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AN

ADDITIONAL REPORT,

ON

WATER POWER,

BY THE

WATERING COMMITTEE:

WITH

COMMUNICATIONS ON THE SUBJECT

FROM

**MESSRS. ARIEL COOLEY, LEWIS WERNWAG, THOMAS OAKES,
WILLIAM BRIGGS, AND WILLIAM LEHMAN.**

And other Documents.

PRINTED BY ORDER OF COUNCILS.

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1819.

ADDITIONAL REPORT

ON

WATER POWER,

BY THE WATERING COMMITTEE.

THE Watering Committee, on the 5th ult. made a report to Councils, intended to draw their attention to the subject of obtaining water power from the Schuylkill, and stated their impression at that time of the probable cost of the work. The committee however determined not to call up the subject for decision, until further enquiry should enable them to determine with some degree of certainty, as to the practicability of the measure, and the cost of its execution. In their former report the committee stated, they had consulted with Mr. Cooley, who had promised on his return from New England to furnish such further information as was in his power. Accordingly, on his return, the committee engaged Mr. Cooley to make a more accurate survey of the river, which he proceeded to accomplish, and finally gave his decided opinion as to the practicability of the measure. Messrs. Briggs and Lehman, the former a mason, who constructed the locks at Flat Rock, and the latter an ingenious mechanic, also were desired to make an examination, after which, they also approved of the measure, and have offered to contract for its execution.

Mr. Lewis Wernwag, well known for his judgment and skill, has also stated his belief of the practicability of a dam, and his willingness to undertake the construction of it.

The committee in their enquiries for persons properly skilled in works of the kind, were recommended to apply to Mr. Oakes of Bloomfield, New Jersey, for whom they accordingly sent, and requested him to examine the subject, and to furnish his ideas. His approbation of the measure will be found in the accompanying communication, which also goes into other details, very interesting, and con-

firms the calculation heretofore offered by the committee, as to the quantity of water that can be raised to Fair Mount.

The several communications received from the above named gentlemen, are submitted herewith; as also the provisional engagements entered into by the committee, to which they beg leave to refer, as part of this report.

It will be found, that the cost of erecting a dam, will exceed that before estimated, in consequence of a more extensive one being required, than was before supposed. When Mr. Cooley made his former examinations, it was supposed the bottom of rock extended across the whole river; but on a more careful survey, it is conjectured to be a bottom of mud, for two hundred and forty feet west of the engine house, and the remainder of rock, as is more fully detailed by Mr. Oakes, whose estimate for completing the work is also the largest.

Mr. Wernwag, however, who is well acquainted with the river, having built the bridge near Fair Mount, asserts that the bottom is of rock, and covered to some depth with mud, which can readily be removed.

The committee have found Mr. Oakes a gentleman of information, knowledge, and caution, and are satisfied from his character, that the estimate he furnishes, is calculated to exceed the cost of the work, rather than to fall short of it.

Mr. Cooley has estimated in his last communication, that the cost would be for the dam, locks, race, &c., without the mills and machinery, about 100,000

Messrs. Briggs and Lehman have offered to do the same for . . . 96,000

Mr. Wernwag estimates it at 147,960

Mr. Oakes estimates it at 150,000

Making in all 493,960

The average of which four estimates is 123,490

To which add the mills, &c. 40,000

The cost of water power 150,000

Whole cost, Dollars, 313,490

The committee have not taken into calculation the cost of overflowing about forty acres of ground, which might be put down at 3000 dollars, nor taken credit for the materials at the Falls, which are worth double the money.

The calculation before offered will be found correct, with the difference of the interest on the extra cost of the water, say 63,490 dollars at six per cent. per annum is 3,809

From which should be deducted an allowance for working the mills, before stated at 3,000

By estimate of Mr. Oakes, is only 2,100 900

Making a difference of Dollars, 2,909

So that the clear annual gain to the city, instead of 22,858 dollars, would still be 19,949 dollars.

The committee are sensible, that the cost of the contemplated work is large; but when it is considered, that a safe and an economical means of obtaining 10,000,000 of gallons of water can be had, in lieu of a costly and precarious supply of but little more than 2,000,000, and at the cost of not much more than one half, without calculating on the sale of a gallon to our neighbours in the districts; it is conceived, that councils should not reject a plan so long sought for; hitherto unattainable; and if now suffered to escape from our grasp, never to be reclaimed. The committee believe, that their fellow citizens view with anxiety the accomplishment of a measure so important to the health of this great city; already combining so many advantages, and which if this plan be carried into effect, will, at so small an expense, be better watered by artificial means, than any other in the world.

The committee forbear to display the advantages which would be derived in extreme hot weather, from a constant flow of water in our streets, and the playing of fountains in our public walks, creating an elasticity in the air so necessary to health; but they cannot forbear alluding to the advantages which would be derived from the surplus water of the river being used to feed canals connecting in various parts, the Schuylkill with the Delaware, and many other important uses to which it could be applied in the heart of the city.

Though it is believed by the Committee, that the work can be completed for about 320,000 dollars, yet willing to place the subject in the most unfavourable point of view, they assume as the cost, the whole sum stated by Mr. Oakes,

	Dollars, 196,000
Add cost of water power,	150,000
	Which amounts to 346,000
The Interest of which is	20,760
And the expense of working mills,	2,100
	Making, 22,860
From which deducting the sum assumed before, to be received from the Liberties,	10,000
	Leaves, 12,860

Which being deducted from 30,858 dollars, the cost of only one steam engine, will leave a gain of 17,998 dollars per annum, as soon as the work is completed, which it is believed can be done in one year from August next, if the work is now commenced; and if it is to be executed at all, no time is to be lost.

The sum of 17,998 dollars, applied as a sinking fund, will redeem the cost of the water power in about twelve years; after which the income to the city will

be as stated by the committee in their last report; to which may be added the tolls receivable from canals, or such other objects as the surplus water may be applied to.

Mr. Cooley, Mr. Wernwag, and Messrs. Briggs and Lehman have offered, in case of making a contract, to give full security for the construction and safety of the work.

The Committee on further consideration beg leave to offer a Bill, in lieu of the one before proposed, which is herewith presented,—they also present a plan of the works, prepared by Mr. Oakes, and also another prepared by Mr. Wernwag.

By Order of the Committee,

JOSEPH S. LEWIS, Chairman.

March 8, 1819.

Messrs. Joseph S. Lewis, and others concerned.

GENTLEMEN,

HAVING been requested to make an estimate, or in other words, to say for what I would erect a dam, locks, and other necessary works, at Fair Mount, so as to raise the waters of the Schuylkill to a level of the surface of the water in Josiah White's dam, when at its proper height: having considered and reflected upon the subject, beg leave to report the following, viz:—

I have no doubt on my mind respecting the practicability of the same, but when I consider the vast length of the intended dam, together with the depth of the water and the softness of the bottom in the deepest part, added to the double difficulty on account of the tide; I am in duty bound and in truth must say, that this vast work cannot be effected and completed in manner and form as it ought to be, so as to render the whole work perfectly safe and secure, and so as to fully answer all the purposes intended short of a heap of cash. I think that you can find a man that will be willing to undertake said work, and find surety for its accomplishment and safety for one hundred and fifty thousand dollars; and after the subject is fully detailed, perhaps a less sum may answer. If you Gentlemen shall think this partial report worth consideration, and will shortly wait upon me by Committee, or otherwise, I will let you know who that man is; and will be happy to confer with you further upon the subject.

I am with due regard and esteem

Yours, &c.

ARIEL COOLEY.

[Received February 23d, 1819.]

Philadelphia, February 24, 1819.

Messrs. Joseph S. Lewis, and others concerned.

GENTLEMEN,

I FIND it impossible for me at present to make a judicious estimate of the expense which may occur, in the erection of a dam and other works in contemplation, at Fair Mount.

I do not think that it would be prudent to calculate, taking the whole collectively which has been talked of, to expect to erect at an expense less than one hundred thousand dollars; it may cost more and it may cost less. In order to be able to make a just estimate of the whole, it will be necessary in the first place, to

have an accurate survey and admeasurement, of both the length of said dam, the height that it is to be raised, and the space that there is between the top line, and the rock bottom below, as also of the soft bottom; all of this taken at the different points:—also the place should be selected for the locks, so as to have ascertained the length and the depth of the tail-race, and what the matter is, whether rock or earth; as also of the head-race, the depth and width should be ascertained; and it should be known how much rock and how much other matter. After the above is known, it will not be so difficult to make an estimate of the probable expense. There is but one thing respecting the whole business on which remains no doubt; that is this,—the practicability of the work, on which to me there remains no doubt.

I am Gentlemen, your humble servant,

ARIEL COOLEY.

Extract of a letter from Lewis Wernwag, dated March 4, 1819.

To Joseph S. Lewis.

I RECEIVED your favour of 27th ult. As for the practicability of making a dam at the present Water Works, I never had a doubt; and I can bring Sheridan and several other gentlemen who will say, that I remarked when building the upper ferry bridge, that if they would give me the money that was spent in engines and house, I would build a dam at that place, that would afford an opportunity of selling water power that would amount to more than the expense of the work. I often viewed the situation, and observed what an advantageous improvement it would be to the city. I candidly tell you I feel desirous to have the building of that dam, in order to put my plan into execution; and if you feel desirous, I will make a draught and model, and send or bring it to town; and when you see it I have no doubt but you will be convinced that the project is within the bounds of practicability, and can be made to withstand any thing. I am well acquainted with the situation. I wanted to build the bridge where the dam is intended, as the rock at that place runs all the way across the river.

With sincere respect I remain

Your friend,

LEWIS WERNWAG.

JOSEPH S. LEWIS.

March 10, 1819.

Upon further consideration, I estimate the cost of the dam, guard lock, guard walls, chamber locks, gates and race, at 147,960 dollars; to be done according to a plan which I herewith furnish.

LEWIS WERNWAG.

Communication of Thomas Oakes.

To the Watering Committee of the Corporation of the City of Philadelphia.

GENTLEMEN,

I HAVE considered carefully the subject to which you have required my attention, in all its various parts, in order to give you the best ideas I can form, for accomplishing the object, and those of the most direct practical execution.

The mode of raising water for a supply of the city, by using the water power of the river Schuylkill by a water fall at Fair Mount, appears to me to be the most effectual and desirable of any within the reach of the city.

It is however accompanied by difficulties, owing to the peculiar situation of the river at this place; and the difficulties to be overcome appear to me to form the only objection to it.

As however, no natural water fall exists, it is to be considered whether it is possible to create an artificial one; whether it can be relied on as to its construction and permanency, and if it will produce the effect.

The situation pointed out for the dam, although the best which can be obtained, I consider by no means propitious, but *not* of insurmountable difficulty. All the objects to be accomplished are by art, and the labour in perfecting them will arise from the following circumstances.

First, I treat of the local situation of the place. The river at the location of the proposed dam is about 4,000 feet wide. The depth of mud and water, about 240 feet from the eastern shore, (at low water) 30 feet; and at this depth it is uncertain in places; from that point, for 420 feet it is rock, with from 26 to 14 feet water, from which to the western shore it is rock alone at low water. A tide of 6 feet deep flows over the whole in and out twice in 24 hours.

I consider some inconvenience to result from too limited a plot for the use of the water at the site for the mills, between the abutment of the dam and the present engine house. These I believe are the chief difficulties to be overcome, and in conformity to your wishes I have considered and adopted the following plan for effecting the object in view.

The construction of the lower part or artificial foundation to be first attended to, and erected over the deepest part of the river.

This I consider may be done over the first section of 240 feet in two ways; either by filling up the bed of the river with small stones carried out from the hill, and thereon erecting a dock above the water; or, which I should much prefer, to drive two tier of piles about 12 feet apart and 3 feet asunder in the

tier; over these piles cases of plank will be slid down, so as to form a kind of open case or chest across the river, to regulate and secure the sides and foundation; which chest I propose to fill with small broken stones, gravel, &c. to form what is called shingle grouting.

The middle section of 420 feet over the rock under water, I would form of hollow blocks, cased on the outside with plank of the same width as the other, with timbers perpendicular, the bottoms whereof when sunk, to rest on the rock. These blocks to be filled and sunk with shingle grouting, and interlock each other when sunk.

A sketch of my ideas handed with this, is the form of the dam, which is circular, or arched up stream, which I have adopted for its superior strength and being better suited to the bed of the river.

The depth of water, added to the extraordinary length of the dam, requires much attention to have all the water that possibly can be stopped from running through. This can be best effected with the execution of the cases and grouting; and if tolerably well stopped at that point, the mud and sand brought down in the river and put in, will insinuate itself among the stones above, and make a solid mass.

Above these blocks and cases, I would put in small stones mixt with larger ones for a considerable distance up stream; in the deepest part 100 feet, and filled up two feet above low water, to make a top of 35 feet wide, on which to erect the upper part of the dam.

Below, I would promiscuously throw in large stones, so as to form a gradual slope. Thus a bank of stone and gravel compacted, laid across the river, having in its middle part, a column of grouting and two rows of plank, in a measure to render it tight and form a foundation on which the upper part is built, and to which it may be firmly connected.

This I consider the first step, and also the most difficult; and that it may be the labour of the ensuing season, and left in that situation for the tides to flow over until the next, which will considerably solidate it, and render it more tight. The next operation which may be attended to will be the execution of the piers and locks on the west side, with the piers and guard gates on the east, which may probably be executed before winter.

The upper part of the dam, I propose to build of logs and plank, well filled in with stone in the usual form of a crib dam, and well backed with gravel and stone.

In forming an idea of these works, I cannot but refer to those at Flat Rock, and it leads me to make the following comparison respecting them.

The dam at Flat Rock is 500 feet long, and I judge about 12 feet high, founded on solid rock. The dam now to be erected will have to be placed on an artificial foundation, raised 26 to 30 feet from the bottom, and in the sweeping tide of the river, and will then have the dam erected upon it 12 feet high and 1,000 feet long.

From a careful attention to the quantity of water in the river, I am very well satisfied it affords 300 cubic feet, running at the rate of two and an half feet per second, making 45,000 feet per minute equal to 64,800,000 in 24 hours. Then taking

Thomas Oake's estimate at	64,800,000 in 24 hours.
Mr. Graff's,	66,732,000
Josiah White's,	115,500,000
	<hr/>
	3)247,032,000
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Mean of three estimates, 82,344,000 cubic feet in 24 hours.

I will assume 70,000,000, which is probably not far from the truth in common times of the water. Now allowing five feet of virtual fall, according to my calculation and experience, it will lift one forty-second part of its own volume 100 feet high, if the machinery is properly constructed, which would furnish in the reservoir on Fair Mount, upwards of 10,000,000 of gallons in 24 hours; but deducting for leakage in the dam, one-fifth of the whole quantity, upwards of 8,000,000 will be left for the daily supply; which quantity may be furnished from the whole power of the river at common times.

I would recommend the water wheels of 15 feet diameter, and 18 feet wide on the bucket, to move by gravity, with one foot head above the aperture; the daily expense of water on the wheel would be 47,628,000 gallons, which would raise 1,182,240 gallons; which I would raise by a pump of 16 inches diameter, and a six foot stroke, making eight double strokes per minute. Then four such wheels and pumps, would raise 4,728,960 gallons, which might be safely estimated at 4,000,000 of gallons in 24 hours, raised into the reservoir, at an expense of about 31,000,000 of cubic feet of water in the same time, which might be considered about half the river, allowing for leakage.

It would take a water wheel 28 feet wide, and 15 feet diameter to work a pump 20 inches diameter, 6 feet stroke, 8 double strokes per minute, lifting 1,843,200 gallons in 24 hours. I would not recommend a wheel of so great width as is necessary for a 20 inch pump, being too heavy, wide and ponderous to be durable.

The head race ought to be 80 feet wide in the clear, and four feet deep, to carry the water to the first wheel, without diminishing the head; after which the race may be proportionably narrower as it extends by the wheels; this allowance in width is calculated to take all the water in the river at common times and sufficient for 8 wheels.

The calculation of raising 8,000,000 of gallons in 24 hours, is founded on placing the lower part of the water wheels at high water-mark, or allowing six feet of total head and fall, and raising the water 100 feet high. By placing the wheels as above it will raise 9,250,000 eighty-six feet high, which I understand

is the height from the top of the water in the reservoir. By placing the wheels, as intended, two feet below the top of high water-mark, the quantity raised would be about 10,500,000 gallons to the height of 100 feet, and 12,500,000 to the height of 86 feet.

In the above calculations I have made an allowance of nearly one-fifth for leakage and waste of the piston and valves in the pumps, and about one-eighth for leakage through the dam and locks of the river, and allowing the river to discharge 70 millions of cubic feet of water in 24 hours. I have estimated for the dam

- 60,000 cubic feet of timber,
- 184,000 superficial feet of 2, 3 and 4 inch plank for dam,
- 75,000 Ditto and timber for ways, scaffolding and contingencies,
- 75,000 perch of stone, gravel, &c. for filling in, above and below the dam.

Four water wheels, stone aprons, stop gates, drawing gears and gates, with levers, pitmen and cranks, 22,500 dollars; this is independent of pumps, race and mill-house; calculated to be done with the very best materials, and best manner.

Three men are amply sufficient to attend four wheels and pumps, day and night and do the small necessary repairs; for which allow

- Four dollars per day, 1,460 dollars per annum.
- For grease, oil, candles and fire wood, 200
- Wear and tear, as below, average, 440

The wear, tear, &c. for the first seven years, will be very trifling, unless from neglect or accidents.

The timber part of the wheels, may be calculated to be removed every 12 or 14 years, at an expense of probably 12 or 1600 dollars, each wheel.

The calculations of the expenses I have made, are as follows; and are to the best of my judgment, and probably as near as such things can be estimated.

Dam	Dolls. 125,000
Locks, Piers and head gates,	25,000
Four wheels, four pumps, mill house, head race, and 80 feet of raising main to each pump,	46,000

Whites Town, February 24th, 1819.

SIR,

We, the undersigned, have viewed the Schuylkill at, or near Fair Mount water works, and find that there would be a practicability in building a dam and locks on that part of the river, and that the expense would not exceed 96,000 dollars, to build a good substantial stone dam, locks, guard walls, head gates, and dig the race

of sufficient width and depth. If the company think it worthy of their notice we will give them a plan, and the particulars of the manner in which we have calculated upon.

Yours

With sentiments of respect,

WILLIAM BRIGGS,
WILLIAM LEHMAN.

JOSEPH S. LEWIS.

January 29, 1819.

At a meeting of the Committee of conference with Messrs. Gillingham and White.

Present

Messrs. Lewis,	Messrs. Gillingham,
Williams,	White.
Watson,	

Messrs. G. and White proposed to sell the entire and exclusive power of the use of the water of the Schuylkill freed from all persons claiming under them, and reserving the fast lands they now own on both sides of the River, and the liberty of removing the present buildings, for the sum of 160,000 dollars, payable in cash or in certificates of stock of the city, payable with interest half yearly, redeemable at the pleasure of councils.

The city to place a dam below the Falls at any time they think proper, and to indemnify Gillingham and White against the claims of the Navigation Company for the further improvement and passage of the locks at the Falls. Any damage by overflowing up to the limits granted by the Navigation Company to Gillingham and White, to be paid by the city.

If the city should decide to use the water power at the Falls, to be at liberty to do so; and Gillingham and White will convey to the city any ground below the bridge at the Falls on the east side, the city may think useful to it, belonging to them, free of cost.

Should the city determine to use the power at the Falls, possession to be given within one year.

The above is the substance of the conversation and agreements made this day.

JOSEPH S. LEWIS,
SAMUEL WILLIAMS,
JOSEPH WATSON.

It being understood that the agreements on our part are not to be binding unless sanctioned by councils in a reasonable time, say four months.

Consideration, one hundred and sixty thousand dollars.

JOSIAH WHITE,
JOSEPH GILLINGHAM.

February 3, 1819.

At a meeting of the persons above named the consideration was reduced to one hundred and fifty thousand dollars, which the committee of the Watering Committee were authorised and did offer, provided the city be at liberty to use any part of the present materials of the locks, dams, gates, &c. except the guard wall, which they may think proper. The title to be made complete to the satisfaction of the city solicitor, and the money to be paid on the first March next, or interest to be allowed thereon from that day. Should the city place a dam below the Falls, to be at liberty to do so; and the city to make a dam, and thereby stop the works at the Falls as soon as it pleases.

This agreement to be binding when approved by councils.

JOSEPH S. LEWIS,
SAMUEL WILLIAMS,
JOSEPH WATSON,
JOSIAH WHITE,
JOSEPH GILLINGHAM.

At a meeting of a Sub-Committee from the Watering Committee, and a Committee of the Schuylkill Navigation Company, January 23, 1819.

Present.

Messrs. Watson, Williams, Lewis, on behalf of the City.

Messrs Cresson, Mifflin, and Preston, on behalf of Navigation Company.

The committee of the Schuylkill Navigation Company stated, they were authorised to say their company would consent to the erection of a dam at or near Fair Mount, and give all the aid of their act of incorporation to the purpose, the city defraying the whole expense of erecting the dam, guard locks, locks, &c. and any damage whatsoever occasioned thereby. The locks when finished, to be put into the possession of the Navigation Company, and the city to enjoy all the water power not necessary for the passage of the locks. The city also to furnish room for the erection of a toll-house, to be erected at the expense of the Navigation Company.

The water power to be used by the city for any object deemed useful to the city, but not to lease the water power for the erection of mills, or other machinery for profit.

The committee stated that a canal leading to the Delaware would not be deemed an infringement of the agreement.

The water not to be drawn down below the top of the dam. The dam to be kept in repair by the city for ever, and if out of order to be repaired without delay. The locks to be kept in order by the Navigation Company.

Philadelphia, January 26, 1819.

Henry Nixon, Esq.

DEAR SIR,

That I may not mistate to the Watering Committee, the subject of our conversation, give me leave to ask whether you did not engage that the owners of the Morrisville estate would (in case of the city putting up a dam, &c. for water power) permit the dam and race to be placed on your ground, northward of our late purchase at Fair Mount, free of cost to the city for the ground occupied. It being understood the city would, as far as could be done in accordance with their plans, place the dam in such situation, as would be most agreeable to you.

I am, respectfully,

JOSEPH S. LEWIS,

Chairman Watering Committee.

The above is correct, with the exception of not exceeding fifty feet, for the dam free of cost.

HENRY NIXON.

Philadelphia, January 28, 1818.

Henry Nixon, Esq.

Damn Fee

That I may not mistake to the Watering Committee, the subject of our conversation, give me leave to ask whether you did not engage that the owners of the Morrisville estate would (in case of the city putting up a dam, &c. for water power) permit the dam and race to be placed on your ground, northward of our late purchase at Fair Mount, free of cost to the city for the ground occupied. It being understood the city would, as far as could be done in accordance with their plans, place the dam in such situation, as would be most agreeable to you.

I am, respectfully,

JOSEPH S. LEWIS,

Chairman Watering Committee.

The above is correct, with the exception of not exceeding fifty feet, for the

dam free of cost.

HENRY NIXON.