SECONDARY WATER QUALITY TREATMENT SYSTEM REQUEST
Belle Ridge Well #2 NC 03-92-358
WSF ID No: P02
AQUA NORTH CAROLINA

A. EXECUTIVE SUMMARY

Aqua proposes installing an AdEdge Iron (Fe) and Manganese (Mn) filter system to treat water at the single point of entry (POE) at Belle Ridge Well #2, P02. The Belle Ridge Master System is comprised of two (2) active wells (#1 and 2) and two single points of entry (POEs), identified as P01 and P02. **NC DEQ issued a Notice of Deficiency in July 2016 due to Fe and Mn levels exceeding the secondary limits. Combined Fe and Mn levels at this well are consistently greater than 1 mg/L which makes it one of Aqua's Group 1 Priority Secondary Water Quality Projects as per the 2018 Water Quality Plan.** The latest Mn concentration at the POE is 0.294 mg/L. 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 an Fe/Mn treatment system is the most effective and permanent solution since it physically removes the Fe and Mn.

B. PROPOSED SYSTEM REQUIRING TREATMENT

1. System Name: Belle Ridge Well #2, P02
2. PWS ID: NC 03-92-358
3. No. Total Water Connections: 57
4. No. Total Connections at Build Out: 57
5. List of DEH/PWSS Approved Wells and Storage

TABLE 1: Approved and Active Wells in Proposed System*

Well Name and No.	Capacity (GPM)				Max, Avg., Min Pump Runtime (hrs./day)			Average Inorganic Sampling Results (Over Past 3 Years)				
	App.	Max, Avg., Min 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.)
Well #1, P01	20	22	18	15	17	8	4	ND	ND	---	---	---
Well #2, P02	**30**	**35**	**28**	**23**	**5**	**1**	**0.5*** **	**1.21**	**0.282**	**~0.27**	**~98.1**	**~0.66**

*In terms of interconnection and consolidated treatment, the closest other well to Well #2 is Belle Ridge Well #1 (See attached system map).

- Distance apart = ~2,100 ft. (See attached map)
- Approximate cost to construct interconnection = $210,000 (at $100/ft.)
- The interconnection would require Aqua to obtain 7 easements from private residents.
- Well #1 is ND for both Fe and Mn as of the latest IOC compliance sample dated October 2016.
- Interconnection would create one combined entry point for the entire water system and the wells would be required to run simultaneously. It is better from an operational perspective to keep the POE's separate.
- Thus, Aqua does not plan to pursue interconnection and consolidated treatment with Well #1.

There are no other wells close enough to Well #2 to consider for possible interconnection and consolidated treatment.

**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.

***Aqua currently has Well #2 in operational backup mode and relies on Well #1 for meeting system demand. Until Fe/Mn treatment is installed, there is not enough available water volume to correctly flush the system. The max, average, and min pump rate and well runtime numbers are calculated from 2017 when Well #2 was online.

TABLE 2: Existing Storage at Well Sites

Well Name and No.	Storage Description		Most Recent Cleaning Date	
	Type	Gallons	Tank	Dist. System
Well #1, P01	Hydro	10,000	Feb. 2018	June 2017
Well #2, P02	**N/A**	**N/A**	**N/A**	**June 2017**

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

   Response: June 2016, June 2017, June 2018.

7. Next Planned Distribution System Flushing Occurrence

   Response: June 2019.

8. List of chemicals being used:

TABLE 3: Existing Chemicals Used at Well Site

Well Name and No.	Chemical Description			
	Cl_2	OP-37	NaOH	SeaQuest
Well #2, P02	X	N/A	N/A	X

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: The system switched from OP 37 to SeaQuest in August 2015 to sequester the Fe and Mn and clean the distribution lines, as well as to prevent further mineral accumulation on the pipe walls. Aqua installed a Harmsco particulate cartridge filter at Well #2 in September 2017 and it is still online. Started distribution and POE total and soluble sampling in September 2017; Started raw total and soluble sampling and testing in Dec. 2017. According to Aqua's records, the last pump and motor replacement at Well #2 was in August 1995 and at Well #1 was in November 1994 (See attached pump installation reports). Aqua will continue to flush distribution system annually and maintain cartridge filter.

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

    Response: None.

11. Comments on Approved/Current Well Capacity.

    Response: Both wells operate near the State approved capacity as seen in Table 1. Aqua currently has Well #2 in operational backup mode and relies on Well #1 for meeting system demand. Until Fe/Mn treatment is installed, there is not enough available water volume to correctly flush the system. The max, average, and min pump rate and well runtime numbers are calculated from 2017 when Well #2 was online.

C. CURRENT SECONDARY WATER QUALITY CONCERNS

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

   * Both wells are required to meet the State minimum required supply of 400 GPD/connection. Also, two sources of supply are required since there are greater than 49 connections in the system. See attached system demand and supply calculations.

3. Are combined Fe/Mn concentrations above 1 mg/L? Yes*

   *The past 3-year average combined POE concentration at Well #2 is 1.49 mg/L (Fe+Mn).

4. Date of most recent POE Fe/Mn sampling results 11/15/2018

TABLE 4: Most Recent Fe/Mn Inorganic Analysis at Well #2 POE

Belle Ridge Laboratory Analysis						
Date	Iron (Fe) POE, mg/L			Manganese (Mn) POE, mg/L		
	Tot.	Sol.	Insol.	Tot.	Sol.	Insol.
1/5/2018	0.348	0.063	0.285	0.370	0.330	0.040
2/2/2018	1.010	0.227	0.783	0.316	0.248	0.068

3/8/2018	1.010	0.125	0.885	0.319	0.228	0.091
4/3/2018	1.320	0.109	1.211	0.386	0.298	0.088
5/3/2018	1.520	0.097	1.423	0.323	0.293	0.030
7/12/2018	2.200	0.067	2.133	0.301	0.281	0.020
8/2/2018	1.950	1.510	0.440	0.312	0.299	0.013
9/6/2018	2.230	0.385	1.845	0.334	0.260	0.074
10/16/2018	1.490	1.080	0.410	0.322	0.319	0.003
11/15/2018	2.360	1.420	0.940	0.294	0.274	0.020

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

   Response: The system switched from OP 37 to SeaQuest in August 2015 to sequester the Fe and Mn. Flushed distribution system annually since June 2016 and will continue to flush water mains annually. Aqua began collecting and testing POE total and soluble sampling in Sept. 2017 and the most recent results are noted in Table 4 above. 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. Aqua installed a Harmsco particulate cartridge filter in Sept. 2017 but no real reduction in total or insoluble Fe and Mn has been observed. 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. — Attached

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 0
2. Total number of customer complaints in past 12 months 0
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 None
5. Provide 12-month list of all completed water quality work orders None
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: No complaints. Even though there were no customer complaints in the past 12 months, the adverse health effects and public health issues resulting from elevated Mn make removal by Fe/Mn treatment system the most prudent and responsible step moving forward.

F. PROPOSED SECONDARY WATER QUALITY TREATMENT

1. Proposed treatment recommendation: AdEdge Water Technologies Treatment system
2. Proposed System Cost: $190,000.00
   (Includes vendor, consulting engineer, and contractor costs)
3. Estimated annual operating and maintenance expenses: $1,000.00
4. Comments: The water quality at this well has resulted in a NOD from NCDEQ since July 2016. The elevated level of Mn also poses a health risk to customers that must be addressed. Once treatment is installed, Well #2 will operate near the approved rate of 30 GPM. Aqua will use 30 GPM as the treatment system design (max) flow rate.

   For these reasons, Aqua proposes an AdEdge treatment system for Fe and Mn removal to be installed at Belle Ridge Well #2 with no interconnection and consolidated treatment (See footnote in Section B. above).