INTERIM REPORT OF COMMISSION OF ENGINEERS APPOINTED TO REPORT UPON THE PRESENT AND FUTURE WATER SUPPLY FOR TORONTO.

Toronto, November 30th, 1911.

To His Worship the Mayor, and Members of the Board of Control:

GENTLEMEN,—We, your Commissioners, upon whom you have imposed the duty of making a study of the needs of the City of Toronto in the matter of its water supply, and of reporting to you the measures which should be taken to insure both the sufficiency and the purity of that supply, now respectfully report the extent of our investigations and our recommendations based thereupon. We have gathered a large volume of information which it was essential that we should have before we could arrive at conclusions that would be based upon ascertained facts, and this information we shall embody in appendices to our report, that it may become of permanent record; its value being so great that it should be so preserved.

Likewise we have had prepared for our use a large number of maps, charts and graphical exhibits which are of permanent value and which should become records of the Public Works Department of the City.

The history of the water works of the City has also been gathered and reduced to a concise form and will find its place among the appendices. We have been greatly aided by the data relating to water supply given us by the authorities of several American Cities, many of them Lake Cities, with problems analogous to our own.

With this brief preface we will now take up in their order the questions which bear upon the Water Supply of Toronto.

SOURCE OF SUPPLY.

From what source shall Toronto draw the water for its potable and industrial needs?

We are satisfied that the only two sources of supply which come within the range of serious consideration are: 1st, Lake Simcoe; 2nd, Lake Ontario.

Lake Simcoe has a drainage area of 1,100 square miles and a water surface of 250 square miles. Assuming that the evaporation from the lake equals the rainfall over its area, we have 850 square miles from which to derive the water supply by run off. We are advised that the average annual rainfall is 30 3-4 inches nearly, and the average annual run off about 15 inches. From these ascertained facts we derive a discharge into the lake of 939 cubic feet per second, but the report of the Hydro-Electric Power Commission gives the low water flow of the Severn River, which is the outlet of Lake Simcoe, as only 633 cubic feet per second. Now allowing 118 imperial gallons per capita—which is about the water consumption in

Toronto—100,000 inhabitants would require 3 2-3 per cent. of the low water flow of the Severn; the present population of Toronto (assumed as 350,000), would require 12 8-10 per cent., 500,000 would require 18 1-3 per cent. and a population of 1,000,000—to which Toronto can look forward with reasonable assurance—would require 36 2-3 per cent. We have been advised by the City Solicitor, in an opinion transmitted to us in a letter dated August 5th, 1911, that "the City has, under existing statutes, no power to secure a water supply from Lake Simcoe." It is hardly within the range of reasonable expectation, in the light of the facts recited, covering the volume of flow and the City's requirements, that enabling legislation can be secured under which this water can be taken by Toronto, and the procurement of this legislation is less probable in view of the further fact that the Dominion Government proposes canalizing the Severn River as a part of the Trent Valley Canal System and will require that the natural level of the lake shall be maintained.

Moreover, the waters flowing from the lake through the Severn River are being used for power development by one municipality and by one power company under vested rights of which the users cannot be deprived without just compensation.

But there are further reasons why this lake should not be used as the source of supply for Toronto. A careful comparison of the results of chemical analyses of the waters of Lake Simcoe with those of Lake Ontario shews that the Simcoe waters are higher in ammonias, both free and albuminoid; lower in the nitrites and nitrates; higher in oxygen consumed in four hours and in fifteen minutes; lower in chlorine; higher in total solids, and lower in loss by ignition. The bacterial count is very greatly in favor of Lake Simcoe; but, contrary to our expectation, colon bacteria were found in the samples taken for determination of micro organisms. Of thirty-nine (39) samples, five (5) shewed colon.

Our conclusion is that there is nothing in the chemical constituents or even in the micro organic conditions which would lead us to prefer Lake Simcoe to Lake Ontario as a source of supply. While our estimates of cost have not been carried to a conclusion they have gone far enough to satisfy us that the outlay required to bring Simcoe water to Toronto will largely exceed the cost of taking the supply from Lake Ontario.

We consider Lake Ontario as being the best and most available source of water supply for Toronto.

The chemical and bacteriological investigations carried on for us in Lake Ontario have been extensive, though not exhaustive, and they have given us some surprising results; results which run counter to beliefs hitherto held by us; beliefs which were generally accepted, viz: that the deep water was not only cold but practically sterile. The analyses shewed that deep water may be the habitat of pathogenic bacteria.

On August 9th, Dr. Amyot secured thirty-nine samples of Lake Ontario water at varying depths. No. 13 at 60 feet depth contained 4,250 per c.c. No. 16 at surface contained 7,000 c.c., No. 21 at 75 feet depth 60,000 c.c., and No. 38 at 50 feet depth 30,000 c.c.* On this day no surface sample shewed. (Note: * indicates colon bacillus). On September 1st nearly all surface samples shewed * as did all deep samples at 50 feet depth, but one. An examination of the tables giving analytical results is both instructive and interesting, and leads to the inevitable conclusion that pathogenic micro organisms may be encountered at any depth.

These investigations also lead to the conclusion that there is no locality along the lake front, from Mimico to Scarboro Heights, which has an assured purity, and, further than that, it is demonstrated that waters fifteen miles from shore are not free from contamination; hence there is no one locality within the range under consideration at, or on, which you can locate a water intake with assurance that the water taken into it will be free from contamination; although at times healthful water could be secured at almost any chance location. And, therefore, we have no expectation of obtaining a water supply which must not be subjected to efficient artificial method of purification.

Sewage Contamination.

With the disposal of the sewage of the City as an academic question we have no present concern; with its disposal as a practical question we must deal, because the City is using now—and proposed to use hereafter—its reservoir or source of water supply also as a means or method of sewage purification; a condition which is abhorrent to all ideas of hygiene. This process has been going on ever since Toronto outgrew its wells and its privies at the rear of the lots.

A continuation of this process means the gradual but inevitable lowering of the quality of the water which constitutes the City's supply for potable and other domestic uses. In support of the statement that the quality of the lake water is steadily deteriorating may be cited the great increase of the chlorine contents disclosed by analyses extending over a period of thirty years. As the quality deteriorates the danger to health increases, and the cost of guarding against that danger becomes each year a heavier burden.

Toronto Bay has been the receptacle for Toronto's sewage ever since the City began the use of sewers, with the result that the waters of the Bay serve to dilute the sewage to a degree that renders the outflow from it non putrescible; they are, however, heavily laden with micro organisms, some of which are pathogenic. The circulation of water in this bay is caused by wind action; at times the water flows out of the Eastern Gap and is replaced by water from Humber Bay entering through the western passage, and with shifting winds the flow is reversed, and it passes out through the

western passage and enters through the Eastern Gap. When these contaminated waters escape into the lake they are the sport of the wind and are driven east, west or south, according to the quarter from which the wind comes. The City has built an intercepting sewer system and proposes to emancipate Toronto Bay from servitude to sewage. This is all right for the bay, but as we understand the working out of the project, about 30 per cent. of the solid contents of the sewage will be removed, and the remaining 70 per cent., with the greater proportion of the micro organisms peculiar to sewage, will be discharged into the lake east of the Eastern Gap and about 3,500 feet from shore in 25 feet of water. This, in our judgment, creates a condition vastly more harmful to the water supply of Toronto than is the existing condition with the sewage discharging into the Bay. It is true that the water supply is soon to be filtered, and that filtration may be counted upon to remove about 98 per cent. of the micro organisms. This means much or little according to the number of micro organisms in the water treated; a raw water with 5,000 bacteria per c.c. would shew an elimination of 4,900 after passing through the filter, and could be accepted as a safe water, but a raw water with 10,000 per c.c. would let 200 per c.c. pass, and that would be an unsafe water. Our analyses show as high as 60,000 per c.c. It is said that the sewage will be so diluted by the vast body of lake water into which it will be discharged that it will be rendered innocuous. We do not accept that theory; we know from our own observations that bodies of polluted water will often times move in mass. Unless there is violent wave action or some internal commotion to disturb it there is no reason why the discharged sewage should diffuse itself into the surrounding pure water. Hence, a body of this highly polluted water may swerve to the intake and be drawn into it at any time. We have seen converging streams flow together for many miles after their confluence, with a clear line of demarcation between their waters. A notable case in point is that of the St. Lawrence and the Ottawa Rivers. The former being a fairly clear stream and the latter almost always tawny in color. Then we have as an illustration rivers that discharge into tidal waters. The tide rises and backs the river water up, raising it often several feet; the upper part of the stream maintaining its freshness and offering a water dam to the invading salt water.

We believe that the sewage from the disposal works should be disinfected before it is allowed to pass into the lake.

The proper works for treating the sewage before it is discharged into the lake will require the occupation of a considerable area of land.

In the tract known as Ashbridge's Bay, the City owns approximately 550 acres. We believe that at least one-fourth of this tract, or to state it roundly, 150 acres, should be reserved to provide the needed ground for sewage disposal works. We suggest that all of that part of the tract lying east of Leslie Street be reserved for the purposes indicated.

Supply for the Present and the Near Future.

The intake pipe from the crib which has been in use since 1893 has been repaired and is now undergoing careful inspection to determine what further work must be done upon it to make it secure. A contract has been let for a new crib and intake pipe located to the south-west of the existing intake. Both the present supply pipe and the one to be laid will lead to pumps at the new filter plant, which plant is now about to be put into commission. The rated capacity of this filtration plant is 45,000,000 Imperial gallons per day. The two supply pipes will furnish together 100,000,000 gallons per day. The 72-inch pipe which passes from the filter beds to the tunnel will deliver 56,000,000 gallons per day. There is across the Island an unused 60-inch main which should be repaired, lowered to proper depth and connected with both tunnel and filtered water reservoir. These two pipes would be capable of delivering 100,000,000 Imperial gallons to the eight foot tunnel, which has ample capacity to convey that volume of water to the pumps in the City Pumping Station. The capacity of the filter beds should be doubled, also the pumps that deliver the water from the intake mains should be duplicated, and the available supply when these things are done would be 90,000,000 gallons per day. That volume could be delivered to the City pumps. The nominal capacity of the City's steam pumping plant is 50,000,000 gallons, and of its electrical pumps 54,000,000 gallons. Conditions have arisen in our neighbor City of Buffalo which have demonstrated that it is both unsafe and unwise to depend wholly upon electrically operated pumps for the City water supply; and that City is reinforcing its electrical plant with a steam plant of a capacity equal to all requirements. So in our judgment it would be wise to add a steam pump of about 25,000,000 gallons capacity to the plant now installed.

The new intake and crib is now under contract, and provision is being made for paying for it. Likewise provision has been made for meeting the cost of the repairs to the old intake pipe.

Estimate of Cost.

The cost of duplicating the Filtration Plant would probably equal the cost of the original installation, or say	$750,000
The cost of lowering, repairing and connecting the 60-inch conduit in Blockhouse Bay	50,000
One 25,000,000 gallon pumping engine.....	155,000
Three 200 h.p. boilers	20,000
Engine House and Boiler House complete	50,000
Engineering and superintendence, 10 per cent.	105,000
	$1,130,000

This outlay, for the purposes designated, would make the water supply sure and safe during the period which must elapse before the additions to the plant, which we shall recommend, can be constructed.

Of course there must be extensions of the water pipe system of the City which we have not considered and, therefore, cannot indicate what we think should be done in that direction.

It has been the experience of the larger cities in the United States that it is unwise to concentrate at one point all of the pumping plant required to meet the needs of public water supply. Chicago has eight major pumping plants and three minor ones. It has four intake cribs distributed along its twenty-two miles of water front. These cribs are capable of supplying 635,000,000 gallons per day, an amount nearly forty per cent. in excess of the needs of the present population of 2,250,000 people, and designed to keep in advance of a reasonable expectation of growth. It has in use over forty-nine miles of water tunnels and 2,270 miles of water mains. Its water system proper had cost, up to December 31st, 1909, $45,782,420. In addition to this sum $66,000,000 has been expended in diverting the sewage from Lake Michigan, with the result that the typhoid fever death rate which was 173.8 per 100,000 inhabitants in 1891, was reduced to 15.6 in 1908. No City can foul its water supply and drink the polluted water without paying the penalty with the lives of its citizens.

Future Provision.

We believe that in the future, not remote, but as proximate as it is possible to make financial provision for, the City should enter upon the construction of a second intake and water supply system to be cross connected with the present system of water mains. We believe that this plant should be located about nine miles east of the City Hall in the locality known as Scarboro Heights.

The description of this plant is as follows: A modern intake crib on the lines of those built for Chicago and for Buffalo should be constructed two miles from shore in water approximating 100 feet in depth. Crib building has not been attempted in water of that depth heretofore, but we have developed a design which we believe can be successfully constructed in water 100 feet deep, or even deeper. This crib should be connected with the pumping plant on shore by a tunnel of diameter not less than ten feet. Our borings and all of the information that we have been able to secure indicate that the material through which this tunnel would be drifted is of shale or rock well suited to such construction. The mains from the pumping station should lead to a filtration plant from which the filtered water should pass into reservoir to be constructed on ground which is 355 feet above the lake level. This reservoir should be a covered structure occupying 20 acres of land and providing for a depth of 25 feet, its capacity with these dimensions would be 130,000,000 Imperial gallons. From this reservoir a large part of the City could be supplied by a gravity flow.

The advantages of this proposed development appear to be the provision of an inevitably needed additional water supply from a location further

removed from the danger of pollution from the City environment and water sheds of the Don and Humber; the location chosen commends itself in view of the trend of residence development toward the east, and the almost certain enlargement of the corporate jurisdiction in that direction. The high ground available affords an ideal site for a reservoir from which distribution by gravity flow can be secured for the lower level and therefore the greater part of the City.

For the present system the total supply is pumped twice, first at the Island, secondly at the John Street Pumping Station, and about one-third of the supply is repumped at the High Level Station. With a reservoir at the higher elevation at Scarboro, 95 per cent. of the supply required to meet present demands would be pumped once only.

The land north and north-west of the Town of North Toronto has practically the same elevation as Scarboro Heights, and we have under consideration the ultimate construction of a second reservoir in this vicinity as a reserve for the western section of the City. It should be noted, however, that for the higher districts, or say all that section that has an elevation exceeding 150 feet above Lake Ontario, repumping will be necessary whatever site be selected for a reservoir.

The utility of having in reserve in the reservoir about two and one-half days' supply to meet emergencies due to accidents or to the necessity of laying up one or more pumps for repairs, must be recognized as an insurance of great value.

Water Waste.

The Commission has not yet had the time or opportunity to devote attention to the waste of water and the means of prevention. This subject is of great importance, especially in the light of the present high per capita consumption, and it is our intention to gather data and to submit our conclusions in connection therewith at an early date.

Plans and Estimates.

The time at our disposal since we secured the data upon which to base our conclusions has not been long enough for us to work out plans in detail upon which to predicate estimates of the cost of the new work which we now merely outline, and therefore we would ask for your further indulgence and patience until such time as our full report with all details is formulated.

Respectfully submitted,

Board of Commissioners, *re* Water Works,

Isham Randolph,
T. Aird Murray,
Willis Chipman.