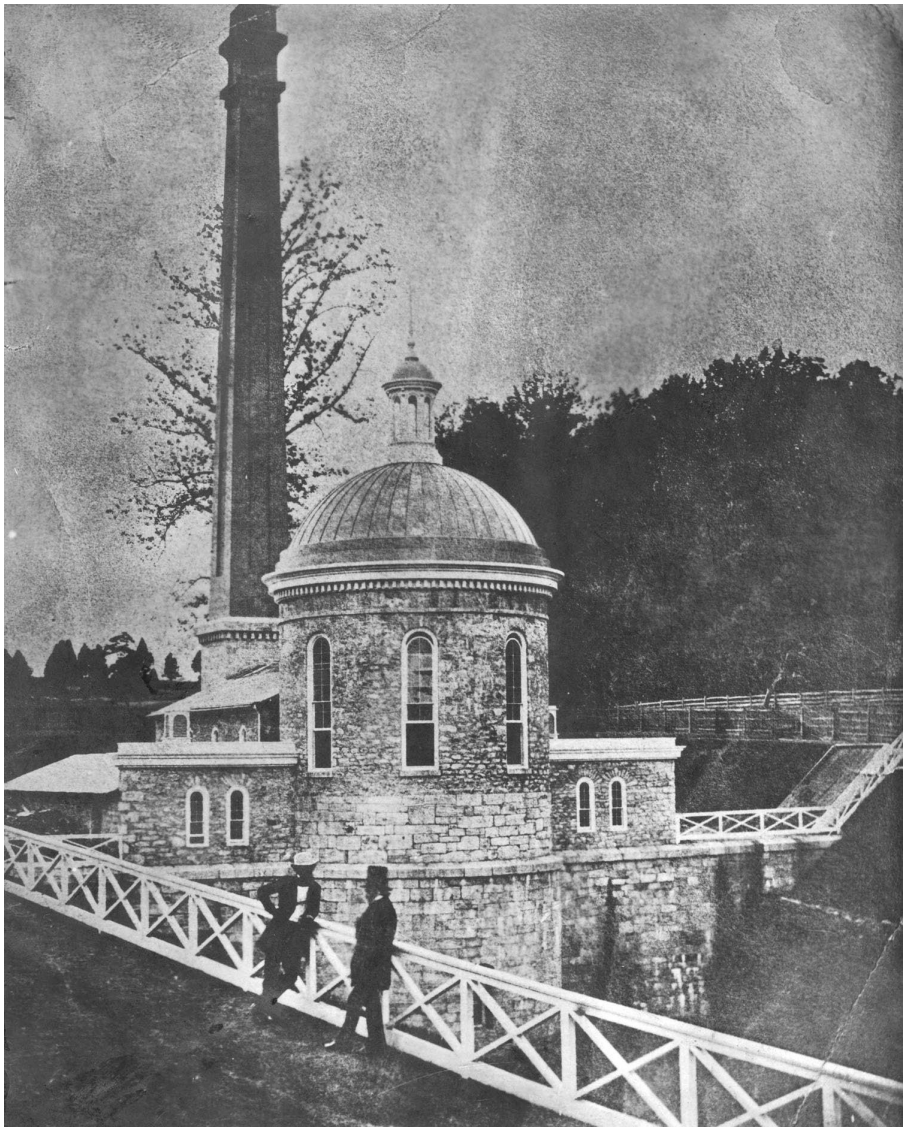
This compilation of information represents a tremendous amount of labor, done before digital appliances such as computers, cameras, scanners made this kind of work both simpler to compile and easier to research. It covers the history of Philadelphia's water works and their pumping engines through 1931.

Unfortunately, while the authors cite various wholesale references, no detailed footnotes are included. This means that we either have to either trust that the authors and typists transcribed all the hundreds of dates and numbers and names and other pieces of complicated information accurately, or, before citing any of this material, we need to check with a primary source – in most cases, an annual report of the Philadelphia Water Department. For example, in Chapter 1 the authors give Frederick Graff's birth year as 1776, while other sources give this as 1774 or 1775. I considered trying to add in footnotes to corroborate the text (a few of which I have left), but decided instead to present the text as it is.

As the historian for PWD, I will be cross-checking the information in this volume whenever I cite it, but I have the advantage of having the entire run of annual reports at my fingertips. My main advice to other researchers is to understand that this is NOT a primary source, and to realize that while all due diligence may have been taken by the authors (and this editor) to prevent errors, some will have inevitably crept in.

Since I transcribed this hand-typed volume (from the only known copy, at the Historical Society of Pennsylvania), additional errors may have been made by the optical character recognition (OCR) software, though I have corrected the most obvious errors and many that required more careful scrutiny. I took the liberty of converting numbers written in text into numerals, which are much easier to read but which is another source of possible error. For all these reasons, be forewarned. HSP has the only copy of this, but I also have photographs of each page which I can provide if needed.

CHAPTER 9
Twenty-fourth Ward (or West Philadelphia] Water Works, 1855



SOURCE: PWD Historical Collection, SOURCE: PWD Historical Collection, 2004.057.0237.049

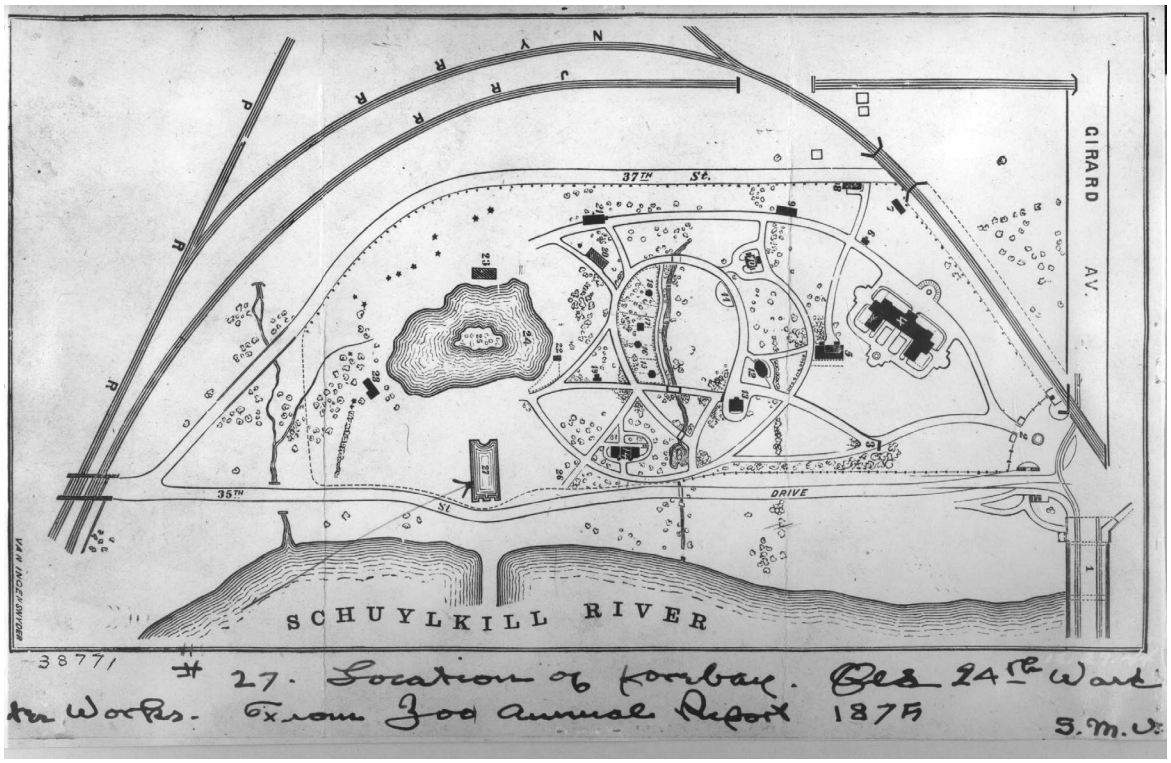
The public water supply activities until 1851 had been confined to the districts of the city east of the Schuylkill River, but in the fall of that year a group of influential men of West Philadelphia assembled for the purpose of considering the expediency and practicability of erecting a water works to supply West Philadelphia.

A committee was appointed consisting of the following citizens: Mr. E. M. Eakin, as Committee President; and Messrs. Benjamin R. Miller, Dr. R. Bicknell, C. C. Pierson, J. Sidney Keen and Robert L. Martin. They

employed Messrs. Birkinbine and Trotter, civil engineers and contractors, to make a thorough examination of the whole subject. The following plan was submitted to the committee:

The location to be on the west side of the Schuylkill, near the foot of the old inclined plane, at or near the Belmont Cottage; a subsiding reservoir to be constructed together with a pumping plant consisting of two direct acting vertical Cornish pumping engines with a capacity that would supply the district for some time anticipating reasonable growth; and two reservoirs to be built on the elevated ground near the top of the plane. The plan seemed to be satisfactory, but the estimated cost, $300,000, was considered too great a financial burden for the district to carry.

Mr. Birkinbine then came forward with a plan for works similar in design but smaller and more limited in capacity. This plan was also rejected because it still called for spending more money than the committee thought advisable. The committee was then persuaded to visit



SOURCE: PWD Historical Collection, 2004.0570237.047

the works of the Germantown Water Company. The layout and equipment of these works impressed them very much. Plans and estimates were prepared for a somewhat similar layout with modifications to suit the views of the committee, and a contract was almost immediately entered into at an estimated cost of $120,000. The contract called for completion in one year, and this short period required for construction influenced the committee in its decision. It was also

decided to install a standpipe to serve until the district could afford to finance the cost of storage reservoirs and lay the estimated three miles of main pipes required to connect the reservoirs with the built-up sections of the district. The site selected was situated north of the Fairmount Dam, on the west side of the Schuylkill River where the Zoological Gardens were later located. On January 24, 1853 the construction operations began. They were completed and service was inaugurated in August 1855.

At first two high pressure engines were ordered for these works, and they were already under construction when it was decided to change the specifications to call for direct acting vertical Bull Cornish engines and cancel the order for the high pressure engines, since the Cornish engines were considered more economical in fuel consumption than the high pressure engines. It was figured that one-quarter the amount of fuel required by the high pressure engines would be saved by using the Bull Cornish engines, and that this would in but a short time more than offset the cost of the work already done on the high pressure engines.

The water from the river was directed through a planked tunnel to a paved chamber in which were placed three screening strainers. In ordinary stages of the river, the water was 5½ feet deep in the tunnel and at the extremely low rate of flow (two miles per day in the tunnel when but 2 million gallons per day were taken into the chamber) there was sufficient time for the heavier waterborne particles to settle. The lighter floating particles were screened out. Provision was made for the convenient removal of the sediments.

The subsiding reservoir was 165 feet long and 75 feet wide and its water depth was 16½ feet under ordinary conditions of river water volume. This reservoir acting as a sedimentation basin allowed the water to deposit most of the impurities. The depth of the water proved to be of the greatest importance in purifying by subsidence. It was found that the reservoir was of ample capacity and size to render the water pure and limpid under almost all conditions of the river, provided no greater volume of water was pumped from it than the works were calculated to supply.

The water works buildings were all of stone of the hard gneiss rock variety found in the vicinity of the works. The engine house was circular and surmounted by a dome supported on cast iron girders. On the girders strong hooks were attached over each engine cylinder for use in lifting the machinery in case repairs were needed. The boiler houses were built one on each side of the engine house with short flights of stairs connecting them with the engine house. Slate supported on iron framing was used for the fireproof roofs of the buildings. The boiler stack was built on a base of cut stone 30 feet high. Above this the stack was continued in brick to 90 feet making a total height of 120 feet. The stack flues were 40 inches in diameter and lined with fire-brick to a height of 30 feet from the bottom.

The cylinders of the Bull Cornish engines were bored 50 inches in diameter and had a piston stroke of eight feet (96 inches!). The cylinders were inverted and placed directly over the pumps with the piston rods directly connected to the plungers of the pumps. These plungers were each 17 inches in diameter and operated in the same stroke as the engines, i.e., eight feet. They were plain plunger pumps fitted with double beat valves having metallic facings. A lever beam operated the air, feed and cold water pumps. These engines were also fitted with Birkinbine's patented equilibrium governor. All parts of the machinery were made of extraordinary strength from materials of the best quality. Great care was taken to make the engines as efficient as possible so as to economize on fuel consumption. Each steam cylinder was surrounded by a steam tight jacket or outer cylinder of somewhat larger diameter and steam was introduced into the space between them on its way to the power cylinder. The jacket was covered with two inches of felt, outside of which was a six inch brick wall, and this latter was in turn encased by wooden staves, bound with polished metallic bands.

There were four boilers of Cornish design, two in each boiler house. Each boiler was six feet in diameter and 32 feet long and equipped with two safety valves. Either of the engines might be supplied with steam from any one or all of the boilers, and they were so arranged that any one boiler might be removed without disturbing all the others. The engines were also entirely independent of each other.

The standpipe was situated on high ground, about 2,000 feet from the works, near 35th and Sycamore Streets. Its base was 100 feet above the level of the river. Its main body was of heavy boilerplate five feet in diameter and 130 feet high. Around its lower portion there was an octagonal base of ashler masonry composed of gneiss rock, 36 feet high, and each angle of this base was sustained by a buttress.

A 16-inch main led from the works to the standpipe, and a 16-inch outlet led from near the bottom of the standpipe to the distributing mains of the district. Water was maintained in the standpipe at a height of 100 to 127 feet, giving heads of water in the different parts of the district varying from 120 to 225 feet.

Each pump raised 90 gallons at every stroke and operated at the rate of 10 strokes a minute and so lifted 1,296,000 gallons in 24 hours. Under necessity the pumps were capable of making 14 strokes per minute by which the capacity of each of the pumps was increased to 1,814,400 gallons in 24 hours. These works without storage reservoirs could supply about 20,000 persons with water.

In 1870 after 15 years of active service the works were abandoned. At this time the Belmont Works further up the river had been completed and supplied all the West Philadelphia districts. The abandonment caused considerable criticism for many years, because the works had proven adequate to meet all demands made upon them, and the engines were the most economical in the Water Department.