March 6, 2020

Mr. Delane Jackson, Manager
Town of River Bend
45 Shoreline Drive
River Bend, NC 28562

SUBJECT: Preliminary Water System Evaluation
River Bend, North Carolina
Rivers Project No. 2019145

Dear Delane:

You have requested that Rivers & Associates, Inc. conduct a cursory review of the Town of River Bend's water treatment system, and provide our observations and opinion relative to the cause(s) of the periodic emergence of colored water at customer homes.

In separate conversations with you and Brandon Mills, Public Works Director, we understand that when colored water appears, it is red or reddish-brown. We also understand that the appearance of colored water is sporadic and scattered throughout the distribution system. Generally, the Town's response to a customer report of colored water is to flush water from the distribution system in the immediate vicinity of the report.

Background:

On December 11, 2019, Greg Churchill, P.E. of Rivers & Associates, Inc. met with Tommy Harper, ORC to inspect River Bend's existing wells and Water Treatment Plants (WTPs). The Town operates three groundwater wells that supply raw water to two water treatment plants. Each well withdraws groundwater from the Castle Hayne aquifer. Groundwater from the Castle Hayne aquifer is plentiful, but treatment is required for the removal of iron and manganese. Neither iron nor manganese in drinking water presents a health hazard to the general population; however, a small percentage of the population may be affected if they suffer from excess iron retention in the body (hemochromatosis). Castle Hayne water is also hard (high in calcium and magnesium ions) since groundwater is transmitted through the openings and pores in the limestone aquifer formation. We understand that raw groundwater supplying the WTPs have a hardness concentration in the range of approximately 180 – 250 mg/L. The Town of River Bend does not soften the water prior to distribution. Instead, softening is accomplished preferentially by customers on an individual basis through the use of residential water softeners.

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Treatment Plant - Wells #1 and #2 (Entry Point P01):

Wells #1 and #2 feed water to the water treatment facility located at the northeast corner of the intersection of Shoreline Drive and Plantation Drive. Well #1 has a vertical turbine pump with the wellhead housed in a wood frame pump house located immediately in front of the water treatment building. Well #1's 12-hour supply rating is 0.252 MGD. Well #2 has a submersible pump with the wellhead housed in a wood frame pump house located near the entrance to Quarterdeck Townhomes approximately 700 feet from the water treatment plant. Well #2's 12-hour supply rating is 0.285 MGD.

The WTP supplied by Wells #1 and #2 consists of two parallel multi-media filter trains with one filter serving each well. The total capacity of this WTP is 0.60 MGD. Each well pump generates sufficient total dynamic head to supply water from the well, through the filter and face piping, into the distribution system and elevated tanks without need of separate filter or high service pumps. Prior to reaching the filter, raw water is injected with Caustic Soda (sodium hydroxide) for pH adjustment and compressed air (oxygen) to oxidize soluble iron and manganese.

Each multi-media filter contains a layer of anthracite over Birm© sand filter media. Anthracite is commonly used as a medium density filtration media to remove sediment and turbidity from the raw water flow stream. Birm is advertised as an efficient and economical media for the reduction of dissolved iron and manganese compounds from raw water supplies. It is an insoluble catalyst primarily used to enhance the reaction between dissolved oxygen and iron compounds. Birm enhances the oxidation of soluble iron to a precipitate for filtration by the media. Birm can also be used for manganese reduction. For water that contains both iron and manganese, the pH should be in the range of 8.0 – 8.5. No regeneration is required to maintain the condition of the media. The filters are periodically backwashed to remove captured solids from the filter media. Backwash waste is directed to a floor sump for discharge to a buried steel waste holding tank. The steel tank provides a quiescent environment to allow precipitated solids to settle. Duplex submersible pumps are intended to periodically transfer the backwash supernatant to a NPDES permitted surface water discharge point located near the wooden seawall at the community boating canal near Plantation Drive bridge. At the time of the site visit, one of the submersible waste pumps was out of service.

Primary and residual disinfection of filtered water is provided by a gaseous chlorine prior to finished water entering the distribution system.

Treatment Plant - Well #3 (Entry Point P03):

Well #3 feeds water to the water treatment plant located adjacent to the Rhems Fire Department on Shoreline Drive. Well #3 has a submersible pump with the wellhead housed inside the wood frame water treatment building. Well #3's 12-hour supply rating is 0.252 MGD.

The WTP supplied by Well #3 consists of four multi-media filter operating in parallel. The total capacity of this WTP is 0.35 MGD. The well pump produces sufficient total dynamic head to supply water from the well, through the filters and face piping, into the distribution system and elevated tanks without need of separate filter or high service pumps. Prior to reaching the filters, raw water is injected with Caustic Soda (sodium hydroxide) for pH adjustment and oxygen to oxidize soluble iron and manganese.

Each multi-media filter contains a layer of anthracite over Birm© sand filter media similar to the other WTP. Primary and residual disinfection of filtered water is provided by a gas chlorinator prior to finished water entering the distribution system.

The filters are periodically backwashed to remove captured solids from the filter vessel. Backwash waste is directed to a floor sump for discharge to a buried steel waste holding tank. The steel tank provides a quiescent environment to allow precipitated solids to settle. Duplex submersible pumps periodically transfer the backwash supernatant to a NPDES permitted surface water discharge point located in a ditch that is tributary to the community boating canal.

Distribution System:

The Town's distribution system provides consumptive demand and fire flow suppression to approximately 1,462 customers through roughly 19 miles of 2" – 8" diameter pipelines and 108 fire hydrants. Approximately 98% of the pipelines are constructed of PVC with the remainder being Ductile Iron Pipe. Water Storage is provided through two steel, multi-leg elevated water tanks. The older elevated tank is located on the site of the WTP site serving Well #3, and has a capacity of 100,000 gallons. It is shorter in height than the newer tank, and has an altitude valve to prevent overflow. The newer elevated tank is located near the northwest termination of Plantation Drive. It has a capacity of 300,000 gallons for a total system storage capacity of 400,000 gallons.

The 2018 Local Water Supply Plan (LWSP) for River Bend is attached as Appendix A. Per the LWSP, the Town produced approximately 238,000 gpd on an annual average basis. The maximum month production occurred during September, 2018 at 267,000 gpd on an average daily basis. The 2018 maximum daily production also occurred in September at 586,000 gpd.

Current Water Treatment Process:

The Town utilizes a combination of chemical injection and pressure filtration to treat and disinfect their raw groundwater supply prior to distribution. The principle of operation of the treatment process involves the following steps:

- pH Adjustment: The pH of the raw groundwater is in the range of 6.7 – 6.8. In order for the Birm filter media to function most effectively for iron and manganese removal, the pH must be in the range of 8.0 – 8.5. The operator indicates their target pH is 8.0 – 8.3 at 18.5º

C. If pH is outside of the recommended range, then manganese may not be effectively removed, and colloidal iron may be formed which is difficult to filter out. Liquid diaphragm metering pumps are used to inject Caustic Soda (sodium hydroxide) in the raw water piping located ahead of the filters to increase the pH of the water on the filter media. The pumps are activated based on the flow of water from the well. Dosage is manually adjusted at the pump. The effectiveness of Caustic Soda to control pH is somewhat temperature sensitive and subject to manual dosage adjustment.

- Dissolved Oxygen Addition: Compressed air is injected from a vertical electric air compressor into the raw water piping located ahead of the filters in order to increase the dissolved oxygen (D.O.) concentration of the raw water. For optimal operational conditions, Birm media requires the D.O. concentration to be at least equal to 15% of the iron and manganese content. The operator indicates that the target D.O. concentration is 2.50 mg/L. Operation of the air compressor is activated based on the well call-to-run signal. An electric solenoid valve controls air flow into the raw water piping.
- Filtration: The sand filters are pressurized, multi-media filters containing a layer of anthracite over Birm media. As water flows through the Birm media, a chemical reaction occurs between the dissolved oxygen and dissolved ferrous iron compounds to form an insoluble ferric hydroxide. As water containing dissolved iron flows through the media, if there is sufficient dissolved oxygen, the Birm media causes the iron to form rust particles. The rust particles are then trapped in the filter media. Similarly, soluble manganese, if oxidized to manganese dioxide, can be captured by the filter media. Periodically the filter media is backwashed to remove the trapped particles.
- Polyphosphate Addition: Following filtration, polyphosphate is added as a sequestering agent and scale inhibitor. The operators report that AquaMag by Carus is the chemical utilized. As a sequestering agent, the polyphosphate binds with any remaining soluble metals such as iron, manganese, calcium and magnesium to reduce their precipitation in the distribution system. This is intended to control remaining iron and manganese to minimize rusty and dirty water in the system, reduce discoloration, staining, and mineral buildup, and diminish calcium scale deposits. Liquid diaphragm metering pumps are used to inject polyphosphate into the filtered water effluent piping. The pumps are activated based on the well call-to-run signal. Dosage is manually adjusted at the pump.
- Disinfection: Gas chlorine is utilized for primary and residual disinfection of the finished water prior to entering the distribution system. Chlorine is utilized to kill pathogens such as bacteria, viruses and protozoans. A low residual chlorine concentration is maintained throughout the distribution system to prevent recontamination. Dual chlorine cylinders are provided on a cylinder scale located within a dedicated chlorine room. Vacuum regulators and an automatic cylinder switchover module are provided to control the chlorine gas supply. Chlorine gas is supplied to ejectors to automatically draw and regulate chlorine flow to mix with makeup water supplied by filtered water booster pumps dedicated to each treatment train. Operation of the booster pumps and chlorine injection is activated based on the flow of water from each well. Chlorine is a weak acid that reduces the pH of the finished water close to neutral range (7.0 - 7.2).

- Dechlorination: The backwash waste stream from each WTP contains residual chlorine since finished water is utilized to periodically backwash the pressure filters. Sodium bisulfite is employed to provide dechlorination to comply with NPDES surface water discharge permit requirements. Sodium bisulfite is injected into the waste discharge piping via peristaltic hose pumps. The pumps are manually activated during the backwash cycle. Dosage is manually adjusted at the pump.
- Standby Power: All three wells and associated WTP facilities are powered by commercial electricity. However, in the event of a power failure, all three wells and their associated water treatment equipment have backup power supplied by fixed, diesel-fueled generators and auto-transfer switches.
- System Control: The wells and associated WTP equipment have basic electrical control panels integrated with radio-based telemetry communications. The well pumps are operated either automatically or manually based on controls manufactured by Master Level Control Company. Radio telemetry is incorporated to allow monitoring, communications and control between the remote sites. The radio telemetry system was manufactured by Pribusin, Inc. The master level control and telemetry panels for operation of the wells are located at Well #3 with individual control and remote telemetry panels at Wells #1, #2 and the new elevated tank. In automatic mode, well operations are controlled by the water level in the new elevated tank with time delay relays. An altitude valve prevents water from overflowing the older elevated tank which is constructed to a lower overflow elevation than the new tank. Chemical feed systems are controlled electrically based on well start signals. Filter face piping valves are manually operated based on service or filter backwash requirements.

Daily Monitoring Reports:

Twelve consecutive months of the Operator’s daily monitoring reports (DMR) for each WTP were obtained and reviewed for calendar year 2019. The monitoring reports document the volume of water produced and the water quality following treatment at the entry points to the distribution system. The following parameters are routinely monitored and reported as part of daily operations:

- Source Water Pumped (Gallons)
- Free Chlorine (mg/L)
- pH
- Phosphate (mg/L)
- Iron (mg/L)
- Manganese (mg/L)

The following table summarizes average and maximum values recorded for water produced at each WTP for 2019.

	PO1 (Wells 1 &2)		PO3 (Well 3)		SMCL
	Annual Average	Daily Max	Annual Average	Daily Max	
Source Water Pumped (gpd)	173,864	525,000	79,219	411,000	
Free Chlorine (mg/L)	1.06	1.93	1.20	1.84	
pH	7.2	7.5	7.2	7.5	
Phosphate (mg/L)	1.32	2.66	1.27	4.29	
Iron (mg/L)	0.03	0.22	0.03	0.21	0.3
Manganese (mg/L)	0.07	0.14	0.07	0.16	0.05

The monitoring reports indicate that the iron concentration at the system entry points is consistently within the EPA Secondary Maximum Contaminant Limit (SCML). Manganese, however, routinely exceeds the limit.

Raw and Finished Water Sampling Results:

Water Department Staff was unable to provide raw water quality sampling and testing results from prior well sampling. As such, for purposes of this evaluation, Environmental Chemists, Inc. of Wilmington, NC was requested to obtain samples for limited raw and finished water quality testing. Samples were obtained from each raw water well, and at the discharge from each treatment train on February 11, 2020. Testing was conducted for the following parameters:

- Iron
- Manganese
- pH
- Temperature
- Hardness
- Alkalinity

The results of the testing are summarized below:

Parameter	Well #1		Well #2		Well #3	
	Raw	Finished	Raw	Finished	Raw	Finished
Iron (mg/L)	2.20	0.060	2.61	0.13	1.23	<0.060
Manganese (mg/L)	0.063	0.038	0.068	0.044	0.047	0.034
pH	7.26	7.87	7.17	7.69	7.35	7.53
Temperature (^oC)	18.8	18.6	18.5	18.6	18.8	18.3
Hardness	185	217	253	211	189	197
Alkalinity	240	240	240	250	220	240

A full copy of Envirochem's test results are attached as Appendix B.

The limited raw water testing results validate the expected water quality characteristics of the Castle Hayne Aquifer. The groundwater exhibits high concentration for hardness, iron and manganese. The current treatment process appears to significantly reduce the iron concentration with finished water iron concentrations significantly below the SMCL of 0.3 mg/L. Although some reduction of manganese is observed, the finished water results are still very near the SMCL of 0.05 mg/L. The average DMR finished water values for manganese appear to exceed the instantaneous values obtained via Envirochem's testing, as well the EPA SMCL limit. This is likely a function of the less accurate capability of portable field-testing equipment versus laboratory testing. Regardless, the results suggest that the current treatment process is not as effective as other treatment processes for manganese removal. Finally, no municipal softening is provided; therefore, no appreciable reduction in hardness is expected or observed.

Colored Water:

The Town's raw water supply originates from the Castle Hayne aquifer. Groundwater from the Castle Hayne is hard and contains dissolved calcium, magnesium, iron and manganese which are common elements found in the earth's crust. Groundwater that passes through soil and rock dissolves minerals, acquires their metal ions, and holds them in solution. Neither hardness, iron or manganese are hazardous to the general public; however, they can be a nuisance in drinking water systems.

Hard water has a tendency to cause mineral buildup inside water pipes. Calcium and lime deposits, i.e. limescale, is a buildup of calcium bicarbonate which attaches to pipe walls. Although PVC piping does not rust, it is susceptible to scaling. Hot water heaters, dishwashers, coffee makers, etc. can be impacted by the presence of limescale. The high temperature from the heater destabilizes calcium bicarbonate in water causing conversion into calcium carbonate that adheres to the pipe walls, heating elements, etc. Hard water also has a tendency to produce poor lathering/cleaning soaps and detergents with soap scum formed as a byproduct. As noted previously, the Town's WTP facilities do not provide softening capability. As such, hard water is transmitted throughout the public water distribution system.

Iron and manganese also occur naturally in the Castle Hayne aquifer. Iron oxide, i.e. rust, is formed from the presence of iron, water and oxygen. Unlike iron, manganese is not oxidized by air at neutral pH, and is not removed during water treatment processes unless a chemical oxidation step is included.

In the soluble (dissolved) form, the iron and manganese in groundwater is colorless. However, when exposed to air, iron is oxidized and changes from a colorless, dissolved form to a colored, solid precipitate. Oxidation of dissolved iron particles changes the iron to white, then yellow and finally to red-brown solid particles that settle out of the water. Iron that does not form large enough particles to settle out remains suspended and is referred to as colloidal iron. Colloidal iron causes the water to have a red tint. Iron will cause reddish-brown staining of laundry, porcelain, dishes utensils and glassware. Oxidized colloidal manganese causes water to have a black tint. Manganese acts similarly to iron but causes brownish-black staining. Iron and manganese can also affect the flavor of food and water. Manganese produces an objectionable taste when present even in very small concentrations.

The presence of iron and even low levels of manganese in water may result in deposition of iron and manganese oxides within the low points or on the walls of pipelines, tanks, water heaters and water softeners. These deposits can cause restriction of water flow, increased friction loss and periodic flushing or sloughing of solids.

Flushing or sloughing of iron and manganese oxide deposits results in water of poor aesthetic quality which can have a reddish-brown to brown-black color respectively. In addition, undesirable tastes and staining of fixtures, equipment, swimming pools, and laundry may be produced.

EPA Standards for drinking water fall into two categories, Primary Standards and Secondary Standards. Primary Standards are based on health considerations and are designed to protect consumers from pathogens, radioactive elements and toxic chemicals. Secondary Standards are based on aesthetic qualities of taste, odor, color, corrosivity, foaming and staining properties of water. Iron and manganese are both classified under Secondary Maximum Contaminant Levels (SMCL) standards. The SCMLs for iron and manganese in drinking water is 0.3 mg/L and 0.05 mg/L, respectively. Water with less than these concentrations should not normally present an unpleasant taste, odor, appearance or side effect caused by a secondary contaminant.

Iron pipes can also be a source of iron in water. However, the Town's distribution system is comprised almost entirely of PVC pipes, contains minimal quantity of ductile iron pipes, and no cast iron pipes.

This limited evaluation and analysis suggests that the red or reddish-brown water observed at customers' homes appears to be a result of limitations in the current WTP process. Oxidation of iron and manganese with air is cost-effective since there is no chemical cost; however, the oxidation process can be slowed and the reaction has to be quite large if there are high levels of manganese. Also, small changes in water quality may affect the pH of the water and the oxidation rate may slow to a point where the plant capacity for iron and manganese removal is reduced. Additionally, Birm media is not as effective in removing manganese as other types of filter media.

It appears that iron, manganese and calcium that are not completely removed through the treatment process result in deposition/scaling within the distribution system. Periodically, water flow through the distribution piping will cause the deposits to flush out/slough off and appear as colored water at the customers' taps.

Potential Treatment Improvements:

The River Bend water treatment system appears to be a fairly simple treatment process relative to operations and maintenance, which is probably favorable for a relatively small community. Overall, the treatment plants appear to perform well for iron removal. However, the Birm media does not appear to be the optimal media for manganese reduction. Rivers & Associates, Inc. has designed many filter/softener water treatment plants to treat Castle Hayne aquifer water in eastern North Carolina, and we have not seen Birm filter media utilized.

Several treatment alternatives are available which could be expected to improve the finished water quality of River Bend's drinking water. The following is a summary of various options:

A. **Filtration/Softening WTP:** A combination of the following process improvements could be considered to improve the performance of the River Bend water system utilizing filtration and/or softening processes:

   Greensand/Greensand Plus Filtration - One of the first types of filters to be used to treat water containing iron and manganese was the greensand filter. The active material in greensand is glauconite. Glauconite is a green clay mineral that contains iron and has ion exchange properties. The glauconite is mined, washed, screened and treated with various chemicals to produce a durable greenish-black filter media that is able to adsorb soluble iron and manganese. Greensand Plus is an artificially manufactured filter media that has all the same physical properties of manganese greensand.

   As water passes through the greensand filter, soluble iron and manganese are pulled from solution and later react to form insoluble iron and manganese. Regular backwashing, as recommended by the manufacturer, is required to remove the insoluble forms of iron and manganese. In addition, the greensand filter must be regenerated continuously with potassium permanganate. Greensand Plus can be regenerated with chlorine or any strong oxidant. Greensand Plus is more durable than Greensand and can withstand higher differential pressure across the filter, resulting in less frequent backwashing and a lower percentage of backwash waste.

Most greensand filters are rated to be effective treating water with iron concentrations up to 10 mg/l. If the pH of the water is lower than 6.8, the greensand will not filter out the iron and manganese adequately, and the pH must be raised prior to filtration. Backwashing is used to remove particles collected in the filter. Regular backwashing is essential for effective filter performance and requires flow rates that are often three to four times the normal usage rate.

A greensand filter system is considered to be superior to Birm filters for iron and manganese removal, albeit it is more complex and expensive.

Ion Exchange Softening – Ion exchange softening is frequently used in municipal water treatment applications to reduce the hardness associated with raw water such as that from the Castle Hayne aquifer. It is quite common for Castle Hayne water treatment facilities to include both greensand filtration for iron and manganese removal followed by ion exchange softening to reduce hardness. Some raw waters that have lower amounts of iron and manganese can be treated by ion exchange softening only because dissolved iron and manganese can be exchanged for sodium on the anionic exchange resin or zeolite. The process of iron and manganese removal is the same ion exchange process that removes hardness or calcium and magnesium.

In the case of River Bend's raw water, we would not recommend the use of ion exchange softening without first reducing iron and manganese via filtration. As such, ion exchange softening would be employed only if the Town desired to supply softened water directly to the customers in lieu of each customer providing a residential water softener.

The ion exchange softener can be considered a polishing treatment step for iron and manganese removal when following filtration. Residual iron and manganese from the filters can be absorbed during normal operation of the water softeners. Iron, manganese, calcium and magnesium are subsequently removed from the exchange media during the softener regeneration and backwashing steps.

A greensand filter system followed by cationic softening would make for a high-quality water that is capable of consistently meeting secondary limits. Further, it would be expected to practically eliminate the appearance of colored water at the customer taps.

Chlorination (Oxidation) Plus Filtration - Chemical oxidation followed by filtration is a treatment method that can also be employed for iron and manganese removal when concentrations are high.

For this treatment method, chlorine solution is injected with a chemical feed pump ahead of the sand filter. Soluble iron and manganese begin to settle out following contact with the chlorine solution. Approximately 20 minutes of contact time is needed to form particles that can be filtered. Sufficient contact time is typically provided via a detention tank.

This type of system will remove soluble and suspended particles of insoluble iron and manganese from the source water. Backwashing the sand filter to remove precipitated iron and manganese is an important part of continued filtration.

An additional advantage of using the chlorination system is its bactericidal effect. Iron and manganese bacteria, along with other bacteria, are destroyed. Potential clogging problems in the sand filter are eliminated. To our knowledge, River Bend's water wells have not demonstrated significant bacterial contamination like some other eastern North Carolina water supply wells.

A potential disadvantage of the pre-chlorination feed is that disinfection byproducts such as trihalomethanes (THM) and haloacetic acids (HAA) can be produced when organic matter is present in the raw water. THMs and HAAs are considered to be carcinogenic and additional treatment or disinfection methods may need to be employed to maintain levels within primary drinking water standards.

For River Bend, if Greensand/Greensand Plus Filtration was employed, a pre-oxidant feed such as potassium permanganate or chlorine would be required to provide continuous regeneration of the filter media. In addition, a detention tank would be required to provide appropriate reaction time for the oxidant ahead of the filter vessels. The chemical dosage, however, would not likely be of the greater magnitude required for exceptionally high iron and manganese concentrations and/or for the presence of iron and manganese bacteria in the raw groundwater.

If filtration and/or softening were employed to improve the drinking water quality for the Town of River Bend, a single new 1.0 MGD filtration/softening water treatment plant would likely be required. This would entail modifications to the Town's existing well pumps and raw water piping to direct all raw water flow to a new water treatment plant site. The WTP would likely consist of new aeration, pre-oxidant feed system and raw water detention tank to begin oxidation of the soluble iron and manganese. Filter feed pumps would be required to pump flow through the filter and/or softener treatment trains and subsequently into the distribution system and elevated tanks. As a minimum, the filter/softener treatment trains and associated chemical feed systems would need to be housed in a new treatment building. Chemical feed systems may include caustic for pH control, potassium permanganate for continuous regeneration of the filter media, polyphosphate as a corrosion inhibitor, and chlorine for primary and residual disinfection. If chlorine reacted with organic compounds in the raw water supply to create excessive disinfection byproducts, an ammonia feed system may be employed to create chloramines for residual disinfection within the distribution system. New electrical and controls would be utilized for proper monitoring and control of the overall water supply, treatment and distribution of finished water. Backwash/regeneration waste treatment and disposal modifications would also be required.

A detailed cost estimate for such a system is not included within the scope of this preliminary evaluation; however, a ballpark figure is expected to be on the order of $6.5 million. If a $6.5 million loan was secured for 20 years at an interest rate of 3.5%, the monthly debt service equals $37,697. If this cost is spread across 1,462 customers, the average monthly cost per customer equals $25.78.

B. **Nanofiltration WTP:** An alternative to a filtration/softening water treatment plant is nanofiltration. Nanofiltration makes use of partially permeable membranes to separate contaminants at a molecular level from a fresh water supply. Nanofiltration membranes are capable of removing organics, soluble iron, manganese, hardness and other contaminants, and produces a very high-quality drinking water.

   If nanofiltration were utilized in River Bend, a new 1.0 MGD water treatment plant would be required. All of the Town's well pumps would need to be submersible to minimize oxidation and precipitation of iron and manganese which could foul the membranes. A new water treatment plant building would house the cartridge filters, nanofiltration pumps, membrane skids, clean-in-pace system, chemical feed systems, and electrical gear. Chemical feed systems may include caustic for pH control, a scale inhibitor to prevent membrane fouling, calcium carbonate to restore hardness, polyphosphate for corrosion control, and chlorine for primary and residual disinfection. With the nanofiltration process, disinfection byproducts are not of concern since the organic precursors are removed. As such, chlorine is acceptable for disinfection. New electrical and controls would be utilized for proper monitoring and control of the overall water supply, treatment and distribution of finished water. Concentrated waste stream disposal of the membrane reject water would also be required.

The cost of nanofiltration has decreased over time relative to the cost of more traditional filtration and softening. However, we expect the cost for a nanofiltration treatment system may still be 20-25 percent greater than the more traditional filters and softeners. A ballpark figure for a nanofiltration system is $8 million. If an $8 million loan was secured for 20 years at an interest rate of 3.5%, the monthly debt service equals $46,397. If this cost is spread across 1,462 customers, the average monthly cost per customer equals $31.74.

C. **Bulk Water Customer:** An alternate to designing and constructing a new water treatment facility for the Town of River Bend is to consider purchasing bulk potable water from the City of New Bern. The City's WTP is a Filtration and Softening WTP that produces a high-quality drinking water utilizing processes similar to those described in Alternative A above. In addition, the City's distribution system includes an existing 8" water main that extends along US Hwy 17 past the River Bend corporate limits.

Rivers & Associates, Inc. conducted a preliminary hydraulic evaluation in March, 2017 to evaluate a one-way emergency water system interconnect between River Bend and the City of New Bern in the event that the Town lost their well water supply. A copy of the letter report is attached as Appendix C. The evaluation indicated that the existing 8" water main was capable of supplying the current average day demand, but insufficient to supply the current maximum day demand event. As noted in the letter report, the City of New Bern is still working toward design and installation of transmission and elevated water tank improvements to serve the western side of their service area. When complete, those improvements would significantly improve the capability for New Bern to supply River Bend. Additional hydraulic evaluation is warranted to confirm that fire flow demand can be simultaneously met during the maximum day demand event as well.

The cost for the 6" metered interconnect in March, 2017 was estimated at $104,000. In addition, a 6" water main extension was recommended along Old Pollocksville Road to complete the loop with the Efird Boulevard main. The estimated cost in 2017 was $27,500. These two cost estimates today are expected to approximately 15% higher at $120,000 and $32,000, respectively.

The average daily consumption based on the Town of River Bend's 2018 LWSP is approximately 181,000 gpd based on 1,462 residential, commercial and industrial customers.

The City of New Bern's current Water Rates schedule is attached as Appendix D. The following rates are applicable for customers located outside the City of New Bern:

Readiness to Serve Charge – 6" Water Meter = $2,417.12/month
Consumptive Charge = $6.06 per 1,000 gallons (under 10,000 gallons)
Consumptive Charge = $8.18 per 1,000 gallons (over 10,000 gallons)

On this basis, the estimated monthly cost paid to the City of New Bern per customer equals $32.45 computed as follows:

Readiness to Serve =	$2,417.12
First Day Consumptive Charge (First 10,000 gallons) = $6.06 x 10kgal =	$60.60
First Day Consumptive Charge (Over 10,000 gallons) = $8.18 x 171kgal =	$1,398.78
Remainder of Average Month Consumptive Charge = $8.18 x 181kgal x 29.42 days =	$43,558.66
Total Average Monthly Cost =	$47,435.16
Total No. of Customers =	1,462
Estimated Average Consumption Cost per Customer per Month* =	$32.45

* Exclusive of interconnection capital cost financing and other water system operation, maintenance and debt costs.

We hope the information presented herein is helpful. Should you wish to discuss anything further, please feel free to give me a call at (252) 752-4135. Rivers & Associates, Inc. stands ready to assist the Town of River Bend with any of your water system needs.

With best regards,

Gregory J. Churchill, P.E.
President

NORTH CAROLINA PROFESSIONAL SEAL 16744 ENGINEER GREGORY J. CHURCHILL
3-6-2020

Enclosures
cc: Brandon Mills, Public Works Director, w/ enclosure
File 2019145 F w/ enclosure

APPENDIX A

River Bend

2018 ▾

The Division of Water Resources (DWR) provides the data contained within this Local Water Supply Plan (LWSP) as a courtesy and service to our customers. DWR staff does not field verify data. Neither DWR, nor any other party involved in the preparation of this LWSP attests that the data is completely free of errors and omissions. Furthermore, data users are cautioned that LWSPs labeled **PROVISIONAL** have yet to be reviewed by DWR staff. Subsequent review may result in significant revision. Questions regarding the accuracy or limitations of usage of this data should be directed to the water system and/or DWR.

1. System Information

Contact Information

Complete

Water System Name:	River Bend	PWSID:	04-25-113
Mailing Address:	45 Shoreline Drive River Bend, NC 28562	Ownership:	Municipality
Contact Person:	Brandon Mills	Title:	Public Works Director
Phone:	252-638-3540	Cell/Mobile:	--

Distribution System

Line Type	Size Range (Inches)	Estimated % of lines
Ductile Iron	6-8	2.00 %
Polyvinyl Chloride	2-8	98.00 %

What are the estimated total miles of distribution system lines? 19 Miles

How many feet of distribution lines were replaced during 2018? 0 Feet

How many feet of new water mains were added during 2018? 0 Feet

How many meters were replaced in 2018? 0

How old are the oldest meters in this system? 18 Year(s)

How many meters for outdoor water use, such as irrigation, are not billed for sewer services? 6

What is this system's finished water storage capacity? 0.4000 Million Gallons

Has water pressure been inadequate in any part of the system since last update? *Line breaks that were repaired quickly should not be included.* No

Programs

Does this system have a program to work or flush hydrants? Yes, Semi-Annually

Does this system have a valve exercise program? Yes, Annually

Does this system have a cross-connection program? Yes

Does this system have a program to replace meters? Yes

Does this system have a plumbing retrofit program? No

Does this system have an active water conservation public education program? Yes

Does this system have a leak detection program? No

Water Conservation

What type of rate structure is used? Uniform

How much reclaimed water does this system use? 0.0000 MGD For how many connections? 0

Does this system have an interconnection with another system capable of providing water in an emergency? No

2. Water Use Information

Service Area

Sub-Basin(s)	% of Service Population	County(s)	% of Service Population
Trent River (10-3)	100 %	Craven	100 %

What was the year-round population served in 2018? 2,871

Has this system acquired another system since last report? No

Water Use by Type

Type of Use	Metered Connections	Metered Average Use (MGD)	Non-Metered Connections	Non-Metered Estimated Use (MGD)
Residential	1,450	0.1320	0	0.0000
Commercial	11	0.0120	0	0.0000
Industrial	1	0.0110	0	0.0000
Institutional	0	0.0000	0	0.0000

How much water was used for system processes (backwash, line cleaning, flushing, etc.)? 0.0450 MGD

3. Water Supply Sources

Monthly Withdrawals & Purchases

	Average Daily Use (MGD)	Max Day Use (MGD)		Average Daily Use (MGD)	Max Day Use (MGD)		Average Daily Use (MGD)	Max Day Use (MGD)
Jan	0.2490	0.4590	May	0.2310	0.3620	Sep	0.2670	0.5860
Feb	0.1990	0.3530	Jun	0.2370	0.3630	Oct	0.2480	0.5030
Mar	0.2100	0.3630	Jul	0.2560	0.4050	Nov	0.2380	0.3390
Apr	0.2380	0.4860	Aug	0.2410	0.3640	Dec	0.2390	0.3080

Ground Water Sources

Name or Number	Average Daily Withdrawal (MGD)		Max Day Withdrawal (MGD)	12-Hour Supply (MGD)	CUA Reduction	Year Offline	Use Type
	MGD	Days Used					
Well#1	0.1200	361	0.404	0.2520	CUA0		Regular
Well#2	0.0510	353	0.214	0.2850	CUA0		Regular
Well#3	0.0570	363	0.229	0.2520	CUA0		Regular

Ground Water Sources (continued)

Name or Number	Well Depth (Feet)	Casing Depth (Feet)	Screen Depth (Feet)		Well Diameter (Inches)	Pump Intake Depth (Feet)	Metered?
			Top	Bottom			
Well#1	105	77			8	85	Yes
Well#2	110	81	0	0	6	65	Yes
Well#3	103	90	0	0	8	85	Yes

Are ground water levels monitored? Yes, Monthly

Does this system have a wellhead protection program? Yes

Water Treatment Plants

Plant Name	Permitted Capacity (MGD)	Is Raw Water Metered?	Is Finished Water Ouput Metered?	Source
River Bend WTP	0.3500	Yes	No	Well #3
River Bend WTP	0.6000	Yes	No	Wells 1 and 2

Did average daily water production exceed 80% of approved plant capacity for five consecutive days during 2018? No

If yes, was any water conservation implemented?

Did average daily water production exceed 90% of approved plant capacity for five consecutive days during 2018? No

If yes, was any water conservation implemented?

Are peak day demands expected to exceed the water treatment plant capacity in the next 10 years? No

4. Wastewater Information

Monthly Discharges

	Average Daily Discharge (MGD)		Average Daily Discharge (MGD)		Average Daily Discharge (MGD)
Jan	0.1700	May	0.1380	Sep	0.1920
Feb	0.1570	Jun	0.1440	Oct	0.1410
Mar	0.1480	Jul	0.1510	Nov	0.1590
Apr	0.1460	Aug	0.1680	Dec	0.1740

How many sewer connections does this system have? 930

How many water service connections with septic systems does this system have? 497

Are there plans to build or expand wastewater treatment facilities in the next 10 years? No

Wastewater Permits

Permit Number	Permitted Capacity (MGD)	Design Capacity (MGD)	Average Annual Daily Discharge (MGD)	Maximum Day Discharge (MGD)	Receiving Stream	Receiving Basin
NC0030406	0.3300	0.3300	0.1380		Trent River	Trent River (10-3)
NC0086797	0.0270	0.0270	0.0200		Plantation Canal	Trent River (10-3)

5. Planning

Projections

	2018	2020	2030	2040	2050	2060
Year-Round Population	2,871	2,873	2,901	2,930	2,959	2,988
Seasonal Population	0	0	0	0	0	0
Residential	0.1320	0.1322	0.1334	0.1348	0.1361	0.1374
Commercial	0.0120	0.0122	0.0123	0.0124	0.0126	0.0127
Industrial	0.0110	0.0111	0.0112	0.0113	0.0114	0.0116
Institutional	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
System Process	0.0450	0.0430	0.0500	0.0550	0.0600	0.0650
Unaccounted-for	0.0247	0.0253	0.0269	0.0287	0.0302	0.0308

Demand v/s Percent of Supply

	2018	2020	2030	2040	2050	2060
Surface Water Supply	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ground Water Supply	0.7890	0.7890	0.7890	0.7890	0.7890	0.7890
Purchases	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Future Supplies		0.0000	0.0000	0.0000	0.0000	0.0000
Total Available Supply (MGD)	0.7890	0.7890	0.7890	0.7890	0.7890	0.7890
Service Area Demand	0.2247	0.2238	0.2338	0.2422	0.2503	0.2575
Sales	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Future Sales		0.0000	0.0000	0.0000	0.0000	0.0000
Total Demand (MGD)	0.2247	0.2238	0.2338	0.2422	0.2503	0.2575
Demand as Percent of Supply	28%	28%	30%	31%	32%	33%

The purpose of the above chart is to show a general indication of how the long-term per capita water demand changes over time. The per capita water demand may actually be different than indicated due to seasonal populations and the accuracy of data submitted. Water systems that have calculated long-term per capita water demand based on a methodology that produces different results may submit their information in the notes field.

Your long-term water demand is 46 gallons per capita per day. What demand management practices do you plan to implement to reduce the per capita water demand (i.e. conduct regular water audits, implement a plumbing retrofit program, employ practices such as rainwater harvesting or reclaimed water)? If these practices are covered elsewhere in your plan, indicate where the practices are discussed here.

Are there other demand management practices you will implement to reduce your future supply needs?

What supplies other than the ones listed in future supplies are being considered to meet your future supply needs?

How does the water system intend to implement the demand management and supply planning components above?

Additional Information

Has this system participated in regional water supply or water use planning? No

What major water supply reports or studies were used for planning?

Please describe any other needs or issues regarding your water supply sources, any water system deficiencies or needed improvements (storage, treatment, etc.) or your ability to meet present and future water needs. Include both quantity and quality considerations, as well as financial, technical, managerial, permitting, and compliance issues:

envirochem
ANALYTICAL & CONSULTING CHEMISTS

Environmental Chemists, Inc.

6602 Windmill Way, Wilmington, NC 28405 • 910.392.0223 Lab • 910.392.4424 Fax
710 Bowsertown Road, Manteo, NC 27954 • 252.473.5702 Lab/Fax
255-A Wilmington Highway, Jacksonville, NC 28540 • 910.347.5843 Lab/Fax
info@environmentalchemists.com

APPENDIX B

Town of River Bend
45 Shoreline Drive
New Bern NC 28562
Attention: Brandon Mills

Date of Report: Feb 20, 2020
Customer PO #:
Customer ID: 12110004
Report #: 2020-02397
Project ID: Water Quality Samples

Lab ID	Sample ID: Raw	Collect Date/Time	Matrix	Sampled by
20-05857	Site: Well 3	2/11/2020 9:55 AM	DW	Connie Branch

Test	Method	Results	Date Analyzed
Iron	EPA 200.7	1.23 mg/L	02/12/2020
Manganese	EPA 200.8	0.047 mg/L	02/12/2020
Alkalinity	SM 2320B	220 mg/L	02/20/2020
Total Hardness	SM 2340 C	189 mg/L	02/19/2020

Lab ID	Sample ID: Finish	Collect Date/Time	Matrix	Sampled by
20-05858	Site: Well 3	2/11/2020 10:00 AM	DW	Connie Branch

Test	Method	Results	Date Analyzed
Iron	EPA 200.7	<0.060 mg/L	02/12/2020
Manganese	EPA 200.8	0.034 mg/L	02/12/2020
Alkalinity	SM 2320B	240 mg/L	02/20/2020
Total Hardness	SM 2340 C	197 mg/L	02/19/2020

Lab ID	Sample ID: Raw	Collect Date/Time	Matrix	Sampled by
20-05859	Site: Well 1	2/11/2020 10:05 AM	DW	Connie Branch

Test	Method	Results	Date Analyzed
Iron	EPA 200.7	2.20 mg/L	02/12/2020
Manganese	EPA 200.8	0.063 mg/L	02/12/2020
Alkalinity	SM 2320B	240 mg/L	02/20/2020
Total Hardness	SM 2340 C	185 mg/L	02/19/2020

envirochem (SM)
ANALYTICAL & CONSULTING CHEMISTS

Environmental Chemists, Inc.

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710 Bowsertown Road, Manteo, NC 27954 • 252.473.5702 Lab/Fax
255-A Wilmington Highway, Jacksonville, NC 28540 • 910.347.5843 Lab/Fax
info@environmentalchemists.com

Town of River Bend
45 Shoreline Drive
New Bern NC 28562
Attention: Brandon Mills

Date of Report: Feb 20, 2020
Customer PO #:
Customer ID: 12110004
Report #: 2020-02397
Project ID: Water Quallity Samples

Lab ID	**Sample ID:** Finish	**Collect Date/Time**	**Matrix**	**Sampled by**
20-05860	**Site:** Well 1	2/11/2020 10:05 AM	DW	Connie Branch

Test	**Method**	**Results**	**Date Analyzed**
Iron	EPA 200.7	0.060 mg/L	02/12/2020
Manganese	EPA 200.8	0.038 mg/L	02/12/2020
Alkalinity	SM 2320B	240 mg/L	02/20/2020
Total Hardness	SM 2340 C	217 mg/L	02/19/2020

Lab ID	**Sample ID:** Raw	**Collect Date/Time**	**Matrix**	**Sampled by**
20-05861	**Site:** Well 2	2/11/2020 10:15 AM	DW	Connie Branch

Test	**Method**	**Results**	**Date Analyzed**
Iron	EPA 200.7	2.61 mg/L	02/17/2020
Manganese	EPA 200.8	0.068 mg/L	02/12/2020
Alkalinity	SM 2320B	240 mg/L	02/20/2020
Total Hardness	SM 2340 C	253 mg/L	02/19/2020

Lab ID	**Sample ID:** Finish	**Collect Date/Time**	**Matrix**	**Sampled by**
20-05862	**Site:** Well 2	2/11/2020 10:15 AM	DW	Connie Branch

Test	**Method**	**Results**	**Date Analyzed**
Iron	EPA 200.7	0.130 mg/L	02/12/2020
Manganese	EPA 200.8	0.044 mg/L	02/12/2020
Alkalinity	SM 2320B	250 mg/L	02/20/2020
Total Hardness	SM 2340 C	211 mg/L	02/19/2020

Comment:

Reviewed by: Marioke Alejanz

Environmental Chemist, Inc., Wilmington, NC Lab #94

6602 Windmill Way
Wilmington, NC 28405
910.392.0223

Sample Receipt Checklist

Client: RIVER BEND Date: 2/11/20 Report Number: 20-02397

Receipt of sample:	Delivered ☒	UPS ☐ FedEx ☐	Other ☐
☐ YES	☐ NO	☒ N/A	1. Were custody seals present on the cooler?
☐ YES	☐ NO	☒ N/A	2. If custody seals were present, were they intact/unbroken?
Original temperature upon receipt ______ ºC		Corrected temperature upon receipt ______ ºC	
How temperature taken:	☐ Temperature Blank	☒ Against Bottles	
IR Gun ID: Thomas Traceable S/N 192511657		IR Gun Correction Factor °C: 0.0	
☐ YES	☐ NO		3. If temperature of cooler exceeded 6°C, was Project Mgr./QA notified?
☒ YES	☐ NO		4. Were proper custody procedures (relinquished/received) followed?
☒ YES	☐ NO		5. Were sample ID's listed on the COC?
☒ YES	☐ NO		6. Were samples ID's listed on sample containers?
☒ YES	☐ NO		7. Were collection date and time listed on the COC?
☒ YES	☐ NO		8. Were tests to be performed listed on the COC?
☒ YES	☐ NO		9. Did samples arrive in proper containers for each test?
☒ YES	☐ NO		10. Did samples arrive in good condition for each test?
☒ YES	☐ NO		11. Was adequate sample volume available?'
☒ YES	☐ NO		12. Were samples received within proper holding time for requested tests?
☒ YES	☐ NO		13. Were acid preserved samples received at a pH of <2? *
☐ YES	☐ NO		14. Were cyanide samples received at a pH >12?
☐ YES	☐ NO		15. Were sulfide samples received at a pH >9?
☐ YES	☐ NO		16. Were NH3/TKN/Phenol received at a chlorine residual of <0.5 m/L? **
☐ YES	☐ NO		17. Were Sulfide/Cyanide received at a chlorine residual of <0.5 m/L?

* TOC/Volatiles are pH checked at time of analysis and recorded on the benchsheet.

** Bacteria samples are checked for Chlorine at time of analysis and recorded on the benchsheet.

Sample Preservation: (Must be completed for any sample(s) incorrectly preserved or with headspace)

Sample(s) ____________ were received incorrectly preserved and were adjusted accordingly

by adding (circle one): H_2SO_4 HNO_3 HCl NaOH

Time of preservation: ________ If more than one preservative is needed, notate in comments below

Note: Notify customer service immediately for incorrectly preserved samples. Obtain a new sample or notify the state lab if directed to analyzed by the customer. Who was notified, date and time: ____________

Volatiles Sample(s) ____________ were received with headspace

COMMENTS:

envirochem
Analytical & Consulting Chemists

ENVIRONMENTAL CHEMISTS, INC

NCDENR: DWQ CERTIFICATION # 94 NCDHHS: DLS CERTIFICATION # 37729

6602 Windmill Way Wilmington, NC 28405
OFFICE: 910-392-0223 FAX 910-392-4424
info@environmentalchemists.com

COLLECTION AND CHAIN OF CUSTODY

Client: Town of River Bend	PROJECT NAME: Water Quality Samples	REPORT NO: 20-02397
ADDRESS:	CONTACT NAME: Brandon Mills, ORC	PO NO:
	REPORT TO: Greg Churchill, PE (Rivers)	PHONE/FAX:
	COPY TO:	gchurchill@riversandassociates.com

Sampled By:

SAMPLE TYPE: I = Influent, E = Effluent, W = Well, ST = Stream, SO = Soil, SL = Sludge, Other:

Sample Identification	Collection Date	Collection Time	Collection Temp	Sample Type	Composite or Grab	Container (P or G)	Chlorine mg/L	LAB ID NUMBER	NONE	HCL	H2SO4	HNO3	NAOH	THIO	OTHER	ANALYSIS REQUESTED
3 RAW Well: pH: 7.35	2/11/20	0955	18.8°C		C	P		05857				<2 pH				7.35
					G	G			X			X				Fe,Mn,Hardness,Alkalinity
3 Finish Finished: pH: 7.53	2/11/20	1000	18.30°C		C	P		05858				<2 pH				7.53
					G	G			X			X				Fe,Mn,Hardness,Alkalinity
1 RAW Well: pH: 7.26	2/11/20	1005	18.80°C		C	P		05859				<2 pH				
					G	G			X			X				Fe,Mn,Hardness,Alkalinity
1 Finish Finished: pH: 7.87	2/11/20	1005	18.60°C		C	P		05860				<2 pH				
					G	G			X			X				Fe,Mn,Hardness,Alkalinity
RAW 2 7.17 Well: pH:	2/11/20	1015	18.50°C		C	P		05861				<2 pH				
					G	G			X			X				Fe,Mn,Hardness,Alkalinity
Finish 2 Finished: pH: 7.69	2/11/20	1015	18.60°C		C	P		05862				<2 pH				
					G	G			X			X				Fe,Mn,Hardness,Alkalinity
					C	P										
					G	G										
					C	P										
					G	G										

Transfer	Relinquished By:	Date/Time	Received By:	Date/Time
1.				2/11/2020 1020
2.				

Temperature when Received: 4.2°C Accepted: ✓ Rejected: Resample Requested:

Delivered By: Received By: Date: 2/11/20 Time: 3:45

Comments: TURNAROUND:

March 9, 2017

Mr. Delane Jackson, Town Manager
Town of River Bend
45 Shoreline Drive
River Bend, North Carolina 28562

SUBJECT: River Bend – New Bern Emergency Water System Interconnect
Budgetary Estimates

Dear Delane:

Attached are three Preliminary Opinions of Probable Project Cost to design and construct an emergency interconnect between the water systems of the City of New Bern and the Town of River Bend. The interconnect would be a "one-way" interconnect for the purpose of supplying potable water to the Town of River Bend from the City of New Bern in the event that River Bend temporarily lost their well water supply.

Preliminary hydraulic evaluation indicates that the interconnection would beneficially supply the Town of River Bend during a current average day demand scenario. During a current maximum day demand event, however, the City of New Bern would not be able to supply River Bend's additional demand. This is principally due to the lengthy distance between the City's existing elevated water storage tanks and the additional demand imposed by the customers of New Bern and River Bend during a maximum day demand event.

The City of New Bern is currently in the design phase for transmission and elevated water storage improvements to serve the western side of their service area. These improvements will significantly improve the capability for New Bern to successfully serve River Bend during an emergency shortage under current and future average day and maximum day demand scenarios.

We have provided cost estimates for two options relative to the emergency water interconnection:

(1) 4" compound meter which is capable of supplying and metering flow at present and for the near future. The estimated project cost for this option is $99,000.
(2) 6" compound meter which is capable of supplying and metering flows for the current and distant future as estimated in the Town's 2015 Local Water Supply Plan. The estimated cost for this option is $104,000.

Attached are sketch plans to indicate the proposed locations and arrangement for the interconnection. The valve vault is proposed for location on a residual property currently owned by Henry Stilley, Jr. at the corner of US Hwy 17 and East Church Road. The proposed 8" interconnecting water main would be tapped from the City's existing 8" water main on US Hwy

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17, extend through the proposed meter/check valve vault located on the Stilley property, and then extend along the Hwy 17 right of way to the Town's existing 6" main located in the Barbara Drive right of way.

We have also observed that only a single water supply main exists along Efird Boulevard to supply River Bend during an emergency event. It would be further advantageous during an emergency water shortage event to have a second 6" water main extending along Old Pollocksville Road to complete the loop with the Efird Blvd main. We have included an Preliminary Opinion of Probable Cost for this item as an adder to the primary interconnect project. The estimated cost for this work is $27,500.

We recognize that these costs are greater than what you and Jordan Hughes, City Engineer of New Bern, have previously discussed. However, we have a high level of confidence that our estimates are representative of today's costs as we have obtained preliminary pricing from a reputable supplier and contractor.

We will be happy to discuss this further at your earliest convenience, and will appreciate the opportunity to work with the Town of River Bend on this project. Should you have any questions, please feel free to call.

With best regards,

Gregory J. Churchill, P.E.
President

Cc: Brandon Mills w/ enclosures
File w/ enclosures

Rivers & ASSOCIATES, INC.

ENGINEERS PLANNERS SURVEYORS LANDSCAPE ARCHITECTS

PRELIMINARY OPINION OF PROBABLE PROJECT COST

Town of River Bend
River Bend - New Bern Interconnect (4" Compound Meter)
March 8, 2017

ITEM NO.	QTY.	UNIT	DESCRIPTION		EST. UNIT COST		ESTIMATED COST
1.	1	LS	Mobilization			$	5,000
2.	1	EA	8" Tapping Tee & Valve	$	3,750	$	3,750
3.	1500	LB	Mechanical Joint Fittings	$	9.00	$	13,500
4.	2	EA	Thrust Collars	$	625	$	1,250
5.	1	EA	8" Gate Valve and Accessories	$	1,500	$	1,500
6.	1	EA	6" Gate Valve and Accessories	$	1,200	$	1,200
7.	1	LS	Asphalt Replacement	$	2,100	$	2,100
8.	1	LS	Meter Vault, 4" Compound Meter and Associated Piping	$	23,500	$	23,500
9.	1	LS	Clearing and Site Work	$	1,000	$	1,000
10.	400	LF	8" C-900 PVC	$	35.00	$	14,000
11.	60	LF	8" RJDIP	$	60.00	$	3,600
12.	1	LS	Testing Allowance	$	1,000	$	1,000
13.	50	LF	Silt Fence	$	3.00	$	150
14.	1	EA	Temporary Rock Check Dam	$	250	$	250
			Subtotal - Construction			$	71,800
			Contingencies @ 10% +/-			$	7,200
			Technical Services:				
			Hydraulic Evaluation	$	1,000		
			Preliminary/Final Design & Permitting	$	8,000		
			Informal Bid	$	3,000		
			Construction Administration/Part-time Inspection	$	6,000		
			Additional Services - Easement Survey	$	2,000		
			Subtotal Technical Services			$	20,000
			Preliminary Opinion of Probable Project Cost			$	99,000

107 E. Second Street, Greenville, NC 27858 ▪ PO Box 929, Greenville, NC 27835 ▪ Phone: 252-752-4135 ▪ Fax: 252-752-3974
NCBELS Lic. No. F-0334 www.riversandassociates.com NCBOLA Lic. No. C-312

Rivers & ASSOCIATES, INC.

ENGINEERS PLANNERS SURVEYORS LANDSCAPE ARCHITECTS

PRELIMINARY OPINION OF PROBABLE PROJECT COST

Town of River Bend
River Bend - New Bern Interconnect (6" Compound Meter)
March 8, 2017

ITEM NO.	QTY.	UNIT	DESCRIPTION	EST. UNIT COST	ESTIMATED COST
1.	1	LS	Mobilization		$ 5,000
2.	1	EA	8" Tapping Tee & Valve	$ 3,750	$ 3,750
3.	1500	LB	Mechanical Joint Fittings	$ 9.00	$ 13,500
4.	2	EA	Thrust Collars	$ 625	$ 1,250
5.	1	EA	8" Gate Valve and Accessories	$ 1,500	$ 1,500
6.	1	EA	6" Gate Valve and Accessories	$ 1,200	$ 1,200
7.	1	LS	Asphalt Replacement	$ 2,100	$ 2,100
8.	1	LS	Meter Vault, 6" Compound Meter and Associated Piping	$ 28,000	$ 28,000
9.	1	LS	Clearing and Site Work	$ 1,000	$ 1,000
10.	400	LF	8" C-900 PVC	$ 35.00	$ 14,000
11.	60	LF	8" RJDIP	$ 60.00	$ 3,600
12.	1	LS	Testing Allowance	$ 1,000	$ 1,000
13.	50	LF	Silt Fence	$ 3.00	$ 150
14.	1	EA	Temporary Rock Check Dam	$ 250	$ 250
			Subtotal - Construction		$ 76,300
			Contingencies @ 10% +/-		$ 7,700
			Technical Services:		
			Hydraulic Evaluation	$ 1,000	
			Preliminary/Final Design & Permitting	$ 8,000	
			Informal Bid	$ 3,000	
			Construction Administration/Part-time Inspection	$ 6,000	
			Additional Services - Easement Survey	$ 2,000	
			Subtotal Technical Services		$ 20,000
			Preliminary Opinion of Probable Project Cost		$ 104,000

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Rivers & Associates, Inc.
ENGINEERS PLANNERS SURVEYORS LANDSCAPE ARCHITECTS

PRELIMINARY OPINION OF PROBABLE PROJECT COST
(ADDER TO INTERCONNECT ESTIMATE)

Town of River Bend
River Bend - New Bern Interconnect
6" Water Main Extension - Old Pollocksville Road
March 8, 2017

ITEM NO.	QTY.	UNIT	DESCRIPTION		EST. UNIT COST		ESTIMATED COST
1.	520	LF	6" C900 PVC		27.50	$	14,300
2.	2	EA	6" Gate Valves and Accessories		1,050	$	2,100
3.	250	LB	Fittings		9.00	$	2,250
4.	1	LS	Testing Allowance	$	500	$	500
5.	50	LF	Silt Fence	$	3.00	$	150
6.	1	EA	Temporary Rock Check Dam	$	250	$	250
			Subtotal - Construction			$	19,550
			Contingencies @ 10% +/-			$	1,950
			Additional Technical Services:				
			Hydraulic Evaluation	$	0		
			Preliminary/Final Design & Permitting	$	2,000		
			Informal Bid	$	0		
			Construction Administration/Part-time Inspection	$	4,000		
			Additional Services - Easement Survey	$	0		
			Subtotal Additional Technical Services			$	6,000
			Preliminary Opinion of Probable Project Cost (Adder to Interconnect Cost Estimate)			$	27,500

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NCBELS Lic. No. F-0334 www.riversandassociates.com NCBOLA Lic. No. C-312

RIVERS AND ASSOCIATES, INC.
Engineers/Planners/Surveyors
107 E. 2ND ST GREENVILLE, NC 27858
P.O. BOX 929 GREENVILLE, NC 27858
(252) 752-4135 Fax (252) 752-3974

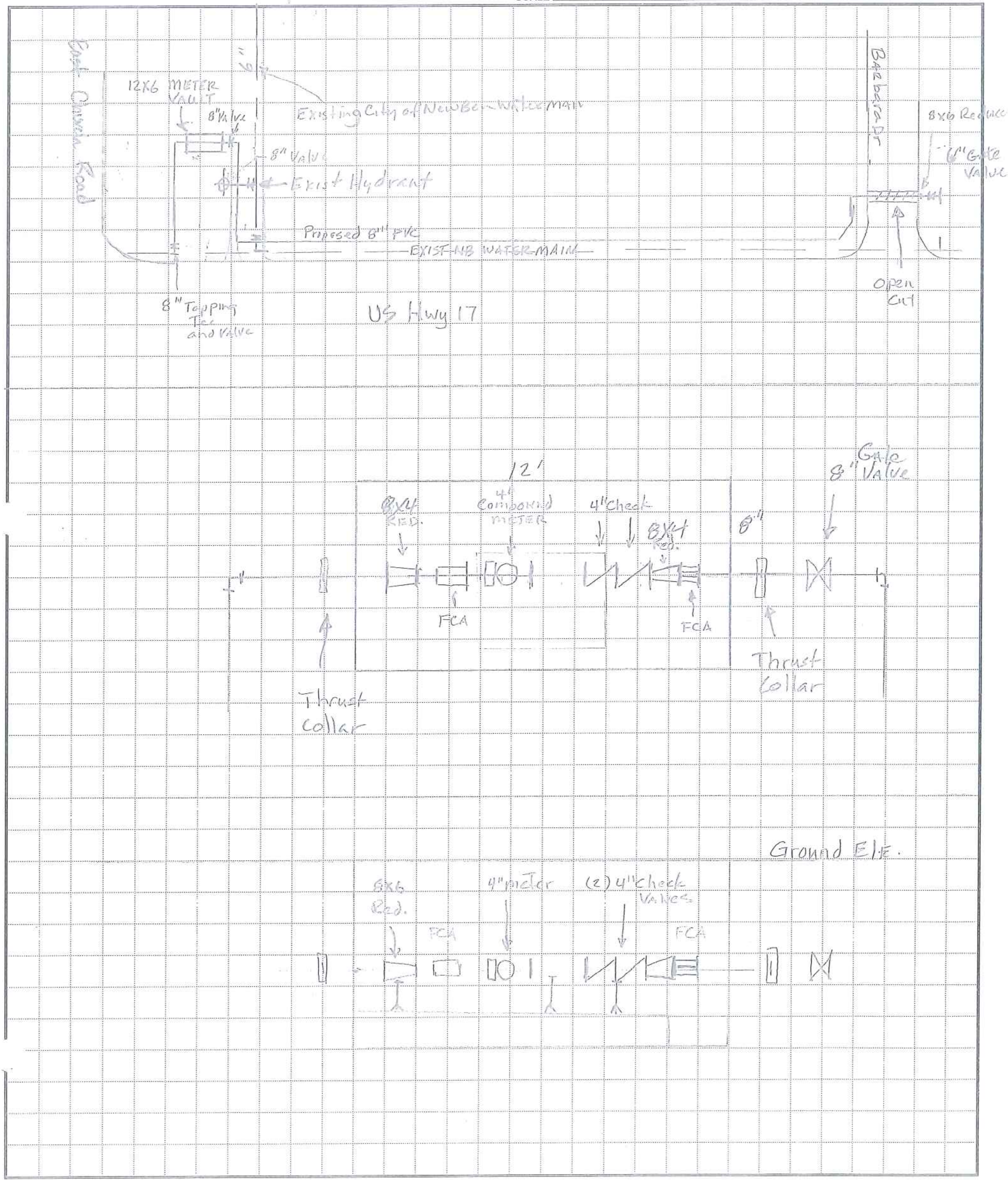
JOB River Bend/New Bern Meter Vault

SHEET NO. 1 OF 1

CALCULATED BY GS DATE 3-3-17

CHECKED BY GC DATE 3-9-17

SCALE NTS

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AN ORDINANCE TO RESTATE THE SCHEDULE OF WATER RATES APPLICABLE TO CUSTOMERS OF THE CITY OF NEW BERN

BE IT ORDAINED BY THE BOARD OF ALDERMEN OF THE CITY OF NEW BERN:

Section 1. That there is hereby established, as one component of the water rates to be charged all water customers of the City of New Bern, monthly readiness-to-serve charges, based on the customer's water meter size and the customer's location: i.e. within or without the City of New Bern, as follows:

Effective with all billing beginning July 1, 2015

METER SIZE	INSIDE THE CITY OF NEW BERN	OUTSIDE THE CITY OF NEW BERN
5/8" & 3/4"	$21.62	$43.24
1" & 1 ¼"	$54.05	$108.10
1 ½"	$108.10	$216.20
2"	$172.96	$345.92
3"	$356.73	$713.46
4"	$590.23	$1,180.45
6"	$1,208.56	$2,417.12
8"	$1,826.89	$3,653.78
10"	$2,793.30	$5,586.61

Section 2. That there are hereby established, as the second component of water rates to be charged all water customers of the City of New Bern, monthly commodity charges, i.e., rates per thousand gallons of water use, as follows:

Effective with all billing beginning July 1, 2015

Water Customers Located within the City Limits of the City of New Bern.	**$3.03**	**per 1,000 gallons (under 10,000 gallons)**
Water Customers Located within the City Limits of the City of New Bern.	**$4.09**	**per 1,000 gallons (over 10,000 gallons)**
Water Customers Located outside the City Limits of the City of New Bern.	**$6.06**	**per 1,000 gallons (under 10,000 gallons)**
Water Customers Located outside the City Limits of the City of New Bern.	**$8.18**	**per 1,000 gallons (over 10,000 gallons)**

Section 3. All contract rate terms which are based on the in-city rates are hereby changed in accordance with the terms of the contract and with the changes approved herein.

Section 4. That all Ordinances and Resolution heretofore adopted by the Board of Aldermen in fixing water rates to be charged to customers of the City of New Bern which are in conflict with the rates herein set forth be, and the same are hereby repealed.

Section 5. That this Ordinance shall be in full force and effect as of July 1, 2015.

ADOPTED THIS 23RD DAY OF JUNE, 2015

Dana E. Outlaw

Mayor

Brenda E. Blanco

Deputy City Clerk