

ENGINEER'S REPORT

Water Works Improvements

WHITESTOWN
INDIANA

AUGUST 2, 1973

Sullivan & Fu
INDIANAPOLIS

ENGINEER'S REPORT
WATER WORKS IMPROVEMENTS

TOWN OF WHITESTOWN
BOONE COUNTY, INDIANA

AUGUST 2, 1973

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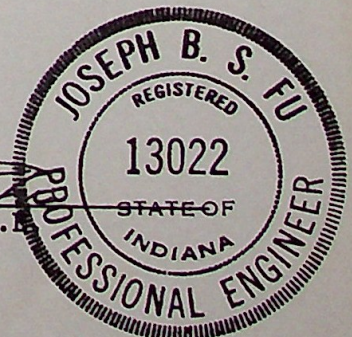
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Sullivan and Fu, Inc. / engineers & designers / Fred D. Sullivan & Joseph B. S. Fu, P.E.

August 2, 1973

Board of Trustees
Town of Whitestown
Whitestown, IN 46075

Gentlemen:

Transmitted herewith is the Engineer's Report - Water Works Improvements - Town of Whitestown, dated August 2, 1973.

This report has been prepared at your direction and for the purpose of presenting certain needed improvements to the present water works system. The report should be of assistance to the Board in explaining the proposed items to the people of Whitestown. Also the report is intended to familiarize and inform the State and Federal Agencies with Whitestown and the proposed improvements.

The Town Board has shown their concern for the welfare of the community by authorizing this report. The accomplishment of the proposed improvements contained herein will require your time and talents. We are looking forward to working with you to the successful completion of this project.

We would like to thank Mr. Don Sorters and the Town Board for their assistance in preparing this report. The entire Town Board is to be commended for their continued interest, constructive comments and suggestions during this period also.

Very truly yours,

SULLIVAN AND FU, INC.

F. D. Sullivan
President

FDS:jms

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SECTION 2

INTRODUCTION

Business's Report

TABLES, GRAPHS AND DIAGRAMS

The intended purpose of this report is to:

1. Present all pertinent information relating to the present water systems.

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SECTION I
INTRODUCTION

Engineer's Report

The intended purpose of this report is to:

1. Present all pertinent information relating to the present water works systems.
2. Propose certain improvements to that system.
3. Outline a method of financing the proposed improvements.
4. Familiarize State and Federal Agencies with Whitestown, Indiana and to inform them of your situation and proposed improvements.

It is intended to serve the Town Board of Whitestown by explaining the proposed project, and furnishing information that will enable the Town Board to make the decisions required of them during such a program. The proposed project will be described, as well as the existing system. Cost estimates will be shown followed by a sound financing plan. From these proposed project costs, estimated user rates will be developed. Based on an analysis of the above information, recommendations will be made, resulting in a well defined project, serving the best interest of the entire community.

The Indiana State Board of Health will use this report for examining the proposed water system, treatment facilities, and their operation. They will be interested in the operation, control, safety, and performance of the entire system.

The FHA (Farmers Home Administration) will evaluate the proposed project from this report, state recommendations and assist in applications for grants in aid.

Should conventional financing be required, the Bond Attorneys and Investment Houses will use the report in connection with the legal and financial considerations of the

project. The project must not only be feasible from the engineering concept, but also legally sound and financially secure.

The Water Corporation

The Whitestown Water Corporation was formed in 1954 when the existing system was constructed. There have been no extensive extensions, reconstruction or improvements to the system since that time. The system remains basically as it was initially built.

The Water Corporation is primarily responsible for, but not limited to, the following:

1. Providing clean, safe water in adequate quantities to the users of the system.
2. Operating the system and the Corporation efficiently and with fiscal responsibility.
3. Maintenance of the system and planning for required improvements and/or expansion to serve the community.

The Water Corporation through its officers, the Town Board of Whitestown, has for some time recognized the need for improvements to the present water system. The initial steps were undertaken to meet these needs with the authorization of this report.

Interested Agencies

The primary agency that will review this proposed project will be the Indiana State Board of Health. The review, comments and approval will be by the Water Supply Section, Division of Sanitary Engineering, Office of Environmental Health. These offices are at 1330 West Michigan Street, Indianapolis, Indiana (46206).

This State Agency will review the project in terms of adequate supplies, storage, distribution, treatment, health and safety. They will issue an approval which may

or may not be contingent upon inclusion of additional work not herein recommended or otherwise intended.

The Insurance Service Office of Indiana is a private agency that will not be directly interested in this report; however, the implementation of the project will eventually affect your community and its relationship to this agency.

The Insurance Service Office of Indiana, (formerly the Indiana Rating Bureau), is a private group which is supported by the fire insurance companies who furnish fire insurance coverage to the people of the State of Indiana. It is the business of this organization to rate the community in terms of fire protection ability. They accomplish this by checking the system pressures, hydrants, valves, storage and supply capacities. The fire department is also investigated, as to equipment, men, training, etc.

Any improvements to the existing system will influence the rating for your community. However, it is beyond the scope of this report to discuss new rates or to estimate the savings in reduction of insurance rates.

Farmers Home Administration (FHA)

The F.H.A. operates within the U. S. Department of Agriculture and is empowered to offer grants, and/or loans to communities like Whitestown for the purpose of constructing water, sewage, and waste disposal systems.

This agency will work with your attorney and engineer in preparing legal, fiscal and engineering documents, for the purpose of insuring a loan for the construction of the proposed improvements. This work will be accomplished through both their local county officer as well as the state office in Indianapolis.

The FHA Engineer will have suggestions for this project during the course of planning and engineering. We will make every effort to consider his ideas and implement those that are compatible with the system, to our mutual satisfaction.

You will see that in Section VI - Project Financing, that the only funding considered is that participation furnished by FHA. We believe that this is the only reasonable help available and without it the project could not go ahead.

Whitestown, Indiana

It is our intention that this report will assist the Town Board of Whitestown in the following ways:

1. Explaining to their constituents the reasons, needs and solutions for improvements to the present water system.
2. Inform all area, state and federal parties of the problems and solutions for the same.
3. Establishment of a sound improvement program and fiscal responsibility to pay for the required construction.

The proposed project, as herein described, will require the investment of not only money, but your time and personal energies. The completed project should be one that returns these investments, in community pride and accomplishment, and at the same time providing adequate water supplies for your town.

SECTION II

GENERAL

Location and Area

The Town of Whitestown is located in Worth Township, in the southeast area of Boone County, Indiana. Whitestown is approximately seven miles southeast of Lebanon, Indiana, four miles west and three miles north of Zionsville, Indiana, and three miles north of the intersection of State Road 334 and Interstate 65. The area of Whitestown, Indiana has been basically a farming community and should remain much the same for the next few years. However this area of Boone County has become a very desirable residential area and is certainly enhanced by its easy access to Interstate 65 and the connections both to Indianapolis and Lebanon.

Whitestown has been served with its own water supply and distribution system since 1954. The town is currently in the process of installing sanitary sewers and sewage treatment facilities which represent a major monetary expenditure. With the completion of the afore mentioned sewage system and the proposed improvements to the water system as recommended in this report, the Town Board will have accomplished much in the way of improvements for the people of Whitestown.

The old town has been platted and has developed at the intersections of North 101st Road and West 146th Street. The Penn Central Railroad cuts the town from the northwest to the northeast just south and west of the above intersection. The surface run-off from the present town generally is contributory to Jackson Run which drains to the east to the Eagle Creek Water Shed. There are a limited number of water users west along West 146th Street. We would recommend that this area be annexed to the city.

Population

Our research shows that a post office was established in Whitestown in 1853. Whitestown remained a rural community until 1949 when it was incorporated. The U. S. Census

of the next year, 1950, shows a population for Whitestown of 550 persons. The next 10 year period, 1960, shows an increase of population to 613 persons. The 1970 census shows a population of 569 persons.

The following tabulation, POPULATION TABLE, shows the populations for Worth Township, Boone County, Lebanon, Whitestown and Zionsville for the years 1950, 1960 and 1970.

POPULATION TABLE

<u>Year</u>	<u>Worth Township</u>	<u>Boone County</u>	<u>Lebanon</u>	<u>Whitestown</u>	<u>Zionsville</u>
1950	999	23,993	7,631	550	1,536
1960	1,200	27,543	9,523	613	1,822
1970	1,486	30,870	9,766	569	1,857

The population for all other communities, townships, or counties has increased over the past 20 years. Whitestown is the only population indicated at a slight decrease.

Our projections for the Town of Whitestown has not been influenced by the slight decrease in population shown between 1960 and 1970. In our opinion the out migration from the metropolitan area of Indianapolis and Marion County will continue into Boone County in the near future. The Town's location in relation to the Interstate Highway System, and the proximity of Zionsville, Lebanon, and the industrial areas of Marion County, indicate a strong desirable area for future residential development.

The Town Board has retained the services of a planning consultant for the purposes of implementing area and town planning and zoning ordinances. When these studies are complete we believe that a definite trend in area development will be established, resulting in the prediction of better population potentials.

In keeping with the above discussion, we believe that we would be remiss not to recommend a plant improvement that would increase the capabilities of the present water supply and treatment facilities by two times the current capacity. This would furnish the

Town with the resources and treatment capabilities to provide water to the community of at least 1,200 persons.

Existing Supply Facilities

The entire water supply for the Town of Whitestown is furnished from one deep well pump located on the northeast corner of the existing treatment building. This well was placed in service in late 1934, and since that time we can find no record of any maintenance or re-lining to this pump or well.

The well is an 8" diameter tubular well which is approximately 125 1/2 feet deep. The static water level was located at 21 feet below the top of the foundation at the time the well was finished in 1934.

The well pump is a 6" diameter, 12 stage, pump with a 4" discharge column. The pump bowls are set at 170 feet below the pump foundation, and the pump is fitted with a 10 foot length of 4" section pipe with a 4" cone strainer. The overall length from pump base on top of strainer to bottom of cone is 134 feet 6 inches. The pump is rated to discharge 60 gallons per minute when operating against a total dynamic head of 120 feet. The pump is operated by a 1 H.P., 1800 RPM motor.

It is the opinion of this writer, that this single source of supply is the most critical factor in the water supply system. It is recommended that the town should consider the installation of a second well to provide a backup supply of water in the event of a failure of the existing well. The well should be installed on the northeast corner of the treatment building, and should be approximately 125 feet deep. The well should be installed on the northeast corner of the treatment building, and should be approximately 125 feet deep.

The treatment building, which is located on the northeast corner of the town, is a concrete structure which is approximately 100 feet long and 20 feet wide. It contains the pump and the discharge pipe, and is the only building of its kind in the town.

SECTION III

WATER SUPPLY AND TREATMENT

Existing Supply Facilities

The entire water supply for the Town of Whitestown is furnished from one deep well pump located at the northeast corner of the existing treatment building. This well was placed in service in late 1954, and since that time we can find no record of any maintenance or re-building to this pump or well.

The well is an 8" diameter tubular well which is approximately 228 1/2 feet deep. The static water level was located at 21 feet below the top of the foundation at the time the well was finished in 1954.

The well pump is a 6" diameter, 12 stage, pump with a 4" discharge column. The pump bowls are set at 120 feet below the pump foundation, and the pump is fitted with a 10 foot length of 4" suction pipe with a 4" cone strainer. The overall length from pump base to top of strainer is 134 feet 6 inches. The pump is rated to discharge 60 gallons per minute when operating against a total dynamic head of 180 feet. The pump is operated by a 5 H.P., 1800 RPM motor.

It is the opinion of this writer, that this single source of supply is the most critical area of concern of all elements of this system. It is good and recommended practice that any municipal water system be supplied with a minimum of two wells for insuring adequate supply of water at all times. The wells should be so operated as to alternate operation or furnish an operating and stand-by condition. We therefore recommend at least one new well be constructed at a minimum distance of 500 feet beyond the present well and an interconnecting 6" line be installed.

The treatment facilities, all housed within the operating building, consist of an atomerator, air compressor, sand bed iron removal filter, and a hypo-chlorinator. The intended operation of this system was such that the atomerator and air compressor

should inject air into the discharge line of the well pump prior to the water influent into the iron filter. The aeration of the well water was for the purpose of oxidizing and flocculating the iron in the well water, which would then be filtered out on the sand bed of the iron filter. The water would then be chlorinated and discharged to the elevated storage tank for distribution into the system. There are a number of possibilities and/or reasons why the atomerator never accomplished the intended purpose, as well as the operating difficulties of the present iron removal facilities.

Extensive improvements are not planned for the elevated storage tank within the scope of this project. The tank is in generally good condition, however a certain normal and routine maintenance items are now in need. This tank is fitted with an aerator at the top of the tank for the purpose of aerating the water prior to storage in the tank. It is our recommendation that this item be removed from the tank or that the piping be so arranged that the tank can be filled from the bottom without the aeration occurring for the stored water. The tank is most certainly in need of attention in the following areas, it should be drawn down and cleaned thoroughly inside and out and also painted inside and out. The tank leg foundations have begun to deteriorate and these should be chipped away to solid concrete and rebuilt with epoxy and concrete to the original protection of the footings and foundation structure. This work could be done within the proposed contract or could be done from revenues as normal maintenance work on the tank.

The existing storage tank has a capacity of 50,000 gallons and rests upon a steel four leg tower 100 feet above ground to low water. At this time the storage capacity and the well capacity together is not considered an adequate available volume of water for a community of 600 persons. However if a second well can be developed which will furnish additional available capacity, we feel that the Town can forego any additional above ground storage at this time.

The distribution system within the Town of Whitestown is shown on the plan sheet at the back of this report. The system is indicative of a basic elemental system for a community of this size. The existing system is well valved and generally serves the community as required. In our opinion extensive improvements are not needed to the distribution system at this time and it would not be a good recommendation on our part for the Town to expend any additional sums on improvements to distribution system at this time. In our opinion any improvements that are needed to the system can be accomplished as normal maintenance work within the duties of the Water Superintendent.

There has been discussion on the possibility of extending mains to the north and west to serve a few residential users in areas beyond the corporate limits. Our studies in regard to making these extensions indicate that the cost involved would far exceed the income derived from such users at this time. In the future as the adjacent grounds are developed we think these are very reasonable extensions to be made and should be made at that time at the developers expense. Therefore the next item of discussion, proposed improvements, will not include any additional work within the distribution system.

Proposed Improvements

The proposed water works improvements shall be divided into two divisions of work. These shall be: Division A, Water Supply; and Division B, Treatment Facilities. The Division A work shall be limited to the well installation, and the connection to the treatment facilities as now located. The Division B work shall include all expansion and treatment improvements at the current treatment plant and also certain items of work at the elevated water tank.

It is our recommendation that the Division A work include a new 8" diameter well, outfitted with a new 6" pump located approximately 500 feet northwest of the existing

well. We further recommend that every effort be made to obtain a well which will produce in the range of 100 to 120 gpm minimum. The existing pump and motor should be removed from the existing well and the pump should be renovated as required to bring it back to the original operating condition. It may be necessary to provide a higher horse power motor for this pump so as to prevent an overload condition while pumping under the new system heads. The new well and pump shall be connected to the existing system with 500 lineal feet of 6" cast iron pipe. These items should conclude all Division A's work.

The Division B work required for the improvements to the treatment facilities represents extensive work within the present structure and at the treatment site. We consider the following recommendations to be very basic improvements to the treatment facilities.

The existing 3" piping system should be removed and replaced with new 4" piping and valves. The existing filter media within the iron removal filter should be removed and the entire filter cleaned inside and out. New filtering media should be included in the division of work. A second iron removal filter rated for 60 gpm should be installed at this time.

The existing aerator shall be removed from the system as well as the present chemical feed equipment and hypo-chlorination equipment. The existing well pump should be re-piped to discharge into a new aerator instead of direct discharge to the iron filtering system. A new aluminum aerator shall be installed above the new steel retention basin all set on a concrete base. The aerator shall have a capacity of 160 gpm, and the retention basin shall have the holding capacity of 5200 gallons. These two items will be located along the west side of the existing structure.

Two new high service pumps, each rated at 120 gpm, shall be installed within the existing structure. These pumps shall take their suction from the above described retention basin

and shall discharge into the new and existing iron filters. The existing hypochlorinator shall be removed and replaced with a new gas chlorinator and chlorine room.

The above improvements will require the installation of considerable new electrical work. The electrical systems shall provide that the two well pumps operate alternately as well as the two new high service pumps. The well pumps shall be operated from water level within the retention basin, and the high service pumps shall be operated from the water level within the existing elevated storage tank.

One item which has not been mentioned up to this time is the flow meter for metering the water discharge into the system. The existing flow meter shall be removed from the present piping system and reinstalled within the new piping arrangement.

The estimated construction cost for all of the above work as described in Division A and Division B is shown in the following tabulation.

1. High Service Pumps, Overall for Vertical Shafting, 200 gpm	1,200.00
2. New Chlorine Building, Separate Room and Gas Chlorinator	4,200.00
3. 6" Steel Iron Connections to New Well	1,200.00
4. General Construction and Electrical Work	2,100.00
Sub-Total Division B Work	8,700.00
Total Estimated Construction Cost for Division A and Division B Work	27,300.00

ESTIMATE OF CONSTRUCTION COST
DIVISION A - WATER SUPPLY AND
DIVISION B - TREATMENT FACILITIES

Division A - Water Supply

1. New 8" diameter cased Well and Screen	\$ 4,900.00
2. New 6" Well Pump, Shafting, Motor	2,750.00
3. Rebuild Existing Well Pump	<u>1,850.00</u>
Sub-Total Division A Work	\$ 9,500.00

Division B - Treatment Facilities

1. Replace existing 3" piping with new 4" piping and butterfly valves	\$ 2,600.00
2. Existing Iron Removal Filter, Replace existing media, clean the filter and under drains	1,100.00
3. Aeration Equipment, New aluminum aerator with water retention basin and base	9,300.00
4. New Iron Filter	7,000.00
5. High Service Pumps, Install two vertical turbine booster pumps each rated at 60 gpm	3,500.00
6. New Chlorine Facilities, Separate Space and Gas Chlorinators	6,000.00
7. 6" Cast Iron Connections to New Well	2,500.00
8. General Construction and Electrical Work	<u>6,000.00</u>
Sub-Total Division B Work	\$38,000.00

Total Estimated Construction Cost for Division A and Division B Work	\$47,500.00
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SECTION IV
PROJECT FINANCING

Funding

There are several statutes in Indiana enabling towns to collect funds for financing the construction of Water Works projects. Funds may be derived from:

1. Cumulative Building Funds
2. General Obligation Bonds and
3. Revenue Bonds

The funding method which has proven most workable, (therefore, the most popular) is the latter. This section will be developed assuming this procedure for the retirement of the "Revenue Bonds." Revenue Bonds are retired by the application of the income, or revenue, produced by the users of the system. This user charge is based on the metered water sales.

Whitestown is now operating under a recent rate increase granted by the Public Service Commission of Indiana in early 1973. The rate increase now proposed to finance the work as outlined in this report, shall be a straight across the board percentage increase. As discussed in Section I of this report, the only financial analysis presented in this section will be based up on Whitestown receiving an FHA loan. The bond retirement would then be arranged for a 38 year period at a 5% interest rate.

Current Water Rates

The present water rates were approved by the Public Service Commission of Indiana in Cause No. 32960 in the early part of 1973. The following is a tabulation of the current water user rates for Whitestown.

Current Water User Rates*
Whitestown, Indiana

<u>Metered Water Usage Per Month</u>		<u>Rate per 1,000 Gallons</u>
First	2,000 gallons	\$ 2.10
Next	8,000 gallons	.70
Next	10,000 gallons	.63
Next	30,000 gallons	.56
Over	50,000 gallons	.49

Minimum Charge Per Month

5/8 inch meter (2,000 gallons)	\$ 4.20
3/4 inch meter (2,000 gallons)	4.20
1 inch meter	7.00
1-1/2 inch meter	14.00
Hydrant Rental - per annum	\$140.00

The Water Works is now collecting the new rate from all users. From our discussions with the rate consultant and the Clerk-Treasurer we have decided that sufficient history has not yet been developed on this current rate structure to prepare a tabulation of operating receipts. This work will be accomplished by your rate consultant as this project continues.

Annual Operations and Maintenance Budgets

A realistic budget must be established for any business operation. The water works system of even the smallest community is no exception. The initial bonds must be retired, and as stated earlier we expect this to be accomplished at a five percent interest rate over a 38 year period. In current FHA funding programs it is acceptable to reduce the annual bond coverage to 10%. This is a sizeable savings to the community when compared to the normal 25 - 35% bond coverage that would be expected from a conventional bond sale.

*Taken from "Municipal Water Utility, Whitestown, Indiana" as published by McCullough and Associates, January, 1973.

The annual operations and maintenance budget, has a more direct affect on the user rate cost than any other item in the annual revenue requirements. This item of the annual cost shall include salaries for the system operator, billing clerk, part-time help, operations of the system including electrical power and chemicals, maintenance of the system, and miscellaneous cost including taxes, audit, insurance, and telephone. These items are all set out in the following tabulation, annual operations and maintenance budget.

The depreciation allowance is nearly always overlooked, it cannot be excepted from the annual fiscal requirements. No matter what we build today, it will not last forever, and new equipment and materials will be required for replacement. If a depreciation fund is maintained, the next bond issue could be greatly reduced.

Estimated Annual Operations and
Maintenance Budget

Salaries

System Operator	\$3,000.00
Billing Clerk	1,000.00
Part Time Assistant	500.00

Operations

Electric Power	\$1,200.00
Chemicals	200.00
Office Supplies	200.00

Maintenance

Water Supply System	\$ 400.00
Elevated Storage Tank	500.00
Distribution System	500.00

Miscellaneous

Taxes	\$ 250.00
Audit	270.00
Insurance	200.00
Miscellaneous	<u>280.00</u>

ESTIMATED ANNUAL BUDGET

\$8,500.00

Project Cost Analysis

The following project cost analysis is arranged in three tabulations:

1. Estimated Total Project Cost; this tabulation identifies the contingent cost generally encountered for a project of this type. These costs are usually contingent upon the construction amount.
2. Estimated Annual Revenue; this tabulation reflects the general disbursement of receipts and operating expenditures as well as the bonds retirement cost on an annual basis for the operation for the proposed system.
3. Estimated Water User Rates; this tabulation reflects the estimated user rates and the required increases to support the annual revenue required to finance the improvements to the system as proposed in this report. These figures are only estimated figures and your rate consultant will further refine these figures for his presentation to the Public Service Commission of Indiana.

Estimated Total Project Cost

1. Division A - Water Supply	\$ 9,500.00
2. Division B - Treatment Facilities	<u>38,000.00</u>
3. Sub Total - Construction Cost	\$47,500.00
4. Engineering Fee	\$ 5,000.00
5. Construction Inspection	2,500.00
6. Legal and Bond Counsel	4,500.00
7. Public Service Comm. Fee	1,500.00
8. Accounting and Rate Studies	2,500.00
9. Bond Printing	500.00
10. Well Site and Easements	1,500.00
11. Contingency Fund	<u>7,300.00</u>
Estimated Total Project Cost	\$72,800.00

Estimated Annual Revenue

1. Estimated Total Bond Issue	\$72,800.00
2. Bond Retirement (FHA; 5%-38 years)	4,315.00
3. Bond Coverage (10%)	432.00
4. Annual Operations and Maintenance Budget	8,500.00
5. Depreciation Fund	1,200.00
6. Retirement and Coverage of Existing Bonds	<u>6,864.00</u>
7. Estimated Total Annual Revenue Required	\$21,311.00
8. Estimated Current Revenue Income	<u>18,028.00</u>
9. Estimated Increase in Revenue Required	\$ 3,283.00
10. Estimated Percent Rate Increase -- (\$3,283.00 ÷ \$18,028.00)	18%

Estimated Water User Rates

<u>Metered Water Usage</u>		<u>Rate Per 1,000 Gallons</u>		<u>Proposed</u>
<u>Per Month</u>		<u>Present</u>	<u>Proposed</u>	<u>User Bill</u>
First	2,000 Gallons	\$2.10	\$2.48	\$4.96 (Min.)
Next	8,000 Gallons	0.70	0.83	11.60
Next	10,000 Gallons	0.63	0.74	19.00
Next	30,000 Gallons	0.56	0.66	38.80
Over	50,000 Gallons	0.49	0.58	--

Minimum Charge Per Month For:

5/8 inch meter (2,000 Gallons)	\$4.20	\$4.96
3/4 inch meter (2,000 Gallons)	4.20	4.96
1 inch meter	7.00	8.26
1 1/2 inch meter	14.00	16.52
Fire Hydrant Rental per year	\$140.00	\$165.00

SECTION V

ENGINEER'S RECOMMENDATIONS

The following recommendations are based on the foregoing discussions, and from decisions made, during the preparation of this report with the Town Board. It is our intention that these recommendations provide and culminate in a system which serves the best interest of the people of Whitestown.

We recommend that:

1. A new well be developed to provide for a second raw water supply. The capacity of the new well should be a minimum of 150 gpm.
2. The existing well be removed and rebuilt, and integrated into the new system.
3. The existing atomerator be removed from the system and replaced with a new aeration tower and retention basin.
4. The existing iron filter be cleaned and the media be replaced.
5. The existing internal piping be removed and replaced with 4" piping.
6. A new iron filter added to the system.
7. High service pumps be installed for providing pressure to the system.
8. The existing hypo-chlorinator be removed and replaced with a new gas chlorinator in a separate space.
9. The application for FHA financing be completed and submitted to that agency immediately.
10. This report be submitted to the State Board of Health for review and approval prior to proceeding with construction plans.

APPENDIX A

GLOSSARY OF WATER WORKS TERMS

The following glossary is an abridged extract of words and phrases frequently used in water works engineering from "Glossary - Water and Sewage Control Engineering" compiled under the joint sponsorship of American Public Health Association, American Society of Civil Engineers, American Water Works Association and Federation of Sewage Works Associations.

AERATION - The bringing about of intimate contact between air and a liquid by one of the following methods: Spraying the liquid in the air; bubbling air through the liquid; or by agitation of the liquid to promote surface absorption of air.

AERATOR, TRAY - An aerator in which the water enters the top tray of a series of perforated trays of equal areas, and falls as a rain through the air into a lower tray, or collector.

APPURTENANCES, WATER SYSTEM - Structures, devices, and appliances, other than pipe and conduit, which are used in connection with a water distribution system, such as valves, hydrants, corporation cocks, services, etc.

AQUIFER - A geologic formation that is water bearing, and which transmits water from one point to another.

CHLORINATION - The application of chlorine to water, sewage, or industrial wastes, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

CRENOTHRIX - A genus of bacteria characterized by unbranched attached filaments having a gelatinous sheath in which iron is deposited. They precipitate metallic deposits in pipes, etc., which sometimes color the water. They also, after their death, cause disagreeable taste and odor in the water.

DEMAND, FIRE - The quantity of water and rate of flow required for fire fighting purposes based on population, duration of fire, and pressure requirements.

FILTER, PRESSURE - A rapid sand filter of the closed type employing a vertical or horizontal cylinder of iron, steel, or wood, inserted in a pressure line. The rate of filtration is commonly from 2 gal to 4 gal per min per sq ft of filter area.

FILTER, ZEOLITE - In water softening, a filter for removing certain chemical constituents from water by base exchange, where the zeolite takes the place of the filtering medium.

HARDNESS - A characteristic of water, chiefly due to the existence therein of the carbonates and sulfates and occasionally the nitrates and chlorides of calcium, iron, and magnesium, which caused "curdling" of the water when soap is used, an increased consumption of soap, the deposition of scale in boilers, injurious effects in some industrial processes, and sometimes objectionable taste in the water. It is commonly computed from the amounts of calcium and magnesium in the water and expressed as equivalent calcium carbonate.

PUMP, DEEP-WELL - A pump used for lifting water from deep wells, the pumping mechanism usually being installed within the well at a considerable distance below the surface. The pump may be of the reciprocating or centrifugal type.

RESIDUAL, CHLORINE - The quantity of chlorine, in excess of the CHLORINE DEMAND, remaining in water, sewage, or effluents after a selected contact period of time, expressed in parts per million. The difference between the chlorine dose and the chlorine demand.

SCREEN, WELL - A special form of slotted perforated well casing that admits water from an aquifer consisting of unconsolidated granular material, while preventing the granular material from entering the well.

SOFTENING, WATER - The process of removing from water certain mineral substances which produce a condition called HARDNESS. There are two softening processes in general use: CHEMICAL PRECIPITATION and the ZEOLITE PROCESS.

TUBERCULATION - A condition which develops on the interior of pipe lines due to corrosive materials present in the water passing through the pipe and which results in the creation of small, more or less hemispherical lumps (TUBERCULES) on the walls of the pipe, which increase the friction loss and, by reducing the velocity, also reduce the capacity of the pipe.

ZEOLITE - A chemical compound so imperfectly bound together that its composition will change in accordance with the concentration of chemicals in solution in its presence. Zeolites are used in water-softening processes.

