ABSTRACT

AN INTERNSHIP IN ENVIRONMENTAL EDUCATION AND WATER QUALITY WITH SANITATION DISTRICT NO. 1

by Ashley Michelle Olwine

The purpose of this report is to describe my internship experience with Sanitation District No. 1 (SD1) from January 2010 to July 2010. SD1 is a public utility, which manages wastewater and storm water in the Northern Kentucky Region. SD1 is dedicated to protecting the environment, safeguarding public health and enhancing the quality of life in the region. The District has been nationally recognized and employs a large array of diversified personnel, including professional engineers, environmental scientists, education specialists, sewer line inspectors, treatment plant workers and construction workers. My internship was focused on assisting in the Water Resources Department with the both the Environmental Scientist and Environmental Educator. This report discusses the work pertaining to my six-month internship with SD1, as well as the impact the Institute of Environmental Sciences on my professional environmental career. As an assistant to the Environmental Educator, I taught storm water lessons in a variety of schools, developed wastewater lessons for middle school curriculum and directed tours for interactive education outreach at SD1’s Public Service Park. While working with the Environmental Scientist I collected wet weather and dry weather water quality samples and compiled scientific reports based on synthesized and evaluated data.

This report summarizes the projects and activities with which I was involved as well as the training and experiences during my internship with SD1.
AN INTERNSHIP IN ENVIRONMENTAL EDUCATION AND WATER QUALITY WITH SANITATION DISTRICT NO. 1

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LIST OF ACRONYMS

BMP – Best Management Practices

EPA – Environmental Protection Agency

GCEE – Greater Cincinnati Environmental Educators

GIS – Geographic Information Systems

IES – Institute of Environmental Sciences

LEAN – Lifestyle Exercise Attitude Nutrition

M. En. – Master of Environmental Science

PSP – Public Service Park

SD1 – Sanitation District No. 1

SIP – Source Identification Program

TANK – Transit Authority of Northern Kentucky

WWTP – Wastewater Treatment Plant
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Also, I want to thank the Institute of Environmental Sciences for providing me with the practical experiences and significant lessons that have helped prepare me for the environmental professional world.

Thank you to my internship committee, Dr. Woy-Hazleton, Dr. Boardman and Dr. Perry. Each of you have assisted me with valuable guidance during the completion of my M. En. degree.

I want to recognize the staff and employees at the Sanitation District No. 1(SD1). I appreciated being treated as an equal member to the Water Resources Department and a part of the SD1 team.
INTRODUCTION

To fulfill the requirements for a Master of Environmental Science (M. En.) from Miami University’s Institute of Environmental Sciences (IES), I completed a six-month internship with Sanitation District No. 1 (SD1), located in Fort Wright, Kentucky. The duration of the internship was from January 2010 to July 2010. While interning at SD1, I was part of the Water Resources Department, spending about 65% of my time working with educational duties, while the other 35% of my time I spent working with water quality assessments. As the focus of my graduate work in Environmental Education, this internship allowed me actively participated in SD1’s education outreach first hand and contribute time to develop wastewater lessons for the middle school curriculum plan. I also worked with veteran scientists to sample stream quality in local watersheds and learn about the effects of impaired water systems in the region. This report will show a glimpse into my environmental education experiences and stream quality fieldwork while an intern with SD1.

Sanitation District No. 1

SD1 serves 33 communities in three counties; Boone, Kenton and Campbell County. The public utility operates under a regional approach to storm water and wastewater management. The region is located at the edge of the Ohio River Basin, which is a heavily populated and industrialized area.

Until the mid-1900s, wastewater from Northern Kentucky was sent directly to the Ohio River. After Congress passed its first law, the Federal Water Pollution Control Act, in 1948, sending sewage to local bodies of water became unacceptable.

Sanitation District No. 1 was established in 1946 to aid the collection and treatment of local wastewater. The district worked to create a plan that reduces stream pollution and protects area watersheds.

Today, SD1 is governed and operated by a Board of Directors who review and approve policies and procedures vital to ensuring the quality of life in Northern Kentucky.
SD1 maintains more than 1,600 miles of sanitary sewer line, 143 wastewater pumping stations, 15 flood pump stations, 8 package treatment plants, two major wastewater treatment plants, more than 250 miles of storm sewer and over 17,800 storm sewer structures. The SD1 study area, combining storm water and wastewater sewer lines, as well as school education programming is seen in Figure 1.

**Figure 1. SD1 Study Area**

Mission

Serving Boone, Campbell and Kenton counties through regional collaboration, education of the public and unparalleled customer service, Sanitation District No. 1 will provide affordable, sustainable protection of our water resources and enhance economic opportunities.

Vision

Sanitation District No. 1, a nationally recognized steward of the environment, enhancing the quality of life in Northern Kentucky.

Core Values

The core values of our organization provide the foundation for how work is conducted on a daily basis. These values provide a constant in a surrounding environment that is forever changing.

- Safety First
Scope of the Internship

As an intern with the Water Resources Department at SD1, the focus of my work varied because I assisted both the environmental educator and the environmental scientist. The department worked in correspondence with the Regional Storm Water Management Program, which was created to comply with U.S. EPA’s 1999 Federal Storm Water Phase II Regulations.

The environmental scientist assists with the administration of SD1’s watershed management initiatives. This position performs the activities associated with the characterization and assessment of local watersheds, supports the development and execution of watershed plans, and works with regulators and other agencies to address water quality issues.

SD1’s educational programming offers a unique and interactive approach to lessons pertaining to water resources and the environment. Since 2003, SD1 has offered storm water curriculum to area teachers. In 2004, the Public Service Park opened on SD1’s main office property. This park allows students and citizens to learn about the effects and concerns of storm water pollution. The park consists best management practices (BMPs), which allows students to participate with hands-on activities during school field trips.

Working and collaborating with both the Environmental Scientist and Environmental Educator allowed me to participate in many different efforts within Water Resources
Department. Through education outreach, I taught storm water lessons, developed wastewater curriculum, attended weekly meetings. I also helped coordinated events, such as Jr. Achievement Job Shadow Day and the Protecting the environment Award program. While working with the Environmental Scientist, I assisted in generating water monitoring reports, evaluating sampling data, and stream sampling for both biological and water quality.

The Water Resources Department treated me as an equal member to their team though encouraging my input, attending weekly meetings, and allowing me to participate in various efforts. Through my internship experiences at SD1, I gained insight about responsibilities of the employees and the commitment to safeguarding public health. My internship was conducted with great environmental professionalism and balanced understanding of the wastewater and storm water management.

ENVIRONMENTAL EDUCATION OUTREACH

Background
During the beginning of my internship, I focused on learning and assisting the environmental educator with duties already etched out by SD1. A major assignment that I was responsible for was to shadow the environmental educator on the first Environmental Unit lesson and be able to teach the lesson on my own to classes across the Northern Kentucky area. Toward the end of my internship, I lead the Public Service Park field trips offered to participating schools. I also created two lessons to complete the wastewater curriculum unit to be offered to middle school teachers. I helped plan and coordinate Jr. Achievement Job Shadow Day and the Protecting the Environment Award and Ceremony and manage storm drain marking outreach.

Environmental Unit
In 2003, SD1 partnered with area school districts to create an Environmental Unit. The unit includes five one-hour lessons that teach about storm water runoff pollution, watershed management, BMPs, wetlands and point source and non-point source
pollution. The unit is offered to all elementary schools within SD1’s service area and reaches nearly 5,000 students per year.

Schools within the service area are offered a 25% storm water fee credit, which is used an incentive to encourage Environmental Unit participation. The storm water fee is based on the school’s impervious rooftop and parking lot surfaces. In some cases, this can save the school up to $1,000.00 on their yearly fee. Every year each school participant has to sign the credit agreement policy, which holds schools accountable to teaching all five lessons from the Water Log Workbook during the school year and commits the school to turning in one completed workbook per class to SD1. In Figure 2 shows students using the Water Log Workbooks during a school lesson. For the 2010-11 school year, I organized all 62 elementaries into the program registration database.

Figure 2. Students with Water Log Workbook, White’s Tower Elementary, 5th grade

SD1 offers to teach the first lesson of the unit to all schools, termed the “Enviroscape” lesson. The environmental educator or a representative will travel to schools during the school year teach between one and eight lessons depending on the number of classes and size of the grade. SD1 has developed corresponding SMART Board presentation for each lesson available to teachers. In Figure 3 I am introducing the lesson with the interactive SMART Board. All materials for the five lessons are free to participating schools in the service area. Evaluations are given to each teacher at the end of the lesson and feedbacks and comments are taken into considerations for changes in the upcoming year.
As part of my internship, I observed and taught the Enviroscape lesson, which uses an interactive model of a town to demonstrate the causes and effects of storm water runoff and pollution. Figure 4 shows the Enviroscape model, where I am teaching students about how storm water drains to the nearest body of water. The students contribute by being assigned to one of the five areas of land development that shows how people can make positive and negative changes to the environment. Transportation to each school was through the SD1 vehicle, Ford Escape Hybrid that is reserved weeks in advance to the lesson. During my internship, I taught 26 Enviroscape lessons in 12 different public, private and independent schools with an approximate total of impacting 596 students in the service area.
Figure 4. Enviroscape Lesson with model, St. Mary’s School, 5th grade

Teaching in many schools of different sizes, locations and socio-economic levels forced the ability to be flexible within the classroom. I adjusted to daily school operations, such as a fire drills or afternoon prayer. Although the lesson was the same, it did not become tedious because of the constant change of students and locations.

Storm Drain Marking Program
The program titled, “Save-A-Stream” allows students and community members to actively participate in community education about storm water pollution. All community members are able to participate in the program, in which children must be supervised by an adult. Storm drains are marked with the decals (Figure 5) through heavy adhesive and informative door hangers are delivered houses in the area of the storm drains marked. This volunteer program is aimed at educating the public about what does not belong in the storm drains. Northern Kentucky has over 25,000 storm drains and SD1 hopes to mark all drains to help save streets and streams. The materials are free of charge and participants receive a map of the storm drains they will mark, which is created by SD1’s GIS department.
Some teachers and students mark storm drains surrounding their school or community to share with the public about what the students learned through the SD1’s Environmental Unit. SD1 markets for the program in the mail media sent to teachers and advertised during the Enviroscape lesson, at feature nine of the Public Service Park field trip and a brochure is available in the main office lobby.

As part of my internship, I gathered materials for participating groups to create personal "Save-A-Stream" kits. The kits include: markers, adhesive, rubber gloves, hand sanitizer, wire brush, door hangers, map of storm drain locations and detailed instructions. I also edited and recreated communication pieces to update old material with a newer look. One of the documents I recreated was the storm drain marking brochure. Requests from the environmental educator were to recreate the previous brochure with updated material. The document was sent to two other departmental members for edits and adjustments. Please see Appendix A for the Storm Drain Marking Brochure. To increase participation, I suggested marketing the program during Enviroscape lessons and field trips, which you can see in Figure 6.
Jr. Achievement Job Shadow Day

Job Shadow Day is hosted by SD1 every year and is overseen by the Junior Achievement nationwide organization. In February, SD1 invited students from Gray Middle School, located in Union, Kentucky to participate in an academically motivating day, which allowed students to see an up-close look at the jobs of many SD1 employees.

The students arrived in the morning and were lead to the Board Room to complete an icebreaker activity. During the introduction, students learned about SD1’s role in the community and career opportunities. Next, students toured the building and met with 15 employees to learn about their daily work. They interviewed employees to discover the role each employee plays at SD1, how his or her education or past work experiences has helped prepare for their current job and the most important skill needed to be successful in their position. After the tour, the students ate lunch and concluded with a resume building and career journal. The students in Figure 7 are seen completing the resume building activity.
As part of my internship, I helped prepare and create many of the documents the students received during Job Shadow Day. I researched resume tips and workbooks to insert in the students portfolio book, created a SD1 BINGO cards, which the students used as they met employees, tabbed sections of their notebooks with ideas for them to use during their middle and high school years. I organized much of the materials for the event on my own, while assisting the Environmental Educator during the event. Although this was only one day, I realized how much planning is involved to prepare students for such a unique opportunity.

**Wastewater Curriculum**

The wastewater curriculum unit is currently being created to make available to middle school teachers. I created two lessons during my internship, which focused on the process of wastewater treatment and a topography lesson that discusses basic map principles.

My first lesson, “After it all goes down the drain” teaches students the primary purpose, the physical aspects of wastewater treatment, explains how wastewater travels from homes and industries to a WWPT and identifies the four basic treatment steps: Preliminary, Primary, Secondary and Final Treatment. Please see Appendix B for the lesson.
For the second lesson (title not determined yet), I collaborated with a GIS technician to create two maps for the topography activity. This lesson teaches students to spatially understand differences in elevation, state the primary purpose of pumping stations, define the physical aspects of the Conveyance Tunnel in Boone County, explain how wastewater travels from homes and industries to a WWPT and describe patterns of human settlement in the present day and explain how these patterns are influenced by human needs. Figure 8 shows the one of the two maps that will be used in the lesson, which were created by an SD1 GIS technician. The map will be used to calculate distances, locate symbols and learn about the basic principles needed on a map. Please see Appendix C for the draft of lesson, which is still being created.

![Western Regional Conveyance Tunnel](image)

**Figure 8.** Map for lesson created by an SD1 GIS technician

The two lessons I created will be available on SD1’s website in completion of the other wastewater lesson created by the current environmental educator. SD1 will encourage many middle school teachers to use the lessons, but currently there is not a plan to create an extensive education outreach program, such as the Environmental Unit.
Public Service Park

The Public Service Park is dedicated to those who enhance Northern Kentucky’s quality of life through public service. The Park opened in 2004 with environmental best management practices (BMPs) and innovative educational outreach. It is open to the public 8:00 am until dusk daily, which allows community members to walk their dog in the 0.5 mile native trail loop.

In coordination with the Environmental Unit, elementary classes that complete the five-lesson unit are invited to take the Journey of a Drop of Water field trip organized by SD1. The students explore and experiment through hands-on and outdoor environmental education. During the field trip, students will complete 10 missions as they tour the site, which is seen in Figure 9. Students reinforce why it is important to reduce the amount of pollution entering our streams and rivers through storm water runoff and learn about many different BMPs. All teachers and chaperones attending the field trip must attend a training session prior to the field trip on a bi-yearly basis. Through SD1’s environmental partnership program, the Transit Authority of Northern Kentucky (TANK) provides transportation for all schools to the PSP.

Figure 9. Map of Public Service Park
The 10 mission-based on water inquiry stations are:

1. Vegetated Roof
2. Aquatic Bugs
3. Aquarium, Water: Source of Life
4. Water: Sculptor of Land / Gift of the Earth
5. Watershed World
6. Cistern, Runoff Race, Porous Concrete
7. Wetland Classroom
8. Oil Water Separator, Air Pollution
9. Educational Creek Overlook
10. Native American Creek History Walk

During my internship, I assisted in all PSP school field trips and organized and lead several field trips on my own. Figure 10 shows students arriving to the park and walking into the main lobby at SD1. The field trip begins at 9:30 when the students are sent to the boardroom where I introduced students to the site and told them what fun was planned for the day’s activities. During this time, students meet and read a letter from SD1’s fish mascot, Splash McClean. Prior to getting the field trip started, I spoke to all the teachers and chaperones for 10 minutes about reminders for the field trip and delivered their PSP items, which include a backpack, radio and tour badge. During the field trip, I walked around to each site to see if any volunteers needed assistance and to answer questions. I also announced over the radio when it was time to move to the next feature, which was every 13-15 minutes. I concluded with a wrap up and review of the day for the entire school at the wetland area classroom.
SD1 also partners with Wal-Mart throughout the year, which many of the Fort Wright Wal-Mart employees, among others volunteer at a particular feature during the field trip. The volunteers are assigned to either feature 7 or 9, which allows for the teachers or chaperones leading the field to take a break and let another person lead the mission. During several field trips, I taught at either feature 7 or 9. In Figure 11 you can see me teaching a lesson about the importance of wetland ecosystems, while the students perform a pH test on the wetland. Through this mission, students act as scientists as they learn about how a wetland can reduce stormwater pollution and provide habitat for plants and animals.
At mission 9, the Educational Creek Overlook, students physically see how storm drains lead to the nearest body of water. Environmentally safe pink dye is poured down the storm drain with a bucket of water and the students walk to the bank of Banklick Creek and see the pink water fall into the creek. Through this lesson students conceptually see the relationship between storm drains and how anything that enters a storm drain leads to the nearest body of water. I also taught this at this feature occasionally during the PSP field trips.

Figure 11. The Wetland Classroom feature with pH testing

Figure 12. Students at storm drain and Banklick Creek overlook
Protecting the Environment Award

Each year through SD1’s Protecting the Environment Award, teachers and scouts troops to apply for cash prizes to complete a project that contributes to making a positive impact on water resources with high community participation or impact. Since 2008, Wal-Mart has partnered with SD1 to offer more funding and resources for the expansion of the award program. The program also recognizes individual students for their environmental accomplishments.

During my internship, I worked closely with SD1’s environmental educator to: brainstorm ideas of how to increase award applications, create flyers and documents to promote the award program to teacher and scout leaders, organize applicants into the database and spent many hours organizing gaining donations for the Protecting the Environment Award Ceremony. Of the awarded projects, one will coordinate a local creek clean-up, three plan to create or maintain a rain garden, while others plan to develop school curriculum. Below is the full list of the awarded projects being completed during the 2010-11 school year:

- Gunpowder Creek Clean Up
- Banklick Watershed Clean Up
- Creek Water Testing
- 3 Rain Gardens
- Wetland Signage
- Water Conservation through Gardening
- Water Cycle Lesson
- Global Water Awareness Curriculum
- Storm Water Curriculum

The Protecting the Environment Award Ceremony was held in June and honored all the 2010 award recipients. Scout troops and teachers, among other affiliates attended the ceremony. To plan for the ceremony, I contacted different organizations in the community to donated items for the award recipients. I helped SD1 gain gift donations from: Kroger, Meijer, Panera Bread, Natorp’s Garden Store and Landscape and the John R. Green Company. In Appendix D you can see the donation letter I drafted to be signed by the Environmental Educator, which generated ten, $10.00 gift cards for 2010 recipients.
At the ceremony, I presented six of the 10 awards to local schoolteachers, which is shown in Figure 13. I also helped prepare for the ceremony by contracting Be Creative Catering to deliver the dinner and set up the event with other SD1 employees.

Figure 13. Presenting an at the Protecting the Environment Award Ceremony

ENVIRONMENTAL WATER QUALITY SCIENCE

Background
Polluted water run off from urban and agriculture land use, failing septic systems and industrial point sources impact the water quality of Northern Kentucky. The federal court order (Consent Decree) SD1 is under, which is mandated by the EPA allows the District to take a watershed management approach. With this approach, watersheds were prioritized for consideration of control alternatives. Water quality was characterized based on nutrient, bacterial and physical parameters. Also, stream dispositions over time are tracked. This approach also allows for the input of green infrastructure, such as implementing a wetland to reduce storm water runoff instead of building more underground storm water sewer lines.

Wet Weather Sampling
Wet weather sampling is conducted by SD1’s environmental scientist, with the objective to collect data to characterize water quality in all of SD1’s service area. In 2006, the wet
weather sampling effort began and the goal is to sample all watersheds in Northern Kentucky by the end of 2010. The map on the left in Figure 14 shows the 2006 wet weather initiative, while the map on the right shows the goal of sampling all of the SD1 study area by the conclusion of 2010. Each watershed has three to five site locations depending on the size of the watershed. Each watershed requires three events per year to compile the complete watershed characterization assessment. The criteria to determine a wet weather event include: no precipitation in the watershed 72-hours prior to the event and a minimum of 0.25 inches of rain over a six-hour period.

![Figure 14. Map of Wet Weather Sampling, 2006-2010](image)

During my internship I worked with the environmental scientist in which I prepared the needed materials for the upcoming sampling season. I prepared the materials for several of the wet weather events for Gunpowder, Big Bone and Woolper Creeks. Many sampling bottles need to be labeled, organized and banded together by hour and placed into boxes. There are sometimes up to 10 samples being taken at each site within the watershed at each sampling hour. In Figure 15 you see me adding sulfuric acid prior to the nutrient sample to act as a preservative. Sampling starts at hour 0, prior to the rain and continues from hour 2, 4, 6, 12, 24, 30, 36 and 48 and occasionally hour 72 is added in the event of extreme rain or a delayed start to the precipitation. All the samples at analyzed and data is compiled at SD1's Dry Creek Laboratories.
Also, I met with XCG consultants, who were hired to sample hours 0, 2, 4, 6 of Gunpowder and Big Bone Creek of Events 1, 2, 3. I traveled to each site to review the sample locations, delivered sampling bottles, distilled water and the chain of custody records.

Report Writing

A summary of each wet weather event is created into a report and after the three events are analyzed a complete watershed monitoring report is created. I double-checked data results for accuracy from the 2009 Wet Weather Monitoring Summary Report of the Licking River Watershed, which was compiled by Limno Tech consultants. I also edited and helped write the Sand Run events 1,2,3, Elijahs Creek events 1,2,3 and Woolper Creek 1 and 2 Wet Weather Reports using the already created report template. Through these documents I compiled USGS data to create precipitation vs. water gage height rainfall plots. Figure 16 shows the gage height rainfall plot from the Sand Run Event 1. Please see Appendix E for the Sand Run Event 1 Report, which I helped create.
Figure 16. Rainfall plot for Sand Run Event 1.

Hydromodification

Hydromodification is part of the SD1’s Aquatic Biologists research, in which I assisted with occasionally throughout my internship. Sites are sampled approximately once a year and the data collected will be used to compare the changes in the stream over time. I helped conduct pebble counts for a stability quality assessment and cross section and profile surveying at different sites throughout SD1’s study area. I also input the hydromodification data into the database.
ADDITIONAL OPPORTUNITIES

During my internship with SD1, I also participated in other activities and fieldwork opportunities. I attended three Professional Development Committee meetings of the Greater Cincinnati Environmental Educators (GCEE) organization. I also attended the at-large GCEE organization meeting, which included over forty members. GCEE enables the ability to centralize environmental education outreach in the Greater Cincinnati area. I reviewed and edited the Illicit Discharge Field Guide that instructs SD1 assistants on the protocol for an illicit discharge investigation. This field guide will be used when hiring new assistants within the illicit discharge group. I also attended multi-departmental conference webinars, participated in SD1’s onsite Blue Bird Monitoring Program, assisted in sampling bacteria and fecal coliform levels in the Source Identification Program (SIP) and attended LEAN meetings, which encourages employee health and fitness.

CONCLUSION

Prior to accepting my internship position with SD1, I had a very difficult time finding internship availabilities because many organizations weren’t looking for interns to begin in January and many positions have been cut due to economic hardships. I sent in a resume to SD1 in October 2009 and received a phone call from SD1’s environmental scientists in
December 2009. After interviewing and accepting the six-month position, I feel that I very much lucked out with my internship.

The opportunities offered at SD1 allowed me to prepare for the environmental professional world while there was still room for personal growth as an official student in the IES program. From the beginning of my internship, I was treated as an equal member to my department and a part of the SD1 team. I was encouraged to contribute to as many projects that I felt comfortable and my opinions were important to my co-workers.

Working with both the environmental scientist and the environmental educator has allowed me to see two totally different sides at SD1. I greatly enjoyed leaving the office to teach lessons at various schools across the three counties in Northern Kentucky. I equally enjoyed sampling in streams throughout the Northern Kentucky watershed.

While working with schools, students and teachers, I learned the need to be extremely flexible. At times, teaching the same lesson became slightly tedious, but there was always something unexpected in each school. During my internship, I made a drastic improvement to my communication skills with other professions. I learned how to write professional letters, e-mails and correspond on a trained level. Through the educational programming offered at SD1, I relive how much time and effort is put into planning events, activities and field trips. I feel that I have taught students the about the importance of reducing storm water pollution and through these lessons students will contribute to making Northern Kentucky a healthier and safer environment. SD1’s environmental education outreach has given me great insight on the preparation and hard work needed for a successful program.

Under SD1’s environmental scientist, I learned the importance if minor details. Double and triple checking data in a report is critical to scientific reliability in the professional world. Since most of my internship was during the non-sampling season, I spent time working on compiling reports for wet weather and dry weather events. Helping write scientific reports made me aware of how essential it is to be as clear and concise as
possible. Toward the end of my internship, I was able to sample several in the field, which allowed for a break from the office and was beneficial to understanding the different watersheds. Through my internship under the environmental scientists, I realize that SD1 has made a major impact in the watersheds of Northern Kentucky, because protecting water resources and public health are a priority to their work.

On days when I was not in the classroom or sampling, the hardest part of my internship was getting used to spending an entire eight-hour work shift within the office either at my desk or in meetings. This was difficult to adjust to, but as the workload increased, I found that the days weren't quite as long.

As I look back on my internship and while writing this report, I realize how much I actually contributed with and learned at SD1. Due to some hard work and luck, I was offered a position as Environmental Education Program Manager, which would allow me take over all the education outreach I assisted with during my internship. The environmental educator I was under will be going part-time, working on expanding middle and high school outreach. I feel honored to be welcomed on as a full-time employee with such a well-respected organization.

It couldn't have been without the education and guidance given to be by the professors and peers through Miami University's Institute of Environmental Sciences program. The constant coursework and personal lessons through the IES program has helped me be prepared with the knowledge and flexibility the environmental professional world demands. Completing the IES program was a rigorous undertaking, but once I was finished with coursework, I felt a sense of accomplishment and gratitude toward my time spent at Miami University. Through my master's degree with IES and my internship with SD1, I feel very prepared to enter the environmental professional world. It was with these two opportunities that I am able to move forward with making a different in the education of other, while protecting the environment. I look forward to my position as Environmental Education Program Manager at SD1 hope to keep learning as I create my
own outreach programs. I would like to thank all of those who impacted my educational journey. I appreciate all of your guidance and support.
APPENDICES
Volunteer Storm Drain Marking Program

- Rake grass clippings, leaves, and debris away from curbside storm drains.
- Do not discard litter/trash (i.e., plastic jugs or soda cans) into storm drains.
- Never pour motor oil down storm drains.
- Wash your car in the grass instead of the driveway.
- Plant where you can. Vegetation reduces storm water runoff, erosion and flooding.
- Pick up after your pets.

How to Keep Your Streets From Flooding

- Volunteering is a great way to give back to your community.
- Your involvement helps to protect our environment.
- Sign up today to make a difference!
Our curbside storm drains can be a major channel for pollution. Many people dump oil and other pollutants into these storm drains, unaware that they empty directly into nearby streams where fish and other wildlife live.

After heavy rains, storm water runs off our streets and parking lots into storm drains, picking up leaves, debris and litter along the way. These substances clog the pipes causing streets to flood.

If you keep your streets and drains clean you can help stop flooding, protect your waterways and keep wildlife safe.

There is a way you can help keep your streets and streams clean and beautiful. Sanitation District No. 1 (SD1) has organized a storm drain marking program called "Save-A-Stream." By getting your community involved, you can help make people more aware of the connection between storm drains and our natural streams.

This volunteer program is aimed at educating the public about what doesn’t belong in a storm drain. Northern Kentucky has over 25,000 storm drains. SD1 hopes to mark all drains where dumping may occur, with the message "No Dumping, Drains To Stream / Waterways." By participating in this program, you are helping to save your streets and streams.

Gather a group from your neighborhood, school, scout troop, civic/social organization or business. This is a community service project that all ages can find rewarding and fun. Please note: All children must be supervised by an adult! SD1 will provide your group with free storm drain marking supplies.

Just follow these simple steps:

1. Fill out and return the form on the other side of this brochure.

2. Schedule a marking day and reserve your free marking kit. Each kit includes: markers, adhesive, wire brush, door hangers, plastic gloves, detailed instructions, a map showing the drain locations and more.

If you have any questions or concerns, please contact SD1’s Environmental Educator at 859-578-6745 or info@sd1.org.
Lesson 4

“After it all goes down the drain...”

CORE CONTENTS:
Middle School Science
- Physical Science: SC-M6 1.1.1 - Students will explain how or why mixtures can be separated using physical properties.
- Physical Science: SC-06-1.1.2 - Students will identify and describe evidence of chemical and physical changes in matter.
- Earth/Space Science: SC-06-2.3.3 - Students will compare constructive and destructive forces on Earth in order to make predictions about the nature of landforms.

Practical/Living Vocational Studies
- Consumer Decisions: PL-06/07/08 3.1.4. – Students will describe consumer actions (reuse, reduce, recycle) and explain how these actions impact the environment (e.g., conserving resources, reducing pollution, reducing solid waste, conserving energy).

OBJECTIVES (“Students will be able to”):
- Define wastewater
- State the primary purpose of a wastewater treatment plant (WWTP)
- Define the physical aspects of wastewater treatment
- Explain how wastewater travels from homes and industries to a WWPT
- Identify the four basic treatment steps: Preliminary, Primary, Secondary and Final Treatment

ACTIVITY DESCRIPTION:
- Teacher Notes:
  - This lesson will work well with the EnviroScape “Drinking Water and Wastewater Treatment” interactive model. Contact the SD1 Environmental Educator at (859) 578 – 7450 to schedule a day to check out the EnviroScape model. This is recommended and a great tool to bring into your classroom!
Also, a virtual tour of Dry Creek Wastewater Treatment Plant is available for access on the SD1 website (?). Please feel free to utilize during the lesson. SD1 invites you to schedule a class field trip to Dry Creek Wastewater Treatment Plant located in Kenton County, KY to tour and see the plant in action. Please contact the Environmental Educator at (859) 578 – 7450 or info@SD1.org to plan a tour today!

- **The following lesson plan outlines a way to teach the lesson “After it all goes down the drain...” without using the EnviroScape model.**

  o The class should be divided evenly into four groups representing:
    - Group 1: Preliminary Treatment Facilitators; The “Cleaners”
    - Group 2: Primary Treatment Facilitators; The “Settlers”
    - Group 3: Secondary Treatment Facilitators; The “Aerators”
    - Group 4: Final Treatment Facilitators; The “Dischargers”

  The group members are the leaders of a particular step in the wastewater treatment plant procedures. Each group will have a hand in cleaning the wastewater before it is reintroduced into a larger body of water.

  o In addition to the demonstration, please use the Powerpoint, SMART Board document, or Wastewater Treatment video during the lesson, which will help students visually understand the stages of wastewater treatment. The photos and film from are from Dry Creek Wastewater Treatment Plant.

  o Attached are the Scientists Observation Table and the Post-Demonstration Exercise. Students will be asked to fill out the Scientists Observation Table during the demonstration and complete the Post-Demonstration Exercise after the completion of the lesson.
Lesson 4

MATERIALS:

- 5 liters (L) of “wastewater”
  - 2 ½ cups of mulch – add the mulch to the 5 liters (L) of water
  - Litter items – smaller pieces of cut up rag, match stubs, pen caps, pop can tabs, paper clips, etc.
  - 5 tablespoons of vegetable oil

**Making “Wastewater”:** Mix 5 liters (L) of tap water with 2 ½ cups of mulch in a large (preferably clear) bucket. Stir the “wastewater” and add litter items to the water. Litter can be created from cutting up pieces of plastic grocery bags, broken eggshells, small pieces of rag, match stubs, small pieces of toilet paper and pop tabs. Then add 5 tablespoons of vegetable oil on top of the water to represent the top layer of scum and grease.

- 2 tablespoons of dry lemonade powder
- 1 Spray bottle – combine water with lemonade powder to create milky appearance, which will act as “odor control.” During the demonstration, be prepared pour the unused amount of odor control substance down the drain and replace it with clear water as the “dechlorination” for later in the lesson.
- 2 Strainers – 1 large-hole strainer and 1 smaller-hole strainer
- 2 containers to represent the grit removal station
- 1 Large Spoon
- Twelve 1,000 milliliters (mL) beakers (or clear containers) - six to represent the Settling Tanks and six to represent the Aeration Tanks. Labeling the beakers (containers) will create a clearer understanding during the demonstration.
- 6 drinking straws
- Stopwatch
- **Final Clarifier:**
  - 2 liter (L) bottle
  - 1 cup small washed pebbles
  - Coffee filter
  - Rubberband
  - 1 Large container

**Making the “Final Clarifier”:** Use an emptied, clear and cleaned 2-liter bottle without the label. Cut 2 inches off the bottom of the bottle. Turn the bottle upside down and use a rubberband to tightly secure at the open mouth of the bottle. Pour in 1 cup small washed pebbles toward the coffee filter. Keep a bucket under the Final Clarifier for the water to enter when it is filtered.

LESSON LENGTH:

- 45 minutes – 1 hour
ESSENTIAL QUESTIONS (that will be answered):
- What is wastewater?
- Where does it go when it travels down the drain?
- How is wastewater cleaned?
- Why do we clean wastewater?

VOCABULARY WORDS:
*For all words that need to be defined during the lesson, please refer to the definitions below.
- **Wastewater** – water that is collected and treated (cleaned) at a local wastewater treatment plant
- **Grey Water** – water generated from domestic activities such as laundry, bathing and showering
- **Black Water** – wastewater generated by toilets, kitchen sinks and dishwashers
- **Sanitary Sewer System** - an underground carrying system to transport wastewater from houses or industry to treatment facilities
- **Sewage** – water-carried wastes, in either solution or suspension
- **Influent Discharge** –
- **Effluent Discharge** – the outflow of treated (cleaned) water from a WWTP
- **Filtration** – a process that separates solids from liquids
- **Settling** – cause to sink, become compact or come to rest
- **Sludge** – semisolid material that is separated from the wastewater
- **Aeration Tanks** – a tank that supplies the bacteria living in the wastewater with the circulation of air
- **Clarification** – the act of removing solid particles from a liquid
- **Pumping Station** – a facility that assists in moving fluids to a different location or high elevations, such as hills or mountains
- **Septic Tank** – a holding tank that provides local treatment for residential wastewaters. It is used as an alternative to municipal sewer systems in some locations. Wastewater collected in a septic tank is treated before released into the septic field surrounding the home.

PROCEDURES:
INTRODUCTION
- **Step 1)** Write Wastewater on the board. Ask the students, “How do you use water on a daily basis?” (Allow time for brief responses). Define Wastewater.
- **Step 2)** Write the vocabulary words Grey Water and Black Water on the board and define Grey Water. Ask the students, “Why do you think it is called grey water?” (Allow time for brief responses). Tell the students that it is called grey water from its appearance; it is neither fresh, nor highly polluted.
Lesson 4

Define the term Black Water. (Allow time for the students to get their giggles out about this topic). State that although it is called black water, the water does not always appear black, but it is darker than grey water.

- **Step 3** Ask the class, “What happens to that water once it goes down the drain?” (Allow time for possible responses). Inform the students that drains are connected to sewer pipes that travel below the ground surface. These pipes are part of the sanitary sewer system. Define Sanitary Sewer System. The wastewater goes down the drain, through the pipes below the ground and is sent to the Wastewater Treatment Plant (some treatment plants are titled: Water Reclamation Facility). The water is moved by gravity or the use of pumping stations. Define pumping station.
  - **SD1 Extra Information** – SD1’s service area has a population of over 340,000 and owns, operates and maintains approximately 1,600 miles of sewer pipes (if you stretched out the pipes they would run from here to Texas). SD1 also operated two major water reclamation facilities, four smaller treatment plants, 129 pump stations and 15 flood pump station that help to transport and treat over 36 million gallons of wastewater per day.

- **Step 4** Inform the class that some residents clean their wastewater at their own home through a septic system. Ask the class, “Do any of you use a septic system at home?” The wastewater is sent to a septic tank outside of the residential home and cleaned. Define Septic Tank.
  - **Septic System Information**: Please visit the website created by the EPA (2005) to learn more about the septic system process: http://www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf

- **Step 5** Introduce the demonstration: Now we’re going to learn what happens to the wastewater after it gets sent to the WWTP. At the Wastewater Treatment Plant there are four basic treatment steps: Preliminary, Primary, Secondary and Final Treatment
  - Reminder: Making ‘Dirty’ Water: Mix 5 liters (L) of tap water with 2 ½ cups of mulch in a large (preferably clear) bucket. The day of the activity, stir the ‘dirty’ water and add litter to the water. Litter can be created from cutting up pieces of plastic grocery bags, broken eggshells, small pieces of rag, match stubs, small pieces of

**PRELIMINARY TREATMENT – Cleaners**

- **Step 6** Is the first stage of Wastewater Treatment. This can’t be completed without the help from our Cleaners (ie: Group1)
  - Reminder: Making ‘Dirty’ Water: Mix 5 liters (L) of tap water with 2 ½ cups of mulch in a large (preferably clear) bucket. The day of the activity, stir the ‘dirty’ water and add litter to the water. Litter can be created from cutting up pieces of plastic grocery bags, broken eggshells, small pieces of rag, match stubs, small pieces of
toilet paper and pop tabs. Then add 4 tablespoons of vegetable oil on top of the water to represent scum and grease.

- **Step 7**) Show the students the 5 liter bucket of “wastewater.” Tell the students to put on their scientists goggles and use their Scientists Observation Table to fill out their sight and smell observations of the water at the PRE-DEMONSTRATION STAGE, where it enters Headworks. Headworks is the location where the dirty water first enters to be cleaned. [NOTE: please inform the students this is pretend “wastewater” and there is not any fecal matter in the bucket]

- **Step 8**) Tell the students that usually the wastewater smells really bad from all the pollution. The Cleaners have to add a chemical (sodium hypochlorite) to help control the odor, so the workers and surrounding residents aren’t bothered by the smell. Spray the dirty water with the water and lemonade powder solution. This spray represents sodium hypochlorite, which is the chemical the Cleaners add to the wastewater to control odor.

- **Step 9**) Strain the dirty water with a large-hole strainer into two separate containers, which will allow only the water and dirt though. This process filters the larger pieces of litter (it’s okay if you don’t catch all the litter in this process, it will be filtered out later). Inform the students this process at the WWTP removes large debris through three separate bar screens, the debris is carried away on a conveyor belt into the dumpster and taken to a nearby landfill.

- **Step 10**) Next, the dirty water is sent to the grit removal station. This process uses a vortex motion to force materials such as sand, gravel and eggshells to separate from lighter materials. To represent this, use a large spoon to stir the dirty water vigorously in both grit tanks. Explain that the separated grit is sent to the dumpster and eventually the landfill. [Note: Inform the students that usually the grit is separated, but in today’s experiment we will not be able to demonstrate this.]

- **Step 11**) Tell the students to use their Scientists Observation Table and state any changes in the wastewater and their sight and smell observations. Thank the Cleaners for their help at the PRELIMINARY TREATMENT STAGE. Now the wastewater is ready for the PRIMARY TREATMENT STAGE.

**PRIMARY TREATMENT – Settlers**

- **Step 12**) Is the second stage of Wastewater Treatment. This can’t be completed without the help from our Settlers (ie: Group 2)

- **Step 13**) After the dirty water is finished at the grit removal station, it is sent to the Settling Tanks. Pour all of the dirty water evenly into six 1,000 mL beakers. [Note: If you do not have any beakers, you can substitute clear containers. Also, you can label the beakers/containers as “Settling Tanks.”] Try to leave some of the grit behind to be sent to the dumpster. Once in the six settling tanks, use a stopwatch and let the water sit for 2 minutes and thirty seconds. Tell the students it usually stays in the holding tanks for 5
hours and 40 minutes. Tell the students to use their Scientists Observation Table and state any changes in the wastewater fill out their sight and smell observations of the water at the PRIMARY TREMENT STAGE, after it settles in the tanks.

- **Step 14**) During this step, the lighter materials in the dirty water, such as grease and scum float (represented by the vegetable oil) to the top of the water. They are removed through a process called skimming and sent to the landfill. Use a spoon to skim the top of the water and take off any of the vegetable oil in the tanks and put the oil in the previous grit removal tanks. Also, when the wastewater is in the settling tanks, sludge is compacted at the bottom of the tanks. Define Sludge. Now, the wastewater is ready to move onto the next stage. Thank the Settlers for their assistance.

SECONDARY TREATMENT – Aerators

- **Step 15**) Is the third stage of Wastewater Treatment. This can’t be completed without the help from our Aerators (ie: Group 3)
- **Step 16**) The wastewater leaves the settling tanks and is distributed into six aeration tanks, where the water receives biological treatment. Define Aeration Tanks. Use the smaller-hole strainer to distribute each of the holding tanks into six new 1,000 mL beakers to represent the aeration tanks.
  
  [Note: If you do not have any beakers, you can substitute clear containers. Also, you can label the beakers/containers as “Aeration Tanks.”]

- **Step 17**) Supply air into the tanks during the biological treatment stimulates the breakdown of any left over material. This is called the activated sludge process, where the microscopic sludge bacteria in the tanks eat away at the non-settling material (“floaties”), but the bacteria need to be able to breathe (like you and I) to do its job. So, the Aerators pump compressed air into the bottoms of the tanks where it bubbles up through the wastewater. Place the six straws in each of the beakers and slowly blow through each one for a few seconds to create bubbles and air for the bacteria. These microorganisms get full from eating the non-settling material and sink to the bottom of the tanks.
  
  [Note: The teacher should complete this process. Please make sure you do not allow the students to blow into the straws incase one of them accidently sucks in the wastewater.]

- **Step 18**) Tell the students to use their Scientists Observation Table and state any changes in the wastewater and fill out their sight and smell observations of the water at the end of the SECONDARY TREMENT STAGE, after the wastewater has been aerated. Thank the Aerators for their assistance.

FINAL TREATMENT - Dischargers

- **Step 19**) Is the fourth and final stage of Wastewater Treatment process. This can’t be completed without the help from our Dischargers (ie: Group 4)
Lesson 4

- **Step 20** Though gravity, the wastewater is pumped to the final clarifiers, where it will continue to be cleaned and remove any remaining sludge. Pour all six aeration tanks into the Final Clarifier and give the water time to settle into a clean bucket.
  - **Making the “Final Clarifier”:** Use an emptied, clear and cleaned 2-liter bottle. Cut 2 inches off the bottom of the bottle. Turn the bottle upside down and use a rubberband to tightly secure at the open mouth of the bottle. Pour in 1 cup small washed pebbles toward the coffee filter. Keep a bucket under the Final Clarifier for the water to enter when it is filtered.

- **Step 21** Now the water is almost completely cleaned and ready to be put back into our water system, but there is still one last step before we can send it to the river. During the Preliminary Stage, sodium hypochlorite was added to the water and chlorine is one of the harmful chemicals in the substance. Now, we have to remove any chlorine left in the water before it is sent to the nearest body of water. Spray the wastewater from the Final Clarifier with the spray bottle of clear water to represent the dechlorination process. This will help protect the environment and the living organisms in the water systems.

- **Step 22** Now the water is at the purified effluent stage. Define Effluent Discharge. The Dischargers help send the water back to the nearest body of water (i.e.: the Ohio River). Explain that this water is actually cleaner than the water that is already part of the river system.

- **Step 23** Tell the students to use their Scientists Observation Table and state any changes in the wastewater and fill out their sight and smell observations of the water at the end of the FINAL TREATMENT STAGE, where the effluent water is ready to be discharged. Thank the Dischargers and the rest of the WWTP workers for helping with the demonstration. You can now pour the bucket of cleaned water down the drain.

- **Step 24** Inform the students they should go back to their seats and fill out their answers to the Post-Demonstration Exercise, questions 1 – 4.

Wrap Up/Review of Essential Questions:
- What is wastewater?
- Where does it go when it travels down the drain?
- How is wastewater cleaned?
- Why do we clean wastewater?

Extension of Lesson: The discussion of SD1’s current and potential environmental practices in wastewater treatment.
- UV Treatment
- Burning waste to generate energy
- Pump station auto features
- Plans and fact sheets
Lesson 4

Post-Demonstration Exercise:
1. What is wastewater?

2. In order, what are the FOUR stages of wastewater treatment?
   1)
   2)
   3)
   4)

3. What was your group? ______________________
   What was the role of your group during the wastewater process?

4. With the diagram below and using the word bank, can you fill in the blanks to wastewater treatment? (?)

5. Wastewater Treatment: Order of Operations
   Please fill out the steps (A-J) below in the correct order.

<table>
<thead>
<tr>
<th>Order in Process</th>
<th>Step in Wastewater Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1) _________</td>
<td>A. Large debris in wastewater is removed by bar screens.</td>
</tr>
<tr>
<td>Step 2) _________</td>
<td>B. The wastewater undergoes skimming process, which takes off grease and scum on top.</td>
</tr>
<tr>
<td>Step 3) _________</td>
<td>C. Wastewater is sent to Final Clarifiers, where it goes through one last cleansing.</td>
</tr>
<tr>
<td>Step 4) _________</td>
<td>D. Wastewater goes down drain and through underground pipes to the Wastewater Treatment Plant.</td>
</tr>
<tr>
<td>Step 5) _________</td>
<td>E. Wastewater moves to Aeration Tanks where oxygen is pumped into base to activate bacteria, which eats solid material.</td>
</tr>
<tr>
<td>Step 6) _________</td>
<td>F. Chemicals are added to the wastewater to help control the odor.</td>
</tr>
<tr>
<td>Step 7) _________</td>
<td>G. Vortex motion forces material to separate at the Grit Removal Station.</td>
</tr>
<tr>
<td>Step 8) _________</td>
<td>H. The wastewater has been treated and is not at the effluent stage. It is ready to be released into the nearest body of water.</td>
</tr>
<tr>
<td>Step 9) _________</td>
<td>I. Wastewater is dechlorinated to remove any remaining harmful chemicals.</td>
</tr>
<tr>
<td>Step 10) _________</td>
<td>J. Wastewater is sent to Settling Tanks for 5 hours and 40 minutes to allow time for the sludge to sink to the bottom.</td>
</tr>
</tbody>
</table>
### Student Scientist Observation Table:

#### TREATMENT STAGE

<table>
<thead>
<tr>
<th>FINAL TREATMENT STAGE</th>
<th>SECONDARY TREATMENT STAGE</th>
<th>PRIMARY TREATMENT STAGE</th>
<th>PRELIMINARY TREATMENT STAGE</th>
<th>PRE-DEMONSTRATION STAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGHT</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SMELL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHANGES</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>
“Mapping Lesson”

**CORE CONTENTS:**

**Middle School Social Studies**

The Use of Geographic Tools
- SS-06-4.1.1 - Students will use a variety of geographic tools (maps, photographs, charts, graphs, databases, satellite images) to interpret patterns and locations on Earth’s surface in the present day.

Regions
- SS-06-4.2.1 - Students will describe how regions in the present day are made distinctive by human characteristics (e.g., dams, roads, urban centers) and physical characteristics (e.g., mountains, bodies of water, valleys) that create advantages and disadvantages for human activities (e.g., exploration, migration, trade, settlement, development).
- SS-06-4.2.2 - Students will describe and give examples of how places and regions in the present day change over time as technologies, resources and knowledge become available.

Patterns
- SS-06-4.3.1 - Students will describe patterns of human settlement in the present day and explain how these patterns are influenced by human needs.

Human-Environment Interaction
- SS-06-4.4.1 - Students will explain how technology in the present day assists human modification (e.g., irrigation, clearing land, building roads) of the physical environment in regions.

**Middle School Math**

Number Properties and Operations:
- MA-06-1.1.1 - Students will provide examples of and identify fractions, decimals and percents.
- MA-07-1.1.1 - Students will provide examples of and identify integers, fractions, decimals, percents and \( \pi \).

Estimation
- MA-06-1.2.1 - Students will estimate to solve real-world and mathematical problems with whole numbers, fractions, decimals and percents, checking for reasonable and appropriate computational results.
- MA-07-1.2.1 - Students will estimate to solve real-world and mathematical problems with fractions, decimals and percents, checking for reasonable and appropriate computational results.

Measuring Physical Attributes
- MA-06-2.1.1 - Students will measure lengths (to the nearest eighth of an inch or the nearest centimeter) and will determine and use in real-world and mathematical problems:
  - area and perimeter of triangles;
  - area and perimeter of quadrilaterals (rectangles, squares); (using the Pythagorean theorem will not be required as a strategy) and
  - area and perimeter of compound figures composed of triangles and quadrilaterals.
- MA-07-2.1.1 - Students will measure lengths (to the nearest eighth of an inch or the nearest centimeter) and will determine and use in real-world and mathematical problems:
  - area and perimeter of triangles;
  - area and perimeter of quadrilaterals (rectangles, squares, trapezoids) (using the Pythagorean theorem will not be required as a strategy);
  - area and circumference of circles and
  - area and perimeter of compound figures composed of triangles, quadrilaterals and circles.

Representations of Data Sets
- MA-06-4.1.4 - Students will determine and construct appropriate data displays (bar graphs, line plots, Venn diagrams, tables, line graphs), and will explain why the type of display is appropriate for the data.
- MA-07-4.1.4 - Students will determine and construct appropriate data displays (bar graphs, line plots, Venn diagrams, tables, line graphs, stem-and-leaf plots), and will explain why the type of display is appropriate for the data.

Characteristics of Data Sets
- MA-06-4.2.1 - Students will determine and apply the mean, median, mode and range of a set of data.

OBJECTIVES ("Students will be able to"):  
- Spatially understand differences in elevation
- State the primary purpose of pumping stations
- Define the physical aspects of the Conveyance Tunnel in Boone County
- Explain how wastewater travels from homes and industries to a WWPT
- Students will describe patterns of human settlement in the present day and explain how these patterns are influenced by human needs.

ACTIVITY DESCRIPTION:
- The class should be divided evenly into four groups
- The group members are the leaders of a particular step in the wastewater treatment plant procedures. Each group will have a hand in cleaning the wastewater before it is reintroduced into a larger body of water.
- In addition to the demonstration, please use the Powerpoint, SMART Board document, or Wastewater Treatment video during the lesson, which will help students visually understand the stages of wastewater treatment. The photos and film from are from Dry Creek Wastewater Treatment Plant.
- Attached are the Scientists Observation Table and the Post-Demonstration Exercise. Students will be asked to fill out the Scientists Observation Table during the demonstration and complete the Post-Demonstration Exercise after the completion of the lesson.
- Teacher Notes:
  - A virtual tour of Dry Creek Wastewater Treatment Plant is available for access on the SD1 website (2). Please feel free to utilize during the lesson. SD1 invites you to schedule a class field trip to Dry Creek Wastewater Treatment Plant located in Kenton County, KY to tour and see the plant in action. Please contact the Environmental Educator at (859) 578 – 7450 or info@SD1.org to plan a tour today!
Optional Activity: Tunnel building competition

MATERIALS:
- “Title” Map 1 – one color copy per student
- “Title” Map 2 – one color copy per student
- “Geography Sheet” (front/back double-sided copy) – one per student
- Rulers - one per student
- “Tunnel” Powerpoint
- Tunnel Article – one copy per student
- Tunnel Article – Two copies to share with class
- Gallon jug
- 10 ft. of yarn

LESSON LENGTH:
- 45 minutes – 1 hour

ESSENTIAL QUESTIONS (that will be answered):
- What is wastewater?
- Where does it go when it travels down the drain?
- How is wastewater cleaned?
- Why do we clean wastewater?

VOCABULARY WORDS:
*For all words that need to be defined during the lesson, please refer to the definitions below.
- **Regions** – water that is collected and treated (cleaned) at a local wastewater treatment plant
- **Sanitary Sewer System** - an underground carrying system to transport wastewater from houses or industry to treatment facilities
- **Sewage** – water-carried wastes, in either solution or suspension
- **Pumping Station** – a facility that assists in moving fluids to a different location or high elevations, such as hills or mountains
- **Septic Tank** – a holding tank that provides local treatment for residential wastewaters. It is used as an alternative to municipal sewer systems in some locations. Wastewater collected in a septic tank is treated before released into the septic field surrounding the home.

PROCEDURES:
Part I: Introduction
1. Complete a quick overview of what wastewater is and why we clean it. The students should have completed Lesson, “After it all goes down the drain...” and know the basics about wastewater treatment.
   o Remind the students that the water we use on a daily bases gets dirty (by showering, brushing our teeth, the dishwasher, washing machine, flushing the toilet, etc.) and becomes dirty wastewater. It goes down the drain, sent through the sewer pipelines and ends up at the wastewater treatment plant. There it is treated and cleaned before it is sent back into the Ohio River.
2. Ask the students:
   o Why it is important to clean our dirty water?
   o How has our technology advanced to treat water?
     a) Tell them that in the past people in N. Kentucky didn’t actually treat the water before it was sent into the Ohio River.
3. Tell them today we’re learning about how water is moved from one location to Northern Kentucky’s Dry Creek Wastewater Treatment Plant.
4.
5.
6.

Part II: Tunnel Article
7. Introduce the topic by stating that through the advancement of technology places like N. Kentucky are able to treat and clean more wastewater. This advancement has a
8. Give each student the article, “Boone sewage tunnel ahead of schedule” (01/16/2010) and allow 5-8 minutes for the students to read the tunnel article.
9. Once they finish ask a few questions for a quick review about the article:
   o What is the nickname of the machine creating the tunnel?
     a) The Celtic Tiger
   o In what county of N. Kentucky is the tunnel being built?
     a) Boone County (show the students where Boone County is located in the N. Kentucky area)
   o How many gallons will the tunnel be able to hold after a heavy rain?
     a) 14 gallons – hold up your gallon jug for a visual understanding
10. Show Tunnel Powerpoint that has several pictures from the Tunnel Project
11. Yarn Activity – circumference of the tunnel

Part III: Mapping 1
12. Pass out a “______ Map,” ruler and ______ Sheet to each student
13. Use map to answer the following questions on the ______ sheet
14. Once they finish discuss the 4 open-response questions. (pertaining to Geography/SS)

Part IV: Mapping 2
15. Pass out a “______ Map,” and ______ Sheet to each student
16. Use map to answer the following questions on the ______ sheet
17.

Part V: Wrap Up/Review
18. Ask the students the essentional questions below:
   o What is wastewater?
   o Where does it go when it travels down the drain?
   o How is wastewater cleaned?
   o Why do we clean wastewater?

Extension of Lesson: The discussion of SD1’s current and potential environmental practices in wastewater treatment.
- UV Treatment
- Burning waste to generate energy
- Pump station auto features
- Plans and fact sheets

**Optional Activity:**
Tunnel building competition:
Post-Demonstration Exercise:
1. What is wastewater?

2. In order, what are the FOUR stages of wastewater treatment?
   1) 
   2) 
   3) 
   4) 

3. What was your group? ______________________
   What was the role of your group during the wastewater process?

4. With the diagram below and using the word bank, can you fill in the blanks to wastewater treatment?

5. Wastewater Treatment: Order of Operations
   Please fill out the steps (A-J) below in the correct order.

<table>
<thead>
<tr>
<th>Order in Process</th>
<th>Step in Wastewater Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1) _________</td>
<td>A. Large debris in wastewater is removed by bar screens.</td>
</tr>
<tr>
<td>Step 2) _________</td>
<td>B. The wastewater undergoes skimming process, which takes off grease and scum on top.</td>
</tr>
<tr>
<td>Step 3) _________</td>
<td>C. Wastewater is sent to Final Clarifiers, where it goes through one last cleansing.</td>
</tr>
<tr>
<td>Step 4) _________</td>
<td>D. Wastewater goes down drain and through underground pipes to the Wastewater Treatment Plant.</td>
</tr>
<tr>
<td>Step 5) _________</td>
<td>E. Wastewater moves to Aeration Tanks where oxygen is pumped into base to activate bacteria, which eats solid material.</td>
</tr>
<tr>
<td>Step 6) _________</td>
<td>F. Chemicals are added to the wastewater to help control the odor.</td>
</tr>
<tr>
<td>Step 7) _________</td>
<td>G. Vortex motion forces material to separate at the Grit Removal Station.</td>
</tr>
<tr>
<td>Step 8) _________</td>
<td>H. The wastewater has been treated and is not at the effluent stage. It is ready to be released into the nearest body of water.</td>
</tr>
<tr>
<td>Step 9) _________</td>
<td>I. Wastewater is dechlorinated to remove any remaining harmful chemicals.</td>
</tr>
<tr>
<td>Step 10) ________</td>
<td>J. Wastewater is sent to Settling Tanks for 5 hours and 40 minutes to allow time for the sludge to sink to the bottom.</td>
</tr>
<tr>
<td>TREATMENT STAGE</td>
<td>FINAL TREATMENT STAGE</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
June 3, 2010

Dear Michael Born:

Sanitation District No. 1 (SD1) has hosted the Protecting the Environment Award Program since 2003. This year, Wal-Mart has partnered with SD1 to offer funding to Northern Kentucky Scout Troops and local schools that want to complete environmental projects. The program aims to protect water resources and the environment. In May, we have selected 10 winners for various types of water-related projects. One project will coordinate a local creek clean-up, three plan to create or maintain a rain garden, while others plan to develop school curriculum.

We request that Kroger sponsor a $10.00 gift card donation for each of the ten teacher and scout leader winners of the award. Providing donations recognizes teachers and shows your support for local environmental initiatives, which will also educate the community. The enclosed document provides summary information for all the projects. The ceremony will be held on Tuesday, June 29, 2010 at Twenhofel Middle School. Any items you are able to provide will be greatly valued!

For supplying donations, we would like to invite you to attend the ceremony and award your donation to the winners if desired. We are happy to present on your behalf if you are unable to attend. We can also recognize and advertise Kroger at the ceremony through supplying business cards and/or your logo on our sponsorship page at the end of our presentation. If there is another way you would like SD1 to recognize your business simply let us know. We can pick up items from your store anytime prior to the ceremony.

Please contact me with additional questions. We appreciate Kroger’s commitment as a local community partner and your time in considering this gift donation. Thank you!

Sincerely,

Witni L. Sztanyo

Environmental Educator
SD1: Managing Northern Kentucky's Wastewater and Storm Water
1045 Eaton Drive
Ft. Wright, KY 41017
Phone: 859-578-6764
Fax: 859-331-2436
wsztanyo@sd1.org

Enclosed: Project Summaries
Northern Kentucky Sanitation District No.1
1045 Eaton Drive
Fort Wright, KY  41017

March 2010
Final
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APPENDICES
Appendix A - Field Data Sheets
Appendix B - Calibration Sheets
Appendix C - Chain of Custody Records
Appendix D - Laboratory Case Narrative
1. **Introduction**

Sanitation District No. 1 (SD1) has entered into a Consent Decree with State and Federal Environmental Regulators to address overflows in Northern Kentucky. In complying with this Consent Decree, SD1 is utilizing an adaptive watershed management approach for identifying impairments and prioritizing areas for action. This approach ensures that available resources are most effectively used. SD1 has developed an Adaptive Watershed Management Plan that identifies Watershed Characterization as an initial step. The results of this Watershed Characterization will be used to identify impaired watersheds and prioritize them for consideration of control alternatives.

The monitoring conducted in the Sand Run watershed was performed in accordance with the Field Monitoring and Sampling Plan (FMSP) and the associated Quality Assurance Project Plan (QAPP). These plans together describe the water quality monitoring program to be undertaken.

As described in the FMSP, three wet weather sampling events were planned. Each wet weather event included grab sample collection and in-stream water quality measurements at each of the two locations in the Sand Run watershed. As a result of Sand Run being a smaller watershed with only two locations, the sampling was combined with the neighboring Elijahs Creek watershed which only has two sites. There is also a USGS continuous monitoring station in Elijahs Creek which was utilized for flow and precipitation data.

The objective of the monitoring and sampling program is to characterize water quality in Sand Run during and following wet weather conditions. The sampling is to characterize the nutrients, bacterial, and physical parameters of the water.

The criteria used to define a wet weather sampling event include:

- No precipitation in the watershed 72-hours before the event; and,
- A minimum of 0.25 inches of rain over a six-hour period.

Table 1 and Figure 1 identify the selected monitoring and sampling locations.

2. **Event Overview**

On June 10, 2009 a band of storms moved across the Sand Run watershed. Figures 2 through 5 show the local radar images during the storm. From a review of flow and precipitation records from the USGS continuous monitoring station at Elijah Creek, no precipitation occurred during the three days prior to the event dates.
The USGS monitoring station records indicate that the rainfall event started at 7:30 AM on June 10 and deposited 1.28 inches of rain over 48 hours. Table 2 and Figure 6 depict rainfall data for the duration of the rainfall event. As a result of the duration of the storm, rainfall fell after hour 12 and prior to hour 24. Due to this occurrence, an additional hour 30 and hour 72 were added to the event.

Because no rain fell in the watershed during the 72-hours prior to the event date, and over 0.25 inches of precipitation fell over the watershed area, the June 10th storm satisfied the criteria for a wet weather sampling event.

SD1 field crews (at minimum 2 persons per crew) were dispatched to gather data and samples as shown in Table 3. For each sample time SD1 dispatched one field crew to gather data and samples at the two sites in the following order: SDR 4.0 and SDR 0.6.

All locations recorded on-site measurements of dissolved oxygen, pH, temperature, conductivity and turbidity. Field observations were recorded on the field data sheets.

The first samples of the event were collected at 9:15 AM, and the final samples of the event were collected at 10:53 AM June 13, 2009. All grab samples were delivered to Dry Creek for laboratory analysis.
<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDR 0.6 Sand Run</td>
<td>♦ End of Route 8&lt;br&gt;♦ Wet Grab Samples&lt;br&gt;♦ On-site WQ Measurements</td>
<td>♦ Site captures lower portions of the watershed</td>
</tr>
<tr>
<td>SDR 4.0 Sand Run</td>
<td>♦ Thornwilde Subdivision&lt;br&gt;♦ Wet Grab Samples&lt;br&gt;♦ On-site WQ Measurements</td>
<td>♦ Site captures upper portions of the watershed</td>
</tr>
</tbody>
</table>
Figure 1  Sand Run Monitoring and Sampling Stations

Sand Run Watershed

Legend
- Sampling Locations
- SD1 Sampling Sites
- Streams
- Watersheds
- Sand Run
Figure 4  Storm Total Precipitation June 10, 2009 Start of Event

Storm Total Precipitation

Radar Precip Est From 03:17 AM EDT Wed Jun 10 2009 to 02:32 PM EDT Wed Jun 10 2009

NWS Cincinnati, OH

Figure 5  Storm Total Precipitation June 10, 2009 End of Event

Storm Total Precipitation
Radar Precip Est From 0647 PM EDT Wed Jun 10 2009
to 0825 AM EDT Thu Jun 11 2009
<table>
<thead>
<tr>
<th>Sample Period</th>
<th>Date</th>
<th>Time</th>
<th>Precipitation Accumulation (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hour 0</td>
<td>06/10/2009</td>
<td>9:15</td>
<td>0.34</td>
</tr>
<tr>
<td>Hour 2</td>
<td>06/10/2009</td>
<td>11:15</td>
<td>0.61</td>
</tr>
<tr>
<td>Hour 4</td>
<td>06/10/2009</td>
<td>13:15</td>
<td>0.63</td>
</tr>
<tr>
<td>Hour 6</td>
<td>06/10/2009</td>
<td>15:15</td>
<td>0.72</td>
</tr>
<tr>
<td>Hour 12</td>
<td>06/10/2009</td>
<td>21:00</td>
<td>0.72</td>
</tr>
<tr>
<td>Hour 24</td>
<td>06/11/2009</td>
<td>9:45</td>
<td>0.92</td>
</tr>
<tr>
<td>Hour 30</td>
<td>06/11/2009</td>
<td>15:15</td>
<td>0.92</td>
</tr>
<tr>
<td>Hour 36</td>
<td>06/11/2009</td>
<td>21:00</td>
<td>0.92</td>
</tr>
<tr>
<td>Hour 48</td>
<td>06/12/2009</td>
<td>12:15</td>
<td>1.28</td>
</tr>
<tr>
<td>Hour 72</td>
<td>06/13/2009</td>
<td>10:25</td>
<td>1.28</td>
</tr>
</tbody>
</table>

Table 2: Elijahs Creek USGS Continuous Monitoring Station Rainfall
Figure 6  USGS Continuous Monitoring Station Rainfall Plot

Note:
Time scale shown from 06:00 June 10, 2009 to 18:00 on June 13, 2009.
Data recorded continuously at 15-minute intervals. Precipitation data are instantaneous values for 15 minute interval (not cumulative).
Measurements at U.S. Geological Survey (USGS) Monitoring Station: USGS 03260100 Elijahs Creek
Source: USGS 2009
### Table 3  Sampling Crews for Event 1

<table>
<thead>
<tr>
<th>Samp in Time</th>
<th>Sample Period</th>
<th>Crew Designation</th>
<th>Crew Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 10, 2009</td>
<td>Hour 0</td>
<td>Crew One</td>
<td>Craig Frye Matt Wooten</td>
</tr>
<tr>
<td>09:15 – 09:59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 10, 2009</td>
<td>Hour 02</td>
<td>Crew One</td>
<td>Craig Frye Matt Wooten</td>
</tr>
<tr>
<td>11:15 – 11:35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 10, 2009</td>
<td>Hour 04</td>
<td>Crew One</td>
<td>Craig Frye Matt Wooten</td>
</tr>
<tr>
<td>13:23 – 13:45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 10, 2009</td>
<td>Hour 06</td>
<td>Crew One</td>
<td>Craig Frye Matt Wooten</td>
</tr>
<tr>
<td>15:25 – 15:50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 10, 2009</td>
<td>Hour 12</td>
<td>Crew Two</td>
<td>Casey Apgar Tim Bracke</td>
</tr>
<tr>
<td>21:08 – 21:40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 11, 2009</td>
<td>Hour 24</td>
<td>Crew Three</td>
<td>Casey Apgar Tim Bracke Javier Laboy</td>
</tr>
<tr>
<td>09:48 – 10:15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 11, 2009</td>
<td>Hour 30</td>
<td>Crew Four</td>
<td>Casey Apgar Tim Bracke</td>
</tr>
<tr>
<td>15:20 – 15:42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 11, 2009</td>
<td>Hour 36</td>
<td>Crew Five</td>
<td>Casey Apgar Tim Bracke</td>
</tr>
<tr>
<td>21:07 – 21:27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 12, 2009</td>
<td>Hour 48</td>
<td>Crew Six</td>
<td>Craig Frye Matt Wooten</td>
</tr>
<tr>
<td>12:24 – 12:48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 13, 2009</td>
<td>Hour 72</td>
<td>Crew Seven</td>
<td>Craig Frye Casey Apgar</td>
</tr>
<tr>
<td>10:25 – 10:53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2.1 Grab Samples

Grab samples were collected at each of the sample locations during each of the ten visits over the 72-hour period. One of the sample containers to be filled at each sample site was a one-liter bottle, which contained no preservatives. The one-liter bottle with no preservatives was used as an intermediate container to promptly collect and distribute (and filter as necessary) sample volume to each of the other sample bottles, which contained preservative. Ortho-phosphate samples were filtered utilizing disposable 60 ml syringes with 0.45 µm nylon filters. After filling all other sample bottles, the one-liter bottle with no preservative was filled directly from the stream. Samples were collected from the middle of a flowing portion of the stream at each sample location. The process of collecting and distributing samples to the bottles was completed in as short of time as possible. Table 4 outlines the details of sample containers and preservatives to be used.
Table 4  Guidelines for Sample Container Preparation and Preservation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Container</th>
<th>ecommended Sample Volume</th>
<th>Preservation</th>
<th>Maximum Storage Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fecal Coliform E. coli</td>
<td>Pre-Sterilized</td>
<td>120 ml</td>
<td>Add Na$_2$S$_2$O$_7$</td>
<td>12 hours$^2$</td>
</tr>
<tr>
<td></td>
<td>Polyethylene or Glass</td>
<td></td>
<td>Refrigerate to 4°C</td>
<td></td>
</tr>
<tr>
<td>Nutrients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH$_3$, TKN, NO$_3$ - NO$_2$</td>
<td>Polyethylene or Glass</td>
<td>1000 ml</td>
<td>Add H$_2$SO$_4$, pH&lt;2</td>
<td>28 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Refrigerate to 4°C</td>
<td></td>
</tr>
<tr>
<td>Ortho Phosphate</td>
<td>Polyethylene or Glass</td>
<td>120 ml</td>
<td>Field filter</td>
<td>48 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Refrigerate to 4°C</td>
<td></td>
</tr>
<tr>
<td>Conventional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS, CBOD$_5$</td>
<td>Polyethylene or Glass</td>
<td>1000 ml</td>
<td>Refrigerate to 4°C</td>
<td>7 days (TSS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>48 hours (CBOD$_5$)</td>
</tr>
</tbody>
</table>

1. Sodium Thiosulfate (Na$_2$S$_2$O$_7$) prevents continuation of bacteriocidal action.
2. The maximum allowable holding time for bacteria samples will be 12 hours with a goal of 6 hours when practical.

2.2 QA/QC Samples

The monitoring team used two types of QA/QC samples collected in the field to assist in validating chemical data sets – sample duplicates and blanks. Each type of QA/QC sample is described in the following sections.

2.2.1 Sample Duplicates

Sample duplicates are to be collected for laboratory analysis for all parameters at selected sites and times. The purpose of these analyses is to evaluate sample collection precision by comparing the duplicate analytical results. Table 5 shows the schedule for duplicates. As a result of Sand Run watershed and Elijahs Creek watershed being sampled together, the duplicates were collected in the Elijahs Creek watershed during event 1.
### Table 5  Duplicate Sample & Equipment/Field Blank Schedule

<table>
<thead>
<tr>
<th>Crew</th>
<th>Hour</th>
<th>Duplicate Site ID</th>
<th>Blank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>X*</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>X*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>48</td>
<td>X*</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The duplicate sites were collected in the Elijahs Creek watershed.

#### 2.2.2 Equipment Blanks

Equipment blanks were to be collected for laboratory analysis for all parameters as appropriate. Equipment blanks are collected by decontaminating the sampling bucket with deionized (DI) water, then refilling the bucket with DI water which is then poured directly into a set of sample containers. The purpose of these analyses is to assess potential cross-contamination of samples by the equipment, including intermediate sample containers. When collecting samples by hand or using the sample pole and TSS bottle, no equipment blanks were required. Equipment blanks are required when using the sampling bucket to transfer water to the sample bottles.

#### 2.2.3 Method Blanks

Method blanks are collected for laboratory analysis for ortho-phosphate. DI water is filtered with disposable 60 ml syringes and 0.45 µm nylon filters for the ortho-phosphate method blank sample. The purpose of this analysis is to assess the potential contamination of sample by the syringe and/or filters.

#### 2.2.4 Field Blanks

Field blanks are to be collected for laboratory analysis for all parameters. Field blanks are collected in the field by directly filling each sample container with DI water. No intermediate containers or filters are utilized in collecting the field blanks. The purpose of these analyses is to determine if samples collected have been contaminated by field handling and/or cleaning methods. All scheduled field blanks were collected during the survey. Table 5 also shows when the field blanks were collected.
2.3 **Field Logs and Records**

Field crews documented all activities associated with the monitoring program at each monitoring site, including unusual or anomalous conditions, if any. In addition, a description of any problems encountered during the monitoring period and/or any deviations to the Field Monitoring and Sampling Plan (FMSP) were also documented. This information may subsequently be used for data interpretation and analyses. Copies of field data sheets are provided in Appendix A.

2.3.1 **Chain of Custody Records**

Chain of Custody (COC) records were maintained by the field crews and Dry Creek Lab (analysis) for sample documentation. Copies of the COCs are provided in Appendix C.

2.3.2 **Event Deviations**

No deviations were found during Wet Weather Event No. 1.

2.3.3 **Sample Containers and Preservation**

Table 4 presents details of sample containers and preservatives to be used.

3. **Review of Results**

Table 7 summarizes the in-stream water quality measurements and the laboratory analysis results of the grab samples for each parameter. The in-stream water quality measurement completeness was 100%. The laboratory analysis completeness was 100%. Overall completeness was 100%. The Field Data Sheets are included in Appendix A, Calibration Sheets are included in Appendix B, Chains of Custody Forms in Appendix C, and Laboratory Case Narrative in Appendix D.

3.1 **Laboratory Test Results**

All samples were analyzed within hold times. For all samples, the total Kjeldahl nitrogen (TKN) exceeded ammonia as nitrogen and the total phosphorus exceeded ortho-phosphate.

The *E. coli* exceeded the fecal coliform for 7 of the 20 sample times. The Colilert method of measuring *E. coli* can produce results above the fecal coliform results.

3.2 **In-Stream Water Quality Measurements**

The in-stream measurements for temperature, pH, dissolved oxygen, conductivity and turbidity generally fell within expected ranges.

For all sample times, 100% of in-stream water quality measurements were collected. The calibration sheets for the equipment are included in Appendix
B. The RPDs for all parameters were less than the RPD objective of 10% for all parameters as shown in Table 6.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Parameter</th>
<th>Pre Calibration</th>
<th>Post Check</th>
<th>PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>38337</td>
<td>Dissolved Oxygen</td>
<td>8.36</td>
<td>8.45</td>
<td>1.1%</td>
</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>1000</td>
<td>999</td>
<td>0.1%</td>
</tr>
<tr>
<td></td>
<td>pH 7</td>
<td>7.00</td>
<td>6.98</td>
<td>0.3%</td>
</tr>
<tr>
<td></td>
<td>pH 10</td>
<td>10.00</td>
<td>9.94</td>
<td>0.6%</td>
</tr>
<tr>
<td></td>
<td>Turbidity</td>
<td>800</td>
<td>801</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

3.3 QA/QC Samples

For each duplicate parameter analyzed, the relative percent difference (RPD) was calculated. The RPD objective for fecal coliform and *E. coli* is 100%, for CBOD$_5$ is 40%, and for the nutrients and sediment is 30%.

The RPD objectives were not met for one parameter at EJC 0.3 HR 2 – ammonia (114%).

The RPD objectives were not met for two parameters at EJC 2.8 HR48 – ammonia (76%) and nitrate nitrite (51%).

Two sets of field blanks were collected during this event, after HR6 and HR48. Both sets of field blanks had nitrate-nitrite and total phosphorous above the detection limit. Possible causes for this are discussed in the Laboratory Case Narrative in Appendix D.

The method blank for HR6 was above the detection limit for orthophosphate. This result may be due to the filter, as the field blank collected at the same time was below the detection limit.
<table>
<thead>
<tr>
<th>Site ID</th>
<th>Hour</th>
<th>Sample Type</th>
<th>Lab ID</th>
<th>Lab ID</th>
<th>Basin</th>
<th>Date</th>
<th>Time</th>
<th>Temp.</th>
<th>pH</th>
<th>D.O.</th>
<th>Sp. Cond.</th>
<th>Turbidity</th>
<th>Depth</th>
<th>Fecal Coliform</th>
<th>E. coli</th>
<th>NH3 as N</th>
<th>TKN</th>
<th>Nitrate-Nitrite as N</th>
<th>Ortho Phosphate</th>
<th>Total Phosphorus</th>
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APPENDIX A

FIELD DATA SHEETS
**Sanitation District No.1 Field Data Sheet**

**Project Name**: Sand Run/Elijahs Creek  
**Date**: 6/10/2009

**Study Basin**: North  
**Start Time**: 08:43

**Samplers**: MW, CF  
**End Time**: 16:15

**Equipment ID**: Multiprobe Sonde# 38337

**Project Descriptor**: Wet Weather Event 1

**Stream Conditions**

**Weather Conditions**: Air Temp (°F)

**Field Observations**: Very Wet!!! Duplicate site = EJC 0.3 HR 2

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<th>pH</th>
<th>DO (mg/L)</th>
<th>Sp.Cond. (μS/cm)</th>
<th>Turbidity (NTU)</th>
<th>Depth (feet)</th>
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## Sanitation District No.1 Field Data Sheet

**Project Name**: Sand Run/Elijahs Creek  
**Date**: 6/10/2009

**Study Basin**: North  
**Start Time**: 20:45

**Samplers**: CA, TB  
**End Time**: 22:07

**Equipment ID**: Multiprobe Sonde# 38337

**Project Descriptor**: Wet Weather Event 1

**Stream Conditions**

**Weather Conditions**: Air Temp (°F)

### Field Observations

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<th>Turbidity (NTU)</th>
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Characterization_Planning - WT\Monitoring Program\Watershed Specific\SDR and EJC\Wet Weather\Event 1\Field Data\Sandrun Elijah Creek HR 12.xls
### Field Data Sheet

**Project Name:** Sand Run/Elijah Creek  
**Date:** 6/11/2009

**Study Basin:** North  
**Start Time:** 08:45

**Samplers:** CA, TB, JL  
**End Time:** 10:15

**Equipment ID:** Multiprobe Sonde # 38337

**Project Descriptor:** Wet Weather Event 1

**Stream Conditions**

**Weather Conditions:** Overcast

**Air Temp (°F):**

**Field Observations:**

DUP HR 24: taken at EJC2.8  
Hydrolab surveyor batteries died  
Real time readings were at 0934  
Started light rain at 1045

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<td>Temp (°C)</td>
<td>pH</td>
<td>DO (mg/L)</td>
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<td>Turbidity (NTU)</td>
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<td>Time (hh:mm)</td>
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Project Name: Sand Run/Elijahs Creek
Date: 6/11/2009
Study Basin: North
Start Time: 14:48
End Time: 16:07
Equipment ID: Multiprobe Sonde# 38337
Project Descriptor: Wet Weather Event 1
Stream Conditions: North
Weather Conditions: Overcast

Field Observations:
- Site Bank Depth Temp pH DO Sp.Cond. Turbidity Depth Time
  - 1 SDR0.6 HR30 Middle Surface 20.3 7.9 7.9 446 165 15:42
  - 2 SDR4.0 HR30 Middle Surface 20.2 8.1 9.0 580 40 15:20
  - 3 EJC0.3 HR30 Middle Surface 21.5 8.3 9.0 427 31 16:07
  - 4 EJC2.8 HR30 Middle Surface 21.5 7.7 8.1 372 21 14:48

characterization_Planning - WT\Monitoring Program\Watershed Specific\SDR and EJC\Wet Weather\Event 1\Field Data\Sandrun Elijah Creek HR 30.xls
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<th>Temp (°C)</th>
<th>pH</th>
<th>DO (mg/L)</th>
<th>Sp.Cond. (μS/cm)</th>
<th>Turbidity (NTU)</th>
<th>Depth (feet)</th>
<th>Time (hh:mm)</th>
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Project Name: Sand Run/Elijahs Creek
Date: 6/11/2009
Study Basin: North
Start Time: 20:45
End Time: 21:54
Equipment ID: Multiprobe Sonde# 38337
Project Descriptor: Wet Weather Event 1
Stream Conditions: Overcast
Weather Conditions: Overcast
Air Temp (°F): 70
### Sanitation District No.1 Field Data Sheet

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<th>Turbidity (NTU)</th>
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**Field Observations:**
- DUP HR48: taken at EJC0.3
### Field Data Sheet

**Project Name** Sand Run/Elijah Creek  
**Date** 6/13/2009

**Study Basin** North  
**Start Time** 10:09

**Samplers** CF, CA  
**End Time** 11:25

**Equipment ID** Multiprobe Sonde# 38337

**Project Descriptor** Wet Weather Event 1

**Stream Conditions**  
**Weather Conditions** Clear/Sunny  
**Air Temp (°F)**

**Field Observations** This is an extra sampling day based on the amount and timing of rain during this event.

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This is an extra sampling day based on the amount and timing of rain during this event.
APPENDIX B

CALIBRATION SHEETS
### SANITATION DISTRICT NO. 1 MULTIPROBE INSTRUMENTATION CALIBRATION & QA SHEET

**Instrument Model**: 38337  
**Date**: 6-10-09  
**Site Location**: SD1  
**Serial Number**:  
**Analyst(s)**: C.F  
**Instrument I.D.**: SDR/EC Wet #1  
**Note**:  

#### CALIBRATION READINGS

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<td>Elevation (ft) ⇒ Correction Factor</td>
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<td>Percent Saturation</td>
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#### POST CHECK READINGS - 6-17-09

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#### Conductivity

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#### Turbidity

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#### Additional Comments:

- **Note**: Do NOT make adjustments during Post Check. Simply record values observed.
APPENDIX C

CHAIN OF CUSTODY RECORDS
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<th>Sample Site (Location)</th>
<th>Date</th>
<th>Time</th>
<th>Composite / Grab</th>
<th>Sample Location</th>
<th>No. of Containers</th>
<th>E. coli</th>
<th>TSS</th>
<th>ORP 25</th>
<th>CINO 4.0</th>
<th>Remarks</th>
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Requisitioned By:  Sample
Date: 6/10/09  Time: 10:25

Accepted By: Field Runner
Date: 6/10/09  Time: 10:25

Received By: Laboratory
Date: 6/10/09  Time: 10:25

Remarks: 12.1-17.9°C - Sample T
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<th>E. Coli</th>
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Remarks:

- E20: Sample Codes
- Preserved Samples
- +H2SO4
- +H2SO4
- Soap Temp: 31°-15.6°
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Reinquished by: [Signature]

Received By: Lab Runner

Date: 4/10/09

Time: 14:25

Remarks: 31° - 11.4°
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Temp@ 1713 6.3-14.8°C pH < 2
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**Survey Initiation Date**: 6/10/09

**Remarks**: 48.31514, 20 31515, 21 31516, 22 31517

**Temp**: 22.4°C

**pH**: 2

**H2SO4 added to EJC2.8**
### Chain Of Custody Record

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**Crew3 Due 1**

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**Remains: 1.8°-13.4°**
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**Lab Matrix**

**Survey Location**
Sand Run & Elijah Creek

**Survey Type**
Wet Weather Event

**Survey Initiation Date**

**Sample Matrix**
Water

**Remarks**

**Reporting By:** Sample

**Date:** 6-11-09, **Time:** 10:29

**Accepted By:** Field Runner

**Date:** 6-11-09, **Time:** 10:29

**Received By:** Laboratory

**Date:** 6-11-09, **Time:** 22:35

**Temp:** 4.8-8.3 °C

**pH:** 2
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<th>Role / Basal / Groove</th>
<th>Sample Location</th>
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**PH < 2**

**Temp @ 1359 (53°-51°C)**
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**Remarks:**
- AB31733
- 31734
- 31735
- 31736

**Temp:** 58-15.9°C  
**pH:** 2
General Information
Sample bottles, labels, and chains of custody (COC) were prepared according to sampling plan, outlined in the QAPP. Laboratory personnel performed an initial quality check upon samples’ arrival. Coliform samples analyzed upon arrival. All other samples were placed in laboratory refrigerators until analyses performed.

Analytical Results

AMMONIA – No problems noted with this analysis.

NITRATE-NITRITE – Groups 1 and 2 have method blanks slightly above 0 mg/L. Samples and certified QCs with known amounts passed. Field Blanks resulted in slightly above the laboratory’s Method Detection Limit. Possible causes to this are:
1. The cadmium column used in this FIA method could have been losing it efficiency. Therefore, giving slightly inaccurate results and also varying results. The laboratory replaced it 11/2009. The laboratory will look into replacing it more frequently.
2. Residual chlorine from the sample(s) can interfere by oxidizing the cadmium column.
3. Nitrate is an ion that is in an intermediate phase. It will link with others very easily; therefore contamination is very high.
4. The MDL for nitrates is low. A new study will be performed.

cBOD – Groups 3 and 4 had a method depletion exceeding 0.2 mg/L. GGA standard did not pass. Certified QCs did pass. The recovery was low. Sample recoveries were Below Detection Limit (BDL). Possible cause of issues is BOD dilution water. It is made every two days. Human error in distributing sample could be another cause. Therefore, it is difficult to pin direct cause.

Fecal Coliform and E. Coli – Most samples were tested within holding times. HR 36 samples exceeded 6 hour holding time but not 12 hour holding time. No other problems with this analysis.

TP – Method Blanks (MB) were under BDL. Watershed Qualifier B. All certified QCs passed.

ORTHO PHOSPHATE - No problems noted with this analysis.

TOTAL Suspended Solids - No problems noted with this analysis.