HOW TO LOG FLOW THROUGH A WATER METER (20 July 2021)

Equipment Needed to Log a Water Meter

The following items are necessary for installing the logger on a water meter:

- Logger (small black or blue case with attached Velcro mounting straps and yellow F 5-pin cable)
- Battery with matching yellow M 5-pin cable (battery or batteries may be in a waterproof box)
- Note-taking ability (e.g., pad of paper and pen or pencil)

Optional but useful equipment includes:

- Smartphone or tablet or laptop or digital camera
- Flashlight (or Smartphone flashlight app)
- Logging sheet for multiple logger deployments – see *Appendix A*
- Large-brimmed hat or parasol/sun shade if there is bright sunlight
- Locking device and padlock to secure the meter box lid (see below)

NOTE – For best results, attach the battery to the logger only after securing the logger to the water meter. If you apply power prematurely, the logger's highly sensitive sensor will detect the Earth's magnetic field and assume it is movement of a water meter register magnet. If the logger is powered up before being installed on a meter, it will eventually figure things out and recalibrate itself. However, this process can take several minutes of water flow through the meter to recognize and correct the calibration. During that time, water usage will not be logged.

Installing the Logger

Open the water meter box lid cautiously. If the lid is metallic and is in full sun, it may be too hot to handle with your bare hands. Also, there is a small chance of finding bees, other insects, lizards or small mammals (typically rodents) inside. If you cannot see inside the meter box clearly, use a flashlight to illuminate the interior before reaching inside.

Record the meter ID number in writing or with a camera. This number is almost always printed on top of the flip-up lid that protects the plastic cover on the meter register. It may also be printed on the inside of the plastic meter cover.

You also need to record the logger ID, if you have more than one. The logger ID number is the last three digits of the logger's serial number. It should be found near the end of the logger cable. It may also be found on the cable near the logger and/or on the top or bottom of the logger. If possible, take one picture that shows the meter ID, the logger ID, and the current meter reading. Otherwise, record this information in two pictures.

Record the date, time and location of the logger deployment (date and time may also be recorded as meta-data on the photo(s) of the meter ID# and current meter reading). Also record any other relevant observations, such as whether there is water in the meter box or signs of leaks.

Place the bottom of the logger (black side with strap loops) against the side of the meter. The upper side of the logger should be roughly even with, or slightly below the top of the meter. Use the straps to

hold the logger in place. One of the attached straps is non-stretchy Velcro, and the other is elastic with a piece of Velcro "hooks" sewn on. Wrap the non-stretchy strap around the meter head and then stretch and attach the other strap to the first strap using the Velcro hooks.

If you find this process difficult, attach the two strap ends together to make a loop that is a bit smaller than the meter head. Then stretch the loop around the meter head so that the logger cable is pointing up and the top side of the logger is at or a bit below the top of the meter.

NOTE – Many water meters now have Itron or other automatic meter reading (AMR) devices attached to the side of the meter. You can try putting the straps around the water meter, passing between the Itron and the meter body, but it may be easier to wrap the straps around both the meter and the Itron. This potential need is why the straps are fairly long.

The logger's exact location and orientation is not critical, as the logger contains three highly sensitive magnetometers set orthogonal, or at right angles to each other (along the X, Y, and Z axes). Therefore, do not worry about the angle of the cable from the logger or the exact height of the logger. In general, the logger should be slightly above the level between the "wet" or bottom half of the meter and the "dry" or upper half of the meter, aka the register.

NOTE – If you are logging a Neptune meter, we do recommend a specific orientation. See *Appendix B* below for details.

If you haven't already done so, record the meter reading with a camera. Sometimes glare makes reading the meter from a picture difficult, so we highly recommend writing it down as well. Most meters are analog in design, with a registry that resembles a car's odometer. However, many newer meters have digital read-outs. In either case, the meters may read in units of gallons, thousands of gallons (Kgals), cubic feet (cf), or hundreds of cubic feet (Ccf). The units should be marked on the meter's face.

ANALOG METERS The first several digits are read like a car odometer, but the position of the needle on the dial records the last 2 digits. See www.smarthomewaterguide.org/how-to-read-your-water-meter for examples and meter reading guidance.

DIGITAL METERS The meter reading should be displayed as black numbers on a gray background. Reading is simpler, but check that any pix you take of the meter are legible before leaving the site.

Insert pix of analog and digital meters here.

Next, attach the battery cable to the logger cable to start the logger. Some logger and battery cable 5-pin connectors have non-continuous "split" threads and a square white "key" dot to assure proper alignment. Push the two connectors together and then rotate the silver rings a quarter turn to screw them tight and create a water-proof connection.

Other cables lack the split threads and key and simply screw together to create a water-proof connection. Make sure the connectors are property aligned to prevent cross-threading.

Place the battery or the waterproof battery case in the meter box.
NOTE – If you are using a disposable battery such as a 9V "transistor" battery without a waterproof case, we recommend placing it and the end of the battery cable in a Ziploc-type plastic bag.

The following directions let the user verify that the logger is successfully calibrated and recording water flow. However, if one simply powers up the logger and departs, in almost all cases it will work as intended.

In order for the logger to learn the meter's parameters and begin to record data, water must be sent through the meter at a rate fast enough to cause the register's magnetic fields to revolve. The minimum rate required depends on the meter, but half a gallon per minute should suffice for residential and small commercial meters. If the meter isn't already turning and you have access to an outdoor spigot, turn the water on and let it run for a few minutes until the logger lights indicate it is recording data (see information below on interpreting the lights). If the meter is not running and you have no way to turn on a tap, the logger will set the parameters at the first sustained water use. However, your log file will begin at that time, rather than when the logger is initially powered up.

NOTE – If the meter indicates no water uses are currently taking place but you are able to open a tap, consider filling a container of known quantity (e.g., a 5-gallon can) or until the meter indicates a given amount of water has been used, and record the time and volume. While this is not necessary, it provides a double-check on the subsequent calibration of the meter trace.

Once power is applied to the logger and the logger is attached to a meter, the two LED lights inside the logger will illuminate. (NOTE – For loggers with translucent blue cases, you will see the lights shining through the case. For loggers in black opaque cases, the lights will shine through the two lenses on the top of the case.) The amber light indicates the strength of the magnetic signal received from the meter. On unknown meter types, we suggest placing the logger in such a way as to maximize the brightness of the amber light, preferably a constant amber signal over a blinking one.

The red light is dual purpose: it will be lit at full strength while in learning mode when it is calibrating itself; when not fully lit the red light shows pulse rate synchronized with the magnetic field emitted by the meter. (Note: This pulse rate usually indicates a fraction of a measured unit. For many residential meters, there will be 50 or 60 pulses per gallon.) Once the red light stops pulsing, the logger has learned the meter's parameters and you can now stop any temporary water flow through the meter.

Securing the Logger

Close the lid. If the logger will be left in place for an extended period of time and the meter has an AMR device like an Itron, you may ask the water utility for permission to secure the lid. One simple way to do this is to fashion a shaft from a turnbuckle with a loop for the left-hand thread side and a set of hooks of different lengths made from threaded rod for the right-hand thread side (see picture, below left). Hook

the threaded rod end under the water pipe and adjust the turnbuckle so that the loop extends partway through the slot on the water meter lid. Then secure it with a lock (see picture below, right).

Modified turnbuckle for securing meter box lid   Meter box lid secured with turnbuckle and lock

If locking the meter box is not an option, you may want to place a placard in the box cautioning anyone from touching or removing the logger and containing contact information for the water utility. See *Appendix C* for a sample placard.

Removing the Logger

Take the same pad of paper or logger sheet, a pen, and optionally, a Smartphone, tablet, laptop or digital camera, a flashlight, and sun shade to the meter box.

Carefully remove the meter box lid, taking the same precautions as before. Disconnect the battery cable from the logger. If the cables are of the "split thread" style, unscrew the metallic rings so that the white dots are realigned and then firmly pulling the cable connectors apart. With the other type of cable, simply unscrew the two cable ends from each other. The resulting loss of power will end the logging session.

Immediately record the meter reading by taking a photo and writing it down, as per the instructions above. Also record the time, unless the meter photo includes a time stamp. (Verify the photo is legible.)

Remove the logger and the battery. Record date, location, and any other relevant observations.

Replace the meter lid and take all equipment with you.

Note that one can deploy the logger several times on various water meters before downloading and observing the meter traces. To avoid confusion, carefully check file names and dates.

Downloading and Installing Logger Software

The MagneFlow software for the logger must be installed on your Windows computer in order to configure, update, download or view data from the logger. Links for the Windows software are located on the MagneFlow website.
https://magneflowloggers.com/downloads/

Download and double click on the *MagneFlowUtility-vX.X.X.msi* installer file. Follow the prompts to install MagneFlow Utility.

NOTE – Installing the software may give an alarming "unknown source" or some other security warnings. Currently there is no way around this except by clicking "Advanced" then "Install".

If do not have administrator access to your device (or are otherwise prohibited from installing software on your device) it is still possible to still use the software by downloading and extracting the *MagneFlowUtility-vX.X.X.zip* file, then running *MagneFlowUtility.exe* directly. When using the Zip File, the driver for the MagneFlow USB Adapter is not installed, so the software may not recognize the USB adapter unless you can get the driver installed using one of the following methods:

- It is a very common FTDI branded driver, and may already be installed.
- It may be possible to get Windows to identify, download, and install the proper driver if you attach it while connected to the internet and security settings allow for automatic USB driver installation.
- If you can obtain administrator access one time, you can install the FTDI driver directly (located in the .zip file at */driver/dpinst-amd64.exe*).

Observing Traces and Downloading Data

The default log file output location can be viewed or edited in the File→Settings menu. Consider creating a subdirectory on your computer for the particular meter logging. Upload any digital images and relevant metadata (time, date, place) to this subdirectory. If you have written notes, type them into a text file or take a photo of them.

The logger communicates with the computer through a special USB connecter cable that has a small white (usually) box with a yellow 5-pin cable on one end and a USB Type B-Mini connector on the other. Connect the logger to your computer by first attaching the USB cable's 5-pin connector to the 5-pin connector on the logger. Then use the USB Type A to USB Type B-Mini cable to connect the logger to your computer.

NOTE – For best results, please connect directly to a USB port on your device and NOT to a USB hub.

NOTE – While the logger and adapter can be attached to your computer in any order. The recommended order is to open MagneFlow Utility, attach the MagneFlow USB Adapter, then attach a logger to the adapter.

Open the MagneFlow Utility application. Attach a MagneFlow USB Adapter. The software should recognize the attached adapter. If it fails to do so, you will see this status:

! No MagneFlow adapter detected

If this occurs, double-check your connections and click the refresh button by the Serial Port drop-down box. If you have an old adapter, it is possible it will not be autodetected and you will need to select the COM port that is associated with the attached MagneFlow USB Adapter.

If the adapter is recognized, you will now see the status:

! Logger Not Connected
Searching for device...

Now, attach the MagneFlow Logger to the MagneFlow USB Adapter. Finally, the status should change to

✓ Logger Connected

Look at the data file(s) by clicking on DEVICE LOGS at the bottom of the main screen.

To save the "raw" timestamp data, click on the SAVE button. This file contains full information from the logging session, namely, the time to the nearest tenth of a second that each magnetic pulse was detected. Typically, you won't use the raw timestamps directly. Instead, you'll want to export the data into a spreadsheet or external format.

Select the data file you want to open by either clicking on the OPEN button at the right, or by double-clicking on the file name. This will generate a time series bar graph showing the number of logged events at 10-second intervals. The interval length can be changed by entering a different number of seconds into the "Grouping Interval" field at the top of the screen. Note that a 2-second or a 3-second interval is extremely high resolution; 5-second or the default 10-second interval is considered high-resolution; 60-second to 300-second intervals (1 or 5 minutes) is considered medium resolution; and 3,600-second intervals (1 hour) is low resolution, similar to what most AMR meters record.

Before export, we recommend that you add any known metadata to the rlog. These are details such as the meter make, model, initial reading, end reading, and client details. These fields are saved in the rlog file and are exported to the relevant fields when exporting to XLSX, Trace Wizard or CSV. In addition, meter readings from the metadata can be used to calculate flow rates during export.

|	
Logger Serial	MF3XR00101
Logger Device Name	TestLogger
Logger Job Name	Site01
Meter Make	Badger ▼
Meter Model	EX42-B
Meter Size	3/4"
Meter Reading Unit	Gallons ▼
Meter Reading Start	12
Meter Reading End	108

CLOSE

Example of Metadata

Data Export

The data for any chosen interval can be saved/exported to various formats.

- MagneFlow Raw Log (encoded and compressed) (RLOG)
- One all-inclusive excel file (XLSX)
- Individual Comma Separated Value (CSV) files
- TraceWizard (TXT) format, viewable in TraceWizard

To export a file, click the EXPORT button at the upper right. You may wish to save data at multiple intervals, e.g., 300 seconds (5 minutes) to produce a quick overview trace, and 5 or 10 second intervals to reveal fine details of water uses or help distinguish between multiple simultaneous water uses. When you export trace data at a given frequency, that filename will end with the frequency, e.g., for an exported CSV file using 10 second intervals, the file name will end in "_10s.csv".

Subsections of the data can be cropped and exported separately by first selecting the desired range, then ensuring "Limit exported data to selected region" is checked in the export dialog. To select an exact range of time, use the EDIT SELECTION button.
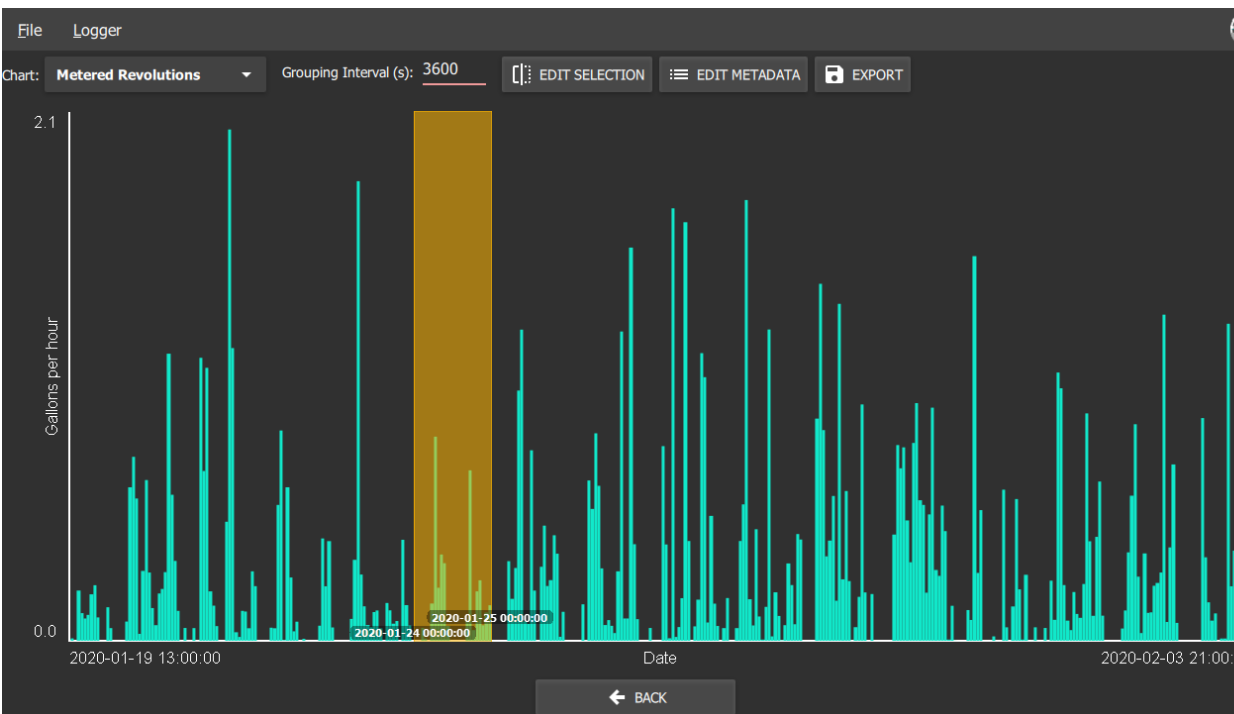
An example trace, grouped into 1 hour intervals, with a 24 hour period selected.

Setting Logger File Names Before Logging

The logger generates file names based on the current name of the logger, the logging session number, and the name of the job at the time the session was created. The log file name format is:

[**DEVICE-NAME**]_[**SESSION-NUMBER**]_[**JOBNAME**].EXT

The name of the device and the name of the job can be set in the PC software.

Click on the **Logger** menu, go to **Variables**. Under "Persistents" change **Device Name** and **Job Name**, then click on **COMMIT PERSISTENTS**.

The session number is incremented when the device powers on and begins writing a new log. The session number can be reset to 0 by clearing all logs on the **DEVICE LOGS** page, accessible from the main screen.
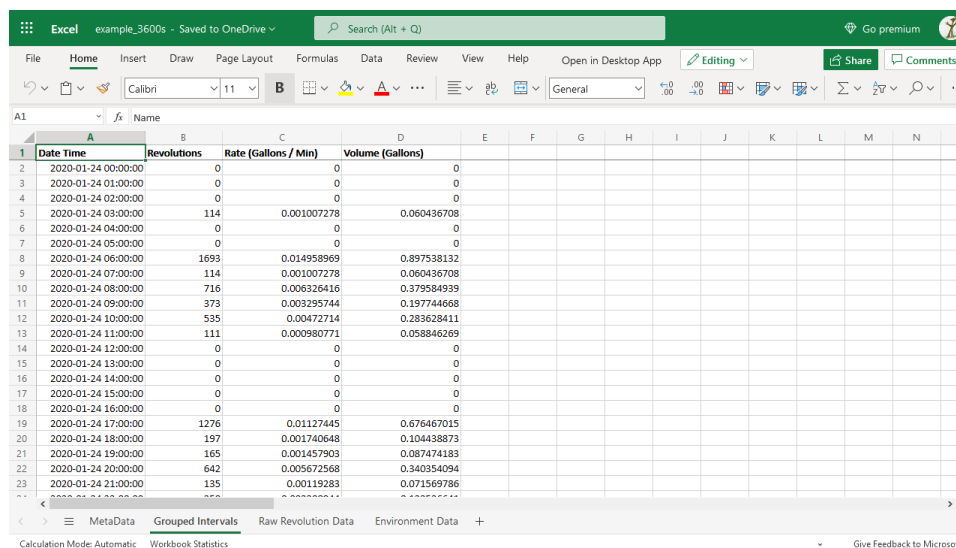
Analyzing exported logger files

Depending on the objective, one might learn everything necessary from observing the logger traces shown by the MagneFlow Utility application. For instance, if a logger is deployed overnight to determine the characteristics of a leak, the trace may clearly reveal the distinctive pattern of a toilet flapper leak. But for longer periods of logging, and to identify and quantify all water uses, you will want to save and analyze the logger data.

The logger generates data files with a ".rlog" extension. These raw data files contain time stamps of every magnetic rotation detected, and can be read by the MagneFlow Utility application, but they are compressed and encoded.

All logged data can be exported to either an Excel File (.xlsx) or to Comma Separated Values file (.csv) formats. These formats can be viewed in any spreadsheet software, but in general are not too useful for analysis and graphing.

For anyone using the data in automated processes such as scripting, the CSV files are the more robust choice due to the complete openness of the format and no table size limits. XLSX does have such restrictions, so very large datasets may be truncated.

On the other hand, the XLSX Format is more convenient, because it includes all data exports as worksheets within a single workbook. These worksheets can be accessed from the tabs at the bottom of Excel, Google Sheets, Open/LibreOffice.

Example XLSX output, showing grouped intervals

Appendix A – Sample Logging Sheet

If you are deploying several loggers or are deploying the same logger in succession on multiple meters, a log sheet can be useful. The table below is offered as an example.

LOGGER FIELD INFORMATION									
Customer Info.			Logging Date/Time		Meter Information			Logger Info	Notes
Name	Address	Phone/ Email	Install	Pickup	Model/ Serial #	Reading at install	Reading at pickup	Serial #	

Appendix B – Neptune T-10 Logger Placement

Neptune water meters are more challenging to log than other makes and models. In addition, the Neptune T-10 has at least two different internal hardware implementations for the same model number, producing different patterns of magnetic pulses. To accommodate both possible models, the logger must be placed in a specific location.

The optimal position for Neptune T-10s is strapped tightly to the register, above the outflow pipe threads, against the hinge of the register, as close to the top of the register as is stable. The yellow wire should come out in a clockwise direction when looking from above. The register should still be readable with the logger attached. See the photos below.
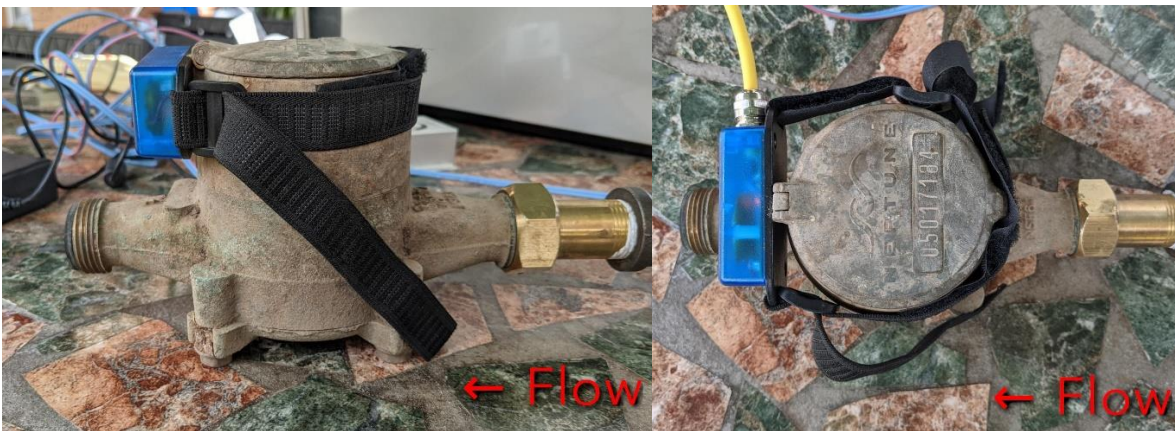
Logger placement on Neptune T-10 (side view)   *Logger on Neptune T-10 (overhead view)*

In the remote chance that you fail to get a good flow trace with this logger placement, try flipping the meter cover up and placing the logger directly on top of the plastic or glass lens. Note that this orientation precludes reading the meter.

Appendix C – Sample Placard to Insert in Meter Boxes

Assuming the meter box will not be locked after the logger is installed, we recommend inserting a placard, perhaps 5.5x8.5 inches, in the meter box. Including seal(s) for the sponsoring city, department, and/or agency is recommended. The following is offered as an example.

DO NOT TOUCH!

The device temporarily placed on this water meter is part of a project by AnyTown's water department to ensure reliable water service in the future.

If you have any questions about the device or this project, you can contact John Doe at AnyTown Water Department at 555-123-4567 or visit the project's Q&A website at: www.xxxxxx.gov.

Thank you.