

MAWC 24

Exhibit No.:
Issues: Residential Usage/Customer
Fixture Specifications
Future Declining Use
Declining Use Impact on Revenue

Witness: Gregory P. Roach
Exhibit Type: Direct
Sponsoring Party: Missouri-American Water Company
Case No.: WR-2015-0301
SR-2015-0302
Date: July 31, 2015

MISSOURI PUBLIC SERVICE COMMISSION

**CASE NO. WR-2015-0301
CASE NO. SR-2015-0302**

DIRECT TESTIMONY

OF

GREGORY P. ROACH

ON BEHALF OF

MISSOURI-AMERICAN WATER COMPANY

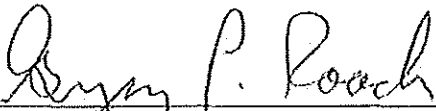
MAWC Exhibit No. 24
Date 3-21-16 Reporter TR
File No. WR-2015-0301

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

IN THE MATTER OF MISSOURI-AMERICAN) WATER COMPANY FOR AUTHORITY TO) FILE TARIFFS REFLECTING INCREASED) RATES FOR WATER AND SEWER) SERVICE)	CASE NO. WR-2015-0301 CASE NO. SR-2015-0302
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AFFIDAVIT OF GREGORY P. ROACH

Gregory P. Roach, being first duly sworn, deposes and says that he is the witness who sponsors the accompanying testimony entitled "Direct Testimony of Gregory P. Roach"; that said testimony and schedules were prepared by him and/or under his direction and supervision; that if inquiries were made as to the facts in said testimony and schedules, he would respond as therein set forth; and that the aforesaid testimony and schedules are true and correct to the best of his knowledge.



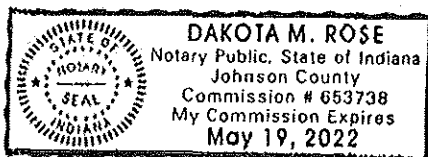
Gregory P. Roach

State of Indiana
County of Johnson
SUBSCRIBED and sworn to
Before me this 20th day of July 2015.



Notary Public

My commission expires: May 19, 2022



**DIRECT TESTIMONY
GREGORY P. ROACH
MISSOURI-AMERICAN WATER COMPANY
CASE NO. WR-2015-0301**

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DIRECT TESTIMONY

GREGORY P. ROACH

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Gregory P. Roach. My business address is 555 E. County Line Road, Suite 201, Greenwood, IN 46143.

Q. BY WHOM ARE YOU EMPLOYED?

A. I am employed by the American Water Works Service Company, Inc. (“Service Company”) as the Manager of Revenue Analytics. My responsibilities include leading the Revenue Analytics group, whose main area of focus is the analysis and forecasting of system delivery, customer usage and revenue for the Service Company affiliates, including the Missouri-American Water Company (“MAWC”).

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to support and validate the significant and continuing trend of declining water usage by MAWC’s residential customers.

Q. COULD YOU PLEASE DESCRIBE YOUR BUSINESS EXPERIENCE IN THE UTILITY INDUSTRY?

1 A. I have over 25 years of experience working in the electric, gas and water utility sectors as both
2 consultant and utility employee. I began my career with Public Service Indiana (“PSI” now
3 Duke Energy) in January of 1980, where my responsibilities were focused on transforming
4 PSI’s load forecasting processes from time series to econometric based models. In May of
5 1982, I accepted the position of Senior Economist with the management consulting firm of R.
6 W. Beck and Associates (“Beck”) (now part of Science Applications International
7 Corporation, “SAIC”). I received numerous promotions through my career with Beck to the
8 eventual position of Principal Economist. During the course of my career at Beck, I was
9 responsible for the management of all rates/regulatory, load forecasting and financing
10 feasibility client engagements managed by the Indianapolis office. As such, I delivered
11 testimony on behalf of agency, municipal and co-op clients throughout the United States
12 related to cost of service, rate design, load forecasting, system planning, electric and gas
13 production plant economic feasibility, revenue requirement pro-forma adjustments, production
14 cost optimization and cost of capital to state regulatory commissions and the Federal Energy
15 Regulatory Commission. In May of 1991, I took the position of Principal Economist with the
16 regulatory management consulting firm of SVBK Consulting Group (“SVBK”). In that
17 position I was responsible for all consulting engagements executed from the Indianapolis
18 regional office on behalf of SVBK’s national utility clients. In addition to the regulatory
19 matters to which I testified while at SVBK, I offered testimony related to merger & acquisition
20 cost reductions/synergies, large power pool generation and transmission dispatch strategies,
21 power pool generation/transmission pricing schemes, price elasticity sales adjustments and
22 retail rate impact of specific power/transmission pooling cost minimization arrangements and
23 payments. In July 1993, I became owner and president of a retail operations holding company

1 with three franchise store outlets. In that position I was responsible for all management,
2 operation, sales and financial functions of the firm. In November 1998, I sold the retail
3 holding company to begin operations of the Roach Consulting Group, Ltd as Principal
4 Consultant. In that position, I advised industrial and utility clients related to business
5 intelligence systems, enterprise/manufacturing resource planning systems, customer
6 information systems as well as general accounting systems. I also appeared as an expert
7 witness providing testimony related to economic and punitive damages in personal injury and
8 wrongful death legal proceedings. In July 2011, I joined the Service Company as Manager of
9 Rates and Regulation, supporting Indiana-American Water and Michigan-American Water
10 Company. In August of 2014, I accepted the position of Manager of Revenue Analytics with
11 the Service Company where I provide analytical support to all the American Water affiliated
12 companies.

13
14 **Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND.**

15 A. I graduated from Indiana University in 1980 with a Bachelor of Arts degree in Economics
16 and Political Science. I graduated from Butler University in 1982 with a Master's Degree in
17 Economics.

18
19 **Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE MISSOURI PUBLIC
20 SERVICE COMMISSION, OTHER REGULATORY AGENCIES, OR CIVIL
21 COURTS RELATED TO UTILITY MATTERS?**

22 A. This is my first opportunity to testify before this Commission. I have testified in numerous
23 regulatory proceedings before the Indiana Utility Regulatory Commission, the Public Utilities

1 Commission of Ohio, the Public Service Commission of West Virginia, the Public Service
2 Commission of Louisiana, Council of the City of New Orleans, the Public Utility Commission
3 of Texas, the Arkansas Public Service Commission, the Common Pleas Court of Ohio, and the
4 Federal Energy Regulatory Commission.

5 **III. MAWC RESIDENTIAL CUSTOMER DECLINING WATER USE**

6 **Q. PLEASE DESCRIBE THE WATER USE TREND OF MAWC'S RESIDENTIAL**
7 **CUSTOMERS?**

8 A. There is a continuing annual decline of water use across all MAWC districts, ranging from
9 508 gallons per customer per year (gpcy) in the St. Joseph district to 1,424 gpcy in the
10 Brunswick district. In the Company's largest district, St. Louis County, the rate of decline is
11 1,137 gpcy, or approximately 3.1 gallons per customer per day (gpcd).

12
13 **Q. WHAT DO YOU BELIEVE IS THE CAUSE OF THIS DECLINE?**

14 A. This decline can be attributed to several key factors, including but not limited to: increasing
15 prevalence of low flow (water efficient) plumbing fixtures and appliances within residential
16 households, conservation efforts of the customers, conservation programs implemented by
17 the federal government, state government, MAWC and other entities, and price elasticity.

18
19 **Q. PLEASE EXPLAIN WHAT YOU MEAN BY THE PREVALENCE OF LOW FLOW**
20 **FIXTURES AND APPLIANCES.**

21 A. Plumbing fixtures such as toilets, showerheads, and faucets available to consumers today are
22 more water efficient than they were in the past. Similarly, appliances such as dishwashers
23 and washing machines are also more water efficient. When a customer replaces an older

1 toilet, washing machine, or dishwasher with a new unit, the new unit will likely use less
2 water than the one it replaced. When new homes are built, they include water efficient
3 fixtures, and every time a customer remodels or installs new appliances in his or her kitchen,
4 bathroom or laundry room, he or she will consume less water in the future.

5
6 **Q. HOW MUCH WATER DO THE NEW FIXTURES AND APPLIANCES SAVE?**

7 A. The Energy Policy and Conservation Act of 1992 and 2005 (“EPAct92” and “EPAct05”
8 respectively) mandated the manufacture of water efficient toilets, showerheads and faucet
9 fixtures. For example, a toilet manufactured after 1994 uses 1.6 gallons per flush, compared
10 to a pre-1994 toilet which uses 3.5 to 7 gallons per flush. In fact, toilets using only 1.28
11 gallons per flush or less are now becoming more prevalent in the marketplace. Replacing an
12 old toilet with a new one can save from 2 to nearly 6 gallons per flush. The potential scope
13 of replacing these fixtures is significant as the United States Environmental Protection
14 Agency (“USEPA”) estimates that there are more than 220 million toilets in the U.S.,¹ and
15 that approximately 10 million new toilets are sold each year for installation in new homes
16 and businesses or replacement of aging fixtures in existing homes and businesses.²

17 The Energy Independence & Security Act of 2007 (Public Law 110–140) (“EISA”) will
18 further reduce indoor water consumption. EISA established stringent efficiency standards
19 for dishwashers and clothes washers. Dishwashers manufactured after 2009 and clothes
20 washers manufactured after 2010 must use 54% and 30% less water, respectively. All other
21 factors being equal, a typical residential household in a new home constructed in 2015, with

¹ US EPA, Water Sense Tank-Type High-Efficiency Toilet Specification Supporting Statement, February 9, 2007.

² D&R International, Plumbing Fixtures Market Overview: Water Savings Potential for Residential and Commercial Toilet and Urinals, September 30, 2005.

1 water efficient toilets, clothes washers, dishwashers and other fixtures, would use
2 approximately 35% less water for indoor purposes than a non-retrofitted home built prior to
3 1994. Schedule GPR-1, pages 1-3 of 12 provides additional detail about the expected
4 impact of water efficiency measures on residential water consumption.

5
6 **Q. PLEASE ELABORATE ON SOME OF THE OTHER FACTORS CAUSING THE**
7 **DECLINE IN RESIDENTIAL CONSUMPTION.**

8 A. Programs to raise customer awareness and interest in the benefits of conserving water and
9 energy continue to increase. For example, WaterSense is a USEPA voluntary partnership
10 programs that seek to protect the future of our water supply by offering people a simple way
11 to use less water with water-efficient products, new homes, and services. EnergyStar is
12 another USEPA voluntary partnership that helps businesses and individuals save money and
13 protect our climate through superior energy efficiency. These programs specifications, as
14 well as others, are detailed in Schedule GPR-1, pages 4-12 of 12. This listing is a
15 reproduction of the Alliance for Water Efficiency Water Products Standard Matrix which
16 was updated in March 2010. In addition, as Missouri-American president Frank Kartmann
17 describes, MAWC offers several programs that encourage customers to use water
18 efficiently. As awareness of water and energy efficiency increases, customers may decide to
19 replace a fixture or appliance even before it has broken. Additionally, customers may
20 further reduce consumption by changing their household water use habits in other various
21 ways. Missouri-American's residential customers in the St. Louis County district have
22 reduced their base usage by approximately 3.5 gallons per customer per day on average. A

1 3.5 gallon per day decrease can be achieved by subtle changes in customer behavior. For
2 instance, here are some ways a customer can reduce 3.5 gallons per day:

- 3 o Taking a shower that is 1 minute shorter per day;
- 4 o Two flushes per day with a newer replacement low-flow toilet fixture vs. an older
5 toilet;
- 6 o Running the dishwasher 5 times per week instead of 7; or
- 7 o Turning off the water for approximately 1 minute while brushing your teeth.

8 In addition, there is some negative price elasticity that contributes to a reduction in usage as
9 rates increase and usage declines in response to those price increases.

10 III. MAWC RESIDENTIAL CUSTOMER USAGE TREND ANALYSIS

11 Q. **PLEASE DESCRIBE THE METHODOLOGY OF YOUR TRENDING ANALYSIS.**

12 A. An analysis was undertaken of monthly customer consumption by MAWC's residential
13 customers over the past ten years. In order to calculate the usage per customer trend, a three-
14 step calculation was performed. I have attached graphs of the calculations described below.
15 These graphs are attached as Schedules GPR-2, Pages 1-3 of 3.

16 1) Monthly water sales data were totaled and divided by the number of customers to
17 yield the average usage per customer. For graphing purposes, the time variable in months was
18 plotted on the x-axis, and the consumption per customer variable was plotted on the y-axis.
19 (Note that water sales data lag behind actual consumption by approximately one month for
20 customers on a monthly meter reading cycle). See Schedule GPR-2, Page 1 of 3.

21 2) Average annual residential consumption, expressed in gallons per customer, was
22 calculated for each year from 2005 through 2014. For each year, a single point, representing
23 the average monthly usage for that year was plotted, see Schedule GPR-2, Page 2 of 3.

1 3) A “best-fit” linear regression trend line was created using the 10 year annual
2 average usage per residential customer history; see Schedule GPR-2, Page 3 of 3.
3

4 **Q. WHAT ARE THE RESULTS OF YOUR ANALYSIS?**

5 **A.** MAWC has experienced a substantial and continuing decline in residential water
6 consumption over the period covered by the historical data set. The regression analysis
7 projects a continuing annual decline of 1,194 gallons per residential customer per year; this
8 is an annual decrease of 1.94% per year, or approximately 3.4 gallons per residential
9 customer per day (“gpcd”).
10

11 **Q. IS WATER USAGE IMPACTED BY WEATHER?**

12 **A.** Yes. The system level regression analysis that I have conducted trends base usage over time
13 without attempting to normalize for weather. Base usage is defined by the residential average
14 use per customer measured over the period of February through April of each year when there
15 isn’t any appreciable outdoor usage of water typically associated with weather related affects.
16 In other words, my methodology studies the trending decline of base usage over time having
17 removed the effects of weather which are captured by the exclusion of non-base usage from
18 the data set and hence my analysis. Knowing that weather can be a factor influencing short-
19 term customer usage patterns, MAWC witness Dunn performed an analysis which averages
20 weather and, in effect, removes weather variations as a factor in predicting future usage.
21 The results of Mr. Dunn’s analysis and mine align very closely. This provides a high degree
22 of confidence that the drivers described earlier in my testimony are the predominant causes of
23 the decline in water consumption by MAWC residential customers. Furthermore, Mr. Dunn’s

1 analysis reinforces our conclusion that, under average weather conditions, the water
2 consumption decline is predictable and will continue into the foreseeable future.

3
4 **Q. HAVE YOU STUDIED WATER CONSUMPTION TRENDS FOR OTHER**
5 **AMERICAN WATER SUBSIDIARIES BESIDES MAWC?**

6 A. Yes.

7
8 **Q. ARE THE RESULTS OF MR. DUNN'S ANALYSIS CONSISTENT WITH YOUR**
9 **ANALYSIS IN OTHER STATES?**

10 A. Yes. We have studied the residential consumption patterns for other American Water state
11 operating systems located in climates and geographies similar to Missouri. It has become
12 clear that the trend experienced by MAWC is very similar to the trends being experienced in
13 other states. The results are shown on Schedule GPR-3. The Schedule illustrates that
14 nearby states in the American Water footprint have experienced a decline in residential
15 consumption per customer averaging 2.0% per year over the last 10 years. Clearly the
16 estimated Missouri system wide reduction in residential customer usage per annum of 1.9%
17 falls close to this average. Further, Mr. Dunn's district level analysis indicates reductions in
18 residential usage per customer ranging from -0.96% (St. Joseph) to -3.15% (Brunswick)
19 over the same period of analysis. These rates of decline estimated for certain MO districts
20 by Mr. Dunn appear reasonable and are well within the bounds of the comparable rates of
21 decline for the MAWC system in total and similar states in the American Water footprint.

1 **Q. IS THIS TREND BEING OBSERVED ACROSS THE INDUSTRY, BEYOND MAWC**
2 **AND OTHER AMERICAN WATER COMPANIES?**

3 A. Yes. According to the 2010 Water Research Foundation (“WRF”) report, “many water
4 utilities across the United States and elsewhere are experiencing declining water sales
5 among households.” (WRF Report, p. 1)³ The report further states: “A pervasive decline in
6 household consumption has been determined at the national and regional levels.” (WRF
7 Report, p. xxviii).

8

9 **IV. MAWC CUSTOMER DECLINING WATER USE – FORECASTS**

10 **Q. DO YOU EXPECT THE MAWC CUSTOMER DECLINING USAGE TREND TO**
11 **CONTINUE IN THE FUTURE?**

12 A. Yes. It is clear that water efficient fixtures and other drivers such as conservation education
13 and price elasticity will continue to drive further efficiency into residential usage per
14 customer. In fact, the trend is well established and continues to impact water usage on the
15 MAWC system as well as most water utilities across the United States. The rate of the
16 continued trend is dependent on the pace of fixture replacement within the MAWC service
17 footprint as well as being influenced by the broadening acceptance of a conservation ethic
18 through: raised customer and business awareness programs, government conservation policy
19 and similar behavior modification related programs. Water usage declines when a resident
20 changes from an older, less efficient fixture, to a new, efficient fixture. According to the
21 2010 American Housing Survey, 90% of homes in the Missouri service area were built prior

³ Coomes, Paul et al., North America Residential Water Usage Trends Since 1992 – Project #4031. (Water Research Foundation, 2010)

1 to 1994.⁴ These homes were constructed with toilets, washing machines, and dishwashers
2 that are more water-intensive than newer fixtures and appliances now on the market. As
3 turnover of household fixtures and appliances continues to occur over time, residential usage
4 will continue to decline accordingly. The regulations mandating water efficient washing
5 machines and dishwashers are relatively new. Given the life expectancy of appliances, it is
6 likely that the replacement of existing appliances, and the corresponding reduction in water
7 used, will continue to occur over time for the indefinite future.

8 According to a recent AWWA Journal article, technology is now available for
9 newer, more water efficient products that further improve on Energy Policy Act levels, and
10 now there is a growing movement to codify these more stringent specifications. The recent
11 introduction of progressive code modifications—such as the International Code Council’s
12 (“ICC’s”) International Green Construction Code (“IGCC”) and the International
13 Association of Plumbing and Mechanical Officials (“IAPMO”) Green Plumbing and
14 Mechanical Code Supplement (2011) support uniform implementation of increased water
15 efficiency standards.”⁵ AWWA research also indicates that this decline in water
16 consumption will continue. An article in the June 2012 issue of the AWWA Journal entitled
17 “Insights into declining single-family residential water demands” states: “Reduced
18 residential demand is a cornerstone of future urban water resource management. Great

⁴ U.S. Census Bureau, Selected Housing Characteristics. 2010 American Community Survey 5-Year Estimates (2006-2010), *<http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>.

⁵ Hoecker, Jay and Bracciano, David. Tampa Bay Water. “Passive Conservation: Codifying the use of Water-Efficiency Technologies” February 2012, Journal AWWA. 104:2.

1 progress has been made in the last 15 years and the industry appears poised to realize further
2 demand reductions in the future.”⁶

3 The regulations mandating water efficient washing machines and dishwashers are
4 relatively new. Given the life expectancy of appliances, it is likely that the replacement of
5 existing appliances, and the corresponding reduction in water used, will continue to occur
6 over time for the next fifteen years or more.

7
8 **Q. HAVE THE CUSTOMERS OF MAWC RECEIVED ANY BENEFIT FROM**
9 **REDUCED WATER USAGE BY RESIDENTIAL CUSTOMERS?**

10 A. Yes. Residential customers share in numerous benefits from reduced usage. There are
11 environmental and operational benefits from lower water usage by residential customers.
12 Reduced usage helps maintain source water supplies. Diversions from supply sources are
13 lessened, leaving more water for passing flows, environmental benefit, or drought reserve.
14 Reductions in power consumption, chemical usage, and waste disposal not only reduce
15 water utility operating costs but also provide environmental benefits such as reduced carbon
16 footprint and waste streams. Furthermore, reduced water usage by residential customers
17 also reduces energy consumption within the customer’s home, for instance, through lower
18 hot water heating needs. In addition, on a case-specific basis, reduced water usage has the
19 potential to enable the utility to delay or downsize a capacity addition. In systems where
20 demand is approaching the capacity of water supplies or treatment facilities, the water saved
21 through efficient usage by customers can be a preferred alternative to a supply-side
22 expansion, with a resulting lower cost to customers.

⁶ DeOreo, William and Mayer, Peter. American Water Works Association Journal. Vol. 104. Issue 6.
http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0076117. June 2012.

1 Over the long term, reduced usage per residential customer has helped lower
2 operating costs, and has helped avoid some capacity-related needs. These savings and
3 avoided costs have benefitted customers through the ratemaking process.
4

5 **Q. PLEASE DESCRIBE HOW DECLINING USAGE AND WATER CONSERVATION**
6 **ACTIVITIES CAN RESULT IN AVOIDED CAPITAL COSTS.**

7 A. As discussed previously, the decline in residential water consumption has been steadily
8 progressing since the 1990's. Base water consumption for the average MAWC per
9 residential customer is approximately 28% lower than it was 20 years ago. Without the
10 development of high-efficiency water fixtures and appliances and water conservation
11 programs, residential customers might still be using 30% more water than they do today. As
12 a result to these ongoing reductions in water usage, the water utility industry has avoided the
13 need to build supply, treatment, and transmission facilities to meet those now avoided
14 additional usage demands.
15
16

17 **Q. IS THE RESIDENTIAL WATER CONSUMPTION RATE SHOWING ANY SIGNS**
18 **OF BOTTOMING OUT?**

19 A. Residential water consumption in the MAWC service territory shows no signs of reaching
20 bottom any time soon. New water efficiency technology and water efficiency regulations
21 are expected to continue to drive water use downward even more in the future. As explained
22 by the American Council for Energy Efficiency

23 Home appliance manufacturers and energy efficiency advocates have
24 recently agreed to improved efficiency standards and tax policies for

1 refrigerators, freezers, clothes washers, clothes dryers, dishwashers, and room
2 air conditioners. This agreement could save enough energy to meet the total
3 energy needs of 40 percent of American homes for one year and the amount
4 of water necessary to meet the current water needs of every customer in the
5 City of Los Angeles for 25 years.⁷
6

7 These higher efficiency dishwasher and clothes washer standards were effective in January
8 2013 and January 2015 respectively, including providing tax incentives for consumer
9 purchases. Therefore, consumers will be achieving an even higher level of water-use
10 efficiency (i.e., lower usage) than the Federal regulations mandated in the Energy Policy Act
11 of 1992.
12

13 **Q. HAVE YOU PERFORMED ANALYTICS THAT GIVE VISIBILITY TO**
14 **POTENTIAL FUTURE TERM OF THE OBSERVED DECLINING USE TREND**
15 **FOR MAWC?**

16 **A.** Yes, I have. Reviewing Schedule GPR-4, Page 1 of 1, I have developed estimates of the
17 impact of the Water Sense / Energy Star usage specifications on a example family of four
18 occupants' water usage. Generally, the model applies the typical usage per capita⁸ times the
19 estimated reduction for specific appliance usage from the pre-regulatory standard generally
20 in place until 1994 to the Water Sense/Energy Star usage specifications generally in effect
21 since 2010/2011 respectively, times the number of users in the household (4 in this example)
22 annualized. I then summed the various usage reductions for the example family of four

7 American Council for Energy Efficiency, Major Home Appliance Efficiency Gains to Deliver Huge National Energy and Water Savings and Help to Jump Start the Smart Grid, <http://aceee.org/press/2010/08/major-home-appliance-efficiency-gains-deliver-huge-natio>. Date Accessed: 8/7/2012.

⁸ Source: Handbook of Water Use and Conservation, Amy Vickers, May, 2001

1 across all fixtures that could be replaced to get an average total usage reduction for the
2 family of four. My analysis indicates that a typical family of four would see an approximate
3 54,315 annual gallon reduction in usage due to fixture replacement at the Water
4 Sense/Energy Star specifications.

5
6 **Q. WHAT DOES THE ESTIMATED 54,315 GALLON ANNUAL REDUCTION IN**
7 **USAGE FOR A FAMILY OF FOUR IMPLY RELATED TO THE POTENTIAL**
8 **TERM OF THE ESTIMATED DECLINING USE TREND YOU HAVE ESTIMATED**
9 **FOR THE MAWC?**

10 A. Dividing the total estimated annual usage decline for the MAWC of 505.638 MM Gallons
11 by the annual estimated annual usage decline for the example family of four of 54,315
12 gallons, implies that 9,309 residential customers, or 2.2%, of the test year average of
13 423,483 residential customers, would need to make these fixture changes to account for the
14 estimated total annual residential declining usage. Further, taking the reciprocal of the 2.2%
15 of residential customers needed to account for the annual usage decline implies a theoretical
16 term of 45 years to fully convert the installed fixture base to the Water Sense/Energy Star
17 usage specifications, all other factors remaining equal.

18
19 **Q. CONCEPTUALLY HOW MANY ADDITIONAL YEARS COULD THE**
20 **ESTIMATED DECLINING USE TREND FOR MAWC CONTINUE?**

21 A. Based on the historical data that we have available for MAWC, the current declining use
22 trend has been evident since the year 2000. To date, that trend has progressed for 15

1 consecutive years. Given the implied theoretical term of the trend at 45 years, all factors
2 staying the same, the trend could continue for an additional 30 years.

3
4 **Q. HAVE YOU PERFORMED AN ANALYSIS THAT SUPPORTS OR ILLUSTRATES**
5 **THE POTENTIAL FOR SUCH DECLINING USE TREND CONTINUING TO**
6 **IMPACT USAGE ON THE MAWC SYSTEM?**

7 A. Yes, I have, by analyzing usage per customer in the Joplin district, pre- and post- the
8 devastating tornado of May 22, 2011 (“Joplin Tornado”).

9
10 **Q. PLEASE DESCRIBE HOW THE JOPLIN TORNADO PROVIDED EVIDENCE OF**
11 **FUTURE DECLINING WATER USE.**

12 A. The impact of the Joplin Tornado was an immediate reduction of MAWC customer
13 connections in the Joplin district by approximately 3,060 customer connections (14.4% of
14 the May 2011 Joplin residential total) when comparing June 2011 to May 2011. Given that
15 the devastation caused by an EF5 tornado to residential housing is nearly absolute, it follows
16 that a certain percentage of the Joplin district residential housing stock would require
17 complete rebuilding before being inhabited again. Such rebuilding would conform to the
18 water use standards that are discussed earlier in my testimony and detailed in Schedule
19 GPR-1.

20 **Q. PLEASE DESCRIBE YOUR ANALYSIS OF THE PRE- AND POST-2011 JOPLIN**
21 **TORNADO RESIDENTIAL CUSTOMER USAGE.**

22 A. We developed and compared the results of regression models that estimated the base
23 residential usage per customer trend for the 10 years leading up to and including 2011 and a

1 similar regression model that estimated the base residential usage per customer trend for the
 2 period of 2012-2015. Based on the results of those two independently constructed
 3 regression models, we can see the impact on residential average customer usage due to the
 4 rebuilding housing stock to the enhanced post 2007-2011 water use standards. A significant
 5 change in Joplin average residential customer usage following the May 2011 tornado would
 6 support the concept that there are numerous opportunities for continued residential customer
 7 base average usage reductions going into the future on the MAWC system.

8
 9 **Q. PLEASE DESCRIBE THE STATISTICAL RESULTS OF YOUR ANALYSIS OF**
 10 **THE PRE- AND POST-2011 JOPLIN TORNADO RESIDENTIAL CUSTOMER**
 11 **USAGE.**

12 A. The results of the analysis are in the table below:

**Table GPR-1
 Missouri-American Water Co.
 Joplin Declining Use Analysis
 Usage Trend Pre / Post-2011 Tornado**

Measure	Prior to 2011	Post 2011
R-Square	0.855	0.987
Usage Trend	-2.02%	-2.77%

13 Table GPR-1 illustrates the results of the regression analysis of average base usage per
 14 customer both pre- and post the Joplin Tornado. It is clear from the statistical results of that
 15 regression analysis that the Joplin district usage per customer trend has accelerated given
 16 that residential customers have rebuilt using water use fixtures that meet or exceed the

1 contemporary water efficiency standards thus effectively replacing older less efficient
2 fixtures as part of the rebuilding process. The results show that the decline in the base
3 residential usage per customer data series has increased from an annual rate of -2% to -2.8%
4 due to the reconstruction of approximately 2,500 (13.8%) residential dwellings since May
5 2011 in the Joplin district. This is an approximate 37% acceleration of the rate of decline in
6 Joplin post May 2011. This acceleration of the trend is illustrated graphically on Schedule
7 GPR-5.

8
9 **Q. WHAT DO THE RESULTS OF THE PRE- AND POST-2011 JOPLIN TORNADO**
10 **REVEAL ABOUT MAWC RESIDENTIAL CUSTOMER'S USAGE SUGGEST**
11 **ABOUT FUTURE WATER USAGE DECLINES?**

12 A. The statistical results from the Joplin Tornado, when combined with the results of the
13 theoretical family of four usage analysis outlined in Schedule GPR-4, offer compelling
14 empirical evidence as to the potential scope and duration of continued reductions in
15 customer water use patterns appears to be quite significant. First, based on the increase in
16 customer connections in the Joplin district beginning in June 2011 to the present, the
17 rebuilding of homes in the Joplin district resulted in a 37% acceleration of the annual usage
18 per customer reduction from approximately -2% to approximately -2.8%. Second, those
19 2,500 rebuilt customer dwellings experienced an approximately 3,200 gallon annual usage
20 reduction or roughly an 8.4% reduction in usage from their 2011 pre Joplin Tornado levels.
21 That 3,200 gallon average residential usage reduction by the rebuilt customers is nearly
22 equal to the loss of an entire months' worth of water sales to a typical MAWC Joplin
23 residential customer (based on average usage in Joplin post 2011).

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Q. WHAT IS YOUR CONCLUSION RELATED TO THE CONTINUATION OF REDUCTIONS IN RESIDENTIAL WATER USAGE ON THE MAWC SYSTEM?

A. Residential water use reductions will continue to be significant well into the foreseeable future for the MAWC system.

Q. HAVE YOU ANALYZED THE IMPACT OF REDUCED WATER USAGE ON MAWC WATER SALES AND REVENUES AS COMPARED TO LEVELS AUTHORIZED IN CASE NO. WR-2011-0337?

A. Yes I have. Table GPR-2 below is a summary Schedule GPR-6. Table GPR-2 illustrates that MAWC has been under its allowed Total Revenue and Water Sales levels set in Case WR-2011-0337 (the “2011 Rate Case”) in 3 out of the 4 years comprising the post-case period of 2012 to 2015. Only during the extended drought year of 2012 did MAWC experience Water Sales and Revenue levels in excess of those authorized by the 2011 Rate Case. More specifically, for the period of 2012 through 2015, MAWC will be under its allowed revenue for the period by approximately \$42.6 million. Similarly, for that same period, MAWC will be under its allowed total water sales by approximately 5.1 billion gallons. The inability of MAWC to meet its allowed revenue from the 2011 Rate Case is linked directly to water usage reductions that have been instrumental in attributing to the 5.1 billion gallon short fall in total sales levels set in the 2011 Rate Case. As a result MAWC has made pro forma adjustments to its water sales volumes in this case to account for reduced water usage impacting recovery of its allowed revenue level.

Table GPR-2
Missouri American Water Co.
Actual Revenue/Water Sales Compared to Allowed
(2012-2015)

	2012**	2013	2014	2015***	2012-2015
MAWC Total Annual Revenue	279,467,636	264,778,072	270,239,218	266,369,812	
Total Allowed Revenue*	265,856,142	276,498,635	289,598,802	291,518,793	
Revenue Recovery to Allowed (Under)/Over	13,611,494	(11,720,563)	(19,359,584)	(25,148,981)	(42,617,634)
MAWC Total Annual Water Sales	64,866,438	58,083,752	56,927,384	56,979,050	
Total Allowed Water Sales*	60,512,361	60,512,361	60,512,361	60,512,361	
Water Sales to Allowed (Under)/Over	4,354,077	(2,428,610)	(3,584,977)	(3,533,311)	(5,192,822)

* Per State of Missouri Public Service Commission Order WR-2011-0337, Issued March 7, 2012, adjusted for subsequent ISRIS Filings.
** Summer 2012 historically warm and dry; 4th driest summer since 1895, warmest summer since 1895 NOAA/NCDC
*** 2015 Annualized based on average ratio of YTD/Annual for the period 2010-2014

1 **Q. HOW HAS MAWC FACTORED THE OBSERVED TREND IN RESIDENTIAL**
2 **CUSTOMER USAGE INTO ITS PRO FORMA TEST YEAR REVENUES IN THIS**
3 **CASE?**

4 **A.** The development of MAWC's revenue requirement, including the adjustment to test year
5 data to reflect the observed trend in residential customer usage as well as normalized
6 weather, will be addressed by the Direct Testimony of Ms. Jeanne Tinsley.

7
8 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

9 **A.** Yes, it does.

The following regulations are listed in the "Energy Independence & Security Act of 2007," Public Law 110-140 – Dec. 19, 2007:

1. A top-loading or front-loading standard-size residential clothes washers manufactured on or after January 1, 2011 shall have a water factor of not more than 9.5. (water factor is equal to gallons/cycle/cubic feet)
2. Dishwashers manufactured on or after January 1, 2010, shall—
 - a. for standard size dishwashers (≥ 8 place settings + six serving pieces) not exceed **6.5 gallon per cycle**; and
 - b. for compact size dishwashers (< 8 place settings + six serving pieces) not exceed **4.5 gallons per cycle**.

TABLE 1
Flow rates from typical fixtures and appliances before and after Federal Standards

Type of Use	Pre-Regulatory Flow*	New Standard (maximum)	Federal Standard	Year Effective	WaterSense / ENERGY STAR Current Specification+ (maximum)
Toilets	3.5 gpf	1.6 gpf	U.S. Energy Policy Act	1994	1.28 gpf
Clothes washers**	41 gpl (14.6 WF)	Estimated 26.6 gpl (9.5 WF)	Energy Independence & Security Act of 2007	2011	Estimated 16.8 gpl (6.0 WF)
Showers	2.75 gpm	2.5 gpm	U.S. Energy Policy Act	1994	2.0 gpm
Faucets***	2.75 gpm	2.5 gpm (1.5 gpm)	U.S. Energy Policy Act	1994	1.5 gpm at 60 psi
Dishwashers	14.0 gpc	6.5 gpc for standard; 4.5 gpc for compact	Energy Independence & Security Act of 2007	2010	4.25 gpc for standard; 3.5 gpc for compact
Commercial Pre Rinse Spray Valves	1.8 to 6 gpm	1.6 gpm	U.S. Energy Policy Act of 2005	2006	1.28 gpm

* Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001

** Average estimated gallons per load and water factor (see calculations)

*** Regulation maximum of 2.5 gpm at 80 psi, but lavatory faucets available at 1.5 gpm maximum (see calculations)

+Source: <http://www.epa.gov/watersense/> and <http://www.energystar.gov> websites

ABBREVIATIONS USED	
gpcd	gallons per capita per day
gpf	gallons per flush
gpl	gallons per load
gpm	gallons per minute
gpc	gallons per cycle
WF	water factor, or gallons per cycle per cubic feet capacity of the washer (the smaller the water factor, the more water efficient the clothes washer)

TABLE 2
Daily indoor per capita water use from various fixtures and appliances in a typical single family home before and after Federal Regulations

Type of Use	Pre-Regulatory Standards Amount** (gpcd)	Post-Regulatory Standards Amount** (gpcd)	Savings from Pre-Reg	Water Sense/ Energy Star Amount** (gpcd)	Additional Savings from Post-Reg
Toilets	17.9	8.2	54%	6.5	21%
Clothes washers*	15	9.8	35%	6.2	37%
Showers	9.7	8.8	9%	7.1	19%
Faucets	14.9	10.8	28%	8.1	25%
Dishwashers*	1.4	0.65	54%	0.43	34%
Total Indoor Water Use	58.9	38.3	35%	28.3	26%

Note: List only includes common household fixtures and appliances and excludes leaks and "other domestic uses" in order to be conservative.

*Regulatory Standards effective in 2010 and 2011. For calculations of amount in gpcd, refer to the calculation below.

**Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001

CALCULATIONS

Clothes washer (pre-regulatory):

Number of times clothes washer used everyday * = 0.37 loads per day
 Clothes washer water use rate range * = 39 gpl to 43 gpl
 Average water use rate = 41 gpl
 Water usage per capita = 41 gpl * 0.37 loads/day
 = 15 gpcd
 Water factor (WF) as gallons/cycle/cu. ft = 41 gpl / 2.8 cu. ft (assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
 = 14.6

Clothes washer (new standard):

Number of times clothes washer used everyday * = 0.37 loads per day
 New regulatory standard = 9.5 WF
 = 9.5 gallons/per cycle/cubic feet

Therefore, new usage per capita = 26.6 gpl (Assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
= 26.6 gpl * 0.37 loads/day
= 9.8 gpcd

Clothes washer (WaterSense/Energy Star):
Number of times clothes washer used everyday * = 0.37 loads per day
New regulatory standard = 6 WF
= 6 gallons/per cycle/cubic feet
= 26.6 gpl (Assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
Therefore, new usage per capita = 16.8 gpl * 0.37 loads/day
= 6.2 gpcd

Dishwasher:
Number of times dishwasher used everyday* = 0.10 times
New regulatory standard = 6.5 gallons/per cycle (for standard dishwashers only)
Therefore, new usage per capita = 6.5 gallons/per cycle * 0.1
= 0.65 gpcd

Dishwasher (WaterSense/Energy Star):
Number of times dishwasher used everyday* = 0.10 times
New regulatory standard = 4.25 gallons/per cycle (for standard dishwashers only)
Therefore, new usage per capita = 4.25 gallons/per cycle * 0.1
= 0.43 gpcd

Faucet:
Actual faucet flow during use* = 67% rated flow
Rated flow* = 1.5 gpm to 2.5 gpm
Frequency of faucet use* = 8.1 min/day
Range of usage per capita = 8.1 gpcd to 13.5 gpcd
Assume average of range for estimated gpcd = 10.8 gpcd

Faucet (WaterSense/Energy Star):
Actual faucet flow during use* = 67% rated flow
Rated flow* = 1.5 gpm
Frequency of faucet use* = 8.1 min/day
Usage per capita = 8.1 gpcd
Assume average of range for estimated gpcd = 8.1 gpcd

*Source: *Handbook of Water Use and Conservation*, Amy Vickers, May, 2001

National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPA Act 1992, EPA Act 2005, "Energy Independence and Security Act of 2007" (or backlog NAECA updates)		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Residential Toilets	1.6 gpf ¹	1.28 gpf/ 4.8 Lpf proposed by efficiency advocates for tank-type only	Tank-type toilets: WaterSense = 1.28 gpf (4.8L) with at least 350 gram waste removal + LA Spec.		No specification	
Residential Lavatory (Bathroom) Faucets	2.2 gpm at 60 psi ²	1.5 gpm/ 5.7 Lpm proposed by efficiency advocates	WaterSense = 1.5 gpm maximum & 0.8 gpm minimum at 20 psi		No specification	
Residential Kitchen Faucets				None proposed at this time	No specification	
Residential Showerheads	2.5 gpm at 80 psi		WaterSense = 2.0 gpm		No specification	
Residential Clothes Washers	MEF ≥ 1.26 ft ³ /kWh/cycle *No specified water use factor Note: MEF measures energy consumption of the total laundry cycle (wash + dry). The higher the number, the greater the energy efficiency	Energy Independence and Security Act of 2007 specified effective in 2011: MEF ≥ 1.26 ft ³ /kWh/cycle WF ≤ 9.5 gal/cycle/ft ³ Also specified: DOE shall publish final rule by Dec 31, 2011, determining if standards will change effective 1/1/2015.	Energy Star (DOE) effective July 1, 2009: MEF ≥ 1.8 ft ³ /kWh/cycle WF ≤ 7.5 gal/cycle/ft ³	Energy Star (DOE) To be effective Jan 1, 2011: MEF ≥ 2.0 WF ≤ 6.0 gal/cycle/ft ³	Tier 1: MEF ≥ 1.80 ft ³ /kWh/cycle; WF ≤ 7.5 gal/cycle/ft ³ Tier 2: MEF ≥ 2.00 ft ³ /kWh/cycle; WF ≤ 6.0 gal/cycle/ft ³ Tier 3: MEF ≥ 2.20 ft ³ /kWh/cycle; WF ≤ 4.5 gal/cycle/ft ³	

¹ EPA Act 1992 standard for toilets applies to both commercial and residential models.

² EPA Act 1992 standard for faucets applies to both commercial and residential models.

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EPA Act 2005: Energy Policy Act of 2005

EF: energy factor
ft³: cubic feet
gal: gallons
gpm: gallons per minute

gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance

NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor
Lpf: Litres per flush

Updated March 2010
Koeller/Dietemann



National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAAct 1992, EPAAct 2005, "Energy Independence and Security Act of 2007" (or backlog NAECA updates)		WaterSense* or Energy Star*		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Standard Size and Compact Residential Dishwashers ³	<p><i>Standard models:</i> Energy Independence and Security Act of 2007 specified: effective 1/1/2010: Standard Size: 355 kWh/year (.62 EF + 1 watt standby) WF ≤ 6.5 gallons/cycle Compact Size: 260 kWh WF ≤ 4.5 gallons/cycle</p> <p>EF is the number of cycles the machine can run for each kWh of electricity</p>	<p>Also specified by the Act: DOE shall publish final rule by 1/1/2015 determining if dishwasher standards will change effective 1/1/2018.</p>	<p>Energy Star (DOE) Effective since July 1, 2009 Standard Size: 324 kWh/year WF ≤ 5.8 gallons/cycle Compact Size: 234 kWh/year WF ≤ 4.0 gallons/cycle</p> <p>kWh/yr is replacing EF since it includes the cycles the machine can run for each kWh, but also includes up to 8 kWh/yr of standby power (when the machine isn't cycling)</p>	<p>Energy Star effective July 1, 2011: Standard Size: 307 kWh/yr 5.0 gallons per cycle</p> <p>Compact Size: 222 kWh/yr 3.5 gallons per cycle</p>	<p><i>Effective Aug. 11, 2009:</i> <i>Standard models:</i> EF; maximum kWh/year Tier 1: EF ≥ 0.72 cycles/kWh; and 307 max kWh/year; 5.0 gallons per cycle Tier 2: EF ≥ 0.75 cycles/kWh; 295 max kWh/year; 4.25 gallons per cycle</p> <p><i>Compact models:</i> Tier 1: EF ≥ 1.0 cycles/kWh; 222 max kWh/year; 3.5 gallons per cycle</p>	<p>Could adjust Tiers after July 1, 2011 when new Energy Star becomes effective</p>

³ **Standard models:** capacity is greater than or equal to eight place settings and six serving pieces; **Compact models:** capacity is less than eight place settings and six serving pieces

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National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAct 1992, EPAct 2005 (or backlog NAECA updates)		WaterSense [*] or Energy Star [*]		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Toilets	1.6 gpf ⁴ /6.0 Lpf Except blow-out fixtures: 3.5-gpf/13 Lpf Note: Some states prohibit blow-out at 3.5 gpf	1.28 gpf/ 4.8 Lpf proposed by efficiency advocates for tank-type only	<u>Tank-type only:</u> WaterSense at 1.28 gpf (4.8L) with at least 350 gram waste removal + LA Spec.	<u>Flushometer valve/ bowl combinations:</u> WaterSense specification in development. No release date promised.	No specification	
Commercial Urinals	1.0 gpf	0.5 gpf/ 1.9 Lpf proposed by efficiency advocates	WaterSense = 0.5 gpf/1.9Lpf (flushing urinals only)		No specification	
Commercial Faucets	Private faucets: 2.2 gpm at 60 psi ⁵ Public Restroom faucets: 0.5 gpm at 60 psi ⁵ Metering (auto shut off) faucets: 0.25 gallons per cycle ⁶			WaterSense draft specification now under consideration	No specification	

⁴ EPAct 1992 standard for toilets applies to both commercial and residential models.

⁵ In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code for all except private applications, private being defined as residential, hotel guest rooms, and health care patient rooms. All other applications subject to the 0.5 gpm/1.9 Lpm flow rate maximum.

⁶ Metering faucets not subject to flow rate maximum

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gpf: gallons per flush
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National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPA Act 1992, EPA Act 2005 <i>(or backlog NAECA updates)</i>		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Clothes Washers (Family-sized)	MEF ≥ 1.26 ft ³ /kWh; WF ≤ 9.5 gal/cycle/ft ³	New standards under development: DOE scheduled final action: January 2010; Rulemaking process postponed by DOE in 2008; began again in Dec. 2009.	Energy Star (DOE) MEF ≥ 1.72 ft ³ /kWh/cycle; WF ≤ 8.0 gal/cycle/ft ³		Adopted Jan 1, 2007 (Note: this spec covers only normal capacity family washers, NOT large capacity commercial washers) Tier 1: 1.80 MEF 7.5 gal/cycle/ft ³ Tier 2: 2.00 MEF 6.0 gal/cycle/ft ³ Tier 3: 2.20 MEF 4.5 gal/cycle/ft ³	

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Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAAct 1992, EPAAct 2005 <i>(or backlog NAECA updates)</i>		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Dishwashers	No standard		Energy Star (EPA) using NSF/ANSI standards for water use and ASTM standards for energy use Effective 10/11/2007 <i>Under counter:</i> Hi Temp: 1.0 gal/rack; <= 0.90 kW; Lo Temp 1.70 gal/rack <= 0.5 kW <i>Stationary Single Tank Door:</i> Hi Temp: 0.95 gal/rack; <= 1.0 kW Lo Temp: 1.18 gal/rack; <= 0.6 kW <i>Single Tank Conveyor:</i> Hi Temp: 0.70 gal/rack; <= 2.0 kW; Lo Temp: 0.79 gal/rack; <= 1.6 kW <i>Multiple Tank Conveyor:</i> Hi Temp: 0.54 gal/rack; <= 2.6 kW Lo Temp: 0.54 gal/rack; <= 2.0 kW		No specification	

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Fixtures and Appliances	EPAAct 1992, EPAAct 2005 (or backlog NAECA updates)		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Automatic Commercial Ice Makers ⁷	Effective 1/1/2010: Energy and condenser water efficiency standards vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table)		Energy Star (EPA) Energy and water efficiency standards vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table). <u>Water cooled machines excluded from Energy Star</u>		Energy and water (potable and condenser) standards are tiered and vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table)	
Commercial Pre-rinse Spray Valves (for food service applications)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)		No specification	Proposed Energy Star specification abandoned after standard established in EPAAct 2005; WaterSense specification in development in conjunction with Energy Star	No specification (program guidance recommends 1.6 gpm at 60 psi and a cleanability requirement)	

⁷ Optional standards for other types of automatic ice makers are also authorized under EPAAct 2005.

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 EPAAct 2005: Energy Policy Act of 2005

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Fixtures and Appliances	EPA Act 1992, EPA Act 2005 <i>(or backlog NAECA updates)</i>		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Steam Cookers ⁸	No standard		Energy Star (EPA) <i>Electric:</i> 50% cooking energy efficiency; idle rate 400–800 Watts <i>Gas:</i> 38% cooking energy efficiency; idle rate 6,250–12,500 British thermal units/hour *No specified water use factor		<i>Electric:</i> 50% cooking energy efficiency; idle rate 400–800 Watts <i>Gas:</i> 38% cooking energy efficiency; idle rate 6,250–12,500 British thermal units/hour Water Use Factor (for both electric and gas models): Tier 1A: ≤ 15 gal/hr Tier 1B: ≤ 4 gal/hr	

⁸ Idle rate standards vary for 3-, 4-, 5-, and 6-pan commercial steam cooker models.

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Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Information/materials on EAct 2005/NAECA standards:

Schedule for development of appliance and commercial equipment efficiency standards:

http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html

Commercial Clothes Washers and Dishwashers (agenda/presentations at 4/27/06 DOE public meeting on rulemaking):

http://www.eere.energy.gov/buildings/appliance_standards/residential/home_appl_mtg.html

Automatic Commercial Ice Maker Standards:

http://www.eere.energy.gov/buildings/appliance_standards/pdfs/epact2005_appliance_stds.pdf (Page 18)

Pre-rinse Spray Valves

http://www.eere.energy.gov/buildings/appliance_standards/pdfs/epact2005_appliance_stds.pdf (Page 10)

Information/materials on WaterSense specifications:

Toilets

<http://www.epa.gov/watersense/products/toilets.html>

Urinals

<http://www.epa.gov/watersense/products/urinals.html>

Bathroom Lavatory Faucets

http://www.epa.gov/watersense/products/bathroom_sink_faucets.html

Information/materials on Energy Star specifications:

Residential Clothes Washers

http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers

Commercial Clothes Washers

http://www.energystar.gov/index.cfm?fuseaction=clotheswash.display_commercial_cw

Residential Dishwashers

http://www.energystar.gov/index.cfm?c=dishwash.pr_dishwashers

Commercial Dishwashers

http://www.energystar.gov/index.cfm?c=new_specs.comm_dishwashers

Automatic Commercial Ice Makers

http://www.energystar.gov/index.cfm?c=new_specs.ice_machines

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 EAct 1992: Energy Policy Act of 1992
 EAct 2005: Energy Policy Act of 2005

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Commercial Steam Cookers

http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers

Information/materials on CEE specifications:

Residential Clothes Washers

<http://www.cee1.org/resid/seha/rwsh/rwsh-main.php3>

Residential Dishwashers

<http://www.cee1.org/resid/seha/dishw/dishw-main.php3>

Commercial, Family-Sized Clothes Washers

<http://www.cee1.org/com/cwsh/cwsh-main.php3>

Commercial Ice-Makers

<http://www.cee1.org/com/com-ref/ice-main.php3>; Spec Table: <http://www.cee1.org/com/com-kit/ice-specs.pdf>

Pre-rinse Spray Valves

<http://www.cee1.org/com/com-kit/prv-guides.pdf>

Commercial Steam Cookers

<http://www.cee1.org/com/com-kit/sc-hc-specs.pdf>

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gal: gallons
gpm: gallons per minute

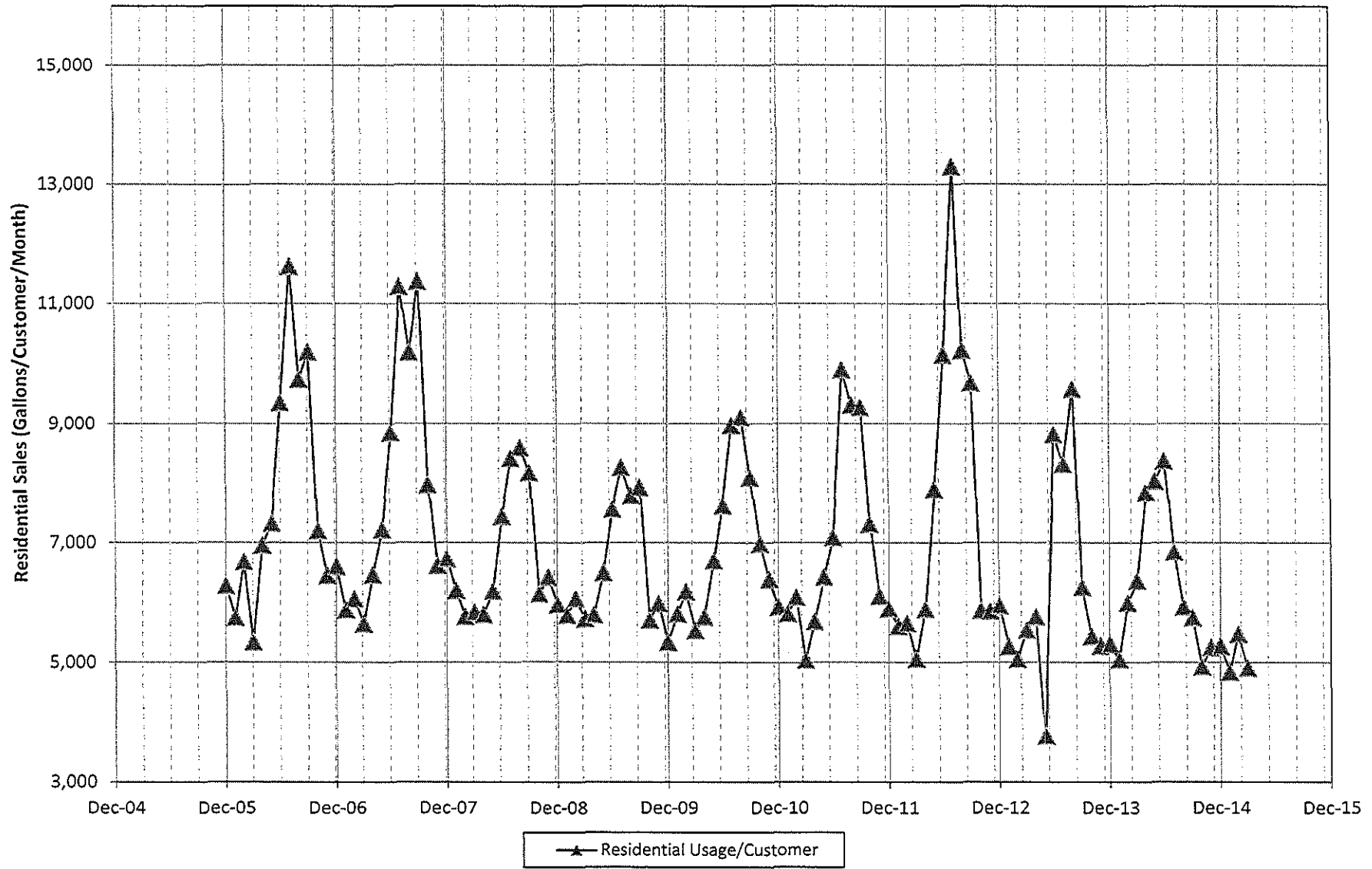
gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance

NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor
Lpf: Litres per flush

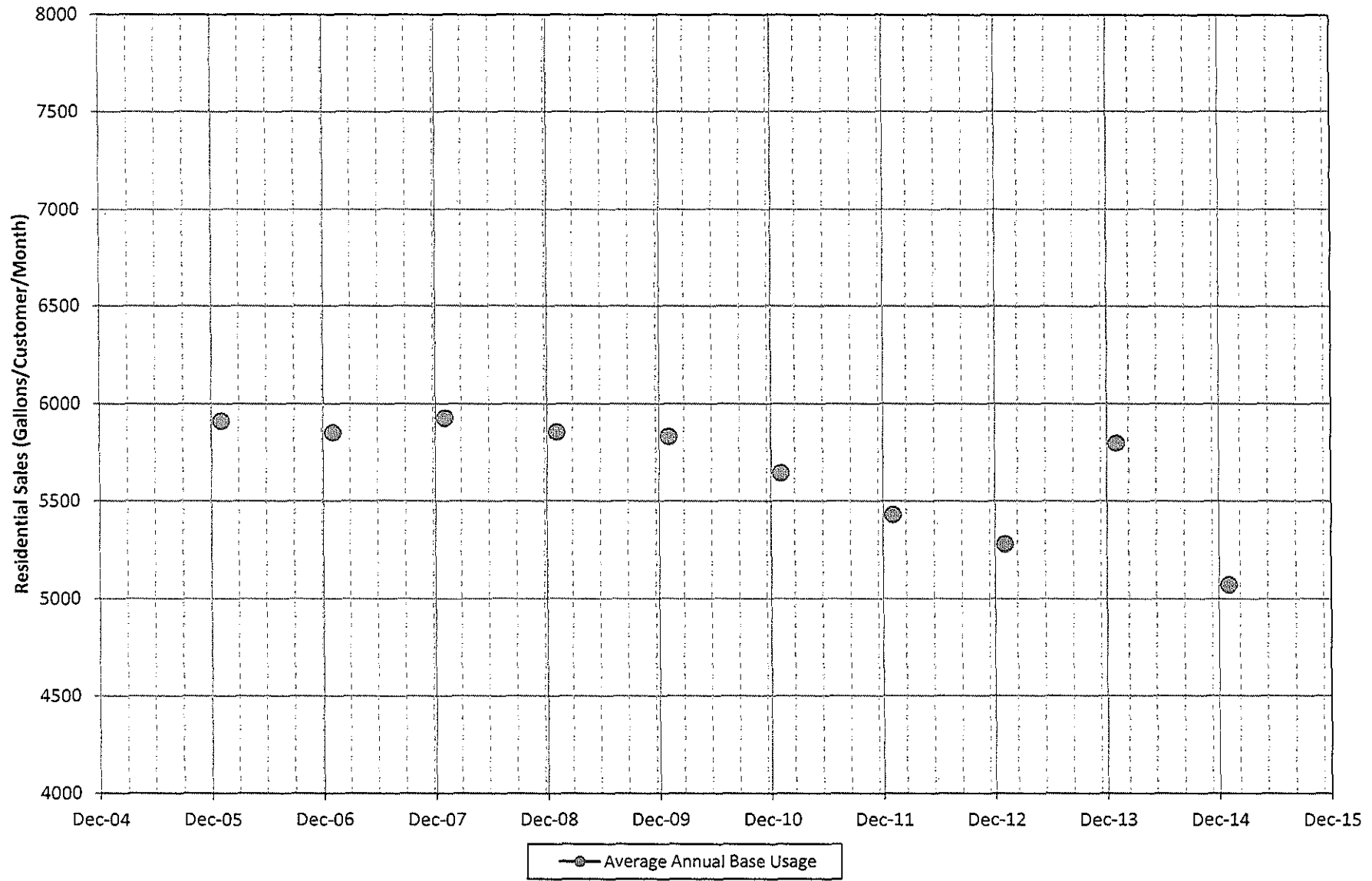
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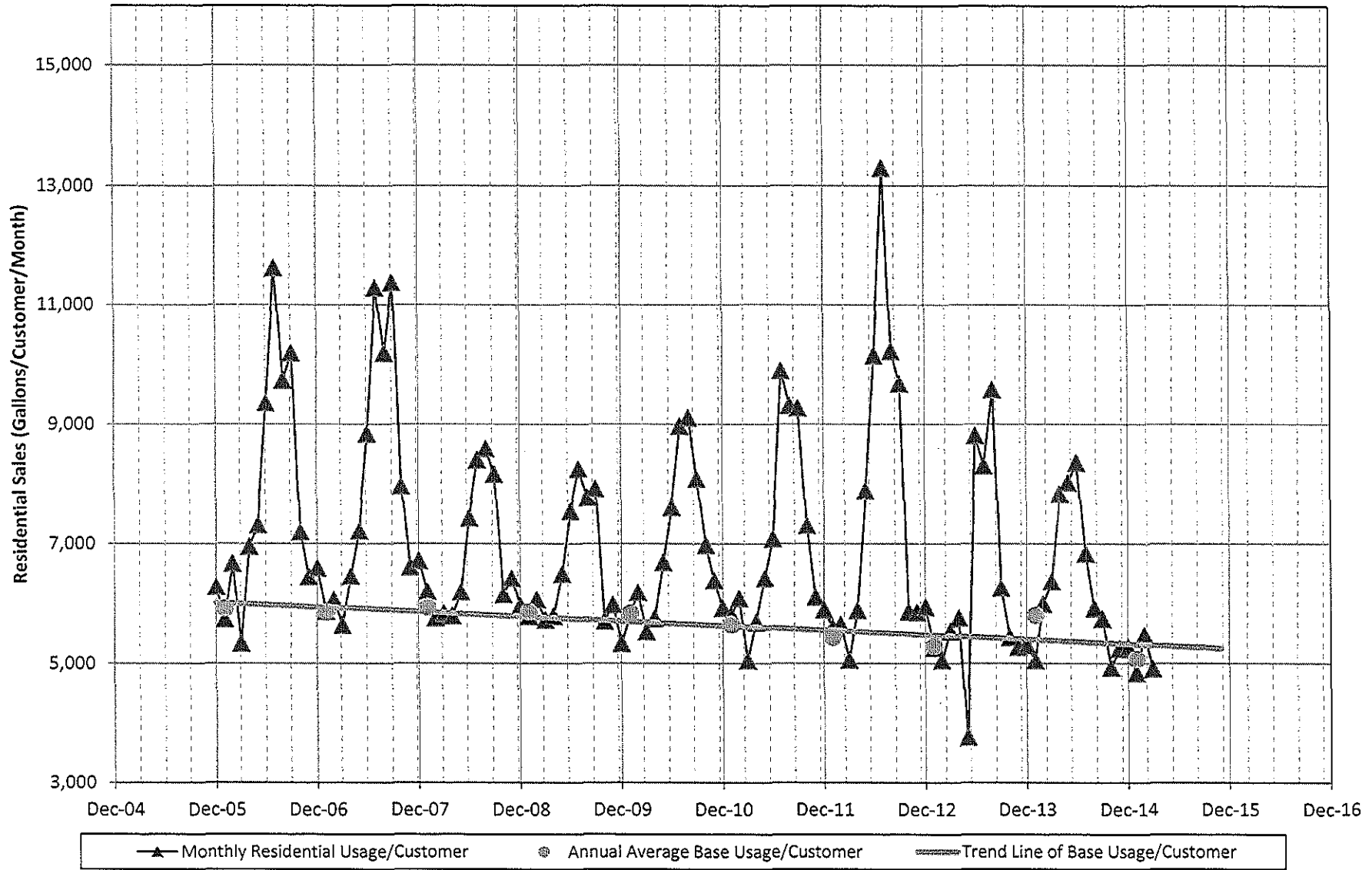
Missouri American Water
Residential Sales per Customer
(10-year Annual Trend)



Missouri American Water
Residential Sales per Customer
(10-year Annual Trend)



Missouri American Water
Residential Sales per Customer
(10-year Annual Trend)



Residential Water Usage Forecasts Based on 10 year history
Based on Winter Usage Trends except where noted below

State	Annual Decline (GPCY) ^{***}	Rate of Decline 2012-2013 (%) ^{***}
	10-year (2006-2015)	10-year (2006-2015)
California*	-4,773	-4.3%
Illinois	-829	-1.7%
Indiana	-798	-1.7%
Iowa	-1,235	-2.9%
Kentucky	-816	-1.9%
Maryland**	-1,192	-2.8%
Missouri	-1,194	-1.9%
New Jersey (SA1)	-1,293	-2.3%
New Jersey (SA2)	-1,293	-2.3%
New York	-1,529	-2.4%
Pennsylvania	-1,008	-2.1%
Tennessee	-798	-1.7%
Virginia	-1,120	-2.9%
West Virginia	-428	-1.1%
Michigan++	-1,017	-2.4%
Weighted Average (w/o CA)	-1,039	-2.0%
Weighted Average (w/ CA)	-1,241	-2.1%

Notes:

*California used the Annual Average Method for trending using a 10 yr (2006-2015) history

**MD used the Annual Average Method for trending using a 10 yr (2006-2015) history

++ MI Analyses presented were performed using an annual average method for a 10 year duration only

Missouri American Water Co.
Reasonableness of Consumption Decline Calculation
1,194 Gallons Per Customer Per Year

Illustrating: Replacement of Clothes Washing, Toilet, Fixtures and Dishwashers Based on Family of Four

Washer:

Old: Usage per load - gallons	41	Average Use Per Capita Per Day	0.37
New: Usage per load - gallons	17	Average Loads per week - 4 People	10
Usage decline	24	Savings per week	251
		Savings per year - Gallons	13,037

Toilet:

Old: Usage per flush - gallons	3.5	Flush per person per day	5
New: Usage per flush - gallons	1.3	Household number	4
Usage decline	2.2	Flush per day per household	20
		Flush per year per household	7,300
		Savings per year - Gallons	16,206

Fixtures (Showers):

Old: Gallons/min flow	2.75	Flow Minutes Per Person Day	8
New: Gallons/min flow	2.00	Household Number	4
Usage Decline	0.75	Total Flow Minutes Per Day	32
		Total Flow Savings Per Day	24
		Savings per year - Gallons	8,870

Fixtures (Faucets):

Old: Gallons/min flow	2.75	Flow Minutes Per Person Day	8
New: Gallons/min flow	1.50	Household Number	4
Usage Decline	1.25	Total Flow Minutes Per Day	32
		Total Flow Savings Per Day	41
		Savings per year - Gallons	14,783

Dish Washer:

Old: Gallons/cycle	14	Average Use Per Capita Per Day	0.10
New: Gallons/cycle	4	Average Loads per week - 4 People	3
Usage decline	10	Savings per week	27
		Savings per year - Gallons	1,420

Total Impact of All Appliances:

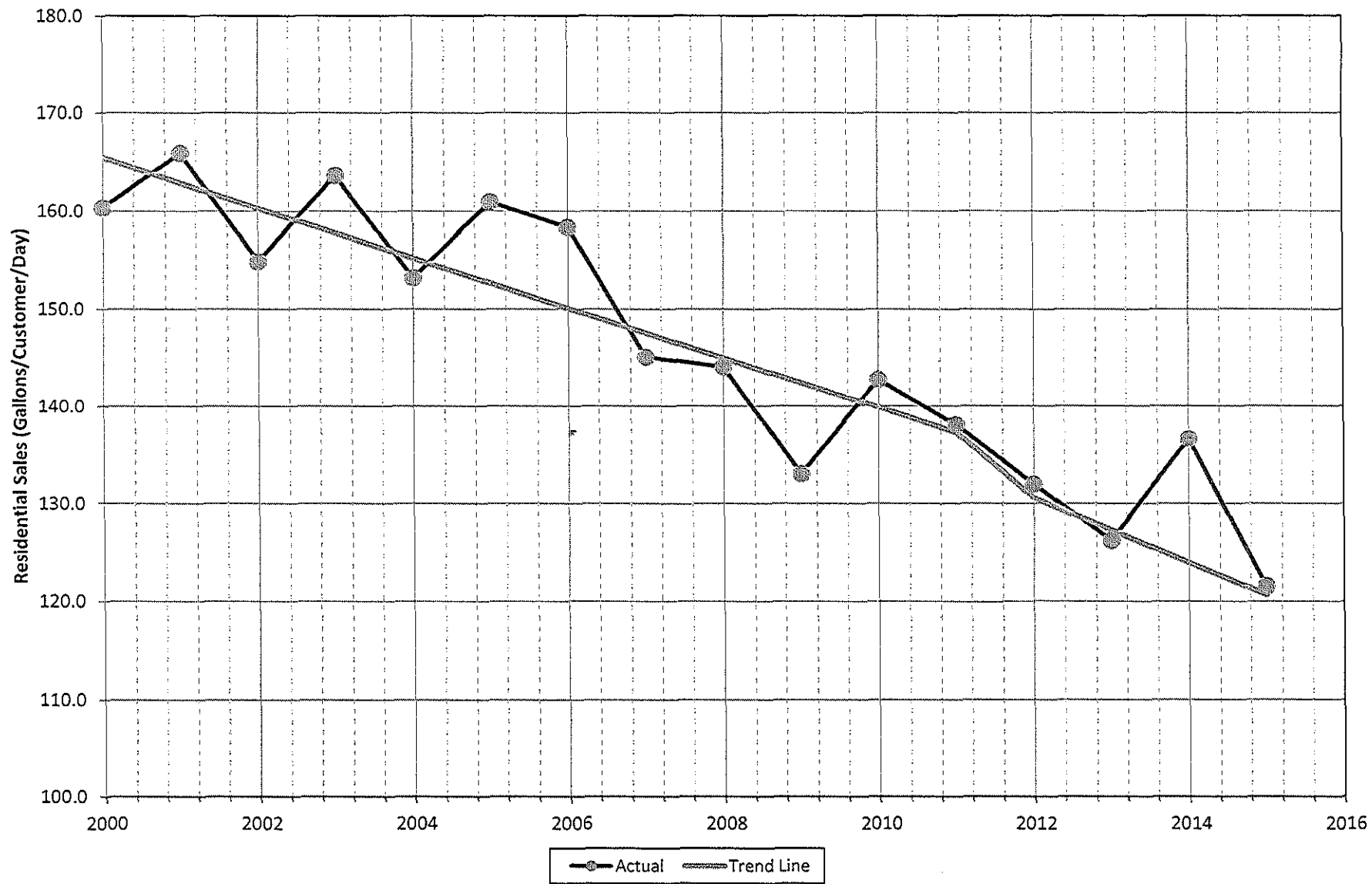
Total Calculated Annual MOAW Decrease in Usage (Gallons)	505,638,205
Divided by: Total Estimate Water Usage Savings For Family of Four (Gallons)	54,315
Implied Number of Toilet, Clothes Washer, Fixture and Dish Washer Changes Accounting For Annual Usage Reduction WVAW (Number of Customers)	9,309

MOAW - Average Number of Residential Customers	423,483
Maximum number of Customers in a single year contributing to decline	2.20%

*1 Source: Handbook of Water Use and Conservation, Amy Vickers, May, 2001

*2 Source: www.home-water-works.org, A project of the Alliance for Water Efficiency, 2011.

Missouri American Water
Joplin District Residential Sales per Customer
(Annual Average Usage Historic vs. Trend Estimated)



Missouri American Water Company
Allowed Sales and Revenue Compared to Annual Actual
(2010 - 2015)

Measure	2010	2011	2012	2013	2014	2015***	2012-2015
MAWC Total Revenue - Actual	224,608,260	242,414,295	279,467,636	264,778,072	270,239,218	266,369,812	
Case No. WR-2011-0337 Allowed Revenue*		261,866,275	261,866,275	261,866,275	261,866,275	261,866,275	
Commission Order, Case Number WO-2012-0401 Issued 9/20/12, Eff 9/25/12	3,989,867		3,989,867	3,989,867	3,989,867	3,989,867	
Commission Order, Case Number WO-2013-0406 Issued 6/7/13, Eff 6/21/13	5,827,176			5,827,176	5,827,176	5,827,176	
Commission Order, Case Number WO-2014-0055 Issued 11/13/13, Eff 12/14/13	4,815,317			4,815,317	4,815,317	4,815,317	
Commission Order, Case Number WO-2014-0237 Issued 5/28/14, Eff 5/30/14	4,113,382				4,113,382	4,113,382	
Commission Order, Case Number WO-2015-0059 Issued 12/17/14, Eff 12/31/14	8,986,785				8,986,785	8,986,785	
Commission Order, Case Number WO-2015-0211 Issued 6/17/15, Eff 6/27/15	1,919,991					1,919,991	
Total Allowed Revenue By Year		261,866,275	265,856,142	276,498,635	289,598,802	291,518,793	
Revenue Recovery Compared to Allowed (Under)/Over		(19,451,980)	13,611,494	(11,720,563)	(19,359,584)	(25,148,981)	(42,617,634)
MAWC Total Annual Water Sales (000s Gallons)	60,275,921	61,244,732	64,866,438	58,083,752	56,927,384	56,979,050	
Case No. WR-2011-0337 Allowed Water Sales (000s Gallons)*		60,512,361	60,512,361	60,512,361	60,512,361	60,512,361	
Water Sales Compared to Allowed (Under)/Over (000s Gallons)		732,371	4,354,077	(2,428,610)	(3,584,977)	(3,533,311)	(5,192,822)

* Per State of Missouri Public Service Commission Order WR-2011-0337, Issued March 7, 2012, Adjusted for Subsequent ISRIS Filings.

** Summer 2012 historically warm and dry; 4th driest summer since 1895, warmest summer since 1895 NOAA/NCDC

*** 2015 Annualized based on average ratio of YTD/Annual for the period 2010-2014

The following regulations are listed in the "Energy Independence & Security Act of 2007," Public Law 110-140 – Dec. 19, 2007:

1. A top-loading or front-loading standard-size residential clothes washers manufactured on or after January 1, 2011 shall have a water factor of not more than 9.5. (water factor is equal to gallons/cycle/cubic feet)
2. Dishwashers manufactured on or after January 1, 2010, shall—
 - a. for standard size dishwashers (≥ 8 place settings + six serving pieces) not exceed **6.5 gallon per cycle**; and
 - b. for compact size dishwashers (< 8 place settings + six serving pieces) not exceed **4.5 gallons per cycle**.

TABLE 1
Flow rates from typical fixtures and appliances before and after Federal Standards

Type of Use	Pre-Regulatory Flow*	New Standard (maximum)	Federal Standard	Year Effective	WaterSense / ENERGY STAR Current Specification+ (maximum)
Toilets	3.5 gpf	1.6 gpf	U.S. Energy Policy Act	1994	1.28 gpf
Clothes washers**	41 gpl (14.6 WF)	Estimated 26.6 gpl (9.5 WF)	Energy Independence & Security Act of 2007	2011	Estimated 16.8 gpl (6.0 WF)
Showers	2.75 gpm	2.5 gpm	U.S. Energy Policy Act	1994	2.0 gpm
Faucets***	2.75 gpm	2.5 gpm (1.5 gpm)	U.S. Energy Policy Act	1994	1.5 gpm at 60 psi
Dishwashers	14.0 gpc	6.5 gpc for standard; 4.5 gpc for compact	Energy Independence & Security Act of 2007	2010	4.25 gpc for standard; 3.5 gpc for compact
Commercial Pre Rinse Spray Valves	1.8 to 6 gpm	1.6 gpm	U.S. Energy Policy Act of 2005	2006	1.28 gpm

* Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001

** Average estimated gallons per load and water factor (see calculations)

*** Regulation maximum of 2.5 gpm at 80 psi, but lavatory faucets available at 1.5 gpm maximum (see calculations)

+Source: <http://www.epa.gov/watersense/> and <http://www.energystar.gov> websites

ABBREVIATIONS USED	
gpcd	gallons per capita per day
gpf	gallons per flush
gpl	gallons per load
gpm	gallons per minute
gpc	gallons per cycle
WF	water factor, or gallons per cycle per cubic feet capacity of the washer (the smaller the water factor, the more water efficient the clothes washer)

TABLE 2
Daily indoor per capita water use from various fixtures and appliances in a typical single family home before and after Federal Regulations

Type of Use	Pre-Regulatory Standards Amount** (gpcd)	Post-Regulatory Standards Amount** (gpcd)	Savings from Pre-Reg	Water Sense/ Energy Star Amount** (gpcd)	Additional Savings from Post-Reg
Toilets	17.9	8.2	54%	6.5	21%
Clothes washers*	15	9.8	35%	6.2	37%
Showers	9.7	8.8	9%	7.1	19%
Faucets	14.9	10.8	28%	8.1	25%
Dishwashers*	1.4	0.65	54%	0.43	34%
Total Indoor Water Use	58.9	38.3	35%	28.3	26%

Note: List only includes common household fixtures and appliances and excludes leaks and "other domestic uses" in order to be conservative.

*Regulatory Standards effective in 2010 and 2011. For calculations of amount in gpcd, refer to the calculation below.

**Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001

CALCULATIONS

Clothes washer (pre-regulatory):

Number of times clothes washer used everyday * = 0.37 loads per day
 Clothes washer water use rate range * = 39 gpl to 43 gpl
 Average water use rate = 41 gpl
 Water usage per capita = 41 gpl * 0.37 loads/day
 = 15 gpcd
 Water factor (WF) as gallons/cycle/cu. ft = 41 gpl / 2.8 cu. ft (assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
 = 14.6

Clothes washer (new standard):

Number of times clothes washer used everyday * = 0.37 loads per day
 New regulatory standard = 9.5 WF
 = 9.5 gallons/per cycle/cubic feet

Therefore, new usage per capita = 26.6 gpl (Assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
= 26.6 gpl * 0.37 loads/day
= 9.8 gpcd

Clothes washer (WaterSense/Energy Star):

Number of times clothes washer used everyday * = 0.37 loads per day
New regulatory standard = 6 WF
= 6 gallons/per cycle/cubic feet
= 26.6 gpl (Assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
Therefore, new usage per capita = 16.8 gpl * 0.37 loads/day
= 6.2 gpcd

Dishwasher:

Number of times dishwasher used everyday* = 0.10 times
New regulatory standard = 6.5 gallons/per cycle (for standard dishwashers only)
Therefore, new usage per capita = 6.5 gallons/per cycle * 0.1
= 0.65 gpcd

Dishwasher (WaterSense/Energy Star):

Number of times dishwasher used everyday* = 0.10 times
New regulatory standard = 4.25 gallons/per cycle (for standard dishwashers only)
Therefore, new usage per capita = 4.25 gallons/per cycle * 0.1
= 0.43 gpcd

Faucet:

Actual faucet flow during use* = 67% rated flow
Rated flow* = 1.5 gpm to 2.5 gpm
Frequency of faucet use* = 8.1 min/day
Range of usage per capita = 8.1 gpcd to 13.5 gpcd
Assume average of range for estimated gpcd = 10.8 gpcd

Faucet (WaterSense/Energy Star):

Actual faucet flow during use* = 67% rated flow
Rated flow* = 1.5 gpm
Frequency of faucet use* = 8.1 min/day
Usage per capita = 8.1 gpcd
Assume average of range for estimated gpcd = 8.1 gpcd

*Source: *Handbook of Water Use and Conservation*, Amy Vickers, May, 2001

National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPA Act 1992, EPA Act 2005, "Energy Independence and Security Act of 2007" (or backlog NAECA updates)		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Residential Toilets	1.6 gpf ¹	1.28 gpf/ 4.8 Lpf proposed by efficiency advocates for tank-type only	Tank-type toilets: WaterSense = 1.28 gpf (4.8L) with at least 350 gram waste removal + LA Spec.		No specification	
Residential Lavatory (Bathroom) Faucets	2.2 gpm at 60 psi ²	1.5 gpm/ 5.7 Lpm proposed by efficiency advocates	WaterSense = 1.5 gpm maximum & 0.8 gpm minimum at 20 psi		No specification	
Residential Kitchen Faucets				None proposed at this time	No specification	
Residential Showerheads	2.5 gpm at 80 psi		WaterSense = 2.0 gpm		No specification	
Residential Clothes Washers	MEF ≥ 1.26 ft ³ /kWh/cycle *No specified water use factor Note: MEF measures energy consumption of the total laundry cycle (wash + dry). The higher the number, the greater the energy efficiency	Energy Independence and Security Act of 2007 specified effective in 2011: MEF ≥ 1.26 ft ³ /kWh/cycle WF ≤ 9.5 gal/cycle/ft ³ Also specified: DOE shall publish final rule by Dec 31, 2011, determining if standards will change effective 1/1/2015.	Energy Star (DOE) effective July 1, 2009: MEF ≥ 1.8 ft ³ /kWh/cycle WF ≤ 7.5 gal/cycle/ft ³	Energy Star (DOE) To be effective Jan 1, 2011: MEF ≥ 2.0 WF ≤ 6.0 gal/cycle/ft ³	Tier 1: MEF ≥ 1.80 ft ³ /kWh/cycle; WF ≤ 7.5 gal/cycle/ft ³ Tier 2: MEF ≥ 2.00 ft ³ /kWh/cycle; WF ≤ 6.0 gal/cycle/ft ³ Tier 3: MEF ≥ 2.20 ft ³ /kWh/cycle; WF ≤ 4.5 gal/cycle/ft ³	

¹ EPA Act 1992 standard for toilets applies to both commercial and residential models.

² EPA Act 1992 standard for faucets applies to both commercial and residential models.

DOE: Department of Energy
EPA: Environmental Protection Agency
EPA Act 1992: Energy Policy Act of 1992
EPA Act 2005: Energy Policy Act of 2005

EF: energy factor
ft³: cubic feet
gal: gallons
gpm: gallons per minute

gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance

NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor
Lpf: Litres per flush

Updated March 2010
Koeller/Dietemann



National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances
Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAAct 1992, EPAAct 2005, "Energy Independence and Security Act of 2007" (or backlog NAECA updates)		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed/Future Specification
Standard Size and Compact Residential Dishwashers ³	<p><i>Standard models:</i> Energy Independence and Security Act of 2007 specified: effective 1/1/2010: Standard Size: 355 kWh/year (.62 EF + 1 watt standby) WF ≤ 6.5 gallons/cycle Compact Size: 260 kWh WF ≤ 4.5 gallons/cycle</p> <p>EF is the number of cycles the machine can run for each kWh of electricity</p>	<p>Also specified by the Act: DOE shall publish final rule by 1/1/2015 determining if dishwasher standards will change effective 1/1/2018.</p>	<p>Energy Star (DOE) Effective since July 1, 2009 Standard Size: 324 kWh/year WF ≤ 5.8 gallons/cycle Compact Size: 234 kWh/year WF ≤ 4.0 gallons/cycle</p> <p>kWh/yr is replacing EF since it includes the cycles the machine can run for each kWh, but also includes up to 8 kWh/yr of standby power (when the machine isn't cycling)</p>	<p>Energy Star effective July 1, 2011: Standard Size: 307 kWh/yr 5.0 gallons per cycle Compact Size: 222 kWh/yr 3.5 gallons per cycle</p>	<p><i>Effective Aug. 11, 2009:</i> <i>Standard models:</i> EF; maximum kWh/year Tier 1: EF ≥ 0.72 cycles/kWh; and 307 max kWh/year; 5.0 gallons per cycle Tier 2: EF ≥ 0.75 cycles/kWh; 295 max kWh/year; 4.25 gallons per cycle <i>Compact models:</i> Tier 1: EF ≥ 1.0 cycles/kWh; 222 max kWh/year; 3.5 gallons per cycle</p>	<p>Could adjust Tiers after July 1, 2011 when new Energy Star becomes effective</p>

³ **Standard models:** capacity is greater than or equal to eight place settings and six serving pieces; **Compact models:** capacity is less than eight place settings and six serving pieces

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Updated March 2010
 Koeller/Dietemann



National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAc 1992, EPAc 2005 (or backlog NAECA updates)		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Toilets	1.6 gpf ⁴ /6.0 Lpf Except blow-out fixtures: 3.5-gpf/13 Lpf Note: Some states prohibit blow-out at 3.5 gpf	1.28 gpf/ 4.8 Lpf proposed by efficiency advocates for tank-type only	Tank-type only: WaterSense at 1.28 gpf (4.8L) with at least 350 gram waste removal + LA Spec.	Flushometer valve/ bowl combinations: WaterSense specification in development. No release date promised.	No specification	
Commercial Urinals	1.0 gpf	0.5 gpf/ 1.9 Lpf proposed by efficiency advocates	WaterSense = 0.5 gpf/1.9Lpf (flushing urinals only)		No specification	
Commercial Faucets	Private faucets: 2.2 gpm at 60 psi ⁵ Public Restroom faucets: 0.5 gpm at 60 psi ⁵ Metering (auto shut of) faucets: 0.25 gallons per cycle ⁶			WaterSense draft specification now under consideration	No specification	

⁴ EPAc 1992 standard for toilets applies to both commercial and residential models.

⁵ In addition to EPAc requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code for all except private applications, private being defined as residential, hotel guest rooms, and health care patient rooms. All other applications subject to the 0.5 gpm/1.9 Lpm flow rate maximum.

⁶ Metering faucets not subject to flow rate maximum

DOE: Department of Energy
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EPAc 1992: Energy Policy Act of 1992
EPAc 2005: Energy Policy Act of 2005

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psi: pounds per square inch
WF: water factor
Lpf: Litres per flush

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National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances
Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAAct 1992, EPAAct 2005 <i>(or backlog NAECA updates)</i>		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Clothes Washers (Family-sized)	MEF ≥ 1.26 ft ³ /kWh; WF ≤ 9.5 gal/cycle/ft ³	New standards under development: DOE scheduled final action: January 2010; Rulemaking process postponed by DOE in 2008; began again in Dec. 2009.	Energy Star (DOE) MEF ≥ 1.72 ft ³ /kWh/cycle; WF ≤ 8.0 gal/cycle/ft ³		Adopted Jan 1, 2007 (Note: this spec covers only normal capacity family washers, NOT large capacity commercial washers) Tier 1: 1.80 MEF 7.5 gal/cycle/ft ³ Tier 2: 2.00 MEF 6.0 gal/cycle/ft ³ Tier 3: 2.20 MEF 4.5 gal/cycle/ft ³	

DOE: Department of Energy
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*Updated March 2010
 Koeller/Dietemann*



National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPA Act 1992, EPA Act 2005 (or backlog NAECA updates)		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Dishwashers	No standard		Energy Star (EPA) using NSF/ANSI standards for water use and ASTM standards for energy use Effective 10/11/2007 <i>Under counter:</i> Hi Temp: 1.0 gal/rack; <= 0.90 kW; Lo Temp 1.70 gal/rack <= 0.5 kW <i>Stationary Single Tank Door:</i> Hi Temp: 0.95 gal/rack; <= 1.0 kW Lo Temp: 1.18 gal/rack; <= 0.6 kW <i>Single Tank Conveyor:</i> Hi Temp: 0.70 gal/rack; <= 2.0 kW; Lo Temp: 0.79 gal/rack; <= 1.6 kW <i>Multiple Tank Conveyor:</i> Hi Temp: 0.54 gal/rack; <= 2.6 kW Lo Temp: 0.54 gal/rack; <= 2.0 kW		No specification	

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 psi: pounds per square inch
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 Lpf: Litres per flush

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National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances
Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAAct 1992, EPAAct 2005 <i>(or backlog NAECA updates)</i>		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Automatic Commercial Ice Makers ⁷	Effective 1/1/2010: Energy and condenser water efficiency standards vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table)		Energy Star (EPA) Energy and water efficiency standards vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table). <u>Water cooled machines excluded from Energy Star</u>		Energy and water (potable and condenser) standards are tiered and vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table)	
Commercial Pre-rinse Spray Valves (for food service applications)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)		No specification	Proposed Energy Star specification abandoned after standard established in EPAAct 2005; WaterSense specification in development in conjunction with Energy Star	No specification (program guidance recommends 1.6 gpm at 60 psi and a cleanability requirement)	

⁷ Optional standards for other types of automatic ice makers are also authorized under EPAAct 2005.

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 EPAAct 2005: Energy Policy Act of 2005

EF: energy factor
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National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPA 1992, EPA 2005 <i>(or backlog NAECA updates)</i>		WaterSense [®] or Energy Star [®]		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Steam Cookers ⁸	No standard		Energy Star (EPA) <i>Electric:</i> 50% cooking energy efficiency; idle rate 400–800 Watts <i>Gas:</i> 38% cooking energy efficiency; idle rate 6,250–12,500 British thermal units/hour *No specified water use factor		<i>Electric:</i> 50% cooking energy efficiency; idle rate 400–800 Watts <i>Gas:</i> 38% cooking energy efficiency; idle rate 6,250–12,500 British thermal units/hour Water Use Factor (for both electric and gas models): Tier 1A: ≤ 15 gal/hr Tier 1B: ≤ 4 gal/hr	

⁸ Idle rate standards vary for 3-, 4-, 5-, and 6-pan commercial steam cooker models.

DOE: Department of Energy
 EPA: Environmental Protection Agency
 EPA 1992: Energy Policy Act of 1992
 EPA 2005: Energy Policy Act of 2005

EF: energy factor
 ft³: cubic feet
 gal: gallons
 gpm: gallons per minute

gpf: gallons per flush
 kWh: kilowatt hour
 MEF: modified energy factor
 MaP: maximum performance

NAECA: National Appliance Energy Conservation Act
 psi: pounds per square inch
 WF: water factor
 Lpf: Litres per flush

*Updated March 2010
 Koeller/Dietemann*



National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances
Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Information/materials on EPAAct 2005/NAECA standards:

Schedule for development of appliance and commercial equipment efficiency standards:

http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html

Commercial Clothes Washers and Dishwashers (agenda/presentations at 4/27/06 DOE public meeting on rulemaking):

http://www.eere.energy.gov/buildings/appliance_standards/residential/home_appl_mtg.html

Automatic Commercial Ice Maker Standards:

http://www.eere.energy.gov/buildings/appliance_standards/pdfs/epact2005_appliance_stds.pdf (Page 18)

Pre-rinse Spray Valves

http://www.eere.energy.gov/buildings/appliance_standards/pdfs/epact2005_appliance_stds.pdf (Page 10)

Information/materials on WaterSense specifications:

Toilets

<http://www.epa.gov/watersense/products/toilets.html>

Urinals

<http://www.epa.gov/watersense/products/urinals.html>

Bathroom Lavatory Faucets

http://www.epa.gov/watersense/products/bathroom_sink_faucets.html

Information/materials on Energy Star specifications:

Residential Clothes Washers

http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers

Commercial Clothes Washers

http://www.energystar.gov/index.cfm?fuseaction=clotheswash.display_commercial_cw

Residential Dishwashers

http://www.energystar.gov/index.cfm?c=dishwash.pr_dishwashers

Commercial Dishwashers

http://www.energystar.gov/index.cfm?c=new_specs.comm_dishwashers

Automatic Commercial Ice Makers

http://www.energystar.gov/index.cfm?c=new_specs.ice_machines

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**National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances
Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)**

Commercial Steam Cookers

http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers

Information/materials on CEE specifications:

Residential Clothes Washers

<http://www.cee1.org/resid/seha/rwsh/rwsh-main.php3>

Residential Dishwashers

<http://www.cee1.org/resid/seha/dishw/dishw-main.php3>

Commercial, Family-Sized Clothes Washers

<http://www.cee1.org/com/cwsh/cwsh-main.php3>

Commercial Ice-Makers

<http://www.cee1.org/com/com-ref/ice-main.php3>; Spec Table: <http://www.cee1.org/com/com-kit/ice-specs.pdf>

Pre-rinse Spray Valves

<http://www.cee1.org/com/com-kit/prv-guides.pdf>

Commercial Steam Cookers

<http://www.cee1.org/com/com-kit/sc-hc-specs.pdf>

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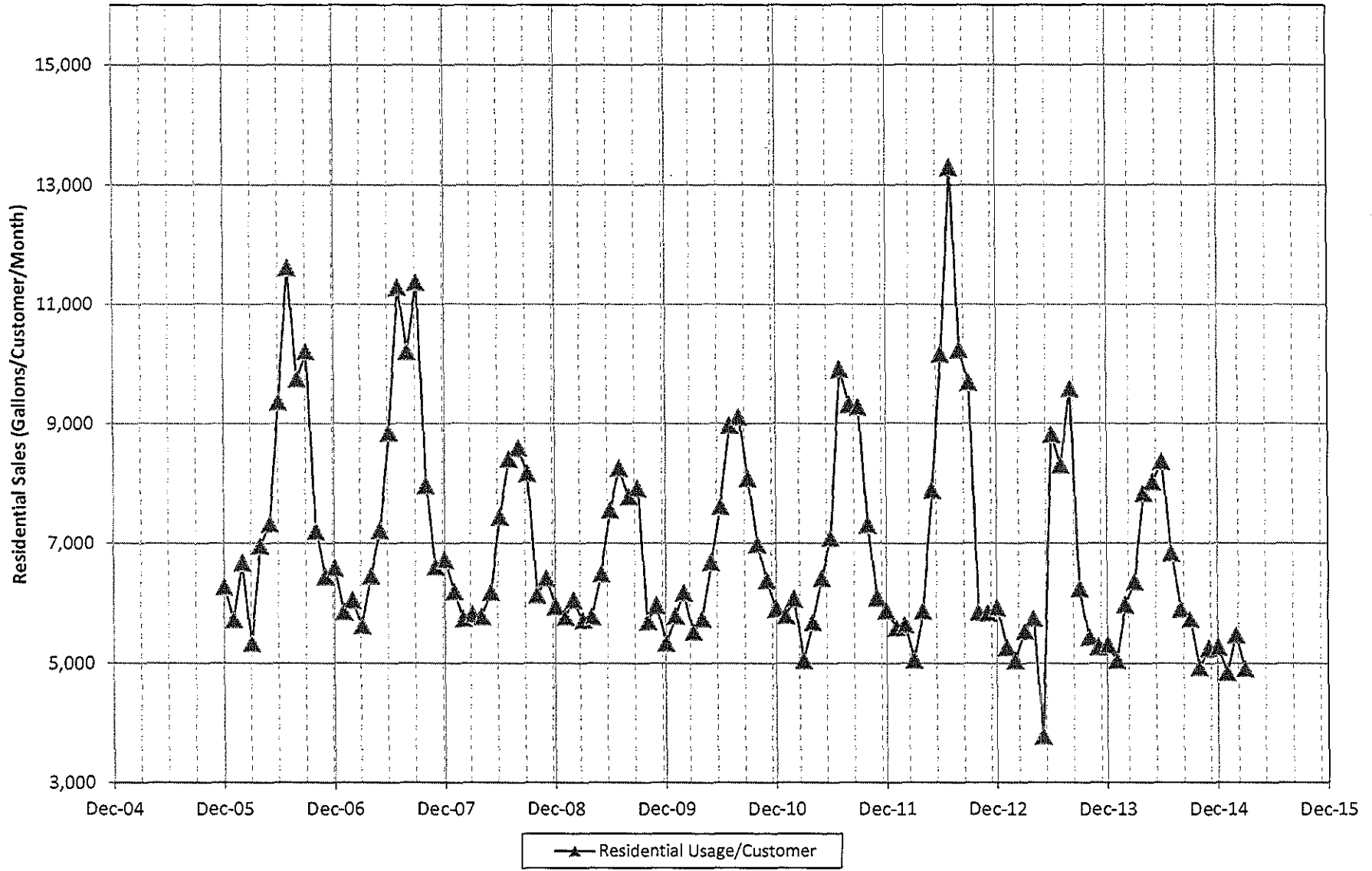
gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance

NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor
Lpf: Litres per flush

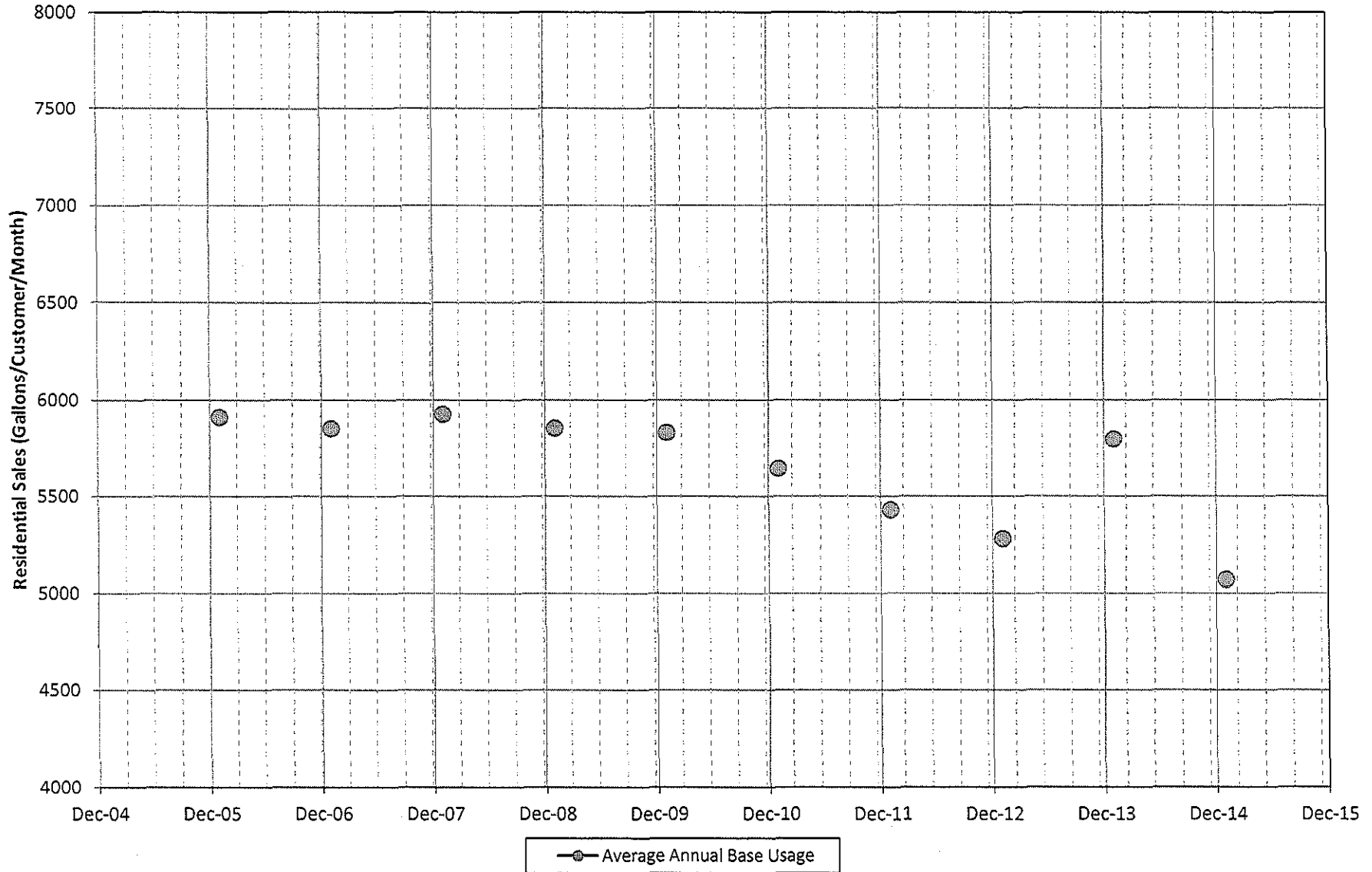
Updated March 2010
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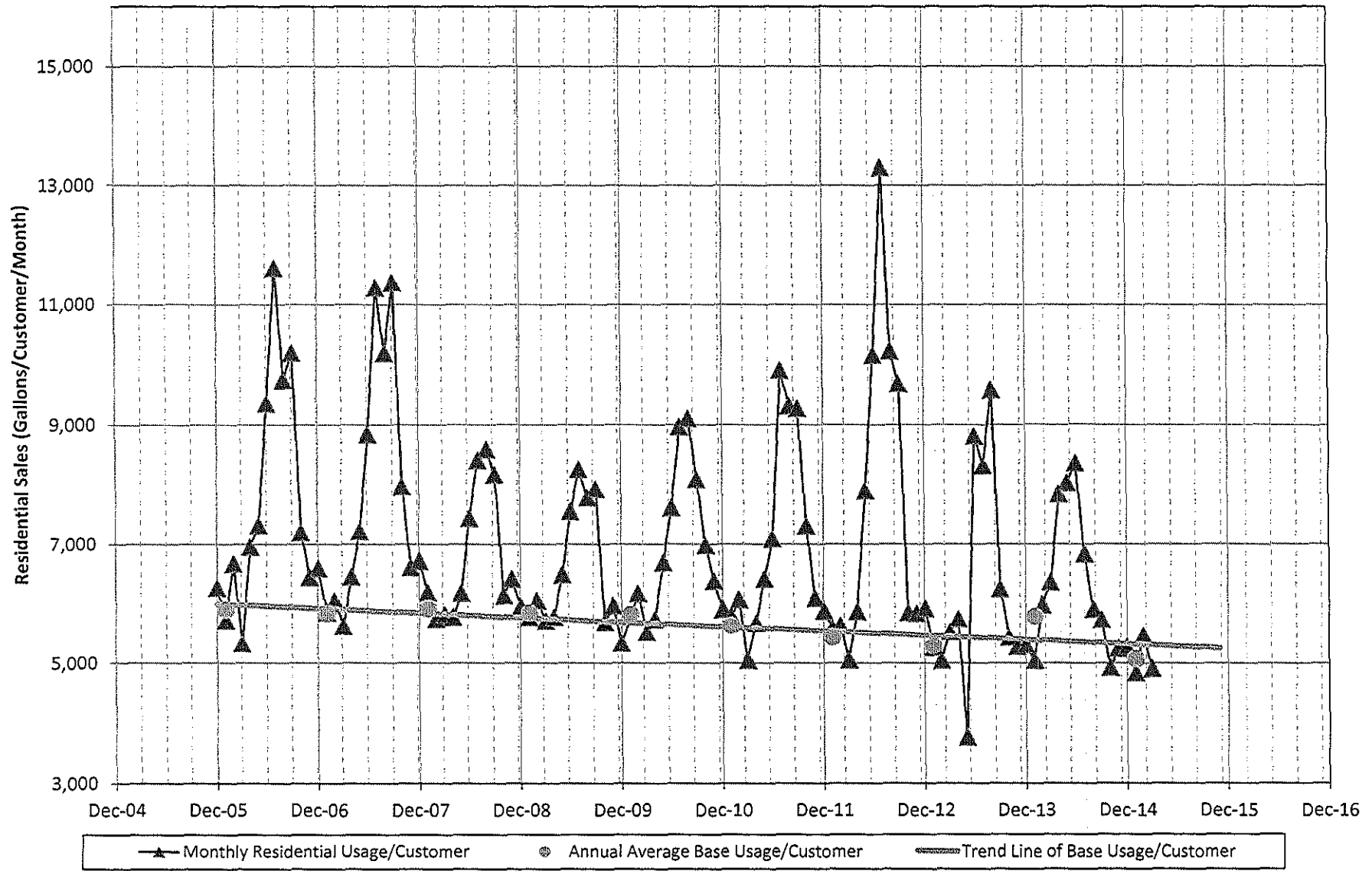
Missouri American Water
Residential Sales per Customer
(10-year Annual Trend)



Missouri American Water
Residential Sales per Customer
(10-year Annual Trend)



Missouri American Water
 Residential Sales per Customer
 (10-year Annual Trend)



Residential Water Usage Forecasts Based on 10 year history
Based on Winter Usage Trends except where noted below

State	Annual Decline (GPCY)^{***} 10-year (2006-2015)	Rate of Decline 2012-2013 (%)^{***} 10-year (2006-2015)
California*	-4,773	-4.3%
Illinois	-829	-1.7%
Indiana	-798	-1.7%
Iowa	-1,235	-2.9%
Kentucky	-816	-1.9%
Maryland**	-1,192	-2.8%
Missouri	-1,194	-1.9%
New Jersey (SA1)	-1,293	-2.3%
New Jersey (SA2)	-1,293	-2.3%
New York	-1,529	-2.4%
Pennsylvania	-1,008	-2.1%
Tennessee	-798	-1.7%
Virginia	-1,120	-2.9%
West Virginia	-428	-1.1%
Michigan++	-1,017	-2.4%
Weighted Average (w/o CA)	-1,039	-2.0%
Weighted Average (w/ CA)	-1,241	-2.1%

Notes:

*California used the Annual Average Method for trending using a 10 yr (2006-2015) history

**MD used the Annual Average Method for trending using a 10 yr (2006-2015) history

++ MI Analyses presented were performed using an annual average method for a 10 year duration only

Missouri American Water Co.
Reasonableness of Consumption Decline Calculation
1,194 Gallons Per Customer Per Year

Illustrating: Replacement of Clothes Washing, Toilet, Fixtures and Dishwashers Based on Family of Four

Washer:

Old: Usage per load - gallons	41	Average Use Per Capita Per Day	0.37
New: Usage per load - gallons	17	Average Loads per week - 4 People	10
Usage decline	24	Savings per week	251
		Savings per year - Gallons	13,037

Toilet:

Old: Usage per flush - gallons	3.5	Flush per person per day	5
New: Usage per flush - gallons	1.3	Household number	4
Usage decline	2.2	Flush per day per household	20
		Flush per year per household	7,300
		Savings per year - Gallons	16,206

Fixtures (Showers):

Old: Gallons/min flow	2.75	Flow Minutes Per Person Day	8
New: Gallons/min flow	2.00	Household Number	4
Usage Decline	0.75	Total Flow Minutes Per Day	32
		Total Flow Savings Per Day	24
		Savings per year - Gallons	8,870

Fixtures (Faucets):

Old: Gallons/min flow	2.75	Flow Minutes Per Person Day	8
New: Gallons/min flow	1.50	Household Number	4
Usage Decline	1.25	Total Flow Minutes Per Day	32
		Total Flow Savings Per Day	41
		Savings per year - Gallons	14,783

Dish Washer:

Old: Gallons/cycle	14	Average Use Per Capita Per Day	0.10
New: Gallons/cycle	4	Average Loads per week - 4 People	3
Usage decline	10	Savings per week	27
		Savings per year - Gallons	1,420

Total Impact of All Appliances:

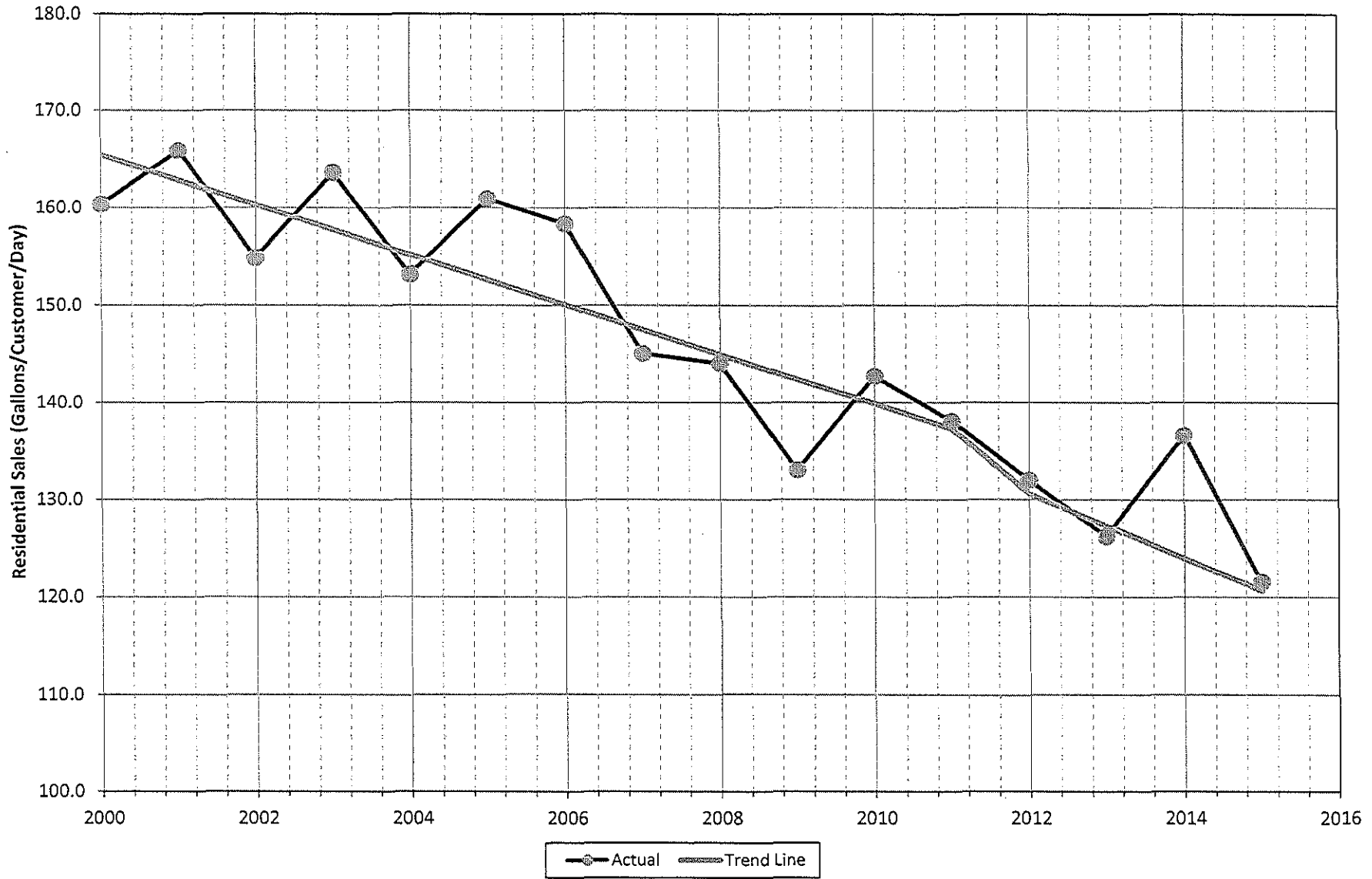
Total Calculated Annual MOAW Decrease in Usage (Gallons)	505,638,205
Divided by: Total Estimate Water Usage Savings For Family of Four (Gallons)	54,315
Implied Number of Toilet, Clothes Washer, Fixture and Dish Washer Changes Accounting For Annual Usage Reduction WVAW (Number of Customers)	9,309

MOAW - Average Number of Residential Customers	423,483
Maximum number of Customers in a single year contributing to decline	2.20%

*1 Source: Handbook of Water Use and Conservation, Amy Vickers, May, 2001

*2 Source: www.home-water-works.org, A project of the Alliance for Water Efficiency, 2011.

Missouri American Water
Joplin District Residential Sales per Customer
(Annual Average Usage Historic vs. Trend Estimated)



Missouri American Water Company
Allowed Sales and Revenue Compared to Annual Actual
(2010 - 2015)

Measure	2010	2011	2012	2013	2014	2015***	2012-2015
MAWC Total Revenue - Actual	224,608,260	242,414,295	279,467,636	264,778,072	270,239,218	266,369,812	
Case No. WR-2011-0337 Allowed Revenue*		261,866,275	261,866,275	261,866,275	261,866,275	261,866,275	
Commission Order, Case Number WO-2012-0401 Issued 9/20/12, Eff 9/25/12	3,989,867		3,989,867	3,989,867	3,989,867	3,989,867	
Commission Order, Case Number WO-2013-0406 Issued 6/7/13, Eff 6/21/13	5,827,176			5,827,176	5,827,176	5,827,176	
Commission Order, Case Number WO-2014-0055 Issued 11/13/13, Eff 12/14/13	4,815,317			4,815,317	4,815,317	4,815,317	
Commission Order, Case Number WO-2014-0237 Issued 5/28/14, Eff 5/30/14	4,113,382				4,113,382	4,113,382	
Commission Order, Case Number WO-2015-0059 Issued 12/17/14, Eff 12/31/14	8,986,785				8,986,785	8,986,785	
Commission Order, Case Number WO-2015-0211 Issued 6/17/15, Eff 6/27/15	1,919,991					1,919,991	
Total Allowed Revenue By Year		261,866,275	265,856,142	276,498,635	289,598,802	291,518,793	
Revenue Recovery Compared to Allowed (Under)/Over		(19,451,980)	13,611,494	(11,720,563)	(19,359,584)	(25,148,981)	(42,617,634)
MAWC Total Annual Water Sales (000s Gallons)	60,275,921	61,244,732	64,866,438	58,083,752	56,927,384	56,979,050	
Case No. WR-2011-0337 Allowed Water Sales (000s Gallons)*		60,512,361	60,512,361	60,512,361	60,512,361	60,512,361	
Water Sales Compared to Allowed (Under)/Over (000s Gallons)		732,371	4,354,077	(2,428,610)	(3,584,977)	(3,533,311)	(5,192,822)

* Per State of Missouri Public Service Commission Order WR-2011-0337, Issued March 7, 2012, Adjusted for Subsequent ISRIS Filings.

** Summer 2012 historically warm and dry; 4th driest summer since 1895, warmest summer since 1895 NOAA/NCDC

*** 2015 Annualized based on average ratio of YTD/Annual for the period 2010-2014