

densely settled residential district. The Phipps Conservatory and Lake Elizabeth are interesting features of this park.

Riverview Park is a beautiful tract of 240 acres. The Allegheny Observatory, located in this park, contains the second largest telescope in this country, and is an object of interest to visitors from all parts of the United States who are scientifically inclined.

The park system of the City, with its many adjuncts, is under the supervision of the Bureau of Parks.

PLAYGROUNDS AND RECREATION.

A Bureau of Recreation is operated for the purpose of providing instructive play for children and also for the physical development of adults. Sixteen parks, having a total area of 95½ acres, have been provided. The equipment of these parks include outdoor gymnasiums, swimming and wading pools, sand bins, baseball fields, tennis courts, outdoor basket-ball courts, field houses, swings and other valuable equipment and paraphernalia. Some of the playgrounds which are operated throughout the year take more or less the nature of community centers, and commodious buildings of brick and concrete have been installed containing gymnasiums, locker, library, club and shower rooms.

The activities of the Bureau include the organization of play for little children, the organization and conduct of athletic meets, baseball leagues, football, hockey and volley-ball, and promotion of neighborhood clubs in dramatics, choral singing, etc., conduct of play festivals, folk dancing, the promotion of outdoor life for children and the exercise habit for the adults, also the conduct of summer camps. It is quite probable that the near future will see the development of aquatic sports on the river, such as rowing, canoeing, etc., the fostering of which will add much to the outdoor life of the community.

The organization is under the supervision of a superintendent, who has under his direction an edequate field force of supervisors, recreation directors, physical directors, playground directors, swimming instructors, janitors and assistants. In the summer months the force is increased to cover the greater activities during the hot months when the Bureau not only operates the playgrounds above mentioned, but also leased properties and school yards.

PITTSBURGH'S WATER SUPPLY

HISTORICAL.

The water supply of Pittsburgh, with the exception of a small section in the eastern extremity of the City and some recently annexed sections south of the City, is furnished by a municipally owned and operated plant. The territory supplied by the City plant covers an area of thiry six square miles, with a population of about 540,000 people. This territory is divided into three main divisions by the Allegheny, Monongahela and Ohio Rivers, that part lying between the Allegheny and Monongahela being the original city proper, sometimes designated as Peninsular Pittsburgh; the part south of the Ohio and Monongahela designated as the South Side and the part lying north of the Ohio and Allegheny being originally the City of Allegheny, now generally spoken of as the North Side.

The part of the plant lying in the original City proper between the Allegheny and Monongahela Rivers was built entirely by the City of Pittsburgh. The first record of any activity towards supplying the then small town with water dates back to 1802, when proposals were received for building four public wells on Market Street. These wells were to cost \$497.96. Individuals who already had wells for their own use were to be compensated, provided they dedicated their wells to public use. It appears that \$170.00 of this tax was collected but the fate of the well proposition is lost in history.

In December 1813, an enterprising public citizen, Mr. George Evans by name, with possible foresight as to future public utilities served notice that he had been urged by many citizens to furnish a water supply and that he was now ready to pump water sufficiently high to run to any part of the town and to sell the same at the price of 3 cents per barrel, which assuming a barrel to be 50 gallons, would be at the rate of 60 cents per thousand gallons. In January 1818 it appears that Messrs. Foster and Hamilton came forward with a petition for permission to furnish the town with water. There is no record of the success of either of these enterprises.

The first real and definite step taken by the City was in February 1824, when a Committee consisting of Messrs. Fairman, Magee, Denny, Carson and Hays, all of which names are prominently identified with the history of Pittsburgh, was appointed to arrange a loan of \$50,000.00 and in 1826 the Mayor was authorized to negotiate a loan of \$40,000.00 for water works construction and in June of that year a reservoir site was purchased on Grant's Hill where the Court House now stands and an engine house site was purchased at the foot of Cecil Alley, just below the present Sixth Streef Bridge. The reservoir was to hold one million gallons and had an elevation of practically 80' above the town. The steam pumping engine was to be capable of raising 600,000 gallons in twelve hours. This plant was ready for service in September 1828. Developments were continued and the plant appears to have been in good working order in 1832 and represented an expenditure of about \$111,000. This formed a nucleus for the subsequent development of the present municipal water plant. The growth of the city towards the highlands to the east developed the necessity of reservoirs at higher elevations and resulted in the construction of a pumping station further up the Allegheny River. In 1843 we find a pumping station on the Allegheny River, about 11th Street, and a reservoir at the corner of Prospect and Elm St., 160 feet above the river. In 1847, the consumption had reached 1,600,000 gallons per day and mention is made of attempts to prevent waste of water, also in the same year a proposal was submitted to Council for filtering the supply and for the use of a smoke con-The next attempt to meet the move of the population tosumer. wards the highlands resulted in the construction, in 1850, of the This basin is still in use and represents the line Bedford Basin. of demarcation where the development of the old original plant with a pumping station on the lower river met the subsequent and present development of the plant with pumping stations on the upper river in the neighborhood of Brilliant and primary reservoirs in Highland Park.

In 1867 the first serious consideration appears with reference to the sanitary quality of the water. A recommendation of the Superintendent, at that time, was to the effect that the existing pumping plant located at 11th Street on the Allegheny should be abandoned owing to the sewage and filth entering the river above the intake pipe. 1868 we find the authorities recommending the location of a pumping station on the site of the present Brilliant Pumping Station, about six miles above the then existing station at 11th Street, and the construction of a basin in what is now Highland Park. This work was completed and in operation about 1880, and the source of supply transferred to Brilliant Station although the lower works at 11th Street were not abandoned until 1884. In conjunction with this work, the secondary pumping station at Herron Hill and the Herron Hill Reservoir were also constructed.

That part of the present plant located in what is known as the South Side was originally built by the Monongahela Water Company, a private company operating under a charter. Their plant was condemned and acquired by the City in 1909. At the time of acquiring the plant, it consisted of a pumping station that took the water from the Monongahela River at the foot of 29th Street, a low service reservoir known as the Birmingham Basins, now abandoned, and a small secondary pumping station located at the Birmingham Basin pumping to the Allentown Tanks, together with the pipe line system. Raw River water was suppled to the customers.

The part of the plant lying to the north of the Ohio and Allegheny was originally built by the City of Allegheny and acquired by annexation in 1907.

Work was begun on the Allegheny plant about 1847. Troy Hill Reservoir, located on Troy Hill, together with River Avenue

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Pumping Station, located a short distance above 16th Street Bridge were constructed at that time. Troy Hill Pumping Station, a secondary station was built in 1872. These units have all been abandoned in the recent consolidation. Howard Street Pumping Station, completed in 1882, is still in operation as the secondary station of the North Side. The ever present question of a more sanitary supply was agitated about 1886 with the result that in 1896 a new pumping station was constructed at Montrose Station, about ten miles above the original station from which Allegheny continued to draw its supply until some time after consolidation with the City of Pittsburgh, or until the North Side was furnished filtered water through the new Aspinwall Pumping Station, the raw water being taken from the river at Ross Station, three miles below Montrose Station.

The acquisition of the plant of the Monongahela Water Company together with the plant of the City of Allegheny imposed upon the Bureau of Water the necessity of consolidating these three plants into one economic operating whole. The City of Allgheny, at this time, was receiving a supply of raw water from Montrose Pumping Station, the rising main from Montrose Pumping Station to Allegheny passing through the City Filter Plant. In this connection, a study was made of the entire system for the purpose of remodeling and redesigning in the interest of economic operation.

This work, with the exception of some contemplated changes in the Distribution System on the North Side, is practically completed. Prior to the undertaking of the same, there were in commission twelve pumping stations. This number has been reduced to eight in the consolidation. The work involved the construction of a new pumping station at Mission Street on the South Side, to take the place of the old 29th Street Station and Hill Station, of the Monongahela Water Company, the construction of a new pumping station at Aspinwall to take the place of Montrose and for the purpose of pumping filtered water to Allegheny; the installation of additional pumping equipment in Ross Station; the construction of a 150,000,000 gallon distribution reservoir to supply the North Side and to take the place of Troy Hill Reservoir which had long since been inadequate; the construction of lines across the Allegheny and Monongahela Rivers in order to give elasticity of operation and to unify the low service district; the installation of a preliminary system of filtration in order to economically increase the output of the filter plant. At the same time, although not essentially a part of the consolidation, a pumping station known as Garfield Station, located in the eastern part of the City was abandoned. this work being transferred to the Herron Hill Station and the water conveyed to the Garfield District by a line from Herron Hill Reservoir. The pumping station known as Troy Hill Station, locate on Troy Hill, North Side, was abandoned, the pumping work was transferred to Howard Street Station and the water conveyed to Troy Hill by means of an additional pipe line from Spring Hill tanks. Both of which moves resulted in very material saving in expenses. The attached chart shows the operating units as they existed prior to and after the consolidation of the plants. Altogether six pumping stations were abandoned and two new pmping stations built. Two reservoirs and one tank system were abandened and one new reservoir built.

ORGANIZATION.

The rapid expansion of the municipal water plant due to the completion of the filter plant, acquiring the property of the Monongahela Water Company and the annexation of the City of Allegheny, so increased the duties and responsibilities of the Bureau of Water that it became necessary to completely reorganize the same. Careful studies of this subject were made and late in 1912 the reorganization was made effective. The units of this organization designated as Divisions are each in charge of a Division Superintendent reporting to a Managing Engineer who has charge of all matters pertaining to the water supply. The divisions, four in number, each have charge of one basic function involved in producing the supply and are designated as the Filtration, Mechanical, Distribution and Accounting Divisions.

The Filtration Division is in charge of a Sanitary Engineer. The duty of this Division is to receive the raw water at the plant, to properly filter and purify the same and deliver it to the suction trunks of the primary pumping stations, also to investigate the water during its progress through the system for the purpose of determining that its sanitary quality is not impaired before reaching the consumer.

The Mechanical Division is in charge of a Mechanical Engineer. The duty of this Division is to raise the water to the require elevations for distribution purposes.

The Distribution Division is in charge of a Civil Engineer. This Division receives the water at the reservoirs and tanks and has charge of all maters involved in the distribution of the same to the consumers.

The Accounting Division in charge of a Chief Clerk keeps the Bureau accounts.

The design and construction of extensions and installation of new equipment is supervised directly by the Division responsible for the operation of the same.

This form of organization was in effective working order during the year 1913 and special studies were started for the purpose of reducing operating costs with the result that the annual operating costs of the Bureau have been reduced from about \$915,000.00 in 1912 to about \$790,000.00 in 1915, with still further economies in view. This reduction was coincident with a large increase in the amount of work performed by the plant. The added burden of supplying the North Side with filtered water assumed during this period, increased the output of the Filter Plant from 90 million gallons a day to 125 million gallons a day. The raw water pumpage at Ross Station was increased by a like amount.

During the last three years in addition to the studies in economic operation, the Bureau supervised the design, construction and installation of over five million dollars worth of plant extension, consisting of improvements to the Filtration Plant, the construction of the North Side Reservoir, the erection of new pumping stations, installation of pumping engines, boiler plants and rising mains, the construction of new distribution lines and river crossing, together with the progressive metering of the City.

TOPOGRAPHICAL FEATURES.

The territory supplied by the Pittsburgh Plant presents an unusually rough topography for a large city, and results in a complicated system of distribution districts requiring a large amount of secondary pumpage. Water is delivered through a total vertical elevation of about 700 feet. This 700 feet difference in elevation, generally speaking, may be considered to be divided into three horizontal pressure zones. The intersection of these pressure zones with the hilly topography results in ten different pressure supplies. Some of these supplies cover several sections of territory not contiguous to each other, which further subdivides the distribution system into 17 different divisions, each one of which constitutes practically a pipe line distribution system within itself.

The low lying districts along the three rivers, not above 200 feet in elevation, including the downtown section of Pittsburgh, part of Lawrenceville, lower Allegheny, the lower South Side, West End and Hazelwood, constitute the low service district and are supplied by two reservoirs, Highland Reservoir No. 2 and the North Side Reservoir. This district, although geographically divided by the rivers into three separate territories, has been consolidated into one water service district by cross river lines. It is the district of congested building values and high conflagration risks. Its water supply is insured by the two large reservoirs mentioned and by several large supply lines which reach it over different routes.

A large section of territory in the central and eastern part of Peninsular Pittsburgh is between 200 feet and 300 feet above river level and is designated as the intermediate district of this section of the City. It includes Soho, Oakland, Shadyside, Bloomfield, part of Lawrenceville, East Liberty and Homewood and is supplied by Highland Reservoir No. 1. It is a populous residential district containing several important business centres.

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Surrounding the district of intermediate elevations just referred to are five sections of territory ranging from 300 feet in elevation to a maximum of about 600 feet, Squirrel Hill on the South, Herron Hill on the West, Garfield and Heberton Hill on the North and Lincoln Hill on the East. All of these high service districts with the exception of Lincoln are supplied from Herron Hill Reservoir. A tank system near the eastern city line supplies the Lincoln district. The territory is principally residential.

On the South Side the river hills rise abruptly from the low levels along the water courses to a maximum elevation of about 600 feet; between elevations 150 and 300 feet, very little territory is susceptible to improvement, above this elevation the available territory is built up. The low districts form a part of the low service district previously noted. The highlands are served from the Arlington tanks. There is no intermediate service district on the South Side, the nature of the territory as before stated not warranting the maintenance and operation of a separate pressure system.

That section of the North Side, fronting in the Ohio and Allegheny Rivers is a comparatively level crescent shaped territory rising gradually from the rivers to the base of the hills to the north; its maximum width at the centre of the crescent is about one mile. This section forms a part of the low service district previously mentioned; it is thickly populated and contains important business centres. From the northern boundary line of this river plain the contour changes into hills and pleateaus rising steadily toward the north and attaining a maximum elevation of about 700 feet in the outer Perrysville district. Most of the territory is built up; the greater part of it is included between elevations 150' and 450' and is divided in two pressure districts supplied by tank systems, the intermediate tanks are known as the Montgomery and Spring Hill Tanks, the high service tanks are known as the Lafayette Tanks. At the extreme northern boundary of the City the ground rises to its maximum elevation. This small section of high territory is supplied by the Greentree Tanks.

GENERAL DESCRIPTION OF PLANT.

The value of the Pittsburgh Water Plant is estimated at about thirty million dollars, invested substantially as follows:

A Filtration Plant consisting of three settling basins, 56 slow sand filters and a filtered water reservoir. (See detailed description of filter plant). One river pumping station supplying raw water to the filter plant. Two primary pumping stations handling the output of the filter plant. Three primary distributing reservoirs. Five secondary pumping stations. Two secondary distributing reservoirs. Five secondary distributing tank systems. About 750 miles of pipe line and three pipe yards.

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About 675 men are regularly employed in the operating force. The total operating cost for the year 1915 was about \$790,000.00 of this amount about \$104,000.00 was expended in purifying the water, about \$462,000.00 in pumping and about \$196,000.00 in distributing the same, the remaining balance covered the expenses of the Managing Engineer's office and the Accounting Division and includes office rental for the entire Bureau. As indicated by the preceding figures the plant is distinctively a pumping plant, the eight stations ranging in type and equipment from the smallest stations such as Lincoln Station, equipped with direct acting horizontal pumps handling less than a million gallons a day or Greentree Station equipped with electircally driven pumps and handling less than a half million gallons daily, through the larger secondary stations such as Herron Hill, Mission Street and Howard Street, equipped with vertical triple expansion plunger pumps of from 5 to 7 million gallons capacity each, to the primary station, Brilliant and Aspinwall equipped with vertical compound and triple expansion pumps ranging in capacity from 8 million to 20 million gallons daily each. The pumping equipment in Ross Station consists of centrifugal pumps including one turbine driven geared centrifugal of 100 million gallons daily capacity.

Water for the use of the City is taken from the Allegheny River at Ross Station, about seven miles above the point, the level of the pool is 24.50, it is conducted by gravity through a 124 inch suction trunk to the centrifugal pumps in Ross Station and elevated through a 96" rising main to the receiving basin of the filter plant, elevation 72 feet, thence by gravity in either direction through the preliminary filters, "A" frame baffles, settling basins and sand filters to the filtered water reservoir, elevation 55 feet, capacity 50 million gallons. From the filtered water reservoir the water is conducted to two primary pumping stations, Aspinwall and Brilliant. Aspinwall Station located just east of the Reservoir takes its supply by gravity through a short 72" steel suction trunk and delivers the same through a 60" steel rising main to the new North Side Reservoir, located in Shaler Township, capacity 150 million gallons, elevation 275'. Aspinwall Station, recently completed, is making a high record in mechanical efficiency.

Brilliant Station is located on the South Bank of the Allegheny River opposite the filtered water reservoir, from which it receives its supply through two 72" lines laid under the Allegheny River. It pumps to two reservoirs, Highland No. 1, capacity 117 million gallons, elevation 368', and Highland Reservoir No. 2, capacity 125 million gallons, elevation 276.5'.

Highland Reservoir No. 2 and the North Side Reservoir supply the district previously described as the low service district including lower Pittsburgh and the North and South Sides. This is accomplished through several large supply lines, a 60" steel line leads into Allegheny along the north side of the river and is crossconnected by means of a 48" line under the river at 26th Street with a 42" and a 36" line, which lines follow the southerly side of the river from Highland No. 2 to the downtown section. The 36" line is again cross-connected by two 24" lines across the Point Bridge, with the North Side System. The 36" line then makes a loop of the downtown section and parallels the Monongahela River, connecting by means of two 24" lines with the South Side System, which is connected with and supplied by a 50" line which crosses the town in a southerly direction from Highland No. 2 and passes under the Monongahela River at Greenfield Avenue. The arrangement of supply lines places the storage of the two reservoirs available to any part of the congested district through these large supply lines traversing different routes.

Highland Reservoir No. 1 supplies directly the intermediate district of Peninsular Pittsburgh. The high district of the same section secure their supply through Herron Hill and Lincoln Pumping Stations from this reservoir. Four 30" lines extend from the reservoir in a southerly direction and diverge through the district, one 36" line takes a southeasterly course and supplies Homewood and the eastern sections. One of the 30" lines referred to acts as a feeder to Herron Hill Pumping Station located at Centre Avenue This station and Dithridge Street, elevation center of suction 282'. contains two 6 million and one five million gallon vertical triple pumps, delivering water to Herron Hill Reservoir, elevation 559', and one five million gallon vertical triple, pumping to Bedford Reservoir, elevation 398'. The Herron Hill Reservoir supplies the Herron Hill highlands on which the reservoir is located, and supply lines therefrom convey water across the intervening low lying territory southeast to Squirrel Hill and Northeast to Garfield and Heberton Hill.

The Lincoln Highlands in the extreme northeast section of the City are supplied through Lincoln Station located at the corner of Park Avenue and Dean Street, elevation of suction 273'. This station draws its supply from the intermediate or Highland No. 1 system and elevates it to the Lincoln Tanks, elevation 583'. Lincoln Station is a small station equipped with two horizontal direct acting pumps of one million gallons capacity each.

The 50" line, previously described, as crossing the town in a southerly direction from Highland Reservoir No. 2 and passing under the Monongahela River at Greenfield Avenue, is the base of supply for the Mission Street Pumping Station located on Mission Street, South Side, elevation centre of suction 164'. A 30" branch line from the 50" line supplies this station, which elevates the water through a 30" rising main to the Allentown Tanks, elevation 598'.

These tanks supply the high districts of the South Side. Mission Street Station is a recently completed plant, the pumps, steam plant, and accessories are of the latest design and most recent development, with high mechanical efficiency. The present pumping equipment consists of two 7 million gallon vertical triples, with space for two future installations. This station was designed to ultimately supply the adjacent section of Pittsburgh now supplied by the South Pittsburgh Water Company.

Howard Street Pumping Station, elevation center of suction 135', located on Howard Street, North Side, is the main secondary pumping station of the North Side and handles all the water used in the highlands of this district. The 60" line previously described as entering this district, from the North Side Reservoir, along the northerly side of the Allegheny River, is connected with the Howard Street Station by means of a 30" branch line. The Water is pumped to two levels, the intermediate district is supplied by two separate tank systems, elevation 503', located on the highlands on either side of the East Street valley and known as the Montgomery Tanks and Spring Hill Tanks. The high service is supplied from the Lafayette Tanks, elevation 583.5', located on Lafayette Avenue.

A small electrically operated station known as Greentree Station, elevation centre of suction 450', located on Broadway in the cuter Perrysville district draws its supply from the system fed by the Lafayette Tanks and elevates the same to the Greentree Tanks, elevation 692'. These tanks supply a small district of maximum elevation at the extreme northern boundary of the City.

FIL/TRATION PLANT.

Location.

The Pittsburgh Filtration Plant is located on the north bank of the Allegheny River, about seven miles above its junction with the Monongahela.

General Description.

The plant consists of a receiving basin, contact baffle system, "A" frame baffle walls, two sedimentation basins, fifty-six covered slow sand filters of one acre each, a chlorination house, a covered filtered water reservoir, and the necessary conduits, piping and appurtenances.

Course of Water.

Raw water flows from the Allegheny River through a 124-inch suction trunk to the low lift pumps of Ross Pumping Station. It is then pumped through a 96-inch steel rising main encased in concrete, to the receiving basin. This rising main is approximately 2,000 feet long. From the receiving basin the water passes to either of the contact baffle systems, thence into the large sedimentation basins. In the passage through the sedimentation basins, the water also passes through openings in the "A" frame baffle walls so arranged as to draw the clearer water near the surface, thus decreasing the turbidity to a considerable extent.

The water passes from the sedimentation basins, at the ends most remote from the receiving basins, through reinforced concrete settled water conduits, varying from seven to eight feet in diameter, to the covered galleries, and then into the filters.

After filtration the water passes through steel pipes into the reinforced filtered water conduit, which has a maximum 'diameter of 124 inches, and finally reaches the covered filtered water reservoir.'

Just before the water enters the filtered water reservoir it is subjected to chlorination. Liquid chlorine is introduced into the filtered 'water conduit.

Aspinwall Pumping Station draws its supply from the inlet of the filtered water reservoir. The supply for Brilliant Pumping Station 'passes through the filtered water reservoir, and is conducted under the Allegheny River by means of two steel pipes, each seventy-two inches in diameter.

Administration Building.

The Administration Building is a three-story brick building, occupying a generally central location with reference to the remainder 'of the plant.

The lower floor of this building is a gate room. In this room sluice gates are so arranged that the river water may pass into the receiving basin, into either or both of the larger sedimentation basins, or directly into filters without passage into any of the basins. The sluice gates are motor-operated, thus permitting rapid operation with a minimum of manual labor.

The second floor of the building has the general offices of the plant. On this floor is a large concrete vault, in which are filed the records of operation. The third floor has the chemical and bacteriological laboratories.

Receiving Basin.

The receiving basin covers about three acres. It is concrete lined, with a depth of about 15 feet and a capacity of about 12 million gallons.

The water enters through a conduit extending along the bottom and across the entire width of the basin. This conduit has circular holes in the top, thus adoiding disturbance of the dirt which lies upon the floor of the basin. A large part of the heavy suspended matter in the river water is removed in passage through the receiving basin. It is necessary to clean this basin every two or three years.

The water leaves the receiving basin through eight circular passages, each 48 inches in diameter, entering the contact baffle system.

Contact Baffles.

The contact baffles were constructed after the plant had been operated for several years, with the view of better preparing the river water for application to the slow sand filters.

Each of the larger sedimentation basins is equipped with twenty-four contact baffle units. Each unit is a rectangular compartment, with a filtering area approximately 60 feet by 40 feet, containing six vertical feet of gravel. The upper five feet of gravel is such that 100% shall pass a screen of $1\frac{1}{4}$ -inch mesh and be retained on a screen of $\frac{1}{2}$ -inch.

The lower foot consists of two sizes of somewhat larger dimensions, so that the gravel shall not pass between the strainer beams.

The filtering material is supported by 'reinforced concrete beams, 3 inches wide and eight inches deep, with a clear span of 5 feet 6 inches. These strainer beams are arranged 'so that a clear space of two inches separates them. The strainer beams were cast separate, and were allowed to age for several months before any load was applied.

The strainer beams are in turn supported by arched 'longitud' inal beams, with arches of such dimensions as to permit easy access to the portion of the unit below the filtering material without disturbance of any part of the structure. This affords opportunity for inspection.

The water passes through a 24-inch inlet, downward through the gravel, out through a 24-inch outlet into the treated water channel.

Cleaning of the unit is accomplished by closing the inlet and outlet, and flushing rapidly downward through two 24-inch drains. Raw water is used in flushing.

These units are now being operated at the rate of about 45 million gallons per acre, daily, the rate being limited by the output of the plant. It is believed that satisfactory results may be obtained with rates as high as 75 million gallons per acre daily.

"A" Frame Baffle Walls.

From the contact baffles the water passes into the sedimentation basin, in which are installed two "A" frame baffle walls.

These walls are inverted "V" shaped, of reinforced concrete slabs, 4 inches thick, with openings near the top on the upstream side and at the bottom of the basin on the downward side. The openings are of such number and size as to permit the water to pass through at a velocity of approximately 3 inches per second. The object of taking water in at the top and releasing at the bottom is primarily to afford satisfactory displacement.

Filters.

Fifty-six slow sand filters are divided into five main groups, as follows:

Gallery 1—12 filters of one acre each. Gallery 2—12 filters of one acre each. Gallery 3—12 filters of one acre each. Gallery 4—10 filters of one acre each. Gallery 5—10 filters of one acre each.

In the first four galleries, the filter construction is of the usual concrete construction, with a groined arch roof supported by square concrete piers spaced 15 feet centre to centre. The floor is of inverted groined arch construction.

Gallery 5 has groined arch roof, with cylindrical piers spaced 14 ft. 10 in. centre to centre. The floor is flat. Upon a six-inch layer of re-inforced concrete was laid a water-proofing membrane consisting of two layers of wool felt and three thin layers of asphalt. Upon the water-proofing membrane was placed a 4-inch layer of plain concrete.

The filtering material consists of a foot of graded gravel and from two to four feet of sand. All filtering material was dredged from the Allegheny River, which bounds the City property on the south. The filter sand has an effective size of 0.29 m. m. and a uniformity coefficient of 2.1.

Galleries.

Covered galleries contain all piping required for the supplying of settled water to, and for the removal of the filtered water from the filters. They also contain all valves and appurtenances essential to operations.

Sand washers are also in the galleries, thus rendering it possible to clean sand conveniently in winter and summer, and by day or night.

The galleries are heated by steam supplied by the pumping station. A motor driven Sturtevant fan, eight feet in diameter is installed in each gallery, to aid in heating and ventilation.

Entrance from the galleries to the filters is effected by the use of large sluice doors much similar to battleship bulkheads.

In the first four galleries, the roof construction is of the groined arch type. In Gallery 5, the roof construction is of flat slabs of reinforced concrete.

Filtered Water Reservoir.

The Filtered Water Reservoir has a floor area of about 6 acres. It is about 1200 feet long, and holds 50 million gallons when filled to a depth of 25 feet.

The roof is of groined arch construction, and the floor is of inverted groined arch construction. The roof is supported by cylindrical piers, 27 inches in diameter, 21½ feet high, and spaced 18 feet centre to centre.

A reinforced concrete conduit, eight feet in diameter, extends the entire length of the main axis of the basin, serving as a by-pass from the inlet gate house to the outlet gate house. It also allows one-half of the basin to be filled to a depth of $10\frac{1}{2}$ feet while the other half is empty, thus permitting inspection of repairs without seriously interfering with operation.

Chronological Data.

Construction of the plant was started in 1905.

The first filtered water was delivered on Dec. 18, 1907. Filters were then thrown into service as rapidly as they were completed. From Dec. 18, 1907, until Oct. 3, 1908, Peninsula Pittsburgh was furnished water part of which was filtered. and part of which was raw river water. Starting Oct. 3, 1908, Peninsula Pittsburgh received filtered water exclusively.

The South Side, except a small portion known as Esplen, received filtered water on February 4, 1909. Esplen received filtered water on December 24, 1912.

The North Side was furnished partly filtered water on March 29, 1914. In July,1914, the new pumping station had progressed sufficiently to permit pumping practically all filtered water to the North Side. In December, 1914, the North Side received filtered wated exclusively.

Construction of the contact baffle system in Basin 3 was completed on December 24, 1912, but the filtering material was not entirely placed until June 22, 1913.

Construction of the contact baffle system in Basin 1 was completed on December 4, 1913, but the filtering material was not entirely placed until June 21, 1914.

Sterilization.

Calcium hypochlorite was first applied to the filtered water on Jan. 3, 1910. It was discontinued on Mar. 31, 1910. It was applied again from Nov. 16, 1910 to Apr. 25, 1911. From Aug. 18, 1911 to Nov. 7, 1915, calcium hypochlorite was applied to the filtered water continuously.

The rate of application was approximately three to three and one-half pounds per million gallons of water treated. From Nov. 7, 1915, to the present time, liquid chlorine has been applied to the filtered water at the rate of one pound per million gallons of water treated.

Starting November 29, 1911, calcium hypochlorite was applied to the raw river water pumped from Montrose Pumping Station to the North Side. This treatment was discontinued when the station was abandoned, in December, 1914.

Typhoid Fever.

Following is a statement of typhoid fever cases and deaths in Pittsburgh, not including non-inhabitants in institutions, since 1907:—

Year	Typhoid Cases.			Typi	oid Deaths.		
	Pen. Pgh.	So. Side	No. Side	Pen. Pgh.	So. Side	No. Side	
1907	3877	406	• • •	373	57	••	
1908	1082	270	363	128	33	60	
1909	326	131	297	36	15	41	
1910	295	97	435	43	10	63	
1911	196	76	373	33	13	61	
1912	145	81	108	17	12	15	
1913	245	106	108	27	15	15	
1914	148	62	66	22	7	18	
1915	146	50	63	21	3	13	

The populations of these districts were shown by the census of 1910 to be as follows:----

Peninsula Pittsburgh	295,452
South Side	106,170
North Side	132,283

Total 533,905

The estimated population for 1915 was 571,984.

In 1906, one out of every seventy-one inhabitants of Pittsburgh had typhoid fever during the year.

In 1915, one out of every 2208 inhabitants had typhoid fever. The resident typhoid case reduction therefore appears to be 96.8%.

In 1906, 6.8% of the deaths from all causes were resident typhoid fever deaths.

In 1915, 0.43% of the deaths from all causes were resident typhoid fever deaths.

PUMPING STATIONS.

Ross Pumping Station:

This station takes its supply from the Allegheny River, and pumps raw water directly to the sedimentation basins of the Fil-

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tration Plant. It also furnishes water to the sand-washing system, and heat and electrical current for the Filtration Plant. Pumping Equipment: 1-100 M. G. turbine driven, geared centrifugal pump; 4-35 M. G. compound engine direct driven centrifugal pumps; total head, 60 feet. Auxillary Equipment: 2-5 M. G. and 1-3 M. G. horizontal, tandem compound, direct acting, wash water pumps; total head 235 feet. Electric Generating Equipment: 3 compound engine direct driven, multipolar, three-wire D. C. 175 K. W., 500 volt generators; 1 motor driven arc light machine D. C. Steam Generating Equipment: 10-350 H. P. water tube boilers with economizer; steam pressure 160 pounds.

Brilliant Pumping Station.

This station receives its supply from the filtered water reservoir, through 2-72" suction trunks laid under the bed of the Allegheny River, and pumps to Highland Reservoir No. 1 and Highland Reservoir No. 2. Pumping Equipment: 4-15 M. G. and 4-12 M. G. vertical compound crank and fly-wheel pumping engines; 1-8. M. G. vertical, triple expansion, crank and fly-wheel pumping engine; total head, 380 feet to Highland Reservoir No. 1 and 280 feet to Highland Reservoir No. 2. Electric Generating Equipment: 1 compound engine, direct driven, 75 K. W. 110 volt D. C. generator; 1 compound engine, belt driven, 55 K. W. 110 volt generator. Steam Generating Equipment: (in course of construction) 7-500 H. P. water tube boilers; superheaters for 125 degrees superheat and economizers; steam pressure 190 lbs.

Aspinwall Pumping Station:

This station receives its supply from the filtered water reservoir, through a 72" suction trunk; this station being located in close proximity to the filtered water reservoir, and pumps to the North Side Reservoir. The elevation of this reservoir is the same as that of Highland Reservoir No. 2. Pumping Equipment: 4-20 M. G. vertical, triple expansion, crank and fly-wheel pumping engines. Total head 265 feet. Electrical Generating Equipment: 2 compound engine, direct connected, 100 K. W. 250 volt generators. Steam Generating Equipment: 6-275 H. P. water tube boilers; superheaters for 125 degrees superheat and economizer; steam pressure 160 lbs.

Herron Hill Pumping Station:

This station receives its supply from Highland Reservoir No. 1, through a 30° cast iron supply main, and pumps to Herron Hill Reservoir and to Bedford Reservoir. Pumping Equipment: 2—6 M. G. and 2—5 M. G. vertical, triple expansion, crank and fly-wheel

pumping engines; total head, 247 feet for Herron Hill Reservoir, and 115 feet for Bedford Reservoir. Steam Generating Equipment: 1 ---450 H. P. water tube boiler with superheater for 125 degrees superheat; 2---225 H. P. water tube boilers; steam pressure 150 lbs.

Howard Street Pumping Station:

This station receives its supply from the North Side Reservoir, through a 60" and a 30" suction line, and pumps to Spring Hill and Lafayette Tanks. Pumping Equipment: 1-8 M. G. and 1-5 M. G. vertical, triple expansion, crank and fly-wheel pumping engine; 3-3 M. G. horizontal compound, direct acting pumps; total head, 427 feet for Lafayette Tanks and 332 feet for Spring Hill Tanks. Steam Generating Equipment: 6-250 H. P. water tube boilers; steam pressure 125 lbs.

Mission Street Pumping Station:

This station receives its supply from Highland Reservoir No. 2 through a 60" and a 36" suction line, the 36" portion being laid under the Monongahela River, and pumps to the Allentown Tanks; Pumping Equipment: 2-7 M. G. vertical, triple expansion, crank and fiy-wheel pumping engines; total head 364 feet; Electric Generating Equipment: 1 turbine, direct driven, electric 25 K. W. 110 volt generator. Steam Generating Equipment: 2-325 H. P. water tube boilers with superheaters for 125 degrees superheat.

Lincoln Pumping Station.

This station receives its supply from Highland Reservoir No. 1 and pumps directly to the Lincoln Tank. Pumping Equipment: 2—1 M. G. horizontal, compound, direct acting pumps. Total head 383 feet. Steam Generating Equipment: 2—75 H. P. water tube boilers.

Greentree Pumping Station:

This station receives its supply from the Lafayette Tanks and pumps directly to the Montana Tanks. Pumping Equipment: 2 motor driven 75 H. P. 3 plunger pumps, capacity % of a million gallon daily, each.

RESERVOIRS AND TANKS.

North Side Reservoir:

The North Side Reservoir is located in Shaler Township, about 5 miles northeast of City Hall, and about one mile east of the borough of Millvale. It was completed in the fall of 1914. Type: Embankment and excavation, lined with two layers of concrete, separated by a layer of waterproofing; elevation 275.00; area 17 acres; depth 40 feet; capacity 151,000,000 gallons. The main gate house contains inlet, outlet and overflow control, together with recording gages.

Highland Reservoir No. 1:

Highland Reservoir No. 1 was built in 1874, in Highland Park, about 5 miles from City Hall, on the South Side of Allegheny River. Type: Embankment and excavation, paved with rubble; elevation 368.00; area 19.8 acres; depth 21 feet; capacity 117,000,000 gallons. Dividing wall to elevation of coping, dividing reservoir into two large bays.

Highland Reservoir No. 2:

Highland Reservoir No. 2 is located in Highland Park, about 1000 feet west of No. 1. Type: Embankment and excavation; floor lined with concrete, slopes paved with stone. Elevation: 276.50 same as North Side Reservoir and is cross-connected to it. Area 18.9 acres; depth 30 feet; capacity 125,000,000 gallons.

Herron Hill Reservoir:

Herron Hill Reservoir was built in 1880, about 2 miles from City Hall. Type: Embankment and excavation; bottom lined with concrete, slopes paved with stone. Elevation 559.00; area 2 acres; depth 21 feet; capacity 12,000,000 gallons.

Bedford Reservoir:

Bedford Reservoir is located on Bedford Avenue, near Ledlie Street, about ¾ mile from City Hall. Type: Embankment and excavation; lined with concrete. Elevation: 398.00; area 1.1 acres; depth 10 feet; capacity 2,800,000 gallons.

Tanks.

On the North Side there are four (4) pairs of open tanks, each 40 feet in diameter, 22 feet in height, and having a capacity of 207,000 gallons. These are known as the Greentree tanks, located at Montana Street at elevation of 692.10; Lafayette tanks, located at Lafayette Street at elevation of 583.50; the Nunnery Hill tanks located on Rising Main Street, and the Spring Hill tanks, located at Longlane and Erk Streets, both at elevation 503.00.

In the central city is the Lincoln tank, a closed tank, located at Brushton and the City Line. It is 40 feet in diameter; 25 feet in height and has a capacity of 235,000 gallons. It is at elevation 583.00.



Baum Boulevard Bridge over P. J. R. R.



Phipps Conservatory-Schenley Park.



Proposed entrance to Schenley Park.



North bank—Allegheny River— Ross and Aspinwall Pumping Stations.



Mission St. Pumping Station-South Side High Service.



Settling Basin No. 3-Filtration Plant.





North bank—Allegheny River— Ross and Aspinwall Pumping Stations.



Mission St. Pumping Station-South Side High Service.



Settling Basin No. 3-Filtration Plant.



Connecting two 60" Steel Lines under 100 lbs. Pressure—Aspinwall.



Brilliant Pumping Station.

On the South Side, in Allentown, are three (3) open tanks at an elevation of 598.00. These tanks are 60 feet in diameter, 40 feet in height and have a total capacity of 2,540,000 gallons.

All the above tanks are made of steel.

Distribution Mains In Service.

Sanuary 1, 1910					
Pipes			Pi	ipes	
Diam.	Length	Percent	Diam.	Length	Percent
Inches	Miles	of Total	Inches	Miles	of Total
* 4"	116.90	15.81	20"	28.23	3.82
6″	342.01	46.24	24″	11.11	1.50
8″	83.33	11.27	30″	17.97	2.43
10"	26.54	3.58	36″	13.66	1.85
12"	58.04	7.84	42"	4.68	.63
14"	.74	.10	48″	.98	.13
15"	9.41	1.27	50"	5.40	.73
16"	16.27	2.20	60"	3.24	.44
18"	.82	.11	66"	.32	.05
			TOTAL	739.65	100.00

(*) Includes a small amount of $1\frac{1}{2}$ ", 2" and 3" pipe. Above table does not include rising mains as follows:—8-Inch, 0.48 miles; 12-Inch, 0.92 miles; 16-Inch, 0.78 miles; 20-Inch, 2.61 miles; 24-Inch, 1.22 miles; 30-Inch, 1.25 miles; 36-Inch, 0.15 miles; 42-Inch, 0.02 miles; 48-Inch, 0.75 miles; 50-Inch, 1.39 miles; 60-Inch, 7.25 miles; 96-Inch, 0.35 miles.

RECENT WATER WORKS IMPROVEMENTS.

Filtration Improvements.

Character of Improvement	Status	Cost	Totals
Baffle System, Basin No. 3	. Finished	\$160,000.00	
Repairs to Gallery No. 5	. Finished	140,000.00	
Baffle System, Basin No. 1	. Finished	180,000.00	

\$480,000.00

Pumping Station Improvements.

Character of Improvement	Status	Cost	Totals
60" Rising Main No. 3 to			
Highland Reservoir No. 1.	Finished	60,000.00	
Mission Street Pumping			
Station—Complete	Finished	475,000.00	

66 THE CITY OF PITTSBURGH AND ITS PUBLIC WORKS.

48,000.00
11,000.00
5,000.00
60,000.00
160,000.00
875,000.00
100,000.00
60,000.00

\$1,854,000.00

*Roadways and Waterproofing not complete.

Distribution Improvements.

Character of Improvement Sta Relaying and Raising Mains, North Side, West End and Du-	atus Cost	Totals
quesne Way Flood Districts Fini	shed \$ 86,000.00	
Relaying Mains, Hump District. Fini	shed 54,000.00	
Monongahela River Crossing, Second Avenue Main, South		
Side Main and ConnectionsFini	shed 105,000.00	
Allegheny River Crossings at		
26th St. and Point BridgeFini	shed 230,000.00	
Miscellaneous Main Extensions. Fini	shed 510,000.00	
North Side ReservoirFini	shed 952,000.00	
Meter Extensions 1914-16 In Prog	gress 510,000.00	
Meter Extensions 1917-20.Contempl	ated 700,000.00	

\$3,147,000.00

Summary.

Filtration Improvements	.\$ 480,000.00
Pumping Station Improvements	. 1,854,000.00
Distribution Improvements	. 3,147,000.00

Grand Total\$5,481,000.00

PENNSYLVANIA WATER COMPANY.

The Pennsylvania Water Company furnishes the water supply for a number of boroughs lying East of peninsular Pittsburgh and also supplies a section of the City situated on the Easterly boundary line, including a considerable portion of the Thirteenth and parts of the Twelfth and Fourteenth Wards. The Boroughs supplied include those adjoining the City on the East, in the Turtle Creek Valley, and those bordering the Monongahela River between the City Line and Turtle Creek.

The water supply is taken from three filter cribs located in the bottom of the Allegheny River at Nadine Station, about one and onehalf miles above the City's Brilliant Pumping Station. A small quantity of water is also taken direct from the River. The water is pumped against a head of about 630 feet to a purification plant located about a mile from the River and flows thence by gravity to the reservoirs and distribution system. About ten million gallons per day is supplied.

The pumping plant is of interest on account of the type of pumping machinery which has been in successful operation for more than ten years. The pumping equipment consists of two main units each having a capacity of ten million gallons daily. These are vertical, cross-compound, condensing pumping engines, having mechanically operated water valves. These engines have a piston speed of 540 feet per minute, and hold the record for duty for compound pumping engines 157,300,000 and 163,700,000 feet pounds per thousand pounds of steam, respectively.

The purification plant consists of sedimentation basins where the coagulant is added and ten mechanical filters, each unit of 1,250,000 gallons per day capacity. Hypo-chlorite of lime is added immediately before the water is delivered to the filters. From the filtered water reservoir at the plant the water is conveyed to the distribution pipe system and other distribution reservoirs.

The distribution system consists of 161 miles of pipe, ranging from 4-inches to 42-inches in diameter. Water is distributed at pressures varying from a few pounds per square inch on the hill-tops to a maximum of 210 pounds, a considerable portion of the distribution system being under from 125 to 175 pounds pressure.

The total population supplied by this company is about 110,000 and the service is practically all metered. The filter plant has been, in operation for six years with uniformly satisfactory results. The typhoid death rate in the district served has averaged about seven per year.

TESTING LABORATORY.

Physical and chemical tests of materials used by the City are

made by the Bureau of Tests, which is in charge of a Director of Tests.

The Laboratory is well equipped with facilities for making both chemical and physical tests of various materials. The mechanical installation includes a 300,000 pound Universal machine for tensile and compression tests; a standard brick rattler; a complete equipment for the physical testing of rubber materials; ductility and penetration machines for asphalt, and other equipment and apparatus.

At this laboratory not only these materials used by the Department of Public Works are inspected and tested, but also materials purchased and used by other bureaus and departments. Among the materials which are tested in the ordinary course of business of the laboratory, are the following: Portland cement, paving and sewer brick, refined asphalt and flux, asphalt wearing surface (samples taken from pavements being laid under contract), wood block, creosote oil, water-proofing materials, bridge timber, concrete, sand, gravel, coal, soap, lubricating oil, brass, bearing metal, fire, street and filtration hose, and other materials. Tests are made to determine not only the physical and chemical qualities of the materials, but also to determine the value for payment.

Research work is also carried on by the Laboratory and some interesting experiments and research work have been done upon paving materials, particularly relating to asphalt and wood block. Data and information regarding materials for the preparation of specifications are also supplied to the various bureaus and departments.

A valuable feature of the laboratory is in the records which are kept showing the life and relative good or poor qualities of materials used in construction work, particularly those used in street paving and wearing surface. These records show the analyses of materials used and their performance during a term of years. Tests are made at the laboratory and where necessary, as in the case of wood block treatment, at the point of origin.

REFUSE DISPOSAL

Separate collections of garbage, rubbish and ashes are made. Garbage and rubbish are collected and disposed of by contract while ashes are privately disposed of by householders and commercial places. There are two contracts for the disposal of garbage and rubbish, one covering the North Side and the other the balance of the City. The contracts relating to the collection and disposal of these wastes was entered into in 1912 and expires February 1, 1918. Under the terms of these contracts, the companies receive \$3.00 and \$2.25 per ton, respectively, for the collection of rubbish and garbage.