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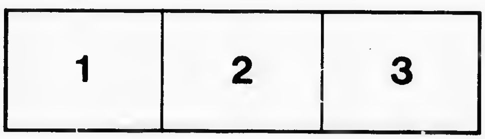
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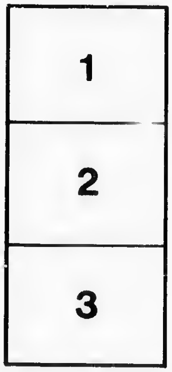
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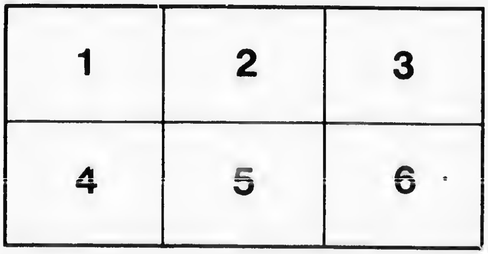
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+ 3 Map Plans

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Canadian Society of Civil Engineers.

INCORPORATED 1887.

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THE DARTMOUTH, N.S., WATER AND SEWERAGE WORKS.

By F. A. Creighton, Stud. Can. Soc. C. E.

To be read Thursday, March 1st, 1894.

In the year 1875 Mr. T. C. Keefer, M. Can. Soc. C.E., was called to Dartmouth, N.S., to report on the cost of a system of water-works for that town. The most feasible plan seemed to be a gravity system, supplied from Lamont and Topsail Lakes, a splendid natural reservoir situated among the hills, distant about three miles to the northeast of the town. Mr. Keefer had an extensive survey made of these lakes as well as of Loon Lake, which, as will be seen by the plan, is situated to the east of Topsail Lake and is distant from it about 1500 feet. Mr. Keefer reported with plans and estimates, and the matter was dropped for the time. The question of the introduction of water was raised from time to time, until finally in the latter part of the year 1889 Mr. E. H. Keating, M.I.C.E., at that time City Engineer of Halifax, was called upon to make plans and estimates for the immediate introduction of a water and sewerage system. When the estimates and plans were ready, a public meeting of ratepayers was called, which, however, was adjourned for one year. A meeting was held in January, 1891, when the ratepayers authorized the Council to ask permission of the Legislature to borrow the sum of $100,000 to introduce the water and sewerage systems into the town, and the works were finally begun in the fall of 1891.

WATER SUPPLY.

The plans of Messrs. Keefer and Keating were followed in the main, and the water brought from Lamont and Topsail Lakes. (Plate III.)

These lakes are at an elevation of 225 feet above the mean tide level of Halifax Harbour, and have a combined watershed (exclusive of the lakes themselves) of 588 acres, mostly of thickly wooded land. The combined area of the lakes is 163 acres, Lamont being 22 and Topsail 141 acres. The depth of the lakes ranges from 12 to 25 feet, and the bottom is for the most part gravelly, though the north end of Lamont Lake has a considerable area of muddy bottom.

The stream between the lakes was originally about 2 feet deep and 350 feet long, but this was enlarged to a canal 8 feet deep and 4 feet wide at the bottom, with the side slopes rip-rapped for their entire length.

Lamont and Topsail Lakes are capable of supplying to the town 750,000 gallons per diem, while for the present 250,000 is all that will be used. The storage capacity is 234,000,000 gallons.

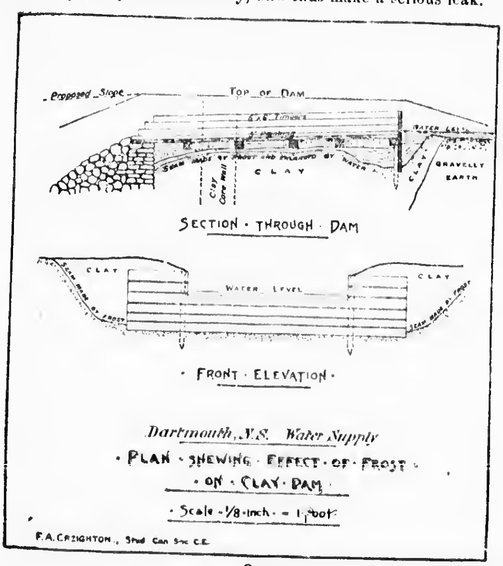
The efficiency of these lakes may be more than doubled as soon as necessity arises, by the addition of Loon Lake, which, as has been mentioned above, is distant from Topsail about 1500 feet. This lake belongs to a different watershed from Topsail Lake. It was the reservoir of the old Shubenacadie canal, and is some 3 feet lower than Topsail. Before connecting Topsail and Loon Lakes the water level of Loon would of course have to be raised, which could be done by means of a dam about 150 feet long at the outlet at a cost of $500. It is proposed to connect the lakes by a 24 inch crock pipe, laid so as to take the overflow of Loon Lake. This pipe when laid as proposed can deliver, running full, some 2,600,000 gals. per diem, thus largely increasing the available water supply. The total cost of the connection is estimated at $5000.

DAM AND GATE HOUSE.

The dam and gate house are situated at the foot of Lamont Lake. The original dam was built to supply water for a grist mill, but the mill had not been in use for some years when the town took the lake for its supply. The old dam, which was built roughly with stones, brush, and other rubbish, was raised 2 or 3 feet and the gate house built in the front part. When the lakes rose, the dam was found to be leaking considerably. The different leaks were repaired as they appeared, but finally a trench 2½ feet wide was cut along the whole length of the dam, down to a bed of clay some 2 feet under the original ground surface, and filled with well puddled clay. This seemed to stop the leaks effectually, and no trouble was experienced till February 7, 1893, when it was found to be leaking about the waste-weir, and an examination showed as follows: It will be seen by the sketch how the waste-weir is constructed. It is 12 feet wide and set into the dam some 2½ feet. 6 in. x 8 in. timbers bedded in the clay are put in running across the weir 4 feet apart. These are planked over with 3 in. plank, caulked and run with tar to keep the water from making its way through to the clay. Another layer of 3 in. plank is put on as a protection from the sun when no water is running over the weir. Stakes are driven down in front at the lake end of the weir, and 3 in. plank extending 4 feet out on each side of the weir spiked to them. 6 in. x 6 in. timber sides are then put in, with the timbers well fastened together with ragbolts. Then clay is well rammed down in front of the apron and around the sides. A dry wall is built at the back of the dam under the weir, and loose rock thrown in behind to break the force of the water falling over.

Frost action.—It is known that as frost works down through clay it expands the clay, which of course must rise, and anything in the clay must of necessity rise with it. Thus it will be seen that as the frost found its way down past the apron in front of the dam, each plank, as the frost reached it, rose and separated from the one below it. In our case there were spaces of from ½ to 1 inch between them, while the first short plank at the sides was separated from its neighbour fully 2 inches.

Then as frost goes down through clay there is always a space (usually half filled with ice needles) between the frozen ground on top and that unfrozen underneath. It will readily be seen that as soon as the frost had worked down below the water-level, the water would begin to find its way between the lifted planks in front, and along the seam made by the frost, and out into the stones behind the dam. It would not be long before the water would wear away a considerable quantity of the soft clay, and thus make a serious leak.



The state of the dam at Dartmouth was about as shown on the sketch. The ground at the side of the weir had risen by the action of the frost and taken the weir up with it. This left spaces between the planks, and the frost had then made a seam below the water mark, admitting the water, which rapidly wore away the dam.

To repair this temporarily, the lake was dammed off in front of the weir, and the apron in front double planked, breaking joints. The planks were nailed on one side only, so that if the frost raised them again no harm would be done. Each plank would work against its neighbour and always keep a tight joint. Clay was then puddled in front and rammed back as far as possible under the weir. This stopped the leak, and about a week later the wood of the waste weir was taken out, the space filled up, and the weir removed further along to the end of the dam, where it has a gradual fall back to the tail race.

In the spring it is intended to carry the slope of the dam back some 90 or 100 feet, which will give the inside of the dam a slope of about 20 to 1.

The Gate House.—The gate house is set in the front of the dam. The intake ditch is 6 feet wide at the bottom, with side slopes varying from almost perpendicular at the gate house to about 3 to 1 at the outer end. The sides are rip-rapped for the entire length. The ditch runs out into the lake about 125 feet to deep water on a level with the bottom of the gate house. The foundation and wing walls are built of rubble and cement masonry When the lakes first filled up, this wall was found to leak considerably, so a coating of cement concrete 4 inches thick was put on the inside; this did not stop it, so a similar coat was put on the outside, and this seemed to make the wall tight. After the lakes filled up a second time, however, a slight run of water came out of the end of the waste flume. This leak has not yet been located, but will probably be repaired as soon as the frost is out of the ground.

As will be seen by the plan of the gate house (see Plate—) there are two sets of screens, they are of copper-gauze and set 4 feet apart. The screen frames, as well as the sluices and guide timbers, are made of pitch pine. Some difficulty was experienced at first by these swelling on coming in contact with the water, but after being planed down they gave no more trouble.

The opening in front of the gate house is two feet wide, and runs the whole depth of the wall. This opening is covered with an iron grating to prevent sticks, loose ice, etc., from coming in contact with the screens.

The waste sluice at the back of the house, which may be used to drain off the lakes, is built 3 ft. high and 2 ft. wide; it is made of 6 in. x 6 in. hemlock, fastened together with rag bolts, and braced inside every 6 ft. The bottom floor is 8 ft. 9 in. below the high water level of the lake, and the top of the town supply pipe is 6 ft. 2 in. below the water level.

THE MAIN PIPE LINE.

The main pipe from the lakes to the town is 12,600 ft. long. It starts from the gate house with 20 in. pipe, which continues for about half a mile, where it is reduced to a 12 in. which runs a distance of 9,300 ft. to the town. In the line, there are 3 blow offs and 3 air cocks. For a distance of 800 ft. just before the end of the 20 in. pipe there is a hill rising above the lake level; this had to be cut through to a depth of 23 ft. in order to get the pipe down to grade. At a place 1,300 ft. from the lake the trench bottom was found to be too soft to lay the 20 in. pipe on; so a platform of 2 in. plank was built for a distance of some 75 ft.

At the upper canal bridge (see Map, Plate II.) the 12 in. pipe is reduced to a 10 in., and a special left to take an 8 in. pipe down Portland st., to the lower canal bridge, thence across the bridge, to connect with the 6 in. pipe at the corner of Portland st. and Wilson lane. This pipe will serve as a safeguard in case of the water having to be turned off the 10 in. pipe at present supplying the town.

The 10 in. pipe runs from the upper bridge 1,600 ft. along Ochterloney st. to Dundas st., where the distribution commences. This pipe is laid across Sullivan's pond. The pond was drained off for the purpose, and the pipe laid in a shallow trench in the bottom.

The main line as well as 1,500 ft. of the 10 in. pipe is jointed with wood instead of the ordinary lead joint. This has been proved to be quite as efficient a joint as lead, while the saving in cost, as will be seen later, is considerable.

The joint is made about as follows :—The staves are made of the best white pine, and are cut to the exact curve of the pipe for which they are intended. They are from 4 to 5 inches long and 3 inches wide, and about $\frac{1}{8}$ in. thicker than the space they are intended to fill. To make the joint, steel wedges are driven into the faucet under the pipe, so as to force the spigot of one pipe well up against the faucet of the other. Then the lower third of the faucet is filled with the staves, driven as tightly as a man can with a heavy hand hammer. The wedges are then taken out and driven in on top, so as to drive the pipe firmly down on the staves below, and the upper two-thirds of the staves first started in, and then driven firmly home with a hammer weighing 7 or 8 lbs. The staves are then forced apart with a small steel wedge, and pine wedges of the same material as the staves driven into the spaces. This makes a good tight joint, and in every way as lasting a one as lead ; but care must be taken in putting in the small wedges, to put in enough and drive them well home, as one of them left out means a considerable leak. If a wood joint does leak it will be seen that, on account of the wood swelling, it must tend to get better instead of worse, as would be the case with lead.

One great advantage of the wood joint over lead is that it can, if necessary, be made with as much as half of the pipe under water. This saved an expensive cofferdam in one place in Dartmouth, where the pipe had to cross a loose rock embankment across a pond—a distance of about 300 ft. Had lead joints been used, the pipe would have been laid along the side of the embankment and a cofferdam built to keep out the water.

Of course, before adopting wood joints, care must be taken to see that the castings are made reasonably smooth, as any projecting piece of iron on the faucet will peel off the stave as it is driven in, and thus cause a leak. In the pipe used in Dartmouth, some of the pipes were rather rough, and considerable trouble was found in getting some of the joints tight.

The following table will give about the saving effected in Dartmouth by the adoption of the wood joints :

Diam. of Pipe.	Cost including laying. Wood.	Cost including laying. Lead.	Saving per joint	No. joints.	Total saving.
	$ c.	$ c.	$ c.		$ c.
20 in.	1 38	2 30	92	205	188 60
12 in.	90	1 15	55	870	478 50
10 in.	77	1 25	48	125	60 00
					$ 727 10

This saving, together with the saving of the cost of the cofferdam referred to above, would dig up and repair a great many joints if they should happen to leak on account of wood not making so sure a joint as lead.

DISTRIBUTION.

The distribution system is shown in dotted line on the plan (Plate II.) The 10 in. pipe runs down Ochterloney st. as far as King st., where it is reduced to an 8 in., this runs as far as Water st., then turns along Water st., as far as Stairs st. An 8 in. also branches off and runs along King st. as far as Portland st. The south end of Water st., Prince st., portions of King and Wentworth streets and Quarl and Portland streets are laid with 6 in. pipes. Boggs, Green, Dundas and part of Wentworth streets and Wilson's lane are laid with 4 in.

The following are the lengths of the different sizes of pipes in the town:

584 ft 10 in. pipe.
1943 " 8 " "
6054 " 6 " "
2033 " 4 " "

The extensions shown on the plan will probably be made next summer (1893), this will include 3760 feet 8 in., 6250 feet 6 in., and 788 feet 4 in. pipe.

The pipes are all in 12 feet lengths, and are made by the Londonderry Iron Co. They have given every satisfaction, only 4 being broken on the main line, and when the pressure was put on in the town, only one broken pipe showed up, which was a 6 in. split for about 3 feet in the middle. The special castings were made by the Truro Foundry Co., and the valves are of the Ludlow pattern and made by Stevens & Burns, London, Ont.

The pipes in the town, with the exception of 300 feet of 6 in. and 250 feet of 8 in., are all jointed with lead. The pressure in the town was so great that it would have been difficult to make wood joints in the small pipes tight without having the water on to test them as they were laid. The difference in cost between wood and lead joints in the small pipe would have been very slight. The 300 feet of 6 inch pipe laid with wood is on Water st. from Ochterloney to Quarl, and has not shown a single leak though under a pressure of 95 lbs.

The dead ends and specials left for future extension were plugged with a wooden plug turned to the proper diameter and put in with an ordinary wood joint. These have stood very well. Out of twenty, only two, and these each under a pressure of from 90 to 95lbs., have blown out.

The hydrants, of which there are 25, are made by the Burrell Johnston Iron Co., Yarmouth, N.S. The valve in this hydrant shuts against the pressure, is faced with leather, and shuts against a brass seat. The screw for working the spindle is at the top, working in a brass nut. They have two 2½ in. discharge nozzles, and are all connected with the main by 6 in. branches.

After the hydrants were set, it was found that through some mistake the nozzles would not fit the hose then used by the town. The cheapest way to overcome this difficulty was found to be to change the nozzles, which were of brass leaded into the top of the hydrants. To get them out, pieces of iron about 2 inches in diameter and 5 ins. long were heated in a portable forge, and one inserted in each nozzle. As they cooled, fresh ones were put in, and after being changed three times the nozzle usually dropped out, and the new ones were leaded right in. Three men with four iron lumps and a portable forge changed all the hydrant nozzles in the town in two days.

The cost of the hydrants in Dartmouth when set was about $50.00 each.

HOUSE SERVICES.

The house connections are all made with ½ inch lead pipe weighing 7 lbs. to the yard, and costing when laid in the trench about 12c per foot. The trenching for house services was done by labourers at a contract price of 12c per foot run, and men working at that price made very good wages. The lead pipe is taken from the main by a straight brass screw nipple. The corporation cocks are set in the sidewalk about a foot out from the side line of the street. The service boxes are on the extension pattern made of cast iron. All the service boxes, stopcock and nipples were made by Stevens & Burns. Connections between brass and lead were made by the ordinary compression joint.

The service-pipes were laid to a depth of 5 feet; this seems to be below frost level in Dartmouth, as no service-pipe has frozen up to date (March 16, 1893), and this has been an exceptionally cold winter. The average cost of a house service where there was no rock to contend with was about $10.

The *trenching* on the main line from the lakes to Pine street, as well as the pipe laying, was done by contract at the following prices per cubic yard: rock, $1.75; loose rock, 65c; and earth 27c. The refilling was done at the rate of 10cts. per cubic yard. As to the trenching in the town, see below.

The *pressure* in the town, as indicated by a gauge on the hydrants, varies from 75 to 91 lbs. This is sufficient to throw a good stream over any building in town without the aid of a fire engine.

SEWERAGE SYSTEM.

As will be seen by the plan (Plate No. II.), the sewerage of Dartmouth is divided into three separate systems, each having its own outfall. The principal outfall is that at North street, which will eventually drain most of the town north of Ochterlony street, though the area at present draining into it is only about 29 acres.

The outfall is a 20 in. x 30 in. concrete block egg-shaped sewer, extended out into the harbour 30 feet, with a circular wooden box 30 ins. in diameter with the sides 5 ins. thick. The main sewer of this system starts with a 12 in. pipe at the corner of Pine and Ochterlony streets, and runs down Ochterlony street 1188 feet, to King street, where it increases to 15 inches diam., running with that diameter 580 ft., as far as Water street. It then turns north along Water street as a 20 in. x 30 in. concrete sewer, and runs 280 feet to North st., and then turns down North street 221 feet to the outfall. The sewer receives branches from most of the cross streets on the way down, and will eventually drain them all. It can also drain Pine, part of Maple, and Beech streets with all their cross streets. This system can also be extended from Stairs st. north along the Windmill Road about 1,000 feet, and also up Stairs st., to drain Church st., and the north ends of Prince, King and Wentworth streets.

The next system empties at Boggs st. This is capable of very little further extension. It at present drains 10½ acres. The outfall is of 15 in. crock pipe extended 18 feet into the harbour with a circular wooden box 16 in. diam., with the sides 4 in. thick. This system drains Water st. (south of Quarl), Prince st., Portland st. and Boggs st.

The other system, emptying at the foot of Wentworth st. into the canal, can be extended no further. It drains an area of 14.7 acres, the outlet is a 16 inch wooden box, sides 4 in. thick, and runs out into the stream 80 feet. This system drains most of Portland st. and half of Quarl st. with their several cross streets. At the corner of Dundas and Portland streets a cutting of 17 feet had to be made to overcome the rising ground from Wilson's lane to Dundas st.

The lengths of the different size sewers at present laid in the town are as follows:

500 feet	20 in. x 30 in.	concrete block sewer.	
1087 "	15 in.	Vitrified salt glazed	sewer pipe.
4146 "	12 in.	do	do
4882 "	9 in.	do	do
475 "	6 in.	do	do

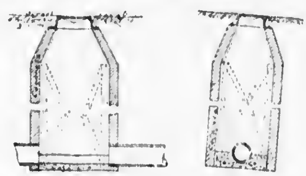
All the sewer pipe used was from The Standard Drain Pipe Co. of St. Johns, P.Q. The concrete sewer came from the city of Halifax at a cost of $1.30 per running foot, with an addition of $1 per ton truckage and ferriage.

The Wooden Box Extensions to the Boggs and North street outfalls were made after the outfalls were built, it being thought advisable to extend them further out into the harbour so as to empty below low tide level and to keep sand, shingle, etc., from washing into the mouth of the sewer and clogging it up. The Wentworth st. outfall is entirely a wooden box run out into the stream 80 feet. This is not below low water, as when the tide is out the stream is only about 6 inches deep. The boxes are made of hemlock in pieces 12 to 18 feet long, narrowed on the inside so as to form a circle when laid together A raft was first built having a frame of 6 in. x 8 in. timber, and planked with 2 in. planking; the box was then built right onto the raft, one piece being put on at a time and spiked securely to its neighbour. When the box was finished, a cribwork of 6 in. x 8 in. timbers was built up around the mouth to a level with the top of the box and extending back about 8 feet. The raft was then floated into position and the crib filled with stone to sink it. The whole raft and box was then covered over with stone, forming a solid wall as a protection from floating logs, etc. In the canal this wall runs half way across the stream so as to turn the full force of the current directly past the mouth of the sewer and carry the sewage right away.

In laying the sewers under water at the outfall, a cofferdam was built to keep out the water. Stakes were driven in, leaving a space of two feet between them; these were planked up on the inside, and the space between them filled with well rammed clay. This made a very tight dam, effectually keeping the water out until the necessary pipe and masonry had been laid. At the Bogg st. outfall the sewer pipe under water was laid in a bed of cement and covered with the same to a depth of 6 inches.

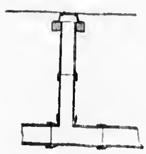
MANHOLES, VENTILATORS AND CATCH PITS.

Wherever two or more sewers meet, there is a manhole, and at every change of grade a lamphole and ventilator, so that there is no sewer in the town which is not open to thorough inspection.



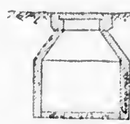
MANHOLE.

The catch basins are connected with the sewer by a 9 in. pipe always with a good fall. All catch basins and manholes are made of concrete instead of brick, which elsewhere is generally used for the purpose.

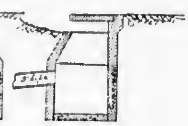


Ventilator.

Top View C. P. Mould.



Front Elevation.



Long'l. Section.

CATCH-PIT.

The catch pits, of which there are 42, were designed by Mr. E. H. Keating, M.I.C.E., then city engineer of Halifax, now city engineer of Toronto. The moulds are made in sections fastened together on the inside by pieces of iron about 2 in x 4 in. and ⅛ in. thick, and common wood screws. The bottoms of the catch pits are 6 feet below the level of the sidewalks. The lower 3 feet 3 in., as will be seen by referring to the plan (Plate IV), is elliptical in shape, 4½ feet long x 3 feet wide, then they begin to narrow and are 2 feet square at the top. The side away from the gutter is perpendicular, while the other side runs out under the gutter. The sides are 6 in. thick; the excavation is taken out, so as to leave a space of from 6 to 8 in. outside the mould. This space is filled with concrete to a height of 3 ft. 6 in., the connection with the sewer having been put in two feet from the bottom. After this, stones are built up around to keep the concrete of the proper thickness till it is built to a height of five feet. Then the top mould, having grooves for the reception of the concrete covers, are put on, and the top finished with a grout of 2 to 1 gravel and cement. After the concrete is set, a man goes inside with a screw-driver, takes the moulds apart, and passes them up piece by piece through the top. The mould is then put together and carted to the next hole. The bottom, which is of concrete with a stone foundation, is then put in. A catch pit of this kind can be built by three men in less than two days at a cost of about $30.

Man-holes being of different depths, a standard mould could not be made more than the two top feet. The remainder was made by a frame 3 ft long x 4 ft. wide of 3 in. by 4 in. scantling braced in position and fastened with lag screws. 1½ inch boards were placed against the outside of the frame, and concrete rammed in against them. The top mould was then set on the posts of the frame and concreted up to the top, leaving the opening at the top 18 in. x 20 in. When the concrete is set, the moulds are taken apart from the inside and passed through the top. A cast iron top with a moveable cover is then put on the concrete, and the bottom, which is of concrete having grooves for the flow of water, is put in, and the man-hole is completed. The cost of a man-hole of course depends entirely on the depth, but an average one, say about 8 or 9 feet deep, in Dartmouth costs about $40.00.

Some objection might be raised against the use of concrete for man-holes, on account of the heavy traffic on the streets being liable to break off the concrete. The traffic on the Dartmouth streets is very heavy, but no trouble of this kind has occurred as yet.

The ventilators or lamp holes are made by a 9 in. crock pipe coming to within a foot of the surface, with a loose concrete collar set over it, about a foot from the ground surface and resting on the ground around the pipe. A round cast-iron top with a moveable cover is set on the collar as a protection to the pipe.

HOUSE DRAINAGE.

The house drains are all, except in the case of a double house, laid with 4 in. crock pipe. No grade is allowed less than 1 foot fall in 48 ft., and they are all laid to a good even grade. The junctions left in the main for house connections are 6 in. branches bevelled from the main pipe; these are reduced at the main to 4 in.

The main trap of most of the houses is the hand-hole trap as made by the Standard D. P. Co. This is set just outside the foundation wall, and has a 4 in. cast-iron pipe coming to the surface as fresh air shaft, to ventilate the main soil pipe inside the house.

TRENCHING.

Within the town, wherever there were both water and sewer pipes to be laid in the same street, they were laid in the same trench, the sewer pipe being 2 ft. to one side and from 2 to 10 ft. below the water pipe.

A trench intended for the reception of the two pipes was started at the top 5 ft. wide, and continued that width until it was 5½ ft. deep, then one side of the trench was dug down 3 ft. wide to the proper grade for the sewer. The sewer pipe was laid first and the trench filled up to the level for the water pipe, then the water pipe was laid and the trench filled up.

After the water was turned on in the town, wherever there was any filling to be done, a hose was put on the nearest hydrant and the water turned into the trench. This settled the earth excellently, and saved much expense in men ramming in the trench and horses and carts to cart away surplus material. When an earth trench was filled in this way there was very rarely any earth at all to be carted away.

In the house connections, house-drains were usually placed in the same trench as the service pipe, always provided, however, that they were put 1½ ft. below the service pipe. It is the author's opinion that this has had a good deal to do with keeping many of the service pipes from freezing up. The last service that was put in was a combined trench, and had to be filled with frozen earth, and the water pipe froze up while the plumbers were at work at it. This was not discovered until after the trench was filled, so it was left a week or two before steps were taken to thaw it out. The people in the house, however, began to use the sink at once. About ten days after the trench was filled the water started of its own accord, and has been running ever since.

The warm air in the sewer pipe actually thawed out the ground for a foot and a half around it, and started the water.

All the rock in the main trenches and in some of the house trenches, which was nearly vertically bedded slate, was taken out by contract with steam drills at a price of $4.00 per cubic yard. This might have been done somewhat more cheaply with hand drills by days labor, but it would probably have extended the work into the next year and cost more in the end. There was a great deal of rock in the town, and the steam drills, working night and day, took it out very quickly. There was removed in the town altogether about 2,650 cubic yards.

The cost of earth trenching, which was done by days work, was from 30 to 35 cts. per yard, and refilling trenches from 10 to 15 cts.

In rock the trenches were taken out 6 ins. below grade, and filled up to grade with good, well rammed earth, making a good bed for the sewer to lie on.

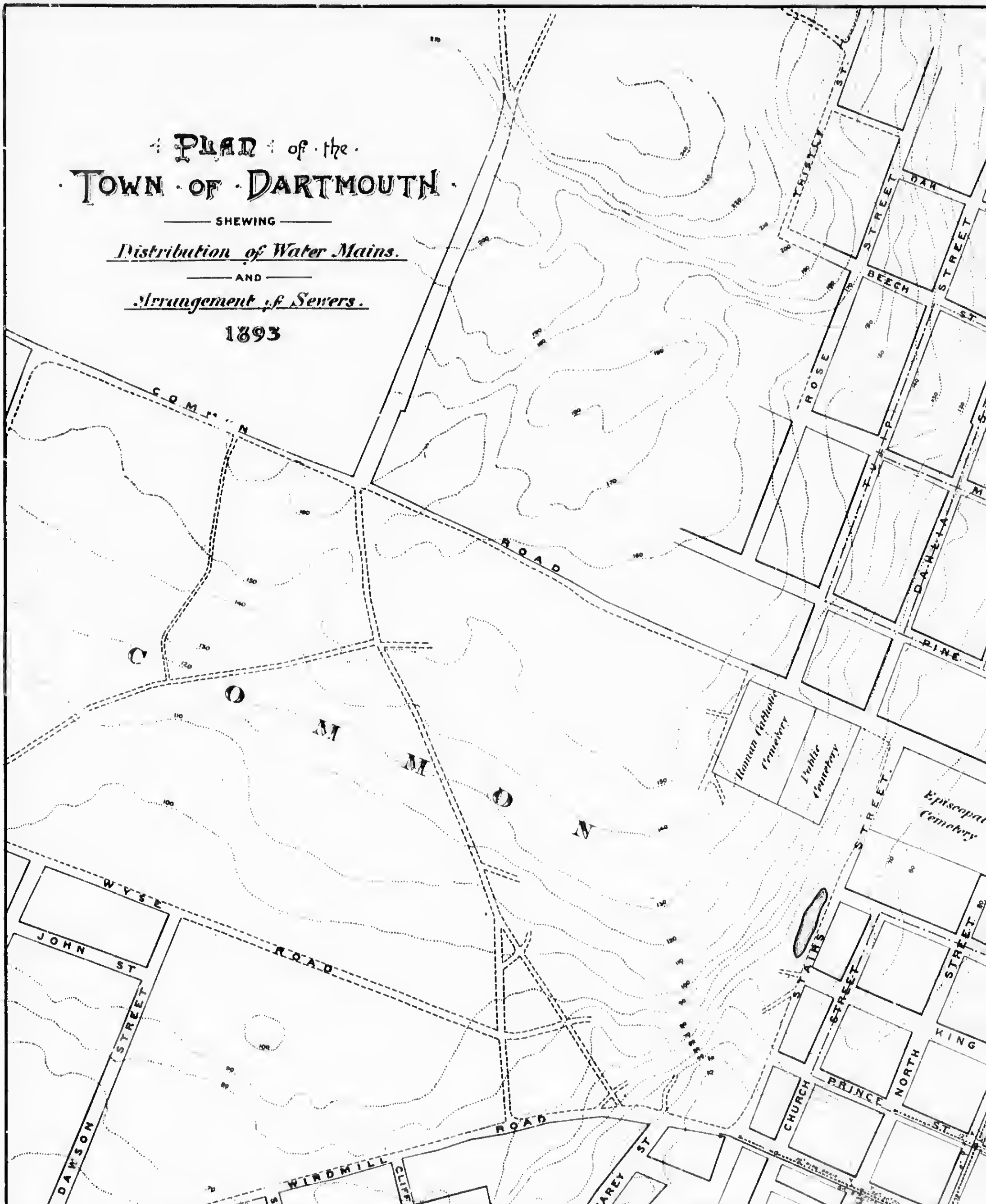
The lightest grade for a sewer in the town is the 12 inch sewer on Ochterloney st. from Pine to Wentworth sts., a length of about 900 ft., falling at the rate of 0.435 per 100.

In connection with sewer ventilation the writer noticed that on frosty mornings warm air was escaping from the mouths of the catch-pits in the more elevated portions of the town, while if a piece of lighted paper were set in front of one of the lower catch pits a strong current of air was seen to be drawn in. This, of course, is only the result of nature's law that warm air rises. As Dartmouth is rather hilly and most of the grades steep, this circulation would naturally, in cold weather, be very rapid, and serve as an excellent ventilation for the sewers. An opportunity has not yet occurred to notice the effect of this in warm weather, but it is supposed that there would be less circulation the more the temperature of the outside air became equal to that of the sewer.

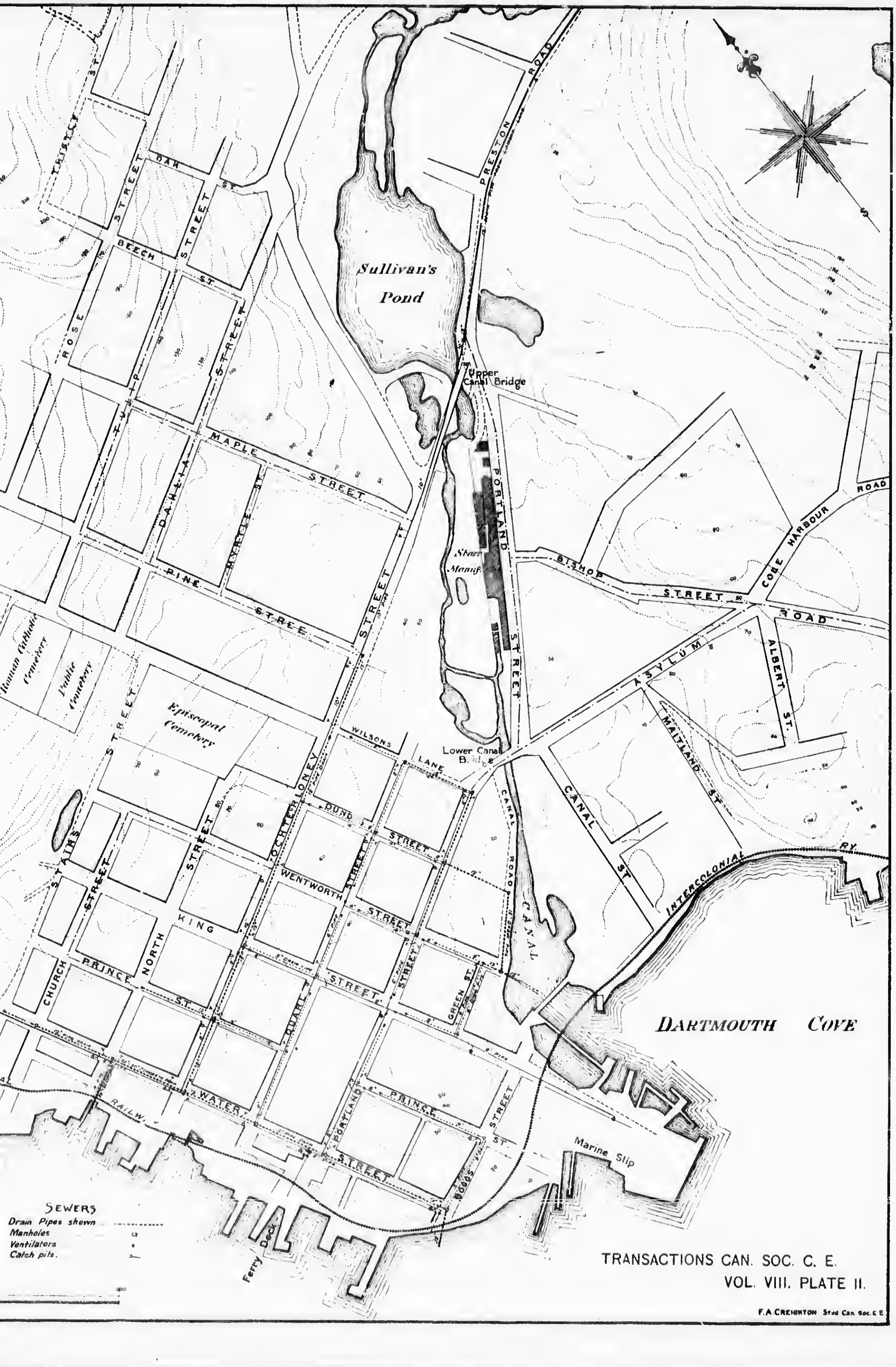
This circulation might in very cold weather endanger the safety of the lower catch-pits on account of freezing the two feet of water always lying in the bottom. This matter has not yet been fully investigated, but as the weather in Dartmouth never remains cold for any great length of time, it is thought they will be tolerably safe.

The cost of the water service was about $59,370 and that of the sewers $30,970. The work was begun in the fall of 1891, under the direction of Mr. C. E. W. Dodwell, M.I.C.E., M.Can.Soc.C.E. In that year the pipe house and a great part of the main pipe line were built, also the sewer outfalls at North and Boggs streets, and some of the sewers laid. Mr. Dodwell resigned in November to accept another position when the work was taken charge of by Mr. W. G. Yorston, C.E. In the following year the remainder of the work was done, the last house service being filled up on December 31, 1892. The deep cutting about half a mile from the lake was done in the winter of 1891-92 and the main line finished in May, 1892. Owing to some delay in repairing the leaks on the line, the water was not finally turned on in the town until November 1st. It has remained on ever since, and given every satisfaction to the rate-payers, as is evidenced by the fact that at a public meeting held March 23, 1893, the town council was authorized to go to the Legislature for permission to borrow $35,000 to carry on the proposed extensions spoken of above.

Note added Feb. 12th, 1894:—During the summer of 1893, the following extensions were made to the water and sewerage systems: There were laid 14,500 ft. of water pipe, making a total now laid of about 7½ miles; also 10,200 ft. of sewers, making a total now laid of over 4 miles. 31 additional hydrants were set, making a total now in use of 55. The number of houses now connected with the water mains is 350, and those using the sewers number about 250. The work of trenching was done in small contracts, and cost on an average about as follows: Solid rock, $2.60 per cubic yard; loose rock, 50cts. per cubic yard; earth, 26cts. per cubic yard. The contractors seem to have done very well at these prices. Flush cocks, varying in size from ½ to 4 inches, have been placed at the dead-ends of most of the sewers; these are comparatively inexpensive, and are very effective in their work.



PLAN of the TOWN OF DARTMOUTH
SHEWING
Distribution of Water Mains.
AND
Arrangement of Sewers.
1893
COMMON ROAD
COMMON
WYSE ROAD
JOHN ST
DAWSON STREET
WINDMILL ROAD
SCARFE
CLIFF
STREET
LANE
FAIRBANKS
UPPER WATER STREET
CAREY ST
INTERCOLONIAL RAILWAY
Roman Catholic Cemetery
Public Cemetery
Episcopal Cemetery
STREET
STAIRS STREET
CHURCH
PRINCE ST
NORTH
KING
ROSE STREET
TRINITY ST
BEECH
DAHLIA
PINE
OAK
WATER PIPES
Existing Water Pipes shewn
Proposed Extensions
Hydrants
Valves
SEWERS
Drain Pipes shewn
Manholes
Ventilators
Catch pits
SCALE OF FEET

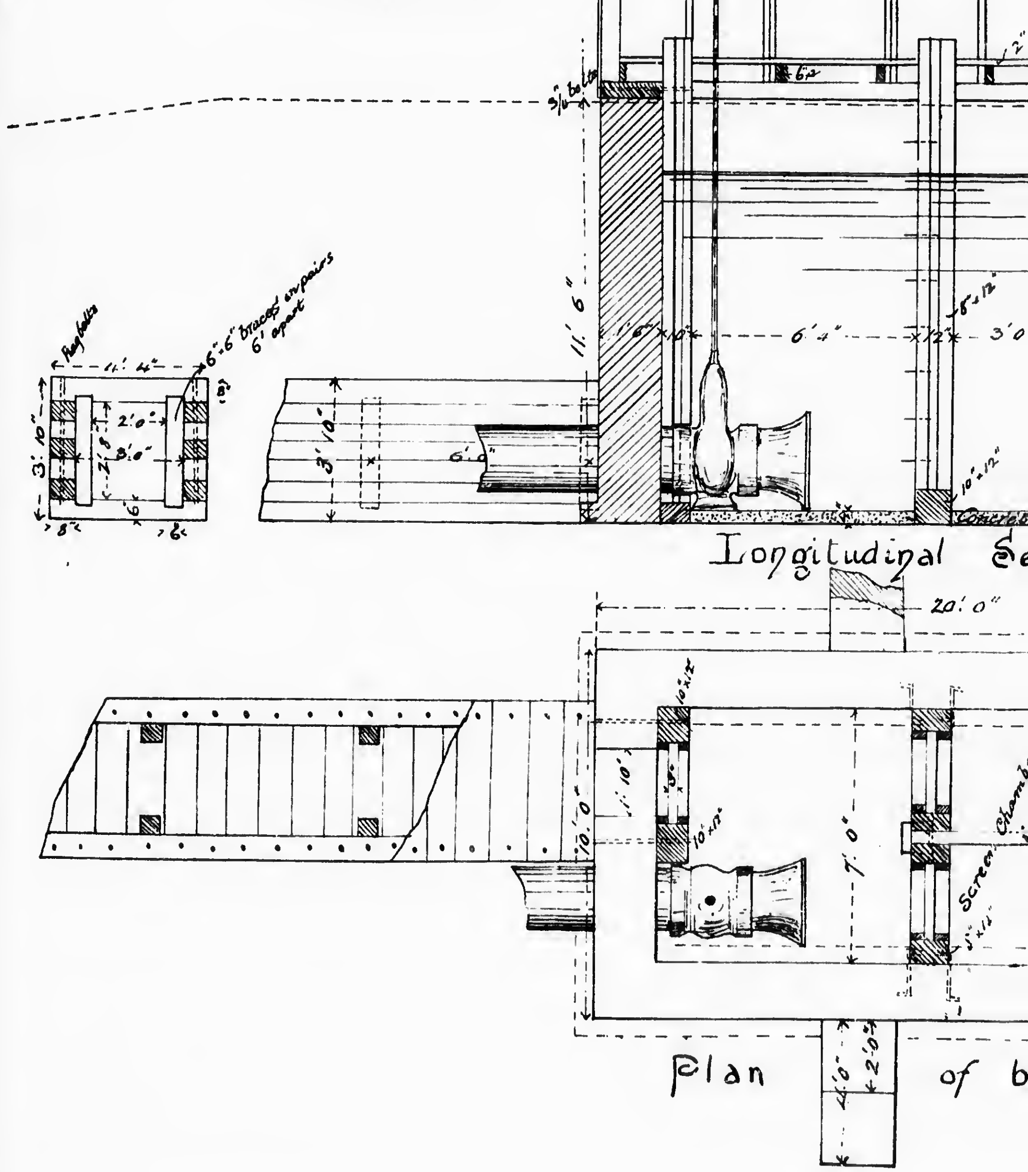


TRANSACTIONS CAN. SOC. C. E.
VOL. VIII. PLATE II.

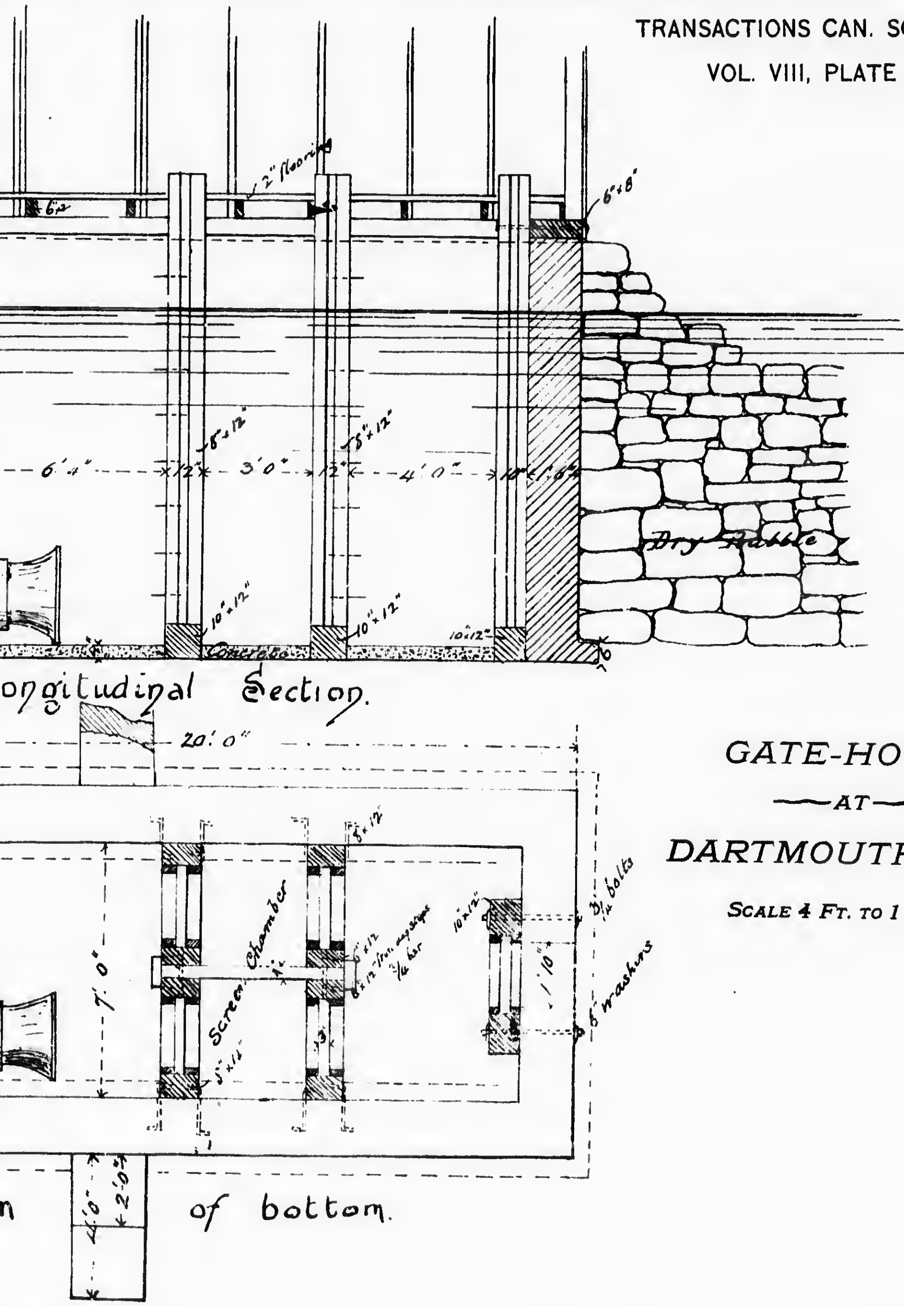
DARTMOUTH WATERWORKS,

By F. A. CREIGHTON,

Stud. Can. Soc. C. E.



TRANSACTIONS CAN. SOC. C. E.
VOL. VIII, PLATE IV.

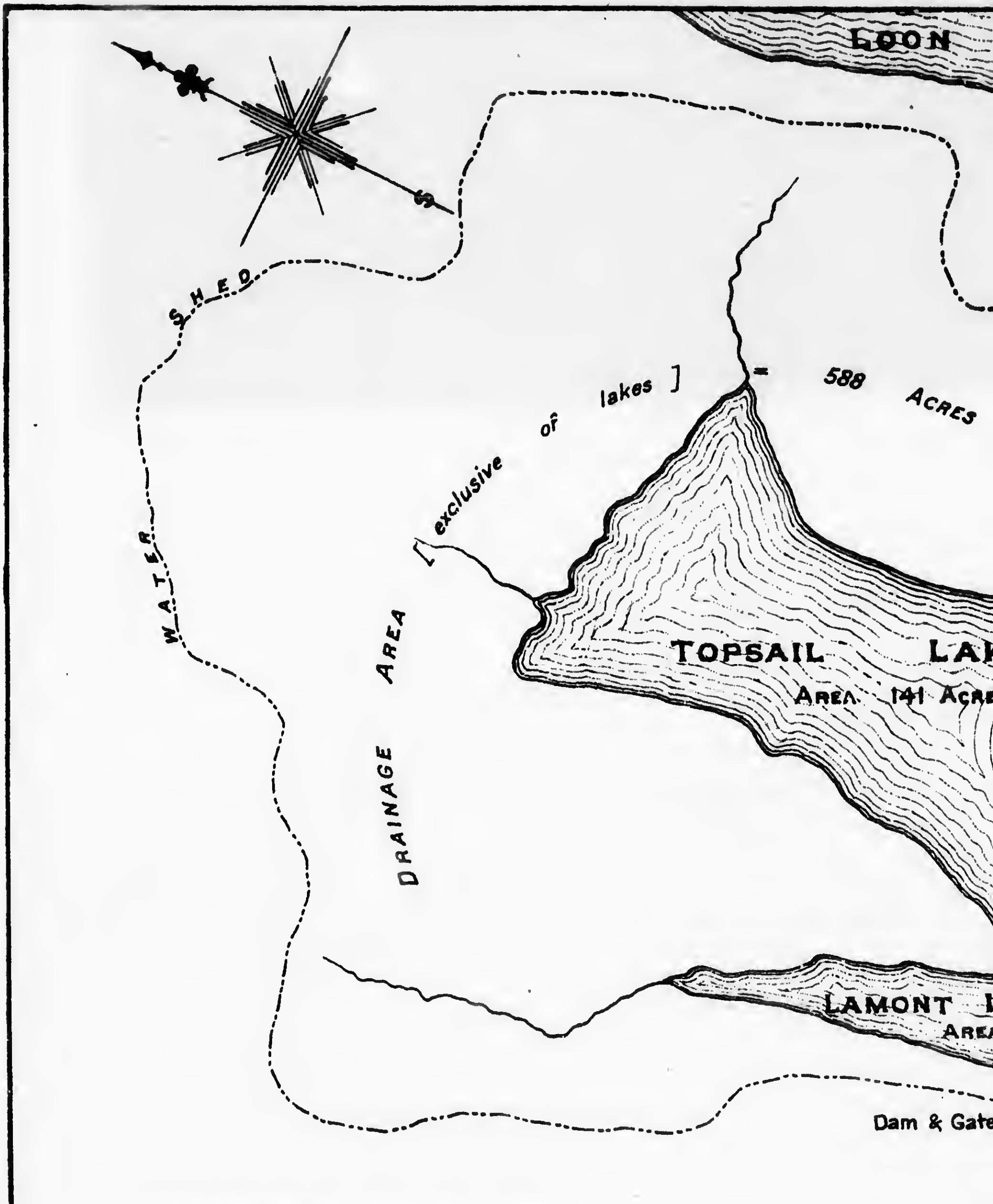


GATE-HOUSE

AT

DARTMOUTH, N. S.

SCALE 4 FT. TO 1 INCH.


LOON
S
WATER SHED
DRAINAGE AREA [exclusive of lakes] = 588 ACRES
TOPSAIL LAK
AREA 141 ACRE
LAMONT
Dam & Gate
F.A.CREIGHTON, Stud. Can. Soc. C.E.

TRANSACTIONS CAN. SOC. C. E..
VOL. VIII. PLATE III.