

Final June 1, 2023



Surface Water Field Sampling

Manual - Appendix II

for water quality parameters and flows



Photo Courtesy of Russ Gibson, Ohio EPA, DSW

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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 are maintained by the OEPA Division of Surface Water Modeling and Assessment Section Manager.

History	Effective Date
<p>Ohio EPA Surface Water Quality Sampling Manual version 9.0 Appendix II: for Water Quality Parameters and Flow Section F: Added Section F5.d to clarify use of sonde data for field measurement. Section G: Updated to include continuous temperature and water-detection loggers.</p>	June 1, 2023
<p>Ohio EPA Surface Water Quality Sampling Manual version 8.0 Appendix II: for Water Quality Parameters and Flow General: Formatting altered, table of contents updated, and acronyms table added. Typos fixed and clarifications added. Section A: Periphyton Sample Collection Sheet updated to latest format. Section C: Churn splitter cleaning procedure updated. Section D: Section D1 updated with latest sampling procedures.</p>	May 21, 2021
<p>Ohio EPA Surface Water Quality Sampling Manual version 7.0 Appendix II: for Water Quality Parameters and Flow Added Section G: Continuous Temperature Data Logger Deployment</p>	April 22, 2019

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Acronyms

Acronyms	
CO	Chain of Custody
CS	Churn Splitter
CWH	Cold Water Habitat
DES	Division of Environmental Services
DI	Deionized
DO	Dissolved Oxygen
DSW	Division of Surface Water
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
ORSANCO	Ohio River Valley Water Sanitation Commission
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QAR	Quality Assurance Record
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
TRE	Toxicity Reduction Evaluation
USGS	United States Geological Survey
WET	Whole Effluent Toxicity
WWTP	Wastewater Treatment Plant

Section A. Chlorophyll-a Sampling Procedure

A1. Sestonic Sampling

A1.a. Equipment List

<input type="checkbox"/> Sharpie	<input type="checkbox"/> Filter Tower
<input type="checkbox"/> Tweezers	<input type="checkbox"/> Flask with Tubing
<input type="checkbox"/> Paper Towels (large stack)	<input type="checkbox"/> Aluminum Foil (at least $\frac{1}{4}$ roll)
<input type="checkbox"/> GF/C Filters, 1.2 μ pore size (at least 25)	<input type="checkbox"/> Graduated Cylinder (100 mL)
<input type="checkbox"/> Plastic Bags (at least $\frac{1}{2}$ a box)	<input type="checkbox"/> DI H ₂ O in vacuum pump (bottle with spout)
<input type="checkbox"/> Rubber Bands (at least 20)	<input type="checkbox"/> 10% HCl in vacuum pump (bottle with spout)
<input type="checkbox"/> Hand Pump	

A1.b. Completing the Field Sheet

The following information should be recorded for each site: description of the site, sample collector(s), sample processor(s), the time of collection and the time of filtration of each sample. The comments area and/or the back of the field sheet can be used to write in depth observations, if needed.

A1.c. Equipment Cleaning

Care must be taken that all required equipment is properly cleaned prior to the preparation of equipment blanks and collection of samples. Clean with dilute HCl acid rinse all non-metal equipment. If possible, soap (non-phosphate) and tap water should be used on all equipment followed by a DI water rinse. In the field, where such cleaning is impossible, a generous DI water rinse will suffice and must be done before each site.

A1.d. Sestonic Equipment Blank

1. Pour DI water into the cleaned container that will be used to collect river water for filtration. Cap the container, if the lid will be used in the sample collection, and shake.
2. Assemble the filtration unit. Note that tweezers MUST be used whenever samples or filters are being handled to prevent contamination.
3. Measure out 100 mL of the DI water and run it through the filter.
4. Carefully fold the filter in half and wrap it in aluminum foil. Place the foil into a plastic bag with the appropriate Sample Master® label affixed to it. Wrap the bag up in an ice pack (or sandwich between two ice packs) with elastic bands and place it into the cooler.

A1.e. Collection of the Sample

The sample collector must first wade out to a representative portion of the stream or river being studied. Water should be collected upstream of the collector to prevent any contamination. Allow any disturbed sediment to settle prior to the collection of the sample to ensure that the water collected is indeed representative of the stretch.

A1.f. Filtering the Sample

1. Filtering should be performed in subdued light as soon as possible after sampling to avoid errors resulting from changes in the algal pigments in the sample after collection. If the water sample cannot be filtered immediately, it is to be stored on ice in darkness. Filtration is to occur within 6-8 hours of water sample collection.
2. Gloves should be worn during all parts of this procedure. Do not use the same pair of gloves as those used to acquire the sample in the river.
3. Measure out 100 mL of the collected water (or however much the sampler feels is necessary for the lab to detect Chlorophyll *a*, without too much water to prevent clogging the filter) and filter. As little as 60 mL can be enough for the lab, just be sure to document the amount filtered. Always use a pair of tweezers when handling the filters.
4. Pour the subsample into the filter tower/funnel of the filtration apparatus and apply a vacuum (remember not to exceed a pressure of 15 cm Hg). Rinse the sides of the filter tower/funnel with DI water. Do not draw the filter dry with the vacuum; instead slowly release the vacuum as the final volume approaches the level of the filter.). Filtration time should not exceed 10 minutes.
5. Carefully fold the filter in half and wrap it in aluminum foil.
6. Place the foil into a plastic bag with the appropriate Sample Master® label affixed to it. Wrap the bag up in an ice pack (or sandwich between two ice packs) with elastic bands and place it into the cooler. The filter may be kept on ice or sandwiched between two ice packs for up to 48 hours – as long the ice in the cooler is refreshed often to keep from thawing significantly. Freeze the sample immediately upon return to an Ohio EPA facility with a deep freeze, and before shipping to DES. Then send the filter to DES between two freezer packs. If DES cannot process the filter immediately upon receipt, DES will store the sample at - 20° C.

A2. Benthic Sampling

A2.a. Equipment List

- Sharpie
- Tweezers
- Paper Towels (large stack)
- GF/C Filters, 1.2 μ pore size (at least 25)
- Plastic Bags (at least $\frac{1}{2}$ a box)
- Rubber Bands (at least 20)
- Hand Pump
- Filter Tower
- Flask with Tubing
- Aluminum Foil (at least $\frac{1}{4}$ roll)
- Metal Tray (for collecting slurry)
- Circles (tops of Ortho-P syringes; at least 2)
- 3 Scrapers (Exacto knives with at least 3 extra blades)
- Scribe
- Brush
- Immersion Blender
- Stainless Steel Blending Cup
- Auto Pipette (with at least 25 plastic tips)
- Kim Wipes (at least $\frac{1}{2}$ large box)
- Graduated Cylinder (100 mL and 1,000 mL)
- Ruler
- DI H₂O in vacuum pump (at least 2, with at least 1 large bottle per box)
- 10% HCl in vacuum pump (1)
- Full 1 L screw top bottles of DI H₂O and 10% HCl (1 each in sealed gallon bag)
- Extension Cord

A2.b. Completing the Field Sheet

Ideally, data will be recorded on a “periphyton sample for chlorophyll-a field sheet” which is included in this document below. The following information should be recorded for each site: description of the site, sample collector(s), sample processor(s), the time of collection and the time of filtration of each sample. It is the responsibility of the sample collector(s) to measure and note the length of the stream reach sampled as well as stream flow and turbidity, sky, canopy, riparian and channel characteristics. The comments area and/or the back of the field sheet can be used to write in depth observations, if needed.

After processing the sample, the volume of filtered slurry must be recorded. Sum the volume of filtered slurry and the volume of slurry remaining in blending cup to determine the total volume of slurry processed. Record the total volume of slurry. Use a ruler to measure the minimum and maximum diameter of each scraped area. It is best to have the person who scraped the rock measure the area scraped. If the sampler who is measuring the scrape cannot delineate between the area that was scraped and area that was not scraped, the sampler should make a note on the

field sheet that the diameter of the 60 mL B-D syringe that is used as a pattern is used as the diameter of the scrape instead of direct measurements of the minimum and maximum diameters of the scrape. Calculate the average diameter of each individual scrape. Use the diameter to area conversion table (on field sheet) to determine the area of each individual scrape. Sum the areas of the individual scrapes to determine the total area scraped.

A2.c. Equipment Cleaning

Care must be taken that all required equipment is properly cleaned prior to the preparation of equipment blanks and collection of samples. Clean with dilute HCl acid rinse all non-metal equipment. If possible, soap (non-phosphate) and tap water should be used on all equipment followed by a DI water rinse. In the field, where such cleaning is impossible, clean all non-metal equipment with a dilute HCl acid rinse then generously rinse all equipment with DI water.

A2.d. Rock Scraping Equipment Blank

1. Pour DI water into one of the trays that will be used to collect the rock scrapings.
2. All instruments (or portions of instrument, i.e. not the handles) that will be used in the collection of the periphyton samples, such as knives, brushes, and stirrers, must contact this DI water so that the equipment blank will accurately reflect any potential for contamination. Then pour the water into the blending cup and allow the blender to come into contact with the water.
3. Assemble the filtration unit. Note that tweezers MUST be used whenever samples or filters are being handled to prevent contamination.
4. Use the pipette to collect 5 mL of the DI water in the tray. Run this sample through the filter. Note that each pipette tip can only be used with the preparation of one blank or one sample.
5. Carefully fold the filter in half and wrap it in aluminum foil. Place the foil into a plastic bag with the appropriate Sample Master® label affixed to it. Wrap the bag in an ice pack (or sandwich between two ice packs) with elastic bands and place it into the cooler.

A2.e. Collecting the Rocks

A2.e.i. Time of Day for Collection.

To afford the greatest opportunity for light penetration into the benthic zone, rocks should be collected between 1000 and 1800 hrs, inclusive¹. Some excursions (about 0.5 hr) from this time window can be tolerated due to workload and staff resources. It is critical that notes on light penetration to the substrate should be recorded for each site. Factors such as canopy cover, topographic shade, cloudiness, presence of surface scum, and water column turbidity (caused by both suspended sediment and seston) should be described accurately. The transparency of the water column is inversely affected by both color and turbidity.

¹ Chlorophyll-*a* production from algal biomass will stabilize after a certain amount of light incidence occurs of the course of the day (Matheson et al. 2012, p. 1627). Whether this saturating amount is achieved in a given sampling event depends on the time of day, season of year, and the stream conditions identified above. Sampling within the 1000-1800 hr time window affords the best opportunity to achieve light saturation.

A2.e.ii. Representative Reach and Minimum Number of Rocks to be Collected.

A target of 15 rocks is sought and collected from a representative length of stream. The goal is to collect rocks at a sample length that is representative of the site (reach) and at a minimum of 100 m sampling length.

1. Sample anywhere rock substrate is available with a target to sample various hydrological flow structures (i.e. riffle, run, pool, and glide)².
2. When rock substrate is not as prevalent, such as at sites that experience heavy sedimentation or have natural bedrock slabs, the target rock count may not be realized. In these situations, less than 15 rocks may be collected. However, an effort to sample the equivalent area should be made (i.e., scrape 15 or nearly 15 circles from the rocks which are collected). Document the uniqueness of the situation in the Periphyton Sampling Field Sheet and, most importantly, in the “Field Comments” section of the DES laboratory submission sheet [form EPA 4709 (1/10)]. While atypical, this type of sampling approach should be undertaken to understand the trophic status of the sampling reach (site).
3. If less than 15 rocks are collected and they are sampled from non-representative areas of the stream (e.g., only 4 rocks were collected, and all were sampled from the edge of water), then the benthic algae analysis should be discontinued. Document the uniqueness of the situation in the Periphyton Sampling Field Sheet and/or field reconnaissance sheet.

A2.e.iii. How to collect.

The collection procedure involves wading to a given portion of the site, reaching down, and selecting a representative rock to be sampled. A gentle swirling of the rock in the water will help to remove any sediment that has settled on the surface and dislodge macroinvertebrates. Also, gently brushing the underside of the rock by hand will help to dislodge caddisfly cases. Rocks selected should clearly show signs of having been undisturbed; such rocks have a distinct bi-colored appearance due to algae growing only on the exposed surface. If two or more samplers participate in the collection, disturbance of downstream sampling sites should be avoided or minimized. One sampling method that minimizes disturbance by two samplers is to align a sampler on each edge of water and progress upstream in a zig-zag pattern, with each sampler responsible for one-half of the stream width. It should be noted that the portion of the stream closest to the edge tends to be grazed and have less algae. Typically, a green swath can be seen nearer the middle of the stream. Rocks should be collected from that greener area as that is more representative of the stream segments productivity. Rocks in the clearer areas along the edges should be avoided, as well as any rocks that are not submerged.

² Sampling different microhabitats allows for collection of a large number of co-existing species (Wetzel 2001, pp. 594-599). In streams with moderate to high enrichment, runs typically produce the highest biomass because the lower velocities (compared to riffles) prevent sloughing of periphyton (Biggs and Kilroy 2002, p. 28). In streams with moderate to low enrichment, riffles produce the highest biomass because higher mass (nutrient) transfer occurs in higher velocity areas (also p. 28).

A2.e.iv. Number of Days Following a Storm (runoff) Event Before Collection.

High streamflow velocity and corresponding particle movement has great potential in scouring benthic algae. Community composition tends to change as flow velocity changes (Biggs 2000). For example, filamentous forms dominate at low velocity (< 1.6 m/s) whereas mucilaginous mats dominate at high velocity (> 3 fps).

1. Following a moderate to low storm event, sampling is typically scheduled in the following week. Benthic surveys usually begin on Tuesday of a given week and in association with a dissolved oxygen survey using multi-parameter sensor devices. Hence, if a moderate to low storm event occurred anytime in the preceding week (up to the Saturday evening prior), the survey would not be cancelled. For moderate to high storm events, benthic sampling for the following week should be postponed one week or longer and scheduled when flows return to normal (specific to the time of year) during the interim week (or weeks).
2. Flow hydrographs should be monitored from US Geological Survey gauges at or near a given site with attention paid to existing flow versus (long-term) normal flow. Flow conditions for benthic sampling are considered ideal if existing flow has been at base level for 10 or more days without interruption by a moderate or high storm event.
3. When a study watershed is prone to frequent high flow events, sample as late after the previous high flow event as is sensibly possible (Biggs and Stokseth 1996).

A2.e.v. Time Between Collection and Scraping.

After collection, the rocks should be stored in a shaded area, and submerged in ample stream water to mitigate temperature changes. The rocks can be transported to the scraping location with these precautions taken. The rocks should be processed at a location that is less than 30 minutes of total transport time from the collection area.

A2.f. Scraping the Rocks

1. When deciding what area on the rock to scrape, bear in mind that the goal is to acquire a representative sample of the algal growth on the rock wherever such growth is possible. As such, avoid areas on the rock where the rock was buried and areas where the growth is extreme. Choosing an area to scrape that is near an edge of the rock is recommended to limit how much material may get stuck on other parts of the rock, as well as material from other parts of the rock that could get into the final sample. And again, keep in mind that the time between collecting and scraping rocks should be minimized.
2. The most important aspect of the procedure is making sure that the area scraped is known. Therefore, the collector should inscribe a circular boundary onto the surface of the rock. Care must be taken to make sure that any material removed from the rock by the process is collected into the pan.
3. If large plant fibers are present within the sample site, collect these first. Use best professional judgment to decide which portions of the algae belong within the sample area and which are outside the boundary. Large fibers should be diced up within the pan as much as possible.
4. Use a knife (flat edge knife best at this phase) and brush to remove material from the area being sampled. All such material should be collected in the pan used to prepare the blank. A squirt bottle filled with DI water is often useful here, especially when removing algal material from the brushes.

5. Use care when rinsing the cleaned sample surface with the squirt bottle to avoid contaminating the sample with material outside the boundary. If the surrounding surface is covered with loose sediment, such a rinse may prove impossible.
6. Use best professional judgment to determine when a given rock sample has been sufficiently scraped.
7. Measure and record the diameter of the area scraped. If this region ends up exceeding the original bounds, make several “diameter” measurements and average.

A2.g. Filtering the Sample and Duplicate Sample

1. Filtering should be performed in subdued light as soon as possible after sampling to avoid errors resulting from changes in the algal pigments in the sample after collection. If the water sample cannot be filtered immediately, it is to be stored on ice in darkness. Filtration is to occur within 24 hours of water sample collection.
2. Transfer all material collected in the pan into a blending container. Use the spray bottle to rinse the pan into the container to make sure that nothing is left behind.
3. Use an immersion blender to thoroughly mix the sample and prevent sediment from settling to the bottom.
4. Use the pipette to acquire a 5 mL (or however much the sampler feels is necessary for the lab to detect Chlorophyll *a*, without too much water to prevent clogging the filter) aliquot of the sample from the blending cup. Continue to mix the sample while using the pipette.
5. Filter the aliquot, rinse the sides and inside of the pipette then rinse the sides of the filtering funnel if necessary. Carefully fold the filter in half and wrap it in aluminum foil. Always use tweezers when handling the filters.
6. NOTE: If making a duplicate repeat steps 4 and 5 and submit as a separate filter.
7. Place the foil into a plastic baggie with the appropriate Sample Master® label affixed to it. Wrap this baggie up in an ice pack (or sandwich between two ice packs) with elastic bands and place it into the cooler. The filter may be kept on ice or sandwiched between two ice packs for up to 48 hours – as long the ice in the cooler is refreshed often to keep from thawing significantly. Freeze the sample immediately upon return to an Ohio EPA facility with a deep freeze, and before shipping to DES. Then send the filter to DES between two freezer packs. If DES cannot process the filter immediately upon receipt, the sample will be stored at - 20° C.
8. Measure the total volume of scrapings collected and record. Remember to account for the volume of filtered sample.

A3. Sample Storage, Labeling, and DES

The wrapped filters must be kept on ice until their release to DES. The water column filters and the rock scraping filters should be stored as two distinct groups as described above. The container used to hold them could be as simple as a zip-lock bag as long as it is, or can be made, waterproof. If zip lock bags are used, double bagging is recommended to ensure water proofing.

References Cited

Biggs, B.J.F. (2000). Eutrophication of streams and rivers: Dissolved nutrient-chlorophyll relationships for periphyton. *Journal of North American Benthological Society*, 19, 17–31.

Biggs, B.J.F. & Kilroy, C. (2002). *Stream Periphyton Monitoring Manual*. Hamilton, New Zealand: National Institute of Water & Atmospheric Research.

Biggs, B.J.F. & Stokseth, S. (1996). Hydraulic habitat preferences for periphyton in rivers. *Regulated Rivers: Research and Management*, 12, 251-261.

Matheson, F.E., Quinn HM, & Martin ML. (2012). Effects of irradiance on diel and seasonal patterns of nutrient uptake by stream periphyton. *Freshwater Biology*, 57, 1617-1630.

Wetzel, R. (2001). *Limnology: Lake and River Ecosystems* (3rd ed.). San Diego CA: Academic Press.

Chlorophyll-*a* Sample Submission Form

Sample Submission

Name/District/Division:

Date: _____

One sheet can be used for each batch of samples submitted to the lab regardless of when they were collected. Use the sheet for both water and rock scrape samples. Fill out the appropriate spaces for that particular sample you are collecting. Duplicate filters should be noted in the location. Field blanks should be labeled as such. Field blank should be submitted every 10 samples.

****REMINDER**** - All filters should be filtered in the field, placed in foil, labeled and frozen.

Field Comments:

Periphyton Sample for Chlorophyll-a Field Sheet

Station ID _____

Date _____

Site # _____

Site Name _____

Collected by _____

River Mile _____

Scraped by _____

Composite Number of Rocks _____

Filtered by _____

Total Area Scraped _____ cm²

Diameter of individual scrape	Area of individual scrape
1 (____ + ____)/2 = _____	1 _____
2 (____ + ____)/2 = _____	2 _____
3 (____ + ____)/2 = _____	3 _____
4 (____ + ____)/2 = _____	4 _____
5 (____ + ____)/2 = _____	5 _____
6 (____ + ____)/2 = _____	6 _____
7 (____ + ____)/2 = _____	7 _____
8 (____ + ____)/2 = _____	8 _____
9 (____ + ____)/2 = _____	9 _____
10 (____ + ____)/2 = _____	10 _____
11 (____ + ____)/2 = _____	11 _____
12 (____ + ____)/2 = _____	12 _____
13 (____ + ____)/2 = _____	13 _____
14 (____ + ____)/2 = _____	14 _____
15 (____ + ____)/2 = _____	15 _____
16 (____ + ____)/2 = _____	16 _____
17 (____ + ____)/2 = _____	17 _____
18 (____ + ____)/2 = _____	18 _____
19 (____ + ____)/2 = _____	19 _____
20 (____ + ____)/2 = _____	20 _____

Total _____

Diameter to Area Conversion

Diameter (cm)	Area (cm ²)
2.3	4.155
2.35	4.337
2.4	4.524
2.45	4.714
2.5	4.909
2.55	5.107
2.6	5.309
2.65	5.515
2.7	5.726
2.75	5.940
2.8	6.158
2.85	6.379
2.9	6.605
2.95	6.835
3.0	7.069
3.05	7.306
3.1	7.548
3.15	7.793
3.2	8.042

Comments:

How well does sample represent bed algae?

Total Slurry Volume _____ mL

Sample Number

____	Rock	Vol. _____ mL	Collected/Filtered
____	Duplicate	Vol. _____ mL	Time _____
____	Blank	Vol. _____ mL	Time _____

Collected/Filtered

Visual Estimates - Aerial Coverage

Stream bed algae: _____ %

Sampleable substrate: _____ %

Observer Initials: _____

Length of reach sampled _____ ft / yd / m

Lab Result Estimate _____ Observer Initials _____

(Make after picking rock /prior to scraping)

O High >250 mg/m² O Med 50-250 O Low <50

Flow: None Low Normal Elevated High

Turbidity: Clear Low Moderate* High*

*Explain _____

Sky: Overcast M. Cloudy P. Cloudy M. Clear Clear

Canopy*: Open 25% Closed 50% Closed 75% Closed Closed

Channel*: _____ % Riffle _____ % Run _____ % Glide _____ % Pool

* Describe stream reach where rocks were collected.

Rock sample not collected. Check all that apply:

Not enough samplable substrate

Streamflow too high Other: _____

Time of observation: _____

Section B. Critical Cleaning Procedure for Orthophosphate Sampling Syringes*

B1. Critical Cleaning Procedure for Ortho-P Syringes:

1. Fill a warm water bath with enough water to cover a batch of syringes.
2. Add "Liqui-Nox" (or other **non-Phosphorous** detergent) per directions on package.
3. Pull plungers out of syringes and add both to bath.
4. Use small brush to scrub out the inside of all syringes, 5-10 sec apiece. Suck up detergent solution with syringes and squirt out.
5. Rinse once with DI water (or out-of-date nanopure) to remove detergent.
6. Rinse inside of syringes 1x thoroughly with squirt bottle of 10% HCl.
7. Triple rinse with DI.
8. Lay on clean drying rack and cover with clean paper towels until dry.
9. After about one day place the clean, dried syringes in labeled Ziploc gallon bags.

Clean and re-use up to a maximum of **three** times.

*DO NOT USE THIS PROCEDURE WHEN DOING LOW-LEVEL ORTHO-PHOSPHORUS TESTING OR WHEN DOING DISSOLVED ORGANIC CARBON TESTING – ONLY NEW, CLEAN SYRINGES SHALL BE USED WHEN COLLECTING SAMPLES FOR THOSE TESTS.

Section C. Churn Splitter Sampling and Maintenance

Purpose: As part of DSW's commitment to Quality Control (QC) sampling, we are sampling all duplicate samples with churn splitters to assure uniformity of the duplicate sample water. This procedure is designed to help DSW staff uniformly use this sampling equipment. A reference for this procedure is the USGS National Field Manual for the Collection of Water-Quality Data Chapter A5. Processing of water samples Techniques of Water-Resources Investigations(https://pubs.usgs.gov/twri/twri9a5/twri9a5_chap5_2-2009.pdf).

Summary: This procedure details the steps for DSW staff to consistently use, clean and maintain churn splitters for duplicate sampling. The churn splitters may also be used to integrate samples from different lake depths. This procedure is easiest to implement with two people.



C1. Sampling Procedure

1. Choose the appropriate churn splitter (CS) for the total sample volume required. The 14-liter CS has a useable volume of about 12 liters. The 8-liter CS has a useable volume of about 6 liters.
2. Using a clean bucket that has been rinsed with site water, add 2 to 4 liters of site sample water to the churn splitter and swirl the water around (also raising/lowering the churn paddle in the rinse water), thoroughly rinsing the inside. Empty some of the water out through the spigot to rinse that also. Extra water can be poured out at the end.

Note: The CS may be equipped with push button or turn valve spigots. The turn valves are not very sturdy and should be operated carefully to extend their lifetime.

3. Fill the churn splitter with sample water using the same bucket, swirling out any sediment in the bucket each time more is added to the CS. Each succeeding fill of the bucket can help collect any remaining sediment from the previous fill. Fill to a couple inches of the top of the tank. This is the maximum height the churn goes during churning. This leaves about 2 liters of head space, which is needed to properly mix the sample and avoid spillage.
4. Place the lid over the stirrer. For two-person operation, the stirring can be continuous. One person can hold down the lid and operate the churn while the other can operate the valve and fill the containers. The sample should be stirred at a uniform rate of approximately 9 inches vertical change per second by raising and lowering the churn paddle, touching the bottom and then reaching the water surface with every stroke. Stir the sample for about 10 complete cycles before withdrawing samples through the spigot. For one-person operation, care must be taken not to displace the lid by over lifting the churn. The rate of churning and the number of churning before sampling should still be achieved.
5. Withdraw the largest volume samples first, always operating the valve spigot in the full open position. Churning must be continuous during sample withdrawal. If sampling is interrupted, you must again stir the sample for about 10 complete cycles before resuming sample withdrawal. As samples are withdrawn, and the volume in the CS decreases, the round-trip frequency with the churn paddle should increase to compensate. Once you go below the recommended useable capacity, the churning becomes less efficient and excessive air is introduced to the sample. This is undesirable and may change characteristics of the sample water.
6. After all the water down to the level of the spigot has been withdrawn, the remaining water may be used for filtered samples only. It is recommended to allow any sediment to settle out for a few minutes prior to processing the filtered subsamples.
7. If the CS must be used a second time prior to following the complete cleaning procedure below, it should be thoroughly rinsed with site water. Slosh site water around the interior to loosen any remaining debris, let water pass through the valve spigot, then dump out of the top. Repeat if there is any visible debris.

C2. Cleaning Procedure

1. Wash all churn splitter parts with warm tap water and laboratory grade non-phosphate detergent (0.1-0.2% solution). Scrub with a soft brush or sponge to avoid damage and pass some of the solution through the spigot. Rinse well with tap water, passing some through the spigot.
2. Rinse well with de-ionized water, passing some through the spigot.
3. Dry and store CS in plastic bags.

Section D. Sampling Method for Documentation of a Public Health Nuisance

Sampling Methods for Documentation of a Public Health Nuisance under OAC Rule 3745-1-04 (F) & (G)

Introduction

Ohio law (section 6117.34 of the Ohio Revised Code) provides a mechanism for local jurisdictions to initiate complaints of unsanitary conditions and for the Director of Ohio EPA to issue orders to correct the problems. Bacterial counts are a primary means used to document unsanitary conditions in lakes, rivers, and streams. Bacteriological standards are the safe levels of bacteria (fecal coliform and E. coli) associated with the recreational use designations (bathing waters, primary contact recreation and secondary contact recreation) of lakes rivers and streams. The bacteriological standards are in Chapter 3745-1 of the Ohio Administrative Code (OAC). After a court case established that the bacteriological criteria associated with recreational uses do not apply to small streams or water bodies that are unlisted in the water quality standard rules the Agency adopted changes in OAC rule 3745-1-04. A subsequent rulemaking occurred in March 2010 that designated all surface waters of the state primary contact recreation waters - unless otherwise designated as bathing waters or secondary contact recreation. Using these standards and the sampling protocols in this guidance Ohio EPA and local health departments can investigate incidents of raw or poorly treated sewage in small streams, roadside ditches or similar water bodies that meet the definition of surface waters of the state [OAC rules 3745-1-02(B)(83)] and take appropriate actions to alleviate public health nuisances.

D1. General Bacteria Sample Collection Procedures

Samples are to be collected directly into a sterilized glass or polypropylene (or other autoclavable plastic) bottle. Samples should be collected by hand according to the following procedure:

Sampler must stand downstream of collection bottle, and sample "into the current." Avoid contamination by surface films or debris by opening the container under water. This is accomplished by holding the container near the base with one hand and removing the cap with the other hand. The container is quickly pushed into the water to a depth of about six inches with the mouth of the collection container down. The mouth of the bottle is then tilted upward into the current and allowed to fill. If there is no current, move the container through the water in a continuous and unbroken movement. Bottles should be filled to between 2/3 and 3/4 full. Add sodium thiosulfate crystals or 0.1 ml of a 10 percent sodium thiosulfate solution to the sample if residual chlorine is suspected.

For safety reasons, it may be impossible to collect a bacteria sample directly into the sterile container. If samples must be collected remotely, a clean bucket may be used to collect the sample and then the sample transferred to the sterile container by pouring the contents of the bucket into the sample container and taking great care to avoid backsplash from the surface upon which the container is placed.

Note: Special sampling considerations if intending to document a public health nuisance associated with raw or poorly treated sewage pursuant to OAC rule 3745-1-04 (F) & (G): Samples must be conducted by, or under the supervision of, Ohio EPA or a sanitarian registered under Chapter 4736 of the Ohio Revised Code:

D1.a. Sample Location

The bacteria sample shall be collected in "surface waters of the state" as defined in OAC rule 3745-1-02(B)(83), and where odor, plus color and/or visual manifestations of raw or poorly treated sewage occur, as defined in Section 1.5.

Bacteria samples also may be collected at a control location outside the influence of the sewage discharge to determine background levels of bacteria in the surface water being tested.

D1.b. Sampling Time and Frequency

Bacteria samples may be collected year-round, but only when the surface water is at a flow that is representative of dry weather, “baseflow”, conditions as defined in Section 1.4. A minimum of two bacteria samples must be collected over a time period not to exceed thirty days. Bacteria samples may be collected at any time of day at least two hours apart. It is recommended but not required, that at least two bacteria samples be collected on the same day within the thirty-day period, because it is difficult to predict when baseflow conditions will change rapidly.

D1.c. Preservation and Chain of Custody

The sample shall be cooled to 6 degrees Celsius and delivered to the laboratory for analysis within 6 hours. According to 40 CFR 136.3, Table II, the time from sample collection to the time the laboratory begins analysis of the sample is 8 hours. Make arrangements with the laboratory if transport time will exceed 6 hours to ensure that the 8-hour ultimate holding time is not exceeded. A Chain of Custody (COC) form must be used for the transfer of samples to the testing laboratory in order to get samples into evidence in a legal proceeding.

D1.d. Documentation of Baseflow or Dry-weather Flow

OAC Rule 3745-1-04(G)(1) requires that bacteria samples be collected only when the flow and height of the surface water is not rapidly changing in response to rainfall or snow melt. This dry-weather flow condition is called *baseflow* and is defined as “water that sustains stream flow during rainless periods.” (T. Dunne and L.B. Leopold, 1978, *Water in Environmental Planning*, W.H. Freeman and Company). *Baseflow* levels in a stream can change over time due to antecedent rainfall and saturated soil conditions.

Before collecting bacteria samples, document that the surface water being tested is at baseflow. For the purposes of OAC rule 3745-1-04(G)(1) a baseflow condition will be present if and only if all three of the following field observations are met: (1) the channel water stage is less than bankfull, and (2) muddy-brown turbidity from runoff of silt/clay is not present, and (3) there is no visual evidence of runoff from wet pavement or snowmelt in the upstream vicinity of where the bacteria sample is collected.

For the purposes of OAC rule 3745-1-04(G)(1) the ‘stage’ of the water is defined as the elevation of the water in the stream channel. And “bankfull flow” occurs when the channel is completely full and the stream stage is level with the floodplain (Dunne and Leopold, 1978). Observations on baseflow conditions may be recorded on the Public Health Nuisance Field Form provided in Section D3.

If available, USGS real-time flow hydrograph data and/or rainfall data from the National Weather Service or other local sources can be used to further document that baseflow conditions were present at the time of the sample. The Ohio River Valley Water Sanitation Commission (ORSANCO) uses a “dry-weather” rainfall criterion of 72 hours antecedent dry period, and a “wet-weather” criteria of 48-hour antecedent dry period plus at least 0.3 inches of precipitation in a six-hour period. Measurements on stage height to the nearest (cm) may be taken to document that the flow did not change rapidly between the two required bacteria samples. These additional data are not required in order to document baseflow conditions at the time of sampling.

D2. Documentation of Odor, Plus Color, and/or Other Visual Manifestations of Raw or Poorly Treated Sewage.

To document a public health nuisance under OAC rule 3745-1-04(F)(1) bacteria samples should be collected only when there is evidence of odor, plus color, and/or other visual manifestations of raw or poorly treated sewage. For purposes of meeting the requirements of this rule, the following explanations of odor, color, and other visual manifestations of raw or poorly treated sewage are provided as guidelines for staff to use in the field.

D2.a. Odor

A fully acceptable system for characterizing odor has not been developed. Jain, et al (1977, Environmental Impact Analysis, Van Nostrand Reinhold Company, pp. 195-200) state that the contaminant odor of septic sewage a commonly accepted odor descriptor type known as “rotten egg”, which results from the high amount of organic matter and sulfide compounds present. In addition, failing sewage systems often have a unique septic odor that combines with the rotten egg smell. Health effects from odors include reducing appetite, producing nausea, causing headaches, and disturbance of sleep, breathing, and olfactory sensation (Jain, et al. 1977).

For each odor contaminant, a concentration can be defined for which there can be no human perception of the odor, generally known as the odor threshold. Odor intensity levels can be measured by the following scale following Jain, et al. (1977):

<u>Levels</u>	<u>Descriptors</u>
0	No odor
1	Odor threshold (very slight)
2	Slight odor
3	Moderate odor
4	Strong odor

An environment with no odor at all is considered to be an ideal air environment. The “odor threshold” represents a tolerable level, and a gradient of impairment of the air environment is found from the sequence of slight to moderate to strong odor levels.

A violation of OAC rule 3745-1-04(F)(1) will exist if septic sewage odors are found at levels greater than or equal to a slight odor level (level 2) as perceived by the investigator at the time of sampling. Observations on odor may be recorded on the Public Health Nuisance Field Form provided after Section D3.

D2.b. Color

Apparent color means the color of water that includes substances in solution and color due to suspended matter. Raw or poorly treated sewage contains a mixture of carbon-based organic matter, sulfide compounds, oils and greases, and other compounds that may create a nuisance in surface waters. The colors imparted by raw or poorly treated sewage may range from white to black with various shades of grey within the spectrum. In addition to the imparted color a characteristic rainbow sheen may or may not be present as a result of oils refracting ambient light.

Brown-orange-yellow colored water would be expected in water that contained silts and/or clays, diatoms, humic and/or tannic acids, and/or elemental iron from acid mine drainage. Observations on the type of *apparent color*

present in the surface water at the time of sampling may be recorded on the Public Health Nuisance Field Form provided in Section 1.6.1.

D2.c. Other Visual Manifestations of Raw or Poorly Treated Sewage

OAC rule 3745-1-04(F)(1) indicates that a public nuisance may exist if visual manifestations of raw or poorly treated sewage other than color are also present in the surface water. OAC rule 3745-1-04 (A), (B), & (E) define other visual types of evidence of sewage as including: sewage sludge particles in the water, sewage sludge deposits in bottom sediments, floating oils and scums, and nuisance growths of aquatic weeds and algae from nutrient enrichment. A nuisance also may be caused by the growth of "sewage fungus", which is defined as a slimy matrix of bacteria, fungi, and protozoa associated with sewage. Bacteria including, among others, the *Sphaerotilus-Leptothrix* group, are associated with the "sewage fungus" matrix. These bacteria can form extensive cotton-wool-like plumes (white, grey, or brown) of filamentous mats in areas of organic pollution and are aesthetically undesirable (Curtis, E.J.C., 1969 *Sewage Fungus: Its Nature and Effects*, in Water Research, Vol. 3, pp. 29-311, Pergamon Press). Observations on visual manifestations of problems other than color may be recorded on the Public Health Nuisance Field Form provided in Section 1.6.1.

D3. Public Health Nuisance Field Form

As a standard operating practice, Ohio EPA field personnel should utilize the Public Health Nuisance Field Form below when collecting samples pursuant to OAC rule 3745-1-04 (F) & (G). Local Health Departments and other sanitarians registered under OAC Chapter 4736 may use the form at their discretion because the form is not required by the rule.

Public Health Nuisance Field Form, OAC Rule 3745-1-04(F)&(G)

Description of Event Location _____

Latitude: _____ County _____

Longitude: _____ Township _____

Agency _____

I certify that bacteria samples were collected at times when the surface water being tested met the odor, plus color and/or other visual manifestation of raw or poorly treated sewage requirement of OAC rule 1-04(F)&(G).

Printed Name of Sample Collector

Title _____

Signature of Sample Collector

Date _____

Bacteria Sample # _____

Location of Sample _____

Bacteria Sample # _____

Location of Sample _____

Date of Sample _____

Date of Sample _____

Time of Sample _____ AM _____

Time of Sample _____ AM _____

PM _____

PM _____

Baseflow Documentation:

Stage less than bank full _____ yes _____ no

Muddy-brown turbidity absent _____ yes _____ no

Pavement/ snow melt runoff absent _____ yes _____ no

Baseflow Documentation:

Stage less than bank full _____ yes _____ no

Muddy-brown turbidity absent _____ yes _____ no

Pavement/ snow melt runoff absent _____ yes _____ no

[All three baseflow conditions must be met (yes) before a bacteria sample can be collected]

Odor Documentation:

_____ No odor, level (0)

_____ Odor Threshold (very slight), level (1)

_____ Slight Odor, level (2)

_____ Moderate Odor, level (3)

_____ Strong Odor, level (4)

Odor Documentation:

_____ No odor, level (0)

_____ Odor Threshold (very slight), level (1)

_____ Slight Odor, level (2)

_____ Moderate Odor, level (3)

_____ Strong Odor, level (4)

[An odor level of 2 or greater must be met before a bacteria sample can be collected]

Visual Documentation: (check all that apply)

Color Documentation:

[non sewage colors]

_____ clear, no color

_____ brown-yellow-orange

_____ muddy-brown

[sewage colors]

_____ white

_____ gray

_____ black

Visual Documentation: (check all that apply)

Color Documentation:

[non sewage colors]

_____ clear, no color

_____ brown-yellow-orange

_____ muddy-brown

[sewage colors]

_____ white

_____ gray

_____ black

Other Visual Manifestations:

_____ oily sheen

_____ floating scums

_____ suspended sludge

_____ sludge deposits

_____ aquatic plants

_____ sewage fungus

_____ algae

_____ other*

_____ aquatic plants

_____ sewage fungus

_____ algae

_____ other*

[At least one sewage color and/or other visual manifestation of sewage must be met before a bacteria sample can be collected. Check all the above that are present at the time of sampling.]

Additional field notes, as needed, should be written on the reverse side of this form.

Section E. Compliance and Whole Effluent Toxicity Sampling

Specific objectives of the compliance and whole effluent toxicity (bioassay) sampling conducted of regulated entities typically include the following:

- Verify accuracy of reports and program self-monitoring.
- Support permit development reissuance and/or revision and compliance evaluation inspections.
- Determine the quantity and quality of effluent.

Sampling, analysis, preservation techniques, sample holding times, and sample container requirements are provided in Section E of the Surface Water Field Sampling Manual.

E1. Effluent Sample Collection

E1.a. Sample Types

Two types of sample techniques are used by Ohio EPA: grab and composite. The type of samples taken should be consistent with those required in the NPDES permit to the extent possible.

Grab Samples: The collection of a grab sample is appropriate when a sample is needed to:

- Represent an effluent that does not discharge on a continuous basis.
- Provide information about instantaneous concentrations of pollutants at a specific time.
- Sample effluent that is not expected to vary over the 24-hour period (e.g. settling basin discharge).
- Corroborate composite samples.
- Monitor parameters not amenable to compositing (e.g., pH, temperature, dissolved oxygen, chlorine, purgeable organics, oil and grease, *E.coli*, and others specified by the NPDES permit, which may include phenols, sulfites, cyanide, and hexavalent chromium).

Composite Samples: Composite samples are collected when:

- Average pollutant concentration during the compositing period is desired.
- Mass per unit time loadings are calculated.
- Wastewater characteristics are highly variable.

DSW staff should consider variability in waste stream flow rate, parameter concentrations and the approved EPA methods when choosing compositing methods, sampling equipment (tubing and containers), and quality assurance procedures.

E1.b. General Guidelines

The following general guidelines apply when taking samples:

- Take samples at a location specified in the NPDES permit and/or at a location selected to yield a representative sample. Occasionally, municipal plant permits may specify sampling prior to chlorination. For these plants, monitor all parameters at the pre-chlorinated location except E. coli, pH, and total residual chlorine.
- Use the sampling method (grab or composite) specified in the permit. Some parameters that must be collected as an individual grab sample are dissolved oxygen, oil and grease, E. coli, purgeable organics, sulfides, cyanide, and total phenols.
- Avoid collecting large nonhomogeneous particles and objects.
- Collect the sample holding the container with the opening facing upstream into the flow to avoid contamination.
- Collect sufficient volume to allow for quality assurance testing (see Tables E-1 and E-2 in the Surface Water Field Sampling Manual)
- When sampling for compliance purposes only (no WET sampling), test schedules should be chosen based on the size and type of facility.
- Oil and grease samples should be collected in a quiescent location and should be collected from near the water surface.

The following general guidelines apply when using automatic samplers:

- Collect samples where the wastewater is well mixed. Collect the sample near the center of the flow channel at mid-depth.
- Obtain a sufficient volume of sample to perform all required analyses plus any additional amount for quality control. Individual portions of a composite sample should be at least 100 milliliters to minimize sampler solids bias. Generally, samplers should be set to collect at least 24 aliquots (1/hr) and volume for each can be calculated based on total volume needed and the capacity of each jar. Where effluent is highly variable or the study plan objectives indicate the need, more aliquots may be collected.
- Since the aliquot volume is influenced by how and where the sample intake screen is set at each individual site, the aliquot volume should be checked and verified and adjusted if necessary, prior to starting the sampler program.
- The sampler should be filled with ice around the sample bottle to maintain the collected sample at 6°C.
- For automatic samplers that use a peristaltic pump, obtain adequate flow rates in the sampler tubing to effectively transport the suspended solids. To avoid solids bias, the velocity of the wastewater in sample tubing should be at least 2 feet per second (fps) and the tubing diameter should be at least 0.25 inch.
- For composite samples, a start time and end time shall be recorded. The holding time for the samples begins when the first aliquot is dispensed into the composite sample container.

- Field parameters should be collected at the start and end times to document effluent conditions. Logistical conditions can cause a delay in end time readings, when not able to take an end time reading, plan to do so as soon as possible.

E2. Whole Effluent Toxicity (WET) Sampling

WET is a National Pollutant Discharge Elimination System (NPDES) permits program parameter designed to evaluate the toxicity of the entire waste stream as opposed to its individual components. The DSW staff person should understand the permittee's WET testing requirements so that the appropriate objectives can be met. These objectives may include:

- Assess adequacy of self-monitoring procedures.
- Document presence or absence of toxic conditions.
- Identify need to perform Toxicity Reduction Evaluation (TRE) and/or a Toxicity Identification Evaluation (TIE).
- Identify permit terms and conditions that may not be strong enough to ensure state WET water quality standards are met.

All WET samples should usually be collected by composite sample to be consistent with the DSW biomonitoring guidance and NPDES permit conditions (exceptions may be made for discharges from settling ponds or other uniform discharges). Upstream control water samples should be submitted to the laboratory along with the effluent samples. Samples taken for toxicity testing purposes must be analyzed within 36 hours after completion of sample collection.

E2.a. Effluent

The WET testing effluent sampling strategy should be specified in the NPDES permit. In some instances, the sampling location specified in the permit may not be adequate for the collection of a representative sample. In that case, OEPA staff should determine the most representative sampling point available and collect a sample at that location as well as the location specified by the permit (or chosen by the permittee). Effluent samples must be representative of the entire final effluent discharge and free of contamination from other sources.

Effluent samples used to conduct the acute toxicity tests shall be collected as 24-hour composite samples. If the effluent is chlorinated for disinfection purposes, the effluent sample should be collected at a point prior to chlorination. However, if dechlorination is an integral part of the disinfection system at the facility, the sample should be collected at the final outfall.

E2.b. Upstream/Dilution Water

The choice of dilution water to use in WET definitive tests should be specified in the NPDES permit and depends on the purpose of the toxicity test. Synthetic dilution water is used to evaluate the inherent toxicity of the effluent. Dilution water from the receiving stream or a nontoxic equivalent is used to test for interactions after an effluent discharge thoroughly mixes with the receiving water (where state laws allow for a mixing zone). Receiving waters, synthetic waters, or synthetic waters adjusted to approximate receiving water characteristics may be used for dilution water, if the water meets the qualifications for an acceptable dilution water. For Ohio EPA-conducted WET testing, upstream water is prioritized as the dilution water of choice as long as the QA protocols are met (outlined in "Ohio EPA Permit Guidance #5, 1998"). If Ohio EPA staff do not have safe access to the receiving stream, they should request the WET lab use synthetic water for dilutions.

Dilution water obtained from receiving waters should be collected following all sampling procedures including the use of a chain-of-custody form, and should be kept at 6°C. To ensure that no appreciable change in toxic characteristics occurs before testing, the holding time from the time the receiving water sample is collected to the first use of the receiving water sample in the WET test initiation must not exceed 36 hours unless a variance has been granted. The location of the receiving water sample should be noted on the field form and the chain-of-custody form. It should be upstream and out of the influence of the permitted outfall. Care should be taken to assure that any upstream backflow of the effluent is avoided when selecting the upstream sampling location. The location should also be free of other sources of contamination (e.g., other facility outfalls). If the facility's 801 station is appropriately located then samples should be taken there. Field parameters should be collected at the upstream sampling location to help verify the location is not influenced by the site or an upstream source.

E2.c. Upstream/Downstream Water

If data is needed for wasteload allocations, downstream samples should be collected to determine receiving water hardness or additional parameters as needed. These samples should generally be collected at or near the facility's 901 station (after mixing of effluent).

Unless specifically modified by the NPDES permit, an acute toxicity test of an effluent requires that an upstream control sample be collected. The upstream control sample is to be collected as a grab sample upstream from the zone of effluent and receiving water interaction.

E2.d. Testing

Acute toxicity tests conducted by Ohio EPA will normally be static tests. Acute toxicity tests may be categorized as either screening tests or definitive tests. A screening test is a test in which the effluent and control solutions are evaluated at full strength. This is an inexpensive test designed to indicate presence or absence of toxicity in the effluent. A definitive test uses dilutions of the effluent to quantify toxicity.

Since detection of toxic conditions in the Acute Screening test (>50% adverse effects such as mortality or lack of motility) may require re-sampling of the WWTP effluent with subsequent definitive testing, district staff may choose to forgo the screening test and move directly to definitive testing (resource-dependent) if there is a reasonable expectation that the screening will detect toxic conditions (e.g. previous tests had >50% adverse effects).

These two types of tests are described further below:

1. Acute Screening Tests: These tests are performed by Ohio EPA to screen for toxicity in the effluent. The effluent and control solutions are tested full strength, but the test durations are 48 hours for both *Pimephales promelas* and *Ceriodaphnia dubia*.
2. Acute Definitive Tests: A definitive test is designed to quantify the amount of toxicity in an effluent. In order to accomplish this, the effluent is diluted to various concentrations with one of the control waters. A minimum of 5 effluent concentrations shall be used in a definitive test. The typical dilutions used are 100, 50, 25, 12.5 and 6.25 percent by volume effluent.

E2.e. Quality Assurance

There may be instances when poor survival or other adverse effects exhibited by control organisms preclude the use of data from an effluent toxicity test and the test must be repeated. The following conditions outline when a repeat of an acute toxicity test is mandatory.

A repeat of an acute toxicity test is mandatory when a combination of mortality and adverse effects in both receiving water and laboratory controls exceeds 10 percent of a particular species. A repeat test is not necessary if there is 10 percent or less affected in one of the two control waters. A repeat test is necessary only for the species exhibiting unacceptable effects in the controls.

Failure to follow approved procedures may result in a requirement to repeat a toxicity test. Any deviations from approved procedures should be explicitly described in the report of the tests results.

E2.f. Chemical Analysis

A sufficient volume of effluent shall be collected to allow aliquots for use in acute toxicity tests and chemical analysis. Bioassay effluent sampling may be coordinated with other sampling requirements as appropriate to avoid duplication. The analyses detailed in the currently effective Part I, Effluent Limitations and Monitoring Requirements tables in the NPDES permit need to be conducted for the effluent sample. In addition, alkalinity and hardness (as CaCO₃) should be measured. Chemical analysis must comply with Ohio EPA accepted procedures.

When WET sampling is conducted, a complete list of conventional, nutrient and metal pollutants need to be collected and analyzed (use Bioassay Composite and Bioassay Grab test schedules). Also, priority organic pollutants in the Volatile, Acid and Base/neutral fractions must be collected.

References

Reporting and Testing Guidance for Biomonitoring Required by the Ohio Environmental Protection Agency, Permit Guidance 5, Final. Ohio EPA, Division of Surface Water, Revision 1, July 1998

Section F. Water Quality Sonde Deployments

F1. Introduction

This section outlines best practices for the deployment of auto-logging water quality sondes (sondes). Sondes can be outfitted with sensors to collect many parameters, but commonly Ohio EPA staff collect the set of temperature, specific conductivity, pH, and dissolved oxygen (DO). The resulting data are utilized in various analyses, including supporting the assessment of nutrient enrichment and identifying the influence of intermittent non-point sources on conductivity. Details of the type of data collected and how it supports a project are documented in the Quality Assurance Project Plan (QAPP) for that project. The processes documented in this procedure are appropriate for deployments where equipment is deployed for less than 2 weeks and is returned to the central laboratory location. Longer-term deployments that require field calibration and maintenance are outside the scope of this procedure.

F2. Equipment preparation

F2.a. Calibration

The manufacturer's specifications are to be followed. Specific procedures vary based on equipment manufacturer and type. Ohio EPA has developed a maintenance and calibration log that is maintained for each instrument. The log consists of two parts: a maintenance log (F.7.a) and a calibration log (F.7.b). For each sonde deployment the calibration should be logged in the maintenance log and a calibration log filled out documenting the details of the calibration. Each form should be filled out completely. Calibration is to be performed to known standards or be traceable to a known standard. The exception is dissolved oxygen, which is calibrated with air saturated tap water or water saturated air.

F2.b. Programming

Sondes are programmed by staff to begin taking readings at a certain time. This date, time and interval is typically reflected on the sonde deployment request form. Staff are to write the sonde serial number on the deployment field sheet (F.7.c), along with other related information.

F2.c. Additional Documentation

Any instability in readings should be documented within the comments of the calibration log, as this is possibly a sign of sensor damage in the pH or DO components. Unusual sensor wear or other peculiarities noted during the calibration and programming should be noted in the appropriate location. Any maintenance done to the sonde, such as changing sensors, sensor components, batteries or servicing the pH reference junction, should be documented in the maintenance log (F.7.a).

F3. Deployment

F3.a Field conditions

All sondes should be appropriately secured when deployed. Ohio EPA typically uses a stainless-steel sleeve to protect the body of the sonde as well as provide additional weight. The stainless-steel tubes slide over the body of the sonde and are secured when the deployment sensor guard is tightened. Other securing mechanisms can be appropriate if they provide adequate protection of the sonde against the field conditions.

F3.b. Sampling method

Sondes are to be placed in a location that captures median stream character. For example, a sonde should not be placed in the only deep pool of the stream segment being assessed. However, if the stream is largely pooled and sluggish, water moving more swiftly should not be sought out. In streams with typical run-riffle-pool-glide structure, the most ideal location to place the sonde is within the run or glide. These segments have sufficient velocity to help prevent biofouling but have slower velocities than riffles, which may move coarser bed materials into the protective sleeve and sensor guard, making them difficult to remove. This also ensures the adequate velocity required for some sensors (Ohio EPA does not have any of these sensors currently). Large riffles and waterfalls can have substantial local impacts due to reaeration. If these are uncommon in the reach being assessed, they should be avoided by deploying on the upstream end of them.

Sonde deployment location needs to be representative of the conditions across the channel. This is typically accomplished by placing the sonde within the thalweg of the stream where most of the flow occurs. In general, eddies and peripheral areas should be avoided. In some streams, especially larger streams with wide channels, lateral variability can be a concern. If these concerns arise, they should be discussed in the QAPP for the project. The probes need to avoid sediment deposits at the stream bottom. If a sonde is being deployed in deep water, an empty cubitainer or similar device should be used to float the sensors into the water column. In the case of bracketing a point source, the downstream sonde needs to be deployed beyond the mixing zone.

F3.c. Documentation (field notes)

For every sonde deployment, field sheets need to be filled out (F7.c). Sonde field sheets document the date, time, exact location of deployment, and qualitative environmental data (such as depth, velocity, substrate, flow regime, rainfall and weather condition) at the time of deployment. These observations are repeated at sonde retrieval to allow the user to interpret the data under the specific conditions that occurred at the time of deployment.

F4. Equipment Retrieval

F4.a. Inspection

Upon retrieval, the sensors should be visually inspected, and any conditions with potential effects on data quality should be noted on the field sheet. Probes need to be maintained in the same condition as the deployment, to the extent possible, when the storage cap is put on. If substantial fouling occurs and is minimally disrupted, the post-check process can identify the impact on the data.

F4.b. Documentation (field notes)

For every sonde retrieval, a field sheet needs to be filled out. Sonde field sheets document the date, time, qualitative environmental data at the time of retrieval, and sonde inspection results.

F5. Data management

F5.a. Data download and storage

The raw data files are downloaded from the sondes, typically during the QC post-check process. The files are saved in the Excel .csv format (comma separated value). The raw files are stored locally on the state of Ohio servers. Raw data is organized by year and project. The downloaded file names are created using the start date of the deployment (YYYYMMDD), site number (project specific meaning), watershed or project name, and the station ID. (e.g. 20180724_01_Swan_123456.csv).

F5.b. Post-check measurement

Upon the return of equipment from the field, a post-check measurement shall be performed. This must be done no later than one day after the return of the equipment. All sondes are placed in a bath of aged tap water for five minutes before being turned on. Data is then logged for at least 40 seconds, after which the data is recorded. This data is used as a control point to validate the calibration of the sondes and evaluate possible issues with fouling. The post-check data is logged electronically and on a hard copy then stored with hard copies of the field sheets.

F5.c. Data review

A staff person within the Modeling, Assessment and TMDLs section at Ohio EPA reviews the raw data with regard to collected QC data and transfers it to editable fields for adjustment/approval. The raw datafiles (.csv's) are moved into an Excel workbook and initially trimmed so the start and end time correspond to the deploy and retrieval times. Then, the post-check data is fitted with a trendline and the trendline is bounded by the specified accuracy of the sensors being evaluated. If the post check data lies outside of the accuracy range for a specific sensor, data collected with that sensor is not approved. The values are rounded to the appropriate significant units prior to making this assessment. For example, if a sonde D.O. sensor reads 8.62 mg/L, the average of the bath is 8.5 mg/L, and the specified accuracy is 0.1 mg/L the reading would be rounded to 8.6 and kept. If the value were above 8.65 it would be rejected. Other anomalies in the data are considered and field notes are reviewed. If data is removed from the dataset, a specific quality assurance record (QAR) note is developed. QARs are recorded in files stored on the state of Ohio's servers. Once all data for a site is reviewed, the field sheet is initiated and dated by the reviewer. At this point, the data is approved and can be used.

F5.d Field data measurements

Sonde data may be used for field measurements in lieu of a handheld field meter when the sondes are equipped with the necessary probes (dissolved oxygen, pH, conductivity, and temperature). During data and review and download, the staff member will identify the sampling point closest in the time to the collection of grab samples at each site. They will then enter the data into an excel template to be used as the field data measurement.

F6. Maintenance and Care

F6.a. Routine maintenance

- Maintenance should be performed according to manufacturer's specifications.
- Need for maintenance is continuously tracked in the calibration and maintenance logbook and the lab post-check process outlined in this procedure.
- Malfunctioning equipment shall be evaluated for problems using manufacturer troubleshooting guides and in-house best professional judgment.

F6.b. Storage during field season

The equipment should be stored according to the manufacturer's recommendations, except for HACH® branded equipment that has a serviceable reference junction for pH sensors. These reference junctions are prone to leaking and the manufacturer's recommendation to store in a moist environment should not be followed. The sensors should be surrounded by water (full cup) so air bubbles do not develop within the reference junction. The compromise is slightly faster wear on the pH sensor cathode and electrode.

F6.b. Winterizing

The external battery supply for each sonde must be removed during long term storage. The pH porous junctions are to be stored separately in KCL solution. The sensors are to be fully submersed in pH 4 buffer solution. As a pre- or post-season maintenance item, the DO silver anode may be treated with ammonia to lessen the effects of oxidation. Winterizing helps prolong the life of the sensors but is not required for quality data if other QA procedures are followed.

F7. Supporting Documents

The following forms are used by Ohio EPA staff.

F7.a. Maintenance Log

MAINTENANCE LOG FOR EQUIPMENT MODEL _____ NUMBER _____

F7.b. Calibration Log

Year _____

Instrument # _____

Date: _____	Time: _____	Operator: _____	Project: _____
Specific Conductance Calibrated? Y / N Initial Reading: _____ (us/cm) Solution Standard: 1413 / other _____ Solution Date: _____			
pH 7 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [0 +/- 50] Buffer Date: _____			
pH 10 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [-165 to -180 from pH 7] Buffer Date: _____			
pH 4 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [+165 to +180 from pH 7] Buffer Date: _____			
Dissolved Oxygen Calibrated? Y Initial Reading: _____ (%)		Barometric Pressure: _____	Battery voltage: _____
Notes: After Calibration Conductivity Cell Count: _____ pH Slope: _____ DO Sensor Value: _____			
Date: _____	Time: _____	Operator: _____	Project: _____
Specific Conductance Calibrated? Y / N Initial Reading: _____ (us/cm) Solution Standard: 1413 / other _____ Solution Date: _____			
pH 7 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [0 +/- 50] Buffer Date: _____			
pH 10 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [-165 to -180 from pH 7] Buffer Date: _____			
pH 4 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [+165 to +180 from pH 7] Buffer Date: _____			
Dissolved Oxygen Calibrated? Y Initial Reading: _____ (%)		Barometric Pressure: _____	Battery voltage: _____
Notes: After Calibration Conductivity Cell Count: _____ pH Slope: _____ DO Sensor Value: _____			
Date: _____	Time: _____	Operator: _____	Project: _____
Specific Conductance Calibrated? Y / N Initial Reading: _____ (us/cm) Solution Standard: 1413 / other _____ Solution Date: _____			
pH 7 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [0 +/- 50] Buffer Date: _____			
pH 10 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [-165 to -180 from pH 7] Buffer Date: _____			
pH 4 Calibrated? Y / N Initial Reading: _____ (SU) _____ (mV) [+165 to +180 from pH 7] Buffer Date: _____			
Dissolved Oxygen Calibrated? Y Initial Reading: _____ (%)		Barometric Pressure: _____	Battery voltage: _____
Notes: After Calibration Conductivity Cell Count: _____ pH Slope: _____ DO Sensor Value: _____			

F7.c. Deployment Sheet



Multisensor Sonde Form

Parameter Requirements all

Site# _____ Stream _____ RM _____

Location: _____

Comment: _____

STORET _____ River Code _____

LAB USE ONLY

Type / Serial# _____

Programmer/Date _____

Device File Name _____

Downloader/Date _____

Raw File Name _____

Reviewer/Date _____

QAR# _____

FIELD DATA

Deployment Location: Dist. fr. Bridge _____ ft./yds. **Side of bridge:** DWST / UPST **Cabled on:** LEW / REW

Stream width _____ ft. / yds. **Dist. fr. stream edge** _____ ft. / yds. **Notes:** _____

Flow Pattern: Riffle% _____ Run% _____ Pool% _____

Daily Shade: None - 25% - 50% - 75% - Full

Glide% _____

Glide% _____

Dominant Substrate(s): Bedrock - Cobble - Gravel - Sand - Silt - Muck

Aq Vegetation: Detritus - None - Light - Mod - Dense

Substrate(s): Other: _____

Water Coloration: _____

Benthic Algae: None - Light - Mod - Heavy

↳ Sample Possible: Y / N

DEPLOY DATA

RETRIEVE DATA

Date/Time _____

Crew Names _____

Equipment Damage Check _____

Weather _____

Flow Status (low/norm/high) _____

Local Velocity (ft/s) _____

Local Depth (ft) _____

Sensor Height (bottom/float) _____

Retrieval Notes (sensor silt/algae buildup, etc, **or circle** - all good): _____

Section G. Continuous Temperature Data Logger Deployments

G1. Introduction

This section outlines best practices for the deployment of continuous temperature data loggers (loggers). Temperature loggers are used to collect temperature data in surface waters to document the ambient temperature profile over a long time period, recorded at pre-programmed time intervals. These devices come in various shapes and sizes but in general they are small having a length of around 4.5 inches, a diameter of around 1.2 inches, and a weight of about 1.5 ounces. These devices come in various styles and can be referred to in different ways such as a probe, sensor, or logger. Some models are also able to detect the presence of water and can be used to record low-flow or dry periods in the stream. Although the resulting data may be utilized for various analyses, one potential purpose for collection of these data is to support a coldwater habitat (CWH) aquatic life habitat use designation to a stream. Plans to deploy temperature data loggers will typically be documented in the QAPP for a specific project. The procedures described within this document are intended for long-term deployments ranging from weeks to months.

G2. Equipment preparation

G2.a. Calibration

Calibration of the logger is normally unnecessary but consult the directions and specifications provided by the manufacturer to verify this for the specific model being used. The accuracy of the logger should be approximately 0.2°C with an expected drift of approximately 0.1°C per year. Accuracy of the logger should be tested against a calibrated thermometer prior to each deployment, ensuring the readings are within the accuracy range provided by the manufacturer. The internal clock is not expected to deviate more than about one minute per month. The internal battery should be checked prior to deployment of the logger to ensure there is enough remaining charge to last throughout the planned deployment. The battery check is usually conducted during programming. Note that most of these devices typically have no user-serviceable parts, including the battery.

G2.b. Programming

The loggers are programmed by staff prior to field deployment to begin taking readings on a specified date and time and at prescribed time intervals. A measurement interval of 30 minutes is recommended but should be at least hourly to adequately characterize the thermal regime of the water body over the length of the deployment. Record the programmer's name, programming date, the date and time the device is programmed to begin measurements, along with the programmed measurement interval on the field data sheet (G7.a) in the space provided in the "Lab Use Only" box. Update the deployment tracking spreadsheet as the loggers are deployed recording the deployer's name and the deployment location and date.

G3. Deployment

G3.a. Equipment List

<input type="checkbox"/> Programmed Temperature Logger	<input type="checkbox"/> Zip Ties	<input type="checkbox"/> Cable Cutters
<input type="checkbox"/> Wire Cable or Cord	<input type="checkbox"/> Field Sheet	<input type="checkbox"/> Thermometer or Field Meter
<input type="checkbox"/> Padlock and Key	<input type="checkbox"/> GPS Device	<input type="checkbox"/> Camera
<input type="checkbox"/> Cinder Block, half size	<input type="checkbox"/> Meter Stick	<input type="checkbox"/> Flagging Tape

G3.b. Deployment considerations

Temperature loggers need to be placed, secured and concealed to maximize the chance of obtaining a continuous record of ambient water temperature for an extended time period lasting from weeks to months. Place the logger as close spatially to the biological sampling locations as possible and avoid exposure to direct sunlight where possible while accounting for other factors such as water depth and concealment opportunities. Avoid placing the logger near or immediately downstream of road crossings or recently disturbed areas unless this is unavoidable. A prime consideration for placement in smaller streams is water depth. The goal is for the logger to remain submerged throughout the deployment period. Additionally, placement should avoid areas with potential for significant deposition of fine silts or sands that may bury the logger in these materials. For deployments made to support a potential CWH designation, plans should be made to deploy the logger by June 30th and for it to remain in the stream through August 31st, after which it can be retrieved when time permits.

G3.c. Deployment method

Secure the pre-programmed logger to the inside hollow center of a half cinder block using a zip tie or similar fastener as shown in Figure 1 below. Place the logger in a location as close as practical to the collection of biological sampling. Consult Part C of the Volume III biocriteria manual updates (June 2015) for tips on qualitative macroinvertebrate sampling and the macrohabitats the biologists will look for when sampling.



Figure 1. Temperature Logger Affixed to a Cinder Block

Place the block with attached logger onto the stream bed with the long axis of the block parallel to the flow in a pool or other location that is likely to remain deep enough for the logger to remain submerged for the duration of the deployment. Choose a location out of direct sunlight where possible and within the main channel. Place in an area out of view from casual observation and where maximum concealment opportunities exist to minimize vandalism or theft. This could include log jams, root mats, boulder slabs, or undercut banks, for example. Secure the block to a stable object such as a log or tree using a wire cable and padlock. In some streams such as those completely dominated by bedrock or that are extremely shallow, it may be necessary to use alternative methods and some ingenuity to place and secure the logger, such as tightly wedging it into the crevice of the bedrock or cabling it directly to the underside of a large boulder or slab. Alternative methods not using a cinder block must: 1) Sufficiently anchor the logger; 2) Shield the logger from solar radiation; and 3) Protect the logger from physical damage.

Water-detection loggers are usually smaller and should be secured to smaller bricks using two zip ties or a similar fastener. These loggers are placed in a glide within the sampling reach with the bricks slightly buried in the substrate, with the loggers facing up, so the loggers are level with the streambed.

Using a thermometer or field meter, measure and record the water temperature at the time of deployment. Take photos of the stream and deployment location, document the latitude/longitude of the deployment location, and record any field notes that may be useful in the recovery of the logger. See Figure 2 for an example of in-stream logger deployment.

G3.d. Documentation (field notes)

A field data sheet is completed for every temperature logger deployment (G7.a). The field data sheet is used to document the date, time, exact location of deployment, and qualitative environmental data (such as depth, flow type, velocity, substrate, stream shading, flow regime, and weather condition) at the time of deployment. The field data sheet is also used to document information regarding the location of the logger's placement so that it may be retrieved following a long deployment.



Figure 2. Example of a deployed temperature logger

G4. Equipment Retrieval

G4.a. Inspection

When possible, a periodic check of the logger is recommended during the deployment period to verify that the logger is fully submerged and that it has not been lost, stolen, damaged, or buried by fine materials such as muck, silt, or fine sand. Time permitting, these inspections are especially recommended shortly after a large storm event where higher flows have a greater chance of dislodging the logger. If any inspections are made of the logger while deployed, record any notes made along with the date(s) in the space provided on the field sheet. Upon retrieval, the logger should be visually inspected for any obvious damage and for battery operation with notes made to the field sheet in the “retrieval notes” section.

G4.b. Documentation (field notes)

Using the same field sheet used for deployment, document the date, time and qualitative environmental data at the time of retrieval along with any inspection notes. Measure and record the temperature at the time and location the logger is retrieved using a thermometer or field meter.

G5. Data management

G5.a. Data download and storage

The raw data files are downloaded from the loggers and saved in a comma separated value (.csv) format. The raw files are stored locally on the state of Ohio servers. Raw data are organized by year and project. The downloaded file names are created using the start date of the deployment (YYYYMMDD), watershed or project name, and the station ID (e.g. 20180724_Swan_123456.csv). Ensure that the unit is turned off once the data have been successfully downloaded. Record the date the logger is returned along with associated information on the tracking spreadsheet.

G5.b. Data review

Staff within the Assessment and Modeling Section at Ohio EPA review the raw data with regards to collected QC data. The raw datafiles are trimmed so the start and end time correspond to the deploy and retrieval times. Other anomalies in the data are considered and field notes are reviewed. If data are removed from the dataset, a specific quality assurance record (QAR) note is developed. QARs are recorded in files stored on the state of Ohio's servers. Once all data for a site are reviewed, the field sheet is initialed and dated by the reviewer. At this point, the data are approved and are ready to be used. A total of 2,976 temperature data points will be logged during a July 1st through August 31st deployment period programmed for a thirty-minute measurement interval.

G6. Maintenance and Care

G6.a. Routine maintenance

There is no routine maintenance necessary. Equipment should be cleaned after retrieval to remove any debris, deposits or algal growth.

G6.b. Storage

The equipment should be stored according to the manufacturer's recommendations, which may vary slightly depending on the model. Storage outside of a range from 32°-77°F may reduce expected battery life.

G7. Supporting Documents

The following forms are used by Ohio EPA staff.

G7.a. Field Sheet

Temperature Data Logger Field Form

Ver 1.0
4/15/19



Stream Name _____

Location: _____

Station ID _____ River Code _____

Interim Deployment Period Notes (if any)

Date #1 _____ Notes _____

Date #2 _____ Notes _____

LAB USE ONLY

Brand/Model# _____

Serial # _____

Programmer/Date _____

Begin Date/Time _____

Measurement Interval _____

File Name _____

Downloader/Date _____

Reviewer/Date _____

FIELD DATA

Cabled on: LEW / REW (as facing downstream; circle one)

Deployment Notes: _____

Retrieval Notes: _____

Daily Shade (circle one): None - 25% - 50% - 75% - Full

Dominant Substrate(s): Bedrock - Cobble - Gravel - Sand - Silt - Muck - Other _____

Springs/Seeps Observed Nearby: Yes No (circle one)

DEPLOYMENT DATA

Date/Time _____

Crew Names _____

Weather _____

Flow Status (circle one)

Low	Normal	High
-----	--------	------

Low	Normal	High
-----	--------	------

Flow Type (circle one)

Dry	Intermittent	Interstitial	Surface
-----	--------------	--------------	---------

Dry	Intermittent	Interstitial	Surface
-----	--------------	--------------	---------

Sensor Depth (ft) _____

Local Depth (ft) _____

Temp (thermometer or field meter)
(circle one) _____

RETRIEVAL DATA