Understanding the Relationship between Biological Impairments and Suspended Sediment

What is Biological Monitoring?
The Minnesota Pollution Control Agency (MPCA) uses biological monitoring to track the health of riverine and wetland environments. The health of a biological system is a direct measure of environmental stress. Biological monitoring is therefore often preferred over chemical monitoring for assessing environmental health.

Biological monitoring occurs for fish, plant, or macroinvertebrate communities. Monitoring data are used to conduct a bioassessment, which is an examination of attributes such as community composition, reproductive function, tolerance to human disturbance, abundance, and condition. Each attribute changes in a predictable way with human influence. Quantifying these attributes results in a score called an Index of Biological Integrity (IBI).

What is a Biological Impairment?
Streams or wetlands with IBI scores less than a certain value are considered impaired for Aquatic Life and placed on the U.S. EPA 303(d) List of Impaired Waters. IBI scores may be calculated for fish, macroinvertebrate, or plant assemblages. The pollutant or stressor for waters on the impaired water list may therefore include fish bioassessments, aquatic macroinvertebrate bioassessments, and/or aquatic plant bioassessments.

Including the 2008 proposed 303(d) list of impaired waters, there are 41 stream stretches where the pollutant or stressor is fish bioassessments, 19 for aquatic macroinvertebrate bioassessments, and 22 for both (see figure). MPCA anticipates increased use of biological monitoring to assess water quality. Therefore, it is likely the number of assessed streams and wetlands having biological impairments will increase in the future.

What is a TMDL?
A biologically-impaired stream or wetland must be restored to a specific assemblage of fish, macroinvertebrates, or plants through the TMDL (Total Maximum Daily Loads) process. A TMDL is the maximum amount of a pollutant that can be discharged to a receiving water and still comply with water quality standards. During development of a TMDL, detailed analyses are conducted to determine reductions in pollutant loading needed to restore a stream or wetland to its intended use.

For biological impairments, the pollutant may not be known. For example, a stream may not support a healthy fish assemblage because of elevated temperature, chloride, sediment, and so on. For biological impairments, a pollutant must be identified to develop the TMDL.

Why is Sediment a Surrogate Pollutant for Biological Impairments?
The link between sediment and biological impairment has been documented (see References). Suspended and bedded
sediments impact macroinvertebrates due to abrasion, clogging of filtration mechanisms used for ingestion and respiration, and mortality due to smothering and burial. Sediment impacts fish through suffocation and loss of spawning habitat. Other effects of sediment include decreased viability or disappearance of habitat features such as pools and riffles, loss of intolerant species such as darters and trout, and increased turbidity in the water column. For these reasons, several current TMDL projects for biological impairments identify suspended or bedded sediment as the primary cause of impairment.

What is the relationship between biological impairments and construction stormwater?
Federal law prohibits new or expanded discharges to an impaired water unless the discharge can be shown to not cause or contribute to the impairment. New construction qualifies as a new discharge. Monitoring is typically not conducted at construction sites. The EPA has determined that for stormwater, best management practices (BMPs) comprise a suitable effluent limit. Thus, a suite of BMPs must be developed that are considered to not cause or contribute to water quality impairments.

The primary concerns with construction stormwater are sediment and sediment-related pollutants. Since sediment will be the surrogate pollutant for most biological impairments, construction sites requiring a permit and located within one mile of a stream or wetland where the pollutant or stressor is fish bioassessments, aquatic macroinvertebrate bioassessments, and/or aquatic plant bioassessments, must comply with the impaired water provisions of the construction stormwater permit.

References
Berry, W; Rubenstein, N; Melzion, B; and Hill, B. 2003. The biological effects of suspended and bedded sediment (SABS) in aquatic systems: A review. Internal Report of the USEPA Office of Res. and Develop., Narragansett, RI.


