Cacapon Institute's Potomac Highlands Watershed School
High School Lesson Plan for the Real-Time Data

March 2012

Overview The **Real Time Data Portal** can be used to explore scientific concepts of graphing, data collection and drawing conclusions or as a resource for significant further studies. Students can monitor real-time data for precipitation, stream flow, Chesapeake Bay conditions, and mny river related conditions in numerous locations throughout the Chesapeake Bay Watershed. Using this lesson, a localized study help students understand how activities in local watersheds effect the Chesapeake Bay as a whole.

Goals Students will:

- explore relationships and correlations in nature by collecting and evaluating data.
- be able to explain how sedimentation and other pollutants impact life in a stream.
- explore how graphs work and better understand graphing principles and techniques.
- explore using technology and several online data collection techniques.
- understand how local events can affect the Chesapeake Bay as a whole.
- understand how to become stewards of their watershed and why it is important.

Duration

- This is designed to be a long-term activity (from one month to an entire semester), where students in a class trade off responsibility for collecting real time data on the internet and graph that data. The class will discuss the data trends together periodically.

Preparation

1. Create three posters to hang up in class. (As an alternative, you may decide to create a shared Excel Spreadsheet and make your graphs electronically.)
   a. The three graphs with will each have two Y axes (sometime referred to as a 'double graph' that can be explained as one graph superimposed on another. Do not put scales on the Y-Axes yet.
      i. Title the first poster Precipitation vs. Stream Flow at Station 1
         1. Label the X axis Time in Days.
         2. Label the left Y axis as Discharge in Cubic Feet per Second
         3. Label the right Y axis Precipitation in Inches of Rainfall.
      ii. Title the second poster Stream Flow of Station 1 and Station 2
         1. Label the X axis Time in Days
         2. Label the left Y axis as Discharge in Cubic Feet per Second
         3. Label the right Y axis as Discharge in Cubic Feet per Second
      iii. Title the third poster Station 2 River Flow vs. Buoy Turbidity if turbidity data is available. If not, label the poster Station 2 River Flow vs. Buoy Chlorophyll A
         1. Label the X axis Time in Days
         2. Label the left Y axis as Discharge in Cubic Feet per Second
         3. Label the right Y axis as Turbidity in NTU (or Chlorophyll A ug/L)

2. For the first day activity, reserve a school computer lab. This will allow all the students to go through the activity together to better understand what they will be doing when they collect the data alone. The **Sedimentation Blues** activity will be done as a teacher presentation, the rest will be done by students individually or working in teams.
3. Because the following lessons focus on the action of water as it moves from the sky as precipitation across the landscape and in our streams, it is important that your students have a clear understanding of the term "watershed." The term itself is defined in the vocabulary section of the eSchool's blackboard. A more nuanced understanding is useful, and readily gained by spending ten minutes running through the **"What is a Watershed"** activity found on the blackboard of the Middle and Elementary eSchool classrooms.

Activity:

1. Introduction of sedimentation and pollution
    a. Start the **Sedimentation Blues** online activity:
        i. Go to www.cacaponinstitute.org
        ii. Navigate to the eSchool by clicking the 'eSchool' tab on the top of the homepage or the Potomac Highlands Watershed School logo at the right of the page.
        iii. Click on the High School door.
        iv. Click on the BMI poster hanging on the cabinet on the left of the room.
        v. In the **Benthic Macroinvertebrate Portal**, click on the **Sedimentation Blues** activity.
        vi. If the activity is not the optimal size on the screen, maximize the window in your browser, then hold down the control key and press the + or – keys to adjust the zoom.
            a. (Note: you can also hold control and use the mouse wheel)
            b. Note: for some devices, you may have to manually change the zoom on the browser or computer
    b. Complete the **Sedimentation Blues** activity
    c. Review presentation concepts
        i. Discuss how sediment enters the rivers and streams.
        ii. Discuss how precipitation can carry pollution to streams.
    d. Show the class how to navigate through the Real Time Data to complete this season long activity
2. Have the entire class navigate to the eSchool high school classroom
3. Have the entire class click on the yellow CBIB Buoy (Chesapeake Bay Interpretive Buoy) in the middle of the classroom.
    a. This will open up a portal that will allow you to access data on precipitation, stream flow, and from the CBIBs.
4. Students will now collect the data to populate the three graphs. Have the whole class find:
    a. **River flow and water data** from two US Geological Survey (USGS) River Gauge Stations.
        i. Water data for major rivers are listed at the bottom of the page and additional streams and small rivers can be found divided by state in the River Flow and Water Data section.
            1. The first of the River Gauge Stations should be the downstream gauge closest to your school geographically.
                a. Find this location by:
                i. Clicking on your state to enter the USGS water data page
                ii. Clicking on the colored dot on the map that is closest to your school. If you hover over a dot, the detailed name for the stream section will

pop up on your screen. (You may need to locate your school on another map of the state before you do this.)

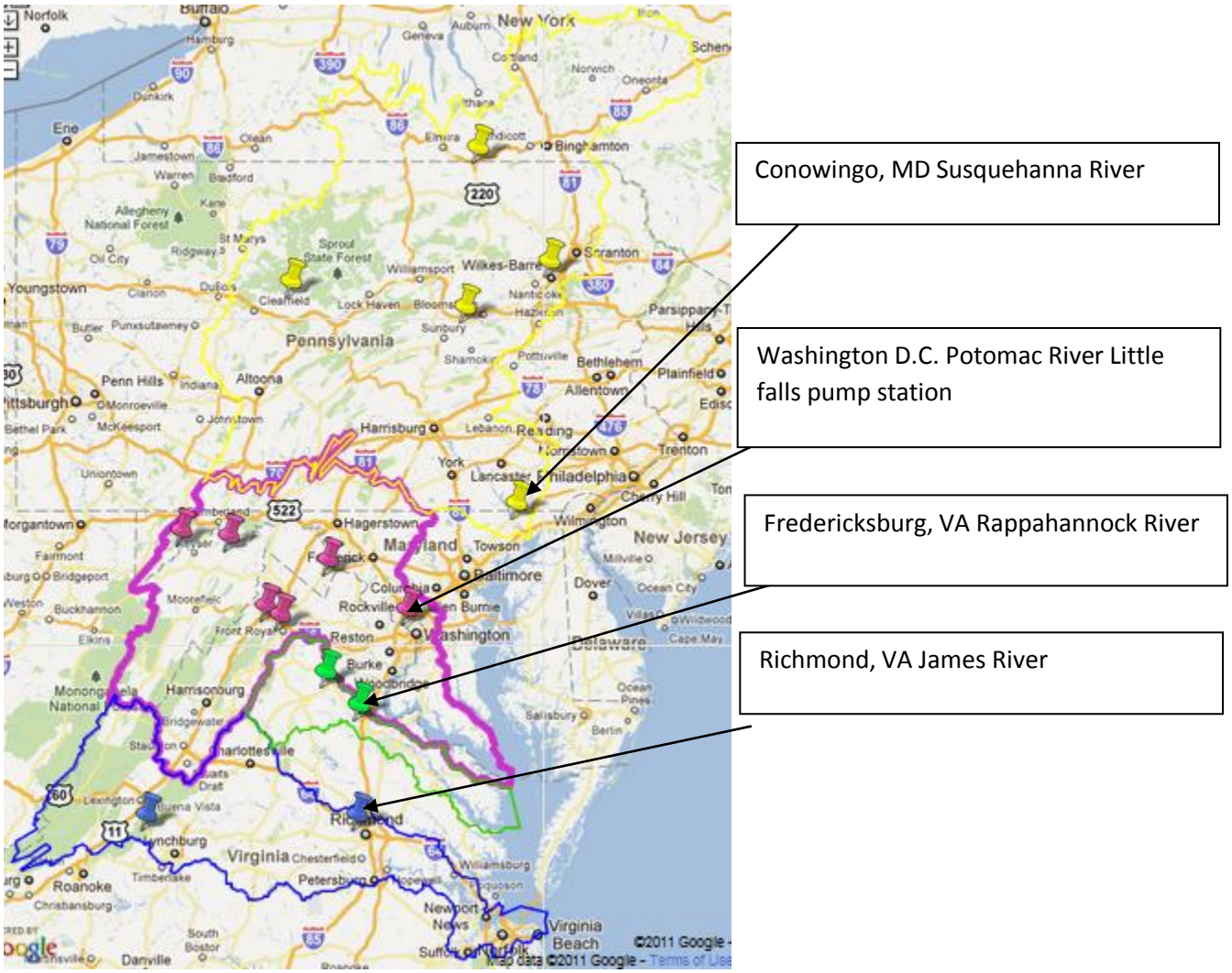
b. This will be 'Station 1'

i. **VERY IMPORTANT!** It's time to set the Y-Axis scale on the stream flow graph for Station 1. Look at the table below the discharge graph, and see the number in the column reading 75th percentile. Use this number for the top number on your graph, but leave some white space above it so you can write-in higher flows. Discuss with your students why this is necessary when you have data that has a very wide range.

2. The second River Gauge Station should be the major river downstream of where your river feeds.

a. Use the browser "back" button to return to the Real Time Data page

b. Click on the Google map image in the river flow & water data session. See the copy of the map provided below in this lesson.



c. Choose one of the following gauges depending on your location

i. If you are located in the Yellow region, choose **Conowingo, MD Susquehanna River** for your second River Flow Station.

ii. If you are located in the Purple Region, choose **Washington D.C. Potomac River Little Falls Pump Station** for your second River Flow Station.

iii. If you are located in the Green Region, choose **Fredericksburg, VA Rappahanock River** for your second River Flow Station.

iv. If you are located in the Blue Region, choose **Richmond, VA James River** for your second River Flow Station

d. Name this station 'Station 2'

i. **VERY IMPORTANT!** It's time to set the Y-Axis scale on the stream flow graph for Station 1. Look at the table below the discharge graph, and see the number in the column reading 75th percentile. Use this number for the top number on your graph, but leave some white space above it so you can write-in higher flows.

3. *(For example: if you are in Martinsburg WV, choose Opequon Creek as the first river gauge station. You are located within the purple region, the Potomac River Watershed. Opequon Creek flows into the Potomac River. Choose the* **Washington D.C. Potomac River Little Falls Pump Station** *as the second river gauge station)*

b. **Current Precipitation Data** from the nearest precipitation data collection point.

i. These are divided into state and then to county on the linked NOAA website. Some of the states have very spotty coverage and you may need to use a **Weather Underground** (same page) station instead of an official government station to get precipitation data that is close to your school.

1. Click on your state under Current Precipitation Data.
2. If possible choose the collection point within your local subwatershed.
   a. Locations are organized by county. Click on the county to see a map of all the gauges in that county. Click on the tabular data to find the precipitation for the previous 24 hour period in inches

c. **Your Bay Buoy** in your watershed.

i. In the Real Time Data Portal, click on the link to the Chesapeake Bay Interpretive Buoy System.

1. If you are located in the Yellow region, and you choose Conowingo, MD Susquehanna River for your second River Flow Station, choose Susquehanna for your Chesapeake Bay Interpretive Buoy system location.

2. If you are located in the Purple Region, and you choose Washington D.C. Potomac River Little falls pump station for your second River Flow Station, choose Upper Potomac for your Chesapeake Bay Interpretive Buoy system location.

3. If you are located in the Green Region, and you choose Fredericksburg, VA Rappahannock River for your second River Flow Station, choose Stingray Point for your Chesapeake Bay Interpretive Buoy system location.

4. If you are located in the Blue Region, and you choose Richmond, VA James River for your second River Flow Station, choose Jamestown for your Chesapeake Bay Interpretive Buoy system location.

5. *Note: If there is only one buoy in your local river, use the First Landing Buoy.*

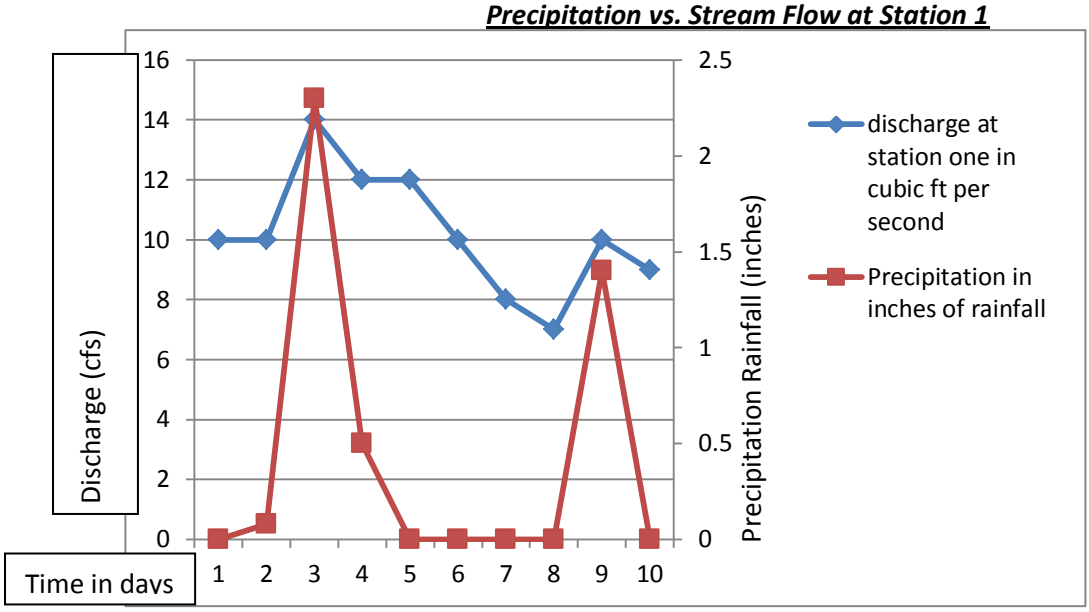
4. Come to an agreement as a class on the data collection stations that your class will be using.
   a. Write these locations on the board and name them appropriately.

5. Now that the students have familiarized themselves with the site and what they will be doing, the class is ready to navigate to their proper data locations and begin recording data.

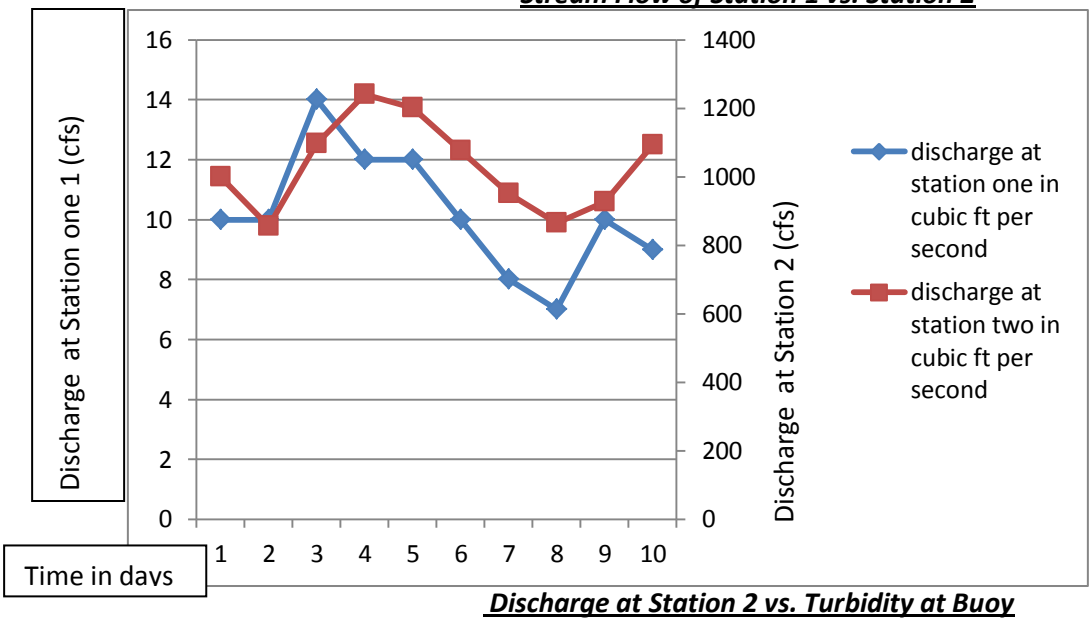
6. The following steps should be completed as a class on individual computers the first day, then individually by a different student on each of the following school days.
   a. Go back to the high school classroom http://cacaponinstitute.org/high.htm.
   b. Click on the Bay Buoy in the classroom to navigate to the Real Time Data Portal, and then find the two USGS River Gauge Stations that you have selected for your class.
      i. Find the chart reading "Discharge"
      ii. Record the Most Recent Instantaneous Value in cubic feet per second (cfs) at each River Gauge Station.
      iii. Place a distinctly colored and distinguished point on each of the corresponding posters
   c. Show the students how to navigate to their nearest precipitation data collection point.
      i. Go back to the Real Time Data page.
      ii. Record total precipitation data for the last 24 hours.
      iii. Place a distinctly colored and distinguished point on the first poster
   d. Show the students how to navigate to their Bay Buoy.
      i. Go back to the Real Time Data page.
      ii. Record the Turbidity (or Chlorophyll A) for the buoy the current time
      iii. Place a distinctly colored and distinguished point on the third poster
2. Prior to starting this season-long activity, have students make predictions based on the following questions and any other questions that they can think of.
   a. Make predictions on:
      i. What *correlations* do you find between the rainfall and discharge?
      ii. What delay or lag time, if any, is there between precipitation and stream flow?
      iii. What correlation, if any, is there between the discharge at smaller stream at Station 1 and the large river at Station 2? Will there be a delay or time lag?
      iv. Does the discharge in the river at station 1 seem to have any visible effect on the river at Station 2?
      v. What are some differences between the two rivers and their watersheds?
      vi. Does the discharge at Station 2 seem to have any effect on turbidity measured at the bay buoy?
      vii. Are there *correlations* of the data? If so what are they?
      viii. Does local precipitation data have any correlation with turbidity at the bay buoy?
      ix. If there are differences, why do you think they exist?
3. Each day, have a different student visit the Real Time Data page at the same time of day to log the appropriate data onto your graphs. You may use this data log form (see final page below) or, if you are doing your graphs electronically, the students may enter data directly into the spreadsheet.
4. Once data is on the charts, review these questions again to test student hypotheses based on the charts in your classroom.
5. After the season is complete, discuss the graphs and examine conclusions.
6. Lead a discussion on the findings and possibilities for further research projects.

7. **Graph Examples**

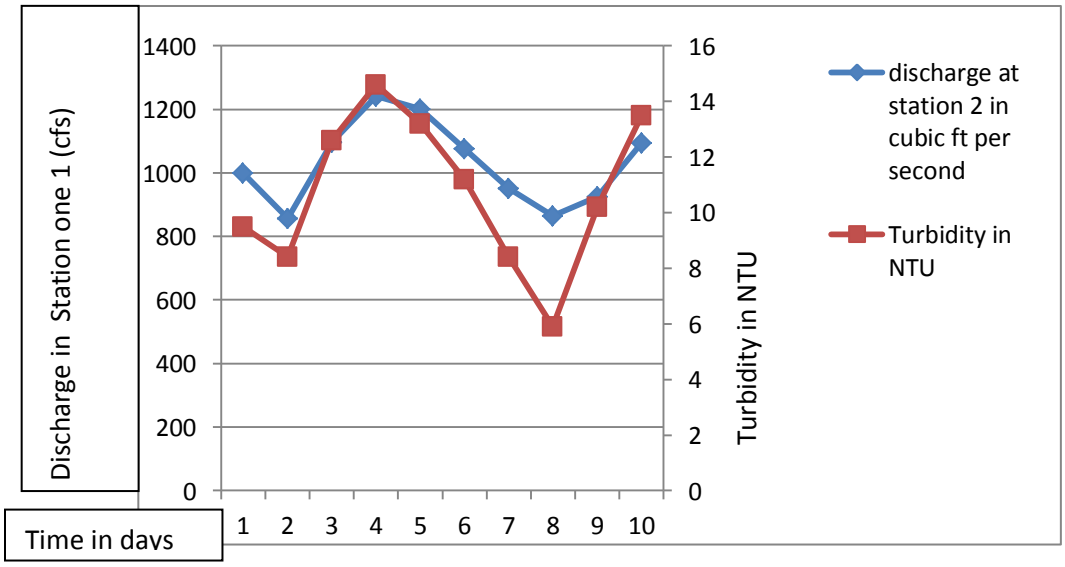
Precipitation vs. Stream Flow at Station 1



Stream Flow of Station 1 vs. Station 2



Discharge at Station 2 vs. Turbidity at Buoy



Student Cacapon Institute Real Time Data Log

On your designated date, visit www.cacaponinstitute.org/high.htm and navigate to the Real Time Data Portal to record the following information

School: _____ Class Name:_____ Teacher:_____ Class Time:_____
Precipitation Gauge location:_____ Flow Station 1 location: _____
Flow Station 2 location: _____ Bay Buoy location: _____

Date	Student	Time	Precipitation last 24 hours (inches)	USGS Stream Gage		Bay Buoy	
				Station 1 (cfs)	Station 2 (cfs)	Turbidity (NTU)	Chlorophyll a (ug/L)