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REPORT

OF

LIEUT. COL. JAMES H. ^{Survey} SIMPSON,
CORPS OF ENGINEERS, U. S. A.,

ON THE

UNION PACIFIC RAILROAD AND BRANCHES, CENTRAL PACIFIC RAILROAD
OF CALIFORNIA, NORTHERN PACIFIC RAILROAD, WAGON ROADS
IN THE TERRITORIES OF IDAHO, MONTANA, DAKOTA,
AND NEBRASKA, AND THE WASHINGTON
AQUEDUCT.

MADE TO

HONORABLE JAMES HARLAN,
SECRETARY OF THE INTERIOR,

NOVEMBER 23, 1865.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1865.

Road from Virginia City, in Montana, upon the most practicable route to Lewiston, in Idaho; appropriation \$50,000.

Mr. John Connell was appointed superintendent and disbursing agent for this road, March 24, 1865, but on account of the hostile attitude of the Indians in that region, and with the concurrence of the Secretary, he has not entered upon the discharge of his duties.

WASHINGTON AQUEDUCT.

The report of Mr. Theodore B. Samo, the engineer in charge, for the year ending September 30, 1865, including his estimate of the cost for completing this important work, is herewith respectfully submitted.

On the 31st of August last, I inspected, by direction of the Hon Secretary of the Interior, this work throughout its entire length, Mr. Samo accompanying me to point out and explain its different portions and the arrangements made for the management of the water in its passage to the city.

This great work, although in a condition to meet the present wants of Georgetown and Washington, is far from being in that complete and permanent state which is necessary to insure "an unfailing and abundant supply of good and wholesome water," as the law requires.

To insure an abundant supply during the hot months of the summer and fall, when the Potomac is at a low stage and the wants of the community are greatest, it is absolutely requisite that the solid masonry dam, already commenced, across the Maryland channel of the Potomac river at the head of the conduit, should be completed with the least possible delay, so as to create a head of water sufficient to afford the necessary quantity. The temporary dams which have been made from time to time for this purpose, have in every instance been carried away, and nothing will serve the purpose but the solid dam referred to, which is required not only as a matter of necessity but also of economy.

2d. To insure a supply of the pure water of the Potomac, unadulterated by the shallow water of Powder Mill branch and the surface drainage of the surrounding country, and to enable the receiving reservoir to be used entirely for storage purposes in case of accident happening to the conduit above, or in time of freshets when the Potomac is unfit for use, the connecting conduit around the receiving reservoir should, as proposed in previous reports, and by Mr. Samo, be completed without delay.

3d. The distributing reservoir affording, under the most favorable circumstances, only a depth of eleven feet, and practically on account of the inability of the conduit above the reservoir to sustain the pressure of any considerable head above the crown of the arch, only a maximum depth of about seven feet, it should, as suggested in previous reports, and in Mr. Samo's, be excavated to an additional depth of thirteen feet, making total depth twenty-four feet. This excavation is of essential importance, not only because it will double the capacity of the present reservoir, but the water being increased from the shallow depth of seven to twenty feet, it will give time for the deposit of many of its impurities and the decomposition of others, and will not be liable to that degree of overheating in the sun's rays, which encourages the growth of confervæ and animalcules, and the putrescent decomposition of organic matter.

4th. To prevent the wash of the interior slope or water faces of the distributing reservoir, I consider the substitution of a slope rubble wall, of one foot in thickness, laid on a facing six inches thick, of small broken stone, and extending from the bottom of the reservoir to and over the top of the slopes as absolutely necessary; and therefore recommend the construction of this improvement,

agreeably to the report of Mr. Samo. The water from this reservoir during the past year has been remarkably pure; but as the washings from its unprotected interior slope are increasing yearly, thus making the reservoir more shallow, and the water more turbid, it is essential that the proposed completion of the slope-wall should be effected without delay.

5th. I also approve of the other recommendations of Mr. Samo, and his estimates, which have been examined in this office.

Report of Mr. Samo.

DEPARTMENT OF THE INTERIOR, OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., October 1, 1865.

SIR: In compliance with your request of the 23d instant, I have the honor to submit the following report, in relation to the Washington aqueduct, for the year ending September 30, 1865.

At the date of the last annual report of the chief engineer the works authorized by Congress, including the solid masonry dam across the Maryland channel of the Potomac river, and the connecting conduit around the receiving reservoir, were progressing with a rapidity that would have insured their completion during the present year.

On the 1st day of January the work on the dam was suspended for the winter; that on the connecting conduit was continued day and night until the 1st day of April, when the contractors were notified to suspend all work embraced in their contract, in consequence of no appropriation having been made at the second session of the thirty-eighth Congress for the continuation of work upon the Washington aqueduct, and a final estimate was paid them, under the clause in their contract which provides that, in case of a suspension, they shall be paid in full for all work done and materials furnished.

The works generally are in a good condition, considering that all parts of the aqueduct, whether finished or unfinished, have necessarily been in constant use, in order to furnish the large supply of water required during the past season, and which has averaged from fifteen to twenty millions of gallons daily.

Very few breaks have occurred; the most important one happened on the morning of the 12th of May, when water was discovered by the watchman rushing through the embankment of the high service reservoir at Georgetown. At that time the water in this reservoir was about fifteen feet deep, and what might have been a serious accident resulted in very little damage, owing to the promptitude and good management of Mr. Robert S. King, the efficient foreman of the pipe line. He soon brought the water under his control, and rapidly emptied the reservoir. In a few days the break was repaired, and the water again introduced. The cause of this break was owing to the unfinished condition of the reservoir.

The Worthington water-engine at bridge six, which supplies this reservoir, has been in constant operation, except a short time in June, when it was stopped and thoroughly repaired; a new set of rubber buffers and wire springs were put in place of the old ones. It is now in good order, is taxed to its utmost capacity day and night, and works well.

Several leaks have occurred in the pipe line; the most important one was at the intersection of Pennsylvania avenue and Eleventh street. At this point the main is eleven feet below the surface, and the pipe has leaked for several years, the water that escaped being led off through a four inch drain pipe three feet below the surface. On the morning of the 8th of June it broke out with renewed force and in such quantities as to force its way upward through the pavement into the avenue. Preparations were immediately made to repair it. The water was shut off from the main, and with the assistance of the steam-fire engine, "M. C. Meigs," the damage was easily repaired.

The repairs made since the 1st of April have necessarily been limited to such work as was absolutely necessary to continue the supply of water, and to prevent some of the most important mechanical structures from suffering deterioration. The tubular bridge over College pond has been thoroughly painted, and the floor of the tubular bridge over Rock creek has been renewed with three inch oak plank, laid water-tight, and provided with drains and scuppers for carrying off the rain. This structure now only needs painting to render it in appearance what it is in reality, one of the grandest and strongest bridges in the world.

At the distributing reservoir the gate-houses are all in an unfinished condition. At the Great Falls the large cut stone gate-house also remains unfinished; all the protection it has had for several years is a roof of rough boards; in its present condition it is suffering from exposure, the floor has become decayed, and will soon have to be renewed. All of these structures have been designed to endure for many years, and when completed will be well adapted for regulating the flow of the water.

Bridges number one and two are yet unfinished, and require a stone coping. Bridge number three is also unfinished; this is an elliptical arch, of seventy-five feet span; the roadway requires to be properly laid and supplied with drain-pipes, and on the sides a stone parapet and coping should be built to render the roadway safe to the travelling public. Bridge number four, "Union Arch," is also unfinished; this is a circular arch of one hundred and ten degrees, with a span of two hundred and twenty feet, being, I believe, the largest stone arch in the world; it requires the roadway to be properly laid, and supplied with drain-pipes, and the sides protected with stone-parapets and coping.

In May, after the spring freshets had subsided, an examination showed that no damage had been done to the unfinished cut-stone dam, but a considerable portion of the temporary crib dam had been washed away. It was repaired in July, and the supply of water was abundant until the end of August, when, owing to the low stage of water in the river, and to the fact that nearly all the water escaped through the interstices of the temporary dam, the supply failed, and extra repairs had to be made. The channel in the river was cleaned out by cutting the trees and bushes, and blowing up some of the rocks that obstructed the flow of water, and temporary dams were built among the numerous small islands, thus diverting the water towards the head of the conduit. Since the completion of these repairs the supply has been abundant.

This temporary dam, upon which depends the daily supply of water to the cities of Washington and Georgetown, has been washed away each spring since it was first constructed, and the same result is likely to ensue next spring. It follows, therefore, that the permanent dam across the Maryland channel of the Potomac is the most important work in an unfinished condition upon the Washington aqueduct.

The work next in importance is the distributing reservoir. No work has been done on this since June, 1864. During the past season the water furnished by the aqueduct has been very clear and pure, owing to the fact that this reservoir has been used in its incomplete condition for storage purposes, the water from the receiving reservoir being detained in it until sufficiently clear for distribution.

The Potomac water is generally clear and pure when it enters the receiving reservoir, but by the time it has passed through that stream it is adulterated with the waters of Powder Mill branch, and the surface drainage of the surrounding country.

The receiving reservoir is a basin that was formed by building a dam across Powder Mill branch, and has an area of fifty three acres, with an unprotected shore line of nearly three miles, and a width varying from one hundred to five hundred feet. There are several acres where the water is not more than one foot in depth, in which the hot sun breeds vegetable and animal life. For several years this reservoir supplied Washington and Georgetown with all the water that was furnished by the aqueduct, until the completion of the conduit to the Great Falls, when the Potomac water was introduced. It has fully answered the purpose for which it was at first constructed, and with the completion of the connecting conduit it can be used entirely for storage purposes to furnish the necessary supply, in case of an accident happening to the conduit above, or in time of freshets, when the water from the Potomac is unfit for use.

The following in relation to the distributing reservoir is extracted from the supplemental report of Silas Seymour, esq., late chief engineer of the Washington aqueduct, dated February 22, 1864:

"The original plan contemplated that the slopes should be covered with broken stone or rip-rap, eighteen inches thick only, from a point one foot above the surface at the flow line, to a point seven feet below the surface, making a vertical height of eight feet."

The changes from the original plan contemplate: First, "the substitution of slope-wall for rip-rap facing on the interior slopes, and extending the same from the bottom of the reservoir to and over the top of the slopes. Second, in the construction of the dividing bank to the full height of the exterior banks, and the substitution therein of a central gate-house for the culvert as heretofore contemplated. Third, in the excavation of the whole or a portion of the bottom of the reservoir to an additional depth of thirteen feet."

The reasons for these changes are fully given in the report above referred to, and are too lengthy for insertion here. The first and second changes have been adopted and partially carried out. If the third change is adopted the reservoir will have double the storage capacity, and the water will be purer and clearer on account of the increased depth. As at present constructed the reservoir allows all these changes to be made without detriment to any work previously done, the pipes leading from it being lower than the contemplated bottom.

The connecting conduit around the receiving reservoir was begun in July, 1864, and the work continued day and night till the 1st of April, 1865, the date of suspension, when a large amount of the earth and rock excavation, and a considerable portion of the stone conduit were completed. The tunnel headings were driven six hundred and twenty feet, leaving only one hundred and twenty-five feet yet to do.

The roadway over the conduit between the Great Falls and the distributing reservoir requires an increase of embankment throughout in order to place more weight on the crown of the conduit. At present, if the water is raised much above the springing line of the conduit, there are several places, where, owing to the light embankment, the masonry opens longitudinally at top and bottom.

The following estimate of the cost of completing the Washington aqueduct has been carefully prepared from actual measurements, and, I believe, fully covers the entire work:

Estimate of the cost of completing the cut stone dam across the Maryland channel of the Potomac river.

2,877 cubic yards of excavation, at \$2 50.....	\$7,192 00
1,110 cubic yards of back filling, at \$3 50.....	3,885 00
545 cubic yards of concrete, at \$8	4,360 00
1,041 cubic yards of foundation masonry, at \$14	14,574 00
815 cubic yards of superstructure masonry, at \$14	11,410 00
367 cubic yards of coping, at \$20	7,340 00
7,776 pounds of wrought iron bolts and clamps, at 15 cents.....	1,166 00
Total	49,927 00

FEEDER MASONRY.

38 cubic yards of coping for head of conduit, at \$20	\$760 00
8 cubic yards of coping for pier, at \$20	160 00
42 cubic yards of coping for dam, at \$20	840 00
Total	1,760 00

GATE-HOUSE AT GREAT FALLS.

40,000 bricks, at \$27	\$1,080 00
70 cubic yards of masonry, at \$20	1,400 00
600 square feet of rubbed surfaces, at \$1 75.....	1,050 00
15 squares of slating.....	300 00
1 lantern	150 00
Total	3,980 00

BRIDGES NOS 1, 2, 3, AND 4.

714 cubic yards of cut stone masonry for parapets and copings, at \$30	\$21,420 00
500 cubic yards of broken stone, at \$3	1,500 00
1,300 feet of drain pipe, at \$1	1,300 00
Total	24,220 00

CONNECTING CONDUIT.

21,422 cubic yards of earth excavation, at 35 cents.....	\$7,497 00
2,070 cubic yards of rock excavation, at \$3 50.....	7,245 00
1,500 cubic yards of tunnel excavation, at \$10	15,000 00
3,510 cubic yards of conduit masonry, at \$10	35,100 00
100 cubic yards of cut stone masonry, at \$20	2,000 00
12,869 cubic yards of embankment, at 42 cents.....	5,405 00
Total	72,247 00
Deduct 540 cubic yards of stone on hand, at \$2 50.....	1,350 00
Balance	70,897 00

DISTRIBUTING RESERVOIR, INCLUDING BOTH DIVISIONS.

550,195 cubic yards of earth excavation, at 39 cents		\$214,576 00
8,971 cubic yards of slope wall, at \$3		56,913 00
8,022 cubic yards lining, at \$3		24,066 00
2,500 cubic yards of embankment, at 18 cents		450 00
Total		296,005 00
Deduct bricks on hand	\$1,600 00	
Deduct stone on hand	6,494 00	
		8,094 00
Balance		287,911 00

CENTRAL GATE-HOUSE.

2,800 cubic yards of earth excavation, at 39 cents		\$1,092 00
241 cubic yards of concrete, at \$5 50		1,325 00
216 cubic yards of rubble masonry, at \$7		1,512 00
340 cubic yards of masonry, at \$20		6,800 00
37 cubic yards of coping, at \$30		1,110 00
200,000 bricks, at \$27		5,400 00
Gates		3,000 00
Total		20,239 00

EFFLUENT GATE-HOUSE.

74,300 bricks, at \$27		\$2,006 00
252 cubic yards of masonry, at \$20		5,040 00
483 square feet of rubbed surfaces, at \$1 75		845 00
13 $\frac{3}{10}$ squares of slate, at \$20		266 00
Gates and screws		2,000 00
Doors		400 00
Total		10,557 00

INFLUENT GATE-HOUSE.

67,600 bricks, at \$27		\$1,825 00
100 cubic yards of masonry, at \$20		2,000 00
414 square feet of rubbed surfaces, at \$1 75		724 00
1 door		100 00
1 gate		1,500 00
9 squares of slate, at \$20		180 00
Total		6,329 00

AUXILIARY GATE-HOUSE.

17,500 bricks, at \$27		\$472 00
46 cubic yards of masonry, at \$20		920 00
336 square feet of rubbed masonry, at \$1 75		588 00
3 $\frac{3}{10}$ squares of slate, at \$20		66 00
1 door		100 00
Total		2,146 00

STAIR WELL-HOUSE.

7,400 bricks, at \$27		\$470 00
18 cubic yards of masonry, at \$20		360 00
176 square feet of rubbed masonry, at \$1 75		308 00
1 $\frac{5}{10}$ squares of slate, at \$20		30 00
1 door		50 00
Total		1,218 00

150 feet of 48 inch iron pipe to be laid in pipe vault		\$7,500 00
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HIGH SERVICE RESERVOIR.

200,000 bricks, at \$27.....	5,400 00
4,500 square yards of plastering, at 40 cents	1,800 00
Centering, &c.	800 00
Total.....	8,000 00

VENTILATORS FOR CONDUIT.

8 ventilators, estimated at \$350 each	\$2,800 00
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ABSTRACT.

Cut stone dam across Maryland channel.....	\$49,927 00
Masonry at the feeder and head of conduit.....	1,760 00
Gate-house at the Great falls.....	3,980 00
Bridges Nos. 1, 2, 3, & 4	24,220 00
Connecting conduit at the receiving reservoir.....	70,897 00
Distributing reservoir.....	287,911 00
Central gate-house at receiving reservoir.....	20,239 00
Effluent gate-house at receiving reservoir.....	10,557 00
Influent gate-house at receiving reservoir.....	6,329 00
Auxiliary gate-house at receiving reservoir.....	2,146 00
Stair well-house at receiving reservoir	1,218 00
Pipe vault at receiving reservoir.....	7,500 00
High service reservoir.....	8,000 00
Ventilators for conduit.....	2,800 00
Embankment over conduit.....	8,000 00
Fencing conduit and reservoirs.....	20,000 00
Land and law expenses.....	5,000 00
Engineering, superintending, and repairs.....	30,000 00
	560,484 00
Add ten per cent. for contingencies.....	56,048 00
Total.....	616,532 00
Deduct amount of appropriation on hand September 23	7,058 00
Amount of appropriation required to complete.....	609,474 00

Now that the war is over, and peace and union again prevail throughout the United States, it is to be hoped that Congress will see the necessity of making an appropriation to complete this great national work, which, when fully completed, will be worthy of the American nation and second to none on the continent; one which will be a credit to the accomplished engineer who designed the works; one that will furnish to the cities of Washington and Georgetown an unfailing and abundant supply of water.

I have the honor to be, sir, very respectfully, your obedient servant,

THEODORE B. SAMO,

Engineer in charge of the Washington Aqueduct.

Colonel J. H. SIMPSON,
Corps of Engineers United States Army.

The following are my estimates of appropriations required on account of this office:

Estimate of appropriations required to meet deficiencies for the fiscal year commencing 1st day of July, 1865, and terminating 30th day of June, 1866, on account of engineer office, Department of the Interior, having the supervision of the Pacific railroad and branches, the land grant railroads, the wagon roads, and the Washington aqueduct, &c.:

1 clerk, 6 months, at \$1,800 per year.....	\$900 00
1 clerk, 6 months, at \$1,500 per year.....	750 00
1 clerk, 6 months, at \$1,200 per year.....	600 00
Compensation of 3 government commissioners, Central Pacific railroad, appointed agreeably to act of July 1, 1862, and amended act of July 2, 1864, and instructed by the Secretary of the Interior to attend meeting of board of government directors, commissioners, and engineer, at Washington, D. C., January 10, 1866, for purpose of fixing standard of railroad to which the Pacific railroad and branches shall conform—75 days, at \$8 per day each.....	1,800 00

Mileage of said 3 commissioners from San Francisco to Washington, 6,569 miles and back, at 10 cents per mile.....	3,941 40
Compensation of 5 government directors while attending meeting of board of government directors, commissioners, and engineer, for purposes above stated—15 days at \$8 per day each.....	600 00
Mileage of do from their residences to Washington and back.....	700 00
Mileage of government engineer from Cincinnati, Ohio, to Omaha, Nebraska, and thence to Washington, in July, 1865, directed by the President of the United States to examine and report upon Union Pacific railroad routes west from Omaha, 2,902 miles, at 10 cents per mile.....	290 20
Mileage of do from Washington to New York and back in August, 1865, on account of Union Pacific railway, 225 miles each way, at 10 cents per mile.....	45 00
Compensation of 3 government commissioners appointed by the President of the United States, agreeably to act of July 1, 1862, to examine 40 miles of Union Pacific railroad, eastern division, (Kansas branch,) in May, 1865, 14 days, at \$8 per day each.....	336 00
Mileage of do. at 10 cents per mile.....	200 00
Compensation of 3 government commissioners appointed by the President of the United States to re-examine 40 miles Union Pacific railroad, eastern division, in October, 1865, 31 days, at \$8 each per day.....	744 00
Mileage at 10 cents per mile.....	500 00
Compensation and mileage of government commissioners Central Pacific railroad during two examinations already made of railroad, at \$500 each.....	1,000 00
Compensation and mileage of 3 commissioners of Union Pacific railroad, Union Pacific railroad, eastern division, and of Central Pacific railroad, appointed by President agreeably to act of July 1, 1862, and amended act of July 2, 1864, during probable examinations of railroad before close of fiscal year, two examinations, 20 days each, at \$1,000.....	6,000 00
Compensation and mileage of commissioners to examine portions of railroads reported completed according to law, to which grants of land enure.....	2,500 00
Pay, subsistence, and transportation of surveying party required by act approved July 1, 1862, to make the surveys to enable the President of the United States to fix the point on the one hundredth meridian of longitude, between the south margin of the valley of the Republican river and the north margin of the valley of the Platte river, at which the several branch roads shall converge and meet the Union Pacific railroad.....	20,000 00
Drawing instruments, mapping material, stationery, &c.....	150 00
Cost of completing bridge over Big Sioux river near Sioux City.....	10,000 00
Incidental travelling expenses.....	1,000 00
Contingencies of Pacific railroad and branches and wagon roads.....	10,363 32
Total.....	<u>62,419 92</u>

Estimate of appropriations required for the fiscal year commencing 1st day of July, 1866, and terminating 30th day of June, 1867, on account of engineer office, Department of the Interior, having the supervision of the Pacific railroad and branches, the land grant railroads, the wagon roads, and the Washington aqueduct, &c.:

Compensation of clerk.....	\$1,800 00
Compensation of clerk.....	1,500 00
Compensation of clerk.....	1,200 00
Compensation and mileage of 3 commissioners appointed by the President of the United States agreeably to act of July 1, 1862, and amended act of July 2, 1864, to examine from time to time and report upon certain completed portions of the Pacific railroad and branches, to wit, Union Pacific railroad, Union Pacific railroad, eastern division, Atchison branch, and Central Pacific railroad, each two examinations of 20 days, at \$1,000 each.....	8,000 00
Compensation and mileage of commissioners to examine portions of railroads reported completed according to law, and to which grants of land enure.....	5,000 00
Drawing instruments, mapping materials, stationery, &c.....	200 00
Add 20 per cent. for contingencies.....	3,540 00
Total.....	<u>21,240 00</u>

All of which is respectfully submitted :

J. H. SIMPSON,
Lieutenant Colonel Engineers, in charge.