REPORT

OF

Water Works Commission

Upon Water Supply

FOR

City of Parkersburg.

CHAPIN & KNOWLES
Engineers

AUGUST 24, 1908

Report Upon Water Supply Investigation

OF PARKERSBURG, WEST VIRGINIA.

Report by CHAPIN & KNOWLES, Engineers.

August 24, 1908.

To the Honorable Water Works Commission,
Parkersburg, West Virginia,
Mr. S. D. Camden, President.

Gentlemen:—

I have the honor to submit herewith, in accordance with the terms of the contract and supplement, signed February 20th, 1908, a report upon the Water Supply Investigations for the City of Parkersburg, West Virginia.

This report is divided into the followings headings:—

GENERAL:—This includes a description of the present works; the pumping station, equipment and conditions; the distribution system, record of hydrant pressures and the storage facilities.

PROJECTS FOR NEW WORKS:—These are divided into four main groups:

First, considers impounding supplies some by gravity and some requiring pumping.

Second, considers improvement of the present plant; namely, the present pumping station and outfit with additions, improvements and filtration; additional storage and distribution facilities.

Third, considers new works, to be built on the south side of the Little Kanawha, in order to deliver water to a reservoir at Fort Boreman; other additions about the same.

Fourth, considers works at a new site for intake and pumping station at the Camden Farm; other additions about the same.

GENERAL STATEMENT OF PROJECTS.

Project No. 1 was early eliminated on account of the excessive cost.

Project No. 2 was separated into four parts by the question of storage; (A), whether a higher stand pipe at the present site on Prospect Hill; (B), whether a lower stand pipe on Boreman Hill; (C), whether reservoir at Boreman Hill with greater capacity; or (D) a reservoir at Fort Boreman, would best suit the growing needs of the community.

Of these four sub-divisions, "C" is the best, because what is needed is a greater storage and not higher elevation; for, although there are some isolated areas in the city which either now or in the near future will need additional pressure, they are small and the demand so speculative that they need not be considered in connection with this broader investigation, but can well be handled at a future date, by special provision, when the need arises. Furthermore, considerably greater storage, than can be obtained in stand pipes, is advisable, in order to have something to fall back upon in case of the pumps being disabled. For these reasons, the Projects 2-A, 2-B and 2-D were eliminated. For the same reason that Project 2-D was not thought worthy of consideration, Project 3-D does not meet with my approval, for this was studied solely to see what advantage the pumping station site south of the Kanawha would have in case Fort Boreman should be chosen for the location of a reservoir.

In Project No. 4, there are three sub-divisions, each of which uses the concrete reservoir at the Boreman Hill site. These are:—(A), mechanical filters; (B), sand filters; and (C), wells. Project No. 4-B is quickly eliminated in this study and for this situation, on account of the large cost.

This leaves then for final consideration Projects 2-C, 4-A and 4-C, and in the final analysis of these propositions, while the financial view is very instructive, there are many other things worthy of consideration. The most important of these is, that while we have tried to think of all the necessities of the case, it is quite probable that if the city enters into repairing and revamping an old plant, many things not now easily visible, like the foundations, piping, interior of machinery, et cetera, will be found to require expensive alterations, repairs and strengthening. It is also true, on account of the limited available area at the old works and the fact that growth for a long time in the future is not so certain to be well taken care of, as at a new site; that we have planned for somewhat less margin beyond present needs than at the new plant. This is entirely in accord, however, with the best practice and does make the cost of fixing up the old works look somewhat better than building new ones. The fact that the city is growing up the river and that the larger cost for force and distribution mains is for material in the ground which will be good for added population in this territory, is worthy of thoughtful consideration, because new main feeders will not have to be built so soon into this territory, as if the water were sent from down town. In addition to this, the new works are to be located about a mile up the river, and will always be above a great deal of the city sewage, whereas the old location may in,

the near future, be below the output of many of the important sewers likely to be built in the upper parts of the present city.

COMPARISON OF ADVANTAGES.

An interesting analysis shows that the building of a new pumping station on the Camden Farm with the use of wells would, in our estimates, save about $1,200 in annual charges; as compared with the continued operation of the present works with mechanical filter, taking into account all of the fixed charges and operating expenses and depreciation, or a saving of $6,500 annually compared with a mechanical filter plant at new Camden Farm site. Assuming the wells to have a life of only ten years, the annual saving over the continued operation of the present plant, would amount, with interest at 5 per cent, to one fifth the cost of a mechanical filter plant at the end of that time. On the other hand, if it should be definitely decided to abandon the present location and build new works at the Camden Farm, the annual saving of the well project as compared with the mechanical filter plant would suffice to add the filters at the end of ten years, if the well water should not prove satisfactory after that time. Thus, if assuming the well supply shows good water in sufficient quantities for present needs, even though our period of test is somewhat short and as it is fair to assume that the life will be at least ten years, this would seem to be the best installation.

At any rate, a bond issue of the amount required for building the reservoir, reinforcing the distribution system and building a pumping station and power plant, in so far as the high life machinery is concerned, would be a wise move; in order to insure doing promptly those things which are absolutely necessary and which are common to both projects. In the meantime a more thorough investigation could and should be made into the quality and quantity of water to be obtained from the present twelve inch well and from others located some distance apart. If it should happen that the results are not such as are now expected, but little money will be expended for this purpose and the oppropriation then can be made for the greater sum for the mechanical filter plant instead of for the wells, if this seems to be better. It has been generally suggested that the people will not vote any bond issue of great magnitude or for moving the works, but that they will vote to repair the old works. This is usually a pleasant but an insiduous proposition, because of the belief that additions can be made from time to time. The error lies in the fact that they usually are made from time to time and at long times apart, instead of doing promptly and thoroughly all of the work that is required.

In addition to this the problem of keeping up the supply while repairing the old works would be a troublesome one at best and a dangerous one from what I learn of the present conditions of the foundations and equipment, while the building of new works can go ahead promptly without interfering with the old in any way; and with larger mains and

a new reservoir installed at once, some of these present dangers will be lessened, especially that of fire loss.

A word as to the financial ability may be wise. I understand that the present water revenue is about $45,00, and that there is an expenditure of about $35,000 for maintenance, operation and fixed charges of sinking fund and interest. It should be noticed that, according to our Project No. 2-C, the annual charges for all purposes will be $53,000. As this does not include the Superintendent and street gang, nor interest and sinking fund on bonds not yet matured, it will probably be wise to add $5,000 to go to cover these amounts, making a total of $58,000. Now, as the revenue is $45,000, with the chance for supplying more services when more water is available than now; it is patent that there need be no increase of water rates to meet the cost of the improvemnts. In fact the further installation of meters is recommended to curtail the waste, so that more water for proper use will be available.

SUMMARY.

It is recommended that the ultimate object to be looked forward to, is the establishing of new water works at the Camden Farm with the building of either wells or mechanical filter plant; the former, if investigations show the feasibility, and the latter, if not so found; in connection with this, to appropriate at once all the available money to provide for the strengthening of the distributing system. In all, we have outlined to build a new reservoir of four million gallons capacity at Boreman Hill and to equip a pumping station and power plant at the Camden Farm, with high service machinery. The remainder of the oppropriation to be used in determining the capacity and quality of the well water and when this be known to appropriate sufficient money to build the works best adapted.

The details of the several studies are grouped in the eight appendices attached, as follows:

Appendix No. 1—General Studies,
Appendix No. 2—Project 1, Impounding Supply,
Appendix No. 3—Projects 2 and 3, Present Works and Fort Boreman Site.
Appendix No. 4—Project No. 4, Camden Farm Works.
Appendix No. 5—Summary of Estimates,
Appendix No. 6—Tabulation of Analyses,
Appendix No. 7—Tabulation of Pressures,
Appendix No. 8—Well Tests,

Respectfully submitted,
CHAPIN & KNOWLES, Engineers,
Per M. Knowles

APPENDIX NO. 1.

GENERAL STUDIES.

POPULATION:

Various studies have been made of the population of Parkersburg, but for none of these is there as such accurate data as we could have wished. We have made all the customary trials to study the relation between the number of taxables, the number of school children, and the number of building permits, to population in census years. None of these studies afforded any definite information. We have also failed to secure a census, which it was thought would be made by the postal authorities at this time. The census returns since 1870 are as follows:

Years	Authority.	Population.	Per Cent. Increase in 10 Years.
1870	U. S. Census	5,546	
1880	U. S. Census	6,582	18.7
1890	U. S. Census	8,408	27.8
1900	U. S. Census	11,703	39.1
1906	U. S. Census Est.	16,477	67.6
1908	Approx. Estimate	20,000	107.0

It will thus be seen, from the best determination, we believe the population this year is 20,000 people within the city limits. It may be somewhat less than this, now, due to the depression of business, but anything which will tend to enliven the interest in the city; particularly a better drinking water supply; greater fire protection, as a matter of safety to the business interest; as well as the disposal of sewage and general sanitary improvements; will all contribute to make the place more attractive for the location of new interests and new increase in population. The topographical and geographical situation is such that Parkersburg should have a good growth and interesting future.

USE OF WATER:

In the matter of use of water, records are rather incomplete, particularly in not allowing for the slip and leakage at the pumps, and have been in error due to inaccurate estimate of plunger displacement. Therefore, in order to have accurate data, we conducted tests on March 18th, 1908; to determine these factors. It was found that the ordinary use of water in the town is about 2-1-3 million gallons per day. This use of water, amounting to about 115 gallons per day per inhabitant, is large for a city of the size of Parkersburg, with its conditions. In order to provide for future growth, however, we have planned the new works on a basis of an average daily use of 4-million gallons per day, which will thus provide for some time in the future; probably fifteen or twenty years. There are at the present time about 640 services in the town which are metered,

or 17-1-2 percent. Because the use of water is greater than it should be, I recommend that steps be taken immediately, to meter a large portion and finally all of the services; beginning first with those who are likely to be the greatest wasters, at the same time, also, place a Venturi meter on the rising main; in order that the total quantity of water supplied may be accounted for.

CHARACTER OF WATER:

The character of the Ohio River, as at present used as a supply for the city, is probably too well known to need extensive comment. It is always polluted and contains sewage and pathogenic bacteria, making the water dangerous for drinking. It is generally muddy and unpleasant for cooking and washing. This latter characteristic is perhaps the most commonly noticed by all users, and while not the more serious, is a sufficient reason for purification and rendering clear.

In regard to its polluted condition; the statistics of typhoid and similar diseases of Parkersburg are not sufficiently reliable from which to draw definite conclusions. We know in general that Typhoid Fever is always prevalent and frequently to a marked degree. Individual differences in reporting, where the disease is somewhat closely allied, and lack of penalty for failure to report, means a meager accumulation of information of this sort. The history, however, of all of the other cities taking water from similar polluted streams, particularly that of Pittsburg and Wheeling, and the knowledge that the already polluted Allegheny and Monongahela Rivers have received vast quantities of sewage from Pittsburgh, with additions from Wheeling and from the cities and towns on the Beaver Valley water shed, show without doubt the unwholesomeness of the Ohio River supply at Parkersburg.

The data for 1906 and 1907 show a rate of deaths from typhoid fever to 75 and 60 per 100,000, respectively, which is very high. The tabulation of analyses of water made for the Commission is given in Table A in Appendix No. 5.

PRESENT WATER WORKS SYSTEM.

PUMPING STATION:

The water works system of Parkersburg was first installed in 1884, with the present pumping station and stand pipes. Various additions to the machinery have been made from time to time and the present installation at the pumping station includes three flue boilers, 16 feet long, 60 inches in diameter, numbers 1and 2 having forty-four, 4-inch flues and number 3 having fifty-two, 4-inch flues; Nos. 1 and 2 boilers are stated to be 85 H. P. and No. 3 of 100 H. P. There is also one Atlas tube boiler of 215 H. P., with 108, 4-inch tubes 19 feet long. There is also one feed water heater and two boiler feed pumps, one 6" x 4" x 6", Deane and the

other a 7-1-2" x 5" x 10", McGowan.

There are two 1-million gallon vertical direct plunger pumps of the Wilson-Snyder make, each double acting, having 18 inch steam end, 30 inch stroke, with 12 inch lower water plunger and 6 inch upper equalizing water plunger. Both pumps were somewhat overhauled in 1907, but one has a cracked chamber and cannot be depended upon with certainty. These pumps have had numerous repairs and reborings and, while they can keep up the supply, the amount of steam required is excessive and if new works are not built at once, it will require the installation of additional and better machinery to insure the safety of the supply. In tddition to the above, there is a 2-million gallon-compound-direct-acting-plunger pump of the Wilson-Snyder make, placed in the bottom of a pit near the river. As the sides of the pit leak, flooding the pump aut at times of high water, it cannot be considered a safe unit for all occassions. This pump is 19" x 34" x 24" with 15" water plunger and is outside center packed. The plungers were new in 1906; the rocker arms need repairs and the low pressure cylinder has never been examined. The pump has a 14" inch suction, for the 36" intake, which is used with other connections, for the other two pumps. The distribution main from this pumping station to the stand pipe on Prospect Hill, is 12 inches in diameter, and as there is only a single one there is no provision for break or other emergency. It is the statement of Mr. Clark, Superintendent, that he is obliged to have a regulation at the pumping station not to permit the pressure on this main to get above 105 pounds for fear of some accident, it being his only source of supply.

TANKS:

The two tanks at Prospect Hill were built in 1884 by Riter-Conley Company, of Pittsburgh, and are 40 feet high and 65 feet in diameter. They are cleaned out once a year and pitting and corrosion of the plate take place to some extent. During 1906, the fourth ring from the top, in each tank, was replaced with new plates because of this action on the metal. We realize the situation of some sparsely populated areas, which are somewhat higher than these tanks, and this has led us to consider the question of higher elevation. However, upon study and finding that this need is really so far in the future and that the more pressing need at present is for more storage; we have been led to discard the idea of a higher elevation and to use the reservoir at Boreman Hill, prefering to obtain a large volume of storage at an elevation only slightly higher than that of the present tanks. This also gives us the added advantage that, while having the reservoir a longer distance from the pumping station and in the newer part of town, where building will occur, it permits the present tanks to remain where they are as auxiliaries for storage and for equalizing the pressure in the down-town districts, particularly at times of heavy draught for fire.

PIPING SYSTEM:

There is at present a total mileage of 26.8 miles of pipe, which is divided into the following sizes:

Size	Miles
4 inch	5.3
6 inch	18.4
8 inch	1.7
10 inch	0.3
12 inch	1.1
Total	26.8

The small amount of larger sizes is noticeable and the large amount of four inch pipe is worthy of attention. There are also a number of dead ends existing on the system, to a total of 30 or 35. This lack of good circulation and cross feeding and the filling up of these dead ends and small lines with mud prevent good pressure at times of sudden demand for large quantities. In addition to all this, the hydrants are too few in number and placed too far apart and of an inefficient type for this service, being particularly small in the barrel.

For these reasons a very complete reinforcement of the distribution system is recommended, with the establishment of many hydrants of 6 inch barrel and all to have two 2-1-2 inch hose outlets and one-half of the number in important places to have steamer connections. All of this is shown in red upon the blueprints of the city streets accompanying this report.

PRICES:

In connection with our studies we have made an investigation of the local prices prevailing in the Parkersburg district, for all parts of the work and we also enquired into the financial management of selling and redeeming bonds in the city and made a study of the proper depreciation of the parts of the work. The results of these investigations are as follows:

Excavation for small structures,	50c to 75c per cu. yd.
Excavation for reservoir and similar large structures,	35c to 60c per cu. yd.
Plain Concrete,	$6 to $8 per cu. yd.
Reinforced Concrete,	$10 to $14 per cu. yd.
Steel Reinforcement,	4c per pound
Steel plate in tanks,	4c per pound

Cost of pipe laid, including the pipe, excavation, back filling, valves and specialties, in unpaved streets as follows:

4 inch	$ .70
6 inch	1.00
8 inch	1.25
10 inch	1.60
12 inch	1.90
14 inch	2.45
16 inch	2.95
18 inch	3.70
20 inch	4.40

In addition to these individual prices, there is added, in case the streets are paved; amounts varying from 10c, for the smallest pipe, to 20c per foot, for the largest pipe.

The cost of the new hydrants recommended was taken at a total of $50 per hydrant in place, which allows $35 for the hydrant and $15 for the setting. In all of the estimates made there is an amount added for engineering contingencies, which is 10 percent for all of the pipe lines, 15 percent on all of the remainder, except the wells and equipment, for which 20 percent is allowed.

For the purpose of determining the annual charges we have assumed the general financial condition as prevailing at present; namely, that bonds bearing 5 percent interest will be issued for a term of 20 years, which would mean a payment of 3.02 percent annually for the sinking fund requirement; the entire amount of the bonds being retired at the end of the period. This will make the total annual fixed charge of 8 percent, in round figures.

For the purpose of determining the additional fixed annual charges, each proportion of the work is estimated to have a depreciation charge dependent upon its life, character as to performance of installation, and its likelihood of wearing out or being replaced by more modern machinery. These figures are as follows, being the percentage charged each year:

Cast iron pipe in the streets	2 percent
Concrete structures,	2 percent
Buildings and foundations, new,	2 percent
Buildings and foundations, old,	3 percent
Tanks and stand pipes,	5 percent
Machinery and appurtenances, new,	5 percent
Machinery and appurtenances, old,	6 percent
Steam piping and miscellaneous connections,	8 percent
Boilers and appurtenances,	6 percent
Wells and equipment	10 percent

In addition to the above, each project is charged with the annual operating and maintenance expenses, divided into two parts; first, that for pumping and; second, that for filter expense where the latter is incurred.

APPENDIX NO 2.

PROJECT NO. 1—IMPOUNDING SUPPLIES.

In order that all of the ground should be thoroughly covered and that it might not be said that anything had been left undone or any project, possibly feasible, had been forgotton, we first looked into the question of an impounding supply for a new water works. It may perhaps seem to some that such expenditure of money for such a purpose was not wholly required, but it is often as necessary to show what cannot be done as well as what can be done. For the purpose of considering the limits to which it would be advisable to go for such supply, we determined, from the comparison of the fixed charges with operating expenses that if such a supply could be obtained, which would not require filtering and not require pumping, it would pay, in round figures, to go 25 miles for such. On the other hand, if we could secure a low lift supply not requiring filtration, but which would require pumping, it would pay to go about 11 miles for such.

In first studying this feature of the problem we estimated on a ten million gallon daily supply, with the idea that anything less would not be prudent to plan for with the possibilities of future demands. In the final study of the Worthington Creek Project, however, a supply of four million gallons is estimated. These general estimates for an impounding supply do not include reinforcement of distribution system.

In all, fifteen of the quadrangles, or sheets of the United States Geological Survey, in West Virginia, in the vicinity of Parkersburg, were investigated for available sites for an impounding supply. Worthington Creek, on the Marietta Sheet; Tygart Creek and the North Fork of Lee Creek, on the Belleville Sheet, were the low lift projects considered, which would require pumping. Goose Creek on the St. Mary's Sheet; North Fork of the Hughes River, on the West Union Sheet, seem to present available sites for gravity supply without pumping. The remainder of the sheets either did not present a satisfactory site or were too far away.

The Tygart Creek supply would have a drainage area of about 20 square miles, with a reservoir capacity of 7.5 billion gallons, and require about 10.5 miles of pipe line and is estimated to cost about $1,600,000, including capitalization of the operating expenses. The Goose Creek supply would have a drainage area of about 15 square miles, a reservoir capacity of about 14.5 billion gallons, and a pipe line 19 miles long and is estimated to cost about $3,300,000. The north branch of the Hughes River would have a water shed of four square miles and cost is considered greater than any of the above, while it is doubtful if the area would yield sufficient supply, as well as being much farther away. The Lee Creek, North Fork, is also found to have insufficient drainage area, and of all of those considered, the Worthington Creek low level supply is the only one coming within reason.

This is estimated to have a drainage area of about 26 square miles;

distance 4-1-4 miles from Parkersburg, and a reservoir giving about 8.8 billion gallons storage can be obtained. The village of Boreman would be flooded. The creek is frequently muddy and it seems, because of the drainage of three or four small towns, that it will, in time, if not now, require filtration to purify the supply, as well as the pumping which would now be necessary. The total cost of this project is $500,000 for pipe line and structures of the reservoir and dam, $300,000 for pumping station and intakes, and a capitalization of $420,000 for pumping cost, making a total charge, comparable with the other impounding schemes, of $1,220,000. Its actual cost, on the four million gallon daily basis, when compared on the same basis as the other improvement projects scheduled, is $580,000, giving a total annual charge, of which the greater part is interest and sinking fund, of $71,241; or the highest of all of those considered, which entirely precludes its feasibility as a source of additional supply.

APPENDIX NO. 3.

PROJECTS 2 AND 3.

In Appendix No. 3, we take up Project No. 2, with its four different sub-divisions, and Project No. 3, which uses the same reservoir site as Project 2-D. In Project 2-A, it is planned to use the present pumping station site and to re-equip, with some new buildings and considerable new machinery and to add a mechanical filter plant, a new force main from the station to a high stand pipe of 2-million gallons capacity on Prospect Hill, and to reinforce the distribution system to the extent of about $60,000. The additional equipment is as follows:

A new intake with concrete structure in the river and piping to the pump well, and a new building for pumps and filters, and improvements to the old building, including foundations and pump pit, and a reserve allowance of $10,000, which at a future time can be utilized to put in boilers, to replace the three which are now somewhat insecure upon their foundations and probably should be replaced in the near future, say within five or six years. The machinery includes one new 4-million gallon high lift pump, three 2-million low lift centrifugal pumps and engines to pump river water to the settling basins, and the moving and repairing of the present compound pump, the reseting of the Atlas boiler above floods and adding one new boiler; also all of the steam pipe and miscellaneous appurtenances inside the building. The total for this pumping station equipment is $67,000, as shown on the tabulation of estimates.

The filters, of 4-million gallons average daily capacity, are made up of eight concrete beds, 12 feet by 18 feet, using a coagulating basin of four hours' capacity. The filtered water reservoir is of reinforced concrete of 1-1-2 hours supply, making a total cost of $53,500. The new force main, 16 inches in diameter is planned to run from the present pumping station

to the tanks and is 4,060 feet in length and is estimated to cost $14,200. The new stand pipe to hold 2-million gallons, is planned to be 65 feet high and 75 feet in diameter, with flow line at elevation 256, and is estimated to cost, with foundation, $35,000. The reinforcement of the distribution system, including 40 new hydrants, one-half of which are to have steamer nozzles, and including the following lengths of pipe:

12 inch	1,150 feet
10 inch	15,640 feet
8 inch	11,110 feet
6 inch	12,000 feet
4 inch	400 feet

is estimated at a total cost of $59,900. These additions to the distribution system have been considered with Mr. E. U. Richards, the engineer of the Board of Fire Underwriters of Columbus, Ohio, and I am glad to state that the only additions requested have been a stronger feed to the vicinity of Green and Second Streets, meaning an addition of 1000 feet of 10 inch pipe and 2200 feet of 8 inch pipe, replacing 1400 feet of 8 inch pipe, and 400 feet of 6 inch pipe, increasing the estimate about $3,000. This is, also, heartily recommended.

This makes the total cost of this project, including $10,000 for the present worth of the future boilers, $239,600. The total annual charges are estimated to be $47,030 per year.

PROJECT 2-B:

In Project 2-B, the pumping station equipment, filters and equipment and increasing distribution system are the same, but an additional force main is provided from 11th Street and Market Street to Boreman Hill. This would be 8,760 feet long, and would cost $18,400. The reinforcement of the distribution system would be as before, $59,900. A stand pipe at Boreman Hill, available for the high service of the city and having a flow line of 290 feet would cost, including the foundations, $11,300. Total cost of this project, therefore, as outlined in the tabulation, and including the $10,000 above mentioned, would be $234,300, and the annual charges are estimated to be $45,789.

PROJECT 2-C:

In the Project 2-C, the changes from Project 2-A consist in using a 16 inch force main from the pumping station to Boreman Hill, 10,170 feet long, costing $33,500; also, the building of a reinforced concrete reservoir at this site, of 4-million gallons capacity, being 235 feet long, 140 feet wide and 25 feet deep, flow line at elevation 265, and costing $32,500, making the total cost of this project, with the $10,000 previously mentioned, $256,400. The annual charges are estimated at $47,660.

PROJECT 2-D:

In this project, the improvements to the pumping station and filter plant and the distribution system remain about as before, but a new force main 16 inches in diameter, 7330 feet long, is run from the present pumping station to a reservoir across the Little Kanawha River upon Fort Boreman, and estimated to cost $28,000. A reservoir on Fort Boreman, 4-million gallons capacity, flow line at 270, is estimated to cost $38,200, making the total cost of the project $250,200; with the annual charges $47,140.

PROJECT 3-D:

This project has the suffix of the letter "D" in order to compare it with 2-D, and while using about the same reinforcement of the distribution system and the reservoir at Fort Boreman, plans to build a pumping station and filtration plant just down stream from the Little Kanawha River, but to draw water from the Ohio River. In this case, the pumping station, which would be a new one, is estimated to cost $96,000, and the filters and equipment, $69,400. The total cost of this project is $282,900, and the total annual charges are estimated to be $51,631.

APPENDIX NO. 4.

PROJECT NO. 4—CAMDEN FARM WORKS.

PROJECT 4-A:

The three sub-divisions of Project 4, lettered A, B and C, all provide for new works on the Camden Farm, on the left bank of the Ohio River, at the northern edge of the City. No land cost has been allowed in these projects; the city now owns the reservoir site and it is understood that sufficient area for water works purposes will be donated at the site of the proposed pumping station by the Camden Estate. Project 4-A contemplates a concrete intake at the river with piping to a pump well, three, 2-1-2 million gallon low lift centrifugal pumps and three, 2-1-2 million gallon high lift pumps with the necessary boilers, buildings and foundations and pump pits, all costing $86,900. The mechanical filter plant is to have an average daily capacity of 4-million gallons and to consist of eight concrete beds 12 feet by 18 feet, a reinforced concrete coagulating basin of four hours supply, with a concrete filtered water reservoir of 2-1-2 hours supply, and is estimated to cost $80,600. The concrete reservoir at Boreman Hill is estimated to be the same as for Project 2-C. While the distribution system, on account of including a force main from the Camden Farm to Boreman Hill, being 9,200 feet of 20-inch pipe and costing $49,500, brings the total cost of this project up to $316,700, with an estimated annual charge of $53,000.

PROJECT 4-B:

This coincides in every way with Project 4-A, except that we use a slow sand filter plant, of 4-million gallons average daily capacity, instead of a mechanical filter plant. This is planned to consist of six beds, 134 feet x 90 feet, to operate at an average rate of 3-million gallons per acre per day with the use of coagulant. The coagulating basin it to have 24 hours, and the filtered water reservoir 2-1-2 hours capacity. The total cost of the filter plant is estimated at $173,600 which is quite excessive for the capacity, on account of the measures required to keep out floods. This necessity also considerably increases the cost of the mechanical filter works at the same place.

The other details of this estimate remain the same as previous ones, giving a total cost of $409,700, with a total annual operating charge of $59,112, which makes it next in cost to the impounding supply.

PROJECT 4-C:

This coincides in every way with Project 4-A, except that, instead of the mechanical filter plant and low lift centrifugal pumps, there is estimated ten 12-inch wells, each assumed to be 145 feet deep and spaced 500 feet apart, with a 20 inch collecting pipe, also, an air compressor and air piping to the wells, and a collecting well of concrete. These details are estimated, after consultation with Mr. C. F. Preslar and increasing our own figures, to cost $63,600, which, added to the other details of Project 4, make the total cost of $280,500, or a total annual charge of $46,491.

PROJECT 4-D:

This has been included in the tabulation, for the purpose of showing what this last arrangement would cost, if instead of using the 4-million gallon concrete reservoir on Boreman Hill, the 600,000 gallon stand pipe should be used, as per Project 2-B. This is really the cheapest project, amounting to $259,300, with an annual charge of $44,710, but it is not recommended, on account of the desire to have greater storage and thus safety in case of heavy draught and the sudden disability of the pumps.

WELL SUPPLY:

It is to be regretted that the information in regard to wells was not obtained sooner and also that at the present time we do not have more accurate and extensive information as to the quantity and quality of water. Two reasons have operated to prevent this:

First, the original sum of money allotted to the Commission by the City government, did not permit of drilling wells and testing same and, therefore, the Candem Estate, in accordance with the desires of the late Honorable J. N. Camden, contributed the amount of $1,500 for this purpose, and this aid has been gratefully accepted and appreciated. Then,

later, after it was learned that this amount would be available and having all of the other data well in hand for presentation, it was found that the time was not propitious for either the drilling or testing of wells, the river and consequently the ground water level being so high that a test would show too favorable conditions. Therefore, this investigation was postponed until the warm, dry season at the time of low flow, both of surface and ground water. The conditions now are the best for some time, the river being lower than for three seasons. One twelve inch well 146 feet deep has been drilled, near the top of the river bank, one four inch well, 188 feet away and at the low water line, another four inch well, 336 feet away on the land side, all in accordance with a contract with the C. F. Preslar, Prospecting and Engineering Company, signed May 22d, 1908. The depth of the wells, formations encountered and other data, is given upon the sketch hereto attached.

The drilling shows a layer of sand stone at 88 feet below the surface of the ground, and about one foot thick. Under this there is stated to be shale of varying hardness and color. This story is also bourne out by the drilling of the test well, up stream from the Steel Works, in 1906, and verified by the formation noticed at the construction work of Dam No. 18, about four miles up stream. The twelve inch well has been pumped forty-eight hours by compressed air and a log of the results is given in Appendix No. 8. The smaller wells were pumped occasionally for the purpose of securing samples of water, and were also used as observation wells to see how the draft of water in the large well affected the ground water level in the vicinity. The rate of pumping varied from 500 to 300 gallons per minute, depending upon steam and air pressure occassionally, evidently on the losening up the formation in the vicinity of and below the strainer. The water generally came clear and free from sand and silt, although occassionally it was turbid, due to the action above noted.

Wells may in time lessen in yield and the water also, may grow harder and contain more iron. This first can only be told by long continued pumping and even then, after a period of years, the yield may show a marked reduction. The general lowering of the ground water level in Indiana is an illustration. The draft at present pumping does not indicate a serious lowering, but for safety of a larger test is recommended and, also, a large factor of safety in well installation.

The Ohio River water while hard compared to several waters of the glacial drift formation is not considered too much so for general use in the valley. Well waters on the other hand are frequently much harder, most of them too much so for boiler feed and for comfortable domestic use. Iron. also, has been found in large quantities in some wells, particularly the one drilled above the Steel Works; too much for a public water supply. Present analyses do not indicate any troublesome features of this sort but here again prudence suggests further and longer continued tests before expend-

ing too large an amount of money in such a project. The analyses of samples from the twelve inch well show a water slightly harder than the Ohio River at this point and much more clear and less highly colored than the latter. The nitrogen determinations seem to indicate a previous serious pollution, thoroughly remedied by natural processes of purification. The Bacterial results confirm our confidence in the present healthfulness of the water for drinking purposes and the amount of chlorine is not unusual for this neighborhood. Iron is present to a greater degree than in the Ohio River, but even in this respect, the amount is unusually small compered with many wells in daily use in Ohio, and unless the amount should increase with continued pumping, the water will be perfectly satisfactory in this respect.

On the whole, the analyses show that this well is, at present, furnishing a water entirely satisfactory for municipal supply.

It cannot be too strongly urged that, while the well proposition is attractive, further investigations should be made, perhaps in other localities nearer the proposed reservoir site, pending final decision of this important problem, and, in the meantime, much of the money can be appropriated and much of the construction work done, which will all operate to the improvement of the supply, and the insurance of a greater quantity and certainly of greater pressure at times of need.

A tabulated summary of all of the several projects is given in Appendix No. 5.

APPENDIX NO. 5.

SUMMARY OF PRELIMINARY ESTIMATES ON PARKERSBURG WATER WORKS GIVING TOTAL COST OF FOUR DIFFERENT PROJECTS.

Project No.	Description	Pump Sta. and Equipment	Filters and Equipment	Stand Pipe or Reser.	Force and Distri Mains	Total Cost
1.	Impound Res. on Worthington Creek with Pipe line & High lift Pumping Station	*70,700	282,000	35,000	191,900	579,600
2-A.	Old Site Mechanical Filter Plant New for Main High Service. 2-Million St. Pipe and Rein. Dis. Sys.	*77,000	53,500	35,000	74,100	*239,600
2-B.	Old Site Mechanical Filter plant for Main Street pipe at Boreman Hill District System.	*77,000	53,500	11,300	92,500	*234,300
2-C.	Old Site, same as No. 2 but Conc. Res. at Boreman Hill.	*77,000	53,500	32,500	93,400	*256,400
2-D.	Old Site Improvements; and Res. at Fort Boreman.	*77,000	53,500	38,200	81,500	*250,200
3-D.	New Pumping Station Mechanical Filtration Plant near & Reservoir at Fort Boreman.	96,000	69,400	38,200	79,300	282,900
4-A.	New Works Camden Farm Mechanical Filtration Plant, Reservoir, Boreman Hill.	86,900	80,600	32,500	116,700	316,700
4-B.	Same as 4-A but slow sand Filtration Plant.	86,900	173,600	32,500	116,700	409,700
4-C.	Same as 4-A but well supply instead of Mech. Filter Plant.	67,700	Wells. 63,600	32,500	116,700	280,500
4-D.	Same as 4-C but 600,000 Gallon Stand pipe on Boremans Hill. Hill.	67,700	63,600	11,300	116,700	259,300

*Includes $10,000 as present value of money which will have to be expended in five years for a new boiler house and boilers. No depreciation charged against this amount for this period of five years.

APPENDIX NO. 5.

SUMMARY OF ANNUAL CHARGES FOR IMPROVEMENTS TO PARKERSBURG WATER WORKS FOR TEN DIFFERENT PROJECTS.

Project No.	Int. and Sink. Fund	Depre. of Pump. Sta.	Depre. of Filters	Depre of Distr. Sys. and Stfr'g	Opera. of Pump Sta.	Opera. of Filters	Total Charges
			Reservoir				
1.	$46,368.	$2,835	$2,020.	$5,018.	$15,000.	$.....	$71,241
2-A.	19,168.	3,380	2,250.	3,232.	11,000.	8,000.	47,030
2-B	18,744.	3,380	2,250.	2,415.	11,000.	8,000.	45,789
2-C.	20,512.	3,380	2,250.	2,518.	11,000.	8,000.	47,660
2-D.	20,016.	3,380	2,250.	2,394.	11,100.	8,000.	47,140
3-D.	22,632.	3,940	2,663.	3,496.	11,000.	7,900.	51,631
4-A.	25,336.	3,592	2,388.	2,984.	10,900.	7,800.	47,140
4-B.	32,776.	3,592	3,460.	2,984.	11,200.	5,100.	59,112
			Wells				
4-C.	22,440.	2,815	3,252.	2,984.	15,000.	.....	46,491
4-D.	20,744.	2,815	3,252.	2,899.	15,000.	.....	44,710

APPENDIX NO. 6.
ANALYSES OF VARIOUS WATERS,

Parts per Million. Analyses by Prof. E. S. Merriam' Marietta, Ohio.

	Meyercord-Carter Co. Well, some miles above Parkersburg.					George Davis Well, Sand Plains, north of Parkersburg.				
Date	4-7	4-14	4-21	4-28	Average	4.7	4-14	4-21	4-28	Average
Color	2	2	3	4	3	10	10	10	10	10
Turbidity	—10	—10	0	0	3	—10	—10	35	..	15
Alkalinity	99	123	132	132	122	108	112	115	116	113
Hardness	194	211	226	228	215	74	79	81	84	80
Incrustants	95	88	94	96	93	0	0	0	0	0
Calcium	78	75	79	81	78	26	27	27	26	26
Iron	.05	.02	.11	.25	.11	.05	.06	.03	.02	.04
Bacteria c. c.	750	1600	400	140	722	7150	2400	3150	5300	4500
Coli	—	—	—	—		—	—	—	—	

APPENDIX NO. 6. Cont'd.
ANALYSES OF VARIOUS WATERS.

Parts per Million.

	Ohio River at Parkersburg						Little Kanawha River at Parkersburg.				
Date	4-7-08	4-14	4-21	8-24	4-28	Average	4-7	4-14	4-21	4-28	Average
Color	8	9	8		11	9	15	16	10	18	15
Turbidity	75	90	65		..	77	130	200	110	..	147
Alkalinity	26	27	25	49	23	30	25	24	27	32	27
Hardness	51	51	57	145	58	72	39	29	29	29	32
Incrustants	25	24	32	96	35	42	14	5	2	0	5
Calcium	15	16	17		16	16	9	8	8	11	9
Iron	.07	.04	.06		.12	.07	.04	.02	.03	.05	.04
Bacteria c. c.	1300	2000	3250		1900	2112	2250	3000	2300	2000	2388
Coli	—	—	—	—	—		—	—	—	—	
Chlorine				25							

APPENDIX NO. 6. Cont'd.

ANALYSES OF VARIOUS WATERS,

Parts per Million.

	Steel Plant Well above Camden Farm.					No. 1, 4-inch well in River.		
Date	4-7	4-14	4-28	Average	:	8-22	8-24	Average
Color	16	15		13	:	2		2
Turbidity	0	0	0	0	:	0	Slight	0
Alkalinity	87	86	93	89	:	96	84	90
Hardness	126	116	129	124	:	115	137	126
Incrustants	39	30	36	35	:	19	55	37
Calcium	44	40	43	42	:	37	35	36
Iron	0.35	0.40	0.25	.33	:	0.15	0.05	.10
Bacteria c. c.	215	40	870	375	:	280		280
Coli	—	—	?		:	—		
Total Solids					:	187	180	184
Loss on Ignition					:	68	12	40
Chlorine					:	5	6	6
N. Free Amm.					:	.0024	.003	.0027
N. Alb. Amm.					:	.006	.006	.006
N. Nitrites					:	.006	.001	.004
N. Nitrates					:	2.5	3.0	2.8
Ox. Consumed					:	1.4	0.4	0.9

APPENDIX NO. 6. Cont'd.

ANALYSES OF VARIOUS WATERS,

Parts per Million.
Test Well on Camden Farm

	No. 2, 4-inch well on Land Side.			No. 3, 12-inch Well.		
Date	8-22	8-24	Average	8-22	8-24	Average
Color	—			4		4
Turbidity	Slight			0		0
Alkalinity	127	125	126	58	66	62
Hardness	140	168	154	77	85	81
Incrustants	13	43	28	19	19	19
Calcium	47	46	46	25	25	25
Iron	0.50	0.55	0.52	0.10	0.05	0.08
Bacteria c. c.	1450		1450	630		630
Coli	—			—		
Total Solids	212	196	204	176	158	167
Loss on Ignition	46	15	30	48	32	40
Chlorint	4 .0	5	2.2	12.0	6	9
N. Free Amm.	.022	.002	0.012	.004	.002	0.003
N. Alb. Amm.	.011	.013	0.012	.007	.010	0.008
N. Nitrites	.008	.017	0.012	.0006	.001	0.0008
N. Nitrates	1 .6	1.50	1.60	2 .0	2.75	2.38
Ox. Consumed	2.4	0.40	1.40	1 .4	0.50	0.10

APPENDIX NO. 7

HYDRANT PRESSURE TESTS.

No.	Location of Hydrant	DAY Pres.	DAY Equiv. Elev.	NIGHT Pres.	NIGHT Equiv. Elev.
1	Market and 6th Streets	59	199	72	229
2	Court Square	75	221	80	233
3	Market and First	80	218	82	223
4	Julian and First	80	220	83	227
5	Ann and Second	78	218	84	232
6	End of Grant	78	219	80	224
7	Juliana and 7 1-2 Streets	72	221	76	230
8	Juliana and 13th	58	221	64	235
9	Market between 13th. and 16th.	50	221	54	230
10	Sand Road and 16th.	62	192	68	205
11	Avery and 19th	38	206	48	229
12	Foot of 19th	74	208	..	...
13	Sand Road and 26th	62	201	72	223
14	Dudley and 25th	44	211	54	234
15	Dudley and Gould	45	205	54	225
16	St. Mary's and 16th	46	211	53	227
17	17th and Park Streets	48	205	57	226
18	Park Avenue and 19th	59	210	69	233
19	7th and Bryant Streets	60	205	65	217
20	George and Virginia	44	211	55	237
21	Jeanette and William	61	209	70	230
22	Gale Avenue and 5th Street	69	223	74	234
23	Green and 2nd Streets.	76	215	83	231
24	Avery and 3rd,	75	214	81	228
25	Avery and 6th Streets	64	226	70	240
26	Green and 7th Streets	63	224	68	235
27	End of Madison Avenue.	22	233	23	235
28	Lynn and Charles	54	222	60	236
29	13th and Stevenson Line	58	206	66	225
30	St. Mary's and 13th	40	214	46	228
31	Avery and 11th Streets	56	222	63	238
32	Market and 8th Streets	66	231	68	235

NOTE: The Equivalent Elevation is the elevation above Parkersburg City datum to which water would rise in a pipe attached to the hydrant.

Approximate Elevation of water in storage tanks was 243.

Night Pressures were observed March 20th, 1908.

Day Pressures are the averages of two observations made in the afternoon of March 12th and the forenoon of March 16th, 1908, respectively.

APPENDIX NO. 8.

LOG OF TEST WELLS.

Date Aug. 22	Head on Weir	Disc. Gals. per M.	Water Surf. Well No. 3. Below Surf.	Above River	Water Surf. Well No. 1. Bel. Surf.	Above River	Water Surf Well No. 2. Bel. Surf.	Above River	Pressure Steam	Air	Speed of Compr. R. P. M	Appearance of Water
Before Pumping	..		36	6	...	..	...	..	..	..	.....	....
A. M.												
9:40	.36	510	45	- 3	-0.2	2.7	31.4	3.0	70	43	.....	....
4: P. M.	.35	490	46	- 4	-0.2	2.7	31.9	2.5	60	40	.....	....
7:00	.28	355	46	- 4	-0.1	2.6	32.5	1.9	75	40	.....	N. C.
7:30	.31	411	46	- 4	...	..	...	..	75	40	.....	....
8:00	.31	411	46	- 4	0	2.5	32.0	2.4	75	40	Medium	....
8:30	.29	373	46	- 4	...	..	...	..	70	40	Slow	C.
9:00	.31	411	46	- 4	0.2	2.3	32.0	2.4	75	40	Fast	C.
9:30	.32	430	46	- 4	...	..	...	..	75	40	Fast	S. M.
10:00	.29	373	46	- 4	0.3	2.2	32.0	2.4	65	40	Slow	C.
11:00	.30	392	44	- 2	...	..	...	..	85	40	65	C.
11:20	.29	373			...	..	...	..	80	40	55	C.
11:30	.29	373	44	- 2	0.6	2.0	32.0	2.5	85	40	61	C.
12:M	.27	337	42	0	...	..	...	..	80	38	62	C.
Aug. 23 A. M.												
12:30	.28	355	44	- 2	...	..	...	..	80	40	56	C.
1:00	.30	392	44	- 2	...	..	...	..	90	40	68	S. M.
1:30	.30	392	45	- 3	0.3	2.3	33.6	0.9	85	40	72	C.
2:A. M.	.31	411	46	- 4	...	..	...	..	90	40	60	M.

Date Aug. 23	Head on Weir	Disc. Gals. per M.	Water Surf. Well No. 3. Below Surf.	Above River	Water Surf. Well No. 1. Bel. Surf.	Above River	Water Surf Well No. 2. Bel. Surf.	Above River	Pressure Steam	Air	Speed of Compr. R. P. M.	Appearance of Water
2:30	.31	411	46	- 4	...	..	...	..	80	40	75	M.
3:00	.30	392	46	- 4	1.3	1.4	32.0	2.5	80	40	70	M.
3:30	.31	411	47	- 5	...	..	...	..	90	40	82	C.
4:00	.28	355	44	- 2	...	..	...	..	80	40	53	M.
4:03	.25	302	..		...	..	...	..	75	40	53	M.
4:30	.30	392	48	- 6	1.7	1.0	32.5	2.1	80	40	70	C.
5:00	.32	430	47	- 5	...	..	...	..	90	40	100	S. M.
5:30	.30	392	48	- 6	...	..	...	..	90	40	75	M.
6:00	.33	450	46	- 4	1.5	1.2	31.6	3.0	90	40	106	M.
6:30	.33	450	48	- 6	...	..	...	..	90	40	97	M.
7:00	.32	430	48	- 6	...	..	...	..	90	40	100	M.
7:30	.32	430	48	- 6	1.5	1.3	32.5	2.7	90	40	100	M.
8:00	.31	411	50	- 8	...	..	...	..	90	40	94	M.
8:30	.32	430	50	- 8	...-	..	...	..	90	40	100	S. M.
9:00	.32	430	51	- 9	...	..	...	..	85	40	100	M.
9:30	.30	392	47	- 5	...	..	...	..	85	40	70	M.
10:00	.31	411	53	-11	1.5	1.3	32.5	2.2	70	40	75	M.
10:45	.30	392	48	- 6	1.0	1.8	32.0	2.7	65	40	70	M.
11:00	.30	392	47	- 5	1.0	1.8	32.0	2.7	70	40	70	M.
11:30	.33	450	46	- 4	...	..	...	..	70	40	112	S. M.
12: M.	.33	450	46	- 4	1.0	1.8	32.0	2.8	80	40	130	N. C.
12:30	.31	411	46	- 4	...	..	...	..	80	40	70	S. M.
1:P. M.	.30	392	46	- 4	1.0	1.8	32.0	2.8	80	40	80	C.

Date Aug. 23	Head on Weir	Disc. Gals. per M.	Water Surf. Well No. 3. Below Surf.	Above River	Water Surf. Well No. 1. Bel. Surf.	Above River	Water Surf Well No. 2. Bel. Surf.	Above River	Pressure Steam	Air	Speed of Compr. R. P. M.	Appearance of Water
1:30	.31	411	46	- 4	...	..	...	..	75	40	100	M.
2:00	.31	411	46	- 4	1.0	1.8	32.0	2.8	80	40	90	C.
2:30	.29	373	47	- 5	...	..	...	..	75	40	70	C.
3:00	.30	392	49	- 7	1.0	1.9	32.0	2.8	85	40	75	....
3:30	.30	392	46	- 4	1.0	1.9	32.0	2.8	70	40	75	M.
4:00	.30	392	46	- 4	1.0	1.9	32.0	2.8	90	40	..	M.
4:30	.31	411	44	- 2	...	..	...	..	95	43	100	S. M.
5.P. M.	.31	411	46	- 4	1.0	1.9	32.0	2.8	85	40	120	....
5:30	.30	392	48	- 6	...	..	...	..	90	40	80	N. C.
6:P. M.	.31	411	51	- 9	1.0	1.9	32.0	2.9	85	40	95	C.
6:30	.30	392	46	- 4	...	..	...	..	85	40	92	C.
7:P. M.	.31	411	50	- 8	1.0	1.9	32.0	2.9	90	43	120	C.
7:30	.28	355	48	- 6	...	..	...	..	85	38	80	C.
8:00	.31	411	46	- 4	...	..	...	..	90	40	100	C.
8:30	.31	411	48	- 6	1.0	2.0	32.0	2.9	90	40	100	C.
9:00	.31	411	47	- 5	...	..	...	..	90	40	95	C.
9:30	.30	392	46	- 4	1.0	2.0	32.3	2.7	85	40	90	C.
10:P. M.	.30	392	48	- 6	...	..	...	..	85	40	90	C.
11:00	.30	392	44	- 2	0.7	2.4	32.4	2.7	85	40	100	N. C.
11:30	.30	392	45	- 3	...	..	...	..	85	40	95	N. C.
12:00	.30	392	45	- 3	...	..	...	..	95	40	104	N. C.
Aug. 24.												
12:30 A. M.	.29	373	45	- 3	0.8	2.4	32.5	2.6	95	40	100	M.
1:A. M.	.30	392	46	- 4	...	..	...	..	85	40	104	M.
1:30	.29	373	47	- 5	...	..	...	..	95	40	98	M.

Date Aug. 24	Head on Weir	Disc. Gals. per M.	Water Surf. Well No. 3. Below Surf.	Above River	Water Surf. Well No. 1. Bel. Surf.	Above River	Water Surf Well No. 2. Bel. Surf.	Above River	Pressure Steam	Air	Speed of Compr. R. P. M.	Appearance of Water
2:00	.30	392	45	- 3	0.8	2.4	32.5	2.6	90	40	100	S. M.
2:30	.29	373	47	- 5	...	..	...	..	75	40	80	C.
3:00	.30	392	46	- 4	...	..	...	..	80	40	90	M.
3:30	.30	392	45	- 3	...	..	...	..	90	40	108	M.
4:00	.30	392	48	- 6	...	..	...	..	90	40	100	M.
4:30	.30	392	44	- 2	...	..	...	..	85	40	92	M.
5:00	.29	373	44	- 2	0.8	2.5	32.5	2.7	85	40	100	M.
5:30	.29	373	45	- 3	...	..	...	..	85	40	95	S. M.
6:00	.29	373	45	- 3	...	..	...	..	85	38	104	S. M.
6:30	.29	373	46	- 4	...	..	...	..	85	40	100	S. M.
7:00	.29	373	44	- 2	0.9	2.4	32.5	2.8	90	40	108	M.
7:30	.29	373	44	- 2	...	..	...	..	90	40	..	M.
8:A. M.	.30	392	46	- 4	0.9	2.5	32.3	3.0	..	..	120	M.
8:30	.30	392	48	- 6	...	..	...	..	90	40	110	S. M.
9:00	.30	392	46	- 4	...	..	...	..	90	45	110	S. M.
9:30	.30	392	48	- 6	0.9	2.5	32.2	3.1	80	40	100	S. M.
10:A. M.	.30	392	48	- 6	...	..	...	..	90	40	106	....
10:30	.30	392	48	- 6	...	..	...	..	90	42	110	S. M.
11:00	.30	392	48	- 6	1.0	2.5	32.2	3.2	90	45	135	....
11:30	.30	392	52	-10	...	..	...	..	90	45	125	....

NOTE—N. 3 is the 12-inch well—No. 1 is the 4-inch well near low water line. No. 2 is the 4-inch well on land side. Elevations and head on weir in feet—Pressures in pounds per square inch.

NOTE—M—Muddy. N. C.—Nearly Clear. S. M.—Slightly Muddy. C—Clear. A—Elevation for water surface above river level signifies that the water in the well is lower than that in the river.

NOTE—Samples for analysis were taken from all three wells early in the afternoon of Aug. 22nd. and from all three wells and the Ohio River about 6 A. M., Aug. 24th. The results of these analyses are recorded in Appendix No. 6. Owing to difficulty of measurement the elevations of water surfaces are subject to some uncertainty.

Report of Water Works Commission.

August 26th, 1908.

To the Honorable Mayor and City Council
of Parkersburg, West Virginia.

Gentlemen:—

The Water Works Commission appointed by your Honorable Body on the 23rd day of May, 1907, for the purposes more specifically set forth in the resolutions passed on that date, after rather long and tedious labors, involving the examination and investigation of numerous questions and plans in connection with the proposed new water works system for the City of Parkersburg, now have the honor to submit the following report with reference to the preliminary plans for said work, as called for by your resolution of May 23rd, 1907.

The engineer employed by your Commission, Mr. Morris Knowles of Pittsburg, Pa., submitted to the Commission his completed report on the 24th day of August, 1908, a copy of said report being transmitted as a part of this report. Your Commission, after a careful examination and discussion of the various projects set forth in said report, now recommends that said report as a whole be accepted and the project as contained in the summary on last page of said report be adopted as a plan for a new water supply for this city. It will be observed that this project contemplates the occupation of land belonging to the estate of the late Hon J. N. Camden, deceased. As has heretofore been stated publicly and through the press, an offer was made by the heirs of Senator Camden proposing to donate to the City of Parkersburg so much of said land as might be needed for water works purposes, a copy of which said offer, signed by said heirs is as follows:

'The estate of the late Senator J. N. Camden, deceased, by and with the concurrence and approval of J. N. Camden, Jr. and Mrs. Annie Spilman, the sole heirs of the said Senator J. N. Camden, desiring to carry out the wishes and proposition of Senator Camden to the City of Parkersburg, as contained in his open letter to the Mayor, Council, Board of Affairs and the Water Works Commission of the City of Parkersburg, dated February 16, 1908, as follows:

"I therefore respectfully propose, in order to test the question of natural filtration, that I will at my own cost and expense, sink and test wells, both on the river front and on the foot of Neal's Island, for which I already have the permission of the owner, to ascertain the quality and quantity of water that can be obtained by natural filtration, and to commence as soon as the engineers selected by the city authorities and water works commission are ready to direct and superintend the tests to be made. This will cost the city nothing, and will no doubt be of value in arriving at conclusions. I will also add should the city desire to locate its plant or pumping station or wells upon any grounds owned by me, I will donate to the city all the ground it may need for water works purposes."

"But it is understood and agreed that the costs of making the tests above mentioned shall not exceed Flfteen Hundred ($1500.00) Dollars."

"And it is now appearing that the above proposition and limitation as to the cost of the tests was the final proposition made by the late Senator

J. N. Camden to the authorities of the City of Parkersburg, we now therefor confirm and ratify the same.

J. N. Camden, Jr.
Mrs. Annie T. Spilman.
Union Trust & Deposit Co., Executor,
Estate of J. N. Camden,
By W. E. Davis, Treas."

It will be seen upon examination that the project above referred to, which your Commission now recommends as the best to adopt, leaves open the question as to whether or not the water supply shall be obtained from a system of wells or by means of mechanical filtration. Your Commission has partially investigated the well plan, the expense of which investigation having up to this time been borne by the estate of the late Senator Camden; but before recommending this system our engineer, Mr. Knowles, as well as your Commission, feels that further investigation should be made in order to more definitely ascertain the quantity and quality of water that may be obtained from wells, and the most economical method of installing them for service. This investigation it is estimated will cost about Fifteen Hundred ($1500.00) Dollars, and your Commission earnestly recommends that this amount be appropriated to fully complete the test already begun. As is more fully set forth in the report of Mr. Knowles, this investigation as to the water supply can be conducted while other portions of the work proposed are being carried on in order to relieve the dangerous condition now confronting the people of this city.

It is recommended that a bond issue be made as soon as is practicable for the amount sufficient in connection with available funds already on hand, to cover the entire project recommended by Mr. Knowles and endorsed by your Commission. If this money be made available within the near future, the urgent portions of the work can be done at once, and at the same time the best method of obtaining the water supply can be definitely determined.

Your Commission would call the attention of your Honorable Body to the fact that the preject endorsed by your Commission contemplates the construction of a four million gallon concrete reservoir on Boreman's Hill (known as Terrapin Knob) to be connected by a twelve inch main with the tanks now on Prospect Hill, thereby giving much larger additional storage capacity. However, the Commission feels that the retaining of these tanks on Prospect Hill, will eventually become a menace to the safety of a portion of our city, due to the danger of their becoming weakened by corrosion and otherwise; and to the further danger of being struck by lightning. It is recommended by Mr. Knowles that these tanks be eventually replaced by a re-inforced concrete stand-pipe, the estimated cost of which is $25,000.00 It is further pointed out by him that if the tanks be finally abandoned and the new reservoir solely relied on for water storage, it will be necessary to construct a new twenty inch main from the

reservoir on Terrapin Knob into the heart of the city, at a cost of about $20,000.00. These estimates are in addition to the total cost of the project as set forth in his report and recommended by your Commission by a vote of six in the affirmative and one in the negative

All of which is respectfully submitted.

B. S. Pope,
H. H. Moss,
Wm. M. Hall,
S. D. Camden,
W. H. Gerwig,
C. D. Forrer,
Members of Water Works Commission.

Minority Report by W. B. PEDIGO, Mayor.

Parkersburg, W. Va., August 26th, 1908.

To the Honorable Council and Board of Affairs,
Parkersburg, W. Va.,

Gentlemen:

Not being able to agree with the other members of the Water Works Commission as to the details of their recommendations, I beg leave to submit the following minority report:

The data so far obtained is not sufficient to enable either Mr. Knowles or the Commission to make a specific recommendation as to the character of water supply system to be adopted. Mr. Knowles recommends that the pumping station be located on the Camden Farm; that the work on the distributing system be begun at once; that a bond issue covering a portion, if not all of the estimated cost of the system, be submitted to the people: in the meantime, through further investigations, he expects to be able to say whether a well system is practicable, or whether a mechanical filter will have to be installed. This is the substance of the recommendations of the majority of the Commission, as I understand them. I can not give my assent to the Commission's report, therefore, for the following reasons:

1. I believe the city should decide definitely what system of water works it will have, before it begins to build it.

2. I believe the whole matter ought to be decided before a bond issue is asked for.

3. If the well system should be found impracticable I do not believe there is any advantage in removing the water works from their present location to the Camden farm.

In my opinion the following course should be pursued by the city:

1. The well on the Camden farm should be pumped continuously, to the limit of its capacity, for at least fourteen days.

2. If said well is still found satisfactorily productive, a new well of the same size should be drilled about 500 feet distant, and pumped

continuously, with the first well, for at least two weeks.

3. Two or three more observation wells should be drilled at such points as may be deemed best to get a correct idea of the effect of the pumping on the supply of water.

4. If these tests are satisfactory, one well should be put down with a diamond drill, and a core taken out, wherever the ground will core, to show the exact character of the formations below the surface.

5. In the meantime a careful examination of the present pumping station, such as was contemplated by the supplement to the contract with Mr. Knowles, should be made with a view to determining the condition of those portions of said plant, which Mr. Knowles describes "as not now easily visible, like the foundations, piping, interior of machinery, etc." and to ascertain what alterations, repairs or strengthening these parts of the plant may need, in order that the exact cost of rebuilding said plant may be made known.

A resolution covering some of these recommendations and others deemed desirable at this time, is presented with this report.

Very Respectfully,

W. B. Pedigo,

Mayor.

In the Fifty-first Congress.

Contested Election Case.

CHARLES B. SMITH,

VERSUS

JAMES M. JACKSON.

From the

Fourth Congressional District

—OF—

West Virginia.

BRIEF FOR CONTESTEE.

J. W. ST. CLAIR,
J. B. JACKSON,
Attorneys for Contestee.