REPORT,

ON THE

DIVERSION OF THE WATER

OF THE

GENESEE RIVER,

FOR THE SUPPLY OF THE

ERIE AND GENESEE VALLEY CANALS.

BY DANIEL MARSH,
CIVIL ENGINEER.

ROCHESTER:
PRINTED BY A. STRONG & CO.
1847.

REPORT

ON THE

DIVERSION OF THE WATER FROM THE GENESEE RIVER.

To the Committee appointed by the owners and occupants of Water Power in the city of Rochester:

Gentlemen:—At your request I have made an examination of the various matters connected with the supply of water for the Erie and Genesee Valley Canals drawn from the Genesee River by the State, and beg leave to submit the following report:—

My first attention was directed to the condition of the river and of the Erie canal and its feeders at this place, and subsequently to the Genesee Valley Canal, with all the sources of waste from either canal, and the facts herewith presented are the result of a series of observations extending from the 20th of July to the close of navigation.

This investigation embraces the following topics, viz:

1st. The quantity of water naturally flowing in the channel of the Genesee River at lowest water and the quantity remaining after supplying the canals.

2nd. The quantity drawn from the river and its tributaries to supply both the Erie and G. Valley canals.

3d. The injurious effect of such diversion upon the hydraulic privileges of Rochester.

4th. The minimum quantity of water required to feed these canals, and the means of procuring this supply without resort at times of low water, to the Genesee river.

Genesee River.

The Genesee river was extremely low this season and the drought continued for an unusually long period, extending from the middle of June to the last of October, and increasing in severity towards the close of that period.

Previous to the 8th of August the quantity of water drawn into the Erie canal was large and pretty uniform, and after that time the exertions of the Engineer and Superintendants diminished this quantity and effected a supply from the West, more than equivalent to this diminution in the draught from the river; although the height of the water in the canal varied from time to time a few inches, yet I am informed that it was maintained in good navigable condition through the season.

From various measurements made with care in the East and West Races near Court Street, and in Brown's Race, and also in the river at the Rapids I fonnd the quantity of water flowing in the river to be 16,472 cubic feet per minute, to this add the quantity drawn from the river to feed the Erie and G. V. canals, and we have 24,842 c. ft. per m. for the whole volume of the river at low water.*

Supply of Canals drawn from the River.

The supply of the Erie canal, which is now drawn through both the feeder on the East side of the river

* See Appendix A. and B. for details.

and the Genesee Valley canal on the West side, now practically become a feeder for the Erie canal, amounted to 4130 c. ft. per m., until Aug. 8th, and 2110 c. ft. after that time.*

From some facts observed in the course of this season and from the former history of the canal, I am induced to believe that much of the consumption of water between Lockport and Montezuma is caused by defects in the original plan of the canal and by unskilful management of the water at the waste weirs and lock gates, and that more speedy and certain relief might be afforded by a change in these respects than by the discharge of double the present quantity of water into the lower level at Lockport. At the time of the original construction of the Erie Canal it was proposed to construct feeders from the Irondequoit Creek and Canandaigua Lake and others were actually constructed from Mud Creek, near Lyons, and from the Oak Orchard Creek at Medina, and the cautious Commissioners, after repeated examinations reluctantly abandoned their favorite route through Genesee county, by way of Black and Tonawanda creeks, and finally encountered the deep and expensive rock cut at Lockport to secure an unfailing supply of water from Lake Erie.†

The design was constantly entertained and repeatedly declared to supply the canal as far east as Seneca river with water from Lake Erie, and was successfully accomplished, say the Commissioners, for a few years,‡ and not only were the proposed feeders abandoned but those which had been constructed at Lyons

*See Appendix B.

† See Canal Laws, Vol. 1, page 202; Vol. 2, page 7, 8, 9, 12, 97, 102.

‡ Canal Laws, Vol. 1, page 58, 82; Vol. 2, page 12, 79, and Assembly Documents 1839, No. 86, page 19; 1841—72, 43, and 250, p. 3.

and Medina were neglected; the canal, as I am informed by Mr. Wm. Buell, a superintendant on this part of the canal from 1826 to 1831, being amply supplied from Lake Erie during that period, and not until the canal had become much filled up beyond Lockport, and the waste weirs from Lockport to Rochester neglected, was a resort to the Genesee river necessary.

The first season the canal was opened to Lockport it was fed during a period of drought exclusively and abundantly from that place to Brockport, 43 miles, by the Oak Orchard feeder.*

To show an unequal and unnecessary expenditure of water upon some portions of the canal I refer to the results of a series of gauges of the Erie canal made in 1841, under the direction of Alfred Barrett, Chief Engineer of the western division of the enlargement. (See appendix E. and F.) While the expenditure from Lockport to Medina was 23 c. ft. per minute, per mile, it was from Medina to Lockport 142 c. ft. per minute per mile, and from Rochester to Seneca river 56. The quantity of water thus consumed upon the canal from Medina to Brockport, would at the rate used from Medina to Lockport, supply 240 miles of canal. Upon this portion of the canal several extensive mills have been constructed deriving a material part of their supply in the dry season from water which flows from the canal into channels which would otherwise be nearly dry, and although serious obstacles have existed beyond Lockport, from the insufficient width and depth of the canal to the passage of an adequate supply of water, yet as I am informed a

* See Canal Laws, 2: 243.

part of what passes the mountain ridge is used in supplying mills at Lockport, and thus subtracted from the supply required eastward. These facts are adduced as evidences of the failure of the canal from defects in its original plan to send eastward the water which can be brought to Lockport. These defects are the inadequate height of banks and insufficient descent in the bottom of the canal from Lockport to Rochester;* the twenty miles of level canal from Brockport to Rochester producing an effect equivalent to a dam from 15 to 20 inches high and causing an overflow at all points westward. This evil may be increased by improper plans or inadequate efforts to remedy it, and will endure until the bottom of the canal be depressed from Rochester to Brockport and the banks be raised thence to Lockport, according to the plan once adopted, but unfortunately afterwards abandoned, of giving from 1 to 2 inches of descent per mile from Lockport to Rochester.†

Much of the draught from the Genesee river this season was occasioned by the condition of the Weighlock, requiring a high level for the convenience of weighing boats, which would cause an increased flow over the weir at the first lock in Brighton, thus drawing from the river more than the exigencies of the canal east required. This evil will be enhanced the coming season if the water at the weighlock be kept at the same level as last season, the canal thence to the 1st lock being deepened and rendered more capacious, the facility and certainty of drawing more water east will be increased. The extraordinary declivity given to the bottom of the canal from Rochester to the Seneca river, being 1 inch per mile, increases the

*See Assembly Documents 1841, 72—13. †See Canal Laws vol. 2, p. 12.

difficulty of an economical management of the water of this portion of the canal.

This descent being double that from Lockport to Brockport and equal to that required to bring from Pendleton to Lockport the full supply required from Lake Erie, would produce too strong a current in the levels east of Rochester, and render it extremely difficult to preserve a proper depth of water near the foot of each lock while the next lock tender is drawing largely from the other end of the level under instructions to keep up to a given mark the level next below. On the two levels near Palmyra this excessive declivity must raise the usual top water line several inches above the four feet or waste weir level and cause a large and constant discharge of water at every weir—the same effect, although to a less extent, will be produced on shorter levels.* The plan of the enlargement will produce still greater evils since it is proposed to increase the descent eastward half an inch per mile.†

On the 4th of August I proceeded up the Genesee Valley canal, carefully examining its banks, weirs and feeders, and particularly all sources of leakage and waste. Being familiar with the localities of this canal, (having been employed as an engineer in its construction,) I examined minutely those sections which were very leaky when they were first filled with water, most of which are now perfectly tight, showing the certainty with which all the banks of this canal might now be rendered good. On some other sections there is a great waste which might be prevented. The ditches designed to drain

*See Apendix E. and F. † See Assembly Documents 1836, No. 99.

the extensive swamps opposite Tone's Tavern in Chili, which border upon the canal about two and a half miles were never sufficient for that purpose and are now partially filled up, and those swamps which were dry in the summer before the construction of this canal are now kept constantly filled by drainage from the canal, presenting an extensive surface for evaporation. About three miles above Scottsville the canal bank is very leaky for about a quarter of a mile in extent, the water spreading directly from the foot of the bank over several acres of meadow and swamp. Three miles farther south occurs another similar leaky bank, and there is one leaky section about one mile in extent on the Dansville side cut. At Cuylerville there are ditches cut on each side of the canal at the foot of the bank for a considerable distance, which necessarily increases the filtration and waste through the banks. The water from these and other ditches of similar character together with that discharged from nearly all the waste weirs, by passing off circuitously and often into swamps extends the surface subject to evaporation and materially increases the consumption of water by this canal.

Of the amount of water unavoidably lost by filtration into the earth probably very little, if any, ever reaches the river, owing to its distance from the canal with an intervening flat lower than the canal. It would naturally rise to the surface and is, doubtless, expended in supplying evaporation from the adjacent lands. This is strikingly obvious at points where the canal approaches near the river elevated from 40 to 100 feet above it, presenting even in porous soils a dry surface from the canal to the river's edge.

I should estimate the amount of unnecessary waste from the various sources now enumerated at about 1100 c. ft. per minute from Dansville to Rochester. The quantity diverted from the river to supply this canal I found to be 4240 c. ft. per minute,* and the total diversion from the river is 8370 until August 8th, and 6350 c. ft. per minute after that time.† This canal when completed, is estimated to require the additional quantity of 2460 c. ft. per minute to be taken from the river.‡ This is doubtless a high estimate, but at the rate indicated by this canal this season it will require 1470 c. f. per minute, which will swell the whole diversion from the river for this canal, when completed, to 5710 c. f. per minute.

The deficiency of water on the Dansville Branch complained of by the commissioners in 1843, 4 and 5, and also occurring in 1846, was caused by the bad condition of the lock gates, as may be seen from the gauges of Mr. Kimball and myself,‡ which show that about 1100 c. f. per minute, sufficient to supply thirty miles of good canal was unnecessarily drawn into and passed through this canal into the river at Mount Morris, while it was scarcely in a navigable condition.

According to the requirements of the act authorizing the construction of this canal, the Commissioners declared their opinion that the hydraulic privileges of Rochester would be injured by supplying the canal from the river and its tributaries, and they therefore caused a junction to be formed with the river at the Rapids, to return the surplus and lockage water of the canal into the river.§ This opening has

* See Appendix C. † Appendix C.

‡ See Assembly Documents 1840, No. 96. p. 30. ‡ See Appendix C. and D.

§ See Laws of 1836, chap. 247, and Assembly Documents of 1837, No. 73, p. 51, and 1838, No. 61, p. 41, and 1841, 250, p. 3.

been closed since 1842, until late this season, when a partial opening was made, too narrow, and with its waste-board too high to discharge into the river the enormous leakage of the adjacent lock which now passes on into the Erie canal.

Injury to Water Power.

One means of estimating the permanent injury to owners of water power on the Genesee River, caused by a diversion of its water, is to ascertain the amount of machinery it would propel if permitted to flow in its natural channel. From an examination of several flouring mills this season, some in Rochester, and some in other places, I have ascertained that the amount of water diverted by the State, would propel, on both the upper and lower races, 45 runs of stone, with all the machinery required to manufacture flour, at the rate of fifty to sixty barrels per day. At the rate of fifty barrels per day, 45 runs of stone would manufacture 2250 barrels per day, and 225,000 barrels during the dry season of 1846.

Minimum Supply of Canal, and Remedies.

One inquiry, preliminary to the construction of any canal, is whether the maximum quantity of water requisite for every contingency of climate or of trade can be obtained, and the estimates of different engineers, many of them based confessedly upon new and leaky canals, vary from 50 to 100 c. ft. per minute per mile.* But this is distinct from the present inquiry.

Availing myself of the favorable opportunity offered by the drought of midsummer, I have ascertained the minimum supply required per mile for our

* Assembly Documents of 1840, 96—25, and 1836, 99, 13, 56.

canals to be considerably lower, and deduce, from the examples refered to, 35 c. ft. per minute per mile as a safe estimate, exclusive of lockage.* This applies directly to the Genesee Valley Canal, since all surplus water may be discharged from it at points whence it will be directly returned to the river, and an amount equivalent to the lockage of this canal may at all times be returned to the river at the weigh-lock. The Erie Canal, from Lockport to Montezuma, is also favorably situated for maintaining good navigation with an economical expenditure of water, the 63 mile level having an abundant supply of water from the west, with the Medina Feeder near its centre, and facilities of drawing water from the Genesee river in any unforeseen emergency, and the eastern portion being divided into eight short levels. It is obvious that the extravagant waste of water, which the results of these examinations disclose, upon some portions of the canal is referable to an erroneous plan in the construction of the canal, or unskilful superintendence, and that examples of small expenditure being referable to more perfect workmanship in the construction, and to more skillful superintendence of the canal ought to control the investigation as to the necessary supply of water per mile to meet the loss referable to evaporation and filtration.

The first item is small, being less than 3 c. ft. per minute per mile.†

Upon canals constructed in favorable soils, or having their banks lined with good materials, the loss from

*See Apehdix E. and F.

† See Regents' Report, 1839, p. 222, and Assembly Documents 1837, 73—70, and 1839, 99—17, and Eden. Encyclopedia, vol. 8, p. 807.

filtration is also small, but can only be ascertained by experiment, the aggregate from both sources has been found to be as low in one case as 19, and in another as 25 c. ft. per minute per mile*

Upon one section of the Erie canal it was 23 c. ft. per minute per mile, and upon the Dansville side cut 30.†

From these data, I derive 35 c. ft. per minute per mile as a sufficient supply in summer for a well constructed canal, without lockage; to this add 3 c. ft. per minute per mile to provide for average lockages, amounting to 38 c. ft. for the supply requisite for the Erie Canal per minute per mile from Lockport to Seneca River.

The quantity of water available, without drawing from the Genesee river, for supplying the Erie canal, to Seneca River, is 7,077 c. ft. per minute for the whole distance, and is sufficient for 186 miles of similar canal.

The last inquiry is, what changes are required in the canal to insure a constant flow, eastward, of the copious supply of water thus found at the west?

1st. A sufficient and uniform declivity in the bottom of the canal from Lockport to Rochester, should be obtained by depressing the bottom from Brockport to Rochester, and by raising the banks from Brockport to Lockport.

2d. Were the waste wiers raised from 3 to 6 inches above the average water line, it would prevent unnecessary waste, and still be a sufficient protection to the canal banks.

3d. The cradle of the Weigh Lock at Rochester should be depressed six inches, to facilitate the

* See Assembly Documents, 1840, 96—25. † See Appendix C. and F.

weighing of boats, without the necessity of feeding from the river to preserve a level, necessary only for the weighing of boats, and which cannot be preserved by water from the west.

4th. There should be a Waste Weir at or near the weigh lock, which should, together with the weigh lock, produce a uniform discharge from the canal, to preserve an equilibrium in the surface, which is now disturbed by the irregularity of weighing boats, and of lockage at the first Brighton lock. The water discharged by such an arrangement, would not probably be equal to what constantly flows from the G. V. Canal into the Erie.

5th. A Weir should be made at the Rapids, of the full width of the former opening into the river, and low enough to discharge all surplus water.

6th. All leaky banks should be rendered tight, by lining with good material.

7th. The waste weirs and lock gates, from Rochester to Seneca River, should be so arranged as in all cases to preserve the level above each lock a few inches higher than at present, and the bottom should be depressed at the opposite end of the level, sufficient to diminish the descent to one-half inch per mile. I estimate the expense of all these changes at $50,000.

8th. I would suggest that the entire control of the water from Lake Erie to Seneca River, be put into the hands of one person of competent skill and experience, as a remedy for the evils now owing in part to want of experience and a want of concert between the Superintendents.

DANIEL MARSH,

Rochester, Dec, 1846. *Civil Engineer.*

APPENDIX.

A.

Gauges of the Genesee River, 1846.

	C. Ft. per minute.	Average c. ft. per min.
July 22nd	17,900	
" 33d	17,530	
" 28th	16,740	
" 30th	17,090	
" 31th	17,080	16,472
Aug. 1st	17,530	
" 8th	17,080	
" 24th	14,370	
" 28th	14,930	
1839.		
Oct. 30th	16,153	

B.

Gauges of the Erie Canal Feeder.

July 21st	2,530	
" 25th	2,515	
" 25th	2,537	
" ——	2,530	2,527
" 28th	2,520	
Aug. 1st. (Rejected for supposed error)	412	
" 8th	2,530	
" 19th	1,260	
Sept. 1st	1,260	1,260
" 2nd	1,260	

Gauges of the Genesee Valley Canal at the First Lock, 1846.

	C. Ft. per minute.	Total c. ft. per. min.
July 21st To Aug 8th } Amount of Leakage	1,360	
} Average Lockage	255	
		1,615
Since Aug 8th } Amount of Leakage	593	
} Average Lockages	257	
		850

Thus the amount drawn into the Erie Canal is—

Per the feeder to the 8th August.....	2,527	
" G. V. Canal "	1,603	
		4,130
" Feeder, since 8th of Aug.	1,260	
" G. V. Canal, since 8th of Aug.....	850	
		2,110

C.

Gauges of the Genesee River and its Tributaries, so far as used to feed the Genesee Valley Canal, Aug. 5th, 1846.

Mill Creek at Dansville	710	
Canascraga Creek at Woodville	916	
Genesee River at Mt Morris.....	3,880	
Allen's Creek at Scottsville	1,234	
		6,740
From this amount deduct the quantity which passes from the canal into the river at Mt Morris.	900	
Also what passes from this canal into the Erie Canal at Rocherter.....	1,600	
		2,500
There remains the quantity used for the G. V. Canal.....		4,240
Add the quantity used for the Erie Canal.....		4,130
Total diverted from the river		8,370
Do. after August 8th.....	4,240	
	2,110	
		6,350
Canascraga at Woodville, 2nd experiment	1099	

D.

Gauges made by Mr. Kimble, C. E. according to his testimony before the Board of Canal Appraisers at Rochester, Dec. 1846.

Mill Creek at Dansville, 1840–41	700	
Canascraga Creek at Woodville	1,700	
		2,400
Amount flowing from the canal into the river at Mt. Morris, average during Oct., 1846.....		1,594
Amount drawn into the G. V. Canal at Mt. Morris. average from Aug. 31 to Oct. 31, 1846.		3,757
Gauge of the Canascraga and Mill Creek, 1834, by F. C. Mills.....		2,458

E.

Results of various gauges of the Erie Canal made daily from July to October, 1841, *by Alfred Barrett, C. E.*

Where the gauges were made:

Below town, Lockport	5,191
Erie Canal above Medina	5,069

Erie Canal above Waste Wear, Medina	4,743
Do below Do do	4,398
Waste weir at Medina	436
Feeder do	1,886
Erie Canal above Waste Weir, Brockport	3,010
Do below do do	3,186
Waste weir, Brockport	49
Rochester Aqueduct	2,376
Weighlock, Rochester	480
Erie Canal feeder, Rochester	1,599
Genesee Valley Canal, "	1,256
Erie Canal, at Pittsford	2,840

F.

Rates of Expenditure on various portions of the Erie and G. V. Canals, 1841 and 1846.

Between what Points.	Dist.	Amount.	Rate per mile.
Lockport and Medina	18	403	23
Medina and Brockport	25	2,552	142
Medina and Rochester	45	4,295	95
Rochester and Pittsford	10	655	65
Rochester and Seneca River	57	3,495	56
Dansville and Mt. Morris, aver. of all gauges		480	30
Do do Aug. 5th		215	13
Lockport and Brockport in 1824	43	1,886	43

G.

Gauge of the Erie Canal at first Brighton Lock, 1846.

	Amount.	Total c. ft. per minute.
Leakage of gates, Aug. 1st, 1846	530	
Flow over waste weir at head of lock	2,120	
Average Lockages	411	
		3061
Leakage of gates, Sept. 1st. 1846	530	
Over weir	2,024	
Average Leakages	330	
Amount drawn by paddle gates	1,006	
		3890
Gauge by Professor Renwick in 1839		3,850
Do Alfred Barrett in 1841		3,495

H.

Results of the gauges made at different times upon the Erie Canal from Rochester to Seneca River.

	Date.	Dist.	C. Ft. per minute.	C. Ft. pr. m. per mile.
Judge Bates	1824	57	5,572	101,26
" Roberts		61	5,500	90,16
Professor Renwick	1839	57	3,350	59,00
A. Barrett	1841	57	3,495	53,00
D. Marsh	1846	57	3,475	53,00

The last three are the result exclusive of lockage.

Gauges of Erie Canal at Lockport.

H. Hutchinson, in round numbers, 1836,...	63	5,500	
A. Barnet, 1841	63	5,191	
H. Hutchinson estimate for enlargement		30,720	

J.

The quantity of water drawn to supply the Erie Canal from Lockport to Seneca River in 1841, *by A. Barrett.*

	C. Ft. per minute.	Total c. ft. per min.
Flowing through Lockport.....	5,191	
By feeder at Medina.....	1,886	
Do Rochester	1,599	
Do Genesee Valley Canal	1,251	
		9,927
Probable amount in 1846:		
From Lockport, same as in 1841.....	5,191	
Feeder at Medina, "	1,886	
From the Genesee River	4,240	11,317

K.

The quantity of water available to supply the Erie Canal without drawing upon the Genesee River.

Flowing through Lockport	5,191	
From the Feeder at Medina.....	1,886	
		7,077

L.

Declivities in Bottom of Canal.

	Inch.	
Old Canal from Pendleton to Lockport.....	1	per mile.
Enlargement do do	2	"
Old Canal from Lockport to Brockport.....	½	"
* Do do Brockport to Rochester.....	0	"
Old Canal from Rochester to Seneca River.....	1	"
Enlargement do do about	1½	"

* See Ass. Doc. 1841: 72—43, and 1836: 99—190.