– REPORT–

Water Losses And Customer Water Use In The United Water New York System

July 2015

Prepared for

Rockland County Task Force on Water Resources Management
Rockland County, New York

Prepared by

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EXECUTIVE SUMMARY

This report was prepared by Amy Vickers & Associates, Inc. for the Rockland County Task Force on Water Resources Management, based in Rockland County, New York. The report presents the findings from a study of system (infrastructure) water losses and customer water use in the United Water New York (UWNY) drinking water supply system that supplies most of the towns and villages in Rockland County, New York.

The focus of the study is the extent to which system water losses (e.g., leakage, accounting errors, and theft) and customer (residential and nonresidential) water use in the UWNY service area are at, above, or below water industry standards, benchmarks, and performance indicators for water use efficiency. Based on that analysis, preliminary estimates of the potential long-term water savings from improvements to UWNY's water loss control and customer conservation programs were made and are provided in this report.

The primary sources for the data and information used to conduct this study include but are not limited to:

- United Water New York (UWNY). System production, water loss, and customer meter data and related system and service area background information and reports.
- New York State Public Service Commission (PSC). Non-revenue water and Annual Reports of United Water New York, 2008-2014.
- New York State Department of Environmental Conservation (DEC). Water Withdrawal Reports submitted by UWNY, 2012-2014, and Water Conservation Program Report submitted by UWNY, 2010 (most recent).
- American Water Works Association (AWWA). AWWA Water Audit Software v5.0 (2014), and various manuals of standards and practices including M36–Water Audits and Loss Control Programs (3rd ed.) and M6–Water Meters: Selection, Installation, Testing, and Maintenance (5th ed.).
- Water Research Foundation and the Environmental Protection Agency. *Real Loss Component Analysis: A Tool for Economic Water Loss Control*, Report #4372a (2014).

A complete listing of source materials used for this study is provided in the References section at the end of this report.

Key findings and conclusions from this study include:

1. **Water demand in United Water New York's service area has been largely flat since 2000 despite a growing service area population, a trend that may continue for the foreseeable future**. Historical total annual average day volumes of water supplied today are nearly the same since the year 2000 despite an 11.2% growth in Rockland County's population over those same years. More people are using less water, and less water is needed to serve more people. Further, the continuing impacts of national and state water efficiency standards for plumbing fixtures and appliances along with changing economic conditions, may very well continue to keep customer water demands stable for the foreseeable future.

2. **Data inconsistencies, errors, and missing data in UWNY's records and reports make it difficult if not impossible to know the true volumes of water supplied, imported, exported, consumed by retail customers, and "lost" to non-revenue/unaccounted-for water (e.g., leakage, meter and other accounting errors) for the years 2012, 2013, and 2014 that were the focus of analysis for this study.**

3. **The sluggish pace of UWNY's main replacement put it on a multi-century 704-year schedule in 2014, on top of being more than a decade behind the state's recommended timetable for surveying leaks in system mains**. In 2014, only 1.5 miles of UNWY's 1,056 miles of mains–a fraction of one percent–were rehabilitated. At that rate of replacement, it will take 704 years for all of UWNY's existing mains, many of which are already past their service life, to be replaced. In addition, despite the New York Department of Environmental Conservation's recommended maximum 3-year schedule for water system leak surveys, in 2014 UWNY sounded only 7% of its mains for leaks, putting it on a 14-year schedule that likely contributed further to the utility's backlog of needed leak repairs. Both schedules are similar to those in other recent years.

4. **An estimated 2.5 MGD to 3.3 MGD of potentially recoverable leakage exists within the UWNY system based on revised AWWA Water Audit reports using corrected data, UWNY's Annual Report figures reported to the PSC, and AWWA defaults for 2012-2014–a sharp contrast to previous UWNY estimates using flawed data and assumptions**.[1] A series of data errors, missing and inconsistent data, and flawed assumptions about system water losses appear to have resulted in several major errors in UWNY's AWWA Water Audit reports to the PSC for at least 2012-2014. To more accurately profile and understand the status of UWNY's system's water losses and non-revenue water, as well as the potential for future leakage reduction, the water audit reports were recalculated by the Task Force consultant (Amy Vickers & Associates, Inc.) using AWWA Water Audit defaults and related assumptions, corrected data provided by UWNY, and data from UWNY's Annual Reports to the PSC for 2012-2014. In contrast to UWNY's previous reports that found non-revenue losses to consist largely of apparent losses and only a small portion of recoverable leakage, the revised reports indicate the reverse: a high volume of potentially recoverable leakage and a moderate level of apparent losses. Such findings are consistent with UWNY's substandard schedules for main replacement and system leak detection and repair.

5. **A preliminary estimate of 1.9 MGD to 3.6 MGD of potential water demand reductions from customer-oriented conservation measures exists within the UWNY system.** Based on a detailed analysis of customer water demands for the past three years and a preliminary set of minimum water conservation and efficiency measures that could be adopted in the UWNY service area, potential customer savings are estimated to average 2.8 MGD based on recent water demands. While average residential customer water demands in the UWNY service area are relatively low compared to national averages, the top 50% of single-family homes have high and in some cases excessive water demands that could be reduced through a comprehensive conservation program. Accelerated installation of water efficient plumbing fixtures and appliances, mandatory irrigation schedules, high-efficiency commercial and industrial equipment and processes, reuse, rainwater harvesting, water audits, rebates and a more

[1] The terms "corrected reports" and "revised reports" are used interchangeably in this document. These terms refer to reports prepared by the Task Force consultant who recalculated UWNY's AWWA Water Audit reports for 2012-2014, utilizing the following values: AWWA Water Audit default values; corrected and/or revised data provided by UWNY to the consultant; and other data and information reported by UWNY to NY State agencies.

effective conservation-oriented rate structure are just some of the many water-saving measures and incentives that could be implemented in Rockland County.

6. **A preliminary estimated combined total of 4.4 MGD to 7.0 MGD of potentially recoverable system leakage and customer water savings from conservation is currently available within the UWNY system**. These estimates, as shown in Table ES-1 and illustrated in Figure ES-1, represent a potential reduction of approximately 15% to 25% in total system demands based on average day demands of about 29 MGD in 2014. Given UWNY's high volumes of system water losses, a significant portion which is estimated to be due to leakage, and a customer service area with a largely untapped conservation potential–UWNY's conservation efforts thus far have been minimal and focused largely on outdated public education strategies for which there are no independently verified water savings–such future demand reductions are likely feasible given sufficient resources. Further, there are precedents for system-wide savings from conservation that exceed 25%, as evidenced by programs sponsored by New York City (NY), the Massachusetts Water Resources Authority (metropolitan Boston, MA), and Seattle (WA), among other U.S. water systems. These savings estimates are preliminary only and will likely be refined as part of a more detailed analysis in the conservation planning project that will follow this study.

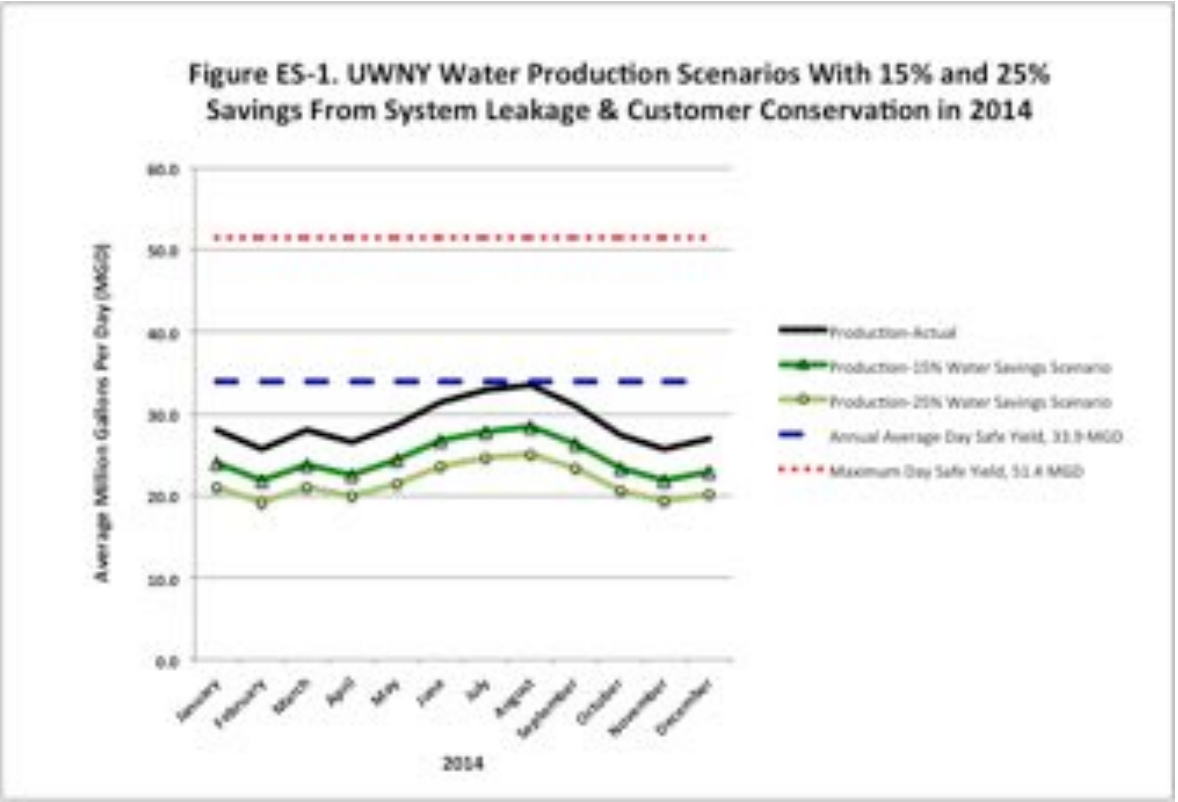
Table ES-1. Preliminary Estimates of Potential Water Savings From Conservation Based on System Water Losses and Retail Customer Demands in 2012-2014*

Category of Water Use	Low Savings Estimate, Avg. MGD	High Savings Estimate, Avg. MGD	Average Savings Estimate, Avg. MGD	Average Savings Estimate, Percent of Total Savings
UWNY System Leakage (Recoverable)				
Est. Total System Savings Potential†:	**2.5**	**3.3**	**2.9**	**51.2%**
Customer Water Use				
Single-Family	1.1	2.1	1.6	28.2%
Multi-Family	0.3	0.4	0.3	5.8%
Sloatsburg (Village)	0.0	0.0	0.0	0.3%
Commercial	0.4	0.8	0.6	10.7%
Industrial	0.2	0.3	0.2	3.6%
Service Points without Meters	Unknown			
Est. Total Customer Savings Potential:	**1.9**	**3.6**	**2.8**	**48.8%**
EST. TOTAL POTENTIAL WATER SAVINGS:	**4.4**	**7.0**	**5.7**	**100.0%**

Notes:
Some numbers may not add due to rounding.

* Estimates of potential water savings shown are preliminary only based on UWNY's combined average system water losses and retail customer water demands in 2012-2014 and do not represent actual savings that may be achieved. A more detailed analysis of the full range of conservation and efficiency measures available to reduce system leakage and customer water use is needed to produce a final estimate of future potential water savings in the UWNY service area.

† Estimates of potential water savings shown from system leakage reduction are preliminary only and represent the range of estimated recoverable leakage based on revised AWWA Water Audit reports for 2012-2014 as shown in Table 2-6.



7. **In addition to conservation, water reuse technologies, rainwater harvesting, and green infrastructure options offer Rockland County significant new opportunities to drive down UWNY's water demands even further while also achieving increased water supply independence.** Aside from the water supplied by UWNY to Rockland County customers, untapped alternative water supply opportunities exist from reuse, rainwater harvesting, and green infrastructure technologies now available that offer very different water supply and demand scenarios in the future than those assumed in the past. Municipal reclaimed water systems linked to community wastewater treatment plants, such as those increasingly common in the Southeastern and Western United States, for example, can replace potable water demands for landscape irrigation, golf courses, and many types of industrial water demands—and often at a lower cost for consumers. Today's rainwater harvesting and treatment technologies, installed at individual customer properties or scaled up for communities, can replace many nonpotable and in some cases potable demands. Green infrastructure, a more advanced and sustainable system of managing stormwater, similarly offers opportunities for satisfying irrigation and other nonpotable water demands. In short, UWNY is one of several sources of water supply available to meet Rockland County's water needs.
8. **The need for additional water supply capacity seems doubtful at this time given UWNY's potential water savings from aggressive system leak repairs and main rehabilitation, implementation of a comprehensive customer-oriented conservation program, and opportunities for Rockland County to develop alternative reuse and rainwater harvesting water supplies in the future**. An optimistic picture of new water supply capacity emerges in the form of water waste that can be recaptured through system rehabilitation and conservation. United Water New

York's decades-long record of high system water losses and minimal, outdated water conservation efforts for which there are little if any water savings to report has, in effect, produced an opportunity for new water supply capacity through optimized system rehabilitation and conservation. Those untapped opportunities to drive down water demands, in addition to alternative water supply options such as reuse and rainwater harvesting options available to the County, offer a range of future water supply and demand scenarios that are sharp contrast to those considered in the recent past.

9. **Updated and more aggressive system water loss reduction and customer water conservation standards and requirements are needed in New York to minimize avoidable system leakage and customer water waste. Failure to establish a higher standard for water conservation and efficiency will continue to put the public, ratepayers, and the environment at risk from costly new water supply projects that may not be needed.** Both the PSC and DEC appear to be relying on outdated water conservation standards, guidance documents, and approaches that fail to guide water utilities toward the many more efficient and green water development and management practices that are available today. Examples include the DEC water conservation manual published in 1989 (26 years old) and the PSC's outdated definition and standard for system water losses. States such as Massachusetts, Texas, and Georgia are just a few examples of those with more updated and rigorous conservation and water loss requirements and resources than those available currently in New York.

SECTION 1

OVERVIEW OF WATER SUPPLY AND DEMANDS OF UNITED WATER NEW YORK

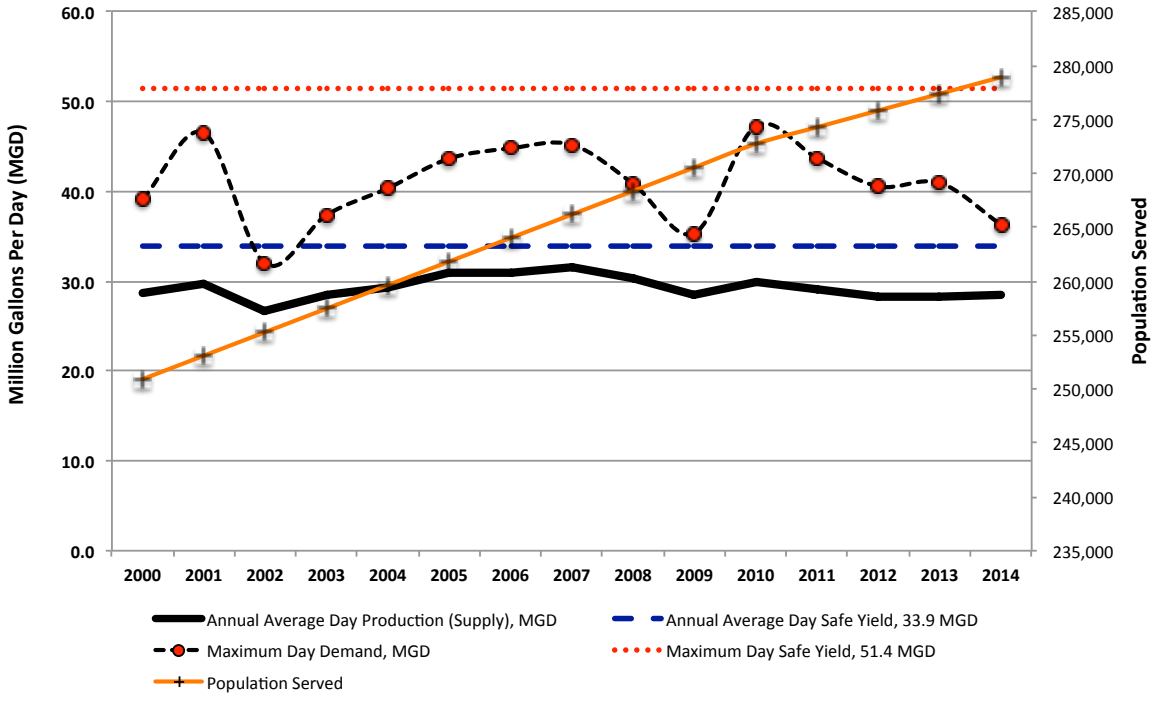
This section summarizes United Water New York's (UWNY) historical water production (supply) and demands as well as their current major categories of water use.

Historical Water Supply and Demand

The historical annual water supply and demands in the UWNY service area, including safe yield capacities and population served, are shown from 2000 through 2014 in Figure 1-1.

Despite a population increase of over 28,000 (11.2%) from 2000 to 2014, annual average day demand in 2014 was 0.1 million gallons per day (MGD) less than in 2000, and the maximum day demand in 2014 was 2.8 MGD less than in 2000. Further, over the past 5 years, from 2010 to 2014, despite a population increase of nearly 6,200 (2.3%), annual average day and maximum day demands decreased by 1.3 MGD (4.4%) and 10.9 MGD (23.1%), respectively. On a total system per capita basis–total annual production divided by population served–system per capita use averaged about 114 gallons per capita per day (GPCD) in 2000 but was down to 102 gpcd in 2014.

Figure 1-1. United Water New York: Annual Average Day Production, Maximum Day Demand and Population Served, 2000-2014



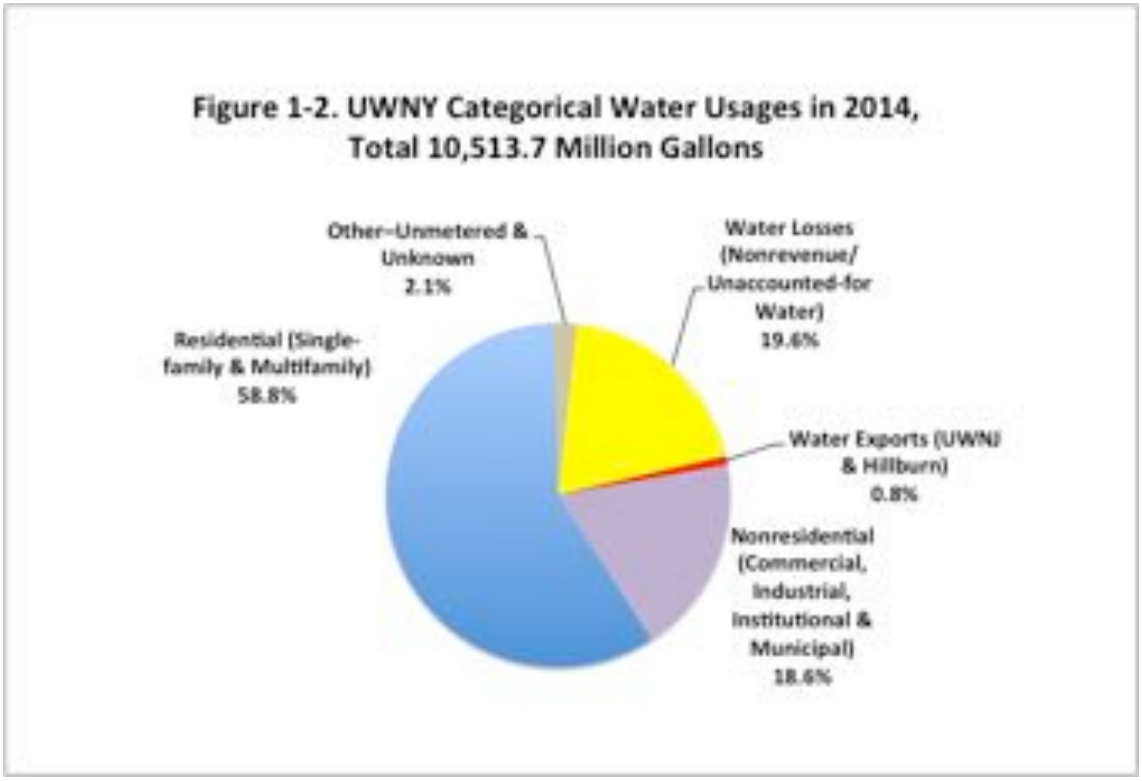
These historical trends indicate that in particular for most years since 2007, average and peak day metered water demands as well as system per capita use has been declining. Further, population growth in the UWNY service area today is less likely to correlate to increased average and peak day water demands than it was in the past. Put simply, more people are using less water, and less water is needed to serve more people.

The decreasing water demand trends in the UWNY service area are similar to those reported by many U.S. water supply suppliers for well over a decade. National and state plumbing fixture and appliance efficiency standards, decreasing industrial and manufacturing activities, and changing economic conditions are among the commonly cited reasons for this decline among residential and nonresidential customers. While it is always difficult to predict future demand, on an average per account basis, U.S. indoor residential demand is expected to continue to decline for at least another decade (Vickers and Bracciano, 2014), and commercial, industrial, and institutional (CII) water use may trend lower as more water-efficient equipment and processes are adopted in the years ahead.

Categorical Water Demands

United Water New York's major categorical water usages in 2014 are presented in Figure 1-2. Of the total 10,513.682 million gallons (mg) supplied as reported by UWNY in its 2014 Annual Report to the PSC, approximately 77% was consumed by residential and nonresidential customers, 1% was exported, 20% was non-revenue/unaccounted-for water, and 2% was other-unmetered and unknown.

The characteristics of UWNY's system water losses and customer water demands are discussed in Sections 3 and 4, respectively.



SECTION 2

SYSTEM WATER USE AND WATER LOSSES

This section presents an analysis of system water losses, usually described as non-revenue water (NRW) and/or unaccounted-for water (UFW), in the United Water New York (UWNY) system. In addition, UWNY's records and reports of the volumes of water supplied, consumed, and lost as NRW/UFW are also discussed.

Introduction To System Water Loss Concepts And Tools

Commonly used concepts, definitions, and tools used by the water utility industry to describe and analyze water system losses are summarized below. These concepts and tools are referred to in the analysis of UWNY's water losses that begins in Section 2.1.

Water Loss Definitions

The terms "non-revenue" water and "unaccounted-for" water are often used to describe water utility system water losses. The two terms are sometimes used interchangeably and often together, although the American Water Works Association (AWWA) and other major water organizations as well as some utilities and regulators define them differently.

Historically, unaccounted-for water or UFW has typically been defined as the difference between the total volume of water produced and imported into a service area and the total volume consumed, described as "lost water" (a combination of leakage or "real losses" and apparent losses, which are authorized and unauthorized unmetered usages, theft, and meter and data recording errors). Older definitions of UFW include authorized and billed but unmetered usages such as fire hydrants and municipal buildings in the category of "lost water" because their exact use can only be estimated, and often not reliably estimated.

Today, non-revenue water or NRW is the more commonly accepted term. The definition for NRW it is similar to that for UFW except that it excludes (according to AWWA) water exports as well as billed authorized but unmetered consumption that is estimated and revenue producing (thus categorized as "consumption" and not counted as "lost" or non-revenue water).

In short, system water losses–non-revenue water–are a combination of two factors:

- **Real losses**–physical leaks in mains, service lines, hydrants, and valves as well as utility reservoirs and water storage tanks
- **Apparent losses**–water meter and data recording inaccuracies, such as over- or under-registering meters, and meter reading, billing, and accounting errors

The AWWA Water Audit Report: The Water Industry's Standard Tool for Evaluating System Water Losses

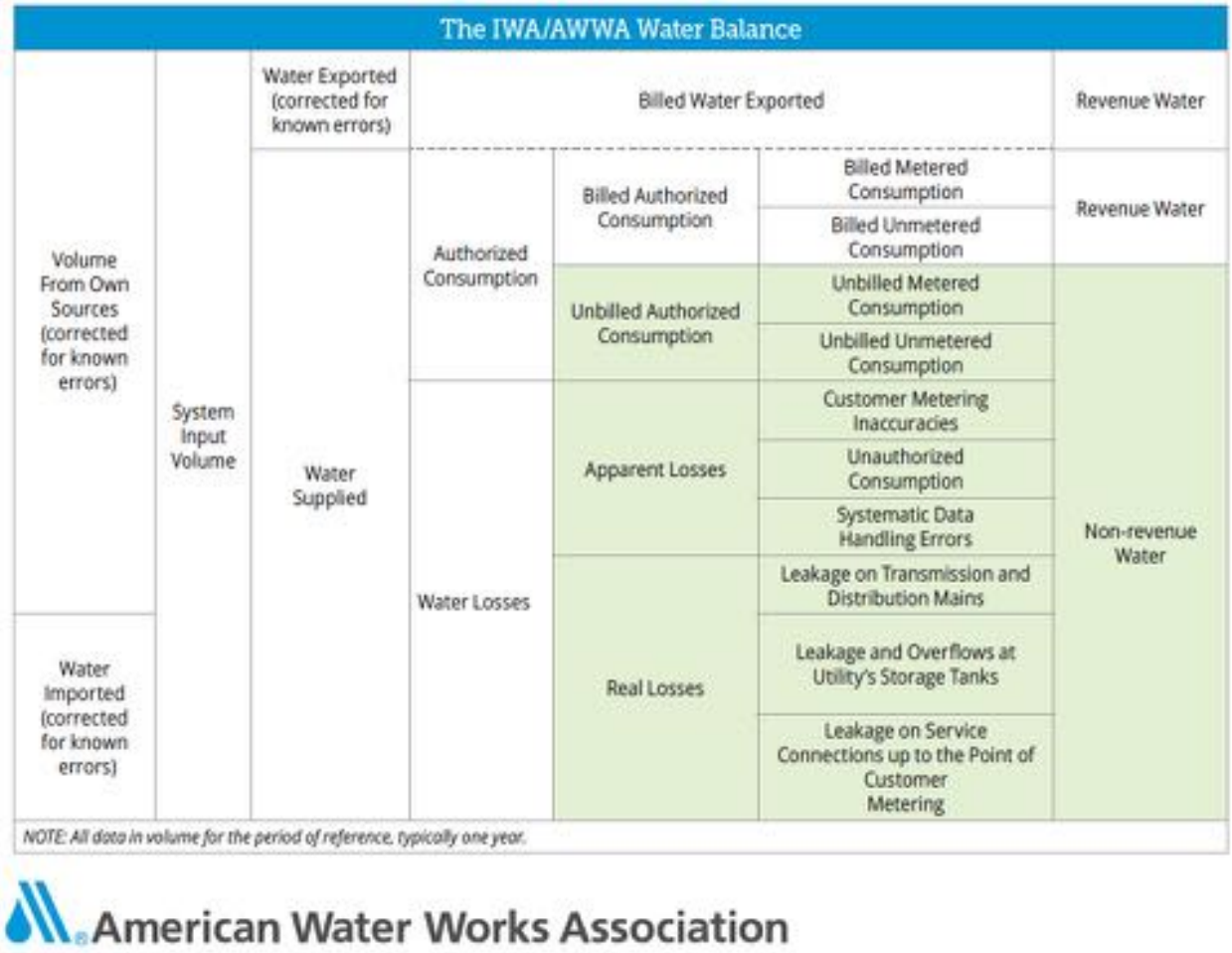
The AWWA Water Audit report is a standard industry tool used by many water utilities to evaluate their system water losses, or non-revenue water. Findings from the AWWA reports help water suppliers quantify and define the volume and extent of their real and apparent losses. Knowing what volume of water losses is attributable to real losses (i.e., leakage) compared to

the volume of losses that are due to apparent losses (i.e., meter and recording errors) helps determine the amount of water leakage that is recoverable as usable supply.

The AWWA Water Audit report is generated using AWWA's Water Audit Software, an Excel-based model currently available in version 5.0 (released in August 2014). The model consists of several worksheets for inputting water utility values related to water supply, consumption, and system losses: Reporting Worksheet, System Attributes and Performance Indicators, and Water Balance.

An illustration of the components of water supply, consumption, and water losses that are evaluated for a utility using the AWWA Water Audit software is provided in Figure 2-1. A more detailed description of the model's findings for water losses in the UWNY system in 2012-2014 is provided later in this section.

Figure 2-1. AWWA Water Balance: Water Losses and Non-revenue Water



2.1. Data Inconsistencies in UWNY Reports of Volumes of Water Supplied, Customer Consumption, and Water Losses

The actual volumes of water supplied, imported, consumed by customers, resold as exports, and lost to non-revenue water in the UWNY service area in Rockland County at least for the years 2012, 2013, and 2014 are unclear. This uncertainty is due to the fact there are multiple sets of conflicting water supply and demand figures reported by UWNY. These data inconsistencies include those reported by UWNY to the PSC (Annual Reports and Non-revenue Water "NRW" reports), DEC (annual Water Withdrawal reports), and multiple UWNY internal data sets sent to the Task Force consultant during the course of this study, as summarized in Table 2-1.

Excerpts from the original reports and documents for which the data shown in Table 2-1 are derived are provided as Appendices: Appendix A–United Water New York (UWNY) Water Production, Consumption, and Water Loss Data Sent to the Task Force Consultant, Versions 4, 5, 6, and 7; Appendix B–UWNY Annual Reports to the New York State Public Service Commission (PSC), pages 300, 305 and 400, 2012-2014; and Appendix C–UWNY Annual Water Withdrawal Report Forms to New York State Department of Environmental Conservation (DEC), Sections 1, 2 and 4, 2012-2014.

The differences in reported figures for water supply, consumption, and system loss as shown in Table 2-1 in some instances are relatively minor, but others are substantial. For example, the volume of reported water consumption by customers in 2014 is 8,221.3 MG/Y according to the first three sets (v4, v5, and v6) of UWNY internal system data (population, water production, consumption, and NRW) sent to the Task Force consultant. However, UWNY later increased that figure to 8,453.8 MG/Y in the final data set (v7), which is consistent with UWNY's Annual Report to the PSC. However, those and other total customer consumption figures shown in Table 2-1 do not equal the sum of customer metered demands for single-family, multi-family, Village of Sloatsburg, commercial, and industrial accounts as provided in Excel files by UWNY to the Task Force consultant for this study, which totaled 8,101.5 MG/Y in 2014. The maximum difference among the customer consumption figures for 2014 is 352.4.5 MG/Y, equivalent to more than 12 days of water supply to Rockland County customers.

The v4, v5, and v6 internal data sets provided by UWNY to the Task Force consultant for both the total volume of water produced (including imports) and the total volume of water consumed (including exports) for the years 2012-2014, as shown in Table 2-1, are usually lower than those reported by United to the PSC, DEC, and in their non-revenue (NRW) reports as well as the final data set (v7) sent to the consultant. A comparison of the original "v4" data set sent to the consultant in early April 2015 compared to the final v7 data set provided in late May 2015 is provided in Appendix A, with UWNY's revised figures in v7 highlighted in gray. A brief review of UWNY's water supply and demand figures for some years prior to 2012 found additional examples of conflicting reported data, but those years and that task is outside the scope of this study.

There are several reasons why UWNY's clarification of these water data discrepancies is necessary. First, to ensure that only the correct set of data are presented to the public, ratepayers, and regulators so that the true volumes of water supply, demand, and system losses are known. Second, to provide UWNY with an opportunity to explain how these data inconsistencies occurred as well as how they will be prevented in the future. In some cases, conversion of metered water demands from CCF (100 cubic feet) to gallon-based water units may explain minor accounting differences. (All water data in CCF units received for this study were converted to gallon units, where 1 CCF = 748.05195 gallons.) Third, to enable UWNY to correct previously submitted reports that may contain errors, particularly those which have

Table 2-1. Data Inconsistencies in Volumes of Water Supply, Demand, and Water Losses (UFW/NRW) in UWNY Reports to the PSC, DEC and Task Force Consultant

Total Water Produced (Sources of supply)	Million Gallons per Year		
	2012	2013	2014
PSC Annual Report of UWNY (p. 400):	10,348.87	10,384.00	10,513.68
NY DEC Annual Water Withdrawal (Permit) Report by UWNY, Section 2:	10,330.82	10,384.03	10,513.68
UWNY data sent to Task Force consultant, v4, v5 and v6:	10,322.66	10,357.80	10,402.64
UWNY data sent to Task Force consultant, v7:	10,348.87	10,384.00	10,513.68
Maximum difference among ranges, MG/Y:	**26.20**	**26.20**	**111.04**

Total Water Purchases (Imports)	Million Gallons per Year		
	2012	2013	2014
PSC Annual Report of UWNY (p. 305)	182.50	182.50	182.50
NY DEC Annual Water Withdrawal (Permit) Report by UWNY, Section 2:	0.00	0.00	0.00
UWNY data sent to Task Force consultant, v4, v5, v6 and v7:	0.00	0.00	0.00
Maximum difference among ranges, MG/Y:	**182.50**	**182.50**	**182.50**

Total Water Consumption (Customer demands)	Million Gallons per Year		
	2012	2013	2014
PSC Annual Report of UWNY (p. 300)	8,188.56	8,068.39	8,453.84
PSC Annual Report of UWNY (p. 400):	8,141.95	8,068.39	8,453.84
NY DEC Annual Water Withdrawal (Permit) Report by UWNY, Section 2:	8,192.28	8,124.09	8,447.44
UWNY data sent to Task Force consultant, v4, v5 and v6:	8,142.36	8,068.39	8,221.31
UWNY data sent to Task Force consultant, v7:	8,141.95	8,068.39	8,453.84
UWNY data sent to Task Force consultant, total of customer metered demands*:	7,981.15	7,825.20	8,101.46
Maximum difference among ranges, MG/Y:	**211.13**	**298.89**	**352.58**

Total Water Sold (Exports/Resale)	Million Gallons per Year		
	2012	2013	2014
PSC Annual Report of UWNY (pages 300 and 305): United Water New Jersey and	*35.33*	*38.45*	*39.46*
Village of Hillburn	*38.24*	*32.41*	*44.74*
Total Exports reported to PSC:	73.57	70.87	84.20
NY DEC Annual Water Withdrawal (Permit) Report by UWNY, Section 2:	41.54	32.41	44.73
UWNY data sent to Task Force consultant, v4, v5 and v6:	73.75	70.98	80.32
UWNY data sent to Task Force consultant, v7:	73.57	70.87	84.20
Maximum difference among ranges, MG/Y:	**32.21**	**38.57**	**39.47**

Total NRW/UFW: Water Produced/Imported Minus Water Consumed/Exported†	Million Gallons per Year		
	2012	2013	2014
PSC Annual Report of UWNY (p. 400)	2,315.85	2,427.24	2,158.14
NY DEC Annual Water Withdrawal (Permit) Report by UWNY, Section 2:	2,138.55	2,259.94	2,066.25
UWNY data sent to Task Force consultant, v4, v5 and v6:	2,111.10	2,232.30	2,064.40
UWNY data sent to Task Force consultant, v7:	2,206.90	2,315.60	2,059.80
Maximum difference among ranges, MG/Y:	**204.75**	**194.94**	**98.34**

Total NRW/UFW: Water Produced/Imported Minus Water Consumed/Exported†	Percent		
	2012	2013	2014
PSC Annual Report of UWNY (p. 400):	22.0%	23.0%	20.2%
NY DEC Annual Water Withdrawal (Permit) Report by UWNY, Section 2:	20.7%	21.8%	19.7%
UWNY data sent to Task Force consultant, v4, v5 and v6:	20.5%	21.6%	19.8%
UWNY data sent to Task Force consultant, v7:	21.3%	22.3%	19.6%
Maximum difference among ranges, Percent:	**1.5%**	**1.4%**	**0.6%**

Notes:

* Excel files of metered demands by single-family, multi-family, Village of Sloatsburg, commercial, and industrial customer accounts. Excludes UWNY estimates of water use by approximately 170 unmetered customer accounts.

† Reporting methods for NRW/UFW volumes vary and may account for some data inconsistencies shown.

AWWA–American Water Works Association

DEC–New York State Department of Environmental Conservation

MG/Y–Million Gallons Per Year

NRW–Non-Revenue Water

PSC–New York State Public Service Commission

Task Force (TF)–Rockland County Task Force on Water Resources Management

Task Force consultant–Amy Vickers & Associates, Inc.

UFW–Unaccounted-for Water

UWNY–United Water New York

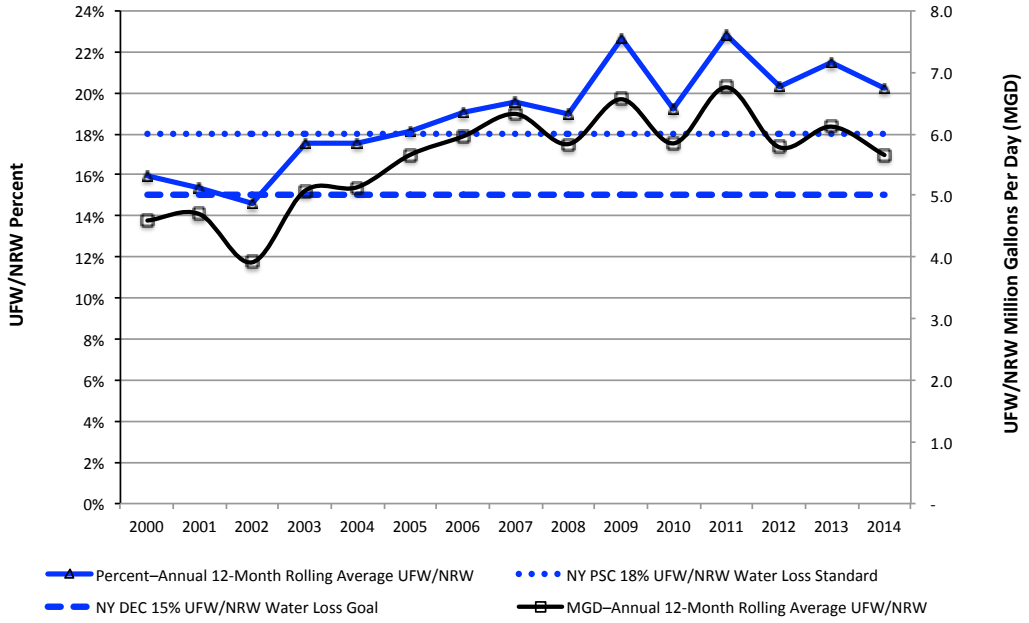
bearing on major future capital planning decisions such as new water supply development projects (i.e., Haverstraw desalination proposal). And fourth, so that the true volume of water supply, customer consumption, and real and apparent losses in the UWNY system can be established for the development of relevant, reliable and fact-based water loss reduction and water conservation plans and programs in the future.

It is important to note that UWNY's data inconsistencies will inevitably ripple through this report to some extent. For example, the categorical water use percentages and total water supplied shown in Figure 1-2 (Section 1) are based on figures reported by UWNY in their 2014 Annual Report to the PSC. However, those figures differ from the total volume and percentages of water produced, metered customer consumption, unmetered estimated demands, water exports, and water loss data reported by UWNY in other reports as listed in Table 2-1 as well as the volumes of metered customer water use discussed later in this report. In another example, page 305 of UWNY's Annual Report to the PSC from 2012 through 2014 states that 182.5 MG of purchased water supply from the New York State Office of Parks was imported each of those years. However, staff at UWNY communicated to the Task Force consultant that the 182.5 MG is only a contractual obligation and that the water was not actually imported during those years.

2.2. Persistent High Volumes of "Real" Losses (Leakage) and "Apparent" Losses in UWNY System That Exceed Water Industry Standards

High volumes and percentages of system water losses have persisted in the UWNY system for a number of years, as shown in Figure 2-2. Over the past 10 years, UWNY's annual 12-month rolling average unaccounted-for water/non-revenue water (UFW/NRW) has exceeded the PSC's maximum 18% UFW/NRW water loss goal.

Figure 2-2. UWNY Non-revenue/Unaccounted-for Water (UFW/NRW) Annual 12-month Rolling Average, 2000-2014



Compared to DEC's maximum 15% water loss goal, had UWNY been a municipal water supplier it would have exceeded the state's threshold for all the years shown except 2002. Further, compared to the water loss standards and goals in other Northeastern and Great Lakes states as shown in Table 2-2, the percentage of UWNY's system non-revenue water is nearly twice as high as those in Massachusetts and some Great Lakes states.

Table 2-2. Survey of System Water Loss Standards and Goals in the Northeast and Great Lakes States

State/Region	Maximum Allowable Water Loss		Terms Used*
	Target	Standard or Goal	
Connecticut	10-15%	Goal	UFW/NRW
Massachusetts	10%	Standard	UAW
New York			
DEC: public/municipal	15%	Goal	UFW/NRW
PSC: investor-owned	18%	Standard	UFW/NRW
New Jersey	15%-20%	Goal/Standard; notification > 18%	UFW
Rhode Island	15% (10% long-term)	Standard	UFW ("Non-account water")
Great Lakes states (55 suppliers surveyed)	10%-20% (most 15%)	Goal (29 states) or Standard (26 states)	UFW (50%), NRW (35%)

Notes:

* Definitions of water loss terms vary somewhat but common examples include:

NRW–Non-revenue Water: Unbilled metered and unbilled unmetered consumption, apparent losses (unauthorized consumption, theft, meter inaccuracies, and data handling errors), and real losses (leakage, overflows in utility storage tanks).

UFW/UAW–Unaccounted-for Water: NRW plus it may or may not include billed unmetered consumption. UFW/UAW is often measured as total production minus total metered consumption.

2.3. Significant Errors Discovered in UWNY's Annual AWWA Water Audit (Non-revenue) Water Reports for 2012-2014: Revised Reports Reveal The Potential for Substantially More Recoverable Leakage Than Previously Reported

A series of data inconsistencies, persistent data errors, missing information, and irregular assumptions were found in UWNY's calculations in its annual "Year-End Non-revenue Water Report" to the PSC for 2012-2014, specifically UWNY's annual AWWA Water Audit report that it attaches to the annual non-revenue report.

In sum, the problematic errors and other figures used by United in their annual AWWA Audit reports for 2012-2014 appear to have resulted in overestimates of UWNY's apparent losses, and underestimates of its potential volume of recoverable leakage. Some of these errors include unusually high and undocumented estimates of apparent losses for unauthorized consumption and data handling errors. In sum, these errors produced reports that generate a flawed understanding of the components of UWNY's system water losses and priorities for future actions to reduce those losses.

In order to more accurately profile and evaluate UWNY's non-revenue water and its potential recoverable leakage, the following subsections (2.3.1, 2.3.2, and 2.3.3) review each part of UWNY's annual AWWA Water Audit reports for 2012-2014. Background information and definitions for various concepts used in the AWWA Water Audit software and reports are provided in Appendix D.

The set of AWWA Water Audit reports as prepared by UWNY (Appendix E) are compared to the revised reports prepared by the Task Force consultant (Appendix F). The reports prepared by the consultant are based on data reported by UWNY in their Annual Reports to the PSC as well as standard water industry assumptions about unmetered water usage and related estimates.[1]

A comparison of the data used and findings in UWNY's AWWA Water Audit reports for 2012-2014 compared to those prepared by the Task Force consultant is discussed below along with Table 2-3 (Reporting Worksheets) and Table 2-4 (Performance Indicators). Both tables follow the format and content of the AWWA reports. A summary of the data and key findings are provided in Table 2-5 (Summary of UWNY's System Losses and Recoverable Leakage). In each table, the UWNY report data are shown in the "A" columns, and the revised reports prepared by the Task Force consultant using data reported by UWNY in their Annual Reports to the PSC are shown in the "B" columns. Different, inconsistent and missing data in the UWNY "A" columns are highlighted in the gray cells in Tables 2-3, 2-4, and 2-5.

2.3.1 Review of UWNY's AWWA Water Audit Reports: "Reporting Worksheet" (Table 2-3)

The Reporting Worksheet page in the AWWA Water Audit Excel-based software, discussed here in the context of UWNY, is the first step in a water utility's preparation of an AWWA Water Audit report. The Reporting Worksheet is where utilities input their annual data for the total volumes of water supplied, consumed by customers, and lost to non-revenue water.

The accuracy of the data used by a utility in the preparation of an AWWA Water Audit report, including its estimated volumes of unmetered water usages, meter errors, system data handling errors, and other assumptions, can have a significant influence on the results generated by the AWWA software. Specifically, data errors and overrides of the model's default values can result in flawed findings about the volumes and types of water losses in a water system. For example, inaccurate results can distort the volumes of system losses that are "real" losses–recoverable leakage– in contrast to "apparent losses" that are meter and other data errors which can yield no additional supply (but can increase revenues) once they are corrected.

In sum, the problematic data used in UWNY's 2012-2014 reports contributed to *overestimates of the system's apparent water losses* and *underestimates of the volume of water being lost to leakage (real losses),* including recoverable leakage.

For each section of the Reporting Worksheet shown in Table 2-3 and described below, the same data as inputted by UWNY in their AWWA Water Audit Reports for 2012-2014 are shown in Appendix E. Alongside the data in Table 2-3 from UWNY's reports, the comparative set of AWWA Water Audit reports for UWNY for those same years that contain corrected and revised data and findings as prepared by the Task Force consultant are also provided, based on UWNY data submitted in its annual reports to the PSC, are also shown in Appendix F.

[1] The terms "corrected reports" and "revised reports" are used interchangeably in this document. These terms refer to reports prepared by the Task Force consultant who recalculated UWNY's AWWA Water Audit reports for 2012-2014, utilizing the following values: AWWA Water Audit default values; corrected and/or revised data provided by UWNY to the consultant; and other data and information reported by UWNY to NY State agencies.

Table 2-3. Reporting Worksheets in UWNY's Annual AWWA Water Audit Report: Data Inconsistencies, Missing Data, and Errors in Reports Prepared By UWNY (Gray Cells) Compared to Revised Reports Using Data in UWNY's Annual Reports to the PSC, 2012-2014

REPORTING WORKSHEET (AWWA Water Audit Software*)	"A" Columns: UWNY Water Audit Data & Default Overrides			"B" Columns: Revised UWNY Water Audit Data Using UWNY's PSC Annual Report Data & No Default Overrides		
	2012	2013	2014	2012	2013	2014
A. WATER SUPPLIED	*Million Gallons per Year*			*Million Gallons per Year*		
Volume from own sources (MG/Y):	10,348.865	10,389.154	10,513.682	10,348.865	10,383.997	10,513.682
Water Imported (MG/Y):	0.0	0.0	0.0	182.500	182.500	182.500
Water Exported (MG/Y):	41.542	27.280	0.0	73.569	70.866	84.201
Total Water Supplied (MG/Y):	**10,307.3**	**10,361.9**	**10,513.7**	**10,457.8**	**10,495.6**	**10,612.0**
B. AUTHORIZED CONSUMPTION	*Million Gallons per Year*			*Million Gallons per Year*		
Billed Metered Consumption (MG/Y):	8,192.276	8,124.086	8,447.437	8,141.947	8,068.390	8,453.843
Billed Unmetered Consumption (estimate) (MG/Y):	0.0	0.0	0.0	43.117	129.600	131.275
Unbilled Metered Consumption (MG/Y):	29.555	65.717	30.250	0.825	4.019	8.250
Unbilled Unmetered Consumption (estimate) (MG/Y):	128.842	129.523	131.421	2.670	5.968	6.385
Total Authorized Consumption:	**8,350.7**	**8,319.3**	**8,609.1**	**8,188.6**	**8,208.0**	**8,599.8**
C. WATER LOSSES	*Million Gallons per Year*			*Million Gallons per Year*		
Total Water Losses (Water Supplied-Authorized Consumption) **(MG/Y):**	**1,956.7**	**2,042.5**	**1,904.6**	**2,269.2**	**2,287.7**	**2,012.2**
C.1 Apparent Losses						
Unauthorized Consumption (estimate) (MG/Y):	497.0	412.9	373.8	26.1	26.2	26.5
Customer Metering Inaccuracies (estimate)(MG/Y):	222.1	221.2	229.0	219.9	218.0	228.6
Systematic Data Handling Errors (estimate)(MG/Y):	80.0	191.7	143.9	20.4	20.2	21.1
Total Apparent Losses (MG/Y):	**799.1**	**825.8**	**746.7**	**266.4**	**264.4**	**276.2**
C.2. Real Losses (Current Annual Real Losses or CARL)						
Total Real Losses (MG/Y):	**1,157.6**	**1,216.8**	**1,157.9**	**2,002.8**	**2,023.2**	**1,736.0**
Total Water Losses (MG/Y):	**1,956.7**	**2,042.5**	**1,904.6**	**2,269.2**	**2,287.7**	**2,012.2**
D. NON-REVENUE WATER	*Million Gallons per Year*			*Million Gallons per Year*		
Total Non-Revenue Water, MG/Y:	**2,115.1**	**2,237.8**	**2,066.2**	**2,272.7**	**2,297.6**	**2,026.9**
Total Non-Revenue Water, Percent of Total Water Supplied:	**20.5%**	**21.6%**	**19.7%**	**21.7%**	**21.9%**	**19.1%**
E. SYSTEM DATA	*System Data*			*System Data*		
Length of mains (miles):	1,049.3	1,050.5	1,056.3	1,049.3	1,050.5	1,056.3
Number of active and inactive service connections:	73,733	74,576	74,973	73,733	74,576	74,973
Service connection density (conn./miles main)	70	71	71	70	71	71
Average length of service line (ft):	75.0	75.0	44.0	44.0	44.0	44.0
Average operation pressure (psi):	107.0	103.30	103.30	107.0	103.30	103.30
F. COST DATA	*Cost Data*			*Cost Data*		
Total annual cost of operating water system ($/year):	$32,332,734	blank	$52,637,304	$28,759,617	$27,442,369	$26,529,066
Customer retail unit cost (applied to Apparent Losses ($/100 ccf)):	$ 5.74	blank	$ 5.11	$ 5.32	$ 5.53	$ 5.78
Variable production cost (applied to Real Losses) ($/MG):	$ 362.00	blank	$ 430.51	$ 362.00	$ 430.51	$ 430.51
G. WATER AUDIT DATA VALIDITY SCORE (maximum 100)†						

Notes:

MG/Y–Million Gallons/Year

MGD–Million Gallons per Day

* UWNY's AWWA Water Audit reports were completed using v4.0 (2010) of the AWWA software. The revised reports prepared by the Task Force consultant were completed using v5.0 (2014), the latest version of the software. For that reason there are some minor differences in the report formats as shown in Appendices E and F.

† The Data Validity score for "A" Columns averaged 87 and "B" Columns averaged 63. The reliability of the Data Validity score and the ILI (see Table 2-5) are linked. The Data Validity score is determined by the utility submitting the data; it is subjective. While UWNY scored its data ("A" Column) as having high validity, a lower Data Validity score may be more accurate given the inconsistencies in UWNY's reported figures for supply, consumption and NRW. Thus due to these data uncertainties, "B" Column data have a lower Validity Score score even though the data shown was reported by UWNY in its Annual Reports to the PSC.

A. Water Supplied. UWNY's internal data ("A" columns) record no water imports, lower total volumes of water exports, and slightly higher water supplied from its own sources in 2013 in contrast to what it reported in its Annual Report to the PSC ("B" columns). For each year shown, UWNY reported to the PSC that it imported 182.5 MG/Y and that it exported water to UWNJ and the Village of Hillburn, NY.

B. Authorized Consumption. Discrepancies exist in the volume of billed unmetered and unbilled unmetered consumption reported by UWNY in their AWWA Water Audit reports, as shown in Table 2-3. Inexplicably, no (zero) water is estimated for "Billed Unmetered Consumption" in UWNY's reports for all three years. That is odd, because UWNY has about 170 unmetered residential and nonresidential customers that are billed. In addition, no explanation is provided by UWNY for the large volume of estimated "Unbilled Unmetered Consumption"–who are these users, why did they not pay for water, why are they not metered, and on what basis is their estimated water usage calculated? UWNY has stated that they use AWWA assumptions for such estimates. However, no references to specific values or metrics cited by AWWA that might support those estimates have been provided by UWNY, despite specific requests for clarifications by the Task Force consultant and the Chair of the Task Force, Leg. Harriet Cornell.

C. Water Losses. Total Losses. UWNY's total water losses are lower according to its internal data as reported in their NRW/AWWA reports ("A" Columns) compared to figures in its Annual Reports to the PSC used in the Revised Water Audits ("B" Columns). In 2014 for example, UWNY's NRW/AWWA report stated a water loss total of 1,904.6 MG compared to 2,012.2 MG in the Task Force consultant's revised audit report based on UWNY data provided to the PSC. The 107.7 MG difference is equivalent to more than 3 days of water supply to Rockland County.

C.1 Apparent Losses. UWNY's AWWA Water Audit reports for all three years contain at least several major errors that lead to inaccurate calculations of what portion of the system's non-revenue water is recoverable leakage–which represents the potential for increased water supply capacity–compared to apparent losses (accounting errors and water theft) that are not recoverable capacity.

- **Unauthorized Consumption**. UWNY's estimate of unauthorized consumption (e.g., theft) is more than 15 times higher than AWWA's default value. UWNY provides no explanation for this extreme estimate. For example, in 2012 UWNY estimated that it lost 497 MG to theft and other unauthorized usage ("A" Columns), but the AWWA default value for all three years assigned only 26 MG to theft ("B" Columns) based on a percentage of UWNY's total water losses. In each year of the UWNY audit report, the AWWA model signaled an alert on its Reporting Worksheet (see Appendix E) that these high volumes of unauthorized consumption exceeded the model's default values. However, UWNY neither corrected the value it entered for each year nor did it provide any data to support such high estimates.
- **Customer Metering Inaccuracies.** The figures shown are based on a 2.63% estimate by UWNY. These are also applied to the "B" columns since no other information is available.
- **Systematic Data Handling Errors.** Very high and inexplicably erratic estimates of apparent losses due to data handling errors are reported by UWNY ("A" Columns) compared to AWWA's lower 0.25% default estimate (shown in "B" Columns). From 80 MG in 2012, 191 MG in 2013, and then to 143 MG in 2014, UWNY estimates of its data handling errors are approximately 4 to 9 times higher than the AWWA model's normal default value of 20 MG/Y to 21 MG/Y (which is based a percentage of UWNY's total water losses). UWNY's unusually large estimate of apparent losses due to data handling errors is another factor that serves to boost their high estimate of apparent losses while minimizing its volume of real losses and recoverable leakage. Again, UWNY provides no explanation for what type of data errors these are or how these volumes were estimated. Note: these data errors cannot include meter errors since those are included in the prior Customer Metering Inaccuracies estimate.

- **Total Apparent Losses.** UWNY's total estimates of apparent losses ("A" Columns), including the high estimates of unauthorized consumption errors and data handling errors cited above, range between 746 MG TO 825 MG for 2012-2014, and are nearly three times higher than those estimated by the AWWA model using its normal default values and figures submitted by UWNY in their Annual Reports ("B" Columns). These are significant differences.

C.2 Real Losses (Leakage). By generating a very high estimate of apparent water losses, UWNY's estimate of real losses–including recoverable leakage–is driven down significantly ("A" columns) compared to substantially higher estimates of real losses for 2012-2014 that result when applying normal AWWA model defaults and UWNY's Annual Report data ("B" columns). In 2014 for example, UWNY calculates its real losses at 1,157.9 MG, while the revised "B" column shows them to be 1,736 MG–a 578 MG/Y difference. As a volume of potentially recoverable leakage, the 578 MG/Y is equivalent to nearly 3 weeks of water supply to Rockland County.

D. Non-Revenue Water. Similar percentages but different total volumes of NRW are found in the UWNY reports ("A" columns) compared to those that are based on UWNY's Annual Report data to the PSC and the AWWA's model normal default values ("B" columns).

E. System Data. In 2012 and 2013, UWNY inexplicably inputted a large value of 75 feet for the average length of its customer service lines while it used a distance of 44 feet in 2014 ("A" columns). (UWNY reports this distance as 50.0 feet in its 2010 AWWA Audit Report.) The influence of increasing this data point is not insignificant: when the 75 foot value is used in the model, a higher estimate of unavoidable leakage (less water that is recoverable) and apparent losses (again, not recoverable as usable water supply capacity) plus a more favorable Infrastructure Leakage Index (ILI, to be discussed shortly) is produced. The 44 feet value is used for all years in the "B" columns of the revised reports, which influences the findings for the performance indicators discussed in the next section.

> *"This [customer service line length] is a particularly important error because this field is used for calculation of the UARL [unavoidable real losses] value: overestimating the customer length inflates UARL values and results in artificially low ILI values."*
>
> *–Water Research Foundation and U.S. EPA (Real Loss Component Analysis, 2014, p. 18)*

F. Cost Data. No cost data were provided in UWNY's 2013 AWWA Water Audit report (those sections are inexplicably blank). The total annual operating costs cited by UWNY in its 2012 and 2014 reports are significantly different and they also do not match those it reported in its Annual Reports to the PSC (page 309, "Water Operation and Maintenance Expenses"). Cost data shown in the "B" columns are derived from UWNY's Annual Reports (page 309), but its accuracy is uncertain and thus the actual costs associated with real losses and apparent losses are not clear.

G. Water Audit Data Validity Score. This score is supposed to be a reflection of the reliability of the data used in the generation of the AWWA water audit report. However, it is self-scoring, and as can be seen in the "A" Columns, UWNY gave itself a high score for the quality of its data despite the errors and software default overrides that are contained in their reports. A more realistic, lower score was assigned to the data in the "B" Columns even though the source of that data is also UWNY. For these reasons, UWNY's Infrastructure Leakage Indicator (ILI) as calculated by the model (discussed below) is likely inaccurate and an unreliable indicator of the present condition of UWNY's infrastructure.

2.3.2 Review of UWNY's AWWA Water Audit Reports: "Performance Indicators" (Table 2-4)

The AWWA software generates a Performance Indicators report page for a utility's water losses based on the data inputted in the "Reporting Worksheet" as discussed previously. The performance indicators express the scale and costs associated with system water losses, e.g., the volumes of apparent losses and real losses, the average volume of leakage per customer connection, and the annual costs associated with leakage and apparent losses. The performance indicators are useful in analyzing the state of water losses by their components (i.e., real vs. apparent losses), and also for assessing those losses on a comparative basis, such as evaluating changes in water losses from one year to another, and from one water utility to another.

As described below and shown in Table 2-4, the revised AWWA audit reports ("B" columns) result in performance indicators that find lower volumes of water lost to apparent losses such as meter errors, i.e., about 10 gallons/connection/day, compared to UWNY's higher estimates of apparent losses that average about 29 gallons/connection per day when averaged over 2012-2014. In addition, the revised reports ("B" columns) find a significantly higher volume of real losses than those reported by UWNY. The leakage lost per service connection averages about 70 gallons/day in the revised audit reports, and about 43 gallons/day in the UWNY reports for 2012-2014. (Both leakage estimates are high.)

In sum, the details presented below describe how the revised AWWA audit reports find a larger volume of leakage, much of which may be potentially recoverable as usable water supply, whereas the UWNY reports find a lower volume of leakage and a higher volume of apparent losses which cannot yield more usable supply.

H. System Attributes (Table 2-4)

- **Apparent Losses (Data recording and meter errors, water theft).** As described above and shown again in Table 2-4, the revised audit findings ("B" columns) estimate that apparent water losses are significantly less, about one-third, of those estimated by UWNY ("A" columns). In 2014 for example, the UWNY ("A" columns) report finds apparent losses to total 746 MG/Y, while the revised report ("B" columns) estimate apparent losses to total much less–276 MG/Y.
- **Real Losses (Leakage primarily).** As shown in Table 2-4, the revised audit findings shown in the "B" columns of Table 2-4 indicate that real water losses are more than 1.5 times higher than those estimated by UWNY ("A" columns). In 2014 for example, the UWNY ("A" columns) report finds real losses to total 1,157 MG/Y, while the revised report ("B" columns) estimate real losses to total much more–1,736 MG/Y.
- **Water Losses.** The figure shown for "Water Losses" is the combined total volume of apparent losses and real losses.
- **Unavoidable Annual Real Losses (UARL)**, shown in Table 2-4, is an estimate generated by the AWWA software of the baseline volume of background leakage that exists within UWNY's water system–and which is unavoidable since all systems will leak to some extent. Using UWNY's internal data as well as that it reported to the PSC (Columns "A" and "B"), in 2014 both sets of water audit reports indicate that about 816 MG/Y of the total volume of real losses (leakage) in the UWNY system is background leakage and cannot be recovered.

- **Costs of Apparent and Real Losses.** The "B" column figures reflect the reduced apparent loss and increased real loss estimates. As stated previously, uncertainties about UWNY's operational costs make it difficult at this time to determine the true costs associated with UWNY's NRW.

Table 2-4. Performance Indicators in UWNY's Annual AWWA Water Audit Report: Results of Data Inconsistencies, Missing Data, and Errors in Reports Prepared By UWNY (Gray Cells) Compared to Revised Reports Using Data in UWNY's Annual Reports to the PSC, 2012-2014

PERFORMANCE INDICATORS (AWWA Water Audit Software*)	"A" Columns: UWNY Water Audit Data & Default Overrides			"B" Columns: Revised UWNY Water Audit Data Using UWNY's PSC Annual Report Data & No Default Overrides		
	2012	2013	2014	2012	2013	2014
H. System Attributes	*Million Gallons per Year*			*Million Gallons per Year*		
Apparent Losses (MG/Y):	799.1	825.8	746.7	266.4	264.4	276.2
+ Real Losses (CARL) (MG/Y):	1,157.6	1,216.8	1,157.9	2,002.8	2,023.2	1,736.0
= Water Losses (MG/Y):	**1,956.7**	**2,042.5**	**1,904.6**	**2,269.2**	**2,287.7**	**2,012.2**
Unavoidable Annual Real Losses (UARL) (MG/Y):	**960.4**	**935.6**	**816.2**	**833.6**	**811.8**	**816.2**
	Cost Data			*Cost Data*		
Annual cost of Apparent Losses:	$ 6,131,511	blank	$ 5,095,668	$ 1,894,860	$ 1,954,947	$ 2,134,347
Annual cost of Real Losses:	$ 419,042	blank	$ 498,483	$ 725,013	$ 871,010	$ 747,365
I. Financial Performance Indicators	*Performance Indicators*			*Performance Indicators*		
Non-revenue water as percent by volume of Water Supplied:	20.5%	21.6%	19.7%	21.7%	21.9%	19.1%
Non-revenue water as percent by cost of operating system:	20.4%	blank	10.8%	9.1%	10.3%	10.9%
J. Operational Efficiency Performance Indicators	*Performance Indicators*			*Performance Indicators*		
Apparent Losses per service connection per day (gal/connection/day):	**29.7**	**30.3**	**27.3**	**9.9**	**9.7**	**10.1**
Real Losses per service connection per day (gal/connection/day):	**43.0**	**44.7**	**42.3**	**74.4**	**74.3**	**63.4**
Real Losses per length of main per day (applies to small systems only):	NA	NA	NA	NA	NA	NA
Real Losses per service connection per day per psi pressure:	0.40	0.43	0.41	0.7	0.72	0.61
Real Losses = Current Annual Real Losses (CARL) (MG/Y):	**1,157.6**	**1,216.8**	**1,157.9**	**2,002.8**	**2,023.2**	**1,736.0**
Infrastructure Leakage Index (ILI)* [CARL/UARL]:	1.21	1.30	1.42	2.40	2.49	2.13

Notes:

MG/Y–Million Gallons/Year

MGD–Million Gallons per Day

* UWNY's AWWA Water Audit reports were completed using v4.0 (2010) of the AWWA software. The revised reports prepared by the Task Force consultant were completed using v5.0 (2014), the latest version of the software. For that reason there are some minor differences in the report formats as shown in Appendices E and F.

† The reliability of the Data Validity score and the ILI (see Table 2-5) are linked. The Data Validity score is determined by the utility submitting the data; it is subjective. While UWNY scored its data ("A" Column) as having high validity, a lower Data Validity score may be more accurate given the inconsistencies in UWNY's reported figures for supply, consumption and NRW. Thus due to these data uncertainties, "B" Column data have a lower Validity Score score even though the data shown was reported by UWNY in its Annual Reports to the PSC.

I. Financial Performance Indicators (Table 2-4)

The annual cost figures shown in Table 2-4 reflect the approximate short-term costs to UWNY and its ratepayers for the volumes of apparent losses and real losses in the system during 2012-2014. The basis for the apparent loss costs are the average retail water rate paid by customers, and the costs associated with real losses are the variable (O&M) power and chemicals used to pump, treat, and distribute water lost to leakage (based on the "Cost Data" in Table 2-3).

The accuracy of the cost data and annual cost figures shown in Table 2-4 is uncertain. No cost data were reported by UWNY in 2013, and the operational and customer retail unit cost data they provided for 2012 and 2014 are different from the figures they reported in their annual reports to the PSC. The higher annual cost figures reported by United in Table 2-4 ("A" columns) for apparent losses in 2014–$5.0 million–compared to those based on cost figures reported to the PSC (revised "B" columns)–$2.1 million–reflect the higher volume of apparent losses that United estimates to exist within their system. The "B"" columns show a lower cost for apparent losses and a higher cost for leakage, a reflection of the findings from the revised AWWA Water Audit reports that there is more water lost to leakage than apparent losses.

The AWWA Water Audit software does not calculate the long-term costs associated with system water losses, which can be considerably higher than those shown in Tables 2-4. For example, the estimated annual operating costs associated with UWNY's real (leakage) losses do not reflect the potential new capital costs that ratepayers might incur if water lost to leakage is not recovered through leak repairs. The capital costs to develop additional freshwater supplies range from about $2 million to $9 million per MGD of capacity. Desalination project costs are far higher, e.g., approaching $30 million per MGD of capacity in the case of the San Diego County (Calif.) Carlsbad desalination plant.

Neglect of needed system leak repairs can also incur significant infrastructure rehabilitation costs for ratepayers even when unrepaired leakage does not lead to the need for new water supply development. Leaks in mains that are not repaired in a timely fashion can later result in main failure, which is far most expensive to repair than when a utility makes ongoing incremental repairs as needed. Where a leak repair in a distribution main might cost from roughly $5,000 to $10,000, a backlog of needed repair work that results in the need for large sections of main replacement can cost roughly between $950,000 to $1.2 million per mile, if not more (i.e., recent projects in Madison, Wisconsin and Baltimore, Maryland). At the same time, it is important to point out that some estimates of main leak repairs overstate the costs of leakage recovery by basing them on total main replacement, and on a per mile basis, instead of isolated leak repairs which in some cases can recover substantial volumes of water at relatively low cost. UWNY has stated that their average cost to repair a main break ranges between about $6,500 and $9,000, and service line leaks range from less than $3,500 to over $4,500.

UWNY's estimated economic level of leakage (ELL)–the financial benefits and costs of its leak recovery-were requested of UWNY during this study. However, United Water does not appear to have a detailed financial analysis of leakage in the UWNY system. Instead, they base their assumptions for the cost-effectiveness of leakage recovery in the Rockland County service area according to a 2012 study by Halcrow consultants (based largely on system data for year 2010 and earlier) of United Water's *New Rochelle* and *Westchester* service areas. However, it is difficult to understand how the condition of another water supply system could be directly comparable to that in Rockland County given the many factors which make water infrastructure systems unique (i.e., design, age, condition, service area, maintenance practices, operating costs, etc.).

J. Operational Performance Indicators (Table 2-4)

- **Per connection losses**. The revised figures in the "B" columns reflect the findings that there are lower apparent losses and higher real/leakage losses in the system. In particular, notice how in 2014 the estimated apparent losses averages 27 gallons per connection per day (gal/connection/day) according to UWNY's estimates in column "A," but these are reduced to 10 gal/connection/day in the revised column "B." Conversely, a much higher estimate of real losses, 63 gal/connection/day is found in the "B" column but a 42 gal/connection/day in the "A" column. As a point of reference,

the average American currently uses about 55 gallons per day inside their home. In effect, the estimated average 63 gal/connection/day lost to leakage in 2014 is equivalent to an additional water-using occupant at every service connection in the UWNY system.

- **Current Annual Real Losses (CARL).** This performance indicator is an estimate by the AWWA software of the baseline volume of total leakage or real losses (excluding apparent losses) that exists within the UWNY system. The portion of this total volume of leakage that is recoverable is shown in Table 2-5 and discussed below.
- **Infrastructure Leakage Index (ILI).** Due to UWNY's data uncertainties, the reliability of the ILI figures shown is doubtful.

2.3.3 Review of UWNY's AWWA Water Audit Reports: "Summary of UWNY's System Losses And Estimated Potentially Recoverable Leakage" (Table 2-5)

A summary of estimated findings based on calculations using data in the UWNY ("A" columns) and revised ("B" columns) AWWA Water Audit reports are presented in Table 2-5 and discussed below.[2] In sum, for the years 2012-2014, calculations from figures in the revised reports find a lower volume and percent of water lost to apparent losses, and a higher volume and percent of water lost to real losses and potentially recoverable leakage, compared to findings using figures found in the UWNY reports.

Table 2-5. Summary of UWNY's System Water Losses and Estimated Potentially Recoverable Leakage: Comparison of Findings from Data Calculations Using UWNY's (Gray Cells) and Revised Annual AWWA Audit Reports, 2012-2014*

SYSTEM LOSSES AND RECOVERABLE LEAKAGE	"A" Columns: Findings from Data in UWNY Water Audit Reports			"B" Columns: Findings from Data in Revised UWNY Water Audit Reports		
	2012	2013	2014	2012	2013	2014
K. Non-revenue Water Loss Components	*Percent of Total Water Supplied*			*Percent of Total Water Supplied*		
Total Non-revenue Water, Percent of Total Water Supplied:	20.5%	21.6%	19.7%	21.7%	21.9%	19.1%
Total Apparent Losses, Percent of Total Water Supplied:	7.8%	8.0%	7.1%	2.5%	2.5%	2.6%
Total Real Losses, Percent of Total Water Supplied:	11.2%	11.7%	11.0%	19.2%	19.3%	16.4%
Potentially Recoverable Real Losses, Percent of Total Water Supplied:	1.9%	2.7%	3.3%	11.2%	11.5%	8.7%
L. Estimated Potentially Recoverable Leakage	*Measurements of Recoverable Leakage*			*Measurements of Recoverable Leakage*		
Current Annual Real Losses-Leakage (CARL) (MG/Y):	1,157.6	1,216.8	1,157.9	2,002.8	2,023.2	1,736.0
Unavoidable Annual Real Losses-Leakage (UARL) (MG/Y):	960.4	935.6	816.2	833.6	811.8	816.2
Est. Potentially Recoverable Leakage (CARL-UARL), MG/Y:	**197.2**	**281.2**	**341.7**	**1,169.2**	**1,211.4**	**919.8**
Est. Potentially Recoverable Leakage/Real Losses, Average MGD:	**0.54**	**0.77**	**0.94**	**3.20**	**3.32**	**2.52**
Est. Potentially Recoverable Leakage Per Mile of Main, Avg. MG/Y:	**0.19**	**0.27**	**0.32**	**1.11**	**1.15**	**0.87**
Est. Potentially Recoverable Leakage, Percent of Total Water Supplied:	**1.9%**	**2.7%**	**3.3%**	**11.2%**	**11.5%**	**8.7%**

Notes:
MG/Y–Million gallons per year
MGD–Million gallons per day

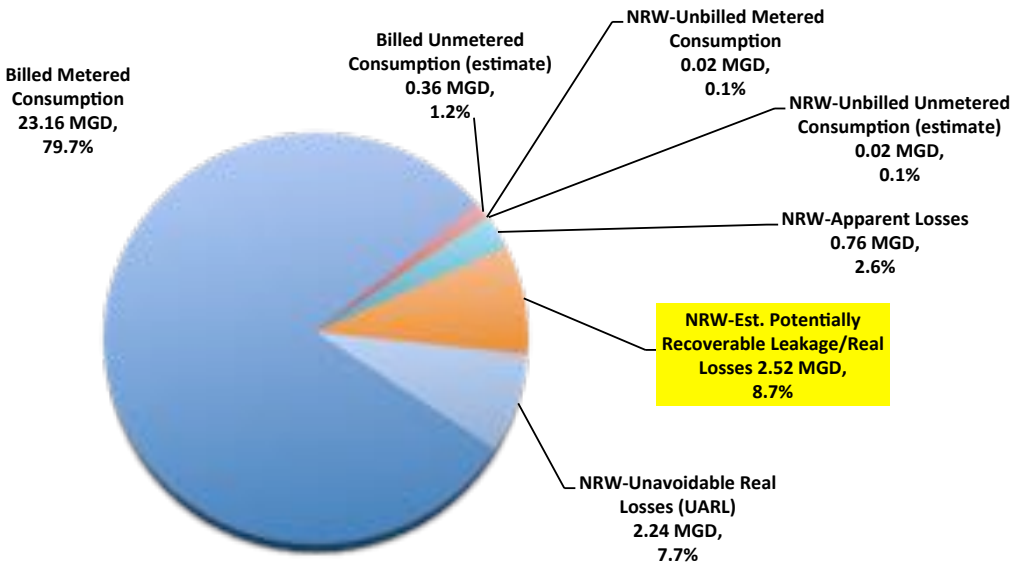
* Estimates of potentially recoverable leakage/real losses as shown in this table and report are based on data calculated from the AWWA Water Audit reports; such estimates are not included in the AWWA reports.

[2] Note: The estimates of potentially recoverable real losses and leak reduction as shown in Table 2-5 and described in this report are based on calculations using data in the AWWA water audit reports. Such estimates are not included in the AWWA reports.

K. Non-revenue Water Loss Components. These figures break down and estimate UWNY's NRW volume losses into their components based on calculations using data in UWNY's annual report to the PSC and the AWWA Water Audit reports. In 2014, for example, the "B" column findings estimate that about 2.6% of water supplied is lost to apparent losses (in contrast to 7.1% estimated using UWNY data in the "A" column) and 16.4% of NRW is lost to real/leakage losses (in contrast to 11.0% estimated using UWNY data in the "A" column). Further, the "B" column findings estimate that about 8.7% of NRW is potentially recoverable leakage (in contrast to only 3.3% in the "A" column based on data in UWNY's AWWA Water Audit report).

An illustration of the estimated component's of UWNY's non-revenue water, metered demands, and potentially recoverable leakage in 2014 drawn from data in their Annual Report to the PSC and the revised AWWA Water Audit reports is shown in Figure 2-3.

Figure 2-3. Revised Water "Balance" of UWNY's Consumption, Non-Revenue Water (NRW), and Potentially Recoverable Leakage in 2014



L. Estimated Potentially Recoverable Leakage. Based on the non-revenue water loss components as presented in Table 2-3 and Table 2-4, the estimated volumes of potentially recoverable leakage for 2012-2014 as shown in Table 2-5 yield very different estimates when using data calculated from UWNY AWWA Water Audit reports ("A" columns) compared to data in the revised reports ("B" columns). In 2014, for example:

- **Recoverable Leakage: Estimated potential total 919.8 MG (2.52 MGD) in 2014.** This estimated volume of potentially recoverable real losses–leakage-from leak repairs and main renewal and replacement using the revised data ("B" Columns), is based a calculation of two values generated by the AWWA's Water Audit software: the UARL (unavoidable annual real losses) background leakage value, which is the theoretical technical low limit of leakage that can be achieved using best available technology, is subtracted from the CARL (total physical/real water losses) value. For example, the 2014 "B" column shows a potential 919.8 MG of recoverable leakage, an average of 2.52 MGD, or 8.7% of the total volume of water supplied that year.

  The "A" column estimates of 341 MG of recoverable leakage in 2014 based on calculations using UWNY data are much lower due to the data issues in UWNY's reports discussed previously that appear to have resulted in a flawed overestimate of apparent losses. In either case, the estimated potential recoverable leakage in 2012 and 2013 was even lower than in 2014, as illustrated in Figure 2.4.

  Seeking to reduce a system's real losses (CARL) close to its estimated lowest technical limit (UARL), while not a common practice among water suppliers, is neither impossible nor should it be rejected as a goal according to the AWWA's model. AWWA's definition of the UARL value, provided in Appendix D, includes (emphasis added):

  > "Striving to reduce system leakage to a level close to the UARL is usually not needed ***unless the water supply is unusually expensive, scarce, or both***."
  >
  > *–AWWA Water Audit Software: Definitions*

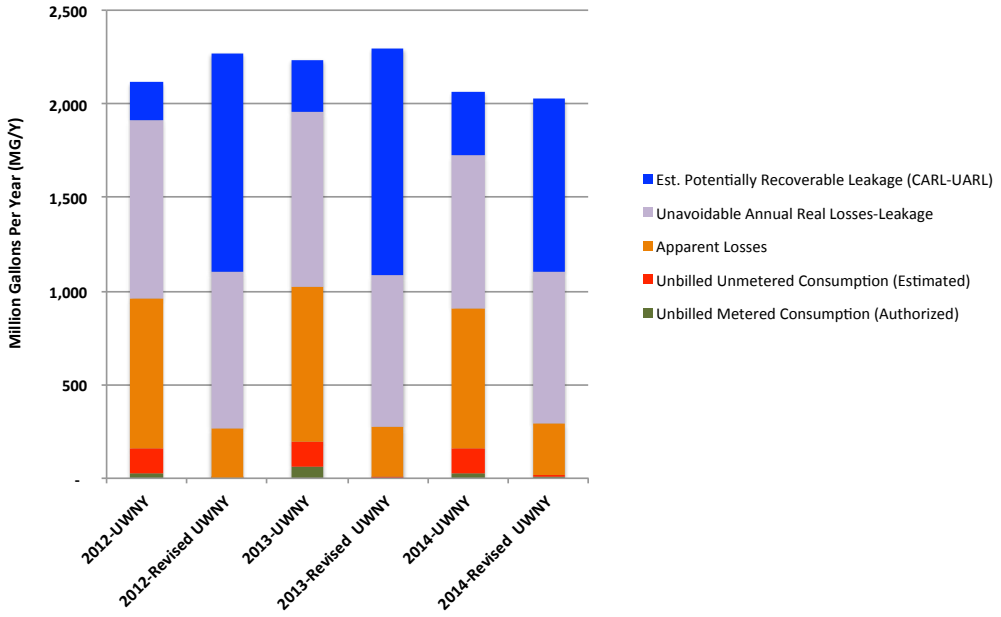
  Further, it is important to point out that unavoidable real loss estimates based on the AWWA Water Audit software are higher than some other methods. For example, some estimates assume minimum background leakage to range as low as 1000 gallons per day (gd) of main to 1500 gd/mile of main. In the case of UWNY and their 1,056 miles of main (2014), applying such assumptions yield unavoidable leakage estimates of between 385 MG/Y and 578 MG/Y–much lower than the AWWA model's 816.2 MG/Y estimate.

- **Recoverable Leakage: Estimated potential average 0.87 MG/Y per mile of main in 2014.** The 919.8 MG of potentially recoverable leakage available in 2014 as shown in the "B" column averages to savings of nearly 900,000 gallons per mile of main.

- **Recoverable Leakage: Estimated potential 8.7% of total water supplied in 2014**. Based on the revised AWWA Water Audit reports for UWNY for 2012-2014, the estimated volume of recoverable leakage existing within the system averages about 10% of total water supplied for those years. If that leakage was recovered through leak repairs and other improvements, the water needed to supply the system could be reduced by that same amount (barring other factors, i.e., increased or decreased customer water demands).

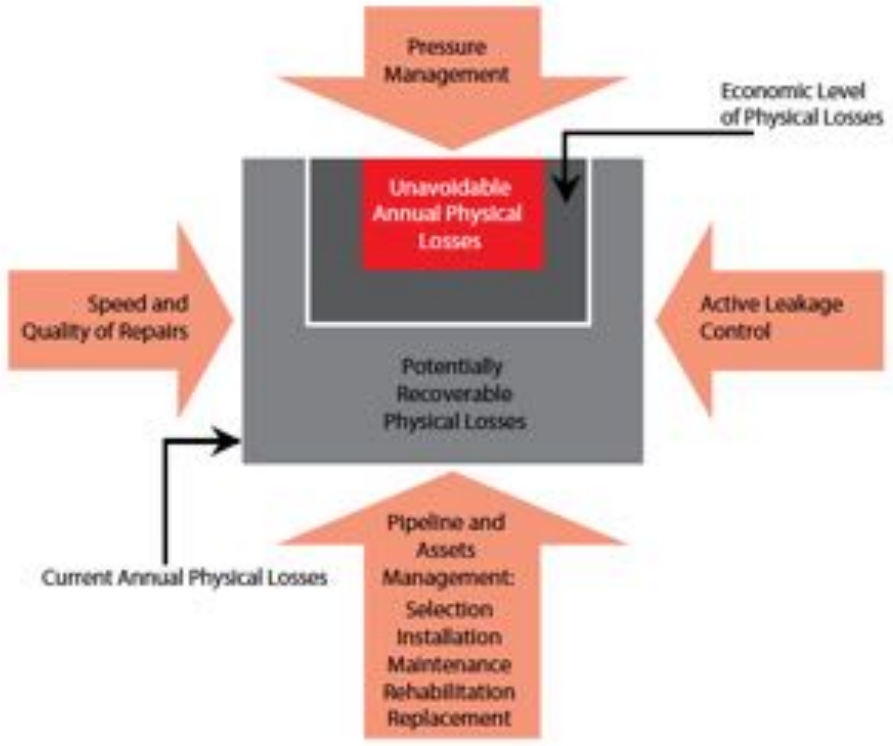
  In sum, a much larger volume of potentially recoverable leakage is estimated to exist within the UWNY system than has been reported by UWNY. This potential is based on calculations that make use of consistently applied Annual Report water data from UWNY as reported to the PSC, along with the use of normal AWWA Water Audit software model default values and the elimination of UWNY's data errors and high estimates of apparent losses.

Figure 2-4. Comparison of Estimated Potentially Recoverable Leakage and NRW Components Based on Calculations Using Data in UWNY and Revised UWNY AWWA Water Audits, 2012-2014



Common water industry components of leakage control as described by AWWA are illustrated in Figure 2-5.

Figure 2-5. AWWA's Four Pillars of Leakage Control



2.4. The State of UWNY Infrastructure: Factors Behind High Water Losses

By several measurements of UWNY's infrastructure condition and water loss management practices as shown in Table 2-6, the high volumes of leakage and other water losses existing within that system are unsurprising:

- **Main Replacement Schedule: Centuries-long.** The sluggish pace of UWNY's main renewal and replacement investments–1.5 miles in 2014–put it on track for an multi-century 704-year schedule to replace all 1,056 miles of its mains, to be completed by year 2718. This is a major problem, for numerous reasons, but particularly since by UWNY's and water industry estimates the large volume of cast iron mains in its distribution system are deteriorating rapidly, with some portions of main likely already past their useful life. Like a dental cavity, the longer broken and leaking water mains and other system appurtenances are not repaired the greater the volume of water losses and the higher the cost to repair.

  "Ultimately we will have to face the need to 'catch up' with past deferred investments, and the more we delay the harder the job will be when the day of reckoning comes. In the years ahead, all of us who pay for water service will absorb the cost of this investment, primarily through higher water bills."

  –American Water Works Association, *Buried No Longer: Confronting America's Water Infrastructure Challenge (2012)*

- **Main Break Frequency: Above The North American Average.** The number of main breaks reported by UWNY for the past three years exceed the average for North American water systems, and it is almost twice as high compared to optimized distribution systems, according to performance indicators established by the Water Research Foundation and the U.S. EPA. In a recent report, UWNY suggests that their high break frequency rate such as that in 2014 was due to harsh winter and temperature conditions. Weakened and aged mains are particularly vulnerable to failure under such conditions, but had they been repaired or replaced earlier some of those breaks may have been avoided.

  "Aging water mains are subject to more frequent breaks and other failures that can threaten public health and safety (such as compromising tap water quality and fire-fighting flows). Buried infrastructure failures also impose significant damages (for example, through flooding and sinkholes), are costly to repair, disrupt businesses and residential communities, and waste precious water resources. These maladies weaken our economy and undermine our quality of life. As large as the cost of reinvestment may be, **not** undertaking it will be worse in the long run by almost any standard."

  –American Water Works Association, *Buried No Longer: Confronting America's Water Infrastructure Challenge (2012)*

Table 2-6. UWNY Infrastructure Compared to Water Industry Standards and Performance Indicators, 2012-2014

MAIN REPLACEMENT	2012	2013	2014
Miles of main in UWNY distribution system (excluding customer service line pipes)	1,053	1,051	1,056
Miles of main UWNY renewed/replaced	4.2	2.7	1.5
Percentage of main UWNY renewed/replaced	0.4%	0.3%	0.1%
Est. average service life in years for UWNY's mains (primarily cast iron and ductile iron) when it was installed*†		50-100	
At current rate, approximate number of years it will take UWNY to replace its mains:	**248**	**389**	**704**
MAIN BREAK FREQUENCY	**2012**	**2013**	**2014**
UWNY Main breaks	221	286	384
Average failure frequency in North America‡, number of breaks/100 miles of main/year:	25	25	25
Average failure frequency for optimized distribution systems‡, number of breaks/100 miles of main/year:	15	15	15
UWNY Main breaks, number of breaks/100 miles of main/year:	21	27	36
LEAK DETECTION	**2012**	**2013**	**2014**
Miles of pipe on which UWNY performed leak detection using sonic listening equipment (noise loggers)	76	156	75
Percentage of main sounded for leaks	7%	15%	7%
DEC Water Conservation Program's recommended maximum number of years to survey an entire system for leaks:	**3 (Minimum one-third annually)**		
At current rate, approximate number of years it will take UWNY to survey its entire systems for leaks:	**14**	**7**	**14**
LEAKS DETECTED/REPORTED	**2012**	**2013**	**2014**
Surfacing (visible) leaks reported in UWNY system, number	271	353	389
Non-surfacing (invisible) leaks reported in UWNY system, number	27	46	102
Total number of leaks detected/reported by UWNY:	**298**	**399**	**491**
Surfacing (visible) leaks detected/reported, percent:	**91%**	**88%**	**79%**
Non-surfacing (invisible) leaks detected/reported, percent:	**9%**	**12%**	**21%**
WATER RECOVERED BY LEAK REPAIRS–POTENTIAL AND ACTUAL	**2012**	**2013**	**2014**
Estimated recoverable leakage in UWNY distribution system (Table 2-6, Revised UWNY water audits), MG/Y:	1,169.2	1,211.4	919.8
Volume of leakage recovered by UWNY (mains, service lines, and valves), MG/Y:	57.1	64.1	63.1
Volume of leakage recovered by UWNY as percent of total water supplied:	**0.5%**	**0.6%**	**0.6%**
Volume of leakage recovered by UWNY as percent of estimated recoverable leakage (revised water audits):	**4.9%**	**5.3%**	**6.9%**
At current rate, approximate number of years it will take UWNY to perform repairs on its recoverable leakage:	**20**	**19**	**15**

Notes:
DEC–Department of Environmental Conservation, New York

* American Water Works Association. *Buried No Longer: Confronting America's Water Infrastructure Challenge*, 2012.

† Defective cast iron main and harsh ground conditions have contributed to reduced service life for many mains and pipes in the UWNY service area. "T]"he class of cast iron pipe installed from 1961 through 1970 in United Water's Rockland County system has a very high failure rate....these mains constituted approximately 40 percent of United Water's Rockland County system and approximately 70 percent of the main failures. These cast iron pipes were estimated to have a lifespan of 65 years, even though the industry-normal life for cast iron mains is approximately 100 years." United Water New York, Supplemental Submission to the New York Public Service Commission, Case 13-W-0303, November 8, 2013, p. 18.

‡ Sturm, R., Gasner, K, Wilson, T., Preston, S., and Dickinson, M.A. *Real Loss Component Analysis: A Tool for Economic Water Loss Contr*ol, sponsored by the Water Research Foundation and the U.S. Environmental Protection Agency. Web Report #4372a, 2014.

- **Leak Detection: The Pace of UWNY's Minimal "Lift and Shift" Leak Detection Approach is Over a Decade Behind DEC's Recommended 3-year Schedule.** Only a small portion of UWNY's pipes is surveyed annually with sonic leak detection equipment to detect the presence of leaks according to UWNY annual reports to DEC in 2012-2014, as shown in Table 2-6. UWNY is years behind DEC's recommended maximum 3-year schedule for surveying an entire distribution system for leaks.

  While UWNY's water loss management approach has multiple components, its leak detection strategy relies primarily on passive "lift and shift" electronic noise loggers. Noise loggers are typically deployed by attaching them to hydrants and valves, leaving them in place overnight, and checking them the next day to see if they detected any leaks. Noise loggers can be moved ("lift and shift") around a distribution system to survey it for leakage.

Several problems exist with noise loggers that limit their capacity to detect leaks. They can easily pick up false leaks on hydrants due to nearby traffic noise, not all valves are accessible which limits the scope of infrastructure that they can sound, and they "have a clear disadvantage in detecting leaks on plastic main materials" according to a report, "Leakage Management Technologies," sponsored by the AWWA Research Foundation and the U.S. EPA. The report also found that "each utility should undertake detailed trials to assess where noise loggers are a useful tool for their leak detection efforts, as they are definitely not a general remedy for reducing real losses."

Aggressive water utility leak reduction programs that seek to minimize system leakage don't rely primarily on noise loggers but instead a suite of field-based crews and tools that include more sophistical listening devices which can reach every pipe and connection in the service area and with greater accuracy–and on a schedule that is fast-tracked. While UWNY's plan to install an Automated Metering Infrastructure (AMI) system will yield more useful information about water losses and where they may be occurring, monitoring alone doesn't reduce leakage and other losses. Putting more leak detection, repair, and main replacement crews to work are the practical steps required to staunch the flow of leaks.

- **Leaks Detected/Reported: Mostly Only Visible Leaks.** On average, nearly 90% of the leaks reported by UWNY between 2012 and 2014 were visible, which indicates at least some if not many of these leaks were reported to rather than detected by UWNY–a reactive leak detection strategy. The facts behind these reports are unknown, but given that only a small portion (about 10%) of the leaks found were invisible is another indicator that the water company's "lift and shift" approach to leak detection isn't working very well at finding leaks occurring underground.

> "Utilities that employ this type of [reactive] leakage response most likely have excessive leakage that will never be reliably contained. Controlling leakage effectively relies upon a *proactive* leakage management program that includes a means to identify hidden leaks, optimize repair functions, manage excessive water pressure levels, and upgrade piping infrastructure before its useful life ends."
>
> –American Water Works Association, *Water Loss Control: Apparent and Real Losses* (2012)

- **Water Recovered By Leak Repairs–Barely Tapping The Potential**. The volume of water recovered by UWNY's leak repair work totaled 63.1 MG/Y in 2014, as shown in Table 2-6. This volume was only a small percentage (6.9%) of the estimated potential recoverable leakage existing within the system as shown in Table 2-5, based on calculations using revised UWNY AWWA Water Audit data in column "B" (919.8 MG/Y). At its current rate of leak repair, it is estimated that it would take UWNY 15 to 20 years to recover the several millions of gallons of water it is now losing daily to fixable leakage (Table 2-6).

2.5. Additional Factors in UWNY's High Leakage and System Water Losses

Additional factors that appear to be contributing to UWNY's leakage, apparent loss, and related water loss issues include:

- **High pressure** in parts of the distribution system is yet another factor contributing to leakage in the UWNY system. This problem has been known to UWNY for some time, and the company has plans for a new AMI system and District Meter Area (DMA) program that is projected to be installed by 2017. While an AMI system will be useful, it can never replace the work of investments in high pressure regulation and properly sized district management zones, trained field crews dedicated to daily leak detection and repair work, and sufficient budget allocations to not just find but also repair and replace broken and leaking mains, service lines, hydrants and valves.

- **Apparent losses due to theft and unmetered customers** have been a long-standing but largely unsolved problem in the UWNY service area. Why? Accelerated replacement of older meters, legal pursuit of unauthorized water users (thieves), and metering of currently unmetered customers are obvious steps toward apparent loss reduction. For reasons unknown, UWNY does not appear to be aggressive in reducing its apparent losses despite their estimates that it represents the majority of its water losses. By projecting a high estimate of apparent losses, UWNY's estimates of recoverable leakage –which is effectively new water supply–are low and undervalued.

SECTION 3

CUSTOMER WATER USE: RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL

This section describes the findings from an evaluation of water use and efficiency by retail customers served in the UWNY service area, which is comprised primarily of residential single-family and multi-family, commercial, and industrial water users in Rockland County. In addition, preliminary estimates of potential water savings from conservation based on current customer water demands are provided.

Export (resale) water is supplied by UWNY to its two wholesale customers, United Water New Jersey (UWNJ) and the Village of Hillburn, NY, who serve primarily residential customers. Because the customers in those two service areas are metered and billed by their respective local water utilities, their water use characteristics are not discussed here.

Note: To protect customer confidentiality, no customer names, locations, or other information that might identify a particular customer is provided in this report. Where it is relevant, in some instances examples of common types of customers associated with a particular customer category may be described but are not meant to refer to any particular customer served by UWNY.

3.1 OVERVIEW OF UWNY CUSTOMER WATER USE

A detailed evaluation was made of UWNY's residential (single-family and multi-family) and nonresidential (commercial and industrial) water consumption records for a 36-month period between January 2012 and December 2014. Three years of customer meter data were combined for the evaluation in order to minimize atypical weather and other impacts that can distort normal water use characteristics when only one year of data are evaluated.

A summary of the average annual numbers of customers served and related water consumption figures combined for the three years evaluated is provided in Table 3-1 for each major customer category. As averages, the figures shown in Table 3-1 do not represent any one particular year but a recent snapshot of general trends in customer water use. The monthly demands for each major customer category are illustrated in Figure 3-1.

Residential water demand, and single-family homes in particular, represent the majority (about 75%) of customer water use in Rockland County. The Village of Sloatsburg's water use is comprised primarily of single-family customers, and a small number of commercial customers. The balance of UWNY's retail water demand is by commercial and industrial users. About 170 customers are unmetered and include residential, commercial, and industrial users. The reasons that these customers remain unmetered are not known.

Other than performing an on-site water audit, the water use characteristics of commercial and industrial water customers, much like multi-family properties, can only be roughly assessed by evaluating their water meter readings. This is because such customers represent a diverse range of water end uses, users, and property types that are not easily comparable (e.g., a metal finishing operation is very different than a manufacturer, restaurant, or office building complex). In the case of UWNY's nonresidential customers, for reasons of confidentiality, no specific types of customers are discussed here and thus only general comments are provided.

Table 3-1. Summary of UWNY Average Customer Water Use Characteristics, 2012-2014*

Customer Category	Average No. Accounts†	Percent Water Demand of All Accounts†	Average No. Active Customers†	Average Month Demand, MG	Average Day Demand, MGD	Average Account Demand, GD	Est. Average Account Indoor Demand, GD‡	Est. Average Account Seasonal/ Outdoor Demand, GD§	Est. Average Account Outdoor Water Use, Percent
Residential									
Single-Family (SF)	75,259	62.1%	65,456	412.9	13.6	207	188	19	9%
Multi-Family (MF)	1,839	13.1%	1,725	86.8	2.9	1,552	1,510	42	3%
Total Residential:	**77,098**	**75.2%**	**67,181**	**499.7**	**16.4**	**1,759**	**1,698**	**61**	
Sloatsburg (Village)									
Total Residential/Nonresidential:	**1,124**	**0.7%**	**983**	**4.8**	**0.16**	**141**	**129**	**12**	**9%**
Nonresidential									
Commercial/Public	4,949	19.3%	4,589	127.8	4.2	916	757	158	17%
Industrial	78	4.8%	99	31.8	1.0	13,401	12,803	598	4%
Total Nonresidential:	**5,027**	**24.0%**	**4,688**	**159.6**	**5.2**	**14,317**	**13,560**	**756**	
Service Points without Meters									
Total Unmetered:	**170**	Unknown	**170**	Unknown					
TOTAL:	**83,419**	**100.0%**	**73,022**	**664.2**	**21.8**	**16,217**	**15,387**	**829**	**5%**

Notes:

* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.

† There are more customer accounts than active customer/water-using properties. Some customer properties have multiple accounts due to having more than one owner/occupier during the years shown, and some (usually) nonresidential customers have multiple meters/accounts at one site. Accounts with zero use for the years shown are considered inactive and not counted here. The estimated housing units shown for single-family customers are for houses, and those for multi-family customers reflect estimated apartment units based on a combination of U.S. Census and Rockland County demographic data.

‡ Based on an average of February, March and April meter readings, usually the lowest volume usage and presumably indoors only.

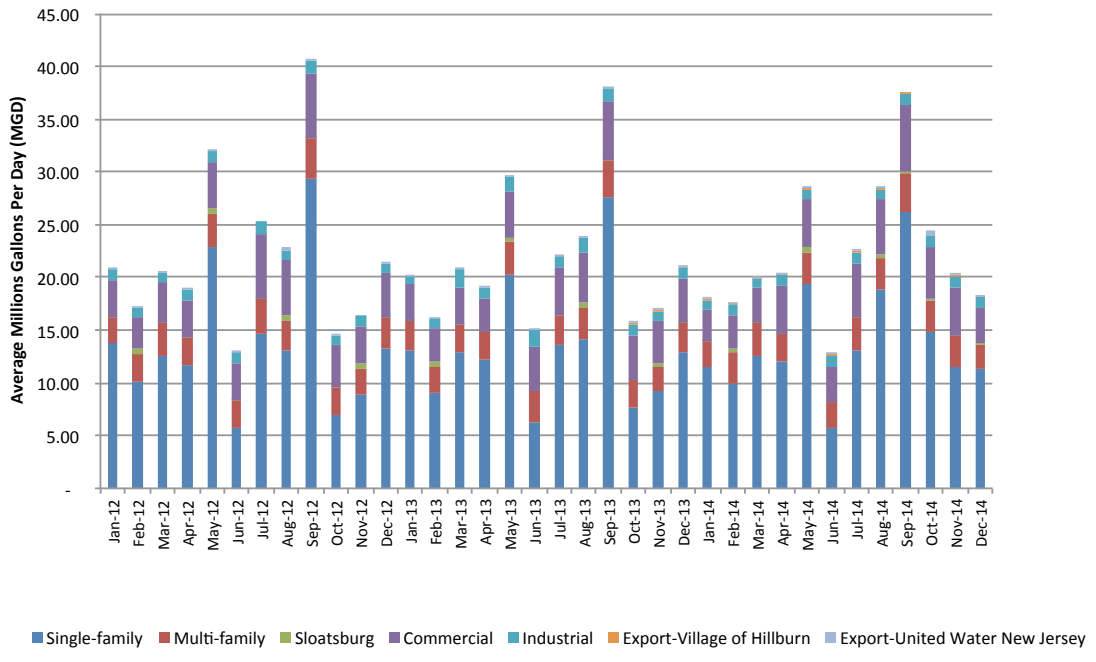
§ Based on total annual demand minus the estimated average indoor demand.

MGD–Million Gallons per Day

MG–Million Gallons

GD–Gallons per Day

Figure 3-1. UWNY Retail Customer And Export/Wholesale Water Demands, Average Million Gallons Per Day (MGD), 2012-2014



Metrics for Customer Water Use Evaluation

Water use metrics ("indicators") used to characterize and evaluate the water use efficiency of customers served by UWNY include average as well as rank, percentile, indoor and seasonal/outdoor water use, and single-family residential per capita use:

- **Rank** of an individual customer's average water use relative to others in their customer category. The 1st ranked water user in a customer category uses more water than all the others, and the lowest ranked customer uses the least. The very highest water users in the residential customer sector, for example, very often have excessive outdoor water use and are top candidates for outdoor water use reduction measures.
- **Percentile** is a measure of subgroups of customers' water use relative to other customers in their customer category. The top 1% of customers with the highest water demands often has a much higher per-account water savings potential compared to the bottom or lower 50% of customers with the lowest water demands.
- **Indoor and Seasonal/Outdoor** water use. Indoor water use in homes typically reflects that used for plumbing fixtures, appliances, and leakage. Seasonal and outdoor residential water demands during warm months is commonly for lawn and landscape irrigation, outdoor water features, pools, and car washing. Nonresidential indoor and outdoor water use may or may not follow similar patterns. Hotels and office parks, for example, often have similar indoor and outdoor water use patterns to those of residential users. However, many other types of commercial and industrial customers' indoor and winter months' use is often driven more by economic circumstances than seasonal weather conditions, which is why some nonresidential water users have higher demands in cool winter months and lower use in the summer.
- **Low water use** customers include many of those in the bottom 50th percentile of users that are listed as "active" but in some cases may be using as little as a few gallons a day. Low water-use customers can reflect a number of circumstances, including people who are very efficient "super savers," part-time or partial year residents, and properties with private wells. Low use accounts can also indicate broken, under-registering, poorly sized meters, water theft, and closed or unoccupied properties. Zero and low-use accounts for properties that are unoccupied but which are still counted as active customers can distort measurements of average customer account and per capita water usage.
- **Per capita** water use by residential customers. Single-family per capita use in particular is a well-known indicator of water use efficiency because many if not most people in this customer group share common types of water end uses, e.g., toilets, showers, faucets, and lawn watering that are comparable on a volume basis. Further, evaluating residential per capita use among all customers within that group as well as to national averages and efficiency benchmarks helps identify the potential for future water savings. Note: Nonresidential per capita use is not included here since it is usually a weak indicator of water use efficiency when comparing one nonresidential customer to another. For example, the ways in which water is used and the volumes consumed by a beverage manufacturer or food processor are very different than those at a municipal office building, school, or hospital.

Several limitations associated with UWNY's customer water use records are important to note. First, some of UWNY's commercial and industrial customers have multiple meters and thus multiple accounts at one address, e.g., one customer property has individual meters for

cooling and heating systems, offices, and outdoor uses. Similarly, due to multiple owner/occupiers that resided at some residential properties between 2012 and 2014, there are more customer accounts than the number of customer properties served by UWNY. For those reasons, both the number of customer accounts and number of customers are provided in the tables below since per-customer usage more accurately describes how water is used than basing it on a per-account basis. Second, quarterly meter reading practices for single-family and most multi-family accounts were in effect in 2012 through the first half of 2014, after which monthly meter reading began. The seasonal water use analysis for those customers included data adjustments to estimate indoor and outdoor water use for the second half of 2014. Third, a meter records-based desktop analysis of individual or groups of customers' water use cannot replace an onsite evaluation of water use, particularly at nonresidential sites that have a wide variety and complexity of water end uses compared to those used at homes.

3.2 RESIDENTIAL CUSTOMER WATER USE

Residential water demand includes essential indoor water-using activities, such as those for bathroom, kitchen, and laundry, and often some amount of discretionary outdoor water use, such as that for lawn irrigation, swimming pools, water features (ponds, fountains, and misting systems), and car washing.

3.2.1 Single-Family Residential Water Use

A summary of UWNY's Single-Family (SF) residential customers' water use characteristics by percentile group averaged for 2012-2014 is provided in Table 3-2. Single-family per capita water use characteristics are provided in Table 3-3 and illustrated in Figure 3-2.

Table 3-2. Single-Family Residential Average Customer Water Use Characteristics By Percentile, 2012-2014*

Single-Family Customer Account Percentile	Average No. Active Accounts†	Percent Water Demand of All Accounts†	Average No. Active Customers†	Average Month Demand, MG	Average Day Demand, MGD	Average Customer Demand, GD	Est. Average Customer Indoor Demand, GD‡	Est. Average Customer Seasonal/ Outdoor Demand, GD§	Est. Average Customer Outdoor Water Use, Percent§
Total	**75,259**	**100%**	**65,456**	**413**	**13.6**	**207**	**188**	**19**	**9.2%**
Top 1%	753	5%	655	22	0.7	1,097	812	285	26.0%
Top 10%	7,526	28%	6,546	117	3.8	586	480	106	18.0%
Top 25%	18,815	52%	16,364	216	7.1	435	374	60	13.9%
Top 50%	37,630	79%	32,728	327	10.7	328	292	36	11.0%
Bottom 50%	37,630	21%	32,728	86	2.8	87	85	2	2.4%

Notes:

* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.

† There are more customer accounts than active customer/water-using properties. Some customer properties have multiple accounts due to having more than one owner/occupier during the years shown, and some (usually) nonresidential customers have multiple meters/accounts at one site. Accounts with zero use for the years shown are considered inactive and not counted here. The estimated housing units shown for single-family customers are for houses, and those for multi-family customers reflect estimated apartment units based on a combination of U.S. Census and Rockland County demographic data.

‡ Based on an average of February, March and April meter readings,

§ Based on total annual demand minus the estimated average indoor demand.

** Based on an average of 3.13 persons per household. Source: U.S. Census Bureau, Rockland County, NY, 2009-2013

MGD–Million Gallons per Day

MG–Million Gallons

GD–Gallons per Day

Table 3-3. Single-Family Customer Average Gallons Per Capita Per Day, By Percentile, 2012-2014*

Single-Family Customer Account Percentile	Average Total GPCD		Est. Avg. Indoor GPCD		Est. Avg. Outdoor GPCD
	Average GPCD	More (Less) Than The National Average 88 GPCD†	Average Indoor GPCD	More (Less) Than National Indoor Average, 55 GPCD‡	
Total	**66**	**(22)**	**60**	**5**	**6**
Top 1%	350	262	259	204	91
Top 10%	187	99	153	98	34
Top 25%	139	51	120	65	19
Top 50%	105	17	93	38	11
Bottom 50%	28	(60)	27	(28)	1

Notes:

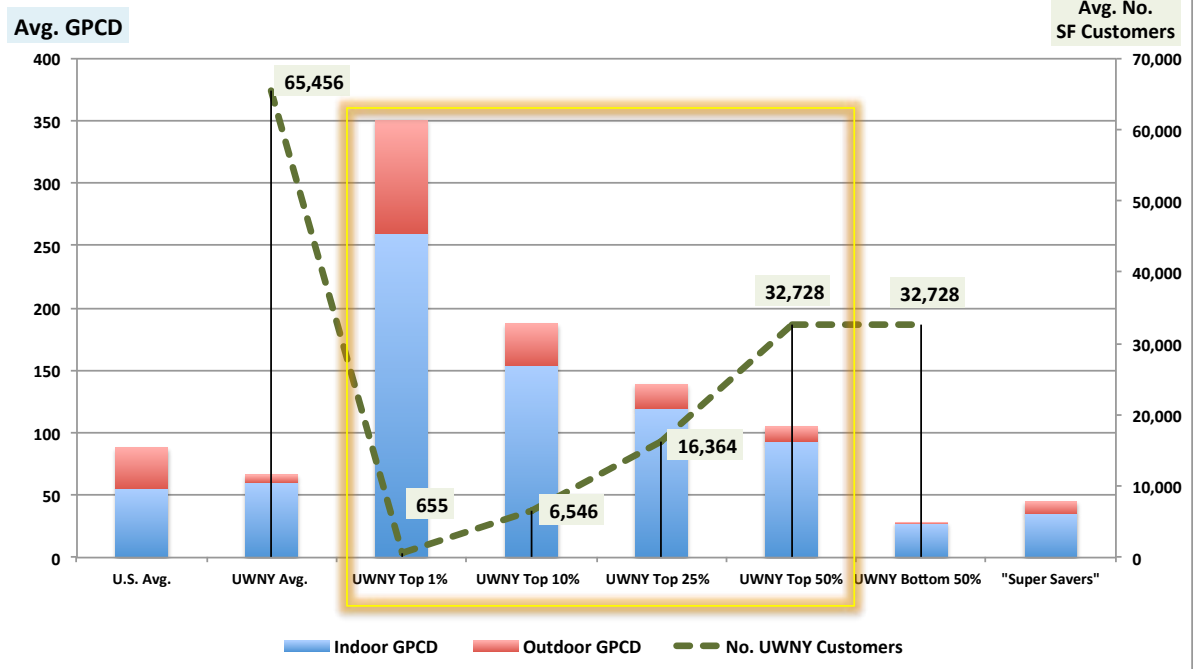
* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.

† U.S. national domestic average 88 GPCD. Source: U.S. Department of the Interior, U.S. Geological Survey. *Estimated Use of Water in the United States in 2010, Circular 1405* (2014).

‡ U.S. home indoor water use averages about 55 GPCD. Source: *Residential End Uses of Water Study* (final report pending 2015) sponsored by the Water Research Foundation.

GPCD–Gallons Per Capita Per Day

Figure 3-2. Single-family Average Gallons Per Capita Per Day (GPCD), Est. Indoor and Outdoor Use: U.S., UWNY*, and "Super Savers"



* Figures shown for United Water New York (UWNY) are based on a 3-year average (2012-2014).

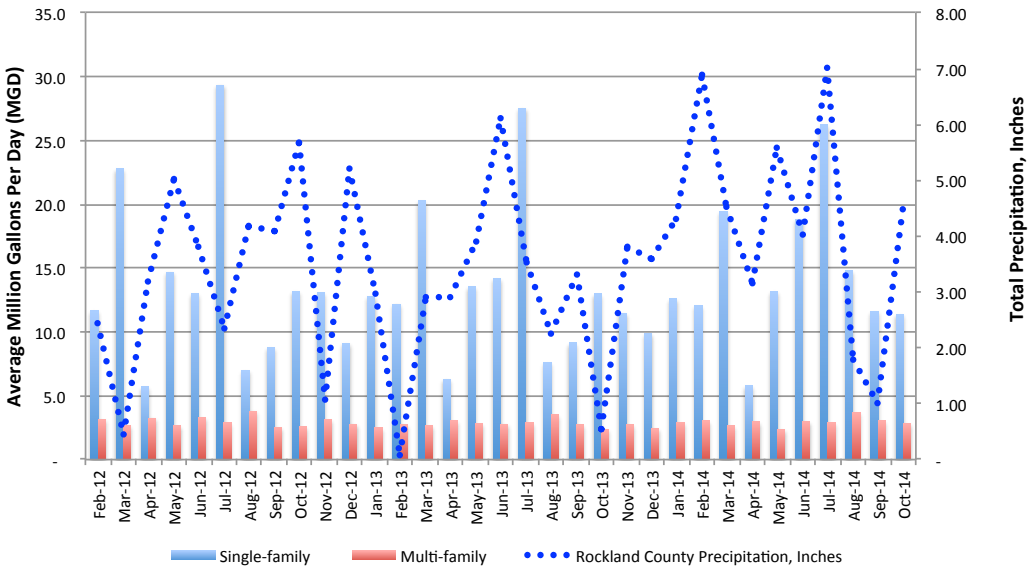
- **Average SF customers: Lower metered water use compared to the national average**
    - Average 66 gallons per capita per day (gpcd) is similar to some other systems in the Northeast but is 22 gpcd less than the most recently published national domestic (household) average of 88 gpcd (U.S. Geological Survey, 2014).
    - Homes with private wells that are used for irrigation and other purposes may partially explain why average single-family use is below the national average.
- **Number 1 ranked highest water-using SF customer:** Averaged nearly 6,500 GD in 2012-2014, over 30 times more than the average SF customer (207 GD). Very high single-family water demand like this is often attributable to excessive lawn irrigation and other outdoor usages such as artificial pools, ponds, and fountains.
- **Top 1% SF customers: Very high water use**
    - Use an average of nearly 1,100 gallons per day (GD) per account and 350 gpcd– which is about five times the average SF household served by UWNY, and nearly four times the national average of 88 gpcd.
    - Estimated outdoor water use is more than 10 times the average SF customer, averaging about 285 GD on an annual average day basis, equivalent to about 104,000 gallons annually per property.
    - Estimated indoor water use is more than four times higher than the average SF customer.
    - These customers likely have the highest per-customer potential for saving water from both indoor and outdoor water efficiency measures. Homes with residents that exceed the average 3.13 persons per household in Rockland County may explain why some houses have high indoor use, but for others it may be explained by the installation of old and inefficient fixtures and appliances, leakage, and other water waste.
- **Top 10% SF customers: High water use**
    - Use more than twice than the average SF household. Their seasonal/outdoor water demand totals close to 39,000 gallons annually, compared to about 6,900 gallons for the average SF home.
    - These customers likely have a high potential for saving water from both indoor and outdoor water efficiency measures
- **Top 25% to 50% SF customers: About 1.5 times the average**
    - These top users use about 1.5 times the average SF customer.
    - These customers have a moderate to high potential for saving water from indoor as well as outdoor water efficiency measures.
- **Bottom 50% SF customers: Very low water use, including "Super Savers"**
    - Averaging less than 85 GD per account and only 28 gpcd, these customers are using about one-third the national average for homes.
    - Homes that also use private wells are likely included in this customer group.

- Average water use figures in this SF group may reflect a number of homes that are single occupancy, small households, part-time residents, and infrequently occupied households as well as unoccupied houses for sale or under foreclosure.
- Meter under-registration, inaccurately size meters, and water theft may also explain some of the very low water usage in this customer group.
- This SF customer group has a relatively low potential for future water savings from conservation but in some cases may be a good target for repairs and simple fixture retrofits.

- **Seasonal/Outdoor SF use**: On average, SF customer outdoor/seasonal use is relatively low compared to national averages. The top 50% water users, however, on an average annual day per-account basis average about 36 GD, and the 655 customers in the top 1% average about 285 GD.

  Residential summer outdoor demand in Rockland County, as shown in Figure 3-3, while approximated for the months shown due to adjustments for customer meter reading schedules, is generally higher in months of lower rainfall levels than in those with higher rainfall levels. This is a common pattern for single-family residential water use that reflects landscape irrigation and other outdoor water demands.

Figure 3-3. Rockland County's Monthly Precipitation and Residential Water Demand Adjusted to Months of Actual Usage, 2012-2014



Several features of single-family customer water use as presented in Table 3-2 and Table 3-3 suggest the following future water conservation program priorities:

- **Recommended future conservation program priorities for SF customers**
    - Top 1% to 10% (High priority) and top 25% to 50% (Moderate-high priority) of water-using SF customers: Emphasize measures to reduce both high indoor and outdoor water use. Potential efficiency measures include water audits, efficient indoor fixtures, appliances, leak repair, graywater systems, rainwater harvesting, and outdoor water-saving measures such as an irrigation watering schedule, a 'Rockland Water-wise Landscape' program that emphasizes native plant design, maintenance, and thrifty or "rainfall only" irrigation, "smart" irrigation controllers such as moisture sensor-based controllers, irrigation tune-ups, and pool maintenance upgrades, among other measures.
    - Bottom 50% of water-using SF customers: Emphasize maintenance measures such as faucet and toilet leak detection and minor plumbing repairs, other indoor fixture and appliance efficiency measures (Low-moderate priority)
    - Incentives such as rebates, high-efficiency fixture "giveaways," water audits, more aggressive conservation-oriented rates, and ordinances to promote customer adoption of conservation measures and practices.
- **Preliminary estimate of potential water conservation savings by Single-family customers:** Approximately 1.0 to 2.1 MGD based on 2012-2014 average day demands, assuming a 10% to 20% savings among the top 50% of water-using customers.
- **Examples** of water saving programs in the residential single-family and multi-family customer sector as sponsored by the San Antonio Water System (TX) are illustrated in Figure 3-4.

Figure 3-4. Examples of Residential Conservation Programs: San Antonio Water System (TX)

3.2.2 Multi-Family Residential Water Use

A summary of UWNY's Multi-Family (SMF) residential customers' average total active accounts, total demands, and customer water use characteristics by percentile group averaged for 2012-2014 are provided in Table 3-4.

Table 3-4. Multi-Family Residential Average Customer Water Use Characteristics By Percentile, 2012-2014*

Multi-Family Customer Account Percentile	Average No. Active Accounts†	Percent Water Demand of All Accounts†	Average No. Active Customers†	Average Month Demand, MG	Average Day Demand, MGD	Average Customer Demand, GD	Est. Average Customer Indoor Demand, GD‡	Est. Average Customer Seasonal/ Outdoor Demand, GD§	Est. Average Customer Outdoor Water Use, Percent§
Total	**1,839**	**100%**	**1,725**	**86.8**	**2.9**	**1,552**	**1,510**	**42**	**2.7%**
Top 1%	18	20%	17	17.7	0.6	31,671	36,276	(4,605)	-14.5%
Top 10%	184	59%	173	51.2	1.7	9,155	9,351	(196)	-2.1%
Top 25%	460	80%	431	69.2	2.3	4,949	4,936	13	0.3%
Top 50%	920	93%	863	81.0	2.7	2,895	2,844	51	1.8%
Bottom 50%	920	7%	863	5.8	0.2	208	175	33	15.9%

Notes:
* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.
† There are more customer accounts than active customer/water-using properties. Some customer properties have multiple accounts due to having more than one owner/occupier during the years shown, and some (usually) nonresidential customers have multiple meters/accounts at one site. Accounts with zero use for the years shown are considered inactive and not counted here. The estimated housing units shown for single-family customers are for houses, and those for multi-family customers reflect estimated apartment units based on a combination of U.S. Census and Rockland County demographic data.
‡ Based on an average of February, March and April meter readings, usually the lowest volume usage and presumably indoors only. Figures less than zero indicate water use that is lower in warm weather months compared to cool weather months.
§ Based on total annual demand minus the estimated average indoor demand.

The water use efficiency of Multi-Family customers is difficult to gauge from their water meter readings alone. Unlike single-family customers for which there are like features by which water use can be compared, MF accounts typically represent buildings with a diverse range in their number of dwelling units and occupancy levels, and some multi-family buildings are combined with commercial properties with many types of nonresidential use characteristics. For example, the highest MF customers often represent large apartment buildings with many dwelling units. In contrast, very low water-using (e.g. bottom 50%) MF customers typically have buildings with a small number of dwelling units. The two cannot be compared easily in terms of efficiency. Similarly, the average gallons per capita per day (gpcd) for MF customers in the UWNY service area is not shown here due to incomplete demographic data to accurately estimate and evaluate MF usage on a per capita basis.

Several features of MF customer water use as presented in Table 3-4 suggest the following future water conservation program priorities:

- **Average MF customers: Wide variation in use**
    - Averages about 1,152 GD per account.
- **Number 1 ranked highest water-using MF customer:** Averaged nearly 57,000 GD in 2012-2014, over 35 times higher than the average MF customer. Again, given the unknowns about the number of multi-family units and population served by each MF customer, it is impossible to compare their efficiency of use to other MF customers based on consumption alone.

- **Top 1% to 10% customers: higher water use in cool weather months compared to low water use in the summer (negative outdoor water demand).** These customers may include buildings with little or no outdoor water use and lower occupancy in the summer compared to the winter months.
- **Bottom 50% customers: Low water use**
    - Averaging only about 200 GD per customer, this is unusually low and may reflect partially used buildings with low occupancy levels, under-registering meters, and customers with oversized meters.
- **Seasonal/Outdoor MF use**: Averages less than 5% of total MF usage. This is not unusual for multi-family properties in the Northeast with limited irrigation, pools, and other outdoor usages. Transient populations, e.g., students and temporary workers, can also affect MF seasonal water use.
- **Recommended future conservation program priorities:**
    - Top 1% to 50% of MF customers: Emphasize measures to reduce both high primarily indoor and outdoor water use (Moderate-high priority)
    - Bottom 50% of MF customers: Inspect customer meters for accuracy, sizing, and classification. Emphasize maintenance measures such as faucet and toilet leak detection and minor plumbing repairs, other indoor fixture and appliance efficiency measures (Low priority).
- **Preliminary estimate of potential water conservation savings by Multi-family customers:** Approximately 0.25 MGD to 0.4 MGD based on 2012-2014 average day demands, assuming a 10% to 15% savings among the top 50% of water-using customers. Potential efficiency measures include those described for Single-family customers, among other options.

3.3 SLOATSBURG (VILLAGE) WATER USE

A summary of Sloatsburg's customer characteristics and water use averaged for 2012-2014 is provided in Table 3-5.

The relative water use efficiency of Sloatsburg customers is difficult to evaluate since they include both residential and nonresidential customers with very different types of end uses of water. For example, while the majority of Sloatsburg customers are residential, some of the top water users include nonresidential customers that average several thousands of gallons of daily use that cannot be easily be compared to residential customers.

Future evaluations of Sloatsburg water conservation potential should include classifying each customer by its use types so that it can be compared to the use efficiency of similar customer types, i.e., other single-family customers.

Preliminary estimate of potential water conservation savings by Sloatsburg customers: Approximately 0.01 MGD to 0.02 MGD based on 2012-2014 average day demands, assuming a 10% to 20% savings among the top 50% of water-using customers. Potential efficiency measures those described for Single-family customers, among other options.

Table 3-5. Sloatsburg (Village) Average Customer Water Use Characteristics By Percentile, 2012-2014*

Sloatsburg (Village) Customer Account Percentile	Average No. Accounts†	Percent Water Demand of All Accounts†	Average No. Active Customers†	Average Month Demand, MG	Average Day Demand, MGD	Average Account Demand, GD	Est. Average Account Indoor Demand, GD‡	Est. Average Account Seasonal/ Outdoor Demand, GD§	Est. Average Account Outdoor Water Use, Percent§
Total	**1,124**	**100%**	**983**	**4.8**	**0.16**	**141**	**129**	**12**	**9%**
Top 1%	11	8%	10	2.1	0.01	1,111	902	209	19%
Top 10%	112	29%	98	1.4	0.05	406	352	53	13%
Top 25%	281	51%	246	2.5	0.08	288	252	37	13%
Top 50%	562	77%	492	3.7	0.12	218	197	21	10%
Bottom 50%	562	23%	492	1.1	0.04	63	61	3	4%

Notes:

* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.

† There are more customer accounts than active customer/water-using properties. Some customer properties have multiple accounts due to having more than one owner/occupier during the years shown, and some (usually) nonresidential customers have multiple meters/accounts at one site. Accounts with zero use for the years shown are considered inactive and not counted here. The estimated housing units shown for single-family customers are for houses, and those for multi-family customers reflect estimated apartment units based on a combination of U.S. Census and Rockland County demographic data.

‡ Based on an average of February, March and April meter readings, usually the lowest volume usage and presumably indoors only. Figures less than zero indicate water use that is lower in warm weather months compared to cool weather months.

§ Based on total annual demand minus the estimated average indoor demand.

3.4 COMMERCIAL WATER USE

Commercial water customers typically include retail, office buildings, hotels/motels, restaurants, medical and dental facilities, schools, government and public buildings and facilities, parks, golf courses, and recreational facilities. End uses of water at commercial sites include appliances, plumbing fixtures, commercial kitchen, and medical equipment to sophisticated water cooling, heating, and treatment systems, irrigation, pools, among many other uses.

A summary of UWNY's Commercial customers' average total active accounts, total demands, and customer water use characteristics by percentile group averaged for 2012-2014 are provided in Table 3-6.

Table 3-6. Commercial Average Customer Water Use Characteristics By Percentile, 2012-2014*

Commercial Customer Account Percentile	Average No. Active Accounts†	Percent Water Demand of All Accounts†	Average No. Active Customers†	Average Month Demand, MG	Average Day Demand, MGD	Average Customer Demand, GD	Est. Average Customer Indoor Demand, GD‡	Est. Average Customer Seasonal/ Outdoor Demand, GD§	Est. Average Customer Outdoor Water Use, Percent§
Total	**4,949**	**100%**	**4,589**	**128**	**4.2**	**916**	**757**	**158**	**17%**
Top 1%	49	36%	46	46	1.5	33,230	27,512	5,719	17%
Top 10%	495	74%	459	95	3.1	6,807	5,581	1,226	18%
Top 25%	1,237	89%	1,147	114	3.7	3,260	2,674	586	18%
Top 50%	2,475	97%	2,295	124	4.1	1,780	1,467	313	18%
Bottom 50%	2,475	3%	2,295	4	0.1	52	48	4	8%

Notes:

* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.

† There are more customer accounts than active customer/water-using properties. Some customer properties have multiple accounts due to having more than one owner/occupier during the years shown, and some (usually) nonresidential customers have multiple meters/accounts at one site. Accounts with zero use for the years shown are considered inactive and not counted here. The estimated housing units shown for single-family customers are for houses, and those for multi-family customers reflect estimated apartment units based on a combination of U.S. Census and Rockland County demographic data.

‡ Based on an average of February, March and April meter readings, usually the lowest volume usage and presumably indoors only. Figures less than zero indicate water use that is lower in warm weather months compared to cool weather months.

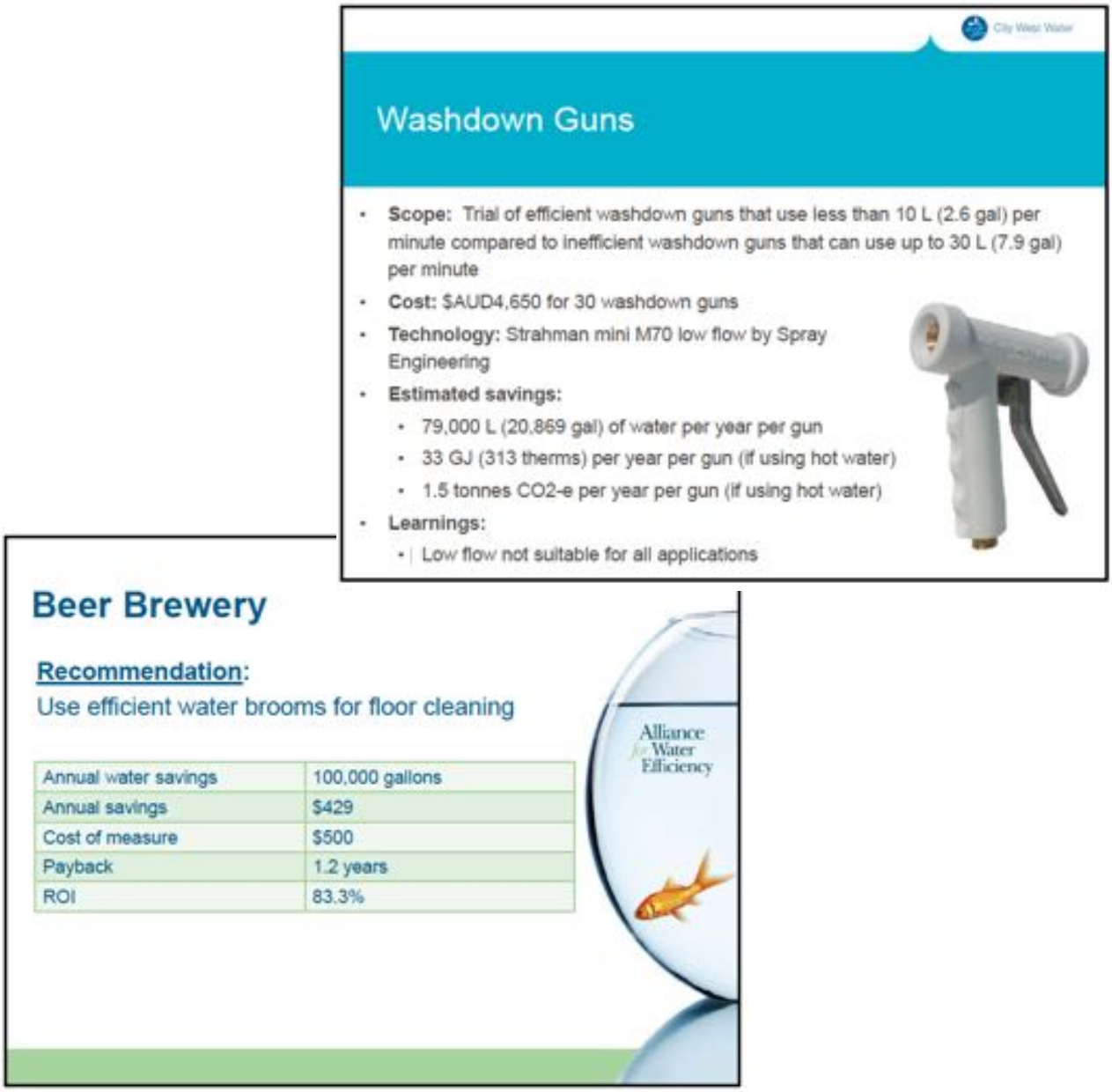
§ Based on total annual demand minus the estimated average indoor demand.

Several features of Commercial customer water use as presented in Table 3-6 suggest the following future water conservation program priorities:

- **Number 1 ranked highest water-using Commercial customer:** Averaged over 100,000 GD in 2012-2014.
- **Top (highest) volume Commercial accounts use a disproportionate volume of water:**
    - Top 1% accounts use over 35% of commercial water demand
    - Top 25% accounts use 89% of commercial water demand
    - Very good potential for large per-customer water savings from conservation
- **Bottom (lowest) volume 50% of Commercial accounts represent only 3% of demand**
    - Average account use is 52 GD, with many less than 20 GD.
    - These very low accounts should be checked for meter size accuracy and calibration to determine their low use.
    - Some very low use customers may also reflect infrequently used submeters, difficult economic conditions, and water theft.
    - Meters that are undersized and not calibrated represent potential revenue losses that could be recouped by UWNY and which contribute to apparent water losses.
- **Outdoor use is relatively consistent among many Commercial customers**
    - 18% of average Commercial customers' water demands appear to be for seasonal or outdoor water usages. However, a wide range in seasonal usage can be found among some accounts.
- **Recommended future conservation program priorities**
    - Top 1% Commercial accounts may have highest per account potential for water savings (very high priority)
    - Top 10% to 25% Commercial accounts likely have a moderate to high per potential for water savings (high priority)
    - Types of water-saving measures to target for Commercial customers include:
        - Water audits of buildings and facilities, indoors and outdoors
        - Upgrades and replacements of water-using equipment, appliances, fixtures, and maintenance practices
        - Financial incentives for conservation, such as rebates, loans, grants, and technical assistance.
        - Incentives and ordinances to promote efficient commercial water use practices and equipment, such as rebates and policies that replace inefficient water-using equipment at the point of property sale or lease.
        - Themed conservation outreach programs for specific user categories, e.g., office buildings, medical/hospital/dental, hospitality establishments, schools, and public buildings and recreational centers.

- **Preliminary estimate of potential water conservation savings by Commercial customers:** Approximately 0.4 MGD to 0.8 MGD based on 2012-2014 average day demands, assuming a 10% to 20% savings among the top 50% of water-using customers.
- **Examples** of commercial customer conservation water savings reported by City West Water (Melbourne, AU) and the Alliance for Water Efficiency are shown in Figure 3-5.

Figure 3-5. Examples of Commercial Conservation Programs: City West Water (Melbourne, AU) & Alliance for Water Efficiency



3.5 INDUSTRIAL WATER USE

Industrial water customers typically include manufacturing, processing, warehouses, data centers, and other types of buildings and facilities with large water demands.

A summary of UWNY's Industrial customers' average total active accounts, total demands, and customer water use characteristics by percentile group averaged for 2012-2014 are provided in Table 3-7.

Table 3-7. Industrial Average Customer Water Use Characteristics By Percentile, 2012-2014*

Industrial Customer Account Percentile	Average No. Active Accounts†	Percent Water Demand of All Accounts†	Average No. Active Customers†	Average Month Demand, MG	Average Day Demand, MGD	Average Customer Demand, GD	Est. Average Customer Indoor Demand, GD‡	Est. Average Customer Seasonal/ Outdoor Demand, GD§	Est. Average Customer Outdoor Water Use, Percent§
Total	**78**	**100%**	**78**	**31.8**	**1.05**	**13,401**	**12,803**	**598**	**4%**
Top 1%	1	42%	1	13.3	0.44	561,543	541,533	20,010	4%
Top 10%	8	93%	8	29.6	0.97	124,835	119,053	5,782	5%
Top 25%	20	98%	20	31.0	1.02	52,286	49,872	2,414	5%
Top 50%	39	99%	39	31.6	1.04	26,631	25,429	1,201	5%
Bottom 50%	39	1%	39	0.2	0.01	172	177	(6)	-3%

Notes:

* Figures shown are the average for 2012, 2013 and 2014. Some numbers may not add due to rounding.

† There are more customer accounts than active customer/water-using properties. Some customer properties have multiple accounts due to having more than one owner/occupier during the years shown, and some (usually) nonresidential customers have multiple meters/accounts at one site. Accounts with zero use for the years shown are considered inactive and not counted here. The estimated housing units shown for single-family customers are for houses, and those for multi-family customers reflect estimated apartment units based on a combination of U.S. Census and Rockland County demographic data.

‡ Based on an average of February, March and April meter readings, usually the lowest volume usage and presumably indoors only. Figures less than zero indicate water use that is lower in warm weather months compared to cool weather months.

§ Based on total annual demand minus the estimated average indoor demand.

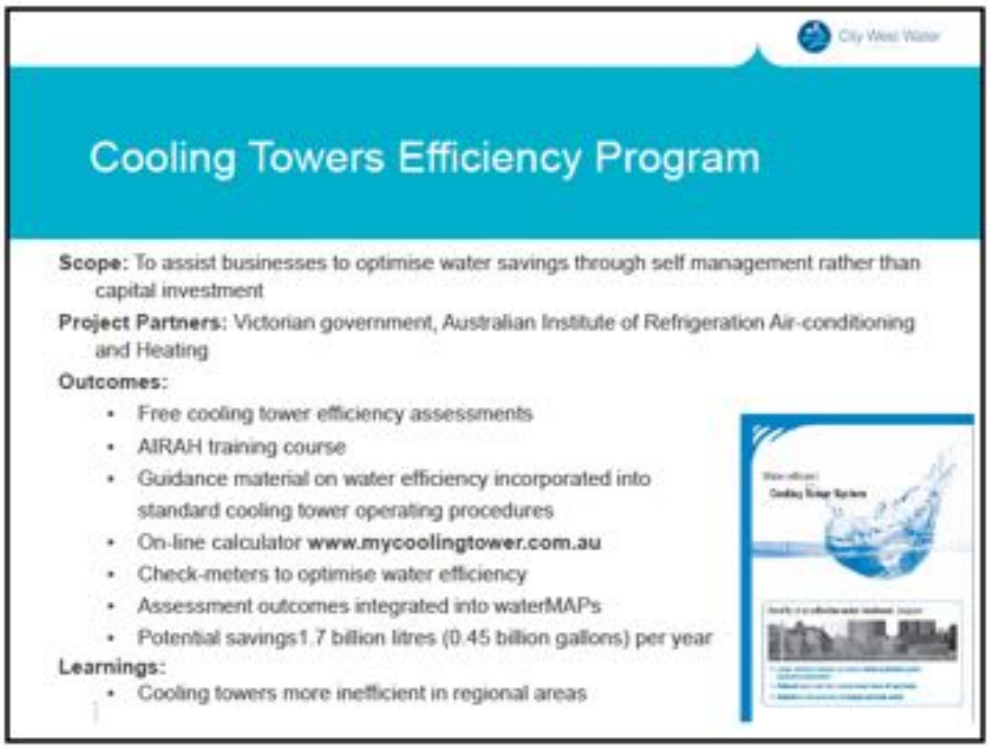
Several features of Industrial customer water use as presented in Table 3-7 suggest the following future water conservation program priorities:

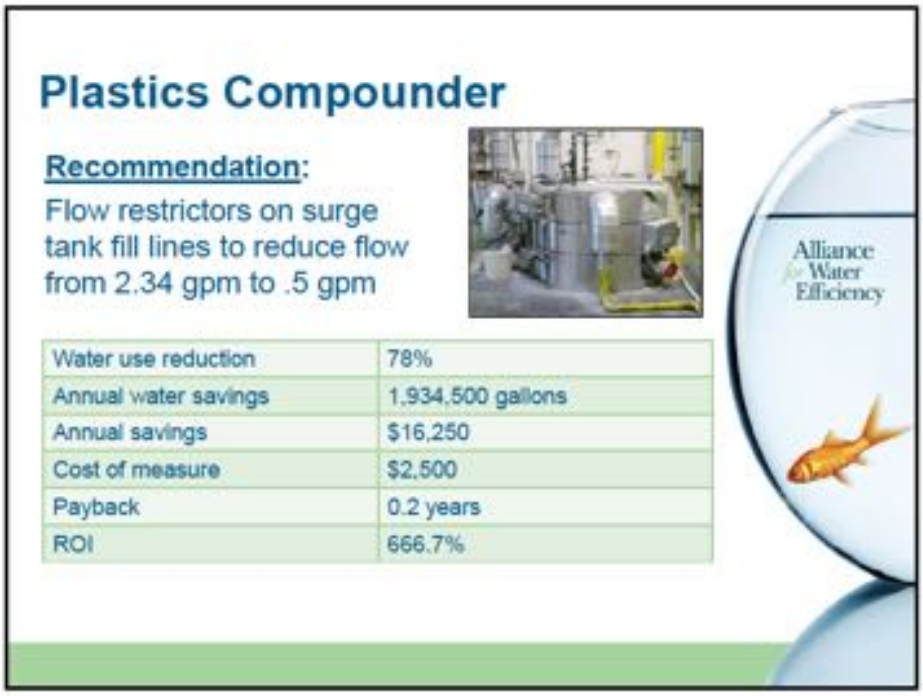
- **Number 1 ranked and top 1% highest water-using Industrial customer:** Averaged over 500,000 GD in 2012-2014.
- **Top (highest) volume Industrial accounts use a disproportionate volume of water:**
  - Top 10% accounts use 93% of industrial water demand
  - Very good potential for large per-customer water savings from conservation
- **Bottom (lowest) volume 50% of Industrial l accounts represent only 1% of demand:**
  - Average account use is 172 gallons/day–very low for an industrial account
  - Very low accounts should be checked for meter size accuracy and calibration, explanation for very low use, and possible theft.
  - Some very low use accounts may also reflect a low-use or infrequently used submeter as well as decreased business activity.

- Meters that are undersized and not calibrated represent apparent losses and revenue losses that could be recouped by UWNY.
- Very low industrial accounts with legitimate low usage may be more appropriately classified as commercial accounts.

- **Seasonal and outdoor use appears relatively low and may be more representative of industrial business cycles than irrigation and other water demands**
- **Recommended future conservation program priorities, which are similar to those for Commercial customers:**
  - Top 1% to 50% (39) accounts likely have the highest per account potential for water savings (high priority)
  - Types of water-saving measures to target for these customers include:
    - Water audits of buildings and facilities, indoors and outdoors
    - Upgrades and replacements of water-using equipment, appliances, fixtures, and maintenance practices
    - Financial incentives for conservation, such as rebates, loans, grants, and technical assistance
    - Incentives and ordinances to promote efficient industrial water use practices and equipment, especially for large-volume cooling, heating, and processing activities
    - Themed conservation outreach programs for specific user categories, e.g., manufacturers, large water processing, heating, and cooling operations
- **Preliminary estimate of potential water conservation savings by Industrial customers:** Approximately 0.2 MGD to 0.3 MGD based on 2012-2014 average day demands, assuming a 10% to 20% savings among the top 50% of water-using customers.
- **Examples** of industrial customer water savings reported by City West Water (Melbourne, AU) and the Alliance for Water Efficiency are provided in Figure 3-6.

Figure 3-6. Examples of Industrial Conservation Programs:
City West Water (Melbourne, AU) & Alliance for Water Efficiency





SECTION 4

FINDINGS AND RECOMMENDATIONS

A detailed evaluation of United Water New York's system water losses and customer water demands for the past three years (2012-2014) finds that potentially there exists a high volume of recoverable system leakage as well as significant future water demand reductions from a comprehensive and aggressive water conservation program.

The primary findings and recommendations from this study include:

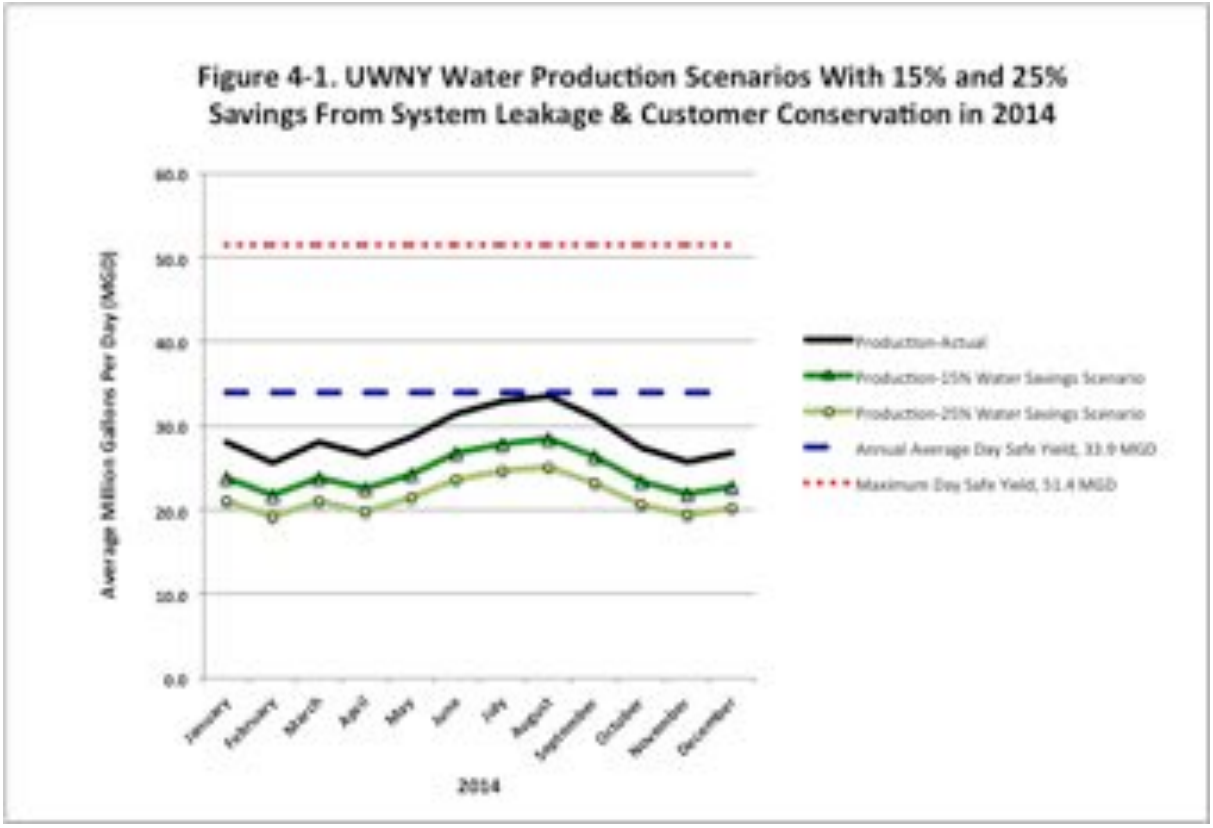
1. **Finding: Ambiguous water data.** A troubling trend of inconsistent data and errors were found in some recent UWNY reports to New York State regulatory agencies as well as internal utility records of the volumes of water supplied, consumed by customers, and lost as non-revenue water (NRW)/unaccounted-for water (UFW). In particular, these flawed data appear to have contributed to an inaccurate representation of how much of UWNY's high system water losses are recoverable leakage as useful water supply, at least for the three years of data and reports reviewed (2012-2014). As documented in this report, corrections and revisions to UWNY's AWWA Water Audit reports of non-revenue water for the last three years reveal a materially different estimate of the potential volume of water that is recoverable from infrastructure leak repairs.
    a. **Recommendation:** The New York State Public Service Commission (PSC) and the Department of Environmental Conservation (DEC) need to more closely monitor and scrutinize UWNY's annual reports and other documents to ensure that the actual volumes of water supplied, consumed by customers, and lost to non-revenue water are reported accurately and consistently. The veracity of these water volume data are important, because they influence regulators and ratepayers one way or the other on important decisions such as investments in system water loss recovery, customer water rates, and the need (or not) for new water supply capacity.
2. **Finding: Static historical water demand trends.** Customer water demand in the UWNY service area has been relatively flat since 2000, despite an 11% increase in population over that time. State and federal water efficiency standards and other factors will likely enable such trends to continue. Future water supply need projections require new evaluation that account for these new trends, technologies and efficiency standards, in order to allow for strategic water planning and avoid costly and unnecessary new water supply projects that may be unduly burdensome to Rockland County ratepayers.
    a. **Recommendation:** A revised analysis of demographic and economic trends as well as the potential demand reductions from an aggressive conservation program, active system leakage and water loss reduction, water reuse, and rainwater harvesting opportunities in the UWNY service area is needed to more realistically assess future water supply needs in Rockland County.
3. **Finding: Estimated 15% to 25% untapped water-savings potential in UWNY system.** A preliminary estimate of 4.4 MGD to 7.0 MGD of potentially recoverable system leakage and customer water savings from conservation is currently available within the UWNY system, as shown in Table 4-1.

Table 4-1. Preliminary Estimates of Potential Water Savings From Conservation Based on System Water Losses and Retail Customer Demands in 2012-2014*

Category of Water Use	Low Savings Estimate, Avg. MGD	High Savings Estimate, Avg. MGD	Average Savings Estimate, Avg. MGD	Average Savings Estimate, Percent of Total Savings
UWNY System Leakage (Recoverable)				
Est. Total System Savings Potential†:	**2.5**	**3.3**	**2.9**	**51.2%**
Customer Water Use				
Single-Family	1.1	2.1	1.6	28.2%
Multi-Family	0.3	0.4	0.3	5.8%
Sloatsburg (Village)	0.0	0.0	0.0	0.3%
Commercial	0.4	0.8	0.6	10.7%
Industrial	0.2	0.3	0.2	3.6%
Service Points without Meters	Unknown			
Est. Total Customer Savings Potential:	**1.9**	**3.6**	**2.8**	**48.8%**
EST. TOTAL POTENTIAL WATER SAVINGS:	**4.4**	**7.0**	**5.7**	**100.0%**

Notes:
Some numbers may not add due to rounding.
* Estimates of potential water savings shown are preliminary only based on UWNY's combined average system water losses and retail customer water demands in 2012-2014 and do not represent actual savings that may be achieved. A more detailed analysis of the full range of conservation and efficiency measures available to reduce system leakage and customer water use is needed to produce a final estimate of future potential water savings in the UWNY service area.
† Estimates of potential water savings shown from system leakage reduction are preliminary only and represent the range of estimated recoverable leakage based on revised AWWA Water Audit reports for 2012-2014 as shown in Table 2-6.

These potential savings, as illustrated in Figure 4-1, represent about a 15% to 25% potential reduction in UWNY's recent demand levels. Such savings are not unprecedented, with New York City (NY), the Massachusetts Water Resources Authority (metropolitan area of Boston, MA), and Seattle (WA) having achieved over 25% total savings from past conservation efforts. Moreover, given the latest advances in high-efficiency fixtures and equipment, water reuse technologies, rainwater harvesting, green infrastructure, and the "Resilient Cities" planning approaches that are starting to take hold in the United States, it is reasonable to expect that future potable water demands may very well *decrease* even with increasing populations and economic growth.



a. **Recommendation:** Implement aggressive customer conservation and system water loss reduction programs that have measurable goals to capture Rockland County's excellent potential for water savings. To ensure that the water savings from conservation are permanent, emphasis needs to be less on consumer behavior and more on the installation of high-efficiency "hardware" measures such as water-efficient fixtures, appliances, and commercial and industrial processes and equipment. Public education about the need for water conservation is essential to support customer adoption of those measures, but it requires sophisticated strategies that rise above the level of free 'save water' bumper stickers and blue balloons to be effective. In addition, local lawn irrigation schedules and policies to update standards for water-efficiency fixtures and other water-using devices and equipment can contribute to incremental and permanent water savings in Rockland County. Incentives such as rebates, a more effective conservation-oriented water rate structure, and other strategies to engage residential and nonresidential customers in adoption of water efficiency measures are also needed.

4. **Finding: Higher leakage and lower apparent losses found in UWNY's system according to revised AWWA Water Audit reports.** Higher real losses and lower apparent losses more accurately describe UWNY's 2012-2014 non-revenue water losses according to the revised AWWA Water Audit reports prepared by the Task Force consultant that resulted from this study. These findings are the opposite of UWNY's present assumptions about the components of its system water losses. Despite these findings, however, UWNY's long history of high water losses and promises but poor performance in actually reducing them is cause for concern. Any effort by UWNY to remedy its high water losses will require significant work and possibly years of catch-up after decades of a passive approach to water loss management.

a. **Recommendation:** UWNY's future AWWA Water Audit reports should use consistent data that matches other UWNY supply and customer consumption records, provide clear justification and supporting documentation for estimated values when not using AWWA's software default values, and grade the validity of its data more accurately in order to generate reliable Infrastructure Leakage Index (ILI) performance indicator scores.

b. **Recommendation:** A robust, proactive leak detection and repair program is essential for UWNY to break its long history of high volumes and percentages of non-revenue water that have too often exceeded the PSC's maximum 18% threshold since at least the year 2000. The leak detection approaches currently implemented by UWNY are largely passive as they rely primarily on noise loggers and visible leak detection. Such approaches can easily lead to high leakage and a growing backlog of needed leak repairs. Additional crews of trained personnel and equipment dedicated to leak detection and repair are needed to be working daily in the UWNY service area if water losses are to be reduced.

c. **Recommendation:** An accelerated main renewal and replacement program that gets ahead of the declining service life of UWNY's mains, if implemented, may have a significant role in reducing the estimated large volume of leakage in Rockland County.

d. **Recommendation:** Going forward, the PSC needs to actively monitor, at least on a quarterly basis, UWNY's progress in water loss reduction to ensure that it is taking constructive steps toward meeting its required non-revenue water goals.

5. **Finding: A motivated, skilled, and independent team outside of UWNY is needed to champion successful water conservation and system loss reduction programs in Rockland County**. For too many years, UWNY's system water loss reduction and conservation efforts have been woefully outdated, inadequate, and underperforming. UWNY's approaches to conservation are geared largely to public relations and education, with little if any permanent water savings achieved. Further, chronic high system water losses and a main replacement program that is centuries behind schedule suggest that the condition of UWNY's infrastructure is in doubt.

   In short, the findings of this study indicate that, based on past performance, UWNY may not have the ability to deliver more than promises to implement a meaningful water conservation program and system efficiency overhaul. Unless there is a substantial change in UWNY's commitment, corporate culture, and financial support for conservation and system loss reduction, even with the best conservation plan it is questionable whether UWNY can effectively manage a large-scale, multi-year water-saving program in Rockland County on its own accord.

   a. **Recommendation:** To ensure that UWNY's potential water savings from leak recovery and conservation are realized within a reasonable timeframe–no more than five years which is achievable given the right resources–responsibility for implementation of fast-tracked water loss reduction and conservation programs may be more reliably accomplished by an outside, independent agency or organization. In addition, this independent program management entity should be kept under the supervision of Rockland County, state regulators, and a citizens' advisory organization to ensure that conservation plan goals are achieved.

6. **Finding: The PSC's 18% allowable system water loss threshold is outdated and enables avoidable infrastructure leakage and other losses to go unrepaired.** The PSC's 18% allowable UFW/NRW standard is outdated, too low, and too often not enforced. Several states, such as Massachusetts, allow a maximum of only 10% system losses. Further, major advances in leak detection and repair technologies as well as infrastructure monitoring software and other devices have been available for well over a decade to help water utilities minimize leakage and apparent losses—if they want to. Briefly, here are some basic recommendations to drive down avoidable real and apparent system water losses in the future:

    a. **Recommendation: Establish a maximum 10% NRW/UFW standard**. Update and establish mandatory maximum allowable water loss standards to a maximum of 10% NRW as defined by the AWWA Water Audit software, v.5.0.

    b. **Recommendation: Unmetered customers should be reviewed and metered as necessary**. The PSC should review UWNY's current roster of approximately 170 residential and nonresidential unmetered customers and require them to be metered unless a valid, proven reason can be provided otherwise.

    c. **Recommendation: Require detailed reports and assumptions for estimated water usage by all unmetered connections, not just vague references to AWWA manuals**. Estimates for each type of unmetered usage should be developed and updated regularly, such as those for fire hydrant usage (e.g., based on Fire Department response logs and recorded hydrant flushing events), street cleaning trucks and equipment, permits for hydrant use (e.g., construction and hydro-seeding), and treatment plant backwashing, among other unmetered usages. Date, time, water flow rate and pressure, and estimated usage should be recorded for each unmetered connection.

    d. **Recommendation: Require residential meter replacement every 10 years instead of every 15 years to ensure meter accuracy**. Many water utilities and states recommend that the service life of residential meters should not exceed 10 years, after which they are prone to meter reading errors and failures which contribute to apparent losses.

    e. **Recommendation: Provide training to PSC staff in utility water loss analysis and monitoring**. Training for PSC staff in how to prepare and analyze AWWA Water Audit reports will assist them to more effectively review and scrutinize water utility reported system losses and related loss reduction activities.

    f. **Recommendation: Assign an independent organization or contractor–that reports to the PSC and Task Force–to inspect, test, and verify the accuracy of all UWNY master meter connections and customer records.** This monitoring program should continue for at least two years to ensure that accurate and consistent water supply, consumption, and water loss records are maintained. This monitoring project should include periodic and unannounced readings of UWNY master meters as well as both SCADA and customer meter consumption records.

    g. **Recommendation: Put in place a more effective and equitable conservation rate structure for UWNY customers.** For example, with single-family customers, create a baseline year-round rate for efficient indoor users and multiple higher rate blocks for high water-using customers, including those with excessive irrigation.

h. **Recommendation: Post online, and make easily accessible to the public, all water company Annual Reports, NRW reports, and related water conservation and efficiency performance reports and documents**. The public has a right to know how their water is being managed, particularly whether or not it is being done so in an efficient and responsible manner.

7. **Finding: Rockland County has an important role to play in water conservation.**

   a. **Recommendation: Establish a mandatory maximum one-day or two-day per week landscape irrigation schedule to reduce excessive outdoor water use on a permanent basis, applicable to UWNY, other municipal, and private well water users**. This schedule should apply to water that is both publicly supplied (i.e., UWNY or other municipal) in addition to water drawn from private wells, rainwater harvesting systems, and onsite and plumbed-in graywater and reuse water supplies. When establishing a community landscape irrigation schedule, it is important to regulate not only potable water but also alternative water supplies since both are finite sources and irrigation restrictions are only effective when they apply to all water sources. (It is very difficult to enforce a watering schedule if it applies only to certain types of water, such as municipally supplied.) During drought, one-day-per-every-10-days and other schedules as well as no-landscape-watering restrictions will continue to be options to reduce water use further should that be necessary.

   b. **Recommendation: Require high-efficiency water standards for new plumbing fixtures, appliances, irrigation systems, and certain types of commercial and industrial water-using equipment at the point of unit replacement, property lease, and sale.** State and local (e.g., plumbing code) water efficiency standards, such as those based on the EPA's WaterSense standards for plumbing fixtures, help to reduce water use as those fixtures are replaced. One way to accelerate the replacement of old, inefficient water-using appliances on an incremental basis is to require that new high-efficiency units be installed at the point of property lease or sale, e.g., a home, office building, or industrial site.

   c. **Recommendation: Coordinate County and local public records for real estate transactions and permits for construction and building renovations with UWNY to help ensure that all water connections are metered and paid for.** Unauthorized and unmetered water use–theft–contributes to apparent losses that UWNY ratepayers subsidize through their water bills. Similarly, existing homes and properties that increase or decrease their size should have their meters evaluated for sizing and accuracy to avoid meter under-registration and water use that is not fully recorded and paid for.

   d. **Recommendation: Clarify the number of private wells in use in Rockland County to determine their impact on current and future groundwater supplies**. Both UWNY and the County have estimates of private wells, but a definitive number seems to be lacking. An account of the total number of wells in the County, their use category (e.g., residential, industrial, irrigation, recreation), and estimates of their withdrawals will help to better understand current and future water demands.

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