Stormwater Monitoring Field Procedures

Salish Sea STORMWATER MONITORING

Background

The Washington Department of Ecology and Puget Sound Partnership acknowledge stormwater is the largest contributing factor to pollution in Puget Sound. Monitoring stormwater draining into Puget Sound is inadequate, as readily acknowledged by stormwater managers. Communities lack funding and capacity to monitor and characterize their stormwater systems. Southern Resident Killer Whales (SRKW) as top-tier predators in the Puget Sound food web experience serious consequences from pollution and necropsies of dead whales have revealed high levels of toxic pollutants.

This project will build capacity by using community science volunteers to help city/county/tribal stormwater managers to identify stormwater pollution sources, focus mitigation and/or corrective actions, and improve water and habitat quality for SRKWs and other marine inhabitants of the Salish Sea.

Goals

- Monitor pollution levels in stormwater outfalls and streams discharging into the Salish Sea
- Provide city and state regulators high quality data on stormwater pollution levels to assist them in conducting investigations to identify and eliminate illicit discharges
- Improve the water quality of the Salish Sea and tributary streams for all the wildlife that depend on it

Before You Head Out

- Print out Stormwater Monitoring Datasheets from https://stormwater-salishsea.org/
- Fill out top of the Field, Test Strip & Bacteria Datasheets
- Assemble Equipment:
    - Map of sites
    - Clipboard
    - Datasheets
    - Field notebook
    - Plastic folder
    - Pen/pencil
    - Sharpie
    - Hand sanitizer
    - Plastic gloves
    - YSI -Turn on before packing!
    - Sampling buckets
    - Distilled water
    - Phone/camera
    - Turbidity meter, empty vials, calibration vials & cloth
    - Sampling containers for bacteria
    - Cooler & ice/icepack
- Determine the tide height at start of sampling: www.tidesandcurrents.noaa.gov. Most sites require a low tide to sample.
- Record the rainfall for the 24 hours just preceding start of sampling. For best source of rainfall data for your city visit https://stormwater-salishsea.org/

In the Field

1. **As you are leaving to sample, turn on the YSI meter** by pressing and holding the ON/OFF button. At the first monitoring location, (turn meter on if you forgot) remove the gray vinyl sleeve and place meter in the shade while you get set up. You can leave the instrument on in between outfalls.

2. **Arrival Time:** Record the time when you reach the site, even if dry or stagnant.

3. **Flow:**

    a. Record water flow in the creek or coming out of the pipe and record as N, T, M or H.
    b. Indicate if flow is greater or less than expected given the last 24 hours of rain.

Flow Rate	Stormwater Outfall	Creek
N = none	no flow/stagnant pooled water	creek bed is dry
T = trickle	fills 16 oz. cup in 2 minutes	lots of exposed rocks/sediment
M = moderate	between trickle and high	between trickle and high
H = high	fills 16 oz. cup in 1 second	flow close to high water mark

4. **Air Temp:** Record air temperature using field thermometer placed in the shade. Depending upon the type of thermometer used, it may take up to 3-4 minutes for it to stabilize.

5. **Water Sample**: Be sure hands are clean or wear nitrile gloves to avoid sample contamination and protect yourself from potential contaminants. Collect sample water from the outfall or creek by rinsing the plastic bucket 3 times with the water to be sampled and then collecting a 4th sample to measure. Avoid collecting sediment with the water sample, avoid touching the water or inside of the bucket. If you cannot directly sample from the creek or outfall for bacteria and turbidity measurements, you may want to collect 2 buckets. **Do not collect sample if water is stagnant.**

6. **Bacteria Sample**:
    a. Collect the water sample from flowing water at the site (preferred method) using a sterile bottle, rinse the bottle and cap 3 times with sample water before collecting the sample. If the flow is too low, rinse and collect the sample from the sampling bucket that has been rinsed 3 times prior. Do not touch or contaminate the inside of the bottle or cap.
    b. Tightly screw the lid back on the sample bottle. Record the bottle letter on the datasheet.
    c. Keep the samples at 4°C (40°F) by placing them in an ice-filled cooler. Within 6 hours of sampling either begin culture procedures or place in a refrigerator.

7. **Water Quality Test Strips:**
    a. Rinse collection container (test tube or cup) 3 times with stormwater/creek and keep 4th for testing.
    b. The preferred method is to test in the test tube or a separate sample cup than the one the probe is placed in to avoid contamination (by test strip chemicals) or potential changes caused by the probe. If same sample is used, dip test strip first.
    c. Replace the lid immediately after removing a strip at each outfall before beginning testing. Even short exposure to open air can degrade the performance of the test strips.
    d. Insert strip into sample for **2 seconds,** shake off excess water & lay horizontally along

bottle label to read. Horizontal placement prevents drips from diluting the adjacent parameter squares.

e. Read entire strip in < 1 minute or else the air will discolor the test strip & skew readings.

f. Record value of the matching color for each parameter. If it is between 2 colors, record the higher value.

g. Rinse test tube with distilled water, if available.

h. If you believe your test strips have been compromised due to exposure to open air or if your test strips have expired, ask for a new container of test strips.

8. **Turbidity** (ntu):
    a. Turn on the AMSTAT Turbidity Meter by quickly pressing POWER - top center button.
    b. Rinse the sample vial 3 times with stormwater directly from the outfall or creek (preferred method) or pour water from a sample bucket that was used to sample for bacteria. If using water from the sample bucket - collect turbidity sample immediately after collecting sample so heavy particles don't have time to settle out.
    c. Collect a 4th vial to be sampled.
    d. Dry and clean the vial with a soft cloth, shammy, or Kimwipe to remove any water droplets, dirt and fingerprints from the vial. These may result in an inaccurate measurement.
    e. GENTLY (to avoid introducing air bubbles) invert the vial three times before testing.
    f. Place the vial in the AMTAST meter lining up the black dot on the lid with the gray arrow on the meter.
    g. Quick press READ button - bottom center button. Turbidity number appears within 10-15 seconds.

Troubleshooting: If the turbidity meter readings seem unusual:

- Remove sample vial, gently invert three times and read again.
- Check meter performance by reading calibration vials.

    h. Record measurement on the datasheet.
    i. Remove vial and discard sample water, rinse with distilled water.

9. **Water Temperature** (T) C^o**, Dissolved Oxygen** (DO) mg/L**, Specific Conductivity** (SPC) µS/cm**, Salinity** (ppt)**,** and **pH:**
    a. Measure using the YSI Meter.
    b. Dip the probe in the water sample and stir gently for 15 seconds. Parameters should be measured as soon as possible after the sample has stabilized as conditions in the bucket will change quickly.
    c. DO will take the longest to stabilize. Swirl the probe quickly, but slow enough to not spill the sample. If you are swirling too fast, DO will keep increasing. If you are swirling too slow, DO will keep decreasing. When DO is both increasing and decreasing slightly with a random pattern, it is time to take the reading.

Troubleshooting: If the DO probe provides unusual measurements, such as;

- abnormally high values greater than 20 mg/l,
- negative numbers,
- never stabilizes,
- or values swing up and down no matter if you stir or not,
- then the membrane in the yellow cap may be perforated or split.
- Disregard the DO values for the rest of the survey. The yellow cap requires

replacement.
- Email the person who calibrates the instrument when you return the instrument. Report that the DO cap membrane is possibly perforated or split.

d. Record the values shown on the meter on the datasheet.
e. Replace the gray vinyl sleeve.

10. Observations of the outfall or creek, the sample and immediate downstream area: Record both a number representing severity of the condition observed and write out a short description in the space provided. Use the Notes section if additional space is needed.
    a. **Color**: Assess color qualitatively using visual observations of how severely a sample is discolored. Observations included brown, reddish brown, light green etc… Record the color seen followed by a 1 to 3 scale. Ex: Brown, 3. See below.
    b. **Odor**: Assess odor by describing the intensity or severity of odor. Observations may include sulfur, fossil fuel, sewer, perfume etc. Record 0 or the odor/smell followed by a 1 to 3 scale. Ex: Rotten eggs 2. See below.
    ~~c.~~ **Visual Indicators**: Document the visual observations by describing objects that are on the surface of the water. Observations include sheen, floaters, foam etc... Record 0 or the visual followed by a 1 to 3 scale. Ex: Sheen 1. See below.
    d. Take a photo to document any unusual observations.
    e. NOTE: If the situation is complex with multiple odors, color and other visuals, fill out a detailed Color, Odor & Visual Indicators Datasheet for the outfall.

Color Severity Scale		**Odor Severity Scale**		**Visual Indicators Scale**	
0	None	0	None	0	None
1	Faint color in sample	1	Faint odor	1	Few/slight
2	Color clearly visible in sample	2	Odor easily detected	2	Moderate
3	Color clearly visible in outfall flow or creek	3	Odor noticeable from a distance	3	Excessive/severe

11. At any time, if you note a significant source of pollution (ex: large oil sheen, rushing water when it hasn't rained, very strong color or odor) immediately call one of the contact numbers listed below in the section "Contacts to Report Pollution".

12. Pack up equipment and clipboard and proceed to the next site, repeat steps 1-10.

13. Turn off the YSI meter after the last sampling site.

Back at the Lab

1. Create a digital copy of your datasheets using your smartphone, or any other method, to generate a clear, readable pdf (preferred), jpg, or HEIC file.

2. Email to woodc@umich.edu for data entry.

3. Put your datasheet in the appropriate file.

4. Clean & Store Equipment:
    a. Wipe YSI meter down with Clorox sanitizing wipes.
    b. Wipe YSI cable down with Clorox wipes.
    c. Remove gray vinyl probe cover and set it in white tub in an upside-down position.
    d. Knock out yellow sponge and leave in the tub, also.
    e. Place YSI probe into 1 qt storage container filled with pink pH 4 solution, in the tub.
    f. Wash sample cup and turbidity vials with a dilute mixture of DAWN dish soap and water. Place in tub to air dry.

Reporting Pollution

OIL SPILLS
Call immediately!

- WA Emergency Management Division (800) OILS-911 [(800) 645-7911]
- National Spills Response (800) 424-8802

OTHER POLLUTION
Including sick salmon

- Ecology Northwest Regional Office (Island, King, Ktsap, San Juan, Skagit, Snohomish, and Whatcom) (20) 594-0000 or nwroerts@ecy.wa.gov
- Ecology Southwest Regional Office (Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, and Wahkiakum): (360) 407-6300 or swroertrs@ecy.wa.gov

LOCAL STORMWATER HOTLINES

- Anacortes: (360) 293-1921
- Bellingham: (360) 778-7979
- Edmonds: (425) 771-0235
- Everett: (425) 257-8821
- Mukilteo: (425) 263-8088
- Oak Harbor: (360) 279-4764
- Shoreline: (206) 801-2700

OTHER HOTLINES

- Derelict Fishing Gear (Dept of Fish & Wildlife): (855) 542-3935
- Derelict Boats (Dept of Natural Resources): (360) 902-2628
- Large marine debris, creosote debris, abandoned boats: https://mycoast.org/wa
- Navigation Hazards (US Coast Guard Puget Sound): (206) 217-6200
- West Coast Marine Mammal Stranding Network: (866) 767-6114

Parameters - What they Indicate

Outflow: Flow in an outfall during dry weather is an indicator that a water source other than stormwater is flowing through the storm drainage system. It could be natural groundwater flow but could also be sanitary sewer cross-connection, potable water (swimming pool, hydrant flushing), or illegal dumping.

Color: The color of water is influenced by the presence or absence of substances such as metallic salts, organic matter, dissolved or suspended materials. Color can indicate when stormwater has been contaminated by an illicit discharge or illicit connection, but not all illicit discharges will have a color.

Odor: Odor should be assessed qualitatively in the field using your nose to determine if a water sample has a distinct smell. Odor observations are subjective and may include descriptions such as a petroleum, sewage, or chemical odor.

Visual Indicators: Visual indicators other than color, odor, and flow can often indicate when stormwater has been contaminated by an illicit discharge or illicit connection; however, not all illicit discharges will have visual indicators. Visual indicators are assessed qualitatively by field staff using simple visual observations. Ex: abnormal vegetation, algae/bacteria/fungus, deposits/staining, fish kills, floatable, surface film/sum/sheen, or trash/debris.

Water Temperature (T) °C: Temperature extremes can threaten the health and survival of fish and other aquatic species in many life stages including embryonic development, juvenile growth, and adult migration. Water temperature can be useful in identifying contamination by sanitary wastewater or industrial cooling water. Household and commercial sewage produces heat due to microbial activity during anaerobic decomposition, while industrial cooling water is heated as it is circulated through heat exchangers. Water temperature measurements are typically the most useful for IDDE when indicator sampling is being conducted during cold weather and temperature differences can be significant.

Dissolved Oxygen (DO) mg/L*:* DO is an important parameter for salmonids and other aquatic organisms. Low dissolved oxygen levels can be harmful to larval life stages and respiration of juveniles and adults. DO depends on local hydraulic conditions affecting the oxygenation of the discharge. For this reason, DO is not a widely useful indicator for illicit discharges.

Specific Conductivity (SPC) µS/cm*:* Specific conductivity, also referred to as specific conductance, is a measure of how well water can conduct an electrical current based on ionic activity and content. Specific conductivity is an indicator of dissolved solids from potential pollutant sources such as sewage and wash water, and can help distinguish groundwater from illicit discharges and identify commercial/ industrial liquid waste if used in combination with another parameter such as Hardness, Turbidity, or Detergents/Surfactants. Specific conductivity can also be used in combination with caffeine or pharmaceuticals (see Other Indicators) to indicate sanitary wastewater.

Salinity (ppt)*:* This is the saltiness or dissolved inorganic salt content of water. The Pacific Ocean has an average salinity of 34 parts per thousand (ppt) compared to 29 ppt in Puget Sound. Measuring salinity will indicate if there is saltwater intrusion in the outfall or creek which will affect conductivity (make it higher).

pH*:* pH measures the hydrogen ion activity on a scale from 1 to 14. Water with a pH below 7.0 is acidic and water with a pH above 7.0 is alkaline or basic. pH values that are lower than 6.5 or higher than 8.5 may be harmful to fish and other aquatic organisms. A low pH can cause heavy metals to leach out of stream sediments, resulting in an increase in dissolved metals concentrations. A high pH can produce a toxic environment, in which ammonia becomes more poisonous to aquatic organisms.

Turbidity (ntu): Turbidity is a measure of how transparent or clear water is based on the amount of sediment or suspended particulates. Large amounts of suspended material can affect fish growth and survival by impairing their vision, gill function, and affecting egg and larval development. Higher turbidity can also increase temperature and thereby decrease dissolved oxygen concentrations in water bodies, affecting the growth of both aquatic animals and plants. High turbidity in water can be attributed to many different sources including soil erosion, construction activities, sanitary wastewater, excessive algal growth, or industrial processes.

E. coli and Enterococci **Bacteria (cfu/100 ml)**: These bacteria indicate the presence of fecal contamination by warm-blooded animals. *E. coli is* typically used as an indication of fecal contamination of stormwater and fresh water systems while *Entero* is used as an indication of fecal contamination in marine waters. A relatively elevated test result for fecal coliform bacteria may indicate an illicit discharge or illicit connection associated with sewage or a failing septic system. However, it may also indicate waste related to large domestic animals (such as cows, llamas, etc.), pets, or wild animals.

References

- WA Stormwater Center: https://www.wastormwatercenter.org/
- Stormwater Action Monitoring (SAM) Program
- IC-ID Field Screening and Source Tracing Manual May 2020
- COB Surface and Stormwater and Comprehensive Plan 2020

CHECKLIST
Field Monitoring Procedure

Salish Sea STORMWATER MONITORING

First of the month

- ☐ Check daytime low tide dates for your town.
- ☐ Select your day & reserve equipment.

Before you head out

- ☐ Print out Stormwater Monitoring Datasheets: https://stormwater-salishsea.org/
- ☐ Fill out top of Field, Test Strip & Bacteria Datasheets.
- ☐ Determine rainfall for the past 24 hours: www.weather.gov. Enter your town in the box, select the closest weather station, hit enter. From options on the right, select 3-day history. Find your start time in the table.
- ☐ Assemble equipment and instruments.
- ☐ Turn on your YSI meter.

In the field, at each outfall

- ☐ Record your arrival time.
- ☐ Record the flow & air temps.
- ☐ **Bacteria**: Collect bacteria samples. Rinse container 3x & keep 4th fill.
- ☐ **Turbidity:** Rinse vial 3x & keep 4th fill.
- ☐ Wipe vial with microfiber towel to remove water, debris, & finger prints.
- ☐ Invert vial 3x gently & insert into meter. Record data on datasheet. If meter reading is 00.0, invert vial 3x gently again & re-read.
- ☐ **Water Quality Test Strips**: Follow procedure on datasheet.
- ☐ **YSI Meter:** Dip probe in water sample & stir gently for 15 seconds.
- ☐ Record readings on datasheet.
- ☐ **DO** will take longest. Swirl/stir probe quickly, but slow enough not to spill sample. When DO increases or decreases slightly in a random pattern record the value.
- ☐ **Observations of outfall or creek.** Record color, odor & visual indicators.
- ☐ Leave YSI meter on between sites.

Back at the lab

- ☐ Complete datasheet. Include end time.
- ☐ Photograph datasheets with smartphone & send to **woodc@umich.edu; pdf preferred.**
- ☐ Rinse out sample cup & vial of any sediment or debris.
- ☐ Turn off YSI meter & wipe instrument with clorox wipes. Remove grey vinyl probe cover and place probe in pink storage solution.

Equipment Checklist

- ☐ Map of sites
- ☐ Clipboard
- ☐ Datasheets for Field, Test Strips & Bacteria
- ☐ Field notebook
- ☐ Pen/pencil/Sharpe
- ☐ Hand sanitizer
- ☐ Plastic gloves
- ☐ YSI instrument – turn on before packing in backpack
- ☐ Field thermometer
- ☐ Sampling cup or bucket
- ☐ Sampling pole
- ☐ Phone
- ☐ Turbidity meter, vial, and cloth
- ☐ Water Quality Test Strips, test tube, distilled water
- ☐ Bacteria sampling containers
- ☐ Cooler and icepack for bacteria samples
- ☐ Backpack