Important Information About this Document

The accompanying study was commissioned by the Southern Nevada Water Authority (SNWA) and conducted by Utah State University (USU). The primary purpose of the study was to determine the relative accuracy of consumer leak detection devices which purport to provide water use information. The USU evaluation is part of a larger undertaking by the SNWA to determine the water conservation and efficiency potential of consumer leak detection devices.

This report does not constitute an endorsement or recommendation for any product by either the SNWA or USU and the information herein shall not be used to imply endorsement by these organizations.

The SNWA advises the following information be considered in reviewing the study or referencing the results.

1. Table 1 should reflect that Phyn does provide pressure monitoring.
2. Streamlabs does not recommend use of their device on PVC pipe. Accuracy ratings for this product on PVC are informational and should not be used as a measure of the product's accuracy.
3. One of the Flo devices (SN 295375850012) was a first-generation device. Flo states that improvements in metering capabilities at low flow rates have been implemented in their second-generation devices.

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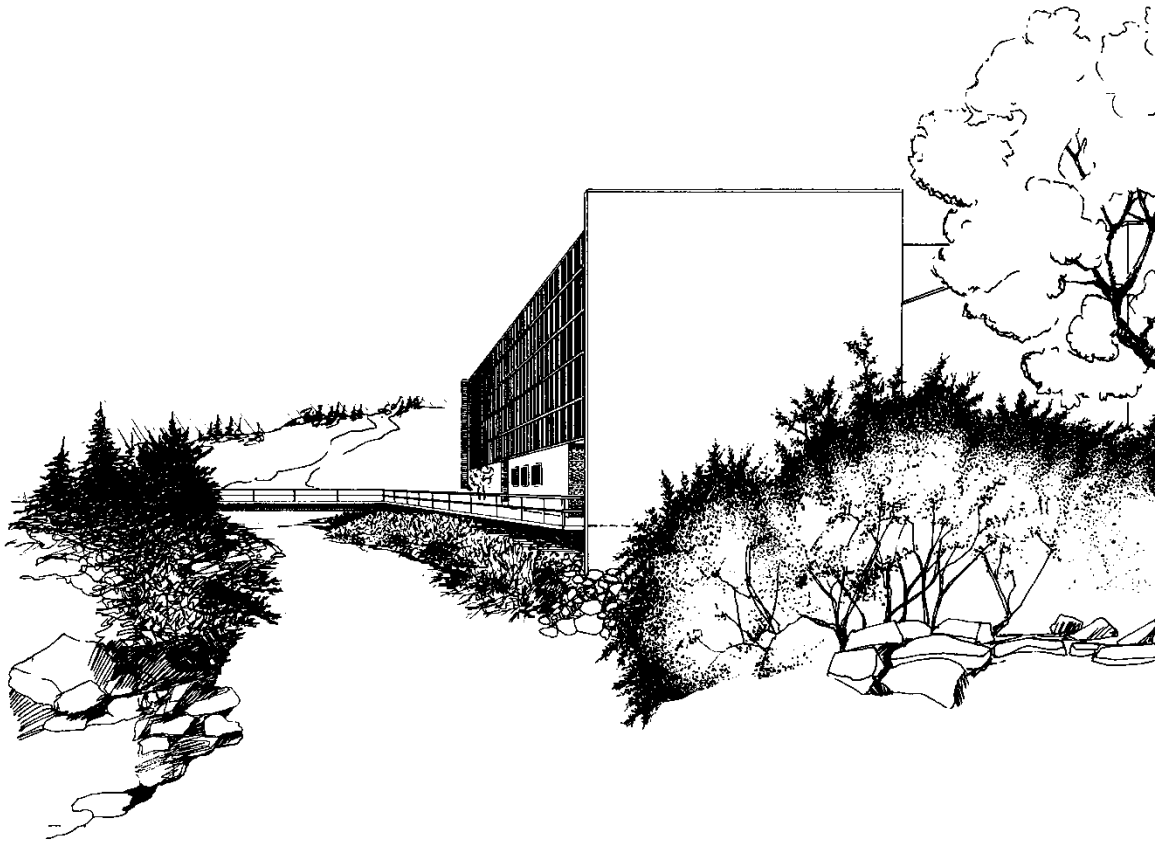
PERFORMANCE EVALUATION OF FIVE DIFFERENT FLOW MONITORING DEVICES

Prepared for

SNWA

June 2019



UTAH WATER RESEARCH LABORATORY

Utah State University
Logan, Utah

Report No. 4211

PERFORMANCE EVALUATION OF FIVE DIFFERENT FLOW MONITORING DEVICES

Submitted to:

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June 2019

Hydraulics Report No. 4211

INTRODUCTION

Utah State University was contracted by Southern Nevada Water Authority (SNWA) to perform a performance evaluation at the Utah Water Research Laboratory (UWRL) in Logan, Utah on five water smart devices (Streamlabs Water Monitor, Buoy by Buoy Labs, Phyn by Phyn LLC, Flo by Moen, Flume by Flume Inc.). Table 1 provides a summary of the capabilities of each device, and although the capabilities of each device do vary, the ability to monitor total flow rate is common to all. Specifically, this study included cold-water tests performed to determine each device's flow measurement accuracy over a wide range of flow rates.

Table 1. Comparative summary of flow monitoring device capabilities

Feature \ Device	Flo*	Buoy	Flume	Phyn	Streamlabs (Water Monitor)	Streamlabs (Water Control)
Subscription req'd	X*	X				X**
Flow Monitoring	X	X	X	X	X	X
Pressure Monitoring	X	X				X
Temperature Monitoring	X	X		X	X	X
Humidity Monitoring						X
Single unit	X	X		X	X	X
In-line installation	X	X		X		X
Alexa/Nest/Google Home Pairing	X	X		X	X	X
Plumber reccomended/req'd		X				
Automatic shutoff	X	X		X		X
Manual shutoff	X	X		X		X
Usage goals	X		X			
Leak alarms	X	X	X	X	X	X
Freeze detection/alerts	X			X	X	X
Water usage by fixture	X*	X		X		
24/7 Live support	X*	X				
Battery-powered		X	X			
Multiple Units from Single Device		X (Unlimited)	X	X (6)	X (2)	X (2 or 5**)
Warranty	1-year (3-year*)	1-year	1-year	2-year	2-year	2 or 5**-year (7-year brass)

Notes:
* Only with FloProtect
** Only with StreamPlus Enhanced

EXPERIMENT SETUP AND PROCEDURE

The various water assistants were installed and tested in series (see Figure 1). The Streamlabs Water Monitors were first mounted to a ¾-inch PVC pipe with 3 to 4 inches between each Monitor. The pipe was first wiped clean with a wet cloth and allowed to dry. The Monitor was then placed on the pipe and zip-tied firmly on both ends of the device.

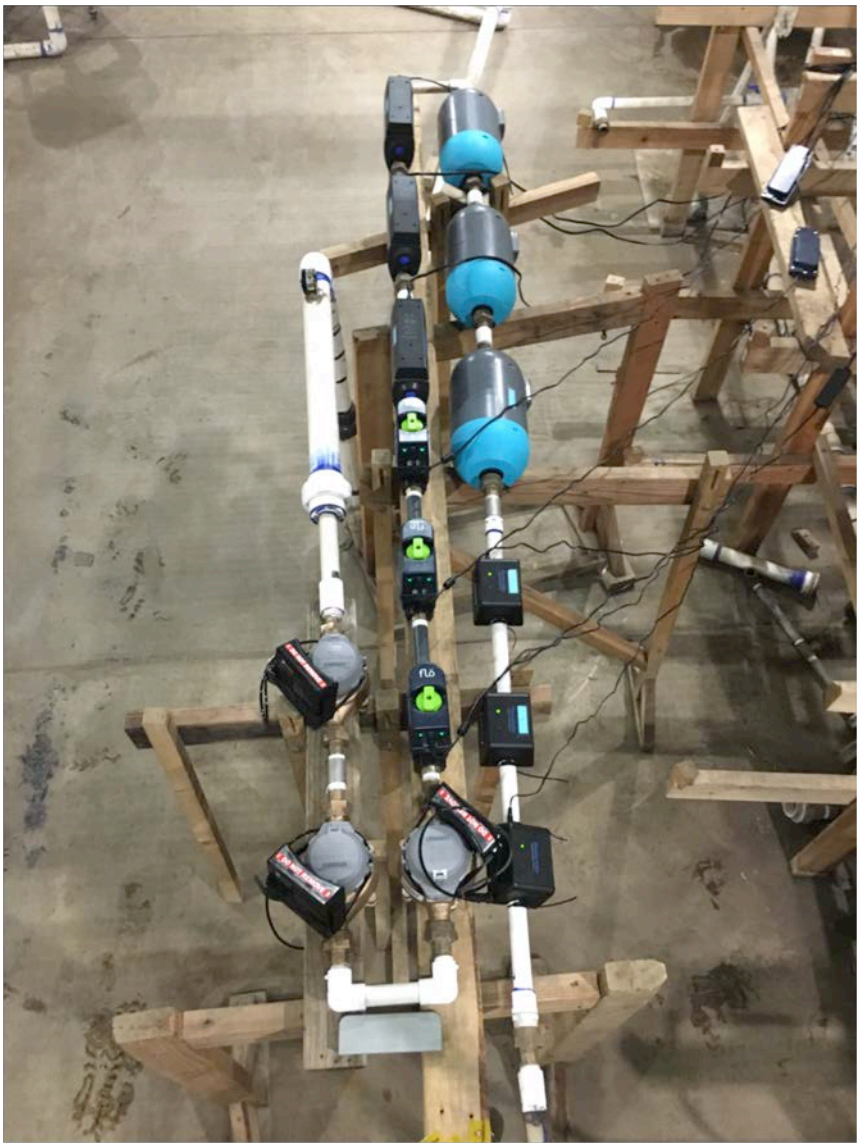

Figure 1. Installation of flow monitoring devices

The Buoy, Phyn, and Flo devices were all installed in-line with 4-inch couplings between each device. The couplings consisted of two brass couplers connected by a PVC nipple. Badger Model 35 meters were installed downstream of the Flo devices with the same 4-inch couplings between meters. The Flume water sensors were strapped onto the side of the Model 35 meter heads using the rubber strap provided. Note: It is important to note that placement of the water sensor had a significant impact on the Flume's accuracy. During the first test after setup, one Flume registered over 500% of actual flow, another registered over

300%, and the third registered nearly 100%. The Flumes appeared to be similarly placed on their respective meters.

After preliminary tests were performed, the calibrators made slight adjustments to the two Flumes with poor registries, and all Flume devices registered accurately since that adjustment. After working more with the various devices, though, the calibrators decided that there could have been other sources of error besides water sensor placement. Regardless, homeowners should always be attentive to water sensor placement during installation.

Since PVC is not considered a compatible pipe material for the Streamlabs Water Monitor, the Monitors were tested in a second setup independent from the other devices (Figure 2). The devices were placed on ¾-inch type L Copper pipe for the second setup. The contact pads were replaced on each Water Monitor between the PVC and Copper tests.

Figure 2. Streamlabs copper pipe installation

For each flow rate, a control valve was used to set the flow rate. Then an isolation valve was closed to stop flow. The total throughput was recorded after at least five minutes with no flow to ensure that the throughput shown in each app was completely updated before calibration. Once the daily throughput for each device was recorded, the isolation valve was opened, and a stopwatch was started. Water temperatures were measured at the beginning, midpoint, and end of each test.

Once at least 100 gallons had been collected in the weight tank, the isolation valve was closed and the stopwatch was stopped. The actual throughput was calculated using the weight of water collected and the test time. After at least five minutes, the total daily throughput was again recorded for each device. The percent registry was then calculated using Equation 1.

$$R = \frac{V_m - V_a}{V_a} * 100\%$$

Where R is percent registry, V_m is volume measured in gallons, and V_a is actual volume in gallons.

Additional photographs of the five devices are shown in Appendix A.

RESULTS

The following tables summarize the test results for the devices. The accuracy data is presented in certificate format.

The last certificate is for the Badger 35 meters to which the Flume water sensors were mounted. These calibrations were necessary so that a clearer picture of the Flume's accuracy could be noted.

As indicated by the test results, the Buoy, Phyn and Flume devices were the most accurate over the range of flow rates that were tested.

Meter Accuracy Certificate

This is to certify that Buoy devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Buoy	00500742	110.98%	99.65%	100.56%	99.79%
Buoy	00500175	106.76%	98.67%	100.56%	99.02%
Buoy	00500154	112.94%	101.12%	99.60%	98.93%

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Meter Accuracy Certificate

This is to certify that Phyn devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Phyn	221746PP100C8E	100.98%	99.75%	100.66%	101.04%
Phyn	221817PP10038B	100.00%	98.77%	100.66%	99.12%
Phyn	221805PP100019	100.00%	98.77%	100.66%	97.19%

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Meter Accuracy Certificate

This is to certify that Flume devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Flume	30NLECSUDP4IL	99.90%	99.75%	96.79%	98.17%
Flume	30FXJ9RS3L41J	99.02%	101.31%	99.50%	99.42%
Flume	30GNN24XH3NVE	99.90%	100.82%	98.24%	98.65%

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Meter Accuracy Certificate

This is to certify that Flo by Moen devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Flo	295375850012	99.02%	100.73%	89.05%	0.00%
Flo	312911790038	101.96%	102.68%	114.21%	123.05%
Flo	312911790034	98.04%	96.81%	95.82%	87.57%

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Meter Accuracy Certificate

This is to certify that Streamlabs Water Monitor devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested on 3/4 in. PVC Schedule 40 and Copper Type L pipes at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

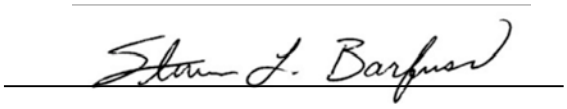
Device Accuracy

PVC Results

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Water Monitor	182000829WZU5	93.13%	95.84%	109.37%	102.97%
Water Monitor	182000930WZU5	91.17%	92.90%	97.76%	53.89%
Water Monitor	182000945WZU5	90.19%	91.92%	92.92%	47.15%

Copper Results

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Water Monitor	182000829WZU5	116.39%	125.15%	126.32%	90.26%
Water Monitor	182000930WZU5	124.15%	137.66%	181.03%	283.83%
Water Monitor	182000945WZU5	116.39%	110.71%	147.21%	0.00%



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Meter Accuracy Certificate

This is to certify that Badger 35 cold water meters devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

Device Type	Serial Number	15 gpm	2 gpm	0.50 gpm	0.25 gpm
Badger 35	1069527	99.75%	100.60%	98.11%	98.85%
Badger 35	1069526	99.71%	99.56%	95.71%	98.29%
Badger 35	1069522	99.87%	101.04%	99.37%	99.77%

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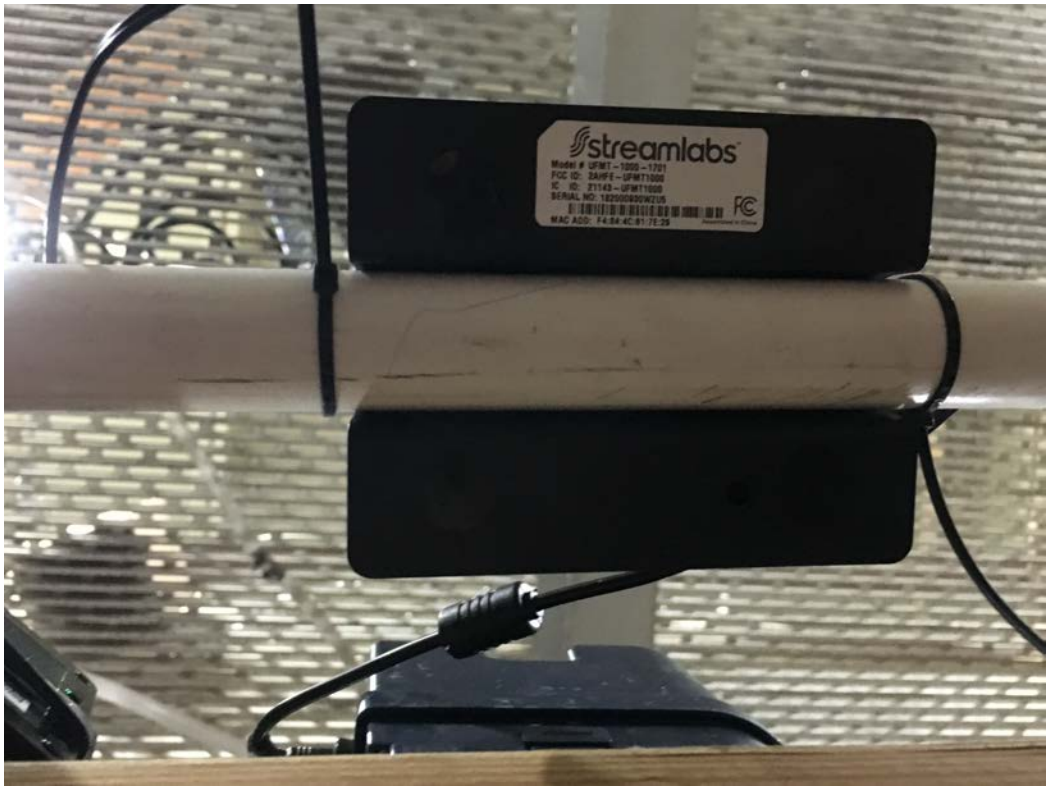
APPENDIX A

Streamlabs Water Monitor on PVC pipe




LED 1
Model: F1100
FCC ID: 2AOX8-F1100
Contains Primary Lithium Cells
Made in USA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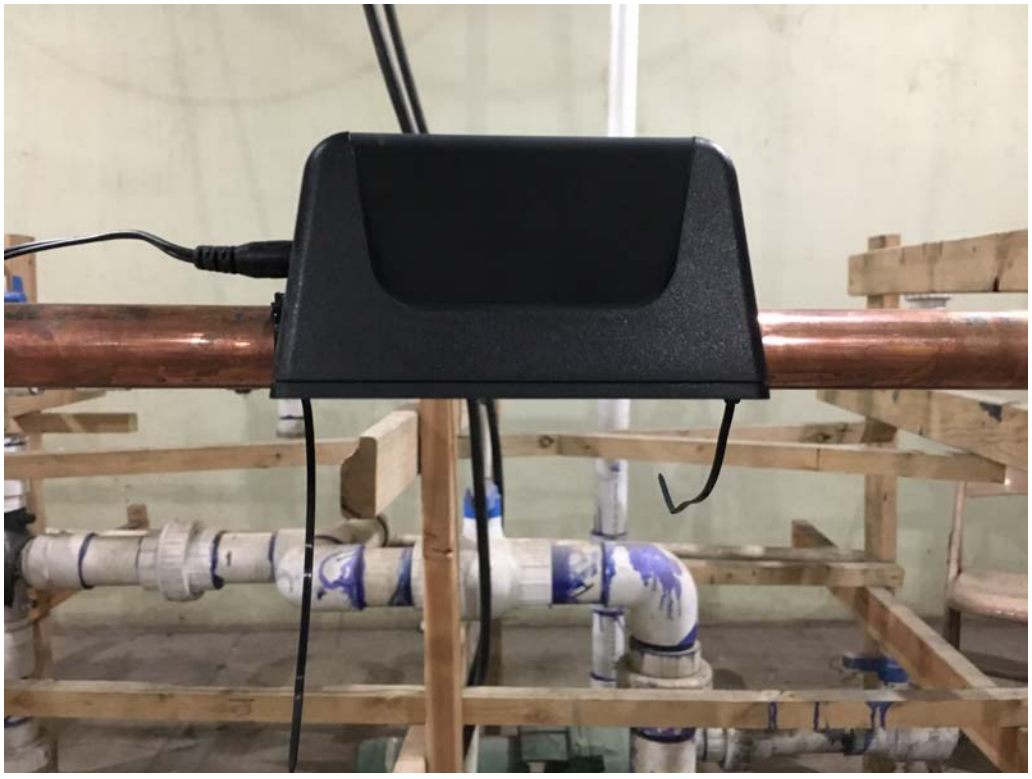
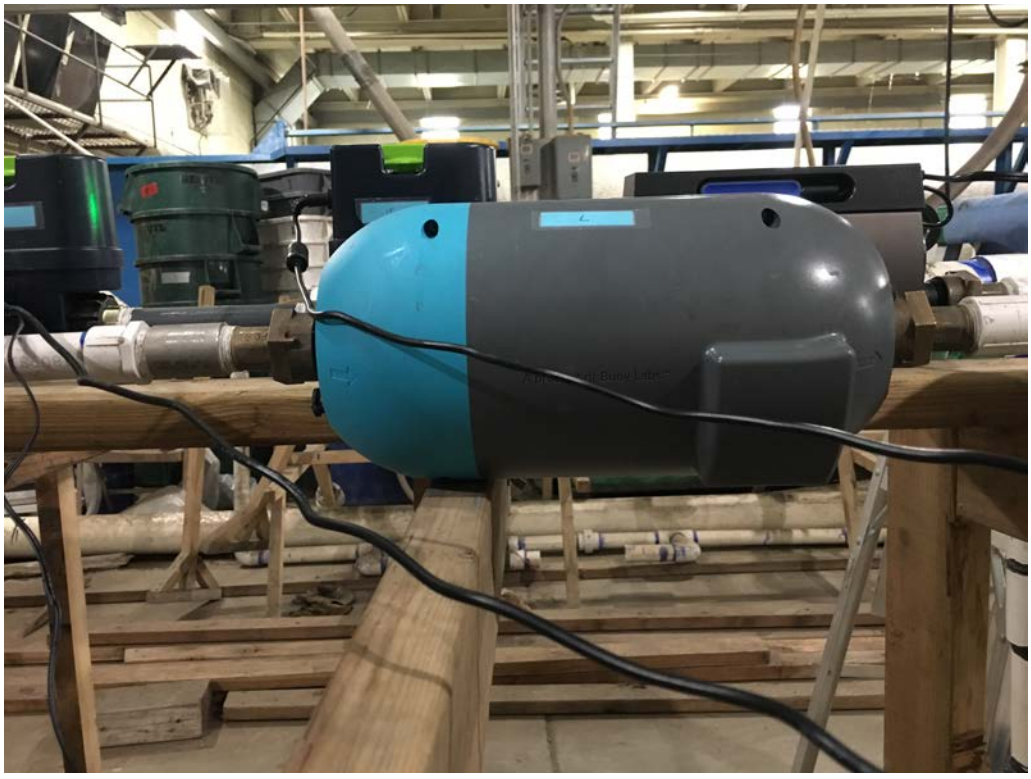
DO NOT REMOVE
flo

Streamlabs Water Monitor on copper pipe




streamlabs

Buoy by Buoy Labs



Phyn by Phyn LLC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Flo by Moen


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Flume by Flume Inc


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