

STREET AND SIDEWALK PAVING.

Statement of Expenditure for Permanent Pavement from 1st May,
1891, to 30th April, 1892.

1891.	11.	Work on Ordnance Sidewalk.....	252 72
		John Kline for gutter stones.....	1872 52
June	2.	Hauling and piling blocks.....	237 52
	13.	H. Surette, for granite.....	2100 00
	15.	S. M. Brookfield, steam roller.....	1190 00
	16.	Hauling and piling granite.....	88 63
July	1.	do do.....	77 37
	10.	H. Surette, for blocks.....	2100 00
	14.	Shifting and piling blocks.....	322 08
	28.	do do.....	119 11
Aug.	11.	Draft for Belgium blocks.....	13185 40
		Paid for hauling and piling blocks.....	49 62
		H. Surette, for granite.....	2100 00
	25.	Hauling and piling blocks.....	52 99
Sept.	22.	Work on sidewalks around parade.....	260 38
		Hauling and piling blocks.....	24 86
		John Kline for gutter blocks.....	1059 54
Oct	6.	Work at crusher and various streets.....	822 01
	15.	H Surette for granite blocks.....	3220 00
	20.	Work at crusher and Pleasant Street.....	805 04
Nov.	3	do do and curbings.....	882 38
	17.	do do do.....	940 88
		H. Surette, for granite blocks.....	812 00
		D. L. Johns, for drain tiles.....	22 23
Dec.	1.	Work at crusher &c.....	688 36
	10	H. Surette, granite blocks.....	500 00
	18.	Work at crusher and streets.....	651 50
		Street account for cement.....	423 40
	29.	Work at crusher.....	276 40
Jan.	8.	H. Surette, for hauling blocks.....	1000 00
	12.	Work at crusher.....	297 19
		W. C. Castle, acct of crusher.....	83 28
		John Kline, for granite.....	204 75
	26.	This amount transferred to horse acct.....	500 00
		H. H. Fuller and other accts.....	451 17
Feb.	9.	Work at crusher and accounts.....	565 92
	16.	John Kline, for granite.....	250 00
	25.	Work at crusher.....	555 08
March	7r	Lease of Merkles field.....	200 00
	8.	Work at crusher.....	524 43
	22.	John Kline, per contract.....	600 00
		Work at crusher and accounts.....	614 44
	24.	H. Surette, for granite.....	2278 25
	31.	John Kline, granite.....	877 83
April	5.	Work at crusher and H. H. Fullers acct.....	655 66
	14.	This amount transferred to street account.....	1275 71
	19.	Work at crusher &c.....	506 13

\$46612 78

FUEL ACCOUNT.*Statement of Expenditure for Fuel from 1st May, 1891, to 30th April, 1892.*

1891.				
June	2.	Paid	S. Cunard & Co. for coal	3 10
			W. Roche "	11 55
July	14.		S. Cunard & Co. "	6 20
Oct.	14.		For Acadia coal "	267 40
Nov.	3.		Wm. Roche, coal and handling	41 60
Dec.	29.		" " "	28 45
1892.				
Jan.	12.		" for Acadia Coal Co	185 79
	26.		Putting in coal	4 40
Feb.	9.		S. Cunard and Co. Coal and handling	68 30
			W. Roche " "	31 42
April	5.		Putting in coal	14 00
	25.		This amount transferred to horse account	100 00
				\$762 21

TELEPHONE ACCOUNT.*Statement of Expenditure for Telephones from 1st May 1891, to April 30th, 1892.*

1891.				
June	2.	Paid	For Telephone in Aldermen's Room 6 months	12 50
July	14.		Telephones in City Hall, 6 months	110 00
Sept.	22.		" to Stipendiary's house	11 10
Nov.	3.		" to Engineers "	6 25
Jan.	12.		Rent of 8 instruments 6 months to the Prison, the } Poor's Asylum and elsewhere	147 50
				\$287 35

GAS ACCOUNT.

Statement of Expenditure for Gas from 1st May 1891, to April 30th, 1892.

1891.					
Aug. 17.	Paid	Halifax Gas Co. for lighting City Hall.....		189	40
Nov. 1.	"	" " " "		231	00
1892.					
March 1.	"	" " " "		216	03
					<u>\$636 43</u>

THE CITY HALL.

Statement of Expenditure for City Hall, from 1st May 1891, to 30th April, 1892.

1891.					
June 26.	Paid	Longard Brothers their acct.....		140	33
Sept. 23.		W. Foster, balance his acct.....		408	44
Oct. 23.		Rhodes and Curry "		529	34
Nov. 7.		Power & Co., work at heating apparatus.....		245	00
Dec. 2.		A Stephen & Sons, balance of account.....		815	48
10.		Sheppard & Co., electric fixtures.....		344	68
		McDonald & Co., their account.....		429	86
		C. W. Davies, for locks and work at safes.....		114	10
		Reilly & Davidson, their account.....		90	60
		Sundry small bills for work &c.....		121	65
					<u>\$3239 48</u>

WIDENING CAMPBELL ROAD.

Statement of Expenditure for Widening Campbell Road from 1st May, 1891, to 30th April, 1892.

1891.					
June 18		Requisition from Board of Works paid J. Sullivan....		360	00
July 1		Grading street		58	90
13		John Sullivan, extra work		22	87
Aug. 25		Work front of Wellington Barracks		7	50
Sept. 22		do do		24	48
26		J. Richardson contract		150	00
Oct. 7		do balance contract		75	00
		do extra work		1	65
Dec. 1		Work on Road		54	22
10		This amount transferred to sewerage account		243	20
13		John Sullivan per contract		85	00
15		Work at sidewalk		55	44
					<u>\$1138 26</u>

PUBLIC SCHOOLS.

*Statement of Monies paid Commissioners of Public Schools from
1st May, 1891, to 30th April, 1892.*

1891					
May	Paid	Commissioners	.....	604	84
June		do	.....	2936	82
July		do	.....	2409	47
Aug.		do	.....	9957	45
Sept.		do	.....	9345	45
Oct.		do	.....	8415	68
Nov.		do	.....	5135	91
Dec.		do	.....	4641	92
1892					
Jan.		do	.....	7984	00
Feb.		do	.....	5091	23
Mar.		do	.....	4841	20
Apl.		do	.....	3445	23
				<u>\$64,869</u>	<u>20</u>

COUNTY OF HALIFAX.

*Statement of Monies paid County of Halifax from 1st May, 1891,
to 30th April, 1892.*

1891					
June	18.	Paid	W. H. Wiswell	.....	268 98
July	14.		do	.....	51 68
Aug.	18.		do	.....	555 36
Sept.	15.		do	.....	1600 05
Oct.	15.		do	.....	1046 08
Nov.	13.		do	.....	1180 35
Dec.	11.		do	.....	675 33
1892.					
Feb.	2.		do	.....	1826 21
March	3.		do	.....	644 97
April	18.		do	.....	941 39
					<u>\$8790</u>
					<u>40</u>

SPECIAL LOAN FOR LADDER HOUSE, (\$4000)

*Statement of Expenditure for Ladder House from 1st May, 1891,
to 30th April, 1892.*

1891.						
Sept. 5.	Paid	Brown & Hames	per contract	.....	2000	00
Oct. 7.		do	do do	.....	800	00
Nov. 21.		do	do do	.....	1194	62
					\$3994	62
					\$3994	62

SPECIAL LOAN FOR STEAM ROLLER

*Statement of Expenditure for purchase of Steam Roller from
1 May 1891 to 30 April 1892*

Apl. 13	Paid	Duties and Freight	.....	1029	92
		Truckage and work	Setting up Machinery	.....	121 27
		Bill of Exchange	remitted G. B.	.....	2612 40
					\$3763
					\$3763
					59

INDUSTRIAL SCHOOL, QUINPOOL ROAD.

*Statement of monies paid to Industrial School from 1st May, 1891,
to April 30th, 1892.*

1891.						
June 10	Paid	Secretary Meynell	acct of appropriation	.....	400	00
Sept 5		do	do do	.....	400	00
Nov. 24		do	do do	.....	200	00
1892.						
Mar. 30		do	do do	.....	200	00
					\$1200	00
					\$1200	00

ST. PATRICK'S HOME FOR BOYS.

*Statement of Monies Paid St. Patrick's Home from 1 May 1891
to 30 April 1892*

1891			
Aug. 15	Paid Bro. Candidus.....		308 99
Nov. 17	do		297 91
1892			
Feb. 9	.....		286 00
			<u>\$892 90</u>

SCHOOL FOR THE BLIND.

*Statement of Monies paid to School for the Blind from 1st May,
1891, to 30th April, 1892.*

Sept. 10.	Paid	E. D. Meynell, for 4 pupils \$75 per appropriation....	\$225 00
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HALIFAX DISPENSARY.

*Statement of Monies paid the Dispensary from 1st May, 1891,
to 30th April, 1892.*

1891.			
Dec. 24.	Paid	W. H. Wiswell, amount of appropriation	\$750 00

INFANTS HOME TOWER ROAD.

*Statement of monies paid the Infants Home from 1 May 1891 to
30 April 1892*

1891			
June	13	Paid Miss Nordbeck amt. of appropriation.....	\$300 00

R. C. INFANTS HOME, BRUNSWICK STREET.

*Statement of Monies paid R. C. Infants Home from 1st May,
1891, to 30th April, 1892.*

June	13.	Paid	Sister Benedicta amount of appropriation.....	\$300 00
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INSTITUTION FOR DEAF AND DUMB.

*Statement of Monies paid Insttution for the Deaf and Dumb from
1 May 1891 to 30 April 1892*

1891				
Dec.	7	Paid	A. McKinley for 4 Pupils \$60.....	\$240 00

COURT OF APPEAL.

*Statement of monies paid to Court of Appeals from 1st May, 1891,
to 30th April, 1892.*

1891					
June	2	Paid	T. E. Cooke	100	00
			J. H. Symons	100	00
			W. F. MacCoy	100	00
					<u>\$300 00</u>

INSURANCE OF FIREMEN.

*Statement of Amount paid for Insurance of Firemen from 1st
May, 1891, to 30th April, 1892*

1891.					
May	16.	Paid	Manufacturers Accident Co.....	713	33
1892.					
March	12.		do do	348	53
					<u>\$1061 86</u>

**SPECIAL LOAN FOR PURCHASE OF HORSES AND CARTS
(\$3100.00).**

*Statement of Monies expended for purchase of Horses and Carts
from 1st May, 1891, to 30th April, 1892.*

1891.					
June	6.	Paid	for Horses	800	00
Sept.	6.		John White, for Horses (2)	310	00
			E. W. Crease, Horse (1).....	175	00
					<u>\$1285 00</u>

LOAN FOR PROVINCIAL EXHIBITION OF 1891, \$5000.00.

Statement of monies paid Commissioners for Provincial Exhibition, 1891.

1892.

Sept. 10	Paid Alderman J. T. Hamilton.....	1500 00
23	Robert Taylor	2500 00
Oct. 2	do	1000 00
		<u>\$ 5000 00</u>

INCOME ACCOUNT.

*Statement of Income received for Licenses, Fines, Rents &c., from
1st May 1891, to 30th April 1892*

1891.

Received for Liquor Licenses.....	10049 19	
Less this amount paid Inspector of 6 months 1891.....	599 90	
		<u>9449 29</u>
Fines and Fees, City Clerks Office		4366 06
Licenses for Hacks, Trucks &c.....		2248 00
Rents of City Property		877 75
Dog Tax.....		493 00
City Marshals Fees.....		550 55
Current interest.....	4348 45	
Paid Common Commutation Fund.....	330 54	
		<u>4027 91</u>
		<u>\$ 22,002 56</u>

CAMP HILL CEMETERY.—Credit Account.

Statement of monies received for sale of Lots in Camp Hill Cemetery, from 1st May 1891, to 30th April 1892.

1891.					
June	By Sale 9 Lots	\$8	.....		72 00
July	do 8 do	8	.....		64 00
Aug	do 14 do	8	.....		112 00
Sept	do 9 do	8	.....		72 00
Nov	do 1½ do	8	.....		12 00
Dec	do 8 do	8	.....		64 00
Jan	do 12½ do	8	.....		100 00
Feb	do 6½ do	8	.....		52 00
Mar	do 10 do	8	.....		80 00
Apl	do 15½ do	8	.....		124 00
					<u>\$752 00</u>

COMMON AND GARDENS.—Credit Account.

Statement of Monies received for Concerts, Rents, &c., by Commissioners of the Common and Gardens, from 1st May, 1891, to 30th April 1892.

1891.					
June	14	By Cash for Rent, Wanderer's Grounds	.....		100 00
Aug	13	Proceeds of Concerts	.....		327 45
	31	Cash for Rents of Fields &c.	.....		111 68
Sep	2	Special loan to pay accounts	.....		1650 00
Oct	9	Cash from Mrs. Daly, Seaman's fair	.....		342 48
		Proceeds of Concert	.....		212 90
	26	do do	.....		571 76
		Interest on Commutation Fund	.....		330 54
					<u>\$3646 81</u>

SEWERAGE ACCOUNT.—Credit Side.

*Statement of monies received for Sewerage Rates, from 1st May
1891 to 30th April 1892.*

1891.			
May		Received from City Collector.....	73 17
July		do do	994 54
Aug		do do	88 97
Sept		do do	9 66
Oct		do do	529 18
Nov		do do	853 66
Dec		do do	1498 11
Jan'y		do do	844 05
Feb		do do	663 05
March		do do	411 69
April		do do	146 74
			<u>\$ 6112 82</u>

POINT PLEASANT PARK, 1891-2.

*Point Pleasant Park in account with John Doull, Secretary
and Treasurer.*

1891.		DR.	
Feb	28	To Balance	353 21
Apl	1	Paid J. Vennor for March.....	31 00
	30	“ do for Labour.....	132 00
			<u>163 00</u>
May	1	“ J. Vennor for April.....	30 00
	30	“ do for Labour.....	453 50
			<u>483 50</u>
June	1	“ J. Vennor for May.....	31 00
	30	“ do for Labour.....	269 00
			<u>300 00</u>
July	1	“ J. Venno for June.....	30 00
	31	“ do for Labour.....	290 00
			<u>320 50</u>
Aug	1	“ J. Vennor for July.....	31 00
	31	“ do for Labour.....	389 00
			<u>420 00</u>

Sept	1	"	J. Vennor for August.....	31 00	
		"	do for Labour.....	213 00	
					244 00
Oct	1	"	J. Vennor for September.....	30 00	
	31	"	do for Labour.....	85 00	
					115 00
Nov	1	"	J. Vennor for October.....	31 00	
		"	do for Labour.....	8 00	
		"	Stairs, Son and Morrow.....	32 41	
					71 41
Dec	1	"	J. Vennor for November.....	30 00	
	31	"	do for Labour.....	20 00	
					50 00
1892.					
Jan	1	"	J. Venor, for December.....	31 00	
		"	do for December.....	7 61	
					38 61
Feb	1	"	J. Vennor for January.....	31 00	
	29	"	do for February.....	29 00	
		"	do for Labour.....	10 00	
					70 00
			Interest paid Bank Nova Scotia.....		23 33
					\$ 2652 56

CR.

			By Cash from City, (1890).....	200 00	
June		do	do do.....	1500 00	
Nov		do	do do.....	500 00	
			Balance on hand.....	452 56	
					52 56

Certified,

C. S. LANE,
W. F. PICKERING, } Commissioners

LIQUOR LICENSE FUND.—Credit Side.

Statement of amounts received for Liquor Licenses, from 1st May 1891, to 30th April 1892.

1891.					
May	19	By Cash from J. A. Mackasey.....		140 00	
	29	" do.....		30 09	
	30	" do.....		90 00	
June	16	" do.....		173 00	
		" do.....		20 00	
	26	" do.....		50 00	

CITY ENGINEER'S OFFICE,

HALIFAX, N. S., Aug. 1st, 1892.

To the Chairman of the Board of

Commissioners of City Works :

SIR,—I beg to lay before you the Annual Report of this department for 1891-92.

Immediately after receiving notice of appointment to the position of City Engineer, I reported to His Worship the Mayor, who instructed me to enter at once upon the duties of the office. At this date, June 6th, 1891, the street work for the year was just beginning, while sewer work had been carried on through the Winter and Spring.

The usual work was being carried on in the

WATER DEPARTMENT

under the supervision of Mr. E. Morrison. During the year, 8981 lineal feet of cast iron distribution mains were laid and 4668 lineal feet of lead service pipes put in. There were 117 houses supplied with water and 45 service pipes renewed. The number of fire hydrants put down was 8 making the total 351. The total number of lineal feet of excavation made in carrying out the work was 13,833 or 2.62 miles.

The total length of mains now in use is 51.23 miles. The water extensions included what was known as the

SOUTH WEST EXTENSION.

This work embraced the laying of a 9 inch pipe on Shirley and Walnut Streets to Coburg Road, which resulted in an increase of pressure at the corner of LeMarchant Street and Coburg Road from 1 pound to 29 lbs. A 9 inch pipe was laid on Coburg Road from Seymour Street to Robie Street, that portion between Seymour

Street and Edward Street being laid while the sewer was under construction, thereby lessening the cost of the work. The old 3 inch pipe on Summer Street was replaced with six inch pipe, which increased the pressure at the Victoria General Hospital from 22 pounds to 52 pounds. The alteration in the distribution outlined above has greatly decreased the danger from fire in the South Western portion of the City controlled by the High Service system but will also increase the consumption in that district which, under the present condition of the water supply, is a serious item.

CLEANING LAKES AND MAINS.

The settling basins at Chain Lake were emptied and thoroughly cleaned. The shores of the Upper and Lower Chain Lakes were in a very bad state. Decaying stumps, roots, sticks, etc., lined the margin of both lakes and in some places extended some distance into the lake. The water was run off and a gang of men employed to grub and clean up the whole shore. The work was not finished before the Fall rains and the completion was postponed until this season.

Spruce Hill Lakes have also been neglected and the same remedy should be applied as soon as the water falls.

The low service main and the 15 inch high service main were cleaned as usual by mechanical scrapers,

SPRUCE HILL LAKE DAMS.

The dams at Spruce Hill Lakes had a dilapidated appearance and the second dam had broken in the Spring. The face of the third dam was falling and all of them were too low. Mr. Hartlen, the gate house keeper, was employed while the water was falling cutting stone to face the broken dam and the work was completed before the Lake began to rise. Part of the foundation for the face of the main dam was laid before the close of the season, and men were employed during the winter cutting stone to face and raise all the dams. In consequence of the weak state of the dam we were obliged to let the water run off when the Lake had risen to the waste weir. This Lake very seldom reaches the level of the waste weir, but in March it was overflowing.

When the work is completed Spruce Hill Lake will store all the Water that falls on its gathering grounds, and the appearance of the structures will be more creditable to the Corporation.

July	6	Balance from 1890.....	9348 37
Oct	1	Cash from J. A. Mackasey.....	30 00
Nov	9	do do	50 00
Dec.	18	do do	117 82
			\$ 10,049 19

LIQUOR LICENSE FUND.

*Statement of Monies paid Inspector of Licenses and others, from
1st May 1891, to 30th April 1892.*

Dr

1891.			
May	16	Paid W. H. McLellan	30 00
		J. A. Mackasey	83 33
		do	5 00
July	27	W. W. McLellan	40 00
Aug	14	J. A. Mackasey	83 33
Sept	2	do	83 33
	3	Theakston and MacDonald, for copying.....	10 00
Oct	1	J. A. Mackasey	83 33
	7	Mrs C. Rennet	75 00
		J. A. Mackasey	83 33
		Morning Herald Co.	23 25
			\$ 599 90

REVISORS OF ELECTORAL LISTS.

Statement of Monies paid Revisors Electoral Lists

1892.			
March	26	Paid William Woodill.....	100 00
Apl.	30	Alderman Mosher.....	100 00
			\$ 200 00

RATES AND TAXES

*Statement of City School and County Taxes received from 1st May,
1891, to 30th April, 1892.*

1891			
M		By Cash from Collector.....	11896 36
Ji		do do	14322 98
J		do do	9943 78

Aug 31	By	Cash from Collector	.....	27999 29
Sept 30	"	do do	.....	18464 64
Oct 31	"	do do	.....	19988 88
Nov 30	"	do do	.....	11443 66
Dec 31	"	do do	.....	16288 14
1892.				
Jan 31	"	do do	.....	17108 82
Feb 29	"	do do	.....	10512 21
Mar 29	"	do do	.....	14905 13
Apl 30	"	do do	.....	4856 28

177430 17

1891.

SCHOOL RATES.

May 31	"	do do	.....	1868 02
June 30	"	do do	.....	2095 50
July 31	"	do do	.....	3989 45
Aug 31	"	do do	.....	11377 67
Sept 30	"	do do	.....	7514 29
Oct 31	"	do do	.....	8577 60
Nov 30	"	do do	.....	4888 95
Dec 31	"	do do	.....	7270 04
1892				
Jan 31	"	do do	.....	5905 02
Feb 29	"	do do	.....	4665 57
Mar 31	"	do do	.....	6775 00
Apl 30	"	do do	.....	1983 83

66853 03

1891.

COUNTY RATES.

May 31	"	do do	.....	268 98
June 30	"	do do	.....	286 53
July 31	"	do do	.....	555 36
Aug 31	"	do do	.....	1600 05
Sept 30	"	do do	.....	1046 08
Oct 31	"	do do	.....	1180 35
Nov 30	"	do do	.....	675 33
Dec 31	"	do do	.....	1015 97
1892.				
Jan 31	"	do do	.....	810 24
Feb 29	"	do do	.....	644 97
Mar 31	"	do do	.....	941 39
Apl 30	"	do do	.....	275 19

00 44

3 64

0 81

Balance uncollected, 30th April, 1892 *tem*

45

Amount assessed for 1891 U.

45

REVISING CITY CHARTER.
Special Vote [(\$500.)

*Statement of amounts paid for Revising City Charter from 1st
May, 1891, to 30th April, 1892.*

1891.

June 13.	Paid	B. Russel,.....	200 00
Sept 1.		W. Ousley,.....	120 00
Oct. 24.		N. S. Printing Co., for printing.....	176 75

\$496 75

REPORT OF BOARD OF WORKS.

The Board of City Works beg to submit the Annual Report for the civic year (1891-92) which was laid before them this day. It was decided to forward the same to the Council for its information.

Respectfully submitted,

W. T. PICKERING,

Chairman.

Halifax, Feb. 27th, 1893.

CHAIN LAKE DAM.

The face of the dam at the foot of Upper Chain Lake was giving way, and the face wall was taken down and rebuilt.

NEW MAIN.

In July I was directed to make surveys for a duplicate main for the low service system, and in September instructions were giving by your Honourable Board to report on the scheme as soon as plans and estimates were completed. The report (attached hereto) was presented in February, and the Council ordered the work to be carried out.

The deplorable waste of water which has caused the expenditure still continues. When the proposed work is completed our water supply system will have cost over one million dollars, and if the waste continues and increases with the increase in pressure the present supply will not be sufficient and the taxpayers will be asked to start on the second million to bring in a new supply.

If the waste is checked the pressure will be increased and the danger from fire in the low service district will be greatly diminished as each main will give an independent service and while one is turned off the other will supply the City.

The high service will not be complete until a storage reservoir is constructed in the city, capable of containing several day's supply. When the water is turned off now, there is great danger of a fire gaining headway before the pipes could be filled again, and the result of any accident to dams or pipes cutting off the supply would be serious.

METERS.

Meters are being put on all service pipes where there is a large consumption with very satisfactory results. There were 40 meters in use at the close of the year varying in size from $\frac{1}{2}$ inch to 6 inches. If the waste of water cannot be stopped by strict plumbing rules and inspection, meters will have to be more generally adopted.

REPORTS AND PLANS.

Mr. Morrison, Foreman of the Department, has long ago made

a reputation for efficiency. His report is appended showing the work done and stock on hand, with the reports of the Water Inspectors for the year.

A complete plan of the distribution has been made and filed in this office, showing the size of all pipes and the location of all valves and hydrants.

EFFICIENCY OF SERVICE.

Since the work of the Water Department has been under my supervision frequent complaints have been made (principally through the Local Press) that the pressure was poor, and consequently the service was inefficient for fire purposes. A great injustice has been done to the City and to the Officials of the City immediately connected with the Water Service. I may cite one instance to show how misleading the newspaper reports are as a rule in criticising the water service. The fire at Dempster's Mill was (with one exception) the largest fire during the year. The report of this fire contained the usual complaint that the water pressure was very poor, and consequently the fire could not be properly handled. This seems to be a stereotyped complaint, and it has been used by insurance people to such an extent that the reputation of the City for fire protection has been seriously injured. There is an average domestic pressure all over the City of 30 pounds, while the fire pressure is very much in excess of that amount. The low service main had been cleaned by mechanical scrapers a few days before the fire at Dempster's Mill, and the service was in a condition to give all the pressure available when at its best. There were 8 streams of water poured into the burning block at one time, and notwithstanding this enormous drain there was 40 lbs. pressure on the fire plug at the foot of Green Street. When such a pressure can be kept up with 8 streams going at one time the fire service for that district cannot be considered inefficient; yet we have to submit to the opinion of men who know nothing about the service, and allow their statements to be published broadcast, while the property owner who carries insurance pays for it at the rate of 50% increase on former premiums. I think some effort should be made to prevent the circulation of such misleading statements respecting the water service, when they are entirely at variance with the facts.

SEWERS.

This branch of the public works has assumed proportions of considerable magnitude. A large amount of money is being expended annually and an army of men await the fortnightly visit of the Clerk of Works.

Several sewers were under construction at the 1st of June and the work was continued without intermission till the end of the civic year. On June 29th. I received instructions to have all necessary sewer work done in Water Street at once where paving was to be laid. Five gangs of men were employed, and the sewers were completed before the end of December. Property owners along both sides of the street were notified to put in house drains and before the end of January all buildings had been connected. The sewer from DeWolf's Wharf to Cornwallis Street is the main trunk sewer for the whole North Western portion of the City.

Several sewers were started in January and the work of construction was pushed on through the Winter, giving employment to a large number of men. This expenditure cannot be considered a success for if it was intended for charity it would have been cheaper for the taxpayers if the men had been paid to stay at home. One piece of sewer on Coburg Road cost 60% more than the same work can be done for in Summer. The cost of excavation in Winter was much greater than in Summer and all other work was much more expensive. The earth and rock thrown out of the trenches froze into one solid mass, and we were obliged to drill holes and break it up with dynamite so that the trenches could be re-filled. Nor did the trouble end there, for the back-filling could not be properly rammed and has settled at times all through the Summer, necessitating constant inspection and repairs, to prevent accidents for which the City would be liable. The construction of sewers in rock last winter used up the appropriation to such an extent that several sewers which had been ordered to be done at once could not be built this year, and the districts to be drained have to remain in a disgraceful condition for another year. There were very few houses on the streets in which sewers were constructed, during the Winter, and the sections affected were, speaking generally, not in an unsanitary condition. The whole system of construction is wrong. The old stone sewers in the centre of the City are bad enough in themselves, but instead of beginning at the foundation to build we put on an extra storey to make the old foundation more dangerous. New sewers are being built in the

suburbs, bringing in the sewage of the outlying districts to add to the filth already lodged in the old trunk drains in the centre of the City. By allowing the offensive catchpits and drains to remain, and admitting additional sewage every year, we are not only increasing the danger of disease, but we are establishing a reputation for the City which is anything but desirable. Before we realize the situation the sewer appropriation will be expended, and no improvements made where they are so urgently needed.

The outlets should be extended to low water mark if no farther. The extension of the outlet at the

ESPLANADE

will be an improvement, but when completed on the plan adopted by the Council, will not in my opinion be an entire success. When the sewer is extended it will discharge below low water mark and for a time the nuisance formerly complained of will be abated, but the water is so shallow for some distance out that the deposit made outside the wall, will in a year or two be as offensive as before. The money that will be paid out for this work would have carried the sewer to deep water if properly expended, and the extension of the outfall to the end of the shoal is only a question of time. The work performed has been done cheaply. Part of the wall has been built in four and a half feet of water at low tide. The work was carried on by day's work at a cost of about six dollars a yard, while the lowest tender received was seven dollars for the same work.

CLEANING AND FLUSHING.

About six and a half miles of sewers were thoroughly examined cleaned, flushed and repaired. Mr. Longueil's report shows the work done.

CATCH-PITS.

The removal of the most offensive stone catchpits was begun in September and will be continued this year. They are being replaced with concrete pits, the top and cover being of the same material. In Water Street and on corners a granite curb is set in the concrete and cast iron covers used.

HOUSE DRAINS.

The connection of house drains were carried on formerly with little or no supervision, often without a permit. The issuing of permits was transferred to this office on the 13th day of July, 1891 and 227 permits were granted from that date to the close of the year. The police are instructed to report all persons opening the street without a permit, and all work is inspected before being covered up. The need of proper supervision can be seen in nearly every case where old drains are uncovered, and in many instances the sewers are being ventilated into the houses.

A thorough inspection of all houses on the line of sewers was made and of 745 house inspected only 324 were connected with the main sewer in the street. Notices were at once sent to the property owners instructing them to comply with the law and at the end of the year a great many drains had been laid.

Mr. McDonald, Foreman of Works, has had a busy year, and few people are aware of the amount of work performed under his supervision. The statements of work done are compiled from his returns.

STREETS.

The expenditure on streets was controlled by the individual members of your Honorable Board, and the system has received much unfavorable criticism. Complaints, however, may always be expected in connection with this service, while the amount placed at the disposal of the Board is so small. It is impossible to satisfy an exacting public, while we have only one dollar to do five dollars worth of work. The money might be expended more advantageously by making some changes in the system of expenditure, but no man would be anxious to have the whole control and responsibility, because many streets must be neglected every year in consequence of the fund being inadequate to meet the demand.

PERMANENT PAVEMENT.

Very little work chargeable to this fund was performed during the year. The porphyry and granite blocks were delivered for Water Street pavement, and the stone crusher was started at Merklesfield. 176,000 bushels of broken stone and screenings were turned out during the year at a cost of $3\frac{3}{4}$ cents per bushel.

About 480 square yards of concrete sidewalk was laid on Pleasant Street at a cost of \$1.87 per square yard. The tender for granolithic on a similiar foundation was \$3.25 per square yard.

INTERNAL HEALTH.

The work done under this service requires closer supervision. Men who could not obtain employment elsewhere have been engaged in this Department at fair wages, and although a great deal of work is performed during the season we have not obtained full value for the money paid out. The internal health squad seems to be a dumping ground for the whole City. The reason given for the employment of such men is that they would have to be kept alive by the City, and street cleaning is about the only work they can do. Taxpayers are continually complaining of the incompetency of the workmen, and yet when a labourer is discharged the same men are most active in their endeavours to have him put at work again. If the name of a Cape Breton or Newfoundland man appears on the pay-roll a howl is raised at once that we are showing a preference for foreign labour. We have as good men in Halifax as can be found outside of it, but if there is no competition the men will take advantage. Charity is allowed to rob the funds of every City service. It cuts down the street fund by adding to the cost of broken stone, and cuts down the amount available for other services by the employment of incompetent labourers. If City work is to be a work of charity, it should be clearly understood, and the Engineer should not be held responsible for the cost. If on the other hand all public work is to be done as efficiently and economically as possible, no man must be employed who will not earn his wages. In this way only can the City get one hundred cents value for every dollar expended.

CITY PROPERTY.

The amount of property owned by the City cannot be determined with any degree of accuracy. Up to the present time I have not seen a single boundary mark to show where a piece of land supposed to belong to the City is situated. Some properties may be located from the description in the deed book which has been posted up to date, but by far the larger number are not recorded. An effort will be made during the coming season to place proper boundary stones or other permanent marks on all City property.

The exhibition building is the only structure which I have had occasion to examine. It was not in a fit state to be occupied for exhibition purposes and extensive repairs were made. It needs a thorough overhauling and a considerable amount of money must be expended to place it in good repair.

The old fishmarket is beyond repair and should be torn down. The slip should be rebuilt in a more permanent manner.

STREET RAILWAY.

The North-west branch of the Street Railway was opened in August 1891. The route is up St. Paul's St. to Argyle St. thence, via Buckingham St., Brunswick St., Cogswell St., Gottingen St. and Cunard St. to Robie St. The grades are heavy but unavoidable. If a new street were opened by extending Brunswick St. from Cogswell St. to the City Hall an easy grade would be obtained and a street railway line could be operated with less danger and at less expense. The street should have a good width as it would be the main outlet to the North-end, and would soon be one of the principal streets of the City. The streets now traversed by the North-west branch are narrow and the roadway cannot carry the traffic. Cogswell St. may be widened, but Buckingham and Argyle Streets cannot be improved except at great expense. On market days especially, Argyle St. is sometimes blocked, so that traffic must be diverted to other streets. The opening of the new street (first suggested some time ago) is worthy of consideration, and it will probably become a necessity should electricity be used as the motive power in operating the road.

The length of the main line is 3.92 miles, not including side tracks and turnouts. The whole length, including turnouts, is 4.65 miles.

The branch adds 1.24 miles of line and .13 miles of turnouts making a total of 6.02 miles in operation.

GENERAL.

Many laws and ordinances passed for the benefit of the City generally are not strictly enforced. Individuals benefit by the laxity but the City suffers both in pocket and appearance. A new system should be adopted (especially respecting streets,) and rigidly adhered to. We have surely risen above the rank of a village, and instead of having straggling, crooked, neglected looking

streets lined with projections of all kinds, including signs, great and small, steps from one to ten, porches, verandahs, bay windows, etc., we should insist that the line of streets be kept straight and the streets neat and trim and free from encroachments of every description. Strict ordinances should be passed and existing laws enforced. Legislation is required to restrict the opening of new streets, and place the control of such matters in the hands of the City instead of leaving it to speculators who naturally work for their own interest. Proper regulations should be made to prevent builders occupying the whole sidewalk with hatches and coal holes, and consequently obstructing traffic whenever they are in use.

A new survey of the City should be made and street lines established and marked by proper boundaries. The work of the office at present occupies the time of the whole staff, and some additional assistance would be needed; but this work is imperative and delay means tedious lawsuits and expense to the City. The importance of this matter does not seem to be realized, and unfortunately nothing can be done towards street improvement as far as the lines are concerned, until some action is taken by your Honorable Board or the Council.

In submitting this my first annual report, I take the opportunity of expressing my gratitude for the courtesy shown me when entering upon the duties of the office, and the assistance given me by the Board and its officials.

I am, Sir,

Yours respectfully,

F. W. W. DOANE,

City Engineer.

REPORT.

On Improvement in the Water Supply of the City of Halifax, N. S.

CITY ENGINEER'S OFFICE,

HALIFAX, N. S.,

FEB. 12TH, 1892.

Chairman Board of City Works :

SIR,—on the 6th of July, 1891, a resolution was passed by your Honorable Board requesting me to make such surveys as were necessary for the purpose of determining the most favorable route for a duplicate main for the low service system.

In accordance with that resolution, after examining every possible route, I submitted a report dated September 5th, 1891, recommending the adoption of a line which, in my opinion, would be most favorable if the scheme for a new pipe should be carried out. The route was described as follows:—

“Starting at the north pipe house at Lower Chain Lake and following the present pipe to the brow of the hill on the west side of the Arm, the route of survey turns northwardly and running in a nearly direct line to Bayer's Road continues along the highway to McCollough Street. Thence the line proceeds along the lowest part of the depression across Windsor Street, and passing north of the Paint Factory crosses Kempt Road and Longard Street to Young Street. From Young Street the pipe may be laid down Gottingen Street or down Kaye Street to Campbell Road.”

The report mentioned above was referred back to me for cost of right of way and such other information as I could obtain. I therefore beg to submit the following communication, and in doing so I may say that the delay has been caused by the difficulty in getting answers from property owners on the proposed line, some of whom are in England.

The first point to be considered is the necessity for improvement or increase in the water supply of the city. That there is need of improvement cannot be disputed. The question to be decided, however, is how that improvement is to be made. The object apparently would be to obtain the greatest degree of efficiency in the most economical manner. The system has never been perfect since its inception, and looking over the history of the works it is almost impossible to discover any year in which complaints were not made respecting its inefficiency.

The original works were constructed by a private company organized in 1845, of which Jas. B. Uniacke was President. After some preliminary surveys, made by Mr. Charles F. Fairbanks, C. E., they obtained the services of John B. Jervis, a civil engineer well known in connection with the Croton Water Works in New York. He made a report on the 28th of August, 1845, which resulted in the laying of a twelve inch main from Lower Chain Lake to St. Andrew's Cross. Mr. Jervis considered a ten inch main ample for the estimated population of from 20,000 to 25,000, but in order to provide for future requirements he recommended a twelve inch pipe. He also proposed to construct a distributing reservoir at a point within the city known at that time as Windmill Hill, and described as about one thousand feet from St. Andrew's Cross. This important part of the scheme was never carried out, although subsequently advised by other engineers, including my predecessor. Water was first turned on from the Chain Lake in 1847.

In 1854 an additional main 15 inches in diameter was laid down to make the supply equal to the rapidly increasing demand. In 1855 Long Lake was drawn down 3 ft. 9 in. below the waste weir, leaving only 2 feet of water over the bottom of the conduit between Long Lake and Upper Chain Lake. This evidence of the limited storage capacity of the lakes and the necessity of a further increase in the supply roused the City Council to action and a

Water Committee, of which Henry E. Pugsley was Chairman, employed Jas. Laurie, C. E., to report on several proposed plans for improvement. In 1861 the works were purchased by the city and a Board of Commissioners of water supply was appointed of which John A. Bell, the present City Auditor, was Chairman. The first work carried out by the new Commissioners was the lifting of the old 12 inch main and the substitution of a new 24 inch pipe which was completed in 1861, or early in 1862. This pipe is the present low service main. The two mains were capable of supplying about 12 times as much as the demand estimated by Mr. Jervis, although the population had only increased 50 per cent.

The Long Lake water, however, did not control the highest portions of the city and in many places where the domestic supply was sufficient no pressure could be obtained for fire purposes. Accordingly in 1868 the High Service Works were constructed under the supervision of the Board of Commissioners of Water Supply and on the recommendation of Thomas C. Keefer, a hydraulic engineer of the highest standing.

In 1864 Long Lake fell to within 11 inches of the bottom of the conduit carrying the water to the Upper Chain Lake. Mr. Keefer reported in connection with the high service on the practicability and advisability of raising Long Lake dam, but it was not carried out until 1877, when the work was performed under the supervision of the City Engineer at a cost of \$13,500. The raising of the lake and consequent increase in storage had become an absolute necessity. During the preceding summer Long Lake was so low that window washing, street watering and other similar uses of water were prohibited, and water takers had to be cautioned against waste. In 1886 the conduit between Long and Chain Lake was lowered and the storage capacity of our low service reservoir increased over 100,000,000 gallons.

Notwithstanding the fact that the supply considered sufficient at the inception of the works, has been multiplied by from 12 to 15, while the population has not even doubled, we are again compelled to consider the question of increase. The experience of Halifax is repeated in few cities and the consumption per capita at times has been exceeded by none. Taking the statistics of consumption for works all over the country we find on comparison that there is a great difference in the amount of water consumed

in different places, and if from 30 to 50 gallons suffice in certain cities, the use of 90 or 100 gallons in others presupposes a considerable waste. For domestic and household uses 20 gallons per person per diem is a sufficient allowance; taking into account the water used for mechanical and manufacturing purposes, that necessary for street sprinkling, extinguishing fires, for use in stables, etc., 60 gallons per diem for each inhabitant is a liberal quantity in the case of the larger cities and manufacturing towns. In the case of the smaller, non-manufacturing towns 35 or 40 gallons should suffice.

The great waste which takes place in Halifax being acknowledged, the question arises how to prevent or at least diminish it. There should be no doubt in the mind of any citizen that a great waste does take place, for instead of 60 gallons per day being sufficient on an average, our daily consumption has at times reached four times that quantity. The cause of such an enormous consumption has been pointed out so often that the City Council has ceased to take any notice of it, if indeed it ever did. As a natural consequence of the complaints respecting waste being made to unheeding ears we are now compelled to face a possible expenditure of \$150,000 to improve the service to say nothing of the thousands of dollars that have gone up in smoke in some parts of the city which better pressure might have saved. Nor will the expense stop on the completion of the proposed improvements, for if the consumption increases as in the past the quantity of water available will be exhausted and we will be asked to solve the problem of augmenting the supply.

If the question of expenditure were less important and the supply inexhaustible I would have no hesitation in recommending immediate increase on account of the difficulty in checking waste in our climate and the impolicy of restricting every legitimate use of water. A lavish waste of water seems to have begun soon after the first pipe was laid, and following the history of the works we find the water pressure rapidly decreasing and in some parts of the town where a few years ago, streams from the fire hydrants could be thrown over the top of buildings, the water now will not rise to the nozzles. In consequence the High Service had to be diverted to the low, thereby destroying the High Service System. All over the city stop-cocks have had to be partially or entirely closed in order to give a supply to houses which otherwise would have none.

As the consumption increases from year to year the loss of head which was at first trivial must increase so that during fires and in times of greatest draught the water must fall away in houses receiving it on the second and third floor to the first floor and basement and from elevated houses altogether.

Not only will consumption of daily supply, when reached generally take place in the 12 hours of the day and therefore require a capacity double the average for the 24 hours, but at all times when fire occurs the demand requires the utmost efficiency throughout every part of the pipe. That the consumption of daily supply has been reached has been proved by the fact that at times the draught is so great that not only is there no pressure on Quinpool Road but the water does not fill the pipe. By the time those who are inclined to doubt the enormous consumption or waste have digested that statement they may, perhaps, be converted.

The most important result of the great waste is the greater risk from fire and consequent higher rate of premiums. Waste and therefore loss of pressure destroys the value of the fire department. When a fire breaks out the first sound of the alarm calls the turnkeys, who have special instructions, and the Foreman of the Water Department under whose immediate direction the turnkeys are. I also attend as many alarms as possible myself. The first duty of the men is to concentrate the water as much as possible to the locality of the fire by shutting it off from the other parts of the city, and in this way the pressure necessary can be obtained, although in the higher parts of the Low Service, where there was formerly a fair fire pressure, the High Service has to be utilized. It is necessary to exercise the greatest caution in concentrating the whole available force of water so that the wrong valves may not be opened or closed and the district entirely deprived of water. There is also a danger of the same result from the bursting of a main caused by a valve being closed too hastily. If the waste were checked the normal pressure would be greatly augmented and the necessity for concentration would not exist. Moreover I shall be able to prove that if the waste were stopped the benefit obtained would be greater than that from any other improvement within our present means.

The principal causes of waste are bad plumbing, exposed pipes, taps and fixtures and hopper water closets. One strong proof that

waste is caused by exposed pipes, taps and fixtures and bad plumbing lies in the fact that the consumption in winter is much greater and the pressure consequently much less than in summer. The consumption during the winter of 1874-5 became so great that the water had to be concentrated in districts during a certain portion of each day on the higher streets, in order to give a domestic and manufacturing supply. The weak pressure made it necessary to turn off the water from one district to supply another, and in some places the High Service had to be tapped to supply the Low Service districts

In 1879 the City Engineer reported that there were 4291 service pipes, the greater part of which were $\frac{1}{2}$ inch. In 1492 buildings supplied with water the pipes were laid in exposed and dangerous positions, so that the inmates were obliged to let the water run almost constantly through the winter. In 1185 buildings, the pipes, or water fittings were in bad condition or in some way defective.

In 1889 there were 5215 service pipes with a total of 13966 taps. In 1890 there were over 800 exposed pipes and taps. About 3500 taps running at a rate of one gallon in a minute would consume almost the entire available supply. In some cases tested it was found that the waste from a single tap was $8\frac{1}{2}$ gallons in a minute. In view of this fact it is not surprising that the pressure is weak, and when to the waste from exposed taps is added that from hopper closets does any body wonder why the mains cannot supply the draught caused by the enormous useless discharge into the sewers. In 1879 there were 880 hopper closets; in 1884 there were 1400. In a report dated August 3rd, 1891, now on the order of the day in the City Council, I gave the result of some experiments made in Boston to determine the waste in hopper closets, and taking the result as an average in our own case showed that the waste in Halifax would be over 400,000,000 gallons in a year. It was also stated that we had been able to make a test for ourselves with 9 closets, and applying the average result to the whole number of hopper closets in the city, we were sending a useless stream into the harbor during the year, amounting to over 900,000,000 gallons, a quantity equal to the whole storage capacity of Long Lake.

In 1881 the heavy incrustation was taken off the inside of the High and Low Service Mains by mechanical scrapers, and the result was that the pressure was largely increased all over the city. At

some hydrants the increase amounted to 28 pounds. This improvement lasted for a short time only and the old evil destroyed the benefit derived from the cleaning of the pipes. The effect of the increased pressure was that more water was wasted, and the condition of the works will soon be about the same as in 1880. The following statement shows the pressure at some well known points before the cleaning operations were undertaken, after the first cleaning, and during the month of March, 1891.

LOCALITY.	Lowest pressure	Lowest pressure	Pressure March
	in winter of 1880.	in winter of 1881.	1891.
INTERSECTION OF.	lbs.	lbs.	lbs.
Agricola Street and North Street	5	30	6
“ “ “ Almon “	10	34	13
Almon Street and Kempt Road	8	34	12
Bilby “ “ Gottingen Street	15	40	23
Brunswick Street and Prince “	5	13	5
“ “ “ Jacob “	12	27	21
“ “ “ North “	0	12	32
Cogswell “ “ Gottingen Street	5	19	10
Dresden Row “ Artillery Place	35	60	42
Duke Street and Barrington Street	23	39	33
Grafton “ “ Blowers “	0	15	6
“ “ “ George “	4	20	11
Prince “ “ Argyle “	6	23	13
Quinpool Road and Robie “	24	52	31
Water Street “ Fawson “	23	38	23
“ “ “ North “	18	46	27
Moren's Wharf	33	50	33
Queen's Wharf	36	55	47
Cronan's “	32	58	51
West's “	30	56	47

Under the present condition some parts of the city have no reason to complain and probably have always had a good supply for domestic and fire purposes. It is necessary that the same benefit should be extended to all parts of the city in order that the feeling of security, the advantages arising from reduced premiums

for insurance, and the luxury of a full supply of pure water enjoyed by that part of the city where the most trade is carried on the bulk of the merchandise stored and the most costly buildings erected, may be equally enjoyed by all.

The quantity of water available in the High Service system should be ample to supply one-half of the city (in population.) The City Works yield enough water to supply a population of 80,000 and if anything like economy were enforced the supply would suffice for a much larger number. With a source 200 feet above tide, making every allowance for loss of force from friction in pipes and constant draught for domestic supply, all points 150 feet above tide should be provided by the Low Service with sufficient means for extinguishing fires. Such, however, is not the case and in some places the High Service is let down to points 94 feet above tide. These extensions have destroyed the High Service and in any dry season it is liable to become exhausted.

PREVENTION OF WASTE.

I would not give so much attention to waste concerning which the Council has already heard so much, if no remedy could be recommended. In some countries it has been found necessary to adopt very harsh measures in order to try and prevent unnecessary waste. Waste in cold climates depends on the regulations for prevention and the degree of stringency with which such regulations are enforced.

A step in the right direction has already been taken. House to house inspections are made during the winter and the water is turned off wherever exposed taps or pipes are discovered. We are not yet in a position to prevent bad plumbing in houses, although we may be certain when it is being put in that it will cause waste. If the plumbing regulations submitted to the Council by the City Health Board become law we shall be able to control all new work.

The most important recommendation I could make for the prevention of waste is the abolition of all hopper water closets. The inmates of houses in which hopper closets are found allow a small stream to run day and night with the idea that they are flushing out their drains or preventing the entrance of sewer gas. They could not be more mistaken, for the small stream does neither.

A bucket of water would do more towards flushing the drain than the small stream would do in a week. It is impossible to flush a six inch drain with the amount of water usually found running for that alleged purpose. Neither does it prevent the entrance of noxious gases. In most cases the water is turned on by the tipping of the pan worked by a handle or lever. When closed the pan is filled with water and forms a water trap, effectually preventing the entrance of gases. Not satisfied with this condition, which is the safest, such unsanitary arrangements can be left in, the water taker generally props up the handle or lever so that a stream will run continuously. This operation opens the trap and provides an unobstructed canal up which sewer gas may pass into the house. The City Health Board have asked the Council to wipe them out of existence, but so far no action has been taken. They are the most unsanitary form of closet and every time the pan is tipped, if only for an instant, the door is open to disease. In my opinion these closets are responsible for the greater part of the disease which the city authorities have tried to stamp out, and while such facilities exist for communication from house to house through untrapped drains laid with criminal negligence, we cannot hope to see its extermination.

There is another effectual remedy for waste which should be generally adopted in Halifax. The experience in other cities shows a great reduction in the consumption by the use of meters for detecting waste. Wherever they are used they play a most important part in reducing or keeping down the consumption of water and consequently the necessary size and corresponding cost of water works. There are a few in use in Halifax, but very few compared with the number of taps. Meters were first used in the city in 1876. The meter put on at the Halifax Hotel in that year reduced the daily consumption from 18,600 gallons to 6,700 gallons and at the International Hotel from 10,500 to 1,290 gallons. At present there is no meter on either of those houses.

In one instance coming under my own notice during the past summer a meter was put on where the average consumption was supposed to be about 10,000 or 12,000 gallons a month. During the first month a waste amounting to 1,400,000 gallons was detected. As a result of the application of the meter that amount is saved to the city every month.

There is a good deal of opposition from consumers to the general adoption of meters, and I am sorry to have to add that their efforts to prevent the putting on of meters have in some cases been effectually assisted by members of the City Council. In an ordinary house where care is used to prevent waste the cost to the consumer should not be greater than under the present system of assessment, while those persons who will not exercise common care would have to pay in proportion to their consumption. There can be no question of the justice and propriety of measuring the water used for manufacturing purposes, or in hotels and large institutions. It is sometimes objected that the adoption of meters in private dwellings will cause an injurious economy in the use of water among the very class of the population where it is important that water should be used freely. This objection is obviated to a great extent, in some places, where meters are employed by fixing a minimum tax—to be paid by all water takers—which shall cover a certain quantity, based on a reasonable estimate of domestic needs. Water used in excess of this quantity should be paid for by measurement, and special arrangements may be made for tenement houses. Cold weather waste can never be completely stopped until property owners are obliged to arrange their plumbing so that the water can be completely drawn from the pipes when liable to freeze. By the use of meters the waste will be reduced to the minimum amount required to prevent the pipes from freezing, and it would become a question to the water taker whether it was economy to waste water or remodel his fixtures.

Some consumers protest against the use of meters because they are unsanitary and in proof of their statement say that they are not in use in other cities. To show that such is not the case I will give a few figures taken from recent returns. Of 77 German cities with a population of 7,600,000 twenty-six per cent, sell water *exclusively* by meters. In the remainder meters have been generally adopted. Since 1878 Berlin has used meters exclusively in selling water. Manchester, New Hampshire, has a population of 44,126 and uses 1135 meters. Providence, Rhode Island, with 14,896 taps has 9286 meters. Halifax with 13,966 taps uses 44 meters. In the United States 43.1 per cent. of all the works have meters in use. Alleghany, with a consumption per capita of 238 gallons per diem, uses no meters. Atlanta, with 89.6 per cent. of taps metered, consumes 36 gallons and Fall River, with population of 74,398 and 74.6 per cent. of taps metered, consumes only 29

gallons per capita, or 2,157,542 gallons per diem. Halifax with one-half the population of Fall River has an estimated consumption of 6,500,000 gallons. No further comment is necessary.

All the remedies mentioned should be ordered by the City Council and faithfully applied. If the suggestions made were strictly carried out at once I have no hesitation in saying that when the pressure at the hydrants is taken in March, 1893, the results will show the works to be in as good condition as in 1882. If this course is not followed we must resort to the most expensive remedy, additional supply.

CONSTRUCTION OF RESERVOIR.

The most economical method of increasing the supply would be the construction of a reservoir in some central position within the city limits. It was a part of the original design for the works and has been repeatedly recommended by the City Engineer during the past three years. The advantages are generally, that while the effective head and consequently the discharge is diminished by the friction on the sides of the pipes and the various curves and bends in long mains, the reservoir collects near the centre of distribution a large quantity of water at nearly the full elevation of the source of supply, and by a system of stop cocks exerts the force due to that elevation upon the service pipes and hydrants. In case of accident to the main or during cleaning operations the city is supplied for a time proportionate to the capacity of the reservoir, independent of the lakes. The water discharged into the reservoir during the night or while the consumption is lightest during the day, is fed out to the overworked main during the time of greatest consumption when the draught becomes too great for the capacity of the pipe. In some cities, however, the amount of water drawn from the distributing reservoir during the night often far exceeds the average used in the day time. Under the present condition of the service a similar occurrence would be noticed in Halifax. In winter, on the highest parts of the High and Low Service the pressure is at times 5 pounds less during the night than in the day time. Such being the case I would hesitate to recommend the adoption of a reservoir as a solution of the difficulty. While it might be very beneficial in summer I fear it would be of little use in winter, when most needed. The main will not deliver as much Water into the

reservoir as it will directly into the distribution while its full capacity is exerted, because in the latter case it will always be discharging under a lower head. Now when at times during the day we find the draught so great that the main on Quinpool Road is not full, we also find the pressure less at night than during the day where is the water coming from to fill our reservoir? It would not only be impossible to fill it, but during the coldest days not a drop of water would be discharged into it so long as the consumption is so great.

DUPLICATE MAIN.

While there is a possibility of the reservoir failing in its purpose it would be advisable to offer an alternative scheme for your consideration. Such a scheme has been outlined in the proposal to lay a duplicate main. The advantages of a duplicate main would be, in a measure, similar to those already mentioned in connection with the reservoir, while there would be no danger of failure except from limited supply. It will be readily acknowledged that the necessity for better fire protection is very urgent. Should a fire gain headway in some parts of the district supplied by the Low Service while a burst in the main is being repaired, or while the scraper is being run through the pipe, the result would be disastrous. In the latter case it might take three or four hours to get water to the scene of conflagration. When the water is turned off on the High Service it takes five hours from the time of turning on to reach the highest and most remote points in the city. The following statement taken from a table prepared for Alderman Pickering, Chairman of the Board of Firewards, shows the normal and concentrated pressure at five Low Service hydrants near recent fires:

LOCALITY.	Normal Pressure.	Pressure concentrated on district.
INTERSECTION OF	lbs	lbs
Barrington and George Street	30	47
Spring Garden Road and Grafton Street . .	25	31
“ “ “ “ Pleasant “ . .	21	35
Brunswick Street and Prince “ . .	7	12
Water Street, opposite Taylor's Wharf . . .	48	65

The pressure at the corner of Brunswick and Prince Streets is obtained by turning on the High Service. It can be still further increased by about 30 pounds, but concentration takes time. The pressure on this hydrant in 1881 was 13 pounds from the Low Service alone.

The supply of water available for the Low Service System is by no means inexhaustible, although the attention of the Council has not been called to the fact in former reports made on the subject of improvement. In wet seasons the quantity of water drawn from Long Lake could be doubled without exhausting the supply. In the dryest seasons our surplus is limited. Below is given the lowest point to which the water has been known to fall each year since 1881, the year in which the mains were first cleaned :

MONTH.	YEAR.	LEVEL OF SURFACE BELOW WASTE. WEIR.	RAINFALL FOR YEAR. AT LAKES.
October	1881	3 ft. 1½ in	48.65
September . .	1882	2 " 4½ "	56.089
January	1883	3 " 4 "	46.201
October	1884	3 " 9¾ "	59.252
October	1885	4 " 5 "	47.995
November . . .	1886	2 " 3 "	46.60
August	1887	3 " 9 "	59.82
June	1888	1 " 3¾ "	68.525
November . . .	1889	5 " 11 "	46.81
August	1890	4 " 1½ "	59.38
October	1891	3 " 6½ "	57.12

It will be seen that the lowest level reached since 1881 was 5 feet 11 inches below the waste weir. Long Lake will yield the requisite quantity per diem till it is drawn down to 8.22 feet below the waste weir. The quantity of water remaining in Long Lake available for city use was about 225,000,000 gallons. During the year 1889 the amount of water running over the waste weir was about 250,600,000 gallons. Assuming that this could be saved and added to the quantity remaining in Long Lake in November, 1889, we could have increased the consumption during the year by 475,600,000 gallons, which is only 1,300,000 gallons per diem.

The rainfall during 1889 was much below the average, being only 46.81 inches. Only twice since 1858 has it fallen below 46 inches. In 1860 the rainfall in the city was only 39.51 inches and in 1879 it was 40.76 at Chain Lake. In reference to the latter case, however, the City Engineer says in his report for 1886-7, "There is reason to believe that sufficient care was not always exercised when making the observations." In the city during the same year it was reported as 47.7 inches.

If the rainfall in 1889 had been no greater than in 1860 the available supply from the Long Lake Water Shed would have been diminished 490,000,000 gallons, and the present 24 inch main would have drained the lake to the lowest possible level. If a duplicate pipe is laid and the consumption increased there would be a risk in very dry seasons of the city being entirely deprived of water. It is therefore an absolute necessity to reduce the consumption, no matter what other plan for improvement is adopted.

Taking 46 inches of rainfall as a basis on which to calculate the required diameter of pipe for the proposed new line and considering the loss of head as the pipe gets foul and the fact that the consumption of daily supply, if properly controlled, takes place in the 12 hours of day, it would be advisable to lay a pipe not less than 24 inches in diameter. If we consider the efficiency demanded when a fire occurs (more especially when the other main is turned off) nothing less than a 27 inch pipe will satisfy the requirements.

There is another question which should govern the decision respecting the size of the pipe. We should first ascertain by careful survey and estimate of cost whether when the question of additional supply again arises we shall be able to bring more water into the Long Lake Water Shed or look for increase from a separate service. In a short report made by Wm. Gossip, C. E., he suggested that it might be found cheaper to bring water from Governor's Lake than from Birch Cove or Pockwock Lakes. If there is any probability of water being brought from Governor's Lake the capacity of the new main should be proportioned to the future supply and consumption. Judging from a cursory inspection of Governor's Lake I am of the opinion that any increase in supply will not come from that locality.

From the limited information I have been able to obtain in the time at my disposal I can only give an approximate estimate of the cost of the proposed line of pipe. A portion, say one mile of main, should be of extra thickness on account of the heavy pressure it must sustain in crossing the hollow at the head of the North West Arm. The cost of laying a 24 inch main would be about \$94,000, not including new distribution, land damages and changes required at the lakes. The cost of a 27 inch main would be about \$104,000. The cost of right of way is estimated at \$3,000 besides some concessions respecting water supply. Should a new line of pipe be laid, some alterations and additions will be necessary in the distribution. There will also be some alterations needed in the gate houses at Lower Chain Lakes. The intake pipe at the north gate house is too small, even for present use, and is not capable of supplying the Low service when the south intake is shut off. The screen boxes would be too small and an additional chamber would have to be added in each gate house. The loss of head caused by the inefficiency of the gate house is very important. It may be found necessary to raise Long Lake one foot. In any case Nickerson's dam should be strengthened. The work should not be neglected until some improvement is made in the service, but should be carried out at once.

Earthen dams give very little warning before giving way and while I do not wish to cause unnecessary alarm, I would recommend that the work required to make this dam reasonably safe be ordered at once. The lake was raised in 1877, but the dam was left in an unfinished condition. The whole lake face requires strengthening. In 1881, after a north-east gale, about 200 feet of the wall showed signs of movement towards the lake. There is a risk during every north-east storm that from the action of the waves the lake wall of the dam will slide northward or into the lake. Any accident to this structure occasioned by storm or freshet would be attended with such serious consequences, that immediate measures should be taken to prevent such a calamity. The leaks, some of which have existed since 1848, show no apparent increase.

DIVERSION OF HIGHWAY.

Another very necessary improvement in connection with the Low Service reservoirs is the diversion of the public highway

This work, like the completion of the dam, should be carried out in any case. The proximity of the road to the Chain Lakes is one great cause of the acknowledged impurities in the water in these lakes. During the spring thaws, when the entire accumulations of winter are being washed from the road into the lake, the discoloration of the water may be noticed at times extending over half-way across.

MILL OWNER'S CLAIMS.

I will also call attention to another great source of annoyance and loss to the city. We gain practically nothing by making the Chain Lakes part of the Low Service Works owing to the great quantity of water claimed by the mill owners for the natural flow through the Upper and Lower Chain Lake. Some definite agreement should be made with the mill owners along the brook and at the head of the Arm stating the quantity of water they should be entitled to receive. This matter should be settled before one dollar of expenditure is made which might lead to new difficulties. The purchase of the water-power would be a very expensive remedy, and in 1876 and following years it was recommended as a solution of the difficulty that the supply be taken direct from Long Lake by conduit or tunnel at an estimated cost of \$45,000. In support of this project it was claimed that the whole head could be utilized, purer water could be obtained, the water would be entirely at our own disposal, the complaints of mill owners would be avoided and the city freed from the danger and uncertainty of a suit at law.

All these benefits except freedom from mill owners claims, can be obtained more economically by raising Lower Chain Lake and in addition the loss of 190,000,000 gallons of storage would be avoided, and the capacity of these Low Service Reservoirs would be increased to 350,000,000 gallons, a matter of the greatest importance considering the present condition of the works. The proposed conduit could not have been built in permanent material for the amount estimated. The design was for a wooden structure 6 feet high, the bottom of which was to be placed 11 feet below the ordinary surface level of the water. In order to prevent the wood from decaying it was intended to keep it always under water. If this intention had been carried out the available depth of storage would be five feet, minus the thickness of the wooden top of the conduit. The depth of storage under the present system to the top of the conduit between Long and Chain Lakes is a few inches more

At times it will be absolutely necessary in order to satisfy the demand to draw the lake down 3 feet lower. Such being the case it would not be advisable to construct such an expensive piece of work of perishable material. A comparison of the cost of building the conduit of permanent material with that of raising Lower Chain Lake, all the resultant benefits on both sides being considered, would probably lead to the adoption of the latter scheme. If carried out it would have the effect (besides that already mentioned) of increasing the head 7 feet, the pressure 3 pounds and the capacity of the main half a million gallons per diem, while the increase in storage would be 165,000,000 gallons.

The city owns nearly all the land around Long Lake, but there are one or two pieces yet to be acquired. The land owned by the city should be marked by proper boundaries. At present it is impossible to determine where any portion of it lies. I would strongly recommend that all land around Long Lake, Chain Lakes, Bayer's Lake, Ragged Lake and Spruce Hill Lakes, not already purchased, be acquired at once by the city and permanent bounds set up. Delay in this matter will cost the city thousands of dollars.

INCREASE IN HIGH SERVICE.

Mr. Keefer suggested the creation of an intermediate service to relieve the High Service by constructing a reservoir in the valley of the Beaver-dam Brook. We cannot afford, however, to take any water from the Long Lake gathering grounds as the whole supply of Long Lake is required for those portions of the city commanded by it. The High Service cannot be increased from Spruce Hill Lakes as the present main will discharge all the water that can be obtained from that source. It would be practicable to bring the storage of Ragged Lake into the pipe leading from Spruce Hill Lakes and a 40 days supply of 1,500,000 gallons a day could be obtained during the dryest season, while the storage capacity, if the lake was raised 10 feet, would be over 400,000,000 gallons.

We have a few men employed at Spruce Hill Lakes cutting stone to complete the work of strengthening the dams. A portion of the work was done last fall, but the water came so near the top of the dam last month that we were obliged to insure the safety of the structure by lowering the lake. When the work on

the dams is finished we shall be able to store all the water that the Spruce Hill Lakes watershed will supply.

To recapitulate: the matters submitted for your consideration are:—

1. The necessity for improvement or increase in the supply.
2. Prevention or reduction of waste by the adoption of strict plumbing rules, house to house inspection, abolition of hopper and all other closets and urinals that are not self acting and the general use of meters.
3. The construction of a distributing reservoir or a duplicate Low Service Main.
4. Strengthening Nickerson's dam.
5. Diversion of highway at Chain Lakes.
6. Final settlement of mill owner's claims.
7. Raising Lower Chain Lake.
8. Acquiring land around lakes and setting permanent bounds.
9. Increase in High Service by bringing Ragged Lake into the system.

Respectfully submitted,

F. W. W. DOANE,

City Engineer.

WATER DEPARTMENT OFFICE.

August 1st, 1892.

F. W. W. DOANE, ESQ., *City Engineer* :

SIR,—In accordance with your instructions I have prepared a schedule of stock on hand, number of feet of main pipe laid, number of feet of service pipe laid and renewed, with the length of main pipe recleaned, and the number of fire hydrants put down during the Summer of 1891, and Spring of 1892.

The Water Inspectors returns you will find appended, all of which is respectfully submitted.

E. MORRISON,
Foreman Water Department.

**List of Pipes Recleaned by Mechanical Scrapers During the
Summer of 1891.**

No.	LOCALITY.	Diameter of Pipe, inches	Length cleaned in ft.	Total Cost.	REMARKS.
1	Low Service Main	24	13400		
2	High Service Main	15	29500		

**Lists of Streets where Water Pipes have been laid during
season of 1891 and Spring of 1892.**

Name of Street.	From	To.	Diameter of Pipe.	Length of pipe in feet	Total Length.
South Street	West side Robie	Centre of Robie ..	6	35	.....
South "	"	798 feet West	6	798	.....
Robie "	Willow	100 feet South	6	100	.....
Uniacke "	E. End of Pipe	144 " East	4	144	.....
Bloomfield Street	" "	288 " "	6	288	.....
Salter "	Water Street	" " "	3		.....
Robie "	West "	380 feet North	6	380	.....
Fenwick "	W. Side Bland	54 " East	6	54	.....
College "	End of Pipe	" " West	6	54	.....
Douglas Wharf	Fire Plug on wharf	" " "	3		.....
Welsford Street	End of $\frac{3}{4}$ Pipe	122 feet East	4	122	.....
Shirley "	Preston Street	Walnut Street	9	487	.....
Walnut "	Shirley "	Coburg Road	9	2250	.....
Union "	Young "	Hanover Street	6	838	.....
Lemarchant "	Coburg Road	N. to End of Street ..	6	732	.....
Veith "	Young Street	330 feet North	6	330	.....
Coburg Road	Seymour Street	Robie Street	9	850	.....
Edward Street	Coburg Road	258 feet South	6	258	.....
College "	Carlton Street	275 " East	6	275	.....
Woodill "	Agricola "	233 " "	4	233	.....
Summer "	College "	Spring Garden Road ..	6	418	.....
Service pipes put into ..	Houses	Lead	$\frac{1}{2}$	821	.....
"	"	" "	$\frac{1}{2}$	4347	13649

117 Houses supplied with Water in 1891 and spring of 1892.

45 Service Pipes renewed.

List of Fire Hydrants put down in 1891.

Name of Street.	Where Situated.	Size of Pipe.	Length in feet.	Total Length
South Street	Feet West Lemarchant Street	6	18	
Robie " .....	.....	6	15
Fenwick Street	Opp. Bland Street	6	15	
Walnut Street	S. E. Cor. Jubilee Road	6	40	
Coburg Road	Opp. Walnut Street	6	10	
Veith Street	310 feet North Young	6	16	
Union "	Feet North Young	6	27	
" "	Opp. Hanover	6	27	
Coburg Road	Opp. Edward	6	16	

Total No. of Feet excavated in 1891, and Spring of 1892—13333 feet.
Total No. of Fire Plugs in use 351.

Pipe Stock on hand April 30th, 1892.

No. of Pieces.	Diameter.	Weight of one.	Weight in lbs.	Weight of whole.	Cost per lb.	Total Value.	REMARKS.
11	27	2651	29161	.....	.....	.....	.....
8	24	3192	25536	.....	.....	.....	.....
6	20	1263	7578	.....	.....	.....	.....
3	15	1029	3087	.....	.....	.....	.....
114	12	680	77520	.....	.....	.....	.....
13	10	550	7150	.....	.....	.....	.....
51	9	538	27438	.....	.....	.....	.....
100	8	386	38600	.....	.....	.....	.....
718	6	280	201040	.....	.....	.....	.....
21	5	222	4662	.....	.....	.....	.....
411	4	156	64116	.....	.....	.....	.....
69	3	128	8832	.....	.....	.....	.....
20	2½	26	520	.....	.....	.....	Stand Pipes.
20	.....	12	240	.....	.....	.....	Plates.
20	.....	6	120	.....	.....	.....	Caps.
40	.....	1½	60	494660	2½	1112985	Thimbles.

Wooden Wedges.

Diameter of Pipes.	No. of Wedges.	Total No.	Cost of each.	Total Value.
24	1500	.....	.....	.....
20	2500	.....	.....	.....
15	3500	.....	.....	.....
12	1800	.....	.....	.....
9	2000	.....	.....	.....
6	7500	18800	1 $\frac{1}{4}$	23500
Keys	5000	5000	$\frac{1}{4}$	1250

BRANCH PIPES AND IRREGULAR PIECES.

No. of Pieces.	Diameter.	Description.	Weight of one in lbs.	Weight of whole.	Total weight.	Cost per unit.	Total Cost.
3	27	Bell-mouth	831	2493	.....	.....	.....
1	24	Caps	290	290	.....	.....	.....
19	24	Thimbles	396	7524	.....	.....	.....
5	20	"	230	1150	.....	.....	.....
3	15	Double Branches, 15 in. outlet...	896	2688	.....	.....	.....
3	15	" " 4 in. " ..	660	1980	.....	.....	.....
1	15	Single Branches, 15 in. " ..	812	812	.....	.....	.....
2	15	Y Branches.....	1012	2024	.....	.....	.....
3	15	Thimbles.....	234	702	.....	.....	.....
1	15	Reducing to 6 in	400	400	.....	.....	.....
1	15	Saddle 4 in. outlet	122	122	.....	.....	.....
1	15	" 3 in. "	115	115	.....	.....	.....
3	12	Double Branches 9 in outlet	500	1150	.....	.....	.....
3	12	Single " 12 in "	524	1572	.....	.....	.....
4	12	" " 9 in "	494	1976	.....	.....	.....
4	12	" " 6 in "	469	1876	.....	.....	.....
1	12	Reducing to 9-6 in outlet.....	450	450	.....	.....	.....
11	12	Thimbles.....	160	1760	.....	.....	.....
2	12	Saddles, 3 in outlet.....	86	172	.....	.....	.....
5	12	Caps.....	45	225	.....	.....	.....
3	12	Reducing to 6 in without Faucet..	200	600	.....	.....	.....
1	12	" " with Faucet.....	200	200	.....	.....	.....
8	9	Double Branches.....	411	3288	.....	.....	.....
2	9	Single "	355	710	.....	.....	.....
2	9	Double " 3 & 9 in outlet...	354	708	.....	.....	.....
3	9	Single 4 in outlet.....	200	600	.....	.....	.....
					35587	2½	88967
2	9	Single Branches 6 in. outlet.....	306	612	.....	.....	.....
3	9	Reducing from 9 in to 6 in	121	363	.....	.....	.....
9	9	Thimbles.....	116	1044	.....	.....	.....
5	9	Offsets.....	136	680	.....	.....	.....
6	9	Caps	32	192	.....	.....	.....
11	6	Double Branches	255	2805	.....	.....	.....
1	6	Single Branches	209	209	.....	.....	.....
3	6	Y Branches	250	627	.....	.....	.....
5	6	Reducing to 4 in with Faucet....	124	620	.....	.....	.....
12	6	" " without Faucet.	114	1368	.....	.....	.....
1	6	" " 3 "	66	66	.....	.....	.....
7	6	" 3 in with Faucet....	114	798	.....	.....	.....
1	6	Double Branch 3 in outlet... ..	180	180	.....	.....	.....
4	6	Offsets.....	140	560	.....	.....	.....
18	6	Thimbles.....	67	1206	.....	.....	.....

Branch Pipes and Irregular Pieces, (Continued.)

15	6	Bends	136	2040			
35	6	Caps	19	665			
22	4	Double Branches	123	2706			
5	4	Single "	114	570			
2	4	Angle "	96	192			
4	4	Reducing 4 in to 3 in with Faucet	95	380			
5	4	" " " without "	84	420			
22	4	Thimbles	29	638			
9	4	Caps	11	99			
21	4	Caps for Main Stopcocks	15	315			
5	4	Offsets with Faucets	66	330			
					19685	2 $\frac{1}{2}$	492 12
4	3	Single Branches	81	321			
5	3	Crosses	90	450			
24	3	Thimbles	26	624			
4	3	Caps	8	32			
1	3	Double Branches	100	100			
6	2	Double Branches	30	180			
4	2	Angle "	23	92	1799	2 $\frac{1}{4}$	40 48
6	24	Split Thimbles	620	14880			
1	20	" "	453	453			
9	15	" "	260	2340			
2	12	" "	222	444			
20	9	" "	139	2780			
27	6	" "	92	2474			
9	4	" "	64	576			
8	3	" "	48	384			
6	5	Split Collars for Fire Plugs	61	366			
6	5	Thimbles	51	306			
13		Extension pieces	124	1612	26615	2 $\frac{3}{4}$	665 37
2	15	Stopcocks				100 00	200 00
7	12	"				79 00	553 00
2	9	"				55 00	110 00
27	6	"				30 00	810 00
16	4	"				20 00	320 00
3	3	"				14 00	42 00
4	15	Gun Metal Screws	28	112			
6	9	" "	14	84			
13	6	" "	9	117			
2	4	" "	6	12			
4	3	" "	5	20	345	60	207 00
10	6	Siemens Meters on hand				143 43	1434 30
5	4	" " "				86 75	433 75
20	3	" " "				65 67	233 75
3	2	" " "				44 65	133 95
1	1 $\frac{1}{2}$	" " "				34 42	34 42
12	1	" " "				21 50	250 00
52	1	" " "				15 50	806 00
78	1	" " "				14 40	1122 20
1	1	Crown " "				49 25	49 25
1	1	" " "				37 92	37 92
1	1	" " "				26 25	26 25
2	2	Frost " "				31 22	62 44
2	2	" " "				21 47	42 94

Branch Pipes and Irregular Pieces, (Continued.)

5	Pressure Gauges				10 00	50 00
4	Fire Plugs with Jackets,				66 50	266 00
3	" without "				50 00	150 00
3	Spare Jackets for Fire Plugs.....	340	1020	1020	24	22 95
4	2½ Old Fire Plugs				13 00	52 00
200	Brass castings all sorts				35	70 00
108	¾ Stopcocks for Service Pipes.....				1 25	134 40
	Pipe Tapping Machine.....					127 60
5	1 Service Stopcocks				2 50	12 50
1	4 H. P. Gas Engine					475 50
	5 H. P. Steam Engine and pump					625 00
	Tin Tubing		40		60	24 00
3	Lathes					400 00
	Blacksmiths Tools.....					200 00
1	12 Regulating Valve					
1	6 " "					

RECAPITULATION.

Lbs.	Description.	Cost per lb	Value.	Total Value
494660	Pipes	2½	11129 85	.....
18800	Wood Wedges	1¼	235 00	.....
5000	Key Wedges	¼	12 15	.....
55272	Branch Pipes	2½	1381 79	.....
1799	" 	2¼	40 48	.....
26615	Split Thimbles	2½	665 37	.....
.....	Stopcocks from 15 to 3		2035 00	.....
345	Gun Metal Screws	60	207 00	.....
.....	Fire Hydrants		416 00	.....
.....	Casting for Fire Hydrants.....		22 95	.....
.....	Old Style Fire Hydrants		52 00	.....
.....	Brass Castings all sorts		70 00	.....
.....	Meters from 6 in. to ½ in.		4667 17	.....
.....	Pressure Gauges		50 00	.....
.....	Stopcocks for Service Pipes		146 50	.....
1	4 H. P. Gas Engine		475 50	.....
1	5 H. P. Steam Engine and pump		625 00	.....
1	Pipe Tapping Machine		127 60	.....
3	Lathes		400 00	.....
.....	Tin Tubing		24 00	.....
.....	Regulating Valves .....		.....	.....

\$2278376

PRECIPITATION FOR THE YEAR 1891.

1891.	SPRUCE HILL LAKES.				CHAIN LAKES.				CITY OF HALIFAX, N. S.			
	Inch's Snow.	Melted Snow.	Rain.	Total	Inch's Snow.	Melted Snow.	Rain.	Total.	Inches Snow.	Rain.	Total.	
January....	18.00	2.70	5.70	8.40	18.75	2.30	6.55	8.85	2.28	4	6.099	.....
February....	14.75	1.89	6.32	8.21	11.00	1.94	5.45	7.39	1.800		6.940	.....
March.....	17.25	1.97	1.47	3.44	7.75	1.28	1.17	2.45	1.118		1.567	.....
April.....	2.50	.24	3.00	3.24	1.75	.18	3.29	3.47	0.482		3.528	.....
May.....			4.36	4.36			4.105	4.105			4.195	.....
June.....			3.93	3.93			3.80	3.80			4.131	.....
July.....			4.26	4.26			3.76	3.76			4.003	.....
August....			3.19	3.19			2.61	2.61			3.385	.....
September..			2.68	2.68			2.25	2.25			3.052	.....
October....			11.47	11.47			11.77	11.77	0.005		9.616	.....
November..			1.65	1.65			2.49	2.49			2.388	.....
December..	2.50	.35	3.81	4.16	2.50	.45	3.71	4.16	0.092		3.984	.....
	55.00	7.15	51.84	58.99	41.75	6.15	50.955	57.105	57.81	52.888	58.669	