Staff Text Memorandum
Water Demand Evaluation Update
May 2019

January 2012

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Background:
During 2018 and early 2019 the City of Longmont completed an updated review of the future water demand projection for buildout of the city's urban planning area. This study was completed to allow the city to review prior study efforts in light of two major recent changes. The most significant changed condition, since the 2012 study, involved adoption of the city's new comprehensive plan, Envision Longmont. The second most significant change was changing the status of property north of Colorado Highway #66 and converting it to Open Space status, from potential development status. The results of these updated Water Demand Evaluation study efforts are documented in the sections that follow. A summary of the process to develop future Water Demands follows this multi-step process:

Step 1: The first step in this process is to evaluate the historical water demand for the city. From this effort is developed what is referred to as the **Reference Forecast for Total Treated Water Demand.** The result of this step in the process are documented in **Table 17** of both the original Water Demand Evaluation and as the revised Table 17 in this update effort.

Step 2: The Reference Forecast for Total Treated Water Demand must then be further evaluated to account for raw water uses, such as irrigation of parks and greenways as well as system loss in transporting the water from its source of supply to the water treatment plants for treatment. This second step in the evaluation process results in calculation of the **Reference Forecast for Total Raw Water Demand**. The result of this step in the process are documented in **Table 20** of both the original Water Demand Evaluation and as the revised Table 20 in this update effort. This effort results in projecting what future water demands would be if future water demand would look exactly like past water demands were. This evaluation then needs to be adjusted by an evaluation of what future demand might actually occur.

Step 3: The Reference Forecast for Total Raw Water Demand is then adjusted for any present or future changed conditions. This third step results in factors that could vary future demand and are referred to as the Variability Assumptions. This effort results in a **Total Water Demand Variability to be applied to the Reference Forecast**. The results of this step in the process are documented in **Table 22** of both the original Water Demand Evaluation and as the revised Table 22 in this update effort.

Step 4: The Reference Forecast for Total Raw Water Demand is then combined with the Total Water Demand Variability to be applied to Reference Forecast. This effort results in an **Adjusted Forecast for Total Raw Water Demand**. The results of this step in the process are documented in **Table 22** of both the original Water Demand Evaluation and as the revised Table 22 in this update effort. **The results of this effort indicate a slightly reduced future water demand of <u>32,500 Acre-feet</u>**, 230 Acre-feet less than the 2012 estimate of 32,730 Acre-feet.

Existing Water Demand Evaluation and Modeling:
The first step in the update process was to look at the significantly additional water use data that is available to the city. Longmont contracted with GIS Associates to complete the historical water demand evaluation by completing a GIS based modeling effort. Longmont's GIS staff supplied GIS Associates with a newly constructed land supply GIS (Geographic Information System) layer identifying the projected land use per the Envision comp plan, for every parcel in the Longmont planning area. Historic consumption data was tied to the individual parcels with existing meters. Projected consumption was calculated based on the projected land use and

historic consumption per acre for that land use type. The model utilized 17 years of data to develop the projected water demands that became the basis for evaluation of the new Reference Forecast for Total Treated Water Demand.

Future Water Demand Evaluation:
After GIS Associates finished modeling the existing water demand, staff received that information and used the modeling effort to develop a Reference Forecast for Total Treated Water Demand. Consistent with the 2012 Water Demand Evaluation, the reference treated water demands were broken out into parcels, arterial irrigation, outside water services, and export to the Town of Lyons to create an average annual day total water demand. The total metered water demand was then adjusted to include unmetered water loss (7.2 % of metered demand) and authorized but unmetered uses (1% of metered demand) resulting in a Reference Forecast for Total Treated Water Demand.

The 2012 Water Demand Evaluation used 2008 water consumption data as a representative year because the average annual water consumption fit closely on the long-term trend line. For this update, the full 17 years of available water meter data were used for the analysis. The reference forecast includes two major adjustments to avoid skewing data due to reduction in usage by large water industrial customers:

- Water consumption for a mixed-use redevelopment was adjusted to equal the tap credit agreement, and
- Water consumption for a Primary Employment property was adjusted to equal the average of two highest years.

The results of that effort are summarized on Table 17:

Table 17 - Summary of Reference Forecast for Total Treated Water Demand (Annual Average)

	2012 WDE w/ 2008 data			2001 - 2017 Average		Forward 5-Yr Ave Trend Line to 2022	
Treated Water Demand	**mgd**	**ac-ft / yr**		**mgd**	**ac-ft / yr**	**mgd**	**ac-ft / yr**
Boulder County Parcels	18.8	21,138		17.0	19,151	14.9	16,718
Weld County Parcels	0.4	458					
Arterial Irrigation	0.4	433		0.4	449	0.4	449
Outside Water Services	0.1	61		0.1	112	0.1	112
Export to Town of Lyons	0.6	641		0.6	674	0.6	674
Total Metered Demand	**20.3**	**22,731**		**18.1**	**20,386**	**16.0**	**17,954**
Authorized Uses - 1.0% (excluding exports)	0.2	227		0.2	227	0.2	227
Water Losses - 7.2% for RF (excluding exports)	1.5	1,637		1.3	1,460	1.1	1,236
Subtotal Distributed Treated Water Demand	**1.7**	**1,864**		**1.5**	**1,685**	**1.3**	**1,460**
Reference Forecast for Total Treated Water Demand		**24,595**			**22,071**		**19,414**

Upon conclusion of the Reference Forecast for Treated Water Demand, the City evaluated system loss in the raw water conveyance system, water treatment plant losses and demand for raw water in other areas such as raw water irrigation of parks and greenways. The results of this second step of the evaluation are summarized in Table 20:

Table - 20 Adjustments for Reference Forecast for Total Raw Water Demand			
Raw water provided to Town of Lyons	-641	-674	-674
Raw Water Supply and Water Treatment Plant Losses	1,230	1,545	1,359
Deficit between downstream raw water demand and supply	1,902	1,050	1,902
Reference Forecast for Total Raw Water Demand	27,086	23,992	22,001

More information on the Reference Forecast part of this update effort can be found in the attached technical memo prepared by Jacobs Engineering.

Existing and Future Raw Water Rights Inventory:
Concurrently with the GIS modeling effort, the City developed an in-house GIS based water rights tracking model. This model allowed the City to more accurately determine which water rights would be received upon full buildout of the City, as well as track those water rights that will not be received by the City as a result of conversion of previous development area to Open Space status.

Variability Assumptions Evaluation:
Upon Completion of the Reference Forecast, the City completed the Variability Assumptions evaluation. This part of the study effort involved looking at each of the variability factors considered in the 2012 study and re-evaluating them based upon new comprehensive planning from the Envision Longmont plan and current field conditions that exist. The most significant difference between the 2012 study and this update was as a result of land use changes reflected in the Envision Longmont plan. Results of that evaluation are summarized below in Table 22:

Table 22 - Summary of Variable Assumptions for Adjusted Total Water Demand Forecast (Annual Average)						
1a. Redevelopment (non-residential)	-0.004	(4)	1.3	1,415	1.3	1,415
1b. Redevelopment (residential)			0.1	124	0.1	124
2. Partially Developed or Occupied	0.4	447		0		0
3a. New Development (non-residential)	-0.3	(291)	1.0	1,067	1.0	1,067
3b. New Development (residential)			0.2	180	0.2	180
4. High Water Industrial Users (5% of parcels)	1.1	1,200	1.1	1,200	1.1	1,200
5. Primary Employment conversion to Mixed Use	0.0	0	0.1	146	0.1	146
6. Additional Water Loss	0.0	0	0.5	562	0.4	449
7. Adjust to Average Trend	0.4	449		0		0
8a. Climate Variability	1.8	1,968	1.6	1,766	1.4	1,553
8b. City Raw Water Irrigation			-0.1	(112)	-0.1	(112)
9. Dry Year Adjustment	1.3	1,445	2.3	2,584	2.0	2,247
10. Future Water Conservation	-1.6	(1,750)	-0.8	(928)	0.0	0
11a. Factor of Safety / Contingency (5%)	1.1	1,230	0.9	1,011	0.7	786
11.b Airport Redevelopment				150		150
12. Distribution system water loss from variability assumptions	0.0	0	0.0	0	0.0	0
Subtotal Treated Water Demand Variabilities		**4,724**		**9,163**		**9,205**
13. Climate variability impact on Raw Water Supply		541		489		433
14. Climate varibility impact on raw water irrigation demand by city		136		136		136
15. Raw Water Supply and Treatment Plant losses for Variability factors		236		641		644
16. Colorado River Compact Call				0		0
17. Add 8b back in for raw water supply				112		112
Subtotal Raw Water Demand Variability		**913**	0.0	**1,379**	0.0	**1,326**
Total Water Demand Variability to be applied to Reference Forecast		**5,637**		**10,542**		**10,530**

This variability evaluation, when combined with the reference forecast, results in the total future water demand that is put into the water rights yield model.

Table 24 Treated Water Reference Forecast + Variability			
Total Metered Demand (Subset of Table 17)	22,731	20,386	17,954
Reference Forecast for Total Treated Water Demand (Table 17)	24,595	22,071	19,414
Reference Forecast for Total Raw Water Demand (Table 20)	27,086	23,992	22,001
	+	+	+
Mid Level Variability Water Demand Adjustments (Table 22)	5,637	10,542	10,530
	=	=	=
Adjusted Forecast For Total Raw Water Demand	**32,723**	**34,534**	**32,532**

Future Raw Water Rights Yield Evaluation:

Utilizing the two future demand scenarios, Longmont contracted with Deere and Ault to run a water rights yield model to determine the ability of the city's current and future water portfolio to supply water for the future. The model was recalibrated with the new water rights portfolio's supplied by the City and run under a number of various water demand scenarios. The results of this modeling effort indicate that the current (2019) water portfolio will support a total demand of approximately 28,750 AF and the build-out water rights portfolio will support a total raw water demand of 30,500 AF. This build-out yield is less that the projected raw water demand at build-out so additional water supply will be required at that time. The City's current plan for meeting this future demand is to participate in the Windy Gap Firming Project.

JACOBS

Memorandum

5777 Central Ave Suite 205
Boulder, CO 80301
United States
T +1.720.286.0733
www.jacobs.com

Subject	**City of Longmont Water Demand**
Project Name	2019 Water Demand Projections Summary
Attention	City of Longmont
From	Holly Link and Al Paquet/Jacobs Engineering Group Inc.
Date	May 10, 2019

Water Demand Projections Evaluation Report Summary

1.1 Background

The City contracted with GIS Associates (GISA) in 2018 to perform water demand projections to support planning efforts for water utility infrastructure projects. The City's 2016 Envision Longmont service area boundary and land use planning map (Figure 1) and new land use categories were used as the basis for water demand forecasting for the undeveloped areas and redeveloped areas anticipated. The results of the evaluation provide the City with an estimate of the service area water demands for the "build out" condition of a 50 to 100-year planning horizon comparable to the expected life of water utility infrastructure.

The work by GISA revises and refines the demands forecasted in the Water Demand Evaluation adopted in 2012, which supported the Integrated Treated Water Supply Master Plan (ITWSMP) dated June 2013. The 2012 Water Demand Evaluation used 2008 water consumption data as a representative year because the average annual water consumption fit closely on the long-term trend line. For this update, the 17 years of available water meter data were used for the analysis.

This update follows the same two-step process of a reference forecast using historic water consumption rates plus variable assumptions to estimate factors such as redevelopment and climate change. The 2018 demand projections reflect the following changes from the 2012 Water Demand Evaluation.

- Updated Longmont Planning Area, including Envision Longmont land uses
- Redevelopment of areas formally served by large water users
- Additional open space area
- Some parks have been changed from potable water to raw water (ditch water) irrigation, and
- Updated long-term development and water conservation trends

Other factors such as an allowance for future industrial high water users and climate change are consistent with the 2012 Water Demand Evaluation.

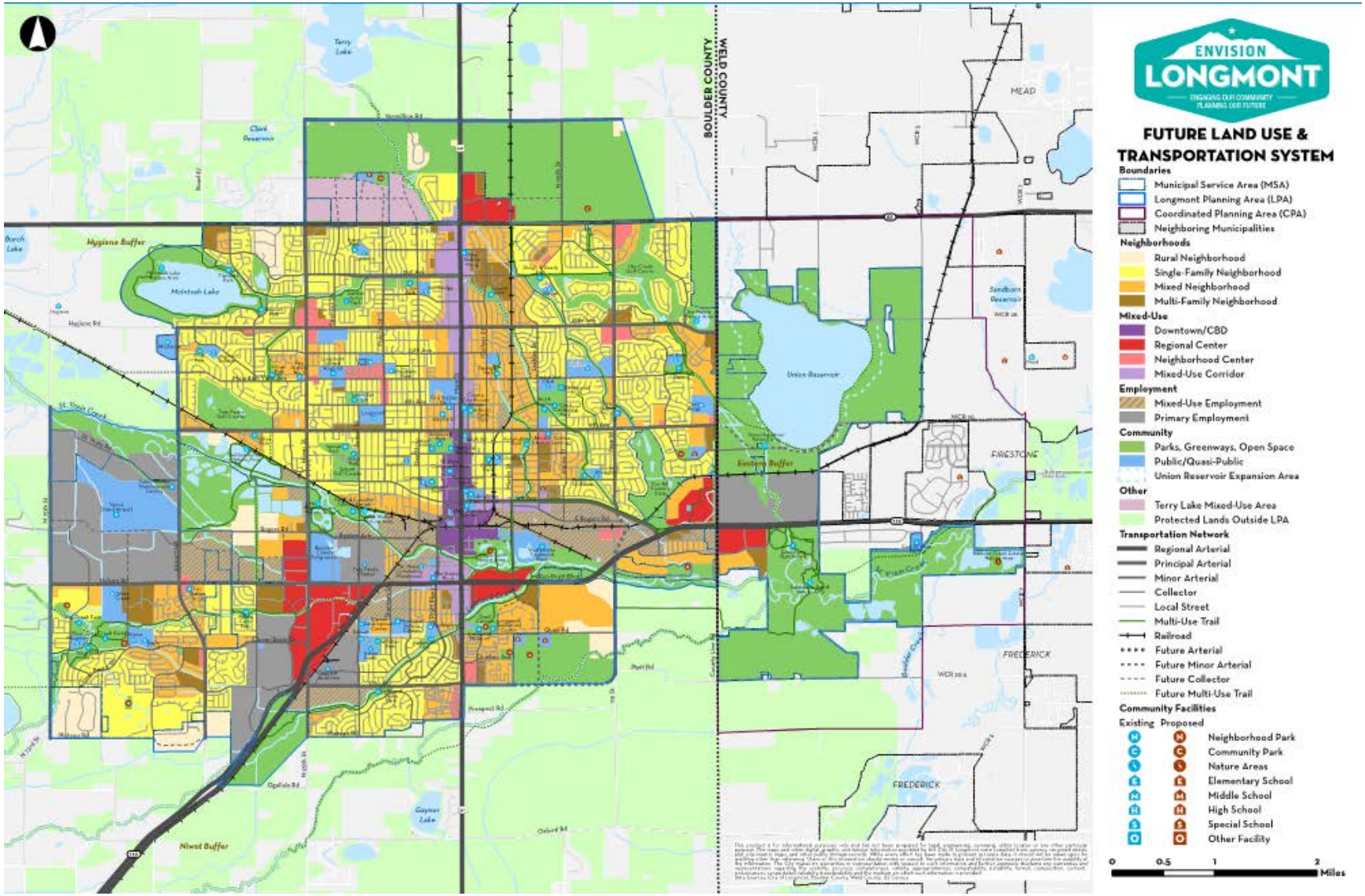


Figure 1 – Envision Longmont Future Land Use and Transportation System Map (June 28, 2016)

1.2 Methodology

The City and GISA analyzed water consumption data for the period between 2001 and 2017 using the Envision Longmont land use classifications shown below to categorize water customers:

- ✓ Downtown/Central Business District
- ✓ Primary Employment
- ✓ Rural Neighborhood, Mixed Employment, Regional Center
- ✓ Single Family Neighborhood
- ✓ Mixed Used Corridor
- ✓ Mixed Neighborhood
- ✓ Parks, Greenways and Open Space
- ✓ Neighborhood Center
- ✓ Multifamily neighborhood, Public/Quasi-Public

Historic water consumption rates were evaluated in gallons per day per platted acre by customer class. Figure 2, provided by the CITY/GISA, shows the Water Consumption Rates analyzed by customer class over the 2001 to 2017 period.

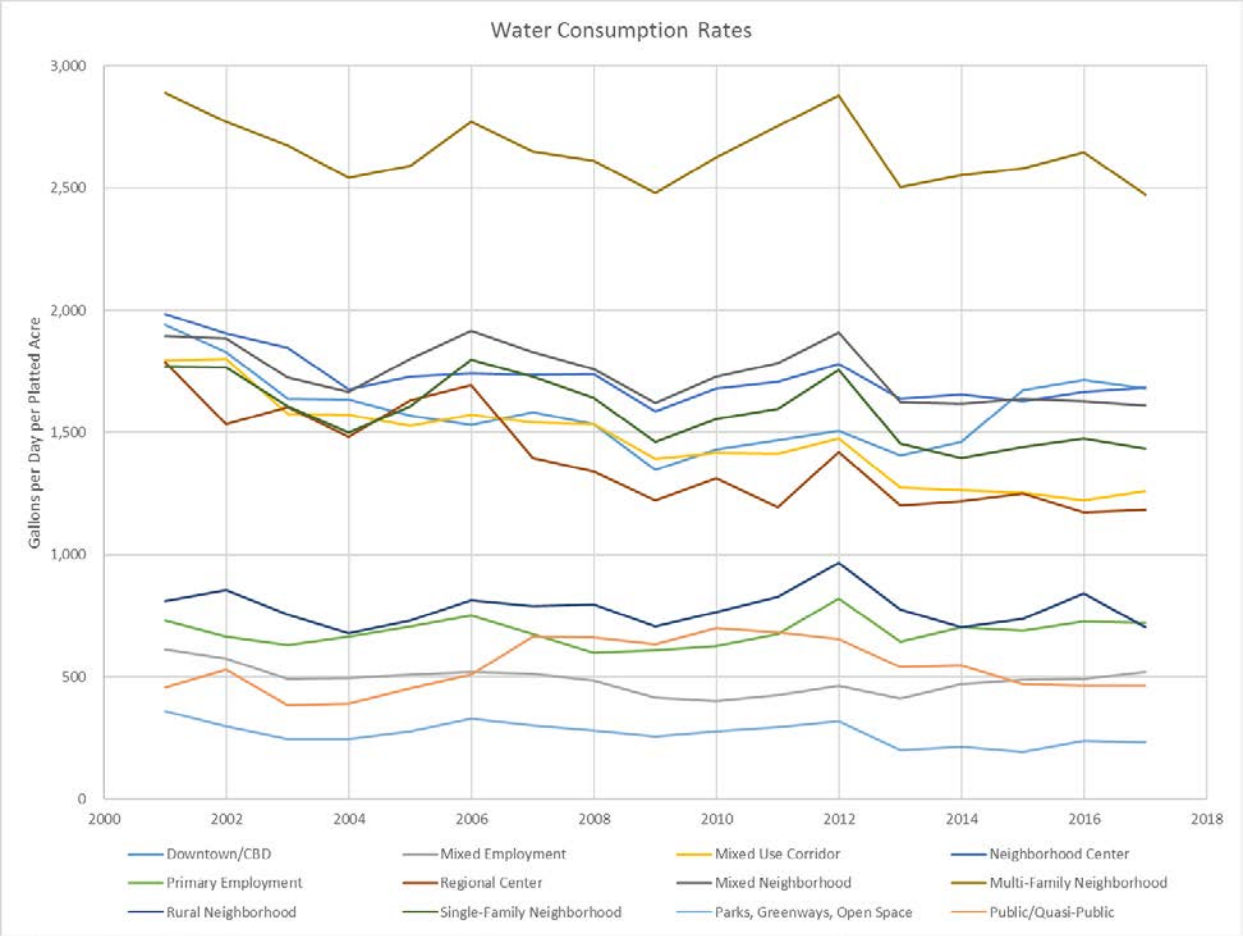


Figure 2 – Water Consumption Rates (2001-2017) by Customer Class [figure provided by City/GISA]

The analysis of the data showed that unit water consumption rates on a per acre basis are decreasing for all customer classifications except for Public/Quasi-Public and Primary Employment. Also, the average water usage on a per acre basis is relatively consistent between the last 5 year (2013-2017) and 10-year averages (2008-2017) indicating a leveling off of the rate of water reduction and conservation observed. Table 1 provides a statistical summary of water consumption rates for the following time periods.

- Maximum Average (2001-2017)
- Average (2001-2017)
- Last 10-years Average (2008-2017)
- Last 5-years Average (2013-2017)

Table 1 – Summary of Water Consumption Rates and Trends

Summary of Water Consumption Rates and Trends						
	Water Consumption Rate (Gallons / Day / Platted Acre)				2001 - 2017 Trends	
Envision Longmont Land Use Classifications	2001 - 2017 Maximum	2001 - 2017 Average	2008 - 2017 Average	2013 - 2017 Average	Slope GPD/Ac/Yr	Percent per Decade
Business						
Downtown/CBD	1,938	1,584	1,522	1,586	-11.3	-7%
Mixed Employment	611	487	457	476	-5.6	-11%
Neighborhood Center	1,983	1,728	1,676	1,654	-14.3	-8%
Primary Employment	819	685	681	697	2.2	3%
Regional Center	1,786	1,391	1,252	1,205	-33.7	-24%
Mixed Use						
Mixed Use Corridor	1,801	1,464	1,350	1,255	-33.0	-23%
Residential						
Mixed Neighborhood	1,915	1,743	1,692	1,623	-13.9	-8%
Multi-Family Neighborhood	2,889	2,646	2,610	2,551	-11.1	-4%
Rural Neighborhood	966	780	782	752	-0.7	-1%
Single-Family Neighborhood	1,796	1,587	1,521	1,440	-18.0	-11%
Public						
Parks, Greenways, Open Space	360	269	250	216	-5.6	-21%
Public/Quasi-Public	698	541	582	497	4.3	8%

1.3 Reference Forecast

Consistent with the 2012 Water Demand Evaluation, the reference treated water demands were broken out into County parcels, arterial irrigation, outside water services, and export to the Town of Lyons to create an Average Annual day Total Metered Water Demand. The Total Metered Water Demand was then adjusted to include unmetered water loss (7.2 % of metered demand) and authorized but unmetered uses (1% of metered demand) resulting in a Reference Forecast for Total Treated Water Demand (annual average).

The City and GISA applied the water consumption rates for each year of available meter data to the entire Envision Longmont land use plan. As shown in Figure 3, the trend line of reference forecasts for the 17 years of data was extended forward 5 and 10 years to demonstrate the linear decline in the demand should the 17 year trends continue; however, these long-term trends may level off as further conservation and water reduction by customer class may be anticipated based on the most recent data.

The reference forecast includes two major adjustments to avoid skewing data due to reduction in usage by large water customers:

- Water consumption for a mixed-use redevelopment was adjusted to equal the tap credit agreement, and
- Water consumption for a Primary Employment property was adjusted to equal the average of two highest years.

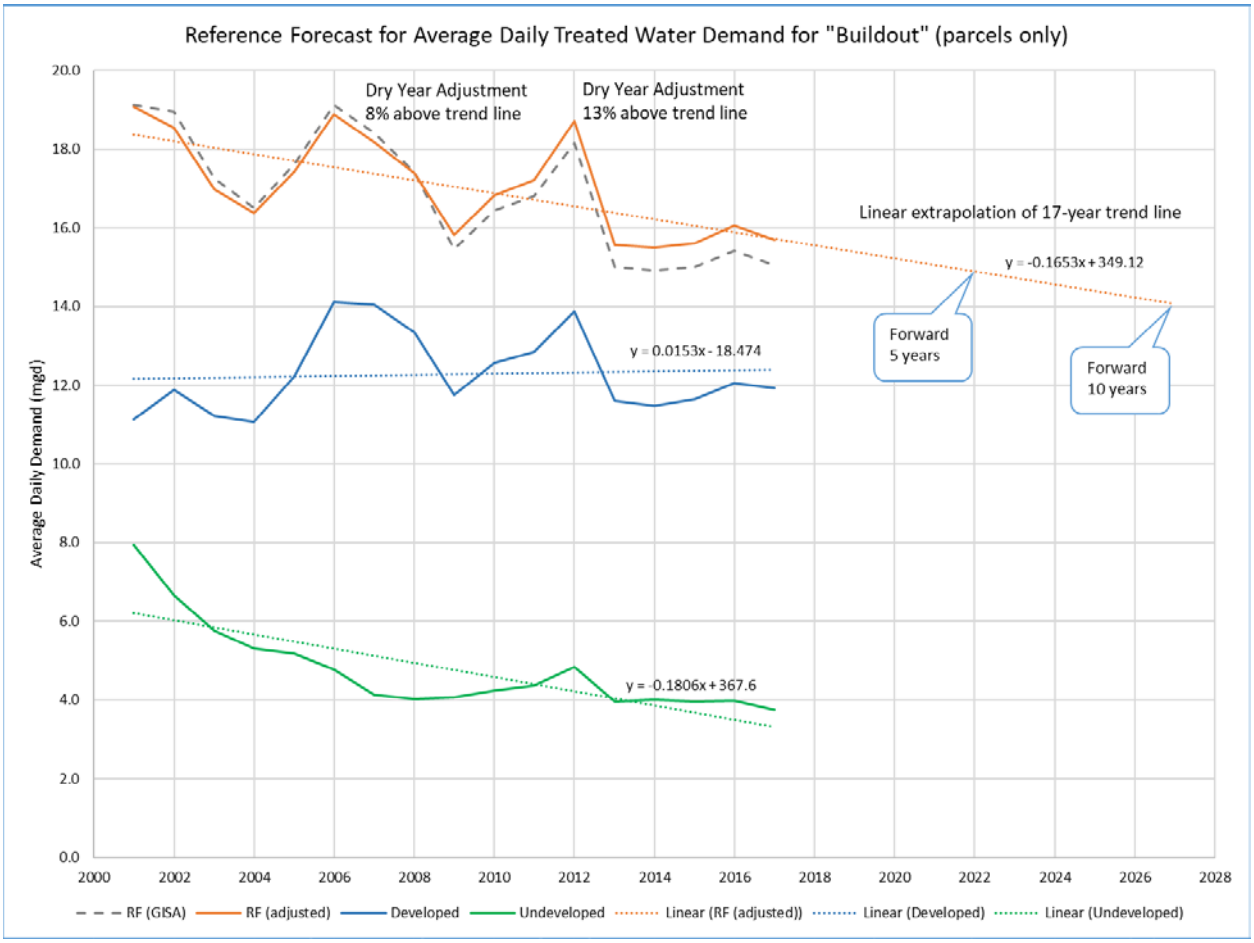


Figure 3 – Trend Line of Reference Forecasts [figure provided by City/GISA]

Analysis for water treatment and distribution infrastructure is normally presented in million gallons per day (MGD) while water supply normally uses acre-feet per year. As shown in Table 2, the Reference Forecast results for the statistical approaches noted above show that the average annual treated water demand could vary from 16.3 to 21.8 MGD compared to 21.9 MGD forecasted in the 2012 Water Demand Evaluation (WDE). Similarly, Table 3 shows the Reference Forecast results for average annual treated water demand could vary from 18,261 to 24,453 acre-feet compared to 24,560 acre-feet forecasted in the 2012 WDE.

Table 2 - Summary of Reference Forecast for Total Treated Water Demand (million gallons per day)

Annual Average			17 -Yr	Last 10-Yr	Last 5-Yr	Forward 5-Yr	Forward 10-Yr
	2012 WDE w/ 2008 data	2001 - 2017 Maximum	2001 - 2017 Average	2008 - 2017 Average	2013 - 2017 Average	Avg. Trend Line to 2022	Ave Trend Line to 2027
Treated Water Demand	**mgd**	**mgd**	**mgd**	**mgd**	**mgd**	**mgd**	**mgd**
Boulder County Parcels	18.8	19.1	17.0	16.6	15.7	14.9	14.1
Weld County Parcels	0.4						
Arterial Irrigation	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Outside Water Services	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Export to Town of Lyons	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total Metered Demand	**20.3**	**20.2**	**18.1**	**17.7**	**16.8**	**16.0**	**15.2**
Authorized Uses - 1.0% (excluding exports)	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Water Losses - 7.2% for RF (excluding exports)	1.4	1.4	1.3	1.2	1.2	1.1	1.0
Subtotal Distributed Treated Water Demand	**1.6**	**1.6**	**1.5**	**1.4**	**1.4**	**1.3**	**1.1**
Reference Forecast for Total Treated Water Demand	**21.9**	**21.8**	**19.6**	**19.1**	**18.2**	**17.3**	**16.3**

Table 3 – Summary of Reference Forecast for Total Treated Water Demand (acre-feet/year)

Annual Average			17 -YR	Last 10-Yr	Last 5-Yr	Forward 5-Yr	Forward 10-Yr
	2012 WDE w/ 2008 data	2001 - 2017 Maximum	2001 - 2017 Average	2008 - 2017 Average	2013 - 2017 Average	Avg. Trend Line to 2022	Ave Trend Line to 2027
Treated Water Demand	**Acre-feet**	**Acre-feet**	**Acre-feet**	**Acre-feet**	**Acre-feet**	**Acre-feet**	**Acre-feet**
Boulder County Parcels	21,137	21,420	19,151	18,624	17,617	16,718	15,790
Weld County Parcels	457						
Arterial Irrigation	433	449	449	449	449	449	449
Outside Water Services	61	112	112	112	112	112	112
Export to Town of Lyons	674	674	674	674	674	674	674
Total Metered Demand	22,762	22,656	20,386	19,859	18,853	17,954	17,026
Authorized Uses - 1.0% (excluding exports)	225	225	225	225	225	225	112
Water Losses - 7.2% for RF (excluding exports)	1,573	1,573	1,460	1,348	1,348	1,236	1,123
Subtotal Distributed Treated Water Demand	1,797	1,797	1,685	1,573	1,573	1,460	1,236
Reference Forecast for Total Treated Water Demand	24,560	24,453	22,071	21,432	20,426	19,414	18,261

1.4 Variable Assumptions

The annual average Reference Forecast was further refined by applying the variable assumptions. The City decided in the 2012 Water Demand Evaluation that since the basis for the Reference Forecast relies on acutely defined unit demand rates, the variability of other assumptions in the forecast must be explicitly addressed. This approach allows the City more flexibility to change individual water demand assumptions instead of adjusting the unit demand rates. Variable assumptions in the forecast include:

- ✓ Re-development
- ✓ New development,
- ✓ High water user or Industrial user
- ✓ Primary Employment Area conversion to Mixed use
- ✓ Additional Water Loss
- ✓ Climate variability
- ✓ Raw water Irrigation Conversion
- ✓ Dry year adjustment
- ✓ Future Water Conservation
- ✓ Factor of safety

For the 50 to 100 year planning horizon, this update replaced the variable assumptions in the 2012 Water Demand Evaluation (WDE) for redevelopment, partially developed or partially occupied properties and new development with a statistical approach. With this approach, the City and GISA evaluated the developed and vacate properties within the Areas of Change (largely business/non-residential land uses) and Areas of Stability (largely residential land uses). No variable assumption was included for redevelopment of public lands.

For the Areas of Change, the 2012 WDE variable assumptions were updated by applying the water consumption rates of existing mixed-use developments in the City to percentages of the acreage in the Areas of Change. 40 existing properties in 5 subdivisions were selected as examples of mixed-use development in the City. Of these properties, 19 were selected as examples of multi-story mixed-use developments. Many of these properties are newer developments so the water consumption rates are based on 2015 through 2017 data. For the overall (40) and multi-story (19) mixed-use examples, the average annual water consumption rates were 2,390 and 4,240 gallons per day per platted acre, respectively. Table 4 shows the percentages of each water consumption rate that was applied to each land use.

Table 4 – Summary of Non-Residential Redevelopment and New Development

Land Use	Redevelopment		New Development	
	Overall Rate	Multi-Story Rate	Overall Rate	Multi-Story Rate
Neighborhood Center	-	-	-	-
Primary Employment	-	-	-	-
Regional Center	10%	-	100%	-
Terry Lake Mixed-Use Area	25%	-	25%	-
Mixed Employment	-	25%	100%	-
Downtown/CBD	-	20%	-	100%
Mixed Use Corridor	-	25%	-	100%

The update of the variable assumptions for non-residential redevelopment and new development using this approach is expected to result in an average annual increase of 1.3 mgd (1,415 acre-feet/year) and 1.0 mgd (1,067 acre-feet/year), respectively.

For residential redevelopment and new development, the updated variables assumed that a percentage of residential neighborhoods would redevelop/develop at the water consumption rate of a higher density neighborhood. For single-family neighborhoods, 5% of existing properties would redevelop and 25% of vacant properties would develop as mixed neighborhood. For mixed neighborhoods, 5% of existing properties would redevelop and 25% of vacant properties would develop as multi-family neighborhoods. For multi-family neighborhoods, 50% of vacant properties would develop as multi-story mixed use properties as described above. The update of the variable assumptions for residential redevelopment and new development using this approach is expected to result in an average annual increase of 0.1 mgd (124 acre-feet/year) and 0.2 mgd (180 acre-feet/year), respectively.

A summary of the variable assumptions is provided in Table 5, which has been updated from Table 22 in the 2012 WDE. Other changes from the 2012 WDE include an additional conversion of Primary Employment properties to Mixed Use; an additional water loss to the maximum observed value during the 17-year period; the conversion of 7 city parks and a City golf course to raw water irrigation and redevelopment on the airport property. The dry year adjustment was revised to the higher percentage shown in Figure 3.

Table 5 – Summary of Variable Assumptions (mgd)

Annual Average			**17-Yr**	**Last 10-Yr**	**Last 5-Yr**	**Forward 5-Yr**	**Forward 10-Yr**
	2012 WDE w/ 2008 data	**2001 - 2017 Maximum**	**2001 - 2017 Average**	**2008 - 2017 Average**	**2013 - 2017 Average**	**Avg. Trend Line to 2022**	**Ave Trend Line to 2027**
1a. Redevelopment (non-residential)	-0.004	1.3	1.3	1.3	1.3	1.3	1.3
1b. Redevelopment (residential)	-	0.1	0.1	0.1	0.1	0.1	0.1
2. Partially Developed or Occupied	0.4	-	-	-	-	-	-
3a. New Development (non-residential)	-0.3	1.0	1.0	1.0	1.0	1.0	1.0
3b. New Development (residential)	-	0.2	0.2	0.2	0.2	0.2	0.2
4. High Water Industrial Users (5%)	1.1	1.1	1.1	1.1	1.1	1.1	1.1
5. Primary Employment conversion to Mixed Use (5%)	-	0.1	0.1	0.1	0.1	0.1	0.1
6. Additional Water Loss (2.8%)	-	0.5	0.5	0.5	0.4	0.4	0.4
7. Adjust to Average Trend	0.4	-	-	-	-	-	-
8a. Climate Variability (8%)	1.7	1.7	1.6	1.5	1.5	1.4	1.3
8b. City Raw Water Irrigation	-	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
9. Dry Year Adjustment (13%)	1.3	2.5	2.3	2.2	2.1	2.0	1.9
10. Future Water Conservation	-1.6	-0.8	-0.8	-0.8	-0.8	-	-
11a. Factor of Safety / Contingency (5%)	1.1	1.0	0.9	0.8	0.8	0.7	0.7
11b. Airport Redevelopment	-	0.1	0.1	0.1	0.1	0.1	0.1
Treated Water Demand Variability	**4.1**	**8.6**	**8.2**	**7.9**	**7.7**	**8.2**	**8.0**

Table 6 – Summary of Variable Assumptions (acre-feet/year)

Annual Average			17-Yr	Last 10-Yr	Last 5-Yr	Forward 5-Yr	Forward 10-Yr
	2012 WDE w/ 2008 data	2001 - 2017 Maximum	2001 - 2017 Average	2008 - 2017 Average	2013 - 2017 Average	Avg. Trend Line to 2022	Ave Trend Line to 2027
1a. Redevelopment (non-residential)	-4	1,415	1,415	1,415	1,415	1,415	1,415
1b. Redevelopment (residential)	-	124	124	124	124	124	124
2. Partially Developed or Occupied	447	-	-	-	-	-	-
3a. New Development (non-residential)	-291	1,067	1,067	1,067	1,067	1,067	1,067
3b. New Development (residential)	-	180	180	180	180	180	180
4. High Water Industrial Users (5%)	1,230	1,230	1,230	1,230	1,230	1,230	1,230
5. Primary Employment conversion to Mixed Use (5%)	-	146	146	146	146	146	146
6. Additional Water Loss (2.8%)	-	562	562	562	449	449	449
7. Adjust to Average Trend	449	-	-	-	-	-	-
8a. Climate Variability (8%)	1,968	1,910	1,797	1,685	1,685	1,573	1,460
8b. City Raw Water Irrigation	-	-112	-112	-112	-112	-112	-112
9. Dry Year Adjustment (13%)	1,445	2,808	2,584	2,471	2,359	2,247	2,134
10. Future Water Conservation	-1,750	-928	-928	-928	-928	-	-
11a. Factor of Safety / Contingency (5%)	1,230	1,123	1,011	899	899	786	786
11b. Airport Redevelopment	-	150	150	150	150	150	150
Treated Water Demand Variability	**4,724**	**9,675**	**9,226**	**8,889**	**8,664**	**9,255**	**9,029**

The Variable Assumptions Adjustments results in a range of 7.7 to 8.6 MGD (8,664 to 9,675 acre-feet/year) of annual average demand to be added to the Reference Forecast treated water demand. Table 6, in the next section, presents the annual average treated water demand in MGD using the Reference Forecast and the Variable Assumption Adjustment to derive the Total Annual Average treated water demand for developed land use plan.

1.5 Total Treated Water Demand

The total water annual average demands are summarized in Tables 7 and 8. City staff reviewed the ranges of water uses over the historic and projected periods and excluded as outliers the 2001-2017 maximum yearly demand as too conservative and the Forward 10-yr trend as too optimistic for continuing conservation and demand reduction. The total average demand range anticipated is 25.5 to 27.8 mgd, or 28,669 to 31,297 acre-ft/year.

The peak day use in MGD is determined by applying the average historical peaking factor of 2.13 to the average annual demand. This results in a peak day demand at buildout of 54.3 to 59.2 MGD. The peak day will determine the capacity of the City's Nelson Flanders Water Treatment Facility to provide the capacity and redundancy required to meet the forecasted buildout demand.

Table 7 – Summary of Forecast for Total Treated Water Demand (Annual Average -MGD)

	2001 - 2017 Maximum	2001 - 2017 Average	2008 - 2017 Average	2013 - 2017 Average	Forward 5-Yr Avg. Trend 2	Forward 10-Yr Avg.
Reference Forecast Treated Water Demand	21.8	19.6	19.1	18.2	17.3	16.3
Variable Assumptions Adjustments	8.6	8.2	7.9	7.7	8.2	8.0
Total Annual Average for Service Area	30.4	27.8	27.0	25.9	25.5	24.3
Peak Day[1, 2]	64.8	**59.2**	**57.5**	**55.2**	**54.3**	51.8

[1] Peak Day to Annual Average factor = 2.13

[2] Peak and Average Annual Day Range selected by the City highlighted in Blue

Table 8 – Summary of Forecast for Total Treated Water Demand (Annual Average - Acre-ft)

	2001 - 2017 Maximum	2001 - 2017 Average	2008 - 2017 Average	2013 - 2017 Average	Forward 5-Yr Avg. Trend 2	Forward 10-Yr Avg.
Reference Forecast Treated Water Demand	24,453	22,071	21,432	20,426	19,414	18,261
Variable Assumptions Adjustments	9,675	9,226	8,889	8,664	9,255	9,029
Total Annual Average for Service Area	34,128	31,297	30,321	29,090	28,669	27,290

[1] Average Annual Day Range selected by the City highlighted in Blue

1.6 Water Demand Projections Timing

The evaluation performed by GISA projected the total treated water demand but did not determine timing of growth towards the projected demand. Jacobs Engineering met with the City to discuss growth assumptions and updated the treated water production projection graphs from the 2013 ITWSMP with the data provided from the GISA analysis.

Treated water demand growth rate assumptions were re-evaluated and updated from those used in the 2013 ITWSMP. An annual treated water demand growth rate of 1.75% was used in the 2013 ITWSMP for planning purposes. However, the actual treated water demand trends have not kept pace with that assumption. It is important to review long-term trends of water demand because climate and rainfall can vary significantly and too short of a time frame may not represent worst-case demand or growth conditions.

Annual average and peak treated water demand for various points and time frames from 1990 through 2018 were evaluated. In a long-term case, treated water demand increased an average of 0.5% annually from the 1990-1994 time period compared to the 2013-2018 time period. In another case, treated water demand increased 1.7% annually from the 1990-1994 time period compared to the 2004-2008 time period. The long-term trend line (1990-2018) for treated water demand is equivalent to an annual increase of 0.9%; and the same trend line from 2000-2011 is 1.3%. Overall, depending on the methodology to determine growth over time, the annual increase in treated water demand could range from 0.5% to 1.7%. Figure 4 shows the updated treated water demand projections with four annual growth rates: 0.5%, 0.9%, 1.3% and 1.75%. For purposes of planning construction phases for the NFWTP the City selected the 1.3% growth rate for treated water demand. With this growth rate the NFWTP would be expanded by 15 MGD (to a total capacity of 45 MGD) immediately (Phase 1) to replace the treatment capacity and redundancy of decommissioning the Wade Gaddis WTP; then Phase 2 would not occur until approximately 2045.

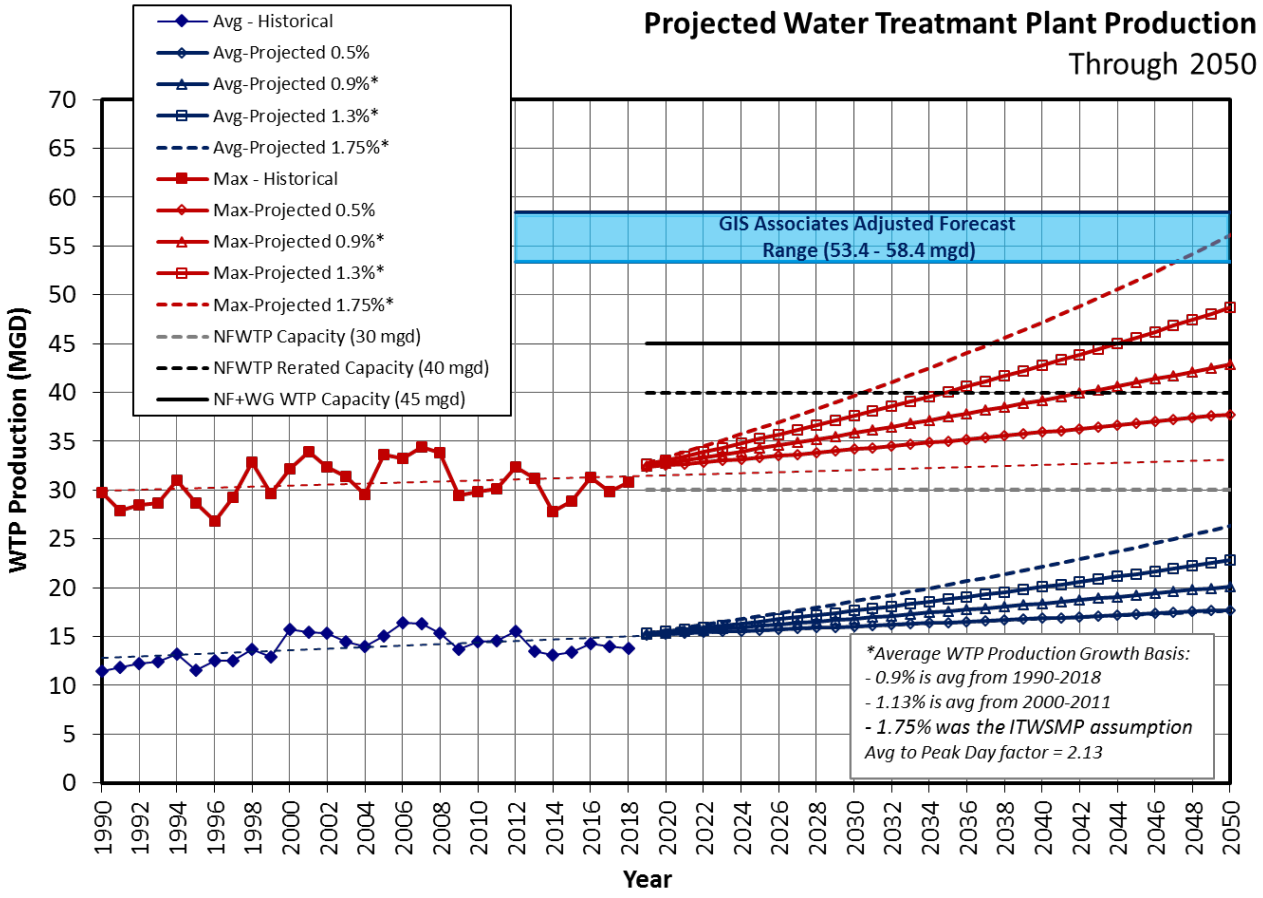


Figure 4 – Projected Water Treatment Plant Production (i.e. Treated Water)

Water Demand Evaluation – Raw Water Supply Modeling

TASK MEMORANDUM

May 2019

EXECUTIVE SUMMARY

Deere & Ault Consultants, Inc. ("D&A") adapted and utilized a model previously developed for the City of Longmont to evaluate the ability of its raw water supply system to meet demands through a 1-in-100 year drought at buildout according to Envision Longmont. The analysis is built upon previous efforts (especially late 2010/early 2011) and continues to utilize most of the recommendations presented in the Draft Water Demand Evaluation ("Water Demand Evaluation") report prepared by CH2M Hill, dated August 2011 (revised October 2011).

This analysis considered two future total municipal raw water demand levels; 32,616 acre-feet per year and 34,800 acre-feet per year for treatment, plus a total contract raw water lease and trade demand ranging from 3,559 to 6,061 acre-feet per year (leases plus Public Service Company of Colorado, or PSCo, trade depending on annual C-BT quota), or equal to 1,057 acre-feet per year without the PSCo trade. The modeled total raw demands range from 33,673 acre-feet per year (32,616 ac-ft municipal demand plus 1,057 ac-ft contract demand and no PSCo trade) to 40,861 acre-feet per year (34,800 ac-ft municipal demand plus 1,057 ac-ft contract demand plus PSCo trade).

Though the modeled demands have not changed, two other modeling assumptions have changed resulting in different results from the previous analysis. These are, an overall reduced projected future water rights portfolio as a result of an updated appraisal of future development and raw water acquisitions, and a more conservative assumption regarding the efficiency of use of municipal return flows as a result of increased State administration of water right in the St. Vrain basin. Significant changes to the projected future water rights portfolio (as compared to the 2011 projected future portfolio) include 1,000 less C-BT units and less Longmont Supply, Oligarchy, Bonus, South Flat, Zweck & Turner, Union, Pleasant Valley and Burch Lake. To reflect the more stringent State administration and anticipating subsequent future changes of water rights would be similar, the lower municipal return flow factors decreed in a number of Longmont's changes of water rights were assumed for the operations of all existing and future changed water rights. Use of these factors primarily produces less irrigation season municipal return flows thus requiring use of more original supplies at times to meet augmentation and return flow replacement obligations and downstream demands.

Results show that the water rights portfolio projected to be provided through the Raw Water Requirement Policy, along with the existing raw water supply infrastructure, will not be adequate to meet Longmont's demand at build-out through a 1-in-100 year drought when future projected demands are considered. The projected shortages are greater than in the 2011 analysis due to the

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 ● Fax: 303-651-1469

projected changes in the future water rights portfolio and the stricter State administration that is assumed.

Participating in the Windy Gap Firming Project at three levels – 6,000 acre-feet, 8,000 acre-feet and 10,000 acre-feet of storage space – was evaluated for its ability to increase the yield of Longmont's raw water supply system sufficiently to meet the projected future demands. The Windy Gap Firming project improves the system's yield and performance such that with either 8,000 acre-feet or 10,000 acre-feet of Windy Gap storage, the projected drought demands can be met during a 1-in-100 year drought at buildout for the 32,616 acre-feet per year municipal raw water demand level. Even with 10,000 acre-feet of Windy Gap firming storage, a small shortage is projected for the 34,800 acre-feet per year municipal demand level.

An additional infrastructure project, the Union Reservoir pipeline, was also evaluated considering two levels, irrigation season use only (previously referred to as Phase 2 and allowing deliveries to ditches in the area of Lake McIntosh in exchange for upstream municipal diversions), and year-round use (previously referred to as Phase 4 and allowing direct deliveries to the Nelson-Flanders water treatment plant). The analysis shows the year-round option with the future water rights portfolio can meet projected future raw water demand. The seasonal use version does not meet the future demand.

The PSCo trade has a significant impact on meeting future demands and provides a major benefit to Longmont. There is no scenario evaluated without the PSCo trade that shows the ability to meet Longmont's future projected demands at either demand level. The best performing scenario (32,616 acre-feet municipal demand with 10,000 acre-feet of Windy Gap storage) still shows a substantial shortage in meeting Longmont's demands through a prolonged drought. The year-round Union Reservoir pipeline option also leaves a shortage between demands and supplies without the PSCo trade. Without the PSCo trade, it would be necessary to combine projects - both Windy Gap firming and some version of the Union Pipeline - and to include demand management to reduce demands during and immediately after a serious multi-year drought so that the supply is adequate.

WATER DEMAND UPDATE

Recent efforts by City of Longmont Water resources staff and outside consultants evaluating Longmont's future municipal raw water demands utilized different methods to evaluate Longmont's future demand at buildout but obtained an estimated future demand of approx. 32,000 acre-feet per year, within 2 percent of the demand previously evaluated by Longmont. This is within the error of estimate and accordingly the previously modeled ultimate future municipal demand of 32,616 acre-feet per year was adopted for this evaluation. The details of resulting modeled water demand of 32,616 acre-feet per year is summarized in **Table 1**. For the higher demand scenario, the total modeled municipal raw water requirement was scaled up by approx. 6.7 percent, based on the ratio of 34,800 acre-feet to 32,616 acre-feet.

Table 1
Modeled Annual Municipal Raw Water Demands at Buildout During 1-in-100 Year Drought
(acre-feet)

Description	Amount	Notes
Residential Use	14,067	Water Demand Evaluation, Attachment 12
Business and Industrial Use[1]	9,189	Water Demand Evaluation, Attachment 12
Treated Parks	1,585	Water Demand Evaluation, Attachment 12
Subtotal - Metered Use	**24,841**	
Authorized Uses	248	1% of Metered Use
System Losses	1,739	7% of Metered Use
Net of Remaining Variable Assumptions[2]	745	3% of Metered Use
Subtotal - WTP Production	**27,573**	
Raw Water and WTP Losses	1,454	5% of WTP Raw Water Requirement
WTP Raw Water Requirement	**29,027**	
Increased Drought Year Raw Water Requirement[3]	1,445	5% increase on all demand and losses
Increased Climate Change Irrigation Demand[4]	2,144	18% increase on lawn irrigation use for 2040
Total Modeled Municipal Raw Water Requirement	**32,616**	

In addition to Longmont's municipal demands, this evaluation considered that Longmont's current level of raw water provision by contract would continue through buildout, except for a few that will expire and are not assumed to be extended or renewed. Between trades (where the partnering entity provides raw water to Longmont in return for deliveries) and straight multi-year leases, Longmont's contract deliveries of raw water to others during the modeled drought range from 3,559 acre-feet per year to 6,061 acre-feet per year and average 4,393 acre-feet per year over the 7 drought years when the PSCo trade is included. The amount varies because a large portion of this demand is tied to the amount of water provided by its partners as determined by the annual C-BT quota. Fully consumable municipal effluent after municipal use by Longmont is the highest priority source used for satisfying these demands. The annual municipal, contract and total raw water demands are shown in Table 2. When the PSCo trade is not included the annual demand in every year is 32,616 plus 1,057 or 33,673 acre-feet per year.

Table 2
Annual Raw Water Demands at Buildout During 1-in-100 Year Drought – PSCo Trade Included
(acre-feet)

Type	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Average
Municipal	32,616	32,616	32,616	32,616	32,616	32,616	32,616	32,616
Contract	6,061	5,561	4,560	3,559	3,559	3,559	3,559	4,345
Total	38,677	38,177	37,176	36,175	36,175	36,175	36,175	36,961

[1] Includes Water Demand Evaluation Table 22 Variable Assumption 4 Economic development for high demand industrial uses.
[2] Net of Variable Assumptions 1, 2, 3, 6, 7, 8, 10, 11, 12 and 13 (Table 22 of the Water Demand Evaluation), expressed as a percent of Metered Use.
[3] Equivalent of Table 22 Variable Assumption 9 Dry year adjustment.
[4] Equivalent of Table 22 Variable Assumption 5 Climate variability impacts.

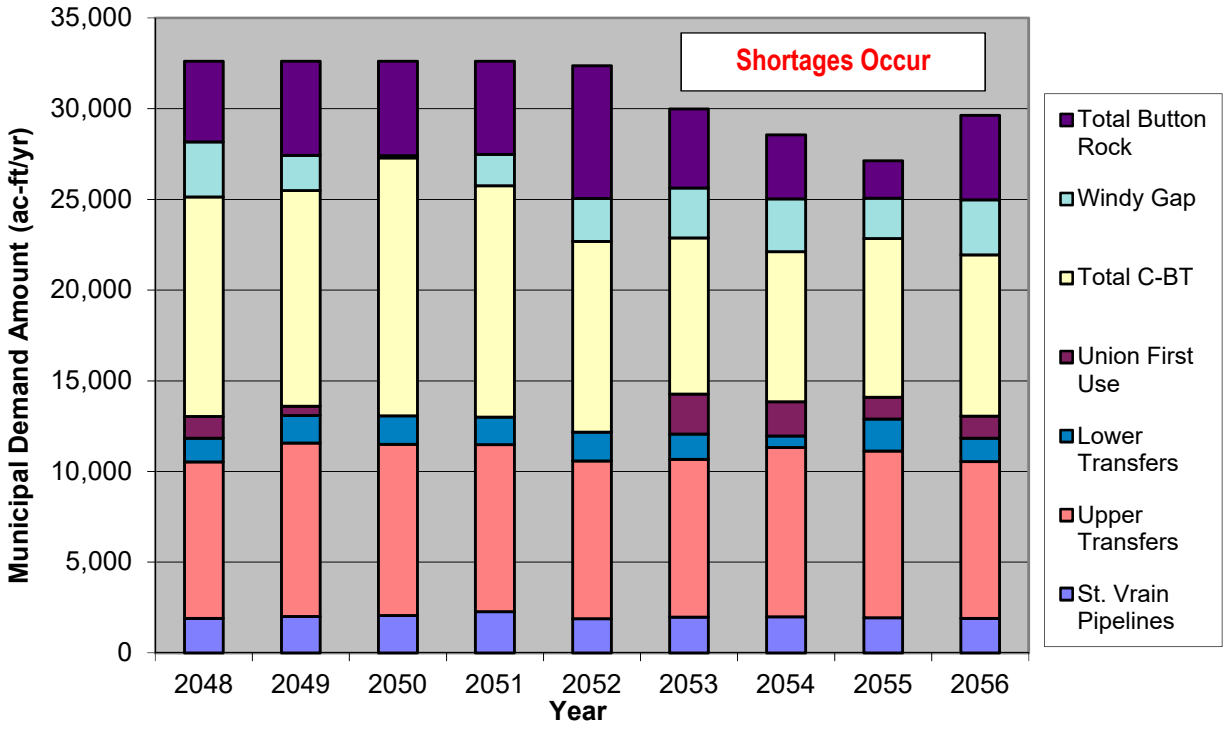
RESULTS

BASELINE CONDITIONS – D&A evaluated Longmont's ability to meet its projected demand at buildout per Envision Longmont with its current and projected water rights portfolio and its existing raw water infrastructure, referred to as "Baseline Conditions," to determine if the existing and projected raw water supply will be adequate to meet the projected demands of 32,616 or 34,800 acre-feet per year, plus additional raw water contract deliveries, both with and without the PSCo trade. The Baseline Condition was evaluated for both the existing water rights portfolio only (assuming no additional supplies are added from the Raw Water Requirement Policy), and for the existing portfolio plus projected water rights acquisition as a result of development within the City.

Results show that during the first 4 years of the 7 year drought the projected 2048 supply portfolio and current infrastructure would meet all of Longmont's demands, except for an insignificant part of the 4th year demand. However, in the last three years of the drought, and in the year following, there would be an unmet demand of 15,049 acre-feet, or 11.5 percent of the 32,616 acre-feet per year of municipal demand during those 4 years. In the last year of the drought, the shortage is approx. 16.5 percent of the demand. The contract raw water demand would be met throughout the drought because it largely relies on sources not directly available for municipal use (primarily reusable municipal return flows). **Figure 1** on the following page shows the annual distribution of raw water supplies used to meet Longmont's demand and shows that shortages would be projected in the last three years of the drought and in the year following.

Figure 1

Baseline Condition, Future Water Rights Portfolio, Municipal Demand = 32,616 acre-feet per year



If an increased future municipal raw water demand of 34,800 acre-feet per year is assumed for the future portfolio baseline condition, there are five years of shortage, the last four years of the seven year drought and the following year. During those five years the unmet demand is 15.3 percent of the total demand. In the last year of the drought, the shortage is approx. 20.2 percent of the demand.

However, without the PSCo trade Longmont's system would not meet the 32,616 acre-feet per year municipal demand during five of the seven drought years plus the following year. During the years of shortage, the deficit would be 17.2 percent of the demand and in the most severe year, 23.3 percent of the demand would not be met. If the municipal demand is 34,800 acre-feet per year, the shortage during the years it occurs represents 22.2 percent of the demand and in the worst year over 27 percent of the demand would not be met.

Table 3 and **Table 4** (following the body of this report) provide a summary of the results of the analyses for the two projected future municipal raw water demand levels for each of the 20 scenarios examined (10 scenarios for each demand level).

WINDY GAP FIRMING – D&A re-evaluated Longmont's ability to meet the projected demands at buildout through participation in the Windy Gap firming project assuming it adds 6,000 acre-feet, 8,000 acre-feet or 10,000 acre-feet of storage and its associated firm yield of water from that project. At a storage ratio of 2.42:1 6,000 acre-feet of storage would firm the yield for approximately 28.5 units of Windy Gap. Increasing the storage to 8,000 acre-feet would provide firming for 38 units, and 10,000 acre-feet of storage would firm 47.5 units. Adding either 8,000 or 10,000 acre-feet of Windy Gap firming storage allows the system to meet the projected municipal and contract raw water demands through buildout during the 1-in-100 year drought, for the assumed future municipal demand of 32,616 acre-feet per year as shown in **Table 3**. **Table 4** shows that no scenario completely meets the demand for a municipal raw water demand of 34,800 acre-feet per year. Firming Windy Gap with 10,000 acre-feet of new storage achieves the best result with a modest (3 percent) shortage in the year following the seven year drought.

UNION RESERVOIR PIPELINE – D&A also considered Longmont's ability to meet the projected demands at buildout through construction of a 10 cfs pumping system and pipeline to deliver raw water from Union Reservoir to ditch systems in the Lark McIntosh area (for May through October use) or to the Nelson-Flanders water treatment plant for year-round use. As shown in **Table 3** and **Table 4**, the summer use option provides a modest reduction in future demand shortages versus the Baseline scenario with the future water rights portfolio. The year-round option with the future portfolio would be adequate to meet projected demands through the extended drought for the 32,616 acre-feet per year municipal demand if the PSCo trade is operating. A shortage remains with the year-round version if the PSCo trade is not active. When the demand level is evaluated at 34,800 acre-feet per year, shortages occur for all scenarios, though the shortage assuming a year-round pipeline is small.

COMBINED PLAN ELEMENTS IF NO PSCO TRADE – As mentioned previously the lack of the PSCo trade has a significant impact on Longmont's ability to meet its projected future water demands, and without the trade, none of the options described above are adequate by themselves to meet those demands without an operating trade with PSCo. Therefore, we undertook additional evaluations to understand whether combinations of the above projects with demand management might be able to meet demands in a future that does not include the PSCo trade. The results are included in **Table 5**, **Table 6**, and **Table 7**. Projected demands can be met with 6,000 acre-feet or more of Windy Gap firming storage plus a year-round use Union Reservoir pipeline, without requiring managed demand reductions.

If the Union Reservoir pipeline is only completed to Phase 2 for seasonal operation, projected future demands can be met with Windy Gap firming plus the pipeline, but only if additional demand management is employed to reduce demands during and immediately following the extended drought. The demand management levels evaluated are 5 to 15 percent per year. The reductions are applied to the total municipal raw water demand. Generally, 5 percent demand reductions are inadequate to meet projected demands with the seasonal use Union Reservoir pipeline and less than 10,000 acre-feet of Windy Gap firming storage as shown in **Table 5**. With 10 percent demand reductions in three to seven of the nine years, the projected demands (based on the projected demand of 32,616 acre-feet per year) can be met with the seasonal Union Reservoir pipeline and Windy Gap firming storage of 6,0000 to 10,000 acre-feet as summarized in **Table 6**. As shown in **Table 7**, if the projected future demand is 34,800 acre-feet per year, 10 percent annual demand reductions are not sufficient and 15 percent demand reductions would be required during five to eight of the nine years.

Table 3
Summary of Results – 32,616 acre-feet per year Municipal Raw Water Demand

Scenario	Water Rights Portfolio	Include PSCo Trade?	Total Municipal Shortage (ac-ft)	Years of Shortage	Percent Unmet During Shortage	Greatest Unmet Annual Demand
Baseline	Present	Yes	22,717	5	13.9%	17.7%
Baseline	Present	No	42,027	6	21.5%	26.6%
Baseline	Future	Yes	15,049	5 (1 scant)	11.5%	16.5%
Baseline	Future	No	33,611	6	17.2%	23.3%
Windy Gap Firming 6,000 af	Future	Yes	1,030	1	3.2%	3.2%
Windy Gap Firming 6,000 af	Future	No	19,058	5	11.7%	18.3%
Windy Gap Firming 8,000 af	Future	Yes	0	0	0%	0%
Windy Gap Firming 8,000 af	Future	No	13,728	4	10.5%	16.3%
Windy Gap Firming 10,000 af	Future	Yes	0	0	0%	0%
Windy Gap Firming10,000 af	Future	No	8,242	3	8.4%	14.1%
Union Pipeline (Summer only)	Future	Yes	14,268	5 (1 scant)	10.9%	16.8%
Union Pipeline (Summer only)	Future	No	27,816	6	14.2%	21.6%
Union Pipeline (Year-round)	Future	Yes	0	0	0%	0%
Union Pipeline (Year-round)	Future	No	2,914	2	4.5%	4.9%

Notes: Total Municipal Shortage is the total volume of unmet municipal raw water diversion demand during the study period. The study period includes a 7-year drought plus one average year preceding and one average year following. Years of shortage is number of years out of nine with unmet demand. Percent Unmet During Shortage is the volume of unmet demand during years with shortage divided by the total demand during the same number of years. Greatest Unmet Annual Demand is the percentage of the annual demand that is not met in the year with the greatest unmet demand.

Table 4
Summary of Results – 34,800 acre-feet per year Municipal Raw Water Demand

Scenario	Water Rights Portfolio	Include PSCo Trade?	Total Municipal Shortage (ac-ft)	Years of Shortage	Percent Unmet During Shortage	Greatest Unmet Annual Demand
Baseline	Present	Yes	22,717	6	16.7%	22.4%
Baseline	Present	No	42,027	7	23.0%	30.6%
Baseline	Future	Yes	15,049	5	15.3%	20.3%
Baseline	Future	No	33,611	6	22.2%	27.3%
Windy Gap Firming 6,000 af	Future	Yes	1,030	3	11.4%	15.1%
Windy Gap Firming 6,000 af	Future	No	19,058	5	18.1%	21.1%
Windy Gap Firming 8,000 af	Future	Yes	0	2	9.2%	12.5%
Windy Gap Firming 8,000 af	Future	No	13,728	5	14.9%	19.4%
Windy Gap Firming 10,000 af	Future	Yes	0	1 (small)	3.0%	3.0%
Windy Gap Firming10,000 af	Future	No	8,242	5	11.8%	18.1%
Union Pipeline (Summer only)	Future	Yes	25,089	5	14.4%	19.4%
Union Pipeline (Summer only)	Future	No	39,810	6	19.1%	25.4%
Union Pipeline (Year-round)	Future	Yes	1,714	2 (1 scant)	2.5%	3.6%
Union Pipeline (Year-round)	Future	No	15,029	5	8.6%	14.5%

Notes: Total Municipal Shortage is the total volume of unmet municipal raw water diversion demand during the study period. The study period includes a 7-year drought plus one average year preceding and one average year following. Years of shortage is number of years out of nine with unmet demand. Percent Unmet During Shortage is the volume of unmet demand during years with shortage divided by the total demand during the same number of years. Greatest Unmet Annual Demand is the percentage of the annual demand that is not met in the year with the greatest unmet demand.

Table 5
Summary of Results – Combination Scenarios at 32,616 acre-feet per year Municipal Raw Water Demand and 5 Percent Demand Reduction in Certain Years

Scenario	Water Rights Portfolio	Total Municipal Shortage (ac-ft)	Years of Shortage	Years of 5 percent Demand Reduction Required
Windy Gap Firming 6,000 af plus Union Res. Pipeline (Year-round)	Future	0	0	0
Windy Gap Firming 6,000 af plus Union Res. Pipeline (Seasonal)	Future	6,695	8	5 percent reduction inadequate
Windy Gap Firming 8,000 af plus Union Res. Pipeline (Seasonal)	Future	977	2	5 percent reduction inadequate
Windy Gap Firming 10,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 5 through 8 (4 years)

Notes: Total Municipal Shortage is the total volume of unmet municipal raw water diversion demand during the study period. The study period includes a 7-year drought plus one average year preceding and one average year following. Years of shortage is number of years out of nine with unmet demand.

Table 6
Summary of Results – Combination Scenarios at 32,616 acre-feet per year Municipal Raw Water Demand and 10 Percent Demand Reduction in Certain Years

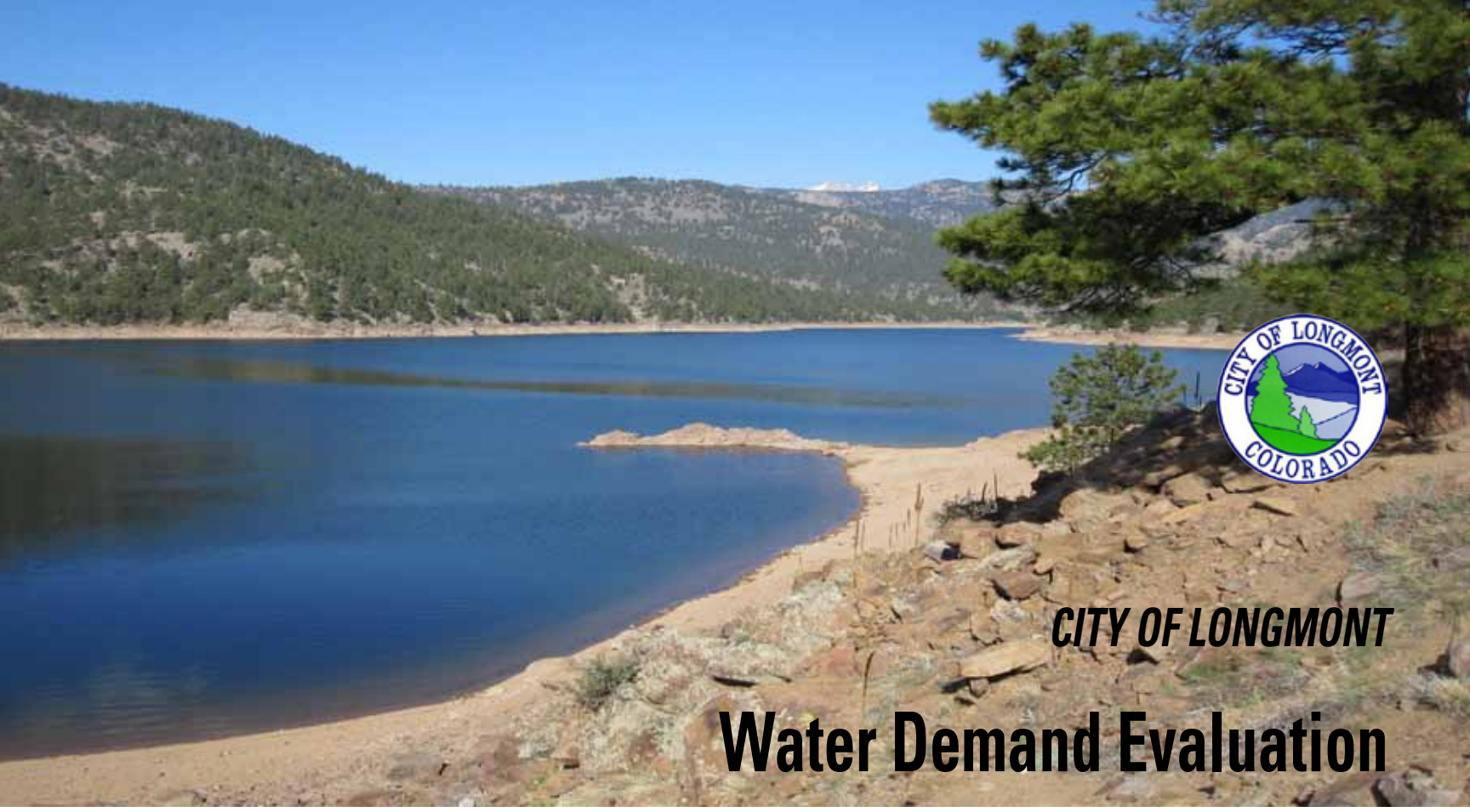
Scenario	Water Rights Portfolio	Total Municipal Shortage (ac-ft)	Years of Shortage	Years of 10 percent Demand Reduction Required
Windy Gap Firming 6,000 af plus Union Res. Pipeline (Year-round)	Future	0	0	0
Windy Gap Firming 6,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 3 through 9 (7 years)
Windy Gap Firming 8,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 5 through 8 (4 years)
Windy Gap Firming 10,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 7 through 9 (3 years)

Notes: Total Municipal Shortage is the total volume of unmet municipal raw water diversion demand during the study period. The study period includes a 7-year drought plus one average year preceding and one average year following. Years of shortage is number of years out of nine with unmet demand.

Table 7
Summary of Results – Combination Scenarios at 34,800 acre-feet per year Municipal Raw Water Demand and 15 Percent Demand Reduction in Certain Years

Scenario	Water Rights Portfolio	Total Municipal Shortage (ac-ft)	Years of Shortage	Years of 15 percent Demand Reduction Required
Windy Gap Firming 6,000 af plus Union Res. Pipeline (Year-round)	Future	0	0	0
Windy Gap Firming 6,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 2 through 9 (8 years)
Windy Gap Firming 8,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 3 through 8 (6 years)
Windy Gap Firming 10,000 af plus Union Res. Pipeline (Seasonal)	Future	0	0	Years 3 through 7 (5 years)

Notes: Total Municipal Shortage is the total volume of unmet municipal raw water diversion demand during the study period. The study period includes a 7-year drought plus one average year preceding and one average year following. Years of shortage is number of years out of nine with unmet demand.



CITY OF LONGMONT

Water Demand Evaluation




January 2012

CH2MHILL

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