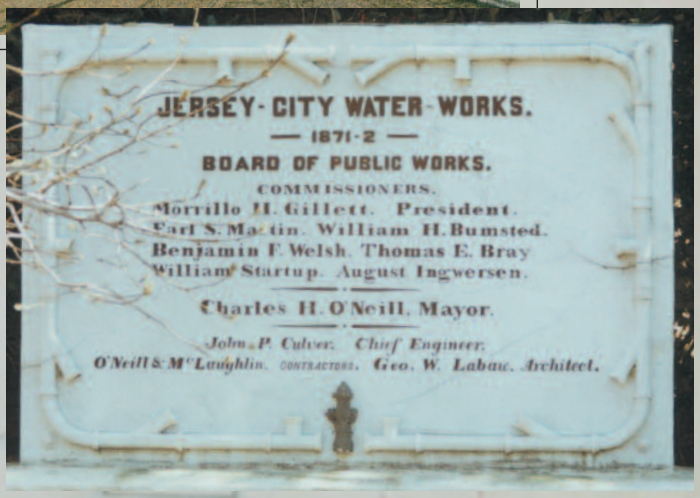
Cultural Resources Survey of the

Jersey City Water Works Pipeline

1851-1873

US Route 1&9 Truck Interim Improvements Project

Charlotte Circle, Jersey City, Hudson County, NJ



prepared for

New Jersey Department of Transportation

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The RBA Group, Inc. *Engineers • Architects • Planners*

May 2001

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THE JERSEY CITY WATER WORKS PIPELINE, 1851-1873

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CULTURAL RESOURCES SURVEY
OF THE JERSEY CITY WATER WORKS PIPELINE

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1. INTRODUCTION

The following report documents research conducted by The RBA Group, Inc. on the Jersey City Water Works Pipeline and related features of the 19th-century waterworks. The project location and historic pipeline are shown in Figures 1.1 and 1.2. The pipeline, consisting of parallel 20" and 36" cast iron mains, was surveyed for the U.S. Routes 1&9 Truck Improvements Project in 1999 (Porter et al. 2000) and was found to be eligible for the National Register of Historic Places. It was not tested at the time of that survey because project effects were undetermined. Subsequently, the 1&9 Interim Improvements to Charlotte Circle and Tonnelle Circle Project was found to involve a potential impact on the water pipeline from relocation of a 72" sewer drain through Charlotte Circle. It was known that the sewer line crossed the 20" water main at some point in or adjacent to the traffic circle. The precise location of the crossing of the sewer line with the historic water line was not known, nor was it known whether or how installation of the sewer line had impacted the water line. It was necessary to determine the relationship of the two lines in advance so that the sewer line relocation could be planned and the water line replaced if necessary, since the latter is still active in this area.

A meeting was held with representatives from the New Jersey Department of Transportation and Mike Gregg of the State Historic Preservation Office to determine a course of action vis a vis the historic pipeline. It was decided that archaeological inspection of the historic water line would be undertaken during the utilities testing designed to determine the location and method of the crossing of the water and sewer lines. The inspection would determine the integrity of the pipeline in this location so that a determination of effect could be made. It was also decided that a complete documentary study of the pipeline would be undertaken. This study, along with the field recordation of the pipes in Charlotte Circle, would serve to mitigate future potential adverse effects of the U.S. 1&9 Truck Improvements Project on the eligible pipeline. The documentary study involved primary research on the pipeline and the larger water works system of which it was a part.

Test trenching was conducted by Taylor, Wiseman & Taylor under the direction of engineer and project manager Glen Schetelich of Hardesty & Hanover and archaeologist Jean Howson of the RBA Group in February and March of 2001. Field assistance was provided by Leonard Bianchi and Adam Maskevich of the RBA Group. Research was conducted by Howson. The assistance of the librarians at the Jersey City Public Library, Mr. John Libitz of United Water of Jersey City, and Mr. Kay Liu and Mr. Bob Lorfing of Jersey City the Department of Public Works, Water Engineering, is gratefully acknowledged.

The field effort was successful in exposing an intact section of the original 20" pipeline and the observation and recordation of this component of the resource, in conjunction with the documentary study, was adequate for data recovery purposes. The 36" pipeline that parallels the 20" line was not observed in the test trenches, but it was fully addressed in the documentary study. No further archaeological investigation of the 20" pipeline is

recommended. If future construction work for the 1&9 Truck project may affect the 36" pipeline, a limited program of monitoring is recommended.

This study has been completed for the New Jersey Department of Transportation (NJDOT) by The RBA Group's Cultural Resource Unit (RBA/CRU). All work has been completed pursuant to the instructions and intents set forth by Section 101(b)(4) of the National Environmental Policy Act of 1969; Section 1(3) and 2(b) of Executive Order 11593; Section 106 of the National Historic Preservation Act; 23 CFR 771, as amended October 30, 1980; the guidelines developed by the Advisory Council on Historic Preservation published November 26, 1980; the amended procedures for the Protection of Historic and Cultural Properties as set forth in 36 CFR Part 800 (October 1, 1986); and the amended procedures for the Protection of Historic Properties as set forth in 36 CFR 800 (May 18, 1999).

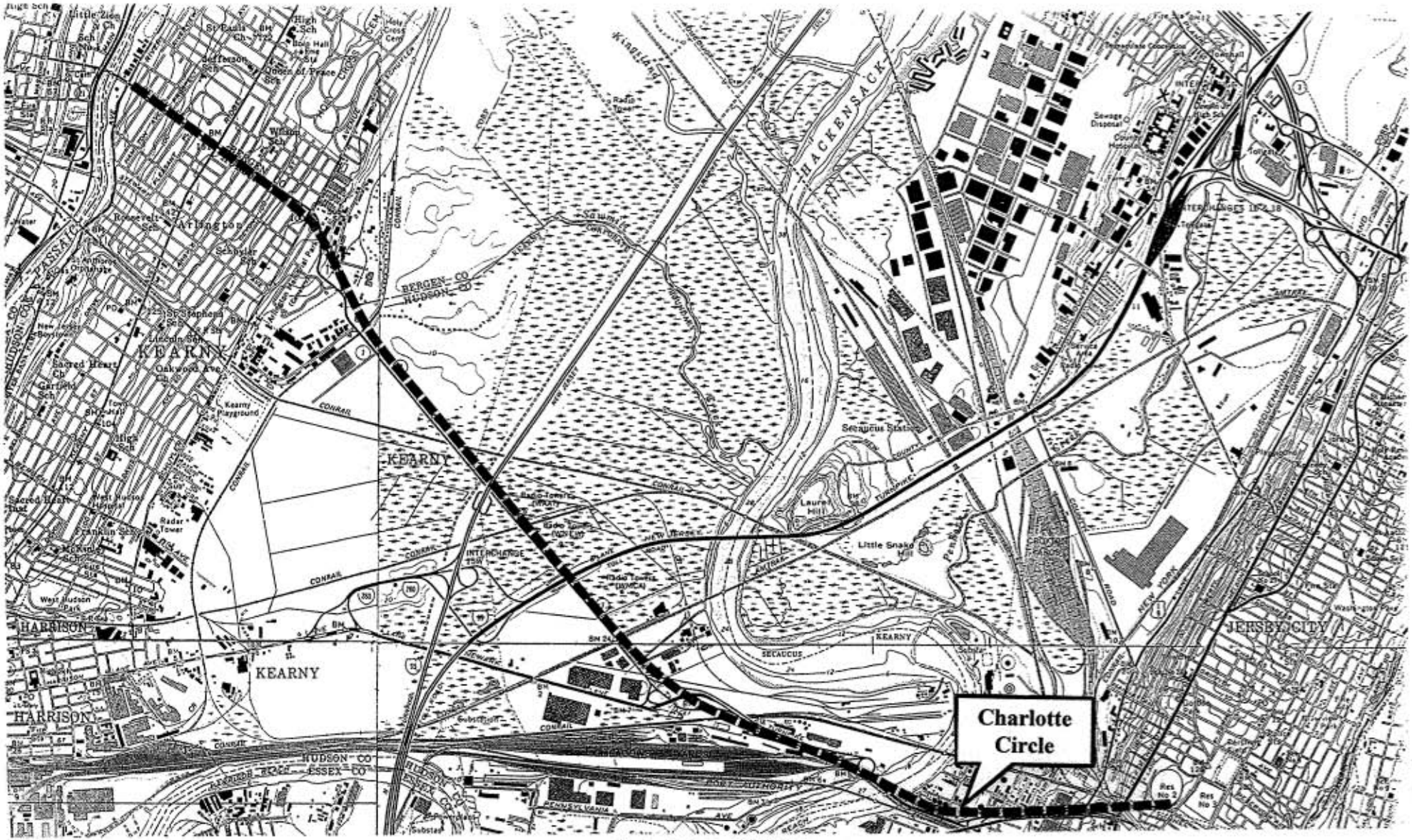


Figure 1.1 **Project Area Location, U.S.G.S. Jersey City, Elizabeth, Orange, and Weehawken Quadrangles. Dashed line is the route of the Jersey City Water Works Pipeline.**

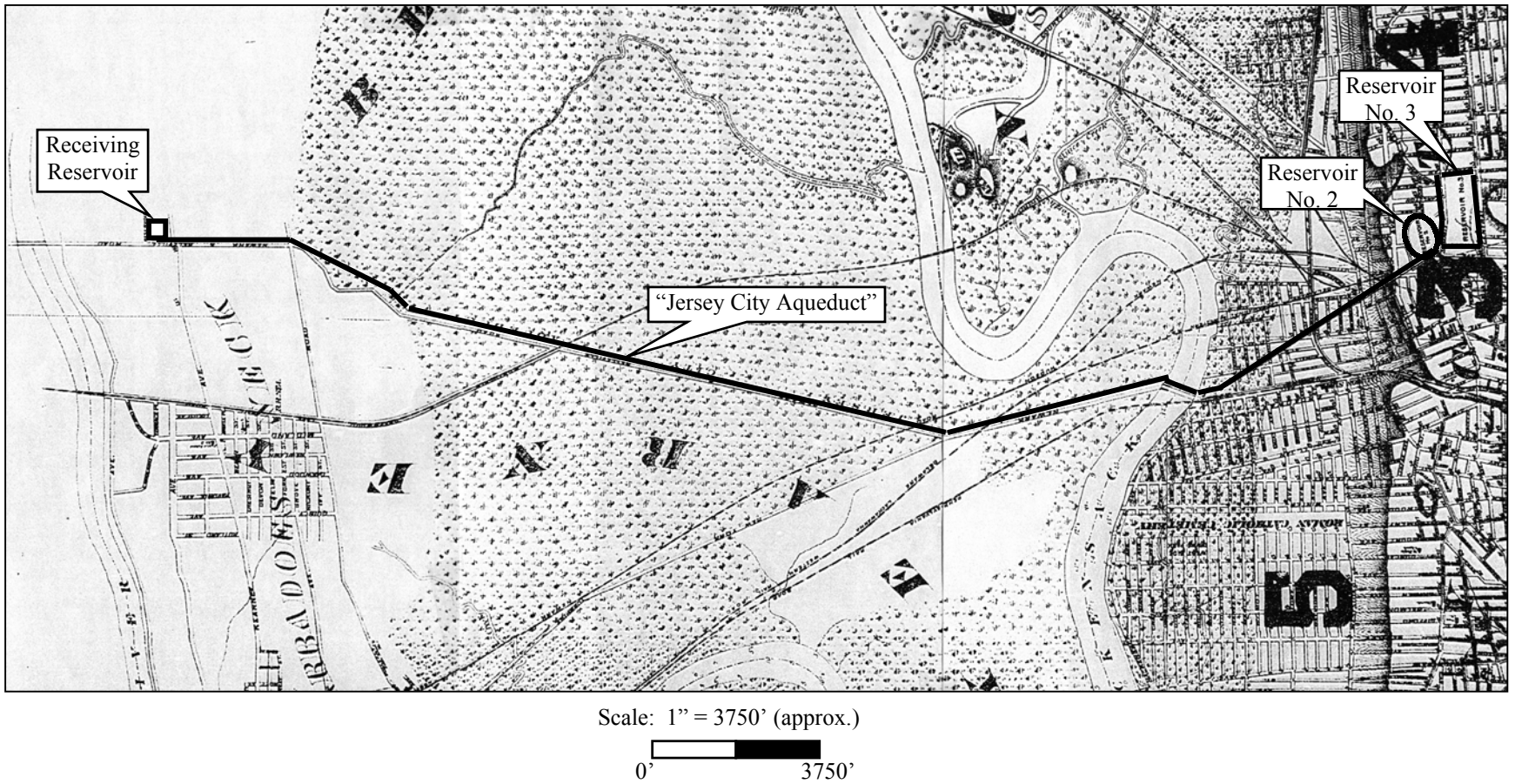


Figure 1.2. Brush, Charles B. *Insurance Maps of Hudson County, N.J.* 1885. Map showing the "Jersey City Aqueduct" route from the Receiving Reservoir above the Passaic through the meadows, across the Hackensack into Jersey City and up to the distributing reservoirs on Bergen Hill. Reservoir No. 3 had been recently completed. It is shown in its originally-intended full size; only the south half was built. The pumping station at the Passaic River, located west of the receiving reservoir, is not shown.

2. LITERATURE REVIEW

Recent research on the Jersey City Waterworks has focused on the distributing reservoirs -- Reservoirs No. 2 and No. 3 -- on Bergen Hill. Reservoir No. 2, part of the original waterworks, was in use through 1978, and Reservoir No. 3, dating to the 1870s, was not drained until 1994. Engineering studies of these facilities were completed in 1981 for the Department of Public Works (Langan Engineering Associates 1981a and 1981b). The studies included background histories of the waterworks, focusing on the reservoirs, as well as descriptions and evaluations of extant structures.

In 1982 the two reservoirs were cited in the Historic Sites Survey of Jersey City and recommended as eligible for the National Register of Historic Places under Criterion A (Brooks 1982). At that time, the surveyor identified two structures at Reservoir No. 2 as dating from the late 19th century, "a maintenance structure and possibly a pumping station." Neither remains standing.

In 1991, the New Jersey State Historic Preservation Office issued an opinion of eligibility for the "Jersey City Reservoirs 2 and 3 Complex" (James F. Hall, Letter of 15 October 1991). Criteria A and D were cited, with Reservoir No. 3 identified as an extant structure and Reservoir 2 as an archaeological component of the complex. In order to mitigate the effects of construction of the Saint Joseph School for the Blind campus on the north side of Reservoir 2, a data recovery program was required. The SHPO stipulated that "the data recovery shall consist of a detailed history of the reservoir and public water system in Jersey City and the research questions shall be framed within the general subject of urban planning, engineering and administration." The historical study was completed and submitted to the Office of New Jersey Heritage in 1992 (James and Dresdner 1992).

The engineering and cultural resource studies of the reservoirs cited above relied heavily on the semi-annual *Reports of the Water Commissioners* (hereafter cited as *RWC*), which began in 1851, for primary data. The bound reports are available at the Jersey City Public Library; they were often published verbatim in the local newspaper, the *Evening* (later *Daily*) *Telegraph*, available on microfilm. The reports and their appendices document the work of the commission from its inception through design selection and construction of the original waterworks system and its subsequent alterations. They do not, however, contain plans or other graphic sources on the works. Plans for various components of Jersey City's water system are retained at the Department of Water Engineering of the Public Works Department. Designs and plans for the original waterworks have not been found, however, and these may have been destroyed. After the reorganization of Jersey City in 1871 following the incorporation of Hudson City and Bergen, the oversight of the waterworks fell to the Board of Public Works. Information is contained in the Reports of the Chief Engineer to the Board for 1871 and subsequent years. The Manual of the Board of Street and Water Commissioners, available for 1871-72 on, contains the Board's weekly meeting minutes including resolutions heard, bids

opened, bills paid, etc., providing detailed information on waterworks plans, contracting, and expenditures.

Supplementing the Commission reports, Engineer's reports, and minutes, important primary sources include local and state laws and ordinances, records of property transactions, newspaper articles and advertisements. Most important, John D. Ward, the first President of the Water Commission, wrote a descriptive account of the original waterworks that was published in 1856. This account is reproduced in Appendix A. An early history of Hudson County's water supply by Edlow Harrison (1909) is also useful. The nation's first engineering journal, *Engineering News*, which commenced publication in the 1870s, contained occasional pieces on Jersey City, including a November 27, 1880 article on Reservoir No. 3 and an account of the Jersey City system in its series on the history of American waterworks (appearing June 4, 1881). Map sources include Douglas (1841), Clerk and Bacot (1854), Wood (1855), Culver and Culver (1859), Dripps (1860), Walling (1860), Hopkins (1873), Spielman & Brush (1880), Brush (1885), Fowler (1887), the Sanborn insurance maps, and miscellaneous utility maps mainly dating from the early 20th century, on file at the Jersey City Department of Public Works.

There is a large body of secondary literature on the history of public works in America (see Hoy and Robinson 1982). An overview on water supply is provided by Armstrong et al. (1976, Chapter 8). Anderson (1980) presents results of an investigation of the technology and economics of 19th-century urban water supply, focussing on northeastern cities. The most important urban water supply systems of the first half of the 19th century were those of Philadelphia, New York, and Boston. Blake's *Water for the Cities* (1956) remains the standard secondary work on these and other cities (see also Wegmann [1896], Weidner [1974], Koeppel [2000], Weston [1878], Gibson [1978]). The New York and Boston cases are particularly relevant for Jersey City. New York's 1840s Croton system was cited repeatedly in discussions surrounding the design of the Jersey City Waterworks, and the latter's Chief Engineer, William S. Whitwell, had previously served as one of the principal engineers for the Boston works.

Using both primary and secondary sources, the James and Dresdner (1992) study provides an excellent historical context for the 1854 waterworks system as a whole. It should be referred to for an account of the original construction of the works and for a discussion of the policy, financial, engineering, and public health issues involved. The present study contributes a more detailed description of the pipelines, a history of the waterworks subsequent to the 1854 opening with a description of the later features, and additional graphic depictions of components of the system. In addition it describes the archaeological examination of the original 20" cast iron pipeline.

3. DOCUMENTARY STUDY

3.A. The Original Waterworks

Prior to 1854 Jersey City relied on wells and cisterns for water, but according to the head of the town's first Water Commission the supply was always poor:

> …a large proportion of the lands lying within the chartered limits of Jersey City, are a part of what was formerly an extensive marsh, the soft mud of which reaches in some parts to a depth of seventy feet… From this marshy soil, no water fit for domestic use could be obtained; nor was it found by boring the underlying rocky strata, to the depth of 300 feet; and in that part of the city which in its natural state was above the reach of tide, the formation is of such character that water found by sinking wells was poor in quality, and the supply small and uncertain (Ward 1856:1).

Crowds formed around public wells, and water was carted from Bergen Hill (west of the town at that time) in casks for sale in the streets of Jersey City (*ibid*.).

As in other American cities, with rapid population growth the need for a reliable supply of fresh water became acute. In addition to the lack of water for domestic use, fires in the increasingly dense urban core could not be brought under control with the supplies at hand. While disease micro-organisms were unknown, foul water and emanating miasmas were thought to cause disease and contribute to the spread of epidemics. By mid-century, a number of eastern cities (New York, Boston, and Philadelphia, along with smaller cities such as Buffalo) provided models for the development of municipal water supplies. The municipalities of Jersey City, Van Vorst Township, and Hoboken together applied to the New Jersey State Legislature for the creation of a water commission in January, 1851 (Ward 1856; James and Dresdner 1992). An Act was passed on March 18 of that year for the appointment of commissioners to supply the municipalities with "pure and wholesome water" (*Acts of the Legislature*).

The Commission's work in its first years has been recounted in a previous report on the Waterworks (Dresdner and James 1992), but the salient points are summarized and some additional detail offered here.

The Commission hired an engineer, William S. Whitwell, to evaluate various plans that had been put forward for supplying the municipalities with water. Whitwell had been in charge of design and construction of the "Eastern Division" of Boston's Cochituate Aqueduct, the section that carried water from a receiving reservoir on the outskirts of town to a distributing reservoir in the city. The Commission had Whitwell study several proposed water supply routes (see James and Dresdner [1992:16-18]) and had a survey prepared (Figure 3.1).

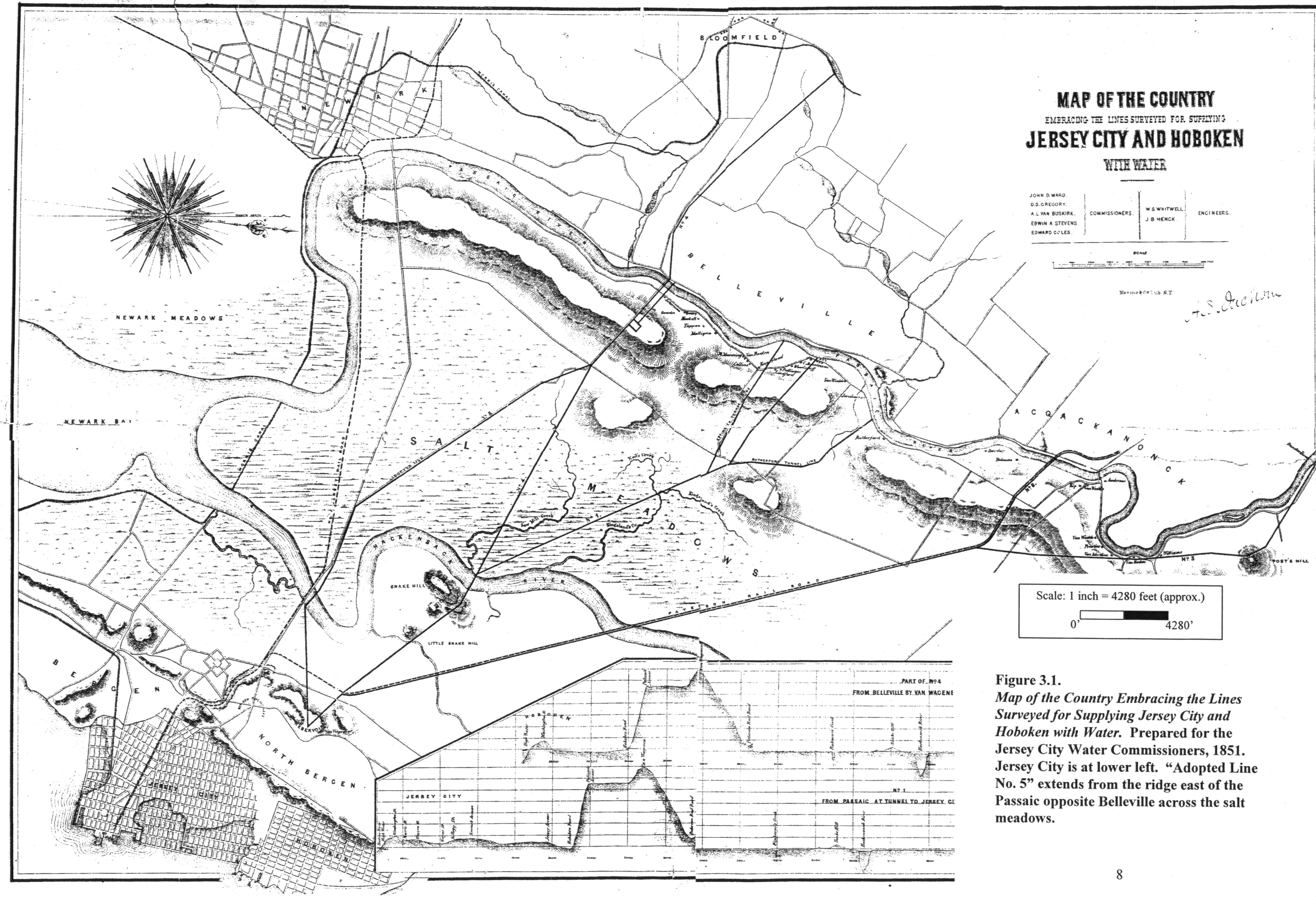


Figure 3.1.
Map of the Country Embracing the Lines Surveyed for Supplying Jersey City and Hoboken with Water. **Prepared for the Jersey City Water Commissioners, 1851. Jersey City is at lower left. "Adopted Line No. 5" extends from the ridge east of the Passaic opposite Belleville across the salt meadows.**

A tentative site for the distributing reservoir, on the estate of J. Van Wagenon on Bergen Hill just west of Jersey City, was selected in advance in order to evaluate the various schemes. In addition to evaluating in depth the previously proposed alternatives (*RWC*, 1st Report, December 1851, Appendix), Whitwell presented his own plan for Jersey City (shown on Figure 3.1 as "No. 5"), involving components essentially similar to his section of the Boston system (Weston 1878). It called for water to be steam-pumped from the Passaic River opposite Belleville into a receiving reservoir, then carried by gravity in a 6.2-mile pipeline across the salt meadows up to the distributing reservoir. The pipeline could pass under the Hackensack River near Snake Hill or could parallel the Belleville Turnpike and then the Newark Turnpike and cross the river next to the turnpike bridge (Figure 3.1). Whitwell argued that the latter route was preferable, though a bit longer, because with the bridge crossing the pipeline would be more easily accessible for repairs.

Other elements of the plan were outlined in Whitwell's first report to the Commission (*RWC*, 1st Report, December 1851, Appendix). An open cut approximately 400 feet long would bring water from the Passaic to a pump well. From there it would be pumped through 20-inch pipes 2,200 feet to a reservoir or stand pipe at the top of the ridge on Barbadoes Neck, 150 feet above high water. A suitable site for the pumping house was noted across the river from Belleville on the east side of River Road, and the area adjacent to the Belleville Turnpike on top of the ridge was found to be suitable for a reservoir. The 20-inch pipeline would cross the marsh from the reservoir to the Hackensack, and be carried over the river via a structure alongside but distinct from the turnpike bridge. The structure would consist of piers and an airtight wooden box, with a line of guard piles and fenders tied into the turnpike bridge to protect the box from river traffic. At the draw, a 30-inch diameter syphon would carry the water down below the reach of ships and back up. The capacity of the pipeline was calculated at 2 million gallons of water per day.

For the pumping station at the Passaic Whitwell proposed a "Cornish engine," so called because it had been developed to raise water in the mines of Cornwall. As of 1851, only three such engines were in use in the United States, two in the mines of Pennsylvania and one at the Buffalo waterworks. No information on the performance of these three engines was available at the time of Whitwell's report, but an English engineer had reported very favorably to the Jersey City Water Commission on the Cornish engine at work at the East London waterworks (Figure 3.2). It was estimated that an engine installed at the Passaic would only have to operate for six hours per day to pump one million gallons.

The reservoir opposite Belleville was intended to avoid pumping directly into the supply pipe, but would also serve to store water and as a settling tank. It was to be sited above the pumping station on top of the ridge, which was at an elevation of 150 feet above high water. Whitwell planned for it to be quite small, 200 feet square and 8 feet deep, for a capacity of 2 million gallons. He noted that it could be "made nearly all in excavation, in which case the sides and bottom, after being covered with puddled earth, will be faced with bricks laid in cement." It was suggested that a lot large enough to accommodate

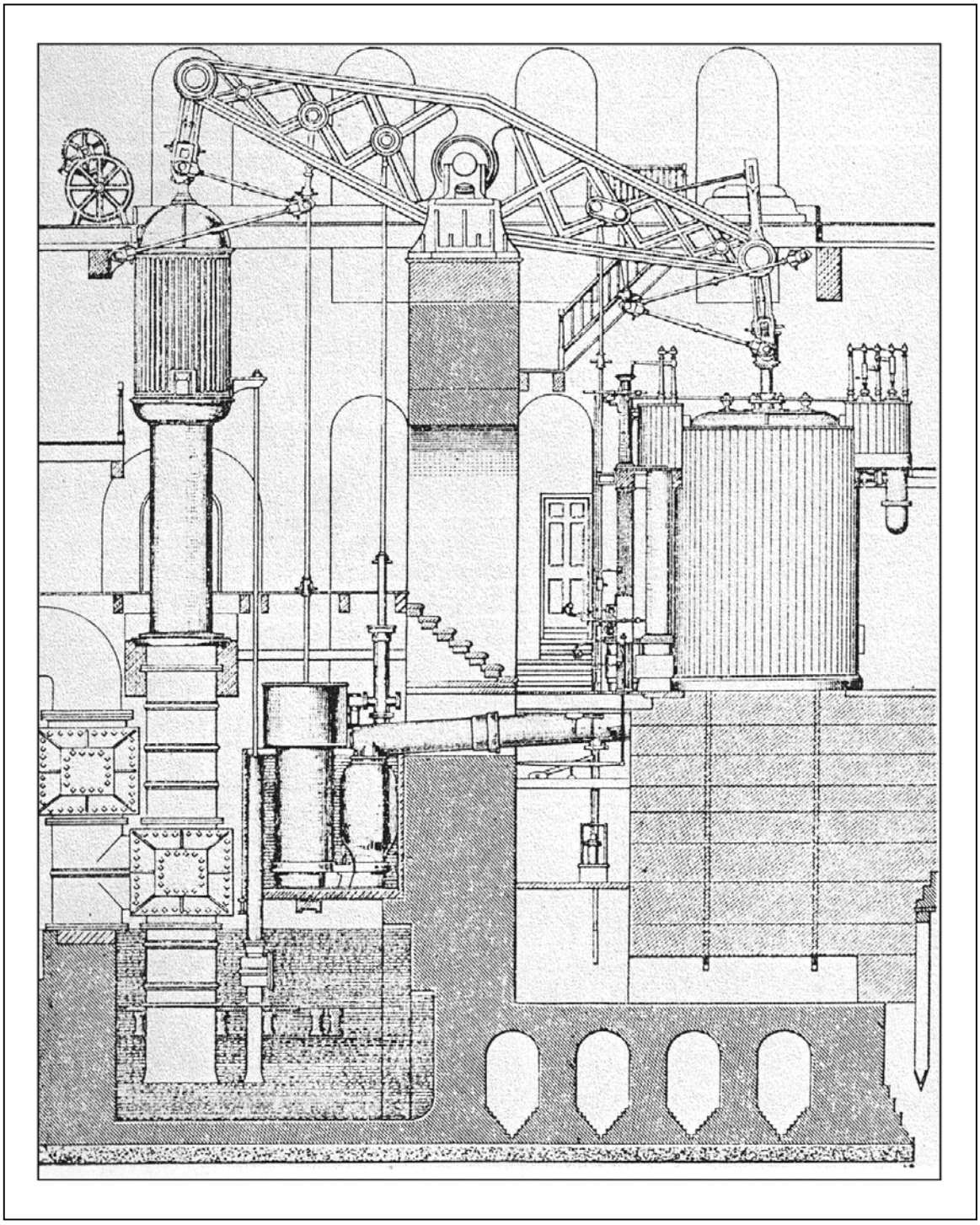


Figure 3.2. Depiction of the Cornish steam pumping engine at the East London Water Works, erected in 1838. Source: Hunter 1979, Vol. 2.

future expansion be acquired. It was also suggested that to save on the system's initial expense, a stand pipe could be built instead of this reservoir.

Whitwell originally planned the distributing reservoir on Bergen Hill as a 13-acre, 10-foot deep structure containing 30 million imperial gallons. The top water line was to be 125 feet above high water, which was lower in elevation than the receiving reservoir, enabling it to be filled by gravity flow. It would also be 104 feet above the highest point in what was then Jersey City, a height that would produce water pressure superior to that of the systems in New York, Philadelphia, or Boston (*RWC*, 2nd Report, January 1853). Its banks were to be 4 feet above the water line and sloped 1.5:1 on the inside and 2:1 on the outside. A wall of puddled earth would be built at the center of the bank, the bottom lined with gravel, and the sides gravelled and then lined with mortared bricks "laid upon their edges" to a depth of 6 feet or deep enough to accommodate fluctuations in the water level. The outside embankment was to be sodded and the top gravelled. Brick influent and effluent conduits would pass through the bank, with their stop-cock chambers on the interior. Whitwell's plan called for the reservoir to be divided into two chambers by a brick wall with a gate and weir, so that each half could be drained and cleaned periodically. The dividing wall was never built.

Whitwell's arguments for his scheme, in addition to the accessibility of the pipeline at the Hackensack, were as follows:

> By this mode of supply the works may be made of a size adapted to the present wants of your citizens, and enlarged whenever the increase of the population requires.
> …By placing the lifting power at the Passaic, instead of at the foot of Bergen Hill, the conducting pipe is reduced from thirty to twenty inches, a reduction of expense not only in the first cost, but applies to the period when a second pipe will be needed.
> …In crossing the marsh, upon this plan, the pipe may be laid upon the top of the turf, and the expense and inconvenience of laying beneath the surface avoided, a feature inherent to all plans in which the lifting power is at the foot of Bergen Hill.
> …it is shorter than any other line, except that north of Snake Hill, and consequently the cost of repairs and renewals is proportionably less.
> …the expense is nearly two hundred thousand dollars less than that of any other plan by which the water is delivered at the same height (*RWC*, 1st Report, December 1851, Appendix).

Cost estimates for each alternative were provided (*ibid.*):

No. 1, From Passaic, by a tunnel,	$1,049,868.44
No. 2, From the canal at Paterson,	904,841.07
No. 3, From the Dundee dam,	933,921.91
No. 4, From the Morris canal,	969,396.96
No. 5, From the Passaic at Belleville,	786,692.34

Whitwell's plan "No. 5" was presented as the most cost-effective (see discussion in Dresdner and James 1992) and was adopted. The system that was actually built over the next two years was modified in certain respects both from the original plan and from the designs actually contracted in 1852 (see *RWC*, 2nd Report, January 1853). It was described in detail by Commissioner Ward in his 1856 account and reference should be made to this document (Appendix A). Major differences between the plan originally put forth by Whitwell and the system as built included:

- Enlargement of the pumping house at the Passaic to accommodate two engines, in anticipation of future expansion
- Considerable enlargement of the receiving reservoir – its depth was 16 feet, capacity 10.3 million imperial gallons
- Modifications of the distributing reservoir and an increase in its capacity – its elevation was 128 feet, surface size 12 acres, depth 12 feet, and capacity up to 45 million gallons
- An increase in the total mileage of distributing pipes

Land acquisition began as soon as the Whitwell plan was approved. Figure 3.3 illustrates the properties affected along the route of the pipeline east of the Hackensack and at the Bergen Hill reservoir site. The deeds for the pipeline generally specified a 30-foot strip of land for the Waterworks Pipe Line right-of-way, with adjacent property owners retaining rights to cross it (e.g. Hudson County Deeds, 30:340, 344; 31:185, 221; 32:189). At least one property owner, Mr. Tice, opposed the transaction, and a legal proceeding was undertaken (*RWC*, 3rd Report, April 1853). Properties in the salt meadows included strips of land through "Schuyler's Meadows" and "Costar's Meadows" along the north side of the Belleville Turnpike.

Bids from contractors were solicited in the summer of 1852 (see Dresdner and James [1992:22-23] for details). Construction of the distributing reservoir on Bergen Hill began in October of that year, and the laying of the 6.2-mile pipeline began on November 2 (*RWC*, 2nd Report, January 1853).

Only high-quality cast iron pipe was solicited for the Jersey City water system. Cast iron had taken the place of wood for water pipes as urban systems were developed during the first half of the 19th century (Anderson 1980:10-13; Armstrong et al. 1976:233). The first domestically produced cast iron water pipe was 6-inch pipe manufactured for the Albany water system in 1813. Larger diameter cast iron pipe was rare in the early 19th century, and 20-inch pipe was first manufactured in the United States in Philadelphia in 1820 for that city's water system. By the 1850s, cast iron was normally used instead of wood. An early technical problem with iron pipes was inconsistent thickness caused by the horizontal casting technique. In 1846, a vertical casting technique was developed that improved the strength, uniformity, and accuracy of pipes. Vertical casting quickly made the older horizontal technique obsolete (Anderson 1980:13). A second problem of cast iron pipes was interior deterioration due to the interaction of the iron with water.

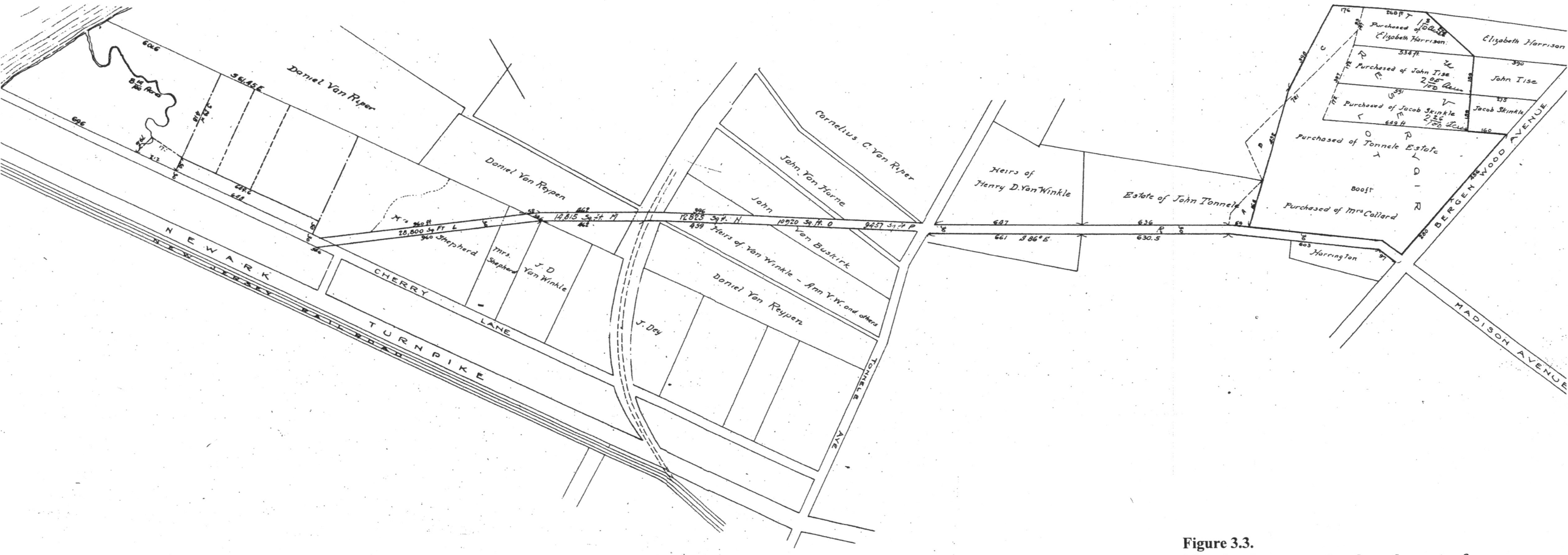


Figure 3.3.
Map showing properties along the route of the Jersey City Water Works and the Bergen Hill Reservoir lots. The Hackensack River is at left, Bergenwood (now Summit) Avenue at right. From an undated volume on file at the Jersey City Department of Public Works.

One solution was offered by cement-encased cast iron pipe, a product developed in the 1850s (*ibid*.). A Jersey City firm, the Patent Water and Gas Pipe Company, was among the first producers of this pipe, and would supply some of the distribution pipes for the city's system.

The first pipes for the Jersey City system, including 400 feet of 26-inch diameter, 1426 feet of 20-inch, 813 feet of 12-inch, and 5640 feet of 6-inch, was to meet strict specifications (*Daily Telegraph*, 14 July 1852, in Dresdner and James [1992:Supplement #3]) and was subject to inspection by the Chief Engineer. Sections had to be 9 feet long, of uniform thickness and cast for pressure of 300 lbs. per square inch. Joints were to be of the spigot and faucet type. All 20-inch and 26-inch pipes had to be cast vertically, and preference was given to companies that also produced the 12-inch and 6-inch pipes using this superior method. The quality of the iron was to be equal to "good No. 2 pig-iron remelted, and such as will bear cutting and drilling."

Pipe was ordered initially from three suppliers: Colwell & Co. of Philadelphia, and two New York City firms, Mott &Ayres and Rider & Ward (*RWC*, 2nd Report, January 1853). The first shipment was received, from the Philadelphia firm, in mid-October. Whitwell reported that 3 miles of 6-inch distribution pipes and 1200 feet of the 20" main between the Hackensack and the Bergen Hill Reservoir were laid during November and December of 1852, after which work was halted for the winter. Pipe laying would be resumed the following spring, when work on the boxing and pilings for the Hackensack River pipe crossing would also begin (*ibid*.). At some point during 1854 the Patent Water and Gas Pipe Company of Jersey City would begin to supply the newly-developed type of cement encased distribution pipes (*RWC*, 7th Report, January 1856; Patent Water and Gas Pipe Co., 1857).

In the fall of 1852 a proposal from the West Point Foundry, engineer Robert P. Parrot, was accepted for construction of the Cornish pumping engine. The engine was to be the largest of its kind in the United States (*RWC*, 2nd Report, January 1853; 3rd Report, April 1853). Whitwell, accompanied by the West Point engineer, visited Buffalo to examine that city's two Cornish engines in December. He reported that they worked quietly and steadily, and at less cost for fuel than any other water pumping engine in the country. The Jersey City engine was built in early 1853. Proposals from contractors for the receiving reservoir, pumping station, and inlet conduit at the Passaic were solicited in the winter and spring of 1853.

"Difficulties" in the labor market impeded progress in the early spring of 1853, but work had picked up by April (*RWC*, 3rd Report, April 1853). The receiving reservoir was being built by James and Charles Collins, the pumping station by Keeney, Halladay & Randall. It is not known whether an architect had designed the engine house and other structures. Construction of the pumping station had proven more difficult than anticipated due to the high water table.

Figure 3.4 is a plan of the "Belleville Works" dating to approximately 1865. Structures shown on this plan that were completed in 1853 and 1854 were the Engine House, Boiler House, stables, the Conduit House, a coffer dam for the inlet conduit, and a pier extending into the Passaic to the north of the Conduit House, built to prevent ice from obstructing the inlet. See Appendix A for a profile drawing of the brick inlet conduit, possibly the only surviving design drawing from the original waterworks.

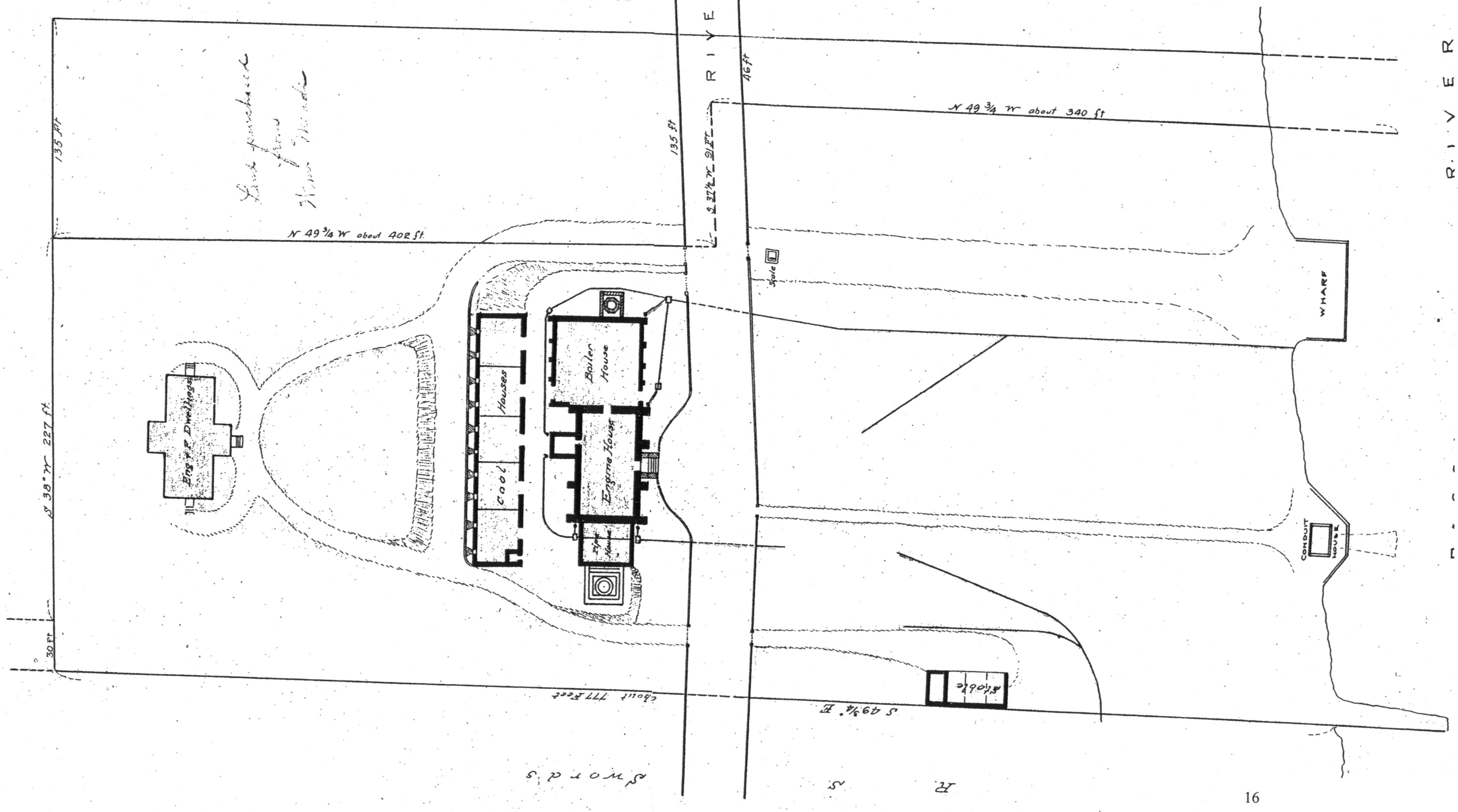
Also underway in April 1853 was construction of the siphon for carrying the pipeline under the Hackensack at the draw, and work on the distributing reservoir and pipe laying continued. By the time of the Commission's 4th Report in January 1854, all pipe on order had been delivered and most of it laid, 122 hydrants had been set throughout Jersey City, the steam engine had been delivered, the Hackensack River pipe box was close to completion, the siphon was built and ready to be installed, and the reservoirs were nearing completion. Construction of the pumping station at the Passaic was proving most problematic, but was expected to be completed in the spring of 1854. A problem had also been encountered at the distributing reservoir, when the soil at the bottom proved too porous to be simply covered with gravel, and had to be covered with a layer of clay and then puddled gravel. The small brick gate and screen houses at the reservoir remained to be completed.

The installation of the 20" pipeline across the marsh is of particular interest here. Whitwell described the method used in his report to the commission:

> All but a very small portion of that long extent of marsh between the Hackensack river and a point one half mile east of Belleville ridge, was formerly covered with a dense cedar forest, the roots and trunks of which now bind its surface together into a strong platform, capable of bearing a certain amount of additional weight without sinking. Over this part the 20 inch main pipe has been laid upon a platform of planks eight feet wide, laid in some places with spaces between, but for the most part with the edges of the planks in close contact. The pipe as then been covered with the mucking taken from the ditches, to the height of one foot above the top of the pipe, over which has been laid a coating of gravel of four inches in depth, to protect the vegetable matter in the mucking from combustion (*RWC*, 4th Report, January 1854).

Commissioner Ward's description of the pipeline (Appendix A) added the detail that "for short distances, near the solid ground at each side of the marsh, two rows of piles were driven and capped to serve as a foundation for the pipes…." This method was used between the east side of the Hackensack and the foot of Bergen Hill as well for half a mile at the base of the Belleville ridge, where the marsh matrix was too soft to form a solid base (*RWC*, 6th Report, February 1855). Because the salt marsh between the Passaic and the Hackensack was known to be unstable, the pipe laid in 1852-53 had been carefully monitored and tested. Though only minor settling had been noted, Whitwell cautioned that the effect of the weight of the water over time could not be precisely predicted. He suggested that in the future additional shoring could be built and pipe joints re-set as needed to maintain the pipeline.

Figure 3.4.
Plan of the Belleville Works, circa 1865.
From an undated volume on file at the
Jersey City Department of Public Works.



By July of 1854 only minor interior and landscaping work remained at the pumping station at Belleville (*RWC*, 5th Report, July 1854). The Cornish engine had been erected and tested in June, but a valve case had given way, and a new one was awaited. The siphon was in place beneath the Hackensack. Water had been let from the reservoirs into the distributing pipes, and a few defective pipes had been repaired. The public was growing impatient, having heard that the pipes had actually been filled, and newspaper editors urged the Water Commission to make it available:

> …our citizens are waiting patiently for a further adjournment of their expectations. …we have heard it stated, on pretty good authority, too, that the Passaic water has passed throughout city, and that the authorities wish it to be kept still until they can get up a celebration in honor of the occasion. This may be all very well, but keeping back such an indispensable article as water for the purpose of making a display over it, is almost an absurdity. Gentlemen of the Water Commission, if there is, or has been, water in the pipes, let our citizens know it, for they are anxious not only to know, but to see and taste it ere the summer is ended…(*Daily Sentinel & Advertiser*, 7 July 1854).

Water rates and municipal regulations regarding the water supply, as well as a new plumbers' license and record forms for tapping the Passaic water, were published for Jersey City with the Commision's report for July of 1854 (Appendix B). William S. Whitwell left the post of Chief Engineer in July, having completed his duties; it is likely he took another similar post elsewhere, but it is not known where. The Commission appointed engineer George Bailey in his place.

The pumping station was put into operation on August 15, 1854 (*RWC*, 6th Report, January 1855), and the distribution system was tested in the following days. Civic pride replaced impatience in the local press:

> No. 1's boys [the fire company] had the "old masheen" out on Saturday night [August 19], washing the streets, the Commercial and Sentinel Buildings, and other points, to their great delight. The other companies, were enjoying themselves in the same manner in other parts of the city. Yesterday [August 20] the water was allowed to run from the pipes for the purpose of cleaning them; and at the foot of Essex street, a large jet issued to the height of fifty feet during the day, being perceptible to the New Yorkers, and those going on excursions down the bay, who were constantly asking "what was up in the Jerseys?" thinking, no doubt, that the stream of Passaic which was mingling intself with the waters of the Hudson, was a water spout! (*Daily Sentinel & Advertiser*, 21 August 1854).

Jersey City's civic celebration was held in October, with a parade of dignitaries marching from downtown up to the reservoir, orations, and fireworks (James and Dresdner 1992:28 [no source is given]). In February 1855 the Commission reported on the first few months of operation, noting a few modifications that had been made or were needed and items of work that remained, and favorably evaluating the performance of the steam

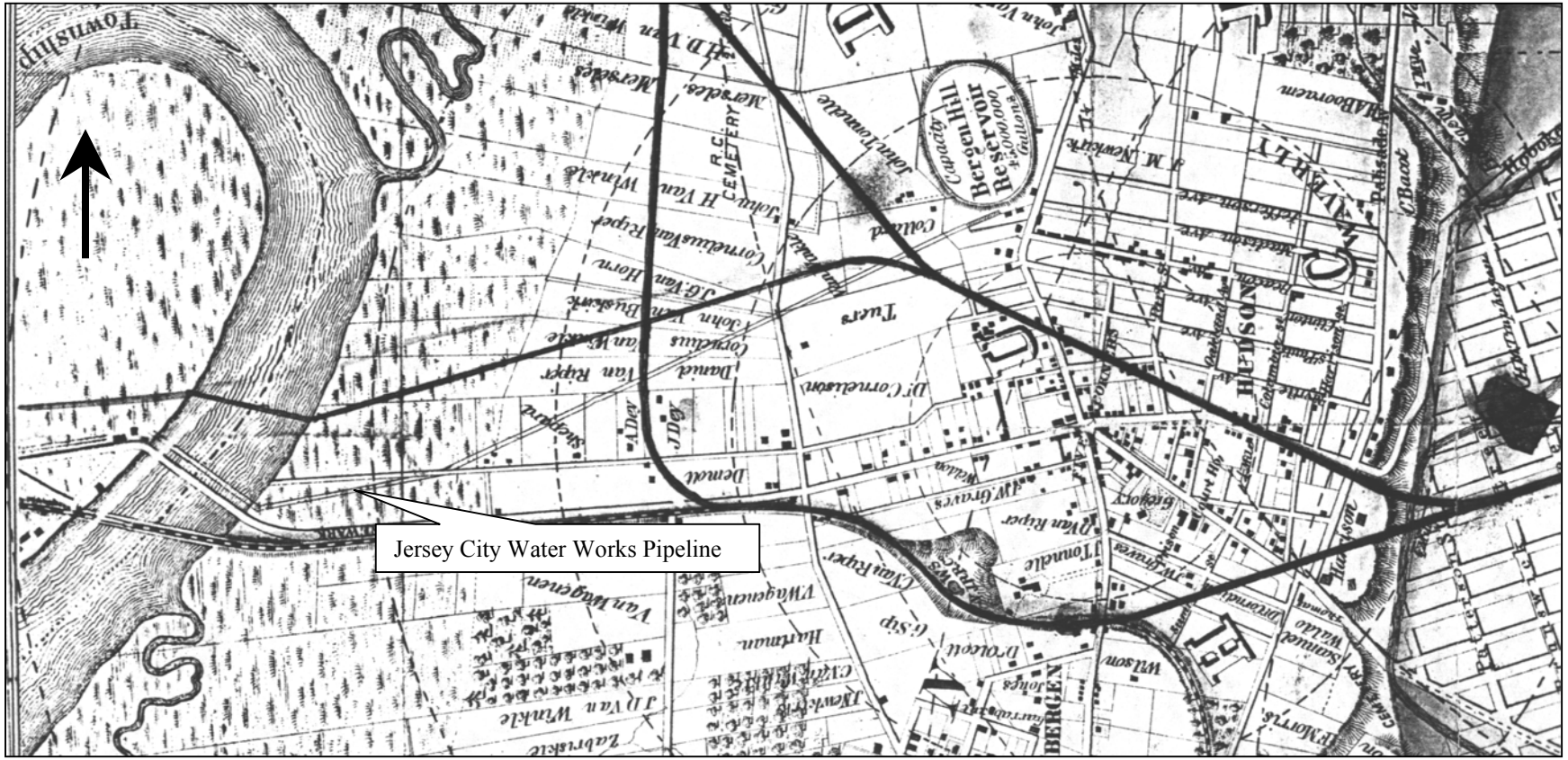
engine (*RWC*, 6th Report, February 1855; see summary in James and Dresdner 1992:28-29). The Wm. H. Wood map of Jersey City in 1855 (Figure 3.5) depicted the pipeline and the Bergen Hill Reservoir shortly after their opening.

The pipeline between the two reservoirs was reported in good condition after the first months of operation. Settling was believed to have caused the pulling apart of sections of pipe in the box across the Hackensack, and placement of a slip joint to the west of the siphon was recommended. The embankment carrying the pipe across the marsh had succumbed to erosion by wind and rain and the line had to be completely re-covered. In the following years fires burned over the meadows in the summer months, exposing the pipes again; the covering of the pipes would become a matter of yearly maintenance (*RWC*, 8th Report, Sept. 1857, 9th Report, July 1858).

Dwellings for waterworks personnel were another concern in the first year. The pumping station personnel resided across the Passaic in Belleville. As this was found to be inconvenient, the Water Commission contracted for "three frame dwellings in the rear of the engine house, to be occupied by the engineers and firemen" in early 1855 (*RWC*, 6th Report, February 1855). It was reported in January of 1856 that the buildings for the engineer and firemen had been completed and occupied (*RWC*, 7th Report, January 1856). A single engineer's and firemen's dwelling is depicted on Figure 3.4 (the cross-shaped structure shown to the east of the coal houses). Apparently the original houses were replaced by the single large residence shown on the plan; alternatively, the latter, with its three entrances, in fact depicts the "three frame dwellings" as originally built.

At the distributing reservoir on Bergen Hill, a dwelling that stood "within the enclosure" was put in order in the fall of 1854 and the superintendent was in residence by the end of that year (*RWC*, 6th Report, February 1855). It is not clear whether the house was purpose-built or had stood on the site prior to the reservoir's construction. No plan of the reservoir from this period has been found, and it is not known where the dwelling stood. The 1855 Wood map (Figure 3.5) shows a structure immediately adjacent to the east side of the reservoir, in approximately the same location as the dwelling associated with the later pumping station (see below), first depicted on the 1873 Hopkins map (Figure 3.6).

Minor modifications and repairs were made to the waterworks system in its first years, mainly to the pumping apparatus at Belleville, including addition of a third boiler and introduction of air chambers in the rising main to create pressure for a constant flow to the reservoir. Though the engine was pumping plenty of water for current needs, due to wastefulness Jersey City's consumption was higher than had been anticipated; it was already clear that an increase in consumption would render the works inadequate. Engineer Bailey reiterated his recommendation for a stand pipe to allow the engine to work at a higher rate of speed (*RWC*, 7th Report, January 1856). Still, the Cornish engine compared very favorably both with other types of engines at work in American cities and with the Cornish engines at Buffalo and in England, and by winter of 1856 two other U.S. cities, Philadelphia and Cleveland, were installing new Cornish engines for their waterworks (*ibid*.).



Scale: 1 inch = 1500 feet (approx.)

0’ 1500’

Figure 3.6. **Hopkins, G.M., *Combined Atlas of the State of New Jersey and the County of Hudson.* 1873. The High Service pumping station on the east side of Reservoir No. 2 had just been completed, and plans had been approved for the "New Reservoir" depicted on the map. The latter was not completed until 1880 and only the southern half was built.**

Water distribution pipes continued to be laid throughout the streets of Jersey City. Though the mains were buried beneath the frost line, service pipes to houses had a tendency to freeze in the coldest weather. Customers had learned to leave their water running in order to prevent their pipes from freezing, causing a great deal of waste during the winter months. While meters had been installed to measure water consumption at factories, private houses had unlimited use. Bailey wrote to the Commission: "The most effectual check on the waste of water…would be had by the application of meters in all cases, as has been suggested in New York and elsewhere…" (*RWC*, 7th Report, January 1856).

As in all cities that introduced abundant public water supplies, a sewerage system quickly became a necessity in Jersey City. The Water Commission, mindful of the experience of nearby New York after the introduction of Croton Water in the 1840s, had planned from the start to develop the city's sewers in tandem with the water system, and Whitwell had submitted a plan in 1853 (Whitwell 1853). Construction of Jersey City's public sewers began in 1855. The first sewer main ran from the Morris Canal to the Hudson River. It was built of brick, three feet in diameter, as far east as Hudson Street, and of timber from Hudson Street to the river (through the filled lots). Laterals were of brick and were eighteen inches in diameter (*RWC*, 7th Report, January 1856). Sewers were meant to be flushed from a navigable, tide-water filled canal which was to be constructed along the base of Bergen Hill; however, the canal was eventually deemed unfeasible, and the problem of adequately flushing the sewers would not be solved for decades (*RWC*, 11th Report, March 1860).

As had his predecessor Whitwell, engineer Bailey recommended some immediate improvements to the system, specifically a stand pipe and a second engine at the Belleville pumping station (*RWC*, 6th Report, February 1855). In fact, the Jersey City Waterworks was destined to evolve almost continually from the late 1850s throughout the remainder of the century. Average daily consumption increased rapidly (Table 3.1). Peak consumption was in the winter months, when many users left water running to prevent their pipes from freezing, and the maximum daily consumption was fast approaching the system's limit (*RWC*, 8th Report, Sept. 1857). Furthermore, in 1857 Hudson City (west of Jersey City at the time) and Hoboken were entering into contracts to get their water from the Bergen Hill reservoir (though it would be a few years before Hudson City would be ready to receive the service).

Bailey could predict with assurance that the original system would soon be inadequate. By the summer of 1858 the engineer considered it a matter of luck that no accident had occurred to interrupt operation of the single engine, and urged the Commission to acquire a second (*RWC*, 9th Report, July 1858). He reported that per capita consumption was at 60 gallons per day, "a quantity entirely beyond the wants of such a population, and indicates an enormous waste, which can only be checked by a strict watchfulness, and the enforcement of most stringent rules" (*ibid*.). By 1858 the meters that had been installed at manufacturing establishments were no longer working. New types of meters were being tested, and the regulation of commercial water use would be gradually achieved in

the following decade, including metering of water hydrants at the wharves, used by steam vessels. Individual house meters, however, would not be available until later in the century, when inexpensive models were patented. The atrocious waste of water by Jersey City residents would be decried by city officials throughout the century.

Table 3.1. Daily and annual consumption of water

Year (ending month)	Average daily consumption during the year	Annual consumption
1856 (July)	581,000 gals.	
1857 (July)	1,000,000 gals.	
1858 (July)	1,425,000 gals.	516,472,876 gals.
1859 (July)	1,732,000 gals.	631,498,602 gals.
1860 (July)	2,076,000 gals.	733,627,969 gals.
1861 (July)	2,216,000 gals.	790,787,958 gals.
1862 (July)	2,316,743 gals.	844,368,585 gals.
1863 (July)	2,552,586 gals.	931,694,000 gals.
1864 (July)	3,045,924 gals.	1,111,772,500 gals.
1865 (July)	3,587,890 gals.	1,309,580,000 gals.
1866 (July)	540,307 cu. ft.	197,212,222 cu. ft.
1867 (July)	573,276 cu. ft.	209,246,015 cu. ft.
1868 (July)	628,001 cu. ft.	229,220,661 cu. ft.
1870 (Jan.)	810,665 cu. ft.	295,892,887 cu. ft.
1871 (Jan.)	923,323 cu. ft.	337,014,354 cu. ft.
1872 (Jan.)	1,036,407 cu. ft.	378,288,541 cu. ft.
1873 (Jan.)	1,279,307 cu. ft.	468,226,403 cu. ft.
Source: Jersey City Water Commissioners, Annual Reports; Reports of the Chief Engineer.		

3.B. Expansion

The Jersey City Water Works was designed to be expanded over time. As noted, the engine house at the Belleville pumping station had been built to allow for the addition of a second engine. A second pipeline was also anticipated. Openings for future 36" pipes had been built into the embankments of both the receiving and distributing reservoirs alongside the 20" apertures (see Appendix A). These were sealed off pending the anticipated increased consumption that would necessitate the additional pipeline.

The first major improvement to the works was the construction in 1859 of a stand pipe for the pumping engine (see Figure 3.4). The column, of ironwork by J.S. Bunce & Co., was 6.5 feet across at the base and 4 feet at the top, and rose to a height of 160 feet on a base of brick and stone *(RWC*, 10th Report, July 1859). It enabled the engine to work at

double the speed and resulted in many fewer repairs to the pump (*RWC*, 12th Report, March 1861).

But by the close of the 1850s, just six years after its inauguration, it was clear that the system's capacity would soon fall short of demand without a second pipeline, and a second engine was deemed essential to avoid any interruption in pumping. In October 1860, William Birkbeck, of the Fulton Foundry of Jersey City, was contracted to build a new engine similar in design to the Cornish engine at the works. The choice of a local foundry was deliberate:

> …this Board will feel much satisfaction from having received from the hands of the mechanics of our own city, at a moderate price, so important a monument of skill. It will present to the country at large, a sufficient demonstration that we have among us both the ability and the facilities for the constructuion of steam machinery of the largest capacity, and of the most perfect and delicate adjustment (*RWC*, 13th Report, August 1861).

The new engine was installed at Belleville in the fall of 1861, had its trial run in November, and after a few repairs was ready for full operation by late February 1862. The West Point engine was taken off line for a thorough overhaul, during which time the new engine's operation was reported as satisfactory. Thenceforth, the Jersey City engine continued to serve as backup to the older engine. However, serious accidents during 1863-64 required $11,000 in repairs to the new engine, and the Board of Water Commissioners blamed defects in the materials used in its construction, suggesting that the death of William Birkbeck before completion of the engine had resulted in inferior work at the Jersey City foundry (*RWC*, 17th Report, July 1864). The small inlet conduit limited operations to one pumping engine at a time (*RWC*, 18th Report, July 1865), but both had to be in working order to allow for maintenance and repairs.

Other Civil-war era improvements to the complex at Belleville included a new brick addition east of the engine house for a blacksmith shop and storerooms, a 124-foot by 29-foot coal house to the rear of the engine house, enlargement of the boiler house eastward to house two additional boilers, and construction of a brick building connecting the engine house to the stand pipe (see Figure 3.4). Numerous repairs to the various structures of the works and to the staff dwellings, acquisition of an adjacent dwelling and lot to house additional staff, rebuilding of the gatehouse at the reservoir, and landscaping were also accomplished at Belleville during its expansion in the early 1860s (*RWC*, 14th Report, January 1862, 15th Report, July 1862, 16th Report, July 1863).

The new pipeline from Belleville to Bergen Hill was in the planning stages in 1860-61. To spread the cost over an extended period, it was suggested that the 36" pipeline between the two reservoirs be laid in segments over three years, with each portion connected over to the 20" line until the entire line was in place. In this way delivery could be increased incrementally while saving on interest, and construction costs could be paced with increased revenues. It was also suggested that the new pipeline be submerged beneath the Hackensack, as the box bridge carrying the 20" pipe was

continually subject to damage from ice and river traffic; ultimately, however, a new bridge would be built instead (*RWC*, 12th Report, March 1861, 13th Report, August 1861).

In late 1861 the Commission contracted with the Warren Foundry and Machine Company of Philipsburgh, N.J, to furnish the first 10,000 feet of 36" pipe, to be cast in lengths of 12 feet 4 inches (*RWC*, 14th Report, January 1862). These longer lengths would save money, as fewer joints would be needed. The first delivery was made in April of 1862, and a second contract was let to the same firm for 10,000 more feet of pipe. In addition, the Patent Water and Gas Pipe Company of Jersey city was contracted to produce 2000 feet of their wrought iron and cement pipe, to be used for the segment on the eastern slope of the Belleville ridge. The laying of the first installment of the 36" pipeline, from the receiving reservoir to a point west of the Hackensack, where it was tied in to the 20" main, was completed in December of 1862 (*RWC*, 15th Report, July 1862, 16th Report, July 1863).

The new pipeline paralleled the 20" line across the meadows, but a new method for laying the pipe within the marsh was adopted. This was necessary because the repeated excavations on the sides of the first pipeline to restore its covering had left nothing but mud as a base. It was also noted that the gradual settling of the first pipe beneath the surface of the meadow made it difficult to detect leaks and make repairs. The 36" main was laid as follows:

> Two rows of piles are driven, three feet apart, to a solid foundation, which is found at a depth varying from 12 to 20 feet below the meadow surface. The heads of the piles are then cut off 16 inches below the meadow, and cross capped with 10x12-inch pine timber; upon this capping a brick pier 12 inches thick, 44 inches long, and 13 inches high, is laid up in hydraulic cement.
>
> The pipe when placed upon this pier is securely held in its position by additiional courses of brick work built up on its sides. The piling and capping are thus kept constantly immersed in water, rendering it perfectly secure from decay, and the joints of the pipe being just above the meadow surface enable them to be caulked without difficulty (*RWC*, 15th Report, July 1862).

The new pipeline was completed on both sides of the Hackensack in 1863. The Water Commissioners reported that the new main increased the supply delivered to the Bergen Hill reservoir by one million gallons per day, and that

> Without this additional supply, the board would have been compelled to reduce the consumption of water used by the manufactories, or else cut off a portion of the wtaer required for a full supply of Hoboken and Hudson City.
>
> Happily that painful necessity has been obviated, and there is now no probablility of a recurrence of such a crisis (*RWC*, 17th Report, July 1864).

The 26" distribution main from the distributing reservoir to Jersey City was also backed up by installation of a second line to ensure that service would not be interrupted in the

event of an accident or repairs to the original distribution pipe (*RWC*, 15th Report, July 1862).

The 36" inlet that had been built (for future use) into the embankment of the distributing reservoir in 1853 had been sealed at both ends with brick and cement. The exterior seal was removed and the connection with the new pipeline was made, but it proved impossible to remove the seal from the interior end of the opening due to the depth of water over the pipe and the hardening of the seal over time. Also, "the end of the pipe being on the bottom [of the reservoir], the force of the water would disturb the mud, rile the water, and being so near the mouth of the distributing [outlet] pipes, (16 feet) [the disturbed water] would pass through the distributing pipes into the city before sufficient time for settling had elapsed…" (*RWC*, 19th Report, July 1866; Langan Engineering Associates, 1981). It was decided to run the 36" pipeline over the embankment on the southwest side of the reservoir. At Belleville, as a backup to the reservoir, a connection was made from the rising main around the reservoir to the gatehouse, so that water could be pumped directly into the 36" pipeline (*RWC*, 17th Report, July 1864). This improvement was completed just in time: the eastern wall of the Belleville reservoir collapsed in 1864 and had to be rebuilt, and while repairs were underway water was in fact pumped directly into the new pipeline (*RWC*, 18th Report, July 1865).

It was decided in 1864 that a single bridge would be built to carry both the 20" and 36" supply lines over the Hackensack River, with parallel siphons at the draw. Two other methods had been considered, building a tunnel or laying the pipe on the river bottom. The former alternative was rejected because its cost could not be determined. The submerged pipe plan was initially approved by the engineer, but later was rejected because it was feared the pipe would burst under the pressure of the water. Also, the cost of building the bridge and siphons was estimated at $50,000, while submerging the pipe would have cost twice that sum (*RWC*, 17th Report, July 1864; ultimately the bridge and siphon cost more than anticipated). The original 20" pipeline had 24" diameter pipe at the siphon, but this had been found to cause a loss of pressure. It was specified that the siphon for the new 36" pipeline would be same diameter as the main (*ibid*.).

Work on the bridge and siphon was accomplished in 1864-66, with a brief interruption when the residents of Hackensack brought an injunction, arguing that their navigation of the river would be hindered. The courts removed the injunction, the bridge and siphon were built, and the second pipeline was finally completed across the river in the summer of 1866. The siphon proved to be the Achilles heel of the new pipeline, however, and it had to be replaced several times in the first year. When water was first let into it the pressure caused the joints to come apart. It was replaced with flange-jointed pipe sections bolted together, but one of the sections broke soon after. Several more breaks occurred, one due to ice (*RWC*, 20th Report, July 1867). The Commission quickly became aware that their decision to use a bridge over the Hackensack might cost more than it had saved. By 1870 they had signed a contract for the laying of a 36" pipe, using Ward's Patent flexible joints, under the river (*RWC*, 22nd Report, January 1870; Manual of the Board of Street and Water Commissioners, 1871-72). The submerged crossing was located a short distance to the north (upstream) of the bridge.

In 1871, the newly organized Board of Public Works decided to add a 36" branch pipeline from the 36" main to the reservoir on Bergen Hill. It would tap the 36" cast iron pipeline on the west side of the river, then cross beneath the river in a line with St. Paul's Avenue, proceeding up that street to Bergenwood Avenue (now Summit Avenue) and thence to the reservoir (Report of the Chief Engineer for 1871). The Chief Engineer recommended that the 20" main also be laid across the bottom of the Hackensack, or, to avoid the expense, tied in to the 36" main on the each side of the river to make use of the existing submerged crossing – the latter alternative was ultimately adopted.

The following year, in 1872, the Board moved to add a third pipeline, this one of 36" diameter wrought iron and cement, from the receiving reservoir to connect to the St. Paul's Avenue pipeline (Manual of the Board of Street and Water Commissioners, 1872-73). Apparently convinced by Chief Engineer Culver, the committee on pumping and reservoirs agreed unanimously to specify the cement-lined wrought iron pipes, citing the tendency of Passaic water to react to form accretions on the interior of unlined iron pipes (Report of the Chief Engineer for 1872). The new 36" pipeline was contracted to the American Water and Gas Pipe Company of Jersey City. Its installation was described in detail in *Engineering News* account of the Jersey City waterworks:

> The foundation consisted of two rows of piles 2 ft. apart, capped transversely by timbers 12 in. square and 6 ft. long, on which are laid five stringers 8 by 10 in., with a plank flooring, the whole securely spiked. On this a brick cradle is built in which rests the pipe imbedded in an inch of cement and an 8-in. arch of brick turned over the pipe, 1 in. of cement intervening, the whole covered with 12 in. of earth and sodded.
>
> The length is 22,300 ft., of which 17,500 ft. are laid on the meadows. There are now three 36-in. submerged pipes crossing the river connected with the 36-in. mains (*Engineering News*, June 4, 1881; there were, in fact, only two 36" crossings).

The switch from cast iron to wrought iron and cement was evidently controversial. The new pipeline was opened in December, 1873, and Chief Engineer Culver reported it in excellent condition a year later:

> It is rare in hydraulic engineering to have such an unusual occurrence as a line of such large pipe and for such a great distance, and even across amarsh ofr miles, to be entirely free from some defects, causing vexation and interruption in supply; and if therefore a little pardonable pride is manifested in regarding so unprecedented a success, it is hoped it will be excusable on account of the saving of a large sum in the construction, and ITS adoption in the face of much opposition, when this form of conduit was selected in preference to cast iron (Report of the Chief Engineer for 1874).

The bridge crossing and siphon for the old 36" main were dismantled and removed in 1874; interestingly, the dismantled pipes were "stored in handy localities for future use"

(Report of the Chief Engineer for 1874). The date of removal of the 20" pipeline bridge and siphon is uncertain – it was described as still operating in 1881 (*Engineering News*, June 4, 1881).

In the meantime, improvements at the pumping station at Belleville were being made in order to insure that enough water to meet demand was pumped. In 1867, the stand pipe was altered to make it possible to work both engines at once for part of the time, and engineering improvements to both engines were made to improve their performance in the late 1860s (JCWC, 19th Report, July 1865, 20th Report, July 1867). In 1869-70 a third Cornish engine was built and was put into operation in November 1870 (JCWC, 22nd Report, January 1870; *Engineering News*, June 4, 1881:226). It was housed in an extension built on the east side of the engine house (see Figure 3.7). The new engine was seriously damaged in a major accident one year later, but was repaired and put back into service. Two new boilers were also added at the pumping station, and another extension to the building was constructed to house these (Manual of the Board of Street and Water Commissioners, 1871-72; Report of the Chief Engineer for 1871).

Substantive improvements at the pumping station in the early 1870s also included a new rising main and a new stand pipe. The new stand pipe was160 feet in length and 6 feet in diameter, weighing some 32 tons. A contract for a tower to house the two stand pipes was given to builder William Robertson (Manual of the Board of Street and Water Commissioners, 1871-72; Report of the Chief Engineer for 1871). The 210-foot high tower of brick and brownstone was described in considerable detail in the Chief Engineer's report for 1872 (Report of the Chief Engineer for 1872; *Engineering News*, June 4, 1881).

Building repairs and landscaping improvements were ongoing at Belleville throughout the 1860s. In 1869, as the staff at the pumping station had increased, two more "comfortable double houses" were built for firemen and other hands (JCWC, 22nd Report, January 1870). The dwellings depicted on the 1922 Sanborn (Figure 3.7) are doubtless those erected for workers at the pumping station (none remain standing today). A river wall was built along the waterworks property at the Passaic, serving to protect the inlet, provide a dock for unloading coal and building materials, and improve the appearance of the waterfront (*RWC*, 22nd Report, January 1870; Report of the Chief Engineer for 1871).

During the remainder of the 1870s and the 1880s improvements and modernization of the Belleville works would continue. Repairs to the foundations of the three engines were found to be essential in 1872, and one of the Duplex engines intended for the new pumping station on Bergen Hill (see below) was installed at Belleville in a temporary engine house the following year. An account of this addition and of the numerous further modifications to the pumping station are beyond the scope of the present study. Detailed descriptions, along with discussions of the output of the engines and the impending inadequacy of the Passaic water supply, are contained in the Reports of the Chief Engineer to the Board of Public Works.

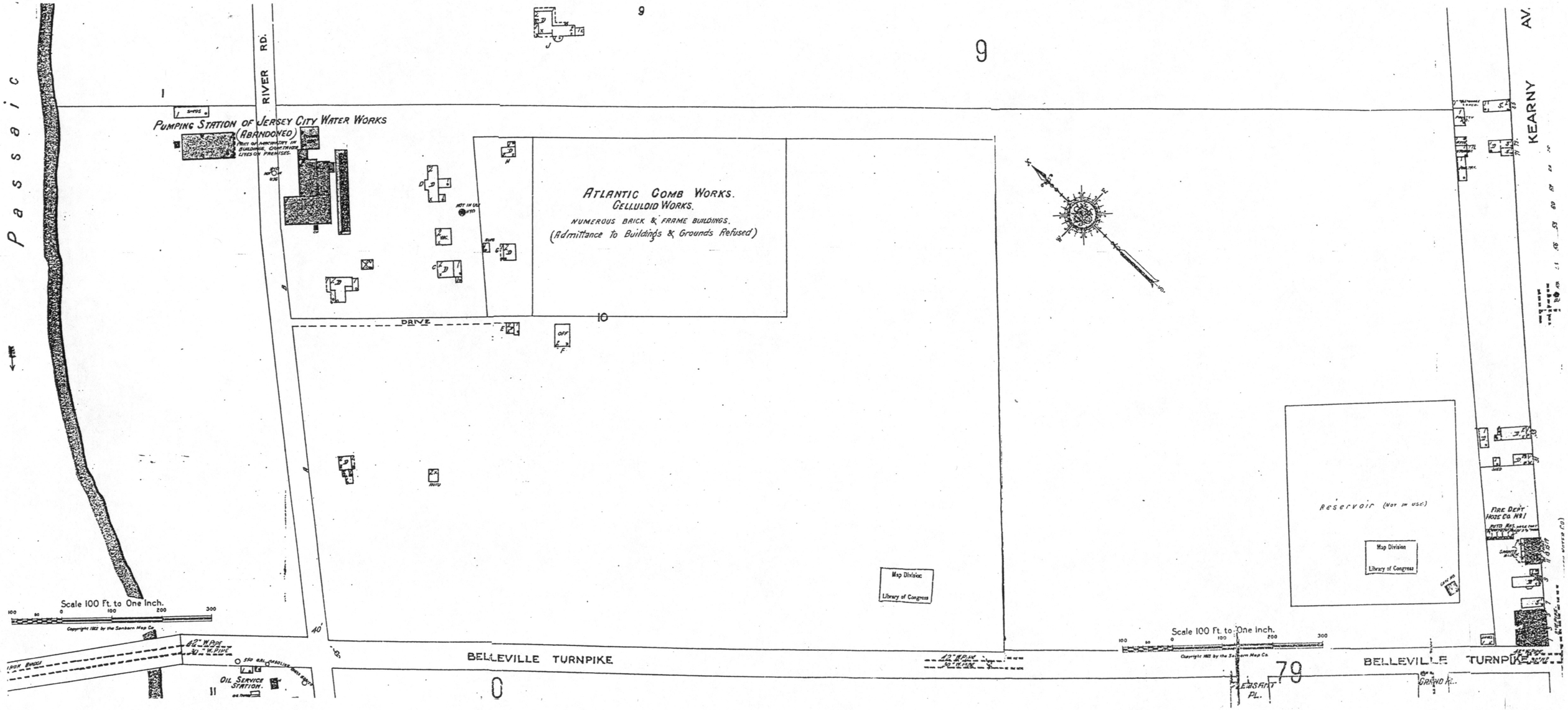


Figure 3.7.
Sanborn Map Company. 1922. The Belleville Pumping Station and Reservoir of the Jersey City Water Works. The facility had been abandoned but not demolished. No structures would remain by 1950.

3.C. The High Service Works and Reservoir No. 3

As early as 1863, less than a decade after the opening of the Jersey City Water Works, the Commission's chief engineer was arguing for a second distributing reservoir (*RWC*, 16th Report, July 1863). Because the original reservoir on Bergen Hill had not been built with a dividing wall, it could not be drained one half at a time to be cleaned, and the water had a tendency to be discolored due to sediments and decaying vegetation. In addition, he argued, increasing consumption would eventually make it necessary to increase the supply available for immediate distribution. During the early 1860s, annual consumption nearly doubled (Table 3.1), and the Water Commissioners predicted that by 1870 only eight days supply of water would be held by the existing reservoir (*RWC*, 18th Report, July 1865). The 1864 collapse of part of the Belleville reservoir may have increased concern about such an accident at the distributing reservoir, and with no additional basin an interruption in service would have been inevitable. Accidents to the bridge, pipes, siphons, and engines were also to be expected, and if more water could be stored near the distribution area such problems would cause less disruption in service (*RWC*, 19th Report, July 1866).

By 1865 the need for another reservoir was accepted and the Board of Water Commissioners began purchase of 20 acres on Bergen Hill east of the first reservoir as a site for the new basin. At $3,700 per acre, the Commission believed it was making a good investment:

> All of the ground surrounding the old reservoir is laid out into building lots and had not the ground been secured now, a few years would undoubtedly have seen it covered with buildings, making it impossible to buy it for reservoir purposes without paying three or four times the present price for the land (*RWC*, 18th Report, July 1865).

As it turned out, it would be six years before the reservoir was actually begun, and nearly two decades would pass before it was completed. In the meantime the supply available for distribution was rendered sufficient through improvements at the pumping station and stringent regulation to prevent waste.

Though the original plans for the new reservoir called for an embankment sloped on both sides with a puddle core, the design was modified to include only an interior slope with a rubble wall exterior (Langan Engineering Associates, 1981). Specifications were as follows:

> …the embankment must be carried up to a level with the top of the present distributing reservoir and twenty-five feet in vertical height from the foot of the inside slope; the side of the bank to be cut down. The material of the bank to be well selected, free from lumps or stones more than three inches in diameter and put on in six-inch layers, dampened and rolled. The puddle to be made of the best material found on the ground, put on as shown in the drawings and worked as

> directed by the engineer. A foot-path on top, of Schrimshaw pavement, laid four inches thick. The slope wall to consist of a backing of clean, small stones, or spalls, twenty-four inches thick and well packed; on this to be a face wall eighteen inches thick, composed of a single course of stones laid dry, no stone to have less than fifteen inches bed, and no joint to be open more than three-quarters of an inch. "In earth, stones of two feet square shall be used for the lowest course; and in rock, a face at right-angles to the slope shall be made on which to start the wall."
>
> Cut stone for coping stairways, etc., to be of the best Maine granite, double patent hammer dressed.
>
> All rubble work to be of blue or brown stone laid in full beds of cement mortar.
>
> Concrete to be made of mortar with two parts of sand to one of cement, and such amount of clean, broken stone as may be directed by the engineer (*Engineering News*, Nov. 27, 1881).

Work on the new reservoir, known as Reservoir No. 3 (the first distributing reservoir would now be called Reservoir No. 2), began in late June of 1871 under Chief Engineer John P. Culver (Report of the Chief Engineer for 1871). The contract had gone to the lowest bidders, John W. Mitchell and David B. Bridgeford, who had sublet part of the work to J. B. Clevelend. Irregularities in the billing prompted the city to refuse payments and work stopped until the State Legislature authorized a settlement in 1878. The size of the reservoir was reduced to the southern half of the basin originally planned, which was nearly complete, and the northern half (already excavated but not completed) was filled in (later to become Pershing Field) (Langan Engineering Associates, 1981). Numerous maps of the 1870s and 1880s depict the reservoir at its full intended size (see Figures 1.2 and 3.6).

Water was let in to the reservoir to a limited depth for the first time in September of 1880, but it leaked so badly that cellars in the neighborhood were filled with water. The Chief Engineer at the time, W.W. Ruggles, had in fact advised against filling the basin, having noted that water flowed into it under the walls from adjoining streets. The failure was caused, in the opinion of the editors of *Engineering News*, by the failure of the contractor to put in the line of puddle 18 inches thick from the bottom of the slope to the puddle wall and the slope wall from the bottom of the reservoir to the bench wall. The rubble wall did not reach down to bedrock, and the water leaked through an intervening layer of coarse gravel (*Engineering News*, Nov. 27, 1881; Figure 3.8).

Solutions were proposed, but it is not clear what was actually done to make the reservoir serviceable:

> One scheme is to concrete the entire bottom; another is to build down at the side of the puddle wall to the solid rock. We were informed by Mr. Ruggles that in all probability a wall two feet in thickness would be built from the foot of the slope wall to the rock with a puddle front of one foot in thickness, and the slope to the bench wall covered with a layer of concrete eighteen inches thick. If this project

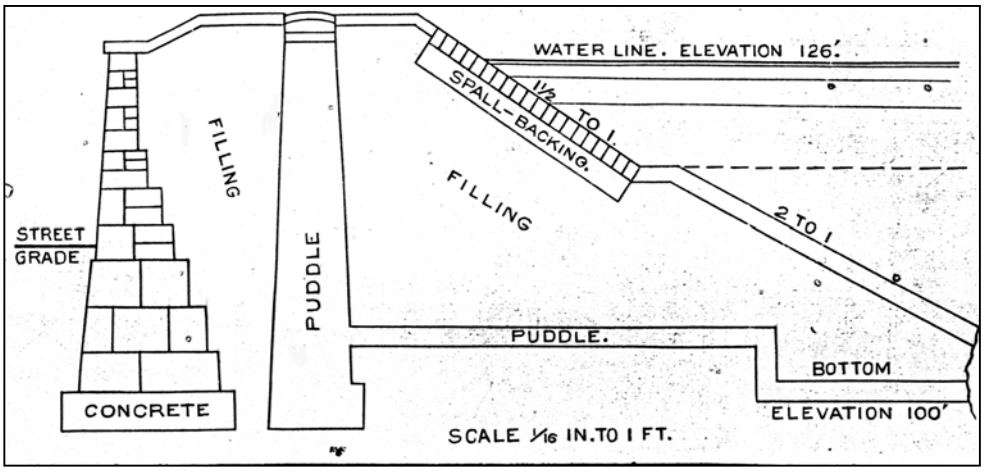


Figure 3.8. Profile of Reservoir No. 3, Jersey City Water Works. From *Engineering News*, November 27, 1880.

> be carried out, we do not see anything to prevent a leak through the slope above the bench wall and thence out through the filling (*Engineering News*, Nov. 27, 1881).

The American engineering profession, represented by its main organ *Engineering News*, took an interest in the details of the basin's construction because in that period each public works project could potentially serve as an example (good or bad) for other cities.

Reservoir No.3, presumably following some modification of the walls, was tested to full height in August of 1881, but leaks were found at the west wall of the Gatehouse on Summit Avenue. The wall of the gatehouse was butressed on the interior with iron castings set in hydraulic cement, which apparently stopped the leakage, and the reservoir was finally put into regular use (Langan Engineering Associates, 1981).

In the bird's eye view of Jersey City produced in 1883 (Figure 3.9), the two reservoirs are shown, with the southern half of Reservoir No. 3 filled and the northern half a fallow field. Two early 20th-century views across Reservoir No. 3 are reproduced in Figure 3.10. Plates 3.1 through 3.3 show extant features of the reservoir, now drained. As of the date of this report, a cut has been made through the south wall of the basin allowing a view of the profile (Plate 3.4).

In addition to the new reservoir, by the end of the 1860s a pumping station was recommended for the Bergen Hill portion of the waterworks. The small cities of Bergen and Hudson City had grown, and areas had been developed that were higher in elevation that could not be served adequately by the gravity distribution system. In 1870-71, the two municipalities were incorporated into Jersey City, and the need to supply them with water became a priority for the new Board of Public Works:

> The water line in the distributing reservoir [Reservoir No. 2] is at an elevation of 125 feet…and while this elevation gives sufficient head to render the supply plenteous in old Jersey City and Hoboken, yet portions of former cities of Bergen and Hudson are at grades approximating so nearly to that of the water line that the quantity furnished is inadequate, while the upper portion of the city is entirely without any supply whatever except what is obtained from wells and springs.
>
> As the growth of such localities is retarded by the lack of water facilities, while liable for any indebtedness incurred in the extension and maintainance [sic] of the works, this is manifestly unjust (Report of the Chief Engineer for 1871).

Construction of the High Service Pumping Station on the east side of the distributing reservoir was begun in 1870 and completed in 1872. The engine and boiler houses were in an impressive, three story brick Second Empire building with a prominent four story tower fronting Summit Avenue (Figures 3.11 and 3.12; see also Figures 3.6, 3.9, and 3.10). The architect was George W. Labaw, the contractor O'Neill & McLaughlin. A standpipe, located south of the engine house, raised the water to a height of 13 feet above the reservoir's high water mark. This standpipe was fitted to the influent line to Reservoir No. 3 in 1884 (Langan Engineering Associates 1981).

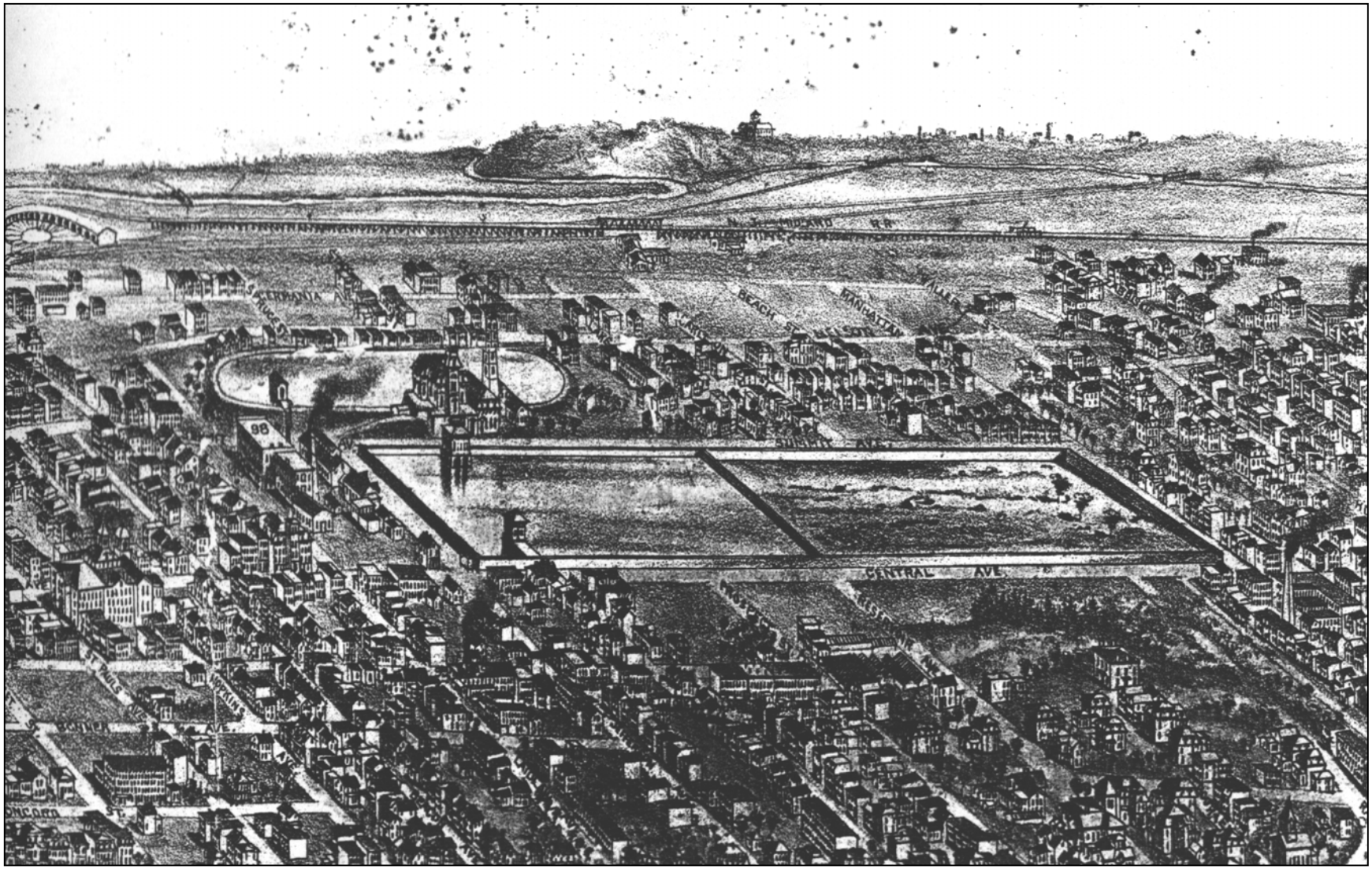


Figure 3.9. **Part of *Jersey City, N.J.* bird's-eye view, 1883, showing Reservoir No. 2 (eliptical), the new Reservoir No. 3 (rectangular) and the high-service pumping station of the Jersey City Waterworks (Second Empire building between the two reservoirs). View is toward the west/northwest. The northern half of Reservoir No. 3 was never built.**

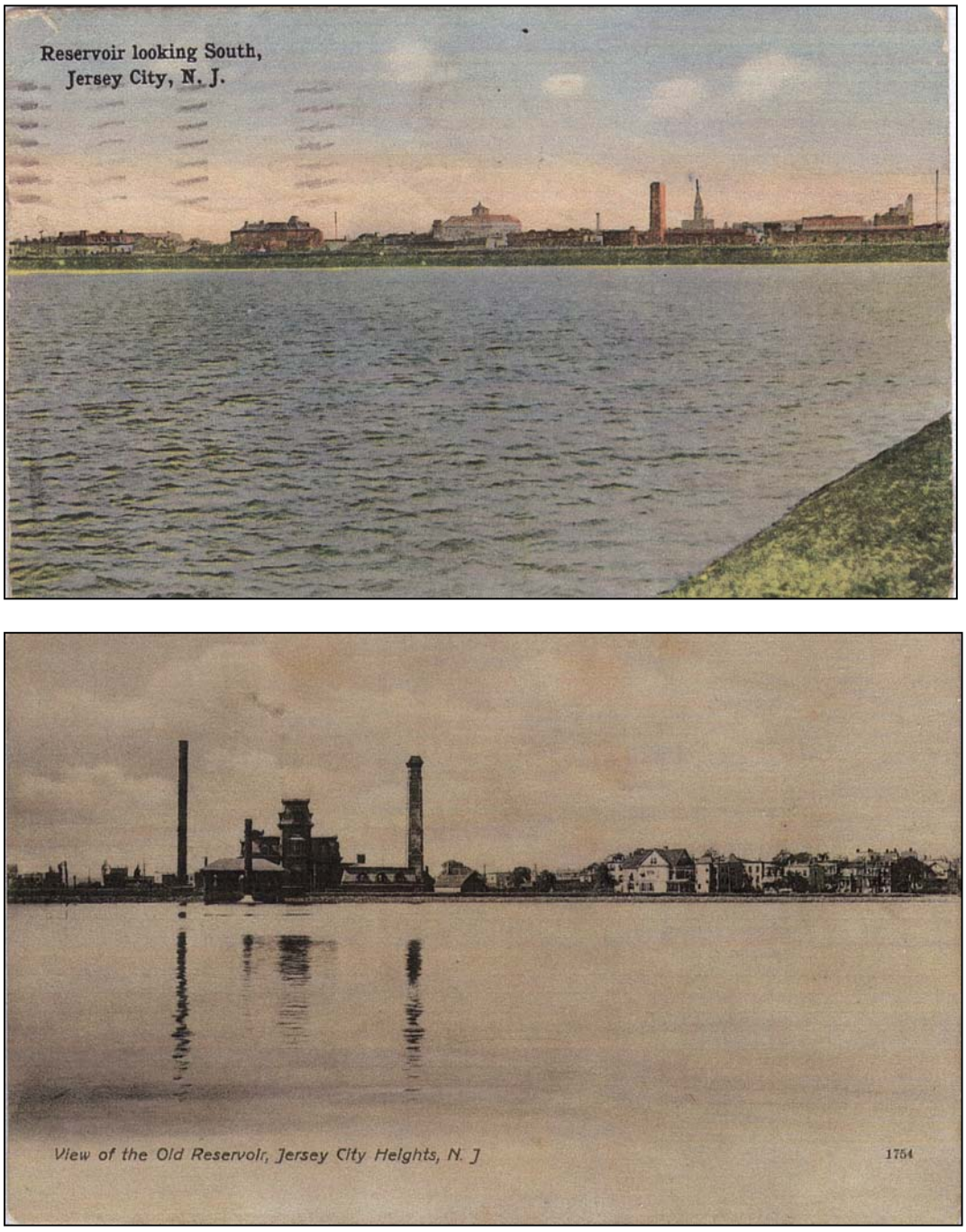


Figure 3.10. **Two postcard views across Reservoir No. 3, Jersey City Water Works. At the top is a view toward the south, post-marked 1914 (Jersey City Public Library Picture # 9310). At the bottom is a view toward the west (J.C.P.L. Picture # 9811), showing the high service pumping station that stood on Summit Avenue. The standpipe tower is seen to the left of the pumping station, the chimney to the right.**

Plate 3.1 **Reservoir wall and Gatehouse, Reservoir No. 3, Jersey City Water Works. View is to east. Plaque reads as in Plate 3.5 below. Photograph: Jean Howson, February 2001.**

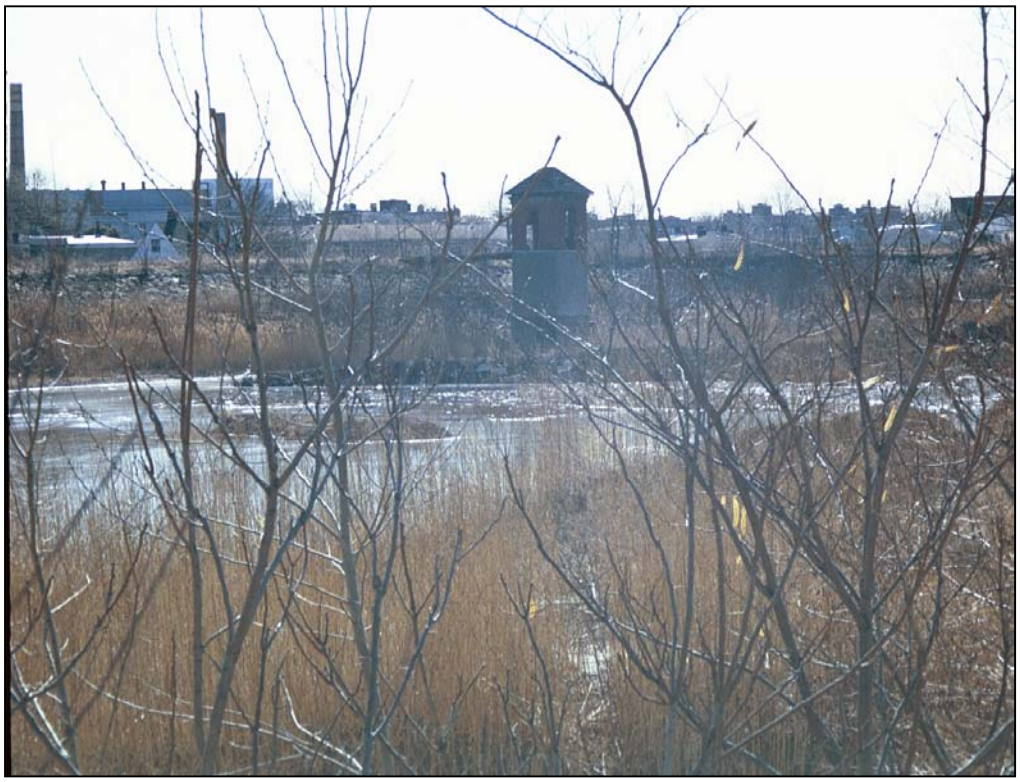


Plate 3.2. **Jersey City Water Works Reservoir No. 3. Screen House is at the center of the photograph. View is to the southeast across the bed of the reservoir. Photograph: Jean Howson, February 2001.**

Plate 3.3. Jersey City Water Works, Reservoir No. 3, , interior wall face. View is to east. Photograph: Jean Howson, February 2001.

Plate 3.4. Cross section cut through wall of Reservoir No. 3, Jersey City Water Works. Photograph: Jean Howson, February 2001.

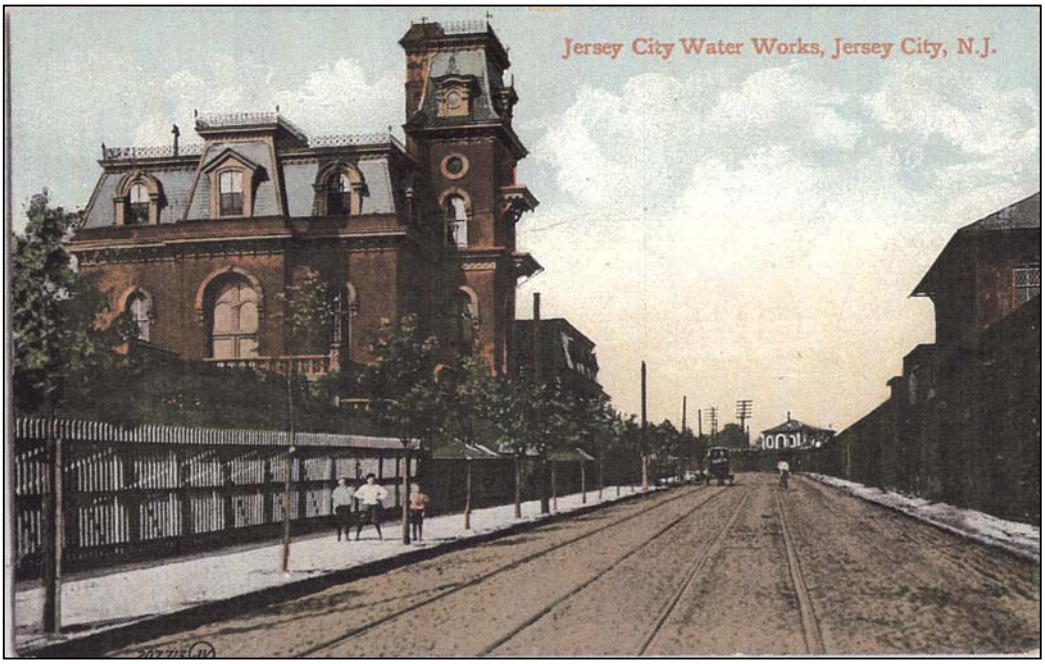


Figure 3.11. Postcard showing the Jersey City Waterworks High Service Pumping Station, circa 1910 (Jersey City Public Library, Picture #10158). The view is along Summit Avenue toward the north. The building, designed by architect George W. Labaw, was constructed in 1871-72. It was demolished in the 20th century.

The 2 ½-story section of the building (foreground) was the engine house, and the 2-story section further north housed the boiler. Reservoir No. 2 was to the west of the building, out of view.

Along the east side of Summit Avenue (right side of the photograph) is the wall of Reservoir 3. Its Gate House is visible in the right foreground. In the background is the later Intake Crib for the Boonton supply pipelines, at the northwest corner of the reservoir. These Reservoir No. 3 structures are still standing.

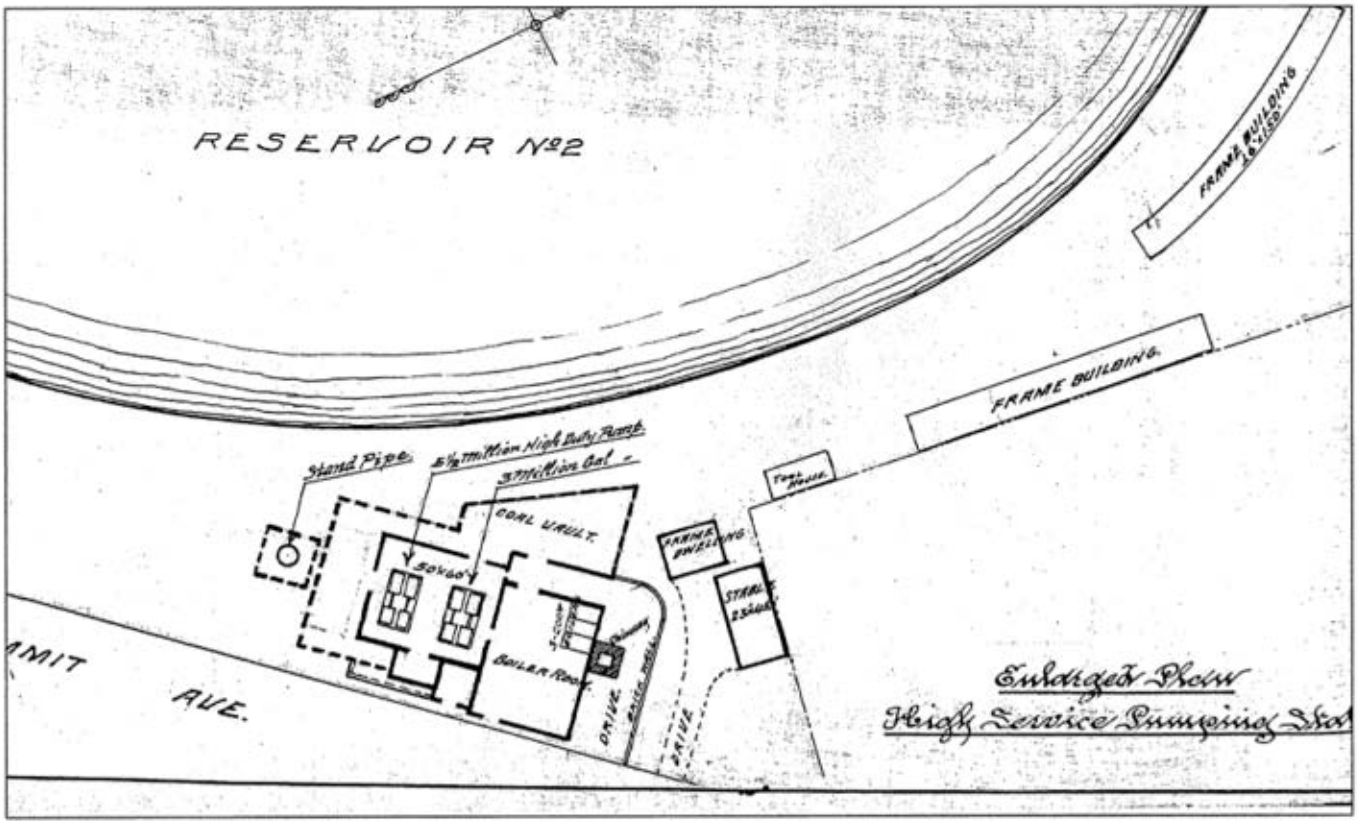


Figure 3.12. Plan of the High Service pumping station on Summit Avenue, circa 1920. Drawing on file, Jersey City Department of Public Works.

Two Cornish engines were originally intended for the High Service works, but upon the recommendation of Chief Engineer Culver two of Henry R. Worthington's Duplex Pumping Engines were ordered instead. Culver had visited the Mystic Water Works in Charlestown, Massachusetts and the Fairmount Works in Philadelphia to inspect their Worthington engines, and reported them superior (Report of the Chief Engineer for 1872). The Worthington Pump Manufacturing Company of New York was one of two major American steam pump manufacturers to emerge after 1860. In 1859, Worthington had perfected the duplex steam feed pump, in which one engine activated a second, which allowed a more even, quiet flow of water (Anderson 1980:21). By 1863, the duplex engines manufactured by Worthington were widely adopted (*ibid*.; Figure 3.13). The Jersey City Worthington engines were built in 1871-72. In 1872, it was decided that one of the engines was needed at the Belleville pumping station so that the foundations for the Cornish engines there could be reconstructed. The other was installed at the High Service works (Reports of the Chief Engineer for 1871, 1872; Manual of the Board of Street and Water Commissioners, 1871-72).

In April of 1872, the Board paid $490 to Dickson Brothers for a commemorative plaque for the High Service engine house (Manual of the Board of Street and Water Commissioners, 1871-72). This marble plaque, with its unique border of water pipes and hydrant carved in marble, now stands on the grounds of the former Water Department buildings at the southwest corner of Reservoir No. 3 (Plate 3.5).

3.D. The need for a new supply

Reservoir No. 3, the High Service Works, the third supply main, and expansion and modernization of the Belleville pumping station together rendered the Jersey City Water Works viable for the remainder of the 19th century – but just barely. By the 1890s the supply provided by the works was no longer adequate for the still-growing municipality, nor was the water of the Passaic River at Belleville potable. Despite the on-going expansion of the pumping station and the increased capacity afforded by three supply mains and two distributing reservoirs, there was a critical limiting factor in the system: the intake point. With just one conduit, the Passaic at low tide provided only enough water for one engine, and even with a new conduit built in the 1870s, the output of the expensive pumping station could not be maximized. Contrary to Ward's sanguine assertion of 1856 that "the quantity [of water] which may be brought to the distributing reservoir is only limited by the power of the machinery employed to raise, and number and dimension of the pipes to deliver it; and as these may be increased indefinitely, it may be safely said that the water supply in Jersey City is inexhaustible" (Ward 1856:632), the limit was the source itself.

As early as 1865, the Water Commissioners had pointed out that the supply from the Passaic at Belleville would become inadequate in the not-too-distant future. They urged the Mayor and Council to return to consideration of one of the proposals made back in 1851, that of supplying the works from Greenwood Lake via the Morris Canal near

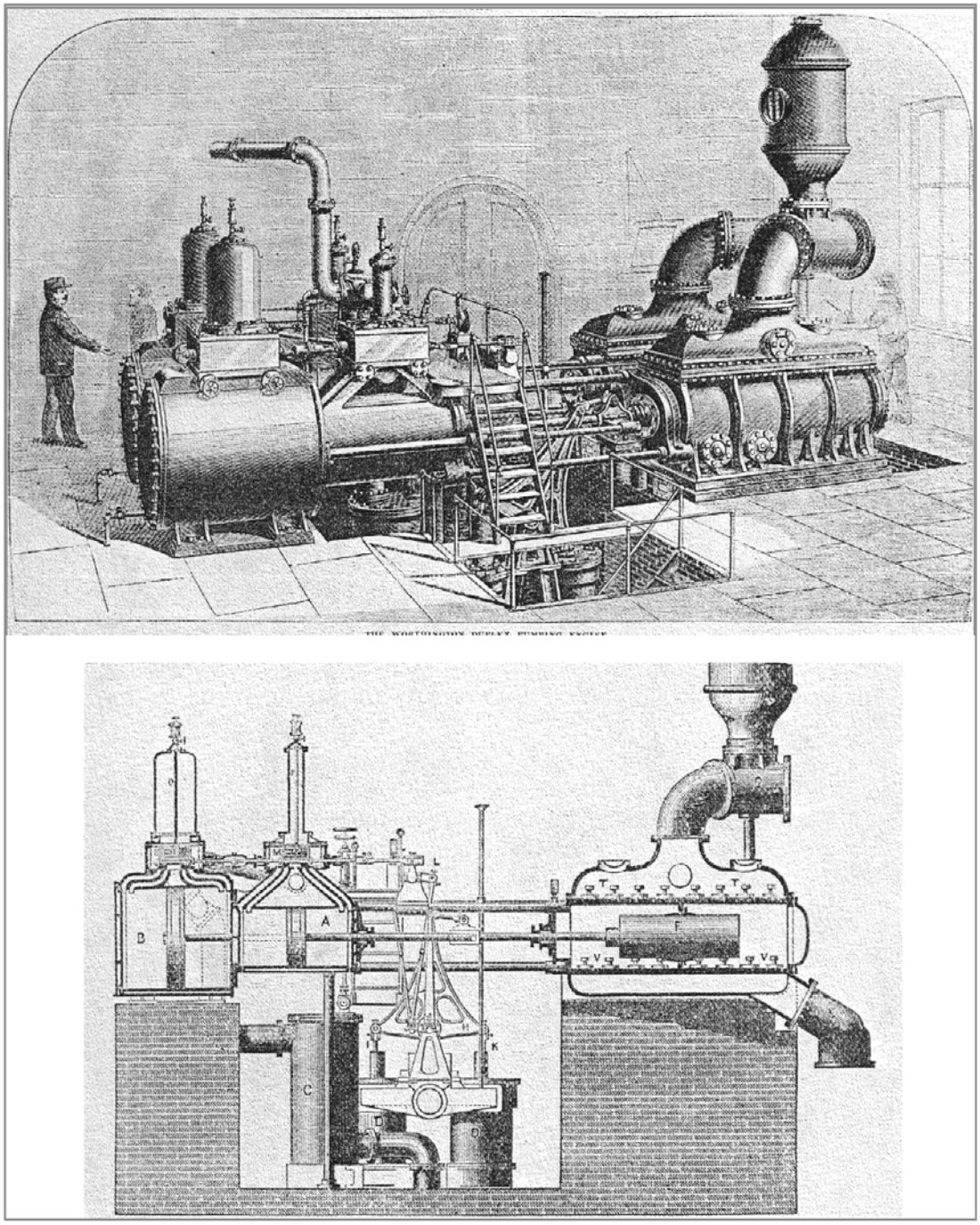


Figure 3.13 Depictions of the Worthington Duplex Pumping Engine. Source: Hunter 1979, Vol. 2.

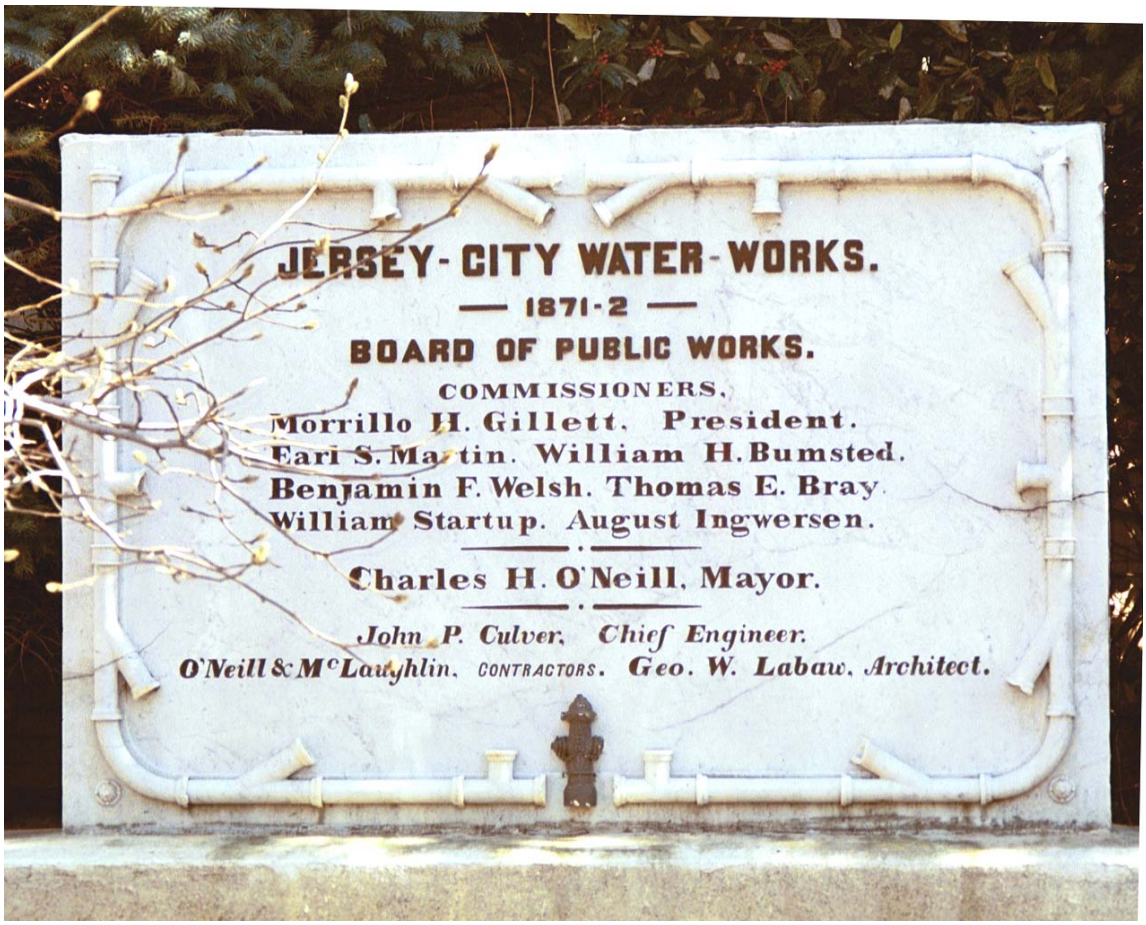


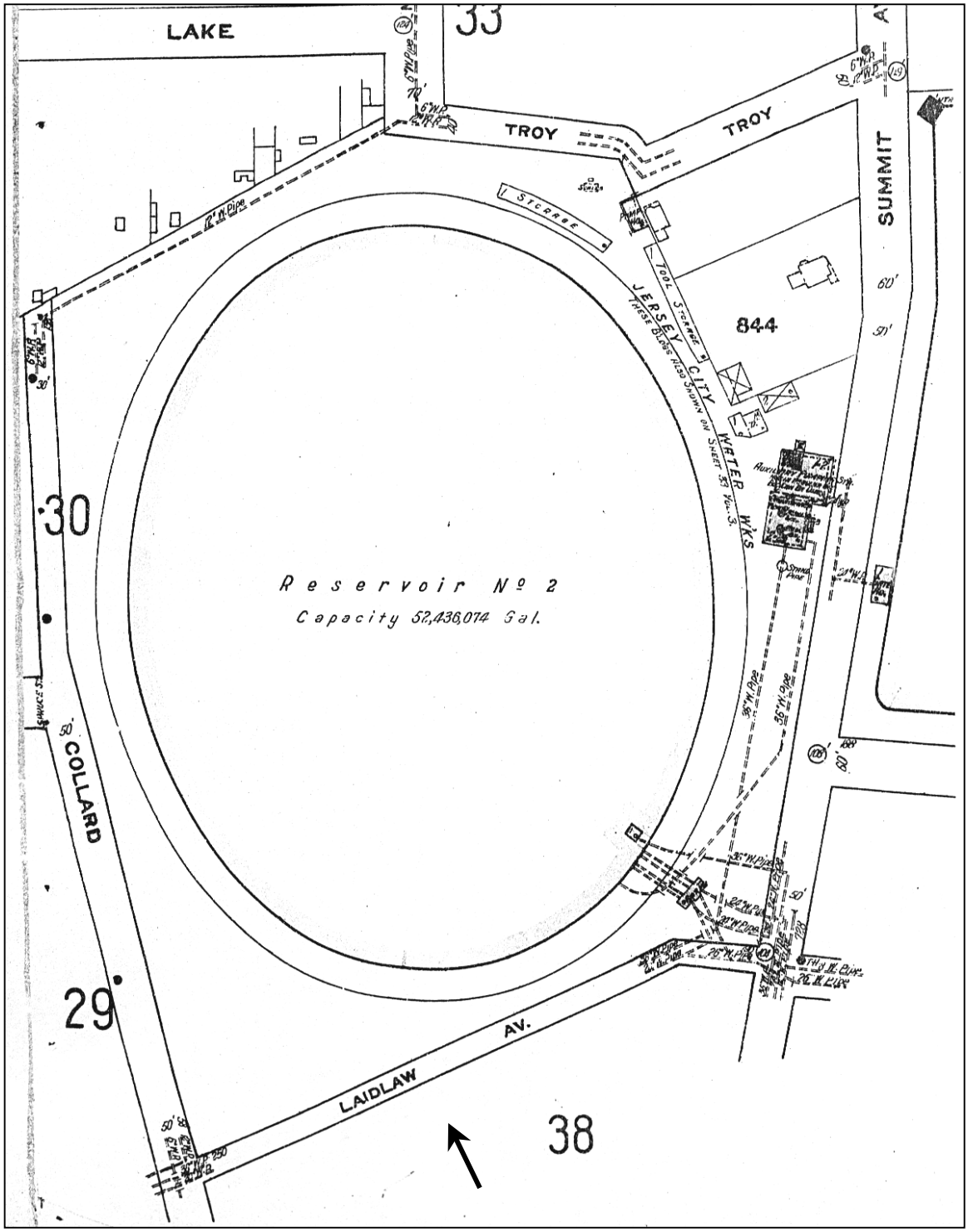
Plate 3.5. **Plaque commemorating construction of the High Service Works on Bergen Hill. The plaque was commissioned in 1872 by the Board from Dickson Brothers for $490 (Jersey City Board of Public Works, 1872). Photograph: Jean Howson, February 2001.**

Bloomfield (*RWC*, 18th Report, July 1865). In subsequent years the Commission considered other plans for supplying additional water, including building a tunnel from the Passaic through Snake Hill to the foot of Bergen Hill (*RWC*, 22nd Report, January 1870).

In 1873 a joint commission on the water supply of Newark and Jersey City was formed. In his report to that body, Engineer Culver stated that though the system had been designed with a maximum of 30 gallons per day per person output, it was now accepted that in general a supply of 100 gallons per day was needed in manufacturing districts (Culver 1873). Taking the growth rate of Jersey City into account, Culver predicted that it would cost at least one million dollars to expand the existing system to meet the demand by 1890, and that the annual operating costs would come to $404,000, not including costs due to accidents and repairs. Culver, returning to a plan that had been discussed earlier, recommended discontinuing the system of pumping Passaic water in favor of a new, gravity system based on acquisition of the Morris Canal from Lake Hopatcong. Despite Culver's repeated arguments for this plan, it was never adopted.

It was, ultimately, the pollution of the Passaic that would force adoption of a new water supply for Jersey City. Waste from industries in Newark, Paterson, and Passaic, as well as sewer outfall from Newark (brought up by tide) and all of the communities upriver from Belleville, had rendered the river unsuitable as a source of city water. By the 1890s it was well-known that diseases, especially typhoid fever, were spread through contaminated water, and the rising disease rate in Jersey City was blamed on the polluted Passaic water that flowed through its vast system of distribution pipes.

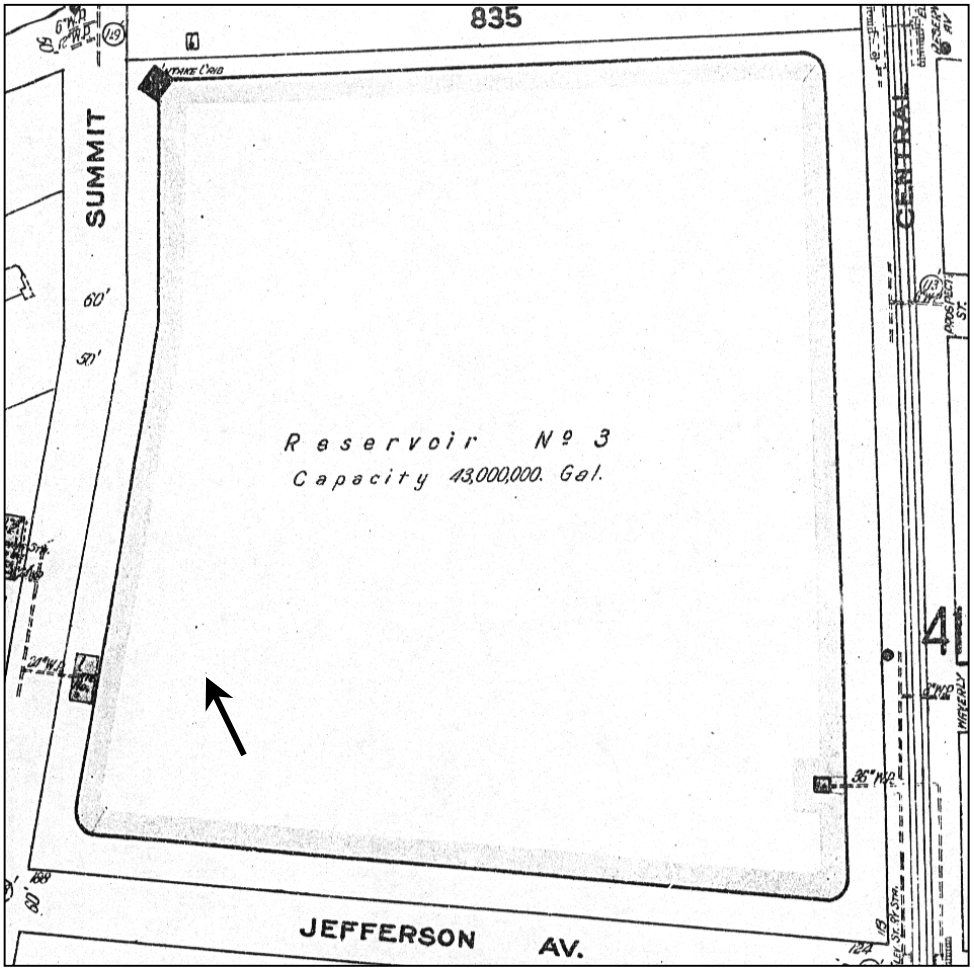
In 1896, a temporary supply from the Pequannock watershed was tapped, and in 1899 a contract was signed for a new system to be supplied from the Rockaway River at Boonton. The new waterworks featuring the Boonton Dam, Reservoir, and Aqueduct, opened in 1904 (see compilation of newspaper accounts and other documents pertaining to the Boonton system in Dempsey [n.d.]). The original waterworks pipelines tapped the new pipeline and continued in use, in some sections to this day, and the reservoirs were modified to take in the new supply (Langan Engineering Associates, 1981a, 1981b). Figures 3.14 and 3.15 depict the waterworks facilities on Bergen Hill in 1910. The reservoirs on Bergen Hill remained in service for most of the 20th century. Reservoir No. 2 was drained in 1978, No. 3 in 1994. The High Service Pumping Station became an auxiliary pumping station after the 1904 opening of the Boonton Aqueduct, and later was turned into a meter testing laboratory. It was demolished in the 1950s.



Scale: 1 inch = 200 feet

0’ 200’

Figure 3.14. Sanborn Map Company. 1910. Reservoir No. 2, Jersey City Water Works.



Scale: 1 inch = 200 feet

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Figure 3.15. Sanborn Map company. 1910. Reservoir No. 3, Jersey City Water Works.

4. FIELD INSPECTION OF THE 20" CAST IRON MAIN

The 20" cast iron water main was exposed in three contiguous trenches excavated at Charlotte Circle (Figure 4.1) on February 20 and March 10, 2001. The undisturbed soil profile in this location consisted of fill strata overlaying a dark grey, clayey, wet soil representing the former marsh (Plate 4.1). The fill strata included secondarily-deposited coal-ash layers and cleaner fill representing former surfacing. The ash layers contained numerous artifacts dating to the end of the 19th and early 20th centuries. The easternmost trench (Trench 1) exposed approximately five feet of *in situ* original 20" pipeline consisting of two joined pipe sections (Plates 4.1 and 4.2). The top of the pipe was at an elevation of 1.103 meters above sea level, approximately 8 feet below the current surface. The bottom of the trench began to fill with water during recordation.

The exposed pipes were cleaned off with trowels and compressed air. No foundry mark was visible, although the pipes were in good condition overall. Soil was excavated around the pipes, revealing a large supporting timber. This timber was one foot wide, oriented perpendicular to the pipes. An iron spike had been driven into the timber on the south side of the pipe, evidently securing it to a piling below. It was not possible to further expose the wooden support structure. The engineer's report on the original pipeline state that between the Hackensack and the foot of Bergen Hill it was laid on piles (*RWC*, 6th Report, January 1855).

In the westernmost trench (Trench 2) only the top of the water pipe was exposed in order to locate it and determine its orientation. The elevation was 1.091 meters, the pipeline apparently sloping slightly toward the west. The direction of the pipeline also shifts in this location, as indicated in the mapping.

The trench that exposed the crossing of the water and sewer pipes (Trench 3) was excavated last. It revealed that the 20" main had been removed and replaced with new cast iron pipe carrying it up and over the sewer pipe and then back down to reconnect with the original (Plates 4.3 and 4.4). To the east and west of this overpass conduit the original water pipes were *in situ* and the overlying strata substantially intact. See Figure 4.2 for a schematic drawing of the pipe crossing.

Field investigations also included an inspection of an exposed and disturbed section of the abandoned portion of the original pipeline, located on Eastern Oil property at the Hackensack River (Figure 4.3, Plates 4.5 through 4.6). Here too, the pipeline had evidently been laid upon planks on pilings. Any further study of the cast iron pipes themselves may be accomplished at this location without the need for excavation. As was the case in the Charlotte Circle trenches, no foundry marks were noted.

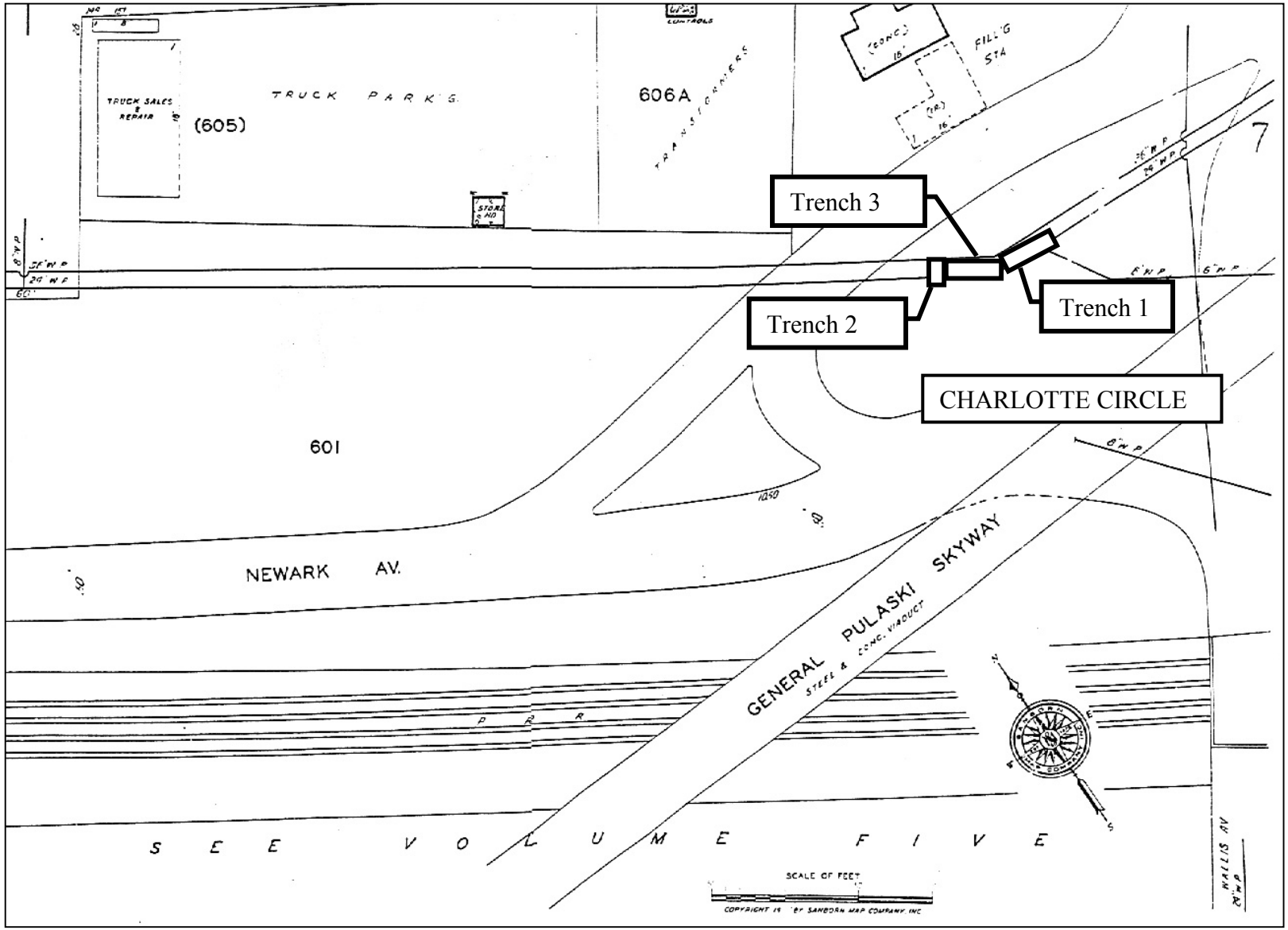


Figure 4.1. Location of test trenches in Charlotte Circle. Sanborn Map Co. 1994.

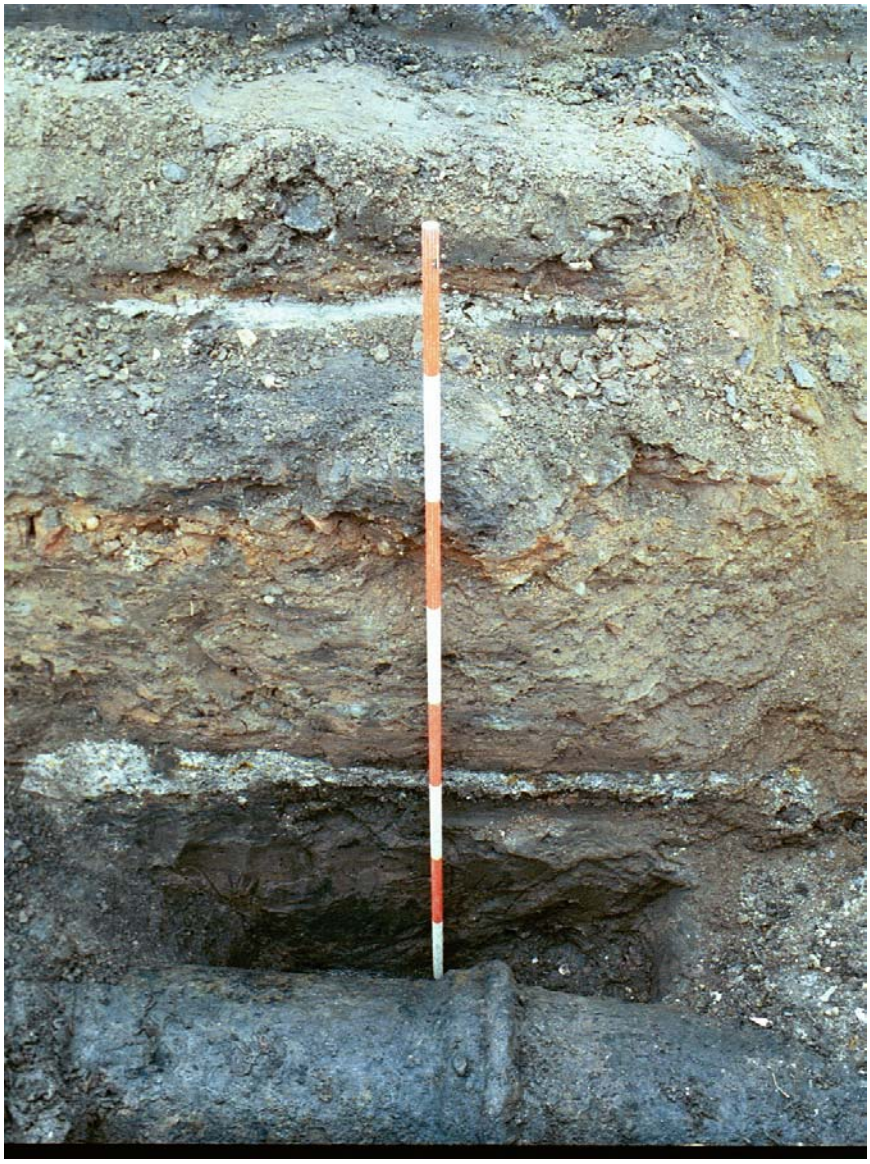
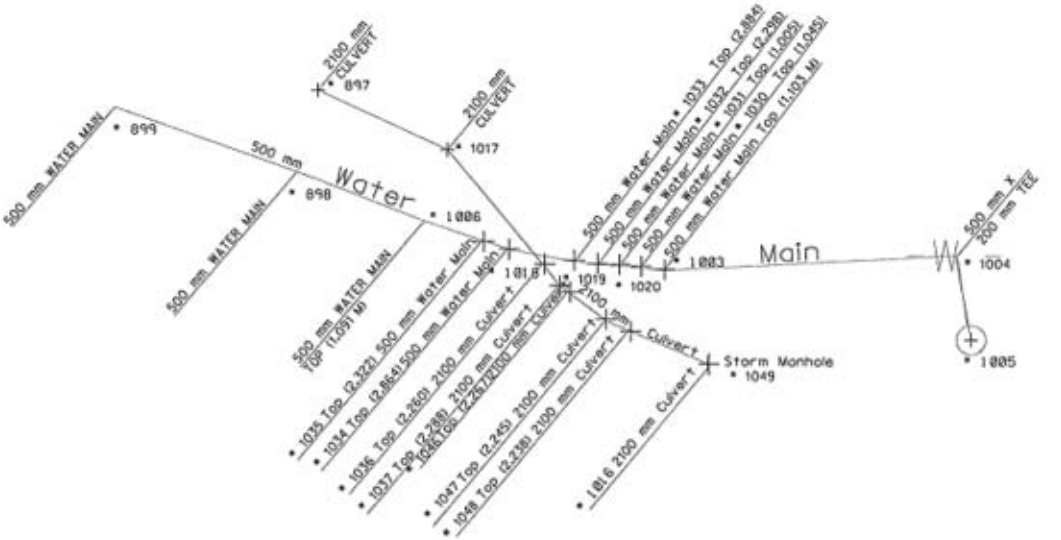


Plate 4.1. **Jersey City Water Works Pipeline, south profile of Test Trench 1. The photograph shows two joined sections of the original 20" cast iron water pipe. The pipe is in a layer of dark grey, wet clay, representing the muck of the original marshland through which it was laid. The first surface overlying the pipe, a layer containing cinder, shows as light grey, overlain in turn by successive layers of fill and subsequent surfaces. The modern surface is at the very top of the photograph. Photograph: Leonard Bianchi, February 2000.**

Plate 4.2. **Jersey City Water Works Pipeline. A large wooden plank underlay the pipe, part of the original timber cribbing that carried the pipeline through the marsh and eastward from the Hackensack. An iron spike was driven into the plank immediately adjacent to the pipe. North is at right. Photograph: Leonard Bianchi, February 2001.**

Plate 4.3. **Replaced section of 20” pipeline crossing over the sewer conduit at Charlotte Circle. Left: View is toward west. Above: View is toward northwest. Photograph: Leonard Bianchi, February 2001.**



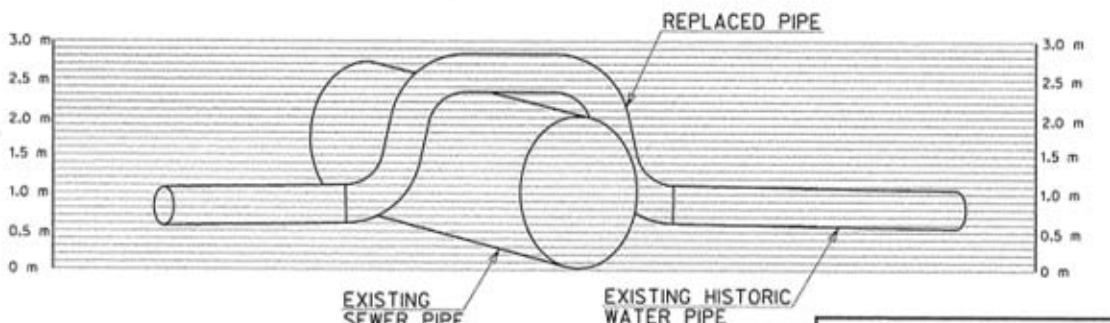


FIGURE 4.2.
SURVEY AND SCHEMATIC PROFILE OF SEWER CROSSING, CHARLOTTE CIRCLE.

SCALE: 1"= 2 m

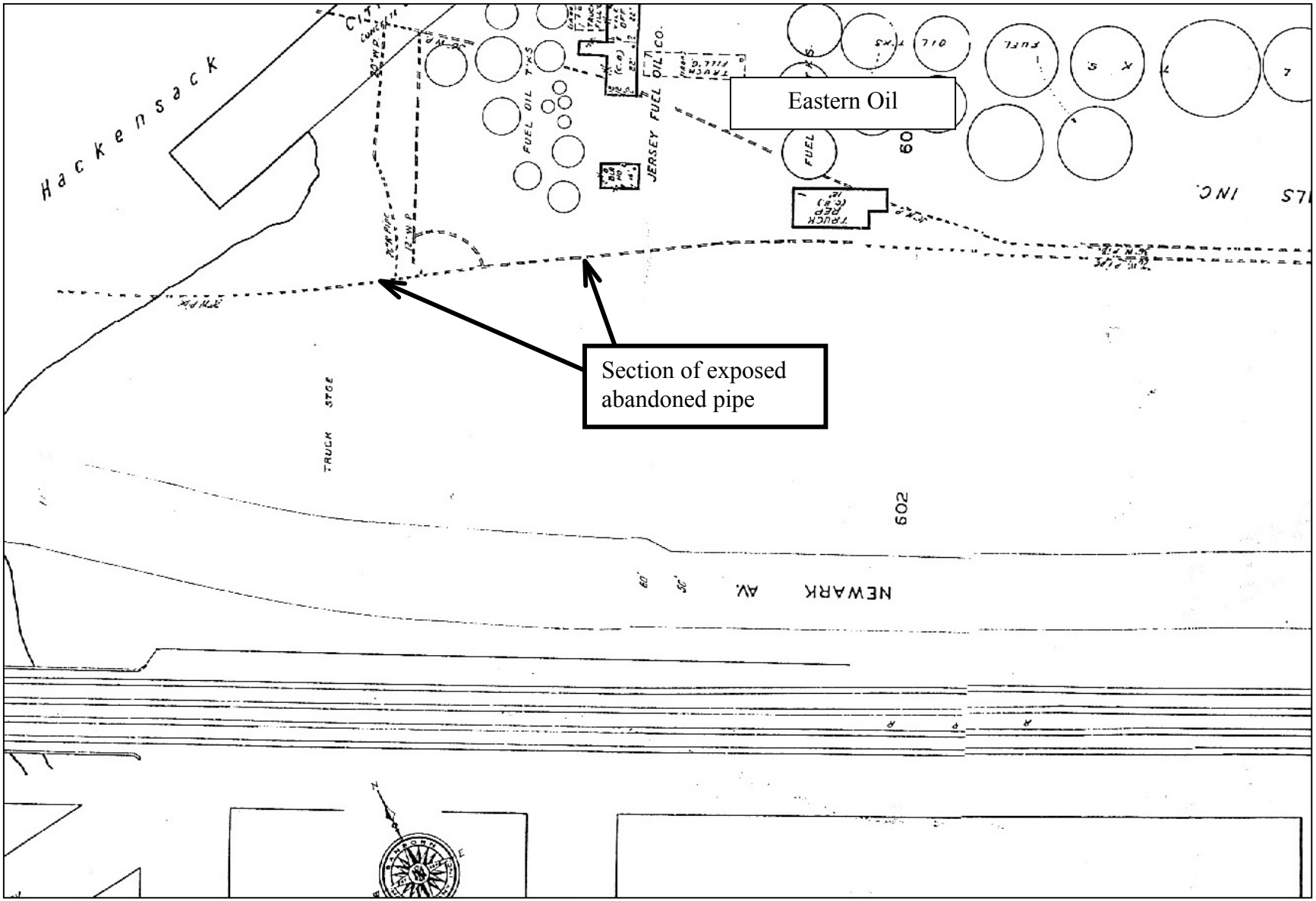


Figure 4.3. Location of exposed sections of abandoned 20" cast iron pipe, Jersey City Water Works.

Plate 4.4. **Exposed abandoned sections of 20” cast iron water pipe near the Hackensack River. Top: View is toward southwest, with Pulaski Skyway in background. Bottom: View is toward north. Photograph: Jean Howson, February 2001.**

Plate 4.5. **Photographs of remains of pilings for the Jersey City Water Works Pipeline at the Hackensack River. A double row of pilings supported the 20" main on cross-beams. Top view is toward the west-southwest, bottom toward the southeast. Photograph: Jean Howson, February, 2001.**

Plate 4.6.. Detail of abandoned segment of Jersey City Water Works 20” cast iron main on support timbers, east of the Hackensack River. View is toward southeast. Photograph: Jean Howson, February 2001.

5. CONCLUSIONS AND RECOMMENDATIONS

The U.S. Routes 1&9 Truck Interim Improvements at Charlotte Circle and Tonnelle Circle Project involves relocating a sewer line that runs beneath the original 20" cast iron main of the National-Register eligible Jersey City Water Works Pipeline. Current plans call for removal of a stretch of original water pipe in conjunction with the relocation of the sewer. Testing revealed that a section of the water pipeline already had been removed in circa 1950 in order to relocate it over the sewer line. However, additional disturbance of the original 20" pipe, which has been proven to possess excellent integrity at this location, will be required. This will constitute an adverse effect on the National-Register eligible resource.

The research, including documentary study and field recordation, presented in this report is intended to serve as data recovery in mitigation of the project's adverse effect on the pipeline. No further archaeological investigation of the 20" main is necessary.

The 1861 36" cast iron pipeline that runs parallel to the 20" main was not inspected in the field, as it was not expected to be impacted by the interim improvements and was not exposed in the test trenches. This pipeline has been documented in the present study. Should future plans for the Routes 1&9 Truck project involve disturbance of this element, a limited program of field monitoring and recordation is recommended. Sections of the line are visible at the surface in the meadows (Robert Lorfin, Dept. of Public Works, personal communication), and should be photographed.

It is recommended that the Jersey City Water Works as a whole be considered for National Register eligibility under Criteria A and D. In addition to the pipelines, thus far the "Jersey City Reservoirs 2 and 3 Complex" has been found to be eligible. The SHPO opinion specified the below-ground remains of Reservoir No. 2 and the extant structure of Reservoir No. 3 as components of the complex. The marble plaque erected for the High Service Pumping Station on Summit Avenue, currently in the front yard of the former Water Department buildings (now Police Department offices) should also be considered an eligible component. No trace of the Belleville works is visible above ground today. The entire area has been intensively developed since the abandonment of the facilities in the early 20th century (see Figure 3.6). It is possible, however, that archaeological remains associated with the works are extant below the surface.

Although beyond the scope of the present study, future work on the Jersey City Water Works should include an inventory of other extant features, including buried conduits, reservoir walls and other structures such as influent and effluent pipes, remains of buildings that may be extant below ground, and remains associated with the dwellings at the Belleville and Bergen Hill works. Representative elements of the vast city water distribution and sewer system, including original hydrants, manholes, and examples of pipes of varying dimension may also be recorded. Further documentary study of the sewer system and of the waterworks in the last two decades of the 19th century, and a

complete contextual account and inventory of the Boonton works are also recommended. Ultimately, the entire Jersey City Water Works system may be considered as a single eligible complex, recognizing that, like most public works, it evolved over time, incorporating older elements with new.

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APPENDIX A

John D. Ward, 1856
***A Historical and Descriptive Account of the Jersey City Water Works*.**

A HISTORICAL AND DESCRIPTIVE ACCOUNT OF THE JERSEY CITY WATER WORKS.

BY A MEMBER OF THE INSTITUTE.

Jersey City, 30th Sept., 1856.

HORACE MANN, Esq., Rec. Sec'y of the American Institute:

Dear Sir—In compliance with your request, I have much pleasure in furnishing you an account of the legislative proceedings, preliminary examinations, construction and cost of the Jersey City water works, with a short description of the works themselves, and some account of their present management and future prospects.

It may be proper to state by way of introduction, that a large proportion of the lands lying within the chartered limits of Jersey City, are a part of what was formerly an extensive marsh, the soft mud of which reaches in some parts to a depth of seventy feet, or more, and over which the high spring tides regularly ebbed and flowed. From this marshy soil, no water fit for domestic use could be obtained; nor was it found by boring the underlying rocky strata to the depth of 300 feet; and in that part of the city which in its natural state was above the reach of tide, the formation is of such character that water found by sinking wells was poor in quality, and the supply small and uncertain.

In consequence of this peculiarity of the site upon which the city is built, the want of good water began to be felt almost as soon as it was occupied, and became more pressing and inconvenient with every addition to the population; the few public wells which afforded water fit for household purposes being, at some seasons, surrounded from early dawn till a late hour in the evening, with crowds waiting to secure a small portion of the scanty supply which they furnished: and it became a trade to transport water in casks from Bergen hill, and sell it in the streets

of the city to consumers who were unable to obtain their supply from the public wells.

This scarcity was so severely felt in the autumn of 1850, that an application was made to the Legislature at its session in the succeeding January, for the passage of "An act for the appointment of Commissioners in relation to supplying the townships of Hoboken, Van Vorst, and the city of Jersey City, with pure and wholesome water."

The Legislature passed the law as desired, and it was approved 18th March, 1851. The commissioners named in it were Edwin A. Stevens, Edward Coles, Dudley S. Gregory, Abraham L. Van Boskerck and John D. Ward; and it was made "their duty to examine and consider all matters relative to supplying the said townships of Hoboken, Van Vorst, and Jersey City, with a sufficient quantity of pure and wholesome water for the use of their inhabitants, and the amount of money necessary to effect this object." These commissioners entered upon the performance of the duties assigned to them in June, 1851, electing John D. Ward, President, and Edward Coles, Secretary, and shortly afterwards engaging the services of William S. Whitwell, as engineer.

They first considered a plan which was proposed for obtaining water from a small reservoir which had been excavated by the New Jersey Railroad and Transportation Company, at the side of their road where it passes through Bergen hill; a report in favor of this as the source of supply having some time before been made to the municipal government of the city.

Another plan brought to their notice was, to pump the water required directly from Hackensack river, after building a dam at some point not far from Snake hill, and extending embankments each way from the dam across the meadows to the high ground, to prevent the salt water below from being carried at any time by the tide and mixed with the fresh water above.

It was supposed by some that a good supply could be obtained by converting the Western slope of Bergen hill into a gathering ground, and collecting the water from the net work of underground drains, into a canal extending along the foot of the hill, from which it was proposed to raise it by a steam engine to a reservoir upon the summit.

It was also proposed to take water from the Passaic river above the falls at Paterson, and conduct it to Jersey City in pipes; and another proposition was to take it at the Dundee

dam between Paterson and Acquackanonck, and raise it to the required height by water power furnished by the river.

Rockland lake, and Greenwood lake or Long pond, were also proposed as sources of supply, both of which are sufficiently elevated to render pumping unnecessary. But to each of these, and sundry other projects, which were brought to the notice of the commissioners, objections were found sufficiently serious to cause their rejection, and the plan of raising the water by a steam engine, directly from Passaic river, at Belleville, was, after extensive and careful examinations, surveys and estimates, considered by the board the one best adapted to furnish to the inhabitants of Hoboken and Jersey City a permanent supply of pure and wholesome water at a reasonable cost.

The commissioners, as directed by law, made a report of their proceedings to the legislature in January, 1852, and presented a copy of the same to the municipal authorities of Hoboken and Jersey City, the township of Van Vorst having, during the year preceding, been annexed to and made part of the latter corporation. In their report the commissioners, after describing and discussing the merits of the various plans which had received their consideration, recommended the construction of works in conformity with the plan approved, the estimated cost of which was $653,359.

The people of Hoboken, however, after seeing and deliberating upon the commissioners' report concluded that it would be inexpedient for them, at that time, to be concerned in the construction of works so large and expensive as those proposed; and declined uniting with the citizens of Jersey City in asking the legislature to grant authority for that purpose. The citizens of Jersey City, though disappointed at the determination of their neighbors to withdraw from any share in the prosecution of the enterprise, were not discouraged, but determined if assistance could not be obtained, to proceed with the work alone. At their request the legislature passed "An act to authorize the construction of works for supplying Jersey City, and places adjacent, with pure and wholesome water;" and for that purpose to borrow, on the credit of the city, the sum of $600,000 at a rate of interest not exceeding six per cent per annum, and for a term not exceeding fifty years. The construction of the works was, by the act, placed under the direction of five commissioners, three of whom, (J. D. Ward, D. S. Gregory, and M. B.

Bramhall,) were named in the act, one was directed to be elected at the next ensuing charter election, and the president, for the time being, of the board of aldermen, was constituted a member *ex-officio*. This board was first regularly organised on the 28th April, 1852. The members constituting it at that time were John D. Ward, Dudley S. Gregory, Moses B. Bramhall, Thomas A. Alexander, then recently elected, and David S. Manners, then president of the board of aldermen, commissioner *ex-officio*. Of this board John D. Ward, was elected president; and as the law under which they acted required that before any work could be undertaken, they should obtain a loan for at least one-half the estimated cost of the whole, the attention of the commission was first necessarily directed to the financial part of its duties, and inquiries were instituted to ascertain where and on what terms the requisite amount of money could be obtained. The result of their inquiries was a conclusion to advertise for proposals for a loan of $300,000, or one-half the sum required for the works, for twenty-five years at an interest of six per cent per annum, payable half yearly. When the bids for this were opened on the 9th June, it was found that the sum of $1,421,000 was offered at rates varying from 1½ to 3 11/12 per cent premium. The average rate of premium on the bids accepted was 2,006 per cent. The commissioners being thus furnished with the means of proceeding, engaged Wm. S. Whitwell, the engineer employed in making the preliminary surveys and examinations, to direct and superintend the construction of the works.

Contracts were soon after entered into for the principal part of the iron pipes required, for the stop-cocks and fire hydrants, for excavating and refilling the trenches for water pipes in the streets, and for the construction of the distributing reservoir on Bergen hill; and the contractors entered almost immediately upon the execution of the work which they had undertaken. Contracts for the pumping engine, and pipes for the rising main, for the engine house, the inlet conduit, and the receiving reservoir at Belleville were made during the succeeding winter.

The number of contracts entered into, and the progress made by the contractors in executing them, admonished the commissioners that the remainder of the loan which they were authorized to contract would be required at no very distant day to enable them to meet their engagements; they therefore on the

10th December, 1852, invited proposals for the further sum of $300,000. These were opened on the 19th January following, and found to amount to $976,000, at rates of premium varying from 2½ to 5 per cent, and the average rate on the bids accepted was 4.266 per cent—the amount received for 300 bonds of $1000 each being $312,798.80. Such parts of the work as could be executed during the winter without injury were carried on without interruption, and such as were necessarily suspended during the severe weather were resumed as early as the return of the warm season permitted, and prosecuted regularly until their completion.

In June, 1854, the steam engine was first started, and the several parts of the works were so far completed that a small quantity of water raised by it reached the distributing reservoir, when the failure of a valve chamber of the large pump caused a suspension of its operations for some weeks; and it was not until the latter part of August that the water commissioners were able to commence the regular distribution of Passaic water to their tenants, which since that time they have regularly continued.

These works take water from the Passaic river at Belleville and raise it to the height of 157 feet, into a receiving reservoir on Belleville ridge, from which it flows through iron pipes to the distributing reservoir on Bergen hill, and thence through distributing pipes to all parts of Jersey City, and will no doubt soon be furnished to the citizens of Hoboken, as negotiations are now in progress between the municipal authorities of that city and the water commissioners intended to effect that object. The works comprise,

First. The inlet conduit and pump-well which receive the water from the river.

Second. The engine house, pumping engine and boilers, pump, and rising main through which the water is raised to the reservoir.

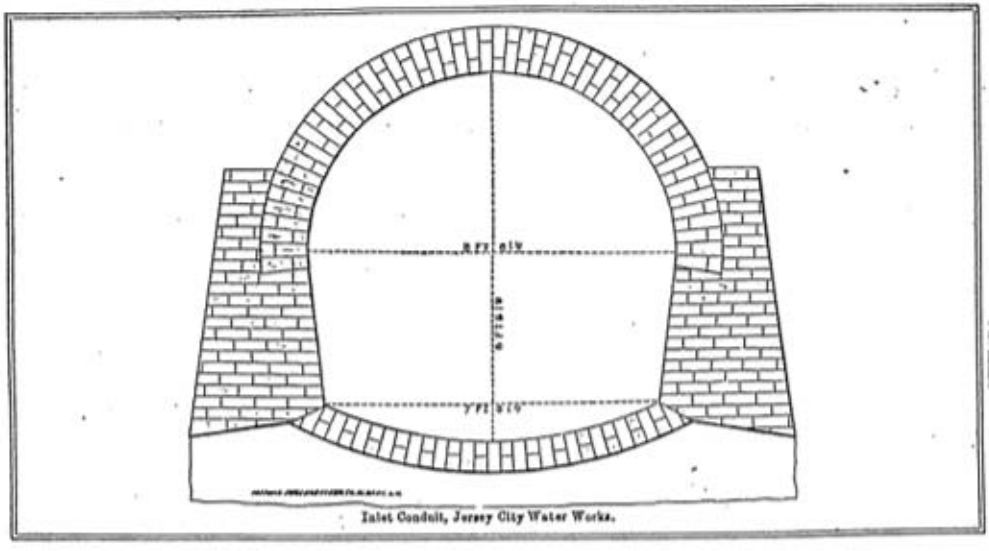
Third. The receiving reservoir.

Fourth. The pipes which conduct the water from the receiving to the distributing reservoir.

Fifth. The distributing reservoir.

Sixth. The distributing pipes which conduct the water from the reservoir to the consumers.

The inlet conduit, the bottom of which is four feet below ordinary low water in Passaic river, is about 375 feet in length, and of the form and dimensions shown by the annexed drawing. It



Inlet Conduit, Jersey City Water Works.

has sliding gates and wire screws at its mouth, which are placed in proper vertical grooves in the masonry, and these are protected by a small brick gate-house erected over them, which in its turn is protected by a row of piles driven a few feet in front of it, and parallel with the course of the river. The pump-well, into which the water is received from the conduit, is divided into two parts by a wall through its centre, making each, twenty-six feet nine inches, by sixteen feet three inches. Large arched openings are formed in the lower part of this wall, for the passage of the water, and it is carried up through the engine-house to the same height as the beam walls, dividing it into two equal and similar engine rooms. The pump-well was sunk to the red sandstone rock which underlies that region, and which, though somewhat loosely stratified, was found sufficiently firm to sustain the weight of the pump, together with the water which it contains, and the plunger loaded to the extent required to raise the water into the receiving reservoir. The foundation for it was prepared by simply levelling and smoothing that part of the rock on which the pump stands.

The engine house, which is a handsome brick structure, 127 feet in length, including the boiler house, and 39 feet in breadth, was built and fitted for receiving two Cornish pumping engines, with steam cylinders of 80 inches diameter, and stroke of 11 feet, each intended to work a pump with a stroke of 11 feet, and plunger 34½ inches in diameter. But one of these is yet erected; the present demand for water not requiring half the power of the one now in operation. But as the consumption is constantly increasing, the time may not be far distant when it will become necessary to provide the means for increasing the supply.

The Rising Main, which at present passes out through the side of the engine house, in the rear, is 36 inches in diameter, and 2305 feet in length. It is taken through the embankment of the receiving reservoir at its northwest angle, on a level with the bottom, from which it rises with an easy curve to the height of the top water line, in order that the amount of work to be performed by the pumping engine may remain constant whether the reservoir be full or empty (a condition necessary to its good performance); and also to guard against the possible injury which might be caused by the current if a failure in the lower part of the main should occur, and its mouth within the reservoir be so placed as to permit the water to re-enter and flow back through it. This latter contingency is to some extent guarded against

by a set of self-acting stop valves, placed in the main near its lower end; and it is also furnished with two stop-cocks of the ordinary form, which may be closed when required.

The Receiving Reservoir.—This is situated on Belleville ridge, about 3,000 feet from the bank of the river. Its form is that of a parallelogram; the length is 390 feet, the breadth 318 feet, the depth 19 feet, and it is intended to contain 16 feet water, or about 10,334,229 imperial gallons. Nearly half its depth was excavated, and the remainder was obtained by raising an earthen embankment, with a puddle wall in the middle of its breadth, to the top water line, which is 157 feet above ordinary high water in the Passaic.

The embankment is twelve feet wide on the top, and has a slope of one foot vertical to two feet horizontal on the outside, and one vertical to one and a half horizontal on the inside. The outside slope is sodded to the top, and the inside is faced with bricks laid in cement, as high as the top water line. A small gate house at the southeast angle encloses the gates and screens of the outlet pipes, of which there are two, one of 20 inches, and one of 36 inches diameter. The smaller one only is used at present, the larger, extending no further than the outside of the embankment, to be used when the demand for water shall render a larger supply necessary than the 20 inch will convey to the distributing reservoir. A similar provision exists at the opposite angle, a 36 inch pipe being laid through the embankment, to which another rising main may be attached whenever such addition shall become necessary.

The Connecting Pipes between the Receiving and Distributing Reservoirs.—These are 20 inches in diameter, cast in the usual form, with spigot and faucet joints, and were laid in the ordinary way wherever the ground was sufficiently solid, but at least three-fourths of them were laid upon a marsh so wet and soft, and containing so many stumps and roots, that any attempt to lay them in a trench would have proved impracticable.

In that part of the line they were therefore laid upon the surface, and have a covering of earth forming a low embankment, which is composed partly of marsh mud and partly of gravel, taken from Belleville ridge.

For short distances, near the solid ground at each side of the marsh, two rows of piles were driven and capped to serve as a foundation for the pipes; but the largest proportion of them were laid upon a bed formed by cutting away such portions of the

stumps as projected much above the surface, and levelling up the lower parts with such materials as could be obtained from shallow ditches excavated at the sides. In this way the bed was raised from 4 to 6 inches above the general level of the marsh; on this was laid a flooring, of two inch hemlock plank, about eight feet in width, and in some parts of double thickness, the planks crossing each other at right angles. The pipes laid upon this have remained in good condition, notwithstanding a trifling settlement of the line in some parts. At Hackensack river a narrow bridge about 1000 feet in length was built, upon which a box, made of timber six inches in thickness, strongly bolted and trussed, was laid to receive the pipes, which are furnished with what is technically termed a slip joint near each end of the bridge, for the purpose of preventing the lead joints from being destroyed by the contraction and expansion of the iron, caused by changes of temperature. As the Hackensack is a navigable river, it was of course necessary to provide for the passage of vessels through the bridge. This was done by sinking about 60 feet of the box and pipes, opposite to the draw in the adjacent turnpike bridge, to 12 feet below low water, which places the whole completely out of reach of the keel of every vessel that navigates the river.

The diameter of the pipes used for this inverted syphon, is 24 inches, the larger size being adopted to compensate for the obstruction to the flow, caused by the four changes of direction which the water receives in passing through the syphon. The distance between the two reservoirs is nearly six miles, and the difference of level of the water in them is generally about 25 feet. With this head, the 20 inch pipe will deliver into the distributing reservoir, a little more than 2,000,000 imperial gallons in twenty-four hours, the quantity that would be raised by working the engine eight strokes per minute for twelve hours, a rate at which it may be worked if a proper stand pipe is erected. This addition to the works will, no doubt, indeed, *must*, be made as soon as the increased demand for water requires more than can be raised by working the engine constantly at the present rate of 4½ to 5 strokes per minute, a rate which, with the present arrangement, cannot be exceeded with safety, because the water being sent from the pump directly into the rising main, the friction and inertia of a column 2305 feet in length must be overcome, and the whole set in motion at each separate stroke. This slow rate of working, however, is favorable to economy, the duty obtained having been as high as 60,000,000 or 65,000,000 lbs. of water raised one foot with 90 lbs. of Cumberland coal.

The Distributing Reservoir.—This is situated on Bergen hill, about two miles from the Jersey City ferry. Its form is oval, being 897 feet in length, and 722 feet in breadth, with an average depth of about 15 feet. The top water line is 128 feet above ordinary high water in the harbor of New-York, and extends over an area of nearly twelve acres. The average depth of water, when filled, is about 12 feet. The upper or northern part is principally formed by excavation, and the lower or southern part by an embankment which, on the lowest ground has a breadth at its base of something more than 100 feet, and is about 20 feet in height. The slope of the embankment on the outside is 1 perpendicular to 1½ horizontal, and on the inside 1 perpendicular to 2 horizontal. The inside is protected by a slope wall of stone extending from the top water line to a level 11 feet below it, or 14 feet below the top. The outside is sodded, and the top, which is 16 feet in width, has a gravelled walk of 10 feet bordered by sods at the sides, which on the inside reach to the stone wall.

The capacity of this reservoir is about 45,000,000 imperial gallons, and of this and the receiving reservoir together 55,334,229—a quantity sufficient to supply a population of 100,000 persons with 30 gallons each for nearly 19 days.

At the southeasterly side is the gate-house, through which the influent and effluent pipes pass, and in which are placed stop-cocks for regulating the flow of the water; and near to this, within the reservoir, is the screen-house, a low brick structure, without a roof, in which are fixed wire screens, for preventing fish and floating substances from entering the effluent, or distributing pipes, and being carried to the mouths of the service pipes where they would become troublesome to the water-tenants. A 36 inch influent pipe is laid through the embankment at this reservoir, as was done at Belleville, and also a 26 inch effluent pipe in addition to the one now used, and arrangements made for connecting new lines of influent and effluent pipes when required, without interfering at all with the operation of those already in use. Provision is also made for taking the water into the city without allowing it to pass into the Bergen hill reservoir—an arrangement which will permit alterations, or repairs to be made in that, when necessary, without interrupting the regular supply to consumers.

Distributing Pipes.—Of these there are now laid about 19 1-5 miles, of the following sizes and lengths, to wit:

Of 26 inches	diameter,	.....	3,420 feet.
" 20	"	.....	8,472 "
" 16	"	.....	1,411 "
" 12	"	.....	12,124 "
" 6	"	.....	69,195 "
" 4	"	.....	6,778 "
			101,400 feet, or

19 miles, 1080 feet. And there are used in the rising main, connecting pipes and distributing pipes, 143 stop-cocks, varying in size from 36 inches to 4 inches, and in the streets of Jersey City are fixed 186 fire hydrants, from any one of which, by attaching a hose of sufficient strength, the water may be thrown over the highest buildings yet erected within the city limits. And if the same proportions are hereafter adhered to in laying down distributing pipes, which have hitherto been observed in that department of the work, the same effective head will be retained as the city is extended, and fire engines continue to be an entirely useless apparatus, so that the municipal government may not only be saved the expense of purchasing others, but with perfect propriety may dispose of most of those now on hand, and place the proceeds of the sales in the city treasury.

The quality of Passaic water, as received by the consumers, after resting as it does in the reservoirs, is excellent; and careful analyses have shown that it is superior to the water furnished to the people of Albany, New-York, or Philadelphia; and experience has shown that it is well suited for domestic use, and for all manufacturing or other purposes where pure and wholesome water is required, and the quantity which may be brought to the distributing reservoir is only limited by the power of the machinery employed to raise, and number and dimensions of the pipes to deliver it; and as these may be increased indefinitely, it may be safely said that the water supply in Jersey City is inexhaustible.

The actual cost of constructing the works made up from the statement of receipts and expenditures contained in a semi-annual report of the water commissioners, to the mayor and common council of Jersey City, on the 1st July, 1854 (after the steam engine had been actually at work), was $594,885.78, or a little more than $5,000 below the original estimate; although various parts had been made larger and more complete than was originally contemplated; the length of pipes had been increased from about 19½ miles to 25½; the engine house had been built and fitted to receive two pumping engines, instead of one; the Belleville reservoir was enlarged to contain four or five times the quantity proposed, besides other extensions of the plan. Some parts of the works and grounds were not, at that time, in a completely finished state, and the expenditures required for their completion, together with the additions and extensions which have been called for, during two years which have elapsed since the introduction of the water, had, on the 1st July, 1856, increased the cost to $640,828.04 as appears from the subjoined statement furnished from the books of the water commissioners. This excess of expenditure, over the original estimates, is sufficiently accounted for by the construction of works of greater extent and more efficient character than were at first supposed necessary, but which the rapid growth of Jersey City, and the almost absolute certainty that Hoboken would require to be supplied from them, appeared to render necessary and proper.

Summary of cost of the works, 1st July, 1856.

Pumping engine and pump, ...	$37,323 07
Engine house, inlet conduit, dock, &c., &c., ...	92,593 96
Rising main, check valves, stop cocks, &c., ...	37,652 00
Belleville reservoir, ...	35,946 63
Bergen hill reservoir, ...	53,416 27
Connecting pipes between reservoirs, ...	127,500 00
Distributing pipes, ...	189,571 34
Pipe bridge and syphon, ...	9,315 14
Land, ...	38,005 00
Engineering expenses, ...	19,499 63
	$640,828 04

The works continue in effective operation completely realizing the wishes and expectations of their projectors and the citizens generally, who are not backward in availing themselves of the advantages which are afforded by an abundant supply of excellent water. The income derived from the sale of water, is steadily increasing; the receipts for the present year are estimated by the water commissioners, at $47,669.53, and the expenditures, including interest on the whole water debt, $58,212.00, leaving a deficiency of $10,542.47 to be provided from other sources; of this

about $5,000 will be supplied by a small tax of fifty cents per lot, levied equally on all grounds improved, or unimproved within the city limits (the collection of which is to cease when the receipts from water rents are sufficient to pay the current expenses), the balance will be raised by an addition to the general tax. And it is confidently believed, that within two years, the receipts will exceed the expenditures, and enable the commissioners to make investments in securities to form a sinking fund, out of which to pay the water debt as the bonds severally become due.

The law authorising the construction of waterworks, made it "the duty of the commissioners to cause all such surveys and examinations to be made as would enable them to decide upon and recommend a suitable plan for a general system of sewers for the whole district proposed to be supplied with water." These surveys and examinations were made as directed, and after mature consideration a plan was drawn up and submitted to the municipal government for its consideration.

That body, after careful examination and inquiry, adopted the plan, and by an ordinance directed that all sewers hereafter authorised in the city, shall be constructed under the direction of the water commissioners, and in conformity with the plan submitted and adopted. This contemplates a canal at the foot of Bergen hill, in rear of Jersey City, to be connected at one end with Hudson river, and at the other with the Morris canal, and into which water from the river will be admitted and retained by gates at high water level; the sewers are to be made in the streets, running from the canal to the river, with lateral branches in the cross streets; and each main sewer to have a fall in its whole length of four and a half feet. With this arrangement the water in the canal will be let into the sewers at the time of low water in the river; and as at spring tides there will be a difference of level of six feet between the water in the canal and that in the river and bay, all the sewers may be perfectly cleansed as often as required; and, in the language of the late Nicholas Dean, Esq., "*will leave Jersey City nothing to desire in the important matters of public health and individual convenience.*"

I remain your very obedient servant, W.

APPENDIX B

Jersey City Water Rates and Regulations, 1854

(Jersey City Water Commissioners, 5th Report, July 1854)

By amount charged to W. S. Whitwell, for incidental expenses.		$200 00
" " to syphon account		1,608 40
" " to pipe box account		7,327 24
" " to Hackensack bridge account		8,946 25
" " to crane account		264 75
" " to hydrant boxes, and setting hydrants		1,509 40
" " to fuel account		330 63
" " to commision account		1,000 00
" " to preliminary examinations and expenses.		1,631 67
By am't at loan upon interest	$17,250 00	
" balance in Merchants' Exchange Bank at interest	1,866 81	
" balance in Hudson County Bank	595 78	
" balance in Mechanics' and Traders' Bank	252 42	
Amount available	$19,965 01	19,965 01
		$660,216 79

T. F. TITUS, *Clerk.*

Jersey City, July 1, 1854.

[C.]

JERSEY CITY WATER RATES.

REGULAR RATES.

	Rates.
I. For all dwellings not exceeding 25 feet in width and 1 story high, occupied by one family,	$7 50
2 stories " " "	10 00
3 stories " " "	12 00
4 stories " " "	14 00
5 stories " " "	16 00
II. For all dwelling exceeding 25 feet in width and not exceeding 30 feet, occupied by one family,	
1 story high " "	$9 00
2 stories " "	12 00
3 stories " "	14 00
4 stories " "	16 00
5 stories " "	18 00
III. For all dwellings exceeding 30 feet in width and not exceeding 50 feet, occupied by one family,	
1 story high " "	$12 00
2 stories " "	15 00
3 stories " "	18 00
4 stories " "	21 00
5 stories " "	24 00

IV. For all dwellings exceeding 40 feet in width and not exceeding 50 feet, occupied by one family,

1 story high	"	"	$13 50
2 stories	"	"	18 00
3 stories	"	"	21 50
4 stories	"	"	25 00
5 stories	"	"	28 50

At the above rates one bath and one water-closet will be permitted in each tenement.

V. The rent to be charged for water used in tenements exceeding 50 feet in width will be fixed by special contract with the water commissioners.

VI. For each family, more than one occupying any tenement, 25 per cent. will be added to the above rates.

VII. A half story or attic in any building, will be charged at one-half the rate of a full story, and rear buildings at two-thirds the rates of front buildings.

VIII. The water rents for all vacant lots fronting upon streets, avenues, lanes or alleys through, or into which distributing pipes are or shall be laid, shall be at the rate of ten cents for each 100 square feet of their surface.

IX. The annual water rents on all buildings and vacant lots must be paid, as fixed in the foregoing list, whether the water is introduced and used or not, *provided* a distributing pipe is laid in that part of the street, lane, avenue, or alley on which the lot or building fronts.

EXTRA AND MISCELLANEOUS RATES.

Extra rates.

BAKERIES.—For the daily average consumption of flour per annum, not less than $3.00 per barrel.

BATHING TUBS.—Beyond one in private houses $3.00 each per annum. In public houses, boarding houses, barber shops, and bathing establishments $6.00 each per annum.

BOARDING SCHOOLS.—To be charged 25 cents for each scholar per annum, over and above the rent chargeable upon the house as a dwelling occupied by a single family.

BUILDING PURPOSES.—For each barrel of lime or cement used, 10 cents.

COW STABLES.—For each cow per annum, $1.00.

FERRIES.—For each 100 pounds of coal used, 1 cent.

FOUNTAINS AND JETS OF ALL KINDS.—The right to use these will only be granted at the discretion of the water commissioners, and must not in any case be used more than six hours per day. The quantity of water used will be determined by actual experiment in each case, and charged for at the rate of 2 cents per 100 gallons.

No private fountain will be permitted on any premises where the Passaic water is not taken and used for other purposes. And if the water from a fountain shall be used, or disposed of for any other purpose, an additional rent, equal to the rate fixed for such use will be charged, or the supply will be stopped, and the payment for the same forfeited.

HOTELS AND BOARDING HOUSES.—In addition to the regular rates for private dwellings shall be charged for each bed for boarders or lodgers, $1.00 per annum.

HORSE TROUGHS.—For each trough on a sidewalk, which must be made to conform to a model trough kept in the commissioners' office, $5.00 per annum.

MARKET STALLS AND STANDS, viz.:

BUTCHERS' STALLS,	each per annum	$3 to $5
FISH STALLS,	" "	5 to 7
FRUIT AND VEGETABLE STANDS,		3 to 5

PORTER HOUSES, GROCERIES, TAVERNS, REFECTORIES, OYSTER SALOONS, &c., shall be charged an extra rent, at the discretion of the commissioners.

PRINTING OFFICES, not including steam engine, if one is used upon the premises, $10 to $40 per annum.

RAILROADS.—For the supply of each locomotive, once a day, $75 per annum; twice a day, $150 per annum; supply of station for washing cars, water closets, &c., per annum, $75.00.

SLAUGHTER HOUSES, each $15 to $25 per annum.

STONE CUTTERS, $15 to $50 each per annum, exclusive of water for steam engines.

STABLES.—Private stables at which horses and carriages are kept, including water for washing carriages, for one horse, $5.00; two horses, $8.00; and for each horse more than two, $2.00 per annum.

LIVERY STABLES.—For each horse up to and not exceeding 25, $2.00 per annum; for all over 25, $1.50. Omnibus and cartmen's stables, for each horse $2.00 per annum.

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STEAM ENGINES, worked not exceeding 12 hours per day, and not exceeding 10 horse power, $10.00 per annum for each horse power; for each horse power over 10, and not exceeding 15, $7.50 per annum; and for each horse power over 15, $5.00 per annum.

SHIPPING.—For each 100 gallons delivered on board, 25 cents.

STREET WASHERS, each per annum $3.00.

STORES.—For each tenement occupied as a warehouse, store, office or shop, and not included in any other classification, and not requiring an extraordinary supply of water, from $5 to $25 per annum. For each wash hand basin more than one in such tenements, $3.00 per annum.

URINALS.—If self closing, $2.00 each per annum; all other kinds, $5.00 per annum.

WATER CLOSETS.—For each beyond one, $2.00 per annum, and must be of a kind approved by the commissioners.

All manufacturing or other establishments requiring large quantities of water, will be charged for the quantity estimated to be used during the year, at the following rates:

When the quantity used averages 200 gallons per day, at the rate of 5 cents per 100 gallons.

From	200 to	500 gls.	per day,	at the rate of	4c.	per 100 gls.
"	500 to	1000	"	" "	3½	"
"	1000 to	3000	"	" "	3	"
"	3000 to	10000	"	" "	2	"

When the quantity used exceeds 10,000 gallons per day, the price shall be fixed by special agreement.

All matters not hereinbefore specified will be made the subject of special contract with the water commissioners.

In no case will a service pipe of more than ¾ inch diameter be permitted, unless the rent fixed for the premises to be supplied shall exceed $25.00 per annum. The tenements, manufactories or other establishments paying over $25.00 per annnm, and not exceeding $45.00, a ⅝ inch pipe will be allowed; to those paying over $45.00, and not exceeding $80.00, a ¾ inch pipe will be allowed. To those paying over $80.00 per annum, such size as may be agreed upon. And in all cases the stop-cock inserted in the iron pipe in the street must be at least ¼ inch less than the service pipe.

NOTE.

Changes in rates.

Since the adoption of the foregoing rates, the following changes have been made:

BUILDINGS.	1 Story.	2 Stories.	3 Stories.	4 Stories.	5 Stories.
Less than 15 ft. in width....	$6 00	$7 50	$9 00	$10 50	$12 00
15 ft. and under 20 ft. in width	6 75	8 25	9 75	11 25	12 75

Tenement buildings are allowed four families, at the above rates. For each family over four, $1.

Instead of the charge for building purposes, the building is charged at the regular rate from the time it is commenced.

Steam engines and manufacturing establishments are charged as follows for the quantity of water used, as ascertained by metre. Payments for measured water are required to be made quarterly, at the expiration of each quarter.

For the first	200 gals. per day,	at the rate of 5 c. per 100 gals. making		10 c.
" next	300	" " 4 " "		12
	500	" cost.....		22
" "	500	" at the rate of 3½ c. per 100 gals.	"	17½
	1000	" cost.....		39½
" "	2000	" at the rate of 3 c. per 100 gals.	"	60
	3000	" cost.....		99½
" "	7000	" at the rate of 2 c. per 100 gals.	"	1 40
	10,000	" cost.....		$2 39½

All over 10,000 gallons per day at the rate of 1 cent per 100 gallons. To the above prices add 20 per cent. for consumers out of the city. Three hundred days to constitute a year for measured water.

RULES AND REGULATIONS.

Rules and regulations.

No person will be permitted to have a tap or stop-cock inserted in any water pipe, or connect any service pipe to convey water from the pipes in the streets to any house, building or manufactory, or for any purpose whatever, without written permission first obtained from the commissioners, specifying the name of the person or persons for whose use the water is required, and the street and number where it is to be taken—the size of the stop-cock and service pipe

—the purpose for which the water is intended to be used, and the name of the person authorized to tap the street pipe.

Tapping. No plumber or other person, except the tapper employed by the water commissioners, will, on any account, be permitted to tap any street pipe. And any plumber employed to fit up pipes, water-closets, baths, or other apparatus for the distribution and use of Passaic water, in any house, manufactory, or other place where it may be used, shall, within five days after the same is finished, fill up and return to the office of the water commissioners such blanks, in a printed form of report (which will be furnished), as will enable them to ascertain the general character of the apparatus and arrangements for using the water in every case.

No addition to, or alteration whatever, in or about any tap, pipe, or water-cock, shall be made, or caused to be made, by any person, without permission first had in writing, from the water commissioners.

No owner, or tenant, will be allowed to supply water to other persons or families.

Provisions. All persons taking water, must keep their own service pipes, including the tap in the street, and all apparatus connected with the service, in good repair, and protected from frost, and *shall prevent all waste of water.*

Street washers. Street washers will not be allowed upon the side-walks, and must be used only between the hours of 5 and 7 A. M., and 5 and 7 P. M., from the 1st April to the 15th October, and not more than one hour in a day at any season of the year; nor shall they be converted into jets, or the water suffered to run to waste, or used to wash the filth of gutters down upon neighbours, or into the receiving basins of sewers.

It will not be permitted to use a hose, or jet to wash carriages or horses, in any case, or under any circumstances.

Hydrants. No hydrant will be permitted upon any side-walk, or in any front area, and if standing in a yard or alley attached to any building, must not be permitted to be left running when not actually required; and if the drip or waste from such

hydrant overruns the side-walk, and from freezing becomes dangerous in winter, the supply will be shut off.

Taps. Taps at wash-basins, water-closets, baths, urinals, or other places, must not be left running.

Applications. Applications for water must state fully and truly, all the purposes for which it is intended to be used; and when paying the annual charges for it, parties must frankly and without concealment, answer all questions put to them relating to its consumption.

Fountains and jets. No yard fountain, or jet in any porter-house, grocery, or other building, shall be in use more than six hours in each day, without a special permit first obtained in writing, and additional payment therefore beyond the established rate. And the water commissioners reserve the right to suspend the use of, or to abolish all private fountains and jets, whenever in their opinion the public interest requires such proceeding.

Vessels. No ferry boat, or vessel of any kind, shall transport Passaic water to any other place for sale, or for the use of any individual or family, nor shall any person attached to any ferry, transport it for his own use, or the use of others, or for sale.

Right of access. The water commissioners, personally, and every person by them delegated for that purpose, shall have free access, at all proper hours, to all parts of every building, or steam vessel, or other place where Passaic water is delivered or consumed.

Penalties. The penalties for violating any of the preceding rules, will be first, the prompt stoppage of the supply of water, without any further or other preliminary notice; nor will its use be again permitted, except upon payment of the expense of shutting off and putting on, and satisfactory assurances that no cause of complaint shall afterwards be given; second, such as may be awarded by the courts, on complaint by the water commissioners, under the 20th and 21st sections of the "Act to authorize the construction of works for supplying Jersey City and places adjacent with pure and wholesome

water;" and, third, in the event of the water not being again let on, the forfeiture of all payments made for the use of water, or for which the party offending may be liable on account thereof.

JOHN D. WARD, *President.*

WATER COMMISSIONERS' OFFICE,
Jersey City, 1st *June*, 1854.

[D.]

No.

APPLICATION FOR SERVICE PIPE.

For Premises No.................................. *Street, Jersey City.*

TO THE WATER COMMISSIONERS OF JERSEY CITY:

GENTLEMEN—A supply of Passaic Water, to be delivered through a ......inch Stop Cock, and ......inch Service pipe, is desired for the premises No.............. ....Street. The.....................is situated on the....... ....side of the street, and upon the....................of the lot.

The Water is required for..............................and the apparatus proposed to be fixed for it are—

Street Washers..................................		Sinks in Kitchen..............................	
Baths..		" in Bar..................................	
Water Closets..................................		Jets in Bar.......................................	
Urinals..		Wash Basins....................................	

A Stop Cock, of the size mentioned, and a Permit to attach a Service Pipe thereto, after the same is fixed in the Distributing Pipe, will oblige,

Your obedient servant,

....

[E.]

PERMIT *issued*...*th*.....185

to.......................

for..........*inch Stop Cock,*

and............*inch Service Pipe, to connect with Distributing Pipe in*..........

street, for supplying No.....

...........*side.*

....................*Tapper.*

..................*Plumber.*

Water Commissioners' Office,

JERSEY CITY,.........185

RECEIVED *from*...........................

..............*Dollars, in payment for the Stop Cock described in the annexed Permit, and inserting the same in the Distributing Pipe.*

......................REGISTRAR.

WATER COMMISSIONERS' OFFICE,

Jersey City,..........185

PAYMENT has been made at this Office for one......inch Stop Cock, to be inserted in the Distributing Pipe of the Jersey City Water Works, in............street, for the purpose of delivering a supply of Passaic Water to Premises No......situated on the........side thereof, and occupied as a..............by.........................

You are therefore authorized to insert such Stop Cock, and...... ....(a licensed Plumber,) is permitted to connect therewith a.......inch Service Pipe, to be used for the purpose above mentioned, he conforming in all things to the Regulations printed on the other side.

To........................TAPPER.

......................REGISTRAR.

N. B.—The Stop Cocks furnished by the Water Commissioners are the best which they can obtain, and are proved with a hydraulic pressure of 300 pounds per square inch. Having done all in their power for the security of the work, they must not be held responsible for damage which may result from its failure; but they will replace any Stop Cock, without charge, which may be found defective within one year from the time it is inserted.

REGULATIONS RESPECTING TAPPING, DISTRIBUTING PIPES, AND ATTACHING SERVICE PIPES.

No one will be permitted, under any circumstances, to tap the distributing pipes or insert stop-cocks therein, except the tapper employed by the water commissioners or persons in his service and approved by them. Pipes and rules.

No plumber not licensed by the water commissioners will be permitted to attach service pipes to the stop-cocks when inserted; and every plumber attaching a service pipe must build a solid pier of brick work not less than eight inches square at the side of the iron distributing pipe for the service pipe and tapper's box to rest upon, and prevent them from settling and injuring or breaking the stop-cock.

Trenches opened in the streets for the purpose of inserting stop-cocks and attaching service pipes, must not be allowed to remain open any longer than is *really necessary* to perform the work required in a proper manner. And in refilling them the earth must be carefully rammed, in order that the whole may be returned, and the surface of the street must be left in as good condition as it is found.

Every plumber is required to report to this office within five days after the same is completed, the extent and character of all apparatus in or about any dwelling, manufactory, or other place where he may have fixed the same, for introducing and using Passaic water.

JERSEY CITY, 1*st May*, 1854.

[F.]

No.

Water Commissioners' Office,

JERSEY CITY,..... 185

The Tapper is authorized to insert a.....Stop Cock in the iron pipe, in front of premises No.....

172

.....*Plumber.*

.....*Registrar.*

[G.]

WATER COMMISSIONERS' OFFICE,
JERSEY CITY.....18..

Mr......

To WATER COMMISSIONERS OF JERSEY CITY, Dr.

To Water Rents on the under described premises, from May 1st, 18....to May 1st, 18....

☞ Water Rents are payable annually, in advance on the 1st of May. On the 1st of July following, five per cent. will be added on all unpaid rents; and on the first of October after, an additional ten per cent. From the 20th of December, interest will be added at the rate of twelve per cent. per annum, to the date of payment. For Rules, Regulations and Penalties, see back of this bill.

Office Hours, from 9 to 4 o'clock. Bankable money only received.

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Block.	Lot No.	Street No.	Location of premises.	Stories High	Front Building.	Rear Building.	No. ex'a families.	Extra families.	Other uses.	Amount.	Register Folio.

Received payment.....18..

.....*Registrar.*

The Board of Water Commissioners of Jersey City, by authority conferred in the "Act to authorize the construction of works for supplying Jersey City and places adjacent with pure and wholesome water," approved 25th March, 1852, and a supplement thereto, approved 16th March, 1854, have established the following:

RULES, REGULATIONS AND PENALTIES RESPECTING THE USE OF PASSAIC WATER.

Rules and regulations.

1. No tenant will be allowed to supply water to other persons or families; if found doing so, the supply will be stopped, and the amount of payment forfeited.

2. No addition or alteration whatever in or about any conduit, pipe, or water-cock, shall be made or caused to be made, by persons taking the water, without notice thereof being previously given to, and permission had in writing from the board.

3. All persons taking the water shall keep their own service pipes, stop-cocks, and apparatus in good repair, and protected from frost at their own expense, *and shall prevent all unnecessary waste of water.*

4. *Street washers* must only be used between the hours of 5 and 7 A. M. and 5 and 7 P. M. from the 1st of April to the 15th of October, and not more than one hour in the day at any season of the year, under a penalty of five dollars for each offence; and if found out of order or leaking, or if converted into jets, or suffered to run when not used, the supply will be cut off without previous notice.

5. No hydrant will be permitted upon the sidewalk or in the front area; and if standing in a yard or alley attached to any dwelling or building, will not be permitted to be kept running when not in actual use; taps at water-closets, wash-basins, baths and urinals must be kept closed in like manner.

6. Applications for water must state truly all purposes for which it is required, and when paying the annual charge for it parties must frankly, and without concealment, answer all questions put to them relating to its consumption. In case of fraudulent misrepresentation on the part of the applicant, or of uses of the water, not embraced in this bill, or of wilful or unreasonable waste of water, the water commissioners shall have the right to forfeit his payment, and the supply of water will be stopped, unless the party shall promptly pay such additional charge as the board may impose.

7. The commissioners, personally, and every person by them delegated for the purpose, must have free access, at proper hours of the day, to all parts of every building and steam vessel in which Passaic water is delivered and consumed.

8. The penalty for a violation of any of the preceding rules and requirements will be the prompt stoppage of the supply of water without any further or other preliminary notice; nor will it be restored, except upon payment of the expense of shutting it off and putting it on, and upon a satisfactory understanding with the party that no future cause of complaint shall arise.

[H.]

PLUMBERS' BOND.

Plumbers' bond.

KNOW ALL MEN BY THESE PRESENTS, THAT WE,

are held and firmly bound unto the water commissioners of Jersey City, in the sum of one thousand dollars, lawful money of the United States of America, to be paid to the said "Water Commissioners of Jersey City," their successors and assigns. For which payment, well and truly to be made, we hereby bind ourselves, our heirs, executors and administrators, firmly by these presents. Sealed with our seals, and dated this day of one thousand eight hundred and

WHEREAS, the above named is one of the plumbers licensed by the water commissioners of Jersey City, for introducing and distributing Passaic water, where the same may be required.

Now the condition of the above obligation is such, That if the said shall indemnify and save harmless the water commissioners and the mayor and common council of Jersey City, of and from all accidents

and damages consequent thereupon, for, or by reason of any opening, in any street, lane, avenue, alley or court, made by him, or by those in his employment, for the purpose of putting down or inserting any service pipe or pipes, hydrant or other apparatus for the introduction or use of Passaic water, or for making any connection with any public or private sewer, or for any other object or purpose whatever; and shall also replace and restore the street pavement over every such opening, to as good state and condition as he found it; and keep and maintain the same in good order, to the satisfaction of the street inspector of Jersey City, for the space of six months thereafter; and also make true and faithful reports to the "Water Commissioners of Jersey City," of the situation, size, number, and character, of all pipes, hydrants, washers, water-closets, baths, and all other work or apparatus for conveying, containing, or consuming Passaic water, made, fixed, or inserted by him, or under his direction, within five days after the same shall be completed, then this obligation shall be void and of no effect.

Sealed and delivered in presence of

[I.]

No.

THIS IS TO CERTIFY,

THAT.....*having executed and filed the required Bond, is hereby licensed by the* "WATER COMMISSIONERS OF JERSEY CITY," *to make and connect Service Pipes for conducting Passaic water into, and distributing and using the same in Houses and Tenements where the same may be required.*

THE CONDITIONS OF THIS LICENSE *are, that the said licentiate shall, at all times, and in all respects, carefully and truly observe the regulations which have been, or may hereafter be established by the said Water Commissioners respecting the introduction and use of Passaic water.*

This license may be revoked at the pleasure of the Water Commissioners.

By order of the Board.

WATER COMMISSIONERS' OFFICE,

Jersey City,.....18..

.....*President.*

No.

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178

[K.]

REPORT OF PLUMBER'S WORK FOR USING PASSAIC WATER:

Plumber's report.

Made by.....*for*.....

and fixed in.....*street, No*.....

Jersey City.

	NEW.	OLD.
Service Pipe,.....inch diam.....		
Stop Cock in ditto.....inch diam.....		
Taps at sinks.....		
Taps at Wash Basins.....		
Urinals, self-closing.....		
do. closing by hand.....		
Water Closets, self-closing.....		
do. closing by hand.....		
Baths.....		
Street Washers.....		
Fountains.....		

Other work made and fixed, or found on the premises, not included in the above list:

I [CERTIFY that the above report specifies all the work done by me, or under my direction, or that was heretofore made and fixed, and remains upon the above mentioned premises; and that to the best of my knowledge and belief it includes all pipes or apparatus of any kind, for conveying or consuming Passaic water, fixed or used therein.

.....*Licensed Plumber.*

Jersey City,.....185 .

SIXTH REPORT.

To the Honorable the Mayor and Common Council of Jersey City:

Report. In compliance with the requirements of the law under which we act, to report the condition of the Water Works, and the receipts and expenditures on account of the same, we submit herewith a report of the chief engineer, and an abstract from the books of the office, made by the clerk; both documents refer to transactions connected with the works, to the end of the year 1854.

The report of the engineer is minute and full of interesting particulars.

Abstract. The abstract of the clerk is an exhibit of the receipts of money from all sources, and disbursements on the whole works, from their commencement to the end of the year 1854.

The term for the water rents collected, as shown on said statement, commenced on Sept. 1st, 1854, and ends May 1st, 1855—being eight months.

There is a considerable amount yet unpaid, which is in the course of collection.

The annual rents for the water will hereafter commence on the 1st May.

Income. The changes in the monetary condition of the country, which have been severely felt by the community for some months, will materially affect the income calculated to be derived from the use of the water, from the mechanical and manufacturing interests of the place, and the same causes