



DENVER
PUBLIC WORKS

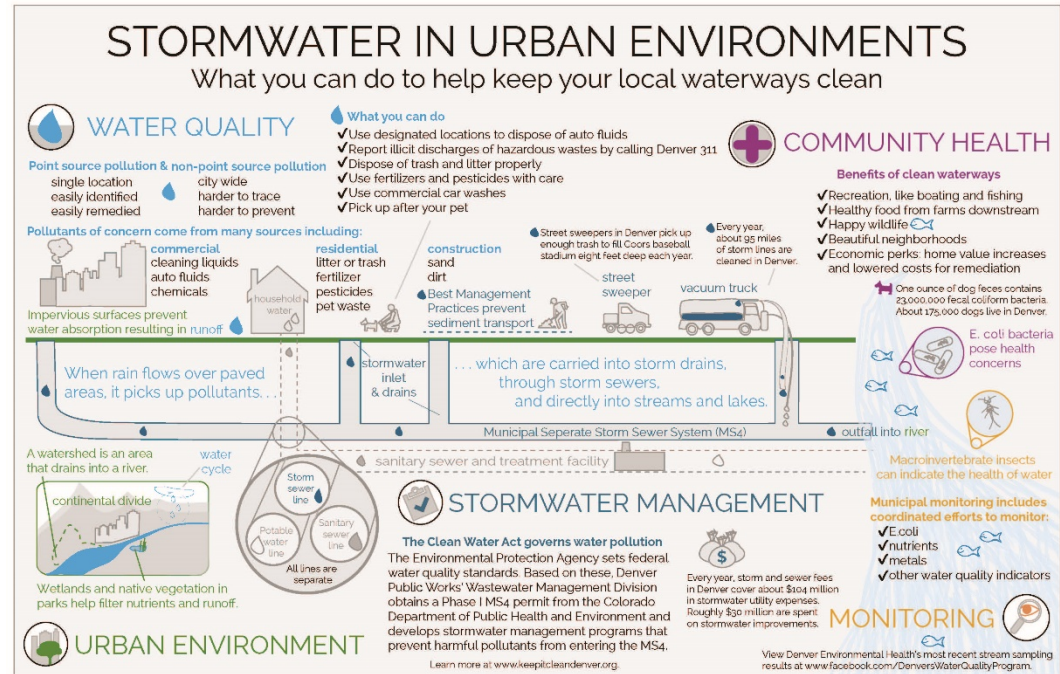
MS4 ?

**More \$ for
You**

Donny Roush, CMEE
Stormwater Education & Outreach

MS4 =

Municipal Separate Storm Sewer System



The U.S. Clean Water Act's 1987 amendments established rules for stormwater and created a new type of permit, called Municipal Separate Storm Sewer Systems (MS4s). Amazingly, "education and outreach" was a required MS4 component.

Today, the nation's 7,500 MS4s cover lands on which 80% of the country's human population lives, even while encompassing only 4% of total land area. Because MS4s coincide with the most urbanized places and cost billions in civic infrastructure, stormwater has emerged as a pressing urban issue – and a significant opportunity for EE entrepreneurs.

I convene this roundtable to learn of others' work with MS4s and to share the story of development, and consequent institutionalization, of Denver's stormwater education program.

For framing, I will:

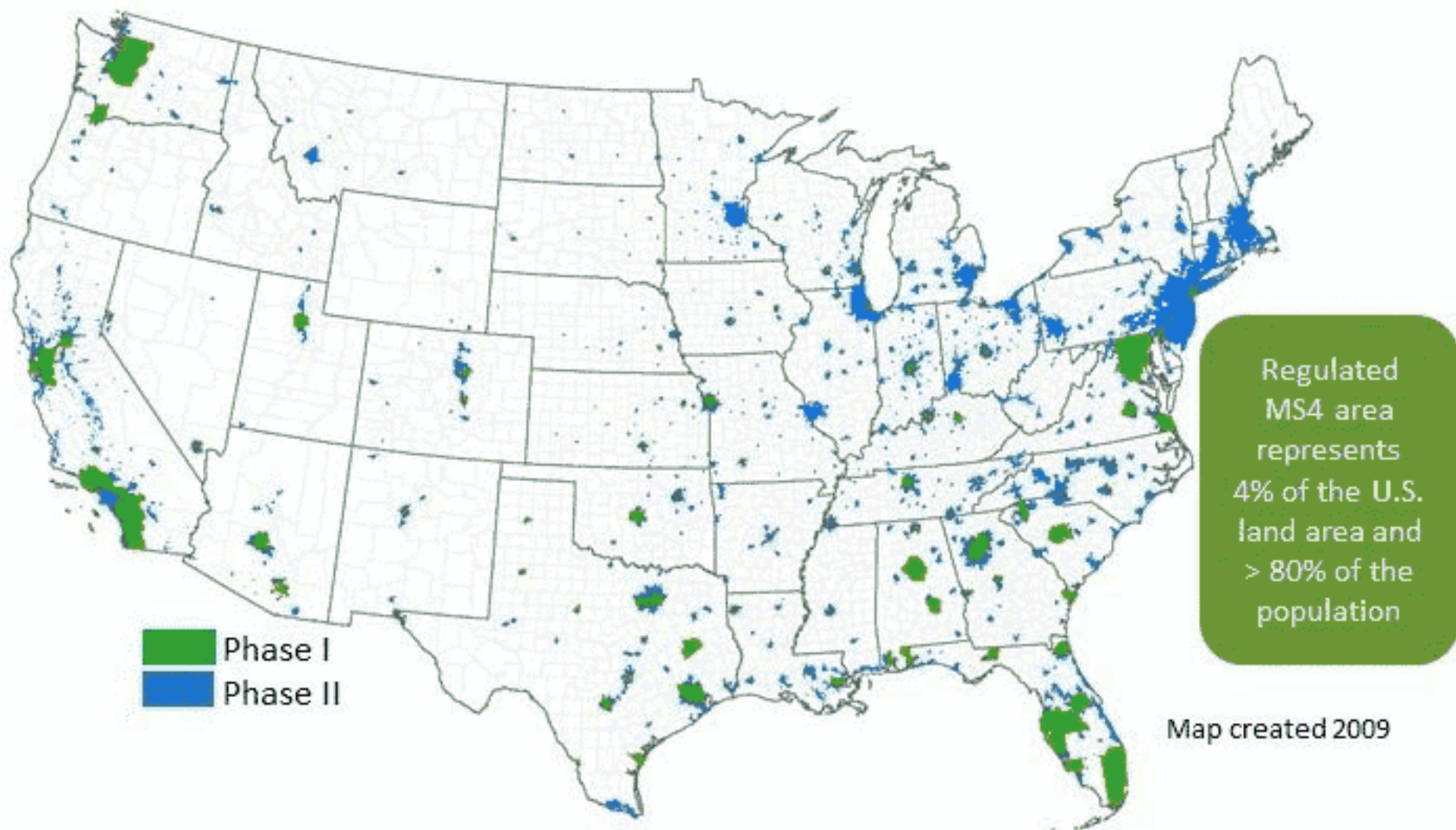
1. Offer basic definitions and concepts:
 - Stormwater is precipitation falling in a city, conveyed by publicly-owned curbs, gutters, drains, pipes, culverts and ditches.
 - Runoff is stormwater plus whatever pollutants it picks up during conveyance.
 - MS4s are almost always managed by engineers with little-to-no experience with EE.
 - MS4s aren't connected to sanitary sewers, so stormwater receives no industrial treatment before discharging into natural, surface waters.
 - With stormwater, little things add up. Water quality suffers from collective contributions of pet waste, litter, excess fertilizer and vehicular secretions. Environmentally responsible individual behaviors matter, and are the educational outcome MS4 managers want.
2. Tell (briefly) the story of Denver's program, which includes a full-time EE position and reaches 10,000 K-12 students.
3. Invite others with MS4 experience to share stories and advice.

Denver's program operates on 0.2% of the MS4 budget of \$60 million. (A healthy EE program carved out with what's almost a rounding error!) I contend many other MS4s could do the same, with the right EE introductions and propositions.

Time permitting, we can also explore:

1. How to encourage engineers and educators to collaborate more.
2. How MS4s commonly lump outreach and education, and why drawing a distinction leverages EE excellence.
3. How municipal objectives simultaneously meet educational needs of urban youth, equity and civic engagement.
4. How Next Generation Science and Common Core feed rationale for robust MS4 education programs.

National Map of Regulated MS4s





Keep It Clean Education and Outreach 2017 Annual Report

a Denver Public Works - Earth Force partnership

Under the federal Clean Water Act, the City and County of Denver holds a permit for its stormwater system. A required component of the City's "MS4" (municipal separate storm sewer system permit) is *education and outreach*. Since 2003, Denver Public Works has partnered with nonprofit Earth Force on this work. In 2012, they reimagined their partnership to focus more on K-12 education. Though traditional outreach elements remain, a new youth education approach was created in response to Next Generation Science Standards, the South Platte Urban Waters Federal Partnership, and Denver's 2020 Sustainability Goals. Donny Roush, a certified master environmental educator, administers Keep It Clean for Denver Public Works.

Keep It Clean Denver's 2017 achievements include:

Education

- **12,485 K-12 students reached**
- **406 lessons and field activities facilitated**
- **16 new classroom teachers trained**
- **6 water quality field trips & 4 vacuum truck demonstrations led**
- **827 World Water Monitoring Challenge tests performed**
- **2 formal partnerships with The Greenway Foundation's South Platte River Environmental Education (SPREE) program and Earth Force managed**

Outreach

- **32,251 Denver residents via 5 events**
- **5,483 dog waste bag dispensers distributed**
- **44,014 views of "Day in the Life of a Vacuum Truck" video on YouTube**
- **4 professional presentations for Colorado Association of Stormwater and Floodplain Management, North American Association for Environmental Education, Cherry Creek Stewardship Partners and South Platte River Urban Waters Federal Partnership**



How do we teach a new generation of water stewards? This is the guiding question of our K-12 education curriculum, “KIC-NET” (Keep It Clean – Neighborhood Environmental Trios). The name refers to locations where waterways and Denver parks are in close enough proximity to serve as learning laboratories within walking distance of neighborhood schools. KIC-NET blends the best of environmental education and action civics, engaging young people in improving urban waterways.

Students and teachers, with support from Denver Public Works, conduct watershed investigations, examining stormwater infrastructure and water quality issues in their neighborhoods. They develop sustainable solutions to local pollution and runoff concerns. KIC-NET consists of:

- **Toolkits for each KIC-NET school** (water quality monitoring equipment, activity guides with 29 sequenced and place-based lessons, reference collections, an environmental history fact sheet specific to each site)
- **Instructional partnering** (professional development workshops, unit creation and lesson-planning, co-facilitation of activities and field work, sponsorship of culminating activities)
- **Evaluation** (collections of student works, student surveys for quantitative data, and participant interviews for qualitative data)

KIC-NET was named “**Best New Program 2014**” by the Colorado Alliance for Environmental Education. In July 2015, KIC-NET was recognized by the Change the Equation STEMworks Database’s highest rating of “**Accomplished**,” one of the first 50 U.S. education programs identified. KIC-NET won a **2016 Achievement Award** from the National Association of Counties.

KIC-NET 2017 highlights

Denver watershed network of 24 schools, with 1,364 students and 68 teachers, who produced 21 action projects in 2017

Student-led action projects:

- **Writing and pitching a rain garden and green roof proposal (St. Rose of Lima Catholic Academy)**
- **Public service announcements about Berkeley Lake, Goldsmith Gulch and Tollgate Creek (Centennial, Samuels and Tollgate elementaries)**
- **Podcasts about South Platte River water quality (Odyssey School of Denver)**



11 giant straws fabricated, with 9 delivered to Colorado Springs, Sterling, Lakewood, Cañon City, Sheridan, Steamboat Springs, Basalt, Durango and Grand Junction and 2 displayed in Denver



First-ever Denver Watershed Tour for Teachers saw 16 teachers and 4 facilitators travel 300 miles from Auraria Campus to South Park’s Rocky Mountain Land Library to Cheesman Dam and back, learning about “One Water as a teachable concept” along the way (Co-created with Denver Water’s Youth Education Program)



Drain-Marker app pilot-tested during storm drain marking events

KIC-NET program replicated in Albuquerque (NM) and Lakewood (CO) and managed by Earth Force

“Think about your children’s future. They will be drinking and swimming in this water.” – Serene, 8th grade KIC-NET student

Putting One Water Into Stormwater Education


By Lacey L. Williams



Third-grade students from Denver Public Schools' Centennial—A School for Expeditionary Learning listen to a talk about One Water during a recent field trip. (Photo courtesy of Erin Abner.)


AS A UNIFYING CONCEPT, ONE WATER continues to drive integration across water sectors professionally. Less has been done to introduce the concept to wider audiences. However, over the past five years within Denver's municipal separate storm sewer system (MS4) permit program, outreach work has been re-focused onto K-12 education. With its integration

of STEM (science, technology, engineering, and math) content, civic skills-building, and environmental problem-solving One Water education has proven to be a powerful way to reach teachers and students. Reaching about 1,500 students annually, this outreach work contributes to Denver's water quality goal of fishable and swimmable waters.




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Rock Trencher at Pueblo West Metropolitan District Sewer Extension Project

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At one recent event, Donny Roush, Stormwater Education and Outreach coordinator for the City and County of Denver’s Department of Public Works (DPW), introduced the concept to a group of students.

“All the water we have ever had, or ever will have, is already here on this planet,” Roush explained to a group of 70 third graders from Denver Public Schools’ Centennial—A School of Expeditionary Learning.

The outreach program includes a new *Water Around the World* module. For 12 weeks, students experience a deep-learning dive into the importance of clean freshwater. They build STEM knowledge about pollution of, access to, and demand for water and also hone literacy skills through challenging readings and writing assignments to support their points of view with

reasons, facts, and details.

During the multi-disciplinary unit, Roush visits each class seven times, providing a more sustained instructional partnership than is typical from a municipal utility. Activities are facilitated on water chemistry, water quality testing, and aquatic macroinvertebrates. The students also have a final performance task—writing a public service announcement about water conservation.

One Water has intentionally been incorporated into the program providing what educators call a “Big Idea,” a key concept that is important for mastery across disciplines, while also being compelling to students as they learn (and, almost as important, to teachers, so they teach with passion).

Currently, One Water appears explic-


itly in two components of Denver’s program:

- within *Water Around the World* units, and
- as the theme for the Denver Watershed Tour for Teachers, a summer professional development workshop for classroom teachers.

One Well

Water around the World was written by Expeditionary Learning Schools, a popular school reform model, in 2013. Expeditionary Learning (now EL Education) is an offshoot of Outward Bound, nonprofit purveyors of learning and personal growth through challenging experiences in the outdoors. In 1991, that approach was expanded into formal education. In the 150 EL Education schools in 30 states, the basic unit of curricu-

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lum is the learning expedition, in which classes—called crews—take a journey into the unknown together. Together, crews learn about a single compelling topic, constructing knowledge as a group and applying their learning to local issues. EL schools have lots of public celebrations of learning and fewer tests and quizzes. EL's motto is "We are crew, not passengers."

This field-work-oriented model fits DPW's stormwater education goals well. Roush works with eight EL schools, among the 20 project-based learning schools in metropolitan Denver supported by DPW as a community partner.

Water Around the World starts with these guiding questions and big ideas:

- Where does our water come from?
- What happens when people don't have access to clean water?
- How do writers use text-based evidence to strengthen their message?
- Water is a finite resource.
- Water is a natural resource that every living thing needs.
- Access to clean freshwater affects where and how people live.

All concepts are simpatico with the precepts of One Water.

Another attractive feature of this unit is the use of an anchor text—a non-fiction children's book used repeatedly throughout the cycle of lessons. *One Well: The Story of Water on Earth*, by Rochelle Straus, is particularly delightful. It opens with:

Imagine for a moment that all the water on Earth came from just one well.

This isn't as strange as it sounds. All water on Earth is connected, so there really is just one source of water—one global well—from which we all draw out water. Every ocean wave, every lake, stream and underground river, every raindrop and snowflake and every bit of ice in glaciers and polar icecaps is part of this global well.

So whether you are turning on a faucet in North America, pulling water from a well in Kenya or bathing in a river in India, it is all the same water. And because it is all connected, how we treat the water in the well will affect



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Denver Watershed Tour for Teachers professional development workshop

Roush used the same passage from One Well for the 16 classroom teachers as part of the Denver Watershed Tour for Teachers. The workshop's theme is "One Water as a teachable concept" and has learning targets that include understanding:

- the importance and role of components of Denver's water system(s), such as the South Platte River, Roberts Tunnel, Antero Reservoir, Cheesman Dam, and small scale green infrastructure facilities, and
- the integration of resources from Denver Water and Denver Public Works.

In a borrowed school bus, the group traveled from Denver's Auraria Campus to South Park and back on a two-day journey that never left the South Platte River watershed. Teachers saw how our metropolitan area's water moves from source to faucet to storm drain to river.

Roberts Tunnel in Grant, Cheesman Dam at Deckers, and a rain garden in Denver were all visited. The group even camped at the Rocky Mountain Land Library on the Buffalo Peaks Ranch, on the banks of the Middle Fork of the South Platte.

"The most positive part about this workshop was visually seeing how water moves from the mountains to the Front Range," said one participant. "This built understanding for myself to share with my students. I have lots of ideas for new components to teach this year."

In 2018, the Denver Watershed Tour for Teachers will be held August 1 and 2.

A unifying idea

So, do students understand One Water? Ruby, a 7th grader at The Odyssey School of Denver, had this to say after her watershed investigation: "I'm more careful about the footprint I leave. I try really hard not to litter or not to put a lot of stuff in my garden that would wash off, or to overwater it. Because it helps the water source and all water is connected. So, in the end it would just come back to you and you don't want polluted water coming out of your sink."



Lacey L. Williams is the Publication, Education, Participation, and Outreach Coordinator for the South Platte and Metro Roundtables and the Publications Chair for the Rocky Mountain AWWA and WEA. She has been involved with water and sustainability issues for more than 25 years. She can be reached at Lacey@Coloradowater.org.

ERRATUM

THE ARTICLE PUTTING ONE WATER INTO STORMWATER EDUCATION ON PAGE 14 OF THE JULY 2018 ISSUE should have been co-authored by **Donny Roush**. As a result of the editing process, some additional clarification is needed.

- Although the program is referred to as “outreach” in paragraph four, Roush clarified that the K–12 support discussed in this article should be recognized as education, the facilitation of learning.
- In the next paragraph, the article states that Roush visits each class seven times. Although this is true in the case of the specific school and unit in this article, it’s not necessarily true across the board. Roush visits—sometimes

in classrooms and sometimes in the field—as many times as they will have him and supports the work of students’ learning. So, the number of visits varies from one to more than a dozen.

Finally, during the production process, a sidebar and photos intended to run with the article were dropped. We are offering them here along with our sincere apologies for these errors and oversights.

—Rocky Mountain Water Staff



South Platte River Learning Expeditions— A Brief History

By **Donny Roush**

Students collect macroinvertebrates to indicate water quality at the South Platte River in Denver. PHOTO COURTESY OF DONNY ROUSH.



Teachers gesture upstream toward the Continental Divide at the Rocky Mountain Land Library during the 2017 Denver Watershed Tour for Teachers. PHOTO COURTESY OF DONNY ROUSH.



Third grade students and their teacher learn to use kick-nets in Tollgate Creek in Aurora, Colorado, as part of their *One Water* unit. PHOTO COURTESY OF DONNY ROUSH.

I AM IN MY 10TH YEAR OF SUPPORTING SCHOOLS by doing long-term, project-based studies of Denver’s rivers. I first worked with sixth graders at the Odyssey School of Denver in 2009.

A *South Platte River Expedition* was rewritten as *The Role of Freshwater around the World* and made available for use in any watershed by Expeditionary Learning (EL) Education in 2013. In 2015, it was revised again to align with Next Generation Science Standards and Common Core State Standards, and made available openly along with other modules. EL

Education reports more than 3.2 million downloads and adoption in 465 school districts.

Water Around the World was adopted in 2015 by Denver Public Schools as a district-suggested third-grade unit. I use this unit for third-grade programs at Centennial, Samuels, and Tollgate elementaries, as well as Odyssey.

Donny Roush is the Stormwater Education and Outreach Coordinator for the City and County of Denver’s Department of Public Works.