Upstream Suburban Philadelphia Cluster
DRWI Citizen Science

EnviroDIY sensor stations for stream monitoring, community outreach, and education

November 12, 2017

Presenter: David Bressler, Stroud Water Research Center, Presented on behalf of USP cluster
Stroud Center EnviroDIY: Shannon Hicks (Engineer), David Arscott, PhD (Exec. Dir.), Rachel Johnson (Tech), Christa Reeves (Tech), David Bressler (Facilitator)
Overview

Features of the EnviroDIY Mayfly Data Logger

- **MicroUSB port**: Connects to a standard MicroUSB cable to a computer for programming the Mayfly using the Arduino software.
- **Power switch**: Turns the Mayfly board on and off.
- **microSD/SPI connector**: Socket for vertical microSD memory card adapter board or other SPI devices.
- **Pushbutton**: Connected to pin D2 for user-defined input.
- **microSD card socket**: Socket for storing data on a standard microSD memory card.
- **Analog pin header**: Access to the Mayfly’s power, ground, & analog pins, and also the four Auxiliary 16-bit Analog-to-Digital converter pins.
- **Auxiliary ADC Grove connectors**: Pairs of Auxiliary Analog pins along with ground and power (3.3V or 5V).
- **Digital pin Grove connectors**: Pairs of digital pins along with ground and power (3.3V or 5V), for connecting sensors and Grove accessories.
- **PC port Grove connector**: Connection for any devices that use the PC protocol.
- **5V boost converter**: Generates 5V for powering external sensors.
- **Digital pin header**: Access to the Mayfly’s power, ground, & digital pins.
- **Clock battery**: Socket for CR1220 Lithium battery to keep clock chip running when no other power is connected to Mayfly.
- **LiPo battery connectors**: JST socket for connecting Lithium Polymer (LiPo) rechargeable battery. Additional socket is for providing power to high-current peripheral devices.
- **Solar panel connector**: JST socket for connecting 5V solar panel for charging the LiPo battery.
- **FTDI programing header**: Alternative port for programming board using an external FTDI adapter instead of using the Mayfly microSD port.
- **Bee module socket**: Connection port for various telemetry modules that use the Bee footprint (meshradio, Wi-Fi, cellular).
- **Red & Green LEDs**: LEDs for providing visual feedback, connected to pins D8 (green) and D9 (red).
- **Real-time clock**: DS3231 clock module with on-board temperature sensor, retains the date and time after initial programming, requires battery.
- **Processor**: ATmega1284p microprocessor.

Stroud Water Research Center
Delaware River Watershed Initiative EnviroDIY sensor stations

http://drwisensors.dreamhosters.com/
Current USP cluster EnviroDIY sensor stations
Current USP cluster EnviroDIY sensor stations

• Stroud Center EnviroDIY sensor stations in USP Cluster (as of 11/9/17) (Conductivity/Temperature/Depth and Turbidity):
  – Pennypack Creek (Kevin Roth)
    • Location at upstream end of PERT preserve along Pennypack Parkway: [http://drwisensors.dreamhosters.com/charts_main_SL111.php](http://drwisensors.dreamhosters.com/charts_main_SL111.php)
    • Location at downstream end of PERT preserve, downstream of Papermill Bridge: [http://drwisensors.dreamhosters.com/charts_main_SL112.php](http://drwisensors.dreamhosters.com/charts_main_SL112.php)
  – Wissahickon Creek (Jenn Bilger, Lindsay Blanton)
  – Housten Run (Jenn Bilger, Lindsay Blanton)
  – Jenkintown Creek (Frankie Lazauskas)
  – To be installed
    • One station: UT to Cobbs Creek at McCall Golf and Country Club (Derron LaBrake)
    • Two stations: Naylors Run at Drexel Gardens Park (Jamie Anderson and Madeline Foley)
### Current USP cluster EnviroDIY sensor stations

For use in data reporting on Field Visit Data form

<table>
<thead>
<tr>
<th>SiteID</th>
<th>Stream</th>
<th>Location</th>
<th>latitude</th>
<th>longitude</th>
<th>LoggerID</th>
<th>Lock box code</th>
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<td>Pennypack Creek</td>
<td>Parkway location</td>
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<td>SL111</td>
<td>657</td>
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<td>PUPP3S</td>
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<td>Paper Mill Bridge</td>
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<td>Moyer Blvd</td>
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<td>-75.295281</td>
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<td>888</td>
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<td>PUHR1S</td>
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<td>888</td>
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<td>PUJC2S</td>
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<td>SL123</td>
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<td>UT</td>
<td>Cobbs Creek</td>
<td>McCall Golf and Country Club</td>
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<td>-75.285220</td>
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<td></td>
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<td></td>
<td>Naylors Run</td>
<td>Upstream, Drexel Garden Park</td>
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<td>-75.294430</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Naylors Run</td>
<td>Downstream, Drexel Garden Park</td>
<td>39.960990</td>
<td>-75.290820</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of stations deployed by Stroud Center
Current USP cluster EnviroDIY sensor stations

Housten Run (may be relocated) – one station
Current USP cluster EnviroDIY sensor stations

Houston Run (may be relocated) – one station

Houston Run (Jenn Bilger, Lindsay Blanton), Upstream of N Spring Garden Street:
http://drwisensors.dreamhosters.com/charts_main_SL117.php
Current USP cluster EnviroDIY sensor stations

Wissahickon Creek – one station
Wissahickon Creek – one station

Wissahickon Creek (Jenn Bilger, Lindsay Blanton), Off of Wissahickon Green Ribbon Trail and near Moyer Blvd:
http://drwisensors.dreamhosters.com/charts_main_SL118.php
Current USP cluster EnviroDIY sensor stations

Jenkintown Creek – two stations

Upstream – Cadwalader Ave

Downstream – Osceoloa Ave
Jenkintown Creek – two stations

Jenkintown Creek (Frankie Lazauskas), upstream and downstream of Ethel Jordan Park, TTF restoration project

Current USP cluster EnviroDIY sensor stations

Pennypack Creek – two stations

Upstream – Pennypack Parkway

Downstream – Papermill Bridge
Current USP cluster EnviroDIY sensor stations

Pennypack Creek – two stations

Pennypack Creek (Kevin Roth), upstream and downstream ends of PERT preserve

- Upstream location, along Pennypack Parkway: [http://drwisensors.dreamhosters.com/charts_main_SL111.php](http://drwisensors.dreamhosters.com/charts_main_SL111.php)

General Maintenance

Field Visit Data form - recording staff gauge data
General Maintenance

Field Visit Data form

Enter and view data online: [https://wikiwatershed.org/drwi/](https://wikiwatershed.org/drwi/); pass: drwi
General Maintenance

Field Visit Data form – enter data online
General Maintenance

Field Visit Data form – view data online

<table>
<thead>
<tr>
<th>Data entry timestamp</th>
<th>Name(s)</th>
<th>Site/Stream name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Photos?</th>
<th>General notes</th>
<th>Location</th>
<th>Date</th>
<th>Time</th>
<th>Time zone</th>
<th>Staff gage height (ft)</th>
<th>Precip last 24 hours</th>
<th>Precip units</th>
<th>Water clarity</th>
<th>Sensors calibrated?</th>
<th>Sensor location changed?</th>
<th>Old sensor depth</th>
<th>New sensor depth</th>
<th>Sensors cleaned?</th>
<th>Notes</th>
</tr>
</thead>
</table>
Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship)
General Maintenance

Understanding the data

SL127 - Water Turbidity

Turbidity (in NTU)

Rainfall causes increased stream flow (depth) and washes in sediment causing rise in turbidity.
General Maintenance

Understanding the data

Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship)

Jenkintown Ck, downstream station (Osceola Ave)

Next slide
Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship)

Jenkintown Ck, downstream station (Osceola Ave), Oct 24-25, 2017

Calibration to USP sites – compare data for specific storms
Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship).
Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship).

Calibration to USP sites – compare data for specific storms.
General Maintenance

Understanding the data

Jenkintown Ck, downstream station (Osceola Ave), Oct 24-25, 2017

SL123 - Water Turbidity
Turbidity (in NTU)

Leaves/debris detach
Leaves/debris

Seems to be closer to turbidity of actual water (not leaves)

Calibration to USP sites – compare data for specific storms
General Maintenance

Understanding the data

SL112 - Water Turbidity

Turbidity (in NTU)

Highlight to zoom in, double-click to zoom out.

Note: you can highlight either vertically or horizontally to zoom the x or y axis

Turbidity increases with storms but storms can wash leaves and debris into stream that can clog sensor

Leaves/debris

Seems to be turbidity of actual water (not leaves)

Pennypack Ck, downstream station (Papermill Br), Oct 24-25, 2017

Calibration to USP sites – compare data for specific storms
Rainfall has low conductivity but picks up road salts before entering stream and briefly increases instream conductivity (positive relationship).
General Maintenance

Cleaning the sensors

• If you don’t keep the sensors functioning the whole effort is pointless – data that aren’t accurate are useless
  • Turbidity sensor in particular requires regular cleaning – once a week, possibly more this time of year (but it’s situational)
General Maintenance

Cleaning the sensors

This screenshot of live data shows a storm and shows the turbidity rise in response to increased flow.

This is a piece of debris (probably leaves or aquatic vegetation) that was momentarily blocking the sensors.
General Maintenance

Cleaning the sensors – Fouling and cleaning

Very high NTU - debris attached to sensor

Debris detaches but NTU still higher than normal – is water actually at ~50-80 NTU or is there algae growing on the sensor?
General Maintenance

Cleaning the sensors – Fouling and cleaning

Fairly high turbidity (~30-40 NTU) prior to precipitation – algae growth on sensor

Precipitation happens (depth increases), turbidity increases – possible actual increase but may also be due to leaves and prior algae

Sensor cleaned, NTU immediately drops back to near 0 – makes it nearly impossible to determine what actual turbidity was at time of storm

0.58in rain - https://www.wunderground.com/personal-weather-station/dashboard?ID=KPAFORTW5#history/s20170829/e20170829/mdaily
General Maintenance

Cleaning the sensors – Fouling and cleaning

SL.118 – Water Turbidity

Turbidity (in NTU)

Highlight to zoom in, double-click to zoom out.

Note: you can highlight either vertically or horizontally to zoom the x or y axis

Turbidity – accumulation of algae (gradual increase over days) and leaves (spikes) on sensor

Sensor was cleaned
General Maintenance

Cleaning the sensors – Fouling and cleaning

Water depth returns to baseflow but turbidity remains high indicating fouling, with sharp drop-offs (leaves detaching and reattaching)

Sensor cleaned or all leaves fell off – NTU back to 0
General Maintenance

Cleaning the sensors – Fouling and cleaning

*Aside: Explanation of TurbLow and TurbHigh

TurbLow and TurbHigh are essentially the same readings when NTU>250, so if NTU>250 TurbLow flat-lines and TurbHi carries on.
General Maintenance

Battery and cell signal

- For proper sensor station function, battery level should stay above **3.7v**

Jenkintown Creek, upstream location at Cadwalader Ave – has minimal cell coverage – the Mayfly board is trying to send data but is unable to because of breaks in cell coverage and it’s draining the battery
General Maintenance

Battery and cell signal

- For proper sensor station function *battery level should stay above 3.7v*

Jenkintown Creek, upstream location at Cadwalader Ave – has minimal cell coverage – the Mayfly board is trying to send data but is unable to because of breaks in cell coverage and it’s draining the batter.
General Maintenance

Battery and cell signal

- For proper sensor station function, battery level should stay above 3.7v.

Jenkintown Creek, downstream location at Osceola Ave – battery level consistently above 3.7v, better cell coverage, no battery drain.
General Maintenance

Battery and cell signal

- Cell signal at some locations (e.g., Jenkintown Creek upstream site) is relatively low - in these situations data transmission may stop (see “Additional Information” section at end of presentation)
  - First solution is to cycle power (i.e., turn the Mayfly board off, pause for a couple minutes, and turn it on again); often this will restore the connection and data will begin transmitting again
  - To confirm if the sensors are still working and data are being logged during breaks in cell coverage/online transmission, look to see if data are being recorded on SD card up to present time. **To do download data from SD card:**
    1. Turn logger board off
    2. Remove SD card from board
    3. Insert blank SD into board
    4. Turn board back on
    5. Insert SD card (the one you just removed) into Adaptor, insert in appropriate port on computer, and open data in Excel on your computer; review and graph if necessary
General Maintenance

Backing up data from http://drwisensors.dreamhosters.com/

SL124 Turbidity/CTD Logger

This is data from logger SL124.
The logger is equipped with a Decagon CTD which measures water conductivity, temperature, and depth; and a Campbell Scientific OBS3 which measures turbidity in two ranges.

Show all data in the database as table or as CSV text
Get raw CSV text file

Latest readings:

At 2017-11-05 16:05:31 EST:
CTD Depth= 296mm, CTD Temp= 15.3 degreesC, CTD Conductivity= 417 uS/cm
Turbidity Low= 0.7 NTU, Turbidity High= -0.5 NTU, Board Temp= 19.5 degreesC; Battery= 3.34 volts

*Back up data in case the website ever crashed and data were lost
General Maintenance

Backing up data from http://drwisensors.dreamhosters.com/

*Recommended frequency of backups: every six weeks

*Recommended naming convention for downloaded files: “Logger number (SL#)_date of download” e.g., SL124_11-10-17

Show all data in the database as table or as CSV text

Get raw CSV text file

Copy all data, paste special (unicode text) into Excel

If necessary, use “Text to Columns” feature in Data tab in Excel; Save file with SL# and date of download
Intro to supplemental sampling

Discharge measurements and grab sample collection

- Discharge measurements to develop hydrologic rating curve
- Grab samples to develop turbidity/TSS rating curve
Intro to supplemental sampling

Discharge measurements

- Discharge measurements to develop hydrologic rating curve

\[ \text{Discharge (m}^3/\text{s)} = \text{Area (m}^2) \times \text{Velocity (m/s)} \]
Intro to supplemental sampling

Hydrologic rating curve – linking sensor depth (mm) to stream discharge ($m^3/s$ or $ft^3/s$ [“cfs”])

Add A New Discharge Measurement

**Rating Equation - Discharge to Stage**

\[
\text{Total Discharge} = (6.289 \times \text{Stage}) - 1.400
\]

**Rating Equation - Discharge to Stage plus Sensor Depth Offset**

\[
\text{Total Discharge} = (6.289 \times \text{Sensor Depth}) - 1.500
\]
Intro to supplemental sampling

Hydrologic rating curve – linking sensor depth (mm) to stream discharge (m$^3$/s or ft$^3$/s [“cfs”])

- Take discharge measurements at different water levels – these are then related to the staff gauge levels and sensor depths associated with these discharges
- Wetted area (m$^2$) x velocity of water (m/s) = discharge (m$^3$/s)

Max depth for our purposes

Baseflow – acquired at time of station installation
Intro to supplemental sampling

Hydrologic rating curve – linking sensor depth (mm) to stream discharge (m$^3$/s or ft$^3$/s [“cfs”])

- Take discharge measurements at different water depths – these are then related to the staff gauge levels and sensor depths (left y-axis) associated with these discharges (see next slide)
- Wetted area (m$^2$) x velocity of water (m/s) = discharge (m$^3$/s)

Baseflow – acquired at time of station installation
Intro to supplemental sampling

Hydrologic rating curve – linking sensor depth (mm) to stream discharge (m$^3$/s or ft$^3$/s [“cfs”])

Pennypack, Upstream – Pennypack Parkway

- Infer discharge based on the relationship between sensor depth and field measured discharge
Intro to supplemental sampling

Grab sample collection and shipping

• Grab samples to develop turbidity/TSS rating curve
  • Grab samples analyzed for **TSS** (mg/l)
  • Grab samples also analyzed for **anions** (mg/l)(negative ions, e.g., Chloride [Cl\textsuperscript{-}])

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**GRAB SAMPLE INFORMATION**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result</th>
<th>Parameter</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Conductivity (mS/cm)</td>
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<td>pH</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td></td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/L)</td>
<td></td>
<td>Temperature (mg/L)</td>
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<tr>
<td>Standard</td>
<td></td>
<td>Turbidity (NTU)</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td></td>
<td>TEST FOR AND MEASURE OTHER PARAMETERS</td>
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**OTHER PARAMETERS COLLECTED**

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<th>Parameter</th>
<th>Result</th>
<th>Parameter</th>
<th>Result</th>
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<tbody>
<tr>
<td>Microbial?</td>
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<td>Other Info About Parameters:</td>
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<td>Std. Duplicates of Grab Sample?</td>
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<td>Performed Cross Section Survey?</td>
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<td>Flow Measurement via TDS? Yes/No</td>
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[Stroud Water Research Center logo]
Intro to supplemental sampling

Grab sample collection and shipping
Intro to supplemental sampling

Turbidity/TSS rating curve – linking sensor turbidity (NTU) to total suspended solids (mg/l)

- Take grab samples at different turbidity levels, analyzed for Total Suspended Solids (TSS) – these are then related to the turbidity readings (right y-axis)(see next slide)

Baseflow – grab acquired at time of station installation
Intro to supplemental sampling

Turbidity/TSS rating curve – linking sensor turbidity (NTU) to total suspended solids (mg/l)

Kaba et al. 2014
Intro to supplemental sampling

Turbidity/TSS rating curve – linking sensor turbidity (NTU) to total suspended solids (mg/l)

- Infer TSS based on the relationship between sensor turbidity data and laboratory TSS data
Understanding your site

- Investigate the character of your watershed:
  - Watershed area
  - Land use
  - Sediment and nutrients
  - Point sources
  - Precipitation regime
  - Co-located USGS stations
  - Precipitation monitoring stations - coverage grid mean monthly precip

- Do this using Model My Watershed
  - [https://wikiwatershed.org/](https://wikiwatershed.org/); [https://app.wikiwatershed.org/](https://app.wikiwatershed.org/)

- Start to understand the character of the watershed in relation to in-stream conditions, as shown by the sensor station data, as well as other data sources
Understanding your site

- Do this using Model My Watershed

Wissahickon watershed upstream of sensor station
Understanding your site

- Model My Watershed
- Free MMW webinar on Thursday 11/30, 12:00-1:00

To join the event as an attendee

1. Go to https://swrc.webex.com/swrc/onstage/g.php?MTID=e5790ae1fa580d5a799c7d2cbd0c71971
2. Click "Join Now".

To join the audio conference only

US Toll: +1-415-655-0002
Access code: 858 659 285

Stroud Center’s WikiWatershed website offers teachers, citizens, and professionals a suite of useful online and hands-on tools to promote freshwater stewardship. This webinar will introduce WikiWatershed and then focus on the Model My Watershed web app, which demonstrates the effects of land use and best management practices on your local streams and watersheds. This webinar will be appropriate for individuals and groups working in the Delaware River Watershed Initiative.
Understanding your site

- Model My Watershed
  - [https://wikiwatershed.org/](https://wikiwatershed.org/); [https://app.wikiwatershed.org/](https://app.wikiwatershed.org/)
- Request from Stroud Center
  - We’d like to hear your stories about usage of MMW, please contact Dave Bressler ([dbressler@stroudcenter.org](mailto:dbressler@stroudcenter.org); 610-268-2153 x 312) with your examples of how you’ve used MMW (e.g., education, monitoring, planning, etc.)
    - *Examples can be simple or complex – we’d like to know about any level of usage*
Understanding your site

• Look at current and historical data and learn about the hydrologic behavior of your stream; USGS stations on USP streams (available online):
  – Pennypack Creek
    • USGS 01467042 Pennypack Creek at Pine Road, at Philadelphia, PA
    • USGS 01467031 Pennypack Creek at Horsham, PA
    • USGS 01467039 Pennypack Creek near Willow Grove, PA
    • USGS 01467048 Pennypack Cr at Lower Rhawn St Bdg, Phila., PA
    • USGS 01467036 Pennypack Creek trib at Hatboro, PA
  – Wissahickon Creek
    • USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA
    • USGS 01473900 Wissahickon Creek at Fort Washington, PA
    • USGS 01473900 Wissahickon Creek at Fort Washington, PA
  – Poquessing Creek
    • USGS 01465798 Poquessing Creek at Grant Ave. at Philadelphia, PA
  – Cobbs Creek
    • USGS 01475548 Cobbs Creek at Mt. Moriah Cemetery, Philadelphia
    • USGS 01475530 Cobbs Cr at U.S. Hghwy No. 1 at Philadelphia, PA
  – Tookany-Tacony-Frankford
    • USGS 01467086 Tacony Creek ab Adams Avenue, Philadelphia, PA
    • USGS 01467087 Frankford Creek at Castor Ave, Philadelphia, PA
• Learn about the relationship between precipitation amount and intensity to stream flow/flooding on your stream:
  • **Weather Underground**
    • [https://www.wunderground.com/history/](https://www.wunderground.com/history/)
    • Weather underground personal weather stations
    • [https://www.wunderground.com/wundermap](https://www.wunderground.com/wundermap)
  • BiG CZ data viewer (includes NWIS and CDO): [https://portal.bigcz.org/](https://portal.bigcz.org/)
  • NWIS version: [https://maps.waterdata.usgs.gov/mapper/index.html](https://maps.waterdata.usgs.gov/mapper/index.html)
  • Climate data online: [https://www.ncdc.noaa.gov/cdo-web/](https://www.ncdc.noaa.gov/cdo-web/)
Understanding your site

Search on the town that you’re interested in

At bottom of weather underground search results page are links to personal stations (see next slide)
Understanding your site
Understanding your site

https://www.wunderground.com/personal-weather-station/dashboard?ID=KPAFORTW5#history/s20170829/e20170829/mdaily

Timing and amounts of precipitation
Understanding your site

• Learn about the relationship between precipitation amount and intensity to stream flow/flooding on your stream:

Reeves, ESU, 2017
Understanding your site

- Learn about the relationship between precipitation amount and intensity to stream flow/flooding on your stream:

https://www.wunderground.com/personal-weather-station/dashboard?ID=KPAFORTW5#history/s20171107/e20171107/mdaily
Additional Information

*See following slides
Instream patterns

Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship)
Instream patterns

Rainfall (low conductivity) increases stream flow (depth) and dilutes instream conductivity (inverse relationship).

Conductivity increasing over time (ions increasing in concentration) as depth (amount of water in stream) gradually decreases.

Precipitation adds low ion concentration water to stream – increases depth and decreases conductivity.

As stream returns to normal (decreasing depth) conductivity begins to rise, returning to normal levels.
Rainfall has low conductivity but picks up road salts before entering stream and increases instream conductivity (positive relationship).
Instream patterns

Rainfall causes increased stream flow (depth) and washes in sediment causing rise in turbidity.

Turbidity starts declining before depth – pulse of sediment at beginning of storm as loose sediment on land and stream banks is washed in with first flush of water.
Instream patterns

Water high and muddy

Water still high but has already dropped substantially in turbidity

Water level has dropped substantially since peak flow depth (~1100mm) but still double the baseflow depth (~250mm) and turbidity remains elevated (~20NTU) after major pulse of sediment at beginning of storm
Instream patterns

Increases in depth not associated with rainfall – unknown upstream discharge

Identifying source of discharge: be on-site when daily depth increase happens (carry phone or tablet to access the real-time data), scout upstream of station during depth increase and attempt to identify source via visual inspection of stream edges where water may be entering via tributaries/pipes/etc.; prior to going to site identify possible effluents/tributaries/pipes/other where increased discharge could be coming from
Fouling

Very high NTU - debris attached to sensor

Debris detaches but NTU still higher than normal – is water actually at ~50-80 NTU or is there algae growing on the sensor?

Turbidity (NTU)

Water Samples:

250  100  50  25  10
Fouling

SL118 - Water Turbidity

Turbidity (in NTU)

Highlight to zoom in, double-click to zoom out.

Note: you can highlight either vertically or horizontally to zoom the x or y axis

Turbidity – accumulation of algae (gradual increase over days) and leaves (spikes) on sensor

Sensor was cleaned
Mayfly board battery signal issues – battery dropping below 3.7v – contact Stroud Center for assistance

The battery level over this time period dipped far below 3.7v but data continued to be transmitted to the website, which shouldn’t be able to happen at these low volts – this information indicates that the battery was not actually as low as what is indicated by the data

Solution: a replacement Mayfly board was quick the solution
Mayfly board battery signal issues – battery dropping **below 3.7v** – contact Stroud Center for assistance

The battery level over the time period dipped far below 3.7v but data continued to be transmitted to the website, which shouldn’t be able to happen at these low volts – this information indicates that the battery was not actually as low as what is indicated by the data

Solution: a replacement Mayfly board was quick the solution
Battery

Gradual battery decline – cloudy days and decreasing sunlight

Solution: consider bigger battery and/or backup battery along with charger to supplement potential incomplete solar charging during cloudy winter months

Large battery:
https://www.adafruit.com/product/354
Jumbo battery:
LiPo battery charger:
https://www.sparkfun.com/products/12711
Power cord for charger:
https://www.sparkfun.com/products/14158
Cellular data transmission

No cellular data transmission, break in cell coverage – data stopped being sent to website even though battery level was above 3.7v

Solution: Cycle power on Mayfly board (turn it off and on again) – when cell coverage is lost cycling the power can reset things and get the board back online; possibly change battery in cases when battery level may have dropped too low to begin transmission after board reset. Also confirm sensors functioning during break in cell coverage by checking data on SD card from time period over which cell coverage was lost.
Cellular data transmission

Solution: Cycle power on Mayfly board (turn it off and on again) – when cell coverage is lost cycling the power can reset things and get the board back online; possibly change battery in cases when battery level may have dropped too low to begin transmission after board reset. Also confirm sensors functioning during break in cell coverage by checking data on SD card from time period over which cell coverage was lost.

Fluctuations in battery level potentially due to repeated failed attempts to send data – failed attempts likely due to random drop in cell coverage.

Data transmission stops entirely due to random drop of cell coverage – sensor data no longer being sent to website.