Pima County
2015 Annual Stormwater Report
&
Permit Renewal Application

July 2014 – June 2015
AZPDES Permit No. AZS000002

PIMA COUNTY

September 2015

Stormwater Management Plan

Prepared in cooperation with:
Regional Wastewater Reclamation Department
Department of Transportation
Regional Flood Control District
Development Services
Pima Association of Governments

Stormwater Management Program
Pima County Department of Environmental Quality
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EXECUTIVE SUMMARY

Introduction
This report describes activities performed and data collected for Pima County's Arizona Pollutant Discharge System (AZPDES) Permit No. AZS000002 between July 1, 2014 and June 30, 2015. This permit authorizes Pima County to discharge stormwater from a municipal separate storm sewer system (MS4) to waters of the United States.

This report is the fourth annual report prepared under the new state permit issued on June 16, 2011 and effective on July 18, 2011, herein referred to as the 2011 MS4 permit. Under the previous EPA MS4 permit issued on February 14, 1997, 14 annual reports were prepared. This report contains the extra Appendix R containing the renewal application.

Certification
Pima County's principal executive officer signs and certifies this annual report was prepared by qualified personnel to properly gather and evaluate the information submitted (Part 2).

Stormwater Management Program (SWMP)
Best management practices (BMPs) were implemented in accordance with the SWMP during the reporting period. Information for the SWMP is found in the following parts: Narrative summary of SWMP activities (Part 3 and Appendices), Numeric summary of SWMP activities (Part 4), Evaluation of SWMP (Part 5), and Modifications to SWMP (Part 6).

Wet Weather Monitoring
Water quality samples were collected from the five Monitoring Sites (Part 7). Storm event records were automatically recorded and summarized (Part 8). Analytical results for the water quality samples (Part 9), the water quality assessment (Part 10) and the estimate of annual pollutant loadings (Part 11) document the quality of surface water flows.

Expenditures and Proposed Budget
A summary of the annual expenditures and the proposed budget are summarized (Part 12).

Conclusions
Pima County implemented the SWMP and Wet Weather Monitoring Program. Activities included maintenance of the roadways and drainage systems. Inspections were performed at 38 outfalls, 38 construction sites, 56 post construction sites, 17 county facilities and 11 private industrial facilities. The public reported 1,330 environmental complaints. All were inspected or referred to another jurisdiction. These inspections resulted in 395 Notices of Violation and 374 remediated sites. Ten stormwater samples were collected at five monitor sites. Analysis of the water quality results for 134 parameters shows copper and *E. Coli* were the two pollutants detected above Arizona's Surface Water Quality Standards (SWQS). These activities and increasingly effective stormwater stewardship practices by the public contribute to stormwater quality with two parameters above standards and meeting the other 106 SWQS.

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1. General Information

A. Name of Permittee: Pima County

B. Permit Number: AZS000002

C. Reporting Period: July 1, 2014 - June 30, 2015

D. Name of Stormwater Management Program Contact: Marie Light

Title: Principal Hydrologist

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Email Address: marie.light@pima.gov

E. Name of Certifying Official: John M. Bernal

Title: Deputy County Administrator for Public Works

Mailing Address: 130 W. Congress

City: Tucson

Zip: 85701-1317

Phone: 520-724-8474

Fax Number: 520-740-8171

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F. Scope of Permit

The physical components within the permit area include 2,087 miles of roadway, 39 miles of storm drains and appurtenances that collect and convey runoff from precipitation events, with lengths reported by Pima County Department of Transportation (PDOT) and Regional Flood Control District (RFCD, respectively. The permit area is unincorporated Pima County within the Santa Cruz River watershed (Figure 1-1, blue area). In both rural areas and metropolitan areas, runoff collects in ephemeral stream channels and infiltrates into alluvial deposit in the valley (USGS, 1973). Flows in ephemeral stream channels occur in response to rainfall events that are larger than 0.2 inches. Most runoff infiltrates within Pima County.

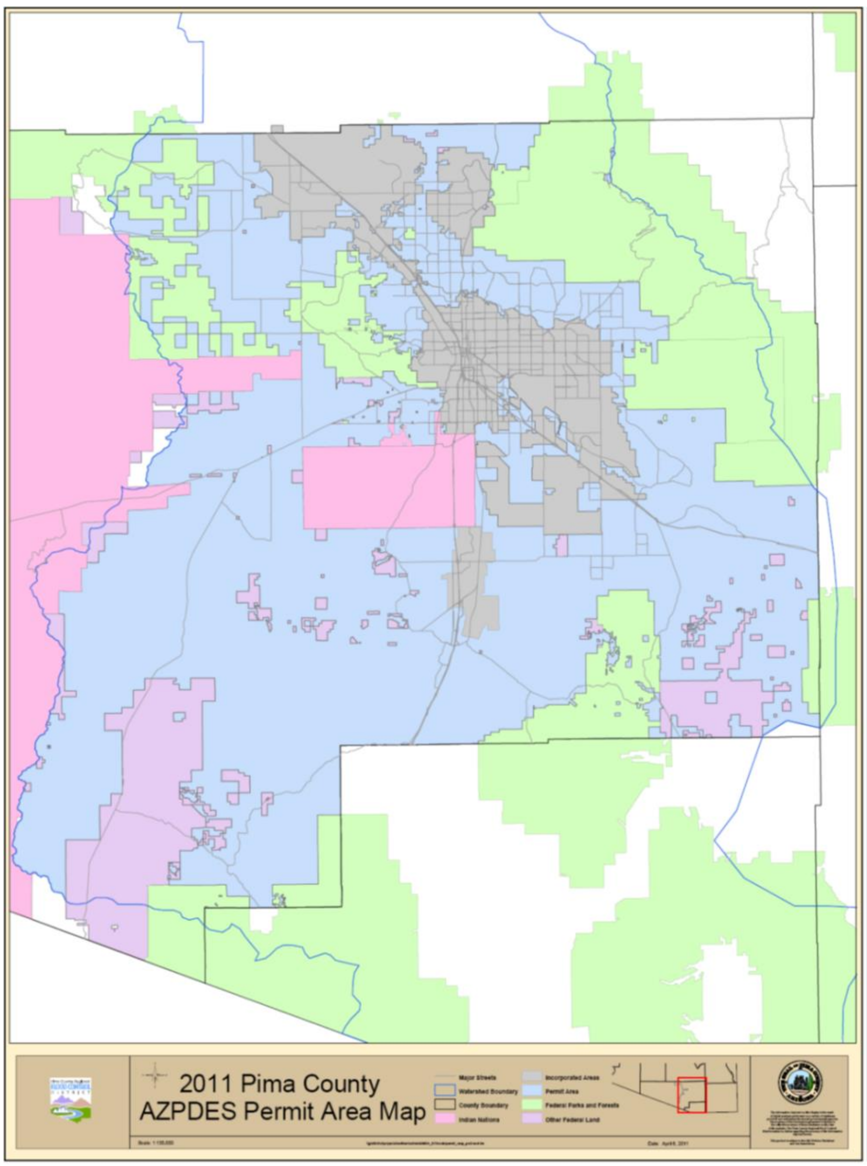

Figure 1. 2011 AZPDES Permit Area Map

Managements Activities

Management of the program includes coordinating with Pima County departments maintain roadways and drainageways, purchasing open space to conserve land and manage stormwater operations between five county departments. Pima County collaborates with local jurisdictions, businesses, educational institutions, and interested members of the public to engage the public in restoring and maintaining the integrity of surface waters in the county. Education and training include teaching techniques to keep water clean and using stormwater as a resource for landscape irrigation and other beneficial uses. Staff engages the novice to the profession as well as kids to great grandparents.

Field Activities

Pima County inspects outfalls, construction sites, industrial facilities, and reported environmental complaints that could lead to illicit discharge detection and elimination. To characterize water quality, Pima County collects water samples at five monitor sites representing low density residences, medium density residences, high density residences, commercial and industrial land uses.

Permit Renewal

This report contains the renewal application for Pima County, in accordance with 2011 Permit, Part 8.1.2 and is attached as Appendix R.

References

USGS, 1973. *Geohydrology and Water Resources of the Tucson Basin, Arizona*, Geological Survey Water-Supply Paper 1939-E, 80 pp.

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2. ANNUAL REPORT CERTIFICATION AND LEGAL AUTHORITY

Written by: **Date:**

Marie Light
Principal Hydrologist

September 23, 2015

Reviewed by: **Date:**

Ursula Nelson
Director, Department of Environmental Quality

9.23.15

Approved by:

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

John M. Bernal
Deputy County Administrator for Public Works

Date 9/24/15

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3. Narrative Summary of Stormwater Management Program

Pima County's municipal separate storm sewer storm drain system consists of 2,087 miles of roadways, 39 miles of storm drains, and infrastructure collecting runoff into drainageways or discharging runoff to ephemeral stream channels. Pima County utilizes a Public Awareness Program and a Public Participation Program to invest in behaviors protecting the quality of stormwater as it flows through the county. The public is encouraged to report illegal dumping and unusual environmental conditions to remove materials in washes or on land that could be transported into a wash during rainfall events. Management of Pima County Facilities includes maintenance of infrastructure and acquisition of property to prevent stormwater pollution. Inspections of Industrial Facilities and Construction Sites also reduce stormwater pollution. Post Construction activities include inspections once construction is completed at a site as well as implementation of Green Infrastructure and Low Impact Development (GI/LID) to prevent flooding and stormwater pollution.

A. Public Awareness

The public awareness program involves on-going education of the public and businesses, and contributes to environmental and stormwater educational events. Pima County DEQ staff delivered the keep-stormwater-clean message using literature, promotional materials, presentations, and assistance to business. A wide range of literature provided to the public includes 49 types ranging from bookmarks, booklets, brochures, posters, stickers, bags and fact sheets (Appendix A). Literature is being prepared in both Spanish and English as the demographic population is 35% Hispanic or Latino and 74% white.

<u>Conferences, Seminars and Presentations</u>

Pima Community College requests PDEQ staff to provide a three-hour presentation for students in the class *Building/Construction Technology 265 Sustainability*. The presentation is provided once each semester, and class sizes range between 5 to 30 registered students. This fiscal year the topic addressed the application of Low Impact Development and Green Infrastructure to achieve sustainable water use. The presentation was made on March 3, 2015.

Additional presentations were made to the professionals, including a presentation given to the Arizona Builders Alliance on April 21, 2015, addressing how to keep stormwater clean during construction projects.

The topics presented to the general public include wash protection, illicit discharges, and illegal dumping. The "Protect Our Water with Proper Trash Disposal" campaign for the general public continued into this past fiscal year through PowerPoint presentations with community groups on October 16, 2014 and November 13, 2014. The presentations identified the following methods of reducing illegal dumping and stormwater pollution: hire someone you know and can trust, or hire a permitted solid waste hauler (list available through PDEQ); know your hauler's name, address, and phone number; pay by check and get a receipt from the hauler; and make arrangements to pay the hauler half of the fee up front and the balance upon return with a dated landfill receipt.

PDEQ staff continued the provision of previous key stormwater pollution prevention messages to the public including reducing pollution caused by improper disposal of animal waste and keeping vehicles well-maintained, while introducing the anti-illegal dumping and littering message.

PDEQ partnered with AZ Lotus stations for a six week monsoon campaign. AZ Lotus owns four radio stations in Pima County; two English language (KLPX and KFMA) and two Spanish language (KCMT and KTKT), with a combined audience of 197,000. The campaign started on June 22, 2015 and ran through August 2, 2015, and included 360 water tips followed by commercials on live and streaming radio, website advertisements, emails blasts, and social media. Topics addressed during the campaign, included water harvesting, car repair and pet waste. PDEQ staff were also interviewed for a fifth radio station, which aired on June 27, 2015 and July 4, 2015. The interview addressed stormwater harvesting, illegal dumping, pet wastes, and pool draining.

MS4s within Pima County, ADEQ and the construction industry meet regularly at the Stormwater Management Working Group (SWMWG) hosted by Pima Association of Governments (PAG) to develop a stormwater message for the area. PDEQ helped define messages for residents, home owners, schools and the development community. The group developed a multi-media outreach campaign designed to educate residents about stormwater pollution, watershed awareness, wash protection, illicit discharges and illegal dumping. Public events, media interviews, magazine ads, articles, signage, website and social media communication, promotional materials and educational literature formed the multi-media campaign.

The slogan “Clean Water Starts with Me” was used for the seventh consecutive year to increase familiarity with the successful message. Artwork and style matches the imagery used by the local jurisdictions in school programs. Public Service Announcements (PSAs), radio ads, billboards, magazine ads, bus advertisements and social media ads were run beginning in July of 2014. Comprehensive topics addressed by outreach include animal waste, management and disposal of used oil, proper vehicle washing, residential practices including LID, post-construction LID and water harvesting, pesticides and fertilizers, preventing improper dumping and litter, and construction related issues. Pima County continues to utilize the GIS layer showing the area distribution of all MS4s in Pima County.

SWMWG formed a key partnership in fiscal year 2013-14 with the University of Arizona’s Project Water Education for Teachers (WET) to expand outreach to youth audiences. Project WET is based in Science, Technology, Engineering & Math (STEM) standards and meets Arizona State Science Standards. Students address real world problems through a variety of experiments using watershed models and observing relative effectiveness of stormwater management systems. SWMWG collaborated with Project WET staff to further enhance development of the stormwater curriculum. During this fiscal year 22,830 teachers and students participated in Project WET activities.

A phone survey was conducted in June 2014 to assess the public’s attitudes towards stormwater and their trash disposal behaviors. The results were finalized in a report (FMR Associates, 2014).

The results of the survey were initially presented to Pima County, Town of Oro Valley, City of Tucson, Town of Marana and PAG staff working on air and water quality public outreach in early July 2014. Additional presentations were made to PAG's Stormwater Management Working Group on September 11, 2014 and October 23, 2014.

Pima County, in cooperation with City of Tucson, PAG, the University of Arizona, Tucson Electric Power, Stantec, Watershed Management Group and Wheat Design Group planned and implemented the 2015 Low Impact Development Workshop held on April 9-10, 2015. The workshop included presentations on regional low impact development achievements and research, breakout groups, and an interactive field experience. PDEQ gave a presentation, Stormwater Quality Standards and Protecting Aquatic Communities of Ephemeral Streams. The attendees were 100 engineers, landscape architects, development managers, water resource managers, stormwater quality managers and researchers.

EcoNook for Desert Dwellers and Eco Kids Corner

This community outreach project continues to provide a significant source of stormwater literature to the public at 33 Pima County Public Libraries and community centers. Librarians and program staff are invited to create special areas within each library where free environmental literature is available for patrons. "EcoNook for Desert Dwellers" targets teenagers and adults while "Eco Kids Corner" serves children 12 years and under. Educational materials cover stormwater quality topics including stormwater pollution prevention, water harvesting, desert gardening, and Green Infrastructure/Low Impact Development. About 15 people from the Pima County Community Center Manager's meeting attended on August 4, 2014.

Business Assistance Program

Activities in the Business Assistance Program help local businesses comply with applicable environmental requirements (Table 2). Pima County DEQ staff assists businesses in the completion of permit applications, clarifies the complex regulations, identifies potential violations, informs businesses about pollution prevention methods and makes suggestion to reducing stormwater discharges to stay in compliance. Free literature is provided upon request.

Table 1. Summary of Business Assistance Program

Type of Assistance	Number
Telephone/E-mail inquiries	100
DEQ office assistance visits	5
Letters/information mailed	20
Educational literature distributed	24,528
Seminars/presentations given	9
Number of times stormwater website was visited	871

B. Public Participation

Engaging the public in substantive actions to reduce pollutants from entering stormwater is key to long-term success. Members of the public clean trash from roadways and drainageways, recycle or dispose of hazardous materials at the Household Hazardous Waste Facility and report environmental issues to Pima County DEQ.

Adopt-a-Roadway Program

Volunteers in Pima County's Adopt-a-Roadway program clean up roadways and public lands. The program had 369 clean-up events over a total length of 598.3 miles. Pima County tracks the amount of material cleaned up from each adopted road (Appendix B).

Environmental Complaints

The public and businesses are encouraged to fax, phone or e-mail information about environmental complaints to Pima County DEQ. Each complaint is inspected or, if the location of the complaint places it within another jurisdiction, the complaint is referred to the responsible jurisdiction. Additional information about the inspection and potential enforcement process is described in the next section on illicit discharge detection and elimination activities.

ABOP Program

Pima County contracted Tucson Recycling & Waste Services on June 1, 2013 to operate the County's landfills and transfer stations. Recycling of antifreeze, batteries, oil and paint (ABOP) occurs at Catalina Transfer Station, Ryan Transfer Station, and Sahuarita Landfill. Additionally, used oil is recycled at the Ajo Landfill. Recycling is free and participants are encouraged to be careful with their containers during transport. Tucson Recycling & Waste Services tracks the number or batteries and gallons of paint while they recycle the oil and antifreeze with Arizona Waste Oil Services Inc. who provides an annual estimate of the amounts (Appendix C).

Last fiscal year Pima County concluded the joint operation and funding of the Household Hazardous Waste Program. This program continues to operate under the management of the City of Tucson. County residents may take materials to the HHW program for a small fee or recycle various types of paper products, cardboard, milk cartons and drink boxes, magazines, plastic, aluminum cans, steel/tin cans with Pima County's ABOP Program for free.

C. Illicit Discharge Detection and Elimination Activities

Pima County DEQ receives complaints from the general public, elected officials, regulators, and local governments identifying potential sources of pollutants that could endanger public health or the environment. Each complaint within Pima County's jurisdiction is inspected to determine if a pollutant has entered the environment and if so, the severity of the problem. The complaint is tracked until it is closed (Appendix D) or is escalated to the enforcement action of a Notice of Violation (NOV). NOVs are closed when the pollutant has been abated (Appendix E).

The number of complaints filed within Pima County's jurisdiction during this fiscal year was 1,330. Each complaint was inspected and the average time between filing the complaint and the inspection was 0.9 days. The number of inspections performed within three days was 1,260 or 95% of all Pima County responses. Some complaints are addressed by sending an information letter, such as how to remove buffelgrass or how to drain a pool properly.

These inspections led to 395 NOVs. During the fiscal year 374 cases were closed or rescinded and 21 remained open. The open cases are either in the process of closing or have entered an escalated enforcement process such as assessment of penalties, referral to Pima County Attorney's Office, an order to show cause with the court, or contempt of court. The enforcement phase has a closure rate of 95% and average closure time is 38 days. Illicit discharges of solid wastes, such as wildcat dumping and improper disposal of solid wastes, comprise 54% of complaints received by Pima County DEQ and 80% of issued NOVs.

Illicit discharges of liquids to the MS4 are relatively rare due to the high visibility of the ephemeral stream system and the high likelihood that a liquid illicit discharge will be seen and tracked to the source. The most common illicit discharges are dumping solid waste in a remote location. These types of events are reported by the public as an environmental complaint. Pima County takes the extra step of inspecting 95% of the 40 identified outfalls within the permit area to assess if liquid illicit discharges are taking place (Appendix F-1). This is over and above the permit requirement of inspecting 20% each year. While 23 are rated major outfalls based on size, none have a high priority due to the lack of illicit liquid discharges. In addition, both the Pima County Department of Transportation (PDOT) and Regional Wastewater Reclamation Department (RWRD) document when the public spills hazardous materials within the county (Table 2).

A. County Facilities

Management of County Facilities includes preparing an inventory of county facilities, GIS mapping of the MS4 features, maintaining roadway and drainageway infrastructure, drainageways, acquiring land to conserve open spaces, inspecting facilities for implementation of Material Handling and Spill Response Procedures and training staff directly involved in stormwater activities. All activities are preventive measures to keep stormwater clean.

<u>County Facility Inventory and Spill Prevention</u>

An inventory of county-owned or operated facilities with the potential to discharge pollutants to receiving waters shows none of them have a high potential for discharge pollutants (Appendix G-1). Many facilities are permitted with Arizona Department of Environmental Quality water permits such as Aquifer Protection Permits (APP) and Arizona Pollutant Discharge Elimination System (AZPDES). County facilities that are not required to obtain a state or federal environmental permit were inspected to determine if there was a potential for the discharge of a pollutant and if the site did have the potential, how well the facility was implementing the Materials Handling and Spill Response Plan (Appendix G-2). Nine facilities were determined to

Table 2. Spills within Permit Area - update

Date	Depart-ment	Location	Town-ship-Range-Section	Description	Response
02/05/15	PCDOT	Ajo & Alvernon	14-14-33	Homeless person camp. Starts at Ajo and extends into wash. Trash, personal belongings, tent inside culvert.	PDOT Operations cleaned up the location.
05/19/15	PCDOT	NE corner of Arcadia Ave and Wyoming St, Arcadia Ave.	15-14-02	Dump site. Trash, tires, mobile homes (2), feces, hazardous waste discarded in ROW.	PC Risk Management coordinated clean-up. Waste discarded by Southwest Hazard Control: trash - 63.9 tons, tires - 1720 pounds, televisions - 260 pounds, 15 pounds - metal. Trailers did not contain asbestos. Hazardous waste - 516 pounds of flammable motor oil, paint, mineral spirits.
8/28/14	RWRD	236 W Kentucky	14-13-36SW	Rodder hydraulic hose broke and spilled 5 g oil onto asphalt road.	Shut down rodder to stop oil leak. Absorbent was applied to spill area
10/7/2014	RWRD	1600 W El Rio Dr	14-13-03NE	Hydraulic hose broke while crew was performing flush PM. The hose is located between the cab and the debris body. Six g hydraulic fluid spilled on asphalt over a 40 sf area.	Crews show down truck to try and stop the fluid from flowing. Crews were sent to wash down the street.

g = gallon
sf = square feet
PDOT = Pima County Department of Transportation
RWRD = Pima County Regional Wastewater Reclamation Department

have no potential for discharge of pollutants. Some were closed landfills that have been capped. Others were restoration projects where minimal herbicides and pesticides were applied so sensitive amphibian populations could be restored. These nine facilities will be removed from the current inventory leaving 34 county facilities. One project is pending as the land will be donated to Pima County through the current owner's will. The project will remain on the inventory until the area has been inspected to determine if there is a potential for a discharge of pollutants.

Proper use and storage of chemicals is regulated within Pima County through enforcement of local requirements (environmental nuisance, solid waste, and liquid waste requirements) established in Title 7 of the Pima County Code (Pima County, 2011b). Contractors hired to maintain Pima County landscaped areas and public right-of-ways are required to follow spraying protocols established by State of Arizona rules and manufacturer's recommendations.

GIS Mapping

Pima County's Geographic Information System (GIS) includes layers facilitating the management of stormwater (Appendix H).

Infrastructure Maintenance

Roadways

Pima County Department of Transportation (PDOT) maintains 2,087 miles of roads and the drainageways in the road right-of-ways. The types of roadway maintenance include sweeping, shoulder repairs, pothole repairs, grading and blading, sidewalk and curb repair, street surface repairs and litter and debris removal (Appendix I).

Drainageways

Pima County RFCD maintains 450 miles of drainage, excluding the major water courses of the Santa Cruz River, Rillito River, Pantano Wash and Cañada Del Oro Wash. RFCD prioritizes 150 miles for inspection, and inspects the identified outfalls (Appendix F) and drainage reaches. They then follow up with grading; spot litter, debris, weed control; sediment removal; mowing; and spraying vegetation where needed (Appendix J).

Land Conservation

Land has been purchased under the 1997 Open Space Bond Program (OSBP), the 2004 Conservation Acquisition Bond Program (CABP) and the Flood prone Land Acquisition Program (FLAP) to conserve land (Appendix K). The 1997 OSBP and 2004 CABP protect the region's most prized natural and cultural resources (Pima County, 2011d). The FLAP preserves land in floodways (Appendix N).

Training staff directly working on stormwater control measures

Pima County trains field personnel to recognize and report potential illicit discharges to Pima County DEQ by fax, phone or e-mail. Additionally, Pima County provided 26 events to train 177 staff members on technical topics such as construction site inspections, stormwater management for industrial facilities and installation of Low Impact Development features. An additional five events were provided to 16 people for increasing public education skills and knowledge of stormwater regulations.

B. Industrial and Commercial Facilities

The Industrial Facilities Inventory is based on ADEQ's list of facilities that filed for the 2010 Multi-Sector General Permit (2010 MSGP) and facilities which need to file a Notice of Intent for the 2010 MSGP. Facilities located within the permit area and which have the potential to discharge to a Pima County roadway or drainageway were added to the inventory (Appendix L-1). Stormwater inspections are designed to evaluate consistency with the ADEQ's 2010 MSGP and compliance with Pima County ordinances. The Site Inspection Report form was modified to incorporate the 2010 MSGP and Pima County 2011 MS4 permit. Of the 51 industrial facilities, eleven were inspected for the first time during this fiscal year (Appendix L-2). As the permit requires inspections of 20%, the permit requirement has been met.

C. Construction Sites

Activities reducing pollutants to stream channels include plan reviews, issuance of air quality permits and Floodplain Use Permits, construction site inspections, and staff training.

Plan Reviews

Before grading permits or construction permits are issued, plans for development are first reviewed by Pima County Development Services Department (DSD). These plans must conform to requirements for Pima County Buffer Overlay Zone (BOZO), grading standards (GS), setback requirements for BOZO and GS, hydro seeding and revegetation, Hillside Development Overlay Zone and surface stabilization (Appendix M). Pima County DSD staff inspects the sites to verify the construction is proceeding according to approved plans.

Pima County Permits

Septic Systems

All new septic systems within Pima County must undergo pre-construction design approval, percolation testing, and post-construction installation approval. Septic system failure or exfiltration of water from these systems into the Pima County MS4 rarely occurs. If a surface discharge from a septic system were to occur, it would be regulated under Title 7 of the Pima County Code §7.21.025.A.

Floodplain Use Permit (FLUP)
Pima County RFCD issues FLUPs for specific improvements within the regulatory floodplain or erosion hazard area (Appendix N). The permits are required prior to beginning construction in areas were flows exceed 100 cubic feet per second or where sheet flooding occurs.

Pima County Air Quality Activity Permits
Pima County requires air quality activity permits, called fugitive dust activity permits, for trenching operations, road construction, and land stripping or earthmoving activities that disturb one acre or more. Each permit requires the construction site operator to take reasonable precautions to control fugitive dust emissions from the site. Proper dust suppression techniques prevent the deposition of windblown dust that may later become entrained in stormwater and reduces tracking from construction sites.

<u>Construction Site Inventory and Inspections</u>
Pima County DEQ prepares a construction site inventory based on ADEQ's list of operators filing for the 2013 Construction General Permit (CGP) as well as identification of sites that need to file an NOI for the 2013 CGP. A total of 40 Notices of Intent were inspected during the fiscal year out of a total of 167. The low rate of inspection is due to low staffing levels during the process of replacing a field stormwater inspector. Pima County focused on the sites with the greatest potential for a stormwater issue and did not inspect the low priority construction sites, unless a complaint was received. The vacancy has been filled and the program is again fully staffed. The construction site inventory lists all the permitted sites and dates of the inspections (Appendix O-1). The results of the site inspection reports show the level of consistency with the 2013 CGP as well as compliance with ordinances (Appendix O-2). The construction inspection reports were found to meet written protocols and industry standards for inspection on construction sites.

D. Post Construction

After construction has been completed, an inspection is performed to track the effectiveness of the new construction and if the site has been properly cleaned of temporary sediment and erosion control measures. The post-construction site inventory (Appendix P-1) identifies which sites have been inspected and copies of the site inspection reports show how well the projects are functioning (Appendix P-2). Post-construction inspections are typically conducted within one year after the completion of the project; however, inspections were delayed this fiscal year while replacing the field stormwater inspector. The completion of the project is determined by the date of which the notice of termination, (NOT), is submitted to the Arizona Department of Environmental Quality. Post-construction inspections ensure that post-construction stormwater controls are adequate, complete and maintainable. Post-construction inspections also encompass the verification of compliance with specific Pima County ordinances. These ordinances confirm that retention/detention basins do not cause an environmental nuisance, proper disposal of used oil and the removal of construction debris and temporary stormwater controls.

E. Non-filer Reporting

Pima County requests entities provide a copy of the NOI Certificate for activities appearing to qualify for a Construction General Permit or a Multi-Sector General Permit. If an NOI has not been obtained, the name, address and contact information are submitted to the Southern Regional Office or Phoenix main office. Sometimes in the process of making a request a construction site manager will obtain an NOI thereby shifting from being a non-filer to a filer. Between July 1, 2014 and June 30, 2015, this occurred once. One contractor at La Hacienda Del Sol had an NOI with a well-defined area, which was different from locations where the land surface had been disturbed or where stock piles were being actively managed. Inspections on February 23, March 17 and April 3, 2015 did not result in the other contractors obtaining the appropriate NOIs. PDEQ referred the site to ADEQ on April 17, 2105 to the Southern Regional Office.

F. References

FMR Associates, 2013. *Evaluation of the 2012-2013 Pima County Clean Air Campaign and Baseline Stormwater Issue Awareness Survey*, prepared for Pima County Department of Environmental Quality, June 2013.

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Schueler, Thomas R. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments.

U.S. Environmental Protection Agency. 1992. *Guidance Manual For The Preparation Of Part 2 Of The NPDES Permit Applications For Discharges From Municipal Separate Storm Sewer Systems*. Office of Water (EN-336), EPA 833-B-92-002. November.

4. Numeric Summary of Stormwater Management Program Activities

Control Measures (number, unless specified otherwise)	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**
A. Public Awareness (Appendix A)					
Conference, seminars, presentations	8	16	14	10	
Literature distributed	18,133	16,841	20,547	24,528	
B. Public Participation (Appendix B & C)					
Adopt-a-Roadway (bags collected)	2,624	3,522	4,898	6099	
Household Hazardous Waste Collection (tons)	540	490	440	129	
ABOP Program (gallons, # batteries				30,675; 500	
C. Illicit Discharge Detection and Elimination Program					
1. County Employee Training					
Training sessions (non-stormwater discharges, IDDE program)	1	1	1	9	
Employees attending training	15	14	15	14	
2. Spill Prevention (Appendix D & E)					
County facilities identified with hazardous materials	9	9	9	11	
Spills in outside areas @ county facilities w/ hazardous materials	0	0	7	0	
Facility assessments completed	NA	10/28/13	4	17	
Site Specific Materials Handling & Spill Response Procedures (date)	11/12/11		12/01/13	06/30/15	
Environmental complaints	1,220	1,366	1,185	1,330	
Environmental complaints inspected within 3 days	1,054	1,342	1,287	1,260	
Notices of Violation for illicit liquid discharges	61	107	59	72	
Notices of Violation for illicit solid discharges	392	405	406	318	
Notices of Violation closed for illicit discharges, solid and liquid	425	492	465	374	
3. Outfall Inspections (Appendix F)					
Outfalls inspected[2]	9	39	39	40	
Priority Outfalls identified to date	20	39	39	40	
Priority Outfalls inspected	9	39	39	40	
Dry weather flows detected	0	0	0	0	
Dry weather flows investigated	NA	NA	NA	NA	
Major outfalls sampled during dry weather flows	0	0	0	0	
Illicit discharges identified	0	0	0	0	
Illicit discharges eliminated	NA	NA	NA	NA	
Amount of stormwater drainage system inspected	53%	100%	100%	100%	
Storm drain cross-connection investigations	0	0	0	0	
Illicit connections detected	0	0	0	0	
Illicit connections eliminated	NA	NA	NA	NA	
Corrective/enforcement actions initiated w/ 60 days of identification	NA	NA	NA	NA	
Cases resolved w/ 1 year of original enforcement action (%)	NA	NA	NA	NA	
Illicit discharge reports received from public	1,220	1,366	1,185	1,330	
Illicit discharge reports responded to (%)	100%	98%	100%	100%	
Responses initiated within three (3) business days of receipt	1,075	1,101	1,276	1,260	

Control Measures (number, unless specified otherwise)	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**
D. County Facilities (See Appendix G, I & J for details)					
1. Employee Training					
Training events (Part 3 for dates & topics)	1	1	1	1	
Staff trained	15	14	15	8	
2. Inventory, Map, or Database of County Owned/Operated Facilities					
Facilities on inventory	46	39	39	43	
Date identification of Higher Risk facilities completed [begins 12/13]	NA	10/18/13	-	-	
Date prioritization of county facilities completed	NA	NA	09/30/13	-	
3. Inspections					
Miles of MS4 drainage system prioritized for inspection	150	150	150	150	
Miles of MS4 drainage system visually inspected	238	238	238	238	
Higher Risk county facilities inspected [no high risk, low risk shown]	NA	0	0	15	
Higher Risk county facilities needing improved stormwater controls "	NA	NA	NA	NA	
4. Infrastructure Maintenance					
Linear miles of MS4 drainage system cleaned each year	175	175	175	175	
Spot litter, debris, weed control (acres)	133.5	243	518	533	
Number of retention/detention basins cleaned	50	52	52	0	
Catch basins identified to date [begins FY12/13]	NA	0	953	996	
Catch basins cleaned	0	0	0	0	
Amount of waste collected from catch basin cleaning (tons)	0	0	0	0	
Roadway surface maintenance (CY)	2,925	504,263	342,090	656,621	
Street and intersection sweeping (miles)	4,208	2,180	2,720	2,740	
Shoulder repair sites (CY)	26,468	24,534	30,391	10,296	
Pothole repair (tons)	10,068	4,896	6,587	9,254	
Sidewalk & curb repair (LF)	3,306	1,355	6,619	1,266	
Roadway grading (miles)	965.35	208	239	35	
Drainageway grading (miles)	0.25	0.25	0.25	0.25	
E. Industrial & Commercial Sites Not Owned by the County (Appendix L)					
Training events for county staff	1	1	1	12	
County staff trained	15	14	15	183	
Facilities on priority list	49	51	52	51	
Industrial facilities inspected	10	10	10	12	
Corrective/enforcement actions initiated on industrial facilities	8	9	9	12	
Cases resolved w/ 1 year of original enforcement action (%)	1	8	7	0	
F. Construction Program Activities (Appendix K, M, N & O)					
Training events for county staff (Part 3.A for topics)	1	1	1	5	
County staff trained	80	14	15	34	
Construction/grading plans submitted for review	62	53	72	50	
Construction/grading plans reviewed	27	47	70	50	
Construction sites inspected	75	123	75	39	
Corrective/enforcement actions initiated on Construction Sites	16	25	21	29	
Corrective/enforcement actions resolved on Construction Sites	15	23	15	23	
Buffer overlay zone plan reviews	4	2	0	50	
Floodplain Use Permits issued	108	354	319	349	

Control Measures (number, unless specified otherwise)	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**
Floodplain Use Permit violations	0	0	0	0	
Open Space land acquisition (acres)	473.03	2393.86	57,473	58,124	
Flood-prone Acquistion Program (FLAP) (# of sites)	0	0	13	5	
Hillside development overlay zone plan reviews	0	2	11	50	
Hydroseeding and revegetation projects	0	0	14	50	
Set-back requirements	0	0	36	50	
Slope stabilization	0	0	68	50	
G. Post Construction Program Activities (Appendix P)					
Post-construction inspections completed for Post Construction	32	52	35	56	
Corrective/enforcement actions initiated for Post Construction	0	2	1	4	

NA - Not applicable

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5. EVALUATION OF STORMWATER MANAGEMENT PROGRAM

Activities of the Stormwater Management Program (SWMP) include control measures to reduce discharges in stormwater through public awareness and public involvement programs, maintenance of roadways and drainage ways, and investigation of illicit connection and illegal dumping, new development and significant redevelopment programs, industrial facility inspections, construction site inspections, and enforcement actions. Water quality data from five monitor points documents runoff quality. Inspections at construction sites and industrial facilities maintain awareness of the importance of following Stormwater Pollution Prevention Plans. Regular inspections and business assistance is needed to maintain surface water quality consistent with state SWQS and AZPDES permits.

Update of Recommendations

Recommendations from previous annual reports have been continued. Additions were implemented this year to improve the program. A summary is described below.

1. **Assess status of enforcement cases by watershed.**
   The distribution of enforcement actions in the four watersheds parallels the population density, with the Upper Santa Cruz watershed with the most at 56%, Rillito watershed at 19%, Brawley watershed at 24% and the Lower Santa Cruz watershed at 1% (Appendix E). The most frequently issued NOVs are for solid waste on private property and wildcat dumping on public land in the Upper Santa Cruz watershed and the Brawley watershed.

2. **Evaluate water quality and pollutant loadings by season**
   Four years of water quality data have been collected under the new permit. Full sets of analytes are collected in both seasons, when water is available. Four monitor points have three summer samples, and four sample sites have four winter samples where an early trend could be evident. The data is insufficient at this time to characterize seasonal pollutant loadings.

3. **Tracking spills by County Facilities, not just by public in county property**
   County departments report the spills caused by the public or county employees (Table 3-2).

4. **Track drainage cleanup the way PDOT tracks roadway cleanup.**
   Maintenance of the drainageways has detailed tracking and is reported in Appendix J. The maintenance of retention and detention basins has been added to the record.

5. **Track training in PDEQ, RWRD, PDOT, and RFCD.**
   Training within the departments is tracked individually for the staff working in the field and the methodology is different between each department and division. A new program will be developed and implemented in fiscal year 2014-2015.

6. **Arrange for analytical work with detection limits smaller than Surface Water Quality Standards, if laboratories are certified for the analytical method.**

The licensed laboratory is following protocols established by 40 CFR Part 136, Appendix B. The detection limit cannot be changed without approval from ADHS and EPA Region 9.

7. Calculate acres of five land uses within new permit area to facilitate evaluation of pollutant loading estimates by land use.

The areas of the five land uses within the new permit area have been calculated. The MS4 is dominantly Low Density Residential.

Table 4. Land Use Area within Unincorporated Pima County

Land Use	Area (square miles)	Percent
High Density Residential	5.7	0%
Commercial	5.9	0%
Industrial	21.2	1%
Medium Density Residential	160.0	8%
Low Density Residential	1,766.7	90%

8. Calculate acres of five land uses within new permit area to facilitate evaluation of pollutant loading estimates by land use.

This recommendation will not be implemented due to the limitations of the pollutant load estimates. For the low density residential land use, the percent imperviousness in unincorporated Pima County is expected to be less than the imperviousness of monitor site #1, which is zoned for low density residences. This is likely result in a different contribution of parameters to the pollutant load.

The construction site inventory was updated in 2013 to calculate the time construction firms take to return to compliance with the Construction General Permit and Pima County ordinances. Compliance rate is easy to track as well as identify if there are chronic non-compliance problems. Several projects had developed chronic non-compliance issues and as many as 8 projects were out of compliance longer than 30 days within one quarter. By the end of the fiscal year only two projects were out of compliance longer than 30 days for compliance issues that were easily resolvable. The significantly higher level of compliance is due to added enforcement of SWPPP requirements and training of a second field inspector

A comprehensive training program has been implemented to train staff working directly on stormwater management activities. Also, awareness training has been developed for staff with responsibilities related to stormwater management activities. A record keeping process has been initiated to document new staff have received full training and existing staff have a refresher course every couple years as well as to document the type of training provided.

A. Evaluation of 2015 Stormwater Management Program

The Stormwater Management Program has made significant progress and has a high level of success in restoring and maintaining the chemical, biological and physical integrity of the surface waters flowing in Pima County's permit area. The written summary evaluates public education and outreach, public involvement and participation, IDDE, county facility pollution prevention and good housekeeping practices, residential and commercial control measures, industrial facilities and construction sites.

1. Program Progress

Pima County developed a series of documents describing the procedures to be used in various activities impacting stormwater quality and identified in the 2011 MS4 Permit. The current date for the Standard Operation Procedure (SOP) is included.

- STW-001 SOP for Stormwater Inspection at a Construction Site (December, 2014)
- STW-002 SOP for Stormwater Post Construction Inspection (December, 2014)
- STW-003 SOP for Industrial Facility Inspection (December, 2014)
- STW-004 SOP for Illicit Discharge Detection and Elimination Inspection (2014)
- Sampling and Analysis Plan for Stormwater Management Program (September, 2015)
- Pima County Stormwater Management Program (September, 2015)
- Stormwater Control Measure Field Manual Prescribed by AZPDES Permit No. AZS000002 (December, 2014)
- Stormwater Training Program (December, 2014)
- Template for Materials Handling & Spill Response Procedures for Pima County Facilities (December, 2014; updated July, 2015)

2. Program Successes

During the permit cycle, the following successes are attributed to Pima County's Stormwater Management Program and Regional Flood Control District.

- Organized Celebrate World Water Day by Keeping Washes Clean that included a day where citizens were invited to clean up a wash, a TV interview, two fact sheets and a website article.
- EPA Factsheet for Improving Community Resiliency with Green Infrastructure credited Pima County for using GI for flood control and drought management.
- Referral of 254 stormwater-related complaints to other jurisdictions functioning to clean up citizen reported environmental contamination.
- Partnered with University of Arizona's Wet Water Education for Teachers to expand outreach to youth audiences.
- Trained 45 children at Littlestown Community Center how to properly dispose of trash.
- Water conservation radio program to encourage the public to use stormwater to irrigate native plants to save on water utility bills, and potentially electricity bills if the native trees are planted to shade buildings.

Pima County published the *Low Impact Development and Green Infrastructure Guidance Manual* describing how stormwater harvesting features effective in the semi-arid climate of

Pima County can be implemented at the neighborhood scale. Pima County Regional Flood Control District published the *Design Standards for Stormwater Detention and Retention Basins* in June, 2014, which includes extensive provisions for implementing LID. The Pima County Board of Supervisors amended Title 18 (Zoning) to include Stormwater Harvesting Systems on March 17, 2015. The Pima County Comprehensive Plan *Pima Prospers* was adopted on May 19, 2015 and includes LID in land management and water resource management (Appendix R).

3. *Reduction of pollutants to and from the MS4*

The control measures implemented in the stormwater management program include Public Awareness and Public Participation, Public Reporting and Response, Anti-freeze, Batteries, Oil and Paint Program, Infrastructure Maintenance and Land conservation.

a. Public Awareness and Public Participation

Outreach activities provide environmental literal and 24,528 pieces were collected by members of the public at libraries, public events and private events reaching a wide range of people with information specific to their interest. A phone survey conducted in early June 2014 assessed the public's attitudes toward Low Impact Development. The information will be used to refine the outreach message to implement the LID Guidance Manual at the neighborhood scale.

Public participation included volunteers in Pima County's Adopt-a-Roadway program clean up roadways and public lands. The program had 367 clean-up events over a total length of 596 miles. Outreach activities reduce the amount pollutants entering the MS4.

b. Public Reporting and Responses

Pima County received 1,330 complaints from the public and responded to them within an average of 0.9 days. Inspections effectively addressed most of the complaints and 395 resulted in an enforcement action of Notice of Violation (NOV). The NOV closure rate of 96% within an average closure period of 38 days reduced the amount of pollutants entering stormwater.

c. Anti-freeze, Batteries, Oil and Paint Program

The Pima County ABOP program collected 30,675 gallons of anti-freeze, oil and paint as well as 500 batteries preventing the disposal in a landfill or from being dumped in the desert.

d. Infrastructure Maintenance

Roadway maintenance at 7,820 locations removed sediment from streets and repairs roads which stabilized the surface reducing erosion (Appendix I). Drainageway maintenance includes clearing vegetation, mowing, removal of trash, and channel maintenance at 660 locations. The infrastructure maintenance reduces the amount of pollutants leaving the permit area.

e. Land conservation

Pima County has invested over $209 million to conserve 58,124 acres thereby preserving the natural landscape and reducing erosion that would contribute a pollutant to stormwater.

6. Stormwater Management Program Modifications

ADEQ issued the new 2011 MS4 permit on June 16, 2011. A new Stormwater Management Program was developed to meet the provisions of the 2011 MS4 permit. Below are the identified changes to the 2015 SWMP.

1. **Addition of New Control Measures**
   A new training program was implemented to train Pima County staff and a tracking mechanism was initiated to document training for key individuals. Low Impact Development has been added as a control measure through the publication of two reports and one ordinance, namely the *Low Impact Development and Green Infrastructure Guidance Manual*, the *Design Standards for Stormwater Detention and Retention* and Ordinance 2015-7.

2. **Addition of Temporary Control Measures**
   No temporary control measures were proposed.

3. **Increase of Existing Control Measures**
   Existing control measures were maintained.

4. **Replacement of Existing Control Measures**
   Existing Control Measures were not replaced.

5. **Modifications to SWMP**
   The SWMP was modified in accordance with requests by EPA following the stormwater audit in July 2013. The County Facility Inventory was reduced as there were four inactive landfills, four restoration projects and one park that did not have the potential for discharge pollutants.

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7. Monitoring Locations

Five monitor sites are sampled each summer and winter season for field parameters, microbiology, metals, nutrients, toxic organic pollutants, volatile organic compounds (VOCs), semi-VOCs, PCBs and pesticides, as identified in the permit. Water quality data from each site is intended to characterize the water chemistry of runoff from five land uses, namely low density residential, medium density residential, high density residential, commercial and industrial. Results may also be used to identify and eliminate illicit discharges. The data is evaluated to assess the effectiveness of control measures to reduce the discharge of pollutants.

Table 5. Monitor Site Locations

Site No.	Receiving Water	Monitor Site Location Information				
		Location	Latitude Longitude	Elevation (famsl*)	Drainage Area (acres)	Dominant Land Use
1	Unnamed wash, tributary to Rillito River	Calle Esplendor/ Calle Barril	32°17'46.1" -110°54'30.6”	2642	2.8	Residential Low Density
2	Unnamed wash, tributary to Rillito River	Ruthrauff Road/La Cholla Blvd.	32°17'32.6" -111°00'42.6"	2275	56.8	Residential Medium Density
3	Valley View Wash	Valley View Rd/ Sunrise Drive	32°18'22.9" -110°54'38.8"	2709	7.3	Residential High Density
4	Valley View Wash	Valley View Rd/ Sunrise Drive	32°18'23.0" -110°54'38.8"	2710	41.6	Commercial
5	Unnamed wash, tributary to Tucson Diversion Channel	4101 S. Country Club Rd	32°10'27.5" -110°55'34.1"	2542	52.2	Industrial

* famsl – feet above mean sea level

All sites have an adjacent weather station with a tipping bucket rain gage and remote data collection equipment using Pima County’s Automated Local Evaluation in Real Time (ALERT) system. Flow is measured using a depth gage and channel characteristics or the bucket method. When sampling the stormwater, a pH meter with a temperature sensor is used to collect pH. For deep sampling locations, a dipping pole is used to collect the water samples.

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8. Storm Event Records

Summer storms in Pima County typically have a short duration and high intensity. Winter storms are generally longer in duration and less intense. The extended event duration in the winter may result in a delay from the time rainfall begins and runoff begins that is greater than one hour. Although permit and guidance documentation indicates the first sample is to be collected within an hour of the start of rainfall, storm runoff may not begin until several minutes or hours after the initial rainfall. In this case, first flush is collected when runoff begins.

During the reporting period there were 56 rainfall events, of which 24 qualified for stormwater sampling (Table 8-1). The annual rainfall at the monitor sites ranged from 13.52 to 13.80 inches, which is higher than the annual normal rainfall of 11.59 inches (National Weather Service Forecast Office, Tucson, AZ, 2011). All ten wet weather samples were collected during this fiscal year.

Table 6. Storm Event Records for Monitor Sites

Season	Date	Site #1	Rainfall (in)	Site #2	Rainfall (in)	Site #3	Rainfall (in)	Site #4	Rainfall (in)	Site #5	Rainfall (in)
W	06/30/15	NR	0.04	NR	0.16	NR	0.04	NR	0.04	NR	0.04
W	06/29/15	-	0.24	NR	0.04	-	0.24	-	0.24	NR	0.08
W	06/28/15	NR	0.08			NR	0.08	NR	0.08		
W	06/09/15	NR	0.08	NR	0.12	NR	0.08	NR	0.08	-	0.24
W	06/05/15	NR	0.04	NR	0.08	NR	0.04	NR	0.04		
W	05/16/15	NR	0.16			NR	0.16	NR	0.16	NR	0.04
W	05/05/15	NR	0.04			NR	0.04	NR	0.04		
W	05/04/15	NR	0.04	-	0.24	NR	0.04	NR	0.04		
W	04/26/15	NR	0.16	-	0.20	NR	0.16	NR	0.16	NR	0.08
W	03/19/15									NR	0.04
W	03/18/15	-	0.20	NR	0.08	-	0.20	-	0.20	NR	0.12
W	03/02/15	NR	0.12	NR	0.08	NR	0.12	NR	0.12	-	0.32
W	02/24/15									NR	0.08
W	02/01/15	NR	0.04	NR	0.08	NR	0.04	NR	0.04	NR	0.04
W	01/31/15	NR	0.52	NR	0.44	NR	0.52	NR	0.52	NR	0.72
W	01/30/15	-	1.68	-	1.40	**SC**	**1.68**	-	1.68	-	1.60
W	01/27/15	NR	0.08	NR	0.08	NR	0.08	NR	0.08	NR	0.04
W	01/14/15			NR	0.04						
W	01/13/15	NR	0.08	NR	0.04	NR	0.08	NR	0.08		
W	01/08/15	-	0.20	NR	0.16	IF	0.20	**SC**	**0.20**	-	0.28
W	01/01/15	NR	0.16	NR	0.16	NR	0.16	NR	0.16	NR	0.16
W	12/31/14	-	0.32	-	0.48	TD	0.32	TD	0.32	-	0.48
W	12/25/14	NR	0.04			NR	0.04	NR	0.04	NR	0.12
W	12/18/14	NR	0.04			NR	0.04	NR	0.04		
W	12/17/14	**SC**	**0.44**	-	0.40	AOS	0.44	AOS	0.44	NR	0.16
W	12/17/14	NR	0.12	NR	0.08	NR	0.12	NR	0.12	NR	0.16
W	12/13/14	AOS	0.32	**SC**	**0.40**	AOS	0.32	AOS	0.32	**SC**	**0.40**
W	12/04/14	TD	0.88	TD	0.56	TD	0.88	TD	0.88	TD	0.80
S	10/09/14			-	0.48					-	0.40

Season	Date	Site #1	Rainfall (in)	Site #2	Rainfall (in)	Site #3	Rainfall (in)	Site #4	Rainfall (in)	Site #5	Rainfall (in)
S	10/08/14			-	0.64					-	0.76
S	09/19/14									NR	0.16
S	09/18/14	NR	0.04			NR	0.04	NR	0.04		
S	09/17/14	NR	0.08	NR	0.16	NR	0.08	NR	0.08	NR	0.16
S	09/16/14	NR	0.12	NR	0.08	NR	0.12	NR	0.12	NR	0.12
S	09/12/14									NR	0.12
S	09/08/14	-	1.88	-	1.16	-	1.88	-	1.88	-	1.56
S	09/07/14	NR	0.08	-	0.68	NR	0.08	NR	0.08		
S	09/06/14	NR	0.12			NR	0.12	NR	0.12		
S	09/04/14	-	0.32	-	0.64	-	0.32	-	0.32	-	0.20
S	08/26/14	-	0.40	NR	0.04	**SC**	**0.40**	-	0.40		
S	08/21/14			NR	0.04						
S	08/19/14	IF	0.20	NR	0.12	IF	0.20	IF	0.20	NR	0.04
S	08/17/14	NR	0.16	-	0.24	NR	0.16	NR	0.16	-	0.52
S	08/14/14	NR	0.12			NR	0.12	NR	0.12		
S	08/12/14	**SC**	**0.80**	-	0.56	AOS	0.80	**SC**	**0.80**	NR	0.08
S	08/11/14									NR	0.04
S	08/02/14	NR	0.04	NR	0.04	NR	0.04	NR	0.04	-	1.12
S	08/01/14	NR	0.12	-	0.76	NR	0.12	NR	0.12	NR	0.08
S	07/27/14	NR	0.12			NR	0.12	NR	0.12	NR	0.04
S	07/23/14	IF	0.20			IF	0.20	IF	0.20		
S	07/15/14	NR	0.20	-	1.32	NR	0.20	NR	0.20	-	0.64
S	07/13/14	TD	0.24	NR	0.12	TD	0.24	TD	0.24	-	0.60
S	07/09/14	DC	1.40			DC	1.40	DC	1.40	-	0.48
S	07/05/14	NR	0.72	**SC**	**0.92**	NR	0.72	NR	0.72	**SC**	**0.36**
S	07/03/14	IF	0.32	IF	0.28	IF	0.32	NF	0.32		
Winter total			6.12		5.32		6.12		6.12		6.00
Summer Total			7.68		8.32		7.68		7.68		7.52
Annual total			13.80		13.64		13.80		13.80		13.52

Seasons: Summer June 1 - October 31 Winter November 1 - May 31
NR - Not Representative (storm event < 0.2 inches or within 72 hours of last rain)
SC - Sample collected
IF - Insufficient Flow for sample collection
NF - No flow
DC - Dangerous Conditions
TD - Technical Difficulty (Refer to Part 3H for details)
AOS - Staff monitoring/collecting data at other site
- Sample already collected

References

National Weather Service Forecast Office, Tucson, AZ. 2011. Monthly and Daily Normals (1981 – 2010) plus Daily Extremes (1895-2011) for TUCSON, ARIZONA. Downloaded from the National Weather Service, NOAA website on October 5, 2011 from http://www.wrh.noaa.gov/twc/climate/tus.php.

9. Water Quality Data from Monitor Sites

The permit requires a full suite of water quality parameters on the first, third, and fifth years of the permit. In the other years a smaller set of analytes are defined. Due to drought conditions and missing samples from a monitor site, the pattern of collecting full suites every other year was difficult to track. To maintain a good data set, a full suite is now collected for every event (Table 7).

Table 7. Monitor Site Sample Dates and Type of Sample Set

Site	Summer	Type	Winter	Type
1	08/12/14	Full suite	12/17/14	Full Suite
2	07/05/14	Full suite	12/13/14	Full suite
3	08/26/14	Full suite	01/30/15	Full suite
4	08/12/14	Full suite	01/08/15	Full suite
5	07/05/14	Full suite	12/13/14	Full suite

Analytical Methods in Full Suite:

- SM 9233B E. Coli
- SM4500-CN-BCE Total Cyanide
- EPA 1664A Oil & Grease, Total Petroleum Hydrocarbons
- EPA 624 Acrolein, Acrylonitrile
- EPA 8260 Volalite Organic Compounds (VOCs)
- EPA 625-BNA Semi-volatile Organic Compounds (SVOCs)
- EPA 625-P&PCBS Pesticides and PCBs
- SM 4500-NH3D Ammonia
- EPA 351.2 Total Kjheldahl Nitrogen
- EPA 365.1 Total Phosphorus, Ortho Phosphate
- EPA 353.2 Nitrate-Nitrite
- Hach 8000 Chemical Oxygen Demand
- EPA 200.8 Total Metals, Dissolved Metals
- EPA 245.1 Mercury
- SM 2540C Total Dissolved Solids
- SM 2450D Total Suspended Solids
- SM 5210B Biological Oxygen Demand

Analytical Methods in Small Set: Same as above without VOCs, SVOCs, P&PCBs

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Table 8. Water Quality Data Monitor Site #1

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			**07/04/11**		-		**07/15/12**		**12/14/12**		-		**11/22/13**		**08/12/14**		**12/17/14**				
Conventional Parameters																					
Average Flow Rate3 (m3/s)	-		0.0003				0.00044		0.0006				0.0004		0.00155		0.000269				
pH	6.5-9.0		6.4				7.6		8.1				6.9		8		7				
Temperature (°Celcius)	-		29°C				27.5		12.1				15.1		ND		16.1				
Hardness4 (mg/L)[5]	-	67	67			30.7	30.7	37.4	37.4			26	26	54.5	54.5	88.9	88.9				
Total Dissolved Solids (TDS) (mg/L)	-		-				71.4		34.0				72		150		292				
Total Suspended Solids (TSS) (mg/L)	-		60				35.0		50.0				62		195		334				
Biological Oxygen Demand (BOD) (mg/L)	-		-				10.5		5.00				4.9		9.8		3.8				
Chemical Oxygen Demand (COD) (mg/L)	-		-				62		40.0				57		67		88				
Inorganics																					
Cyanide, total (ug/L)[6]	84		-				ND		2.98				3.78		2.14		ND				
Nutrients																					
Nitrate + Nitrite as N (mg/L)			-				0.40		0.20				0.17		0.98		0.36				
Ammonia as N (mg/L)			-				0.58		0.53				0.53		0.66		0.33				
TKN (mg/L)			-				2.12		1.63				1.41		1.98		0.82				
Total Phosphorus (mg/L)			-				0.25		0.22				0.15		0.52		0.44				
Total Orthophosphate (mg/L)			-				0.09		0.07				ND0.50		0.19		0.08				
Microbiological																					
Escherichia coli (*E. coli*) (CFU/100 mg or MPN)[7]	575		48840				10						10		487		15500				
Total Metals8																					
AntimonyT (µg/L)	747		-				0.25		0.21				0.53		0.43		0.55				
ArsenicT (µg/L)	200		-				1.19		1.87				1.46		2.91		4.49				
BariumT (µg/L)	98000		-				30		67.2				57.6		93.3		189				
BerylliumT (µg/L)	1867		-				ND		0.26				0.23		0.53		1.32				
CadmiumD (µg/L)			-			7	ND	9	ND			6	ND	13	ND	20	ND				
ChromiumT (µg/L)	1000		-				ND		1.18				3.96		7.2		15.5				
CopperD (µg/L)		15.95	30.80			7.65	5.77	9.21	3.26			6.54	4.20	13.13	5.30	20.82	1.91				
LeadD (µg/L)		87.90	Trace			36.91	0.24	46.03	0.12			30.62	ND	69.98	ND	119.88	ND				
MercuryT (µg/L)	10		-				ND		ND				0.32		-		0.082				
NickelD (µg/L)		2963.33	-			1531.23	1.72	1809.55	0.72			1330.42	1.01	2488.35	1.03	3764.36	0.58				
SeleniumT (µg/L)	33		-				ND		ND				ND		0.79		0.88				
SilverD (µg/L)		1.62	-			0.42	ND	0.59	2.66			0.32	ND	1.13	ND	2.63	ND				
ThalliumT (µg/L)	75		-				ND		ND				ND		ND		0.41				
ZincD (µg/L)		792.02	70.90			408.84	6.61	483.28	3.74			355.15	4.68	664.90	48.30	1006.49	ND				
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-				2.59		10				9.39		7.65		8.35				
Total Oil & Grease (mg/L)	-		-				3.78		4.89				10.1		11.06		12.59				
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-				ND		-				ND		ND		ND				
Acrylonitrile (µg/L)	37,333		-				ND		-				ND		ND		ND				
Benzene (µg/L)	3,733		-				ND		-				ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			**07/04/11**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/14**				
Bromoform (µg/L)	18,667		-				ND		-				ND		ND		ND				
Carbon tetrachloride (µg/L)	1,307		-				ND						ND		ND		ND				
Chlorobenzene (µg/L)	18,667		-				ND		-				ND		ND		ND				
Chlorodibromomethane (µg/L)	18,667		-				ND		-				ND		ND		ND				
Chloroethane (µg/L)	-		-				ND		-				ND		ND		ND				
2-chloroethylvinyl ether (µg/L)	-		-				ND		-				ND		ND		ND				
Chloroform (µg/L)	9,333		-				ND		-				ND		ND		ND				
Dichlorobromomethane (µg/L)	18,667		-				ND		-				ND		ND		ND				
1,2-dichlorobenzene (µg/L)	5,900		-				ND		-				ND		ND		ND				
1,3-dichlorobenzene (µg/L)	-		-				ND		-				ND		ND		ND				
1,4-dichlorobenzene (µg/L)	6,500		-				ND		-				ND		ND		ND				
1,1-dichloroethane (µg/L)	-		-				ND		-				ND		ND		ND				
1,2-dichloroethane (µg/L)	186,667		-				ND		-				ND		ND		ND				
1,1-dichloroethylene (µg/L)	46,667		-				ND		-				ND		ND		ND				
1,2-dichloropropane (µg/L)	84,000		-				ND		-				ND		ND		ND				
1,3-dichloropropylene (µg/L)	28,000		-				ND		-				ND		ND		ND				
Ethylbenzene (µg/L)	93,333		-				ND		-				ND		ND		ND				
Methyl bromide (µg/L)	1,307		-				ND		-				ND		ND		0.39				
Methyl chloride (µg/L)	-		-				ND						ND		ND		0.3				
Methylene chloride (µg/L)	56,000		-				-		-				-		ND		ND				
1,1,2,2-tetrachloroethane (µg/L)	93,333		-				ND		-				ND		ND		ND				
Tetrachloroethylene (µg/L)	9,333		-				ND		-				ND		ND		ND				
Toluene (µg/L)	373,333		-				ND		-				ND		ND		ND				
1,2-trans-dichloroethylene (µg/L)	18,667		-				ND		-				ND		ND		ND				
1,1,1-trichloroethane (µg/L)	1,866,667		-				ND		-				ND		ND		ND				
1,1,2-trichloroethane (µg/L)	3,733		-				ND		-				ND		ND		ND				
Trichloroethylene (µg/L)	280		-				ND		-				ND		ND		ND				
Trimethylbenzene (µg/L)	-		-				-		-				-		-		-				
Vinyl chloride (µg/L)	2,800		-				ND		-				ND		ND		ND				
Xylene (µg/L)	186,667		-				ND		-				ND		ND		ND				
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667		-				ND		-				ND		ND		ND				
2,4-dichlorophenol (µg/L)	2,800		-				ND		-				ND		ND		ND				
2,4-dimethylphenol (µg/L)	18,667		-				ND		-				ND		ND		ND				
4,6-dinitro-o-cresol (µg/L)	3,733		-				-		-				-		ND		ND				
2,4-dinitrophenol (µg/L)	1,867		-				ND		-				ND		ND		ND				
2-nitrophenol (µg/L)	-		-				ND		-				ND		ND		ND				
4-nitrophenol (µg/L)	-		-				ND		-				ND		ND		ND				
p-chloro-m-cresol (µg/L)	48,000		-				-		-				-		ND		ND				
Pentachlorophenol (µg/L)			-			67.2	ND		-			33.2	ND	100.4	ND	36.8	ND				
Phenol (µg/L)	180,000		-				ND		-				ND		ND		ND				
2,4,6-trichlorophenol (µg/L)	130		-				ND		-				ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			**07/04/11**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/14**				
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000		-				ND		-				ND		ND		ND				
Acenaphthylene (µg/L)	-		-				ND		-				ND		ND		ND				
Anthracene (µg/L)	280,000		-				ND		-				ND		ND		ND				
Benzo(a)anthracene (µg/L)	0.2		-				ND1.44		-				ND1.44		ND1.44		ND1.44				
Benzo(a)pyrene (µg/L)	0.2		-				ND1.55		-				ND1.55		ND1.55		ND1.55				
Benzo(b)fluoranthene (µg/L)	-		-				ND		-				ND		ND		ND				
Benzo(g,h,i)perylene (µg/L)	-		-				ND		-				ND		ND		ND				
Benzo(k)fluoranthene (µg/L)	1.9		-				ND2.28		-				ND2.28		ND2.28		ND2.28				
Chrysene (µg/L)	19		-				ND		-				ND		ND		ND				
Dibenzo(a,h)anthracene (µg/L)	1.9		-				ND		-				ND		ND		ND				
3,3-dichlorobenzidine (µg/L)	3		-				ND		-				ND		ND		ND				
Diethyl phthalate (µg/L)	746,667		-				ND		-				6.68		ND		ND				
Dimethyl phthalate (µg/L)	-		-				ND		-				ND		ND		ND				
Di-n-butyl phthalate (µg/L)	1,100		-				ND		-				26.6		9.31		ND				
2,4-dinitrotoluene (µg/L)	1,867		-				ND		-				ND		ND		ND				
2,6-dinitrotoluene (µg/L)	3,733		-				ND		-				ND		ND		ND				
Di-n-octyl phthalate (µg/L)	373,333		-				ND		-				ND		ND		ND				
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8		-				ND		-				ND		ND		ND				
Fluroranthene (µg/L)	37,333		-				ND		-				ND		ND		ND				
Fluorene (µg/L)	37,333		-				ND		-				ND		ND		ND				
Hexachlorobenzene (µg/L)	747		-				ND		-				ND		ND		ND				
Hexachlorobutadiene (µg/L)	187		-				ND		-				ND		ND		ND				
Hexachlorocyclopentadiene (µg/L)	11,200		-				ND		-				ND		ND		ND				
Hexachloroethane (µg/L)	850		-				ND2.25		-				ND2.25		ND		ND				
Indeno(1,2,3-cd)pyrene (µg/L)	1.9		-				ND		-				ND		ND		ND				
Isophorone (µg/L)	186,667		-				ND		-				ND		ND		ND				
Naphthalene (µg/L)	18,667		-				ND		-				ND		ND		ND				
Nitrobenzene (µg/L)	467		-				ND4.23		-				ND		ND		ND				
N-nitrosodimethylamine (µg/L)	0.03		-				ND		-				ND4.23		ND4.23		ND4.23				
N-nitrosodi-n-propylamine (µg/L)	88,667		-				ND		-				ND		ND		ND				
N-nitrosodiphenylamine (µg/L)	290		-				ND		-				ND		ND		ND				
Phenanthrene (µg/L)	-		-				ND		-				ND		ND		ND				
Pyrene (µg/L)	28,000		-				ND		-				ND		ND		ND				
1,2,4-trichlorobenzene (µg/L)	9,333		-				ND		-				ND		ND		0.1				
PCB/Pesticides																					
Aldrin (µg/L)	0.003		-				ND0.10		-				ND0.10		ND0.09		ND0.09				
Alpha-BHC (µg/L)	1,600		-				ND		-				ND		ND		ND				
Beta-BHC (µg/L)	560		-				ND		-				ND		ND		ND				
Gamma-BHC (µg/L)	11		-				ND		-				ND		ND		ND				
Delta-BHC (µg/L)	1,600		-				ND		-				ND		ND		ND				
Chlordane (µg/L)	3.2		-				ND		-				ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			**07/04/11**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/14**				
4,4'-DDT (µg/L)	1.1		-				ND		-				ND		ND		ND				
4,4'-DDE (µg/L)	1.1		ND				ND		-				ND		ND		ND				
4,4'-DDD (µg/L)	1.1		-				ND		-				ND		ND		ND				
Dieldrin (µg/L)	0.003		-				ND0.07		-				ND0.07		ND0.05		ND0.05				
Alpha-endosulfan (µg/L)	3		-				ND		-				ND		ND		ND				
Beta-endosulfan (µg/L)	3		-				ND		-				ND		ND		ND				
Endosulfan sulfate (µg/L)	3		-				ND		-				ND		ND		ND				
Endrin (µg/L)	0.004		-				ND0.10		-				ND0.10		ND0.09		ND0.09				
Endrin aldehyde (µg/L)	0.7		-				ND		-				ND		ND		ND				
Heptachlor (µg/L)	0.9		-				ND		-				ND		ND		ND				
Heptachlor epoxide (µg/L)	0.9		-				ND		-				ND		ND		ND				
PCB-1242 (AROCLOR-1242) (µg/L)	0.001		-				ND0.10		-				ND0.10		ND0.23		ND0.23				
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-				ND0.07		-				ND0.07		ND0.07		ND0.07				
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-				ND0.09		-				ND0.09		ND0.09		ND0.09				
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-				ND0.16		-				ND0.16		ND0.11		ND0.11				
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-				ND0.16		-				ND0.16		ND0.19		ND0.19				
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-				ND0.25		-				ND0.25		ND0.10		ND0.10				
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-				ND0.10		-				ND0.10		ND0.05		ND0.05				
Toxaphene (µg/L)	0.005		-				ND5.08		-				ND5.08		ND0.71		ND0.71				

Note:Results higher than SWQ are shown in red font. Non-detectable results with the Method Detection Limit (MDL) above the SWQS are shown as ND with the MDL in parentheses.

1 - Partial Body Contact (PBC), Aquatic & Wildlife ephemeral (A&We) or Agricultural Livestock watering (AgL).
2 - Surface Water Quality Standards (A.A.C R18-11-101 through Appendix B) selected from lowest of PBC, A&We or AgL.
3 - Average flow rate during the sampling event. m3/s = meters cubed per second.
4 - Hardness of sample event is used to calculate SWQS for Cadmium, Chromium, Copper, Lead, Nickel, Sliver, and Zinc.
5 - mg/l = milligram per liter
6 - µg/L = micrograms per liter
7 - CFU/100 ml = colony forming unit per 100 milliliters, MPN = Most probable number per 100 ml
8 - SWQS for Total Metals are denoted with "T". SWQS for Dissolved Metal for A&We are denoted with a "D".
9 - Volatile Organic Compounds
10 - Dash means information unavailable (ie. SWQS was not established or sample was not collected).
11 - Total of α-BHC, β-BHC, γ-BHC, δ-BHC.
12 - Refer to Appendix Part 13O for Analytical Laboratory Reports

Table 9. Water Quality Data Monitor Site #2

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		-		03/18/12		-		01/26/13		08/22/13		11/22/13		07/05/14		12/13/14					
Conventional Parameters																					
Average Flow Rate3 (m3/s)	-				0.0050				0.013		0.040		0.016		0.0065		0.0288				
pH	6.5-9.0				7.5				8.73		-		6.7		6.4		6.4				
Temperature (°Celcius)	-				13.7°C				15.1		-		13.9		26.9		14.5				
Hardness4 (mg/L)[5]				50	Trace 50			48.9	48.9	147	147	62.5	62.5	154	154	57.7	57.7				
Total Dissolved Solids (TDS) (mg/L)	-				36				109		126		114		243		127				
Total Suspended Solids (TSS) (mg/L)	-				40.8				45		426		88		316		42				
Biological Oxygen Demand (BOD) (mg/L)	-				19				12.6		12.2		9.3		19		7.6				
Chemical Oxygen Demand (COD) (mg/L)	-				106				53.0		124		107		132		84				
Inorganics																					
Cyanide, total (ug/L)[6]	84T				ND1.7				1.31		1.31		ND1.40		1.73		ND				
Nutrients																					
Nitrate + Nitrite as N (mg/L)					5.3				1.6		2.52		0.96		2.08		3.44				
Ammonia as N (mg/L)					1				0.63		0.98		0.53		1.58		0.39				
TKN (mg/L)					2.8				1.88		2.83		1.97		4.24		1.56				
Total Phosphorus (mg/L)					T0.06				0.30		0.23		0.49		1.21		0.3				
Total Orthophosphate (mg/L)					T0.02				0.16		0.98		0.22		0.34		0.11				
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575				30				4884		19863		4884		24810		14400				
Total Metals8																					
AntimonyT (µg/L)	747				ND				0.72		1.08		0.85		0.96		0.81				
ArsenicT (µg/L)	200				1.3				1.48		4.1		2.11		4.57		1.74				
BariumT (µg/L)	98,000				22				38.4		163		83.6		157		58.2				
BerylliumT (µg/L)	1867				ND				ND		0.64		0.28		0.88		ND				
CadmiumD (µg/L)				12	ND			11	ND	33	ND	14	ND	35	ND	13	ND				
ChromiumT (µg/L)					1.9				2.12		9.35		4.1		11.8		3.23				
CopperD (µg/L)				12.11	61			11.85	6.37	33.44	8.18	14.94	7.45	34.94	14.40	13.85	11.80				
LeadD (µg/L)				63.60	ND			62.05	0.53	206.78	0.62	81.41	0.50	217.37	1.24	74.54	0.37				
MercuryT (µg/L)	10								ND		ND		ND		ND		ND				
NickelD (µg/L)				2313.39	1.20			2270.26	0.87	5760.64	0.76	2794.05	0.72	5991.88	1.64	2611.41	0.59				
SeleniumT (µg/L)	33				ND				ND		0.94		ND		1.36		ND				
SilverD (µg/L)				0.98	ND			0.94	ND	6.24	ND	1.43	ND	6.76	1.14	1.25	ND				
ThalliumT (µg/L)	75				ND				ND		0.2		ND		0.51		ND				
ZincD (µg/L)				618.08	22.00			606.54	9.51	1541.25	7.46	746.71	10.70	1603.21	15.50	697.83	13.27				
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-				T0.745				1.12		2.09		8.38		6.98		8				
Total Oil & Grease (mg/L)	-				T0.829				11.2		3.72		8.08		20.93		13.25				
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467				ND				ND		ND		ND		ND		ND				
Acrylonitrile (µg/L)	37,333				ND				ND		ND		ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			-		03/18/12		-		01/26/13		08/22/13		11/22/13		07/05/14		12/13/14				
Benzene (µg/L)	3,733				ND				ND		ND		ND		ND		ND				
Bromoform (µg/L)	18,667				ND				ND		ND		ND		ND		ND				
Carbon tetrachloride (µg/L)	1,307				ND				ND		ND		ND		ND		ND				
Chlorobenzene (µg/L)	18,667				ND				ND		ND		ND		ND		ND				
Chlorodibromomethane (µg/L)	18,667				ND				ND		ND		ND		ND		ND				
Chloroethane (µg/L)	-				ND				ND		ND		ND		ND		ND				
2-chloroethylvinyl ether (µg/L)	-				ND				ND		ND		ND		ND		ND				
Chloroform (µg/L)	9,333				ND				ND		ND		ND		ND		ND				
Dichlorobromomethane (µg/L)	18,667				ND				ND		ND		ND		ND		ND				
1,2-dichlorobenzene (µg/L)	5,900				ND				ND		ND		ND		ND		ND				
1,3-dichlorobenzene (µg/L)	-				ND				ND		ND		ND		ND		ND				
1,4-dichlorobenzene (µg/L)	6,500				ND				ND		ND		ND		ND		ND				
1,1-dichloroethane (µg/L)	-				ND				ND		ND		ND		ND		ND				
1,2-dichloroethane (µg/L)	186,667				ND				ND		ND		ND		ND		ND				
1,1-dichloroethylene (µg/L)	46,667				ND				ND		ND		ND		ND		ND				
1,2-dichloropropane (µg/L)	84,000				ND				ND		ND		ND		ND		ND				
1,3-dichloropropylene (µg/L)	28,000				ND				ND		ND		ND		ND		ND				
Ethylbenzene (µg/L)	93,333				ND				ND		ND		ND		ND		ND				
Methyl bromide (µg/L)	1,307				ND				ND		ND		ND		ND		ND				
Methyl chloride (µg/L)	-				ND				ND		ND		ND		ND		ND				
Methylene chloride (µg/L)	56,000				ND				-		-		-		ND		ND				
1,1,2,2-tetrachloroethane (µg/L)	93,333				ND				ND		ND		ND		ND		ND				
Tetrachloroethylene (µg/L)	9,333				ND				ND		ND		ND		ND		ND				
Toluene (µg/L)	373,333				ND				ND		ND		ND		ND		ND				
1,2-trans-dichloroethylene (µg/L)	-				ND				ND		ND		ND		ND		ND				
1,1,1-trichloroethane (µg/L)	1,866,667				ND				ND		ND		ND		ND		ND				
1,1,2-trichloroethane (µg/L)	3,733				ND				ND		ND		ND		ND		ND				
Trichloroethylene (µg/L)	280				ND				ND		ND		ND		ND		ND				
Trimethylbenzene (µg/L)	-				-				-		-		-		-		-				
Vinyl chloride (µg/L)	2,800				ND				ND		ND		ND		ND		ND				
Xylene (µg/L)	186,667				ND				ND		ND		ND		ND		ND				
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667				ND				ND		ND		-		ND		ND				
2,4-dichlorophenol (µg/L)	2,800				ND				ND		ND		-		ND		ND				
2,4-dimethylphenol (µg/L)	18,667				ND				ND		ND		-		ND		ND				
4,6-dinitro-o-cresol (µg/L)	3,733				-				-		-		-		ND		ND				
2,4-dinitrophenol (µg/L)	1,867				ND				ND		ND		-		ND		ND				
2-nitrophenol (µg/L)	-				ND				ND		ND		-		ND		ND				
4-nitrophenol (µg/L)	-				ND				ND		ND		-		ND		ND				
p-chloro-m-cresol (µg/L)	48,000				-				-		-		-		ND		ND				
Pentachlorophenol (µg/L)				60.8	ND			209.1	ND	NA	ND	27.2	-	20.1	ND	20.1	ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			-		03/18/12		-		01/26/13		08/22/13		11/22/13		07/05/14		12/13/14				
Phenol (µg/L)	180,000				ND				ND		ND		-		ND		ND				
2,4,6-trichlorophenol (µg/L)	130				ND				ND		ND		-		ND		ND				
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000				ND				ND		ND		-		ND		ND				
Acenaphthylene (µg/L)	-				ND				ND		ND		-		ND		ND				
Anthracene (µg/L)	280,000				ND				ND		ND		-		ND		ND				
Benzo(a)anthracene (µg/L)	0.2				ND1.44				ND1.44		ND1.44		-		ND1.44		ND1.44				
Benzo(a)pyrene (µg/L)	0.2				ND1.55				ND1.55		ND1.55		-		ND1.55		ND1.55				
Benzo(b)fluoranthene (µg/L)	-				ND				ND		ND		-		ND		ND				
Benzo(g,h,i)perylene (µg/L)	-				ND				ND		ND		-		ND		ND				
Benzo(k)fluoranthene (µg/L)	1.9				ND2.28				ND2.28		ND2.28		-		ND2.28		ND2.28				
Chrysene (µg/L)	19				ND				ND		ND		-		ND		ND				
Dibenzo(a,h)anthracene (µg/L)	1.9				ND				ND		ND		-		ND		ND				
3,3-dichlorobenzidine (µg/L)	3				ND				ND		ND		-		ND		ND				
Diethyl phthalate (µg/L)	746,667				ND				ND		ND		-		ND		13.8				
Dimethyl phthalate (µg/L)	-				ND				ND		ND		-		ND		ND				
Di-n-butyl phthalate (µg/L)	1,100				56.79				ND		4.94		-		ND		4.02				
2,4-dinitrotoluene (µg/L)	1,867				ND				ND		ND		-		ND		ND				
2,6-dinitrotoluene (µg/L)	3,733				ND				ND		ND		-		ND		ND				
Di-n-octyl phthalate (µg/L)	373,333				ND				ND		ND		-		ND		ND				
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8				ND				ND		ND		-		ND		ND				
Fluroranthene (µg/L)	37,333				ND				ND		ND		-		ND		ND				
Fluorene (µg/L)	37,333				ND				ND		ND		-		ND		ND				
Hexachlorobenzene (µg/L)	747				ND				ND		ND		-		ND		ND				
Hexachlorobutadiene (µg/L)	187				ND				ND		ND		-		ND		ND				
Hexachlorocyclopentadiene (µg/L)	11,200				ND				ND		ND		-		ND		ND				
Hexachloroethane (µg/L)	850				ND				ND		ND		-		ND		ND				
Indeno(1,2,3-cd)pyrene (µg/L)	1.9				ND 2.25				ND 2.25		ND 2.25		-		ND2.25		ND2.25				
Isophorone (µg/L)	186,667				ND				ND		ND		-		ND		ND				
Naphthalene (µg/L)	18,667				ND				ND		ND		-		ND		ND				
Nitrobenzene (µg/L)	467				ND				ND		ND		-		ND		ND				
N-nitrosodimethylamine (µg/L)	0.03				ND 1.06				ND 4.23		ND 4.23		-		ND4.23		ND4.23				
N-nitrosodi-n-propylamine (µg/L)	88,667				ND				ND		ND		-		ND		ND				
N-nitrosodiphenylamine (µg/L)	290				ND				ND		ND		-		ND		ND				
Phenanthrene (µg/L)	-				ND				ND		ND		-		ND		ND				
Pyrene (µg/L)	28,000				ND				ND		ND		-		ND		ND				
1,2,4-trichlorobenzene (µg/L)	9,333				ND				ND		ND		-		ND		ND				
PCB/Pesticides																					
Aldrin (µg/L)	0.003				ND0.10				ND0.10		ND0.10		-		ND0.09		ND0.09				
Alpha-BHC (µg/L)	1,600				ND				ND		ND		-		ND		ND				
Beta-BHC (µg/L)	560				ND				ND		ND		-		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		-		03/18/12		-		01/26/13		08/22/13		11/22/13		07/05/14		12/13/14					
Gamma-BHC (µg/L)	11				ND				ND		ND		-		ND		ND				
Delta-BHC (µg/L)	1,600				ND				ND		ND		-		ND		ND				
Chlordane (µg/L)	3.2				ND				ND		ND		-		ND		ND				
4,4'-DDT (µg/L)	1.1				ND				ND		ND		-		ND		ND				
4,4'-DDE (µg/L)	1.1				ND				ND		ND		-		ND		ND				
4,4'-DDD (µg/L)	1.1				ND				ND		ND		-		ND		ND				
Dieldrin (µg/L)	0.003				ND0.07				ND0.07		ND0.07		-		ND0.05		ND0.05				
Alpha-endosulfan (µg/L)	3				ND				ND		ND		-		ND		ND				
Beta-endosulfan (µg/L)	3				ND				ND		ND		-		ND		ND				
Endosulfan sulfate (µg/L)	3				ND				ND		ND		-		ND		ND				
Endrin (µg/L)	0.004				ND0.10				ND0.10		ND0.10		-		ND0.09		ND0.09				
Endrin aldehyde (µg/L)	0.7				ND				ND		ND		-		ND		ND				
Heptachlor (µg/L)	0.9				ND				ND		ND		-		ND		ND				
Heptachlor epoxide (µg/L)	0.9				ND				ND		ND		-		ND		ND				
PCB-1242 (AROCLOR-1242) (µg/L)	0.001				ND0.10				ND0.10		ND0.10		-		ND0.10		ND0.23				
PCB-1254 (AROCLOR-1254) (µg/L)	0.001				ND0.07				ND0.07		ND0.07		-		ND0.07		ND0.07				
PCB-1221 (AROCLOR-1221) (µg/L)	0.001				ND0.09				ND0.09		ND0.09		-		ND0.09		ND0.09				
PCB-1232 (AROCLOR-1232) (µg/L)	0.001				ND0.16				ND0.16		ND0.16		-		ND0.11		ND0.11				
PCB-1248 (AROCLOR-1248) (µg/L)	0.001				ND0.16				ND0.16		ND0.16		-		ND0.19		ND0.19				
PCB-1260 (AROCLOR-1260) (µg/L)	0.001				ND0.25				ND0.25		ND0.25		-		ND0.10		ND0.10				
PCB-1016 (AROCLOR-1016) (µg/L)	0.001				ND0.10				ND0.10		ND0.10		-		ND0.05		ND0.05				
Toxaphene (µg/L)	0.005				ND5.08				ND5.08		ND5.08		-		ND0.71		ND0.71				

Note:Results higher than SWQ are shown in red font. Non-detectable results with the Method Detection Limit (MDL) above the SWQS are shown as ND with the MDL in parentheses.

1 - Partial Body Contact (PBC), Aquatic & Wildlife ephemeral (A&We) or Agricultural Livestock watering (AgL).

2 - Surface Water Quality Standards (A.A.C R18-11-101 through Appendix B) selected from lowest of PBC, A&We or AgL.

3 - Average flow rate during the sampling event. m3/s = meters cubed per second.

4 - Hardness of sample event is used to calculate SWQS for Cadmium, Chromium, Copper, Lead, Nickel, Sliver, and Zinc.

5 - mg/l = milligram per liter

6 - µg/L = micrograms per liter

7 - CFU/100 ml = colony forming unit per 100 milliliters, MPN = Most probable number per 100 ml

8 - SWQS for Total Metals are denoted with "T". SWQS for Dissolved Metal for A&We are denoted with a "D".

9 - Volatile Organic Compounds

10 - Dash means information unavailable (ie. SWQS was not established or sample was not collected).

11 - Total of α-BHC, β-BHC, γ-BHC, δ-BHC.

12 - Refer to Appendix Part 13O for Analytical Laboratory Reports

Table 10. Water Quality Data Monitor Site #3

PARAMETERS	Standard SWQS[2]	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		09/10/11		03/18/12		07/20/12		12/14/12		-		11/22/13		08/26/14		01/30/15					
Conventional Parameters																					
Average Flow Rate[3] (m^3/s)	-		0.4203		0.2280		0.27		0.185				0.276		0.236		0.178				
pH	6.5-9.0		6.3	7.4	7.4	7.2	7.2	7.5	7.5			7.1	7.1		-	6.2	6.2				
Temperature (°Celcius)	-		47.4		12.4°C		28.7		13.6				18.7		-		16.5				
Hardness[4] (mg/L)[5]	-	50	Trace 50	50	Trace 50	27.4	27.4	13.4	13.4			23.5	23.5	35.9	35.9	27.1	27.1				
Total Dissolved Solids (TDS) (mg/L)	-		-		57		66.0		38				44		42.9		24.3				
Total Suspended Solids (TSS) (mg/L)	-		21.5		55		30.0		4.50				18		28		5.5				
Biological Oxygen Demand (BOD) (mg/L)	-		-		10		8.00		3.00				5.5		12.4		3.4				
Chemical Oxygen Demand (COD) (mg/L)	-		-		140		72.0		28.0				42		107		35				
Inorganics																					
Cyanide, total (ug/L)[6]	84T				ND		ND		ND				ND		ND		ND				
Nutrients																					
Nitrate + Nitrite as N (mg/L)			-		0.3		0.75		0.2				0.22		0.85		0.2				
Ammonia as N (mg/L)			-		0.5		0.91		0.400				0.49		0.57		0.54				
TKN (mg/L)			-		1.1		1.61		0.68				1.03		1.52		0.82				
Total Phosphorus (mg/L)			-		T0.06		0.14		ND				0.16		0.17		ND				
Total Orthophosphate (mg/L)			-		T0.02		0.03		0.04				0.1		0.08		ND				
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575		7701		10		20		63				100		10		59				
Total Metals[8]																					
$Antimony_T$ (µg/L)	747		-		ND		1.23		0.45				0.79		0.83		0.34				
$Arsenic_T$ (µg/L)	200		-		1.3		1.19		0.69				0.42		1.07		0.32				
$Barium_T$ (µg/L)	98,000		-		38		29.2		9.33				14		24.2		8.77				
$Beryllium_T$ (µg/L)	1,867		-		ND		ND		ND				ND		ND		ND				
$Cadmium_D$ (µg/L)		12		12	ND	6	ND	3	ND			6	ND	8	ND	6	ND				
$Chromium_T$ (µg/L)			-		ND		1.28		0.4				0.93		1.24		0.32				
$Copper_D$ (µg/L)		12.11	ND1.0	12.11	21.00	6.87	10.90	3.50	4.66			5.94	8.70	8.86	13.30	6.80	3.90				
$Lead_D$ (µg/L)		63.60	ND	63.60	3.10	32.48	0.12	14.46	ND			27.32	ND	43.97	ND	32.08	ND				
$Mercury_T$ (µg/L)	10		-		ND		ND		ND				0.287		ND		0.044				
$Nickel_D$ (µg/L)			-	2313.39	3.10	1390.78	1.26	759.37	0.49			1221.36	0.98	1747.95	ND	1377.88	0.31				
$Selenium_T$ (µg/L)	33		-		ND		ND		ND				ND		ND		ND				
$Silver_D$ (µg/L)			-	0.98	ND	0.35	ND	0.10	2.25			0.27	ND1	0.55	ND	0.34	ND				
$Thallium_T$ (µg/L)	75		-		ND		ND		ND				ND		ND		ND				
$Zinc_D$ (µg/L)		618.08	51.90	618.08	110.00	371.29	42.60	202.54	38.50			325.99	70.00	466.81	50.80	367.84	40.70				
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-		3.02		18.0		ND				7.37		9.29		10.8				
Total Oil & Grease (mg/L)	-		-		86.63		11.60		3.12				9.29		19.88		15.41				
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-		ND		ND		-				ND		ND		ND				

PARAMETERS	Standard SWQS[2]	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			09/10/11		03/18/12		07/20/12		12/14/12		-		11/22/13		08/26/14		01/30/15				
Acrylonitrile (µg/L)	37,333		-		ND		ND		-				ND		ND		ND				
Benzene (µg/L)	3,733		-		ND		ND		-				ND		ND		ND				
Bromoform (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Carbon tetrachloride (µg/L)	1,307		-		ND		ND		-				ND		ND		ND				
Chlorobenzene (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Chlorodibromomethane (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Chloroethane (µg/L)	-		-		ND		ND		-				ND		ND		ND				
2-chloroethylvinyl ether (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Chloroform (µg/L)	9,333		-		ND		ND		-				ND		ND		ND				
Dichlorobromomethane (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
1,2-dichlorobenzene (µg/L)	5,900		-		ND		ND		-				ND		ND		ND				
1,3-dichlorobenzene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
1,4-dichlorobenzene (µg/L)	6,500		-		ND		ND		-				ND		ND		ND				
1,1-dichloroethane (µg/L)	-		-		ND		ND		-				ND		ND		ND				
1,2-dichloroethane (µg/L)	186,667		-		ND		ND		-				ND		ND		ND				
1,1-dichloroethylene (µg/L)	46,667		-		ND		ND		-				ND		ND		ND				
1,2-dichloropropane (µg/L)	84,000		-		ND		ND		-				ND		ND		ND				
1,3-dichloropropylene (µg/L)	28,000		-		ND		ND		-				ND		ND		ND				
Ethylbenzene (µg/L)	93,333		-		ND		ND		-				ND		ND		ND				
Methyl bromide (µg/L)	1,307		-		ND		ND		-				ND		ND		ND				
Methyl chloride (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Methylene chloride (µg/L)	56,000		-		ND		ND		-				ND		ND		ND				
1,1,2,2-tetrachloroethane (µg/L)	93,333		-		ND		ND		-				ND		ND		ND				
Tetrachloroethylene (µg/L)	9,333		-		ND		ND		-				ND		ND		ND				
Toluene (µg/L)	373,333		-		ND		ND		-				ND		ND		ND				
1,2-trans-dichloroethylene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
1,1,1-trichloroethane (µg/L)	1,866,667		-		ND		ND		-				ND		ND		ND				
1,1,2-trichloroethane (µg/L)	3,733		-		ND		ND		-				ND		ND		ND				
Trichloroethylene (µg/L)	280		-		ND		ND		-				ND		ND		ND				
Trimethylbenzene (µg/L)	-		-		-		-		-				-		-		-				
Vinyl chloride (µg/L)	2,800		-		ND		ND		-				ND		ND		ND				
Xylene (µg/L)	186,667		-		ND		ND		-				ND		ND		ND				
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667		-		ND		ND		-				ND		ND		ND				
2,4-dichlorophenol (µg/L)	2,800		-		ND		ND		-				ND		ND		ND				
2,4-dimethylphenol (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
4,6-dinitro-o-cresol (µg/L)	3,733		-		-		-		-				-		ND		ND				
2,4-dinitrophenol (µg/L)	1,867		-		ND		ND		-				ND		ND		ND				
2-nitrophenol (µg/L)	-		-		ND		ND		-				ND		ND		ND				
4-nitrophenol (µg/L)	-		-		ND		ND		-				ND		ND		ND				
p-chloro-m-cresol (µg/L)	48,000		-		-		-		-				-		ND		ND				

PARAMETERS	Standard SWQS[2]	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			09/10/11		03/18/12		07/20/12		12/14/12		-		11/22/13		08/26/14		01/30/15				
Pentachlorophenol (µg/L)			-	54.9	ND	44.9	ND		-			40.6	ND	NA	ND	16.5	ND				
Phenol (µg/L)	180,000		-		ND		ND		-				ND		ND		ND				
2,4,6-trichlorophenol (µg/L)	130		-		ND		ND		-				ND		ND		ND				
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000		-		ND		ND		-				ND		ND		ND				
Acenaphthylene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Anthracene (µg/L)	280,000		-		ND		ND		-				ND		ND		ND				
Benzo(a)anthracene (µg/L)	0.2		-		ND1.44		ND1.44		-				ND1.44		ND1.44		ND1.44				
Benzo(a)pyrene (µg/L)	0.2		-		ND1.55		ND1.55		-				ND1.55		ND1.55		ND1.55				
Benzo(b)fluoranthene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Benzo(g,h,i)perylene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Benzo(k)fluoranthene (µg/L)	1.9		-		ND2.28		ND2.28		-				ND2.28		ND2.28		ND2.28				
Chrysene (µg/L)	19		-		ND		ND		-				ND		ND		ND				
Dibenzo(a,h)anthracene (µg/L)	1.9		-		ND		ND		-				ND		ND		ND				
3,3-dichlorobenzidine (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Diethyl phthalate (µg/L)	746,667		-		ND		ND		-				ND		ND		ND				
Dimethyl phthalate (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Di-n-butyl phthalate (µg/L)	1,100		-		65.86		10.1		-				21.6		ND		ND				
2,4-dinitrotoluene (µg/L)	1,867		-		ND		ND		-				ND		ND		ND				
2,6-dinitrotoluene (µg/L)	3,733		-		ND		ND		-				ND		ND		ND				
Di-n-octyl phthalate (µg/L)	373,333		-		ND		ND		-				ND		ND		ND				
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8		-		ND		ND		-				ND		ND		ND				
Fluroranthene (µg/L)	37,333		-		ND		ND		-				ND		ND		ND				
Fluorene (µg/L)	37,333		-		ND		ND		-				ND		ND		ND				
Hexachlorobenzene (µg/L)	747		-		ND		ND		-				ND		ND		ND				
Hexachlorobutadiene (µg/L)	187		-		ND		ND		-				ND		ND		ND				
Hexachlorocyclopentadiene (µg/L)	11,200		-		ND		ND		-				ND		ND		ND				
Hexachloroethane (µg/L)	850		-		ND		ND		-				ND		ND		ND				
Indeno(1,2,3-cd)pyrene (µg/L)	1.9		-		ND2.25		ND2.25		-				ND2.25		ND2.25		ND2.25				
Isophorone (µg/L)	186,667		-		ND		ND		-				ND		ND		ND				
Naphthalene (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Nitrobenzene (µg/L)	467		-		ND		ND		-				ND		ND		ND				
N-nitrosodimethylamine (µg/L)	0.03		-		ND1.06		ND4.23		-				ND4.23		ND4.23		ND				
N-nitrosodi-n-propylamine (µg/L)	88,667		-		ND		ND		-				ND		ND		ND				
N-nitrosodiphenylamine (µg/L)	290		-		ND		ND		-				ND		ND		ND				
Phenanthrene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Pyrene (µg/L)	28,000		-		ND		ND		-				ND		ND		ND				
1,2,4-trichlorobenzene (µg/L)	9,333		-		ND		ND		-				ND		ND		ND				
PCB/Pesticides																					
Aldrin (µg/L)	0.003		-		ND0.1		ND0.10		-				ND0.10		ND0.09		ND0.09				
Alpha-BHC (µg/L)	1,600		-		ND		ND		-				ND		ND		ND				

PARAMETERS	Standard SWQS[2]	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			09/10/11		03/18/12		07/20/12		12/14/12		-		11/22/13		08/26/14		01/30/15				
Beta-BHC (µg/L)	560		-		ND		ND		-				ND		ND		ND				
Gamma-BHC (µg/L)	11		-		ND		ND		-				ND		ND		ND				
Delta-BHC (µg/L)	1,600		-		ND		ND		-				ND		ND		ND				
Chlordane (µg/L)	3.2		-		ND		ND		-				ND		ND		ND				
4,4'-DDT (µg/L)	1.1		-		ND		ND		-				ND		ND		ND				
4,4'-DDE (µg/L)	1.1		ND		ND		ND		-				ND		ND		ND				
4,4'-DDD (µg/L)	1.1		-		ND		ND		-				ND		ND		ND				
Dieldrin (µg/L)	0.003		-		ND0.07		ND0.07		-				ND0.07		ND0.05		ND0.05				
Alpha-endosulfan (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Beta-endosulfan (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Endosulfan sulfate (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Endrin (µg/L)	0.004		-		ND0.10		ND0.10		-				ND0.10		ND0.09		ND0.09				
Endrin aldehyde (µg/L)	0.7		-		ND		ND		-				ND		ND		ND				
Heptachlor (µg/L)	0.9		-		ND		ND		-				ND		ND		ND				
Heptachlor epoxide (µg/L)	0.9		-		ND		ND		-				ND		ND		ND				
PCB-1242 (AROCLOR-1242) (µg/L)	0.001		-		ND0.10		ND0.10		-				ND0.10		ND0.23		ND0.23				
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-		ND0.07		ND0.07		-				ND0.07		ND0.07		ND0.07				
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-		ND0.09		ND0.09		-				ND0.09		ND0.09		ND0.09				
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.11		ND0.11				
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.19		ND0.19				
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-		ND0.25		ND0.25		-				ND0.25		ND0.10		ND0.10				
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-		ND0.10		ND0.10		-				ND0.10		ND0.05		ND0.05				
Toxaphene (µg/L)	0.005		-		ND5.08		ND5.08		-				ND5.08		ND0.71		ND0.71				

Note:Results higher than SWQ are shown in red font. Non-detectable results with the Method Detection Limit (MDL) above the SWQS are shown as ND with the MDL in parentheses.

1 - Partial Body Contact (PBC), Aquatic & Wildlife ephemeral (A&We) or Agricultural Livestock watering (AgL).

2 - Surface Water Quality Standards (A.A.C R18-11-101 through Appendix B) selected from lowest of PBC, A&We or AgL.

3 - Average flow rate during the sampling event. m3/s = meters cubed per second.

4 - Hardness of sample event is used to calculate SWQS for Cadmium, Chromium, Copper, Lead, Nickel, Sliver, and Zinc.

5 - mg/l = milligram per liter

6 - µg/L = micrograms per liter

7 - CFU/100 ml = colony forming unit per 100 milliliters, MPN = Most probable number per 100 ml

8 - SWQS for Total Metals are denoted with "T". SWQS for Dissolved Metal for A&We are denoted with a "D".

9 - Volatile Organic Compounds

10 - Dash means information unavailable (ie. SWQS was not established or sample was not collected).

11 - Total of α-BHC, β-BHC, γ-BHC, δ-BHC.

12 - Refer to Appendix Part 13O for Analytical Laboratory Reports

Table 11. Water Quality Data Monitor Site #4

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		09/27/11		03/18/12		07/15/12		12/14/12		-		11/22/13		08/12/14		01/08/15					
Conventional Parameters																					
Average Flow Rate3 (m3/s)	-		0.65		0.46		0.202		0.228				0.39		0.97		0.3365				
pH	6.5-9.0		7.0		7.4		7.70		7.75				6.7		7.5		8.5				
Temperature (°Celcius)	-		26.6		11.8°C		27.1		13.9				17		27.4		13.6				
Hardness4 (mg/L)[5]		54	54	50	Trace 50	42.3	42.3	90.9	90.9			50	50	35.4	35.4	38.2	38.2				
Total Dissolved Solids (TDS) (mg/L)	-		-		51		98.6		24.0				114		98		81.4				
Total Suspended Solids (TSS) (mg/L)	-		44		37.3		12.5		4.50				12		27		33				
Biological Oxygen Demand (BOD) (mg/L)	-		-		15		7.6		4.00				7.3		10.9		8.9				
Chemical Oxygen Demand (COD) (mg/L)	-		-		100		35.0		25.0				50		67		78				
Inorganics																					
Cyanide, total (ug/L)[6]	84T		-		ND		ND		ND				ND		ND		ND				
Nutrients																					
Nitrate + Nitrite as N (mg/L)			-		0.3		0.68		0.7				0.39		0.62		0.34				
Ammonia as N (mg/L)			-		0.7		0.59		0.35				0.46		0.64		0.67				
TKN (mg/L)			-		1.4		1.39		0.94				1.43		1.34		1.1				
Total Phosphorus (mg/L)			-		T0.06		0.19		0.11				0.1		0.19		0.13				
Total Orthophosphate (mg/L)			-		T0.02		0.07		0.07				0.09		0.09		0.06				
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575		12997		697		1789		1850				1178		1850		249				
Total Metals8																					
AntimonyT (µg/L)	747		-		ND		1.70		0.51				1.46		1.33		1.82				
ArsenicT (µg/L)	200		-		1.9		1.41		1.68				1.13		1.35		120				
BariumT (µg/L)	98,000		-		29		112		44.9				33.7		32.1		40.3				
BerylliumT (µg/L)	1,867		-		ND		ND		ND				ND		ND		ND				
CadmiumD (µg/L)			-	12	ND	10	ND	21	ND			12	ND	8	ND	9	ND				
ChromiumT (µg/L)			-		1.9		0.95		0.41				2.15		1.58		1.9				
CopperD (µg/L)		13.02	29.60	12.11	29.00	10.34	12.90	21.26	12.70			12.11	16.00	8.74	23.10	9.39	9.51				
LeadD (µg/L)			ND	63.60	ND	52.81	0.27	122.83	0.15			63.60	0.47	43.29	ND	47.13	0.41				
MercuryT (µg/L)	10		-		ND		ND		ND				0.185		-		ND				
NickelD (µg/L)			-	2313.39	1.50	2008.19	0.78	3835.88	0.78			2313.39	2.20	1727.34	1.10	1842.24	1.36				
SeleniumT (µg/L)	33		-		ND		ND		ND				ND		ND		ND				
SilverD (µg/L)			-	0.98	ND	0.73	0.24	2.73	0.96			0.98	ND1.0	0.54	ND	0.61	ND				
ThalliumT (µg/L)	75		-		ND		ND		ND				ND		ND		ND				
ZincD (µg/L)		659.72	192.00	618.08	290.00	536.42	217.00	1025.64	66.50			618.08	67.60	461.29	73.10	492.02	58.10				
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-		3.02		1.40		5.57				6.67		7.53		9.76				
Total Oil & Grease (mg/L)	-		-		5.47		1.40		8.07				7.07		13.65		14.88				
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-		ND		ND		-				ND		ND		ND				
Acrylonitrile (µg/L)	37,333		-		ND		ND		-				ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		09/27/11		03/18/12		07/15/12		12/14/12		-		11/22/13		08/12/14		01/08/15					
Benzene (µg/L)	3,733		-		Trace 0.10		ND		-				ND		0.03		ND				
Bromoform (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Carbon tetrachloride (µg/L)	1,307		-		ND		ND		-				ND		ND		ND				
Chlorobenzene (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Chlorodibromomethane (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Chloroethane (µg/L)	-		-		ND		ND		-				ND		ND		ND				
2-chloroethylvinyl ether (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Chloroform (µg/L)	9,333		-		ND		ND		-				ND		ND		ND				
Dichlorobromomethane (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
1,2-dichlorobenzene (µg/L)	5,900		-		ND		ND		-				ND		ND		ND				
1,3-dichlorobenzene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
1,4-dichlorobenzene (µg/L)	6,500		-		ND		ND		-				ND		ND		ND				
1,1-dichloroethane (µg/L)	-		-		ND		ND		-				ND		ND		ND				
1,2-dichloroethane (µg/L)	186,667		-		ND		ND		-				ND		ND		ND				
1,1-dichloroethylene (µg/L)	46,667		-		ND		ND		-				ND		ND		ND				
1,2-dichloropropane (µg/L)	84,000		-		ND		ND		-				ND		ND		ND				
1,3-dichloropropylene (µg/L)	28,000		-		ND		ND		-				ND		ND		ND				
Ethylbenzene (µg/L)	93,333		-		Trace 0.08		ND		-				ND		ND		ND				
Methyl bromide (µg/L)	1,307		-		ND		ND		-				ND		ND		ND				
Methyl chloride (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Methylene chloride (µg/L)	56,000		-		ND		ND		-				ND		ND		ND				
1,1,2,2-tetrachloroethane (µg/L)	93,333		-		ND		ND		-				ND		ND		ND				
Tetrachloroethylene (µg/L)	9,333		-		ND		ND		-				ND		ND		ND				
Toluene (µg/L)	373,333		-		1.06		ND		-				ND		ND		ND				
1,2-trans-dichloroethylene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
1,1,1-trichloroethane (µg/L)	1,866,667		-		ND		ND		-				ND		ND		ND				
1,1,2-trichloroethane (µg/L)	3,733		-		ND		ND		-				ND		ND		ND				
Trichloroethylene (µg/L)	280		-		ND		ND		-				ND		ND		ND				
Trimethylbenzene (µg/L)	-		-		ND		-		-				-		-		-				
Vinyl chloride (µg/L)	2,800		-		ND		ND		-				ND		ND		ND				
Xylene (µg/L)	186,667		-		ND		ND		-				ND		ND		ND				
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667		-		ND		ND		-				ND		ND		ND				
2,4-dichlorophenol (µg/L)	2,800		-		ND		ND		-				ND		ND		ND				
2,4-dimethylphenol (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
4,6-dinitro-o-cresol (µg/L)	3,733		-		-		-		-				-		ND		ND				
2,4-dinitrophenol (µg/L)	1,867		-		ND		ND		-				ND		ND		ND				
2-nitrophenol (µg/L)	-		-		ND		ND		-				ND		ND		ND				
4-nitrophenol (µg/L)	-		-		ND		ND		-				ND		ND		ND				
p-chloro-m-cresol (µg/L)	48,000		-		-		-		-				-		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		09/27/11		03/18/12		07/15/12		12/14/12		-		11/22/13		08/12/14		01/08/15					
Pentachlorophenol (µg/L)			-	54.9	ND	74.3	ND		-			27.2	ND	60.8	ND	166.0	ND				
Phenol (µg/L)	180,000		-		ND		ND		-				ND		ND		ND				
2,4,6-trichlorophenol (µg/L)	130		-		ND		ND		-				ND		ND		ND				
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000		-		ND		ND		-				ND		ND		ND				
Acenaphthylene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Anthracene (µg/L)	280,000		-		ND		ND		-				ND		ND		ND				
Benzo(a)anthracene (µg/L)	0.2		-		ND1.44		ND1.44		-				ND1.44		ND1.44		ND1.44				
Benzo(a)pyrene (µg/L)	0.2		-		ND1.55		ND1.55		-				ND1.55		ND1.55		ND1.55				
Benzo(b)fluoranthene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Benzo(g,h,i)perylene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Benzo(k)fluoranthene (µg/L)	1.9		-		ND2.28		ND2.28		-				ND2.28		ND2.28		ND2.28				
Chrysene (µg/L)	19		-		ND		ND		-				ND		ND		ND				
Dibenzo(a,h)anthracene (µg/L)	1.9		-		ND		ND		-				ND		ND		ND				
3,3-dichlorobenzidine (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Diethyl phthalate (µg/L)	746,667		-		ND		ND		-				ND		ND		ND				
Dimethyl phthalate (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Di-n-butyl phthalate (µg/L)	1,100		-		88.44		17.5		-				25		10.7		2.03				
2,4-dinitrotoluene (µg/L)	1,867		-		ND		ND		-				ND		ND		ND				
2,6-dinitrotoluene (µg/L)	3,733		-		ND		ND		-				ND		ND		ND				
Di-n-octyl phthalate (µg/L)	373,333		-		ND		ND		-				ND		ND		ND				
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8		-		ND		ND		-				ND		ND		ND				
Fluroranthene (µg/L)	37,333		-		ND		ND		-				ND		ND		ND				
Fluorene (µg/L)	37,333		-		ND		ND		-				ND		ND		ND				
Hexachlorobenzene (µg/L)	747		-		ND		ND		-				ND		ND		ND				
Hexachlorobutadiene (µg/L)	187		-		ND		ND		-				ND		ND		ND				
Hexachlorocyclopentadiene (µg/L)	11,200		-		ND		ND		-				ND		ND		ND				
Hexachloroethane (µg/L)	850		-		ND		ND		-				ND		ND		ND				
Indeno(1,2,3-cd)pyrene (µg/L)	1.9		-		ND2.25		ND2.25		-				ND2.25		ND2.25		ND2.25				
Isophorone (µg/L)	186,667		-		ND		ND		-				ND		ND		ND				
Naphthalene (µg/L)	18,667		-		ND		ND		-				ND		ND		ND				
Nitrobenzene (µg/L)	467		-		ND		ND		-				ND		ND		ND				
N-nitrosodimethylamine (µg/L)	0.03		-		ND		ND		-				ND4.23		ND4.23		ND4.23				
N-nitrosodi-n-propylamine (µg/L)	88,667		-		ND1.06		ND4.23		-				ND		ND		ND				
N-nitrosodiphenylamine (µg/L)	290		-		ND		ND		-				ND		ND		ND				
Phenanthrene (µg/L)	-		-		ND		ND		-				ND		ND		ND				
Pyrene (µg/L)	28,000		-		ND		ND		-				ND		ND		ND				
1,2,4-trichlorobenzene (µg/L)	9,333		-		0.00		ND		-				ND		ND		ND				
PCB/Pesticides																					
Aldrin (µg/L)	0.003		-		ND0.1		ND0.1		-				ND0.1		ND0.09		ND0.09				
Alpha-BHC (µg/L)	1,600		-		ND		ND		-				ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date			09/27/11		03/18/12		07/15/12		12/14/12		-		11/22/13		08/12/14		01/08/15				
Beta-BHC (µg/L)	560		-		ND		ND		-				ND		ND		ND				
Gamma-BHC (µg/L)	11		-		ND		ND		-				ND		ND		ND				
Delta-BHC (µg/L)	1,600		-		ND		ND		-				ND		ND		ND				
Chlordane (µg/L)	3.2		-		ND		ND		-				ND		ND		ND				
4,4'-DDT (µg/L)	1.1		-		ND		ND		-				ND		ND		ND				
4,4'-DDE (µg/L)	1.1		ND		ND		ND		-				ND		ND		ND				
4,4'-DDD (µg/L)	1.1		-		ND		ND		-				ND		ND		ND				
Dieldrin (µg/L)	0.003		-		ND0.07		ND0.07		-				ND0.07		ND0.05		ND0.05				
Alpha-endosulfan (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Beta-endosulfan (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Endosulfan sulfate (µg/L)	3		-		ND		ND		-				ND		ND		ND				
Endrin (µg/L)	0.004		-		ND		ND		-				ND		ND		ND0.09				
Endrin aldehyde (µg/L)	0.7		-		ND		ND		-				ND		ND		ND				
Heptachlor (µg/L)	0.9		-		ND		ND		-				ND		ND		ND				
Heptachlor epoxide (µg/L)	0.9		-		ND		ND		-				ND		ND		ND				
PCB-1242 (AROCLOR-1242) (µg/L)	0.001		-		ND0.10		ND0.10		-				ND0.10		ND0.23		ND0.23				
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-		ND0.07		ND0.07		-				ND0.07		ND0.07		ND0.07				
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-		ND0.09		ND0.09		-				ND0.09		ND0.09		ND0.09				
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.11		ND0.11				
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.19		ND0.19				
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-		ND0.25		ND0.25		-				ND0.25		ND0.10		ND0.10				
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-		ND0.10		ND0.10		-				ND0.10		ND0.05		ND0.05				
Toxaphene (µg/L)	0.005		-		ND5.08		ND5.08		-				ND5.08		ND0.71		ND0.71				

Note:Results higher than SWQ are shown in red font. Non-detectable results with the Method Detection Limit (MDL) above the SWQS are shown as ND with the MDL in parentheses.

1 - Partial Body Contact (PBC), Aquatic & Wildlife ephemeral (A&We) or Agricultural Livestock watering (AgL).

2 - Surface Water Quality Standards (A.A.C R18-11-101 through Appendix B) selected from lowest of PBC, A&We or AgL.

3 - Average flow rate during the sampling event. m3/s = meters cubed per second.

4 - Hardness of sample event is used to calculate SWQS for Cadmium, Chromium, Copper, Lead, Nickel, Sliver, and Zinc.

5 - mg/l = milligram per liter

6 - µg/L = micrograms per liter

7 - CFU/100 ml = colony forming unit per 100 milliliters, MPN = Most probable number per 100 ml

8 - SWQS for Total Metals are denoted with "T". SWQS for Dissolved Metal for A&We are denoted with a "D".

9 - Volatile Organic Compounds

10 - Dash means information unavailable (ie. SWQS was not established or sample was not collected).

11 - Total of α-BHC, β-BHC, γ-BHC, δ-BHC.

12 - Refer to Appendix Part 13O for Analytical Laboratory Reports

Table 12. Water Quality Data Monitor Site #5

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14					
Conventional Parameters																					
Average Flow Rate3 (m3/s)	-		0.0411		0.0075		0.012		0.0021		0.0206		0.0206		0.0403		0.00508				
pH	6.5-9.0		6.5		8.5		7.8		8.0		7.6		6.8		7.5		6.8				
Temperature (°Celcius)	-		28.2		8.5°C		26.4		16.3		27.5		15.4		27.4		14.1				
Hardness4 (mg/L)[5]		105	105	80	80	143	143	68.7	68.7	185	185	86.7	86.7	466	466	55.6	55.6				
Total Dissolved Solids (TDS) (mg/L)	-		-		71		270		139		269		162		620		104				
Total Suspended Solids (TSS) (mg/L)	-		73		110		214		40.0		336		68		1020		35.5				
Biological Oxygen Demand (BOD) (mg/L)	-		-		5		ND		9.60		37.4		11.7		81.7		5.8				
Chemical Oxygen Demand (COD) (mg/L)	-		-		73		192		46.0		244		65		450		52				
Inorganics																					
Cyanide, total (ug/L)[6]	84T		-		ND		ND		1.10		2.43		ND		2.62		ND				
Nutrients																					
Nitrate + Nitrite as N (mg/L)			-		2.553		2.75		2.3		4.35		1.47		8.31		1.68				
Ammonia as N (mg/L)			-		ND		0.68		0.36		1.28		0.36		2.04		0.19				
TKN (mg/L)			-		0.79		3.77		2.45		5.75		1.83		10.9		0.67				
Total Phosphorus (mg/L)			-		0.43		0.75		0.29		1.02		0.48		2.01		0.19				
Total Orthophosphate (mg/L)			-		0.12		0.34		0.17		0.45		0.29		0.6		0.1				
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575		>241960		4611		52		4106		11199		3873		181		7270				
Total Metals8																					
AntimonyT (µg/L)	747		-		ND		1.73		8.22		2.28		4.5		2.85		0.78				
ArsenicT (µg/L)	200		-		ND		3.36		2.15		5.6		3.21		12		1.69				
BariumT (µg/L)	98,000		-		76		152		57.9		19.3		81.2		519		53.6				
BerylliumT (µg/L)	1,867		-		0.27		0.36		ND		0.39		ND		1.05		ND				
CadmiumD (µg/L)			-	18	1.4	32	0.53	16	ND	20	ND	20	ND	88	ND	13	ND				
ChromiumT (µg/L)			-		6.2		7.67		2.91		10.7		4.6		31		2.92				
CopperD (µg/L)		24.36	35.00	18.85	33.00	32.58	41.20	16.33	19.80	41.53	60.20	20.33	28.90	85.88	132.00	13.38	17.10				
LeadD (µg/L)		143.73	Trace	106.81	20.00	200.74	1.58	90.36	0.88	264.46	1.94	116.64	1.03	592.71	2.56	71.54	0.59				
MercuryT (µg/L)	10		-		ND		ND		ND		ND0.2		0.136		0.272		ND				
NickelD (µg/L)			-	3442.98	ND	5627.75	2.84	3026.81	0.95	6997.58	3.29	3685.40	1.28	13435.79	6.32	2530.78	1.00				
SeleniumT (µg/L)	33		-		ND		0.89		ND		0.34		0.82		4.23		ND				
SilverD (µg/L)			-	2.19	ND	5.95	0.79	1.69	ND	9.27	ND1.0	2.52	ND	34.91	ND	1.17	ND				
ThalliumT (µg/L)	75		-		ND		0.22		ND		0.18		ND		0.4		ND				
ZincD (µg/L)		1158.93	77.50	920.43	110.00	1505.64	23.90	809.02	9.48	1872.75	34.70	985.34	12.50	3599.40	59.30	676.25	6.65				
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-		Trace 0.75		5.56		1.76		2.00		7.88		7.3		11.06				
Total Oil & Grease (mg/L)	-		-		4.27		7.11		1.76		2.89		10.61		25.23		6.24				
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-		ND		ND		-		ND		ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14					
Acrylonitrile (µg/L)	37,333		-		ND		ND		-		ND		ND		ND		ND				
Benzene (µg/L)	3,733		-		11		ND		-		ND		ND		0.05		ND				
Bromoform (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND				
Carbon tetrachloride (µg/L)	1,307		-		ND		ND		-		ND		ND		ND		ND				
Chlorobenzene (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND				
Chlorodibromomethane (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND				
Chloroethane (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
2-chloroethylvinyl ether (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
Chloroform (µg/L)	9,333		-		ND		ND		-		ND		ND		ND		ND				
Dichlorobromomethane (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND				
1,2-dichlorobenzene (µg/L)	5,900		-		ND		ND		-		ND		ND		ND		ND				
1,3-dichlorobenzene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
1,4-dichlorobenzene (µg/L)	6,500		-		ND		ND		-		ND		ND		ND		ND				
1,1-dichloroethane (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
1,2-dichloroethane (µg/L)	186,667		-		ND		ND		-		ND		ND		ND		ND				
1,1-dichloroethylene (µg/L)	46,667		-		ND		ND		-		ND		ND		ND		ND				
1,2-dichloropropane (µg/L)	84,000		-		ND		ND		-		ND		ND		ND		ND				
1,3-dichloropropylene (µg/L)	28,000		-		ND		ND		-		ND		ND		ND		ND				
Ethylbenzene (µg/L)	93,333		-		ND		ND		-		ND		ND		ND		ND				
Methyl bromide (µg/L)	1,307		-		ND		ND		-		ND		ND		ND		ND				
Methyl chloride (µg/L)	-		-		ND		ND		-		ND		0.11		ND		ND				
Methylene chloride (µg/L)	56,000		-		ND		ND		-		ND		ND		ND		ND				
1,1,2,2-tetrachloroethane (µg/L)	93,333		-		ND		ND		-		ND		ND		ND		ND				
Tetrachloroethylene (µg/L)	9,333		-		ND		ND		-		ND		ND		ND		ND				
Toluene (µg/L)	373,333		-		ND		ND		-		ND		0.06		0.09		ND				
1,2-trans-dichloroethylene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
1,1,1-trichloroethane (µg/L)	1,866,667		-		ND		ND		-		ND		ND		ND		ND				
1,1,2-trichloroethane (µg/L)	3,733		-		ND		ND		-		ND		ND		ND		ND				
Trichloroethylene (µg/L)	280		-		ND		ND		-		ND		ND		ND		ND				
Trimethylbenzene (µg/L)	-		-		-		-		-		-		-		-		-				
Vinyl chloride (µg/L)	2,800		-		ND		ND		-		ND		ND		ND		ND				
Xylene (µg/L)	186,667		-		ND		ND		-		ND		ND		ND		ND				
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667		-		ND		ND		-		ND		ND		ND		ND				
2,4-dichlorophenol (µg/L)	2,800		-		ND		ND		-		ND		ND		ND		ND				
2,4-dimethylphenol (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND				
4,6-dinitro-o-cresol (µg/L)	3,733		-		-		-		-		-		-		ND		ND				
2,4-dinitrophenol (µg/L)	1,867		-		ND		ND		-		ND		ND		ND		ND				
2-nitrophenol (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
4-nitrophenol (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
p-chloro-m-cresol (µg/L)	48,000		-		-		-		-		-		-		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14					
Pentachlorophenol (µg/L)			-	166.0	ND14.0	82.1	ND		-	67.2	ND	30.1	ND	60.8	ND	30.1	ND				
Phenol (µg/L)	180,000		-		ND		ND		-		ND		ND		ND		ND				
2,4,6-trichlorophenol (µg/L)	130		-		ND		ND		-		ND		ND		ND		ND				
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000		-		ND		ND		-		ND		ND		ND		ND				
Acenaphthylene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
Anthracene (µg/L)	280,000		-		ND		ND		-		ND		ND		ND		ND				
Benzo(a)anthracene (µg/L)	0.2		-		-		ND1.44		-		ND1.44		ND1.44		ND1.44		ND1.44				
Benzo(a)pyrene (µg/L)	0.2		-		ND2.2		ND1.55		-		ND1.55		ND1.55		ND1.55		ND1.55				
Benzo(b)fluoranthene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
Benzo(g,h,i)perylene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
Benzo(k)fluoranthene (µg/L)	1.9		-		ND2.6		ND2.28		-		ND2.28		ND2.28		ND2.28		ND2.28				
Chrysene (µg/L)	19		-		ND		ND		-		ND		ND		ND		ND				
Dibenzo(a,h)anthracene (µg/L)	1.9		-		ND4.1		ND		-		ND		ND		ND		ND				
3,3-dichlorobenzidine (µg/L)	3		-		ND3.1		ND		-		ND		ND		ND		ND				
Diethyl phthalate (µg/L)	746,667		-		ND		ND		-		ND		ND		ND		ND				
Dimethyl phthalate (µg/L)	-		-		ND		ND		-		ND		8.7		ND		ND				
Di-n-butyl phthalate (µg/L)	1,100		-		ND		14.8		-		ND		ND		ND		1.69				
2,4-dinitrotoluene (µg/L)	1,867		-		ND		ND		-		ND		ND		ND		ND				
2,6-dinitrotoluene (µg/L)	3,733		-		ND		ND		-		ND		ND		ND		ND				
Di-n-octyl phthalate (µg/L)	373,333		-		ND		ND		-		ND		ND		ND		ND				
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8		-		ND2.2		ND		-		ND		ND		ND		ND				
Fluroranthene (µg/L)	37,333		-		ND		ND		-		ND		ND		ND		ND				
Fluorene (µg/L)	37,333		-		ND		ND		-		ND		ND		ND		ND				
Hexachlorobenzene (µg/L)	747		-		ND		ND		-		ND		ND		ND		ND				
Hexachlorobutadiene (µg/L)	187		-		ND		ND		-		ND		ND		ND		ND				
Hexachlorocyclopentadiene (µg/L)	11,200		-		ND		ND		-		ND		ND		ND		ND				
Hexachloroethane (µg/L)	850		-		ND		ND		-		ND		ND		ND		ND				
Indeno(1,2,3-cd)pyrene (µg/L)	1.9		-		ND3.5		ND2.25		-		ND2.25		ND2.25		ND2.25		ND2.25				
Isophorone (µg/L)	186,667		-		ND		ND		-		ND		ND		ND		ND				
Naphthalene (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND				
Nitrobenzene (µg/L)	467		-		ND		ND		-		ND		ND		ND		ND				
N-nitrosodimethylamine (µg/L)	0.03		-		ND5.7		ND4.23		-		ND4.23		ND4.23		ND4.23		-				
N-nitrosodi-n-propylamine (µg/L)	88,667		-		ND		ND		-		ND		ND		ND		ND				
N-nitrosodiphenylamine (µg/L)	290		-		ND		ND		-		ND		ND		ND		ND				
Phenanthrene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND				
Pyrene (µg/L)	28,000		-		ND		ND		-		ND		ND		ND		ND				
1,2,4-trichlorobenzene (µg/L)	9,333		-		ND		ND		-		ND		ND		ND		ND				
PCB/Pesticides																					
Aldrin (µg/L)	0.003		-		ND0.14		ND0.10		-		ND0.10		ND0.10		ND0.09		ND0.09				
Alpha-BHC (µg/L)	1,600		-		ND		ND		-		ND		ND		ND		ND				

PARAMETERS	SWQS2	Hardness SWQS	Summer 2011	Hardness SWQS	Winter 2011-12	Hardness SWQS	Summer 2012	Hardness SWQS	Winter 2012-13	Hardness SWQS	Summer 2013	Hardness SWQS	Winter 2013-14	Hardness SWQS	Summer 2014	Hardness SWQS	Winter 2014-15	Hardness SWQS	Summer 2015	Hardness SWQS	Winter 2015-16
Date		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14					
Beta-BHC (µg/L)	560		-		ND		ND		-		ND		ND		ND		ND				
Gamma-BHC (µg/L)	11		-		ND		ND		-		ND		ND		ND		ND				
Delta-BHC (µg/L)	1,600		-		ND		ND		-		ND		ND		ND		ND				
Chlordane (µg/L)	3.2		-		ND		ND		-		ND		ND		ND		ND				
4,4'-DDT (µg/L)	1.1		-		ND		ND		-		ND		ND		ND		ND				
4,4'-DDE (µg/L)	1.1		ND		ND		ND		-		ND		ND		ND		ND				
4,4'-DDD (µg/L)	1.1		-		ND		ND		-		ND		ND		ND		ND				
Dieldrin (µg/L)	0.003		-		ND0.13		ND0.07		-		ND0.07		ND0.07		ND0.05		ND0.05				
Alpha-endosulfan (µg/L)	3		-		ND		ND		-		ND		ND		ND		ND				
Beta-endosulfan (µg/L)	3		-		ND		ND		-		ND		ND		ND		ND				
Endosulfan sulfate (µg/L)	3		-		ND		ND		-		ND		ND		ND		ND				
Endrin (µg/L)	0.004		-		ND		ND0.10		-		ND0.10		ND0.10		ND0.09		ND0.09				
Endrin aldehyde (µg/L)	0.7		-		0.34		ND		-		ND		ND		ND		ND				
Heptachlor (µg/L)	0.9		-		ND		ND		-		ND		ND		ND		ND				
Heptachlor epoxide (µg/L)	0.9		-		ND		ND		-		ND		ND		ND		ND				
PCB-1242 (AROCLOR-1242) (µg/L)	0.001		-		ND9.0		ND0.10		-		ND0.10		ND0.10		ND0.1		ND0.23				
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-		ND5.6		ND0.07		-		ND0.07		ND0.07		ND0.19		ND0.07				
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-		ND4.0		ND0.09		-		ND0.09		ND0.09		ND0.09		ND0.09				
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-		ND6.8		ND0.16		-		ND0.16		ND0.16		ND0.11		ND0.11				
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-		ND3.5		ND0.16		-		ND0.16		ND0.16		ND0.19		ND0.19				
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-		ND2.9		ND0.25		-		ND0.25		ND0.25		ND0.1		ND0.10				
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-		ND3.3		ND0.10		-		ND0.10		ND0.10		ND0.05		ND0.05				
Toxaphene (µg/L)	0.005		-		ND10		ND5.08		-		ND5.08		ND5.08		ND0.71		ND0.71				

Note:Results higher than SWQ are shown in red font. Non-detectable results with the Method Detection Limit (MDL) above the SWQS are shown as ND with the MDL in parentheses.

1 - Partial Body Contact (PBC), Aquatic & Wildlife ephemeral (A&We) or Agricultural Livestock watering (AgL).

2 - Surface Water Quality Standards (A.A.C R18-11-101 through Appendix B) selected from lowest of PBC, A&We or AgL.

3 - Average flow rate during the sampling event. m3/s = meters cubed per second.

4 - Hardness of sample event is used to calculate SWQS for Cadmium, Chromium, Copper, Lead, Nickel, Sliver, and Zinc.

5 - mg/l = milligram per liter

6 - µg/L = micrograms per liter

7 - CFU/100 ml = colony forming unit per 100 milliliters, MPN = Most probable number per 100 ml

8 - SWQS for Total Metals are denoted with "T". SWQS for Dissolved Metal for A&We are denoted with a "D".

9 - Volatile Organic Compounds

10 - Dash means information unavailable (ie. SWQS was not established or sample was not collected).

11 - Total of α-BHC, β-BHC, γ-BHC, δ-BHC.

12 - Refer to Appendix Part 13O for Analytical Laboratory Reports

10. Assessment of Monitoring Data

A. Stormwater Quality

This report is the fourth of a five year permit. Stormwater from all five sites were sampled in the fiscal year and all five sites were sampled for 134 compounds under the expanded list of parameters. Sufficient data has been collected to discern the difference between outliers and trends in the water quality parameters.

B. Surface Water Quality Standards (SWQS)

Analytical results from the sampling period were tabulated along with the applicable SWQS (Part 9). Results higher than SWQS are also reported (Tables 10-1 through 10-5, Figures X-1 through X-5) and discussed. Several parameters, namely Benzo(a)anthracene, Benzo(a)pyrene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, N-nitrosodi-methylamine, Aldrin, Dieldrin, Endrin, 7 PCBs and Toxaphene, have Method Detection Limits (MDLs) that are higher than the Surface Water Quality Standards established for the designated uses of the watersheds draining to the five monitor sites. The MDL used by the primary laboratory has been accepted by ADHS under laboratory license AZO159 for the associated methods, as shown in Appendix Q. MDLs are performed in accordance with 40 CFR, part 136 App.B. Any modification of this method is considered a major modification and may not be performed without permission from ADHS and Region 9 EPA. Two VOCs, Diethyl phthalate and Di-n-butyl phthalate, used as plasticizers, were detected at very low concentrations. Given there were no other organic compounds detected, the stormwater was likely free of the compounds with MDLs above the SWQSs.

C. Pollutant Concentration Greater than Applicable SWQS

A brief summary of the water quality results is provided. The concentration of dissolved copper was higher than SWQS for Sites 4 and 5 and ranged from 9.5 to 17.1 μg/L. The E. coli concentrations were higher than SWQS for Sites #1 and #2 and ranged from 4,884 to 15,5000 Most Probable Number. These results are similar to previous year's results.

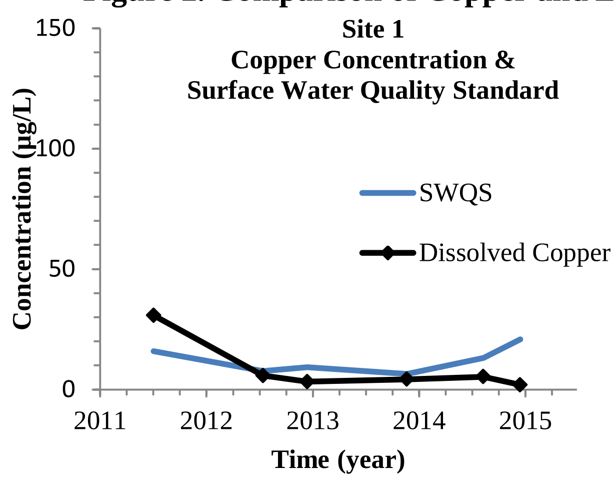
A historical description of the water quality parameters that are higher than the SWQS has been prepared for each wet weather monitor site. The data is tabulated and charts are provided for copper and E. coli.

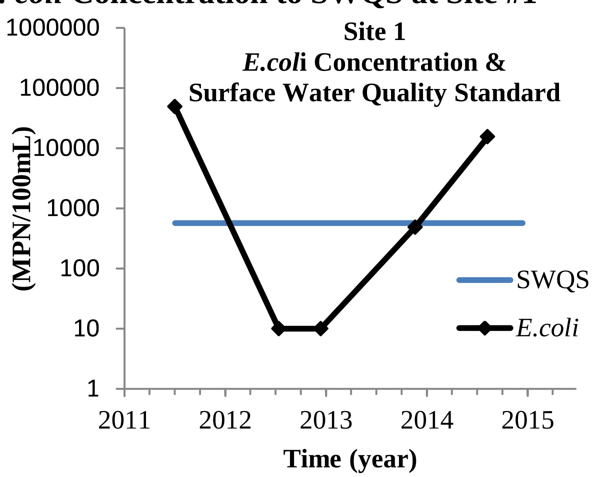
Table 13. Summary of Parameters with Concentrations* Higher than SWQS at Site #1

Site ID: 1 Receiving Water: Rillito	Summer 2011	Winter 11/12	Summer 2012	Winter 12/13	Summer 2013	Winter 13/14	Summer 2014	Winter 14/15
Sample Date	07/04/11	-	07/15/12	12/14/12	-	11/22/13	08/12/14	12/17/14
Hardness (mg/L)	67.0	-	30.7	37.4	-	26.0	54.5	88.9
$Copper_{Dissolved}$ SWQS	15.9	-	7.6	9.2	-	6.5	13.1	20.8
$Copper_{Dissolved}$ Result	30.8	-	5.8	3.3	-	4.2	5.3	1.9
Result > SWQS?	Yes	-	No	No	-	No	No	No
$Silver_{Dissolved}$ SWQS	-	-	0.42	0.59	-	0.32	1.13	2.63
$Silver_{Dissolved}$ Result	-	-	ND	2.66	-	ND	ND	ND
Result > SWQS?	-	-	No	Yes	-	No	No	No
E.coli Result (MPN)	48,840	-	10	-	-	10	487	15,500
Result>SWQS?(575 MPN)	Yes	-	No	-	-	No	No	Yes
pH Result (SU)	6.4	-	7.6	8.1	-	6.9	8.0	7.0
Results > SWQS (6.5-9.0)	Yes	-	No	No	-	No	No	No

* Concentrations are in micrograms per liter, unless noted otherwise.

Figure 2. Comparison of Copper and *E. coli* Concentration to SWQS at Site #1





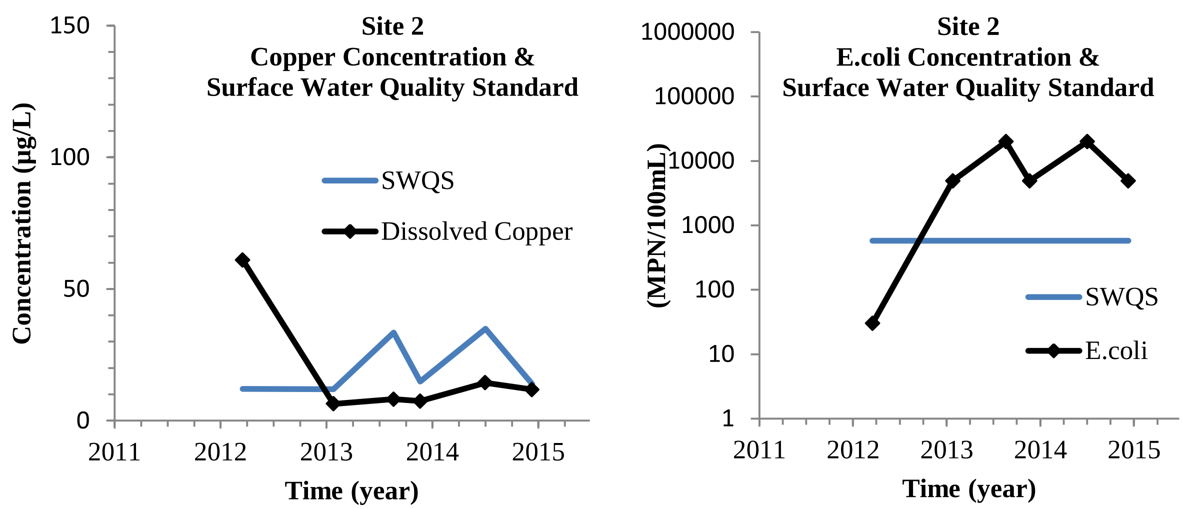
The overall trend for water quality at Site #1 shows a decrease in copper and *E. coli* concentrations. There have been one time occurrences of copper, silver and pH that were outside the SWQS. The higher quality observed at this site is consistent with the low density residential land use. Further actions are not recommended for this wet weather monitoring site.

Table 14. Summary of Parameters with Concentrations* Higher than SWQS at Site #2

Site ID: 2 Receiving Water: Rillito	Summer 2011	Winter 2011-12	Summer 2012	Winter 2012-13	Summer 2013	Winter 2013-14	Summer 2014	Winter 2014-15
Sample Date	-	03/18/12	-	01/26/13	08/22/13	11/22/13	07/05/14	12/13/14
Hardness (mg/L)	-	50.0	-	48.9	147.0	62.5	154.0	57.7
$Copper_{Dissolved}$ SWQS	-	12.1	-	11.9	33.4	14.9	34.9	13.9
$Copper_{Dissolved}$ Result	-	61.0	-	6.4	8.2	7.5	14.4	11.8
Result > SWQS?	-	Yes	-	No	No	No	No	No
$Silver_{Dissolved}$ SWQS	-	1.0	-	0.9	6.2	1.4	6.8	1.3
$Silver_{Dissolved}$ Result	-	ND	-	ND	ND	ND	1.14	ND
Result > SWQS?	-	No	-	No	No	No	No	No
E.coli Result (MPN)	-	30	-	4,884	19,863	4,884	19,863	4,884
Result>SWQS?(575 MPN)	-	No	-	Yes	Yes	Yes	Yes	Yes
pH Result (SU)	-	7.5	-	8.7	-	6.7	6.4	6.4
Results > SWQS (6.5-9.0)	-	No	-	No	-	No	Yes	Yes

* Concentrations are in micrograms per liter, unless noted otherwise.

Figure 3. Comparison of Copper and *E. coli* Concentration to SWQS at Site #2



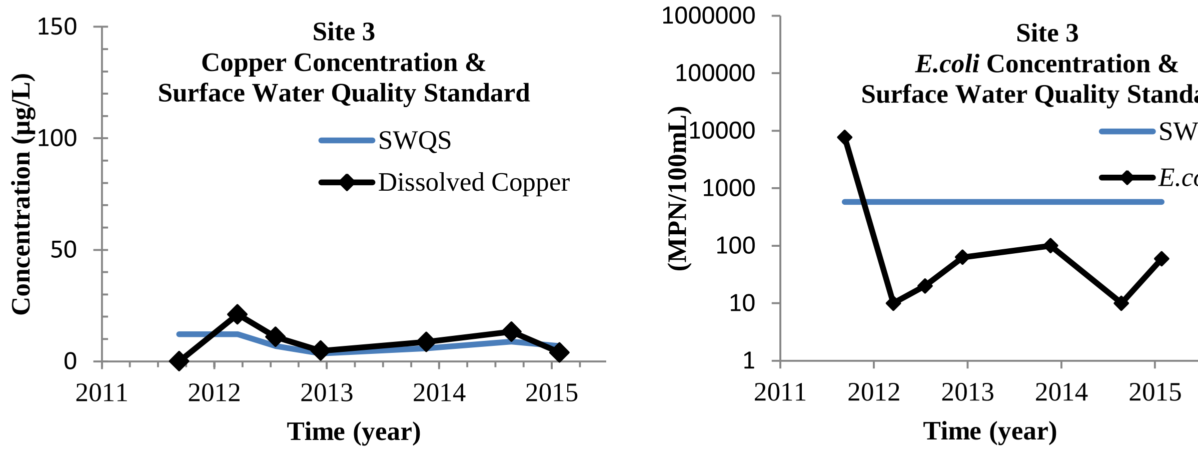
The overall trend for water quality at Site #2 shows copper concentrations are consistently below the SWQS following the first sample in 2012. The *E. Coli* concentrations have been consistently higher than the SWQS since the first sampling in 2011. Two samples had a pH outside the SWQS. The high E. coli concentrations could be related to improper pet waste management in the medium density residential neighborhood. An outreach program will be developed in FY 15/16 to educate the neighborhood and the program will be implemented in FY16/17 with water quality results showing the impacts occurring afterwards.

Table 15. Summary of Parameters with Concentrations* Higher than SWQS at Site #3

Site ID: 1 Receiving Water: Rillito	**Summer 2011**	**Winter 2011-12**	**Summer 2012**	**Winter 2012-13**	**Summer 2013**	**Winter 2013-14**	**Summer 2014**	**Winter 2014-15**
Sample Date	07/04/11	-	07/15/12	12/14/12	-	11/22/13	08/12/14	12/17/14
Hardness (mg/L)	67.0	-	30.7	37.4	-	26.0	54.5	88.9
$Copper_{Dissolved}$ SWQS	15.9	-	7.6	9.2	-	6.5	13.1	20.8
$Copper_{Dissolved}$ Result	30.8	-	5.8	3.3	-	4.2	5.3	1.9
Result > SWQS?	Yes	-	No	No	-	No	No	No
$Silver_{Dissolved}$ SWQS	-	-	0.42	0.59	-	0.32	1.13	2.63
$Silver_{Dissolved}$ Result	-	-	ND	2.66	-	ND	ND	ND
Result > SWQS?	-	-	No	Yes	-	No	No	No
E.coli Result (MPN)	48,840	-	10	-	-	10	487	15,500
Result>SWQS?(575 MPN)	Yes	-	No	-	-	No	No	Yes
pH Result (SU)	6.4	-	7.6	8.1	-	6.9	8.0	7.0
Results > SWQS (6.5-9.0)	Yes	-	No	No	-	No	No	No

* Concentrations are in micrograms per liter, unless noted otherwise.

Figure 4. Comparison of Copper and *E. coli* Concentration to SWQS at Site #3



The overall trend for water quality at Site #3 shows copper concentrations have consistently been slightly higher than the SWQS, with the exception of the 2011 and 2014 winter samples. Aside from the first sampling event, *E. Coli* concentrations have consistently been below the SWQS, reflective of the neighborhood members taking pet waste management very seriously. Note pet owner has a pink plastic dog bone as a carrying case for pink plastic bags for disposal of pet waste. Silver has once and pH has twice been outside the SWQS range.

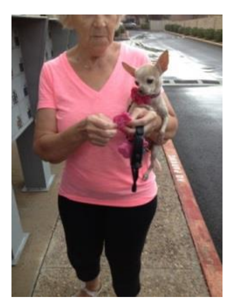
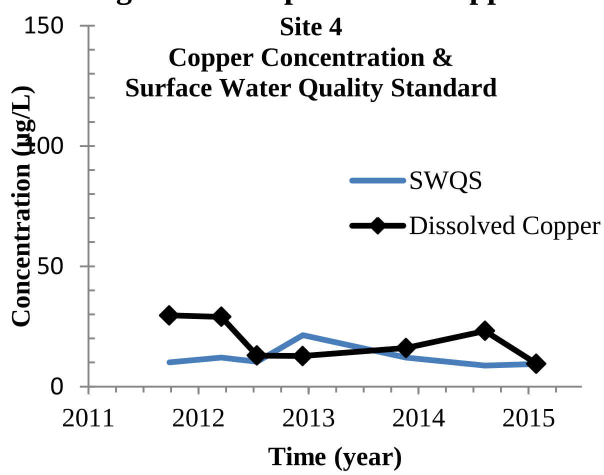


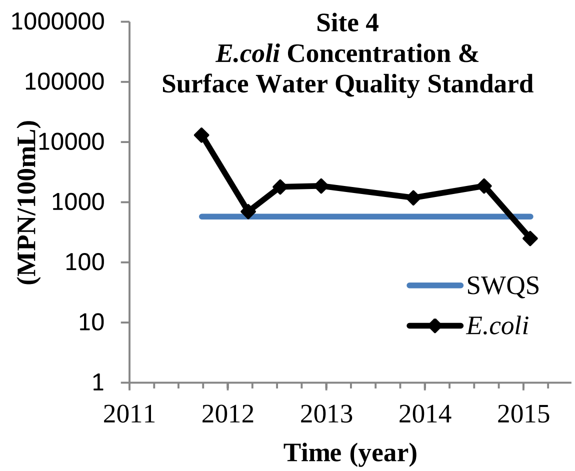
Table 16. Summary of Parameters with Concentrations* Higher than SWQS at Site #4

Site ID: 4 Receiving Water: Rillito	**Summer 2011**	**Winter 2011-12**	**Summer 2012**	**Winter 2012-13**	**Summer 2013**	**Winter 2013-14**	**Summer 2014**	**Winter 2014-15**
Sample Date	09/27/11	03/18/12	07/15/12	12/14/12	-	11/22/13	08/12/14	01/30/15
Hardness (mg/L)	54.0	50.0	42.3	90.9	-	50.0	35.4	38.2
$Copper_{Dissolved}$ SWQS	10	12.1	10.3	21.3	-	12.1	8.7	9.4
$Copper_{Dissolved}$ Result	29.6	29.0	12.9	12.7	-	16.0	23.1	9.5
Result > SWQS?	Yes	Yes	Yes	No	-	Yes	Yes	Yes
$Silver_{Dissolved}$ SWQS	-	1	0.7	2.7	-	1	0.5	0.6
$Silver_{Dissolved}$ Result	-	<1	0.2	1.0	-	<1	<1	<1
Result > SWQS?	-	No	No	No	-	No	No	No
E.coli Result (MPN)	12,997	697	1,789	1,850	-	1,178	1,850	249
Result>SWQS?(575 MPN)	Yes	Yes	Yes	Yes	-	Yes	Yes	No
pH Result (SU)	7.0	7.4	7.7	7.8	-	6.7	7.5	8.5
Results > SWQS (6.5-9.0)	No	No	No	No	-	No	No	No

* Concentrations are in micrograms per liter, unless noted otherwise.

Figure 5. Comparison of Copper and *E. coli* Concentration to SWQS at Site #4





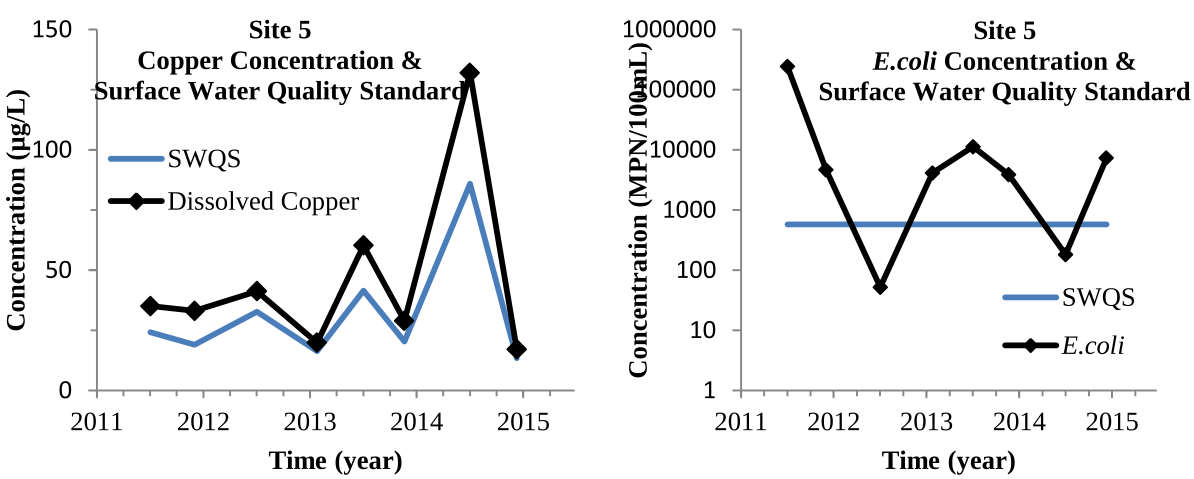
The overall trend for water quality at Site #4 shows a decrease in copper and *E. coli* concentrations; however, both are frequently higher than the SWQS. Silver and pH have consistently met the SWQS. The planned outreach program addressing copper in traditional brake pads could reduce copper concentrations at this location. An outreach program will be developed in FY14/15 to approach the commercial owners about adding pet waste stations as a way of reducing microbiologic pollution in stormwater. The program will be implemented in FY15/16 with water quality results showing impacts afterwards.

Table 17. Summary of Parameters with Concentrations* Higher than SWQS at Site #5

Site ID: 5 Receiving Water: Santa Cruz	**Summer 2011**	**Winter 2011-12**	**Summer 2012**	**Winter 2012-13**	**Summer 2013**	**Winter 2013-14**	**Summer 2014**	**Winter 2014-15**
Sample Date	07/04/11	12/03/11	07/04/12	01/26/13	07/05/13	11/22/13	07/05/14	12/13/14
Hardness (mg/L)	105.0	80.0	143.0	68.7	185.0	86.7	466.0	55.6
Copper$_{\text{Dissolved}}$ SWQS	24.2	18.9	32.6	16.3	41.5	20.3	85.9	13.4
Copper$_{\text{Dissolved}}$ Result	35.0	33.0	41.2	19.8	60.2	28.9	132.0	17.1
Result > SWQS?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Silver$_{\text{Dissolved}}$ SWQS	-	2.2	6	1.7	9.3	2.5	34.9	1.2
Silver$_{\text{Dissolved}}$ Result	-	<1	0.8	<1	<1	<1	<1	<1
Result > SWQS?	-	No	No	No	No	No	No	No
E.coli Result (MPN)	242,000	4,611	52	4,106	11,199	3,873	181	7,270
Result>SWQS?(575 MPN)	Yes	Yes	No	Yes	Yes	Yes	No	Yes
pH Result (SU)	6.5	8.5	7.8	8.0	7.6	6.8	7.5	6.8
Results > SWQS (6.5-9.0)	No	No	No	No	No	No	No	No

* Concentrations are in micrograms per liter, unless noted otherwise.

Figure 6. Comparison of Copper and *E. coli* Concentration to SWQS at Site #5



The overall trend for water quality at Site #5 shows that copper has consistently been above the SWQS. The summer 2014 sample was anomalously high for metals and Total Suspended Solids, which could have contained a particle resulting in the high values. Summer concentrations are higher than winter samples indicating seasonal influences are important. An assessment will be conducted in FY14/15 to identify businesses likely to be contributing copper to stormwater and assess control measures that could reduce them. *E. coli* concentrations have been higher than the SWQS six times. The businesses use guard dogs to maintain security. The outreach program developed for Site #2 will enhanced to address pet wastes from guard dogs at businesses. Silver concentrations and pH have consistently met the SWQS.

A literature review of copper concentration in runoff provides a frame work to compare ambient copper concentrations with those in urban runoff in Pima County and mining district streams. The ambient surface water quality is established by stream data from Cienega Creek, Davidson Canyon, and Harshaw Creek. Near the confluence of Cienega Creek and Davidson Canyon, the concentration of total copper ranged between 1.0 to 2.2 µg/l from stream samples collected between September 2008 and February 2012 (PAG, 2013). The natural background level of dissolved copper in the Harshaw Creek ranged between 2.01 and 3.59 µg/L (ADEQ, 2003). The runoff data from the five monitor sites shows the dissolved copper concentrations range from 3.3 to 61 µg/L since the new permit became effective in July 2011. During the previous permit the total copper concentrations ranged between 1 and 260 ug/L. The few concentrations higher than 100 µg/L were associated with samples having a Total Suspended Solids concentration greater than 230 mg/L (PDEQ, 2011).

Additional data from mining areas in southern Arizona show the maximum dissolved copper concentration was 130 µg/L in the ASARCO Mission Complex (EPA, 2008) and was frequently above 250 µg/L in the mining districts in Alum Gulch and Humboldt Canyon (ADEQ, 2012). This analysis shows ambient dissolved copper concentrations range from 1.0 to 4 µg/L, while urban runoff ranges between 1 to 61 µg/L and mining areas are typically higher than 130 µg/L.

Sources of copper in stormwater include vehicle brake pads; architectural copper; copper pesticides in landscaping, wood preservatives and pool, spa, and fountain algaecides; industrial copper use; deposition of air-borne copper emissions from fossil fuel combustion and industrial facilities; and vehicle fluid leaks and dumping (TDC Environmental, 2006). The Brake Pad Partnership showed brakes account for 35 to 60 percent of copper in California's urban watershed runoff (Copper Development Association, 2013). A study of runoff from copper roofs and gutters shows first flush concentrations immediately downstream from the roof have a mean greater than 1340 ug/L for both total and dissolved copper (Michels, et al, 2001). This study noted roofs with the oxidation by-product brochantite release about half as much as cooper roofs exposed to air.

The outreach program is being expanded to include vehicle maintenance for brake pads as well as using pads with lower concentrations of copper. Outreach is also being expanded to pool, spa, and fountain companies to find alternatives to copper-bearing pesticides, algaecides and fungicides or arrange for discharge to the sanitary sewer. Site inspections of the drainage areas are underway to identify potential sources of copper. Inspections of industrial facilities currently include identification of metals sources, including copper, and development of alternatives to reduce exposure to rainfall and runoff.

D. References

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11. Estimate of Annual Pollutant Load

A. Method of estimating Pollutant Load

Estimates of the annual pollutant loadings were calculated using the "Simple Method" (SMRC, 2012). The Simple Method uses analytical water quality data, precipitation and percent impervious cover to estimate pollutant loadings in urban areas. The data collected at five monitor points represent five land uses within the MS4, namely low density residential, medium density residential, high density residential, commercial, and industrial. Pima County calculated the annual pollutant load estimate for each Monitor Site and each land use category within the permit area.

The following sections describe the methods Pima County used to calculate statistics and estimate the seasonal pollutant load. The results are presented and evaluated.

The amount of pollutants are estimated by multiplying the volume of water that runs off from a precipitation event and the concentration of the pollutants. Runoff is estimated as a fraction of the precipitation based on the type of land use permeability. Pollutant concentration is measured by collecting the stormwater samples after a representative precipitation event occurs. The pollutant load equation is as follows:

$$L = P * P_f * R_c * C * A * 0.0446$$

where

L = annual pollutant load (tons)
P = annual precipitation (inches)
P_f = annual precipitation fraction producing runoff (given a value of 0.9)
R_c = runoff coefficient (unitless)
C = concentration (event mean) of a pollutant (mg/L)
A = area of catchment draining to sample point (acres)
0.0446 = correction factor for measurement units

The parameters in the equation above are defined as follows:

- ***Pollutant load (L)*** is the estimate of total amount of a specific pollutant discharged per time period for the drainage area of each monitor site. Time periods employed for this report were annual and seasonal (winter and summer).

- ***Annual Precipitation***[1] ***(P)*** is the total inches of rainfall occurring during the reporting period July 1, 2012 to June 30, 2013. Anaylsis of available rainfall data for the Tucson

[1] The use of average rainfall data for pollutant load calculations de-emphasizes the effect of spatial rainfall variability. This, in turn, makes aggregation of pollutant load estimates less reliable.

metropolitan area shows approximately 52% (or 13.17 cm) of the annual rainfall occurs during the summer season and 48% (or 12.16 cm) of the annual rainfall occurs during the winter season.

- ***Annual Precipitation fraction***[2] ***(P_f)*** is an adjustment factor for the number of storm events producing measurable runoff. A typical value for this fraction is 0.9 (USEPA, 1992).

- ***Runoff coefficient (Rc)*** is a relative measure of imperviousness, or the percentage of rainfall that becomes surface runoff (EPA, 1992). The following equation was used to calculate "*R*" values for each representative land use category associated with an outfall (EPA, 1992):

  $$R = 0.05 + 0.9*Ia$$

  where *Ia* is the percent impervious area within the drainage area of each monitor site.

- ***Event-mean concentration***[3] ***(C)*** of a pollutant is the flow-weighted average of the pollutant concentration for the summer monsoon sample and the winter rain sample.

  $$C = Fs/(Fs+Fw)*Cs + Fw/(Fs+Fw)*Cw$$

  where

  Fs = Flow during summer sample
  Fw = Flow during winter sample
  Cs = Concentration of summer sample
  Cw = Concentration of winter sample

- ***Area (A)*** is the area of the catchment draining to the sample point.

Parameters specific to each catchment, namely *Ia*, *Rc* and *A* were previously derived during preparation of the Sample and Analysis Plan (Pima County, 2012).

The "Simple Method" transforms a complex set of hydrological processes into an empirical equation. This equation is used to provide reasonable estimates of pollutant loads in storm water runoff (Ohrel, 2000). At the same time, by simplifying these processes, the level of uncertainty increases when attempting to distinguish the influences from runoff characteristics such as rainfall intensity, rainfall duration, runoff, first-flush effects concentrating pollutants, land use, and antecedent weather conditions.

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[2] A measured value is unavailable for the Sonoran Desert region so EPA's standard value (EPA, 1992) was employed.

[3] Analytical results for the monitored parameters ranged from one to five data points per pollutant. These limited data were used to calculate event-mean concentration ("emc") values. As a result, pollutant load estimates may not be representative of the rainfall events, pollutants, outfalls, seasons, and/or land use categories.

Specifically, Schiff (1996) states that "[A]ssumptions based upon extrapolations to un-sampled storms introduces uncertainty because of flow-related variability." For example, he notes the importance of capturing data from representative storm events. Collecting data from the largest storm of the year may result in disproportionately large event mean concentrations and would potentially overestimate un-sampled, smaller storms during the time period of interest. Similarly, capturing smaller storm events might underestimate the actual discharge for a given reporting period. Schiff asserts that "[T]he magnitude of bias associated with un-sampled storm events cannot be assessed" because monitoring programs do not often have sufficient temporal sampling procedures to adequately address the issue. Such is the case for Pima County's monitoring program. This is due, in part, to the fact that the County's program is not designed to measure annual pollutant loads at a specific site, or regional pollutant loads for a specific land use.

According to Dixon and Chiswell (1996), most monitoring programs are instead designed to address regulatory compliance, identify sources of pollutants, and evaluate management actions such as the effectiveness of best management practices. Pima County's program focuses on just such information needs.

Schiff identifies the need to better understand the relationships of water quality to antecedent dry periods and rainfall intensity or duration (pollutant transport). Concepts such as "first flush" and "seasonal flushing" are examples of interactions that have yet to be adequately quantified. The following subsections provide seasonal pollutant load estimates for Pima County's Monitoring sites and identified land use categories within the permit area.

B. Results of Calculations

Analytical results, annual rainfall, drainage area and imperviousness were used to calculate pollutant loads for the five monitor sites were tabulated (Table 11-1). No loadings were calculated for antimony, arsenic, mercury, selenium, silver and thallium as the concentrations were below the detection limits.

C. Evaluation of Results

The pollutant load estimates[4] should be used for comparative purposes only. For the reasons discussed in subsection 11.B, these values cannot be interpreted as representing actual pollutant loads for the watersheds within the permit area. Furthermore, it would be equally inappropriate to extrapolate these estimates in order to predict potential impacts to receiving water bodies.

[4] The term "pollutant load estimate" does not have the same meaning as the term "pollutant load." The Simple Method should only be used when *estimates* are desired and should not be used when *load* values are required (Ohrel, 2000).

Table 18. Pollutant Load Estimates for Monitor Sites										
	Site #1 Low Density Residential		**Site #2 Med Density Residential**		**Site #3 High Density Residential**		**Site #4 Commercial**		**Site #5 Industrial**	
Annual Precipitation (in)	5.0		5.6		5.0		5.0		7.3	
Area (acres)	3.0		12.4		2.3		59		56.9	
Impervious (%)	25%		65%		85%		95%		70%	
Parameter	Flow-weighted Concen-tration	Load (tons)	Flow-weighted Concen-tration	Load (tons)	Flow-weighted Concen-tration	Load (tons)	Flow-weighted Concen-tration	Load (tons)	Flow-weighted Concen-tration	Load (tons)
Conventional Parameters										
BOD(mg/L)	8.9	1	9.7	17	8.5	3	10.4	111	73.2	828
COD(mg/L)	70.1	12	92.8	164	76.0	29	69.8	748	405.4	4,584
TDS (mg/L)	171.0	28	148.4	263	34.9	13	93.7	1,004	562.2	6,357
TSS (mg/L)	215.6	36	92.5	164	18.3	7	28.5	306	909.8	10,287
Nutrients										
TN (mg/L)	3.3	0.5	5.9	10.4	4.5	1.7	2.5	26.5	19.2	216.6
NH4 (mg/L)	0.61	0.1	0.61	1.1	0.56	0.2	0.65	6.9	1.83	20.7
TKN (mg/L)	1.8	0.3	2.1	3.6	1.2	0.5	1.3	13.7	9.8	110.3
Total Metals										
Sb (µg/L)	0.45	0.00	0.84	0.00	0.62	0.00	1.46	0.02	2.62	0.03
As (µg/L)	3.14	0.00	2.26	0.00	0.75	0.00	31.91	0.34	10.85	0.12
Ba (µg/L)	107.45	0.02	76.39	0.14	17.57	0.01	34.21	0.37	466.90	5.28
Be (µg/L)	0.65	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.93	0.01
Cd (µg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cr (µg/L)	8.43	0.00	4.81	0.01	0.84	0.00	1.66	0.02	27.86	0.31
Cu (µg/L)	4.80	0.00	12.28	0.02	9.26	0.00	19.60	0.21	119.14	1.35
Pb (µg/L)	0.00	0.00	0.53	0.00	0.00	0.00	0.11	0.00	2.34	0.03
Hg (µg/L)	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.24	0.00
Ni (µg/L)	0.96	0.00	0.78	0.00	0.13	0.00	1.17	0.01	5.72	0.06
Se (µg/L)	0.80	0.00	0.25	0.00	0.00	0.00	0.00	0.00	3.76	0.04
Ag (µg/L)	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th (µg/L)	0.06	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.36	0.00
Zn (µg/L)	41.16	0.01	13.68	0.02	46.46	0.02	69.24	0.74	53.41	0.60
Totals		78.06		623		54.23		2,219		22,411

In this regard, qualitative comparisons may be made between outfalls and parameters. The conventional parameters contribute to 97% or greater of the pollutant load for each catchment. TDS is the largest contributor to pollutant load, except for the medium density residential neighborhood which contributed a large volume of TSS. Nutrients contribute less than 3% of the pollutant load and metals contribute less than 0.1%. The low contribution of metals is important due to the higher toxicity levels.

D. Limitations of Pollutant Load Estimation Results

The "Simple Method" is an arithmetic equation based on empirical relationships for complex hydrological processes and average pollutant concentrations in storm water runoff. This method can be used to obtain quick and reasonable storm water pollutant load estimates (Ohrel, 2000), but should only be used for planning-level calculations or identifying data-collection needs.

Numerical results presented in Table 11-1 are pollutant load estimates. Employing event mean concentrations derived from first flush data may result in calculated pollutant load estimates that are higher that the remaining rainfall events.

This type of analysis can be misleading when evaluating potential environmental effects from non-point sources (Silverman et al, 1986). Rainfall events in southern Arizona are sporadic, with loads concentrated into limited periods of time during and after precipitation.

Specifically, flow-related variability may introduce uncertainties when extrapolating from sampled to un-sampled rainfall events. Schiff (1996) uses the example of overestimation for data collected from large storms, versus underestimation for data collected from smaller storm events. In the absence of a sufficient temporal sampling program, the error level associated with un-sampled storm events can be substantial, especially when the un-sampled storm events follow the first flush event.

Estimation errors may also be introduced when using average seasonal precipitation values to calculate pollutant loads. For example, smaller runoff volumes (due to low intensity or short duration rainfall events accompanied by extended antecedent dry periods) may produce disproportionately higher pollutant concentrations per sampling event.

Alternatively, dilution from large volume runoffs (accompanied by shorter antecedent dry periods) may produce lower pollutant concentrations per sampling event. Given that the average seasonal precipitation values might not be representative of a specific storm, calculated values for the estimated pollutant loads might in turn be questionable.

Additionally, the monitoring program was not specifically designed to measure pollutant loads. As a result, phenomena such as pollutant build-up, first flush of pollutants, rainfall intensity, duration, and seasonal flushing of pollutants are not adequately addressed by the County's current monitoring program. These phenomena are an unavoidable consequence of the weather conditions and climatology of southern Arizona.

E. References

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12. Annual Expenditures

The itemized budget presents total expenditures for activities occurring within all of Pima County (Table 12-1) for the AZPDES permit.

Table 19. Annual Expenditures and Budget

Activity	Fiscal Year 2014/2015		Fiscal Year 2015/2016	
	Actual Costs	Department Subtotal	Budgeted Costs	Department Subtotal
Environmental Quality		$ 260,000		$ 260,000
NPDES Stormwater	$ 260,000		$ 260,000	
Regional Flood Control District		9,060,289		9,363,061
Floodplain Permitting (1)	1,582,172		1,469,261	
Development Review	58,215		-	
Engineering Support (2)	535,991		471,582	
Long Range Planning, Basin & Drainage Studies (3)	-		-	
FEMA/Mapping	1,507,832		1,369,679	
Drainage Way Maintenance	5,376,079		6,052,539	
Transportation		11,008,040		9,542,699
Environmental Planning & Compliance	105,600		70,174	
Maintenance Administration	964,962		946,163	
Maintenance District # 1	1,342,571		600,072	
Maintenance District # 4	1,500,051		1,631,415	
Maintenance District # 5	1,624,674		1,956,778	
Maintenance Support	2,002,319		1,785,418	
Contract Maintenance Dist. # 2	2,031,116		970,860	
Contract Maintenance Dist. # 3	1,436,747		1,581,819	
Development Services		1,693,252		1,659,029
Regional Comprehensive Plan	233,177		-	
Landscaping Review	-		-	
Development Review	-		-	
Rezoning	1,460,075		1,659,029	
Regional Wastewater Reclamation		15,123		15,000
Ina Road Laboratory Analysis	15,123		15,000	
Stormwater Program Total	**$22,036,704**	**$22,036,704**	**$20,839,789**	**$ 20,839,789**

(1) Landscaping expenses incorporated.
(2) Permitting and Engineering Support are now budgeted within Floodplain Management.
(3) FEMA/Mapping, Basin and Drainage Studies are now budgeted within Planning and Development.

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