Pima County
2016 Annual Stormwater Report

July 2015 – June 2016
AZPDES Permit No. AZS000002

PIMA COUNTY

September 26, 2016

Stormwater Management Plan

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

Stormwater Management Program
Pima County Department of Environmental Quality
33 N. Stone Avenue, Suite 700
Tucson, Arizona 85701-1429

TABLE OF CONTENTS

Executive Summary **1**
1. General Information **3**
2. Annual Report Certification and Legal Authority **7**
3. Narrative Summary of Stormwater Management Program **9**
A. Public Awareness 9
B. Public Participation 11
C. Illicit Discharge Detection and Elimination Activities 12
D. County Facilities 13
E. Industrial and Commercial Facilities 15
F. Construction Sites 15
G. Post Construction 17
H. Non-filer Reporting 17
4. Numeric Summary of Stormwater Management Program Activities **19**
5. Evaluation of Stormwater Management Program **22**
6. Stormwater Management Program Modifications **28**
7. Monitoring Locations **29**
8. Storm Event Records **30**
9. Water Quality Data from Monitor Sites **33**
10. Assessment of Monitoring Data **55**
A. Stormwater Quality 55
B. Surface Water Quality Standards (SWQS) 55
C. Pollutant Concentration Greater than Applicable SWQS 55
11. Estimate of Annual Pollutant Load **62**
A. Method of estimating Pollutant Load 62
B. Results of Calculations 64
C. Evaluation of Results 64
D. Limitations of Pollutant Load Estimation Results 66
12. Annual Expenditures **67**
REFERENCES 68

Appendices

A. Public Awareness: Outreach Materials
A-1. Log of Outreach Materials Distributed
A-2. Outreach Log
A-3. Materials Distributed
A-4. Media Outreach Reports

B. Public Participation: Adopt-A-Roadway Program

C. Public Participation: Household Hazardous Waste Program

D. Illicit Discharge Detection and Elimination Program: Complaints

E. Illicit Discharge Detection and Elimination (IDDE) Program
   E-1. IDDE Summary of Notices of Violation Statistics
   E-2. IDDE Summary of Notices of Violation by Watershed

F. Outfalls
   F-1. Outfall Inventory
   F-2. Outfall Site Inspection Reports

G. County Industrial Facilities
   G-1. County Industrial Facility Inventory
   G-2. Inspection Reports for County Industrial Facilities

H. GIS Map Inventory

I. Infrastructure Maintenance: Roadway System
   I-1. Summary of Road Maintenance
   I-2. Log of Road Maintenance Activities

J. Infrastructure Maintenance: Drainageway System
   J-1. Retention/Detention Basin Maintenance
   J-2. Infrastructure Maintenance

K. Conservation Properties

L. Industrial Facilities
   L-1. Industrial Facility Inventory
   L-2. Industrial Facilities Site Inspection Reports
   L-3. Inventory of Facilities with Potential for Hazardous Substances

M. Plan Reviews for Stormwater-related Ordinances

N. Floodplain Use Permits (FPUP) and Flood-prone Land Acquisition Program (FLAP)

O. Construction Sites
   O-1. Construction Site Inventory
   O-2. Construction Site Inspection Reports

P. Post Construction
   P-1. Post Construction Inspections Due in Fiscal Year 2014-2015
   P-2. Post-construction Site Inspection Reports

Q. Water Quality Laboratory Reports for Monitor Sites #1 through #5

LIST OF FIGURES

Figure 1. 2011 AZPDES Permit Area Map 4
Figure 2. Number of Enforcement Cases for Solid Waste Notices of Violation 22
Figure 3. Number of Enforcement Cases for Wildcat Dumping Notices of Violation 23
Figure 4. Before (left) and after (right) photos of riprap to stabilize channel 24
Figure 5. Comparison of Copper and *E. coli* Concentration to SWQS at Site #1 56
Figure 6. Comparison of Copper and *E. coli* Concentration to SWQS at Site #2 57
Figure 7. Comparison of Copper and *E. coli* Concentration to SWQS at Site #3 58
Figure 8. Comparison of Copper and *E. coli* Concentration to SWQS at Site #4 59
Figure 9. Comparison of Copper and *E. coli* Concentration to SWQS at Site #5 60

LIST OF TABLES

Table 1. Summary of Business Assistance Program 11
Table 2. Spills within Permit Area 13
Table 3. Numeric Summary of Stormwater Management Program Activities 19
Table 4. Land Use Area within Unincorporated Pima County 24
Table 5. Monitor Site Locations 29
Table 6. Storm Event Records for Monitor Sites 30
Table 7. Monitor Site Sample Dates and Type of Sample Set 33
Table 8. Water Quality Data Monitor Site #1 35
Table 9. Water Quality Data Monitor Site #2 39
Table 10. Water Quality Data Monitor Site #3 43
Table 11. Water Quality Data Monitor Site #4 47
Table 12. Water Quality Data Monitor Site #5 51
Table 13. Summary of Parameters with Concentrations* Higher than SWQS at Site #1 56
Table 14. Summary of Parameters with Concentrations* Higher than SWQS at Site #2 57
Table 15. Summary of Parameters with Concentrations* Higher than SWQS at Site #3 58
Table 16. Summary of Parameters with Concentrations* Higher than SWQS at Site #4 59
Table 17. Summary of Parameters with Concentrations* Higher than SWQS at Site #5 60
Table 18. Pollutant Load Estimates for Monitor Sites 65

(This page is intentionally left blank).

EXECUTIVE SUMMARY

Introduction

This report describes activities performed and data collected for Pima County's Arizona Pollutant Discharge Elimination System (AZPDES) Permit No. AZS000002 between July 1, 2015 and June 30, 2016. 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 fifth annual report prepared under the state permit issued on June 16, 2011 and effective on July 18, 2011, hereinafter referred to as the 2011 MS4 permit. Under the previous EPA MS4 permit issued on February 14, 1997, 14 annual reports were prepared.

Certification

Pima County's principal executive officer signs and certifies that 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 five Monitoring Sites (Part 7). Storm events are recorded in the Automated Local Evaluation in Real Time system and summarized (Part 8). Analytical results for the water quality samples (Part 9), 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 40 outfalls, 129 construction sites, 89 post construction sites, 7 county facilities and 9 private industrial facilities. The public reported 1,162 environmental complaints. All complaints were inspected or referred to another jurisdiction. These inspections resulted in 355 Notices of Violation and 314 remediated sites. Seven stormwater samples were collected at five monitor sites. Analysis of the water quality results for 133 parameters shows copper and *E. coli* concentrations were detected above Arizona's Surface Water Quality Standards (SWQS) and pH was just outside the SWQS. These activities and increasingly effective stormwater stewardship practices by the public contribute to stormwater quality with three parameters outside of standards and meeting the other 102 parameters with established SWQS.

(This page is intentionally left blank).

1. General Information

A. Name of Permittee: Pima County

B. Permit Number: AZS000002

C. Reporting Period: July 1, 2015 - June 30, 2016

D. Name of Stormwater Management Program Contact: Marie Light

Title: Principal Hydrologist

Mailing Address: 33 North Stone Avenue, Suite 700

City: Tucson

Zip: 85701-1429

Phone: 520-724-7400

Fax Number: 520-838-7432

Email Address: marie.light@pima.gov

E. Name of Certifying Official: John M. Bernal

Title: Deputy County Administrator for Public Works

Mailing Address: 130 West Congress Street

City: Tucson

Zip: 85701-1317

Phone: 520-724-8474

Fax Number: 520-740-8171

Email Address: john.bernal@pima.gov

F. Scope of Permit

The infrastructure within the permit area includes 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 (PCDOT) and the 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 greater than 0.2 inches. Most runoff infiltrates within Pima County.

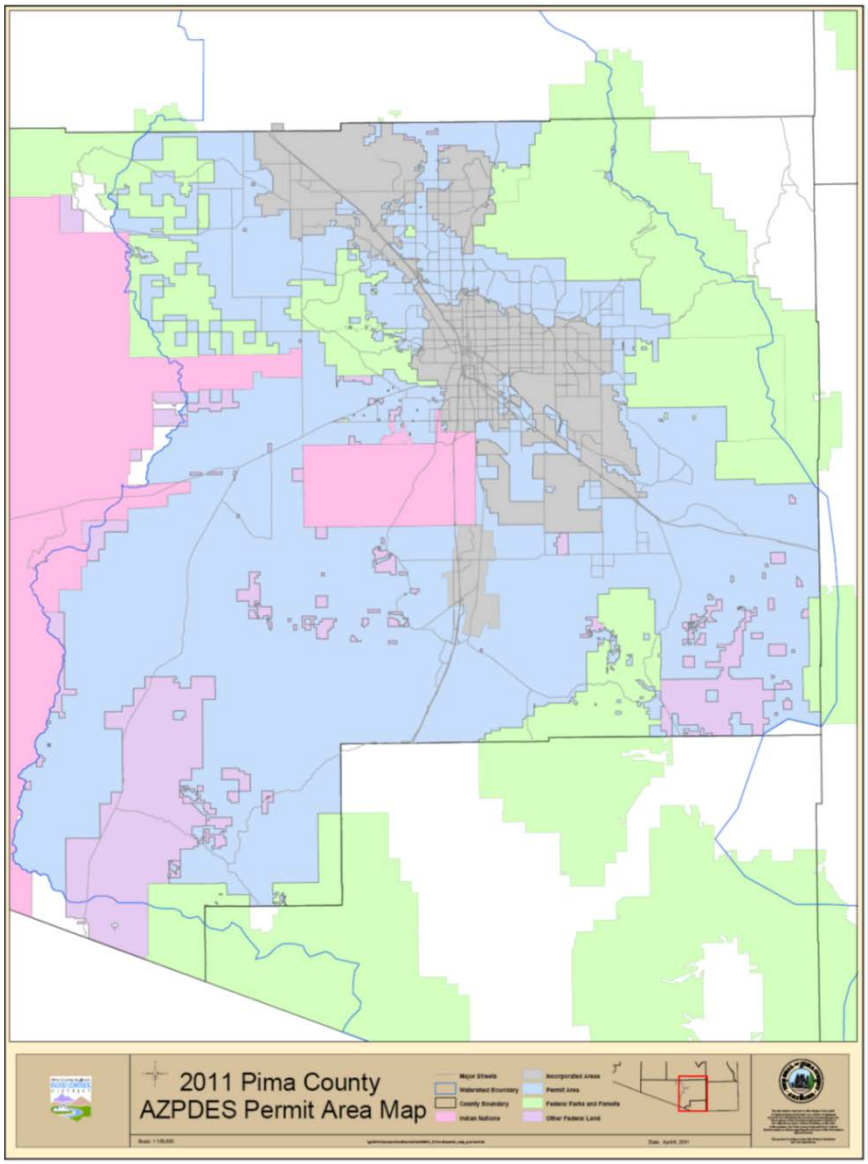


Figure 1. 2011 AZPDES Permit Area Map

Managements Activities

Management of the program includes coordinating with Pima County departments that maintain roadways and drainageways, purchasing open space to conserve land and managing 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 works with novices and professionals 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, medium and high density residences, commercial and industrial land uses.

(This page intentionally left blank).

2. ANNUAL REPORT CERTIFICATION AND LEGAL AUTHORITY

Written by: **Date:**

_____ _____

Marie Light
Principal Hydrologist

Reviewed by: **Date:**

_____ _____

Richard Grimaldi
Deputy Director, Department of Environmental Quality

_____ _____

Ursula Nelson
Director, Department of Environmental Quality

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 September 30, 2016
Deputy County Administrator for Public Works

(This page is intentionally left blank.)

3. Narrative Summary of Stormwater Management Program

Pima County's municipal separate storm sewer 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 and 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 includes environmental and stormwater educational events. The Pima County Department of Environmental Quality (PDEQ) 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 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.

<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 from 5 to 30 students. This fiscal year the topic addressed the application of Low Impact Development and Green Infrastructure (GI/LID) to achieve sustainable water use. The presentation was made on October 8, 2015.

Additional presentations were made to professionals. Two Clean Water and Air Presentations were provided to the IBM Loop update for their engineers on April 26, 2016 as well as the City of Tucson's Sun Van Operators on April 26, 2016. The principles of GI/LID were presented to the Arizona County Directors of Environmental Health Services Association (ACDEHSA) on April 27, 2016 and the 2016 Stormwater Summit on May 3, 2016. These presentations reached over 100 people most likely to implement new technologies.

The topics presented to the general public include wash protection, illicit discharges, illegal dumping and LID. The Clean Water & Air presentation was made to the St. Luke's Home on July 14, 2015, South Park Neighborhood Association on May 2, 2016 and Catalina Foothills summer school on June 30, 2016. The principles and implementation methods for LID were presented to the Villa Del Rio Homeowners Association on April 14, 2016. PDEQ staff

continued to provide 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 LID message.

MS4s within Pima County, ADEQ and the construction industry meet regularly at the Pima Association of Government's (PAG) Stormwater Management Working Group (SWMWG) 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. The multi-media campaign included public events, media interviews, magazine ads, articles, signage, website and social media communication, promotional materials and educational literature.

The slogan "Clean Water Starts with Me" was used for the eighth 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 ran beginning in July of 2014. Comprehensive topics addressed by outreach included management and disposal of animal waste and 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 2015-16 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 the relative effectiveness of stormwater management systems. SWMWG collaborated with Project WET staff to enhance development of the stormwater curriculum for the local desert environment. During this fiscal year, 33,560 teachers and students participated in Project WET activities.

A phone survey was conducted in May 2016 to assess the public's attitudes toward stormwater and their trash disposal behaviors. The results were finalized in a report (FMR Associates, 2016) and the results were 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 2016.

<u>EcoNook for Desert Dwellers and Eco Kids Corner</u>

This community outreach project provides 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 GI/LID.

Business Assistance Program

Activities in the Business Assistance Program help local businesses comply with applicable environmental requirements (Table 2). PDEQ 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	150
PDEQ office assistance visits	20
Letters/information mailed	20
Educational literature distributed	14,383
Seminars/presentations given	10
Number of times stormwater website or LID website was visited	1,473
Number of times website for Water & Wastewater Infrastructure, Supply & Planning Study	674
Number of times Pima County's Comprehensive Plan Pima Prospers website was visited (chapters containing stormwater management, rainwater harvesting or LID) was visited	1,286

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 PDEQ.

Adopt-a-Roadway Program

Volunteers in Pima County's Adopt-a-Roadway program clean up roadways and public lands. The program had 359 clean-up events covering 575.3 miles. Volunteers removed 6,200 bags from the adopted roads (Appendix B).

Environmental Complaints

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

Antifreeze, Batteries, Oil and Paint (ABOP) Program

Pima County contracted with Tucson Recycling & Waste Services on June 1, 2013 to operate the County's landfills and transfer stations. Recycling of ABOP occurs at Catalina and Ryan Transfer Stations, and the 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 collected while it recycles the oil and antifreeze with Arizona Waste Oil Services Inc. that provides an annual estimate of the amounts recycled (Appendix C).

C. Illicit Discharge Detection and Elimination Activities

PDEQ 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) and enforcement action may include issuance of a Notice of Violation (NOV). NOVs are closed when the pollutant has been abated (Appendix E).

The community filed 1,162 complaints within Pima County's jurisdiction during this fiscal year. Each complaint was inspected and the average time between filing the complaint and the inspection was 2.1 days. The number of inspections performed within three business days was 867 or 75% of all Pima County inspections, missing the goal of initiating 80% of these inspections within three business days. During fiscal year 2016 Pima County transitioned to an enterprise database tracking permits and complaints and invested significant time to verify accuracy and functionality from July 2015 through March 2016, contributing to delays in response time. However the percent of inspections performed within four days was 81%. Some complaints are addressed by sending an information letter, such as how to remove buffelgrass or how to drain a swimming pool properly.

These inspections led to issuance of 355 NOVs. During the fiscal year 314 NOVs were closed or rescinded and 41 NOVs remained open. The open NOVs are either in the process of closing or have entered an escalated enforcement process such as assessment of penalties, referral to the 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 an average closure time of 62 days. Illicit discharges of solid wastes, such as wildcat dumping and improper disposal of solid wastes, comprise 58% of complaints received by PDEQ 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 the dumping of 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 100% of the 40 identified outfalls within the permit area to assess the existence of liquid illicit discharges (Appendix F-1). This activity exceeds 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 (PCDOT) and Regional Wastewater Reclamation Department (RWRD) document when the public spills hazardous materials within the county (Table 2).

Table 2. Spills within Permit Area

Date	Depart-ment	Location	Town-ship-Range-Section	Description	Response
12/14/15	RWRD	100 N Camino Español	14-14-09SW	Transmission fluid leaked from rodder truck onto street and ran north 10'. Spill was contained with dirt.	Absorbent was applied to spill area and swept. Combo unit was used to reclaim.
01/08/16	PCDOT	Houghton Road Yard, 4700 South Houghton Rd, Tucson, AZ	14-15-35	20 gallons of diesel fuel was spilled in the fuel island when a PCDOT truck was fueling	PCDOT Operations hired Southwest Hazard Control to clean spill
4/11/16	RWRD	1291 S Mission Rd	14-13-32NW	High pressure motor oil line busted.	Crews applied dry absorbent and reclaimed

PCDOT = Pima County Department of Transportation
RWRD = Pima County Regional Wastewater Reclamation Department

D. 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 Pollution Prevention Plans 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>
Pima County owns or operates 36 facilities with the potential to discharge pollutants to receiving waters (Appendix G-1). Twenty-three facilities are permitted with ADEQ water permits such as Aquifer Protection Permits (APP) and Arizona Pollutant Discharge Elimination System (AZPDES) permits. Nine unpermitted county facilities have a site specific Pollution Prevention Plan and have been inspected to verify that the plans are being implemented (Appendix G-2). 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.

PDEQ conducted seven county facility inspections during the fiscal year: one was the first inspection and the other 6 were follow-up inspections. PDEQ is working with the site manager of the facility where only the first inspection occurred to update the Pollution Prevention Plan, add spill kits to the site, and add control measures. The follow-up inspections at the six facilities ensured that the pollution prevention plans were current, spill kits were adequate and clearly labeled, and materials were stored in a manner to prevent and reduce spills.

Proper use and storage of chemicals is regulated within Pima County through enforcement of local requirements (environmental nuisance, solid waste, and liquid waste requirements) in accordance with 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

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

Infrastructure Maintenance

Roadways

PCDOT 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

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 PDEQ by fax, phone or e-mail. Additionally, Pima County provided 6 events to train 38 staff members

on technical topics such as construction site inspections, stormwater management for industrial facilities and installation of LID features. PDEQ hosted an Environmental Training Class presented by the Arizona Chapter of the Association of General Contractors on May 11-12, 2016 in Pima County's Water and Energy Sustainability Center for twenty Pima County staff and 5 members of the construction industry.

E. 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 that 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 52 industrial facilities, nine were inspected during this fiscal year (Appendix L-2). All industrial facilities permitted during the last five years were inspected. As Pima County has inspected more than 20% in previous years, 18% were inspected during this year. Additionally, one of the facilities we scheduled to inspect needed to file an NOT for the facility that they had previously occupied.

F. 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.

<u>Plan Reviews</u>
Pima County Development Services Department (DSD) reviews plans before issuing construction permits or building permits. 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). DSD staff inspects the sites to verify the construction is proceeding according to approved plans.

<u>Pima County Permits</u>

Septic Systems
All new septic systems within Pima County 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. Potential surface discharges from a septic system are regulated pursuant to Pima County Code § 7.21.025.A.

Floodplain Use Permit (FLUP)
RFCD issues FLUPs for specific improvements within the regulatory floodplain or erosion hazard area (Appendix N). These 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.

Construction Site Inventory and Inspections
PDEQ 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 129 Notices of Intent (NOI) were inspected during the fiscal year out of a total of 131 active NOIs (Appendix O-1). One high priority site with two NOIs was not inspected during the third quarter of 2015 due to miscommunication with other Pima County staff regarding the project start date. The results of the site inspection reports show the level of consistency with the 2013 CGP as well as compliance with county ordinances (Appendix O-2). The construction inspection reports were found to meet written protocols and industry standards for inspection on construction sites.

Due to the low rate of inspections in the previous fiscal year, many of the construction firms had developed bad habits in their construction management and control measure maintenance. Each construction site with deficiencies was given a minimum of 7 days to take corrective action. The construction site could respond to the inspection report by sending revised SWPPP documentation and photos of corrective action or scheduling a follow-up inspection. If there was no response inspectors conducted follow-up inspections until the site was in full compliance with the Construction General Permit. Once the construction managers recognized that the construction site had to be in compliance, their level of responsiveness increased, as evidenced by the following:

- A decrease in the percentage of construction sites out of compliance after the first inspection,
- A decrease in the number of days for the construction site to attain compliance and
- A decrease in the number of inspections conducted to bring the construction sites into compliance.

For example, during Oct-Dec 2015 a total of 84 NOIs were inspected and 77% were out of compliance after the first inspection. During Jan-Mar 2016, a total of 61 NOIs were inspected and 57% were out of compliance after the first inspection. During April-June 2016 a total of 66 NOIs were inspected and 45% were out of compliance after the first inspection. From October 2015 to July 2016 the rate of NOIs in compliance with the Construction General Permit after the first inspection increased 2.5 times.

The average number of days for a construction site to return to compliance if out of compliance after the first inspection decreased over the year, starting at 15 days during October-December 2015, 12 days in January-March 2016 and 10 days in April-June 2016. During October-December 2015, the number of NOIs requiring a second, third and fourth follow-up inspections were, 22, 3, and 1, respectively. During January-March 2016 only 9 NOIs required second inspections and none required a third or fourth inspection. During April-June 2016, the number of inspections decreased even further, with only 4 NOIs requiring second inspections and none requiring a third or fourth inspection.

From July through December 2015 twelve NOIs were out of compliance longer than 30 days. The corrective actions for three NOIs could not be completed within 30 days due to weather conditions. Eight NOIs showed continued progress coming into compliance over a period of up to 43 days. One NOI was referred to ADEQ after three inspections had been completed. None of the NOIs were out of compliance longer than 30 days from January through June 2016.

G. Post-Construction Inspections

After construction has been completed, an inspection is performed to track the effectiveness of the new construction and whether 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, some inspections were delayed during the first quarter. Some post-construction inspections were not completed because there was active construction under a different NOI at the same site where the NOT had been filed. The completion of the project is determined by the date which the Notice of Termination (NOT) is submitted to ADEQ. 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 will not cause an environmental nuisance, proper disposal of used oil and the removal of construction debris and temporary stormwater controls have been achieved.

H. Non-filer Reporting

Pima County requests entities to 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 ADEQ's 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, 2015 and June 30, 2016, this occurred twice. An industry in the scrap recycling sector (Sector N) had recently started a business and had not obtained an MSGP. The manager

voluntarily filed the application and received the authorization on July 26, 2016. Another industry in the land transportation and warehousing sector (Sector P) had moved its business to another location and had not renewed the MSGP at the new location. The manager voluntarily filed the application and received the authorization on April 5, 2016.

4. Numeric Summary of Stormwater Management Program Activities

Table 3. 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	10
Literature distributed	18,133	16,841	20,547	24,528	13,018
B. Public Participation (Appendix B & C)					
Adopt-a-Roadway (bags collected)	2,624	3,522	4,898	6099	6200
Household Hazardous Waste Collection (tons)	540	490	440	129	-
ABOP Program (gallons, # batteries)				30,675; 500	24,705;435
C. Illicit Discharge Detection and Elimination Program					
1. County Employee Training					
Training sessions (non-stormwater discharges, IDDE program)	1	1	1	9	2
Employees attending training	15	14	15	14	7
2. Spill Prevention (Appendix D & E)					
County facilities identified with hazardous materials	9	9	9	11	36
Spills in outside areas @ county facilities w/ hazardous materials	0	0	7	0	3
Facility assessments completed	NA	10/28/13	4	17	0
Site Specific Pollution Prevention Plan (date)	11/12/11		12/01/13	06/30/15	NA
Environmental complaints	1,220	1,366	1,185	1,330	1,162
Environmental complaints inspected within 3 days	1,054	1,342	1,287	1,260	867
Notices of Violation for illicit liquid discharges	61	107	59	72	64
Notices of Violation for illicit solid discharges	392	405	406	318	291
Notices of Violation closed for illicit discharges, solid and liquid	425	492	465	374	314
3. Outfall Inspections (Appendix F)					
Outfalls inspected[2]	9	39	39	40	40
Priority Outfalls identified to date	20	39	39	40	40
Priority Outfalls inspected	9	39	39	40	40
Dry weather flows detected	0	0	0	0	1
Dry weather flows investigated	NA	NA	NA	NA	1
Major outfalls sampled during dry weather flows	0	0	0	0	0
Illicit discharges identified	0	0	0	0	0
Illicit discharges eliminated	NA	NA	NA	NA	NA
Amount of stormwater drainage system inspected	53%	100%	100%	100%	100%
Storm drain cross-connection investigations	0	0	0	0	0
Illicit connections detected	0	0	0	0	0
Illicit connections eliminated	NA	NA	NA	NA	NA
Corrective/enforcement actions initiated w/ 60 days of identification	NA	NA	NA	NA	NA
Cases resolved w/ 1 year of original enforcement action (%)	NA	NA	NA	NA	NA
Illicit discharge reports received from public	1,220	1,366	1,185	1,330	1,162
Illicit discharge reports responded to (%)	100%	98%	100%	100%	100%
Responses initiated within three (3) business days of receipt	1,075	1,101	1,276	1,260	867

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	2
Staff trained	15	14	15	8	7
2. Inventory, Map, or Database of County Owned/Operated Facilities					
Facilities on inventory	46	39	39	43	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	150
Miles of MS4 drainage system visually inspected	238	238	238	238	238
Higher Risk county facilities inspected [no high risk, low risk shown]	NA	0	0	15	7
Higher Risk county facilities needing improved stormwater controls "	NA	NA	NA	NA	NA
4. Infrastructure Maintenance					
Linear miles of MS4 drainage system cleaned each year	175	175	175	175	175
Spot litter, debris, weed control (acres)	133.5	243	518	533	701
Number of retention/detention basins cleaned	50	52	53	55	54
Catch basins identified to date [begins FY12/13]	NA	0	953	996	1092
Catch basins cleaned	0	0	0	0	0
Amount of waste collected from catch basin cleaning (tons)	0	0	0	0	0
Roadway surface maintenance (CY)	2,925	504,263	342,090	656,621	88,531
Street and intersection sweeping (miles)	4,208	2,180	2,720	2,740	5,317
Shoulder repair sites (CY)	26,468	24,534	30,391	10,296	31,921
Pothole repair (tons)	10,068	4,896	6,587	9,254	41,890
Sidewalk & curb repair (LF)	3,306	1,355	6,619	1,266	4,269
Roadway grading (miles)	965.35	208	239	35	1,481
Drainageway grading (miles)	0.25	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	1
County staff trained	15	14	15	183	4
Facilities on priority list	49	51	52	51	50
Industrial facilities inspected	10	10	10	12	9
Corrective/enforcement actions initiated on industrial facilities	8	9	9	12	9
Cases resolved w/ 1 year of original enforcement action (%)	1	8	7	0	1
F. Construction Program Activities (Appendix K, M, N & O)					
Training events for county staff (Part 3.A for topics)	1	1	1	5	3
County staff trained	80	14	15	34	27
Construction/grading plans submitted for review	62	53	72	50	62
Construction/grading plans reviewed	27	47	70	50	62
Construction sites inspected	75	123	75	39	129
Corrective/enforcement actions initiated on Construction Sites	16	25	21	29	89
Corrective/enforcement actions resolved on Construction Sites	15	23	15	23	89
Buffer overlay zone plan reviews	4	2	0	50	62

Control Measures (number, unless specified otherwise)	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**
Floodplain Use Permits issued	108	354	319	349	426
Floodplain Use Permit violations	0	0	0	0	8
Open Space land acquisition (acres)	473.03	2,394	57,473	58,124	58,192
Flood-prone Acquisition Program (FLAP) (# of sites)	0	0	13	5	6
Hillside development overlay zone plan reviews	0	2	11	50	62
Hydroseeding and revegetation projects	0	0	14	50	62
Set-back requirements	0	0	36	50	62
Slope stabilization	0	0	68	50	62
G. Post Construction Program Activities (Appendix P)					
Post-construction inspections completed for Post Construction	32	52	35	56	89
Corrective/enforcement actions initiated for Post Construction	0	2	1	4	22

NA - Not applicable

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 sites document 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 parallel the population density, with the Upper Santa Cruz watershed with most at 46%, Brawley watershed at 29%, Rillito watershed at 25% and the Lower Santa Cruz watershed at 0% (Appendix E). PDEQ frequently issues NOVs for solid waste on private property and wildcat dumping on public land in the Upper Santa Cruz watershed and the Brawley watershed. The average annual number of solid waste and wildcat dumping cases is declining by about 21 and 17, respectively.

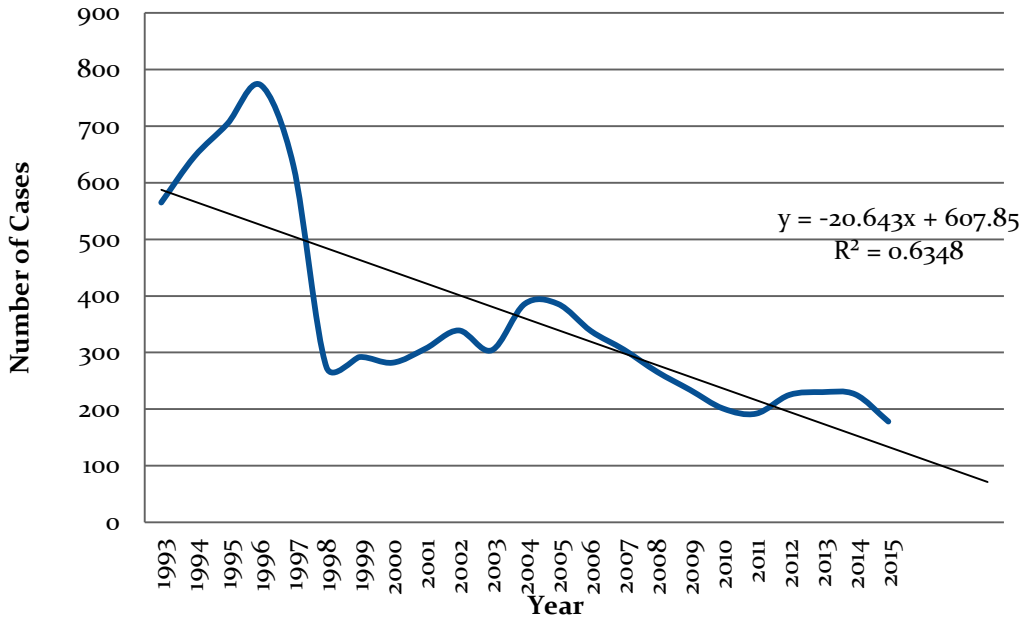


Figure 2. Number of Enforcement Cases for Solid Waste Notices of Violation

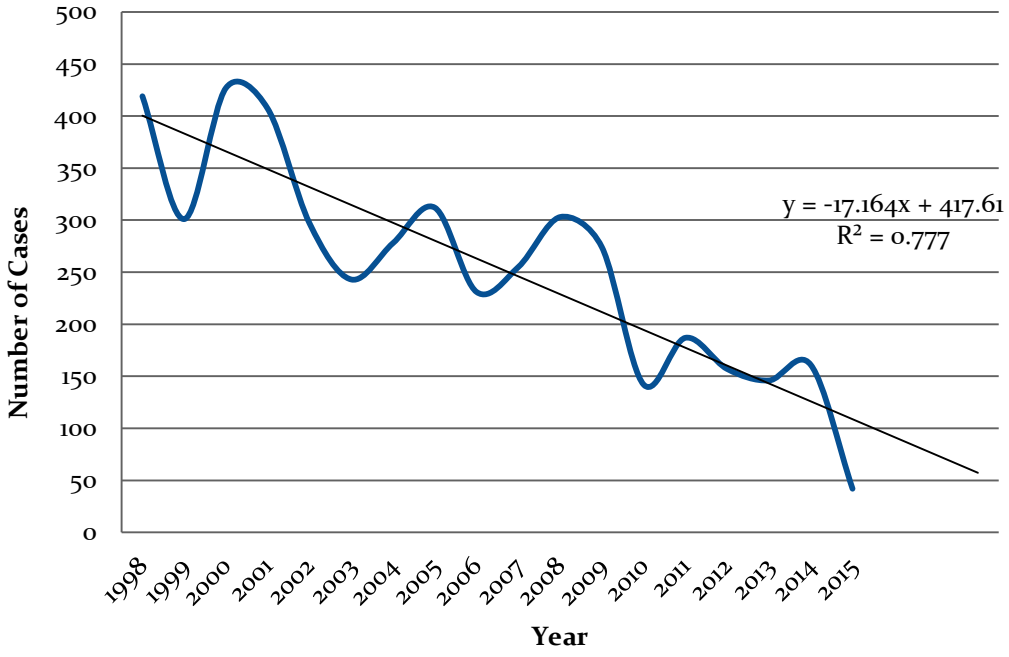


Figure 3. Number of Enforcement Cases for Wildcat Dumping Notices of Violation

2. Evaluate water quality and pollutant loadings by season

Five 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. The monitor sites have three to five summer samples, and three to five winter samples where an early trend could be evident. The data is insufficient at this time to characterize seasonal pollutant loadings.

3. Tracking spills at County Facilities and public areas

County departments report the spills caused by both public and county employees (Table 2). Only three spills occurred this year.

4. **Track drainage cleanup in the same manner as PCDOT tracks roadway cleanup.**

Maintenance of the drainageways has detailed tracking and is reported in Appendix J. The maintenance of retention and detention basins is included in the record.

5. Track training in PDEQ, RWRD, PCDOT, and RFCD.

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

6. 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%

7. Develop outreach program to address elevated copper and E. coli at selected monitor site watersheds.

Development of outreach had been scheduled for the neighborhood runoff collecting at Site #2, Site #4 and Site #5. Priority was given to improving compliance at construction sites and post-construction sites. The outreach activities planned for this year are scheduled to be implemented during fiscal year 2016/2017.

8. Improve compliance activities for construction projects.

Construction managers for non-compliant construction projects took 6 less days to return to compliance and the rate of compliance was 2.5 times greater in the second half of the fiscal year as compared to the first half.

9. Improve compliance at post-construction projects.

The number of post-construction inspections increased by a factor of two between this fiscal year and the average of the preceding four fiscal years. The enforcement rate also increased from zero to 25%. The approach resulted in a preservation of property from the negative impacts of erosion and down-stream deposition of sand and gravel.

Figure 4. Before (left) and after (right) photos of riprap to stabilize channel

A. Evaluation of 2016 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 (December, 2014)
- Stormwater Training Program (December, 2014)
- Template for Pollution Prevention Plan for Pima County Facilities (June 2016)

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 the public were invited to clean up a wash, a TV interview was conducted , two fact sheets and a website article were published.
- 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 on how to properly dispose of trash.
- Water conservation radio program to encourage the public to use stormwater to irrigate native plants in order to save on water utility bills, and potentially reduce electricity bills if the native trees are planted to shade buildings.
- Pima County published the *Low Impact Development and Green Infrastructure Guidance Manual* on March, 2015 describing how stormwater harvesting features can be effective

in the semi-arid climate of Pima County and can be implemented at the neighborhood scale.

- The Pima County Board of Supervisors amended Title 18 (Zoning) of the Pima County Code 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).
- Pima County Regional Flood Control District published the *Design Standards for Stormwater Detention and Retention Basins* in June, 2014 and was approved by the Pima County Board of Supervisors on December 15, 2015. The manual represents a fundamental shift away from conveying runoff to a small number of downstream points through hydraulically efficient infrastructure and toward retaining and using the runoff as close as possible to the source of the runoff for beneficial use.
- The Pima County Subdivision and Development Standards (May, 2016) encourages stormwater harvesting within the right-of-way using the Design Standards for Stormwater Detention and Retention as well as the *Low-Impact Development and Green Infrastructure Guidance Manual*.

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 literature and 13,018 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 May 2016 assessed the public's attitudes toward LID. The information will be used to refine the outreach message to implement the LID Guidance Manual at the neighborhood level.

Public participation included volunteers in Pima County's Adopt-a-Roadway program to clean up roadways and public lands. The program had 359 clean-up events over a total length of 575 roadway miles. Outreach activities reduce the amount of pollutants entering the MS4.

b. Public Reporting and Responses

Pima County received 1,162 complaints from the public and responded to them within an average of 2.1 days. Inspections effectively addressed most of the complaints and 355 resulted in the issuance of a Notice of Violation (NOV). The NOV closure rate of 95% within an average closure period of 62 days, that reduces the amount of pollutants entering stormwater.

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

The Pima County ABOP program collected 24,705 gallons of anti-freeze, oil and paint as well as 435 batteries thus precluding disposal in a landfill or from being dumped in the desert.

d. Infrastructure Maintenance

Roadway maintenance at 12,013 locations removed sediment from streets and repaired roads which stabilized the surface reducing erosion (Appendix I). Drainageway maintenance includes clearing vegetation, mowing, removal of trash, and channel maintenance at 2,013 locations. The infrastructure maintenance reduces the amount of pollutants leaving the permit area.

e. Land conservation

Pima County has invested over $210 million to conserve 58,192 acres thereby preserving the natural landscape and reducing erosion that would contribute pollutants 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 stormwater management program.

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.

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**
   As noted in the previous annual report, the County Facility Inventory was reduced to the facilities confirmed through inspection to those facilities with a potential to discharge pollutants to a receiving water body.

7. Monitor Sites

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.

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 57 rainfall events, of which 14 qualified for stormwater sampling (Table 6). The annual rainfall at the monitor sites ranged from 9.32 to 14.16 inches. Four of the monitor sites received less rainfall than the annual normal rainfall of 11.59 inches. (National Weather Service Forecast Office, Tucson, AZ, 2011).

Seven of the ten wet weather samples were collected during the fiscal year. While there were three qualifying rainfall events for sites 1, 3 and 4 during the winter, samples were not collected. During the first qualifying event there was insufficient staff to collect the sample. During the second qualifying event, sample crews were at other monitor sites collecting samples. During the last qualifying event, 0.32 inches fell over 7.5 hours, resulting in insufficient flow to collect samples.

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	04/12/16	NR	0.04			NR	0.04	NR	0.04		
W	04/10/16	IF	0.32	NR	0.04	IF	0.32	IF	0.32	NR	0.44
W	04/08/16	NR	0.16	-	0.24	NR	0.16	NR	0.16	-	0.28
W	03/08/16			NR	0.16					NR	0.16
W	02/01/16	NR	0.12	NR	0.12	NR	0.12	NR	0.12	-	0.24
W	01/08/16	NR	0.04			NR	0.04	NR	0.04	NR	0.04
W	01/07/16	NR	0.68	NR	1.00	NR	0.68	NR	0.68	NR	0.96
W	01/06/16	NR	0.08	NR	0.04	NR	0.08	NR	0.08		
W	01/04/16	AOS	0.32	**SC**	**0.32**	AOS	0.32	AOS	0.32	**SC**	**0.48**
W	12/14/15	NR	0.20	NR	0.16	NR	0.20	NR	0.20	NR	0.12
W	12/12/15	TD	0.40	TD	0.20	TD	0.40	TD	0.40	TD	0.44
W	12/11/15	NR	0.04	NR	0.04	NR	0.04	NR	0.04	NR	0.08
W	11/16/15	NR	0.08	IF	0.24	NR	0.08	NR	0.08	NR	0.08
W	11/15/15	NR	0.08	NR	0.04	NR	0.08	NR	0.08	NR	0.04
W	11/05/15	NR	0.04			NR	0.04	NR	0.04		
W	11/04/15	NR	0.08	NR	0.04	NR	0.08	NR	0.08		
S	10/30/15	-	0.56	NR	0.12	-	0.56	-	0.56	-	0.20

Season	Date	Site #1	Rainfall (in)	Site #2	Rainfall (in)	Site #3	Rainfall (in)	Site #4	Rainfall (in)	Site #5	Rainfall (in)
S	10/29/15	NR	0.08	NR	0.08	NR	0.08	NR	0.08	NR	0.04
S	10/21/15	-	0.56	-	0.48	-	0.56	-	0.56	NR	0.80
S	10/20/15			NR	0.08					NR	0.20
S	10/17/15	NR	0.28	-	0.80	NR	0.28	NR	0.28	NR	0.56
S	10/16/15	-	0.20	-	0.28	-	0.20	-	0.20	-	0.24
S	10/07/15			NR	0.12						
S	10/06/15	-	0.52	-	0.32	-	0.52	-	0.52	-	0.88
S	09/22/15	NR	0.04			NR	0.04	NR	0.04	NR	0.40
S	09/21/15	**SC**	**0.68**	-	0.84	-	0.68	-	0.68	-	1.16
S	09/15/15									NR	0.04
S	09/14/15	NR	0.04	NR	0.04	NR	0.04	NR	0.04		
S	09/13/15	AOS	0.28	NR	0.04	-	0.28	**SC**	**0.28**		
S	09/10/15	NR	0.16	NR	0.08	NR	0.16	NR	0.16	NR	0.04
S	09/05/15	NR	0.08	NR	0.08	NR	0.08	NR	0.08	NR	0.08
S	09/03/15	NR	0.20	NR	0.24	NR	0.20	NR	0.20	NR	0.24
S	09/01/15	IF	0.28	-	0.28	-	0.28	IF	0.28	-	0.24
S	08/31/15	NR	0.16			NR	0.16	NR	0.16	NR	0.08
S	08/25/15	IF	0.20	-	0.20	-	0.20	IF	0.20	NR	0.04
S	08/24/15	NR	0.04	NR	0.04	NR	0.04	NR	0.04	NR	0.24
S	08/23/15			NR	0.08						
S	08/22/15	NR	0.12			NR	0.12	NR	0.12	-	1.00
S	08/11/15	DC	0.40	-	0.40	-	0.40	DC	0.40	-	0.24
S	08/10/15	NR	0.16			NR	0.16	NR	0.16	NR	0.12
S	08/08/15	NR	0.04	NR	1.00	NR	0.04	NR	0.04	NR	0.08
S	08/07/15	NR	0.16	-	0.20	NR	0.16	NR	0.16	-	0.28
S	08/01/15									-	1.00
S	07/31/15			NR	0.08					NR	0.04
S	07/29/15	NR	0.04	NR	0.04	NR	0.04	NR	0.04	NR	0.12
S	07/28/15	NR	0.08	-	0.20	NR	0.08	NR	0.08	-	1.60
S	07/23/15	NR	0.08	-	0.20	NR	0.08	NR	0.08	NR	0.04
S	07/16/15	IF	0.28	NR	0.04	-	0.28	IF	0.28		
S	07/15/15									NR	0.16
S	07/13/15									**SC**	**0.24**
S	07/12/15	NR	0.04			NR	0.04	NR	0.04		
S	07/05/15	AOS	0.40	**SC**	**1.12**	**SC**	**0.40**	AOS	0.40	NR	0.04
S	06/30/15	NR	0.04	NR	0.16	NR	0.04	NR	0.04	NR	0.04

Season	Date	Site #1	Rainfall (in)	Site #2	Rainfall (in)	Site #3	Rainfall (in)	Site #4	Rainfall (in)	Site #5	Rainfall (in)
S	06/29/15	TD	0.24	NR	0.04	TD	0.24	TD	0.24	NR	0.08
S	06/28/15	NR	0.08			NR	0.08	NR	0.08		
S	06/09/15	NR	0.08	NR	0.12	NR	0.08	NR	0.08	TD	0.24
S	06/05/15	NR	0.04	NR	0.08	NR	0.04	NR	0.04		
Winter total			2.68		2.64		2.68		2.68		3.36
Summer Total			6.64		7.88		6.64		6.64		10.80
Annual total			9.32		10.52		9.32		9.32		14.16

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
IS - Insufficient Sample for analytical method
IF - Insufficient Flow for sample collection
NF - No flow
DC - Dangerous Conditions
TD - Technical Difficulty (Refer to Part 3H for details)
midN - rainfall during midnight hours
AOS - Staff monitoring/collecting data at other site
\- Sample already collected
* - Sample for FY2017

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	09/21/15	Full suite		
2	07/07/15	Full suite	01/04/16	Full suite
3	07/07/15	Full suite		
4	09/13/15	Full suite		
5	07/07/15	Full suite	01/04/16	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 — Volatile 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 Kjeldahl 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

(This page is intentionally left blank).

Table 8. Water Quality Data Monitor Site #1

PARAMETERS	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		**7/4/2011**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/15**		**09/21/15**		**-**	
Conventional Parameters																					
Average Flow Rate[3] (m^3/s)	-		0.0003				0.00044		0.0006				0.0004		0.00155		0.000269		0.0020		
pH	6.5-9.0	6.4	6.4			7.6	7.6	8.1	8.1			6.9	6.9	8	8	7	7	8.6	8.6		
Temperature (°Celcius)	-		29°C				27.5		12.1				15.1		ND		16.1		23.6		
Hardness[4] (mg/L)[5]	-	67	67			30.7	30.7	37.4	37.4			26	26	54.5	54.5	88.9	88.9	58	58		
Total Dissolved Solids (TDS) (mg/L)	-		-				71.4		34.0				72		150		292		94.3		
Total Suspended Solids (TSS) (mg/L)	-		60				35.0		50.0				62		195		334		331		
Biological Oxygen Demand (BOD) (mg/L)	-		-				10.5		5.00				4.9		9.8		3.8		ND		
Chemical Oxygen Demand (COD) (mg/L)	-		-				62		40.0				57		67		88		50		
Inorganics																					
Cyanide, total (ug/L)[6]	84		-				ND		2.98				3.78		2.14		ND		ND		
Nutrients																					
Nitrate + Nitrite as N (mg/L)			-				0.40		0.20				0.17		0.98		0.36		0.1		
Ammonia as N (mg/L)			-				0.58		0.53				0.53		0.66		0.33		0.19		
TKN (mg/L)			-				2.12		1.63				1.41		1.98		0.82		ND		
Total Nitrogen							2.52		1.83				1.58		1.98		1.18		0.10		
Total Phosphorus (mg/L)			-				0.25		0.22				0.15		0.52		0.44		0.33		
Total Orthophosphate (mg/L)			-				0.09		0.07				ND0.50		0.19		0.08		0.04		
Microbiological																					
Escherichia coli (*E. coli*) (CFU/100 mg or MPN)[7]	575		48840				10						10		487		15500		1300		
Total Metals[8]																					
$Antimony_T$ (µg/L)	747		-				0.25		0.21				0.53		0.43		0.55		ND		
$Arsenic_T$ (µg/L)	200		-				1.19		1.87				1.46		2.91		4.49		1.23		
$Barium_T$ (µg/L)	98,000		-				30		67.2				57.6		93.3		189		84.2		
$Beryllium_T$ (µg/L)	1,867		-				ND		0.26				0.23		0.53		1.32		0.52		
$Cadmium_D$ (µg/L)			-			7	ND	9	ND			6	ND	13	ND	20	ND	13	ND		
$Chromium_T$ (µg/L)	1,000		-				ND		1.18				ND		7.2		15.5		2.02		
$Copper_D$ (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	13.92	1.45		
$Lead_D$ (µg/L)		87.90	Trace			36.91	0.24	46.03	0.12			30.62	ND	69.98	ND	119.88	ND	74.96	ND		
$Mercury_T$ (µg/L)	10.00		-				ND		ND				0.32		-		0.082		ND		
$Nickel_D$ (µg/L)		2963.33	-			1531.23	1.72	1809.55	0.72			1330.42	1.01	2488.35	1.03	3764.36	0.58	2622.89	0.21		
$Selenium_T$ (µg/L)	33		-				ND		ND				ND		0.79		0.88		ND		
$Silver_D$ (µg/L)		1.62	-			0.42	ND	0.59	2.66			0.32	ND	1.13	ND	2.63	ND	1.26	ND		
$Thallium_T$ (µg/L)	75		-				ND		ND				ND		ND		0.41		ND		
$Zinc_D$ (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	700.90	1.42		
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-				2.59		10				9.39		7.65		8.35		10.6		
Total Oil & Grease (mg/L)	-		-				3.78		4.89				10.1		11.06		12.59		11.88		
VOCs[9], Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-				ND		-				ND		ND		ND		ND		

PARAMETERS	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		**7/4/2011**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/15**		**09/21/15**		**-**	
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)	6,500.00		-				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		0.39		0.32		
Methyl chloride (µg/L)	-		-				ND						ND		ND		0.3		ND		
Methylene chloride (µg/L)	56,000		-				-		-				-		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)	18,667		-				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		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		ND		

PARAMETERS	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		**7/4/2011**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/15**		**09/21/15**		**-**	
Pentachlorophenol (µg/L)		20.1	-			67.2	ND	111.0	-			33.2	ND	100.4	ND	36.8	ND	183.5	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)	0.20		-				ND1.44		-				ND1.44		ND1.44		ND1.44		ND		
Benzo(a)pyrene (µg/L)	0.20		-				ND1.55		-				ND1.55		ND1.55		ND1.55		ND		
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		ND		
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		-				6.68		ND		ND		ND		
Dimethyl phthalate (µg/L)	-		-				ND		-				ND		ND		ND		ND		
Di-n-butyl phthalate (µg/L)	1,100		-				ND		-				26.6		9.31		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		-				ND2.25		-				ND2.25		ND		ND		ND		
Indeno(1,2,3-cd)pyrene (µg/L)	1.90		-				ND		-				ND		ND		ND		ND		
Isophorone (µg/L)	186,667		-				ND		-				ND		ND		ND		ND		
Naphthalene (µg/L)	18,667		-				ND		-				ND		ND		ND		ND		
Nitrobenzene (µg/L)	467		-				ND4.23		-				ND		ND		ND		ND		
N-nitrosodimethylamine (µg/L)	0.03		-				ND		-				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		0.1		ND		
PCB/Pesticides																					
Aldrin (µg/L)	0.00		-				ND0.10		-				ND0.10		ND0.09		ND0.09		ND		
Alpha-BHC (µg/L)	1,600		-				ND		-				ND		ND		ND		ND		

PARAMETERS	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		**7/4/2011**		**-**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**12/17/15**		**09/21/15**		**-**	
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)	0.00		-				ND0.07		-				ND0.07		ND0.05		ND0.05		ND		
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		ND0.09		ND0.09		ND		
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		ND0.23		ND0.23		ND		
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-				ND0.07		-				ND0.07		ND0.07		ND0.07		ND		
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-				ND0.09		-				ND0.09		ND0.09		ND0.09		ND		
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-				ND0.16		-				ND0.16		ND0.11		ND0.11		ND		
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-				ND0.16		-				ND0.16		ND0.19		ND0.19		ND		
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-				ND0.25		-				ND0.25		ND0.10		ND0.10		ND		
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-				ND0.10		-				ND0.10		ND0.05		ND0.05		ND		
Toxaphene (µg/L)	0.005		-				ND5.08		-				ND5.08		ND0.71		ND0.71		ND		

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. m^3/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-
12 - Refer to Appendix Part 13O for Analytical Laboratory Reports

Table 9. Water Quality Data Monitor Site #2

PARAMETERS	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		-		03/18/12		-		01/26/13		08/22/13		11/22/13		07/05/14		12/13/14		07/05/15		01/04/16	
Conventional Parameters																					
Average Flow Rate[3] (m^3/s)	-				0.0050				0.013		0.040		0.016		0.0065		0.029		0.027		0.016
pH	6.5-9.0			7.5	7.5			8.73	8.73			6.7	6.7	6.4	6.4	6.4	6.4	8.4	8.4	8.0	8.0
Temperature (°Celcius)	-				13.7°C				15.1				13.9		26.9		14.5		26.6		11.8
Hardness4 (mg/L)[5]				50	Trace 50			48.9	48.9	147	147	62.5	62.5	154	154	57.7	57.7	87.2	87.2	82.2	82.2
Total Dissolved Solids (TDS) (mg/L)	-				36				109		126		114		243		127		150		153
Total Suspended Solids (TSS) (mg/L)	-				40.8				45		426		88		316		42		124		100
Biological Oxygen Demand (BOD) (mg/L)	-				19				12.6		12.2		9.3		19		7.6		12.9		14.5
Chemical Oxygen Demand (COD) (mg/L)	-				106				53.0		124		107		132		84		132		93.0
Inorganics																					
Cyanide, total (ug/L)[6]	84T				ND1.7				1.31		1.31		ND1.40		1.73		ND		ND		1.42
Nutrients																					
Nitrate + Nitrite as N (mg/L)					5.3				1.6		2.52		0.96		2.08		3.44		1.64		4.54
Ammonia as N (mg/L)					1				0.63		0.98		0.53		1.58		0.39		0.61		0.63
TKN (mg/L)					2.8				1.88		2.83		1.97		4.24		1.56		1.69		1.90
Total Nitrogen					8.1				3.48		5.35		2.93		6.32		5		3.33		6.44
Total Phosphorus (mg/L)					T0.06				0.30		0.23		0.49		1.21		0.3		0.67		0.5
Total Orthophosphate (mg/L)					T0.02				0.16		0.98		0.22		0.34		0.11		0.27		0.2
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575				30				4884		19863		4884		24810		14400		14100		12000
Total Metals[8]																					
$Antimony_T$ (µg/L)	747				ND				0.72		1.08		0.85		0.96		0.81		0.57		0.56
$Arsenic_T$ (µg/L)	200				1.3				1.48		4.1		2.11		4.57		1.74		2.05		1.16
$Barium_T$ (µg/L)	98,000				22				38.4		163		83.6		157		58.2		61		53
$Beryllium_T$ (µg/L)	1,867				ND				ND		0.64		0.28		0.88		ND		ND		ND
$Cadmium_D$ (µg/L)				12	ND			11	ND	33	ND	14	ND	35	ND	13	ND	20	15.8	19	ND
$Chromium_T$ (µg/L)	1,000				ND				0.51		1.28		0.67		11.8		3.23		2.21		1.45
$Copper_D$ (µg/L)				12.11	61.00			11.85	6.37	33.44	8.18	14.94	7.45	34.94	14.40	13.85	11.80	20.44	13.00	19.34	8.98
$Lead_D$ (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	117.38	0.73	110.03	0.37
$Mercury_T$ (µg/L)	10.00								ND		ND		ND		ND		ND		ND		ND
$Nickel_D$ (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	3703.37	0.97	3522.91	0.82
$Selenium_T$ (µg/L)	33				ND				ND		0.94		ND		1.36		ND		ND		ND
$Silver_D$ (µg/L)				0.98	ND			0.94	ND	6.24	ND	1.43	ND	6.76	1.14	1.25	ND	2.54	ND	2.30	ND
$Thallium_T$ (µg/L)	75				ND				ND		0.2		ND		0.51		ND		ND		ND
$Zinc_D$ (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	990.16	8.91	941.84	9.09
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-				T0.745				1.12		2.09		8.38		6.98		8		6.24		6.56
Total Oil & Grease (mg/L)	-				T0.829				11.2		3.72		8.08		20.93		13.25		9.06		25.89
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467				ND				ND		ND		ND		ND		ND		ND		ND
Acrylonitrile (µg/L)	37333				ND				ND		ND		ND		ND		ND		ND		ND

PARAMETERS	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		**-**		**03/18/12**		**-**		**01/26/13**		**08/22/13**		**11/22/13**		**07/05/14**		**12/13/14**		**07/05/15**		**01/04/16**	
Benzene (µg/L)	3733				ND				ND		ND		ND		ND		ND		ND		ND
Bromoform (µg/L)	18667				ND				ND		ND		ND		ND		ND		ND		ND
Carbon tetrachloride (µg/L)	1307				ND				ND		ND		ND		ND		ND		ND		ND
Chlorobenzene (µg/L)	18667				ND				ND		ND		ND		ND		ND		ND		ND
Chlorodibromomethane (µg/L)	18667				ND				ND		ND		ND		ND		ND		ND		ND
Chloroethane (µg/L)	-				ND				ND		ND		ND		ND		ND		ND		ND
2-chloroethylvinyl ether (µg/L)	-				ND				ND		ND		ND		ND		ND		ND		ND
Chloroform (µg/L)	9333				ND				ND		ND		ND		ND		ND		ND		ND
Dichlorobromomethane (µg/L)	18667				ND				ND		ND		ND		ND		ND		ND		ND
1,2-dichlorobenzene (µg/L)	5,900				ND				ND		ND		ND		ND		ND		ND		ND
1,3-dichlorobenzene (µg/L)	-				ND				ND		ND		ND		ND		ND		ND		ND
1,4-dichlorobenzene (µg/L)	6,500				ND				ND		ND		ND		ND		ND		ND		ND
1,1-dichloroethane (µg/L)	-				ND				ND		ND		ND		ND		ND		ND		ND
1,2-dichloroethane (µg/L)	186,667				ND				ND		ND		ND		ND		ND		ND		ND
1,1-dichloroethylene (µg/L)	46,667				ND				ND		ND		ND		ND		ND		ND		ND
1,2-dichloropropane (µg/L)	84,000				ND				ND		ND		ND		ND		ND		ND		ND
1,3-dichloropropylene (µg/L)	28,000				ND				ND		ND		ND		ND		ND		ND		ND
Ethylbenzene (µg/L)	93,333				ND				ND		ND		ND		ND		ND		ND		ND
Methyl bromide (µg/L)	1,307				ND				ND		ND		ND		ND		ND		ND		ND
Methyl chloride (µg/L)	-				ND				ND		ND		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		ND		ND		ND
Tetrachloroethylene (µg/L)	9,333				ND				ND		ND		ND		ND		ND		ND		ND
Toluene (µg/L)	373,333				ND				ND		ND		ND		ND		ND		ND		ND
1,2-trans-dichloroethylene (µg/L)	-				ND				ND		ND		ND		ND		ND		ND		ND
1,1,1-trichloroethane (µg/L)	1,866,66				ND				ND		ND		ND		ND		ND		ND		ND
1,1,2-trichloroethane (µg/L)	3,733				ND				ND		ND		ND		ND		ND		ND		ND
Trichloroethylene (µg/L)	280				ND				ND		ND		ND		ND		ND		ND		ND
Trimethylbenzene (µg/L)	-				-				-		-		-		-		-		-		-
Vinyl chloride (µg/L)	2,800				ND				ND		ND		ND		ND		ND		ND		ND
Xylene (µg/L)	186,667				ND				ND		ND		ND		ND		ND		ND		ND
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667				ND				ND		ND		-		ND		ND		ND		ND
2,4-dichlorophenol (µg/L)	2,800				ND				ND		ND		-		ND		ND		ND		ND
2,4-dimethylphenol (µg/L)	18,667				ND				ND		ND		-		ND		ND		ND		ND
4,6-dinitro-o-cresol (µg/L)	3,733				-				-		-		-		ND		ND		ND		ND
2,4-dinitrophenol (µg/L)	1,867				ND				ND		ND		-		ND		ND		ND		ND
2-nitrophenol (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
4-nitrophenol (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
p-chloro-m-cresol (µg/L)	48,000				-				-		-		-		ND		ND		ND		ND
Pentachlorophenol (µg/L)				60.8	ND			209.1	ND	NA	ND	27.2	-	20.1	ND	20.1	ND	150.1	ND	100.4	ND
Phenol (µg/L)	180,000				ND				ND		ND		-		ND		ND		ND		ND

PARAMETERS	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		**-**		**03/18/12**		**-**		**01/26/13**		**08/22/13**		**11/22/13**		**07/05/14**		**12/13/14**		**07/05/15**		**01/04/16**	
2,4,6-trichlorophenol (µg/L)	130				ND				ND		ND		-		ND		ND		ND		ND
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000				ND				ND		ND		-		ND		ND		ND		ND
Acenaphthylene (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
Anthracene (µg/L)	280,000				ND				ND		ND		-		ND		ND		ND		ND
Benzo(a)anthracene (µg/L)	0.2				ND1.44				ND1.44		ND1.44		-		ND1.44		ND1.44		ND1.44		ND1.25
Benzo(a)pyrene (µg/L)	0.2				ND1.55				ND1.55		ND1.55		-		ND1.55		ND1.55		ND1.55		ND1.96
Benzo(b)fluoranthene (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
Benzo(g,h,i)perylene (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
Benzo(k)fluoranthene (µg/L)	1.9				ND2.28				ND2.28		ND2.28		-		ND2.28		ND2.28		ND2.28		ND2.29
Chrysene (µg/L)	19				ND				ND		ND		-		ND		ND		ND		ND
Dibenzo(a,h)anthracene (µg/L)	1.9				ND				ND		ND		-		ND		ND		ND		ND
3,3-dichlorobenzidine (µg/L)	3				ND				ND		ND		-		ND		ND		ND		ND
Diethyl phthalate (µg/L)	746,667				ND				ND		ND		-		ND		13.8		ND		ND
Dimethyl phthalate (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
Di-n-butyl phthalate (µg/L)	1,100				56.79				ND		4.94		-		ND		4.02		ND		ND
2,4-dinitrotoluene (µg/L)	1,867				ND				ND		ND		-		ND		ND		ND		ND
2,6-dinitrotoluene (µg/L)	3,733				ND				ND		ND		-		ND		ND		ND		ND
Di-n-octyl phthalate (µg/L)	373,333				ND				ND		ND		-		ND		ND		ND		ND
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8				ND				ND		ND		-		ND		ND		ND		ND
Fluroranthene (µg/L)	37,333				ND				ND		ND		-		ND		ND		ND		ND
Fluorene (µg/L)	37,333				ND				ND		ND		-		ND		ND		ND		ND
Hexachlorobenzene (µg/L)	747				ND				ND		ND		-		ND		ND		ND		ND
Hexachlorobutadiene (µg/L)	187				ND				ND		ND		-		ND		ND		ND		ND
Hexachlorocyclopentadiene (µg/L)	11,200				ND				ND		ND		-		ND		ND		ND		ND
Hexachloroethane (µg/L)	850				ND				ND		ND		-		ND		ND		ND		ND
Indeno(1,2,3-cd)pyrene (µg/L)	1.9				ND				ND		ND		-		ND2.25		ND2.25		ND2.25		ND2.83
Isophorone (µg/L)	186,667				ND				ND		ND		-		ND		ND		ND		ND
Naphthalene (µg/L)	18,667				ND				ND		ND		-		ND		ND		ND		ND
Nitrobenzene (µg/L)	467				ND				ND		ND		-		ND		ND		ND		ND
N-nitrosodimethylamine (µg/L)	0.03				ND				ND		ND		-		ND4.23		ND4.23		ND4.23		ND2.09
N-nitrosodi-n-propylamine (µg/L)	88,667				ND				ND		ND		-		ND		ND		ND		ND
N-nitrosodiphenylamine (µg/L)	290				ND				ND		ND		-		ND		ND		ND		ND
Phenanthrene (µg/L)	-				ND				ND		ND		-		ND		ND		ND		ND
Pyrene (µg/L)	28,000				ND				ND		ND		-		ND		ND		ND		ND
1,2,4-trichlorobenzene (µg/L)	9,333				ND				ND		ND		-		ND		ND		ND		ND
PCB/Pesticides																					
Aldrin (µg/L)	0.003				ND0.10				ND0.10		ND0.10		-		ND0.09		ND0.09		ND0.09		ND0.09
Alpha-BHC (µg/L)	1,600				ND				ND		ND		-		ND		ND		ND		ND
Beta-BHC (µg/L)	560				ND				ND		ND		-		ND		ND		ND		ND
Gamma-BHC (µg/L)	11				ND				ND		ND		-		ND		ND		ND		ND
Delta-BHC (µg/L)	1600				ND				ND		ND		-		ND		ND		ND		ND

PARAMETERS	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		**-**		**03/18/12**		**-**		**01/26/13**		**08/22/13**		**11/22/13**		**07/05/14**		**12/13/14**		**07/05/15**		**01/04/16**	
Chlordane (µg/L)	3.2				ND				ND		ND		-		ND		ND		ND		ND
4,4'-DDT (µg/L)	1.1				ND				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		ND
Dieldrin (µg/L)	0.003				ND0.07				ND0.07		ND0.07		-		ND0.05		ND0.05		ND0.05		ND0.05
Alpha-endosulfan (µg/L)	3				ND				ND		ND		-		ND		ND		ND		ND
Beta-endosulfan (µg/L)	3				ND				ND		ND		-		ND		ND		ND		ND
Endosulfan sulfate (µg/L)	3				ND				ND		ND		-		ND		ND		ND		ND
Endrin (µg/L)	0.004				ND0.10				ND0.10		ND0.10		-		ND0.09		ND0.09		ND0.09		ND0.09
Endrin aldehyde (µg/L)	0.7				ND				ND		ND		-		ND		ND		ND		ND
Heptachlor (µg/L)	0.9				ND				ND		ND		-		ND		ND		ND		ND
Heptachlor epoxide (µg/L)	0.9				ND				ND		ND		-		ND		ND		ND		ND
PCB-1242 (AROCLOR-1242) (µg/L)	0.001				ND0.10				ND0.10		ND0.10		-		ND0.10		ND0.23		ND0.23		ND0.23
PCB-1254 (AROCLOR-1254) (µg/L)	0.001				ND0.07				ND0.07		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		ND0.09		ND0.09
PCB-1232 (AROCLOR-1232) (µg/L)	0.001				ND0.16				ND0.16		ND0.16		-		ND0.11		ND0.11		ND0.11		ND0.11
PCB-1248 (AROCLOR-1248) (µg/L)	0.001				ND0.16				ND0.16		ND0.16		-		ND0.19		ND0.19		ND0.19		ND0.19
PCB-1260 (AROCLOR-1260) (µg/L)	0.001				ND0.25				ND0.25		ND0.25		-		ND0.10		ND0.10		ND0.10		ND0.10
PCB-1016 (AROCLOR-1016) (µg/L)	0.001				ND0.10				ND0.10		ND0.10		-		ND0.05		ND0.05		ND0.05		ND0.05
Toxaphene (µg/L)	0.005				ND5.08				ND5.08		ND5.08		-		ND0.71		ND0.71		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**		**07/05/15**		**-**	
Conventional Parameters																					
Average Flow Rate[3] (m^3/s)	-		0.4203		0.2280		0.27		0.185				0.200		0.236		0.178		0.182		
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	8.5	8.5		
Temperature (°Celcius)	-		47.4		12.4°C		28.7		13.6				18.7		-		16.5		27.4		
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	28.3	28.3		
Total Dissolved Solids (TDS) (mg/L)	-		-		57		66.0		38				44		42.9		24.3		48		
Total Suspended Solids (TSS) (mg/L)	-		21.5		55		30.0		4.50				18		28		5.5		7.6		
Biological Oxygen Demand (BOD) (mg/L)	-		-		10		8.00		3.00				5.5		12.4		3.4		9.5		
Chemical Oxygen Demand (COD) (mg/L)	-		-		140		72.0		28.0				42		107		35		63		
Inorganics			-																		
Cyanide, total (ug/L)[6]	84T				ND		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		0.33		
Ammonia as N (mg/L)			-		0.5		0.91		0.400				0.49		0.57		0.54		0.66		
TKN (mg/L)			-		1.1		1.61		0.68				1.03		1.52		0.82		0.75		
Total Nitrogen					1.4		2.36		0.88				1.25		2.37		1.02		1.08		
Total Phosphorus (mg/L)			-		T0.06		0.14		ND				0.16		0.17		ND		0.18		
Total Orthophosphate (mg/L)			-		T0.02		0.03		0.04				0.1		0.08		ND		0.09		
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575		7701		10		20		63				100		10		59		78.6		
Total Metals[8]																					
$Antimony_T$ (µg/L)			-		ND		1.23		0.45				0.79		0.83		0.34		0.52		
$Arsenic_T$ (µg/L)			-		1.3		1.19		0.69				0.42		1.07		0.32		0.57		
$Barium_T$ (µg/L)			-		38		29.2		9.33				14		24.2		8.77		13.2		
$Beryllium_T$ (µg/L)			-		ND		ND		ND				ND		ND		ND		ND		
$Cadmium_D$ (µg/L)		12		12	ND	6	ND	3	ND			6	ND	8	ND	6	ND	7	ND		
$Chromium_T$ (µg/L)			-		2.0		ND		1.32				0.49		1.24		0.32		0.81		
$Copper_D$ (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	7.08	8.46		
$Lead_D$ (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	33.68	ND		
$Mercury_T$ (µg/L)			-		ND		ND		ND				0.287		ND		0.044		ND		
$Nickel_D$ (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	1429.33	0.77		
$Selenium_T$ (µg/L)			-		ND		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	0.37	ND		
$Thallium_T$ (µg/L)			-		ND		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	381.60	69.30		
Organic Toxic Pollutants			-																		
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-		3.02		18.0		ND				7.37		9.29		10.8		8.12		
Total Oil & Grease (mg/L)	-		-		86.63		11.60		3.12				9.29		19.88		15.41		14.59		
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	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		07/05/15		-	
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)			-		ND		ND		-				ND		ND		ND		ND		
Methyl chloride (µg/L)	-		-		ND		ND		-				ND		ND		ND		ND		
Methylene chloride (µg/L)			-		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		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		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		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		ND		
Pentachlorophenol (µg/L)			-	54.9	ND	44.9	ND		-			40.6	ND	-	ND	16.5	ND	166.0	ND		
Phenol (µg/L)	180,000		-		ND		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		07/05/15		-	
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		ND		
Benzo(a)pyrene (µg/L)	0.2		-		ND1.55		ND1.55		-				ND1.55		ND1.55		ND1.55		ND		
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		-		ND2.28		ND2.28		-				ND2.28		ND2.28		ND2.28		ND		
Chrysene (µg/L)	19		-		ND		ND		-				ND		ND		ND		ND		
Dibenzo(a,h)anthracene (µg/L)	1.9		-		ND		ND		-				ND		ND		ND		ND		
3,3-dichlorobenzidine (µg/L)	3		-		ND		ND		-				ND		ND		ND		ND		
Diethyl phthalate (µg/L)	746,667		-		ND		ND		-				ND		ND		ND		ND		
Dimethyl phthalate (µg/L)	-		-		ND		ND		-				ND		ND		ND		ND		
Di-n-butyl phthalate (µg/L)	1,100		-		65.86		10.1		-				21.6		ND		ND		ND		
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		-		ND		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		-		ND2.25		ND2.25		-				ND2.25		ND2.25		ND2.25		ND		
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		-		ND1.06		ND4.23		-				ND4.23		ND4.23		ND		ND		
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		-		ND0.1		ND0.10		-				ND0.10		ND0.09		ND0.09		ND		
Alpha-BHC (µg/L)	1,600		-		ND		ND		-				ND		ND		ND		ND		
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)	1600		-		ND		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		07/05/15		-	
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		-		ND0.07		ND0.07		-				ND0.07		ND0.05		ND0.05		ND		
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		-		ND0.10		ND0.10		-				ND0.10		ND0.09		ND0.09		ND		
Endrin aldehyde (µg/L)	0.7		-		ND		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		-		ND0.10		ND0.10		-				ND0.10		ND0.23		ND0.23		ND		
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-		ND0.07		ND0.07		-				ND0.07		ND0.07		ND0.07		ND		
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-		ND0.09		ND0.09		-				ND0.09		ND0.09		ND0.09		ND		
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.11		ND0.11		ND		
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.19		ND0.19		ND		
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-		ND0.25		ND0.25		-				ND0.25		ND0.10		ND0.10		ND		
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-		ND0.10		ND0.10		-				ND0.10		ND0.05		ND0.05		ND		
Toxaphene (µg/L)	0.005		-		ND5.08		ND5.08		-				ND5.08		ND0.71		ND0.71		ND		

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	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		09/27/11		03/18/12		07/15/12		12/14/12		-		11/22/13		08/12/14		01/08/15		09/13/15		-	
Conventional Parameters																					
Average Flow Rate[3] (m^3/s)	-		0.65		0.46		0.202		0.228				0.39		0.97		0.3365		0.505		
pH	6.5-9.0		7.0	7.4	7.4	7.7	7.70	7.75	7.75			6.7	6.7	7.5	7.5	8.5	8.5	7.9	7.9		
Temperature (°Celcius)	-		26.6		11.8°C		27.1		13.9				17		27.4		13.6		28.4		
Hardness[4] (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	38.2	38.2		
Total Dissolved Solids (TDS) (mg/L)	-		-		51		98.6		24.0				114		98		81.4		97.1		
Total Suspended Solids (TSS) (mg/L)	-		44		37.3		12.5		4.50				12		27		33		20		
Biological Oxygen Demand (BOD) (mg/L)	-		-		15		7.6		4.00				7.3				8.9		8.8		
Chemical Oxygen Demand (COD) (mg/L)	-		-		100		35.0		25.0				50				78		81		
Inorganics																					
Cyanide, total (ug/L)[6]	84T		-		ND		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		1.01		
Ammonia as N (mg/L)			-		0.7		0.59		0.35				0.46		0.64		0.67		0.97		
TKN (mg/L)			-		1.4		1.39		0.94				1.43		1.34		1.1		ND		
Total Nitrogen (mg/L)					1.7		2.07		1.64				1.82		1.96		1.44		1.01		
Total Phosphorus (mg/L)			-		T0.06		0.19		0.11				0.1		0.19		0.13		0.13		
Total Orthophosphate (mg/L)			-		T0.02		0.07		0.07				0.09		0.09		0.06		0.04		
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575		12997		697		1789		1850				1178		1850		249		384		
Total Metals[8]																					
$Antimony_T$ (µg/L)	747		-		ND		1.70		0.51				1.46		1.33		1.82		1.48		
$Arsenic_T$ (µg/L)	200		-		1.9		1.41		1.68				1.13		1.35		120		0.95		
$Barium_T$ (µg/L)	98,000		-		29		112		44.9				33.7		32.1		40.3		25.9		
$Beryllium_T$ (µg/L)	1,867		-		ND		ND		ND				ND		ND		ND		ND		
$Cadmium_D$ (µg/L)			-	12	ND	10	ND	21	ND			12	ND	8	ND	9	ND	9	ND		
$Chromium_T$ (µg/L)	1000		-		1.3		0.65		1.14				0.79		1.58		1.9		1.9		
$Copper_D$ (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	9.39	12.60		
$Lead_D$ (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	47.13	0.32		
$Mercury_T$ (µg/L)	10		-		ND		ND		ND				0.185		-		ND		ND		
$Nickel_D$ (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	1842.24	0.92		
$Selenium_T$ (µg/L)	33		-		ND		ND		ND				ND		ND		ND		ND		
$Silver_D$ (µg/L)			-	0.98	ND	0.73	0.24	2.73	0.96			0.98	ND1.0	0.54	ND	0.61	ND	0.61	ND		
$Thallium_T$ (µg/L)	75		-		ND		ND		ND				ND		ND		ND		ND		
$Zinc_D$ (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	492.02	62.00		
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-		3.02		1.40		5.57				6.67		7.53		9.76		7.06		
Total Oil & Grease (mg/L)	-		-		5.47		1.40		8.07				7.07		13.65		14.88		10.12		
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-		ND		ND		-				ND		ND		ND		ND		
Acrylonitrile (µg/L)	37333		-		ND		ND		-				ND		ND		ND		ND		

PARAMETERS	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		**09/27/11**		**03/18/12**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**01/08/15**		**09/13/15**		**-**	
Benzene (µg/L)	3733		-		Trace		ND		-				ND		0.03		ND		ND		
Bromoform (µg/L)	18667		-		ND		ND		-				ND		ND		ND		ND		
Carbon tetrachloride (µg/L)	1307		-		ND		ND		-				ND		ND		ND		ND		
Chlorobenzene (µg/L)	18667		-		ND		ND		-				ND		ND		ND		ND		
Chlorodibromomethane (µg/L)	18667		-		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)	9333		-		ND		ND		-				ND		ND		ND		ND		
Dichlorobromomethane (µg/L)	18667		-		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		-		Trace		ND		-				ND		ND		ND		ND		
Methyl bromide (µg/L)	1,307		-		ND		ND		-				ND		ND		ND		0.21		
Methyl chloride (µg/L)	-		-		ND		ND		-				ND		ND		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		-		1.06		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)	-		-		ND		-		-				-		-		-		-		
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		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		ND		
Pentachlorophenol (µg/L)			-	54.9	ND	74.3	ND		-			27.2	ND	60.8	ND	166.0	ND	90.8	ND		
Phenol (µg/L)	180,000		-		ND		ND		-				ND		ND		ND		ND		

PARAMETERS	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		**09/27/11**		**03/18/12**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**01/08/15**		**09/13/15**		**-**	
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		ND		
Benzo(a)pyrene (µg/L)	0.2		-		ND1.55		ND1.55		-				ND1.55		ND1.55		ND1.55		ND		
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		-		ND2.28		ND2.28		-				ND2.28		ND2.28		ND2.28		ND		
Chrysene (µg/L)	19		-		ND		ND		-				ND		ND		ND		ND		
Dibenzo(a,h)anthracene (µg/L)	1.9		-		ND		ND		-				ND		ND		ND		ND		
3,3-dichlorobenzidine (µg/L)	3		-		ND		ND		-				ND		ND		ND		ND		
Diethyl phthalate (µg/L)	746,667		-		ND		ND		-				ND		ND		ND		ND		
Dimethyl phthalate (µg/L)	-		-		ND		ND		-				ND		ND		ND		ND		
Di-n-butyl phthalate (µg/L)	1,100		-		88.44		17.5		-				25		10.7		2.03		ND		
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		-		ND		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		-		ND2.25		ND2.25		-				ND2.25		ND2.25		ND2.25		ND		
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		-		ND		ND		-				ND4.23		ND4.23		ND4.23		ND		
N-nitrosodi-n-propylamine (µg/L)	88,667		-		ND1.06		ND4.23		-				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		-		0.00		ND		-				ND		ND		ND		ND		
PCB/Pesticides																					
Aldrin (µg/L)	0.003		-		ND0.1		ND0.1		-				ND0.1		ND0.09		ND0.09		ND		
Alpha-BHC (µg/L)	1,600		-		ND		ND		-				ND		ND		ND		ND		
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)	1600		-		ND		ND		-				ND		ND		ND		ND		

PARAMETERS	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		**09/27/11**		**03/18/12**		**07/15/12**		**12/14/12**		**-**		**11/22/13**		**08/12/14**		**01/08/15**		**09/13/15**		**-**	
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		-		ND0.07		ND0.07		-				ND0.07		ND0.05		ND0.05		ND		
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		ND		-				ND		ND		ND0.09		ND		
Endrin aldehyde (µg/L)	0.7		-		ND		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		-		ND0.10		ND0.10		-				ND0.10		ND0.23		ND0.23		ND		
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-		ND0.07		ND0.07		-				ND0.07		ND0.07		ND0.07		ND		
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-		ND0.09		ND0.09		-				ND0.09		ND0.09		ND0.09		ND		
PCB-1232 (AROCLOR-1232) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.11		ND0.11		ND		
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-		ND0.16		ND0.16		-				ND0.16		ND0.19		ND0.19		ND		
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-		ND0.25		ND0.25		-				ND0.25		ND0.10		ND0.10		ND		
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-		ND0.10		ND0.10		-				ND0.10		ND0.05		ND0.05		ND		
Toxaphene (µg/L)	0.005		-		ND5.08		ND5.08		-				ND5.08		ND0.71		ND0.71		ND		

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	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		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14		07/13/15		01/04/16	
Conventional Parameters																					
Average Flow Rate[3] (m^3/s)	-		0.0411		0.0075		0.012		0.0021		0.0206		0.0206		0.0403		0.00508		0.00117		0.0266
pH	6.5-9.0		6.5	8.5	8.5	7.8	7.8	8	8.0	7.6	7.6	6.8	6.8	7.5	7.5	6.8	6.8	8.5	8.5	6.4	6.4
Temperature (°Celcius)	-		28.2		8.5°C		26.4		16.3		27.5		15.4		27.4		14.1		31.7		10.3
Hardness[4] (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	101	101	112	112
Total Dissolved Solids (TDS) (mg/L)	-		-		71		270		139		269		162		620		104		166		121
Total Suspended Solids (TSS) (mg/L)	-		73		110		214		40.0		336		68		1020		35.5		202		203
Biological Oxygen Demand (BOD) (mg/L)	-		-		5		ND		9.60		37.4		11.7		81.7		5.8		28.9		10.7
Chemical Oxygen Demand (COD) (mg/L)	-		-		73		192		46.0		244		65		450		52		205		101
Inorganics																					
Cyanide, total (ug/L)[6]	84T		-		ND		ND		1.10		2.43		ND		2.62		ND		2.37		ND
Nutrients																					
Nitrate + Nitrite as N (mg/L)			-		2.553		2.75		2.3		4.35		1.47		8.31		1.68		1.21		3.25
Ammonia as N (mg/L)			-		ND		0.68		0.36		1.28		0.36		2.04		0.19		1.01		0.22
TKN (mg/L)			-		0.79		3.77		2.45		5.75		1.83		10.9		0.67		3.22		1.81
Total Nitrogen (mg/L)					3.34		6.52		4.75		10.10		3.30		19.21		2.35		4.43		5.06
Total Phosphorus (mg/L)			-		0.43		0.75		0.29		1.02		0.48		2.01		0.19		0.78		0.54
Total Orthophosphate (mg/L)			-		0.12		0.34		0.17		0.45		0.29		0.6		0.1		0.43		0.22
Microbiological																					
Escherichia coli (E. coli) (CFU/100 mg or MPN)[7]	575		>241960		4611		52		4106		11199		3873		181		7270		450		551
Total Metals[8]																					
$Antimony_T$ (µg/L)	747		-		ND		1.73		8.22		2.28		4.5		2.85		0.78		1.66		0.85
$Arsenic_T$ (µg/L)	200		-		ND		3.36		2.15		5.6		3.21		12		1.69		2.82		2.2
$Barium_T$ (µg/L)	98,000		-		76		152		57.9		19.3		81.2		519		53.6		90.2		92.1
$Beryllium_T$ (µg/L)	1,867		-		0.27		0.36		ND		0.39		ND		1.05		ND		ND		ND
$Cadmium_D$ (µg/L)			-	18	1.4	32	0.53	16	ND	20	ND	20	ND	88	ND	13	ND	23	ND	25	ND
$Chromium_T$ (µg/L)	1000		-		6.2		1.66		0.62		1.41		1.38		31		2.92		4.9		2.79
$Copper_D$ (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	23.48	32.90	25.88	23.40
$Lead_D$ (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	137.78	1.78	154.16	0.61
$Mercury_T$ (µg/L)	10		-		ND		ND		ND		ND0.2		0.136		0.272		ND		ND		0.08
$Nickel_D$ (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	4193.50	2.17	4576.77	1.04
$Selenium_T$ (µg/L)	33		-		ND		0.89		ND		0.34		0.82		4.23		ND		2.28		0.85
$Silver_D$ (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	3.27	ND	3.91	ND
$Thallium_T$ (µg/L)	75		-		ND		0.22		ND		0.18		ND		0.4		ND		ND		ND
$Zinc_D$ (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	1121.41	36.20	1224.07	6.52
Organic Toxic Pollutants																					
Total Petroleum Hydrocarbons (TPH) (mg/L)	-		-		Trace		5.56		1.76		2.00		7.88		7.3		11.06		8.59		9.00
Total Oil & Grease (mg/L)	-		-		4.27		7.11		1.76		2.89		10.61		25.23		6.24		11.88		29.56
VOCs9, Semi-VOCs, and Pesticides																					
Acrolein (µg/L)	467		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Acrylonitrile (µg/L)	37,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND

PARAMETERS	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		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14		07/13/15		01/04/16	
Benzene (µg/L)	3,733		-		11		ND		-		ND		ND		0.05		ND		ND		ND
Bromoform (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Carbon tetrachloride (µg/L)	1,307		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Chlorobenzene (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Chlorodibromomethane (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Chloroethane (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
2-chloroethylvinyl ether (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Chloroform (µg/L)	9,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Dichlorobromomethane (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,2-dichlorobenzene (µg/L)	5,900		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,3-dichlorobenzene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		0.11		ND
1,4-dichlorobenzene (µg/L)	6,500		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,1-dichloroethane (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,2-dichloroethane (µg/L)	186,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,1-dichloroethylene (µg/L)	46,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,2-dichloropropane (µg/L)	84,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,3-dichloropropylene (µg/L)	28,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Ethylbenzene (µg/L)	93,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Methyl bromide (µg/L)	1,307		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Methyl chloride (µg/L)	-		-		ND		ND		-		ND		0.11		ND		ND		ND		ND
Methylene chloride (µg/L)	56,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,1,2,2-tetrachloroethane (µg/L)	93,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Tetrachloroethylene (µg/L)	9,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Toluene (µg/L)	373,333		-		ND		ND		-		ND		0.06		0.09		ND		ND		ND
1,2-trans-dichloroethylene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,1,1-trichloroethane (µg/L)	1,866,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,1,2-trichloroethane (µg/L)	3,733		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Trichloroethylene (µg/L)	280		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Trimethylbenzene (µg/L)	-		-		-		-		-		-		-		-		-		-		-
Vinyl chloride (µg/L)	2,800		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Xylene (µg/L)	186,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
SVOCs - Acid Extractables																					
2-chlorophenol (µg/L)	4,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
2,4-dichlorophenol (µg/L)	2,800		-		ND		ND		-		ND		ND		ND		ND		ND		ND
2,4-dimethylphenol (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
4,6-dinitro-o-cresol (µg/L)	3,733		-		-		-		-		-		-		ND		ND		ND		ND
2,4-dinitrophenol (µg/L)	1,867		-		ND		ND		-		ND		ND		ND		ND		ND		ND
2-nitrophenol (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
4-nitrophenol (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
p-chloro-m-cresol (µg/L)	48,000		-		-		-		-		-		-		ND		ND		ND		ND
Pentachlorophenol (µg/L)			-	166.0	ND14.0	82.1	ND		-	67.2	ND	30.1	ND	60.8	ND	30.1	ND	166.0	ND	20.1	ND
Phenol (µg/L)	180,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND

PARAMETERS	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		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14		07/13/15		01/04/16	
2,4,6-trichlorophenol (µg/L)	130		-		ND		ND		-		ND		ND		ND		ND		ND		ND
SVOCs - Bases/Neutrals																					
Acenaphthene (µg/L)	56,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Acenaphthylene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Anthracene (µg/L)	280,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Benzo(a)anthracene (µg/L)	0.2		-		-		ND1.44		-		ND1.44		ND1.44		ND1.44		ND1.44		ND1.44		ND1.25
Benzo(a)pyrene (µg/L)	0.2		-		ND2.2		ND1.55		-		ND1.55		ND1.55		ND1.55		ND1.55		ND1.55		ND1.96
Benzo(b)fluoranthene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Benzo(g,h,i)perylene (µg/L)	-		-		ND		ND		-		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		ND2.28		ND2.29
Chrysene (µg/L)	19		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Dibenzo(a,h)anthracene (µg/L)	1.9		-		ND4.1		ND		-		ND		ND		ND		ND		ND		ND
3,3-dichlorobenzidine (µg/L)	3		-		ND3.1		ND		-		ND		ND		ND		ND		ND		ND
Diethyl phthalate (µg/L)	746,667		-		ND		ND		-		ND		ND		ND		ND		7.09		ND
Dimethyl phthalate (µg/L)	-		-		ND		ND		-		ND		8.7		ND		ND		ND		ND
Di-n-butyl phthalate (µg/L)	1,100		-		ND		14.8		-		ND		ND		ND		1.69		ND		ND
2,4-dinitrotoluene (µg/L)	1,867		-		ND		ND		-		ND		ND		ND		ND		ND		ND
2,6-dinitrotoluene (µg/L)	3,733		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Di-n-octyl phthalate (µg/L)	373,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,2-diphenylhydrazine (as azobenzene) (µg/L)	1.8		-		ND2.2		ND		-		ND		ND		ND		ND		ND		ND
Fluroranthene (µg/L)	37,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Fluorene (µg/L)	37,333		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Hexachlorobenzene (µg/L)	747		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Hexachlorobutadiene (µg/L)	187		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Hexachlorocyclopentadiene (µg/L)	11,200		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Hexachloroethane (µg/L)	850		-		ND		ND		-		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		ND2.25		ND2.83
Isophorone (µg/L)	186,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Naphthalene (µg/L)	18,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Nitrobenzene (µg/L)	467		-		ND		ND		-		ND		ND		ND		ND		ND		ND
N-nitrosodimethylamine (µg/L)	0.03		-		ND5.7		ND4.23		-		ND4.23		ND4.23		ND4.23		-		ND4.23		ND2.09
N-nitrosodi-n-propylamine (µg/L)	88,667		-		ND		ND		-		ND		ND		ND		ND		ND		ND
N-nitrosodiphenylamine (µg/L)	290		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Phenanthrene (µg/L)	-		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Pyrene (µg/L)	28,000		-		ND		ND		-		ND		ND		ND		ND		ND		ND
1,2,4-trichlorobenzene (µg/L)	9,333		-		ND		ND		-		ND		ND		ND		ND		0.12		ND
PCB/Pesticides																					
Aldrin (µg/L)	0.003		-		ND0.14		ND0.10		-		ND0.10		ND0.10		ND0.09		ND0.09		ND0.09		ND0.09
Alpha-BHC (µg/L)	1,600		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Beta-BHC (µg/L)	560		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Gamma-BHC (µg/L)	11		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Delta-BHC (µg/L)	1600		-		ND		ND		-		ND		ND		ND		ND		ND		ND

PARAMETERS	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		07/04/11		12/03/11		07/04/12		01/26/13		07/05/13		11/22/13		07/05/14		12/13/14		07/13/15		01/04/16	
Chlordane (µg/L)	3.2		-		ND		ND		-		ND		ND		ND		ND		ND		ND
4,4'-DDT (µg/L)	1.1		-		ND		ND		-		ND		ND		ND		ND		ND		ND
4,4'-DDE (µg/L)	1.1		ND		ND		ND		-		ND		ND		ND		ND		ND		ND
4,4'-DDD (µg/L)	1.1		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Dieldrin (µg/L)	0.003		-		ND0.13		ND0.07		-		ND0.07		ND0.07		ND0.05		ND0.05		ND0.05		ND0.05
Alpha-endosulfan (µg/L)	3		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Beta-endosulfan (µg/L)	3		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Endosulfan sulfate (µg/L)	3		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Endrin (µg/L)	0.004		-		ND		ND0.10		-		ND0.10		ND0.10		ND0.09		ND0.09		ND0.09		ND0.09
Endrin aldehyde (µg/L)	0.7		-		0.34		ND		-		ND		ND		ND		ND		ND		ND
Heptachlor (µg/L)	0.9		-		ND		ND		-		ND		ND		ND		ND		ND		ND
Heptachlor epoxide (µg/L)	0.9		-		ND		ND		-		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		ND0.23		ND0.23
PCB-1254 (AROCLOR-1254) (µg/L)	0.001		-		ND5.6		ND0.07		-		ND0.07		ND0.07		ND0.19		ND0.07		ND0.07		ND0.07
PCB-1221 (AROCLOR-1221) (µg/L)	0.001		-		ND4.0		ND0.09		-		ND0.09		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		ND0.11		ND0.11
PCB-1248 (AROCLOR-1248) (µg/L)	0.001		-		ND3.5		ND0.16		-		ND0.16		ND0.16		ND0.19		ND0.19		ND0.19		ND0.19
PCB-1260 (AROCLOR-1260) (µg/L)	0.001		-		ND2.9		ND0.25		-		ND0.25		ND0.25		ND0.1		ND0.10		ND0.10		ND0.10
PCB-1016 (AROCLOR-1016) (µg/L)	0.001		-		ND3.3		ND0.10		-		ND0.10		ND0.10		ND0.05		ND0.05		ND0.05		ND0.05
Toxaphene (µg/L)	0.005		-		ND10		ND5.08		-		ND5.08		ND5.08		ND0.71		ND0.71		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 fifth of a five year permit. Stormwater from all five sites were sampled in the fiscal year and all five sites were sampled for 133 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 13 through 17, Figures 4 through 8) 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 SWQS 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 Appendix B. Alteration of this method is considered a major modification and may not be performed without permission from ADHS and Region 9 EPA so the analytical methods limit the direct comparison of results to SWQSs. Two VOCs, Diethyl phthalate and Di-n-butyl phthalate, used as plasticizers, were detected at very low concentrations. Given that 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. Elevated dissolved copper concentrations were observed for Sites 3, 4 and 5 and ranged from 8.5 to 32.9 µg/L. Elevated *E. coli* concentrations were observed for Sites #1 and #2 and ranged from 1,300 to 14,100 Most Probable Number. The pH was lower than the SWQS for Site #5. These results are similar to previous years' 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* to illustrate temporal trends.

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

Site ID: 1 Receiving Water: Rillito	FY2011/12 Summer	Winter	FY2012/13 Summer	Winter	FY2013/2014 Summer	Winter	FY2014/15 Summer	Winter	FY2015/16 Summer	Winter
Sample Date	07/04/11	-	07/15/12	12/14/12	-	11/22/13	08/12/14	12/17/14	09/21/15	-
Hardness (mg/L)	67.0	-	30.7	37.4	-	26.0	54.5	88.9	58.0	-
$Copper_{Dissolved}$ SWQS (µg/L)	15.9	-	7.6	9.2	-	6.5	13.1	20.8	13.9	-
$Copper_{Dissolved}$ Result (µg/L)	30.8	-	5.8	3.3	-	4.2	5.3	1.9	1.45	-
Result > SWQS?	Yes	-	No	No	-	No	No	No	No	-
$Silver_{Dissolved}$ SWQS (µg/L)	-	-	0.42	0.59	-	0.32	1.13	2.63	1.26	-
$Silver_{Dissolved}$ Result (µg/L)	-	-	<1	2.66	-	<1	<1	<1	<1	-
Result > SWQS?	-	-	No	Yes	-	No	No	No	No	-
E.coli Result (MPN)	48,840	-	10	-	-	10	487	15,500	1300	-
Result>SWQS?(575 MPN)	Yes	-	No	-	-	No	No	Yes	Yes	-
pH Result (SU)	6.4	-	7.6	8.1	-	6.9	8.0	7.0	8.6	-
Results > SWQS (6.5-9.0)	Yes	-	No	No	-	No	No	No	No	-

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

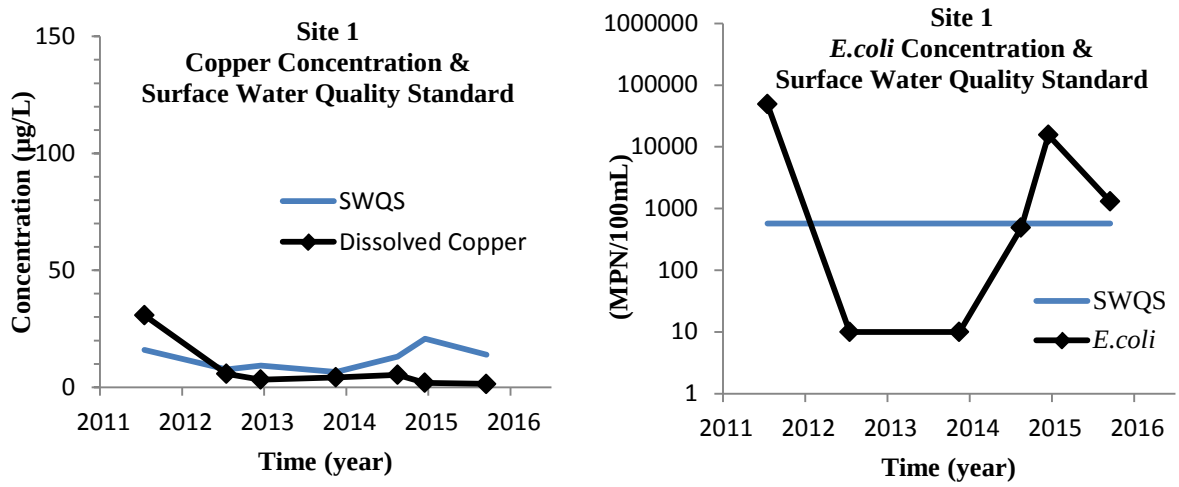


Figure 5. Comparison of Copper and *E. coli* Concentration to SWQS at Site #1

The overall trend for water quality at Site #1, low density residential land use, shows a decrease in copper. *E. coli* concentrations have been below the SWQS and above the SWQS three times. There has been a one-time occurrence of copper, silver and pH that were outside the SWQS. The high *E. coli* concentrations in the last year could be related to improper pet waste management or wildlife waste. The site is next to a wash, which acts as a wildlife corridor. 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	FY2011/12 Summer	FY2011/12 Winter	FY2012/13 Summer	FY2012/13 Winter	FY2013/2014 Summer	FY2013/2014 Winter	FY2014/15 Summer	FY2014/15 Winter	FY2015/16 Summer	FY2015/16 Winter
Sample Date	-	03/18/12	-	01/26/13	08/22/13	11/22/13	07/05/14	12/13/14	07/05/15	01/04/16
Hardness (mg/L)	-	50.0	-	48.9	147.0	62.5	154.0	57.7	87.2	82.2
$Copper_{Dissolved}$ SWQS (µg/L)	-	12.1	-	11.9	33.4	14.9	34.9	13.9	20.4	19.3
$Copper_{Dissolved}$ Result (µg/L)	-	61.0	-	6.4	8.2	7.5	14.4	11.8	13.0	9.0
Result > SWQS?	-	Yes	-	No	No	No	No	No	No	No
$Silver_{Dissolved}$ SWQS (µg/L)	-	1.0	-	0.9	6.2	1.4	6.8	1.3	2.5	2.3
$Silver_{Dissolved}$ Result (µg/L)	-	<1	-	<1	<1	<1	1.14	<1	<1	<1
Result > SWQS?	-	No	-	No	No	No	No	No	No	No
E.coli Result (MPN)	-	30	-	4,884	19,863	4,884	24,810	14,400	14,100	12,000
Result>SWQS?(575 MPN)	-	No	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
pH Result (SU)	-	7.5	-	8.7	-	6.7	6.4	6.4	8.4	8.0
Results > SWQS (6.5-9.0)	-	No	-	No	-	No	Yes	Yes	No	No

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

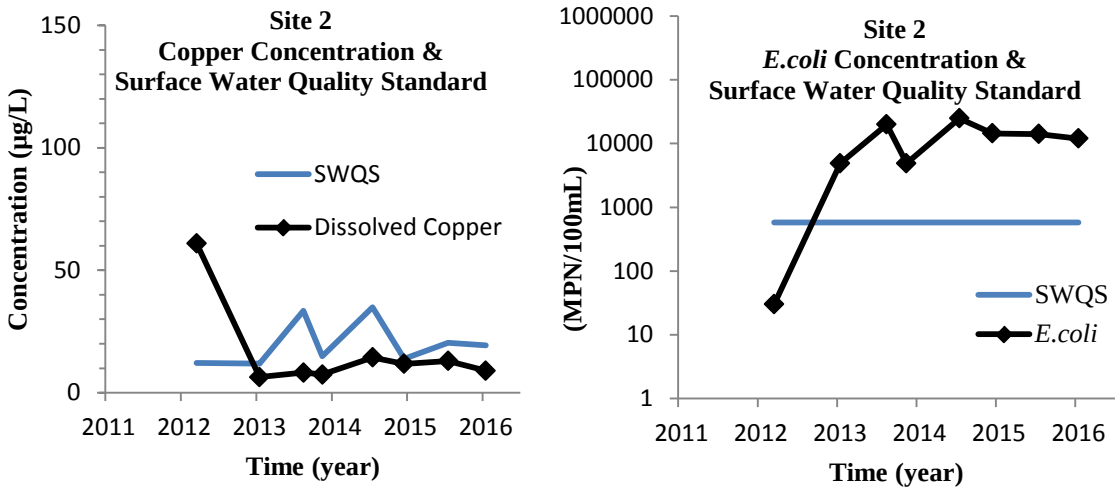


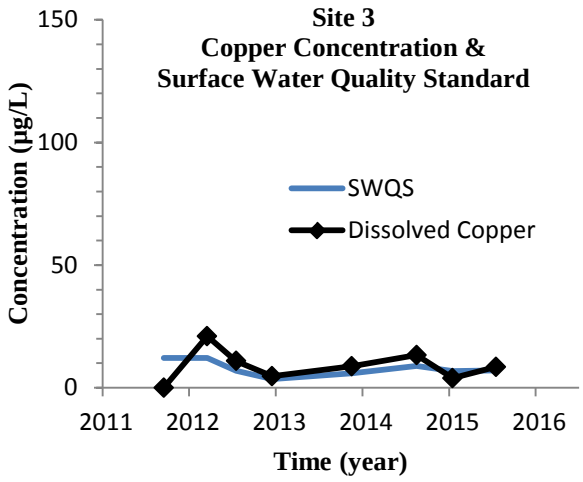
Figure 6. Comparison of Copper and *E. coli* Concentration to SWQS at Site #2

The overall trend for water quality at Site #2, medium density residential land use, 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. c*oli* concentrations could be related to improper pet waste management in the medium density residential neighborhood. An outreach program is being developed to educate the neighborhood. The program will be implemented in FY16/17.

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

Site ID: 3 Receiving Water: Rillito	FY2011/12 Summer	FY2011/12 Winter	FY2012/13 Summer	FY2012/13 Winter	FY2013/14 Summer	FY2013/14 Winter	FY2014/15 Summer	FY2014/15 Winter	FY2015/16 Summer	FY2015/16 Winter
Sample Date	09/10/11	03/18/12	07/20/12	12/14/12	-	11/22/13	08/26/14	01/30/15	07/05/15	-
Hardness (mg/L)	50.0	50.0	27.4	13.4	-	23.5	35.9	27.1	28.3	-
$Copper_{Dissolved}$ SWQS (µg/L)	12.1	12.1	6.9	3.5	-	5.9	8.9	6.8	7.08	-
$Copper_{Dissolved}$ Result (µg/L)	<1	21.0	10.9	4.7	-	8.7	13.3	3.9	8.46	-
Result > SWQS?	No	Yes	Yes	Yes	-	Yes	Yes	No	Yes	-
$Silver_{Dissolved}$ SWQS (µg/L)	-	1.0	0.4	1.0	-	0.3	0.6	0.3	0.4	-
$Silver_{Dissolved}$ Result (µg/L)	-	<1	<1	2.3	-	<1	<1	<1	<1	-
Result > SWQS?	-	No	No	Yes	-	No	No	No	No	-
E.coli Result (MPN)	7,701	10	20	63	-	100	10	59	78.6	-
Result>SWQS?(575 MPN)	Yes	No	No	No	-	No	No	No	No	-
pH Result (SU)	6.3	7.4	7.2	7.5	-	7.1	-	6.2	8.5	-
Results > SWQS (6.5-9.0)	Yes	No	No	No	-	No	-	Yes	No	-

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



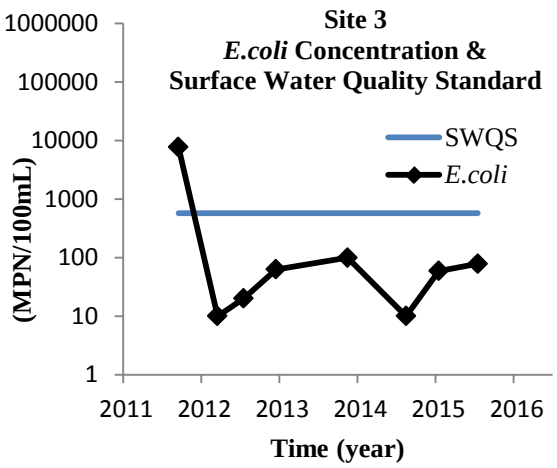


Figure 7. Comparison of Copper and *E. coli* Concentration to SWQS at Site #3

The overall trend for water quality at Site #3, high density residential land use, shows copper concentrations have consistently been slightly higher than the SWQS, with the exception of the 2011 and 2015 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 the pet owner has a pink plastic dog bone as a carrying case for pink plastic bags for disposal of pet waste. The Silver concentration was once above the SWQS and the pH has twice been outside the SWQS range.

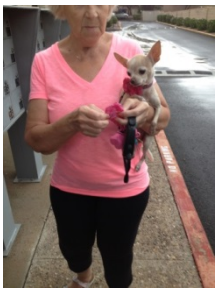


Table 16. Summary of Parameters with Concentrations* Higher than SWQS at Site #4

Site ID: 4 Receiving Water: Rillito	FY2011/12 Summer	FY2011/12 Winter	FY2012/13 Summer	FY2012/13 Winter	FY2013/14 Summer	FY2013/14 Winter	FY2014/15 Summer	FY2014/15 Winter	FY2015/16 Summer	FY2015/16 Winter
Sample Date	09/27/11	03/18/12	07/15/12	12/14/12	-	11/22/13	08/12/14	01/30/15	09/13/15	-
Hardness (mg/L)	54.0	50.0	42.3	90.9	-	50.0	35.4	38.2	38.2	-
$Copper_{Dissolved}$ SWQS (µg/L)	10	12.1	10.3	21.3	-	12.1	8.7	9.4	9.4	-
$Copper_{Dissolved}$ Result (µg/L)	29.6	29.0	12.9	12.7	-	16.0	23.1	9.5	12.6	-
Result > SWQS?	Yes	Yes	Yes	No	-	Yes	Yes	Yes	Yes	-
$Silver_{Dissolved}$ SWQS (µg/L)	-	1	0.7	2.7	-	1	0.5	0.6	0.6	-
$Silver_{Dissolved}$ Result (µg/L)	-	<1	0.2	1.0	-	<1	<1	<1	<1	-
Result > SWQS?	-	No	No	No	-	No	No	No	No	-
E.coli Result (MPN)	12,997	697	1,789	1,850	-	1,178	1,850	249	384	-
Result>SWQS?(575 MPN)	Yes	Yes	Yes	Yes	-	Yes	Yes	No	No	-
pH Result (SU)	7.0	7.4	7.7	7.8	-	6.7	7.5	8.5	7.9	-
Results > SWQS (6.5-9.0)	No	No	No	No	-	No	No	No	No	-

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

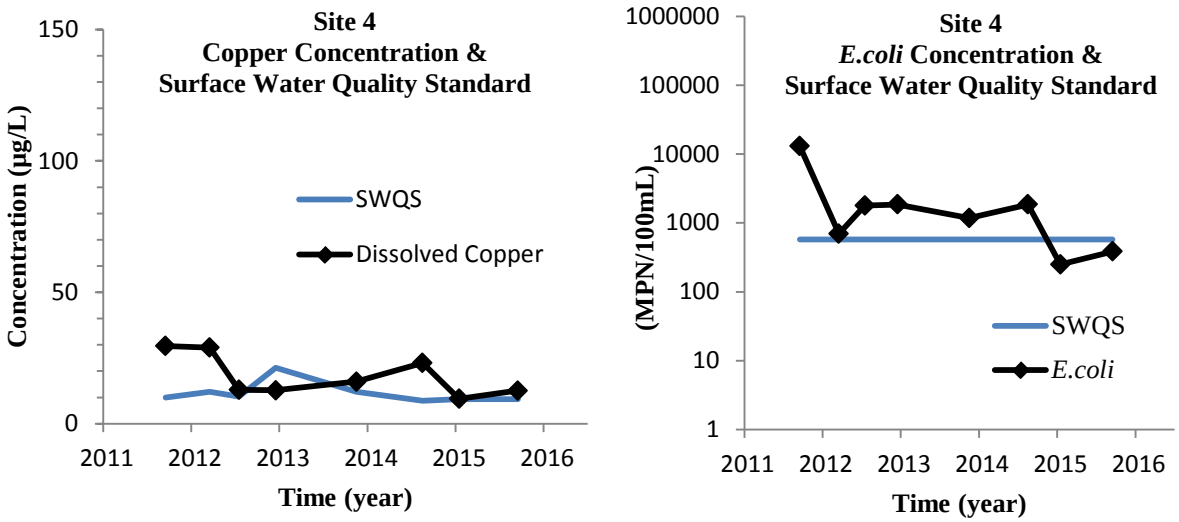


Figure 8. Comparison of Copper and *E. coli* Concentration to SWQS at Site #4

The overall trend for water quality at Site #4, commercial land use, shows copper concentrations have consistently been higher than the SWQS, with the exception of the December 14, 2012 sample. *E. coli* concentrations have decreased and the last two samples were lower 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 is being developed 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 fiscal year 2017.

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

Site ID: 5 Receiving Water: Santa Cruz	**FY2011/12 Summer Winter**		**FY2012/13 Summer Winter**		**FY2013/14 Summer Winter**		**FY2014/15 Summer Winter**		**FY2015/16 Summer Winter**	
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	07/13/15	01/04/16
Hardness (mg/L)	105.0	80.0	143.0	68.7	185.0	86.7	466.0	55.6	101.0	112.0
$Copper_{Dissolved}$ SWQS (µg/L)	24.2	18.9	32.6	16.3	41.5	20.3	85.9	13.4	23.48	25.88
$Copper_{Dissolved}$ Result (µg/L)	35.0	33.0	41.2	19.8	60.2	28.9	132.0	17.1	32.9	23.4
Result > SWQS?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
$Silver_{Dissolved}$ SWQS (µg/L)	-	2.2	6	1.7	9.3	2.5	34.9	1.2	3.3	3.9
$Silver_{Dissolved}$ Result (µg/L)	-	<1	0.8	<1	<1	<1	<1	<1	<1	<1
Result > SWQS?	-	No	No	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	450	551
Result>SWQS?(575 MPN)	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No
pH Result (SU)	6.5	8.5	7.8	8.0	7.6	6.8	7.5	6.8	8.4	6.4
Results > SWQS (6.5-9.0)	No	No	No	No	No	No	No	No	No	Yes

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

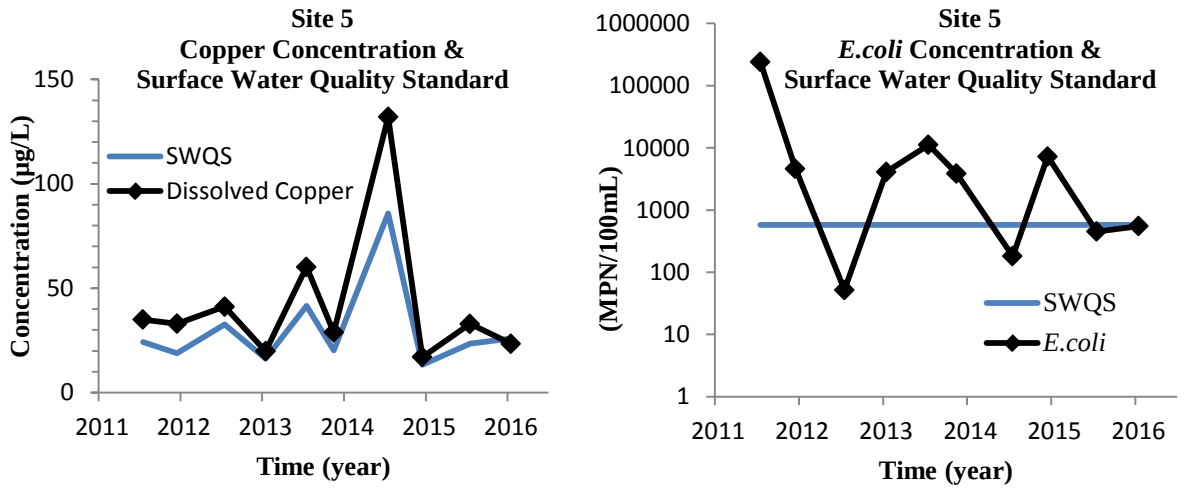


Figure 9. Comparison of Copper and *E. coli* Concentration to SWQS at Site #5

The overall trend for water quality at Site #5, industrial land use, shows that copper has consistently been above the SWQS, with the exception of the winter 2016 sample. The summer 2014 sample was anomalously high for metals and Total Suspended Solids. Summer concentrations are higher than winter samples indicating seasonal influences are important. An assessment will be conducted in fiscal year 2017 to identify businesses likely to contribute 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 be expanded to address pet wastes from guard dogs at businesses. One pH has been outside the SWQS.

A literature review of copper concentration in runoff provides a framework 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 132 µg/L since the July 2011, the permit effective date. During the previous permit the total copper concentrations ranged between 1 and 260 µg/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 132 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 copper as copper 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 to 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.

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 sites 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. The time period employed for this report was both annual and seasonal (winter and summer).

- ***Annual Precipitation***[1] ***(P)*** is the total inches of rainfall occurring during the reporting period July 1, 2015 to June 30, 2016. Analysis 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.

---

[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 that were tabulated (Table 18). No loadings were calculated for 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)	**9.3**		**10.5**		**9.3**		**9.3**		**14.2**	
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)	0.0	0	13.5	53	9.5	7	8.8	189	11.5	276
COD (mg/L)	50.0	17	117.5	457	63.0	48	81.0	1743	105.4	2534
TDS (mg/L)	94.3	31	151.1	588	48.0	36	97.1	2089	122.9	2955
TSS (mg/L)	331.0	110	115.1	448	7.6	6	20.0	430	203.0	4880
Nutrients										
TN (mg/L)	0.1	0.0	4.5	17.5	1.1	0.8	1.0	21.7	5.0	121.0
NH4 (mg/L)	0.19	0.1	0.62	2.4	0.66	0.5	0.97	20.9	0.25	6.1
TKN (mg/L)	0.00	0.0	1.8	6.9	0.8	0.6	0.0	0.0	1.9	44.9
TP (mg/L)	0.33	0.1	0.6	2.4	0.2	0.1	0.1	2.8	0.6	13.2
Total Metals										
Sb (µg/L)	0.00	0.00	0.57	0.00	0.52	0.00	1.48	0.03	0.88	0.02
As (µg/L)	1.23	0.00	1.72	0.01	0.57	0.00	0.95	0.02	2.23	0.05
Ba (µg/L)	84.20	0.03	58.02	0.23	13.20	0.01	25.90	0.56	92.02	2.21
Be (µg/L)	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cd (µg/L)	0.00	0.00	9.92	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Cr (µg/L)	2.02	0.00	1.93	0.01	0.81	0.00	1.90	0.04	2.88	0.07
Cu (µg/L)	1.45	0.00	11.50	0.04	8.46	0.01	12.60	0.27	23.80	0.57
Pb (µg/L)	0.00	0.00	0.60	0.00	0.00	0.00	0.32	0.01	0.66	0.02
Hg (µg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Ni (µg/L)	0.21	0.00	0.91	0.00	0.77	0.00	0.92	0.02	1.09	0.03
Se (µg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.02
Ag (µg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th (µg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zn (µg/L)	1.42	0.00	8.98	0.03	69.30	0.05	62.00	1.33	7.77	0.19
Total		147		1,339		91		4,500		9,900

Relative comparisons can be made between outfalls and parameters. The conventional parameters contribute to 98% or greater of the pollutant load for each catchment. TSS is the largest contributor to pollutant load in the low density residential and industrial watersheds. TDS is the largest contributor to pollutant load in the medium density residential and commercial watersheds. COD is the largest contributor to pollutant load in the high density residential watershed. Nutrients contribute less than 2% 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 18 are pollutant load estimates. Employing event mean concentrations derived from first flush data may result in calculated pollutant load estimates that are higher than 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.

12. Annual Expenditures

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

Activity	Fiscal Year 2015/2016		Fiscal Year 2016/2017	
	Actual Costs	Department Subtotal	Budgeted Costs	Department Subtotal
Environmental Quality		$ 250,435		$ 280,000
AZPDES Stormwater	$ 250,435		$ 280,000	
Regional Flood Control District		$ 8,234,912		$ 9,964,958
Floodplain Permitting (2)	1,416,867		1,629,814	
Development Review	-		-	
Engineering Support (2)	604,274		1,176,292	
Long Range Planning	-		-	
Basin & Drainage Studies (3)	-		-	
FEMA/Mappings (3)	1,115,657		1,256,154	
Drainage Way Maintenance	5,098,114		5,902,698	
Transportation		$11,060,303		$ 11,372,174
Environmental Planning & Compliance	90,265		195,493	
Maintenance Administration	1,005,038		1,108,293	
Maintenance District # 1	1,326,718		1,358,402	
Maintenance District # 4	1,666,546		1,521,304	
Maintenance District # 5	1,726,250		1,696,431	
Maintenance Support	1,873,654		2,238,210	
Contract Maintenance Dist. # 2	1,544,636		1,731,308	
Contract Maintenance Dist. # 3	1,827,196		1,522,733	
Development Services		$ 2,575,773		$ 2,991,802
Regional Comprehensive Plan	-		-	
Landscaping Review	-		-	
Development Review (1)	2,575,773		2,991,802	
Rezoning	-		-	
Regional Wastewater Reclamation		$ 15,000		$ 15,000
Ina Road Laboratory Analysis	15,000		15,000	
Stormwater Program Total	**$22,136,423**	**$22,136,423**	**$24,623,934**	**$ 24,623,934**

(1) Landscaping expenses incorporated.
(2) Plan Reviews and Permit issuance activities are now included in Development Review.
(3) FEMA/Mapping, Basin and Drainage Studies are now budgeted within Planning and Development.

REFERENCES

ADEQ, 2003. Total Maximum Daily Load for Upper Harshaw Creek, Sonoita Creek Basin, Santa Cruz River Watershed. Coronado National Forest, near Patagonia, Santa Cruz County, Arizona, Publication number OFR-07-09.

ADEQ, 2012. 2010 Status of Water Quality, Arizona's Integrated 305(b) Assessment and 303(d) Listing Report. Publication number EQR-12-01.

Agency for Toxic Substances and Disease Registry, 1990. Public Health Statement, Silver, CAS#: 7440-22-4.

Dixon, W. and B. Chiswell. 1996. *Review of Aquatic Monitoring Program Design*. Water Research, vol. 30, no. 9, pp. 1935-1948.

FMR Associates, 2016. *Evaluation of the 2015-2016 Pima County Clean Air Campaign and Clean Water Campaign Survey*, prepared for Pima County Department of Environmental Quality, May 2016.

Michels, H.T., B. Boulanger, N.P Nikolaidis, 2001. Copper Roof Stormwater Runoff – Corrosion and The Environment, downloaded on October 22, 2013 from the Copper Development Association Inc. website at http://www.copper.org/environment/impact/NACE02225/.

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.

Ohrel, Ron. 2002. *Simple and Complex Stormwater Pollutant Load Models Compared*, technical note from Watershed Protection Techniques, 2(2): 364-368. *in*: *The Practice of Watershed Protection*, edited by Thomas R. Schueler and Heather K. Holland, Center for Watershed Protection.

PAG, 2013. Personal communication with Mead Mier, Water Specialist, Cienega Creek Natural Preserve Water Quality Monitoring Laboratory Results.

PDEQ, 2011. 14th Annual Report, National Pollutant Discharge Elimination System Stormwater Discharge Permit No. AZS000002, Pima County, Arizona, October 2011.

Pima County, Arizona, 2011. *Municipal Separate Storm Sewer System AZPDES Permit No. AZS000002.*

Pima County, Arizona. 2012. *Sampling and Analysis Plan for Stormwater Management Program*, Pima County Department of Environmental Quality, pp 9-15.

Pima County, Arizona. 2011. *14th Annual Report for Pima County's National Pollutant Discharge Elimination System [NPDES] Storm Water Discharge Permit No. AZS000002*. Pima County Department of Environmental Quality. September.

Pima County, Arizona, 2011. Code of Ordinances, Title 7, Environmental Quality, http://library.municode.com/index.aspx?clientID=16119&stateID=3&statename=Arizon.

Pima County, Arizona, 2011. *Protecting Our Land, Water and Heritage, Pima County's Voter-supported conservation Efforts*, Pima County Sonoran Conservation Plan. February.

Schiff, Kenneth. 1996. *Review of Existing Stormwater Monitoring Programs for Estimating Bight-Wide Mass Emissions from Urban Runoff*. *in:* Southern California Coastal Water Research Project Annual Report -- 1996, Southern California Coastal Water Research Project.

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

Silverman, Gary S., Michael K. Stenstrom, and Sami Fam. 1986. *Best Management Practices for Controlling Oil and Grease in Urban Stormwater Runoff*. The Environmental Professional, vol. 8, pp. 351-362.

SMRC, 2012. *The Simple Method to Calculate Urban Stormwater Loads*, downloaded on October 1, 2012 from the Stormwater Manager's Resource Center website at http://www.stormwatercenter.net/.

TDC Environmental, 2006. Copper Management Strategy, Development Resources, Final, submitted to Clean Estuary Partnership, prepared by Larry Walker Associates, September, pp. 54.

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.

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.

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