

Appendix C-T1. Direct pore-water sampling devices

<i>Method: Centrifugation</i>		
<p>Description: Collection of sediment followed by centrifugation. Filtration and/or flocculation of residuals are possibly necessary.</p> <p>Measured endpoints: Analysis of pore-water chemistry and comparison with ambient water quality criteria. If sufficient volume is collected, aquatic toxicity tests may be conducted using standard methods (e.g., <i>Daphnia</i> acute toxicity testing).</p> <p>References: USEPA 2001b, NFESC 2003</p>	<p>Advantages: Relatively inexpensive and can be done at most commercial labs. Conservative but generally accepted method by regulatory agencies.</p> <p>Disadvantages: Requires large volumes of sediment and ability to centrifuge large samples at ~10,000 g or higher. Limited sample volumes generated, especially for some sediment types. Can alter pore-water chemistry (i.e., redox).</p>	<p>Analyte capability: All analytes depending on sample volume</p>
<i>Method: Suction devices</i>		
<p>Description: A syringe, airstone, or tubes of varying length (e.g., Michigan sampler) with one or more sampling ports inserted into the sediment to the desired depth. Suction is applied via various means to directly retrieve the pore water sample.</p> <p>Measured endpoints: Analysis of pore-water chemistry and comparison with ambient surface-water quality criteria. If sufficient volume is collected, aquatic toxicity tests may be conducted using standard methods (e.g., <i>Daphnia</i> acute toxicity testing).</p> <p>References: ASTM E1391 2008; USEPA 2001b, n.d. "Measurement"</p>	<p>Advantages: Relatively inexpensive and can be done in situ or within most commercial labs. Conservative but generally accepted method by regulatory agencies.</p> <p>Disadvantages: In situ, low-flow rates in fine-grained substrates. Also need to prevent short-circuiting of overlying surface water. In the laboratory, large volumes of sediment are required (10:1). Limited sample volumes generated especially for some sediment types. Can alter pore-water chemistry (i.e., redox).</p>	<p>Analyte capability: All analytes depending on sample volume</p>
<i>Method: Piezometers (field)</i>		
<p>Description: Similar to laboratory suction devices, suction is applied via various means (usually a peristaltic pump) to directly retrieve the pore-water sample from a piezometer in the field.</p> <p>Measured endpoints: Pore-water concentrations. Concentration limit is method specific.</p> <p>References: USEPA n.d. "Measurement"</p>	<p>Advantages: Relatively easy to install and extract pore water. Can repeatedly sample from same location using dedicated tubing.</p> <p>Disadvantages: Can alter pore-water chemistry (i.e., redox). Need to ensure that overlying surface water is not being drawn. Sample volume dependent on achievable flow rate.</p>	<p>Analyte capability: All analytes depending on sample volume</p>

Method: Trident probe (U.S. Navy)		
<p>Description: Direct-push probe that also collects depth, temperature, and conductivity to determine the appropriate depth for pore-water sampling.</p> <p>Measured endpoints: Analysis of pore-water chemistry and comparison with ambient surface-water quality criteria. If sufficient volume is collected, toxicity testing may also be conducted using pore-water/surface-water methods (e.g., <i>Daphnia</i> acute toxicity testing).</p> <p>References: USEPA n.d. “Measurement,” Chadwick and Hawkins 2008</p>	<p>Advantages: Can determine groundwater/surface-water interface through changes in conductivity and temperature.</p> <p>Disadvantage: Limited familiarity and availability among commercial laboratories.</p>	<p>Analyte capability: Metals all analytes depending on sample volume</p>
Method: Solid-phase microextraction—USEPA SW-846 Method 8272, ASTM D7363-07		
<p>Description: Direct analysis of hydrophobic organics in sediment pore water. Small sediment sample (40 mL) centrifuged and dissolved solids flocculated in the laboratory. SPME fiber added to supernatant and then injected into GC. ASTM method same as SW-8272 except the analysis of alkylated PAHs is specified.</p> <p>Measured endpoints: Pore water at low concentrations (pg/mL).</p> <p>References: USEPA SW-846 Method 8272, Hawthorne et al. 2007</p>	<p>Advantages: Small sediment volume (40 mL) and low detection limits (pg/mL). Procedure does not involve revisiting the site. Removes the limitations imposed by using EqP. Large database relating aquatic toxicity to pore-water concentrations for comparison with site samples.</p> <p>Disadvantages: Fairly complex analytical and data interpretation technique. Method SW-8287 specifies the analysis of only 16 priority pollutants PAH compounds (not alkylated compounds).</p>	<p>Analyte capability: PAHs, PCBs, pesticides</p>
Method: Air bridge		
<p>Description: Works on the principle that organic compounds dissociate from sediments into water, diffuse into air, and then redissolve into clean water as freely dissolved compounds. Measures “truly dissolved” chemical constituents in water.</p> <p>References: Fernandez et al. 2009</p>	<p>Advantages: Method assesses freely dissolved hydrophobic concentrations of compounds such as PAHs and PCBs.</p> <p>Disadvantages: Slow process; larger molecular weight compounds may take weeks, if not months, to equilibrate.</p>	<p>Analyte capability: PAHs, PCBs, pesticides, energetic compounds (nonpolar organics)</p>