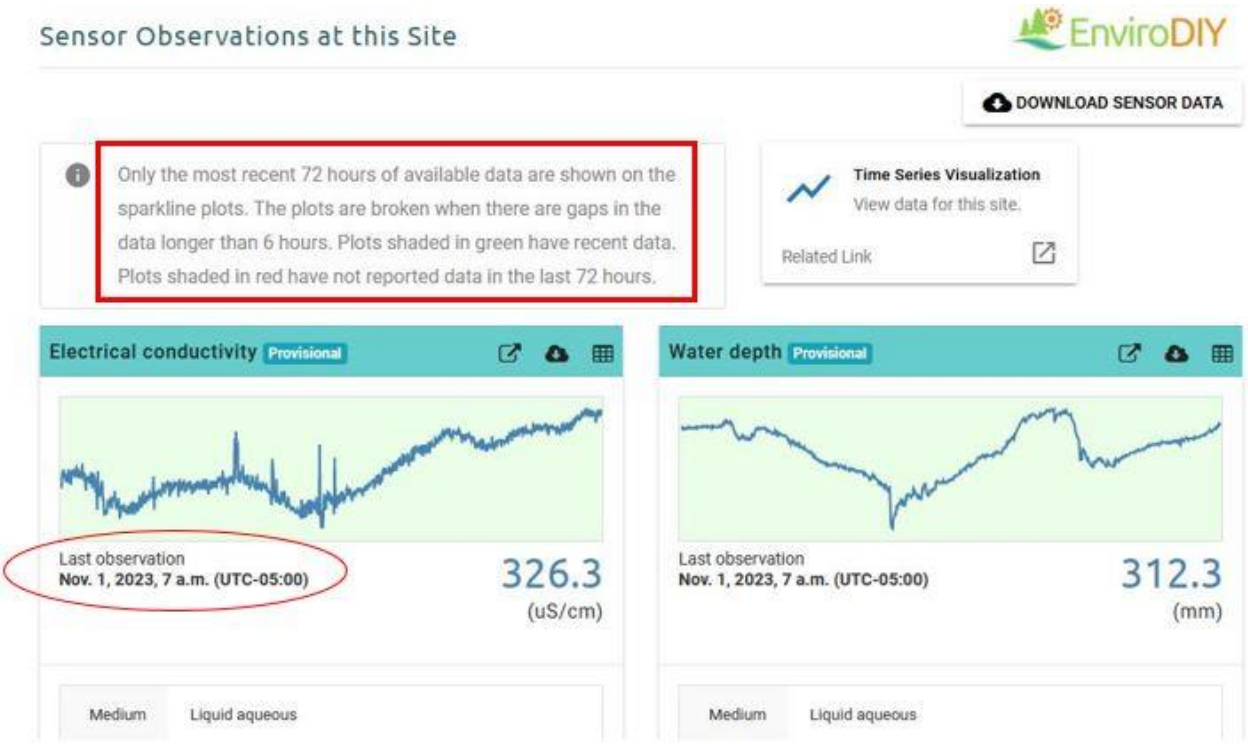
Quick Guide: Monitoring EnviroDIY online data using Monitor My Watershed

The following is a brief tutorial by Master Watershed Steward, Charlie Coulter, who currently (2023) monitors data feeds for ~30 EnviroDIY monitoring stations across the Delaware River Basin. Most EnviroDIY stations are online and transmit data in near real-time to the Monitor My Watershed data portal. As such, station function can be easily monitored from a computer (or even smartphone). Daily (or semi-daily) monitoring of the data is highly recommended so that if/when station issues arise they can be identified and addressed in a timely manner.

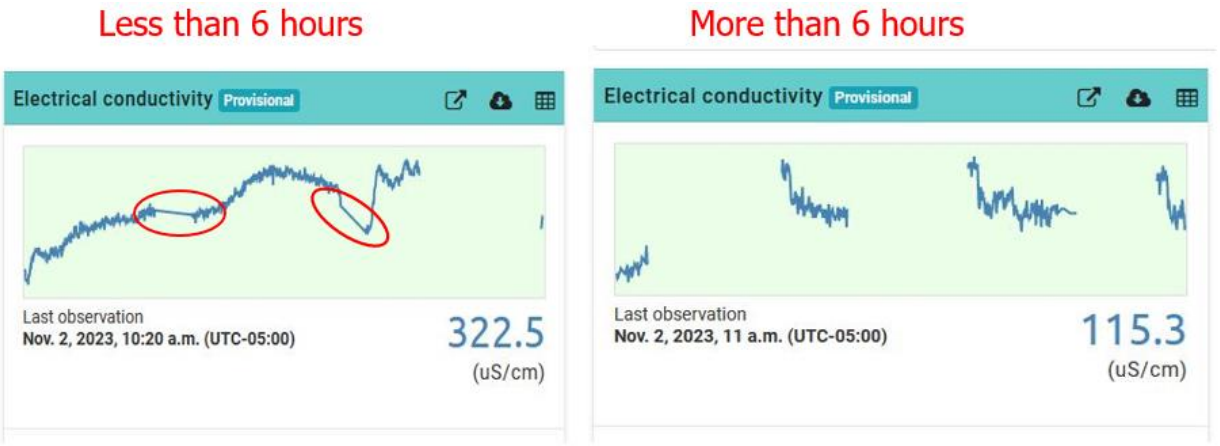
Charlie's process:

- Open the main MonitorMW page for a station.



- The first thing I look for is to see if the station is online.
    - Check observation time (circled in red above). The observation time should be within 5 minutes of local time. This is the one parameter most overlooked. Time is always in Eastern Standard Time (EST), it does not adjust for Eastern Daylight Time (EDT). Data is uploaded every 5 minutes and should agree with local time. If current time is greater than five minutes different from the time shown online then data transmission may be an issue. Note, some stations may transmit less frequently (e.g., 15 minute intervals) – in these cases adjust your online monitoring accordingly.

- As explained in the data description (outlined red box above), gaps in data longer than 6 hours show as breaks in the data plot, however gaps less than 6 hours are connected with a straight line and in some instances may not be noticeable (see figure below).
    - Look for gaps in the plot or straight lines in the plot that seem out of place (circled in red below). Over time you'll know what isn't normal.
- A data value of -9999 indicates the logger is not seeing a valid signal. It may be that there is a connector not making contact, a break in the sensor cable or the sensor has failed.



Station Parameters and some guidance on interpretation of data:

A) CTD Sensor (Meter Hydros 21)
   a. Conductivity (uS/cm)
   b. Water Depth (mm)
   c. Water Temperature (°C)

B) Turbidity Sensor (Campbell OBS3+ or others)
   a. Low Turbidity (NTU)
   b. High Turbidity (NTU)

C) Logger Board (Mayfly Data Logger)
   a. Box Temperature (°C)
   b. Battery Voltage (vdc)
   c. Received Signal Strength (dbm) (Being phased out)
   d. Percent Full Scale (%)
   e. Box Humidity (%RH)

I'll quickly go through the different parameters, so you have an understanding of what to look for. I'll expand on them in the future.

Conductivity (uS/cm) – Is measured by the 4 exposed screw heads in the base of the sensor. If these screw heads become covered in algae or fine sediment (i.e., "fouled") conductivity readings can be affected. Conductivity is a measure of how well water conducts electricity and is directly related to how many ions (cations + and anions -) are in the water, primarily from road salt (NaCl as Na^+ and Cl^- ions) but

also other salts from waste water treatment effluents, industrial effluents, fracking waste, breaks in septic systems, and fertilizers. Generally, rainfall dilutes ion concentration causing conductivity readings

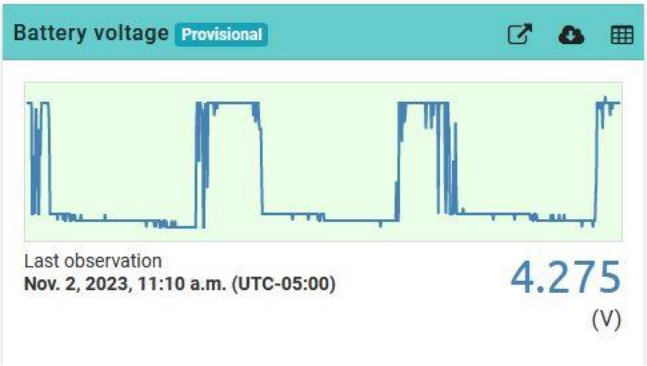
to drop. However, winter storms and associated snow and ice melt can cause spikes in conductivity readings due to flushes of salty runoff. In urban areas these spikes can range up to 50,000 uS/cm or more. Unexplained upward spikes are not normal and should be noted for further investigation. Conductivity varies geographically in relation to geology. Natural conductivity of western U.S. streams may be >1000 uS/cm. Natural conductivity of streams in the eastern U.S. is generally under 300 uS/cm. Eastern streams that flow through carbonate/karst geology (e.g., limestone, dolomite) have higher natural conductivity than streams that flow through sedimentary rock. Groundwater, which is the source of most eastern U.S. streams during baseflow (i.e., non-storm) conditions, is contaminated with salt in most suburban and urban settings and baseflow conductivity in these streams can range up to 1500 uS/cm or higher.

Water Temperature - The second measured parameter in the CTD sensor is a thermistor in the sensor body. It is seldom a problem as there is no fouling that can happen. If a CTD sensor malfunctions sometimes temperature readings will mirror conductivity or depth readings – this pattern can be seen when these measures are plotted in the MonitorMW Time Series Visualization (TSV) tool.

Water Depth – This is measured by a small pressure transducer. Being such a low pressure, it is impacted by barometric pressure. To compensate for it atmospheric pressure is applied to the reference side of the transducer. To accomplish this the sheathing of the sensor cable acts as tubing with a porous white Teflon membrane just outside the logger box. As confusing as this may sound it's just to let you know that any break in the sheathing of the sensor cable will permanently render the sensor inoperable and depth readings will be out of range.

Logger Temperature – This is also a thermistor on the logger board. It measures the air temperature inside the waterproof box. This also is seldom a problem.

Battery Voltage - Battery Voltage is responsible for most of the problems I've seen with stations dropping offline. Looking at the voltage plot it has two parts, the base which is the battery voltage and the daily increases caused by the charging voltage of the solar panel which appear as a plateau. In the plot below it would appear the battery is in fairly good shape at 4.2v. However, the baseline battery voltage is 3.6v. It's at baseline when the solar panel is not active, normally an hour before sunset until an hour after sunrise. An issue with the solar panel would show as a steadily dropping voltage without the charging peaks. It could also mean that the panel isn't receiving enough sunlight due to overhead tree canopy or perhaps snow covering it.



>4.0v	Fully charged battery
3.9v – 3.7v	Battery Discharging
3.69v – 3.59v	Replace battery
~3.54v	Cellular board will shut down/Station offline. Logger still saves data to SIM card.

Received Signal Strength (RRSI) – This is being phased out. It is the signal strength in decibel milliwatts (dbm) and being logarithmic can be very confusing. It is much clearer to use Percent Full scale.

Percent Full Scale – The relative strength of the received signal. Any value above 30 percent indicates the signal strength is suitable for reliable data transmission to MonitorMW.

Box Humidity – Recently included on the newer logger boards. Ideally should be <80% but most of them I've seen are higher. The only time I see it as a concern to me is if humidity stays above 95% for an extended time. Then I would recommend checking the box for condensation and perhaps leaving the box open for a short time to see if humidity drops.