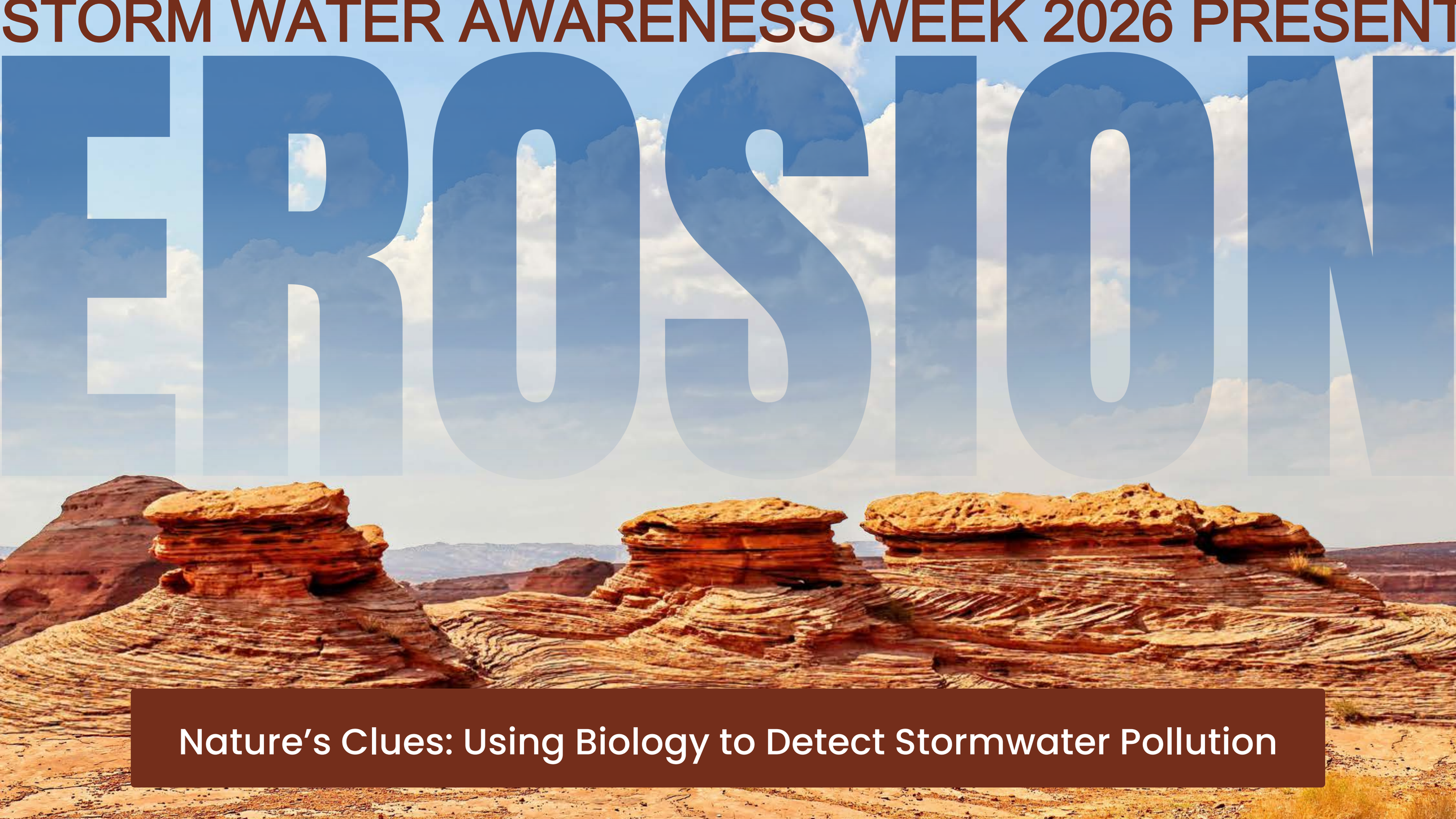
STORM WATER AWARENESS WEEK 2026 PRESENT

EROSION



Nature’s Clues: Using Biology to Detect Stormwater Pollution





- Recognizing nature’s clues can help spot early signs of stormwater/pollution issues before lab results are available.

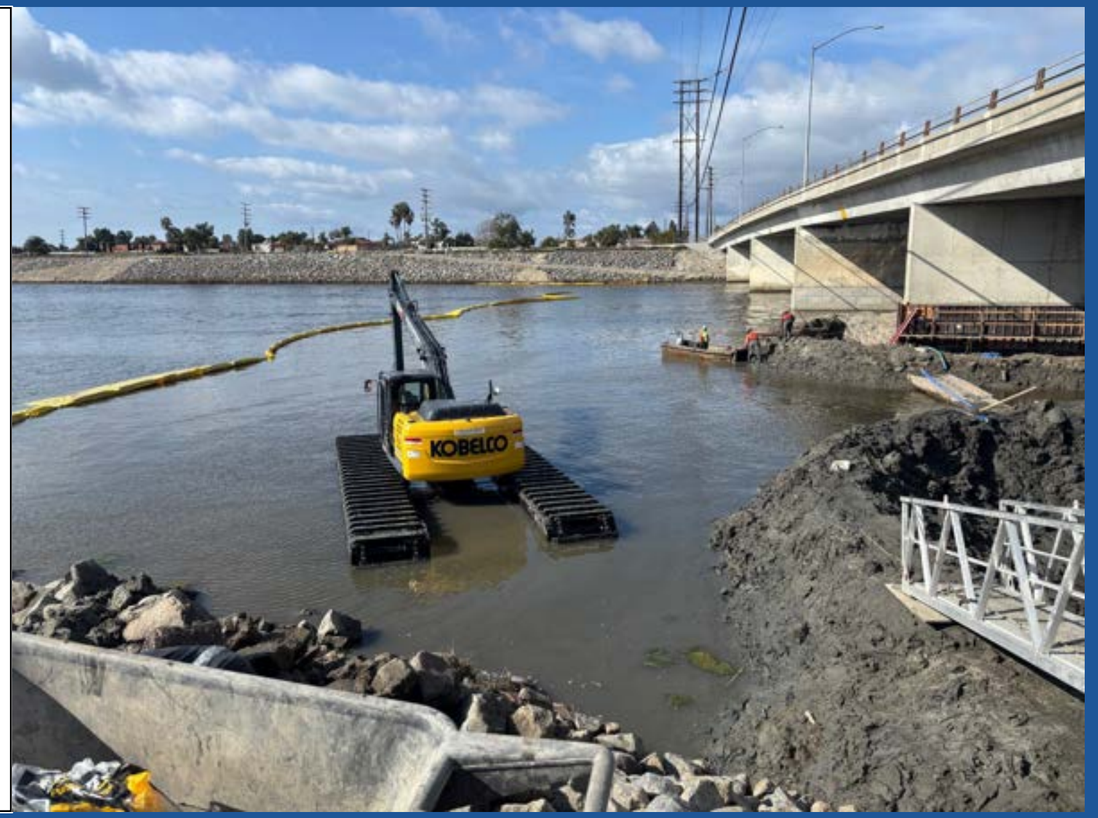
- The objective is to incorporate these indicators into our inspection matrix to guide decision-making.





FOLLOWING THE CLUES IN STORMWATER

Sometimes the answer is obvious …




Sometimes it’s a mystery …

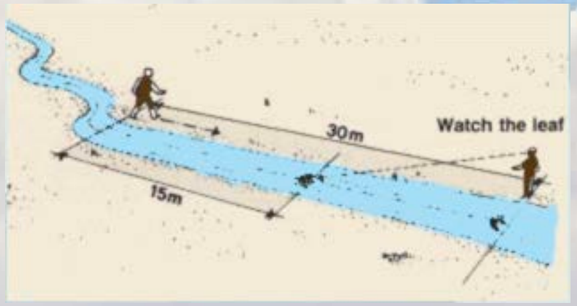
Clue #1: Where Did That Come From?

What you see	What it looks like	Bio-Connection	What to look for
Turbid conditions, trash/debris, eroded areas, standing water, clogged drains	Water came through the site	Vegetation stressed/smashed, leaf litter, fresh silt/mud deposits (even if dry)	High-water lines, key pollution indicators

- Check current weather apps/web pages
- Check upstream and downstream
- Perform a flow test for increased flow and speed

How do you know?

Leaf Test





1) Find a straight section of the creek where water is flowing unimpeded
2) Measure a set distance (10 – 20 feet)
3) Mark start and end points
4) Drop leaf and time (in seconds) to travel from start to finish
5) Perform the test a few times
6) Calculate the average time
7) Calculate the velocity
8) Velocity = Distance/Average Time
9) Example = 10 feet distance/average of 5 seconds = 2 feet per second
10) Increase/Decrease in velocity can tell you the story

Need a Baseline

Clue #1: Where Did That Come From?

What is Nature Telling You?

Soils will tell you how they handle water.

Soil Type	Primary Visual/Physical Clue	Stormwater Behavior	Best Use / Solution
Arid	Light color, cracked surfaces, dusty or rock-hard texture.	High flash-flood runoff caused by surface crusts and water repellency.	Catchment basins, shallow swales, and rainwater harvesting.
Clay	Deep cracks when dry; sticky dough when wet.	High runoff, long-lasting surface puddles, low drainage.	Soil amendments, bioretention with underdrains.
Compacted	Rock-hard surface, patchy grass, instant puddles.	Acts like concrete; causes immediate, heavy surface runoff.	Deep tilling, mechanical aeration, deep-rooted plants.
Organic	Deep black/dark brown, spongy texture.	Soaks up huge volumes of water and releases it very slowly.	Landscape conservation, natural flood mitigation.
Sand	Gritty, won't hold shape, dries instantly.	Perfect drainage, zero runoff, risks groundwater pollution.	Natural filter beds, pollutant-trapping mulch layers.
Saturated	Grey/blue hues (gleying), rusty spots, soft or muddy texture.	Zero infiltration capacity; groundwater table is already at the surface.	Constructed wetlands, subsurface French drains, water-tolerant plants.

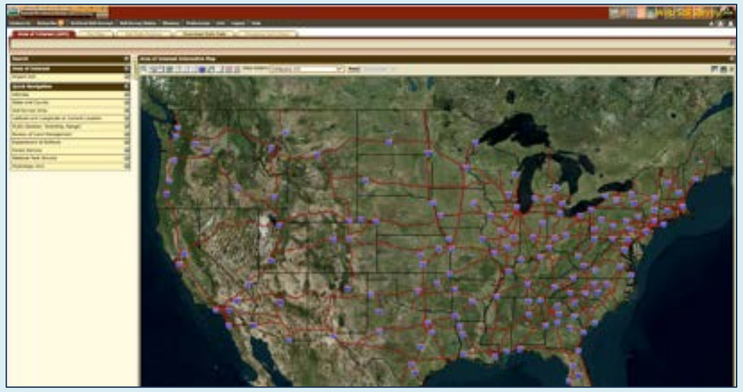
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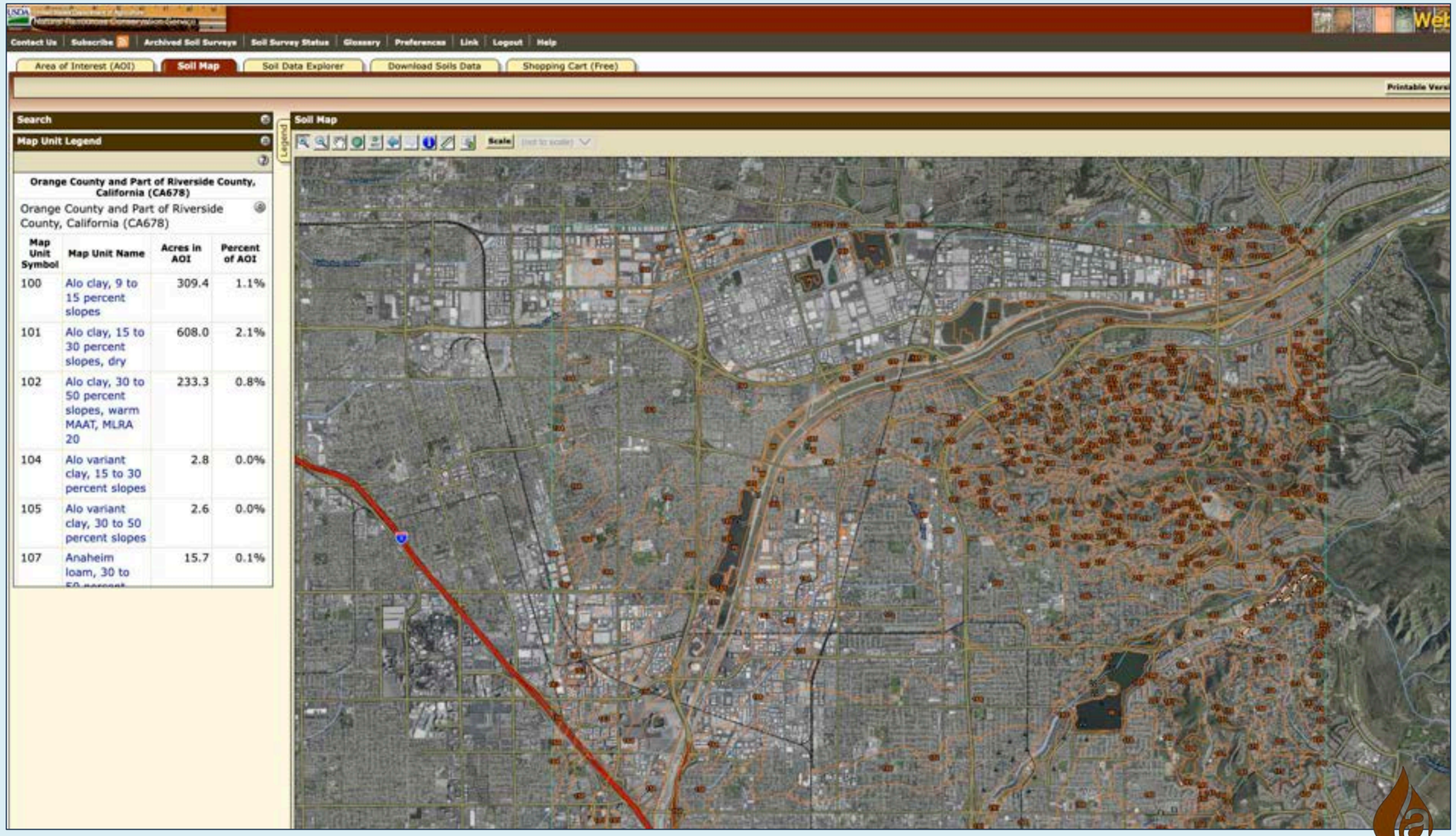
Soils will tell you a clear story about how it handles water.

websoilsurvey.nrcs.usda.gov/app/Web





How do you know?



Clue #1: Where Did That Come From?

When to Worry



- Plume with no rain
- Discoloration
- Oil sheen
- Foam or soap suds
- Foul odors
- Fish kill
- Look for Nature's Clues!



FOLLOWING THE CLUES IN STORMWATER

Clue #2: Natural Sheen vs. Petroleum Sheen

What you see	What it looks like	Bio-Connection	What to look for
Rainbow/oily sheen	Petroleum spill	Decomposing vegetation and microbial activity can produce a sheen	Sheen breaks into patches when disturbed rather than flowing/reforming like petroleum

How do you know?

Petroleum sheen typically moves and reforms, creating a continuous, rainbow-like film.

When disturbed, biogenic sheen film often breaks into plates or fragments and does not immediately flow back together.



Stick Test



Perform the field disturbance test (aka the stick test).

Clue #2: Natural Sheen vs. Petroleum Sheen

What is Nature Telling You?



- Slow-moving or stagnant waters
- In drainage areas receiving runoff from vegetated soils
- Can look more milky-white or tan in color
- Tree leaf litter can produce a sheen– oils from Eucalyptus, Cypress, Conifers



Clue #2: Natural Sheen vs. Petroleum Sheen

When to Worry



- ✓ Crude oil can appear black, red, or yellow
- ✓ Known discharge or spill
- ✓ Strong odors
- ✓ Gas is hard to recover.



Clue #3: Tar Balls

What you see	What it looks like	Bio-Connection	What to look for
Oily balls on sand	Oil spill	Natural seeps where oil slowly leaks out from underground reservoirs	Texture and consistency

How do you know?

Fresh crude oil or recent spill residue appears as sticky, soft, gooey, semi-liquid emulsions rather than solid, resilient nodules



Hard or crusty on the outside and soft and gooey on the inside, like a toasted marshmallow.

Natural tar balls are typically firm, highly weathered, and mixed with or embedded in sand, shell fragments, or debris.



Mostly coin-sized but can be as large as pancakes.

Clue #3: Tar Balls

What is Nature Telling You?



- Common in California, Washington, Oregon, Texas and Florida.
- Come from natural seeps on the ocean floor where oil slowly leaks out from underground reservoirs or oil spills.



1970's Beach Feet

Clue #3: Tar Balls

When to Worry





- ✓ Unusual amounts
- ✓ Strong petroleum smells
- ✓ Sheen on the water
- ✓ Widespread heavy coverage that might signal a major human-made oil spill rather than normal natural seepage

Clue #4: Foam & Bubbles

What you see	What it looks like	Bio-Connection	What to look for
Foam (differing colors), bubbles	Surfactant, chemical or industrial discharge	Natural surfactants released from decaying vegetation/organic matter	Leaf litter, accumulated organic matter, color, check for smells, location



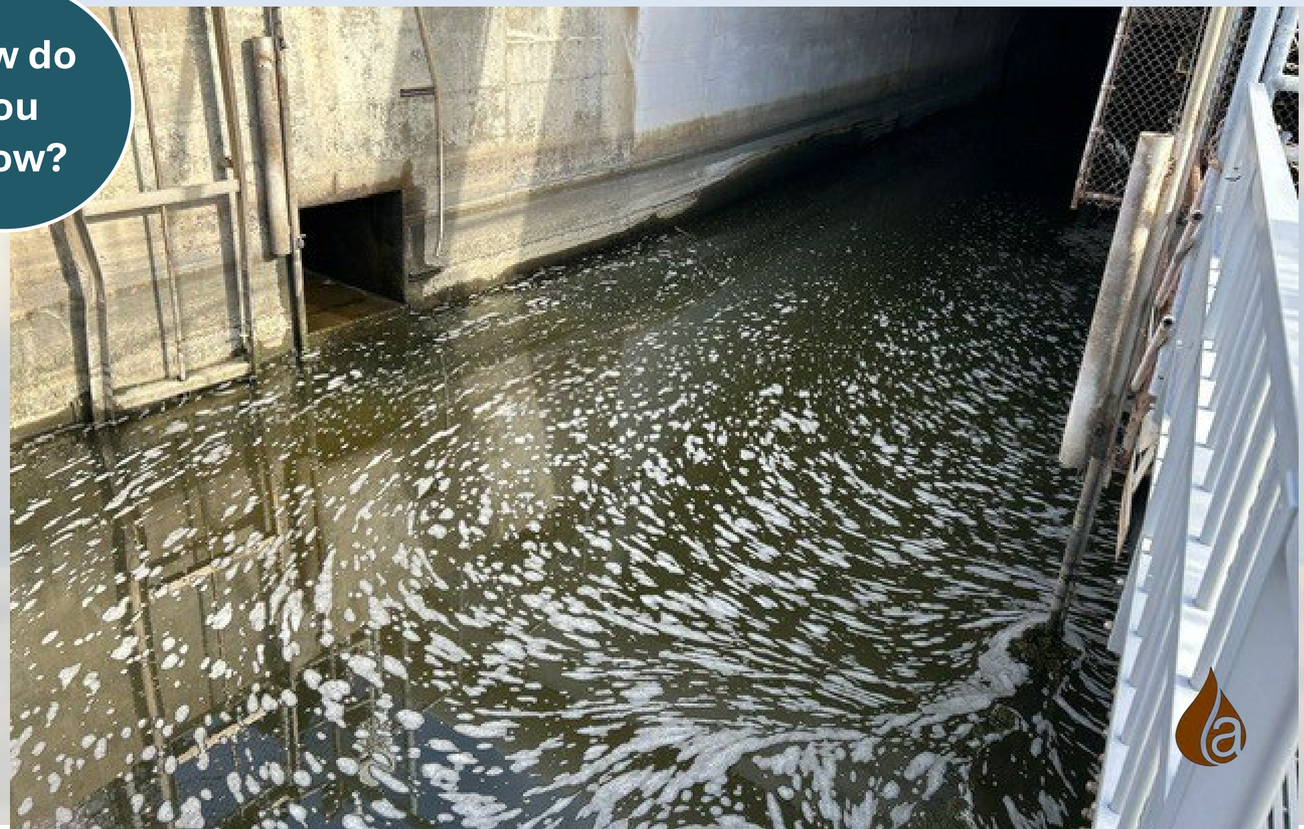
Detergent/chemical foam

- Often very bright white
- May remain even after the water becomes relatively calm.
- May have an unusual fragrance
- **<u>Forms persistent layers or sheets</u>**

Natural foams

- Often off-white or tan
- Occur where water is agitated
- Can have an earthy or plant-like appearance.
- **<u>Breaks down and dissipates quickly</u>**

How do you know?



Clue #4: Foam & Bubbles

What is Nature Telling You?



- Organic materials from plants, algae, and decaying vegetation
- Reflects turbulence, aeration, or gas released from sediments and biological activity.
- Foam at a turbulent outfall may be normal; foam appearing downstream of a pipe or drainage connection is questionable

How do you know?

Shake Test

- ✓ Take a medium-sized (0.5- 1 liter) sample of foamy water.
- ✓ Shake the water sample vigorously for at least 30 seconds.
- ✓ Natural foam will dissipate under agitation
- ✓ Detergent foams will increase.

Clue #4: Foam & Bubbles

When to Worry



Location
Associated with turbulent waters, natural riffles, pipes, or outfalls.

Foam downstream of a discharge pipe, wash area, industrial activity, or other potential source deserves closer investigation.



Clue #5: Tea-Colored Water

What you see	What it looks like	Bio-Connection	What to look for
Water has a tea/coffee/dark brown color	Industrial pollution	Leaves and other vegetation release tannins and humic substances as they decompose	Common in areas with wetlands, forests, leaf litter, and organic-rich soils.



Natural Tannins

- Nature’s fermentation process
- Water that is relatively clear rather than cloudy or oily.
- Color associated with leaves, bark, peat, mulch, or decaying vegetation upstream.
- A gradual increase in color after rainfall or runoff through vegetated/wooded areas.
- No obvious sheen, unusual odor, chemical residue, or visible discharge source.
- Color does not appear as a concentrated plume from a pipe or outfall.

Clue #5: Tea-Colored Water

What is Nature Telling You?





- Indicates dissolved organic matter
- Stormwater can wash tannins from vegetation and organic soils into streams, ditches, and ponds.
- Decomposition of organic matter can affect dissolved oxygen and other water-quality parameters

Clue #5: Tea-Colored Water

When to Worry

Common look-alikes

- ✓ Sediment runoff
- ✓ Dissolved or oxidized iron
- ✓ Industrial discharges
- ✓ Sewage or wastewater
- ✓ Certain dyes or chemical releases

Clue #6: Orange-Rust Sludge

What you see	What it looks like	Bio-Connection	What to look for
Orange/rust-colored deposits on streambed, mats, groundwater seeps	Industrial pollution	Naturally occurring iron-oxidizing bacteria and iron minerals	Often appears as orange, red, or rusty coatings around seeps or streambeds



Iron oxide from groundwater often appears as a fluffy, slimy, or rust-colored deposit rather than a hard metallic crust.

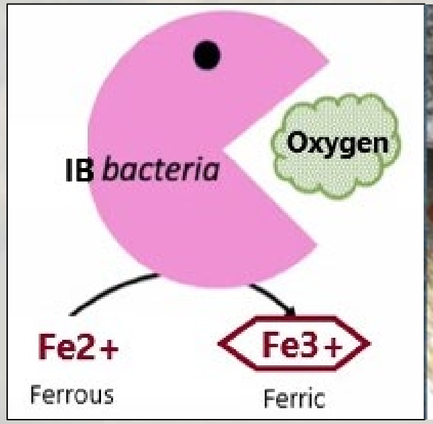


Clue #6: Orange-Rust Sludge

What is Nature Telling You?



- ✓ You've got groundwater
- ✓ Dissolved ferrous iron in oxygen-poor groundwater turns into insoluble ferric iron (rust) immediately upon contact with atmospheric oxygen at the surface.





Clue #6: Orange-Rust Sludge

When to Worry

- ✓Fails the stick (field disturbance) test
- ✓Sludge smells like sewage, rotten egg, sulfur, or gas
- ✓Known runoff from active digging, exposed metal materials, or acid mine drainage
- ✓If the orange sludge or discolored water does not go away after the storm clears and happens during dry weather
- ✓Dead Wildlife (fish, frogs, or insects in or near the water).
- ✓Discharge from Active Construction Sites
- ✓Discharge from industrial areas (factory, scrap yard, or auto repair shop, it could contain heavy metals or toxic runoff).



On August 5, 2015, Colorado's Animas River turned orange. The color change was caused by the accidental release of 3 million gallons of polluted water from an abandoned gold mine near Silverton, Colorado.

Clue #7: Green Water

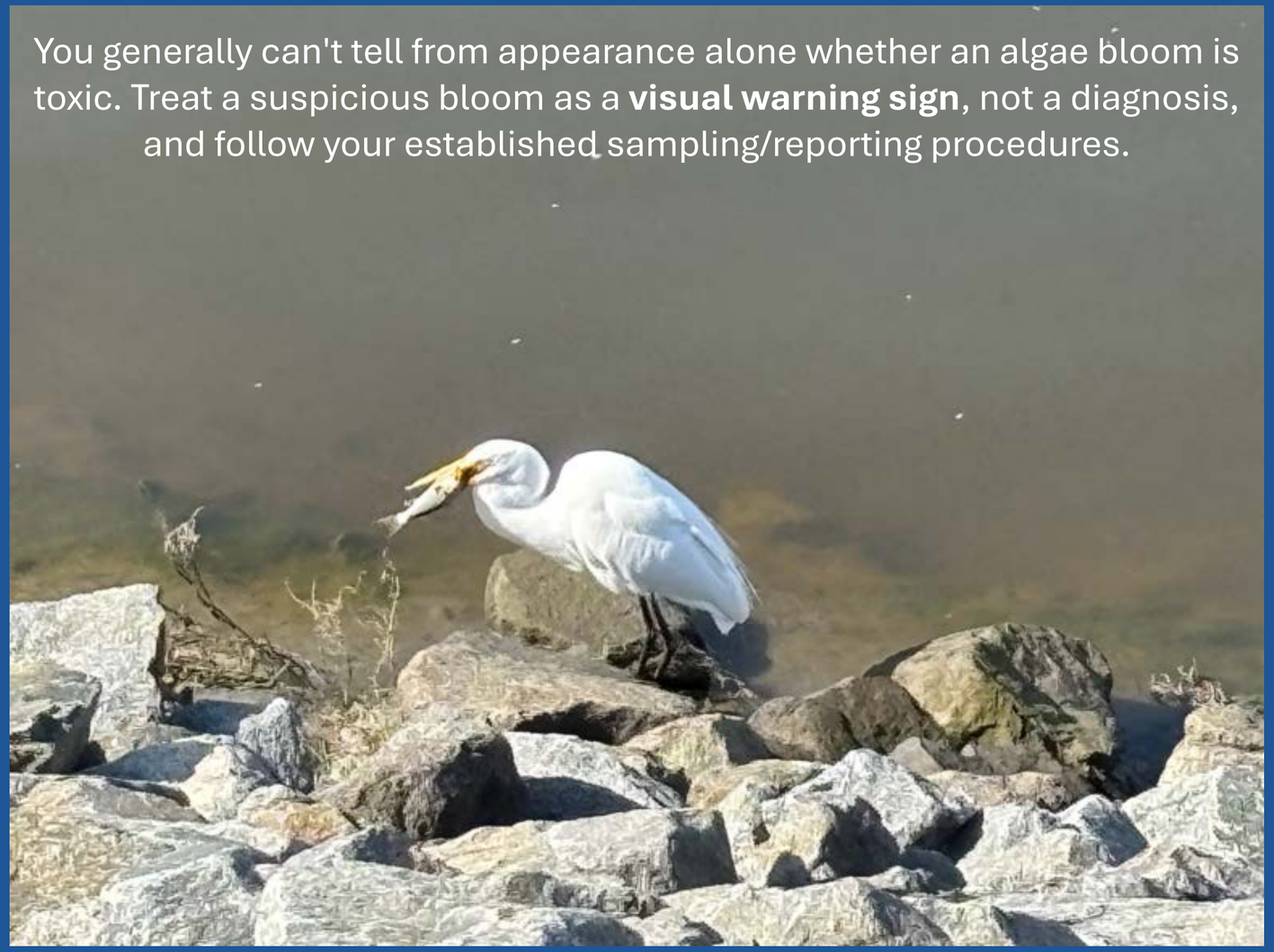
What you see	What it looks like	Bio-Connection	What to look for
Water is green	Chemical/nutrient pollution	Blooms are naturally occurring phenomena created by the growth of large amounts of algae or phytoplankton	Algal mats, floating algae, or increased growth in warm/stagnant water



- ✓ These blooms can come in a variety of colors and are easily mistaken for paint or oil depending upon the species.
- ✓ Growth commonly occurs during periods of warm temperatures and in nutrient-rich waters.
- ✓ Blooms will have either no scent or a grassy and/or fishy odor.
- ✓ Pollution will often have the scent of oil, gasoline, and/or chemicals.

Clue #7: Green Water

What is Nature Telling You?



- ✓ **Warm water**
- ✓ **Poor water circulation**
- ✓ **Excess nutrients**
- ✓ **Potential oxygen problems**
- ✓ **Changing water quality**
- ✓ **Possible harmful algal blooms (HABs)**

Clue #7: Green Water

When to Worry



- ✓ Known contaminate (nutrients, grass clippings)
- ✓ Strong or unusual odors.
- ✓ Large amounts of dead fish or other aquatic life.
- ✓ Sudden or rapid growth - especially if it wasn't there during previous inspections.
- ✓ Bright green, blue-green, or unusual coloration on the water surface.
- ✓ A bloom occurring after a storm or near a suspected nutrient or pollutant source.
- ✓ Signs that the bloom is spreading or getting significantly worse.

Clue #8: Pollen Paint

What you see	What it looks like	Bio-Connection	What to look for
Yellow, powder, swirls	Paint spill	Pollen from Pine, Oak, Eucalyptus, Sycamore can look like paint	Is it along the shore, in corners, behind vegetation or in calm areas.

Pollen can look surprisingly similar to paint floating on water because it is lightweight, naturally water-repellent, and tends to collect at the surface.

- ✓ Yellow, green or tan
- ✓ Powdery, dusty, or clumped
- ✓ Collects in corners and along edges; may move with wind
- ✓ No odor
- ✓ Seasonal near trees and vegetation



How do you know?

Stick Test

Smell Test

Clue #8: Pollen Paint

What is Nature Telling You?

- ✓ Spring has sprung!
- ✓ Do see it in So Cal in Fall with Santa Ana Winds clearing out trees
- ✓ Wind carrying pollen onto the water
- ✓ Rain washing pollen from streets, roofs, and vegetation into storm drains and waterways



Clue #8: Pollen Paint

When to Worry

- ✓ Fails the stick and smell tests
- ✓ A sudden or unusual change in water color or clarity
- ✓ Dead or distressed fish or wildlife
- ✓ Visible solids, trash, sewage-related debris, or sediment
- ✓ A suspicious discharge coming from a pipe, drain, ditch, or outfall
- ✓ Something that doesn't fit the natural conditions of the site



Clue #9: Concrete?

What you see	What it looks like	Bio-Connection	What to look for
White/grey deposits	Concrete, cement or industrial materials	Mineral precipitation of carbonate deposits	Deposits occurring along seeps, rocks or stream margins

Natural sediment (quartz, dolomite, feldspar, gypsum)

- ✓ Grey, tan, beige, or brown
- ✓ Deposits in slower water, pools, edges
- ✓ Can leave a thin muddy/silty coating
- ✓ Often becomes clearer as particles settle



How do you know?

pH Test

Concrete/cement discharge

- ✓ Opaque white/gray
- ✓ May have a more uniform, slurry-like appearance
- ✓ Look for an identifiable concrete-related source
- ✓ Very high pH



Clue #9: Concrete?

What is Nature Telling You?



- ✓ Mineral-rich soil
- ✓ Clay particles and fine silts creating a smooth, cement-like appearance
- ✓ Accumulated dust from roads, roofs, yards, and other surfaces washed into drainage systems
- ✓ Strong water movement suspended particles instead of allowing them to settle.
- ✓ Construction, grading, erosion, or heavy foot/vehicle traffic

Clue #9: Concrete?

When to Worry

- ✓ Very high, persistent milky-white/gray color
- ✓ Visible concrete residue or chunks
- ✓ A discharge coming directly from a construction or concrete-related area
- ✓ Strongly elevated pH
- ✓ A defined plume coming from a specific outfall
- ✓ Evidence of recent concrete washing, cutting, grinding, or equipment cleanup



Clue #10:Critter Connections

Critters can be useful biological clues, especially when you notice a sudden change from what is normally present.
NOTE: A single species usually isn't proof of pollution.

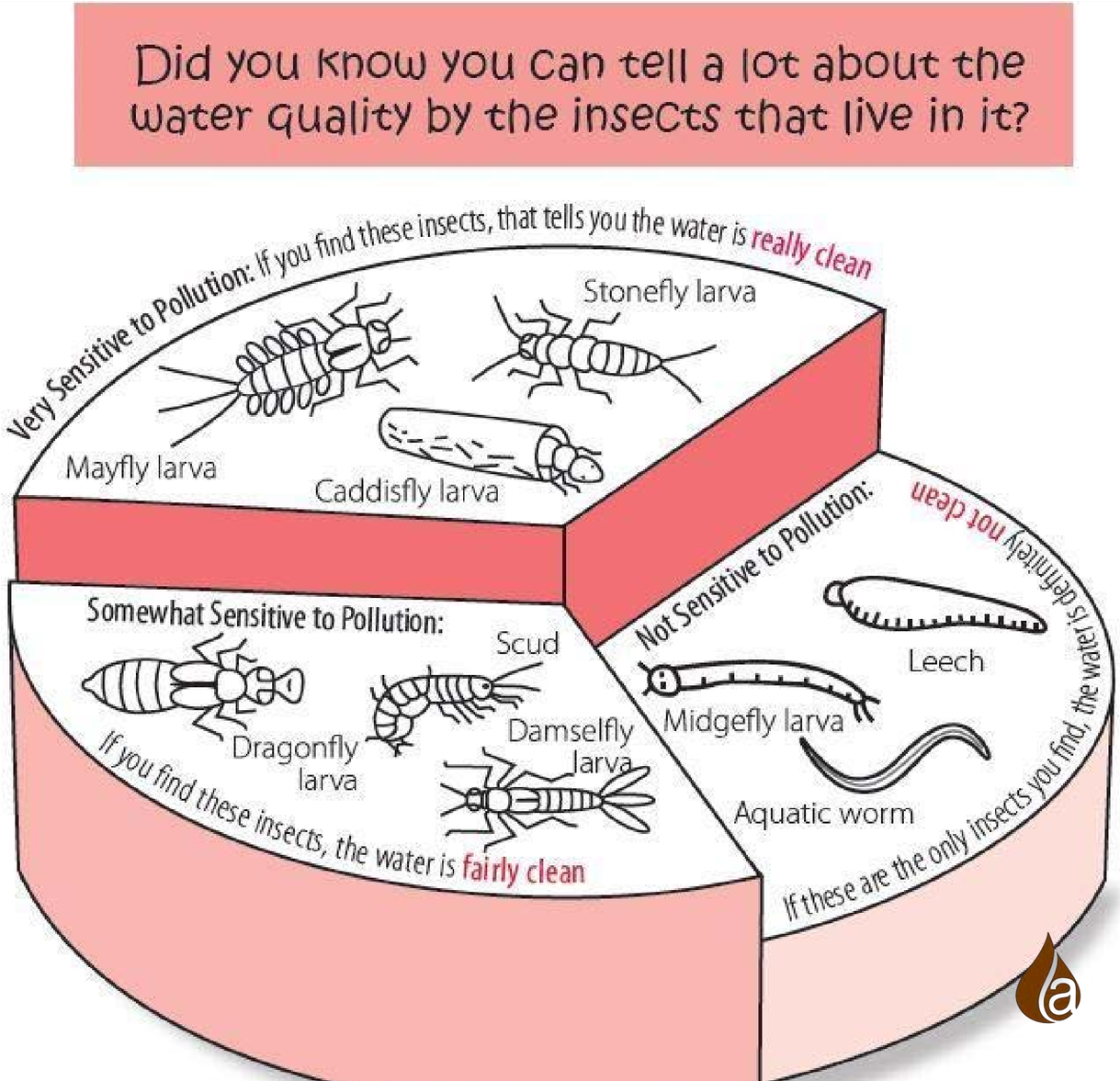
Aquatic insects can be better indicators than simply looking for dead animals.

- ✓ Some organisms are sensitive to pollution and low oxygen, while others are much more tolerant.
- ✓ A stream dominated by tolerant organisms while lacking sensitive insects can indicate changes in water quality.

The Top Three (most sensitive)
Mayflies • Stoneflies • Caddisflies

More tolerant:
Midge larvae • Worms • Some snails

- ✓ Absence or abundance alone doesn't prove stormwater pollution.
- ✓ Temperature, season, habitat, flow, and natural conditions also affect what you find.



Clue #10: Critter Connections

What is Nature Telling You?

Tiny critters & larvae

- Mayfly, Stonefly & Caddisfly
- Midge & Mosquito larvae
- Dragonfly & damselfly nymphs
- Water beetles & boatmen
- Aquatic worms
- Leeches

•\



Snails & other crawlers

- Freshwater snails
- Clams
- Crayfish
- Freshwater shrimp/scuds
- Water mites



Larger critters

- Fish
- Frogs
- Tadpoles
- Salamanders
- Turtles

Common Critters



Clue #10: Critter Connections

What is Nature Telling You?

Dead or distressed fish	Low oxygen, temperature stress	Toxicity
Unusual number of birds	Contribute to fecal bacteria	Large congregations worth watching
Sudden abundance of flies	Decaying organic matter	Worth watching
Excessive snails or other tolerant organisms	Nutrient-rich waters	Disturbed conditions

Clue #10: Critter Connections

When to Worry

- ✓ Dead or distressed fish (fish kill)
- ✓ Dead frogs, tadpoles, or other aquatic life
- ✓ Large numbers of midges, worms, or other tolerant organisms with other signs of stress
- ✓ Sudden changes in the types or numbers of aquatic insects
- ✓ Lots of algae with fewer aquatic animals
- ✓ Animals avoiding an area they normally use
- ✓ Critter changes are occurring along with other clues like odor, discoloration, foam and sediment

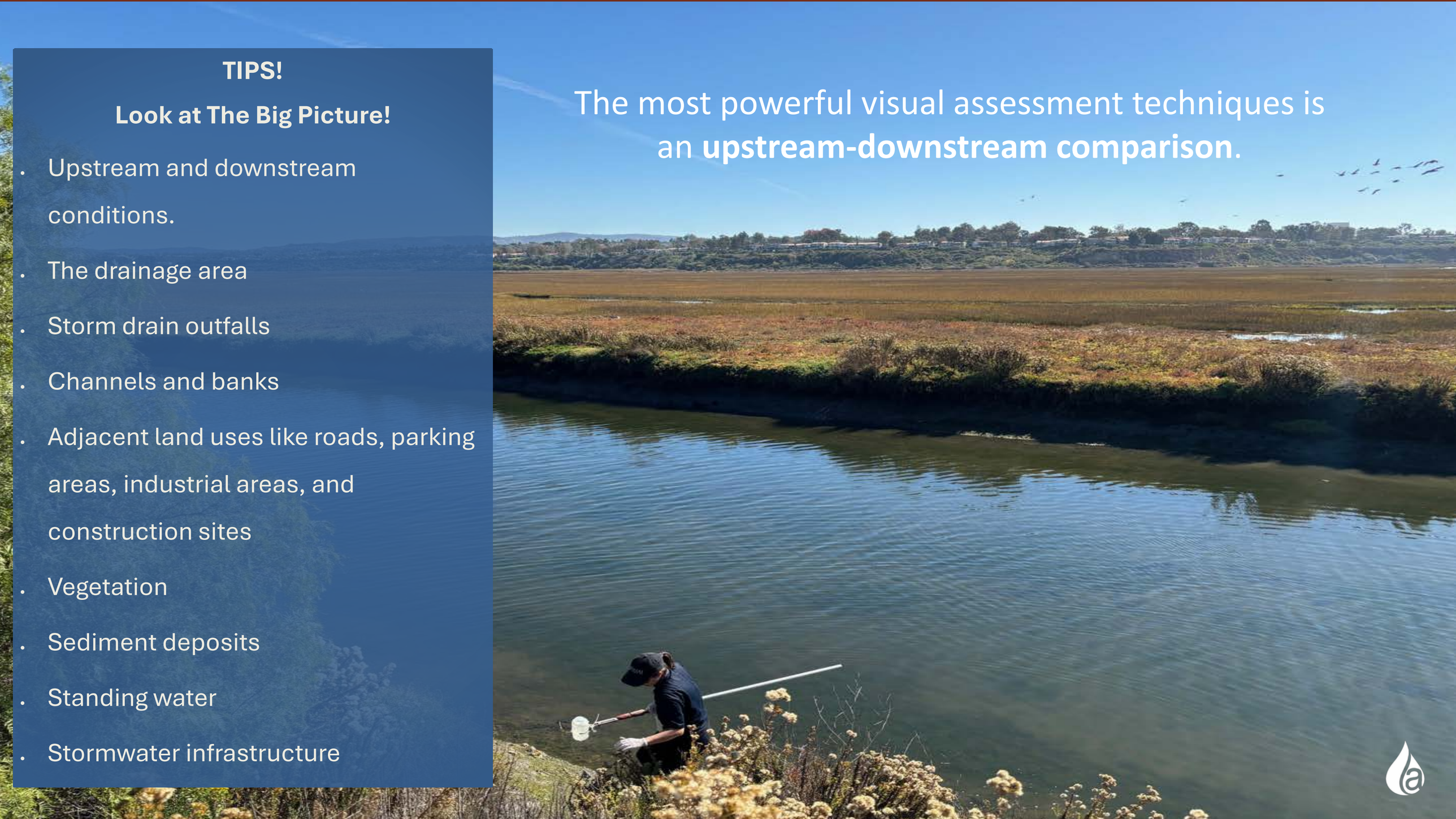


TIPS!

Look at The Big Picture!

- Upstream and downstream conditions.
- The drainage area
- Storm drain outfalls
- Channels and banks
- Adjacent land uses like roads, parking areas, industrial areas, and construction sites
- Vegetation
- Sediment deposits
- Standing water
- Stormwater infrastructure

The most powerful visual assessment techniques is an **upstream-downstream comparison**.



Visual assessments are the first-line screening tool in stormwater programs because they can quickly identify evidence of pollution, illicit discharges, erosion, habitat degradation, and BMP failure.

Ask Yourself:

- Does the water look normal for this location?
- Is there evidence of a recent stormwater discharge?
- Are pollutants entering the water?
- Is sediment being transported or deposited?
- Is there unusual color, sheen, foam, or odor?
- Are aquatic organisms or habitat showing signs of stress?
- Is a stormwater BMP functioning as intended?
- Is there evidence of an illicit discharge?
- Where might the pollutant be coming from?



FOLLOWING THE CLUES IN STORMWATER

The most important skill is not simply noticing something unusual. It is learning to recognize patterns, document observations, and connect those observations to potential causes.

TIP! Add a Simple Visual Assessment to Your Field Checklist

☐ **LOOK — What do you see?**

- ☐ Color
- ☐ Clarity
- ☐ Sediment
- ☐ Sheen
- ☐ Foam
- ☐ Trash/debris
- ☐ Algae
- ☐ Erosion
- ☐ Vegetation
- ☐ Aquatic life
- ☐ Other observations: _____

☐ **LISTEN — What do you hear?**

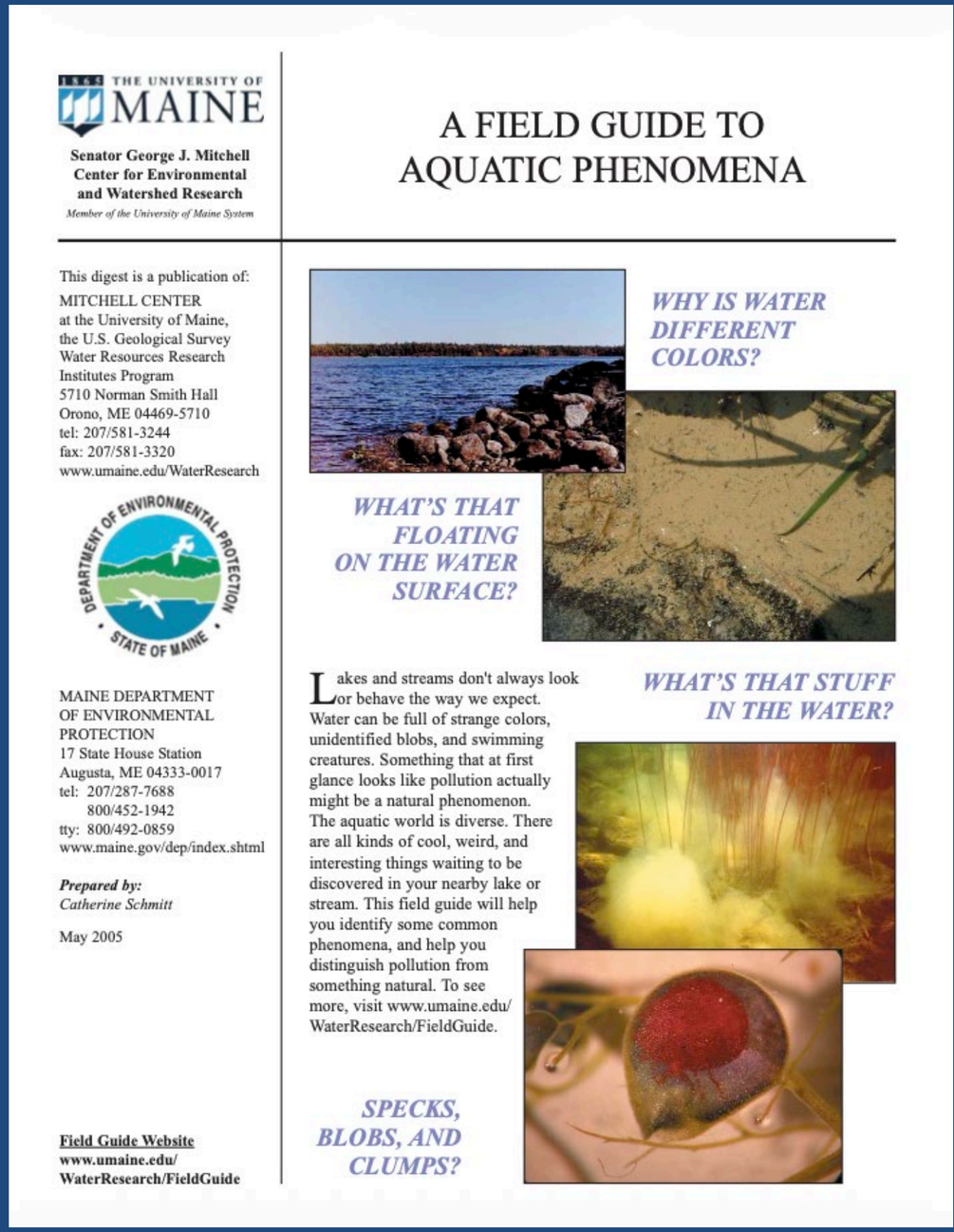
- ☐ Pumping
- ☐ Industrial operations
- ☐ Discharge activity
- ☐ Flow through pipes
- ☐ Construction activity
- ☐ Other: _____

☐ **SMELL — Is there an unusual odor?**

- ☐ No unusual odor
- ☐ Sewage
- ☐ Petroleum/fuel
- ☐ Chemical
- ☐ Organic
- ☐ Other: _____

☐ **COMPARE — How does the site differ?**

- ☐ Upstream
- ☐ Downstream
- ☐ Nearby reference locations
- ☐ Previous inspections
- ☐ Other comparison: _____



THE UNIVERSITY OF MAINE

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May 2005

Field Guide Website
www.umaine.edu/WaterResearch/FieldGuide

A FIELD GUIDE TO AQUATIC PHENOMENA

WHY IS WATER DIFFERENT COLORS?

WHAT'S THAT FLOATING ON THE WATER SURFACE?

WHAT'S THAT STUFF IN THE WATER?

SPECKS, BLOBS, AND CLUMPS?

Lakes and streams don't always look or behave the way we expect. Water can be full of strange colors, unidentified blobs, and swimming creatures. Something that at first glance looks like pollution actually might be a natural phenomenon. The aquatic world is diverse. There are all kinds of cool, weird, and interesting things waiting to be discovered in your nearby lake or stream. This field guide will help you identify some common phenomena, and help you distinguish pollution from something natural. To see more, visit www.umaine.edu/WaterResearch/FieldGuide.

https://dep.wv.gov/WWE/getinvolved/sos/Documents/SOPs/FieldGuidetoAquaticPhenomena.pdf?utm_source=chatgpt.com

Nature’s Clues can be used to support adaptive management practices by stormwater managers.



Potential Stormwater Management Strategies Include:



- Green infrastructure.
- Bioretention.
- Infiltration practices.
- Sediment controls.
- Riparian restoration.
- Improved source controls.
- Industrial stormwater controls.
- Illicit discharge detection and elimination.
- Watershed-scale restoration.

Key Takeaways

- **Look beyond the water itself.** Examine outfalls, banks, sediments, vegetation, habitat, and surrounding land uses.
- **Establish a baseline.** Knowing what normal looks like makes unusual conditions easier to recognize.
- **Look for changes.** Upstream/downstream comparisons can reveal where impacts begin.
- **Don't rely on one visual clue.** Color, odor, sheen, foam, or turbidity alone rarely identifies a pollutant with certainty.
- **Consider timing.** Weather, rainfall, season, and flow conditions can dramatically affect what you see.



FINAL THOUGHTS



- ✓ Apply nature’s clues to your stormwater assessments to support practical stormwater decisions.
- ✓ No single dataset necessarily tells the entire story.
- ✓ The strength comes from connecting the evidence.

Knowledge Check!



THANK YOU!

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