



April 23, 2021

**VIA ELECTRONIC FILING**

Rosemary Chiavetta, Secretary  
Pennsylvania Public Utility Commission  
Commonwealth Keystone Building, 2<sup>nd</sup> Floor  
Harrisburg, PA 17120

**Re: The Pittsburgh Water and Sewer Authority  
Annual Water Audit Summary for Calendar Year 2020  
Docket No. M-2021-3023555**

Dear Secretary Chiavetta:

Enclosed please find The Pittsburgh Water and Sewer Authority's Annual Water Audit Report for 2020 filed at Docket No. M-2021-3023555.

Please contact me at 412-512-2494 or via email at [jquigley@pgh2o.com](mailto:jquigley@pgh2o.com) with any questions you may have.

Respectfully Submitted,

/s/ Julie A. Quigley

Julie A. Quigley

Enclosures



# AWWA Free Water Audit Software v6.0

FWAS v6.0

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This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format and is not meant to take the place of a full-scale, comprehensive water audit format. Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

## Table of Contents (TOC)

- Start Page** The current sheet. Enter contact information and basic audit details.
- Worksheet** Enter the required data on this worksheet to calculate the water balance and data grading.
- Interactive Data Grading** Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.
- Dashboard** Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.
- Notes** Enter notes to explain how values were calculated, document data sources, and related information about data management practices.
- Blank Sheet** By popular demand! A blank sheet. The world is your canvas.
- Water Balance** The values entered in the Worksheet automatically populate the Water Balance.
- Loss Control Planning** Use this sheet to interpret the results of the audit validity score and performance indicators.
- Definitions** Use this sheet to understand the terms used in the audit process.
- Service Connection Diagram** Diagrams depicting possible customer service connection line configurations.
- Acknowledgements** Acknowledgements for development of the AWWA Free Water Audit Software v6.0.

### AWWA Web Resources for Water Loss Control

<https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control>

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

## Enter Basic Information

Name of Utility:

Name of Contact Person:

Email:

Telephone | Ext.:

City/Town/Municipality:

State / Province:

Country:

Audit Preparation Date:

Audit Year:

Audit Year Label:  (Fiscal, Calendar, etc)

Audit Period Start Date:

Audit Period End Date:

Volume Reporting Units:

Water System Structure:

Water Type:

System ID Number:

Validator Name/ID:

Validator Email:

Estimated Total Population Served by Water Utility:

## Key of Input Acronyms *In order of appearance in the Worksheet*

- VOS** Volume from Own Sources
- VOSEA** VOS Error Adjustment
- WI** Water Imported
- WIEA** WI Error Adjustment
- WE** Water Exported
- WEEA** WE Error Adjustment
- BMAC** Billed Metered Authorized Consumption
- BUAC** Billed Unmetered Authorized Consumption
- UMAC** Unbilled Metered Authorized Consumption
- UUAC** Unbilled Unmetered Authorized Consumption
- SDHE** Systematic Data Handling Errors
- CMI** Customer Metering Inaccuracies
- UC** Unauthorized Consumption
- Lm** Length of mains
- Nc** Number of service connections
- Lp** Average length of (private) customer service line
- AOP** Average Operating Pressure
- CRUC** Customer Retail Unit Charge
- VPC** Variable Production Cost

### Color Key

User input  Calculated  Optional default

### Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI)

choose entry option:

1.00%	percent	or
	volume	25.000

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC)

choose entry option:

0.25%	default	or
	custom	75.000

### Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

VOS	VOSEA	WI	WIEA	WE	WEEA	BMAC	BUAC	UMAC	UUAC
SDHE	CMI	UC	Lm	Nc	Lp	AOP	CRUC	VPC	

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources)

Limiting

If you have questions or comments regarding this software please contact us at: [wlc@awwa.org](mailto:wlc@awwa.org)



# AWWA Free Water Audit Software: Worksheet

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Water Audit Report for: **The Pittsburgh Water and Sewer Authority**  
 Audit Year: **2020** | **Jan 01 2020 - Dec 31 2020** | **Calendar**

Click 'n' to add notes | Click 'g' to determine data validity grade | To edit water system info: [go to start page](#)

To access definitions, click the [input name](#)

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

[Water Supplied Error Adjustments](#)

choose entry option:

<b>WATER SUPPLIED</b>							
VOS	Volume from Own Sources:	<input type="text" value="n"/> <input type="text" value="g"/> 7	<input type="text" value="23,550.477"/>	MG/Yr	<input type="text" value="n"/> <input type="text" value="g"/> 8	<input type="text" value="percent"/>	
WI	Water Imported:	<input type="text" value="n"/> <input type="text" value="g"/> n/a	<input type="text" value="0.000"/>	MG/Yr			
WE	Water Exported:	<input type="text" value="n"/> <input type="text" value="g"/> 3	<input type="text" value="850.243"/>	MG/Yr	<input type="text" value="n"/> <input type="text" value="g"/> 4	<input type="text" value="percent"/>	
		<b>WATER SUPPLIED:</b>		<b>22,700.234</b>	MG/Yr		

VOSEA  
WIEA  
WEEA

**AUTHORIZED CONSUMPTION**

BMAC	Billed Metered:	<input type="text" value="n"/> <input type="text" value="g"/> 10	<input type="text" value="6,883.830"/>	MG/Yr			
BUAC	Billed Unmetered:	<input type="text" value="n"/> <input type="text" value="g"/> 2	<input type="text" value="27.040"/>	MG/Yr			
UMAC	Unbilled Metered:	<input type="text" value="n"/> <input type="text" value="g"/> 4	<input type="text" value="6.570"/>	MG/Yr			
UUAC	Unbilled Unmetered:	<input type="text" value="n"/> <input type="text" value="g"/> 4	<input type="text" value="153.600"/>	MG/Yr			
		<b>AUTHORIZED CONSUMPTION:</b>		<b>7,071.040</b>	MG/Yr		

choose entry option:

MG/Yr

**WATER LOSSES**

**15,629.194** MG/Yr

**Apparent Losses**

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

SDHE	Systematic Data Handling Errors:	<input type="text" value="n"/> <input type="text" value="g"/> 3	<input type="text" value="17.277"/>	MG/Yr			
CMI	Customer Metering Inaccuracies:	<input type="text" value="n"/> <input type="text" value="g"/> 9	<input type="text" value="14.500"/>	MG/Yr			
UC	Unauthorized Consumption:	<input type="text" value="n"/> <input type="text" value="g"/> 3	<input type="text" value="17.277"/>	MG/Yr			

choose entry option:

0.25%	default
0.21%	percent
0.25%	default

under-registration

Default option selected for Unauthorized Consumption, with automatic data grading of 3

**Apparent Losses:**  MG/Yr

**Real Losses**

**Real Losses:**  MG/Yr

**WATER LOSSES:**  MG/Yr

**NON-REVENUE WATER**

**NON-REVENUE WATER:**  MG/Yr

**SYSTEM DATA**

Lm	Length of mains:	<input type="text" value="n"/> <input type="text" value="g"/> 10	<input type="text" value="963.2"/>	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	<input type="text" value="n"/> <input type="text" value="g"/> 8	<input type="text" value="81,996"/>		(active and inactive)
	Service connection density:	<input type="text" value="85"/>		conn./mile main	
Lp	Are customer meters typically located at the curbstop/property line?	<input type="text" value="No"/>			
	Average length of (private) customer service line:	<input type="text" value="n"/> <input type="text" value="g"/> 10	<input type="text" value="48.1"/>	ft	(average distance between property line and meter)
AOP	Average Operating Pressure:	<input type="text" value="n"/> <input type="text" value="g"/> 8	<input type="text" value="60.0"/>	psi	

**COST DATA**

CRUC	Customer Retail Unit Charge:	<input type="text" value="n"/> <input type="text" value="g"/> 9	<input type="text" value="\$24.42"/>	\$/1000 gallons (US)	<b>Total Annual Operating Cost</b>
VPC	Variable Production Cost:	<input type="text" value="n"/> <input type="text" value="g"/> 9	<input type="text" value="\$324.47"/>	\$/Million gallons	<input type="text" value="\$63,620,012"/> \$/yr (optional input)

**WATER AUDIT DATA VALIDITY TIER:**

\*\*\* The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. \*\*\*

[go to dashboard](#)

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

**PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:**

Based on the information provided, audit reliability can be most improved by addressing the following components:

- |                                  |
|----------------------------------|
| 1: Volume from Own Sources (VOS) |
| 2: Billed Unmetered (BUAC)       |
| 3: Unauthorized Consumption (UC) |

**KEY PERFORMANCE INDICATOR TARGETS:**

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:	<input type="text"/>	gal/conn/day
Unit Apparent Losses:	<input type="text"/>	gal/conn/day
Unit Real Losses <sup>a</sup> :	<input type="text"/>	gal/conn/day
Unit Real Losses <sup>b</sup> :	<input type="text"/>	gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)

2020

White = incomplete  
Orange = complete

Use acronyms for navigation

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Limiting criteria (see Start Page for details)

go to input

**Volume from Own Sources (VOS) - Data Grading Criteria**

go to notes

vos	Criteria Question	Select Best-Fit Answers to All Visible Questions	
vos.0	Did the water utility supply any water from its own sources during the audit year?	Yes	
vos.1	What percent of own supply volume is metered?	>95 - 99%	
<p><b>For questions 2-10 below: Choose the answer that applies for those meters that measure &gt;90% of the finished water volume.</b></p> <p><b>In-situ flow accuracy testing</b> = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.</p> <p><b>Electronic calibration</b> = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).</p> <p><b>Secondary device</b> can include conversion to mA, meter transmitter or similar instrumentation.</p> <p><b>Tertiary device</b> can include SCADA, historian or other computerized archival system.</p>			
vos.2	What is the frequency of electronic calibration?	Annually	Limiting
vos.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are checked at secondary device(s) AND tertiary device(s)	
vos.4	Is the most recent electronic calibration documentation available for review?	Yes	
vos.5	What is the frequency of in-situ flow accuracy testing?	None, or Not within last 5 years	Limiting
vos.6			
vos.7			
vos.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	No	
vos.9	Which best describes the frequency of finished water meter readings?	Continuous	
vos.10	Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	More frequently than monthly, but not every day	
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>7</b>	

[go to input](#) **Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria** [go to notes](#)

<b>vosea</b>	<b>Criteria Question</b>	<b>Select Best-Fit Answers to All Visible Questions</b>
vosea.1	Are tank levels monitored automatically & recorded daily?	Yes
vosea.2	Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity?	No
vosea.3	Is the annual net distribution storage change included in either the VOS input or the VOSEA input?	No
vosea.4	Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit?	No error adjustment made due to absence of testing or calibration results
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>8</b>

Limiting

[go to input](#)

**Water Imported (WI) - Data Grading Criteria**

[go to notes](#)

wi	Criteria Question	Select Best-Fit Answers to All Visible Questions
wi.0	Did the water utility import any water during the audit year?	No
wi.1		
<p><b>For questions 2-10 below: Choose the answer that applies for those meters that measure &gt;90% of the water imported volume.</b></p> <p><b>In-situ flow accuracy testing</b> = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.</p> <p><b>Electronic calibration</b> = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).</p> <p><b>Secondary device</b> can include conversion to mA, meter transmitter or similar instrumentation.</p> <p><b>Tertiary device</b> can include SCADA, historian or other computerized archival system.</p>		
wi.2		
wi.3		
wi.4		
wi.5		
wi.6		
wi.7		
wi.8		
wi.9		
wi.10		
FINAL DATA GRADE FOR THIS AUDIT INPUT:		n/a

[go to input](#) **Water Imported Error Adjustment (WIEA) - Data Grading Criteria** [go to notes](#)

wiew	Criteria Question	Select Best-Fit Answers to All Visible Questions
wiew.1		
wiew.2		
wiew.3		
wiew.4		
FINAL DATA GRADE FOR THIS AUDIT INPUT:		n/a

[go to input](#)

**Water Exported (WE) - Data Grading Criteria**

[go to notes](#)

we	Criteria Question	Select Best-Fit Answers to All Visible Questions	
we.0	Did the water utility export any water during the audit year?	Yes	
we.1	What percent of water exported is metered?	>99%	
<p><b>For questions 2-10 below: Choose the answer that applies for those meters that measure &gt;90% of the water exported volume.</b>  <b>In-situ flow accuracy testing</b> = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.  <b>Electronic calibration</b> = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).  <b>Secondary device</b> can include conversion to mA, meter transmitter or similar instrumentation.  <b>Tertiary device</b> can include SCADA, historian or other computerized archival system.</p>			
we.2	What is the frequency of electronic calibration?	None, or Not within last 5 years	Limiting
we.3			
we.4			
we.5	What is the frequency of in-situ flow accuracy testing?	None, or Not within last 5 years	Limiting
we.6			
we.7			
we.8			
we.9	Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)?	Continuous	
we.10	What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	Once per month	
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>3</b>	

go to input
Water Exported Error Adjustment (WEEA) - Data Grading Criteria
go to notes

weea	Criteria Question	Select Best-Fit Answers to All Visible Questions
weea.1	Is an agreement in place between Exporting and Importing Utility?	Yes, written
weea.2	Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement?	No, but meter accuracy testing and/or electronic calibration is conducted upon request of the importing utility
weea.3	Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit?	No
weea.4	Who has access to the import meter readings including current and archived data?	Exporting and Importing Utility
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		4

Limiting

[go to input](#)

**Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria**

[go to notes](#)

<b>bmac</b>	<b>Criteria Question</b>	<b>Select Best-Fit Answers to All Visible Questions</b>
bmac.0	Were any customers metered in the audit year?	Yes
bmac.1	For billed metered accounts, what % of bills are estimated in a typical billing cycle?	5% or less
bmac.2	How often does the utility read its customer meters? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	More frequently than monthly
bmac.3	Is the BMAC volume pro-rated to represent consumption occurring exactly during the audit period?	Yes
bmac.4	How frequently does internal review by utility staff of the BMAC volumes occur?	Every billing cycle
bmac.5	What level of detail is examined in the internal review of BMAC volumes?	Totals grouped by use type or customer class and specific accounts flagged for anomalous consumption
bmac.6	When was the most recent billing data review by someone who is independent of the utility billing process?	Within last 3 years
bmac.7	What level of detail was examined in the review by someone who is independent of the utility billing process?	Full billing database query and analysis of raw data to verify the summary consumption volumes
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

[go to input](#)

**Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria**

[go to notes](#)

buac	Criteria Question	Select Best-Fit Answers to All Visible Questions
buac.0	Was there any billed consumption on unmetered accounts in the audit year?	Yes
buac.1	What portion of billed accounts are unmetered (% by number of accounts)?	5% or less
buac.2	Methodology to quantify consumption for unmetered accounts?	Estimated based on assumptions of consumption by customer characteristics (i.e. customer type or meter size)
buac.3	How frequently is unmetered customer consumption estimated?	Monthly
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>2</b>

Limiting

[go to input](#)

**Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria**

[go to notes](#)

umac	Criteria Question	Select Best-Fit Answers to All Visible Questions
umac.0	Did the water utility have any unbilled-metered consumption in the audit year?	Yes
umac.1	Does the water utility policy articulate which accounts are exempt from billing?	Policy broadly addresses and there exists a collective understanding
umac.2	How many unbilled metered accounts exist?	Monitored, count available
umac.3	How often is each unbilled customer meter read? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Monthly or more frequently
umac.4	How often are unbilled metered volumes reviewed for error?	Each billing cycle
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>4</b>

Limiting

[go to input](#) **Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria** [go to notes](#)

uuac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
uuac.0	On the Worksheet, the status of the default option is:	A system specific volume has been entered	Limiting
uuac.1	How well-understood is the extent of unbilled unmetered use?	Examples known, but no complete inventory	
uuac.2	Which best describes the records that are kept for events of unbilled unmetered use?	Documentation exists, but not specific to each event	
uuac.3	How is the majority of unbilled unmetered use estimated?	By number of events multiplied by typical use estimates	
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>4</b>	

[go to input](#)

## Systematic Data Handling Error (SDHE) - Data Grading Criteria

[go to notes](#)

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

FINAL DATA GRADE FOR THIS AUDIT INPUT:

3

[go to input](#)

**Customer Metering Inaccuracies (CMI) - Data Grading Criteria**

[go to notes](#)

<b>cmi</b>	<b>Criteria Question</b>	<b>Select Best-Fit Answers to All Visible Questions</b>
cmi.0	Was there any metered customer usage during the audit period?	Yes
cmi.1	Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)?	Reactive testing conducted
cmi.2	For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)?	Ongoing, conducted annually
cmi.3	Which best describes what meters are included in the proactive small size customer meter testing activities?	Proactive - representative sample (for small meters)
cmi.4	For mid and large size customer meters, which best describes the frequency of the proactive testing program?	Ongoing, conducted annually
cmi.5	Which best describes what meters are included in the proactive mid- and large customer meter testing activities?	Proactive - all large meters are on a testing schedule
cmi.6	Which best describes how the input was derived?	Calculated based on most recent meter accuracy tests, comprehensive of all meter performance
cmi.7	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No
cmi.8	To what extent does meter replacement occur and for which meters?	Annual proactive replacement of subset of meters (i.e. by age or throughput)
cmi.9	Which best describes the reliability of meter installation records?	Records are kept for meter installations, and they include data on installation date, type, size, and manufacturer
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>9</b>

Limiting

[go to input](#)

## Unauthorized Consumption (UC) - Data Grading Criteria

[go to notes](#)

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

FINAL DATA GRADE FOR THIS AUDIT INPUT:

3

[go to input](#)

**Length of Mains (Lm) - Data Grading Criteria**

[go to notes](#)

Lm	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lm.1	How was the input derived?	Derived directly from Mains inventory (GIS, ledger, etc)
Lm.2	Are hydrant laterals included in the input derivation?	Yes
Lm.3	Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date?	Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually
Lm.4	Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory?	Field validation is accomplished (i.e. in daily operations or specific validation projects)
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

[go to input](#)

**Number of Service Connections (Nc) - Data Grading Criteria**

[go to notes](#)

<b>Nc</b>	<b>Criteria Question</b>	<b>Select Best-Fit Answers to All Visible Questions</b>
Nc.1	How was the input derived?	Extracted from Services inventory (GIS, billing system, etc)
Nc.2	What is the count of services based on?	Premise based, i.e. service connection count, location ID count
Nc.3	Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered.	Yes
Nc.4	Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date?	Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually
Nc.5	Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory?	Field validation is accomplished for a portion of the system (i.e. in daily operations or specific validation projects)
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>8</b>

Limiting

[go to input](#)

**Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria**

[go to notes](#)

Lp	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lp.0	Are customer meters typically located at the curbside or property line?	No
Lp.1	How was the input derived?	Derived from full mapping and customer inventory
Lp.2	Which best describes how the Customer Service Line and Meter Locations mapping is kept up to date?	Additions or subtractions are updated in the service line and meter locations inventory, at least annually
Lp.3	Which best describes how the Customer Service Line mapping is validated to what is in the field?	Field validation is accomplished (i.e. through normal work order processes or specific validation projects)
Lp.4	Which best describes the policy to define where the utility's ownership of the service line ends, and the customer's ownership of the service line begins?	Policy is clear, and adherence in practice is consistent
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>10</b>

**Average Operating Pressure (AOP) - Data Grading Criteria**

[go to input](#)

[go to notes](#)

aop	Criteria Question	Select Best-Fit Answers to All Visible Questions
aop.1	Which best describes checks on the boundary integrity for the system's pressure zone(s)?	Normally-closed boundary valves between zones have been confirmed to be fully closed more than 3 years ago
aop.2	Which best describes how one-time pressure readings (i.e. from hydrants) are collected?	Collected annually during routine system flushing and/or hydrant testing
aop.3	Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected?	At zone boundary conditions, plus locations inside the zone(s) representing the full pressure profile
aop.4	Which best describes how continuous pressure data is collected?	Year-round data collection via permanent monitoring
aop.5	How was the input derived?	Derived from hydraulic model, where model has been field calibrated in the last 5 years
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>8</b>

Limiting

[go to input](#)

**Customer Retail Unit Charge (CRUC) - Data Grading Criteria**

[go to notes](#)

<b>cruc</b>	<b>Criteria Question</b>	<b>Select Best-Fit Answers to All Visible Questions</b>
cruc.0	Was any metered consumption billed on a volumetric basis in the audit period?	Yes
cruc.1	Which best describes the use and reliability of the current rate structure?	Customer bill calculations have been checked to confirm the rate structure is correctly implemented
cruc.2	Choose the option that best describes how the input was derived	A volume-weighted average of all rates was calculated
cruc.3	Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer?	Yes, and this has been incorporated into the volume-weighted average calculation
cruc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>9</b>

Limiting

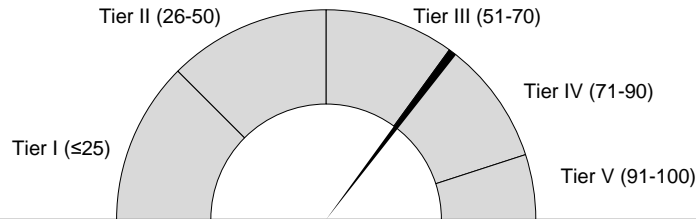
go to input Variable Production Cost (VPC) - Data Grading Criteria go to notes

	<b>Criteria Question</b>	<b>Select Best-Fit Answers to All Visible Questions</b>	
vpc.1	Choose the option that best describes how the input was derived	Only one source of water exists, which was the basis for the input derivation	
vpc.2	Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following: - chemicals + power for treatment, typically applicable if the utility is producing/treating water - power for distribution, typically applicable if pumps exist in the distribution network - water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	All applicable short-run marginal costs are included	
vpc.3	Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following: - water treatment residuals management, typically applicable if solids are produced from water treatment process - accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc) - payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility - accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarcity costs in water scarce areas - full cost pricing that includes all lifecycle costs and externalities (internalized or not) Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	Long-run marginal costs have been evaluated for applicability, and some but not all applicable costs are included	Limiting
vpc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No	Limiting
<b>FINAL DATA GRADE FOR THIS AUDIT INPUT:</b>		<b>9</b>	

## Data Validity

Data Validity Score: **70** Data Validity Tier: **Tier III (51-70)**

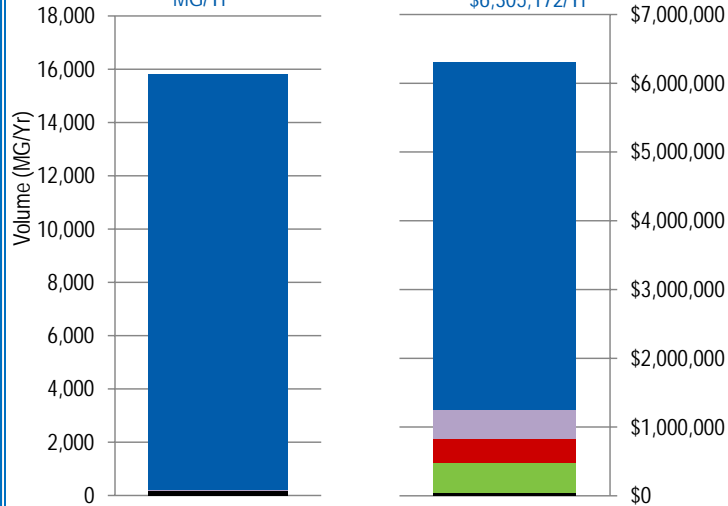
See [Loss Control Planning](#) for Tier Details



## NRW Components Summary

Total Volume of NRW = 15,789 MG/Yr

Total Cost of NRW = \$6,305,172/Yr

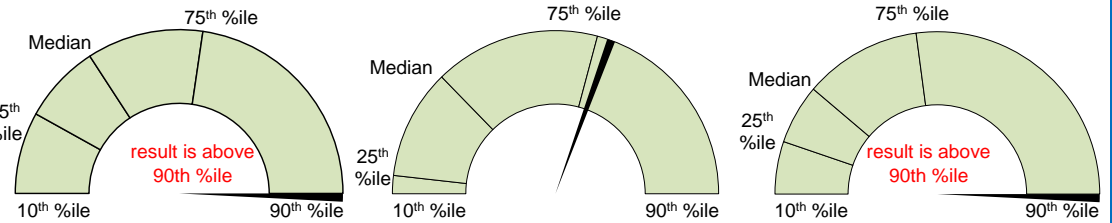


Real Losses  
Systematic Data Handling Errors  
Customer Metering Inaccuracies  
Unauthorized Consumption  
Unbilled Unmetered Auth Cons  
Unbilled Metered Authorized Cons

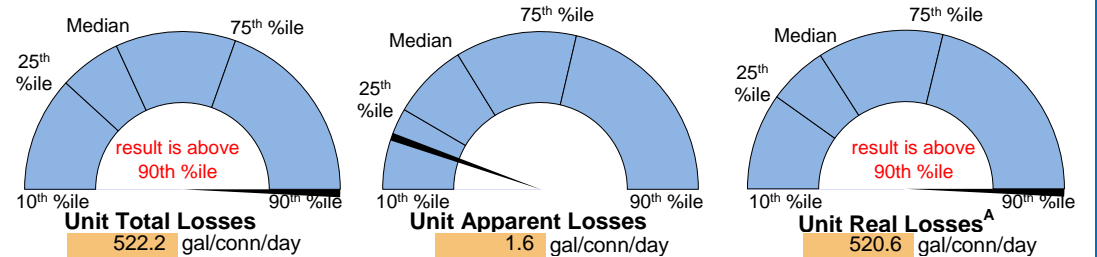
	Volume MG/Yr	Value \$/Yr	Basis of Valuation
Apparent Losses	49.1	\$1,197,581	CRUC
Real Losses	15,580.1	\$5,055,288	VPC
Unbilled Authorized Cons	160.2	\$51,970	VPC
Non-Revenue Water	15,789.4	\$6,304,839	Blended

## Key Performance Indicators

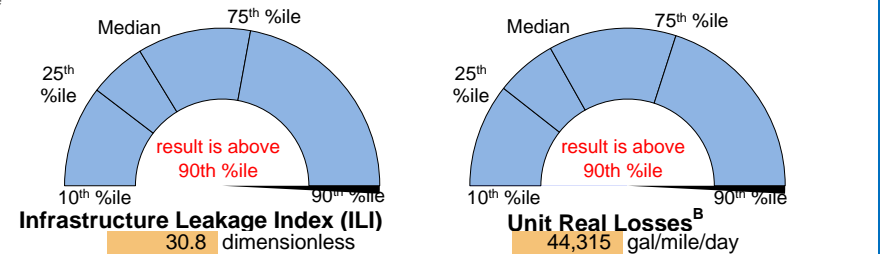
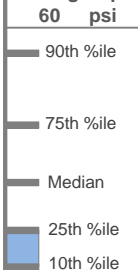
Actual KPI result gauge %iles per validated industry ranges<sup>2</sup>



Actual KPI result gauge %iles per validated industry ranges<sup>2</sup>



## Average Operating Pressure



See UARL definition for additional guidance on the ILI

(UARL) Unavoidable Annual Real Losses **506.2 MG/Yr** **16.9 gal/conn/day**

## Guidance Information for Key Performance Indicators

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs<sup>1</sup>.
- A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
- See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)<sup>1</sup>, with naming conventions updated.
- Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)<sup>2</sup>.
- KPI %iles shown above are not segregated by cohorts. Limited KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)<sup>5</sup>.
- Actual KPI results that fall below 10<sup>th</sup> %ile or above 90<sup>th</sup> %ile do not necessarily imply error, but should be viewed with scrutiny.
- Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.
- See UARL and ILI in Definitions tab for discussion of size and pressure limitations.
- Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

Table 1

Source: AWWA Water Loss Control Committee Report (2020)<sup>1</sup>, with naming conventions updated

2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations

Type	Indicator	Description	Suitable Purposes					Uses and Limitations	Principal Users
			Assessment	Bench-Marking	Target-Setting	Planning	Tracking		
Attribute	Apparent Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Apparent Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess cost loss level	Utility, Regulators
	Real Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Real Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess loss cost level	Utility, Regulators
	Unavoidable Annual Real Loss (UARL)	Calculated by Free Water Audit Software	✓				✓	Reveal theoretical technical low level of leakage	Utility, Regulators
Volume	Unit Apparent Losses (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utility, Regulators
	Unit Real Losses <sup>A</sup> (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utility, Regulators, Policy Makers
	Unit Real Losses <sup>B</sup> (vol/pipeline length/day)	Strong and understandable indicator for use by utilities with low connection density.	✓	✓	✓	✓	✓	Data collection and assessment of systems with "low" connection density	Utility, Regulators, Policy Makers
	Unit Total Losses (vol/conn/day) New KPI	Strong and understandable indicator, suitable for high-level performance measurement.	✓				✓	High level indicator for trending analysis. Not appropriate for target-setting or benchmarking	Utilities, Customers
	Infrastructure Leakage Index (ILI)	Robust, specialized ratio KPI; can be influenced by pressure and connection density.	✓	✓			✓	Benchmarking after pressure management is implemented	Utilities
Value	Apparent Loss Cost Rate (value/conn/year) New KPI	Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs.	✓			✓	✓	Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates	Utilities, Regulators, Customers
	Real Loss Cost Rate (value/conn/year) New KPI		✓			✓	✓		Utilities, Regulators, Customers
Validity	Data Validity Tier (DVT)	Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity.	✓	✓		✓	✓	Assess caliber of data inputs of the water audit	Regulators, Utilities



Water Audit Report for: **The Pittsburgh Water and Sewer Authority**  
Audit Year: **2020**

Calendar  
**Jan 01 2020 - Dec 31 2020**

<b>General Notes:</b>	For detailed information on how the calculations were performed, please refer to the spreadsheet titled "2020WaterAudit_PWSA_CalculationSpreadsheet". The PWSA intends to prepare a Water Audit Validity Evaluation (WAVE) Report. The WAVE Report will detail specific actions to be considered for implementation in order to improve the Data Validity Grading and Input Data quality.	
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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Volume from Own Sources (VOS)</b></p>	<p>Contributors: Michael Czypinski – Water Quality Data Manager Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs Anthony Gallina - Associate Project Manager Robert Herring, PE, PMP – Project Manager</p> <p>Narrative: The Aspinwall Water Treatment Plant (WTP) withdraws water from Allegheny River for treatment and distribution. After treatment, the water is stored within the clearwell and pumped to the distribution system via the Aspinwall Pump Station or the Bruecken Pump Station.</p> <p>The Aspinwall Pump Station consists of eight (8) pumps: Aspinwall Pump No. 1 through No. 4 and Fox Chapel Pump No. 1 through No. 4. The Aspinwall Pumps withdraw from the clearwell and discharge into the Lanpher Rising Main, which ultimately goes to the Lanpher Reservoir and provides water service to the North Side neighborhoods. The flow from these pumps is recorded via two venturi meters: Aspinwall 103 and Aspinwall 104. The meters are located after the pumps, but before the interconnection with the Lanpher Rising Main. The Fox Chapel Pumps to deliver bulk water service to the Fox Chapel Authority. Please note that Fox Chapel Pumps No. 1 through No. 3 withdraw directly from the Lanpher Rising Main, after the Aspinwall 103 and Aspinwall 104 meters. Therefore, the volume of water delivered via these pumps is already accounted for. Fox Chapel Pump No. 4 withdraws directly from the clearwell and the discharge does not pass through a dedicated meter. Please note that Fox Chapel Pump No. 4 is used intermittently when the other Fox Chapel Pumps need to be taken offline for service. To estimate the flows from Fox Chapel Pump No. 4, we would multiply the pump capacity by the runtime. However, in 2020, the PWSA did not utilize Fox Chapel Pump No. 4.</p> <p>The Bruecken Pump Station contains six (6) pumps that discharge into four (4) rising mains. Rising Main No. 1 and Rising Main No. 2 flow toward Highland Reservoir No. 1. The water is either directed toward the distribution system, or enters into a hydraulic control structure that overflows into the Highland No. 1 reservoir. The PWSA does not currently have meters at the Bruecken Pump Station on Rising Main No. 1 or No.2. However, the PWSA has two meters near Highland Reservoir No. 1 to assist with orthophosphate dosing, which are called MFP 1 and MFP 2. The positioning of these meters allows us to measure the volume of water entering the distribution system. Moving forward, the PWSA has plans to install meters on Rising Main No. 1, Rising Main No. 2, the hydraulic overflow into Highland Reservoir No. 1 and after the Microfiltration Plant.</p> <p>Rising Main No. 3 and Rising Main No. 4 flow toward Highland Reservoir No. 2. The PWSA has flow meters on both of these rising mains, located near the Bruecken Pump Station, which are called RM 3 and RM 4. Please note that Highland Reservoir No. 2 is covered, so there should be negligible water loss to evaporation.</p> <p>Based on the foregoing, the Volume From Own Sources was calculated, as follows:</p> <p>Volume From Own Sources = Aspinwall 103 + Aspinwall 104 + Fox Chapel Pump No. 4 + MFP 1 + MFP 2 + RM 3 + RM 4</p> <p>Aspinwall 103: 2,018.84 Million Gallons (MG) Aspinwall 104: 1,840.52 MG Fox Chapel Pump No. 4: 0 MG RM 3: 4,617.30 MG RM 4: 4,490.92 MG MFP 1: 7,881.91 MG MFP 2: 2,700.99 MG Total: 23,550.48 MG</p> <p>The PWSA also monitors the water treatment plant (WTP) effluent downstream of the filters, which provides a convenient check on the above calculations. The WTP Effluent was</p>	Refer to General Notes.
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Volume from Own Sources Error Adjustment (VOSEA)</b></p>	No comment.	Refer to General Notes.
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Water Imported (WI)</b></p>	Not applicable.	Refer to General Notes.
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Water Imported Error Adjustment (WIEA)</b></p>	Not applicable.	Refer to General Notes.
	Contributors: Tracy Willy - Senior AMI and Billing Manager	Refer to General Notes.

[go to worksheet](#)

[go to grading](#)

Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<b>Water Exported (WE)</b>	Ryan Dappen - Business Intelligence Analyst / Database Administrator Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs Anthony Gallina - Associate Project Manager Robert Herring, PE, PMP – Project Manager  Narrative: Please see below for a breakdown on the volume of water provided to neighboring water systems that exist outside the PWSA service area:  Fox Chapel Authority: 674,065,000 gallons Reserve Township: 105,966,000 gallons Aspinwall Borough: 64,174,000 gallons West View Water Authority: 2,692,000 gallons Hampton Shaler Water Authority: 3,346,000 gallons Pennsylvania-American Water Company: 0 gallons Sharpsburg Borough: 0 gallons  Total: 850,243,000 gallons	

Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Water Exported Error Adjustment (WEIA)</b></p>	<p>No comment.</p>	<p>Refer to General Notes.</p>
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Billed Metered Authorized Consumption (BMAC)</b></p>	<p>Contributors:  Tracy Willy - Senior AMI and Billing Manager  Ryan Dappen – Business Intelligence Analyst / Database Administrator  Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs  Brent Lahaie, PE – Associate Project Manager  Anthony Gallina - Associate Project Manager  Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:  Please see below for the breakdown on the 2020 Billed Metered usage per account type:</p> <p>Residential: 2,746.49 Million Gallons (MG)  Residential Capital Assistance Program: 103.59 MG  Commercial: 2,843.47 MG  Industrial: 185.87 MG  Health and Education: 987.43 MG  Fire: 15.40 MG  Flower Gardens: 1.57 MG</p> <p>Total: 6,883.83 MG</p> <p>Please note the following:</p> <p>1.Please refer to the Systematic Data Handling Errors narrative for additional information on our overall billing procedure. In addition, please refer to the Customer Metering Inaccuracies for additional information on the PWSA's meter replacement and testing programs.</p> <p>2.In the 2019 Water Audit, the PWSA declared street sweeping as an unbilled unmetered usage. In 2020, the PWSA provided twelve (12) meters to the City of Pittsburgh's Department of Public Works to record the water usage associated with street sweeping and flushing. The meters were installed with an attached MXU unit, therefore the flow data is being transmitted remotely, and being accounted for within the appropriate account type above.</p> <p>3.On October 3, 2019, the PWSA and the City of Pittsburgh (City) entered into an updated cooperation agreement. The updated cooperation agreement was created under PUC oversight and includes provisions to completely transition the City accounts to be billed and metered. In 2019, the PWSA began metering the remainder of the City accounts. Beginning January 1, 2020, the City shall pay the PWSA for water usage, phased-in over a five (5) year period, as follows:</p> <p>Year – Percentage of Usage Charged  2020 – 20%  2021 – 40%  2022 – 60%  2023 – 80%  2024 – 100%</p> <p>Please note that, even though the City was only billed for 20% of the actual cost, the total flow was included within Billed Metered. The PWSA continues to install meters on the City accounts. As of December 31, 2020, there were only 15 City accounts without a meter, and thus, are still considered Unbilled Unmetered. Please note that the number of unmetered City accounts is a fluctuating number, as we continue to locate unknown services which require a meter.</p> <p>4.The PWSA has an over-the-counter permit process for Developer's to obtain a meter for hydrant use. Typically, these meters are required during construction for temporary water service. Please note that these meters are installed with an MXU unit to transmit the water usage via radio frequency. Therefore, these flows are included within the appropriate category above.</p>	<p>Refer to General Notes.</p>
<p><a href="#">go to worksheet</a> <a href="#">go to grading</a></p> <p><b>Billed Unmetered Authorized Consumption (BUAC)</b></p>	<p>Contributors:  Tracy Willy - Senior AMI and Billing Manager  Ryan Dappen – Business Intelligence Analyst / Database Administrator  Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs  Anthony Gallina - Associate Project Manager  Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:  The PWSA bills 327 unmetered accounts. The billed unmetered accounts largely consist of grandfathered, party-line subdivisions. Please note that our current policies do not allow for the creation of new, unmetered billed accounts. For the existing billed unmetered accounts, the PWSA assumes a usage of 20,000 gallons per quarter for each unit. The total annual flow from billed unmetered accounts is calculated below:</p> <p>Type of Unit – No. of Accounts - Estimated Flow per Year – Total Estimated Flow  Single Family – 318 accounts - 80,000 gallons – 25,440,000 gallons  Two Family – 7 accounts – 160,000 gallons – 1,120,000 gallons  Three Family – 2 accounts – 240,000 gallons – 480,000 gallons</p> <p>The total annual flow from billed unmetered accounts is 27,040,000 gallons per year.</p>	

go to worksheet

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go to grading

Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><b>Unbilled Metered Authorized Consumption (UMAC)</b></p>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen – Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The reported Unbilled Metered usage is limited to PWSA uses for treatment and distribution operations. These connections are metered, but within the billing system are coded as "W_NO BILL RATE".</p>	<p>Refer to General Notes.</p>
<p><b>Unbilled Unmetered Authorized Consumption (UUAC)</b></p>	<p>Contributors:            Sonja Svihla – Project Manager            Bradley McShane – Associate Project Manager            Daniel Cleary – Associate Project Manager            Tom Warner – Senior Manager, Production            William McFaddin – Director of Operations            Rick Obermeier – Chief of Operations            Lucas Erny – Senior Manager, Field Operations            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The Unbilled Unmetered usage was calculated via known data and estimated usages.</p> <p>The following contributors were calculated with known data:</p> <p>1.Reservoir Draining – In 2020, the PWSA drained the Highland Reservoir (North Cell), Lanpher Reservoir (East Cell), Lanpher Reservoir (West Cell) and Lincoln Tank. The work was required for inspection, operation and maintenance and/or construction purposes. The PWSA recorded the pre-drain water surface elevation and post-drain water surface elevation. Based on historical records, we were able to create a spreadsheet to estimate the volume of water discharged for each reservoir and tank.</p> <p>2.Emergency Filter Backwash – The Water Treatment Plan utilizes filters for treatment. Typically, the filters withdraw backwash water directly from the clearwell, which is located before the System Delivery Meters. However, the PWSA also maintains an emergency backwash connection, located after the System Delivery Meters, for O&amp;M purposes. In 2020, the PWSA utilized the emergency backwash connection for 13 days.</p> <p>3.Rising Main Inspection and Disinfection – The PWSA inspected Rising Mains 3 and 4, which runs from the Bruecken Pump Station to the Highland No. 2 Reservoir. The work required draining, disinfection and flushing. Please note that Rising Main 3 and 4 vary between 48-inch and 50-inch, and run for a cumulative 13,107 feet.</p> <p>The following contributors were estimated with the default value of 0.25%:</p> <p>1.Fire Flow Volume: The PWSA has limited data available for this category. The PWSA requires bypass meters for all fire suppression systems. The meter effectively indicates when a fire service is activated, but it does not measure the volumetric usage. In addition, the PWSA does not have any information from the Fire Department for the volumes used to suppress fires, train staff, etc. In the future, the PWSA could coordinate with the Bureau of Fire to get an annual tabulation on the number, and severity, of fires within our service area.</p> <p>2.Flushing Flow Volume for Operation and Maintenance of Distribution System: The PWSA has limited data available for this category. The PWSA will flush water mains in response to water quality complaints. Also, flushing is an effective means of removing settled deposits and distributing flow within lightly used and dead-end water mains. In the future, the PWSA could calculate the run time and available flow of each flushing event to estimate the water usage.</p> <p>3.Flushing Flow Volume for Fire Hydrant Flow Testing: The PWSA has moderate data available for this category. The PWSA requires a fire hydrant flow test for all developments that require a fire suppression system or contain a service larger than one-inch diameter. The flow test results are tabulated and recorded. However, the data does not include the start time and end time of each flush.</p> <p>4.Please refer to the Billed Metered narrative for updates on our efforts to install meters on City properties.</p> <p>Based on the foregoing, the Unbilled Unmetered usage was summed, as follows:</p> <p>Reservoir Draining: 116.80 Million Gallons (MG)            Emergency Filter Backwash: 10.53 MG            Rising Main Draining and Flushing: 8.97 MG            Default Estimation: 17.29 MG            Total Unbilled Unmetered: 153.60 MG</p>	<p>Refer to General Notes.</p>

Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><b>Systematic Data Handling Errors (SDHE)</b></p>	<p>Contributors:            Julie Quigley - Director of Customer Service            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen - Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA collects water usage data through Advanced Metering Infrastructure (AMI) technology. A Meter Transceiver Unit (MXU) is connected to each meter and transmits hourly water usage data via radio frequency. The MXU is situated to facilitate a clear signal. When the meter is located within the structure (e.g., residential building, commercial business, etc.), the MXU is installed on the exterior surface. When the meter is located outside of the structure (e.g., crock, vault, etc.), the MXU is installed within the cover/hatch. The PWSA has four (4) base stations to collect the MXU radio transmissions for the entire service area. The base stations automatically transfer the data to a Regional Network Interface (RNI) server for processing and storage. The RNI will generate notifications if an installed MXU fails to transmit water usage data. Lastly, the PWSA utilizes Cogsdale for customer service and billing system purposes.</p> <p>There were 75,073 accounts reporting water usage data via an MXU and 5,374 accounts that required estimation. In 2020, we achieved a 95.59% actual read rate, which is an improvement upon the 92.97% actual read rate reported in the 2019 Water Audit. The PWSA estimates water consumption when actual metered usage is not obtained through an MXU. The estimated consumption is calculated by Cogsdale and is based off of historical water usage. Typically, estimated water consumption is required due to the following situations:            1.The MXU malfunctions (e.g., equipment fails, battery requires replacement, etc.)            2.The water meter does not have an MXU, and we are unable to conduct a physical reading (e.g., the meter is located within the structure and the homeowner is unresponsive, etc.)</p> <p>The most difficult aspect of repairing or installing MXU's is obtaining access to the meter, as they are typically located within the structure. The Non-Access Project Reference Guide outlines the notification procedure for obtaining access. The notification procedure consists of mailed letters and physical postings at the customer's property. Also, the notification procedure varies, depending if the resident owns the property or rents from a landlord. Failure to provide access to PWSA may result in the termination of water service. It is important to note that the non-access process was negatively impacted by the COVID-19 pandemic, in that PWSA suspended in-home appointments in mid-December 2020.</p> <p>The Cogsdale system automatically flags accounts with suspicious activity, and they are subsequently reviewed by the PWSA Billing Department. Examples include, but are not limited to, the following:            1.Accounts that are coded as shut at the curb, but are registering usage            2.Negative consumption            3.Fire service with registering usage            4.Dramatic changes in a consumption pattern, typically 200% change within the past two months            5.No consumption for meters greater than one-inch (1")            6.Water bills with large monetary charges            7.Zero consumption reported with actual meter readings</p>	<p>Refer to General Notes.</p>
<p><b>Customer Metering Inaccuracies (CMI)</b></p>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Rick Obermeier – Chief of Operations            Randy Bergia – Senior Manager, Field Operations            Bill Bennett – Senior Manager, Field Operations            Matthew Galiotto – Inventory Control Specialist II            John Wagner – Meter Repair Specialist            Sarah Bolenbaugh, P.E. - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            In accordance with the Pennsylvania Code, Title 52 Public Utilities, Chapter 65 Water Service, Section 65.8 Meters, the PWSA must adhere to the following requirements:            1.No water meter which has an error in registration of more than 2% may be placed in service, nor may a water meter which has an error in registration more than 4% be allowed to remain in service            2.Meters shall be tested at the following flow rates: 5/8" (6 gpm), ¾" (10 gpm), 1" (20 gpm), 1 ½" (30 gpm), 2" (50 gpm), 3" (90 gpm), 4" (180 gpm), 6" (300 gpm)            3.Meters up to and including one-inch shall not remain in service for more than 20 years without accuracy testing and calibration            4.Meters larger than one-inch shall not remain in service for more than 8 years without accuracy testing and calibration            5.Meter accuracy test results shall be recorded and maintained for future reference            6.Purchased meters shall be accuracy tested at a rate of 10% of the total shipment, or 10 meters, whichever is greater            7.Removed meters shall be accuracy tested within 30 days of removal            8.The public utility shall have facilities to conduct meter accuracy tests which consistently achieve results within 0.5%            9.Water meters that do not meet the requirements of accuracy tests shall be immediately removed from service</p> <p>Unfortunately, the PWSA has inconsistent record information on the age of existing meters currently in-service. The PWSA began a concerted effort to address this issue with the goal to</p>	<p>Refer to General Notes.</p>

[go to worksheet](#)

[go to grading](#)

[go to worksheet](#)

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
	<p>replace 10,000 meters every year. At the onset of the global pandemic, the PWSA placed a moratorium on all meter replacements, as the work required entry into private structures. Despite these challenges, the PWSA was still able to successfully replaced 5,600 meters. The installation dates were recorded and the removed meters were accuracy tested. The PWSA performs the meter accuracy tests for meters up to and including 2-inches. Removed meters larger than 2-inches were sent to a third-party for accuracy testing. In total, the PWSA had three (3) 2-inch meters that passed, and one (1) 3-inch meter that was unable to be tested due to a malfunctioning register. The accuracy results for new and old meters up to and including 2-inches were as follows:</p> <p>Accuracy Range - No. of Tests - % of Total Tests - Average Accuracy, %  0 &lt; X ≤ 71 – 13 – 0.23% - 19.22  71 &lt; X ≤ 96 – 6 - 0.11% - 93.18  96 &lt; X ≤ 104 - 5,568 - 90.12% - 99.89  104 &lt; X ≤ 500 – 8 – 0.14% - 168.26  TOTAL – 5,595 - 100% - 99.79%</p> <p>The aforementioned table intentionally excludes results which yielded negative, zero or over 500% accuracy. The outliers were typically the result of input errors in the spreadsheet, and the meters registering zero flow were assumed to have seized. The PWSA typically responds to seized meters within days, and inclusion of these meters would not reflect the “silent” accuracy failures occurring within operable meters currently in service. A “passing” meter is represented by an accuracy greater than 96% and up to and including 104%. Therefore, 87.30% of the meters passed the accuracy test.</p> <p>The overall average accuracy for meters up to and including 2-inches was 99.79%. The PWSA assumed this accuracy for all meter sizes.</p>	

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><b>Unauthorized Consumption (UC)</b></p>	<p>No comment.</p>	<p>Refer to General Notes.</p>
<p><b>Length of Mains (Lm)</b></p>	<p>Contributors:            Jackson Stoss, GIS Project Coordinator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA utilized a Geographic Information System (GIS) database to calculate the Length of Mains. In 2020, the PWSA water distribution system contained 5,085,854 feet of active, pressurized water mains. This value represents an increase of 4,118 linear feet as compared to 2019. Please note this quantification excludes pseudo water mains (i.e. water mains illustrated for mapping purposes only, etc.) and private water mains.</p>	<p>Refer to General Notes.</p>
<p><b>Number of Service Connections (Nc)</b></p>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen – Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The breakdown is as follows:            Total Water Accounts = Active Water Accounts + Inactive Water Accounts            Active Water Accounts = 80,023            Inactive Water Accounts = 8,905            Total Water Accounts = 88,928</p>	<p>Refer to General Notes.</p>
<p><b>Average Length of (private) Customer Service Line (Lp)</b></p>	<p>Contributors:            Jackson Stoss, GIS Project Coordinator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA utilized a Geographic Information System (GIS) database to calculate the Average Length of Customer Service Line. In 2020, the PWSA water distribution system contained 81,996 active water service lines with a total length of 3,941,294 feet. The calculated average length of customer service was 48.1 feet, which represents an increase of 0.2 feet as compared to 2019.</p> <p>Please note that the PWSA acquired Millvale Borough's water distribution system in 2009. Most of these service lines are only mapped from the main to the curb box due to incomplete meter location information. Therefore, the service lines located in Millvale Borough were removed from the above calculations.</p>	<p>Refer to General Notes.</p>
<p><b>Average Operating Pressure (AOP)</b></p>	<p>Contributors:            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA water distribution system contains 17 pressure districts, as follows: Allentown Tanks, Bedford Tanks, Bloomfield Regulator, Brashear Tanks, Garfield Tank, Herron Hill Reservoir, Herron Hill Tank, Highland Park/Garfield Regulator, Highland Reservoir 1, Highland Reservoir 2, Inline Pump, Lanpher Reservoir, Lincoln Tank, McNaugher Regulator, McNaugher Reservoir, Squirrel Hill Tank and Zoo Regulator. The large number of pressure districts are required due to Pittsburgh's challenging topography, from the peaks of Mount Washington, to the low-lying communities along the Allegheny, Monongahela and Ohio Rivers.</p> <p>Based on the foregoing challenges, the PWSA utilized a calibrated hydraulic model (model) to determine the average operating pressure. The model was created within the OpenFlows WaterGEMS software program produced by Bentley Systems, Inc. The PWSA averaged pressures from approximately 63,000 nodes to obtain the Average Operating Pressure of 60 psi.</p>	<p>Refer to General Notes.</p>

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<b>Customer Retail Unit Charge (CRUC)</b>	<p>Contributors: Tracy Willy - Senior AMI and Billing Manager Ryan Dappen – Business Intelligence Analyst / Database Administrator Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs Anthony Gallina - Associate Project Manager Robert Herring, PE, PMP – Project Manager</p> <p>Narrative: The PWSA rate structure contains eight (8) account types: Residential, Commercial, Residential Capital Assistance Program (CAP), Fire, City, Institutional, Industrial and Flower Gardens. The number of meters contained within each account type, in descending order of occurrence, are indicated below:</p> <p>Account Type – No. of Meters – % of Total Residential – 70,709 – 84.78% Commercial – 7,150 – 8.57% Residential CAP – 3,060 – 3.67% Fire – 1,314 – 1.58% City – 519 – 0.62% Institutional – 479 – 0.57% Industrial – 99 – 0.12% Flower Garden – 76 – 0.09%</p> <p>Due to variations in the rate structure and prevalence of account types, the PWSA utilized a weighted average approach to calculate a single, composite cost. Please see below for a description of each account type, and the associated rate structure. However, for detailed information on the calculations, please refer to the Calculation Spreadsheet that is associated with the 2020 Water Audit.</p> <p>Residential, Commercial, Institutional, and Industrial: This group of accounts share the same billing structure, which consists of a minimum monthly charge based on the meter size, plus additional charges for usages over the minimum volume per the account type, if any. The minimum monthly charges are indicated below:</p> <p>Meter Size – No. of Meters - Minimum Gallons –Minimum Monthly Charge 5/8" – 1,000 gal – \$35.78 3/4" – 2,000 gal – \$61.60 1" – 5,000 gal – \$130.74 1 1/2" – 10,000 gal – \$259.81 2" – 17,000 gal – \$432.21 3" – 40,000 gal – \$967.81 4" – 268 – 70,000 gal – \$1,642.59 6" – 122 – 175,000 gal – \$3,896.31 8" – 20 – 325,000 gal – \$7,021.00 10" or larger – 4 – 548,000 gal – \$11,506.89</p> <p>For every 1,000 gallons over the minimum, the following rates apply:</p> <p>Account Type – % of Total – Total Combined Rate Residential – \$19.89 Commercial – \$18.69 Institutional - \$23.73 Industrial – \$16.46</p> <p>Residential CAP: The PWSA offers a customer assistance program for income-qualified residential customers. The rate structure is similar above, but offers a 25% discount on the minimum monthly charge and a 7.14% discount on usages over the minimum volume. For example, on a 5/8-inch residential meter, the average CAP account has a monthly charge of \$42.46, whereas a regular Residential account has a monthly charge of \$74.28.</p> <p>Fire:</p>	Refer to General Notes.

Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
	<p>The PWSA requires that every service connection be constructed with a meter. For fire accounts, the meter's primary function is to report if flow is registered or not. As such, the meters are often referred to as "Flow-No Flow" meters. The installation of a meter discourages the construction of illicit plumbing of fixtures onto a fire service line (e.g. connecting a toilet to a dedicated fire sprinkler service). The PWSA charges fire accounts with a minimum charge per the meter size, as follows:</p> <p>1" or less - \$33.24  1.5" To 3" - \$101.97  4" - \$314.42  6" or greater - \$626.83</p> <p>The fire accounts are also assessed a rate of \$14.01 for every 1,000 gallons over the minimum, as detailed in the first section. Typically, due to inactivity, the fire accounts are only billed for the minimum charge.</p> <p>City:  Please refer to the Billed Metered narrative for additional information on City accounts. Currently, the PWSA charges City accounts 20% of the actual usage for the applicable account type.</p> <p>Flower Garden:  The PWSA provides a flat donation of \$500 per growing season for approved community gardens. Typically, each approved garden uses much less, but if usages exceed the \$500 allowance, then the PWSA charges at the additional usage at the residential rates.</p> <p>Summary:  Based on the foregoing, the Customer Retail Unit Cost rate was calculated to be \$24.42 per 1,000 gallons.</p>	
<p><b>Variable Production Cost (VPC)</b></p>	<p>Contributors:  Ed Barca - Director of Finance  John Nagel – Senior Accounting Specialist  Diana Szuch – Water Production Administrator  Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs  Anthony Gallina - Associate Project Manager  Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:  The Variable Production Cost consists of electrical, chemical and diesel costs. Please see below for the breakdown:</p> <p>Electrical = \$4,013,846.58  Chemical = \$4,063,453.13  Diesel = \$38,948.69  Solids Disposal = \$7,200  Total = \$8,123,448.40</p> <p>The PWSA reviewed the 2020 Summary Bill from Duquesne Light and tabulated the costs specific to the production of water. The water distribution system consists of eleven (11) pump stations, as follows: Highland, Inline, Lincoln, Bruecken, Saline, Aspinwall, Ross, Herron Hill Tank, Herron Hill, Howard and Mission. The electrical consumption at the Water Treatment Plant consists of the Ross Pump Station (raw water intake), Bruecken Pump Station (finished water to the Highland Reservoir No. 1 and No. 2) and Aspinwall Pump Station (finished water to the Lanpher Reservoir).</p> <p>The chemicals required for the production of drinking water consist of the following: phosphoric acid (i.e. orthophosphate), cationic flocculant, caustic soda, ferric chloride, hydrofluosilic acid, lime, potassium permanganate and miscellaneous boiler chemicals (i.e. Stelicor, Cyclocore, salt, etc.).</p> <p>The diesel is required for the temporary pumps currently in service at the Highland No. 2 Reservoir. We anticipate these costs will be eliminated once the Micro Filtration Plant is back online.</p> <p>The PWSA discharges solids created during the water treatment process to an ALCOSAN interceptor sewer. The discharges are permitted in accordance with Industrial Discharge Permit No. P2-0008. The PWSA pays an annual fee to discharge between 500,000 gal and 5,000,000 gal per year.</p>	<p>Refer to General Notes.</p>

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# AWWA Free Water Audit Software: User Notes

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Water Audit Report for: **The Pittsburgh Water and Sewer Authority**  
Audit Year: **2020**

Calendar  
Jan 01 2020 - Dec 31 2020

<b>General Notes:</b>	For detailed information on how the calculations were performed, please refer to the spreadsheet titled "2020WaterAudit_PWSA_CalculationSpreadsheet". The PWSA intends to prepare a Water Audit Validity Evaluation (WAVE) Report. The WAVE Report will detail specific actions to be considered for implementation in order to improve the Data Validity Grading and Input Data quality.	
<b>Audit Item</b>	<b>Notes on Input Derivation</b>	<b>Notes on Data Validity Grading</b>
	<p>Contributors: Michael Cypinski – Water Quality Data Manager Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs Anthony Gallina - Associate Project Manager Robert Herring, PE, PMP – Project Manager</p> <p>Narrative: The Aspinwall Water Treatment Plant (WTP) withdraws water from Allegheny River for treatment and distribution. After treatment, the water is stored within the clearwell and pumped to the distribution system via the Aspinwall Pump Station or the Bruecken Pump Station.</p> <p>The Aspinwall Pump Station consists of eight (8) pumps: Aspinwall Pump No. 1 through No. 4 and Fox Chapel Pump No. 1 through No. 4. The Aspinwall Pumps withdraw from the clearwell and discharge into the Lanpher Rising Main, which ultimately goes to the Lanpher Reservoir and provides water service to the North Side neighborhoods. The flow from these pumps is recorded via two venturi meters: Aspinwall 103 and Aspinwall 104. The meters are located after the pumps, but before the interconnection with the Lanpher Rising Main. The Fox Chapel Pumps deliver bulk water service to the Fox Chapel Authority. Please note that Fox Chapel Pumps No. 1 through No. 3 withdraw directly from the Lanpher Rising Main, after the Aspinwall 103 and Aspinwall 104 meters. Therefore, the volume of water delivered via these pumps is already accounted for. Fox Chapel Pump No. 4 withdraws directly from the clearwell and the discharge does not pass through a dedicated meter. Please note that Fox Chapel Pump No. 4 is used intermittently when the other Fox Chapel Pumps need to be taken offline for service. To estimate the flows from Fox Chapel Pump No. 4, we would multiply the pump capacity by the runtime. However, in 2020, the PWSA did not utilize Fox Chapel Pump No. 4.</p> <p><b>Volume from Own Sources (VOS)</b> The Bruecken Pump Station contains six (6) pumps that discharge into four (4) rising mains. Rising Main No. 1 and Rising Main No. 2 flow toward Highland Reservoir No. 1. The water is either directed toward the distribution system, or enters into a hydraulic control structure that overflows into the Highland No. 1 reservoir. The PWSA does not currently have meters at the Bruecken Pump Station on Rising Main No. 1 or No.2. However, the PWSA has two meters near Highland Reservoir No. 1 to assist with orthophosphate dosing, which are called MFP 1 and MFP 2. The positioning of these meters allows us to measure the volume of water entering the distribution system. Moving forward, the PWSA has plans to install meters on Rising Main No. 1, Rising Main No. 2, the hydraulic overflow into Highland Reservoir No. 1 and after the Microfiltration Plant.</p> <p>Rising Main No. 3 and Rising Main No. 4 flow toward Highland Reservoir No. 2. The PWSA has flow meters on both of these rising mains, located near the Bruecken Pump Station, which are called RM 3 and RM 4. Please note that Highland Reservoir No. 2 is covered, so there should be negligible water loss to evaporation.</p> <p>Based on the foregoing, the Volume From Own Sources was calculated, as follows:</p> <p>Volume From Own Sources = Aspinwall 103 + Aspinwall 104 + Fox Chapel Pump No. 4 + MFP 1 + MFP 2 + RM 3 + RM 4</p> <p>Aspinwall 103: 2,018.84 Million Gallons (MG) Aspinwall 104: 1,840.52 MG Fox Chapel Pump No. 4: 0 MG RM 3: 4,617.30 MG RM 4: 4,490.92 MG MFP 1: 7,881.91 MG MFP 2: 2,700.99 MG Total: 23,550.48 MG</p>	Refer to General Notes.
<b>Volume from Own Sources Error Adjustment (VOSEA)</b>	No comment.	Refer to General Notes.
	Not applicable.	Refer to General Notes.

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Water Imported (W I)		
Water Imported Error Adjustment (WIEA)	Not applicable.	Refer to General Notes.
Water Exported (W E)	<p>Contributors: Tracy Willy - Senior AMI and Billing Manager Ryan Dappen - Business Intelligence Analyst / Database Administrator Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs Anthony Gallina - Associate Project Manager Robert Herring, PE, PMP – Project Manager</p> <p>Narrative: Please see below for a breakdown on the volume of water provided to neighboring water systems that exist outside the PWSA service area:</p> <p>Fox Chapel Authority: 674,065,000 gallons Reserve Township: 105,966,000 gallons Aspinwall Borough: 64,174,000 gallons West View Water Authority: 2,692,000 gallons Hampton Shaler Water Authority: 3,346,000 gallons Pennsylvania-American Water Company: 0 gallons Sharpsburg Borough: 0 gallons</p> <p>Total: 850,243,000 gallons</p>	Refer to General Notes.

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<b>Water Exported Error Adjustment (W EIA)</b>	No comment.	Refer to General Notes.
<b>Billed Metered Authorized Consumption (BMAC)</b>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen – Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Brent Lahaie, PE – Associate Project Manager            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            Please see below for the breakdown on the 2020 Billed Metered usage per account type:</p> <p>Residential: 2,746.49 Million Gallons (MG)            Residential Capital Assistance Program: 103.59 MG            Commercial: 2,843.47 MG            Industrial: 185.87 MG            Health and Education: 987.43 MG            Fire: 15.40 MG            Flower Gardens: 1.57 MG</p> <p>Total: 6,883.83 MG</p> <p>Please note the following:</p> <p>1. Please refer to the Systematic Data Handling Errors narrative for additional information on our overall billing procedure. In addition, please refer to the Customer Metering Inaccuracies for additional information on the PWSA's meter replacement and testing programs.</p> <p>2. In the 2019 Water Audit, the PWSA declared street sweeping as an unbilled unmetered usage. In 2020, the PWSA provided twelve (12) meters to the City of Pittsburgh's Department of Public Works to record the water usage associated with street sweeping and flushing. The meters were installed with an attached MXU unit, therefore the flow data is being transmitted remotely, and being accounted for within the appropriate account type above.</p> <p>3. On October 3, 2019, the PWSA and the City of Pittsburgh (City) entered into an updated cooperation agreement. The updated cooperation agreement was created under PUC oversight and includes provisions to completely transition the City accounts to be billed and metered. In 2019, the PWSA began metering the remainder of the City accounts. Beginning January 1, 2020, the City shall pay the PWSA for water usage, phased-in over a five (5) year period, as follows:</p> <p>Year – Percentage of Usage Charged            2020 – 20%            2021 – 40%            2022 – 60%            2023 – 80%            2024 – 100%</p> <p>Please note that, even though the City was only billed for 20% of the actual cost, the total flow was included within Billed Metered. The PWSA continues to install meters on the City accounts. As of December 31, 2020, there were only 15 City accounts without a meter, and thus, are still considered Unbilled Unmetered. Please note that the number of unmetered City accounts is a fluctuating number, as we continue to locate unknown services which require a meter.</p> <p>4. The PWSA has an over-the-counter permit process for Developer's to obtain a meter for hydrant use. Typically these meters are required during construction for temporary water service. Please note that these meters are installed with an MXU unit to transmit the water usage via radio frequency. Therefore, these flows are included within the appropriate category above.</p>	Refer to General Notes.
	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen – Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager</p>	

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<b>Billed Unmetered Authorized Consumption (BUAC)</b>	<p>Anthony Gallina - Associate Project Manager Robert Herring, PE, PMP - Project Manager</p> <p>Narrative: The PWSA bills 327 unmetered accounts. The billed unmetered accounts largely consist of grandfathered, party-line subdivisions. Please note that our current policies do not allow for the creation of new, unmetered billed accounts. For the existing billed unmetered accounts, the PWSA assumes a usage of 20,000 gallons per quarter for each unit. The total annual flow from billed unmetered accounts is calculated below:</p> <p>Type of Unit - No. of Accounts - Estimated Flow per Year - Total Estimated Flow            Single Family - 318 accounts - 80,000 gallons - 25,440,000 gallons            Two Family - 7 accounts - 160,000 gallons - 1,120,000 gallons            Three Family - 2 accounts - 240,000 gallons - 480,000 gallons</p> <p>The total annual flow from billed unmetered accounts is 27,040,000 gallons per year.</p>	
<b>Unbilled Metered Authorized Consumption (UMAC)</b>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen - Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP - Project Manager</p> <p>Narrative:            The reported Unbilled Metered usage is limited to PWSA uses for treatment and distribution operations. These connections are metered, but within the billing system are coded as "W_NO BILL RATE".</p>	Refer to General Notes.
	<p>Contributors:            Sonja Svihla - Project Manager            Bradley McShane - Associate Project Manager            Daniel Cleary - Associate Project Manager            Tom Warner - Senior Manager, Production            William McFaddin - Director of Operations            Rick Obermeier - Chief of Operations            Lucas Erny - Senior Manager, Field Operations            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP - Project Manager</p> <p>Narrative:            The Unbilled Unmetered usage was calculated via known data and estimated usages.</p> <p>The following contributors were calculated with known data:</p> <p>1. Reservoir Draining - In 2020, the PWSA drained the Highland Reservoir (North Cell), Lanpher Reservoir (East Cell), Lanpher Reservoir (West Cell) and Lincoln Tank. The work was required for inspection, operation and maintenance and/or construction purposes. The PWSA recorded the pre-drain water surface elevation and post-drain water surface elevation. Based on historical records, we were able to create a spreadsheet to estimate the volume of water discharged for each reservoir and tank.</p> <p>2. Emergency Filter Backwash - The Water Treatment Plan utilizes filters for treatment. Typically, the filters withdraw backwash water directly from the clearwell, which is located before the System Delivery Meters. However, the PWSA also maintains an emergency backwash connection, located after the System Delivery Meters, for O&amp;M purposes. In 2020, the PWSA utilized the emergency backwash connection for 13 days.</p>	Refer to General Notes.

Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><b>Unbilled Unmetered Authorized Consumption (UUAC)</b></p>	<p>3. Rising Main Inspection and Disinfection – The PWSA inspected Rising Mains 3 and 4, which runs from the Bruecken Pump Station to the Highland No. 2 Reservoir. The work required draining, disinfection and flushing. Please note that Rising Main 3 and 4 vary between 48-inch and 50-inch, and run for a cumulative 13,107 feet.</p> <p>The following contributors were estimated with the default value of 0.25%:</p> <p>1. Fire Flow Volume: The PWSA has limited data available for this category. The PWSA requires bypass meters for all fire suppression systems. The meter effectively indicates when a fire service is activated, but it does not measure the volumetric usage. In addition, the PWSA does not have any information from the Fire Department for the volumes used to suppress fires, train staff, etc. In the future, the PWSA could coordinate with the Bureau of Fire to get an annual tabulation on the number, and severity, of fires within our service area.</p> <p>2. Flushing Flow Volume for Operation and Maintenance of Distribution System: The PWSA has limited data available for this category. The PWSA will flush water mains in response to water quality complaints. Also, flushing is an effective means of removing settled deposits and distributing flow within lightly used and dead-end water mains. In the future, the PWSA could calculate the run time and available flow of each flushing event to estimate the water usage.</p> <p>3. Flushing Flow Volume for Fire Hydrant Flow Testing: The PWSA has moderate data available for this category. The PWSA requires a fire hydrant flow test for all developments that require a fire suppression system or contain a service larger than one-inch diameter. The flow test results are tabulated and recorded. However, the data does not include the start time and end time of each flush.</p> <p>4. Please refer to the Billed Metered narrative for updates on our efforts to install meters on City properties.</p> <p>Based on the foregoing, the Unbilled Unmetered usage was summed, as follows:</p> <p>Reservoir Draining: 116.80 Million Gallons (MG)  Emergency Filter Backwash: 10.53 MG  Rising Main Draining and Flushing: 8.97 MG  Default Estimation: 17.29 MG  Total Unbilled Unmetered: 153.60 MG</p>	
<p><b>Systematic Data Handling Errors (SDHE)</b></p>	<p>Contributors:  Julie Quigley - Director of Customer Service  Tracy Willy - Senior AMI and Billing Manager  Ryan Dappen - Business Intelligence Analyst / Database Administrator  Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs  Anthony Gallina - Associate Project Manager  Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:  The PWSA collects water usage data through Advanced Metering Infrastructure (AMI) technology. A Meter Transceiver Unit (MXU) is connected to each meter and transmits hourly water usage data via radio frequency. The MXU is situated to facilitate a clear signal. When the meter is located within the structure (e.g., residential building, commercial business, etc.), the MXU is installed on the exterior surface. When the meter is located outside of the structure (e.g., crock vault, etc.), the MXU is installed within the cover/hatch. The PWSA has four (4) base stations to collect the MXU radio transmissions for the entire service area. The base stations automatically transfer the data to a Regional Network Interface (RNI) server for processing and storage. The RNI will generate notifications if an installed MXU fails to transmit water usage data. Lastly, the PWSA utilizes Cogsdale for customer service and billing system purposes.</p> <p>There were 75,073 accounts reporting water usage data via an MXU and 5,374 accounts that required estimation. In 2020, we achieved a 95.59% actual read rate, which is an improvement upon the 92.97% actual read rate reported in the 2019 Water Audit. The PWSA estimates water consumption when actual metered usage is not obtained through an MXU. The estimated consumption is calculated by Cogsdale and is based off of historical water usage. Typically, estimated water consumption is required due to the following situations:</p> <ol style="list-style-type: none"> <li>1. The MXU malfunctions (e.g., equipment fails, battery requires replacement, etc.)</li> <li>2. The water meter does not have an MXU, and we are unable to conduct a physical reading (e.g., the meter is located within the structure and the homeowner is unresponsive, etc.)</li> </ol> <p>The most difficult aspect of repairing or installing MXU's is obtaining access to the meter, as they are typically located within the structure. The Non-Access Project Reference Guide outlines the notification procedure for obtaining access. The notification procedure consists of mailed letters and physical postings at the customer's property. Also, the notification procedure varies, depending if the resident owns the property or rents from a landlord. Failure to provide access to PWSA may result in the termination of water service. It is important to note that the non-access process was negatively impacted by the COVID-19 pandemic, in that PWSA suspended in-home appointments in mid-December 2020.</p>	<p>Refer to General Notes.</p>

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading																								
	<p>The Cogsdale system automatically flags accounts with suspicious activity, and they are subsequently reviewed by the PWSA Billing Department. Examples include, but are not limited to, the following:</p> <ol style="list-style-type: none"> <li>1.Accounts that are coded as shut at the curb, but are registering usage</li> <li>2.Negative consumption</li> <li>3.Fire service with registering usage</li> <li>4.Dramatic changes in a consumption pattern, typically 200% change within the past two months</li> <li>5.No consumption for meters greater than one-inch (1")</li> <li>6.Water bills with large monetary charges</li> <li>7.Zero consumption reported with actual meter readings</li> </ol>																									
<p><b>Customer Metering Inaccuracies (CMI)</b></p>	<p>Contributors:  Tracy Willy - Senior AMI and Billing Manager  Rick Obermeier – Chief of Operations  Randy Bergia – Senior Manager, Field Operations  Bill Bennett – Senior Manager, Field Operations  Matthew Gaiotto – Inventory Control Specialist II  John Wagner – Meter Repair Specialist  Sarah Bolenbaugh, P.E. - Senior Group Manager, Water Programs  Anthony Gallina - Associate Project Manager  Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:  In accordance with the Pennsylvania Code, Title 52 Public Utilities, Chapter 65 Water Service, Section 65.8 Meters, the PWSA must adhere to the following requirements:</p> <ol style="list-style-type: none"> <li>1.No water meter which has an error in registration of more than 2% may be placed in service, nor may a water meter which has an error in registration more than 4% be allowed to remain in service</li> <li>2.Meters shall be tested at the following flow rates: 5/8" (6 gpm), ¾" (10 gpm), 1" (20 gpm), 1 ½" (30 gpm), 2" (50 gpm), 3" (90 gpm), 4" (180 gpm), 6" (300 gpm)</li> <li>3.Meters up to and including one-inch shall not remain in service for more than 20 years without accuracy testing and calibration</li> <li>4.Meters larger than one-inch shall not remain in service for more than 8 years without accuracy testing and calibration</li> <li>5.Meter accuracy test results shall be recorded and maintained for future reference</li> <li>6.Purchased meters shall be accuracy tested at a rate of 10% of the total shipment, or 10 meters, whichever is greater</li> <li>7.Removed meters shall be accuracy tested within 30 days of removal</li> <li>8.The public utility shall have facilities to conduct meter accuracy tests which consistently achieve results within 0.5%</li> <li>9.Water meters that do not meet the requirements of accuracy tests shall be immediately removed from service</li> </ol> <p>Unfortunately, the PWSA has inconsistent record information on the age of existing meters currently in-service. The PWSA began a concerted effort to address this issue with the goal to replace 10,000 meters every year. At the onset of the global pandemic, the PWSA placed a moratorium on all meter replacements, as the work required entry into private structures. Despite these challenges, the PWSA was still able to successfully replaced 5,600 meters. The installation dates were recorded and the removed meters were accuracy tested. The PWSA performs the meter accuracy tests for meters up to and including 2-inches. Removed meters larger than 2-inches were sent to a third-party for accuracy testing. In total, the PWSA had three (3) 2-inch meters that passed, and one (1) 3-inch meter that was unable to be tested due to a malfunctioning register. The accuracy results for new and old meters up to and including 2-inches were as follows:</p> <table border="1"> <thead> <tr> <th>Accuracy Range</th> <th>No. of Tests</th> <th>% of Total Tests</th> <th>Average Accuracy, %</th> </tr> </thead> <tbody> <tr> <td>0 &lt; X ≤ 71</td> <td>13</td> <td>0.23%</td> <td>19.22</td> </tr> <tr> <td>71 &lt; X ≤ 96</td> <td>6</td> <td>0.11%</td> <td>93.18</td> </tr> <tr> <td>96 &lt; X ≤ 104</td> <td>5,568</td> <td>90.12%</td> <td>99.89</td> </tr> <tr> <td>104 &lt; X ≤ 500</td> <td>8</td> <td>0.14%</td> <td>168.26</td> </tr> <tr> <td>TOTAL</td> <td>5,595</td> <td>100%</td> <td>99.79%</td> </tr> </tbody> </table> <p>The aforementioned table intentionally excludes results which yielded negative, zero or over 500% accuracy. The outliers were typically the result of input errors in the spreadsheet, and the meters registering zero flow were assumed to have seized. The PWSA typically responds to seized meters within days, and inclusion of these meters would not reflect the "silent" accuracy failures occurring within operable meters currently in service. A "passing" meter is represented by an accuracy greater than 96% and up to and including 104%. Therefore, 87.30% of the meters passed the accuracy test.</p> <p>The overall average accuracy for meters up to and including 2-inches was 99.79%. The PWSA assumed this accuracy for all meter sizes.</p>	Accuracy Range	No. of Tests	% of Total Tests	Average Accuracy, %	0 < X ≤ 71	13	0.23%	19.22	71 < X ≤ 96	6	0.11%	93.18	96 < X ≤ 104	5,568	90.12%	99.89	104 < X ≤ 500	8	0.14%	168.26	TOTAL	5,595	100%	99.79%	<p>Refer to General Notes.</p>
Accuracy Range	No. of Tests	% of Total Tests	Average Accuracy, %																							
0 < X ≤ 71	13	0.23%	19.22																							
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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<b>Unauthorized Consumption (UC)</b>	No comment.	Refer to General Notes.
<b>Length of Mains (Lm)</b>	<p>Contributors:            Jackson Stoss, GIS Project Coordinator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA utilized a Geographic Information System (GIS) database to calculate the Length of Mains. In 2020, the PWSA water distribution system contained 5,085,854 feet of active, pressurized water mains. This value represents an increase of 4,118 linear feet as compared to 2019. Please note this quantification excludes pseudo water mains (i.e. water mains illustrated for mapping purposes only, etc.) and private water mains.</p>	Refer to General Notes.
<b>Number of Service Connections (Nc)</b>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen – Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The breakdown is as follows:            Total Water Accounts = Active Water Accounts + Inactive Water Accounts            Active Water Accounts = 80,023            Inactive Water Accounts = 8,905            Total Water Accounts = 88,928</p>	Refer to General Notes.
<b>Average Length of (private) Customer Service Line (Lp)</b>	<p>Contributors:            Jackson Stoss, GIS Project Coordinator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA utilized a Geographic Information System (GIS) database to calculate the Average Length of Customer Service Line. In 2020, the PWSA water distribution system contained 81,996 active water service lines with a total length of 3,941,294 feet. The calculated average length of customer service was 48.1 feet, which represents an increase of 0.2 feet as compared to 2019.</p> <p>Please note that the PWSA acquired Millvale Borough's water distribution system in 2009. Most of these service lines are only mapped from the main to the curb box due to incomplete meter location information. Therefore, the service lines located in Millvale Borough were removed from the above calculations.</p>	Refer to General Notes.
<b>Average Operating Pressure (AOP)</b>	<p>Contributors:            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA water distribution system contains 17 pressure districts, as follows: Allentown Tanks, Bedford Tanks, Bloomfield Regulator, Brashear Tanks, Garfield Tank, Herron Hill Reservoir, Herron Hill Tank, Highland Park/Garfield Regulator, Highland Reservoir 1, Highland Reservoir 2, Inline Pump, Lanpher Reservoir, Lincoln Tank, McNaugher Regulator, McNaugher Reservoir, Squirrel Hill Tank and Zoo Regulator. The large number of pressure districts are required due to Pittsburgh's challenging topography, from the peaks of Mount Washington, to the low-lying communities along the Allegheny, Monongahela and Ohio Rivers.</p> <p>Based on the foregoing challenges, the PWSA utilized a calibrated hydraulic model (model) to determine the average operating pressure. The model was created within the OpenFlows WaterGEMS software program produced by Bentley Systems, Inc. The PWSA averaged pressures from approximately 63,000 nodes to obtain the Average Operating Pressure of 60 psi.</p>	Refer to General Notes.

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
<p><b>Customer Retail Unit Charge (CRUC)</b></p>	<p>Contributors:            Tracy Willy - Senior AMI and Billing Manager            Ryan Dappen – Business Intelligence Analyst / Database Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The PWSA rate structure contains eight (8) account types: Residential, Commercial, Residential Capital Assistance Program (CAP), Fire, City, Institutional, Industrial and Flower Gardens. The number of meters contained within each account type, in descending order of occurrence, are indicated below:</p> <p>Account Type – No. of Meters – % of Total            Residential – 70,709 – 84.78%            Commercial – 7,150 – 8.57%            Residential CAP – 3,060 – 3.67%            Fire – 1,314 – 1.58%            City – 519 – 0.62%            Institutional – 479 – 0.57%            Industrial – 99 – 0.12%            Flower Garden – 76 – 0.09%</p> <p>Due to variations in the rate structure and prevalence of account types, the PWSA utilized a weighted average approach to calculate a single, composite cost. Please see below for a description of each account type, and the associated rate structure. However, for detailed information on the calculations, please refer to the Calculation Spreadsheet that is associated with the 2020 Water Audit.</p> <p>Residential, Commercial, Institutional, and Industrial:            This group of accounts share the same billing structure, which consists of a minimum monthly charge based on the meter size, plus additional charges for usages over the minimum volume per the account type, if any. The minimum monthly charges are indicated below:</p> <p>Meter Size – No. of Meters - Minimum Gallons – Minimum Monthly Charge            5/8" – 1,000 gal – \$35.78            3/4" – 2,000 gal – \$61.60            1" – 5,000 gal – \$130.74            1 1/2" – 10,000 gal – \$259.81            2" – 17,000 gal – \$432.21            3" – 40,000 gal – \$967.81            4" – 268 – 70,000 gal – \$1,642.59            6" – 122 – 175,000 gal – \$3,896.31            8" – 20 – 325,000 gal – \$7,021.00            10" or larger – 4 – 548,000 gal – \$11,506.89</p> <p>For every 1,000 gallons over the minimum, the following rates apply:</p> <p>Account Type – % of Total – Total Combined Rate            Residential – \$19.89            Commercial – \$18.69            Institutional - \$23.73            Industrial – \$16.46</p> <p>Residential CAP:            The PWSA offers a customer assistance program for income-qualified residential customers. The rate structure is similar above, but offers a 25% discount on the minimum monthly charge and a 7.14% discount on usages over the minimum volume. For example, on a 5/8-inch residential meter, the average CAP account has a monthly charge of \$42.46, whereas a regular Residential account has a monthly charge of \$74.28.</p> <p>Fire:</p>	<p>Refer to General Notes.</p>

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Audit Item	Notes on Input Derivation	Notes on Data Validity Grading
	<p>The PWSA requires that every service connection be constructed with a meter. For fire accounts, the meter's primary function is to report if flow is registered or not. As such, the meters are often referred to as "Flow-No Flow" meters. The installation of a meter discourages the construction of illicit plumbing of fixtures onto a fire service line (e.g. connecting a toilet to a dedicated fire sprinkler service). The PWSA charges fire accounts with a minimum charge per the meter size, as follows:</p> <p>1" or less - \$33.24            1.5" To 3" - \$101.97            4" - \$314.42            6" or greater - \$626.83</p> <p>The fire accounts are also assessed a rate of \$14.01 for every 1,000 gallons over the minimum, as detailed in the first section. Typically, due to inactivity, the fire accounts are only billed for the minimum charge.</p> <p>City:            Please refer to the Billed Metered narrative for additional information on City accounts. Currently, the PWSA charges City accounts 20% of the actual usage for the applicable account type.</p> <p>Flower Garden:            The PWSA provides a flat donation of \$500 per growing season for approved community gardens. Typically, each approved garden uses much less, but if usages exceed the \$500 allowance, then the PWSA charges at the additional usage at the residential rates.</p> <p>Summary:            Based on the foregoing, the Customer Retail Unit Cost rate was calculated to be \$24.42 per 1,000 gallons.</p>	
<p><b>Variable Production Cost (VPC)</b></p>	<p>Contributors:            Ed Barca - Director of Finance            John Nagel – Senior Accounting Specialist            Diana Szuch – Water Production Administrator            Sarah Bolenbaugh, PE - Senior Group Manager, Water Programs            Anthony Gallina - Associate Project Manager            Robert Herring, PE, PMP – Project Manager</p> <p>Narrative:            The Variable Production Cost consists of electrical, chemical and diesel costs. Please see below for the breakdown:</p> <p>Electrical = \$4,013,846.58            Chemical = \$4,063,453.13            Diesel = \$38,948.69            Solids Disposal = \$7,200            Total = \$8,123,448.40</p> <p>The PWSA reviewed the 2020 Summary Bill from Duquesne Light and tabulated the costs specific to the production of water. The water distribution system consists of eleven (11) pump stations, as follows: Highland, Inline, Lincoln, Bruecken, Saline, Aspinwall, Ross, Herron Hill Tank, Herron Hill, Howard and Mission. The electrical consumption at the Water Treatment Plant consists of the Ross Pump Station (raw water intake), Bruecken Pump Station (finished water to the Highland Reservoir No. 1 and No. 2) and Aspinwall Pump Station (finished water to the Lanpher Reservoir).</p> <p>The chemicals required for the production of drinking water consist of the following: phosphoric acid (i.e. orthophosphate), cationic flocculant, caustic soda, ferric chloride, hydrofluosilic acid, lime, potassium permanganate and miscellaneous boiler chemicals (i.e. Stelicor, Cyclocore, salt, etc.).</p> <p>The diesel is required for the temporary pumps currently in service at the Highland No. 2 Reservoir. We anticipate these costs will be eliminated once the Micro Filtration Plant is back online.</p> <p>The PWSA discharges solids created during the water treatment process to an ALCOSAN interceptor sewer. The discharges are permitted in accordance with Industrial Discharge Permit No. P2-0008. The PWSA pays an annual fee to discharge between 500,000 gal and 5,000,000 gal per year.</p>	<p>Refer to General Notes.</p>

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**AWWA Free Water Audit Software**  
**Water Balance**

Water Audit Report for: **The Pittsburgh Water and Sewer Authority**

Audit Year: **2020**

Jan 01 2020 - Dec 31 2020

Data Validity Tier: **Tier III (51-70)**

FWAS v6.0

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Volume from Own Sources (VOS) (corrected for known errors)  <b>23,550.477</b>	System Input Volume <b>23,550.477</b>	Water Exported (WE) (corrected for known errors) <b>850.243</b>	Billed Water Exported				Revenue Water (Exported) <b>850.243</b>
		Water Supplied <b>22,700.234</b>	Authorized Consumption  <b>7,071.040</b>	Billed Authorized Consumption  <b>6,910.870</b>	Billed Metered Consumption (BMAC) (water exported is removed) <b>6,883.830</b>	Revenue Water  <b>6,910.870</b>	
Water Losses  <b>15,629.194</b>	Unbilled Authorized Consumption  <b>160.170</b>			Unbilled Metered Consumption (UMAC) <b>6.570</b>	Non-Revenue Water (NRW)		
		Apparent Losses <b>49.055</b>	Unbilled Unmetered Consumption (UUAC) <b>153.600</b>	<b>15,789.364</b>			
Real Losses <b>15,580.140</b>	Systematic Data Handling Errors (SDHE) <b>17.277</b>	Leakage on Transmission and/or Distribution Mains <b>Not broken down</b>					
	Customer Metering Inaccuracies (CMI) <b>14.500</b>		Leakage and Overflows at Utility's Storage Tanks <b>Not broken down</b>				
	Unauthorized Consumption (UC) <b>17.277</b>			Leakage on Service Connections <b>Not broken down</b>			
Water Imported (WI) (corrected for known errors)  <b>0.000</b>							



## AWWA Free Water Audit Software: Determining Water Loss Standing

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Water Audit Report for: The Pittsburgh Water and Sewer Authority  
 Audit Year: 2020 Jan 01 2020 - Dec 31 2020  
 Data Validity Tier: Tier III (51-70)

### Water Loss Control Planning Guide

Water Audit Data Validity Tier (Score Range)					
Functional Focus Area	Tier I (1-25)	Tier II (26-50)	Tier III (51-70)	Tier IV (71-90)	Tier V (91-100)
Audit Data Collection	Launch auditing and loss control team; address supply metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs; Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon with PIs for performance comparisons for real losses	Performance Benchmarking with PIs is meaningful in comparing real loss standing	Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*



# AWWA Free Water Audit Software: Definitions

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Item Name	Description
<p><b>Apparent Losses</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>= systematic data handling errors + customer metering inaccuracies + unauthorized consumption</p> <p>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).</p> <p>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.</p>
<p><b>AUTHORIZED CONSUMPTION</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>= billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption</p> <p>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.</p> <p>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Typically a lag will exist between timing for reading of supply meters and reading of customer meters. A lag-time correction should typically be calculated to account for this. <b>Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.</b></p> <p>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled Unmetered Authorized Consumption)</p>
<p style="text-align: center;"><a href="#">View Service Connection Diagram</a></p> <p><b>Average Length of (private) Customer Service Line (Lp)</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>This is the average length of underground customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator for the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.</p> <p>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.</p> <p>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a total Lp length (Lc) and subsequently a weighted average Lp length for the entire system.</p> <p>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.</p>
<p><b>Average Operating Pressure (AOP)</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>This is the average pressure in the distribution system that is the subject of the water audit. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.</p> <p>In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines.</p> <p>If your water utility has an up-to-date and calibrated hydraulic model of the water distribution system, it can be utilized to obtain a very accurate quantity of average pressure. However using the average pressure of all "nodes" in the system model is not necessarily the most accurate way to calculate the average operating pressure. This is especially true if there are significant pressure differences throughout the system, and the "nodes" are not evenly distributed throughout the distribution system. The most accurate calculation is to obtain the average pressure that each pipe segment experiences. The way to do this is to calculate the pressure at each end of the pipe. Then calculate the average of those two values and multiply this average value by the length of that pipe. This must be calculated for all pipe segments in the model. Finally calculate the sum of all of these values and divide by the total pipe length. This effectively calculates a weighted average of pressure over the total pipe length. For low density systems (&lt;32 connections/mile), average mains pressures at the service connection or curb stop may have greater influence and should be considered.</p>
<p><b>Billed Authorized Consumption</b></p>	<p>All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.</p>

Item Name	Description
<p><b>Billed Metered Authorized Consumption (BMAC)</b></p> <p><a href="#">Find</a></p>	<p>All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. <b>It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.</b> The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.</p>
<p><b>Billed Unmetered Authorized Consumption (BUAC)</b></p> <p><a href="#">Find</a></p>	<p>All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined <u>by utility policy</u> to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. <b>This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.</b></p>
<p><b>Customer Metering Inaccuracies (CMI)</b></p> <p><a href="#">Find</a></p>	<p>Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial, institutional and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.</p> <p>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for <u>all</u> customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.</p> <p>Note that a value of zero will be accepted but is not recommended, as all metered systems tend to have some degree of inaccuracy. A positive value should be entered. A value of zero in this component is generally valid only if the water utility does not meter its customer population.</p> <p>The formula for calculating a volume of CMI from a percentage input is as follows: <math>CMI\ volume = (BMAC+UMAC)/(1-CMI\%)-(BMAC+UMAC)</math></p>
<p><b>Customer Retail Unit Charge (CRUC)</b></p> <p><a href="#">Find</a></p>	<p>The Customer Retail Unit Charge represents the volumetric portion of the total charges that customers pay for water service. The CRUC does not include fixed charges. This unit charge cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different charges costs based upon class of customer, a volume-weighted average of water sold at each unique rate should be calculated to determine a single composite charge that should be entered into this cell. Finally, the weighted average charge should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed.</p> <p>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Charge Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.</p> <p>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either \$/1,000 gallons, \$/hundred cubic feet, or \$/1,000 litres) and automatically converts these units for purpose of calculating Apparent Loss valuations. The monetary units are United States dollars, \$.</p>
<p><b>Infrastructure Leakage Index (ILI)</b></p> <p><a href="#">Find</a></p>	<p>The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). This performance indicator is dimensionless.</p> <p><b>NOTES ON THE UARL AND ILI:</b></p> <ol style="list-style-type: none"> <li>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (&lt; 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.</li> <li>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed.</li> </ol>

Item Name	Description
<p><b>Length of Mains (Lm)</b></p> <p><a href="#">Find</a></p>	<p>Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:</p> <p>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ] or Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ]</p>
<p><b>NON-REVENUE WATER</b></p> <p><a href="#">Find</a></p>	<p>= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.</p>
<p><b>Number of Service Connections (Nc)</b></p> <p><a href="#">Find</a></p>	<p>Number of customer service connections, extending from the water main to supply water to a customer. This includes the actual number of pressurized piping connections, including fire connections, <b>whether active or inactive</b>. This may differ substantially from the number of customers (or number of accounts). <b>Note: this number does not include the pipeline leads to fire hydrants. The total length of piping supplying fire hydrants should be <u>included</u> in the "Length of mains" input, and <u>excluded</u> from the Number of service connections input.</b></p>
<p><b>Real Losses</b></p> <p><a href="#">Find</a></p>	<p>Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.</p>
<p><b>Revenue Water</b></p>	<p>Those components of System Input Volume that are billed and have the potential to produce revenue.</p>
<p><b>Service Connection Density</b></p> <p><a href="#">Find</a></p>	<p>=number of customer service connections / length of mains</p>
<p><b>Systematic Data Handling Errors (SDHE)</b></p> <p><a href="#">Find</a></p>	<p>Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. <b>Systematic Data Handling Errors occur as a customer consumption volume and can result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.</b></p> <p>Utilities typically measure water consumption volumes registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the registered consumption volume value being less than the actual consumption volume, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.</p> <p>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption volume, thus under-stating the actual consumption. Account activation lapses may allow new buildings to begin using water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building water service commencing without a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors &amp; data handling errors.</p> <p>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Negative or zero values are not allowed for this audit component.</p> <p>Note: occasionally billed consumption volumes for a customer account may be over-stated due to issues of double-counting an account or applying an over-stated meter multiplier. The possibility of such occurrences should be explored in the data validation process, particularly if billed authorized consumption volumes for the year, or for any sub-group of customers (by classification or meter size), appears to be inordinately high. It is recommended to correct any such errors in the billed consumption total for the year, rather than consider these volumes part of Systematic Data Handling Error.</p>
<p><b>Total annual operating cost (optional input)</b></p> <p><a href="#">Find</a></p>	<p>*This input has been made optional, as it is no longer used in calculating a Performance Indicator. Auditors are welcome to continue to track this input as desired.* These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.</p>

Item Name	Description
<p><b>Unauthorized Consumption (UC)</b></p> <p><a href="#">Find</a></p>	<p>Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended to use the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities tend to have some volume of unauthorized consumption occurring in their system.</p>
<p><b>Unavoidable Annual Real Losses (UARL)</b></p> <p><a href="#">Find</a></p>	<p>The UARL is a theoretical reference value representing the technical low limit of leakage for well managed systems in good condition, with aggressive active leakage control. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI).</p> <p>UARL (gallons) = <math>(5.41L_m + 0.15N_c + 7.5L_c) \times P \times 365 \text{ d/year}</math>,  or  UARL (litres) = <math>(18.0L_m + 0.8N_c + 25.0L_c) \times P \times 365 \text{ d/year}</math></p> <p>where:  L<sub>m</sub> = length of mains (miles or kilometres)  N<sub>c</sub> = number of customer service connections  L<sub>p</sub> = the average length of customer service connection piping (feet or metres)  (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of L<sub>p</sub>)  L<sub>c</sub> = total length of customer service connection piping (miles or km)  L<sub>c</sub> = N<sub>c</sub> X L<sub>p</sub> (miles or kilometres)  P = Average operating pressure (psi or metres) (see Average Operating Pressure definition)</p> <p><b>NOTES ON THE UARL AND ILI:</b></p> <p>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (&lt; 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.</p> <p>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed.</p>
<p><b>Unbilled Authorized Consumption</b></p>	<p>All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Authorized Consumption (UMAC) + Unbilled Unmetered Authorized Consumption (UUAC). See "Authorized Consumption" for more information.</p>
<p><b>Unbilled Metered Authorized Consumption (UMAC)</b></p> <p><a href="#">Find</a></p>	<p>Metered consumption which is authorized by the water utility, but, for any reason, is <u>deemed by utility policy</u> to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. <b>It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.</b></p>
<p><b>Unbilled Unmetered Authorized Consumption (UUAC)</b></p> <p><a href="#">Find</a></p>	<p>Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component.</p> <p>This component does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. Also, if any potable water used at a water treatment plant is tapped from a location <u>upstream</u> of the meter(s) used to determine the Volume from Own Sources in the audit, this is outside of the boundary of the audit and should therefore not be included as part of Unbilled, Unmetered Authorized Consumption.</p> <p>This component has many sub-components of water use which may not yet be quantified. The default is 0.25% of the Billed Authorized Consumption volume (BMAC + BUAC), and is recommended for temporary use if customized estimates are not yet available, with recommendation to begin tracking and estimating these volumes for the next audit.</p> <p>Note that a value of zero is not permitted, since all water utilities likely have some volume of water in this component occurring in their system.</p>

Item Name	Description								
<b>Units and Conversions</b>	<p>The user may develop an audit based on one of three unit selections:            1) Million Gallons (US)            2) Megalitres (Thousand Cubic Metres)            3) Acre-feet</p> <p>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units):</p> <div style="text-align: center; margin: 10px 0;"> <table style="margin: auto;"> <tr> <td style="text-align: center;">Enter Units:</td> <td style="text-align: center;">Convert From...</td> <td style="text-align: center;">=</td> <td style="text-align: center;">Converts to.....</td> </tr> <tr> <td style="text-align: center; border: 1px solid black; padding: 2px;">100</td> <td style="text-align: center; border: 1px solid black; padding: 2px;">Million Gallons (US)</td> <td></td> <td style="text-align: center; border: 1px solid black; padding: 2px;">306.888329    Acre-feet</td> </tr> </table> <p>(conversion factor = 3.0689)</p> </div>	Enter Units:	Convert From...	=	Converts to.....	100	Million Gallons (US)		306.888329    Acre-feet
Enter Units:	Convert From...	=	Converts to.....						
100	Million Gallons (US)		306.888329    Acre-feet						
<b>Variable Production Cost (VPC) (applied to Real Losses)</b>  <input type="button" value="Find"/>	<p>The cost to produce and supply the next unit of water (e.g., \$/million gallons). This cost can include both short-run and long-run marginal costs. See the VPC data grading questions on IDG tab for examples of short-run and long-run marginal costs that may be included.</p> <p>It is common to apply the VPC unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor may be justified in applying the Customer Retail Unit Charge to the Real Loss volume, rather than applying the Variable Production Cost.</p>								
<b>Volume from Own Sources (VOS)</b>  <input type="button" value="Find"/>	<p>The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured as treated effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. Water treatment plants are also often supplied potable drinking water and therefore are a "customer" of the water utility. If the service connection line serving the water treatment plant is downstream of treated water effluent flowmeters, this water should be metered and billed as billed authorized consumption. In this case, this volume of water does not enter into any calculations for Volume from Own Sources. If the service connection line supplying potable water to the treatment plant is upstream of treated water effluent flowmeters, then this water is considered "process" water and included with calculations accounting for process water use.</p> <p>If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, plant potable water consumption (if the supply is drawn upstream of effluent flowmetering.) and similar uses. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.</p>								
<b>Volume from own sources: error adjustment</b>  <input type="button" value="Find"/>	<p>An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common. Enter a <u>positive</u> percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. <b>See Water Supplied Error Adjustments definition for guidance on how to calculate this input.</b></p>								
<b>Water Exported (WE)</b>  <input type="button" value="Find"/>	<p>The Water Exported volume is the bulk water conveyed or sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling or transferring the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells or transfers bulk water in this manner, they are an exporter of water.</p> <p>Note: The Water Exported volume is typically sold to wholesale customers who are charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. <b>Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Worksheet. This volume should be included only in the Water Exported box.</b></p>								
<b>Water Exported: Error Adjustment (WEEA)</b>  <input type="button" value="Find"/>	<p>An estimate or measure of the volume by which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. <b>See Water Supplied Error Adjustments definition for guidance on how to calculate this input.</b></p>								

Item Name	Description
<b>Water Imported (WI)</b> <input type="button" value="Find"/>	<p>The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water wholesale supplier, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.</p>
<b>Water Imported: Error Adjustment (WIEA)</b> <input type="button" value="Find"/>	<p>An estimate or measure of the volume by which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. <b>See Water Supplied Error Adjustments definition for guidance on how to calculate this input.</b></p>
<b>Water Supplied Error Adjustments</b> <input type="button" value="Find"/>	<p><b>Disclaimer:</b> The guidance provided below should be considered general, representing a typical approach to determining Error Adjustment. Supply metering setups, metering technologies, instrumentation, data recording/archival, and data management systems can vary significantly from one water utility to the next. Inherent margins of error will also vary among different testing and calibration methods and the measurement systems being tested. Other factors that may be important include, but are not limited to, frequency of testing and calibration practices, data communication outages in the audit period, tested flowrates versus typical operating flowrates, and test durations. All of these factors must be considered when assessing Error Adjustment for the Water Supplied inputs. Each specific situation should be carefully analyzed to determine the most appropriate approach for determining the Error Adjustment to input, if any.</p> <p><b>General:</b> For the Water Supplied inputs, there are three typical sources of error that may warrant an Error Adjustment on the Worksheet.</p> <ol style="list-style-type: none"> <li><b>1. Meter error:</b> measurement inaccuracy in the meter(s) used to derive the input volume, typically identified through in-situ flow accuracy testing. Applicable for VOS, WI and WE. If no such testing has been performed, adjustment for meter error is not typically recommended.</li> <li><b>2. Data transfer error:</b> inaccuracy in archived volumes, typically due to gaps in data, programming errors impacting unit conversions, and/or programming errors impacting totalization of measured volumes over the audit period. Applicable for VOS, WI and WE. These errors are typically identified through electronic calibration to verify data transfer at the secondary device (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or the tertiary device (i.e. SCADA, historian or other computerized archival system).</li> <li><b>3. Net distribution storage change:</b> The difference between end of audit period and beginning of audit period for total finished water stored, downstream of the system input meter(s). Typically applicable for VOS or WI. This volume is typically derived by comparing distribution storage tank water levels at end and beginning of the water audit period and using approximate tank geometry to convert levels to volumes.</li> </ol> <p><b>Derivation Guidance:</b></p> <p>If an Error Adjustment input is being calculated as a <u>volume</u>, each source of error (described above) may be separately calculated, with careful consideration of under- vs over-registration, then added together to determine the composite <u>volume</u> to input. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.</p> <p>If an Error Adjustment input is being calculated as a <u>percent</u>, some very general guidance for calculating each error source (described above) is provided below. The auditor is again cautioned that each specific water supply setup needs to be evaluated closely as noted in the <u>Disclaimer</u>. Refer to the latest AWWA M36 Manual for additional discussion and guidance on this matter.</p> <ol style="list-style-type: none"> <li><b>1. Meter error:</b> If in-situ flow accuracy testing has been performed, and inherent testing method error is understood, first the <i>meter accuracy %</i> may be determined as follows:  <math display="block">\text{meter accuracy \%} = \text{System input meter(s) volume} / \text{Reference volume}</math> <p>Then, the <i>meter error %</i> may be determined as follows:  <math display="block">\text{meter error \%} = \text{meter accuracy \%} - 100\%</math></p> </li> <li><b>2. Data transfer error:</b> If electronic calibration at the secondary (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or tertiary (i.e. SCADA, historian or other computerized archival system) devices has been performed, first the <i>data transfer accuracy %</i> may be determined as follows:  <math display="block">\text{data transfer accuracy \%} = \text{Tertiary device volume} / \text{Reference volume (typically at Secondary device)}</math> <p>Then, the <i>data transfer error %</i> may be determined as follows:  <math display="block">\text{data transfer error \%} = \text{data transfer accuracy \%} - 100\%</math></p> <p>If no error is identified, or if electronic calibration has not been performed, or if no secondary or tertiary devices exist, a <i>data transfer error %</i> adjustment is not typically recommended.</p> </li> <li><b>3. Net distribution storage change.</b> If meter error and/or data transfer error are being calculated as a %, it is recommended to make the adjustment for net distribution storage change as a volume adjustment, directly in the VOS or WI input, as applicable.</li> </ol> <p>The final step is to add <i>meter error %</i> and <i>data transfer error %</i>:  <math display="block">\text{Error Adjustment \%} = \text{meter accuracy \%} + \text{data transfer error \%}</math></p> <p>If the total Error Adjustment % calculates out as a negative number, it represents an under-registration. Vice versa, if positive. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.</p>

Item Name	Description
<p><b>WATER LOSSES</b></p> <p><a href="#">Find</a></p>	<p>= apparent losses + real losses            = water supplied - authorized consumption</p> <p>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA), if one of these configurations are the basis of the water audit.</p>



## Average Length of Customer Service Line

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line,  $L_p$ , for the three most common piping configurations.

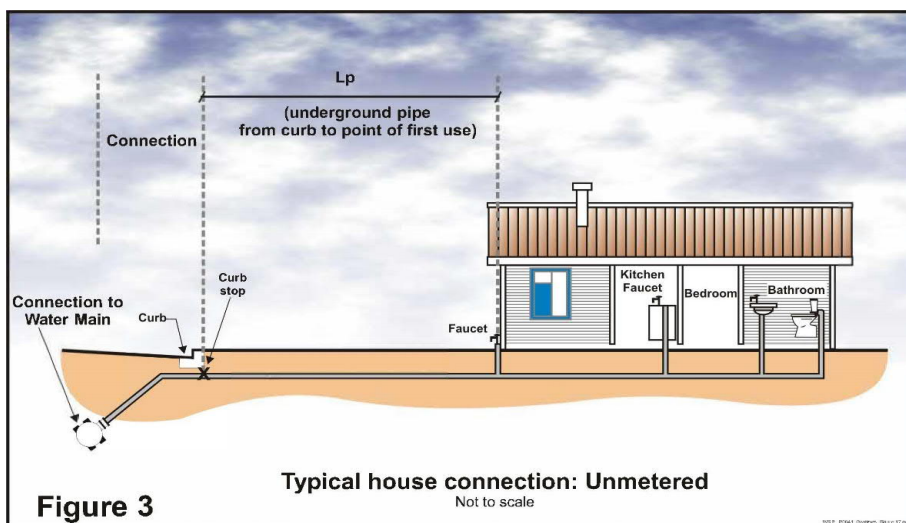
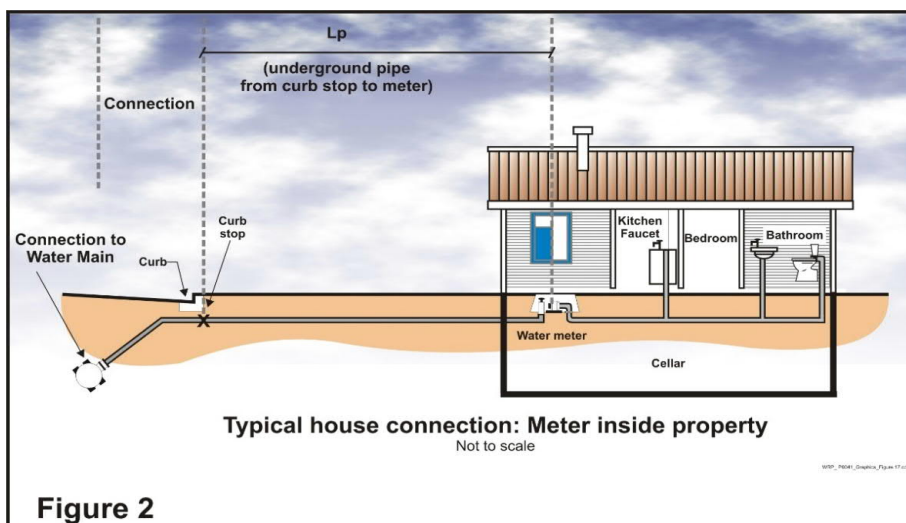
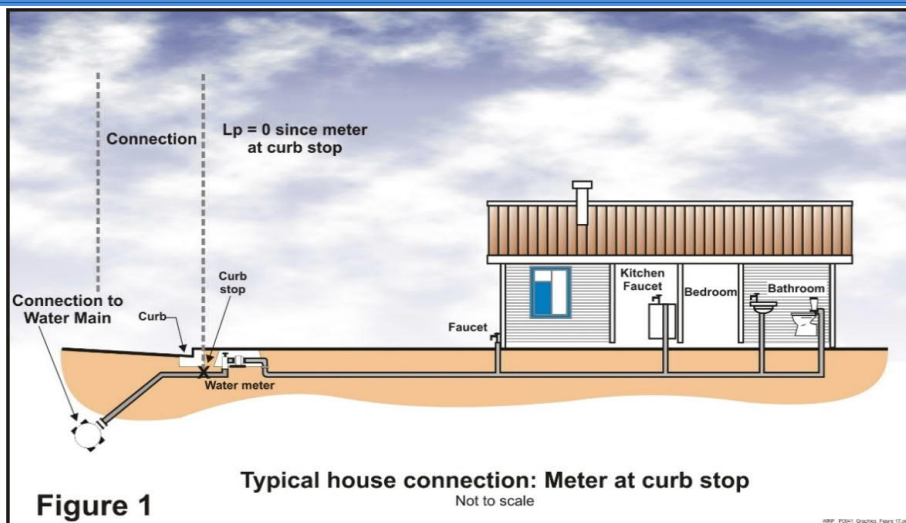
**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration  $L_p = 0$  since the distance between the curb stop and the customer metering point is essentially zero.

**Figure 2** shows the configuration of the customer water meter located inside the customer building, where  $L_p$  is the distance from the curb stop to the water meter.

**Figure 3** shows the configuration of an unmetred customer building, where  $L_p$  is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the  $L_p$  will vary notably in a community of different structures, therefore the average  $L_p$  value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

[Click for more information](#)





American Water Works Association

Dedicated to the World's Most Important Resource®

AWWA Free Water Audit Software - Version 6.0

developed by the Water Loss Control Committee of the American Water Works Association December 2020



World Water Loss Day 4th December

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

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A special thanks to those members of the AWWA Water Loss Control Committee and other water industry stakeholders who assisted in the review and testing of this software.

REFERENCES:

1. Kunkel, G., G. Trachtman, A. Wyatt, and W. Jernigan. Water Loss Control Committee Report: Key Performance Indicators for Non-Revenue Water—AWWA's 2020 Position. 2020. Journal AWWA. https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/awwa.1428
2. Kunkel, G. et al. AWWA WLCC Reference Water Audit Dataset. 2020. AWWA. Denver, CO.
3. AWWA Water Audits and Loss Control Programs, M36 Publication. 5th Edition, (forthcoming) 2021. AWWA. Denver, CO.
4. Trachtman G., A. Wyatt, et al. 2019. Assessment of Performance Indicator for Non-Revenue Water Target Setting and Progress Tracking. AWWA. Denver, CO.
5. Trachtman G., A. Wyatt, et al. 2019. WRF 4695: Guidance on Implementing an Effective Water Loss Control Plan. Water Research Foundation. Denver, CO.
6. Lambert, A. 2020. Low ILIs and Small Systems. Llandudno, UK. https://leakssuitelibrary.com
7. Good Practices on Leakage Management, Main Report. EU Reference Document. European Commission, Luxembourg. 2015. https://circabc.europa.eu/sd/a/1ddfba34-e1ce-4888-b031-6c559cb28e47/Good%20Practices%20on%20Leakage%20Management%20-%20Main%20Report\_Final.pdf https://circabc.europa.eu/sd/a/ec13ae01-7800-4114-8d72-98827b509e18/Good%20Practices%20on%20Leakage%20Management%20-%20Case%20Study%20document\_Final.pdf
8. Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.
9. Sturm, R., W. Jernigan, C. Stief, and D. Blackwell. Level 1 Water Audit Validation Guidance Manual. 2nd Edition, (forthcoming) 2021. Project #5057. Denver: Water Research Foundation.

<b>VERSION HISTORY:</b>			
<b>Version:</b>	<b>Release Date:</b>	<b>Number of Worksheets:</b>	<b>Key Features and Developments</b>
v1	2005/ 2006	5	The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated.
v2	2006	5	The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses.
v3	2007	7	In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit.
v4 - v4.2	2010	10	v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the required data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknowledgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2.
v5	2014	12	In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used.
v6	2020	11	v6 brings an overhaul to the user interface for data grading, now presented as a series of questions on the Interactive Data Grading (IDG) tab for each input that, when answered (by selecting best-fit answer from a dropdown menu), automatically determines the data grade for the given input. This provides transparency to the data practices selected and which specifically are limiting, removes subjectivity in data grade assignments, and provides clarity on candidate next steps for data validity improvements. IDG tab includes navigation buttons across top banner for ease of movement between inputs, and color signals for completion. The Worksheet (fka Reporting Worksheet) includes overt designation of error adjustment as "under" or "over" for the 3 Water Supplied inputs, as well as Customer Metering Inaccuracies. This makes the convention consistent, transparent, and reduces chance of user error. A Blank Sheet has been added allowing the user to, as desired, perform supplemental calculations or capture additional relevant information. The Dashboard has been overhauled to include Data Validity, NRW Components and Key Performance Indicators (KPIs). KPIs are presented in gauge format, depicting the specific KPI result against the range of results from Level 1 validated data in North America (see Web Resources, Start Page). Percentage-based indicators (% of supply, % of cost) removed as these indicators were deemed unreliable and sunset by the AWWA Water Loss Control Committee, subsequent to research and reporting from its NRW Performance Indicators Task Force.

If you have questions or comments regarding the software please contact us via email at: [wlc@awwa.org](mailto:wlc@awwa.org)





**AWWA Free Water Audit Software:  
Determining Water Loss Standing**

FWAS v6.0

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Water Audit Report for:

Audit Year:

Data Validity Tier:

**Water Loss Control Planning Guide**

Functional Focus Area	Water Audit Data Validity Tier (Score Range)				
	Tier I (1-25)	Tier II (26-50)	Tier III (51-70)	Tier IV (71-90)	Tier V (91-100)
Audit Data Collection	Launch auditing and loss control team; address supply metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs; Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon with Pls for performance comparisons for real losses	Performance Benchmarking with Pls is meaningful in comparing real loss standing	Identify Best Practices/ Best in class; Pls are very reliable as real loss performance indicators for best in class service

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*



# AWWA Free Water Audit Software: Definitions

FWAS v6.0

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Item Name	Description
<p><b>Apparent Losses</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>= systematic data handling errors + customer metering inaccuracies + unauthorized consumption</p> <p>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).</p> <p>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses.</p>
<p><b>AUTHORIZED CONSUMPTION</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>= billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption</p> <p>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.</p> <p>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Typically a lag will exist between timing for reading of supply meters and reading of customer meters. A lag-time correction should typically be calculated to account for this. <b>Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.</b></p> <p>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled Unmetered Authorized Consumption)</p>
<p style="text-align: center;"><a href="#">View Service Connection Diagram</a></p> <p><b>Average Length of (private) Customer Service Line (Lp)</b></p> <p style="text-align: center;"><a href="#">Find</a></p>	<p>This is the average length of underground customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.</p> <p>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.</p> <p>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a total Lp length (Lc) and subsequently a weighted average Lp length for the entire system.</p> <p>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration.</p>

Item Name	Description
<p><b>Average Operating Pressure (AOP)</b></p> <p>Find</p>	<p>This is the average pressure in the distribution system that is the subject of the water audit. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.</p> <p>In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines.</p> <p>If your water utility has an up-to-date and calibrated hydraulic model of the water distribution system, it can be utilized to obtain a very accurate quantity of average pressure. However using the average pressure of all "nodes" in the system model is not necessarily the most accurate way to calculate the average operating pressure. This is especially true if there are significant pressure differences throughout the system, and the "nodes" are not evenly distributed throughout the distribution system. The most accurate calculation is to obtain the average pressure that each pipe segment experiences. The way to do this is to calculate the pressure at each end of the pipe. Then calculate the average of those two values and multiply this average value by the length of that pipe. This must be calculated for all pipe segments in the model. Finally calculate the sum of all of these values and divide by the total pipe length. This effectively calculates a weighted average of pressure over the total pipe length. For low density systems (&lt;32 connections/mile), average mains pressures at the service connection or curb stop may have greater influence and should be considered.</p>
<p><b>Billed Authorized Consumption</b></p>	<p>All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.</p>
<p><b>Billed Metered Authorized Consumption (BMAC)</b></p> <p>Find</p>	<p>All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. <b>It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.</b> The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant.</p>
<p><b>Billed Unmetered Authorized Consumption (BUAC)</b></p> <p>Find</p>	<p>All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined <u>by utility policy</u> to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. <b>This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.</b></p>
<p><b>Customer Metering Inaccuracies (CMI)</b></p> <p>Find</p>	<p>Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial, institutional and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.</p> <p>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for <u>all</u> customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.</p> <p>Note that a value of zero will be accepted but is not recommended, as all metered systems tend to have some degree of inaccuracy. A positive value should be entered. A value of zero in this component is generally valid only if the water utility does not meter its customer population.</p> <p>The formula for calculating a volume of CMI from a percentage input is as follows: <math>CMI \text{ volume} = (BMAC+UMAC)/(1-CMI\%)-(BMAC+UMAC)</math></p>

Item Name	Description
<p><b>Customer Retail Unit Charge (CRUC)</b></p> <p><a href="#">Find</a></p>	<p>The Customer Retail Unit Charge represents the volumetric portion of the total charges that customers pay for water service. The CRUC does not include fixed charges. This unit charge cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different charges costs based upon class of customer, a volume-weighted average of water sold at each unique rate should be calculated to determine a single composite charge that should be entered into this cell. Finally, the weighted average charge should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed.</p> <p>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Charge Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.</p> <p>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either \$/1,000 gallons, \$/hundred cubic feet, or \$/1,000 litres) and automatically converts these units for purpose of calculating Apparent Loss valuations. The monetary units are United States dollars, \$.</p>
<p><b>Infrastructure Leakage Index (ILI)</b></p> <p><a href="#">Find</a></p>	<p>The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). This performance indicator is dimensionless.</p> <p><b>NOTES ON THE UARL AND ILI:</b></p> <p>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (&lt; 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.</p> <p>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed.</p>
<p><b>Length of Mains (Lm)</b></p> <p><a href="#">Find</a></p>	<p>Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:</p> <p>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ]</p> <p style="text-align: center;">or</p> <p>Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ]</p>
<p><b>NON-REVENUE WATER</b></p> <p><a href="#">Find</a></p>	<p>= Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility.</p>
<p><b>Number of Service Connections (Nc)</b></p> <p><a href="#">Find</a></p>	<p>Number of customer service connections, extending from the water main to supply water to a customer. This includes the actual number of pressurized piping connections, including fire connections, <b>whether active or inactive</b>. This may differ substantially from the number of customers (or number of accounts). <b>Note: this number does not include the pipeline leads to fire hydrants. The total length of piping supplying fire hydrants should be included in the "Length of mains" input, and excluded from the Number of service connections input.</b></p>
<p><b>Real Losses</b></p> <p><a href="#">Find</a></p>	<p>Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.</p>
<p><b>Revenue Water</b></p>	<p>Those components of System Input Volume that are billed and have the potential to produce revenue.</p>
<p><b>Service Connection Density</b></p> <p><a href="#">Find</a></p>	<p>=number of customer service connections / length of mains</p>

Item Name	Description
<p><b>Systematic Data Handling Errors (SDHE)</b></p> <p><a href="#">Find</a></p>	<p>Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. <b>Systematic Data Handling Errors occur as a customer consumption volume and can result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.</b></p> <p>Utilities typically measure water consumption volumes registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the registered consumption volume value being less than the actual consumption volume, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.</p> <p>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption volume, thus under-stating the actual consumption. Account activation lapses may allow new buildings to begin using water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building water service commencing without a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors &amp; data handling errors.</p> <p>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Negative or zero values are not allowed for this audit component.</p> <p>Note: occasionally billed consumption volumes for a customer account may be over-stated due to issues of double-counting an account or applying an over-stated meter multiplier. The possibility of such occurrences should be explored in the data validation process, particularly if billed authorized consumption volumes for the year, or for any sub-group of customers (by classification or meter size), appears to be inordinately high. It is recommended to correct any such errors in the billed consumption total for the year, rather than consider these volumes part of Systematic Data Handling Error.</p>
<p><b>Total annual operating cost (optional input)</b></p> <p><a href="#">Find</a></p>	<p>*This input has been made optional, as it is no longer used in calculating a Performance Indicator. Auditors are welcome to continue to track this input as desired.* These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.</p>
<p><b>Unauthorized Consumption (UC)</b></p> <p><a href="#">Find</a></p>	<p>Includes water illegally withdrawn from fire hydrants, illegal connections, by-passes to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended to use the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities tend to have some volume of unauthorized consumption occurring in their system.</p>

Item Name	Description								
<p><b>Unavoidable Annual Real Losses (UARL)</b></p> <p><a href="#">Find</a></p>	<p>The UARL is a theoretical reference value representing the technical low limit of leakage for well managed systems in good condition, with aggressive active leakage control. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI).</p> <p>UARL (gallons) = <math>(5.41L_m + 0.15N_c + 7.5L_c) \times P \times 365</math> d/year,  or  UARL (litres) = <math>(18.0L_m + 0.8N_c + 25.0L_c) \times P \times 365</math> d/year</p> <p>where:  L<sub>m</sub> = length of mains (miles or kilometres)  N<sub>c</sub> = number of customer service connections  L<sub>p</sub> = the average length of customer service connection piping (feet or metres)  (see the Worksheet "Service Connection Diagram" for guidance on deterring the value of L<sub>p</sub>)  L<sub>c</sub> = total length of customer service connection piping (miles or km)  L<sub>c</sub> = N<sub>c</sub> X L<sub>p</sub> (miles or kilometres)  P = Average operating pressure (psi or metres) (see Average Operating Pressure definition)</p> <p><b>NOTES ON THE UARL AND ILI:</b></p> <p>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (&lt; 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.</p> <p>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed.</p>								
<p><b>Unbilled Authorized Consumption</b></p>	<p>All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Authorized Consumption (UMAC) + Unbilled Unmetered Authorized Consumption (UUAC). See "Authorized Consumption" for more information.</p>								
<p><b>Unbilled Metered Authorized Consumption (UMAC)</b></p> <p><a href="#">Find</a></p>	<p>Metered consumption which is authorized by the water utility, but, for any reason, is <u>deemed by utility policy</u> to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. <b>It does <u>not</u> include water supplied to neighboring utilities (water exported) which may be metered but not billed.</b></p>								
<p><b>Unbilled Unmetered Authorized Consumption (UUAC)</b></p> <p><a href="#">Find</a></p>	<p>Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component.</p> <p>This component does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. Also, if any potable water used at a water treatment plant is tapped from a location <u>upstream</u> of the meter(s) used to determine the Volume from Own Sources in the audit, this is outside of the boundary of the audit and should therefore not be included as part of Unbilled, Unmetered Authorized Consumption.</p> <p>This component has many sub-components of water use which may not yet be quantified. The default is 0.25% of the Billed Authorized Consumption volume (BMAC + BUAC), and is recommended for temporary use if customized estimates are not yet available, with recommendation to begin tracking and estimating these volumes for the next audit.</p> <p>Note that a value of zero is not permitted, since all water utilities likely have some volume of water in this component occurring in their system.</p>								
<p><b>Units and Conversions</b></p>	<p>The user may develop an audit based on one of three unit selections:</p> <ol style="list-style-type: none"> <li>1) Million Gallons (US)</li> <li>2) Megalitres (Thousand Cubic Metres)</li> <li>3) Acre-feet</li> </ol> <p>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units):</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Enter Units:</td> <td style="text-align: center;">Convert From...</td> <td style="text-align: center;">=</td> <td style="text-align: center;">Converts to.....</td> </tr> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">Million Gallons (US)</td> <td style="text-align: center;">=</td> <td style="text-align: center;">306.888329 Acre-feet</td> </tr> </table>	Enter Units:	Convert From...	=	Converts to.....	100	Million Gallons (US)	=	306.888329 Acre-feet
Enter Units:	Convert From...	=	Converts to.....						
100	Million Gallons (US)	=	306.888329 Acre-feet						

Item Name	Description
	(conversion factor = 3.0689)
<p data-bbox="66 317 212 436"><b>Variable Production Cost (VPC)</b> (applied to Real Losses)</p> <p data-bbox="87 457 191 499">Find</p>	<p data-bbox="224 296 1495 344">The cost to produce and supply the next unit of water (e.g., \$/million gallons). This cost can include both short-run and long-run marginal costs. See the VPC data grading questions on IDG tab for examples of short-run and long-run marginal costs that may be included.</p> <p data-bbox="224 373 1495 449">It is common to apply the VPC unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor may be justified in applying the Customer Retail Unit Charge to the Real Loss volume, rather than applying the Variable Production Cost.</p>
<p data-bbox="66 699 201 772"><b>Volume from Own Sources (VOS)</b></p> <p data-bbox="87 783 191 825">Find</p>	<p data-bbox="224 554 1495 680">The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured as treated effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works.</p> <p data-bbox="224 684 1495 810">Water treatment plants are also often supplied potable drinking water and therefore are a "customer" of the water utility. If the service connection line serving the water treatment plant is downstream of treated water effluent flowmeters, this water should be metered and billed as billed authorized consumption. In this case, this volume of water does not enter into any calculations for Volume from Own Sources. If the service connection line supplying potable water to the treatment plant is upstream of treated water effluent flowmeters, then this water is considered "process" water and included with calculations accounting for process water use.</p> <p data-bbox="224 814 1495 911">If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, plant potable water consumption (if the supply is drawn upstream of effluent flowmetering.) and similar uses. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source.</p>
<p data-bbox="66 972 212 1045"><b>Volume from own sources: error adjustment</b></p> <p data-bbox="87 1098 191 1140">Find</p>	<p data-bbox="224 957 1495 1163">An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common. Enter a <u>positive</u> percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. <b>See Water Supplied Error Adjustments definition for guidance on how to calculate this input.</b></p>
<p data-bbox="66 1318 207 1371"><b>Water Exported (WE)</b></p> <p data-bbox="87 1392 191 1434">Find</p>	<p data-bbox="224 1199 1495 1295">The Water Exported volume is the bulk water conveyed or sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling or transferring the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells or transfers bulk water in this manner, they are an exporter of water.</p> <p data-bbox="224 1325 1495 1476">Note: The Water Exported volume is typically sold to wholesale customers who are charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. <b>Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Worksheet. This volume should be included only in the Water Exported box.</b></p>
<p data-bbox="66 1602 212 1675"><b>Water Exported: Error Adjustment (WEEA)</b></p> <p data-bbox="87 1696 191 1738">Find</p>	<p data-bbox="224 1518 1495 1749">An estimate or measure of the volume by which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. <b>See Water Supplied Error Adjustments definition for guidance on how to calculate this input.</b></p>
<p data-bbox="66 1801 207 1854"><b>Water Imported (WI)</b></p> <p data-bbox="87 1875 191 1917">Find</p>	<p data-bbox="224 1801 1495 1898">The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water wholesale supplier, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate.</p>

Item Name	Description
<p><b>Water Imported: Error Adjustment (WIEA)</b></p> <p>Find</p>	<p>An estimate or measure of the volume by which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. <b>See Water Supplied Error Adjustments definition for guidance on how to calculate this input.</b></p>
<p><b>Water Supplied Error Adjustments</b></p> <p>Find</p>	<p><b>Disclaimer:</b> The guidance provided below should be considered general, representing a typical approach to determining Error Adjustment. Supply metering setups, metering technologies, instrumentation, data recording/archival, and data management systems can vary significantly from one water utility to the next. Inherent margins of error will also vary among different testing and calibration methods and the measurement systems being tested. Other factors that may be important include, but are not limited to, frequency of testing and calibration practices, data communication outages in the audit period, tested flowrates versus typical operating flowrates, and test durations. All of these factors must be considered when assessing Error Adjustment for the Water Supplied inputs. Each specific situation should be carefully analyzed to determine the most appropriate approach for determining the Error Adjustment to input, if any.</p> <p><b>General:</b> For the Water Supplied inputs, there are three typical sources of error that may warrant an Error Adjustment on the Worksheet.</p> <ol style="list-style-type: none"> <li><b>1. Meter error:</b> measurement inaccuracy in the meter(s) used to derive the input volume, typically identified through in-situ flow accuracy testing. Applicable for VOS, WI and WE. If no such testing has been performed, adjustment for meter error is not typically recommended.</li> <li><b>2. Data transfer error:</b> inaccuracy in archived volumes, typically due to gaps in data, programming errors impacting unit conversions, and/or programming errors impacting totalization of measured volumes over the audit period. Applicable for VOS, WI and WE. These errors are typically identified through electronic calibration to verify data transfer at the secondary device (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or the tertiary device (i.e. SCADA, historian or other computerized archival system).</li> <li><b>3. Net distribution storage change:</b> The difference between end of audit period and beginning of audit period for total finished water stored, downstream of the system input meter(s). Typically applicable for VOS or WI. This volume is typically derived by comparing distribution storage tank water levels at end and beginning of the water audit period and using approximate tank geometry to convert levels to volumes.</li> </ol> <p><b>Derivation Guidance:</b></p> <p>If an Error Adjustment input is being calculated as a <u>volume</u>, each source of error (described above) may be separately calculated, with careful consideration of under- vs over-registration, then added together to determine the composite <u>volume</u> to input. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.</p> <p>If an Error Adjustment input is being calculated as a <u>percent</u>, some very general guidance for calculating each error source (described above) is provided below. The auditor is again cautioned that each specific water supply setup needs to be evaluated closely as noted in the <u>Disclaimer</u>. Refer to the latest AWWA M36 Manual for additional discussion and guidance on this matter.</p> <ol style="list-style-type: none"> <li><b>1. Meter error:</b> If in-situ flow accuracy testing has been performed, and inherent testing method error is understood, first the <i>meter accuracy %</i> may be determined as follows:  <math display="block">\text{meter accuracy \%} = \text{System input meter(s) volume} / \text{Reference volume}</math> <p>Then, the <i>meter error %</i> may be determined as follows:  <math display="block">\text{meter error \%} = \text{meter accuracy \%} - 100\%</math></p> </li> <li><b>2. Data transfer error:</b> If electronic calibration at the secondary (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or tertiary (i.e. SCADA, historian or other computerized archival system) devices has been performed, first the <i>data transfer accuracy %</i> may be determined as follows:  <math display="block">\text{data transfer accuracy \%} = \text{Tertiary device volume} / \text{Reference volume (typically at Secondary device)}</math> <p>Then, the <i>data transfer error %</i> may be determined as follows:  <math display="block">\text{data transfer error \%} = \text{data transfer accuracy \%} - 100\%</math></p> <p>If no error is identified, or if electronic calibration has not been performed, or if no secondary or tertiary devices exist, a <i>data transfer error %</i> adjustment is not typically recommended.</p> </li> <li><b>3. Net distribution storage change.</b> If meter error and/or data transfer error are being calculated as a %, it is recommended to make the adjustment for net distribution storage change as a volume adjustment, directly in the VOS or WI input, as applicable.</li> </ol> <p>The final step is to add <i>meter error %</i> and <i>data transfer error %</i>:  <math display="block">\text{Error Adjustment \%} = \text{meter accuracy \%} + \text{data transfer error \%}</math></p> <p>If the total Error Adjustment % calculates out as a negative number, it represents an under-registration. Vice versa, if positive. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.</p>

Item Name	Description
<p><b>WATER LOSSES</b></p> <p><a href="#">Find</a></p>	<p>= apparent losses + real losses = water supplied - authorized consumption</p> <p>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA), if one of these configurations are the basis of the water audit.</p>



**Average Length of Customer Service Line**

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line,  $L_p$ , for the three most common piping configurations.

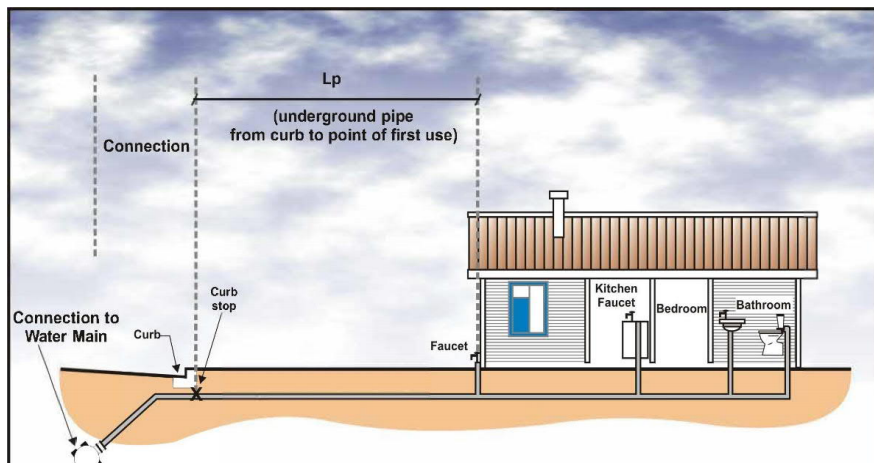
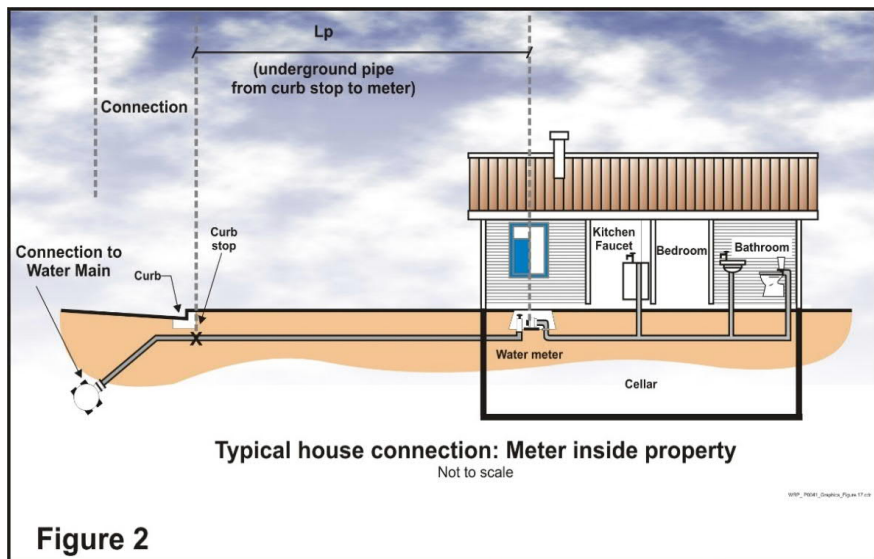
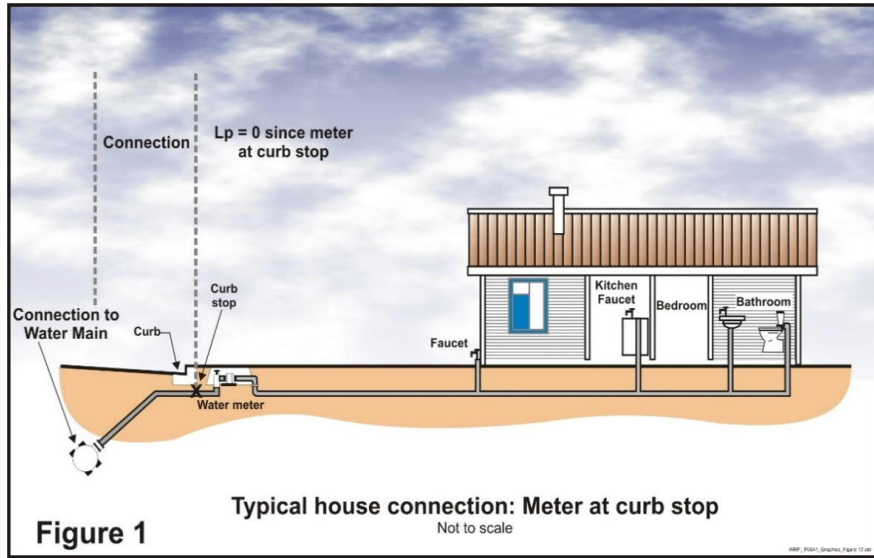
**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration  $L_p = 0$  since the distance between the curb stop and the customer metering point is essentially zero.

**Figure 2** shows the configuration of the customer water meter located inside the customer building, where  $L_p$  is the distance from the curb stop to the water meter.

**Figure 3** shows the configuration of an unmetred customer building, where  $L_p$  is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the  $L_p$  will vary notably in a community of different structures, therefore the average  $L_p$  value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

[Click for more information](#)



**Figure 3**

**Typical house connection: Unmetered**  
Not to scale



American Water Works Association

Dedicated to the World's Most Important Resource®

AWWA Free Water Audit Software - Version 6.0

developed by the Water Loss Control Committee of the American Water Works Association December 2020



World Water Loss Day 4th December

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

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A special thanks to those members of the AWWA Water Loss Control Committee and other water industry stakeholders who assisted in the review and testing of this software.

REFERENCES:

1. Kunkel, G., G. Trachtman, A. Wyatt, and W. Jernigan. Water Loss Control Committee Report: Key Performance Indicators for Non-Revenue Water—AWWA's 2020 Position . 2020. Journal AWWA. https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/awwa.1428
2. Kunkel, G. et al. AWWA WLCC Reference Water Audit Dataset. 2020. AWWA. Denver, CO.
3. AWWA Water Audits and Loss Control Programs, M36 Publication. 5th Edition, (forthcoming) 2021. AWWA. Denver, CO.
4. Trachtman G., A. Wyatt, et al. 2019. Assessment of Performance Indicator for Non-Revenue Water Target Setting and Progress Tracking . AWWA. Denver, CO.
5. Trachtman G., A. Wyatt, et al. 2019. WRF 4695: Guidance on Implementing an Effective Water Loss Control Plan . Water Research Foundation. Denver, CO.
6. Lambert, A. 2020. Low ILLs and Small Systems. Llandudno, UK. https://leakssuitelibrary.com
7. Good Practices on Leakage Management, Main Report . EU Reference Document. European Commission, Luxembourg. 2015.
https://circabc.europa.eu/sd/a/1ddfb34-e1ce-4888-b031-6c559cb28e47/Good%20Practices%20on%20Leakage%20Management%20-%20Main%20Report\_Final.pdf
https://circabc.europa.eu/sd/a/ec13ae01-7800-4114-8d72-98827b509e18/Good%20Practices%20on%20Leakage%20Management%20-%20Case%20Study%20document\_Final.pdf
8. Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.
9. Sturm, R., W. Jernigan, C. Stief, and D. Blackwell. Level 1 Water Audit Validation Guidance Manual . 2nd Edition, (forthcoming) 2021. Project #5057. Denver: Water Research Foundation.

**VERSION HISTORY:**

<b>Version:</b>	<b>Release Date:</b>	<b>Number of Worksheets:</b>	<b>Key Features and Developments</b>
v1	2005/2006	5	The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated.
v2	2006	5	The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses.
v3	2007	7	In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit.
v4 - v4.2	2010	10	v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the required data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknowledgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2.
v5	2014	12	In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used.

v6	2020	11	<p>v6 brings an overhaul to the user interface for data grading, now presented as a series of questions on the Interactive Data Grading (IDG) tab for each input that, when answered (by selecting best-fit answer from a dropdown menu), automatically determines the data grade for the given input. This provides transparency to the data practices selected and which specifically are limiting, removes subjectivity in data grade assignments, and provides clarity on candidate next steps for data validity improvements. IDG tab includes navigation buttons across top banner for ease of movement between inputs, and color signals for completion. The Worksheet (fka Reporting Worksheet) includes overt designation of error adjustment as "under" or "over" for the 3 Water Supplied inputs, as well as Customer Metering Inaccuracies. This makes the convention consistent, transparent, and reduces chance of user error. A Blank Sheet has been added allowing the user to, as desired, perform supplemental calculations or capture additional relevant information. The Dashboard has been overhauled to include Data Validity, NRW Components and Key Performance Indicators (KPIs). KPIs are presented in gauge format, depicting the specific KPI result against the range of results from Level 1 validated data in North America (see Web Resources, Start Page). Percentage-based indicators (% of supply, % of cost) removed as these indicators were deemed unreliable and sunset by the AWWA Water Loss Control Committee, subsequent to research and reporting from its NRW Performance Indicators Task Force.</p>
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If you have questions or comments regarding the software please contact us via email at: [wlc@awwa.org](mailto:wlc@awwa.org)

Water Supplied			Notes
Volume from Own Sources	23,550.48	MG	See "Volume from Own Sources Tab"
Water Imported	N/A	MG	No Water Imported
Water Exported	850.24	MG	Water sold to neighboring water systems outside service area. See "Water Exported" tab.

Water Consumption			Notes
Billed Metered	6,883.83	MG	See "Billed Metered" tab.
Billed Unmetered	27.04	MG	See "Billed Unmeter" tab.
Unbilled Metered	6.57	MG	See "Unbilled Metered" Tab
Unbilled Unmetered	153.60	MG	See "Unbilled Unmetered" Tab

System Data			Notes
Length of Mains	963.23	miles	Supplied by GIS (Jackson Stoss).
Service Connections	81,996	connections	Supplied by GIS (Jackson Stoss).
Average Length of Service Line	48.10	feet	Supplied by GIS (Jackson Stoss).
Average Operating Pressure	60	psi	Value from 2018 Audit. Steady state pressure over 63,000+ nodes.

Cost Data		Notes
Annual Operating Cost	\$ 63,620,011.95	See "Annual Operating Cost" tab.
Customer Retail Unit Cost	\$ 24.42	See "Customer Retail Unit Cost" tab.
Variable Production Cost	\$ 324.47	Report this value in audit.(Total Cost/Total Consumption; \$/MG)

### 500. WATER DELIVERED INTO SYSTEM DURING YEAR

Every estimated value shall be supported by such detailed information as will permit a ready identification, analysis, & verification of all relevant facts. The Company shall be prepared to furnish to the Commission this detailed information.

Line No.	Description (a)	(Gallons) (b)	(gpd) (c)
1	<b>Water Delivered for Distribution &amp; Sale:</b>		-
2	Water Obtained from Company Sources	23,550,476,783	64,521,854
3	Water Obtained from Other Independent Utilities	0	0
4	<b>Total Water Delivered</b>	<b>23,550,476,783</b>	<b>64,521,854</b>
5	<b>Metered Sales:</b>		
6	Residential Residential and CAP	2,850,085,000	7,808,452
7	Commercial	2,843,472,000	7,790,334
8	Industrial	185,868,000	509,227
9	Public Health & Education	987,429,000	2,705,285
10	Other Water Utilities	850,243,000	2,329,433
11	Private Fire Protection	15,403,000	42,200
12	Public Fire Protection		0
13	Other Metered Sales Identify Flower Gardens	1,573,000	4,310
14	<b>Total Metered Sales</b>	<b>7,732,500,000</b>	<b>21,184,932</b>
15	<b>Unmetered Sales:</b>		
16	Residential	27,040,000	74,082
17	Commercial		0
18	Industrial	0	0
19	Private Fire Protection	0	0
20	Public Fire Protection		0
21	Other Unmetered Sales Identify	0	0
22	<b>Total Unmetered Sales</b>	<b>27,040,000</b>	<b>74,082</b>
22	<b>Total Sales</b>	<b>7,759,540,000</b>	<b>21,259,014</b>
23	<b>Non-Revenue Usage Allowances:</b>		
24	<b>Authorized Unmetered Usage:</b>		
25	Main Flushing	17,277,000	47,334
26	Blow-off Use		0
27	Others: Identify Reservoir & Rising Main Flushing	136,302,797	373,432
28	Unauthorized Use	17,277,000	47,334
29	Unavoidable Leakage 44,315 gpd/mile of main	16,174,975	44,315
30	Adjustments:		
31	Located & Repaired Breaks in Mains & Services	5,324,893,655	14,588,750
32	Others Identify Emergency Backwash Procedure	10,532,507	28,856
33	<b>Total Allowances &amp; Adjustments</b>	<b>5,522,457,935</b>	<b>15,130,022</b>
34	<b>Unaccounted-for-Water</b>	<b>10,268,478,848</b>	
35	<b>Percentage Unaccounted-for-Water</b>	<b>43.6%</b>	

	Filter Backwash (gallons)	Filter Effluent Flow	WTP Effluent	Aspinwall 103	Aspinwall 104	RM 3	RM 4	MFP 1	MFP 2	System Delivery/WTP Effluent %	System Delivery (MGD)
1/1/2020	1,555,312.99	74.92	73.36	-	17.01	17.02	13.33	21.32	7.56	104%	76.24
1/2/2020	2,705,986.26	68.61	65.90	-	17.00	12.00	9.44			58%	38.44
1/3/2020	2,060,065.75	76.30	74.24	-	16.94	15.51	12.14	20.20	10.69	102%	75.49
1/4/2020	2,076,825.38	70.65	68.57	-	17.06	14.08	11.05	18.65	9.93	103%	70.77
1/5/2020	1,938,464.05	72.82	70.88	-	17.08	14.31	11.26	18.74	10.06	101%	71.45
1/6/2020	2,136,477.95	68.94	66.81	-	17.03	12.27	9.67	21.69	7.66	102%	68.32
1/7/2020	2,015,409.71	71.52	69.50	-	17.02	12.38	9.77	24.17	5.19	99%	68.54
1/8/2020	2,644,657.61	71.18	68.53	-	17.01	13.32	10.55	24.72	3.20	100%	68.80
1/9/2020	2,467,267.75	76.09	73.62	-	16.92	16.96	13.32	23.68	4.36	102%	75.24
1/10/2020	1,996,676.45	71.12	69.13	-	16.96	9.59	7.59	24.43	5.01	92%	63.57
1/11/2020	2,326,515.44	72.10	69.77	-	16.98	16.87	13.21	23.41	5.55	109%	76.02
1/12/2020	2,005,969.29	74.16	72.16	-	16.99	14.46	11.34	23.91	4.42	99%	71.13
1/13/2020	2,248,119.83	72.83	70.58	-	17.06	12.24	9.62	27.52	1.25	96%	67.69
1/14/2020	2,617,277.62	68.14	65.52	-	17.06	11.47	9.03	27.18	1.81	102%	66.56
1/15/2020	1,917,100.67	77.13	75.21	-	17.05	12.58	9.89	24.61	4.06	91%	68.18
1/16/2020	2,229,158.16	72.96	70.73	-	17.03	11.72	9.23	23.66	5.51	95%	67.15
1/17/2020	2,218,428.37	70.83	68.61	-	17.10	14.44	11.36	22.33	7.32	106%	72.54
1/18/2020	2,086,532.83	70.09	68.00	-	17.04	14.09	11.11	20.75	8.07	105%	71.06
1/19/2020	2,540,908.10	69.33	66.79	-	17.05	12.51	9.93	20.67	7.69	102%	67.85
1/20/2020	2,039,704.80	71.70	69.66	-	17.04	12.18	9.67	24.54	2.67	95%	66.10
1/21/2020	2,174,883.37	65.95	63.77	-	17.07	10.54	8.40	26.78	1.66	101%	64.45
1/22/2020	1,869,256.38	71.06	69.19	-	16.99	13.43	10.60	27.34	1.19	101%	69.55
1/23/2020	2,423,453.09	71.24	68.82	-	17.05	12.77	10.10	26.06	2.72	100%	68.69
1/24/2020	1,427,843.09	71.51	70.09	-	17.04	14.31	11.25	24.79	4.04	102%	71.42
1/25/2020	1,882,988.81	71.06	69.18	-	17.01	10.71	8.48	22.96	5.98	94%	65.13
1/26/2020	1,951,388.60	71.03	69.08	-	17.03	16.51	12.95	21.36	7.68	109%	75.52
1/27/2020	2,601,170.54	70.84	68.24	-	17.12	11.09	8.78	22.72	7.49	98%	67.20
1/28/2020	1,509,636.76	75.92	74.41	-	17.04	14.07	11.05	23.24	6.65	97%	72.04
1/29/2020	2,057,741.40	70.79	68.74	-	17.08	14.85	11.69	22.58	6.83	106%	73.02
1/30/2020	1,692,984.34	73.40	71.71	-	17.10	12.98	10.26	24.45	4.78	97%	69.57
1/31/2020	2,018,860.10	75.09	73.07	0.00	17.09	15.33	12.05	25.79	2.52	100%	72.77
2/1/2020	2,538,924.93	75.62	73.08	-	17.07	16.93	13.28	24.22	4.31	104%	75.81
2/2/2020	2,397,239.21	73.69	71.30	-	17.11	13.75	10.83	21.59	7.40	99%	70.68
2/3/2020	2,220,317.13	69.95	67.73	-	17.08	10.53	9.58	21.67	8.62	100%	67.48
2/4/2020	1,893,506.77	73.90	72.01	0.00	17.04	13.86	17.24	21.56	8.75	109%	78.45
2/5/2020	1,925,760.87	72.72	70.79	8.27	10.23	8.47	9.96	20.38	8.58	93%	65.90
2/6/2020	2,617,426.87	72.92	70.30	13.99	0.02	13.91	17.31	20.69	9.27	107%	75.18
2/7/2020	2,466,685.06	69.61	67.15	14.07	0.02	10.94	13.68	20.45	9.28	102%	68.44
2/8/2020	2,030,630.59	68.60	66.57	14.03	0.02	10.24	12.81	20.34	9.44	100%	66.88
2/9/2020	2,097,758.77	72.46	70.36	14.06	0.02	11.37	14.20	19.80	8.78	97%	68.22
2/10/2020	2,466,314.32	70.17	67.71	14.01	0.02	10.88	13.57	20.85	8.67	100%	68.00
2/11/2020	2,107,724.67	70.63	68.53	14.13	0.02	11.31	13.53	23.34	6.10	100%	68.43
2/12/2020	2,529,427.53	71.65	69.12	14.08	0.02	11.58	14.44	23.46	5.84	100%	69.42
2/13/2020	2,680,297.37	75.10	72.42	14.09	0.02	11.49	14.33	24.13	5.24	96%	69.28
2/14/2020	1,448,280.57	70.53	69.08	14.09	0.01	12.56	15.66	23.23	6.16	104%	71.72
2/15/2020	2,084,274.29	65.51	63.43	14.04	0.01	8.91	11.21	23.16	5.98	100%	63.32
2/16/2020	2,699,475.53	69.73	67.03	14.09	0.01	11.32	14.13	23.20	5.90	102%	68.65
2/17/2020	2,349,263.91	72.32	69.97	14.12	0.01	11.58	14.44	22.71	7.42	100%	70.29
2/18/2020	1,619,655.49	69.50	67.88	14.11	0.01	11.33	14.13	21.35	8.26	102%	69.19
2/19/2020	1,440,384.15	71.28	69.84	14.10	0.01	13.08	12.76	20.26	8.80	99%	69.02
2/20/2020	2,433,567.76	73.71	71.28	14.06	0.01	16.90	13.30	19.59	9.73	103%	73.59
2/21/2020	2,482,088.09	73.38	70.90	13.99	0.01	13.31	10.50	18.41	10.74	94%	66.95
2/22/2020	2,093,947.41	69.39	67.29	14.11	0.01	12.03	13.02	18.71	10.83	102%	68.70
2/23/2020	1,419,527.41	72.66	71.24	14.04	0.01	13.27	10.47	20.00	10.51	96%	68.31
2/24/2020	1,901,333.69	78.45	76.55	14.02	0.01	14.19	11.15	19.65	10.88	91%	69.91
2/25/2020	2,435,027.84	72.83	70.40	13.99	0.61	14.91	11.68	18.84	11.17	101%	71.20
2/26/2020	2,682,086.23	71.38	68.70	14.04	0.02	13.32	10.46	19.26	10.76	99%	67.84
2/27/2020	1,138,302.45	69.11	67.97	14.14	0.02	12.61	12.09	19.53	10.70	102%	69.09
2/28/2020	2,274,234.77	68.36	66.09	14.12	0.02	10.95	13.68	18.56	10.67	103%	67.99
2/29/2020	2,100,003.24	68.05	65.95	14.09	0.02	10.41	13.03	18.98	10.34	101%	66.87
3/1/2020	2,784,733.06	68.31	65.53	14.09	0.02	9.45	11.85	19.22	10.34	99%	64.97
3/2/2020	1,978,535.53	70.57	68.59	14.00	0.02	13.14	16.30	18.74	10.70	106%	72.89
3/3/2020	2,079,570.06	70.26	68.18	14.08	0.03	9.39	11.54	19.14	10.80	95%	64.99
3/4/2020	2,613,567.83	71.63	69.02	14.17	0.02	12.34	15.33	18.76	10.41	103%	71.03
3/5/2020	2,049,647.09	67.85	65.80	14.02	1.55	10.37	12.74	19.07	10.56	104%	68.30
3/6/2020	1,932,190.18	68.53	66.60	14.06	0.02	9.26	11.25	19.67	10.45	97%	64.70
3/7/2020	1,448,009.73	68.59	67.15	14.16	0.02	11.63	14.08	19.21	9.00	101%	68.10
3/8/2020	2,455,165.15	63.94	61.49	14.14	0.02	11.52	13.98	19.20	9.04	110%	67.91
3/9/2020	2,455,165.15	72.21	69.75	12.59	0.01	12.84	14.73	20.18	10.39	101%	70.75
3/10/2020	2,297,885.66	76.77	74.47	-	0.00	23.80	21.14	20.24	9.69	101%	74.87
3/11/2020	2,016,333.58	75.02	73.00	-	0.00	17.29	13.50	21.90	8.05	83%	60.74
3/12/2020	2,364,134.31	64.72	62.35	-	0.00	18.62	15.43	24.50	5.45	103%	64.00
3/13/2020	2,364,134.31	66.26	63.89	-	0.00	18.07	14.74	23.88	5.74	98%	62.43
3/14/2020	2,332,670.69	68.01	65.68	-	0.00	18.68	15.56	22.21	7.42	97%	63.87
3/15/2020	2,332,670.69	65.28	62.94	-	0.00	16.92	13.28	21.51	8.28	95%	59.99
3/16/2020	1,989,927.17	67.39	65.40	6.43	6.91	14.30	12.27	20.92	9.14	107%	69.97
3/17/2020	1,867,038.37	75.86	73.99	-	17.24	17.50	14.27	19.66	10.09	106%	78.76
3/18/2020	1,934,460.64	76.09	74.16	-	17.16	12.28	12.19	20.08	9.84	96%	71.56
3/19/2020	2,064,239.26	72.06	70.00	-	17.07	8.91	8.54	20.67	9.56	93%	64.75
3/20/2020	2,536,493.06	72.54	70.01	-	17.13	10.60	11.02	20.97	9.54	99%	69.25
3/21/2020	2,551,931.62	73.04	70.49	-	17.12	11.02	12.01	34.57	7.03	116%	81.76
3/22/2020	2,404,103.52	69.46	67.05	-	17.06	9.94	12.58	24.64	14.95	118%	79.17
3/23/2020	2,587,946.65	69.96	67.37	-	17.04	7.72	9.82	18.51	16.36	103%	69.44
3/24/2020	2,587,946.65	69.81	67.22	-	17.05	8.50	10.68	15.74	15.90	101%	67.87
3/25/2020	2,272,517.20	67.72	65.44	-	17.04	10.50	9.04	15.21	14.27	101%	66.05
3/26/2020	2,748,535.63	68.84	66.09	-	17.06	7.81	7.27	15.37	14.43	94%	61.94
3/27/2020	2,343,009.47	66.43	64.09	-	16.98	8.65	10.91	15.72	14.73	105%	66.99
3/28/2020	2,021,153.45	66.62	64.60	-	17.03	5.49	6.99	15.91	13.81	92%	59.23
3/29/2020	2,021,153.45	64.60	62.58	-	17.06	6.80	8.58	16.31	13.85	100%	62.60
3/30/2020	2,194,208.86	66.95	64.75	-	17.05	11.00	12.29	16.87	13.38	109%	70.60
3/31/2020	2,194,208.86	68.05	65.85	-	17.08	7.13	6.95	17.01	12.69	92%	60.87
4/1/2020	2,171,900.99	65.75	63.58	-	9.95	13.71	12.83	17.10	12.31	104%	65.90
4/2/2020	2,324,347.73	67.07	64.74	-	0.00	15.98	13.71	18.52	11.15	92%	59.36
4/3/2020	2,570,458.41	64.27	61.70	-	0.00	18.40	16.17	17.08	9.53	99%	61.19
4/4/2020	2,570,458.41	60.57	57.99	-	0.00	13.60	11.16	17.81	9.89	90%	52.45

5/13/2020	2,416,057.35	71.54	69.12	-	0.00	29.64	0.13	19.88	8.79	85%	58.45
5/14/2020	2,416,057.35	65.20	62.78	-	0.01	32.60	0.12	19.56	8.46	97%	60.74
5/15/2020	2,238,838.20	66.50	64.26	4.51	0.00	19.18	9.18	20.61	9.15	97%	62.64
5/16/2020	2,241,208.55	63.94	61.70	-	0.01	15.05	14.45	20.17	8.87	95%	58.55
5/17/2020	2,682,560.21	66.10	63.42	-	0.01	16.65	16.34	19.15	8.34	95%	60.49
5/18/2020	3,184,834.48	65.69	62.51	9.90	0.00	13.62	13.14	20.43	9.06	106%	66.15
5/19/2020	2,491,541.86	67.88	65.39	3.88	0.00	14.59	15.24	19.83	8.60	95%	62.15
5/20/2020	2,491,541.86	66.27	63.78	-	0.01	15.98	18.07	19.69	8.48	98%	62.24
5/21/2020	2,922,005.89	65.53	62.61	-	0.00	14.51	15.50	19.64	8.53	93%	58.18
5/22/2020	2,922,005.89	66.24	63.31	6.66	0.01	14.40	15.31	19.50	8.34	101%	64.21
5/23/2020	2,148,650.17	65.62	63.47	6.06	0.01	15.71	14.65	19.89	8.72	102%	65.02
5/24/2020	2,148,650.17	66.63	64.49	4.11	0.00	13.17	12.90	19.75	8.53	91%	58.46
5/25/2020	2,783,314.47	69.80	67.01	-	0.00	20.03	19.94	19.07	8.13	100%	67.18
5/26/2020	2,783,314.47	67.43	64.64	2.95	0.01	14.91	14.59	21.24	8.55	96%	62.23
5/27/2020	2,371,480.70	67.05	64.68	2.73	0.00	15.57	15.48	21.66	6.92	96%	62.37
5/28/2020	2,092,867.85	65.10	63.00	-	0.00	15.81	15.62	20.30	7.79	94%	59.54
5/29/2020	2,877,559.42	68.55	65.67	7.20	0.00	15.05	15.23	20.23	8.16	100%	65.87
5/30/2020	2,877,559.42	73.97	71.09	14.06	0.00	13.61	14.36	19.75	8.20	98%	69.99
5/31/2020	2,160,015.58	73.89	71.73	0.06	0.00	14.45	16.90	19.36	8.38	82%	59.16
6/1/2020	2,124,486.92	64.84	62.71	-	0.00	14.47	16.92	19.62	8.32	95%	59.33
6/2/2020	1,937,083.24	72.60	70.66	-	6.36	13.78	16.14	20.01	8.50	92%	64.78
6/3/2020	1,999,319.20	74.89	72.89	-	17.12	12.08	11.77	20.17	9.15	96%	70.29
6/4/2020	2,743,510.01	73.21	70.47	-	17.08	6.95	7.33	18.07	8.68	82%	58.11
6/5/2020	2,743,510.01	70.65	67.90	-	13.49	10.48	10.82	19.56	8.37	92%	62.72
6/6/2020	2,121,223.45	68.16	66.04	9.04	0.01	11.40	10.89	18.77	8.33	88%	58.43
6/7/2020	2,243,687.15	65.21	62.96	14.03	0.01	10.14	9.70	19.92	8.73	99%	62.52
6/8/2020	2,536,432.03	71.22	68.68	14.04	0.00	13.20	12.46	19.98	8.53	99%	68.21
6/9/2020	2,400,255.68	74.36	71.96	14.05	0.00	12.99	12.26	19.52	8.31	93%	67.13
6/10/2020	2,370,077.85	70.88	68.51	14.10	0.01	10.54	10.04	20.56	8.71	93%	63.96
6/11/2020	2,370,077.85	70.44	68.07	14.10	0.01	8.53	8.30	19.80	8.53	87%	59.26
6/12/2020	2,189,603.33	69.06	66.87	14.10	0.01	9.73	9.36	20.19	8.65	93%	62.04
6/13/2020	2,839,901.45	69.51	66.67	14.10	0.02	8.25	8.08	19.31	8.09	87%	57.84
6/14/2020	2,839,901.45	67.39	64.55	14.09	0.01	9.03	8.78	19.57	8.29	93%	59.78
6/15/2020	2,082,900.05	64.69	62.61	14.06	0.01	11.23	10.75	19.12	8.98	102%	64.16
6/16/2020	2,500,529.77	64.17	61.67	14.13	0.02	9.59	9.29	19.26	9.53	100%	61.83
6/17/2020	1,526,275.63	70.76	69.23	10.83	6.82	12.82	12.42	19.28	9.56	104%	71.73
6/18/2020	2,570,129.63	78.74	76.17	4.37	16.88	13.24	12.64	19.23	9.57	100%	75.93
6/19/2020	2,930,071.59	82.41	79.48	-	17.16	12.96	12.35	19.92	8.76	90%	71.15
6/20/2020	2,659,890.65	77.06	74.40	-	17.24	11.53	11.03	20.29	8.60	92%	68.69
6/21/2020	1,497,527.60	74.20	72.70	4.28	11.77	14.56	13.68	19.38	9.14	100%	72.80
6/22/2020	2,228,525.40	75.95	73.72	13.30	10.16	9.79	9.45	20.18	8.41	97%	71.29
6/23/2020	2,603,154.42	75.47	72.87	6.96	5.59	14.14	13.07	21.56	6.77	93%	68.09
6/24/2020	3,109,127.52	71.36	68.25	14.18	0.03	9.49	9.76	21.10	7.86	91%	62.43
6/25/2020	1,980,804.56	69.81	67.82	12.76	6.27	7.93	8.18	20.41	8.47	94%	64.02
6/26/2020	2,079,820.63	68.94	66.86	0.02	6.04	12.79	13.21	19.10	8.94	90%	60.10
6/27/2020	2,574,067.59	65.43	62.86	10.26	0.02	9.26	9.55	19.45	9.57	92%	58.12
6/28/2020	2,757,472.75	66.49	63.74	14.12	0.03	9.38	9.65	20.10	8.21	96%	61.48
6/29/2020	2,757,472.75	67.57	64.82	14.15	0.03	10.13	10.50	22.12	6.83	98%	63.75
6/30/2020	1,917,796.49	68.63	66.71	14.24	0.03	8.89	10.57	22.78	6.79	95%	63.30
7/1/2020	2,210,777.04	65.99	63.78	1.78	0.02	10.24	12.09	22.91	5.81	83%	52.85
7/2/2020	2,612,383.37	64.47	61.86	9.01	0.02	11.56	12.57	21.39	7.44	100%	61.99
7/3/2020	2,675,220.01	75.11	72.44	14.34	0.04	12.07	12.67	22.73	7.36	96%	69.22
7/4/2020	2,675,220.01	75.94	73.27	14.25	0.04	10.78	11.29	21.42	8.24	90%	66.02
7/5/2020	2,016,039.13	73.57	71.55	14.26	0.04	10.03	10.46	20.28	8.59	89%	63.65
7/6/2020	1,636,997.70	69.74	68.10	14.24	0.04	12.16	12.77	22.97	6.17	100%	68.35
7/7/2020	1,895,538.45	71.18	69.29	14.22	0.04	10.16	10.65	23.19	5.49	92%	63.76
7/8/2020	2,396,288.87	75.48	73.08	14.17	0.04	6.98	7.12	24.55	7.91	83%	60.77
7/9/2020	1,708,979.49	82.75	81.04	14.27	0.04	11.54	11.62	24.42	6.27	84%	68.16
7/10/2020	1,993,736.39	82.54	80.54	14.15	0.04	13.12	13.13	24.42	3.06	84%	67.93
7/11/2020	2,430,754.42	73.21	70.78	14.18	0.05	11.70	12.04	23.91	3.69	93%	65.55
7/12/2020	1,929,594.04	71.29	69.36	14.21	0.04	9.51	9.70	25.35	2.22	88%	61.03
7/13/2020	2,415,044.31	70.46	68.05	14.15	0.04	9.35	9.73	26.83	1.87	91%	61.96
7/14/2020	2,066,554.55	70.54	68.47	14.16	0.04	9.99	9.90	25.48	2.22	90%	61.80
7/15/2020	1,831,594.82	71.85	70.01	14.26	0.04	9.30	9.33	26.61	2.53	89%	62.06
7/16/2020	1,608,550.55	72.86	71.25	14.41	0.04	10.88	10.94	27.69	2.00	93%	65.95
7/17/2020	2,733,643.77	75.55	72.81	14.34	0.04	13.59	13.66	25.21	3.89	97%	70.74
7/18/2020	2,733,643.77	77.83	75.09	14.36	0.03	11.31	11.41	23.42	5.89	88%	66.42
7/19/2020	2,662,799.12	76.17	73.51	14.39	0.03	11.53	11.66	24.05	5.66	92%	67.32
7/20/2020	2,290,215.97	75.46	73.17	14.46	0.04	11.44	11.56	24.56	5.20	92%	67.25
7/21/2020	2,480,867.62	79.92	77.44	14.41	0.04	9.62	10.22	23.78	6.92	84%	65.00
7/22/2020	2,486,998.56	81.36	78.87	13.87	11.18	8.50	8.58	22.00	7.98	91%	72.12
7/23/2020	2,486,998.56	80.17	77.68	4.12	16.96	10.04	10.14	21.24	9.11	92%	71.62
7/24/2020	2,312,018.16	74.91	72.59	6.97	7.68	9.89	10.02	22.66	7.84	90%	65.05
7/25/2020	2,391,489.74	73.90	71.51	14.22	0.03	10.22	10.36	22.67	7.50	91%	65.00
7/26/2020	2,952,893.97	73.43	70.47	14.23	0.03	7.15	7.24	21.16	7.36	81%	57.18
7/27/2020	2,952,893.97	71.96	69.01	14.19	0.03	8.87	8.89	23.22	7.66	91%	62.87
7/28/2020	1,978,712.32	69.87	67.89	14.23	0.03	9.66	9.61	23.83	6.62	94%	63.99
7/29/2020	1,972,250.94	68.99	67.01	14.27	0.03	8.88	8.84	24.99	4.33	92%	61.34
7/30/2020	2,397,517.68	69.49	67.09	14.23	0.03	10.94	10.92	24.68	5.00	98%	65.80
7/31/2020	2,397,517.68	70.74	68.35	14.26	0.03	9.68	9.65	22.41	7.05	92%	63.07
8/1/2020	2,532,802.34	73.65	71.12	14.22	0.03	8.11	8.09	20.77	8.41	84%	59.62
8/2/2020	2,532,802.34	71.67	69.14	14.28	0.03	9.52	9.55	19.32	9.45	90%	62.14
8/3/2020	2,404,089.93	68.87	66.46	14.34	0.03	9.05	9.04	19.62	10.11	94%	62.18
8/4/2020	1,606,841.44	66.62	65.01	14.30	0.03	8.45	8.68	19.92	9.97	94%	61.36
8/5/2020	2,584,046.13	69.49	66.90	14.23	0.03	9.13	9.62	19.50	9.94	93%	62.45
8/6/2020	2,876,403.33	64.18	61.30	14.30	0.02	7.77	9.07	19.57	10.02	99%	60.75
8/7/2020	2,756,300.93	67.25	64.50	14.24	0.03	9.07	10.58	19.38	10.13	98%	63.43
8/8/2020	1,006,530.28	65.23	64.22	14.26	0.03	9.09	10.64	19.51	10.30	99%	63.83
8/9/2020	3,327,547.07	64.48	61.15	14.29	0.03	8.51	10.07	19.53	10.31	103%	62.74
8/10/2020	2,013,592.96	63.94	61.92	14.27	0.03	8.45	9.82	21.54	8.29	101%	62.40
8/11/2020	2,576,717.85	62.71	60.13	14.30	0.03	16.31	0.09	22.54	7.24	101%	60.51
8/12/2020	1,480,905.89	66.31	64.83	14.28	0.03	20.05	0.04	22.72	7.82	100%	64.94
8/13/2020	1,869,825.72	64.92	63.05	14.38	0.03	18.59	0.05	24.99	4.69	99%	62.73
8/14/2020	1,998,361.71	66.45	64.45	9.03	6.47	16.76	0.03	22.44	2.71	89%	57.44
8/15/2020	2,677,410.84	68.40	65.72	0.04	17.13	20.67	2.09	23.56	3.42	102%	66.90
8/16/2020	2,295,195.34	73.24	70.94	0.04							

9/26/2020	3,046,954.15	69.29	66.24	0.03	17.28	-	10.75	24.61	4.27	86%	56.94
9/27/2020	2,603,357.79	66.68	64.08	0.03	17.27	-	17.45	24.54	5.18	101%	64.46
9/28/2020	980,374.16	70.21	69.23	0.03	17.23	-	19.12	24.61	5.67	96%	66.66
9/29/2020	1,943,809.27	64.07	62.13	0.03	17.24	-	13.71	23.43	6.08	97%	60.48
9/30/2020	2,639,283.66	63.56	60.92	0.04	17.24	-	14.54	22.79	6.55	100%	61.16
10/1/2020	2,319,371.46	70.14	67.82	0.04	17.11	-	19.32	22.09	6.96	97%	65.53
10/2/2020	1,484,230.40	65.27	63.79	0.04	17.22	-	18.77	23.00	6.38	103%	65.41
10/3/2020	1,515,736.94	63.93	62.41	0.03	17.13	-	18.00	22.10	6.48	102%	63.74
10/4/2020	2,333,892.82	64.67	62.33	0.03	17.04	-	13.26	22.44	7.12	96%	59.89
10/5/2020	2,958,400.01	66.95	63.99	0.04	17.07	-	14.19	22.28	7.29	95%	60.87
10/6/2020	1,912,346.84	66.19	64.27	0.02	8.03	-	18.14	22.71	7.55	88%	56.45
10/7/2020	1,776,708.36	60.97	59.19	8.45	0.02	-	18.36	24.34	5.70	96%	56.87
10/8/2020	2,480,566.74	65.60	63.12	14.45	0.03	-	15.75	27.83	2.06	95%	60.12
10/9/2020	2,513,657.33	66.60	64.09	14.41	0.03	-	14.73	27.62	2.12	92%	58.90
10/10/2020	2,682,246.92	64.07	61.38	14.38	0.03	-	15.89	26.35	2.56	96%	59.21
10/11/2020	2,392,703.77	65.07	62.68	14.42	0.03	-	16.60	25.80	3.51	96%	60.37
10/12/2020	1,046,953.80	66.08	65.04	14.41	0.03	-	17.02	26.44	2.81	93%	60.71
10/13/2020	-	62.19	62.19	14.34	0.03	2.99	16.04	27.44	1.66	100%	62.49
10/14/2020	1,027,231.34	66.32	65.29	14.21	0.03	8.02	9.14	26.72	2.88	93%	60.99
10/15/2020	1,664,457.44	73.66	71.99	0.31	0.01	16.59	19.96	25.15	4.02	92%	66.04
10/16/2020	1,870,194.55	68.20	66.33	8.12	6.33	9.63	11.57	22.85	5.48	96%	63.97
10/17/2020	3,709,308.39	70.68	66.97	0.03	12.29	11.67	12.17	22.65	6.10	97%	64.91
10/18/2020	1,761,480.09	66.21	64.44	0.00	0.01	9.39	9.41	22.36	7.35	75%	48.52
10/19/2020	1,444,689.15	62.84	61.40	5.97	0.01	10.67	10.52	22.14	7.65	93%	56.96
10/20/2020	1,829,688.79	65.13	63.30	10.85	0.02	10.19	9.91	21.85	7.30	95%	60.13
10/21/2020	2,379,149.68	63.25	60.87	0.01	0.01	11.97	12.20	22.58	7.56	89%	54.33
10/22/2020	2,293,417.93	61.11	58.82	0.01	0.01	11.55	12.96	21.64	7.26	91%	53.44
10/23/2020	1,159,620.29	65.44	64.28	12.83	0.02	8.50	9.32	22.29	7.32	94%	60.29
10/24/2020	2,479,056.60	64.10	61.62	0.00	0.01	13.66	13.35	21.22	7.04	90%	55.27
10/25/2020	2,889,809.85	62.18	59.29	0.51	0.01	14.27	13.44	21.22	6.98	95%	56.42
10/26/2020	1,569,921.37	65.81	64.24	4.40	11.11	9.27	8.65	21.95	7.40	98%	62.78
10/27/2020	1,951,051.59	66.46	64.51	0.41	2.08	12.76	12.32	25.96	5.16	91%	58.70
10/28/2020	2,250,146.87	69.68	67.43	0.00	0.01	13.59	12.82	24.55	4.69	83%	55.65
10/29/2020	3,233,194.59	69.31	66.08	3.94	0.01	13.71	13.50	23.59	5.32	91%	60.08
10/30/2020	1,034,715.18	68.03	67.00	7.99	0.02	14.50	13.53	22.50	5.50	96%	64.03
10/31/2020	2,123,632.91	65.60	63.48	4.06	0.01	10.85	9.94	21.60	6.24	83%	52.70
11/1/2020	2,701,114.42	62.19	59.49	2.81	0.01	12.75	11.42	21.47	6.88	93%	55.34
11/2/2020	3,081,160.31	60.40	57.32	4.15	0.01	14.54	12.90	21.77	7.21	106%	60.58
11/3/2020	1,024,886.85	58.11	57.09	0.99	0.01	15.23	13.43	22.01	7.23	103%	58.91
11/4/2020	2,657,262.09	62.04	59.39	0.00	0.01	11.93	10.55	22.09	7.33	87%	51.91
11/5/2020	2,642,688.75	59.34	56.70	0.01	0.01	14.69	13.33	21.51	7.15	100%	56.70
11/6/2020	1,454,576.13	60.26	58.81	0.01	0.01	13.26	13.01	21.78	7.27	94%	55.34
11/7/2020	2,291,866.06	63.04	60.75	6.31	0.01	13.21	13.01	22.53	7.70	103%	62.77
11/8/2020	2,129,303.93	61.06	58.93	3.43	0.01	11.60	11.39	21.79	7.29	94%	55.51
11/9/2020	2,849,219.32	59.87	57.02	3.92	0.01	9.07	8.79	22.05	7.49	90%	51.32
11/10/2020	1,986,146.45	62.63	60.64	5.98	0.02	13.66	12.98	23.09	6.17	102%	61.91
11/11/2020	1,937,690.02	58.46	56.53	0.00	0.01	13.81	12.92	23.88	4.50	98%	55.12
11/12/2020	1,426,560.88	63.15	61.72	0.02	9.35	11.73	10.79	23.96	5.65	100%	61.50
11/13/2020	2,461,301.80	69.15	66.69	0.02	7.86	12.95	11.77	21.66	6.96	92%	61.22
11/14/2020	1,936,734.44	63.81	61.87	0.01	2.44	14.60	13.15	21.97	5.20	93%	57.37
11/15/2020	1,803,745.15	70.47	68.67	0.03	11.06	14.59	13.07	21.99	6.27	98%	67.01
11/16/2020	1,357,269.17	65.90	64.55	0.02	5.34	12.52	11.12	24.16	5.58	91%	58.73
11/17/2020	3,272,942.54	61.95	58.67	0.00	0.00	12.11	10.67	23.10	4.69	86%	50.58
11/18/2020	2,717,079.40	64.97	62.25	0.01	3.68	15.11	13.20	22.20	6.79	98%	60.99
11/19/2020	1,632,670.64	65.00	63.37	0.01	0.01	15.18	13.21	26.66	2.36	91%	57.42
11/20/2020	1,988,464.83	59.57	57.59	2.30	0.01	12.57	11.00	25.27	3.99	96%	55.15
11/21/2020	2,054,143.43	65.26	63.20	4.19	0.01	15.00	13.20	22.65	5.10	95%	60.15
11/22/2020	2,481,714.49	61.70	59.22	0.01	0.01	15.22	13.31	23.28	4.61	95%	56.44
11/23/2020	2,630,729.91	66.23	63.60	0.02	4.48	13.48	11.78	23.26	4.38	90%	57.40
11/24/2020	1,192,589.76	63.98	62.79	0.02	3.32	13.89	12.22	23.10	5.81	93%	58.36
11/25/2020	2,102,651.60	63.35	61.25	0.02	3.48	15.07	13.44	21.22	6.83	98%	60.07
11/26/2020	2,242,473.84	64.52	62.28	4.10	0.01	12.84	11.51	23.28	5.47	92%	57.21
11/27/2020	2,658,062.93	66.09	63.43	6.20	0.01	15.07	13.46	21.63	6.18	99%	62.56
11/28/2020	1,535,461.54	62.91	61.37	0.01	0.01	14.16	12.64	21.57	7.11	90%	55.50
11/29/2020	2,291,207.79	67.07	64.78	0.01	4.35	13.30	11.88	22.19	6.47	90%	58.21
11/30/2020	1,517,158.51	62.55	61.04	2.42	0.01	15.21	13.53	23.43	4.66	97%	59.25
12/1/2020	2,432,433.61	67.43	65.00	0.03	9.30	15.38	13.63	25.44	2.84	103%	66.62
12/2/2020	1,413,177.49	67.40	65.99	0.02	2.80	15.42	13.62	24.83	4.18	92%	60.88
12/3/2020	2,630,460.02	64.05	61.42	0.01	3.68	10.60	9.23	22.68	6.91	86%	53.11
12/4/2020	1,047,107.46	63.56	62.51	2.95	0.17	14.40	14.88	23.74	4.42	97%	60.56
12/5/2020	2,531,900.64	65.52	62.99	0.00	0.01	13.90	16.09	23.58	5.88	94%	59.47
12/6/2020	1,959,244.25	66.15	64.19	4.39	0.01	13.96	16.12	21.09	6.85	97%	62.42
12/7/2020	1,959,063.89	64.89	62.94	4.51	0.00	14.02	16.08	23.77	5.03	101%	63.42
12/8/2020	1,434,667.71	68.10	66.66	2.39	0.01	14.08	16.04	21.25	7.20	91%	60.98
12/9/2020	2,395,796.06	64.79	62.39	2.36	0.01	14.03	15.88	22.37	6.19	98%	60.84
12/10/2020	1,985,585.21	65.99	64.01	2.30	0.00	10.35	10.30	26.41	2.68	81%	52.03
12/11/2020	1,998,378.99	67.93	65.93	4.92	0.01	14.80	13.30	23.12	5.78	94%	61.93
12/12/2020	1,304,769.40	63.69	62.38	3.27	0.01	14.18	16.01	21.67	6.68	99%	61.83
12/13/2020	2,163,939.48	63.98	61.82	3.46	0.01	14.24	16.02	21.17	6.33	99%	61.21
12/14/2020	1,602,823.50	65.65	64.04	3.77	0.01	14.30	16.03	21.65	6.98	98%	62.74
12/15/2020	2,018,479.11	67.18	65.16	2.64	0.01	12.13	13.56	22.47	6.57	88%	57.38
12/16/2020	1,461,075.66	66.81	65.35	5.86	0.01	14.38	16.03	21.22	7.07	99%	64.57
12/17/2020	1,965,486.88	66.08	64.11	5.28	0.01	14.43	16.04	22.24	5.18	99%	63.18
12/18/2020	2,183,803.56	66.93	64.74	5.13	0.01	14.44	16.07	21.53	6.32	98%	63.49
12/19/2020	2,749,666.45	65.66	62.91	3.59	0.01	14.49	16.12	19.39	5.83	94%	59.43
12/20/2020	1,174,494.39	66.20	65.03	0.00	0.01	19.26	20.41	19.55	6.43	101%	65.66
12/21/2020	2,786,219.84	67.91	65.12	5.73	0.01	14.45	16.05	21.01	7.67	100%	64.92
12/22/2020	2,173,715.11	68.81	66.64	3.38	0.01	13.71	15.20	21.82	4.49	88%	58.62
12/23/2020	2,549,829.72	68.28	65.73	3.57	0.01	15.67	14.56	21.06	6.47	93%	61.34
12/24/2020	973,950.45	67.41	66.43	1.88	0.01	18.48	18.25	18.67	6.30	96%	63.60
12/25/2020	2,808,995.72	64.91	62.10	7.04	0.01	14.64	16.21	16.65	8.58	102%	63.12
12/26/2020	2,930,881.02	70.65	67.72	0.01	0.01	18.39	19.52	16.14	11.65	97%	65.71
12/27/2020	3,127,683.40	66.22	63.10	6.04	0.01	14.63	16.09	15.43	12.02	102%	64.23
12/28/2020	1,183,972.60	67.77	66.59	5.23	0.01	14.64	16.11	15.96	12.53	97%	64.49
12/29/2020	2,279,653.31	70.25	67.97	4.45	0.01	15.22	14.64	14.64	13.50	92%	62.45
12											

umLocationID	CUSTNMBR	Customer Name	Customer Class	Status	Rate Code	Meter Size (inch)	Month Year	Usage Billed (tgals)	Dollars Billed
5057737	1009331	PA AMERICAN WATER COMPANY A24	WHOLESALE	ACTIVE	W_WHS_PAWC	16	2020	-	\$ 77,411.04
5069621	1006498	HSWA	WHOLESALE	ACTIVE	W_WHS_HAMPTON	4	2020	1,921	\$ 5,017.30
5069622	1006499	HSWA	WHOLESALE	ACTIVE	W_WHS_HAMPTON	4	2020	1,275	\$ 3,340.50
5069657	1006500	HSWA	WHOLESALE	ACTIVE	W_WHS_HAMPTON3	16	2020	150	\$ 1,113.00
5069684	1005132	FOX CHAPEL WATER AUTHORITY	WHOLESALE	ACTIVE	W_WHS_FOXCHAPEL	8	2020	3,042	\$ 36,909.79
5069687	1001651	BOROUGH OF SHARPSBURG	WHOLESALE	ACTIVE	W_WHS_SHARPSBUR	10	2020	-	\$ -
5069714	1001646	BOROUGH OF ASPINWALL	WHOLESALE	ACTIVE	W_WHS_ASPINWALL	6	2020	-	\$ -
5076095	1013813	WEST VIEW WATER AUTHORITY	WHOLESALE	ACTIVE	W_WHS_WESTVIEW	6	2020	2,688	\$ 52,111.78
5076096	1013814	WEST VIEW WATER AUTHORITY	WHOLESALE	ACTIVE	W_WHS_WESTVIEW	6	2020	4	\$ 29,969.62
5076097	1013815	WEST VIEW WATER AUTHORITY	WHOLESALE	ACTIVE	W_WHS_WESTVIEW	6	2020	-	\$ 30,650.76
5076098	1013812	WEST VIEW WATER AUTHORITY	WHOLESALE	ACTIVE	W_WHS_WESTVIEW	6	2020	-	\$ 30,650.76
5076100	1010735	RESERVE WATER DEPT	WHOLESALE	ACTIVE	W_WHS_RSRV 10"	10	2020	92,650	\$ 374,226.28
5076101	1010736	RESERVE WATER DEPT	WHOLESALE	ACTIVE	W_WHS_RSRV 6"	6	2020	8,781	\$ 40,244.88
5081776	1010737	RESERVE WATER DEPT	WHOLESALE	ACTIVE	W_WHS_RSRV 6"	6	2020	4,535	\$ 23,770.40
5082168	1005132	FOX CHAPEL WATER AUTHORITY	WHOLESALE	ACTIVE	W_WHS_FOX12	12	2020	671,023	\$ 2,064,844.50
5123328	1001646	BOROUGH OF ASPINWALL	WHOLESALE	ACTIVE	W_WHS_ASPINWALL	6	2020	62,860	\$ 211,838.20
5133155	1001646	BOROUGH OF ASPINWALL	WHOLESALE	ACTIVE	W_WHS_ASPINWALL	8	2020	1,314	\$ 4,428.18

\*Unhide between customer lines for monthly breakdown

2020 Total Volumes		
Fox Chapel Authority:	674,065,000	Gal
Reserve Township:	105,966,000	Gal
Aspinwall Borough:	64,174,000	Gal
West View Water Authority:	2,692,000	Gal
Hampton Shaler Water Authority:	3,346,000	Gal
PA American Water:	0	Gal
Total Volume-	850,243,000	Gal
	850.243	MG

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Totals	
<b>Residential</b>														
Number of Accounts Billed	68,737	68,788	68,677	68,805	68,671	68,728	68,570	68,428	68,452	68,531	68,519	68,446	68,613	
Total Consumption	218,862	218,628	207,559	226,375	221,970	234,502	247,678	253,551	245,884	229,806	228,124	213,552	2,746.49	
<b>Residential - CAP</b>														
Number of Accounts Billed	2,207	2,278	2,344	2,401	2,481	2,541	2,622	2,673	2,721	2,787	2,832	2,912	2,567	
Total Consumption	7,606	7,679	7,414	7,704	8,323	9,176	9,449	9,770	9,234	9,074	9,205	8,960	103.59	
<b>Commercial</b>														
Number of Accounts Billed	6,854	6,872	6,900	6,952	6,956	6,946	6,944	6,936	6,948	6,958	6,954	7,016	6,936	
Total Consumption	240,392	249,176	233,806	196,864	184,319	206,379	276,316	288,271	283,041	266,175	228,007	190,726	2,843.47	
<b>Industrial</b>														
Number of Accounts Billed	106	99	50	26	26	29	29	29	30	32	32	32	43	
Total Consumption	16,727	14,753	12,357	5,267	5,807	16,118	17,096	21,585	23,876	20,823	16,843	14,616	185.87	
<b>Health &amp; Education</b>														
Number of Accounts Billed	476	475	475	476	476	478	476	478	469	474	476	463	474	
Total Consumption	73,376	82,081	82,969	62,073	60,468	72,764	98,384	117,252	103,088	95,659	76,090	63,225	987.43	
<b>Fire</b>														
Number of Accounts Billed	1,289	1,291	1,321	1,334	1,310	1,310	1,306	1,306	1,314	1,317	1,328	1,331	1,313	
Total Consumption	519	938	490	8,619	517	468	548	431	458	1,387	381	647	15.40	
<b>Flower Gardens</b>														
Number of Accounts Billed	66	72	73	74	74	75	80	80	80	80	80	81	76	
Total Consumption	-	-	-	-	-	49	600	545	276	59	23	21	1.57	
<b>Total</b>														
Number of Accounts Billed	79,735	79,875	79,840	80,068	79,994	80,107	80,027	79,930	80,014	80,179	80,221	80,281	80,022.58	<b>Average Accounts</b>
Total Consumption	557,482	573,255	544,595	506,902	481,404	539,456	650,071	691,405	665,857	622,983	558,673	491,747	6,883.83	<b>MG</b>

Account Type	Number of Accounts	Volume Billed (gal)	Total
Single Family	318	80,000	25,440,000
Two Family	7	160,000	1,120,000
Three Family	2	240,000	480,000
Total	327	Gal	27,040,000
		<b>MG</b>	<b>27.04</b>

Document Number	Location ID	Customer Number	Tariff ID	Billing Date	Consumption
BILL00015898981	5027630	1206349	W_NO BILL RAT	01/16/20	0
BILL00016025517	5027630	1206349	W_NO BILL RAT	02/13/20	0
BILL00016147591	5027630	1206349	W_NO BILL RAT	03/15/20	0
BILL00016259327	5027630	1206349	W_NO BILL RAT	04/14/20	0
BILL00015897233	5032906	1235961	W_NO BILL RAT	01/16/20	0
BILL00016020550	5032906	1235961	W_NO BILL RAT	02/13/20	0
BILL00015923140	5047872	1219635	W_NO BILL RAT	01/20/20	0
BILL00015923203	5047959	1218572	W_NO BILL RAT	01/20/20	0
BILL00015923203	5047959	1218572	W_NO BILL RAT	01/20/20	1.6
BILL00015923203	5047959	1218572	W_NO BILL RAT	01/20/20	1.4
BILL00015923466	5048251	1156865	W_NO BILL RAT	01/20/20	0
BILL00016046830	5048251	1156865	W_NO BILL RAT	02/19/20	0
BILL00016172002	5048251	1156865	W_NO BILL RAT	03/18/20	0
BILL00015923473	5048261	1156879	W_NO BILL RAT	01/20/20	0
BILL00015852928	5055808	1232125	W_NO BILL RAT	01/07/20	0
BILL00015967551	5055808	1232125	W_NO BILL RAT	02/03/20	0
BILL00016093461	5055808	1232125	W_NO BILL RAT	03/03/20	0
BILL00016210564	5055808	1232125	W_NO BILL RAT	04/01/20	0
BILL00016323687	5055808	1232125	W_NO BILL RAT	05/03/20	0
BILL00016442749	5055808	1232125	W_NO BILL RAT	06/02/20	0
BILL00016582892	5055808	1232125	W_NO BILL RAT	07/05/20	0
BILL00015855525	5064279	1223342	W_NO BILL RAT	01/08/20	0
BILL00015855525	5064279	1223342	W_NO BILL RAT	01/08/20	1.54838
BILL00015855525	5064279	1223342	W_NO BILL RAT	01/08/20	22.45162
BILL00015983155	5064279	1223342	W_NO BILL RAT	02/06/20	28
BILL00015983155	5064279	1223342	W_NO BILL RAT	02/06/20	0
BILL00016108553	5064279	1223342	W_NO BILL RAT	03/08/20	0
BILL00016108553	5064279	1223342	W_NO BILL RAT	03/08/20	29
BILL00016225703	5064279	1223342	W_NO BILL RAT	04/06/20	25
BILL00016225703	5064279	1223342	W_NO BILL RAT	04/06/20	0
BILL00016339187	5064279	1223342	W_NO BILL RAT	05/06/20	20
BILL00016339187	5064279	1223342	W_NO BILL RAT	05/06/20	0
BILL00016463652	5064279	1223342	W_NO BILL RAT	06/07/20	0
BILL00016463652	5064279	1223342	W_NO BILL RAT	06/07/20	24
BILL00016597940	5064279	1223342	W_NO BILL RAT	07/08/20	59
BILL00016597940	5064279	1223342	W_NO BILL RAT	07/08/20	0
BILL00015841511	5064434	1236593	W_NO BILL RAT	01/06/20	0
BILL00015982361	5064434	1236593	W_NO BILL RAT	02/05/20	0
BILL00015835989	5064534	1190084	W_NO BILL RAT	01/01/20	0
BILL00015836059	5065584	1216912	W_NO BILL RAT	01/01/20	0
BILL00015972242	5065584	1216912	W_NO BILL RAT	02/03/20	0
BILL00016088630	5065584	1216912	W_NO BILL RAT	03/01/20	0
BILL00016213054	5065584	1216912	W_NO BILL RAT	04/01/20	0
BILL00016326540	5065584	1216912	W_NO BILL RAT	05/01/20	0
BILL00016437933	5065584	1216912	W_NO BILL RAT	06/01/20	0
BILL00015870723	5066443	1236565	W_NO BILL RAT	01/12/20	0.45455
BILL00015870723	5066443	1236565	W_NO BILL RAT	01/12/20	0
BILL00015870723	5066443	1236565	W_NO BILL RAT	01/12/20	2.54546
BILL00015988517	5066443	1236565	W_NO BILL RAT	02/09/20	2
BILL00015988517	5066443	1236565	W_NO BILL RAT	02/09/20	0
BILL00016113885	5066443	1236565	W_NO BILL RAT	03/09/20	1
BILL00016113885	5066443	1236565	W_NO BILL RAT	03/09/20	0
BILL00016231083	5066443	1236565	W_NO BILL RAT	04/07/20	0
BILL00016344503	5066443	1236565	W_NO BILL RAT	05/07/20	0
BILL00016468964	5066443	1236565	W_NO BILL RAT	06/08/20	0
BILL00016603273	5066443	1236565	W_NO BILL RAT	07/09/20	0
BILL00016731228	5066443	1236565	W_NO BILL RAT	08/10/20	0
BILL00016885717	5066443	1236565	W_NO BILL RAT	09/09/20	0
BILL00017031557	5066443	1236565	W_NO BILL RAT	10/07/20	0
BILL00017201773	5066443	1236565	W_NO BILL RAT	11/08/20	0
BILL00017384395	5066443	1236565	W_NO BILL RAT	12/08/20	0
BILL00015875020	5068409	1015491	W_NO BILL RAT	01/12/20	0
BILL00015992819	5068409	1015491	W_NO BILL RAT	02/09/20	0
BILL00016118174	5068409	1015491	W_NO BILL RAT	03/09/20	0
BILL00016235384	5068409	1015491	W_NO BILL RAT	04/07/20	0
BILL00016348806	5068409	1015491	W_NO BILL RAT	05/07/20	0
BILL00016473266	5068409	1015491	W_NO BILL RAT	06/08/20	0
BILL00016607570	5068409	1015491	W_NO BILL RAT	07/09/20	0
BILL00016735471	5068409	1015491	W_NO BILL RAT	08/10/20	0
BILL00016889963	5068409	1015491	W_NO BILL RAT	09/09/20	0
BILL00017035807	5068409	1015491	W_NO BILL RAT	10/07/20	0
BILL00017206021	5068409	1015491	W_NO BILL RAT	11/08/20	0
BILL00017388649	5068409	1015491	W_NO BILL RAT	12/08/20	0
BILL00015875021	5068410	1015491	W_NO BILL RAT	01/12/20	0
BILL00015992820	5068410	1015491	W_NO BILL RAT	02/09/20	0

6,570	Tgal
6.57	MG
17,950	Gal/Day
44	Accounts

BILL00016118175	5068410	1015491	W_NO BILL RAT	03/09/20	0
BILL00016235385	5068410	1015491	W_NO BILL RAT	04/07/20	0
BILL00016348807	5068410	1015491	W_NO BILL RAT	05/07/20	0
BILL00016473267	5068410	1015491	W_NO BILL RAT	06/08/20	0
BILL00016607571	5068410	1015491	W_NO BILL RAT	07/09/20	0
BILL00016735472	5068410	1015491	W_NO BILL RAT	08/10/20	0
BILL00016889964	5068410	1015491	W_NO BILL RAT	09/09/20	0
BILL00017035808	5068410	1015491	W_NO BILL RAT	10/07/20	0
BILL00017206022	5068410	1015491	W_NO BILL RAT	11/08/20	0
BILL00017388650	5068410	1015491	W_NO BILL RAT	12/08/20	0
BILL00015873531	5069045	1236593	W_NO BILL RAT	01/12/20	0
BILL00015991330	5069045	1236593	W_NO BILL RAT	02/09/20	0
BILL00015857264	5071251	1237390	W_NO BILL RAT	01/08/20	0
BILL00015858495	5072447	1235533	W_NO BILL RAT	01/08/20	0
BILL00015837265	5076107	1223351	W_NO BILL RAT	01/06/20	0.32258
BILL00015837265	5076107	1223351	W_NO BILL RAT	01/06/20	9.67742
BILL00015837265	5076107	1223351	W_NO BILL RAT	01/06/20	0
BILL00015978119	5076107	1223351	W_NO BILL RAT	02/05/20	8
BILL00015978119	5076107	1223351	W_NO BILL RAT	02/05/20	0
BILL00016103513	5076107	1223351	W_NO BILL RAT	03/05/20	9
BILL00016103513	5076107	1223351	W_NO BILL RAT	03/05/20	0
BILL00016220695	5076107	1223351	W_NO BILL RAT	04/05/20	8
BILL00016220695	5076107	1223351	W_NO BILL RAT	04/05/20	0
BILL00016334183	5076107	1223351	W_NO BILL RAT	05/05/20	0
BILL00016334183	5076107	1223351	W_NO BILL RAT	05/05/20	8
BILL00016453180	5076107	1223351	W_NO BILL RAT	06/04/20	0
BILL00016453180	5076107	1223351	W_NO BILL RAT	06/04/20	9
BILL00016592922	5076107	1223351	W_NO BILL RAT	07/06/20	0
BILL00016592922	5076107	1223351	W_NO BILL RAT	07/06/20	7
BILL00015836061	5123297	1016531	W_NO BILL RAT	01/01/20	0
BILL00015836063	5123682	1031906	W_NO BILL RAT	01/01/20	0
BILL00015972249	5123682	1031906	W_NO BILL RAT	02/03/20	0
BILL00016088635	5123682	1031906	W_NO BILL RAT	03/01/20	0
BILL00016213059	5123682	1031906	W_NO BILL RAT	04/01/20	0
BILL00016326545	5123682	1031906	W_NO BILL RAT	05/01/20	0
BILL00016437938	5123682	1031906	W_NO BILL RAT	06/01/20	0
BILL00015841453	5124321	1009812	W_NO BILL RAT	01/06/20	0.25806
BILL00015841453	5124321	1009812	W_NO BILL RAT	01/06/20	0
BILL00015841453	5124321	1009812	W_NO BILL RAT	01/06/20	7.74194
BILL00015982303	5124321	1009812	W_NO BILL RAT	02/05/20	9
BILL00015982303	5124321	1009812	W_NO BILL RAT	02/05/20	0
BILL00016107698	5124321	1009812	W_NO BILL RAT	03/05/20	0
BILL00016107698	5124321	1009812	W_NO BILL RAT	03/05/20	8
BILL00016224878	5124321	1009812	W_NO BILL RAT	04/05/20	6
BILL00016224878	5124321	1009812	W_NO BILL RAT	04/05/20	0
BILL00016338362	5124321	1009812	W_NO BILL RAT	05/05/20	7
BILL00016338362	5124321	1009812	W_NO BILL RAT	05/05/20	0
BILL00016457358	5124321	1009812	W_NO BILL RAT	06/04/20	0
BILL00016457358	5124321	1009812	W_NO BILL RAT	06/04/20	7
BILL00016597100	5124321	1009812	W_NO BILL RAT	07/06/20	8
BILL00016597100	5124321	1009812	W_NO BILL RAT	07/06/20	0
BILL00015841454	5124322	1009812	W_NO BILL RAT	01/06/20	0
BILL00015836066	5124432	1001765	W_NO BILL RAT	01/01/20	0
BILL00015972253	5124432	1001765	W_NO BILL RAT	02/03/20	0
BILL00016088638	5124432	1001765	W_NO BILL RAT	03/01/20	0
BILL00016213062	5124432	1001765	W_NO BILL RAT	04/01/20	0
BILL00016326548	5124432	1001765	W_NO BILL RAT	05/01/20	0
BILL00016437941	5124432	1001765	W_NO BILL RAT	06/01/20	0
BILL00015835990	5130679	1184432	W_NO BILL RAT	01/01/20	0
BILL00015835992	5131795	1184432	W_NO BILL RAT	01/01/20	0
BILL00015835993	5131796	1184432	W_NO BILL RAT	01/01/20	0
BILL00015835994	5132982	1016393	W_NO BILL RAT	01/01/20	0
BILL00016012286	5135258	1238469	W_NO BILL RAT	02/12/20	0
BILL00016137617	5135258	1238469	W_NO BILL RAT	03/12/20	0
BILL00016249336	5135258	1238469	W_NO BILL RAT	04/13/20	0
BILL00016362741	5135258	1238469	W_NO BILL RAT	05/12/20	0
BILL00016487275	5135258	1238469	W_NO BILL RAT	06/11/20	0
BILL00016562850	5135258	1238469	W_NO BILL RAT	06/23/20	0
BILL00016627025	5135258	1238469	W_NO BILL RAT	07/14/20	0
BILL00016749401	5135258	1238469	W_NO BILL RAT	08/13/20	0
BILL00016903824	5135258	1238469	W_NO BILL RAT	09/14/20	0
BILL00017069937	5135258	1238469	W_NO BILL RAT	10/13/20	0
BILL00017227272	5135258	1238469	W_NO BILL RAT	11/12/20	0
BILL00016012287	5135259	1238471	W_NO BILL RAT	02/12/20	0
BILL00016137618	5135259	1238471	W_NO BILL RAT	03/12/20	0
BILL00016249337	5135259	1238471	W_NO BILL RAT	04/13/20	0



BILL00016249344	5135266	1238478	W_NO BILL RAT	04/13/20	0
BILL00016362749	5135266	1238478	W_NO BILL RAT	05/12/20	0
BILL00016487283	5135266	1238478	W_NO BILL RAT	06/11/20	0
BILL00016562847	5135266	1238478	W_NO BILL RAT	06/23/20	0
BILL00016627033	5135266	1238478	W_NO BILL RAT	07/14/20	0
BILL00016749409	5135266	1238478	W_NO BILL RAT	08/13/20	0
BILL00016903832	5135266	1238478	W_NO BILL RAT	09/14/20	0
BILL00017069945	5135266	1238478	W_NO BILL RAT	10/13/20	0
BILL00017227280	5135266	1238478	W_NO BILL RAT	11/12/20	0
BILL00016137626	5135320	1239369	W_NO BILL RAT	03/12/20	0
BILL00016249345	5135320	1239369	W_NO BILL RAT	04/13/20	0
BILL00016362750	5135320	1239369	W_NO BILL RAT	05/12/20	0
BILL00016487284	5135320	1239369	W_NO BILL RAT	06/11/20	0
BILL00016562813	5135320	1239369	W_NO BILL RAT	06/23/20	0
BILL00016627034	5135320	1239369	W_NO BILL RAT	07/14/20	0
BILL00016749410	5135320	1239369	W_NO BILL RAT	08/13/20	0
BILL00016903833	5135320	1239369	W_NO BILL RAT	09/14/20	0
BILL00017069946	5135320	1239369	W_NO BILL RAT	10/13/20	0
BILL00017227281	5135320	1239369	W_NO BILL RAT	11/12/20	0
BILL00016137627	5135321	1239371	W_NO BILL RAT	03/12/20	0
BILL00016137627	5135321	1239371	W_NO BILL RAT	03/12/20	7
BILL00016249346	5135321	1239371	W_NO BILL RAT	04/13/20	153
BILL00016249346	5135321	1239371	W_NO BILL RAT	04/13/20	0
BILL00016362751	5135321	1239371	W_NO BILL RAT	05/12/20	0
BILL00016362751	5135321	1239371	W_NO BILL RAT	05/12/20	217
BILL00016487285	5135321	1239371	W_NO BILL RAT	06/11/20	325
BILL00016487285	5135321	1239371	W_NO BILL RAT	06/11/20	0
BILL00016560443	5135321	1239371	W_NO BILL RAT	06/23/20	0
BILL00016560443	5135321	1239371	W_NO BILL RAT	06/23/20	325
BILL00016627035	5135321	1239371	W_NO BILL RAT	07/14/20	0
BILL00016627035	5135321	1239371	W_NO BILL RAT	07/14/20	72
BILL00016749411	5135321	1239371	W_NO BILL RAT	08/13/20	0
BILL00016749411	5135321	1239371	W_NO BILL RAT	08/13/20	501
BILL00016903834	5135321	1239371	W_NO BILL RAT	09/14/20	0
BILL00017069947	5135321	1239371	W_NO BILL RAT	10/13/20	0
BILL00017227282	5135321	1239371	W_NO BILL RAT	11/12/20	0
BILL00017430348	5135321	1239371	W_NO BILL RAT	12/11/20	0
BILL00016137628	5135322	1239372	W_NO BILL RAT	03/12/20	0
BILL00016137628	5135322	1239372	W_NO BILL RAT	03/12/20	4
BILL00016249347	5135322	1239372	W_NO BILL RAT	04/13/20	0
BILL00016249347	5135322	1239372	W_NO BILL RAT	04/13/20	7
BILL00016362752	5135322	1239372	W_NO BILL RAT	05/12/20	6
BILL00016362752	5135322	1239372	W_NO BILL RAT	05/12/20	0
BILL00016487286	5135322	1239372	W_NO BILL RAT	06/11/20	0
BILL00016487286	5135322	1239372	W_NO BILL RAT	06/11/20	6
BILL00016560444	5135322	1239372	W_NO BILL RAT	06/23/20	6
BILL00016560444	5135322	1239372	W_NO BILL RAT	06/23/20	0
BILL00016627036	5135322	1239372	W_NO BILL RAT	07/14/20	0
BILL00016627036	5135322	1239372	W_NO BILL RAT	07/14/20	5
BILL00016749412	5135322	1239372	W_NO BILL RAT	08/13/20	7
BILL00016749412	5135322	1239372	W_NO BILL RAT	08/13/20	0
BILL00016903835	5135322	1239372	W_NO BILL RAT	09/14/20	0
BILL00017069948	5135322	1239372	W_NO BILL RAT	10/13/20	0
BILL00017227283	5135322	1239372	W_NO BILL RAT	11/12/20	0
BILL00016236228	5135332	1239670	W_NO BILL RAT	04/07/20	6
BILL00016236229	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236226	5135332	1239670	W_NO BILL RAT	04/07/20	6.2
BILL00016236228	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236249	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236248	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236237	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236241	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236232	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236239	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236247	5135332	1239670	W_NO BILL RAT	04/07/20	5.2
BILL00016236245	5135332	1239670	W_NO BILL RAT	04/07/20	5.6
BILL00016236230	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236240	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236241	5135332	1239670	W_NO BILL RAT	04/07/20	5.1
BILL00016236247	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236220	5135332	1239670	W_NO BILL RAT	04/07/20	6.3
BILL00016236243	5135332	1239670	W_NO BILL RAT	04/07/20	5.2
BILL00016236226	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236231	5135332	1239670	W_NO BILL RAT	04/07/20	5.6
BILL00016236244	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236221	5135332	1239670	W_NO BILL RAT	04/07/20	0

BILL00016236223	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236249	5135332	1239670	W_NO BILL RAT	04/07/20	0.75758
BILL00016236245	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236239	5135332	1239670	W_NO BILL RAT	04/07/20	5.2
BILL00016236220	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236230	5135332	1239670	W_NO BILL RAT	04/07/20	6.1
BILL00016236222	5135332	1239670	W_NO BILL RAT	04/07/20	6.3
BILL00016236237	5135332	1239670	W_NO BILL RAT	04/07/20	4.7
BILL00016236224	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236225	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236234	5135332	1239670	W_NO BILL RAT	04/07/20	1.35
BILL00016236222	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236248	5135332	1239670	W_NO BILL RAT	04/07/20	4.6
BILL00016236242	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236249	5135332	1239670	W_NO BILL RAT	04/07/20	4.24243
BILL00016236242	5135332	1239670	W_NO BILL RAT	04/07/20	5.3
BILL00016236224	5135332	1239670	W_NO BILL RAT	04/07/20	6.1
BILL00016236246	5135332	1239670	W_NO BILL RAT	04/07/20	10.6
BILL00016236232	5135332	1239670	W_NO BILL RAT	04/07/20	2.4
BILL00016236246	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236234	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236231	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236240	5135332	1239670	W_NO BILL RAT	04/07/20	4.8
BILL00016236244	5135332	1239670	W_NO BILL RAT	04/07/20	4.8
BILL00016236227	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236243	5135332	1239670	W_NO BILL RAT	04/07/20	0
BILL00016236227	5135332	1239670	W_NO BILL RAT	04/07/20	6.8
BILL00016236229	5135332	1239670	W_NO BILL RAT	04/07/20	6.7
BILL00016236223	5135332	1239670	W_NO BILL RAT	04/07/20	6.7
BILL00016236221	5135332	1239670	W_NO BILL RAT	04/07/20	6.5
BILL00016236225	5135332	1239670	W_NO BILL RAT	04/07/20	6.4
BILL00016236234	5135332	1239670	W_NO BILL RAT	04/07/20	0.25
BILL00016241774	5135333	1239671	W_NO BILL RAT	04/08/20	0
BILL00016241773	5135333	1239671	W_NO BILL RAT	04/08/20	0
BILL00016241771	5135333	1239671	W_NO BILL RAT	04/08/20	0
BILL00016241772	5135333	1239671	W_NO BILL RAT	04/08/20	0
BILL00016262541	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262534	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262536	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262535	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262537	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262533	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262539	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262540	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016262538	5135333	1239671	W_NO BILL RAT	04/14/20	0
BILL00016284645	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284636	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284646	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284639	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284643	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284641	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284647	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284637	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284640	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284634	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284638	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016284635	5135333	1239671	W_NO BILL RAT	04/20/20	0
BILL00016137629	5135334	1239372	W_NO BILL RAT	03/12/20	0
BILL00016249348	5135334	1239372	W_NO BILL RAT	04/13/20	0
BILL00016362753	5135334	1239372	W_NO BILL RAT	05/12/20	0
BILL00016487287	5135334	1239372	W_NO BILL RAT	06/11/20	0
BILL00016487287	5135334	1239372	W_NO BILL RAT	06/11/20	9
BILL00016577889	5135334	1239372	W_NO BILL RAT	06/23/20	9
BILL00016577889	5135334	1239372	W_NO BILL RAT	06/23/20	0
BILL00016627037	5135334	1239372	W_NO BILL RAT	07/14/20	50
BILL00016627037	5135334	1239372	W_NO BILL RAT	07/14/20	0
BILL00016749413	5135334	1239372	W_NO BILL RAT	08/13/20	143
BILL00016749413	5135334	1239372	W_NO BILL RAT	08/13/20	0
BILL00016903836	5135334	1239372	W_NO BILL RAT	09/14/20	438
BILL00016903836	5135334	1239372	W_NO BILL RAT	09/14/20	0
BILL00017069949	5135334	1239372	W_NO BILL RAT	10/13/20	410
BILL00017069949	5135334	1239372	W_NO BILL RAT	10/13/20	0
BILL00017227284	5135334	1239372	W_NO BILL RAT	11/12/20	59
BILL00017227284	5135334	1239372	W_NO BILL RAT	11/12/20	0
BILL00017430350	5135334	1239372	W_NO BILL RAT	12/11/20	1
BILL00017430350	5135334	1239372	W_NO BILL RAT	12/11/20	0

BILL00016731195	5135425	1241192	W_NO BILL RAT	08/10/20	0
BILL00016885683	5135425	1241192	W_NO BILL RAT	09/09/20	0
BILL00017031523	5135425	1241192	W_NO BILL RAT	10/07/20	0
BILL00017201738	5135425	1241192	W_NO BILL RAT	11/08/20	0
BILL00016627038	5135455	1241452	W_NO BILL RAT	07/14/20	0
BILL00016627038	5135455	1241452	W_NO BILL RAT	07/14/20	1218
BILL00016749414	5135455	1241452	W_NO BILL RAT	08/13/20	0
BILL00016749414	5135455	1241452	W_NO BILL RAT	08/13/20	1072
BILL00016903837	5135455	1241452	W_NO BILL RAT	09/14/20	0
BILL00017069950	5135455	1241452	W_NO BILL RAT	10/13/20	0
BILL00017227285	5135455	1241452	W_NO BILL RAT	11/12/20	0
BILL00016681128	5135500	1242274	W_NO BILL RAT	07/26/20	0
BILL00016681128	5135500	1242274	W_NO BILL RAT	07/26/20	460
BILL00016828054	5135500	1242274	W_NO BILL RAT	08/26/20	0
BILL00016828054	5135500	1242274	W_NO BILL RAT	08/26/20	584
BILL00016972672	5135500	1242274	W_NO BILL RAT	09/28/20	0
BILL00017151045	5135500	1242274	W_NO BILL RAT	10/28/20	0
BILL00017317604	5135500	1242274	W_NO BILL RAT	11/25/20	0
BILL00017534247	5135500	1242274	W_NO BILL RAT	12/31/20	0
BILL00017132334	5135655	1245686	W_NO BILL RAT	10/22/20	0
BILL00017132333	5135655	1245686	W_NO BILL RAT	10/22/20	0
BILL00017132335	5135655	1245686	W_NO BILL RAT	10/22/20	0
BILL00017132332	5135655	1245686	W_NO BILL RAT	10/22/20	0
BILL00017132336	5135655	1245686	W_NO BILL RAT	10/22/20	0
BILL00017152923	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152929	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152921	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152932	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152927	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152933	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152915	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152924	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152916	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152926	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152928	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152919	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152925	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152920	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152930	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152917	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152934	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152931	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152918	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152914	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017152922	5135655	1245686	W_NO BILL RAT	10/29/20	0
BILL00017156350	5135655	1245686	W_NO BILL RAT	11/02/20	0
BILL00017373515	5135677	1246042	W_NO BILL RAT	12/07/20	0
BILL00017373516	5135679	1246044	W_NO BILL RAT	12/07/20	0

Reservoir and Tank Work						
Reservoir Name	Dates Drained	Dates Filled	Total Drains	Total Fills	Volume Drained	Reservoir Volume Gal
Allentown					-	3,055,097
Bedford					-	2,199,670
Brashear					-	5,585,099
Garfield					-	1,761,782
Highland 1					-	144,723,910
Highland 2					-	124,996,980
Herron Hill Res North	4/1/2020,8/31/2020,9/8/2020		2.87		16,540,759	5,767,301
Herron Hill Res South					-	5,767,301
Herron Hill Tank					-	369,892
Lanpher West			1		79,463,399	79,463,399
Lanpher East			1		17,646,852	17,646,852
Lincoln	9/17/2020		1		3,150,498	3,150,498
McNaugher Tank 1					-	5,026,957
McNaugher Tank 2					-	367,199
Spring Hill					-	499,391
Squirrel Hill					-	3,102,099
Reservoir Total						116,801,508
MG						116.80

Large Diameter Main Work						
Main Name	Operation	Operation Date	Estimated Water Usage	Pipe Volume (gal)	Leak Rate (gpm)	Duration (hr)
Rising Main 1	Inspection					
	Disinfection					
Rising Main 2	Inspection					
	Disinfection					
Rising Main 3	Inspection		4,324,368.00	577,456.00	600	72
	Disinfection					
Rising Main 4	Inspection		4,644,414.00	684,138.00	600	72
	Disinfection					
Lanpher Rising Main	Inspection					
	Disinfection					
Large Diameter Total						8,968,782.00
MG						8.97

Emergency Back Washing		
Start	Finish	Total BW flow (gal)
10/11/2020	10/12/2020	976,378.34
10/12/2020	10/13/2020	4,174.52
10/13/2020	10/14/2020	403,299.59
10/14/2020	10/15/2020	851,771.04
10/15/2020	10/16/2020	755,244.69
10/16/2020	10/17/2020	1,749,720.70
10/17/2020	10/18/2020	590,308.22
10/18/2020	10/19/2020	593,724.82
10/19/2020	10/20/2020	691,126.46
10/20/2020	10/21/2020	1,185,492.57
10/21/2020	10/22/2020	1,133,139.22
10/22/2020	10/23/2020	366,477.49
10/23/2020	10/24/2020	1,231,649.72
Total Emergency BW Flow (MG)		10.53

Total OPS	136.30
0.25% Default	17.29
<b>Total Unbilled Unmetered</b>	<b>153.60</b>
1.25% Default	86.47

\*Comparison to method used last year

System Data			Notes
Length of Mains	963.23	miles	Supplied by GIS (Jackson Stoss).
Service Connections	81,996	connections	Supplied by GIS (Jackson Stoss).
Average Length of Service Line	48.10	feet	Supplied by GIS (Jackson Stoss).
Average Operating Pressure	60.00	psi	Value from 2018 Audit. Steady state pressure over 63,000+ nodes.

These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water.

2020 Expenses	Total
Salaries	\$ 12,037,635.56
Benefits	\$ 3,486,007.01
Equipment	\$ 510,426.01
Materials	\$ 333,881.77
Operating Contracts	\$ 1,983,616.86
Urgent Water Repair	\$ 3,244,307.26
Repairs & Maintenance	\$ 755,664.20
Surface Restoration	\$ 5,146,251.83
Testing	\$ 13,563.51
Inventory Expense	\$ 1,305,945.03
Fees	\$ 6,452.11
Freight & Postage	\$ 16,176.43
Equipment Rental	\$ 165,272.35
Professional Services	\$ 1,425,773.08
Office Supplies	\$ 21,341.15
Grounds and Maintenance Supplies	\$ 511,529.91
Travel & Training	\$ 9,154.85
Utility Expense	\$ 428,343.02
Administrative Expense	\$ 698.75
Insurance	\$ 1,032,447.39
Depreciation	\$ 12,947,015.79
Debt Service	\$ 18,238,508.08
<b>Grand Total</b>	<b>\$ 63,620,011.95</b>

Acct. Type	Meter Size	Meter Count	%	Minumum	Minimum Charge	Estimated Average	Estimated Bill	Cost/ 1000 gal	
Residential	5/8"	65,616	78.74%	1,000	\$ 35.55	2,947	\$ 74.28	\$ 25.20	
	3/4"	2,675	3.21%	2,000	\$ 61.14	5,445	\$ 129.67	\$ 23.81	
	1"	2,392	2.87%	5,000	\$ 129.64	8,580	\$ 200.84	\$ 23.41	
	1 1/2"	22	0.03%	10,000	\$ 257.54	12,242	\$ 302.14	\$ 24.68	
	2"	4	0.00%	17,000	\$ 428.37	32,604	\$ 738.74	\$ 22.66	
Commercial	5/8"	2,766	3.32%	1,000	\$ 35.55	4,064	\$ 92.82	\$ 22.84	
	3/4"	685	0.82%	2,000	\$ 61.14	6,015	\$ 136.18	\$ 22.64	
	1"	1,387	1.66%	5,000	\$ 129.64	11,500	\$ 251.12	\$ 21.84	
	1 1/2"	897	1.08%	10,000	\$ 257.54	27,272	\$ 580.35	\$ 21.28	
	2"	864	1.04%	17,000	\$ 428.37	47,606	\$ 1,000.40	\$ 21.01	
	3"	264	0.32%	40,000	\$ 959.05	119,530	\$ 2,445.47	\$ 20.46	
	4"	189	0.23%	70,000	\$ 1,627.59	263,648	\$ 5,246.87	\$ 19.90	
	6"	84	0.10%	175,000	\$ 3,860.37	552,604	\$ 10,917.79	\$ 19.76	
Health & Education	5/8"	35	0.04%	1,000	\$ 35.55	2,307	\$ 66.65	\$ 28.89	
	3/4"	9	0.01%	2,000	\$ 61.14	9,074	\$ 229.43	\$ 25.28	
	1"	26	0.03%	5,000	\$ 129.64	5,061	\$ 131.09	\$ 25.90	
	1 1/2"	65	0.08%	10,000	\$ 257.54	8,597	\$ 257.54	\$ 25.75	
	2"	139	0.17%	17,000	\$ 428.37	38,414	\$ 937.82	\$ 24.41	
	3"	95	0.11%	40,000	\$ 959.05	126,265	\$ 3,011.29	\$ 23.85	
	4"	70	0.08%	70,000	\$ 1,627.59	306,594	\$ 7,256.16	\$ 23.67	
	6"	36	0.04%	175,000	\$ 3,860.37	907,192	\$ 21,279.22	\$ 23.46	
	8"	2	0.00%	325,000	\$ 6,955.89	2,466,833	\$ 57,910.10	\$ 23.48	
Industrial	5/8"	23	0.03%	1,000	\$ 35.55	6,134	\$ 120.06	\$ 19.57	
	3/4"	12	0.01%	2,000	\$ 61.14	299	\$ 61.14	\$ 30.57	
	1"	23	0.03%	5,000	\$ 129.64	10,007	\$ 212.06	\$ 21.19	
	1 1/2"	6	0.01%	10,000	\$ 257.54	1,875	\$ 257.54	\$ 25.75	
	2"	16	0.02%	17,000	\$ 428.37	108,844	\$ 1,940.12	\$ 17.82	
	3"	2	0.00%	40,000	\$ 959.05	648,250	\$ 10,970.85	\$ 16.92	
	4"	9	0.01%	70,000	\$ 1,627.59	568,278	\$ 9,829.24	\$ 17.30	
	6"	2	0.00%	175,000	\$ 3,860.37	2,168,583	\$ 36,674.75	\$ 16.91	
	8"	4	0.00%	325,000	\$ 6,955.89	652,188	\$ 12,341.40	\$ 18.92	
CAP	5/8"	3,016	3.62%	1,000	\$ 8.89	2,817	\$ 42.46	\$ 15.07	
	3/4"	31	0.04%	2,000	\$ 15.29	2,500	\$ 24.52	\$ 9.81	
	1"	13	0.02%	5,000	\$ 32.41	4,468	\$ 32.41	\$ 6.48	
	City	5/8"	381	0.46%	1,000	\$ 7.11	1,529	\$ 9.21	\$ 6.03
		3/4"	20	0.02%	2,000	\$ 12.23	550	\$ 12.23	\$ 6.11
		1"	33	0.04%	5,000	\$ 25.93	49,126	\$ 201.46	\$ 4.10
		1 1/2"	31	0.04%	10,000	\$ 51.51	18,019	\$ 83.41	\$ 4.63
		2"	35	0.04%	17,000	\$ 85.67	58,169	\$ 249.44	\$ 4.29
		3"	13	0.02%	40,000	\$ 191.81	58,737	\$ 266.35	\$ 4.53
4"		3	0.00%	70,000	\$ 325.52	120,278	\$ 525.52	\$ 4.37	
6"		3	0.00%	175,000	\$ 772.07	4,056,056	\$ 16,210.91	\$ 4.00	
Fire	5/8"	1,217	1.46%	1,000	\$ 33.24	330	\$ 33.24	\$ 33.24	
	3/4"	6	0.01%	2,000	\$ 33.24	-	\$ 33.24	\$ 16.62	
	1"	24	0.03%	5,000	\$ 33.24	29,010	\$ 128.75	\$ 4.44	
	1 1/2"	34	0.04%	10,000	\$ 101.97	498	\$ 101.97	\$ 10.20	
	2"	13	0.02%	17,000	\$ 101.97	4,205	\$ 101.97	\$ 6.00	
	3"	1	0.00%	40,000	\$ 101.97	-	\$ 101.97	\$ 2.55	
	4"	4	0.00%	70,000	\$ 314.42	1,854	\$ 314.42	\$ 4.49	
	6"	12	0.01%	175,000	\$ 626.83	7,597	\$ 626.83	\$ 3.58	
	8"	2	0.00%	325,000	\$ 626.83	7,708	\$ 626.83	\$ 1.93	
	10"+	1	0.00%	548,000	\$ 626.83	-	\$ 626.83	\$ 1.14	

Rates for Usages Over Monthly Minimum Volume		
Acct. Type	Number of Meters	Price/1000 Gal
Residential	70,709	\$ 19.89
Commercial:	7,150	\$ 18.69
Institutional:	479	\$ 23.79
Industrial:	99	\$ 16.46
CAP	3,060	\$ 18.47
City	519	\$ 3.98
Fire:	1,314	\$ 14.01

Results Table	
Total Meters	83,330
Total Volume	7,070.50
<b>C.R.U.C.</b>	<b>\$ 24.42</b>

Chemical	\$	4,063,453.13
Electricity	\$	4,013,846.58
Diesel	\$	38,948.69
Solids Disposal	\$	7,200.00
Total	\$	8,123,448.40
Total Consumption	\$	25,036.26

<b>Variable Production Cost</b>	<b>\$</b>	<b>324.47</b>	<b>Cost/ MG</b>
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Diesel													
GL Account Number	Journal Entry	Source Document	Reference	TRX Date	Series	Department	Account Number	Debit Amount	Credit Amount	Vendor ID	Vendor Name	Description	
10		553420	GJ	RVRS 2019 AP ACCRUAL		12/31/2020	Financial	322	10-322-7422-100000000	-	12,179.27		RVRS 2019 AP ACCRUAL
10		555680	GJ	2020 AP ACCRUAL		12/31/2020	Financial	322	10-322-7422-100000000	3,942.37	-		2020 AP ACCRUAL
10		498464	RECVG	PWSA128 BULK DIESEL FUEL		1/27/2020	Purchasing	322	10-322-7422-100000000	2,322.24	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		498465	RECVG	PWSA128 BULK DIESEL FUEL		1/27/2020	Purchasing	322	10-322-7422-100000000	928.80	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		499248	RECVG	PWSA128 BULK DIESEL FUEL		1/31/2020	Purchasing	322	10-322-7422-100000000	683.65	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		499249	RECVG	PWSA128 BULK DIESEL FUEL		1/31/2020	Purchasing	322	10-322-7422-100000000	1,255.45	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		501384	RECVG	PWSA128 BULK DIESEL FUEL		2/14/2020	Purchasing	322	10-322-7422-100000000	719.02	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		501394	RECVG	PWSA128 BULK DIESEL FUEL		2/14/2020	Purchasing	322	10-322-7422-100000000	512.38	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		501400	RECVG	PWSA128 BULK DIESEL FUEL		2/14/2020	Purchasing	322	10-322-7422-100000000	1,129.44	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		501401	RECVG	PWSA128 BULK DIESEL FUEL		2/14/2020	Purchasing	322	10-322-7422-100000000	1,150.68	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		502299	RECVG	PWSA128 BULK DIESEL FUEL		2/19/2020	Purchasing	322	10-322-7422-100000000	840.42	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		502308	RECVG	PWSA128 BULK DIESEL FUEL		2/19/2020	Purchasing	322	10-322-7422-100000000	906.31	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		504339	RECVG	PWSA128 BULK DIESEL FUEL		2/27/2020	Purchasing	322	10-322-7422-100000000	1,220.06	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		504350	RECVG	PWSA128 BULK DIESEL FUEL		2/27/2020	Purchasing	322	10-322-7422-100000000	1,273.27	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		505882	RECVG	PWSA128 BULK DIESEL FUEL		3/6/2020	Purchasing	322	10-322-7422-100000000	1,295.81	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		505883	RECVG	PWSA128 BULK DIESEL FUEL		3/6/2020	Purchasing	322	10-322-7422-100000000	1,241.44	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		506969	RECVG	PWSA128 BULK DIESEL FUEL		3/13/2020	Purchasing	322	10-322-7422-100000000	1,132.41	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		513508	RECVG	PWSA128 BULK DIESEL FUEL		5/5/2020	Purchasing	322	10-322-7422-100000000	821.65	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		513509	RECVG	PWSA128 BULK DIESEL FUEL		5/5/2020	Purchasing	322	10-322-7422-100000000	501.12	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		514925	RECVG	PWSA128 BULK DIESEL FUEL		5/13/2020	Purchasing	322	10-322-7422-100000000	7,598.55	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		524960	RECVG	PWSA128 BULK DIESEL FUEL		7/22/2020	Purchasing	322	10-322-7422-100000000	192.87	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		524961	RECVG	PWSA128 BULK DIESEL FUEL		7/22/2020	Purchasing	322	10-322-7422-100000000	1,028.01	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		527395	RECVG	PWSA128 BULK DIESEL FUEL		8/7/2020	Purchasing	322	10-322-7422-100000000	708.20	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		529615	RECVG	PWSA128 BULK DIESEL FUEL		8/21/2020	Purchasing	322	10-322-7422-100000000	880.08	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		530926	RECVG	PWSA128 BULK DIESEL FUEL		8/31/2020	Purchasing	322	10-322-7422-100000000	1,098.95	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		530927	RECVG	PWSA128 BULK DIESEL FUEL		8/31/2020	Purchasing	322	10-322-7422-100000000	138.58	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		531518	RECVG	PWSA128 BULK DIESEL FUEL		9/3/2020	Purchasing	322	10-322-7422-100000000	1,023.20	-	31773	GLASSMERE FUEL SERVICE, INC. Purchases
10		495106	RECVG	DIESEL ORD		1/6/2020	Purchasing	322	10-322-7422-100000000	937.86	-	30331	MONARCH OIL COMPANY INC Purchases
10		495107	RECVG	DIESEL ORD 553971		1/6/2020	Purchasing	322	10-322-7422-100000000	1,428.42	-	30331	MONARCH OIL COMPANY INC Purchases
10		495110	RECVG	DIESEL ORD		1/6/2020	Purchasing	322	10-322-7422-100000000	1,711.02	-	30331	MONARCH OIL COMPANY INC Purchases
10		495113	RECVG	DIESEL ORD 553447		1/6/2020	Purchasing	322	10-322-7422-100000000	1,605.83	-	30331	MONARCH OIL COMPANY INC Purchases
10		495114	RECVG	DIESEL ORD 553739		1/6/2020	Purchasing	322	10-322-7422-100000000	1,221.53	-	30331	MONARCH OIL COMPANY INC Purchases
10		495115	RECVG	DIESEL ORD 553559		1/6/2020	Purchasing	322	10-322-7422-100000000	1,295.64	-	30331	MONARCH OIL COMPANY INC Purchases
10		495116	RECVG	DIESEL ORD 553785		1/6/2020	Purchasing	322	10-322-7422-100000000	1,347.50	-	30331	MONARCH OIL COMPANY INC Purchases
10		495117	RECVG	DIESEL ORD 553838		1/6/2020	Purchasing	322	10-322-7422-100000000	574.04	-	30331	MONARCH OIL COMPANY INC Purchases
10		495118	RECVG	DIESEL ORD 553998		1/6/2020	Purchasing	322	10-322-7422-100000000	662.97	-	30331	MONARCH OIL COMPANY INC Purchases
10		495837	RECVG	DIESEL ORD 554132		1/8/2020	Purchasing	322	10-322-7422-100000000	1,123.64	-	30331	MONARCH OIL COMPANY INC Purchases
10		495843	RECVG	DIESEL ORD 552691		1/8/2020	Purchasing	322	10-322-7422-100000000	1,394.46	-	30331	MONARCH OIL COMPANY INC Purchases
10		495995	RECVG	DIESEL ORD 554182		1/10/2020	Purchasing	322	10-322-7422-100000000	1,450.61	-	30331	MONARCH OIL COMPANY INC Purchases
10		497010	RECVG	DIESEL ORD 554301		1/16/2020	Purchasing	322	10-322-7422-100000000	908.25	-	30331	MONARCH OIL COMPANY INC Purchases
10		497011	RECVG	DIESEL ORD 554402		1/16/2020	Purchasing	322	10-322-7422-100000000	921.23	-	30331	MONARCH OIL COMPANY INC Purchases
										51,127.96	12,179.27	Total	\$ 38,948.69

Electrical													
GL Account Number	Journal Entry	Source Document	Reference	TRX Date	Series	Department	Account Number	Debit Amount	Credit Amount	Vendor ID	Vendor Name	Description	
7605		500635	GJ	JAN 2020 MISC REVENUE RECL		1/31/2020	Financial	322	10-322-7605-100000000	-	5,543.80		RCLS DIRECT NRG DEC 18, 2019
7605		500635	GJ	JAN 2020 MISC REVENUE RECL		1/31/2020	Financial	322	10-322-7605-100000000	-	5,766.92		RCLS DIRECT NRG JAN 17, 2020
7605		505017	GJ	FEB 2020 MISC REVENUE RECL		2/28/2020	Financial	322	10-322-7605-100000000	-	5,766.92		RCLS DIRECT NRG FEB 18, 2020
7605		509455	GJ	MAR 2020 MISC REVENUE REC		3/31/2020	Financial	322	10-322-7605-100000000	-	5,320.67		RCLS DIRECT NRG MARCH 2020
7605		513365	GJ	APR 2020 MISC REVENUE RECL		4/30/2020	Financial	322	10-322-7605-100000000	-	5,766.92		RCLS DIRECT NRG APR 17, 2020
7605		522469	GJ	JUN 2020 MISC REVENUE RECL		6/30/2020	Financial	322	10-322-7605-100000000	-	5,543.80		RCLS DIRECT NRG MAY 18, 2020
7605		526934	GJ	JUL 2020 MISC REVENUE RECL		7/31/2020	Financial	322	10-322-7605-100000000	-	5,766.92		RCLS DIRECT NRG JUN 18 2020
7605		535806	GJ	SEP 2020 MISC REVENUE RECL		9/30/2020	Financial	322	10-322-7605-100000000	-	2,257.52		RCLS DIRECT NRG AUG 18, 2020
7605		540634	GJ	OCT 2020 MISC REVENUE RECL		10/31/2020	Financial	322	10-322-7605-100000000	-	2,411.46		RCLS DIRECT NRG SEP 18, 2020
7605		544746	GJ	NOV 2020 MISC REVENUE RECL		11/30/2020	Financial	322	10-322-7605-100000000	-	2,411.46		RCLS DIRECT NRG OCT 16, 2020
7605		549443	GJ	DEC 2020 MISC REVENUE RECL		12/31/2020	Financial	322	10-322-7605-100000000	-	2,257.52		RCLS DIRECT NRG NOV 18, 2020
7605		553420	GJ	RVRS 2019 AP ACCRUAL		12/31/2020	Financial	322	10-322-7605-100000000	-	452,874.14		RVRS 2019 AP ACCRUAL
7605		555680	GJ	2020 AP ACCRUAL		12/31/2020	Financial	322	10-322-7605-100000000	682,194.76	-		2020 AP ACCRUAL
7605		534881	RECVG	4476 EVERGREEN ROAD		9/28/2020	Purchasing	322	10-322-7605-100000000	24.78	-	31933	DIRECT ENERGY BUSINESS Purchases
7605		495867	RECVG	SUMMARY BILL		1/9/2020	Purchasing	322	10-322-7605-100000000	326.43	-	30155	DUQUESNE LIGHT COMPANY Purchases

7605		496937	RECVG	BUNKER HILL ST	1/16/2020	Purchasing	322	10-322-7605-100000000	7,185.07	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		498891	RECVG	BLACKSTONE/TESLA STREET	1/29/2020	Purchasing	322	10-322-7605-100000000	215.57	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		498892	RECVG	SCIENCE STREET	1/29/2020	Purchasing	322	10-322-7605-100000000	177.79	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		499762	RECVG	MONTANA STREET CELL	2/4/2020	Purchasing	322	10-322-7605-100000000	17.90	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		500622	RECVG	SUMMARY BILL 2 2 2020	2/10/2020	Purchasing	322	10-322-7605-100000000	328.14	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		500932	RECVG	SUMMARY BILL 2 5 20	2/11/2020	Purchasing	322	10-322-7605-100000000	738,389.81	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		502030	RECVG	BUNKER HILL ST 2 9 20	2/18/2020	Purchasing	322	10-322-7605-100000000	8,097.03	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		502601	RECVG	SCIENCE ST 2 13 20	2/20/2020	Purchasing	322	10-322-7605-100000000	168.95	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		505466	RECVG	MONTANA STREET CELL	3/4/2020	Purchasing	322	10-322-7605-100000000	17.89	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		506318	RECVG	SUMMARY BILL 3 1 2020	3/10/2020	Purchasing	322	10-322-7605-100000000	328.10	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		506320	RECVG	BLACKSTONE TESLA STS	3/10/2020	Purchasing	322	10-322-7605-100000000	216.08	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		507415	RECVG	BUNKER HILL ST 3 9 2020	3/16/2020	Purchasing	322	10-322-7605-100000000	10,033.06	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		507772	RECVG	23 WELSH WAY	3/19/2020	Purchasing	322	10-322-7605-100000000	175.93	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		508281	RECVG	SUMMARY BILL 3 5 2020	3/23/2020	Purchasing	322	10-322-7605-100000000	402,120.01	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		509973	RECVG	MONTANA STREET CELL	4/6/2020	Purchasing	322	10-322-7605-100000000	17.04	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		509974	RECVG	BLACKSTONE TESLA STS	4/6/2020	Purchasing	322	10-322-7605-100000000	202.67	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		510721	RECVG	SUMMARY BILL	4/13/2020	Purchasing	322	10-322-7605-100000000	328.10	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		511668	RECVG	BUNKER HILL ST	4/20/2020	Purchasing	322	10-322-7605-100000000	10,051.97	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		512453	RECVG	SUMMARY BILL 4 6 2020	4/29/2020	Purchasing	322	10-322-7605-100000000	305,401.57	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		513306	RECVG	SCIENCE ST	5/4/2020	Purchasing	322	10-322-7605-100000000	2,560.90	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		513307	RECVG	BLACKSTONE TESLA STS	5/4/2020	Purchasing	322	10-322-7605-100000000	1,660.04	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		513872	RECVG	MONTANA STREET CELL	5/7/2020	Purchasing	322	10-322-7605-100000000	17.28	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		515583	RECVG	SUMMARY BILL	5/20/2020	Purchasing	322	10-322-7605-100000000	329.18	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		515800	RECVG	SUMMARY BILL	5/21/2020	Purchasing	322	10-322-7605-100000000	341,702.12	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		516473	RECVG	BUNKER HILL ST	5/27/2020	Purchasing	322	10-322-7605-100000000	9,985.80	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		517328	RECVG	SCIENCE ST	6/2/2020	Purchasing	322	10-322-7605-100000000	4,550.90	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		518029	RECVG	BLACKSTONE TESLA STS	6/8/2020	Purchasing	322	10-322-7605-100000000	1,953.56	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		518030	RECVG	MONTANA STREET CELL	6/8/2020	Purchasing	322	10-322-7605-100000000	16.50	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		519074	RECVG	SUMMARY BILL	6/15/2020	Purchasing	322	10-322-7605-100000000	329.18	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		520028	RECVG	BUNKER HILL ST	6/22/2020	Purchasing	322	10-322-7605-100000000	9,287.25	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		520031	RECVG	SUMMARY BILL 6 10 2020	6/22/2020	Purchasing	322	10-322-7605-100000000	308,651.83	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		521524	RECVG	SCIENCE ST	6/29/2020	Purchasing	322	10-322-7605-100000000	4,055.16	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		522744	RECVG	BALCKSTONE/TESLA 6.20	7/9/2020	Purchasing	322	10-322-7605-100000000	179.46	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		522745	RECVG	MONTANA STREET CELL 6.20	7/9/2020	Purchasing	322	10-322-7605-100000000	15.89	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		524802	RECVG	SUMMARY BILL	7/21/2020	Purchasing	322	10-322-7605-100000000	328.00	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		524976	RECVG	SUMMARY BILL	7/22/2020	Purchasing	322	10-322-7605-100000000	301,766.82	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		526735	RECVG	BUNKER HILL ST	8/4/2020	Purchasing	322	10-322-7605-100000000	4,108.60	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		527875	RECVG	SCIENCE ST	8/11/2020	Purchasing	322	10-322-7605-100000000	2,686.29	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		527876	RECVG	MONTANA STREET CELL	8/11/2020	Purchasing	322	10-322-7605-100000000	16.42	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		527877	RECVG	BLACKSTONE TESLA STS	8/11/2020	Purchasing	322	10-322-7605-100000000	183.83	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		529013	RECVG	SUMMARY BILL	8/18/2020	Purchasing	322	10-322-7605-100000000	328.41	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		530205	RECVG	SUMMARY BILL	8/25/2020	Purchasing	322	10-322-7605-100000000	354,734.61	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		530997	RECVG	BUNKER HILL ST	8/31/2020	Purchasing	322	10-322-7605-100000000	4,108.60	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		530998	RECVG	SCIENCE ST	8/31/2020	Purchasing	322	10-322-7605-100000000	3,856.11	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		532107	RECVG	BLACKSTONE/TESLA 8.2020	9/9/2020	Purchasing	322	10-322-7605-100000000	177.94	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		532108	RECVG	MONTANA STREET CELL 8.2020	9/9/2020	Purchasing	322	10-322-7605-100000000	15.95	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		533014	RECVG	SUMMARY BILL	9/15/2020	Purchasing	322	10-322-7605-100000000	328.41	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		534871	RECVG	BUNKER HILL ST	9/28/2020	Purchasing	322	10-322-7605-100000000	4,108.60	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		534872	RECVG	SCIENCE ST	9/28/2020	Purchasing	322	10-322-7605-100000000	3,987.50	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		534873	RECVG	SUMMARY BILL	9/28/2020	Purchasing	322	10-322-7605-100000000	289,857.22	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		536142	RECVG	BLACKSTONE TESLA STS	10/7/2020	Purchasing	322	10-322-7605-100000000	178.75	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		536143	RECVG	MONTANA STREET CELL	10/7/2020	Purchasing	322	10-322-7605-100000000	16.07	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		536699	RECVG	SUMMARY BILL	10/13/2020	Purchasing	322	10-322-7605-100000000	328.41	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		539068	RECVG	SCIENCE ST	10/27/2020	Purchasing	322	10-322-7605-100000000	8,078.59	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		539163	RECVG	SUMMARY BILL 10 12 20	10/28/2020	Purchasing	322	10-322-7605-100000000	323,540.60	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		540162	RECVG	BUNKER HILL ST	11/3/2020	Purchasing	322	10-322-7605-100000000	4,153.10	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		541198	RECVG	MONTANA STREET CELL	11/10/2020	Purchasing	322	10-322-7605-100000000	16.41	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		541199	RECVG	BLACKSTONE TESLA STS	11/10/2020	Purchasing	322	10-322-7605-100000000	174.03	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		542069	RECVG	SUMMARY BILL	11/17/2020	Purchasing	322	10-322-7605-100000000	329.84	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		542915	RECVG	SUMMARY BILL	11/23/2020	Purchasing	322	10-322-7605-100000000	330,220.60	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		543918	RECVG	BUNKER HILL	12/1/2020	Purchasing	322	10-322-7605-100000000	19,409.08	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		545011	RECVG	BLACKSTONE TESLA STS	12/9/2020	Purchasing	322	10-322-7605-100000000	178.45	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		545012	RECVG	SCIENCE ST	12/9/2020	Purchasing	322	10-322-7605-100000000	569.96	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		546057	RECVG	MONTANA STREET CELL	12/15/2020	Purchasing	322	10-322-7605-100000000	17.02	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		546964	RECVG	SUMMARY BILL	12/18/2020	Purchasing	322	10-322-7605-100000000	319.79	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		547956	RECVG	BUNKER HILL 12.20	12/28/2020	Purchasing	322	10-322-7605-100000000	5,981.55	-	30155	DUQUESNE LIGHT COMPANY	Purchases	
7605		547998	RECVG	SALINE STREET DEC 2020	12/28/2020	Purchasing	322	10-322-7605-100000000	115.37	-	31392	PEOPLES NATURAL GAS	Purchases	
									4,515,534.63		501,688.05	Total	\$	4,013,846.58

Chemicals													
GL Account Number	Journal Entry	Source Document	Reference	TRX Date	Series	Department	Account Number	Debit Amount	Credit Amount	Vendor ID	Vendor Name	Description	
5005		497003	RECVG	PWSA ORTHO 2017-322-107-1	1/16/2020	Purchasing	322	10-322-5005-100000000	21,178.80	-	30450	SAL CHEMICAL	Purchases
5005		501378	RECVG	PWSA ORTHO 2017-322-107-1	2/14/2020	Purchasing	322	10-322-5005-100000000	21,178.80	-	30450	SAL CHEMICAL	Purchases
5005		506221	RECVG	PWSA ORTHO 2017-322-107-1	3/10/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5005		512381	RECVG	PWSA ORTHO 2017-322-107-1	4/23/2020	Purchasing	322	10-322-5005-100000000	21,178.80	-	30450	SAL CHEMICAL	Purchases
5005		515643	RECVG	PWSA ORTHO 2017-322-107-1	5/20/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5005		520354	RECVG	PWSA ORTHO 2017-322-107-1	6/24/2020	Purchasing	322	10-322-5005-100000000	21,178.80	-	30450	SAL CHEMICAL	Purchases
5005		527146	RECVG	PWSA ORTHO 2017-322-107-1	8/6/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5005		531520	RECVG	PWSA ORTHO 2017-322-107-1	9/3/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5005		535104	RECVG	PWSA ORTHO 2017-322-107-1	9/30/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5005		542503	RECVG	PWSA ORTHO 2017-322-107-1	11/19/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5005		547000	RECVG	PWSA ORTHO 2017-322-107-1	12/15/2020	Purchasing	322	10-322-5005-100000000	25,414.56	-	30450	SAL CHEMICAL	Purchases
5010		495101	RECVG	cyclocore	1/6/2020	Purchasing	322	10-322-5010-100000000	478.00	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		498459	RECVG	CYCLOCRE BOILER CHEM	1/27/2020	Purchasing	322	10-322-5010-100000000	833.00	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		505884	RECVG	BOILER CHEMICALS	3/6/2020	Purchasing	322	10-322-5010-100000000	3,847.00	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		511245	RECVG	BLR ANYLS/EQUIP/SHIPPG	4/16/2020	Purchasing	322	10-322-5010-100000000	163.00	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		516225	RECVG	BOILER CHEMS/FREIGHT	5/26/2020	Purchasing	322	10-322-5010-100000000	660.00	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		532906	RECVG	BOILER CHEMS/FREIGHT	9/14/2020	Purchasing	322	10-322-5010-100000000	65.85	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		537234	RECVG	BOILER CHEMICALS 2021	10/15/2020	Purchasing	322	10-322-5010-100000000	11,005.00	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		537250	RECVG	BOILER ANYLS/CHEMICALS	10/15/2020	Purchasing	322	10-322-5010-100000000	404.80	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		542334	RECVG	BLR ANYS./CHEMS/FREIGHT	11/19/2020	Purchasing	322	10-322-5010-100000000	241.80	-	31070	CRAFT PRODUCTS COMPANY	Purchases
5010		505955	RECVG	WATER SOFTNER PELLETS-BO	3/6/2020	Purchasing	322	10-322-5010-100000000	3,577.00	-	31010	MUELLER'S HARDWARE INC	Purchases
5010		505968	RECVG	WATER SOFTNER PELLETS-BO	3/9/2020	Purchasing	322	10-322-5010-100000000	3,577.00	-	31010	MUELLER'S HARDWARE INC	Purchases
5010		536207	RECVG	WATER SOFTNER PELLETS-BO	10/7/2020	Purchasing	322	10-322-5010-100000000	5,571.30	-	31010	MUELLER'S HARDWARE INC	Purchases
5010		544822	RECVG	Receivings Transaction Entry	12/7/2020	Purchasing	322	10-322-5010-100000000	7,428.40	-	31010	MUELLER'S HARDWARE INC	Purchases
5015		522797	RECVG	CALCIUM HYPOCHLORITE-TAI	7/9/2020	Purchasing	322	10-322-5015-100000000	4,000.00	-	30526	UNIVAR USA INC	Purchases
5015		524530	RECVG	CALCIUM HYPOCHLORITE-TAI	7/20/2020	Purchasing	322	10-322-5015-100000000	13,000.00	-	30526	UNIVAR USA INC	Purchases
5020		555680	GJ	2020 AP ACCRUAL	12/31/2020	Financial	322	10-322-5020-100000000	13,072.54	-			2020 AP ACCRUAL
5020		499251	RECVG	PWSA129 CAT FLOC	1/31/2020	Purchasing	322	10-322-5020-100000000	12,624.58	-	31378	POLYDYNE INC	Purchases
5020		499267	RECVG	PWSA129 CAT FLOC	1/31/2020	Purchasing	322	10-322-5020-100000000	12,624.58	-	31378	POLYDYNE INC	Purchases
5020		505902	RECVG	PWSA129 CAT FLOC	3/6/2020	Purchasing	322	10-322-5020-100000000	12,630.17	-	31378	POLYDYNE INC	Purchases
5020		511827	PORET	PWSA129 CAT FLOC	4/21/2020	Purchasing	322	10-322-5020-100000000	-	12,624.58	31378	POLYDYNE INC	Purchases
5020		512394	RECVG	PWSA129 CAT FLOC	4/23/2020	Purchasing	322	10-322-5020-100000000	12,669.34	-	31378	POLYDYNE INC	Purchases
5020		519408	RECVG	PWSA129 CAT FLOC	6/17/2020	Purchasing	322	10-322-5020-100000000	12,613.38	-	31378	POLYDYNE INC	Purchases
5020		527151	RECVG	PWSA129 CAT FLOC	8/6/2020	Purchasing	322	10-322-5020-100000000	12,591.00	-	31378	POLYDYNE INC	Purchases
5020		528039	POIVC	PWSA129 CAT FLOC	8/7/2020	Purchasing	322	10-322-5020-100000000	441.00	-	31378	POLYDYNE INC	Purchases
5020		533828	RECVG	PWSA129 CAT FLOC	9/18/2020	Purchasing	322	10-322-5020-100000000	12,602.19	-	31378	POLYDYNE INC	Purchases
5020		541597	RECVG	PWSA129 CAT FLOC	11/13/2020	Purchasing	322	10-322-5020-100000000	12,607.79	-	31378	POLYDYNE INC	Purchases
5025		512380	RECVG	CAUSTIC SODA-25%	4/23/2020	Purchasing	322	10-322-5025-100000000	723.20	-	30450	SAL CHEMICAL	Purchases
5025		516213	RECVG	CAUSTIC SODA-25%	5/26/2020	Purchasing	322	10-322-5025-100000000	1,084.80	-	30450	SAL CHEMICAL	Purchases
5025		527147	RECVG	CAUSTIC SODA-25%	8/6/2020	Purchasing	322	10-322-5025-100000000	1,084.80	-	30450	SAL CHEMICAL	Purchases
5025		542498	RECVG	CAUSTIC SODA-25%	11/19/2020	Purchasing	322	10-322-5025-100000000	361.00	-	30450	SAL CHEMICAL	Purchases
5025		542840	POIVC	CAUSTIC SODA-25%	11/20/2020	Purchasing	322	10-322-5025-100000000	0.60	-	30450	SAL CHEMICAL	Purchases
5025		547001	RECVG	CAUSTIC SODA-25%	12/15/2020	Purchasing	322	10-322-5025-100000000	723.20	-	30450	SAL CHEMICAL	Purchases
5040		542499	RECVG	CITRIC ACID	11/19/2020	Purchasing	322	10-322-5040-100000000	1,670.00	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5040		545729	RECVG	CITRIC ACID	12/11/2020	Purchasing	322	10-322-5040-100000000	1,670.00	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5040		512379	RECVG	CITRIC ACID	4/23/2020	Purchasing	322	10-322-5040-100000000	1,786.90	-	30526	UNIVAR USA INC	Purchases
5040		517667	RECVG	CITRIC ACID	6/3/2020	Purchasing	322	10-322-5040-100000000	1,786.90	-	30526	UNIVAR USA INC	Purchases
5040		519664	RECVG	CITRIC ACID	6/19/2020	Purchasing	322	10-322-5040-100000000	1,336.20	-	30526	UNIVAR USA INC	Purchases
5040		524974	RECVG	CITRIC ACID	7/22/2020	Purchasing	322	10-322-5040-100000000	1,670.00	-	30526	UNIVAR USA INC	Purchases
5050		553420	GJ	RVRS 2019 AP ACCRUAL	12/31/2020	Financial	322	10-322-5050-100000000	-	51,072.14			RVRS 2019 AP ACCRUAL
5050		555680	GJ	2020 AP ACCRUAL	12/31/2020	Financial	322	10-322-5050-100000000	150,407.62	-			2020 AP ACCRUAL
5050		495826	RECVG	LIQUID FERRIC CHLORIDE	1/8/2020	Purchasing	322	10-322-5050-100000000	33,928.70	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		497002	RECVG	LIQUID FERRIC CHLORIDE	1/16/2020	Purchasing	322	10-322-5050-100000000	17,143.44	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		499252	RECVG	LIQUID FERRIC CHLORIDE	1/31/2020	Purchasing	322	10-322-5050-100000000	33,574.77	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		499253	RECVG	LIQUID FERRIC CHLORIDE	1/31/2020	Purchasing	322	10-322-5050-100000000	16,365.08	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		499848	RECVG	LIQUID FERRIC CHLORIDE	2/4/2020	Purchasing	322	10-322-5050-100000000	33,527.07	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		499849	RECVG	LIQUID FERRIC CHLORIDE	2/4/2020	Purchasing	322	10-322-5050-100000000	33,333.41	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		501375	RECVG	LIQUID FERRIC CHLORIDE	2/14/2020	Purchasing	322	10-322-5050-100000000	33,508.62	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		501376	RECVG	LIQUID FERRIC CHLORIDE	2/14/2020	Purchasing	322	10-322-5050-100000000	4,172.07	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		505891	RECVG	LIQUID FERRIC CHLORIDE	3/6/2020	Purchasing	322	10-322-5050-100000000	33,554.88	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		505892	RECVG	LIQUID FERRIC CHLORIDE	3/6/2020	Purchasing	322	10-322-5050-100000000	33,540.74	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		505893	RECVG	LIQUID FERRIC CHLORIDE	3/6/2020	Purchasing	322	10-322-5050-100000000	33,419.73	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		506981	RECVG	LIQUID FERRIC CHLORIDE	3/13/2020	Purchasing	322	10-322-5050-100000000	33,580.11	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		509158	RECVG	LIQUID FERRIC CHLORIDE	3/31/2020	Purchasing	322	10-322-5050-100000000	33,544.22	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		509159	RECVG	LIQUID FERRIC CHLORIDE	3/31/2020	Purchasing	322	10-322-5050-100000000	29,176.06	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		510677	RECVG	LIQUID FERRIC CHLORIDE	4/13/2020	Purchasing	322	10-322-5050-100000000	16,630.64	-	30433	PVS TECHNOLOGIES, INC.	Purchases

5050		510678	RECVG	LIQUID FERRIC CHLORIDE	4/13/2020	Purchasing	322	10-322-5050-100000000	33,317.92	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		510679	RECVG	LIQUID FERRIC CHLORIDE	4/13/2020	Purchasing	322	10-322-5050-100000000	29,523.38	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		512374	RECVG	LIQUID FERRIC CHLORIDE	4/23/2020	Purchasing	322	10-322-5050-100000000	8,382.84	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		512395	RECVG	LIQUID FERRIC CHLORIDE	4/23/2020	Purchasing	322	10-322-5050-100000000	29,644.58	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		512396	RECVG	LIQUID FERRIC CHLORIDE	4/23/2020	Purchasing	322	10-322-5050-100000000	29,444.93	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		514934	RECVG	LIQUID FERRIC CHLORIDE	5/13/2020	Purchasing	322	10-322-5050-100000000	29,544.64	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		514935	RECVG	LIQUID FERRIC CHLORIDE	5/13/2020	Purchasing	322	10-322-5050-100000000	20,761.73	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		516214	RECVG	LIQUID FERRIC CHLORIDE	5/26/2020	Purchasing	322	10-322-5050-100000000	29,513.84	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		516215	RECVG	LIQUID FERRIC CHLORIDE	5/26/2020	Purchasing	322	10-322-5050-100000000	29,658.40	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		518398	RECVG	LIQUID FERRIC CHLORIDE	6/10/2020	Purchasing	322	10-322-5050-100000000	4,157.53	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		518399	RECVG	LIQUID FERRIC CHLORIDE	6/10/2020	Purchasing	322	10-322-5050-100000000	25,152.58	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		518400	RECVG	LIQUID FERRIC CHLORIDE	6/10/2020	Purchasing	322	10-322-5050-100000000	29,303.94	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		521629	RECVG	LIQUID FERRIC CHLORIDE	6/30/2020	Purchasing	322	10-322-5050-100000000	29,732.69	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		521630	RECVG	LIQUID FERRIC CHLORIDE	6/30/2020	Purchasing	322	10-322-5050-100000000	29,611.15	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		524539	RECVG	LIQUID FERRIC CHLORIDE	7/20/2020	Purchasing	322	10-322-5050-100000000	12,640.46	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		524540	RECVG	LIQUID FERRIC CHLORIDE	7/20/2020	Purchasing	322	10-322-5050-100000000	29,454.19	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		524596	RECVG	LIQUID FERRIC CHLORIDE	7/20/2020	Purchasing	322	10-322-5050-100000000	29,366.67	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		527148	RECVG	LIQUID FERRIC CHLORIDE	8/6/2020	Purchasing	322	10-322-5050-100000000	29,511.77	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		527149	RECVG	LIQUID FERRIC CHLORIDE	8/6/2020	Purchasing	322	10-322-5050-100000000	12,668.75	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		527150	RECVG	LIQUID FERRIC CHLORIDE	8/6/2020	Purchasing	322	10-322-5050-100000000	29,717.55	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		528283	RECVG	LIQUID FERRIC CHLORIDE	8/13/2020	Purchasing	322	10-322-5050-100000000	37,398.19	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		528284	RECVG	LIQUID FERRIC CHLORIDE	8/13/2020	Purchasing	322	10-322-5050-100000000	33,727.93	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		532884	RECVG	LIQUID FERRIC CHLORIDE	9/14/2020	Purchasing	322	10-322-5050-100000000	29,476.03	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		532886	RECVG	LIQUID FERRIC CHLORIDE	9/14/2020	Purchasing	322	10-322-5050-100000000	29,765.70	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		532887	RECVG	LIQUID FERRIC CHLORIDE	9/14/2020	Purchasing	322	10-322-5050-100000000	33,682.18	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		532888	RECVG	LIQUID FERRIC CHLORIDE	9/14/2020	Purchasing	322	10-322-5050-100000000	29,594.14	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		532889	RECVG	LIQUID FERRIC CHLORIDE	9/14/2020	Purchasing	322	10-322-5050-100000000	8,391.79	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		536037	RECVG	LIQUID FERRIC CHLORIDE	10/6/2020	Purchasing	322	10-322-5050-100000000	25,178.31	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		536038	RECVG	LIQUID FERRIC CHLORIDE	10/6/2020	Purchasing	322	10-322-5050-100000000	29,214.54	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		536039	RECVG	LIQUID FERRIC CHLORIDE	10/6/2020	Purchasing	322	10-322-5050-100000000	29,164.73	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		536040	RECVG	LIQUID FERRIC CHLORIDE	10/6/2020	Purchasing	322	10-322-5050-100000000	29,468.25	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		536041	RECVG	LIQUID FERRIC CHLORIDE	10/6/2020	Purchasing	322	10-322-5050-100000000	21,045.68	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		538405	RECVG	LIQUID FERRIC CHLORIDE	10/22/2020	Purchasing	322	10-322-5050-100000000	1,082.22	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		541598	RECVG	LIQUID FERRIC CHLORIDE	11/13/2020	Purchasing	322	10-322-5050-100000000	8,406.98	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		541599	RECVG	LIQUID FERRIC CHLORIDE	11/13/2020	Purchasing	322	10-322-5050-100000000	30,579.15	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		541600	RECVG	LIQUID FERRIC CHLORIDE	11/13/2020	Purchasing	322	10-322-5050-100000000	29,500.28	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		541601	RECVG	LIQUID FERRIC CHLORIDE	11/13/2020	Purchasing	322	10-322-5050-100000000	29,333.66	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		542505	RECVG	LIQUID FERRIC CHLORIDE	11/19/2020	Purchasing	322	10-322-5050-100000000	27,612.82	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		543553	RECVG	LIQUID FERRIC CHLORIDE	11/30/2020	Purchasing	322	10-322-5050-100000000	54,804.53	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		544911	RECVG	LIQUID FERRIC CHLORIDE	12/8/2020	Purchasing	322	10-322-5050-100000000	25,265.49	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		545731	RECVG	LIQUID FERRIC CHLORIDE	12/11/2020	Purchasing	322	10-322-5050-100000000	8,390.74	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		545732	RECVG	LIQUID FERRIC CHLORIDE	12/11/2020	Purchasing	322	10-322-5050-100000000	4,191.61	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5050		545733	RECVG	LIQUID FERRIC CHLORIDE	12/11/2020	Purchasing	322	10-322-5050-100000000	29,433.19	-	30433	PVS TECHNOLOGIES, INC.	Purchases
5055		553420	GJ	RVRS 2019 AP ACCRUAL	12/31/2020	Financial	322	10-322-5055-100000000	-	8,864.81			RVRS 2019 AP ACCRUAL
5055		532885	RECVG	HYDROFLUOSILICIC ACID	9/14/2020	Purchasing	322	10-322-5055-100000000	9,137.69	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5055		535106	RECVG	HYDROFLUOSILICIC ACID	9/30/2020	Purchasing	322	10-322-5055-100000000	8,944.40	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5055		538408	RECVG	HYDROFLUOSILICIC ACID	10/22/2020	Purchasing	322	10-322-5055-100000000	8,796.59	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5055		540050	RECVG	HYDROFLUOSILICIC ACID	11/2/2020	Purchasing	322	10-322-5055-100000000	8,485.81	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5055		543554	RECVG	HYDROFLUOSILICIC ACID	11/30/2020	Purchasing	322	10-322-5055-100000000	8,258.41	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5055		499255	RECVG	HYDROFLUOSILICIC ACID	1/31/2020	Purchasing	322	10-322-5055-100000000	8,387.27	-	30526	UNIVAR USA INC	Purchases
5055		499850	RECVG	HYDROFLUOSILICIC ACID	2/4/2020	Purchasing	322	10-322-5055-100000000	8,929.24	-	30526	UNIVAR USA INC	Purchases
5055		501374	RECVG	HYDROFLUOSILICIC ACID	2/14/2020	Purchasing	322	10-322-5055-100000000	8,864.81	-	30526	UNIVAR USA INC	Purchases
5055		506975	RECVG	HYDROFLUOSILICIC ACID	3/13/2020	Purchasing	322	10-322-5055-100000000	9,111.16	-	30526	UNIVAR USA INC	Purchases
5055		510688	RECVG	HYDROFLUOSILICIC ACID	4/13/2020	Purchasing	322	10-322-5055-100000000	9,183.17	-	30526	UNIVAR USA INC	Purchases
5055		513504	RECVG	HYDROFLUOSILICIC ACID	5/5/2020	Purchasing	322	10-322-5055-100000000	9,175.59	-	30526	UNIVAR USA INC	Purchases
5055		513505	RECVG	HYDROFLUOSILICIC ACID	5/5/2020	Purchasing	322	10-322-5055-100000000	9,061.89	-	30526	UNIVAR USA INC	Purchases
5055		513685	RECVG	HYDROFLUOSILICIC ACID	5/7/2020	Purchasing	322	10-322-5055-100000000	9,042.94	-	30526	UNIVAR USA INC	Purchases
5055		517671	RECVG	HYDROFLUOSILICIC ACID	6/3/2020	Purchasing	322	10-322-5055-100000000	8,868.60	-	30526	UNIVAR USA INC	Purchases
5055		521635	RECVG	HYDROFLUOSILICIC ACID	6/30/2020	Purchasing	322	10-322-5055-100000000	8,804.17	-	30526	UNIVAR USA INC	Purchases
5055		524972	RECVG	HYDROFLUOSILICIC ACID	7/22/2020	Purchasing	322	10-322-5055-100000000	8,921.66	-	30526	UNIVAR USA INC	Purchases
5055		527451	RECVG	HYDROFLUOSILICIC ACID	8/7/2020	Purchasing	322	10-322-5055-100000000	8,959.56	-	30526	UNIVAR USA INC	Purchases
5060		553420	GJ	RVRS 2019 AP ACCRUAL	12/31/2020	Financial	322	10-322-5060-100000000	-	12,574.50			RVRS 2019 AP ACCRUAL
5060		555680	GJ	2020 AP ACCRUAL	12/31/2020	Financial	322	10-322-5060-100000000	30,223.39	-			2020 AP ACCRUAL
5060		495827	RECVG	LIME ULTRALIME	1/8/2020	Purchasing	322	10-322-5060-100000000	2,509.50	-	31273	APPLIED SPECIALTIES, INC	Purchases
5060		495828	RECVG	LIME ULTRALIME	1/8/2020	Purchasing	322	10-322-5060-100000000	3,613.50	-	31273	APPLIED SPECIALTIES, INC	Purchases
5060		495829	RECVG	LIME ULTRALIME	1/8/2020	Purchasing	322	10-322-5060-100000000	3,169.50	-	31273	APPLIED SPECIALTIES, INC	Purchases
5060		495830	RECVG	LIME ULTRALIME	1/8/2020	Purchasing	322	10-322-5060-100000000	3,006.00	-	31273	APPLIED SPECIALTIES, INC	Purchases
5060		497000	RECVG	LIME ULTRALIME	1/16/2020	Purchasing	322	10-322-5060-100000000	3,145.50	-	31273	APPLIED SPECIALTIES, INC	Purchases







5075		513684	RECVG	SODA ASH-DENSE	5/7/2020	Purchasing	322	10-322-5075-100000000	7,199.29	-	30450	SAL CHEMICAL	Purchases
5075		514936	RECVG	SODA ASH-DENSE	5/13/2020	Purchasing	322	10-322-5075-100000000	7,202.39	-	30450	SAL CHEMICAL	Purchases
5075		514937	RECVG	SODA ASH-DENSE	5/13/2020	Purchasing	322	10-322-5075-100000000	7,124.94	-	30450	SAL CHEMICAL	Purchases
5075		515644	RECVG	SODA ASH-DENSE	5/20/2020	Purchasing	322	10-322-5075-100000000	7,066.68	-	30450	SAL CHEMICAL	Purchases
5075		515645	RECVG	SODA ASH-DENSE	5/20/2020	Purchasing	322	10-322-5075-100000000	7,177.60	-	30450	SAL CHEMICAL	Purchases
5075		516212	RECVG	SODA ASH-DENSE	5/26/2020	Purchasing	322	10-322-5075-100000000	7,255.05	-	30450	SAL CHEMICAL	Purchases
5075		517665	RECVG	SODA ASH-DENSE	6/3/2020	Purchasing	322	10-322-5075-100000000	7,131.14	-	30450	SAL CHEMICAL	Purchases
5075		517666	RECVG	SODA ASH-DENSE	6/3/2020	Purchasing	322	10-322-5075-100000000	7,174.50	-	30450	SAL CHEMICAL	Purchases
5075		518401	RECVG	SODA ASH-DENSE	6/10/2020	Purchasing	322	10-322-5075-100000000	7,001.03	-	30450	SAL CHEMICAL	Purchases
5075		518402	RECVG	SODA ASH-DENSE	6/10/2020	Purchasing	322	10-322-5075-100000000	7,090.86	-	30450	SAL CHEMICAL	Purchases
5075		518403	RECVG	SODA ASH-DENSE	6/10/2020	Purchasing	322	10-322-5075-100000000	7,406.84	-	30450	SAL CHEMICAL	Purchases
5075		519409	RECVG	SODA ASH-DENSE	6/17/2020	Purchasing	322	10-322-5075-100000000	7,183.80	-	30450	SAL CHEMICAL	Purchases
5075		519413	RECVG	SODA ASH-DENSE	6/17/2020	Purchasing	322	10-322-5075-100000000	7,059.89	-	30450	SAL CHEMICAL	Purchases
5075		519414	RECVG	SODA ASH-DENSE	6/17/2020	Purchasing	322	10-322-5075-100000000	7,028.91	-	30450	SAL CHEMICAL	Purchases
5075		520353	RECVG	SODA ASH-DENSE	6/24/2020	Purchasing	322	10-322-5075-100000000	7,487.38	-	30450	SAL CHEMICAL	Purchases
5075		521631	RECVG	SODA ASH-DENSE	6/30/2020	Purchasing	322	10-322-5075-100000000	7,273.63	-	30450	SAL CHEMICAL	Purchases
5075		521632	RECVG	SODA ASH-DENSE	6/30/2020	Purchasing	322	10-322-5075-100000000	7,326.30	-	30450	SAL CHEMICAL	Purchases
5075		524535	RECVG	SODA ASH-DENSE	7/20/2020	Purchasing	322	10-322-5075-100000000	7,019.61	-	30450	SAL CHEMICAL	Purchases
5075		524536	RECVG	SODA ASH-DENSE	7/20/2020	Purchasing	322	10-322-5075-100000000	1,951.61	-	30450	SAL CHEMICAL	Purchases
5075		524537	RECVG	SODA ASH-DENSE	7/20/2020	Purchasing	322	10-322-5075-100000000	6,991.73	-	30450	SAL CHEMICAL	Purchases
5075		524538	RECVG	SODA ASH-DENSE	7/20/2020	Purchasing	322	10-322-5075-100000000	6,914.29	-	30450	SAL CHEMICAL	Purchases
5075		527137	RECVG	SODA ASH-DENSE	8/6/2020	Purchasing	322	10-322-5075-100000000	7,109.45	-	30450	SAL CHEMICAL	Purchases
5075		527141	RECVG	SODA ASH-DENSE	8/6/2020	Purchasing	322	10-322-5075-100000000	7,010.32	-	30450	SAL CHEMICAL	Purchases
5075		527142	RECVG	SODA ASH-DENSE	8/6/2020	Purchasing	322	10-322-5075-100000000	6,926.68	-	30450	SAL CHEMICAL	Purchases
5075		527143	RECVG	SODA ASH-DENSE	8/6/2020	Purchasing	322	10-322-5075-100000000	7,128.04	-	30450	SAL CHEMICAL	Purchases
5075		527144	RECVG	SODA ASH-DENSE	8/6/2020	Purchasing	322	10-322-5075-100000000	7,140.43	-	30450	SAL CHEMICAL	Purchases
5075		527145	RECVG	SODA ASH-DENSE	8/6/2020	Purchasing	322	10-322-5075-100000000	6,121.25	-	30450	SAL CHEMICAL	Purchases
5075		527455	RECVG	SODA ASH-DENSE	8/7/2020	Purchasing	322	10-322-5075-100000000	7,140.43	-	30450	SAL CHEMICAL	Purchases
5075		528279	RECVG	SODA ASH-DENSE	8/13/2020	Purchasing	322	10-322-5075-100000000	7,044.40	-	30450	SAL CHEMICAL	Purchases
5075		528285	RECVG	SODA ASH-DENSE	8/13/2020	Purchasing	322	10-322-5075-100000000	7,159.02	-	30450	SAL CHEMICAL	Purchases
5075		528286	RECVG	SODA ASH-DENSE	8/13/2020	Purchasing	322	10-322-5075-100000000	2,707.48	-	30450	SAL CHEMICAL	Purchases
5075		529622	RECVG	SODA ASH-DENSE	8/21/2020	Purchasing	322	10-322-5075-100000000	7,165.21	-	30450	SAL CHEMICAL	Purchases
5075		529623	RECVG	SODA ASH-DENSE	8/21/2020	Purchasing	322	10-322-5075-100000000	7,276.73	-	30450	SAL CHEMICAL	Purchases
5075		530908	RECVG	SODA ASH-DENSE	8/31/2020	Purchasing	322	10-322-5075-100000000	7,131.14	-	30450	SAL CHEMICAL	Purchases
5075		530925	RECVG	SODA ASH-DENSE	8/31/2020	Purchasing	322	10-322-5075-100000000	2,406.99	-	30450	SAL CHEMICAL	Purchases
5075		531516	RECVG	SODA ASH-DENSE	9/3/2020	Purchasing	322	10-322-5075-100000000	7,224.07	-	30450	SAL CHEMICAL	Purchases
5075		531517	RECVG	SODA ASH-DENSE	9/3/2020	Purchasing	322	10-322-5075-100000000	7,007.22	-	30450	SAL CHEMICAL	Purchases
5075		532588	RECVG	Receivings Transaction Entry	9/11/2020	Purchasing	322	10-322-5075-100000000	14,101.19	-	30450	SAL CHEMICAL	Purchases
5075		532890	RECVG	SODA ASH-DENSE	9/14/2020	Purchasing	322	10-322-5075-100000000	7,001.03	-	30450	SAL CHEMICAL	Purchases
5075		535089	RECVG	SODA ASH-DENSE	9/30/2020	Purchasing	322	10-322-5075-100000000	402.71	-	30450	SAL CHEMICAL	Purchases
5075		536042	RECVG	SODA ASH-DENSE	10/6/2020	Purchasing	322	10-322-5075-100000000	7,056.79	-	30450	SAL CHEMICAL	Purchases
5075		536043	RECVG	SODA ASH-DENSE	10/6/2020	Purchasing	322	10-322-5075-100000000	7,174.50	-	30450	SAL CHEMICAL	Purchases
5075		536045	RECVG	SODA ASH-DENSE	10/6/2020	Purchasing	322	10-322-5075-100000000	7,155.92	-	30450	SAL CHEMICAL	Purchases
5075		536046	RECVG	SODA ASH-DENSE	10/6/2020	Purchasing	322	10-322-5075-100000000	7,189.99	-	30450	SAL CHEMICAL	Purchases
5075		536052	RECVG	SODA ASH-DENSE	10/6/2020	Purchasing	322	10-322-5075-100000000	7,097.06	-	30450	SAL CHEMICAL	Purchases
5075		538402	RECVG	SODA ASH-DENSE	10/22/2020	Purchasing	322	10-322-5075-100000000	7,183.80	-	30450	SAL CHEMICAL	Purchases
5075		538403	RECVG	SODA ASH-DENSE	10/22/2020	Purchasing	322	10-322-5075-100000000	7,224.07	-	30450	SAL CHEMICAL	Purchases
5075		538404	RECVG	SODA ASH-DENSE	10/22/2020	Purchasing	322	10-322-5075-100000000	7,041.30	-	30450	SAL CHEMICAL	Purchases
5075		539756	RECVG	SODA ASH-DENSE	10/30/2020	Purchasing	322	10-322-5075-100000000	7,115.65	-	30450	SAL CHEMICAL	Purchases
5075		539757	RECVG	SODA ASH-DENSE	10/30/2020	Purchasing	322	10-322-5075-100000000	7,273.63	-	30450	SAL CHEMICAL	Purchases
5075		539758	RECVG	SODA ASH-DENSE	10/30/2020	Purchasing	322	10-322-5075-100000000	7,010.32	-	30450	SAL CHEMICAL	Purchases
5075		540052	RECVG	SODA ASH-DENSE	11/2/2020	Purchasing	322	10-322-5075-100000000	7,199.29	-	30450	SAL CHEMICAL	Purchases
5075		540053	RECVG	SODA ASH-DENSE	11/2/2020	Purchasing	322	10-322-5075-100000000	7,211.68	-	30450	SAL CHEMICAL	Purchases
5075		542501	RECVG	SODA ASH-DENSE	11/19/2020	Purchasing	322	10-322-5075-100000000	7,087.77	-	30450	SAL CHEMICAL	Purchases
5075		542502	RECVG	SODA ASH-DENSE	11/19/2020	Purchasing	322	10-322-5075-100000000	7,140.43	-	30450	SAL CHEMICAL	Purchases
5075		542504	RECVG	SODA ASH-DENSE	11/19/2020	Purchasing	322	10-322-5075-100000000	7,193.09	-	30450	SAL CHEMICAL	Purchases
5075		544765	RECVG	SODA ASH-DENSE	12/4/2020	Purchasing	322	10-322-5075-100000000	7,450.21	-	30450	SAL CHEMICAL	Purchases
5075		545734	RECVG	SODA ASH-DENSE	12/11/2020	Purchasing	322	10-322-5075-100000000	6,939.07	-	30450	SAL CHEMICAL	Purchases
5075		545735	RECVG	SODA ASH-DENSE	12/11/2020	Purchasing	322	10-322-5075-100000000	7,165.21	-	30450	SAL CHEMICAL	Purchases
5075		546993	RECVG	SODA ASH-DENSE	12/15/2020	Purchasing	322	10-322-5075-100000000	7,124.94	-	30450	SAL CHEMICAL	Purchases
5080		553420	GJ	RVRS 2019 AP ACCRUAL	12/31/2020	Financial	322	10-322-5080-100000000	-	9,403.68			RVRS 2019 AP ACCRUAL
5080		555680	GJ	2020 AP ACCRUAL	12/31/2020	Financial	322	10-322-5080-100000000	10,860.80	-			2020 AP ACCRUAL
5080		531513	RECVG	LIQUID SODIUM HYPOCHLORI	9/3/2020	Purchasing	322	10-322-5080-100000000	3,625.60	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5080		531514	RECVG	LIQUID SODIUM HYPOCHLORI	9/3/2020	Purchasing	322	10-322-5080-100000000	3,611.20	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5080		531515	RECVG	LIQUID SODIUM HYPOCHLORI	9/3/2020	Purchasing	322	10-322-5080-100000000	3,620.00	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5080		532891	RECVG	LIQUID SODIUM HYPOCHLORI	9/14/2020	Purchasing	322	10-322-5080-100000000	3,617.60	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5080		532892	RECVG	LIQUID SODIUM HYPOCHLORI	9/14/2020	Purchasing	322	10-322-5080-100000000	3,623.20	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases
5080		532893	RECVG	LIQUID SODIUM HYPOCHLORI	9/14/2020	Purchasing	322	10-322-5080-100000000	3,600.80	-	30526	UNIVAR SOLUTIONS USA, INC.	Purchases



