Town of Braintree

SOP 13 –Water Quality Screening with Field Kits

Approved By:

Date:

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SOP 13: WATER QUALITY SCREENING IN THE FIELD

Introduction

Outfalls from an engineered storm drain system can be in the form of pipes or ditches. Under current and pending regulations, it is important to inspect and document water quality within the MS4 system under both dry weather and wet weather conditions. SOP 1, "Dry Weather Outfall Inspection" and SOP 2, "Wet Weather Outfall Inspection", cover the objectives of these activities and how water quality parameters can be collected during both types of inspections. SOP 3, "Catch Basin Inspection and Cleaning", describes how this operations and maintenance activity can serve as an additional opportunity to collect water quality data.

SOP 2 included detailed information on how to collect discrete analytical samples to be processed by a laboratory. In contrast, this SOP addresses screening-level measurements that can be collected at outfalls, catch basins, receiving waters, or other water bodies. The measurements can be collected with field test kits or with portable meters.

Water quality screening data collected in this manner can feed into an illicit discharge detection and elimination investigation, like the process described in SOP 10, "Locating Illicit Discharges".

Visual Condition Assessment

SOP 1, SOP 2, and SOP 3 describe a Visual Condition Assessment to collect observations related to the quality of stormwater conveyed by an engineered storm drain system. These observations may include such visual evidence and/or potential pollutants as:

- Foaming (detergents)
- Discoloration
- Evidence of sanitary waste
- Optical enhancers (fluorescent dyes added to laundry detergent); and
- Turbidity

If a Visual Condition Assessment indicates the presence of these pollutants, it may be necessary to quantify the extent of each, and gather data on other parameters that cannot be visually observed but can be measured using field kits or meters. These parameters include:

- Ammonia
- Bacteria (E. Coli and
- Chloride (present in treated drinking water but not groundwater)
- Conductivity
- Fluoride
- pH
- Potassium

Field Kits and Sampling Methods Available

In recent drafts of new MS4 Permits, U.S. EPA Region 1 has identified several test kits that are acceptable for use in the field, and other regulatory agencies have also completed similar reviews. The following table shows example field test kits and portable meters that can be used for screening parameters.

Table SOP 13-1
Field Measurements, Test Kits, and Instrumentation

Analyte or Parameter	Instrumentation (Portable meter)	Field Test Kit
Ammonia	CHEMetrics™ V-2000 Colorimeter Hach™ DR/890 Colorimeter Hach™ Pocket Colorimeter™ II	CHEMetrics™ K-1410 CHEMetrics™ K-1510 (series)
Bacteria	Bacteria field test kits require 24-hour window	
Boron	N/A	Hanna™ HI 38074 Taylor™ K-1541
Chloride	CHEMetrics™ V-2000 Colorimeter Hach™ Pocket Colorimeter™ II LaMotte™ DC1200 Colorimeter	CHEMetrics™ K-2002 through K-2070 Hach™ CDS-DT Hach™ Chloride QuanTab® Test Strips
Color		Hach™ ColorDisc
Conductivity	CHEMetrics™ I-1200	N/A
Detergents (Surfactants)	CHEMetrics™ I-2017	CHEMetrics™ K-9400 and K-9404 Hach™ DE-2
Fluoride	CHEMetrics™ V-2000 Colorimeter Hach™ Pocket Colorimeter™ II	N/A
Hardness	N/A	CHEMetrics™ K-1705 and K-1710 CHEMetrics™ K-4502 through K-4530 Hach™ HA-DT Hach™ Hardness Test Strips
Optical enhancers	Field tests still under development	
pH	CHEMetrics™ I-1000	Hach™ 17J through 17N Hach™ pH Test Strips
Potassium	Horiba™ Cardy C-131	LaMotte™ 3138 KIW
Turbidity	CHEMetrics™ I-1300	N/A

Each field test kit will include instructions specific to that test kit, and most kits are available in configurations that detect different ranges of the parameter. For example, the CHEMetrics™ detergents kit K-9400 shown above detects concentrations of 0 to 3 milligrams per liter (mg/L) while the K-9404 kit detects concentrations of 0 to 1,400 mg/L.

The table below shows values identified by the U.S. EPA and the Center for Watershed Protection as typical screening values for select parameters.

The bacteria water quality criteria for freshwater is based upon E. Coli and the threshold is 235 cfu/100 ml. For brackish and marine waters, the water quality standard is based upon bacteria and the threshold is 61cfu/100 ml. These represent the typical concentration (or value) of each parameter expected to be found in stormwater. Screening values that exceed these benchmarks may be indicative of pollution and/or illicit discharges.

The MS4 permit requires that ammonia, surfactants, and bacteria exceed specific thresholds to indicate contamination. For the purpose of Braintree, exceedance of bacteria and either ammonia or surfactants will be used to indicate contamination.

If any of the conditions below are met the outfall is consider to be potentially contaminated with sewage:

- Olfactory of visual evidence of sewage
- Ammonia ≥ 0.5 mg/l or surfactants ≥ 0.25 mg/l, and bacteria levels greater than the water quality criteria applicable to the receiving water
- Ammonia ≥ 0.5 mg/l, surfactants ≥ 0.25 mg/l, and detectable levels of chlorine
- Bacteria levels greater than four times the water quality criteria applicable to the receiving water

(Brown and Caldwell, 2019)

Table SOP 13-2
Water Quality Criteria & Threshold Levels

Analyte or Parameter	Benchmark
Ammonia	≥ .5 mg/l
Bacteria (E. Coli.) Bacteria (Enterococci)	Freshwater: 235 cfu/100 ml Brackish: 61 cfu/ 100 ml
Chlorine	> Reporting Limit
Conductivity	>2,000
Detergents (Surfactants)	≥ 0.25 mg/L
Fluoride	>0.25 mg/L
pH	<5
Potassium	>20 mg/L

Note: Adapted from EPA New England Bacterial Source Tracking Protocol (2012). Retrieved from https://www3.epa.gov/region1/npdes/stormwater/ma.

If and when water quality screening samples, whether using field test kits or portable meters, exceed these benchmark concentrations, the inspector should consider collecting analytical samples for laboratory analysis. Additionally, the source of the pollution should be investigated by following SOP 10 Locating Illicit Discharges.

Advantages and Disadvantages of Field Testing

Field test kits can be convenient for use as a screening tool, initial purchase costs are low (typically $0.50 to $5.00 for the kits included in Table SOP 13-1), and the costs are far less than full analyses at a laboratory. However, some disadvantages of this screening method include:

- Limited shelf life
- Labor cost associated with inspector's time
- Generation of wastes, including glass vials and used reagent
- Steps and processes for each kit can vary widely, resulting in errors
- Trained staff are required in order to effectively utilize kits
- Not all kits are accepted by all regulatory agencies
- Limited useful detection range

Portable instrumentation such as the colorimeters shown in Table SOP 13-1 have the benefit of providing accurate readings, measure to low detection limits, and can be purchased pre-programmed to measure concentrations of most parameters required. Disadvantages of portable instrumentation include:

- High initial purchase cost
- Requirement for ongoing calibration and maintenance
- Individual probes require periodic replacement
- Specific storage requirements to maintain calibration
- Trained staff are required in order to effectively utilize meters

References

1. Brown and Caldwell. (2019) *Appendix E: Outfall Inspection and Dry Weather Sampling SOP*
2. EPA. (2012) *EPA New England Bacterial Source Tracking Protocol*

Related Standard Operating Procedures

1. SOP 1, Dry Weather Outfall Inspection
2. SOP 2, Wet Weather Outfall Inspection
3. SOP 3, Catch Basin Cleaning and Inspection
4. SOP 10, Locating Illicit Discharges

Attachment 1
Water Quality Screening Form

WATER QUALITY SCREENING FORM

Outfall I.D.			
Outfall Location			
Inspector's Name			
Date of Inspection		Date of Last Inspection	
Start Time		End Time	
Type of Inspection: Regular ☐ Pre-Storm Event ☐ During Storm Event ☐ Post-Storm Event ☐			
Most Recent Storm Event			

FIELD WATER QUALITY SCREENING RESULTS

Sample Parameter	Field Test Kit or Portable Instrument Meter	Benchmark	Field Screening Result	Full Analytical Required?
Ammonia[1]		> 50.0 mg/L		☐ Yes ☐ No
Boron[1]		> 0.35 mg/L		☐ Yes ☐ No
Chloride[2]		230 mg/L		☐ Yes ☐ No
Color[1]		> 500 units		☐ Yes ☐ No
Specific Conductance[1]		> 2,000 µS/cm		☐ Yes ☐ No
Detergents & Surfactants[3]		> 0.25 mg/L		☐ Yes ☐ No
Fluoride[3]		> 0.25 mg/L		☐ Yes ☐ No
Hardness[1]		< 10 mg/L or > 2,000 mg/L		☐ Yes ☐ No
pH[1]		< 5		☐ Yes ☐ No
Potassium[1]		> 20 mg/L		☐ Yes ☐ No
Turbidity[1]		> 1,000 NTU		☐ Yes ☐ No

[1] – *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection and Robert Pitt of University of Alabama, 2004, p. 134, Table 45.

[2] –*Env-Ws 1703.21 Water Quality Criteria for Toxic Substances*, State of New Hampshire Department Surface Water Quality Regulations.

[3] – *Appendix I – Field Measurements, Benchmarks and Instrumentation*, Draft Massachusetts North Coastal Small MS4 General Permit, 2009.

FULL ANALYTICAL TESTING WATER QUALITY RESULTS

Sample Parameter	Analytical Test Method	Sample Collection (Time/Date)	Testing Lab	Analytical Testing Result
Ammonia	EPA 350.2/SM4500-NH3C			
Bacteria	E coli: 1103.1; 1603 Enterococcus: 1106.1; 1600			
Boron	EPA 212.3			
Chloride	EPA 9251			
Color	EPA 110.2			
Specific Conductance	SM 2510B			
Detergents & Surfactants	EPA 425.1/SM5540C			
Fluoride	EPA 300.0			
Hardness	EPA 130.1/SM 2340B			
Optical Enhancers	N/A*			
pH	EPA 150.1/SM 4500H			
Potassium	EPA 200.7			
Turbidity	SM 2130B			

*- There is presently no USEPA Standard Method for analysis of optical enhancers. Typically, sample pads are described as with “Present” or “Not Present” for fluorescing dye when exposed to UV light or a fluorometer.