




An Experiment in Making Water Affordable: Philadelphia's Tiered Assistance Program (TAP)

Elizabeth A. Mack , Sarah Wrase, Joanne Dahme, Susan M. Crosby, Martha Davis, Melody Wright, and Ravonne Muhammad

Research Impact Statement: This article presents and assesses customer and revenue impacts of a groundbreaking income-based billing solution to the challenge of water services affordability in Philadelphia, Pennsylvania.

ABSTRACT: The ability to pay for water and wastewater services is a growing issue in the developed world. To this point in time, utilities have helped customers grappling with affordability issues using different types of customer assistance programs (CAPs). Income-based billing approaches differ from CAPs in that bills are structured so as to be affordable for customers at the outset. Recently, the City of Philadelphia implemented an innovative program to work towards resolving the affordability problem in their city using income-based billing. This tiered assistance program or TAP structures bills for water, wastewater, and stormwater services to program enrollees' income. Given the innovative nature of the program, this paper describes the rollout of TAP and assesses the impact of the program on customers and utility revenues. The paper closes with a critical assessment of TAP and considerations for utilities evaluating the implementation of similar programs.

(KEYWORDS: water policy; sustainability; water affordability; urban areas.)

INTRODUCTION

In cities across the United States (U.S.; e.g., Detroit, Baltimore, Philadelphia), thousands of consumers have had their water shut off or are at risk for having their water shut off for nonpayment (Hunter 2016; Spencer 2016; Weiner 2017; Stafford 2018; Philadelphia Water Department 2018a). This is a public health concern for city officials, but also a concern for utilities who lose revenue from these customers and incur additional costs for shutting off and restoring services. There are a variety of reasons for rising water costs including the cost of maintaining

and upgrading infrastructure, the cost of building new infrastructure, regulatory compliance, changing customer bases, and climate change (ASCE 2017; Bipartisan Policy Center 2017). The cost of maintaining and expanding service represents a large portion of these costs, which are estimated at about 1 trillion dollars over the next 25 years (ASCE 2017). Since the federal government funds a shrinking percentage of these costs (Congressional Budget Office 2015), the majority of the funding burden falls on individual utilities and their customers. This is particularly the case for public utilities that bill water and wastewater services at cost (Mack and Wrase 2017).

Paper No. JAWRA-19-0024-P of the *Journal of the American Water Resources Association* (JAWRA). Received February 14, 2019; accepted January 22, 2020. © 2020 American Water Resources Association. **Discussions are open until six months from issue publication.**

Department of Geography, the Environment, and Spatial Sciences (Mack), Michigan State University, East Lansing, Michigan, USA; Department of Accounting (Wrase), Michigan State University, East Lansing, Michigan, USA; Philadelphia Water Department (Dahme, Wright), Philadelphia, Pennsylvania, USA; Northeastern University School of Law (Davis), Boston, Massachusetts, USA; Philadelphia Law Department (Crosby), Philadelphia, Pennsylvania, USA; and Philadelphia Department of Revenue (Muhammad), Philadelphia, Pennsylvania, USA (Correspondence to Mack: emack@msu.edu).

Citation: Mack, E.A., S., Wrase, J., Dahme, S.M., Crosby, M., Davis, M., Wright, and R., Muhammad. 2020. "An Experiment in Making Water Affordable: Philadelphia's Tiered Assistance Program (TAP)." *Journal of the American Water Resources Association* 56 (3): 431–449. <https://doi.org/10.1111/1752-1688.12830>.

The common mechanism for improving customers' ability to pay for water and wastewater services is to provide customer assistance programs (CAPs). The structure and types of CAPs vary from utility to utility. However, common types of CAPs offered include: bill discounts, flexible terms, lifeline rates, temporary assistance, and water efficiency programs (USEPA 2016). While helpful, CAPs do not necessarily make water services affordable at the outset and do not resolve the issue of past due balances. This raises two research questions. One, can rates be structured to provide affordable water and wastewater bills at the outset to alleviate affordability problems? Two, if more affordable rates can be structured, what is the impact on customers and what does this mean for revenue recovery for utilities?

In light of rising affordability problems related to water services, the City of Philadelphia launched its Tiered Assistance Program (TAP) on July 1, 2017. This program is different from CAPs because it is the first income-based billing program in the U.S. In other words, bills for water services are structured based on customers' income, which is different from the CAP approach of providing assistance after customers are billed for services. Given the uniqueness of this program, which is a potential model for establishing a proactive means of structuring affordable water bills for low-income customers, this paper will describe the rollout of TAP and assess the impact of the program on customers. The paper will also discuss revenue recovery mechanisms built into the program to mitigate losses from program implementation and customer revenues. The paper closes with a critical assessment of TAP and considerations for utilities evaluating the implementation of similar programs.

CUSTOMER ASSISTANCE PROGRAMS

The present means of making bills for water and wastewater services more affordable for customers is to offer some type of assistance program. The structure and types of programs offered vary from utility to utility. However, common types of CAPs offered include: bill discounts, flexible terms, lifeline rates, temporary assistance, and water efficiency programs (USEPA 2016). Bill discount programs reduce a customer's bill by a predetermined amount while flexible term programs include arrearage forgiveness, flexible deadlines, level billing, and payment plans. Lifeline rates allow customers to pay a subsidized rate for the amount of water that is needed for their basic needs, with an increasing rate structure after that usage

amount is exceeded. Temporary assistance programs help customers with their bills on a short-term basis, usually to help customers deal with an unexpected hardship. Finally, water efficiency programs encourage conservation and take direct action by replacing inefficient fixtures or repairing/replacing leaking pipes.

There are many resources available to help utilities develop CAPs, and a wide variety of options for implementation. To date, prior work has centered on reviews of existing assistance programs, with the goal of helping utilities create their own programs based on information from other utilities (Hasson 2002; USEPA 2016). Work has also been done to identify best practices within CAP design (Beecher 1994; Cromwell et al. 2010; National Consumer Law Center 2014) and highlight the variety of assistance programs utilities can implement.

An important consideration is that every community is different, and utilities are faced with the task of taking into account their own individual challenges when designing a program that works best for them. The costs of CAPs also vary based on the type of assistance offered, as well as program size (USEPA 2016). Costs to utilities of CAPs include the following: administrative costs, costs associated with paying for water efficiency devices and services, and lost revenues from reduced rates and fees (USEPA 2016). Information from a 2010 Water Research Foundation survey found that 65% of responding utilities paid less than \$25,000 annually and 7% spent more than \$25,000 (Cromwell et al. 2010). About 24% of respondents to this same survey did not know the annual cost (ibid). This percentage highlights that more work is needed to understand these program costs: this research need is also noted in recent publications about these programs (Grigg 2017).

One of the challenges of structuring assistance programs is the lack of a guiding federal framework for doing so (Grigg 2017). Thus, the number and types of assistance offered varies from utility to utility, as do the eligibility requirements (Cromwell et al. 2010). In this respect, water services are distinct from energy services. Through the U.S. Department of Health and Human Services Low Income Home Energy Assistance Program (LIHEAP), the federal government distributes funds to assist low-income households in meeting their energy needs. States, territories, and tribal governments are in charge of administering LIHEAP to residents, and often add funds of their own to the program (Office of Community Services 2019). In contrast, this lack of funding for water services at both the federal and state level leaves many utilities on their own in terms of providing customer assistance. The absence of a federal framework for water assistance programs also presents unique legal

challenges for utilities in their attempts to develop their own programs.

The legal barriers to CAPs vary by state and by utility type, depending on how utilities are regulated and how state statutes are worded and interpreted. Just four states, Washington, California, Arkansas, and Mississippi, plus the District of Columbia, provide unambiguous language regarding the use of CAPs in publicly run water utilities. Of these five jurisdictions, Washington State and the District of Columbia explicitly allow CAPs while the three remaining states explicitly prohibit them. That leaves 46 states plus Puerto Rico with varying degrees of legal uncertainty (UNC Environmental Finance Center 2018). In 27 states and in Puerto Rico, relevant statutes are silent on the issue; in these jurisdictions, water districts typically take advantage of this ambiguity to implement CAPs without experiencing any legal consequences. An example is the Commonwealth of Massachusetts, where modest CAPs are adopted by many water districts despite the lack of explicit state statutory authorization (Davis 2019).

In the remaining 19 states, case law or administrative interpretations throw into doubt the legality of CAPs. A widely known example is Michigan, where the state supreme court opined that a regulatory fee must be proportionate to the cost of services (Guillen 2016). Because CAPs distinguish between customers based on need rather than water usage, some contend that these programs run afoul of this nondiscrimination principle. A similar proportionality principle or nondiscrimination language appears in statutes, ordinances, or case law in the other 18 states where adopting a CAP raises a legal risk to the water district (UNC Environmental Finance Center 2018). Though many argue that it is misguided to view such principles as barring need-based programs, the legal uncertainty created by these differing views is a deterrent to utilities' adoption of CAPs or other creative approaches to addressing water burdens. Certainly, this legal disagreement and the risk of litigation are factors that have slowed progress toward adoption of a CAP or affordability plan in Detroit (Guillen 2016).

WATER AFFORDABILITY

While studies have acknowledged the affordability dilemma for customers for quite some time (Beecher 1994), research on water affordability compared to assistance programs is a comparatively sparse, but growing, area of research (Baird 2010; U.S. Water Alliance 2017). To this point, a great deal of attention

in public and private water utility literature has been paid to the rate setting practices of utilities (Hughes et al. 2014; Tiger et al. 2014; Food and Water Watch 2016). Work on water affordability is growing, but is challenging because of the diverse range of affordability metrics available. For example, the United Nations Development Program affordability standard is 3% of household income (Banerjee and Morella 2011) while the U.S. Environmental Protection Agency's (USEPA)'s standard is 2% for drinking water, 2.5% for wastewater, and 4.5% for both drinking water and wastewater (USEPA 2002). These differences in benchmarks for affordability are complicated by the means of measuring affordability. Here there are expenditure- and income-based approaches (Fankhauser and Tepic 2007). Examples of expenditure-based measures include the share of income consumed by household expenditures while income-based measures might look at the share of annual income consumed by water costs (Hutton 2012). Compounding the complexities associated with the variety of measures and benchmarks used in studies, is the lack of agreement about what constitutes the level of water consumption associated with meeting basic human needs. Here too studies vary widely as to the minimally necessary usage level which ranges from 13.21 gallons (50 L) per person per day to 35.66 gallons (135 L) per person per day (Gleick 1996). Above and beyond this basic need threshold level, actual water use also varies by gender, income, and country of residence.

Existing work on water affordability is of two varieties, studies that assess the affordability of services (Sawkins and Dickie 2005; Fankhauser and Tepic 2007; Banerjee and Morella 2011; Mack and Wrase 2017) and studies that seek out better affordability metrics (García-Valiñas et al. 2010; Teodoro 2018; Vanhille et al. 2018). This latter issue is considered particularly important for understanding the extent of the issue and designing better water tariffs (García-Valiñas et al. 2010). Recent work on designing better metrics (Teodoro 2018) attempts to overcome the flaws of the USEPA affordability guidelines (USEPA 2002). Alternatives are suggested that do a better job of considering essential uses of water (e.g., indoor use) and the essential costs of living (i.e., housing, energy, health care, food). Affordability assessments and associated metrics remain open areas of inquiry in the research and policy communities.

STUDY AREA

The City of Philadelphia is the largest city in the state of Pennsylvania and has a large percentage of

people living in poverty (26%) (Pew Charitable Trust 2018). Recent statistics from the Philadelphia Water Department (PWD) highlight that 40,000 residences were eligible for shut off due to nonpayment at the end of April 2018 (Philadelphia Water Department 2018a). Based on these numbers and growing consensus from City officials and community leaders, efforts began to take shape in 2015, to make water more affordable for customers in need. The pursuit of an affordability program was viewed as having multiple benefits for the Water Department and its customers.

The PWD and the Philadelphia Water Revenue Bureau are the City agencies responsible for designing and implementing the TAP. The water utility services about 500,000 residential customers in the city of Philadelphia (email from PWD). It also sells water on a wholesale basis to neighboring communities (Rate Board 2018). The PWD is a cost of service utility, which means that the rates are designed to cover operations, maintenance, reinvestment, and build out of water, wastewater, and stormwater systems (Philadelphia Water Department 2018a). Rates for city customers are set by a rate board via a series of public and technical hearings.

DATA

To glean information about various aspects of TAP from its conception to implementation, several sources of information are utilized. These sources included news articles about the development and rollout of the program as well as memoranda from the Rate Board, minutes from Advisory Board Committee meetings, conversations, and email communications with managers involved with TAP. Other sources of information included a 2018 annual report to the mayor, which is required by Philadelphia Code Section 19-1605 (2015) (7). Information about the program and associated costs was drawn from Rate Board memoranda and notes from rate proceedings (Rate Board 2016, 2018). Survey data from PWD also provided customer evaluations of the program.

ASSISTANCE PROGRAM ANTECEDENTS TO TAP

Table 1 summarizes the assistance programs available to PWD customers which provided a combined total of \$34 million of assistance to customers in the 2017 fiscal year (Philadelphia Water Department

2018a). Of these programs, the Water Rate Assistance Program was central to helping customers with affordability problems. There were two drawbacks to this program, however. One, customers had to be delinquent to enroll in the program. Two, a customer was given a set amount to pay based on his/her usage. Despite this fixed amount, any billed amount over the required payment continued to add to the delinquent balance.

DESCRIPTION OF TAP

The Water Revenue Assistance Program (WRAP) is now being phased out with the initiation of TAP. The road to TAP started on November 19, 2015 when the city council passed Council Bill 140607-AA (City Council 2015): *an ordinance amending Title 19 of the Philadelphia Code (Finance, Taxes and Collections), Chapter 1600 (Water and Sewer Rents), by providing for installment payment agreements, all under certain terms and conditions*. In the ordinance, the program is referred to as the Income-Based Water Rate Assistance Program; its operational name is TAP (Department of Revenue, "Annual Report to the Mayor on the TAP" unpublished report March 31, 2018). On December 1, 2015, the Mayor (Michael Nutter) signed the ordinance into effect (City Council 2015). One year later on June 8, 2016, the rate board decided on parameters for fiscal year 2017–2018 rates (Philadelphia Water Department 2018a). July 1, 2017 was the first day customers could submit applications to participate in the program (Philadelphia Water Department 2018a).

The goal of the program is to help low-income households that are between 0% and 150% of federal poverty levels (FPL level), as well as households above the 150% FPL level, facing circumstances that temporarily place them in financial hardship (Philadelphia Water Department 2017). Several events can qualify a customer for an income-based bill due to hardship. Examples of these events include an increase in household size, death of the primary wage earner, unemployment for more than four months, domestic violence, and a serious illness lasting more than nine months (Philadelphia Water Department 2017).

This program is different from prior CAPs in Philadelphia and in other cities because *bills for water, wastewater, and stormwater services are structured based on each program participant's income*. This means that each customer receives a unique bill, in a consistent, predictable amount each month, based on their household income, making budgeting

TABLE 1. Summary of Philadelphia water assistance programs.

Name of program	Description
Senior citizen discount	25% discount for persons 65 years of age and older with a total annual income of \$32,300 or less (City of Philadelphia 2018b)
Water Revenue Assistance Program (WRAP)	Three types of payment agreements for households with 250% income or less of federal poverty level (FPLLevel): <ol style="list-style-type: none"> 1. Paid in full agreements* 2. Extended payment agreements* 3. Water Revenue Bureau Conference* Committee (WRBCC) payment agreement *See Appendix C for details
Utility Emergency Services Fund (UESF)	PWD matches every dollar provided by UESF to help get a customer's delinquent account current. To be eligible customers must: have a notice of termination/be off service, live in Philadelphia, have not received a grant in the past two years, have applied for LIHEAP Cash and Crisis program first, owe an amount that is not in excess of the utility grant (if the amount surpasses the maximum grant allowed the applicant is responsible for the balance), and be at or below 250% of poverty level (Utility Emergency Services Fund n.d.)
Homeowners Emergency Loan Program	Provides zero-interest repair loans, payable over a 60 month period, for homeowners in danger of shutoff because PWD inspectors found a leaking water or sewer line and issued a Notice of Defect. The property's water bill must be current. If there are arrearages, a payment agreement with the Water Revenue Bureau must be current for at least six months, prior to receiving the Notice of Defect (Philadelphia Water Department n.d.)
Conservation Assistance Program	"Provides water conservation devices and education to customers at or below 150% of poverty level." (City of Philadelphia 2018c)
Cross Connection Abatement Program	"Replaces sanitary drainage lines that are connected to the storm sewer. If a cross-connection is identified by the PWD Cross-Connection inspection program, the PWD will provide an information package to the homeowner and a referral to the Cross-Connection Repair Program." (City of Philadelphia 2018c)
Basement Protection Program	PWD inspects the property to ensure the property laterally functions properly. Once this is determined, they will pay for the backwater valve and all related work necessary to install and maintain the valve, as well as necessary rain leader modifications (Philadelphia Water Department 2018b)
Low-income payment agreements	Low-income payment agreements increase the amount of time you have to pay the full amount that you owe. To qualify, you must: live in the property for which you apply, show that your total household income is within federal low-income guidelines, provide proof of residency for the property, and have a working water meter in the property (City of Philadelphia 2018d)

Notes: LIHEAP, Low-Income Home Energy Assistance Program; PWD, Philadelphia Water Department.

for expenses easier. Monthly bills range from 2% to 4% of total household income, which is well within the range of EPA guidelines of 4.5% of median household income (USEPA 2002). While customers are enrolled in TAP, payments on past due amounts are not required. After customers have made payments in full for 24 months, prior penalty charges from past due amounts are forgiven (Rate Board 2018). As per Philadelphia Code Section 19-1606 (2015) forgiveness of past due amounts that have aged 15 years is also possible irrespective of TAP participation (City Council 2015; Rate Board 2018). Here it is important to note two things. First, people who have debt <15 years old will not see a reduction in past due amounts. Second, while bills are based on income, water consumption does factor into debt repayment for customers whose usage charges are below their computed tap charge. For example, if a customer with a computed tap charge of \$40 uses \$35 worth of water, the excess \$5 is used to pay down the customer's back debt.

Any residential customer can apply to the program. This includes customers who have zero usage

or no water at the time of application (PWD Meeting Notes, 2018. Meeting with Ravonne Muhammad and Joanne Dahme. December 6, 2018). It also includes customers who are enrolled in other water assistance programs, those who are delinquent on their water bills, and customers who are not delinquent on their bills. When customers apply for TAP, they are also applying for several programs simultaneously (e.g., extended payment agreements, the senior citizen bill discount) (Raftelis 2018). PWD chooses the program that is most beneficial for the customer. If enrolled in TAP because it provides the best bill for the customer, federal poverty line (FPLLine) benchmarks are used to determine the amount of assistance provided. Table 2 breaks down the FPLLine groups and types of assistance provided to each group. Appendix A contains the monthly household income thresholds by household size for determining assistance. Appendix B breaks out the annual household income thresholds by household size for determining the assistance outlined in this table.

The program has several unique features that differentiate this program from traditional CAPs. First,

customers do not need to be delinquent on their bills to apply and qualify (Philadelphia Water Department 2017). Two, bills are designed based on income and do not ask customers to pay a portion of past due amounts. Penalties from past due amounts are forgiven after 24 full payments of the TAP amount are received (Philadelphia Water Department 2017). Their principal is not forgiven at this time, however; only debt on past due amounts that have aged 15 years. Unpaid TAP bills will result in shut off notices. Customers can enter an agreement for past due TAP bills. As long as a customer is eligible and enrolled in TAP, their arrears are held in suspension. If a customer leaves TAP, they are required to pay down arrearages, which is negotiated through a payment agreement.

There are a few items to keep in mind about the program. First, customers cannot fill out a blank application since a unique barcode is generated for each customer (Philadelphia Water Department 2017). Instead, they must fill out the application generated for them. Two, the review process can take some time; initial estimates of the review time were two months (Philadelphia Water Department 2017). Three, customers enrolled in TAP are not eligible for other discounts (City of Philadelphia 2018a). Four, customers can be removed from the program for a variety of reasons. These reasons are as follows: “submitting intentionally false enrollment or recertification information/documentation, unauthorized use of service, failure to recertify, or failure to accept and reasonably maintain free conservation services offered by the Water Department” (Department of Revenue, “Annual Report to the Mayor on the TAP” unpublished report March 31, 2018). Fifth, customers can have their water shut off if payments are two bill cycles in arrears and balances are \$75 or more (Philadelphia Water Department 2017).

The TAP program replaces the old WRAP program (Stewart 2017). WRAP customers for the two years preceding the start of TAP, as well as current WRAP customers received an application in the mail (Philadelphia Water Department 2017). Customers requesting a TAP application were granted a 14 day grace period to allow the application to process if they were in danger of shut off; customers with water shut-off had service restored for a 14 day grace period

(Philadelphia Water Department 2017). WRAP participants will be enrolled in the new TAP program if it does a better job of meeting customer needs (Philadelphia Water Department 2017). As of July 1, 2017, however, no new entrants were permitted into the WRAP program (Philadelphia Water Department 2017).

In addition to reaching out to WRAP participants, the TAP program was advertised via a wide range of mechanisms including: bill stuffers, emails to customers, fliers, facts sheets, posters (English and Spanish), newspaper advertisements, and advertisements on buses, bus shelters, and subways (Department of Revenue, “Annual Report to the Mayor on the TAP” unpublished report March 31, 2018). A press conference in late June 2017 was also held to announce the program to the public and enhance its visibility (ibid). There are also plans to reach out to two target groups: senior citizens and customers with owner-occupied real estate tax payment agreements (OOPA) (ibid). In Philadelphia, OOPA is a means for homeowners to make payments that are affordable to them on property taxes that are past due (ibid).

Initiation and Design

The idea to move forward with a solution to address the affordability challenges of Philadelphia residents was initiated by several parties. Within the PWD, leadership realized a new solution to the affordability problem that moved beyond the current WRAP program was necessary. Philadelphia has a history of offering protection to low-income homeowners, such as the Senior Freeze and Owner-Occupied Payment Agreements for real estate taxes. Thus offering protection to water customers was the next logical step. At the community level, key advocates for an affordability solution were Councilwoman Maria D. Quiñones-Sánchez (Wogan 2017) and Community Legal Services (CLS), acting in its capacity as the city’s Public Advocate in water-rate cases. Dating back as far as 2015, numerous individuals debated the structure of the program. One of the original versions of the affordability program was a bill structure based on income tiers. A consulting party, Black and Veatch provided financial models that informed

TABLE 2. TAP customer groups and assistance provided.

	Income 0%–50% FPLlevel	51%–100% FPLlevel	101%–150% FPLlevel	>151% FPLlevel or more and special hardship
Bill cap	2% monthly income	2.5% monthly income	3% monthly income	4% monthly income
Payments in arrears	None	None	None	None

Source: Philadelphia Water Department (2017).

TABLE 3. Implementation timeline.

	June 2016	January 2017	March 2017	July 2017	May 2018
Process and policy development					
Outreach to WRAP customers					
General customer outreach					
Workshops: review program & application					
Online and program call center customer resources					

Note: The shading indicates when particular activities were undertaken in the implementation phase of the TAP program.

Source: Philadelphia Water Department (2018a).

program design and the assessment of program options. In addition, the 2015 City Council ordinance outlining the program stated explicitly that the new income-based bills would satisfy the requirements in the Philadelphia City Code that rates be reasonable and nondiscriminatory.

Implementation

After the development of the policy, implementation of the program reflected cooperation between the Revenue and Water departments, consultants, several stakeholders, and community groups. This involved several activities prior to enrolling participants including: the development of operating procedures, the development of internal business processes, and the hiring and training of staff. Information technology had to be developed to support the submission and review of applications and the billing system modified. Table 3 displays the timeline for program implementation between 2016 and 2018. In addition to these implementation decisions, after the initial phase-in period, the Rate Board approved modest rate increases and the addition of a TAP surcharge on bills of non-TAP recipients (Rate Board 2018).

Aside from the cooperation between plan partners, there were six key components of implementation. One component was the identification of a vendor to mail and receive customer applications. This was an important element because the receipt and tracking of applications are key elements of TAP. To do this, a request for proposals was issued and potential vendors evaluated. Vanguard was selected as the application vendor.

A second component was the design of a website to communicate with internal and external parties (Raftelis 2018). From an internal perspective, the website allows staff at the Water Rate Board (WRB) to view customer applications and associated documentation. This not only streamlines the application approval process, but also helps staff provide information to customers inquiring about the status of their application (Raftelis 2018). The internal website also

communicates with the billing system. This makes tracking of program costs, application approval speed, and other valuable metrics about the program readily accessible (Raftelis 2018). The external website serves as an interface for customers to access applications and other information about the program (Raftelis 2018).

A third component of implementation was the development of a software system called Customer Assistance Management Program (CAMP) to compute unique bills for program participants. Two entities, Raftelis and Miitek, codeveloped this software. The system is flexible and accepts both scanned paper documents and online, electronic applications. Unique applications are generated and assigned a bar-code which tracks and monitors the application during the approval process. The bar code is also used to monitor the timeliness of payments after a participant is enrolled in the program.

Upon receipt of an application, CAMP computes the federal poverty level of the applicant (FPLLevel), compares billing options for the customer against all other assistance options (e.g., low-income payment agreements, senior citizen discounts), and selects the best option for the customer. WRB staff ensure the information in Vanguard is correct and verify if the scanned documents are valid proofs of income and residency. They also confirm CAMP program selection. The entire program selection process is blind-repeated to ensure quality control. Once an option is selected, a letter is generated that explains the billing process to the customer, and the means of identifying the program best suited to their financial situation. If enrolled in the TAP program, CAMP tracks and records participants' payment history and progress toward the earned forgiveness element of the program described above.

A fourth component was stakeholder involvement to educate potential participants and to encourage program enrollment. Nine public meetings were held — as a component of PWD's FY19-20 Rates Process — to educate people about the program (Rate Board 2018). These meetings served to educate potential enrollees about the value of the program and the difference

between the new program and existing programs. They also stressed the value of the program to communities in general and explained why it is important to help people pay their bills. An inability to pay for services can result in a tax lien for the delinquent water debt (with a \$1,000 maximum threshold).

This involved working with community ambassadors to get feedback about the program and pitfalls for enrollment. Another critical, new point of emphasis among these groups was to highlight the key takeaway: *Every* water account holder in Philadelphia can apply for TAP, because under the new program, even people who have never qualified for assistance before, may be eligible for help, whether or not they have fallen behind in their payments. Several community-based organizations were also involved in education and enrollment of participants. Examples of involved community organizations include Benephilly, CLS, Neighborhood Energy Centers, the Energy Coordinating Agency, and the Utility Emergency Services Fund (UESF). Neighborhood energy centers served as intake centers for persons applying to the program. Nonprofit organizations were trained to work with customers to help them fill out applications.

A fifth component of implementation was the ongoing involvement of consultants from the concept phase of the program to the present (PWD Meeting Notes, 2018. Meeting with Ravonne Muhammad and Joanne Dahme. December 6, 2018). Consultants were involved in estimating the cost of the program and the number of staff needed to service the program based on projected enrollment figures. They were also instrumental in the training of staff persons affected by the new program. This included the training of an estimated 70 people at the call center which is the hub for questions about bills, applications to the program, and PWD-managed water repair and maintenance issues (PWD Meeting Notes, 2018. Meeting with Ravonne Muhammad and Joanne Dahme. December 6, 2018). Consultants also trained staff in billing, appeals, and collections. From a community perspective, they were also involved at customer intake centers.

A sixth aspect of implementation was the role of communication across all parties involved in the program. This included providing customers with information about the status of their applications as well as weekly and monthly meetings between all actors involved in the program. A critical component to the monthly meetings were the monthly updates to the software designed for the program.

Reporting

Philadelphia Code Section 19-1605 (2015) (7) requires the Department of Revenue to submit an annual report to the Mayor, updating the status of the TAP. This Code provision requires that the report includes four metrics: (1) number of customers enrolled in the program; (2) number of applicants NOT enrolled in TAP; (3) number of payment agreements with customers that are not related to TAP; and (4) number of customers who have defaulted from TAP (Philadelphia Code Section 19-1605 2015 (7)(b)(1-4). Tables 4 and 5 described above, were derived from information provided in this annual report. The inaugural edition of the report, published in March of 2018, also outlined the efforts made to stand up the program, including development of its policies, operating procedures, business processes technology components, and administration guidelines.

Advisory Program

The program has an advisory committee which meets on a quarterly basis to assist with messaging, advertising, assisting customers with the application process, and feedback about the application process (TAP Advisory Committee Meeting Notes, March 29, 2017). The first meeting of the advisory committee on October 5, 2016 provided feedback about the application, documentation required to validate income and/or hardship, and application turnaround time (TAP

TABLE 4. TAP enrollees and associated debt by federal poverty level (FPLlevel).

Federal poverty level	Number of enrollees	% of enrollees	Total debt: pre-TAP enrollment	% of pre-TAP debt
0%–50%	1,027	22.3	\$3,243,020.46	20.9
51%–100%	2,401	52.1	\$8,589,123.96	55.4
101%–150%	1,130	24.5	\$3,480,156.92	22.4
151%–250%	48	1.0	\$181,990.37	1.2
251%	4	0.1	\$16,543.94	0.1
Total	4,610	100.0	\$15,510,835.65	100.0

Source: Department of Revenue, “Annual Report to the Mayor on the TAP” unpublished report March 31, 2018.

TABLE 5. Breakdown of applications not enrolled in TAP.

	Number applications
Denied	
Did not meet income and residency guidelines	104
Did not meet income guidelines and/or did not measure special hardship	307
Did not meet residency guidelines	235
Installation type not TAP eligible	10
Missing or invalid income or residency documentation	1,555 ¹
Application missing information	95
Did not prove special hardship	38
Total applications Denied	2,344
Enrolled in alternative program	
Senior citizen discounted bill and extended payment agreement	35
Senior citizen discounted bill	92
Regular bill and extended payment agreement	273
Regular bill	121
WRBCC agreement what does this mean??	152
Total alternatives	673
Other	
Application withdrawn	3
Duplicate applications whose data were transferred to newer application	73
Total	76

¹54 applications were declined erroneously and have been approved since December 31, 2017.

Source: Department of Revenue, "Annual Report to the Mayor on the TAP" unpublished report March 31, 2018.

Advisory Committee Meeting Notes, October 5, 2016). Postlaunch, the advisory committee focused on obtaining application process feedback (TAP Advisory Committee Meeting Notes, July 26, 2017) and providing assistance to customers in gathering materials and completing the application (TAP Advisory Committee Meeting Notes, November 2, 2017). One year after implementation, meetings focused on reaching new applicants and improved assistance with the application process (TAP Advisory Committee Meeting Notes, August 9, 2018). This included launching neighborhood-based Utility Assistance Fairs to offer customers the opportunity to apply for water, gas, and electric assistance in one location using one set of customer documents.

Public Advocate

In the 1990s, the City of Philadelphia was the first city in the nation to create a position of temporary Public Advocate to represent customers in local oversight of water ratemaking proceedings (Bouma n.d.). In addition to providing testimony in formal hearings, the Public Advocate participates in policy development and legislative advocacy on behalf of water

consumers. The Public Advocate was involved in the development of the TAP program and has continued to monitor the program since its implementation.

CLS was named to the Public Advocate position during ratemaking proceedings in both 2016 and 2018. On both occasions, the Public Advocate challenged proposed rate increases and was able to secure some key concessions that moderated rates. In this effort, the Public Advocate was aided by an expert witness, Roger Colton, who presented evidence concerning alternative water funding approaches. In the 2018 ratemaking proceeding, the TAP program was very much at the center of the debate, as the Water Board proposed a new fee to be added to non-TAP consumer bills to help make the TAP program financially sustainable.

In analyzing Philadelphia's rate-setting process, the University of Michigan concluded that the Public Advocate played an important role. According to the analysis, "[a] water rate governance system that ... empowers a public advocate to be an equal party with water utilities in water rate proceedings can create a process that ensures a strong voice for all stakeholders during rate-setting discussions" (Bouma n.d.). The TAP program itself is one product of this dynamic mutual engagement.

PROGRAM IMPACTS

Enrollment

Expert testimony by Raftelis during the FY 17-18 Rate Case referenced the number of customer water accounts between 0% and 150% of federal poverty levels (FPLlevel) at 56,156 (Davis Testimony n.d.). This is the number of persons who would qualify for the program without considering special hardship, and serves as a good estimate of the number of people eligible for the new program. Initial emphasis was placed on reaching the enrollment numbers for the WRAP program, which was about 10,000 customers (Bethel Testimony n.d.). Outside of WRAP, it is estimated that there are about 4,600 persons enrolled in other CAPs (communication with PWD August 1, 2019).

Table 4 contains the 2017 enrollment numbers in TAP between July 1 and December 31. The table also includes the total amount owed by these customer groups (pre-TAP debt). During this period, 4,610 customers enrolled in the program. Combined, these customers owed over 15 million dollars to the water department. About 74% of these customers were at or below 100% of federal poverty guideline income

levels. Combined, this group of customers accounted for just over 11.8 million dollars of debt (Department of Revenue, “Annual Report to the Mayor on the TAP” unpublished report March 31, 2018). Of the 7,500 applicants, 3,093 were not enrolled for a variety of reasons (Department of Revenue, “Annual Report to the Mayor on the TAP” unpublished report March 31, 2018); Table 5 provides details about customers who applied but were not enrolled in TAP. As of May 31, 2018, 37,521 applications were requested and 21,522 applications were submitted (Philadelphia Water Department 2018a). By the end of the first fiscal year of the program in 2018, just over 12,000 people had enrolled. The Public Advocate has noted that this number falls short of the 31,000 projected enrollees at the time of the 2016 Rate Case (Rate Board 2018).

The most recent estimate of TAP enrollees is 15,079 (September 20, 2019 email communication with PWD). This figure is short of the 16,924 target number of enrollees for 2019. It exceeds the 10,000 customers enrolled in the old WRAP program, however, and exceeds the combined 14,600 participants in all CAPs previously (including WRAP).

Cost of the Program

Prelaunch estimates of revenue losses/costs from/of the program for the fiscal year 2018 were estimated to be about 16.3 million dollars and revenue losses postlaunch for the fiscal year 2018 were estimated to be 3.9 million dollars (Rate Board 2016). About 2.8 million dollar of the 3.9 million dollar is from recurring administration costs and the remaining 1.1 million dollar is for start-up costs in the first two years of the program (Rate Board 2016). Table 6 presents information about the number of projected enrollees and the costs associated with these enrollment figures (Merritt 2018). This table highlights that the cost per enrollee is expected to increase over time because lost revenues will increase as program participation increases. These lost revenues will be spread across the customer base as costs are budgeted.

The 2018 fiscal year costs will be covered via rates and charges (Merritt 2018). About 41% of revenue losses will be recovered from water services and 59% will come from sewer and stormwater bills (Merritt 2018). These surcharges will be added to base rates for the quantity charge component of the bill (Merritt 2018). Tables 7 and 8 outline what this looks like for water and sewer users respectively.

While these surcharges are anticipated to pay for the cost of the program, these surcharges may collect too much or too little in revenues. This is because these

TABLE 6. Projected enrollees and costs.

Fiscal year	Projected number of enrollees	Projected cost (in thousands of dollars)	Per enrollee projected cost
2018	11,211	\$3,900	\$347.87
2019	16,924	\$9,800	\$579.06
2020	22,981	\$13,700	\$598.14
2021	26,397	\$17,000	\$644.01

Note: Data from Merritt (2018).

surcharges are based on projected enrollments and costs. If enrollments and costs differ from these projections, some strategy is needed to make adjustments to the surcharge outside the annual rate case. The TAP Rider was created to address the need for timely adjustments to surcharges (Rate Board 2018). The equation for the TAP Rider (TAP-R) in \$/MCF (1,000 cubic feet) is specified as follows (Merritt 2018):

$$TAP - R = \frac{C - (E + I)}{S}, \tag{1}$$

where *C* = the estimated billing loss from TAP for the current period, *E* = net over/under collections from TAP surcharge for the most recent period, *I* = interest received from over/under collections from TAP surcharge for the most recent period, *S* = Projected sales from customers not participating in TAP (in MCF).

The equation outlined above has several advantages. It utilizes available data for both the TAP and non-TAP customer base instead of projections. Once filed, the Rate Board has 60 days to make a decision (Merritt 2018).

Impacts on Customer Billing

In terms of individual customer billing, the impacts on non-TAP and TAP customers are varied. To provide some sense of how the surcharges for water and wastewater services outlined in Tables 7 and 8 respectively impact non-TAP customers, consider the following formula for a residential customer

TABLE 7. TAP surcharge for water bills (effective date September 1, 2018).

Water usage (MCF)	Base charge	TAP surcharge	Total
0–2	\$44.85	\$0.67	\$45.52
2.1–100	\$38.54	\$0.67	\$39.21
100.1–2,000	\$29.87	\$0.67	\$30.54
2,000+	\$29.05	\$0.67	\$29.72

Source: Merritt (2018).

TABLE 8. TAP surcharge for wastewater (effective date September 1, 2018).

Usage	Base charge	Tap surcharge	Total
All billable water usage	\$30.82	\$0.94	\$31.76

Source: Merritt (2018).

after the surcharge went into effect September 1, 2018 (Merritt 2018):

$$\alpha k + \rho k + \lambda k + \varepsilon k + (m \times x) + (m \times y) + z, \quad (2)$$

where α is a set charge per MCF for water services as listed on the rate sheet for a given period of time, ρ is a set charge per MCF for sewer services as listed on the rate sheet for a given period of time, λ is the TAP surcharge for water, ε is the TAP surcharge for wastewater, k corresponds to the volume of water used (in MCF), m is the days factor for a billing period which is computed by dividing the number of days of service by the number of days in the billing period for each customer x is the monthly service charge for water for a particular rate cycle, y is the monthly service charge for sewer for a particular rate cycle, z is a fixed stormwater charge for a particular rate cycle.

Figure 1 displays the bill for a PWD customer with a 5/8 in. meter between September 3 and October 1, 2018 for 8 centum (hundred) cubic feet or 0.8 MCF of usage over 30 days of service and a 30 day billing period. This means that the days factor is 1 because the days of service is equal to the number of days in the billing period. The TAP surcharge during this billing period is \$0.67 per block tier for water services (see Table 7) and \$0.94 for sewer services (see Table 8). The breakdown for the calculation of this bill is as follows:

$$\begin{aligned} &(44.85 \times 0.8) + (30.82 \times 0.8) + (\$0.67 \times 0.8) \\ &+ (\$0.94 \times 0.8) + (1 \times \$5.12) + (1 \times \$7.04) \quad (3) \\ &+ \$15.53 = \$89.52. \end{aligned}$$

An analysis of the bill highlights the amount of the TAP surcharge on this customer for this billing cycle and is \$1.29. While this number will vary with usage, the surcharge amount, is small, and constitutes about 1.4% of this particular bill.

Figure 2 displays the bill for the same PWD customer between October 1 and November 1, 2018 after enrollment in the TAP program. For this billing period, the customer had 0.7 MCF of usage over 33 days of service for a 31 day billing period. This translates to a days factor of 1.0645. Equation III is used to determine the pre-TAP billing amount:

$$\begin{aligned} &(44.85 \times 0.7) \\ &+ (30.82 \times 0.7) + (\$0.67 \times 0.7) + (\$0.94 \times 0.7) \\ &+ (1.0645 \times \$5.12) + (1.0645 \times \$7.04) \\ &+ \$15.53 = \$82.57. \end{aligned} \quad (4)$$

The TAP bill, which is listed as “total current charges” in Figure 2 is computed using one of the equations listed below (V-VIII). This amount is \$45.17 and is based on their monthly income. These percentages are determined by buckets, defined using federal poverty lines (FPLine) (see Appendix A for sample monthly figures and Appendix B for annual figures based on 2017 FPLine). This means that residents pay the same amount every month regardless of water consumption. This equates to the following formulas for the different FPLlevel buckets:

$$0.02 \times \text{gross monthly income } 0 - 50\% \text{ FPLlevel} \quad (5)$$

$$0.025 \times \text{gross monthly income } 51 - 100\% \text{ FPLlevel} \quad (6)$$

$$0.03 \times \text{gross monthly income } 101 - 150\% \text{ FPLlevel} \quad (7)$$

$$0.04 \times \text{gross monthly income } > 151\% \text{ FPLlevel and special hardship.} \quad (8)$$

The TAP discount is the difference between the TAP bill amount and the bill amount if the customer were not enrolled in TAP. This translates into the following formula:

$$\text{TAP bill} - \text{Non TAP bill amount} \quad (9)$$

As mentioned previously, water consumption does not determine the amount of the TAP bill. Water consumption is factored into debt repayment for customers, however. For customers whose usage charges are less than their computed TAP charge, this difference is applied to pay down the customer’s existing balance.

In contrast to non-TAP customers, the impact of the program on enrolled customers is more significant. The TAP discount of \$37.40 is a bill reduction of 45% on this particular monthly bill. A comparison of Figures 1 and 2 also highlights differences in how late payment penalties are handled. In Figure 1, the please pay box highlights the balance the customer is required to pay. This amount includes current



Water/Sewer & Stormwater Bill

Please pay **\$5,121.19**

Questions?

www.phila.gov/revenue

(215) 686-6880 Monday-Friday, 8am-5pm

Customer Name: [REDACTED]
 Service Address: [REDACTED]
 Bill Date: October 04, 2018 (Bill Period: Sep 03, 2018 - Oct 01, 2018)

Account Number: 00 [REDACTED]
 Water Access Code: [REDACTED]
 Bill Number: [REDACTED]
 Includes Payments Through: October 04, 2018

Your Account

Water/Sewer/Stormwater balance at last bill	\$5,031.67
No payment received	\$0.00
Unpaid Balance	\$5,031.67

This Bill

Usage Charge (8 ccf, see below for details)	\$61.83
Service Charge	\$12.16
Stormwater Charge	\$15.53
Senior Citizen Discount	\$0.00
Total Current Charges	\$89.52
Total Account Balance	\$5,121.19
Please Pay Now	\$5,121.19

Past Due Balance

When your water bill is past due, your service is subject to shut-off. To avoid shut-off, pay your balance in full at one of our payment centers in the city. Payment information can be found on the back.

Payment Types

Pay by phone (877) 309-3709; credit card or e-check at www.phila.gov. Select water bill from pay menu options.

See back for more information and contact details →

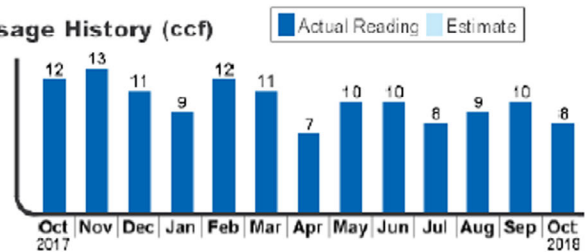
Your Water Usage

Meter Readings

Meter: 0456642 ERT: 0023009898 Service: 41R

October 01, 2018	actual reading	1733
September 03, 2018	actual reading	1725
Total CCFs used		8
<i>Approximate gallons used per day</i>		<i>213</i>

Usage History (ccf)



Please fold and detach



Paying by mail?
 Send this coupon with your payment.
 See back for other ways to pay →



Please pay	\$5,121.19
Late payment penalty	\$29.63
Total amount due if paid after Nov 05, 2018	\$5,150.82



FIGURE 1. Non-Tiered Assistance Program (TAP) customer bill.



Water/Sewer & Stormwater Bill

Please pay **\$45.17**

Questions?

www.phila.gov/revenue

(215) 686-6880 Monday-Friday, 8am-5pm

Customer Name: [REDACTED]
 Service Address: [REDACTED]
 Bill Date: November 05, 2018 (Bill Period: Oct 01, 2018 - Nov 01, 2018)

Account Number: 00 [REDACTED]
 Water Access Code: [REDACTED]
 Bill Number [REDACTED]
 Includes Payments Through: November 05, 2018

Your Account

Water/Sewer/Stormwater balance at last bill	\$5,121.19
No payment received	\$0.00
Unpaid Balance	\$5,121.19

This Bill

Usage Charge (7 ccf, see page 2 for details)	\$54.09
Service Charge	\$12.95
Stormwater Charge	\$15.53
Senior Citizen Discount	\$0.00
TAP Discount	-\$37.40
Total Current Charges	\$45.17
Late payment penalty	\$29.77
Total Account Balance	\$5,196.13
Please Pay Now	\$45.17
Your monthly TAP charge	\$45.17

Payment Types

Pay by phone (877) 309-3709; credit card or e-check at www.phila.gov. Select water bill from pay menu options.

See back for more information and contact details →

Please fold and detach



Paying by mail?
 Send this coupon with your payment.
 See back for other ways to pay →



Please pay	\$45.17
Late payment penalty	\$0.00
Total amount due if paid after Dec 05, 2018	\$45.17

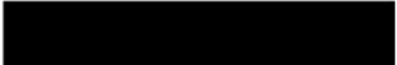


FIGURE 2. Customer bill after TAP enrollment.



Customer Name: [REDACTED]
 Service Address: [REDACTED]
 Bill Date: November 05, 2018 (Bill Period: Oct 01, 2018 - Nov 01, 2018)

Bill Number: [REDACTED]
 Includes Payments Through: November 05, 2018

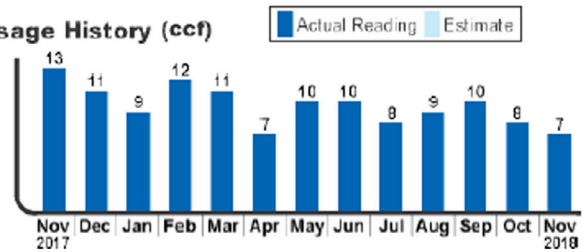
Your Water Usage

Meter Readings

Meter: [REDACTED] ERT [REDACTED] Service: 41R

November 01, 2018	actual reading	1740
October 01, 2018	actual reading	1733
Total CCFs used		7
Approximate gallons used per day		168

Usage History (ccf)



Your TAP History

Total actual usage and service charges ¹	\$82.57
Total TAP charges	\$45.17
Total amount you've saved	\$37.40
Total amount you've paid towards past due bills	\$0.00
Earned penalty forgiveness counter ²	0

¹ Includes usage, service, sewer, and stormwater charges.

² Number of full payments. Penalties forgiven after 24 full payments.

charges and past due charges, late payment penalties, and interest. Alternatively, the please pay box in Figure 2 highlights that customers are not required to pay the entirety of their past due balance. Instead, they are responsible for the current bill amount. It is important to note that the bill shows late payment penalties from prior unpaid balances do continue to accumulate. Any unpaid TAP bills also contribute to the account balance of a customer. As mentioned previously, forgiveness of late payment penalties is possible after 24 months of payments made in full (Rate Board 2018). Forgiveness of past due amounts aged 15 years is also possible irrespective of TAP participation (City Council 2015; Rate Board 2018).

Customer Reviews of the Program

In 2019, the PWD surveyed TAP program participants to obtain a variety of information including: how they learned about the program, reasons for applying, thoughts about the application process, and the demographics of survey participants. It also asked respondents about their satisfaction with the program, its impacts on participants, and participants' preferred means of communication. The survey was deployed between April 30 and May 27. About 1,782 people completed the survey out of the 6,773 invited participants for a response rate of 26%. Survey responses were weighted by income and a comparison of weighted survey data with the income levels of TAP participants revealed the responses were representative of people enrolled in the program.

The majority of respondents are homeowners (85%), female (85%), and 43% Black or African American. Most of the respondents (88%) were enrolled in the WRAP program previously. About 43% learned about the program through a flyer in their water bill. In terms of the application process, 44% used the mail service to apply, and 24% applied in person with the help of a supporting organization (e.g., PWD or the WRB). Neighborhood energy centers and the UESF were other support organizations people visited to receive help with the application. About 75% of participants experienced a turnaround time of less than two months on their application; 47% noted that it took less than one month to turn around their application, and 28% experienced a turnaround time between one and two months. Seventeen percent did not recall how long it took to process the application.

In terms of the financial impact on participants, 88% felt the program helped their monthly budget while 8% indicated no change and 4% felt the program did not help their budget. From a water use standpoint, many respondents did not indicate they were using more water while enrolled in the

program; 42% noted they were using the same amount of water and 32% noted they were using less water. Twenty-five percent of respondents were unsure about trends in water use. Only 1% of respondents indicated they were using more water while they were enrolled in the program.

DISCUSSION

At this point, TAP is in the refinement phase and PWD is working on expanding program coverage for eligible persons. In terms of outcomes, the program has successfully enrolled about 27% people needing assistance with their water bill. Thus, although these numbers are lower than projected, they indicate a positive direction for the program. The number of customers enrolled in TAP also exceeds the number of people enrolled in the old WRAP and other assistance programs combined, which indicates the new program has broader impact than older programs. Customers have also positively reviewed the program and indicated that it has helped with their monthly budgets.

In terms of the financial impact on PWD, the first set of TAP customers will have completed two years of enrollment in the program only recently and the issue of debt forgiveness has yet to be addressed in a rate case. The impact of debt forgiveness may be addressed in the next rate case. In this circumstance, the formula for the surcharge can be adjusted to recover the amounts forgiven. There is also flexibility to adjust this surcharge outside of annual rate hearings should revenues exceed or fall short of projections. As mentioned previously, the impact of lost revenue since program implementation has already been structured into the TAP surcharge.

In July 2019, the program celebrated its second birthday. In these two years of program operations, PWD learned that they need to be more nimble in their outreach to customers and move away from relying on the mail. Since the first year, they are attending community events, utility fairs, and visiting senior centers to spread the word about the program. They are currently preparing an outreach study to determine what type of mailed communication provides the highest rate of response. Steps have been taken to help customers find their water access code. These efforts include information on a bulletin to show customers where to find the code and access to the billing system for enrollment partners so they can help customers look up their access code.

This overview and assessment of customer impacts of the unique program indicates several item utilities need to consider in exploring the implementation of a

program similar to TAP. One, the legal framework needs to be in place. In the case of Philadelphia, a special ordinance was passed to clarify the program's legality. Communities with legal obstacles to this type of program may want to pass state and/or local legislation to lower the risks of legal challenges moving forward. Second, deploying this type of program is a community effort that requires political will and leadership, mechanisms for gaining approval, and a willingness of customers to pay. Third, the size of the utility could impact the feasibility of this type of program. PWD is a large utility with about 500,000 residential customers. This allows them to spread the impact of lost revenues from reduced bills for low-income customers via the TAP surcharge across many customers. An analysis of this surcharge on the size of the customer bills suggests this added amount is relatively small for non-TAP customers. This may not be the case with utilities who have smaller customer bases.

Fourth, steps to encourage water conservation need to be incorporated in income-based billing programs. Many countries around the world are concerned with the use of pricing mechanisms to encourage water conservation via particular rate structures; in this respect, increasing block tariffs are noted to encourage lower water use (OECD 1999). The TAP program is a means of cross-subsidizing the cost of water for low-income customers. PWD is encouraging conservation in two ways. One, customers whose usage charges are below their computed tap charge can use the difference to pay down their account balance. Two, TAP customers are monitored for excessive water usage. If excessive use is evident, customers are educated about conservation, tests for leaks are conducted, and the customer receives low-flow fixtures at no cost to them (Walton 2017). While the survey of TAP customers did not indicate increased water use after program enrollment, continued monitoring is necessary to evaluate if this trend continues or additional mechanisms are needed to incentivize conservation. Moving forward, utilities evaluating the potential for a TAP-like program could consider the implementation of income-

based billing in combination with revised tariff structures that encourage conservation.

This evaluation could be conducted with the help of consultants, which PWD noted played an important role in program development and initiation (PWD Meeting Notes, 2018. Meeting with Ravonne Muhammad and Joanne Dahme. December 6, 2018). Members of the consulting party provided information that was relevant to program design and were also involved in the training of people affected by the program. This included persons working at the call center as well as people working in collections, appeals, and billing (PWD Meeting Notes, 2018. Meeting with Ravonne Muhammad and Joanne Dahme. December 6, 2018).

As countries around the world grapple with how to provide affordable, yet financially and environmentally sustainable water service to all people (OECD 1999, 2009), new financial models are needed to address these challenges. The TAP is an innovative case study in the U.S. This income-based approach is different from the traditional approach of offering CAPs (e.g., bill discounts, flexible terms, temporary assistance, and water efficiency programs) and structures unique bills for each customer based on their monthly gross household income. For communities where customers have challenges paying for water services, this type of solution may prove feasible. However, it is important to note that any solutions developed should suit the unique situation of a community and the utility/utilities involved after a consideration of the financial, managerial, and regulatory context. Utilities implementing similar solutions should also keep in mind that this type of program is a long-term investment in the community that requires buy-in, teamwork, and ongoing communication and continuous refinement to be successful.

ACKNOWLEDGEMENTS

The authors thank Marc Cammarata and Erica DePalma for their help and support to this manuscript. This research was funded by National Science Foundation (NSF) grants #1444758 and Supplement #1444758.

APPENDIX A

TABLE A1. 2017 federal poverty line income guidelines by household size monthly numbers (gross income).

Household size	0%–50%	51%–100%	(101%–150%)	(151%–250%)
1 person	0–503	513–1,005	1,015–1,508	1,518–2,513
2 people	0–677	690–1,353	1,367–2,030	2,044–3,383
3 people	0–851	868–1,702	1,719–2,553	2,570–4,254
4 people	0–1,025	2,050–2,071	2,071–3,075	3,096–5,125
5 people	0–1,199	2,398–2,422	2,422–3,598	3,621–5,996
6 people	0–1,373	2,747–2,774	2,774–4,120	4,147–6,867
7 people	0–1,548	3,095–3,126	3,126–4,643	4,673–7,738
8 people	0–1,722	3,443–3,478	3,478–5,165	5,199–8,608

Note: Income is rounded so customers do not fall between tiers. Source: Philadelphia Water Department (2017).

APPENDIX B

TABLE B1. 2017 federal poverty line income guidelines by household size annual numbers (gross income).

Household size	0%–50%	51%–100%	(101%–150%)	(151%–250%)
1 person	0–6,030	6,151–12,060	12,181–18,090	18,211–30,150
2 people	0–8,120	8,282–16,240	16,402–24,360	24,522–40,600
3 people	0–10,210	10,414–20,420	20,624–30,630	30,834–51,050
4 people	0–12,300	12,546–24,600	24,846–36,900	37,146–61,500
5 people	0–14,390	14,678–28,780	29,068–43,170	43,458–71,950
6 people	0–16,480	16,810–32,960	33,290–49,440	49,770–82,400
7 people	0–18,570	18,941–37,140	37,511–55,710	56,081–92,850
8 people	0–20,660	21,073–41,320	41,733–61,980	62,393–103,300

Source: Derived from 2017 Poverty Guidelines from the ASPE (n.d.) U.S. Department of Health & Human Services.

APPENDIX C

TABLE C1. WRAP payment agreement details.

	Key criteria	Description
Paid in full agreements	Available to customers who are able to pay off delinquent balance in full	<ol style="list-style-type: none"> 1. If delinquent balance less than or equal to \$550: customer receives \$500 City Grant 2. If delinquent balance > \$550 a Utility Emergency Services Fund grant and a “matching water department grant” used to help pay off debt
Extended payment agreements	Available to people unable to pay off debt in full even after grant assistance is provided <ol style="list-style-type: none"> 1. Tenants 250% or less of FPL level 2. Owners with income >150% and ≤250% FPL level 	The 10/5 plan requires: <ol style="list-style-type: none"> 1. 10% down payment of delinquent balance 2. Monthly payments of the current bill AND 5% of delinquent balance 3. Customers have up to 60 months to pay off delinquent balance
Water Revenue Bureau Conference Committee	Available to owners with income of ≤150% FPL level	<ol style="list-style-type: none"> 1. Receipt of \$500 City Grant — \$300 used to pay down delinquent balance, \$200 applied to reduce current monthly bill payments 2. Remaining delinquent balance deferred 3. One-year agreement 4. Renewal is possible, customer must initiate renewal process

Note: ¹WRAP, Water Revenue Assistance Program. Source: Bethel Testimony (n.d.).

LITERATURE CITED

- ASCE (American Society of Civil Engineers). 2017. "America's Infrastructure Report Card." <https://www.infrastructurereportcard.org>.
- ASPE. n.d. "2017 Poverty Guidelines." Office of the Assistant Secretary for Planning and Evaluation (ASPE), U.S. Department of Health & Human Services. <https://aspe.hhs.gov/2017-poverty-guidelines>.
- Baird, G.M. 2010. "Water Affordability: Who's Going to Pick up the Check?" *Journal American Water Works Association* 102 (12): 16–23. <https://doi.org/10.1002/j.1551-8833.2010.tb11358.x>.
- Banerjee, S.G., and E. Morella. 2011. "Africa's Water and Sanitation Infrastructure: Access, Affordability and Alternatives." <http://documents.worldbank.org/curated/en/712211468202191672/pdf/608040PUB0Afri10Box358332B01PUBLIC1.pdf>.
- Beecher, J.A. 1994. "Water Affordability and Alternatives to Service Disconnection." *Journal American Water Works Association* 86 (10): 61–72. <https://doi.org/10.1002/j.1551-8833.1994.tb06261.x>.
- Bethel Testimony.n.d. "Direct Testimony of Michelle L. Bethel and Mark D. Harvey Before the Philadelphia Water, Sewer and Stormwater Rate Board." Re: Application of the Philadelphia Water Department for Increased Rates and Related Charges Fiscal Years 2017–2018. https://www.phila.gov/water/rateboard/PDF/PWD_St.-6.pdf.
- Bipartisan Policy Center. 2017. "Safeguarding Water Affordability." <https://www.mayorsinnovation.org/images/uploads/pdf/BPC-Infrastructure-Safeguarding-Water-Affordability.pdf>.
- Bouma, D.n.d. "Managing Public Water Infrastructure with Resource Constraints: Reimagining the Water Rate-Setting Process in Philadelphia (Univ. of Michigan)." <http://graham.umich.edu/media/pubs/Water-CS-Reimagining-the-Water-Rate-setting-Process.pdf>.
- City Council. 2015. "City of Philadelphia City Council." Legislation Detail Bill #140607. <https://phila.legistar.com/legislation.aspx>.
- City of Philadelphia. 2018a. "Regulations: Chapter 2 Assistance Programs." <https://www.phila.gov/water/PDF/PWDregCH2.pdf>.
- City of Philadelphia. 2018b. "Water, Gas, & Utilities: Senior Citizen Water Bill Discount." <https://www.phila.gov/services/water-gas-utilities/pay-or-dispute-a-water-bill/senior-citizen-water-bill-discount/>.
- City of Philadelphia. 2018c. "Customer Assistance Programs." <https://www.phila.gov/water/educationoutreach/customerassistance/pages/default.aspx>.
- City of Philadelphia. 2018d. "Income-Based Water Bill Payment Agreements: Low-Income Payment Agreements." <https://www.phila.gov/services/payments-assistance-taxes/income-based-assistance-programs/income-based-water-bill-assistance/>.
- Congressional Budget Office. 2015. "Public Spending on Transportation and Water Infrastructure, 1956 to 2014." <https://www.cbo.gov/publication/49910>.
- Cromwell, J., R. Colton, S. Rubin, C. Herrick, J. Mobley, K. Reinhardt, and R. Wilson. 2010. "Best Practices in Customer Payment Assistance Programs." Water Research Foundation. <http://www.waterrf.org/publicreportlibrary/4004.pdf>.
- Davis, M.F. 2019. "A Drop in the Bucket: Water Affordability in Twelve Massachusetts Communities." <https://www.northeastern.edu/law/pdfs/academics/phrge/water-report-2019.pdf>.
- Davis Testimony. n.d. "Direct Testimony of Jon Davis Before the Philadelphia Water, Sewer and Stormwater Rate Board." Re: Application of the Philadelphia Water Department for Increased Rates and Related Charges Fiscal Years 2017–2018. https://www.phila.gov/water/rateboard/PDF/PWD_St.-8.pdf.
- Fankhauser, S., and S. Tepic. 2007. "Can Poor Consumers Pay for Energy and Water? An Affordability Analysis for Transition Countries." *Energy Policy* 35 (2): 1038–49. <https://doi.org/10.1016/j.enpol.2006.02.003>.
- Food and Water Watch. 2016. "The State of Public Water In the United States." <http://www.foodandwaterwatch.org/insight/state-public-water-united-states>.
- García-Valiñas, M., R. Martínez-Espineira, and F. González-Gómez. 2010. "Affordability of Residential Water Tariffs: Alternative Measurement and Explanatory Factors in Southern Spain." *Journal of Environmental Management* 91 (12): 696–706. <https://doi.org/10.1016/j.jenvman.2010.07.029>.
- Gleick, P.H. 1996. "Basic Water Requirements for Human Activities: Meeting Basic Needs." *Water International* 21 (2): 83–92. <https://doi.org/10.1080/02508069608686494>.
- Grigg, N. 2017. "Affordability Programs for Water Utilities." Water Finance & Management. <https://waterfm.com/water-customer-assistance-programs-affordability/>.
- Guillen, J. 2016. "Legal Experts: Detroit can Reduce Water Rates for Needy." Detroit Free Press. <https://www.freep.com/story/news/2016/01/15/legal-experts-detroit-can-reduce-water-rates-need-y/78852696/>.
- Hasson, D.S. 2002. "Water Utility Options for Low-income Assistance Programs." *Journal American Water Works Association* 94 (4): 128. <https://doi.org/10.1002/j.1551-8833.2002.tb09457.x>.
- Hughes, J., M. Tiger, S. Eskaf, S. Berahzer, S. Royster, C. Boyle, and D. Batten. 2014. "Defining a Resilient Business Model for Water Utilities." Water Research Foundation. https://efc.sog.unc.edu/sites/default/files/4366_Exec_Summary_0.pdf.
- Hunter, G. 2016. "Detroit to Start Water Shut-Offs Monday." Detroit Free Press. <https://www.detroitnews.com/story/news/local/detroit-city/2016/04/30/hundreds-detroiters-line-avoid-water-shut-offs/83753926/>.
- Hutton, G. 2012. "Monitoring 'Affordability' of Water and Sanitation Services after 2015: Review of Global Indicator Options." A Paper Submitted to the UN Office of the High Commissioner for Human Rights. <https://www.ircwash.org/resources/monitoring-%E2%80%9Caffordability%E2%80%9D-water-and-sanitation-services-after-2015-review-global>.
- Mack, E.A., and S. Wrase. 2017. "A Burgeoning Crisis? A Nationwide Assessment of the Geography of Water Affordability in the United States." *PLoS ONE* 12 (1): e0169488. <https://doi.org/10.1371/journal.pone.0169488>.
- Merritt, B. 2018. "Philadelphia Water's Tiered Assistance Program (TAP): TAP Cost Recovery & Financial Safeguards." Black & Veatch. <http://ipu.msu.edu/wp-content/uploads/2018/10/Philadelphia-Water%E2%80%99s-Tiered-Assistance-Program-TAP.pdf>.
- National Consumer Law Center. 2014. "Review and Recommendations for Implementing Water and Wastewater Affordability Programs in the United States." <http://www.nclc.org/images/pdf/pr-reports/report-water-affordability.pdf>.
- OECD. 1999. "Household Water Pricing in OECD Countries." Organization for Economic Co-operation and Development. Report ENV/EPOC/GEEI(98)12/FINAL. [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=env/epoc/geei\(98\)12/final](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=env/epoc/geei(98)12/final).
- OECD. 2009. "Managing Water for All: An OECD Perspective on Pricing and Financing. Key Messages for Policy Makers." <https://www.oecd.org/env/resources/42350563.pdf>.
- Office of Community Services. 2019. "Low Income Home Energy Assistance Program (LIHEAP)." <https://www.acf.hhs.gov/ocs/programs/liheap>.
- Pew Charitable Trust. 2018. "Philadelphia 2018 The State of the City." <https://www.pewtrusts.org/en/research-and-analysis/reports/2018/04/philadelphia-2018-the-state-of-the-city>.
- Philadelphia Water Department. n.d. "Homeowner's Emergency Loan Program (HELP)." https://www.phila.gov/water/PDF/HELP_AssistanceProgram.pdf.
- Philadelphia Water Department. 2017. "Tiered Assistance Program (TAP) Frequently Asked Questions (FAQs), Version 1."

- Philadelphia Water Department. <https://www.mayorsinnovation.org/images/uploads/pdf/TAP-FAQs-17.06.19.pdf>.
- Philadelphia Water Department. 2018a. "City of Philadelphia Tiered Assistance Program (TAP)." Philadelphia Water Department. https://www.mayorsinnovation.org/images/uploads/pdf/4_Addressing_Affordability_McCarty.pdf.
- Philadelphia Water Department. 2018b. "Basement Protection Program (BPP)." http://www.phillywatersheds.org/watershed_issue/s/flooding/basement_backup_protection.
- Raftelis. 2018. "Philadelphia Water Department. Tiered Assistance Program Development and Implementation." <https://www.raftelis.com/work/philadelphia-water-department/>.
- Rate Board. 2016. "Memorandum: Determination of Water Department Rates and Charges for FY 2017–2018." City of Philadelphia Water, Sewer, and Storm Water Rate Board. <https://www.phila.gov/water/rateboard/PDF/DeterminationDate%20Stamped.060716.pdf>.
- Rate Board. 2018. "Memorandum: Rate Determination of Water Department Rates and Charges for FY 2019–2020." City of Philadelphia Water, Sewer, and Storm Water Rate Board. <https://www.phila.gov/media/20180713144736/2018-RATE-DETERMINATION-TIMESTAMPED.pdf>.
- Sawkins, J.W., and V.A. Dickie. 2005. "Affordability of Household Water Services in Great Britain." *Journal of Applied Economic Studies* 26 (3): 207–13. <https://doi.org/10.1111/j.1475-5890.2005.00011.x>.
- Spencer, G. 2016. "7 Years, No Water at Home for Senior." NBC Philadelphia. <http://www.nbcphiladelphia.com/news/local/7-Years-No-Water-375060031.html>.
- Stafford, K. 2018. "Controversial Water Shutoffs Could Hit 17,461 Detroit Households." Detroit Free Press. <https://www.freep.com/story/news/local/michigan/detroit/2018/03/26/more-than-17-000-detroit-households-risk-water-shutoffs/452801002/>.
- Stewart, B. 2017. "How To: Qualify To Receive Financial Assistance For A Water Bill." <https://philadelphianeighborhoods.com/2017/09/06/how-to-qualify-to-receive-financial-assistance-for-a-water-bill/>.
- Teodoro, M.P. 2018. "Measuring Household Affordability for Water and Sewer Utilities." *Journal American Water Works Association* 110 (1): 13–24. <https://doi.org/10.5942/jawwa.2018.110.0002>.
- Tiger, M., J. Hughes, and S. Eskaf. 2014. "Designing Water Rate Structures for Conservation & Revenue Stability." <https://efc.sog.unc.edu/sites/default/files/Texas%20Rate%20Report%202014%20Final.pdf>.
- UNC Environmental Finance Center. 2018. "Navigating Pathways to Rate-Funded Customer Assistance Programs." <https://efc.sog.unc.edu/project/navigating-legal-pathways-rate-funded-customer-assistance-programs>.
- U.S. Water Alliance. 2017. "An Equitable Water Future: A National Briefing Paper." http://uswateralliance.org/sites/uswateralliance.org/files/publications/uswa_waterequity_FINAL.pdf.
- USEPA (U.S. Environmental Protection Agency). 2002. "Affordability Criteria for Small Drinking Water Systems: An EPA Science Advisory Board Report a Report by the Environmental Economics Advisory Committee of the EPA Science Advisory." <http://bit.ly/38J414t>.
- USEPA (U.S. Environmental Protection Agency). 2016. "Drinking Water and Wastewater Utility Customer Assistance Programs." https://www.epa.gov/sites/production/files/2016-04/documents/dw-ww_utilities_cap_combined_508.pdf.
- Utility Emergency Services Fund. n.d. "Utility Grant Program." <https://uesfacts.org/our-programs/utility-grant-program/>.
- Vanhille, J., T. Goedemé, T. Penne, L. Van Thielen, and B. Storms. 2018. "Measuring Water Affordability in Developed Economies. The Added Value of a Needs-Based Approach." *Journal of Environmental Management* 1 (217): 611–20. <https://doi.org/10.1016/j.jenvman.2018.03.106>.
- Walton, B. 2017. "Philadelphia Water Rate Links Payments to Household Income." Circle of Blue. <https://www.circleofblue.org/2017/water-management/pricing/philadelphia-water-rate-links-payments-household-income/>.
- Weiner, D. 2017. "Insurmountable Bills Lead to Water Shutoffs in Baltimore." WBALTV11. <https://www.wbal.com/article/insurmountable-bills-lead-to-water-shutoffs-in-baltimore/8775838>.
- Wogan, J.B. 2017. "The Cost of Water Is Rising. Philadelphia Has an Unprecedented Plan to Make It More Affordable." *Governing Magazine*. <http://www.governing.com/topics/transportation-infra-structure/gov-philadelphia-income-based-water-bills.html>.
- Philadelphia Code Section 19-1605. 2015. "Limitation on Action to Enforce Collection, Income-Based Water Rate Assistance Program. Chapter 19–1600." Water and Sewer Rents. [http://library.amlegal.com/nxt/gateway.dll/Pennsylvania/philadelphia_pa/title19financetaxesandcollections/chapter19-1600waterandsewerrents?f=templates\\$fn=altmain-nf.htm\\$q=\[field%20folio-destination-name:%27Chapter%2019-1600%27\]\\$x=Advanced#JD_Chapter19-1600](http://library.amlegal.com/nxt/gateway.dll/Pennsylvania/philadelphia_pa/title19financetaxesandcollections/chapter19-1600waterandsewerrents?f=templates$fn=altmain-nf.htm$q=[field%20folio-destination-name:%27Chapter%2019-1600%27]$x=Advanced#JD_Chapter19-1600).
- Philadelphia Code Section 19-1606. 2015. "Penalties and Interest for Late Payment. Chapter 19-1600." Water and Sewer Rents. [http://library.amlegal.com/nxt/gateway.dll/Pennsylvania/philadelphia_pa/title19financetaxesandcollections/chapter19-1600waterandsewerrents?f=templates\\$fn=altmain-nf.htm\\$q=\[field%20folio-destination-name:%27Chapter%2019-1600%27\]\\$x=Advanced#JD_Chapter19-1600](http://library.amlegal.com/nxt/gateway.dll/Pennsylvania/philadelphia_pa/title19financetaxesandcollections/chapter19-1600waterandsewerrents?f=templates$fn=altmain-nf.htm$q=[field%20folio-destination-name:%27Chapter%2019-1600%27]$x=Advanced#JD_Chapter19-1600).