Report on Red River Valley Water Supply Project Needs and Options

Water Conservation Potential Assessment

Final Report

U. S. Department of the Interior
Bureau of Reclamation
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WCPA EXECUTIVE SUMMARY

The Water Conservation Potential Assessment (WCPA) evaluates potential water conservation measures and identifies reasonable and achievable water reduction activities. The Dakota Water Resources Act (DWRA) identified water conservation measures as one of the water needs to be evaluated in developing the future water demands of the Red River Valley. The Red River Valley future water demands will be presented in the *Report on Red River Valley Water Needs and Options* (Needs and Options Report). The Needs and Options Report also identifies options or alternatives to meet the identified future water demands. The cost of water conservation is included as one of the features that comprise each of the alternatives.

The WCPA should be viewed as a tool box of water conservation opportunities which could achieve the reported results. Some measures may achieve higher savings than estimated while others may not be acceptable to the water users and are ineffective.

Some of the water conservation measures investigated in the first draft of the WCPA have been modified or eliminated while others have been added based on input provided by stakeholders and peer reviewers. The conservation measures involving new industrial water demands were eliminated because there was no scientifically sound method to estimate water savings of a theoretical industrial facility prior to its design. Xeriscaping was also eliminated because it was not cost effective. These changes resulted in lowering the overall water saving potential in the WCPA.

The water systems in the Red River Valley already have made significant progress on water conservation in the last 10 to 15 years. This is due to the direct actions of the water systems in terms of metering service connections, monitoring water use, repairing and replacing pipelines, and providing effective management of their water systems. There are also regulatory requirements which have resulted in the installation of water efficient plumbing fixtures which have significantly saved water. Water savings in the last 10 to 15 years are estimated between 5.0 gpc/d and 37.3 gpc/d or 4.3% to 33.2% depending on the water system. These existing water conservation savings are the foundation that the WCPA will build on in terms of identifying reasonable water conservation measures to pursue through 2050.

There are over 120 municipal, rural and industrial water systems in the Red River Valley ranging in size from small towns with populations under 100 to the city of Fargo with a population approaching 100,000 (2000 census). In addition to evaluating Fargo, Grand Forks, Moorhead and West Fargo, two groups of medium and small/rural water systems were consolidated to simplify WCPA analysis. The two groups include medium size water systems (cities) with a population ranging from 1,000 to 15,000, and rural water systems and small community water systems with a population less than 1,000.

A total of 19 water conservation measures were originally considered in the WCPA analysis. However, three of the proposed measures - ULF toilet rebate program, water efficient clothes washer rebate program, and wastewater reuse were eliminated prior to being analyzed because they could not be reasonably implemented. Rebate programs do not affect long term (2050) water savings and wastewater reuse was previously studied and found ineffective. Table S1

shows the final 16 water conservation measures analyzed in the WCPA. There are two supply management measures which relate to water use up to and including the water service meter and 14 demand management measures which relate to water use by the water customer. Thirteen of the 16 measures were considered economically feasible because they had costs less than $1.25 per 1,000 gallons. The cost of $1.25 per 1,000 gallons was used as the basis of comparison to the cost of an alternate water supply. The In-Home Low-Flow Water Fixtures Giveaway Program, Install Low-Water-Use Turf and Plants in Landscaping, and Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate programs were eliminated during analysis because they exceeded the cost of alternative sources of water.

Table S1 - Specific Water Conservation Measure Evaluated in WCPA.

Supply Management
1. Install Water Meters
2. Audit Water Use, Detect Leaks, and Repair Distribution Systems
Demand Management
1. Program Administration and Public Education Programs
2. Promote Installation of 1.6 Gallon ULF Toilets[1]
3. Promote Installation of Low-Flow Shower Heads[1]
4. Promote Installation of Faucet Aerators[1]
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]
6. Promote Installation of Water Efficient Dishwashers[1]
7. Install Low-Water-Use Turf and Plants in Landscaping – Xeriscaping Rebate Program
8. Install Water Efficient Landscape Irrigation Systems – ET Controller Rebate Programs
9. Efficient Landscape Irrigation Scheduling
10. Industrial Water Use Efficiency Measures
11. Commercial Water Use Efficiency Measures
12. Institutional Water Use Efficiency Measures
13. Conservation Pricing
14. Promote Installation of Efficient Clothes Washers[1]

[1] These measures will be enforced by new plumbing and appliance codes and implemented on their own prior to 2050 .

Table S2 summarizes WCPA per capita and annual water savings plus the estimated water conservation costs for the four individual municipalities, medium sized, and rural/small communities evaluated in the WCPA. The most important result of the WCPA analysis is the per capita per day water savings estimate for each of the systems. Per capita water savings

ranged from 6.54 to 9.02 gallons per person per day or 6.1% to 8.6% expressed as a percentage. Water conservation measure cost implementation ranged from $0.51 to $0.68 per 1000 gallons saved for the community water systems. Annual water savings are estimated based on the population served and per capita water savings rate for each water system. These savings are based on the population projection prepared by Reclamation (2003).

Annual costs of implementing water conservation programs range from $54,700 to $326,000. The cost is largely dependent on the size of the service population, so Fargo has the highest cost. The overall annual water conservation cost is estimated at $780,000. This cost will be included in all action alternatives developed in the Needs and Options Report.

Table S2 - WCPA Summary Results.

Water System(s)	Water Savings (gals/yr)	Annual Costs	Cost Per 1,000 Gallons	Average Water Savings (gpc/d)	Estimated Average Daily Per Capita Water Demand (gpc/d)	Percent Water Savings
Fargo	591,178,000	$325,914	$0.55	7.93	112.4	7.1%
Grand Forks	252,445,000	$137,863	$0.55	8.25	135.4	6.1%
West Fargo	80,920,000	$54,709	$0.68	6.54	91.2	7.2%
Moorhead	130,212,000	$74,054	$0.57	8.07	118.4	6.8%
Medium Size Municipal Water Systems (population 1,000 to 15,000)	149,444,000	$76,526	$0.51	9.02	110.0	8.2%
Rural Water Systems including cities <1,000 in population	202,702,000	$110,796	$0.55	8.80	102.9	8.6%
Totals	1,406,901,000	$779,863				

The WCPA resulted in lower per capita water savings than might be expected because of the historic water use in the Red River Valley. The largest single residential water use in the United States is outdoor landscape irrigation. The national average outdoor landscape irrigation water use is approximately 100 gpc/d (American Water Works Association Research Foundation 1999) while such use in the Red River Valley ranges from 10 to 17 gpc/d. This demonstrates that Red River Valley residents are very conservative in their outdoor water use and eliminates an opportunity to save a significant amount of water through water conservation. Indoor water use savings also have limitations because most of the water use is non-discretionary. A water user has limited control over how many times the toilet is flushed or how often clothes are washed.

The best potential for savings is in the improvement of water fixture efficiency which is emphasized in the WCPA.

The cost of water service also affects water consumption. It may be difficult to quantify, but higher water costs will result in lower water use. An analysis of water rates clearly shows that water systems in the Red River Valley generally charge higher rates than their national or regional counterparts. Red River Valley rural water system customers typically pay up to 4 times more for their water service than the national average. Since the Red River Valley has higher than average water costs, this also has an effect on the potential for future water savings.

The WCPA analysis shows that approximately 1.4 billion gallons (4,300 acre-feet) of water can be saved annually with reasonable water conservation measures. The per capita water demand used to estimate future Red River Valley water system needs will be reduced by 6.54 to 9.02 gallons per person per day. These measures will cost about $780,000 per year to implement and will be included in the cost of Needs and Options Report alternatives.

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Acronyms ..... Back Cover

Acknowledgements

The historic photo on the cover was provided courtesy of the city of Grand Forks.

Cities and rural water systems within the Red River Valley provided data necessary to complete this document.

INTRODUCTION

The Water Conservation Potential Assessment (WCPA) evaluates potential water conservation measures and identifies reasonable and achievable water reduction activities. The Dakota Water Resources Act (DWRA) identified water conservation measures as one of the water needs to be evaluated in developing the future water demands of the Red River Valley. The Red River Valley future water demands will be presented in the *Report on Red River Valley Water Needs and Options*. The Needs and Options Report also identifies options or alternatives to meet the identified future water demands. The cost of water conservation is included as one of the features that comprise each of the alternatives.

The accurate estimate of water savings achievable from any one water conservation measure is difficult given the changing landscape of water conservation. The WCPA should be viewed as a tool box of water conservation opportunities which could achieve the reported results. Some measures may achieve higher savings than estimated while others are not accepted by water users and are ineffective. As the Red River Valley Water Supply Project evolves so will opportunities for water conservation.

Water conservation programs and drought contingency plans are often confused by the water user community. One misconception is that water conservation and drought contingency planning are interchangeable terms. While it is true that water conservation and drought contingency planning both address water use reduction, they are different in their application. Water conservation is something that water systems or users should practice daily under all water supply conditions, while drought contingency measures are used during times of drought or emergency water shortages. Drought contingency planning associated with reducing water usage during periods of drought or emergency water shortages will not be addressed in the WCPA but will be addressed in the Needs and Options Report.

The water systems in the Red River Valley have made significant progress on water conservation in the last 10 to 15 years. This is due to the direct actions of the water systems in terms of metering service connections, monitoring water use, repairing and replacing pipelines, and providing effective management of their water systems. There are also regulatory requirements which have resulted in the installation of water efficient plumbing fixtures which has saved significant water. Water savings in the last 10 to 15 years are estimated between 5.0 gpc/d and 37.3 gpc/d or 4.3% to 33.2% depending on the water system. These existing water conservation savings are the foundation that the WCPA will build on in terms of identifying reasonable water conservation measures to pursue through 2050. Estimated water savings for measures that have already been incorporated by water systems in the Red River Valley are included in Exhibit 3.

During development of future per capita water demands based on historic water use data, it became apparent that Red River Valley water users differ from their national counterparts. Residents in the Red River Valley use less water for landscape irrigation and other outdoor activities. This is important because outdoor water use is the largest single potential source of water savings. The climate in the valley is sub-humid and the soils are mostly clay which retain water resulting in less water demand for lawn watering. Another factor to consider when reading

the WCPA is that the cost of water in the Red River Valley is higher than in other regions of the country. The annual median household income is also one of the lowest in the country. These conditions lead to a more cost conscious water consumer and can affect water use and potential opportunities to save water.

Another difference in this WCPA compared to other water conservation programs is the time frame for results. Most water systems implement water conservation programs to delay costly infrastructure improvements and immediate results are important. Water conservation in the context of the Needs and Options Report is an ongoing process through 2050. The maximum water demand will be in 2050 since populations are projected to increase over time, and 2050 is the end of the project planning horizon. This allows for an expanded WCPA timeline and increased saturation of some water conservation measures. Some water conservation plans include rebate programs to accelerate the saturation rate of water efficient appliances and fixture installation. Since the Red River Project has such a long planning horizon, rebate programs for water-efficient plumbing fixtures or appliances are not needed.

Some of the water conservation measures investigated in the first draft of the WCPA have been modified or eliminated while others have been added based on the input provided by stakeholders and peer reviewers. The conservation measures involving new industrial water demands were eliminated because there were no scientifically sound methods to estimate savings of a yet to be constructed industrial facility. Also, existing industries in both Grand Forks and Moorhead have worked very closely with the industrial water system to conserve water resulting in reduced potential for more water savings.

Xeriscaping was also investigated in the draft WCPA. During the review process comments were raised about the water savings and costs associated with this measure. After further review of the xeriscaping measure it was determined that the Red River Valley has not had success implementing this measure due to costs. The sub-humid climate in the Red River Valley generally provides adequate precipitation and the clay soils provide good moisture holding characteristics severely limit the benefits of this measure. Water users in the Red River Valley are conservative in their outdoor water use due to the high cost of water. The xeriscaping measure was re-evaluated in the draft report and the water saving potential in the Red River Valley was less than originally estimated.

The water savings potential of establishing inverted water rates was added to the measures investigated in the WCPA. Water costs in the Red River Valley are generally higher as compared to other water systems in the country. However, research has shown that rate increases on discretionary water use can reduce water demand, so the measure was included in the WCPA.

Definition: Water Conservation Potential Assessment

A WCPA is an evaluation of water conservation measures or activities to determine potential water use reduction. Water conservation "measures" are defined as specific tools (technologies) and practices (behavior changes) that result in more efficient water use. Water conservation measures are difficult to analyze individually because traditional water conservation program analysis generally focuses on overall performance rather than the specific results of any one

measure. A water conservation program is actually a series of measures (activities) that when implemented, yield a resulting water use reduction. The challenge in the WCPA is to identify specific water conservation measures and evaluate their individual potential to reduce water demand. These individual measures are then combined into a proposed water conservation plan or feature that will be included in all alternatives developed in the Needs and Options Report.

Another complicating factor is the reality that not all municipal, rural and industrial (MR&I) water systems are identical in water use characteristics, or water conservation implementation. Each water system or community has its own water use characteristics and the potential to save water directly relates to those characteristics. For example, the proportion of water use associated with domestic, commercial, industrial, and institutional sector demands can affect water savings. Some sectors may have less or more water saving potential than others. The percentage of single family homes as compared to multi-family homes in a community significantly affects water savings. Multi-family homes (apartments) generally use less water per capita, which affects the overall water savings potential of a community. These and other water system characteristics are accounted for in the WCPA.

The status of water conservation implementation has an effect on water conservation potential. For example, urban water systems may have a high percentage of new housing construction while other rural communities have more older homes. Newer homes generally have more water conserving devices already installed, which affects their water conservation potential. However, newer homes generally have higher landscaping water requirements than older homes, often reducing the difference between new and old homes in terms of water use. The WCPA will take into account the status of water conservation implementation by looking at both technical and behavioral measures.

WCPA Relation to Red River Project Needs and Options Report

The needs assessment portion of the Needs and Options Report will estimate the future water demand requirements of the Red River Valley in North Dakota plus 3 Minnesota cities along the Red River. These needs are identified in the DWRA and include MR&I, aquatic, recreation, water quality and water conservation measures. The WCPA estimates potential reduction in water use based on implementation of specific water conservation measures. For example, a hypothetical community may have an estimated per capita water demand of 140 gallons per capita per day (gpc/d). If one assumes that the water conservation potential for that city is estimated at 10 gpc/d as a result of this assessment, the net water demand for the hypothetical city would be estimated at 130 gpc/d.

Water conservation programs also have a cost, which is estimated in the WCPA. Economically reasonable and implementable water conservation measures recommended in the WCPA will be combined into a water conservation feature. This feature and associated cost will be included in all alternatives developed in the Needs and Options Report and evaluated in the Red River Project Environmental Impact Statement (EIS).

WCPA Study Approach

There are over 120 MR&I water systems in the Red River Valley ranging in size from small towns with populations under 100 to the city of Fargo with a population approaching 100,000 (2000 census). Obviously, the MR&I water use characteristics vary widely across the Red River Valley. Small towns generally have older homes, older residents, and lower per capita income. Fargo on the other hand has newer homes, a younger population, and higher per capita income. These and many other community characteristics influence water use and water conservation potential.

Estimating the water conservation potential of every MR&I system in the Red River Valley would be very time consuming and is not necessary to estimate the potential of water conservation measures. Therefore, medium and small size MR&I water systems in the Red River Valley were combined into two groups to simplify the scope of this assessment. The two groups include medium size water systems (cities) with a population ranging from 1,000 to 15,000, and rural water systems and small community water systems with a population less than 1,000. These two groups were selected under the assumption that they generally have similar water use characteristics. Larger municipal systems including Fargo, Grand Forks, West Fargo and Moorhead were evaluated separately. Table 1 lists the individual systems/groups of similar systems evaluated in the WCPA.

Table 1 - MR&I Water Systems Evaluated.

MR&I Water Systems
Fargo
Grand Forks
West Fargo
Moorhead[1]
Medium Size Water Systems (population 1,000 to 15,000)
Rural and Small Water Systems (population <1,000)

[1] Excludes populations of Dilworth, Oakport Township, and Americana Estates in WCPA analysis.

CURRENT WATER USE PROFILE

The Red River Valley has a water use profile different from that generally found in other parts of the country. The majority of water use in the Red River Valley is for residential use, and valley residents are conservative in their water use. This is apparent when reviewing historical water use data in Table 2.

Table 2 shows the average summer, winter and annual water use for water systems in the Red River Valley. Data were collected from 1988 to 2002 and used to determine the values listed in

the table. Outdoor water use during summer months, May through October, is typically a large percentage of overall water use. However, due to the conservative nature of water users in the Red River Valley, average water use during the summer does not increase significantly. The American Water Works Association Research Foundation *Residential End Uses of Water* report, which will be discussed in more detail later, noted that 59% of residential water use is used outdoors. Table 2 shows that outdoor water use ranges from 8.9% to 17.1% demonstrating that Red River Valley residents are very conservative in outdoor water use, which is the most discretionary of all water use categories. Small and rural water systems have a relatively high outdoor water use percentage at 12.2%, but a significant amount of that water is related to crop spraying.

Industrial and institutional water use data for the Red River Valley have been collected for use in the WCPA. Measures have been examined to reduce water use in these facilities. The cities of Grand Forks and Moorhead have industries with higher than average water demands. Grand Forks and Moorhead have worked closely with these industries to conserve water so these cities have limited additional opportunity to reduce industrial water use. Fargo, Grand Forks and Moorhead also have large institutional water demands due to the colleges in the area. Water conservation measures have been proposed to decrease water use in these facilities.

Table 2 - Historical MR&I Water System Water Use.

MR&I Water Systems	Average Winter Use (gpc/d)	Average Summer Use (gpc/d)	Average Annual Use (gpc/d)	Average Annual Outdoor Use (gpc/d)	Percentage Outdoor Water Use (%)
Fargo	95.7	128.9	112.4	16.6	14.8
Grand Forks	123.1	148.0	135.4	12.5	9.2
West Fargo	82.8	114.0	91.2	15.6	17.1
Moorhead[1]	109.1	130.0	118.5	10.5	8.9
Medium Size Water Systems (population 1,000 to 15,000)	100.0	120.0	110.0	10.0	9.1
Rural and Small Water Systems (population <1,000)	90.0	115.8	102.9	12.9	12.2

[1] Did not include populations of Dilworth, Oakport Township and Americana Estates in WCPA analysis.

History of Water Conservation in the Red River Valley

Very few water systems in the Red River Valley have a formal water conservation program in place. North Dakota does not require water conservation programs for systems, while Minnesota does require systems to have a water conservation program. Grand Forks, Fargo, and Moorhead have water conservation programs; however, these water conservation programs could be improved to include measures considered in the WCPA.

Despite not having a large number of formal water conservation plans, significant progress on water conservation has been made in the Red River Valley in the last 10 to 15 years. Exhibit 3 summarizes this progress and identifies the measures water systems have taken and the resulting water savings. The water conservation savings prior to 2002 ranged from a high of 37 gpc/d for Fargo to 5 gpc/d or 33.2% to 4.3% expressed as a percentage. These estimates only included the quantifiable water savings. Exhibit 3 also identifies water savings that could not be estimated, but do exist. The establishment of water savings prior to 2002 is important because this is the foundation that the WCPA will build on in terms of identifying reasonable water conservation measures to pursue through 2050.

SELECTION OF WATER CONSERVATION MEASURES

A number of factors need to be considered when developing a list of water conservation measures to be evaluated. These factors include consideration of how water is presently used and how much water costs. Identification of how water is used helps target the higher volume uses, which yield the greatest potential water savings. The analysis of current water use rates in the Red River Valley will show how the cost of water influences water use and whether the current rate structures encourage or discourage water use behavior.

Measures that have been mandated by law or authorized by regulation, such as best management practices, also need to be considered in the WCPA. Also, measures that will be enforced due to changes in plumbing and appliance codes must be included. Major water organizations such as the American Water Works Association (AWWA), governmental entities, academic institutions, and private consultants have also contributed significantly to the field of water conservation. All of these resources were reviewed to determine water conservation measures to evaluate and how each can be applied in the WCPA.

Typical Residential Water Use

When considering water conservation measures, current use of water must be understood so that the WCPA can be tailored to focus on the highest water uses. The highest residential water uses will have the greatest water savings potential. For communities and water systems evaluated in the WCPA, approximately 75%[1] of total water use is domestic, so it is appropriate to focus a significant amount of attention on residential use. The AWWA commissioned a groundbreaking study called *Residential End Uses of Water* in 1999, which was the first comprehensive attempt to analyze residential water use including the impact of water conserving plumbing fixtures. The sample group included 1,188 homes equally divided among 12 North American cities. The AWWA assessment used the results developed in the AWWA study to estimate water savings for a number of the water conservation measures. Figure 1 shows the results of the *Residential End Uses of Water* study for various water uses in gallons per capita per day.

[1] Based on the *Red River Valley Water Needs Assessment Phase II; Appraisal of Alternatives to Meet Projected Shortages Report* excluding large industrial facilities.

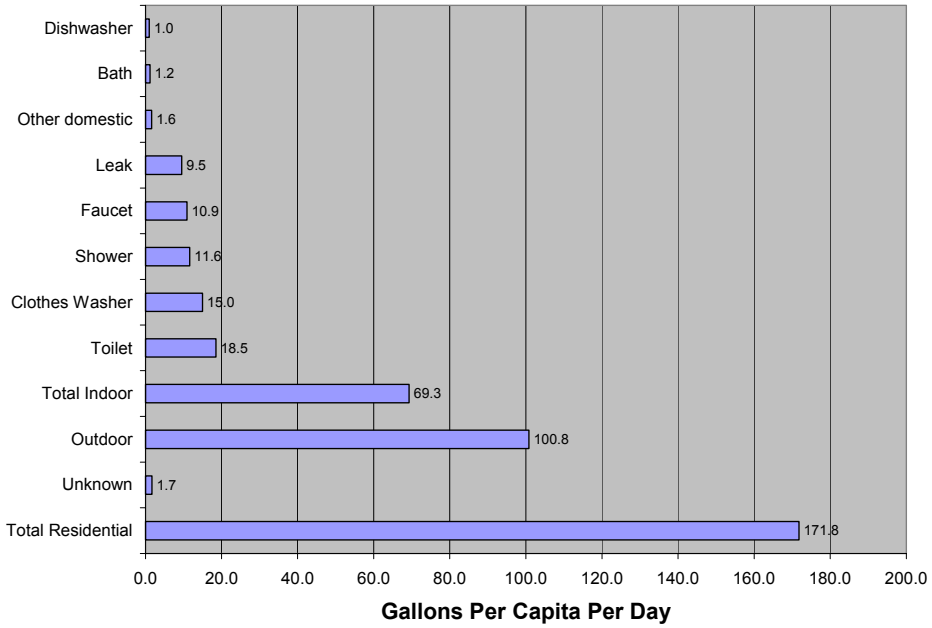

Figure 1 - Residential End Uses of Water.

Figure 2 depicts relative percentages of indoor water use. The highest percentage of indoor water use is for toilets (18.5 gpc/d at 26%) with clothes washing (15.0 gpc/d at 22%) as a close second. There was significant variance in the outdoor use which averaged 100.8 gpc/d. This is somewhat misleading in that some communities surveyed had very high outdoor usage due to their dry climates, while other communities had lower water use due to more moderate climates. There was relatively good consistency when comparing indoor water use among the 12 communities surveyed.

An analysis of historic Red River Valley per capita water use indicates that generally the Red River Valley has significantly lower than average outdoor water use as compared to the above stated average of 100.8 gpc/d. Fargo for example annually averages approximately 16.6 gpc/d for outdoor use while Grand Forks averages 12.5 gpc/d. The results in the rest of the Red River Valley are very similar. Given that outdoor water use is so low in the Red River Valley, the overall potential water savings would be significantly less than one would expect when comparing water conservation programs in other parts of the country.

All of the indoor water uses identified above are addressed in the WCPA. For study purposes "bath" and "shower" water use are addressed together. No specific water conservation measure addressed "other domestic" water use because it was a catch-all category and no specific measure could be identified to address it. "Leaks" at 14% were not directly addressed because most of this water use is related to the improper functioning of plumbing fixtures. However, "leaks" will be indirectly addressed in that the WCPA assumed that 90% of all plumbing fixtures would be replaced by 2050 and that consistent public education program message would encourage leak repairs.

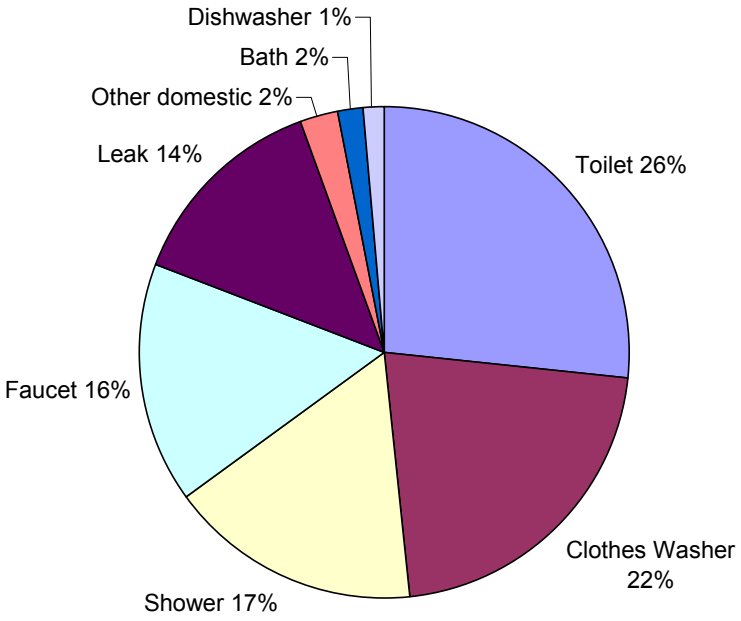

Figure 2 - Indoor Per Capita Water Use Percent by Fixture

Red River Valley Water Rate Analysis

The cost of water service is one of the most important factors when evaluating water use patterns. One of the basic principles of economics is that the cost of a product will influence its consumption. While a direct comparison of water use costs and the potential for water conservation savings may be difficult to quantify, the influence does exist and needs to be considered when assessing the overall results of the WCPA.

Water rates in the Red River Valley were analyzed and compared to national water rates. This water rate analysis also evaluated water affordability. The analysis addressed the percent of annual median household income used to purchase water service and compared the Red River Valley to the rest of the nation. Exhibit 2 in Appendix A provides a complete description of the water rate analysis.

The goal of the analysis was to determine how water rates in the Red River Valley compare to national and regional water rates. The analysis clearly demonstrates that water systems in the Red River Valley charge higher rates than their national or regional counterparts, particularly the rural water systems. The residents of the Red River Valley pay some of the highest water rates in the nation but rank 42nd nationally in annual median household income.

The use of inverted or increasing water rates is one of the water conservation measures evaluated in the WCPA. Exhibit 4 in Appendix A documents water savings from converting declining

water rates to an inverted water rate structure for each system analyzed in the WCPA. As discussed above with outdoor water use, residents of the Red River Valley have a limited amount of discretionary water use; and therefore, the influence of inverted water rates may be limited.

Best Management Practices and WCPA

Over the past decade a standard group of water conservation practices or Best Management Practices (BMPs) have evolved through the efforts of a number of state and local governments. The State of California has been a leader in this evolution and has developed at a list of 14 BMPs that cover the extent of an effective water conservation program. Arizona and Texas have lists similar to California. This list of BMPs (Table 3), will be used as an additional source or checklist to assure the WCPA addresses major water conservation measures. The disposition of how each water conservation practice is addressed is also listed.

Table 3 – California Best Management Practices Applicable to Red River Valley Water Conservation Measures.

BMP Description	Red River Valley WCPA Measures
Water survey program for single and multi-family residential customers	Program Administration and Public Education Program measure
Residential plumbing retrofit	Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets (ULF), Promote Installation of Low-Flow Shower Heads, Promote Installation of Faucet Aerators, and In-Home Low-Flow Water Fixtures Giveaway Program measures
System water audits, leak detection and repair	Program Administration and Public Education Program measure
Metering with commodity rates for all new connections and retrofit of existing connections	Not included because near 1005 of RRV water systems already require service metering.
Large landscape conservation programs and incentives	Install Low-Water-Use Turf and Plants in Landscaping – Xeriscape Rebate Program and Install Water Efficient Irrigation Systems – ET Controller Rebate Program measures
High-efficiency washing machine rebate programs	Program Administration and Public Education Program and Promote Installation of Efficient Clothes Washers measure
Public information program	Program Administration and Public Education Program measure
School education program	Program Administration and Public Education Program measure
Conservation programs for commercial, industrial, and institutional accounts	Industrial Water Use Efficiency, Institutional Water Use Efficiency and Commercial Water Use Efficiency measures

Wholesale agency assistance programs	Not included - No major wholesale accounts are in the Red River Valley with the exception of cities provided bulk service from rural water systems. These cities are already covered under other conservation measures.
Conservation pricing	Conservation Pricing measure
Conservation coordinator	Program Administration and Public Education Program measure
Water waste prohibition	Not included - Outside scope of WCPA.
Residential ULF toilet replacement program	Promote Installation of 1.6 Gallon ULF measure

Staffing positions, including a conservation coordinator, are required as depicted in Table 3. Conservation coordinators staff size would depend on the size of the community. In a small community a conservation coordinator may need a limited number of staff to fulfill the duties. Larger communities would require more staff time in which case the conservation coordinator position may take on a management/coordination role. Some duties could include community outreach to promote water conservation though classes, workshops and seminars, water audits, and leak detection programs.

General Categories of Water Conservation Measures

A full range of water conservation measures was evaluated in the WCPA. The range of measures was developed from a literature review of various water conservation publications, references, and research papers. Water conservation measures were divided into two areas of evaluation, supply management and demand management. Supply management measures include activities conducted by water utilities and relate to reducing water loss by optimizing delivery of water. Demand management measures involve water use reduction practices by the end customer after the water has been delivered. The measures are divided into these two categories because the implementation will depend on who is managing water use at what point in the system. This will also affect who pays for the water conservation measure - the MR&I system or the consumer.

Tables 4 and 5 identify the general categories of supply management and demand management water conservation measures evaluated in the WCPA. More specific measures under these general categories are identified in the next section (Table 6) and are described in further detail in Appendix A, Exhibit 1.

Table 4 - Supply Management Water Conservation Measures.

Water Conservation Measure	Method of Evaluation
Install Water Meters	Research has shown that metered service connections use less water. Determine number of un-metered service connections and estimate cost of meter installation and corresponding water savings.
Audit Water Use, Detect Leaks and Repair Distribution Systems	Determine if the water system has a water auditing and leak detection program and degree to which it is implemented. Estimate the additional annual cost of an adequately managed leak detection program, and estimate the corresponding water savings.

Table 5 - Demand Management Water Conservation Measures.

Water Conservation Measure	Method of Evaluation
Program Administration and Public Education Programs	Public education is an important aspect of any successful water conservation plan. No water savings will be estimated for this measure, but costs will be distributed to individual water conservation measures.
Low-Water-Use Landscaping Program (Detailed analysis was conducted on low-water use turfs and plants, efficient irrigation systems, and landscape irrigation scheduling and xeriscaping.)	Determine the current amount of low-water-use landscaping practiced by the water users and if additional practices could be reasonably implemented. Estimate the annual cost of improving the use of low-water use landscaping (water system costs) and the corresponding water savings. Also include the implementation of a xeriscaping program. This measure does not include drought water use restriction associated with landscape irrigation. This will be addressed in separate investigations.
Retrofitting of Water Fixtures using Low-Water–Use Fixtures (Detailed analysis was conducted on shower heads, ULF toilets, and hand faucet aerators.)	In 1992, the U.S. Energy Act was passed which established the maximum allowable water-use rates for plumbing fixtures in the United States. Since the enactment of the law, all plumbing fixtures sold in the United States are required to be manufactured to reduce water use. As water users rehabilitate their present plumbing fixtures or construct new homes/businesses, they automatically will be installing the new low-water-use fixtures. Estimate the percentage or saturation of low-water-use fixture installation from 1992 to present and from present to 2050 to estimate the corresponding water savings. The period of 1992 to present is estimated because this is already reflected in water use data.

Water Conservation Measure	Method of Evaluation
Giveaway Program - Retrofitting of In-home Water Fixtures	Research has shown that low-water-use plumbing fixture giveaway programs can increase the percentage of these devices installed. The giveaway program normally includes faucet aerators, shower heads, and replacement toilet flappers. Estimate the annual cost of a giveaway program and the corresponding water savings.
Rebate Program – ULF Toilets	An ULF toilet rebate program can increase the use of these devices. This program normally targets elderly and low income households who may have limited financial resources. Estimate the annual cost of a ULF toilet rebate program and the corresponding water savings.
Installation of Water Efficient Appliances (Dishwashers and clothes washers were evaluated.)	Water efficient appliances are becoming more popular in some segments of the public. The potential water savings associated with increased use of water efficient appliances were estimated.
Rebate Program – Water Efficient Appliances (Dishwashers and clothes washers were evaluated.)	Some cities have implemented water efficient dishwasher and clothes washer rebate programs to increase the percentage of these appliances installed. Estimate the annual cost of a water efficient appliance rebate program and the corresponding water savings.
Conservation-Oriented Water Rates	Most of the water systems in the Red River Valley have declining water rate structures so an inverted rate structure could reduce water consumption. The inverted conservation rate structure would only affect discretionary water use so it does not have a negative economic impact on low-income and elderly water users. Estimate the annual cost of implementing a conservation-oriented water rate structure and estimate the corresponding water savings.
Wastewater Reuse (landscape watering of public areas)	Determine what wastewater reuse is currently taking place within each water system. Then identify opportunities for wastewater reuse and estimate the capital and annual costs of implementing a reuse program and estimate the corresponding water savings.
Water Use Efficiencies by Industrial, Commercial and Institutional Water Users	Based on literature reviews of industrial, commercial, and institutional water conservation studies, estimate the general potential for water use reduction and associated costs.

Specific Water Conservation Measures Evaluated

Sixteen water conservation measures were evaluated and are listed in Table 6. Three additional water conservation measures were considered but eliminated from further consideration. They included ULF toilet rebate program, water efficient clothes washer rebate program, and wastewater reuse.

The ULF toilet rebate program and water efficient clothes washer rebate program were eliminated because rebate programs are used to promote a short-term increase in fixture installation to address near-term water problems. A rebate program would not have any long-term influence on the number of water efficient fixtures that are installed through 2050. The Red River Project is a long-term project, so near-term solutions are not considered feasible.

Wastewater reuse was also eliminated from further consideration in the WCPA based on analysis previously conducted in the Phase II Report (Reclamation 2000). Phase II concluded that there were limited potential water savings with wastewater reuse because municipal return flows (particularly downstream of Fargo) comprised a significant amount of the water in the Red River during a drought. Only the community reusing wastewater would benefit from this process. Communities downstream would be harmed because they depend on the wastewater return flows into the river. Every gallon of wastewater reused would be one gallon less downstream.

Due to changes in plumbing and appliance codes some of the measures will be implemented unconsciously because older fixtures and appliances will no longer be available. These measures are highlighted in Table 6. Natural replacement of these fixtures and appliances will occur before 2050 in older homes and the new codes will enforce use of these fixtures in newly constructed homes. Although these measures will be implemented due to changes in codes, program costs will be assigned to these measures in the WCPA. The costs will include promoting and educating the valley residents about these water conserving fixtures and appliances and making them aware of the changing codes.

Table 6 - Specific Water Conservation Measure Evaluated in WCPA.

Supply Management
1. Install Water Meters
2. Audit Water Use, Detect Leaks, and Repair Distribution Systems
Demand Management
1. Program Administration and Public Education Programs
2. Promote Installation of 1.6 Gallon ULF Toilets[1]
3. Promote Installation of Low-Flow Shower Heads[1]
4. Promote Installation of Faucet Aerators[1]
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]
6. Promote Installation of Water Efficient Dishwashers[1]
7. Install Low-Water-Use Turf and Plants in Landscaping – Xeriscaping Rebate Program
8. Install Water Efficient Landscape Irrigation Systems – ET Controller Rebate Program
9. Efficient Landscape Irrigation Scheduling

10. Industrial Water Use Efficiency Measures
11. Commercial Water Use Efficiency Measures
12. Institutional Water Use Efficiency Measures
13. Conservation Pricing
14. Promote Installation of Efficient Clothes Washers[1]

[1] These measures will be enforced by new plumbing and appliance codes and implemented on their own prior to 2050

Appendix A, Exhibit 1 provides a detailed description of each water conservation measure, assumptions associated with its application, and references to studies or publications used as resources.

EVALUATION OF WATER CONSERVATION MEASURES

This section discloses the water conservation measure results for each water system or group of water systems. This includes evaluation of sixteen specific supply and demand water saving measures for each system recognizing that not all of the measures will reasonable from a cost standpoint. A "reasonable cost" was identified so measures could be evaluated, not only for their water savings potential, but from a cost perspective.

Reasonable Cost of Water Conservation Measure Implementation

Water conservation measures need to be economical for a water system to consider implementation. This WCPA defines "economically reasonable" water conservation measures as those measures that reduce water use at a cost equal to or less than the cost of alternative water supplies. Basic economics dictate that water systems will pursue the least costly sources of new water supply whether they are new sources or water conservation. The WCPA only recommends the implementation of those water conservation measures estimated to cost less than or equal to the cost of an alternative water supply. The alternative water supply cost used as a basis of comparison was the least costly (per 1000 gallons) alternative estimated in the Phase II Report. Alternative 3 (In Basin, Enlarge Lake Ashtabula) at an estimated cost of $1.25 per 1000 gallons had the lowest total allocated cost per 1000 gallons. Therefore, a water conservation measure was considered reasonable and recommended for implementation if it had a cost of $1.25 per 1000 gallons or less.

Water Conservation Potential Assessment Results

Table 7 summarizes results for each of the water systems or groups of water systems evaluated. Project-wide, approximately 1.41 billion gallons (4,318 acre-feet) per year can be saved for approximately $780,000 per year. On a per capita basis, the water savings ranged from 6.54 gpc/d to 9.02 gpc/d. The cost of implementing the water conservation measures range from $0.51 to $0.68 per 1000 gallons saved, which was less than the estimated cost of a replacement water supply at $1.25 per 1000 gallons. The overall composite water conservation measure cost rate was $0.55 per 1000 gallons.

The Needs and Options Report will project the water demand for future (yet to be built) industries. However, the WCPA assumed zero water conservation costs and water savings for these future industrial facilities because there were no existing facilities to evaluate. Given that water costs to industries could be $1.25 per 1000 gallons or higher, it is reasonable to assume that these future industrial facilities would make every effort to minimize their water consumption.

The In-Home Low-Flow Water Fixtures Giveaway Program, Install Low-Water-Use Turf and Plants in Landscaping, and Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program were eliminated because the measures had a per 1000 gallon cost higher than the $1.25/1000 gallons cost identified as "economically reasonable". These measures are not included in Table 7 and were eliminated from all water systems evaluated because the costs exceeded the $1.25/1000 gallon cost threshold.

Table 7 - WCPA Summary Results.

Water System(s)	Water Savings (gals/yr)	Average Water Savings (gpc/d)	Annual Costs	Cost Per 1000 Gals
Fargo	591,177,937	7.93	$325,914	$0.55
Grand Forks	252,445,152	8.25	$137,863	$0.55
West Fargo	80,920,230	6.54	$54,709	$0.68
Moorhead	130,211,953	8.07	$74,054	$0.57
Medium Size Municipal Water Systems (population 1,000 to 15,000)	149,443,656	9.02	$76,526	$0.51
Rural Water Systems including cities <1,000 in population	202,701,688	8.80	$110,796	$0.55
Totals	1,406,900,616	NA	$779,863	NA

Water System WCPA Results

Using the water conservation measures identified in Table 6, the WCPA calculates the cost and potential water savings for each of the six water systems or groups of water systems identified in Table 1. The actual computation estimates are located in Appendix A, Exhibits 5 through 10.

Fargo WCPA Results

Table 8 shows each water conservation measure's potential water savings and cost for the city of Fargo. Exhibit 5 documents how water savings and costs were calculated.

Table 8 - Fargo WCPA Results.

	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management				
1. Install Water Meters	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA
Demand Management				
1. Program Administration and Public Education Programs[2]	0	0.00	$357,525	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	117,791,582	1.58	$64,653	$0.55
3. Promote Installation of Low-Flow Shower Heads	30,361,718	0.41	$16,665	$0.55
4. Promote Installation of Faucet Aerators	34,898,526	0.47	$19,155	$0.55
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]	6,347,356	0.09	$8,582	$1.35
6. Promote Installation of Water Efficient Dishwashers	9,000,979	0.12	$4,940	$0.55
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program[1]	49,514,148	0.66	$536,971	$10.84
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program[1]	4,332,488	0.06	$8,750	$2.02
9. Efficient Landscape Irrigation Scheduling	30,946,343	0.42	$16,986	$0.55
10. Industrial Water Use Efficiency Measures	25,144,835	0.34	$13,801	$0.55
11. Commercial Water Use Efficiency Measures	37,717,253	0.51	$20,702	$0.55
12. Institutional Water Use Efficiency Measures	52,804,154	0.71	$28,983	$0.55
13. Conservation Pricing	62,265,533	0.84	$35,605	$0.57
14. Promote Installation of Efficient Clothes Washers	190,247,015	2.55	$104,423	$0.55
Totals	591,177,937	7.93	$325,914	$0.55

[1] This water conservation measure is not included in the totals because it exceeds the $1.25/1000 gallon cost threshold. It would be cheaper to purchase an alternate source of water.
[2] The cost for Public Education Programs is distributed among the other measures.

The WCPA estimates that Fargo could save approximately 591 million gallons (1,814 acre-feet) annually with a water conservation program costing approximately $325,900 per year. Water conservation measure cost implementation for Fargo is $0.55 per 1000 gallons saved.

Figure 3 depicts distribution of water saving measures for Fargo.

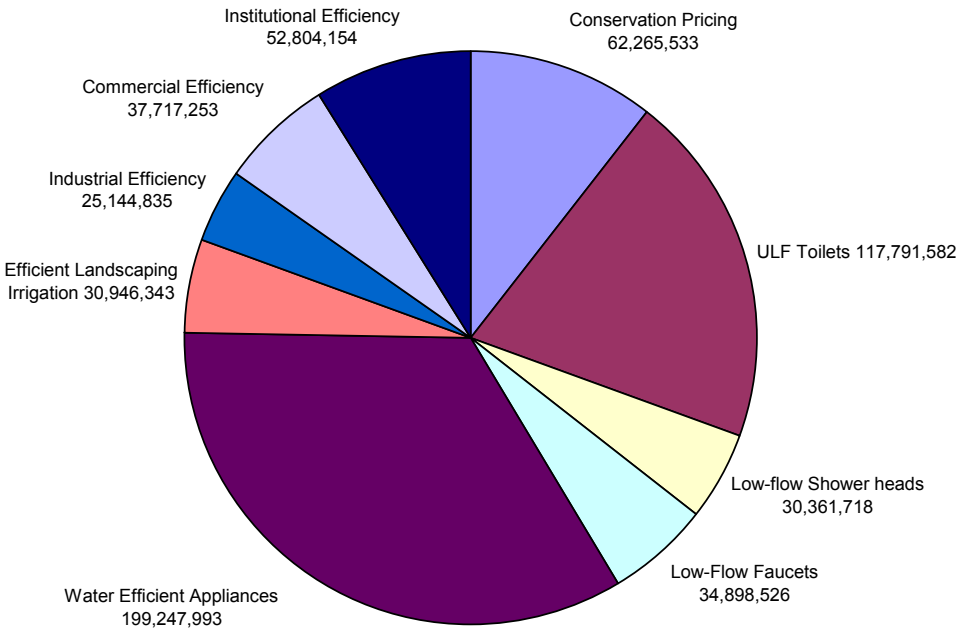

Figure 3 - Fargo WCPA Water Savings in Gallons

Grand Forks WCPA Results

Table 9 shows each water conservation measure's potential water savings and cost for the city of Grand Forks. Exhibit 6 documents how water savings and costs were calculated.

Table 9 - Grand Forks WCPA Results.

	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management				
1. Install Water Meters	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA
Demand Management				
1. Program Administration and Public Education Programs[2]	0	0.00	$146,650	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	84,230,795	2.75	$45,523	$0.54
3. Promote Installation of Low-Flow Shower Heads	12,453,803	0.41	$6,731	$0.54
4. Promote Installation of Faucet Aerators	14,314,716	0.47	$7,736	$0.54
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]	2,603,565	0.09	$3,386	$1.30
6. Promote Installation of Water Efficient Dishwashers	3,901,623	0.13	$2,109	$0.54
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program[1]	15,232,326	0.50	$206,107	$13.53
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program[1]	1,066,263	0.03	$2,555	$2.40
9. Efficient Landscape Irrigation Scheduling	7,616,163	0.25	$4,116	$0.54
10. Industrial Water Use Efficiency Measures	0	0.00	$0	$0.00
11. Commercial Water Use Efficiency Measures	18,636,659	0.61	$10,072	$0.54
12. Institutional Water Use Efficiency Measures	18,636,659	0.61	$10,072	$0.54
13. Conservation Pricing	18,811,005	0.62	$11,595	$0.62
14. Promote Installation of Efficient Clothes Washers	73,843,729	2.41	$39,909	$0.54
Totals	252,445,152	8.25	$137,863	$0.55

[1] This water conservation measure is not included in the totals because it exceeds the $1.25/1000 gallon cost threshold. It would be cheaper to purchase an alternate source of water.
[2] The cost for Public Education Programs is distributed among the other measures.

The WCPA estimates that Grand Forks could save approximately 252 million gallons (775 acre-feet) annually with a water conservation program costing approximately $138,000 per year. Water conservation measure cost implementation for Grand Forks is $0.55 per 1000 gallons.

Figure 4 depicts distribution of water saving measures for Grand Forks.

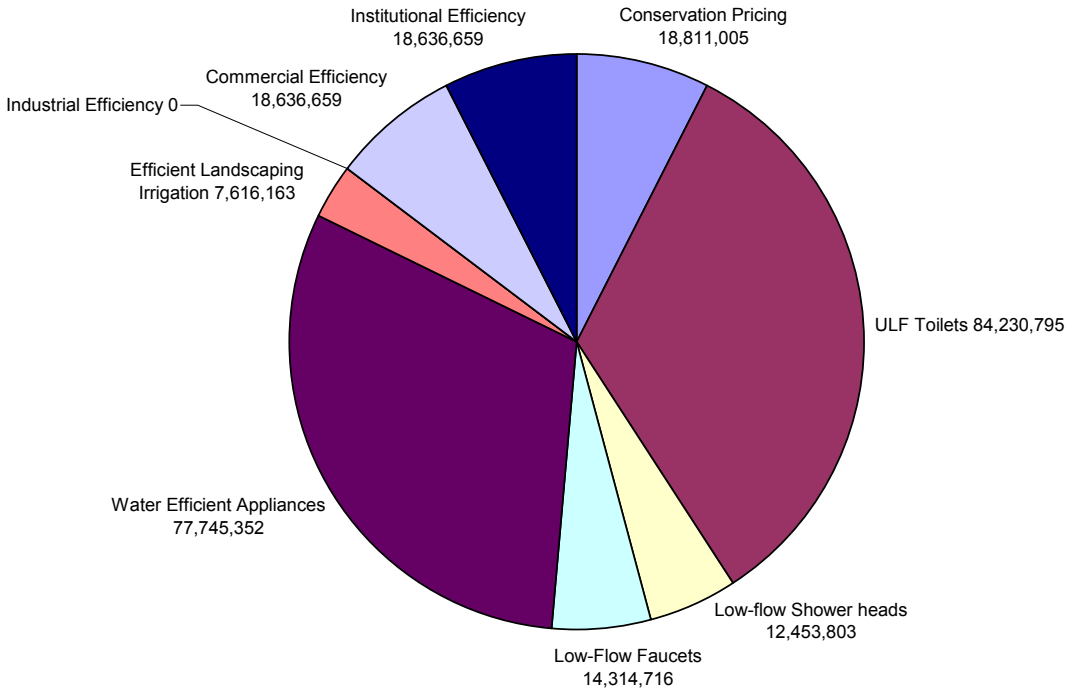

Figure 4 - Grand Forks WCPA Water Savings in Gallons

West Fargo WCPA Results

Table 10 shows each water conservation measure's potential water savings and cost for the city of West Fargo. Exhibit 7 documents how water savings and costs were calculated.

Table 10 - West Fargo WCPA Results.

	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management				
1. Install Water Meters	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA
Demand Management				
1. Program Administration and Public Education Programs[2]	0	0.00	$59,325	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	18,781,292	1.52	$12,366	$0.66
3. Promote Installation of Low-Flow Shower Heads	5,037,994	0.41	$3,317	$0.66
4. Promote Installation of Faucet Aerators	5,790,798	0.47	$3,813	$0.66
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]	1,053,232	0.09	$1,539	$1.46
6. Promote Installation of Water Efficient Dishwashers	1,493,554	0.12	$983	$0.66
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program[1]	7,721,064	0.62	$89,675	$11.61
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program[1]	405,356	0.03	$901	$2.22
9. Efficient Landscape Irrigation Scheduling	2,895,399	0.23	$1,906	$0.66
10. Industrial Water Use Efficiency Measures	0	0.00	$0	$0.00
11. Commercial Water Use Efficiency Measures	5,078,084	0.41	$3,344	$0.66
12. Institutional Water Use Efficiency Measures	5,078,084	0.41	$3,344	$0.66
13. Conservation Pricing	5,196,870	0.42	$4,850	$0.93
14. Promote Installation of Efficient Clothes Washers	31,568,154	2.55	$20,786	$0.66
Totals	80,920,230	6.54	$54,709	$0.68

[1] This water conservation measure is not included in the totals because it exceeds the $1.25/1000 gallon cost threshold. It would be cheaper to purchase an alternate source of water.
[2] The cost for Public Education Programs is distributed among the other measures.

The WCPA estimates that West Fargo could save approximately 81 million gallons (248 acre-feet) annually with a water conservation program costing approximately $55,000 per year. Water conservation measure cost implementation for West Fargo is $0.68 per 1000 gallons saved.

Figure 5 depicts distribution of water saving measures for West Fargo. The water savings from the installation of ULF toilets is somewhat smaller than what would be expected. This is because West Fargo is expected to grow significantly in the future and with growth comes the associated construction of single and multi-family residents which will already have ULF toilets; therefore, the water savings from toilet replacement is reduced as compared to other cities.

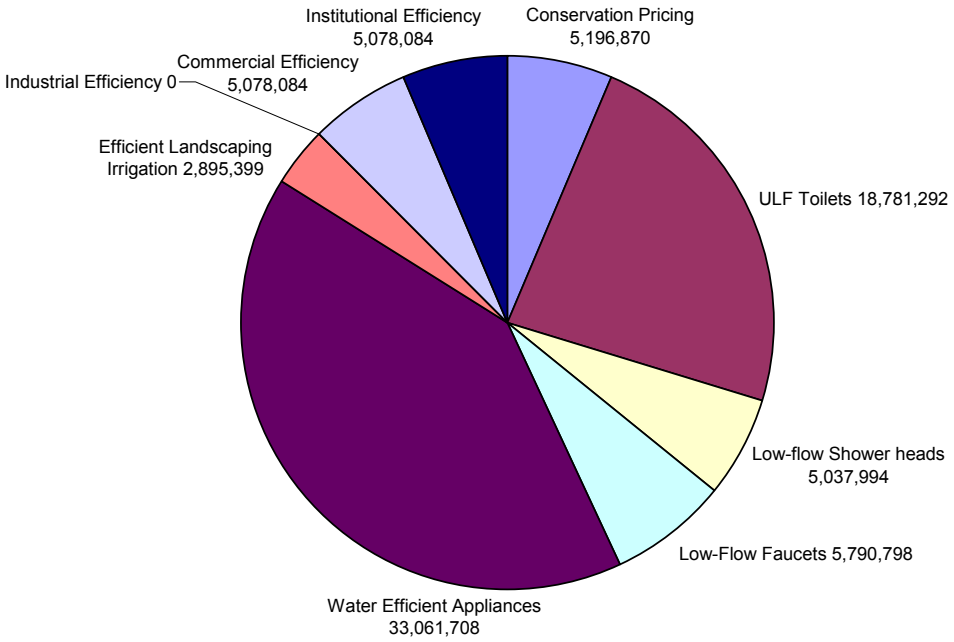

Figure 5 - West Fargo WCPA Water Savings in Gallons

Moorhead WCPA Results

Table 11 shows each water conservation measure's potential water savings and cost for the city of Moorhead. Exhibit 8 documents how water savings and costs were calculated.

Table 11 - Moorhead WCPA Results.

	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management				
1. Install Water Meters	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA
Demand Management				
1. Program Administration and Public Education Programs[2]	0	0.00	$77,350	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	49,383,693	3.06	$27,544	$0.56
3. Promote Installation of Low-Flow Shower Heads	6,568,712	0.41	$3,664	$0.56
4. Promote Installation of Faucet Aerators	7,550,244	0.47	$4,211	$0.56
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]	1,373,241	0.09	$1,764	$1.28
6. Promote Installation of Water Efficient Dishwashers	2,151,437	0.13	$1,200	$0.56
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program[1]	6,743,594	0.42	$103,592	$15.36
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program[1]	354,039	0.02	$946	$2.67
9. Efficient Landscape Irrigation Scheduling	2,528,848	0.16	$1,410	$0.56
10. Industrial Water Use Efficiency Measures	0	0.00	$0	$0.00
11. Commercial Water Use Efficiency Measures	8,595,662	0.53	$4,794	$0.56
12. Institutional Water Use Efficiency Measures	8,595,662	0.53	$4,794	$0.56
13. Conservation Pricing	7,582,510	0.47	$5,658	$0.75
14. Promote Installation of Efficient Clothes Washers	37,255,184	2.31	$20,779	$0.56
Totals	130,211,953	8.07	$74,054	$0.57

[1] This water conservation measure is not included in the totals because it exceeds the $1.25/1000 gallon cost threshold. It would be cheaper to purchase an alternate source of water.
[2] The cost for Public Education Programs is distributed among the other measures.

The WCPA estimates that Moorhead could save approximately 130 million gallons (400 acre-feet) annually with a water conservation program costing approximately $74,000 per year. Water conservation measure cost implementation for Moorhead is $0.57 per 1000 gallons saved.

Figure 6 depicts distribution of water saving measures for Moorhead. Moorhead also has a high ULF toilet water savings potential, as compared to Fargo or West Fargo, because it has a higher percentage of older homes.

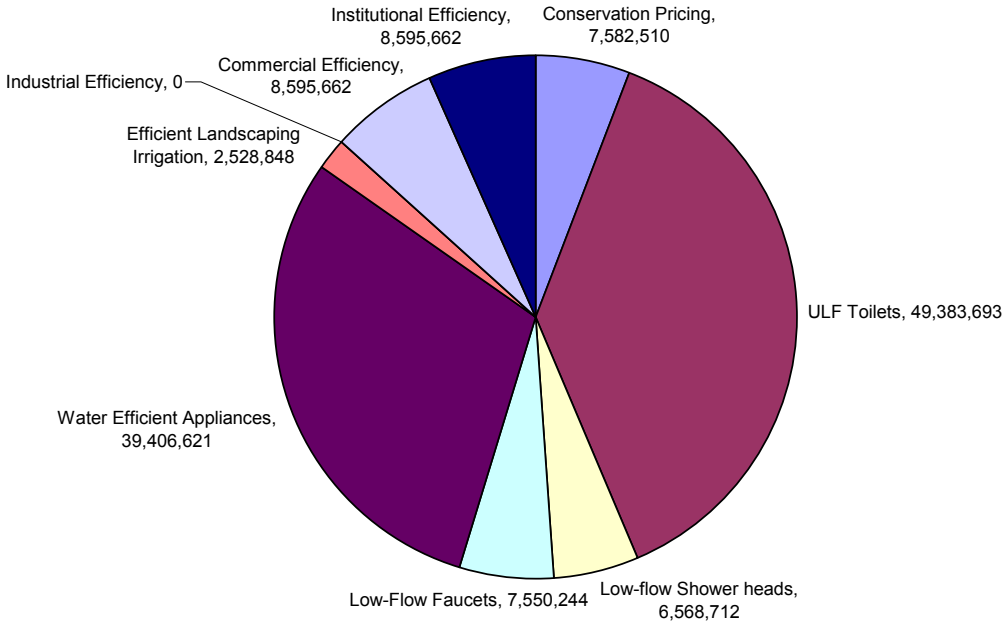

Figure 6 - Moorhead WCPA Water Savings in Gallons

Medium Size Water Systems WCPA Results

Table 12 shows each water conservation measure's potential water savings and cost for the Medium Size Water Systems. Exhibit 9 documents how water savings and costs were calculated.

Table 12 - Medium Size Water Systems WCPA Results.

	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management				
1. Install Water Meters	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA
Demand Management				
1. Program Administration and Public Education Programs[2]	0	0.00	$79,450	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	58,529,043	3.53	$29,412	0.50
3. Promote Installation of Low-Flow Shower Heads	6,747,048	0.41	$3,391	0.50
4. Promote Installation of Faucet Aerators	7,755,228	0.47	$3,897	0.50
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]	1,410,524	0.09	$1,872	1.33
6. Promote Installation of Water Efficient Dishwashers	1,947,810	0.12	$979	0.50
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program[1]	7,125,530	0.43	$119,916	16.83
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program[1]	124,697	0.01	$354	2.83
9. Efficient Landscape Irrigation Scheduling	890,691	0.05	$448	0.50
10. Industrial Water Use Efficiency Measures	5,468,430	0.33	$2,748	0.50
11. Commercial Water Use Efficiency Measures	8,202,645	0.50	$4,122	0.50
12. Institutional Water Use Efficiency Measures	8,202,645	0.50	$4,122	0.50
13. Conservation Pricing	8,285,500	0.50	$5,592	0.67
14. Promote Installation of Efficient Clothes Washers	43,414,615	2.62	$21,817	0.50
Totals	149,443,656	9.02	$76,526	0.51

[1] This water conservation measure is not included in the totals because it exceeds the $1.25/1000 gallon cost threshold. It would be cheaper to purchase an alternate source of water.
[2] The cost for Public Education Programs is distributed among the other measures.

The WCPA estimates that Medium Size Water Systems could save approximately 149 million gallons (459 acre-feet) annually with a water conservation program costing approximately $77,000 per year. Water conservation measure cost implementation for Medium Size Water Systems is $0.51 per 1000 gallons saved.

Figure 7 depicts distribution of water saving measures for Medium Size Water Systems. The largest water savings for Medium Size Water Systems is related to the installation of ULF toilets. This is because population trends have been relatively stable in these communities and there has not been significant single and multi-family housing construction in the recent past. Therefore, there are a higher percentage of high water-use toilets in these communities as compared to Fargo. This results in higher toilet replacement water savings since a higher percentage of the toilets will be replaced in the future.

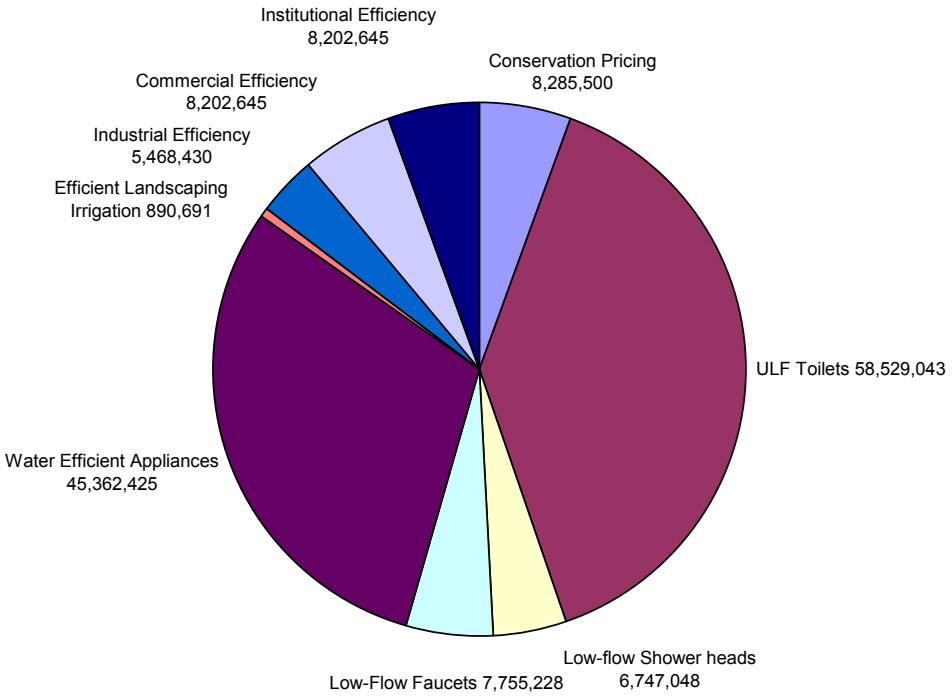

Figure 7 - Medium Size Water Systems WCPA Water Savings in Gallons

Rural and Small Water System WCPA Results

Table 13 shows each water conservation measure's potential water savings and cost for the Rural and Small Water Systems. Exhibit 10 documents how water savings and costs were calculated.

Table 13 - Rural and Small Water Systems WCPA Results.

	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management				
1. Install Water Meters	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA
Demand Management				
1. Program Administration and Public Education Programs[2]	0	0.00	$110,425	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	120,913,650	5.25	$65,239	$0.54
3. Promote Installation of Low-Flow Shower Heads	9,377,506	0.41	$5,060	$0.54
4. Promote Installation of Faucet Aerators	10,778,742	0.47	$5,816	$0.54
5. In-Home Low-Flow Water Fixtures Giveaway Program[1]	1,960,441	0.09	$2,888	$1.47
6. Promote Installation of Water Efficient Dishwashers	2,391,561	0.10	$1,290	$0.54
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program[1]	0	0.00	$0	$0.00
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program[1]	0	0.00	$0	$0.00
9. Efficient Landscape Irrigation Scheduling	0	0.00	$0	$0.00
10. Industrial Water Use Efficiency Measures	0	0.00	$0	$0.00
11. Commercial Water Use Efficiency Measures	6,398,842	0.28	$3,452	$0.54
12. Institutional Water Use Efficiency Measures	10,664,736	0.46	$5,754	$0.54
13. Conservation Pricing	14,855,318	0.65	$9,444	$0.64
14. Promote Installation of Efficient Clothes Washers	27,321,334	1.19	$14,741	$0.54
Totals	202,701,688	8.80	$110,796	$0.55

[1] This water conservation measure is not included in the totals because it exceeds the $1.25/1000 gallon cost threshold. It would be cheaper to purchase an alternate source of water.
[2] The cost for Public Education Programs is distributed among the other measures.
[3] Little or no landscape irrigation is conducted in rural water systems so no water savings of costs were estimated.

The WCPA estimates that Rural Water and Small Size Water Systems could save approximately 203 million gallons (622 acre-feet) annually with a water conservation program costing approximately $111,000 per year. Water conservation measure cost implementation for Rural Water and Small Size Water Systems is $0.55 per 1000 gallons saved. The In-Home Low-Flow Water Fixtures Giveaway Program was eliminated because the measure exceeds the $1.25/1000 gallon cost threshold.

Figure 8 depicts distribution of water saving measures for Rural and Small Water Systems. The largest water savings for Rural and Small Water Systems is related to the installation of ULF toilets. This is because population trends have been relatively stable in these communities and there is a lack of recent single and multi-family housing construction. Therefore, there are a higher percentage of older high water-use toilets in these communities, as compared to Fargo. This results in higher toilet replacement water savings since a higher percentage of the toilets will be replaced in the future.

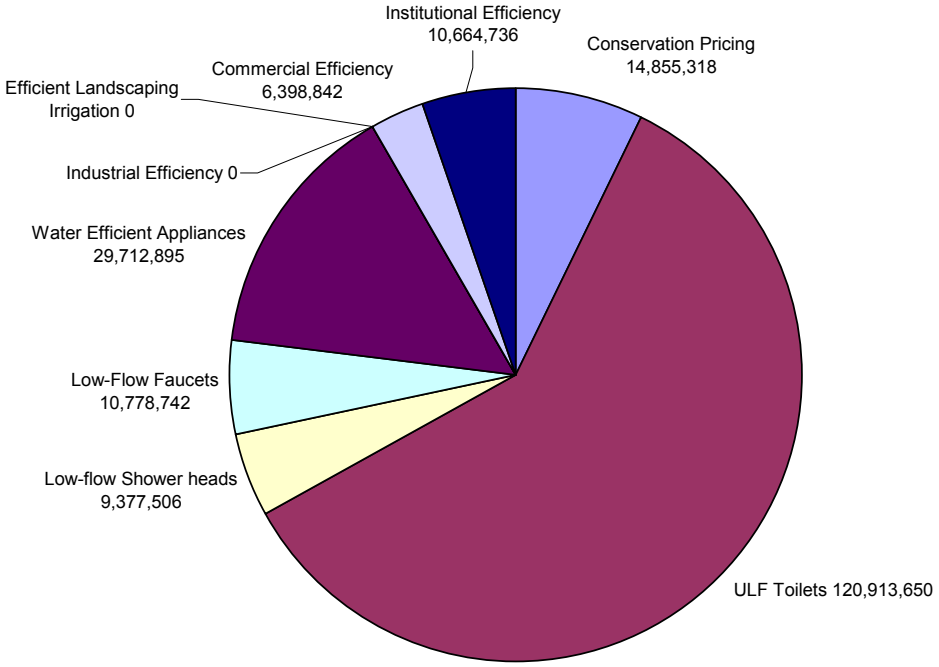

Figure 8 - Rural and Small Water Systems WCPA Water Savings in Gallons

CONCLUSIONS

In this report, the water conservation potential of the Red River Valley was analyzed using 19 water conservation measures. These water conservation measures included a range of BMPs developed by state and local governments as guidance in the development of water conservation plans. Three of the proposed measures, ULF toilet rebate program, water efficient clothes washer rebate program and wastewater reuse rates were eliminated prior to being analyzed because they could not be reasonably implemented. The In-Home Low-Flow Water Fixtures Giveaway Program, Install Low-Water-Use Turf and Plants in Landscaping, and Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program were eliminated during analysis because they exceeded the cost of alternative sources of water.

Four individual municipalities, medium sized and rural/small communities were evaluated in the WCPA. Table 14 summarizes WCPA per capita and annual water savings plus the estimated water conservation costs for each water system or group of water systems. The most significant result of the WCPA analysis is the per capita per day water savings estimate for each of the systems. Per capita water savings ranged from 6.54 to 9.02 gallons per person per day. Water conservation measure cost implementation ranged from $0.55 to $0.68 per 1000 gallons saved for the community water systems. Annual water savings is estimated based on the population served and per capita water savings rate for each water system. These savings are based on the population projection prepared by Reclamation (2003) in the report titled *Current and Future Population Red River Valley Region 2000 Through 2050*. Overall annual water savings for all water systems was estimated at 1.4 billion gallons; however, this total will vary depending on the actual population served.

Annual costs of implementing water conservation programs range from $54,700 to $326,000. The cost is largely dependent on the size of the service population, so Fargo has the highest cost. The overall annual water conservation cost is estimated at $780,000. This cost will be included in all action alternatives developed in the Needs and Options Report.

Column 4 and 5 of Table 14 breaks down the summer and winter water savings in gallons per capita per day. Summer water savings are higher because of landscape irrigation water savings. When estimating future per capita water demands, generally the summer water savings are used in the estimate because peak water use generally occurs in the summer months for most MR&I systems in the Red River Valley.

Table 14 - WCPA Summary Results.

Water System(s)	Water Savings (gals/yr)	Average Water Savings (gpc/d)	Summer Water Savings (gpc/d)	Winter Water Savings (gpc/d)	Annual Costs	Cost Per 1,000 Gallons
Fargo	591,177,937	7.93	9.19	6.67	$325,914	$0.55
Grand Forks	252,445,152	8.25	9.12	7.38	$137,863	$0.55
West Fargo	80,920,230	6.54	7.19	5.89	$54,709	$0.68
Moorhead	130,211,953	8.07	8.70	7.44	$74,054	$0.57
Medium Size Municipal Water Systems (population 1,000 to 15,000)	149,443,656	9.02	9.57	8.47	$76,526	$0.51
Rural Water Systems including cities <1,000 in population	202,701,688	8.80	9.45	8.15	$110,796	$0.55
Totals	1,406,900,616	NA	NA	NA	$779,863	NA

Table 15 shows the water conservation measure results for each water system or group of water systems as a percent of water savings. The percent savings ranges from 6.1 to 8.6 percent. The WCPA resulted in lower percentages than might be expected because of the historic water use in the Red River Valley. In the United States the largest single residential water use is outdoor landscape irrigation. The national average use for outdoor landscape irrigation is approximately 100 gpc/d (AWWARF 1999) while such use in the Red River Valley ranges from 10 to 17 gpc/d. This demonstrates that Red River Valley residents are very conservative in their outdoor water use and eliminates an opportunity to save a significant amount of water through water conservation. Indoor water use savings also has limitations because most of the water is non-discretionary use. A water user has limited control over how many times the toilet is flushed or how often clothes are washed. The best potential for savings is in the improvement of water fixture efficiency.

The cost of water service also affects water consumption. It may be difficult to quantify, but higher prices lower water use. Given the Red River Valley higher than average water rates, this also has an effect on the potential for future water savings.

The relative differences between WCPA results for water systems are presented in Table A4 of Appendix A, which lists all water systems and all water conservation measure results. Each water system is unique, and therefore, has its own water conservation potential. Factors such as

age of housing, size of industrial water demand, and landscape watering demand affect water conservation potential.

Table 15 - WCPA Water Savings.

Water System	Estimated Average Daily Per Capita Water Demand (gpc/d)	WCPA Water Savings (gpc/d)	Percent Water Savings
Fargo	112.4	7.93	7.1%
Grand Forks	135.4	8.25	6.1%
West Fargo	91.2	6.54	7.2%
Moorhead	118.4	8.07	6.8%
Medium Size Water Systems (population 1,000 to 15,000)	110.0	9.02	8.2%
Rural and Small Water Systems (including cities <1,000 in population)	102.9	8.80	8.6%

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APPENDIX A

WATER CONSERVATION MEASURE POTENTIAL EVALUATION

Individual water systems or groups of water systems were evaluated to determine their water saving potential based on a list of possible water conservation measures. Each water conservation measure was evaluated based on its potential for implementation in specific cities or groups of water systems listed in Table A1.

Some basic assumptions related to population and service connections facilitated the analysis and are listed below in Table A1. The population data generated by Reclamation (2003) in the *Current and Future Population Red River Valley Region 2000 through 2050 Final Report* were used for the analysis.

Table A1 – Water System Assumptions.

Water System	Service Population[1] (2050)	Number of Service Connections[2] (2050)	Persons per Household [3] (2000 Census)
Fargo	204,300	89,214	2.29
Grand Forks	83,800	34,628	2.42
West Fargo	33,900	14,803	2.29
Moorhead [4]	44,200	17,470	2.53
Medium Size Water Systems (population 1,000 to 15,000)	45,400	20,359	2.23
Rural and Small Water Systems (including cities <1,000 in population)	63,100	32,030	1.97

[1] *Current and Future Population Red River Valley Region 2000 through 2050* (Reclamation 2003)
[2] Estimated based on 2050 Population Projections and Persons per Household Data
[3] U.S. Bureau of Census Demographic Profiles 2000
[4] Moorhead is annexing some rural townships and serving Dilworth in the future, but these populations were not included in the analysis.

Medium and small communities were divided into two separate groups to simplify water conservation measure analysis. Medium size communities included cities having a population between 1,000 and 15,000. Smaller size communities with populations less than 1,000 were included in the rural water system category. Table A2 lists communities included in each of the two categories. Communities with a population over 1,000 are grouped with the rural water systems. There are also a few water systems serving less than 1,000 people included in the medium size category because they probably will not be served by a rural water system in the future.

Table A2 – Cities Included in Medium and Rural/Small Categories.

Medium Size Water Systems (Population 1,000 to 15,000)			
Grafton	Larimore	Park River	Breckenridge
Hillsboro	Lisbon	Valley City	East Grand Forks
Langdon	Mayville	Wahpeton	
Rural and Small Water Systems (Population <1,000)			
Abercrombie	Edinburg	Horace	Osnabrock
Adams	Edmore	Hunter	Oxbow
Alsen	Egeland	Inkster	Page
Amenia	Elliot	Kathryn	Pekin
Aneta	Emerado	Kindred	Pembina
Ardoch	Enderlin	Lakota	Petersburg
Argusville	Fairdale	Lankin	Pillsbury
Arthur	Fairmount	Lawton	Pisek
Barney	Fingal	Lidgerwood	Portland
Bathgate	Finley	Litchville	Reynolds
Binford	Forest River Colony	Luverne	Rutland
Brocket	Forman	Mantador	Saint Thomas
Buffalo	Galesburg	Manvel	Sanborn
Buxton	Gardar	Mapleton	Sarles
Calio	Gardner	Marion	Sharon
Calvin	Gilby	McVille	Sheldon
Casselton	Glasston	Michigan	Sibley
Cavalier	Grand Forks AFB	Milnor	Thompson
Cavalier AF Station	Grandin	Milton	Tolna
Cayuga	Great Bend	Minto	Tower City
Cogswell	Gwinner	Mooreton	Verona
Colfax	Hamilton	Mountain	Walcott
Cooperstown	Hampden	Munich	Wales
Conway	Hankinson	Neche	Wallalla
Crystal	Hannaford	Nekoma	Wimbledon
Davenport	Harwood	Niagara	Wyndmere
Dazey	Hatton	Nome	
Drayton	Hoople	Northwood	
Dwight	Hope	Oriska	

Water Conservation Measure Analysis References and Assumptions

The analysis of each potential water conservation measure was based on published results of studies by water organizations, government agencies, and academic institutions. Listed in Exhibit 1 are each of the water conservation measures evaluated in the WCPA and the references and assumptions used in the analysis.

Water Conservation Potential Assessment Results

Table A3 summarizes results for each of the water systems or groups of water systems evaluated. Table A4, tabulates the detailed WCPA results. Project-wide, approximately 1.4 billion gallons (4,318 acre-feet) per year can be saved for approximately $780,000 per year. On a per capita basis, the water savings ranged from 6.54 gpc/d to 9.02 gpc/d. The cost of implementing the water conservation measures ranged from $0.51 to $0.68 per 1000 gallons saved, which is less than the estimated cost of a replacement water supply at $1.25 per 1000 gallons. Establishing a cost of $1.25 per 1000 gallons as the replacement water supply cost is explained in the WCPA report. The overall composite water conservation measure cost rate was $0.55 per 1000 gallons.

Table A3 – WCPA Summary Results.

Water System(s)	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 Gals
Fargo	591,177,937	7.93	$325,914	$0.55
Grand Forks	252,445,152	8.25	$137,863	$0.55
West Fargo	80,920,230	6.54	$54,709	$0.68
Moorhead	130,211,953	8.07	$74,054	$0.57
Medium Size Water Systems (population 1,000 to 15,000)	149,443,656	9.02	$76,526	$0.51
Rural and Small Water Systems (including cities <1,000 in population)	202,701,688	8.80	$110,796	$0.55
Totals	1,406,900,616	NA	$779,863	NA

Exhibits 1 Through 10

Exhibit 1 documents water conservation measure references and analysis assumptions used in the WCPA. Exhibit 2 documents the Red River Valley water system water rate analysis. Exhibit 3 documents the historic water conservation in the Red River Valley. Exhibit 4 tabulates the inverted water rate structure water savings computations. An inverted rate structure would increase the unit cost of water for water use beyond that deemed to be non-discretionary. Exhibits 5 through 10 provide the WCPA computation sheets for each of the 6 communities or groups of water systems evaluated.

TABLE A4 - SUMMARY COMPUTATION SHEET WATER CONSERVATION POTENTIAL ASSESSMENT RED RIVER VALLEY WATER SUPPLY PROJECT.

	Fargo				Grand Forks				West Fargo				Moorhead				Medium Size Water Systems				Rural & Small Water Systems			
	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals	Water Savings (gals/yr)	Water Savings (gpc/d)	Annual Costs	Cost Per 1000 gals
Supply Management																								
1. Install Water Meters	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA
2. Audit Water Use, Detect Leaks and Repair Distribution System	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA	0	0.00	$0	NA
Demand Management																								
1. Program Administration and Public Education Programs	0	0.00	$357,525	NA	0	0.00	$146,650	NA	0	0.00	$59,325	NA	0	0.00	$77,350	NA	0	0.00	$79,450	NA	0	0.00	$110,425	NA
2. Promote Installation of 1.6 Gallon ULF Toilets	117,791,582	1.58	$64,653	$0.55	84,230,795	2.75	$45,523	$0.54	18,781,292	1.52	$12,366	$0.66	49,383,693	3.06	$27,544	$0.56	58,529,043	3.53	$29,412	0.50	120,913,650	5.25	$65,239	$0.54
3. Promote Installation of Low-Flow Shower Heads	30,361,718	0.41	$16,665	$0.55	12,453,803	0.41	$6,731	$0.54	5,037,994	0.41	$3,317	$0.66	6,568,712	0.41	$3,664	$0.56	6,747,048	0.41	$3,391	0.50	9,377,506	0.41	$5,060	$0.54
4. Promote Installation of Faucet Aerators	34,898,526	0.47	$19,155	$0.55	14,314,716	0.47	$7,736	$0.54	5,790,798	0.47	$3,813	$0.66	7,550,244	0.47	$4,211	$0.56	7,755,228	0.47	$3,897	0.50	10,778,742	0.47	$5,816	$0.54
5. In-Home Low-Flow Water Fixtures Giveaway Program*	6,347,356	0.09	$8,582	$1.35	2,603,565	0.09	$3,386	$1.30	1,053,232	0.09	$1,539	$1.46	1,373,241	0.09	$1,764	$1.28	1,410,524	0.09	$1,872	1.33	1,960,441	0.09	$2,888	$1.47
6. Promote Installation of Water Efficient Dishwashers	9,000,979	0.12	$4,940	$0.55	3,901,623	0.13	$2,109	$0.54	1,493,554	0.12	$983	$0.66	2,151,437	0.13	$1,200	$0.56	1,947,810	0.12	$979	0.50	2,391,561	0.10	$1,290	$0.54
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program*	49,514,148	0.66	$536,971	$10.84	15,232,326	0.50	$206,107	$13.53	7,721,064	0.62	$89,675	$11.61	6,743,594	0.42	$103,592	$15.36	7,125,530	0.43	$119,916	16.83	0	0.00	$0	$0.00
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program*	4,332,488	0.06	$8,750	$2.02	1,066,263	0.03	$2,555	$2.40	405,356	0.03	$901	$2.22	354,039	0.02	$946	$2.67	124,697	0.01	$354	2.83	0	0.00	$0	$0.00
9. Efficient Landscape Irrigation Scheduling	30,946,343	0.42	$16,986	$0.55	7,616,163	0.25	$4,116	$0.54	2,895,399	0.23	$1,906	$0.66	2,528,848	0.16	$1,410	$0.56	890,691	0.05	$448	0.50	0	0.00	$0	$0.00
10. Industrial Water Use Efficiency Measures	25,144,835	0.34	$13,801	$0.55	0	0.00	$0	$0.00	0	0.00	$0	$0.00	0	0.00	$0	$0.00	5,468,430	0.33	$2,748	0.50	0	0.00	$0	$0.00
11. Commercial Water Use Efficiency Measures	37,717,253	0.51	$20,702	$0.55	18,636,659	0.61	$10,072	$0.54	5,078,084	0.41	$3,344	$0.66	8,595,662	0.53	$4,794	$0.56	8,202,645	0.50	$4,122	0.50	6,398,842	0.28	$3,452	$0.54
12. Institutional Water Use Efficiency Measures	52,804,154	0.71	$28,983	$0.55	18,636,659	0.61	$10,072	$0.54	5,078,084	0.41	$3,344	$0.66	8,595,662	0.53	$4,794	$0.56	8,202,645	0.50	$4,122	0.50	10,664,736	0.46	$5,754	$0.54
13. Conservation Pricing	62,265,533	0.84	$35,605	$0.57	18,811,005	0.62	$11,595	$0.62	5,196,870	0.42	$4,850	$0.93	7,582,510	0.47	$5,658	$0.75	8,285,500	0.50	$5,592	0.67	14,855,318	0.65	$9,444	$0.64
14. Promote Installation of Efficient Clothes Washers	190,247,015	2.55	$104,423	$0.55	73,843,729	2.41	$39,909	$0.54	31,568,154	2.55	$20,786	$0.66	37,255,184	2.31	$20,779	$0.56	43,414,615	2.62	$21,817	0.50	27,321,334	1.19	$14,741	$0.54
Totals	591,177,937	7.93	$325,914	$0.55	252,445,152	8.25	$137,863	$0.55	80,920,230	6.54	$54,709	$0.68	130,211,953	8.07	$74,054	$0.57	149,443,656	9.02	$76,526	0.51	202,701,688	8.80	$110,796	$0.55

*This water conservation measure is not included in the totals because it exceeded the $1.25/1000 gallon cost threshold in which it would be less costly to purchase alternate sources of water.

Exhibit 1
Water Conservation Measure References and Assumptions

Water Conservation Measure	References and Assumptions
Supply Management	
Install Water Meters	A nation-wide study in Canada (Sharratt 1996) concluded that homes with meters used 33% less water than their non-metered counterparts. However, the report did not state whether the reduction was related to the meter installation or to other water conservation factors. Vickers (2001:250) states that, "Meters provide indirect water savings; they provide information that can be used to assess water use and to identify opportunities to reduce unnecessary water demand, leaks and losses." **Assumption** - The cost of metering all remaining residents in the RRV will be included in water conservation, but no actual water savings will be estimated.
Audit Water Use, Detect Leaks and Repair Distribution System	Elimination of unaccounted-for water is a goal of every water utility. A commonly accepted level of unaccounted-for water loss is 15%, although higher or lower levels or goals may be appropriate under specific circumstances (Mays 2000). The water industry goal for unaccounted-for-water is 10% (EPA 2003). **Assumption** - A level of unaccounted-for water losses of 15% will be used for medium, rural, and small water systems and 10% will be used for Fargo, Grand Forks, West Fargo and Moorhead in the WCPA. Unaccounted-for water loss = (WTP production – customer meters)/WTP production. Given that a rural water system could have 50 times more installed distribution pipe per capita than a city, it seems reasonable to consider 15% as a reasonable goal. For example, Fargo serves about 200 residents for every mile of distribution pipeline while Southeast Water Users District serves 4 customers per mile of pipe.

Exhibit 1 (Cont.)
Water Conservation Measure References and Assumptions

Water Conservation Measure	References and Assumptions
Demand Management	
Public Administration and Public Education Programs	The budget for the Water Conservation Office in Melbourne, Florida, is $86,000 for 2003. The budget includes salary for one employee, public relations, postage, printing, and other expenses for operating the office. With a current population of approximately 71,300 the cost per person for the Water Conservation Program is $1.20 (Wilster, personal communication 2003). The total budget for 2003 is approximately $2 million with $1.2 million used for rebate programs. The remaining $0.8 million is used for salaries, public relations, supplies, and other expenses for operating the office. With a current population of approximately 449,000, the cost per person for the Water Conservation Program is $1.78 (Yuhaus, personal communication 2003). The water conservation plan would cost about $25 million over the first ten years (Houston 2003). **Assumption** - The annual cost of conducting a water conservation program will be estimated for each water system, but no water savings will be attributed to the activity based on the above reference. Assuming the annual cost of a coordinator or water conservation program staff at $1.75 per person served; costs for mailings, public education, and public relations are included at $1.75 per person served; and costs for starting a water conservation program are higher in the beginning, the RRV would need more than one employee for a water conservation program.
Promote Installation of 1.6 Gallon ULF Toilets	The *Residential End Uses of Water* (American Water Works Association Research Foundation 1999) conducted an extensive study on residential water use in 12 different North American cities totaling 1,188 individual homes. The greatest water use typically in a home is toilet usage estimated at 26.7%. The report collected toilet installation rate data and estimated various types of toilet performance. The data will be used to estimate the water saving potential if additional 1.6 gallon ULF toilets are installed. The net potential water saving when comparing "ULF only" homes to the "non-ULF" homes is 10.5 gpc/d (AWWARF 1999:xxviii). Gravity-flush toilets have a typical life span of 25 to 50 years; however, replacement at 15 to 20 years is very common in households (Vickers 2001). The City of Santa Monica has had an aggressive water conservation program since the late 1980s that included an Ultra Low-Flush toilet rebate program. After over 10 years of offering the ULF toilet rebates, they achieved a 68% saturation rate in single-family homes and 94% in multi-family homes (City of Santa Monica 2002). **Assumption** - The WCPA assumes an overall ULF toilet installation (saturation) rate of 90% in the study area through the planning period of 2050. The saturation rate is not 100% because there are always households for aesthetic or economic reasons that will not replace their current toilet(s). WCPA assumes a useful life of 25 years for toilets. The replacement rate of toilets in homes constructed before 1994 = 8 yrs / 25 yrs = 0.24 or 32%.

Exhibit 1 (Cont.)
Water Conservation Measure References and Assumptions

Promote Installation of Low-Flow Shower Heads	Shower and bath water use is generally the third greatest water use in a home at 16.8% or 11.6 gpc/d. The report estimated homes which have low-flow shower heads use 9% less water than homes that have not been completely retrofitted. The report also noted that in a customer survey, 50.6% of the respondents indicated that they had installed a low-flow showerhead (AWWARF 1999). The City of Santa Monica (2002) has had an aggressive water conservation program since the late 1980s including a give-away low-flow shower head program. After over 10 years of offering free shower heads, they achieved a 82.4% saturation rate in single-family units and 94.3% in multi-family units. **Assumption** - The WCPA assumes a current low-flow showerhead installation rate of 51% based on AWWARF (1999). A combined saturation rate of 90% will be assumed in the WCPA.
Promote Installation of Faucet Aerators	Faucet usage is generally the fourth largest water use in a home at 15.7% or 10.9 gpc/d. No rate of faucet aerator installation could be found in the literature search, but there is a high correlation between aerator installation and low-flow showerhead installation, so 50.6% will be used for the current faucet aerator installation rate (AWWARF 1999). The City of Santa Monica (2002) has had an aggressive water conservation program since the late 1980s. After over 10 years of promoting water conserving plumbing fixtures, they have achieved a 30.7% saturation rate in single-family units and 19.1% in multi-family units. A recent water use study conducted by the City of Seattle (2001) determined that 1.2 gpc/d could be saved if low-flow faucet aerators were installed. **Assumption** - The WCPA assumes an increase in low-flow faucet aerator installation similar to the shower head rate estimated above. Each housing unit where faucet aerators are installed will result in a 1.2 gpc/d water savings.
In-Home Low-Flow Water Fixtures Giveaway Program	A plumbing fixture retrofit giveaway program generally includes a toilet displacement device, low-volume showerhead, and faucet aerators (Vickers 2001). "Installation strategies for large-scale fixture rebate programs. If a mass-mailing is used… A study in Bridgeport, Connecticut determined that 61% of the customers ordered a free kit and that 38% of the total customers actually installed at least one of the devices" (Vickers 2001:66). **Assumption** - The WCPA assumes that a low-flow plumbing fixture giveaway program will be focused on the 10% of households who will not be naturally up-grading their shower heads and faucets by 2050. Kits will be targeted to elderly and low-income households, and water savings will be based on a 38% installation rate. Kits and associated distribution costs will be estimated at $10 per kit. Water savings will be based on shower head and faucet aerator installation at 1.04 and 1.2 gpc/d, respectively. Water savings for each kit is 2.24 gpc/d. The kits have a useful life of 20 years, so the program will be repeated once to cover through 2050.

Exhibit 1 (Cont.)
Water Conservation Measure References and Assumptions

Promote Installation of Water Efficient Dishwashers	Approximately 75% of the homes surveyed had dishwashers (AWWARF 1999:73). The Santa Monica (2002) study indicated that only 1% of the dishwashers installed were rated as water efficient (i.e., used 4.5 to 7 gallons per load). Water efficient dishwashers are classified as using 4.5 to 7 gallons per load and have been available since 1995. The 7 gallons per load models are the most commonly installed. Prior to 1995, typical dishwashers used from 7 to 14 gallons per load. Dishwasher water use represents only 1.4% of typical household indoor water use, or about 1.0 gpc/d. Household dishwasher use is 0.10 loads per capita per day (Vickers 2001:126-128). Approximately 50.2% of U.S, households have a dishwasher. Typical life-span of a dishwasher is 13 years (Vickers 2001:126). **Assumption** - The WCPA will not evaluate a dishwasher rebate program because typically water savings are relatively small. However, it is reasonable to assume that additional water efficient dishwashers will be installed as fixtures are replaced. The WCPA assumes that all dishwashers installed since 1995 use 7 gallons per load and represent 8/13 or approximately 60% of the currently installed dishwashers. A saturation rate of 90% is assumed in the WCPA. Water savings per load will be ((7 + 14)/2 – 7) = 3.5 gallons per load Dishwasher loads per day per capita = 0.10
Install Low-Water-Use Turf and Plants in Landscaping – Xeriscaping Rebate Program	Reclamation has assisted in funding a Xeriscape Program in Fargo since 1996. The program includes $1,200, professional design assistance and, discounts on materials and education programs for a total cash value of approximately $2,000 per yard (Medina, personal communication 2003). **Assumption**s - WCPA assumes: • 10% xeriscaping participation rate • 20% outdoor water savings, and • Rebate cost of $2,000 per yard rebate program to encourage xeriscaping. Note: The number of housing units does not equate to the number of yards or landscaped areas in a city because multi-family units may have over 20 units in a building but one landscaped area. To simplify water savings estimates, the total number of single and multi-family units were used in estimating the number of yards implemented in this measure.

Exhibit 1 (Cont.)
Water Conservation Measure References and Assumptions

Install Water Efficient Landscape Irrigation Systems – ET Controller Rebate Program	Five to ten percent reduction in landscape irrigation water use with use of moisture probes/sensor and ET irrigation controller in irrigation systems can be achieved (Vickers 2001:200). Approximately 18% of homes in Fargo have landscape irrigation systems. That percentage is increasing, particularly with larger more expensive home construction (Al White, personal communication 2003). No similar data are available from Grand Forks or other cities in the RRV. ET Controllers were installed in 40 landscape irrigation systems for a period of a year to investigate the potential water savings of ET controllers. A 7% reduction in overall household water use was observed. These were the highest water users in a selected housing development, so the results may be lower with a larger sample size including all types of water use scenarios (Ash, et al. 2001). **Assumption** - The WCPA assumes that 10% of the landscape irrigation systems will install ET controllers under the rebate program. The percentage of homes with landscape irrigations systems is difficult to determine. Most cities do not track this statistic. The WCPA assumes that 25% of future Fargo homes will have irrigation systems. For Grand Forks 20% is assumed, 15% for West Fargo and Moorhead, and 10% for Medium Size Water Systems. The WCPA assumes that none of the homes in rural and small water systems will have landscape irrigation systems due to the cost of water. A 7% reduction in household water use is assumed. Note: The number of housing units does not equate to the number of yards or landscaped areas in a city because multi-family units may have over 20 units in a building but one landscaped area. To simplify water savings estimates, the total number of single and multi-family units were used in estimating the number of yards implementing this measure.
Efficient Landscape Irrigation Scheduling	Ten to fifteen percent reduction in landscape irrigation water use with improved irrigation scheduling can be achieved (Vickers 2001:200). **Assumption** - This measure will have 10% water savings on all homes with lawn irrigation, and 50% of housing units with lawn irrigation systems will participate. Note: The number of housing units does not equate to the number of yards or landscaped areas in a city because multi-family units may have over 20 units in a building but one landscaped area. To simplify water savings estimates, the total numbers of single and multi-family units were used in estimating the number of yards implementing this measure.
Industrial Water Use Efficiency Measures	Water users classified as industrial customers are typically involved in small- or large-scale product manufacturing and processing activities (Vickers 2001:232). Typical water conservation measures in the industrial sector are site-specific engineering modifications to water-using equipment (Vickers 2001:238). Ploser Heller (et al. 1992:65) cites no specific potential water savings for industrial water users, but a range of 10% to 90% was noted. Some industrial users will make no improvements meaning others need to save 30% to compensate. Market penetration rates are 50 to 70% (Maddaus 2003). **Assumption** - The WCPA assumes a 10% water savings potential for the industrial facilities served by municipal systems and a 60% penetration rate.

Exhibit 1 (Cont.)
Water Conservation Measure References and Assumptions

Commercial Water Use Efficiency Measures	Water users classified as commercial or business customers typically provide or distribute a retail service or product (Vickers 2001:234). Typical water conservation measures in the commercial sector are related to plumbing fixture replacement or retrofit (Vickers 2001:238). Potential water savings for commercial water use are typically in the 15% to 35% range. In general, water conservation programs that have been implemented are rarely well documented and evaluated. Many available documents lack direct information for generalizing water savings (Dziegielewski 2000:xxvi). Some accounts will make no improvements meaning others need to save 30% to compensate. Market penetration rates are 50 to 70% (Maddaus 2003). **Assumption** - The WCPA assumes a 15% water savings potential and a 60% penetration rate for the commercial sector because of the limited documented studies.
Institutional Water Use Efficiency Measures	Water users classified as institutional customers, including governmental and public facilities typically include government buildings, hospitals, schools, prisons, and churches (Vickers 2001:234). Typical water conservation measures in the institutional sector are related to plumbing fixture replacement or retrofit (Vickers 2001:238). Potential water savings are typically in the 15% to 35% range. In general, water conservation programs that have been implemented are rarely well documented and evaluated. Many available documents lack direct information for generalizing water savings (Dziegielewski 2000:xxi). Some institutional accounts will make no improvements meaning others need to save 30% to compensate. Market penetration rates are 50 to 70% (Maddaus 2003). **Assumption** - The WCPA assumes a 15% water savings potential and a 60% penetration rate for the institutional sector because of the limited documented studies.
Conservation Pricing	The most likely range for elasticity of residential water demand is -.20 to -.40, meaning a 10% increase in price lowers demand by 2 to 4% (Stallworth 2000:13). Indoor water use is 69.3 gpc/d (AWWARF 1999). **Assumption** - Assumes a 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase. Assumes average indoor water use is 70%.
Promote Installation of Efficient Clothes Washers	Clothes washers manufactured after 2004 will be required to meet a modified energy factor (MEF) of 1.04 (20% more efficient than the current standard). This level will remain in effect until 2007, at which time an MEF of 1.26 (35% higher than the current standard) will be required (U.S. Water News Online 2003). Water savings per load are 6.8 gallons for a washer with an MEF of 1.26 (Consortium for Energy Efficiency Residential Clothes Washer Initiative Program Description 2003). Currently 23% of clothes washers sold nationwide are water efficient (Smith, personal communication 2003). **Assumption** - The WCPA assumes a 90% saturation rate due to increase in clothes washer efficiency measures from the Department of Energy. Water savings will be based on an average water savings of 6.9 gallons per cycle at 392 cycles per year per household. Nationwide water efficient clothes washers sales are 23% of the total sales. The WCPA also assumes a current saturation rate of 10% for the RRV.

Exhibit 2
Red River Valley Water Rate Analysis
Red River Valley Water Supply Project

Introduction

The cost of water service is one of the most important factors when evaluating water use patterns. One of the basic principles of economics is that the cost of a product influences its consumption. Exhibit 2 compares the cost of water service in the Red River Valley to other locations and addresses how the cost of water service influences water use. Water is also a necessity of life; some basic level of consumption is required at any cost. However, there are many discretionary uses of water like irrigating your lawn. The decision to irrigate may be determined by economic factors (i.e. how much water costs, how much can you afford, and how discretionary the water use is).

Water rates in the Red River Valley were analyzed and compared to national and regional water rates. The analysis also evaluated water affordability, which is the percent of annual median household income used to purchase water service. The Red River Valley water system affordability results were compared to national and regional water systems. These water rate and affordability comparisons provide some context into historic water use in the Red River Valley and the potential or effectiveness of water conservation. If water users are already water use conscious because of high water rates, then the potential of identifying significant water savings may be limited.

Red River Valley Water System Rate Analysis

Table 1 displays average monthly water charges for national, selected regional, and Red River Valley water systems. The water rate and median household income data were obtained from the *2002 Water and Wastewater Rate Survey* by Raftelis Financial Consulting (2002), except for the Red River Valley rural water systems which were obtained from the North Dakota Rural Water Association. Typical monthly household water usage was estimated at 6,000 gallons for comparison purposes in Table 1.

Raftelis Financial Consulting (2002) collected and analyzed rate data from selected cites in the United States. The cities were divided into three groups based on population. Some Canadian cities were also collected as a separate group. Group A included cities having a service population of 500,000 to 5,000,000. Group B represented cities serving 150,000 to 500,000 with Group C serving populations from 15,000 to 150,000. Group C is of particular interest because it most closely resembles the size of cities in the Red River Valley such as Fargo and Grand Forks.

Table 1 shows the average monthly water costs and affordability index for various groups or individual water systems in the United States and Canada. Referring to the column labeled 6,000 gallons, the highest water costs are in the Red River Valley as compared to national averages, groups of cities by population, or selected regional cities.

Table 1 - Average Monthly Water Costs and Affordability Index
2002 Water and Wastewater Rate Survey.

	Water Costs @ Various Use Rates Per Month					Median Household Income	Affordability Index [2] (water cost/income)
	0 cf or 0 gal	500 cf or 3,740 gal	1,000 cf or 7,480 gal	1,500 cf or 11,220 gal	6,000 gal		
Nation-wide Survey [1]							
All Systems	$5.61	$10.83	$17.71	$25.05	$14.99	$41,787	0.43%
Group A - Service population 500,000 - 5,000,000	$4.68	$9.70	$15.76	$22.14	$13.36	$44,324	0.36%
Group B - Service population 150,000 - 500,000	$4.86	$9.48	$15.53	$22.15	$13.14	$42,302	0.37%
Group C - Service population 15,000 - 150,000	$6.41	$12.06	$19.77	$27.92	$16.72	$40,067	0.50%
Red River Valley							
Fargo	$6.60	$12.34	$24.68	$37.03	$19.80	$36,584	0.65%
Grand Forks	$4.39	$13.81	$23.24	$32.66	$19.51	$36,253	0.65%
Rural Water Systems - Eastern North Dakota (average) [3]	NA	NA	NA	NA	$50.75	$34,606	1.76%
Other Regional Cities							
Bismarck	$3.50	$11.00	$18.50	$26.00	$15.53	$39,090	0.48%
Billings, MT	$4.96	$10.21	$15.46	$20.71	$13.38	$36,549	0.44%
Duluth, MN	$2.50	$9.95	$17.40	$24.85	$14.45	$33,345	0.52%
St. Paul, MN	$1.50	$7.50	$15.00	$21.00	$12.03	$37,809	0.38%
Winnipeg, MB	$2.52	$11.11	$19.71	$28.30	$16.31	$34,257	0.57%

[1] Data from Raftelis Financial Consulting (2002).
[2] Based on 6,000 gallons per month water usage.
[3] Red River Valley rural water system data - average of 13 eastern ND rural water systems.

Figure 1 shows a bar chart comparing the monthly water service costs for various individual and groups of cities using 6,000 gallons per month as a basis of comparison. The national average monthly water cost is $14.99. Group A (population 500,000 to 5,000,000) and Group B (population 150,000 to 500,000) are relatively equal in cost at $13.36 and $13.14 per month, respectively. Group C (pop. 15,000 to 150,000) at a monthly cost of $16.72 is higher than Group A and B and the national average, which is to be expected because of economics of scale. The regional cities of Bismarck, Billings, Duluth, St. Paul, and Winnipeg have monthly water service costs ranging from $12.03 to $16.31, which is similar to the group and to national averages.

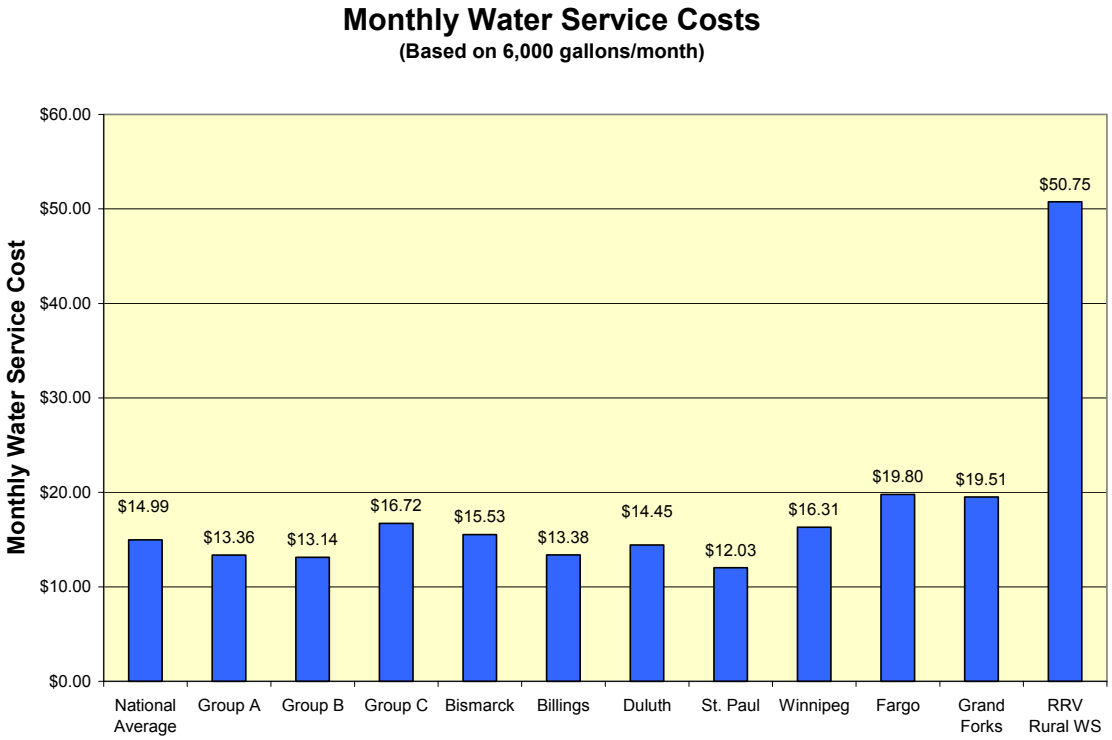

Figure 1 – Monthly Water Service Costs

Fargo has a monthly water cost of $19.80, which is 32% higher than the national average or 18% higher than Group C. Group C includes cities similar to Fargo in service population, which may be a more appropriate cost comparison. Grand Forks has a monthly water cost of $19.51, which is 30% higher than the national average or 17% higher than Group C.

Raftelis Financial Consulting (2002) did not include water cost data on rural water systems in the Red River Valley. A separate analysis was conducted and an average monthly water service cost of $50.75 was estimated for 6,000 gallons per month. Based on this analysis, a typical rural water customer pays 239% more for water service as compared to the national average.

The last column of Table 1 shows the relative cost of water service based on an affordability index. An affordability index is the ratio of annual water service cost and annual median household income expressed as a percentage, as seen in the equation below. Figure 2 provides the same results graphically.

$$\text{Affordability Index} = \frac{\text{Monthly Water Service Cost} \times 12}{\text{Annual Median Household Income}} \times 100$$

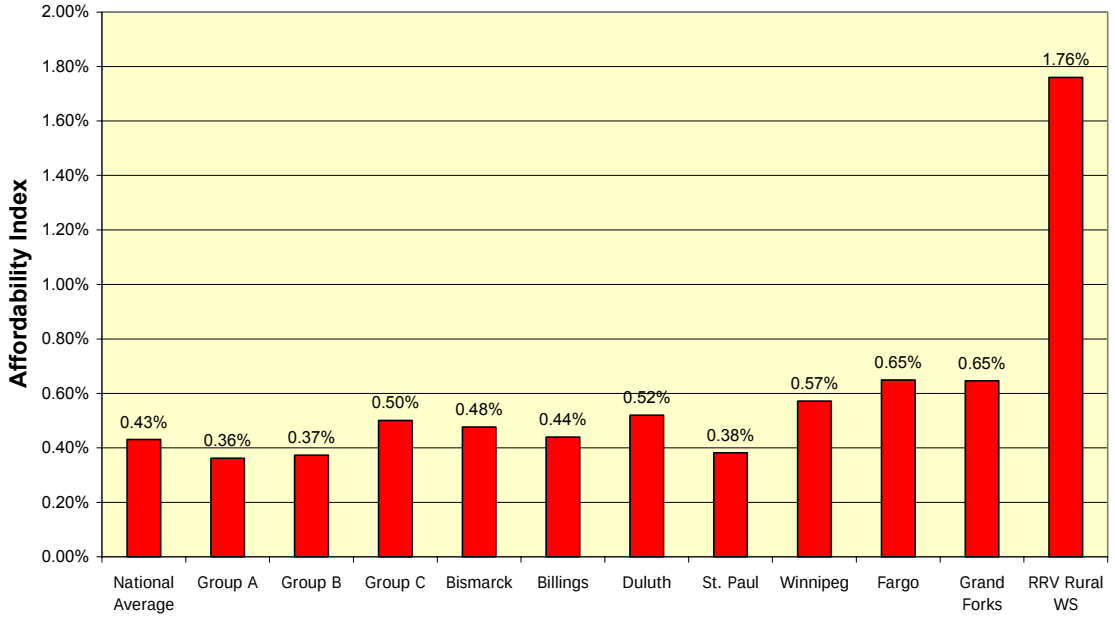

Figure 2 – Affordability Index
(Water Cost as a % of Median Household Income.)

The advantage of an affordability index as compared to water service costs is that it takes into account the effect of income. The index shows what percentage of a typical household's pre-tax annual income is spent on water service. The higher the index, the higher the percentage of household income dedicated to purchasing water.

Figure 2 shows the national average affordability index is 0.51% for water service. The index is lower for larger cities (Groups A and B) and higher for Group C. This is to be expected because generally larger cities have higher median incomes, which drive the affordability index down. The regional cities (Bismarck, Billings, Duluth, St. Paul and Winnipeg) have indexes ranging from 0.38% to 0.57%.

Fargo and Grand Forks have affordability indexes of 0.65%, which is 51% higher than the national average or 30% higher than Group C. Again, Group C includes cities similar to Fargo and Grand Forks in service population. It should be noted that Fargo has 32% higher monthly water cost, but a 51% higher affordability index, compared to national averages. That is because Fargo has a lower annual median household income at $36,584 as compared to the national average at $41,787.

Rural water systems in the Red River Valley have an affordability index of 1.76% or 309% higher than the national average. In comparison, the affordability index in Winnipeg, Manitoba, is 0.57%, St. Paul, Minnesota, is 0.38%, Bismarck, North Dakota, is 0.48%, or the United States average is 0.43%. This means that rural water system customers typically have to pay up to 4 times more of their yearly wages on water service as compared to other locations or to the national average. Study results show that rural water system customers have the worst possible water purchasing scenario. They pay some of the highest water service costs and have the least income. Therefore, as a group, they pay some of the highest effective water rates in the country. Another illustration of this is if the city of Bismarck had an affordability index of 1.76%, the average water bill would be $57 per month as compared to the $15.53 users pay currently.

Conclusions

The objective of this analysis was to determine how water rates in the Red River Valley compare to national and regional water rates. The results clearly demonstrate that water systems in the Red River Valley charge higher rates than their national or regional counterparts, particularly the rural water systems. Residents of the Red River Valley pay some of the highest water rates in the nation and rank in the lower 20 percent in annual median household income (North Dakota is ranked 42nd in the nation in annual median household income). Increasing costs even further could create an environmental justice issue by making drinking water too expensive for many rural residents of the Red River Valley.

Most residents in the Red River Valley are conservative in their water use due to the cost of water. The cost of water service is one of the main factors affecting water consumption. When interpreting the results of the WCPA, it is important to note the effects higher than average water rates have on potential water conservation measures. Historic water use is conservative, therefore the potential savings from an inverted rate structure water conservation measure is limited.

Exhibit 3
Historic Water Conservation in the Red River Valley
Red River Valley Water Supply Project

Introduction

When developing a water conservation potential assessment (WCPA) and interpreting the results, it is important to understand the historic water use of the respective water systems. This includes identifying water conservation savings that have already taken place so the WCPA results are interpreted in context. Whether recognized or not, water systems receive the benefits of a water conservation program if they are responsibly operating and maintaining their water system facilities. The federal government set standards for water efficient plumbing fixtures a decade ago which resulted in quantifiable water savings. Some water systems have also implemented specific water-related ordnances that affected water use. This section of the WCPA estimates the results of those water conservation efforts in the Red River Valley to date.

During the development of the WCPA many differences in the way Red River Valley residents use their water in comparison to water users in the rest of the United States became apparent. Water users in the Red River Valley use significantly less water for outdoor purposes as compared to other parts of the country. This is important because outdoor landscape irrigation is typically the largest single water savings measure available in a WCPA. Xeriscaping has had limited success in Fargo after 4 years of a trial program sponsored by Reclamation. This is generally due to adequate precipitation associated with a sub-humid local climate and the favorable moisture holding conditions of clay soils in the Red River Valley.

Industrial water use generally has some water savings potential, but that is not necessarily true in the Red River Valley. Cites such as Grand Forks and Moorhead which have higher than average industrial water demands have worked closely with their industrial customers to conserve water which limits new opportunities to reduce water use. Water purchased from community water systems for industrial purposes is a significant cost of production and industrial water users already have strong financial incentives to conserve water in their facilities.

Historic Water Conservation in the Red River Valley

While there are few comprehensive water system conservation programs in the Red River Valley, water systems have implemented specific water conservation measures as part of responsible water system operations. In the last 15 years the cities of Fargo and Grand Forks have made significant improvements in unaccounted for water loss reduction, as shown in Table 3-1, by repairing leaks and replacing old water distribution system pipes. The city of Moorhead has historically had water loss consistently less than 10% over the last 15 years. No water loss data were available for the city of West Fargo to draw any conclusions, but they have one of the lowest historic per capita water use in the Red River Valley, which indicates responsible water management and use.

Table 3-1 –Water Conservation Measure Water Savings Prior to 2002.

Measure:	Audit Water Use, Detect Leaks and Repair Distribution System (gpc/d)	Promote Installation of 1.6 Gallon Low-Flush Toilets (gpc/d)	Promote Installation of Low-Flow Shower Heads (gpc/d)	Promote Installation of Faucet Aerators (gpc/d)	Promote Installation of Water Efficient Dishwashers (gpc/d)	Promote Installation of Efficient Clothes Washers (gpc/d)	Total Water Savings (gpc/d)
MR&I Water System:							
Fargo	32.2	3.36	0.53	0.61	0.24	0.32	37.31
Grand Forks	4.6	3.36	0.53	0.61	0.26	0.3	9.62
West Fargo	NA[1]	3.36	0.53	0.61	0.24	0.32	5.06
Moorhead	0.0[2]	3.36	0.53	0.61	0.27	0.27	5.04
Medium Size Water Systems	NA[3]	3.36	0.53	0.61	0.24	0.33	5.07
Rural and Small Water Systems	NA[3]	3.6	0.53	0.61	0.21	0.37	5.32

[1]West Fargo did not provide information on unaccounted for losses.
[2] Unaccounted for losses from 1987-2001 remained relatively similar resulting in no water savings.
[3] Limited water loss data was available from Medium, Rural, and Small water systems so no analysis was conducted.

Estimating unaccounted for water loss savings for medium (population 1,000 to 15,000) and rural/small (population under 1,000) water systems was difficult due to incomplete data. The medium size cities of Breckenridge and Valley City showed a decrease in system water loss over the last few years. Overall it appears that water systems in the Red River Valley have made good progress in reducing unaccounted for water losses.

Water users in the Red River Valley have saved water through other conservation measures as depicted in Table 3-1. The table summarizes the estimated water savings in gallons per capita per day for the Red River Valley prior to 2002. Column 2 shows the water savings for leak detection and repair or distribution pipeline replacement programs. Column 3 – 7 depict the estimated water savings resulting from installation of water efficient plumbing fixtures and appliances. The water savings prior to 2002 have been significant. Most of these water savings may have happened unconsciously due to plumbing and appliance codes, but they saved water just the same.

Another factor which has already affected present water use is the increased cost of water service in the Red River Valley. Exhibit 2 provides some comparative costs of water service with in and outside the Red River Valley. Some cities including Fargo have had to more than double their water rates in the last 15 years to fund required capital improvements to their water systems. This and other water rate increases discourages water use, but no actual water savings were estimated due to lack of data and complexity of analysis.

The water savings calculated in the WCPA range from 6.54 gpc/d to 9.02 gpc/d. When water savings in Table 3-1 are added to those estimated in the WCPA, the range of water savings is 11.6 gpc/d to 45.24 gpc/d as shown in Table 3-2. Expressed as a percentage, water savings prior to 2002 ranges from 4.3% to 33.2% when compared to the estimated average daily per capita water demand. The total water savings ranges from 11.1% to 40.2%.

Table 3-1 does not include all water savings prior to 2002 due to lack of data, but these unquantified savings could be significant. These additional water savings include (1) influence of water use due to higher water rates, (2) industrial, commercial or institution water savings, (3) mandatory water metering for all service connections, and (4) alternate-day landscape watering in some major cities in the valley.

Table 3-2 – Combined Water Savings – WCPA and Savings Prior to 2002.

MR&I Water System	Estimated Average Daily Per Capita Water Demand (gpc/d)	Water Savings Prior to 2002 (gpc/d)	Water Savings Prior to 2002 (%)	WCPA Water Savings (gpc/d)	Total Water Savings (gpc/d)	Total Percent Water Savings
Fargo	112.4	37.31	33.2%	7.93	45.24	40.2%
Grand Forks	135.4	9.62	7.1%	8.25	17.87	13.2%
West Fargo	91.2	5.06	5.5%	6.54	11.6	12.7%
Moorhead	118.4	5.04	4.3%	8.07	13.11	11.1%
Medium Size Water Systems	110.0	5.07	4.6%	9.02	14.09	12.8%
Rural and Small Water Systems	102.9	5.32	5.2%	8.8	14.12	13.7%

Conclusion

Table 3-1 results demonstrate that significant progress on water conservation has been made in the Red River Valley in the last 10 to 15 years. This is due to the direct actions of the water systems in terms of repairing pipe leaks, pipe replacements, and overall management of their water systems. There are also regulatory requirements which have resulted in installation of water efficient plumbing fixtures which have saved considerable amounts of water. The analysis presented in this exhibit documents water savings prior to this WCPA. This is the foundation that the WCPA builds upon to identify reasonable water conservation measures to pursue through 2050.

Exhibit 4
Water Savings from Conversion to Inverted Water Rate Structure

Fargo

Current Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 - 2,000 (minimum)	$6.60
2,001 - 200,000	$3.30
200,001 - 2,000,000	$3.05
2,000,001 and >	$2.70

Inverted Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 - 2,000 (minimum)	$6.60
2,001 - 7,000	$3.30
7,001 and >	$4.13

Number of households in 2050	89,214
Persons per household	2.29
Average annual water use (gpc/d)	112.4
Average non-discretionary per capita water use (gpc/d)	95.7
Average discretionary per capita water use (gpc/d)	16.7
Average monthly household water use (gallons)	6,575

Assumed rate increase for discretionary water use =	25%
Water Savings = 2% for every 10% in rate increase	
Water Savings on discretionary water use (gpc/d) =	0.84
Annual water savings on discretionary water use (gallons) =	62,266,000

Grand Forks

Current Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$4.39
0 - 30,000	$2.52
30,001 - 200,000	$2.32
200,001 - 3,000,000	$2.12
3,000,001 >	$1.93

Inverted Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$4.39
0 - 9,000	$2.52
9,001 and >	$3.15

Number of households in 2050	34,628
Persons per household	2.42
Average annual water use (gpc/d)	135.4
Average non-discretionary per capita water use (gpc/d)	123.1
Average discretionary per capita water use (gpc/d)	12.3
Average monthly household water use (gallons)	8,937

Assumed rate increase for discretionary water use =	25%
Water Savings = 2% for every 10% in rate increase	
Water Savings on discretionary water use (gpc/d) =	0.62
Annual water savings on discretionary water use (gallons) =	18,811,000

Exhibit 4 (Cont.)
Water Savings from Conversion to Inverted Water Rate Structure

West Fargo

Current Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 - 2000 (minimum)	$3.00
2,001 - 6,000	$1.50

Inverted Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 - 2,000 (minimum)	$3.00
2,001 - 6,000	$1.50
6,001 and >	$1.88

Number of households in 2050	14,803
Persons per household	2.29
Average annual water use (gpc/d)	91.2
Average non-discretionary per capita water use (gpc/d)	82.8
Average discretionary per capita water use (gpc/d)	8.4
Average monthly household water use (gallons)	5,688

Assumed rate increase for discretionary water use =	25%
Water Savings = 2% for every 10% in rate increase	
Water Savings on discretionary water use (gpc/d) =	0.42
Annual water savings on discretionary water use (gallons) =	5,197,000

Moorhead

Current Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$5.15
1 and >	$2.88

Inverted Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$5.15
0 - 9,000	$2.88
9,001 and >	$3.60

Number of households in 2050	17,470
Persons per household	2.53
Average annual water use (gpc/d)	118.5
Average non-discretionary per capita water use (gpc/d)	109.1
Average discretionary per capita water use (gpc/d)	9.4
Average monthly household water use (gallons)	8,281

Assumed rate increase for discretionary water use =	25%
Water Savings = 2% for every 10% in rate increase	
Water Savings on discretionary water use (gpc/d) =	0.47
Annual water savings on discretionary water use (gallons) =	7,582,000

Exhibit 4 (Cont.)
Water Savings from Conversion to Inverted Water Rate Structure

Medium Size Water Systems

Current Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 - 2000 (minimum)	$4.78
2,001 - 6,000	$2.40
6,001 - 25,000	$2.32
25,001 and >	$2.25

Inverted Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$4.78
0 - 6,000	$2.40
6,001 and >	$3.00

Number of households in 2050	20,359
Persons per household	2.23
Average annual water use (gpc/d)	110.0
Average non-discretionary per capita water use (gpc/d)	100.0
Average discretionary per capita water use (gpc/d)	10.0
Average monthly household water use (gallons)	6,690

Assumed rate increase for discretionary water use =	25%
Water Savings = 2% for every 10% in rate increase	
Water Savings on discretionary water use (gpc/d) =	0.50
Annual water savings on discretionary water use (gallons) =	8,286,000

Rural and Small Water Systems

Current Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$26.75
0 - 5,000	$4.00
5,001 - 10,000	$3.50
10,001 - 15,000	$3.00
15,001 - 20,000	$2.75
20,001 and >	$2.50

Inverted Rate Structure	
Monthly Water Use (gallons)	Cost per 1,000 gallons
0 (minimum)	$26.75
0 - 6,000	$4.00
6,001 and >	$5.00

Number of households in 2050	31,980
Persons per household	1.97
Average annual water use (gpc/d)	102.9
Average non-discretionary per capita water use (gpc/d)	90.0
Average discretionary per capita water use (gpc/d)	12.9
Average monthly household water use (gallons)	5,319

Assumed rate increase for discretionary water use =	25%
Water Savings = 2% for every 10% in rate increase	
Water Savings on discretionary water use (gpc/d) =	0.65
Annual water savings on discretionary water use (gallons) =	14,832,000

EXHIBIT 5
Water Conservation Potential Assessment
Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
Supply Management						
1. Install Water Meters	Fargo has a policy requiring service water meters so this measure has no estimated savings or costs.					
	Water Savings =			0	0	
	Measure Cost =					$0
2. Audit Water Use, Detect Leaks and Repair Distribution System	Fargo has an unaccounted-for water loss in recent years under 10%, for this measure no water savings will be estimated.					
	Water Savings =			0	0	
	Measure Cost =					$0
Demand Management						
1. Program Administration and Public Education Programs	Research has shown that public education programs alone do not result in any quantifiable water savings, but they are required to implement other water conservation measures. No water savings will be estimated for this measure, but cost will distributed to individual water conservation measures.					
	Water Savings =			0	0	
	Measure Cost =					
	Annual Measure Cost ($1.75 * 2050 Population) =					$357,525
2. Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. It is assumed that end-users will pay for the cost of toilet replacement. Single-family and multi-family units will have a combined 90% saturation rate.					
	Water Savings =					
	ULF Toilet saturation rate =	90.0%				
	Number of housing units in Fargo (2000) =	39,268	housing units			
	Number of housing units in Fargo (2050) =	89,214	housing units			
	Number of housing units built after 1994 w/ ULF Toilets =	56,357	housing units			
	Number of housing units built before 1994 =	32,857	housing units			
	Number of housing units built before 1994 w/ ULF Toilets =	10,514	housing units			
	Number of housing units w/ ULF Toilets =	66,871	housing units			
	Number of housing units w/out ULF Toilets =	22,343	housing units			
	Saturation rate of ULF Toilets (# dwellings * 90%) =	80,293	housing units			
	Number of housing units that will install ULF Toilets =	13,421	housing units			
	Water savings (# of housing units replacing toilets * 10.5 * 2.29 * 365 days) =			117,791,582		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				1.58	
	Measure Cost =					
	Public Education and Program Administratio =					$64,653
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
3. Promote Installation of Low-Flow Shower Heads	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assume the end-user will pay for the cost of replacing low-flow shower heads. Single-family and multi-family housing units w have an assumed low-flow shower head installation saturation rate of 90%.					
	Water Savings =					
	Low-Flow Shower Head installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow shower heads (90% - 51%) =	39.0%				
	Per capita water savings per low-flow shower head installatio (11.6 gpc/d * 9%) =	1.04	gpc/d			
	Water savings (39% * # households * 1.04 * 2.29 * 365 days) =			30,361,718		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio =					$16,665
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			

EXHIBIT 5
Water Conservation Potential Assessment
Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
4. Promote Installation of Faucet Aerators	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assume the end-user will pay for the cost of replacing faucet aerators. The increased percentage of faucet aerator installation in single-family and multi-family units will be assumed to be the same as for low-flow shower heads.					
	Water Savings =					
	Faucet Aerator installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow faucet aerator (90% - 51%) =	39.0%				
	Water savings (39.0% * # households * 1.2 * 2.29 * 365 days) =			34,898,526		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratio =					$19,155
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
5. In-Home Low-Flow Water Fixtures Giveaway Program	The WCPA will assume a low-flow plumbing fixture giveaway program that targets the 10% of housing units occupied by low-income and elderly residents.					
	Water Savings =					
	Number of housing units targeted in giveaway progran (# households * 10%) =	8,921	housing units			
	# of housing units actually installing devices (38%) =	3,390	housing units			
	Annual water savings (# of housing units * 2.24 gpc/d * 2.29 * 365 days) =			6,347,356		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.09	
	Measure Cost =					
	Annual measure cost (# of housing units / 35 * 2 * $10 per kit) =					$5,098
	Public Education and Program Administratio =					$3,484
	Measure cost per 1000 gallons =	$1.35	$/1000 gals			
6. Promote Installation of Water Efficient Dishwashers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assume a future saturation rate of 90% and currently 60% of installed dishwashers are the water-saving 7 gpl model.					
	Water Savings =					
	Water savings per capita per dish washer replacemen (3.5 gpl * 0.1 * 2.29 persons per unit) =	0.80	gpc/d			
	Percentage of dish washers replaced [(90% - 60%) * 50.2%] =	15.1%				
	Number of dish washers replaced (# dwellings * 15.1%) =	13,436	housing units			
	Annual water savings (# dish washers replaced * 0.8 gpc/d * 2.29 * 365 days) =			9,000,979		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.12	
	Measure Cost =					
	Public Education and Program Administratio =					$4,940
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program	A xeriscaping rebate program will be implemented to encourage use of low-water-use turfs and plants in landscaping. A 10% saturation rate will be assumed for the program with a 20% water savings per yard. The cost of the rebate program is $2,000 per yard.					
	Water Savings =					
	Number of yards implementing xeriscaping (# households * 10%) =	8,921	yards			
	Daily water savings per yard [20% * (summer per capita use - winter per capita use) * 2.29] =	15.2	gpd			
	Total annual water savings (# of yards * 15.2 gpd per year) =			49,514,148		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.66	
	Measure Cost =					
	Annual measure cost [(# yards * $2000)/ 35 years] =					$509,794
	Public Education and Program Administratio =					$27,177
	Measure cost per 1000 gallons =	$10.84	$/1000 gals			

EXHIBIT 5
Water Conservation Potential Assessment
Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program	WCPA assumes that 10% of the homes with irrigation systems (25% of homes in Fargo will have irrigation systems) will install ET controllers under the rebate program. The cost of the rebate program is $100 per yard.					
	Water Savings =					
	Number of housing units in rebate program (# yards * 10% * 25%) =	2,230	yards			
	Annual water savings [# of yards * 7% * (summer per capita use - winter per capita use) * 2.29 * 365 days =			4,332,488		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.06	
	Measure cost =					
	Annual measure cost [(# of yards * $100) / 35 years] =					$6,372
	Public Education and Program Administration=					$2,378
	Measure cost per 1000 gallons =	$2.02	$/1000 gals			
9. Efficient Landscape Irrigation Scheduling	WCPA assumes that 50% of the homes with irrigation systems (25% of homes in Fargo will have irrigation systems) and will participate in the irrigation scheduling program.					
	Water Savings =					
	Number of housing units in program (# Households * 50% * 25%) =	11,152	housing units			
	Annual water savings [# of yards * 10% * 2.29 * (summer per capita use - winter per capita use) *365 days =			30,946,343		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.42	
	Measure Cost =					
	Public Education and Program Administratio =					$16,986
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
10. Industrial Water Use Efficiency Measures	WCPA assumes a 10% reduction in industrial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of total per capita water use is for industrial purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita industrial water use =	3.37	gpc/d			
	Per capita water savings (industry water use gpc/d * 10%) =			25,144,835		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.34	
	Measure Cost =					
	Public Education and Program Administratio =					$13,801
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
11. Commercial Water Use Efficiency Measures	WCPA assumes a 15% reduction in commercial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for commercial purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita commercial water use =	3.37	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			37,717,253		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.51	
	Measure Cost =					
	Public Education and Program Administratio =					$20,702
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			

EXHIBIT 5
Water Conservation Potential Assessment
Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
12. Institutional Water Use Efficiency Measures	WCPA assumes a 15% reduction in institutional water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 7% of the total per capita water use is for institutional purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita institutional water use =	4.72	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			52,804,154		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.71	
	Measure Cost =					
	Public Education and Program Administratio =					$28,983
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
13. Conservation Pricing	Estimate water savings and cost of implementing an increasing or inverted water rate structure for water systems which currently have a declining water rate structure. Includes prorated administration and education costs plus one-time $50,000 cost to implement new rate structure. Assumes 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase.					
	Water Savings =					
	Average annual water use (gpc/d) =	112.4	gpc/d			
	Average non-discretionary per capita water use (gpc/d) =	95.7	gpc/d			
	Average discretionary per capita water use (gpc/d) =	16.7	gpc/d			
	Average monthly household water use (gallons) =	6,575	gallons			
	Water savings on discretionary water use [(25%/10%) * 16.7 * 2%] gpc/d =	0.84	gpc/d			
	Annual water savings on discretionary water use =			62,265,533		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.84	
	Measure Cost =					
	Public Education and Program Administratio =					$34,176
	One-time cost to implement new rate structure ($50,000 / 35 years) =					$1,429
	Measure cost per 1000 gallons =	$0.57	$/1000 gals			
14. Promote Installation of Efficient Clothes Washers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assume 90% of homes will install water efficient clothes washers through 2050. Costs for installing clothes washers are covered by homeowners. Assumes current saturation rate is 10%.					
	Water Savings =					
	Number of Housing Units to add efficient clothes washers by 2050 [(90%-10%) * Households] =	71,371	housing units			
	Annual water savings (# of clothes washers replaced * number of loads per household * 6.8 gallons per load =			190,247,015		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				2.55	
	Measure Cost =					
	Public Education and Program Administratio =					$104,423
	Measure cost per 1000 gallons =	$0.55	$/1000 gals			
Totals						
	Total Annual Water Savings All Measures (gallons) =			651,371,929		
Totals for Measures Not Exceeding Threshold of $1.25 per 1000 gallons						
	Total Annual Water Savings Measures (gallons)=			591,177,937		
	Total Per Capita Water Savings (gpc/d) =				7.93	
	Total Annual Measure Costs =					$325,914
	Total Measure Costs (assume 35 years, 2015 - 2050) =	35	years			
	Cost of Water Conservations Measures per 1000 gallons =	$0.55				
	Water Conservation Overall Percentage Water Use Reduction for Measures=	7.1%				
	Fargo data used in estimates:					
	2050 Population =	204,300				
	Number of single/multi-family housing units in 2050 =	89,214	housing units			
	Number of persons per household =	2.29				
	Total per capita water use (w/out losses) =	112.4				

EXHIBIT 6
Water Conservation Potential Assessment
Grand Forks Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
Supply Management						
1. Install Water Meters	Grand Forks has a policy requiring service water meters so this measure has no estimated savings or costs.					
	Water Savings =			0	0	
	Measure Cost =					$0
2. Audit Water Use, Detect Leaks and Repair Distribution System	Grand Forks has an unaccounted-for water loss in recent years under 10%, for this measure no water savings will be estimated.					
	Water Savings =			0	0	
	Measure Cost =					$0
Demand Management						
1. Program Administration and Public Education Programs	Research has shown that public education programs alone do not result in any quantifiable water savings but are required to implement other water conservation measures. No water savings will be estimated for this measure, but costs will distributed to individual water conservation measures.					
	Water Savings =			0	0	
	Measure Cost =					
	Annual Measure Cost ($1.75 * 2050 Population) =					$146,650
2. Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. It is assumed that end-users will pay for the cost of toilet replacement. Single-family and multi-family units will have a combined 90% saturation rate.					
	Water Savings =					
	ULF Toilet saturation rate =	90.0%				
	Number of housing units in Grand Forks (2000) =	20,830	housing units			
	Number of housing units in Grand Forks (2050) =	34,628	housing units			
	Number of housing units built after 1994 w/ ULF Toilets =	16,180	housing units			
	Number of housing units built before 1994 =	18,448	housing units			
	Number of housing units built before 1994 w/ ULF Toilets =	5,903	housing units			
	Number of housing units w/ ULF Toilets =	22,083	housing units			
	Number of housing units w/out ULF Toilets =	12,545	housing units			
	Saturation rate of ULF Toilets (# dwellings * 90%) =	31,165	housing units			
	Number of housing units that will install ULF Toilets =	9,082	housing units			
	Water savings (# of housing units replacing toilets * 10.5 * 2.42 * 365 days) =			84,230,795		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				2.75	
	Measure Cost =					
	Public Education and Program Administration =					$45,523
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
3. Promote Installation of Low-Flow Shower Heads	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assume the end-user will pay for the cost of replacing low-flow shower heads. Single-family and multi-family housing units ha an assumed low-flow shower head installation saturation rate of 90%.					
	Water Savings =					
	Low-Flow Shower Head installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow shower heads (90% - 51%) =	39.0%				
	Per capita water savings per low-flow shower head installation (11.6 gpc/d * 9%) =	1.04	gpc/d			
	Water savings (39% * # households * 1.04 * 2.42 * 365 days) =			12,453,803		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administration =					$6,731
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			

EXHIBIT 6
Water Conservation Potential Assessment
Grand Forks Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
4. Promote Installation of Faucet Aerators	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assume the end-user will pay for the cost of replacing faucet aerators. The increased percentage of faucet aerator installation in single-family and multi-family units is assumed to be the same as for low-flow showe heads.					
	Water Savings =					
	Faucet Aerator installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow faucet aerators (90% - 51%) =	39.0%				
	Water savings (39.0% * # households * 1.2 * 2.42 * 365 days) =			14,314,716		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratior =					$7,736
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
5. In-Home Low-Flow Water Fixtures Giveaway Program	The WCPA assumes a low-flow plumbing fixture giveaway program that targets the 10% of housing units occupied by low-income and elderly residents.					
	Water Savings =					
	Number of housing units targeted in giveaway program (# households * 10%) =	3,463	housing units			
	# of housing units actually installing devices (38%) =	1,316	housing units			
	Annual water savings (# of housing units * 2.24 gpc/d * 2.42 * 365 days) =			2,603,565		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.09	
	Measure Cost =					
	Annual measure cost (# of housing units / 35 * 2 * $10 per kit) =					$1,979
	Public Education and Program Administratior =					$1,407
	Measure cost per 1000 gallons =	$1.30	$/1000 gals			
6. Promote Installation of Water Efficient Dishwashers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes a future saturation rate of 90% and that currently 60% of installed dishwashers are the current water-saving 7 gpl model.					
	Water Savings =					
	Water savings per capita per dish washer replacemen (3.5 gpl * 0.1 * 2.42 persons per unit) =	0.85	gpc/d			
	Percentage of dish washers replaced [(90% - 60%) * 50.2%] =	15.1%				
	Number of dish washers replaced (# dwellings * 15.1%) =	5,215	housing units			
	Annual water savings (# dish washers replaced * 0.85 gpc/d * 2.42 * 365 days) =			3,901,623		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.13	
	Measure Cost =					
	Public Education and Program Administratior =					$2,109
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program	A xeriscaping rebate program will be implemented to encourage the use of low-water use turfs and plants in landscaping. A 10% saturation rate is assumed for the program with a 20% water savings per yard. The cost of the rebate program is $2,000 per yard.					
	Water Savings =					
	Number of yards implementing xeriscaping (# households * 10%) =	3,463	yards			
	Daily water savings per yard [20% * (summer per capita use - winter per capita use) * 2.42] =	12.1	gpd			
	Total annual water savings (# of yards * 12.1 gpd per year) =			15,232,326		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.50	
	Measure Cost =					
	Annual measure cost [(# yards * $2000)/ 35 years] =					$197,875
	Public Education and Program Administratior =					$8,232
	Measure cost per 1000 gallons =	$13.53	$/1000 gals			

EXHIBIT 6
Water Conservation Potential Assessment
Grand Forks Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program	WCPA assumes that 10% of the homes with irrigation systems will install ET controllers under the rebate program. 20% of homes in Grand Forks will have irrigation systems. The cost of the rebate program is $100 per yard.					
	Water Savings =					
	Number of housing units in rebate program (# yards * 10% * 20%) =	693	yards			
	Annual water savings [# of yards * 7% * (summer per capita use - winter per capita use) * 2.42 * 365 days] =			1,066,263		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.03	
	Measure cost =					
	Annual measure cost [(# of yards * $100) / 35 years] =					$1,979
	Public Education and Program Administratior =					$576
	Measure cost per 1000 gallons =	$2.40	$/1000 gals			
9. Efficient Landscape Irrigation Scheduling	WCPA assumes that 50% of the homes with irrigation systems will participate in the irrigation scheduling program. 20% of homes in Grand Forks will have irrigation systems.					
	Water Savings =					
	Number of housing units in program (# Households * 50% * 20%) =	3,463	housing units			
	Annual water savings [# of yards * 10% * 2.42 * (summer per capita use - winter per capita use) *365 days] =			7,616,163		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.25	
	Measure Cost =					
	Public Education and Program Administratior =					$4,116
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
10. Industrial Water Use Efficiency Measures	Grand Forks has worked closely with industries on water conservation. No estimated savings or costs will be included.					
	Water Savings =					
	Per capita industrial water use =	0	gpc/d			
	Per capita water savings (industry water use gpc/d * 10%) =			0		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure Cost =					
	Public Education and Program Administratior =					$0
	Measure cost per 1000 gallons =		$/1000 gals			
11. Commercial Water Use Efficiency Measures	WCPA assumes a 15% reduction in commercial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for commercial purposes and penetration rate of 60%.					
	Water Savings =					
	Per capita commercial water use =	4.06	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			18,636,659		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.61	
	Measure Cost =					
	Public Education and Program Administratior =					$10,072
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			

EXHIBIT 6
Water Conservation Potential Assessment
Grand Forks Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
12. Institutional Water Use Efficiency Measures	WCPA will assume a 15% reduction in institutional water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for institutional purposes and penetration rate of 60%.					
	Water Savings =					
	Per capita institutional water use =	4.06	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			18,636,659		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.61	
	Measure Cost =					
	Public Education and Program Administratior =					$10,072
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
13. Conservation Pricing	Estimates the water savings and cost of implementing an increasing or inverted water rate structure for water systems which currently have a declining water rate structure. Includes prorated administration and education costs plus one-time $50,000 cost to implement new rate structure. Assumes 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase.					
	Water Savings =					
	Average annual water use (gpc/d) =	135.4	gpc/d			
	Average non-discretionary per capita water use (gpc/d) =	123.1	gpc/d			
	Average discretionary per capita water use (gpc/d) =	12.3	gpc/d			
	Average monthly household water use (gallons) =	8,937	gallons			
	Water savings on discretionary water use [(25%/10%) * 12.3 * 2%] gpc/d =	0.62	gpc/d			
	Annual water savings on discretionary water use =			18,811,005		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.62	
	Measure Cost =					
	Public Education and Program Administratior =					$10,166
	One-time cost to implement new rate structure ($50,000 / 35 years) =					$1,429
	Measure cost per 1000 gallons =	$0.62	$/1000 gals			
14. Promote Installation of Efficient Clothes Washers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes 90 percent of homes will install water efficient clothes washers through 2050. Costs for installing clothes washers are covered by homeowner. Assumes current saturation rate is 10%.					
	Water Savings =					
	Number of Housing Units to add efficient clothes washers by 2050 [(90%-10%) * # Households] =	27,702	housing units			
	Annual water savings (# of clothes washers replaced * number of loads per household * 6.8 gallons per load) =			73,843,729		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				2.41	
	Measure Cost =					
	Public Education and Program Administratior =					$39,909
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
Totals						
	Total Annual Water Savings All Measures (gallons) =			271,347,306		
Totals for Measures Not Exceeding Threshold of $1.25 per 1000 gallons						
	Total Annual Water Savings Measures (gallons)=			252,445,152		
	Total Per Capita Water Savings (gpc/d) =				8.25	
	Total Annual Measure Costs =					$137,863
	Total Measure Costs (assume 35 years, 2015 - 2050) =	35	years			
	Cost of Water Conservations Measures per 1000 gallons =	$0.55				
	Water Conservation Overall Percentage Water Use Reduction for Measures=	6.1%				
	Grand Forks data used in estimates:					
	2050 Population =	83,800				
	Number of single/multi-family housing units in 2050 =	34,628	housing units			
	Number of persons per household =	2.42				
	Total per capita water use (w/out losses) =	135.4				

EXHIBIT 7
Water Conservation Potential Assessment
West Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
Supply Management						
1. Install Water Meters	West Fargo has a policy requiring service water meters so this measure has no estimated savings or costs.					
	Water Savings =			0	0	
	Measure Cost =					$0
2. Audit Water Use, Detect Leaks and Repair Distribution System	West Fargo has an unaccounted-for water loss in recent years under 10%, therefore for this measure no water savings will be estimated.					
	Water Savings =			0	0	
	Measure Cost =					$0
Demand Management						
1. Program Administration and Public Education Programs	Research has shown that public education programs alone do not result in any quantifiable water savings but are required to implement other water conservation measures. No water savings will be estimated for this measure, but costs will distributed to individual water conservation measures.					
	Water Savings =			0	0	
	Measure Cost =					
	Annual Measure Cost ($1.75 * 2050 Population) =					$59,325
2. Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. It is assumed that end-users will pay for the cost of toilet replacement. Single-family and multi-family units will have a combined 90% saturation rate.					
	Water Savings =					
	ULF Toilet saturation rate =	90.0%				
	Number of housing units in West Fargo (2000) =	6,524	housing units			
	Number of housing units in West Fargo (2050) =	14,803	housing units			
	Number of housing units built after 1994 w/ ULF Toilets =	9,479	housing units			
	Number of housing units built before 1994 =	5,324	housing units			
	Number of housing units built before 1994 w/ ULF Toilets =	1,704	housing units			
	Number of housing units w/ ULF Toilets =	11,183	housing units			
	Number of housing units w/out ULF Toilets =	3,620	housing units			
	Saturation rate of ULF Toilets (# dwellings * 90%) =	13,323	housing units			
	Number of housing units that will install ULF Toilets =	2,140	housing units			
	Water savings (# of housing units replacing toilets * 10.5 * 2.29 * 365 days) =			18,781,292		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				1.52	
	Measure Cost =					
	Public Education and Program Administratio=					$12,366
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			
3. Promote Installation of Low-Flow Shower Heads	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing low-flow shower heads. Single-family and multi-family housing units will have an assumed low-flow shower head installation saturation rate of 90%.					
	Water Savings =					
	Low-Flow Shower Head installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow shower heads (90% - 51%) =	39.0%				
	Per capita water savings per low-flow shower head installation (11.6 gpc/d * 9%) =	1.04	gpc/d			
	Water savings (39% * # households * 1.04 * 2.29 * 365 days) =			5,037,994		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio=					$3,317
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			

EXHIBIT 7
Water Conservation Potential Assessment
West Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
4. Promote Installation of Faucet Aerators	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing faucet aerators. The increased percentage of faucet aerator installation in single-family and multi-family units will be assumed to be the same as for low-flow shower heads.					
	Water Savings =					
	Faucet Aerator installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow faucet aerators (90% - 51%) =	39.0%				
	Water savings (39.0% * # households * 1.2 * 2.29 * 365 days) =			5,790,798		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratio=					$3,813
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			
5. In-Home Low-Flow Water Fixtures Giveaway Program	The WCPA assumes a low-flow plumbing fixture giveaway program that targets the 10% of housing units occupied by low-income and elderly residents.					
	Water Savings =					
	Number of housing units targeted in giveaway program (# households * 10%) =	1,480	housing units			
	# of housing units actually installing devices (38%) =	563	housing units			
	Annual water savings (# of housing units * 2.24 gpc/d * 2.29 * 365 days) =			1,053,232		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.09	
	Measure Cost =					
	Annual measure cost (# of housing units / 35 * 2 * $10 per kit) =					$846
	Public Education and Program Administratio=					$693
	Measure cost per 1000 gallons =	$1.46	$/1000 gals			
6. Promote Installation of Water Efficient Dishwashers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes a future saturation rate of 90% and currently 60% of installed dishwashers are the current water-saving 7 gpl model.					
	Water Savings =					
	Water savings per capita per dish washer replacemen (3.5 gpl * 0.1 * 2.29 persons per unit) =	0.80	gpc/d			
	Percentage of dish washers replaced [(90% - 60%) * 50.2%] =	15.1%				
	Number of dish washers replaced (# dwellings * 15.1%) =	2,229	housing units			
	Annual water savings (# dish washers replaced * 0.8 gpc/d * 2.29 * 365 days) =			1,493,554		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.12	
	Measure Cost =					
	Public Education and Program Administratio=					$983
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program	A xeriscaping rebate program will be implemented to encourage the use of low-water-use turfs and plants in landscaping. A 10% saturation rate is assumed for the program with a 20% water savings per yard. The cost of the rebate program is $2,000 per yard.					
	Water Savings =					
	Number of yards implementing xeriscaping (# households * 10%) =	1,480	yards			
	Daily water savings per yard [20% * (summer per capita use - winter per capita use) * 2.29] =	14.3	gpd			
	Total annual water savings (# of yards * 14.3 gpd per year) =			7,721,064		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.62	
	Measure Cost =					
	Annual measure cost [(# yards * $2000)/ 35 years] =					$84,591
	Public Education and Program Administratio=					$5,084
	Measure cost per 1000 gallons =	$11.61	$/1000 gals			

EXHIBIT 7
Water Conservation Potential Assessment
West Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program	WCPA assumes that 10% of the homes with irrigation systems will install ET controllers under the rebate program. 15% of homes in West Fargo will have irrigation systems. The cost of the rebate program is $100 per yard.					
	Water Savings =					
	Number of housing units in rebate program (# yards * 10% * 15%) =	222	yards			
	Annual water savings [# of yards * 7% * (summer per capita use - winter per capita use) * 2.29 * 365 days] =			405,356		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.03	
	Measure cost =					
	Annual measure cost [(# of yards * $100) / 35 years] =					$634
	Public Education and Program Administratio =					$267
	Measure cost per 1000 gallons =	$2.22	$/1000 gals			
9. Efficient Landscape Irrigation Scheduling	WCPA assumes that 50% of the homes with irrigation systems will participate in the irrigation scheduling program. 15% of homes in West Fargo will have irrigation systems.					
	Water Savings =					
	Number of housing units in program (# Households * 50% * 15%) =	1,110	housing units			
	Annual water savings [# of yards * 10% * 2.29 * (summer per capita use - winter per capita use) *365 days] =			2,895,399		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.23	
	Measure Cost =					
	Public Education and Program Administratio =					$1,906
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			
10. Industrial Water Use Efficiency Measures	West Fargo has minimal water needs for industrial purposes. No water savings or costs are estimated for this measure.					
	Water Savings =					
	Per capita industrial water use =	0	gpc/d			
	Per capita water savings (industry water use gpc/d * 10%) =			0		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure Cost =					
	Public Education and Program Administratio =					$0
	Measure cost per 1000 gallons =	$0.00	$/1000 gals			
11. Commercial Water Use Efficiency Measures	WCPA assumes a 15% reduction in commercial water use with a prorated share of public education and administrative costs based on water savings. Measure assumes tha 5% of the total per capita water use is for commercial purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita commercial water use =	2.74	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			5,078,084		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio =					$3,344
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			

EXHIBIT 7
Water Conservation Potential Assessment
West Fargo Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
12. Institutional Water Use Efficiency Measures	WCPA assumes a 15% reduction in institutional water use with a prorated share of public education and administrative costs based on water savings. Measure assumes tha 5% of the total per capita water use is for institutional purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita institutional water use =	2.74	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			5,078,084		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio=					$3,344
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			
13. Conservation Pricing	Estimates the water savings and cost of implementing an increasing or inverted water rate structure for water systems which currently have a declining water rate structure. Includes prorated administration and education costs plus one-time $50,000 cost to implement new rate structure. Assumes 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase.					
	Water Savings =					
	Average annual water use (gpc/d) =	91.2	gpc/d			
	Average non-discretionary per capita water use (gpc/d) =	82.8	gpc/d			
	Average discretionary per capita water use (gpc/d) =	8.4	gpc/d			
	Average monthly household water use (gallons) =	5,688	gallons			
	Water savings on discretionary water use [(25%/10%) * 8.4 * 2%] gpc/d =	0.42	gpc/d			
	Annual water savings on discretionary water use =			5,196,870		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.42	
	Measure Cost =					
	Public Education and Program Administratio=					$3,422
	One-time cost to implement new rate structure ($50,000 / 35 years) =					$1,429
	Measure cost per 1000 gallons =	$0.93	$/1000 gals			
14. Promote Installation of Efficient Clothes Washers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes 90 percent of homes will install water efficient clothes washers through 2050. Costs for installing clothes washers are covered by homeowner. Assumes current saturation rate is 10%.					
	Water Savings =					
	Number of Housing Units to add efficient clothes washers by 2050 [(90%-10%) * # Households] =	11,843	housing units			
	Annual water savings (# of clothes washers replaced * number of loads per household * 6.8 gallons per load) =			31,568,154		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				2.55	
	Measure Cost =					
	Public Education and Program Administratio=					$20,786
	Measure cost per 1000 gallons =	$0.66	$/1000 gals			
Totals						
	Total Annual Water Savings All Measures (gallons) =			90,099,882		
Totals for Measures Not Exceeding Threshold of $1.25 per 1000 gallons						
	Total Annual Water Savings Measures (gallons)=			80,920,230		
	Total Per Capita Water Savings (gpc/d) =				6.54	
	Total Annual Measure Costs =					$54,709
	Total Measure Costs (assume 35 years, 2015 - 2050) =	35	years			
	Cost of Water Conservations Measures per 1000 gallons =	$0.68				
	Water Conservation Overall Percentage Water Use Reduction for Measures=	7.2%				
	West Fargo data used in estimates:					
	2050 Population =	33,900				
	Number of single/multi-family housing units in 2050 =	14,803	housing units			
	Number of persons per household =	2.29				
	Total per capita water use (w/out losses) =	91.2				

EXHIBIT 8
Water Conservation Potential Assessment
Moorhead Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
Supply Management						
1. Install Water Meters	Moorhead has a policy requiring service water meters, so this measure has no estimated savings or costs.					
	Water Savings =			0	0	
	Measure Cost =					$0
2. Audit Water Use, Detect Leaks and Repair Distribution System	Moorhead has an unaccounted-for water loss in recent years under 10%, so no water savings will be included					
	Water Savings =			0	0	
	Measure Cost =					$0
Demand Management						
1. Program Administration and Public Education Programs	Research shows that public education programs alone do not result in any quantifiable water savings, but programs are required to implement other water conservation measures. No water savings will be estimated for this measure, but costs will distributed to individual water conservation measures.					
	Water Savings =			0	0	
	Measure Cost =					
	Annual Measure Cost ($1.75 * 2050 Population) =					$77,350
2. Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes that end-users will pay for the cost of toilet replacement. Single-family and multi-family units will have a combined 90% saturation rate.					
	Water Savings =					
	ULF Toilet saturation rate =	90.0%				
	Number of housing units in Moorhead (2000) =	12,718	housing units			
	Number of housing units in Moorhead (2050) =	17,470	housing units			
	Number of housing units built after 1994 w/ ULF Toilets =	7,411	housing units			
	Number of housing units built before 1994 =	10,059	housing units			
	Number of housing units built before 1994 w/ ULF Toilets =	3,219	housing units			
	Number of housing units w/ ULF Toilets =	10,630	housing units			
	Number of housing units w/out ULF Toilets =	6,840	housing units			
	Saturation rate of ULF Toilets (# dwellings * 90%) =	15,723	housing units			
	Number of housing units that will install ULF Toilets =	5,093	housing units			
	Water savings (# of housing units replacing toilets * 10.5 * 2.53 * 365 days) =			49,383,693		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				3.06	
	Measure Cost =					
	Public Education and Program Administratio=					$27,544
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			
3. Promote Installation of Low-Flow Shower Heads	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing low-flow shower heads. Single-family and multi-family housing units will have an assumed low-flow shower head installation saturation rate of 90%.					
	Water Savings =					
	Low-Flow Shower Head installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow shower heads (90% - 51%) =	39.0%				
	Per capita water savings per low-flow shower head installation (11.6 gpc/d * 9%) =	1.04	gpc/d			
	Water savings (39% * # households * 1.04 * 2.53 * 365 days) =			6,568,712		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio=					$3,664
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			

EXHIBIT 8
Water Conservation Potential Assessment
Moorhead Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
4. Promote Installation of Faucet Aerators	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing faucet aerators. The increased percentage of faucet aerator installation in single-family and multi-family units will be assumed to be the same as for low-flow shower heads.					
	Water Savings =					
	Faucet Aerator installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow faucet aerators (90% - 51%) =	39.0%				
	Water savings (39.0% * # households * 1.2 * 2.53 * 365 days) =			7,550,244		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratio=					$4,211
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			
5. In-Home Low-Flow Water Fixtures Giveaway Program	The WCPA assumes a low-flow plumbing fixture giveaway program that targets the 10% of housing units occupied by low-income and elderly residents.					
	Water Savings =					
	Number of housing units targeted in giveaway program (# households * 10%) =	1,747	housing units			
	# of housing units actually installing devices (38%) =	664	housing units			
	Annual water savings (# of housing units * 2.24 gpc/d * 2.53 * 365 days) =			1,373,241		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.09	
	Measure Cost =					
	Annual measure cost (# of housing units / 35 * 2 * $10 per kit) =					$998
	Public Education and Program Administratio=					$766
	Measure cost per 1000 gallons =	$1.28	$/1000 gals			
6. Promote Installation of Water Efficient Dishwashers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes a future saturation rate of 90%. Currently 60% of installed dishwashers are the current water-saving 7 gpl model.					
	Water Savings =					
	Water savings per capita per dish washer replacemen (3.5 gpl * 0.1 * 2.53 persons per unit) =	0.89	gpc/d			
	Percentage of dish washers replaced [(90% - 60%) * 50.2%] =	15.1%				
	Number of dish washers replaced (# dwellings * 15.1%) =	2,631	housing units			
	Annual water savings (# dish washers replaced * 0.89 gpc/d * 2.53 * 365 days) =			2,151,437		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.13	
	Measure Cost =					
	Public Education and Program Administratio=					$1,200
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program	A xeriscaping rebate program will be implemented to encourage the use of low-water-use turfs and plants in landscaping. A 10% saturation rate is assumed for the program with a 20% water savings per yard. The cost of the rebate program is $2,000 per yard.					
	Water Savings =					
	Number of yards implementing xeriscaping (# households 10%) =	1,747	yards			
	Daily water savings per yard [20% * (summer per capita use - winter per capita use) * 2.53] =	10.6	gpd			
	Total annual water savings (# of yards * 10.6 gpd per year) =			6,743,594		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.42	
	Measure Cost =					
	Annual measure cost [(# yards * $2000)/ 35 years] =					$99,831
	Public Education and Program Administratio=					$3,761
	Measure cost per 1000 gallons =	$15.36	$/1000 gals			

EXHIBIT 8
Water Conservation Potential Assessment
Moorhead Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program	WCPA will assume that 10% of the homes with irrigation systems will install ET controllers under the rebate program. 15% of homes in Moorhead will have irrigation systems. The cost of the rebate program is $100 per yard.					
	Water Savings =					
	Number of housing units in rebate program (# yards * 10% * 15%) =	262	yards			
	Annual water savings [# of yards * 7% * (summer per capita use - winter per capita use) * 2.53 * 365 days] =			354,039		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.02	
	Measure cost =					
	Annual measure cost [(# of yards * $100) / 35 years] =					$749
	Public Education and Program Administratio =					$197
	Measure cost per 1000 gallons =	$2.67	$/1000 gals			
9. Efficient Landscape Irrigation Scheduling	WCPA assumes that 50% of the homes with irrigation systems will participate in the irrigation scheduling program. 15% of homes in Moorhead will have irrigation systems.					
	Water Savings =					
	Number of housing units in program (# Households * 50% * 15%) =	1,310	housing units			
	Annual water savings [# of yards * 10% * 2.53 * (summer per capita use - winter per capita use) *365 days] =			2,528,848		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.16	
	Measure Cost =					
	Public Education and Program Administratio =					$1,410
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			
10. Industrial Water Use Efficiency Measures	Moorhead has worked closely with the industries on water conservation. No estimated savings or costs will be included for this measure.					
	Water Savings =					
	Per capita industrial water use =	0	gpc/d			
	Per capita water savings (industry water use gpc/d * 10%) =			0		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure Cost =					
	Public Education and Program Administratio =					$0
	Measure cost per 1000 gallons =		$/1000 gals			
11. Commercial Water Use Efficiency Measures	WCPA assumes a 15% reduction in commercial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for commercial purposes and penetration rate of 60%.					
	Water Savings =					
	Per capita commercial water use =	3.55	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			8,595,662		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.53	
	Measure Cost =					
	Public Education and Program Administratio =					$4,794
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			

EXHIBIT 8
Water Conservation Potential Assessment
Moorhead Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
12. Institutional Water Use Efficiency Measures	WCPA assumes a 15% reduction in institutional water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for institutional purposes and penetration rate of 60%.					
	Water Savings =					
	Per capita institutional water use =	3.55	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			8,595,662		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.53	
	Measure Cost =					
	Public Education and Program Administratio =					$4,794
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			
13. Conservation Pricing	Estimates water savings and cost of implementing an increasing or inverted water rate structure for water systems which currently have a declining water rate structure. Includes prorated administration and education costs plus one-time $50,000 cost to implement new rate structure. Assumes 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase.					
	Water Savings =					
	Average annual water use (gpc/d) =	118.5	gpc/d			
	Average non-discretionary per capita water use (gpc/d) =	109.1	gpc/d			
	Average discretionary per capita water use (gpc/d) =	9.4	gpc/d			
	Average monthly household water use (gallons) =	8,281	gallons			
	Water savings on discretionary water use [(25%/10%) * 9.4 * 2%] gpc/d =	0.47	gpc/d			
	Annual water savings on discretionary water use =			7,582,510		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratio =					$4,229
	One-time cost to implement new rate structure ($50,000 / 35 years) =					$1,429
	Measure cost per 1000 gallons =	$0.75	$/1000 gals			
14. Promote Installation of Efficient Clothes Washers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes 90 percent of homes will install water efficient clothes washers through 2050. Costs for installing clothes washers are covered by homeowner. Assumes current saturation rate is 10%.					
	Water Savings =					
	Number of Housing Units to add efficient clothes washers by 2050 [(90%-10%) * Households] =	13,976	housing units			
	Annual water savings (# of clothes washers replaced * number of loads per household * 6.8 gallons per load) =			37,255,184		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				2.31	
	Measure Cost =					
	Public Education and Program Administratio =					$20,779
	Measure cost per 1000 gallons =	$0.56	$/1000 gals			
Totals						
	Total Annual Water Savings All Measures (gallons) =			138,682,826		
Totals for Measures Not Exceeding Threshold of $1.25 per 1000 gallons						
	Total Annual Water Savings Measures (gallons)=			130,211,953		
	Total Per Capita Water Savings (gpc/d) =				8.07	
	Total Annual Measure Costs =					$74,054
	Total Measure Costs (assume 35 years, 2015 - 2050) =	35	years			
	Cost of Water Conservations Measures per 1000 gallons =	$0.57				
	Water Conservation Overall Percentage Water Use Reduction for Measures=	6.8%				
	Moorhead data used in estimates:					
	2050 Population =	44,200				
	Number of single/multi-family housing units in 2050 =	17,470	housing units			
	Number of persons per household =	2.53				
	Total per capita water use (w/out losses) =	118.4				

EXHIBIT 9
Water Conservation Potential Assessment
Medium Size Water Systems Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
Supply Management						
1. Install Water Meters	Medium Size Water Systems have a policy requiring service water meters, so this measure has no estimated savings or costs.					
	Water Savings =			0	0	
	Measure Cost =					$0
2. Audit Water Use, Detect Leaks and Repair Distribution System	Medium Size Water Systems have a combined unaccounted-for water loss rate of 15%, so no water savings or costs will be estimated.					
	Water Savings =			0	0	
	Measure Cost =					$0
Demand Management						
1. Program Administration and Public Education Programs	Research has shown that public education programs alone do not result in any quantifiable water savings, but they are required to implement other water conservation measures. No water savings will be estimated for this measure, but costs will distributed to individual water conservation measures.					
	Water Savings =			0	0	
	Measure Cost =					
	Annual Measure Cost ($1.75 * 2050 Population) =					$79,450
2. Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes that end-users will pay for the cost of toilet replacement. Single-family and multi-family units will have a combined 90% saturation rate.					
	Water Savings =					
	ULF Toilet saturation rate =	90.0%				
	Number of housing units in Medium Size Water Systems (2000) =	14,286	housing units			
	Number of housing units in Medium Size Water Systems (2050) =	20,359	housing units			
	Number of housing units built after 1994 w/ ULF Toilets =	7,294	housing units			
	Number of housing units built before 1994 =	13,065	housing units			
	Number of housing units built before 1994 w/ ULF Toilets =	4,181	housing units			
	Number of housing units w/ ULF Toilets =	11,475	housing units			
	Number of housing units w/out ULF Toilets =	8,884	housing units			
	Saturation rate of ULF Toilets (# dwellings * 90%) =	18,323	housing units			
	Number of housing units that will install ULF Toilets =	6,848	housing units			
	Water savings (# of housing units replacing toilets * 10.5 * 2.23 * 365 days) =			58,529,043		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				3.53	
	Measure Cost =					
	Public Education and Program Administratio =					$29,412
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
3. Promote Installation of Low-Flow Shower Heads	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing low-flow shower heads. Single-family and multi-family housing units have an assumed low-flow shower head installation saturation rate of 90%.					
	Water Savings =					
	Low-Flow Shower Head installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow shower heads (90% - 51%) =	39.0%				
	Per capita water savings per low-flow shower head installation (11.6 gpc/d * 9%) =	1.04	gpc/d			
	Water savings (39% * # households * 1.04 * 2.23 * 365 days) =			6,747,048		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio =					$3,391
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			

EXHIBIT 9
Water Conservation Potential Assessment
Medium Size Water Systems Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
4. Promote Installation of Faucet Aerators	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing faucet aerators. The increased percentage of faucet aerator installation in single-family and multi-family units is assumed to be the same as for low-flow shower heads.					
	Water Savings =					
	Faucet Aerator installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow faucet aerators (90% - 51%) =	39.0%				
	Water savings (39.0% * # households * 1.2 * 2.23 * 365 days) =			7,755,228		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratio =					$3,897
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
5. In-Home Low-Flow Water Fixtures Giveaway Program	The WCPA assumes a low-flow plumbing fixture giveaway program that targets the 10% of housing units occupied by low-income and elderly residents.					
	Water Savings =					
	Number of housing units targeted in giveaway program (# households * 10%) =	2,036	housing units			
	# of housing units actually installing devices (38%) =	774	housing units			
	Annual water savings (# of housing units * 2.24 gpc/d * 2.23 * 365 days) =			1,410,524		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.09	
	Measure Cost =					
	Annual measure cost (# of housing units / 35 * 2 * $10 per kit) =					$1,163
	Public Education and Program Administratio =					$709
	Measure cost per 1000 gallons =	$1.33	$/1000 gals			
6. Promote Installation of Water Efficient Dishwashers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes a future saturation rate of 90%. Currently 60% of installed dishwashers are the current water-saving 7 gpl model.					
	Water Savings =					
	Water savings per capita per dish washer replacemen (3.5 gpl * 0.1 * 2.23 persons per unit) =	0.78	gpc/d			
	Percentage of dish washers replaced [(90% - 60%) * 50.2%] =	15.1%				
	Number of dish washers replaced (# dwellings * 15.1%) =	3,066	housing units			
	Annual water savings (# dish washers replaced * 0.78 gpc/d * 2.23 * 365 days) =			1,947,810		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.12	
	Measure Cost =					
	Public Education and Program Administratio =					$979
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program	A xeriscaping rebate program will be implemented to encourage use of low-water-use turfs and plants in landscaping. A 10% saturation rate is assumed for the program with a 20% water savings per yard. The cost of the rebate program is $2,000 per yard.					
	Water Savings =					
	Number of yards implementing xeriscaping (# households 10%) =	2,036	yards			
	Daily water savings per yard [20% * (summer per capita use - winter per capita use) * 2.23] =	9.6	gpd			
	Total annual water savings (# of yards * 9.6 gpd per year) =			7,125,530		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.43	
	Measure Cost =					
	Annual measure cost [(# yards * $2000)/ 35 years] =					$116,336
	Public Education and Program Administratio =					$3,581
	Measure cost per 1000 gallons =	$16.83	$/1000 gals			

EXHIBIT 9
Water Conservation Potential Assessment
Medium Size Water Systems Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program	WCPA assumes that 10% of the homes with irrigation systems will install ET controllers under the rebate program. 5% of homes in Medium Size Water Systems wi have irrigation systems. The cost of the rebate program is $100 per yard.					
	Water Savings =					
	Number of housing units in rebate program (# yards * 10% * 5%) =	102	yards			
	Annual water savings [# of yards * 7% * (summer per capita use - winter per capita use) * 2.23 * 365 days] =			124,697		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.01	
	Measure cost =					
	Annual measure cost [(# of yards * $100) / 35 years] =					$291
	Public Education and Program Administratio =					$63
	Measure cost per 1000 gallons =	$2.83	$/1000 gals			
9. Efficient Landscape Irrigation Scheduling	WCPA assumes that 50% of the homes with irrigation systems will participate in the irrigation scheduling program. 5% of homes in Medium Size Water Systems will have irrigation systems.					
	Water Savings =					
	Number of housing units in program (# Households * 50% * 5%) =	509	housing units			
	Annual water savings [# of yards * 10% * 2.23 * (summer per capita use - winter per capita use) *365 days] =			890,691		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.05	
	Measure Cost =					
	Public Education and Program Administratio =					$448
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
10. Industrial Water Use Efficiency Measures	WCPA assumes a 10% reduction in industrial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of total per capita water use is for industrial purposes and penetration rate of 60%.					
	Water Savings =					
	Per capita industrial water use =	3.3	gpc/d			
	Per capita water savings (industry water use gpc/d * 10%) =			5,468,430		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.33	
	Measure Cost =					
	Public Education and Program Administratio =					$2,748
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
11. Commercial Water Use Efficiency Measures	WCPA assumes a 15% reduction in commercial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for commercial purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita commercial water use =	3.30	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			8,202,645		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.50	
	Measure Cost =					
	Public Education and Program Administratio =					$4,122
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			

EXHIBIT 9
Water Conservation Potential Assessment
Medium Size Water Systems Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
12. Institutional Water Use Efficiency Measures	WCPA assumes a 15% reduction in institutional water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for institutional purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita institutional water use =	3.30	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			8,202,645		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.50	
	Measure Cost =					
	Public Education and Program Administratio =					$4,122
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
13. Conservation Pricing	Estimates the water savings and cost of implementing an increasing or inverted water rate structure for water systems which currently have a declining water rate structure. Includes prorated administration and education costs plus one-time $50,000 cost to implement new rate structure. Assumes 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase.					
	Water Savings =					
	Average annual water use (gpc/d) =	110	gpc/d			
	Average non-discretionary per capita water use (gpc/d) =	100	gpc/d			
	Average discretionary per capita water use (gpc/d) =	10	gpc/d			
	Average monthly household water use (gallons) =	6,690	gallons			
	Water savings on discretionary water use [(25%/10%) * 10 * 2%] gpc/d =	0.50	gpc/d			
	Annual water savings on discretionary water use =			8,285,500		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.50	
	Measure Cost =					
	Public Education and Program Administratio =					$4,164
	One-time cost to implement new rate structure ($50,000 / 35 years) =					$1,429
	Measure cost per 1000 gallons =	$0.67	$/1000 gals			
14. Promote Installation of Efficient Clothes Washers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes 90 percent of homes will install water efficient clothes washers through 2050. Costs for installing clothes washers are covered by homeowner. Assumes current saturation rate is 10%.					
	Water Savings =					
	Number of Housing Units to add efficient clothes washers by 2050 [(90%-10%) * Households] =	16,287	housing units			
	Annual water savings (# of clothes washers replaced * number of loads per household * 6.8 gallons per load =			43,414,615		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				2.62	
	Measure Cost =					
	Public Education and Program Administratio =					$21,817
	Measure cost per 1000 gallons =	$0.50	$/1000 gals			
Totals						
	Total Annual Water Savings All Measures (gallons) =			158,104,406		
Totals for Measures Not Exceeding Threshold of $1.25 per 1000 gallons						
	Total Annual Water Savings Measures (gallons)=			149,443,656		
	Total Per Capita Water Savings (gpc/d) =				9.02	
	Total Annual Measure Costs =					$76,526
	Total Measure Costs (assume 35 years, 2015 - 2050) =	35	years			
	Cost of Water Conservations Measures per 1000 gallons =	$0.51				
	Water Conservation Overall Percentage Water Use Reduction for Measures=	8.2%				
	Medium Size Water Systems data used in estimates:					
	2050 Population =	45,400				
	Number of single/multi-family housing units in 2050 =	20,359	housing units			
	Number of persons per household =	2.23				
	Total per capita water use (w/out losses) =	110.0				

EXHIBIT 10
Water Conservation Potential Assessment
Rural and Small Water System Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
Supply Management						
1. Install Water Meters	Rural Water Systems and Small Water Systems have a policy requiring service water meters, so this measure has no estimated savings or costs.					
	Water Savings =			0	0	
	Measure Cost =					$0
2. Audit Water Use, Detect Leaks and Repair Distribution System	RWS and Small WS have an assumed unaccounted-for water loss of 15%, so no water savings and costs will be estimated.					
	Water Savings =			0	0	
	Measure Cost =					$0
Demand Management						
1. Program Administration and Public Education Programs	Research has shown that public education programs alone do not result in any quantifiable water savings, but they are required to implement other water conservation measures. No water savings will be estimated for this measure, but costs will distributed to individual water conservation measures.					
	Water Savings =			0	0	
	Measure Cost =					
	Annual Measure Cost ($1.75 * 2050 Population) =					$110,425
2. Promote Installation of 1.6 Gallon Ultra Low-Flush Toilets	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. It is assumed that end-users will pay for the cost of toilet replacement. Single-family and multi-family units will have a combined 90% saturation rate.					
	Water Savings =					
	ULF Toilet saturation rate =	90.0%				
	Number of housing units in RWS and Small WS (2050) =	32,030	housing units			
	Number of housing units w/ ULF Toilets (40%) =	12,812	housing units			
	Number of housing units w/out ULF Toilets =	19,218	housing units			
	Saturation rate of ULF Toilets (69,800 units * 90%) =	28,827	housing units			
	Number of housing units that will install ULF Toilets =	16,015	housing units			
	Water savings (# of housing units replacing toilets * 10.5 * 1.97 * 365 days) =			120,913,650		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				5.25	
	Measure Cost =					
	Public Education and Program Administratio =					$65,239
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
3. Promote Installation of Low-Flow Shower Heads	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing low-flow shower heads. Single-family and multi-family housing units will have an assumed low-flow shower head installation saturation rate of 90%.					
	Water Savings =					
	Low-Flow Shower Head installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow shower heads (90% - 51%) =	39.0%				
	Per capita water savings per low-flow shower head installation (11.6 gpc/d * 9%) =	1.04	gpc/d			
	Water savings (39% * # households * 1.04 * 1.97 * 365 days) =			9,377,506		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.41	
	Measure Cost =					
	Public Education and Program Administratio =					$5,060
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			

EXHIBIT 10
Water Conservation Potential Assessment
Rural and Small Water System Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
4. Promote Installation of Faucet Aerators	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes the end-user will pay for the cost of replacing faucet aerators. The increased percentage of faucet aerator installation in single-family and multi-family units will be assumed to be the same as for low-flow shower heads.					
	Water Savings =					
	Faucet Aerator installation saturation rate =	90.0%				
	Percent of housing units to upgrade to low-flow faucet aerators (90% - 51%) =	39.0%				
	Water savings (39.0% * # households * 1.2 * 1.97 * 365 days) =			10,778,742		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.47	
	Measure Cost =					
	Public Education and Program Administratio =					$5,816
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
5. In-Home Low-Flow Water Fixtures Giveaway Program	The WCPA assumes a low-flow plumbing fixture giveaway program that targets the 10% of housing units occupied by low-income and elderly residents.					
	Water Savings =					
	Number of housing units targeted in giveaway program (# households * 10%) =	3,203	housing units			
	# of housing units actually installing devices (38%) =	1,217	housing units			
	Annual water savings (# of housing units * 2.24 gpc/d * 1.97 * 365 days) =			1,960,441		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.09	
	Measure Cost =					
	Annual measure cost (# of housing units / 35 * 2 * $10 per kit) =					$1,830
	Public Education and Program Administratio =					$1,058
	Measure cost per 1000 gallons =	$1.47	$/1000 gals			
6. Promote Installation of Water Efficient Dishwashers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes a future saturation rate of 90%. Currently 60% of installed dishwashers are the current water-saving 7 gpl model.					
	Water Savings =					
	Water savings per capita per dish washer replacemen (3.5 gpl * 0.1 * 1.97 persons per unit) =	0.69	gpc/d			
	Percentage of dish washers replaced [(90% - 60%) * 50.2%] =	15.1%				
	Number of dish washers replaced (# dwellings * 15.1%) =	4,824	housing units			
	Annual water savings (# dish washers replaced * 0.69 gpc/d * 1.97 * 365 days) =			2,391,561		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.10	
	Measure Cost =					
	Public Education and Program Administratio =					$1,290
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
7. Install Low-Water-Use Turf and Plants in Landscaping - Xeriscaping Rebate Program	Due to the expense of rural water, rural residents are conservative with outdoor water use. No water savings or costs will be estimated.					
	Water Savings =					
	Number of yards implementing xeriscaping (# households 10%) =	0	yards			
	Daily water savings per yard [20% * (summer per capita use - winter per capita use) * 1.97] =	0.0	gpd			
	Total annual water savings (# of yards * 15.2 gpd per year) =			0		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure Cost =					
	Annual measure cost [(# yards * $2000)/ 35 years] =					$0
	Public Education and Program Administratio =					$0
	Measure cost per 1000 gallons =		$/1000 gals			

EXHIBIT 10
Water Conservation Potential Assessment
Rural and Small Water System Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
8. Install Water Efficient Landscape Irrigation Systems - ET Controller Rebate Program	Due to the expense of rural water, rural residents are conservative with outdoor water use. No water savings or costs will be estimated.					
	Water Savings =					
	Number of housing units in rebate program (# yards * 10% * 25%) =	0	yards			
	Annual water savings [# of yards * 7% * (summer per capita use - winter per capita use) * 1.97 * 365 days] =			0		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure cost =					
	Annual measure cost [(# of yards * $100) / 35 years] =					$0
	Public Education and Program Administratio =					$0
	Measure cost per 1000 gallons =		$/1000 gals			
9. Efficient Landscape Irrigation Scheduling	Due to the expense of rural water, rural residents are conservative with outdoor water use. No water savings or costs will be estimated.					
	Water Savings =					
	Number of housing units in program (# Households * 50% * 25%) =	0	housing units			
	Annual water savings [# of yards * 10% * 1.97 * (summer per capita use - winter per capita use) *365 days] =			0		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure Cost =					
	Public Education and Program Administratio =					$0
	Measure cost per 1000 gallons =		$/1000 gals			
10. Industrial Water Use Efficiency Measures	Due to the expense of rural water, a minimal amount of water is used for industrial purposes. No costs or savings will be estimated.					
	Water Savings =					
	Per capita industrial water use =	0	gpc/d			
	Per capita water savings (industry water use gpc/d * 10%) =			0		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.00	
	Measure Cost =					
	Public Education and Program Administratio =					$0
	Measure cost per 1000 gallons =		$/1000 gals			
11. Commercial Water Use Efficiency Measures	WCPA assumes a 15% reduction in commercial water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 3% of the total per capita water use is for commercial purposes and penetration rate of 60%.					
	Water Savings =					
	Per capita commercial water use =	1.85	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			6,398,842		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.28	
	Measure Cost =					
	Public Education and Program Administratio =					$3,452
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			

EXHIBIT 10
Water Conservation Potential Assessment
Rural and Small Water System Computation Sheet

Water Conservation Measure	Comments and Computations	General Results	Units	Annual Water Savings (gals/yr)	Annual Water Savings (gpc/d)	Annual Costs
12. Institutional Water Use Efficiency Measures	WCPA assumes a 15% reduction in institutional water use with a prorated share of public education and administrative costs based on water savings. Measure also assumes that 5% of the total per capita water use is for institutional purposes and a penetration rate of 60%.					
	Water Savings =					
	Per capita institutional water use =	3.09	gpc/d			
	Annual water savings (per capita water use * 15% * 2050 Population * 365 days) =			10,664,736		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.46	
	Measure Cost =					
	Public Education and Program Administratio =					$5,754
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
13. Conservation Pricing	Estimates the water savings and costs of implementing an increasing or inverted water rate structure for water systems which currently have a declining water rate structure. Includes prorated administration and education costs plus one-time $50,000 cost to implement the new rate structure. Assumes 25% rate increase for discretionary water use and water savings of 2% for every 10% in rate increase.					
	Water Savings =					
	Average annual water use (gpc/d) =	102.9	gpc/d			
	Average non-discretionary per capita water use (gpc/d) =	90	gpc/d			
	Average discretionary per capita water use (gpc/d) =	12.9	gpc/d			
	Average monthly household water use (gallons) =	5,319	gallons			
	Water savings on discretionary water use [(25%/10%) * 12.9 * 2%] gpc/d =	0.65	gpc/d			
	Annual water savings on discretionary water use =			14,855,318		
	Prorated per capita water savings (Annual water savings / 2050 population / 365 days) =				0.65	
	Measure Cost =					
	Public Education and Program Administratio =					$8,015
	One-time cost to implement new rate structure ($50,000 / 35 years) =					$1,429
	Measure cost per 1000 gallons =	$0.64	$/1000 gals			
14. Promote Installation of Efficient Clothes Washers	Implementation costs are based on the prorated share of public education and administrative costs in the Program Administration and Public Education Programs demand measure based on water savings. Assumes 90 percent of homes will install water efficient clothes washers through 2050. Costs for installing clothes washers are covered by homeowner. Assumes current saturation rate is 10%.					
	Water Savings =					
	Number of Housing Units to add efficient clothes washers by 2050 [(90%-10%) * # Households] =	10,250	housing units			
	Annual water savings (# of clothes washers replaced * number of loads per household * 6.8 gallons per load =			27,321,334		
	Prorated per capita Water Savings (Annual water savings / 2050 population / 365 days) =				1.19	
	Measure Cost =					
	Public Education and Program Administratio =					$14,741
	Measure cost per 1000 gallons =	$0.54	$/1000 gals			
Totals						
	Total Annual Water Savings All Measures (gallons) =			204,662,129		
Totals for Measures Not Exceeding Threshold of $1.25 per 1000 gallons						
	Total Annual Water Savings Measures (gallons)=			202,701,688		
	Total Per Capita Water Savings (gpc/d) =				8.80	
	Total Annual Measure Costs =					$110,796
	Total Measure Costs (assume 35 years, 2015 - 2050) =	35	years			
	Cost of Water Conservations Measures per 1000 gallons =	$0.55				
	Water Conservation Overall Percentage Water Use Reduction for Measures=	8.6%				
	RWS and Small WS data used in estimates:					
	2050 Population =	63,100				
	Number of single/multi-family housing units in 2050 =	32,030	housing units			
	Number of persons per household =	1.97				
	Total per capita water use (w/out losses) =	102.9				

Acronyms

AWWA	American Water Works Association
BMPs	Best Management Practices
cf	cubic feet
DWRA	Dakota Water Resources Act
EIS	Environmental Impact Statement
gals	gallons
gals/yr	gallons per year
gpc/d	gallons per capita per day
gpl	gallons per load
MEF	Modified energy factor
MR&I	municipal, rural, and industrial
Needs and Options Report	*Report on Red River Valley Water Needs and Options*
Phase II Report	*Red River Valley Water Needs Assessment Phase II; Appraisal of Alternatives to Meet Projected Shortages Draft Report*
RRV	Red River Valley
RWS	Rural Water System
Red River Project	Red River Valley Water Supply Project
ULF	ultra low-flush
WCPA	Water Conservation Potential Assessment
WTP	Water Treatment Plant