Executive Summary

The City of Tallahassee selected ARCADIS U.S., Inc. and Diversified Drafting and Design (3DS) to prepare the 2015 Water Master Plan Update (WMPU). The purpose of the WMPU is to identify water supply and system improvements necessary to meet projected water demands through the year 2035.

The majority of the improvements identified in this WMPU are driven by water demand, fire flow, renewal and replacement of infrastructure, and future growth; as such, the timing of many of these improvements is ultimately driven by when specific projects are actually required. The capital improvements plan (CIP) presented herein is intended to serve as a budgeting tool. The City will need to monitor growth and other project-specific factors to adjust the CIP schedule as appropriate. For example, growth in one development may occur more quickly than projected and, as such, certain improvements may need to happen sooner than indicated. On the other hand, growth may not return as quickly as projected meaning certain projects can be delayed.

Population Projections

Three different population projection methodologies were evaluated: Traffic Analysis Zones (TAZ), University of Florida Bureau of Economic and Business Research (BEBR), and U.S. Census data. The Tallahassee-Leon County Planning Department (TLCPD) utilizes TAZ projections for concurrency planning and development of the Comprehensive Plan. The City also recently utilized TAZ projections for development of the 2014 Master Sewer Plan. Thus, for consistency with other planning efforts and because TAZ projections have historically been more representative of growth in the Tallahassee area, the population and water demand estimates in this WMPU are based upon TAZ projections.

The urban service area (USA) is intended to provide for growth and development within the 20 year planning horizon of the Comprehensive Plan. Development within the USA is characterized by an urban level of government services such as roads, mass transit, stormwater, water, sewer, solid waste and parks. There are 691 TAZs in the USA. A summary of the TAZ-based population projections for growth inside the USA is provided in Table ES-1.

Table ES-1
Summary of TAZ-Based Population Projections

Year	Estimated USA Population
2007	231,506
2015	247,159
2020	256,498
2025	265,811
2030	275,163
2035	284,218

Source: City of Tallahassee, Master Sewer Plan Phase 2 Population and Wastewater Flow Projection, Hatch Mott MacDonald (2014).

Future Water Demand

The TLCPD estimates an additional 16,119 habitable units (single-family, multi-family, and other residential units) in known developments in the USA by the year 2035. The department utilizes a factor of 2.51 persons per unit for planning purposes. Therefore, an estimate of the persons associated with the 16,119 habitable units can be calculated by multiplying the number of units by 2.51 persons per unit for a total of 40,458 persons. Subtracting these persons from the total TAZ projected population growth of approximately 37,059 people results in approximately 3,400 additional people planned in the planned developments that are not in the current TAZ projections in the USA

Future water demand was projected based on the following:

a. Known Planned Developments:

   i. Average annual day (AAD) demand of 100 gallons per capita per day (gpcd) will be used to determine future annual average day demands. The existing demand in addition to the planned development demand will generate total future demand. This assumes the majority of future growth in these areas is residential in nature.

   ii. A peaking factor of 1.6 will be used to calculate the maximum day demand (MDD), or the total level of service (LOS) for the planned developments.

b. Outside Known Planned Developments:

i. Population growth outside known planned developments will be evenly distributed across the system to the nodes with existing demands.

ii. Future MDD outside known planned development, but within the USA, will be based on 150 gpcd due to the uncertainty of the type of demand.

A summary of future demands for the period of 2015-2035 is provided in Table ES2.

Table ES-2
Projected Future Water Demands (2015-2035)

YEAR	Population Total (Inside USA)	Increase	Demand (Million Gallons Per Day, MGD)				
			Additional LOS	Cumulative LOS	Additional AAD	Cumulative AAD	Cumulative MDD*
2015	247,159	--	--	39.55	--	30.53	45.80
2020	256,498	9,339	1.49	41.04	0.89	31.42	47.13
2025	265,811	9,313	1.49	42.53	0.89	32.31	48.47
2030	275,163	9,352	1.50	44.03	0.89	33.20	49.80
2035	284,218	9,055	1.45	45.47	0.86	34.06	51.09
TOTAL		**37,059**	**5.93**		**3.54**		

Under the City's current consumptive use permit (CUP), the permitted withdrawal quantities are as follows:

1. Combined average annual withdrawal of 33,700,000 gallons per day (gpd)
2. Maximum combined withdrawal of 61,500,000 gallons during a single day
3. Combined monthly withdrawal of 1,470,000,000 gallons.

Based on the projections in Table ES-2, the projected 2035 AAD of 34.06 is greater than the City's existing permitted annual average withdrawal by 0.36 MGD. However, the projected 2035 MDD of 51.09 MGD is less than the permitted maximum day withdrawal of 61.5 MGD. Based on these projections, it will likely be necessary to modify the CUP annual average day capacities towards the end of the Planning Period.

Distribution Hydraulic Modeling

For the purposes of developing the WMPU, the current City of Tallahassee Water Distribution hydraulic model was updated in InfoWater, version 10.2.1. The City's geographic information system (GIS), including improvements completed as a part of this project, was used as the basis for the model development.

There are no strict guidelines for performance of calibration in terms of goodness-of-fit between modeled and measured data. The level of calibration required generally depends on the specific system being modeled and the intended use of the model. The calibration results for the Tallahassee model fall within the suggested goodness-of-fit ranges. The results at each of the storage tanks were good, with most predicted tank levels falling within the standard of ±6 feet. The majority of final modeled flows were within 2% of the measured values.

The calibration process provided many insights into the operation of the Tallahassee distribution system. Overall, the calibration resulted in a model that will effectively serve to address the goals of the WMPU, and enable the City to effectively evaluate distribution system operation and improvements in the future.

Future Water Supply Alternatives

Projected additional future demands from planned developments will result in the need for improvements to the City's water system. A new or larger tank with either significant changes to the well operational strategies for Wells 23 and 26, or upgraded piping will be required in the northwest quadrant in the vicinity of Tank 5. Additional capacity will be needed in the vicinity of Tank 5 to provide the required storage needs of this portion of the City's distribution system throughout the planning period. There were two options considered for this; Option 1: demolish Tank 5 and construct a single 1 million gallon tank. Option 2: add an additional 500,000 gallon tank in the vicinity of Tank 5. The two options were analyzed using the water model, either option was deemed a feasible alternative to provide the storage needs near Tank 5.

For the purposes of the Water Master Plan Update, a decision whether to construct (1) 1 million gallon tank or utilize the existing tank and add a new 500,000 gallon tank will be made after property is acquired and before design is started by the City of Tallahassee.

Additionally, a groundwater well with a capacity of 2,500 gpm will be required in the vicinity of Tank 7. This new well will be required to maintain water levels in Tank 7 and Tank 8 above the minimum threshold under anticipated 2035 demands. The area around

Tank 7 is located within a region of high groundwater quality and availability. Though productivity will vary locally depending on the site-specific geology encountered, high capacities and favorable water quality similar to other wells near Tank 7 are to be expected. The proposed location for the additional well in the vicinity of Tank 7 is within the planned Welaunee Toe and Heel development. Land for the new well site can be identified and/or procured prior to the construction of the development.

Distribution Expansion Alternatives

The City's existing infrastructure is largely adequate to meet future water supply needs. The City has a highly looped, extensive water supply grid and as a result there are very few identifiable bottlenecks in the system that would prevent the City from meeting future water demands. Based on a detailed review of the system and projected water demands from 2015 to 2035, the following improvements are recommended:

- Renewal of the existing CUP prior to July 1, 2016 for a 20-year period (through 2035) and monitoring of future demands to confirm whether an increase in permitted capacity is required towards the end of the planning period as projected.
- Prior to 2020, installation of a new 500,000 gallon or larger elevated storage tank in the northwest quadrant of the system, or replacement of the existing tank with a 1 million gallon or larger tank.
- Prior to 2020, modification of controls at Well 23 and 26 and/or completion of the following:
  - Replacement of 3.5 miles of existing 6-, 8-, and 10-inch piping running east to west along Mahan and Call on either side of downtown with 12-inch mains.
- Installation of a pipe parallel to the Woodville pipe consisting of approximately 18,000 ft (3.5 miles) of 10 to 12-inch pipe, and would require an additional PRV on the pipe to reduce the pressures and aid in fire flow to the southern (Woodville) portion of the system.
- Installation of a 2,500 gpm water supply well in the vicinity of Tank 7 in the northeastern portion of the City's service area, i.e. the western section of the Welaunee development.
- Monitoring of existing supply well production capabilities and rehabilitation of wells as required. This project will not be included in the CIP, the funds for this will be taken out of the yearly operating budget.

Downtown Infrastructure Replacement

It is recommended that the City continue with the downtown infrastructure improvements from the 2010 WMPU which replace aging infrastructure to improve system capacity, reliability, and fire protection.

Capital Improvements

Table ES-3 provides a summary of the capital improvement recommendations resulting from these master planning efforts. The information contained in the table includes only those operational and capacity improvements necessary to meet the water supply needs of future customers and other improvements included in this report, such as the cost of the downtown infrastructure improvements.

Table ES-3
Detailed Capital Improvements Schedule

Project ID	Project Description	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	20-Year Total
Capacity Improvements																						
1	Design and Install New Welaunee Well Near Tank #7								$ 1,200,000	$ 1,700,000												$ 2,900,000
2	Pipeline addition for VA Hospital			$ 510,000																		
	Total Capacity Improvements	$ -	$ -	$ 510,000	$ -	$ -	$ -	$ -	$ 1,200,000	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,410,000
Operational Improvements																						
3	Downtown Infrastructure Replacement	$ 1,070,000	$ 1,135,000	$ 1,600,000	$ 1,600,000	$ 1,700,000	$ 1,200,000	$ 1,200,000	$ 1,500,000													$ 11,005,000
4	Design and Construct New 1 MG Tank (NW to replace Tank #5)	$ 750,000	$ 1,750,000																			$ 2,500,000
5	Well #23 Rehabilitation and Upgrade	$ 1,000,000	$ 1,100,000																			$ 2,100,000
6	Old Bainbridge Rd Line Size Upgrades (connected to Well 26)						$ 220,000															$ 220,000
7	Raymond Diehl Road Line Size Upgrades (connected to Well 16)							$ 250,000														$ 250,000
8	Minor Line Extensions and Upgrades	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 15,000,000
9	East-West 12-Inch Water Main Replacement											$ 1,200,000	$ 1,200,000	$ 1,200,000	$ 1,200,000	$ 1,200,000						$ 6,000,000
	Total Operational Improvements	$ 3,570,000	$ 4,735,000	$ 2,350,000	$ 2,350,000	$ 2,450,000	$ 2,170,000	$ 2,200,000	$ 2,250,000	$ 750,000	$ 750,000	$ 1,950,000	$ 1,950,000	$ 1,950,000	$ 1,950,000	$ 1,950,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 37,080,000
Areas of Concern/ Fire Flow Improvements (Discretionary Funding)																						
10	Misc. Fire Flow Improvements	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 2,400,000
11	Areas in conjunction with Welaunee Development			$ 120,000	$ 120,000	$ 120,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 230,000	$ 230,000	$ 230,000						$ 2,520,000
12	Woodville Fire Flow Improvements (Northern Loop)										$ 1,966,403											$ 1,966,403
	Total Concern/Fire Flow Improvements	$ 120,000	$ 120,000	$ 240,000	$ 240,000	$ 240,000	$ 330,000	$ 330,000	$ 330,000	$ 330,000	$ 2,296,403	$ 330,000	$ 330,000	$ 350,000	$ 350,000	$ 350,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 6,886,403
	Total Improvements	$ 3,690,000	$ 4,855,000	$ 3,100,000	$ 2,590,000	$ 2,690,000	$ 2,500,000	$ 2,530,000	$ 3,780,000	$ 2,780,000	$ 3,046,403	$ 2,280,000	$ 2,280,000	$ 2,300,000	$ 2,300,000	$ 2,300,000	$ 870,000	$ 870,000	$ 870,000	$ 870,000	$ 870,000	$ 47,376,403

5. Projected Water Demands

5.1. Overview

The purpose of this section is to provide water demand projections developed for the WMPU and to summarize the data sources utilized in developing those projections. The planning horizon for these projections and the WMPU is through the year 2035.

Existing City-County planning documents (Comprehensive Plan, Evaluation and Appraisal Report-EAR , etc.) and population projections for Leon County from a variety of sources including U.S. Census Bureau data, City and County Traffic Analysis Zone (TAZ) data, University of Florida's Bureau of Economic and Business Research (BEBR) and data provided by City-County Planning staff were reviewed as part of these efforts. Based on this data, population and water demand projections have been provided for the years 2013 (baseline or existing demand), 2015, 2020, 2025, 2030, and 2035.

The TLCPD maintains a considerable amount of data related to population projections for greater Leon County. The focus of this section is the population projections for the USA. The USA was adopted as part of the Comprehensive Plan in 1990. Leon County consists of approximately 667 square miles, of which approximately 161 square miles are within the USA. Almost all of the City's 100 square miles are located within the USA. The USA is intended to provide for growth and development within the 20-year planning horizon of the Comprehensive plan. Development within the USA is characterized by an urban level of government services such as roads, mass transit, stormwater, water, sewer, solid waste and parks.

The USA was established for a number of reasons revolving around managed and environmentally acceptable growth. Specifically, the reasons include:

1. Control premature development of rural lands;
2. Promote compact development;
3. Encourage multi-modal transportation options;
4. Encourage affordable living; and
5. Promote the economic and efficient provision of urban services.

Historically, the USA has remained virtually unchanged. The last EAR was completed in 2007. The EAR and Statistical Digests have reflected this and confirmed that the USA

contains sufficient developable land to accommodate approximately 90% of the development that has occurred since the Comprehensive Plan's adoption.

City-County Planning staff is scheduled to complete an EAR evaluation and send a notification letter to the Florida Department of Economic Opportunity by 1/1/2016. In the meantime, Planning staff does not anticipate any substantial expansion of the existing USA limits through the year 2020. Beyond 2020 staff anticipates additional population growth within the USA and in limited areas in which the USA would be expanded. The urban fringe land use category and location of planned development provide direction as to areas in which these long term population and water demand increases will occur.

5.2. Population Projection Methodology

The methodology used by the TLCPD to formulate long-range population projections is set forth in a 2007 TLCPD memorandum. In part, it explains that long range projections involve extrapolations (curve fittings) performed using U.S. Census Bureau population data and fit to linear, geometric, parabolic, modified exponential, Gompertz, and logistic curves. The extrapolation technique is a simplistic model that uses past gross population trends to project future population levels.

The base periods studied by TLCPD were 1950-2000 and 1980-2000. Using the six curves and two different base periods, twelve possible models were generated. The fit of the models was evaluated using three quantitative statistical forms of evaluation. The base period 1980-2000 was chosen even though it includes only three points of observed data (census data), due to the fact that the curves resulted in projections much more similar in comparison with the BEBR projections through the year 2035 than when using the 1950-2000 base period. To decide which curve to use to project population, the following factors were considered: 1) the curve fit statistics; 2) how well the curve fit when visually compared to other plots; and 3) how realistic and close the projections were to the 2010, 2020 and 2030 BEBR projections.

The Gompertz curve with a base period of 1980-2000 was the model used for the population projections. The population estimates calculated by this model match the historical census data and the BEBR projections very well. Staff determined that the Gompertz curve predicts similar increases to those exhibited in the Census historical population data for Leon County and the projections produced by BEBR through 2035 (A Gompertz curve or function is a type of mathematical model characterized by the slowest rates of growth at the beginning and end of a time period. It assumes a confined area for growth to occur within and a limitation on resources within that area.) Staff

notes that extreme caution should be exercised when using any long-range population projections.

5.3. Population Projection Data

5.3.1. Transportation Analysis Zone Data

In 2004, a database was developed by the TLCPD based upon TAZ. These zones vary in size based upon the density or nature of development. In a predominantly urban area the TAZ may be as small as a city block; in rural areas a TAZ may be as large as 10 square miles. Typically the zones are intended to encompass homogeneous urban activities, i.e. residential, commercial, or industrial. Zones are designed to be relatively homogeneous traffic generators and are sized so that only 10-15 percent of the trips are intra-zonal. The TAZ data are developed based on historic development patterns, permitting activity, zoning and future land use categories, and anticipated new development.

Leon County contains 760 TAZs. The total number of TAZs in the USA is 691. The population estimated and projected for each zone formed the basis for the population projections. These population estimates have been updated as a part of the City of Tallahassee Master Sewer Plan and are attached in Appendix A. For Table 5-1, calculations were made to determine the estimated USA population based on the percent of residents in the USA versus Leon County. The report analyzed each zone within the USA in the context of existing and planned development in that zone. A summary of the TAZ-based population projections received from Hatch Mott Macdonald (HMM) for growth inside the USA is provided in Table 5-1. Table 5-2 presents the previous City of Tallahassee Master Sewer Plan USA population estimates, completed in 2009. A comparison of Table 5-1 and Table 5-2 shows that the previous estimates were higher and did not account for the population downturn that was experienced between 2009 and 2014. However, moving into the future, the estimates presented in Table 5-1 account for the current population growth trends in the USA.

It should be noted that the basis for TAZ data produced in 2014 is the 2007-2013 BEBR data. The BEBR data were broken down into the TAZ framework and specifically updated as development occurred or was anticipated. The most recent 2014 BEBR data are found in Appendix B. The trends reflected in BEBR data over the past 5 years should be considered.

Table 5-1
Summary of 2014 TAZ-Based Population Projections

Year	Estimated USA Population
2007	231,506
2015	247,159
2020	256,498
2025	265,811
2030	275,163
2035	284,218

Source: *2015 City of Tallahassee, Master Sewer Plan Population and Wastewater Flow Projections.*

Table 5-2
Summary of 2010 TAZ-Based Population Projections

Year	Estimated USA Population
2003	225,960
2005	233,430
2008	244,634
2010	252,103
2015	270,177
2020	285,548
2025	300,320
2030	315,092

Source: *2010 City of Tallahassee, Master Sewer Plan Phase 2 Population and Wastewater Flow Projection, Hatch Mott MacDonald (2009).*

The TAZ-based population projections are currently being used as the basis for capacity projections in connection with wastewater flow projections by the City of Tallahassee. Similarly, these population projections have historically appeared to be more accurate than other methods discussed herein. This report recommends utilizing the TAZ-based population projections for purposes of estimating future potable water demands.

5.3.2. Bureau of Economic and Business Research Data

The University of Florida Bureau of Economic and Business Research (BEBR) provides annual population estimates and projections for the state of Florida and its local jurisdictions. BEBR uses the housing unit method, which encompasses a wide variety of data sources including occupied housing units, number of active electric utility meters, building permits, and the estimated average population per household. Historically, the BEBR population estimates have tended to overestimate population growth in a growing housing market. For example, a speculative boom during the 2002-2006 timeframe resulted in a 2006 spike in the BEBR population estimates for Tallahassee and Leon County during the applicable planning period. After 2006, the estimates dropped significantly, and from 2012 through 2014 the estimates have stabilized and are remaining consistent. The 2014 BEBR population estimates and 2015-2035 projections are attached in Appendix B. A comparison of the BEBR 2015-2035 projections during years 2010-2014 is provided in Table 5-3.

Table 5-3
Comparison of Recent 2035 Population by BEBR (2010-2014)

Year	BEBR Population Projection				
	2010	2011	2012	2013	2014
2015	284,900	286,600	283,200	284,800	283,200
2020	297,600	300,000	296,200	298,400	296,800
2025	309,900	313,000	308,700	311,100	309,400
2030	321,200	324,900	320,300	322,900	321,100
2035	331,400	335,600	331,100	332,700	332,200

Source: University of Florida Bureau of Economic and Business Research (2010-2014).
Note: These projections produced by BEBR are for Leon County, not just the USA. They are informational to show the variation in the 2010-2014 projections.

As discussed above, it should be noted that the 2007 BEBR data provided the baseline data for the projections contained in the TAZ-based population projections for the USA. These projections were on the front end of the significant increase in population estimates due to the housing boom. The 2014 projection for the year 2035 is 332,200 compared with the 2010 projection of 331,400 - a difference of only 800, which is statistically irrelevant. The projections for the year 2035 (Table 5-3) ranged from 331,100 on the low side to 335,600 on the high side, a difference of 4,500. This indicates that population projections have been relatively constant over the past five years.

5.3.3. Census Tract Data

A census tract is a geographic region defined for the purpose of taking the census. In most circumstances, these coincide with the boundaries of cities and towns in urban areas. In unincorporated areas, they can be arbitrary except for coinciding with political lines. Census tracts are subdivided into block groups or census blocks. Leon County contains 68 total census tracts. Attached in Appendix C is a map reflecting population growth by census tract from 2010-2014 (*TLCPD*). The observations as to the nature and extent of growth provide insight into what can be expected in the areas of the USA during the planning period for this project (2035). Table 5-4 provides the total population of Leon County and the population inside the USA for the past five census years as well population projections. The most recent census data was collected in 2010.

Table 5-4
Comparison of Recent Census-Based Population Projections

Year	Population Inside USA	Percent of Population Inside USA	Total Population
1970 CENSUS	96,861	94.0%	103,047
1980 CENSUS	135,047	90.8%	148,655
1990 CENSUS	170,527	88.6%	192,493
2000 CENSUS	208,432	87.0%	239,452
2010 CENSUS	242,388	87.9%	275,487
2015 PROJECTION	249,216	88.0%	283,200
2020 PROJECTION	261,184	88.0%	296,800
2025 PROJECTION	272,272	88.0%	309,400
2030 PROJECTION	282,568	88.0%	321,100
2035 PROJECTION	292,336	88.0%	332,200

Source: Tallahassee-Leon County Planning Department, 1970-2010, TLCPD estimates based on U.S Bureau of the Census data; 2008-2035, Capital region Transportation Planning Agency, Long Range Transportation Plan.

Note: This table provides a comparison of the trend in census population estimates to BEBR data. The population projections for the years 2015 and 2035 were modified to match the most recent 2014 BEBR population projections i.e. the BEBR total population projections were used for years 2015 thru 2035, % of population inside the USA has been determined by TLCPD.

An additional illustrative resource is the map attached in Appendix C, which depicts the existing distribution system overlaid on the Census Tract map for Leon County.

5.4. Recommended Population Projection Method

The purpose of this section is to discuss the relative strengths and weaknesses of the various population projection methods. This section also considers specific current and anticipated areas of growth within the USA and outside the USA. Future water demand projections are presented based on the analysis of the various population projection methods and anticipated growth within the USA.

It should be noted that the City provides potable water outside the limits of the USA. However, City staff has indicated that water users located outside the USA and into neighboring Wakulla County account for only 1-2 percent of the total water used by the system. The demand from areas outside the USA is included in total flow numbers reported by the NWFWMD.

Historically, TLCPD staff and consultants have used three sources of population data - TAZ, BEBR, and the Census - to develop population estimates and projections. In many cases these data are blended in an effort to accurately model actual conditions. Analysis of the data, modeling, and discussions with planning staff resulted in the following observations:

- Census data are the backbone of the population projections.
- The current TAZ data utilize the 2010 Census information and 2007-2013 BEBR estimate as its baseline.
- The TAZ data are regularly updated to reflect actual development and development in the planning stage. Although subjective, these updates reflect planning staff's best judgment as to the realization of certain development.
- The BEBR data have been quite consistent over the past five years. Historically however, the BEBR data have not shown a consistent trend in predicting future growth with respect to periods of boom/bust in the housing market.
- From 1970 to 2000, the population in Leon County as reflected by Census Data increased at a noticeably steady rate (Table 5-5). The rate of population growth decreased by 23% over the most recent Census period. Note that this table includes population outside of the USA.
- A comparison of the most recent (2014) TAZ (Table 5-6) and BEBR (Table 5-7) projections reflects similar population growth trends to Census data. Again, note these tables include population outside of the USA.

Table 5-5
Estimated 10-Year Population Growth Rates Using U.S. Census Data

Census Years	Year 1	Year 10	Population Increase
1970-1980	103,047	148,655	45,608
1980-1990	148,655	192,493	43,838
1990-2000	192,493	239,452	46,959
2000-2010	239,452	275,487	36,035

Source: U.S. Census Bureau (2010)

Table 5-6
Projected 10-Year Population Growth Rates Based on TAZ Data

Census Years	TAZ Year 1	TAZ Year 10	Population Increase
2010-2020	275,487	301,376	25,889
2020-2030	301,376	323,980	22,604
2030-2035*	323,980	334,954	10,974

Source: City of Tallahassee, Master Sewer Plan Phase 2 Population and Wastewater Flow Projection, Hatch Mott MacDonald (2014)
**Population increase is only for a 5 year period*
Note: Population for TAZ Year 1 (2010) is the 2010 Census Population.

Table 5-7
Projected 10-Year Population Growth Rates Based on BEBR Data

Census Years	BEBR Year 1	BEBR Year 10	Population Increase
2010-2020	275,487	296,800	21,313
2020-2030	296,800	321,100	24,300
2030-2040	321,100	341,600	20,500

Source: University of Florida, Bureau of Economic and Business Research (2014)
Note: Population for BEBR Year 1 (2010) is the 2010 Census Population.

Based on the quantitative analysis presented in Table 5-5 through 5-7, the most recent TAZ projections that are to be used by HMM for the 2014 City of Tallahassee Sewer Master Plan more closely track the historic trend in census data than the 2014 BEBR projections. Additionally, BEBR projections only estimate the total Leon County population, not the USA. There is also to be a consistency between the Water and Sewer Master Plans for planning purposes. Consequently, the 2014 TAZ-based population projections are recommended for purposes of projecting water demand.

5.5. Planned Development and Future Demand in the Urban Service Area

The TLCPD maintains a list of major planned and proposed developments inside the USA. A map prepared by TLCPD showing the location of these developments is attached as Appendix D. A breakdown of the units anticipated from these developments and their associated future maximum day (based on LOS of 160 gpcd or 401 gpd per unit) and average day (based on 100 gpcd or 251 gpd per unit) is provided in Table 5-8.

Table 5-8
Summary of Major Planned Developments in the USA and Associated Future Water Demand

Name of Development	Number of Units	Future Annual Average Day (MGD)	Future Maximum Day (MGD)
Bull Run	471	0.12	0.19
Canopy PUD**	1,572	0.39	0.63
English Property PUD** (including VA Hospital)	780	0.23	0.37
Fallschase	1,514	0.38	0.61
Park Place	680	0.17	0.27
Southwood	4,770	1.20	1.92
University Green	404	0.10	0.16
Welaunee Toe-East	1,817	0.46	0.73
TOTAL	**12,008**	**3.05**	**4.88**

Source: Tallahassee-Leon County Planning Department Report on Major Planned Developments in the TLCPD Planning Area.
Note: No units have been attributed to Welaunee North inside the USA (approx. 1,900 acres), or Welaunee outside the USA inside the City (approx. 2,900 acres).
*** Planned unit development*

The TLCPD maintains a database of other major projects (over 40 units) planned inside the USA. These amount to an additional 4,111 (approximately) units inside the USA contained in developments that are ongoing or proposed. A breakdown of these units and their associated future average and maximum day water demand is provided in Table 5-9.

Table 5-9
Additional Planned Development in the TLCPD Planning Area and Associated Demand

Type	SF Detached	Townhouse	Condo	Multi-Family	Total Units	Future Annual Avg Day (MGD)	Future Max Day (MGD)
Proposed	-	-	-	391	391	0.10	0.16
Under review	-	-	-	520	520	0.13	0.21
Approved (in subs/projects not yet started)	-	-	-	839	839	0.21	0.34
Approved (in subs/projects under construction)	-	-	-	-	-	0.0	0.0
Clearing Site	-	-	106	222	328	0.08	0.13
Under Construction	1412	367	-	254	2033	0.51	0.82
Total by Type	**1,412**	**367**	**106**	**2,226**	**4,111**	**1.03**	**1.65**

Source: Tallahassee-Leon County Planning Department Report on Additional Major Projects (over 40 units) Planned in the TLCPD Planning Area.

The numbers in Table 5-9 do not account for system losses and abnormal usage. The system losses have been consistently under the NWFWMD's water use efficiency goal of 10 percent for each of the past 5 years.

A comprehensive map showing the location of major ongoing and proposed projects is attached in Appendix D. This map is included as a visual tool of areas of concentrated growth.

By combining the totals in Table 5-8 and Table 5-9, the TLCPD estimates that the combined number of units coming to the market by 2035 based on existing and proposed projects is 16,119. This translates to an increased annual average day potable water demand of 4.08 MGD and maximum day demand (MDD) of 6.53 MGD through the year 2035.

An estimate of the persons associated with the 16,119 habitable units can be calculated by multiplying the number of units by 2.51 persons per unit for a total of 40,458 persons. Subtracting these persons from the total TAZ projected population growth of

approximately 37,059 people results in approximately 3,400 additional people planned in the planned developments that are not in the current TAZ projections in the USA. The future MDD for these people based on LOS is 0.82 MGD; future average day demand for these persons is 0.51 MGD (based on 150 gpcd). A summary of future demands for the period of 2015-2035 is provided in Table 5-10. It should be noted that the demand projections presented compare reasonably well to the NWFWMD projections provided in Table 4-2.

While the demand projections presented above compare reasonably well to those of the NWFWMD, they differ slightly. The NWFWMD projections are slightly lower than the demand projections included in this report, which are based on more recent population estimates.

Table 5-10
Projected Future Water Demands (2015-2035)

YEAR	Population			Demand (MGD)			
	Total (Inside USA)	Increase	Percentage in Planned Development*	Additional LOS	Cumulative LOS	Additional AAD	Cumulative AAD
2015	247,159	0	--	--	39.55	--	30.53
2020	256,498	9,339	109%	1.49	41.04	0.89	31.42
2025	265,811	9,313	109%	1.49	42.53	0.89	32.31
2030	275,163	9,352	109%	1.50	44.03	0.89	33.20
2035	284,218	9,055	109%	1.45	45.47	0.86	34.06
TOTAL		**37,059**		**5.93**		**3.54**	

Note: The percentage of the population increase in the planned development area is based on the total number of persons (40,458) assumed in planned development as a percentage of the total population growth (37,059). It was assumed that this percentage would hold for each of the five-year planning periods.

5.5.1. Consumptive Use Permit

The NWFWMD is charged with protecting the surrounding water resources. The District issues a CUP as a means to control withdrawal from the Floridian Aquifer. The CUP is provided in Appendix E. The City's current permitted withdrawal quantities are as follows:

- Combined average annual withdrawal of 33,700,000 gpd
- Maximum combined withdrawal of 61,500,000 gallons during a single day
- Combined monthly withdrawal of 1,470,000,000 gallons.

Based on the projections in Table 5-10, the anticipated 2035 AAD of 34.06 MGD is greater than the City's existing permitted annual average withdrawal of 33.7 MGD by 0.36 MGD. However, the projected 2035 MDD of 51.09 MGD is less than the permitted maximum day withdrawal of 61.5 MGD. The City's current CUP expires July 1, 2016. Based on the projections, it may be necessary to modify the CUP annual average day capacities towards the end of the Planning Period. This will be assessed with additional updates to the water demand projections using new population trend data. The City plans to request a 20-year permit renewal when their current CUP expires.

5.5.2. Target Water Service Areas

The Water and Sewer Agreement between the City and Leon County established three "Target Areas" in the USA which are in need of water and/or sewer service: Woodville Community, Centerville Trace Subdivision, and Harbinwood Subdivision.

Woodville receives a portion of its water supply from the City, but discharges no wastewater to the City. Centerville Trace receives all of its water supply from the City, but similarly discharges no wastewater. Finally, Harbinwood neither receives City water, nor discharges wastewater to the City. Per the Comprehensive Plan, the City must plan to provide water to the Target Areas. Because these areas are located within the existing City USA, the Target Areas are already included in the population projections, as well as the demand projections and were included in the modeling efforts as both current and future demands. Although Harbinwood currently receives water from Talquin, it was included in the model as current and future demand to cover the possibility that Talquin may, in the future, desire to abandon its potable water and distribution systems for Harbinwood in favor of connecting to the City's system. The water demand projections presented herein reflect the future addition of these areas to the City's water system.

5.5.3. Anticipated Direction of Planned Development

Over the past 30 years, the northeast (NE) quadrant of the City has seen the most growth. This has begun shifting to the Southeast (SE) since 2000 due to Southwood and the Southside developments - both DRI. The Comprehensive Plan tends to indicate that this trend of growth will continue, however the NE is growing significantly as well. The urban fringe land use category is found predominantly in the SE quadrant of the County. These are areas designated for expansion of the USA and future urban style growth. The NE is constrained to some extent by current land use designations. A copy of the Future Land Use Map is attached in Appendix F.

Particularly informative is the *Population Accommodation and the USA* figure in Appendix D, which reflects that the three (3) major projects that will continue to drive development in the SE quadrant of the USA: the Southwood, Fallschase and English

Property PUD. Together these account for 58.8% of the major planned development growth anticipated to occur in the County. There is also significant growth occurring in the NE quadrant, with three (3) major projects, Bull Run, Canopy PUD, and Welaunee Toe-East, that will account for 32.5% of the major planned development growth.

Another indicator of growth in the NE quadrant of the City can be observed by the roadway projects planned for each approximate quadrant of the City. The TLCPD divides the County into 'Significant Benefit Zones" for purposes of roadway improvement projects. These zones align roughly with the quadrants of the City. A map prepared by TLCPD staff describing these projects and delineating the zones is attached as Appendix G. Table 5-11 is a summary of anticipated cost of the planned roadway projects.

Table 5-11
Anticipated Cost of Roadway Projects by City Quadrant

Significant Benefit Zone	I (Northeast)	II (Southeast)	III (Southwest)	IV (Northwest)
Total Estimated Cost of Roadway Projects	$79.3 million	$69.9 million	$71.6 million	$70.6 million

Source: Tallahassee-Leon County Planning Department, "Significant Benefit Zones" anticipated roadway projects and funding.

The data indicates that the more money will be spent on major roadway improvements in Zone I (the approximate NE zone) of the City than any other. This provides an additional insight as to direction of growth.

8. Future Expansion Alternatives

The performance of the existing system during 2015 maximum day conditions was analyzed using the calibrated model. The performance criteria used for the analysis were based on industry standards for acceptable pressures and velocities (Recommended Standards for Water Works, Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2003; Distribution System Requirements for Fire Protection, AWWA Manual M31, 1998; Distribution Network Analysis for Water Utilities, AWWA Manual M32, 1989; Advanced Water Distribution Modeling and Management, Haested Methods et al, 2003). The criteria are summarized in Table 8-1.

Table 8-1
Summary of System Performance Criteria for Maximum Day Demand

Item	Performance Criteria
Velocity	5 fps* maximum
Normal Operating Pressure	40 psi minimum
Fire Flow Pressure	20 psi minimum

**feet per second*

In general, it is recommended that pipe pressures not exceed 100 psi due the increased risk of pipe failure. However, pressures can sometimes exceed 100 psi in the Tallahassee distribution system especially in the low lying areas. The variability of the terrain, including steep slopes and rolling hills, prevent Tallahassee from maintaining pressures below the 100 psi guideline.

8.1. 2015 Maximum Day Demand Analysis

The MDD Analysis was performed using the calibrated model with base demands set to the average consumption in 2013 multiplied by 1.021 and a global multiplier set to 1.0 (Table 6-4). Pump status (on/off) was controlled by either the tank level or timed operation, depending on a specific pump's current operating protocol. The pressure reducing valve (PRV) from the main system to the southern portion of the system was set at 61.5 psi. An extended period simulation of 24-hours was run for this analysis.

The results of the analysis show that the system has very few areas of concern in regard to excessive pipe velocities on the maximum day (see Appendix L). The 12-inch distribution main running west along Santa Anita, the 4-inch main along Dark Star Trail, and the 12-inch main running along Centerville directly downstream of Well 29 showed

velocities over 5 fps. These velocities only occur when Well 29 is operating; the velocities are not expected to increase with future demands as the flowrate from Well 29 is relatively constant. To decrease the velocities, the mains would need to be increased to larger than 16-inch diameter pipe; a 16-inch pipe results in velocities just slightly above 5 fps. Since the velocities will not increase due to future demands, increasing the pipe diameter is a maintenance consideration and does not impede future growth.

The 12-inch piping near Old Bainbridge Road connected to Well 26, see Appendix K, showed velocities over 5 fps. Increasing the size of these connecting pipes to at least 16-inch diameter results in velocities around 3.7 fps, which is within the 2-5 fps standard, and would decrease the head loss through this segment. This is a potential future project, considering that the well runs at least 6 days a week.

The 16-inch piping near Raymond Diehl Road, connected to Well 16, showed velocities over 5 fps. Increasing the size of this connecting pipe to at least 24-inch diameter results in velocities around 2.3 fps, which is within the 2-5 fps standard, and would decrease system head loss. Operation of Well 16 is controlled based on the levels of Tanks 3, 6, 7 and 8. The required reliability of this well makes this a potential future project.

A few other areas identified in the 2015 maximum day analysis did not meet the performance criteria stated above. A few of the junctions in the south-western portion of the system have pressures that exceed 120 psi. This is due to the large elevation drop on that side of the City. This is an occurrence that is difficult to control, and should be monitored, but also does not impede future growth in the system.

An analysis of the minimum system pressures during a MDD found that the lowest pressure was 41 psi, but the majority of the pressures remained above 50 psi. These pressures are within a normal system operating pressure range.

During the development of the 2010 WMPU, the City expressed concern about pressure in the north portion of the system around Tank 8, and about the lack of "looping" to the southern portion of the system. The system was analyzed for MDD and did not indicate low pressures in the northern portion; nearly all of the minimum pressures were above 50 psi. The MDD scenarios did not show a need for additional pressure or wells in the northern portion of the system.

The City has since determined that the low pressure concerns in the northern portion of the service area are attributed to the higher than normal demand patterns of larger homes/properties during extended periods of dry weather, in combination with the added

pressure loss associated with irrigation system backflow preventers, and are typically limited to areas located at the highest elevations.

Generally, it is good practice to loop as much of the system as possible for water quality and to avoid losing water to customers due to a main break, but the scenarios that were modeled did not indicate a pressure or velocity reason for a redundant, "looping", pipe for the southern portion of the system.

8.2. Future System Analyses

For the future system analysis, new demands in areas where growth is projected were added to the model under a separate demand category. Utilizing this methodology, the MDD for the system is anticipated to be 50.8 MGD in 2035. A breakdown of the modeled demands by year is presented in Table 8-2. The demands associated with specific new developments were applied to nodes representative of those developments, while the remaining increase in demand was applied evenly across the existing demand nodes.

Table 8-2
Projected Future Water Demands (2015-2035)

YEAR	Cumulative Demand (MGD)	
	Average Day Demand	Max Day Demand
2015	25.24	37.85
2020	28.17	42.38
2025	29.88	45.70
2030	31.46	48.88
2035	31.77	50.78

For the 2020 to 2035 scenarios, Options 1 and 2, planned water projects currently included in the City's CIP were added to the model, the results are provided in Appendices M, N, O, and P. No additional transmission mains were required to meet future customer demands. The well flowrates are relatively constant and are not dependent upon future demands; therefore the tank levels were used to determine the need for future improvements.

The controls, based on tank elevations, were updated for each scenario to ensure the tank levels remained between the high and low standard operating levels. The existing infrastructure, along with the current CIP planned improvements, was sufficient to meet the 2015 scenario demands. However, the 2020 scenario required a new tank in the vicinity of Tank 5.

The previous WMPU, completed in 2010, modeled an additional tank near Tank 5. This two-tank configuration would require more complex operational control strategies. In the future model scenarios analyzed in the current 2015 WMPU, Tank 5 Options were analyzed to see which option was feasible moving forward. The Option 1 scenario included replacing the current tank with (1) 1 million gallon tank in a location that the City chose and demolishing the current Tank 5. The Option 2 scenario included keeping the current Tank 5 and adding an additional tank in the location the City chose. For both options there would need to be control changes required for the tank and Wells 23 and 26. The option to replace the current tank with a new tank at the same location of Tank 5 was not possible due to the operational issues of flooding in the area when the Tank is taken down for maintenance. The tank is in a residential area and shares a driveway with a homeowner that has flooding issues into their yard when the tank is taken down.

For the purposes of the Water Master Plan Update, a decision whether to construct (1) 1 million gallon tank or utilize the existing tank and add a new 500,000 gallon tank will be made after property is acquired and before design is started by the City.

Currently Well 26 operates for the majority of the time with supplemental operation from Well 23. For both tank Options, because the new tank is a more central location to Well 23 and 26 and the increased flow needed for twice the capacity (1 million gallons total), both Wells would be required. Currently the Wells operate dependent of each other, the modeled scenarios displayed that, if the Wells operated independent of each other and by tank level for the current Tank 5 and new tank, the Wells would have adequate capacity for the increased tank size.

If the City desires to maintain current operations of Well 23 and Well 26, they can replace approximately 3.5 miles of 6-, 8-, and 10-inch pipe through the downtown area with 12-inch pipe to allow flow from the east to the west. A map showing the piping improvement option is presented in Appendix K.

Tank 5 is supplied by Wells 23 and 26. Both wells are known to have elevated iron and manganese concentrations. The City installed greensand filters and rehabilitated Well 26 in 2007 and is in the process of developing a strategy to control iron and manganese at Well 23. Well 23 has been off-line since approximately September of 2013. This well typically rotates operation with Well 26 to supply Tank 5.

A new 2,500 gpm well in the vicinity of Tank 7 was also found to be required for the planning periods after 2020. This proposed well, also referred to as the Welaunee Well, is

also already accounted for in the CIP, and the exact location of the well will be dependent upon land available for the City to purchase or obtain an easement. See Figure 8-1 for potential location of the new well. The location of the proposed well is within the portion of the City's wellfield with high water quality and additional treatment requirements are not expected. The model should be updated with potential locations for confirmation of system performance. In addition to the 2025 improvements, the 2030 and 2035 scenarios only required adjusting the well controls to meet future demands.

In the 2035 scenario, the pipe velocities are below 5 fps with the exception of the pipes from Well 29. The lowest pressure is 40 psi while the majority of system pressures are still above 50 psi. The number of junctions with pressure above 120 psi has increased, as shown in Appendix P, due to the significant elevation changes in portions of the City's distribution system, and should be monitored in the future.

The results for the current and future scenarios (Options 1 and 2) are located in Appendix L through P.

N

Well 32
Tank 8
Well 25
Bull Run
Tank 6
Well 29
Well 18
Well 16
Proposed Tank
Tank 5
Well 19
Tank 3
Well 11
Welaunne Toe and Heel
Canopy PUD
Park Place
Well 20
Well 22
Well 21
New Well
Tank 7
Well 26
Well 23
University Green Condos
Well 8
Fallschase
Tank 2
Well 2
Well 4
Well 13
Well 6
Well 7
Well 5
Well 9
Tank 4
Well 15
Well 1
Well 3
Well 17
Well 35
Well 12
Southwood
Well 17
English Property PUD
Well 28
Tank 1
Well 33

Legend
- Planned Developments
- Active Wells
- Abandoned Wells
- Proposed Wells
- Roadway
- Pipe

0 0.05 0.1 0.2 0.3 0.4 Miles

CITY OF TALLAHASSEE

ARCADIS	CITY OF TALLAHASSEE TALLAHASSEE, FLORIDA WATER MASTER PLAN UPDATE	FIGURE 8-1 PROPOSED NEW WELL LOCATIONS	ARCADIS AUGUST 2015

8.3. System Improvements Related to Specific Developments

The known planned developments, also shown in Figure 8-1, include eight large developments; English Property PUD, Bull Run, Southwood, Fallschase, University Green Condominiums, Welaunee Toe and Heel, Canopy PUD, and Park Place.

The future demands for English Property PUD and Southwood will be supplemented by the use of the constructed, but not yet utilized, Well 32. No additional wells or tanks are required to meet the future demands of these developments.

The addition of the new tank near Tank 5 will be required before 2020, when the combined total population of Park Place and University Green Condominiums reaches 875.

The addition of the new Welaunee Well located in the vicinity of Tank 7 (in the Welaunee and Toe development area) is anticipated to be required before 2025 to provide adequate flow to Tanks 7 and 8, when the total population of Fallschase, Bull Run, Canopy PUD and Welaunee Toe and Heel reaches 12,481.

8.4. Target Areas

The Water and Sewer Agreement between the City and Leon County established three target areas which are in need of water and/or sewer service: Woodville Community, Centerville Trace Subdivision, and Harbinwood Subdivision.

The existing and projected populations for these target areas are included in the USA population estimates in Section 5. Therefore the water demand projections reflect the addition of these areas to the City's water system. The populations of the Harbinwood, Centerville Trace, and Woodville target areas were included in the modeling effort as both current and future demands. Although Harbinwood currently receives water from Talquin, it was included in the model as current and future demand to cover the possibility that Talquin may, in the future, desire to abandon its potable water and distribution systems in favor of connecting to the City's system. These areas are already within the existing City water service area which is indicated in Appendix Q.

8.5. Areas of Concern

In addition to the target areas discussed previously, the City has four areas of concern;

1. Well 35 / Southwood DRI – The Southwood development, located in the southeast quadrant of the system, is in the middle of construction. The size/water demand of the development required a new production well in the vicinity. That well, Well 35, has already been designed and constructed. This well is required for future growth and shall be utilized when the population warrants the need for it.

2. Northwest Tallahassee reported pressure problems – The City has received complaints from residents in the Northwest portion of the system regarding low pressures at the residences. The City hired Chastain Skillman before the last WMPU in 2010 to study the area and provide a report with recommendations. The study found that the normal hydrant pressures at the test locations were between 47 and 102 psi, which is consistent with the master plan model results. They determined that the low pressures were due to pressure drop in the service lateral between the street and the houses. The results of the Master Plan are consistent with Chastain Skillman's report and do not alter any of their recommendations.

3. Woodville – The concern regarding the Woodville area is both low fire flow pressures and reliability due to one pipe connecting to the rest of the system. Increased looping can aid in fire flow scenarios by connecting a new pipe to the existing system at Oak Ridge Rd. and continuing the pipe north towards the intersection of Wakulla Springs Rd and Crawfordville Rd and connecting to the system again. This looping option would consist of approximately 18,000 ft (3.5 miles) of 10 to 12-inch pipe, and would require an additional PRV on the pipe to reduce the pressures to the southern portion of the system. While this option will help with fire flows, the City should also consider Inter-City agreements with St. Marks to provide water in case of a large fire in the area.

4. Welaunee Development – There are three Welaunee Developments: Toe, Heel and North. The Toe and Heel are included in the future demands and require a new well to sustain their populations. Welaunee North is not projected to be built within the next 20 years and was not included; however, the addition of the Welaunee North development might require an additional well.

5. Downtown – The infrastructure in the downtown area is some of the oldest in the City's system, much of it is 40+ years old. Many of the valves in this area do not operate correctly. This area of concern is discussed in more depth in Section 9.

The Highway 90 West concern presented in the 2010 Water Master Plan Update has since been removed as an area of concern. The level of service in fire flow protection for those areas currently accessible to City water is acceptable for the current land use and is minimally improved with the proposed water system improvements identified by the previous capital improvement project. Of the 1.5 miles of proposed water system improvements, 1.2 miles lie within and/or adjacent to an existing Talquin Electric Coop (TEC) water service area. Of the 1.2 miles, 0.8 miles are along S.R. 20 and are currently served by the TEC water system with fire protection. The properties adjacent to the remaining 0.3 miles along Barineai Road south of Jordan Pass Drive are mostly undeveloped large parcels. As such, the opportunity for additional demand on this proposed water main extension is minimal, which will lead to future water quality

problems and maintenance cost above and beyond those which are normally expected with the routine operation of a water system.

Well 32 – The City's operations staff expressed concern during the 2010 WMPU regarding the redundancy of supply in the northern portion of the system in the vicinity of Well 25. Various scenarios were modeled and as a result a new Well (Well 32) was since designed and construction is in progress in the northern portion of the system.

Chason Woods – In the 2010 WMPU, the Chason Woods development was thought to potentially add 350-540 units to the Woodville area. This property has since been purchased by the State and will no longer be developed. As a result, there will be no additional demand in this area of the water distribution and it has been removed from the future modeling scenarios.

8.6. Fire Flow Analysis

In the United States, community fire protection infrastructure (water distribution network) is audited and rated by the Insurance Service Office (ISO) using the *Fire Protection Rating System* (ISO, 2008). Although the actual water needed to fight a fire depends on the structure and the fire itself, ISO has developed a method to determine a *Needed Fire Flow* that must be maintained in a system without allowing system pressure to drop below 20 psi in any part of the system. According to ISO, the minimum needed fire flow for any structure is not less than 500 gpm and the maximum for any building requiring public fire suppression is no more than 3,500 gpm. Although some large industrial users may need up to 12,000 gpm for fire protection, anything beyond 3,500 gpm requires individual property fire suppression. For fires requiring 2,500 gpm or less, ISO maintains that system must be designed for 2-hour fire duration. For fires requiring 3,000 - 3,500 gpm or more, 3-hour fire duration is recommended.

As part of the 2015 WMPU, an analysis was performed on the available flow from every node in the model while maintaining a minimum pressure of 20 psi using the fire flow module in Infowater. This was performed using a 3-hour fire duration. Results for every planning horizon from 2015 through 2035, Options 1 and 2, are presented in Appendix R. Like the 2010 analysis, the majority of the potential problem areas where 500 gpm could not be achieved appeared on model nodes located along pipes with diameters of less than 4-inches that were intended to provide fire protection. As a result of this, and because pipes with a diameter 4-inch and smaller do not provide fire flow to the system, the nodes that represented flow on pipes 4-inch and smaller were removed from the fire flow analysis and the Fire flow figures in Appendix R. To maintain acceptable limits on pipe velocities (slightly higher than 5 fps is acceptable under a short duration fire event), the minimum pipe diameters needed for various fire flow rates were presented and are in

Table 8-3. The City has implemented a programmed approach to replace all system piping smaller than 6-inches in diameter having a service connection.

Table 8-3
Minimum Pipe Diameters Required to Provide Fire Flow

Fire Flow Rate	Minimum Diameter Required	Resultant Velocity
500 gpm	6 inches	5.67 fps
1000 gpm	8 inches	6.4 fps
1,500 gpm	10 inches	6.12 fps
2,500 gpm	14 inches	5.2 fps
3,500 gpm	16 inches	5.58 fps

Areas of concern include the southern portion of the distribution system which appears to have limited fire protection capabilities because service to this area comes primarily through a PRV from a higher elevation. It is recommended that this PRV is not relied upon for fire protection. For this area, the City could consider adjusting the controls at Well 33 to turn a pump on when minor pressure drops (5-10 psi) are experienced. Considering the capacity of this pump, fire protection of up to 500 gpm can be provided by this well. Looping of pipes in this area would improve the fire flow in this area and is the primary recommendation for addressing the fire protection needs in the Woodville community. Additional alternatives to aid this area of the system also include 1) an additional well and pump station constructed to supply the very southern end of the system in an emergency situation; 2) construction of an additional elevated storage tank to augment emergency system pressures and fire flow; 3) installation of individual PRVs at affected home residences. For both Options 1 and 2, there are similar Fire Flow results, with the only major concern in the south Woodville area.

10. Conclusions, Recommendations and Capital Improvement Plan

10.1. Conclusions

The majority of the improvements identified in this WMPU are driven by water demand, fire flow, renewal and replacement of infrastructure, and future growth; as such, the timing of many of these improvements is ultimately driven by when specific projects are actually required. The CIP presented is intended to serve as a budgeting tool. The City will need to monitor growth and other project-specific factors to adjust the CIP schedule as appropriate. For example, growth in one development may occur more quickly than projected, and as such, certain improvements may need to happen sooner than indicated. On the other hand, growth may not occur as quickly as projected, meaning certain projects can be delayed.

10.2. Recommendations

As discussed in Section 5, for consistency with other planning efforts and because TAZ projections have historically been the most representative growth in the Tallahassee area, the population and water demand estimates in this WMPU are based upon TAZ projections. A summary of projected future population and water demands for the period of 2015-2035 is provided in Table 10-1.

Table 10-1
Population and Water Demand Projection (2015-2035)

YEAR	Population			Demand (MGD)			
	Total (Inside USA)	Increase	Percentage in Planned Development*	Additional LOS	Cumulative LOS	Additional AAD	Cumulative AAD
2015	247,159	0	--	--	39.55	--	30.53
2020	256,498	9,339	109%	1.49	41.04	0.89	31.42
2025	265,811	9,313	109%	1.49	42.53	0.89	32.31
2030	275,163	9,352	109%	1.50	44.03	0.89	33.20
2035	284,218	9,055	109%	1.45	45.47	0.86	34.06
TOTAL		**37,059**		**5.93**		**3.54**	

**The percentage of the population increase in the planned development area is based on the total number of persons (40,458) assumed in planned development as a percentage of the total population growth (37,059). It was assumed that this percentage would hold for each of the five-year planning periods.*

The City's hydraulic model was calibrated and utilized to assess future system MDD scenarios over the planning period. This effort provided many insights into the future operation of the City's distribution system, including spatial information on system demands, velocities, and pressures. This tool was important in the identification of several recommended capital projects to be implemented over the coming years. The model will also serve to enable the City to effectively evaluate distribution system operation and improvements in a real-time manner, as required in the future.

10.2.1. Future Capacity Growth Improvements

Projected future demand will result in the need for some improvements to the water system to ensure that future demands of the City's service area are able to be supplied. Based on a detailed review of the system and projected water demands from 2015-2035, the following are recommended:

- Prior to 2025, design and install a new 2,500 gallon per minute water supply well in the eastern portion of the City's service area (to be called Welaunee Supply Well, and located in the vicinity of Tank 7).
- Continued monitoring of existing supply well production capabilities and on-going well rehabilitation. This will not be a capital improvements option, the funds for this will come out of the yearly operating budget.

10.2.2. Target Areas/Operational Improvements/Fire Flow Improvements

Improvements associated with increased system operational efficiencies, ongoing infrastructure maintenance activities, and service area pressure and velocity upgrades are recommended. The Areas of Concern and results of the future MDD modeling and fire flow analysis produced a need for additional relatively minor improvements to the water system. The following improvements are recommended:

- Continue the Downtown Water Infrastructure Replacement Plan improvements.
- Beginning FY 2016, design and construct either a new 1 million gallon storage tank and demolish Tank 5, or construct a new 500,000 gallon tank and retain Tank 5, in the northwest quadrant of the system (in the vicinity of Tank 5). This proposed improvement was originally projected to be needed in FY2024 in the 2010 WMPU based on future growth projections. Recent operational changes and fire flow testing under the current operational strategy have revealed that additional storage capacity is needed for fire protection as soon as practical. As such, the funding to construct the new tank should be released in FY2016, not FY2024.
- In FY 2016, rehabilitate and construct a treatment system at Well 23.
- Replace 350 LF of 12-inch piping near Old Bainbridge Road with 16-inch piping (connected to Well 26).
- Replace 250 LF of 16-inch piping near Raymond Diehl Road with 24-inch pipe (connected to Well 16).
- Continue the Minor Line Extensions and Upgrades Project, which is a system-wide project that targets undersized mains, mains with recurring maintenance problems, and main extensions into unserved areas (including the 6 and 12-inch piping along Santa Anita and Buck Lake Road that is connected to Well 29, for example).
- East-West 12-inch Water Main Replacement, which includes replacing 3.5 miles of existing 6-, 8-, and 10-inch piping running east to west along Mahan and Call, on either side of downtown with 12-inch mains to allow for flow from the east to the west downtown. This is not a required capital improvement, but shall be implemented depending on available funds.

10.3. Capital Improvement Plan

10.3.1. Cost Estimates

Opinions of probable construction cost were developed for the distribution system capital projects. Capital project costs include equipment, labor, materials, installation, contingencies, and incidentals.

The compiled capital project costs are consistent with an Association for the Advancement of Cost Engineering Class 4 estimate, where the project definition is between 1% and 15% and engineering design is 1% to 5% complete. The typical purpose of this level of estimate is for conceptual studies or feasibility evaluations. These estimates are primarily stochastic in nature (i.e., they are based on inferred or statistical relationships between similar projects and/or equipment quotes with additional factors applied). Class 4 estimates are generally prepared based on limited information and thus they have a wide accuracy range, typically -15 to +30%. These estimates can successfully be used by owners for budget estimating purposes. Costs are presented in Table 10-2, and items are presented in 2015 dollars.

10.3.2. 20-Year CIP Schedule

Table 10-2 presents a recommended 20-year CIP. The plan contains needed capacity and operational improvements during the planning period based on analyses summarized in this report. Figure 10-1 shows the annual and cumulative capital expenditures over the 20-year planning period from 2015 through 2035.

The detailed CIP presented in Table 10-2 envisions an investment of $11 million for Downtown Infrastructure replacement. Expansions into other unserved areas, (including the Woodville northern loop) have been included in the CIP, however these expansions would be funded based on financial feasibility, and development trends and needs. It also should be noted that this assumes developers will be responsible for the cost and construction of infrastructure within specific developments.

Table 10-2
Detailed Capital Improvements Schedule

Project ID	Project Description	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	20-Year Total
Capacity Improvements																						
1	Design and Install New Welaunee Well Near Tank #7								$ 1,200,000	$ 1,700,000												$ 2,900,000
2	Pipeline addition for VA Hospital			$ 510,000																		
	Total Capacity Improvements	$ -	$ -	$ 510,000	$ -	$ -	$ -	$ -	$ 1,200,000	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,410,000
Operational Improvements																						
3	Downtown Infrastructure Replacement	$ 1,070,000	$ 1,135,000	$ 1,600,000	$ 1,600,000	$ 1,700,000	$ 1,200,000	$ 1,200,000	$ 1,500,000													$ 11,005,000
4	Design and Construct New 1 MG Tank (NW to replace Tank #5)	$ 750,000	$ 1,750,000																			$ 2,500,000
5	Well #23 Rehabilitation and Upgrade	$ 1,000,000	$ 1,100,000																			$ 2,100,000
6	Old Bainbridge Rd Line Size Upgrades (connected to Well 26)						$ 220,000															$ 220,000
7	Raymond Diehl Road Line Size Upgrades (connected to Well 16)							$ 250,000														$ 250,000
8	Minor Line Extensions and Upgrades	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 15,000,000
9	East-West 12-Inch Water Main Replacement											$ 1,200,000	$ 1,200,000	$ 1,200,000	$ 1,200,000	$ 1,200,000						$ 6,000,000
	Total Operational Improvements	$ 3,570,000	$ 4,735,000	$ 2,350,000	$ 2,350,000	$ 2,450,000	$ 2,170,000	$ 2,200,000	$ 2,250,000	$ 750,000	$ 750,000	$ 1,950,000	$ 1,950,000	$ 1,950,000	$ 1,950,000	$ 1,950,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 37,080,000
Areas of Concern/ Fire Flow Improvements (Discretionary Funding)																						
10	Misc. Fire Flow Improvements	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 2,400,000
11	Areas in conjunction with Welaunee Development			$ 120,000	$ 120,000	$ 120,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 210,000	$ 230,000	$ 230,000	$ 230,000						$ 2,520,000
12	Woodville Fire Flow Improvements (Northern Loop)										$ 1,966,403											$ 1,966,403
	Total Concern/Fire Flow Improvements	$ 120,000	$ 120,000	$ 240,000	$ 240,000	$ 240,000	$ 330,000	$ 330,000	$ 330,000	$ 330,000	$ 2,296,403	$ 330,000	$ 330,000	$ 350,000	$ 350,000	$ 350,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 6,886,403
	Total Improvements	$ 3,690,000	$ 4,855,000	$ 3,100,000	$ 2,590,000	$ 2,690,000	$ 2,500,000	$ 2,530,000	$ 3,780,000	$ 2,790,000	$ 3,046,403	$ 2,280,000	$ 2,280,000	$ 2,300,000	$ 2,300,000	$ 2,300,000	$ 870,000	$ 870,000	$ 870,000	$ 870,000	$ 870,000	$ 47,376,403

Figure 10-1: Annual and Cumulative CIP Capital Expenditures