2021 WATER RESOURCES PLAN UPDATE

Technical Memorandum

July 2021

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Acronyms and Abbreviations

AFY	acre-feet per year
Arcadis	Arcadis U.S., Inc.
ASR	aquifer storage and recovery
AWWA	American Water Works Association
CIP	Capital Improvements Plan
COMM	commercial
CoNB	City of New Braunfels
CTGCD	Comal Trinity Groundwater Conservation District
C_x	change in demand per household/account
CY	calendar year
DOR	drought-of-record
EAA	Edwards Aquifer Authority
FNI	Freese and Nichols, Inc.
FY	fiscal year
GBRA	Guadalupe-Blanco River Authority
GOPA	Geographically Organized Property Assessment
GPCD	gallons per capita per day
gpm	gallons per minute
GVSUD	Green Valley Specialty Utility District
G_x	account and household growth rates
HH	household
INST	institutional
LCA	leakage component analysis
MBP	Mid-Basin Project
MF	Multi-Family
MG	million gallons
MGD	million gallons per day
MTP	Membrane Treatment Plant
NBU	New Braunfels Utilities
NRW	non-revenue water

PER	preliminary engineering report
P_x	people per household
ROR	run-of-river
ROW	right(s)-of-way
SF	Single-Family
SUD	Special Utility District
SWTP	surface water treatment plant
TBD	To Be Determined
TCEQ	Texas Commission on Environmental Quality
TWCA	Texas Water Conservation Association
V_x	vacancy rates
WRF	Water Research Foundation
WRP	Water Resources Plan
WTP	water treatment plant

1 Introduction and Background

In 2018, Arcadis U.S., Inc. (Arcadis) collaborated with New Braunfels Utilities (NBU) to develop an initial Water Resources Plan (WRP), which detailed the projected demand through 2043 in the NBU service area, summarized existing water supply sources, and recommended potential water supply sources. The 2018 WRP recommended annual updates to the supply and demand model. Thus, in 2019, Arcadis and NBU updated the WRP with a supplemental technical memorandum, the 2019 WRP Update, which documented the changes to water supply sources, the ongoing conservation efforts, and the revised methodology for NBU service area demand projections. In 2020, NBU procured refined historical water consumption datasets. These datasets were subsequently incorporated into the 2020 WRP Update.

Thus, the purpose of this document is to update the demand projections to include the most recent calendar year (CY) of billing and supply data, using the total and per capita demand projection methodology Arcadis established in the 2019 WRP Update. Additionally, this memorandum summarizes the changes to NBU's planned water supply sources, details the progress of ongoing conservation efforts, and documents recommendations for future WRP updates. Note that this technical memorandum supplements but does not replace the 2018 WRP and the 2019 and 2020 WRP Updates.

1.1 Summary of Water Resources Plan Updates

A Water Resources Plan was developed in collaboration with NBU in 2018. Since that time, an annual update has been developed, focusing only on changes to information documented previously. Information that can be found in the prior documents, which has not since been revised in a newer update, is summarized in **Table 1-1**.

Table 1-1: Summary of Information Located in Past WRP and WRP Updates

FY	Document Title	Data Provided in Prior Documents Not Updated in the Current Document
2018	2018 WRP	• Detailed description of existing NBU water supply rights and water supply availability in a Drought-of-Record (DOR), as of 2018 • In-depth summary of existing and potential conservation and non-revenue water programs, as of 2018 • Analysis of potential new sources of water supply
2019	2019 WRP Update	• Summary of updated demand projection methodology
2020	2020 WRP Update	• Map of NBU system entry points • Detailed information about the new purchased and raw water contracts acquired in 2020

FY	Document Title	Data Provided in Prior Documents Not Updated in the Current Document
2021	2021 WRP Update (This Document)	• Current NBU water supply sources • Updated demand projections, using the most recent demand projection methodology • Summary of historical per capita demand and projection of future per capita demand, based on various conservation scenarios • Updated documentation of conservation and non-revenue water programs • Comparison of most recent supply and demand projections through 2070

1.2 Format of the 2021 Supplemental Update Memorandum

This supplemental 2021 update technical memorandum is not a comprehensive document; rather, it is meant to be read in tandem with the 2018 WRP, and the 2019 and 2020 WRP Updates. For ease of parallel reading, the 2021 NBU WRP Update Technical Memorandum adheres to the same chapter format as the 2018 WRP and discusses the following items:

1 Introduction and Background

Chapter 1 (i.e., this section) reinforces the necessity of the 2021 WRP Update, summarizes data available in prior WRP Updates, and outlines the contents of the 2021 WRP Update.

2 Current and Planned Water Supplies

Chapter 2 reviews the existing water supply sources in NBU's portfolio, as well as those planned for the future.

3 Population Projection

Chapter 3 outlines the historical and projected NBU water service area population. The calculated historical and projected future service area population is presented.

4 Demand Projections

Chapter 4 summarizes the updated demand projections using the most recent datasets.

5 Conservation and Water Management Programs

Chapter 5 documents conservation and water management efforts that have been implemented by NBU, including the ongoing non-revenue water study.

6 Evaluation of Supply and Demand

Chapter 6 presents an updated comparison of supply and demand, based upon the new demand projections and current water supply sources.

7 Water Supply Alternatives

Chapter 7 was not updated. Refer to the 2018 WRP for an in-depth discussion of each prior water supply alternative considered.

8 Water Quality Considerations

Chapter 8 summarizes the blending studies that have been conducted by NBU as new water supply sources are brought online and the additional blending studies that will be required as new water supply sources are integrated.

9 Conclusions and Recommendations

Chapter 9 outlines new conclusions and recommendations based on the 2021 WRP Update and restates relevant conclusions and recommendations made in the 2018 WRP and the 2019 and 2020 WRP Updates.

10 References

Chapter 10 lists any new sources referred to in the 2021 WRP Update Technical Memorandum. Additional resources cited in the 2018 WRP and 2019 and 2020 WRP Updates remain applicable.

2 Current and Planned Water Supplies

NBU's water supply portfolio consists of surface water, groundwater, and purchased water. NBU evaluates the water supply portfolio considering both the firm yield water supply and the deliverable volume of water available.

- **Firm Yield:** *The firm yield water supply is the supply of water available during a repeat DOR.* As described in-depth in the 2018 WRP, the existing supplies are limited by drought restrictions and current treatment capacities; the entire authorized volumes of Edwards Aquifer groundwater and run-of-river (ROR) surface water are not always available.
- **Deliverable Firm Yield:** *NBU's deliverable firm yield water is the water supply available for delivery to NBU customers during a repeat DOR. The deliverable volume is reduced when the capacity of existing NBU infrastructure to treat and transport a water supply within the NBU distribution system is limited.* Non-revenue water volumes that may be used during production and treatment are accounted for separately as a demand.

2.1 Current Water Supply Sources

The following sections summarize NBU's current water portfolio, outline the updates to NBU's water supply portfolio that have occurred since the 2020 WRP Update, and summarize potential future sources of supply.

2.1.1 Calendar Year 2021 Water Supply Portfolio

A complete list of NBU's current water supply sources is provided in **Table 2-1** based upon water supply projects in the current 5-year Capital Improvements Plan (CIP). Refer to the 2020 WRP Update for additional information about the new purchased and raw water contracts acquired in 2020. Since the 2020 WRP Update, the following changes were made to NBU's water supply portfolio (**Table 2-1**):

- Wholesale of the Guadalupe-Blanco River Authority (GBRA) Canyon Reservoir water is no longer being considered.
- The existing maximum supply for Trinity Aquifer wells has been adjusted to 4,200 acre-feet per year (AFY) based on a sustainable annual design capacity of 3.75 million gallons per day (MGD) as directed by NBU on 5/20/21.
- The Copper Ridge well supply currently only includes Well 13 sustainable yield (currently 238 gallons per minute [gpm]) per direction from NBU on 5/20/21.

Supply volumes shown assume that sources are fully available the year they come online; however, the full volume of a source may not be available in its first year online. Thus, future supply portfolio changes should be considered needed in the year prior to when demand exceeds supply.

2.1.2 Potential Wholesale

NBU has not planned any wholesale of its water but continues to be open to future opportunities.

Table 2-1: Summary of NBU Current Annual Water Supplies, as of the end of Calendar Year 2021

Source Name	Source Type	Maximum Supply (AFY)		Firm Yield Supply (AFY)	
		Contracted	Deliverable	Contracted	Deliverable
Guadalupe River ROR water	Surface Water	6,952	8,400	0	8,400
GBRA Canyon Reservoir		9,720		9,720[1]	
GBRA Canyon Reservoir Expanded Rights (Womack and Coleto Creek Power Station)		8,350		8,350[1]	
Edwards Aquifer Wells - Edwards Aquifer Authority (EAA) Permits	Groundwater	9,269	9,269	5,439	5,439
Existing Trinity Aquifer Wells[2]	Groundwater	4,200[3]	4,200[3]	3,900[4]	3,900[4]
Copper Ridge Wells[5]	Groundwater	384	384	384	384
Green Valley Special Utility District (GVSUD)[6]	Blended treated ground and surface water from the GVSUD system	1,000	1,000	1,000	1,000
City of Seguin Water[6]	Blended treated ground and surface water from the Seguin distribution system	1,500	1,100	1,500	1,100
Total Contracted Water per Year, as per 2021 WRP Update		**41,375**	**24,353**	**30,293**	**20,223**

1. In times of extreme drought (i.e., more intense than the DOR), GBRA can request that NBU reduce its usage of Canyon Reservoir water by a factor of 15 percent (GBRA Drought Contingency Plan, July 17, 2019). Because these conditions have not been reached, this 15 percent reduction is not included in the firm yield volume.
2. Volume is not limited by contracts; thus, the contracted volume is treated as equal to the deliverable volume.
3. This yield is based on a design capacity of 3.75 MGD as directed by NBU on 5/20/21.
4. This yield is based on a sustainable capacity of 3.5 MGD as directed by NBU on 5/20/21.
5. Deliverable yield currently only includes Well 13 sustainable yield (currently 238 gpm) per direction from NBU on 5/20/21. The Trinity Aquifer withdrawal volume is not limited by contracts; thus, contracted volume is treated as equal to the deliverable volume.
6. NBU will maintain the GVSUD interim and Seguin Interim water supplies as emergency water supplies going forward.

2.2 Water Supply Sources Included in Future Water Supply Projections from 2022 – 2070

Additional water supplies planned to be added to NBU's water supply portfolio are summarized in **Table 2-2** and **Figure 2-1**. These water sources have been considered as part of NBU's water supply projections to be contracted and deliverable in the years shown. Infrastructure required to deliver the GBRA Mid-Basin Project (MBP) and additional Trinity Aquifer water is included in the current five-year CIP. The Seguin Interim supply contract will continue to deliver 1,100 AFY of the 2,500 AFY until the interconnect is constructed; 1,500 AFY is currently available contractually.

In addition, NBU is currently planning to expand its surface water treatment capacity in 2028 to utilize the available firm yield surface water rights, either through the construction of a new surface water treatment plant (SWTP) or through expansion of the existing SWTP. Until the path forward is determined, an additional 9,670 AFY is assumed. If only the 8 MGD expansion of the existing SWTP is conducted, NBU estimates a sustainable (annual) production of 15 MGD from the expanded existing SWTP, which would leave approximately 1 MGD of firm yield surface water, which could be treated with a new SWTP in the future.

Table 2-2: Water Supply Sources Planned to be Added to the NBU Portfolio

Source Name	Description	Maximum Supply (AFY)		Firm Yield Supply (AFY)		Anticipated Year Supply Available (CY)
		Contracted	Deliverable	Contracted	Deliverable	
Seguin Interim	Additional treated purchased water contractually available to NBU annually, effective October 1st of corresponding year	500	0	500	0	2022
		500	0[1]	500	0	2023
	Total	*1,000*	*0*	*1,000*	*0*	*2023*
GBRA Mid-Basin Project	Purchased, treated Carrizo-Wilcox Aquifer groundwater from Gonzales County	8,000	8,000	8,000	8,000	2024[1]
Trinity Aquifer Wellfield Expansion	Four new groundwater wells treated at NBU's membrane facility	4,200	4,200	3,900	3,900	2024
Surface Water Treatment Capacity Expansion	*An expansion of the existing SWTP and/or construction of a new SWTP*	*0*	*9,700*	*0*	*9,700*	*≥2028*

Notes:

1. Although the GBRA MBP water is contractually available in 2023, GBRA plans to finish construction on the infrastructure to deliver the water to NBU by 2024.

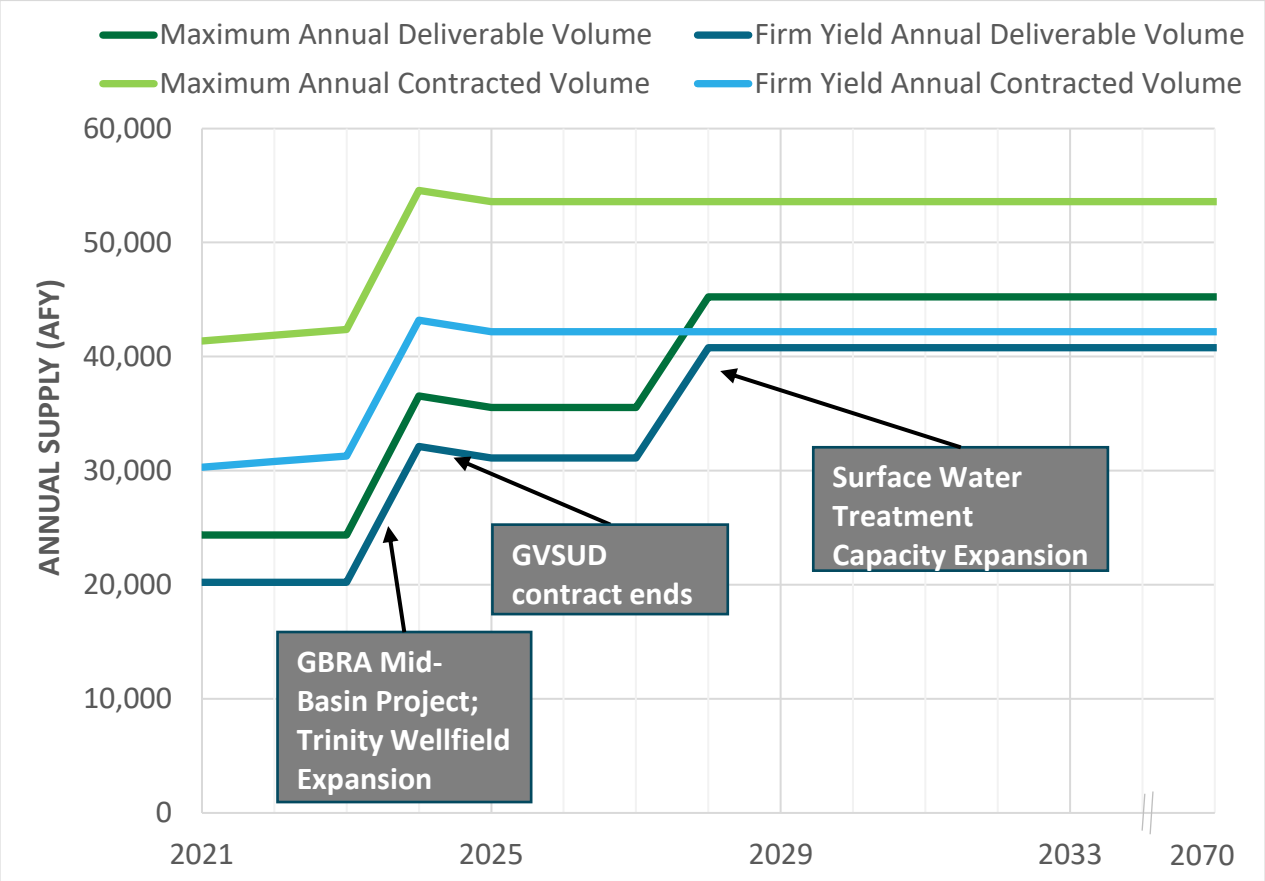


Figure 2-1: NBU Planned Water Supply Sources through 2070

2.2.1 SWTP No. 2 Feasibility Study

In 2021, Arcadis completed the Hueco Springs Road SWTP Preliminary Feasibility Study. NBU purchased a 37.5-acre plot of land near the northern end of the NBU service area and has plans to eventually construct a second surface water treatment plant (SWTP No. 2) at this site. The Hueco Springs Road SWTP Preliminary Feasibility Study evaluated the most appropriate water treatment capacity and construction year for SWTP No. 2 based on multiple operational scenarios and the annual supply and demand projections provided in the 2020 WRP Update. However, the 2021 NBU Master Plan is anticipated to recommend an earlier construction date (e.g., 2030) for SWTP No. 2 to ensure that the NBU system can meet peak daily demands (see **Appendix A**).

2.2.2 Additional Water Supply Sources Under Consideration Requiring Further Evaluation

Additional water supplies under consideration by NBU are listed in **Table 2-3**. These sources were not considered to be an available supply in NBU's water supply portfolio in the 2020 WRP Update as they require further evaluation. NBU will continue to evaluate additional surface water, groundwater, and purchased water opportunities as they become available.

Table 2-3: Additional Water Supply Sources Under Consideration Requiring Further Evaluation

Source Name	Description	Contracted Supply		Anticipated CY Supply Available
		Maximum	Firm Yield	
GBRA Lower Basin Project	Potential water supply swap allowing for additional surface water from Canyon Reservoir	3,604	3,604	2026[1]
GBRA Mid-Basin Project Phase-2	Treated groundwater supply project using water produced from a wellfield in Gonzales County; possible ASR collaboration	TBD	TBD	TBD
Hueco Springs[2]	Spring flow (would have to be captured and stored to add firm supply)	TBD	0	TBD
KT Wells[2]	Trinity Aquifer groundwater wells	TBD	TBD	TBD

1. Water volume not deliverable until additional surface water treatment capacity is added to the NBU system.
2. Source is in the feasibility evaluation stage.

2.3 Water Supply Diversification and Resiliency

NBU remains focused on improving system resiliency and diversifying water supply sources. Water Supply Resiliency is the ability to overcome vulnerabilities to provide a continuous supply of safe, clean water to meet the demands of utility customers. NBU's diverse water supply (see **Figure 2-2**) currently consists of five separate supplies (Guadalupe River surface water via GBRA Canyon Reservoir contracts, Guadalupe River surface water via Texas Commission on Environmental Quality (TCEQ) run-of-river contracts, groundwater from the Edwards Aquifer, groundwater from two different areas of the Trinity Aquifer, and purchased treated water). NBU is currently conducting a Water Supply Resiliency Study to understand the vulnerabilities of each supply and the potential consequence of those vulnerabilities on NBU's ability to deliver safe drinking water to NBU customers. A mitigation plan and implementation roadmap will be developed; recommendations will be incorporated, as appropriate, into future WRP Updates and NBU's One Water program.

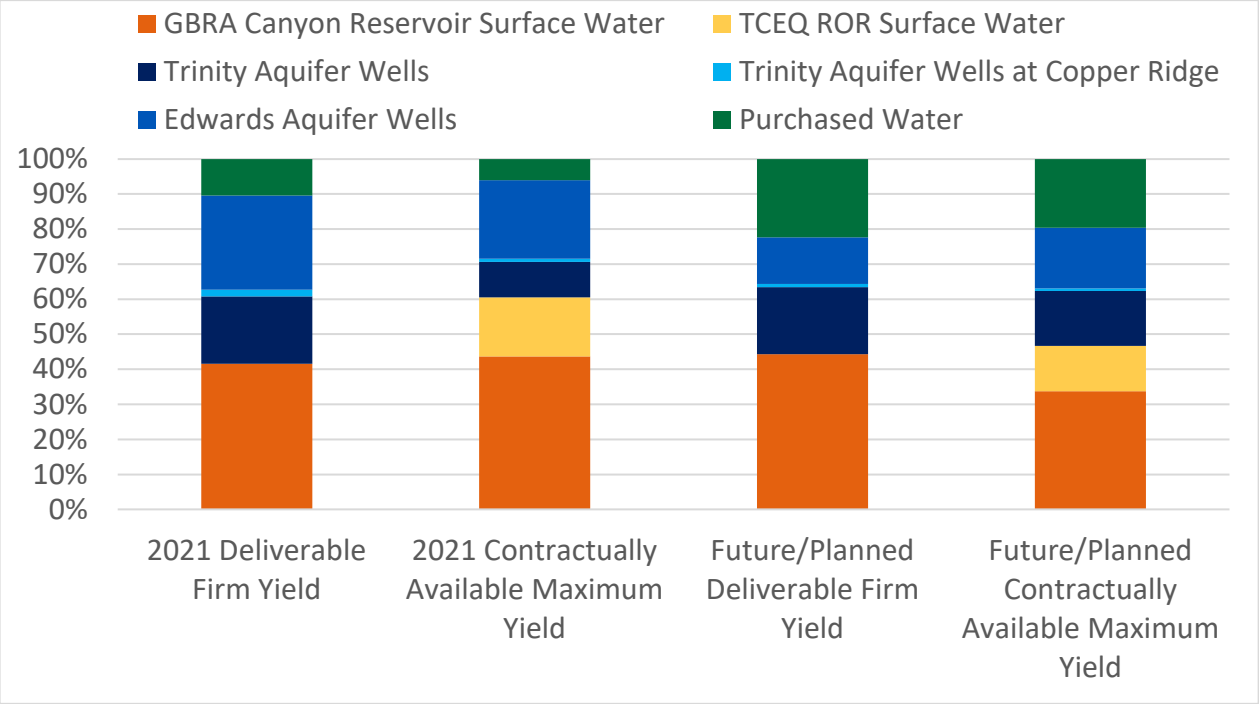


Figure 2-2: Current and Future/Planned Diversification of NBU Water Supplies

3 Population Projections

The population calculation methodology summarized in the 2020 WRP Update and new 2020 NBU service area data were used to update the NBU service area population projections. Rather than use the estimated population of the City of New Braunfels (CoNB), NBU has decided to estimate its service area population using a combination of the number of NBU accounts, the associated account types, and 2010 Census Data. Population projections also consider the duration of rapid growth experienced previously in Central Texas communities situated along the Interstate-35 corridor, such as Round Rock.

3.1 Historical Population Calculation

Table 3-1 compares the projected population (calculated in 2020 using the methodology described in the 2020 WRP Update and the growth trends established in the 2018 WRP) for the NBU service area, and the historical 2020 population estimated for the City of New Braunfels by the U.S. Census. The population estimated by the U.S. Census Bureau for the City of New Braunfels was very near (one percent less) that projected for the NBU service area using NBU data. Note that the City of New Braunfels and the NBU service area overlap in many cases but do have different boundaries.

Table 3-1: Projected NBU Service Area vs. Estimated City of New Braunfels 2020 Population

Value	Projected using NBU Service Area Data - 2020	Estimated City of New Braunfels[1] - 2020
Population	102,890	101,863

1. Estimated by the U.S. Census Bureau.

3.1.1 Confirmation of Population Growth Scenarios

Arcadis developed three phases of account growth, summarized in **Table 3-2**, based on the growth patterns in Central Texas communities situated along the Interstate-35 corridor, such as Round Rock (**Table 3-3**). Account growth was then used to calculate population (using the formulae shown in the 2020 WRP Update).

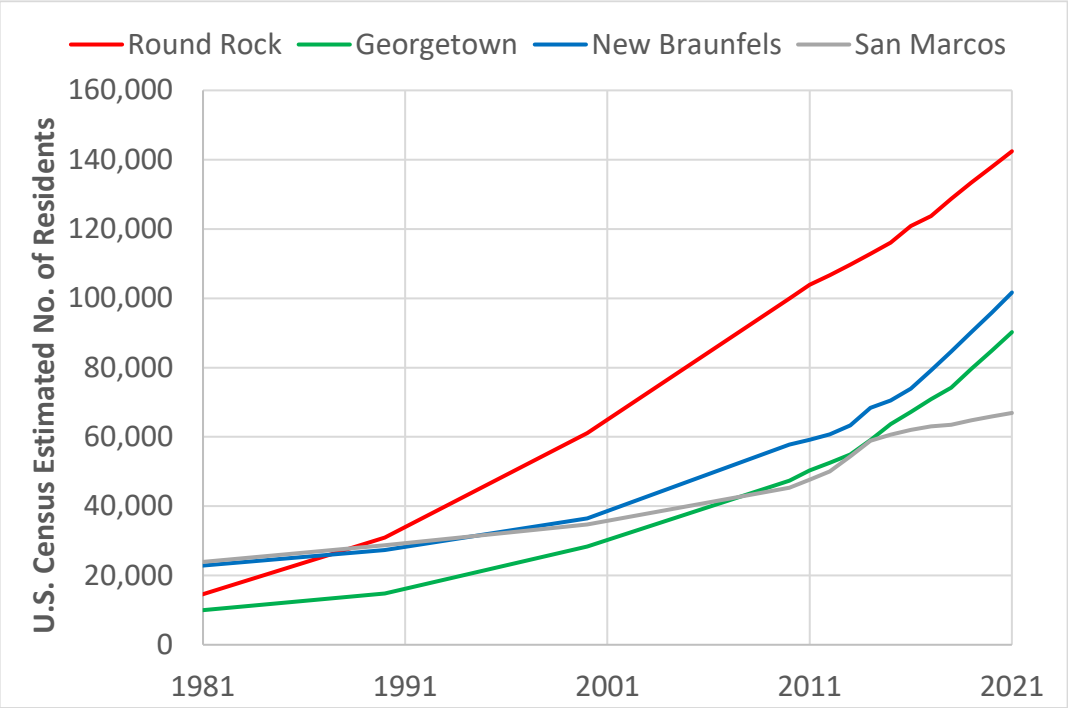
Table 3-2: Assumed Phased Growth Projections for NBU Accounts

Phase	Growth Rate Basis	Phase Duration
1	Historical 5-Year Average (2016 to 2020)	2022 – 2026
2	Half of the Historical 5-Year Average (2016 to 2020)	2027 – 2042
3	A third of the Historical 5-Year Average (2016 to 2020)	2043 – 2070

Table 3-3: Summary of Round Rock Historical Population Growth

U.S. Census Years	Average Round Rock Population Increase per Year per U.S. Census
1980 – 1990	14%
1990 – 2000	10%
2000 – 2010	6%
2010 – Current	4% (Estimated)

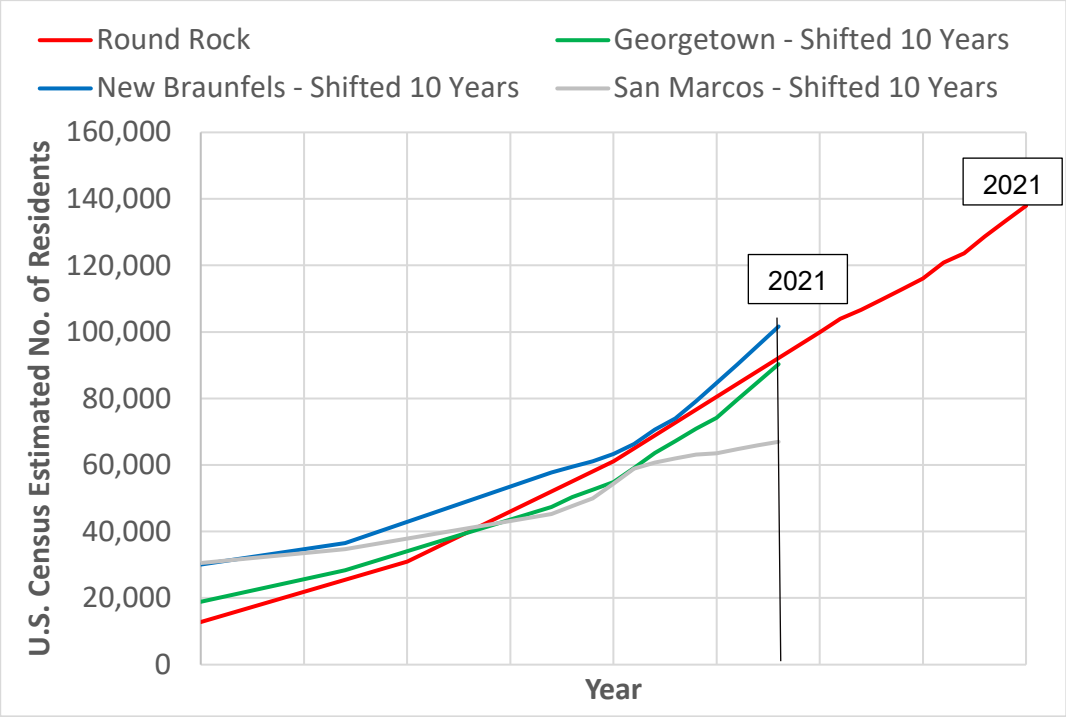
As part of this WRP Update, Arcadis reviewed whether growth within the City of New Braunfels was still following the previously observed trends. **Figure 3-1** shows the most recent population data for Central Texas communities situated along the Interstate-35 corridor, as estimated by the U.S. Census Bureau. Round Rock, like the City of New Braunfels, experienced a period of rapid growth (i.e., greater than 6 percent population growth per year).



Note: New Braunfels population reflects growth within the city limits; the NBU service area and city limits are different boundaries.

Figure 3-1: U.S. Census Estimated Population in Central Texas Cities along the Interstate-35 Corridor

Based on these population data, population growth in Round Rock is roughly ten years ahead of the growth observed in New Braunfels, Georgetown, and San Marcos. When adjusted to account for the difference in the year rapid growth began (see **Figure 3-2**), growth in New Braunfels appears to continue to follow a similar rate as has been observed in Round Rock. Thus, the growth rate assumptions used appear to be possible at least for the next ten years based on the U.S. Census estimates of growth in Round Rock during the most recent 10 years. However, growth assumption should continue to be reevaluated as these communities continue to develop.



Note: New Braunfels population reflects growth within the city limits; the NBU service area and city limits are different boundaries.

Figure 3-2: U.S. Census Estimated Population in Texas Cities along the Interstate-35 Corridor, Shifted 10 Years

3.2 Population Projections

Updated historical five-year average growth rates (2016 to 2020) are shown in **Table 3-4**. Because the five-year average growth rates in most customer groups are smaller when the CY 2020 data are incorporated, the updated population projection is lower. The updated population projections are shown in **Table 3-5**, with the population projections from the 2020 WRP Update included as a reference. These calculations use the 2010 U.S. Census data for estimating number of people per household, as well as vacancy rates for rented and owned households. New U.S. Census data are expected to be released by the end of CY 2021. The population projections will be updated accordingly moving forward. However, 2020 U.S. Census data will not be applied retroactively for population calculations in years past.

Projections from the 2020 WRP Update are also shown in **Table 3-5** for reference. Population projections are ultimately slightly lower this CY, due primarily to a lower five-year historical average (i.e., for 2016 to 2020 compared to for 2015 to 2019) for growth in SF1 and SF2 households, which make up the largest share of NBU customers. The 2021 population projection is slightly higher in the short term due to increased growth projected in multifamily accounts.

Table 3-4: Percent Growth in Number of Households/Accounts per Customer Group

Customer Group	Percent Growth in the Number of Households/Accounts, based on 2016 to 2020 5-Year Average Growth		
	Phase 1	Phase 2	Phase 3
SF1	4.9%	2.5%	1.6%
SF2	0.4%	0.2%	0.1%
MF1	8.0%	4.0%	2.7%
MF2	6.6%	3.3%	2.2%
MF3	3.2%	1.6%	1.1%
INST[1]	1.0%	0.5%	0.3%
COMM[1]	2.5%	1.2%	0.8%

Notes:

1. Growth in institutional (INST) and commercial (COMM) accounts is only shown for reference; it is not ultimately factored into the population calculation.

Table 3-5: NBU Service Area Population Projections, 2021 through 2070

Year	2020 WRP Update	2021 WRP Update
	No. of Projected Residents in the NBU Service Area	
2021	108,189	107,212
2025	132,400	131,700
2030	154,500	154,200
2035	175,800	176,100
2040	200,300	201,300
2045	222,500	224,200
2050	243,000	245,500
2055	265,500	269,000
2060	290,100	300,200
2065	317,200	305,800
2070	346,800	311,500

3.2.1 Consideration of Buildout Capacity

As part of the 2021 NBU Master Plan process, NBU estimated a buildout capacity. NBU's buildout capacity (beyond year 2070) is defined as the maximum number of households/accounts (sometimes referred to as connections) that can be supported by development within the future projected service area boundaries based on

land use assumptions. At the direction of NBU, Freese and Nichols, Inc. (FNI) provided Arcadis with initial projections of the NBU service area buildout capacity (shown in **Table 3-6**). Buildout capacity projections are included for each customer group. See **Appendix B** for FNI's Microsoft PowerPoint Presentation titled "Buildout TCEQ Connections", dated June 21, 2021, which explains in greater depth how FNI developed these values.

A comparison of the number of accounts projected for each customer group in 2070 and the buildout capacity (beyond year 2070) is shown in **Table 3-6**. Key differences between the estimated maximum values include:

- The buildout capacity shows a tendency toward larger lot sizes for single family (SF) homes; and
- The buildout capacity suggests greater growth in commercial and institutional accounts with less growth in multifamily (FM) accounts, which will have a direct impact on the future overall system per capita demand in gallons per capita day (GPCD).

Table 3-6: 2070 NBU Service Area Estimated Buildout Capacity and Projected No. of Accounts

Customer Group	Projected No. of Households/Accounts in 2070, Based on the 2021 WRP Update Demand Model	Buildout Capacity (> 2070) for Households/Accounts, Based on the 2021 NBU Master Plan Draft[1]
SF1	94,300	88,900
SF2	500	34,400
SF TOTAL	**94,800**	**123,300**
MF1	34,100	18,500
MF2	6,300	2,500
MF3	1,900	1,200
MF TOTAL	**42,300**	**22,200**
INST	200	1,500
COM	3,900	14,900
TOTAL	**141,200**	**16,400**

Per discussion with NBU, no changes were made to the 2021 projection model based on the buildout capacities. Because the model uses five-year average growth rates, the effects of zoning and boundary restrictions on individual customer groups will be felt gradually over time and the projections will shift accordingly. The model is focused on an overall system demand projection; capping individual customer groups at their buildout capacity does not account for the increased growth that may subsequently occur in other customer groups as a result (i.e., SF2 development may increase more than currently anticipated in order to make up for the buildout capacity limit to SF1). Further, considering the projected buildout capacity collectively verifies that the magnitude of the accounts currently projected by the 2021 demand model is possible. However, continued comparison of future year projection updates to the buildout capacity is recommended. Additionally, continued tracking of zoning change trends within the City of New Braunfels is recommended.

The buildout capacity projections developed by FNI show a much higher number of institutional and commercial accounts and fewer multifamily accounts than the 2021 WRP Update Demand Model predicts in the year 2070.

[1] Based on the June 21, 2021 Microsoft PowerPoint Presentation, NBU Buildout TCEQ connections

Both institutional and commercial accounts have, on average, a higher rate of use per account. If the buildout capacity projections are correct, NBU's system-wide per capita demand will rise due to increased institutional and commercial usage without corresponding population growth. A comparison of the projected 2070 demand and the eventual (beyond year 2070) maximum demand predicted by the buildout capacity (both using the average demand per account/household for each customer group observed in 2020) is shown in **Figure 3-3**. Ultimately, this comparison indicates that the maximum demand projected at buildout is greater than the 2070 demand projected by Scenario 2 of the Arcadis 2021 WRP Model (refer to Scenario 2 in Section 4), suggesting that this projected demand is possible within NBU's projected future service area.

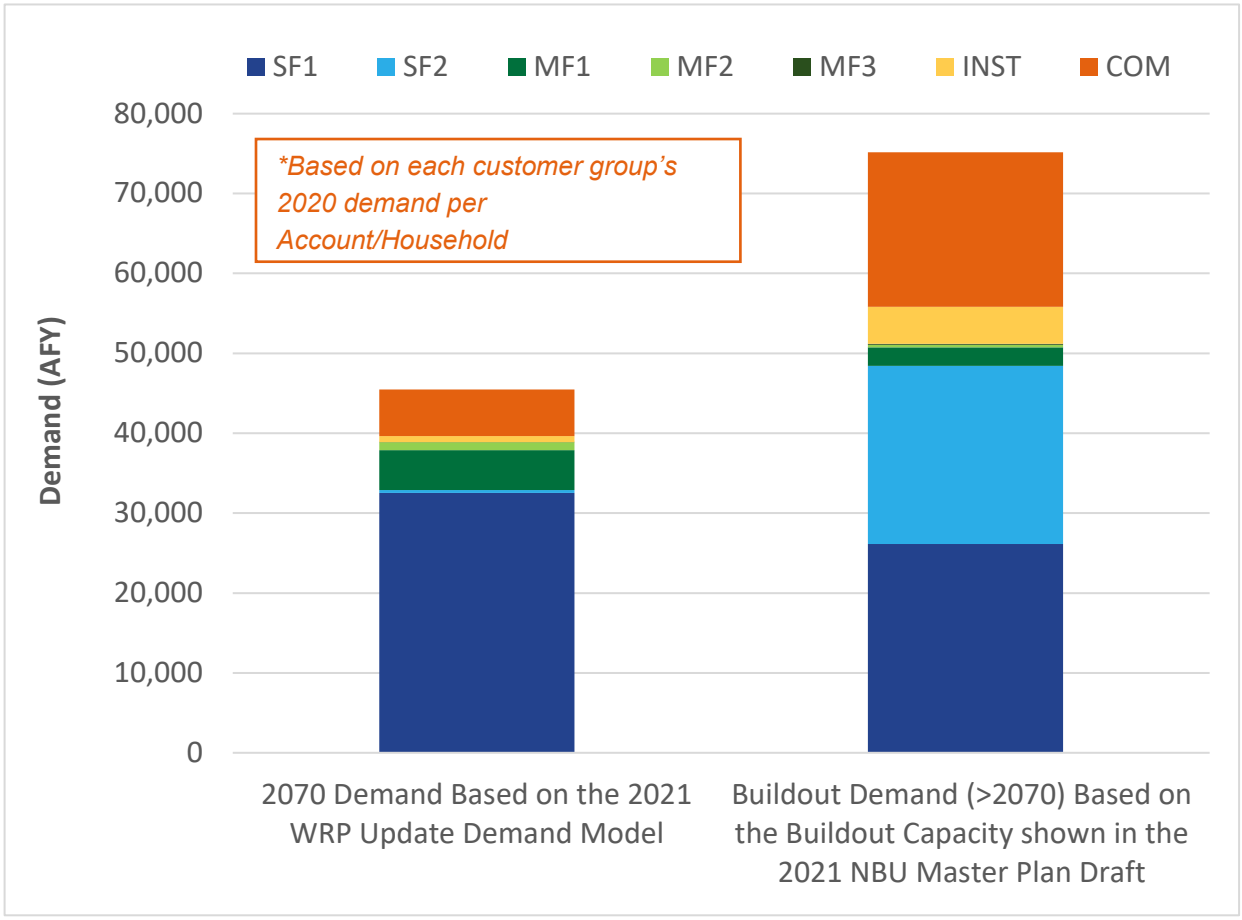


Figure 3-3: Comparison of 2070 Demand (Based on the 2021 WRP) and Buildout Demand Beyond 2070 (Based on the 2021 NBU Master Plan Draft), Assuming 2020 Rates of Demand per Account/Household

4 Demand Projections

The demand projection methodology developed as part of the 2020 WRP Update and data from CY 2020 were used to provide updated demand projections. For an in-depth description of the demand projection methodology, refer to the 2020 WRP Update. The 2020 demand data is summarized in the subsequent sections, and the updated demand projections are provided.

4.1 Updated Historical Demand Calculations

Because the demand projection model utilizes running five-year averages for the account and household growth rates (G_x), as well as the change in demand per household/account (C_x), the incorporation of the 2020 NBU demand data slightly altered demand projection results.

4.1.1 Change in Demand per Household/Account (C_X)

NBU is continuing to consider three scenarios related to *the change in demand per household (HH) or accounts* (conservation factor, C_x), listed below:

1. Scenario 1: Historical 5-Year Average Change in Demand per HH/Account
2. Scenario 2: Current Year Demand per HH/Account
3. Scenario 3: Reductions in Demand per HH/Account to Meet Conservation Goal

The historical demands per HH/account for each customer group are shown in **Table 4-1**. These are used to calculate the conservation factor used in Scenario 1, and the 2020 value is used in Scenario 2 as the projected demand per HH/account.

Table 4-1: Demand per Household/Account

Customer Group	Demand (Million Gallons [MG]) per HH/Account					
	2015	2016	2017	2018	2019	2020
SF1	0.088	0.088	0.089	0.088	0.094	0.096
SF2	0.18	0.18	0.19	0.18	0.21	0.21
MF1	0.044	0.046	0.040	0.037	0.039	0.041
MF2	0.046	0.045	0.041	0.037	0.040	0.044
MF3	0.045	0.042	0.042	0.045	0.041	0.038
INST	0.84	0.82	1.0	1.1	1.1	1.0
COMM	0.78	0.88	0.64	0.88	0.92	1.1

Updated conservation factors for each scenario, C_x, including the most recent 2020 data, as well as the previous 5-year average change in demand per HH/account are shown in **Table 4-2**. The demand per account/household for single family homes, institutional accounts, and commercial accounts continues to increase, with the greatest trend of increasing demand observed for commercial accounts. However, the magnitude of the percent increase was reduced for all categories except SF2 by incorporation of the 2020 demand data.

Table 4-2: Conservation Factors (Cx) based on Conservation Scenarios

Conservation Factor, C_x, per Customer Group	Historical 5-Year Average Change in Demand per HH/Account		Future Change in Demand Scenarios (Incorporating the 2020 Demand Data)		
	2015 - 2019	2016 - 2020	C_x for Scenario 1[1]	C_x for Scenario 2	C_x for Scenario 3[2]
C_{SF1}	+0.3%	+1.8%	+1.8%	0%	-0.13%
C_{SF2}	+1.6%	+3.2%	+3.2%	0%	-0.13%
C_{MF1}	-2.0%	-1.3%	-1.3%	0%	-0.13%
C_{MF2}	-0.6%	-0.6%	-0.6%	0%	-0.13%
C_{MF3}	-0.6%	-3.2%	-3.2%	0%	-0.13%
C_{INST} [3]	+7.4%	+4.4%	+4.4%	0%	-0.13%
C_{COMM}	+0.7%	+0.2%	+0.2%	0%	-0.13%

Notes:

1. The total demand per account is capped at the highest demand per HH/account observed at an individual level in 2019.
2. Reductions in the change in demand were only considered until NBU's per capita demand goal is met. Change in demand per HH/account is 0.0 percent thereafter to maintain NBU's goal.
3. From 2016 to 2017, NBU data shows that demand per institutional accounts increased by 25% (or 35 MG). This percent increase in demand per institutional account is much higher than what occurred in any other year (in other years, this value ranged from -8.0% to 9.8%); however, the increase represents, by volume, just 0.8% of NBU's total demand for 2017. The increase is likely due to the addition of new high-using institutional accounts in 2017 (such as Veramendi Elementary and additional Landa Park irrigation). Ultimately, the exclusion of this 25% increase does not change the results significantly. When the projection is extended to 2070, the inclusion of the 25% increase ultimately increases the total demand projection by 6%, which is well within the potential error anticipated for projections 50 years into the future.

4.1.2 Water Loss (Unmetered Water) Factor

The water loss factor compares the total volume of water pumped from NBU's sources with the volume of water ultimately metered. As shown in **Table 4-3**, the rate of water loss (unmetered water) has steadily increased and remained high in recent years[2]. To account for the annual variation in NBU's percent of unmetered water, the 2020 Demand Model uses the average of the most recent two years, to ensure that the model is more accurately reflecting the current conditions of the NBU system. In addition, a technical memorandum describing non-revenue water in the NBU system is being compiled under a separate contract and is summarized in **Section 5.3**.

[2] This value is calculated by comparing the total water pumped and the total water billed (which includes the volume of metered unbilled water).

Table 4-3: Water Loss (Unmetered Water) Factor, 2016 - 2020

Year	Water Loss (Unmetered Water) Factor (% of Total Volume Sourced)
2016	9%
2017	8%
2018[1]	11%
2019	18%
2020	17%

Notes:

1. In 2018, NBU brought the Seguin Interim water and Trinity Membrane Treatment Plant (MTP) online. Losses during production and transmission may have contributed to the increase in unmetered distributed water. However, the Trinity MTP has overall been very efficient (see **Table 4-4**).

NBU can measure the volume of water lost during treatment and production for two sources: the Trinity MTP and the SWTP. At both plants, there is now a meter measuring the intake volume and the effluent volume[3]. The production losses over the past three years, since data have been available, are shown in **Table 4-4**.

Table 4-4: Production Losses Measured at NBU Treatment Plants

Year	Trinity MTP[1]			SWTP		
	Intake Volume (MG)	Effluent Volume (MG)	% Lost in Production	Intake Volume (MG)	Effluent Volume (MG)	% Lost in Production
2018	300	300	0.12%	-[1]	-[1]	-[1]
2019	890	870	2.4%	-[1]	-[1]	-[1]
2020	900	870	3.1%	1,800	1,700	5.2%

1. Membrane facilities typically observe 92 to 97 percent water recovery (American Water Works Association [AWWA] Membrane Process Committee 2008; Adham et al. 2005)

4.2 Projected Annual NBU Service Area Water Demand

Updated annual water demand projections, which incorporate the 2020 demand data and the updated water loss (unmetered water) factor, are shown in **Table 4-5** and displayed graphically in **Figure 4-1**. Note that the 2070 demand for Scenario 1 exceeds the buildout capacity demand projected by the 2021 NBU Master Plan Draft (refer to **Section 3.2.1**). Demand for Scenarios 1 and 2 is broken up by customer group in **Figure 4-2** and **Figure 4-3**, respectively. These figures illustrate the potential for conservation to be one of NBU's key strategies for meeting future demand. Note that billed demand is shown in these figures rather than total demand. Additionally, these demands are based on annual water usage for the purpose of evaluating water supply needs; peak day demand is discussed further in **Appendix A.**

[3] Data for the meter on the effluent line of the SWTP is available as of 1/1/2020. Data for the Trinity MTP is available as of 8/1/2018.

Table 4-5: Projected Annual Water Demand, Based on Conservation Scenarios

Year	NBU Service Area Water Demand		
	Scenario 1: 5-Year Average Change in Demand per Household (HH)/Account	Scenario 2: 2020 Demand per HH/Account	Scenario 3: Reductions in Demand per HH/Account to Meet Conservation Goal
	AFY	AFY	AFY
2025	21,000	19,600	19,500
2030	25,700	22,400	22,100
2035	30,800	25,100	24,600
2040	37,100	28,100	27,400
2045	43,800	30,800	29,900
2050	51,100	33,300	32,300
2055	59,600	36,000	35,000
2060	69,600	39,000	37,800
2065	81,400	42,200	40,900
2070	94,700	45,700	44,400

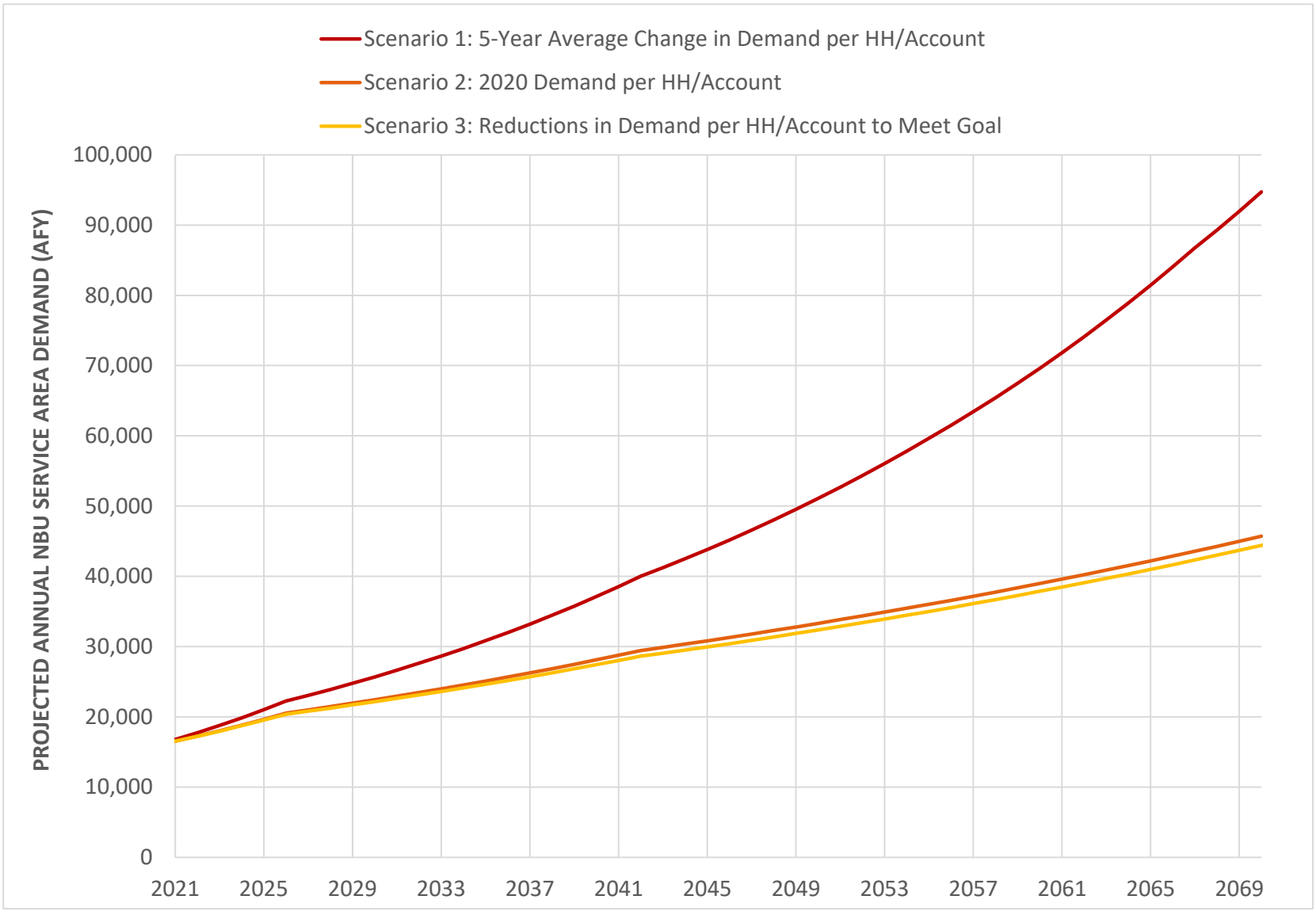


Figure 4-1: Projected Annual Water Demand Based Upon Conservation Scenarios (AFY)

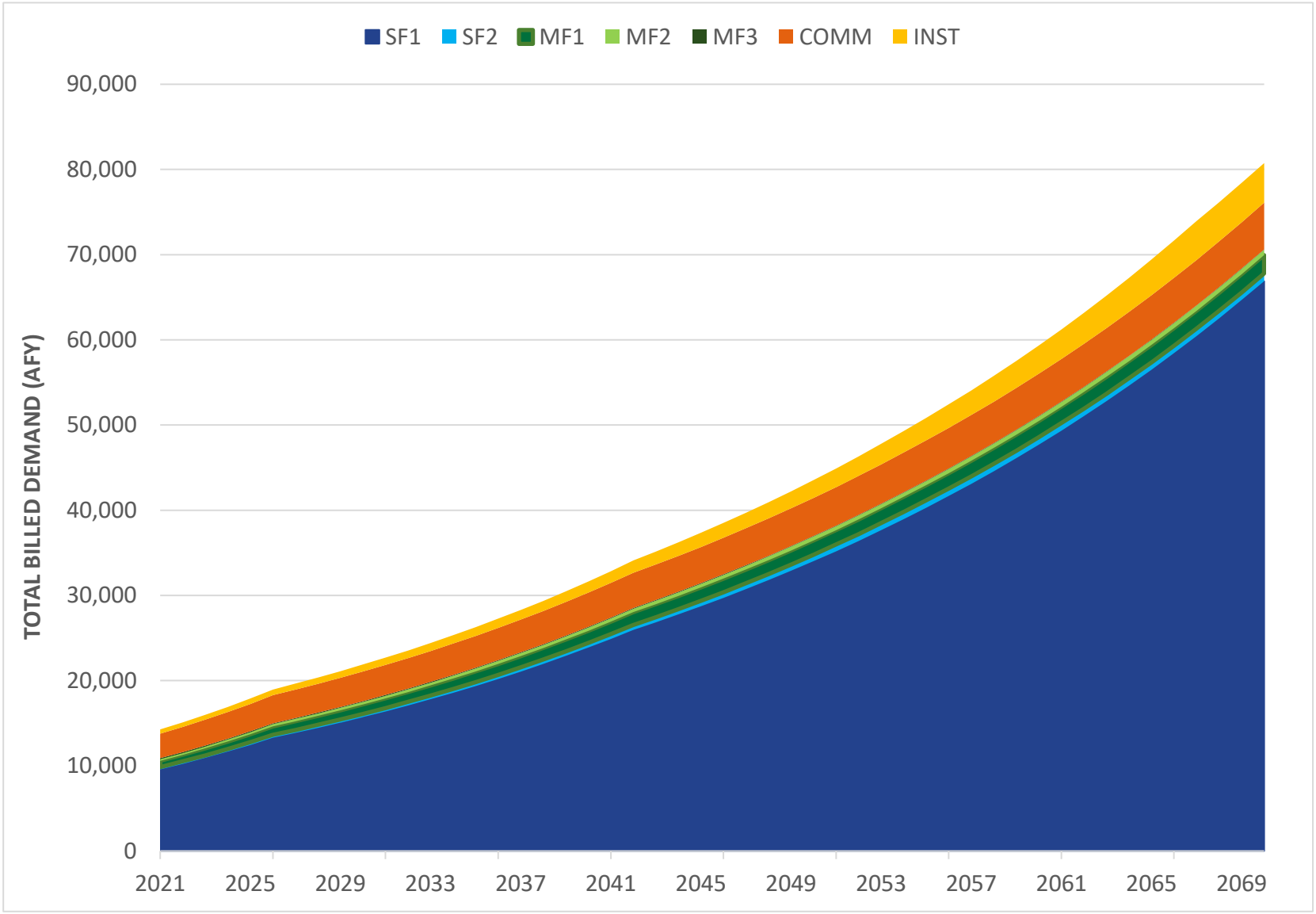


Figure 4-2: Scenario 1 Projected Billed Demand, by Customer Group

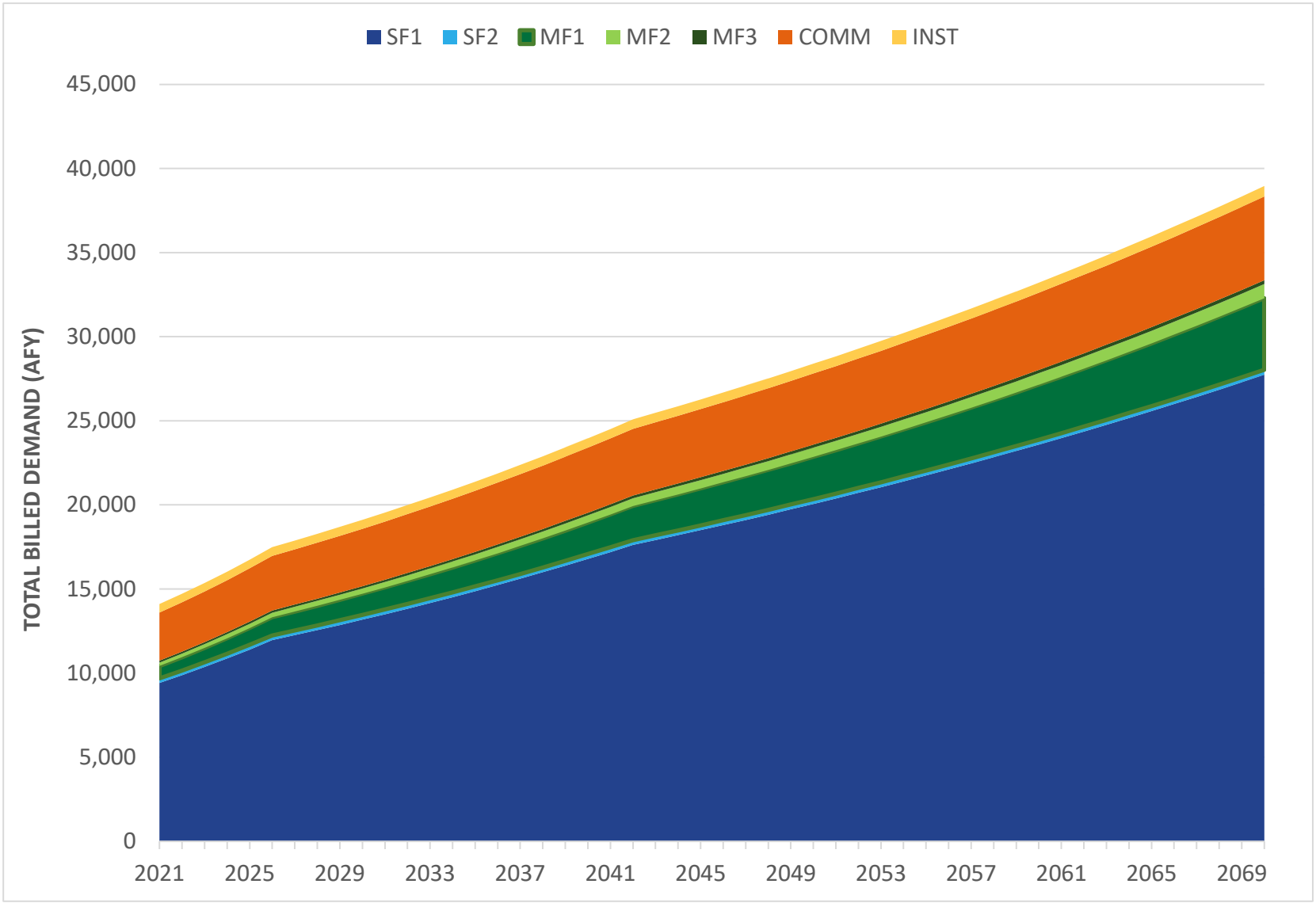


Figure 4-3: Scenario 2 Projected Billed Demand, by Customer Group

4.3 Sourced Water Per Capita Demand

Per capita demand refers to the volume of water used per person in the service area per day. For the purposes of this WRP Update, the per capita demand is based upon the total water sourced whereas other efforts (e.g., non-revenue water loss studies) consider the water produced (i.e., excluding water usage during treatment). Refer to the 2020 WRP Update for an in-depth explanation of the sourced water per capita demand calculation methodology. NBU has set an internal goal to reach a per capita demand of 120 gallons per capita per day (GPCD) by the year 2043.

4.3.1 Historical Sourced Water Per Capita Demand

Historical sourced water per capita demand for the years 2009 through 2020 is shown on **Figure 4-4**. As shown in the figure, the sourced water per capita demand decreased during the drought period (2009 – 2013). Since 2014, the per capita demand has ranged between 128 and 178, and the per capita demand in 2020 was 146. As shown by the demand changes per customer group (**Section 4.1.1**), recent increases in sourced water per capita demand may be due to increasing use by single family homes (e.g., a trend toward larger lot sizes) as well as increasing institutional and commercial usage. Separate consideration of a residential per capita demand would allow for further targeting conservation efforts. The residential sourced water per capita demand is also shown on **Figure 4-4**. As shown, residential sourced water per capita demand is slightly lower than the total system per capita demand but follows similar trends.

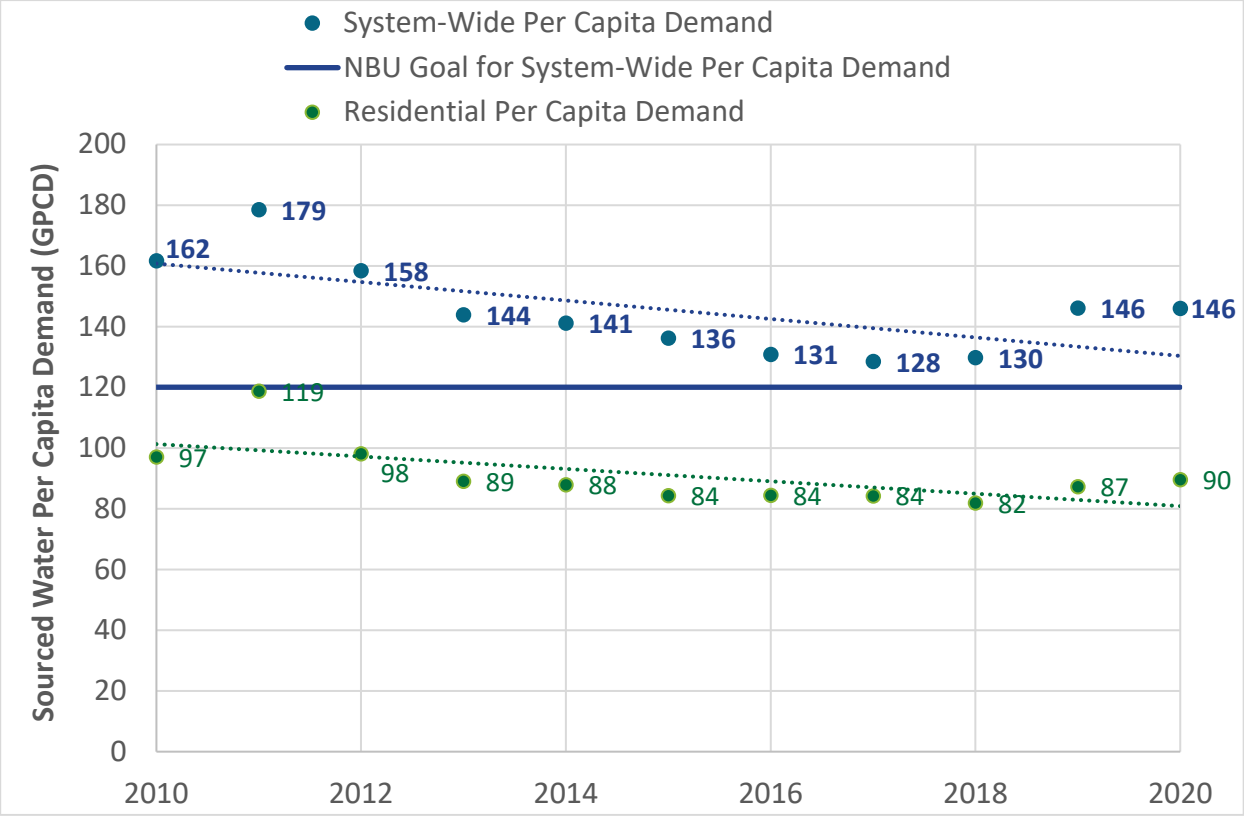


Figure 4-4: Historical Sourced Water Per Capita Demand in the NBU Service Area, 2010 - 2020

4.3.2 Projected Sourced Water Per Capita Demand

Projected sourced water per capita demand is shown in **Table 4-6**. The projected sourced water per capita demand in Scenario 1 is much higher than that shown in the previous WRP update. This is due to increased demand (based on a higher C_x for most residential customer groups), an increased water loss factor (rising from 12 percent to 15 percent), and a decreased projected population (based on lower 2020 growth in most customer groups). Small shifts in trends can have large effects on performance projected in 2070, when compounded over 50 years. Further, as discussed in **Section 6.2**, water use trends observed in 2020 may not be indicative of long-term water use trends. Regardless, these data demonstrate a large opportunity for meeting future water demands by focusing on conservation.

Table 4-6: Sourced Water Per Capita Demand Projections through 2070

Year	NBU Sourced Water Per Capita Demand Projection (GPCD)		
	Scenario 1: 5-Year Average Change in Demand per HH/Account[1]	Scenario 2: 2020 Demand per HH/Account	Scenario 3: Reductions in Demand per HH/Account to Meet Goal
2025	142	133	132
2030	149	130	128
2035	156	127	125
2040	165	125	122
2045	174	123	**119**[2]
2050	186	121	**118**
2055	198	**120**	**116**
2060	211	**118**	**115**
2065	225	**117**	**113**
2070	239	**115**	**112**

Notes:

1. According to the 2018 TWDB Regional Planning Water User Group Utility Summary Estimates, some utilities serving a similarly sized population in Texas (i.e., between 50,000 and 500,000 residents) have reached a per capita demand as high as 267 GPCD. However, the median per capita demand for medium-large and large utilities is 135 GPCD.
2. Bold green text signifies that this per capita demand is equal to or below NBU's system-wide per capita demand goal.

4.4 Irrigation Water Use

Shown in **Table 4-7** is the volume and proportion of water use due to irrigation each year. One concern for NBU has been that an increase in SF2 accounts (i.e., more larger single-family lots) may be contributing to an increase in irrigation water use. Irrigation in SF2 accounts is specifically shown in **Table 4-8**. However, work is ongoing to confirm bill codes for irrigation accounts. Thus, data presented should be considered preliminary.

Table 4-7: Preliminary Water Use due to Irrigation, 2010-2020

Year	Volume of Irrigation Water Use (AFY)	Percent of Total Water Metered
2010	385	3.9%
2011	420	3.5%
2012	344	3.2%
2013	346	3.4%
2014	342	3.3%
2015	357	3.4%
2016	371	3.4%
2017	437	3.7%
2018	439	3.6%
2019	533	4.0%
2020	525	3.8%

Table 4-8: Preliminary Water Use due to Irrigation for SF2 Accounts, 2010-2020

Year	Volume of Irrigation Water Use (AFY) for SF2 Account	Percent of Total Water Metered
2010	11.1	0.11%
2011	17.7	0.15%
2012	13.5	0.13%
2013	12.6	0.13%
2014	10.1	0.10%
2015	12.1	0.12%
2016	12.5	0.11%
2017	12.8	0.11%
2018	11.2	0.09%
2019	12.7	0.10%
2020	12.7	0.09%

5 Conservation and Water Management Programs

NBU has an internal team that focuses on implementation of conservation programs and non-revenue water reduction programs. In addition, NBU has begun development of a One Water program. Efforts are summarized herein. Although NBU has had significant success with conservation programs implemented to-date, the demand projection scenarios presented in this update show a large opportunity for expanded conservation programs to be a key component in NBU's water supply strategy.

5.1 Status of Conservation Efforts

In CY 2020, NBU began to pursue the following new conservation effort:

- **Geographically Organized Property Assessment (GOPA):** Through GOPA, NBU notifies customers via flyers of their water use as it compares to both their neighborhood, and the system as a whole. Based on this information, customers can assess and improve their own conservation efforts. The flyers also include information on NBU water conservation programs and NBU staff contact information. The program began in Fall 2020.

Descriptions of each of the ongoing conservation efforts are summarized in the 2020 WRP Update. Savings estimated by NBU due to conservation efforts are shown in **Table 5-1**. NBU has estimated an increased savings of 342 MG from 2019 to 2020, primarily due to the success of the continuous consumption alerts. Data presented are estimated potential savings due to implementation of these technologies; savings are not the estimated water lost.

Covid-19 Update: *From March 2020 to August 2020, most conservation and water management programs were suspended as part of NBU's Covid-19 response. This accounts for the decline in water savings by some programs between 2019 and 2020.*

Table 5-1: Status of Conservation Efforts

Conservation Strategy	Water Savings (MG)						
	2014	2015	2016	2017	2018	2019	2020
Top 30 Water User Initiative							On Hold Until Further Notice
Top 10 Water Violator Strategy							7.42
Rebates	2.5	3.3	1.8	1.7	3.4	2.4	1.07
Education and Outreach							
Home and Commercial Performance Assessments	0.69	0.59	1.8	2.2	1.7	1.3	0.82
Continuous Consumption Alerts				4.0	29.9	45.6	355.69
Drought Development and Enforcement							
Utilis Satellite Leak Detection					20	20	50.5

Conservation Strategy	Water Savings (MG)						
	2014	2015	2016	2017	2018	2019	2020
Total Savings per Year (MG/year)	**3.2**	**3.9**	**3.6**	**7.9**	**55**	**69**	**416**
Total Savings per Year (GPCD/year)	**0.12**	**0.13**	**0.12**	**0.25**	**1.6**	**1.9**	**11**
Total Cumulative Savings (MG)	**3.2**	**7.1**	**11**	**19**	**74**	**143**	**558**

5.2 One Water Initiative

NBU partnered with the CoNB and GBRA to develop a One Water program for the greater New Braunfels community. The Water Research Foundation (WRF) defines One Water as "an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, and meeting both community and ecosystem needs" (WRF, 2019). A working group was created by NBU in October 2019 and has been developing a One Water Roadmap specific to the challenges in New Braunfels. The Roadmap is undergoing final review and includes a vision and specific objectives, indicators, targets, strategies, actions, and evaluations to achieve that vision. NBU's water resources planning fulfills the following components of the One Water Roadmap:

Mission:	To ensure water remains a celebrated and protected feature of our community by collaboratively managing our water resources to safeguard watersheds, waterways, and groundwater.
Vision Element:	• Provide a sustainable and resilient water supply • Ensure water quality meets the standards for its intended use
Actionable Items:	• Increases integration of One Water • Reviews the diversification and resiliency of NBU's water portfolio • Plans for alternative water management strategies, including tracking NBU's Aquifer Storage and Recovery (ASR) demonstration project • Establishes a methodology for calculating per capita demand • Documents historical and forecasted per capita demand • Documents conservation programs and water savings • Tracks non-revenue water demand • Documents and tracks blending studies that aim to maintain NBU's Superior Drinking Water Rating as additional supplies are incorporated

5.3 Non-Revenue Water Program

NBU has developed a holistic and interdepartmental approach to managing non-revenue water (NRW), which began by assembling key stakeholders from NBU's water engineering, operations, and treatment and compliance teams, in addition to engaging the billing supervisor and environmental affairs manager. NBU contracted Arcadis

to review NBU's NRW performance and the strategies implemented to-date. Recommendations will include next steps for improving data quality and ultimately reducing NBU's NRW volume. Efforts to reduce NRW are part of NBU's strategy to reverse the current trend of increasing per capita demand and meet the per capita demand goal set in the 2018 WRP (see **Section 4.3**). Arcadis is currently completing a leakage component analysis (LCA), a computer-based model that will further study leakage and water loss in the NBU system using a "bottom-up" approach. This approach will allow NBU to pinpoint the specific causes of NRW in the system. NBU can then use the findings of the LCA to conduct an informed cost-benefit analysis of NRW reduction technologies and programs, and ultimately identify the most economical. These efforts are anticipated to be a part of the solution to decrease the per capita demand (**Section 4.3**) in the NBU service area.

5.4 Aquifer Storage and Recovery

NBU is also continuing to evaluate ASR as a water management strategy. When NBU's supply exceeds its demand, the excess supply can be injected into ASR wells and extracted during drought years, emergencies, and/or to meet peak demand. NBU is currently testing an initial demonstration well to confirm the reliability and volume of water that can be stored. The first cycle of ASR water recovery is anticipated to take place in September to October 2021; these data will be used to continue to assess the viability of the ASR supply. Insights learned in the coming years through demonstration testing should be included in future annual WRP updates.

6 Evaluation of Supply and Demand

NBU has established a diverse water supply inventory, robust demand management strategies, and innovative water management strategies. Regardless, NBU continues to evaluate available sources of water supply and the rapidly increasing water demand in the NBU water service area.

6.1 Updated Supply and Demand Projections

As shown in **Figure 6-1**, if water demand continues to grow at its current rate, annual demand will exceed the planned annual supply that is deliverable during a drought of record by as soon as 2042. If growth in demand per household or account does not increase from 2020 levels, the annual water supply will fulfill annual demand until 2063. Practically, it is possible that actual demand may fall between these two scenarios. Note that the supply scenarios shown in **Figure 6-1** assume a full utilization of firm yield surface water rights by 2028. Alternatively, if the existing SWTP is not expanded, demand would exceed supply by as early as 2035 (**Figure 6-2**); assuming a ten year period for design and construction of a greenfield water treatment plant, work would need to begin in 2025 (i.e., ahead of the current year planned for construction of the SWTP expansion).

Arcadis also reviewed demand on a monthly basis (see **Appendix C**).

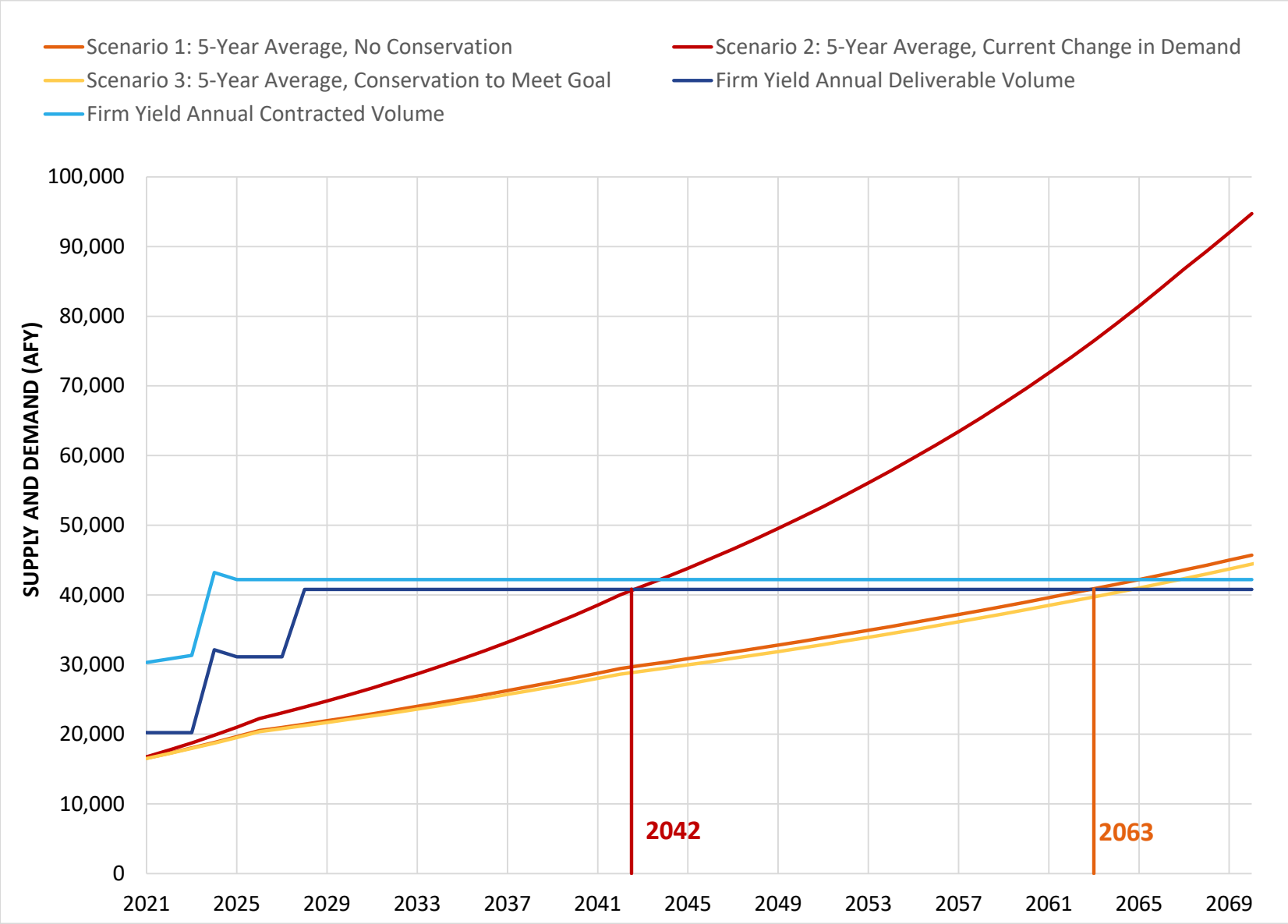


Figure 6-1: Annual Firm Yield Supply versus Demand

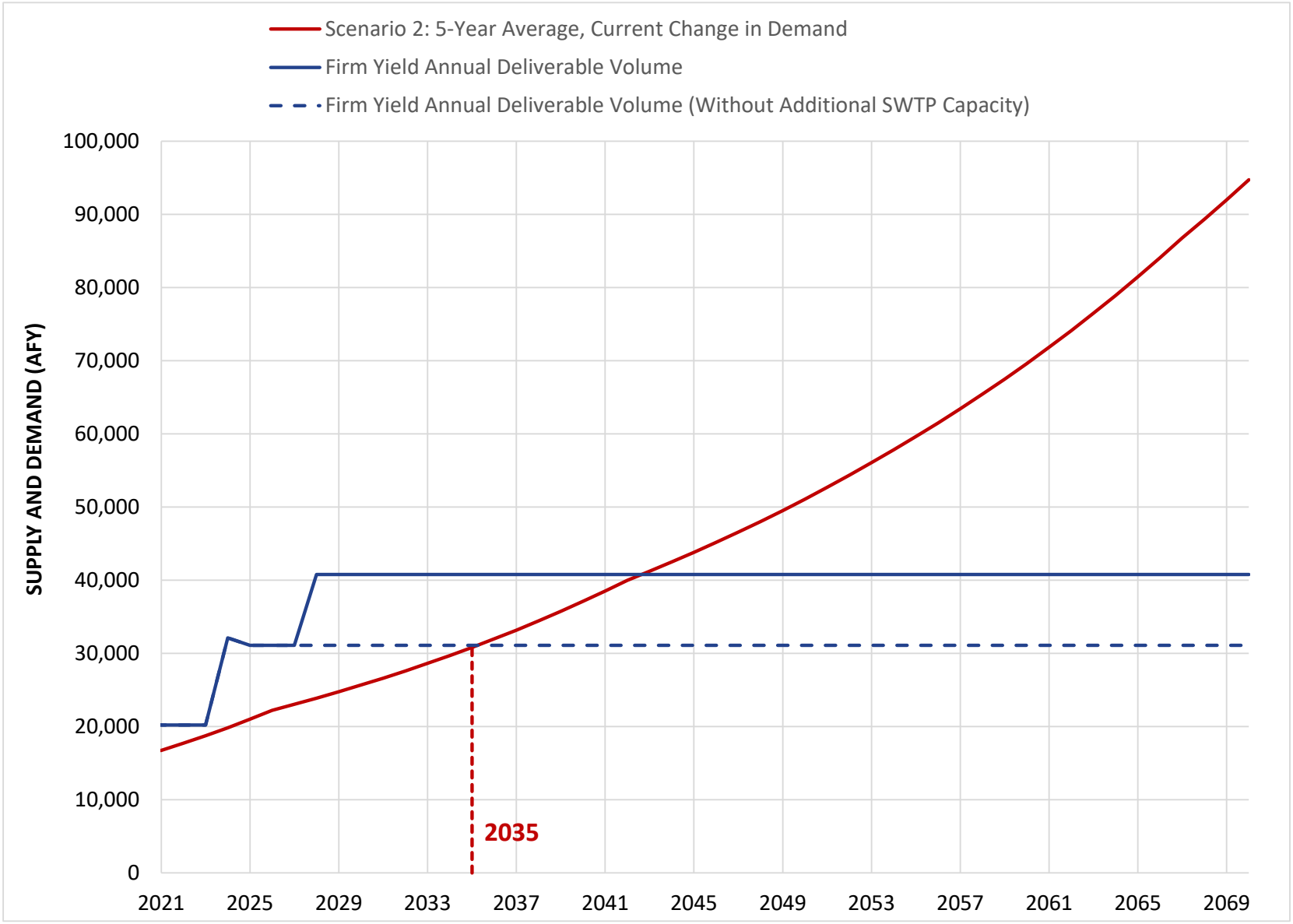


Figure 6-2: Annual Firm Yield Supply versus Demand without Additional Surface Water Treatment Capacity.

6.2 Analysis of 2020 Growth and Demand Trends

Figure 6-3 and **Figure 6-5** display growth for each customer group based on the number of accounts and total use, respectively. **Figure 6-4** and **Figure 6-6** focus in on the growth trends seen for the other customer groups, excluding SF1. In general, the growth trends and demand increase over the last five years (shown by dotted linear trend lines) appears to reasonably reflect the overall trends observed over the past 10 years.

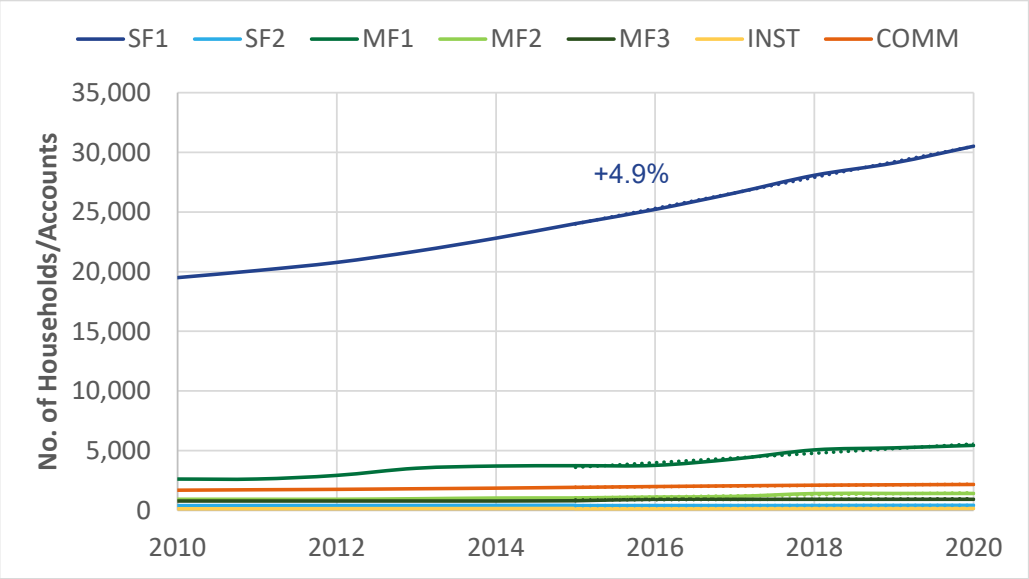


Figure 6-3: Change in No. of Households/Accounts per Customer Group from 2010 – 2020

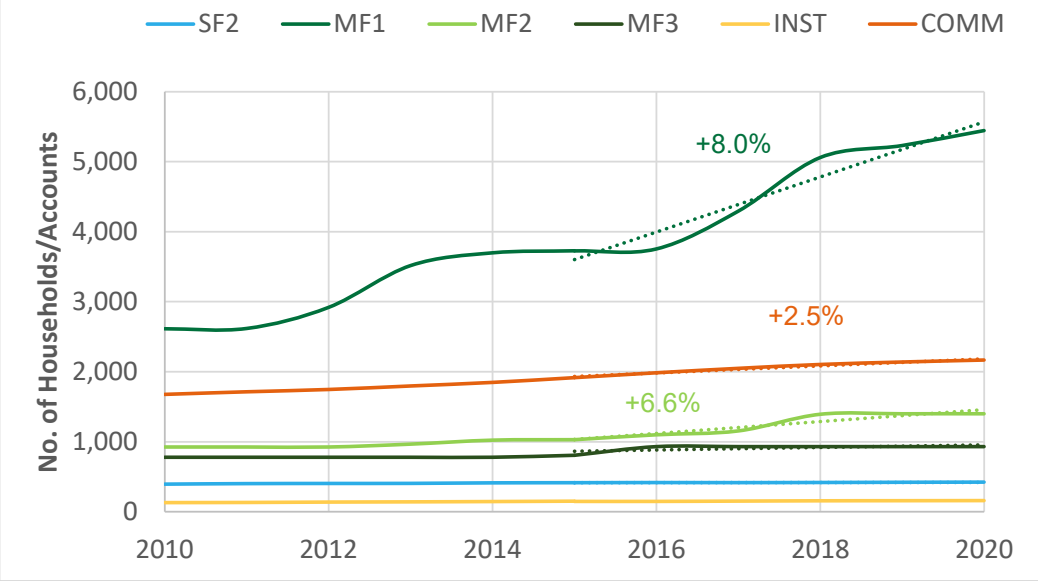


Figure 6-4: Change in No. of Households/Accounts per Customer Group from 2010 – 2020 (Excluding SF1)

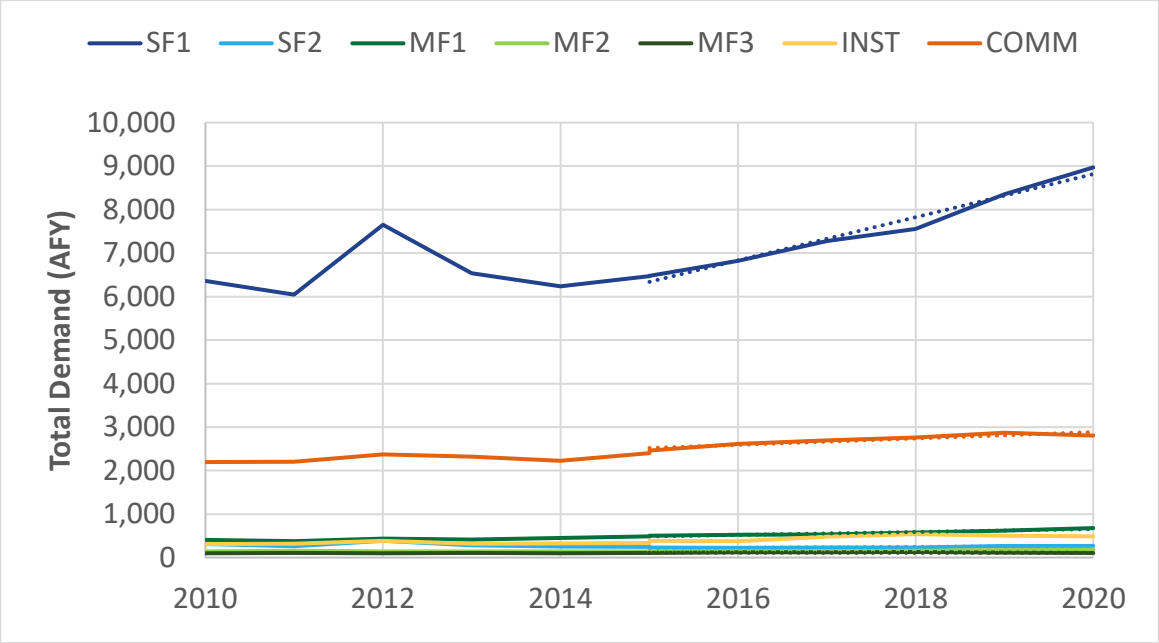


Figure 6-5: Change in Total Demand per Customer Group from 2010 – 2020

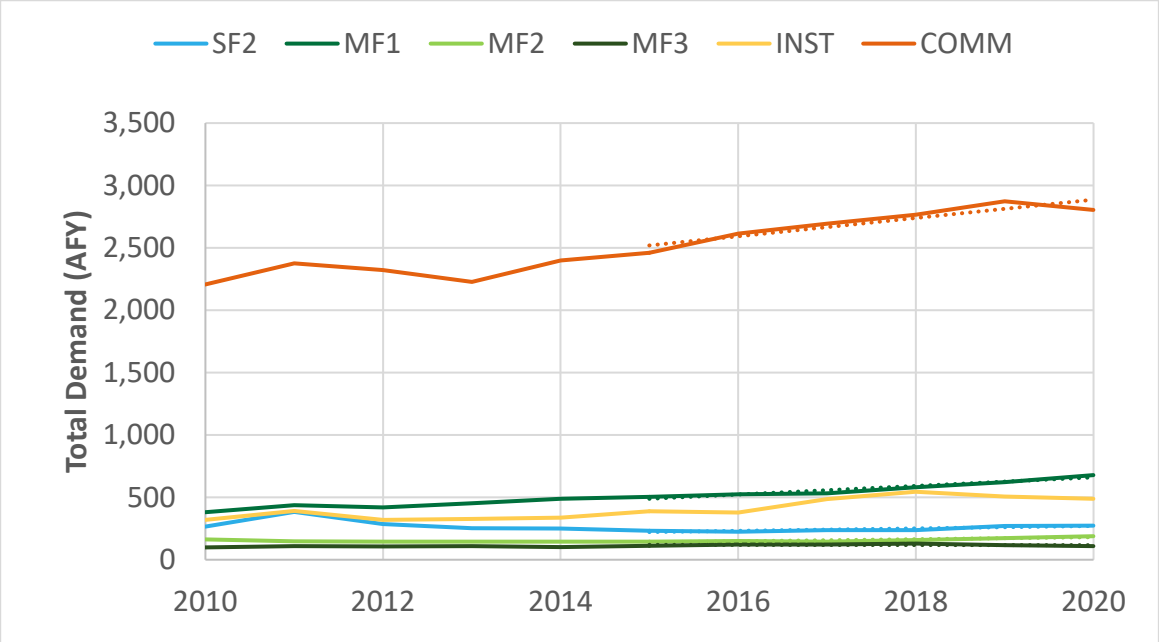


Figure 6-6: Change in Total Demand per Customer Group from 2010 – 2020 (Excluding SF1)

The demand per household or account over the course of the last ten years in shown in **Figure 6-7** (with a closer look at residential demand per household in **Figure 6-8**). The changes in growth and demand per household or account observed in 2020 may be a result of shifting behaviors due to Covid-19. For much of CY 2020, some residents worked or attended school from home, possibly leading to a rise in residential use and a decline in commercial and institutional water use. In addition, NBU updated the rate schedule in November 2020 (see

https://www.nbutexas.com/rate-change/). This could have affected water use at the end of the year. Thus, the impact of CY 2020 trends should continue to be assessed as data for the next few years become available.

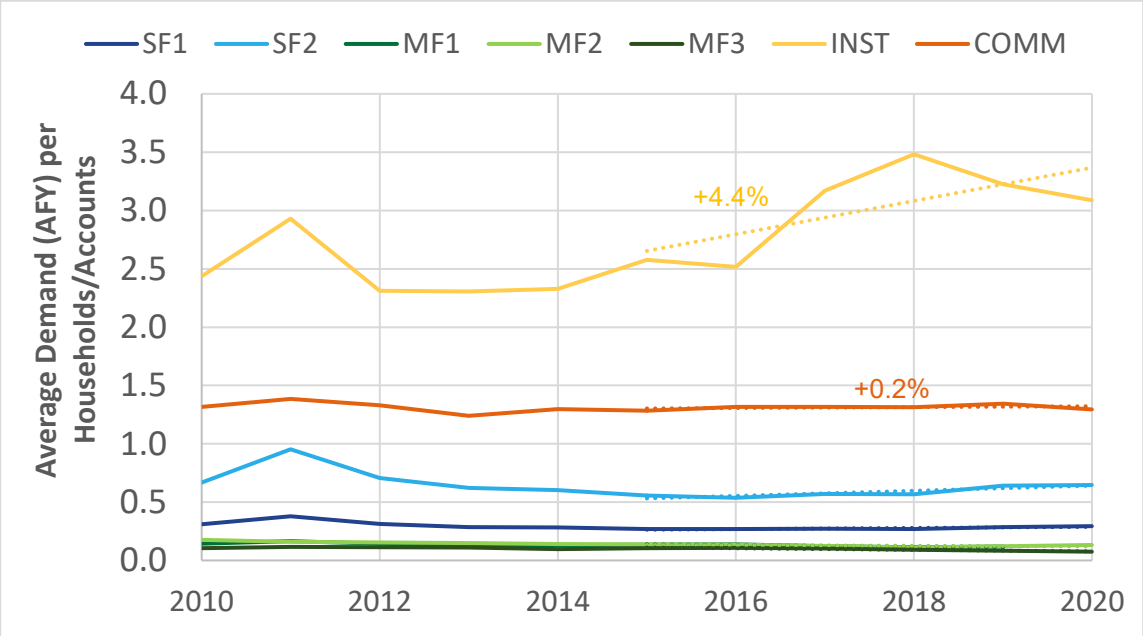


Figure 6-7: Average Demand (in MG) per Household/Account per Customer Group from 2010-2020

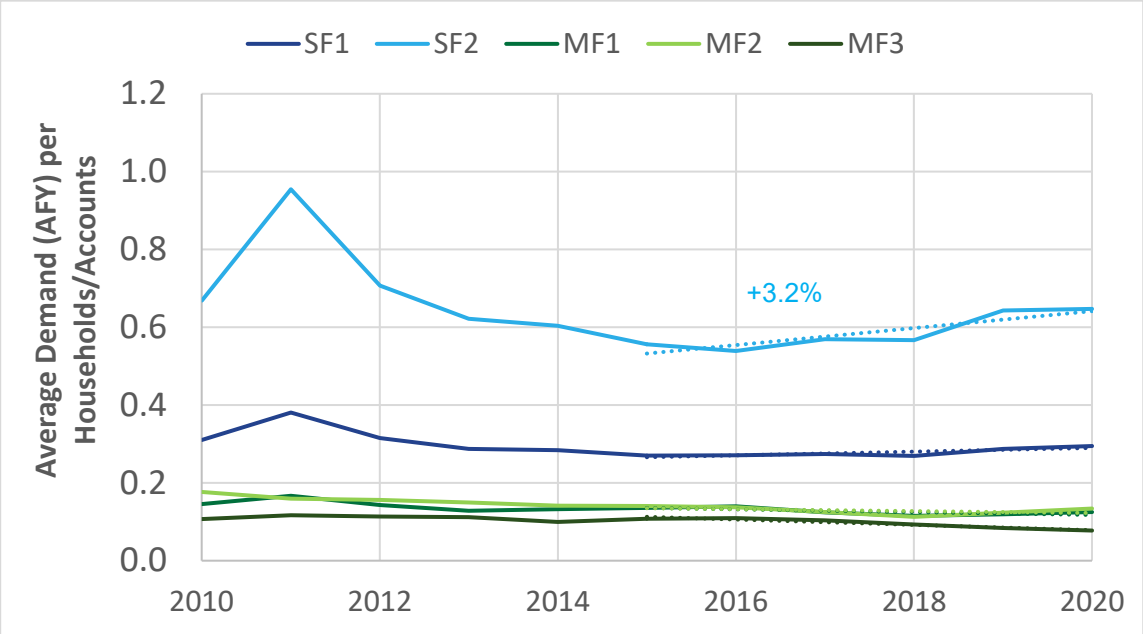


Figure 6-8: Average Demand (in MG) per Residential Household per Customer Group from 2010-2020

7 Water Supply Alternatives

No supply alternatives were evaluated as part of the 2021 WRP Update. The 2018 WRP includes information on the water supply alternatives considered previously, including construction timeframes, potential technical implementation issues, environmental considerations, permitting considerations, and forecasted project costs.

8 Water Quality Considerations

New water sources that are introduced into the NBU water system may impact water quality (e.g., corrosion control or nitrification). In addition to studies of other supplies discussed in prior updates, analysis of the GBRA Mid-Basin Project surface water is currently in progress. Preliminary results suggest that corrosion control could be required. Refer to prior WRP 2020 update for a more in-depth discussion of ongoing water quality considerations. Additionally, in 2021, NBU completed an update to the water supply, treatment, and distribution monitoring plans to incorporate water supply changes. The updated plan includes a water quality checklist for evaluating new water supplies.

9 Conclusions and Recommendations

Recommendations for future WRP updates and general water resources planning are summarized in sections below. Additionally, recommendations from prior studies that remain relevant are repeated. The scale of some updates will allow for incorporation into the next annual update, while the scale of other updates may be better suited for the next new WRP scheduled for 2023.

9.1 New 2021 WRP Update Recommendations

Based on the findings of the **2021 WRP Update,** recommendations for future WRP updates are summarized in the list below.

- Begin to analyze water demand and supply on a fiscal year (FY) basis to align data with other NBU planning studies.
- Consolidate customer groups (i.e., combine SF1 and SF2; combine MF1, MF2, and MF3).
- Track residential per capita demand and consider establishing separate per capita demand goals for system-wide demand and residential demand; facilitate a conversation about recommended per capita demand targets based on performance by other utilities as well as the commercial and large lot size growth anticipated in the NBU service area.
- Continue evaluating the likelihood of each demand scenario.
- Confer with the City of New Braunfels planning team on zoning change trends.
- Continue to expand resources dedicated to NBU's water conservation program as conservation will be a key strategy for meeting future demand.
- Examine bill codes in greater depth to confirm that irrigation is correctly categorized.
- Refine the existing Water Loss PowerBI Dashboard to include statistics related to water usage, such as:
    - Per capita demand (Sourced Water, Produced Water, and Residential)
    - Monthly number of accounts per customer group
    - Monthly water usage (total and by customer group)
    - Monthly water production
    - Monthly water sourced
- Evaluate water usage during treatment as additional data become available from the new SWTP flow meters.
- Continue evaluating NBU's water supply portfolio:
    - Evaluate next steps for NBU as the Seguin Interim contract expires.
    - Conduct a cost-benefit analysis for water supplies under consideration; consider whether NBU should pursue participation in the second phase of the GBRA MBP, which is anticipated to come

online in the 2030s, including the potential for getting this water at a reduced rate early and storing it in ASR (NBU-owned or jointly owned) until needed.

- Develop infrastructure to fully utilize surface water firm yield rights, including beginning initial environmental and land/easement acquisitions for the future Hueco Springs SWTP within the next fiscal year.

- Incorporate recommendations from the Resiliency Study and NRW studies.

In addition, consider the recommendations in **Section 9.2** through **Section 9.4**.

9.2 Relevant 2020 WRP Update Recommendations

Existing recommendations from the 2020 WRP Update that remain applicable and should be considered in addition to the above goals are repeated below. Goals that have been completed or are no longer applicable have been struck through; additional language added is shown in brackets.

- Consider the impact of the newly implemented rate change.
- Consider the short-term and long-term impacts of COVID-19 on population and demand projections.
    - ~~Re-evaluate the comparable cities on the IH-35 corridor to understand how their growth rates are changing.~~
    - ~~Evaluate the changes to demand and the higher-demand water users.~~
    - ~~Document the actions taken by NBU during the pandemic that could impact supply and demand.~~
- Consider projecting commercial and institutional account growth using employment projections rather than projecting historical growth rates.
- Consider new census data concerning the vacancy rates (i.e., V_X) and the numbers for people per household (i.e., P_X) for future updates; however, a sensitivity analysis should be conducted before these are implemented, in order to assess the impact of changing those values in 10-year increments (i.e., evaluation of whether the population increases more than it naturally should in a single year due to census changes).
- Continue to monitor the two-year average growth rates as a sensitivity check.
- ~~Conduct a resiliency study and incorporate its results.~~
- ~~Consider transitioning future non-revenue water calculations to follow the AWWA *Manual of Practice 36: Water Audits and Loss Control Program* recommendations.~~
- ~~Evaluate the steps that will need to be taken if the GBRA Mid-Basin Project delivery date is postponed to beyond 2023 by as much as one year.~~
- Begin negotiations with GBRA to establish the second SWTP diversion location and the maximum diversion rate for the second diversion location.

9.3 Relevant 2019 WRP Update Recommendations

Existing recommendations from the 2019 WRP Update that remain applicable and should be considered in addition to the above goals are repeated below. Goals that have been completed or are no longer applicable have been struck through; additional language added is shown in brackets.

- ~~Beginning with the 2020 WRP Update, implement, expand upon and validate the new methodology for calculating the NBU water service area population and projecting demand summarized in this 2019 WRP Update.~~
- ~~Update the NBU water service area population formula to incorporate the actual number of units included in each multifamily account based upon NBU billing data.~~
- ~~Update all data to include 2019 and use the most recent data sources and sorting formulas identified during the 2019 WRP Update.~~
- ~~Update the distribution water loss factor and the production water loss factor based upon the most recent flow data, including the SWTP effluent flow from the new meter as data become available.~~
- ~~Analyze the annual GPCD reduction achieved by current conservation programs and compare to the desired GPCD reduction~~.
- Incorporate One Water goals and strategies, as applicable for effective water resources planning.
- ~~Calibrate the demand model to account for the maximum possible growth for each account type based upon NBU's projected future water service area and projected land use. It may be advantageous to schedule this in parallel with the next Impact Fee Update beginning in Fall of 2020.~~
- Further refine the estimates for the years in which the growth rates decrease. The current years were visually selected, based on growth trends in similarly-sized communities located in Central Texas along Interstate 35.
- ~~Further refine the estimates for sustainable capacities of the SWTP and Trinity Wellfield GWTP using historical data.~~
- ~~Provide a monthly supply and demand breakdown for planning purposes, showing each source's availability and historical demand per month.~~
- Additional 2019 WRP Update recommendations related to water resources planning are summarized below.
    - Currently, there is no limitation on how much water NBU can produce from its Trinity Aquifer wells; however, the Comal Trinity Groundwater Conservation District (CTGCD) has begun to put rules in place to regulate water production in the Trinity Aquifer. Production limits have still not been imposed but may be imposed in the future. NBU should increase its involvement with the CTGCD, to allow for closely monitoring and influencing the decision-making process moving forward.

- Stay informed about the implementation of the Mid-Basin Project to assure that the Project will be properly operated and maintained as a valuable, long-term regional water supply source. Closely monitor the status of the design, permitting, right-of-way (ROW) acquisition, and construction of the GBRA Mid-Basin project to confirm it is on schedule for delivery in ~~2023~~ [prior to summer 2024]. [If the schedule is delayed, evaluate potential next steps.]
- Stay actively involved in the South Central Texas Regional Water Planning Group and the Group's regional planning process and continue to lead and participate in regional One Water planning activities.
- Continue to participate in technical water organizations, such as the AWWA and the Texas Water Conservation Association (TWCA). Through these and other avenues, stay informed on innovative water supply and treatment technologies, and periodically evaluate the viability of such technologies, such as direct potable reuse.

9.4 Relevant 2018 WRP Recommendations

Existing recommendations from the 2018 Water Resources Plan that remain applicable and should be considered in addition to the above goals are repeated below. Goals that have been completed or are no longer applicable have been struck through; additional language added is shown in brackets.

- On an annual basis, review actual population and water use data (total, per capita and peak day water use) and compare those data to the assumptions used in the 2018 Water Resources Plan. As necessary, but not less than once every five years, update the Water Resources Plan to determine if the implementation of supply projects can be delayed or if projects need to be accelerated.
- Continue to pursue the ASR program through a process of demonstration and evaluation, followed by the first full-scale ASR well. One of the benefits of ASR is the ability to make decisions and implement aquifer storage and recovery in measured stages. Each phase provides additional data and information for informed decision making. For NBU, the next major steps include: ~~completion of the current TWDB-funded demonstration project, including data analysis and reporting; getting legislative authorizations necessary to store blended surface and groundwater from the NBU distribution system; permitting the first "experimental" ASR well with TCEQ and construction of that well~~; construction of additional monitor wells, as required in the Interlocal Agreement with EAA; cycle testing to confirm recharge and recovery rates, and gather additional data; [development of an analytical model;] permitting the full-scale operation of the first ASR well with TCEQ; and construction of additional ASR wells.
- Continue to use water conservation and demand management measures to reduce per capita unit demand to at least [120]~~125~~ GPCD by 2043. NBU has a history of innovation and being on the "cutting edge" of modern technologies. That approach is especially important in seeking new ways to save water and stretch existing supplies. [In addition, continue to pursue One Water after the roadmap has been completed.]
- ~~Contract with GBRA for a firm-yield supply of 8,000 AFY of water from the Mid-Basin Project, taking care to make sure that the contract includes provisions that give NBU the ancillary rights and privileges related to getting access to future GBRA water sources.~~
- ~~Initiate [Complete the] preliminary design for the expansion of the existing SWTP. Preparing a Preliminary Engineering Report (PER) is important for decision-making, especially if the expansion is~~

~~warranted as soon as expected.~~ [Complete permitting and begin construction of the expansion of the existing SWTP as soon as possible. In parallel, proceed with environmental and field assessments needed to procure the property and easements needed for the Hueco Springs SWTP site, as described in **Section 9.5**, in case TCEQ does not approve construction of the expansion of the existing SWTP within the floodplain in the future.] As discussed above, expanding the SWTP provides multiple benefits, which include: improving the reliability of the NBU ROR water rights; providing a means to more quickly build storage in an ASR wellfield; [providing additional peaking capacity;] and providing the ability to utilize additional Canyon Reservoir water ~~following GBRA's implementing the Lower Basin Project~~.

- Closely monitor the treated water quality and quantity from the Trinity Aquifer treatment plant ~~currently under construction. The results of the first phase of that project will confirm the viability of the expansion of the Trinity Aquifer Wellfield as a future water source~~. [Proceed with expanding the Trinity Wellfield and Membrane WTP].
- ~~Purchase any needed well sites for the expansion of the Trinity Aquifer Wellfield, as soon as the suitability of the first phase of that project is confirmed.~~
- Monitor the status of GBRA's Lower Basin [off-channel reservoir] project, and the availability of water from other GBRA projects. If GBRA implements the Lower Basin ~~off-channel reservoir~~ project in Calhoun County, NBU should take advantage of its contract for additional water from Canyon Reservoir. [During contract negotiations, consider delaying purchase of the water until SWTP No. 2 is constructed.]
- Before new water sources are introduced into the NBU distribution system, ~~review the recommendations in Subsection 8.4.2 above. Use those recommendations~~ conduct a blending study to evaluate the potential impacts of the new source(s) and the changes influenced by new blending ratios between [different] treated surface water[s] and ~~different~~ groundwaters.

9.5 2014 Phase 1 Water Resources Report Relevant Recommendations

In the **2014 Draft Phase 1 Water Resources Report**, Arcadis made three recommendations related to the implementation of SWTP No. 2 (Hueco Springs). Those recommendations are restated below for reference.

- After additional study, purchase the property and ROW necessary for the diversion pump station and raw water pipeline for SWTP No. 2. The cost of this land acquisition will continue to increase in the future. Property on the Guadalupe River for the diversion pump station and easements for the pipeline will be expensive, but the time to purchase those assets is before they are needed in a hurry. Based on previous NBU studies, the diversion point will likely be located somewhere between the First Crossing bridge and the Second Crossing bridge.
- Continue to periodically evaluate the need for the design and construction of SWTP No. 2. The need for that plant will most likely be triggered by factors such as: the availability of significantly more Canyon Reservoir stored water; [opportunities to partner with another water utility to reduce NBU's design and construction costs, as well as O&M expenses]; and/or significant growth in customer demand on the north side of NBU's system, which makes it more feasible to build SWTP No. 2, rather than constructing new distribution piping.

Continue to evaluate the best source of raw water for SWTP No. 2 and take any necessary steps to get the needed authorizations. One important consideration in the permitting of SWTP No. 2 will be the TCEQ requirement to amend NBU's ROR water rights and/or its GBRA contracts to have the authority to divert water from the Guadalupe River at a new raw water intake location. It is likely that GBRA will be agreeable to amending the NBU water supply contracts to authorize a second point of diversion. In fact, an upstream diversion point closer to Canyon Dam is beneficial to GBRA because it reduces the instream losses that GBRA must compensate for in its deliveries of water to NBU. Amending the ~~COAs~~ [NBU ROR water rights] to add an upstream diversion point will be much more complicated. Any time a TCEQ water right is opened for amendment, there are opportunities for TCEQ to impose more restrictive special conditions related to environmental flows and/or senior water rights. If TCEQ determines that public notice must be given for the amendment application to be processed, there are also opportunities for other water rights holders to object to the amendment and request a hearing. TCEQ may also want to impose limitations on how the current diversion rates are allocated between the existing SWTP diversion point and the second diversion point at SWTP No. 2. Given the volumes of water authorized under the TCEQ certificates and the GBRA contracts, it may be prudent for NBU to supply the second WTP solely from its GBRA contracts.

10 References

Previous references are still applicable.

AWWA Subcommittee on Periodical Publication of the Membrane Process Committee. (2008, December). *"Microfiltration and ultrafiltration membranes for drinking water".* AWWA.

Freese and Nichols, Inc. (2021, June). "New Braunfels Utilities Buildout TCEQ Connections" "[Presentation].

Texas Water Development Board. (2020, June 15). Regional Water Planning Water User Group (WUG) Utility - Summary Estimates.

Appendix A

FNI Master Plan Draft Comparison

Memo

SUBJECT
NBU Water Master Plan Draft Comparison

DATE
July 2021

The 2021 NBU Water Master Plan is currently in progress. This document is evaluating the system's ability to meet peak day demands of individual pressure zones. In contrast, the WRP and subsequent WRP Updates, as well as the SWTP No. 2 Feasibility Study discussed in Section 2.2.1, evaluate NBU's ability to meet the annual water supply demands of the entire system. Annual supply and demand are not analogous to the daily pumping (i.e., delivery) capacity of the NBU system and the peak day demand. The capacities and demands being examined in greater depth in the NBU Master Plan focus on the ability to deliver water where and when it is needed. **Table 1** compares the average daily demand (based on the annual projected demand across the entire NBU service area) and the peak day projected demand, per the 2021 NBU Water Master Plan draft. Note that peak day projections are only available through 2045. Based on the NBU Water Master Plan, it appears that NBU needs additional peaking capacity as well as pumping and distribution capacity prior to the dates when NBU has need for additional water supplies to meet annual demand. The NBU Master Plan will be officially published in 2021. Values listed in the completed NBU Master Plan will replace any draft values included in this report.

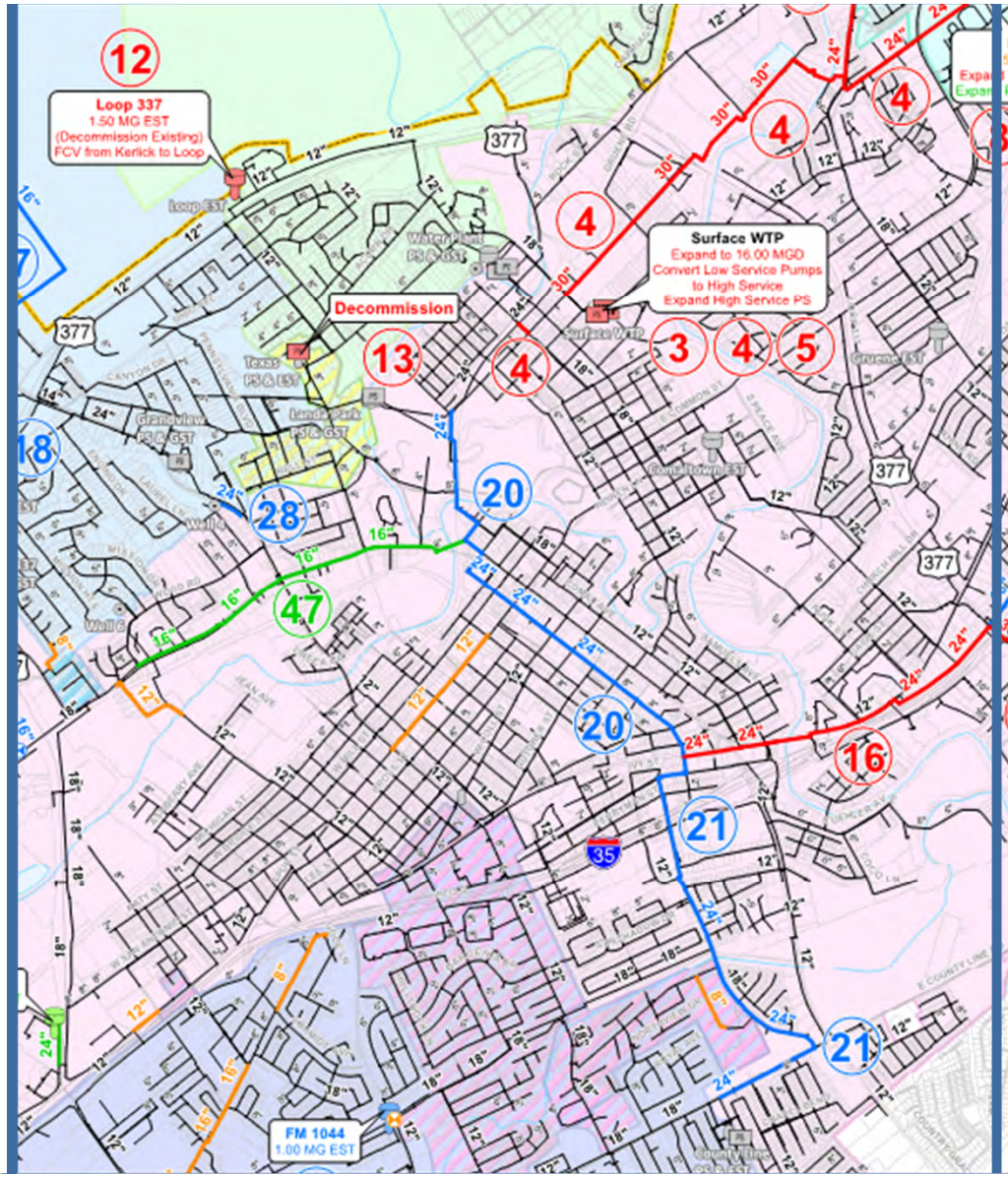
Table 1: Comparison of Daily Demand, 2021 WRP Update vs. 2021 Waster Master Plan Draft

Year	Average Annual Day Projected Demand per 2021 WRP Update (MGD)	Peak Day Projected Demand, per June 2021 Water Master Plan Draft (MGD)
2021	15.0	31.5
2022	15.8	33.0
2023	16.7	34.5
2024	17.7	36.1
2025	18.8	37.8
2026	19.9	39.0
2027	20.6	40.1
2028	21.3	41.3
2029	22.1	42.4
2030	22.9	43.6
2031	23.8	44.8
2032	24.7	46.0
2033	25.6	47.1

Year	Average Annual Day Projected Demand per 2021 WRP Update (MGD)	Peak Day Projected Demand, per June 2021 Water Master Plan Draft (MGD)
2034	26.5	48.3
2035	27.5	49.5
2036	28.6	50.7
2037	29.6	51.9
2038	30.8	53.0
2039	31.9	54.2
2040	33.1	55.4
2041	34.4	56.6
2042	35.7	57.8
2043	36.8	59.0
2044	37.9	60.1
2045	39.1	61.3

Appendix B

FNI Microsoft PowerPoint Presentation, “Buildout TCEQ Connections”

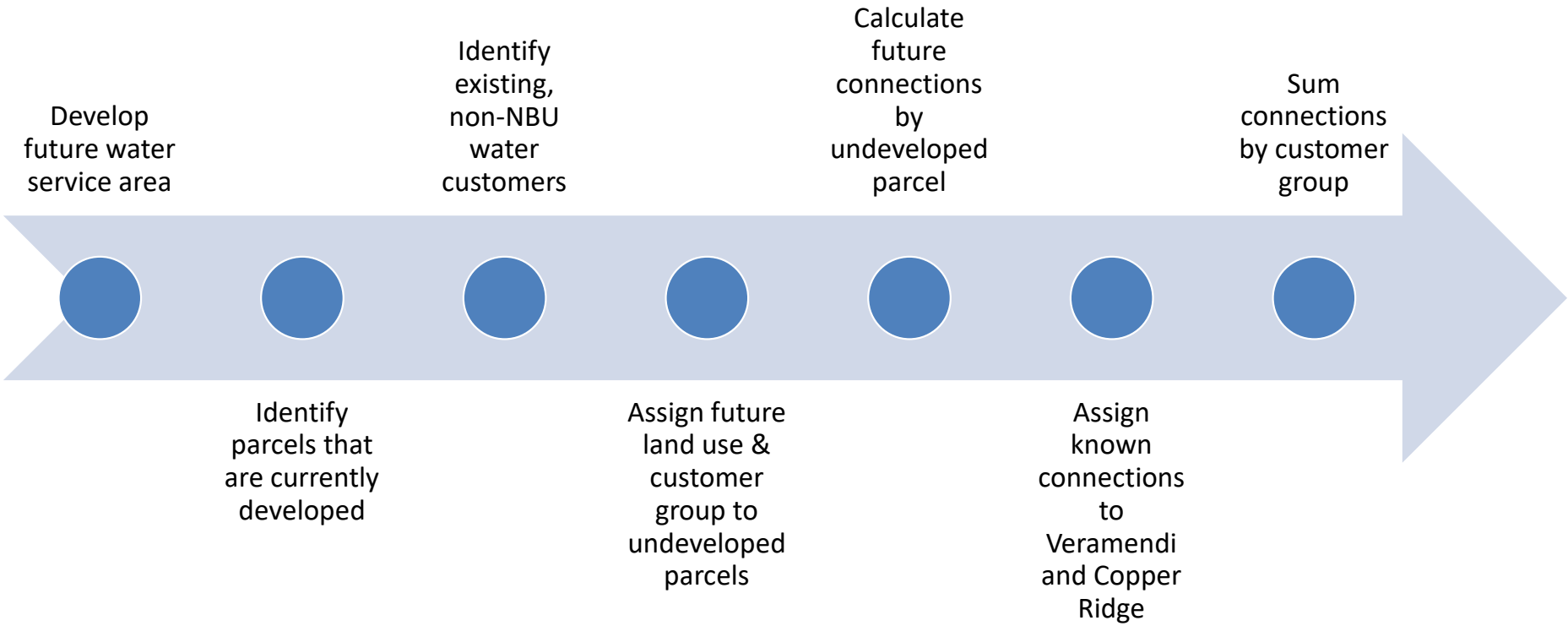


NEW BRAUNFELS UTILITIES

BUILDOUT TCEQ CONNECTIONS

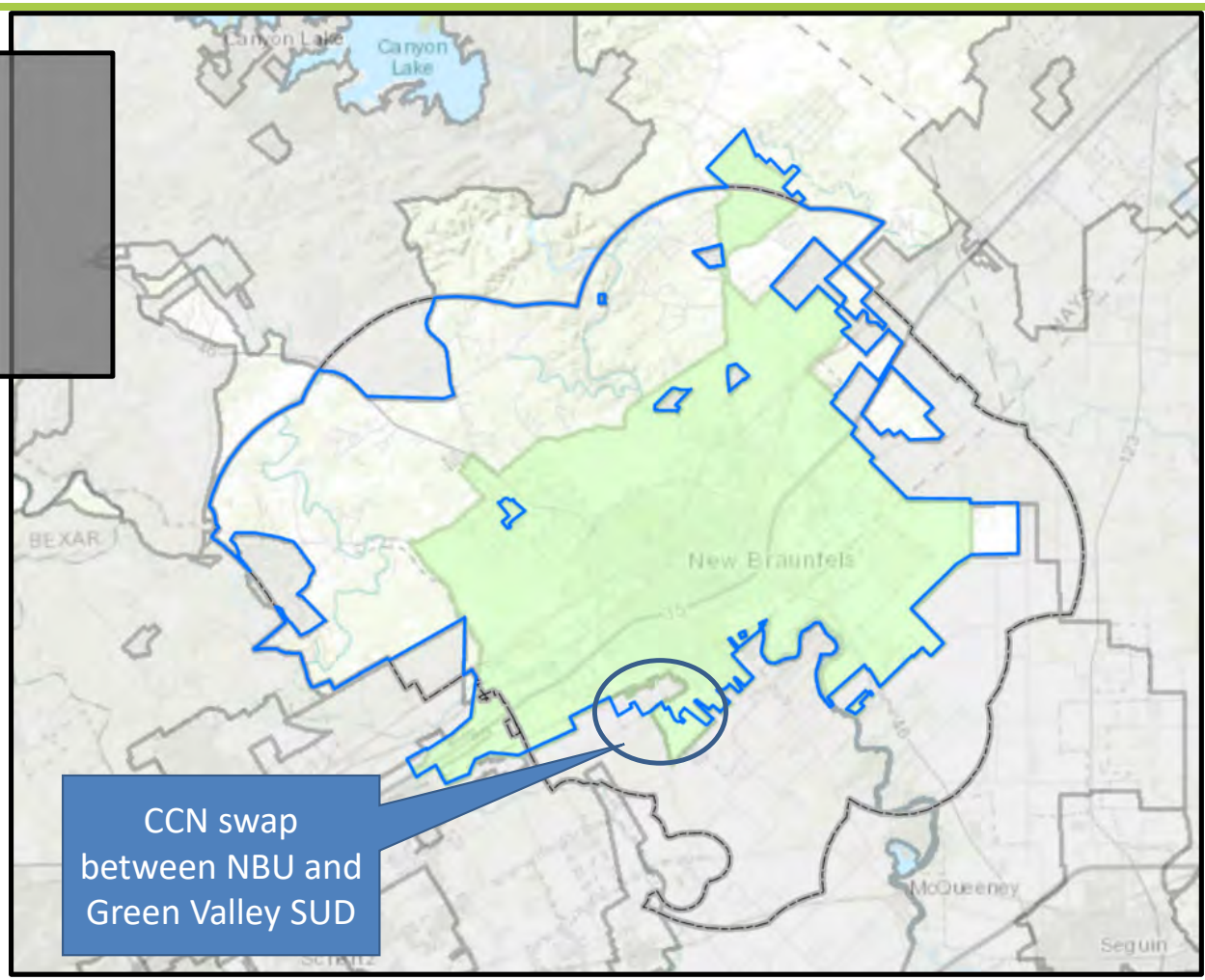
FREESE AND NICHOLS

BUILDOUT PROJECTIONS METHODOLOGY



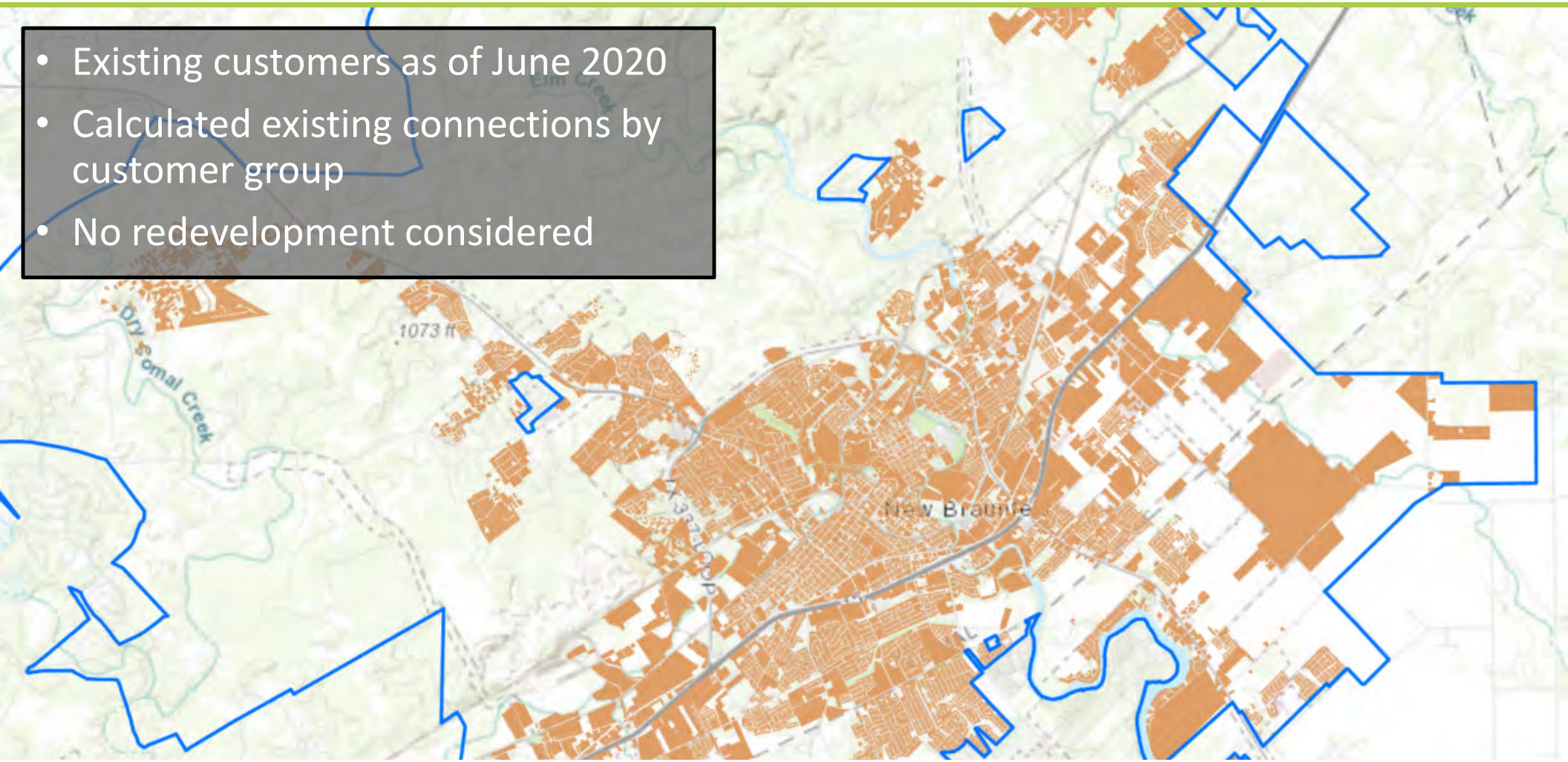
FUTURE WATER SERVICE AREA

- ETJ excluding other CCNs
- CCN swap between NBU and Green Valley SUD
- GLO included

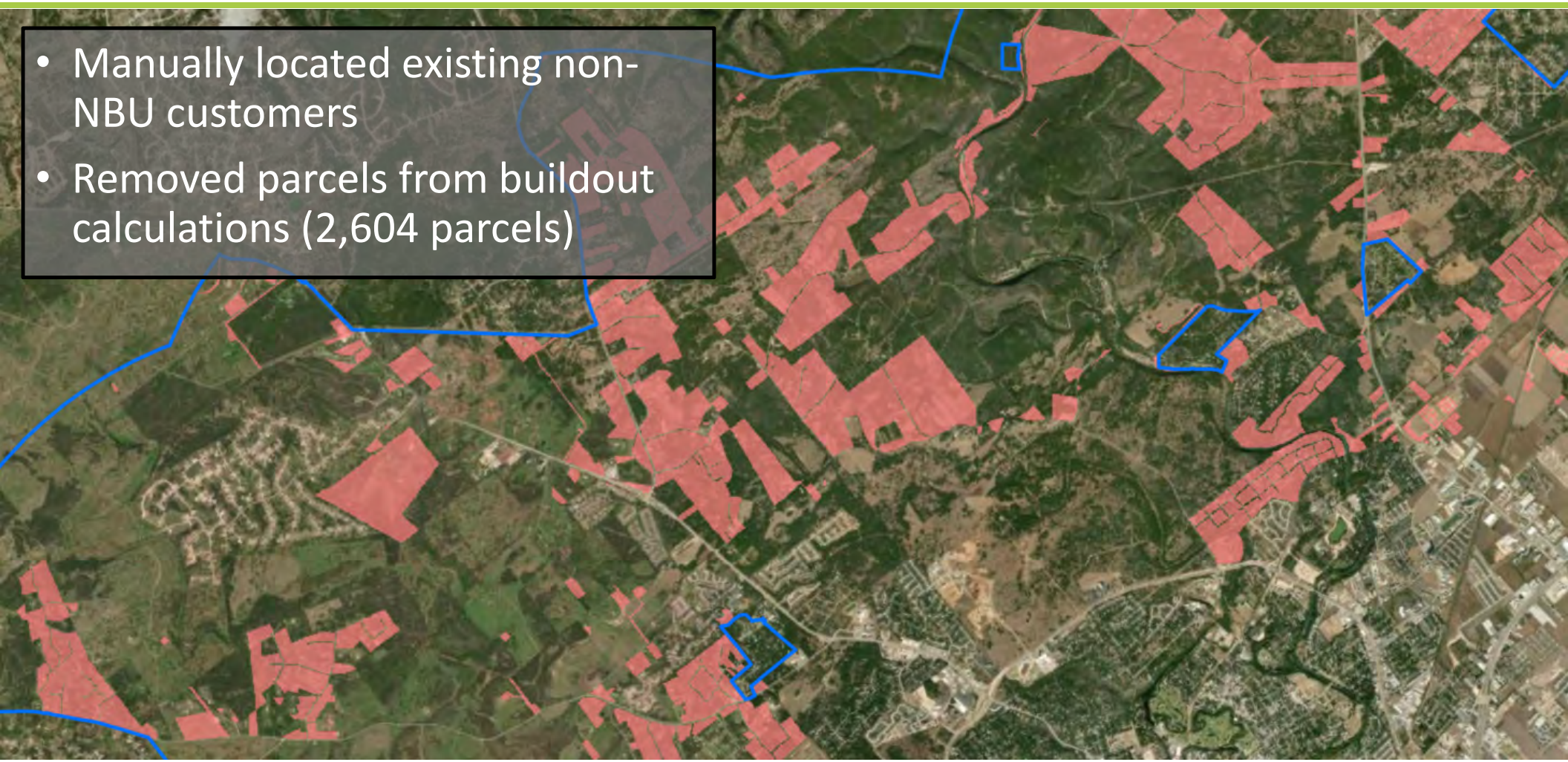


DEVELOPED PARCELS

- Existing customers as of June 2020
- Calculated existing connections by customer group
- No redevelopment considered

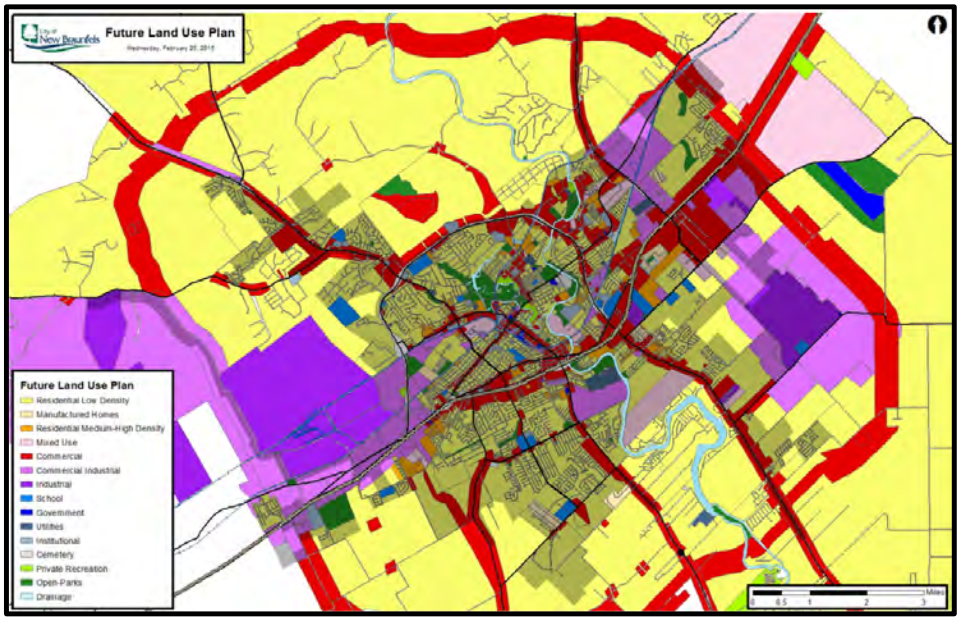


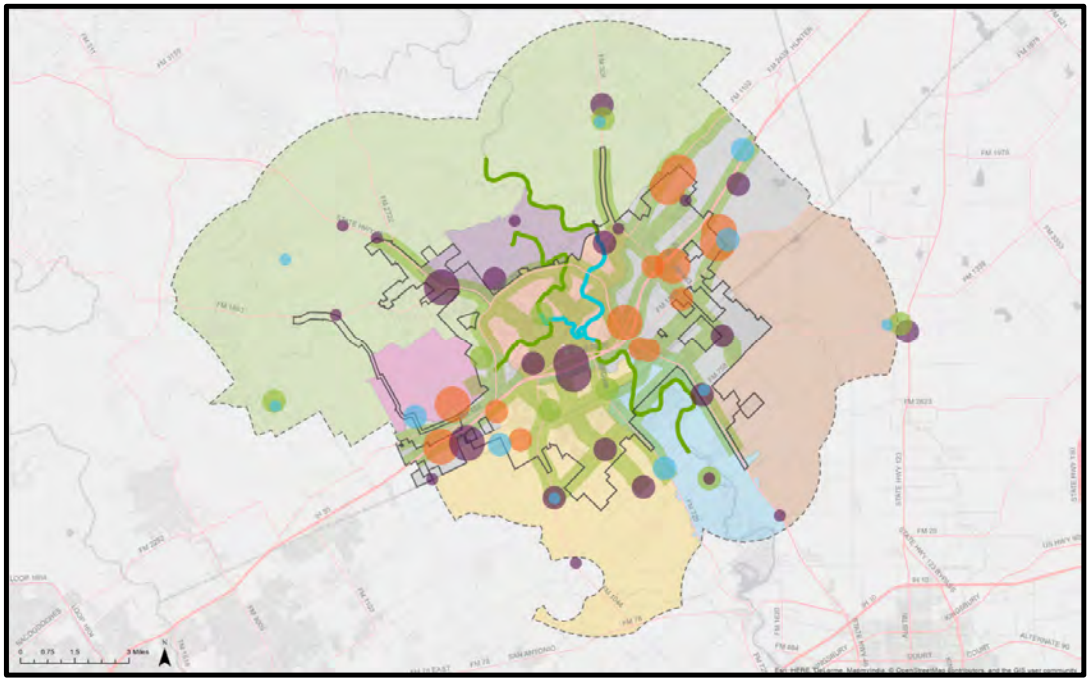
NON-NBU WATER CUSTOMERS



FUTURE LAND USE PLANS

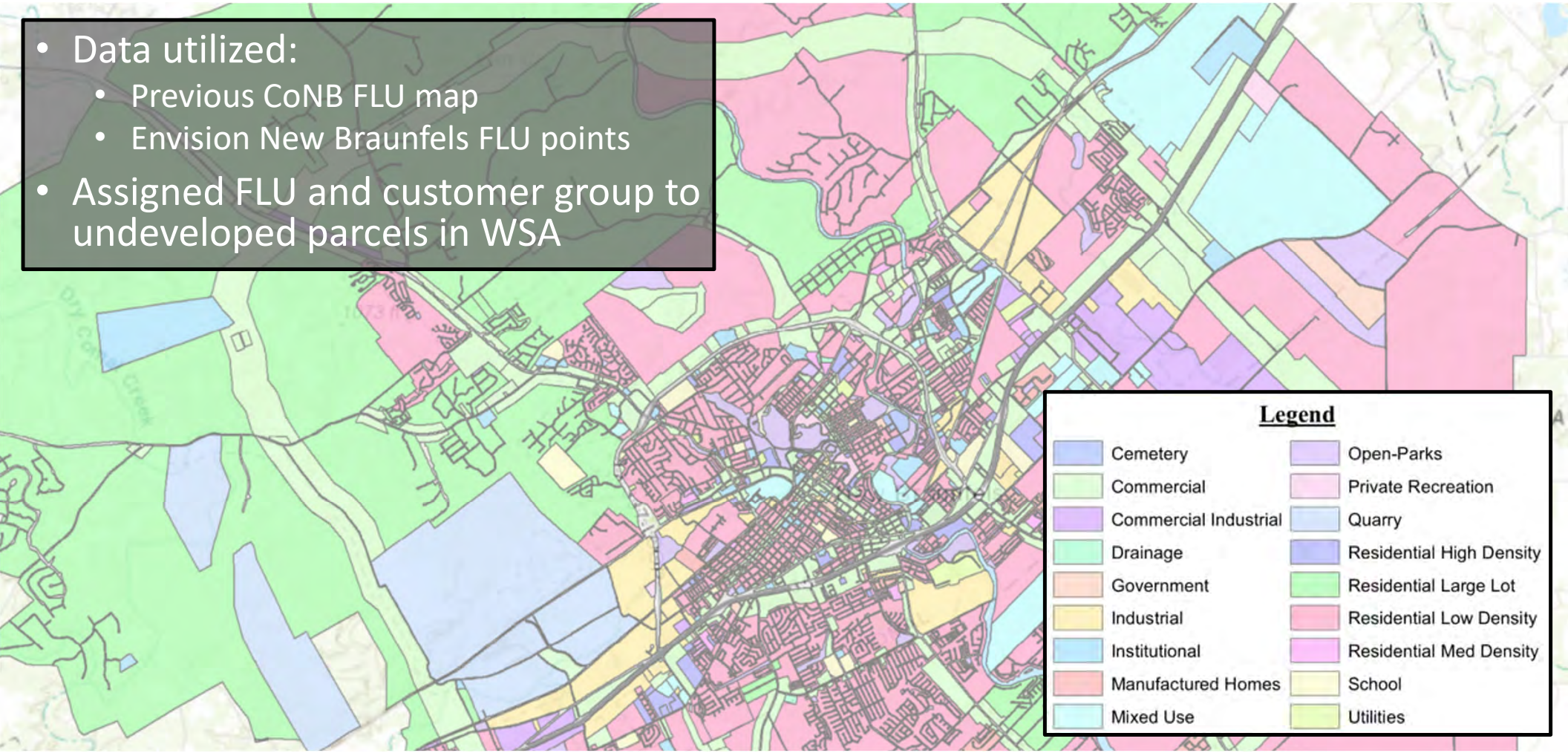
- Data utilized:
  - Previous CoNB FLU map
  - Envision New Braunfels FLU points
- Assigned FLU and customer group to undeveloped parcels in WSA





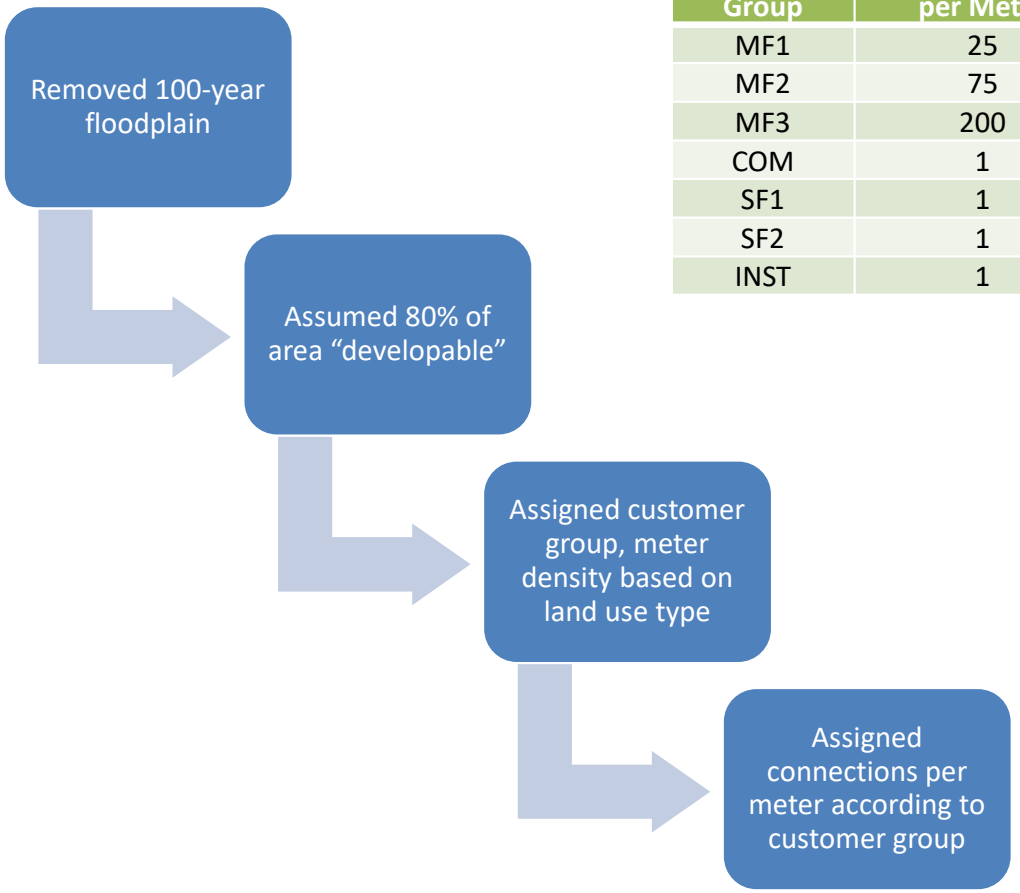
FUTURE LAND USE PLANS

- Data utilized:
  - Previous CoNB FLU map
  - Envision New Braunfels FLU points
- Assigned FLU and customer group to undeveloped parcels in WSA



TCEQ CONNECTION CALCULATIONS

FOR EACH UNDEVELOPED PARCEL:

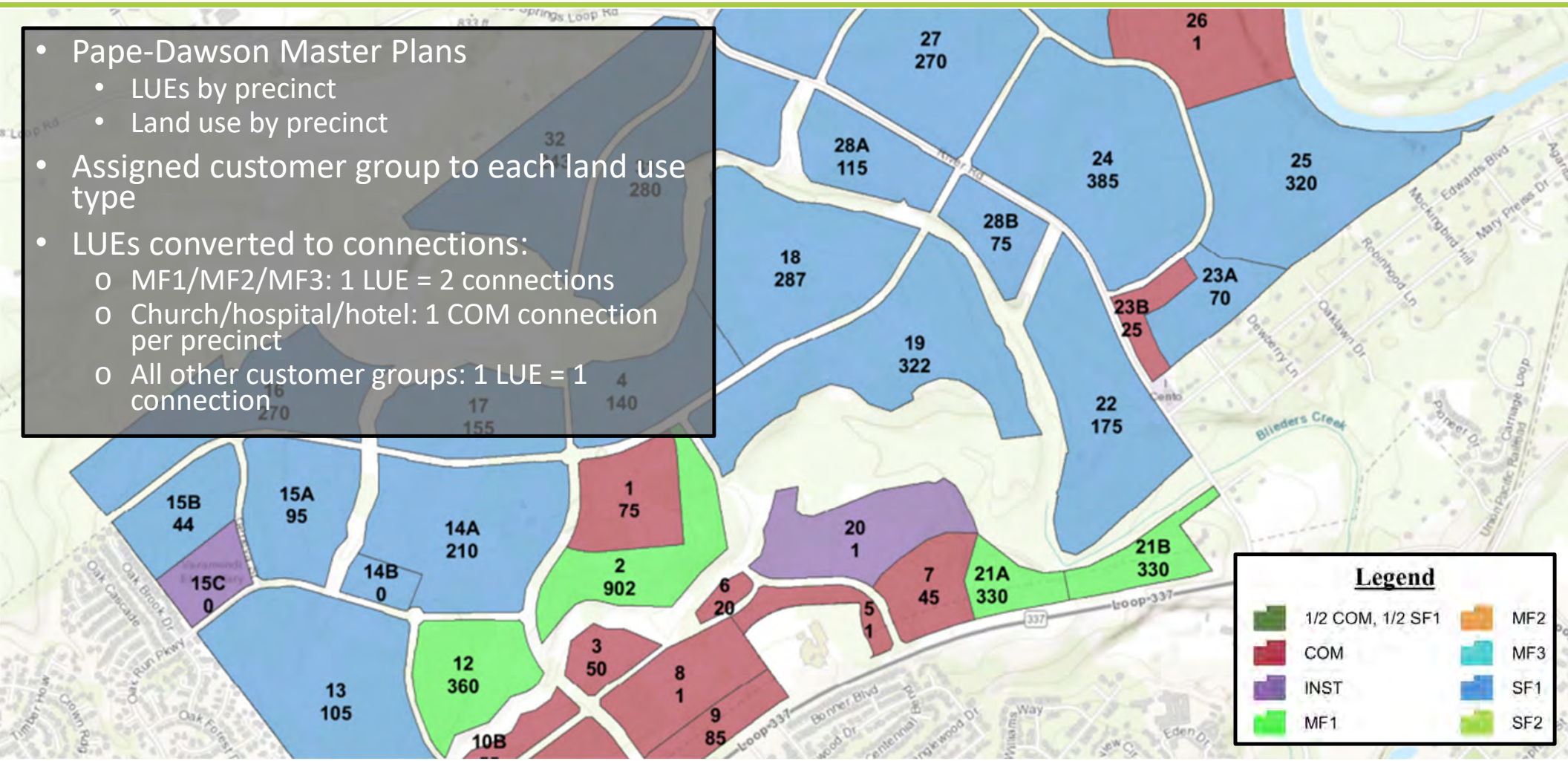


Customer Group	TCEQ Connections per Meter
MF1	25
MF2	75
MF3	200
COM	1
SF1	1
SF2	1
INST	1

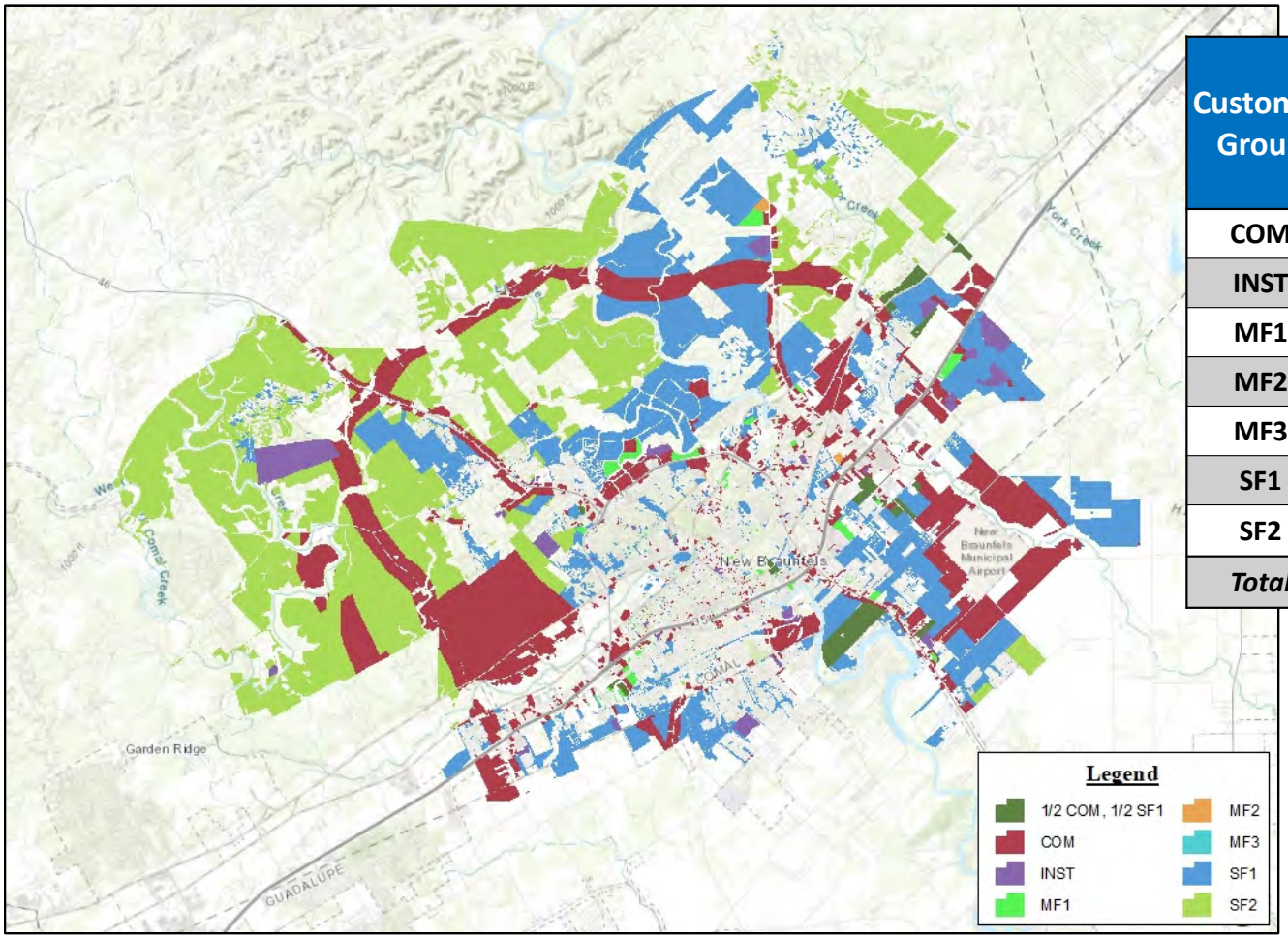
Land Use	Customer Group	Selected Meters per Acre
Mixed Use	½ COM, ½ SF1	7.50
Residential High Density	MF3, MF1 (area dependent)	0.33
Residential Med Density	MF2, MF1 (area dependent)	0.40
Manufactured Homes	SF1	5.50
Residential Low Density	SF1	5.00
Commercial	COM	0.80
Government	INST	3.00
Private Recreation	COM	0.20
Industrial	COM	0.20
Institutional	INST	2.00
Open-Parks	SF1	2.00
Residential Large Lot	SF2	2.00
School	INST	2.00
Commercial Industrial	COM	0.30
Utilities	INST	1.00
Quarry	COM	0.50
Drainage	-	0.00
Cemetery	-	0.00

KNOWN CONNECTIONS – VERAMENDI & GLO

- Pape-Dawson Master Plans
  - LUEs by precinct
  - Land use by precinct
- Assigned customer group to each land use type
- LUEs converted to connections:
  - MF1/MF2/MF3: 1 LUE = 2 connections
  - Church/hospital/hotel: 1 COM connection per precinct
  - All other customer groups: 1 LUE = 1 connection



BUILDOUT TCEQ CONNECTION PROJECTION



Customer Group	2020 June Connections	2045 Connection Projections	Buildout TCEQ Connections
COM	3,456	7,021	14,917
INST	159	249	1,508
MF1	5,351	15,825	18,512
MF2	1,400	1,888	2,532
MF3	932	1,182	1,224
SF1	30,020	62,838	88,852
SF2	414	858	34,440
Total	***41,732***	***89,861***	***161,985***

DISCUSSION

Appendix C

Monthly Demand Review

Memo

SUBJECT
Monthly Analysis of Demand in the NBU System

DATE
July 2021

As part of the 2021 WRP Update, Arcadis reviewed the monthly trends in the sourced and metered water. The monthly water sourced from 2015 to 2020 is shown in **Figure 1**. As shown, water use generally rises during the warmer months (June, July, August) and begins to decline in autumn. A comparison of the sourced and metered water on a monthly basis is shown in **Figure 2**. As shown, there is the largest gap between water metered and water sourced during July, which implies that on average, this is when the greatest volume water loss occurs, coinciding with the greatest overall water demand.

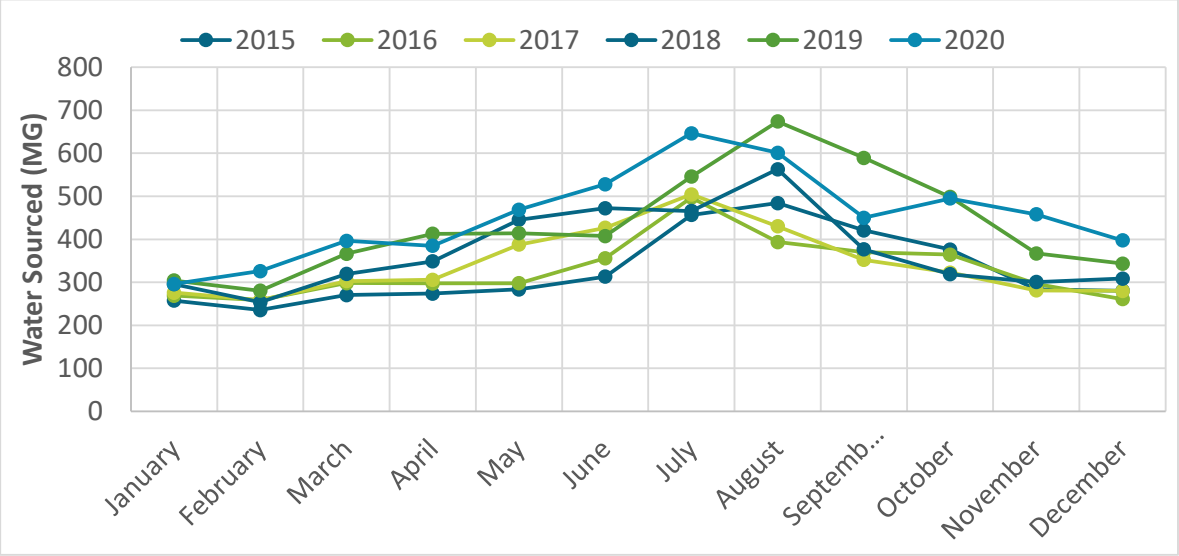


Figure 1: Monthly Demand of the NBU System, CY 2015 to 2020

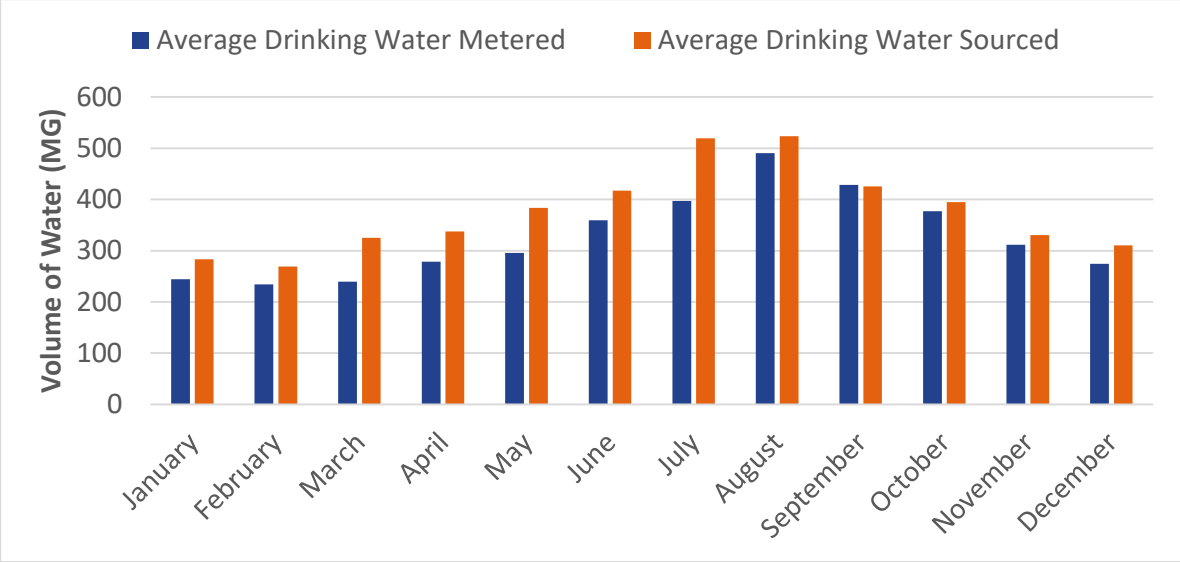


Figure 2: Monthly Water Sourced and Metered in the NBU System, based on CY 2015 - 2020

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