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MITIGATION STUDY AND REPORT ON THE RIDGEWOOD AQUEDUCT, NASSAU EXPRESSWAY QUEENS AND NASSAU COUNTIES, NEW YORK

by

David E. Church

and

Edward S. Rutsch, S.O.P.A.

of

HISTORIC CONSERVATION AND INTERPRETATION, INC.
Box 111, RD 3, Newton, New Jersey 07860

for

Vollmer Associates
11 W. 19th Street, New York, N.Y. 10011
&
United States - Department Of Transportation
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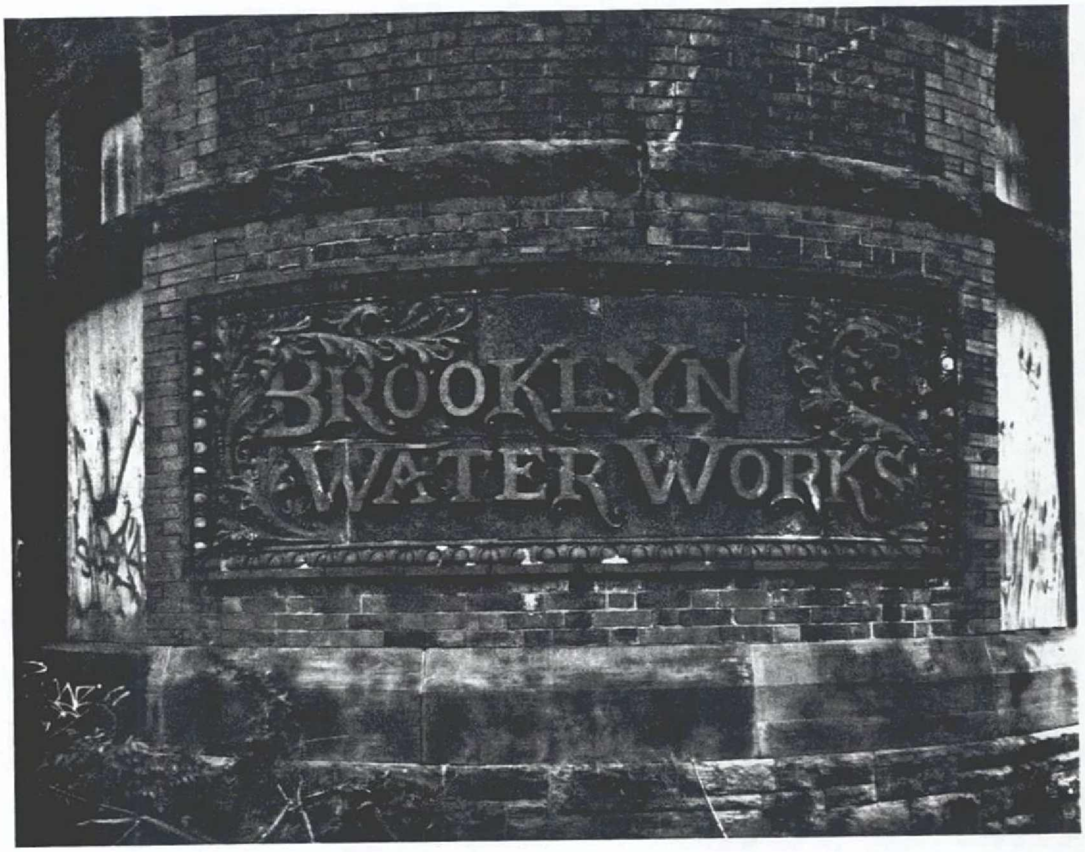

DETAIL, FRONT FACADE
MILLBURN PUMPING STATION

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I. INTRODUCTION

The New York State Department of Transportation (NYSDOT) is requesting approval for proceeding with construction stages for the proposed Nassau Expressway in Queens and Nassau counties, New York, which will require demolition and/or removal of portions of the Ridgewood Aqueduct--an abandoned water conduit which originally served the City of Brooklyn. The Ridgewood Aqueduct is currently listed on the National Register of Historic Places. The Ridgewood Waterworks system was the first water supply system built in the mid-nineteenth century to supply water to the City of Brooklyn. It is significant because of the engineering solution utilized to accommodate the water supply needs of a rapidly urbanizing area. The Ridgewood Aqueduct itself is historically significant as the trunk into which a series of reservoirs extending into present Nassau County were channeled to provide the City of Brooklyn with water.

A. Compliance with Federal Legislation

The listing of the Ridgewood Aqueduct on the National Register of Historic Places requires that special consideration be given to the site with respect to any federally funded or authorized undertaking that might adversely affect it.

The Federal Legislation which directly applies to the Ridgewood Aqueduct includes the Historic Preservation Act of 1966; the National Environmental Policy Act of 1969, and Section 4(f) of the United States Department of Transportation Act of 1966; Title 36, Chapter VIII, Part 800, Code of Federal Regulations (36CFR 800); Executive Order 11593.

In compliance with the requirements set forth in these legislations, it was determined, based on an environmental assessment, that the Nassau Expressway Project Alternatives will have an impact on the Ridgewood Aqueduct. Both the FHWA (New York Division Office) and the New York State Historic Preservation Office (SHPO) applied the criteria set forth in Section 106 (36 CFR, part 800) procedures of the National Historic Preservation Act of 1966 (PLO 89-665) and determined that the site was potentially eligible for the National Register. After applying for an opinion from the Secretary of the Interior, federal notification of the site's eligibility was received from the Keeper of the Register on October 20, 1978 (see Appendix A, page A-9). In order that a determination of "adverse effect" or "no adverse effect" be undertaken based upon criteria set forth in Section 106 (36 CFR, Part 800.9), the SHPO recommended that an "Evaluation Report" be prepared.

The report, entitled Documentary Literature Search and Evaluative Report on the Ridgewood Aqueduct, was subsequently prepared by qualified industrial archeologists (Church and Rutsch 1979) in conformance with Section 106 requirements and Historic American Engineering Record (HAER) procedures (executive order 11593). The 1979 report served further to establish the probable direct impact of expressway construction on the Aqueduct as well as on an existing gatehouse and several minor associated waterworks features. The 1979 report also fully documented the history of waterworks and of Brooklyn's overall history in securing a public water supply. Finally, it clearly established the potential eligibility of the entire waterworks system for inclusion on the NRHP. This report was incorporated in the Draft Environmental Impact Statement (DEIS) and Section 4(f) report (Church and Rutsch 1979). After reviewing the report, the SHPO and FHWA determined that the project will have an adverse effect on the Ridgewood Aqueduct.

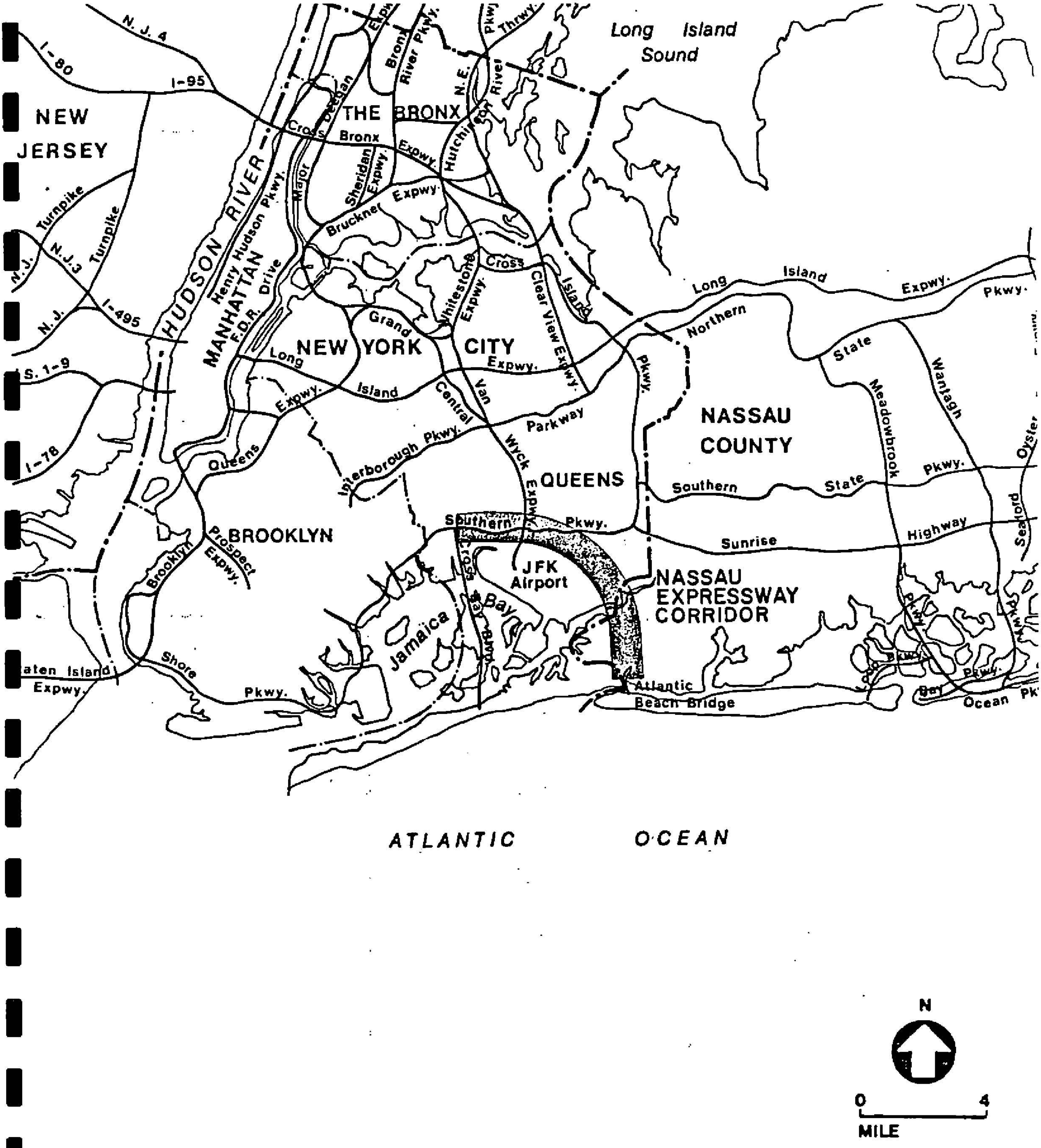
A "Case Report" was then submitted to the Advisory Council On Historic Places in complaince with Section 106 (36 CFR, Part 800.6) procedures of the National Historic Preservation Act of 1966 (PLO 89-665).

A "Memo of Understanding" (see Appendix A) between the Advisory Council on Historic Preservation and the Federal Highway Administration (FHWA) was subsequently executed and formed the basis for this mitigation study and report. The mitigation of Nassau Expressway construction impacts as identified in the FEIS and "Memo of Understanding" included (1) the preparation of a complete documentation on the entire Ridgewood Aqueduct system including those elements outside the project area, (2) a field survey and photo documentation of all surviving features of the system, and (3) periodic observations during construction to allow an archeologist to record, document, and photograph the excavations that will destroy portions of the Aqueduct that are being eliminated.

B. Mitigation Study and Report

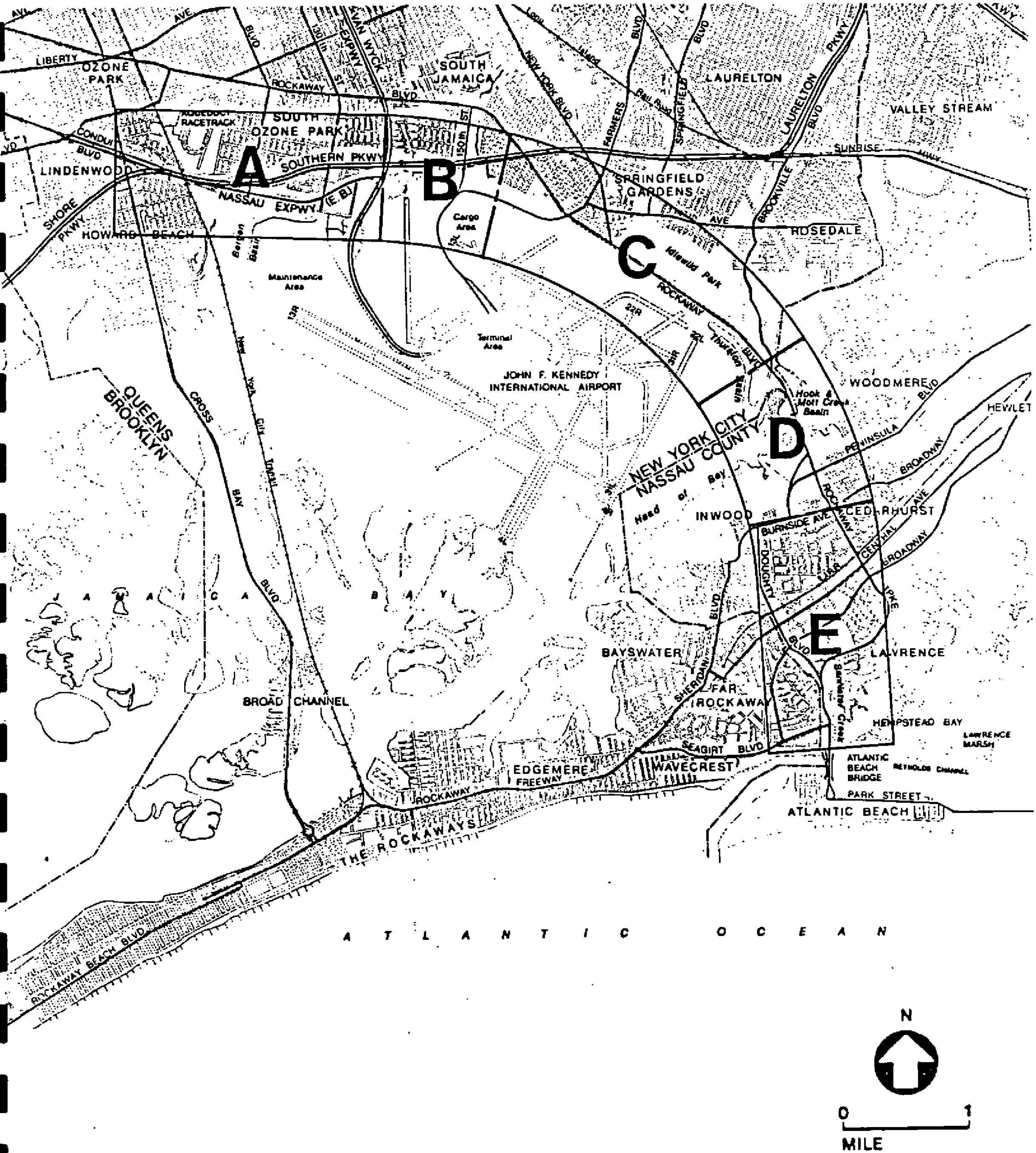
This report presents the results of a mitigation study on the Ridgewood Aqueduct and Waterworks System, which is situated in Kings, Queens, and Nassau counties, New York (see Figures 1 and 2). The study was conducted by Historic Conservation and Interpretation, Inc. (hereafter also "HCI") during 1985/1986. Because proposed construction stages for the Nassau Expressway will impact portions of the buried Ridgewood Aqueduct and associated waterworks features, and because this waterworks system has been determined eligible for and has subsequently been included on the National Register of Historic Places, documentary and infield research was completed as part of the mitigation of negative impacts to this historic but abandoned waterworks system.

As part of negotiated agreements between the SHPO, the NYSDOT, Vollmer Associates, and HCI, the mitigation study of



LOCATION MAP

FIGURE 1A



NASSAU
EXPRESSWAY
CORRIDOR

FIGURE 1B

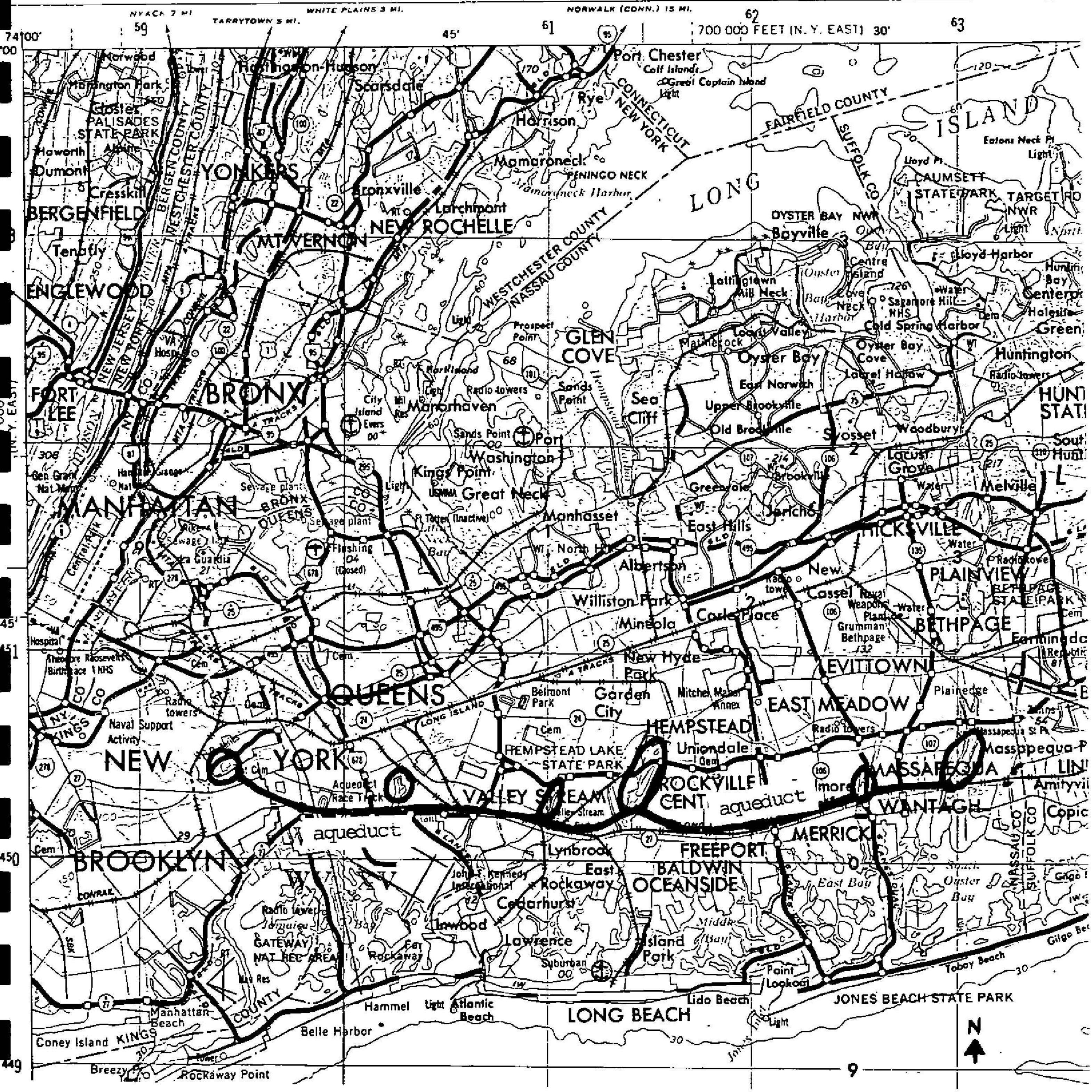


FIGURE 1D. Location map to illustrate overview of the Ridgewood Aqueduct project area. Scale: 1:250,000. Source: USGS NK 18-6, New York, N.Y.; N.J.; Conn.

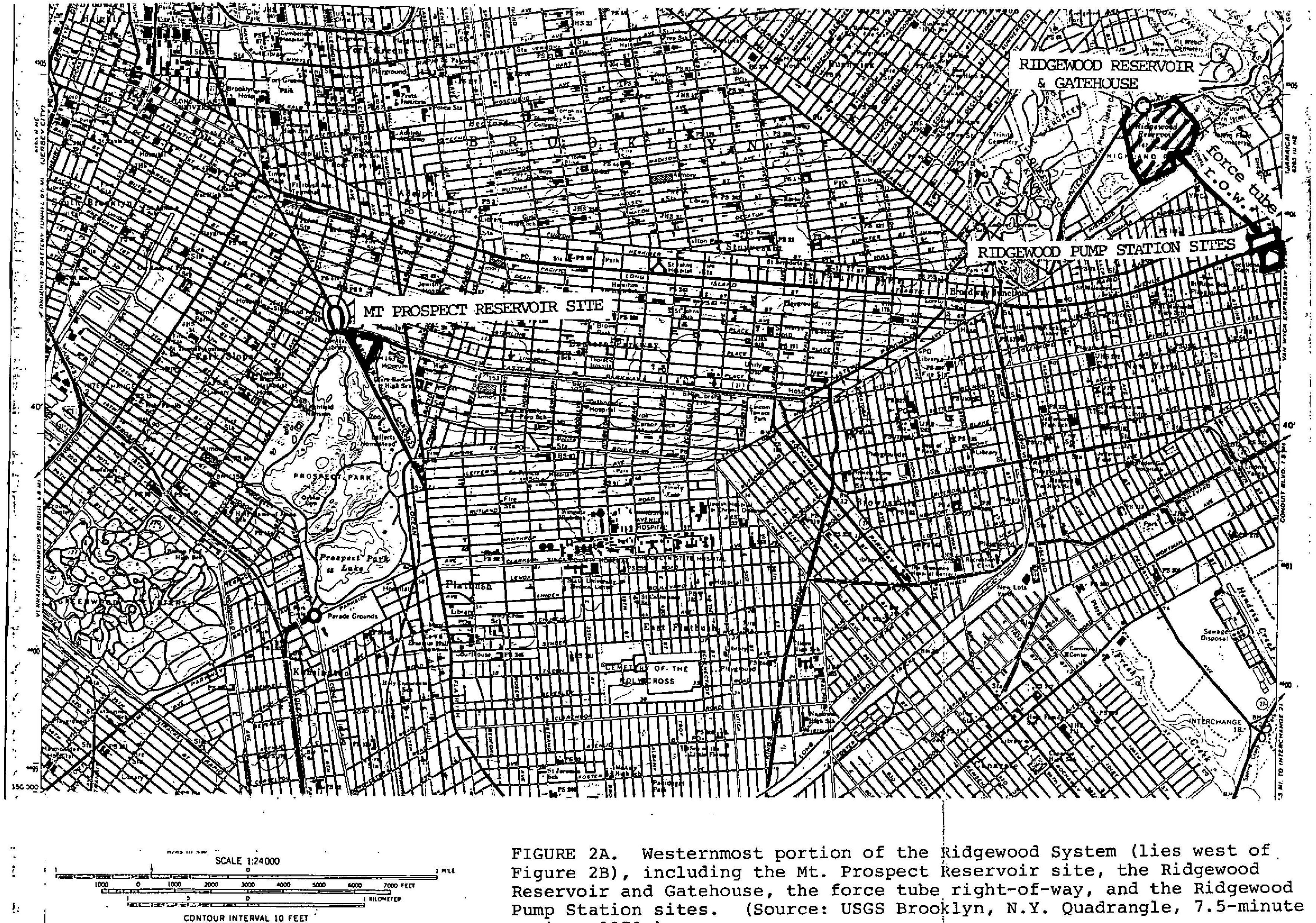


FIGURE 2A. Westernmost portion of the Ridgewood System (lies west of Figure 2B), including the Mt. Prospect Reservoir site, the Ridgewood Reservoir and Gatehouse, the force tube right-of-way, and the Ridgewood Pump Station sites. (Source: USGS Brooklyn, N.Y. Quadrangle, 7.5-minute series, 1979.)

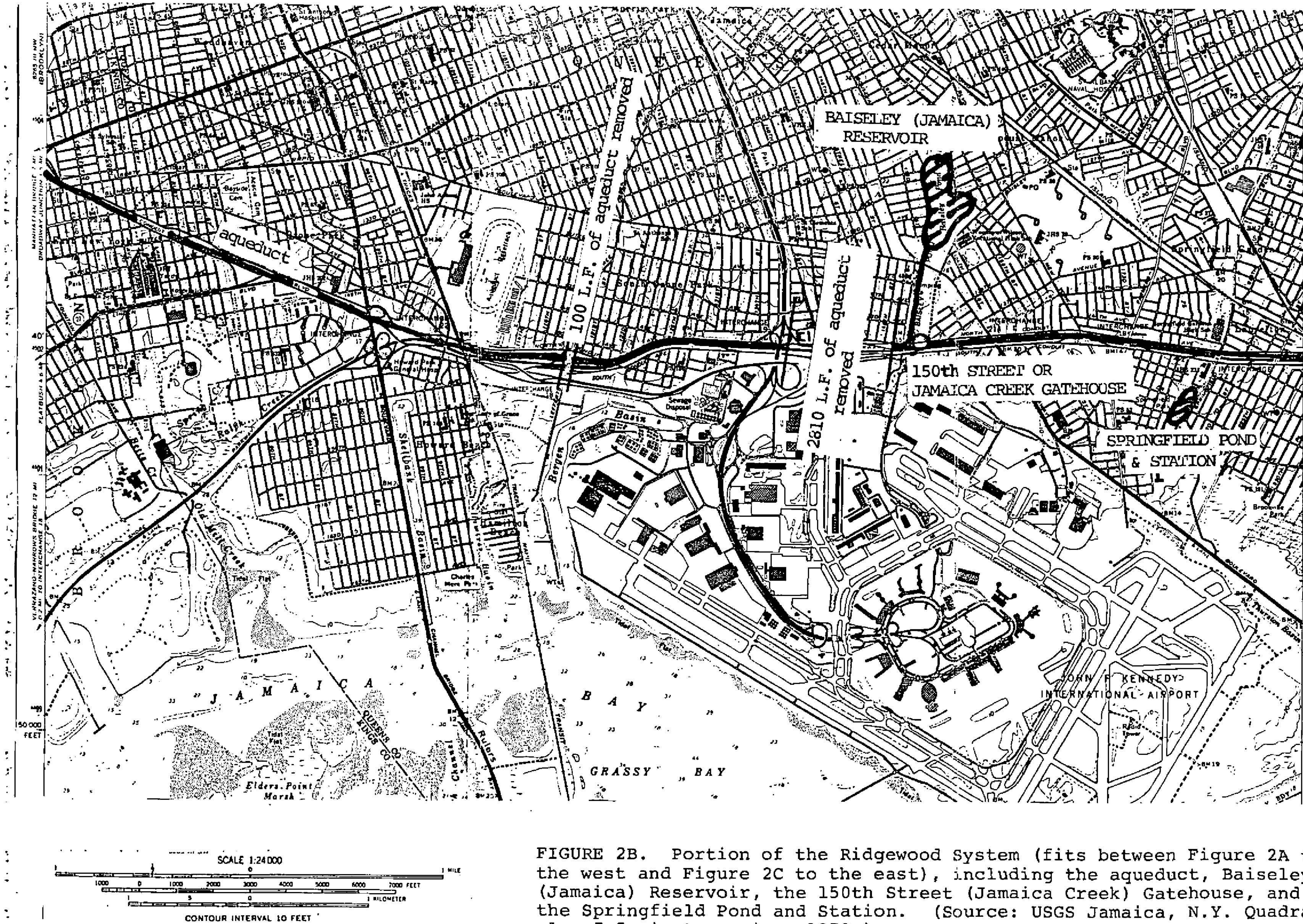


FIGURE 2B. Portion of the Ridgewood System (fits between Figure 2A to the west and Figure 2C to the east), including the aqueduct, Baiseley (Jamaica) Reservoir, the 150th Street (Jamaica Creek) Gatehouse, and the Springfield Pond and Station. (Source: USGS Jamaica, N.Y. Quadrangle, 7.5-minute series, 1979.)

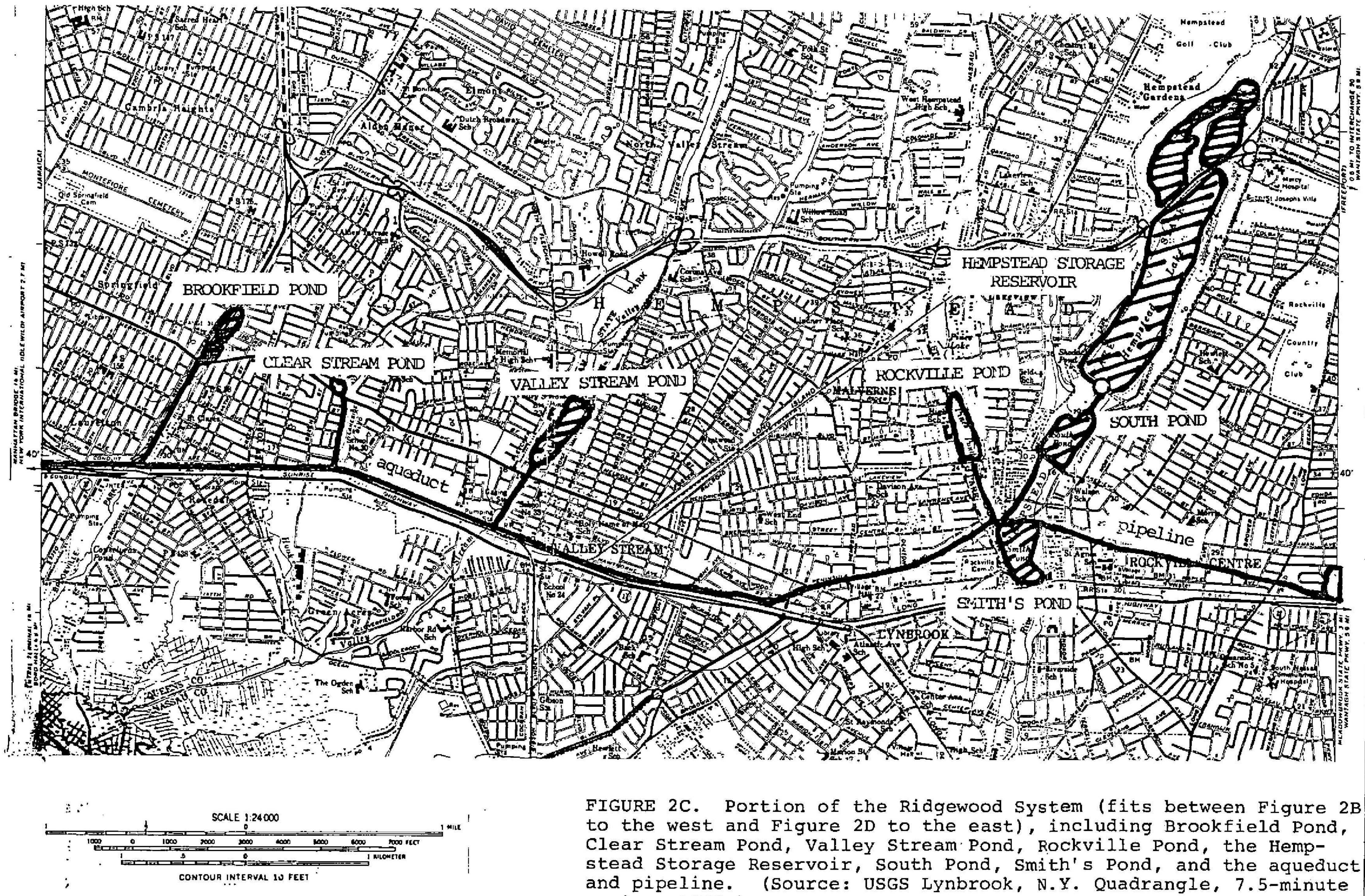


FIGURE 2C. Portion of the Ridgewood System (fits between Figure 2B to the west and Figure 2D to the east), including Brookfield Pond, Clear Stream Pond, Valley Stream Pond, Rockville Pond, the Hempstead Storage Reservoir, South Pond, Smith's Pond, and the aqueduct and pipeline. (Source: USGS Lynbrook, N.Y. Quadrangle, 7.5-minute series, 1979.)

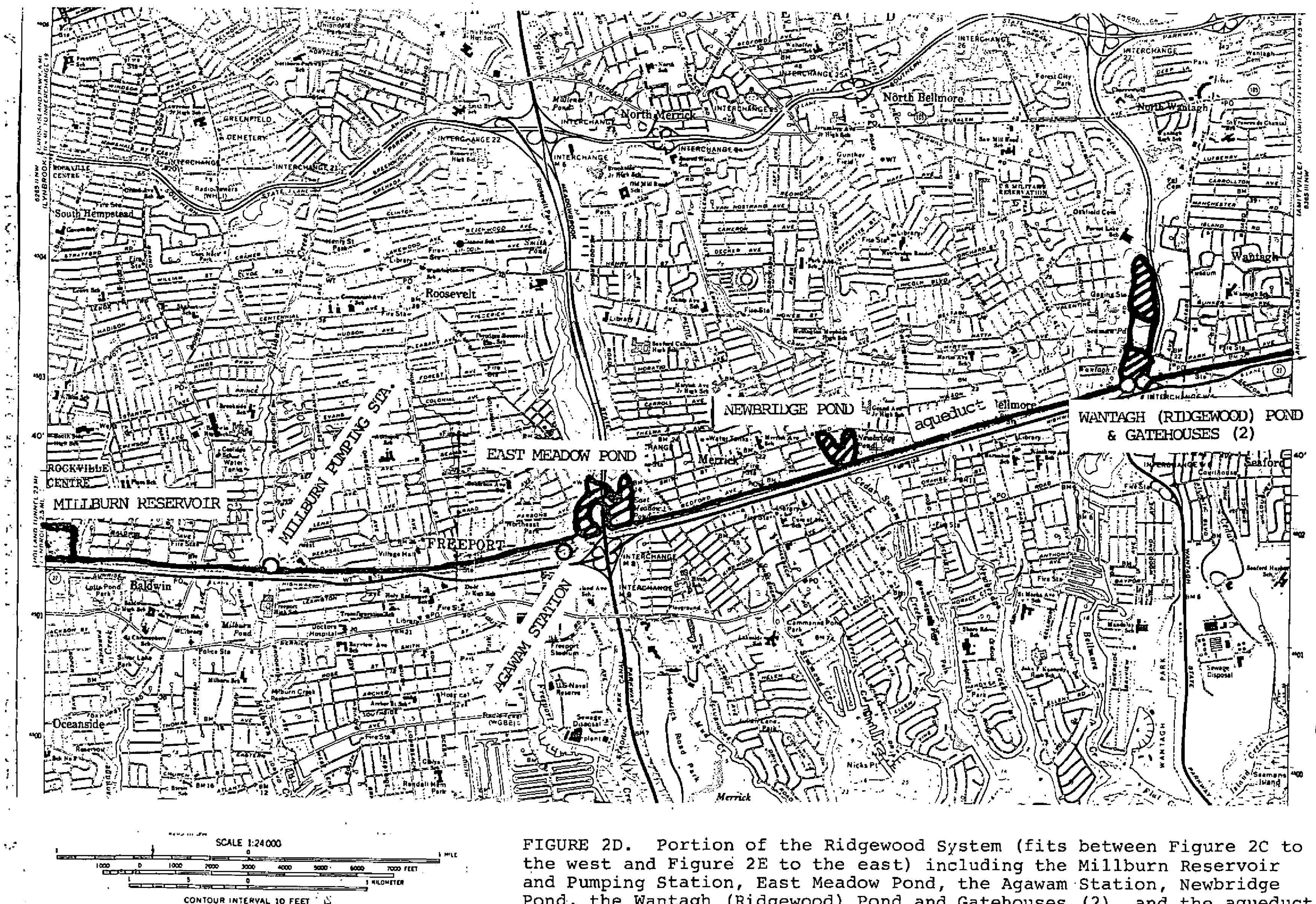


FIGURE 2D. Portion of the Ridgewood System (fits between Figure 2C to the west and Figure 2E to the east) including the Millburn Reservoir and Pumping Station, East Meadow Pond, the Agawam Station, Newbridge Pond, the Wantagh (Ridgewood) Pond and Gatehouses (2), and the aqueduct. (Source: USGS Freeport, N.Y. Quadrangle, 7.5-minute series, 1979.)

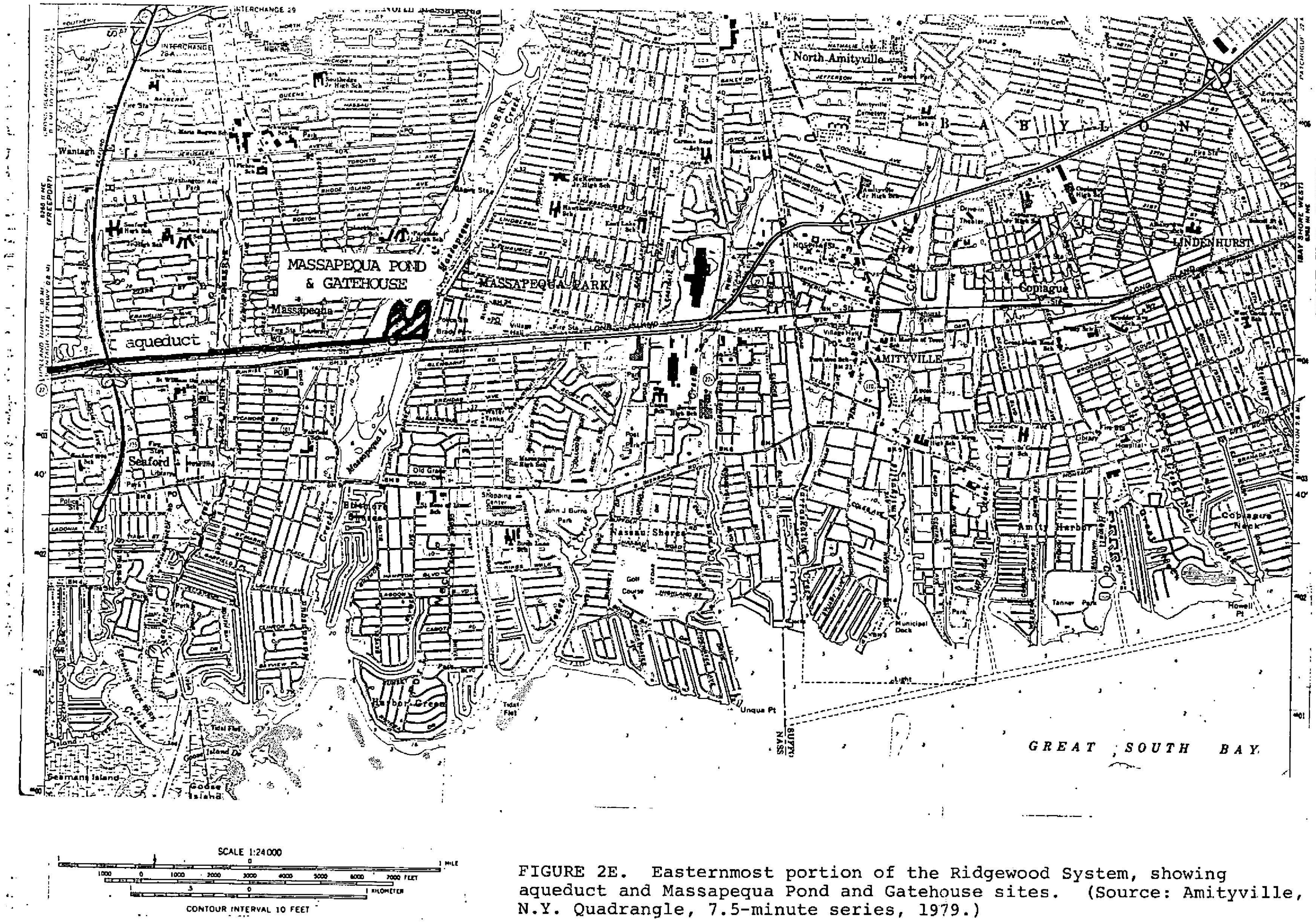


FIGURE 2E. Easternmost portion of the Ridgewood System, showing aqueduct and Massapequa Pond and Gatehouse sites. (Source: Amityville, N.Y. Quadrangle, 7.5-minute series, 1979.)

the Ridgewood System was determined to be necessary for three reasons. First, the report completes documentary research on the entire waterworks system and serves as a supplement to the 1979 report, which primarily focused on the system within the proposed Nassau Expressway study area. Second, the mitigation study included a field survey and photo-graphic documentation of all surviving features of the Ridgewood waterworks system, not just those features within the Nassau Expressway study area. Finally, archeological testing was completed within the study area in order to sample the nature and extent of archeological features which may be destroyed by expressway construction. The results of this research are presented within the following report.

Documentary research summarized in this report is a supplement to the documentary research presented in the 1979 report (Church and Rutsch 1979). Data collected previously are summarized herein for convenience and continuity. For more detailed historical information, the reader should refer to the 1979 report, the FEIS, and the Preliminary Case Report.

The following pages also present the findings of the 1985 architectural and archeological field survey. The methodology for these two field surveys is presented as introductions to the field report chapter (Section IV).

The appendix of this report contains a copy of pertinent correspondence, the "Memo of Understanding," the specific impacts of each stage of Nassau Expressway construction, and a description of the proposed method to preserve and stabilize the Jamaica Creek Gatehouse.

C. Acknowledgments

Historic Conservation and Interpretation, Inc. acknowledges several individuals for their assistance and/or guidance in researching the Ridgewood System. Bill Asadorian and Nick Falco at the Long Island Division of the Queens Borough Public Library were very helpful in opening up their documentary resources and allowing HCI to make long-term loans of several important references. Art Larsen of the New York City Department of Water Resources, Bureau of Water Supply proved to be a wealth of information regarding a public water supply virtually forgotten by New York City. Industrial archeologist Matt Roth and historian Dr. Leo Hershkowitz both supplied insights or particular bits of information when most needed. Finally, Karl Rubenacker and Tim Hinrichs of Vollmer Associates were both instrumental in managing the completion of this study and also in supplying crucial historical information which they encountered as engineers for the project.

II. CULTURAL GEOGRAPHICAL BACKGROUND

Coastal areas in the Middle Atlantic States tended to be settled by pioneer Europeans traveling in small coastal-sized sailing vessels. Initial settlement occurred at those locations along the shoreline which were most easily accessible from the water. On the south shore of Long Island, these settlement locales generally tended to be on the mainland north of the salt bay and barrier beach islands. The very term used to describe the favored landing places--i.e., inlets--depicts their function in the settlement pattern: the mouths of freshwater streams deep enough to draw a sailing vessel close to a dry landing site.

Such locations were enriched by two other attractive environmental factors. First, inlets, at the juncture of fresh- and saltwater biota, are extremely rich in available food. Shellfish, fish, and useful plants abound in this area of enriched intermeshing econiches. In fact, the south shore settlers' capacity to harvest such riches quickly created an historically long-lived and commercially important regional economy, which only modern pervasive human pollution is ending.

Second, just upstream from the juncture of fresh- and tidewaters were sites that could be effectively dammed, creating millponds for potential hydropower and developing the fall or "head" of water necessary to drive the wheel and thus perform the work of the mill. In America's preindustrial past, a variety of waterpowered mills processed agricultural and natural resources into usable commodities. Sawmills processed timber into usable lumber; oil, flax, and hemp mills processed useful products from plants; fulling, carding, and textile mills produced woolens.

But the most important and powerful of these mills was the gristmill, whose ability to grind grain into food was literally a community necessity. Such mills were public places, and required considerable investment to develop what was then the most powerful machinery in the entire culture. When, as elsewhere, the Long Island farmers began to produce a surplus, they shipped their flour to market on these estuaries' coastal ships.

Gristmills have comparatively very substantial dams, many of which were wide and massive enough to support roads that served as causeways or bridges. The evolution of this function seems clear enough: ready access across a stream allowed a mill to garner customers from farms on both sides. When settlement grew increasingly more dense, Long Islanders, as did many of the region's coastal settlers, began to travel from one inlet village to another along the shore, creating tracks that became roads. These travelers stayed on higher dry ground, and therefore crossed streams on the convenient gristmill dams. When the Ridgewood Aqueduct was laid out, it was this pre-existing shore route that was followed, and it was the coastal streams' millseats that were purchased, enlarged, and channeled for the city's water system.

Ironically, the growth of the urban population throughout America's postindustrial history both led to the increasing demand for freshwater and, at the same time, contributed to the pollution and environmental destruction that accompanied urbanization, thereby reducing the region's ability to produce clean water. What a paradox. We have decreased the environment's abilities to supply resources at the same time we have increased our needs and demands for what has been made unfit for use.

The typical answer to these environmental dilemmas, as is true in the case of the Ridgewood Aqueduct, has been to abandon what is spoiled rather than to clean up the polluting factors. The spoiled local resources were therefore replaced with unspoiled water in greater quantity from more remote, thus cleaner, sources.

Yet a transport route--i.e., the shore road and aqueduct under discussion--became the valuable asset it is today because it established a corridor that crosses a densely populated region in which assembling land parcels for a routeway is, at best, difficult or impossible. It is interesting, but not surprising, that larger and larger roads have been built using this previously established routeway. Although recognition of the value of this linkage is attributed to Robert Moses, the region's preeminent public planner, this type of reuse has long been a common resource throughout Megalopolis. Similarly, today's efforts to build the latest version of the conduit's route will undoubtedly be redone as soon as the demands of the future are realized.

III. DOCUMENTARY RESEARCH

A. Historic Setting

The following text summarizes the history of Brooklyn's efforts to secure a reliable public water supply as well as the story of the construction, expansion, and eventual abandonment of the Ridgewood System as that water supply. This history is presented in greater detail within the previously completed report, A Documentary Literature Search and Evaluative Report on the Ridgewood Aqueduct, Nassau Expressway, Queens and Nassau Counties, New York (Church and Rutsch 1979). Additional information found during the 1985 research has been added to this summary. In particular, more information has been gathered regarding some of the problems encountered by Brooklyn in securing a public water supply and in convincing the public of such a need, as well as regarding problems occurring through operation of the Ridgewood System as water demand increased and as the drainage area of southern Long Island became developed.

Documentary research for both this and the 1979 report was conducted primarily at the Queens Borough Library. Additional research was carried out at the Long Island Historical Society, the Brooklyn Public Library, the New York Public Library, and the New-York Historical Society.

Two documents are of particular note in reference to the history of the Ridgewood System. J. P. Kirkwood's The Brooklyn Water Works and Sewers, published in 1867 by D. Van Nostrand for the Board of Water Commissioners, is a thorough, clinical description of the early efforts to secure water and sewer systems in Brooklyn. As engineer of the Ridgewood System, Kirkwood presents a full textual and graphic account of its original construction, including reproductions of important correspondence and as-built to-scale drawings of major aspects of the waterworks.

Expanding on Kirkwood's work is the 1896 History and Description of the Water Supply of the City of Brooklyn (Brooklyn City Works Dept. 1896), similarly commissioned by the city but now including descriptions of the numerous additions to and expansions of the original system. The 1896 volume relies heavily on Kirkwood's work for the pre-1867 period while adding complementary descriptive information as well as photographs and drawings of the entire system, including additions. Many of these drawings are previously unpublished as-built details of the waterworks system, including several beautifully water-colored graphics. The 1896 volume includes important sections on the historical, financial, regulatory, and biographical background relating to the construction and operation of the Ridgewood System. Also included are numerous tables detailing various aspects of the Ridgewood System, from financing to rainfall monitoring and stream-flow gaugings to a full account of all waterworks features and their locations built up to 1896. Three of these tables fully documenting the waterworks structures comprising the Ridgewood System are reproduced within this report (see Appendix; Brooklyn City Works Dept. 1896: Tables 58-60).

Both these accounts, of course, reflect the views of the Brooklyn City Works Department and its commissioners; therefore, the more colorful and problematic aspects of the history of Brooklyn's waterworks and the people behind that waterworks are commonly undocumented. Newspaper accounts, correspondence, Common Council minutes, and histories of the system published after 1896 all help to "fill in the gaps" of this history. However, for detailed engineering facts regarding the preliminary search for a public water supply and the construction of the Ridgewood System, the two texts previously referenced are invaluable and should be considered a thorough recording of the as-built condition of the Ridgewood System.

In addition, Long Island Sources, a two-volume report on Long Island hydrology and public waterworks, published in 1912 by the Board of Water Supply of the City of New York, provides more detailed information. Published as a review of potential Long Island water sources for New York City, the report includes engineering and hydrologic analysis as well as historic and meterological information. Also of interest is an appendix covering briefs of court cases for damages decided or pending against Brooklyn and New York as owners of the Ridgewood System.

These three volumes can be found at the Queens Borough Library, the Brooklyn Library, the Long Island Historical Society, the New-York Historical Society, and the annex of the New York Public Library.

1. Waterworks in the New York Region

Beginning in the late eighteenth century and continuing through the nineteenth century, every urban community in America sought to secure a clean and reliable public water supply. Cognizant of chronic urban conditions as well as increased scientific and engineering knowledge, and assuming some creative leadership and foresight, community leaders commissioned the construction of public water supplies adequate for drinking, fire-fighting, sewage disposal, street cleaning, and other hygienic needs. Each community solved its water needs at different times, with different technologies and through different administrative processes. However, for urban America the nineteenth century was a time for abandonment of neighborhood-based public works, such as shallow wells and cisterns at street corners, and for development of central waterworks systems, utilizing larger drainage basins generally found in the sparsely settled hinterlands.

The first municipal waterworks system in America was completed in 1754 for Bethlehem, Pennsylvania. This pioneering system pumped spring water through bored hemlock logs and into a wooden reservoir. By 1801 Philadelphia had dedicated a system designed by Benjamin Latrobe which used two steam engines to pump Schuylkill River water to a central reservoir for distribution to customers through bored logs. Although the 1801 system was plagued with problems, subsequent changes and additions, including use of waterwheels to pump river water and a pioneering use of cast-iron distribution pipes, elevated Philadelphia to a leading position in public works (American Public Works Association 1976: 217-18). Other early municipal waterworks constructed included those of Baltimore in 1804, Cleveland in 1810, Albany in 1813, Cincinnati in 1820, Detroit in 1827, St. Louis in 1830, Chicago in 1840, Boston in 1848, Buffalo and Jersey City in 1852, Washington in 1853, and Savannah in 1854 (McElroy 1892: 2).

New York--or, more accurately, Manhattan--struggled with the issues of public water from the Colonial period throughout its history. In New Netherlands, the only public water supply was a well dug just south of the Bowling Green. With English control beginning in 1677, the New York Common Council began systematic construction of shallow wells in public streets, with the costs of such wells split between the city and individual neighborhoods served by a specific well (Hall 1918: 675). As needed or requested, the Common Council commissioned additional wells and issued ordinances regarding street cleanliness or operation of these wells.

After the first half of the eighteenth century, these wells commonly included hand pumps. By 1809 Manhattan had 249 pump wells (Blake 1956: 13).

Early inhabitants of Manhattan also relied on natural springs and rainwater cisterns. The best known and most popular of the former group was the Tea Water Well, later known as the Tea Water Pump, located at a spring on Park Row east of Baxter Street (Stokes 1918: III, 976). Cisterns, consisting of masonry or wooden basins built in cellars or buried in back lots, collected rainwater runoff from roofs.

Brooklyn, situated on an island composed almost entirely of sands and gravels, had a seemingly limitless, clean, groundwater supply which easily supplied the rural village well into the nineteenth century. Natural springs supplemented by copious shallow wells and rainwater cisterns served the bulk of Brooklyn's population decades after New York and other cities outgrew locally derived water supplies. However, despite the quantity of water available from local sources, more intensive land uses within the burgeoning cities led to inevitable population problems early on. In 1748 Peter Kalm, a Swedish traveler to the region, noted that in New York "There is *no good* water to be met with in the town itself ...," and reported that tea and drinking water were commonly gotten at the Tea Water Pump north of town (Kalm 1937: I, 133). Even the quality of water at the Tea Water Pump became a concern owing to its proximity to the notoriously foul Collect Pond, a wetland district abused by industry and citizens. Rainwater collected in cisterns also showed signs of pollution as increased wood and coal burning for industry and home in this growing urban location expelled increasingly more dust and ash into the atmosphere (Weidner 1974: 15).

Pollution was only one of the early nineteenth-century conditions in New York and Brooklyn which led to interest in improving systems for water supply and urban cleanliness. Periodic episodes of fire and disease proved to both cities that their growing urban populations were living over a public infrastructure of villages. Serious fires gutting four or five buildings were frequent occurrences in both New York and Brooklyn. Volunteer firemen and neighborhood residents had to rely on the nearest pump well from which bucket bridges or hoses brought water to the fire engines available. Major fires hit New York in 1776, 1828, and 1835. The 1835 fire was brought under control only after a line of buildings was blown up, creating a firebreak which kept property losses below $40,000,000, although 674 buildings were destroyed (Blake 1956: 5; Weidner 1974: 18). In Brooklyn, extensive fires occurred in 1812, 1848, and 1850. During the 1848 fire, Brooklyn's firefighters quickly exhausted the public cisterns on which they relied. Thus forced to demolish buildings to form a firebreak, they limited losses to about 200 homes (Howard 1893: 134).

Concurrent with the problems of large-scale fires was the incidence of epidemics. Brooklyn experienced yellow fever outbreaks in 1809 and 1856, and, beginning with the 1798-99 yellow fever epidemic, which took over 2,000 lives, New York suffered an entire series of terrifying yellow fever, small pox, and cholera outbreaks. Such events, led by the infamous Philadelphia yellow fever epidemic of 1793 which shocked the entire nation, led the scientific community to begin serious study of the relationships between urban conditions and disease. Environmental conditions, such as polluted water, were quickly offered as sources for various health problems. Scientific theories born out of environmental determinism soon influenced urban policymakers to institute public improvement projects, with public waters getting much of the attention.

Initially, the scientific community was seriously divided on the issues of the causes of disease, as well as on appropriate treatments. The two major and opposing schools of thought were each identified with a Philadelphia physician. Dr. Benjamin Rush and others aligned with the Academy of Medicine attributed disease to warm climates and a fouled environment, characterized as "putrid exhalations from the gutters, streets, ponds and marshy grounds in the neighborhood of the city" (Academy of Medicine of Philadelphia 1798: 5). These men advocated both treating afflicted individuals with bleedings and purgings and cleaning the city of filth and wastes. On the other side, Dr. William Currie and others associated with the College of Physicians saw various maladies as distinct diseases imported via ships and ship passengers from other locations. They advocated milder treatments and emphasized preventative measures, such as inspection and quarantining of sailors and passengers, when necessary (Blake 1956: 6-7).

Today we know that both groups were essentially wrong thanks to Walter Reed's experiments with mosquitoes, which revealed the insect as the transmitter of viruses. However, stagnant domestic waters were a breeding ground for the mosquito, and initial sources of the viruses it transmitted were correctly theorized as foreign imports. Fortunately for at least some locations, early nineteenth-century public officials decided to be cautious and took the advice of both groups. With Philadelphia as a leader, cities slowly adopted quarantine laws and port regulations, and formed various boards and committees to oversee and adopt measures to obtain clean, reliable water supplies and to combat the accumulation of wastes.

Neither New York nor Brooklyn was particularly quick to respond to this new awareness. Before either city initiated major public works construction they both spent decades debating the issues and suitable methods. They also saw their first successful central water systems initiated by private, not municipal, proposals. As early as 1774, the New York Common Council had commissioned English engineer Christopher Colles to design and build a public waterworks system. However, the Revolutionary War interrupted Colles's work, which was never completed. That system would have relied on the steam pumping of water from a 50-foot deep well near Collect Pond to a reservoir and on through log water mains throughout the city, which was then clustered on lower Manhattan (Hall 1918: 699-701).

With the Revolution settled, New York debated the issue until 1799, when citizens and politicians rallied around a proposal to utilize Bronx River water. When the city sought necessary authorizations from the State Legislature, an interesting series of meetings, memoranda, and legislative maneuverings, orchestrated by the then State Assemblyman Aaron Burr, led not to an authorization for the City to build a waterworks but to the incorporation of a private company empowered to supply New York with water.

As formed, the Manhattan Company had tremendous powers, including the ability to operate as a bank. In subsequent years the company put most of its efforts and finances into banking, but, as a secondary operation, it did manage to meet its obligation to build a public waterworks. As built, the company's unambitious project pumped water from the old Colles well into a reservoir and smaller water tank from which customers received water via bored logs. This was New York's first functioning central waterworks. A certain give-and-take existed with this system, in that the flow of water was often interrupted by repairs or was poor in quality; but customers quickly learned how to tap into mains or to share water with nonpaying neighbors. Fire companies were also offered free access (Blake 1956: 59; Hall 1918: 717-19).

Nearly two-thirds of New York was left unserviced until 1842, when the City was finally able to circumvent the Manhattan Company's low-keyed efforts and brought Croton River drainage water into the entire city. Construction of the Croton Waterworks and Aqueduct was no doubt an inspiration to Brooklyn. Incorporated as a city in 1834, Brooklyn's population swelled from 36,233 to 96,838 between 1840 and 1850. McElroy (1892: 1) reports even higher population statistics, as Brooklyn went from being the seventh largest city in America in 1840 to the third largest city in 1860 with over 266,000 inhabitants.

Brooklyn's debate over how to secure a clean and reliable public source of water began with its incorporation as a city. Its efforts followed in the shadows of the pioneering work in Philadelphia, Boston, and, of course, New York. Those attempts were based both on this recent history of urban waterworks construction and on the unique topography and circumstances found in and near Brooklyn. Subsequent portions of this report present a summary of Brooklyn's efforts to secure a public water supply and document the nature and extent of construction on that supply, initiated with the 1850's work on the Ridgewood Aqueduct.

2. Brooklyn's Search for Water

Almost immediately after Brooklyn's incorporation as a city in 1834, the search was initiated for a public supply of water which would be more reliable than the fickle neighborhood system of shallow wells, cisterns, and springs. New York was already making plans for the Croton System in 1835 when Jonathan Trotter suggested that Brooklyn become a part of that proposal (Judd 1966: 362). However, the Common Council never took action on the matter. Ten years later, The Brooklyn Daily Eagle (Jan. 28, 1845) reported that Brooklyn's connection to Croton water was again advocated with a proposal to link the cities by pipes under the East River. The newspaper argued that Brooklyn was a large and growing city in need of its own water supply. Again, no action was taken, and Brooklyn waited nearly 80 years to get another opportunity to share in New York's water sources.

Other early suggestions for securing a water supply independent of New York's efforts included the storage of well and cistern water in a reservoir on Fort Greene Hill (now Ft. Greene Park) as well as the expansion of cisterns alone (Brooklyn City Works Dept. 1896: 143-44). Influential interests, including The Brooklyn Daily Eagle, remained skeptical of any relationship Brooklyn might have with New York; the two cities were then clearly independent and often rivals. Throughout his article for New York History, Judd (1966) reports on the frustrating decades of the 1840's and 1850's, when Brooklyn's citizens and policymakers struggled with various concepts, many of them superfluous or ill-conceived. As still happens today, in good times--i.e., times of abundant water--discussions over securing more reliable sources did, indeed, seem superfluous. When a drought, significant fire, or epidemic occurred, however, the weaknesses in a water supply and system were once again exposed. Brooklyn's interest in a central public water system ebbed and flowed with such events. However, the great fire of July 1845 in New York inspired the Brooklyn Common Council, as well as other civic groups, to continue serious discussion of water supply needs. The majority of schemes discussed involved relatively simple technologies, such as digging wells or excavating for springs.

In 1847 the Common Council initiated some formal discussion of the water issue. At first the council focused on local sources, particularly artesian wells. However, concern that such small local sources would prove inadequate worked to shift this focus to larger works and supplies beyond the neighborhoods of Brooklyn. Eventually, a special committee was formed. On December 20, 1847 it submitted a report with plans drafted by the distinguished engineer Major D. B. Douglass. That report compared different methods of supply and advocated the sinking of a series of wells south of the hills of eastern Brooklyn and pumping that water by steam engines to a high-level reservoir at least 40 feet above the highest houses then on Brooklyn Heights (Stiles 1884: 584).

The 1847 report also suggested two other potential water sources: either a cooperative plan with New York or the utilization of the streams of Long Island. After the 1847 report, the Common Council advocated a system to tap Long Island groundwater. A watershed of about 2,000 acres was considered sufficient to provide 25 gallons per day to 110,000 people. No action was taken, however, and the city continued to supplement its supply by digging wells near street intersections (Brooklyn City Water Works Dept. 1896: 144; Judd 1966: 364).

Sometime later in 1848, William Burden, an ironworks proprietor, offered the first proposal in which southern Long Island streams would be tapped and diverted to Brooklyn. Burden reported to have found six streams within ten miles of the City, each capable of yielding a minimum of 8,000 gallons per minute. Burden's plan would have included excavating a 100,000,000-gallon basin near Jamaica Creek to collect water drawn from streams through standpipes, and then pumping water through iron pipes for distribution to as many as seven wards in Brooklyn (Stiles 1884: 584; Judd 1966: 364-65).

The Common Council again took only limited action on this proposal. Visits were made to the stream locations and chemical analyses were completed which showed good potential for adequate waters equal in quality to Croton water. However, the estimated costs of such a project kept the Council's focus on less ambitious proposals. Water for firefighting became the prime concern. In 1850 the Common Council requested and received from the State Legislature power to appoint three water commissioners and to issue bonds for $150,000 for the purpose of erecting a waterworks suitable for fighting fires (New York State Laws, Seventy-second Session 1850: 469-78). The Council had discussed the attractiveness and relatively low costs of drawing water from Wallabout Bay and storing it in a basin on Fort Greene Hill, but, again, the Council neither acted nor appointed any water commissioners (Judd 1966: 365).

Special committees of the Brooklyn Common Council provided a continuing supply of information concerning future water supplies for Brooklyn. In 1849 waters supplied from wells within the city and from ponds in adjacent Long Island were recommended. During the following year inquiries were made concerning the costs of pumping water and the quality of the region's water. Finally, in February of 1849, the Legislature passed a city charter containing a provision for a municipal supply of water. In the following month, it authorized the appointment of three water commissioners charged to examine a future water supply and empowered to employ engineers. No action was taken on this latter authorization (Brooklyn City Works Dept. 1896: 146).

In 1850 a plan proposing that well water could be pumped into a reservoir on Mt. Prospect, from which it could be distributed to the City, was submitted to a citizen vote and rejected. However, by the following year the Common

Council had secured an amendment to the city charter providing for the purchase of land and the erection of a waterworks. A special committee of the Council officially rejected the 1850 plan and commissioned the eminent engineers William J. McAlpine and John B. Jervis to separately submit new plans for a water system. Both men had illustrious careers, Jervis having successfully served as District Superintendent of the Erie Canal and as Chief Engineer for the Delaware and Hudson Canal and the Croton Aqueduct (Rappole 1978: 17), and McAlpine having served as Chief Engineer of the East Division of the Erie Canal and the Erie Railroad and as State Engineer of New York (Brooklyn City Works Dept. 1896: 261).

Within a year both Jervis and McAlpine had submitted plans to the Common Council. Both engineers recommended the use of Long Island streams with a reservoir within the city on Mt. Prospect. Jervis included the use of wells placed near stream valleys to provide a sufficient system. McAlpine proposed the exclusive use of surface water by collecting the flows of the four southern Long Island streams nearest to Brooklyn. Baiseleys Pond would serve as the collecting reservoir from which a conduit would deliver the water some nine miles to a pump well at the foot of a reservoir on Mt. Prospect (Brooklyn City Works Dept. 1896: 149-50). Additional supply, when needed, could be obtained from other streams to the east. McAlpine reported that his plan could provide for a population of 250,000 requiring 10 million gallons per day. He estimated the total project cost at $3,500,000 (Judd 1966: 367).

In 1852, the same year that McAlpine was elaborating his original plan, the Williamsburg Water Works was incorporated. The Williamsburg company offered to supply Brooklyn with water from a well within the city and from springs on the north shore of Long Island. Brooklyn's authorities were now faced with deciding whether the city should depend on a private company for its water supply or continue attempts to develop a municipally owned system. The population of Brooklyn had now surpassed 120,000 and the need for a satisfactory water supply was becoming urgent (McElroy 1892: 1). This urgency increased with Brooklyn's annexation of the City of Williamsburg and the Town of Bushwick in 1854.

During the next few years, the Williamsburg Water Works underwent several changes, becoming first the Long Island Water Works and later the Brooklyn Water Company. In 1855, the same year in which the Brooklyn Water Company was formed, the Nassau Water Company was incorporated with power to absorb the former company. Throughout this period, the private water companies had gradually accumulated enough water rights so that the city found it necessary either to buy out the Nassau Water Company or to buy water from it (The Mayor's Catskill Aqueduct Celebration Committee 1917: 71).

The Brooklyn Common Council and the Nassau Water Company reached an agreement in 1856 under which the city subscribed $1,300,000 to the stock of the company with three conditions: that the company should purchase the lands previously bought by the city for its water needs; that the company should construct a waterworks capable of supplying 20,000,000 gallons a day; and that the city should have the privilege of buying out the company at cost (The Mayor's Catskill Aqueduct Celebration Committee 1917: 71). This agreement was the beginning of the Ridgewood System. Within a year, the Nassau Water Company had contracted Henry S. Welles & Co. to construct the entire system (see Figure 3). By 1857 the City of Brooklyn had also absorbed the company under the previously mentioned conditions, and the company's seven directors had become water commissioners (McElroy 1892: 2).

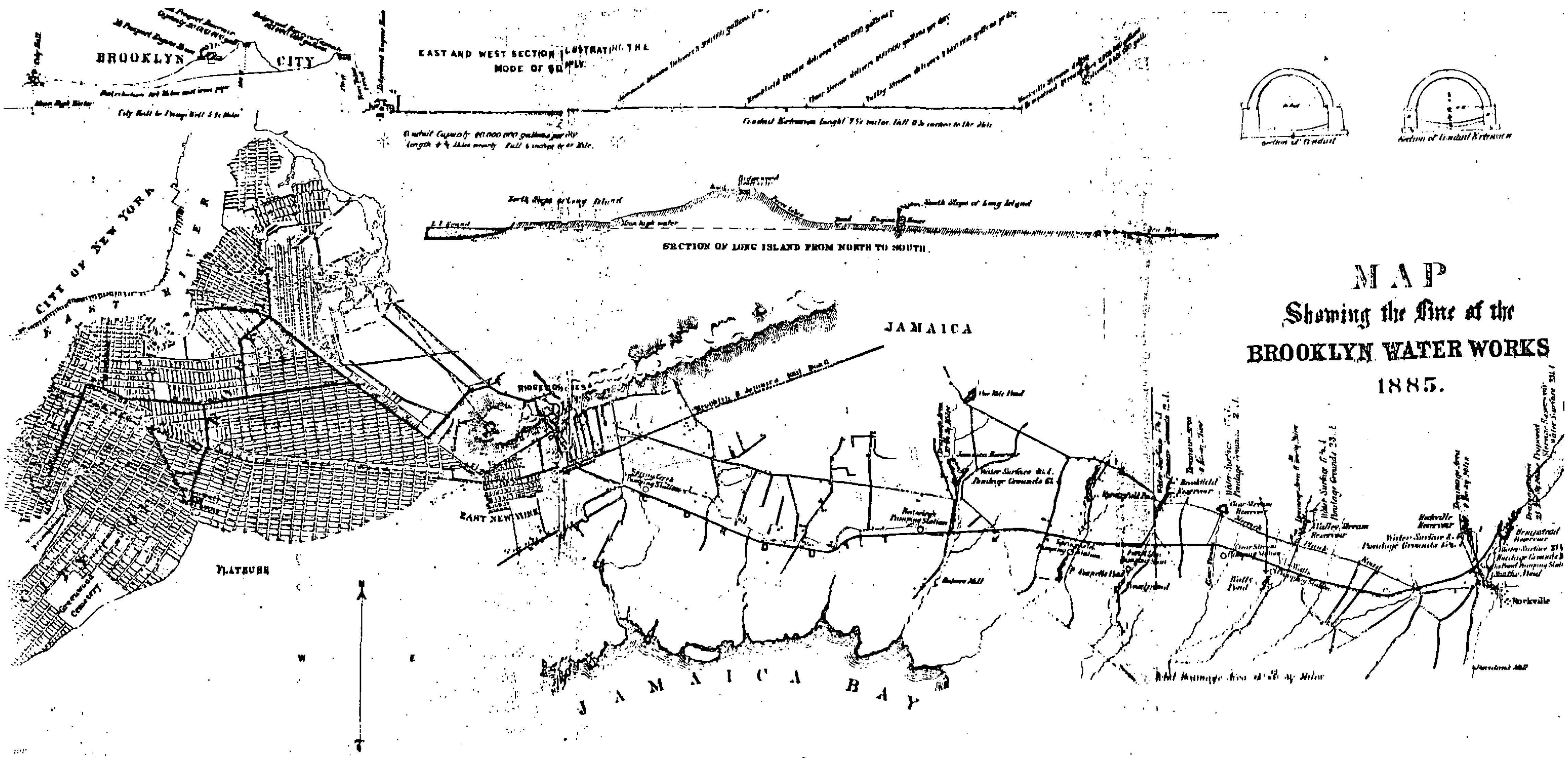

MAP
Showing the line of the
BROOKLYN WATER WORKS
1885.
EAST AND WEST SECTION ILLUSTRATING THE MODE OF SUPPLY.
SECTION OF LONG ISLAND FROM NORTH TO SOUTH.
BROOKLYN
CITY
CITY OF NEW YORK
EAST RIVER
JAMAICA
EAST NEW YORK
FLATBUSH
JAMAICA BAY
W
E

FIGURE 3.

B. Description of the Ridgewood System and Its Additions, As Built

1. Geology and Hydrology of Long Island

Once realized, the attractiveness of Long Island's surface and groundwaters as a source for Brooklyn's water needs became obvious. This attractiveness was in part owing to the immediate proximity of the source to Brooklyn and in part to the nature of surface deposits covering Long Island. The island is composed entirely of unconsolidated layers of sand, gravel, and clay which form natural aquifers several hundred feet thick.

During the Late Cretaceous Period (about 100 million years ago), streams actively flowed southeastward along the dip of a slightly tilted plain now underlying the region containing Long Island. These streams deposited hundreds of feet of gravel, sand, clay, and marl into marshes, bays, and estuaries at the edge of the Late Cretaceous sea. After a long period of erosion, which created a broad plain, deposition was renewed during the Pleistocene glaciations, and an additional accumulation of glacial till and outwash and interglacial clay was deposited (Schuberth 1968: 163-65; see Figures 4 and 5).

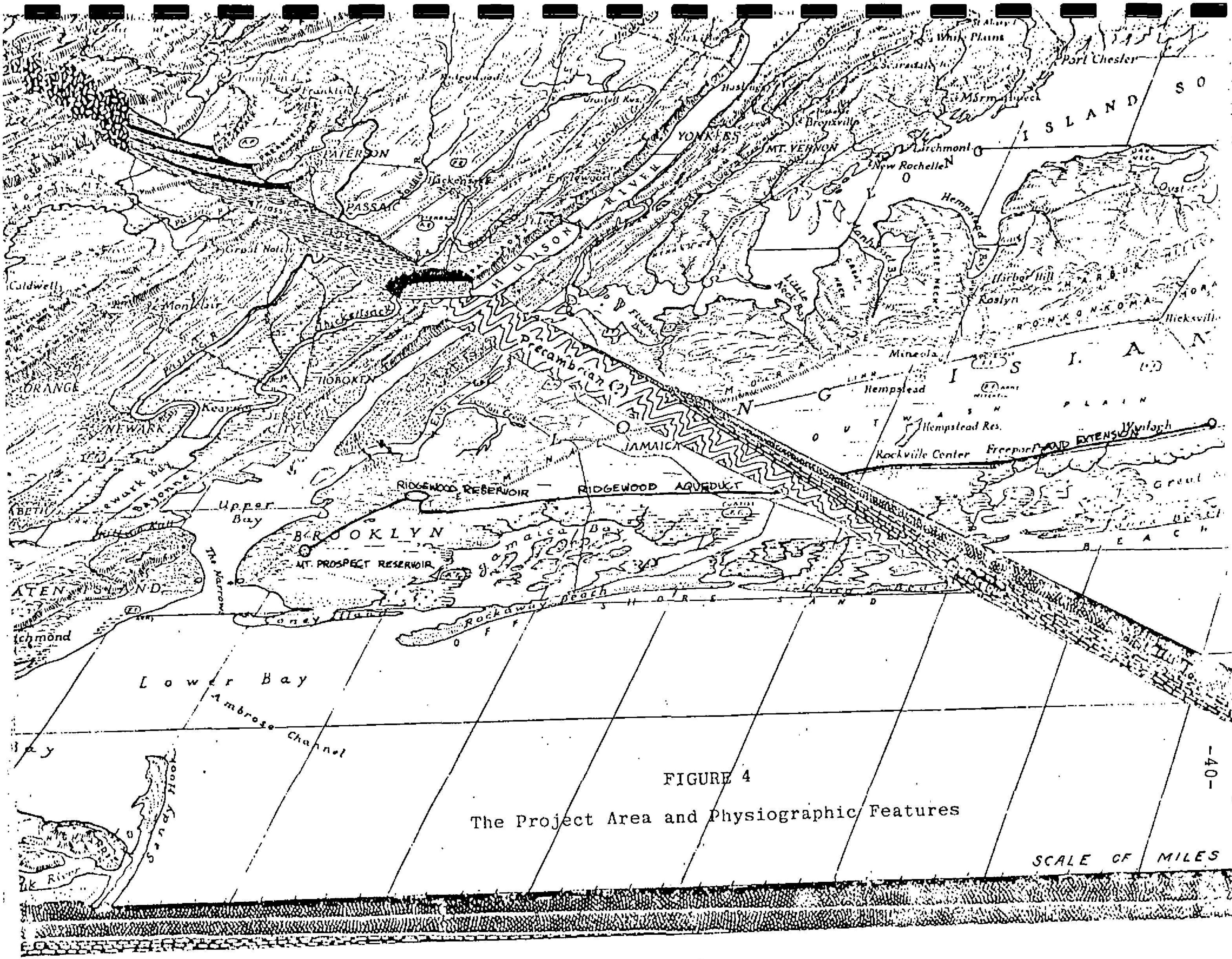


FIGURE 4

The Project Area and Physiographic Features

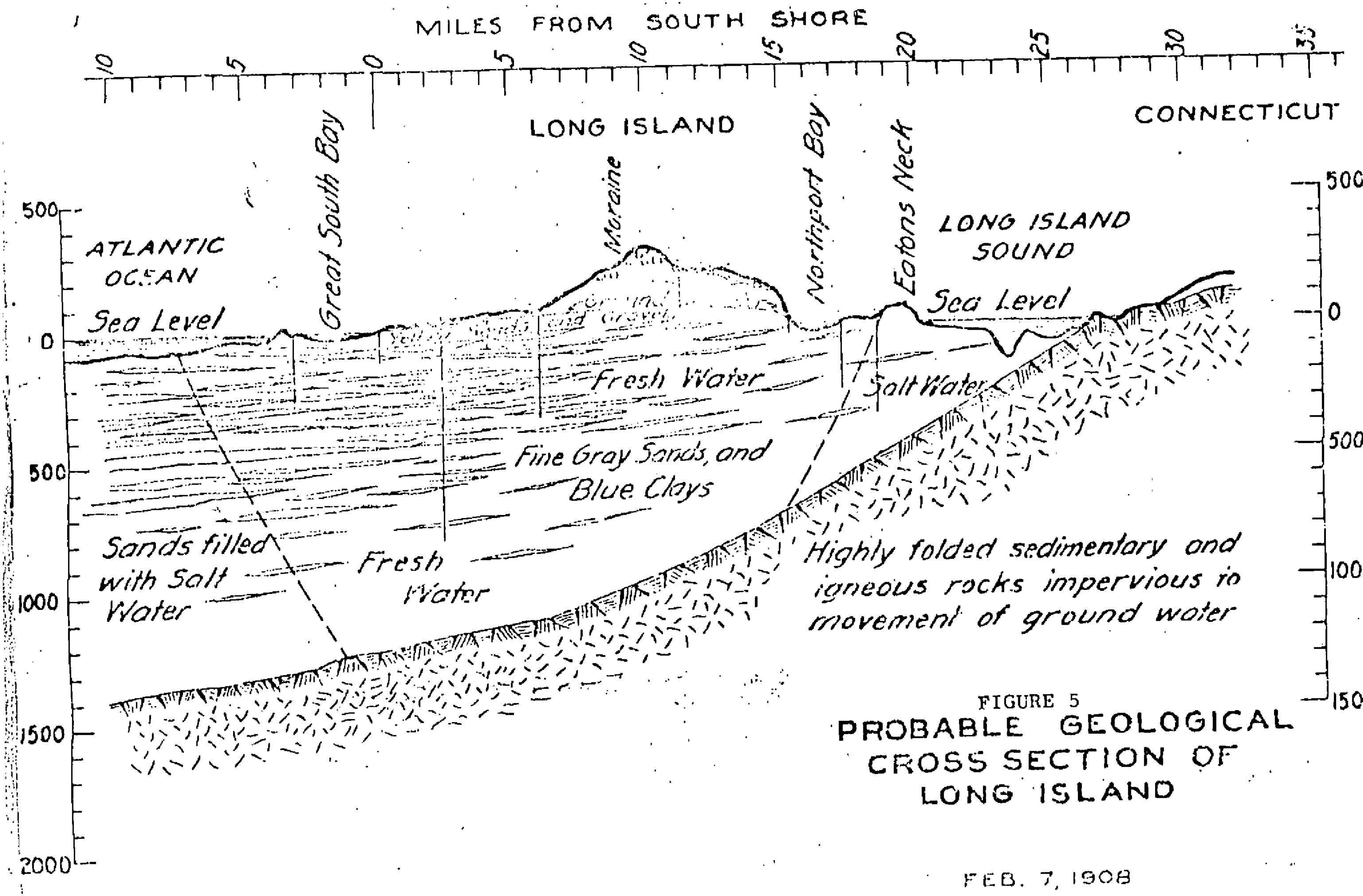


FIGURE 5
PROBABLE GEOLOGICAL CROSS SECTION OF LONG ISLAND

Source: Board of Water Supply of the City of New York, 1912, Sheet 22

Long Island's contemporary landscape is the product of the last of these glaciations, the Wisconsin. During the initial invasion of the Wisconsin glacier, unsorted drift was scoured and transported by the advancing ice. Much of this drift accumulated at the southern terminus of the glacier and formed an irregular east-west-trending ridge of low hills termed the Ronkonkoma Moraine (see Figure 4). After the initial invasion of the glacier, the ice retreated an unknown distance to the north before readvancing to a point just north of the Ronkonkoma Moraine. This readvance formed a second irregular ridge, more extensive than the first, called the Harbor Hill Moraine. It includes the conspicuous ridge of hills along the entire northern shore of Long Island and Brooklyn (Schuberth 1968: 184). On a portion of one of these hills is located the distributing reservoir for the Ridgewood Aqueduct.

With the retreat of glacial ice to the north, meltwater streams poured southward out of the morainal hills and deposited 10 to 20 feet of sand and gravel outwash upon the pre-existing broad, smooth plain. The entire Ridgewood Aqueduct is located within the Hempstead Outwash Plain.

Because of the porous nature of the Cretaceous and Pleistocene sands and gravels which underlie and compose the Hempstead Plain, rainwater and runoff have saturated these deposits, forming natural aquifers. Where this underground water supply surfaces, springs and spring-fed streams are formed. The purity and abundance of this water, filtered through sand and gravel, was recognized as the answer to the water needs of Brooklyn. Several southerly flowing streams in close proximity to the city were soon tapped to supply the homes and industries of Brooklyn.

2. Construction of the Original System, 1856-62

Under a contract between Henry S. Welles & Co., private contractor, and the Nassau Water Company, later absorbed by the City of Brooklyn, construction of a public water supply system for Brooklyn commenced in 1856. The system, designed to impound the waters of six streams just above tidewater on the southern shore of Long Island, consisted of a distribution system within the city, distributing reservoirs at Mt. Prospect and Ridgewood, two pumping stations to deliver water to the reservoirs, a brick conduit from Ridgewood to Baiseleys Pond with an extension as an open canal east to Hempstead Pond, six supply ponds along streams to the north of the conduit, and smaller conduits connecting the supply ponds to the main conduit (Board of Water Supply of the City of New York 1912: 258; see Figure 3).

As constructed, the Ridgewood System was the product of years of careful analysis and investigation into the potential water sources most satisfactory for Brooklyn's needs; the system came to represent an engineering accomplishment "ingeniously contrived to fit the peculiar local situation" (Blake 1956: 267). Utilizing a drainage basin of about 52 square miles, with later additions of some

65 square miles, the Ridgewood System efficiently captured a large, previously undeveloped water source of excellent quality close to the city.

The streams of the Ridgewood drainage basin flow along the gentle, southerly slope of the Hempstead Plain before emptying into the ocean bays of the south shore of Long Island. The streams are born within the morainal hills to the north. Because the Hempstead Plain is underlain by a thick sequence of unconsolidated sediments naturally saturated with freshwater, springs are common within the plain and contribute to stream flow. Therefore, just before the streams reach tidewater they have gained their greatest volumes and, owing to the filtering effects of the underlying sands and gravels, possibly their freshest quality before becoming brackish. The Ridgewood System captured these streams at the optimum position just above tidewater.

The original water system captured and diverted the flow of six Long Island streams. During the next half-century, the growing water needs of Brooklyn, as well as the pollution of existing streams, forced expansion of the original Ridgewood System. Additional streams to the east as far as the Nassau and Suffolk county lines were impounded, and a variety of well systems was initiated. The nature of the original system will be presented first, followed by a description of its later expansion and eventual abandonment.

Under the contract with H. G. Welles & Co., $4,200,000 was provided to construct a water system providing a 20,000,000-gallon-a-day potential. The source of the Ridgewood System was several small supply ponds and their associated streams. These ponds and their capacities in millions of gallons are, from west to east, Baiseleys or Jamaica Pond (41.9), Simonsons or Brookfield Pond (9.9), Clear Stream Pond (1.1), Valley Stream Pond (17.8), Pines or Rockville Pond (9.0), and Hempstead Pond (26.9) (Board of Water Supply of the City of New York 1912: 265; see Figure 3). Water rights for the streams of these ponds had been purchased earlier either by the Nassau Water Company or by Brooklyn. Baiseleys and Simonsons ponds had previously existed as gristmill ponds along streams supporting other mills; therefore, not only did water rights have to be purchased but damages had to be paid for diverting water from mills downstream (History of Queens County, New York 1882: 202).

After the stream channels and millponds were widened and cleaned, earth embankments some 8 feet high with slopes of 1.5 horizontal to 1 vertical were constructed around the ponds. All dams were of puddled clay construction with interior slopes paved and exterior slopes sodded. Sluice gates controlled the flow of water through the dams into branch conduits of brick construction, 42 to 24 inches in diameter. The first six supply ponds of the Ridgewood System, completed between 1858 and 1860, were all north of the main conduit; thus, branch conduits fed south by gravity into the main conduit (Kirkwood 1867: 10; The Water Works of Brooklyn 1873: 14-19).

The main conduit, or Ridgewood Aqueduct, conveyed water from the Long Island supply sources to the distribution system in Brooklyn. Originally, the 12.39 miles of brick conduit was to be completed in two sections. The western section or lower reach connected the pump well at Ridgewood to the branch conduit of Jamaica Pond with a closed conduit of brick construction 4.85 miles long. The upper reach, or western section, was to be constructed after the lower reach, and would connect the eastern end of the waterworks at Hempstead Pond to the lower reach with an open canal of brick construction. Before the upper reach was constructed, it was changed from an open canal to a closed conduit of construction similar to the lower reach (Kirkwood 1867: 11-16).

Figure 6 accurately documents the profiles, sections, and construction materials of the entire Ridgewood Aqueduct as completed (Brooklyn City Works Dept. 1896: Plate 4). The lower reach of the conduit has a horseshoe section of uniform dimensions, 8.8 feet high and 10 feet wide. The bottom of the conduit is an inverted arch of 4-inch brick supported on a 15-foot-wide bed of concrete. The top of the conduit forms an upright arch of 12-inch-thick brick. The conduit is supported by 3-foot-high side walls of cut stone masonry, the stone consisting mostly of gneiss quarried in

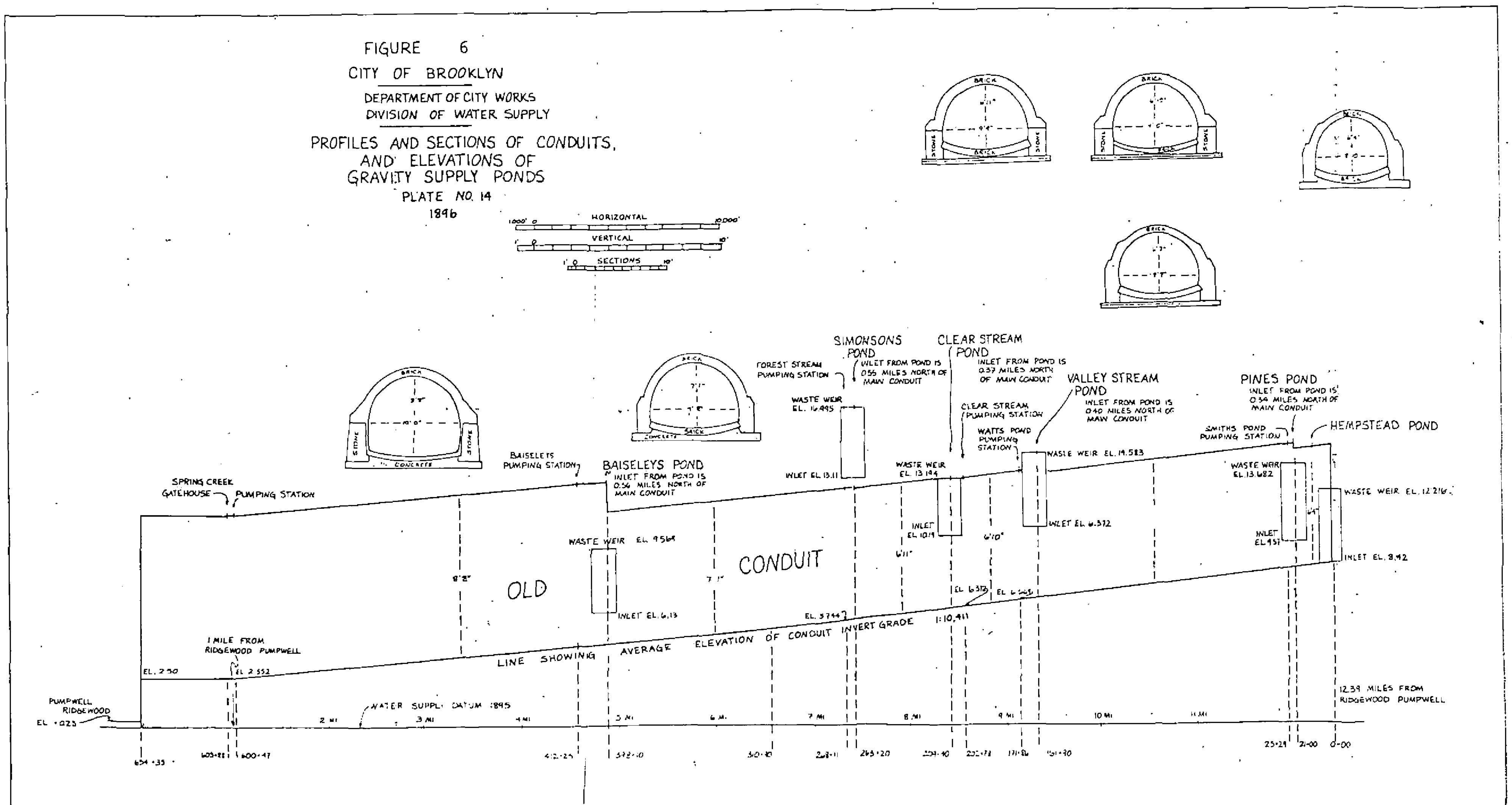


FIGURE 6
CITY OF BROOKLYN
DEPARTMENT OF CITY WORKS
DIVISION OF WATER SUPPLY
PROFILES AND SECTIONS OF CONDUITS, AND ELEVATIONS OF GRAVITY SUPPLY PONDS
PLATE NO. 14
1896
HORIZONTAL
VERTICAL
SECTIONS
SIMONSONS POND
CLEAR STREAM POND
VALLEY STREAM POND
PINES POND
HEMPSTEAD POND
BAISELEYS POND
SPRING CREEK GATEHOUSE
PUMPING STATION
OLD CONDUIT
LINE SHOWING AVERAGE ELEVATION OF CONDUIT INVERT GRADE
WATER SUPPLY DATUM 1895
1 MILE FROM RIDGEWOOD PUMPWELL
12.39 MILES FROM RIDGEWOOD PUMPWELL
PUMPWELL RIDGEWOOD

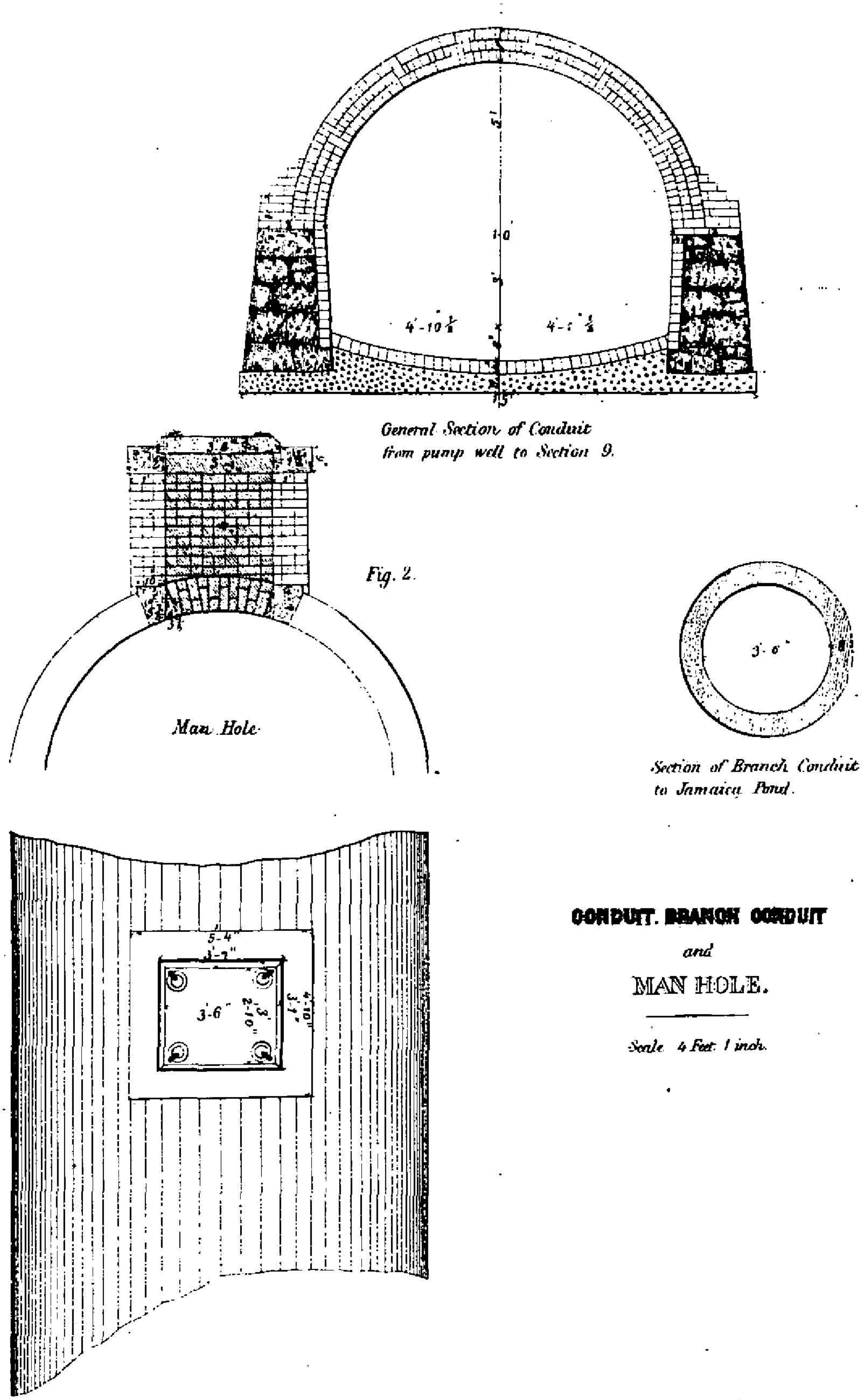
Greenwich, Connecticut (Kirkwood 1867; The Water Works of Brooklyn 1873: 21; see Figure 7).

The profile and associated elevations of the lower reach of the Ridgewood Aqueduct were determined by the low level of Jamaica Pond and by the need of a rate of slope sufficient to convey water by gravity along the conduit to the pump well of the Ridgewood pump station. To establish the constructed slope of 6 inches per mile, deep cutting, often below water level, was necessary. At excavation localities where water was a particular problem, a set of pilings or platform of planking provided a stable bed for the layer of concrete supporting the conduit (Kirkwood 1867: 12).

The materials and workmanship of the upper reach of the Ridgewood Aqueduct were the same as those of the lower reach. The only difference was within the side walls, where the brick lining inside the stone walls was omitted. In this reach, the side walls were built entirely of stone or brick (see Figure 6). Because these side walls do not by themselves provide enough strength to meet the thrust of the arch, particular care was taken to ram and pack earth along the sides of the conduit during backfilling (Kirkwood 1867: 15).

Unlike the lower reach, the upper reach of the conduit is not of uniform width and height. Both dimensions gradually increase to the west to meet the increased volumes of water toward Ridgewood. Beginning at Hempstead Pond, the

FIGURE 7. Conduit, branch conduit, and manhole (Kirkwood 1967).



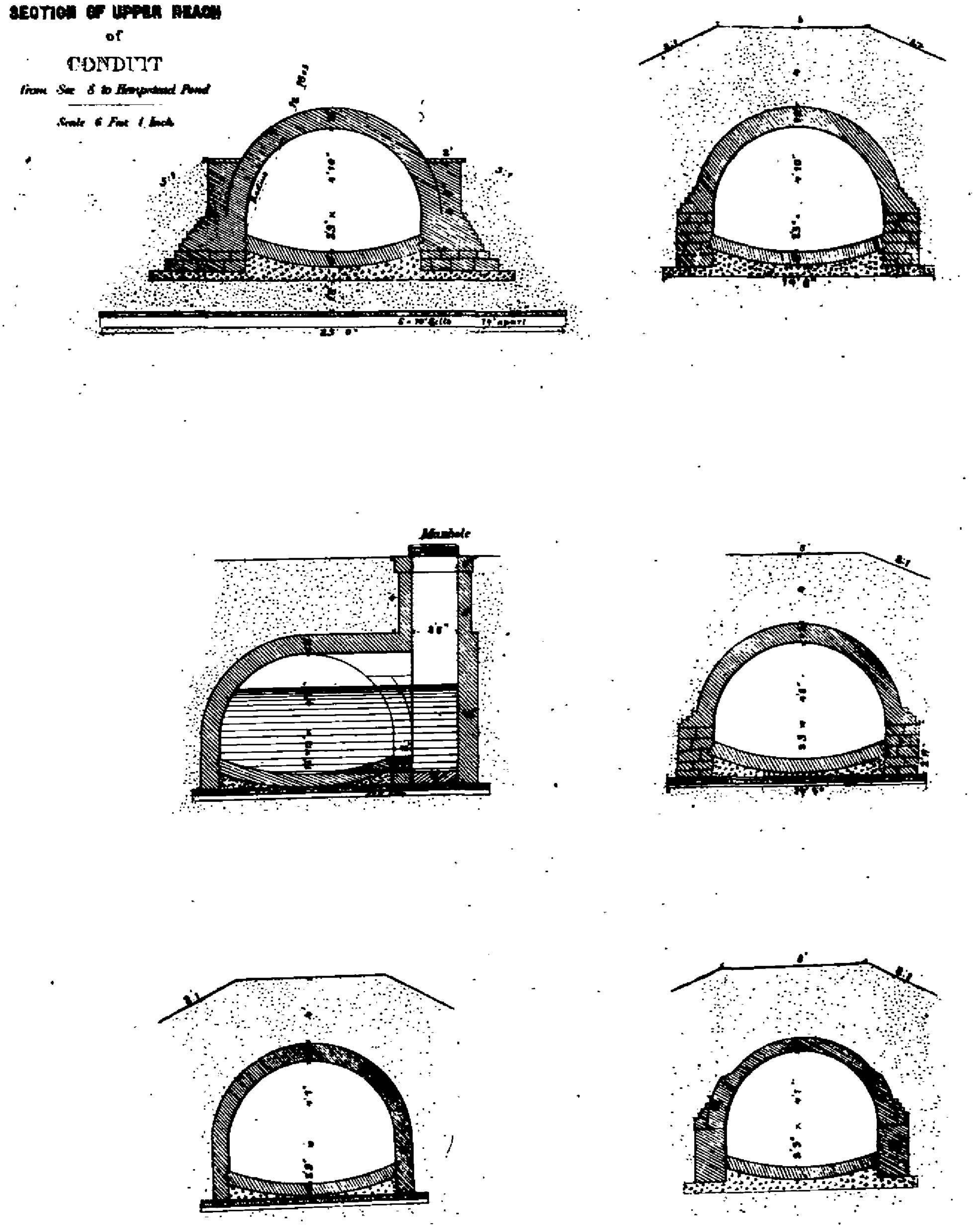
conduit is 8 feet, 2 inches wide and 6 feet, 4 inches high and increases over 7.54 miles to 10 feet wide and 8 feet, 8 inches high where it meets the lower reach (see Figure 8).

Specifications for the construction of the conduit between the Ridgewood Station pump well and Baiseleys or Jamaica Pond are presented in the Appendix (Nassau Water Company 1856). These specifications were established prior to the decision to change the upper reach to a closed conduit, and, therefore, the upper reach is not referred to. With this change it is assumed that the specifications were applied to the entire Ridgewood Aqueduct.

Over the entire length of the Ridgewood Aqueduct the conduit was covered with earth and the property was lined with a post and rail fence. The earth covering was generally 4 feet high and 8 feet wide at that height. Sides of the covering sloped away at a rate of 1.5 horizontal to 1 vertical along the lower reach and 2 to 1 along the upper reach (The Water Works of Brooklyn 1873: 22). Contemporary construction has filled in around the conduit and its earth cover. Today, the remains of the Ridgewood Aqueduct are still buried.

The Ridgewood Aqueduct efficiently captured and conveyed water supplied by the six ponds to the Ridgewood Pump Station through simple gravity flow. Therefore, pumping stations were only required for later additions to the Ridgewood System and at the western terminus of the aqueduct where the Ridgewood pumps forced the water into a

FIGURE 8. Sections of upper reach of conduit (Kirkwood 1967).



distributing reservoir overlooking Brooklyn. Along the right-of-way, a variety of industrial features had to be constructed to provide for the successful operation and maintenance of the conduit. These included culverts, gatehouses, and manholes.

Where the line of the conduit intercepted stream courses, culverts had to be built to allow the independent flow of both streams and conduit. Culverts carried the stream either over or under the conduit through pipes, or through masonry structures similar in construction to the conduit (see Figures 9 and 10).

At several localities along the conduit sluice gates were built within the side walls to allow for the emptying of the conduit when necessary. These sluice gates were located where the conduit crossed streams adequate to handle the additional flow of water created by opening the gates. Arched masonry culverts channeled the streams below the conduit and associated sluice gates. These structures were then protected by one-story gatehouses (Brooklyn City Works Dept. 1896; see Figure 11).

A series of covered manholes was placed along the conduit to allow access for maintenance purposes. The cut-stone covers of these manholes are visible contemporary reminders that the conduit still exists buried below the contemporary landscape (see Figure 7). The Appendix lists all the structures of the Ridgewood System, such as manholes and gatehouses, that are located along the line of the main

FIGURE 9. Pipe culverts (Kirkwood 1967).

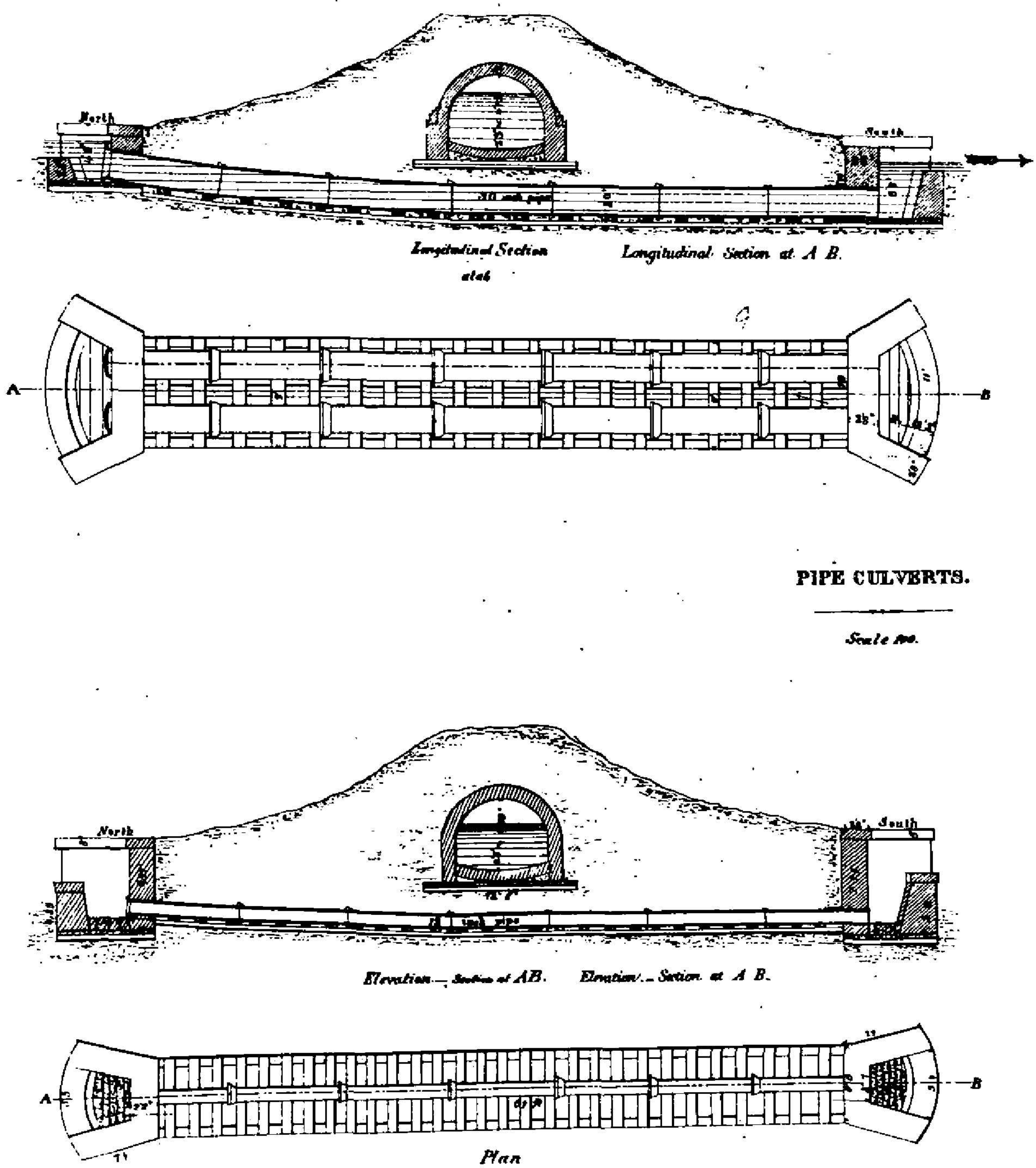


FIGURE 10. Waste weir at Spring Creek (Kirkwood 1967).

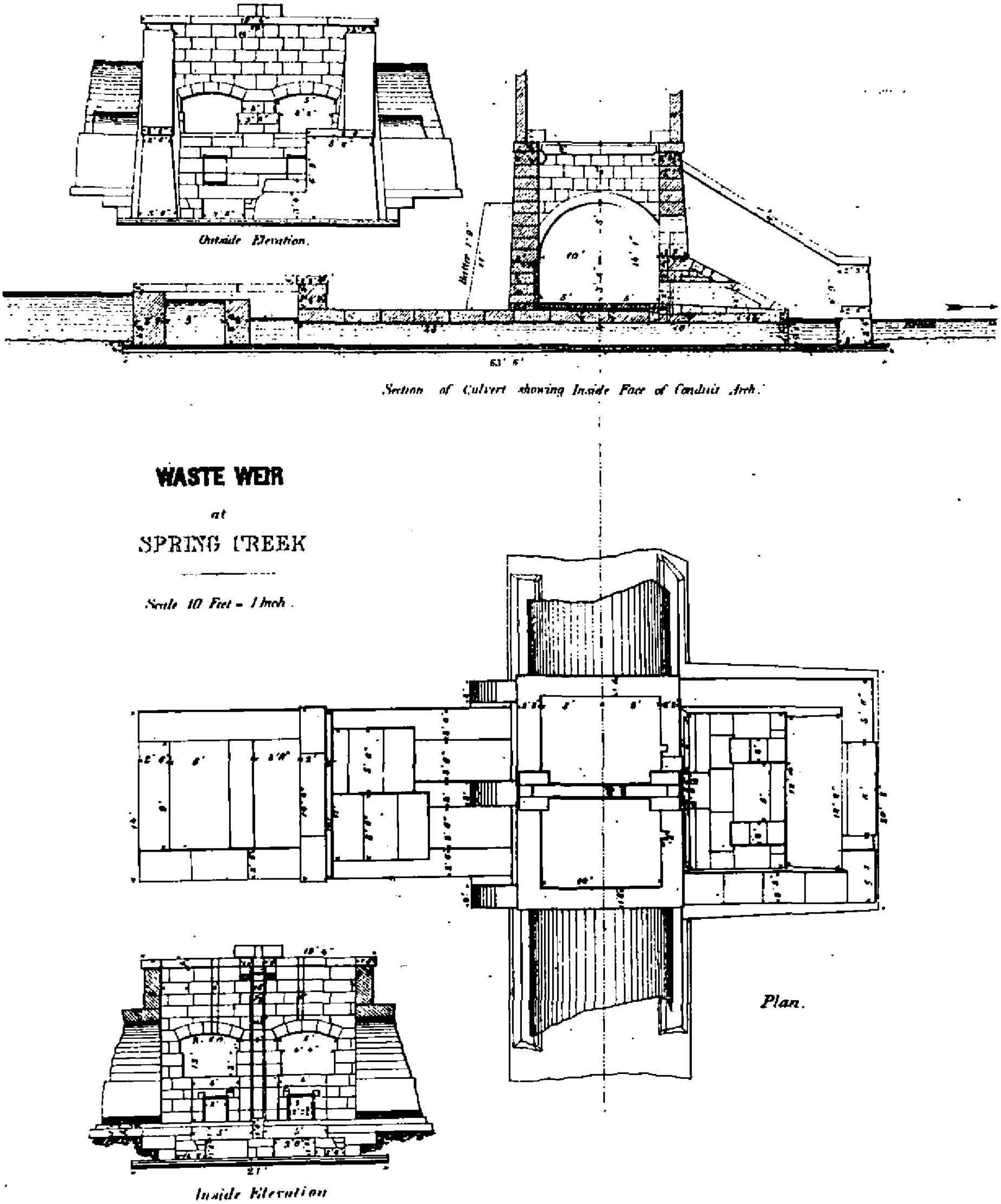
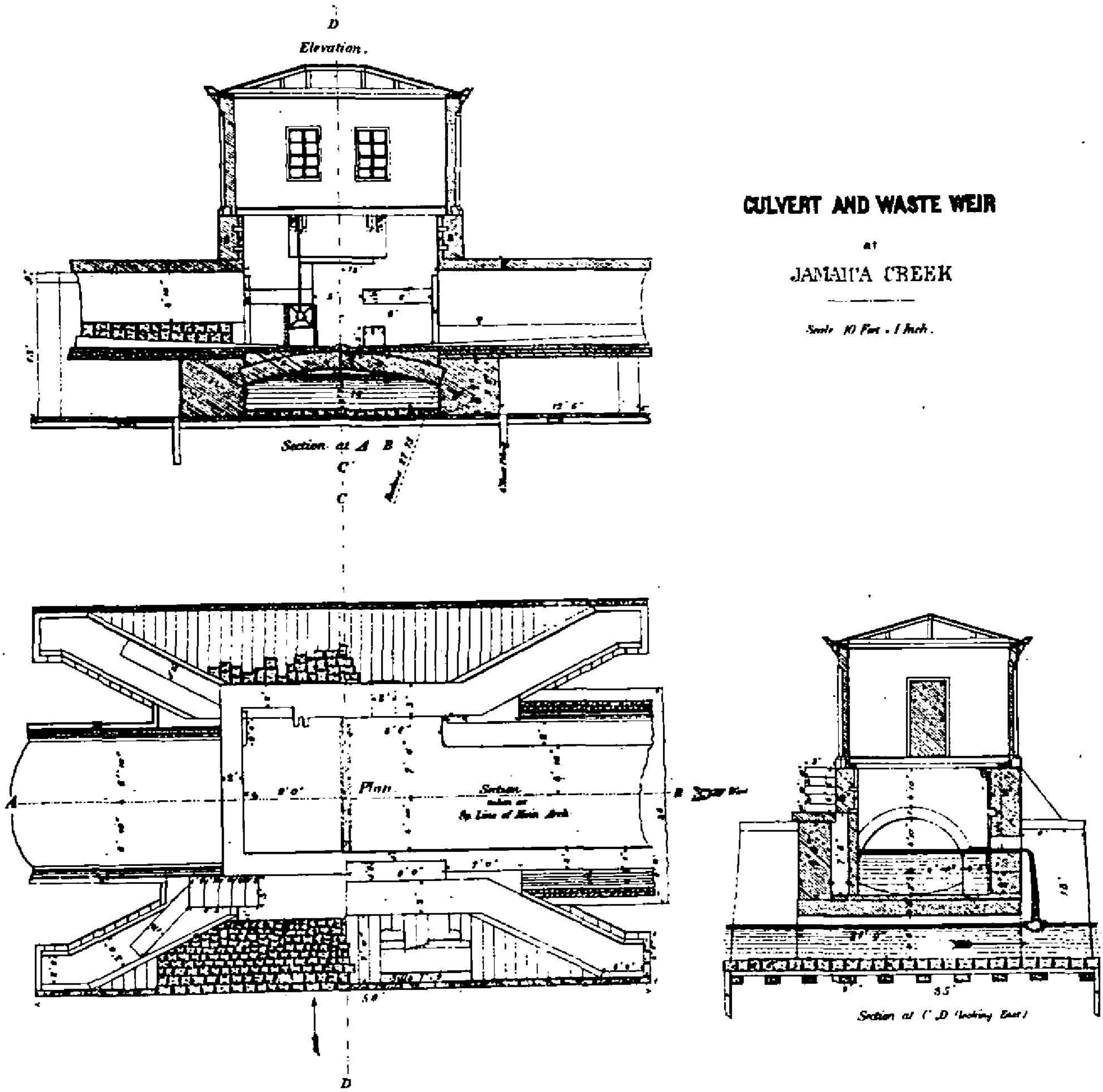


FIGURE 11. Culvert and waste weir at Jamaica Creek (Kirkwood 1967).



conduit between Hempstead Pond and the Ridgewood Pumping Station.

The western terminus of the Ridgewood Aqueduct marks the end of the supply system of the Brooklyn waterworks and the beginning of the distribution system. Here the engines of the Ridgewood Pump Station lifted the supplied water some 164 feet into the basins of the Ridgewood Reservoir. At the original pump station, located on the north side of Atlantic Avenue beyond the northern end of Conduit Avenue, the main conduit ended in an arched basin some 52.5 feet long and at a right angle to the conduit right-of-way. This basin connected to the pump well through four sluices. The pump well was a granite masonry holding tank from which the steam engines drew water (The Water Works of Brooklyn: 1873: 21-22).

The original engine house, completed c. 1858-60, was a substantial brick building with sandstone trim. It housed two Cornish double-acting steam engines, each with 10-foot strokes and capacities of 15,000,000 gallons per day, and associated 80-foot diameter boilers (see Figures 12 and 13). These pump engines forced water through four 36-inch diameter force mains to the two basins of the Ridgewood Reservoir, some 3,450 feet away. Both basins of the reservoir were of puddled clay construction and had inner slopes paved with boulders on a gravel bed. The basins covered 11.85 and 13.73 acres, respectively, and when filled to the maximum depth of 20 feet held 161,220,000 gallons

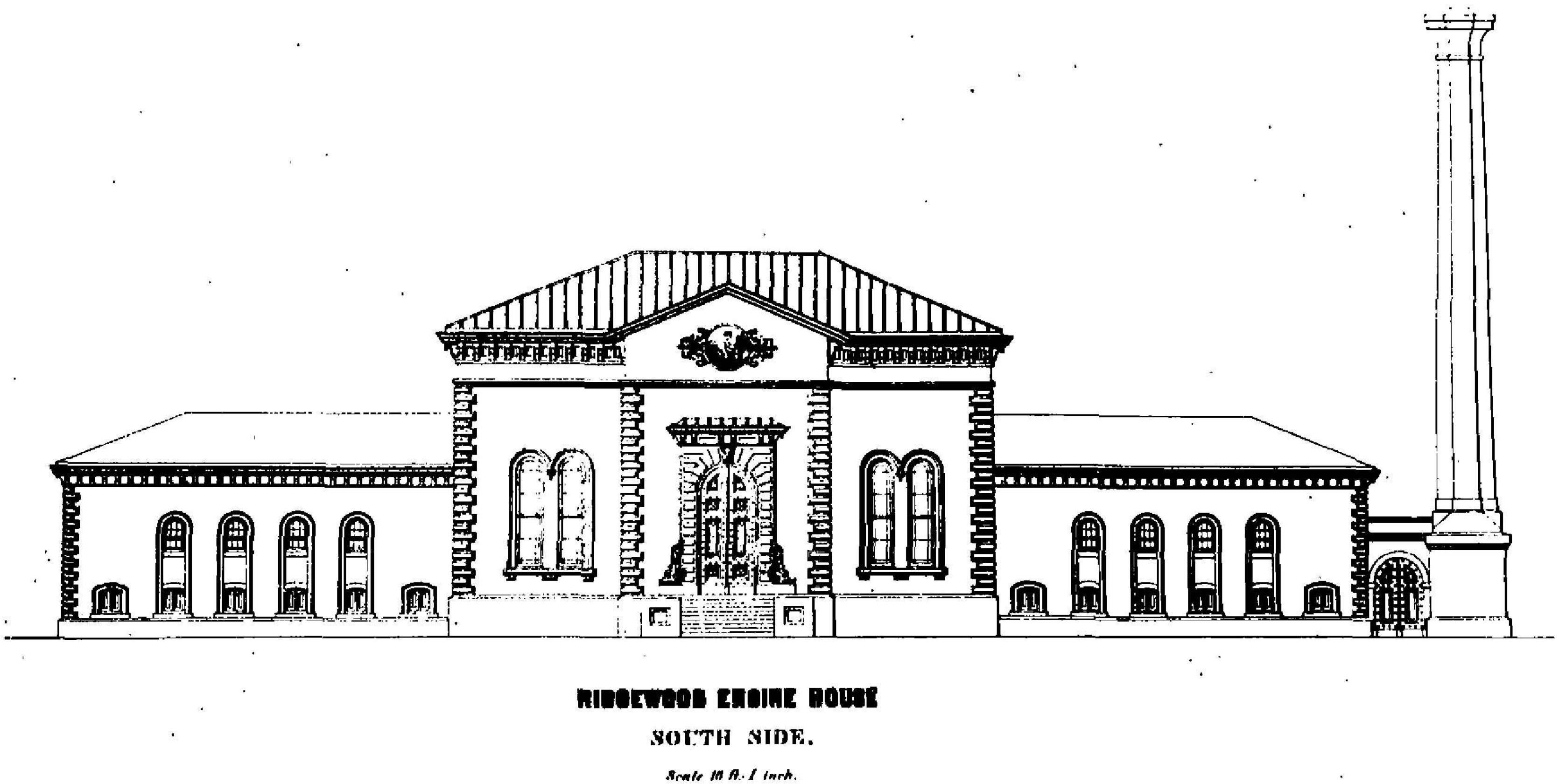


FIGURE 12. Ridgewood Engine House, south facade (Kirkwood 1967).

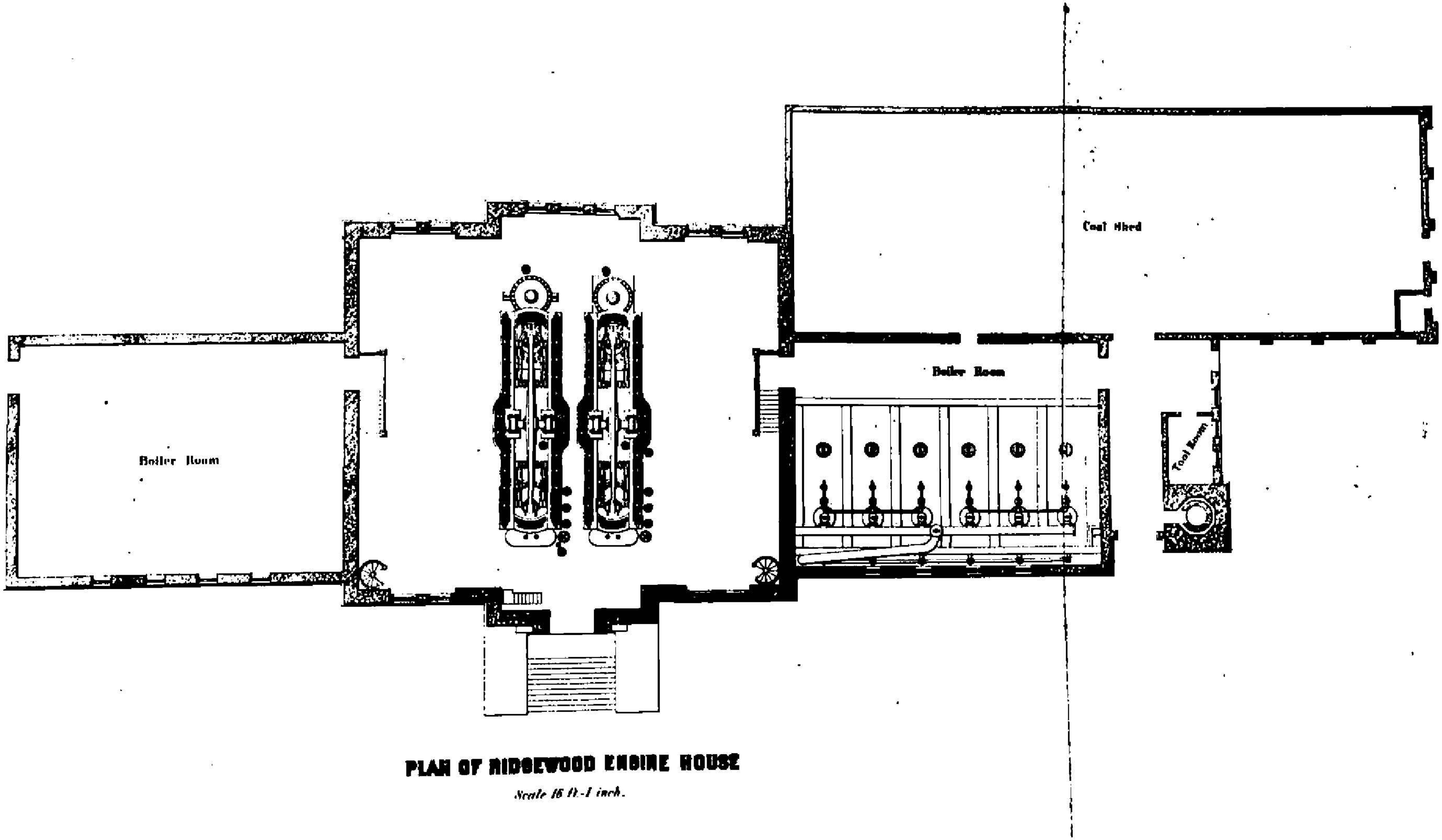


FIGURE 13. Plan of Ridgewood Engine House (Kirkwood 1967).

(The Water Works of Brooklyn 1873: 23-25; McElroy 1892: 5, 8; see Figure 14).

The distribution system from the Ridgewood Reservoir west to Brooklyn consisted of 36-inch mains of cast iron feeding into progressively smaller distribution pipes down to 4-inch hydrant feeders. One of the 36-inch main feeders branched to the Mt. Prospect Pump Station, where pump engines forced water into the 3.31-acre Mt. Prospect Reservoir (see Figure 15). This reservoir had a high water elevation of about 200 feet and, therefore, supplied a slightly higher service than the Ridgewood Reservoir. Remains of the Mt. Prospect Reservoir are now probably buried within the Brooklyn Botanical Gardens (McElroy 1892: 8; Board of Water Supply of the City of New York 1912: 296).

The water system described within the preceding pages was the original Ridgewood System and Aqueduct. On November 18, 1858 the Ridgewood Reservoir received its first water, and on December 16 of that year the City used the water system for the first time to extinguish fires. By 1862 all six supply ponds of the system were providing Brooklyn residents with water (see Figure 16; The Mayor's Catskill Aqueduct Celebration Committee 1917: 72). However, within ten years tremendous growth in residential and industrial use of the waterworks forced expansion of the Ridgewood System.

FIGURE 14. Ridgewood Reservoir and grounds (Kirkwood 1967).

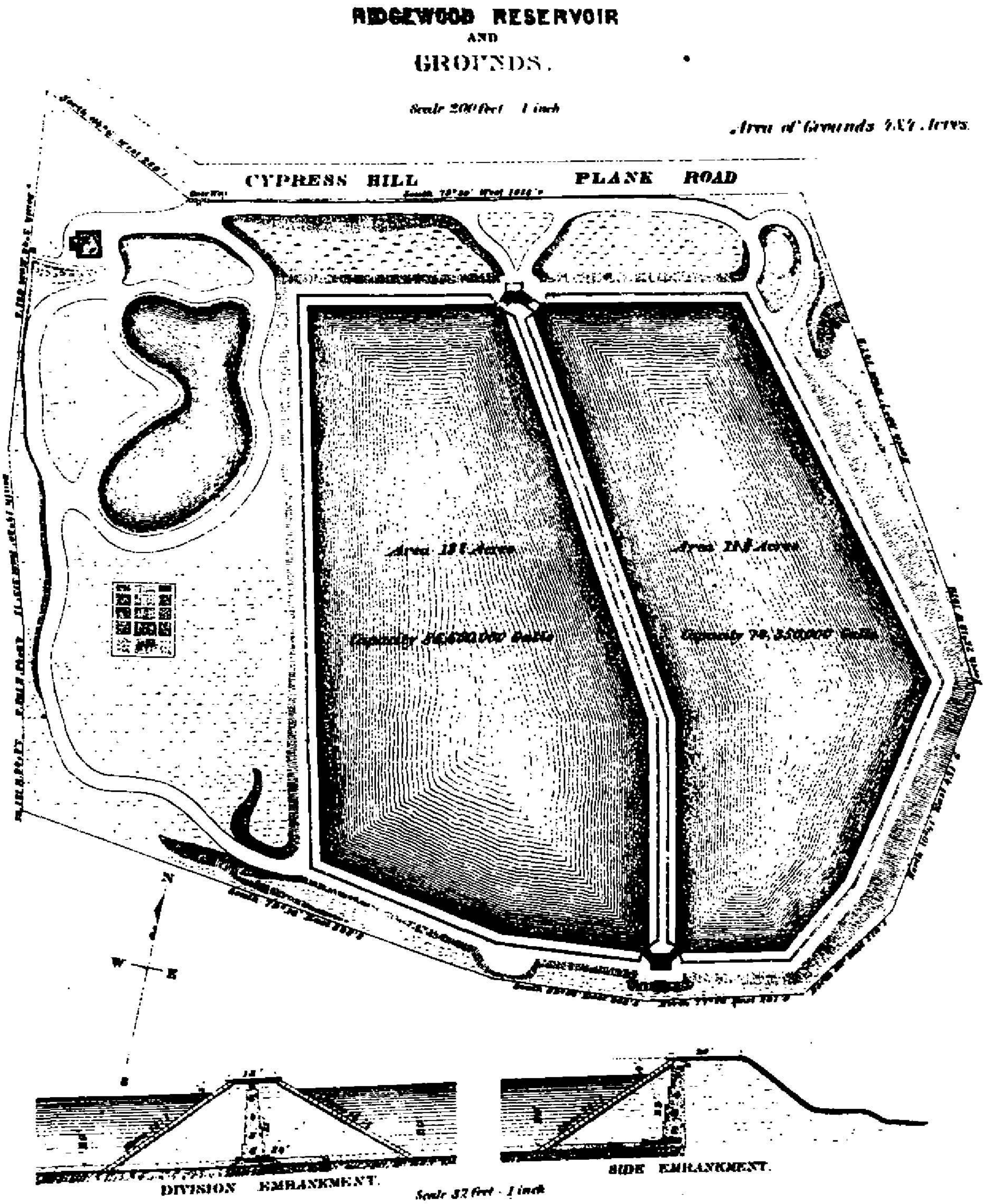


FIGURE 15. Mount Prospect Reservoir, plan and section (Kirkwood 1967).

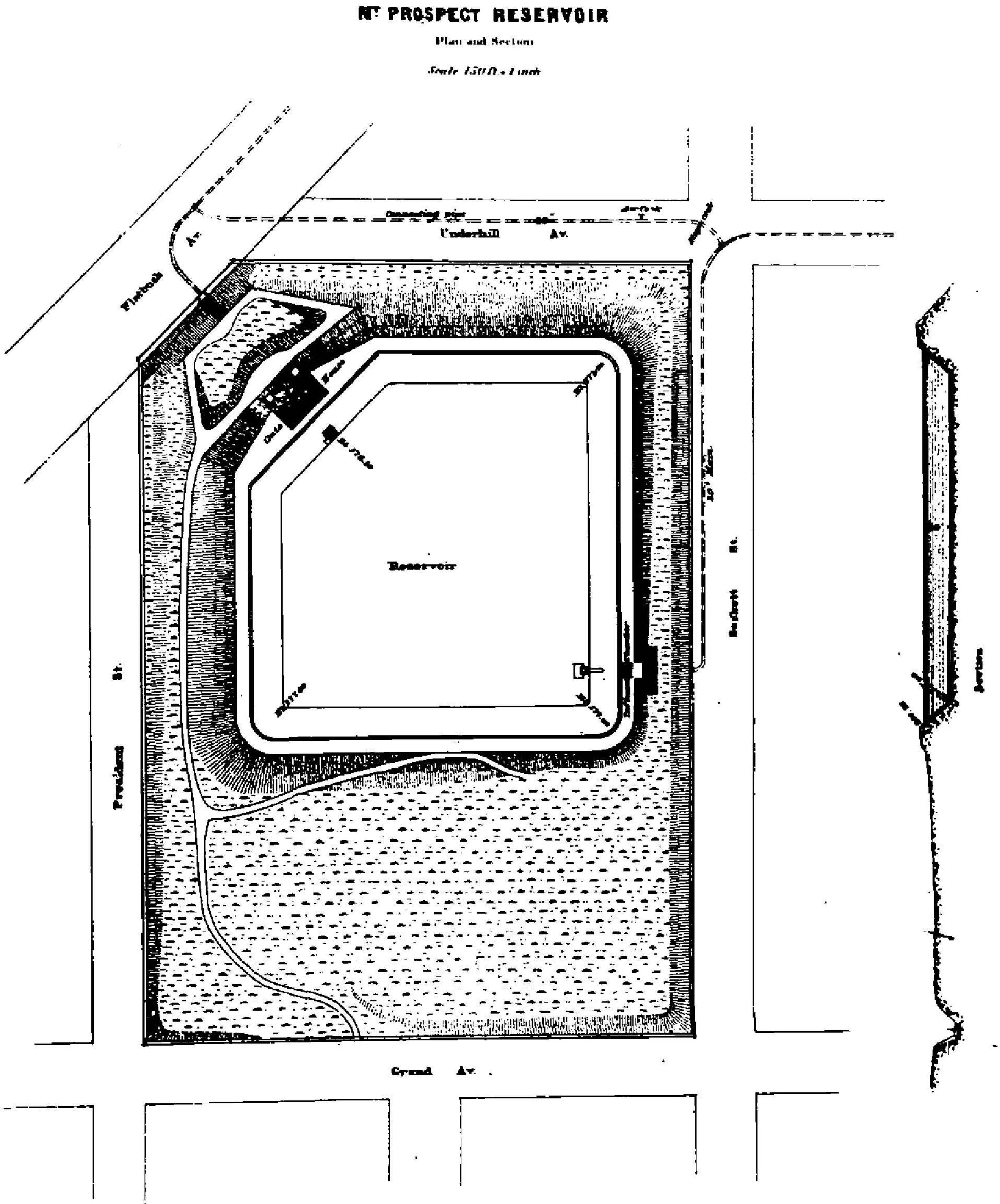
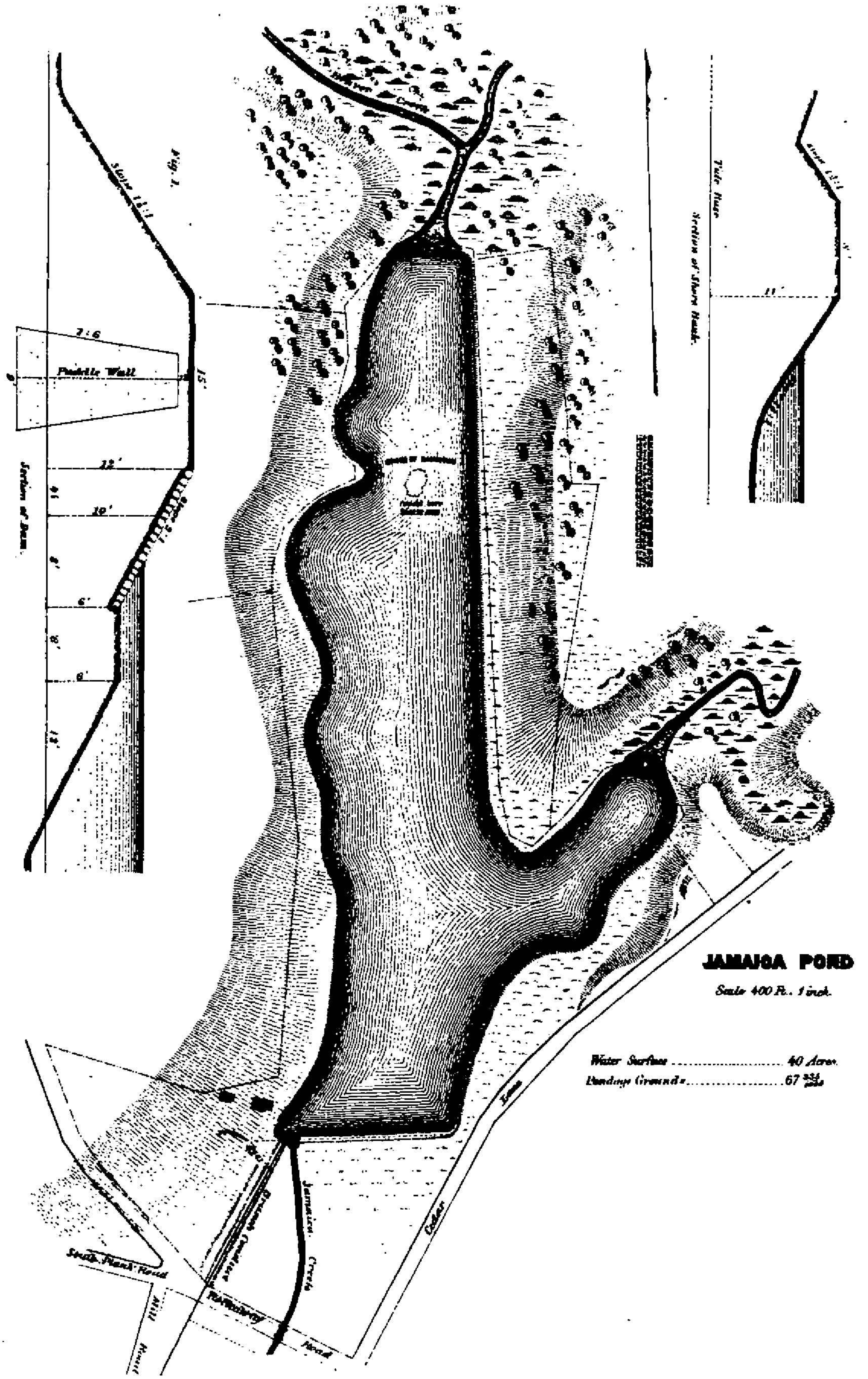


FIGURE 16. Jamaica Pond, plan and sections (Kirkwood 1967).



3. Expansion of the Ridgewood System, 1870-1912

At the time of the Ridgewood System's original construction, the estimated population of Brooklyn was 260,000 and the city's daily water requirements were no more than 20,000,000 gallons. By 1904, Brooklyn's 1,290,800 citizens were consuming over 110,000,000 gallons of water daily supplied by a watershed nearly double the size of that of the original works. As water demands steadily grew throughout the nineteenth century, the physical plant of both the supply and distribution systems grew in response (Board of Water Supply of the City of New York 1912).

In 1870 construction of the Hempstead Storage Reservoir was commenced at the eastern terminus of the Ridgewood Aqueduct. Completed c. 1874, this reservoir became the largest within the system with an available capacity of 860,000,000 gallons increasing the capacity of the entire system nearly eightfold (see Figures 2 and 17). However, before the reservoir was completed, demand within Brooklyn necessitated establishing emergency pump stations at Watts Pond and Smiths Pond (see Figure 17). At each of these stations an open, brick-lined circular well 50 feet in diameter was sunk near a millpond in order to capture groundwater within the surrounding sands. Both these stations were in service while the Hempstead Reservoir was being completed, and Smiths Pond became a permanent station of the waterworks in 1873. By 1881 Watts Pond and a similar

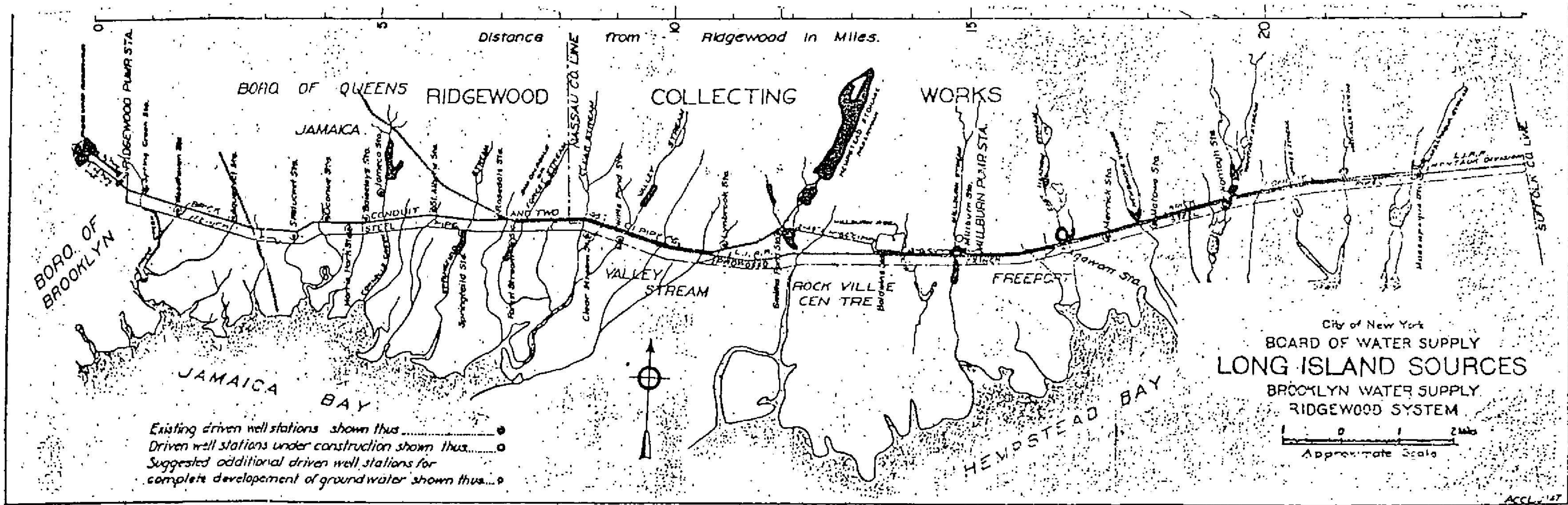

Distance from Ridgewood in Miles.
0
5
10
15
20
RIDGEWOOD PUMP STA.
BORO. OF QUEENS
RIDGEWOOD
COLLECTING
WORKS
JAMAICA
NASSAU CO. LINE
MILLBURN PUMP STA.
BORO. OF BROOKLYN
VALLEY STREAM
ROCK VILLE CEN TRE
FREEPORT
JAMAICA BAY
HEMPSTEAD BAY
Existing driven well stations shown thus
Driven well stations under construction shown thus
Suggested additional driven well stations for complete developement of ground water shown thus
City of New York
BOARD OF WATER SUPPLY
LONG ISLAND SOURCES
BROOKLYN WATER SUPPLY
RIDGEWOOD SYSTEM
Approximate Scale

FIGURE 17

pump station constructed near Springfield Pond had also become permanent stations. Unfortunately, the yield of these open well stations was disappointing owing to a significant lowering of the local water table and the slumping of sand into the wells while the stations were pumping (Board of Water Supply of the City of New York 1912: 258, 268).

During the 1880's the first driven-well stations were constructed for Brooklyn. At these stations, tubular wells of 2-inch iron pipe were driven to depths of from 35 to 40 feet. Individual stations consisted of from 100 to 180 wells connected as a single gang to pump. The iron pipe of each well was driven in 5-foot lengths. A 7-foot strainer of perforated or slotted 2-inch brass pipe covered by gauze and ending in a drive point bottomed each of the wells and provided for the influx of groundwater. The brass strainers were later replaced with similar galvanized iron strainers. Figure 18 illustrates the various strainers used and shows plan views of several of the driven-well stations. Wells at each station were driven 12 feet apart and, when completed, formed a linear series of wells paralleling both sides of a main suction line. Each well was connected to the suction line by 12 feet of 3-inch pipe attached with a valve so that individual wells could be closed (Board of Water Supply of the City of New York 1912: 269-70).

Between 1882 and 1888, driven-well stations were constructed within the existing watershed, first at Spring

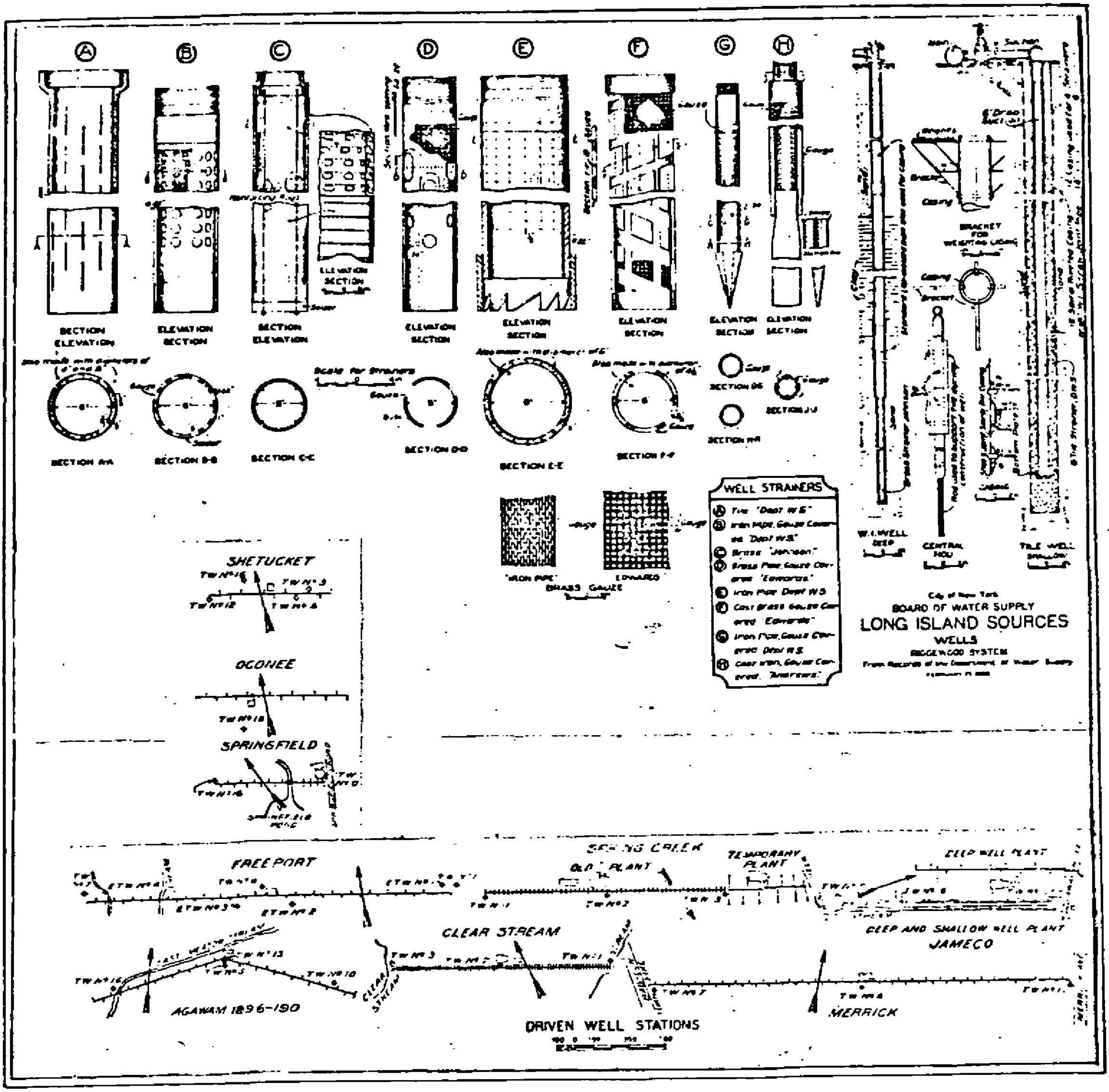


FIGURE 18

WELLS, WELL STRAINERS, AND DRIVEN WELL STATIONS

Source: Board of Water Supply of the City of New York, 1912, Sheets 51 & 56.

Creek and south of Baiseleys Pond and later at Forest Stream and Clear Stream (see Figure 17). In 1888 a contract was also made for the Jameco driven-well station near Baiseleys Pond, and by 1892 it was completed (Brooklyn City Works Dept. 1896: 2-3; Board of Water Supply of the City of New York 1912: 259).

Until 1889, expansion of the Ridgewood System had taken place completely within the same watershed of the original works. In 1889 a major expansion program extended the available watershed eastward through Massapequa to the Suffolk County line. Five new supply ponds created by damming Millburn, East Meadow, Newbridge, Wantagh, and Massapequa streams yielded water by gravity to the Millburn Pumping Station through a brick conduit of similar construction to the older Ridgewood Aqueduct. From Millburn, the water was pumped by the station's seven pumps to the Ridgewood Pumping Station. Because the Ridgewood Aqueduct could not handle the additional daily yield of 20,000,000 gallons from the Millburn Station, three 48-inch cast-iron pipes were constructed, one leading to the Millburn Reservoir--from which a 36-inch cast-iron pipe connected to the Ridgewood Aqueduct at Smiths Pond--and the other two running directly to the Ridgewood Station parallel to and within the right-of-way of the Ridgewood Aqueduct. Later, c. 1909, a similar 72-inch steel pipe was laid south of the aqueduct between the Ridgewood Station and the Clear

Stream Station (Brooklyn City Works Dept. 1896: 3; Board of Water Supply of the City of New York 1912: 290).

Included with the 1889 expansion program was the construction of a collection reservoir at Millburn. Completed in 1893, this reservoir was never watertight and has since been abandoned.

The increased potential of the supply system was accompanied by enlargement of the distribution system. By 1891 the Ridgewood Reservoir's capacity was increased by the addition of a third basin, and a new pumping station was erected on the south side of Atlantic Avenue in Ridgewood. The new station pumped entirely against the Ridgewood Reservoir head; remodeled pumps in the old Ridgewood Station worked against heads of the Ridgewood Reservoir, the Mt. Prospect Reservoir, and the new Mt. Prospect Tower high service, elevation 280 feet, which served the higher elevations of Brooklyn near Prospect Park and Greenwood Cemetery.

The extended water system was only sufficient to meet the demands of the City of Brooklyn until 1894. In that year, an additional driven-well station was built at Spring Creek and a new driven-well station was built near Watts Pond. During the unprecedented drought of 1894, in which rainfall of the summer months dropped to only 1.96 inches from a previous average of 12 inches, contracts were drawn for the construction of driven-well stations capable of providing 25,000,000 gallons daily. By 1896 five stations east of Millburn were in operation. The Agawam, Matowa, Wantagh, and Massapequa Stations were all located just south of existing supply ponds in the new watershed, whereas the Merrick station was located midway between two ponds. All these stations utilized wells with 4.5- to 6-inch open-end strainers within pipe casings. The wells were driven at 30- to 40-foot intervals, 10 feet from the main suction line (Board of Water Supply of the City of New York 1912: 270; see Figures 17 and 18).

Before 1896, the Brooklyn Department of Water Supply generally contracted private companies when constructing its physical plant, but in 1896 the city began sinking wells with its own men when the deep well plants at Jameco, Springfield, Oconee, Shetucket, and Spring Creek were erected. At these stations, a gang of 12 wells was sunk through the uppermost clay layer into coarse sands and gravel at depths of between 130 and 200 feet. Each well was driven with 8-inch iron casing and wrought-iron strainers covered with perforated brass. At first these wells were quite successful, yielding up to 3,000,000 gallons daily from each station, but later sand clogging the strainers became a constant problem (Board of Water Supply of the City of New York 1912: 273).

Because of the varying success of the driven-well stations and the costly repairs to the strainers owing to breakage or clogging, a type of system using open-jointed tile sewer pipe laid horizontally within a gravel bed some

10 to 15 feet below the water table was designed and constructed by the City at Wantagh, c. 1905, and at Massapequa, c. 1906. Called infiltration galleries, the pipes were laid in opposite directions from a central pump well and at near right angles to the general direction of underground water flow. Each gallery contained over 12,000 feet of pipe joined every 250 feet by manholes to facilitate maintenance. Although the tile pipe used was difficult and costly to handle during construction, the cost of water from the galleries was much less than that at the driven-well stations (Board of Water Supply of the City of New York 1912: 284).

Since 1906 driven-well plants have been established at Aqueduct, St. Albans, Rosedale, Woodhaven, and Morris Park (see Figure 17). Also, several small driven-well plants within the Brooklyn City limits helped to supply the city in the 26th, 29th, 30th, 31st, and 32nd wards, which were originally in separate municipalities known as New Lots, Flatbush, New Utrecht, Gravesend, and Flatlands. These latter plants were all constructed by private companies during the 1880's and 1890's. All but the works in Flatbush and Flatlands and a portion of the works in New Lots were later purchased by the City (Board of Water Supply of the City of Brooklyn 1912: 261).

4. Abandonment of the Ridgewood System

With the expansion of the waterworks of the City of Brooklyn throughout the southern plains of Queens and Nassau counties, the countryside of Long Island became more and more developed as the New York metropolitan area grew. During the development period of the original Ridgewood System (c. 1860), the homes and farms within the watershed of the system were widely spaced so that each could have its own well and cesspool with little effect on the quantity and quality of the region's water. By the 1890's, population increases had created significant problems in pollution and over-withdrawal of groundwater.

The first sources of Brooklyn's water supply to be affected by pollution were the supply ponds of the original watershed. In 1894 Baiseleys Pond was abandoned owing to pollution of Jamaica Creek, and a similar fate befell Springfield Pond in 1897, the Hempstead Storage Reservoir in 1902, Simonsons or Forest Stream Pond in 1904, and Clear Stream Pond in 1905. The development of filter plants generally utilizing the natural filtering potential of local sands allowed the re-opening of all these ponds, except at Clear Stream, by 1904. Saltwater infiltration resulting from overdraft of the local water table also forced the closing of well stations at Freeport in 1895 and at Shetucket in 1905 (Board of Water Supply of the City of New York 1912: 263).

In 1898, the City of Brooklyn, then encompassing all of Kings County, became part of the greater City of New York. New York City was then faced with supplying almost 3.5 million people with some 370 million gallons of water a day. Brooklyn continued to rely on Long Island sources, including the original Ridgewood System, and in 1916 had an average daily supply of 73 million gallons from wells, 34 million gallons from infiltration galleries, and 20 million gallons from surface ponds. In 1917 New York City received its first supply of water from the newly developed Catskill project in upstate New York. In the same year, City Tunnel No. 1 was completed and Brooklyn and Queens, the city boroughs across the East River from Manhattan, began using Catskill water (The Mayor's Catskill Aqueduct Celebration Committee 1917: 73; American Public Works Association 1976: 222, 224).

With the introduction of the Catskill water to Brooklyn, the Ridgewood System was placed on standby status. When needed, Long Island sources could be used to supplement the now higher quality Catskill waters, and throughout the 1920's and 1930's the Ridgewood System was used. During the 1930's and 1940's, the completion of additional reservoirs, first in the Catskill Mountains and later in the upper reaches of the Delaware River, increased the water supply of greater New York significantly. A second tunnel, City Tunnel No. 2, was also completed, connecting Brooklyn to these sources. These additions, and the contemporaneous increase of groundwater pumping on Long Island by industries and municipalities other than Brooklyn, ended the need for and availability of waters from the Ridgewood System (State of New York Dept. of Conservation 1951: 34-46; American Public Works Association 1976: 224).

Since the late 1950's, the standby status of the Ridgewood Aqueduct and the associated pair of 48-inch iron pipelines has been changed to the official status of "discontinued." The closing of the Ridgewood Aqueduct and the pipelines was to allow for construction of Lefferts Boulevard and the Van Wyck Expressway, which destroyed portions of the aqueduct. The only conduit of the Ridgewood System which is presently operative is the 72-inch steel pipeline erected c. 1909 running just south of the aqueduct. This pipeline now conveys water from sources other than Long Island (Larsen 1979: personal communication).

IV. INFIELD INVESTIGATIONS

Because of the abandonment of the water system in the twentieth century, the Ridgewood System today serves as a nonfunctioning series of architectural, landscape, and archeological features within Kings, Queens, and Nassau counties. The following test describes the present condition of those surviving waterworks features as identified through an infield survey conducted for this study and for the 1979 documentary literature search (Church and Rutsch 1979). For convenience, description of these surviving features will be made under the three categories of architectural, landscape, and archeological features. All above-ground elements and structures are considered to be architectural features, excluding masonry pavements, foundations, and spillways associated with the collection ponds of the system. Landscape features include conduit and aqueduct rights-of-way, parkland, and surviving elements of the collection ponds. Finally, archeological features include identifiable below-ground features. For locations and descriptions of the waterworks features described in the following text, refer to Figures 2, 3, and 17 as well as to the Appendix.

A. Architectural Elements

From 1856 through the first decade of the 1900's, numerous buildings and structures were built as part of the Ridgewood Waterworks System. Buildings were constructed to house pumping engines and boilers, control gates, waste weirs, and other machinery or gearing. Occasional office buildings and residences were also built in close proximity to sites where machinery required regular maintenance by resident personnel. Although the majority of these buildings have been destroyed, several survive as fragmented reminders of the Ridgewood System and the style of public works construction identified with the latter decades of the nineteenth century.

Sadly, no buildings survive of the original portion of the Ridgewood System, although landscape and archeological features still exist. For instance, of the two once impressive Ridgewood Pumping Stations off Atlantic Avenue at the terminus of the aqueduct and off Conduit Avenue, only empty lots exist (see Figures 12 and 13). Similarly, the Mount Prospect Pumping Station at Prospect Place and Underhill Avenue in Brooklyn (see Figure 15) and the Mount Prospect Reservoir gatehouse and high water tower southeast of Grand Army Plaza are gone, with the sites of the latter two structures and the Mount Prospect Reservoir having been incorporated into the present Brooklyn Botanical Gardens.

A series of smaller buildings were also built as part of the original system. Five brick and granite gatehouses once existed at the five major stream crossings along the original aqueduct from Hempstead west to Ridgewood. These gatehouses, now demolished, covered waste weirs for emptying the aqueduct of water.

A replacement structure for one of these gatehouses does exist. The original Jamaica Creek gatehouse (Figure 11) was replaced with a similar structure c. 1924 over the aqueduct near 150th Street in Queens (see Figures 19 and 20). Replacement of this structure and associated modifications to the waterworks conduits nearby were required during construction of the nearly 60-foot-wide Baiseley Boulevard storm sewer immediately east of the gatehouse (see Figures 21 and 22).

The Jamaica Creek Gatehouse, a one-story brick Colonial Revival-influenced replacement for the original gatehouse, is a single bay wide and two bays long. Granite was used for the ornamentation, including a water table, simple entablature, sills, lintels, and quoins. The brick is laid in a common bond with thin mortar joints. A single-panel wood door is located in one of the narrow facades of the structure. The openings of the other facades are now boarded up, except for one window which contains a triple sash, probably with a center pivot. The upper and lower sash contain three panes and the center sash has six. This gatehouse is the only surviving architectural feature of the waterworks systems within the Nassau Expressway study area.

FIGURE 19. Present Jamaica Creek Gatehouse, front facade (Tony Masso, photographer, 1985).

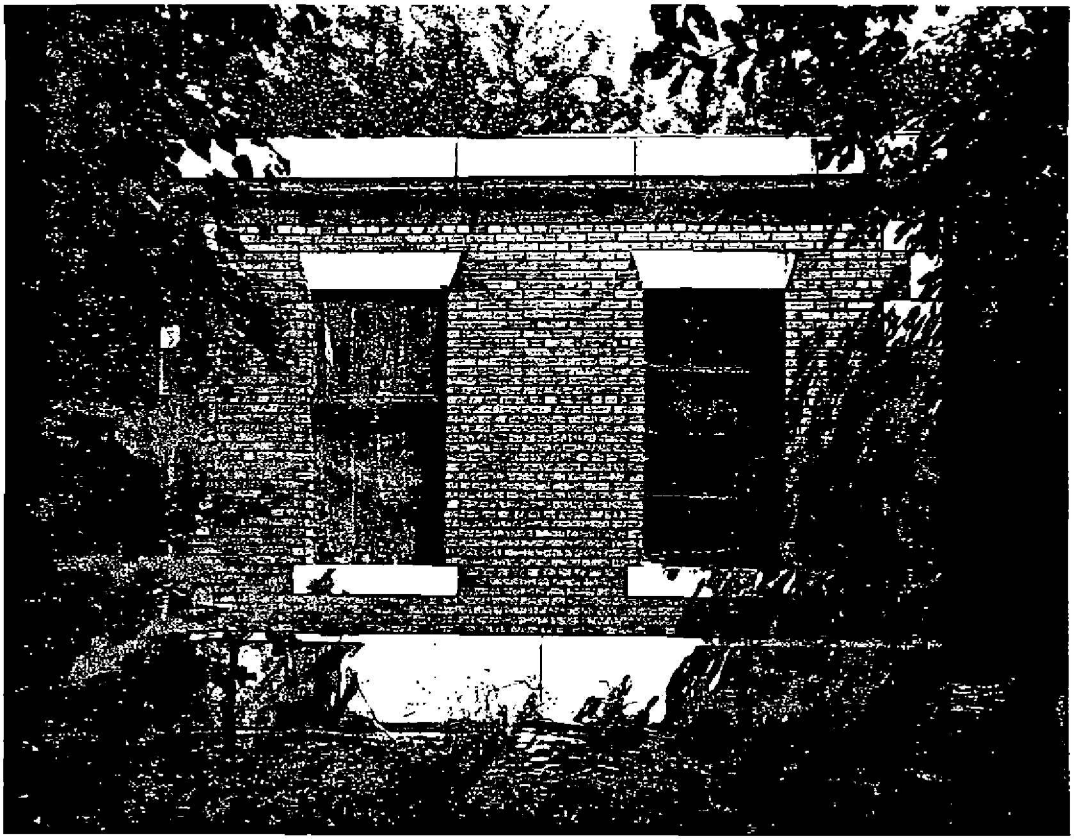


FIGURE 20. Side facade, Jamaica Creek Gatehouse (Tony Masso, photographer, 1985).

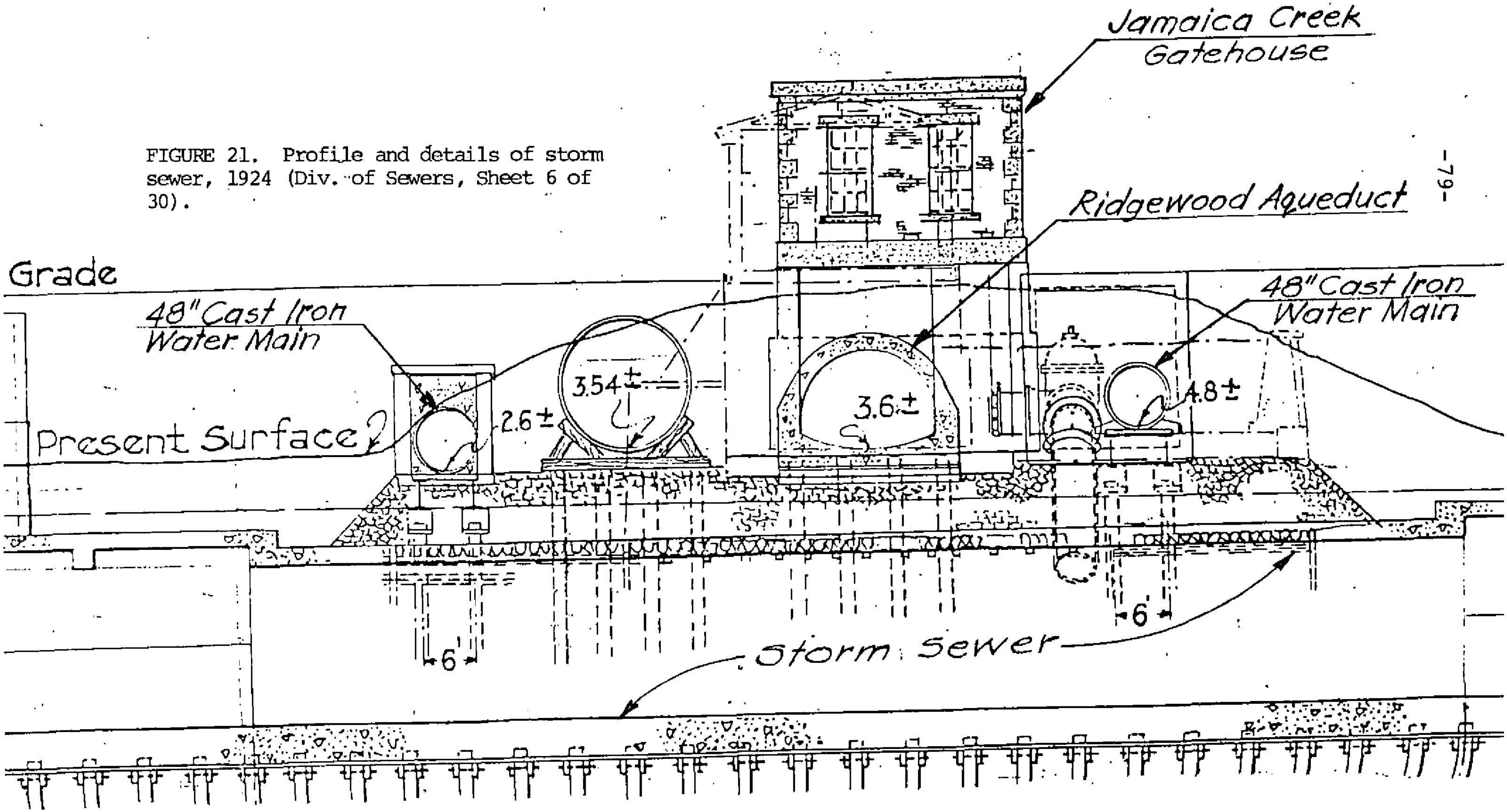


FIGURE 21. Profile and details of storm sewer, 1924 (Div. of Sewers, Sheet 6 of 30).

Two other gatehouse also still stand at their original locations within the original watershed west of Hempstead. Neither of these gatehouses was part of the Ridgewood System as it was first constructed, but both are elements of subsequent expansion of the system in the latter nineteenth century. The first is the Hempstead Storage Reservoir Gatehouse, built as part of the 1872 construction contract for the storage reservoir (Brooklyn City Works Dept. 1896: 54-59; see Figures 2 and 23). It is a one-story classicizing brick structure with a metal-sheathed hipped roof and engaged unornamented corner pilasters serving as quoins. A single bay in each facade is divided into narrow vertical slits, except for the south facade, which consists of three bays with a central door inset into a flush arch flanked by small arched windows. The entire structure sits on a granite substructure, which serves as the efflux chamber of the reservoir dam north of Lake Drive off Peninsula Avenue in the Town of Hempstead.

The second surviving architectural element of the waterworks system within the original watershed is the Ridgewood Distribution Reservoir Gatehouse, another one-story brick building built as part of the expansion of the Ridgewood Distribution Reservoir. Under a series of contracts beginning in 1889, Basin No 3 was added to the original two basins of the reservoir. Part of this construction included the erection of a gatehouse over the efflux chamber of the new basin sometime after 1896

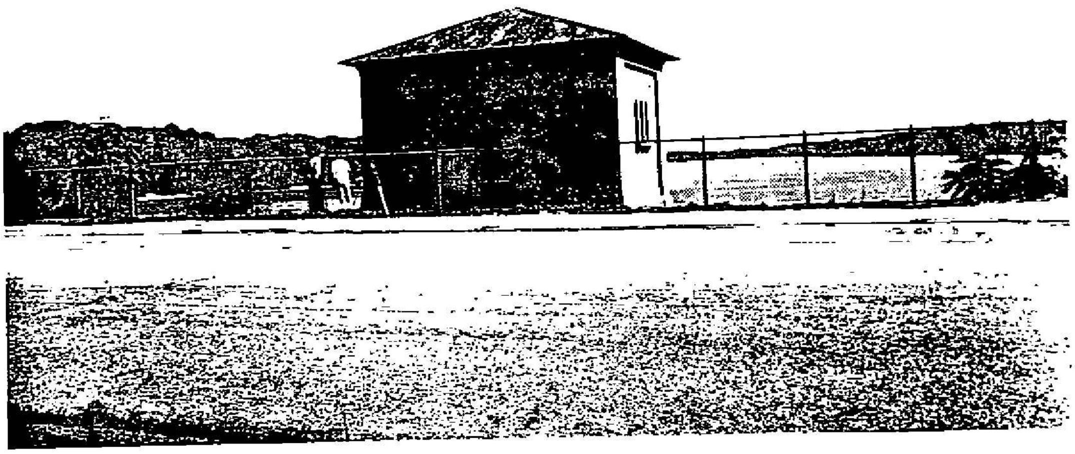


FIGURE 23. View northward at the Hempstead Storage Reservoir Gatehouse (Tony Masso, photographer, 1985).

(Brooklyn City Works Dept. 1896: 111). The result was a one-story, utilitarian, gable-roofed, brick structure set on top of the Basin No. 3 efflux chamber. The structure appears to have been built in two phases: attached to the gable-roofed section is a flat-roofed addition surmounted by a parapet. Both parts of the building feature a brick water table, entablature, and engaged corner pilasters. This gatehouse survives today at its original location off the northeast corner of the reservoir adjacent to the Interborough Parkway (see Figures 2 and 24).

The other surviving architectural elements of the Ridgewood System consist of a series of reservoir gatehouses as well as the prominent Millburn Pumping Station, all of which were built as part of the expansion of the waterworks system east beyond Hempstead to the Nassau/Suffolk County line. As previously referenced, expansion of the system occurred as needed, but in 1889 a major expansion program extended the available watershed eastward by creating five new supply ponds. At Wantagh and Massapequa reservoirs, the furthest east of the five ponds, the original one-story, brick gatehouses still survive, although abandoned. Interestingly, each gatehouse, like those within the original watershed, was constructed in a different style and consistently included attractive architectural detailing and, at times, decorative iron fencing (see Figures 2 and 25-29). Each of these gatehouses protected the gate mechanisms of the reservoir efflux chambers.

FIGURE 24. View southeastward at the Ridgewood Distribution Reservoir Gatehouse, Basin No. 3 (Tony Masso, photographer, 1985).

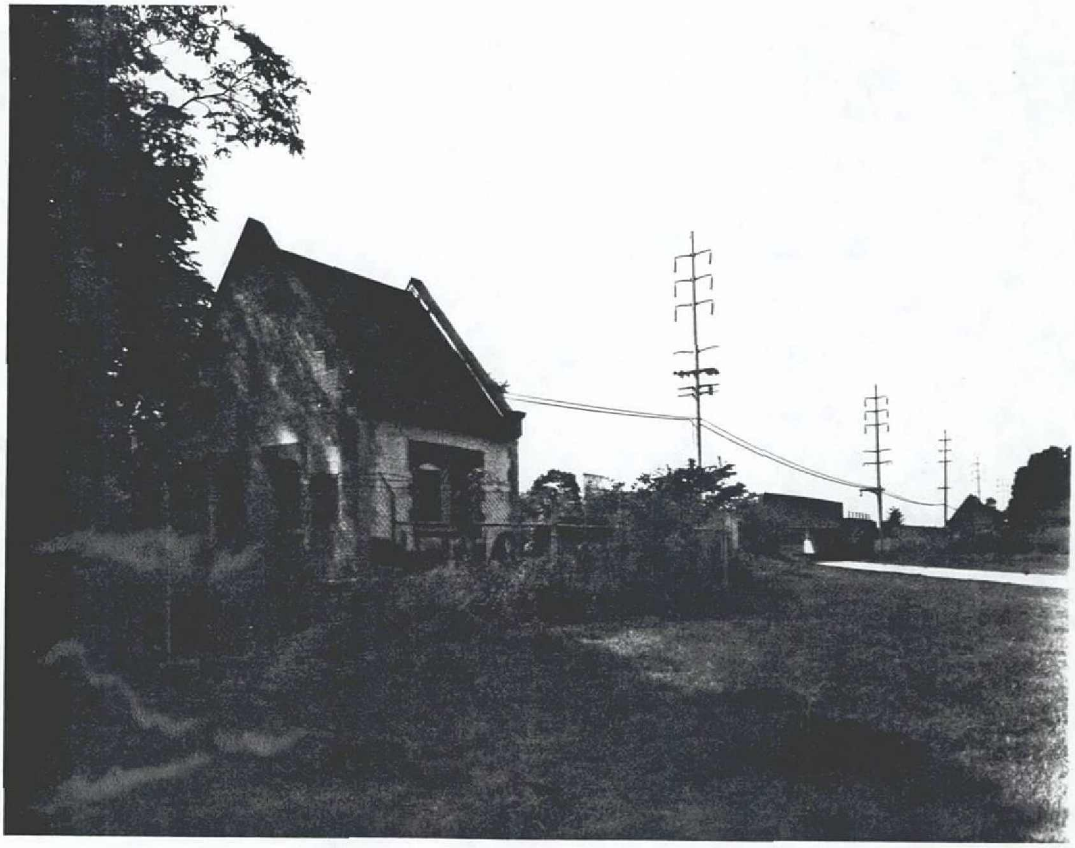


FIGURE 25. View southwestward at the Wantagh Pond Gatehouses. The Long Island Railroad is in the distance, and Wantagh Pond is immediately to the north (out of the photograph to the right). (Tony Masso, photographer, 1985.)

FIGURE 26. East Gatehouse, Wantagh Pond (Tony Masso, photographer, 1985).

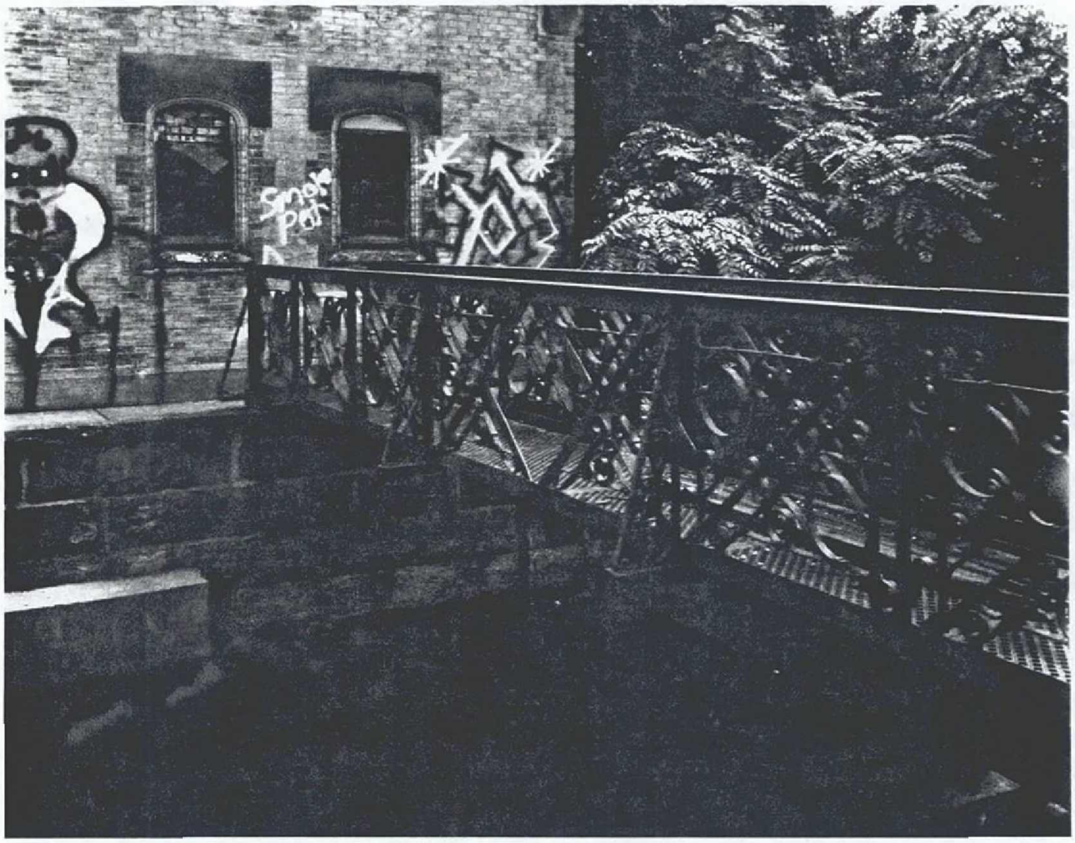


FIGURE 27. Waste weir and bridge at the Wantagh Pond East Gatehouse (Tony Masso, photographer, 1985).

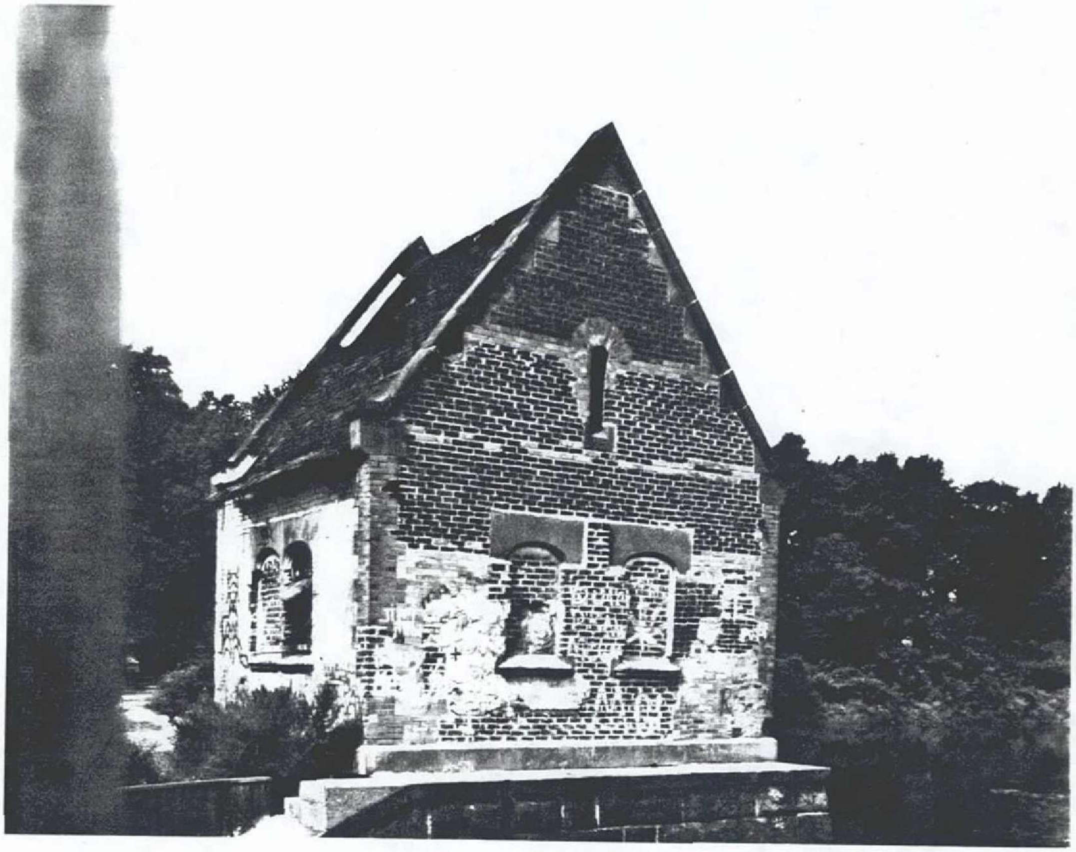


FIGURE 28. View westward at the Wantagh Pond West Gatehouse. Pond is in left foreground. (Tony Masso, photographer, 1985.)

FIGURE 29. View northward at the Massapequa Pond Gatehouse. Pond is in the background. (Tony Masso, photographer, 1985.)

The Wantagh Pond Gatehouses, east and west, are one and one-half-story buff brick buildings with steeply pitched gabled roofs reminiscent of the Flemish Revival style. The use of contrasting materials--such as red brick to create the stepped gable appearance, brownstone for the gable coping, and buff brick for the walls--is a common feature of this architectural influence. Brownstone is also used for the quoins and window and door surrounds. The fenestration consists of two segmentally arched windows set within a square quoined brownstone surround (Gibbs surround) alternating with two detached windows.

The Massapequa Pond Gatehouse is a one-story hipped-roof brick building with a single bay on each facade, except for the entrance facade which contains a door and a window. The building's most notable feature is the eclectic ornamentation of the windows. The south facade has a segmentally arched hooded brick lintel over a large segmentally arched opening. The west facade, which contains the entrance, has an exaggerated lintel over both the door and the window. A small window is also located over the large first-floor window. A stone water table surrounds the base of the building.

Undoubtedly the most impressive surviving element of the Ridgewood System is the Millburn Pumping Station. This striking Richardsonian Romanesque-style structure, designed by Frank Freeman and built through a series of contracts completed between 1889 and 1892, housed the series of pump engines and boilers used to raise and move the water supplied from the additional five supply ponds to the east into the eastern terminus of the original waterworks at Hempstead (see Figures 2 and 30-35).

The Millburn Pumping Station is characteristic of the Richardsonian Romanesque influence prevalent in the last two decades of the nineteenth century. The asymmetrical facade of the large hipped-roof and cross-gabled brick structure consists of a protruding, three-story, steeply pitched gable springing from the ground level with a connected tower flanked by the extensions of the main body of the building. At the base of the pyramidal-roofed four-story tower is a semicircular single-story component with a conical roof and a large terra-cotta plaque ornamented with an egg and dart border, floral motifs, and the name "Brooklyn Water Works." Balancing this feature is a ground-springing arched entrance with deeply set reveals at the opposite base of the facade gable. The gable itself is punctuated with strips of windows, rectangular on the first and third stories and round arched on the second. The apex of the gable is covered with brick strapwork.

The brownstone-quoined tower has rounded corners and is pierced by vertical slit windows set in flush round arches. The uppermost section of the tower immediately under the roof contains two large openings on all sides, below which are billeted panels of brick and three vertical slit windows. One corner of the tower has an engaged circular

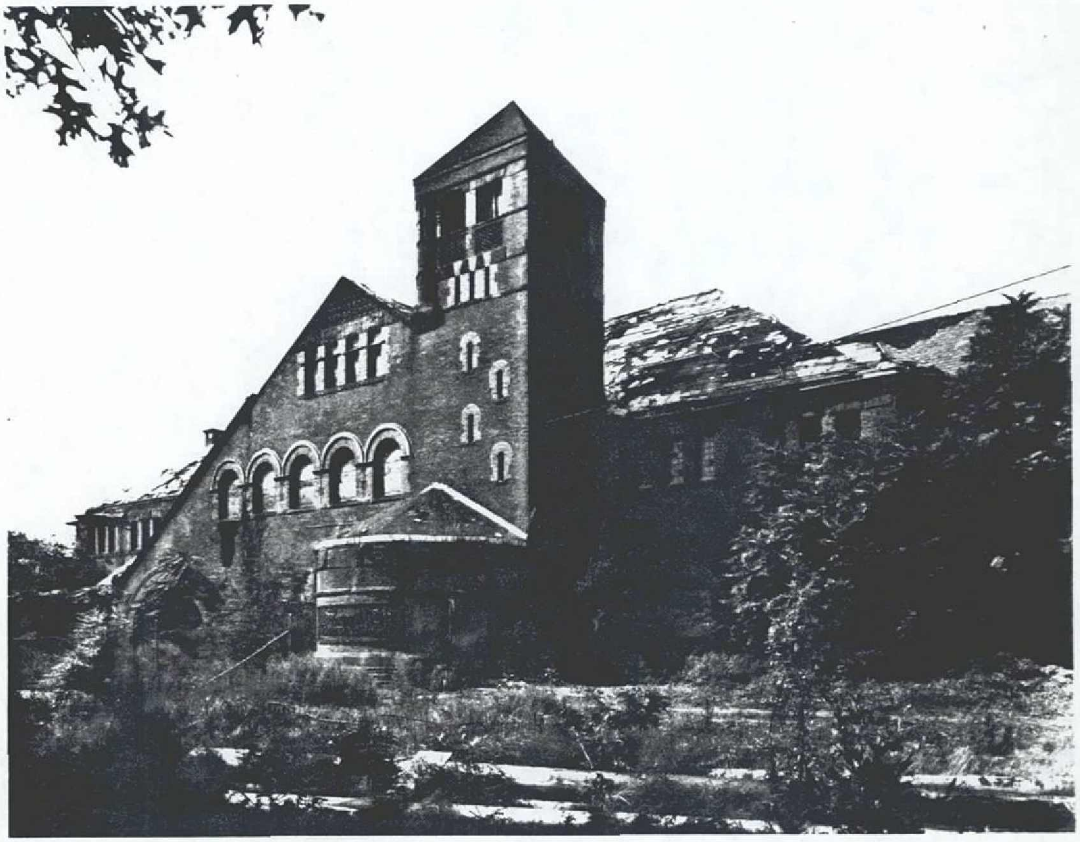


FIGURE 30. View northwestward at the Millburn Pumping Station (Tony Masso, photographer, 1985).

FIGURE 31. View southward at the Millburn Pumping Station. Note the badly burned roof. (Tony Masso, photographer, 1985.)

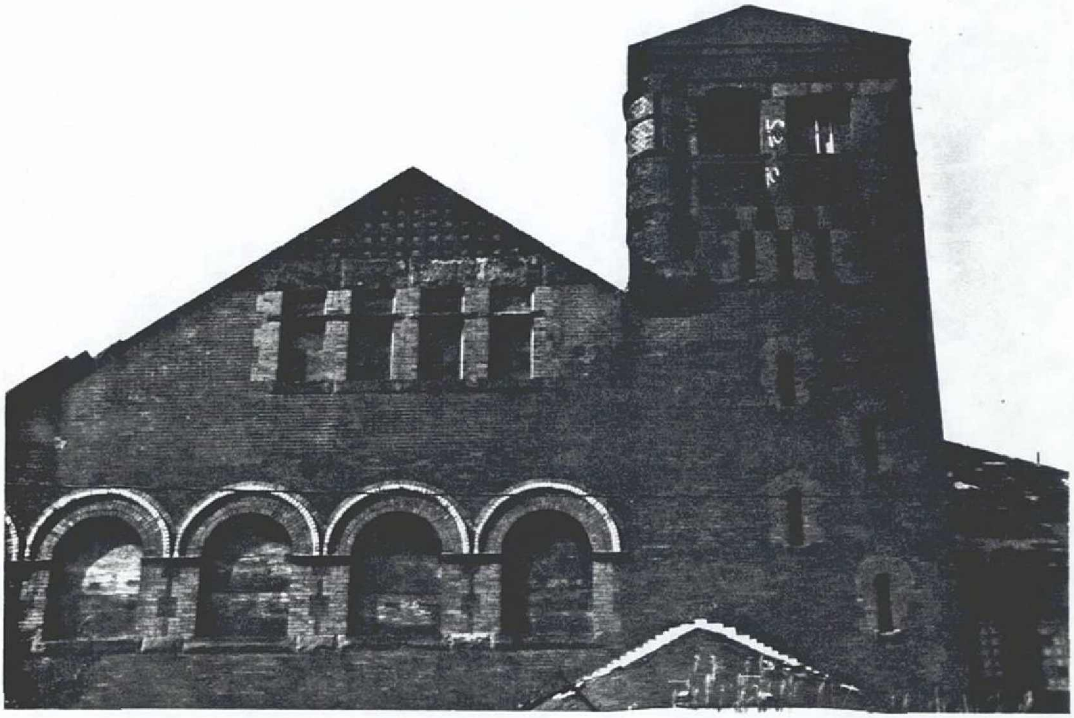


FIGURE 32. Front (south) facade of Millburn Pumping Station (Tony Masso, photographer, 1985).

FIGURE 33. Closeup showing details of front facade entrance of Millburn Pumping Station (Tony Masso, photographer, 1985.)

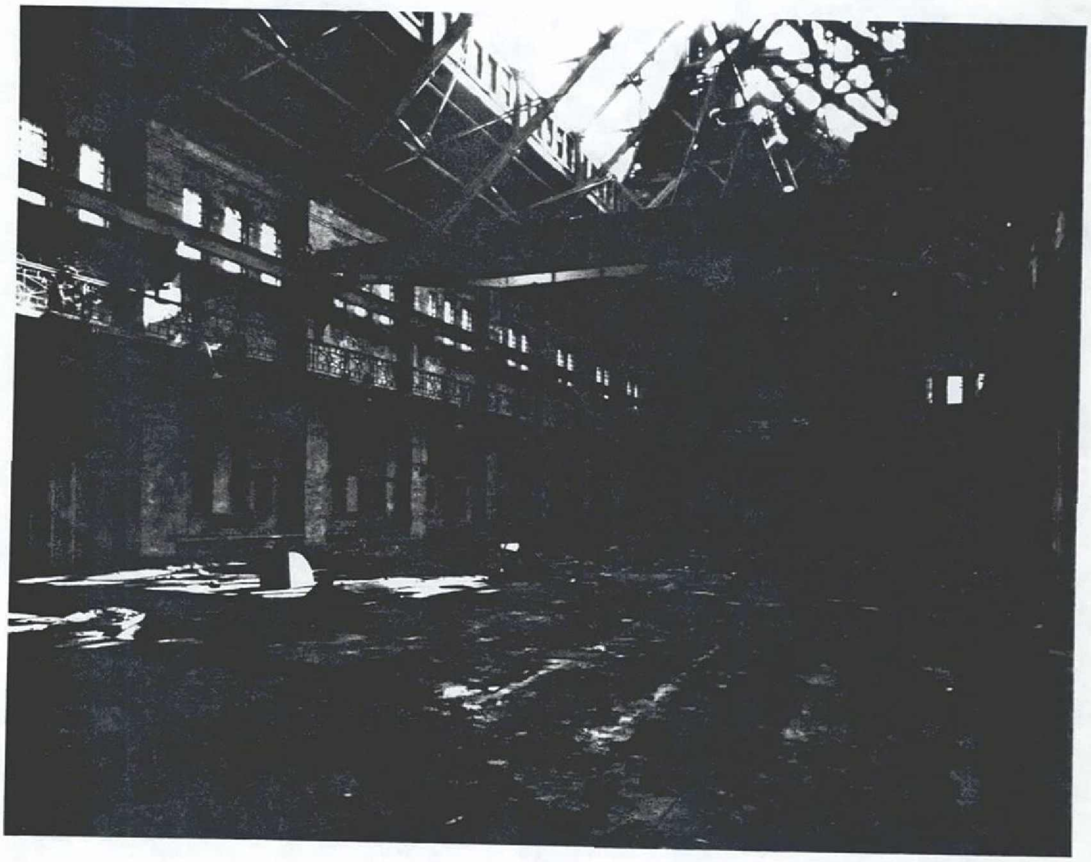


FIGURE 34. View northeastward inside the Millburn Pumping Station (Tony Masso, photographer, 1985).

FIGURE 35. View southwestward at the interior structure of the Millburn Pumping Station (Tony Masso, photographer, 1985).

turret. The body of the building consists of two main stories: a lower story fenestrated with large arched openings; and an upper story divided into bays by groups of three rectangular windows, each group centered over a first-floor arch.

None of the interior machinery survives, and the building is now merely an abandoned shell. Because the building is abandoned, screened by the raised bed of the Long Island Railroad and easily accessible, successive acts of arson have significantly damaged the roof, pine roof trusses, and other interior wooden features.

Frank Freeman, the pumping station architect, was born in Hamilton, Ontario in 1861, the son of a Queen's Councilor. His mother was a member of the Hamilton family, from which the town derived its name, and his brother Manfred was an inventor. Freeman emigrated to New York in 1884, settling in Brooklyn; however, he practiced most of his life at 132 Nassau Street in Manhattan. From this office he worked all over New York City, taking, among others, such commissions as the Brooklyn Savings Bank, the Jay Street Fire House, the Jefferson Association Building, the Hotel Margaret, and a series of handsome residences including some on Riverside Drive. After some of his drawings were published in contemporary architectural publications, Freeman received some commissions outside New York, as far afield as Texas and California. He died in

Brooklyn October 13, 1949 at the age of 88 (Burnham 1952: 36; The New York Times 1949).

Prior to opening an office on Nassau Street, Freeman practiced at 40 Broadway in 1887. In 1888, he teamed up with Lawrence J. O'Connor, an architect known for his church designs, and formed the company of O'Connor and Freeman at the Nassau Street address. By 1895 the team had split up and O'Connor went on to join Fred L. Metcalf. Freeman continued as sole proprietor of his Nassau Street firm, hiring Ulrich J. Huberty (1877-1910) in 1899 as head draftsman (Francis 1980: 32, 58, 90). It is possible that Freeman worked in the office of New York architect Francis H. Kimball for a few years prior to starting his own practice (Robinson 1969: 42).

Freeman's architectural style can best be described as bold, vigorous, and inventive, freely employing the characteristics of the Richardsonian Romanesque influence. His buildings, noted for their three-dimensional plasticity, have deep reveals in the heavy brickwork, pyramidal roofs, polychromatic detailing, and entrances set in arches springing from the floor level or from wall surfaces. Freeman's best-known works include The Jay Street Firehouse for the Brooklyn Fire Department (1891-92), the Eagle Warehouse and Storage Company on the Brooklyn waterfront (1893), the home of Colonel E. M. House in Austin, Texas (1890-91), and the Millburn Pumping Station of the Ridgewood System, Brooklyn Water Works (1889-92).

The Millburn Pumping Station personnel office, now abandoned and located immediately east of the pumping station between it and North Brookside Avenue, is a one-story, hipped-roof, brick structure (see Figure 36). Although the office is stylistically similar to the station, its smaller scale limits its ornamentation to large arches flush with the wall surfaces forming the fenestration and entrance bays. Brownstone detailing consists of a water table and entablature.

The final surviving architectural element of the Ridgewood System is a building which housed the pumping engines and related machinery of the Agawam Station (see Figures 2, 37, and 38). One of the last of the gatehouses built in the expansion of the Ridgewood Aqueduct system, the Agawam Pumping Station is a one-story, hipped-roof, brick building with exterior brick wall buttresses capped with limestone. This small classicizing structure is divided into three bays by the buttresses; a wider central bay is flanked by narrower side bays. Recessed to the east side is a similar wing having only two bays. Additional ornamentation includes a limestone water table, entablature, sills, and chimney caps.

Built after 1896 on land now situated at the southwest intersection of the Long Island Railroad and Meadowbrook State Parkway, Agawam Station was one of five driven-well stations built within the additional watershed east of

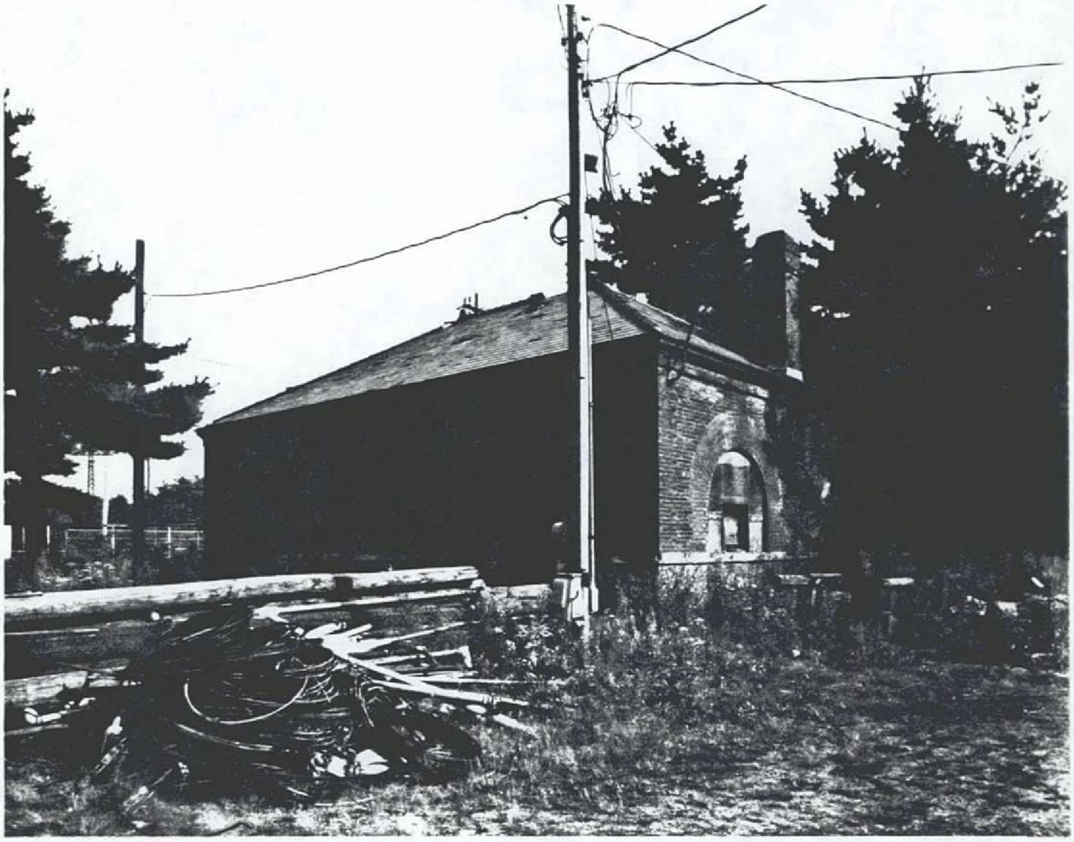


FIGURE 36. Outbuilding immediately east of Millburn Pumping Station (Tony Masso, photographer, 1985).

FIGURE 37. View northward at Agawam Station Pumping Station (Tony Masso, photographer, 1985).

FIGURE 38. Well-heads for two of the series of gang-wells at Agawam Pumping Station (Tony Masso, photographer, 1985).

Hempstead. Although also abandoned, this building is securely closed and structurally intact.

B. Landscape Elements

Perhaps the most significant, yet quite subtle, surviving elements of the abandoned Ridgewood Waterworks System are those features contributing to the landscape in Brooklyn, Queens, and Nassau counties. When constructed, most of the conduits, reservoirs, and pumping stations of this system were situated in an open, rural landscape typical of the nineteenth-century hinterland of Manhattan. Subsequent expansion of the New York metropolitan area resulted in intensified land use in the immediate proximity of the Ridgewood System.

In Brooklyn and Queens, the city incorporated the waterworks sites and eventually took many of them over once the waterwork was abandoned. Residential and, to a lesser degree, commercial development came to occupy the watersheds of the entire system. In some cases, particularly in Nassau County after World War II, residential construction bordered the very edges of reservoirs, pumping stations, and conduit rights-of-way. The conduit rights-of-way, most notably the right-of-way of the original Ridgewood Aqueduct from East New York in Kings County to Hempstead in Nassau County, established important routes through southern Long Island along which came to be located highways, railroads, and other linear utility lines crucial to the infrastructure of one of the world's largest metropolitan areas.

The following discussion details some of the surviving landscape elements of the Ridgewood System which, in part, helped determine subsequent land use patterns in southern Long Island. Many of these same elements, although part of an abandoned waterworks system, still influence development patterns in their region, as exemplified by the most recent Nassau Expressway project. Discussion of these landscape features will begin from west to east, following the waterworks from its distribution system in Brooklyn to its supply system in Queens and Nassau counties.

In Brooklyn the distribution system consisted of cast-iron water mains buried within street rights-of-way and the pump engine houses and distribution reservoirs at Ridgewood and Mount Prospect. As surviving landscape features, only the sites of the two distribution reservoirs are of interest, as is the former right-of-way of a series of force mains connecting the Ridgewood Pumping Stations to the Ridgewood Aqueduct.

To provide adequate service and water pressure to the higher elevated sections of Brooklyn, a pump station, reservoir, and high water tower were established at Mount Prospect immediately southeast of the present Grand Army Plaza (see Figure 2). These features were built as part of the original waterworks c. 1856-62. Upon the abandonment of the system, and given the intense demand for land in

Brooklyn, the Mount Prospect features were demolished. However, the reservoir site has been incorporated into the Brooklyn Botanical Gardens and has therefore contributed to the preservation of a significant piece of open space. Indeed, it might be argued that the location of the Mount Prospect Reservoir on the hilly spine of the glacial moraine cutting diagonally through Brooklyn initiated a prevailing use of that terrain as open or green space through subsequent development of Prospect Park, Greenwood Cemetery, and the Brooklyn Botanical Gardens, which together constitute a significant portion of Brooklyn's park land.

Similarly, another important area of green space within Kings and Queens counties lies along the same peak of glacial moraine to the northwest, on which the Ridgewood Reservoir was the first significant development. With the first two basins built soon after 1856 and the third basin built c. 1899, the reservoir has since become surrounded by a series of cemeteries which today provide a prominent strip of green space overlooking the surrounding intense gridiron development of Brooklyn and Queens (see Figure 2). Because use of the Ridgewood Reservoir as part of Brooklyn's contemporary waterworks distribution system continues, this district should remain in its present use indefinitely. Today, the reservoir is the centerpiece of Highland Park in Queens. This park includes walkways around the reservoir, most of which are poorly maintained. Although most likely unsafe at night, these paths offer splendid views of the surrounding city during the day.

Associated with the Ridgewood Reservoir was a series of force tubes or water mains through which water was pumped by the engines of the Ridgewood Pumping Stations from the aqueduct up and against the approximate 164-foot head separating the pump well at the Ridgewood Station from the reservoir. Although the pump stations are gone, and, therefore, the four 36-inch cast-iron force mains do not function, these mains no doubt still exist buried beneath Force Tubes Avenue. This uniquely named street was defined by the right-of-way of the buried force tubes prior to the introduction of the predominant gridiron pattern of streets in this East New York neighborhood of Brooklyn. Therefore, Force Tubes Avenue runs at an unusual diagonal across the gridiron. Subsequent building construction was also modified to fit the unusual triangular lots created by this diagonal right-of-way (see Figures 2, 39 and 40).

Although the nearby sites of the Old and New Ridgewood Pumping Stations on opposite sides of Atlantic Avenue near the head of Conduit Avenue exist only as empty lots awaiting some proposal for contemporary urban construction, pieces of one interesting feature still survive around the site of the Old Ridgewood Pumping Station on the north side of Atlantic Avenue (see Figure 2): several decorative cast-iron posts for the fence known to have surrounded the pump station property as built c. 1856-62 (see Figure 41).

FIGURE 39. View northwestward at the Force Tubes Avenue right-of-way, looking from the site of the old Ridgewood Pumping Station toward Fulton Street and the Ridgewood Reservoir (Tony Masso, photographer, 1985).

FIGURE 40. View northwestward from Fulton Street at the right-of-way of Force Tubes Avenue (Tony Masso, photographer, 1985).

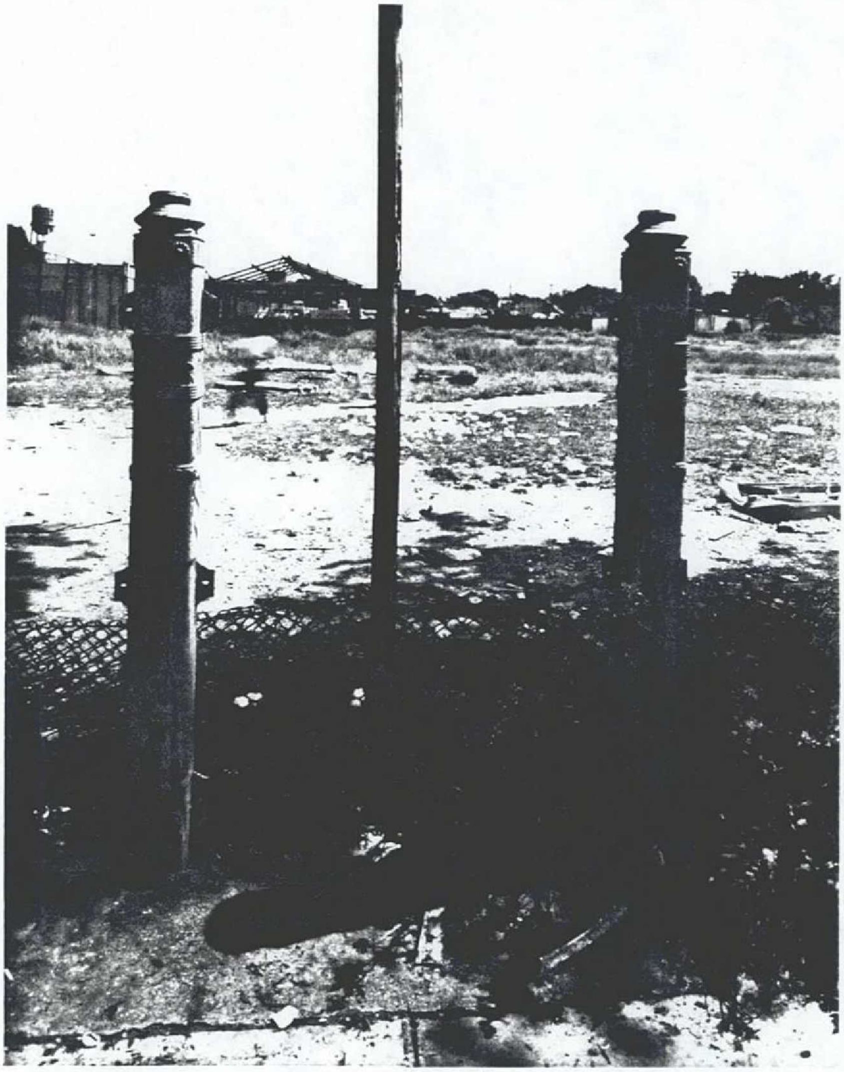


FIGURE 41. Fence posts surrounding old Ridgewood Pumping Station site (Tony Masso, photographer, 1985).

The remaining landscape features associated with and identifying the Ridgewood System consist of the important utility and thoroughfare corridor from East New York to Massapequa, which was established by placement of the Ridgewood Aqueduct east to Hempstead and its later extension further east to Massapequa. Also surviving in close proximity or connected to this approximately 25-mile-long corridor are many of the collection reservoirs which serve as focal points for state, county, or local parks (see Figure 2).

The presence of waterworks conduits within this corridor is not readily apparent. However, occasional cut-granite sheet metal, and cast-iron manhole covers mark the presence of the original aqueduct and the associated parallel pipelines built as part of the Ridgewood System (see Appendix). These manholes, like the Jamaica Creek or 150th Street Gatehouse, survive within a grassy strip paralleling North and South Conduit avenues, the Southern Parkway, Sunrise Highway, and Peninsula Boulevard (see Figure 2). The presence of the new conduit from Millburn east to Massepequa is apparent only as an undeveloped, narrow right-of-way immediately north of the Long Island Railroad. Occasional cast-iron manhole covers also survive along this corridor.

Like Force Tubes Avenue, certain place names still identify the importance of the Ridgewood System as a feature in the landscape. Perhaps the most readily identifiable of these names are Aqueduct Racetrack and nearby Aqueduct Station on the subway to Far Rockaway, both of which are located immediately north of the Ridgewood Aqueduct in Queens (see Figure 2).

North and South Conduit avenues were built in the nineteenth century parallel to the original Ridgewood Aqueduct from Atlantic Avenue eastward nearly to the Nassau County line. These were the first utilities to use the corridor established by the aqueduct and added collection conduits of the Ridgewood System. Other transportation routes now occupying this original waterworks corridor include the Southern Parkway, Sunrise Highway (Route 27), sections of the Long Island Railroad, and, of course, a section of the proposed Nassau Expressway. The existence of these routes as well as the various active utilities lines (including the 72-inch diameter steel pipeline, built south of and parallel to the brick aqueduct, which is the most recent conduit of the Ridgewood System and now conveys upstate New York water) will continue to remind us that this corridor once existed to feed the expanding thirst of Brooklyn.

Like the distribution ponds of the system, nearly all the collection ponds or their sites have survived as parkland or related green spaces. From west to east, Baiseleys Pond, Springfield Pond, Smith Pond, South (Hempstead) Pond, Hempstead Lake (Hempstead Storage Reservoir), Millburn Pond, East Meadow Pond, Newbridge Pond, Wantagh Pond, and Massapequa Pond exist today either within green space settings or as official public parks, focused around the ponds and their associated drainages (see Figures 2, 42-45). Similarly, the sites of the former Simonson's Pond, Valley Stream Pond, and Pine's Pond exist as part of local open spaces. Sites of Valley Stream and Pine's ponds, as well as a filled-in portion of Millburn Pond, are also locations of local high schools and their athletic fields. Only Clear Stream Pond and the Millburn Reservoir have disappeared altogether as a result of urban development.

The surviving landscape features of the Ridgewood System, in combination with the disconnected architectural and archeological features of the system, could provide a unique opportunity for public interpretation of the history of this system and of Long Island, which continues to struggle with issue of public water supply.

C. Archeological Elements

1. Sampling Strategy

The remainder of the Ridgewood System survives as a series of buried or archeological features found throughout the drainage basin of the waterworks. These features included aqueducts and pipelines as well as remains of demolished structures, such as engine houses, pump stations, and gatehouses.

Construction associated with the Nassau Expressway project will impact some of these features, along or near

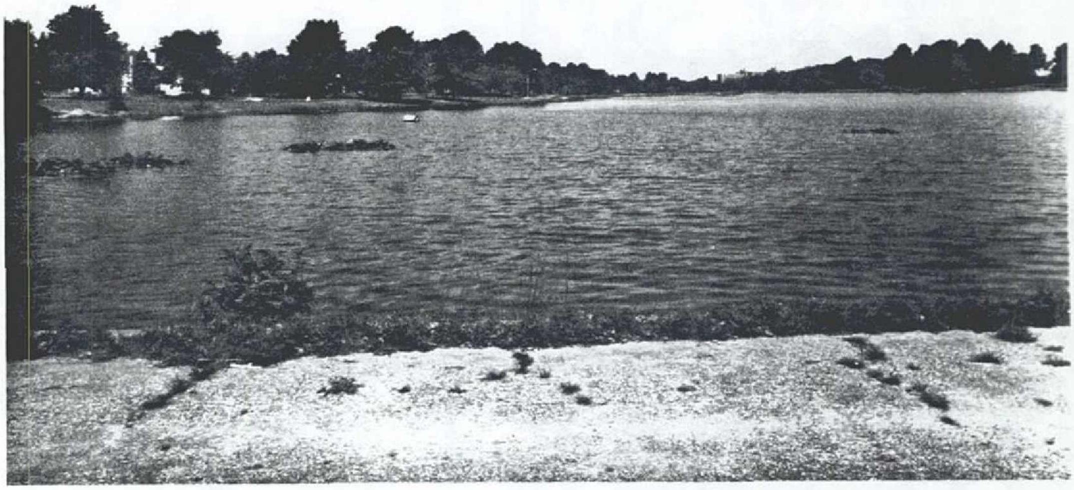


FIGURE 42. View northward at Baiseley's Pond and park from the dam (Tony Masso, photographer, 1985).

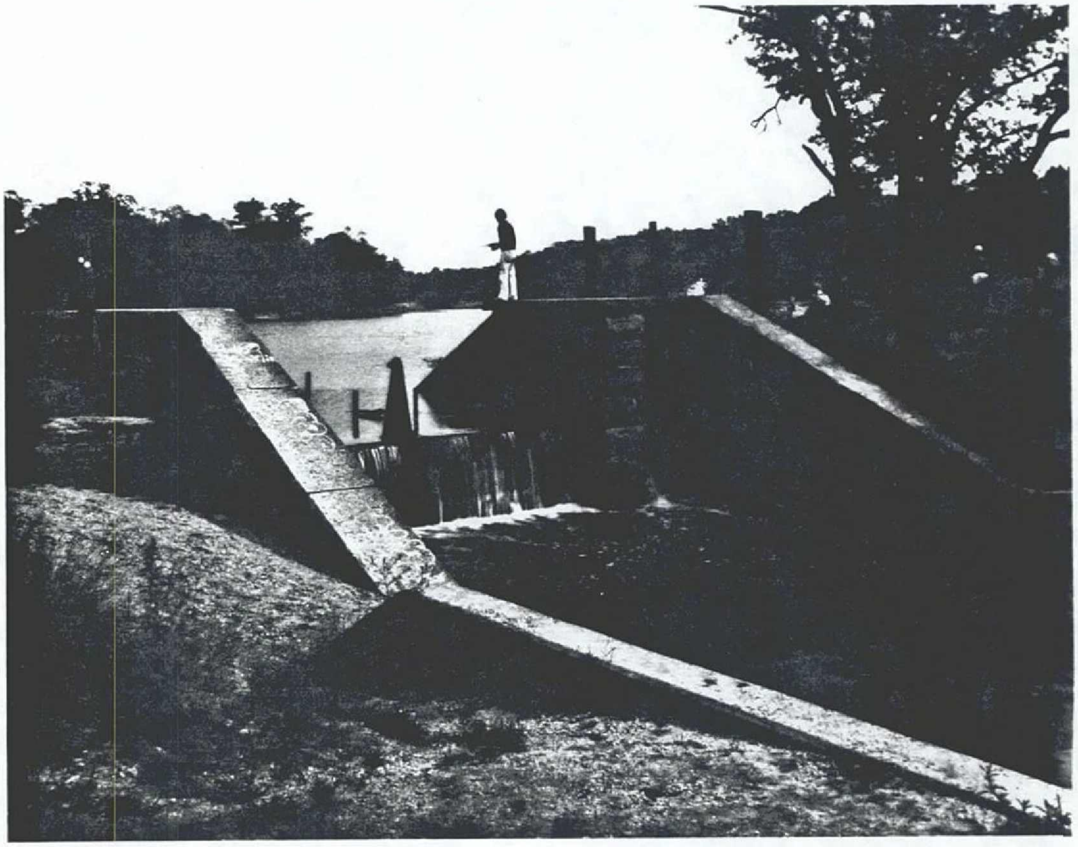


FIGURE 43. Outfall, dam, pond, and park at Massapequa Pond (Tony Masso, photographer, 1985).

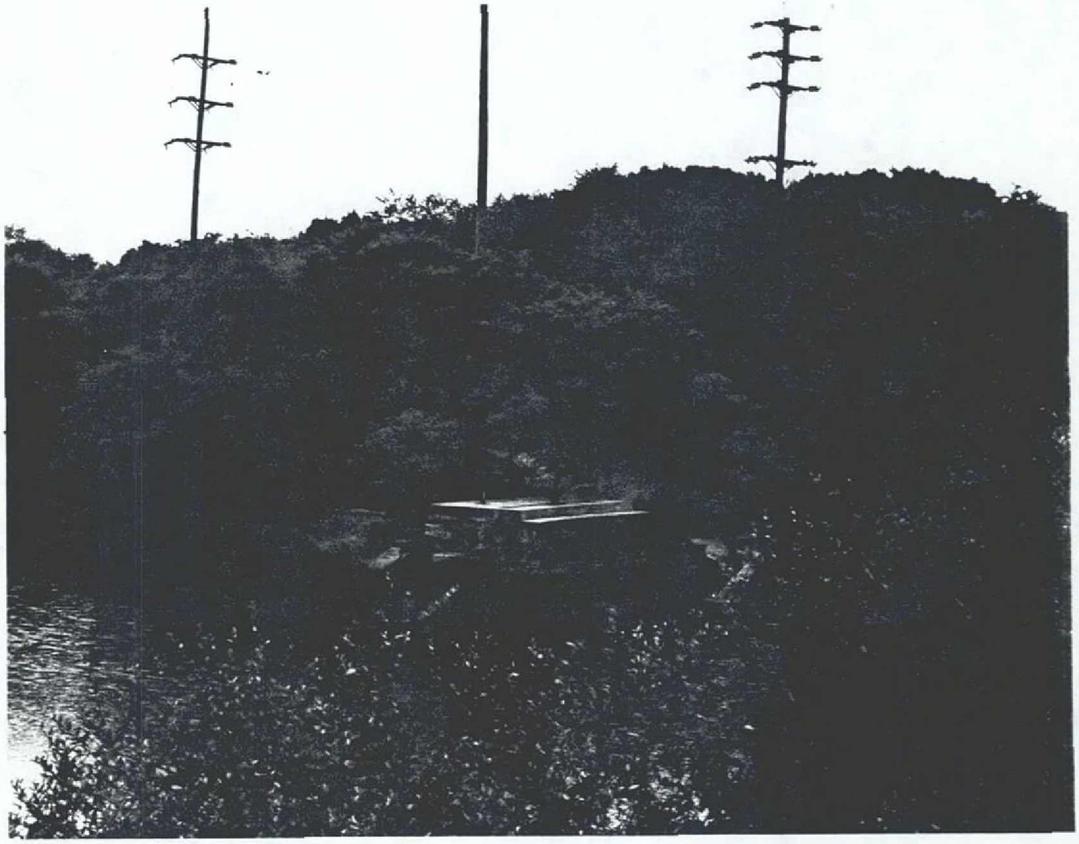


FIGURE 44. View southeastward from Meadowbrook State Parkway at pond, gatehouse site, and aqueduct right-of-way at East Meadow Pond (Tony Masso, photographer, 1985).

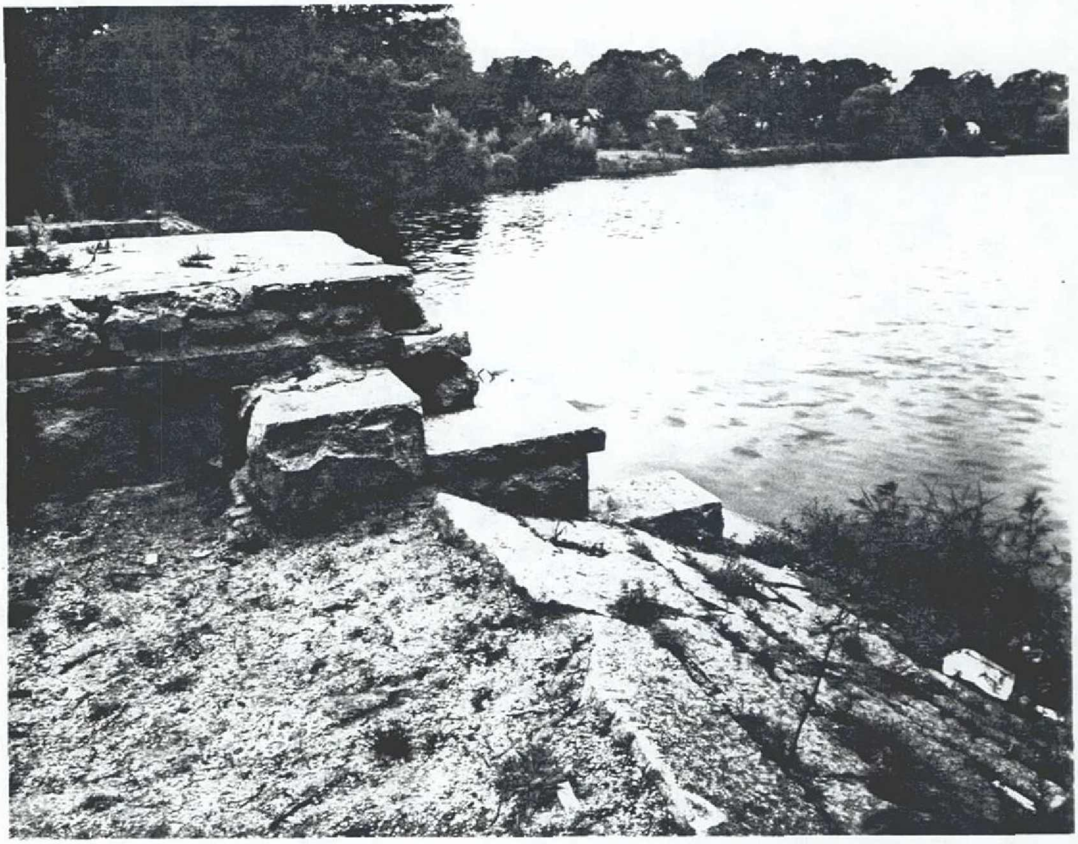


FIGURE 45. Dam and pond pavement surrounding Newbridge Pond (Tony Masso, photographer, 1985).

Southern Parkway between Cross Bay and New York boulevards. The main features that will be impacted are the underground masonry aqueduct built c. 1856 and the pair of parallel 48-inch cast-iron pipelines built as part of the expansion of the waterworks c. 1889. Also within this aqueduct/pipeline right-of-way is a series of cut stone-covered manholes and several masonry culverts which direct natural drainage past the aqueduct.

Inasmuch as documents reporting as-built conditions exist for all these features, HCI archeologists excavated only a small sample. Subsurface testing was necessary to confirm the accuracy of available as-built drawings and descriptions of the waterworks, but it was also designed to test for the existence of possible undocumented features, such as builders' trenches or modifications and repairs to the waterworks.

The testing strategy consisted of targeting an initial location for machine trenching across the aqueduct. The intent was that if the initial trench identified archeological features of interest, then additional testing could be made in other areas having archeological potential. Location of the initial trench was designed to provide a sample within an area not only of high potential for archeological remains but also where damage to landscape plantings, utility lines, and roadways could be minimized. Safety around the excavation activity within this busy highway corridor was also an important factor.

This testing strategy was also appropriate given an evaluation that one area within the aqueduct corridor was of particular archeological interest. Previous fieldwork had identified a cluster of several waterworks features, including the standing 1924 Jamaica Creek Gatehouse, southwest of North Conduit Avenue at Baiseley Boulevard.

2. Field Report

On August 28 and 29, 1985, HCI archeologists made a test excavation in the form of a trench located some 76 feet north of the northwest corner of the Jamaica Creek Gatehouse (see Figures 2, 46 and 47). The locale for this test was chosen because it was within the impact zone of the proposed road construction project and well away from the working sewerage facilities located just south of the pump house. The precise spot was chosen to avoid trees and shrubbery. The archeologists made the test with a Case Extenda Backhoe mounted on rubber tires and operated by R.P. Densen Contractors, Inc. of Little Ferry, New Jersey.

The results of this excavation revealed a cross section of the buried conduit that can be seen in Figure 48. The structure's arched brick cover was some 3 feet 2 inches below the present surface. This surface contained little topsoil and was underlaid by a clean, tan, very dry and unstable sand. Just above the structure, however, a stratum ranging from 2 to 6 inches thick, and consisting of brown sand containing humus, indicated a former surface stratum,

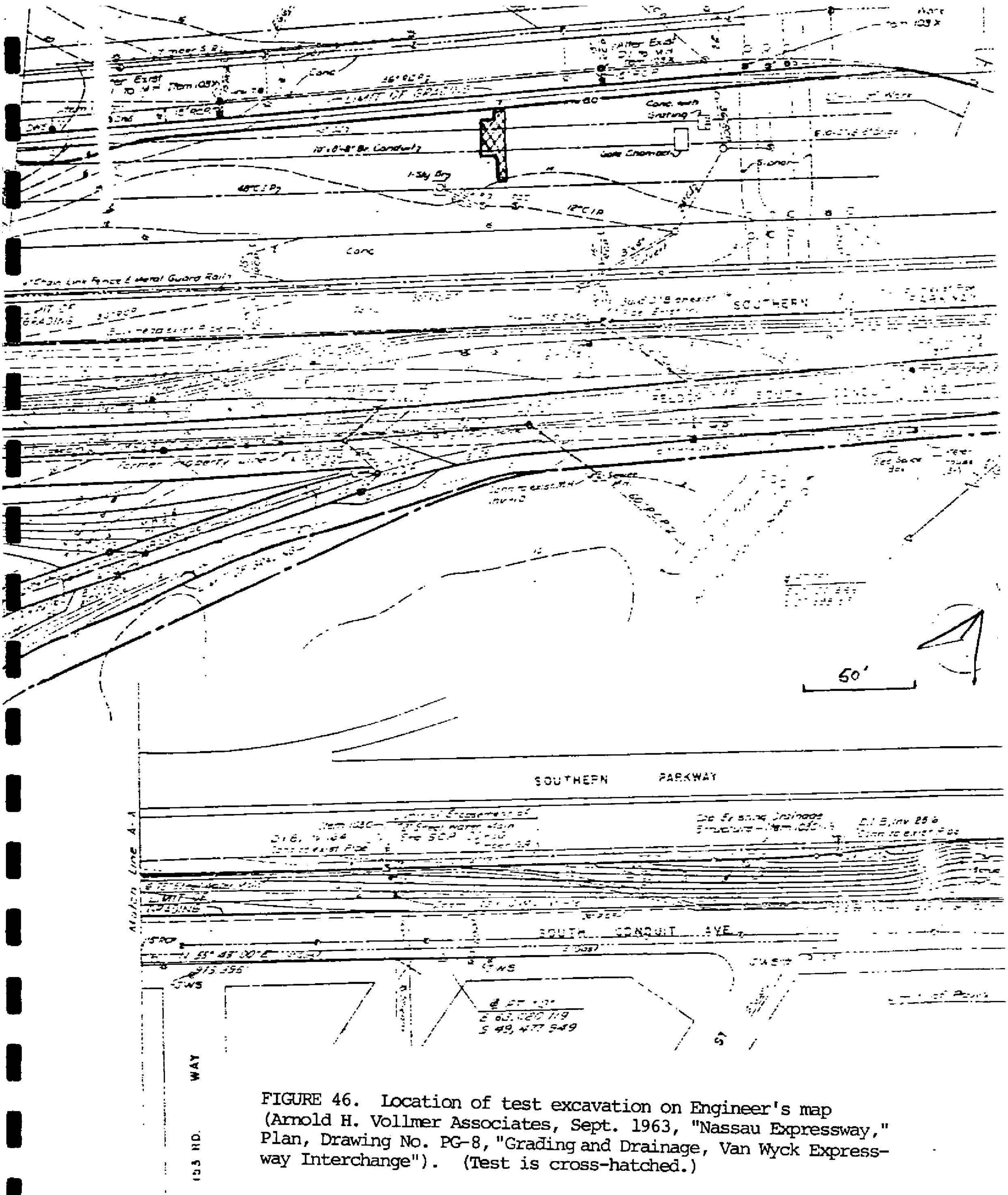
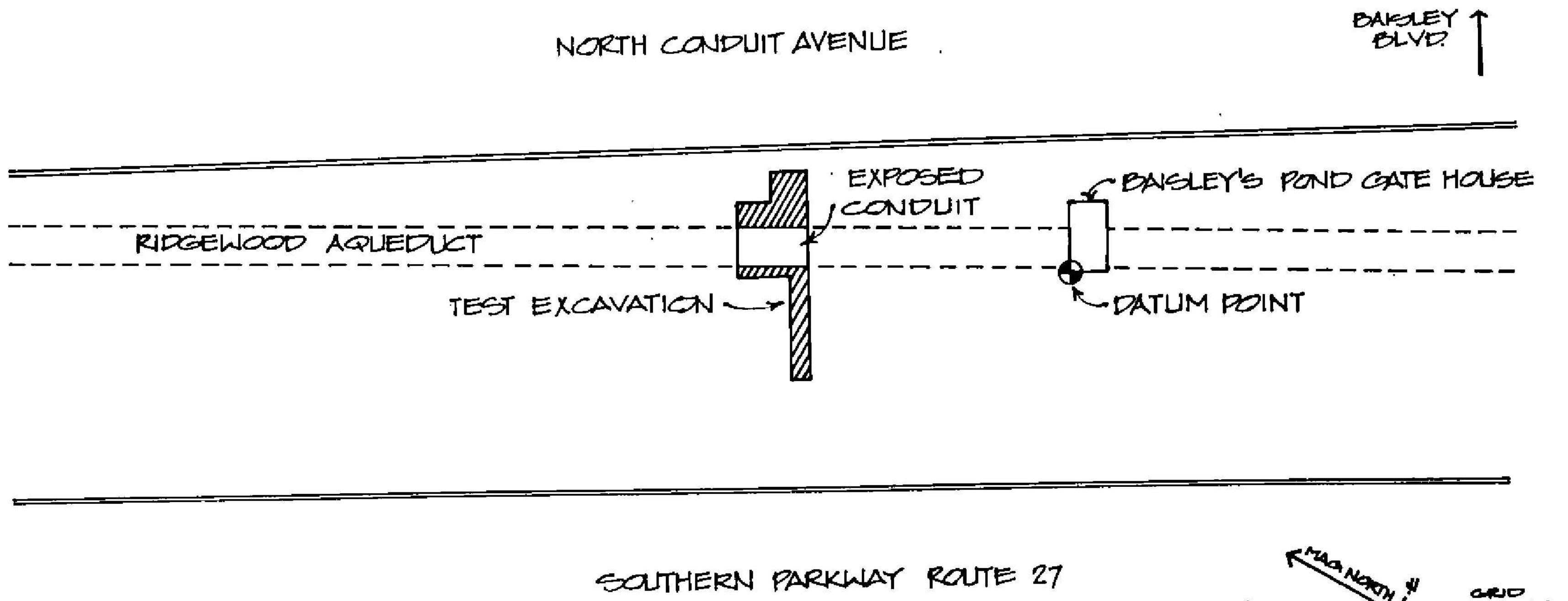


FIGURE 46. Location of test excavation on Engineer's map (Arnold H. Vollmer Associates, Sept. 1963, "Nassau Expressway," Plan, Drawing No. PG-8, "Grading and Drainage, Van Wyck Expressway Interchange"). (Test is cross-hatched.)



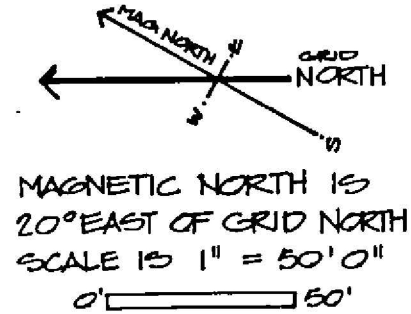


FIGURE 47. Location of test trench excavated Aug. 27-28, 1985.

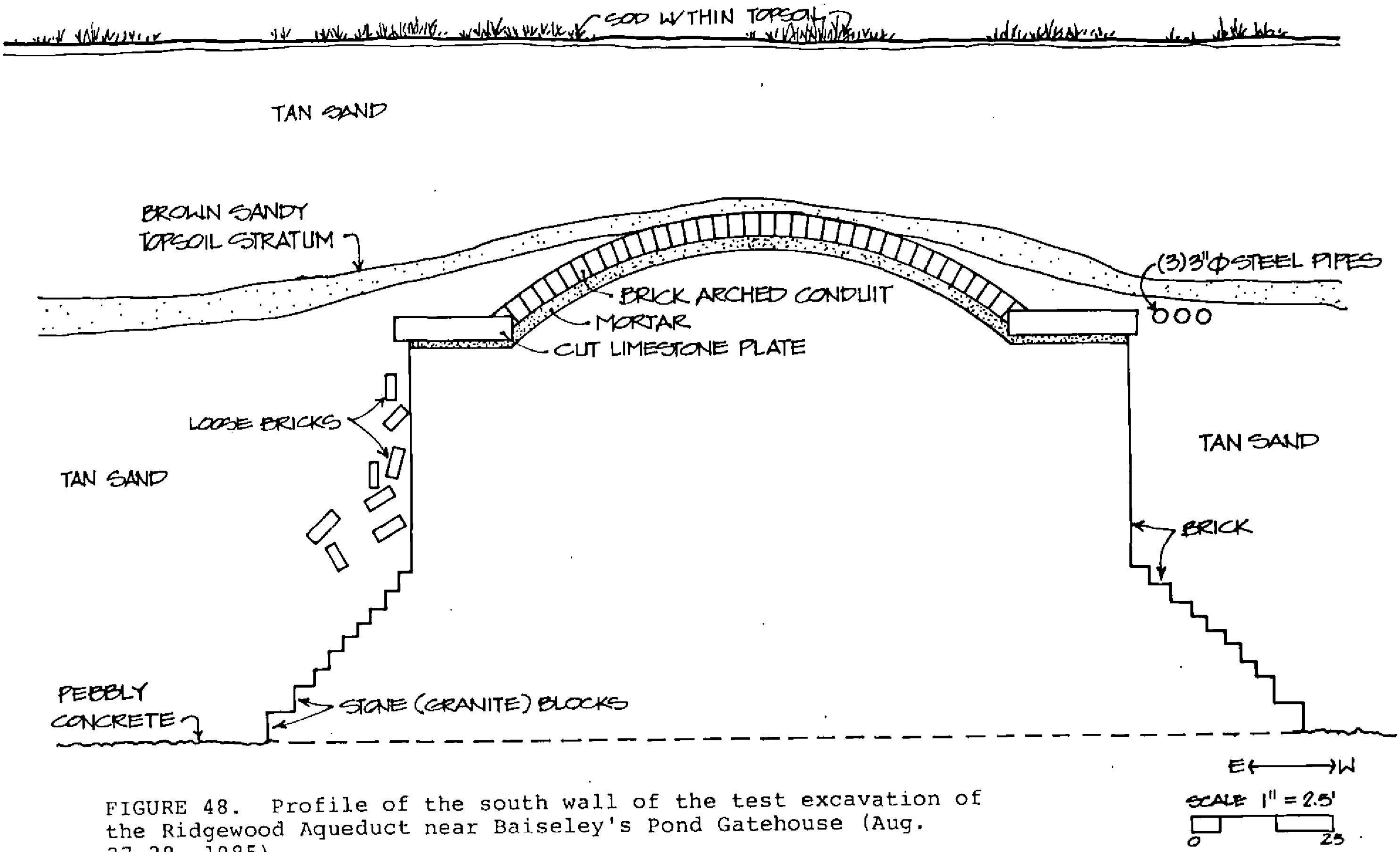


FIGURE 48. Profile of the south wall of the test excavation of the Ridgewood Aqueduct near Baiseley's Pond Gatehouse (Aug. 27-28, 1985).

probably established just after 1862 aqueduct construction and before more fill was placed over the area during construction of the adjacent southern parkway.

The excavation crossed the entire top of the aqueduct and extended down its eastern side. The structure's base was reached 12 feet 6 inches from the surface, where a rough, stony concrete footing extended out from under the entire aqueduct. The conduit above this concrete layer consisted of 2 courses of quarried granite foundation blocks, each 8 inches high, with the second course of stone blocks set back 6 inches to form a step. Above the stone course were found 7 courses of common red brick, with each course stepped back some 3 inches. Above these courses, the wall of the conduit, built of the same brick, were vertical for 4 feet. Here the bricks ended and a cut limestone plate was found capping the wall of the structure below a brick arch. This plate was 4 inches thick and 2 feet wide. With widening of the trench, the plate was found to be part of a single row of plates. A similar row of plates caps the opposite vertical wall of the aqueduct. Lengths of individual wall plates found in this excavation varied between 4 feet and 5 feet 4 inches long. Removal of one of these plates revealed that it was bedded in a layer of fine white sand approximately 1 to 2 inches thick.

The brick arch covering the top of the conduit stretched 10 feet to the plate on the other wall. Between the arched bricks and the limestone wall plate, a mortared joint had been laid to provide a smooth tight surface that would prevent draining groundwater from entering the joint. In excavating across the feature to its western side, the archeologists discovered that each side was identical in shape, dimension, and material of construction.

The sand alongside the conduit was identical to the sand above the structure, except that just adjacent to the wall a scatter of loose bricks identical to the ones used in the conduit was found. These bricks were thoroughly fired, unmarked common red brick measuring 8 inches long, 3.5 inches wide, and 2 inches high. A few of those found had a lime mortar clinging to them. No other cultural debris was encountered in the test, and no builder's trench was discernible. Along the west side limestone wall cover were unearthed three, 3-inch diameter steel pipes that lay parallel to each other approximately 3 inches apart.

The test trench was extended approximately 25 feet to the east and 38 feet to the west, as measured from the center of the brick arched aqueduct structure, in a search for the parallel cast-iron water mains which had been added to the brick conduit. Documentation had indicated that these water mains should have been located approximately 20 feet away from the structure. The effort was unsuccessful, inasmuch as the extremely dry sand continually collapsed into the excavation and it was deemed foolhardy to undermine or otherwise threaten either the Southern Parkway or North Conduit Avenue. These dangerous soil conditions presented a safety concern for both personnel and equipment. The dilemma was solved by excavating wide, sloping walls for the test trench. The base line was an exception, where a vertical excavation was necessary to obtain the soil profile found in Figure 48. Safety considerations mandated a prompt backfilling of the excavation as soon as it was recorded. Although these conditions prohibited photographing the entire structure, the drawings (see Figure 48) both document the physical remains and answer the research questions.

At this point, the conduit was at the beginning of its final reach, within the last intake point at Baiseley's Pond before it was pumped up to its reservoirs and delivery system. In cross section, it is identical to one which is illustrated in the documentary record, (see Figures 6 and 7).

V. SUMMARY

Infield research was divided into a study of visible (above-ground) remains of the Ridgewood Aqueduct System and a single excavation which exposed a section of the structure's buried exterior. Further field work is proposed as mitigation and will be carried out as part of the excavations made during construction of the proposed highway. This work will consist of recording and photographing exposed elements of the aqueduct system while construction proceeds.

Visible remains of the aqueduct included very prominent landscape features, such as the lakes or ponds created to gather the water which the aqueduct carried to Brooklyn. These ponds lie remarkably untouched and are becoming increasingly valuable as recreation areas.

At the outlets of the ponds, and at the locations where water was taken into the system, a variety of architectural features survive, including several intact buildings and identifiable building sites, such as foundations, etc. In addition, remains of pump houses, well fields, and equipment were located, recorded, and identified in the course of the survey work. Several periods of construction and modification were discernible.

These phenomena were photographed to Historic American Engineering Record (HAER) standards. Written analyses of these resources and contemporary graphics are also presented in this mitigative report.

The below-ground remains of the essentially buried aqueduct were exposed in an archeological cross section. This excavation has made it obvious that the structure was previously engineered, built, and documented.

Work was carried out for the Jamaica Creek Gatehouse, which will be moved as part of the road construction (see Appendix A). Other work still to be performed includes observations and photographs to be taken during the construction phase.

Although only the specific impacts to the historic aqueduct now being contemplated during the current highway planning are being mitigated in this work, a framework is provided for recognizing aspects of the historic structures that may be affected when additional or future planning is undertaken. At such time, the NYDOT can use HCI's baseline historical and locational survey study on the results of all infield work to determine what will be needed to comply with cultural resource requirements. From this evaluation, the department can seek the concurrences of the FHWA and the SHPO, as well as such local agencies as may be concerned. Should additional summary procedures be found necessary to determine what resources are present, to evaluate their significance as cultural resources, and to ascertain the exact nature of the proposed impact to them, they can be employed.

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A. APPENDIX A: MATERIAL AND DOCUMENTS PERTAINING TO COMPLIANCE

A-I. NASSAU EXPRESSWAY CONSTRUCTION STAGES

The FEIS and Case Report identified that Alternates A-II and B-II would require demolition and/or removal of substantial lengths (12,500 feet) of the Ridgewood Aqueduct system in the Southern Parkway/Conduit Avenue corridor between Cross Bay and New York Boulevards in Queens County.

The State's highway program anticipates construction of the Nassau Expressway in stages over a long period of time because of funding limitations. Presently, five contracts are under final design or into construction in the Section 'B' area while one contract is progressing in Section 'A'. Of these six contracts, only the third construction contract in Section 'B' affects the Ridgewood Aqueduct.

A-II. SECTION 'B' - STAGE III CONSTRUCTION CONTRACT

This contract consists of the construction of new connections between the Southern Parkway and a new airport access at 150th Street. The following items of the Ridgewood Aqueduct system are affected:

- 4,200 feet of Aqueduct and twin 48 inch cast iron mains between 150th Street and New York Boulevard will be demolished and/or removed.

- The Jamaica Creek Gate House will be moved to a new permanent location to enable construction of bridge and drainage structures. Construction will result in the removal of the exisitng Gate House foundation and related below ground features including the Aqueduct. The Gate House will be placed on a new foundation and left in a stable condition at its new site which will be approximately 250 feet west of its existing location along the Ridgewood Aqueduct alignment. A plaque will be attached to the Gatehouse stating that it has been moved from its original location.

- Several access manholes will be demolished as will several cross culverts and a gate chamber housing a stopcock and 20-inch blowoff for one of the two 48-inch water mains.

A-III. PRESERVATION AND STABILIZATION OF THE JAMAICA CREEK GATE HOUSE

See Attached:

"Outline of Procedures to be Used
in Moving the Jamaica Creek Gate House"

Historic Conservation and Interpretation, inc.
Box 111, RD 3, Newton, New Jersey 07860

OUTLINE OF PROCEDURES TO BE USED IN MOVING
THE JAMAICA CREEK GATE HOUSE

"Moving a historic building is sometimes the only way to save it from demolition" (Curtis 1979: v). In the case of the Ridgewood Aqueduct's Jamaica Creek Gatehouse, the movement of the structure will result in a number of preservation benefits as well as surmounting the problem of rebuilding substantial public utilities under the structure's present foundation. The gatehouse today is a sturdy but decaying masonry building. In the course of the contemplated action, the building's deteriorated fabric will be stabilized. After the gatehouse has been moved 35 feet west on the historic aqueduct and has been put on its new foundation, its now broken windows and door will be secured against vandalism. (Note: Other construction impacts to this historic structure are being mitigated according to a Memorandum of Agreement between NYDOT and the NYDHP.)

The following procedures are outlined in the plan formulated by Vollmer Associates with HCI for moving the gatehouse.

The gatehouse will be moved intact. "The relocation of a building as a single intact unit is generally the most desirable method" (Curtis 1979: 19). Inasmuch as the building is a fairly small masonry structure, moving it intact is possible. Prior to moving, however, a very necessary and useful stabilization process will be undertaken. The roof timbers of the structure will be braced, as needed. Roof boards will be replaced after old roofing material has been removed, and a secure waterproofing will be installed. The present roof shows signs of several leaks, which our inspections have shown have not yet done extensive damage to the roof framing. This stable roof is an essential element to the logical preservation process on this structure.

At the same time that the roof is repaired, loose bricks on the cornices and elsewhere in the building's fabric will be noted, and procedures will be employed to save them from further deterioration.

Regarding documentation, the original 1860 +/- Jamaica Creek Gatehouse was replaced by a new (the present) structure in the 1920's. The gatehouse was a facility on the historic Ridgewood Aqueduct that allowed the aqueduct to

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be drained into Jamaica Creek, which flowed beneath the aqueduct at about a right angle.

Archeological testing was carried out by HCI around the gatehouse in August of 1985. The structure was then documented with the collection of original measured drawings of its construction and via photographs of its present form to HAER standards. Portions of the below-ground fabric of the aqueduct to be removed in the proposed construction have been mitigated, in part, by this work.

A building-moving contractor will be employed to undertake the proposed project. The firm will be responsible for the building's pre-move stabilization, its movement to and its placement on a secure foundation, and its final stabilization and securing.

Edward S. Rutsch
Primary Investigator

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A-IV. PERTINENT CORRESPONDENCE (from FEIS)

10/20/78	Federal notification of the site's eligibility from the Keeper of the Register.
12/04/80	HCI proposal for a final mitigation study and Report on the Ridgewood Aqueduct - (P VI - 93 & 94 in the FEIS).
3/27/81	Advisory Council on Historic Preservation letter transmitting "Memorandum of Agreement" - (P VI 95 & 96 in the FEIS)
9/11/80	Letter from HAER, USDOI - (P VI 92 in the FEIS).

United States Department of the Interior

HERITAGE CONSERVATION AND RECREATION SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
H32-NR

Mr. Victor E. Taylor
Division Administrator
Federal Highway Administration
Leo W. O'Brien Federal Building
Clinton Avenue and North Pearl Street
Albany, New York 12207

OCT 20 1978

Dear Mr. Taylor:

Thank you for your letter requesting a determination of eligibility for inclusion in the National Register pursuant to Executive Order 11593 or the National Historic Preservation Act of 1966, as amended. Our determination appears on the enclosed material.

As you understand, your request for our professional judgment constitutes a part of the Federal planning process. We urge that this information be integrated into the National Environmental Policy Act analysis in order to bring about the best possible program decisions. This determination does not serve in any manner as a veto to uses of property, with or without Federal participation or assistance. Any decision on the property in question and the responsibility for program planning concerning such properties lie with the agency or block grant recipient after the Advisory Council on Historic Preservation has had an opportunity to comment.

We are pleased to be of assistance in the consideration of historic resources in the planning process.

Sincerely yours,

William J. Murtagh

William J. Murtagh
Keeper of the National Register

Enclosure

Historic Conservation and Interpretation, Inc.
Box 111, RD 3, Newton, New Jersey 07860

November 4, 1980

Mr. Karl L. Rubenacker
Vollmer Associates, Inc.
62 Fifth Avenue
New York, NY 10011

RE: PROPOSAL FOR A FINAL MITIGATION STUDY AND REPORT ON THE RIDGEWOOD AQUEDUCT, NASSAU EXPRESSWAY QUEENS AND NASSAU COUNTIES, NEW YORK

Dear Karl:

Enclosed is our proposal for the above-referenced project, which can form the basis of a Memorandum of Agreement concerning the mitigation of the negative impact to the remains of the historic Ridgewood Aqueduct.

If you have any questions, please call me.

Yours truly,

EL

Edward S. Rutsch, S.O.P.A.
President

ESR:js

enc: 1

Telephone (201)383-6355

A-10

Historic Conservation and Interpretation, Inc.
Box 111, RD 3, Newton, New Jersey 07860

PROPOSAL FOR A FINAL MITIGATION STUDY AND REPORT ON
THE RIDGEWOOD AQUEDUCT, NASSAU EXPRESSWAY
QUEENS AND NASSAU COUNTIES, NEW YORK

I. STUDY AREA

The study area for the project is Sections A and B of the Nassau Expressway in Queens (New York City) and Nassau Counties, New York, as shown on the three maps attached to the report entitled Impact of Nassau Expressway Alternatives on the Ridgewood Aqueduct, each dated June 20, 1978.

II. TASKS

A. Documentary Research

Documentary research will consist of library and archival research as needed to collect information concerning specific sites and features of the aqueduct system.

B. Infield Research and Recording

An infield reconnaissance will be conducted on the remains of the Ridgewood Aqueduct water system. The field work will consist in a short period of examination of the remains of the system as it is now. Above-ground features of the Ridgewood system will be measured, photographed, and described according to guidelines established for such examination by the National Architectural and Engineering Record (NAER). No measured drawings will be made where as-built plans are available. Similar examination will be conducted on below-ground features of the system where features are accessible. This examination will generally involve removal of existing stone and metal manholes to facilitate access to below-ground features.

Features to be examined have been identified through preliminary investigations. Waterworks features identified as within or adjacent to the study area of Nassau Expressway are, from west to east:

1. Aqueduct right-of-way itself. Photo-document this ROW between existing roadways.

2. Manhole, cast and raised by brick, about 400 feet east of Cross Bay Boulevard adjacent to entrance ramp to west North Conduit Avenue.

3. Culvert C. No surface evidence, but archeological potential.

Telephone (201)383-6355

4. Aqueduct Station. Former site of wells and pump station, now partially filled abandoned lot north of North Conduit Avenue at Huron Street. No surface evidence.

5. Culvert D. No surface evidence south of Huron Street.

6. Manhole, granite with iron rings on top, 300 feet east of Culvert D.

7. Manhole, south of existing Aqueduct Race Track.

8. Culvert E. No surface evidence.

9. Woodhaven Gatehouse and Culvert F. Gatehouse has been demolished; culvert is probable archeological feature. Several cast manholes nearby within level playground.

10. Manhole, between 120th and 121st streets over conduit. No surface evidence.

11. Schetucket Station. No surface evidence of this former well and pump station site. Now ball fields south of South Conduit Avenue.

12. Culvert G. No surface evidence, but archeological potential.

13. Manhole, cast, within exit ramp of Belt Parkway near 123rd and 124th streets.

14. Manhole, cast, south of 128th Street.

15. Culvert H. No surface evidence.

16. Manhole, sandstone with iron rings, south of 131st Street.

17. Oconee Station. Well and pump station site on undeveloped lot covered by fill north of North Conduit Avenue near 132nd Street. Two cast-iron manholes adjacent to street and marked "Water Supply" constitute the only possible surface evidence. Possibility of archeological remains.

18. Manhole, cast, with "D.W.S." on surface, 200 feet west of Van Wyck Expressway ramp.

19. Between Van Wyck Expressway and 149th Street conduit and associated features have been demolished.

20. Jameco Pump Station, branch conduit and junction chamber at 150th Street. All features but junction chamber are outside the study area. No surface evidence present.

21. Forty-eight-inch cast-iron main gate chamber (photographed in previous report), covered by sheet metal.

22. Jamaica Creek Gatehouse; intact, with manholes nearby.

23. Culvert J. No surface evidence. Adjacent to gatehouse but below ground. May have access through nearby cast manholes.

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24. Culvert K. No surface evidence. Manhole should be nearby but was not located.

25. Square, cut stone manhole over conduit south of 157th and 158th streets.

26. Square, cut stone manhole over conduit south of and about 200 feet east of Latham Lane.

27. St. Albans Station and Culvert L. No surface evidence of site near (immediately west of) New York Boulevard.

A portion of the reconnaissance will focus on a study of the remainder of the Ridgewood system outside the study area for the sake of comparison. Included are the Ridgewood reservoirs, the site of the demolished Ridgewood Pump Station, the former well station sites and storage reservoirs (see previous report), and rights-of-way of force tubes and branch conduits. This examination will record above-ground features or evidence of features through written description, scaled drawings, and photographs.

C. Analysis of Research Materials and Preparation of a Final Mitigative Report

All research materials from both documentary and infield research programs will be analyzed and summarized in a mitigative cultural resources report. It will document the descriptive features of the remains of the Ridgewood system and evaluate the integrity of the Ridgewood system today. The report will include a description of the infield methodology employed as well as the results of the infield reconnaissance. It will be appropriately illustrated and will contain a cultural resources base map showing the location of waterworks features examined during this study. The report will be submitted in three (3) copies, each with original photographs, for use by Vollmer Associates and by State and Federal reviewers. Archive-quality negatives and prints will be submitted to the Library of Congress according to HAER recording standards.

D. Monitoring of Construction Activities

Allowances should be made for monitoring by the consulting archeologist of construction activities that will destroy the Ridgewood Aqueduct. Some instruction should be given the contractor regarding cooperation between his excavators and the archeologist. These considerations need be no more than occasional pauses so that photographs can be taken. The exposed aqueduct or related waterworks features can then be recorded with only minor interruption of the contractor's work. It is understood that this work will proceed on a day-by-day basis depending on the contractor's schedule of activities that will destroy the aqueduct. A brief report documenting the results of this infield task in diary form will follow completion of the monitoring. The report will be submitted in three (3) copies, each with original photographs, for use by Vollmer Associates and by State and Federal reviewers.

Advisory
Council On
Historic
Preservation

1522 K Street, NW
Washington, DC 20005

MAR 27 1981

Mr. Victor E. Taylor
Division Administrator
New York Division Office
Leo O'Brien Federal Building
Clinton Avenue and W. Pearl Street
Albany, NY 12207

Dear Mr. Taylor:

Enclosed is the Memorandum of Agreement reflecting the agreement to mitigate the adverse effects of Nassau Expressway, Nassau and Queens Counties, New York, on the Ridgewood Aqueduct reached by the consulting parties.

Please sign and date this agreement and forward it to Orin Lehman, New York State Historic Preservation Officer, for his dated signature. Thereafter, it must be returned to the Council for ratification by the Chairman. The agreement will become final 30 days after receipt by the Chairman or earlier if ratified by the Chairman.

The ratified Memorandum of Agreement will constitute the Council's comments in accordance with Section 800.6(c)(3) and completes your responsibilities under Section 106 of the National Historic Preservation Act and the Council's regulations.

Thank you for your cooperation.

Sincerely,

Jordan E. Tannenbaum

Jordan E. Tannenbaum
Chief, Eastern Division of
Project Review

Enclosure

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US Department of Transportation
Federal Highway Administration

Memorandum

Subject: PIN 0031.00 et al - Nassau Expressway
Memorandum of Agreement
Nassau & Suffolk Counties

Date: May 4, 1981

From: Victor E. Taylor
Division Administrator
Albany, NY

Reply to Attn of: HA-NY

To: Director, Environmental Analysis Bureau
NY State Department of Transportation
Albany, NY

The Memorandum of Agreement for this project affecting the Ridgewood Aqueduct has been ratified by the Chairman of the Advisory Council on Historic Preservation. A copy of the Agreement is attached.

In accordance with Section 800.6(c)(2) and 800.9(e) of the Advisory Council Regulations, a copy of this Memorandum of Agreement should be included in the FEIS/Section 4(f) for this project.

Anthony J. Fusco

Anthony J. Fusco
District Engineer

Attachment

cc:
Director, Design Bureau - NYSDOT (w/Attachment)

Advisory Council On Historic Preservation

1522 K Street, NW
Washington, DC 20005

MEMORANDUM OF AGREEMENT

WHEREAS, the Federal Highway Administration (FHWA), Department of Transportation, proposes to assist the New York State Department of Transportation (NYDOT) in the construction of a 10 mile segment of the Nassau Expressway, Queens County, New York; and,

WHEREAS, FHWA, in consultation with the New York State Historic Preservation Officer (SHPO), has determined that this undertaking as proposed would have an adverse effect upon one section of the Ridgewood Aqueduct, Queens County, New York, a property included in the National Register of Historic Places; and,

WHEREAS, pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) and Section 800.4(d) of the regulations of the Advisory Council on Historic Preservation (Council), "Protection of Historic and Cultural Properties" (36 CFR Part 800), FHWA has requested the comments of the Council; and,

WHEREAS, pursuant to Section 800.6 of the Council's regulations, representatives of the Council, FHWA, and the New York SHPO have consulted and reviewed the undertaking to consider feasible and prudent alternatives to avoid or satisfactorily mitigate the adverse effect;

NOW, THEREFORE, it is mutually agreed that there are no measures to satisfactorily mitigates the adverse effects of the undertaking as proposed and, if the Secretary of the Department of Transportation determines pursuant to Section 4(f) of the Department of Transportation Act of 1966 that there are no feasible or prudent alternatives to avoid the taking, the undertaking will proceed in accordance with the following stipulations.

Stipulations

1. Prior to and during the partial demolition of the Ridgewood Aqueduct the FHWA will begin recording the property so that there will be a permanent record of its existence. FHWA will work with the National Architectural and Engineering Record (Heritage Conservation and Recreation Service, Department of the Interior, Philadelphia Regional Office and Washington, D.C.) to follow the recommendations of Mr. Donald Jackson, Acting Chief of the Historic American Engineering Record, contained in his letter dated September 11, 1980. The documentation prepared for the recordation will be submitted to NAER in a staged basis, and no demolition or new construction will take place until the documentation for that particular section has been completed and accepted by NAER.

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2. Notice of the partial demolition of the Ridgewood Aqueduct will be submitted to the Keeper of the National Register so that the listing of eligible properties can be updated by this change.

Robert Garvey March 26, 1981
Executive Director
Advisory Council on Historic Preservation

(date) 3-31-81
Federal Highway Administration

Ann Webster Smith (date) 4/1/8
New York State Historic Preservation Officer

Richard H. Jenrette (date) 4-23-81
Chairman
Advisory Council on Historic Preservation

United States Department of the Interior

HERITAGE CONSERVATION AND RECREATION SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO: W465

September 11, 1980

Mr. Victor E. Taylor
Division Administrator
New York Division, FHWA
Leo W. O'Brien Federal Building
Clinton Ave. and North Pearl St.
Albany, New York 12207

Dear Mr. Taylor:

Thank you for your recent letter to Mr. Robert Kapsch concerning documentation of the historic Ridgewood Aqueduct in Nassau and Queens Counties. We found the "Documentary Literature Search and Evaluative Report on the Ridgewood Aqueduct" prepared by Cultural Resource Management Services Inc. to be a well researched and readable report that provides an excellent overview of the aqueduct's history. If the level of quality set by this report can be maintained in preparing the final documentation of the aqueduct then I am certain that it will comprise an excellent addition to the HAER collection at the Library of Congress.

In general, we agree with the "conclusions and recommendations" set forth by CRMSI in their report and believe that final documentation of the aqueduct can be prepared in a timely manner. Those portions of the evaluative report that relate the history of the aqueduct will be sufficient for the HAER historical report if they are supplemented with a HAER title page. Given the large number of historic drawings that survive it does not appear that it will be necessary to prepare any new measured drawings, as large format photocopies of existing drawings can be made instead. However, this may need to be reconsidered if further field work indicates that the aqueduct as built differed significantly from the published plans. We concur with CRMSI that large format photographs of the aqueduct system should be taken as part of the mitigation plan and believe that some should be taken during the demolition process. We estimate that at least 25-30 contemporary photographs should be taken along with 12-15 photocopies.

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We have enclosed a copy of this office's draft standard for documenting historic engineering and industrial resources which includes both our photographic specifications and a sample historical report with a HAER title page. If you have any questions please call me at 202-343-4256.

Sincerely,

Donald C. Jackson

Donald C. Jackson
Acting Chief, Historic American
Engineering Record

Enclosure

Vollmer Associates
11 West 19th Street New York NY 10011
212 691 3800 Telex 12 7357

November 22, 1985

Mr. Joseph M. Yourno
Director, Design Bureau
N.Y. State Dept. of Transportation
State Campus, Bldg. 5, Room 308
1220 Washington Avenue
Albany, New York 12232

Attn: Mr. David Finkelstein
Senior Civil Engineer

Re: Nassau Expressway, Section B, Stage III
PIN 0735.16
Inverted Siphon Construction
Ridgewood Aqueduct Gate House

Dear Sir:

As requested, we are submitting for review, documents supporting the State DOT's contention that removal and restoration of the Ridgewood Aqueduct - Jamaica Creek Gate House during construction to remove the inverted-siphon is in keeping with the FEIS and Memorandum of Agreement with the Advisory Council on Historic Preservation. The enclosed information explains the need to move the Gate House, and shows that the original structure was previously demolished and replaced at a new location with a much more simplified system of drawing off water from the Aqueduct. The Supporting Documentation attached is as follows:

- 1" = 200' scale plans showing the sequencing of construction to maintain vehicular traffic and storm water flow while the inverted siphon is being removed and replaced.
- "Data sheets" from Ed Rutsch documenting original construction of the Jamaica Creek (Baiseleys Creek) Gate House and related system of drawing off water from the Aqueduct.
- Construction Plans (labeled Figures 'A' through 'T') of the inverted siphon showing the original and present-day Gate House and simplified system of drawing off water from the Aqueduct.

Need to Remove the Inverted Siphon

Reasons for removal of the inverted siphon are as follows:

- the siphon causes the total storm drainage system to be deficient.
- certain areas to the north and east flood. Removal of the siphon will reduce the chances of such flooding.

- the present chamber connection causes the 13' x 7' culvert in North Conduit Avenue to backup and creates a silt deposit problem in the chamber and culvert.

- maintenance is very difficult because of the location of access manholes and the need for constant removal of deposits.

Need for the Gate House Removal

The present day Gate House needs to be temporarily removed because of major conflicts with required construction operations as shown in the attached 1" = 200' scale construction sequence plans.

Removing the 60 foot wide existing siphon and replacing it with a new culvert at the same location at a higher invert elevation is quite complex. Construction will require diversion culverts to maintain a large percentage of the storm water runoff (2,300 cfs) and substantial roadway detours to maintain traffic operation for the 230,000 vehicles that use the parkway/conduit corridor each day. The storm water diversion and traffic detours compound the problems of construction which will require the removing/replacing of the siphon well below the existing water table.

Attempting to retain the gate house directly within the major construction zone is unworkable (sheeting installation, dewatering system, detour roads, sight lines, diversion, excavation, heavy construction equipment, etc.)

Alternates for replacing the 60' wide storm sewer away from the Gate House are not feasible because of physical (must meet the existing culvert to the north and south of construction) and economical ($43,000/foot) constraints. In addition, providing a much longer sewer routing, besides being much more costly, would continue to make the storm system hydraulically deficient.

The Original and Present Day Gate House

The original gate house was removed when the inverted siphon was constructed in the 1920's. The original system of sluice-gates and waste-weirs for drawing off water from the Aqeuduct was also destroyed as was the 18 foot wide arched culvert that carried Jamaica Creek beneath the Aqueduct and Gate House. A 140 foot segment of the Aqueduct was also removed and replaced with water flow being temporarily diverted by means of a 9 foot diameter wooden pipe.

The siphon construction resulted in installation of a new gate house located approximately 35 feet west of the original structure while the new simplified drain-off system consisted of a 36 inch diameter pipe connected to the siphon. The data sheets from Ed Rutsch document the original structure/system while the siphon plans (Figures 'A' through 'I') clearly depict impacts of siphon construction and the configuration of present day elements of the Ridgewood Aqueduct system and related Gate House.

We trust the information contained in this submission will assist the SHPO in concurring that the removal/replacement of the present day gate house by the siphon construction is in keeping with the intent of the FEIS and Memorandum of Agreement.

Very truly yours,

Karl L. Rubenacker

Karl L. Rubenacker, P.E.

KLR:nrr
Attachments
8494.01

cc: Mary Ivy
D. Currey/S. Murphy
E. Rutsch

U.S. Department of Transportation

Federal Highway Administration

Memorandum

Subject:	Ridgewood Aqueduct Gatehouse Relocation, PIN 0735.16, Nassau Exp. Section B -- Queens County	Date:	April 18, 1986
From:	Victor E. Taylor Division Administrator Albany, New York	Reply to Attn. of:	HA-NY
To:	Director, Environmental Analysis Bureau NYS Department of Transportation Albany, New York		

Attached is a copy of a proposed Memorandum of Agreement (MOA) and a reference booklet forwarded by the Advisory Council on Historic Preservation that relates to an upcoming Nassau Expressway construction contract. As you may know, this MOA was deemed necessary because of a New York City DOT request to temporarily relocate the historic Ridgewood Aqueduct (Jamaica Creek) gatehouse to allow for storm sewer reconstruction at this location.

You will note that the proposed agreement stipulates three conditions that must be followed if the gatehouse relocation is pursued further. Consequently, we request that appropriate coordination be undertaken with the NYCDOT to secure agreement on these conditions. The MOA will be executed once a positive response is received on this matter.

If you have any questions, we can be contacted to discuss the details further.

Frederick H. Downs

Frederick H. Downs
District Engineer

Attachment

cc: Director, Design Bureau, NYSDOT

DIRECTOR
STENO SUPPORT
DESIGN BUREAU
RECEIVED
ACTION
INFO
MAY 19 1986
IN-HOUSE DESIGN
CONSULTANT MGT.
FILE

Advisory
Council On
Historic
Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

APR 2 1986

Mr. Victor Taylor
Division Administrator
Federal Highway Administration, Region One
Leo W. O'Brien Federal Building, 9th Floor
Albany, NY 12207

REF: NYSDOT PIN 0735.16, Nassau Expressway Construction
New York, New York

Dear Mr. Taylor:

We have received your letter requesting our comments on the referenced project. As you recall the project was the subject of a 1981 Memorandum of Agreement regarding the project's effects on the Ridgewood Aqueduct. However, at the time of the agreement the proposed temporary relocation of the Jamaica Creek Gatehouse was not foreseen. FHWA's proposal to temporarily remove the gatehouse, then replace it on its foundations and repair it is an an excellent proposal, one that successfully avoids demolition. To ensure that this will not result in adverse effects to the Gatehouse, we believe the following conditions would be necessary.

1. The recording stipulated in the 1981 Agreement will be extended to the Gatehouse.

2. The Gatehouse will be moved by a contractor qualified to move historic properties and in accordance with the recommendations in "Moving Historic Buildings" published by the U.S. Department of the Interior (copy enclosed).

3. Plans for repair of the Gatehouse will be developed in consultation with the New York State Historic Preservation Officer (SHPO) and will be submitted to the New York SHPO for review and comment in order to ensure their conformance with "The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings."

If you agree to implement these conditions, please sign on the concurrence line below, return this letter to us, and also send a copy to the New York SHPO . These provisions will then be incorporated into your determination and compliance with Section 106 of the National Historic Preservation Act and the Council's regulations will be complete.

Thank you for your continued cooperation.

Sincerely,

for Don L. Klima
Chief, Eastern Division
of Project Review

Enclosure

I concur:

_______________________________ (date) ___________

B. APPENDIX B: DATA PERTAINING TO RIDGEWOOD SYSTEM IN 1896

The following Table list structures and their locations along the lines of the Ridgewood System (Brooklyn City Works Department 1896: Tables 58-60).

TABLE No. 58.

SHOWING STRUCTURES ON THE OLD CONDUIT [illegible] BETWEEN HEMPSTEAD POND AND RIDGEWOOD PUMP[illegible] STATION.

DESIGNATION.	STATION.	DESCRIPTION.
Hempstead Pond Gate House	0 + 00	Face of conduit arch. East terminal of the original brick conduit; sluiceway connection with Hempstead Pond.
Schodack Branch Conduit	1 + 13.5	Centre. 3' 2" diameter; connects Schodack Brook and Hempstead Storage Reservoir with main conduit.
Manhole	10 + 03.61	Cross cut on S. W. corner of square manhole. Stone head; on east side of conduit.
Pine's Branch Conduit	21 + 06.5	Centre. 30" diameter; connects Pine's Pond with main conduit.
Pine's Creek Gate House (Culvert V)	23 + 30.5	Centre of culvert. Arched culvert 15' wide under gate chamber. Chamber is 35'.75 x 21'.02, and has on south side two overflows, each 5' long, and two sluice-gates, 2' x 2', for emptying the conduit; west terminal of 36" delivery pipe from Millburn Reservoir.
Manhole	25 + 30.7	Centre. Iron manhole over two 20" discharge pipes from Smith's Pond Engine House.
"	33 + 21.92	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
"	46 + 42 ±	Centre of square manhole. Stone head; on south side of conduit.
"	59 + 61.83	Cross cut on N. E. corner of square manhole. Stone head; on north side of conduit.
"	72 + 81.09	" " " " " " "
Culvert U	75 + 24.8	Centre. 12" cast iron pipe carried under conduit.
Manhole	86 + 04.54	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
Culvert T	96 + 04.1	Centre. 12" cast iron pipe carried through conduit into a manhole, and then syphoned under 48" delivery pipe.
Manhole	99 + 15.70	Cross cut on N. E. corner of square manhole. Stone head; on south side of conduit.
"	112 + 39.08	" " " " " " "
"	125 + 62.21	" " " " " " "
Culvert S	132 + 31.7	Centre. 30" cast iron pipe carried under conduit.
Manhole	138 + 80.65	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
"	152 + 02.29	" " " " " " "
Valley Stream Branch Conduit	162 + 58 ±	Centre. 30" diameter; connects Valley Stream Pond with main conduit.
Watt's Creek Gate House (Culvert R)	165 + 11.7	Centre of culvert. Culvert consists of two arches, 6' wide by 3' high in centre; passes under gate chamber, 18' x 10', which has on the north side two overflows, each 4' 4" long, and on south side two sluice gates, 2' x 2', for emptying the conduit; an addition on south side contains a stopcock and a 20" blow-off on 48" delivery pipe.
Watt's Pond Measuring Weir	171 + 85.8	Centre. For measuring the water pumped at Watt's Pond Engine House.
Manhole	181 + 50.94	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
"	194 + 20.81	" " " " " " "
Culvert Q	195 + 68.9	Centre. 12" cast iron pipe carried under conduit.
Manhole	202 + 78	Centre. Iron manhole over discharge pipe from Clear Stream Engine House.
"	207 + 40 ±	Centre of square manhole. Stone head; on south side of conduit.
Culvert P	209 + 19.6	Centre. Two 20" cast iron pipes laid under conduit.
Clear Stream Branch Conduit	210 + 91 ±	Centre. 24" diameter; connects Clear Stream Pond with main conduit.
Manhole	220 + 60.89	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
"	233 + 81.81	" " " " " " "
"	247 + 05.55	" " " " " " "
"	260 + 17.71	" " " " " " "
Culvert O	262 + 70.6	Centre. Two 30" cast iron pipes laid under conduit.
Simonson's Branch Conduit	265 + 52 ±	Centre. 24" diameter; connects Simonson's Pond with main conduit.
Manhole	268 + 10.7	Centre. Iron manhole over discharge pipe from Forest Stream Engine House.
"	273 + 41.46	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
Railroad Crossing	275 + 05 ±	Crossing of the Montauk Division of the Long Island Railroad.
Manhole	286 + 51.21	Cross cut on N. W. corner of square manhole. Stone head; on north side of conduit.
Culvert N	287 + 66.7	Centre. 12" cast iron pipe laid under conduit.
Manhole	299 + 82.87	Cross cut on N. E. corner of square manhole. Stone head; on south side of conduit.
"	310 + 75.9	Centre. Manhole with iron head over 16" and 20" discharge pipes from Springfield Engine House.
Culvert M	312 + 79.2	Centre. Two 36" cast iron pipes laid under conduit.
Manhole	312 + 97.51	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.

TABLE No. 58—*Concluded.*

SHOWING STRUCTURES ON THE OLD CONDUIT LINE BETWEEN HEMPSTEAD POND AND RIDGEWOOD PUMPING STATION.

DESIGNATION.	STATION.	DESCRIPTION.
Manhole	326 + 21.12	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
"	339 + 40.74	" N. E. " " " "
Culvert L	348 + 34.0	Centre. 12" cast iron pipe laid under conduit.
Manhole	352 + 60.23	Cross cut on S. E. corner of square manhole. Stone head; on south side of conduit.
"	365 + 81.30	" " " " " "
"	379 + 22.49	" S. W. " " " "
Culvert K	379 + 70.6	Centre. One 20" cast iron pipe laid under conduit.
Jamaica Creek Gate House (Culvert J)	392 + 15.4	Centre. Arched culvert 18' wide under gate chamber 18' x 12' 4"; on south side, chamber has two overflows, each 6' long, and two sluice-gates, 2' x 2', for emptying the conduit; south of this gate house is a masonry viaduct on which 48" delivery pipe is carried over stream.
Gate Chamber	394 + 52.6	Centre. Gate chamber on 48" delivery pipe; 14' x 11'; contains stop-cock and 20" blow-off.
Baiseley's Terminal Basin	398 + 27.9	Centre. Basin, 35' 6" x 13' 2"; receives Baiseley's branch conduit, 42" diameter, which connects with Jameco Engine House.
" Discharge Pipe	412 + 33 ±	14" discharge pipe from Baiseley's Engine House.
Manhole	412 + 41.5 ±	Centre of square manhole. Stone head; over centre of conduit.
Culvert I	412 + 99.8	Centre. Masonry culvert, 3' 0" x 2' 6".
Manhole	426 + 20.13	Cross cut on S. W. portion of round manhole. Stone head; over centre of conduit.
"	435 + 82 02	" N. E. " " " "
"	451 + 19.17	" " " " " "
Culvert H	451 + 65.3	Centre. Masonry culvert, 2' x 2'.
Manhole	463 + 15.98	Cross cut on N. W. portion of round manhole. Stone head; over centre of conduit.
"	477 + 32.55	" " " " " "
Culvert G	479 + 04	Centre. One 20' cast iron pipe carried under conduit.
Manhole	488 + 55.96	Cross cut on N. W. portion of round manhole. Stone head; over centre of conduit.
Woodhaven Gate House (Culvert F)	502 + 91.3	Centre. Masonry culvert, 1' 6" x 1' 6"; under gate chamber, 16' x 10'; on south side, chamber has two overflows each 4' 4" long, and two sluice-gates, 2' x 2', for emptying the conduit; south of this gate house is a masonry viaduct on which 48" delivery pipe is carried over stream.
Culvert E	510 + 38.5	Centre. Masonry culvert, 2' x 2'.
Manhole	516 + 11.32	Cross cut on S. W. corner of square manhole. Stone head; over centre of conduit.
"	530 + 05.18	" " portion of round " " "
Culvert D	533 + 26.9	Centre. Masonry culvert, 2' x 2'.
Culvert C	543 + 52.9	" " "
Manhole	545 + 60.89	Cross cut on S. E. portion of round manhole. Stone head; over centre of conduit.
"	556 + 67.48	" S. W. " " " "
Culvert B	559 + 22.9	Centre. 12" cast iron pipe laid under conduit.
Manhole	567 + 92.41	Cross cut on S. E. portion of round manhole. Stone head; over centre of conduit.
"	584 + 83.27	" " corner of square " " "
Spring Creek Weir	600 + 46.5	Centre. For measuring the water pumped at Spring Creek Engine House.
Spring Creek Gate-House (Culvert A)	605 + 88.6	Centre. Double masonry culvert, each 2' 0" x 3' 6" under gate chamber; chamber is 16' x 10', and has on south side two overflows each 4' 4" long, and two sluice-gates, 2' x 2', for emptying the conduit; an addition on the south side contains a stopcock and 20" blow-off on the 48" delivery pipe; a 5' passage-way connects on the north with a gate chamber 14' x 15', which is to connect the proposed 66" steel pipe on the east with the two 48" cast iron pipes on the west; is provided with an overflow 5' 6" long and two sluice-gates, 2' x 2', for emptying the pipes.
Manhole	615 + 12.18	Cross-cut on S. W. portion of round manhole. Stone head; over centre of conduit.
"	626 + 03.44	" " " " " "
"	636 + 43 07	" " " " " "
"	642 + 39 ±	Centre of round manhole. Stone head; over centre of conduit.
"	646 + 64 ±	" " " "
Branch Conduit	650 + 22 ±	Centre. Branch conduit, leading to the pump well of the New Ridgewood *Pumping* Station.
Manhole	651 + 52 ±	Centre of round manhole. Stone head; over centre of conduit.
Pocket	654 + 20	Inside face of south wall of pocket, Ridgewood Pumping Station. Pocket is 52' 6" x 10', and connects by sluice-gates 2' wide with pump well.
Ridgewood Pump Well	654 + 35	Inside face of south wall of pump well. Well is 10' x 60'.

TABLE No. 59.

SHOWING STRUCTURES ON THE PIPE LINES BETWEEN THE MILLBURN PUMPING STATION AND CULVERT V AT SMITH'S POND.

DESIGNATION.	STATION.	DESCRIPTION.
Culvert No. 7	4 + 70.2 F. M.	This culvert is 90'.6 north of the centre line. Arched culvert 12' wide, under chamber, 9'.5 × 8'.0, containing check valve and 12" blow-off on the 48" force main.
Culvert No. 6	13 + 07.9 F. M.	Centre. 24" cast iron pipe laid under force main.
Culvert No. 5	31 + 84.7 F. M.	Centre. 12" " " " "
Culvert No. 4	43 + 99.6 F. M.	Centre. 12" " " " "
Culvert No. 3	55 + 79.1 F. M.	Centre. 36" cast iron pipe laid under force main and continued under tracks of Long Island Railroad.
Gate House	68 + 16.6 F. M.	Centre. Chamber, 16'.5 × 21'.0, with frame superstructure; contains stopcocks which allow the water to be passed through the force main or turned into the influx chamber of Millburn Reservoir.
Gate House		At junction of force main and delivery pipe lines. Chamber, 28'.5 × 27'.0, with frame superstructure; contains stopcocks which control the flow through the 48" and 36" delivery pipes from Millburn Reservoir.
Culvert No. 2	28 + 14.3 D.P.L.	Centre. 12" cast iron pipe laid under delivery pipes.
Culvert No. 1	8 + 49.1 D.P.L.	Centre. Arched culvert, 12' wide; under gate chamber 21' x 21'. Chamber contains stopcocks on 48" and 36" delivery pipes and a 20" blow-off on each.

F. M. refers to the "Force Main," which extends from the Millburn Pumping Station to the Efflux Chamber at Millburn Reservoir.
D. P. L. refers to the "Delivery Pipe Line," which extends from Culvert V at Smith's Pond to the Efflux Chamber at Millburn Reservoir.

TABLE No. 60.

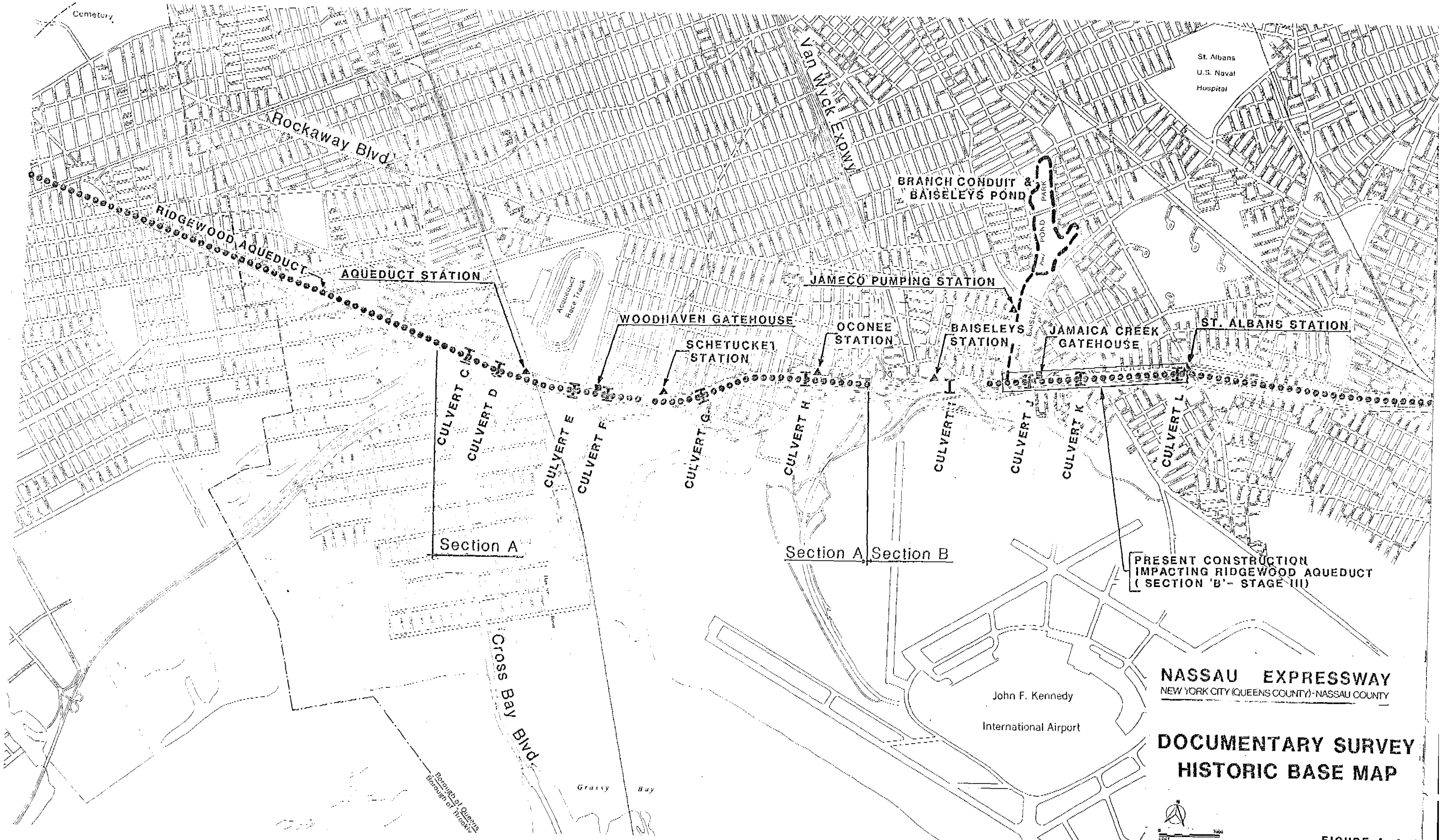
SHOWING STRUCTURES ON THE CONDUIT LINE EAST OF MILLBURN PUMPING STATION.

DESIGNATION.	STATION.	DESCRIPTION.
Millburn Pocket and Pump Well	−(2 + 83)	Inside face of east wall. Pocket is 88' 6" x 10' 0"; connects with a pump well 74' 0" x 12' 0" on the north, and distant about 50' southerly from the Millburn Pumping Station.
Manhole	10 + 00	Centre. Round manhole. Stone head.
"	22 + 38.85	" " "
"	35 + 43.10	" " "
"	47 + 00	" " "
Culvert No. 8	54 + 31	Centre. Two 20" cast iron pipes carried through conduit.
Gate House and Overflow	54 + 56	Centre. Chamber, 12' 4" x 11' 0", with overflow 10' long.
Manhole	60 + 09.17	Centre. Round manhole. Stone head.
"	72 + 00	" " "
Culvert No. 9	75 + 90	Centre. One 18" cast iron pipe carried through conduit.
West Gate House, East Meadow Pond	87 + 38.85	Centre. Gate chamber, 13' 0" x 15' 0"; west terminal of double 48" pipe line through East Meadow dam; 4' x 5' opening, with sluice-gate, connects with East Meadow Pond.
West Waste Weir, " "	87 + 64.85	Centre. 31' long; elevation of crest, 7'-7.
East " " "	94 + 54.92	" " " "
East Gate House, " "	94 + 80.92	Centre. Gate chamber, 13' 0" x 15' 0"; east terminal of double 48" pipe line through East Meadow dam; 4' x 5' opening, with sluice-gate, connects with East Meadow Pond.
Manhole	108 + 00	Centre of square manhole.

TABLE No. 60—*Concluded.*

SHOWING STRUCTURES ON THE CONDUIT LINE EAST OF MILLBURN PUMPING STATION.

DESIGNATION.	STATION.	DESCRIPTION.
Culvert No. 10.	115 + 46	Centre. Paved channel over conduit.
Manhole	121 + 00	Centre of square manhole.
Culvert No. 11	125 + 67	Centre. Paved channel over conduit.
Manhole	134 + 00	Centre. Round manhole, with iron head.
"	147 + 00	Centre of square manhole.
West Gate House, Newbridge Pond	159 + 08.94	Centre. Gate chamber, 13' 0" x 15' 0"; west terminal of double 48" pipe line through Newbridge dam; 4' x 5' opening, with sluice-gate, connects with Newbridge Pond.
West Waste Weir, " "	159 + 29.90	Centre. 20' long; elevation of crest, 8'.5.
East " " "	161 + 41.70	" " " "
East Gate House, " "	161 + 62.66	Centre. Gate chamber, 13' 0" x 15' 0"; east terminal of double 48" pipe line through Newbridge dam; 4' x 5' opening, with sluice-gate, connects with Newbridge Pond.
Culvert No. 12, Gate House and Overflow	172 + 53	Centre. Gate chamber, 12' 4" x 11' 0", with overflow 10' long; one 20" cast iron culvert pipe carried through chamber, and one 20" cast iron pipe built into north wall so that stream may be turned into conduit.
Manhole	182 + 00	Centre. Round manhole, with iron head.
" over Chamber	190 + 23.69	Centre. Round manhole, with iron head, over chamber, 9' 6" x 11' 0"; west terminal of double 48" pipe line under Culvert No. 13.
Culvert No. 13 (Clements' Stream)	190 + 47	Centre. Paved channel over conduit, which is syphoned under in two 48" cast iron pipes.
Gate House	190 + 67.10	Centre. Chamber, 11' 0" x 12' 4"; east terminal of double 48" pipe line under Culvert No. 13.
Manhole	203 + 00	Centre. Round manhole with iron head.
"	217 + 00	" " " "
" over Chamber	228 + 44.17	" " " " over chamber, 9' 6" x 11' 0"; west terminal of double 48" pipe line under Culvert No. 14.
Culvert No. 14 (Lawrence Stream)	228 + 72	Centre. Paved channel over conduit, which is syphoned under in two 48" cast iron pipes.
Gate House and Overflow	228 + 90.93	Centre. Chamber, 11' 0" x 12' 4", with overflow 10' long; east terminal of double 48" pipe line under Culvert No. 14.
West Gate House, Wantagh Pond	243 + 31.65	Centre. Gate chamber, 13' 0" x 15' 0"; west terminal of double 48" pipe line through Wantagh dam; 4' x 5' opening, with sluice-gate, connects with Wantagh Pond.
West Waste Weir, " "	243 + 57.6	Centre. 30' long; elevation of crest, 9'.7.
East Waste Weir, Wantagh Pond	246 + 77	Centre. 30' long; elevation of crest, 9'.7.
East Gate House " "	247 + 01.95	Centre. Gate chamber, 13' 0" x 15' 0"; east terminal of double 48" pipe line through Wantagh dam; 4' x 5' opening, with sluice-gate, connects with Wantagh Pond.
Manhole	258 + 00	Centre. Square manhole.
"	271 + 00	" Round " with iron head.
"	283 + 00	" " " "
"	293 + 00	" " " "
Culvert No. 15 (James' Stream)	300 + 50	Centre. Two 20" cast iron pipes carried through conduit.
Manhole	313 + 00	Centre. Round manhole, with iron head.
"	325 + 00	" " " "
Manhole over Chamber	338 + 21.7	Centre. Round manhole, with iron head, over chamber, 9' 6" x 11' 0"; west terminal of double 48" pipe line under Culvert No. 16.
Culvert No. 16 (Meinell's Stream)	338 + 47.3	Centre. Paved channel over conduit which is syphoned under in two 48" cast iron pipes.
Gate House and Overflow	338 + 66.17	Centre. Chamber 11' 0" x 12' 4", with overflow 10' long; east terminal of double 48" pipe line under Culvert No. 16.
Manhole	350 + 00	Centre. Round manhole, with iron head.
"	362 + 00	" " " "
"	374 + 00	" " " "
Gate House, Massapequa Supply Pond	386 + 36	Centre. Gate chamber 11' 0" x 12' 0"; the east terminal of conduit; 4' x 5' opening, with sluice gate, connects with Massapequa Supply Pond.
Waste Weir " "	389 + 65.3	Centre. 17' long; elevation of crest, 11'.2.

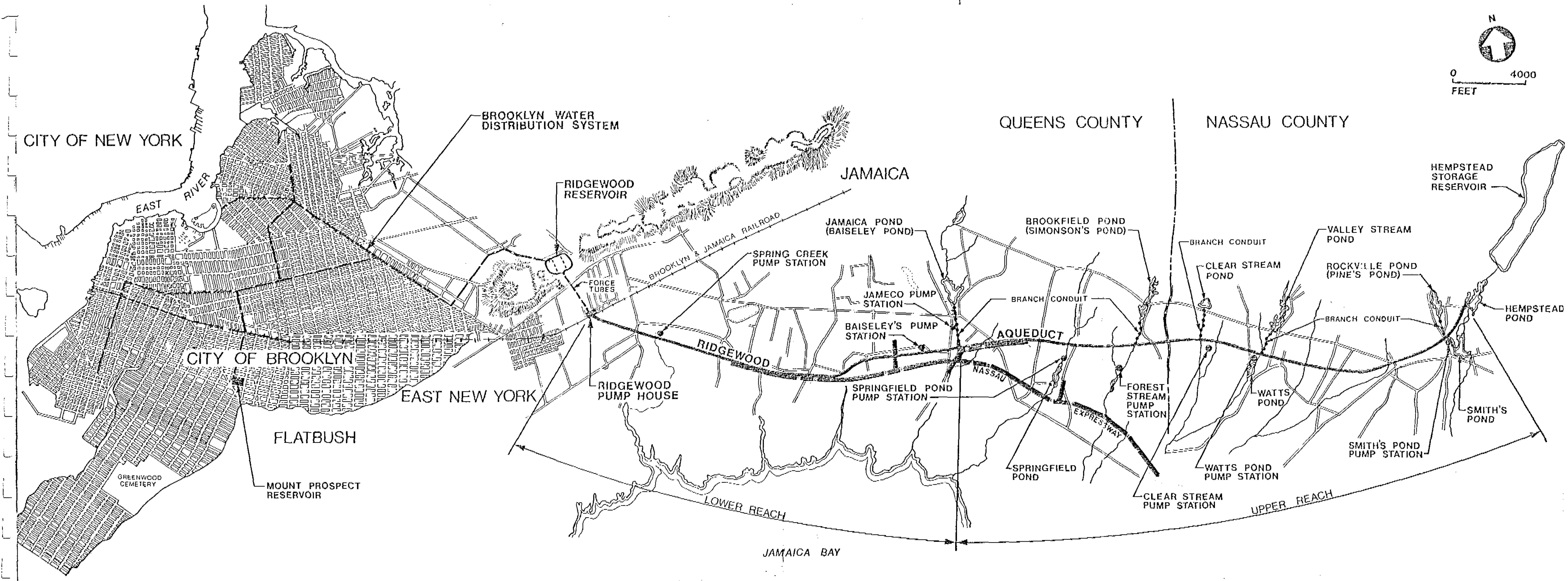

Cemetery
Rockaway Blvd
Van Wyck Expwy
St. Albans
U.S. Naval
Hospital
RIDGEWOOD AQUEDUCT
AQUEDUCT STATION
Aqueduct Race Track
BRANCH CONDUIT &
BAISELEYS POND
PARK
POND
JAMECO PUMPING STATION
WOODHAVEN GATEHOUSE
SCHETUCKET
STATION
OCONEE
STATION
BAISELEYS
STATION
JAMAICA CREEK
GATEHOUSE
ST. ALBANS STATION
CULVERT C
CULVERT D
CULVERT E
CULVERT F
CULVERT G
CULVERT H
CULVERT I
CULVERT J
CULVERT K
CULVERT L
Section A
Section A
Section B
PRESENT CONSTRUCTION
IMPACTING RIDGEWOOD AQUEDUCT
(SECTION 'B'- STAGE III)
Cross Bay Blvd
Borough of Queens
Borough of Brooklyn
Grassy
Bay
John F. Kennedy
International Airport
NASSAU EXPRESSWAY
NEW YORK CITY (QUEENS COUNTY)-NASSAU COUNTY
DOCUMENTARY SURVEY
HISTORIC BASE MAP
FEET
FIGURE A-4

NASSAU EXPRESSWAY

NEW YORK CITY (QUEENS COUNTY) / NASSAU COUNTY

PRESENT AND FUTURE CONSTRUCTION IMPACTS ON THE RIDGEWOOD AQUEDUCT

FIGURE A-3



RIDGEWOOD AQUEDUCT AND RELATED SYSTEM (1889)

FIGURE 22. Plans, profiles, details of storm sewer, Baiseley's Pond, 1924 (Div. of Sewers, Sheet 16 of 30).