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ComEd Water Infrastructure Leak Reduction Pilot Impact Evaluation Report

Energy Efficiency/Demand Response Plan: Program Year 2021 (CY2021) (1/1/2021-12/31/2021)

Prepared for:

ComEd

FINAL

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List of Tables and Figures

1. Introduction

This report presents the results of the impact evaluation of the CY2021 Water Infrastructure Leak Reduction Pilot. CY2021 covers January 1, 2021 through December 31, 2021.

It summarizes the total energy and demand impacts for the pilot broken out by relevant pilot jurisdiction, measure, and pilot structure details. Appendix A provides the impact analysis methodology.

2. Pilot Description

The Water Infrastructure Leak Reduction pilot began in early 2021 and was designed to reduce water loss through detecting and fixing water leaks in water utility infrastructure including customer service connections, fire hydrants, valves, and water mains. Electricity savings from this pilot are attributed to the reduction in water loss, which provides secondary savings by way of reduced need for upstream pumping and processing energy.

The pilot had four participant jurisdictions in CY2021 and conducted water leak fixes on water measures that included fire hydrants, water mains, valves, and customer service connections (see Table 2-1.). With these fixes, the pilot intended to reduce water leaks throughout the water system to save water and energy. The pilot concluded at the end of 2021 and will not be active in 2022.

Table 2-1. Participant Jurisdictions and Leak Projects

Participation	Community A	Community B	Community C	Community D	Total
Leaks Detected	27	8	32	23	90
Leaks Repaired	23	8	20	17	68

Source: ComEd tracking data and evaluation team analysis

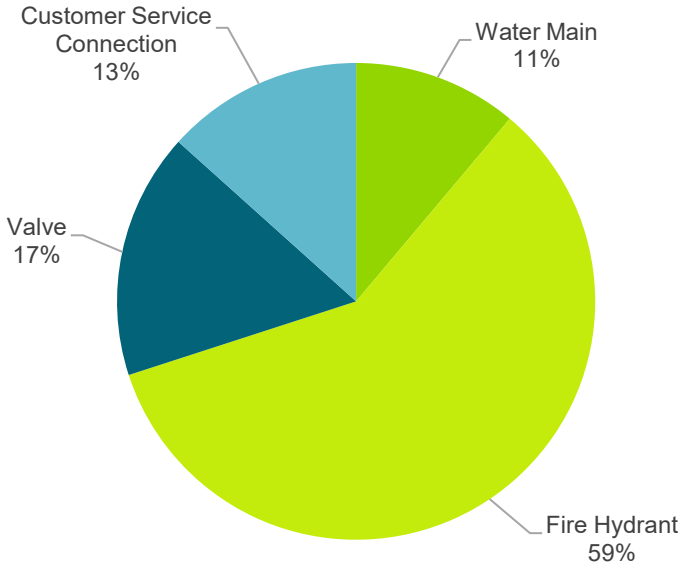
The pilot included the measures shown in Table 2-2 and Figure 2-1.

Table 2-2. Repaired Leaks by Measure Type

Research Category	Quantity Repaired	Unit
Water Main	10	Leak
Fire Hydrant	53	Leak
Valve	15	Leak
Customer Service Connection	12	Leak
Total	**90**	

Source: ComEd tracking data and evaluation team analysis

Figure 2-1. Repaired Leaks by Measure Type



Source: ComEd tracking data and evaluation team analysis

3. Pilot Savings Detail

Table 3-1 summarizes the estimated annual water and energy savings that the Water Infrastructure Leak Reduction pilot achieved through leak fixes conducted during the CY2021 pilot. The pilot's energy savings come completely from the reduction in water usage which produces secondary kWh savings from energy "embedded" in the water supply through the upstream processes of collection, treatment, and distribution. Due to the nature of the pilot, no gas savings are expected.

Table 3-1. Estimated Annual Incremental Electric Savings

Savings Category	Units	Ex Ante Gross Savings	Pilot Gross Realization Rate	Verified Gross Savings	Pilot Net-to-Gross Ratio (NTG)*	CY2019 Net Carryover Savings	CY2020 Net Carryover Savings	Verified Net Savings†
Electric Energy Savings - Direct	kWh	587,663	1.00	587,663	0.80	-	-	470,131
Electric Energy Savings - Converted from Gas	kWh	-	-	-	-	-	-	-
Total Electric Energy Savings	kWh	587,663	1.00	587,663	0.80	-	-	470,131
Summer Peak§ Demand Savings	kW	-	-	-	-	-	-	-

N/A = not applicable (refers to a piece of data that cannot be produced or does not apply).

*No net-to-gross ratio research has been conducted for the Water Infrastructure Leak Reduction pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8 be used for an NTG ratio until such research is completed or a better proxy is determined. Source: https://www.ilsag.info/policy/illinois-ee-policy-manual/

Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 and Figure 4-1 show the measure-specific and total verified gross savings for the Water Infrastructure Leak Reduction Pilot and the cumulative persisting annual savings (CPAS) for the water measures fixed in CY2021. The electric CPAS across all measures installed in CY2021 is shown in Table 4-1. Figure 4-1 shows the savings across the effective useful life of the measures. There is no gas savings for this program, so electric CPAS is equivalent to total CPAS. The CPAS calculations utilize a 30-year effective useful life (EUL) based on California's Water Model[1] and the 2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, which lists a 30-year EUL for drain water heat recovery and while the two measures are not the same, this is referential to plumbing and piping.[2]

[1] Water Loss Control: Water Loss Model, Standards, and Questionnaires: Updated Water Loss Model, 2022, California Water Boards State Water Resources Control Board, https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/docs/2022/water-loss-model-v6.1.xlsx. Accessed 10 March 2022.

[2] 2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, 25 September 2020, https://ilsag.s3.amazonaws.com/IL-TRM_Effective_010121_v9.0_Volumes_1-4_9-25-2020_Final_Compiled.pdf. Accessed 10 March 2022.

Table 4-1. Cumulative Persisting Annual Savings (CPAS)

End Use Type	Research Category	EUL‖	CY2021 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings 2018	2019	2020	2021	2022	2023	2024	2025	2026
Water Leak Reduction	Water Main	30.0	243,918	0.80	5,854,039				195,135	195,135	195,135	195,135	195,135	195,135
Water Leak Reduction	Fire Hydrant	30.0	200,167	0.80	4,804,012				160,134	160,134	160,134	160,134	160,134	160,134
Water Leak Reduction	Valve	30.0	110,877	0.80	2,661,055				88,702	88,702	88,702	88,702	88,702	88,702
Water Leak Reduction	Customer Service Connection	15.0	32,700	0.80	392,404				26,160	26,160	26,160	26,160	26,160	26,160
CY2021 Program Total Electric Contribution to CPAS			**587,663**		**13,711,511**				**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**
Historic Program Total Electric Contribution to CPAS‡														
Program Total Electric CPAS						-	-	-	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**
CY2021 Program Incremental Expiring Electric Savings§										-	-	-	-	-
Historic Program Incremental Expiring Electric Savings									-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings									-	-	-	-	-	-

End Use Type	Research Category	EUL‖	CY2021 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Water Leak Reduction	Water Main	30.0	243,918	0.80	5,854,039	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135
Water Leak Reduction	Fire Hydrant	30.0	200,167	0.80	4,804,012	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134
Water Leak Reduction	Valve	30.0	110,877	0.80	2,661,055	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702
Water Leak Reduction	Customer Service Connection	15.0	32,700	0.80	392,404	26,160	26,160	26,160	26,160	26,160	26,160	26,160	26,160	26,160			
CY2021 Program Total Electric Contribution to CPAS			**587,663**		**13,711,511**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**443,970**	**443,970**	**443,970**
Historic Program Total Electric Contribution to CPAS‡																	
Program Total Electric CPAS						**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**470,131**	**443,970**	**443,970**	**443,970**
CY2021 Program Incremental Expiring Electric Savings§						-	-	-	-	-	-	-	-	-	**26,160**	-	-
Historic Program Incremental Expiring Electric Savings						-	-	-	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings						-	-	-	-	-	-	-	-	-	**26,160**	-	-

End Use Type	Research Category	EUL‖	CY2021 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Water Leak Reduction	Water Main	30.0	243,918	0.80	5,854,039	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135	195,135
Water Leak Reduction	Fire Hydrant	30.0	200,167	0.80	4,804,012	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134	160,134
Water Leak Reduction	Valve	30.0	110,877	0.80	2,661,055	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702	88,702
Water Leak Reduction	Customer Service Connection	15.0	32,700	0.80	392,404												
CY2021 Program Total Electric Contribution to CPAS			**587,663**		**13,711,511**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**
Historic Program Total Electric Contribution to CPAS‡																	
Program Total Electric CPAS						**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**	**443,970**
CY2021 Program Incremental Expiring Electric Savings§						-	-	-	-	-	-	-	-	-	-	-	-
Historic Program Incremental Expiring Electric Savings						-	-	-	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings						-	-	-	-	-	-	-	-	-	-	-	-

* NTG research was not conducted for the *Water Infrastructure Leak Reduction pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8 be used for an NTG ratio until such research is completed or a better proxy is determined.* Source: https://www.ilsag.info/policy/illinois-ee-policy-manual/

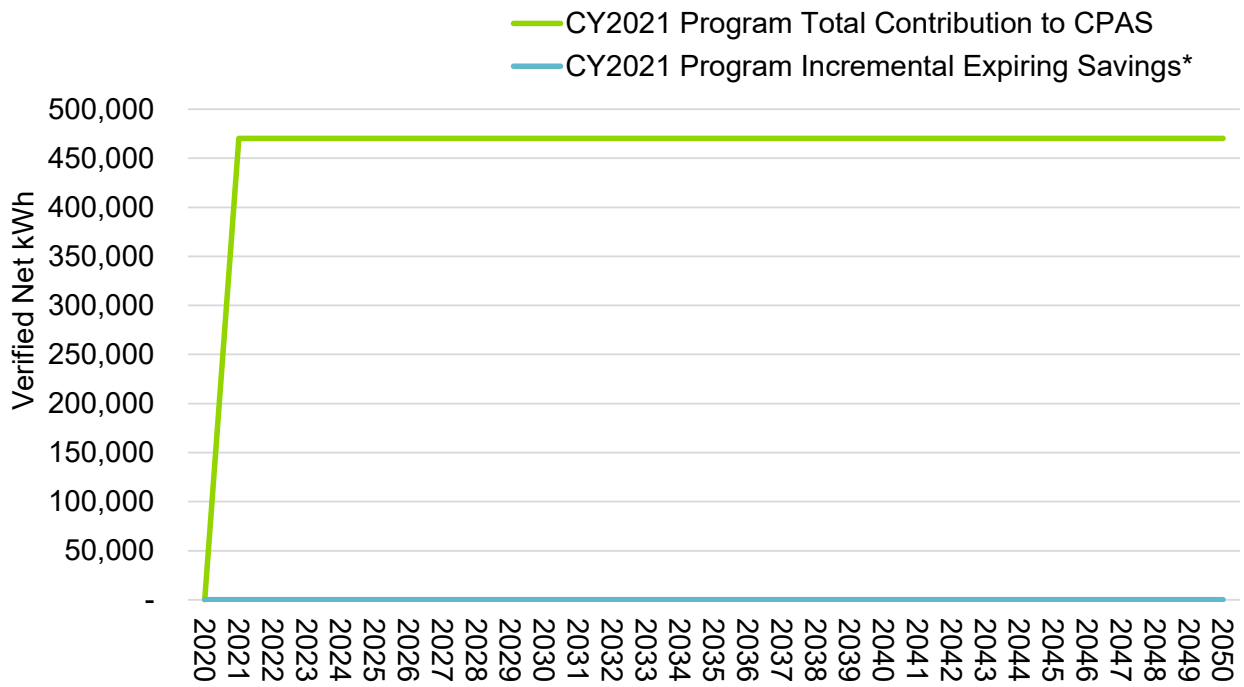
‖Table 4-1 uses a 30 year EUL for repaired water utility infrastructure according to the California Water Model - https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/docs/2022/water-loss-model-v6.1.xlsx and a 15 year EUL for customer service connections.

† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Historical savings are shown back to 2018. This pilot was new in CY2021 so there are no historical savings.

§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n.
Source: Evaluation team analysis

Figure 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric



Source: Evaluation team analysis

5. Pilot Savings by Measure

The pilot included the measures shown in Table 5-1 and Figure 5-1.

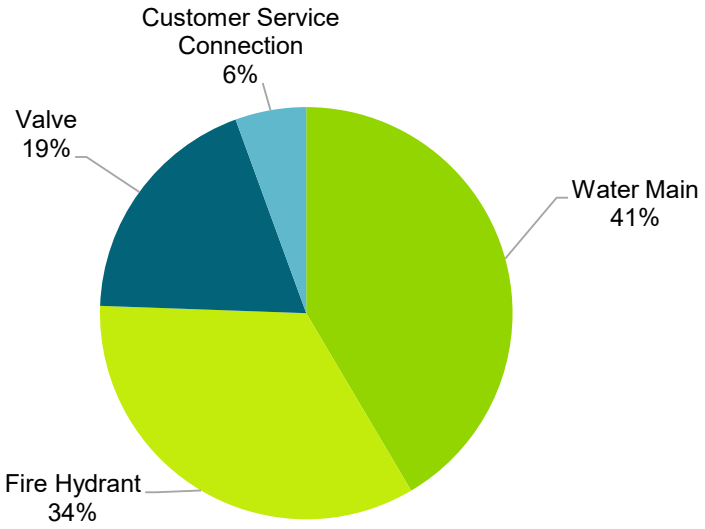
Table 5-1. Number of Leaks by Measure

Research Category	Quantity Repaired	Unit
Water Main	10	Leak
Fire Hydrant	53	Leak
Valve	15	Leak
Customer Service Connection	12	Leak
Total	**90**	

Note: This is the same table as Table 2-1.

Source: ComEd tracking data and evaluation team analysis

Figure 5-1. Verified Net Savings by Measure Type



More precisely, Water Main is 41.5% however, excel forces the rounding down so that the chart totals 100%. Noteworthy only in so far as this percentage does not align with the 42% shown in Table B-3.

Source: ComEd tracking data and evaluation team analysis

The following tables summarize measure level electricity and water savings for the repairs that were completed through this pilot. In addition to verified net kwh savings, Table 5-2 also provides the effective useful life (EUL) for each of the four types of leak repairs. Note, the EULs applied here are indirectly[3] cited from EPA publication EPA 816-R-03-016 Sept. 2003. Table 5-3

[3] Indirect source for EULs as reported in EPA publication EPA 816-R-03-016 Sept. 2003 is the following site: www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/tmfplanningandreports/Typical_life.pdf

includes the annual water conservation in gallons, which are then converted into secondary energy savings.

Table 5-2. Annual Estimated Savings by Measure – Water

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)	EUL (years)
Water Leak Reduction	Water Main	243,918	1.00	243,918	0.80	195,135	30.0
Water Leak Reduction	Fire Hydrant	200,167	1.00	200,167	0.80	160,134	30.0
Water Leak Reduction	Valve	110,877	1.00	110,877	0.80	88,702	30.0
Water Leak Reduction	Customer Service Connection	32,700	1.00	32,700	0.80	26,160	15.0
	Total	**587,663**	**1.00**	**587,663**		**470,131**	

* Net-to-gross ratio research has not been conducted for the Water Infrastructure Leak Reduction Pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8 be used for an NTG ratio until such research is completed or a better proxy is determined. Available at: https://www.ilsag.info/policy/illinois-ee-policy-manual/

Source: ComEd tracking data and evaluation team analysis

The Water Infrastructure Leak Reduction Pilot consists of measures that save water. That reduction in water produces secondary kWh savings from a reduction in water supply use. Table 5-3 shows the secondary measure level savings.

Table 5-3. Secondary Annual Estimated Savings by Measure – Electricity

Research Category	Ex Ante Annual Water Savings (gallons)	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate (RR_{water})	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)
Water Main	94,872,918	243,918	1.00	243,918	0.80	195,135
Fire Hydrant	77,855,769	200,167	1.00	200,167	0.80	160,134
Valve	43,126,142	110,877	1.00	110,877	0.80	88,702
Customer Service Connection	12,718,930	32,700	1.00	32,700	0.80	26,160
Total	**228,573,759**	**587,663**	**1.00**	**587,663**		**470,131**

Note: The water savings in this table are entirely from secondary electric energy (kWh) savings from water supply and wastewater treatment plants for measures claimed by ComEd.

*No net-to-gross ratio research has been conducted for the Water Infrastructure Leak Reduction pilot, so the Illinois EE Policy Manual stipulates that a default value of 0.8 be used for an NTG ratio until such research is completed or a better proxy is determined. Source: https://www.ilsag.info/policy/illinois-ee-policy-manual/.

Source: ComEd tracking data and evaluation team analysis

6. Impact Analysis Findings and Recommendations

The evaluation team understands that this pilot concluded in CY2021 and ComEd does not intend to continue the pilot. The pilot's relatively small data set limits the evaluation team's ability to extrapolate findings beyond the pilot to a wider population or to more communities. If ComEd decides to continue the Water Infrastructure Leak Reduction pilot in the future, or expand this measure set to a full-scale program, the evaluation team has developed the following recommendations based on findings from the CY2021 evaluation.

Finding 1. The pilot data contained limited proof that leaks were fixed.

> **Recommendation 1.** Include supporting documentation that records when, how, and by whom a leak has been fixed. This documentation could include work orders, maintenance tickets, or some other proof of fixed leaks. Photos are encouraged whenever possible. Geocodes (latitude and longitude) are also beneficial, similar to the process used for the LED Streetlighting Program.

Finding 2. Water main breaks represent the lowest proportion of identified leaks (11%) and the lowest rate of leak fixes (30%). And yet water main breaks have the greatest contribution to pilot savings with the highest rate of curtailed water loss at 8.6 million gallons per year (MGY); more than twice the annual water loss of any other measure examined in the pilot. The lower rate of leak fixes could indicate either the difficulty of finding the exact source of water main breaks or the difficulty and cost of repairing water main breaks. Fire hydrants represent 59% of identified leaks and appear to be fixed at a higher rate (71%) than other identified leaks, indicating that fire hydrants may represent easier or lower cost leaks to fix than other sources of water leaks.

> **Recommendation 2.** Solicit input from water system managers regarding barriers to fixing different types of leaks. Include questions related to methods for identifying and prioritizing leak repair, technologies used to identify and repair leaks, cost benefit assessment, and the system operator's ability to temporarily curtail service for the purpose of leak repair. Use these insights into the relative cost and effort required to access and repair various types of leaks, and then tailor the program incentives to align with the anticipated return on investment.

Appendix A. Impact Analysis Methodology

A.1 Impact Method

The evaluation team quantified Water Infrastructure Leak Reduction pilot savings through seven key steps.

1. Assess water leak reduction pilot data for consistency amongst four jurisdictions.
2. Verify the pilot's model for calculating savings. This model heavily incorporated the logic from Table A-1 Leakage flow rates for metallic piping systems as adopted from the American Water Works Association (AWWA) report on water leaks.

Table A-1. Leakage flow rates for metallic piping systems

		Leakage Flow Rate at 70 psi				CWC Leakage Flow Rate at 65 psi*			
		Unreported		Reported		Unreported		Reported	
Type of Leak or Break	Diameter	gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd
Appurtenances									
Fire hydrant	—	3.5	0.005	3.5	0.005	3.37	0.0048	3.37	0.0048
Valve	—	6.9	0.010	6.9	0.010	6.65	0.0096	6.65	0.0096
Customer service connection piping leaks, all sizes	—	6.9	0.010	6.9	0.010	6.65	0.0096	6.65	0.0096
Water Mains									
Joint leak or repair band leak	6 in.	10.4	0.015	10.4	0.015	10.0	0.014	10.0	0.014
Joint leak or repair band leak	8 in.	17.3	0.025	17.3	0.025	16.7	0.024	16.7	0.024
Joint leak or repair band leak	10–48 in.	27.8	0.040	27.8	0.040	23.7	0.034	23.7	0.034
Circumferential crack	4 in.	34.7	0.050	69.4	0.100	33.4	0.048	66.9	0.096
Circumferential crack	6 in.	55.5	0.080	111.1	0.160	53.5	0.077	107.0	0.154
Circumferential crack	8 in.	76.3	0.110	152.6	0.220	73.5	0.106	147.0	0.212
Circumferential crack	10 in.	93.8	0.135	187.6	0.270	90.4	0.130	180.8	0.260
Circumferential crack	12 in.	111.1	0.160	222.2	0.320	107.0	0.154	214.1	0.308
Longitudinal crack or split bell	6 in.	69.4	0.100	138.9	0.200	66.9	0.096	133.8	0.193
Longitudinal crack or split bell	8 in.	93.8	0.135	187.6	0.270	90.4	0.130	180.8	0.260
Longitudinal crack or split bell	10 in.	111.1	0.160	222.2	0.320	107.0	0.154	214.1	0.308
Longitudinal crack or split bell	12 in.	138.9	0.200	277.8	0.400	133.8	0.193	267.7	0.385

* Leakage rate at 65 psi = (Leakage rate at 70 psi)[(65/70)$^{0.5}$]

Note: Underlying data source includes Bristol Water Services, 2001.

Source: American Water Works Association, 2016. Available at: AWWA, M36 Water Audits and Loss Control Programs, Fourth Edition, 2016, ***https://engage.awwa.org/personifyebusiness/Store/Product-Details//51439782****.*

3. Remove incidences in which no leak was found to be fixed but to which savings were attached in the data. The data included three incidences that attributed water savings where no leak was detected and, therefore, no leak was fixed (Table A-3, leak numbers 2, 3, and 5).

4. Utilize the following AWWA algorithm to verify savings calculations:

   Leakage rate at actual pressure Pa = (Leakage rate at 70 psi)[(Pa/70)0.5]

5. Verify energy intensity factor based on Illinois TRM energy per gallon factor in a 2018 paper by Elevate Energy. Sources using the energy intensity factor of 2571 kWh/million gallons of water include: Elevate Energy's 2018 paper: https://www.elevatenp.org/wp-content/uploads/Elevate-Energy_Energy-per-Gallon-Ratio-Whitepaper_May-2018.pdf

   And the 2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, page 60, released September 2020. Available at: https://ilsag.s3.amazonaws.com/IL-TRM_Effective_010121_v9.0_Volumes_1-4_9-25-2020_Final_Compiled.pdf

6. Calculate savings based on formula:

   Million gallons x Energy intensity factor (kWh per million gallons of water) = kWh Saved from leak detection and reduction

7. Utilize a NTG ratio of 0.8 to calculate final net savings of both water and secondary electricity (kWh) savings. This NTG ratio is based on the Illinois Energy Efficiency Stakeholder Advisory Group Policy Manual Version 2.0, Section 7.2 (Net-to-Gross Policy). Source: https://www.ilsag.info/policy/illinois-ee-policy-manual/.

   The policy reads as follows:

   "In the event a new Energy Efficiency pilot Program, Sub-Program, Measure group, and/or special project arises after October 1, Evaluators will supply recommended deemed NTG Ratios as soon as practical, which may be based on secondary research, when that research produces relevant results, and that are intended to represent the Evaluators' best estimates of actual NTG Ratio values likely to occur for the relevant Program Year. Otherwise, a NTG Ratio of 0.80 will be deemed. Evaluators may seek feedback from SAG regarding an appropriate NTG Ratio to deem for the new Energy Efficiency pilot Program, Sub-Program, and/or Measure group. For special projects, Evaluators may determine a project-specific NTG Ratio upfront and deem the project specific NTG Ratio for the life of the project"

The water leak reduction pilot savings were calculated using two key assumptions.

Assumption 1. Based on the pilot data and information obtained from ComEd – snapshots of the provided data are shown below in Table A-2 through Table A-6 - Guidehouse assumed the data is correct given the time, budget, and resources.

Assumption 2. Given the reporting period and when water leak fixes occurred, Guidehouse reported the pilot savings as future annual estimated savings.

A.2 Pilot Data

Table A-2 through Table A-6 are excerpted from the pilot data. These tables show the types of information provided to the evaluation team in order to calculate the water savings for the pilot. The evaluation team used information from these tables and the equation for the corresponding leakage rates at actual pressure described in methodology Step 4 above to estimate savings for this pilot.

In each of the following tables, Main Size refers to the size in inches of the water main leak. Main Leak Type refers to the type of leak in the water main. Hole Area ($IN.^2$) refers to the area size for circular hole water main leaks.

Table A-2. Examples of Original Data Submitted

Average System Pressure (psi)	System Pressure Adjustment Value	System Length Surveyed (LF)	Leak Survey Report Date	Leak Number	Location1	Location2	Address	Leak Repaired? (YES OR NO)	Date Repaired	Method of Confirmation	Measure	Size	Type of Crack	*FOR CIRCULAR HOLE MAIN LEAKS* HOLE AREA (IN.2) HOLE AREA (IN.²)	*FOR FIRE HYDRANT LEAKS* EST. LEAKAGE RATE (GPM)	*FOR VALVE LEAKS* HOLE AREA (IN.2)EST. LEAKAGE RATE (GPM)	*FOR SERVICE LINE LEAKS* HOLE AREA (IN.2) EST. LEAKAGE RATE (GPM)	*FOR CIRCULAR HOLE MAIN LEAKS* HOLE AREA (IN.2) EST. LEAKAGE RATE (GPM)	*FOR JOINT MAIN LEAKS* EST. LEAKAGE RATE (GPM)	*FOR CIRCUM. CRACK MAIN LEAKS* EST. LEAKAGE RATE (GPM)	*FOR LONG. CRACK MAIN LEAKS* EST. LEAKAGE RATE (GPM)	ME SIMPSON ESTIMATED LEAKAGE EST. LEAKAGE RATE (GPM)	M.E. SIMPSON ESTIMATE EST. ACTIVE LEAKAGE RATE (GPM)	M.E. SIMPSON ESTIMATE EST. FIXED LEAKAGE RATE (GPM)	AWWA METHODOLOGY EST. ACTIVE LEAKAGE RATE (GPM)	AWWA METHODOLOGY EST. TOTAL LEAKAGE RATE (GPM)	AWWA METHODOLOGY EST. TOTAL LEAKAGE RATE (MGY)	AWWA METHODOLOGY EST. FIXED LEAKAGE RATE (GPM)	AWWA METHODOLOGY EST. FIXED LEAKAGE RATE (MGY)	With Savings
65	0.96	52425	11/5/2021	1	1	LEONARD WOOD AVENUE	HOA-ARD -OOP	NO			FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	0.00	0.00	0
65	0.96	52425	11/5/2021	2	3	LEONARD WOOD AVENUE	91 LEONARD WOOD AVENUE	YES	11/30/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	3	3	WHEELER ROAD	260 WHEELER ROAD	YES	12/16/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	4	4	NORMANDY ROAD	113 NORMANDY STREET	YES	10/15/2021		CUSTOMER SERVICE CONNECTION				0.00	0.00	6.65	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	-	6.65	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	5	5	SUMMIT AVENUE	AUBURN AVENUE	YES			VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	6.65	-	6.65	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	6	7	SKOKIE HIGHWAY	3150 SKOKIE HIGHWAY	YES			VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	6.65	-	6.65	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	7	8	RIDGE ROAD	FAIRHAVEN ROAD	YES			VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	6.65	-	6.65	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	8	10	LYNN TERRACE	1255 LYNN TERRACE	YES	10/28/2021		WATER MAIN	6	CIRCUMFERENTIAL CRACK		0.00	0.00	0.00	0.00	0.00	53.48	0.00	15.00	0.00	15.00	0.00	53.48	-	28.11	-	53.48	28.11	7227.0
65	0.96	52425	11/5/2021	9	21	TENNYSON LANE	MALORY LANE	YES	12/15/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	10	20	SPRUCE AVENUE	PARK AVENUE	YES	12/15/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	11	19	AUGUSTA WAY	950 AUGUSTA WAY	YES	12/15/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	12	11	COMPTON AVENUE	HALF DAY ROAD	YES	12/15/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	13	13	ROSLYN LANE	EDGECLIFF DRIVE	YES			FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	14	13	MONTGOMERY ROAD	MORAINE ROAD	YES	10/22/2021	LEAK SURVEY REPORT	FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	15	13	ST. JOHN'S AVENUE	WALKER AVENUE	YES	11/24/2021		WATER MAIN	4	CIRCULAR HOLE	0.25	0.00	0.00	61.24	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	61.24	-	32.20	-	61.24	32.20	83782.48
65	0.96	52425	11/5/2021	16	17	SHERIDAN ROAD	ELM PLACE	YES			FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	17	17	ST. JOHN'S AVENUE	VINE AVENUE	YES	12/21/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	18	24	MCKRAKEN ROAD	1560 MCKRAKEN ROAD	NO			CUSTOMER SERVICE CONNECTION				0.00	0.00	6.65	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	6.65	-	6.65	3.49	-	0.00	0.00	0
65	0.96	52425	11/5/2021	19	25	EISENFELD PLACE	FREDRICKSON PLACE	YES	12/21/2021		FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	20	27	LINDEN AVENUE	RAVINE DRIVE	YES			VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	6.65	-	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	21	27	LAKE AVENUE	LAUREL AVENUE	NO			WATER MAIN				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	-	0.00	0.00	-	0.00	0.00	0
65	0.96	52425	11/5/2021	22	30	ST. JOHN'S AVENUE	BEECH STREET	YES			VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	6.65	-	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	23	32	OLD SKOKIE VALLEY ROAD	1350 OLD SKOKIE VALLEY ROAD	YES			FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	24	33	CAVELL AVENUE	RICHFIELD AVENUE	YES	10/22/2021	LEAK SURVEY REPORT	VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	6.65	-	3.49	-	6.65	3.49	8984.9193
65	0.96	52425	11/5/2021	25	33	RIDGE ROAD	OLD DEERFIELD ROAD	YES	10/25/2021	LEAK SURVEY REPORT	FIRE HYDRANT				3.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	3.37	-	3.37	1.77	-	3.37	1.77	4557.5648
65	0.96	52425	11/5/2021	26	39	ST. JOHN'S AVENUE	WOODLAND ROAD	NO			WATER MAIN				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	0.00	0.00	-	0.00	0.00	-	0.00	0.00	0
65	0.96	52425	11/5/2021	27	45	BRIAR LANE	CLAVEY ROAD	YES			VALVE				0.00	6.65	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	6.65	-	3.49	-	6.65	3.49	8984.9193
49	0.84	328944	8/8/2021	1	1	8TH AVENUE	MAIN STREET	YES	2/1/2021	Phone call (time)	FIRE HYDRANT				2.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	2.93	-	1.54	-	2.93	1.54	3857.0773

Table A-3. Community A Water Leak Repair Data

LEAK NO.	LEAK REPAIRED	REPAIR DATE	REPAIR NOTICE	LEAK TYPE	MAIN LEAK SIZE (IN.)	MAIN LEAK TYPE	HOLE AREA (IN.^{2})
1	**NO**			FIRE HYDRANT			
2	**YES**	11/30/21		FIRE HYDRANT			
3	**YES**	12/15/21		FIRE HYDRANT			
4	**YES**	10/12/21		CUSTOMER SERVICE CONNECTION			
5	**YES**			VALVE			
6	**YES**			VALVE			
7	**YES**			VALVE			
8	**YES**	10/18/21		WATER MAIN	6	CIRCUMFERENTIAL CRACK	
9	**YES**	12/15/21		FIRE HYDRANT			
10	**YES**	12/15/21		FIRE HYDRANT			
11	**YES**	12/15/21		FIRE HYDRANT			
12	**YES**	12/15/21		FIRE HYDRANT			
13	**YES**			FIRE HYDRANT			
14	**YES**	10/12/21	LEAK SURVEY REPORT	FIRE HYDRANT			
15	**YES**	11/24/21		WATER MAIN	4	CIRCULAR HOLE	0.25
16	**YES**			FIRE HYDRANT			
17	**YES**	12/15/21		FIRE HYDRANT			
18	**NO**			CUSTOMER SERVICE CONNECTION			
19	**YES**	12/15/21		FIRE HYDRANT			
20	**YES**			VALVE			
21	**NO**			WATER MAIN			
22	**YES**			VALVE			
23	**YES**			FIRE HYDRANT			
24	**YES**	10/22/21	LEAK SURVEY REPORT	VALVE			
25	**YES**	10/25/21	LEAK SURVEY REPORT	FIRE HYDRANT			
26	**NO**			WATER MAIN			
27	**YES**			VALVE			

Table A-4. Community B Water Leak Repair Data

LEAK NO.	LEAK REPAIRED	REPAIR DATE	REPAIR NOTICE	LEAK TYPE	MAIN LEAK SIZE (IN.)	MAIN LEAK TYPE	HOLE AREA (IN.^{2})
1	**YES**	2/24/22	HOME OWNER, NEW SERVICE	CUSTOMER SERVICE CONNECTION			
2	**YES**	2/28/22	POT HOLED, NO LEAK FOUND	WATER MAIN			
3	**YES**	To be completed 3/4/22	Leak not surfacing	CUSTOMER SERVICE CONNECTION			
4	**YES**	Removed, to be replaced	install new hydrant	FIRE HYDRANT			
5	**NO**	2/28/22	Found no leak	VALVE			
6	**YES**	2/28/22	Work order 1138416	FIRE HYDRANT			
7	**YES**	11/24/21	LEAK SURVEY REPORT	FIRE HYDRANT			
8	**YES**	8/18/21	LEAK SURVEY REPORT	FIRE HYDRANT			
9	**YES**	2/28/22	WO 1138417	FIRE HYDRANT			
10	**YES**	9/16/21	LEAK SURVEY REPORT	FIRE HYDRANT			
11	**YES**	9/16/21	LEAK SURVEY REPORT	FIRE HYDRANT			

Table A-5. Community C Water Leak Repair Data

LEAK NO.	LEAK REPAIRED	REPAIR DATE	REPAIR NOTICE	LEAK TYPE	MAIN LEAK SIZE (IN.)	MAIN LEAK TYPE	HOLE AREA (IN.^{2})
1	**YES**	2/1/22	Phone call JWest	FIRE HYDRANT			
2	**YES**	7/19/21	LEAK SURVEY REPORT	FIRE HYDRANT			
3	**NO**			FIRE HYDRANT			
4	**YES**	7/19/21	LEAK SURVEY REPORT	FIRE HYDRANT			
5	**YES**	7/19/21	LEAK SURVEY REPORT	FIRE HYDRANT			
6	**NO**			WATER MAIN			
7	**NO**			WATER MAIN			
8	**NO**			CUSTOMER SERVICE CONNECTION			
9	**YES**	7/20/21	LEAK SURVEY REPORT	FIRE HYDRANT			
10	**YES**	7/20/21	LEAK SURVEY REPORT	FIRE HYDRANT			
11	**YES**	7/20/21	LEAK SURVEY REPORT	VALVE			
12	**YES**	7/20/21	LEAK SURVEY REPORT	FIRE HYDRANT			
13	**YES**	7/20/21	LEAK SURVEY REPORT	FIRE HYDRANT			
14	**YES**	7/20/21	LEAK SURVEY REPORT	FIRE HYDRANT			
15	**YES**	7/20/21	LEAK SURVEY REPORT	FIRE HYDRANT			
16	**NO**			CUSTOMER SERVICE CONNECTION			
17	**YES**	7/22/21	LEAK SURVEY REPORT	FIRE HYDRANT			
18	**NO**			CUSTOMER SERVICE CONNECTION			
19	**YES**	7/23/21	LEAK SURVEY REPORT	FIRE HYDRANT			
20	**YES**	7/23/21	LEAK SURVEY REPORT	FIRE HYDRANT			
21	**NO**			WATER MAIN			
22	**NO**			CUSTOMER SERVICE CONNECTION			
23	**YES**	7/28/21	LEAK SURVEY REPORT	FIRE HYDRANT			
24	**NO**			FIRE HYDRANT			
25	**YES**	7/28/21	LEAK SURVEY REPORT	FIRE HYDRANT			
26	**YES**	9/14/21	EMAIL - 9/14/2021	CUSTOMER SERVICE CONNECTION			
27	**NO**			FIRE HYDRANT			
28	**YES**	7/29/21	LEAK SURVEY REPORT	FIRE HYDRANT			
29	**YES**	7/30/21	LEAK SURVEY REPORT	FIRE HYDRANT			
30	**NO**			CUSTOMER SERVICE CONNECTION			

Table A-6. Community D Water Leak Repair Data

LEAK NO.	LEAK REPAIRED	REPAIR DATE	REPAIR NOTICE	LEAK TYPE	MAIN LEAK SIZE (IN.)	MAIN LEAK TYPE	HOLE AREA (IN.^{2})
1	**YES**	9/13/21	MC EMAIL - 2/18/2022	VALVE			
2	**YES**	9/2/21	LEAK SURVEY REPORT	FIRE HYDRANT			
3	**YES**	9/2/21	LEAK SURVEY REPORT	FIRE HYDRANT			
4	**YES**	9/3/21	LEAK SURVEY REPORT	FIRE HYDRANT			
5	**YES**	9/21/21	MC EMAIL - 2/18/2022	FIRE HYDRANT			
6	**YES**	9/21/21	MC EMAIL - 2/18/2022	VALVE			
7	**YES**	9/7/21	LEAK SURVEY REPORT	FIRE HYDRANT			
8	**YES**	9/7/21	LEAK SURVEY REPORT	FIRE HYDRANT			
9	**YES**	9/16/21	LEAK SURVEY REPORT	FIRE HYDRANT			
10	**YES**	9/21/21	MC EMAIL - 2/18/2022	VALVE			
11	**YES**	9/21/21	MC EMAIL - 2/18/2022	VALVE			
12	**NO**			WATER MAIN			
13	**YES**	9/8/21	LEAK SURVEY REPORT	FIRE HYDRANT			
14	**YES**	9/22/21	MC EMAIL - 2/18/2022	VALVE			
15	**YES**	9/22/21	LEAK SURVEY REPORT	FIRE HYDRANT			
16	**NO**			FIRE HYDRANT			
17	**YES**	11/1/21	MC EMAIL - 2/18/2022	WATER MAIN	8	CIRCUMFERENTIAL CRACK	
18	**NO**			CUSTOMER SERVICE CONNECTION			
19	**NO**			CUSTOMER SERVICE CONNECTION			
20	**YES**	9/24/21	LEAK SURVEY REPORT	FIRE HYDRANT			
21	**YES**	9/23/21	LEAK SURVEY REPORT	FIRE HYDRANT			
22	**NO**			VALVE			
23	**NO**			VALVE			

Appendix B. Impact Findings Detailed Results

The evaluation team examined the participant level data and determined the percentage of identified leaks which were fixed, by measure type.

Table B-1. Leak Fix Rate by Measure Type

Measure	Average Leakage Rate (MGY)	Total Leaks Detected	Leaks Fixed	Percent of Leaks Fixed
Customer Service Connection	3.1	12	4	33%
Fire Hydrant	1.6	53	48	91%
Valve	3.3	15	13	87%
Water Main	9.5	10	3	30%
Total	**3.0**	**90**	**68**	**76%**

MGY = millions of gallons per year

Source: ComEd tracking data and evaluation team analysis.

Using the formulas described in Appendix A, the evaluation team determined the verified savings for each measure type, for each of the four participants. The results for each participant are shown in Table B-2.

Table B-2. Savings and Measure Inputs by Participant

Measure by Jurisdiction	Water Savings (MGY)	Measure Count	System Pressure Adjustment Value (psi)	Average System Pressure (psi)	NTG*	Net Water Savings (MGY)
Community A	**111**	**23**	**0.96**	**65**	**0.80**	**89**
Customer Service Connection	4	1	0.96	65	0.80	3
Fire Hydrant	23	13	0.96	65	0.80	18
Valve	25	7	0.96	65	0.80	20
Water Main	60	2	0.96	65	0.80	48
Community B	**14**	**8**	**0.87**	**53**	**0.80**	**12**
Customer Service Connection	3	1	0.87	53	0.80	3
Fire Hydrant	11	7	0.87	53	0.80	9
Community C	**35**	**20**	**0.84**	**49**	**0.80**	**28**
Customer Service Connection	6	2	0.84	49	0.80	5
Fire Hydrant	26	17	0.84	49	0.80	21
Valve	3	1	0.84	49	0.80	2
Community D	**68**	**17**	**0.86**	**52**	**0.80**	**54**
Fire Hydrant	17	11	0.86	52	0.80	14
Valve	16	5	0.86	52	0.80	13
Water Main	35	1	0.86	52	0.80	28
Grand Total	**229**	**68**				**183**

MGY = millions of gallons per year

Source: ComEd tracking data and evaluation team analysis.

Table B-3. Summary of Pilot Impact by Measure

Measure	Average Flow Rate per Leak (MGY)	Total Leaks Detected	Leaks Fixed	Percent of Leaks Fixed	Secondary Savings per Leak (kWh)	Total Verified Gross Savings (kWh)	Percent of Verified Gross Savings
Water Main	9.5	10	3	30%	81,306	243,918	42%
Fire Hydrant	1.6	53	48	91%	4,170	200,167	34%
Valve	3.3	15	13	87%	8,529	110,877	19%
Customer Service Connection	3.1	12	4	33%	8,175	32,700	6%
Total	**3.0**	**90**	**68**	**76%**	**102,180**	**587,663**	**100%**

MGY = millions of gallons per year

Source: ComEd tracking data and evaluation team analysis.

Appendix C. Total Resource Cost Detail

The only electric savings verified in the Water Infrastructure Leak Reduction Pilot come from secondary kWh savings for water supply and wastewater treatment. The TRM directs that secondary kWh savings should not be included in TRC tests to avoid double counting the economic benefit of water savings. As a result, the TRC table is not included in this report.