Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Dye Tracer Measurements**

Effective Date: July 27, 2017	**Number:** SESDPROC-514-R2

Author

Name: Derek Little
Title: Environmental Engineer

Signature: Date: 7-25-17

Approvals

Name: John Deatrick
Title: Chief, Field Services Branch

Signature: Date: 7/25/17

Name: Hunter Johnson
Title: Field Quality Manager, Science and Ecosystem Support Division

Signature: Date: 7/25/17.

Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDPROC-514-R2, *Dye Tracer Measurements*, replaces SESDPROC-514-R1. **General:** Corrected any typographical, grammatical and/or editorial errors. **Title Page:** Changed Field Quality Manager from Bobby Lewis to Hunter Johnson. **Section 3. 1** Removed fluorescence definition. **Section 3.2** Added clarification to true/tracer dye concentration. **Section 3.3.1** Removed sentence referring to equipment specific hose connections. **Section 3.3.2** Added the following sentence: "Select an appropriate sampling interval to capture dye while minimizing signal noise."	July 27, 2017
SESDPROC-514-R1, *Dye Tracer Measurements*, replaces SESDPROC-514-R0. for use."	May 30, 2013
SESDPROC- 514-R0, *Dye Tracer Measurements*, Original Issue	November 9, 2009

TABLE OF CONTENTS

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when conducting dye tracer measurements in aqueous phase environmental media, including groundwater, surface water and certain wastewaters.

1.2 Scope/Application

The procedures contained in this document are to be used when measuring dye tracer of various, aqueous phase environmental media in the field or on samples returned to the laboratory. On the occasion that the Science and Ecosystem Support Division (SESD) field personnel determine that any of the procedures described in this section cannot be used to obtain dye tracer measurements of the media being sampled, and that another method or dye tracer measurement instrument must be used to obtain said measurements, the variant instrument and measurement procedure will be documented in the field log book, along with a description of the circumstances requiring it's use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for 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 SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the SESD LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

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

USEPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

USGS. 1986. Techniques of Water-Resources Investigation of the USGS, *Fluorometric Procedures for Dye Tracing*. USGS, Denver, CO

1.5 General Precautions

1.5.1 Safety

Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. When using this procedure, minimize exposure to potential health hazards through the use of protective clothing, eye wear and gloves. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

Appropriate precautions should be observed when working in and around bodies of water and on boats. Be aware of fast flowing waters, waterway obstructions such as dams, and other vessels on the water.

1.5.2 Procedural Precautions

All measurements or instruments pertinent to the sampling event should be recorded in the field log book for the event. All records should be entered according to the procedures outlined in the SESD Operating Procedure for Logbooks (SESDPROC-010).

2 Quality Control

All devices for determining dye tracer concentrations shall be maintained and operated in accordance with the manufacturer's instructions and the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). Before a meter or probe is used, it shall be properly calibrated and verified, according to Sections 3.2 and 3.3 of this procedure, to ensure it is operating properly. These calibrations and certification checks shall be documented and maintained in a logbook.

For field use, the ambient temperature in the immediate vicinity of the meter should be measured and recorded in the field logbook to insure the instrument is operated within manufacturer's specified range of operating temperatures. For instruments that are deployed for in-situ measurements, the temperature of the medium being monitored should be measured and recorded in the logbook prior to deployment. *In-situ monitoring equipment may be utilized in unattended deployments where autonomous logging may preclude temperature measurements prior to deployment. Because in-situ instrumentation generally has a wide range of operating temperature, the field investigator may utilize professional judgment in determining if the operating environment is suitable for unattended deployment.*

If at anytime during field investigation, it appears that environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

3 Field Dye Tracer Measurement Procedures

3.1 General

Rhodamine WT is generally used by SESD as a dye tracer; however, other tracers may be used as required by application. Rhodamine WT is a conservative dye and generally good tracer because it is:

1. Water soluble
2. Highly detectable- strongly fluorescent
3. Fluorescent in a part of the spectrum not common to materials generally found in water, thereby reducing the problem of background fluorescence,
4. Harmless in low concentrations
5. Inexpensive
6. Reasonably stable in a normal water environment.
   (USGS 1986)

3.2 Calibration and Verification

Dye concentration are generally measured as tracer or true dye depending on instrumentation specifications. For Rhodamine WT in a 20% solution, tracer concentration can be converted to true dye concentration by dividing by 5. The instrument is calibrated or verified in accordance with the manufacturer's instruction prior to use in the field. If the instrument readings do not agree within ±10 % of the calibration standards, the unit must be recalibrated, repaired or replaced. These verifications should be documented in the field investigator's logbook.

Deionized water should be used as a blank when calibrating instruments but background water may be used in its place if no DI is available or a measureable background concentration is anticipated (e.g. marine waters). When possible two concentrations of rhodamine dye standard should be used in calibration, one at a high range (~20 ppb true /100 ppb tracer) and the second at a lower concentration (~10 ppb true /50 ppb tracer). The higher of the two concentrations should be used as a calibration point with the second lower concentration used as a verification of calibration. After calibration the instrument should be thoroughly rinsed with DI or background water prior to measurements of samples. After the completion of measurements, instruments will be end check verified with standard.

3.3 Sample Measurement Procedures

3.3.1 Grab Sample Measurement

These procedures should be followed when conducting dye tracer measurement of grab samples with a fluorometer:

1. Ample time (approximately 15 minutes) should be allowed for the unit to warm up before conducting measurements.
2. Inlet and outlet hoses should be securely tightened to insure that no air bubbles enter the samples.
3. Enough sample should be poured into a holding funnel or pumped through the fluorometer to flush and fill the sample chamber.
4. Samples should be run through fluorometers such that no vortexes are created in the holding funnel.
5. The resulting dye/tracer concentration should be recorded along with temperature if the unit is not equipped with temperature compensation.
6. When tracer concentrations exceed the maximum reportable concentration of a particular instrument, a serial dilution of the sample may be used to calculate the correct concentration. The diluted sample should be measured following this operating procedure.
7. Hose line should be rinsed with DI or background water between samples until background readings are obtained. Hose lines should also be rinsed following the final sample and stored in clean condition.

3.3.2 In-situ Sample Measurement

When deploying meters for conducting in-situ dye tracer measurement:

1. For extended periods of time, ensure the measurement location is representative, usually midstream and depth. It may be useful to conduct cross-section measurements to ensure completely mixed conditions.
2. Select an appropriate sampling interval to capture dye while minimizing signal noise.