1.0 Purpose and Scope

1.1 This document is for the Environmental Assessment Program Standard Operating Procedure (SOP) for Turbidity Threshold Sampling.

1.2 Turbidity Threshold Sampling (TTS) describes a procedure that uses data from a pressure transducer and an *in situ* turbidity sensor to activate a pump sampler to collect water samples. TTS is used to create a regression model (not covered in this SOP) to relate turbidity with suspended sediment concentrations collected over a range of flow conditions. The regression model can then be used to quantify sediment export from a stream over time or in response to ecosystem disturbances.

2.0 Applicability

2.1 This document was developed as a TTS procedure for the Type N Experimental Buffer Treatment (Type N) Study. The procedure may be applicable for other studies assessing sediment transport in freshwater streams.

3.0 Definitions

3.1 Turbidity Threshold Sampling: a turbidity sampling method using a pressure transducer, *in situ* turbidity sensor, datalogger, and an automatic pump sampler, programmed to activate at a specific turbidity threshold value, to collect water samples during high turbidity events (Lewis 1996; see Appendix A).

3.2 Type N: perennial and seasonal non fish-bearing streams under Washington State's current stream typing system (WAC 222-16-030).

4.0 Personnel Qualifications/Responsibilities

4.1 Knowledge of the contents of this SOP.

5.0 Equipment, Reagents, and Supplies

5.1 Pressure transducer—Ott Messtechnik pressure sensor OTT PS 1 or equivalent

5.2 Electrical conduit pipe, 1.5 inch diameter

5.3 *in situ* turbidity sensor—Forest Technology Systems DTS-12 turbidity sensor or equivalent

5.4 Metal support beams—Unistrut or equivalent

5.5 Pipe and tee connector, 3 inch diameter

5.6 Pipe cement

5.7 Hose clamps

5.8 Wire cable—diameter determined by size of stream

5.9 Cable clamps—size determined by diameter of cable used

5.10 Cable ties

5.11 Suction tubing—tubing diameter determined by pump sampler used; length determined by distance from pump sampler to sampling location in the stream

5.12 Datalogger—Forest Technology Systems HDL1 datalogger or equivalent

5.13 Automatic pump sampler—Teledyne ISCO 6712C portable sampler or equivalent

5.14 Battery—12 volt valve-regulated lead acid battery

5.15 Enclosure—Forest Technology Systems enclosure for Turbidity Threshold Sampling station or equivalent

5.16 Laptop with serial cable interface

5.17 Pump sampler bottles and caps—size determined by pump sampler model used

5.18 Data management software—Forest Technology Systems StreamTrac software or equivalent

6.0 Summary of Procedure

6.1 Install a pressure transducer following the manufacturer's instructions (Ott Messtechnik, nd). The vertical position of the sensor should be the same as that of the flume crest of the streambed. If not, record the offset and adjust the data post-process. Use a conduit or other device to protect the sensor (Figure 1). Secure the apparatus to a stilling well or another stable structure.

6.2 Install an *in situ* turbidity sensor in a pool at the downstream end of the study basin following the manufacturer's instructions (Forest Technology Systems, 2003). Use metal support beams, pipe, tee connector, and hose clamps to suspend the sensor over the stream (Figure 2). Secure the entire apparatus to trees, posts, or another stable structure with wire cable, cable clamps, and cable ties.

6.3 Submerge the open end of the suction tubing in the water near the turbidity sensor (Figure 2).

6.4 Plug the pressure transducer and turbidity sensor into a datalogger (Figure 3). Attach the other end of the suction tubing to an automatic pump sampler. Connect the datalogger to the automatic pump sampler using the provided cables and/or interface. Plug the datalogger and pump sampler into a battery. House the electronic components in an enclosure.

6.5 Program the datalogger using a laptop with a serial cable interface to record stage height and turbidity at specified intervals and to activate the pump sampler at a specified flow and turbidity threshold (see Lewis 1996).

6.6 Program the automatic pump sampler for flow paced sampling (see Lewis 1996).

6.7 Retrieve the samples from the automatic pump sampler following high flow events. Fill the pump sampler with clean pump sampler bottles.

6.8 Submit the samples to the Manchester Environmental Laboratory for suspended sediment concentration analysis. Preserve and ship the samples to the laboratory as described in the laboratory users manual (Manchester Environmental Laboratory 2005).

6.9 Visit the study site periodically to maintain the sensors and tubing, download data, retrieve water samples, and replace batteries. Pressure transducer maintenance includes removing accumulated sediments from the stilling well, re-securing the sensor if needed, and replacing the desiccant in the cable interface. Turbidity sensor maintenance includes replacing wiper blades, removing accumulated sediments from the turbidity sensor pool, and re-securing the sensor and pipe if needed. Pump sampler maintenance includes replacing the pump tube and desiccant annually. Return the pressure transducer to the manufacturer every three to five years and the turbidity sensor once a year for recalibration.

7.0 Records Management

7.1 Maintain data in the StreamTrac database or equilvalent.

8.0 Quality Control and Quality Assurance

8.1 Keep a record of all other sampling activities in the study basin to help explain observed increases in turbidity resulting from sampling activities.

8.2 Ensure that datasheets are completely filled out in the field.

8.3 Check all data entered into the database for accuracy and completeness.

9.0 Safety

9.1 File a field work plan before commencing field activities.

9.2 Use a CB radio to communicate with other traffic on one-way logging roads.

9.3 Learn how to deal with animals and people encountered in remote areas.

10.0 References

10.1 Forest Technology Systems. 2003. DTS-12 SDI Turbidity Sensor Operating Manual, Revision 7. Forest Technology Systems, Victoria, BC. 18 pp.

10.2 Lewis, J. 1996. Turbidity-controlled suspended sediment sampling for runoff-event load estimation. Water Resources Research 32: 2299-2310.

10.3 Manchester Environmental Laboratory. 2005. Lab Users Manual, 8th edition. Environmental Assessment Program, Washington State Department of Ecology, Manchester, WA. 194 pp.+

10.4 Ott Messtechnik. nd. Operating Manual Pressure Sensor OTT PS 1. Ott Messtechnik, Kempten, Germany. 27 pp.

11.0 Figures

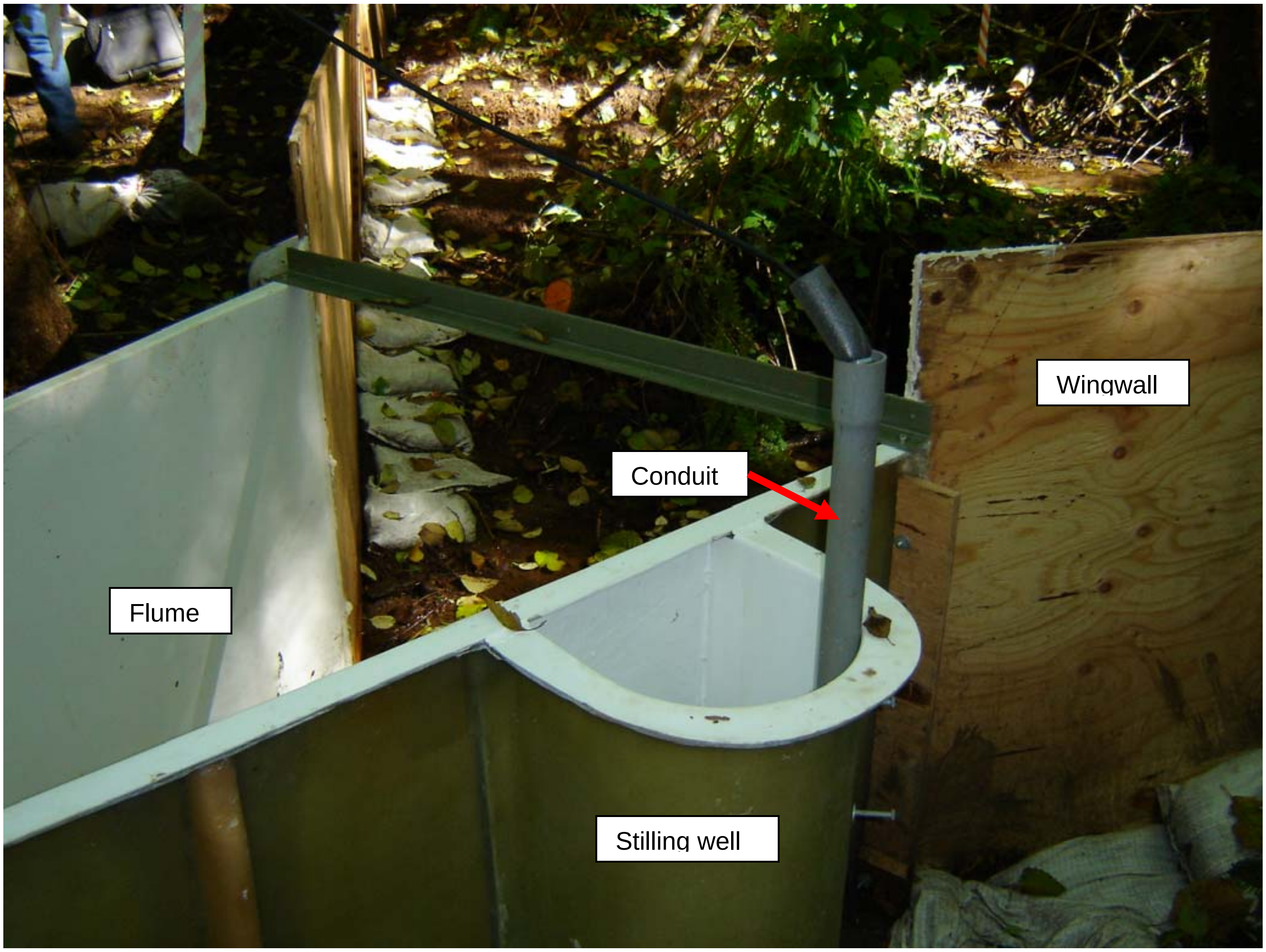

Figure 1. Pressure transducer and conduit in a Type N study stream. Cable ties secure the pressure transducer within the conduit. Holes drilled into the base of the conduit allow water exchange. Bolts secure the conduit to a stilling well and flume.

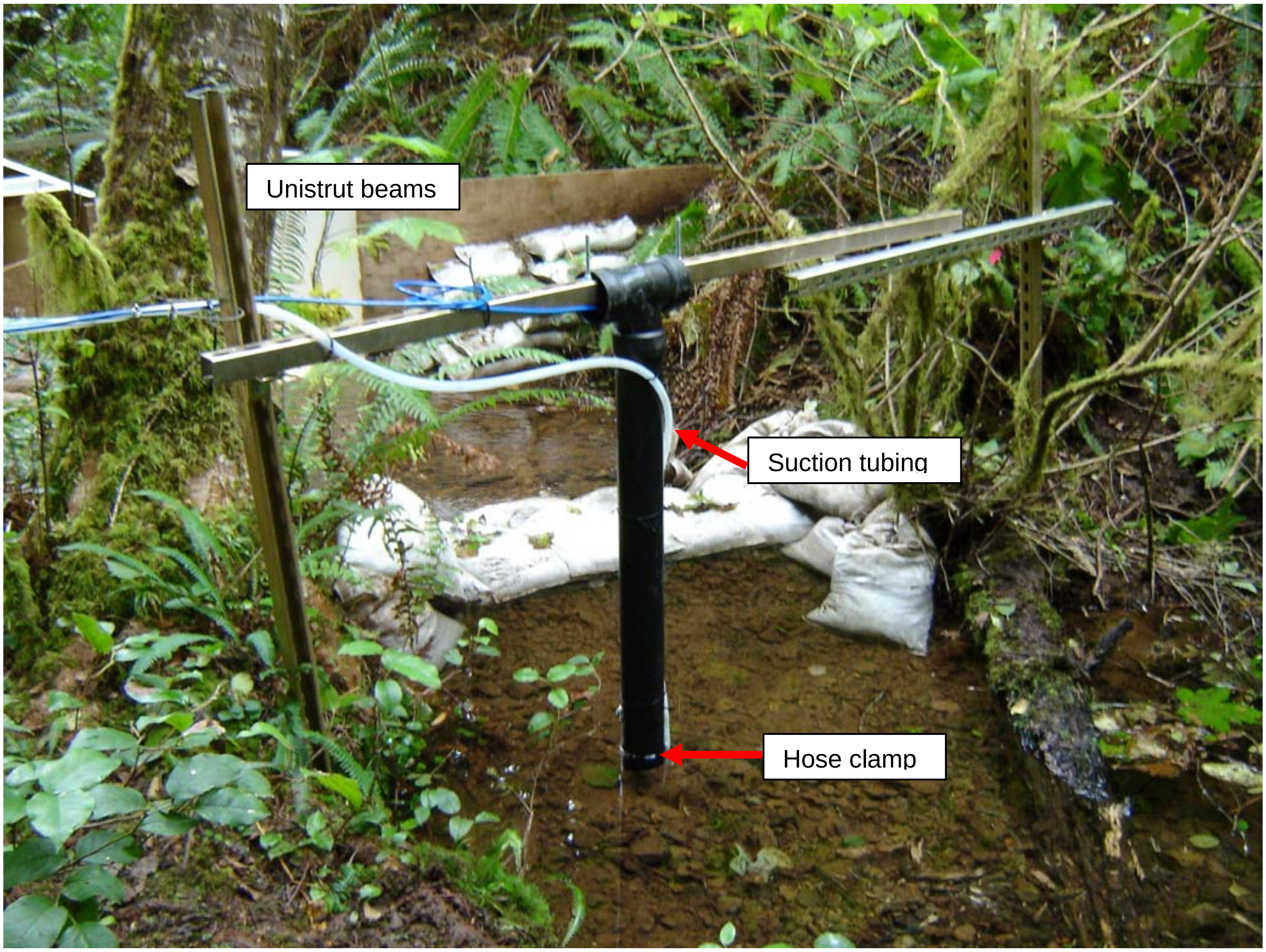

Figure 2. Turbidity sensor apparatus. The turbidity sensor is suspended inside the pipe and secured with hose clamps. The tee connector allows the pipe to move freely with the stream flow. Water is pumped from the stream through the suction tubing and into the pump sampler.

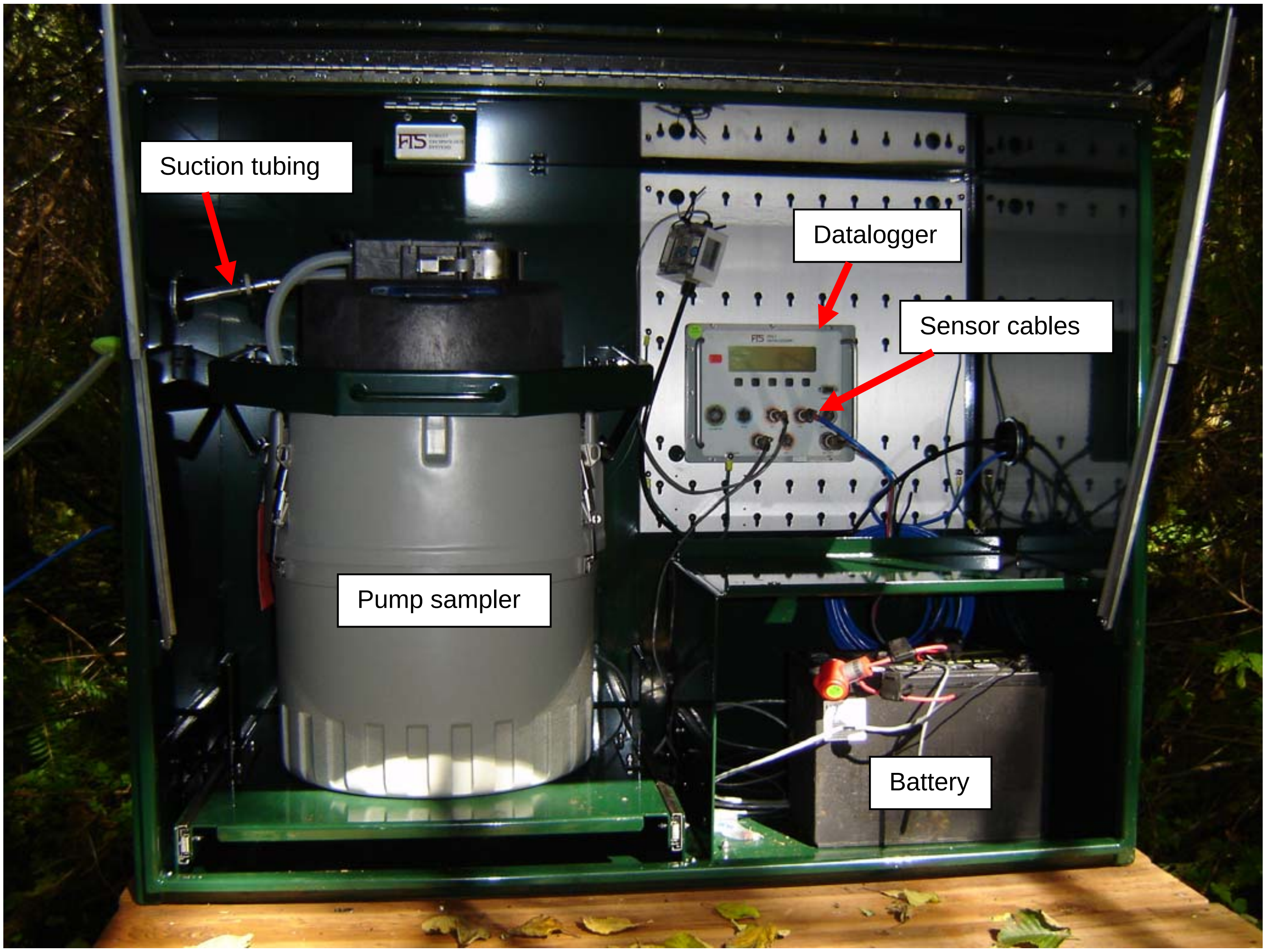

Figure 3. Datalogger and automatic pump sampler with attached components. The datalogger obtains stage height and turbidity readings from the pressure transducer and turbidity sensor at specified intervals. Readings above the specified flow and turbidity threshold trigger the automatic pump sampler to collect a water sample.

12.0 **Appendix A.** Lewis 1996