

Water Supplies and Demands for Participants in the Northern Integrated Supply Project



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Prepared for

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Table of Contents

SECTION I: Introduction

Research Objective, Purpose and Background	1
Research Approach	2
Report Organization	4
Caveats	4

SECTION II: Overview of NISP Participant Demands

Historical Demographic Change	7
Historical Water Use	9
Demographic Projections	12
Water Demand Projections	12

SECTION III: Summary of NISP Participant Conservation Efforts

Conservation Program Overview	19
Estimated Water Savings from Conservation Programs	23
Role of Conservation in Statewide Water Planning	27
Historical Water Use Patterns	31
Evaluation of Water Use Patterns	34

SECTION IV: Additional Water Needs of the NISP Participants

Combined Water Needs of the NISP Participants	44
Future Water Needs of Individual NISP Participants	45
Conclusions about the Need for NISP	62

TABLES

Table I-1. Participant Subscriptions to New Permitted Firm Yield from NISP	4
Table II-1. Potable and Non-Potable Water Deliveries by NISP Participants, Millions of Gallons, 2015	10
Table II-2. Projected 2030 and 2060 NISP Participant Deliveries of Potable and Non-Potable Water, Millions of Gallons	13
Table II-3. Estimated Future Water Losses for NISP Participants	14
Table III-1. Estimates of Historical Water Savings from Conservation for NISP Participants	25
Table III-2. Estimated Future Water Savings from Conservations for NISP Participants	27

Table III-3. Gallons per Capita per Day of Combined NISP Participants.....	32
Table III-4. Total Potable Gallons per Capita per Day Use for Each NISP Participant, 2000 through 2015.....	34
Table III-5. Water Use Patterns for Selected NISP Participants	36
Table IV-1. Projected Water Requirements for NISP Participants in Acre Feet, 2010 to 2060	42
Table IV-2. Projected Water Shortages (Excess) beyond Firm Annual Yields for NISP Participants in Acre Feet, 2020 to 2060	43
Table IV-3. Cumulative New Water Requirements beyond 2015 Firm Annual Yield, in Acre-Feet, 2020 through 2060	44

FIGURES

Figure II-1. Population Growth for NISP Participants in Total, 1990 through 2015	7
Figure II-2. Population Growth for Each NISP Participant, 1990 through 2015	8
Figure II-3. Total Water Deliveries to NISP Participants' End Users, 2000 through 2015, Millions of Gallons.....	11
Figure II-4. Historical and Projected Water Deliveries and Total Water Requirements for NISP Participants, 2000 through 2060, Acre-Feet.....	15
Figure II-5. Total Water Requirements among NISP Participants, 2020 and 2060	16
Figure II-6. Total Water Requirements by NISP Participants, 2000 to 2060, Acre-Feet	17
Figure III-1. Water Use Patterns for NISP Participants, Gallons per Capita per Day, 2000 through 2015	33
Figure III-2. Average GPCD for Selected Cities.....	39
Figure IV-1. Comparison of Future Water Requirements with 2015 Firm Annual Yields for 15 NISP Participants, Combined, in Acre-Feet, 2020 through 2060	44
Figure IV-2. Comparison of Future Water Demands with 2015 Firm Annual Yield, CWCWD, in Acre-Feet, 2020 through 2060	46
Figure IV-3. Comparison of Future Water Demands with 2015 Firm Annual Yield, City of Dacono, in Acre-Feet, 2020 through 2060	47
Figure IV-4. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Eaton, in Acre-Feet, 2020 through 2060.....	48
Figure IV-5. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Erie, in Acre-Feet, 2020 through 2060.....	49
Figure IV-6. Comparison of Future Water Demands with 2015 Firm Annual Yield, City of Evans, in Acre-Feet, 2020 through 2060	50
Figure IV-7. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Firestone, in Acre-Feet, 2020 through 2060	51
Figure IV-8. Comparison of Future Water Demands with 2015 Firm Annual Yield, FCLWD, in Acre-Feet, 2020 through 2060	52
Figure IV-9. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Fort Lupton, in Acre-Feet, 2020 through 2060	53
Figure IV-10. Comparison of Future Water Demands with 2015 Firm Annual Yield, City of Fort Morgan, in Acre-Feet, 2020 through 2060	55

Figure IV-11. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Frederick, in Acre-Feet, 2020 through 2060	56
Figure IV-12. Comparison of Future Water Demands with 2015 Firm Annual Yield, City of Lafayette, in Acre-Feet, 2020 through 2060	57
Figure IV-13. Comparison of Future Water Demands with 2015 Firm Annual Yield, Left Hand Water District, in Acre-Feet, 2020 through 2060.....	58
Figure IV-14. Comparison of Future Water Demands with 2015 Firm Annual Yield, MCQWD, in Acre-Feet, 2020 through 2060	59
Figure IV-15. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Severance, in Acre-Feet, 2020 through 2060.....	60
Figure IV-16. Comparison of Future Water Demands with 2015 Firm Annual Yield, Town of Windsor, in Acre-Feet, 2020 through 2060	61

Appendices

Appendix A: Central Weld County Water District

Appendix B: City of Dacono

Appendix C: Town of Eaton

Appendix D: Town of Erie

Appendix E: City of Evans

Appendix F: Town of Firestone

Appendix G: Fort Collins-Loveland Water District

Appendix H: City of Fort Lupton

Appendix I: City of Fort Morgan

Appendix J: Town of Frederick

Appendix K: City of Lafayette

Appendix L: Left Hand Water District

Appendix M: Morgan County Quality Water District

Appendix N: Town of Severance

Appendix O: Town of Windsor

Appendix P: NISP Participants' 2015 Water Supply Inventories

SECTION ONE

Introduction

This introduction describes a research effort and report prepared by Harvey Economics (HE) for the Northern Colorado Water Conservancy District (Northern District), acting on behalf of the Northern Integrated Supply Project Water Activity Enterprise (NISP). The report's purpose, approach, organization and caveats are described below.

Research Objective, Purpose and Background

HE was originally commissioned by the Northern District in June 2004 to evaluate and prepare water demand forecasts for each of the NISP Participants (Participants), along with a discussion of conservation practices employed by these Participants. Separately, the Northern District staff prepared an evaluation of water supplies for each Participant. These two work elements were then combined to assess potential future water shortages relevant to a determination of purpose and need for NISP. This study was provided to the U.S. Army Corps of Engineers for its use in considering NISP purpose and need and in preparing Chapter One of the NISP Environmental Impact Statement (EIS).

The Northern District had sponsored two other previous water demand studies in the past 15 years. In the year 2000, the Northern District completed a land use based projection of water needs. Unlike the present HE study, that previous effort was focused on demands at buildout capacity. In 1991, the Northern District published the *Regional Water Supply Study*, which examined water requirements for a number of providers, including some of the current Participants. Economic and demographic conditions and prospects have changed considerably for Northern Colorado since that time.

In 2010, HE was again commissioned by the Northern District to update the original study. During the six years since the original study, numerous events have prompted the need for an updated of the 2004 effort. First, numerous comments were received on the draft EIS from the EPA and others, suggesting that with such a severe economic downturn, housing development reversals and declining water use patterns, that water demand projections be reconsidered. Indeed, growth patterns and housing development experienced a major dislocation beginning in 2008. Water use patterns also declined since the original assumptions were developed in the 2004 report because of drought response conservation measures, the economic downturn and more than normal summer rainfall.

HE was once again commissioned by the Northern District to update the study in 2016 to include in the Final EIS as the regulatory process approaches its final stages. Six more years have passed and many of the demographic and economic conditions for the first update have changed again. The major downturn in the housing market that began in 2008 is mostly over; many of the growth rates are returning nearer to historical levels. Conversely, water use patterns have changed as well, in further response to conservation measures, the economic downturn and the flood of 2013. We submitted a draft to the U.S. Army Corps of Engineers in early 2017 and on the basis of their comments, provided this final version.

Research Approach

The HE study team (study team) consisted of Ed Harvey, Susan Walker, Ben Norman, and Jessica Harvey, who together conducted the research and analyses related to water demands and conservation. Carl Brouwer and Katie Melander from the Northern District provided water supply data and other historical information collected from the Participants. The research approach entailed extensive data collection, evaluation and analysis of the information provided, plus conclusions about future water demands and need for NISP. The study team gathered and reviewed supply and demand related information collected by the Northern District and others. The study team established data collection goals for each Participant and then compared those goals with the information collected in the 2010 effort. Personal interviews were conducted with each of the Participants to gather any remaining necessary information, and several follow-up contacts with most Participants were necessary to gather all final information available from each Participant.

The data collection effort, growth projections and water demand projections for each Participant were accomplished as an iterative effort. Initially, the study team provided each of the Participants with a list of information and subject categories that would become part of the purpose and need study. Each of the Participants provided published reports prepared by themselves or by consultants, along with internal operating data related to past and future growth, water use, conservation and water supply. The study team reviewed this information and conducted follow-up interviews with the Participants as needed. Separately, the study team interviewed individual large water users among the 15 Participants to develop separate projections for them. In addition to information collected from Participants, the study team gathered published studies and other data from local, state and Federal government sources related to growth, water use and conservation relevant to Northern Colorado. This work was completed between Spring and Fall 2016.

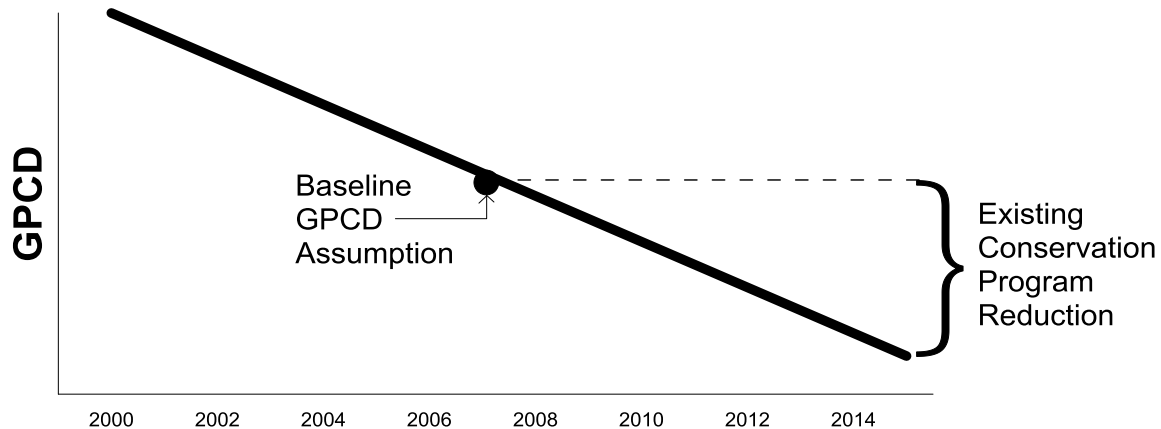
With the data collection phase completed, the study team evaluated projections of growth, water demand and supply as provided by the Participants for acceptance, rejection or modification. The bulk of Participant growth projections were based on recent growth trends and percentage growth rate assumptions, informed by developer projections. The study team evaluation was based upon historical evidence, capacity for growth, developer plans, land use plans, local government policies and an overall understanding of growth in the region. Judgment and reasonableness based upon past experience were applied in determining whether to accept or reject Participant projections. In the 2004 study, HE typically adjusted downward what it considered to be exuberant projections based on unsustainable growth trends. For the 2010 update, the Participants adjusted downward their own growth projections, in some instances excessively. In consultation with those few participants, growth projections were adjusted upward to represent a more reasonable long-term outlook. The 2016 study gave the study team access to data for the 2000 to 2015 period, which contained drought years, flood years, and some normal years. The period also contained years with rapid economic and housing growth, as well as years of economic and housing recession. Overall this 2000 to 2015 period encompassed the full gamut of conditions that could affect water demand.

Besides growth projections, the study team scrutinized historical water use patterns, beginning with sales to end users, separately examining individual agricultural or industrial water intensive customers. The water demand projections were mostly based on water use per capita or per tap assumptions. Assumed future water use patterns reflected recently reduced usage and historical conservation effects. Potable and non-potable¹ demands were considered separately. Water use projections included losses within the distribution system, at the treatment plant or through conveyance or storage. On the basis of all these evaluations, the study team either accepted the Participant's growth and water demand forecasts or independently developed demographic and water demand projections for that Participant.

Finally, the study team performed detailed conservation program evaluations for each of the Participants. Examining each conservation plan, the study team developed assumptions about future conservation savings. Final water demand projections reflect assumptions about historical, existing, and future conservation savings or reduction to demand.

Figure 1-1 depicts an example of a typical project participant's gpcd over time (smoothed for illustration purposes). The baseline gpcd assumption is the 2000 to 2015 average (the midpoint in this example) that was chosen to be used to project future baseline water demands. These demands account for the effects existing conservation programs have had in reducing demands from 2005 to 2015. Next, projected demands were reduced to reflect new future conservation each Participant plans to implement. Section III further explains this approach.

Figure 1-1.
GPCD and Conservation Example



Source: HE, 2017

The study team then prepared draft updates to the original working papers describing historical information, current status, water demand projections and conservation initiatives, shown as appendices to this report. These were reviewed by each of the Participants for

¹ Potable water is any water that is fit for human consumption or food preparation. Non-potable water is generally used for outdoor use or non-food industrial uses.

accuracy. Participants had the opportunity to disagree with assumptions, and further discussions with the study team ensued, leading to a mutual agreement among each of the Participants and the study team that the information and projections in the appendices in this report were as accurate as possible, given available data and the inherent uncertainty of forecasts, generally. Final versions of the Participant water demand evaluations are set forth in Appendices A through O. Specific water sources and firm yield estimates for each Participant are compiled in Appendix P. Additionally, a 10 percent safety factor was added to the total water demand.

Table I-1 lists Participants that were included in this study and the NISP firm yield request of each.

Table I-1.
Participant Subscriptions to New Permitted Firm Yield from NISP

Participant	Permitted Yield Requested (AF)
Central Weld County Water District (CWCWD),	3,500
City of Dacono	1,000
Town of Eaton	1,300
Town of Erie	6,500
City of Evans	1,600
Town of Firestone	1,300
Fort Collins -- Loveland Water District (FCLWD)	3,000
City of Fort Lupton	3,000
City of Fort Morgan	3,600
Town of Frederick	2,600
City of Lafayette	1,800
Left Hand Water District (LHWD)	4,900
Morgan County Quality Water District (MCQWD)	1,300
Town of Severance	1,300
Town of Windsor	<u>3,300</u>
Total	40,000

Source: Northern Colorado Water Conservancy District, 2006 Phase III Participation and Budget.

Report Organization

Following this introduction, this report proceeds with an overview of Participants' water demands. This overview describes historical demographic and water use changes and projections of future demographic conditions and water demands. Section Three provides an identification and evaluation of conservation practices and water use patterns expressed as gallons per capita per day. Participants' water conservation programs are identified in individual Participant water demand evaluations in Appendices A through O.

Section Four focuses on net future water needs by comparing firm annual yields in 2015 with projected water demands. Finally, the report concludes with an identification of each Participant's need for NISP.

Caveats

Standard data sets across all Participants were unavailable. The recordkeeping and data retrieval system for each of the Participants is unique to that Participant. Because of the location and nature of each customer base, water providers, even in close proximity to one another, record, report and utilize different measures as they conduct water resource planning. For example, rural water districts do not normally report population estimates on a consistent basis; rather, they keep track of their customer base by the number of taps, sometimes by type of tap or type of customer. Depending on the rate schedule, Participants may or may not keep track of water use by type of customer. Hence, historical recordkeeping practices are not the same from Participant to Participant, although individual practices may well serve each Participant's water planning purposes. To address this issue, the study team worked with the water use and supply records available for each water provider. From those data, the study team developed historical trends and water use patterns that maximized the completeness of foundational information for each Participant.

Just as the historical demand data were not standardized among Participants, existing projections of water demand also were not standardized. Methodologies for projecting future water demand differ substantially from Participant to Participant, and these methodologies are often determined by the historical foundation of information, by different consultants employed by each Participant, the size and technical capabilities available to a Participant, and the nature of the Participant's service area. Further, Participants adopt projections of demographic change from different sources and focus on different measures, such as population, housing units, number of taps or land uses. The study team adopted the view that no single forecasting methodology was necessarily more acceptable than others, and, similarly, data sources and information driving those projections might come from different sources but still be the most reliable data sources as they pertain to that Participant. For instance, one Participant might rely on its own population or housing unit projections that are up-to-date with specific developer information, as compared with the Colorado State Demographer's projections that naturally lack this kind of local data. Under conditions of rapid change, local information is preferred.

An important caveat for this study and for all studies of this kind lies with the inherent uncertainty of forecasting in general, and of demographic forecasting in particular. Long-term projections always rely upon underlying assumptions, some of which are assumed to continue on into the future, and some of which are assumed to change. For example, this report assumes that migration will continue, as it has in the past, to be the predominant influence on population and housing unit growth in Northern Colorado, whereas natural population changes driven by birth rates and mortality rates will not be a major influence on these projections. Technology related to water use patterns is not assumed to change fundamentally over the long-term. Over the short-term, assumptions such as these are relatively safe, but over the long-term the error risk associated with such assumptions increases.

Other explicit forecasting assumptions such as growth rates, land-use policies and even service area boundaries for individual Participants will vary over the long-term as compared with the more static assumptions embodied in the study team projections provided in this report. For these reasons, long-term projections such as the demographic and related water demand projections provided in this report can be counted upon to be inaccurate on either the low side or the high side as the year 2060 approaches.

One important source of uncertainty in these water demand forecasts is the future growth rates. Rapidly escalating growth rates which have occurred among the Participants since 1990, dramatically reversed in 2008. While many of the participants saw their growth rates return to higher levels by 2015, others did not. None of the participants returned to the growth levels of the 1990s and early 2000s. Although there are strong indications that moderate growth will continue into the foreseeable future, the volatile nature of growth itself significantly adds to the uncertainty of these forecasts. One benefit of long term forecasting is the “smoothing” of growth rates which might gyrate with economic conditions in the short term.

Further, estimates of firm annual yield for Participant water supplies represent only those supplies that existed in 2015. Water supplies can be reduced by water quality concerns, species or habitat preservation issues, or water right conflicts with competing users. Over the long-term, uncertainty of supply, mostly its diminution, creates an uncertainty in the evaluation of the need for NISP presented in this report. If NISP Participants can trade NISP supplies among themselves, this uncertainty is reduced.

This report recognizes these many dimensions of uncertainty. Key assumptions are carefully scrutinized, and assumptions based upon the best available information are adopted where possible. The study team assiduously attempted to bring no bias into the assumptions underlying the projections offered in this report, but the study team recognizes that there is an equal chance that the assumptions could be wrong in either direction. Since no probabilities could be assigned to a different set of assumptions, the study team relied upon only a single set of projections with the presumption of uncertainty described here.

In summary, the study team evaluated demographic and water demand projections provided by each Participant on the basis of that Participant’s individual circumstances. Comparisons with independently derived county or other projections were performed when relevant. The study team drew a conclusion about the water demand forecasting methodology and data sources for each Participant. If clearly better data or a superior demand forecasting methodology was available, the study team identified and then carried out those independent water demand projections. For example, if new lands were annexed to a water provider and not included in the water demand projections, the study team made the necessary adjustments. If assumptions behind the demand projections could not be substantiated with historical information, the study team developed new forecasting assumptions so that the results would be more reliable. The study team attempted to use the most appropriate information available for each provider and to present, in this report, the most defensible water demand projections for the NISP EIS.

SECTION TWO

Overview of NISP Participant Demands

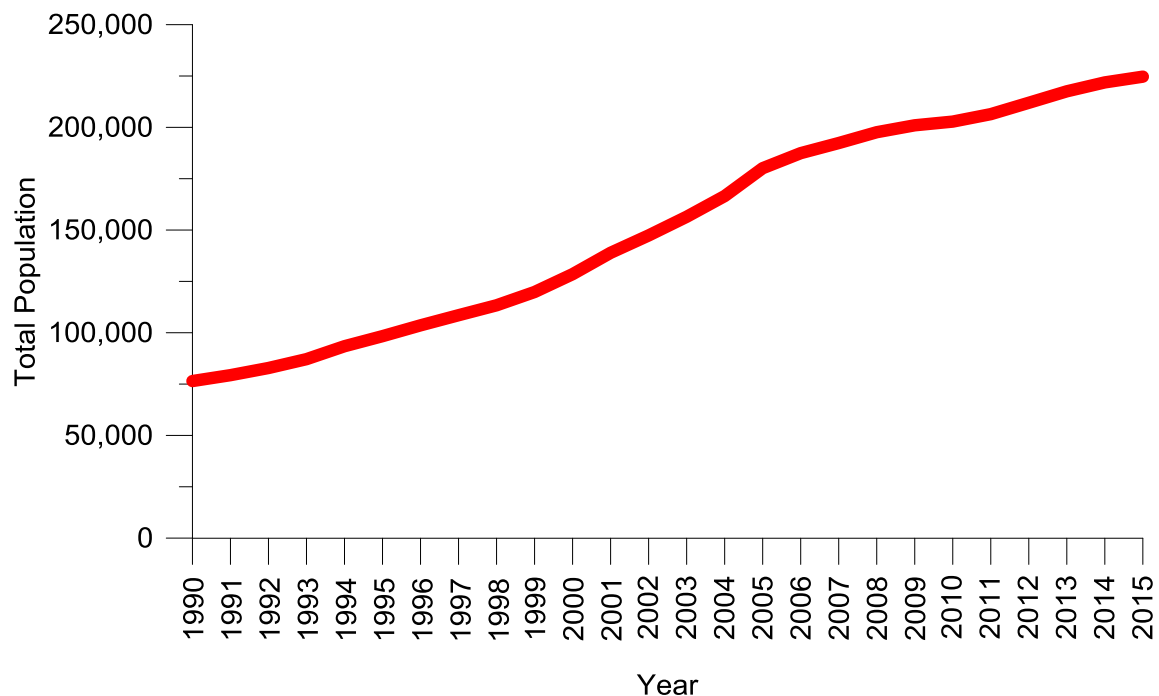
This report section provides the historical foundation for the demographic and water use changes experienced by Participants. Water demand projections combined for all Participants are also identified. Individual historical information and projections for each Participant can be found in Appendices A through O.

Historical Demographic Change

The study team gathered historical population figures, numbers of water taps and housing units for the Participants. Whereas each Participant was able to provide the study team with one or more of these data sets, only population data were available from all 15 Participants.

Figure II-1 depicts historical population trends for all the Participants combined from 1990 through 2015.

Figure II-1.
Population Growth for NISP Participants in Total, 1990 through 2015

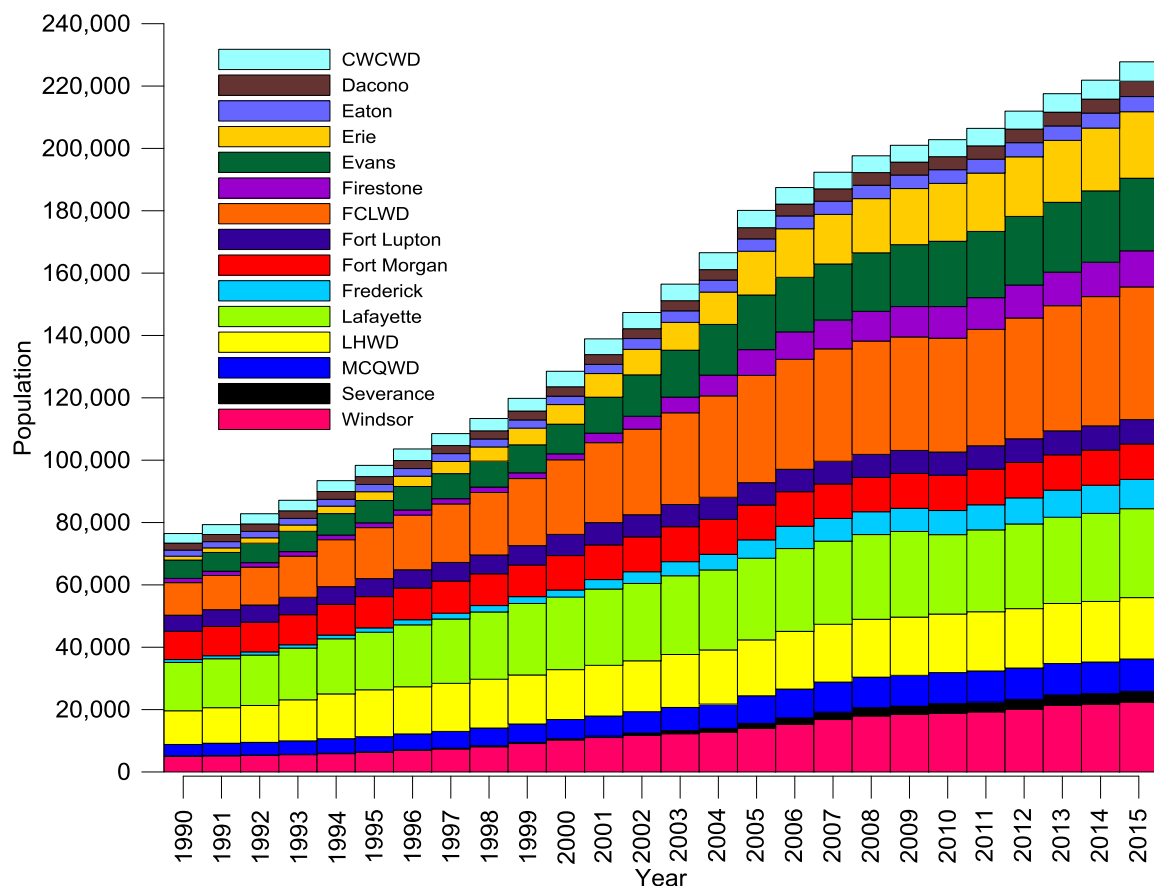


Note: The study team sought the total number of residents in the service area of each Participant from 1990 to 2015. Estimates for missing years were made on the basis of housing units or water taps for a small number of Participants.

Together, the 15 Participants served water to 76,000 persons in 1990, increasing to 225,000 persons by 2015, about a three-fold increase. This expansion represents an average annual growth rate of 4.4 percent. This is more than double the Colorado growth rate over the same period; Colorado population increased by about 65 percent or an average annual growth rate of 2 percent. This unusually rapid growth over such a long period indicates the considerable in-migration that occurred in northern Colorado between 1990 and 2015, likely attributable to a substantial increase in job opportunities in the northern Front Range during this time. To better understand this historical change, this long-term growth can be split into two distinct periods, 1990 to 2006 and 2007 to 2015. The average annual growth rate for Participants in the first period was 5.8 percent, while from 2007 to 2015, the average annual growth rate for Participants was 2.0 percent, reflecting the 2008 to 2010 economic slowdown.

Figure II-2 illustrates population growth by each Participant from 1990 through 2015.

Figure II-2.
Population Growth for Each NISP Participant, 1990 through 2015



Population growth is widespread among all the Participants. The Town of Erie and the Town of Severance grew faster than the other Participants; Severance grew from a population of 89 in 1990 to 3,500 people by the year 2015. The Town of Erie grew over 1600 percent from 1990 through 2015. The most heavily populated water suppliers in 2015 were the Fort Collins-Loveland Water District with 42,600 residents followed by the City of Lafayette with

about 28,500 residents. Together, these two water providers accounted for about one third of the total population of all the Participants in 2015.

Historical Water Use

The 15 Participants serve residential, commercial, industrial, public and other water uses in their service areas. These service areas include communities and the surrounding vicinity in some instances and primarily rural areas with small population centers in others. The study team gathered data for total water use by customer type delivered at the tap, where possible. In many instances, a full breakdown of water use by type of user was not available; however, the study team did distinguish each water provider's large industrial or other single large water users. Historical water uses by customer type, where available, are described for each Participant in Appendices A through O.

Potable water deliveries to end users are segregated from non-potable water deliveries since seven out of the 15 water providers deliver non-potable supplies for irrigation of golf courses, parks, schools and large residential or commercial developments. Whereas these seven water providers are responsible for the non-potable supplies, the Town of Windsor has a dual water system for some land development for which it has no supply obligation.

Table II-1 shows potable and non-potable water deliveries by Participant for 2015.

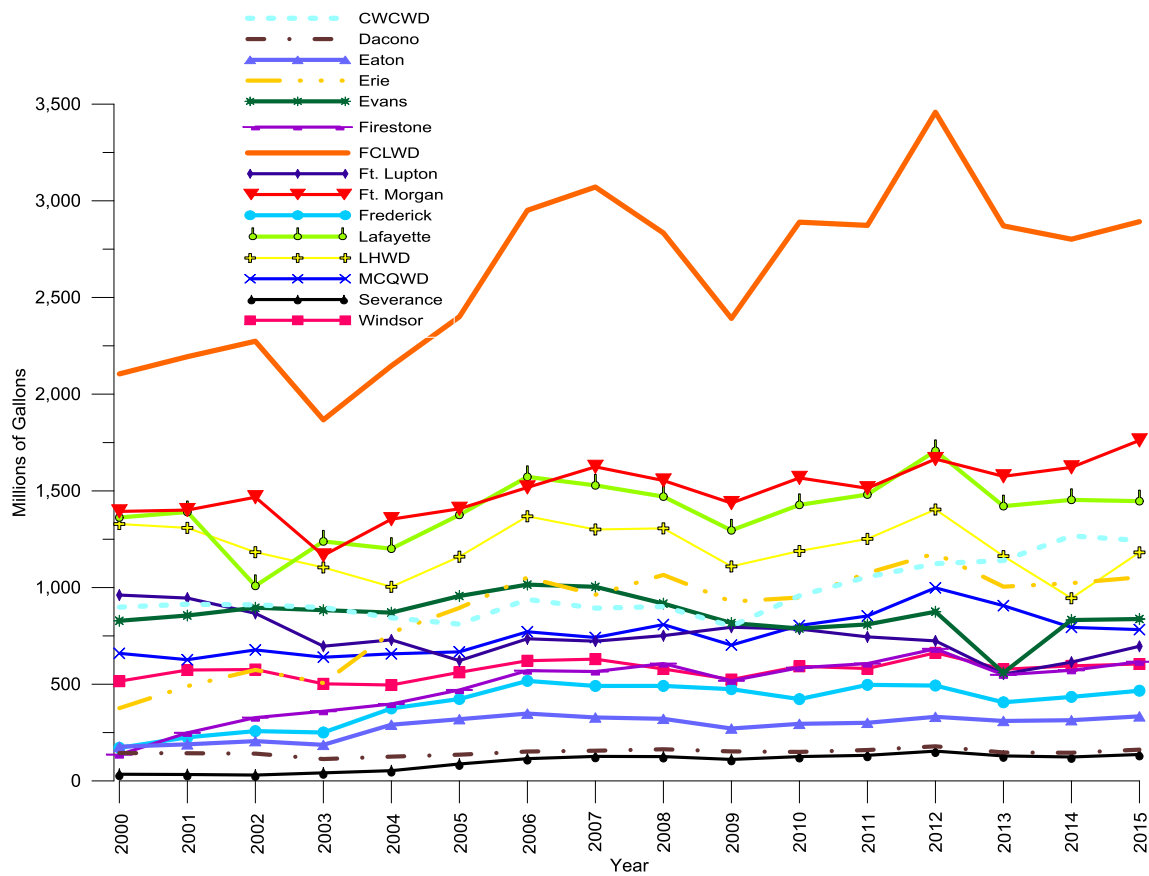
Table II-1.
Potable and Non-Potable Water Deliveries by NISP Participants,
Millions of Gallons, 2015

Participant	Potable Deliveries	Non-Potable Deliveries	Total Deliveries
CWCWD	1,243	0	1,243
City of Dacono	162	0	162
Town of Eaton	228	106	334
Town of Erie	1,003	50	1,053
City of Evans	767	70	837
Town of Firestone	616	0	616
FCLWD	2,892	0	2,892
City of Fort Lupton	312	384	696
City of Fort Morgan	1,524	236	1,761
Town of Frederick	466	0	466
City of Lafayette	1,313	133	1,447
LHWD	1,182	0	1,182
MCQWD	782	0	782
Town of Severance	137	22	137
Town of Windsor	<u>605</u>	<u>0</u>	<u>605</u>
Total	13,233	1,003	14,213

Together, potable and non-potable water deliveries amount to total water deliveries to NISP end users; these total deliveries were a combined 14,200 million gallons (MG) in the year 2015. This amount was down from a peak of 15,600 MG in 2012.

Figure II-3 indicates total water deliveries to end users for each Participant between 2000 and 2015.

Figure II-3.
Total Water Deliveries to NISP Participants' End Users, 2000 through 2015,
Millions of Gallons



The trends, by and large, show decreases in end user deliveries in the early 2000s followed by strong growth in the mid 2000s, then another drop off to the end of the decade. Water use grew after 2010, with the exception of the flood year in 2013. For some providers, water deliveries temporarily ceased during that year. Overall, water use peaked in 2012, with 11 of the 15 participants' peak water use on or after 2012.

The influence of climate, especially precipitation, is always an important consideration for interpreting historical, short term water use changes. Besides the 2013 flood, it is noted that 2011, 2013 and 2014 were relatively wet years in northern Colorado. Conversely, 2010 and 2012 were relatively dry years.² When the precipitation occurs during a year, especially summer, is also important.

² Climate Data Online, National Centers for Environmental Information, NOAA.
www.ncdc.noaa.gov. Accessed September, 2016.

Demographic Projections

The 15 Participants utilize a host of different demographic projections to develop their water demand projections. Ten Participants prepared population projections, whereas five Participants utilize water tap projections. The study team evaluated these projections and their application techniques and modified, updated or replaced them where necessary.

The 2015 population total for the NISP participants was 227,775; the projected 2060 total population is about 560,800 people. This represents a growth of almost 150 percent, or an average annual growth rate of 2 percent. The State Demographer does not provide forecasts for the NISP participants, but does forecast county populations to 2050. The State's forecast of average annual growth for the five counties³ that contain the NISP participants is 1.7 percent. In general, the NISP participants represent the more suburban areas of the counties, so we expect their growth to be a little higher than the overall county growth. Details of demographic and other variable projections are provided for each Participant in Appendices A through O.

Water Demand Projections

Many Participants provided the study team with their own existing water demand projections. The study team either utilized the Participant's water demand forecasts or independently projected potable water deliveries and non-potable water deliveries and summed both to arrive at total water delivery estimates for each Participant. Most existing water delivery projections were derived from demographic projections applied to a water use factor such as gallons per capita per day (gpcd) or gallons per tap per day (gptd). The study team scrutinized each potable water demand forecasting technique and either accepted it, if appropriate, or applied a different technique relevant to that water supplier and used existing projections as a check on those new water demand projections.

Large water users, mostly dairies or industrial companies, were identified by the providers, and projected separately on the basis of individual interviews. The large water user projections were then added to the domestic and commercial projections or non-potable deliveries to arrive at total demand projections.

As part of this current analysis, the effects of current and future water conservation measures have also been incorporated into each Participant's water demand projections. Therefore, the projections presented in this report reflect the estimated water savings of the Participant's existing and anticipated conservation programs. An overview of each Participant's conservation program, estimates of historical and future conservation savings and a description of how those savings estimates were incorporated into the water demand projections are provided in Section Three of this report.

In essence, the water delivery projections are based on the baseline average of water use per capita from 2000 to 2015, a reduction for the effects of existing conservation programs during that period and a further reduction for anticipated new conservation programs.

³ The counties are: Boulder, Larimer, Morgan, Washington, and Weld.

Total water deliveries, the sum of potable and non-potable deliveries, are projected to increase by almost two and a half times from the peak year of 2012, when total deliveries reached 15,600 MG. By 2060, total water deliveries for all Participants are projected to reach 38,100 MG. Increases are expected from all Participants. Potable water deliveries for all Participants are projected to increase from 13,200 MG in 2015 to 33,900 MG in 2060. Non-potable deliveries were projected for eight Participants who intend to rely on non-potable resources in the future. Non-potable deliveries are expected to increase from 1,000 MG in 2015 to 4,300 MG in 2060. Table II-2 provides the potable, non-potable and total delivery projections for the Participants through 2060.

Table II-2.
Projected 2030 and 2060 NISP Participant Deliveries of Potable and Non-Potable Water, Millions of Gallons

Participant	2030 Deliveries			2060 Deliveries		
	Potable	Non-Potable	Total	Potable	Non-Potable	Total
CWCWD	1,600	0	1,600	2,800	0	2,800
Dacono	300	0	300	720	0	720
Eaton	410	150	560	820	240	1,060
Erie	2,000	700	2,700	3,600	700	4,300
Evans	1,160	150	1,310	2,030	260	2,290
Firestone	1,200	0	1,200	2,900	0	2,900
FCLWD	4,500	0	4,500	5,700	0	5,700
Fort Lupton	400	100	500	600	200	800
Fort Morgan	1,800	200	2,000	2,400	200	2,600
Frederick	1,000	200	1,200	2,900	700	3,600
Lafayette	1,800	200	2,000	1,800	300	2,100
LHWD	2,200	0	2,200	3,600	0	3,600
MCQWD	1,100	0	1,100	1,400	0	1,400
Severance	320	40	360	620	70	690
Windsor	<u>990</u>	<u>0</u>	<u>990</u>	<u>1,970</u>	<u>0</u>	<u>1,970</u>
Total	20,780	1,740	22,520	33,860	2,670	36,530

Total water requirements are equal to total water deliveries plus an accounting for losses. Whereas total deliveries are expressed in millions of gallons consistent with Participants' end use sales records, total requirements are expressed in acre-feet, reflective of raw water resource planning units.

Losses are calculated for each Participant from the end user, or point of delivery, to the treatment plant or master meter, and then back to the point of diversion. The study team obtained the distribution, treatment plant and conveyance loss figures from each Participant, based upon their own estimates or calculations. Assumptions about future losses are based on existing estimated losses and indications from Participants about future losses. Total water requirements projections assume the following combined distribution, treatment plant and conveyance losses set forth in Table II-3.

Table II-3.
Estimated Future Water Losses for NISP Participants

Participant	Losses as a Percent of Total Water Requirements
CWCWD	7%
Dacono	9%
Eaton	8% ⁽¹⁾
Erie	8%
Evans	8% ⁽²⁾
Firestone	6% ⁽³⁾
FCLWD	8%
Fort Lupton	10%
Fort Morgan	17%
Frederick	1% ⁽⁴⁾
Lafayette	8%
LHWD	10%
MCQWD	3%
Severance	9% ⁽⁵⁾
Windsor	<u>7%</u> ⁽⁶⁾
Average	8%

(1) Does not include 10 percent water resource charge by NWCWD compounded with 8 percent local distribution losses.

(2) Does not include 13.5 percent shrinkage charge from Greeley.

(3) Does not include CWCWD treatment surcharge of 10 percent.

(4) Does not include CWCWD treatment surcharge of 20 percent.

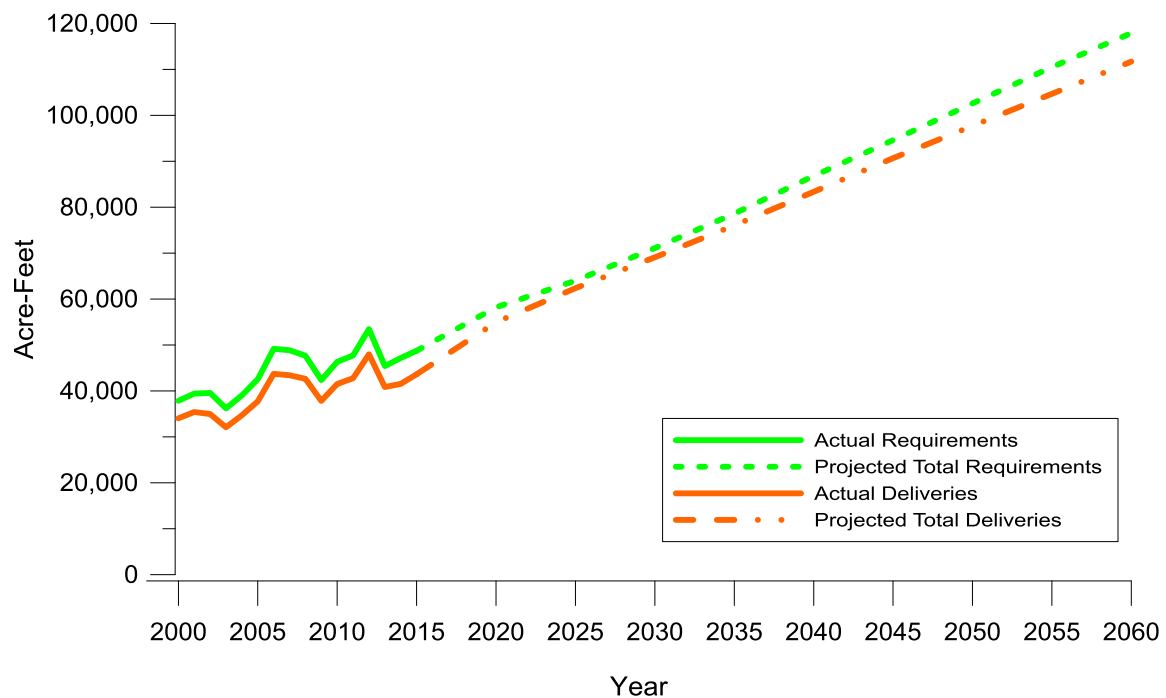
(5) Does not include 10 percent water resource charge by NWCWD.

(6) Does not include 17 percent charge, which is the weighted average water resource charge from Windsor's three treated water suppliers.

A number of Participants acquire their water in a treated form from other water providers who charge 10 to 20 percent water surcharge as a water resource fee.

Figure II-4 provides historical and projected total water requirements and total water deliveries for all Participants from 2000 through 2060.

Figure II-4.
Historical and Projected Water Deliveries and Total Water Requirements for NISP Participants, 2000 through 2060, Acre-Feet

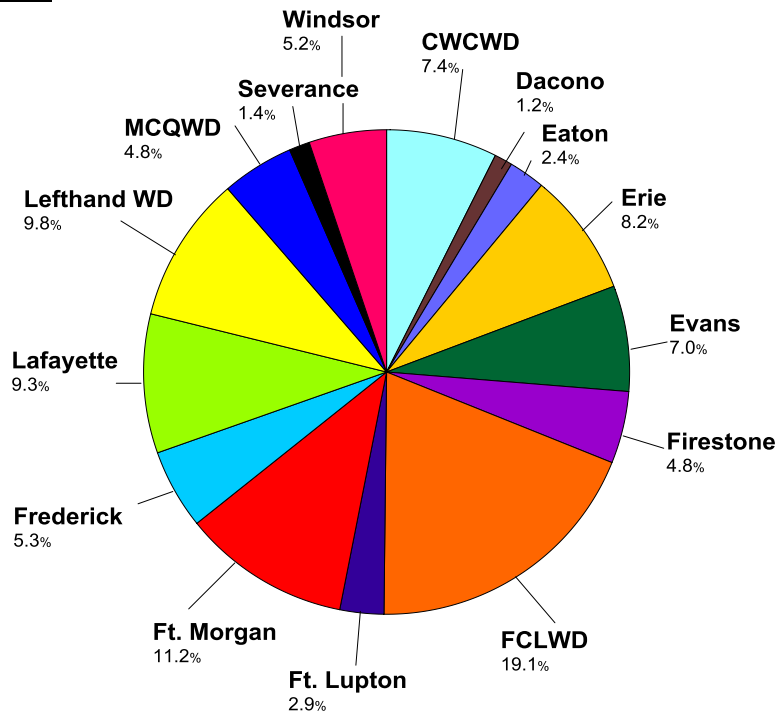


Total water requirements, which include all forms of losses and wholesale water resource fees, are projected to increase from 53,500 acre-feet (AF) in 2012, the peak historical year, to 123,700 AF by the year 2060. This more than doubling would indicate that the Participants together will experience an increase in total water requirements of over 69,000 AF by 2060.

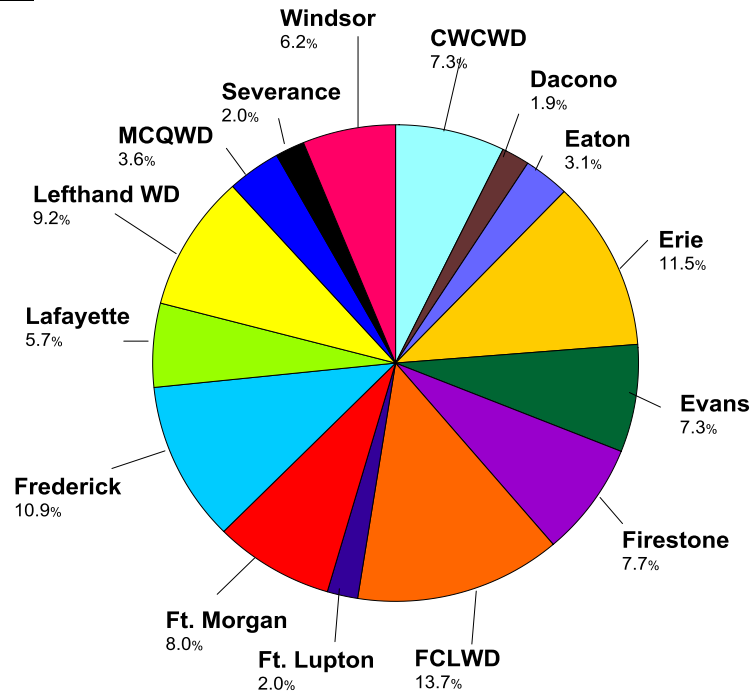
Figure II-5 presents two pie charts, one of total water requirements by Participant in the year 2020, and the other of total water requirements by Participant in 2060.

Figure II-5.
Total Water Requirements among NISP Participants, 2020 and 2060

Year 2020



Year 2060



FCLWD, Ft. Morgan, LHWD, Lafayette, and Erie, are projected to have the largest water demands in 2020. FCLWD, Erie , Frederick, LHWD, and Fort Morgan will be the largest water providers in 2060.

Figure II-6 depicts graphs of total water requirements by Participant through the year 2060. To assist the reader, the first graph includes Erie, FCLWD, Frederick, LHWD and Windsor. The remaining water users are shown in the second graph.

Figure II-6.
Total Water Requirements by NISP Participants, 2000 to 2060, Acre-Feet

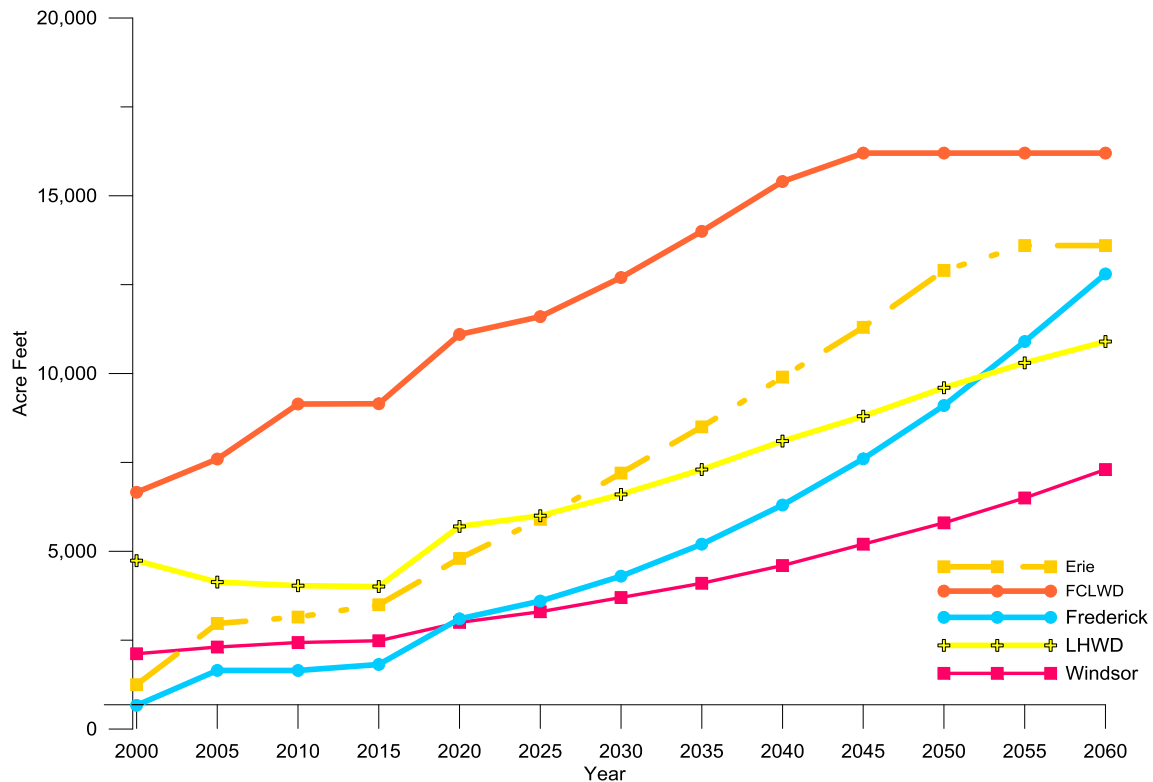
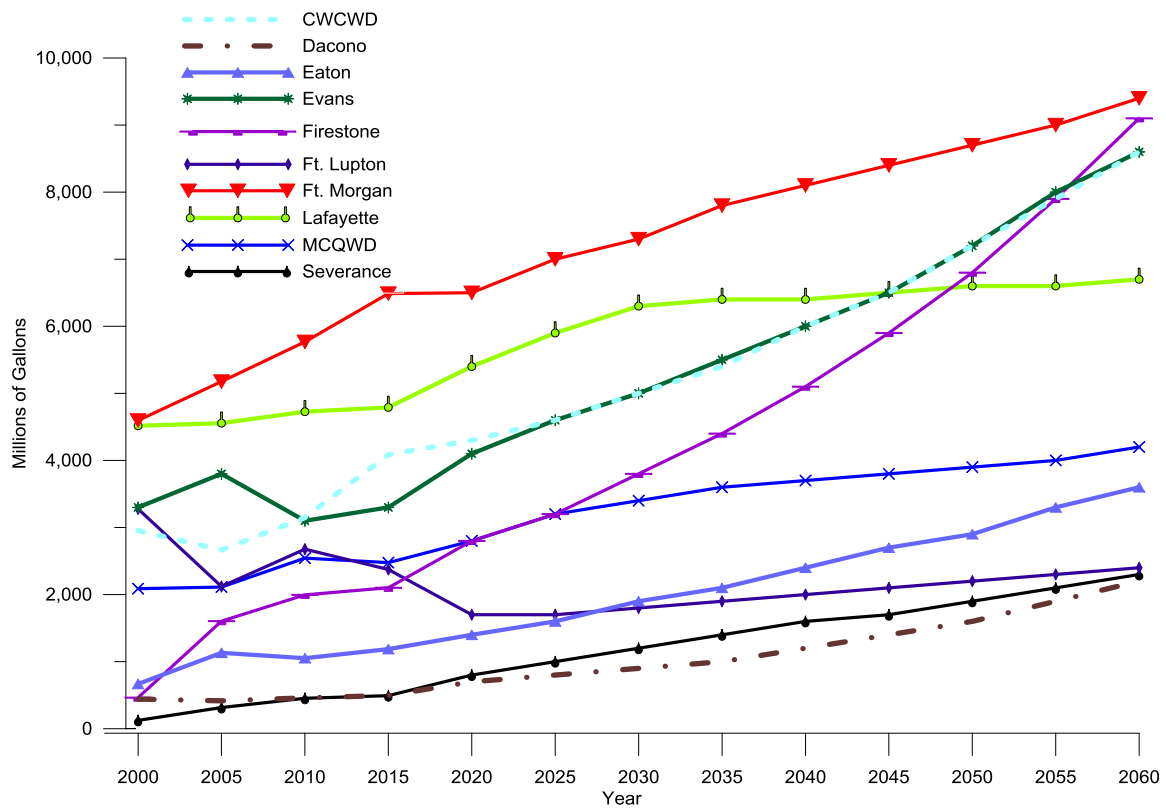


Figure II-6. (Continued)



Although weather affects historical water demand figures, each provider has unique influences which determine their water demand projections. These are further explained in the respective appendices. This figure illustrates that a number of water providers will reach buildout during the forecasting horizon, beginning in 2040. The most rapidly increasing water demands will occur in Firestone, Frederick, Severance, and Erie.

In sum, these water demand projections point to substantial increases within the next 45 years for the Participants. The study team water demand projections imply an average annual growth rate of 2.1 percent from 2015 through 2060, which compares with an average annual growth rate of 2.3 percent from 2000 through 2015, measured on the same basis. These projections indicate that future total water requirements will continue to increase but at a decreasing rate over time. The study team believes that these water demand projections represent the most reliable, justifiable projections available for these Participants.

SECTION THREE

Summary of NISP Participant Conservation Efforts

This section provides an evaluation of ongoing water conservation efforts among the Participants and their customers and estimates of historical and future water savings. The extent of current conservation helps determine the potential for additional water conservation savings that might be available to Participants in considering their need to participate in NISP.

It is important to distinguish ongoing water conservation programs from drought related measures. Water conservation measures are those programs that are consistently applied every year to reduce water demands or to increase supplies. These measures are distinguished from drought restrictions that are special, more severe measures that are implemented temporarily to avoid a true water shortage. Drought restrictions are normally reserved by water resource managers for unusually adverse hydrologic conditions or for unexpected circumstances that threaten the ability of the water provider to meet its customers' requirements.

This section provides a brief summary description of the conservation programs currently in place among the NISP Participants, followed by estimates of current water savings and projected future savings. We also place conservation in the context of State water planning. The study team evaluated water use patterns, measured in potable gallons per capita per day, as an indication of the effectiveness of the conservation efforts currently being practiced among the customers of the Participants.

Conservation Program Overview

The study team gathered information about the different conservation programs practiced by each Participant via review of Participants' current water conservation or municipal water efficiency plans, websites and other relevant documents and from Participant responses to study team inquiries. The water conservation programs for each Participant are described in detail in Appendices A through O.

It is important to recognize that each Participant applies a unique mix of conservation measures suitable to the particular conditions in its community and to the operation of their water system. A brief overview of Participant conservation measures is provided below.

- *Central Weld County Water District (CWCWD)* – CWCWD implemented its water conservation plan in 2003, emphasizing among other elements a diverse public education effort. CWCWD encourages its dairies and other agricultural businesses to use non-treated water when possible. CWCWD utilizes an especially aggressive and advanced computer leak detection system, which monitors inflows and outflows every 2.5 minutes, facilitating rapid system repair.

Its conservation plans call for a future review of its rate structure, including an incentive/reward mechanism and potential surcharges for excessive use. Conservation goals implemented since 2010 include reducing system losses to less than 4.5 percent within ten years and less than 4 percent within 20 years, as well as reducing per customer water usage by at least 5 percent within ten years.

- *City of Dacono* – Dacono encourages water conservation through a variety of measures. They use an increasing block structure for billing, provide their customers with information / education on conserving water, and enact watering restrictions every summer. In addition, they use a demand based formula for calculating the amount of water to be dedicated to each new development. The City's first Water Conservation Plan was developed in 2011. That plan describes many of Dacono's existing conservation measures, as well future water conservation goals. Since that plan was prepared, Dacono has implemented several additional conservation measures, including rate changes, meter maintenance and landscape standards for new development. Incorporation of further conservation measures will reduce the dedication for the developer, providing an incentive to conserve. Dacono's water conservation goals include reducing overall water use by 10 percent over a ten year timeframe.
- *Town of Eaton* – Eaton also has an increasing block rate structure and a public information program, including website information for its customers. Eaton requires new developments to construct a dual use irrigation system which will cut down substantially on summer water use, as reflected in the demand projections in this report. Other conservation measures include billing system updates, leak detection efforts and water waste and restriction ordinances. Eaton completed its first Water Conservation Plan in 2011; that plan describes current conservation measures and future conservation goals. As stated in the plan, Eaton's goal is to reduce overall water use by 8 percent within a ten year period.
- *Town of Erie* – Erie updated its Water Conservation Plan in 2014; the current plan describes several updated water conservation goals, including further reduction of per capita water use (both total and residential indoor water use) and reduction of the percentage of Erie's non-revenue water. Erie has a diverse public education program and emphasizes low water use landscaping for open space and parks. Other components of Erie's long-standing conservation program include leak detection on a continuous basis, an irrigation audit program and an increasing block rate structure. Reusable effluent is used for golf course and landscape irrigation; the reuse program alone saves an estimated 180 AF per year.
- *City of Evans* – The City of Evans 2009 Water Conservation Plan set a goal of reducing water use by 13 percent by 2018. The plan emphasizes an increasing block rate structure, non-potable water use for residential irrigation, and an active leak detection program. In addition, Evans has introduced a rebate program for water efficient devices and has passed several ordinances and water conservation regulations for residents and developers. The reuse system at the wastewater

treatment plant is also a source of water savings. The City is currently in the process of updating its existing conservation plan.

- *Town of Firestone* – Firestone’s 2015 Municipal Water Efficiency Plan Update is an update to the previous 2007 Water Conservation Plan. Current conservation measures include meter upgrades, a tiered water rate structure for residential customers, ordinances and regulations, rebates and other incentives and a variety of educational outreach activities. The 2015 Plan provides an updated conservation goal of reducing overall water use by 10 percent over a ten year period. This goal will be realized through a series of utility maintenance programs, regulatory measures, educational programs, and rebates and incentives.
- *Town of Frederick* – Frederick’s 2011 Water Conservation Plan presents a goal of reducing water use by 17.2 percent within a ten-year timeframe. The Town’s current conservation program includes a number of measures aimed at different types of water users; those measures include rewarding developers for conservation planning, an increasing block rate structure, watering restrictions/ water waste ordinance, upgraded irrigation equipment at parks and open spaces, billing software upgrades, utility maintenance and a meter testing and replacement program. Frederick’s efforts to meet the conservation goal will focus on leak detection, public education, water audits, reducing unaccounted for water and incentive programs.
- *Fort Collins – Loveland Water District (FCLWD)* – According to the Draft 2015 Municipal Water Efficiency Plan, FCLWD’s water conservation goal is to reduce overall water use by 9.8 percent over a ten year period. To meet this goal, they will implement a number of new measures aimed at residential and other types of water use and also expand on several existing measures, including leak detection and repair, recycling water treatment plant filter backwash, residential irrigation audits and educational activities. FCLWD currently employs an increasing block rate structure and a surcharge, which it applies to users who exceed the established monthly allocation. The district’s public information program includes a website with conservation measures and offers to support customers in their various conservation efforts. FCLWD also uses upgraded metering equipment and conducts meter testing and replacement.
- *City of Fort Lupton* – As part of its 2007 Water Conservation Plan, the City of Fort Lupton set long-term conservation goals: reduce residential water by 5 percent over the next decade and by 7 percent after that; meter the water sold to Thermo; and reduce city irrigation water use by 5 percent. To achieve this goal, Fort Lupton is committed to a diverse public education program, which includes monthly monitoring of water savings and a public display of the results. Fort Lupton applies specific water conservation measures to golf courses, restaurants and car washing, along with outdoor watering restrictions, all enforced by police and code enforcement employees. Fort Lupton also has a tiered rate structure, including a surcharge for water use above a set supply allotment, by user.

- *City of Fort Morgan* – Fort Morgan’s 2008 Water Conservation Plan includes the following current conservation measures: leak detection and repair; public education; work with the largest industrial water users to help them conserve, expansion of the landscape efficiency program and water recycling systems. That plan indicated the potential for a 10 percent reduction in water consumption over the long-term, perhaps a 20 year time period, based on proposed future measures and outdoor watering restrictions. Fort Morgan is currently in the process of updating their water conservation plan.
- *City of Lafayette* – The 2009/2010 Lafayette Water Conservation Plan includes a goal of reducing annual water consumption by 12.7 percent. That goal includes reducing system-wide water losses to 5 percent or less. Lafayette offers a diverse public education program and a tiered rate structure. Other initiatives include irrigation system upgrades, water-efficient commercial processes, and improved water accounting and system-wide leak detection.
- *Left Hand Water District (LHWD)* – LHWD has an aggressive leak detection and repair program that has resulted in a large reduction of water distribution losses. The District emphasizes modification to low water use landscaping through demonstrations, classes and requirements for new development through Boulder County. LHWD has an increasing block rate structure. The District reviews high and low water consumption patterns among its customers and replaces meters regularly. They also offer several rebates and other incentives and participate in educational activities. The goal of the 2015 Municipal Water Efficiency Plan Update is to reduce total per capita water use by 9.8 percent over a ten year period, by either expanding existing programs or implementing new ones. Future conservation efforts will address residential, commercial and other types of water use.
- *Morgan County Quality Water District (MCQWD)* – MCQWD has an increasing block rate structure that it considers effective with its agriculturally oriented customers facing low financial margins. As of 2016, the District is in the process of developing a water conservation plan.
- *Town of Severance* – Severance has an increasing block rate structure and a public education program to promote conservation. The Town also maintains permanent watering restrictions regarding days of the week and times of the day that customers can irrigate. Severance plans on completing a water conservation plan in 2017.
- *Town of Windsor* – Windsor has implemented a number of conservation measures over time, many of which are focused on metering, billing, leak detection and educational activities. Windsor has an increasing block rate structure and a surcharge for excessive water use. The Town has plumbing codes requiring low-flow water appliances, and new developments are required to develop dual water systems, where possible, using ditch water. New developments include landscaping restrictions, and all customers face lawn watering restrictions

between 10 am and 6 pm during the summer. The Town also has a leak detection system, car washing guidelines and a diversified public information system promoting conservation. The overall goal of the 2015 Municipal Water Efficiency Plan Update is a 9.3 percent reduction in overall water use. This will be accomplished by either expanding existing programs or implementing new ones.

Although the scale of each Participant's conservation program varies widely, all Participants have implemented at least some individual measures aimed at reducing annual water consumption. Thirteen out of fifteen Participants have water conservation plans or municipal water efficiency plans in place. MCQWD and Severance are currently in the process of developing their first formal conservation plans and several other Participants are working towards updating existing plans. Almost all of the Participants have an educational component to their water conservation programs, which ranges from stuffing bills with water conservation reminders to websites, newspaper and television ads, and school programs. All the Participants also practice universal metering to keep track of water use patterns and to charge customers for the water they consume. The water price signal to customers is accentuated by the increasing block rate structure that is in place for almost all of the Participants. The Participants exhibit considerable emphasis on a strong price signal to customers to conserve water. Leak detection and the repair or replacement of inefficient water mains, pipes and meters are also commonly used by many Participants.

In terms of outdoor water use, a number of Participants have landscape ordinances and permanent outdoor watering restrictions in place. Water audits and the promotion of water efficient appliances are also practiced by a number of Participants. Certain Participants have non-potable irrigation systems or a water re-use system in which wastewater is used for irrigation. In sum, the Participants' ongoing water conservation programs are at least typical among water providers and strong given their size. Northern Colorado water providers place a relatively strong emphasis on price signals to promote efficient use, perhaps reflecting their rural heritage.

Estimated Water Savings from Conservation Programs

The study team endeavored to quantify the water savings from each Participant's historical and current conservation efforts, as well as the savings associated with anticipated future conservation measures. It is clear that a downward trend in potable water use per capita occurred since year 2000.

Historical conservation savings. As specifically described in individual water conservation plans and municipal water efficiency plans, each of the Participants has implemented a unique set of conservation measures over time, depending on their needs and circumstances. In many cases, the need for and interest in promoting additional water conservation was spurred by the drought in the early 2000s and many measures have been implemented since that time. However, it is likely that in addition to the Participant's implemented conservation measures, the public discourse regarding water use in Colorado, the available water supplies, growing demands, water conservation and more efficient use of resources has also had an impact on customer behavior and attitudes towards water use in recent years. A number of other factors may also affect water use rates; for example, weather

patterns, economic conditions or changes in the types of non-residential users served could push each Participant's water use rates up or down. Because the early 2000s drought appeared to be a prime motivating factor in both program implementation and public conversation surrounding water conservation, the study team assumed that the difference between water use prior to the drought and water use after the drought represents the effects of conservation.⁴ As a result, the study team employed the following approach to estimating historical water savings from conservation for each Participant:

- Calculate the difference between the average total gpcd (or gptd) prior to 2005 and the average gpcd (or gptd) between 2005 and 2015 and apply that difference to the population (or taps) in each year from 2005 on to estimate annual and total historical conservation savings.⁵
- The approach described above was applicable to the majority of Participants; however, out of the group of fifteen, there were several Participants that required adjustments for various reasons, mainly to incorporate specific information from water conservation or municipal water efficiency plans.

The study team felt that this was the most appropriate approach to estimating water savings for the NISP Participants for the following reasons:

1. Water savings from any individual conservation measure will be specific to individual water providers, based on a number of factors, including the number of water users affected, the type of water use affected, participation rates, age of facilities, initial water use level and myriad other factors;
2. Water savings from certain conservation measures, specifically education programs, but some others as well, is difficult to quantify under any circumstances;
3. The study team could not identify a specific point in time for any Participant that could be said to be a clear line between "with and without" conservation. Therefore, the application of 2005 as the conservation time period was consistent for all.

Table III-1 portrays the estimated historical water savings for each of the NISP Participants. These estimates are assumed to represent the savings associated with overall, comprehensive water conservation efforts, as compared with little or no conservation.⁶

⁴ A number of other factors may also affect water use rates; for example, weather patterns, economic conditions or changes in the types of non-residential users served could push each Participant's water use rates up or down.

⁵ The year 2005 was chosen as the delineation between the "pre-conservation" period and the "with conservation" period since, by then, most water providers were no longer enforcing drought-related water restrictions, which are not considered long-term conservation measures.

⁶ Any estimates are subject to certain caveats. In this case, many Participants had at least some conservation measures in place prior to 2005, which suggests that these estimates might be conservative.

Table III-1.
Estimates of Historical Water Savings from Conservation for NISP Participants

Participant	Average GPCD/ GPTD Prior to 2005 ⁽¹⁾	Average GPCD/ GPTD 2005 - 2015 ⁽¹⁾	Reduction due to Conservation ⁽²⁾	Average Annual Water Savings from Conservation, AF (2005 - 2015)	Total Water Savings from Conservation, AF (2005 - 2015)
CWCWD *	1,365	1,275	-6.6%	217	2,388
Dacono	124	102	-18.1%	106	1,162
Eaton	158	133	-16.1%	127	1,392
Erie ⁽³⁾	137	144	5.1%	186	2,045
Evans	214	117	-45.3%	2,218	24,399
Firestone	167	159	-5.0%	93	1,027
FCLWD *	547	528	-3.6%	319	3,508
Fort Lupton ⁽⁴⁾	92	88	-3.9%	30	330
Fort Morgan ⁽⁵⁾	173	197	14.0%	0	0
Frederick	167	165	-1.2%	18	193
Lafayette ⁽³⁾	130	135	4.1%	1,828	20,104
LHWD	199	180	-9.5%	399	4,388
MCQWD *	514	405	-21.2%	438	4,821
Severance	200	125	-37.5%	235	2,587
Windsor *	376	291	-22.7%	481	5,289

Notes: (1) An * next to Participant name indicates that GPTD data was used for evaluating conservation savings.
(2) The percent reduction in water use due to conservation activities is equal to the difference in average water use prior to 2005 and average water use from 2005 – 2015.
(3) Water use data indicates an increase in total per capita water use over time. Estimates of conservation savings for these Participants reflect specific quantifiable conservation measures, as provided by their Water Conservation or Water Efficiency Plans.
(4) Fort Lupton's gpcd data and savings estimates reflect residential water use only.
(5) Water use data indicates an increase in per capita water use over time. No information was available to estimate savings from specific measures for these Participants.

Water use data for twelve of the fifteen Participants indicated a decrease in water use during the 2005-2015 “with conservation” period. Data for Erie, Fort Morgan and Lafayette showed an increase in per capita water use; those increases are attributable to changes in the profile of water users for those entities. For example, Fort Morgan added a new large customer in 2007, which has resulted in increased total water use for that city since that time. Both Erie and Lafayette experienced decreases in residential water use, while at the same time they saw total annual water use increase. Those patterns likely reflect the effects of specific conservation measures aimed at the residential sector, in addition to changes in the number or type of commercial or other non-residential water users served. The Erie and Lafayette Municipal Water Efficiency Plans provided data on the water savings from specific conservation measures and that data is included in the table above. The estimated historical water savings varies widely for the NISP Participants, both on an annual basis and a cumulative basis for the period between 2005 and 2015. Fort Morgan shows no water savings due to conservation efforts, while Evans and Lafayette both show water savings of over 1,000

AF per year.⁷ The scale of conservation savings for the majority of Participants depends on the difference in the gpcd (or gptd) values, as well as the number of customers served by the utility. Overall, it appears that historical efforts to encourage, promote and sustain water conservation have resulted in measurable water savings for the majority of Participants.

Future conservation savings. Estimates of future conservation savings are comprised of two components;⁸

- a) the effects of historical conservation efforts, in terms of reduced gpcd (or gptd) applied to growing populations; and
- b) the anticipated savings of future conservation measures and programs, as provided by Participants in their Water Conservation Plans or Water Efficiency Plans.

In general, the Participant's Water Conservation Plans or Water Efficiency Plans presented an evaluation and screening of potential conservation measures to be implemented within a specified time frame. The plans also offered estimates of water savings from individual measures and from the overall future conservation programs. The plans translated those savings estimates into savings goals presented as percentage reductions in total water use.⁹ The study team assumed that those conservation goals remain applicable and that, even though the specific measures to be implemented might change over time, the percentage savings goals would be achieved. The study team also assumed that the anticipated savings presented in the plans were, or would be, met within the timeframe specified in those documents.¹⁰

Table III-2 presents the total estimated water savings in future years (from existing and future measures), as compared with little or no conservation.

⁷ Evans' water savings is due to both the large difference in gpcd values before and after implementation of conservation measures and the relatively large population. The majority of Lafayette's water savings is the result of its reuse program.

⁸ Future conservation savings represents the amount of water saved as compared to little or no conservation at all.

⁹ Although the majority of conservation plans were set up in this way, several plans included unique descriptions of conservation goals, which the study team applied appropriately.

¹⁰ The implementation of future measures was assumed to occur over time and therefore, additional water savings from those measures was also applied over time.

Table III-2.
Estimated Future Water Savings from Conservation for NISP
Participants

Participant	Conservation Plan Savings Goals	Total Water Savings from Existing and Future Conservation Measures (AF)				
		2020	2030	2040	2050	2060
CWCWD	Reduce per customer water use by 5%; Reduce system water loss to 4%	347	518	644	781	947
Dacono	Reduce overall water use by 9.8%	178	249	334	449	604
Eaton	Reduce overall water use by 8.2%	228	326	423	524	648
Erie	Reduce gpcd by 3%; Reduce non-revenue water by 1%	327	468	634	814	845
Evans	Reduce overall water use by 13.0%	2,937	3,521	4,230	5,097	6,150
Firestone	Reduce overall water use by 10.3%	270	577	775	1,041	1,399
FCLWD	Reduce overall water use by 9.8%	915	1,728	2,096	2,203	2,203
Fort Lupton	Reduce residential gpcd by 5% in 10 years and 7% in 25 years; Reduce city irrigation by 5% in 10 years	33	36	40	44	49
Fort Morgan	Reduce water use by 10% over 20 years	58	152	167	182	200
Frederick	Reduce overall water use by 17.2%	74	450	659	941	1,295
Lafayette	Reduce overall water use by 12.7%	1,925	1,963	1,965	1,967	1,969
LHWD	Reduce overall water use by 9.8%	721	1,206	1,470	1,745	1,982
MCQWD	No water conservation plan on file	482	523	567	615	667
Severance	No water conservation plan on file	371	536	703	857	1,044
Windsor	Reduce overall water use by 9.3%	<u>751</u>	<u>1,174</u>	<u>1,492</u>	<u>1,899</u>	<u>2,420</u>
TOTAL		9,615	13,428	16,197	19,158	22,422

Note: The projected water savings presented in Table III-2 reflect the estimated savings from existing and future conservation measures, as compared to water use without any implemented conservation measures.

As with historical savings, the estimates of future conservation savings also vary widely among Participants. Each Participant has stated a unique conservation goal or set of goals applied to their individual circumstances. HE applied the percentage reduction in water use per year to the remaining years in the conservation plan. For example, if a provider had a 10 percent savings goal for a ten year plan, but five years of the plan had passed and water savings occurred, HE applied an additional five percent savings. Total water savings for all NISP Participants increases from about 9,600 AF in 2020 to over 22,400 AF in 2060. The increase over time reflects the effect of these programs on a growing Northern Colorado population.

Incorporation of conservation savings into final demand projections. As described in Section II of this report, the initial demand projections for each Participant are largely based on average water use patterns between the years 2000 and 2015. Those average

gpcd and gptd values already incorporate a portion of each entities conservation savings.¹¹ However, as described above, the effects of existing conservation measures are more fully reflected by the average gpcd (or gptd) values between 2005 and 2015, which generally captures a period of more intensive conservation efforts on the part most Participants.¹² Therefore, a conservation adjustment was made to reduce each Participant's initial projections of water requirements using the following approach:

1. The difference in gpcd or gptd values between the 2000 – 2015 period and the 2005 – 2015 period was applied to population or tap projections, as applicable;
2. Subsequently, the anticipated savings from future conservation measures, as described in each Participant's conservation plans, was applied to the adjusted projections of water requirements.

Role of Conservation in Statewide Water Planning

The State of Colorado, as represented by the Governor's Office, other state legislators and the Colorado Water Conservation Board (CWCB), is actively involved in promoting, encouraging and studying water conservation practices and their effects. The CWCB was created in 1937 to provide policy direction on water issues: *"For the purpose of aiding in the protection and development of the waters of the state for the benefit of the present and future inhabitants of the state there is hereby created a Colorado Water Conservation Board with the powers and duties herein set out."*¹³ CWCB's responsibilities include "protecting Colorado's streams and lakes to water conservation, flood mitigation, watershed protection, stream restoration, drought planning, water supply planning and water project financing. The CWCB also works to protect the state's water apportionments in collaboration with other western states and federal agencies."¹⁴ CWCB also recently completed a final version of Colorado's Water Plan, a state level water planning document that also addresses activities by river basin.

With regard to water conservation, the following sections of this report describe recent legislation, the state water plan and the specific roles and functions of CWCB groups.

State legislation. Several pieces of legislation aimed at promoting conservation and gathering information about the effects of conservation have been passed in Colorado in recent years. That legislation includes the following:

1. The Water Conservation Act of 2004 (HB 04-1365): This act enhanced the role of CWCB's Office of Water Conservation and Drought Planning (OWCDP) in providing technical and financial assistance for drought and water efficiency planning

¹¹ The gpcd and gptd values between 2000 and 2015 reflect the effects of any conservation measures available in those years, in terms of reduced water use.

¹² Many Participant's conservation programs were developed or substantially expanded in response to the drought of the early 2000s.

¹³ House Bill 6, Section 1, as presented on the Colorado Water Conservation Board website, <http://cwcb.state.co.us/about-us/75thAnniversaryCelebration/Pages/Main.aspx>.

¹⁴ Colorado Water Conservation Board website, <http://cwcb.state.co.us/about-us/about-the-cwcb/Pages/main.aspx>.

efforts. Additionally, it required all covered entities (retail water providers that sell 2,000 AF of water or more on an annual basis) to have a State approved water efficiency plan containing certain required minimum plan elements.¹⁵ A State approved plan must summarize each step used in the process of plan development, including the following: (1) profile of existing water supply system; (2) profile of water demands and historical demand management; (3) integrated planning and water efficiency benefits and goals; (4) selection of water efficiency activities; and (5) implementation and monitoring plans.

2. The Act Concerning Additional Information Regarding Covered Entities' Water Efficiency Plans (HB 10-1051): This act requires covered entities to report water use and water efficiency data on an annual basis to the State for statewide water supply planning purposes.¹⁶
3. The Act Concerning the Phase Out of the Sale of Certain Low-Efficiency Plumbing Fixtures (SB 14-103): This act, signed by the governor in 2014, requires that by September 1, 2016 manufacturers of certain types of indoor plumbing fixtures sell only WaterSense labeled products in the State of Colorado. The goal of this legislation is to reduce water use in Colorado where the population is growing rapidly and water supplies are spread increasingly thin.¹⁷

Colorado's Water Plan. Colorado's Water Plan "articulates collaborative, balanced water solutions to Colorado's water challenges. Equally important, it establishes the method by which we will continue to find solutions to those challenges into the future."¹⁸ As part of those solutions, the plan addresses conservation:

Chapter 5: Water Demands. In Chapter 5, the plan discusses conservation within the context of municipal and industrial (M&I) water needs. Projections of M&I water demands are presented for the state, along with estimates of water savings from passive conservation and from high, medium and low levels of active conservation. Total potential water savings from active conservation are estimated to range from about 160,000 AF to 461,000 AF statewide in 2050, with an additional 150,000 AF of savings due to passive conservation activities.¹⁹ The plan states that "not all conservation savings can or should be applied to meet future growth" and that "initial estimates indicate that Colorado water providers could use between 50 and 60 percent of conserved water to meet future growth". This chapter of the plan also includes brief discussions of CWCB guidance on conservation activities, municipal reuse and municipal land use and re-prints the following statements from the SWSI 2010 M&I Water Conservation Strategies report:

¹⁵ Colorado Water Conservation Board, Municipal Water Efficiency Plan Guidance Document, July 2012, prepared by AMEC.

¹⁶ Colorado Water Conservation Board, Municipal Water Efficiency Plan Guidance Document, July 2012, prepared by AMEC.

¹⁷ Colorado Water Conservation Board website, <http://cwcb.state.co.us/water-management/waterEfficiency/Pages/main.aspx>.

¹⁸ Colorado's Water Plan, Chapter 1, <https://www.colorado.gov/pacific/cowaterplan>.

¹⁹ Statewide Water Supply Initiative (SWSI) 2010.

“If water conservation is to be part of Colorado’s future water supply portfolio, it must be supported and funded like other supply initiatives. To obtain the savings forecast in this report, the strategies described must be rigorously implemented at the state, regional, local, and customer level. Water is saved by municipal customers, but customers can be aided in the effort. State policies that promote conservation-oriented rates, water loss control measures, water efficient landscape and building standards, improved plumbing codes, and education and outreach set the stage for regional and local conservation program measures that target high demand customers and ensure new customers join the water system at a high level of efficiency.”

Chapter 6.3: Water Conservation and Reuse. This section of the plan includes detailed discussions on the following topics (1) municipal water conservation; (2) reuse; (3) land use; (4) agricultural conservation, efficiency and reuse; (5) self-supplied industrial conservation and reuse; and (6) state agency conservation. Section 6.3.1, Municipal Conservation, provides highlighted examples of water conservation activities around the state, as well as brief descriptions of the conservation goals included in individual Basin Implementation Plans (BIPs). The goals for the South Platte Basin include a 22 percent reduction in total gpcd between 2010 and 2050, which is described in the plan as “aggressive”.

Overall, Colorado’s Water Plan stresses the important role of conservation in meeting future water demands across the state and also addresses the role of the state in supporting the conservation efforts of water providers and other water users. The plan also acknowledges that conservation is just one component of a multi-faceted approach to meeting future demands and indicates that there must be a balance between the “vital importance of urban landscape and the benefits of water conservation.”

CWCB conservation oriented groups. The CWCB includes several groups dedicated to water conservation issues:

Office of Water Conservation and Drought Planning (OWCDP). The OWCDP is part of the Water Supply Planning Section of CWCB. OWCDP provides public information and technical and financial assistance for entities seeking to plan for and implement meaningful water conservation. Specifically, OWCDP has the following responsibilities:

- Maintain a clearinghouse of water efficiency and drought information and disseminate that information to the water community and public. For example, information about best management practices (as related to water use) for the residential, business, agricultural, commercial and industrial sectors is available on the CWCB website. That information includes the Colorado Statewide Water Conservation Best Practices Guidebook;
- Provide technical assistance and evaluate and approve water efficiency and drought mitigation plans. The OWCDP has developed a number of guidance and reference documents to support entities’ water efficiency planning

efforts. Among others, those documents include the Municipal Water Efficiency Plan Guidance Document and the Utility Water Loss Report;

- Provide financial assistance for water efficiency planning, water efficiency activities, drought management planning, and public education and outreach through the Water Efficiency Grant Program. The grant program offers four types of grants: (1) water conservation planning grants; (2) water conservation implementation grants; (3) drought mitigation planning grants; and (4) water resource conservation public education and outreach grants;
- Provide leadership through the Water Availability Task Force to monitor, forecast, mitigate, and prepare for drought; and
- Coordinate with multiple state and local agencies to provide public information.

Water Conservation Technical Advisory Group (WCTAG). This group meets monthly to discuss water conservation planning and ongoing water conservation projects. The group advises the CWCB on the prioritization of its M & I water conservation related initiatives and studies and provides peer review of resulting water conservation products.

Historical Water Use Patterns

In the 2004 NISP Report, the study team assessed the overall Participants' water use patterns and the water use patterns of each Participant individually based on a comparison of individual gpcd figures. For this study, water use patterns refer to the magnitude of gallons per capita per day (gpcd) of potable water use among end users.

Prior to the 2010 update, research by the American Water Works Association published in the *Water Conservation Measurement Metrics Guidance Report*²⁰ presents a number of findings that argue against measuring "relative water use efficiency across different utilities." The report emphasizes the difference between a metric, a unit of measure such as gpcd, and a benchmark which is a level of performance of a given metric that is set as a goal. For accurate measurement of progress toward achieving efficiency goals, the report recommends disaggregation of water use into categories, such as indoor residential use. These goals should be particular to the utility and based on the characteristics of its users. For each disaggregated category of water use, the report recommends that a ratio-type benchmark be developed. The development of benchmarks is information intensive, which presents a considerable challenge.

While the study team recognizes the validity of this recommendation, such data are not currently available from the Participants. The AWWA report also finds that comparisons of gpcd between water providers can be misleading. As a benchmark, gpcd is highly influenced by weather patterns and changes in customer characteristics. In addition, factors for

²⁰ Dziegielewski, Ben and Jack C. Kiefer, *Water Conservation Measurement Metrics Guidance Report*. The American Water Works Association Water Conservation Division Subcommittee Report. January 2010.

determining gpcd often vary from utility to utility. That is, some utilities do not include losses in this calculation or may include transient populations, such as commuting workers. This finding is problematic as gpcd is the most commonly used measure by water utilities, both in Colorado and across the county. In addition, for the purposes of this study, it is the only metric available from all Participants. In fact, gpcd continues to be used for most planning efforts. While better methods might eventually be developed as recommended, the study team finds no other means of determining the relative success of conservation efforts by the Participants than gpcd at this time.

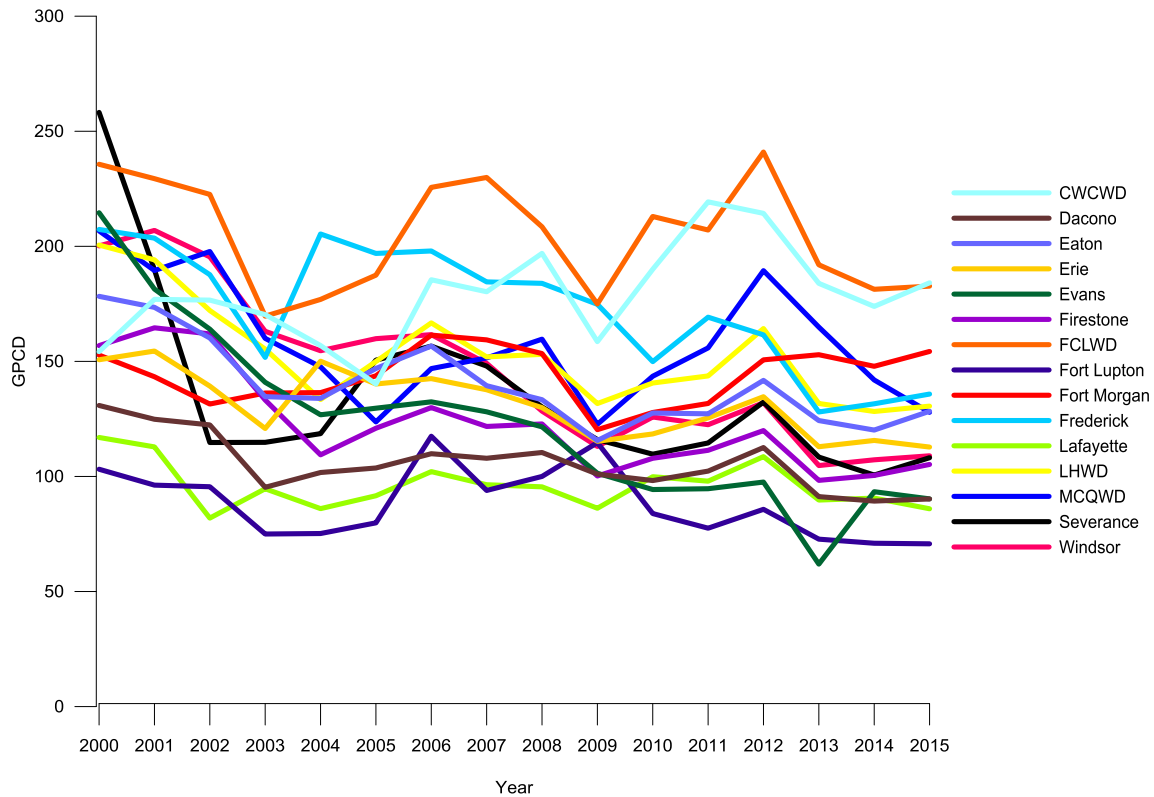
To alleviate some of the problems associated with gpcd metrics, the study team obtained the most consistent and accurate population and service area population data available. Gpcd data for the participants is provided below to demonstrate trends among the Participants as a group and for individual Participants.

Table III-3.
Gallons per Capita per Day of Combined NISP Participants

	Simple Average	Annual Change	Weighted Average	Annual Change
2000	178	NA	172	NA
2001	169	-5%	166	-4%
2002	155	-9%	152	-8%
2003	134	-13%	135	-11%
2004	134	0%	131	-3%
2005	138	3%	137	4%
2006	153	11%	155	14%
2007	145	-5%	150	-4%
2008	142	-2%	145	-3%
2009	123	-13%	124	-14%
2010	129	5%	137	11%
2011	133	4%	138	1%
2012	146	9%	154	12%
2013	121	-17%	126	-18%
2014	120	-1%	126	0%
2015	121	1%	126	0%
Total Change		-32%		-27%

This table shows a simple average of gpcd for all 15 Participants from 2000 through 2015, and then an average gpcd weighted by the population of each Participant. Such a weighting reduces the influence of very small water providers, such as the Town of Severance or the Town of Eaton, in the calculations. Regardless of methodology used, the annual combined figures for the Participants indicate a gpcd that fluctuates up and down largely with weather and water use restrictions as well as economic conditions, but also demonstrates a trend of overall reduction in gpcd during the 2000 to 2015 timeframe. Figure III-1 illustrates the water use patterns for individual Participants from 2000 through 2015.

Figure III-1.
Water Use Patterns for NISP Participants, Gallons per Capita per Day,
2000 through 2015



From 2000 to 2015, most Participants experienced potable gpcd that fluctuated between a fairly narrow range, depending upon weather, and almost all experienced a substantial decline in 2003 due to drought restrictions. It is also evident from the figure that each Participant's water use patterns are unique from the others, even in the same region. The mix of customer types distinguishes the water use patterns of the Participants: the presence of large water users such as dairies or industry; new large lot homes versus older in-town lots; and the presence of commercial activity can all help determine the water use patterns of a single Participant and why they are different from another Participant.

Table III-4 provides annual total potable gpcd for each Participant from 2000 through 2015, along with averages during this period.

Table III-4.
Total Potable Gallons per Capita per Day Use for Each NISP Participant,
2000 through 2015

Participant	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Change 2000-2015
CWCWD	495	496	480	463	426	401	484	459	459	406	481	515	534	527	571	546	484	10%
Dacono	131	125	122	95	102	104	110	108	110	101	98	102	113	91	89	90	106	-31%
Eaton	178	173	160	135	134	147	157	139	133	116	128	127	142	124	120	128	140	-28%
Erie	151	154	139	121	150	140	143	138	130	115	118	125	135	113	116	113	131	-25%
Evans	215	181	164	141	127	130	132	128	122	101	94	95	98	62	93	90	123	-58%
Firestone	157	165	162	133	109	121	130	122	123	100	108	111	120	98	100	105	123	-33%
FCLWD	236	229	223	170	177	187	226	230	208	175	213	207	241	192	181	183	205	-22%
Fort Lupton	103	96	96	75	75	80	117	94	100	115	84	78	86	73	71	71	88	-31%
Fort Morgan	153	143	131	136	136	144	161	159	153	120	128	132	151	153	148	154	144	1%
Frederick	207	204	188	152	205	197	198	185	184	175	150	169	162	128	132	136	173	-35%
Lafayette	117	113	82	95	86	92	102	96	95	86	100	98	109	90	91	86	96	-26%
LHWD	201	194	172	155	133	150	167	152	153	132	141	144	164	132	128	131	153	-35%
MCQWD	207	189	198	160	148	124	147	152	160	123	144	156	189	165	142	128	158	-38%
Severance	258	190	115	115	119	151	157	148	130	116	110	115	132	108	101	108	136	-58%
Windsor	<u>200</u>	<u>207</u>	<u>195</u>	<u>163</u>	<u>155</u>	<u>160</u>	<u>162</u>	<u>149</u>	<u>128</u>	<u>113</u>	<u>126</u>	<u>122</u>	<u>132</u>	<u>105</u>	<u>107</u>	<u>109</u>	<u>146</u>	<u>-46%</u>
Total NISP Average	201	191	175	154	152	155	173	164	159	140	148	153	167	144	146	145	160	-28%

The precipitation in 2015 was considerably higher in the NISP Participants' region than it was in 2000. This will have had an effect on the relative water use between those two years. It is also important to note that the two water providers who had higher gpcds in 2015 supply a substantial amount of water to agricultural and commercial users, whose demand does not change with precipitation.

The water providers with lower gpcd, including Lafayette, Dacono, Firestone and Evans are largely bedroom communities with a higher number of persons per tap than other water providers, which tends to lower potable gpcd. Fort Lupton's small gpcd is due in part to its small residential share of total water use. The water provider with the highest gpcd was CWCWD. CWCWD provides water to various agricultural and commercial users, such as the Fort St. Vrain Power Plant. FCLWD and Morgan County Quality Water District also have substantial demand from dairies and agribusiness.

Evaluation of Water Use Patterns

The evaluation of Participant water use patterns is intended to answer this question: Are Participants' levels of water use and associated water conservation efforts reasonable, or should additional conservation efforts be assumed when considering need for NISP? The 2010 version of this study included a historical examination of water use patterns in Northern Colorado and also included a comparison NISP Participant gpcd to other western cities to answer this question. These data, while imperfect, provide the best source of information as to the ongoing conservation efforts of the Participants.

As shown in the water conservation overview above, most Participants have specific water conservation savings goals. These goals were established with each Participant's understanding of the characteristics of their customer base and have been taken into account

in the demand projections for this study. Further, it is in the best interest of each utility to achieve their maximum conservation savings. For 14 of the participants, the firm annual yield from the NISP Project will fail to meet their projected needs over the study period. These providers will need to secure additional supplies or achieve additional savings through conservation. From an economic perspective, it is reasonable to assume that the Participants have sought or will seek maximum cost effective conservation savings before incurring the large costs associated with the NISP Project.

This evaluation begins with an historical look at water use patterns in Northern Colorado to identify what progress has been made in the area of water conservation. Next, this evaluation focuses on establishing a benchmark for reasonable conservation water usage for comparison with the Participants current water use patterns. A comparison to other western cities is also included to test the reasonableness of Participant water use.

Historical water use patterns in Northern Colorado. Two sources of information offer a comparison of historical water use with current water use patterns in Northern Colorado: the original Windy Gap EIS, which was prepared in the late 1970s and early 1980s, and the Northern District's *Regional Water Supply Study*, prepared in 1991.

The Windy Gap EIS focused on water use patterns of the original participants of that project: Boulder, Estes Park, Greeley, Longmont, Loveland and the Platte River Power Authority. Although none of these water providers are Participants in NISP, geographically they are representative of the Participants and experienced similar weather patterns. In Table 1-1 of that EIS, the average water use of the Windy Gap participants, excluding Platte River Power Authority, amounted to 250 gpcd, which compares with an average gpcd for the Participants in NISP from 1999 through 2009 of 182 (comparable time period of Windy Gap report).

The Northern District's 1991 *Regional Water Supply Study* included estimates of water use patterns for water providers in Northern Colorado and projections of future water use for municipal and industrial water providers from the Northern Denver Metropolitan area through Boulder, Larimer and Weld Counties, including many of the Participants. The water use patterns of the Participants expressed in gpcd, according to the 1991 Regional Study, are presented in Table III-5:

Table III-5.
Water Use Patterns for Selected NISP Participants (Potable Gallons per Capita per Day)

Participant	1988	Average 2000-2015	Change 1988-2015
CWCWD	395	484	23%
Eaton	183	140	-23%
Erie	389	151	-61%
Evans	216	139	-36%
FCLWD	199	205	3%
Fort Lupton	326	125	-62%
Fort Morgan	280	321	15%
LHWD	177	185	5%
MCQWD	245	235	-4%
Windsor	<u>140</u>	<u>146</u>	<u>4%</u>
Total NISP Average	255	213	-16%

Source: Northern Colorado Water Conservancy District and Municipal Subdistrict, *Regional Water Supply Study*, 1991

As a whole, the Participants for whom 1988 data are available show an over 15 percent reduction in gpcd. However, the variations from provider to provider are quite large. For example, FCLWD, Windsor, and LHWD experienced a 3 percent, 4 percent, and 5 percent increase respectively in gpcd (gptd for LHWD) during this period. However, this increase is not due to a failure in conservation efforts, but rather to changes in the composition of water users. Conversely, Erie and Fort Lupton show a remarkable reduction in gpcd of 60 percent. While conservation is likely responsible for a portion of this reduction, changes from an agricultural to suburban economy are also likely responsible for a good deal of this change.

A Bureau of Reclamation analysis of Douglas County water needs stated that a “typical minimum planning use is an average of 165 gallons per day per capita in an area without heavy industry.”²¹ The report goes on to say that Denver Water has a goal of 130 gpcd and makes projections for Douglas County utilizing both the 165 gpcd and 130 gpcd. In 2015, the average gpcd for participants, including CWCWD and MCQWD, which both have large dairies, was 121. On average, NISP Participants are in close range to this goal, suggesting adequate conservation efforts by the Participants.

Normally, water providers and their customers are motivated to take the first steps in a conservation program which achieve the largest savings at the least incremental cost. The

²¹ U.S. Department of the Interior, Department of Reclamation. *Douglas County Rural Water Project Appraisal Report*. July 2010.

Participants have reduced use by implementing relatively inexpensive water saving measures such as public education, watering restrictions and low-flow fixture requirements and landscaping regulation for new construction. In the case of an individual family, this might mean turning off the water while brushing one's teeth, using a hose nozzle when washing the car and limiting outdoor watering. For that same family to achieve greater savings, it might be necessary for them to purchase more efficient appliances or re-landscape using native plants. These reductions would come at a significant cost to the family or to a utility offering rebates. Thus, once waste is reduced, other savings are likely to involve structural changes that are more costly.

Water use benchmark for NISP Participants. A water use benchmark applicable to the Participants may be useful in a comparison to those Participants' existing water use patterns to determine if additional water conservation is a reasonable expectation; however the establishment of such a benchmark is a challenge for a number of reasons.

1. Numerous jurisdictions, including the States of Texas, California and Utah, have attempted to establish water conservation benchmarks, but each developed that benchmark in a unique manner suitable to its own purpose. No single, commonly accepted means for establishing such a benchmark is known to exist as of 2016.
2. Many measures of water use exist, and the calculation of water use is performed differently by agencies and jurisdictions. For example, water use can be measured by gpcd, gallons per tap per day, gallons per household per day, residential water use per capita per day, and so on. Further, the point of measurement, i.e. public water supplies versus all water supplies, or population within the city limits versus service area population, is also not uniform.
3. Customer characteristics vary from provider to provider and small providers are especially sensitive to changes in customer type.

In sum, establishing a benchmark has inherent limitations. For the purposes of this report, the defined benchmark requires judgment based upon comparable areas and an understanding of the site-specific circumstances of the Participants.

Regional average gpcd's provide a starting point for establishing a NISP water use benchmark. The Statewide Water Initiative (SWSI) found that Colorado statewide gpcd averaged between 206 and 332, with the South Platte Basin as the lowest average in the state at 206 gpcd.²² The EPA reports an average water use of 242 gpcd for the entire upper Colorado River Basin.²³ This same EPA report assigns a 194 gpcd to the Platte River Basin. A Western Resource Advocates report indicates an average gpcd for 13 large western U.S. cities of about 229 in 2001.²⁴ Yet another benchmark can be extracted from U.S. Geological Survey water use data produced in the year 2000. This Federal agency gathers water supply, demand and population data for counties throughout the U.S. every five years. In the year

²² CDM, Statewide Water Supply Initiative, Executive Summary, Page ES-9.

²³ Environmental Protection Agency, accessed at EPA.gov/watrhome/use/cap1.html.

²⁴ Western Resource Advocate, Smart Water, Page 66, 2003.

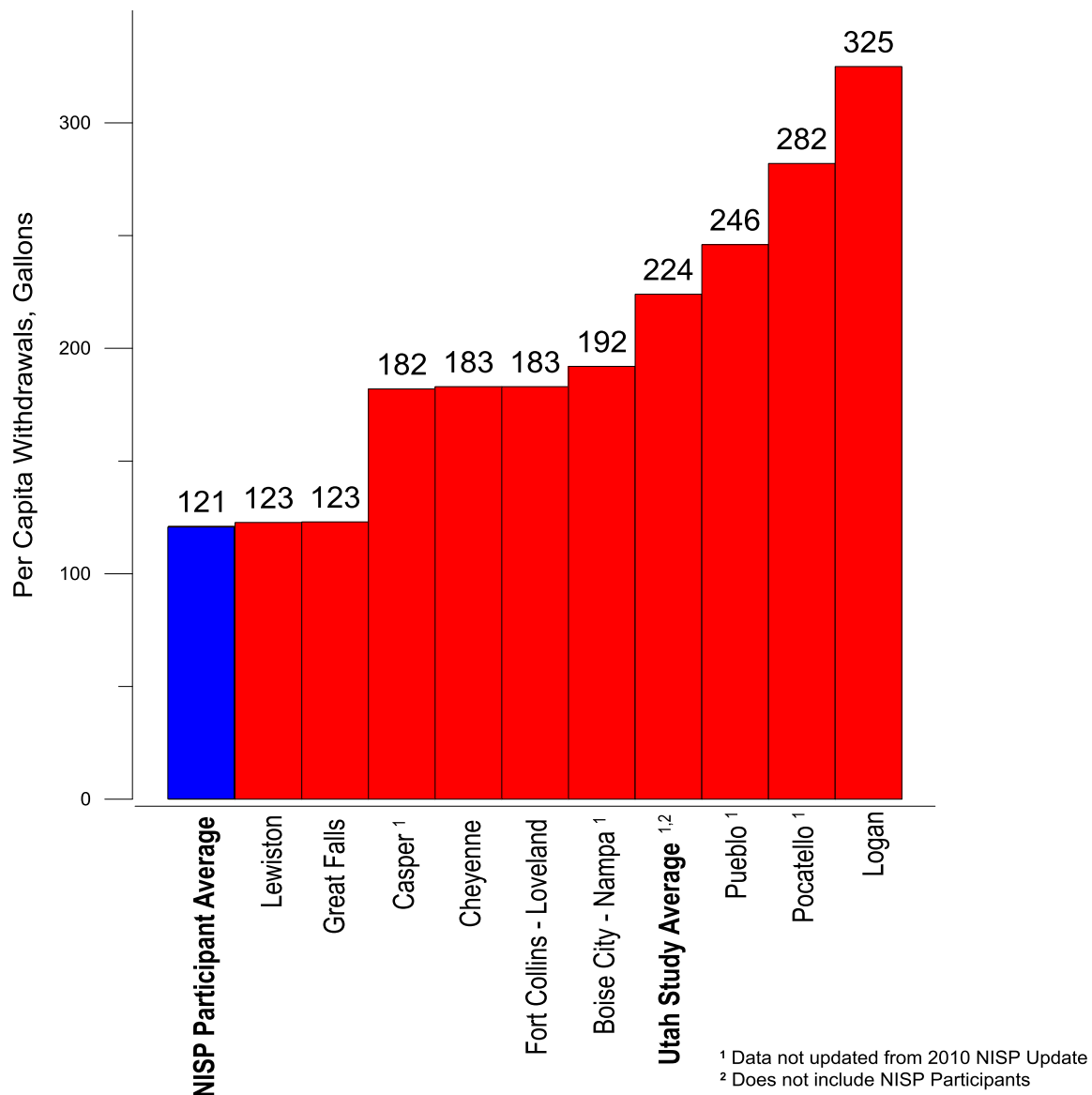
2000, admittedly a high water use year, the average gpcd for Colorado's portion of the South Platte Basin was about 200.²⁵

An additional source of information for establishing a conservation water use benchmark comes from a study entitled, *Water Use and Residential Rate Structures in the Intermountain West*²⁶. In that study, the authors provide water use information for 25 cities in the western U.S. of various sizes and locations. The average gpcd for these 25 cities was 243. However, this study also provides information about the size of each of the communities and their average precipitation and temperature. In isolating cities of less than 301,000 in population and cities with precipitation and average temperature within plus or minus 25 percent of the Fort Collins – Loveland area, a total of nine cities are identified including the Fort Collins – Loveland area. The average gpcd for these communities was 224, as shown in Figure III-2 below.

²⁵ US Geological Survey, Water Supply and Use, year 2000, Colorado.

²⁶ *Water Use and Residential Rate Structures in the Intermountain West*, Utah Economic and Business Review. Volume 65, March/April 2005.

Figure III-2.
Average GPCD for Selected Cities



As a final data point in considering the NISP benchmark, Denver Water exhibited an average potable gpcd usage of 166 between 2007 and 2013.²⁷ Denver is considered to have a well developed water conservation program and is considered by many to be an example of strong conservation along Colorado's Front Range. Denver Water's comparability is somewhat limited in this instance, since it is a much larger metropolitan area with different financial resources than the Participants. Denver Water data also include parks and other outdoor irrigation requirements, whereas potable water use per day within the Participants includes only potable supplies, excluding a modest portion of non-potable use for irrigation. Based upon the foregoing data points, and using its professional judgment, the study team established the water use benchmark of 215 gpcd for Participants' potable water use.

²⁷ Denver Water. Water Conservation Plan Update – Draft. October, 2014.

Comparison of benchmark to NISP Participant usage. The study team compared the benchmark of 215 gpcd to the average gpcd from 2000 to 2015 for each Participant. No Participants were found to be over that benchmark.

Summary observations about conservation. All Participants have active conservation programs in place and each include a host of measures. Conservation programs have been expanded and strengthened since 2004. Programs emphasizing price signals appear to be emphasized by Participants. Conservation programs appear to have had an effect in reducing water use among the Participants, although trend data is limited. To the extent there is a NISP water use benchmark, water use patterns of the Participants are not considered excessive. The relatively higher water using Participants are rural water districts that serve large agribusinesses whose effects on water use patterns are magnified by a relatively small population base. This finding suggests that a reasonable level of efficient water use is being practiced by most Participants' customers.

SECTION FOUR

Additional Water Needs of the NISP Participants

Additional water needs of the Participants are determined by the difference between their projected future water demands and their firm annual water supplies or yields that were owned or controlled by the Participants in 2015. That is, as future water demands in a normalized weather condition year exceed firm annual yield, this excess amounts to future water resource needs for a Participant. Unmet future needs refer to a Participant's inability to meet normal demands during water supply circumstances similar to a defined drought period. This approach is consistent with industry standards.

In anticipation of future demands exceeding firm yield, it would be prudent for a water provider to seek additional water supplies. In fact, a water provider can operate assuming average year supplies, which temporarily forestalls the need for additional water resources, but water customers would be faced with drought restrictions more frequently, and the uncertainty or risk of insufficient supplies would be elevated to a level that is not consistent with good water resource management. Therefore, this evaluation focuses on the difference between total future water requirements and present firm annual yields to assess the need for NISP. It is important to note that projected water requirements assume that future water supplies are available to meet demands. Tables IV-1 and IV-2 summarize total future water requirements and shortages beyond firm yields, respectively, by Participant from 2020 through 2060, with a 10 percent safety factor included for the total.

Table IV-1
Projected Water Requirements for NISP Participants in Acre Feet, 2020 to 2060

Participant	2020	2025	2030	2035	2040	2045	2050	2055	2060
CWCWD	4,300	4,600	5,000	5,400	6,000	6,500	7,200	7,900	8,600
Dacono	700	800	900	1,000	1,200	1,400	1,600	1,900	2,200
Eaton	1,400	1,600	1,900	2,100	2,400	2,700	2,900	3,300	3,600
Erie	4,800	5,900	7,200	8,500	9,900	11,300	12,900	13,600	13,600
Evans	4,100	4,600	5,000	5,500	6,000	6,500	7,200	8,000	8,600
Firestone	2,800	3,200	3,800	4,400	5,100	5,900	6,800	7,900	9,100
FCLWD	11,100	11,600	12,700	14,000	15,400	16,200	16,200	16,200	16,200
Fort Lupton	1,700	1,700	1,800	1,900	2,000	2,100	2,200	2,300	2,400
Fort Morgan	6,500	7,000	7,300	7,800	8,100	8,400	8,700	9,000	9,400
Frederick	3,100	3,600	4,300	5,200	6,300	7,600	9,100	10,900	12,800
Lafayette	5,400	5,900	6,300	6,400	6,400	6,500	6,600	6,600	6,700
LHWD	5,700	6,000	6,600	7,300	8,100	8,800	9,600	10,300	10,900
MCQWD	2,800	3,200	3,400	3,600	3,700	3,800	3,900	4,000	4,200
Severance	800	1,000	1,200	1,400	1,600	1,700	1,900	2,100	2,300
Windsor	<u>3,000</u>	<u>3,300</u>	<u>3,700</u>	<u>4,100</u>	<u>4,600</u>	<u>5,200</u>	<u>5,800</u>	<u>6,500</u>	<u>7,300</u>
Total	58,200	64,000	71,100	78,600	86,800	94,600	102,600	110,500	117,900
Total with 10% Safety Factor	64,020	70,400	78,210	86,460	95,480	104,060	112,860	121,550	129,690

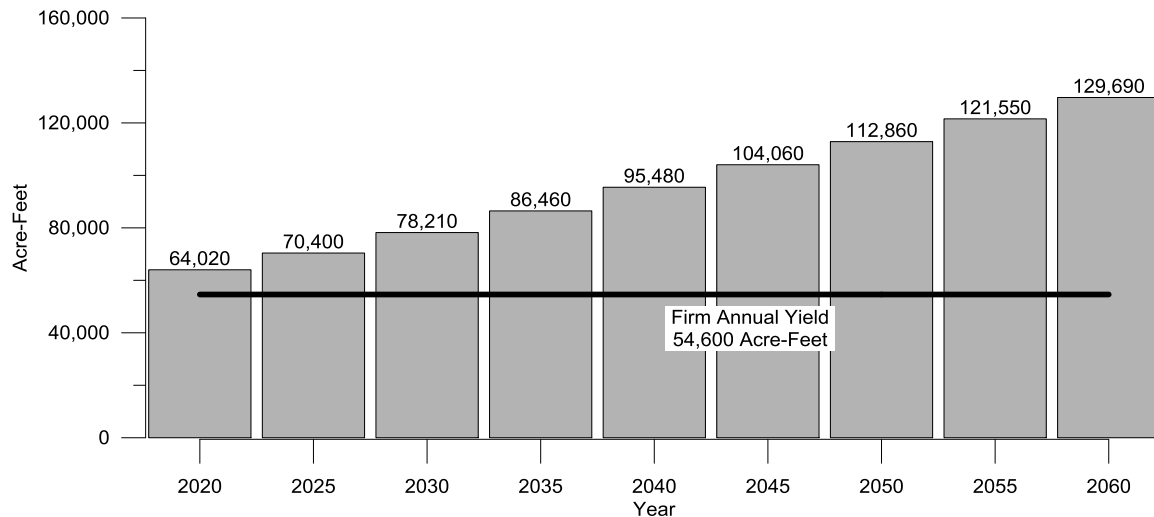
Table IV-2
Projected Water Shortages (Excess) beyond Firm Annual Yields for NISP Participants in Acre Feet, 2020 to 2060

Participant	2020	2025	2030	2035	2040	2045	2050	2055	2060
CWCWD	900	1,200	1,600	2,000	2,600	3,100	3,800	4,500	5,200
Dacono	(400)	(300)	(200)	(100)	100	300	500	800	1,100
Eaton	(300)	(100)	200	400	700	1,000	1,200	1,600	1,900
Erie	200	1,300	2,600	3,900	5,300	6,700	8,300	9,000	9,000
Evans	1,700	2,200	2,600	3,100	3,600	4,100	4,800	5,600	6,200
Firestone	(300)	100	700	1,300	2,000	2,800	3,700	4,800	6,000
FCLWD	(1,000)	(500)	600	1,900	3,300	4,100	4,100	4,100	4,100
Fort Lupton	(100)	(100)	0	100	200	300	400	500	600
Fort Morgan	2,400	2,900	3,200	3,700	4,000	4,300	4,600	4,900	5,300
Frederick	(100)	400	1,100	2,000	3,100	4,400	5,900	7,700	9,600
Lafayette	600	1,100	1,500	1,600	1,600	1,700	1,800	1,800	1,900
LHWD	(300)	0	600	1,300	2,100	2,800	3,600	4,300	4,900
MCQWD	200	600	800	1,000	1,100	1,200	1,300	1,400	1,600
Severance	200	400	600	800	1,000	1,100	1,300	1,500	1,700
Windsor	<u>(100)</u>	<u>200</u>	<u>600</u>	<u>1,000</u>	<u>1,500</u>	<u>2,100</u>	<u>2,700</u>	<u>3,400</u>	<u>4,200</u>
Total	3,600	9,400	16,500	24,000	32,200	40,000	48,000	55,900	63,300
Total with 10% Safety Factor	9,400	15,800	23,600	31,800	40,900	49,400	58,200	66,900	75,100

Combined Water Needs of the NISP Participants

The water needs of the Participants, viewed as a group, are considerable, as illustrated in Figure IV-1.

Figure IV-1.
Comparison of Future Water Requirements with 2015 Firm Annual Yields for 15 NISP Participants, Combined, in Acre-Feet, 2020 through 2060



By 2015, total future demands of all Participants combined will approximate their combined firm annual yield. By the year 2035, the excess of combined demands over current supplies will be more than 25,000 AF. By 2060, the total shortage for Participants will be over 69,000 AF. Table IV-3 estimates the projected margins of future demands compared with 2015 firm annual yield of a combined 54,600 AF, including a 10 percent safety factor.

Table IV-3.
Cumulative New Water Requirements beyond 2015 Firm Annual Yield, in Acre-Feet, 2020 through 2060

Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield	Cumulative Water Requirements with 10% Safety Factor
2020	3,600	9,400
2025	9,400	15,800
2030	16,500	23,600
2035	24,000	31,800
2040	32,200	40,900
2045	40,000	49,400
2050	48,000	58,200
2055	55,900	66,900
2060	63,300	75,100

Note: Firm annual yield for 2015 was estimated to be about 54,600 acre-feet for the 15 Participants combined.

The Participants are seeking a permitted yield from NISP totaling 40,000 AF in new firm yield.²⁸ From a combined standpoint, the Participants will need the yield from NISP no later than 2020, and these Participants will need additional supplies from that time forward. By the 2040's, the NISP yield will be fully absorbed compared with 2015 dry year yield. Of course, individual Participants are most likely pursuing multiple strategies for water resource acquisition.

It should be noted that the Participants' future investment in NISP and other water supplies will very likely increase their overall costs per acre-foot of water supplies. If these costs were recovered through volumetric water rates, it is possible that water price elasticity effects would result in reduced consumption, thereby reducing water needs. However, municipalities and most water providers in Northern Colorado have policies that growth must pay its own way. It is quite likely that large portions of the incremental costs of NISP and other new water supplies will be collected in the form of tap fee increases, instead of in water rate increases. Since almost all water costs along the Front Range of Colorado are increasing, it is unlikely that growth or water use will be affected significantly by increases in the cost of water for the Participants.

Future Water Needs of Individual NISP Participants

Figures IV-2 through IV-16 present the new water requirements for each Participant beyond their own firm annual yields in 2015. For each Participant, a bar chart comparing future water requirements with 2010 firm annual yield is followed by a table that quantifies the excess supplies or unmet demands for each Participant. These new water requirements do not include a safety factor.

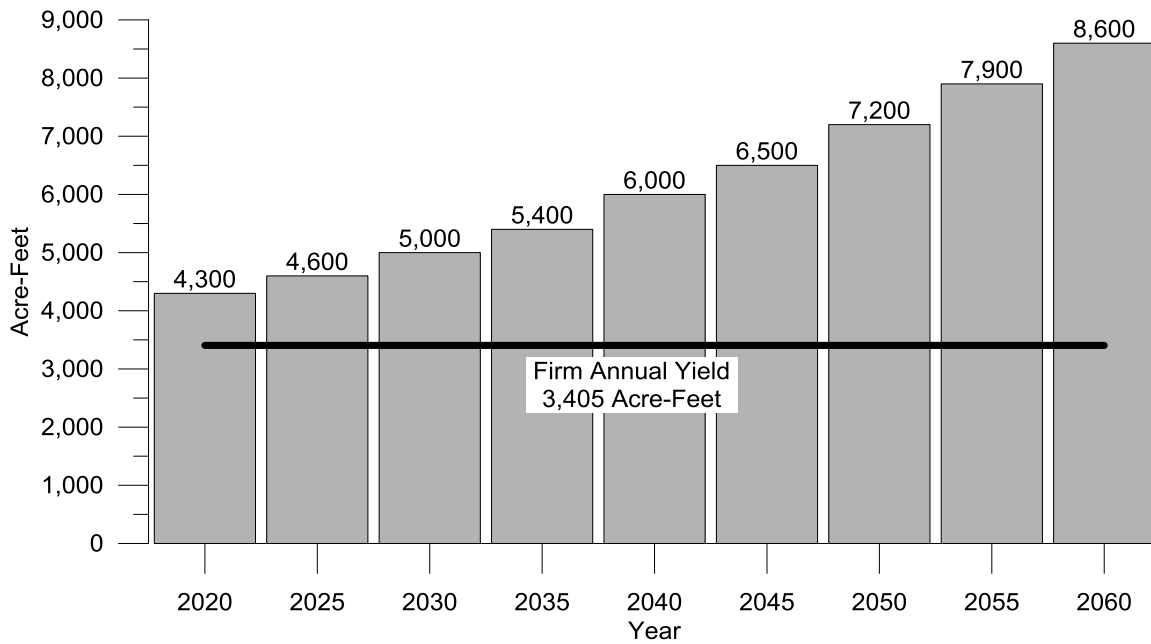
Central Weld County Water District (CWCWD). With 2015 firm annual yield of just over 3,400 AF, CWCWD is, on average already short of water with average year demands from the year 2015. By 2035, demands will exceed supply by 2,000 AF, by 2060 the shortfall will be about 5,200 AF. CWCWD is seeking 3,500 AF of new permitted firm yield from NISP.

Although CWCWD treats water for the communities of Dacono, Firestone, Frederick, Kersey, Milliken, LaSalle, Gilcrest, Platteville, Left Hand and Aristocrat. CWCWD is currently responsible only for providing treatment and not for supplying the raw water for these communities; therefore, they were not included in the demand evaluation.

²⁸ Document obtained from Northern Colorado Water Conservancy District, December 2005.

Figure IV-2.

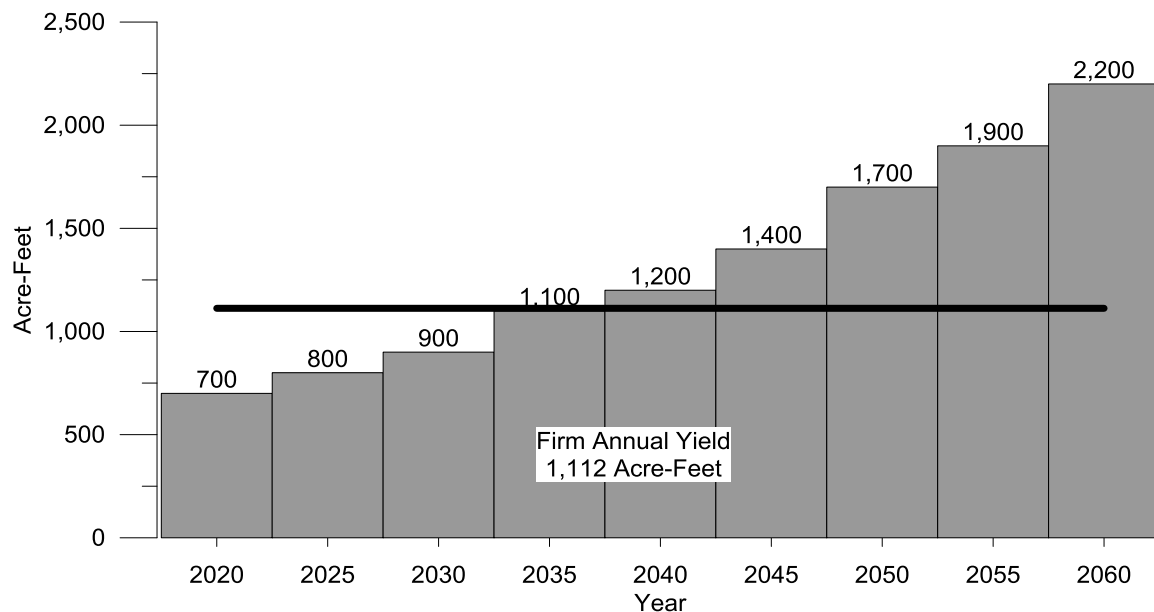
Comparison of Future Water Demands with 2015 Firm Annual Yield, CWCWD, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	900
2025	1,200
2030	1,600
2035	2,000
2040	2,600
2045	3,100
2050	3,800
2055	4,500
2060	5,200

City of Dacono. The City of Dacono’s future water demands will be adequate with its 2015 firm annual yield of 1,100 AF until about 2035. After that, demands will increase steadily until demand exceeds firm annual yield by more than 1,100 AF in 2060. Dacono is seeking 1,000 AF of new permitted firm yield from NISP.

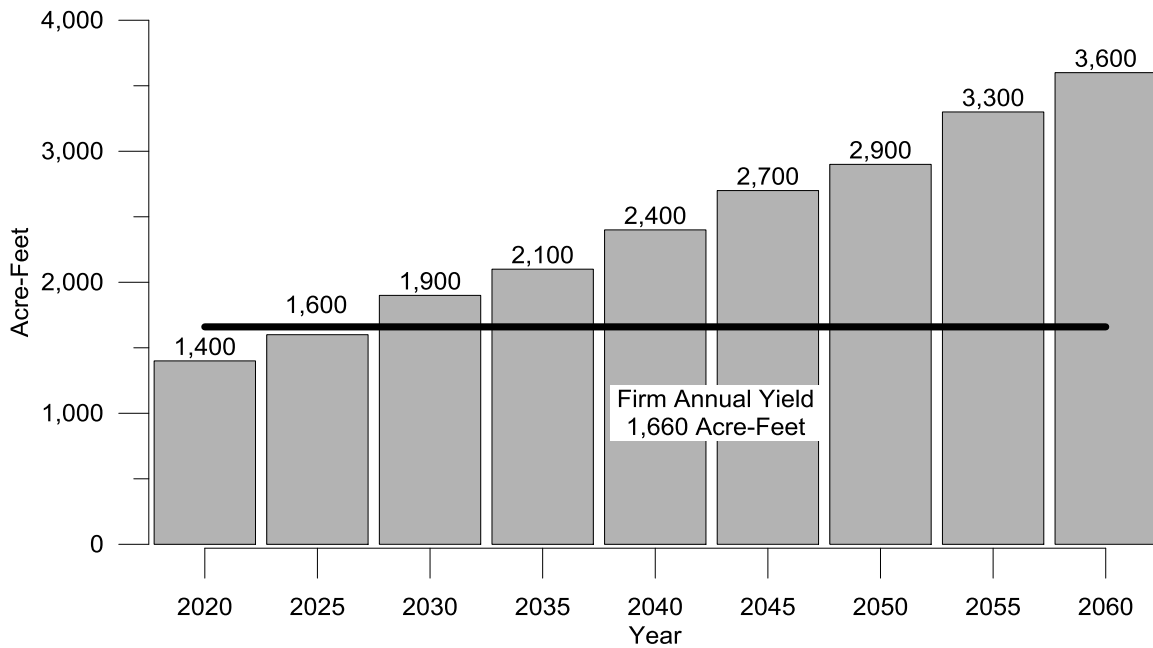
Figure IV-3.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
City of Dacono, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(400)
2025	(300)
2030	(200)
2035	-
2040	100
2045	300
2050	600
2055	800
2060	1,100

Town of Eaton. The Town of Eaton’s future water demands will be adequate with its 2010 firm annual yield of 1,660 AF until about 2025. By the year 2040, the Town of Eaton is projected to need about 700 AF in new, firm annual yield. By 2060, that figures rises to 1,900 AF. Eaton is seeking 1,300 AF of new permitted firm yield from NISP.

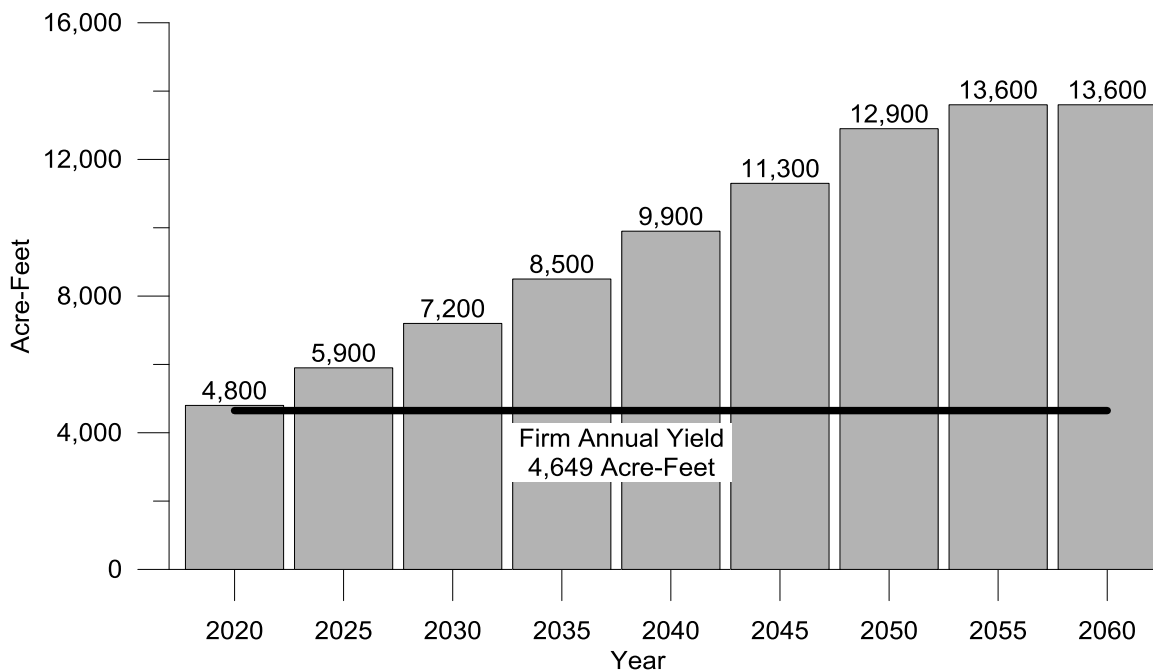
Figure IV-4.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Town of Eaton, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(300)
2025	(100)
2030	200
2035	400
2040	700
2045	1,000
2050	1,200
2055	1,600
2060	1,900

Town of Erie. The Town of Erie has a 2015 firm annual yield of about 4,650 AF and those supplies are insufficient for current water demands in dry years. The Town of Erie needs additional firm annual yield now, and this excess of demands over 2015 water supplies will increase rapidly. By 2035, the demand will exceed firm supplies by more than 3,900 AF and by 2060 that shortfall will increase to 9,000 AF. Erie is seeking 6,500 AF of new permitted firm yield from NISP.

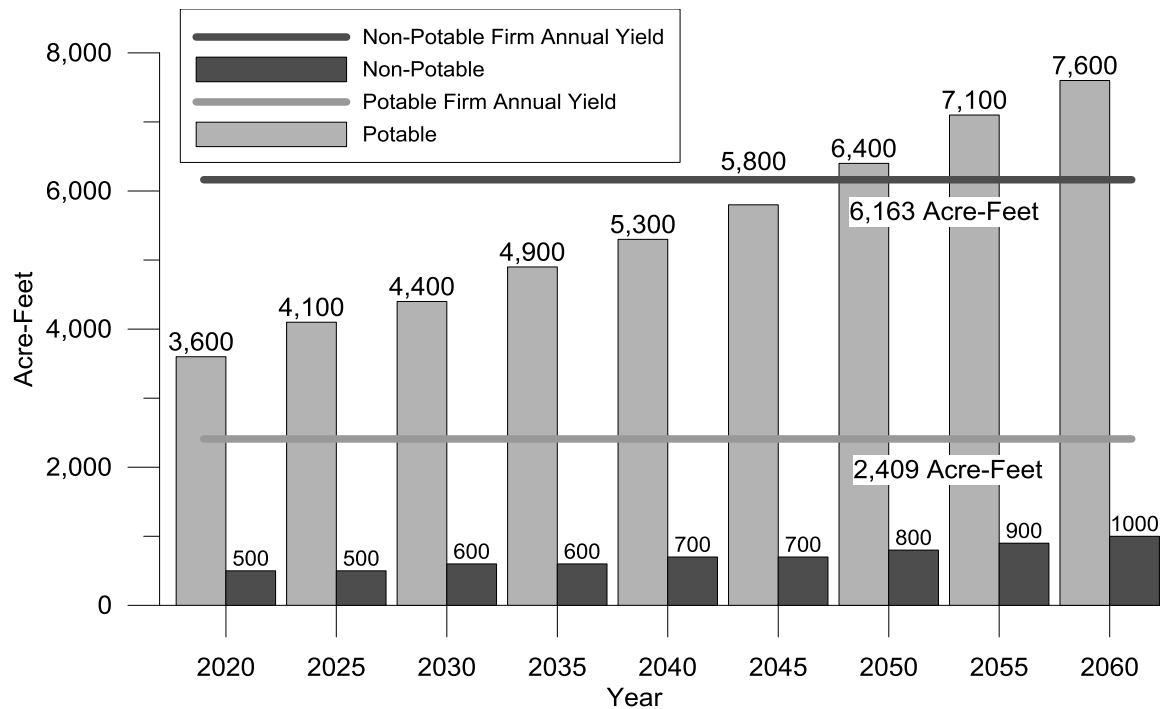
Figure IV-5.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Town of Erie, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	200
2025	1,300
2030	2,600
2035	3,900
2040	5,300
2045	6,700
2050	8,300
2055	9,000
2060	9,000

City of Evans. The City of Evans obtains treated water from the City of Greeley but must provide Greeley with the underlying water resources to meet that need. Evans' firm annual yield in 2015 was estimated at about 8,600 AF, including non-potable supplies that were available only for non-potable deliveries. The City of Evans faces an excess of demands over its supplies in coming years, reaching a deficit of 2,500 AF by the year 2035 and 5,200 AF in 2060. The City of Evans is seeking 1,600 AF of new permitted firm yield from NISP.

Figure IV-6.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
City of Evans, in Acre-Feet, 2020 through 2060

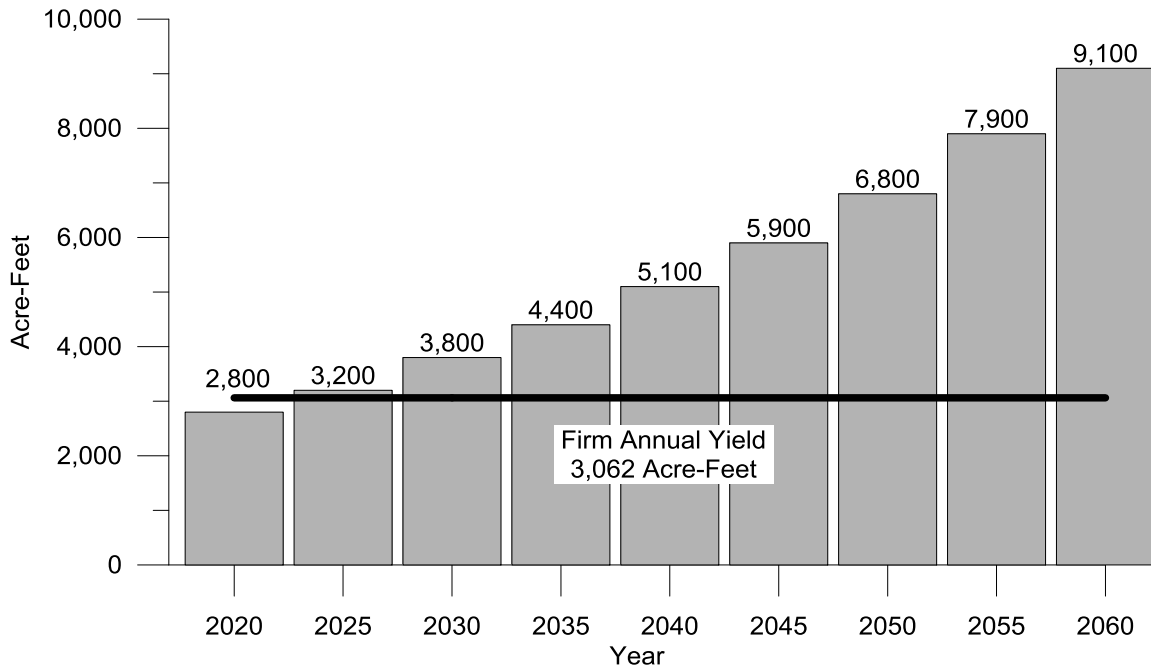


Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	1,200
2025	1,700
2030	2,000
2035	2,500
2040	2,900
2045	3,400
2050	4,000
2055	4,700
2060	5,200

Note: Cumulative water requirements reflect potable water requirements only.

Town of Firestone. The Town of Firestone will have adequate firm annual yield until about 2020, after which shortages will steadily increase. By 2035, firm annual yield will be about 1,300 AF less than projected demands. Firestone’s firm annual yield will be more than 6,000 AF less than demand by 2060. Firestone is seeking 1,300 of new permitted firm yield from NISP.

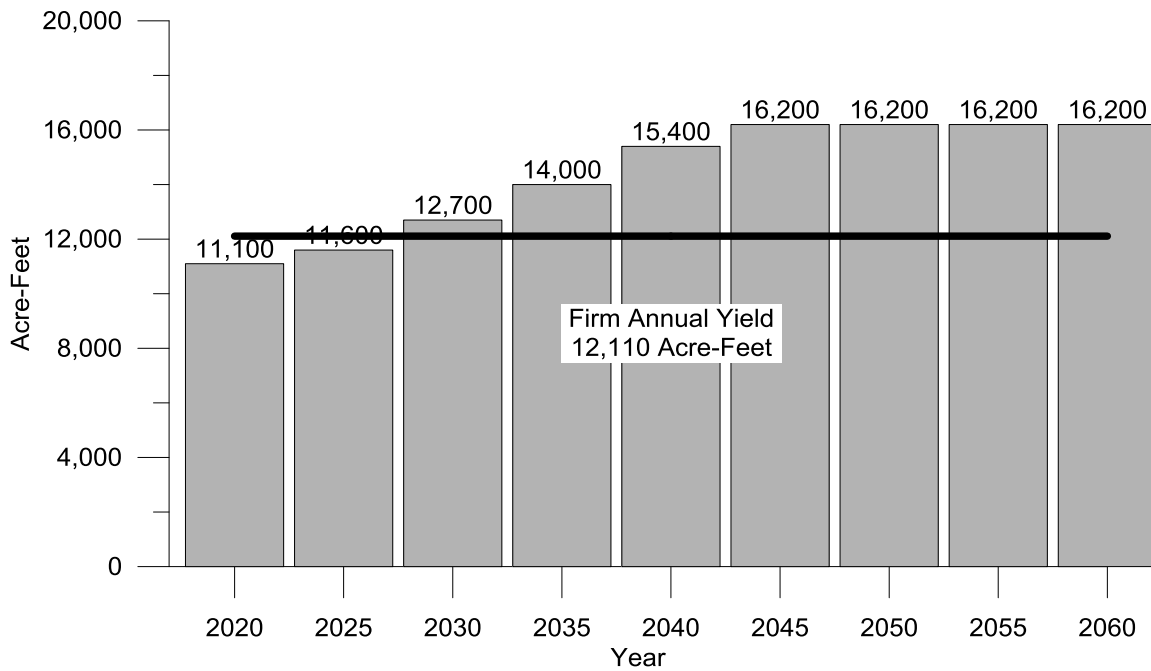
Figure IV-7.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Town of Firestone, in Acre-Feet, 2020 through 2060



Cumulative Water Requirements Beyond 2015 Firm Annual Yield	
Year	
2020	(300)
2025	100
2030	700
2035	1,300
2040	2,000
2045	2,800
2050	3,700
2055	4,800
2060	6,000

Fort Collins-Loveland Water District (FCLWD). With a 2015 firm annual yield of about 12,100 AF, FCLWD will have adequate supply until 2025. After that, shortages will develop and grow steadily to 4,100 AF at buildout, which is projected to be reached around 2045. FCLWD is seeking 3,000 AF of new permitted firm yield from NISP.

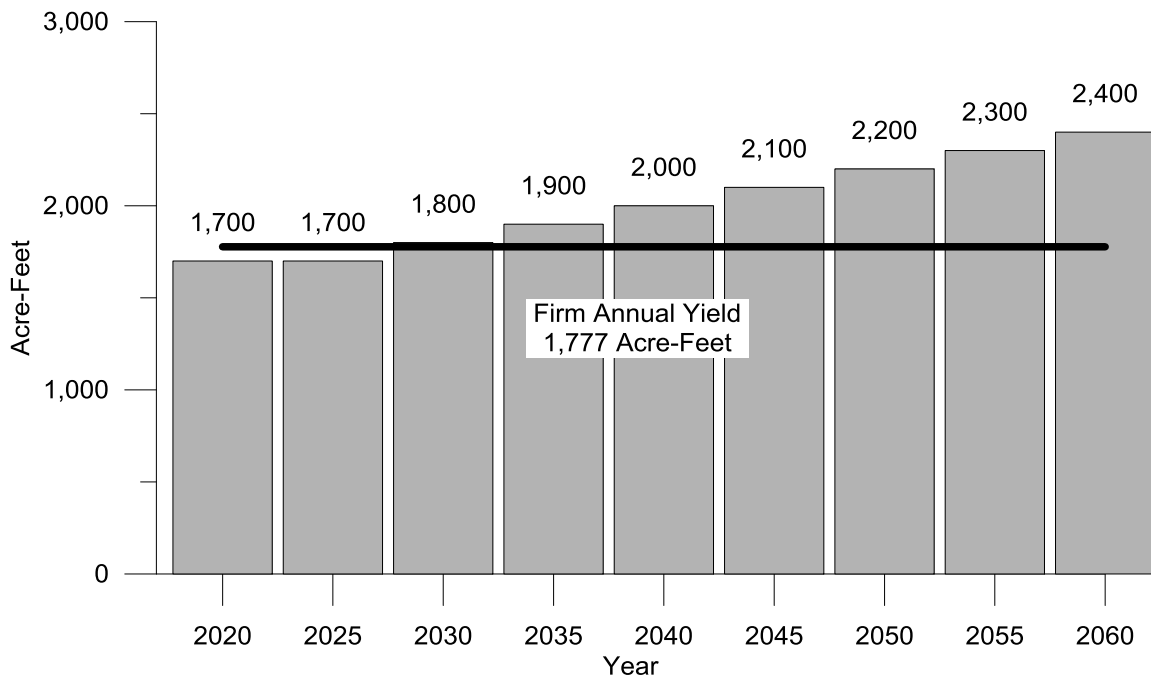
Figure IV-8.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
FCLWD, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(1,000)
2025	(500)
2030	600
2035	1,900
2040	3,300
2045	4,100
2050	4,100
2055	4,100
2060	4,100

City of Fort Lupton. The City of Fort Lupton had a 2015 firm annual yield of almost 2,000 AF, however, with the loss of the Tri-State water²⁹, their 2020 firm annual yield is closer to 1,800 AF. The excess of Fort Lupton's future water demands compared with its firm annual yield will rise slowly but steadily to reach 100 AF by the year 2035 and more than 600 AF by the year 2060. The City of Fort Lupton is seeking 3,000 AF of new permitted firm yield from NISP. The City of Fort Lupton's subscribed amount is justifiable in view of its conservative approach to future water supply planning and the potential for annexation of additional lands in the future and growth beyond current projections. Fort Lupton is not landlocked and developable land is adjacent to the current city limits. It is also possible that the City might sell a portion of its NISP subscription to other NISP Participants. As previously noted, a number of Participants will need to acquire additional supplies before 2060.

Figure IV-9.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Town of Fort Lupton, in Acre-Feet, 2020 through 2060

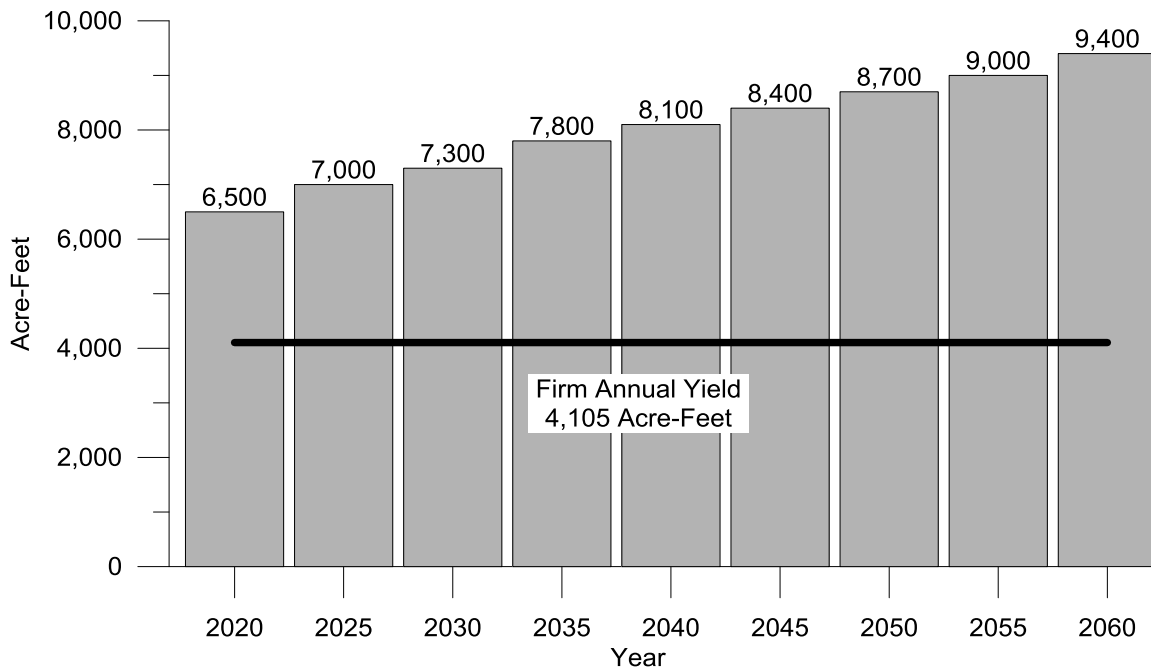


²⁹ Currently Tri-State's water supply is counted under Fort Lupton's account at the Northern District. Tri-State is currently in the process of getting their own account.

Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(100)
2025	(100)
2030	-
2035	100
2040	200
2045	300
2050	400
2055	500
2060	600

City of Fort Morgan. With just over 4,100 AF of 2015 firm annual yield, the City of Fort Morgan could experience shortages in the immediate future. Fort Morgan’s need for new water supplies will grow steadily, reaching 3,700AF in the year 2035 and 5,300 AF in 2060. Fort Morgan is seeking 3,600 AF of new permitted firm yield from NISP.

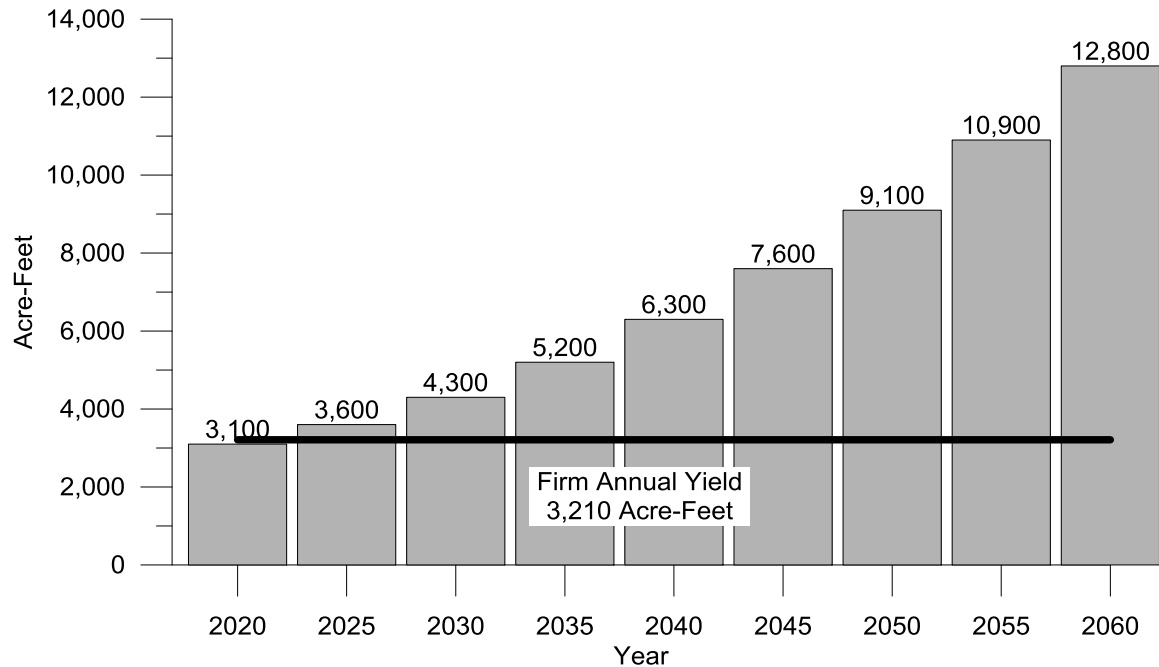
Figure IV-10.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
City of Fort Morgan, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	2,400
2025	2,900
2030	3,200
2035	3,700
2040	4,000
2045	4,300
2050	4,600
2055	4,900
2060	5,300

Town of Fredrick. The Town of Frederick’s projected water demands in 2020 are about 100 AF less than its 2015 firm annual yield of about 3,200 AF. Supplies will be adequate until about 2025, after which shortages will growly at a rapid pace, reaching more 9,000 AF by year 2060. The Town of Frederick is seeking 2,600 AF of new permitted firm yield from NISP.

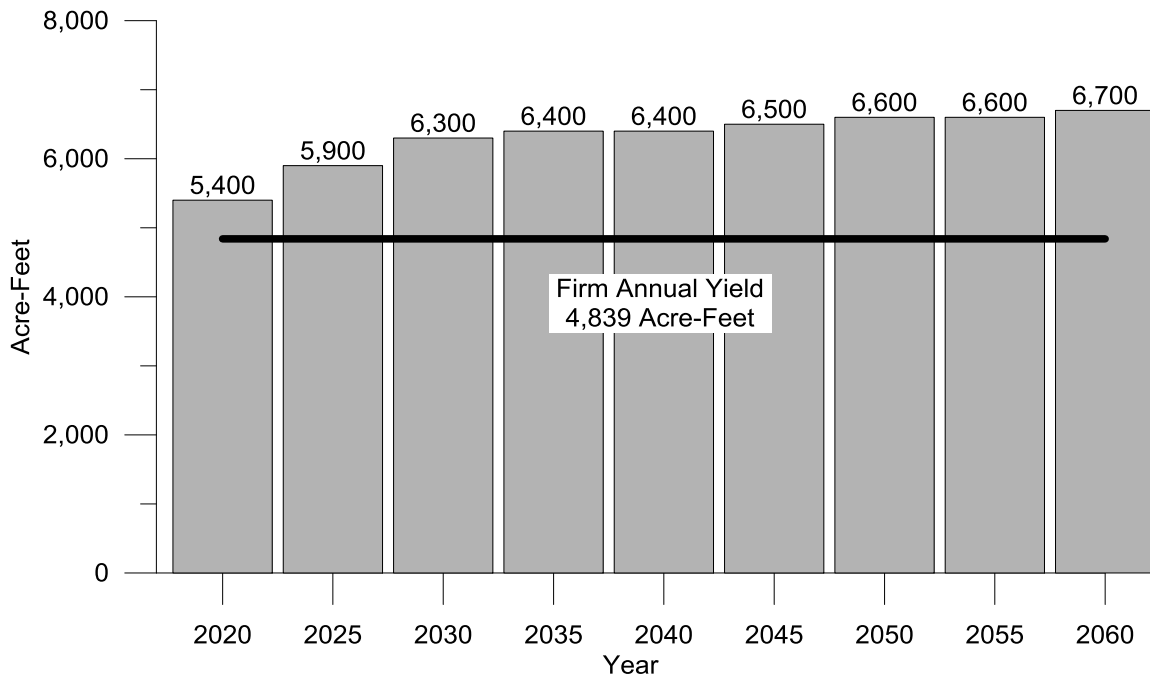
Figure IV-11.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Town of Frederick, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(100)
2025	400
2030	1,100
2035	2,000
2040	3,100
2045	4,400
2050	5,900
2055	7,700
2060	9,600

City of Lafayette. The City of Lafayette’s projected water demands in 2020 are about 600 AF higher its 2015 firm annual yield of about 4,800 AF. From there, the excess of projected demands over 2015 supplies will increase, reaching more than 1,500 AF by the year 2030, when buildout is achieved. Projected water needs increase to 1,900 AF by 2060 due to increasing non-potable demand. The City of Lafayette is seeking 1,800 AF of new permitted firm yield from NISP.

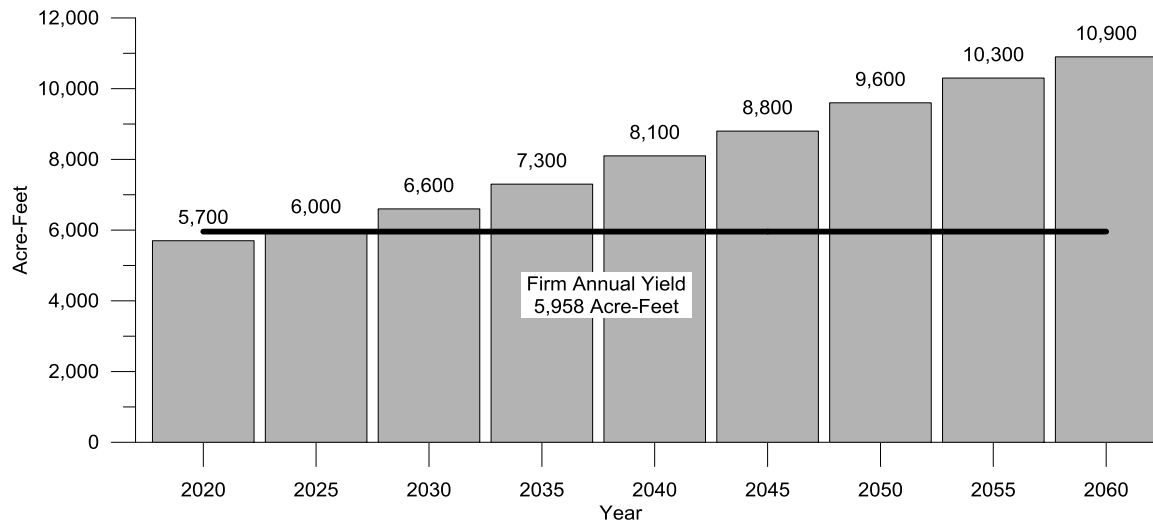
Figure IV-12.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
City of Lafayette, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	600
2025	1,100
2030	1,500
2035	1,600
2040	1,600
2045	1,700
2050	1,800
2055	1,800
2060	1,900

Left Hand Water District (LHWD). LHWD's 2015 firm annual yield of about 6,000 AF will meet average year water demands projected through the year 2020, but supply will be less than demand within the next two to three years. The need for new firm annual yield will grow after that, reaching 4,900 AF at buildout, by the year 2060. LHWD is seeking 4,900 AF of new permitted firm yield from NISP.

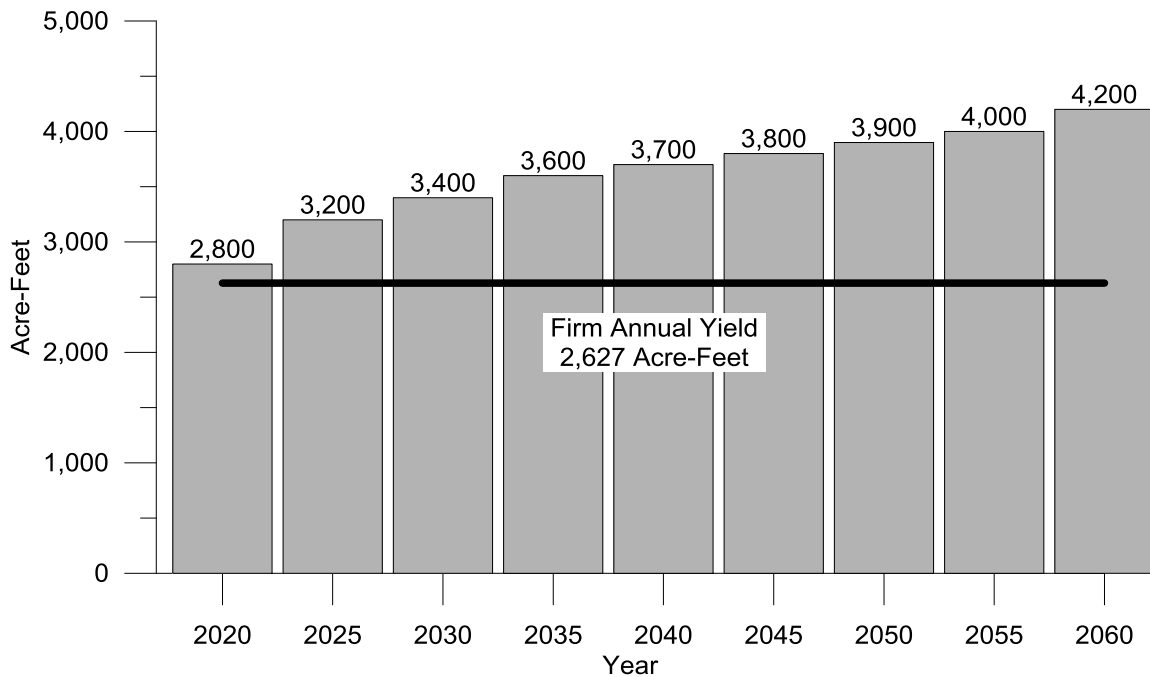
Figure IV-13.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Left Hand Water District, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(300)
2025	-
2030	600
2035	1,300
2040	2,100
2045	2,800
2050	3,600
2055	4,300
2060	4,900

Morgan County Quality Water District (MCQWD). This water district, with over 2,600 AF in 2015 firm annual yield, requires water by the year 2020. After that, the need for new water resources will gradually increase, reaching 1,600 AF by the year 2060. MCQWD is seeking 1,300 AF of new permitted firm yield from NISP.

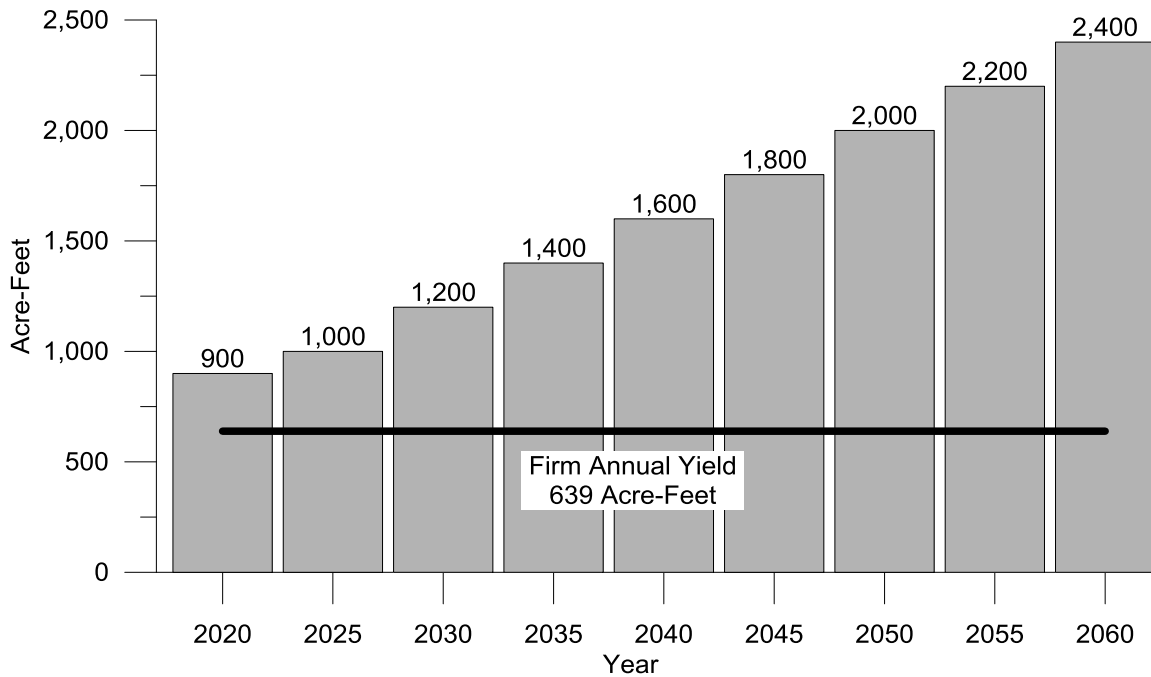
Figure IV-14.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
MCQWD, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	200
2025	600
2030	800
2035	1,000
2040	1,100
2045	1,200
2050	1,300
2055	1,400
2060	1,600

Town of Severance. The Town of Severance’s 2015 firm annual yield of 640 AF is less than projected demands for 2020. New water resource needs for the Town of Severance will grow relatively rapidly, reaching 800 AF by 2035. By 2060, the shortage will be 1,700 AF. The Town of Severance is seeking 1,300 AF of new permitted firm yield from NISP.

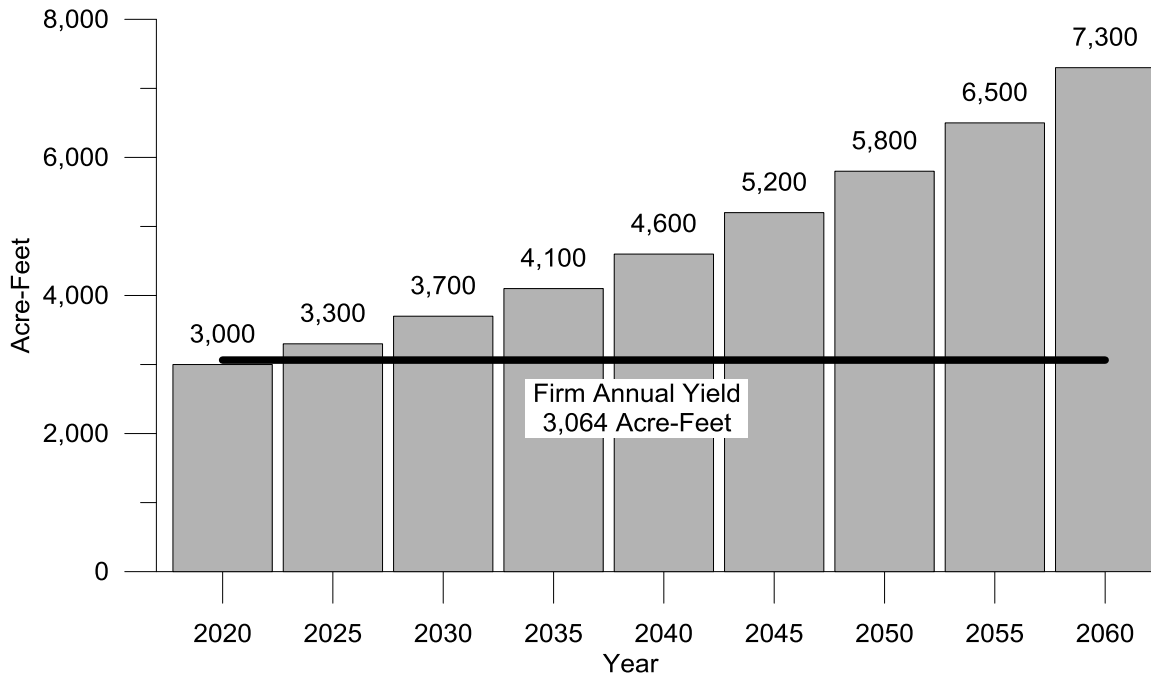
Figure IV-15.
Comparison of Future Water Demands with 2015 Firm Annual Yield,
Town of Severance, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	200
2025	400
2030	600
2035	800
2040	1,000
2045	1,100
2050	1,300
2055	1,500
2060	1,700

Town of Windsor. With 2010 firm annual yield of a little more than 3,000 AF, the Town of Windsor's water demands projected for the year 2020 are about 100 AF less than its supply, but new water supplies will be required in the near future. Windsor's need to secure new water resources will grow, reaching 4,200 AF by the year 2060. The Town of Windsor is seeking 3,300 AF of new permitted firm yield from NISP.

Figure IV-16.
Comparison of Future Water Demands with 2015 Firm Annual Yields,
Town of Windsor, in Acre-Feet, 2020 through 2060



Year	Cumulative Water Requirements Beyond 2015 Firm Annual Yield
2020	(100)
2025	200
2030	600
2035	1,000
2040	1,500
2045	2,100
2050	2,700
2055	3,400
2060	4,200

Conclusions about the Need for NISP

The study team performed a careful analysis of existing supplies and projected water demands for each of the 15 Participants in NISP. In each instance, the Participants have projected new water resource needs that justify participation in this project. One Participant, Ft. Lupton will not require all of the NISP subscription by 2060, but most other providers will reach that point well before 2060. For many Participants, additional water resources should also be identified in the near future.

The NISP Participants are forecast to have an additional need of just over 63,000 acre-ft by the year 2060. Since NISP is a regional project to meet a regional need, it is important to note that while individual Participant supply and demand situations have changed and may continue to change over future, the need on the part of the aggregated group of Participants remains much larger than the 40,000 acre-ft of new supply NISP will provide. It is anticipated that as individual Participant future supply and demand situations become more clear, there will likely be some shifting of NISP participation amongst the various Participants.

By 2015, the total future demand of all Participants combined will exceed their combined firm annual yield. By the year 2035, the excess of combined demands over current supplies will approximate 31,800 AF, and over 75,000 AF by 2060, including the safety factor. The Participants are seeking from NISP a combined 40,000 AF in new permitted firm yield.³⁰ Between 2040 and 2045, these Participants will need additional supplies beyond NISP. Of course, individual Participants are most likely pursuing multiple strategies for water resource acquisition.

³⁰ Northern Colorado Water Conservancy District, 2006 Phase III Participation and Budget, December 2005.