Water System Plan

TECHNICAL MEMORANDUM 3

UGA Extension Analysis

FINAL / August 2025

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Abbreviations

ADD	average day demand
CIP	capital improvement program
City	City of Bellingham
DOH	Department of Health
ERU	equivalent residential unit
FSS	fire-suppression storage
gal	gallons
gpd	gallons per day
gpm	gallons per minute
MG	million gallons
MDD	maximum day demand
mgd	million gallons per day
PHD	peak hour demand
Plan	Water System Master Plan
PS	pump station
psi	pounds per square inch
SS	standby storage
UGA	urban growth area

TM 3 UGA EXTENSION ANALYSIS

3.1 Introduction

The City of Bellingham (City) is updating their Water System Master Plan (Plan) to evaluate the status of the City's distribution system and to plan for renewal and replacement, as well as future capacity infrastructure needs.

As part of this Plan, the City performed additional analysis to determine the effect of extending the City's system into Urban Growth Areas (UGA) on those expanded areas and the overall distribution system. Two areas of UGA extension were evaluated as a part of this effort, and they are captured in this technical memorandum; the North UGA and the South UGA. Figure 3.1 outlines where these UGA extensions are located in the distribution system. These extensions span existing pressure zones and areas currently not served by the City. Once UGA expansion occurs the served portions may densify. The North UGA Reserve spans roughly 125 to 200 feet and can be served directly off the existing Cordata Pressure Zone. Figure 3.2 outlines the North UGA Reserve extents and elevations in the vicinity. The South UGA Reserve spans roughly 450 to 840 feet and can be served directly off the existing Governor Rd, Padden Yew, Samish Highlands, and Reveille Pressure Zones. Figure 3.3 outlines the South UGA Reserve extents and elevations in the vicinity.

The hydraulic profile of the City's distribution system is presented in Figure 3.4. This figure outlines the UGA extensions and what facilities are adjacent to these locations.

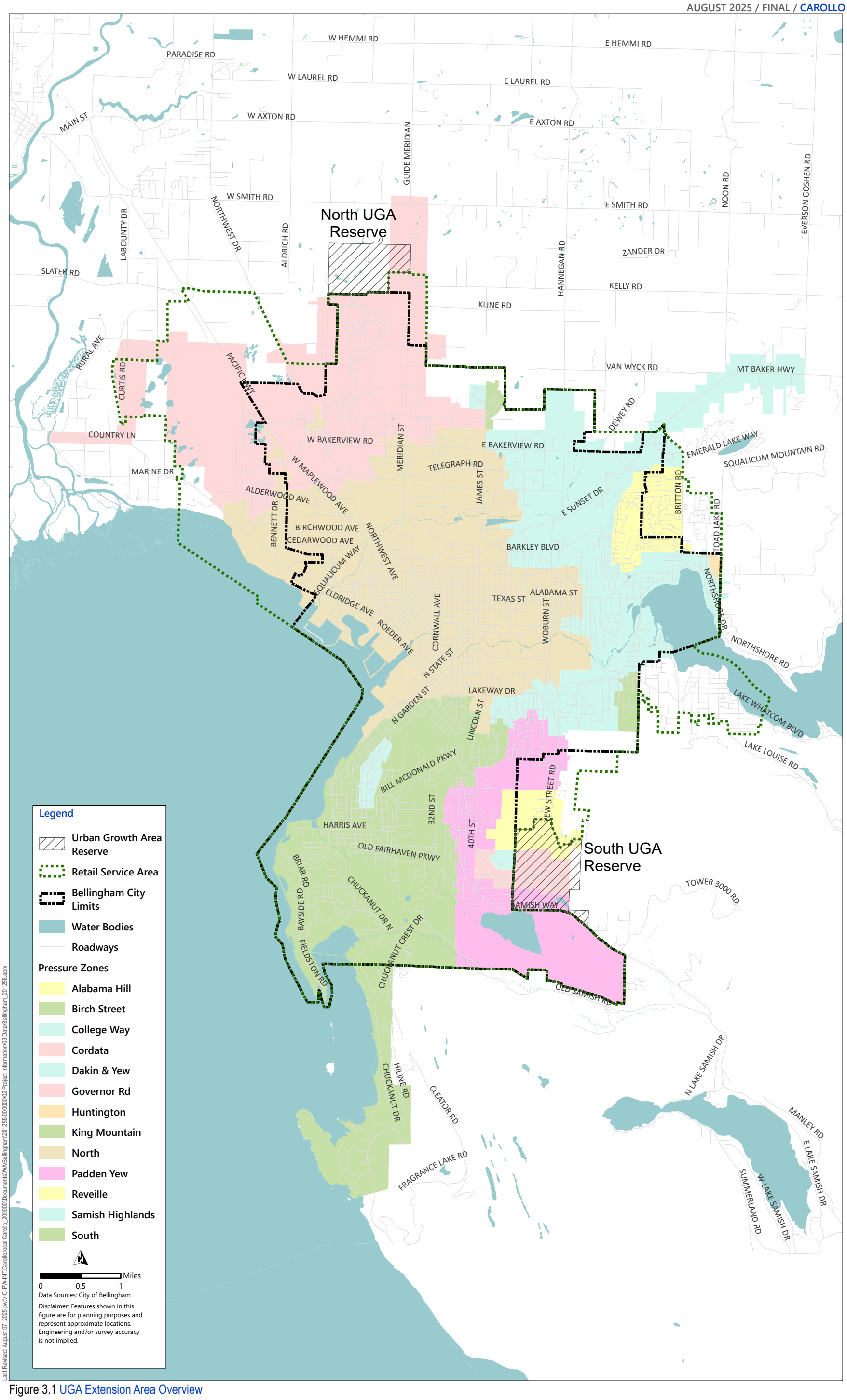

Figure 3.1 UGA Extension Area Overview

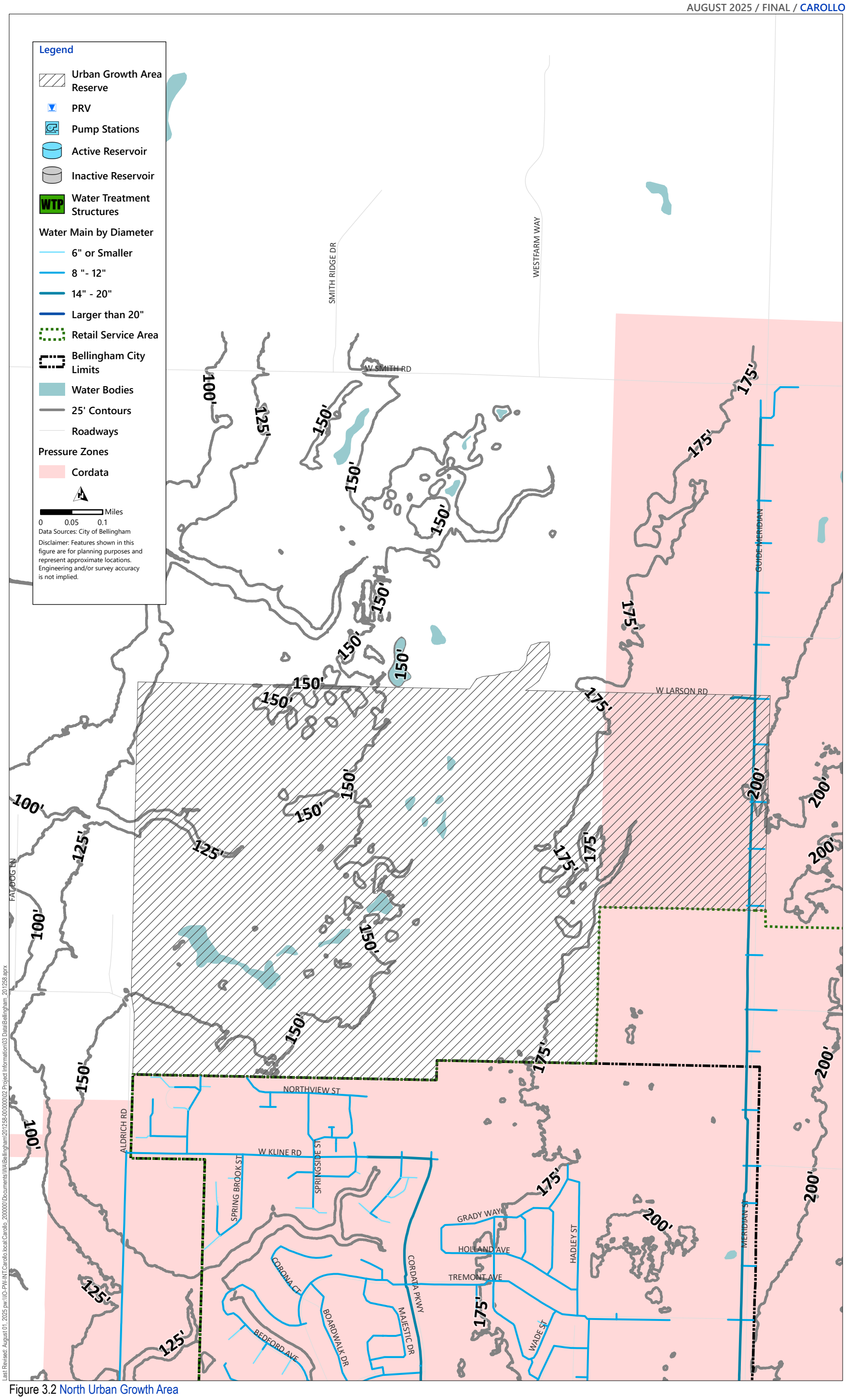

Figure 3.2 North Urban Growth Area

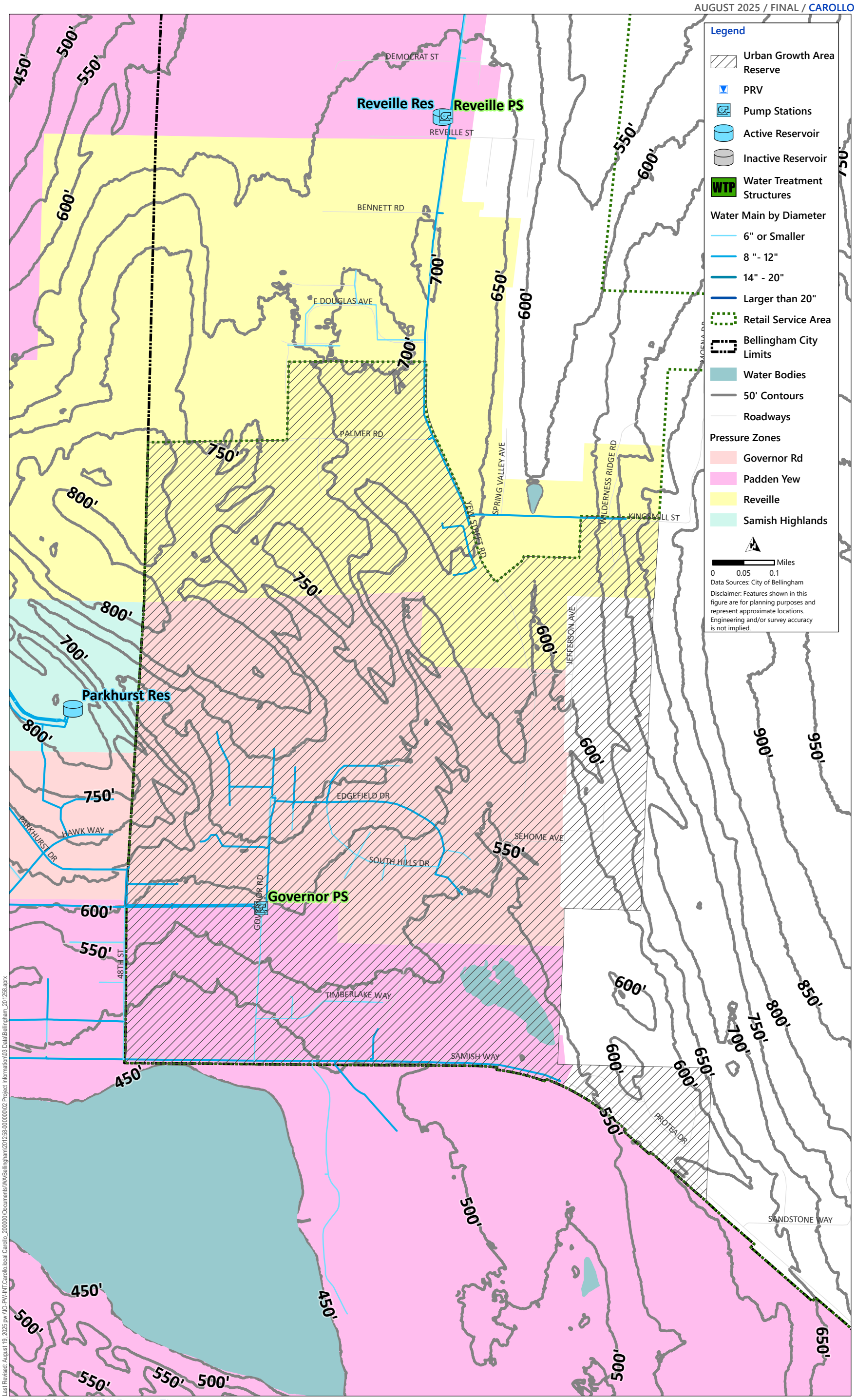

Figure 3.3 South UGA Reserve Elevations

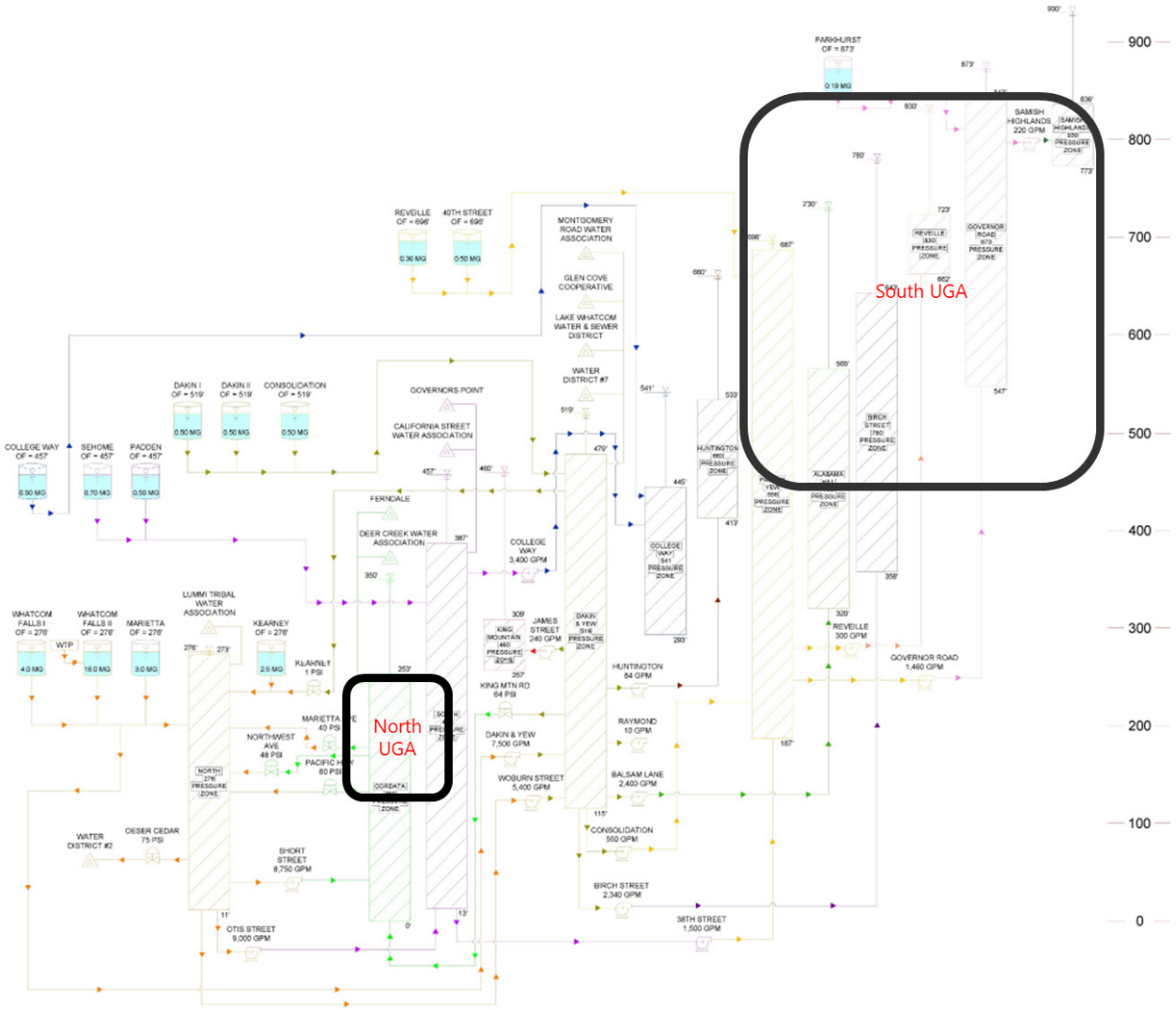

Figure 3.4 Updated Hydraulic Profile

3.2 Urban Growth Area Extension Demand Projections

Carollo developed average day demand (ADD) and maximum day demand (MDD) projections for the North and South UGA reserve area using the historical water demand trends from the Plan and the future growth assumptions for these areas provided by the City. Further details on the City's historical water trends can be found in Chapter 4 - Water Demand Forecast.

The resulting demand projections were used for the expanded system analysis, which identifies deficiencies in future pumping, storage, and distribution system analyses, as well as to size potential improvements to achieve the City's performance criteria.

For this analysis, water demand projections were developed utilizing the methodology outlined in Chapter 4, Section 3.5 of the Plan. While the Plan demand projections were presented for three demand

scenarios (Low, Medium, High), only the Medium scenario was projected for the UGA reserve areas. The demand projections methodology is shown in Figure 3.5 and is as follows:

1. Increase the existing number of water connections by the development plan and land capacity estimates provided by the City (Tables 3.2 and 3.4). It was assumed that each existing housing unit was equivalent to one water connection.
2. Convert connection projections to equivalent residential unit (ERU) projections using the historical ERUs per connection from the Plan (as shown in Table 3.1).
3. Convert the ERU projections to ADD projections using the medium scenario ERU value of 154 gallons (gal)/ERU from the Plan.
4. Apply the Plan's Medium demand scenario MDD to ADD peaking factor of 1.50 to convert ADD to MDD.

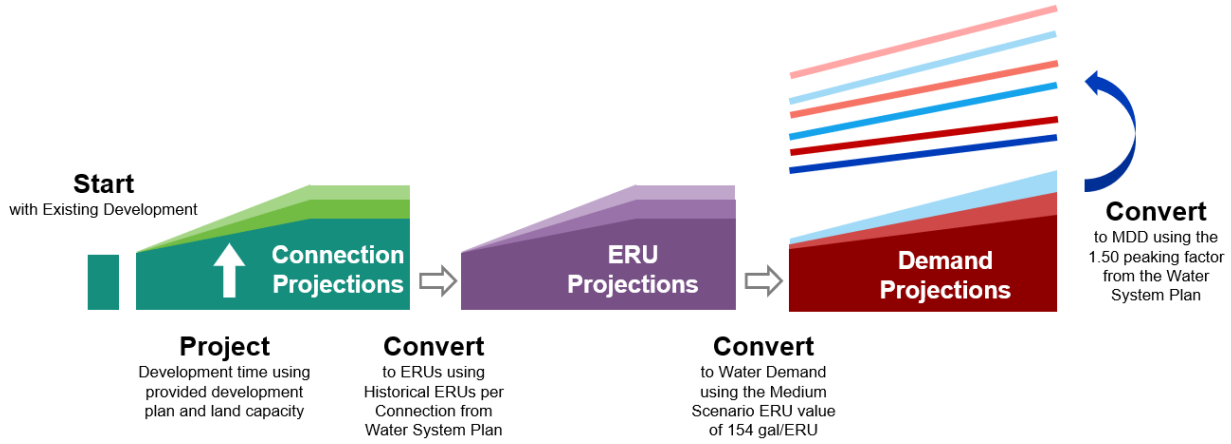

Figure 3.5 Demand Projection Methodology

The UGA North and South include only residential and commercial land uses. Table 3.1 summarizes the customer class ERUs per connection from the Plan. These values are from the City's historical water trends presented in the Plan Chapter 4 and based on the Single Family Residential historical average of 154 gallons per day (gpd)/ERU. For this analysis, only the residential ERUs per connection values were used for converting connection projections to ERU projections. The Table 3.1 values for commercial were a broad citywide average, but not necessarily representative of the planned commercial development in the North UGA. A more specific methodology was used for projecting those commercial demands as described in Section 3.2.1.

Table 3.1 Customer Class ERUs per Connection

Customer Category	ERUs per Connection
Single-Family Residential	1.0
Multi-Family Residential	8.3
Institutional	8.2
Commercial	4.1
Industrial	63.4
Public	7.5
Irrigation	5.6

Notes:
(1) Source: Water System Plan Chapter 4.

Demand projections were developed for four planning horizons:

- 10-Year: 2034.
- 20-Year: 2044.
- 50-Year: 2074.
- 100-Year: 2124.

3.2.1 North Urban Growth Area Reserve Demand Projections

The North UGA Reserve area is 361 acres and has 30 existing residents served by the City. The development plan for this area is as follows:

- 1,200 to 1,600 housing units:
  - 10 percent single detached.
  - 60 percent middle housing.
  - 30 percent multi-unit.
- 300,000 to 500,000 square feet of commercial uses including a mix of retail, services, offices, and a grocery store

Based on the development plan, it was assumed that the buildout of the North UGA Reserve will be 160 single family units (10 percent of 1,600 housing units), 1,440 multi-family units (90 percent of 1,600 housing units), and 500,000 square feet of commercial uses. To project demand for each planning horizon, an estimate of percentage of land capacity developed was provided by the City's Planners for each year, summarized in Table 3.2.

Table 3.2 Estimated Land Development Timeline

Planning Horizon	Percent of Land Capacity Developed
10-Year (2034)	20%
20-Year (2044)	40%
50-Year (2074)	75%
100-Year (2124)	100%

To project residential demand, the methodology described in Section 3.2 was utilized. For commercial demand, Ecology's Criteria for Wastewater Design, known as the Orange Book was used. Table G2-2 in the Orange Book estimates the flow for various discharge facilities. The shopping centers assumption of 300 gpd per 1,000 square feet of floor space was used to convert the planned 500,000 square feet of commercial uses in the North UGA Reserve to an amount of flow, which equates to 0.15 million gallons per day (mgd). It is industry standard to assume that wastewater flows are approximately 80 percent of water flows, so 0.15 mgd was scaled up to 0.18 mgd to account for this difference.

Table 3.3 summarizes the North Area Reserve ADD and MDD projections. Figure 3.6 shows the projections for the full 100-year span.

Table 3.3 North UGA Reserve Area Population Projections

	2024	2034	2044	2074	2124
ADD (mgd)	0.005	0.09	0.18	0.32	0.52
MDD (mgd)	0.01	0.13	0.26	0.49	0.77

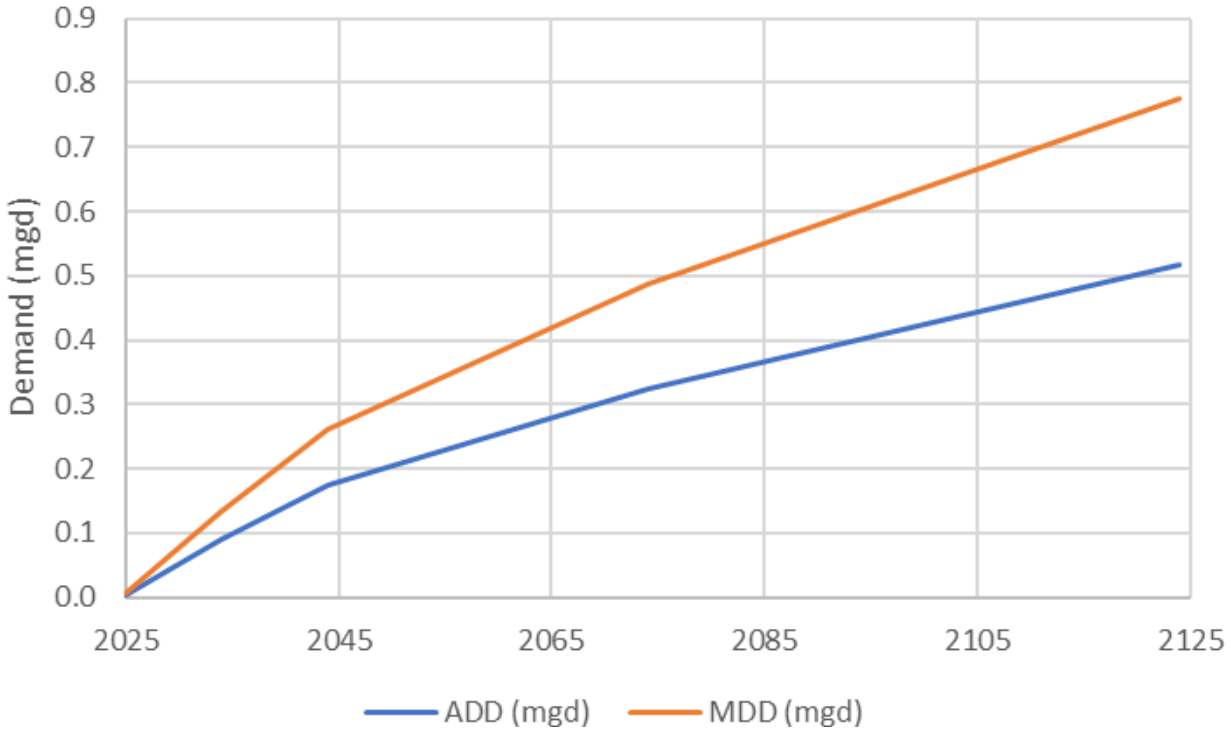

Figure 3.6 North UGA Extension Demand Projection

3.2.2 South Urban Growth Area Reserve Demand Projections

The South UGA Reserve area has 134 single family homes, 187 mobile home units, and 1 school currently served by the City. The development plan for this area is as follows:

- 200 to 300 housing units:
  - 30 percent single detached.
  - 50 percent middle housing.
  - 20 percent multi-unit.

Based on the development plan, it was assumed that the buildout development of the North UGA Reserve will be 300 single family units (100 percent of 300 housing units). To project demand for each planning horizon, an estimate of percentage of land capacity developed was provided by the City's Planners for each year, which is summarized in Table 3.4.

Table 3.4 Estimated Land Development Timeline

Planning Horizon	Percent of Land Capacity Developed
10-Year (2034)	20%
20-Year (2044)	50%
50-Year (2074)	75%
100-Year (2124)	100%

To project residential demand, the methodology described in Section 3.2 was utilized. There is no commercial demand planned for the South UGA Reserve Area. Table 3.5 summarizes the South Area Reserve ADD and MDD projections. Figure 3.7 shows the projections for the 100-year horizon.

Table 3.5 South UGA Reserve Area Population Projections

	2024	2034	2044	2074	2124
ADD (mgd)	0.05	0.06	0.07	0.09	0.11
MDD (mgd)	0.08	0.09	0.11	0.13	0.16

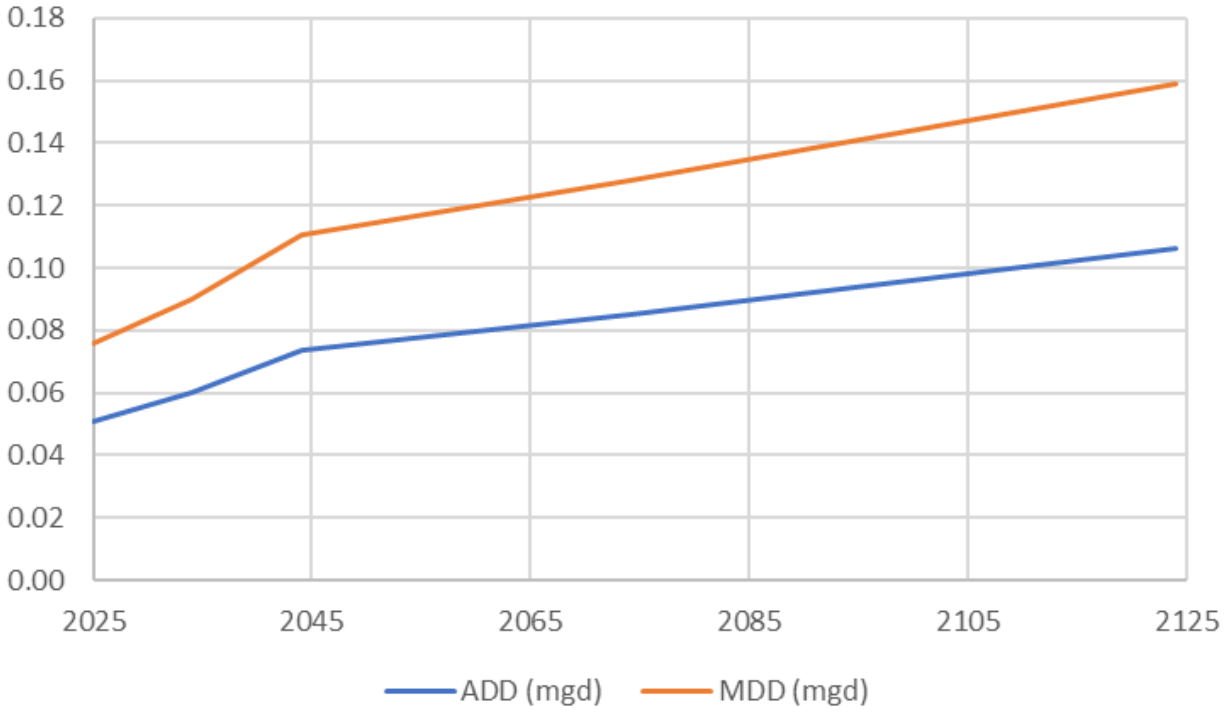

Figure 3.7 South UGA Extension Demand Projection

3.2.3 Revised Demand Projection Summary

Table 3.6 summarizes the revised demands for the total service area, including the North and South Reserve areas.

Table 3.6 Revised Demand Projections Summary

Service Area	2024	2034	2044	2074	2124
UGA Reserve North ADD (mgd)	0.0	0.1	0.2	0.3	0.5
UGA Reserve North MDD (mgd)	0.0	0.1	0.3	0.5	0.8
UGA Reserve South ADD (mgd)	0.1	0.1	0.1	0.1	0.1
UGA Reserve South MDD (mgd)	0.1	0.1	0.1	0.1	0.2
Total Service Area ADD (mgd)	**9.5**	**10.9**	**12.5**	**23.1**	**33.2**
Total Service Area MDD (mgd)	**14.2**	**16.4**	**18.8**	**34.7**	**49.8**

3.3 Expanded System Analysis

The demand projections outlined in Section 3.2 were incorporated with the System Analysis presented in Chapter 7.

3.3.1 Expanded Pumping Analysis

The UGA extension effects Short Street, Otis, 38th Street, Governor Road, Reveille, and Samish Highlands pump stations (PS). To evaluate PS capacities, the City's water distribution system was divided into 12 different pumping areas containing 15 total PS. Open zones are ones with adequate equalizing storage, so the PS are only required to supply the MDD of the pumping area. Closed zones are areas that are supplied solely through a PS; therefore, the PS is required to supply the peak hour demand (PHD) and fire flow.

The following Sections update the pumping area analysis with the UGA Extension demand projections.

3.3.1.1 Cordata Pumping Area

The Cordata pumping area is a closed zone that has one PS, Short Street, containing seven pumps. Two of the pumps have a capacity of 2500 gallons per minute (gpm) each while the other five have capacities of 750 gpm each. This pumping area serves the Cordata pressure zone. Table 3.7 shows the projected demands for the 2024, 2034, and 2044 scenarios compared to the total reliable pumping firm capacity, with the largest pump offline. The Short Street PS has inadequate capacity for the 2044 scenario. No recommendations are planned for the Short Street PS because the City plans to retire it and only use it for backup fire flow pumping during the 20 year planning horizon when the proposed King Mountain improvements are completed.

Table 3.7 Cordata Pumping Area Evaluation

Cordata 350	2024	2034	2044
Total PHD + Fire Flow (gpm)	5,341	5,893	6,413
Total Reliable Capacity (gpm)	8,750	8,750	8,750
Total Reliable Firm Capacity (gpm)	6,250	6,250	6,250
Surplus/Deficit (gpm)	909	357	-163

3.3.1.2 South Pumping Area

The South pumping area is an open zone that includes one PS, Otis Street, which houses four pumps. Two pumps each have a capacity of 3,500 gpm and the other two have capacities of 1,000 gpm each. This pumping area serves the South pressure zone and will eventually serve the Cordata Pressure Zone when Short Street is retired. Table 3.8 shows the projected demands for the 2024, 2034, and 2044 scenarios compared to the total reliable pumping firm capacity, with the largest pump offline. The Otis Street PS has adequate capacity for all planning year scenarios.

Table 3.8 South Pumping Area Evaluation

South 457	2024	2034	2044
Total MDD (gpm)	3,507	4,350	5,183
Total Reliable Capacity (gpm)	9,000	9,000	9,000
Total Reliable Firm Capacity (gpm)	5,500	5,500	5,500
Surplus/Deficit (gpm)	1,993	1,150	317

3.3.1.3 Padden Yew Pumping Area

The Padden Yew pumping area is an open zone including two PS: Consolidation and 38th Street, which contain a total of four pumps. Consolidation has one pump with a capacity of 550 gpm while 38th Street has three pumps with capacities of 500 gpm. This pumping area serves the Padden Yew pressure zone. Table 3.9 shows the projected demands for the 2024, 2034, and 2044 scenarios compared to the total reliable pumping firm capacity, with the largest pump offline. The Padden Yew pumping area PS have adequate capacity for all planning year scenarios.

Table 3.9 Padden Yew Pumping Area Evaluation

Padden Yew 696	2024	2034	2044
Total MDD (gpm)	396	489	594
Total Reliable Capacity (gpm)	2,050	2,050	2,050
Total Reliable Firm Capacity (gpm)	1,500	1,500	1,500
Surplus/Deficit (gpm)	1,104	1,011	906

3.3.1.4 Governor Road Pumping Area

The Governor Road pumping area is an open zone that includes one PS, Governor Road, which has three pumps. One pump has a 1,100 gpm capacity while the other two pumps have capacities of 180 gpm each. This pumping area serves the Governor Road pressure zone. Table 3.10 shows the projected demands for the 2024, 2034, and 2044 scenarios compared to the total reliable pumping firm capacity, with the largest pump offline. The Governor Road PS has adequate capacity for all planning year scenarios.

Table 3.10 Governor Road Pumping Area Evaluation

Governor Road 873	2024	2034	2044
Total MDD (gpm)	69	86	107
Total Reliable Capacity (gpm)	1,460	1,460	1,460
Total Reliable Firm Capacity (gpm)	360	360	360
Surplus/Deficit (gpm)	291	274	253

3.3.1.5 Reveille Pumping Area

The Reveille pumping area is a closed zone that includes one PS, Reveille, which has two pumps. One pump has a capacity of 100 gpm, and the other pump has a 200 gpm capacity. This pumping area serves the Reveille pressure zone. The total demand conservatively assumes 100 percent of the South UGA Reserve is served by this pumping area. Table 3.11 shows the projected demands for the 2024, 2034, and 2044 scenarios compared to the total reliable pumping firm capacity, with the largest pump offline. This table shows the Reveille Pumping Area PS has inadequate capacity for all scenarios.

Table 3.11 Reveille Pumping Area Evaluation

Reveille 830	2024	2034	2044
Total PHD + Fire Flow (gpm)	2,542	2,587	2,640
Total Reliable Capacity (gpm)	300	300	300
Total Reliable Firm Capacity (gpm)	100	100	100
Surplus/Deficit (gpm)	-2,442	-2,473	-2,504

Reveille Pumping Area Recommendations - Project PS-2

The Reveille pumping area has significant fire flow deficiencies in each scenario. If the area served by the Reveille PS is annexed into the City, additional pumping capacity will be needed. An institutional fire flow will increase the fire flow demand from 1,500 gpm to 2,500 gpm. Larger pumps are needed for the recommended Project PS-2 and are described in Section 3.4.

3.3.1.6 Samish Highlands Pumping Area

The Samish Highlands pumping area is a closed zone that includes one PS, Samish Highlands, which contains two pumps. Each pump at this station has a capacity of 110 gpm. This pumping area serves the Samish Highland pressure zone. The total demand conservatively assumes 100 percent of the South UGA Reserve is served by this pumping area. Table 3.12 shows the projected demands for the 2024, 2034, and 2044 scenarios compared to the total reliable pumping firm capacity, with the largest pump offline. This table shows the Samish Highlands Pumping Area PS has inadequate capacity for all scenarios.

Table 3.12 Samish Highlands Pumping Area Evaluation

Samish Highlands 980	2024	2034	2044
Total Demand (gpm)	760	760	760
Total Reliable Capacity (gpm)	220	220	220
Total Reliable Firm Capacity (gpm)	110	110	110
Surplus / Deficit (gpm)	-650	-665	-665

Samish Highlands Area Recommendations - Project PS-4

The Samish Highlands pumping area demonstrates fire flow deficiencies in each scenario. No change from the recommended Project PS-4 outlined in Chapter 7 and Chapter 10 is needed.

3.3.2 Revised Storage Analysis

To evaluate storage capacities, the City's water distribution system was divided into five different storage areas containing 13 total pressure zones. The UGA extension contributes additional demands that increase the storage needs in the South and Governor Road Areas.

Water storage volumes include up to five components:

- Operational storage.
- Equalizing storage.
- Fire-suppression storage (FSS).
- Standby storage (SS).
- Dead storage.

The City combines Fire and Standby into a single band for planning, i.e. nesting. Figure 3.8 schematically shows these components. The extended demand projections affect the Equalizing band and the Fire/Standby band; updates to these are outlined in the subsequent Sections.

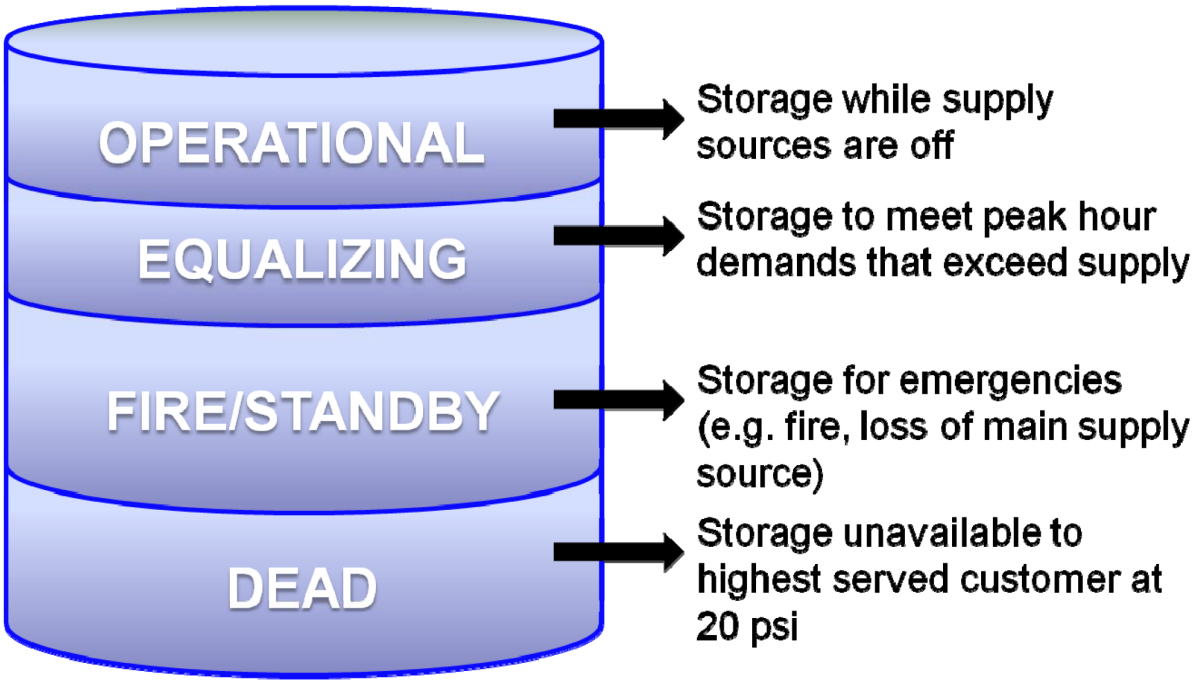

Figure 3.8 Illustration of Storage Components

3.3.2.1 Equalizing Storage

Equalizing storage is the total volume needed to satisfy the peak hourly demands (PHD) that exceed the supply system's capacity. The WAC 246-290-253 requires that equalizing storage be provided for peak demands. Equalizing volume requirements were calculated for each reservoir using the following equation using the storage area demands and are summarized in Table 3.13.

150 min x (PHD – MDD)

PHD was calculated using the individual pressure zone MDD peaking factors determined from the Advanced Meter Infrastructure data, in Chapter 4.

The UGA extension amounts to an increase of 0.01 MG in Equalizing Volume of storage in 2034 and 2044.

Table 3.13 Equalizing Storage Volumes

Storage Area	2024 Equalizing Volume (MG)	2034 Equalizing Volume (MG)	2044 Equalizing Volume (MG)
Dakin and Yew	0.14	0.17	0.20
North	0.42	0.49	0.57
South	0.14	0.16	0.18
Padden Yew	0.02	0.03	0.04
Governor Road	0.01	0.01	0.01
Total	**0.72**	**0.85**	**0.99**

Notes:
MG - million gallons.

3.3.2.2 Standby and Fire Suppression Storage

Standby Storage volumes are required to supply reasonable system demands during an emergency, such as the disruption of the water supply caused by a transmission pipeline or equipment failure, power outage, valve failure, or other system interruptions (as discussed in Chapter 05).

The Department of Health (DOH) Water System Design Manual recommends a minimum standby storage volume of no less than 200 gal per ERU. The City uses a more conservative calculation of two times ADD, which is consistent with the last plan, and approximately 1.55 times more water than the DOH minimum quantity.

Fire flow demand is the quantity of water required for firefighting as defined by applicable water system criteria and fire codes. Firefighting often places the largest demands on a water system because a high volume of water must be supplied over a short time period. Such demands require each component of the system to operate at optimal condition. The following fire flow requirement assumptions were used per land use type:

- Single-Family Residential: 750 gpm (2 hours).
- Multi-Family Residential: 1,500 gpm (2 hours).
- Institutional: 2,000 gpm (2 hours).
- Commercial: 2,500 gpm (2 hours).
- Industrial: 3,500 gpm (3 hours).

Water systems must have storage reservoirs that can meet fire flow requirements while maintaining a level of 20 pounds per square inch (psi) throughout the distribution system.

Table 3.14 outlines the nested standby storage and fire-suppression storage requirements for each operational area. The UGA extension amounts to an increase of 0.16 MG and 0.32 MG in Equalizing Volume of storage, in 2034 and 2044 respectively.

Table 3.14 Nested Standby Storage and Fire-Suppression Storage

Operational Area	Volume (MG)			Controlling Factor (FSS or SS)		
	2024	2034	2044	2024	2034	2044
Dakin and Yew	3.56	4.13	4.74	SS	SS	SS
North	10.81	12.47	14.36	SS	SS	SS
South	3.60	4.06	4.62	SS	SS	SS
Padden Yew	0.63	0.78	0.94	SS	SS	SS
Governor Road	0.35	0.35	0.35	FSS	FSS	FSS

3.3.2.3 Storage Deficiencies

The additional storage needed due to the UGA extension is 0.17 MG in 2034 and 0.33 in 2034. Table 3.15 outlines the storage deficits per zone by planning year. The phased approach to adding storage discussed in Chapter 7 and Chapter 10 can remain unchanged with the additional 0.33 MG incorporated into the recommended sizing. Section 3.4.1.1 outlines the recommended adjustments to CIP Projects ST-01 and ST-02 to address the storage deficits in 2044.

Table 3.15 Storage Deficits by Planning Year

Storage Area	Total Storage (MG)	2024 Required Storage (MG)	2034 Required Storage (MG)	2044 Required Storage (MG)
Dakin and Yew	1.57	4.07	4.68	5.31
North	18.3	16.55	18.28	20.25
South	1.09	3.95	4.43	5.01
Padden Yew	0.92	0.84	0.99	1.16
Governor Road	0.18	0.35	0.35	0.35
Total	**22.06**	**25.76**	**28.72**	**32.06**
Deficit (MG)		**3.70**	**6.66**	**10.01**

3.3.3 Distribution System Model Analysis

The City's calibrated water model was updated to include the 2034 and 2044 UGA extension demand projections and simulated fire flows in the UGA extension areas. Peak hour flow criteria and fire flow criteria are consistent with what was defined in Chapter 7.

3.3.3.1 System Criteria

During normal operations, the minimum pressure as set by the DOH during PHD is 30 psi at the service meter. DOH velocity criteria is to keep pipeline velocities below 8 feet/sec.

The City's goal is to provide a maximum of 100 psi at the service meter during ADD and keep pipeline velocities below 8 feet/sec during peak hour flows.

Using the InfoWater Pro fire flow test feature, the hydraulic model evaluated the fire capabilities at all hydrants in the system. Specifically, it systematically simulated a fire at each model node representing a fire hydrant for each of the planning years. All system nodes with service connections were tested for a minimum pressure of 20 psi during the point fire demands. Fire flow demands summarized in Section 3.3.2.2 were allocated based in the land use nearest the hydrant.

3.3.3.2 Peak Hour Demand Evaluation

Peak Hour Demand Evaluation North UGA Reserve

The exact routing and location of demands in the North UGA Reserve are undetermined, so demands were spread across the North UGA Reserve elevations to determine approximate minimum pressures during peak hour demands at potential meter locations. The pressure band ranged from 69 to 105 psi, thereby exceeding the minimum DOH requirement of 30 psi.

Peak Hour Demand Evaluation South UGA Reserve

The exact routing and location of demands in the South UGA Reserve are undetermined, so demands were spread across the South UGA Reserve elevations to determine approximate minimum pressures during peak hour demands at potential meter locations. The pressure band ranged from 62 to 134 psi, thereby exceeding the minimum DOH requirement of 30 psi.

3.3.3.3 Fire Flow Evaluation

Fire Flow Evaluation North UGA Reserve

The exact routing and location of fire flows in the North UGA Reserve is undetermined, so fire flows were spread across the North UGA Reserve. Results indicated fire flow deficiencies would occur if a 2,500 gpm fire is simulated at dead end pipes in the zone. Using looped piping 8-inch or greater showed no fire flow deficiencies in the North UGA Reserve. Capital improvement program (CIP) Projects D-9 and D-11 are both to address fire flow deficiencies near dead end piping in the Cordata Zone. If pipes are looped from Guide Meridian Rd to W Kline Rd as this area develops; these CIP projects could be re-evaluated and may not be needed.

Peak Hour Demand Evaluation North UGA Reserve

The South UGA Reserve has 1 institutional fire along Yew Street Rd and a number of multi-family fires with undetermined locations. A looped, 8-inch or larger pipe should be used, as the area builds out to ensure that the multi-family fires will not cause any fire flow deficiencies. The simulated institutional fire does cause a fire flow deficiency with pressures dropping below 20 psi. A CIP project is needed to address this and is discussed in the subsequent Section.

3.4 Updated Capital Improvement Program

Chapter 10 combines the various projects recommended in the Plan for the City's water system and presents them as a comprehensive CIP. As a result of the UGA Extension Analysis there are two changes to the CIP as outlined in Chapter 10. There is a change to the total volume of storage recommended, projects ST-01 and ST-02. There is also a new pipeline project recommended to mitigate the institutional fire flow deficiency in the South UGA Reserve. These projects are outlined in the following sub-sections.

3.4.1 Projects ST-01 and ST-02

The phased approach to storage and the installation of pressure reducing valves and transmission mains outlined in Chapter 10 remain unchanged. The City's long term plan is still to add redundancy and share storage between zones. The UGA Extension analysis determined that 0.33 MG of additional storage needs to be accounted for. This would change the recommendation of ST-02 to be a 3.33 MG tank instead of a 3.00 MG tank. The same unit costs presented in Chapter 10 would be used to cost the tank size as a result of the UGA extension. The cost of the ST-02 tank would increase by $3.0 M from $27.3 million to $30.3 million.

3.4.2 Project PS-02

The Reveille PS is unable to supply fire flows for 2024 conditions, however, the area served by this station is not within City limits. If the area served by the Reveille PS is annexed into the City, additional pumping capacity will be needed. Two additional 2,500 gpm capacity fire pumps should be constructed to mitigate these fire flow and pump capacity issues.

The estimated cost for the Reveille PS Replacement (PS-02) would increase from $4.7 million to $5.0 million and is recommended in the long-term.

3.4.3 Project D-22

If South UGA Reserve is annexed into the City and the upgrade of the Reveille PS is constructed, per Project PS-02, a pipeline project would be needed that upsizes an 8-inch to 16-inch to serve fire flows. Project D-22 would install 3,500 linear feet of 16-inch pipe along Yew Street Road at an approximate cost of $3.9 million.

3.5 Urban Growth Area Extension Analysis Summary

The UGA Extension Analysis determined that 0.3 mgd of additional demand will be added to the City's water system. This would increase the total storage deficit the City is facing by 0.33 MG and therefore increase the cost of CIP Project ST-02 by $3.0 million. The City will also need to plan for one additional CIP Project, D-22, to address fire flow deficiencies in the South UGA Extension Area. CIP Projects D-9 and D-11 are both to address fire flow deficiencies near dead end piping in the Cordata Zone. If pipes are looped from Guide Meridian Rd to W Kline Rd as this area develops, these CIP projects should be re-evaluated and potentially eliminated. The City must serve new customers in the UGA Extension Areas off the proper pressure zone hydraulic grade line to ensure minimum pressures are met. The City must also avoid dead end piping and ensure looping as it expands the distribution system into these UGA Extension Areas to prevent fire flow deficiencies.