UNCC-Reclaimed Water System Preliminary Engineering Report

02/16/2016

FEBRUARY 16, 2016

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February 16, 2016

Mr. John A. Fessler, P.E.
Capital Projects Director
Facilities Management Building
The University of North Carolina at Charlotte
9201 University City Boulevard
Charlotte, NC 28223-0001

Re: UNCC-Reclaimed Water System
Preliminary Engineering Report

Dear Mr. Fessler:

Attached please find the referenced report, which presents the scope of services prepared for the project in our letter dated September 25, 2013. This report is the seventh and final task of the scope of work and summarizes the findings of the prior six tasks.

G&D has enjoyed assisting UNCC with this important project. If you have any questions or comments please call.

Sincerely,
GAVEL & DORN ENGINEERING, PLLC

Kirk Gavel

Kirk Gavel, P.E.
Senior Partner

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Executive Summary

The University of North Carolina at Charlotte (UNCC) (the University) wishes to utilize reclaimed water in lieu of potable water for cooling towers and other non-potable uses in an effort to move toward a more sustainable operation. A reclaimed water (RW) source exists just a few miles from campus. Charlotte Water operates the Mallard Creek Wastewater Reclamation Facility (WRF) northeast of campus that produces a stream of reclaimed water with a permitted capacity of 4 million gallons per day (MGD). The firm rated treatment capacity of this plant is 12 MGD with the present treated flow rate at approximately 7 MGD. At the present time the WRF discharges 0.5 MGD during the warmer months for irrigation to The Tradition Golf Course, northeast of campus. The peak demand rate for The Tradition was previously published to be 1,400 gallons per minute of the 2,800 GPM RW supply available from the WRF.

While the present capacity of the RW supply is sufficient to serve present and future demands at UNCC, one key concern could be the reliability of the supply. This concern was demonstrated during the course of this study. Charlotte Water was not able to supply water samples of the treated effluent during this three month study period due to cold weather/off-season operations at the plant, as well as an illicit discharge that occurred into their plant in January. This discharge apparently generated a significant upset to the process which prohibited obtaining a typical sample for chemical analysis. As described by Charlotte Water, this illicit discharge to their plant would have also prohibited them from supplying RW to users during this time period. While it is anticipated that as the RW customer base expands from a present warm weather irrigation demand, to a year-round demand, the operations at the WRF will likely expand to a more consistent year-round supply of RW water; however, a plant upset that significantly changes the water quality cannot be overlooked. Therefore, redundant systems maintaining a potable water supply to each of the RW supply points described in this report will need to be maintained.

The purpose of this study was to review previously published reports and to revisit the previous water use projections in order to determine if there were areas where the proposed reclaimed water distribution system could be refined to better fit the needs of the University. To complete this objective outlined by UNCC, the focus of this study centered on the following key topics:

1. **Define the infrastructure needed to utilize reclaimed water in appropriate use areas where potable water is now consumed.** The RW distribution system was discretely analyzed based on a typical average day and peak daily demand patterns for water consumption in the irrigation and make-up water. A hydraulic model of the proposed distribution system was prepared and used to optimize the distribution piping system based on typical use patterns described by staff and the records for water use on campus. The optimized system consists of a network of 6- and 8-inch ductile iron pipes (DIP) within the campus system that is fed by a 12-inch pipe from Charlotte Water. This on-campus distribution map is included in Figure 1 and the cost of the distribution system is provided in Attachment A. It is recommended that the supply from Charlotte Water be located along Reedy Creek adjacent to the sewer line right-of-way leading to the Mallard Creek WRF. Also, the 12-inch pipeline from Charlotte Water shall adequately serve the RW needs of the University. If Charlotte Water wishes to serve other potential customers off of this transmission

main, then the pipeline size could increase and subsequently the cost difference of upsizing the pipeline should be a cost born by Charlotte Water, not the University.

2. **Investigate the options for service lines extended from the main RW distribution system to the points of use of RW at a typical demand point.** Service connections are closely regulated by the state, as well as industry standards for the safe use of RW where non-potable water is an acceptable replacement for uses that consume potable water. The key issues relate to human contact/exposure to RW, as well as prohibiting cross connection with potable water supplies. While the equipment used at the irrigation points of connection to the RW supply are very similar to those that exist today, the primary difference is in the identification of the water supply in use and installing the appropriate information/warning signs adjacent to each point of connection. The same holds true for the cooling tower make-up water; however the state regulations clearly stipulate that where potable water is used to supplement a RW system it should be completed with an air gap between the two supplies (15A NCAC 2U .0403f). Completing RW connections to facilities that may later need to be supplemented with potable water will pose an issue to the connection method considered. For this reason, it is recommended that RW connections to the cooling towers be completed adjacent to the cooling water make-up connections as air-gap discharges into the common make-up water basin, rather than piped connections with the potable water supplies. This allows the connections to be completed outside of the utility plant buildings, but will require separate flow metering, as well as the possibility of some chemical treatment of the RW prior to discharge into the make-up water basins.

3. **Evaluate the RW chemistry to determine the anticipated level of treatment prior to use.** Since specific water samples could not be obtained of the RW during this evaluation period, the discharge monitoring records (DMR) for the Mallard Creek WRF were reviewed. While the DMR's indicated that the RW met compliance with the state regulations for reuse, primarily disinfection and low levels of organic and chemically reactive biological content, it did not provide a complete picture of the chemical parameters that could affect the performance of the cooling tower equipment. Additional investigation into the water chemistry parameters is required. The water quality parameters that need to be identified include: the ratio of calcium hardness to magnesium hardness, the corrosion potential defining the chloride and sulfate concentration, the silica concentration (which could affect blow-down rates), as well as the ammonia nitrogen concentration with halogen values which could, in turn, form oxidizing biocides.

    a. Based upon the current limited knowledge of cooling water chemistry of Charlotte Water's reclaimed water, it is not anticipated that any additional physical treatment will be required, but a conservative estimate of 50% increase in chemical cost should be considered to maintain the current levels of cycles of concentrations. Even with this chemical treatment strategy, the cycles of concentrations could be reduced due to a number of variables not yet thoroughly assessed or evaluated.

4. **Determine the requirements to implement the use of RW in the UNCC system.** Training of staff will be required and an operation and maintenance manual should be programmed into the final design for the new distribution system. While the training and system operation is not extensive, the University should expect to identify an operator in responsible charge (ORC) to oversee all aspects of operation and maintenance, as well as instruction on the correct use of the system. After the initial instruction period with each maintenance division has been conducted, it should be anticipated that the ORC should conduct periodic visits of each department to insure that stated practices are followed. In addition, it should be expected that short annual reviews be conducted of the policies and procedures with all personnel that have contact with the RW system. This short continuing education will not only reinforce the enhanced safety guidelines to operate the system, but afford the ORC the opportunity to obtain feedback from the staff to adjust the program to best suit the needs of the University.

Project costs to implement the on-campus distribution system were prepared and are presented in Attachment A. The total cost is anticipated to be $2.35 million dollars, which includes the estimated professional fees and a contingency for project implementation; signage and training. Except for the reclaimed water main that follows the Toby Creek floodplain, all construction is along developed corridors on campus, which are congested with buried utilities, sidewalks and landscaped improvements. A general assessment of the costs to negotiate the congested roadways is estimated in the cost opinions. Some cost reduction could be realized if portions of the RW piping are installed while improvements are made to the realignment of Phillips Drive. Another consideration could be to investigate the option of installing portions of the pipe system by directional bore. While this might not reduce overall cost, it could limit the disturbance to the campus community during construction.

Introduction

The University is considering purchasing reclaimed water from the Charlotte Water for use on its campus. The treated effluent at the Mallard Creek Wastewater Treatment plant would be conveyed to UNCC for use as cooling tower make-up water, irrigation, and other purposes. This would require construction of a transmission main from the treatment plant to UNCC, as well as distribution mains on campus, and service lines to the facilities that will be using the reclaimed water. UNCC has requested assistance in defining the infrastructure, applicable permits (and permit requirements), staff training and costs necessary for delivery of the reclaimed water to the various demand points on campus, and any other improvements needed to implement the usage of reclaimed water. The following report presents:

- A description of the Reclaimed Water Supply;
- Water Quality Considerations;
- A Proposed Distribution System and System Demands;
- A Cost Estimate for the Proposed Distribution System.

Reclaimed Water Supply

Charlotte Water operates the Mallard Creek Water Reclamation Facility which has facilities for treating and distributing up to four million gallons per day of reclaimed water. Previous reports indicated that the reclaimed water can be distributed from the plant using a pump system with the following characteristics:

1. Pump Discharge Head: Nominal discharge pressure of 125 PSI, or a typical hydraulic gradient of 920 feet.
2. Pumping Capacity: Rated at 2,800 GPM.

The reclaimed water system meets all current standards of the NC Department of Natural Resources, Division of Water Quality. In addition to the pumping system, supplemental chlorine feed is part of the process prior to distribution to the end users. The only user at the present time is The Tradition Golf Course, operated by Mecklenburg County. Previous reports have indicated that The Tradition has a typical irrigation use of 500,000 gallons per day with a peak demand potential of 1,400 gallons per minute. These demands occur during the warmer months when irrigation is needed to keep the turf grass watered. From this information it can be seen that The Tradition Golf Course consumes about one-half of the capacity of the RW supply available at this time.

During our study period the facilities were not accessible for sampling of the effluent stream or to obtain additional information about the pumping system. Charlotte Water staff indicated that they experienced a plant upset that caused a shut-down of the reclaimed water system. Also, it was mentioned that until a steady user base develops, the reclaimed water facilities are typically shut down or taken off-line during the winter months.

Water Quality Considerations

The water quality of the reclaimed water produced by Charlotte Water's Mallard Creek Water Reclamation Facility is very good. Performance data provided by Charlotte Water for 2013 indicates consistent compliance with the performance levels established by North Carolina regulatory requirements (15A NCAC 2U Reclaimed Water). Although the performance standards are restrictive, they are meant to be general indicators of a highly treated effluent suitable for non-potable use, as well as protecting public health and the environment.

The North Carolina reclaimed water requirements are not intended to address all water quality considerations for non-potable use. This is clearly the case for cooling water makeup, as well as many other specific uses of a non-potable source. There are a myriad of specific constituents that come into consideration with cooling water treatment strategies. The more common constituents that are assessed and evaluated include the following:

- ✓ Turbidity
- ✓ Total Suspended Solids
- ✓ Total Dissolved Solids
- ✓ Conductivity
- ✓ Alkalinity
- ✓ pH
- ✓ Calcium Harness
- ✓ Magnesium Hardness
- ✓ Ammonia
- ✓ Chloride
- ✓ Nitrate & Nitrite
- ✓ Phosphates
- ✓ Silica
- ✓ Microbial Parameters
- ✓ Heavy Metal Parameters

The typical evaluation associated with the use of reclaimed water is to compare the relative differences between current potable water quality and reclaimed water quality. Of course slight differences between water chemistry of a new source would not be as much of a concern compared to more significant water chemistry differences. There may be significant differences with general water quality parameters such as conductivity, hardness, alkalinity, pH or specific constituents such as calcium, magnesium, chlorides, ammonia or others. Evaluation of these water quality parameters are focused on specific impacts to operational aspect such as cycles of concentration, corrosion, scaling and biological controls. These operational factors have a direct impact on both water use and water chemistry management.

Cooling water management (quantity and quality) associated with non-traditional sources of water (reclaimed, recycled, stormwater, groundwater, etc.) typically involve a different water treatment regime or strategy than that of potable water. In the majority of cases this involves the use of different treatment chemicals or different dosages of existing chemicals.

As a rule of thumb, the increased cost associated with the changes in reclaimed water chemistry typically runs about 20-50% higher for reclaimed water as opposed to potable water. In some potable to reclaimed water conversion scenarios, additional point-of-use physical treatment such as filtration, water softening or alkalinity adjustment (acid feed) may be appropriate. Based upon the current limited knowledge of cooling water chemistry of Charlotte Water's reclaimed water, it is not anticipated that any additional physical treatment will be required but a conservative estimate of 50% increase in chemical cost should be considered to maintain the current levels of cycles of concentrations. Even with this chemical treatment strategy, the cycles of concentrations could be reduced due to a number of variables not yet thoroughly assessed or evaluated.

Recommendations

- Specific analyses of constituents of concern for cooling water makeup should be conducted for the Charlotte Water reclaimed water source. Parametric coverage, as well as sufficient monitoring frequency, should be part of a monitoring program to collect water quality data to better characterize the reclaimed water source.

- As data is collected and developed, a water treatment consultant should assess specific treatment strategies to address differences in water quality and potential impacts to cycles of concentration (quantity of water demand, as well as blowdown required) and operational adjustments (chemical treatment changes and associated costs). This assessment should consider the life cycle costs of point of use physical treatment strategies, as well as chemical treatment options.

Proposed UNCC Reclaimed Water Distribution System

The goal of this phase was to optimize the piping arrangement for the needs of the University. The demands were analyzed and the locations mapped (Please refer to Figure 1 next page). Table 1 (following page) identifies the typical demand rates that are observed by staff and recorded in consumption records. It should be noted that the irrigation demands are not metered, but are based on the operation characteristics of the irrigation system. Some key points to keep in mind about the maximum demand rates for the irrigation system that differ from previous reports is that the service lines leading to the points of irrigation are 3- and 4-inch lines. These lines have a maximum flow rate of 100 GPM for the 3-inch lines and 180 GPM for the 4-inch lines. Also as shown in Figure 1 there are two principal connection points for athletic field irrigation water:

1. Practice Football Fields – immediately off the distribution main near the proposed meter vault, and
2. The Athletic Storage Building – off Phillips Drive which is the pump house for the irrigation system serving all of the athletic fields off of Phillips Drive.

Irrigation on each field is zoned where a timer system rotates the supply to a zone of sprinkler heads. This regulates the irrigation demand rates to keep adequate back pressure on the lines so the sprinkler heads operate efficiently, as well as to not over work the pump in the Athletic Storage Building.

One additional comment about the irrigation of the McColl-Richardson field is that the state has specific requirements on the discharge of water from artificial turf fields. The Subchapter 2U rules state the subsurface drainage systems for artificial turf fields must allow for infiltration prior to surface water discharge. No outlets of the subsurface drainage systems are allowed to discharge directly to storm sewers or to intermittent or perennial streams that do not allow for infiltration prior to discharge (15A NCAC 02U .0501 7B). In addition, it was mentioned that the irrigation system for this field is a network of pipes surrounding the field and football center with multiple discharge connection points, which might not be practical for changing over to reclaimed water. Further examination of this irrigation system and under drain system should be considered before programming this field into the reclaimed water system.

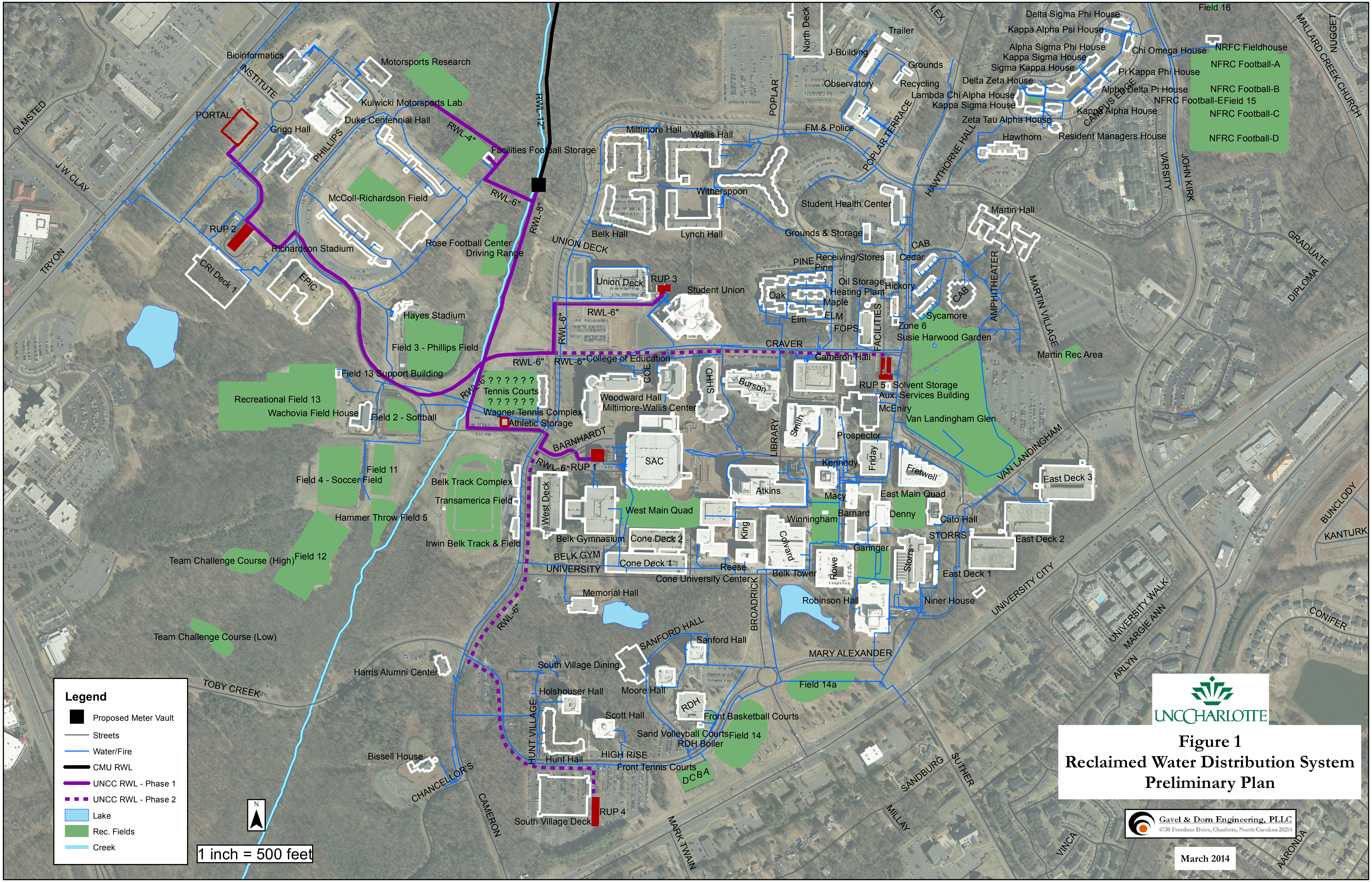

Figure 1
Reclaimed Water Distribution System
Preliminary Plan

Table 1. Reclaimed Water Demands			
Location / Use	Average Water Demand (GPM)	Anticipated Peak Water Demand (GPM)	Notes
RUP-1	51	77	1
RUP-2	59	180	2
RUP-3	54	81	
Football Practice Fields	90	180	3
Athletic Fields	80	100	4

NOTES: The Anticipated Peak Water Demand values were used in the hydraulic model to determine the required size of the reclaimed water lines.

1. RUP - Regional Utility Plant. The average water demand values were obtained from water use records. The peak demand rate was determined based on the previously published data indicating that peak summer use generates an increase of make-up water use up to 48% above the average daily demand. The peak demand rates are also limited by the size of the water make-up lines to the chiller units, where service connections to the cooling towers are 4-inch in size.
2. The Anticipated Peak Demand rate for RUP-2 is based on the option for this plant to double in size in the future.
3. The peak demand rate for the football practice fields is limited on the size of the service line to the fields, which is a 4-inch diameter pipe.
4. The peak demand rate of the Athletic Fields, those fields adjacent to Phillips Drive, is limited on the irrigation system line size (3-inch) and the pumping capacity of the irrigation pump located in the Athletic Field Storage Shed.

A hydraulic computer model was prepared for the proposed system which included the existing pump system and distribution lines as described in previous reports. The boundary condition was established based on the pumping system description at the Mallard Creek WRF. Some assumptions were made on the elevations of the pumping facility, but the model results were not found to be sensitive to those estimates. During final design of the facilities it is recommended that a hydraulic analysis is conducted based on as-built or field collected data to properly characterize the hydraulic constraints of the RW supply. Based on the computer modeling the following conditions should be expected in the UNCC reclaimed water distribution system:

1. Anticipated Hydraulic Grade on Campus: 880 feet which translates to the following anticipated working pressures at the following locations in Table 2 as follows.

Table 2. Hydraulic Model Results	
Location	Anticipated Pressure (PSI)
Football Practice Fields	115
Athletic Fields	100
RUP-1	95
RUP-2	90
RUP-3	100
RUP-4	77
RUP-5	75

The final observed pressures will likely fluctuate based on the final elevations at each location and the demand across the distribution system. The pressures noted above are based on simultaneous demands occurring at various RUP's, as well as irrigation demands at both field service connections.

The distribution system model confirmed that an 8-inch diameter main extending from the 12-inch transmission line from Charlotte Water is sufficient to distribute the reclaimed water to the various RUP's via 8- and 6-inch diameter lines. All lines are of sufficient capacity to keep water velocities in acceptable ranges, typically 3 feet per second or less, and have the capacity to accommodate other irrigation opportunities (planting beds, building lawns, etc.) along the routes of the RW piping system. The recommended pipe layout is presented in Figure 1.

The development of the pipe system is arranged into two phases as shown in Figure 1, as requested by staff during our progress meetings. Also, the cost estimates presented in this report are based on using DIP throughout campus. This, likewise, was at the request of staff, but also has the added benefits of being more durable, having a better hydraulic carrying capacity in comparison to the same size of PVC pipe, and allows flexibility in working around other campus water lines where the required separation distances can be encroached on as stated in the regulations (by using DIP materials).

Service Connection Considerations

Service lines and connections to the various reclaimed water use locations is dictated in part by the requirements in the state regulations (15 NCAC 02U .403) and practical considerations based on the need to maintain redundant service conditions with the potable water connections in the event the reclaimed water supply is interrupted. The following is a summary of the anticipated types of connections that will be made in the RW distribution system:

1. ***Practice Football Fields*** – It is anticipated that a 4-inch service line will extend off of the 8-inch mainline just past the meter vault which marks the ownership and service boundary for the UNCC RW distribution system. This line will extend to each field where below grade hydrant connections will be

established similar to the potable water connections that is present at those fields. It is not recommended that the RW line connect to the potable water line, but laid as a separate service/distribution line to new hydrant locations. The hydrants will have to conform to the regulations (15 NCAC 02U .403c) with proper identification (purple piping, hydrant boxes and signage), as well as be locked from public access. All of these requirements are standard industry practice and durable materials are readily available to accommodate the requirements of the state regulations. For the staff using these connections, the RW system will be easily distinguished by the purple color of the at grade box covers, the signage designating the water source, and that this system will not have a backflow preventer as is presently installed and visible for the potable water service lines. By keeping a completely separate system to the hydrant locations, this will allow the staff to utilize either irrigation water system by simply connecting the irrigation equipment to the hydrant connections in a manner that they are accustomed to at the present time.

2. ***Athletic Fields near Phillip Drive*** – This connection will be slightly different in that all irrigation lines for these fields extend from the Athletic Storage Building located adjacent to Phillips Drive. For this system, minor piping changes will be made to the supply line for the irrigation pump in this building. A dual connection point will be established on a common pump inlet manifold where the irrigation staff can select the water supply source by opening and closing valves within the building. The key design issues include:
    a. A service line of equal diameter to the existing line will extend off of the 8-inch RW distribution line on Phillips Drive. It is understood that a 3-inch line now connects to the pump system located in this building.
    b. Making certain that a reduced pressure zone (RPZ) backflow preventer is installed in the potable water line to physically disconnect the potable water supply from the non-potable backflow in the event the non-potable source is opened simultaneous with the potable source. It could be possible that the non-potable supply pressure is higher than that of the potable supply. The RPZ will prohibit the possibility that a backflow into the potable source could occur. This device may likely be installed on this service line at this time. If so, no additional device would be necessary.
    c. In addition to the RPZ, it will be necessary that the valve controlling the flow from the RW supply line be locked at all times both in the open and closed position. State regulations require that only authorized trained personnel operate those valves.
3. ***RUP Connections*** – Observing the mechanical drawings for RUP-2 demonstrates that space is a premium and there are limited opportunities for additional piping in the yard or buildings of the utility plant. For this reason and to accommodate the state regulations, it is recommended that the reclaimed water piping be 1) terminated in an air-gap discharge to the cooling tower make-up water basin, or 2) connect to the cooling water make-up water piping in the yard of the plant.

Figure 2. Cooling Tower Air-Gap Connection.
Source: Sustainable Silicon Valley, South Bay Water Recycling, Santa Clara, CA

These connection options should be reviewed with the mechanical engineer responsible for the design or operation of the cooling tower system, before the final design is complete to determine the most beneficial method to introduce RW into the RUP system. However, looking at the RUP-2 drawings, and assuming that the other RUP systems will follow a similar piping scheme, there does not seem to be a significant reason to enter the basement with the RW service line, unless it proves to be necessary to add chemical treatment to the RW make-up water before being discharged into the cooling tower basin. If pretreatment is necessary, this chemical injection could be completed separately in the yard before the piping reaches the cooling towers or the make-up water line. A simple schematic of this option is shown in Figure 2.

The existing pipe schematic for RUP-2 shows that chemicals are added on the condenser water return and that no chemicals are added to the potable make-up water. It appears that the chemical conditioning occurs when the two supplies blend in the cooling tower basin. The same conditioning could occur with the RW supply, as well. A capture of the pipe schematic for the cooling towers at RUP-2 is also included as Figure 3 for review. Cooling Tower Piping Schematic (with reference notes) is seen in Figure 4.

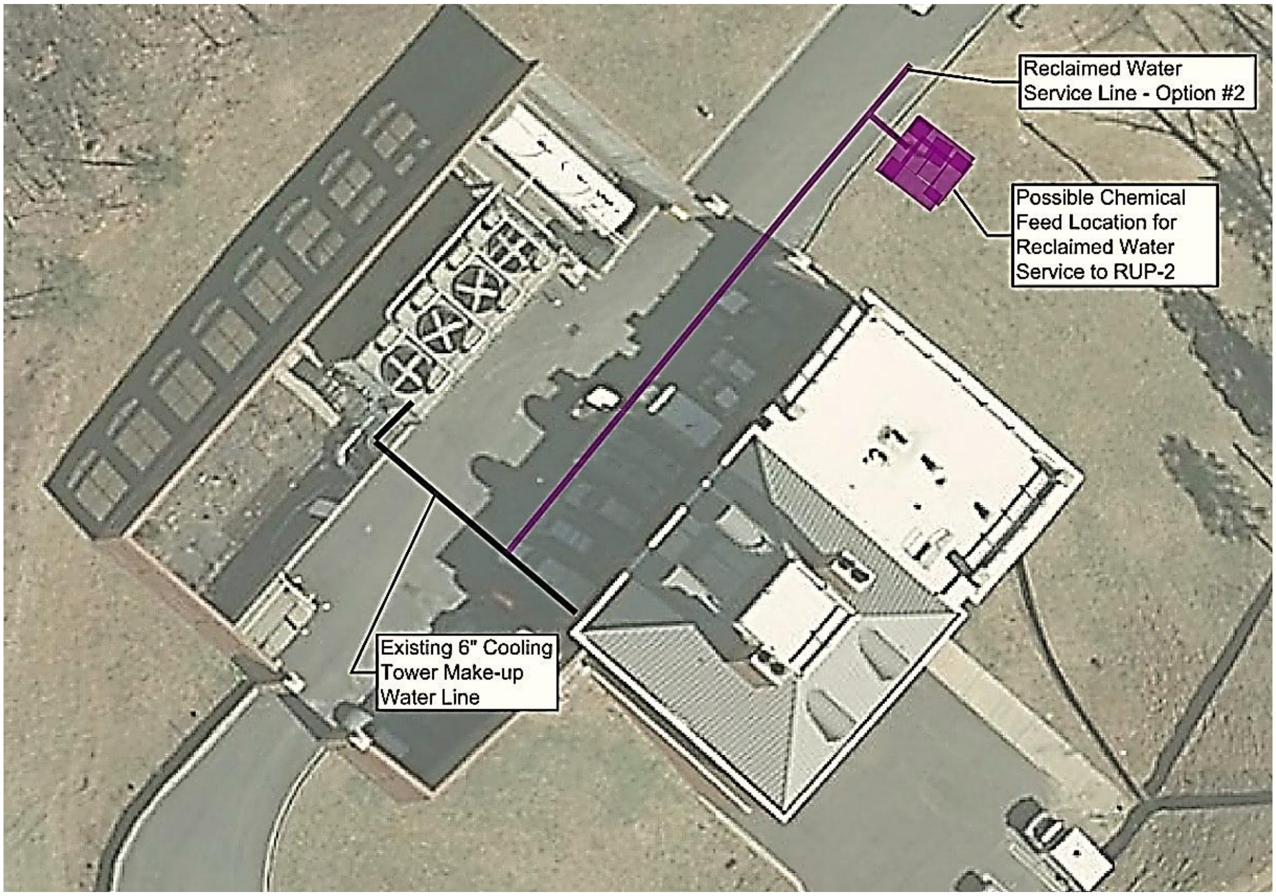

Figure 3. Schematic Image of the Reclaimed Water Piping Connection in Yard of RUP-2.

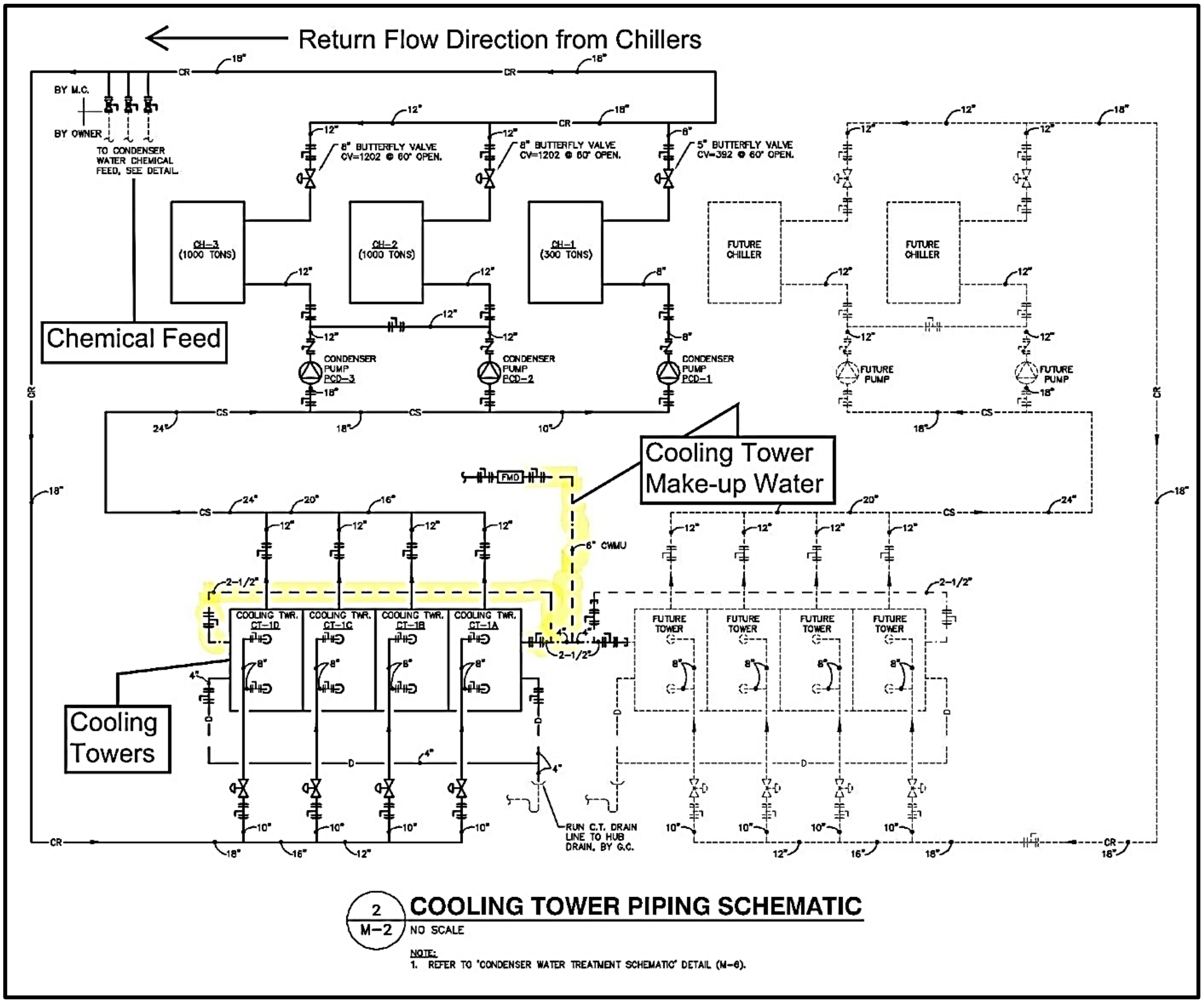

Figure 4. Cooling Tower Piping Schematic (with reference notes).
Source: Sheet M-2, UNCC Regional Utility Plant Plans, United Engineering Group, 09/06/2002

Opinion of Cost and Project Implementation Considerations

The anticipated project cost is presented in Attachment A, which includes the estimated cost of professional services, as well as an estimate of cost for project implementation. All construction of the reclaimed water line will occur along the road system on campus, with the exception of the transmission line in the flood plain of Toby Creek. Most all of the travel corridors are congested with narrow roads, sidewalks, considerable landscaped improvements and other buried utilities, which makes for tough, and expensive construction. The reclaimed water lines are required to maintain separation distances from water lines and be located 10-feet horizontally or 18-inches below vertically from water main piping, as such the construction of these lines are typically deeper than potable water distribution piping, which adds to the complexity and cost of construction.

To implement the project will require staff training, development of communication protocols with Charlotte Water staff at the Mallard Creek WRF, and public notice. Many guidelines are readily available to develop training templates for staff and public notices. Reclaimed water systems have been in use in many other parts of the country and a lot of information is shared online regarding educating the staff and the public about the use and the benefits gained by using this resource. A contingency value is established in the project budget that should cover the costs of implementation.

ATTACHMENT A

ATTACHMENT A
(Rev: 03/31/2014)

OPINION OF PROBABLE CONSTRUCTION COST - PHASE 1 WORK:							
ITEM	DESCRIPTION	QUAN	UNIT		UNIT PRICE		EXTENDED TOTAL
MAIN LINE - 8-inch RWL following Toby Creek floodplain to Phillips Road							
1	Meter Vault	1	LS	$	40,000.00	$	40,000.00
2	8-inch DIP	1500	LF	$	70.00	$	105,000.00
3	8-inch Gate Valves	3	EA	$	1,500.00	$	4,500.00
4	Erosion Control	1500	LF	$	6.00	$	9,000.00
5	Permanent Seeding	3400	SY	$	2.00	$	6,800.00
6	Asphalt Pavement Repair	200	SY	$	55.00	$	11,000.00
7	4-inch DIP to Football Fields	1400	LF	$	50.00	$	70,000.00
8	Irrigation connection points at fields	3	EA	$	1,500.00	$	4,500.00
9				**Subtotal Main Line Cost:**		**$**	**250,800.00**
RWL TO RUP #1							
10	8-inch DIP	300	LF	$	70.00	$	21,000.00
11	8-inch Gate Valves	1	EA	$	1,500.00	$	1,500.00
12	6-inch DIP	900	LF	$	60.00	$	54,000.00
13	6-inch Gate Valves	2	EA	$	1,000.00	$	2,000.00
14	Erosion Control	240	LF	$	6.00	$	1,440.00
15	Pavement Open Cut	1200	LF	$	15.00	$	18,000.00
16	Asphalt Pavement Repair	700	SY	$	55.00	$	38,500.00
17	Connection to RUP #1	1	LS	$	60,000.00	$	60,000.00
18	Connection to Athletic Field Irrigation Shed	1	LS	$	15,000.00	$	15,000.00
19	Traffic Control	1	LS	$	3,000.00	$	3,000.00
20				**Subtotal RWL to RUP #1 Cost:**		**$**	**214,440.00**
RWL TO RUP #2, EPIC & PORTAL BLDGS							
21	6-inch DIP	2900	LF	$	60.00	$	174,000.00
22	6-inch Gate Valves	4	EA	$	1,000.00	$	4,000.00
23	Erosion Control	540	LF	$	6.00	$	3,240.00
24	Pavement Open Cut	2300	LF	$	15.00	$	34,500.00
25	Asphalt Pavement Repair	1500	SY	$	55.00	$	82,500.00
26	Connection to RUP #2	1	LS	$	60,000.00	$	60,000.00
27	Connection to EPIC and Portal Bldgs.	2	EA	$	4,000.00	$	8,000.00
28	Traffic Control	1	LS	$	4,000.00	$	4,000.00
29				**Subtotal RWL to RUP #2 Cost:**		**$**	**370,240.00**
RWL TO RUP #3							
30	6-inch DIP	1200	LF	$	60.00	$	72,000.00
31	6-inch Gate Valves	3	EA	$	1,000.00	$	3,000.00
32	Erosion Control	180	LF	$	6.00	$	1,080.00
33	Pavement Open Cut	900	LF	$	15.00	$	13,500.00
34	Asphalt Pavement Repair	500	SY	$	55.00	$	27,500.00
35	Connection to RUP #3	1	LS	$	60,000.00	$	60,000.00
36	Traffic Control	1	LS	$	2,000.00	$	2,000.00
37				**Subtotal RWL to RUP #3 Cost:**		**$**	**179,080.00**
38	SUBTOTAL COST FOR PHASE 1 (Items 9+20+29+37):					$	1,014,560.00
39	MOBILIZATION - 2% (Item 38)					$	20,300.00
40	PLANNING PHASE CONTINGENCY - 20% (Item 38)					$	207,000.00
41	**TOTAL ANTICIPATED PHASE 1 COST (Item 38+39+40):**					**$**	**1,241,860.00**

ATTACHMENT A
(Rev: 03/31/2014)

	OPINION OF PROBABLE CONSTRUCTION COST - PHASE 2 WORK:						
ITEM	DESCRIPTION	QUAN	UNIT		UNIT PRICE		EXTENDED TOTAL
RWL TO RUP #4 via Cameron and High Rise Streets							
ITEM	DESCRIPTION	QUAN	UNIT		UNIT PRICE		EXTENDED TOTAL
42	6-inch DIP	2800	LF	$	60.00	$	168,000.00
43	6-inch Gate Valves	3	EA	$	1,000.00	$	3,000.00
44	Erosion Control	560	LF	$	6.00	$	3,360.00
45	Pavement Open Cut	2800	LF	$	15.00	$	42,000.00
46	Asphalt Pavement Repair	1600	SY	$	55.00	$	88,000.00
47	Connection to RUP #4	1	LS	$	60,000.00	$	60,000.00
48	Traffic Control	1	LS	$	4,000.00	$	4,000.00
49	**Subtotal RWL to RUP #4 Cost:**					**$**	**368,360.00**
RWL TO RUP #5 via Craver Street							
50	6-inch DIP	2200	LF	$	60.00	$	132,000.00
51	6-inch Gate Valves	3	EA	$	1,000.00	$	3,000.00
52	Erosion Control	450	LF	$	6.00	$	2,700.00
53	Pavement Open Cut	2200	LF	$	15.00	$	33,000.00
54	Asphalt Pavement Repair	1200	SY	$	55.00	$	66,000.00
55	Connection to RUP #5	1	LS	$	40,000.00	$	40,000.00
56	Traffic Control	1	LS	$	2,000.00	$	2,000.00
57	**Subtotal RWL to RUP #5 Cost:**					**$**	**278,700.00**
58	SUBTOTAL COST FOR PHASE 2 (Item 49+57):					$	647,060.00
59	MOBILIZATION - 2% (Item 58)					$	12,900.00
60	PLANNING PHASE CONTINGENCY - 20% (Item 58)					$	132,000.00
61	**TOTAL ANTICIPATED PHASE 2 COST (Item 58+59+60):**					**$**	**791,960.00**

PROJECT COST SUMMARY		
TOTAL CONSTRUCTION COST- PHASE 1 AND 2:	$	2,033,820.00
PROFESSIONAL SERVICES - DESIGN & CONSTR. PERIOD	$	305,000.00
CONTINGENCY FOR SIGNAGE, TRAINING & IMPLEMENTATION:	$	15,000.00
ANTICIPATED TOTAL PROJECT COST FOR ALL PHASES:	**$**	**2,353,820.00**

Gavel & Dorn, PLLC (G&D) has no control over the cost of labor, materials, equipment, or services furnished by others, or over the methods of determining price, or over the competative bidding or market conditions. Any and all professional opinions as to costs reflected herein, including but not limited to professional opinions as to the costs of construction materials are made on the basis of professional experience and available data. G&D cannot and does not guarantee or warrant that proposals, bids or actual costs will not vary from the professional opinions or costs shown herein.