U.S. Geological Survey Implements New Turbidity Data-Reporting Procedures

BACKGROUND: Recent technological advances have resulted in the availability of a variety of turbidimeters designed to meet a variety of objectives. However, because of differences in instrument design, different meters often do not yield equivalent results when measuring natural waters (Gray and Glysson, 2003). In effect, the different meters measure turbidity in different ways, responding differently to color, particle size distributions, or particle concentrations in the water sample. As a result, turbidity data generated from different turbidimeters and determined for various water sources and under different environmental conditions are not necessarily comparable; therefore, these data need to be reported using an information-rich measurement unit.

NEW PROCEDURES: To account for the technological advances and complexities in turbidity measurement, the U.S. Geological Survey (USGS) has collaborated with public and private sector entities (ASTM, 2003) to establish a suite of reporting units for storing and reporting turbidity data that is based on instrument design (effective October 1, 2004). These reporting units, defined in the table below, provide a systematic method by which to characterize the type of turbidimeter used and are intended to improve the comparability of turbidity data within USGS databases. A detailed explanation of USGS data-collection and data-reporting procedures and the associated references are documented in USGS Water Quality Technical Memorandum 2004.03 (available online at http://water.usgs.gov/admin/memo/QW/qw04.03.html, and in the USGS ***National Field Manual for the Collection of Water-Quality Data, Chapter 6.7—Turbidity*** (Anderson, 2004). This report includes a decision tree to help users determine the most appropriate instrument type for their application. Send e-mail to nfm-owq@usgs.gov for more information.

Reporting units corresponding to different turbidity instrument designs

[nm, nanometers; °, degree]

Detector geometry	Light Wavelength	
	White or broad band (with a peak spectral output of 400-680 nm**)**	**Monochrome** (spectral output typically near infrared, 780-900 nm)
Single Illumination Beam Light Source		
At 90° to incident beam	Nephelometric Turbidity Unit (NTU)[a]	Formazin Nephelometric Unit (FNU)[b]
At 90° and other angles. An instrument algorithm uses a combination of detector readings, which may differ for values of varying magnitude.	Nephelometric Turbidity Ratio Unit (NTRU)	Formazin Nephelometric Ratio Unit (FNRU)
At 30°± 15° to incident beam (backscatter)	Backscatter Unit (BU)	Formazin Backscatter Unit (FBU)
At 180° to incident beam (attenuation)	Attenuation Unit (AU)	Formazin Attenuation Unit (FAU)
Multiple Illumination Beam Light Source		
At 90° and possibly other angles to each beam. An instrument algorithm uses a combination of detector readings, which can differ for values of varying magnitude.	Nephelometric Turbidity Multibeam Unit (NTMU)	Formazin Nephelometric Multibeam Unit (FNMU)

[a] Use of NTU: limited to instruments that comply with EPA Method 180.1 (U.S. Environmental Protection Agency, 1993).

[b] Use of FNU: pertains to instruments that comply with ISO 7027, the European drinking-water protocol (International Organization for Standardization, 1999), which includes many of the submersible turbidimeters that are in common use in the USGS for onsite measurements.

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