



ADVANCED MONITORING TECHNIQUES: STREAM SURVEYS & STORMWATER SAMPLING

By Andrea LaMoreaux
Volunteer Lake Assessment Program Coordinator, NHDES

Have you noticed that the VLAP results for your lake/pond show a continuing decrease in water quality? Are the conductivity, turbidity, total phosphorus, and/or *E.coli* levels in a particular inlet (or inlets) to your lake/pond high? Have the levels increased during the past couple of sampling seasons? Are you uncertain of the sources of these elevated levels and do you want to find out the contributing sources to these increases?

If you have answered “Yes” to any of the above questions, the VLAP Coordinator recommends that your monitoring group conduct a stream survey and stormwater sampling along these “problem” inlets.

What is stormwater runoff?

When ice snow and ice melt, the melt water typically does not infiltrate into the ground because the ground is typically frozen. In addition, when it rains “long” enough and “hard” enough during the rest of the year, typically, not all the precipitation will be absorbed into the ground. **Stormwater runoff** is precipitation that has not been absorbed by the ground. Rather, it washes over the surface of the land, picking up pollutants as it travels. Stormwater runoff may collect soil particles from eroding streambanks or other exposed/disturbed soils within the watershed, fertilizer from lawns, petroleum products from roadway and driveway surfaces, residues from industrial activities, litter, and wildlife feces or pet waste. The stormwater runoff can carry these pollutants into surface waters which adversely impacts water quality. Stormwater runoff, which is classified as **non-point source pollution** (pollution that is discharged over a wide land area and does not originate from one easy to identify “point”), is the leading cause of reduced water quality in US rivers, lakes, and ponds.

During what time of year should we conduct stormwater sampling?

Stormwater sampling should be conducted during the growing season (the time period between the last freeze in the spring and the first frost in the fall). During this time of year, vegetative cover is present within the watershed which slows the flow of stormwater runoff over the land and also uptakes some of the pollutants. If possible, it is best to conduct stormwater sampling in the spring, soon after the snow has melted and the ground is exposed. At this time of year, runoff and erosion problems will likely be most evident.

How long should it rain before we go out to collect samples?

It is best to conduct stormwater sampling so that the “**first flush**” is collected.

2002 Special Topic

What is the “first flush”?

Usually, the stormwater that initially runs off an area will be more polluted than the stormwater that runs off later, after the rainfall has 'cleansed' the drainage area. The stormwater containing this high initial pollutant load is called the **“first flush.”**

Does the “first flush” always happen?

No. The “first flush” phenomenon may not occur with every storm event. Specifically, the Environmental Protection Agency (EPA) has conducted intensive stormwater runoff monitoring studies which have shown that the “first flush” phenomenon may not occur in larger drainage areas. While the concept of “first flush” is straightforward, it may not be observed during every storm event for one or more of the following reasons:

- The drainage characteristics of the area may prevent it. Particularly in large watersheds, the initial runoff from the most distant parts of the watershed may not reach the drainage area outlet for some time after a storm starts. This time lag is rarely an issue for smaller watersheds.
- Some pollution discharges are not directly related to stormwater runoff. For example, in urban watersheds during large storms, continuous discharges from sewer overflows may obscure any first flush associated with stormwater runoff.

(Reference: EPA, “Stormwater First Flush Pollution”. www.epa.nsw.gov.au/mao/storwater.htm)

Therefore, as a good rule of thumb, the VLAP Coordinator suggests that stormwater sampling be conducted **after one-half inch of rain has fallen within a 6 hour period after at least 3 days of dry weather**. It is best if the sample is taken **at least 2 hours after one-half inch of rain has fallen**. Following these guidelines will give your monitoring group a good chance of capturing the “first flush”.

How do we know how much it rained?

You can usually find a rain gauge (less than \$10) at a hardware store or other stores that supply gardening or landscaping materials. You can also make one, as follows:

Constructing a Rain Gauge

Materials:

- Clear plastic ruler
- Cylindrical-shaped clear jar (e.g. an olive jar or a plastic test tube – the smaller the jar the better)
- Rubber band
- Funnel
- Transparent tape

Procedure:

1. Remove the jar's label.
2. Attach the ruler to the outside of the jar with a rubber band. Make sure that the bottom edge of the ruler is even with the bottom of the jar. Or, secure the ruler inside the jar so it is standing vertically with the end at the base of the jar/bottle.
3. Tape the ruler in place so the numbers can be read from the outside of the jar/bottle.

2002 Special Topic

(As an alternative to the ruler, you can use a permanent marker to mark the inches on clear tape affixed vertically to the outside of the jar/bottle beginning at the base to the outside of the jar/bottle. Cover the marks with a second piece of clear waterproof tape.)

Directions for use:

1. Put the funnel in the jar.
2. Put the jar outside in a secure, open area. Do not place it near a structure or under trees. Also, make sure that the gauge will not blow over.
3. Record the time when the rainstorm begins. Check the rain gauge periodically to determine when one-half inch of rain has fallen.
4. Empty the water after each rain event.

Preparing for the Big Event!



Stormwater sampling requires a good deal of planning and coordination among the members of your monitoring group and also the cooperation of Mother Nature! (Those volunteer monitors who attempted to conduct stormwater sampling during the summer of 2001 and 2002 had a difficult time due to the lower than normal amount of rainfall!)

To make the sample collection process easier (especially if it is still raining when you actually go out in the field to collect the samples), prior to the actual sampling event, your group should conduct a “**stream survey**” along each stream that will be sampled.

How do we conduct a “stream survey”?

To conduct a “stream survey”, members from your monitoring group should walk along the banks of each stream of concern. Typically it is best to start at the lake/pond edge and then walk along the stream. If possible, it is best to walk up to the headwaters (the start) of the stream, however, this may not be possible for certain streams (or it may be a *very* long distance).

What do we need to bring?

The group will need to bring along many items in order to take notes detailing the characteristics of the stream and to document the major land uses and potential “pollution sources” within the vicinity of the stream. These items include the following:

- ☐ Appropriate clothing for the weather (this should always include waterproof boots and a raincoat with hood if it is raining)
- ☐ Clipboard and pencils or write-in-the rain pens* (waterproof pens only!)
- ☐ VLAP Stream Survey Field Sheet* (as shown at the end of this article)
- ☐ Watershed Map* (A street map may work as well. If you need maps of the area, please ask the VLAP Coordinator.)
- ☐ Camera with color film or color digital camera (A picture is worth a thousand words!)

2002 Special Topic

- ☐ A 50-foot tape measure (to measure the area of the potential pollution-causing sites and the distance from the stream)
- ☐ A life vest (in case you work around large streams with high velocities)
- ☐ A flashlight with fresh batteries (useful for checking pipes and as a safety precaution)
- ☐ Sample bottles and a backpack for carrying bottles (when you actually go out to collect samples)

* = If possible, please store the clipboard and all paperwork in a sealed plastic bag to protect it from getting wet!

(Reference: A Citizen's Guide to Lake Watershed Survey's, Maine Department of Environmental Protection, <http://www.state.me.us/dep/blwq/training/npspubl.htm>)

Safety first!

Please make sure that your group is prepared to be safe in the field. Here is a list of precautions your group should take note of:

- ☐ Always work in teams of at least two.
- ☐ Let someone back at home know where you are going.
- ☐ Have a first aid kit available in the car.
- ☐ Walk only where the footing is safe.
- ☐ Use caution walking on rocks or steep shorelines.
- ☐ Bring water and snacks.
- ☐ Pay attention to "beware of dog" signs.
- ☐ Wear a life jacket when working around high velocity streams.

(Reference: A Citizen's Guide to Lake Watershed Survey's, Maine Department of Environmental Protection, <http://www.state.me.us/dep/blwq/training/npspubl.htm>)

Be prepared to talk with watershed landowners!

If your group will need to cross private property, you should knock on the door to see if anyone is home. If someone is home, you should introduce yourselves and explain the project. In addition, people may approach your group in the field and ask you what you are doing. You will need to be clear about the purpose of the survey by saying something like, "We are trying to identify problems that may be impacting the lake." Your group should be prepared to discuss polluted runoff with landowners, and should be prepared to respond to difficult people. Please remember to always respect the property owner's wishes. If you suspect that a water quality problem exists on a property that you are not allowed to access, please note it on the survey field sheet, let the VLAP Coordinator know, and a DES Biologist will visit the site later.

What should we look for?

Your group will want to look closely at all of the land uses in the immediate vicinity of the stream. Table 1 lists typical watershed land uses and associated water quality issues that can contribute to elevated levels of pollutants.

2002 Special Topic

Table 1: Watershed Land Uses and Potential Water Quality Issues and Pollutants

Land Use (water quality issue of concern)	Elevated Conductivity	Elevated Turbidity	Elevated Total Phosphorus	Elevated E.coli
Construction Area (disturbed/exposed soils)	X	X	X	
Agricultural Area (animal wastes)			X	X
Agricultural Area (erosion, pesticide & fertilizer use)	X	X	X	
Residential/Commercial Area (potentially failed septic system)	X		X	X
Residential/Commercial Area (runoff from impervious areas)	X	X	X	X
Residential/Commercial Area (Lawns with excessive fertilizer use)	X		X	
Road Crossing (dirt – road salt applied in winter)	X	X		
Road Crossing (paved - road salt applied in winter)	X			
Road Crossing (eroding shoulder)	X	X	X	
Wildlife/animals (feces from duck, beaver, geese, pets)		X	X	X

For each land use, your group will want to look closely for the following issues and take notes on the stream survey field sheet:

- ☐ Bare/exposed soil
- ☐ Signs of erosion (gullies and rills)
- ☐ Cloudy (turbid) water
- ☐ Sediment deposits in the water
- ☐ The pathway of stormwater runoff in the area (document if the runoff is going directly into a ditch, stream, or lake)
- ☐ Absence of a vegetated buffer
- ☐ Properly installed erosion and sedimentation barriers around disturbed sites (such as hay bales and silt fencing)

(Reference: A Citizen's Guide to Lake Watershed Survey's, Maine Department of Environmental Protection, <http://www.state.me.us/dep/blwq/training/npspubl.htm>)

Document what you see

While conducting the stream survey, the group should fill out the VLAP Stream Survey field datasheet and mark and label the potential sources of pollution along the stream on a topographical map. In addition, the group should measure the distance of the potential water quality problem area to the stream, and also note the slope of the land.

The next step is take stormwater samples!

As discussed previously, the VLAP Coordinator recommends conducting the stream survey prior to collecting stormwater samples. If the group becomes familiar with the stream and surrounding watershed prior to sampling, this will make the sample

2002 Special Topic

collection process easier, faster, and more enjoyable (especially if it is still raining when you actually go out in the field to collect the samples!).

What parameters should we sample for?

Prior to conducting storm event sampling, you should talk to the VLAP Coordinator to determine exactly what parameters your group will be sampling for. Typically, turbidity, total phosphorus, conductivity, and *E.coli* are the major parameters of concern for stormwater sampling.

Sampling Logistics

Remember, when conducting rain event sampling, the VLAP Coordinator recommends that sampling be conducted **after one-half inch of rain has fallen within a 6 hour period after at least 3 days of dry weather.**

If your monitoring group decides to sample multiple streams during one storm event, you will need a couple of teams (ideally, one team per stream). This minimizes the possibility that the "first-flush" event is captured in one stream, but missed in the other stream(s) since it took a while for the monitors to travel to other sample sites.

Predicting and scheduling sampling for a storm event, is, of course, the tricky part. It will involve keeping a close eye on the weather forecast, having a rain gauge, and having a group of volunteer monitors who are willing to be "on call" and available to go out and sample when the conditions are right! (And, keep in mind, this may involve sampling while it is still raining! Make sure that the members of your group have raincoats, waterproof boots, the necessary safety equipment, and are willing and able to brave the elements!)

How do we collect stormwater samples?

The Coordinators of VLAP recommend collecting stormwater samples using the "**stream bracketing**" technique.

What is the "stream bracketing" technique?

Using the stream bracketing technique, samples are collected in multiple locations along each stream to help pin-point any possible pollution sources. Samples should be taken upstream and downstream of each potential pollution source (as outlined previously in Table 1). Prior to sampling, make sure to consult your VLAP Monitors Handbook which details the proper procedures for collecting tributary samples.

While sampling, please label bottles clearly as to which samples are upstream samples and which are downstream samples, and identify each sampling location on a map. Remember to complete a "VLAP Stream Survey Field Sheet" for each sampling station. (Most of the field sheet will have been previously filled out during the stream survey.)

As usual, samples should be kept in a cooler with ice and should be returned to the laboratory within 24 hours. Please remember that the labs are not open on Saturday or Sunday. If your group plans to sample on the weekend, please sample on Sunday and bring the samples to the laboratory first thing on Monday morning.

2002 Special Topic

What happens next?



The VLAP Coordinator will review the results of the stormwater sampling event with your group. If the data are not conclusive, it may be necessary to conduct additional stormwater sampling using a more refined bracketing technique along the inlet(s) to better “pinpoint” the sources of pollution.

Once the “sources” of the elevated levels of the pollutants of concern have been identified, DES may recommend that Best Management Practices (BMPs), or other corrective actions, be implemented within the watershed to minimize, or, possibly even eliminate, the sources of pollution. Recommended BMPs may be engineered structures, such as special drainage structures that allow sediment and attached nutrients to settle out of the stormwater runoff before it is discharged to the stream. Recommended BMP’s may also be land use management activities, such as pumping out septic systems or reducing the amount of fertilizer use in an area.

If a severe negative water quality condition of a stream is revealed through stormwater sampling, then the lake and its watershed may be eligible for more intensive study through the NHDES Clean Lakes Program.

In addition, it is important to note that DES must enforce all state water quality standards. If your groups’ investigation reveals exceedences of state water quality standards, enforcement actions may be initiated.

Stormwater sampling, in particular, is a useful “tool” that provides DES and volunteer monitors with the ability to trace potential water quality problems to their source before a severe negative impact can be made on the water quality of the lakes/ponds throughout the state. Water quality pollution prevention through routine VLAP monitoring and stormwater sampling ultimately saves the community and the state the cost of expensive, after-the-fact remediation!

If your monitoring group is interested in conducting stormwater sampling, please contact Andrea LaMoreaux, VLAP Coordinator, by calling (603) 271-2658 or by emailing at vlap@des.state.nh.us.