

and pump 100 million gallons per day. This project was put under contract in 1913, but was discontinued in 1916 as unprofitable, owing to various circumstances and changes of conditions, such as the breaking out of the war, and the reduced cost at which purchased power for pumping could be obtained, by reason of the great increase in water power development around Montreal, since the aqueduct widening was first mooted. These delays and interruptions in carrying to completion the aqueduct widening will serve to explain the heterogeneous character of the main steam pumping plant at the present day.

In 1909 it was surely thought that the city within three years would have its pumping done by water power to the extent of 50 million gallons per day. Again in 1911, after the changes in plans to enlarge the projected capacity from 50 to 100 million gallons per day, it was again considered certain that within five years time, or by 1916, the city's pumping would be all done by water power, and the old steam plant would be left to be remodeled at leisure, to serve as a reserve.

Meantime, the water consumption was increasing by leaps and bounds. In the four years, 1910-1914, the daily average consumption increased from 38% to 55% million gallons per day, or over 44 per cent., a greater rate of increase than it had shown in the preceding nine years. During this time steam pumps and boilers were added from year to year, as the wants required and as expediency suggested, within the restricted limits of the pumping station area.

**Description of Existing Supply**

The city's water supply is drawn from the St. Lawrence river about a mile above the Lachine rapids, and at a distance of about five miles from the city. The supply intake is 1,200 ft. from shore, the river at this point being about three-fourths of a mile wide. The water is brought down by gravity a distance of 5 1/4 mi. to the main pumping station, through a covered concrete conduit, circular in shape with flattened invert, practically of 8 1/2 ft. in diameter, having a capacity at the lowest stages of the river, of 80 million Imperial gallons per day.

At the lower end, and to the south of this supply conduit, is the filtration plant, to which the water is led by gravity. Raised by low-lift pumps to the prefilters, the water flows thence to the final filter beds and the filtered water reservoir, being repumped from there to the level of the suction well feeding the main supply pumps. The filtration plant of 50 million Imperial gallons' capacity at present, filters only about three-fourths of the water supplied the pumps. Plans for its enlargement are under way. The whole supply is, however, sterilized by hypochlorite.

The main or low-level pumping station situated at the end of the supply conduit, near the south-western limits of the city has a pumping capacity of 108 million Imperial gallons per day, furnished by means of eight steam pumping engines as follows:—

Pumping Engines Nos. 1, 2 and 4, of the horizontal reciprocating type, Worthington Duplex high-duty steam pumping engines with combined daily capacity in Imperial gal. ....	30 Millions.
Pumping Engines Nos. 3, 5, 6 and 7, of the centrifugal type, high lift pumps, direct connected to high-speed vertical triple expansion engines working at 350 r.p.m., with combined daily capacity in Imperial gal. ....	48 Millions.
Pumping Engine No. 8, De Laval centrifugal high-lift pump geared to steam turbine, with daily capacity in Imperial gal. ....	30 Millions.
Total of 8 pumps with daily capacity in Imperial gal. ....	108 Millions.

The oldest of these pumps, Nos. 1 and 2, were installed in 1886 and 1893 respectively. They are the least efficient machines of the pumping plant, and are to be replaced within a year by two 30-million-gal. electrically-driven high-lift

centrifugal pumps for which contracts have been let. No. 4 pump, installed in 1905, is of more modern type with a trial duty test of about 160 million foot-pounds. The four high-lift centrifugal pumps driven by direct-connection to triple expansion vertical engines of enclosed type at 350 r.p.m., installed from 1909 to 1913, are representative of the change from the reciprocating to the high-lift centrifugal type of water works pumping engines. Their efficiency rating on trial was from 108 to 114 million foot-pounds duty. Their compactness, simplicity and freedom from the number of moving parts of the reciprocating type, as also their adaptability for working under variable loads, have shown them to be a very reliable type of water-works pumping engine. These pumps discharge the water through the force mains against the reservoir head and into the city's distribution system. There are six pumping force mains: one of the 36-in., two of 30-in., and three of 24-in. The others connect more directly and feed into the distributing service pipes throughout the city, as well as being indirectly connected with the reservoir. Thus the system may be said to be direct pumping with regulation of pressure due to the head from the reservoir of limited capacity.

The main reservoir, McTavish reservoir, situated at the head of McTavish Street on the slopes of Mount Royal, about 1 1/2 mi. from the pumping station, has its water surface at elevation 204 above low-water level of the harbor. Its capacity is 37 million Imperial gallons, or about four-sevenths of last year's average daily consumption of 65 million Imperial gallons.

From the early settlements along the river front, the natural expansion of the city was towards the slopes of Mount Royal. In configuration, the city is laid out in main thoroughfares paralleling the river, the cross streets rising towards the mountain in gentle grades to the level of Sherbrooke Street, beyond which begins the slope of the mountain. The elevation of Sherbrooke Street at McTavish Street is 120 ft. above, and the distance some 6,000 ft. from the river.

The business or commercial section of the city lies principally in the lower levels of the city. The pressure head due to the McTavish reservoir supplies the system up to about elevation 130 above the harbor, furnishing water pressures of 80 lb. in the pipes of the down-town district to 35 lb. at the level of Sherbrooke Street.

**High Level System**

Above Sherbrooke Street and generally in that area spread out around the eastern slope of the mountain extends the high level system. The high level or Peel Street reservoir, situated on the mountain slope at the head of Peel Street has its water surface elevation at 422 ft. above the harbor. Its capacity is 1 3/4 million Imperial gallons. The high level system is supplied by repumping the water from the McTavish reservoir level. There are two pumping stations for this purpose: McTavish Street and Papineau Ave. stations. The pumping is done by high-lift centrifugal electrically-driven pumps, with two units, one of 6 and one of 5 million Imperial gallons in each station. The average daily consumption for 1919 of the high level system was 11.9 million Imperial gallons.

**Upper Level System**

To provide for water supply to the still higher residential districts of Cedar Ave. and Redpath Crescent, confined in area by the limits of Mount Royal Park, the upper level system was installed about nine years ago. This consists of a covered reservoir of 200,000 Imperial gallons' capacity hollowed out in the Mount Royal Park at elevation 550 above the harbor. The water is repumped from the high level system to this upper level by a duplicate set of electrically-driven units each of a capacity of 150,000 Imperial gallons per day.

To supply the high levels of Notre Dame de Grace ward, annexed to the city in 1910, there is also provided a booster pumping station on Western Ave. to repump the water from the main low level system. The pumping is done against the pressure head due to 3 tanks of 100,000 gal. capacity and