SECONDARY WATER QUALITY TREATMENT SYSTEM REQUEST
Bayleaf Farms Well #1
NC 03-92-373
WSF ID No: P54
AQUA NORTH CAROLINA, INC.

A. EXECUTIVE SUMMARY

The Bayleaf Master Water System is comprised of 125 approved and active wells. Bayleaf Farms (BF) Well #1 is a single point of entry into the distribution system. **The latest Mn concentration at Bayleaf Farms Well #1 is 0.348 mg/L which makes it one of Aqua's Group 1 Priority Secondary Water Quality Projects as per the latest Water Quality Plan.** Based on studies performed by AWWA and other organizations, elevated concentrations of Mn are being linked to cause adverse health effects. Preliminary engineering studies indicate that Manganese Dioxide filtration is the most effective and permanent solution since it physically removes Fe and Mn. Loading rates are normalized based on a 12-hour per day well runtime.

Aqua proposes installing an oxidation-filtration system at Bayleaf Farms Well #1 in order to remove Fe/Mn below the sMCLs.

Installing an interconnect with a local municipality to supply system demand with purchased water (PW) versus installing a filter at well #1 is not a viable alternative given the magnitude of the Bayleaf master system demand. Moreover, Aqua has previously analyzed the PW alternative for systems of this magnitude and filtration is always preferable to PW in this situation.

Capex and Opex estimates are given below in Section D.2.

PROPOSED SYSTEM REQUIRING TREATMENT

1. System Name: Bayleaf Master-Bayleaf Farms Well #1
2. PWS ID: NC 03-92-373
3. No. Active Residential Connections, as of Jan. 2021: 6,166
4. No. Permitted Residential Connections: 6,356
5. List of DEH/PWSS Approved Wells and Storage

TABLE 1: Approved and Active Wells in Proposed System

Well Name and No.	Capacity (GPM)		Avg. Pump Runtime from Past 12 Months (hrs./day)	Latest POE Inorganic Sampling Results				
	Max from Past 12 Months	Avg. from Past 12 Months		Fe (mg/L)*	Mn (mg/L)	Fe/Mn Loading Rate (lbs./day)	Fe/Mn Loading Rate (lbs./yr.)	Average Fe/Mn Loading Rate Per Residential Customer (lbs./yr.)
BF Well #1	94	74	7	0.0609	0.348	0.2	65	3.1**

*Raw samples are taken directly at the wellhead before chemical treatment and point of entry (POE) samples are taken after chemical injection and treatment but before the tank and distribution system
**3.1 lb./yr. Fe/Mn loading rate based on assumption that most of the Fe/Mn is going to the 21 connections in the Bayleaf Farms S/D.

TABLE 2: Existing Storage at Well Sites

Well Name and No.	Storage Description		Most Recent Cleaning Date
	Type	Gallons	Dist. System
Bayleaf System	Elevated	1,750,000	Jan. 2021
Bayleaf System	Hydro	10,000	
Bayleaf System	Ground	104,500	

*This well uses existing storage in Bayleaf Master System.

6. Past Three (3) Years Flushing Occurrences, list month/year:

   Response: Feb. 2019, Feb. 2020, Jan. 2021

7. Next Planned Distribution System Flushing Occurrence:

   Response: This water system will be flushed again March 2022 and on an ongoing annual basis. Disclaimer: Flushing does not completely remove the mineral accumulation in the distribution mains when utilizing water with exceptionally high levels of iron and manganese in the source water.

8. List of chemicals being used:

TABLE 3: Existing Chemicals Used at Well Site

Well Name and No.	State Approved Treatment			
	Disinfectant	Caustic	Sequestrant	Fe/Mn Filter
Bayleaf Farms Well #1	X	N/A	X	N/A

9. Current description of the water treatment system for each well over the past three (3) years, including specific names of chemicals and dates of changes:

   Response: None.

10. Planned changes (if any) for chemical treatment within the next six (6) months:

    Response: None.

11. Comments on Approved/Current Well Capacity.

    Response: None.

B. CURRENT SECONDARY WATER QUALITY CONCERNS

1. How many wells require treatment? 1
2. Can system operate with single well offline? No*

   * Based on the historical demands of the Bayleaf Master System, every well is required to meet demand. Subsequently, the production from Bayleaf Farms #1 is required and cannot be taken offline or remain offline.

3. Are combined Fe/Mn concentrations above 1 mg/L? No*

   *However, the latest POE Mn concentration is over 0.3 mg/L (0.348 mg/L)

4. Date of most recent POE Fe/Mn sampling results 3/9/2021

TABLE 4: Past 3 Years Fe/Mn Analysis

Bayleaf Farms Well #1 Laboratory Analysis at POE						
Date	Iron (Fe), mg/L			Manganese (Mn), mg/L		
	Tot.	Sol.	Insol.	Tot.	Sol.	Insol.
4/18/2016	0.0726	-	-	0.245	-	-
4/17/2019	0.0644	-	-	0.314	-	-
2/20/2020	0.109	0.0531	0.0559	0.336	0.326	0.01

10/21/2020	0.06	< 0.022	0.06	0.345	0.297	0.048
3/9/2021	0.0609	< 0.022	0.0609	0.348	0.309	0.039

5. Describe previous actions to improve secondary water quality and describe results (i.e.; installation of particulate filters and sequestering agents).

   Response: Aqua is flushing the distribution system annually and feeding Seaquest. The intent of the sequestering agent is to physically chelate or hold Fe and Mn in a soluble state, ideally decreasing the insoluble concentration and resolving water discoloration issues. Because Fe usually reaches the surface in mostly an insoluble state, it is very challenging to convert insoluble Fe back into a soluble state unless the chemical dose of the sequestering agent is increased heavily. Also, sufficiently long contact time is a necessary criterion to make this happen. Because sequestering does not physically remove Mn, Aqua is concerned that its efforts to reduce total Mn will not be effective without adding a Fe/Mn treatment system or equivalent treatment system such as a those using solid phase Manganese Dioxide.

D. UTILITY COMMISION REQUIRED INFORMATION

1. Well Location Map — Attached
2. DEH/PWS Approval Letter — Attached
3. Original 24 hr. Pump Status Report — Attached
4. Past 36 months of pump status reports — Attached
5. Inorganic Analysis Report submitted to DEH for well approval — Attached
6. Past 6 yrs. inorganic analysis from each wellhead — Attached
7. Past 3 yrs. Fe/Mn analyses, both soluble and insoluble. — See Table 4 Above

   Note: For item (6) above, provide information on baseline (w/o treatment – raw samples taken at the well head) and point of entry (after treatment).

E. CUSTOMER COMPLAINT DATA

1. Total number of customer complaints in past 6 months — 36
2. Total number of customer complaints in past 12 months — 81
3. For past 6 months, do customer secondary water complaints exceed 10% of the number of active customers? — No
4. Provide 12-month list of all water quality complaints — Attached
5. Provide 12-month list of all completed water quality work orders — Attached
6. Describe most common customer complaint over the past 12-month period relating to secondary water quality, i.e.; discolored water, taste, or odor.

   Response: Brown, black, and yellow discolored water complaints.

C. PROPOSED SECONDARY WATER QUALITY TREATMENT

1. Proposed treatment recommendation: Oxidation-Filtration Treatment System
2. System Capex Estimate:

Capex					
	Total design flow rate =	94	GPM		
TASK	**DESCRIPTION**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**
1	**Equipment**-Filter Skid, no recycle, sludge management systems required	1	EACH	$ 103,100	$ 103,100
2	Backwash supply system	1	EACH	$ 27,600	$ 27,600
3	Freight (based on shipping costs of similar size filters)	1	EACH	$ 5,000	$ 5,000
4	**Engineering** Design, Permitting, Bidding, & CA/CO (based on design costs of similar size filters)	1	EACH	$ 30,000	$ 30,000
5	**Construction** Bonding, Mobilization and Demobilization	1	EACH	$ 5,000	$ 5,000
6	Site Clearing, Grubbing, Grading, Gravel, erosion control	1	EACH	$ 20,000	$ 20,000
7	Existing Well House Piping Modifications	1	EACH	$ 5,000	$ 5,000
8	Filter Equipment Installation-Including but not limited to all water piping, water treatment filter installation, and necessary appurtenances, within the existing filter building. Also includes all extension piping near filter building	1	EACH	$ 15,000	$ 15,000
9	Filter Building Construction-Including but not limited to concrete floor slab, well house erection, finishing, and necessary appurtenances	1	EACH	$ 45,000	$ 45,000
10	Backwash Supply Tank Installation-Including but not limited to all piping from 12" above grade to 4" air gap, concrete pad, tank setting, electrical, and necessary appurtenances.	1	EACH	$ 10,000	$ 10,000
11	Yard Piping-Including but not limited to all underground pipe, fittings, and valve	1	EACH	$ 15,000	$ 15,000
12	Electrical/Controls-Including but not limited to all electrical power and controls wiring, conduit, panels, fixtures, electric heaters, thermostats, junction boxes, control equipment not provide by filter manufacturer, and miscellaneous appurtenances	1	EACH	$ 20,000	$ 20,000
13	Aqua Direct Cost (payroll, water quality sampling) @	3%			$ 9,021
14	Contingencies @	5%			$ 15,486
				TOTAL COST/TREATED GPM:	**$ 3,511**
				TOTAL ESTIMATED PROJECT COSTS:	**$ 330,000**

Note: The above information is for planning purposes only and is subject to change based on further engineering evaluations, water quality analyses, site conditions, and other site-specific discoveries and information

3. Opex Estimate: $10,000

4. Comments:

Aqua proposes installing an oxidation-filtration system at Bayleaf Farms Well #1 in order to remove Fe/Mn below the sMCLs. Aqua will use the max well production over the past 12 months (94 GPM) as the treatment system design (max) flow rate.