Water Supply Plan

University of Connecticut
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Prepared for:
University of Connecticut
Facilities Operations
25 LeDoyt Road, Unit 3252
Storrs, CT 06269-3252
(860) 486-3113
fo.uconn.edu

MMI #1958-119

Prepared by:
MILONE & MACBROOM, INC.
99 Realty Drive
Cheshire, Connecticut 06410
(203) 271-1773
www.mminc.com

MILONE & MACBROOM
ENGINEERING | PLANNING | LANDSCAPE ARCHITECTURE | ENVIRONMENTAL SCIENCE

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2020 Plan	2020 Water Supply Plan
ADD	Average day demand
APA(s)	Aquifer protection area(s)
ASF	Assignable square feet
CCR(s)	Consumer Confidence Report(s)
CEPA	Connecticut Environmental Policy Act
cf	cubic feet
cfs	cubic feet per second
CGS	Connecticut General Statute
CI	Capital improvement
CUP	Central Utility Plant
CWC	The Connecticut Water Company
DBPR	Disinfection Byproducts Rule
DEEP	Department of Energy and Environmental Protection
DOC	Department of Corrections
DPH	Department of Public Health
EHS	Environmental Health and Safety
EIE	Environmental Impact Evaluation
EPA	Environmental Protection Agency
ESA(s)	Exclusive service area(s)
ESB	Engineering and Science Building
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
gpcd	Gallons per capita day
gpd	Gallons per day
gph	Gallons per hour
gpm	Gallons per Minute
GWUDI	Groundwater under the direct influence of surface water
HAA5	Haleoacetic acids
hcf	hundred cubic feet
IPB	Innovation Partnership Building
ISO	Insurance Services Organization
kV	Kilovolt
kW	Kilowatt
LEED	Leadership in Energy and Environmental Design
LST	Line shaft turbine
MCL(s)	Maximum contaminant level(s)
MG	Million gallons
mgd	Million gallons per day
mg/L	milligrams per liter
MMADD	Maximum month average day demand
MMI	Milone & MacBroom, Inc.
MT-POCD	"Mansfield Tomorrow" Plan of Conservation and Development
MTS	Mansfield Training School
NA	Not applicable
NEWUS	New England Water Utility Services
NextGen	Next Generation Connecticut
OB	Operating budget
OPM	Office of Policy and Management
OS	Outside sources
PDD	Peak day demand
PHC	Public Health Code
psi	Pounds per square inch
PURA	Public Utility Regulatory Authority
PWSMA	Public water supply management area
RCSA	Regulations of Connecticut State Agencies
RO	Reverse osmosis
RWF	Reclaimed Water Facility
SCADA	Supervisory control and data acquisition
SDWA	Safe Drinking Water Act
SDSs	Safety Data Sheets
sf	Square feet
SFHA	Special Flood Hazard Area
SOCs	Synthetic organic compounds
STEM	Science Technology Engineering and Math
SUB	Submersible
TBD	To be determined
TDH	Total dynamic head
TTHM	Total trihalomethanes
UConn	University of Connecticut
UPDC	University Planning, Development, and Construction
USGS	United States Geological Survey
UV	Ultraviolet light
V	Volt
VFD	Variable frequency drive
VOCs	Volatile organic compounds
WPCF	Water Pollution Control Facility
WUCC	Water Utility Coordinating Committee

1.0 INTRODUCTION

The University of Connecticut ("UConn") currently provides potable water to its Storrs (Main) Campus and Depot Campus located in Mansfield, Connecticut. UConn, with the assistance of Milone & MacBroom, Inc. (MMI), has prepared this 2020 *Water Supply Plan* (*2020 Plan*) to update the previous *Water Supply Plan* dated May 2011. Figure 1-1 depicts the area currently served by the UConn water supply system serving the Main Campus and Depot Campus, which are together identified as public water system #CT0780021 by the Connecticut Department of Public Health (DPH)[1].

1.1 Background

Certain regulated water utilities in Connecticut must complete water supply plans in accordance with Section 25-32d of the Connecticut General Statutes (CGS) and Section 25-32d of the Regulations of Connecticut State Agencies (RCSA), namely the updated water supply planning regulations[2] adopted in 2005. The water supply planning regulations and supporting statutes recognize that planning is a critical management activity for all water utilities. The principal goals of water system planning as defined by DPH are to: (1) ensure an adequate quantity of pure drinking water, now and in the future; (2) ensure orderly growth of the system; and (3) make efficient use of available resources.

Although UConn is not considered a "water company" as set forth in CGS Section 25-32a, UConn still views the *Water Supply Plan* as an integral device in planning for a safe and adequate water supply system for the foreseeable future. Thus, the *2020 Plan* addresses (to the extent practical) the requirements of CGS Section 25-32d and UConn will distribute the *2020 Plan* to required State agencies and other required parties for review and comment.

Historically, UConn has been fortunate to have access to high quality drinking water through its Fenton River and Willimantic River wellfields. These resources have served UConn for decades and will continue to serve UConn for years to come. Currently, UConn may withdraw water from seven production wells as well as a recently installed public water supply interconnection (described in more detail below), with an eighth well reserved as emergency backup. A total of four production wells are located at each of the two wellfields. Seven of the eight wells are gravel packed wells, and all eight wells are constructed as high-capacity wells in stratified drift.

The "Fenton River Study" of 2006 and the "Willimantic River Study" of 2010 have demonstrated that normal operation of the wells to supply potable water for the Storrs and Depot Campuses can result in some diminution of river flows in times of drought. Also, under certain low river flow conditions, extended pumping may result in adverse environmental impacts. As such, both wellfields have been recently operated in accordance with the individual management plans that have been consolidated in the *Wellfield Management Plan* document associated with the *2020 Plan*.

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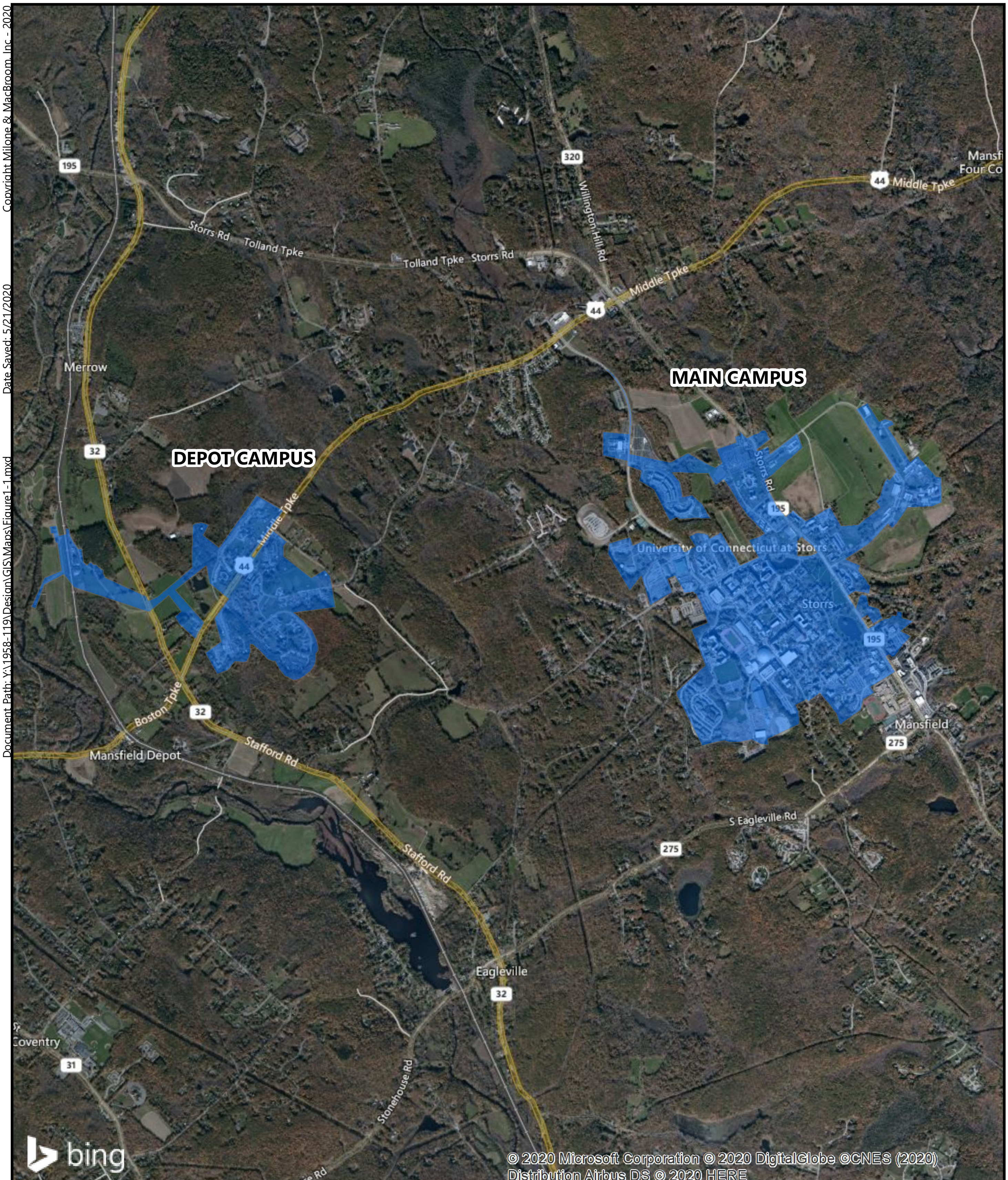
[1] https://portal.ct.gov/DPH/Drinking-Water/DWS/Public-Water-System-Lists
[2] https://eregulations.ct.gov/eRegsPortal/Browse/RCSA/Title_25Subtitle_25-32d/



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99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
WWW.MMINC.COM

UCONN WATER SERVICE AREA

WATER SUPPLY PLAN
UNIVERSITY OF CONNECTICUT
MAIN AND DEPOT CAMPUSES
MANSFIELD, CT

N

0 1,000 2,000
Feet

SCALE	1 " = 3,000 '
DATE	5/21/2020
PROJ. NO.	1958-119

FIG. 1-1

Furthermore, UConn also has a considerable amount of water storage capacity with over eight-million gallons (MG) of potable water storage available. This storage volume, in combination with the UConn's booster pump capacity and various sources of supply, enables the UConn to accommodate all its system demands, including peak day demand (PDD). UConn could, in theory, turn off its wellfields and be able to meet typical demands from storage alone for several days.

Finally, UConn's supply and distribution system includes a water treatment facility at each wellfield, four booster pumping stations, 6 water storage tanks, and approximately 31 miles of water transmission and distribution mains. These resources are described in more detail in subsequent sections of this *2020 Plan*.

1.2 Major Changes Since the Previous *Water Supply Plan*

The May 2011 *Water Supply Plan* was last revised by UConn in December 2013 based on review and comment provided by several State agencies through the DPH. In an approval letter dated March 25, 2014, the DPH memorialized state agency input and requested UConn address the comments in the next *Water Supply Plan* that was to be prepared within 9 years of May 2011 *Water Supply Plan*. The *2020 Plan* addresses, to the extent practical, the March 2014 DPH comments. Similar to previous plans, the *2020 Plan* covers the entire water system.

UConn now utilizes an on-site Reclaimed Water Facility (RWF) on the Storrs Campus as a source of treated wastewater that is used to replace the use of potable water for non-potable uses. Since the spring of 2013, the RWF has provided the UConn Central Utility Plant (CUP) with water for evaporative cooling and boiler make-up. Reclaimed water is also used for flushing toilets and for the cooling system in the Innovation Partnership Building (IPB) that was constructed in 2015-2017 and opened in September 2018. UConn has applied for a permit to use reclaimed water for flushing toilets at the recently constructed Werth Residential Tower Building, and activation of this portion of the reclaimed water system is on hold pending permit approval. The average day production for the RWF in 2019 was approximately 0.33 million gallons per day (mgd). Demand analyses for reclaimed water which are included in the *2020 Plan* factor wastewater reuse as a deduction from what the overall potable water demand would otherwise have been if reclaimed water were not available.

In December 2016, the UConn water system completed an interconnection with The Connecticut Water Company (CWC) – Northern Operations, Western System via a 16-inch diameter regional pipeline which extended approximately 5.3 miles from Tolland to UConn along Route 195. The interconnection allows UConn to purchase supplemental water if and when on-campus potable water demand exceeds what the UConn's wellfield sources are allowed to supply under current *Wellfield Management Plan* protocols. CWC's water supply source for the interconnection is the Shenipsit Reservoir, which is located along the boundary between Tolland, Ellington, and Vernon, Connecticut. Note that purchases through the interconnection in this manner have not been made to date.

Nevertheless, the interconnection is actively used as water delivered through the CWC interconnection supplies potable water to off-campus premises in Mansfield that were previously supplied by the UConn water system. All off-campus premises, including those that are UConn-owned, are now customers of CWC. Furthermore, all off-campus potable water infrastructure is either owned by or is under the direct control of CWC via a licensing agreement with UConn and the Town of Mansfield. When the interconnection was completed, CWC was assigned the responsibility to provide potable water service to all off-campus areas previously served by UConn's potable water system in Mansfield consistent with CWC's exclusive service area (ESA) responsibilities under CGS Section 25-33g and RCSA 25-33h-1(k). As such, the off-campus water use that had previously been included as part of the demand on the UConn water system in prior versions of the UConn *Water Supply Plan* are no longer included in the demand volumes noted for the UConn water system in this *2020 Plan*

Taken together, all the above actions have greatly reduced the average day demand (ADD) on the UConn water system. At the time of the previous *Water Supply Plan* in 2011, the ADD on the water system was 1.29 mgd. The ADD on the system was only 0.72 mgd in 2019, reflecting a savings of nearly 0.6 mgd over that eight-year timeframe. UConn anticipates that demands will increase in the future as opportunities in its various master planning documents for the Main and Depot campuses are realized, although future demands are expected to be mitigated by various water efficiency programs.

1.3 Planning for the Future

UConn has experienced steady growth over the past two decades both in terms of enrollment and the number of campus buildings served by the water system. Nevertheless, the construction and development that has been completed, and is presently planned as part of the "UConn 2000", "21st Century UConn", and “Next Generation Connecticut” initiatives have not adversely stressed the UConn water system. In fact, UConn is using less water today than it did back in the 1980s and early-to-mid 1990s. This reduction in water use was achieved by water conservation efforts, public information campaigns through the Office of Sustainability, and capital improvement programs aimed at reducing water leakage, water waste, and overall consumption. Furthermore, use of reclaimed water produced in the UConn RWF is contributing to the decrease in potable water pumping from UConn’s sources of supply, while programmatic maintenance and renovations on the aged steam and condensate systems continue to promote water conservation by reducing system leakage rates.

Water efficiency programs have been a key component of UConn’s continuing growth and expansion as Connecticut’s flagstaff academic institution. UConn continues to be committed to conserving water and installing water efficient devices in new construction, consistent with sustainability initiatives on water conservation and building efficiency measures (e.g., State of Connecticut High Performance Building Standards and Leadership in Energy and Environmental Design [LEED] requirements) outlined in UConn’s Construction Design Guidelines & Performance Standards.

Similar to the 2011 *Water Supply Plan*, this *2020 Plan* evaluates various components of the UConn water system for the 5-, 20-, and 50-year planning periods. By regulation, the 5-year planning period is projected from the year of the plan preparation (2020), while the 20- and 50-year planning periods are projected from the year of the most recent decennial census (2020). Accordingly, the planning periods correspond to the years 2025, 2040 and 2070, respectively.

This *2020 Plan* assesses the ability of UConn to meet the intended goals of the various Statutes and Regulations overseen by DPH related to public water supply and outlines capital improvements and operations necessary to meet those goals in the future. The information contained in this *2020 Plan* was obtained from a variety of sources, including a review of UConn files and written and verbal information obtained from UConn staff and contractors. Additional information was obtained from a review of reports and records relative to the water supply system that were formulated since 2011. Where appropriate, portions of these documents have been incorporated.

Certain water supply budgetary estimates are referenced in this document. These are preliminary estimates and are intended to be used for planning purposes only. Opinions of probable capital and operational costs are based on best estimates using data available in 2019 and 2020. Actual costs may substantially vary from the costs reported in this planning document.

1.4 Acknowledgments

Special thanks are given to the following individuals for their time, effort, and input throughout the preparation of this updated *Water Supply Plan*:

- Mr. Stanley Nolan, Director of Utility Operations & Energy Management, Facilities Operations
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- Mr. Pete Duncan, S. B. Church Company

2.0 WATER UTILITY STRUCTURE AND ASSETS

2.1 Historical Perspective

The water system at UConn consists of wells and infrastructure developed by UConn, wells and infrastructure developed by the former Mansfield Training School (MTS), and (since 2016) the infrastructure installed to complete the CWC interconnection. As such, the chronology of water system development is of interest and importance. The following historical information was presented in previous *Water Supply Plans* issued in 1999, 2004, and 2011, with supplemental information from recent reports, as well as a variety of other sources.

1880 – 1910:

- The Connecticut General Assembly established the Storrs Agricultural School in 1881 after accepting 170 acres of land, several buildings, and money from Charles and Augustus Storrs. The Storrs Agricultural School opened on September 28, 1881 with 12 students.
- The name of the agricultural school was changed to Storrs Agricultural College in 1893, and the name was again changed to the Connecticut Agricultural College in 1899.
- It is speculated that the source of water during this time was a shallow dug well (or wells) on the main campus.
- In 1905 or 1906, the College's annual report recommended elimination of an eastward sewage outfall to avoid a possible typhoid infection of the City of Willimantic water supply. Eliminating the eastward sewage outfall would allow for future development of the Fenton River well field on UConn property without the risk of sewage contamination.

1910 – 1920:

- The College's biennial report for 1912-1914 quoted the president as saying "The sewage from the eastern side of campus, the drainage from which is toward the Fenton River, the source of the City of Willimantic water supply, is now diverted and filtered, the effluent finding its way to the Willimantic River on the opposite side of the watershed."
- The first MTS buildings were constructed on the site of the present Depot Campus from 1910 to 1919. This facility was a self-sufficient residential hospital complex and its lands included the present site of the Willimantic River Wellfield.
- According to the United States Geological Survey (USGS)[3], the water source was a 240-inch diameter dug well at the Willimantic River Wellfield installed to a depth of 16.5 feet around the year 1913. This dug well was known as MTS Well #1.
- In 1914, UConn erected a 0.3 MG standpipe for water storage at what is now the Towers site. The source of water that was pumped to the 0.3 MG standpipe is not known.

1920 – 1930:

- In 1921, the Town of Mansfield reportedly constructed a water treatment plant at Pink Ravine at the intersection of Bonemill Road and Ravine Road. The plant treated water from Cedar Swamp Brook using rapid sand filtration and utilized a pump station to supply both MTS and UConn. The demand at this facility was reportedly 100,000 gallons per day (gpd).
- A 6-inch pipeline is believed to have extended along Bonemill Road from Pink Ravine in both directions (towards MTS and towards UConn). Portions of this old main served the former

[3] https://pubs.usgs.gov/ctwrb/0012/report.pdf

poultry facility on Bonemill Road north of Pink Ravine and a nearby pasture. The line was capped off beyond the poultry facility in June of 1999, and later capped again on North Eagleville Road at Meadowood Road.

- With State funds awarded to the College and the Town of Mansfield, the College developed Well A at the Fenton River in 1926-1927 to replace the Pink Ravine water treatment plant. A ten-inch pipeline connected Well A to the College, with water stored in two water tanks on campus. The first tank was the 0.3 MG installed in 1914 at the current Towers site. The location of the second water tank is unknown but likely was at the Towers site.
- The Pink Ravine water plant was reportedly disconnected from UConn in 1927 after the development of Well A, although it is possible that the facility continued to serve MTS and may have been considered an emergency back-up source by UConn.

<u>1930 – 1940:</u>

- In 1933, the Connecticut Agricultural College became the Connecticut State College, and in 1939 was renamed UConn.
- 1934 aerial photographs[4] show three water storage tanks in close proximity at MTS near the location of the single 0.75 MG tank which is north of Route 44. Two of the three tanks in the photographs appear to be of a similar size and are installed adjacent to each other while a third smaller tank is located to the southwest. The photographs also depict the recently replaced chemical treatment building at the Willimantic River Wellfield, suggesting that a treatment building for MTS was in place prior to 1934.
- The 1934 aerial photographs show two water storage tanks at the present-day Towers site. One of these tanks appears to be the 0.3 MG tank constructed in 1914. The size and construction date of the second Towers site tank in the 1934 photograph is unknown but may have been completed either before or around the time Well A was installed.
- The graduate school was established in 1940.

<u>1940 – 1950:</u>

- MTS performed investigations in the early 1940s culminating in a 1945 report on water supply facilities and a yield test of MTS Well #1. MTS Well #1 was supplemented by the installation of MTS Well #2 in 1948.
- UConn evaluated Well A in the early 1940s, which was typically operated at night due to power supply limitations and costs. It was determined that additional supply was needed.
- In 1949, UConn developed Well B and Well C at the Fenton River Wellfield. UConn also constructed a 50,000-gallon (twin 25,000-gallon) clearwell basin at the Fenton River Wellfield in 1949.

<u>1950 – 1960:</u>

- A 0.6 MG storage tank was reportedly constructed at the Towers site in 1950, and likely replaced one of the two tanks shown in the 1934 photograph.
- The present-day 1.0 MG storage tank at the Towers site (the third tank at this location) was constructed in 1954.
- UConn constructed a 1,000 gallons per minute (gpm) pumping and treatment station and a 12-inch pipeline from the Fenton River Wellfield to the campus in 1954.
- MTS constructed a 0.5 MG storage tank in 1954 on the east side of the school, south of Route 44, and in 1958 constructed a 0.75 MG water storage tank near the existing tanks north of Route 44. The residential population of MTS was nearing its peak at that time.
- MTS constructed MTS Well #3 at the Willimantic River Wellfield in 1958. This well was intended

[4] http://magic.lib.uconn.edu/mash_up/aerial_index.html

to supplement MTS Well #2, and MTS Well #1 became an emergency (backup) source for potable water.

- UConn constructed Well D at the Fenton River Wellfield in 1958 at a location south of Fenton River Wells A, B, and C.

1960 – 1970:

- MTS Well #1 was disconnected in 1961 due to insufficient yield.
- The MTS water system was reportedly "interconnected" with the UConn system in 1964 to provide redundancy to both systems. This interconnection likely utilized the existing 6-inch main along Bone Mill Road that had been in place since the 1920s and had technically interconnected the two systems since that time, although transfer pumps to move water from one system to another may not have been in place prior to the 1960s.
- The 1965 aerial photographs show the recently (1950s) constructed water tanks at MTS and the main campus. The 0.75 MG tank installed in 1958 at MTS appears to have replaced one of the "twin" tanks that was located between the smaller tank and the other "twin" tank. Three tanks are also shown at the Towers site in this photograph, which appear to be the 0.3, 0.6, and 1.0 MG tanks noted previously.
- In 1969, UConn reached an agreement with MTS where UConn would be granted exclusive use of the land at the Willimantic River Wellfield and certain parcels surrounding MTS. This agreement included MTS Well #1, MTS Well #3, the treatment building, and the water storage towers northwest of Route 44. UConn would provide MTS with potable water. MTS retained ownership and usage of MTS Well #2 as an emergency source and the Bone Mill Road 0.5 MG tank for water storage. MTS Well #2 was used as a backup well and was typically run for a few months each year, through 1990, to supplement the UConn water supply. UConn renamed MTS Well #3 to UConn Well #3.

1970 – 1980:

- UConn installed Well #1 in 1970 and installed Well #2 in 1974 at the Willimantic River Wellfield.
- A 1971 report noted that fire flows were inadequate on the edges of the distribution system. Water mains were reportedly cleaned to increase pressure.
- A 5.4 MG underground storage reservoir was built at W-lot on the Storrs Campus in 1972, with a water treatment facility and a pumping station that pumped water to the storage tanks at the Towers site. The Willimantic River Wellfield was connected to the new 5.4 MG reservoir with a 4.5-mile, 16-inch diameter water-transmission main.
- The 0.6 MG tank (constructed in 1950) and the 1.0 MG tank (constructed in 1954) at Towers site were overhauled in 1980.

1980 – 1990:

- UConn registered its seven wells with the Connecticut Department of Energy and Environmental Protection (DEEP) in 1982. MTS registered MTS Well #2 separately.
- UConn extended its system to 11 homes on Hunting Lodge Road where owners were concerned about potential well contamination. These were the first non-MTS off-campus customers.
- A propane emergency generator was installed at UConn Well #3 in 1986. Two 1,000-gallon underground propane tanks were located at the wellfield; these have since been replaced with above-grade tanks.
- Cracks in the 5.4 MG reservoir were filled and the top of the tank was resealed in 1987.
- In 1988, 15 additional homes, the Storrs Friends Meeting House, and Celeron Square Apartments were connected to the potable water system on Hunting Lodge Road.
- The Town of Mansfield and UConn entered into a "Sewer & Water Service Agreement" in January 1989. UConn agreed to provide services in the South Eagleville Road and Maple Road area to

various Town-owned buildings. This agreement has been superseded.

- UConn submitted its first *Water Supply Plan* to the Department of Health Services (now DPH) in 1989. Water usage at UConn peaked in 1989.
- UConn commissioned an inspection of the 0.3 MG storage tank at Towers in 1989.
- UConn installed a diesel generator for emergency power at Well #1 in 1990.
- UConn commissioned an inspection of the 0.6 MG storage tank at Towers in 1990.

1990 – 1995:

- UConn commissioned an inspection of the 5.4 MG reservoir in 1991. Cracks in the tank were filled and the top of the tank was re-sealed that year.
- UConn commissioned an inspection of the 1.0 MG storage tank at Towers in 1991.
- UConn conducted leak detection surveys at MTS and corrected deficiencies in 1991 and 1993.
- UConn removed the propane tank next to MTS Well #2 in June 1993.
- MTS was closed and officially transferred to UConn on July 1, 1993. As such, MTS Well #2 came under the control of UConn. The MTS campus became known as the Depot Campus.
- UConn submitted a revision of its first water supply plan in 1993 with updates in 1994 to reflect the closure of MTS.
- UConn Well #2 was redeveloped in 1993-1994.
- UConn commissioned an inspection of the 0.75 MG storage tank in 1993 and the 0.5 MG storage tank in 1994 at the Depot campus.
- UConn conducted a Groundwater Under the Direct Influence of surface water (GWUDI) study from 1993 to 1994. It was subsequently determined that the tested wells were not under the direct influence of surface water.
- UConn constructed a generator building and installed an emergency generator at the Fenton Wellfield in 1994. This structure provides emergency power to all four Fenton wells and the pump house.
- The UConn 2000 legislation (Public Act 95-230) passed in 1995, providing $96 million in funding to rebuild and renew UConn. This amount was later increased to one billion dollars in a ten-year program.
- The registration for MTS Well #2 was transferred to UConn in August 1995.
- Water treatment facilities were replaced in 1995.

1996 – 2000:

- In 1996, UConn contracted a firm to conduct a leak detection survey at the Depot Campus and at problem areas associated with the Main Campus. Noted deficiencies were repaired.
- The levels of lead and copper in the Depot Campus system exceeded the action level in 1996. This issue was subsequently corrected by adjusting the pH at the Willimantic River Wellfield treatment building.
- UConn constructed Well #4 at the Willimantic River Wellfield in 1998 to replace the function of MTS Well #2. This well was installed nearby MTS Well #2, which is now inactive.
- UConn officially abandoned MTS Well #1 in December 1998 and dismantled the associated pump house.
- Most of the residences on Hunting Lodge Road were connected to the water system by the end of 1998.
- Two booster pumps were constructed in 1998 to address fire protection pressure problems. The first was installed in the CUP and the other was installed in the new South Campus Chiller Plant. New and renovated buildings in the UConn 2000 program also installed sprinkler systems to provide more efficient fire protection.
- UConn submitted its second *Water Supply Plan* in 1999.
- A totalizing meter was installed on each Fenton well in 1999. Prior to this time, only the total flow from the wellfield was metered.
- The storage tanks at the Depot campus were rehabilitated and repainted in 1999 and 2000.

2000 – 2005:

- UConn revised its second *Water Supply Plan* for approval in 2001.

- Level A Mapping of the Fenton River Wellfield was completed in 2001.
- The Town of Mansfield prepared its own *Water Supply Plan* in 2002.
- The maximum contaminant level of total coliform bacteria was exceeded in October 2001 and September 2003 in the main campus system. During follow up water quality testing, no *E. Coli* bacteria were found in any of the samples. Mechanical problems at the chlorinators were believed to have caused these incidents. Repairs were made and the public was notified.
- An elevated level of fluoride was detected in a sample at the Fenton River pump station in December 2002. Subsequent samples were within the normal range. Public notification was made.
- UConn had a monitoring and reporting violation in its December 2002 water samples. The sample submitted for cyanide was considered "unsatisfactory for examination" by the laboratory. UConn re-sampled for cyanide in January 2003 (none was detected) and issued public notification regarding the violation.
- The Towers Loop Pump Station was activated in 2003. This facility services the Charter Oak Apartments/Suites and the Husky Village (Greek Housing) complexes.
- Based on the success of the UConn 2000 program, the Connecticut General Assembly enacted the "21st Century UConn" legislation in 2003 that committed an additional $1.3 billion dollars for the continuation of capital improvement programs.
- Approximately seven residential dwellings on Meadowood Road and North Eagleville Road were connected to the water system in 2004.
- UConn submitted its third *Water Supply Plan* in 2004 (approved in 2006).

<u>2005 – 2010:</u>

- A series of events in summer 2005 lead to the desiccation of a section of the Fenton River. These events included drought conditions and low river flows, high demands for potable water upon the return of students in August-September, high non-potable water demands at the CUP, and a water management scheme that, at the time, caused more water to be withdrawn from the Fenton River Wells than current practice tends to allow.
- The "Fenton River Study" was completed in 2006. This report suggested successive cutbacks in the pumping rate of the Fenton River Wellfield during natural surface water low-flow periods, with wellfield shutdown occurring when the Fenton River is flowing below 3.0 cubic feet per second (cfs). In the summer of 2006, UConn began operating the Fenton River Wellfield as suggested by the study.
- UConn hired a contract operator to oversee operations of the water system in 2006.
- Revised Level A Mapping of the Willimantic River Wellfield was completed in 2007 and subsequently approved by DEEP.
- The UConn's Water and Wastewater Advisory Committee convened in 2007. The committee included UConn and Town of Mansfield officials. These officials continued to meet through 2016 on a quarterly basis to discuss growth and usage of the water and wastewater systems.
- UConn prepared a *Water and Wastewater Master Plan* in 2007 that was subsequently approved by DPH. The *Water and Wastewater Master Plan* provided a comprehensive review of the existing water and wastewater infrastructure, a summary of operations and management of both systems, an inventory of future infrastructure needs, and a discussion of potential future water supplies.
- UConn prepared a draft *Drought Response Plan* in 2008 that tied projected available water supply to projected usage and set five stages of water conservation measures.
- The "Willimantic River Study" was completed in 2010. This report suggested successive levels of voluntary and mandatory conservation measures be instituted by water users to reduce production at the Willimantic River Wellfield during low-flow periods.
- UConn began operating the Willimantic River Wellfield as suggested by the Willimantic River Study in the summer of 2010, with the

understanding that a *Wellfield Management Plan* would be included as part of the 2011 *Water Supply Plan*, as well as future plans, to formalize operations for the two wellfields (including water conservation and water restriction measures).

2010 – 2015:

- The two smaller Towers site water storage tanks (0.6 MG and 0.3 MG) were replaced with one, new 1.0 MG tank in 2010-2011 sited adjacent to the 1.0 MG tank installed in 1954.
- The Willimantic River Wellfield chemical treatment facility was replaced in 2010-2011.
- UConn prepared its fourth *Water Supply Plan* in 2011 and received DPH approval in March 2014. The approval letter for the 2011 *Water Supply Plan* noted the State's understanding that agency comments provided to UConn would be addressed in future *Water Supply Plan* revisions.
- Construction of the RWF began in 2011 and was completed in spring 2013. Since completion of the RWF, the CUP has received treated water for reuse as boiler make-up water and as evaporative cooling water in the production of chilled water and cogenerated power and heat.
- UConn prepared an *Environmental Impact Evaluation for Potential Sources of Water Supply* in 2011-2012, which identified the CWC interconnection as the most prudent option for new water supply. The corresponding Record of Decision received approval from the Connecticut Office of Policy and Management in 2013.
- In December 2013, UConn and CWC executed a "Water Supply and Development Agreement" for the construction of water transmission line piping and provision of water to UConn and off-campus customers. The new interconnection consisted of a 16-inch diameter pipeline extending from existing CWC infrastructure in the Town of Tolland.
- UConn and CWC jointly submitted a Diversion Permit application to DEEP in 2014 for the construction and operation of the water supply interconnection pipeline.
- Construction of three of four Storrs Center phases, consisting of mixed-use commercial spaces and residential apartments, was completed by the end 2014. The fourth phase of condominiums and townhomes began construction in 2015. Water supply to the commercial and residential buildings at Storrs Center is presently provided by CWC through the CWC interconnection pipeline and associated off-campus water systems.

Recent Improvements:

- UConn replaced the 16-inch diameter water transmission main between the Willimantic Wellfield and the 5.4 MG W-Lot reservoir in two phases spanning 2015-2017. This enhanced reliability of water transmission to the Main Campus.
- The 20-inch diameter section of main connecting the W-Lot (High Head) reservoir to the Towers storage tanks was replaced in 2016-2017.
- The interconnection from the CWC Northern Operations Western System was activated in December 2016. All off-campus infrastructure was licensed to CWC for their use, and nearly all off-campus connections that were formerly customers of UConn became customers of CWC upon activation of the interconnection. The changeover for off-campus customers was completed in early 2017.
- Several recent building projects on campus incorporate features that use reclaimed water instead of potable water to further water conservation efforts. The Engineering & Science Building (constructed 2017) uses reclaimed water for toilet flushing, and the recently completed IPB uses reclaimed water in its cooling towers. Infrastructure is also in place to use reclaimed water in the Werth Residential Tower for cooling and toilet flushing, with connection to occur pending permit approval.

2.2 Organizational Structure

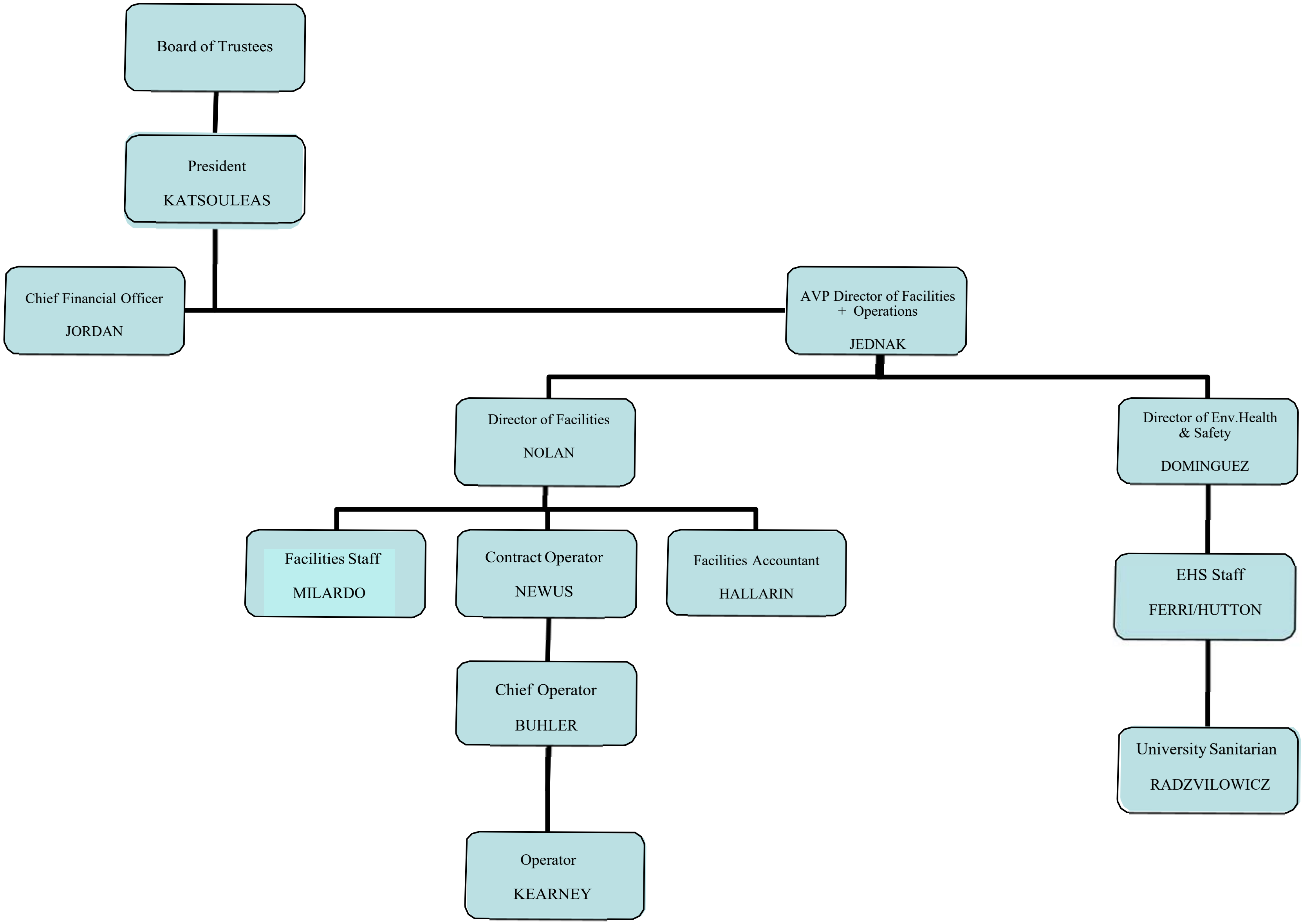
The UConn water system is owned and controlled by UConn. An organizational chart related to water system management is included as Figure 2-1. The Board of Trustees serves as the ultimate governing body on all drinking water matters concerning these systems. UConn administration related to the water system includes the following:

- Mr. Thomas Katsouleas is the President of UConn and oversees the day-to-day operation of the university.
- Mr. Scott Jordan is Executive Vice President for Administration & Chief Financial Officer.
- Mr. Michael Jednak is the Associate Vice President of Facilities Operations & Building Services and he is responsible for oversight of construction contracts, operation contracts, and cross-connection control improvements; oversight of all utilities; and billing. Assistance to Mr. Jednak is provided by the following individuals:
  - Mr. Stanley Nolan is the Director of Utility Operations & Energy Management within Facilities Operations. Mr. Nolan is assisted in water utility operations by Ms. Katie Milardo the Water & Compliance Manager.
  - Mr. Eric Kruger is the Director of Trade Services.
  - Mr. Mickey Gorman is the Manager of Trade Services.
  - Ms. Lynn Hallorin is the Director of the Business Services Center.
- Ms. Laura Cruickshank is the Master Planner and Chief Architect for the university. She is responsible for architectural and engineering matters including "Next Generation Connecticut" (NextGen) projects. Her Office of University Planning, Development, and Construction (UPDC) also oversees contracts pertaining to construction which covers major water system infrastructure projects.
- Ms. Teresa Dominguez is the Director of Environmental Health and Safety (EHS). She is responsible for the team that oversees environmental compliance in planning, construction, permitting, and operational decisions, including those related to water supply
  - Ms. Dominguez is assisted by Mr. James Hutton from the EHS group and Ms. Katie Milardo from the Facilities Operations group on matters related to water supply.

The contract operator for the UConn water system is New England Water Utility Services (NEWUS), a subsidiary of CWC. NEWUS has been the contract operator for the water system since 2006, with its contract most recently renewed in November 2019. NEWUS staff are responsible for the day-to-day operation of the water system and for ensuring that water quality meets state and federal drinking water standards. NEWUS is also responsible for providing 24-hour support to UConn personnel during water system emergencies. NEWUS staff include an assigned water system manager, water system backup manager, and a water system operator, with additional backup staff available.

- Mr. Brant Buhler is the water system manager and the chief operator. His responsibilities include:
  - Scheduling and supervising the water system operators;
  - Preparing regular management reports to UConn personnel;
  - Preparing and updating Standard Operating Procedures for all water system stations;
  - Preparing and implementing a Preventative Maintenance Program for all water system equipment;
  - Supervising purchasing of supplies and equipment;
  - Supervising the preparation of regulatory reports and Consumer Confidence Reports (CCRs);
  - Providing direction to UConn’s on-site primary and/or backup managers to direct the water system staff in the operation of the water systems;
  - Acting as the primary contact for the media in regard to water system operational issues;
  - Performing system checks of the treatment and pumping stations;

Figure 2-1 Water System Management



    - Collecting Connecticut DPH required water quality samples and delivering the samples to a DPH-approved laboratory for analysis;
    - Logging production and/or distribution meter readings;
    - Monitoring equipment for signs of wear and identifying malfunctioning machinery;
    - Maintaining appropriate station logs; and
    - Monitoring the water treatment processes and providing batch treatment chemicals as needed.
- Mr. Tom Kearney is a certified operator and assists Mr. Buhler with field services related to water system maintenance, sampling, inspections, and other field work as listed above.
- Mr. Donnel Dillion is the backup water system manager for times when Mr. Buhler is not available.
- Mr. Don Schumacher is the superintendent of operations for NEWUS.

Additional certified water system operators are assigned from NEWUS as needed for on-site operation and maintenance of water systems on weekends, holidays, after-hours emergencies, and special tasks such as water line flushing and adjusting cross-connections. A Standby Schedule is available to UConn water system managers to ensure that NEWUS staff may be contacted at any time.

2.3 Operator Certification

Section 25-32-9 of the Connecticut Public Health Code (PHC) requires all regulated community water systems with treatment to employ at least one operator who is a certified treatment plant operator. Section 25-32-11 of the PHC requires a certified distribution system operator for regulated systems serving 1,000 or more people. A cross connection inspector and backflow prevention tester must be certified as well.

UConn has contracted the day-to-day operation of its water system to NEWUS who operates the water system consistent with Connecticut PHC requirements. NEWUS personnel who hold treatment plant operator, distribution system operator, and cross connection certifications, and are involved in the operation of UConn's water system, are listed on Table 2-1. Copies of individual certificates are included in Appendix A.

TABLE 2-1
Summary of State Certifications

Individual	Certification Type	Certification Number
Donald Schumacher	Class II Distribution System Operator	DWDO.195068-C2
Brant Buhler	Class III Distribution System Operator	DWDO.201083-C3
Thomas Kearney	Class I Distribution System Operator	DWDO.194019-C1
Donald Schumacher	Class II Water Treatment Plant Operator	DWPO.195129-C2
Brant Buhler	Class II Water Treatment Plant Operator	DWPO.196009-C2
Thomas Kearney	Class II Water Treatment Plant Operator	DWPO.204186-C2
Brant Buhler	Cross Connection Survey Inspector	DWCI.250092
Thomas Kearney	Cross Connection Survey Inspector	DWCI.250064
Brant Buhler	Backflow Prevention Tester	DWBT.204650
Thomas Kearney	Backflow Prevention Tester	DWBT.204406

2.4 Legal Authority and Contractual Agreements

The primary function of the UConn water supply system is to provide the UConn campus with an adequate water supply. State legislation was passed in 1949 authorizing UConn to supply water, sewer, garbage, and waste disposal services. That legislation was amended in 1967 via CGS Section 10-143 which was transferred to CGS Section 10a-138 in 1983. This statute reads that "*The University of Connecticut is authorized to furnish, for compensation, running water and sewage, garbage, and waste disposal service for any property owned or occupied by it or in which it has an interest by reason of a possibility or reverter or of a restriction on alienation in its favor.*"

A number of informal and formal commitments and agreements are in place for the UConn water system. These are described below:

- An agreement was reached in 1969 between MTS and UConn that transferred ownership of the Willimantic River Wellfield to UConn. This agreement provided UConn with the necessary infrastructure and potential well locations to service UConn in the 1970s. The agreement stipulated that UConn would serve MTS. A second agreement was reached in 1993 that transferred the ownership of lands and water system infrastructure held by MTS to UConn after MTS closed. Thus, the MTS campus became part of UConn and known as the Depot Campus. Some of the former MTS lands were transferred to the Connecticut Department of Corrections (DOC) and remained connected to the water system; these lands were later transferred to UConn following closure of the Bergin Correctional Facility in 2011. Homes on Old Colony Road and Spring Manor Lane remained on the system as well. These agreements document the formation of the current water system, but do not commemorate arrangements with separate water systems and/or municipalities; therefore, copies are not included in this *2020 Plan*.

- In the mid-1980s and then again in 2003-2004, UConn reached a series of agreements to serve residential properties on and near Hunting Lodge Road where owners were concerned about potential contamination of their private water supplies by the former UConn landfill. Legal agreements were believed to be in place for some of these commitments. Because these are agreements with individual customers (and are presently superseded by the agreement with CWC), copies are not included in this *2020 Plan*.

- In May 1989, UConn and the Town of Mansfield reached an agreement to provide water and sewer service to Town-owned properties on, and near, South Eagleville Road. The agreement specified which Town-owned properties were to be served by the UConn water system. This agreement is superseded by the December 2013 agreement between UConn and CWC and the January 2014 agreement between the Town of Mansfield and CWC such that a copy is not included in this *2020 Plan*.

- UConn contracted NEWUS to operate its water system in 2006. The water system management contract is regularly rebid, and NEWUS was awarded new contracts in 2010 and 2020. Copies of the operational contracts are maintained in UConn files and are not appended to this *2020 Plan*.

- In November 2006, UConn and Storrs Center Alliance, LLC reached an agreement whereby the UConn would supply up to 170,000 gpd of water to the Storrs Center development area. This agreement is superseded by the December 2013 agreement between UConn and CWC and the January 2014 agreement between the Town of Mansfield and CWC described below such that a copy is not included in this *2020 Plan*.

- As of 2011, UConn was committed to serving three areas of future development and corresponding water service. These were: (1) development in the North Campus area (part of the Main Campus); (2) future development at the Depot Campus; and (3) future development in the King Hill Road area adjacent to North Eagleville Road. Legal agreements were not in place for these three commitments. Subsequent to the December 2013 agreement described below, future development in North Campus may be served by either UConn or CWC depending upon the nature of the development; future development at the Depot Campus will likely be served by UConn; and future development along King Hill Road will be served by CWC.

The process for entering into a new agreement with UConn for water service was previously formalized by the 2006 "University of Connecticut Water System Rules and Regulations". However, in December 2013, UConn and CWC reached an agreement on a long-term water contract to supplement the water supply for the Storrs campus, including the UConn Technology Park, and parts of Mansfield. The agreement calls for CWC to provide UConn up to 1.5 million gallons of water daily as needed over a 50-year term. CWC will charge UConn a State-Owned Infrastructure Rate to reflect the state's ownership and continued operation of the UConn system. The agreement requires UConn to transfer to CWC all fully depreciated off-campus water distribution assets and to license to CWC, for their use, all off-campus water distribution assets, regardless of depreciated value, upon completion of the pipeline interconnection. A copy of this agreement is included in Appendix B. Thus, off-campus areas are now the responsibility of CWC, as established by the December 2013 agreement and the January 2014 agreement described below.

In January 2014, an agreement was reached between CWC and the Town of Mansfield which indicated CWC will serve customers in Mansfield, including the Four Corners area. CWC maintains rates at the existing UConn rate for off-campus customers in Mansfield who had formerly been on UConn's water system. The agreement states that new customers in Mansfield would pay regular residential or commercial rates in effect at the time of connection, as was previously authorized by the Public Utility Regulatory Authority (PURA). A copy of this agreement is included in Appendix B.

Note that if any party in Mansfield is interested in securing a commitment for future water supply from CWC, he or she must submit a request to the Water System Advisory Group (the successor to the Water and Wastewater Advisory Committee) for review and comment. Pertinent to UConn, this includes any potential new buildings on UConn land where the building would not be owned by UConn, such as potential public-private partnerships in the Technology Park. The Group includes UConn and CWC officials as well as representatives from the Town of Mansfield, Town of Coventry, Town of Tolland, and Town of Windham. These officials meet on a semi-annual basis or as needed to discuss growth and usage of the water system. Note that certain controls proscribed by the Record of Decision for the CWC interconnection have been implemented as part of the January 2014 agreement and the Town of Mansfield Zoning Regulations to prevent induced growth related to public water service provided by CWC.

Finally, UConn and CWC prepared a "Standard Operating Procedures" document to guide the operation and maintenance of CWC's off-campus water systems and operation of the CWC interconnection subject to the above agreements. A copy of this document is provided in Appendix B.

2.5 Financial Program

The water supply system that serves the Main Campus and the Depot Campus is owned by UConn. UConn is funded through operating and capital funds. Most of the recent major water system improvements have come through capital funding. The following is a brief overview of these capital funding programs:

- Public Act 95-230 was passed by the Connecticut General Assembly in 1995. More commonly known as the "UConn 2000" Act, this act became a ten-year, $1 billion program, with over 100 capital improvement projects completed.
- The success of the "UConn 2000" program led the Connecticut General Assembly to enact "21st Century UConn" legislation in 2003 that committed an additional $1.3 billion for continuation of the capital improvement projects began under the "UConn 2000" program.
- The NextGen Connecticut legislation (Public Act No. 13-233, 13-184, 14-47), extended the UConn 2000 program through Fiscal Year 2024, and added $1.6 billion in new bond authority.

In addition to these capital-funding initiatives, UConn also receives operating funds from the State of Connecticut. These funds come in the form of an annual block grant.

Prior to the completion of the CWC interconnection and the transfer of off-campus customers from UConn to CWC, UConn also received revenue from the sale of water to off-campus private and commercial customers. Currently, there is a very limited number of private, non-UConn customers from which UConn receives revenue because they continue to be served by the on-campus distribution system. These are described in Section 5.2.3.

UConn's water rate schedule since 1985 is shown in Table 2-2. A uniform meter charge is levied to all customers with meters to cover the cost of reading meters. Metered customers are also charged for actual consumption of water. Note that UConn's water rate schedule includes a flat consumption rate for single-family connections that are not metered. However, the remaining customers who are currently billed by UConn are metered, so the flat rate is not in use at this time.

TABLE 2-2
Summary of Water Rates

Year	Residential Single Family Unmetered	Metered Residential and Commercial		
		First 1,200 cf	Next 10,000 cf	Over 11,200 cf
1985-1986	$25.00	$25.00	$1.50/hcf	$1.00/hcf
1987-1988	$150.00	$25.00	$1.50/hcf	$1.00/hcf
1989	$160.00	$50.00	$1.75/hcf	$1.35/hcf
1990	$176.00	$55.00	$1.93/hcf	$1.48/hcf
1991	$185.00	$60.00	$2.03/hcf	$1.56/hcf
1992-1993	$185.00	$60.00	$2.03/hcf	$1.56/hcf
1994	$195.00	$63.00	$2.13/hcf	$1.64/hcf
1995	$225.00	$72.00	$2.45/hcf	$1.89/hcf
1996-1998	$270.00	$108.00	$2.54/hcf	$2.03/hcf
1999-2003	$300.00	$108.00	$2.54/hcf	$2.03/hcf
2003-2006	$315.00	$113.00	$2.54/hcf	$2.03/hcf
2006-present	$340.00	$3.05/hcf		

Notes: "cf" = cubic feet; "hcf" = hundreds of cubic feet.
UConn currently has a quarterly meter charge of $25.00 per quarter or $100 annually.

As many of the former off-campus customers served by the UConn water system were also sewer customers, the accounting system used to track revenues does not easily breakdown water revenue as opposed to sewer revenue. The amount of revenue collected for water and sewer service from private and commercial users for each year since 1999 is shown in Table 2-3. Note the significant drop-off in residential revenue that began in 2018 once the water customers were fully transferred to CWC billing.

TABLE 2-3
Water & Sewer Annual Revenues

Year	Single Family Residential	Commercial Accounts	Total
1999	$47,750	$201,336	$249,086
2000	$54,030	$284,295	$338,325
2001	$54,150	$175,959	$230,109
2002	$54,900	$302,356	$357,256
2003	$80,175	$412,572	$492,747
2004	$27,075	$576,736	$603,811
2005	$56,382	$473,601	$529,983
2006	$57,638	$458,193	$515,831
2007	$96,684	$443,050	$539,734
2008	$92,700	$490,836	$583,536
2009	$101,983	$747,907	$849,890
2010	$36,035	$665,963	$701,999
2011	$71,314	$570,721	$642,035
2012	$62,096	$624,851	$686,946
2013	$77,808	$633,409	$711,217
2014	$163,193	$670,913	$834,106
2015	$135,195	$305,041	$440,236
2016	$169,735	$273,615	$443,351
2017	$154,963	$224,453	$379,416
2018	$45,364	$80,918	$126,282
2019	$21,457	$322,625	$344,082

Past revenues from the sale of water are not indicative of what future revenues are expected to be now that the CWC interconnection is complete and most off-campus customers have been transferred to CWC. The income from the charges made to off-campus users would not support a water company with a system the size of UConn's. This revenue is not considered to be a significant source of income. State funding remains the primary source of income for the UConn water supply system. The total operating cost of the UConn water system is spread over several departments such that it is difficult to differentiate water system operating funds from other operating funds within each departmental budget.

UConn has made several financial commitments to the maintenance and improvement of its water supply system since 2011 totaling over $14.6 million dollars. The following is a list of projects that included water supply system repairs and upgrades.

TABLE 2-4
Recent Water Supply System Upgrades and Initiatives (2011-2019)

Description	Cost
NEWUS Operation and Management contract ($523,384 per year)	$4,710,456
USGS Streamflow gauge operation ($37,800 per year)	$340,200
Willimantic Well 1 inspection, redevelopment, and pump repair	$67,311
Willimantic Well 2 inspection, redevelopment, and pump repair	$45,176
Willimantic Well 3 inspection, redevelopment, and pump repair	$72,105
Willimantic Well 4 inspection, redevelopment, and pump repair	$54,177
Fenton Tank Clearwell repairs	$12,025
Water Utility Atlas update	$76,828
Willimantic Well building upgrades	$95,756
High Head/Towers Booster building upgrade	$77,555
Meter Pit claval replacement	$5,603
Metering update	$116,665
Insertion valves	$128,540
Repair 100 HP 2750 gpm centrifugal pump at 5.4 MG tank	$43,213
Replace 100 HP pump #2 at High Head pump station	$43,807
Replace 100 HP pump #3 at High Head pump station	$43,807
Pressure wash tanks	$7,803
Clayton Valves - 12	$49,017
Main Water Line Repair and Replacement	$3,750,000
Main Water Line Replacement Phase 2 & CWC interconnection Meter Pit and on-campus segment	$3,492,438
Willimantic Treatment Building – pipe and tank repairs	$46,367
High Head Generator upgrade project	$878,900
EIE for Supplemental Water Supply	$295,510
GWUDI Study for Fenton Well D	$47,200
Low Flow Study of Fenton Well D	$19,190
Water Supply Plan Update Assistance	$41,200
American Water Infrastructure Act Emergency Response Planning	$40,000
Total Upgrades and Initiatives Since 2011	**$14,600,849**

2.6 Water Utility Assets

The assets of the UConn water supply system consist of the following major components:

- Fenton River Wellfield
  - Wells A, B, C, and D
  - Pump house/Lift Station
  - Fenton Wellfield Chemical Facility
  - Underground clearwell basin at Fenton River Wellfield

- Willimantic River Wellfield
  - Wells #1, #2, #3, and #4
  - Willimantic River Wellfield Chemical Facility

- Transmission Mains
  - Willimantic River Wellfield to Depot Campus
  - Willimantic River Wellfield to Main Campus
  - Fenton River Wellfield to Main Campus
  - High Head Reservoir to Towers Standpipes

- Storage
  - W-Lot Reservoir and High Head/Towers Loop Pumping Station
  - Towers Standpipes
  - Depot Campus storage tanks

- Distribution Mains
  - Main and branch lines, valves, and hydrants for the distribution of water to the buildings and facilities of UConn.

Note that main and branch lines, valves, and hydrants for the distribution of water to non-UConn buildings which have not fully depreciated and have not been transferred to CWC, are still owned by UConn. However, CWC is responsible for the operation and maintenance of such off-campus infrastructure. Therefore, for the purposes of this *2020 Plan*, such off-campus infrastructure is considered to be under the control of CWC and is not included in the figures herein.

The replacement cost for the UConn water system, excluding land, was estimated at $26 million in the 1999 *Water Supply Plan*. A 2006 infrastructure report[5] prepared for UConn in September 2006 indicated facility replacement cost of the water system at approximately $23.5 million. This cost is believed to cover all infrastructure, including mains, pumps, and storage tanks in place at that time.

The 2007 *Water and Wastewater Master Plan* provided more in-depth estimates of the value of water system components. The overall replacement costs presented in that document are outlined in Table 2-5. The costs in Table 2-5 are valued in 2007 dollars. Note that the value of the off-campus water mains was estimated at approximately $10.3 million at that time.

[5] ISES, 2006, "Potable Water and Fire Protection Systems Infrastructure Condition Analysis", University of Connecticut.

TABLE 2-5
Probable System Replacement Costs (2007 Dollars)

Item	Cost
Wellfield Replacement	$6,200,000
Pump and Emergency Generator Replacement	$1,236,100
Treatment and Storage Facilities	$12,025,000
On-Campus Water Mains	$7,330,245
Total	**$26,791,345**

While Table 2-5 includes a replacement cost for the two UConn wellfields, it is important to note that these wellfields are invaluable given the current regulatory environment. It is uncertain that permits for similar supply sources and volumes could be obtained in the same, or similar, locations in the future.

2.7 University-Controlled Land

UConn includes two primary campus areas in Mansfield. The Main Campus is located off Route 195 in Storrs, and the Depot Campus is located near the intersection of Route 44 and Route 32 in Mansfield.

The Main Campus was established in 1881 with a gift of land and money from Charles and Augustus Storrs. Additional land was granted by the State of Connecticut in 1893 when the institution became Connecticut's land grant college[6]. Over the years, UConn has expanded through the purchases of additional land surrounding the initial grants, as well as gaining control of land no longer needed by other state agencies.

The Depot Campus consists of land that was originally part of the now defunct MTS, which had been managed by the State Department of Mental Retardation. This State-owned facility opened in 1917 with the merger of the Connecticut Colony for Epileptics (opened at the MTS site in 1910) and the Connecticut Training School for the Feebleminded (originally opened in Lakeville, CT in 1860)[7]. In May 1969, an agreement was reached between numerous State agencies that perpetually granted UConn exclusive use of MTS land, buildings, and equipment on four parcels of land associated with the MTS farm operation. This included water infrastructure such as the Willimantic River Wellfield, piping, pumping stations, and water storage tanks.

The MTS facility was gradually phased out and finally closed in July 1993. The State Legislature transferred the remaining MTS property to UConn under Public Act 93-80. In November 1993, a special Memorandum of Understanding was signed between the State Department of Public Works, UConn, the Department of Mental Retardation, and the Office of Policy and Management regarding the transfer. This document transferred a portion of the MTS property north of Route 44 to the Connecticut DOC that was formerly known as Bergin

[6] Wikipedia, 2010, "University of Connecticut – History", http://en.wikipedia.org/wiki/University_of_Connecticut, Last Accessed October 27, 2010.
[7] Wikipedia, 2010, "Mansfield Training School and Hospital", http://en.wikipedia.org/wiki/Mansfield_Training_School_and_Hospital, Last accessed October 27, 2010.

Correctional Institution. UConn acquired the remaining property and all water system infrastructure. In 2015, the portion of the former MTS property that had been in the custody of DOC was transferred to UConn.

In total, state land in the custody and control of UConn consists of approximately 3,230 acres in Mansfield. Approximately 707 acres (22%) of this land is associated with the Depot Campus. Much of the land owned by UConn is undeveloped. Parcels under the control of UConn are presented in Table 2-6, which also indicates properties that contain water supply system assets described in this *2020 Plan*. Figure 2-2 is a map of Mansfield showing UConn-controlled land listed in Table 2-6.

TABLE 2-6
UConn-Controlled Land in Mansfield

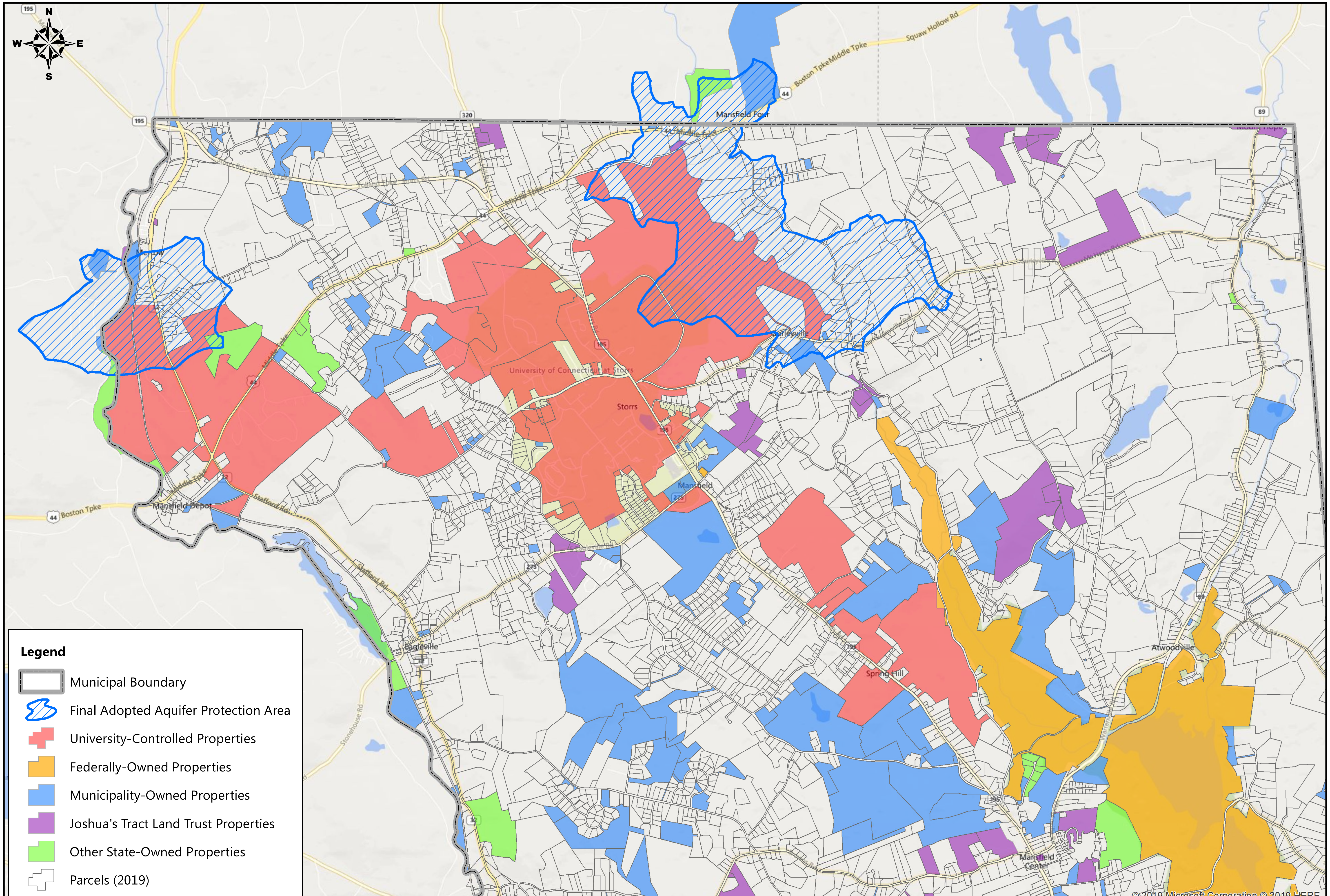
Map.Block.Lot	Location	Comment	Acres	Includes or is Served by Water System Assets
13.13.1	251 Middle Turnpike	Bergin Correctional Facility, Depot Campus	181.50	Yes
13.17.1	Middle Turnpike	Agriculture	5.09	No
14.18.DC2128	1279 Stafford Road	Multi-family residence	5.33	No
14.18.DC2187	30 Plains Rd	Plains Road Sewer Lift Sta.	10.85	No
14.18.19	Middle Turnpike	Depot Campus	233.64	Yes
14.21.2	Northwood Rd	Includes Northwood Apartments west of Northwood Road	139.47	No
14.28.5	Bonemill Road	Pink Ravine Lab / Old Treatment Plant	0.36	No
15.21.UC1036	Northwood Rd	Northwood Apartments east of Northwood Road	6.34	No
15.32.1	29 King Hill Road	Vacant	0.49	No
15.32.15	Storrs Rd / N Eagleville Rd	Main Campus	371.64	Yes
15.32.18-1	Separatist Rd	Vacant	7.90	No
15.32.2	29 King Hill Road	Largely vacant, some parking	12.44	No
15.32.3	King Hill Road	Lot L Parking	4.08	No
15.32.4	17 King Hill Road	Lot X Parking	5.18	No
15.32.5	Hunting Lodge Road	Vacant	8.43	No
15.32.UC1098	1595 Storrs Road	Northern Discovery Drive - Vacant	77.33	Yes
15.33.2	King Hill Road	Vacant	0.91	No
15.33.6	16 King Hill Road	Ted's	0.18	No
16.32.UC314	1 Hillside Road	Single family residence	0.85	No
16.36.UC227	14 Eastwood Rd	Single family residence	0.46	No
16.36.UC424	25 Hillside Circle	Single family residence	1.51	No
16.38.1	Storrs Rd / Gurleyville Rd	Holcomb, Whitney, Sprague Halls	14.50	Yes
16.38.UC243	75 Willowbrook Rd	Single family residence	4.94	No
16.39.UC219	10 Willowbrook Rd	Single family residence	5.39	Yes
16.40.10	9 Oak Hill Road	Buckley & Shippee Halls	10.06	Yes

TABLE 2-6
UConn-Controlled Land in Mansfield

Map.Block.Lot	Location	Comment	Acres	Includes or is Served by Water System Assets
16.40.10-B	1 Dog Lane	Storrs Center	2.14	No
16.57.UC179	1 South Eagleville Rd	Mansfield Apartments	16.80	No
16.62.6	Agronomy Rd	Plant Science Research & Education Facility	156.64	No
23.60.18	Storrs Road	Agronomy Research Farm	62.56	No
23.63.UC1011	950 Storrs Rd	Agronomy Research Farm	41.04	No
23.63.UC1050	986 Storrs Rd	Agronomy Research Farm	21.41	No
23.63.UC1088	968 Storrs Rd	Agronomy Research Farm	9.70	No
23.64.7	Storrs Rd / Chaffeeville Rd	UConn Research Forest	208.13	No
3.25.10	Gurleyville Rd / Old Turnpike Rd	UConn Forest / Horsebarn Hill Facilities / Fenton Wellfield	712.47	Yes
7.12.5	Spring Manor Ln	Spring Manor Farm	156.26	Yes
7.12.6	Spring Manor Ln	Spring Manor Farm / Willimantic River Wellfield	114.19	Yes
8.23.1-4	Discovery Drive	Vacant	3.93	No
8.23.11	Storrs Rd / N Hillside Rd	Technology Park / Charter Oak Apartments	207.64	Yes
8.23.16	Hunting Lodge Road	Hillside Environmental Education Park	63.46	Yes
8.23.16-1	1 Penner Place	Celeron Square Apartments	19.33	No
8.23.16-2	Hunting Lodge Road	Vacant	17.43	No
8.23.2-3	Discovery Drive	Vacant	3.53	No
9.23.15	Storrs Rd	W-lot, Husky Village, Towers, Floriculture	57.14	Yes
9.23.23	46 North Eagleville Road	Saint Thomas Aquinas Chapel	2.07	Yes
9.23.27	North Eagleville Road / North Hillside Road	North and Northwest Residence Halls, Facilities, Water Pollution Control Facility	84.28	Yes
9.24.UC1092	1590 Storrs Rd	Single family residence	3.02	No
9.25.1	Storrs Rd	Horsebarn Hill, East Campus	163.20	Yes
		Total	**3,235.24**	-

UConn also maintains several easements related to former off-campus portions of its water systems that cross private property. These easements are related to water mains that are currently under the control of CWC and are listed below:

- Multiple sections of the 8-inch water main along Route 32 from Spring Manor Lane to Depot Road area;
- Mains serving Mansfield Apartments on South Eagleville Road; and
- A portion of the 10-inch main serving Northwood Apartments near North Eagleville Road.



Sources:
-Land ownership defined within Mansfield and within Level A Aquifer Protection Areas in Coventry and Willington. Ownership of parcels based on best-available data from UConn and online assessors' databases through August 2019. Delineations may not be exact.
-Base map provided by Microsoft via ESRI subscription service.
-Aquifer Protection Areas courtesy of CT DEEP.

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REVISIONS

8/29/2019

University, State, Federal, Municipality-Owned, and Land Trust Lands

University of Connecticut Water Supply Plan

Storrs, Connecticut

SJB	EA	SJB
DESIGNED	DRAWN	CHECKED

SCALE: 1" = 3000'

DATE: 5/5/2011 (Orig.)

PROJECT NO: 1958-119

MXD NAME: Y:\Figure2-2.MXD

FIGURE 2-2

SHEET NO.

3.0 EXISTING WATER SUPPLY SYSTEM

3.1 Overall System Description

The UConn water system was originally installed to provide potable water just to the Main Campus, but was expanded, through a variety of contractual agreements, to provide water to the Depot Campus as well as select off-campus users. As of December 2016 (when the CWC interconnection was permanently activated), commercial, institutional, and residential properties in the Town of Mansfield that are not owned by UConn, as well as certain UConn facilities away from the campus core, began to receive service from CWC. Thus, the water system currently serves all on-campus buildings, residence halls, and apartments at both the Main and Depot Campuses, as well as a handful of remaining off-campus customers.

The ADD for UConn properties in 2019 was 1.05 mgd, of which 0.72 mgd was drawn as potable water from the two UConn wellfields, and 0.33 mgd was generated for non-potable use by the RWF. No water was purchased from the CWC interconnection. PDD in 2019 was approximately 2.05 mgd, occurring in the month of September, including both potable water and RWF flows. Section 5.0 of this *2020 Plan* provides a more detailed overview of system demands.

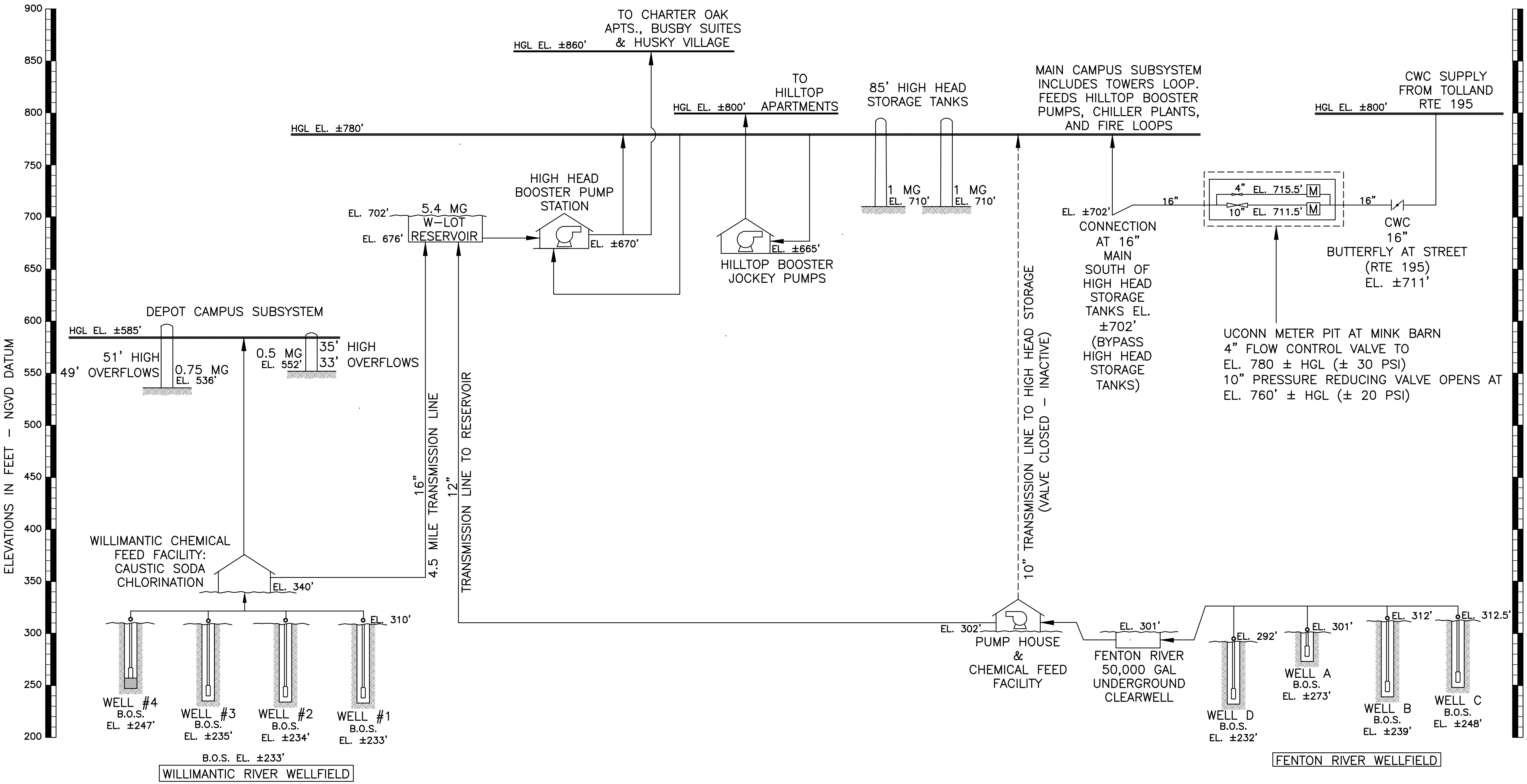
The UConn water system includes seven wells, 6 potable water storage tanks, and approximately 31 miles of water transmission and distribution mains. The system also includes a dedicated fire loop, 146 hydrants, two treatment facilities (one for each wellfield), and numerous transfer pumps located at four pumping stations. Appended Figure 1 depicts major system components. Figure 3-1 is a schematic diagram of the water supply system. Ground water sources are discussed in detail in the ensuing text. Other system components are discussed in Section 4.0 of this *2020 Plan*.

As UConn is a state-wide entity, it operates facilities in other locations that are served by other water systems as well as one smaller public water system that is summarized below.

- UConn Avery Point (Groton): Groton Utilities
- UConn Hartford: Metropolitan District Commission
- UConn Health Center (Farmington): Metropolitan District Commission
- UConn School of Law (Hartford): Metropolitan District Commission
- UConn Stamford: Aquarion Water Company
- UConn Waterbury: City of Waterbury Water Department

UConn formerly operated a Torrington regional campus, but that property was sold in 2019, and UConn no longer operates or maintains a public water system in Torrington. When UConn was operating the Torrington regional campus water supply system, it was classified as a Non-Transient, Non-Community Water System (public water system #CT1435053) by the Connecticut DPH, and the system served approximately 400 commuting students and 40 faculty. The new owner of the Torrington campus property is now responsible for the water supply wells that serve that property. Note that UConn currently leases one building on the Torrington property that is occupied by one of the UConn agricultural extension programs, with water provided by agreement with the new owner.

UConn also has a potable water supply system at the Agronomy Farm in Mansfield located along Route 195 to the south of the Main Campus. However, this water system does not meet the threshold for a public water supply and further discussion of that system is not included herein.



NOTES:
1. DIAGRAM IS FOR SCHEMATIC PURPOSES ONLY. BUILDINGS, TANKS, PUMPS AND DISTANCE BETWEEN STRUCTURES NOT TO SCALE.
2. B.O.S.: BOTTOM OF SCREEN

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SCHEMATIC DIAGRAM
UNIVERSITY OF CONNECTICUT
WATER SUPPLY PLAN
STORRS CAMPUS
MANSIELD, CONNECTICUT

SJB	CME	SJB
DESIGNED	DRAWN	CHECKED

SCALE NTS
DATE DECEMBER 2019
PROJECT NO. 1958-119-04
SHEET NO. FIG. 3-1

Note that for the purposes of this document, the term "water system" refers to the water system of the Main Campus and the Depot Campus in Storrs and Mansfield and not to public water service providers at any of the regional campus systems, or to the small non-public well system at the Agronomy Farm.

3.2 Water Supply Sources

UConn utilizes seven active wells located at two wellfields as the primary source of water for the Main Campus and Depot Campus. Additional potable water is provided by the CWC interconnection, and non-potable water (to offset potable water demands) is provided by the RWF. Four of the UConn wells (three active, one emergency) are located in the stratified drift aquifer beneath the Fenton River (drainage basin #3207), a tributary to the Natchaug River. The remaining five UConn wells (four active, one inactive) are located in the stratified drift aquifer beneath the Willimantic River (drainage basin #3100), a tributary to the Shetucket River.

3.2.1 Fenton River Wellfield

The Fenton River Wellfield consists of three active wells (Well B, Well C, and Well D) and one emergency well (Well A) located along the Fenton River north of Gurleyville Road in Mansfield, Connecticut. Figure 3-2 is a location plan of the Fenton River Wellfield. Well specifications are summarized in Table 3-1. During calendar year 2019 the Fenton River Wellfield provided 58% of the water used by the UConn water system, a greater percentage than the 20% historically produced (see Section 5.3 for more details).

TABLE 3-1
Fenton River Wellfield Specifications

Specification	Well A	Well B	Well C	Well D
Year Drilled	1926	1949	1949	1957
Type	Caisson	Gravel Packed	Gravel Packed	Gravel Packed
Depth	28 feet	70 feet	60 feet	58.5 feet
Diameter	24 feet	18-inch x 8-inch	18-inch x 8-inch	10-inch x 8-inch
Well Safe Yield	400 gpm[1]	838.4 gpm[2]	718.6 gpm[2]	450.2 gpm[2]
Screen Details	18.0-28.0 feet, caisson	52.0-70.0 feet, 0.090-slot	42.0-60.0 feet, 0.090-slot	43.0-58.5 feet, 0.045-slot
Pump Setting	28.0 feet	48.2 feet	39.2 feet	43.5 feet
Pump Type	5 HP LST[3]	10 HP LST	10 HP LST	25 HP LST
Design Pump Capacity	400 gpm @ 38' TDH[3]	400 gpm @ 45' TDH	400 gpm @ 40' TDH	354 gpm @ 66' TDH
Status	Emergency	Active	Active	Active

Notes:
1. Estimated during pumping test in the 1940s as discussed in 2004 *Water Supply Plan*. This yield test may not have met current safe yield guidelines.
2. Determined by UConn *Safe Yield Study* dated March 2020.
3. LST = Line Shaft Turbine; TDH = Total Dynamic Head

Date Saved: 5/10/2020
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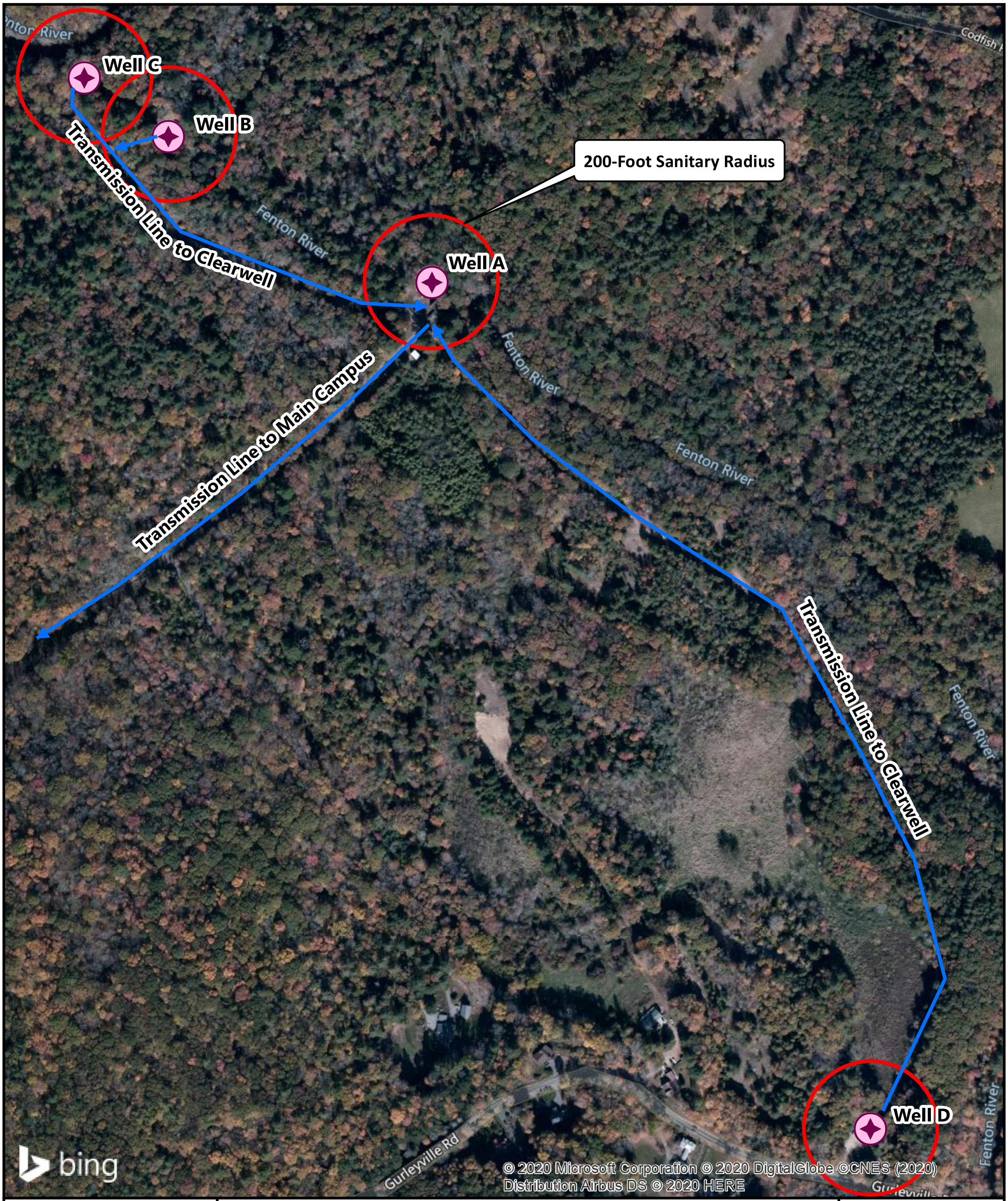

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FENTON RIVER WELLFIELD
WATER SUPPLY PLAN
UNIVERSITY OF CONNECTICUT
GURLEYVILLE ROAD
MANSFIELD, CT

N
0 400
Feet

SCALE 1 " = 400 '
DATE 5/10/2020
PROJ. NO. 1958-119

FIG. 3-2

Well A was the first well developed in the Fenton River Wellfield. It was drilled in 1926 by UConn to replace the Pink Ravine surface water supply which was owned by the Town of Mansfield at that time. Well A (with two pumps installed) was likely UConn's sole source of water supply until Wells B and C were developed in 1949. Well D was added in 1959 to provide an additional water supply source to the UConn system. Well A is presently an emergency well and is physically disconnected from the system to avoid accidental usage.

Water from the four Fenton wells is directed into a 50,000-gallon clearwell (underground tank) located near Well A. Water leaving the clearwell is treated with sodium hypochlorite (chlorine) for disinfection and sodium hydroxide (25% caustic soda) for pH adjustment and corrosion control after it passes the flow meter. The treatment system for the Fenton River Wellfield is located on the pump house road. The treatment building was constructed in 1993. The chemical dosages are paced to flow from a 4-20 milliamp signal. An automatic chlorine residual analyzer continuously measures and records the chlorine residuals.

Water in the clearwell is typically transferred to the Main Campus pressure zone by two booster pumps rated at 550 gpm and 1,000 gpm. This water is directed to the 5.4 MG underground reservoir at W-Lot where it mixes with finished water from the Willimantic River Wellfield. Alternatively, the transmission main from the Fenton clearwell can also direct water into the two 1.0 MG water storage tanks near the Towers Residence Halls, although this valve is typically closed.

Activation of the wellfield is normally dictated by a timer schedule or by the water level within the 50,000-gallon clearwell. Currently the wells are on a "first start – second start" system. Wells B and C are "first start" and Well D is the "second start." Alarm, status, and initiation signals (on/off) are transmitted to the existing UConn Supervisory Control And Data Acquisition (SCADA) system using the existing remote telemetry system located at the facility. Well A is reserved for emergency use at the present time but can be added to the operational schedule as needed upon completion of any necessary potability testing prior to reactivation. The pumps that transfer the water from the clearwell to the campus operate on a timer.

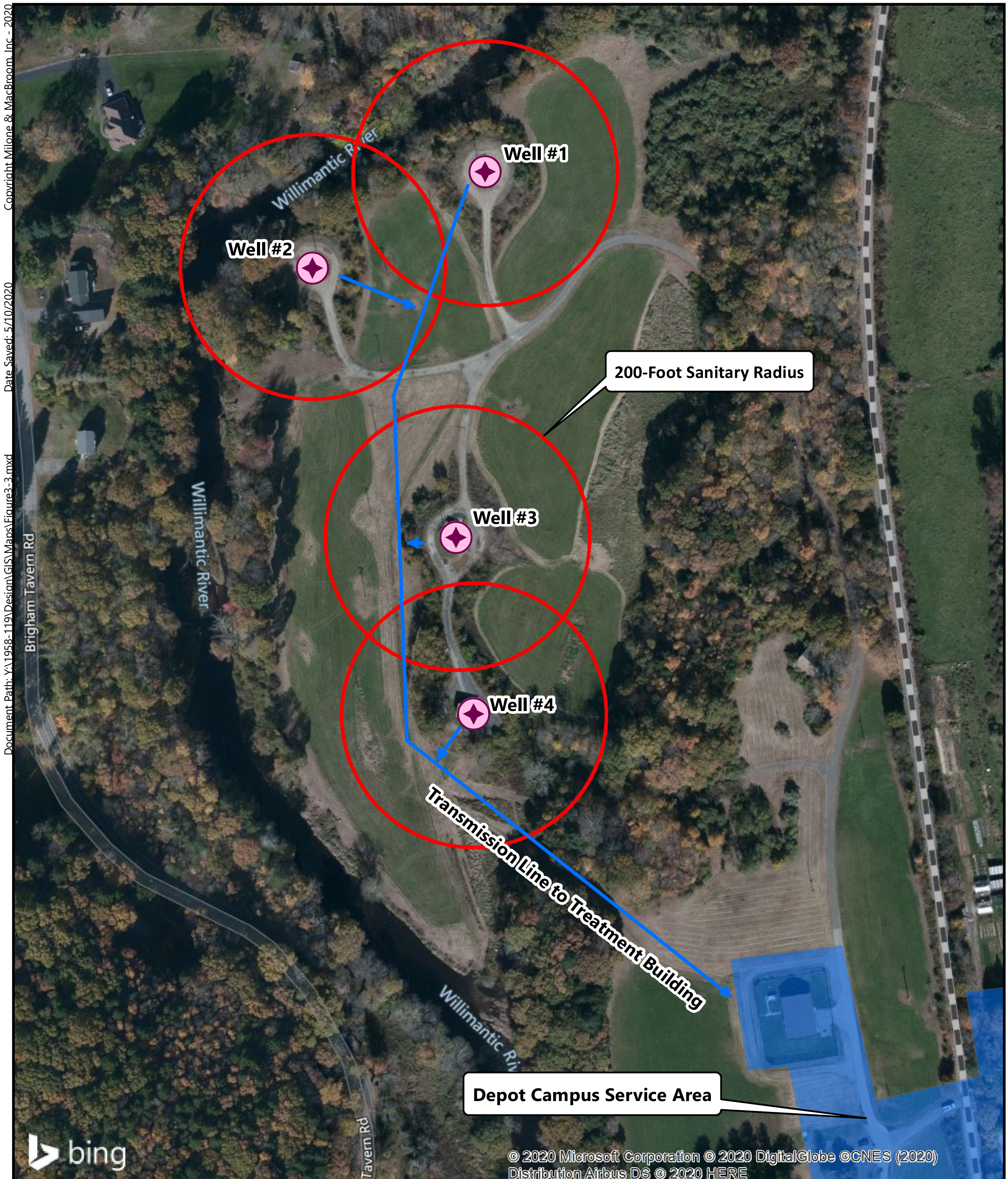
A 400-kilowatt (kW) diesel powered generator provides emergency power to the majority of the Fenton River Wellfield, including power to Wells A, B, C and D, the high lift pumps, the chemical feed pumps, and lighting.

3.2.2 Willimantic River Wellfield

The Willimantic River Wellfield consists of four active wells (Well #1, Well #2, Well #3, and Well #4) and one inactive well (MTS Well #2) located along the Willimantic River west of Spring Manor Farm (and Route 32) and north of Route 44 in Mansfield, Connecticut. Figure 3-3 is a location plan of the Willimantic River Wellfield.

Each well has an above-grade pump house that protects the well and houses a vertical turbine pump and motor, motor drive, valves, and ancillary equipment. Well specifications are provided in Table 3-2. Each well has variable frequency drive (VFD) controls. In 2019, the Willimantic River Wellfield provided 42% of the water used by UConn, which is atypical but partially due to ongoing well redevelopment activities at the wellfield.

The first well utilized at the Willimantic River Wellfield was installed around 1913 for MTS. It was a 24-foot diameter, 16.5-foot deep dug well. This well (known as MTS Well #1) had insufficient yield to supply MTS in the 1940s and was supplemented by MTS Well #2. MTS Well #1 was taken offline in 1961 after the activation of MTS Well #3 (now Well #3). MTS Well #1 was formally abandoned in 1998; its pump house was dismantled, and the well cavity was filled per Connecticut DPH well abandonment guidelines.



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WILLIMANTIC RIVER WELLFIELD

WATER SUPPLY PLAN
UNIVERSITY OF CONNECTICUT
SPRING MANOR LANE
MANSFIELD, CT

N

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Feet

SCALE	1 " = 200 '
DATE	5/10/2020
PROJ. NO.	1958-119

FIG. 3-2

TABLE 3-2
Willimantic River Wellfield Specifications

Specification	Well #1	Well #2	Well #3	Well #4	MTS Well #2
Year Drilled	1970	1974	1958	1998	1948
Type	Gravel Packed	Gravel Packed	Gravel Packed	Gravel Packed	Gravel Packed
Depth	77 feet	78 feet	80.3 feet	65 feet[3]	60 feet
Diameter	30-inch x 16-inch	24-inch x 14-inch	24-inch x 8-inch	20-inch x 12-inch	12-inch
Well Safe Yield	559.7 gpm[1]	280.3 gpm[1]	550.3 gpm[1]	624.8 gpm[1]	525 gpm[2]
Screen Details	56.5-77.0 feet, 0.065-slot	68.3-78.0 feet, 0.100-slot	58.8-80.3 feet, 0.045-slot	43.0-58.0 feet, 0.080-slot	N/A
Pump Setting	71.1 feet	58.8 feet	71.2 feet	56.3 feet	N/A
Pump Type	100 HP LST	30 HP SUB[4]	100 HP LST	100 HP LST	N/A
Design Pump Capacity	400 gpm @ 555' TDH	210 gpm @ 420' TDH	600 gpm @ 500' TDH	540 gpm @ 484' TDH	N/A
Status	Active	Active	Active	Active	Inactive

Notes:
1. As calculated in *Safe Yield Study* dated March 2020.
2. As reported in *Hydrogeologic Data for the Shetucket River Basin* (1967)[8].
3. The bottom 7 feet of Well #4 is a sump and not screened as it has a lower hydraulic conductivity.
4. SUB = Submersible pump

MTS Well #2 was the first gravel-packed well developed at the Willimantic River Wellfield. It was drilled in 1948 to supplement MTS Well #1. Well #3 (formerly MTS Well #3) was constructed in 1958 to replace MTS Well #1. It was around this time that the residential population (and water demand) of MTS was reportedly reaching its peak.

Similarly, the UConn water system (at the Main Campus) was experiencing increased demand in the 1960s, and UConn began looking for additional sources of water to supplement the Fenton River Wellfield. In 1969, UConn and MTS reached an agreement where MTS transferred the Willimantic River Wellfield to UConn, and in return the UConn would provide potable water to MTS. MTS retained MTS Well #2 as a backup well, and UConn renamed MTS Well #3 to Well #3.

UConn commissioned several hydrogeologic studies in the late 1960s that suggested the Willimantic River Wellfield could support a total of six wells in addition to maintaining MTS Well #2 as a backup well. Only two of the four proposed wells were actually drilled: Well #1 was drilled in 1970 and Well #2 was drilled in 1974. MTS Well #2 was transferred to the UConn in 1993 after the closure of MTS, and UConn installed Well #4 in 1998 to replace the function of MTS Well #2. MTS Well #2 lies within the Well #4 pumphouse structure and is currently inactive; it is disconnected from the system and is only used as a water level monitoring point when necessary. UConn has no intention of formally abandoning MTS Well #2 at this time.

Water from the four Willimantic wells is directed to the chemical feed building near the railroad crossing at the western terminus of Spring Manor Lane. The building consists of a 65-foot by 45-foot concrete structure built in

[8] https://pubs.usgs.gov/ctwrb/0012/report.pdf

2010. Treatment includes the addition of sodium hypochlorite (chlorine) for disinfection and sodium hydroxide (25% caustic soda) for pH adjustment and corrosion control.

Each chemical feed system consists of one bulk tank and one day tank, two chemical metering pumps (one active and one spare) and associated chemical appurtenances. The chemical feed system is flow paced, using an on-site raw water magnetic flow meter. Alarm, status, and initiation signals (on/off) are transmitted to the existing UConn SCADA system using the existing remote telemetry system located at the facility. The treatment system can deliver a maximum capacity of 2.3 mgd of treated water. An automatic chlorine residual analyzer continuously measures and records chlorine residuals. Refer to Section 4.1 for more information about treatment.

After leaving the chemical feed building, flow is directed into the 16-inch diameter transmission main running to the Main Campus, or to the transmission main running to the Depot Campus. The transmission split occurs inside the building. Both transmission mains were replaced in their entirety in 2015-2016. The 16-inch diameter transmission main to the Main Campus delivers water to the W-Lot 5.4 MG reservoir.

A transformer pad at the chemical feed building provides a step down from the existing 13.8 kilovolt (kV) service to 480-volt (V) service for the wellfield. The chemical feed facility also houses a 600 kW generator to provide emergency power to the chemical feed equipment and the four well pumps. Normal and emergency 480 V service is provided through an underground electrical distribution system.

3.2.3 Reclaimed Water Facility

Consideration for treating wastewater for reuse on the Main Campus dates back to the early 2000s. The 2004 Campus Sustainable Design guidelines developed for UConn proposed several water reuse strategies, including the potential for treating water for reuse. Coincident with the completion of the Fenton River Study in 2006, the infrastructure conditions assessment performed for UConn that same year recommended an expansion of the UConn Water Pollution Control Facility (WPCF) to include a new wastewater treatment system capable of providing up to 0.5 mgd of treated effluent for reuse on campus. While the capacity of the two wellfields were adequate for typical demand, there was a concern that the capacity of the Fenton River Wellfield would be reduced, or unavailable, during prolonged periods due to low streamflow conditions.

The RWF project was therefore recommended as a means for reducing the demand for water from the Fenton River Wellfield and reducing the overall impact of the wastewater discharge to the Willimantic River. UConn began to further explore this approach in the 2007 *Water and Wastewater Master Plan*[9], culminating in a study completed by the firm Hazen & Sawyer in 2008 which indicated that the use of treated wastewater at the CUP was feasible.

Campus water demand is typically at its highest in September when the students return for fall semester classes; this highest-demand time period often coincides with low stream flow in the Willimantic and Fenton Rivers. Water demands are typically lowest in May when the students leave campus and the summer cooling load at the CUP is not at its peak. Peak demands at the CUP typically occur in the summer months due to increased cooling demands.

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[9] https://envpolicy.uconn.edu/wp-content/uploads/sites/1389/2015/08/FINAL-UConn-Water-and-Waste-Water-Master-Plan.pdf

The CUP utilizes water in its boilers, chilled water systems and cooling towers. Prior to construction of the RWF, potable water was used to fulfill all CUP demands. Water for the boiler system is softened and demineralized via reverse osmosis (RO). Water for the cooling towers and chilled water system is treated for scale, corrosion, and biological growth control. The annual average water consumption for the CUP is 0.25 mgd but consumption can peak as high as 0.45 mgd. Boiler makeup water demand peaks in the winter months, while cooling tower makeup water demand, which is considerably higher than boiler makeup water demand, peaks in the summer. The summer peak season runs from late June to early September and coincides with the lower seasonal flows at the WPCF.

The 2008 feasibility study was referenced in the 2011 *Water Supply Plan*, which noted that the CUP requires an average flow of 0.4 mgd during peak months that could be replaced by non-potable water. Based on the analysis in the 2011 *Water Supply Plan*, it became evident that constructing a RWF could be implemented quickly to reduce wellfield withdrawals and improve system margin of safety. Thus, the short-term intent of the RWF was to generate non-potable water for use at the CUP, thereby freeing up potable water that would otherwise be used at the CUP. Additional uses for the reclaimed water, such as irrigation and toilet water flushing, were also envisioned. As such, a facility with a larger treatment capacity was ultimately designed (capacity of 1 mgd).

In 2013, the RWF was brought online. The WPCF receives sanitary wastewater from both the Main and Depot campuses as well as reject waste streams from the RWF and the CUP. The treated secondary effluent becomes the input into the RWF with the excess secondary effluent is discharged to the Willimantic River. The RWF draws secondary effluent from the chlorine contact tank at the WPCF and processes the water through membrane microfiltration and ultraviolet light (UV) disinfection systems. The reclaimed water is transferred to a 1.0 MG finished water storage tank and then pumped to a greywater distribution system (separate from the potable water system) after disinfection with chloramine. Distribution system uses presently include the CUP (evaporative cooling and boiler make-up water), the cooling system and for toilet flushing at the IPB, and for toilet flushing at the Engineering and Science Building (ESB). Connection to the Werth Residential Tower for cooling and toilet flushing is pending. When these facilities return their waste streams to the WPCF via the sanitary sewer system, the "reclaimed water loop" is completed.

3.2.4 Interconnection with The Connecticut Water Company

The 2011 *Water Supply Plan* identified CWC as one of several alternatives for providing additional potable water supply to UConn. UConn retained MMI in 2011 to conduct an Environmental Impact Evaluation (EIE)[10] under the Connecticut Environmental Policy Act (CEPA) which fully evaluated the potential environmental impacts of different water supply options. Ultimately, an interconnection with CWC was found to be the preferred alternative in the 2013 Record of Decision for the EIE. Following this determination, UConn and CWC coordinated on a water diversion permit application in 2013 authorizing the transfer of water from CWC to UConn and customers in Mansfield, as well as a December 2013 contractual agreement and "Standard Operating Procedures" document (Appendix B) regarding operation of the interconnection and service to off-campus customers previously served by UConn.

[10] https://envpolicy.uconn.edu/cepa-reports-and-related-documents-for-water-supply/

CWC is presently authorized by DEEP Diversion Permit #DIV201404187 (issued June 2, 2015) to transfer a maximum of 1.85 million gallons per day of potable water from CWC's Northern Operations Western System in Tolland to Mansfield and the UConn public water system. A copy of this water diversion permit is included in Appendix C. The permit expires on May 29, 2040.

Construction of the interconnection was completed in 2016. The CWC water main connects to a meter pit owned by UConn prior to connection with the UConn water supply infrastructure. CWC is responsible for maintaining the interconnection meter. As shown on Appended Figure 1, the interconnection between CWC and UConn is located at the north end of the Main Campus near Route 195.

CWC connects to many of its Mansfield customers through the UConn water system. The contractual agreement between UConn and CWC specifies specific properties which are now served by CWC. These properties are also depicted on Appended Figure 1. CWC provides water service to the properties formerly served by UConn through a series of consecutive water systems (note that detailed descriptions of these systems are now beyond the scope of this *2020 Plan*):

- The CWC UConn Depot Division (former service area off the Depot Campus);
- The CWC UConn Hunting Lodge Division (former service area near Hunting Lodge Road);
- The CWC UConn South Eagleville Division (former service area near South Eagleville Road); and
- The CWC UConn Willowbrook Division (former service area near Willowbrook Road).

In general, the CWC interconnection is operated each day to provide a balance of water. These off-campus areas continue to generally be served with water produced by UConn at its wellfields. The formerly served non-UConn properties that are now CWC customers are metered so CWC can track water use and bill these customers accordingly. Per the contractual agreement, CWC ensures that the amount of water entering from the Western System (as measured at the meter pit) is consistent with the demand in each of the consecutive systems, such that inflow to the UConn system is net neutral with the outflows to these CWC consecutive water systems. Flow rates through the interconnection are controlled remotely by the UConn SCADA system. Thus, although water produced at UConn wellfields continue to serve these areas, the demand is offset by water moving through the interconnection into the UConn system.

Note that to date UConn has not purchased any water from CWC through the interconnection for its internal use. Nevertheless, the interconnection remains an important redundant source of supply for UConn, as well as the means by which a significant decrease in water demand on the Fenton River and Willimantic River Wellfields (through the transferring of customers to CWC) has been realized.

3.3 Source Water Assessment

The Connecticut DPH, in conjunction with the DEEP, completed a *Source Water Assessment Report – An Evaluation of the Susceptibility of Public Drinking Water Sources to Potential Contamination* for the Fenton River Wellfield and the Willimantic River Wellfield in 2003. Appendix D contains copies of the two reports.

Both assessments were completed in accordance with the requirements of the 1996 amendment to the Safe Drinking Water Act. As stated in the reports, an assessment can be used to target and implement enhanced source water protection measures such as inspections, land use regulations, land acquisitions, septic system maintenance, and education.

3.3.1 Fenton River Wellfield

The Fenton River Wellfield has a "low" rating for environmental sensitivity (indicating that the source water area is not sensitive), a "low" rating for potential risk factors (indicating that the source water area has low risk), and a "low" rating for source protection needs (indicating protection of the water source is generally good, at this time). The overall susceptibility rating indicated for the Fenton River Wellfield is "low."

Listed strengths of the source water area are the adoption of local aquifer protection regulations, a Public Water System Source Protection Program, and the fact that less than 10% of the source water area is currently developed for commercial or industrial use. Recommendations of the source water assessment report include maintaining monitoring levels found in the PHC, working with local officials to ensure that only low-risk development occurs in the source water area, and acquisition of open space in the source water area.

3.3.2 Willimantic River Wellfield

The Willimantic River Wellfield also has a "low" rating for environmental sensitivity (indicating that the source water area is not sensitive), a "low" rating for potential risk factors (indicating that the source water area has low risk), and a "moderate" rating for source protection needs (indicating protection of the water source is fair and has some room for improvement at this time). The overall susceptibility rating for the Willimantic River Wellfield is "low."

Listed strengths of the source water area are the same as those for the Fenton Wellfield which include: the adoption of local aquifer protection regulations; a Public Water System Source Protection Program; and the fact that less than 10% of the source water area is currently developed for commercial or industrial use. Recommendations of the source water assessment report include maintaining monitoring levels found in the PHC, monitoring around known contaminant release points, working with local officials to ensure that only low-risk development occurs in the source water area, the completion of Level A mapping (completed by UConn in 2007), and acquisition of open space in the source water area.

3.4 Source Water Protection

UConn and the Town of Mansfield understand the importance and significance of the Fenton River and Willimantic River aquifers and are proactive in their efforts to protect these ground water resources. Furthermore, it is the duty of UConn to ensure the protection and quality of drinking water by following appropriate source water protection strategies. UConn has taken steps to implement some of the recommendations of the *Source Water Assessment Reports,* balancing these actions with the desire to develop land in an environmentally friendly manner. The following is a list of efforts, assessments, and oversight being applied to source water and aquifer protection by UConn.

- UConn controls nearly all of the land within the 200-foot sanitary radius around each of its potable water supply wells (See Figure 3-2 and Figure 3-3). Land that UConn does not control within that radius of each well is not believed to be developable due to its proximity to the Fenton River or the Willimantic River.

- UConn has completed Level A mapping delineating the areas of contribution and recharge to both its wellfields.

- UConn has confirmed the Towns of Mansfield, Willington, and Coventry administer local aquifer protection area (APA) regulations for land that includes the two wellfields. Refer to Section 3.5 below for additional information.

- UConn and/or its contract operator visit both wellfields each day to ensure that equipment is operating properly, grounds are in order, and there are no activities taking place that would be of environmental concern.

- UConn directly interacts with the staff of the Windham Water Works regarding watershed protection in the Fenton River watershed, which is a subset of the watershed above the Windham Water Works' Willimantic Reservoir.

- UConn follows the requirements of CEPA before any major project is constructed. The environmental review process is overseen by the Connecticut Office of Policy and Management and provides an opportunity for all state agencies and interested parties to review and comment on a project before it is allowed to be constructed.

- UConn has developed a close working relationship with the Town of Mansfield regarding development projects occurring both on- and off-campus. Representatives of the Town of Mansfield were part of the Technical Advisory Group for both the Fenton River Study and the Willimantic River Study, and also serve on the Water System Advisory Group.

- UConn encourages input from the public during its Water System Advisory Group meetings, particularly from watershed advocates such as the Naubesatuck Watershed Council and the Willimantic River Alliance.

- The Water System Advisory Group is charged with reviewing the Town of Mansfield and UConn source protection and aquifer protection activities.

The Town of Mansfield has been encouraging watershed protection along the Willimantic River and Fenton River and near their respective wellfields for decades through its Zoning Regulations and Inland Wetland Regulations. Additional protections are enforced through these regulations for land in the public water supply watershed of Windham Water Works, which overlaps with the Fenton River APA.

Refer to Figure 2-2 for a depiction of UConn-controlled, other State-owned, municipal-owned, and land trust lands in the APAs associated with the Fenton River and Willimantic River Wellfields. The following land ownership within the APAs is noted:

- The central and southeast portions of the Willimantic River APA are controlled by UConn. The Town of Mansfield owns a tract of land to the north along the river, Joshua's Trust owns a parcel directly across the river to the west of the Town-owned land, the Town of Coventry owns some land on the western side of the river in Coventry, the State owns a landlocked parcel at the southeast corner of the APA as well as some land along the river in Coventry, and the remainder is privately-owned.

- The western portion of the Fenton River APA is largely UConn- controlled land, with a small parcel owned by Joshua's Trust on Old Turnpike Road. The Town of Mansfield owns one parcel along Route 44 and several parcels near Gurleyville Road on the southern end of the APA. The State and the Town of Willington own land in Willington to the north of Route 44. The remainder of the land in the APA is privately owned.

- The UConn-controlled land in the Willimantic River APA is coincident with a portion of the UConn's Spring Manor Farm. UConn is committed to managing these lands as the Spring Manor Farm for the foreseeable future. Development is not planned, although older dilapidated structures are scheduled for demolition in order to eliminate safety hazards. Furthermore, any development that could be proposed in the future would need to be reviewed per CEPA, and any off-campus development by other landowners would have to be authorized by the Town's aquifer protection regulations.

UConn has prepared a separate management plan for its 440-acre tract near the Fenton River Wellfield. The *East Campus Plan of Conservation and Development* (2004)[11] states that "New structural development is discouraged in this area." The Fenton Forest Tract is located within the UConn-controlled land in the Fenton APA and is identified as "preserved land" in the East Campus plan. Important goals to be accomplished in the tract are "to maintain the health, productivity, and natural biological diversity of the forestlands and to demonstrate forest stewardship practices." Consider the following paraphrased discussion from page 8 of the East Campus Plan of Conservation and Development:

- The Preservation Category for East Campus comprises areas of environmental significance that must be recognized in any future planning effort. These include:

  - <u>Fenton Forest Tract</u>: This 440-acre tract is the largest contiguous forest parcel in the entire UConn system and covers half of the East Campus site. Secondary growth upland central hardwoods dominate both the tract and the region. Particular consideration was given during this study to the age and quality of stands within the Fenton Forest Tract. The oldest timber stands – from 60 to 105 years – are centrally located or found near the Fenton River. These areas, including the Oguswitz Meadow, were considered to be of significance and were identified as special forestlands.

  - <u>Fenton River</u>: The tract is also part of a larger habitat corridor and includes important riparian habitat along the Fenton River – a locally significant water resource. The Windham Water Works' water supply reservoir is fed by the Fenton River. UConn has four wells in this area.

  - <u>Direct Recharge Area</u>: The Connecticut DEEP has approved the delineation of the APA for the Fenton River Wellfield, of which 456 acres are within East Campus. Land use prohibitions and restrictions identified in the Town of Mansfield and Town of Willington APA regulations are therefore relevant to this area.

UConn currently maintains this area in traditional agricultural use or as managed forestland. With the exception of maintaining existing agricultural facilities and continuing forest management and environmental education activities, no development is recommended within the Preservation area.

The 2015 Campus Master Plan indicates that limited development of new science and residential buildings may occur in East Campus as an augmentation of existing uses. However, this development is expected to occur outside of the APA. Any development that could be proposed for the East Campus in the future would need to be consistent with the *East Campus Plan of Conservation and Development* and the Fenton Forest Tract goals, reviewed per CEPA, and would be largely consistent with the Town's aquifer protection regulations.

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[11] http://media.masterplan.uconn.edu/Historic/East_Campus_Plan_of_Conservation_and_Dev_2004.pdf

3.5 Wellhead Protection Regulations

3.5.1 DEEP Aquifer Protection Area Regulations

The Aquifer Protection Land Use Regulations[12] were last revised by the State of Connecticut in February 2004. These regulations require that Level A APAs (ground water recharge and contribution areas) be delineated for wells located in stratified drift aquifers serving more than 1,000 people. UConn completed Level A mapping for the Fenton River Wellfield in 2001 and for the Willimantic River Wellfield in 2007. DEEP developed a model ordinance consistent with the regulations to assist municipalities in adopting local regulations. DEEP has identified that Coventry, Mansfield, and Willington each have local regulations consistent with the State's Aquifer Protection Land Use Regulations.

The Town of Mansfield adopted its first APA Regulations on January 17, 2006, with the most recent revision occurring on January 7, 2007. These regulations control certain activities in the Town's formally mapped APAs associated with the Fenton River Wellfield and the Willimantic River Wellfield. The Town of Coventry adopted its regulations on January 24, 2008, and the Town of Willington adopted its regulations on July 1, 2009. Copies of these regulations are included in Appendix E where available.

The Town of Mansfield completed "Mansfield Tomorrow", an update of its Plan of Conservation and Development (MT-POCD)[13] in October 2015; this is the Town's fifth such Plan. The 2015 MT-POCD expressly states Mansfield's strategy to "Protect and conserve groundwater resources", "Maintain and improve health of watercourses, waterbodies, and wetlands", and "Strengthen land use regulations that promote protection of natural systems and habitats." The 2015 MT-POCD places great importance on protecting drinking water supplies to sustain current needs and enable future development in Mansfield. Goal 2.6, Strategy B of the 2015 MT-POCD indicates that the Town of Mansfield will work to "Strengthen regulations protecting critical natural resource areas including water recharge areas, wetlands, water bodies, interior forest tracts, soils and steep slopes", "Identify and evaluate options for expanding protection of stratified drift aquifers and other drinking water resources such as community wells from contamination", and "Establish green infrastructure standards that maximize infiltration of stormwater and natural drainage."

UConn recognizes that the watersheds of small tributaries of the Fenton River are not included in the APA for the Fenton River Wellfield, as they are not direct recharge areas. However, most of these "indirect recharge area" watersheds are located in the "preserved area" described in detail above and identified in the *East Campus Plan of Conservation and Development*. Only the uppermost portion of one indirect recharge area watershed is located in a developed area; this is the stream associated with Mirror Lake. The upper part of this watershed extends from Mirror Lake to the northern side of South Eagleville Road. The UConn-controlled land in this watershed is carefully managed and is continuously evaluated per the *University of Connecticut Storrs Campus Stormwater Management Plan* (2017)[14].

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[12] https://portal.ct.gov/DEEP/Aquifer-Protection-and-Groundwater/Aquifer-Protection/Outline-of-Aquifer-Protection-Regulations
[13] http://new.mansfieldct.gov/DocumentCenter/View/3231/Mansfield-tomorrow_5a1455731723dd74289542c3?bidId=
[14] https://envpolicy.uconn.edu/wp-content/uploads/sites/1389/2017/04/Storrs-Campus-Plan.pdf

3.5.2 DPH Regulations

Environmental Protection Agency (EPA) regulations require significant treatment (filtration and disinfection) of surface water supplies and groundwater supplies under the direct influence of surface water. Potable water from public supply wells within 200 feet of a surface water body are assumed to be at risk and must be tested in order to determine whether the pumped groundwater is not directly connected to surface water.

In the mid-1990s, UConn conducted hydrogeologic studies on certain wells within 200 feet of surface water bodies to determine if groundwater at the Fenton River (Wells A, B, and C) and/or Willimantic River (Wells #1 and #2) Wellfields was under the direct influence of surface water. The Groundwater Under the Direct Influence of surface water (GWUDI) studies were submitted to DPH for review, and State approval letters dated July 27 and 28, 1995 indicated the DPH was satisfied that none of the tested wells were under the direct influence of surface water. A copy of these letters is provided as Appendix F.

In the spring and summer of 2013, DPH conducted a sanitary survey of the UConn potable water system pursuant to public drinking water regulations found in RCSA Section 19-13-B102(e)(7)(E). The DPH survey indicated, in part, that Well D at the Fenton River Wellfield was within 200 feet of a surface water body (wetland). The DPH sanitary survey noted that a GWUDI study could be completed to demonstrate that groundwater withdrawn from Well D was not under the direct influence surface water.

UConn contracted MMI to complete a GWUDI study for Well D in 2014. The MMI report dated April 15, 2015 concluded that Well D was not under the direct influence of surface water from the adjacent wetland and additional treatment measures were not required. The DPH approved the MMI study by a letter dated May 20, 2015. The letter is provided in Appendix F.

3.6 Diversion Permits and Registrations

In addition to being a party to the water diversion permit for the CWC interconnection (DIV-201404187), UConn has a series of water diversion registrations through the Connecticut DEEP. While the majority of the registrations are for public water supply, some of the registrations are recreational. Table 3-3 presents the registrations for the UConn water supply wells. Note that the total registered diversions for each wellfield are less than the sum of the individual registrations for each well. Refer to Appendix C for copies of the water diversion permit and registration confirmation letters.

In 1982, UConn registered Fenton Wells A through D and Willimantic River Wells #1, #2, and #3 with the Connecticut DEEP. MTS registered MTS Well #2 separately. After MTS closed in 1993, the registration for MTS Well #2 was transferred to UConn. UConn installed Well #4 in 1998 to replace the function of MTS Well #2, and the registration rate for MTS Well #2 was transferred to the new Well #4.

The UConn-MTS interconnection is also registered with the DEEP (3100-002-PWS-TR & 3207-005-PWS-TR). This interconnection formerly occurred at a valve pit near the old Chemical Facility at the Willimantic Wellfield, but now occurs inside the new Chemical Facility constructed in 2010. Water treated at the Chemical Facility is directed to the Depot Campus as needed. A previous UConn-MTS interconnection was active through Pink Ravine in the 1960s, but it is believed that this interconnection was abandoned before the 1982 registration deadline as suggested by the "abandoned" 6-inch water main on Weaver Road running towards Bone Mill Road on the 1983 MTS water system map.

TABLE 3-3
Diversion Registrations

Well or Wellfield	Rate (mgd)	Equivalent Rate
Fenton River Well A (3207-001-PWS-GR)	0.576	400 gpm
Fenton River Well B (3207-002-PWS-GR)	1.008	700 gpm
Fenton River Well C (3207-003-PWS-GR)	0.720	500 gpm
Fenton River Well D (3207-004-PWS-GR)	0.720	500 gpm
Subtotal of 4 wells	3.024	--
Fenton River Wellfield Total Permitted Diversion	**0.8443**	**--**
Willimantic River Well #1 (3100-009-INS-GR)	0.648	450 gpm
Willimantic River Well #2 (3100-008-PWS-GR)	0.432	300 gpm
Willimantic River Well #3 (3100-009-PWS-GR	0.648	450 gpm
Willimantic River Well #4 (3100-010-PWS-GR)	0.720	500 gpm
Subtotal of 4 wells	2.448	--
Willimantic River Wellfield Total Permitted Diversion	**2.3077**	**--**

3.7 Flooding

The Willimantic River wells are located in the Special Flood Hazard Area (SFHA) of the Willimantic River, commonly known as the 100-year floodplain. Each well house sits atop a mound that provides elevation of the pumphouse above the floodplain, thus preventing flooding of the wellheads for events equal to or less frequent than the flood with a recurrence interval of less than a 1% chance in any year. The top of each mound is at approximately elevation 312 feet above sea level, while the surrounding ground surface is at an approximate elevation of 300 feet. The 100-year flood elevation is 308 feet.

The SFHA along the Fenton River was mapped by approximate methods. Flood elevations were not determined as part of the Flood Insurance Study (FIS) commissioned by the Federal Emergency Management Agency (FEMA). The four wells may be located adjacent to (are surrounded by) the floodplain, however, the three active wells are not believed to have ever been flooded due to the mounding at each well house.

3.8 Safe Yield Evaluation

Safe yield is the maximum dependable quantity of water per unit of time that may flow or can be pumped continuously from a source of supply during a critical dry period without consideration of available water limitations. The concept of "safe yield" is strictly defined as being in terms of water quantity and does not consider environmental limitations.

A formal safe yield pumping test has not been conducted for either wellfield with all wells pumping simultaneously, although a number of yield tests have been conducted at each wellfield. A *Safe Yield Study* was completed by MMI in March 2020 as part of this *2020 Plan* as presented in Appendix G. The *Safe Yield Study* details known yield tests and other periods of observation, followed by a conclusion relative to safe yield for each wellfield conducted in accordance with DPH procedures.

The total safe yield calculated for the seven active wells at the two wellfields is 4.3441 mgd, of which 2.1678 is from the Fenton River Wellfield and 2.1763 mgd is for the Willimantic River Wellfield. The information in the *Safe Yield Study* has been entered into the required "Worksheet for Determination of Safe Yield", which is included in the first portion of Appendix H. Note that available water limitations (Section 3.9) from diversion registrations, pumping capacity, or other limitations mean that this amount of water is not available to UConn for planning purposes.

3.9 Available Supply

Available supply is the amount of water that can be assumed to be available for planning purposes. It can be lower than the safe yield as encumbered by diversion registrations, treatment limitations, system hydraulics, and wellfield operating protocols.

As required by the DPH, available water has been calculated on the required worksheet which is included in Appendix H. The worksheet reveals that, per applicable regulations and guidance in place at this time, the available water of the UConn water system is 3,647,500 gpd. This volume reflects the fact that water from the Fenton River Wellfield is often unavailable due to the operational protocols in the *Wellfield Management Plan* (as determined by the 2006 "Fenton River Study"), a total of 2,147,500 gpd is available from the Willimantic River Wellfield, and 1,500,000 gpd of water is contractually available to UConn through the CWC interconnection.

Note that although under the strict definition of available water the available supply from the Fenton River Wellfield is zero, the wellfield is typically operated from November through May of each year when flows in the Fenton River are above 3 cubic feet per second (cfs). Use of the Fenton River Wellfields during its operational period will continue to allow balancing of withdrawals with the Willimantic River Wellfield. Furthermore, although at this time purchases of water through the CWC interconnection for UConn use are not necessary, the interconnection provides critical supply redundancy to the UConn water system as well as providing available supply for future planning purposes.

Similar to the 2011 *Water Supply Plan*, this *2020 Plan* also presents the available water supply on a monthly basis in Table 3-4. The times of the year that available water from the Fenton River Wellfield is zero is typically June through October of each year. Note that as the availability of the Fenton River Wellfield is dependent on instream flow conditions, during some dry years water may not be available in the months of May, November, and December; alternatively, during wet years the wellfield may not need to be shutdown at all. However, for monthly planning purposes it is assumed that the wells will be shut down from June through October each year.

The DPH uses the "Largest Well Offline" scenario as a measure of supply redundancy. For the UConn water system, the largest (highest producing) well for planning purposes is Willimantic Well #4 with an available supply of 674,800 gpd. Under this scenario, UConn continues to have 2,972,700 gpd available for planning purposes.

TABLE 3-4
Monthly Available Potable Water Supply

Month	Willimantic River Wellfield (gpd)	Fenton River Wellfield (gpd)	CWC Interconnection (gpd)	Total (gpd)
January	2,147,500	864,000	1,500,000	4,511,500
February	2,147,500	864,000	1,500,000	4,511,500
March	2,147,500	864,000	1,500,000	4,511,500
April	2,147,500	864,000	1,500,000	4,511,500
May	2,147,500	864,000	1,500,000	4,511,500
June	2,147,500	0	1,500,000	3,647,500
July	2,147,500	0	1,500,000	3,647,500
August	2,147,500	0	1,500,000	3,647,500
September	2,147,500	0	1,500,000	3,647,500
October	2,147,500	0	1,500,000	3,647,500
November	2,147,500	864,000	1,500,000	4,511,500
December	2,147,500	864,000	1,500,000	4,511,500

Although the present DPH interpretation of the calculation of available water does not allow for a monthly interpretation as presented in the 2011 *Water Supply Plan*, recent efforts by UConn make a discussion of available water under the "Largest Well Offline" scenario appropriate on a monthly basis. UConn commissioned MMI in 2014 to build upon earlier efforts conducted by UConn and MMI related to evaluating the impact of Fenton Well D on the Fenton River. As described in the *Wellfield Management Plan*, DEEP approved the results of the Low Flow Study of the Fenton River Near Well D (report dated February 26, 2016) by letter dated August 25, 2017. The approval indicates that UConn may utilize Fenton Well D up to a maximum withdrawal of 0.213 mgd during the months of September and October of each year, but only as a backup well. Given that the nature of the request was to utilize Well D when the Fenton River Wellfield would otherwise be shutdown, one or more wells at the Willimantic River Wellfield must be offline for Well D to be used as a backup well.

Table 3-5 summarizes the available supply to the UConn system under the "Largest Well Offline" scenario. As shown in Table 3-5, available supply to UConn under the "Largest Well Offline" scenario varies from 2.97 mgd to 3.84 mgd depending on the time of year.

The projected margin of safety calculation in Section 7.0 will therefore rely on both the "official" available water value (as calculated on the Worksheet for Demonstration of Available Water) of 3,647,500 gpd, as well as the lowest "Largest Well Offline" calculation of available supply in Table 3-5 (2,972,700 gpd) to ensure that sufficient supply will be available under the "Largest Well Offline" condition. These calculations are consistent with the water supply planning regulations. Furthermore, monthly projections will also be presented in Section 7.0 for both scenarios to ensure that sufficient supply will be available on a monthly basis.

Finally, note that although flows from the RWF are tracked by UConn as non-potable production, the RWF does not provide available supply to the UConn potable water system for planning purposes. Instead, flows from the RWF provide a demand reduction for the potable water system, allowing for certain campus uses to be tracked separately from the potable water system. This important distinction will be reinforced throughout this *2020 Plan*.

TABLE 3-5
Monthly Available Potable Water Supply When Largest Well is Offline

Month	Willimantic River Wellfield (gpd)	Fenton River Wellfield (gpd)	CWC Interconnection (gpd)	Total (gpd)
January	1,472,700	864,000	1,500,000	3,836,700
February	1,472,700	864,000	1,500,000	3,836,700
March	1,472,700	864,000	1,500,000	3,836,700
April	1,472,700	864,000	1,500,000	3,836,700
May	1,472,700	864,000	1,500,000	3,836,700
June	1,472,700	0	1,500,000	2,972,700
July	1,472,700	0	1,500,000	2,972,700
August	1,472,700	0	1,500,000	2,972,700
September	1,472,700	213,000	1,500,000	3,185,700
October	1,472,700	213,000	1,500,000	3,185,700
November	1,472,700	864,000	1,500,000	3,836,700
December	1,472,700	864,000	1,500,000	3,836,700

3.10 Margin of Safety

Margin of safety is the unitless ratio of supply over demand. It is system-specific and is based only on available active supplies in consideration of hydraulic or other supply limitations. The PURA and DPH recommend a minimum margin of safety of 1.15 be met for all planning scenarios.

Margin of safety is calculated using a full year of production data (or the average of multiple years of production data) to determine ADD, maximum month average day demand (MMADD), and PDD. These demand scenarios are compared to the available supply presented in Section 3.9. The required DPH worksheet for calculation of margin of safety is presented in Appendix H. Margin of safety calculations for the year 2019 (Table 3-6) indicates that current system margin of safety is adequate with the current sources of supply available to UConn.

TABLE 3-6
Current System Margin of Safety (2019)

Demand Scenario	Available Supply (gpd)	2019 Demand (gpd)	Margin of Safety
Normal Operation			
ADD	3,647,500	723,398	5.04
MMADD	3,647,500	1,190,123	3.06
PDD	3,647,500	1,440,000	2.53
Largest Well Offline Scenario			
ADD	2,972,700	723,398	4.11
MMADD	2,972,700	1,190,123	2.50
PDD	2,972,700	1,440,000	2.06

Similar to the 2011 *Water Supply Plan*, this *2020 Plan* also presents margin of safety from a monthly standpoint in order to better evaluate the interrelationship between the periods each year when students are present as well as the seasonal low-flow period for the Fenton River. Table 3-7 demonstrates that the current margin of safety for the UConn water system is also adequate when considered on a monthly basis, including under the scenario where the largest producing well is offline.

TABLE 3-7
Monthly Margins of Safety, 2019

Month	Total Available Supply (mgd)	Total Available Supply with Largest Well Offline (mgd)	Production (mgd)	Margin of Safety	Margin of Safety with Largest Well Offline
January	4.51	3.84	0.55	8.20	6.98
February	4.51	3.84	0.78	5.78	4.92
March	4.51	3.84	0.78	5.78	4.92
April	4.51	3.84	0.85	5.31	4.52
May	4.51	3.84	0.55	8.20	6.98
June	3.65	2.97	0.44	8.30	6.75
July	3.65	2.97	0.66	5.53	4.50
August	3.65	2.97	0.80	4.56	3.71
September	3.65	3.19	1.01	3.61	3.16
October	3.65	3.19	0.93	3.92	3.43
November	4.51	3.84	0.67	6.73	5.73
December	4.51	3.84	0.50	9.02	7.68

Additional discussion of margin of safety in comparison to projected demands can be found in Section 7.0.

4.0 EXISTING SYSTEM PERFORMANCE

UConn maintains two groundwater sources of water supply for the Main Campus and the Depot Campus. These are the Fenton River Wellfield and the Willimantic River Wellfield. Water from each wellfield is disinfected, pH is adjusted, and corrosion control is added before entering the distribution system.

The UConn water system also receives water through the CWC interconnection that is withdrawn from the Shenipsit Lake Reservoir located in Tolland and Vernon, Connecticut. As described in Section 3.2.4, water has moved through this interconnection since December 2016 to support off-campus customers formerly supplied by UConn. Water from Shenipsit Lake Reservoir is treated by CWC before it is pumped through the interconnection.

Other potable water system components include approximately 31 miles of transmission and distribution system piping, 6 potable water storage tanks, and four booster pump stations (see Table 4-4 for pump descriptions). Each of these system components are described in the ensuing text. Note that this section does not detail non-potable water system components associated with the RWF or the campus grey water system.

4.1 Treatment Facilities

Water from the three active Fenton wells is directed into the 50,000-gallon clearwell located near emergency Well A. Water leaving the Fenton clearwell is treated with sodium hypochlorite (chlorine) for disinfection and sodium hydroxide (25% caustic soda) for pH adjustment and corrosion control. The chemical dosages are paced to flow from a 4-20 milliamp signal. An automatic chlorine residual analyzer continuously measures and records the chlorine residuals. Alarm, status, and initiation signals (on/off) are transmitted to the existing SCADA system using the existing remote telemetry system located at the facility. The treatment system is capable of delivering a maximum capacity of approximately 2.2 mgd of treated water. Table 4-1 summarizes the chemical feed pumps at the Fenton River Wellfield treatment building.

TABLE 4-1
Chemical Feed Pumps at the Fenton River Wellfield Treatment Building

Chemical	Pump	Maximum Pressure	Maximum Treatment Rate
Sodium Hydroxide	Pump 1	100 psi	4 gph
	Spare 1	60 psi	8 gph
	Spare 2	60 psi	9 gph
Sodium Hypochlorite	Pump 1	100 psi	2.5 gph
	Spare	100 psi	2.5 gph

Note: gph = gallons per hour, psi = pounds per square inch.

Water from the four Willimantic wells is directed to the chemical feed building constructed in 2010-2011 near the railroad crossing at the west end of Spring Manor Lane. Treatment includes sodium hypochlorite for disinfection and sodium hydroxide (25% caustic soda) for pH adjustment and corrosion control. Each chemical feed system consists of one bulk tank and one day tank, two chemical metering pumps (one active and one spare) and associated chemical appurtenances. The chemical feed systems are flow paced using an on-site raw water magnetic flow meter. Alarm, status, and initiation signals (on/off) are transmitted to the existing SCADA system using the existing remote telemetry system located at the facility. The treatment system is capable of delivering a maximum capacity of 2.3 mgd of treated water. An automatic chlorine residual analyzer continuously measures and records chlorine residuals. Table 4-2 summarizes the chemical feed pumps at the Willimantic River Wellfield chemical building.

TABLE 4-2
Chemical Feed Pumps at the Willimantic River Wellfield Chemical Building

Chemical	Pump	Maximum Pressure	Maximum Treatment Rate
Sodium Hydroxide	Pump 1	80 psi	10 gph
Sodium Hypochlorite	Pump 1	100 psi	1.3 gph
	Spare 1	300 psi	1.3 gph

4.2 Storage, Pumping, Transmission, and Distribution

4.2.1 Pressure Zones

As shown on Figure 3-1, the UConn water system is comprised of a two primary service zones, the Main Campus and the Depot Campus, that are supplied directly from the pressure in their associated water storage tanks, and two booster pump zones in the Main Campus system that are serviced by the Towers High Pressure Booster Pump Station and the Hilltop Apartments jockey pumps. Each zone is described below and shown on mapping in the *Emergency Contingency Plan*. The associated tanks and pumping stations are discussed in Sections 4.2.2 and 4.2.3.

Main Campus Zone – The Main Campus pressure zone is supplied by both the Fenton River and the Willimantic River wellfields, and includes the Fenton River treatment facility, the 0.05 MG clearwell at the Fenton River Wellfield, the 5.4 MG reservoir at W-Lot, and the twin 1.0 MG water storage standpipes adjacent to the Towers Residence Halls. Pressure in this zone is maintained by the Towers storage tanks. The four well pumps at the Willimantic River Wellfield pump water through the 16-inch transmission main to the 5.4 MG reservoir at W-Lot. The majority of the Main Campus is served with potable water from this zone. Fire protection water is also drawn from the Main Campus pressure zone. Additional information on fire loop pressures is presented in Section 4.2.4.

Towers Loop Zone – The Charter Oak Apartments, the Alan T. Busby Suites, and Husky Village are served by the Towers High Pressure Loop Pumping Station. This booster pumping station can provide flows of up to 8,300 gpm for normal usage, peak usage, and fire protection purposes. Water entering the pump station is drawn from the Towers storage tanks. This station maintains system pressures of at least 140 psi in order to address both potable water system requirements and adequate fire protection within the service area.

Hilltop Apartments Zone – This apartment complex in the southwestern part of the Main Campus is served with the assistance of three 5-horsepower jockey pumps to maintain adequate pressure of at least 80 psi within the Hilltop Apartments complex.

Depot Campus Zone – The Depot Campus Zone is served by water from the Willimantic River Wellfield. This pressure zone includes the two water storage tanks located north (0.75 MG tank) and south (0.5 MG tank) of Route 44 at the Depot Campus. Currently, water is pumped from the four Willimantic River Wellfield wells to the Depot Campus storage tanks when the level in the storage tanks triggers a valve in the chemical feed facility at the Willimantic River Wellfield. From the Depot storage tanks, water service is provided to UConn-owned buildings at the Depot Campus.

4.2.2 Storage Facilities

Six potable water storage facilities serve the UConn system as summarized in Table 4-3. A total of 7.6 MG of useable storage is provided throughout the system for potable use, including the clearwell located at the Fenton River Wellfield. Each of the tanks is further described in the ensuing text.

TABLE 4-3
Summary of Storage Tank Specifications

Specification	Fenton Clearwell	Depot Campus #1	Depot Campus #2	Towers #1	Towers #2	W-Lot Reservoir
Total Capacity (MG)	0.050	0.500	0.750	1.000	1.000	5.400
Useable Capacity (MG)	0.036	0.330	0.500	0.875	0.875	5.000
Overflow	--	33 ft	49 ft	80 ft	80 ft	--
Height	--	35 ft	51 ft	85 ft	85 ft	15 ft
Material	Concrete	Steel	Steel	Steel	Steel	Concrete
Booster Pumps	1 @ 550 gpm 1 @ 1,000 gpm	None	None	None	None	3 @2,750 gpm
Year Constructed	1949	1954	1958	1954	2010	1972
Last Inspection	2017	2013	2013	2009	2012	2015
Condition*	Fair	Fair	Fair	Fair	Good	Good

*Note: Poor would denote significant maintenance, repair, or replacement needed, however, none of the storage tanks are currently found to be in poor condition. Fair denotes a tank in working condition with some maintenance and/or repair needed. Good denotes working condition with no significant deficiencies.

Fenton River Wellfield Clearwell – As described above, raw water from Wells B, C, and D is discharged into a 50,000-gallon clearwell at the Fenton River Wellfield. The clearwell is located adjacent to emergency Well A and is constructed of concrete. The clearwell is divided into two 25,000-gallon sections with separate inlet and outlet piping, and also includes concrete baffling to enhance water detention time within the tank. The clearwell was last inspected in October 2017.

Depot Campus Storage Tanks – The 0.75 MG storage tank on the north side of the Depot Campus is the primary water storage tank for this service zone and measures 51 feet high by 50 feet in diameter. The overflow height is 49 feet. Two older, inactive water storage tanks near this tank date back to the 1910s or 1920s. The 0.50 MG storage tank on the southeast side of the Depot Campus is the secondary storage tank and measures 35 feet high and 25 feet in diameter. The overflow height is 33 feet for this tank. The level set point for both tanks is 26.5 feet with a normal operating range of 25 to 28 feet. Both tanks were last inspected in 2013.

Towers Storage Tanks – The twin 1.0 MG standpipes located in the northeast portion of the Main Campus provide water pressure to the Main Campus service zone. Each tank is 85 feet high by 45 feet in diameter. The overflows are set at 80 feet. The level set point for both tanks is 72 feet with a normal operating range of 67 to 77 feet. Towers #1 was last inspected in 2009 and Towers #2 was last inspected in 2012.

W-Lot Reservoir – This 5.4 MG underground storage tank has dimensions of 180 feet by 280 feet by 15 feet deep. It is divided into two 2.7 MG sections with separate inlet and outlet piping in addition to concrete baffling that enhances water detention time within the tank. The level set point is 13.5 feet with a normal operating range of 13 to 14 feet. The tank was constructed in 1972 to hold water from the Willimantic River Wellfield and was last cleaned and inspected in 2015. The tank is in good condition.

The most recent inspection reports for the W-Lot reservoir, Fenton clearwell, Depot Campus tanks, and the two Towers tanks are included in Appendix I. Note that a seventh 1.0 mgd water storage tank associated with the RWF provides water to the non-potable water system. As this tank is not used for potable water supply, a detailed description is not provided herein.

4.2.3 Pumping Facilities

The pumping facilities that serve the UConn potable water system include well pumps, treatment plant pumping facilities, and distribution pumping facilities. Pumping facilities are summarized in Table 4-4 and described below.

Fenton High Lift Pumping Station – Located at the Fenton River Wellfield treatment facility, this pumping station originally moved finished water up to the twin 1.0 MG standpipes adjacent to the Towers Residence Halls. System improvements were installed in 1998 to allow for finished water to be routed to the 5.4 MG reservoir instead. The pumps are controlled by the SCADA system based on the level in the 1.0 MG standpipes and the clearwell. Emergency power supply is available for the Fenton pumping station.

High Head Pumps – The High Head pumping station consists of three 100 HP pumps capable of moving finished water at a rate of 2,750 gpm from the 5.4 MG reservoir into the twin 1.0 MG storage tanks. Each pump is equipped with VFD to provide constant pressure. Emergency power supply is available for the High Head pumping station.

Towers Booster Pump Station – Located near the 5.4 MG reservoir, this pump station uses as many as eight pumps to boost water into the Towers Loop Zone. Five pumps supply normal demand volume, with two pumps in reserve to assist with peak demand. The eighth pump can provide as much as 3,500 gpm for fire flows. Each pump is equipped with VFD to provide constant pressure. Water passing through this pump station is drawn from the twin 1.0 MG storage tanks. Emergency power supply is available.

Hilltop Apartments Jockey Pumps – This booster station provides constant water pressure to Hilltop Apartments. The booster station contains three Jockey pumps. Water passing through this pump station is drawn from the twin 1.0 MG storage tanks. Emergency power supply is not available to this pumping station. When the pumping station is offline, substandard (low) water pressure is still available in the Hilltop Apartments zone.

TABLE 4-4
Summary of Pumping Specifications

Pump Location	Horsepower (hp)	Year of Pump Installation	Condition*	Aux. Power
Fenton River Well A Pump and Motor	5	1977	Good	Yes
Fenton River Well B Pump and Motor	10	2015	Good	Yes
Fenton River Well C Pump and Motor	10	2015	Good	Yes
Fenton River Well D Pump and Motor	25	2008	Good	Yes
Fenton High Lift Pump – 500 gpm VFD	125	2007	Good	Yes
Fenton High Lift Pump – 1,000 gpm VFD	200	2002	Good	Yes
Willimantic River Well #1 Pump and Motor VFD	100	2018	Good	Yes
Willimantic River Well #2 Pump and Motor VFD	30	2019	Good	Yes
Willimantic River Well #3 Pump and Motor VFD	100	2019	Good	Yes
Willimantic River Well #4 Pump and Motor VFD	100	2018	Good	Yes
High Head #1 – 2,750 gpm VFD	100	Late 1990s	Good	Yes
High Head #2 - 2,750 gpm VFD	100	Late 1990s	Good	Yes
High Head #3 - 2,750 gpm VFD	100	Late 1990s	Good	Yes
Towers Booster Pump Station #1 – 50 gpm VFD	7.5	2013	Good	Yes
Towers Booster Pump Station #2 – 250 gpm VFD	25	2013	Good	Yes
Towers Booster Pump Station #3 – 250 gpm VFD	25	2013	Good	Yes
Towers Booster Pump Station #4 – 500 gpm VFD	40	2013	Good	Yes
Towers Booster Pump Station #5 – 1,250 gpm VFD	40	2013	Good	Yes
Towers Booster Pump Station #6 (Peaking) – 1,250 gpm VFD	125	2013	Good	Yes
Towers Booster Pump Station #7 (Peaking) – 1,250 gpm VFD	125	2003	Good	Yes
Towers Booster Pump Station #8– 3,500 gpm VFD	350	2003	Good	Yes
Hilltop Apartments (constant pressure Jockey pump)	5	2003	Good	No
Hilltop Apartments (constant pressure Jockey pump)	5	2003	Good	No
Hilltop Apartments (constant pressure Jockey pump)	5	2003	Good	No

Note: All VFD pumps have variable rates.

*Poor condition would denote significant maintenance, repair, or replacement needed; however, all pumps are currently in good condition. Fair would denote working condition with some maintenance and/or repair needed. Good denotes working condition with no significant deficiencies; which is the case for all pumps, at the time this report was issued.

4.2.4 System Pressures and Fire Protection

System pressures fluctuate with the time of day. Maximum pressures generally occur at night when demand is slightly lower. Industry standards recommend pressures in the range of 35 psi to 125 psi. In general, pressures are sufficient in the UConn water system to provide adequate service to the top floors of buildings.

According to CDM Smith[15], the majority of the distribution system on the Main Campus experiences pressures in the range of 29 psi to 170 psi, with approximately 86% of the service area having pressures between 35 psi and 100 psi. Areas of highest pressure (above 100 psi) include lower elevation areas along North Eagleville Road and Hunting Lodge Road (these areas are now served by CWC), and at each wellfield. The fire protection system has static pressures ranging from 130 to 180 psi. The Towers Loop pressure zone is operated at a range of 120 to 160 psi, with pressure averaging 140 psi, in order to maintain 140 psi on the discharge side of the booster station. Areas of low pressure (below 35 psi) occur in less than 1% of the service area and occur directly around the Towers standpipes and along Route 195 near Horsebarn Hill Road and Tower Loop Road due to higher elevations in these areas. Although the Depot Campus was not analyzed by CDM Smith, pressures in the Depot Campus zone typically range from 30 psi to 85 psi, with slightly higher pressures realized in the CWC off-campus system.

Fire protection is provided throughout the service areas. The Main Campus receives its fire protection from a combined domestic/fire protection distribution system, with a dedicated fire loop system for the central campus. The fire loop system serving the Main Campus takes its water from the Towers 1.0 MG standpipes. Two fire pumps at South Campus and the CUP also supplement this system for those specific buildings.[16] The Towers loop booster station provides fire service for Husky Village and the Charter Oak Suites and apartment complexes with water drawn from the Towers 1.0 MG standpipes. The Depot Campus receives fire protection through a combined domestic water/fire protection distribution system with pressure provided by the two storage tanks.

The Insurance Services Organization (ISO) provides target fire flows for residential areas of between 750 gpm and 1,000 gpm, and greater than 1,500 gpm to 2,500 gpm for commercial areas. Previous fire flow testing conducted in 2008, 2009, and 2011 met ISO fire flow criteria at all tested locations, including sites in different pressure zones.

A hydraulic model of the UConn water system was initially developed in 2008 and was updated in 2010 in connection with the 2011 *Water Supply Plan*. In July 2016, CDM Smith developed and calibrated a hydraulic model of the UConn water transmission and distribution system for the Main Campus. The model includes all pipes and tanks at the Main Campus, but not the pipes that are generally considered to be laterals (see discussion in Section 4.2.5). In order to calibrate the 2016 hydraulic model, CDM Smith conducted fire flow testing on June 1-2, 2016 at 18 fire hydrant locations listed below. Each hydrant was connected to a water main of 12-inch diameter or less. The tests achieved nighttime fire flows ranging from 391 gpm to 2,089 gpm.

- South Residence Halls – 1,876 gpm
- Whitney Road – 1,799 gpm
- Gampel Pavilion – 993 gpm
- Alumni Drive – 2,089 gpm
- Garrigus Suites – 775 gpm
- Hilltop Apartments – 756 gpm
- N. Eagleville Rd. & Northwood Apts. – 1,342 gpm
- Celeron Square – 1,050 gpm
- Charter Oak Apartments – 1,363 gpm
- Swan Lake – 1,311 gpm
- Route 195 and Beach Hall – 391 gpm
- Willowbrook Road – 391 gpm
- Storrs Road at Mirror Lake – 566 gpm
- Storrs Downtown – 1,332 gpm
- Mansfield Apartments – 590 gpm
- Gilbert Road – 876 gpm
- Mansfield Road – 908 gpm
- Fairfield Way – 981 gpm

[15] CDM Smith, 2016, *Final Report: University of Connecticut Framework Utility Analysis Phase 1 – Existing Conditions: Potable Water & Fire Protection Distribution System Model*, University of Connecticut.
[16] These fire protection facilities are not considered part of the potable water system as they only increase fire pressure for those specific buildings / complexes. Therefore, detailed descriptions of these pumps are not included herein.

At first glance, it would appear that some locations do not have fire flows consistent with ISO standards listed above. Note however that as the testing was done to calibrate the hydraulic model, the June 2016 tests do not necessarily indicate the total fire flow available for a particular area. For example, in areas of lower hydrant flows, there are more hydrants available than were tested that could provide additional fire flow to these areas consistent with ISO standards. Section 4.5 presents additional detailed information about the hydraulic model.

CDM Smith ran the July 2016 hydraulic model to evaluate fire flows under the PDD scenario and found that the available fire flow on the Main Campus ranges from 500 gpm to 5,000 gpm while maintaining a minimum system pressure of 20 psi. Fire flows on the lower end of this range were typically on the outskirts of the system (e.g. Willowbrook Road, now served by CWC) and were due to insufficient hydraulic looping in these areas. Approximately 85% of the hydrants on the Main Campus could provide fire flows above 1,000 gpm under this stressed condition.

4.2.5 Transmission and Distribution System Infrastructure

Water system inventories in previous *Water Supply Plans* have reported a total of approximately 6 miles of water transmission main and more than 30 miles of distribution mains. The piping age has been reported from new to dating back to the 1920s. Many of the older mains were replaced with new pipes as part of the UConn 2000 initiative; however, detailed records of the water system main improvements have not been kept in an accessible central database or mapping inventory.

Electronic mapping of the distribution system was originally completed in November 2005 by UConn and was updated for use in the *Water and Wastewater Master Plan* in 2007 and for the previous *Water Supply Plan* in 2011. UConn's 2011 *Water Supply Plan* included an overall summary of pipe lengths, size, and condition. As of 2011, the UConn water system was estimated to include approximately 54.7 miles of water mains, including 6.4 miles of transmission mains and 29.8 miles of distribution main. The remaining mains included service connections and laterals. Beginning in 2016, CDM Smith has been compiling the distribution system mapping into an electronic utilities atlas that provides a current basis for analysis.

As previously noted, UConn and CWC entered a water supply development agreement in December 2013 which included the transfer of off-campus infrastructure to CWC on a 60-year depreciation schedule. Effectively, any mains greater than 60 years old become owned by CWC. Nevertheless, CWC is responsible for the operation and maintenance of the off-campus infrastructure regardless of ownership. Exhibit 6.1 of the December 2013 agreement identifies 6.7 miles of distribution mains (as well as an additional 5.4 miles of related laterals and service connections) that are now the responsibility of CWC. To date, approximately 1.7 miles (of the 6.7 miles total) of the distribution mains have fully depreciated and transferred ownership to CWC.

Tables 4-5 summarize the results of the pipe evaluation, which includes recent main installations such as along Discovery Drive. Note that the figures in Tables 4-5 include all mains associated with the UConn water system and not those that are the responsibility of CWC. In summary, the UConn potable water system currently consists of approximately 50 miles of pipe ranging in size from 0.5 inches to 20 inches in diameter. Transmission mains are typically 8-inches to 20-inches in diameter (Table 4-6). The vast majority of distribution pipe ranges from 6-inches to 12-inches in diameter, with laterals and service connections typically ranging from less than 1-inch to 8 inches in diameter.

TABLE 4-5
UConn Water Main Summary

Pipe Purpose	Approx. Total Length Potable System	Approx. Total Length Fire System
Main Campus		
Transmission	8.0 miles*	N/A
Distribution	18.6 miles	7.4 miles
Laterals & Service Connections	8.3 miles	N/A
Depot Campus		
Transmission	1.0 miles	N/A
Distribution	3.1 miles	N/A
Laterals & Service Connections	3.6 miles	N/A
Total		
Transmission	9.0 miles	N/A
Distribution	21.7 miles	7.4 miles
Laterals & Service Connections	11.9 miles	N/A
Total All Mains	**50.0 miles**	

*Includes transmission mains at both wellfields.

Note: The Depot Campus receives fire protection through a combined domestic water/fire protection distribution system.

Because the system is not comprised exclusively of water mains beneath roadways, and because UConn property lines do not cleanly separate roadways from building lots in different parts of the Main Campus and Depot Campus, a clear division between the water system laterals and water mains is not always possible. Note that on UConn property most water mains are found beneath roads, but mains may also be located under quadrangle areas and buildings. Additional off-campus mains are still owned by UConn but are under the control of CWC. Off-campus water mains, which are now managed by CWC, were typically installed within roadways.

All of the transmission, distribution, and service mains in the UConn system are believed to be in fair or better condition. Appendix J presents the current condition assessment for each general area of the water system. UConn and NEWUS evaluate condition based on pipe age, type, and recent break patterns and also evaluate the interior of pipes whenever coupons are installed.

UConn retained CDM Smith to update the mapping of the distribution system in 2019. The summaries herein are based on CDM's efforts to date. This project is ongoing, and when completed will provide an updated summary of pipe materials (Table 4-7), lengths, and sizes. This information will supplement the condition assessment in Appendix J once it becomes available, and in conjunction with the hydraulic model will inform UConn's water main cleaning, relining, and replacement program for underground infrastructure over the next several years.

TABLE 4-6
Pipe Size Summary

Pipe Size	Length (mi)
¾-inch	0.1
1-inch	0.3
1 ¼-inch	0.1
1 ½-inch	0.1
2-inch	1.6
2 ½-inch	<0.1
3-inch	0.8
4-inch	1.4
6-inch	3.5
8-inch	11.8
10-inch	4.1
12-inch	8.6
16-inch	4.6
20-inch	0.8
Unknown	12.2
Total	**50.0**

TABLE 4-7
Pipe Type Summary

Pipe Type	Length (mi)
Cast iron	7.7
Copper	0.4
Ductile iron	13.5
Plastic-Steel Composite	0.1
Polyvinyl Chloride	0.1
Steel	0.2
Transite	0.1
Unknown	27.9
Total	**50.0**

A number of improvements to the distribution system have been completed in the past few years, including the replacement of a select number of transmission and distribution water mains. Table 4-8 summarizes the new or replacement water mains installed since 2011.

TABLE 4-8
New or Replaced Water Transmission and Distribution Mains Since 2011

Year	Project	Type	Diameter (in)	Length (ft)	Material
2014	Replace Willimantic River Treatment Building to Hunting Lodge Road	Transmission	16	13,350	Ductile Iron
2016	Replace Hunting Lodge Road to 5.4 MG Reservoir	Transmission	16	4,000	Ductile Iron
2016	Replace 5.4 MG Reservoir to Towers Storage Tanks	Transmission	20	1,000	Ductile Iron
2016	Connect to IPB and to CWC Interconnection	Distribution	12	4,000	Ductile Iron
2016	Install main on Discovery Drive	Distribution	12	3,468	Ductile Iron
2018	North Eagleville Road Replacement	Distribution	12	1,068	Ductile Iron
2019	Athletic District Redevelopment	Distribution	8	676	Ductile Iron
2019	Athletic District Redevelopment	Distribution	6	210	Ductile Iron
2019	Athletic District Redevelopment	Distribution	4	57	Ductile Iron
2019	Replace Water Mains During Fine Arts Project	Distribution	12	170	Ductile Iron
2019	Replace Water Mains During Fine Arts Project	Distribution	8	75	Ductile Iron

In 2016, UConn completed two phases of a construction project that replaced the main transmission pipe connecting the Willimantic Wellfield to the Main Campus storage and distribution system. Approximately 4,000 linear feet of new 16-inch diameter pipe was installed. This project also included connecting to the IPB and the CWC Interconnection. Additional water main replacements occurred during the Athletics District redevelopment project and the Fine Arts redevelopment project.

Major water main breaks sometimes occur in the UConn water system, but they are repaired immediately. In 2017, approximately ten major leaks occurred, which resulted in losses of potable water. A few of the 2017 breaks were related to a utility project that was in process at that time, but the majority of breaks in the system are related to age and/or cold weather. One major leak occurred in 2018, and no major leaks occurred in 2019. Three occurred in early 2020. Table 4-9 summarizes the main breaks that have occurred since 2017.

Leak detection is an important component of maintaining the transmission and distribution systems. The most recent water leak detection survey was conducted from August 23, 2016 through September 1, 2016. The survey found 6 hydrants were not completely closed. The hydrants were closed and re-inspected.

NEWUS currently conducts leak detection surveys every five years, targeting specific areas of the system. This is consistent with the schedule required by the water diversion permit for the CWC interconnection. Copies of the most recent leak detection reports are included in Appendix K.

TABLE 4-9
Recent Water Main Breaks

Month & Year	Location	Estimated Loss Volume (gallons)
July 2017	Lakeside Building	25,000
August 2017	South Eagleville Road	36,000
October 2017	Lakeside Building	50,000
December 2017	White Building	25,000
December 2017	North Campus Residence Halls	35,000
December 2017	Tasker Admission Building	25,000
December 2017	Jorgensen Auditorium	15,000
December 2017	Hillside Road at West Campus	25,000
December 2017	Lakeside Building	65,000
July 2018	North Eagleville Road	165,000
January 2020	Student Recreation Center	54,000
January 2020	Fairfield Way	30,000
January 2020	Fine Arts Building	36,000

4.2.6 Consumptive Use Metering

UConn worked diligently from 2005 to 2011 to install meters on UConn-owned buildings on both campuses, and most off-campus buildings that were formerly served by the UConn system but are now customers of CWC. A number of low water use buildings remain unmetered. Only a few larger buildings remain unmetered at this time, and these are suspected to have low water usage primarily consisting of sanitation needs.

It is not considered cost-effective for UConn to provide 100% metering of the buildings on both campuses, especially since water usage at the Depot Campus is negligible in certain buildings that are seldom and/or under-utilized. Nevertheless, UConn continues to work towards more accurately characterizing unaccounted-for water.

The current metering program has two primary goals. First, UConn is committed to ensuring that at least 85% of production is metered as consumption. In this way, UConn will maintain unaccounted-for water below 15% of production. This program includes regular calibration of all source meters (see Appendix L for most recent calibration reports dated January 2019). Second, UConn is working towards the goal of bringing existing building water meters up to the current UConn metering standard. A copy of the metering standard document is included in Appendix L. This program includes inspection, maintenance, repair and/or replacement of all existing meters on a regular basis. The second goal of the metering program includes the following elements:

- Buildings expected to be taken out of service in the near future will not be metered.
- When buildings are replaced, or renovated, they will be fitted with a meter that meets the current UConn standard. Recent examples include the ESB and the Student Recreational Facility.
- All meters are part of a preventative maintenance program to ensure meters are functioning properly and meet the new UConn metering standard.

A campus-wide inventory of water meters, including the type of meter, size, etc., was completed in 2017. The resulting list of meters was reviewed, and inspection work was prioritized and separated into phases, based on the size of each building (e.g., buildings >20,000 square feet [sf]) and type of water-use activities (residential, academic, administrative) anticipated at each building. To date, a number of meters located in residential buildings and academic/science buildings, which would typically have higher water demand, have been repaired and/or replaced to meet the new standard. A line item has been included in the water supply system Improvement Tables in Section 7.0 for continued metering in accordance with the above program.

4.3 Operations and Maintenance

4.3.1 System Operations

As explained in Section 2.2, UConn's water systems (including the Fenton River and Willimantic River Wellfields) are owned and managed by UConn. The contract operator for the water system is NEWUS, a subsidiary of CWC. NEWUS staff are responsible for the day-to-day operation of the water system and for ensuring that water quality meets state and federal drinking water standards. NEWUS is also responsible for providing 24-hour response to water system emergencies.

UConn and NEWUS conduct water system management and operations at the Facilities Building located off LeDoyt Road. The water system is automated by a computer-controlled SCADA system. The SCADA system continuously monitors production from wells, water treatment, storage levels, water distribution, and water quality.

Facilities staff and NEWUS personnel also monitor the system operations through more traditional means. For example, visual inspections are conducted at the wellfields, treatment plants, storage facilities, and pumping stations to confirm equipment is functioning properly and maintenance issues are identified in a timely manner.

4.3.2 System Maintenance

NEWUS staff operate and maintain the wells, treatment facilities, distribution system piping, and associated storage and pumping facilities. These individuals are responsible for performing minor maintenance on equipment during routine system inspections, scheduling major maintenance, collecting water samples for subsequent laboratory analysis to meet regulatory requirements, monitoring daily chemical dosage and water production, and completing other tasks listed in Table 4-10.

Specialized routine maintenance functions are contracted out. These include maintenance of the SCADA computer system and instrumentation, well redevelopment, and calibration of certain treatment equipment.

Copies of all safety data sheets (SDSs) for chemical additives used at the treatment facilities are kept on-site and at the UConn Facilities Operations building. Files are also kept that document equipment maintenance and emergency responses.

Similar to SDSs, various Operation and Maintenance Manuals for different equipment and components of the water supply system are kept at the treatment facilities and at the Facilities Operations building.

TABLE 4-10
Operation and Maintenance Schedule

Daily Schedule	
Routine readings and inspections	Logbook entries
Water quality testing per DPH requirements	Pumping station inspections
Weekly Schedule	
Water quality testing per DPH requirements	Inspect wells
Minor maintenance as necessary	Inspect tanks and clearwell
Monthly Schedule	
Water quality testing per DPH requirements	Submit monthly reports to DPH
Dead end flushing	Certain customer meter reading
Quarterly Schedule	
Water quality testing per DPH requirements	Certain customer meter reading
Semi-Annual Schedule	
Water quality testing per DPH requirements	Water main flushing
Annual Schedule	
Water quality testing per DPH requirements	Service emergency generators
Calibrate flow meters	Publish Consumer Confidence Report
Cross connection & backflow survey	
As Needed	
Update maps and records	Clean and repair service distribution lines
Meter repairs	Utility mark-outs
Response to complaints	Service alarm system
Grounds maintenance of well sites	Inspect, clean, and repair tanks

4.4 Water Quality

4.4.1 Regulatory Overview

Safe Drinking Water Act

Prior to 1974, the major responsibility for regulation of public drinking water supplies rested on State Government. In 1974, the Federal Safe Drinking Water Act (SDWA) was passed. The SDWA authorized the Federal Government to set national drinking water standards, conduct special studies, and to generally oversee the implementation of the SDWA. However, primary responsibility of implementation and enforcement essentially remained in the hands of State government.

Subsequent to the passage of the SDWA, interim primary drinking water regulations were promulgated. These regulations and subsequent revisions set standards for organic, inorganic, and microbiological contaminants; turbidity; radionuclides; and trihalomethanes.

In June of 1986, amendments to the SDWA were adopted. The amendments converted interim and revised primary drinking water standards to national primary drinking water regulations and converted recommended maximum contaminant levels to maximum contaminant level (MCL) goals.

The SDWA was reauthorized in 1996. The law focused water program spending on the contaminants believed to pose the greatest risk to human health and are most likely to occur in a given water system. It also required water systems to notify the public of water safety violations within 24 hours. The reauthorized SDWA maintains requirements that EPA set both a maximum contaminant level and a maximum contaminant level goal for regulated contaminants based on health risk reduction analysis that includes a cost/benefit consideration. The reauthorized Act also required EPA to establish a database to monitor the presence of unregulated contaminants in water.

At the State level, the authority for regulation of drinking water is established under CGS Section 25-32 and implemented through the PHC. These requirements are consistent with Federal Regulations and have additional requirements such as annual watershed surveys, annual cross connection surveys, monitoring of raw and finished water, and public notification requirements.

Volatile Organic Compounds

Since the adoption of the 1986 amendments, the EPA has been working towards promulgating national primary drinking water regulations for various parameters. On July 8, 1987, EPA published regulations setting MCLs and MCL goals for eight volatile organic compounds (VOCs) and monitoring for a number of additional VOCs that did not have MCLs. These regulations became effective January 9, 1989. In May of 1989, EPA proposed national primary drinking water regulations for 38 more inorganic and organic drinking water contaminants.

On January 30, 1991 (effective date July 30, 1992), EPA promulgated MCLs for a series of parameters referenced as the "Phase II" compounds, which include nine inorganic compounds, 10 VOCs, and 15 synthetic organic compounds (SOCs). Monitoring requirements were specified for an additional 24 SOCs that did not have MCLs. On July 17, 1992 (effective date January 17, 1994), EPA promulgated water quality regulations that identified "Phase V" compounds, including five inorganic compounds and three VOCs with MCLs, and 21 VOCs and 15 SOCs that did not have MCLs.

Lead and Copper Rule

On June 7, 1991, the EPA promulgated maximum contaminant goals and National Primary Drinking Water Regulations for controlling lead and copper. These regulations were adopted pursuant to the Lead Contamination Act of 1988. The regulations specify a treatment technique that includes optimal corrosion control treatment, source water treatment, lead service line/connection replacement, and public education. The lead action level is exceeded if the concentration of lead in more than 10 percent of tap water samples collected during any monitoring period is greater than 0.015 milligrams per liter (mg/L). The copper action level is exceeded if the concentration of copper in more than 10 percent of tap water samples is greater than 1.3 mg/L. Following the first two monitoring periods, if lead and copper levels were less than or equal to the action levels, water monitoring could be reduced. In 2000 EPA published revisions to the Lead and Copper Rule that included streamlining/reducing monitoring and reporting burdens and strengthening the implementation of the rule in the following areas: monitoring, treatment processes, public education, customer awareness, and lead service line replacement. The revisions were finalized in October 2007.

Ground Water Under the Direct Influence of Surface Water

In 1991, the DPH adopted regulations and criteria pursuant to the EPA Surface Water Treatment Rule to evaluate all community ground water sources by June 29, 1994, to determine if the sources were under the direct influence of surface water. Sources of supply under the direct influence of surface water require disinfection and filtration to remove pathogens that may adversely affect human health. UConn conducted a GWUDI study from 1993 to 1994. It was subsequently determined that none of the tested wells (Wells A, B, and C at the Fenton River Wellfield, and Wells #1, #2, and #3 at the Willimantic River Wellfield) were under the direct influence of surface water. A subsequent study conducted for Fenton Well D in 2014 resulted in a similar conclusion. Correspondence from DPH is included in Appendix F.

Disinfection Byproducts

In December 1998, EPA published the Stage 1 Disinfectants/Disinfection Byproducts Rule (DBPR). This Rule requires water suppliers to use treatment methods to reduce the formation of disinfection byproducts and to meet associated water quality standards. The disinfection byproducts and their corresponding standards include the total trihalomethanes (TTHM) and haloacetic acids (HAA5). The total TTHM is measured as the total concentration of chloroform, bromoform, bromodichloromethane, and dibromochloromethane. The EPA standard for TTHM concentration is 80 ppb. The HAA5 is measured as the total concentration of monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. The EPA standard for HAA5 is 60 ppb. Both disinfection byproduct standards are based on annual averages.

The Stage 2 DBPR was published by EPA in January 2006. The purpose for the second stage is to improve public health protection by reducing health risks connected to large concentrations of disinfection byproducts throughout the entire supply system. The Stage 2 DBPR emphasizes the monitoring and reduction of concentrations of TTHM and HAA5 at sampling locations throughout the distribution system. The monitoring frequency and sampling locations are dependent upon the population size which the distribution system serves, inclusive of the system that provides the water.

Total Coliform Rule

The EPA developed and published the Ground Water Rule in 2007 to provide increased protections against microbial pathogens in public water systems that use groundwater sources. The Ground Water Rule targeted groundwater systems that are susceptible to fecal contamination, instead of requiring disinfection for all groundwater systems. The occurrence of fecal indicators in the water supply indicated the potential presence of microbial pathogens that pose a threat to public health. The rule requires systems to conduct monitoring; and those systems where the presence of fecal indicators are detected are required to take corrective actions to reduce exposure.

The revised Total Coliform rule was published February 2013 by EPA. This rule applies to all public water systems and included changes on how coliform is monitored and the corrective actions if a positive sample is detected. The updates to the rule include public water systems maintaining a sample site plan and Level 1 and 2 assessments are defined.

4.4.2 Water Quality Monitoring Program

UConn's water quality monitoring program is conducted in accordance with State and Federal requirements. The program in place for the water system is consistent with the Water Quality Monitoring Schedule posted on the DPH website[17].

UConn has two entry point sample locations (Willimantic River Wellfield and Fenton River Wellfield) which are both listed on the DPH Water Quality Monitoring Schedule. Each of the seven active wells has a raw water sampling location. Note that because Fenton Well A is currently maintained as an emergency well, raw water quality is not regularly monitored in the well at this time. Furthermore, interconnection source water quality is the responsibility of CWC. Finally, note that approximately 60 UConn distribution system sampling sites are maintained.

Tables 4-11 through 4-13 summarize the water quality monitoring program and the frequencies of various analyses.

TABLE 4-11
Raw Water Quality Monitoring Program

Parameter	Monitoring Frequency
Physical (Color, Odor, pH, Turbidity)	Not required; as needed
Nitrogen Compounds	Not required; as needed
Inorganic Compounds (iron, manganese)	Not required; as needed
E. Coli	1 sample per month

TABLE 4-112
Entry Point Water Quality Monitoring Program

Parameter	Monitoring Frequency
Chlorine Residual & pH	Daily
Nitrogen Compounds	1 sample annually
Inorganic Compounds (Iron, Manganese, Copper)	1 sample every three years
Volatile organic compounds (VOCs)	1 sample annually
Pesticides, PCBs, Herbicides (SOCs)	2 samples every three years
Radiologicals	1 sample every three years

[17] https://portal.ct.gov/DPH/Drinking-Water/DWS/-/media/Departments-and-Agencies/DPH/dph/drinking_water/pdf_schedules/Schedules_MANSFIELD_C.pdf

TABLE 4-13
Distribution Water Quality Monitoring Program

Parameter	Monitoring Frequency
Physical Parameters	30 samples per month
Total Coliform	30 samples per month
Lead and Copper	30 samples every three years
Disinfection Byproducts	4 samples per quarter
Asbestos	2 samples every nine years

An annual CCR on water quality is completed each year. UConn's 2017 and 2018 annual CCRs include data for both UConn well fields and for the CWC Northern-Western water supply sources (which includes the Shenipsit Lake Reservoir). The 2017 and 2018 reports are attached in Appendix M.

4.4.3 Entry Point Monitoring

Maximum nitrate levels are typically on the order of 1.0 mg/L in treated water at the entry points. Sodium and chloride levels are typically in the range of 12 to 26 mg/L. VOCs, SOCs, and radiological parameters are either not detected, or detected at levels below their MCLs. Samples are also collected in accordance with the Unregulated Contaminant Monitoring Rule.

4.4.4 Distribution Monitoring

Approximately 60 samples per month are collected at various locations throughout the distribution system, including customer taps, tanks, and pumping stations and are tested for physical and bacteriological parameters. A total of 30 samples are also collected for lead and copper testing every three years. Testing for asbestos is conducted every nine years and was last tested for in 2013.

No coliform violations occurred during the last five years of routine testing. Lead and copper detections have been lower than their criteria. Asbestos has not been detected in distributed water.

Disinfection byproduct levels have generally been low, consistent with the primary use of groundwater. These have increased slightly in recent years as water from the CWC interconnection has been utilized in the Main Campus service zone but continue to be well below the MCLs. Recent testing in March 2019 found TTHM to be in the range of 15-20 ppb, and HAA5 to be in the range of 8-10 ppb.

4.4.5 Cross Connections

As of 2019, 769 cross connection control devices have been installed at the Main Campus and Depot Campus to prevent backflow of water from equipment/fixtures into the UConn distribution piping system. An annual cross connection survey is conducted whereby approximately 223 buildings are investigated to determine if there are potential cross connections and test the equipment for evidence of backflow. Annual reports of the cross-connection survey are submitted to the DPH. Table 4-14 presents the results of the most recent cross connection survey conducted in 2019.

TABLE 4-14
Summary of 2019 Cross Connection Survey Report

Survey Item	Count
Total Devices Tested	769
Total tests Performed	769
Total Number of Failures	35
Total Repairs	35

In 2019, 35 failures were detected. A total of 35 of the failures were repaired and retested to confirm successful repair.

4.4.6 Summary

A review of the water quality data collected over the past ten years indicates that the overall water quality is good, and with appropriate treatment the UConn potable water supply will continue to exhibit appropriate water quality. Entry point and distribution waters have an excellent compliance record and meet State and Federal requirements. No violations of water quality regulations have occurred in the past ten years for raw, entry point, or distribution water.

4.5 Hydraulic Model

Development of a hydraulic model of the UConn water system originally began in 2006 and was completed by Tighe & Bond, Inc. under subcontract to MMI in connection with the 2011 *Water Supply Plan*.

The pre-existing hydraulic model was used by CDM Smith as the basis for developing the current hydraulic model of the Main Campus transmission and distribution system in 2016. The software application InfoWater, which is fully integrated with ArcGIS software, was used to create an accurate representation of a distribution system and to perform real time hydraulic simulations. The model database includes metadata and descriptive information to define, manage, and organize the node and pipe facility data. Information such as pipe and pipe junctions (age, diameter, length, material, internal roughness), pump data, tanks, valves, and controls were incorporated into the model. Additionally, CDM Smith conducted fire hydrant flow testing to calibrate the model. Note that the Depot Campus service area is not included in the model, nor were many laterals and service connections directly included (e.g., demands were applied to distribution pipe segments as opposed to being directly modeled through service connections).

Based on the results of the calibrated model, the UConn transmission and distribution system on the Main Campus was considered to be sufficient and accurately calibrated for a system wide analysis. The calibrated computer model was able to simulate the system under existing conditions and evaluate flow, pressure, and fire flow. Using the model, CDM Smith completed the following tasks:

- Evaluated water pressure throughout the entire distribution system;
- Evaluated distribution system piping for high velocities and high head losses typically indicative of undersized piping as well as dead-end locations and hydraulic looping; and
- Evaluated the distribution system's ability to provide fire flows and maintain adequate residual pressures.

The model found that, in general, the pressures within the potable water system range from about 29 psi to 170 psi throughout the system under average day conditions. CDM Smith determined 86% of all model junctions have pressure within the acceptable range of 35 to 100 psi. Within the fire protection system, static pressure ranges from 130 to 180 psi.

The only locations where simulated pressures were at the lower end of the acceptable pressure range were the suction side of the pumps from the W-Lot reservoir and the immediate vicinity of the Towers standpipes. Because pumping water out of the W-Lot reservoir is sufficient to provide adequate pressure to refill the Towers standpipes, and because there are no customers served off of the suction side of the main, the simulated low pressures are not a concern. Similarly, the simulated low pressures in the immediate vicinity of the Towers standpipes are caused by the high elevations at these locations. Since there are no customers served in the immediate vicinity of the standpipes, these low simulated pressures are also not an immediate concern.

Based on the analysis conducted, the following conclusions were made regarding the adequacy of the existing system to meet current water system demands:

- The area within the domestic system with high pressure exceeding 100 psi, such as Towers Loop pressure zone, should be further evaluated to determine if the current control scheme can be changed or if pressure reducing valves need to be installed. Continued operation at high pressure may cause faucet leakage or hot water heater pressure relief valves to discharge, resulting in unnecessary water waste. Additionally, abnormally high pressure can result in excess water loss through system leakage and water main breaks.
- If future development is planned for the area in the north part of campus along Storrs Road (Route 195) near Horsebarn Hill Road and Tower Loop Road, provisions for individual water booster station(s) or the creation of a larger booster area should be included.
- Where possible, looping dead ends and replacing old unlined water mains will improve system capacity, water quality and reliability.
- Installing flow meters on all pumps and individual services to all buildings within the service area would assist with flow tracking.

Tables 4-15 summarizes the pipes in the hydraulic model by diameter.

TABLE 4-15
Breakdown of Transmission and Distribution System Model Pipes by Diameter

Diameter	Total Length (feet)
4-inch	4,116
6-inch	5,572
8-inch	39,966
10-inch	18,743
12-inch	26,557
14-inch	175
16-inch	37,995
20-inch	592
Total:	**133,716**

Overall, the modeling results indicate that UConn's distribution system reliably provides adequate distribution system pressure and there is not an urgent need for any pipeline replacement or new piping installations due to areas of low pressure or due to high head losses or velocities. However, with the model advanced to its present form, UConn is in a position to use it to help make decisions about the system such as prioritizing water main replacements.

More formalized model calibration and verification will be conducted in the future as time and budgetary considerations allow. A line item for future model calibration and verification has been listed in the Short-Term Improvement Schedule in Section 7.0.

4.6 Utility Design Criteria

The "Rules and Regulations of the University of Connecticut Water System" were adopted by the Board of Trustees and became effective October 1, 2006. Refer to Appendix N for a copy. The document provides policy and procedures for applications for new service, transfers of service, design and ownership of services, metering, billing, collections, termination of service, private fire service, and public fire protection service.

Although basic design criteria are set in the Rules and Regulations, the document does not include detailed design criteria that could be followed by a contractor for construction, installation, testing, and disinfection of pipes, valves, tapping sleeves, hydrants, and water service lines. NEWUS is available to assist in matters related to design criteria.

UConn is presently working on an update to the Rules and Regulations as the majority of off-campus customers are now the responsibility of CWC. The updated document may be combined with the sewer rules and regulations.

4.7 System Deficiencies and Needed Improvements

System deficiencies, where they exist, have been identified throughout the preceding sections. Detailed discussions of specific improvements designed to remediate these deficiencies, as well as those that will be necessary to meet future needs, are presented throughout this *2020 Plan* and are summarized in Section 7.0. Tables 7-8, 7-9, and 7-10 present system improvements in Short-Term, Intermediate-Term, and Long-Term Improvement Schedules.

A distribution system deficiency discussed in the *Emergency Contingency Plan* is that the Depot Campus portion of the system could benefit from increased source redundancy. If the Willimantic River Wellfield were compromised, it would be difficult to immediately flow water from the Fenton River Wellfield through the system and down to the Depot Campus. An item has been added to Table 7-9 to address the potential redundancy improvement.

5.0 SERVICE POPULATION AND HISTORICAL WATER USE

5.1 <u>System Overview</u>

UConn provides potable water for students, faculty, and staff at the Main Campus and nearby Depot Campus in Mansfield, Connecticut. The UConn transmission and distribution system has historically been installed on both state-owned lands and beneath certain roadways owned by the Town of Mansfield.

A small number of residents and businesses in the Storrs area are still served by the UConn water system, following completion of the CWC interconnection in 2016 that resulted in most non-UConn water users becoming CWC customers (see discussion in Section 3.2.4). Residents of Mansfield that live beyond water system service areas are served by private wells or by other small "community" public water systems that are independent from the UConn system.

Source water meters have been installed at the UConn water supply wells for several decades, and usage meters were originally installed in selected campus buildings in the early 1990s to track water consumption by major water users. Approximately 30 on-campus buildings were metered by 1999. Prior to completion of the CWC interconnection, Town of Mansfield facilities and select commercial users were also metered when they were part of the UConn water supply system, but most residential customers were not.

UConn embarked on an intensive metering program for both on-campus and off-campus water users beginning in 2006. The 2011 *Water Supply Plan* was the first UConn *Water Supply Plan* to present reasonable estimates of water usage by traditional user category, and this *2020 Plan* presents refined estimates based on additional metering completed between 2011 and 2019. Water users can be divided into on-campus and off-campus users and are therefore categorized as follows:

- <u>On-campus residential users</u>: This category includes UConn-owned residence halls and apartments on the UConn water system;
- <u>On-campus non-residential users</u>: This category includes transient visitors, non-transient commuting students, faculty, and staff; facilities usage; irrigation usage; the cooling towers, chillers, and boilers at the CUP; and the South Campus chillers.
- <u>Off-campus users</u>: This category includes residential, commercial, and institutional usage for the few remaining off-campus customers directly connected to the UConn water system.

Unlike many other community water systems, the population served by the UConn water system and its future growth are not proportional to population distribution and growth in the surrounding town (Mansfield). This is because UConn's primary interest lies in providing water to serve the needs of its students, faculty, visitors, facilities, and other support services. UConn previously committed to supplying a variety of off-campus users in the Town of Mansfield over the last four decades for several different reasons (some of which are listed in Section 2.1), however these areas now lie within the ESA of CWC and any additional service areas would be served by CWC if needed.

UConn has potential water demands described in Section 6.0 that include future on-campus buildings and to the potential growth of the student population. UConn does not anticipate directly serving additional off-campus customers in the future.

5.2 Historic Water Consumption

Historic water consumption data prior to 2007 is relatively poor due to limited metering. Older *Water Supply Plans* for UConn (through 2004) have necessarily assumed that water production was equivalent or close to water demand. This is not necessarily the case for the UConn water system, as water produced at the wells can go into storage and not reach an end user for several days.

As noted above, water demand categories are divided into on-campus residential, on-campus non-residential, and off-campus uses. These are described in more detail in the subsections below. Table 5-1 is a multi-page table that presents metered water usage by user category since 2000.

Prior to 2006, meters were read on a semi-annual basis. Monthly meter reading began in 2006 for on-campus connections, with the remaining off-campus connections read quarterly. Note that the 2006 data is limited to the last three months of the year, and the 2010 data represents a partial year. Note further that the residential demands in Table 5-1 have been summarized by complex (including any related dining hall demands). The residential complexes are described further in Section 5.2.1.

5.2.1 On-Campus Residential Users

According to the UConn Enrollment Office, the residential population of UConn at the Main Campus at the start of the 2018-2019 academic year was 12,296 people. This total includes undergraduate students and graduate students in UConn-owned residence halls and apartments.

Since the time of the last *Water Supply Plan* in 2011, several changes have occurred to on-campus housing:

- UConn purchased the Nathan Hale Inn in 2015 and used a portion of the rooms for student housing through the spring of 2019. The Inn is currently being renovated and will be used as a hotel operated by the firm "Graduate Hotels" in the future. It will no longer be available for student housing.

- Connecticut Commons (formerly the graduate student residences) closed in the spring of 2016. The facility was demolished and was replaced by the Student Recreation Center. It previously housed approximately 450 students. Northwoods Apartments is now prioritized for graduate student housing.

- The Peter J. Werth Residential Tower was constructed in the Hilltop area as part of the UConn NextGen Program and opened in 2016. This building has capacity for 725 students and resident assistants. The Putnam dining hall is closest to this building.

- Mansfield Apartments and Northwoods Apartments continue to be owned and operated by UConn, but water service is now provided by CWC.

Table 5-2 presents the resident population by housing complex. The 2018-2019 on-campus resident capacities are used as that period reflects the previous residential usage at Nathan Hale Inn.

Table 5-1
Metered Non-Residential Water Demands, 2011-2019
All Figures in gpd

Name	2011	2012	2013	2014	2015	2016	2017	2018	2019
Academic and Other Buildings									
Agriculture Biology, Lab & Greenhouse H2O Flow Bldg 0421	11,080	11,039	13,133	12,267	17,883	13,570	10,754	9,541	9,676
Admission Bldg H20 Flow	N/A	413	520	40,433	466	311	298	330	340
Alumni House	0	285	317	232	296	658	264	285	267
Atwater Laboratory H20 Flow Bldg 0040	1,280	1,028	1,055	807	681	447	530	670	16,258
Babbage Library H20 Flow	19,446	12,562	7,547	8,080	8,851	14,286	6,643	N/A	N/A
Beach Hall H20 Flow Bldg 0038	9,064	5,789	5,294	6,095	6,247	6,234	2,966	3,060	2,795
Benton Museum of Art H20	3	241	346	295	476	706	374	336	N/A
Biobehavioral 4 Original Prefab Bldg 1101A	1,164	1	N/A	N/A	319	326	210	225	199
Bio4 H20 Flow	286	10	N/A	N/A	75	80	202	156	147
BioPhysics H20 Flow Bldg 0384	6,245	5,655	3,703	4,137	4,478	11,004	6,146	6,042	5,430
Bishop Center H20 Flow		600	574	681	1,068	3,359	1,203	629	644
Castleman H20 Flow	1,306	1,215	1,151	142	142	121	85	N/A	N/A
Center UnderGrad H20	1,067	1,104	993	1,030	1,135	1,228	1,246	1,353	1,261
Chemistry H2O Flow Bldg 0409	978	4,951	12,560	7,130	5,454	3,516	3,466	3,219	3,828
CHIPS Ryan Refectory	568	640	887	281	859	1,009	450	462	319
College of Liberal Arts & Science H20 Flow Bldg 0238	1,143	1,171	1,267	1,223	1,297	1,193	1,199	1,265	1,302
Commisary Bakery & Warehouse H20 Flow Bldg 0244	1,386	1,140	589	2,938	15	0	N/A	N/A	N/A
Dodd H20		2,017	2,099	2,966	2,124	2,290	1,822	2,163	1,821
Drama Music H20		2,524	1,305	1,371	1,876	857	1,162	1,356	1,387
Engineering 2 H20 Flow Bldg 0239	14,748	9,458	8,224	9,012	8,834	9,094	3,817	N/A	N/A
Engineering 3 - Arthur Bronwell Building - H20 Flow	6,441	4,359	738	490	493	1,740	496	N/A	N/A
Floriculture H20		19	15	36	40	44	13	9	8
Gulley Hall H20	289	307	267	230	271	320	293	257	210
Human Development H20			827	851	865	741	703	812	766
IMS (Now Gant North) H20 Flow Bldg 0331A	19,108	14,913	14,392	19,808	17,927	16,624	18,561	15,676	N/A
ITEB H20 Flow Bldg 0434	1,266	1,447	1,294	1,542	2,053	1,198	2,258	2,010	2,369
Jones Building H20 Flow Bldg 0240	4,707	11,402	795	1,584	1,265	461	1,402	326	1,213
Lakeside H20	165	149	141	149	184	152	12	N/A	N/A
Laurel (Now McHugh) Hall (West Classroom) H20		879	1,007	1,121	1,568	950	1,135	1,099	991
Museum of Natural History H20 Flow Bldg 0030	30	35	36	60	205	44	39	53	74
Music Building H20		673	1,270	N/A	526	429	592	607	567
Music Orchestra H20		146	208	N/A	524	583	330	350	151
Nathan Hale Inn - UConn Metering	9,373	11,364	9,264	10,496	*Now Under Residential*				
Neag/Gentry H20		947	1,155	1,219	1,142	1,101	1,160	1,176	1,122
New Fine Arts H20		50	833	245	2,199	409	399	519	666
Oak Hall (East Classroom) H20			1,427	1,460	1,588	1,933	1,781	1,667	1,562
Pharmacy/Biology H20 Flow Bldg 0415	25,049	24,961	19,427	159,421	66,900	42,070	39,021	53,189	57,871
Physics Gant Complex (Physics Build, MSB) H20 Flow Bldg 0331C	23,912	23,439	10,631	8,099	9,444	17,282	21,829	N/A	N/A
Psychology Bousfield H20 Flow Bldg 0349	14,241	10,100	4,149	N/A	2,098	3,471	3,782	4,499	4,561
Public Safety H20		575	646	663	688	947	690	656	662
School of Business H20	1,266	1,736	1,858	2,356	2,636	1,985	1,472	1,583	1,469
Storrs Hall Domestic H20	23	11	N/A	N/A	4	1	4	1	N/A

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Table 5-1
Metered Non-Residential Water Demands, 2011-2019
All Figures in gpd

Name	2011	2012	2013	2014	2015	2016	2017	2018	2019
Torrey Life Science H20 Flow Bldg 0252	13,775	15,871	17,230	32,774	12,776	11,529	6,440	5,307	4,236
Total Student Union Including Vendors	15,725	16,506	15,798	17,134	19,952	19,264	12,428	11,381	10,759
Old UConn Co-Op to 2003; New Co-Op and South Garage	1,244	1,244	1,143	1,362	1,263	997	984	1,083	924
UConn Foundation	1,312	1,541	1,474	633	818	545	1,147	686	962
United Technologies Engineering Building H20 Flow Bldg 0369	4,534	1,630	1,690	1,396	1,805	1,855	191	N/A	N/A
Visitors Center H20		78	1,099	1,607	779	635	442	757	988
Whetten Graduate Center H20	437	733	752	764	802	658	584	670	543
White Dairy Building H20 Flow Bldg 0222	2,859	4,557	3,816	2,818	3,783	4,390	2,691	1,686	2,841
Wilbur Cross H20	1,395	1,620	1,497	1,384	1,765	1,299	1,386	935	1,372
Williams Health Services Infirmary H2O Flow Bldg 0171	534	634	888	1,364	3,429	816	648	657	723
Wood Hall H20 Flow Bldg 0131	1,254	342	378	348	318	348	467	335	310
Young Building H20 Flow Bldg 0175	2,028	1,019	N/A	595	864	816	838	843	849
Athletics									
Batting and Pitching Facility H20 Flow Bldg 0406	53	56	36	N/A	15	0	N/A	1	N/A
Burton Football & Shenkman H20 Flow Bldg 0480	45,744	53,905	14,726	10,627	9,555	3,199	4,639	4,546	1,448
Field House H20	11,371	5,875	5,425	5,801	5,804	6,370	6,044	6,249	4,555
Gampel Pavilion Sports Center H2O Flow Bldg 0374	7,463	9,717	8,274	7,231	4,670	4,489	3,996	533	14,293
Ice Rink Arena H20 Flow Bldg 0433	3,287	3,456	4,433	3,818	3,511	4,222	3,638	3,175	3,419
Soccer Field Bldg 530SW	0	0	0	N/A	N/A	0	N/A	1	2
Soccer Practice Field	0	0	1	0	N/A	0	N/A	0	N/A
Utilities									
Cogeneration Chiller Facility H2O Flow Bldg 0483									
CUP Heating and Power Plant H2O Flow Bldg 0141									
CUP RO System Inlet									
Total CUP	400,433	303,049	321,277	102,312	153,195	107,060	97,321	133,699	N/A
RWF Fresh Water Use					56,773	91,158	92,342	84,573	N/A
Waste Water Control Building H20 Flow Bldg 0388	311	243	163	285	177	174	185	139	150
Waste Water: Odor Control H20 Flow Bldg 0389	23,177	16,310	6,939	6,621	1,935	2,649	2,790	2,871	2,591
Waste Water: Process H20 Flow Bldg 0390	12	6	N/A	N/A	N/A	28	22	0	N/A
Depot Campus									
Depot Campus Kennedy Cottage H2O Flow Bldg 2131	81	135	77	85	89	201	124	95	96
Depot Campus Longley School H20 Flow Bldg 1125	119	217	280	277	283	452	478	773	927
Depot Campus Mansfield Cottage H20 Flow Bldg 2138									
Depot Campus Coventry Cottage H20 Flow Bldg 2112	53	2	N/A	54	15	9	N/A	0	N/A
Enterprise H20 Flow (Depot Campus)	308	514	538	394	265	306	250	201	175

TABLE 5-2
Main Campus Resident Population and Water Demand, 2019

Name	Year Built	Dining Hall	2018-2019 Capacity (Estimated Population)[1]	Typical Usage 2011-2019, gpd	Per-Capita Demand, gpcd[2]
Alumni Quadrangle	1966	None	965	22,700	23.5
Buckley Hall	1969	Full Service	390	15,700	40.3
Busby Suites	2003	Kitchens	491	16,000	32.6
Charter Oak Apartments	2003	Kitchens	620	21,700	35.0
East Campus	1922 – 1950	Full Service	562	20,900	37.2
Garrigus Suites	2001	Kitchens	478	15,500	32.4
Greek Campus / Husky Village	2004	Kitchens	300	7,600	25.3
Hilltop Apartments	2001	Kitchens	1,077	34,000	31.6
Hilltop Complex (Ellsworth, Hale)	1971	Full Service	560	20,000	35.7
McMahon Hall	1964	Full Service	602	34,200	56.8
Nathan Hale Inn	2001	None	150	10,400	69.3
North Campus	1950	Full Service	1,318	67,900	51.5
Northwest Quadrangle	1950; Renov. 1999	Full Service	1,022	22,000	21.5
Shippee Hall	1962	None	295	8,300	28.1
South Campus	2000	Full Service	657	18,900	28.8
Towers Quadrangle	1960 & 2003	Full Service	937	28,200	30.1
Werth Tower[3]	2016	None	725	21,800	30.0
West Campus	1955	None	484	12,300	25.4
		Total for UConn Water System[4]:	***11,633***	***417,700***	***34.7***

1. Capacity includes assigned room spaces for students and resident assistants. It does not include hall directors or their families who typically live in an apartment at each complex.
2. Per-capita demand based on the Typical Usage from 2011 to 2019 (gpd) divided by the 2018-2019 capacity, assuming occupancy is 100% of capacity. Note that occupancy is typically near 100% but varies from semester to semester and also from year to year.
3. Flows for Werth Tower estimated as meter is not yet functional.
4. Does not include Mansfield Apartments, Northwoods Apartments, or other off-campus residential buildings that are now served by CWC.

All housing complexes are metered and are nearly 100% occupied for the majority of the year. According to UConn Residential Life, slightly fewer students are typically present during the spring semester than the fall semester due to students studying abroad, transfers, mid-year graduations, and dropouts.

Per capita water use for on-campus residential users was determined to be 34.7 gallons per capita per day (gpcd) based on the average of metered residential water use from 2011 to 2019 (an average of 417,700 gpd). This figure is comparable to the 32.6 gpcd presented in the 2011 *Water Supply Plan*. The per-capita demand figure is low compared to typical community water systems where per-capita consumption varies from approximately 45 gpcd to 75 gpcd, but reasonable for on-campus student housing where laundry, dining, and restroom facilities are shared and outdoor water uses are lacking.

Note that most of the per-capita figures presented above are skewed slightly lower by the averaging that occurs when comparing annual consumption to a population that is largely absent from late May through late August. However, demand trends over the last 5 to 10 years have begun to ramp up in July and August as a result of summer programs at UConn. Note further that UConn has identified the potential for expansion of on-campus housing in the foreseeable future as presented in Section 6.3.1.

5.2.2 On-Campus Non-Residential Users

The on-campus, non-residential population served by UConn is significant. The non-transient, non-residential populations include the pre-school children at the Child Development Lab (which was metered in 2019), the many faculty and staff (estimated at 4,600 people for the Storrs Campus), and the undergraduate and graduate students who live off-campus (estimated to be 10,800 in 2019).

The transient non-residential population includes the many visitors that come for on-campus tours (estimated by the Visitor's Center at 50,000 per year) and those who attend sporting events at Gampel Pavilion or other athletic stadiums. Additionally, other campus venues offer year-round programming to attract off campus visitors, including the Harriet S. Jorgensen Theatre, and the J. Louis von der Mahden Recital Hall, among others. The total transient population attending such functions at UConn is easily greater than 100,000 individual visits per year.

At this time, 67 of the approximately 170 buildings on the Main Campus are metered. The metered uses include the majority of the high water-demand users on campus, so applying an average usage based on the high demand users to the remaining unmetered buildings would be meaningless. Thus, it is impossible at this time to precisely estimate the water usage in the unmetered non-residential buildings. However, UConn's metering program has been updating and replacing certain older meters to meet the current UConn metering standard (Section 4.2.6). Approximately 35 building locations were updated by December 2019. The remaining buildings will be metered as indicated by the improvement schedules listed in Section 7.0 based on the metering program in Section 4.2.6.

The 71 metered on-campus non-residential users (including 4 on the Depot Campus) can be broken down into four subcategories as shown in Table 5-3.

TABLE 5-3
On-Campus Non-Residential Water Usage

Subcategory	Number of Metered Connections	Typical 2011 to 2019 Usage, gpd
Academic, Administrative, and other Buildings	55	214,317
Athletics Buildings	7	35,480
Utilities (CUP, Chillers, RWF, WPCF)	5	215,034
Depot Campus	4	903
Total On-Campus Non-Residential Metered Usage:		***465,734***

Most of the users of the UConn water system exhibit a seasonality to their consumption patterns that is closely linked to the academic schedule. However, the CUP demands follow a modified seasonality pattern that is closely related to the heating and cooling needs. Heating and cooling needs are somewhat dependent on population but are very much affected by the temperature and season.

Daily water consumption at the CUP includes makeup water for chilled water, the cooling towers, and the boilers, with the majority of this demand being met with reclaimed water (approximately 90%). The CUP includes the pre-1960s Boiler Plant, the 1998 Chiller Plant and #9 Boiler, and the Co-Generation Plant with three gas turbines and adsorption chillers. The cooling towers cool water by evaporation and typically evaporate 60 to 70% of the incoming water, with the balance being returned to the sanitary sewer to prevent the buildup of excess solids in the system. Makeup water is needed for boilers to replace steam losses from leaks, steam traps, and humidification systems and to replace water that has been lost in the steam line condensate return system.

Table 5-4 provides a comparison of metered makeup water demands to potable water production in the year 2011. Table 5-5 presents a similar table for the year 2018. The two years provide contrast between previous operations and current operations, with the amount of potable makeup water being used essentially being reduced by two-thirds with the RWF online.

TABLE 5-4
Summary of Makeup Water Consumption at Central Utilities Plant, 2011

Month	Wellfield Production (gallons)	Total CUP Use (gallons)	% of Production Used at CUP
Jan.	38,314,800	7,999,000	21%
Feb.	45,601,100	7,463,000	16%
Mar.	44,920,000	7,580,000	17%
Apr.	44,731,100	7,283,000	16%
May	29,314,300	6,375,000	22%
Jun.	27,446,000	15,685,000	57%
Jul.	32,550,400	**19,897,000**	**61%**
Aug.	35,879,200	18,256,000	51%
Sep.	**48,615,400**	16,724,000	34%
Oct.	46,298,900	12,946,000	28%
Nov.	40,916,500	12,498,000	31%
Dec.	37,209,300	13,452,000	36%
Year	471,797,000	146,158,000	31%

Note: Peak numbers in each category are shown in bold text.

TABLE 5-5
Summary of Makeup Water Consumption at Central Utilities Plant, 2018

Month	Wellfield Production (gallons)	Total Potable CUP Use (gallons)	% of Potable Production Used at CUP	RWF Production (gallons)	Total Non-Potable CUP Use (gallons)	% of RWF Production Used at CUP
Jan.	23,764,000	1,903,000	5%	11,258,919	11,042,369	98%
Feb.	**38,112,000**	2,038,000	4%	8,924,647	8,702,924	98%
Mar.	26,259,000	1,948,000	4%	9,904,007	8,830,942	89%
Apr.	30,190,000	4,094,000	9%	7,397,623	6,835,468	92%
May	19,963,000	4,943,000	17%	3,600,932	3,117,225	87%
Jun.	18,160,000	4,311,000	16%	7,643,286	7,101,746	93%
Jul.	21,456,000	5,447,000	17%	**12,303,901**	11,454,120	93%
Aug.	26,742,000	**9,242,000**	**26%**	10,875,861	10,033,796	92%
Sep.	30,684,000	6,033,000	12%	10,834,525	10,076,043	93%
Oct.	28,729,000	3,160,000	7%	10,934,197	10,195,148	93%
Nov.	23,981,000	3,277,000	8%	7,299,340	7,299,340	100%
Dec.	19,089,000	2,404,000	6%	9,293,780	8,701,636	94%
Year	307,129,000	48,800,000	16%	110,271,018	103,390,757	94%

Note: Peak numbers in each category are shown in bold text.

The boiler makeup demand reaches its peak during the heating season, whereas cooling tower makeup water demands are at their peak when the temperatures are warmest. Overall, the percentage of potable wellfield withdrawals that are directed to the CUP for makeup water now typically ranges from 5% to 26% per month based on the 2018 data.

It is notable that the overall peak month for water production (typically September in any given year) does not coincide with the peak months of CUP makeup water consumption. This is because water usage by the UConn population drives the peak demands when the fall semester begins. Nevertheless, the cooling tower demands are significant in September, and they are an important fraction of overall water usage during that month.

The percentages in Table 5-5 for the percentage of RWF production used at the CUP is not 100% because there are other uses of reclaimed water connected to the RWF. These include toilet flushing at the ESB and the IPB. These grey water uses are not metered, but nevertheless contribute to a potable water demand reduction at those facilities.

Flows leaving the RWF into the grey water system are metered. Monthly flows to the RWF storage tank are presented in Table 5-6. Flows have averaged from 0.24 mgd to 0.33 mgd over the seven years of operation, resulting in reduced potable water demands of a similar volume. Peak day grey water flow into the system was 0.651 MG in March 2017.

TABLE 5-6
Monthly RWF Flows to the Campus Grey Water System

Month	2013 Flows (mgd)	2014 Flows (mgd)	2015 Flows (mgd)	2016 Flows (mgd)	2017 Flows (mgd)	2018 Flows (mgd)	2019 Flows (mgd)
Jan.	N/A	0.219	0.099	**0.407**	0.363	0.363	0.312
Feb.	N/A	**0.334**	0.245	0.384	0.351	0.319	0.296
Mar.	N/A	0.175	**0.344**	0.404	**0.410**	0.319	0.310
Apr.	N/A	0.320	0.316	0.376	0.313	0.247	0.296
May	N/A	0.117	0.095	0.159	0.139	0.116	0.268
Jun.	N/A	0.119	0.247	0.224	0.251	0.255	0.387
Jul.	0.394	0.270	0.336	0.339	0.318	**0.397**	**0.453**
Aug.	**0.555**	0.256	0.293	0.345	0.384	0.351	0.420
Sep.	0.331	0.250	0.262	0.311	0.298	0.361	0.423
Oct.	0.376	0.270	0.083	0.140	0.368	0.353	0.356
Nov.	0.235	0.275	0.223	0.202	0.365	0.243	0.190
Dec.	0.279	0.252	0.342	0.368	0.372	0.300	0.331
Year	0.316	0.238	0.240	0.305	0.320	0.302	0.334

Note: Peak monthly flows for each year are shown in bold text.

5.2.3 Off-Campus Users

UConn previously served approximately 115 residential structures that (1) were not group quarters; and (2) were considered off-campus, even though some of these buildings were owned by UConn. Furthermore, UConn previously served seven off-campus residential complexes as well as a variety of off-campus commercial and institutional uses. After completion of the CWC interconnection in 2016, nearly all off-campus buildings became customers of CWC and are no longer served by the UConn water supply system. Streets that were formerly served include:

- Main Campus Area: Dog Lane, Eastwood Road, Gurleyville Road, Hillside Circle, Hunting Lodge Road, Meadowood Road, Moulton Road, North Eagleville Road, Oak Hill Road, Separatist Road, South Eagleville Road, Westwood Road, and Willowbrook Road, for a total of 106 connections; and,

- Depot Campus Area: Old Colony Road, Spring Manor Lane, and Stafford Road (Route 32), for a total of nine connections.

UConn continues to serve a minimal number of off-campus customers that were not transferred to CWC under the 2013 agreement. These include the following:

- Residence – 4 Moulton Road (metered), typical use of 120 gpd
- Saint Mark's Chapel – 42 North Eagleville Road (metered), typical use of 100 gpd
- Saint Thomas Aquinas Chapel – 46 North Eagleville Road (metered), typical use of 100 gpd
- Saint Thomas Aquinas Residence – 46 North Eagleville Road (metered), typical use of 150 gpd
- Hillel House - 54 North Eagleville Road (metered), typical use of 100 gpd
- Frontier Communications – 1298 Storrs Road (metered), typical use of 20 gpd
- Residence - 64 Spring Manor Lane – (metered), typical use of 190 gpd

- Residence – 66 Spring Manor Lane – (metered), typical use of 140 gpd
- Tri-County Greenhouse – 290 Middle Turnpike (metered), typical use of 700 gpd

Thus, the remaining off-campus users (total of 1,620 gpd) comprise negligible percentage of the total demand on the UConn water system.

5.2.4 Summary of Known Water Usage

The water consumption figures presented in Section 5.2.1 through 5.2.3 are summarized in Table 5-7.

TABLE 5-7
Service Population and Water Usage by Category, 2011-2019

Name	2019 Population	Typical Usage, 2011 to 2019 (gpd)
On-Campus Residential	11,633	417,700
On-Campus Non-Residential	N/A	465,734
Off-Campus	15	1,620
Total:	**11,648**	**885,054**

Note: Does not include unmetered demands.

As discussed in the next two sections, water demands on the UConn water system have significantly decreased since 2011 due to the construction of the RWF and the completion of the CWC interconnection that shifted responsibility for serving most former off-campus customers to CWC.

Table 5-8 summarizes the top ten UConn water users. An understanding of the highest water users is an important component of water conservation. The *Water Conservation Plan* further addresses the top users.

TABLE 5-8
Top Ten UConn Potable Water Users

Name	Type or Use	Typical Usage 2011-2019, gpd*	Per-Capita Demand, gpcd
Central Utility Plant	Utility	119,000	N/A
RWF Fresh Water Usage	Utility	87,900	N/A
Pharmacy / Biology Building	Academic / Research	54,200	N/A
North Campus	Residential / Dining	67,900	51.5
McMahon Hall	Residential / Dining	34,200	56.8
Hilltop Apartments	Residential	34,000	31.6
Towers Quadrangle	Residential / Dining	28,200	30.1
Alumni Quadrangle	Residential	22,700	23.5
Northwest Quadrangle	Residential / Dining	22,000	21.5
Charter Oak Apartments	Residential	21,700	35.0

*List does not include buildings with estimated flows.

5.3 Historic Water Production

Table 5-9 summarizes the annual water production from the Fenton River Wellfield and the Willimantic River Wellfield since 1984. All data are based upon UConn production records. Note that UConn has not yet made any purchases of water through the CWC interconnection, so the annual water production from the wellfields continues to represent 100% of UConn's water production.

TABLE 5-9
Summary of Annual Production

Year	Average Daily Production (mgd)	Year	Average Daily Production (mgd)
1984	1.21	2002	1.26
1985	1.08	2003	1.29
1986	1.36	2004	[not available]
1987	1.35	2005	1.49
1988	1.57	2006	1.36
1989	1.61	2007	1.29
1990	1.54	2008	1.26
1991	1.54	2009	1.23
1992	1.48	2010	1.29
1993	1.31	2011	1.29
1994	1.37	2012	1.26
1995	1.37	2013	1.10
1996	1.30	2014	1.16
1997	1.13	2015	1.19
1998	1.17	2016	1.04
1999	1.22	2017	0.90
2000	1.22	2018	0.75
2001	1.28	2019	0.72

It is well-documented that system demand is higher during the fall and spring semesters and lower when the majority of students are on breaks. Monthly historical demand values are presented in Table 5-10 and ADD by month is presented in Table 5-11. PDD by month is presented in Table 5-12. All three tables are presented below.

As seen in Table 5-10 and Table 5-11, monthly water production has historically peaked in April and October. Since 2002, monthly water production has generally peaked in September, except for 2012 and 2013 when production peaked in April, and 2016 and 2018 when production peaked in February; these peak months coincide with the return of students to campus from various breaks and/or when chiller use begins to ramp up during warmer spring seasons. The highest average day monthly water production in the past several years occurred in September of 2005, when the average daily demand was 1.95 mgd. Since this peak, September water demands from 2006 through 2018 have been decreasing steadily from approximately 1.3 mgd in 2006 to 2011, to approximately 1.0 to 1.1 mgd for the last three years (2017 to 2019). The September demand is critical because it occurs during the typical low-flow periods in the two rivers adjacent to the UConn wellfields.

Table 5-10
Monthly Water Production (MG)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Average Daily Demand (MGD)
1984*	30.75	42.09	38.11	42.20	33.94	27.53	28.06	30.67	43.28	**48.36**	41.05	36.42	442.46	1.21
1985	30.93	39.60	38.71	**42.74**	33.55	25.76	27.36	28.49	35.63	30.44	34.92	26.79	394.92	1.08
1986	38.11	44.93	43.44	47.43	37.25	29.9	39.33	30.58	48.12	**49.76**	46.92	42.07	497.84	1.36
1987	33.28	43.67	44.17	45.66	39.3	30.78	35.47	33.65	47.62	**50.16**	44.48	43.08	491.32	1.35
1988*	42.47	52.54	51.02	54.10	45.27	38.95	41.01	42.37	53.93	**54.99**	48.76	50.10	575.51	1.57
1989	43.48	50.40	49.52	54.50	47.41	39.23	41.81	41.75	55.31	**57.78**	53.00	52.56	586.75	1.61
1990	43.23	50.34	49.55	52.77	44.63	40.09	39.11	39.64	51.86	**54.37**	48.35	48.46	562.40	1.54
1991	46.06	48.86	47.25	50.63	42.27	39.34	39.87	37.93	53.88	**57.58**	49.47	48.32	561.46	1.54
1992*	41.68	50.92	52.02	**54.05**	44.09	40.60	36.68	36.46	48.27	51.21	45.77	41.35	543.10	1.48
1993	36.07	42.12	43.42	**45.23**	37.01	32.12	36.40	36.10	44.99	43.37	42.05	40.22	479.10	1.31
1994	37.93	41.90	45.78	46.79	40.71	34.63	37.07	35.48	45.71	**46.86**	43.59	44.88	501.33	1.37
1995	41.63	46.06	44.52	**47.72**	43.95	35.07	38.37	35.41	43.60	45.55	40.38	38.52	500.78	1.37
1996*	32.61	46.57	45.52	**48.47**	40.31	33.42	37.84	33.36	44.07	41.05	39.19	33.60	476.01	1.30
1997	24.57	35.48	37.22	**43.26**	32.91	29.90	30.87	30.74	40.65	40.42	35.20	30.74	411.96	1.13
1998	30.93	34.15	34.12	40.50	31.10	24.73	34.02	30.00	41.95	**50.04**	38.84	35.96	426.34	1.17
1999	37.20	37.47	37.99	42.44	32.05	28.62	33.55	30.65	44.06	**47.42**	38.08	36.68	446.21	1.22
2000*	30.30	38.01	36.53	40.44	33.47	25.37	27.19	35.77	47.77	**48.54**	42.39	42.02	447.80	1.22
2001	29.55	42.07	40.96	43.84	38.04	30.55	30.97	38.10	40.59	**50.89**	43.75	36.82	466.13	1.28
2002	34.33	41.11	38.80	44.15	37.30	27.85	32.72	36.35	**45.58**	42.36	39.31	38.60	458.46	1.26
2003	37.17	43.06	41.81	44.38	38.76	32.19	35.18	37.58	**45.90**	43.99	37.30	31.91	469.23	1.29
2004*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	43.33	46.52	46.84	49.82	38.00	40.16	42.35	51.01	**58.35**	48.27	38.76	38.94	542.35	1.49
2006	36.98	42.96	44.28	45.68	33.49	32.43	42.52	45.07	**49.68**	49.19	41.93	33.66	497.85	1.36
2007	37.54	42.90	40.21	44.37	33.24	33.96	37.36	40.34	**46.69**	45.35	36.60	31.99	470.54	1.29
2008*	35.26	46.23	38.77	43.23	30.68	32.61	36.00	36.30	**47.74**	44.91	37.83	33.09	462.65	1.26
2009	34.97	40.08	39.58	42.97	32.97	27.73	29.44	35.85	**47.37**	44.76	37.37	37.28	450.37	1.23
2010	36.73	39.90	38.77	45.85	31.77	30.68	35.27	36.04	**49.29**	47.10	40.23	39.49	471.12	1.29
2011	38.31	45.60	44.92	44.73	29.31	27.45	32.55	35.88	**48.62**	46.30	40.92	37.21	471.80	1.29
2012*	38.99	43.62	44.44	**46.01**	30.86	30.49	34.80	35.24	45.20	44.32	37.33	31.46	462.75	1.26
2013	34.04	40.48	39.68	**42.28**	29.57	22.98	24.52	31.81	38.94	37.08	32.27	26.18	399.82	1.10
2014	33.48	36.54	41.11	41.52	30.46	27.42	27.91	32.47	**43.22**	42.75	35.82	29.10	421.80	1.16
2015	34.84	41.49	39.69	41.21	33.74	25.98	31.66	29.78	42.97	**44.77**	34.49	32.87	433.50	1.19
2016*	33.47	**39.11**	35.79	37.76	27.17	24.39	26.59	29.69	38.99	38.77	27.98	22.17	381.88	1.04
2017	26.41	31.11	29.63	33.67	23.11	23.05	25.83	28.28	**35.59**	29.78	21.94	19.11	327.50	0.90
2018	21.85	20.89	23.77	28.71	18.64	17.68	20.87	25.86	**29.60**	26.82	22.52	17.35	274.56	0.75
2019	16.97	24.07	24.23	26.21	17.12	13.79	20.47	24.89	**31.36**	28.68	20.74	15.52	264.04	0.72

Notes: NA = Not Available.

* = Leap year. Average Daily Demand calculation is over 366 days.

Bold values = highest production month for that year.

Table 5-11
Monthly Water Production (MGD) - Average Daily Demand

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum Month Average Daily Demand
1984	0.99	1.45	1.23	1.41	1.09	0.92	0.91	0.99	1.44	**1.56**	1.37	1.17	1.56
1985	1.00	1.41	1.25	**1.42**	1.08	0.86	0.88	0.92	1.19	0.98	1.16	0.86	1.42
1986	1.23	1.60	1.40	1.58	1.20	1.00	1.27	0.99	1.60	**1.61**	1.56	1.36	1.61
1987	1.07	1.56	1.42	1.52	1.27	1.03	1.14	1.09	1.59	**1.62**	1.48	1.39	1.62
1988	1.37	**1.81**	1.65	1.80	1.46	1.30	1.32	1.37	1.80	1.77	1.63	1.62	1.81
1989	1.40	1.80	1.60	1.82	1.53	1.31	1.35	1.35	1.84	**1.86**	1.77	1.70	1.86
1990	1.39	**1.80**	1.60	1.76	1.44	1.34	1.26	1.28	1.73	1.75	1.61	1.56	1.80
1991	1.49	1.75	1.52	1.69	1.36	1.31	1.29	1.22	1.80	**1.86**	1.65	1.56	1.86
1992	1.34	1.76	1.68	**1.80**	1.42	1.35	1.18	1.18	1.61	1.65	1.53	1.33	1.80
1993	1.16	1.50	1.40	**1.51**	1.19	1.07	1.17	1.16	1.50	1.40	1.40	1.30	1.51
1994	1.22	1.50	1.48	**1.56**	1.31	1.15	1.20	1.14	1.52	1.51	1.45	1.45	1.56
1995	1.34	**1.65**	1.44	1.59	1.42	1.17	1.24	1.14	1.45	1.47	1.35	1.24	1.65
1996	1.05	1.61	1.47	**1.62**	1.30	1.11	1.22	1.08	1.47	1.32	1.31	1.08	1.62
1997	0.79	1.27	1.20	**1.44**	1.06	1.00	1.00	0.99	1.36	1.30	1.17	0.99	1.44
1998	1.00	1.22	1.10	1.35	1.00	0.82	1.10	0.97	1.40	**1.61**	1.29	1.16	1.61
1999	1.20	1.34	1.23	1.41	1.03	0.95	1.08	0.99	1.47	**1.53**	1.27	1.18	1.53
2000	0.98	1.31	1.18	1.35	1.08	0.85	0.88	1.15	**1.59**	1.57	1.41	1.36	1.59
2001	0.95	1.50	1.32	1.46	1.23	1.02	1.00	1.23	1.35	**1.64**	1.46	1.19	1.64
2002	1.11	1.47	1.25	1.47	1.20	0.93	1.06	1.17	**1.52**	1.37	1.31	1.25	1.52
2003	1.20	**1.54**	1.35	1.48	1.25	1.07	1.13	1.21	1.53	1.42	1.24	1.03	1.54
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	1.40	1.66	1.51	1.66	1.23	1.34	1.37	1.65	**1.95**	1.56	1.29	1.26	1.95
2006	1.19	1.53	1.43	1.52	1.08	1.08	1.37	1.45	**1.66**	1.59	1.40	1.09	1.66
2007	1.21	1.53	1.30	1.48	1.07	1.13	1.21	1.30	**1.56**	1.46	1.22	1.03	1.56
2008	1.14	1.59	1.25	1.44	0.99	1.09	1.16	1.17	**1.59**	1.45	1.26	1.07	1.59
2009	1.13	1.43	1.28	1.43	1.06	0.92	0.95	1.16	**1.58**	1.44	1.25	1.20	1.58
2010	1.18	1.43	1.25	1.53	1.02	1.02	1.14	1.16	**1.64**	1.52	1.34	1.27	1.64
2011	1.24	**1.63**	1.45	1.49	0.94	0.91	1.05	1.16	1.62	1.49	1.36	1.20	1.63
2012	1.26	1.50	1.43	**1.53**	0.99	1.02	1.09	1.14	1.51	1.43	0.12	1.01	1.53
2013	1.10	**1.45**	1.28	1.41	0.95	0.77	0.79	1.02	1.30	1.19	1.08	0.84	1.45
2014	1.08	1.31	1.32	1.38	0.98	0.91	0.90	1.05	**1.44**	1.38	1.19	0.94	1.44
2015	1.12	**1.48**	1.28	1.37	1.09	0.87	1.02	0.96	1.43	1.44	1.15	1.06	1.48
2016	1.08	**1.35**	1.15	1.26	0.88	0.81	0.86	0.96	1.30	1.25	0.92	0.71	1.35
2017	0.84	1.05	0.96	1.12	0.76	0.76	0.78	0.89	**1.15**	0.93	0.71	0.71	1.15
2018	0.77	**1.36**	0.85	1.01	0.64	0.61	0.69	0.86	1.02	0.93	0.80	0.62	1.36
2019	0.57	0.88	0.81	0.89	0.57	0.52	0.75	0.80	**1.06**	0.94	0.76	0.51	1.06

Notes: NA = Not Available.
Bold values = highest production month for that year.

Table 5-12
Peak Day Production (MGD)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum Peak Day Demand
1988	2.09	2.36	2.50	2.39	2.40	1.83	2.56	1.92	2.25	**2.56**	2.19	2.53	2.56
1989	2.25	**2.85**	2.24	2.56	2.41	1.54	1.79	1.71	2.61	2.35	2.61	2.74	2.85
1990	2.02	2.24	1.94	2.37	1.96	1.85	1.64	1.62	**2.62**	2.05	2.07	2.50	2.62
1991	2.06	1.97	2.00	2.03	1.90	2.10	1.75	1.73	2.07	**2.42**	2.05	2.22	2.42
1992	1.97	2.08	2.17	**2.43**	2.22	2.30	1.46	1.76	2.07	2.23	1.82	2.04	2.43
1993	1.73	1.79	1.81	1.98	1.79	**2.26**	2.04	1.81	2.16	1.85	2.10	1.81	2.26
1994	1.99	1.86	2.00	2.06	1.95	1.47	1.69	1.44	**2.20**	1.84	1.90	2.06	2.20
1995	1.77	1.94	1.81	1.90	**1.97**	1.37	1.63	1.49	1.73	1.73	1.60	1.70	1.97
1996	1.75	2.02	1.83	**2.04**	1.80	1.36	1.59	1.58	1.93	1.68	1.87	1.67	2.04
1997	1.30	1.53	1.66	**1.75**	1.60	1.29	1.57	1.47	1.63	1.58	1.53	1.47	1.75
1998	1.58	1.46	1.60	1.99	1.94	1.25	1.73	1.54	1.78	**2.02**	1.82	1.58	2.02
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	**2.13**	NA	NA	2.13
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006	2.19	2.05	2.01	1.89	1.76	**2.40**	2.13	2.03	2.09	1.86	2.01	1.64	2.40
2007	**1.98**	1.94	1.96	1.80	1.82	1.70	1.69	1.80	1.97	1.88	1.90	1.64	1.98
2008	1.82	2.04	1.84	1.93	1.70	1.90	1.72	**2.33**	2.05	1.84	2.14	1.73	2.33
2009	1.86	1.85	1.45	1.93	1.78	1.48	1.24	1.83	2.11	1.72	**2.16**	2.01	2.16
2010	1.68	1.73	**2.23**	2.03	1.68	1.46	1.93	2.02	2.12	2.02	1.89	1.97	2.23
2011	1.91	2.08	2.02	1.89	1.46	1.44	1.55	2.12	1.92	**2.30**	2.00	1.83	2.30
2012	1.85	**2.26**	2.02	1.97	2.20	1.92	1.93	1.90	1.89	1.93	1.98	1.60	2.26
2013	1.88	1.84	**2.35**	1.84	1.76	1.18	1.03	2.13	2.15	1.68	1.49	1.35	2.35
2014	1.94	1.76	1.93	**2.00**	1.90	1.48	1.54	1.77	1.89	1.80	1.98	1.64	2.00
2015	1.68	2.07	1.78	**2.09**	1.82	1.46	1.83	1.68	1.89	1.68	1.89	1.60	2.09
2016	1.75	**1.91**	1.90	1.68	1.65	1.24	1.21	1.77	1.68	1.56	1.49	1.16	1.91
2017	**1.78**	1.44	1.29	1.56	1.63	1.03	1.26	1.31	1.73	1.31	1.10	1.09	1.78
2018	1.21	1.00	1.23	1.30	1.40	1.00	1.10	**1.73**	1.68	1.34	1.56	1.17	1.73
2019	1.43	1.31	1.19	1.36	1.23	0.80	1.32	1.39	**1.44**	1.36	1.32	1.20	1.44

Notes: NA = Not available.
Bold values = maximum value for year.

Similar to many water utilities in Connecticut, overall demand on the UConn water system has decreased over time as seen in the data through 2016. This trend has continued even with the continuing buildout of the UConn 2000, 21st Century UConn, and NextGen projects due to a variety of projects and programs aimed at reducing overall water demand. Projects that have helped to reduce potable water demand have included:

- Demolition of older, water inefficient buildings;
- Construction of new buildings with more efficient water use devices;
- Installation of water-efficient research equipment;
- Repair and replacement of old and/or leaking water pipes, in particular the 16-inch transmission main from the Willimantic River Wellfield to the 5.4 MG reservoir;
- Repair and replacement of certain steam condensate lines which return water to the steam heating system and thereby reduce potable water consumption; and
- Completion of the RWF and conversion of much of the CUP demand to non-potable water;

The production data following 2016 is reflective of the period where the CWC interconnection was in place, resulting in greatly reduced demands for the UConn system as former off-campus customers were transitioned to CWC. In addition, grey water lines were extended from the RWF to the ESB and the IPB during this period which reduced overall water demands at these facilities.

Whereas the peak month demands are fairly constant, as shown in Table 5-12 the PDD can occur during nearly any month of the year. This is because PDD is often tied to abrupt changes in storage due to main breaks, main and/or tank flushing, and other non-typical demand events such as fire flows. PDD can also be tied to pumping tests; for example, the PDD in August 2008, September 2009, and November 2009 correspond to the 72-hour pumping tests associated with the Willimantic River Study. The maximum annual PDD since 2011 was 2.35 MG in March 2013.

Table 5-13 is a multi-page table that presents the monthly water production at each individual well for the period 2011 through 2019. Refer to previous versions of the *Water Supply Plan* for earlier individual well data. Production levels at the Fenton River Wellfield have tended to decrease through the summer and autumn months since the utilization of the recommendations of the Fenton River Study, and Well A continues to be held in reserve as an emergency well.

Historically, the Fenton River Wellfield produces approximately 20% of the water used each year, while the Willimantic River Wellfield produces approximately 80%. More recently, in 2018 and 2019, the Fenton River Wellfield produced approximately 55% of the water used due to reduced system demands and favorable streamflow conditions. Together, the two wellfields produced approximately 380 to 470 million gallons per year from 2011 through 2016, and approximately 260 to 330 million gallons per year from 2017 through 2019.

TABLE 5-13
UConn Monthly Water Production (Thousands of Gallons)

Month	Well #1	Well #2	Well #3	Well #4	Well A	Well B	Well C	Well D
2011								
Jan.	10,421.0	3,927.8	10,465.0	6,720.0	0.0	3,926.0	2,218.0	611.0
Feb.	12,882.0	5,152.1	13,020.0	8,366.0	0.0	3,792.0	2,159.0	230.0
Mar.	12,150.0	4,596.0	12,192.0	7,808.0	0.0	4,473.0	2,548.0	1,111.0
Apr.	12,267.0	4,785.1	12,332.0	7,894.0	0.0	4,165.0	2,366.0	922.0
May	7,504.0	3,060.3	7,546.0	4,815.0	0.0	3,992.0	2,307.0	52.0
June	8,832.0	3,489.0	8,904.0	5,660.0	0.0	356.0	205.0	0.0
July	10,510.0	4,338.4	10,668.0	6,758.0	0.0	155.0	88.0	1.0
Aug.	11,421.0	4,523.2	11,459.0	7,263.0	0.0	753.0	430.0	0.0
Sept.	14,225.0	5,647.4	14,293.0	9,263.0	0.0	3,261.0	1,926.0	0.0
Oct.	13,104.0	5,181.9	13,060.0	8,797.0	0.0	3,600.0	2,045.0	471.0
Nov.	11,826.0	4,582.5	11,898.0	7,612.0	0.0	2,892.0	1,611.0	495.0
Dec.	10,953.0	4,275.3	10,965.0	7,063.0	0.0	2,181.0	1,236.0	498.0
2012								
Jan.	11,921.0	4,586.9	11,354.0	7,711.0	0.0	5,337.0	3,024.0	2,879.0
Feb.	12,151.0	4,664.9	12,007.0	7,389.0	0.0	4,058.0	2,292.0	0.0
Mar.	10,969.0	4,191.7	10,960.0	7,035.0	0.0	4,892.0	2,759.0	3,754.0
Apr.	13,235.0	5,005.5	12,841.0	8,576.0	0.0	6,339.0	3,551.0	794.0
May	6,491.0	2,460.5	6,319.0	4,140.0	0.0	181.0	101.0	40.0
June	6,579.0	2,467.2	6,742.0	4,019.0	0.0	0.0	0.0	132.0
July	11,549.0	4,513.4	11,078.0	7,298.0	0.0	0.0	0.0	0.0
Aug.	10,882.0	4,891.3	11,549.0	7,747.0	0.0	24.0	10.0	881.0
Sept.	15,056.0	5,947.9	14,254.0	9,947.0	0.0	961.0	534.0	5,538.0
Oct.	14,402.0	5,605.5	13,780.0	9,579.0	0.0	6,295.0	3,525.0	1.0
Nov.	10,188.0	3,989.5	9,391.0	6,727.0	0.0	5,337.0	3,024.0	2,879.0
Dec.	7,135.0	2,972.0	6,415.0	5,076.0	0.0	4,058.0	2,292.0	0.0
2013								
Jan.	7,616.0	2,888.9	7,416.0	4,999.0	0.0	7,389.0	3,685.0	0.0
Feb.	10,148.0	3,932.3	9,679.0	6,567.0	0.0	6,661.0	3,491.0	0.0
Mar.	10,710.0	4,234.0	10,311.0	6,966.0	0.0	4,746.0	2,668.0	0.0
Apr.	10,674.0	4,985.2	10160.0	6,833.0	0.0	6,664.0	3,735.0	0.0
May	9,412.0	3,752.4	9,066.0	6,029.0	0.0	529.0	658.0	75.0
June	4,591.0	1,878.0	4,381.0	2,916.0	0.0	5,873.0	3,325.0	11.0
July	4,375.0	1,768.6	4,174.0	2,759.0	0.0	7,247.0	4,081.0	72.0
Aug.	7,380.0	2,934.0	7,019.0	4,679.0	0.0	6,253.0	3,502.0	0.0
Sept.	9,444.0	3,567.0	8,923.0	5,766.0	0.0	7,211.0	4,032.0	0.0
Oct.	10,536.0	3,526.1	10,021.0	5,989.0	0.0	4,473.0	2,496.0	0.0
Nov.	10,821.0	4,228.9	10,316.0	6,906.0	0.0	0.0	0.0	0.0
Dec.	8,662.0	3,404.3	8,268.0	5,679.0	0.0	74.0	45.0	0.0

TABLE 5-13
UConn Monthly Water Production (Thousands of Gallons)

Month		Well #1	Well #2	Well #3	Well #4		Well A	Well B	Well C	Well D
2014										
Jan.		10,641.0	4,214.8	10,165.0	7,165.0		0.0	799.0	449.0	0.0
Feb.		8,803.0	3,457.3	8,405.0	5,960.0		0.0	6,355.0	3,560.0	0.0
Mar.		10,118.0	3,974.6	9,662.0	6,850.0		0.0	3,505.0	1,960.0	4,996.0
Apr.		10,061.0	3,985.7	9,600.0	6,989.0		0.0	105.0	61.0	10,719.0
May		6,259.0	2,618.1	6,559.0	4,165.0		0.0	1,118.0	681.0	8,938.0
June		5,423.0	2,200.8	5,553.0	3,424.0		0.0	4,184.0	2,354.0	4,280.0
July		5,991.0	3,219.4	8,242.0	5,839.0		0.0	1,701.0	955.0	1,904.0
Aug.		10,582.0	4,034.5	10,069.0	7,075.0		0.0	32.0	18.0	617.0
Sept.		14,104.0	5,357.0	13,430.0	9,534.0		0.0	0.0	0.0	797.0
Oct.		13,683.0	5,197.1	13,039.0	9,263.0		0.0	4.0	2.0	1,533.0
Nov.		11,443.0	4,450.9	11,243.0	8,002.0		0.0	3.0	2.0	672.0
Dec.		9,125.0	3,454.1	9,188.0	6,539.0		0.0	0.0	0.0	764.0
2015										
Jan.		8,688.0	3,459.0	8,747.0	6,193.0		0.0	509.0	289.0	6,917.0
Feb.		10,034.0	4,002.9	10,138.0	7,177.0		0.0	6,385.0	3,554.0	200.0
Mar.		9,082.0	3,628.5	9,167.0	6,474.0		0.0	7,213.0	4,012.0	73.0
Apr.		9,699.0	3,912.5	9,816.0	6,938.0		0.0	6,940.0	3,902.0	0.0
May		7,181.0	2,900.3	7,300.0	5,101.0		0.0	7,181.0	4,019.0	15.0
June		5,347.0	2,019.6	5,386.0	3,790.0		0.0	0.0	0.0	9442.0
July		8,958.0	3,764.0	9,515.0	6,675.0		0.0	21.0	11.0	2,692.0
Aug.		8,948.0	3,721.6	9,383.0	6,484.0		0.0	0.0	0.0	1,206.0
Sept.		13,632.0	5,446.7	13,686.0	9,660.0		0.0	0.0	1.0	547.0
Oct.		14,308.0	5,737.2	14,421.0	10,216.0		0.0	0.0	0.0	43.0
Nov.		11,040.0	4,392.9	11,130.0	7,893.0		0.0	0.0	0.0	39.0
Dec.		10,610.0	4,186.2	10,766.0	7,209.0		0.0	8.0	8.0	54.0
2016										
Jan.		10,011.0	3,986.2	10,449.0	7,216.0		0.0	4.0	21.0	1,739.0
Feb.		10,658.0	4,247.1	10,747.0	7,635.0		0.0	2,168.0	2,548.0	1,110.0
Mar.		7,994.0	3,110.1	8,200.0	5,555.0		0.0	4,958.0	5,929.0	2.0
Apr.		8,532.0	3,424.1	8,936.0	6,090.0		0.0	5,088.0	5,682.0	3.0
May		5,091.0	2,052.0	5,187.0	3,629.0		0.0	4,818.0	6,348.0	4.0
June		4,651.0	2,258.6	5,631.0	3,960.0		0.0	3,625.0	4,251.0	14.0
July		8,617.0	3,191.0	8,657.0	6,084.0		0.0	0.0	0.0	0.0
Aug.		9,752.0	2,569.2	10,255.0	7,083.0		0.0	0.0	0.0	0.0
Sept.		13,434.0	1,978.9	14,128.0	9,451.0		0.0	0.0	0.0	0.0
Oct.		12,484.0	4,073.0	13,293.0	8,891.0		0.0	0.0	0.0	0.0
Nov.		8,501.0	3,627.5	9,471.0	6,341.0		0.0	0.0	0.0	37.0
Dec.		6,975.0	2,639.0	7,486.0	5,037.0		0.0	0.0	0.0	0.0

TABLE 5-13
UConn Monthly Water Production (Thousands of Gallons)

Month		Well #1	Well #2	Well #3	Well #4		Well A	Well B	Well C	Well D
2017										
Jan.		8,186.0	3,150.0	8,996.0	6,037.0		0.0	0.0	0.0	0.0
Feb.		9,880.0	3,583.8	10,551.0	7,062.0		0.0	0.0	0.0	36.0
Mar.		6,218.0	2,299.5	6,648.0	4,460.0		0.0	2,172.0	2,513.0	5,285.0
Apr.		7,294.0	2,688.0	7,739.0	5,179.0		0.0	5,014.0	5,749.0	3.0
May		4,360.0	1,595.0	4,663.0	3,090.0		0.0	4,343.0	4,993.0	6.0
June		3,187.0	1,187.4	3,410.0	2,267.0		0.0	6,023.0	6,967.0	4.0
July		5,765.0	2,098.6	6,146.0	4,085.0		0.0	3,572.0	4,109.0	11.0
Aug.		6,199.0	2,280.2	6,687.0	4,449.0		0.0	3,998.0	4,607.0	5.0
Sept.		10,439.0	3,738.8	11,062.0	7,328.0		0.0	1,408.0	1,614.0	2.0
Oct.		8,756.0	3,196.7	9,342.0	6,201.0		0.0	1,022.0	1,141.0	58.0
Nov.		3,090.0	1,171.1	3,358.0	2,242.0		0.0	5,731.0	6,348.0	3.0
Dec.		4,508.0	1,675.5	4,903.0	3,215.0		0.0	2,593.0	2,160.0	4.0
2018										
Jan.		3,749.0	1,412.9	4,087.0	2,692.0		0.0	4,890.0	4,958.0	3.0
Feb.		2,068.0	1,705.6	4,997.0	3,296.0		0.0	4,213.0	4,608.0	7.0
Mar.		3,764.0	1,584.8	4,595.0	3,054.0		0.0	5,060.0	5,606.0	48.0
Apr.		5,036.0	1,865.7	5,418.0	3,597.0		0.0	6,074.0	6,716.0	6.0
May		1,847.0	687.4	1,928.0	1,311.0		0.0	5,913.0	6,896.0	9.0
June		908.0	665.3	1,922.0	1,273.0		0.0	6,140.0	6,767.0	5.0
July		0.0	1,508.1	4,145.0	2,757.0		0.0	5,896.0	6,495.0	7.0
Aug.		2,044.0	2,204.1	6,204.0	3,153.0		0.0	5,834.0	6,365.0	5.0
Sept.		6,952.0	2,658.7	6,143.0	0.0		0.0	6,711.0	7,129.0	5.0
Oct.		3,849.0	1,628.8	4,718.0	2,666.0		0.0	6,804.0	7,095.0	11.0
Nov.		2,953.0	1,051.6	3,144.0	2,398.0		0.0	6,289.0	6,675.0	5.0
Dec.		2,127.0	771.7	2,280.0	1,466.0		0.0	5,136.0	5,511.0	5.0
2019										
Jan.		1,772.0	668.1	2,039.0	1,267.0		0.0	5,358.0	5,784.0	29.0
Feb.		3,645.0	1,322.5	4,030.0	2,532.0		0.0	5,996.0	6,537.0	6.0
Mar.		3,442.0	1,249.3	3,667.0	2,325.0		0.0	6,436.0	7,042.0	12.0
Apr.		4,094.0	1,516.5	4,409.0	2,838.0		0.0	6,406.0	6,934.0	8.0
May		1,759.0	565.1	1,777.0	1,279.0		0.0	5,625.0	6,054.0	5.0
June		861.0	2.0	18.0	758.0		0.0	5,852.0	6,293.0	1.0
July		2,712.0	315.0	2,558.0	1,589.0		0.0	6,367.0	6,879.0	2.0
Aug.		3,630.0	1,485.6	3,883.0	2,031.0		0.0	8,766.0	5,044.0	0.0
Sept.		6,041.0	2,353.4	6,152.0	3,096.0		0.0	10,717.0	3,004.0	0.0
Oct.		5,116.0	1,956.9	5,116.0	2,660.0		0.0	7,766.0	6,013.0	1.0
Nov.		2,870.0	1,088.0	2,870.0	1,651.0		0.0	5,732.0	6,522.0	7.0
Dec.		1,271.0	481.0	1,271.0	666.0		0.0	5,497.0	6,270.0	7.0

5.4 Non-Revenue & Unaccounted-for Water

Typically, "non-revenue water" is the difference between total water produced at the source and metered water consumption. Some of the traditional non-revenue uses include tank flushing, main flushing and blow-offs, firefighting, main breaks, and unauthorized water use; and these can and occasionally do occur throughout the UConn water system. However, UConn is not a traditional revenue-producing utility, so the term is a misnomer in this context. While UConn produces a minimal amount water that results in the collection of "revenue," the majority of its water production is to provide itself with water. Therefore, a discussion of non-revenue water in the traditional context is not pertinent to the UConn water system.

More pertinent to the UConn water system is the difference between metered consumption and non-metered consumption in relation to production. UConn estimated non-metered water usage in the 2011 *Water Supply Plan* as approximately 15% of production. This value suggested that UConn's unaccounted-for water demand (water that is not accounted for through metering or estimated uses) was less than 15% of total production. The 15% figure is the standard for unaccounted-for water, and typically represents losses due to leaky infrastructure.

Recent data continues to reflect that unaccounted-for water is less than 15% of total production. Table 5-14 presents non-metered water usage for the last three calendar years. The last three years of data are presented because earlier years represent a condition where either the CWC interconnection is not present and/or the RWF is not yet online. Note that the data for 2017 represents a transition year where off-campus customers were transferred to CWC.

TABLE 5-14
Recent Unmetered Water Usage

Year	Wellfield Production (mgd)	On-Campus Residential Metered Consumption (mgd)	On-Campus Non-Residential Metered Consumption (mgd)	Off-Campus Consumption (mgd)	Non-Metered Water (mgd)	Non-Metered as % of Wellfield Production
2017	0.897	0.270	0.380	0.002	0.245	27%
2018	0.752	0.272	0.419	0.002	0.059	8%
2019	0.723	0.255	0.439	0.002	0.027	4%
Average	**0.791**	**0.266**	**0.413**	**0.002**	**0.110**	**14%**

Thus, approximately 14% of the potable water produced by UConn is a combination of (1) distributed water that is consumed by un-metered uses; and (2) transmitted/distributed water that is truly unaccounted or lost. It is therefore believed that UConn's true "unaccounted-for water" continues to amount to much less than 15% of total production each year.

The improvement schedules presented in Section 7.0 include continuation of the ongoing metering program, annual water audits, and biennial leak detection surveys to assess unaccounted-for water. These efforts are anticipated to maintain unaccounted for water at levels below 15%.

6.0 LAND USE, FUTURE SERVICE AREA, & DEMAND PROJECTIONS

6.1 General

An evaluation and analysis of existing and future land uses and zoning was conducted as required by the water supply planning regulations to assess the water supply needs for the UConn water service area. Different land uses generate varying amounts of water demand. In this section, existing land use is described, and future development potential is investigated for UConn. This analysis provides the basis for demand projections in the 5-, 20-, and 50-year planning periods. The approach, the assumptions used, and sources of data are presented in detail in the ensuing text.

Note that off-campus customers will be served by CWC for the foreseeable future. Therefore, projection of off-campus demands is now the responsibility of CWC and will be included in their water supply planning efforts for the CWC Western system and CWC's off-campus systems.

6.2 Land Use, Zoning, and Future Service Area

6.2.1 Existing and Exclusive Service Areas

The boundary of the existing UConn water service area is shown on Figure 1-1 and Appended Figure I. The water service area has changed significantly since the 2011 *Water Supply Plan* was issued but remains entirely constrained within the Town of Mansfield. Off-campus properties in the Town of Mansfield previously served by UConn became customers of CWC in December 2016 when the CWC interconnection was activated. UConn's water service area is now smaller than it was in 2011 and is further described below in the context of the State of Connecticut ESAs for water service.

In 1986, the State of Connecticut established seven Public Water Supply Management Areas (PWSMA) to coordinate state-wide public water supply planning. The original seven PWSMAs were consolidated to three PWSMAs regions (East, West, and Central) in October 2014, with the UConn water service area located within the Central PWSMA. Beginning in June 2016, the Central Corridor Water Utility Coordinating Committee (Central WUCC) met to discuss a variety of water supply topics that impact the region, including the establishment of ESA boundaries in the Town of Mansfield. UConn participated in the entire formal two-year WUCC process and continues to participate in ongoing WUCC meetings.

The Central WUCC recommendations on ESA boundaries for the Central Region PWSMA were published in a 2017 report[18] and subsequently approved by DPH. The report notes that based on the wording of the enabling statute[19], state agencies such as UConn are not authorized to have a formal ESA. Nevertheless, the Central WUCC voted to assign the majority of UConn-owned or controlled property as "State Agency Existing Service Area" to reflect UConn's extensive water system and the area reserved for service by UConn. However, based on

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[18] Milone & MacBroom, Inc., 2017, *Coordinated Water System Plan, Part II – Final Recommended Exclusive Service Area Boundaries,* Connecticut DPH, https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/drinking_water/pdf/CentralESADocument_final20170614.pdf

[19] As determined during the 2016-2018 WUCC process, based on CGS Section 25-33g state agencies cannot be ESA holders. Recognizing that several state agencies (including UConn) own and operate public water systems, the WUCC process reserved certain state lands for service by those state agencies without explicitly assigning an ESA.

coordination with the Town of Mansfield, vacant wooded land surrounding the Fenton River Wellfield, and several UConn-controlled wooded or farm land parcels located west and southeast of the Main Campus, are not considered to be within the "State Agency Existing Service Area" designation and are instead defined as "unassigned" ESAs where public water service is generally not expected to be needed for the foreseeable future.

Areas of Mansfield surrounding UConn that are not considered to be served by the UConn water system (or were left unassigned as noted above) were assigned as either the ESA for existing public water systems or as the ESA for CWC. Several small "community" water systems (those public water supply systems that serve at least 15 service connections or at least 25 of the same population year round, such as subdivisions, cluster housing, apartments, or condominiums) are found adjacent to the UConn service area (see Appended Figure I), but are served by bedrock wells and are not anticipated to affect the UConn water supply. The Central WUCC assigned these entities an ESA coterminous with their service areas. CWC was assigned responsibility for providing public water service to the majority of the remaining areas of Mansfield should it become necessary, with the remaining area in the southern portion of Mansfield being assigned as the ESA of Windham Water Works.

As shown on Appended Figure I, the area reserved for service by the UConn water system includes parcels and buildings that are now served by CWC per the 2013 contract. This discrepancy is because the "State Agency Existing Service Area" was based on UConn-owned and controlled parcels, but some of those parcels (including larger parcels with certain subset areas) are considered to be "off-campus" uses. The opposite is also true in certain cases, such as for the "off-campus" customers who are still served by UConn along North Eagleville Road. Note that this discrepancy between the existing service area and the ESA boundary is not an issue as the service to these areas is governed by contract. UConn does not anticipate serving areas presently served by CWC or serving any additional areas outside of its reserved service area for the foreseeable future.

6.2.2 Land Use

Land use in the Town of Mansfield, including UConn lands, is described in the MT-POCD adopted by the Town Planning and Zoning Commission on September 8, 2015 and effective October 8, 2015. The MT-POCD was developed by the Town in accordance with CGS Section 8-23 which requires municipalities to adopt a POCD every ten years. The 2015 MT-POCD consolidates and expands on work done as part of a project known as Mansfield 2020: A Unified Vision Strategic Plan, dated August 2008. The 2015 MT-POCD also builds on a previous POCD from January 2006. Town of Mansfield Comprehensive Annual Financial Reports for 2011 through 2018 were also reviewed for information on development in the Town since the previous 2011 *Water Supply Plan* was issued.

Mansfield's early development was characterized by a series of 18 village centers typically located near churches, mills, and/or important crossroads. Houses were clustered near these centers, which were often surrounded by agricultural land or wood-lots. Several historical development areas were within or in close proximity to the current UConn water service areas at the Main and Depot Campuses.

During the 20th century, and particularly since 1950, development has been concentrated in a few areas where public water and sewer have been available near the urbanized core of UConn in the northern part of Mansfield and near the village of Willimantic to the south. These development patterns were influenced by the growth of the UConn, Willimantic's nearby urban center, availability of public water and sewer utilities, Mansfield's natural resource development limitations, and municipal land use policies.

The UConn water system has been closely tied to land use in Mansfield and historically allowed development of residential, commercial, and institutional land concentrated in the vicinity of Storrs. Previous expansions of the water system were undertaken to facilitate town-owned development of residential and community facilities near the intersection of South Eagleville Road and Maple Avenue. UConn has accommodated extension of the water system to development outside the UConn-owned or controlled lands in the past, but future expansion of development areas by the Town will require less UConn involvement since the Town will now coordinate water supply with CWC.

Based on U.S. Census data, approximately 26,543 people lived in Mansfield in 2010. U.S. Census estimates for 2018 indicate Mansfield's population at 25,817, which is approximately 3% below the 2010 census population.

According to the U.S. Census data, Mansfield had approximately 6,017 housing units in 2010, excluding "group quarters" facilities at UConn and nursing homes (note that the Bergin Correctional Facility was identified as a group quarters in the 2011 *Water Supply Plan*, but this facility closed in 2011). Approximately 56%, or 3,138 housing units were single-family homes. From 2000 to 2010, the number of housing units increased by about 431 units. According to the MT-POCD, in the twelve-year period from 2000 to 2012, single-family housing permits in Mansfield peaked in 2006 and then began declining through the economic downturn to the lowest levels in the period in 2010.

A number of significant private and governmental building projects have occurred in Mansfield since 2010. The most significant of these projects was the construction of Storrs Center which opened in 2012 and is located across Route 195 from the Main Campus in the vicinity of Dog Lane. This mixed residential and commercial development has approximately 290 studio, one-, two-, and three-bedroom apartments over ground-level retail shops and commercial space. Also included in the Storrs Center project are a stand-alone supermarket, a multi-story parking garage (built 2012), and an intermodal transportation center (built 2014) with transit (bus) services, bicycle commuter facilities, and office space.

The incidence of multi-family permits in Mansfield increased significantly in 2010 due to the start of construction of Storrs Center. A total of 265 new building lots were approved between 2000 and 2012, however only 5 subdivisions and 27 lots were created between 2009 and 2012. Data found on the Census Reporter website[20] from the 2018 5-year American Community Survey indicates approximately 6,170 housing units were available in 2018, with 55% of those being single (family) units.

Commercial development and redevelopment in Mansfield have been relatively limited in the last two decades, other than the Storrs Center project described above. Very few industrial land uses are present in the Town of Mansfield.

6.2.3 Review of UConn Planning Documents

UConn's existing and proposed land use was most recently summarized in the May 2015 Campus Master Plan[21] prepared by UPDC. The Master Plan used 2014 data to address immediate (2015) building and infrastructure needs, as well as projected future needs for 10-, 20-, and long-term (beyond 20 years) time horizons. Projected end dates for the Master Plan horizons were as follows: 2020 to address needs within 5 years; 2025 for the 10-

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[20] https://censusreporter.org/profiles/06000US0901344910-mansfield-town-tolland-county-ct/

[21] Skidmore, Owings & Merrill, LLP, 2015, *UConn Campus Master Plan*, University of Connecticut: University Planning, Design, and Construction, https://masterplan.uconn.edu/.

year horizon; 2035 for the 20-year horizon; and beyond 2035 for long-term growth opportunities. Planning information and data presented in the 2015 Campus Master Plan has been used in our assessment of water demand required over the 5-, 20-, and 50-year time horizons in this *2020 Plan*.

In 2015, UPDC planners focused their efforts on development of Science Technology Engineering and Math (STEM)-related building projects funded through the State's NextGen initiative. New science buildings, residence halls, student activity facilities, and parking areas have been designed and constructed to enhance STEM education, foster advanced collaborative research, and develop sustainable facilities and infrastructure that support UConn's commitment to efficient use of water and energy while reducing carbon emissions. Since 2015, new development projects have included the IPB on Discovery Drive (a STEM maker space), the Werth Residential Towers on Alumni Drive (a new dormitory for STEM students), and the ESB on the northeast science quadrangle (a new engineering building). Infrastructure improvement projects were completed alongside new buildings, including the construction of Discovery drive, which extends Hillside Road north to Route 44. Other projects included the completion of the Main Accumulation Area building near C-Lot.

Although some new on-campus student housing (Werth Residential Towers) has been constructed during the NextGen initiative, certain other older student housing (e.g. Connecticut Commons graduate dormitory complex) has been demolished and renovation of a number of dormitories has resulted in an overall decrease of on-campus (dormitory and apartment) living units. An Honor Students Dormitory that was anticipated in the 2015 Master Plan was tabled for future development if needed in the future based on potentially increasing student enrollment.

In 2010, UConn reported that the population of on-campus housing was 12,689 people while in 2019 this estimate has decreased to 12,047, including 11,633 served by the UConn water system (see Section 5.2.1). Although the on-campus student population has decreased since 2010, off-campus housing has increased to accommodate student housing needs, which have been relatively constant for the last five years. UConn reported 19,133 undergraduate and 6,693 graduate/professional students (25,826 total) at the Main Campus for the 2018-2019 academic year, compared to 18,032 undergraduates and 7,879 graduate/professional students (25,911 total) in 2013-2014. At this time, the Residential Life Office predicts student enrollment will continue to be relatively flat in the near future; although increases of some 1,000 to 5,000 students are still possible (as was anticipated in the 2015 Master Plan) over longer time horizons (10, 20, or 50 years from now). UPDC continues to plan for such enrollment increases.

The 2015 Campus Master Plan indicates that UConn had approximately 350 buildings with approximately 6,262,500 assignable square feet (ASF) at the Main Campus at that time. Projections for future space needs were developed using a multi-tiered model, where it was assumed future student enrollment would increase by some 1,000 to 5,000 additional students over the foreseeable future. Considering 2014 enrollment numbers and the condition of existing buildings and infrastructure, the Master Plan estimated a need for some 796,000 ASF of new space in the near term (2015-2020). With an enrollment increase of some 1,000 additional students by 2025, the Master Plan estimated the need for another 534,000 ASF. Finally, with an enrollment increase of 5,000 additional students by 2035, the Plan estimated the need for another 835,000 ASF.

Relative to construction near the boundary of the UConn campus, the MT-POCD describes 2015 municipal data, presents a compilation of Town planning efforts completed in 2006 and 2008, and summarizes the Town's framework of values, goals, and strategies intended to guide planning and zoning decisions for the next 20 years (through 2035). The goals, strategies, and actions that are summarized at the end of each chapter of the MT-POCD constitute the Town's action plan for conservation and development. For the most part, the MT-POCD recommends land use similar to that described in previous planning documents, with the most intensive land uses proximal to UConn (in north-central Mansfield) and the village of Willimantic (in southern Mansfield). Compact development in the vicinity of existing infrastructure is recommended in the MT-POCD to reduce sprawl and maintain the rural character of the remaining portions of Mansfield.

6.2.4 Zoning

The zoning map for the Town of Mansfield is included as Appended Figure II. Table 6-1 summarizes the zoning districts in the Town of Mansfield. Since the 2011 *Water Supply Plan* was issued, the Town of Mansfield has eliminated the Age Restricted Housing and Industrial Zoning Districts and has re-designated such properties as being in "Other" Districts, which includes "Research & Development/Limited Industrial" Zones.

TABLE 6-1
Summary of Zoning Designations

Type	Symbol	Zone
Residential	R-20	Residence 20
	R-90	Residence 90
	RAR-90	Rural Agriculture Residence 90
	DMR	Design Multiple Residence Zone
Business	PB-1 through PB-5	Planned Business Zones 1 through 5
	B	Business Zone
	NB-1 and NB-2	Neighborhood Business Zones
	PO-1	Professional Office Zone 1
Other	RD/LI	Research & Development/Limited Industrial Zone
	I	Institutional
	FH	Flood Hazard Zone
	SC-SDD	Storrs Center Special Design District
	PVRA	Pleasant Valley Residence/Agriculture Zone
	PVCA	Pleasant Valley Commercial/Agricultural Zone
	W	Water Pipeline Overlay Zone

The UConn water service area includes properties with the following zoning designations:

- Institutional Zone (I) for properties with UConn buildings that comprise the majority of the Main and Depot Campuses, along with many areas along the edge of campus;
- Research and Development / Limited Industrial (RD/LI) for properties associated with the Technology Park in North Campus;
- Rural Agricultural Residence 90 Zone (RAR-90) for properties surrounding the two UConn well fields and certain UConn-controlled agricultural land and maintenance areas (Depot Campus maintenance buildings); and
- Residence Zone 90 (R-90) for a few properties on the west side of the Main Campus.

Future development described below in Section 6.2.6 are located in Rural Agricultural Residence 90 Zone (RAR-90) and Institutional Zone (I). These developments (to be served by the UConn water system) are believed to be generally appropriate relative to their zoning.

6.2.5 General Discussion of Potential Future Water Demands

UConn ceased providing water service to most off-campus properties in late 2016 when the CWC interconnection was completed and those customers were transferred to CWC. Future expansion of the UConn water system to serve off-campus, non-UConn properties is not anticipated. However, continued buildout of the North Campus Technology Park, redevelopment of older, underutilized buildings on the Depot Campus, and an increase in building density on the Main Campus and Depot Campus may result in somewhat greater water demand with time.

The completed CWC interconnection is presently contracted and permitted to provide up to 1.5 mgd to meet UConn's needs, with an additional 0.35 mgd permitted to meet CWC's off-campus needs. CWC anticipates providing between 1.3 and 2.2 mgd for combined UConn and off-campus needs over a 50-year planning horizon. The MT-POCD recognizes that the CWC interconnection will be used to supplement, not replace, the UConn wellfields.

UConn is a member of the Water System Advisory Committee. Representatives from CWC also attend to assist in advising on local water supply issues and to help manage new connections, address water line extension requests, and support water conservation initiatives.

A comprehensive analysis of the Town of Mansfield's current water needs is not presented here since the CWC interconnection and the various related contractual agreements have eliminated the need for UConn to directly supply water to off-campus customers. Potential future service areas for the Town of Mansfield would be discussed in the *Water Supply Plan* for the CWC Western System. Any expansion of the CWC off-campus public water systems will be addressed by CWC in conjunction with the Water System Advisory Committee.

6.2.6 Potential Development Areas

Subsequent to the completion of the previous water supply planning studies for the area in 2002, 2004, 2007, and 2011, UConn revisited its needs for future water service in the 2015 Campus Master Plan (see Appendix D of that Plan: Utilities Master Plan). Based on the 2015 Master Plan, and construction completed or in process, UConn has a firm understanding of water demands that, (1) are likely to occur, and (2) will be served from the UConn water system.

A general discussion of planned UConn growth is presented below for both the Main Campus and the Depot Campus. Specific water demands are presented in Section 6.3.

<u>Main Campus</u>

Since 2011, major projects in the North Eagleville Science District have included the construction of the ESB in 2016, the Peter J. Werth Residence Tower in 2016, and a complete renovation of the south wing of the Gant Science Building in 2017-2019. The Werth Residence Tower added 725 student beds to campus. Phases 2 (west wing) and 3 (north wing) of the Gant Complex renovations will be completed in 2023. In 2018-2019 in the Hillside Road District, a new Student Recreation Center was constructed at the location of the former Connecticut

Commons residential dormitory buildings (which were demolished). In the South Campus District, the Fine Arts Complex was renovated and expanded in 2018 and 2019. The IPB was constructed along Discovery Drive in the north part of the Main Campus in 2016-2017. No significant new construction was completed in the East Campus Districts. In the West Campus District, a significant renovation of athletic fields and renovation and expansion of training facilities was initiated in 2019, with planned completion in 2020. These efforts include switching from natural grass playing fields to artificial turf, and is anticipated to save approximately 9 million gallons of irrigation water per year[22].

Many of the projects listed above were identified in the Near-Term schedule (2015-2020) in the 2015 Campus Master Plan. The 2015 Campus Master Plan identifies potential new development and renovation activities across the Main Campus. These activities have the potential to increase water demands (new buildings or uses) as well as to reduce water demands (through renovation activities that increase water efficiency). In the near term, the Master Plan focused on the North Eagleville Road Science District, initial stages of development of the Technology Park, Athletics District redevelopment, and South Campus. Mid-term, projects begin to expand inward towards the Academic Core. The long-term Master Plan focused primarily on renovations with some presently unfunded new buildings identified. Details are presented below:

- The 2015 Master Plan indicates water demand increases for 2015-2020 were to be tied to construction and/or renovation of new science and research buildings, residence halls, and student health and recreation spaces that could increase water demand. The major renovation projects were to include design elements that reduce water demand through the use of more efficient fixtures as well as the UConn's continued focus on water conservation initiatives. Note that several projects that were anticipated in the 2015 Master Plan have been put on hold due to budget constraints, including proposed STEM research center buildings. The plan also notes that demand may be less if UConn can realize between 10 and 30% water savings due to conservation and sustainability initiatives.

- Similarly, the 2015 Master Plan indicates projected water demand increases for the 2020-2025 planning period will be tied to construction and/or renovation of new research and classroom buildings, residence halls, and student activity spaces that could increase water demand. Construction projects planned for the Main Campus in the 2015 Master Plan are anticipated to realize a smaller water demand increase over this time period since the NextGen building program will be winding down after 2030.

- The 2015 Master Plan likewise indicates projected water demand increases for the 2025-2035 planning period will be tied to construction and/or renovation of additional academic, residential, fine arts and other facilities that could increase overall water demand. Since UPDC has not estimated potential construction out to the 2070 horizon used in this *2020 Plan*, it is assumed that future new water demands will significantly level off beyond 2040.

Depot Campus

While the 2015 Campus Master Plan indicates new growth will be focused on the Main Campus, the Depot Campus will likely support "back-of-house" functions in the short-term as well as providing temporary overflow

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[22] Milone & MacBroom, Inc., 2018, *Environmental Assessment Review – University of Connecticut Athletics District Improvements*, University of Connecticut.

space during construction projects. Mid-term and beyond, the Depot Campus may be the location of public-private development if market conditions support such growth.

Additional development and redevelopment of the Depot Campus area was addressed in detail as part of the 2000 Outlying Parcels Master Plan. A mixture of housing and offices is possible, but no new academic buildings are planned for the Depot Campus at this time.

6.3 Population Projections

The Town of Mansfield has a population count that is uniquely influenced by UConn. Table 6-2 summarizes town-wide population since 1920 alongside statewide population.

TABLE 6-2
Historic Population Data

Year	STATE OF CONNECTICUT		TOWN OF MANSFIELD	
	Population	% Change	Population	% Change
1920	1,380,631	--	2,574	--
1930	1,606,903	16.4%	3,349	30.11%
1940	1,709,242	6.4%	4,559	36.13%
1950	2,007,280	17.4%	10,008	119.52%
1960	2,535,234	26.3%	14,638	46.26%
1970	3,029,074	19.6%	19,994	36.59%
1980	3,107,576	2.5%	20,634	3.20%
1990	3,287,116	5.8%	21,103	2.27%
2000	3,405,565	3.6%	20,720	-1.81%
2010	3,574,097	4.9%	26,543	28.10%
2018	3,572,665	-0.04%	25,817	-2.74%

Source: U.S. Census Bureau

The water supply planning regulations require the evaluation of population projections that were formerly maintained and updated by the Connecticut Office of Policy and Management (OPM). Because the OPM projections are very much out-of-date, their utility for water supply planning has decreased over the last two decades. Projections are additionally insufficient for understanding population growth on the UConn campus, where major residential development projects are well-understood (for example, dormitory renovations) or where residential projects have been proposed in campus planning documents. Therefore, this *2020 Plan* does not include a detailed discussion of population projections for the Town of Mansfield. Such a discussion is more appropriately included in the *Water Supply Plan* for CWC's Western system related to the off-campus areas served by CWC.

Although fluctuations will occur from year to year, UConn's on-campus residential population is dependent upon the available capacity of its housing and the availability of funding for faculty and support staff. At the time of the 2011 *Water Supply Plan*, residential housing was typically overfilled with many lounges and larger rooms being used as "triples" for additional student housing. In recent years, the lowering of UConn's block grant funding from the State has ultimately resulted in the student population growing slower than expected. Thus, residential housing has been operating at unstressed levels. Overall, the year to year fluctuations have occurred within small amounts (5% to 10% of current capacity). The associated water demands have been captured in the recent production and consumption figures.

UConn has identified the following as potential alternatives for expansion of on-campus housing in the foreseeable future, as presented in Table 6-3:

Table 6-3
Potential Future Housing Options

Name	Type	2015 Master Plan Timeframe	Water Supply Plan Timeframe	Estimated Capacity[1]	Service Provider
Mansfield Apartments[2]	Replacement	Future Growth	5-Year (By 2025)	+535	CWC
Honors	New Construction	2015-2020	20-Year (By 2040)	650	UConn
South Hillside	New Construction	2025-2035	20-Year (By 2040)	600	UConn
Hicks/Grange	Expansion	2025-2035	20-Year (By 2040)	+250	UConn
Y-Lot	New Construction	2025-2035	20-Year (By 2040)	900	UConn
West Campus	Replacement	2025-2035	20-Year (By 2040)	+495	UConn
Northwoods Apartments[2]	Replacement or Redevelopment	Future Growth	20-Year (By 2040)	+600	CWC
North and Northwest	Replacement or Redevelopment	Future Growth	50-Year (By 2070)	Unknown	UConn
Husky Village	Replacement or Redevelopment	Future Growth	50-Year (By 2070)	Unknown	UConn
Towers Residence Halls	Replacement or Redevelopment	Future Growth	50-Year (By 2070)	Unknown	UConn
Charter Oaks Apartments and Busby Suites	Replacement or Redevelopment	Future Growth	50-Year (By 2070)	Unknown	UConn
Hilltop Apartments	Replacement or Redevelopment	Future Growth	50-Year (By 2070)	Unknown	UConn

Notes: 1. A "+" denotes additional capacity above current capacity in Table 5-2.
2. Served by CWC now and in the future.

- An Honors Residence Hall in the vicinity of Mirror Lake was in the design phase but has been tabled as the block grant funding from the State has been reduced. This building has been added to the 20-year planning period as shown in Table 6-3.

- The 2015 Campus Master Plan identifies other conceptual potential housing alternatives that have yet to be designed, as presented in Table 6-3. These latter options will be evaluated as necessary to meet on-campus housing needs. These options have been assigned to the 5-year or 20-year planning period in order to estimate potential future demands. Other alternatives, such as replacement of housing in North and Northwest Campus, have yet to be conceptually envisioned and therefore are assumed to occur in the 50-year planning period in this *2020 Plan*. Capacity estimates are not available for these areas at this time.

As the timeframes presented above generally extend past the 5- to 9-year planning timeframe for water supply planning, the next *Water Supply Plan* will likely have updated information about many of these potential projects.

6.4 Projected Water Demands

Recall from Section 1.0 that the subject *2020 Plan* evaluates system performance for the 5-, 20-, and 50-year planning periods corresponding to the years 2025, 2040, and 2070, respectively. Since future water demands must be allocated into the required planning horizons, the following allocations are based on the current understandings associated with the potential demands at the Main Campus and Depot Campus portions of UConn.

Note that Section 6.2.5 discussed UConn's intent to supply water to on-campus growth within its assigned service area, but not to off-campus development which would be supplied by CWC. Over time, it is expected that additional off-campus areas will be supplied by CWC. Therefore, no off-campus demand projections are provided herein.

Note further that although typical water supply plans typically break projected demands down by categories (e.g. residential, commercial, industrial, etc.), that breakdown is not presented herein for several reasons. First, all of UConn's demands could be classified as "institutional demands", although for the purpose of metered consumption residential demands can be readily separated from non-residential consumption. Secondly, the analysis herein draws heavily on the efforts completed by UConn in its 2015 Campus Master Plan, which presents aggregated gross square footage and water demands per square foot, but not a breakdown by categories or by building. Thus, projected water demands are only classified by each campus (Main and Depot) and unaccounted-for water.

6.4.1 Main Campus Projected Demands

Appendix D of the 2015 Campus Master Plan (pages 50 through 52) details the estimated water demands related to the planned Main Campus buildout. Table 6-4 presents the water demand estimates by usage type used in the 2015 Master Plan used to estimate potential flows. Note that new buildings are anticipated to result in additional water demands, while demolition and renovation activities are expected to result in reduced water demands due either to the elimination of the demand or the installation of more water efficient infrastructure in the building.

Table 6-5 presents the usage estimates presented in the 2015 Master Plan for each demand period, both with and without expected conservation measures. Given UConn's commitment to designing and constructing energy efficient buildings that meet a minimum of LEED Silver (LEED Gold preferred) standards, the projected demands with 30% water conservation are not unreasonable for UConn. The 2015 Master Plan notes that renovated buildings were expected to be approximately 30% more water efficient following renovation.

TABLE 6-4
2015 Master Plan Water Demand Estimates by Type

Assumptions	New Buildings (gpd/sf)	Demolition (gpd/sf)	Renovation (gpd/sf)
Academic / Teaching	0.083	-0.108	-0.025
Administration	0.083	-0.108	-0.025
Arts / Culture	0.054	-0.070	-0.016
Athletics & Recreation	0.136	-0.177	-0.041
Miscellaneous	0.000	-0.000	-0.000
Parking	0.000	-0.000	-0.000
Residence / Dining	0.110	-0.143	-0.033
Science	0.137	-0.178	-0.041
Student Services	0.083	-0.108	-0.025
Support / Utility	0.000	-0.000	-0.000

TABLE 6-5
2015 Master Plan Water Demand Estimates for Main Campus

2015 Campus Master Planning Period	Additional Water Demand (No Conservation)	Additional Water Demand (10% Conservation)	Additional Water Demand (20% Conservation)	Additional Water Demand (30% Conservation)
Near-Term Plan (2015-2020)	+115,922 gpd	+104,330 gpd	+92,738 gpd	+81,145 gpd
Mid-Term Plan (2020-2025)	+45,660 gpd	+41,094 gpd	+36,528 gpd	+31,962 gpd
Long-Term Plan (2025-2035)	+132,144 gpd	+118,930 gpd	+105,715 gpd	+92,501 gpd
Total	**+293,726 gpd**	**+264,354 gpd**	**+234,981 gpd**	**+205,608 gpd**

The expected 0.2 to 0.3 mgd increase in water demand at the Main Campus (through the 20-year planning period in this *2020 Plan*) includes potential new buildings, demolitions, and renovations. These are generally shown in Figure 6-1. Although the additional water demand will likely trend towards the lower end (0.2 mgd) due to UConn's water conservation efforts, for the purposes of this *2020 Plan* the more conservative figures will be utilized. Note the following:

- The 2015 Master Plan notes that these water demand estimates do not anticipate future buildout at the Depot Campus (these are in the next subsection below).

- Secondly, the near-term plan includes some demands that have already been realized (but are presently unmetered). Leaving the estimated demands from the 2015 Campus Master Plan in place for those buildings is considered conservative. Additionally, given the slowdown in new construction the mid-term planned demands have been pushed to the 20-year planning period.

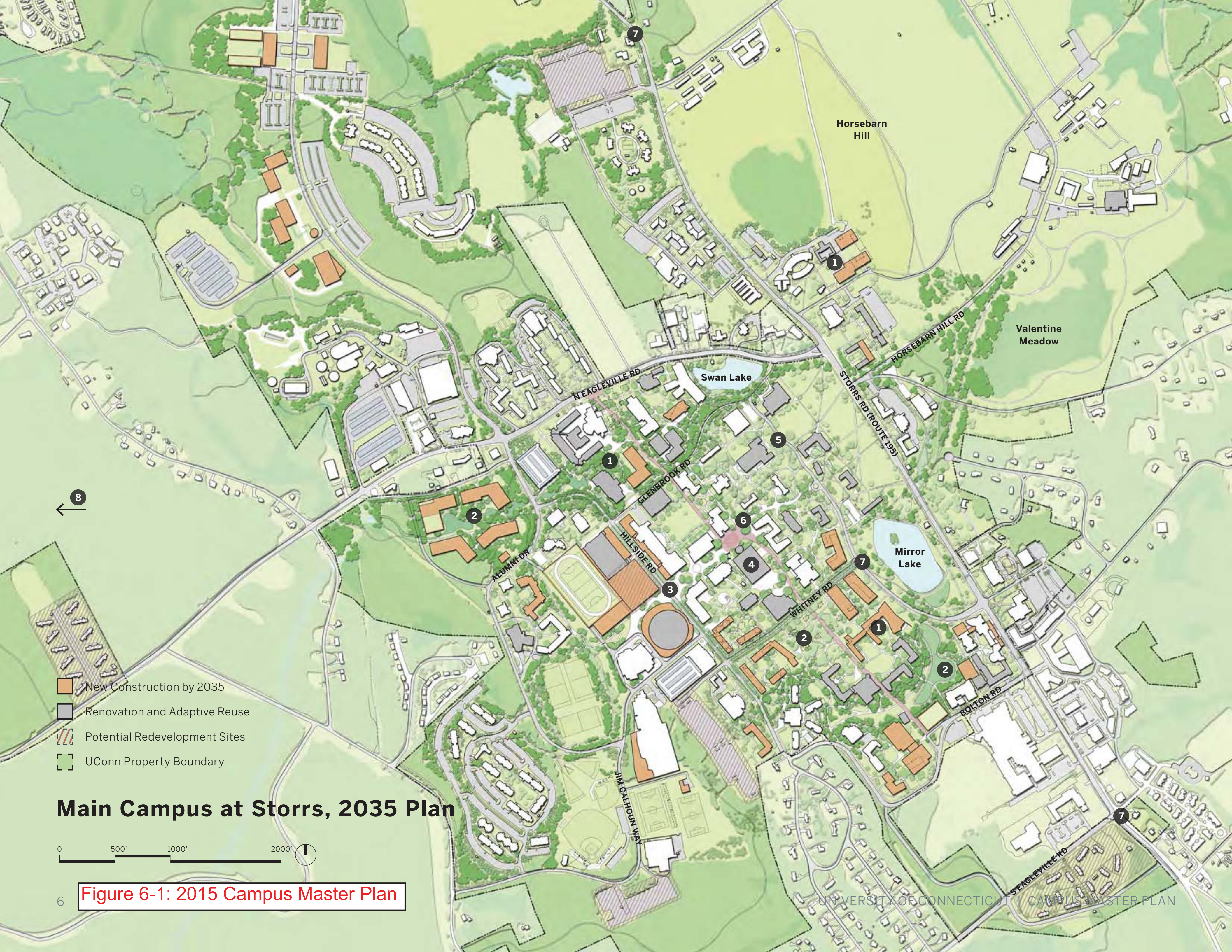


Figure 6-1: 2015 Campus Master Plan

- Furthermore, the 2015 Campus Master Plan water demand estimates included off-campus demands (e.g., replacement of Mansfield Apartments) that are now the responsibility of CWC. As an exact breakdown of projections between what is served by UConn and what is now served by CWC is not available, these conservatively high estimates will be used for the purpose of this *2020 Plan*.

- Finally, note that development in the Technology Park area that is owned by UConn will be supplied by the UConn water system; however, development in the Technology Park area that is owned by private entities, or ownership is shared between UConn and private entities, would be served by CWC through the interconnection. Therefore, projected water demand in the Technology Park area may be less than those identified in the 2015 Campus Master Plan if private developers participate in the growth that occurs in this area over the mid- and long-term horizons.

6.4.2 Depot Campus Projected Demands

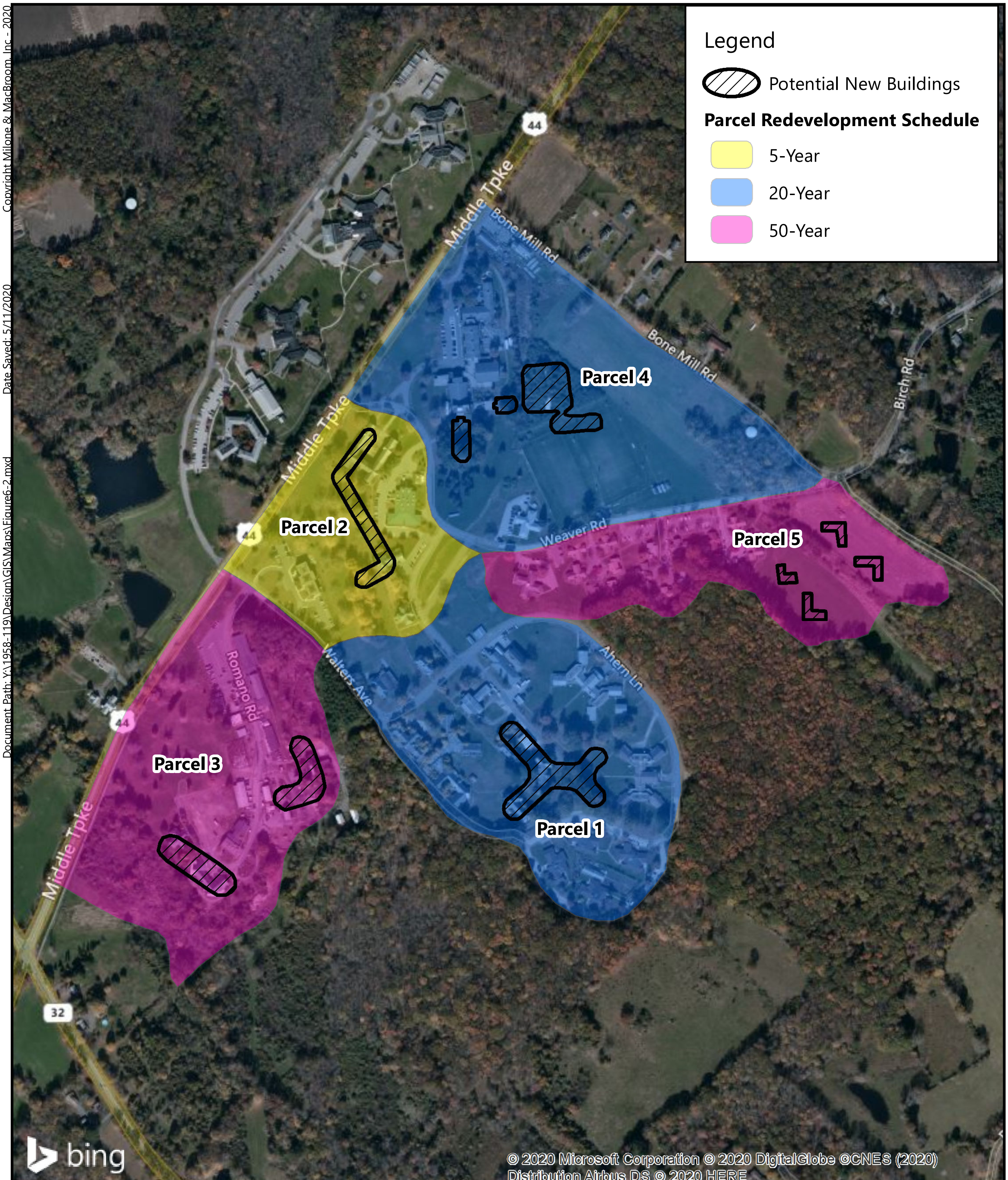
Potential demands for the Depot Campus were estimated in the 2002 Town of Mansfield *Water Supply Plan* on a parcel-by-parcel basis, utilizing the previously-available notations of "Parcel 1" through "Parcel 7" in the 2000 Outlying Parcels Master Plan and taking into account the square footage of existing buildings that will remain on-site, as well as square footage of proposed buildings that may be developed. Water demand was not estimated for existing occupied buildings (such as Parcels 3 and 5), because these already use water from the existing supply. Figure 6-2 presents the generalized buildout model for each parcel on the Depot Campus.

The Center for Clean Energy Engineering ("Enterprise Building") was constructed on Parcel 2 in 2001. This metered building currently has a water demand of approximately 350 gpd. Thus, the previous calculation for Parcel 2 has been revised downward by 350 gpd. Based on these estimates, a water demand of 94,950 gpd for the potential redevelopment activities was calculated. Table 6-6 provides a breakdown of the parcels and their respective square footage and water demand.

Given the lack of information about potential use for many of these properties, these water demands were calculated based on the DPH septic system design standard of 0.1 gpd/sf. UConn recognizes that applying a multiplier of 0.1 gpd/sf is not the most ideal means of estimating water demands (as shown by the variability in Table 6-4 used for the 2015 Campus Master Plan). However, until such time that specific plans are in place for any one of the Depot Campus parcels, the estimate of 94,950 gpd is the most reasonable figure to use for planning purposes.

Furthermore, note that while the individual parcels associated with the Depot Campus will likely be redeveloped one at a time, the exact sequence and timing is largely not known at this time. Note that a potential expansion of the Center for Clean Energy Engineering is already in the planning stages. Therefore, the demands in Table 6-6 for Parcel 2 has been placed in the 5-year planning horizon.

Finally, the former Bergin Correctional Facility closed in 2011 and the Connecticut DOC transferred the property to UConn in 2015. This facility previously had a water demand of approximately 78,000 gpd. UConn presently does not have any redevelopment plans for this property. For the purposes of this *2020 Plan*, the 157,629 gross square feet of building area is assumed to have a future water demand of 15,800 gpd consistent with the above design standard.



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DEPOT CAMPUS FUTURE REDEVELOPMENT

WATER SUPPLY PLAN
UNIVERSITY OF CONNECTICUT
DEPOT CAMPUS
MANSFIELD, CT

N

0 500
Feet

SCALE	1 " = 600 '
DATE	5/11/2020
PROJ. NO.	1958-119

FIG. 6-2

TABLE 6-6
Depot Campus Water Demand Estimates

Parcel	Building Square Footage	Average Day Water Demand Estimate
1	315,000	31,500 gpd
1B	48,800	4,900 gpd
2	135,000	13,500 gpd
2	Enterprise Building	-350 gpd
2C	23,300	2,300 gpd
3 & 3B	96,000	9,600 gpd
4 & 4B	255,000	25,500 gpd
5	Currently occupied	No new water demand
5B	80,000	8,000 gpd
Depot Campus Subtotal		94,950 gpd
Former Bergin Facility		15,800 gpd
Total		**110,750 gpd**

For the purposes of this *2020 Plan*, and in light of the lack of any other specific plans for the Depot Campus under consideration by UConn, the 15,450 gpd from Parcel 2 has been assigned to the 5-year planning period. Half of the remaining demand (47,650 gpd) has been assigned to the 20-year planning period, with the remainder (47,650 gpd) assigned to the 50-year planning period.

6.4.3 Unaccounted-For Water

Recall from Section 5.4 that the average daily metered water consumption from 2017-2019 in was approximately equal to 86% of average daily production over that same time period. Therefore, on average, 14% of UConn's produced water is a combination of (1) distributed water that is consumed by non-metered uses; and (2) transmitted/distributed water that is truly unaccounted-for or lost. Thus, it is believed that UConn's true "unaccounted-for water" amount is much less than 14% of total production. This is consistent with the 2011 *Water Supply Plan*, where the average daily metered water consumption from 2007-2009 was metered at 85% of total production.

The improvement schedules presented in Section 7.0 (and in the *Water Conservation Plan*) include new and upgraded metering as well as planned improvements for the ongoing metering program, annual water audits, and leak detection surveys to assess unaccounted-for water. These efforts are anticipated to maintain unaccounted-for water at levels far below the industry standard of 15% of total production. Similar to the 2011 *Water Supply Plan*, this *2020 Plan* assumes that 5% of the water needed for future committed demands will be truly unaccounted-for and provides for this increment in the projections below.

6.4.4 Seasonality and Peaking Factors

Note that the previous tables provide ADD figures and do not account for seasonality or peaking factors. Any future water consumption by UConn is expected to exhibit a seasonality similar to that already experienced by the UConn water system. These water use patterns essentially require a monthly basis for analysis.

Table 6-7 provides the seasonality factors for 2017 through 2019 (the period after the CWC interconnection was in place and former UConn off-campus customers were being served by CWC). These are based on the ratio of monthly potable water production to the total annual potable water production. Non-potable water demands have been excluded from this calculation in order to ensure that the seasonality factors for the future potable water demands are as realistic as possible.

TABLE 6-7
Monthly Seasonality of Potable Water Production, 2017-2019

Month	2017	2018	2019
January	94.9%	93.7%	75.7%
February	111.9%	89.6%	107.3%
March	106.5%	101.9%	108.0%
April	121.0%	123.1%	116.9%
May	83.1%	79.9%	76.3%
June	82.9%	75.8%	61.5%
July	92.9%	89.5%	91.3%
August	101.7%	110.9%	111.0%
September	**128.0%**	**126.9%**	**139.9%**
October	107.1%	115.0%	127.9%
November	78.9%	96.6%	92.5%
December	68.7%	74.4%	69.2%

Note: Figures in bold are monthly maximums for each year.

Seasonality factors typically range from a low of approximately 60%-80% in the early summer (the average monthly potable water demand is only 60%-80% of the annual average) to a high of approximately 140% in September, 130% in October, and 120% in April. This is reasonable, as the greatest water demand occurs when students are present during months without lengthy vacations. During these times, they are occupying housing and utilizing UConn facilities to the greatest extent possible.

Historic MMADD and PDD for the potable water system were obtained from production records in Section 5.3. Ratios of MMADD to ADD and PDD to ADD are presented in Table 6-8 for the last three years. In order to be conservative, the greatest maximum month ratio (1.40 from September 2019) will be carried forward in the projections, as will the highest peak day ratio (2.30 from 2018) from the last three years.

TABLE 6-8
Peak Demand Analysis

Year	ADD (mgd)	MMADD (mgd)	PDD (MG)	Maximum Month Ratio (MMADD/ADD)	Peak Day Ratio (PDD/ADD)
2017	0.897	1.148	1.777	1.28	1.98
2018	0.752	0.955	1.731	1.27	**2.30**
2019	0.723	1.012	1.440	**1.40**	1.99
Average	**0.791**	1.038	1.649	1.32	2.09

Note: Bold text indicates figure used for projections.

6.4.5 Summary of Projected Demands

Table 6-9 summarizes the allocation of future water demands into the planning horizons.

TABLE 6-9
Allocation of Water Demand Estimates

Description	5-Year By 2025	20-Year By 2040	50-Year By 2070
Main Campus	+115,922 gpd	+177,804 gpd	+0 gpd
Depot Campus	+15,450 gpd	+47,650 gpd	+47,650 gpd
Unaccounted-For Water (5%)	+6,569 gpd	+11,273 gpd	+2,383 gpd
Totals	**+137,941 gpd**	**+236,727 gpd**	**+50,033 gpd**

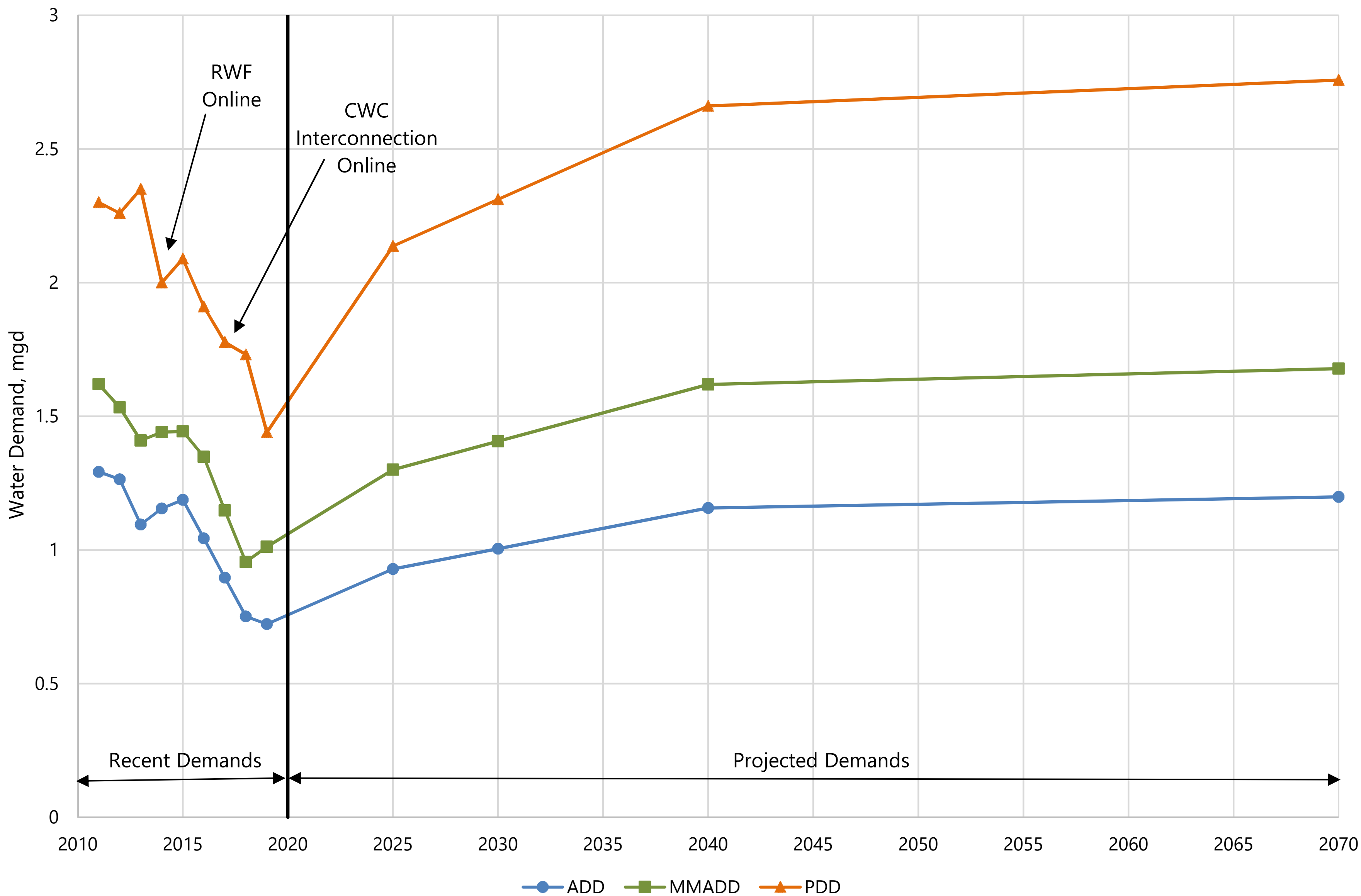
A summary of projected ADD, MMADD, and PDD is given in Table 6-10 for the 5-year, 20-year, and 50-year planning periods. These projections use the average 2017-2019 ADD condition in Table 6-8 (0.791 mgd) as a base, as well as the 1.40 and 2.30 peaking factors identified in Section 6.4.4. These projections are shown graphically in Figure 6-3.

TABLE 6-10
Summary of ADD, MMADD, and PDD Projections

Year	Projected ADD (mgd)	Projected MMADD (mgd)	Projected PDD (MG)
2025	0.929	1.301	2.137
2030	1.008	1.411	2.318
2040	1.166	1.632	2.681
2070	1.216	1.702	2.796

*Note: 2030 (10-year) demands interpolated from 2025 and 2040 projected demands.

Figure 6-3
Recent and Projected Water Demands



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These projections are discussed in the context of available supplies and margin of safety in Section 7.0 of this *2020 Plan*. Note that these projections will be updated in the next *Water Supply Plan* update, expected to be within nine years from the date of this *2020 Plan*.

7.0 ASSESSMENT AND SELECTION OF ALTERNATIVES

7.1 Projected Margins of Safety

Projected water demands are presented in Section 6.4 of this *2020 Plan* (Table 6-6) based primarily on the 2015 Campus Master Plan. Projected margins of safety are discussed herein. Recall from Section 3.0 that UConn has bolstered its margin of safety since completion of the 2011 *Water Supply Plan* through the completion of the RWF (by reducing potable water demands) and the CWC interconnection (by reducing potable water demands and increasing available supply), as well as through further studies of Fenton River Well D (providing source redundancy when a well is offline).

Table 7-1 presents the margins of safety for the UConn water system for 2025, 2030, 2040, and 2070 without consideration of any potential future supplies. These margins of safety are based on the available water calculated on the DPH worksheet (Appendix H) and the smallest available water value with the largest well offline.

TABLE 7-1
Projected Margins of Safety

Year	Total Available Supply (mgd)	Projected ADD (mgd)	Margin of Safety for ADD	Projected MMADD (mgd)	Margin of Safety for MMADD	Projected PDD (mgd)	Margin of Safety for PDD
Normal Operation							
2025	3.648	0.929	3.93	1.301	2.80	2.137	1.71
2030	3.648	1.008	3.62	1.411	2.59	2.318	1.57
2040	3.648	1.166	3.13	1.632	2.24	2.681	1.36
2070	3.648	1.216	3.00	1.702	2.14	2.796	1.30
Largest Well Offline							
2025	2.973	0.929	3.20	1.301	2.29	2.137	1.39
2030	2.973	1.008	2.95	1.411	2.11	2.318	1.28
2040	2.973	1.166	2.55	1.632	1.82	2.681	1.11
2070	2.973	1.216	2.45	1.702	1.75	2.796	1.06

Note: Highlighted cells are less than the recommended margin of safety of 1.15.

Margin of safety for the UConn water system will decrease as future demands are realized in the system. Margin of safety for all demand scenarios will remain above 1.15 until 2040, at such time that margin of safety to meet PDD will fall below 1.15 under the largest well offline scenario. However, as the margin of safety to meet PDD under the largest well offline scenario does not fall below 1.0, Table 7-1 demonstrates that sufficient redundant supply is presently available to the system.

Tables 7-2, 7-3, and 7-4 present the monthly margins of safety for the UConn water system for the 5-year (2025), 20-year (2040), and 50-year (2070) planning periods without consideration of any potential future supplies. Monthly demands were calculated using the 2019 monthly seasonality of potable water production in Table 6-5. Note that when considering monthly water availability for the largest well offline scenario, additional supply is provided by Fenton Well D during the maximum month of demand (September); thus, margin of safety values for the maximum month (September) presented in Tables 7-2, 7-3, and 7-4 will differ from the standardized value required by DPH in Table 7-1.

TABLE 7-2
Projected Monthly Margins of Safety, 2025

Month	Projected Monthly ADD (mgd)	Total Available Supply (mgd)	Margin of Safety	Total Available Supply with Largest Well Offline (mgd)	Margin of Safety
January	0.703	4.512	6.42	3.387	4.82
February	0.997	4.512	4.53	3.387	3.40
March	1.003	4.512	4.50	3.387	3.38
April	1.086	4.512	4.15	3.387	3.12
May	0.709	4.512	6.37	3.387	4.78
June	0.571	3.648	6.39	2.973	5.20
July	0.848	3.648	4.30	2.973	3.51
August	1.031	3.648	3.54	2.973	2.88
September	1.300	3.648	2.81	3.186	2.45
October	1.188	3.648	3.07	3.186	2.68
November	0.859	4.512	5.25	3.387	3.94
December	0.643	4.512	7.02	3.387	5.27
Annual	**0.929**	**3.648**	**3.93**	**2.973**	**3.20**

TABLE 7-3
Projected Monthly Margins of Safety, 2040

Month	Projected Water Demand (mgd)	Total Available Supply (mgd)	Margin of Safety	Total Available Supply with Largest Well Offline (mgd)	Margin of Safety
January	0.882	4.512	5.11	3.387	3.84
February	1.251	4.512	3.61	3.387	2.71
March	1.259	4.512	3.58	3.387	2.69
April	1.363	4.512	3.31	3.387	2.49
May	0.889	4.512	5.07	3.387	3.81
June	0.717	3.648	5.09	2.973	4.15
July	1.064	3.648	3.43	2.973	2.79
August	1.294	3.648	2.82	2.973	2.30
September	1.631	3.648	2.24	3.186	1.95
October	1.491	3.648	2.45	3.186	2.14
November	1.078	4.512	4.18	3.387	3.14
December	0.807	4.512	5.59	3.387	4.20
Annual	**1.166**	**3.648**	**3.13**	**2.973**	**2.45**

TABLE 7-4
Projected Monthly Margins of Safety, 2070

Month	Projected Water Demand (mgd)	Total Available Supply (mgd)	Margin of Safety	Total Available Supply with Largest Well Offline (mgd)	Margin of Safety
January	0.920	4.512	4.97	3.387	3.73
February	1.305	4.512	3.51	3.387	2.63
March	1.313	4.512	3.48	3.387	2.61
April	1.421	4.512	3.22	3.387	2.42
May	0.928	4.512	4.93	3.387	3.70
June	0.748	3.648	4.95	2.973	4.03
July	1.110	3.648	3.33	2.973	2.72
August	1.349	3.648	2.74	2.973	2.23
September	1.701	3.648	2.18	3.186	1.90
October	1.555	3.648	2.38	3.186	2.08
November	1.125	4.512	4.07	3.387	3.05
December	0.841	4.512	5.44	3.387	4.08
Annual	**1.216**	**3.648**	**3.00**	**2.973**	**2.45**

Similar to the results in Table 7-1, the monthly margins of safety for each demand scenario are above 1.15. Therefore, current projections do not suggest that the UConn water system will need additional sources of supply at this time. Nevertheless, a discussion of potential ways to increase margin of safety in the UConn system is presented below should actual demand trend higher than projected demand in the near future.

7.2 Assessment of Alternative Water Supplies

Although the margin of safety analysis in this *2020 Plan* does not indicate that new supply sources will be needed by UConn to meet projected demands, UConn understands that its internal planning processes are extremely dynamic and subject to change. For example, the 2015 Campus Master Plan identified this potential through scenarios where student enrollment increased by either 1,000 students or even 4,000 students over the next 20 years. Given that campus master plans are typically updated every 20 years and water supply plans are typically updated on a 5- to 9-year cycle, UConn must be prepared if increased demands are realized.

The most feasible alternatives for maintaining appropriate system margin of safety include the following options:

- Continue to design new buildings to meet high-efficiency water use standards (reduces future demands);
- Increase the use of treated effluent to supply non-potable needs across campus (reduces future demands);
- Increasing the amount of online / distance learning courses available to students to reduce commuter trips to campus (reduces future demands); and
- If necessary, increase contractual allotment of water and increase purchases from CWC.

Other alternative supply sources identified in the 2011 *Water Supply Plan* are not considered to be prudent at this time but may become prudent in the future. Those are also summarized below.

7.2.1 Continue Water Conservation Efforts in New Design

As noted in the 2015 Campus Master Plan, UConn has the potential for reducing future demands through the installation of high-efficiency water infrastructure as part of new building construction and building renovations. The Master Plan estimated that savings of up to 30% could be realized through the use of such fixtures as well as connection to the RWF for non-potable water uses such as toilet flushing. The benefits of reducing new demands by 10%, 20%, and 30% is presented in Tables 7-5, 7-6, and 7-7.

TABLE 7-5
Projected Margins of Safety with New Demand Reduced by 10%

Year	Total Available Supply (mgd)	Projected ADD (mgd)	Margin of Safety for ADD	Projected MMADD (mgd)	Margin of Safety for MMADD	Projected PDD (mgd)	Margin of Safety for PDD
Normal Operation							
2025	3.648	0.915	3.99	1.281	2.85	2.105	1.73
2030	3.648	0.986	3.70	1.381	2.64	2.268	1.61
2040	3.648	1.128	3.23	1.579	2.31	2.595	1.41
2070	3.648	1.173	3.11	1.643	2.22	2.699	1.35
Largest Well Offline							
2025	2.973	0.915	3.25	1.281	2.32	2.105	1.41
2030	2.973	0.986	3.01	1.381	2.15	2.268	1.31
2040	2.973	1.128	2.64	1.579	1.88	2.595	1.15
2070	2.973	1.173	2.53	1.643	1.81	2.699	1.10

Note: Highlighted cells are less than the recommended margin of safety of 1.15.

TABLE 7-6
Projected Margins of Safety with New Demand Reduced by 20%

Year	Total Available Supply (mgd)	Projected ADD (mgd)	Margin of Safety for ADD	Projected MMADD (mgd)	Margin of Safety for MMADD	Projected PDD (mgd)	Margin of Safety for PDD
Normal Operation							
2025	3.648	0.901	4.05	1.262	2.89	2.073	1.76
2030	3.648	0.964	3.78	1.350	2.70	2.218	1.64
2040	3.648	1.091	3.34	1.527	2.39	2.509	1.45
2070	3.648	1.131	3.23	1.583	2.30	2.601	1.40
Largest Well Offline							
2025	2.973	0.901	3.30	1.262	2.36	2.073	1.43
2030	2.973	0.964	3.08	1.350	2.20	2.218	1.34
2040	2.973	1.091	2.73	1.527	1.95	2.509	1.19
2070	2.973	1.131	2.63	1.583	1.88	2.601	1.14

TABLE 7-7
Projected Margins of Safety with New Demand Reduced by 30%

Year	Total Available Supply (mgd)	Projected ADD (mgd)	Margin of Safety for ADD	Projected MMADD (mgd)	Margin of Safety for MMADD	Projected PDD (mgd)	Margin of Safety for PDD
Normal Operation							
2025	3.648	0.888	4.11	1.243	2.94	2.041	1.79
2030	3.648	0.943	3.87	1.320	2.76	2.168	1.68
2040	3.648	1.053	3.46	1.475	2.47	2.423	1.51
2070	3.648	1.088	3.35	1.524	2.39	2.504	1.46
Largest Well Offline							
2025	2.973	0.888	3.35	1.243	2.39	2.041	1.46
2030	2.973	0.943	3.15	1.320	2.25	2.168	1.37
2040	2.973	1.053	2.82	1.475	2.02	2.423	1.23
2070	2.973	1.088	2.73	1.524	1.95	2.504	1.19

As demonstrated in the tables above, meeting a water conservation goal of 30% for new development and redevelopment would ensure that system margin of safety remains above 1.15 for all demand scenarios through 2070 including when the largest well is offline. This will help to ensure that new sources of supply are not necessary for the foreseeable future. However, as noted in the 2015 Campus Master Plan, UConn will continue to strive for as much water efficiency as possible.

7.2.2 Increase Use of Treated Effluent

In addition to installing grey water infrastructure in new and renovated buildings, UConn could also begin retrofitting other buildings not slated for renovation. This would require a more immediate expansion of the grey water system across campus than is currently planned, although in the short-term buildings close to current grey water lines (such as those near the CUP) could be outfitted.

As noted in Section 3.2.3, the present RWF has a maximum capacity of 1.0 mgd. A cursory examination of the RWF flows to the campus in Section 5.2.2 suggests that the current non-potable water flow is approximately 0.33 mgd, with a peak day peaking factor (based on the March 2017 historic peak) of 1.95. Therefore, the maximum average daily flow that could be maintained is approximately 0.51 mgd while maintaining supply for peak flows. This suggests that approximately 0.18 mgd of additional non-potable water demands over the 2019 average daily flow level could be met by the existing RWF. Note that some of this capacity will be taken up by new construction and renovations discussed Section 7.2.1. Regardless of the demand source, the net result will be reduced demand on the potable water system.

UConn will need to study potential expansion options for the campus grey water system in order to fully allocate the flow from the RWF. Potential expansion of the RWF may also be an option in the future if sufficient need materializes (such as in response to a public-private partnership that requires a high non-potable water demand in the Technology Park or the Depot Campus. However, expansion of the RWF is not believed to be necessary to meet the projected non-potable water demands at this time.

7.2.3 Increase Availability of Online & Distance Learning Classes

While it is not immediately clear what percentage of UConn's water demand can be directly applied to commuting students and faculty, it is believed that some percentage of water savings could be achieved by increasing the number of classes that can be completed via distance learning. As demonstrated during the COVID-19 pandemic, many of UConn's lecture courses may be completed online. Furthermore, while many classes have laboratory or testing components that require in-person attendance, even if one lecture per week for each class could be held online there would likely be a resultant reduction in overall water demand.

The 2015 Campus Master Plan identifies a variety of current, near-term, and long-term strategies for reducing UConn's carbon footprint and overall water use. These strategies included consideration for the potential need for more students (1,000 to 4,000) living and learning on campus. In addition to the suggested strategies to mitigate the potential impacts of that population increase, increased use of distance learning could also be applied to help reduce peak parking needs, reduce single-occupant vehicle trips to campus, and reduce overall carbon emissions (from those trips). The Office of Sustainability should consider the potential feasibility of this option in more detail as it may have campus-wide effects.

7.2.4 Increase Contractual Allotment from The Connecticut Water Company

Whereas the previous options dealt primarily with methods for decreasing demands, UConn's most feasible option for significantly increasing available supply would be to negotiate with CWC for a higher guaranteed contractual volume than the current 1.5 mgd.

According to the *Coordinated Water System Plan, Part III – Final Integrated Report* published in June 2018 for the Central PWSMA, the CWC Western system is expected to still have a surplus of approximately 6.4 mgd in 2060. At this time, it appears that requesting additional supply from CWC in the future will be feasible should the need arise. Furthermore, given that the interconnection is already in place, this may also be UConn's most prudent option from a cost perspective.

7.2.5 Other Sources of New Supply Not Considered Prudent at this Time

The 2011 *Water Supply Plan* presented a detailed list of potential options for securing additional water supply for UConn[23]. Many were more fully evaluated in UConn's *Potential New Sources of Water Supply* EIE in 2012[24] which ultimately resulted in UConn pursing the CWC interconnection. The reader is directed to those documents for a detailed description of the analysis provided for each option. A brief discussion of why these options are no longer considered to be feasible or prudent at this time is presented below:

- <u>Relocation of Fenton Well A</u>: Replacement of Well A with a deeper well was originally evaluated as part of the

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[23] https://envpolicy.uconn.edu/reports-projects-plans/
[24] https://portal.ct.gov/CEQ/Environmental-Monitor/Environmental-Monitor-Archives/2012/November-20-2012

Fenton River Study with the conclusion that induced infiltration from the river would only be minimally reduced. Furthermore, given that Well A is subject to the recommendations of the Fenton River Study which were ultimately used in the *Wellfield Management Plan*, relocating and reactivating Well A would not increase available water. Finally, as Wells B, C, and D can already produce more than the water diversion registration of 864,000 gpd, maintaining Well A will continue to provide much needed resiliency and ensure continuity of operation in the event that another well was offline. Thus, given the status of Well A in its current classification as an emergency well, relocating Well A is neither feasible for increasing available supply nor prudent from a cost perspective.

- Increase Withdrawals from Existing Wellfields: One option that UConn has long been aware of is the potential for increasing withdrawals from its current wellfields. For example, previous studies conducted in the late 1960s evaluated the potential for several additional wells at the Willimantic River Wellfield than are presently installed. Installing new wells at either wellfield for use would require a water diversion permit from DEEP. Securing such a permit for a withdrawal above the registered value for either wellfield may be feasible provided UConn agrees to abide by, at a minimum, the operating strategies promulgated in the Fenton River Study and/or Willimantic River Study as presented in the *Wellfield Management Plan*. Note that any permit application would likely require revisiting the related Instream Flow Study in order to determine potential fisheries impacts from the higher rates of withdrawal, with appropriate adjustment of the existing trigger discharges. Furthermore, note that a new well at the Fenton River Wellfield is unlikely to increase available water (or margin of safety) as there would still be a period of each year where the wellfield would be expected to be shut down. Thus, a new well at the Fenton River Wellfield would only provide additional redundant supply during certain months of the year, while a new well at the Willimantic River Wellfield may provide an additional increment of supply, available water, and margin of safety.

- Interconnection with Windham Water Works: Although this interconnection was identified in the 2018 *Coordinated Water System Plan, Part III – Final Integrated Report* as a potential regional interconnection option, it was identified as an option for providing a redundant source of supply to Windham Water Works as opposed to providing a source of supply to UConn. Nevertheless, the potential still exists that water from Windham Water Works could provide a future increment of supply to UConn. However, as discussed in the 2012 EIE, the same issues surrounding provision of instream flow, permitting, and funding of water treatment plant upgrades and construction costs would need to be overcome. As it is believed that Windham Water Works does not currently have sufficient excess supply to provide a large increment of water to UConn, this alternative is not considered to be either feasible or prudent at this time.

- Interconnection with Tolland Water Department: Given that Tolland Water Department also connected to the CWC Western system as part of the water main extension from Tolland to Mansfield, and that their interconnection was performed, in part, to reduce demand on Tolland's sources of supply, connection to Tolland Water Department to increase UConn's available supply continues to not be feasible.

- New Stratified Drift Wellfields: The 2012 EIE evaluated multiple options for new stratified drift wells along the Willimantic River and the Fenton River away from the existing wellfields, and the evaluation included test borings at certain locations. Ultimately, the individual and cumulative yields from these potential wellfields were considered insufficient to meet future UConn demands at that time, and the distance involved to move that water to the UConn water system was expected to be costly. A copy of the summary describing these sources is presented in Appendix O. UConn may reconsider some of these locations in the future to provide a small increment of additional available supply, but these are not considered to be necessary or prudent at this time.

7.3 System Improvements and Maintenance Activities

Source and system improvements have been identified and described in detail throughout this *2020 Plan*. The improvement schedules summarized in Tables 7-8, 7-9, and 7-10 relate these recommended improvements to the time frame in which they are believed to be necessary. The Short-, Intermediate-, and Long-Term Improvement Schedules correspond to the 5-, 20-, and 50-year planning periods. Cost estimates, financing sources, and the year in which each is anticipated to occur are also listed.

Note that these improvement schedules are general and for planning purposes only. The timing of specific projects will continue to be evaluated and scheduled under UConn's Capital Improvement Program with coordination and advice from its contract operator.

TABLE 7-8
Short Term Improvement Schedule, 2020-2025

Item	Estimated Cost	Year	Funding Source
Continue metering of service connections and groups of buildings	$100,000	2020-2025	OB
Replace Hillside Road water main	$200,000	2020-2025	CI
Additional hydraulic model calibration and expansion as needed	$50,000	2020-2025	OB
Storage tank inspections	$20,000	2020-2025	OB
Update Rules and Regulations for Water Service	NA	2020-2025	OB
Repair main breaks as needed	$5,000/yr	As Needed	OB
Repair leaking services as needed	$5,000/yr	As Needed	OB
Meter testing/calibration/replacement program	$5,000/yr	Annually	OB
Annual water balance and conservation programs	NA	Annually	OB
Leak detection survey	NA	2021	OB

Notes: CI = Capital Improvement funds, OB = Operating Budget, OS = Outside Sources
Cost estimates are for planning purposes only. Where an estimated cost "NA" (Not Applicable) is shown, this work is intended to be conducted by in-house staff or paid for by other departments.

TABLE 7-9
Intermediate Term Improvement Schedule, 2026-2040

Item	Estimated Cost	Year	Funding Source
More fully interconnect the Depot Campus sub-system with the Main Campus sub-system such that the Fenton River Wellfield and CWC interconnection could provide water during emergencies	$700,000	2026-2040	CI
More fully interconnect the Main Campus/CWC system in areas such as Discovery Drive and South Eagleville Road.	$700,000	2026-2040	CI/OS
Demolish inactive water storage tanks near 0.75 MG tank at Depot Campus	$100,000	2026-2040	CI
Redevelop wells as needed	$20,000-$50,000 ea	Various	OB
Storage tank inspections	$7,000 ea	Various	OB
Repair main breaks as needed	$5,000/yr	As Needed	OB
Repair leaking services as needed	$5,000/yr	As Needed	OB
Meter testing/calibration/replacement program	$5,000/yr	Annually	OB
Annual water balance and conservation programs	NA	Annually	OB
Leak detection survey	NA	2026, 2031, 2036	OB
Inspect and maintain storage facilities	$50,000	Various	OB
Update *Water Supply Plan*	$50,000/ea	2029, 2038	OB
Extend campus grey water system (Werth Residence Hall, Science I, and near other areas where there is reclaimed water infrastructure)	TBD	2026	CI/OB

Note: TBD = To Be Determined
Cost estimates are for planning purposes only. Where an estimated cost "NA" is shown, this work is intended to be conducted by in-house staff or paid for by other departments.

TABLE 7-10
Long Term Improvement Schedule, –2041-2070

Item	Estimated Cost	Year	Funding Source
Redevelop wells as needed	$20,000-$50,000 ea.	Various	OB
Storage tank inspections	$7,000 ea	Various	OB
Repair main breaks as needed	$5,000/yr	As Needed	OB
Repair leaking services as needed	$5,000/yr	As Needed	OB
Meter testing/calibration/replacement program	$5,000/yr	Annually	OB
Annual water balance and conservation programs	NA	Annually	OB
Leak detection survey	NA	2041, 2046, 2051, 2056, 2061, 2066	OB
Inspect and maintain storage facilities	$50,000	Various	OB
Update *Water Supply Plan*	$50,000/ea	2047, 2056, 2065	OB

Cost estimates are for planning purposes only. Where an estimated cost "NA" is shown, this work is intended to be conducted by in-house staff or paid for by other departments.

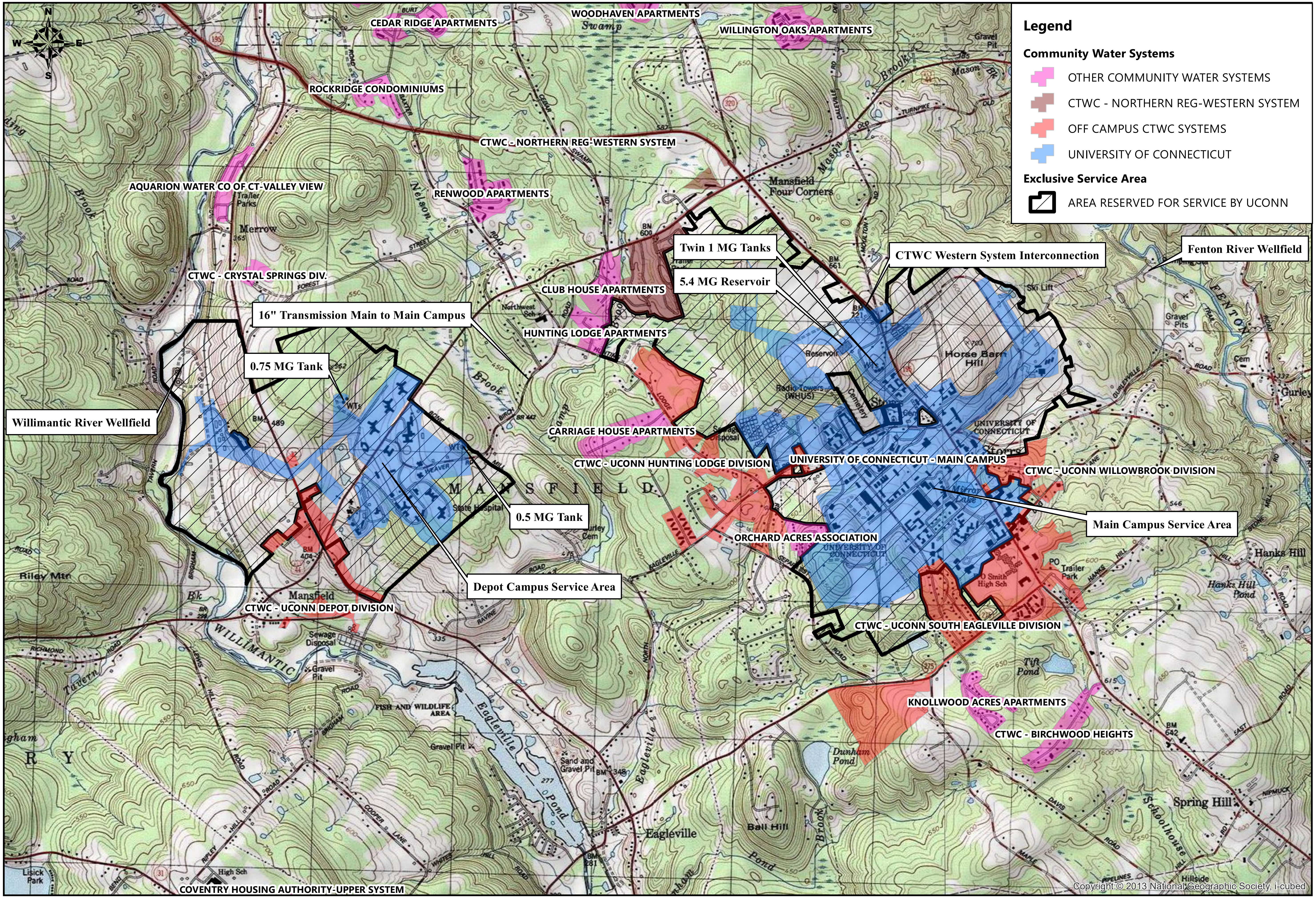
7.4 Financing of Proposed Improvements and Programs

Three types of financing are planned for the above improvements. Operating budget expenses such as metering, meter testing, main breaks, and routine repairs are paid from the annual budget of the Facilities Department. Capital improvement funds are necessary for significant projects which otherwise could not be constructed using funds from annual budgets and the few remaining water ratepayers.

Public/private partnership is an example of the third category of funding. Outside sources may be necessary for some of the projects listed in the improvement tables, such as providing redundant supply to the Depot Campus and extension of the campus grey water system to new buildings. Without these outside sources, some of the proposed projects may be difficult to fund using annual budgets and State funds.

APPENDED FIGURES

Appended Figure 1 – Water Service Areas
Appended Figure 2 – Town of Mansfield Zoning Map



Sources:
-Service Area Based on University of Connecticut System Mapping
-USGS 1997 Topographic Basemap Provided by ESRI
-Other Community Water Systems and Exclusive Service Area from Coordinated Water System Plan

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REVISIONS	
5/9/2011	Service Area
5/21/2020	Service Areas

WATER SERVICE AREAS

UNIVERSITY OF CONNECTICUT
WATER SUPPLY PLAN

STORRS, CONNECTICUT

SJB DESIGNED	SJB DRAWN	DM CHECKED

SCALE: 1" = 2,000'

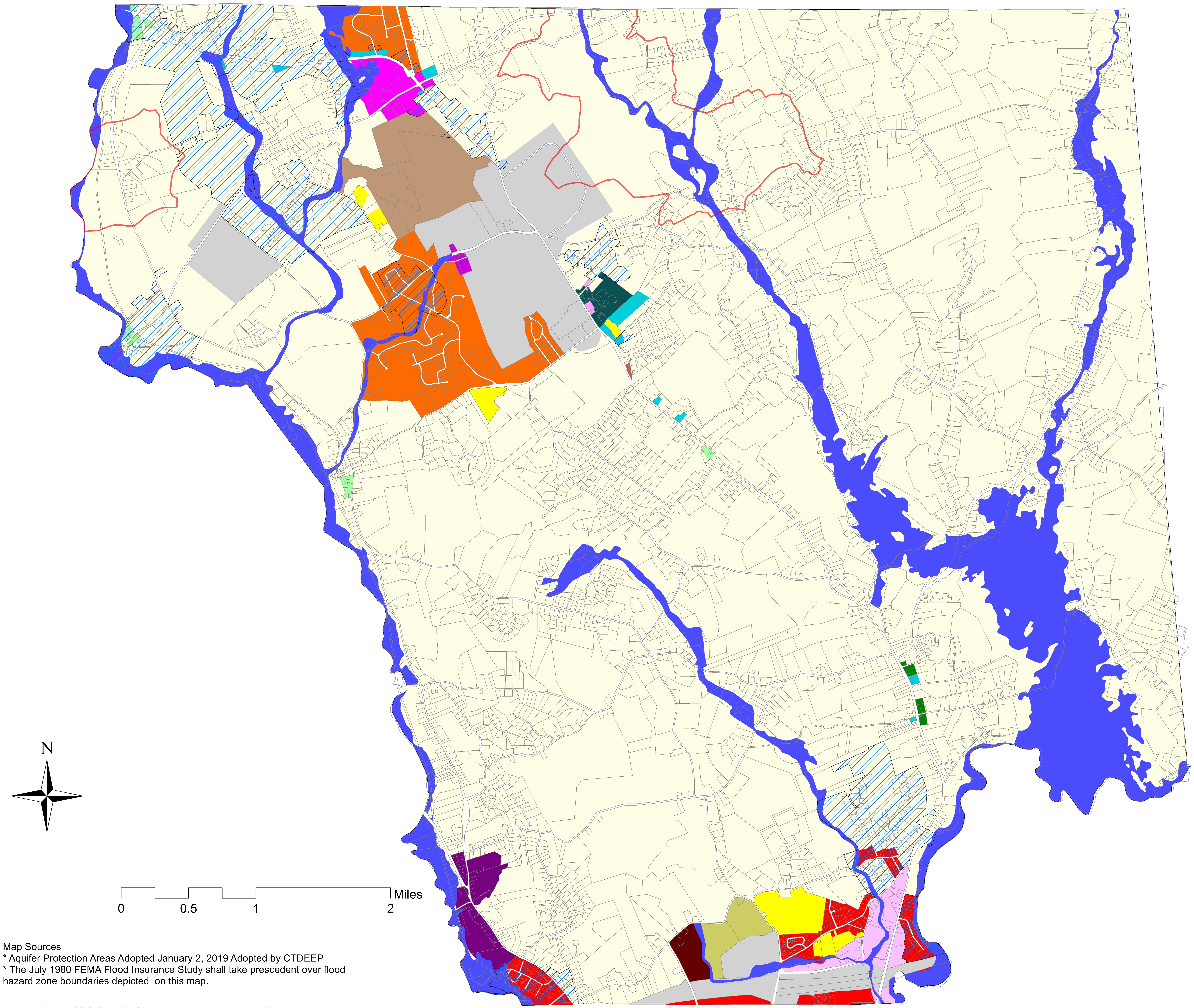
DATE: 3/17/2011

PROJECT NOs: 1958-31, 1958-119

MXD NAME: Y:\AppendedFigureI.MXD

APPENDED FIGURE I

SHEET NO.



Legend

Aquifer Protection Area

- Final Adopted Aquifer Protection

Water Pipeline Overlay Zone

- Water Pipeline Overlay Zone

Zoning

- Residence 20 Zone (R-20)
- Residence 90 Zone (R-90)
- Rural Agricultural Residence 90 Zone (RAR-90)
- Design Multiple Residence Zone (DMR)
- Pleasant Valley Residence/Agriculture Zone (PVRA)
- Pleasant Valley Commercial/Agriculture Zone (PVCA)
- Planned Business 1 Zone (PB-1)
- Planned Business 2 Zone (PB-2)
- Planned Business 3 Zone (PB-3)
- Planned Business 4 Zone (PB-4)
- Planned Business 5 Zone (PB-5)
- Neighborhood Business 1 Zone (NB-1)
- Neighborhood Business 2 Zone (NB-2)
- Professional Office 1 Zone (PO-1)
- Storrs Center Special Design District (SC-DD)
- Research and Development Limited Industrial Zone (RD/LI)
- Flood Hazard Zone (FH)
- Institutional Zone (I)
- Business Zone (B)

Zoning Map

of the
Town of Mansfield, Connecticut
(Effective February 1, 2019)

Map Sources
* Aquifer Protection Areas Adopted January 2, 2019 Adopted by CTDEEP
* The July 1980 FEMA Flood Insurance Study shall take prescedent over flood hazard zone boundaries depicted on this map.

Document Path: N:\GIS CURRENT\Projects\Planning\Planning MXD\Zoning.mxd