Appendix B. Problems encountered in the field and possible solutions

Slide-hammer penetration through saprolite

At three locations

- GF BB: Gwynn Oak Rd at Security Blvd (57.0 cm)
- GF AAA: Owings Mills Blvd at Gwynnbrook Ave (GAGE) (71.8 cm)
- GF S: Black Friars Rd at Chesworth Rd (GAGE) (94.5 cm)

there was evidence that the slide-hammer had penetrated through saprolite for one or more of the measurements, distorting the average bed thickness determination. In these instances, what appeared to be saprolite material was visible on the slide-hammer after it was removed from the streambed. In most cases, the slide-hammer came out of the streambed clean. In the case of GF BB and GF AAA, the values listed above were adjusted (lowered) based on the amount of saprolite material visible on the slidehammer tip after removal from the bed. Data for GF S was thrown out entirely.

At a fourth location:

- GF YY: Owings Mills Blvd at Crondall Lane (34.0 cm)

the entire bed appeared to be saprolite, below which harder bedrock was reached. This location was actually a small headwater channel draining a man-made lake in the northern reaches of the domain.

Measurement of bed thickness was somewhat subjective, as the slide-hammer operator in the field had to judge when the bed material ended and when the bedrock, which was much harder (but still possible) to penetrate, began. Saprolite acted to blur this boundary.

Protecting the threads of the permeameter shaft during insertion into streambed

The top of the permeameter's iron shaft is threaded so that the ball-valve of the reservoir chamber may be attached securely. The iron shaft is pounded into the streambed using a hammer, with only a portion of the force causing insertion into the bed, and the other portion causing distortion of the threads. To prevent this distortion, a steel cap was tightened onto the threads, and the force of the hammer was applied to the cap. The idea was that the cap would distribute the force over multiple threads rather than distorting the top-most threads alone. The cap had to be hand-tightened and removed to prevent disruption of the streambed, and did not function as intended, but instead covered only a few of the iron pipe's threads. A steel flange later replaced the steel cap, and provided a better striking surface for the hammer. The flange was no better at covering a greater number of threads than the cap, however. After many uses of the permeameter with either of these two measures in place, the threads were sufficiently distorted to prevent a secure joining of shaft and ball-valve. The threads of the permeameter shaft then had to be cut off, and new threads created at the top of the shaft, effectively shortening the length of the permeameter. PVC plumbing components were also tried in place of the cap or flange, but would eventually shatter.

Another idea to preserve the threads was the use of a rubber mallet to pound directly on the top of the shaft, with no cap or flange in place. The mallet did not seem to damage the threads as much, but the pounding surface of the mallet was slowly deteriorated, and shed small pieces of rubber, some of which could potentially enter the hollow shaft of the permeameter and disrupt outflow from the mesh. Other ideas were attempted to a limited extent, and no ideal solution was found during the ~10 days of field work. The two best solutions, short of re-designing the permeameter shaft itself, seem to be:

- Use of a steel flange, hand-tightened over as many threads as possible, combined with many light taps of a hammer (rather than fewer powerful taps) when pounding the shaft into the bed. Use of light taps can be difficult in rockier stream channels.
- Use of a rubber mallet to pound on a PVC cap, which completely covers the top of the iron pipe and prevents small pieces of rubber from entering the permeameter shaft.

Less than vertical slide-hammer and permeameter insertion

Many of the sites visited during this study featured very rocky streambeds, both at the surface and beneath. Sub-surface rocks especially made insertion of both the slide-hammer and the permeameter shaft difficult, by forcing the instruments to one side while they were pounded into the bed. This caused the instruments to have a slight angle relative to the bed in some instances. When the angle was more extreme, the instruments were removed and a new attempt at insertion into the bed was performed. At several sites, perfectly vertical insertion at all three measurement locations across the transect was impossible, and slightly angled permeameter tests and bed thickness measurements were performed. The angle is likely to have caused imperfect permeameter performance (and thus slightly inaccurate hydraulic conductivity calculations), and to have caused artificially high bed thickness measurements.

Torn mesh

After many uses, the permeameter mesh inevitably became torn. When used in rockier streambeds, the permeameter shaft was sometimes difficult to remove from the bed. In these cases, the shaft was gently rotated counter-clockwise while being lifted up from the bed. Rotating in the opposite direction may force small sediment particles into the vertical seam of the mesh, which was wrapped around the iron pipe to form a narrow region of overlap. It may be possible to prevent damage to the mesh by using a mesh with a larger wire diameter, though a similar opening size is recommended. The permeameters used in this study used stainless steel mesh with an opening size of 178 µm (0.007 in.) and a wire diameter of 137 µm (0.0055 in.). For information on replacing torn mesh, see Appendix A.

Colloids and clogged mesh

As mentioned in the Methods section of the report, the mesh of the permeameter shaft should be rinsed thoroughly with clean tap water or deionized water immediately prior to insertion into the streambed. Rinsing the mesh is necessary to prevent colloids from clogging the mesh and limiting outflow from the permeameter during a hydraulic conductivity test. The colloids will inevitably build up as each test proceeds and as stream water flows through the mesh, but the rinsing process ensures that each test has an equally unclogged mesh with which to start.

Vertical flow paths and streambed disruption

The permeameter shaft was inserted into the streambed to a depth of at least 7.5 cm, measuring up from the top of the perforated mesh outflow region. This depth was thought to be below the more stable armor layer of the bed, and to be sufficient to prevent disruption of the streambed once the ball-valve was opened and outflow began. In several instances, usually where the bed material consisted primary of fines or smaller sand particles, outflow from the permeameter caused preferential vertical flow paths along the sides of the permeameter shaft, causing a vertical plume of sediment at the bed surface. When this occurred, the test became invalid and was stopped, and a new attempt was made nearby at an increased insertion depth (up to 12.5 cm). In some instances, vertical flow paths were found to be unavoidable, usually where a shallow bed made further permeameter insertion impossible – at these locations, no hydraulic conductivity measurements were performed (and only one or two measurements were used in the conductivity average for that site).

Some streambeds consisted contained such a high percentage of fines that the weight of a full reservoir of water atop the permeameter shaft caused the permeameter to ‘sink’ to a greater insertion depth in the bed. Sinking of the permeameter to a greater insertion depth was not considered a problem, as long as the instrument remained vertical. In some cases, the inability of the bed to support the permeameter caused the instrument to gain a tilt and eventually fall over if not supported. When this occurred, the permeameter was removed and the test redone elsewhere.

Permeameter shaft air entrapment

As mentioned in the Methods section of the report, the permeameter shaft should be fully wetted in stream water prior to insertion into the streambed (and prior to rinsing the mesh). Wetting the permeameter shaft reduces the likelihood that air will be trapped within the hollow iron pipe during a hydraulic conductivity test. Air entrapment prevents water from exiting the reservoir chamber and entering the hollow shaft, and can be recognized by a reservoir water level that does not decline, or declines very slowly, once the ball valve is opened. Large bubbles rising within the reservoir chamber during a hydraulic conductivity test indicate that air entrapment is being resolved, but also that data collected up to that point is invalid and that the test must be restarted.

If air entrapment occurs despite wetting the permeameter prior to use, air release can be accomplished by gently tapping the iron pipe with a small hammer or similar instrument, with the ball-valve open and a reservoir full of water. Tapping the pipe should cause the air to be released up into the reservoir, visible as many small bubbles. Once the air has been released, the ball-valve is closed, the reservoir is refilled to the full “0 marking, and the test can begin. Be careful not to disturb the streambed too much while gently tapping on the pipe. Modifications to the permeameter shaft’s design can be made to bleed off excess air prior to each test, if air entrapment is a frequent problem.

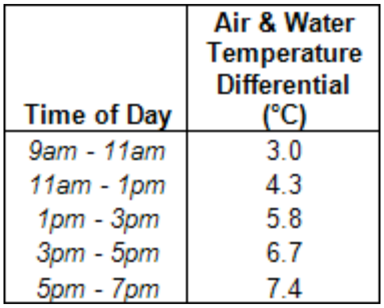
Missing water temperature data

At six of the forty-two sites, reliable water temperature data was not available due to an equipment malfunction in the field. For these sites, estimated values were used based on weather data obtained from:

http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KMDOWING1&graphspan=day&month=7&day=17&year=2008

For each of the thirty-six sites having accurate water temperature data, air temperature data from the above weather station (updated every five minutes) was determined, and the difference between the air temperature and the measured water temperature was calculated. On average, water temperatures at the thirty-six sites were 5.5°C less than air temperatures. The data was broken up into categories based on the time of day, as the air and stream water temperature differential increases during the course of the day. The following averages were determined:

Table B1. Average Air and Water Temperature Differential



Time of Day	Air & Water Temperature Differential (°C)	
9am - 11am	3.0	(based on 6 data points)
11am - 1pm	4.3	(based on 7 data points)
1pm - 3pm	5.8	(based on10 data points)
3pm - 5pm	6.7	(based on 8 data points)
5pm - 7pm	7.4	(based on 5 data points)

The averages in the table above were used to calculate an estimate of water temperature at each of the six sites for which no water temperature data was available. The affected sites include:

- GF G: Ellicott Driveway at W Baltimore St
- GF V: Dogwood Rd at Woodlawn Dr (GAGE)
- GF EE: Purnell Dr at Gwynn Oak Rd
- GF JJ: Liberty Rd at Flannery Ln (GAGE)
- GF GG: Liberty Rd at Essex Rd (GAGE)
- GF II: Millford Mill Rd at Scotts Hill Dr

A plot of air temperature (based on the weather station data) vs. measured water temperature data is displayed below (Figure B1). The six sites listed above and their corresponding water temperature estimates are displayed as pink squares, outlined in black. The sites are listed in the order in which they were visited rather than by date and time to increase readability of the plot. Dramatic declines in air temperature in the plot coincide with the beginning of a new field day, as air temperatures were much lower on the following morning than they were in the late afternoon of the previous day. Differential heating of the stream water (which was used to fill the permeameter reservoirs) based on size of the stream, position of the stream in the watershed (headwaters vs. downstream), or canopy cover was not considered.

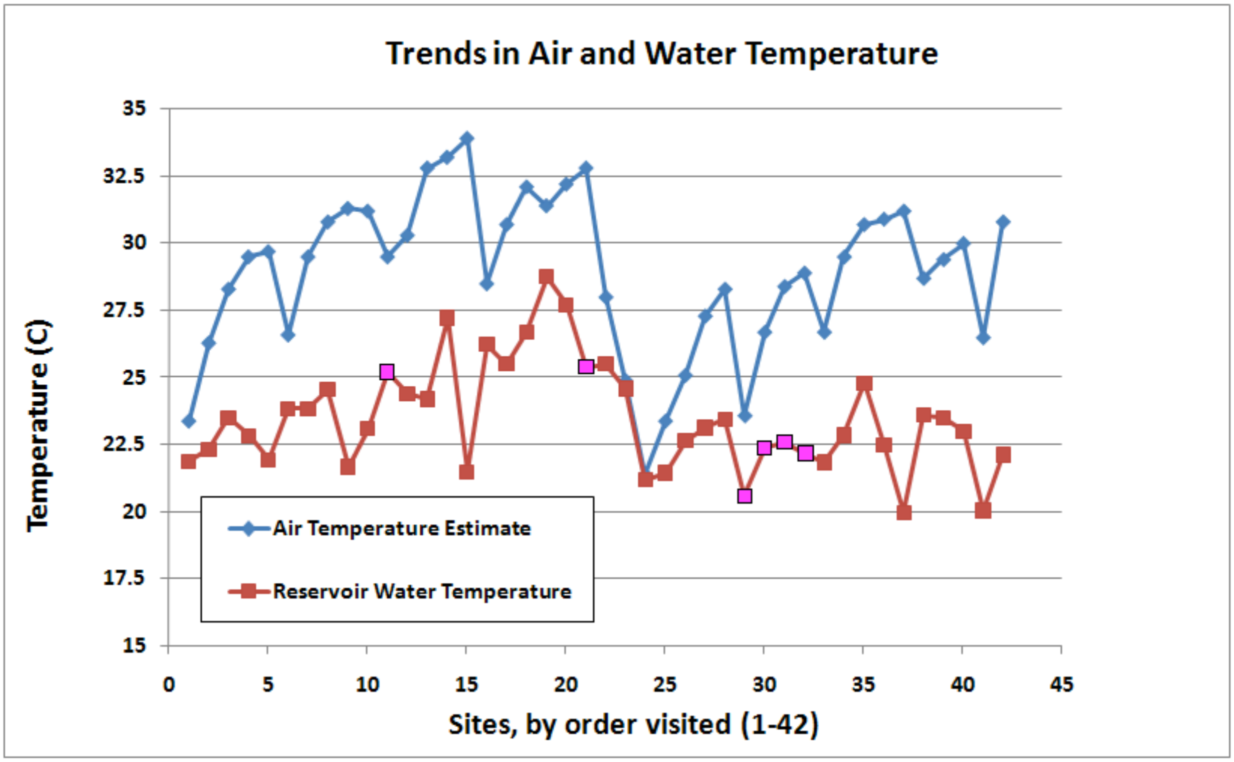


Figure B1. Weather Station air temperatures and measured stream water temperatures.