AQUAFAX

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ST. LOUIS BUILDS NEW WATERWORKS

EDWARD E. WALL, *Director of Public Utilities*, City of St. Louis.

As long ago as 1911 it was seen that some provision must be made for an additional water supply for St. Louis within the following fifteen years. A thorough survey of the condition of the existing works was made together with the possibilities of increasing it to its utmost economical capacity. This was the first thorough investigation that had been made of the water supply of the city of St. Louis for twenty-five years.

A comprehensive plan for reconditioning and increasing the capacity of the existing works was submitted to the Board of Public Improvements and was approved by it. It has been substantially carried out as originally planned, at a cost of more than $5,000,000.

The estimates of the average daily consumption of water in St. Louis made in 1911 have proven to be almost absolutely correct and the capacity of the existing works will be fully taxed by the end of 1926.

New Intake on Missouri River

In looking over all possible sites for the location of a new waterworks on the Missouri or Mississippi rivers, it was found that the best available site was at Howard Bend on the Missouri River, about eight miles above St. Charles, Missouri. There the south shore line had not materially changed in forty years, as shown by government maps. The river is very wide at this point and between its banks are several islands and sandbars, splitting the stream into three separate channels.

No matter where the waterworks would be located on either of the large rivers it would be necessary to control

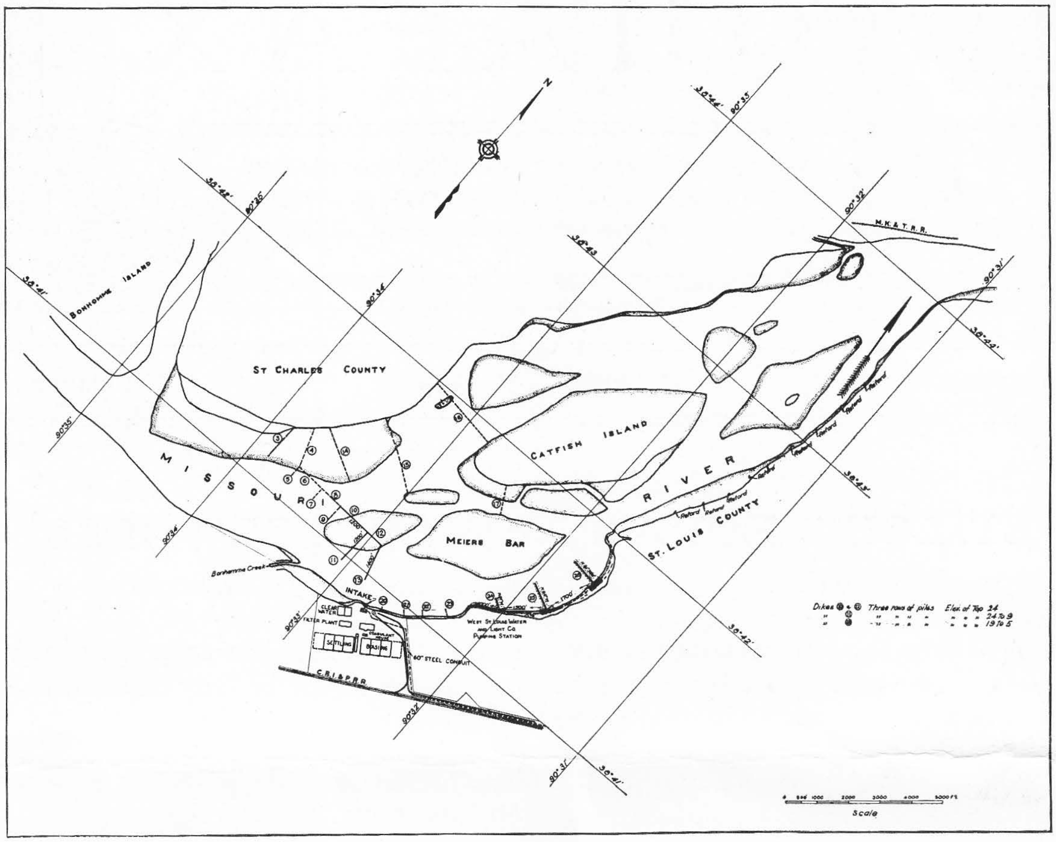


Plate I: Showing the location of the dikes constructed for channel control.

the channel, and it was decided that it would be just as easy to force the main channel to run against the south shore as it would be to maintain it in mid-stream a thousand feet from shore. It was therefore decided that we would build a shore intake with the low service engine pits directly adjacent to the screen chambers back of the intake ports.

The range of the Missouri River between high and low water is about 35 feet, so that the intake ports had to be provided on various levels.

In order to force the main channel over to the south shore, a system of dikes was designed and was approved by the U.S. Engineers Officer in charge of the Missouri River. Altogether fifteen dikes have been built to date at a cost of about $650,000.

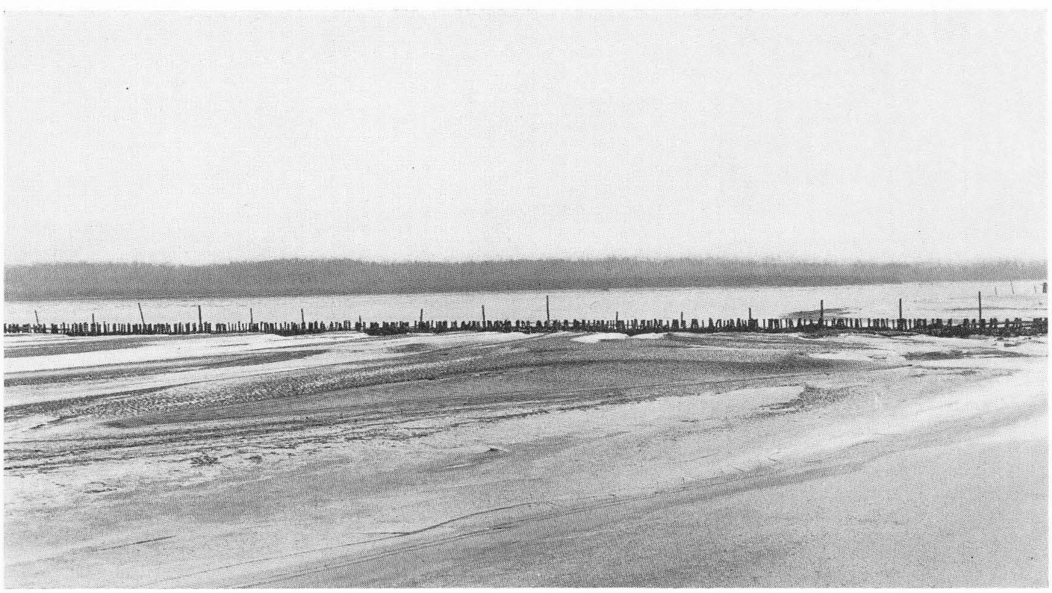
Dikes Control River Channel

The result of the construction of these dikes is that the water has been forced over to the south shore and several hundred acres of land have been reclaimed on the north side of the river. Probably the next high water will result in still larger accretions to the St. Charles County side of the river. Dikes numbered 3, 4, 5, 6, 7, 8, 9, 14, 15, 16, 17, 20, 21, 22 and 23 are the ones that have been completed, as shown on Plate I.

Heavy Silt a Problem

The Missouri River carries a tremendous amount of suspended matter. Last year it was reported from the Kansas City waterworks that a maximum of 16,000 parts per million of suspended matter was found in the water. In our laboratory, tests of samples taken at Howard Bend showed 12,000 parts per million. This meant that keeping the intake clear would be a serious problem, particularly if it were located in midstream and somewhat inaccessible. The large amount of suspended matter would also tend to make the use of long tunnels a dangerous proposition; but, with a shore intake and everything accessible from the land, it is believed that these troubles will be avoided, as well as the trouble of choking up with ice in the winter time.

Operating the intake towers of our existing waterworks, where they are located 1,500 to 2,000 feet from shore, has often given us serious concern and has been a source of a great deal of worry to the operating force. We be-



Hurdle dikes, built to maintain the Missouri River channel, form huge sandbars.

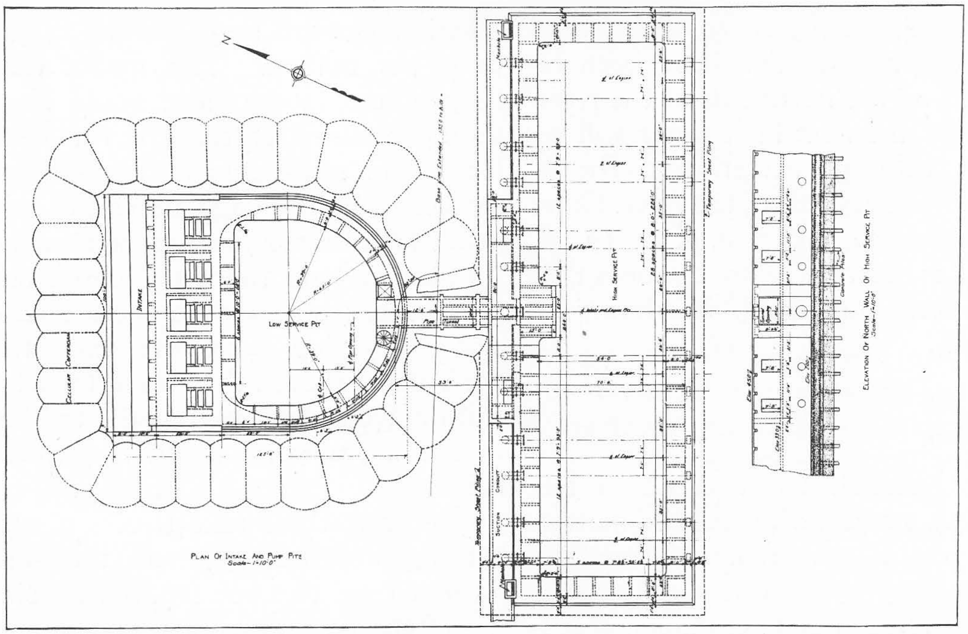


Plate II: Plan of the pump pits and intake, showing also the plan of the cofferdam.

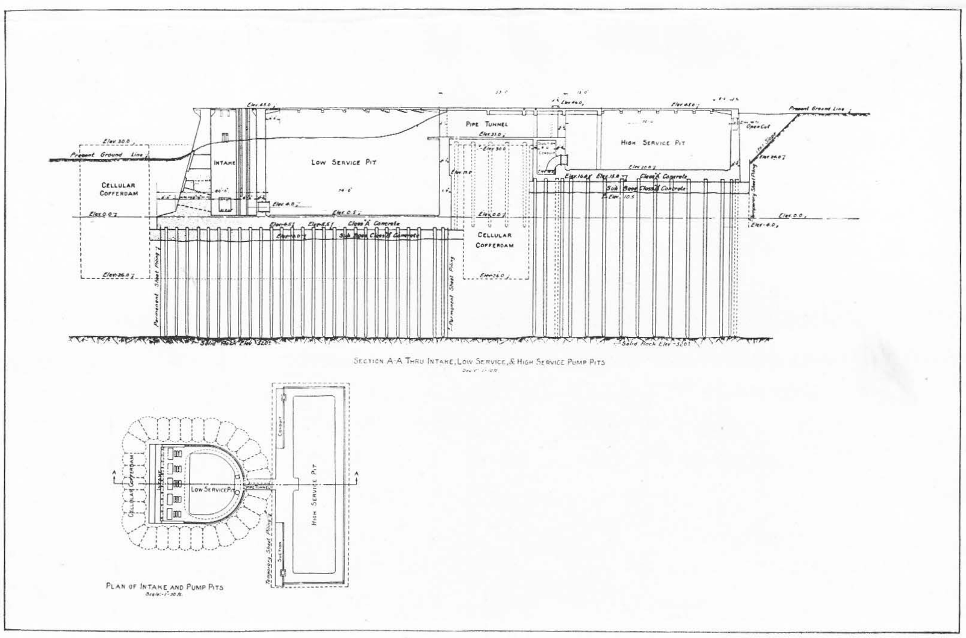


Plate III: Sectional view of the pump pits and intake.

lieve that the shore intake will eliminate all these troubles.

On the other hand we found the construction difficulties for a shore intake at Howard Bend very much more serious than those we encountered in building the existing works on the Mississippi River. At Howard Bend the rock was found to be 92 feet below the surface, covered by sand and silt with an occasional thin layer of gravel. Our design called for the construction of the bottom of the intake and engine pit to be 10 feet below mean low water, which meant that the excavation for the foundation would have to be 10 feet lower, or 20 feet below low water. This indicated that the bottom of the excavation for the foundation would have to be 30 feet below the ordinary stage of the river.

Building the Shore Intake

To inclose the engine pit and intake, which are built together as one structure, would require a cofferdam more than 100 feet wide and more than 125 feet in length. It was decided to build a cellular cofferdam with the cells made of interlocking steel sheet piling 56 feet long—the cells approximately to be 24 by 15 feet—locked together with arched ends to resist any pressure from the outside.

The plan of the intake and engine pits, together with the plan of the cells of the cofferdam, is shown on Plate II.

The steel sheet piling in each cell was set up with the cell closed completely before driven home. The bottoms of the cells were 36 feet below low water, but still about 25 feet above rock. This left the danger of water from the river coming under the cells and into the cofferdam when excavated and unwatered. In order to meet this difficulty a ring of interlocking steel piling 48 feet long was driven to rock after the cofferdam was completed and the sand and silt dredged out to the subgrade for the foundation.

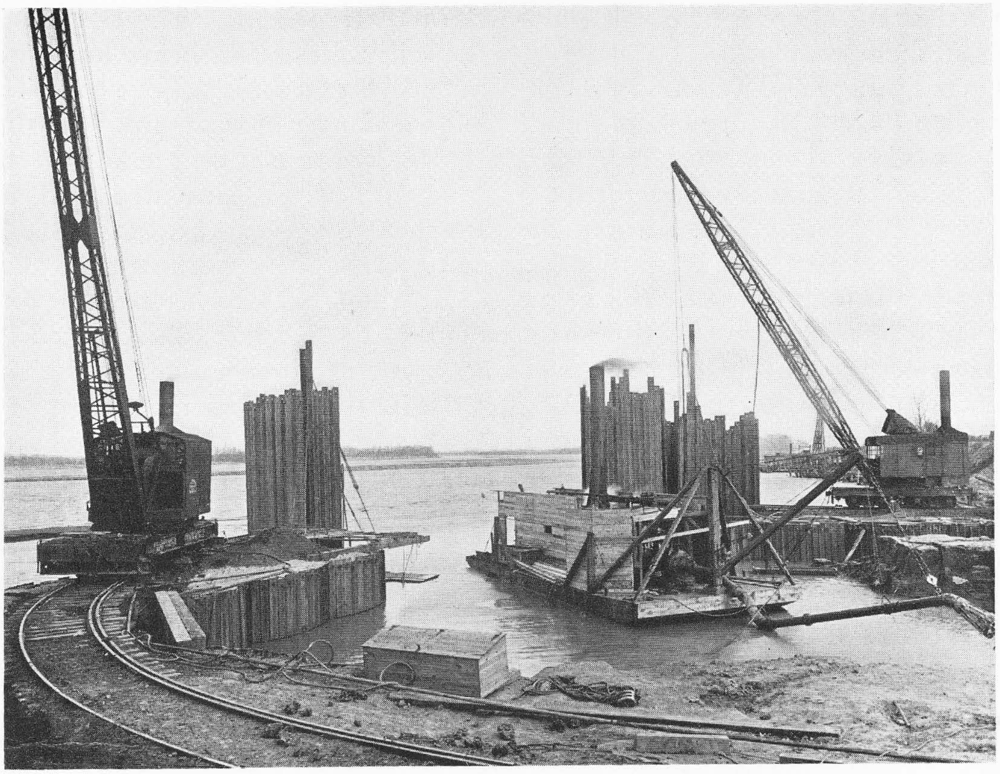
Then inside of this ring of steel sheet piling there were driven to rock 538 reinforced concrete foundation piles 58 feet long. These piles were driven while the cofferdam was full of water, the top of the pile when driven being about 40 feet below the water surface.

Progress of Construction

Then the subbase of concrete, 5 feet thick, was placed over the entire bottom inside the cofferdam, sealing it and making it water-tight. When it was unwatered there was no leakage inside the ring of steel sheet piling. There was some leakage outside the ring next to the cells, which was easily kept down. Plate III shows a section of the intake, low service pit, the foundation piles and, in dotted line, the cellular cofferdam. Plate IV shows the cofferdam when unwatered.

It will be noticed that a number of the piles could not be driven to rock. Out of the 538, about 27 failed to reach rock.

On this subbase was built the rein-



Setting up and driving the steel sheet piling for the cellular cofferdam.

forced bottom and the side walls of the intake and low service engine pit. Just south of the low service engine pit and adjacent to it is the high service engine pit, whose inside dimensions will be 54 feet by 224 feet. As this engine pit is much shallower than the low service engine pit, as shown on Plate III, the cofferdam inclosing it was made of a single row of interlocking steel sheet piling driven about 15 feet below the subgrade of the bottom. The tops of these piles were anchored back to dead men. The sand and silt were then dredged out of the pit and 555 foundation piles of reinforced concrete 68 feet long were driven to rock. The subfoundation of concrete, 5 feet thick, has just been placed in this cofferdam; it will not be unwatered for several weeks or, possibly, not until spring—depending altogether on weather conditions.

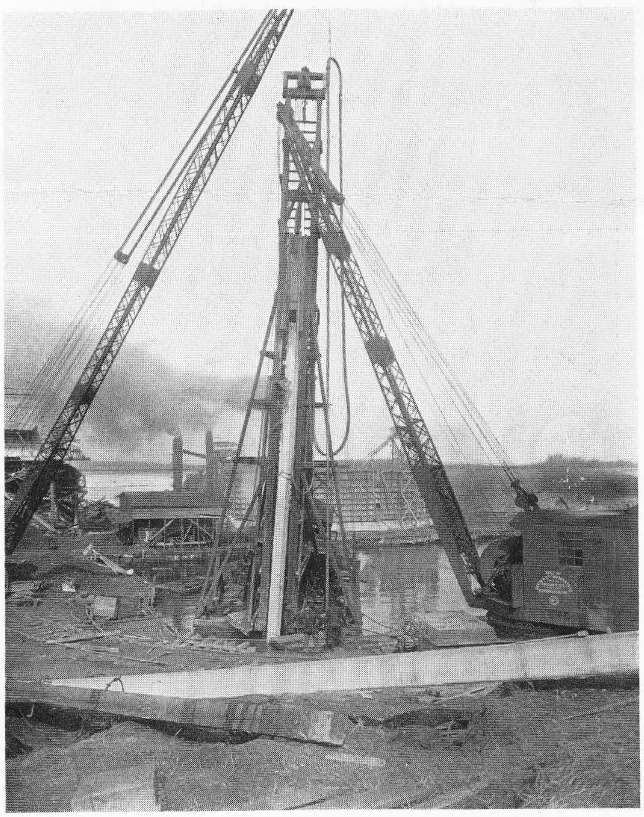
The plans contemplate the building of six settling basins, grit and mixing chambers, coagulant house, filter plant, clear well and other minor structures, together with all necessary sewers, drains, pipe lines, roads and switch track. The plans for superstructures and engine and boiler houses probably will be completed within the next sixty days. The filter plant plans and specifications are practically completed and bids are likely to be asked for shortly.

Plan of New Waterworks

All buildings will be of white native limestone; all pumping engines will be turbine-driven centrifugals.

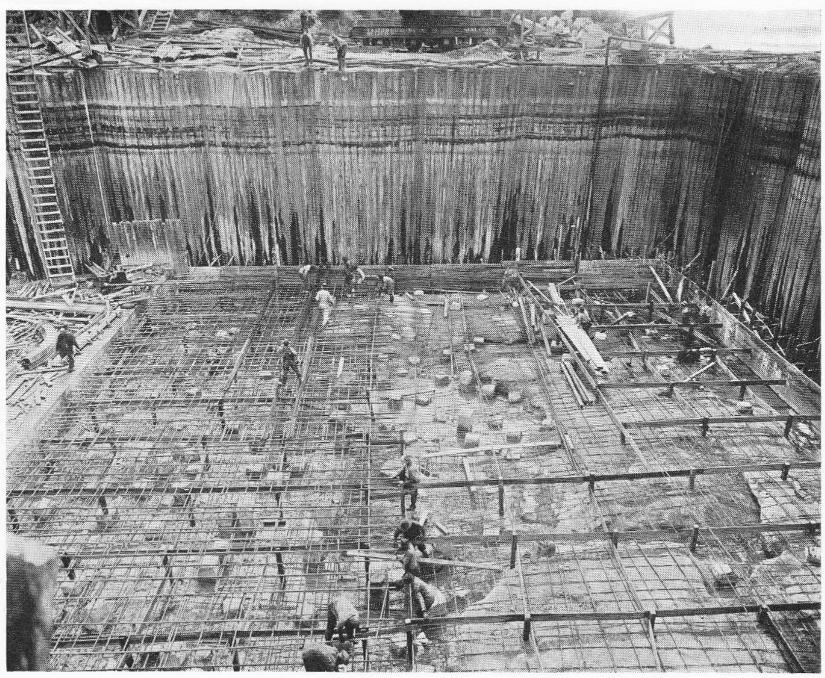
The low service engines will discharge through the grit and mixing chambers into the settling basins, from which the water will pass through the filter plant into a clear well, out of which the high service engines will pump the filtered water to a 100,000-000-gallon reservoir nine and a half miles to the east.

This reservoir is on a plateau of the highest elevation in St. Louis County, being more than 100 feet above any point inside the city limits. The first section of this reservoir is now under contract; it will have a capacity of 100-000,000 gallons and will be built of reinforced concrete. It will be covered.

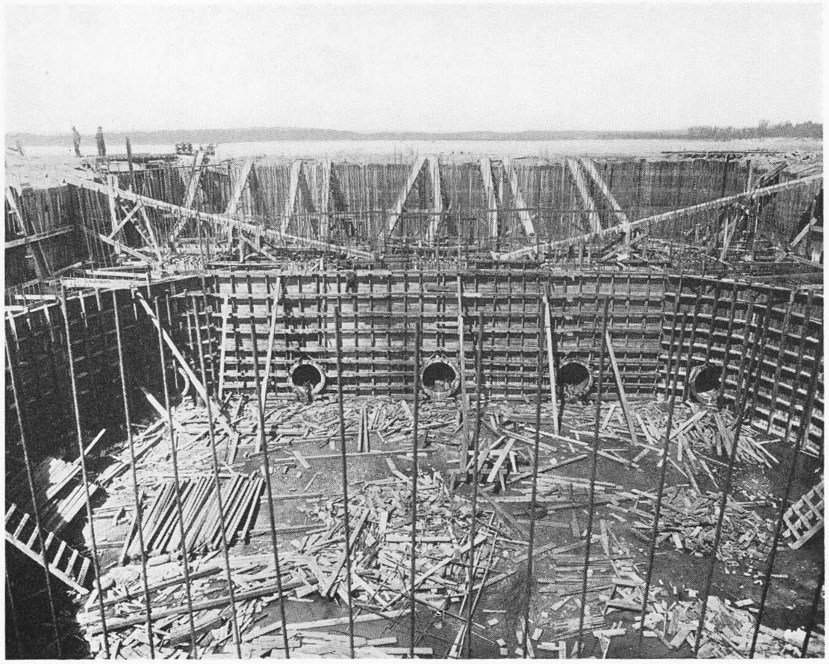


Driving 58-foot reinforced concrete foundation piles in the cofferdam.

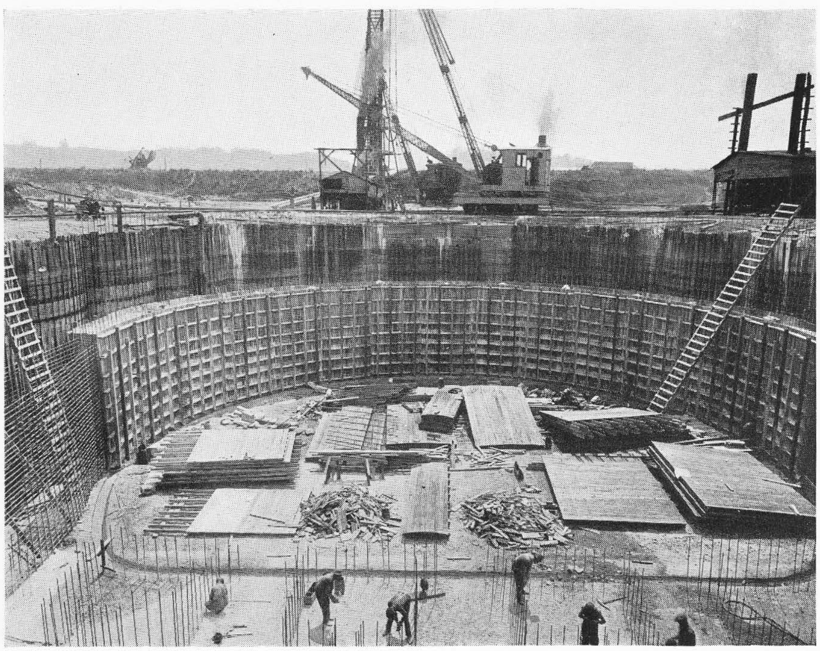
Plate IV: Cofferdam immediately after being unwatered.



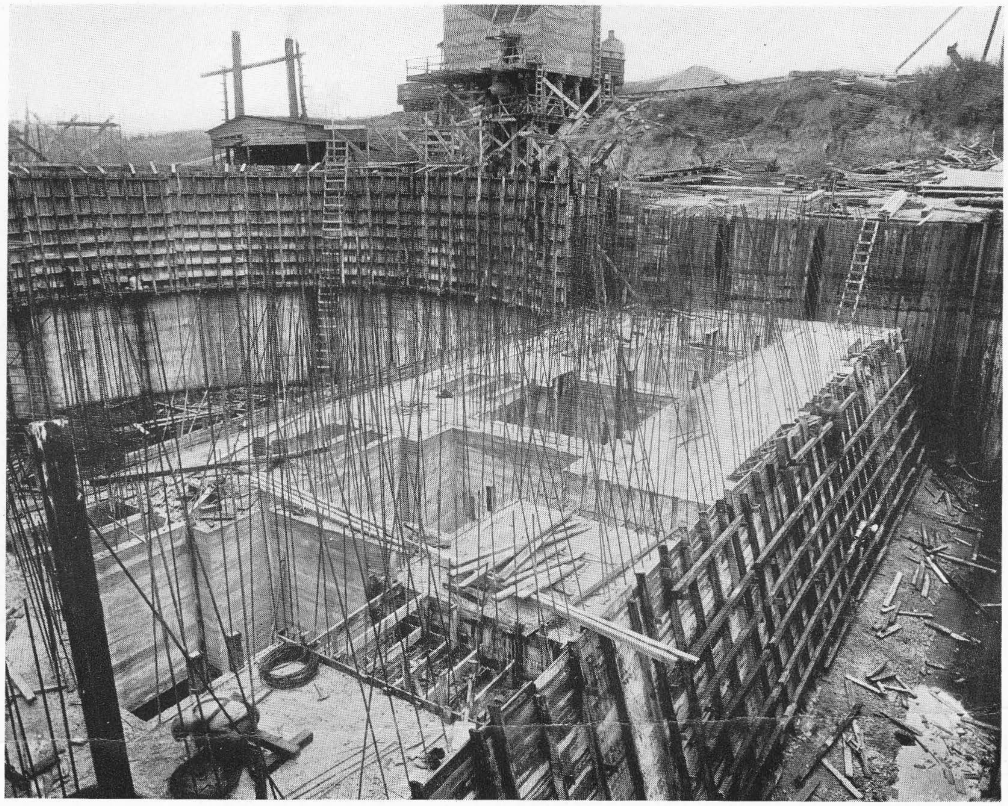
Placing the reinforcing steel for the base of the low-service engine pit.



A view of the work and reinforcement in the side walls of the low-service engine pit —also of the five suction pipes of the low-service engines.



A view showing the first section of the south wall of the low-service engine pit poured and the reinforcement where it joins the intake.



The heavy concrete walls of the intake, under construction.

Later on a second section of the same size and design will be added.

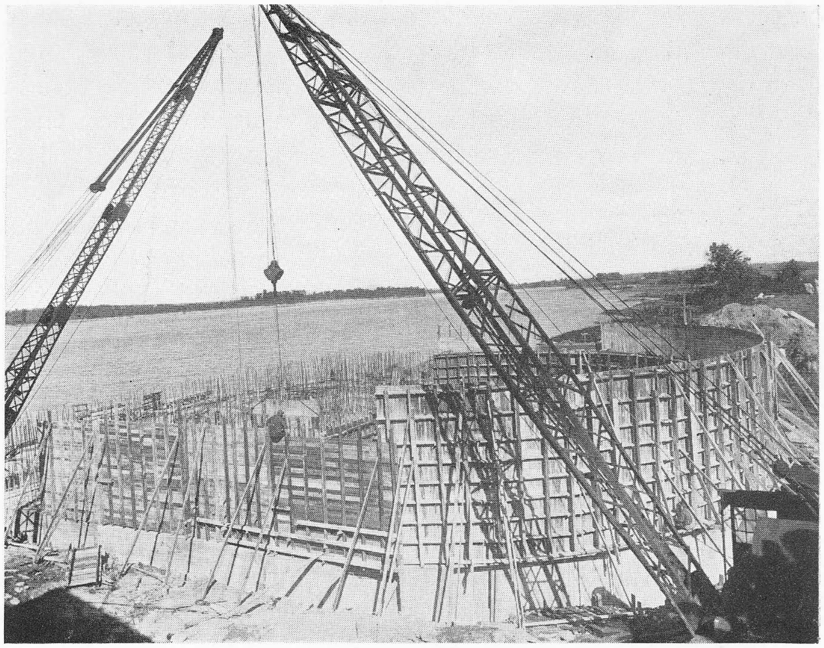
Steel Pipe Lines Laid to City

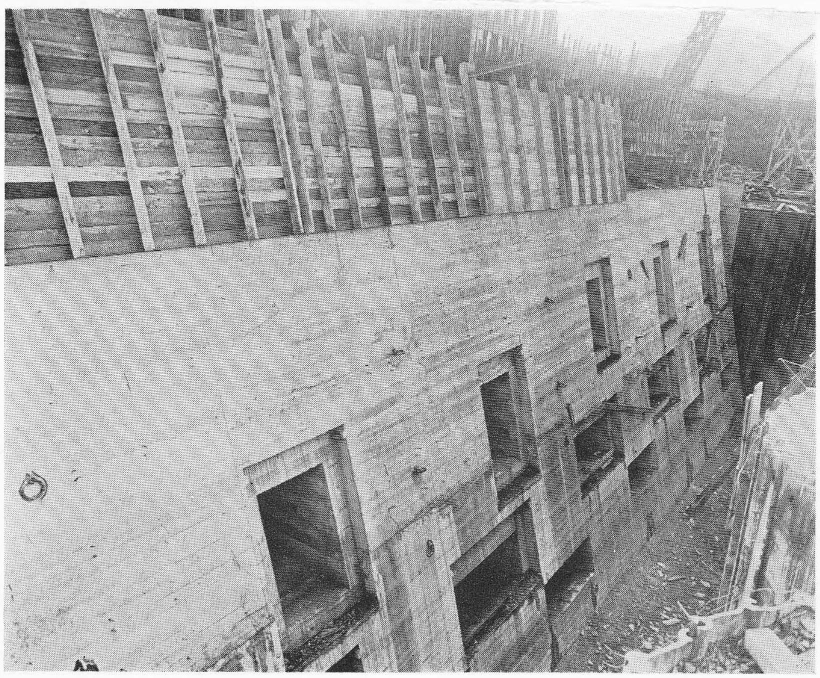
From this reservoir the water will flow to the city by gravity some six miles through 60-inch steel mains. The initial installation provides for a capacity of 60,000,000 gallons daily, to be eventually increased to 200,000,000 gallons daily; the latter will require at least three 60-inch steel mains from the pumps to the reservoir and from the reservoir into the city. One of these steel lines is under contract and two-thirds of it has been completed.

As rapidly as the plans and specifications can be prepared bids will be requested for all of the remaining structures as well as for the necessary machinery, so that the plant should be ready to pump water into St. Louis in the latter part of 1927 or early in 1928.

This new plant is supplemental to the existing waterworks, which will be kept in service indefinitely. The present plant has a capacity of from 160-

The low-service engine pit as it approaches the top; this view also shows the reinforcement of the intake walls.





The river side of the intake showing the ports. All of these, except the lowest row, will be covered with heavy steel gratings to keep out drift and ice, the gates being on the inside of the wall. The lowest ports are below the lowest recorded stage of the river.

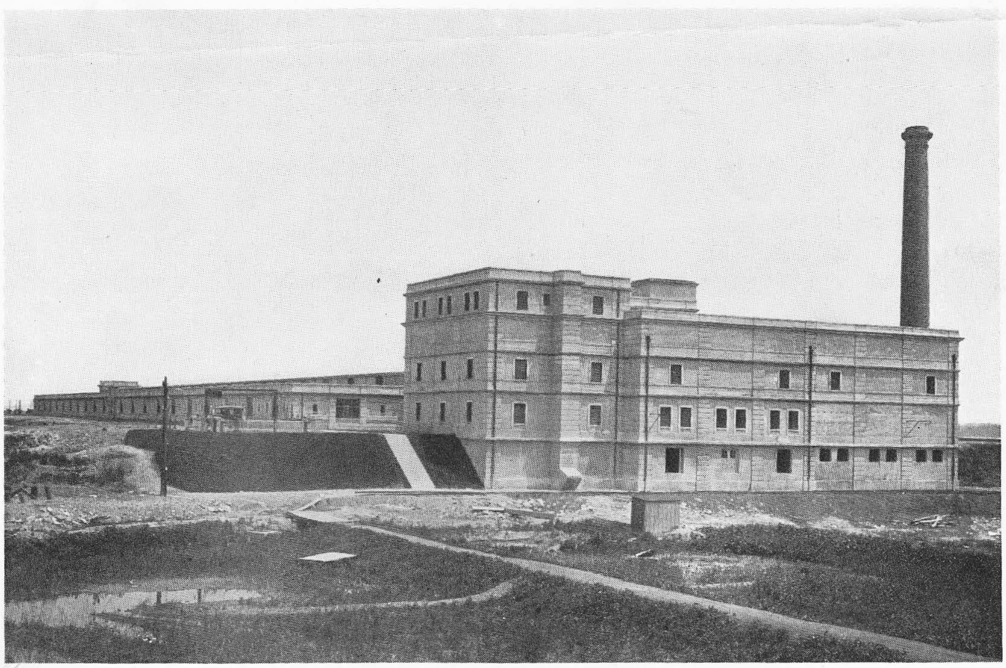
000,000 to 200,000,000 gallons daily. The new plant will start delivering at a uniform rate of 30,000,000 gallons daily, the existing plant taking care of the fluctuations in consumption.

Provisions for Future Consumption

It is estimated that we will have to increase the capacity of the new plant to care for an average daily consumption of 60,000,000 gallons by 1940; to 100,000,000 gallons by 1950; and to 160,000,000 gallons by 1960. That the waterworks may be able to supply these average quantities, the capacity of the plant itself must be at least 50 per cent greater than the average consumption of St. Louis at all times.

Construction on the river control works was begun in August, 1923, but actual work on the intake and engine pit was not started until 1924.

Incidental to the main parts of the waterworks which have been mentioned in this article, is the building of roads, railroad switches and the minor appurtenances of the modern water supply, all of which require time, study, skill and experience. To build an up-to-date waterworks, of 200,000,000 gallons daily capacity, modern in every respect, starting on virgin soil, within a period of five years, is in itself rather a notable achievement—one which has rarely, if ever, been paralleled.



Part of the present waterworks of St. Louis—the headhouse and filter plant.