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OPERATING PROCEDURE

Title: Total Community Metabolism

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
<p>SESDPROC-503-R1, <i>Total Community Metabolism</i>, replaces SESDPROC-503-R0.</p> <p>General Corrected any typographical, grammatical, and/or editorial errors.</p> <p>Title Page Changed title for Bill Cosgrove from Acting Chief to Chief. Changed John Deatricks title from Environmental Engineer to Chief, Ecological Evaluation Section.</p> <p>Table of Contents Renamed Section 1.4, and deleted Section 5.</p> <p>Section 1.3 Updated information to reflect that procedure is located on the H: drive of the LAN. In addition, text has been revised in this section.</p> <p>Section 1.4 List revised to be alphabetical. Citations of SESD procedures added. References in Section 5 merged with this section. Other changes made to be consistent.</p> <p>Section 1.5.1 Title of Safety, Health, and Environmental Management Program Procedures and Policy Manual corrected, and citation added.</p> <p>Section 2.1 Deleted last sentence of second paragraph.</p> <p>Section 2.2 Added SESD procedure.</p> <p>Section 3.1 Changed word from Chapter to Section.</p> <p>Section 3.2 Added SESD procedures.</p>	<p>November 1, 2007</p>

Section 4.1 Updated SESD procedures	
SESDPROC-503-R0, <i>Total Community Metabolism</i> , Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

The purpose of this procedure is to document both general and specific procedures, methods and considerations to be used and observed when evaluating total community oxygen metabolism of a water body.

1.2 Scope/Application

This document also describes both general and specific methods to be used by field investigators when conducting field measurements for the assessment of total community metabolism in the field. In the event that Science and Ecosystem Division (SESD) field investigators determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used, the variant procedure will be documented in the field log book (in accordance with SESD Operating Procedure SESDPROC-010, Logbooks), along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

Odum, H.T. and C.M. Hoskins. 1958. Comparative Studies on the Metabolism of Marine Waters. Institute of Marine Science, University of Texas, Pt. Arkansas, Texas, 5, 16-46.

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version.

SESD Operating Procedure for Measurement of Dissolved Oxygen, SESDPROC-106, Most Recent Version.

SESD Operating Procedure for *In situ* Water Quality Monitoring, SESDPROC-111, Most Recent Version.

SESD Operating Procedure for Hydrological Studies, SESDPROC-501, Most Recent Version.

SESD Operating Procedure for Reaeration Measurement by Diffusion Dome, SESDPROC-505, Most Recent Version.

SESD Operating Procedure for Reaeration Measurement using Krypton Gas, SESDPROC-506, Most Recent Version.

United States Environmental Protection Agency (USEPA). 1985. Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition). EPA/600/3-85/040, Environmental Research Laboratory, Athens, GA. June 1985.

USEPA. 1987. The Enhanced Stream Water Quality Models QUAL2E and QUAL2E-UNCAS: Documentation and User Model. EPA/600/3-87/007. Environmental Research Laboratory, Athens, GA.

USEPA. 2001. Region 4 Ecological Assessment Standard Operating Procedures and Quality Assurance Manual. Science and Ecosystem Support Division, Region 4, Athens, GA.

USEPA. 2007. Safety, Health and Environmental Management Program Procedures and Policy Manual. Science and Ecosystem Support Division, Region 4, Athens, GA.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when measuring total community metabolism. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual (USEPA 2007) and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. These methods may be employed during periods of high stream flow, in estuarine/coastal areas with tides and currents, in water bodies with barge/ship traffic, and in conditions of limited visibility.

1.5.2 Procedural Precautions

The following precautions should be considered when conducting field measurements for the assessment of total community metabolism:

- All instrumentation should be in good condition and operating within the manufacturer's recommended tolerances;
- All instruments should be calibrated and deployed in accordance with the manufacturer's requirements.

2 Special Sampling Considerations

2.1 Quality Control

The Total Community Metabolism method allows assessment of the rates of gross primary production (GPP) and respiration (R) expressed as mass of oxygen produced/consumed per unit area (e.g., grams of oxygen per meter squared [gO_2/m^2]). Partitioning of production/respiration processes between the water column and sediment requires additional concurrent measurements, such as water column oxygen metabolism (e.g., light/dark bottle method), diffusion/reaeration, and/or sediment oxygen demand as dictated by specific data needs. These concurrent measurements are described in separate procedure documents.

All field equipment should be operated, calibrated, and maintained according to manufacturer's specifications. All equipment should be visually inspected prior to deployment to ensure proper operation. If dissolved oxygen monitoring equipment is to be deployed in excess of 72 hours, a calibration check against a Winkler titration or another instrument calibrated on the day of the check should be performed and the instrument recalibrated, if necessary.

2.2 Records

Information generated or obtained by SESD field investigators will be organized and accounted for in accordance with SESD records management procedures. Field notes will be recorded in a bound field notebook (in accordance with SESD Operating Procedure for Logbooks, SESDPROC-010). All measurements shall be traceable to the field investigator(s) making the measurements and the equipment utilized.

3 General Considerations

3.1 General

The technique described in Section 4 of this procedure document is designed to provide a representative assessment of community oxygen production and respiration. The technique is predicated on knowledge of the history of the water at the measurement site in order to account for an in-stream oxygen gain resulting from upstream accrual. If the history of the water is unknown or adjustments for accrual cannot be made with confidence, the community approach should not be utilized. A review of the DO data with hydrologic data (flow/stage) for the water body should provide sufficient information to assess the impacts of water history on application of this procedure.

Also central to the application of this technique is a determination of the average depth of the water body in the immediate vicinity of the measurement site. Measurements of solar energy and light transmission may further enhance data interpretation.

3.2 Equipment Selection Considerations

When applying this technique to marine waters, salinity measurement is required in order to correct DO measurements. Multi-parameter data sondes measure and correct for salinity. However, other DO meters may require separate measurement of salinity. Also, if instrumentation is utilized which lacks logging capability, data must be recorded by hand throughout the diel period. Data should be recorded at least every 3 hours in this case; however, more frequent recording is preferable. If instrumentation has logging capability, data should be logged at consistent intervals of 15 to 30 minutes. Flexibility is provided to allow coincident measurements with other equipment (e.g., current meters) deployed as part of a more comprehensive study. Use of data sondes and other DO meters should be used in accordance with SESD Operating Procedures for Field Measurement of Dissolved Oxygen (SESDPROC-106) and *in situ* Water Quality Monitoring (SESDPROC-111).

4 Community Oxygen Metabolism

4.1 General

Total community oxygen metabolism involves assessment of gross primary production (GPP) and respiration (R) associated with the aquatic community. The technique utilized by SESD is a modification of a diel DO analysis developed by H.T. Odum and C. M. Hoskins (Odum and Hoskins 1958). The method involves graphical analyses of dissolved oxygen monitoring data from a fixed location over a diel period. The specific steps in these analyses are:

- Plot diel DO curves;
- Compute DO saturation based on temperature;
- Plot rate of DO change curve;
- Plot corrected rate DO change with correction based on diffusion rate and saturation deficit;
- Select respiration rate based on professional judgment and plot as baseline for 24 hour period;
- Compute gross primary production from area bracketed by corrected rate of change curve and respiration line for photoperiod;
- Calculate final rates in appropriate units using average depth.

The modification to Odum and Hoskins procedure relates to the determination of the diffusion rate applied to the technique. Odum and Hoskins provide a method for calculating a diffusion constant; however, using procedures described in other procedure documents (SESDPROC-505 and SESDPRO-506), investigators can conduct field measurements to obtain the diffusion rate utilized in the community metabolism assessment. In the absence of a measured diffusion rate, diffusion rates may be determined by the method described by Odum and Hoskins or estimated using equations found in literature such as the Rates, Constants, and Kinetics Manual (USEPA 1985) or the QUAL2E Model Manual (USEPA 1987).

4.2 Equipment and Deployment

The following equipment is available for accurate measurement and monitoring of dissolved oxygen and temperature throughout a diel period:

- Multiparameter sondes (including salinity/conductivity probe and logging capability);
- DO meters with stirrers (also measures temperature – no logging);
- Salinometer (for marine systems if DO meter has no conductivity/salinity probe);
- Depth measurement equipment (e.g., tape down, rod, fathometer). See Hydrological Studies procedure document (SESDPROC-501), Section 7 for more methods of obtaining depth.

Monitoring equipment may be deployed in a variety of methods depending on access, conditions encountered and equipment to be used. Multiparameter sondes are generally preferred because of logging capability. In wadeable streams, sondes may be attached to a pole (e.g., rebar, conduit) driven into the stream bed. In this case, the sonde should usually be deployed at mid-depth. Consideration should be given to potential flow increases during the deployment period. It is advisable to tether the sonde bail to a secure object on shore (e.g., bridge piling, tree) to allow location of the sonde if it becomes submerged or dislodged under higher flow. In larger rivers or where access is precluded, a sonde may be hung from a bridge crossing. Weighting of the sonde may be required if stream currents impact the deployment. A small weight may be attached to the sensor guard; however, if a larger weight is required, it should be attached to the bail on the sonde bulkhead.