CITY OF OMAHA
NPDES PERMIT FOR THE MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4)
NE0133698
2011 ANNUAL REPORT

Submitted by:
Environmental Quality Division
5600 S. 10 St.
Omaha, NE 68107

April 1, 2012

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Report of Certification

"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 the 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 known violations. See 18 U.S.C. 1001 and 33 U.S.C 1319, and Neb. Rev. Stat. 81-1508 thru 81-1508.02."

Signature of Authorized Representative or Cognizant Official

3/28/12
Date

Marty Grate
Printed Name

ES Manager
Title

Introduction

The second Omaha Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit (NE0133698/PCS 73881-P) was issued by the Nebraska Department of Environmental Quality (NDEQ) and became effective on October 1, 2008. The MS4 permit authorizes the City of Omaha to discharge storm water from all existing City of Omaha owned or operated MS4 outfalls to the Papillion Creek, the Missouri River, and their tributaries subject to the identified limitations and the Storm Water Management Plan (SWMP) as modified. The City's Environmental Quality Control Division (EQCD) oversees the administration of the permit and ensures that the City is in compliance with the permit requirements.

The MS4 permit was issued for a five-year period and expires on September 30, 2013. The MS4 permit identifies the current City of Omaha SWMP. The SWMP requires the City to submit an annual report and a semi-annual progress report to the NDEQ. In addition, reports will be made available to the public on the Papillion Creek Watershed Partnership web site (www.papiopartnership.org).

The City of Omaha Departments that participate in meeting the MS4 permit requirements include:

- Public Works Department
  - Environmental Quality Control Division
  - Street Maintenance Division
  - Sewer Maintenance Division
  - Construction Division
  - Design Division
- Parks, Recreation and Public Property Department
  - Park Maintenance
  - Golf Operations
- Fire Department
- Law Department
- Planning Department

The City is committed to partnering with several organizations to meet the MS4 requirements in the most efficient manner possible. The major partners are listed below. The City intends to continue developing additional partnership throughout the permit cycle to meet the permit requirements.

- Keep Omaha Beautiful (KOB)
- Papillion Creek Watershed Partnership (PCWP)
- Douglas-Sarpy County Extension Office
- Papio-Missouri River Natural Resource District (P-MRNRD)
- Natural Resource Conservation Service (NRCS)

This report satisfies the annual reporting requirement for permit year 3 and covers the calendar year from January 1, 2011 through December 31, 2011

The report is laid out as follows: the program elements are shaded, the permit requirements are underlined, and the City's description of permit compliance is in plain text.

I. Public Education & Outreach

A. Distribute informational brochures on the proper disposal of household hazardous wastes and the availability of the Household Hazardous Waste facility.

The City of Omaha contracted with Keep Omaha Beautiful, Inc. (KOB) to distribute educational information. In the annual report submitted to the City by KOB they reported distributing a total of 4340 brochures at community events throughout the year. The 4340 brochures that were distributed covered 13 different topic areas concerning household hazardous waste. Brochures were delivered to commercial and public locations around the City for distribution. Additionally KOB distributed the brochures at outreach events that they attended. Below is a summarized list of the commercial and public locations where materials were distributed.

Earle May – 90th & Center
Sunrise Nursery – 84th & Fredrick
Kubat Pharmacy – 48th & Center
Kohll's Pharmacy – 55th & L ST
HyVee Pharmacy – 96th & Q ST
Walgreens Pharmacy 24th & Vinton ST
Walgreens Pharmacy 24th & L ST
Auto Zone – 50th & Center
Auto Zone – 4201 N 30th St
Auto Zone 72nd & Redick
O'Reilly Autoparts – 50th & L ST
O'Reilly Auto Parts – 30th & Ames
Ace Hardware – 55th & Center
Westlake Ace Hardware – 50th & G
Elkhorn Ace Hardware – 20277 Wirt St
Tractor Supply – 81st & L ST
Menard's – 750 N 205th St
Lowes – 72nd & Dodge ST
Builder's Supply – 72nd & Main ST
Diamond Vogel Paint – 78th & L ST
Pittsburgh Paints 72nd & L ST
Sherwin Williams – 74th & Cass
Omaha Public Library – Willa Cather Branch
Omaha Public Library – Elkhorn Branch
Omaha Public Library – Millard Branch
Omaha Public Library – South Branch
Omaha Public Library – Washington Branch
Mockingbird Community Center
Our Lady of Guadalupe Education Center

In addition to the distribution of brochures, the City maintains a website www.underthesink.org that presents a variety of information about the site, materials accepted and not accepted, hours of operation, and alternative use products.

In the 2011calendar year UnderTheSink, the household hazardous waste facility, had a total of 12,703 drop offs resulting in a total 884,909 lbs of material, an average of 4,425 lbs/day (of days accepting waste). A total weight of 195,858 lbs of HHW was shipped offsite by our disposal contractor. Those drop-offs and that total weight can be further broken down into:

Recycling Totals in 2011:
- Steel from paint and aerosol cans: 69,480 lbs
- Latex paint used with Posi-Shell at Sarpy County Landfill: 17,985 gal
- Oil-based paint and flammable liquids used as industrial fuel: 13,353 gal
- Antifreeze recycled: 1,100 gal
- Automotive batteries: 12,712 lbs
- Fluorescent bulbs: 5,380 bulbs

Oil Totals in 2011:
- Collected approximately 9,200 gal
- Sold a total of 1,551 gal during the summer to Tri-States Oil Reclaimers, Inc.
- The remaining oil, was/is being burned in the waste-oil boiler

ReStore Totals in 2011:

People who took free useable items for their own use: 7,986 persons
Weight of non-paint items taken: 120,774 lbs
Gallons of free paint taken: 18,347 gal

16 tours were conducted in 2011

This permit requirement continues to be met.

B. Issue public service announcements related to storm water protection on local TV, radio or print outlets, which will address TMDL pollutants of concern.

In addition to the distribution of educational brochures and public outreach events, Keep Omaha Beautiful, Inc. contracted with KFAB, a local radio station, to broadcast 4 public service announcements in May, June and August. In total the PSA's were aired 15 times. For a full accounting see Attachment D.

This permit requirement continues to be met.

C. Continue existing drain marking program to improve public awareness concerning illegal dumping utilizing volunteer services, which will address TMDL pollutants of concern.

Keep Omaha Beautiful, Inc. coordinated 73 people throughout 2011 to mark and clean storm sewer inlets. In total, 1,131 disks were placed and 567 storm grates were cleaned resulting in 101 bags of litter collected.

KOB, Inc also uses a GIS tracking system to better direct the volunteers to areas that have not been marked. The City has approximately 110,000 storm drains, using the GIS system should make tracking those inlets which have been marked or need marking easier to manage.

This permit requirement continues to be met.

D. Hold a Sediment and Erosion Control Seminar for the developers, builders, engineers, vendors, and graders, which will address TMDL pollutants of concern.

The City worked with the P-MRNRD, Douglas-Sarpy County Extension Office, NDEQ, NRCS, PCWP, and USACE to present the annual sediment and erosion control seminar on February 2, 2011. There were 180 people that signed in at the seminar. Topics that were covered included:

- Creating An Environmental Compliance Program That Makes Your Company Money
- Project Inspections Reports and Tracking
- Documentation, Your Life Line When It Comes To Litigation

This permit requirement continues to be met.

E. Schedule outreach events with industry trade organizations to educate the regulated community regarding Omaha's Industrial Permitting Program.

In 2009 the City of Omaha hired an outside consultant, Felsburg Holt & Ullevig (FHU), to aid in implementing the industrial permitting program. A presentation was developed by FHU for the City to use in outreach events. The presentation developed by FHU (slightly altered) was given to the Printing Industry on June 22, 2011 with approximately 10 in attendance (only 2 area printers represented). Additionally the City of Omaha worked with Mint Design Group to develop a general stormwater presentation to use at various outreach events which outlines the City of Omaha's program and how it affects residents, industry, development and government. That presentation was presented to a workgroup of facility managers on March 23rd at the Metropolitan Community College – Fort Omaha Campus. Approximately 20 educators were present. For a full accounting of events see Attachment D.

This permit requirement continues to be met.

F. Work collaboratively with other community organizations to develop a campaign aimed at picking up pet waste which will address TMDL pollutants of concern.

The City of Omaha hired a marketing firm, MINT Design Group, to assist in the development and implementation of a pet waste campaign. Advertisements were developed and published in several area news papers, billboard space was used, mass mailings distributed, theater advertising purchased, posters placed on litter cans, radio announcements broadcast, a television commercial produced, and other media printed. It was a very successful campaign and won the Silver Award in the Total Advertising Campaign category from the Eight Annual Service Industry Advertising Awards. For a full accounting of all Pet Waste awareness information that was distributed see Attachment D.

This permit requirement is on schedule to be met.

G. Develop materials and displays associated with BMP demonstration projects installed with Storm Water Management Program Plan funds from NDEQ.

Educational signage was placed at both the UnderTheSink Facility and Orchard Park accessible by the public. The signage explains the design and function of the BMP's onsite. The green and traditional roofs at the Saddlebrook Joint Use facility have two weather monitoring stations installed. The public can view the differences between the two on two separate screens; one located in the library the other located in the stairwell outside of the indoor track. There are also webcams directed toward the green roof which will also be displayed on the screens. We also have the weather information of the green roof available on our website www.omahastormwater.org.

This permit requirement continues to be met.

H. Develop a City Storm Water Program Web Site, including but not limited to storm water related information and provide educational information targeted for residents, children, and industries, which will address TMDL pollutants of concern.

The City of Omaha has developed and deployed a website, www.omahastormwater.org dedicated to our Stormwater Management Program. From the website industries can access the necessary documents to apply for a permit as well as access resources to help them maintain compliance. Developers and engineers can access the necessary documents to apply for Construction and Post-Construction Stormwater permits.

Residents can access information as to how they can improve water quality by actions they take at home. Children's activities are also available on the website. There is also public information available on the demonstration storm water best management practices that have been implemented in areas of the city. The public can access information related to the monitoring program. Additionally there is an online complaint or comment form available to the public.

There were 3,514 visits and 10,672 page views in 2011, a higher number of visits and page views than the previous year. The three most popular areas in terms of page views were the home page followed by the Forms page and finally the Post Construction page. The City continues to add content to the website and track usage.

This permit requirement continues to be met.

II. Public Participation & Involvement

A. Operate a storm water hotline and web based complaint system for Watershed (general information, complaints, reports of illegal dumping, etc.)

The City of Omaha's Environmental Quality Control Division investigated 39 reports of illegal dumping and/or illicit discharges in 2011. Complaints ranged from excess yardwaste in the street to suspicious discharges into a creek. A table compiling the complaints, investigations and resolutions of these reports can be found in Attachment B.

This permit requirement continues to be met.

B. Participate in organizing to hold open houses on Papillion Creek Watershed Plan activities.

The Papillion Creek Watershed Partnership holds monthly meetings, which are open to the public, to discuss watershed and water quality policies. These meetings have been included in the table of outreach activities conducted in the 2011 calendar year, which can be found in Attachment D.

This permit requirement continues to be met.

C. Continue to implement a stream Cleanup Day. Utilize Keep Omaha Beautiful, Inc. to identify stream segments in need of cleanup and recruit volunteers from the local area, public groups, and representatives from local area business and developments.

Keep Omaha Beautiful, Inc. (KOB) organized the 2011 Stream Clean up day on September 19th. There were a total of 68 participants who collected 80 bags of litter during the day. A total of 148 volunteer hours were logged during this event. The water courses that KOB targeted were; Lake Cunningham, Benson Park Lagoon, Spring Lake and Keith Park

This permit requirement continues to be met.

D. Provide tours of UnderTheSink, household hazardous waste facility for schools and neighborhood organizations to learn about the proper way to manage household chemicals and about storm water treatment systems installed at the site.

A total of 16 tours were conducted at the UnderTheSink Facility in 2011. Stormwater Best Management Practices (BMPs) have also been installed at the facility along with educational signage. The BMPs were complete in the Fall of 2009 and are meant to serve as a demonstration project to the public.

This permit requirement continues to be met.

E. Hold World O! Water Festival focused on elementary school aged children to celebrate Clean Water and engage in water quality related activities.

The World O! Water Festival was held on August 20, 2011 from 12 PM until 4PM at Wehrspann Lake / Chalco Hills Recreation Area. There were over 50 organizations that participated by handing out information, conducting an activity or providing a demonstration. An estimated 1500 visitors attended the event. Information that was handed out included water stewardship, recycling, water quality, and water conservation. Activities included putting "waste in its place", canoe rides, nature hikes, and science experiments. Demonstrations were provided by Wild Life Learning Encounters. This was the 7th successful year the event was held.

This permit requirement continues to be met.

F. Participate in community organizations, conferences workshops, and web casts related to water quality and storm water management.

City of Omaha EQCD staff attended or participated in 42 workshops or webcasts in the 2011 calendar year, additionally one inspector viewed the archived EPA Stormwater Webinars from previous years. The following table is an accounting of the seminars attended.

Date(s)	***Title***	***Associated Program***	***Attendees***
1/12/11	Toolbox Meeting -- Firework Safety	Safety	13
2/2/11	Sediment and Erosion Control Seminar by City of Omaha	Erosion	10
2/2/11	Issues in Transition from Construction to Post Construction Stormwater Management	Erosion	3
2/9/11	Toolbox Meeting -- Hydrogen Sulfide	Safety	14
3/1/11	DOT HazMat Training	HHW	1
3/9/11	Toolbox Meeting -- Slips Trips and Falls	Safety	19
3/10/11	Permeable Pavement Seminar by Pavestone	Stormwater	5
3/11/11	Teledyne ISCO Webinar - How to Efficiently Monitor Your Stormwater Run-Off	Stormwater	2
3/16/11	Teledyne ISCO Webinar - Flow Meter Data: Real or Not?	Stormwater	4
3/17/11	Evening Stormwater Presentation - Bruce Ferguson	Stormwater	4
3/24/11	USGS - Trace Organics in the Environment. Monitoring techniques and should we even care?	Stormwater	1
3/25-26/11	Smoke School	Air	2
3/29/11	MoRiver SWPPP Training. Bill Riley Presentation	Stormwater	17
3/30/11	Innovations in Stormwater Treatment "Minnesota Filter"	Stormwater	1
4/12/11	Sediment & Erosion Control Program Review - Kee Presentation	Erosion	14
4/13/11	Toolbox Meeting -- Ladder Safety	Safety	12
4/13/11	Research & Design of Green Stormwater Management Practices - Bill Hunt	Stormwater	5
4/14/11	In-Stream Monitoring for CSO Program - Kee Presentation	CSO	10
4/20/11	CSO Sampling and E. coli Analysis Training	Stormwater	6
4/20/11	NeFSMA Stormwater Round Table	Stormwater	2
4/20-21/11	Nebraska GIS/LIS Biennial Symposium	GIS	1
4/29/11	MS4Web Training Webinar	Stormwater	2
4/29/11	Research & Design of Green Stormwater Management Practices - Bill Hunt	Stormwater	1

Date(s)	*Title*	*Associated Program*	*Attendees*
5/11/11	40 - HR HazwoperTraining	HHW	3
5/18/11	CWP Ultra Urban Design	Erosion	2
5/25/11	Teledyne ISCO Training on 2105c	Stormwater	6
6/8/11	Toolbox Meeting -- Slips Trips and Falls	Safety	16
8/23/11	Omaha CSO Program: Permitting & Env Compliance Training for Construction	CSO	13
8/24/11	Omaha CSO Program: Permitting & Env Compliance Training for Construction	CSO	1
9/13/11	CSO Program Debrief	CSO	13
9/14/11	Toolbox Meeting	Safety	17
9/15/11	Erosion and Sediment Control for Inspectors -"Recertification"	Erosion	3
9/27/11	Erosion and Sediment Control Basics for Inspectors	Erosion	1
10/1/11	DOT HazMat Training	HHW	1
10/12/11	Toolbox Meeting -- Safet Outside the Workplace	Safety	11
11/9/11	Toolbox Meeting -- Protecting Workers in Cold Environments	Safety	16
11/30/11	Hazwoper Refresher Training (8hr)	HHW	1
12/1/11	Hazwoper Refresher Training (8hr)	HHW	3
12/2/11	Hazwoper Refresher Training (8hr)	HHW	4
12/8/11	Iowa Stormwater Design Training (Comprehensive Stormwater Management)	Stormwater	3
12/13/11	Stormwater Inspection and Maintenance -- ForesterU	Stormwater	9
12/14/11	Toolbox Meeting -- Confined Space and How to protect yourself from a Pandemic	Safety	13

This permit requirement continues to be met.

III. Illicit Discharge Detection & Elimination

A. Perform dry-weather inspections including Physical Characteristics Examinations of storm water outfalls 72" or greater and any outfalls with documented complaints.

The City of Omaha – EQCD contracted with WLA Consulting, Inc. (WLA) to inspect all outfalls identified the previous year as priority outfalls (those 72" or greater and/or documented illicit discharges). WLA completed the inspections in September 2011. Any outfall with an obvious or suspicious discharge was to be reported immediately to EQCD. No discharges were found however a sanitary line break was discovered and reported to NDEQ under a separate permit.

Outfall inspections were only conducted after 48 hours of dry weather. A Physical Characteristics Examination form was completed for each outfall, if flow was present sample was collected for pH testing in the field, if an illicit discharge was encountered EQCD Inspectors were called to investigate. Photographs were taken of outfalls to be kept as a record of outfall conditions during the inspection. Outfall inspections were entered into the City of Omaha's MS4 Web application by WLA. A total of 73 outfalls 72" or with documented complaints were inspected.

This permit requirement continues to be met.

B. Investigate and seek resolution concerning any dry weather discharges potentially impacted by sources by notifying the source that they must discontinue discharging, and initiate enforcement action consistent with adopted ordinance which will address TMDL pollutants of concern. Any source that the applicant feels constitutes and immediate health or safety threat will be reported immediately to the NDEQ.

There were no confirmed illicit discharges from an outfall in during the permit year 2011. However a sanitary line break was reported under a separate NPDES permit as well as a Combined Sewer discharge reported under the CSO Permit held by the City.

This permit requirement continues to be met.

C. Dry Weather inspection of storm water outfalls, including smaller outlets and those that discharge to lesser tributaries or other storm conduits in response to suspect conditions and / or complaints.

There were 268 potential outfalls identified by EQCD using GIS information collected by sewer maintenance in 2009. All outfalls were inspected during dry weather. A total of 73 outfalls have now been identified as priority outfalls.

Two outfalls that were inspected by EQCD Staff were suspected to have an illicit discharge. One of the outfalls had sanitary waste from a connection that was missed during a sewer separation; Sewer Maintenance was contacted immediately and the connection was removed. The second instance was not coming from the outfall being inspected; rather it was a sanitary line break in the creek to the east and downstream of the outfall. Sewer Maintenance was notified immediately and the line was repaired.

This permit requirement continues to be met.

D. Enforce Existing City Codes prohibiting illicit discharge connections to storm sewers.

A total of 39 code enforcement actions were taken in 2011. Most actions were "Requests for Voluntary Compliance". There were no fines levied or collected in 2011. A table summarizing the year's activities can be found in Attachment B.

This permit requirement continues to be met.

E. Maintain and prevent instances of sanitary sewer leakage into MS4 or waters of the state.

The Sewer Maintenance Division is responsible for preventing sanitary seepage into the storm sewer. They perform preventive and corrective maintenance to the system and are able to identify areas where seepage is occurring. Because of the way the MS4 system is designed, sanitary seepage to the MS4 is an extremely rare event. Storm water pipes are not located immediately below the sanitary line; they are almost always installed on the other side of the street or parallel to the sanitary line. There was one instance of illicit connection to the storm sewer found in 2011. The connection was reported to NDEQ and removed..

This permit requirement continues to be met.

F. Maintain and update a sewer map of major storm water outfalls and identify the names of respective receiving waters.

The City maintains a GIS mapping application which can be updated in the field using handheld portable GPS units. These units then synchronize the data when they are returned to the office and connected to the GIS mapping application. Additionally the handheld GPS units are used to catalogue and record inspections of outfalls conducted by EQCD. The data from those inspections can be used to enter service requests into Sewer Maintenance's work order tracking software. The outfall data is also used for follow up inspections of potential illicit discharges.

In 2010, EQCD staff used the current GIS data collected by sewer maintenance in 2009 to direct our inspections. Two hundred and sixty eight points were inspected resulting in additional priority outfalls being identified. We are building on a database to better document outfall conditions so that future inspections will be comparative to the past inspections.

In 2011 WLA was contracted to inspect outfalls using the data collected during the inspections that took place in 2010. The data helped to better direct inspection and compare the previous year's condition with the current condition of the outfalls.

This permit requirement continues to be met.

G. Prevent, contain and respond to spills to the MS4. Review, as necessary, interdepartmental SOP's with respects to spills, dumping and illegal disposal that impacts the MS4.

The City of Omaha's Environmental Quality Control Division worked with the Omaha Fire Department (OFD) to develop a policy dealing with spills that the OFD responds to. Previously the OFD would chemically treat a spill to aid in the breaking down of petroleum products. The revised policy requires OFD to spread fly ash over a spill to absorb any petroleum products. They then collect the material and drop it off at one of several locations throughout the City. Each location has a dedicated 55 gallon drum for storage of the waste material. OFD monitors the capacity of the barrels and coordinates disposal with a hazardous materials processing contractor when the barrel is at a predetermined capacity.

The Omaha Fire Department's Hazardous Materials Unit responded to 550 incidents in the 2011 calendar year.

This permit requirement continues to be met.

IV. Construction Site Program

A. Maintain the construction site inspection and reporting web site and continue to make enhancements.
In February of 2009 the City of Omaha released an upgraded version of its sediment and erosion control reporting website. All active sites were transferred to the upgraded system and the City offered training courses to various users and stakeholders. The previous version was PHP based while the new version uses Java language. There is increased functionality and tracking of project activity. Each user is now given a unique id and password to access the system rather than using a firm wide log in. The system is being used by all of the communities within the Papillion Creek Watershed Partnership.

This permit requirement continues to be met.

B. Maintain a construction site inspection program that includes procedures for reporting, resolving deficiencies, and taking appropriate enforcement action consistent with adopted ordinances.
EQCD administers the inspection program for Erosion Control, both within the City of Omaha's jurisdiction as well as the Papillion Creek Watershed Partnership's (PCWP) individual member's jurisdiction. The City's Grading Permit Program requires that the owners of active sites hire an independent inspector to do inspections weekly and after 0.5 inches of rain. In the 2011 calendar year reports were submitted to a website by City Inspectors as well as private firms hired to inspect construction sites as per the NPDES Stormwater Discharges from Construction Sites General Permit. Additionally enforcement actions were entered by City personnel. The table below accounts for the reports submitted for sites within the City of Omaha's jurisdiction.

	City Inspection Reports	Private Inspection Reports
Phase I Sites (>5 acres)	440	2969
Phase II Sites (<5 acres)	360	2240
Total	800	5209

A summary table of enforcements that were taken within the City of Omaha's jurisdiction can be found in Attachment C.

This permit requirement continues to be met.

C. Maintain regulations and design specifications for controlling erosion, sediment loss, and other TMDL pollutants of concern from construction sites that disturb areas of 1 acre or more.
The Omaha Municipal Code Section 32-101 (**Grading Permit Required**) requires owners/operators to obtain a grading permit on sites sufficiently large enough to require an NPDES construction general permit. On March 10, 2003 when the NPDES Phase II regulation became effective the City began enforcing the soil erosion and sediment control measures on sites that disturbed one acre or greater in the City's jurisdictional area, which extends 3 miles beyond City limits in Douglas County. This allows the City to regulate many of the large developments (SIDs) that remain active for years and have a great potential to adversely impact water quality.

The City has incorporated the Sediment and Erosion Control Manual into the Omaha Regional Storm Water Design Manual as Chapter 9. The Omaha Regional Storm Water Design Manual was adopted by the

City of Omaha in April 2006. There were no changes to the Omaha Regional Storm Water Design Manual in 2011.

This permit requirement has been met.

D. Maintain a program for performing review of Grading Permit applications to ensure compliance with applicable regulations and design specifications.

The Public Works Department, Environmental Quality Control Division, reviews the grading permit applications and the associated Storm Water Pollution Prevention Plans (SWPPP). Unless the SWPPP meets the requirements specified in the Omaha Regional Storm Water Design Manual, a grading permit will not be issued. Sites 5 acres or greater are given priority over sites less than 5 acres.

The City of Omaha received 29 permit requests and issued 25 permits for sites greater than 5 acres in the calendar year 2011. There were 51 permit request and 46 permits issued for sites less than 5 acres in size for the calendar year 2011.

This permit requirement continues to be met.

V. Post Construction Runoff Control

A. Develop a guidance document for Post Construction Storm water Management Plan.

The City of Omaha finalized the guidance document titled *City of Omaha Post Construction Stormwater Management Planning Guidance* in July 2009. The document is available on the City's website www.omahastormwater.org. The guidance document was revised in November 2011 to instruct the public to begin using an online document submittal website for Post Construction Stormwater Management Plans. Additionally the document was updated by adding roof drain filters as a BMP.

This permit requirement continues to be met.

B. Participate with other City Departments to prepare an Environmental Element of City of Omaha Master Plan and include applicable storm water management provisions.

The Omaha City Council voted 7-0 to adopt the Environmental Element – a comprehensive environmental vision for the city – as a component of Omaha's master plan Dec. 14, 2010.

The document, developed through a two-year process led by the City of Omaha and Omaha by Design, includes more than 600 recommendations in five sections – the natural environment, urban form and transportation, building construction, resource conservation and community health. Each goal is accompanied by a set of objectives and strategies, and a set of measurements has been developed for each of the five sections.

This permit requirement continues to be met.

C. Develop a database of existing structural BMPs (private and public) that reduce the impact of urbanization on storm water run-off and improve water quality and enhance other amenities and activities such as green space, parks and recreation, urban planning, aesthetics, and public safety.

The City of Omaha reviews proposed post construction storm water BMPs for code compliance, functionality, and manageability. Once the proposed post construction BMP passes the review then a permit is issued which allows construction and implementation to begin. The management plan that is submitted along with the proposed BMP is then attached to the property deed to ensure long term compliance. The City has developed a database, Permix, for tracking purposes and will be integrating the Construction program and Public Improvements into this new database.

A database has been developed to track post construction BMPs within the City of Omaha. Information being entered include; location, ownership, provided capacity, required capacity, contributing drainage area, type of BMP, date of installation and CSO area. Each BMP has the latitude and longitude included so that they can be easily mapped using our GIS.

This permit requirement continues to be met.

D. Inspect annually and maintain (as necessary) City owned storm water BMP structures.

All City owned stormwater BMP structures were inspected for any major maintenance issues in March and October of 2011. A physical characteristics examination form was also completed during the inspection for structures that had flow or were wet. The table below indicates when the inspection occurred as well as any pending maintenance issues.

SITE	INSPECTION DATES	SEDIMENT REMOVAL	TRASH REMOVAL	DEBRIS REMOVAL	MOWING	FERTILIZER	PCE COMPLETE
Storz Expressway (NE)	5/5/2011	Yes	Yes	No	No	No	No
	10/25/2011	Yes	Yes	Yes	Yes	No	Yes
Adams Park Lagoon	5/13/2011	Yes	Yes	No	No	No	Yes
	10/21/2011	No	No	No	No	No	No
Lake James Park	5/5/2011	No	No	No	No	No	No
	10/21/2011	No	No	No	No	No	No
Fontenelle Park Lagoon	5/5/2011	No	Yes	Yes	No	No	Yes
	10/21/2011	No	No	No	No	No	No
Pershing 1.5	5/18/2011	No	No	Yes	No	No	No
	10/25/2011	No	No	Yes	No	No	No
Miller Park	5/18/2011	No	Yes	No	No	No	Yes
	10/25/2011	No	Yes	Yes	No	No	Yes
10th & Nicholas	5/24/2011	No	No	No	No	No	No
	10/24/2011	No	No	No	No	No	No
Storz Expressway (SE)	5/24/2011	Yes	Yes	Yes	No	No	Yes
	10/24/2011	Yes	Yes	No	No	No	No
13th & Carter Blvd	5/19/2011	Yes	Yes	Yes	No	No	Yes
	10/24/2011	Yes	Yes	Yes	No	No	Yes
13 & Fowler	5/19/2011	Yes	Yes	Yes	No	No	Yes
	10/24/2011	No	Yes	Yes	No	No	Yes
Carter Lake							
	10/26/2011	Yes	Yes	Yes	No	No	Yes
19 & Carter Blvd	5/20/2011	Yes	Yes	Yes	No	No	No
	10/24/2011	No	No	No	No	No	No
18th Street E & Ave H	5/20/2011	Yes	Yes	Yes	Yes	No	No
	10/21/2011	No	Yes	No	Yes	No	No
14th & Ida St	5/5/2011	No	Yes	Yes	No	No	No
	10/24/2011	No	No	No	No	No	No
John J. Pershing No. 1	5/10/2011	No	Yes	Yes	Yes	No	No
	10/25/2011	No	No	No	Yes	No	No
John J. Pershing No. 2	5/16/2011	No	Yes	Yes	No	No	No
	10/25/2011	No	No	No	No	No	No
Gifford Dr No. 1	5/24/2011	No	No	No	No	No	No
	10/21/2011	No	No	No	No	No	No

This permit requirement continues to be met.

E. Revise storm water BMP maintenance and inspection plan as needed.

There were two new structures completed in late 2010 at Common Ground, a community center in western Omaha. The two structures were a permeable paving system and a bio-swale. Each feature will be inspected annually at a minimum. All bio-retention gardens are maintained on a Monthly basis at a minimum during the growing season. Maintenance is mostly picking up litter and weeding. No irrigation is required since native grasses are established.

The City also participated in the installation of a swale in the development know as The Colonies in 2011. As with previous BMPs the City will conduct routine inspections better ensure proper function.

This permit requirement continues to be met.

F. Implement strategies, which include a combination of structural and or non-structural BMPs appropriate for the watershed, which will address TMDL pollutants of concern. Evaluate these strategies and implement changes as necessary to improve water quality and address TMDL pollutants of concern.

In addition to the BMP's listed in the previous year's report, the City of Omaha partnered with the Omaha Public Schools to provide the installation and monitoring of four discharge points from the Saddlebrook Joint Use Facility. That facility will have water quality samples taken from traditional design features as well as green design features. Once the data has been collected the City will then do comparative analyses of the traditional versus the green features in terms of volume and pollutant reduction. We hope to have enough data to provide a better understanding of how well BMP's can reduce pollutants of concern so as to better promote their use in new and re-development.

Furthermore the City of Omaha hired an intern from UNL's Graduate Studies in Urban Planning to perform an infiltration study at Orchard Park and UnderTheSink to determine how well the gardens at each site were functioning. The results of that study are included in Attachment F.

This permit requirement continues to be met.

VI. Pollution Prevention/Good Housekeeping

A. Maintain Facility Runoff Control Plans (FRCP) for all City maintenance facilities to indentify BMPs implemented. Review FRCP annually and update as necessary. Inspect all facilities annually.

The City of Omaha conducted compliance audits at 11 City Maintenance Facilities where FRCP's had been implemented. One facility scored poorly and needs improvement, and ten facilities scored satisfactory. The scores were based upon the inspection report log kept at the facility. The auditor not only looked to see that inspections were being conducted but that any corrective actions that were noted had been addressed in a timely manner.

The City conducted seven additional facility inspections where no FRCP had been recommended (primarily public parks/golf courses) to perform a "Hot Spot" evaluation. Three of those facilities scored a needs improvement and the remaining four were satisfactory.

A FRCP was developed for 3 City Maintenance Facilities and implemented at those facilities in 2011.

This permit requirement on schedule to be met.

B. Inspect storm sewer conduits, channels and catch basins and remove and properly dispose of sediment and debris as needed to maintain an efficient system within permitted area.

The Sewer Maintenance Division is responsible for the inspecting, cleaning, repairing and maintaining of the storm sewer system. The Street Maintenance Division is responsible for any creek maintenance cleaning or clearing. They use the same work order tracking system to account for their activities. The table below represents both the Sewer Maintenance and Street Maintenance Divisions' storm sewer system activity for the permit year of 2011.

2011 Storm Sewer Maintenance	
Clean inlet	372
Ditch Maintenance/Cleaning	30
Culvert Repair	2
Culvert Cleaning	16
Creek Maintenance	2
Inlet – Inspect/Debris Removal	48
Total Maintenance Activities	470

This permit requirement continues to be met.

C. Training will be provided for employees to prevent pollutant runoff from municipal operations at City maintenance facilities and at field operations.

The City of Omaha employed the services of Felsburg Holt & Ullevig (FHU) to develop a training program targeted toward municipal operations at City maintenance facilities. EQCD held four training sessions in 2011, there were a total of 81 employees in attendance. In an effort to train more employees in 2012 EQCD will be recognizing April as Stormwater Awareness Month and help to coordinate all facilities in their annual training.

This permit requirement continues to be met.

D. Provide for street cleaning in the following areas: Residential, Business, Major Streets, Other areas in conjunction with special projects.

There are approximately 3,660 curb miles within the City of Omaha. In 2011, the City mechanically swept a total of 10,019 curb mile. The table below gives a more detailed accounting of the City's street sweeping activities. The street sweeping operation no longer allows for debris to be separated by areas of the city.

Area of City	Curb Miles Swept	Tons of Debris Removed
Business District & Major Streets	4,678	925
Residential Areas	5,341	5,467
Totals	10,019	6,392

This permit requirement continues to be met.

E. City staff that applies pesticides will be trained in a certification program that complies with FIFRA regulations.

The City has two Divisions within the Parks and Recreation Department that have applicators who are required to be FIFRA certified. There are 39 certified applicators. Six of those applicators were recertified in 2011. All certifications are obtained from the Douglas–Sarpy County Extension Office.

This permit requirement continues to be met.

F. The City will continue to minimize pesticide and fertilizer use on publically maintained properties.

EQCD works with the Parks Department to encourage applicators to minimize pesticide and fertilizer use on publicly maintained properties. Additionally Keep Omaha Beautiful Inc., distributes educational material regarding proper pesticide and fertilizer use at several events they attend, see Attachment D for a full accounting of those events.

This permit requirement continues to be met.

VII. Industrial Facilities

A. Issue City of Omaha Industrial Stormwater Permits. Permits to be issued to specific sectors to maximize effectiveness of education and outreach activities and utilize staff resources efficiently.

The City of Omaha contracted the services of Felsburg Holt & Ullevig to aid in the assessment and prioritization of industries required to obtain stormwater discharge permit coverage. A "Risk Assessment Checklist" was developed using information gathered from an article published in February 2008 in the *Journal of the American Water Resources Association.* The risk assessment allocates points based upon level of exposure to stormwater as well as any pollutants of concern. As more sites are permitted and assessed for stormwater exposure those sectors and/or industries which score high on the risk assessment will be given a priority status and will be inspected on a more frequent basis then those industries which receive a low score. There were 27 permits issued in 2011.

This permit requirement on schedule to be met.

B. Inspect 20% of facilities per year issued City of Omaha Industrial Stormwater Permits, taking appropriate enforcement action consistent with adopted ordinances.

E & A Consulting Group (E&A) was contracted to assist the City in inspecting industrial facilities during this permit year. City staff accompanied E&A while they were conducting inspections on behalf of the City. A total of 34 facilities in Sector AA (Fabricated Metal Products) were inspected for compliance during the calendar year of 2011. The facilities that were inspected are required to submit permit applications to the City of Omaha in order to remain in compliance with Omaha Municipal Code. Most of the facilities were not permitted by the NDEQ and have been informed of their obligation to comply with the NPDES Program. Additionally, there were 8 or 30% of the 26 facilities permitted previous to 2011 were inspected for compliance by the City of Omaha.

This permit requirement continues to be met.

C. Implement a permit tracking system.

The City purchased CBI Systems, Inc MS4Web software which is used to track permitted sites as well as site inspections. Previously purchased software, Cityworks can also be used to schedule regulatory inspections. As the City issues more permits to industries, these programs will become valuable tools in maintaining permit compliance.

This permit requirement continues to be met.

D. Review City of Omaha Industrial Stormwater Permit for consistency with Federal and State NPDES Industrial Stormwater Permit.

The City of Omaha finalized their Industrial Stormwater Permit on April 1, 2009. In drafting the permit the City used language from the most recent EPA Multi-Sector General Permit (MSGP). Most of the content of the EPA's MSGP was adapted into the City's permit.

This permit requirement has been met.

VIII. Storm Water Monitoring Plan

A. Conduct in-stream water quality monitoring of named creeks in the Papillion Creek Watershed. Collect samples from at least 4 sites located in the Papillion Creek Watershed. Samples will be collected from May through August one day a week and analyzed for the following parameters: BOD5, TSS, ammonia nitrogen, nitrate-nitrogen, total nitrogen, soluble and total phosphorus, turbidity, pH, E coli, and Physical Characteristic Examinations. The purpose of the monitoring will be to evaluate the effectiveness of storm water management practices in the City of Omaha as it relates to TMDL pollutants of concern.

The City of Omaha conducted in-stream monitoring once a week beginning on May 11 and concluding on August 17. The data collected has been compiled into Attachment E.

This permit requirement continues to be met.

B. Develop an assessment monitoring plan for demonstration BMPs. Evaluate the effectiveness of the selected BMPs to treat storm water for the TMDL pollutants of concern and other water quality benefits. Consider implementation of refinements to the BMPs, which would improve their effectiveness. One aspect of the monitoring plan will include the collection stream samples on the segment that runs through Orchard Park to establish baseline conditions for BMP assessment purposes. Additionally, the plan will address how the City proposed to use stream samples collected in dry weather and wet weather, as described in A above, to estimate the pollutant masses discharged on an event basis and an annual basis.

The construction of a green roof and a bioretention garden was completed in 2009 at the Saddlebrook Joint Use Facility. The bioretention garden receives runoff from part of the parking area at the facility. Monitoring stations were also installed at the; green roof discharge point, traditional roof discharge point, bioretention garden discharge point and a point of discharge from a parking area without a BMP upstream.

Flow monitoring equipment has been installed at all four sampling sites as well as a rain gauge. The City will use the data gathered from each site to compare the BMP installed to a traditional parking lot and roof. The City can then analyze the effectiveness of each BMP. Data gathered will be published in future annual reports and will be used as outreach in the future.

The City also used the skills of a graduate student at UNL hired as an intern to perform an infiltration study at Orchard Park and UnderTheSink in 2011. A report has been submitted to the City regarding his findings and is attached to this report as Attachment F. The findings will be used to better design future bio-retention gardens so that they can better treat stormwater runoff.

This permit requirement on schedule to be met.

IX. Additional Permit Reporting Requirements

1. Proposed SWMP Changes and Revisions

Attachment A is the SWMP for the City of Omaha; no changes were submitted 2011. The City annexed the following unincorporated areas in August 2011, and would now be considered part of the MS4 Permit coverage area.

Area Description	Population	Sq Miles	Acres
Pacific Meadows 2nd Add.	1023	0.20	125.77
Autumn Ridge	708	0.14	88.80
Hawthorne	864	0.26	165.46
Le Beau West	221	0.03	20.60
Banyan Hills	717	0.12	78.27
Pacific Hollow and Adjacent Areas	798	0.17	107.18
Glenbrook and Adjacent Areas	774	0.23	148.24
Wynnewood 1st Add. and Adjacent Areas	1174	0.14	90.45
Oakbrook Meadows and Oakbrook Meadows 2nd Add.	479	0.09	54.77

2. Expenditures for the Storm Water Program

At the time of preparation of this annual report the City Finance Department had not finalized the accounting for 2011 expenditures, so the following figures are subject to minor revisions. A copy of the complete City of Omaha budget with past expenditures can be found at http://www.ci.omaha.ne.us/departments/finance. Storm water management activities are embedded in variety of City programs and work groups. These activities are funded by a variety of sources including the General Fund, Sewer Revenue Funds, Stormwater Administrative Fee Fund, Street and Highway Allocations, and the Street Maintenance Fund.

As such, it is difficult to accurately compile a comprehensive financial summary of every City activity that may have impacts on stormwater. For example, the City maintains litter cans in business districts throughout the City and has a contractor scheduled to empty them on a regular basis. This activity constitutes a stormwater source control or pollution prevention program. These costs are expended from the Solid Waste budget and are not included in the figures below.

1. Administrative

The Quality Control Division of the Omaha Public Works Department has responsibility for coordinating City activities to implement the SWMP and insure that the City meets its MS4 and CSO permit requirements. The estimated MS4 administrative expenditures for 2011 and appropriated 2012 budget amounts are listed below.

Administrative	2011 Expenditures	2012 Planned
Flood Control Administration	$350,400	$500,942
Baseline/BMP Monitoring[1]	$174,130	$228,964
Sediment/Erosion Control Program	$174,130	$228,964
Industrial Program[2]	$34,826	$45,793
Public Education/Outreach	$127,695	$167,907
MS4 Planning	$69,652	$91,585
Annual Administrative Total	$930,832	$1,264,154

[1] Includes outfall monitoring, outfall inspections, and illicit discharge investigations

[2] Includes industrial inspections and permitting

2. Operation and Maintenance

The major MS4-related Operation and Maintenance 2011 expenditures and budgeted amounts for 2012 are listed below. These amounts were estimated by evaluating the overall activity costs in the City budget organizations and assigning a percentage for the costs attributable to storm water related activities. There are undoubtedly additional City funded expenditures that impact storm water management, and the following is a conservative estimate of total costs for the City.

Operation and Maintenance	2011 Expenditures	2012 Budgeted
Engineering Design	$373,803	$498,320
Pavement Maintenance	$367,717	$1,007,174
Creek/Open Channel Maintenance	$1,285,703	$1,390,478
Street /Right of Way Cleaning	$1,001,627	$3,315,101
OWP (debris removal)	$12,566	$9,135
Residential Street Rehabilitation	$25,000	$145,055
Bridge Maintenance and Rehab	$91,743	$60,000
Sewer Maintenance	$435,828	$493,194
Annual O&M Total	$3,593,987	$6,918,458

ATTACHMENT A

Attachment A

Stormwater Management Plan for the City of Omaha

#1: Public Education & Outreach

BMP #	SWMP Element Description	Measurable Commitments & Implementation Schedule
1.A	Distribute informational brochures on the proper disposal of household hazardous wastes and the availability of the Household Hazardous Waste facility.	Year 1 – 5: Print and distribute brochures. Include the following in Annual Report: • the quantity of waste received at the drop-off facility; • a summary list of the distribution outlets used for brochures; • an estimate of the brochures distributed each year.
1.B	Issue public service announcements related to storm water protection on local TV, radio or print outlets which will address TMDL pollutants of concern.	Year 1 – 5: A summary of the activities will be included in the Annual Report.
1.C	Continue existing drain marking program to improve public awareness concerning illegal dumping utilizing volunteer services (Boy Scouts) which will address TMDL pollutants of concern.	Year 1 – 5: Mark approximately 1,000 inlets annually and include a summary in the Annual Report.
1.D	Hold a Sediment and Erosion Control Seminar for the developers, builders, engineers, vendors, and graders which will address TMDL pollutants of concern.	Year 1 – 5: Annual Sediment and Erosion Control Seminar. Include a summary of the approximate number of participants in Annual Report.
1.E	Schedule outreach events with industry trade organizations to educate the regulated community regarding Omaha's Industrial Permitting Program.	Year 1 – 2: Industrial Permit Outreach. Include a summary of the number of events and approximate number of participants in Annual Report.
1.F	Work collaboratively with other community organizations to develop a campaign aimed at picking up pet waste which will address TMDL pollutants of concern.	Year 1: Develop outreach material and partnerships. Year 2 - 5: Distribute information. Provide an estimate of number of brochures distributed and activities targeted.
1.G	Develop materials and displays associated with BMP demonstration projects installed with Stormwater Management Program Plan funds from NDEQ.	Year 1 -5: Provide a narrative and examples of materials developed in annual report.
1.H	Develop a City Stormwater Program Web Site, including but not limited to storm water related information and provide educational information targeted for residents, children, and industries which will address TMDL pollutants of concern.	Year 1-5: Develop, operate and maintain a City Stormwater Web site. Include a narrative in the Annual Report describing the functions of the website.

 # 2: Public Participation and Involvement

BMP #	SWMP Element Description	Measurable Commitments & Implementation Schedule
2.A	Operate a stormwater hotline and web based complaint system for Watershed (general information, complaints, reports of illegal dumping, etc.).	Years 1 - 5: Maintain system operation and include summary of received calls/emails in the Annual Report.
2.B	Participate in organizing and hold open houses on Papillion Creek Watershed Plan activities.	Years 1 - 5: A summary of activities will be included in the Annual Report.
2.C	Continue to implement a stream Cleanup Day. Utilize Keep Omaha Beautiful to identify stream segments in need of cleanup and recruit volunteers from the local area, public groups, and representatives from local area business and developments.	Years 1 – 5: Conduct one clean-up day each year. A summary of the clean-up day activities will be included in the Annual Report.
2.D	Provide tours of UndertheSink, household hazardous waste facility, for schools and neighborhood organizations to learn about the proper way to manage household chemicals and about stormwater treatment systems installed at the site.	Year 1 – 5: Provide a summary of the tours conducted on an annual basis for the annual report. Document when BMPs are installed and included in the tour.
2.E	Hold World O! Water Festival focused on elementary school aged children to celebrate Clean Water and engage in water quality related activities.	Year 1-5: Hold event annually. Report estimated number of participants in Annual Report.
2.F	Participate in community organizations, conferences, workshops, and web casts related to water quality and stormwater management.	Year 1- 5: Report number of staff attending, dates, location, and description of events.

 # 3: Illicit Discharge Detection and Elimination

BMP #	SWMP Element Description	Measurable Commitments & Implementation Schedule
3.A	Perform dry-weather inspections including Physical Characteristics Examinations of storm water outfalls 72" or greater and any outfalls with documented complaints.	Year 1 – 5: Inspect and record observations. Included a count of outfalls inspected in the Annual Report.
3.B	Investigate and seek resolution concerning any dry weather discharges of potentially impacted by sources by notifying the source that they must discontinue discharging, and initiate enforcement action consistent with adopted ordinance which will address TMDL pollutants of concern. Any source that the applicant feels constitutes an immediate health or safety threat will be reported immediately to the NDEQ.	Year 1 – 5: The following information will be included in the Annual Report: • the number of potential process or wastewater sources found; • the number of above resolved at local level; and • the identity of any referred and/or unresolved discharge sources.
3.C	Dry weather inspection of storm water outfalls, including smaller outlets and those that discharge to lesser tributaries or other storm conduits, in response to suspect conditions and/or complaints.	Year 1 – 5: Inspect and record observations. Included a count for outfalls inspected in the Annual Report.
3.D	Enforce existing City codes prohibiting illicit discharge connections to storm sewers.	Year 1 -5: Summarize code violations and enforcement actions taken in annual report.
3.E	Maintain and prevent instances of sanitary sewer leakage into MS4 or waters of the state.	Year 1 -5: Summarize investigations of leakage and actions taken in Annual Report.
3.E	Maintain and update a sewer map of major storm water outfalls and identify the names of respective receiving waters.	Years 1 - 5: Map will be maintained electronically on City GIS.
3.G	Prevent, contain and respond to spills to the MS4. Review, as necessary, interdepartmental SOPs with respects to spills, dumping and illegal disposal that impacts the MS4.	Year 1-5: Summarize number of reports of spills and actions taken in Annual Report. Identify City Department SOP and review date in Annual Report.

 # 4: Construction Site Runoff Control

BMP #	SWMP Element Description	Measurable Commitments & Implementation Schedule
4.A	Maintain the construction site inspection and reporting web site and continue to make enhancements.	Year 1-5: Include a narrative in the annual report about major web site upgrades and the date implemented.
4.B	Maintain a construction site inspection program that includes procedures for reporting, resolving deficiencies, and taking appropriate enforcement action consistent with adopted ordinances.	Years 1-5: The Annual Report will contain the following information relative to this commitment: 1) the number of inspections conducted in each of the following size categories: < 5 acres and > 5 acres 2) the number of sites receiving enforcement actions.
4.C	Maintain regulations and design specifications for controlling erosion, sediment loss, and other TMDL pollutants of concern from construction sites that disturb areas of 1 acre or more.	Year 1 -5: Provide a narrative description of any changes implemented in the City's sediment and erosion control regulations or design specifications in the annual report.
4.D	Maintain a program for performing review of Grading Permit applications to ensure compliance with applicable regulations and design specifications.	Year 1 -5: Summarize the number of grading permit issued on an annual basis.

 # 5: Post-construction Runoff Control

BMP #	SWMP Element Description	Measurable Commitments & Implementation Schedule
5.A	Develop guidance document for Post-Construction Stormwater Management Plan.	Year 2: Develop guidance document for Post Construction Storm Water Management Plan Year 2-5: Revise as necessary.
5.B	Participate with other City Departments to prepare an Environmental Element of City of Omaha Master Plan and include applicable storm water management provisions.	Year 1-5: Summarize progress in annual report. Year 5: Present the Environmental Element to City Planning Board and Omaha City Council for their consideration to adopt into the Omaha Master Plan.
5.C	Develop a database of existing structural BMPs (private and public) that reduce the impact of urbanization on storm water run-off and improve water quality and enhance other amenities and activities such as green space, parks and recreation, urban planning, aesthetics, and public safety.	Year 2: Coordinate with engineering firms and the NRD to identify existing BMPs and their location. Year 3: Develop a database and GIS map of BMPs.
5.D	Inspect annually and maintain (as necessary) City owned storm water BMP structures.	Year 1 -5: List BMPs inspected and summarize maintenance activity in Annual Report.
5.E	Revise stormwater BMP maintenance and inspection plan as needed.	Year 1-5: Review maintenance plan annually and include new structures. Make revisions as necessary. Report revisions and new structures in Annual Report.
5.F	Implement strategies, which include a combination of structural and or non-structural BMPs appropriate for the watershed, which will address TMDL pollutants of concern. Evaluate these strategies and implement changes as necessary to improve water quality and address TMDL pollutants of concern.	Year 1 -5: Summarize strategies, findings, and any changes in the Annual Report.

 # 6: Pollution Prevention/Good Housekeeping for Municipal Operations

BMP #	SWMP Element Description	Measurable Commitments & Implementation Schedule
6.A	Maintain Facility Runoff Control Plans (FRCP) for all City maintenance facilities to indentify BMPs implemented. Review FRCP annually and update as necessary. Inspect all facilities annually.	Year 1 -5: Review logs of FRCP updates and inspections. Report dates in annual report.
6.B	Inspect storm sewer conduits, channels and catch basins and remove and properly dispose of sediment and debris as needed to maintain an efficient system within permitted area.	Year 1 - 5: Report maintenance activities in the Annual Report.
6.C	Training will be provided for employees to prevent pollutant runoff from municipal operations at City maintenance facilities and at field operations.	Years 1 – 5: Provide training annually for employees and include summary in Annual Report of when training was held and number of attendees.
6.D	Provide for street cleaning in the following areas: • Residential • Business • Major Streets • Other areas in conjunction with special projects	Year 1 – 5: Summarize street cleaning activities in annual report.
6.E	City staff that applies pesticides will be trained in a certification program that complies with FIFRA regulations.	Year 1 -5: Report total number of City Staff certified each year in the Annual Report.
6.F	The City will continue to minimize pesticide and fertilizer use on publically maintained properties.	Year 1 -5: Summarize efforts in Annual Reports.

 # 7: Industrial Facilities

7.A	Issue City of Omaha Industrial Stormwater Permits. Permits to be issued to specific sectors to maximize effectiveness of education and outreach activities and utilize staff resources efficiently.	Year 1: Develop priority system based on industrial sector for targeting industries to issue City of Omaha Industrial Stormwater Permits Year 2- 5: Issue permits Report number of permits issued and industrial sector/SIC in Annual Report.
7.B	Inspect 20% of facilities per year issued City of Omaha Industrial Stormwater Permits, taking appropriate enforcement action consistent with adopted ordinances.	Year 1 -5: Summarize number of facilities issued permits, number of facilities inspected, and number of enforcement actions in Annual Report.
7.C	Implement a permit tracking system.	Year 2: Implement a GIS based tracking system for permits, inspections, and compliance. Develop automated summary to be included in Annual Report. Year 3 – 5: Include summary in Annual Report
7.D	Review City of Omaha Industrial Stormwater Permit for consistency with Federal and State NPDES Industrial Stormwater Permit.	Year 1 – 5: Summarize updates to City of Omaha Industrial Stormwater Permits in Annual Report.

ATTACHMENT A

#8: Storm Water Monitoring Plan

SWMP Element #	SWMP Element Description	Measurable Commitments & Implementation Schedule
8.A	Conduct in-stream water quality monitoring of named creeks in the Papillion Creek Watershed. Collect samples from at least 4 sites located in the Papillion Creek Watershed. Samples will be collected from May through August one day a week and analyzed for the following parameters: BOD5, TSS, ammonia nitrogen, nitrate-nitrogen, total nitrogen, soluble and total phosphorus, turbidity, pH, E coli, and Physical Characteristic Examinations. The purpose of the monitoring will be to evaluate the effectiveness of storm water management practices in the City of Omaha as it relates to TMDL pollutants of concern. List of potential sites: 170 and Highway 36 (Big Papio) 77th and L Street (Big Papio) 64th and L Street (Little Papio) Ft. Crook Road – USGS station (Papillion Creek)	Year 1- 5: Conduct monitoring The following information shall be included in the Annual Activity Report: • The monitoring data; • A summary report on the findings relative to SWMP efforts; • Any modifications of monitoring locations or procedures.
8.B	Develop an assessment monitoring plan for demonstration BMPs. Evaluate the effectiveness of the selected BMPs to treat storm water for the TMDL pollutants of concern and other water quality benefits. Consider implementation of refinements to the BMPs, which would improve their effectiveness. One aspect of the monitoring plan will include the collection stream samples on the segment that runs through Orchard Park to establish baseline conditions for BMP assessment purposes. Additionally, the plan will address how the City proposed to use stream samples collected in dry weather and wet weather, as described in 8.A above, to estimate the pollutant masses discharged on an event basis and an annual basis.	Year 1 – 2: Visually document and monitor the installation of the demonstration BMPs. Installation is expected to be complete by the end of Year 2. Provide a narrative to report progress in Annual Report. Year 2: Develop the BMP assessment monitoring plan and submit to NDEQ for approval as an attachment to the Annual Report. Years 3 - 5: Conduct monitoring. The following information shall be included in the Annual Activity Report: 1) the location of the monitoring site 2) the intensity and duration of the storm event monitored; 3) the timing of sampling in comparison to the occurrence of the storm event and to the discharge of peak storm water flows; 4) the monitoring data; and 5) a summary report on the findings of the removal rates of the constituents monitored for the BMPs.

ATTACHMENT B

ATTACHMENT B

COMPLAINT INVESTIGATIONS

Date	Complaint Type	Address	IDDE Classification	Enforcement Type
10/1/2010	Suspicious discharge in inlet	2991 G ST	Illicit Discharge	Letter of Warning
10/5/2010	Suspicious discharge into ditch	8920 S 90th ST	Illicit Discharge	Request for Voluntary Compliance
10/13/2010	Suspicious discharge in inlet	2nd & Jaynes ST	Illicit Discharge	None–Suspect could not be identified
10/13/2010	Suspicious discharge on street	2328 N 64th ST	Illicit Discharge	Forwarded to Plumbing Department
10/13/2010	Suspicious discharge on street	1312 S 78th ST	Illicit Discharge	Request for Voluntary Compliance
11/1/2010	Dumping to Creek	811 Cole Creek Dr	Illicit Discharge	Forwarded to Code Enforcement
11/1/2010	Dumping to Creek	822 N 77th ST	Illicit Discharge	Forwarded to Code Enforcement
12/28/2010	Suspicious activity	18605 West Center Road	Potential Illicit Discharge	Request for Voluntary Compliance
12/29/2010	Suspicious discharge in street/inlet	4023 S 13th ST	Illicit Discharge	Cease prohibited activity
1/5/2011	Suspicious discharge at curb	1515 N 105 ST	Plumbing Code Violation	Forwarded to Plumbing Department
1/5/2011	Suspicious discharge at curb	1521 N 105 ST	Plumbing Code Violation	Forwarded to Plumbing Department
1/7/2011	Suspicious discharge at curb	4826 S 165 ST	Plumbing Code Violation	Forwarded to Plumbing Department
1/13/2011	Discharge to inlet	8633 Q Plz	Illicit Discharge	Request for Voluntary Compliance
2/15/2011	Oil spill	4320 S 15 ST	Potential Illicit Discharge	Request for Voluntary Compliance
3/8/2011	Suspicious discharge on street	518/522/526 S 30th ST	Potential Illicit Discharge	Request for Voluntary Compliance
4/5/2011	Grease Discharge	13076 Renfro Cir	Illicit Discharge	Request for Voluntary Compliance
4/9/2011	Suspicious activity	101st & Pacific ST	Potential Illicit Discharge	Cease prohibited activity
4/19/2011	Drainage onto neighboring property	14217 Q ST	Invalid	None
4/28/2011	Pool Draining into Street	12418 Burt Plaza	Allowable Discharge	Informative letter
4/29/2011	Suspicious discharge into inlet	1708 N 48th ST	Illicit Discharge	Cease prohibited activity
4/29/2011	Suspicious discharge on street	Gibson RD & Missouri AVE	Spill	None - Dry removal of material
4/30/2011	Matierial Piled On Street	12607 Burt ST	Illicit Discharge	Request for Voluntary Compliance
5/4/2011	Suspicious activity	811 S 48th ST	Not Classified	No action taken
5/9/2011	Hydraulic Fluid Leak	138th & Meredith	Spill	None - Dry removal of material
5/12/2011	Suspicious discharge on street	11320 Camden AVE	Illicit Discharge	Notice of Violation
5/17/2011	Matierial Piled On Street	831 Pine ST	Illicit Discharge	Request for Voluntary Compliance
5/26/2011	Mud in inlet	99th & Blair High Rd	Not Classified	None - Sewer Maintenance clean
6/1/2011	Sanitary Sewer discharge	5057 Dodge ST	Illicit Discharge	None - Sewer Line Repair

ATTACHMENT B

Date	Complaint Type	Address	IDDE Classification	Enforcement Type
6/8/2011	Oil spill	45th & McKinley	Spill/Illicit Discharge	None - Voluntary Compliance
6/8/2011	Excessive Irrigation	21944 Marcy Cir	Plumbing Code Violation	Forwarded to Plumbing Department
7/19/2011	Manure on street	36th & L	Illicit Discharge	Request for Voluntary Compliance
7/25/2011	Pool Draining into Street	5820 S 99th ST	Illicit Discharge	Request for Voluntary Compliance
8/2/2011	Sanitary Sewer discharge	13076 Renfro Cir	Illicit Discharge	None - Sewer Line Repair
8/12/2011	Mud in street	12611 Burt ST	Illicit Discharge	Request for Voluntary Compliance
9/16/2011	Suspicious discharge on street	14830 Parker PL	Potential Illicit Discharge	Cease prohibited activity
9/21/2011	Car leaking oil	14906 Martha Cir	Invalid	None
9/29/2011	Sanitary Sewer discharge	4605 N 90 ST	Illicit Discharge	None - Sewer Line Repair
10/1/2011	Septic Smell at Creek	4657 G ST	Illicit Discharge	Request for Voluntary Compliance
10/28/2011	Acid discharge	14926 Grover ST	Illicit Discharge	Enforced by NDEQ
11/28/2011	Corn oil discharge	12900 I ST	Spill/Illicit Discharge	Request for Voluntary Compliance
12/15/2011	Suspicious discharge at creek outlet	Elmwood Creek	Not Classified	None

ATTACHMENT C

ATTACHMENT C

Construction Program Enforcement Actions

Project Name	Date Submitted	Action Recommended	Outcome
Whispering Ridge West	1/13/2011	Notice of Violation	Request for Voluntary Compliance
Whispering Ridge West	1/26/2011	Notice of Violation	No Action Taken
Skyline Meadows	2/10/2011	Letter of Warning	No Action Taken
Center Springs	3/15/2011	Letter of Warning	No Action Taken
Hanover Fails	3/26/2011	Letter of Warning	Request for Voluntary Compliance
Shadow View 2nd Addtion (lots 1-169)	4/14/2011	Letter of Warning	LOW Issued
Camden Creek Grading Plan	5/27/2011	Letter of Warning	No Action Taken
MUD - Florence WTP Phase I Process Design	6/3/2011	Letter of Warning	LOW Issued
OPS ELEMENTARY SCHOOL	6/10/2011	Letter of Warning	Request for Voluntary Compliance
Montclair Village Apartments	7/28/2011	Letter of Warning	LOW Issued
OPW52137 - Emile St. Relocation	7/29/2011	Letter of Warning	Request for Voluntary Compliance
Big Papillion Creek Interceptor Sewer Improvements	7/29/2011	Letter of Warning	NOV Issued
UNO Lot 9 Expansion	7/29/2011	Letter of Warning	LOW Issued
UNMC Stanley M. Truhlsen Eye Institute	8/18/2011	Letter of Warning	NOV Issued
Huntington Park Lots 444-465	8/18/2011	Letter of Warning	NOV w/ Fine
Pacific Street W Lots 1-79 Inc & Outlots A-C	8/30/2011	Notice of Violation	Request for Voluntary Compliance
Stoneridge	9/6/2011	Letter of Warning	No Action Taken
Double D Industrial Park	9/16/2011	Notice of Violation	NOV w/ Fine
Manchester Ridge	9/26/2011	Notice of Violation	LOW Issued
Center Pointe	9/29/2011	Letter of Warning	LOW Issued
Altech Business Park	10/6/2011	Letter of Warning	No Action Taken
Pacific Street W Lots 1-79 Inc & Outlots A-C	10/11/2011	Notice of Violation	NOV w/ Fine
UNMC College of Nursing Addition	11/2/2011	Letter of Warning	Withdrawn
Montclair Village Apartments	11/8/2011	Fines	NOV w/ Fine
Huntington Park Lots 444-465	11/29/2011	Letter of Warning	NOV w/ Fine
John Deere	12/5/2011	Letter of Warning	LOW Issued
CVS #5634	12/8/2011	Fines	LOW Issued
John Deere	12/20/2011	Notice of Violation	LOW Issued

ATTACHMENT D

CONSTRUCTION RUNOFF

EVENT

Sediment and Erosion Control

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
02/02/2011	180	Builders, Developers, and Graders	CoCo Key Convention Center	Workshop for engineers, developers and graders to educate them about NPDES Phase II regulations, Omaha's Grading Permit Program, and sediment and erosion control BMPs.

POST-CONSTRUCTION RUNOFF

EVENT

Post-Construction Management

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/26/2010	275	Engineers, Developers	Omaha Marriott	IECA's Great Plains Chapter regional workshop for engineers and developers to educate them about post construction ordinance requirements, BMPs, and stormwater management.

PUBLIC EDUCATION/OUTREACH

BILLBOARD

Pet Waste

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/04/2010		Omaha Area Residents	132nd & L	Digital Billboard, Waitt Outdoor,10/4-10/10, 10-second spots, 5040 spots/week, $500

BROCHURES/PAMPHLETS

Illegal Dumping

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Willa Cather Branch Library	50

KOB Opportunities for Involvement

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	25	Omaha Area Residents	Recycling Postcards	25, "Get a Bin"
09/30/2011	50	Omaha Area Residents	Willa Cather Branch Library	50
09/30/2011	25	Omaha Area Residents	Mockingbird Community Center	25
09/30/2011	25	Omaha Area Residents	Elkhorn Public Library	25
09/30/2011	50	Omaha Area Residents	Millard Branch Library	50
09/30/2011	50	Omaha Area Residents	Under the Sink	50
09/30/2011	50	Omaha Area Residents	South Branch Library	50

KOB Opportunities for Involvement (Spanish)

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	South Branch Library	50
09/30/2011	50	Omaha Area Residents	Our Lady of Guadalupe Education Center	50

PUBLIC EDUCATION/OUTREACH

BROCHURES/PAMPHLETS

OmaGro

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Ace Hardware 50th and Center	50 copies
09/30/2011	50	Omaha Area Residents	Elkhorn Public Library	50 copies
09/30/2011	100	Omaha Area Residents	Earl May 90th and Center	100 copies

Pesticides, Herbicides, and Fertilizer Use

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	75	Omaha Area Residents	Union Pacific	75
09/30/2011	100	Omaha Area Residents	Earth Day Omaha	100
09/30/2011	75	Omaha Area Residents	Ace Hardware (144th and Center)	75
09/30/2011	150	Omaha Area Residents	Gallup	150
09/30/2011	50	Omaha Area Residents	Creighton University	50
09/30/2011	150	Omaha Area Residents	Lauritzen Gardens	150
09/30/2011	60	Omaha Area Residents	ConAgra	60

Prepare yourself to use UTS

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Under the Sink	50

Storm Drain Fact Sheets

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
08/20/2011	100	Omaha Area Residents	Papio NRD - World O! Water	100
09/30/2011	900	Omaha Area Residents	Omaha Residences	900

Storm Drains and Water Pollution

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
08/20/2011	100	Omaha Area Residents	Papio NRD - World O! Water	100
09/30/2011	50	Omaha Area Residents	Omaha	Give out to volunteers during drain disc placement program

Sustainability Starts at Your Sink

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
08/20/2011	100	Omaha Area Residents	Papio NRD - World O! Water	100

Keeping Pollution Out Of Our Storm Drains

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
06/30/2011	169,600	MUD Customers	Omaha and Surrounding Area	Brochure placed in MUD gas and water customers bill.

Using Lawn Chemicals Wisely

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Sunrise Nursery 84th and Frederick	50

PUBLIC EDUCATION/OUTREACH

CLEAN-UP

Adopt-A-Park Program

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	795	Volunteers, Parks	City of Omaha	14 new park adopted, total is 60, 210 cleanups, 795 volunteers, 1140 bags of litter

Clean-up

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
03/01/2011		Volunteers, Dams and waterways	Lake Zorinsky	
03/01/2011		Volunteers, Dams and waterways	Standing Bear	
04/01/2011		Volunteers, Dams and waterways	Riverfront	
05/01/2011		Volunteers, Dams and waterways	Lake Zorinsky	
05/01/2011		Volunteers, Dams and waterways	Big Papio	
06/01/2011		Volunteers, Dams and waterways	Standing Bear	
09/01/2011		Volunteers, Dams and waterways	Benson Park Lagoon	
09/01/2011		Volunteers, Dams and waterways	Walnut Grove Creek	
09/01/2011		Volunteers, Dams and waterways	Gene Leahy Mall	
09/01/2011		Volunteers, Dams and waterways	Lake Cunningham	

Litter

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011		Omaha Area Residents	Omaha	101 Bag of litter collected

Storm Drain Grate Clean

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011		Omaha Area Residents	Omaha	567 Grates Cleaned

DRAIN MARKING

Storm Drain Cards

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	25	Omaha Area Residents	Our Lady of Guadalupe Education Center	25
09/30/2011	25	Omaha Area Residents	Under the Sink	25

PUBLIC EDUCATION/OUTREACH

EVENT

General Stormwater Awareness Education AND Post Construction Policy

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
03/23/2011	20	Educators	MCC - Fort Campus	Present MS4 Permit requirements to educators

Industrial Stormwater Permit

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
06/22/2011	10	Printing Industry	Common Ground Community Center	Industrial Permit Outreach

Living Green: Benson High School Rain Garden Initiative

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/12/2010	60	Benson HS and community	Benson High School	Ribbon cutting and tour of Benson High School's Rain Gardens

MORE Nature Nights

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
03/29/2011	100	Elementary School Students	Picotte Elementary	After school event promoting outdoor nature based play.
08/25/2011	100	Elementary School Students	Joslyn Elementary	After school event promoting outdoor nature based play.
09/20/2011	100	Elementary School Students	Reeder Elementary	After school event promoting outdoor nature based play.

Pet Waste

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
06/18/2011	500+	Omaha Area Residents	Benson	Pet waste and general stormwater awareness
09/25/2011	1,000+	Pet Owners	Nebraska Humane Society	NHS - Walk for the Animals: Information and 1000 pet waste bag dispenser distribution at the Walk for the Animals

World O! Water

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
08/20/2011	1200	Omaha Area Residents	Papio NRD - World O! Water	estimated 1200 in attendance

MUNICIPAL OUTREACH

City of Omaha Hotline

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011		Volunteers	Omaha	Printed on materials handed out to volunteers and volunteers in the storm drain disc placement program are made aware

Omaha World Herald Promotion

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
08/20/2011		Omaha Area Residents	Papio NRD - World O! Water	$2805.86 for promotion

PUBLIC EDUCATION/OUTREACH

NEWSPAPER ARTICLE

Pet Waste

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/04/2010	15,000	Omaha Area Residents	Shout Weekly	1/4 Page in Shout Weekly $200
10/04/2010	19,200	Omaha Area Residents	The Reader	1/2 Page ad in The Reader $672
10/05/2010	184,000	Omaha Area Residents	OWH	6X3 ad in OWH $828
10/07/2010	184,000	Omaha Area Residents	OWH	6X3 ad in OWH $828

POSTER/SIGNAGE

Pet Waste

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/06/2010	1,000+	Omaha Area Residents	Various Trash Cans	Trash Can Inserts, 50 total, $1,250

RADIO COMMERCIAL

Composting

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
05/06/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial
05/13/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial
05/20/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial

Don't Litter-Cigarette Butts

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
05/07/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial
05/14/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial
05/21/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial
05/28/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial

Household Waste Disposal - OIL

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
06/04/2011	1,000+	Omaha Area Residents	KFAB Radio	30-second radio commercial
06/11/2011	1,000+	Omaha Area Residents	KFAB Radio	30-second radio commercial
06/21/2011	1,000+	Omaha Area Residents	KFAB Radio	30-second radio commercial
06/28/2011	1,000+	Omaha Area Residents	KFAB Radio	30-second radio commercial

World O! Water

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
08/06/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial
08/13/2011	1,000+	Omaha Area Residents	KFAB Radio	15-second radio commercial

PUBLIC EDUCATION/OUTREACH

RECYCLING/HHW PROMOTION

Automotive UTS

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Autozone North 30th St	50
09/30/2011	50	Omaha Area Residents	O'Reilly Autoparts 30th and Ames	50
09/30/2011	50	Omaha Area Residents	Autozone 72nd and Redick	50

Generic UTS Cards

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Millard Branch Library	50
09/30/2011	50	Omaha Area Residents	Washington Branch Library 30th and Ames	50
09/30/2011	75	Omaha Area Residents	South Branch Library	75

Get the Point (Medical HHW)

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	75	Omaha Area Residents	Kubat Pharmacy 48th and Center	75
09/30/2011	40	Omaha Area Residents	Kohll's Pharmacy 55th and L	40
09/30/2011	50	Omaha Area Residents	HyVee Pharmacy 96th and Q	50
09/30/2011	50	Omaha Area Residents	Walgreens 24th and Vinton	50
09/30/2011	50	Omaha Area Residents	Walgreens 24th and L	50

Guide to HHW

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	O'Reilly Autoparts 50th and L	50

Household Hazardous Waste

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	750	Omaha Area Residents	Various Groups	750
09/30/2011	200	Omaha Area Residents	Creighton University Earth Day	200
09/30/2011	200	Omaha Area Residents	Earth Day Omaha 2011 (Elmwood Park)	200
09/30/2011	200	Omaha Area Residents	Union Pacific Earth Day	200
09/30/2011	200	Omaha Area Residents	Gallup Earth Day	200
09/30/2011	200	Omaha Area Residents	ConAgra Earth Day	200

Housing Dangerous Products

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Willa Cather Branch Library	50
09/30/2011	50	Omaha Area Residents	Tractor Supply 81st and L	50

PUBLIC EDUCATION/OUTREACH

RECYCLING/HHW PROMOTION

Housing Dangerous Products (Spanish)

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Our Lady of Guadalupe Education Center	50
09/30/2011	50	Omaha Area Residents	Autozone 24th and Vinton	50
09/30/2011	50	Omaha Area Residents	Willa Cather Branch Library	50

Pollution Sources Around Your House

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Ace Hardware 50th and Center	50 copies
09/30/2011	50	Omaha Area Residents	Autozone 49th and Center	50 copies

Proper Paint Disposal

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Lowes 72nd and Dodge	50
09/30/2011	50	Omaha Area Residents	Sherwin Williams 74th and Cass	50
09/30/2011	75	Omaha Area Residents	Pittsburgh Paints 72nd and L	75

Spanish Under the Sink

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Ace Hardware 50th and G	50
09/30/2011	50	Omaha Area Residents	O'Reilly Autoparts 50th and L	50
09/30/2011	50	Omaha Area Residents	AutoZone 50th and Center	50

Under the Sink (Recycling Paint)

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/30/2011	50	Omaha Area Residents	Ace Hardware 50th and Center	50 copies
09/30/2011	50	Omaha Area Residents	Willa Cather Branch Library Center St	50 copies
09/30/2011	100	Omaha Area Residents	Westlake Hardware 50th and G St	100 copies
09/30/2011	50	Omaha Area Residents	Westlake Ace Hardware Elkhorn	50
09/30/2011	50	Omaha Area Residents	Menards Elkhorn	50
09/30/2011	75	Omaha Area Residents	Diamond Vogel Paint 78th and L	75 copies
09/30/2011	50	Omaha Area Residents	Elkhorn Public Library	50
09/30/2011	75	Omaha Area Residents	Builder's Supply 72nd and Main St	75 copies

Omaha Rain Barrel Program

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
07/25/2011	60	Omaha Area Residents	Omaha Residences	Information and design guidance provided with a free barrel to be created into a rain barrel.

PUBLIC INVOLVEMENT/PARTICIPATION

CLEAN-UP

Clean-up

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
04/01/2011		Volunteers	Spring Lake Park	
04/01/2011		Volunteers	Hanscom Park	
04/01/2011		Volunteers	Brown Park	
04/01/2011		Volunteers	Elmwood Park	
04/01/2011		Volunteers	Benson Park	
05/01/2011		Volunteers	Spring Lake Park	
05/01/2011		Volunteers	Highland Park	
06/01/2011		Volunteers	Keystone Park	
06/01/2011		Volunteers	Spring Lake Park	
07/01/2011		Volunteers	Kountz Park	Cleaned weekly for 6 weeks
07/01/2011		Volunteers	Benson Park	
08/01/2011		Volunteers	Hanscom Park	
08/01/2011		Volunteers	Keith Park	
08/01/2011		Volunteers	Manden Park	
08/01/2011		Volunteers	Keystone Park	
09/01/2011		Volunteers	Clarkson Park	
09/01/2011		Volunteers	Keith Park	
09/01/2011		Volunteers	Elmwood Park	

Neighborhood Clean-Up

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/21/2010	20	Omaha Area Residents	Leahy Mall	RSM McGladrey
10/23/2010	759	Omaha Youth	Omaha Area	Youth Fall Clean-up

Park Clean-Up

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/02/2010	12	Omaha Area Residents	Keystone Park	Keystone Neighborhood Association, 1 hour
10/19/2010	5	College Students	Fontenelle Park	Creighton University, 2 hours
10/23/2010	10	Omaha Area Residents	Elmwood Park	2 hours

Stream Clean Up

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
09/19/2011	68	Omaha Area Residents	Area Streams	60 volunteers from Green Coalition

Trail Clean-Up

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/08/2010	10	Omaha Area Residents	Omaha Trails	MeGroup, 2.5 hours

PUBLIC INVOLVEMENT/PARTICIPATION

DRAIN MARKING

Storm Drain Markers

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
10/01/2010	1	Omaha Area Residents	Omaha Streets & Inlets	Hahn, 10 hours
10/01/2010	1	Omaha Area Residents	Omaha Streets & Inlets	Digmans, 15 hours
06/01/2011	452 (Inlets)	Omaha Area Residents	Omaha Streets & Inlets	Installed 452 drain markers
07/01/2011	237 (Inlets)	Omaha Area Residents	Omaha Streets & Inlets	Installed 237 drain markers
08/01/2011	142 (inlets)	Omaha Area Residents	Omaha Streets & Inlets	Installed 142 drain markers
09/01/2011	300 (Inlets)	Omaha Area Residents	Omaha Streets & Inlets	Installed 300 drain markers

SPECIAL INTEREST GROUP MEETING

Watershed Policy

DATE	COUNT	TARGET MARKET	LOCATION	COMMENTS
11/18/2010	11	Partnership Members	Papio NRD	Partnership Meeting
01/21/2011	21	Partnership Members	Papio NRD	Partnership Meeting
02/24/2011	20	Partnership Members	Papio NRD	Partnership Meeting
03/24/2011	19	Partnership Members	Papio NRD	Partnership Meeting
04/28/2011	14	Partnership Members	Papio NRD	Partnership Meeting
05/26/2011	16	Partnership Members	Papio NRD	Partnership Meeting
08/25/2011	15	Partnership Members	Papio NRD	Partnership Meeting
09/22/2011	14	Partnership Members	Papio NRD	Partnership Meeting

ATTACHMENT E

ATTACHMENT E

2011 Precipatation Data							
DATE	**PRECIP (in)**	**DATE**	**PRECIP (in)**	**DATE**	**PRECIP (in)**	**DATE**	**PRECIP (in)**
5/1/2011	0.00	6/1/2011	0.02	7/1/2011	0.00	8/1/2011	0.00
5/2/2011	0.00	6/2/2011	0.00	7/2/2011	0.00	8/2/2011	0.00
5/3/2011	0.00	6/3/2011	0.00	7/3/2011	0.29	**8/3/2011**	**0.00**
5/4/2011	0.00	6/4/2011	0.00	7/4/2011	0.00	8/4/2011	0.09
5/5/2011	0.01	6/5/2011	0.00	7/5/2011	0.69	8/5/2011	0.10
5/6/2011	0.00	6/6/2011	0.00	**7/6/2011**	**0.00**	8/6/2011	0.53
5/7/2011	0.00	6/7/2011	0.00	7/7/2011	0.00	8/7/2011	0.05
5/8/2011	0.00	**6/8/2011**	**0.00**	7/8/2011	0.00	8/8/2011	0.17
5/9/2011	0.00	6/9/2011	0.69	7/9/2011	0.00	8/9/2011	0.00
5/10/2011	0.00	6/10/2011	0.00	7/10/2011	0.00	8/10/2011	0.00
5/11/2011	**1.08**	6/11/2011	0.00	7/11/2011	0.55	**8/11/2011**	**0.06**
5/12/2011	0.81	6/12/2011	0.04	7/12/2011	0.00	8/12/2011	0.73
5/13/2011	0.00	6/13/2011	0.00	**7/13/2011**	**0.00**	8/13/2011	0.00
5/14/2011	0.00	6/14/2011	0.06	7/14/2011	0.00	8/14/2011	0.00
5/15/2011	0.05	**6/15/2011**	**0.00**	7/15/2011	0.02	8/15/2011	0.00
5/16/2011	0.00	6/16/2011	0.02	7/16/2011	0.00	8/16/2011	0.09
5/17/2011	0.00	6/17/2011	0.00	7/17/2011	0.00	**8/17/2011**	**0.00**
5/18/2011	**0.00**	6/18/2011	0.36	7/18/2011	0.00	8/18/2011	1.96
5/19/2011	0.24	6/19/2011	0.04	7/19/2011	0.00	8/19/2011	0.02
5/20/2011	0.86	6/20/2011	0.93	**7/20/2011**	**0.00**	8/20/2011	0.00
5/21/2011	0.17	6/21/2011	0.32	7/21/2011	0.53	8/21/2011	0.00
5/22/2011	0.00	**6/22/2011**	**0.01**	7/22/2011	0.03	8/22/2011	1.51
5/23/2011	0.00	6/23/2011	0.00	7/23/2011	0.00	8/23/2011	0.00
5/24/2011	0.83	6/24/2011	0.00	7/24/2011	0.00	8/24/2011	0
5/25/2011	**0.13**	6/25/2011	0.77	7/25/2011	0.00	8/25/2011	0
5/26/2011	0.00	6/26/2011	1.05	7/26/2011	0.00	8/26/2011	0
5/27/2011	0.00	6/27/2011	0.00	**7/27/2011**	**0.04**	8/27/2011	0
5/28/2011	0.07	6/28/2011	0.00	7/28/2011	1.18	8/28/2011	0.01
5/29/2011	0.03	**6/29/2011**	**0.00**	7/29/2011	0.00	8/29/2011	0
5/30/2011	0.39	6/30/2011	0.00	7/30/2011	0.00	8/30/2011	0.52
5/31/2011	**0.41**			7/31/2011	0.00	8/31/2011	0
Bold = Sampling Day							

66th and L St

(**Bold** text indicates that the sample result was less than the detection limit, gray background indicates probe or analysis error)

	5/11/11		5/18/11		5/25/11		5/31/11		6/8/11		6/15/11		6/22/11		6/29/11		7/6/11		7/13/11		7/20/11		7/27/11		8/3/11		8/10/11		8/17/11		
Total Coliform	241960.0		17329.0		>2419.6	L	>2419.6	L	24196.0		>2419.6	L	>2419.6	L	>24196	L	>24196	L	>24196	L	24196.0		>24196	L	19863.0		>24196	L	19863.0		**SM 9222 D** MDL = 1 cfu / 100 mL
e coli	22043.0	A	1784.0		18339.5	A	17609.5	A	1631.8	A	4058.7	A	8164.0		5794.0		20133.0	A	2204.3	A	316.7		24196.0		166.9	A	1185.4		595.8	A	**Colilert Method** MDL = 1 cfu / 100 mL
Nitrate / Nitrite Nitrogen (mg/L)	1.0		2.1		1.0		1.0		2.2		2.3		1.2		2.1		1.2		1.7		1.6		1.6		1.7		1.9		1.8		**EPA 353.2** MDL = 0.2 mg/L
Kjeldahl Nitrogen (mg/L)	5.51		**< 0.50**	U	2.23		1.87		0.58		1.28		0.75		1.27		1.4		0.98		0.57		1.56		**< 0.5**	U	1.03		0.81		**EPA 351.3** MDL = 0.5 mg/L
Nitrite Nitrogen (mg/L)	0.13		0.09		0.04		0.07		0.13		0.14		0.06		0.06		0.08		0.07		0.04		0.09		0.05		0.03		0.04		**SM 4500-NO_2^- B** MDL = 0.02 mg/L
Ammonia Nitrogen (mg/L)	**< 1**	U	**< 1**	U	**1.0**		**< 1**	U	**1.0**		**< 1**	U	**< 1**	U	**< 1**		**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**SM 4500-NH_3 D** MDL = 1 mg/L
Total Phosphorus (mg/L)	1.72		0.13		0.42		0.55		0.16		0.20		0.24		0.17		0.34		0.19		0.19		0.24		0.13		0.17		0.27		**SM 4500 P F** MDL = 0.05 mg/L
Dissolved Phosphorus (mg/L)	**< 0.05**	U	0.07		0.08		0.08		0.07		0.09		0.09		**<0.05**	U	0.07		0.09		0.08		0.1		0.08		0.11		0.15		**SM 4500 P F** MDL = 0.05 mg/L
pH (lab)	7.42		7.79		7.51		7.51		7.84		7.73		7.59		7.73		7.54		7.76		7.89		7.49		7.85		7.74		7.58		**SM 4500-H^+ B**
BOD (mg/L)	13		**< 2**	U	6		8		**< 2**	U	4		2		2		4		**< 2**	U	**< 2**	U	7		**< 2**	U	**< 2**	U	**< 2**	U	**SM 5210 B** MDL = 2 mg/L
TSS (mg/L)	787		30		247		356		28		31		82		64		178		43		27		14		9		16		6		**SM 2540 D** MDL = 1 mg/L
TDS (mg/L)	421		478		215		252		480		503		302		486		270		439		485		454		505		460		456		**SM 2540 C** MDL = 1 mg/L
Temp (C)	---		14.77	A	18.08	A	18.86	A	23.32	A	19.07	A	18.62	A	20.59	A	21.98	A	22.78	A	26.02	A	24.57	A	24.95	A	22.07	A	---		Field Measurment
DO (mg/L)	6.13	A	9.81	A	8.72	A	8.20	A	7.47	A	7.87	A	8.17	A	8.66	A	7.74	A	7.90	A	7.20	A	7.81	A	8.02	A	8.27	A	---		Field Measurment
SpCond (æS/cm)	490.0	A	784.6	A	380.6	A	---		758.6	A	732.8	A	452.8	A	687.2	A	404.5	A	655.6	A	763.6	A	683.1	A	755.6	A	723.1	A	---		Field Measurment
Turb (NTUs)	898.0	A	26.6	A	240.7	A	335.2	A	21.5	A	28.9	A	102.2	A	65.3	A	212.3	A	46.4	A	106.7	A	154.2	A	0.7	A	---		---		Field Measurment
pH	7.77	A	7.96	A	7.68	A	7.67	A	8.05	A	7.83	A	7.77	A	7.95	A	7.64	A	7.78	A	7.87	A	8.13	A	7.93	A	7.81	A	---		Field Measurment
Duplicate	F		S		F		B		D		F		D		S		F		S		F		D		F		S		F		

Data quality control is done "in house" for the following tests: COD, BOD, TSS, TDS.

A = Value is an average results obtained from multiple analyses

L = The actual value is greater than the value given.

U = Value below detection limit.

X = Value exceeds instrument range.

ATTACHMENT E

Site S 78th and L St

(**Bold** text indicates that the sample result was less than the detection limit, gray background indicates probe error)

	5/11/11		5/18/11		5/25/11		5/31/11		6/8/11		6/15/11		6/22/11		6/29/11		7/6/11		7/13/11		7/20/11		7/27/11		8/3/11		8/10/11		8/17/11		
Total Coliform	111990.0		19863.0		>2419.6	L	>2419.6	L	24196.0		>2419.6	L	>2419.6	L	>2419.6	L	241960.0		>2419.6	L	>2419.6	L	129970.0		46110.0		>2419.6	L	>2419.6	L	**SM 9222 D** MDL = 1 cfu / 100 mL
e coli	13879.5	A	1573.5	A	51720.0		7334.0	A	1553.1	A	2173.0	A	>2419.6	L	1743.2	A	61310.0		36540.0		1249.7	A	13894.5	A	11101.5	A	1183.0	A	5172.0		**Colilert Method** MDL = 1 cfu / 100 mL
Nitrate / Nitrite Nitrogen (mg/L)	1.2		6.1		4.5		4.7		8		7.4		8		7.1		3.5		6.3		8.1		7		7.3		7		6.8		**EPA 353.2** MDL = 0.2 mg/L
Kjeldahl Nitrogen (mg/L)	6.2		0.83		4.24		1.69		0.69		0.68		2.16		1.14		7.09		2.04		0.68		1.04		0.64		0.69		0.61		**EPA 351.3** MDL = 0.5 mg/L
Nitrite Nitrogen (mg/L)	0.07		0.07		0.08		0.08		0.09		0.07		0.07		0.06		0.1		0.07		0.04		0.04		0.04		0.03		0.04		**SM 4500-NO_2^- B** MDL = 0.02 mg/L
Ammonia Nitrogen (mg/L)	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**SM 4500-NH_3 D** MDL = 1 mg/L
Total Phosphorus (mg/L)	2.45		0.34		1.29		0.93		0.42		0.38		1.17		0.46		1.89		0.76		0.38		0.39		0.28		0.26		0.27		**SM 4500 P F** MDL = 0.05 mg/L
Dissolved Phosphorus (mg/L)	**< 0.05**	U	0.12		0.11		0.12		0.14		0.14		0.15		0.13		0.06		0.15		0.16		0.15		0.16		0.15		0.15		**SM 4500 P F** MDL = 0.05 mg/L
pH (lab)	7.46		7.99		7.68		7.81		8.08		8.01		7.86		7.93		7.51		7.92		8.16		7.95		8.12		8.07		8		**SM 4500-H^+ B**
BOD (mg/L)	13		**< 2**	U	5		4		**< 2**	U	2		3		**< 2**	U	8		4		**< 2**	U	3		**< 2**	U	**< 2**	U	**< 2**	U	**SM 5210 B** MDL = 2 mg/L
TSS (mg/L)	1635		177		970		985		229		208		1098		254		3540		550		150		226		102		66		77		**SM 2540 D** MDL = 1 mg/L
TDS (mg/L)	483		447		378		315		456		486		421		482		**< 1**		404		490		446		472		472		511		**SM 2540 C** MDL = 1 mg/L
Temp(C)	19.27	A	14.01	A	17.03	A	19.34	A	21.96	A	17.57	A	17.24	A	19.19	A	18.83	A	20.37	A	25.00	A	25.65	A	24.99	A	21.83	A	---		Field Measurment
DO (mg/L)	7.68	A	10.22	A	9.02	A	8.41	A	8.47	A	9.45	A	9.23	A	9.14	A	8.35	A	8.80	A	8.06	A	6.43	A	8.05	A	8.82	A	---		Field Measurment
SpCond (æS/cm)	323.7	A	631.3	A	500.4	A	549.0	A	705.2	A	707.7	A	627.7	A	673.5	A	353.6	A	590.1	A	715.5	A	710.0	A	710.2	A	696.0	A	---		Field Measurment
Turb (NTUs)	2200.0	A	112.9	A	954.6	A	551.6	A	159.8	A	148.4	A	679.1	A	191.4	A	2862.6	A	797.9	A	174.0	A	--		102.5	A	--		---		Field Measurment
pH	7.75	A	8.02	A	8.00	A	7.89	A	8.29	A	8.13	A	7.95	A	8.14	A	7.68	A	8.05	A	8.18	A	7.68	A	8.24	A	8.17	A	---		Field Measurment

Data quality control is done "in house" for the following tests: COD, BOD, TSS, TDS.

A = Value is an average results obtained from multiple analyses

L = The actual value is greater than the value given.

U = Value below detection limit.

X = Value exceeds instrument range.

ATTACHMENT E

Side D Hwy 75 and Capehart

(**Bold** text indicates that the sample result was less than the detection limit, gray background indicates probe error)

	5/11/11		5/18/11		5/25/11		5/31/11		6/8/11		6/15/11		6/22/11		6/29/11		7/6/11		7/13/11		7/20/11		7/27/11		8/3/11		8/10/11		8/17/11	
Total Coliform	129970		12033		>2196.6	L	>2496.6	L	14136		2419.6		>2419.6	L	>2419.6	L	>2419.6	L	15531		>2419.6	L	14136		12033		>2419.6	L	6488	
e coli	13700.5		954.5	A	17988.0	A	16055.5	A	317.3	A	1681.2	A	12033.0		1308.4	A	7270.0		2070.8	A	44.6	A	129.2	A	107.0	A	648.8		193.2	A
Nitrate / Nitrite Nitrogen (mg/L)	0.8		4.0		1.7		1.6		5.5		5.5		2.8		3.9		2.6		4.5		4.7		4.4		4.8		3.5		4.3	
Kjeldahl Nitrogen (mg/L)	7.08		0.59		3.44		2.2		**< 0.50**	U	**<0.50**	U	1.01		0.73		0.96		0.54		0.82		1.04		0.58		1.05		0.67	
Nitrite Nitrogen (mg/L)	0.07		0.07		0.05		0.07		0.08		0.08		0.07		0.05		0.06		0.05		0.06		0.05		0.05		0.05		0.03	
Ammonia Nitrogen (mg/L)	**< 1**	U	**< 1**	U	1.1		**< 1**	U	1.8		**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	1.5		**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	2.7	
Total Phosphorus (mg/L)	4.08		0.23		0.89		0.92		0.24		0.21		0.28		0.17		0.21		0.18		0.15		0.12		0.2		0.22		0.2	
Dissolved Phosphorus (mg/L)	**< 0.05**	U	0.13		0.09		0.08		0.14		0.15		0.11		0.11		0.08		0.13		0.05		**<0.05**	U	0.14		0.15		0.15	
pH (lab)	7.44		7.85		7.51		7.48		8.02		7.93		7.55		7.69		7.65		7.79		8.06		7.87		8.01		7.88		7.98	
BOD (mg/L)	13		**< 2**	U	7		9		**< 2**	U	3		2		**< 2**	U	3		**< 2**	U	4		4		**< 2**	U	**< 2**	U	**< 2**	U
TSS (mg/L)	587		62.0		340.0		555.0		25.0		20		110		38		47		14.0		11		15		15		34		12	
TDS (mg/L)	233		456.0		144.0		279.0		473.0		508		302		405		337		401		447		403		503		338		532	
Temp (C)	19.87	A	14.52	A	18.87	A	19.66	A	25.06	A	20.10	A	19.54	A	22.26	A	23.03	A	24.26	A	29.96	A	29.68	A	27.72	A	24.53	A	---	
DO (mg/L)	7.84	A	10.02	A	8.78	A	7.99	A	7.80	A	9.00	A	8.09	A	8.34	A	7.80	A	7.99	A	9.84	A	9.59	A	7.97	A	7.94	A	---	
SpCond (æS/cm)	209.8	A	741.8	A	300.9	A	368.4	A	740.0	A	750.1	A	421.8	A	580.2	A	507.4	A	591.6	A	704.8	A	632.0	A	651.6	A	542.5	A	---	
Turb (NTUs)	1957.5	A	61.9	A	657.8	A	545.7	A	25.5	A	22.8	A	186.4	A	67.5	A	112.8	A	3.7	A	51.0	A	20.6	A	5.7	A	---		---	
pH	7.83	A	8.04	A	7.65	A	7.65	A	8.11	A	7.98	A	7.61	A	7.81	A	7.70	A	7.91	A	7.98	A	7.96	A	7.90	A	7.79	A	---	

SM 9222 D MDL = 1 cfu / 100 mL

Colilert Method MDL = 1 cfu / 100 mL

EPA 353.2 MDL = 0.2 mg/L

EPA 351.3 MDL = 0.5 mg/L

SM 4500-NO_2^- B MDL = 0.02 mg/L

SM 4500-NH_3 D MDL = 1 mg/L

SM 4500 P F MDL = 0.05 mg/L

SM 4500 P F MDL = 0.05 mg/L

SM 4500-H^+ B

SM 5210 B MDL = 2 mg/L

SM 2540 D MDL = 1 mg/L

SM 2540 C MDL = 1 mg/L

Field Measurment

Field Measurment

Field Measurment

Field Measurment

Field Measurment

Data quality control is done "in house" for the following tests: COD, BOD, TSS, TDS.

A = Value is an average results obtained from multiple analyses

L = The actual value is greater than the value given.

U = Value below detection limit.

X = Value exceeds instrument range.

ATTACHMENT E

Site B 168th and Hwy 36

(**Bold** text indicates that the sample result was less than the detection limit, gray background indicates probe error)

	5/11/11		5/18/11		5/25/11		5/31/11		6/8/11		6/15/11		6/22/11		6/29/11		7/6/11		7/13/11		7/20/11		7/27/11		8/3/11		8/10/11		8/17/11		
Total Coliform	16501.5	A	19863.0		>24196	L	198630.0		>24196	L	24196.0		>24196	L	>24196	L	241960.0		>24196	L	>24196	L	57940.0		51720.0		24196.0		>24196	L	**SM 9222 D** MDL = 1 cfu / 100 mL
e coli	1100.2	A	2017.1	A	36540.0		26130.0		1108.7	A	954.4	A	>24196	L	1460.0	A	11221.0	A	>24196	L	1658.0		1878.9	A	1773.0	A	1112.1	A	4352.0		**Colilert Method** MDL = 1 cfu / 100 mL
Nitrate / Nitrite Nitrogen (mg/L)	6.5		8.1		8.2		6.8		9.7		9.4		11.0		10.2		8.5		9.5		9.7		9.4		9.2		9.2		9		**EPA 353.2** MDL = 0.2 mg/L
Kjeldahl Nitrogen (mg/L)	0.72		0.88		4.2		4.29		0.68		**<0.50**	U	1.77		1.02		1.4		0.85		0.81		0.64		0.66		0.75		0.81		**EPA 351.3** MDL = 0.5 mg/L
Nitrite Nitrogen (mg/L)	0.17		0.08		0.09		0.09		0.09		0.07		0.05		0.06		0.07		0.08		0.07		0.06		0.06		0.04		0.05		**SM 4500-NO_2^- B** MDL = 0.02 mg/L
Ammonia Nitrogen (mg/L)	**< 1**	U	**< 1**	U	1.6		**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	**< 1**	U	2.7		**SM 4500-NH_3 D** MDL = 1 mg/L
Total Phosphorus (mg/L)	0.33		0.4		1.49		2.23		0.51		0.34		0.99		0.52		0.64		0.43		0.44		0.37		0.34		0.29		0.35		**SM 4500 P F** MDL = 0.05 mg/L
Dissolved Phosphorus (mg/L)	0.13		0.14		0.17		0.15		0.14		0.15		0.19		0.16		0.14		0.18		0.16		0.16		0.18		0.16		0.16		**SM 4500 P F** MDL = 0.05 mg/L
pH (lab)	781		7.86		7.65		7.66		7.89		7.93		7.81		7.84		7.83		8.01		8.04		7.88		8.01		7.97		7.88		**SM 4500-H^+ B**
BOD (mg/L)	2		**< 2**	U	6		6		**< 2**	U	**< 2**	U	2		**< 2**	U	3		**< 2**	U	**< 2**	U	**< 2**	U	**< 2**	U	**< 2**	U	**< 2**	U	**SM 5210 B** MDL = 2 mg/L
TSS (mg/L)	137		245		1235		1905		356		166		804		382		586		192		224		194		178		141		152		**SM 2540 D** MDL = 1 mg/L
TDS (mg/L)	473		461		362		178		454		476		544		504		434		474		474		460		463		443		497		**SM 2540 C** MDL = 1 mg/L
Temp (C)	19.16	A	12.10	A	---		15.97	A	18.51	A	15.57	A	14.67	A	15.92	A	16.94	A	18.19	A	22.24	A	22.24	A	21.86	A	---		---		Field Measurment
DO (mg/L)	9.09	A	10.78	A	9.87	A	9.51	A	9.32	A	10.16	A	9.80	A	9.99	A	9.59	A	9.46	A	8.66	A	8.49	A	8.84	A	---		---		Field Measurment
SpCond (æS/cm)	678.0	A	685.2	A	560.7	A	544.2	A	676.6	A	644.8	A	669.8	A	683.8	A	640.2	A	678.1	A	687.5	A	673.8	A	686.9	A	---		---		Field Measurment
Turb (NTUs)	119.5	A	133.1	A	1064.9	A	2196.4	A	199.5	A	137.4	A	371.9	A	173.1	A	339.3	A	146.3	A	173.9	A	31.0	A	127.9	A	---		---		Field Measurment
pH	8.19	A	8.48	A	8.12	A	8.27	A	8.40	A	8.30	A	8.47	A	8.59	A	8.20	A	8.35	A	8.25	A	8.31	A	8.36	A	---		---		Field Measurment

Data quality control is done "in house" for the following tests: COD, BOD, TSS, TDS.

A = Value is an average results obtained from multiple analyses

L = The actual value is greater than the value given.

U = Value below detection limit.

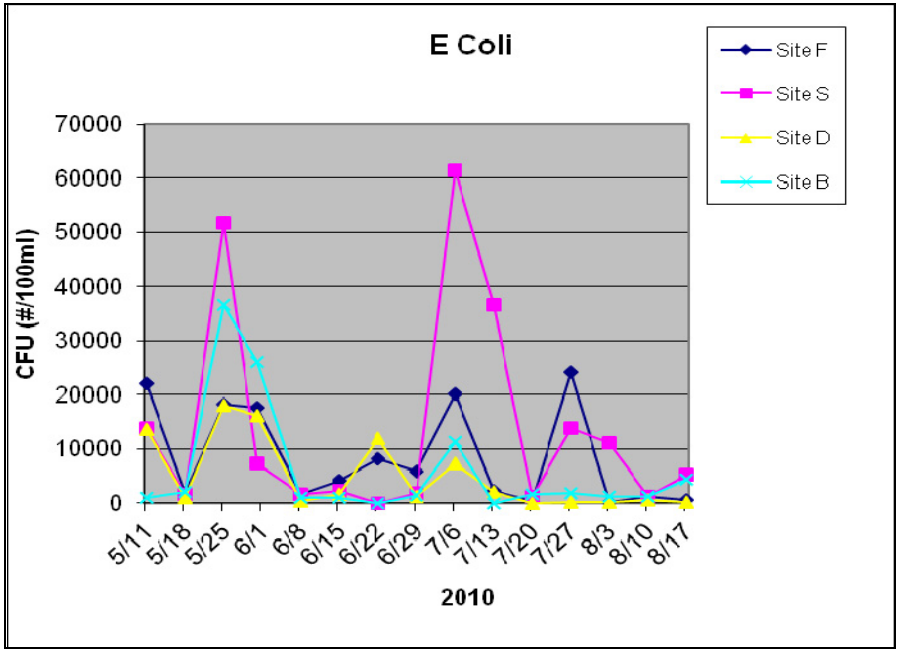
X = Value exceeds instrument range.

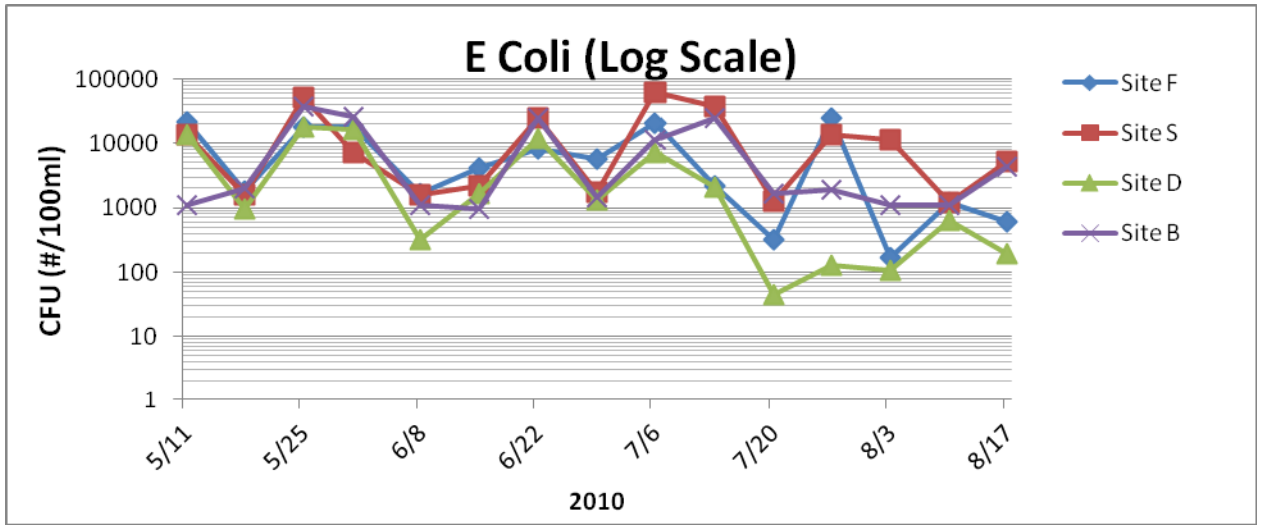
ATTACHMENT E

E. Coli 2011

	Site F	Site S	Site D	Site B
5/11/2011	22043	13879.5	13700.5	1100.2
5/18/2011	1784	1573.5	954.5	2017.1
5/25/2011	18339.5	51720	17988	36540
5/31/2011	17609.5	7334	16055.5	26130
6/8/2011	1631.8	1553.1	317.3	1108.7
6/15/2011	4058.7	2173	1681.2	954.4
6/22/2011	8164	**24196**	12033	**24196**
6/29/2011	5794	1743.2	1308.4	1460
7/6/2011	20133	61310	7270	11221
7/13/2011	2204.3	36540	2070.8	**24196**
7/20/2011	316.7	1249.7	44.6	1658
7/27/2011	24196	13894.5	129.2	1878.9
8/3/2011	166.9	11101.5	107	1112.1
8/10/2011	1185.4	1183	648.8	1112.1
8/17/2011	595.8	5172	193.2	4352
Geomean	3522.48	6806.19	1271.96	3719.34

Bold indicates the actual value is greater than the value given.



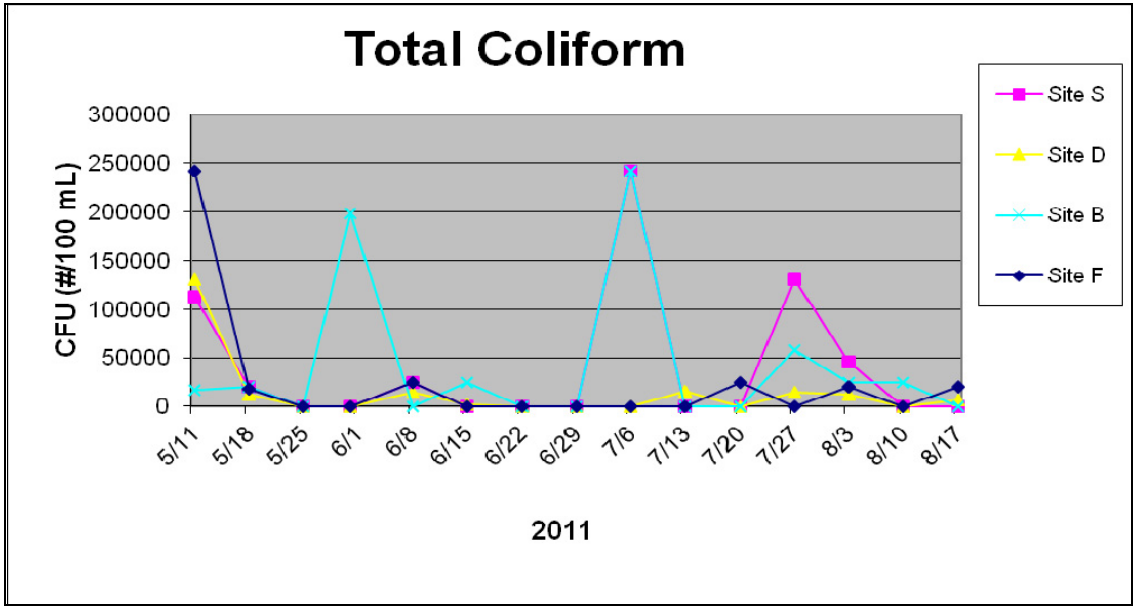


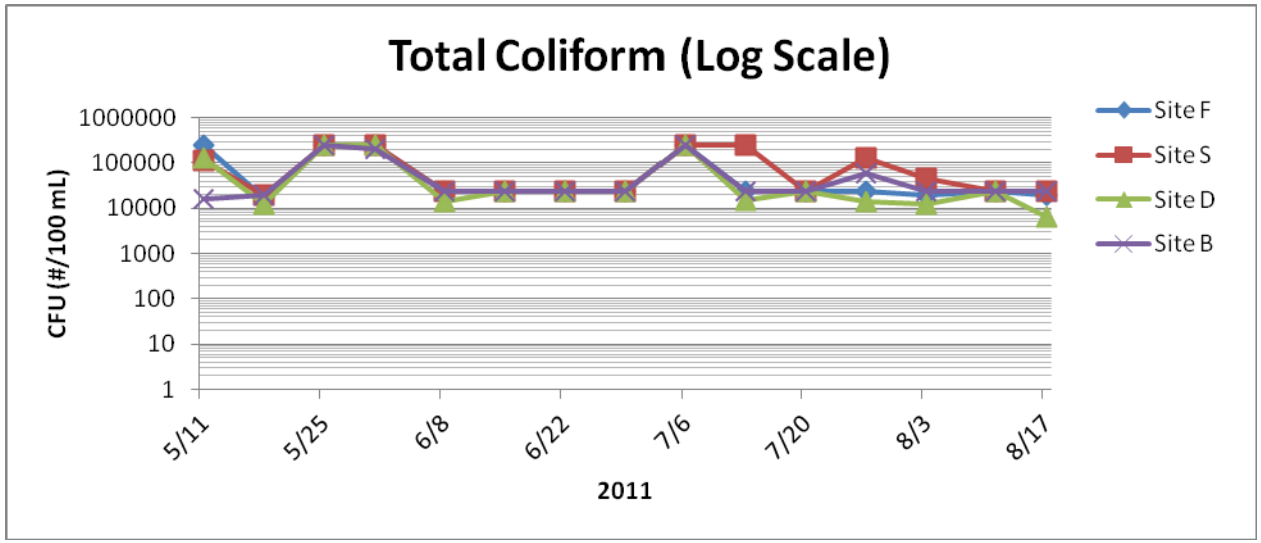
ATTACHMENT E

Total Coliform 2011

	Site F	Site S	Site D	Site B
5/11/2011	241960	111990	129970	16501.5
5/18/2011	17329	19863	12033	19863
5/25/2011	**241960**	**241960**	**241960**	**241960**
5/31/2011	**241960**	**241960**	**241960**	198630
6/8/2011	24196	24196	14136	**24196**
6/15/2011	**24196**	**24196**	24196	**24196**
6/22/2011	**24196**	**24196**	**24196**	**24196**
6/29/2011	**24196**	**24196**	**24196**	**24196**
7/6/2011	**241960**	241960	**241960**	241960
7/13/2011	**24196**	**241960**	15531	**24196**
7/20/2011	24196	**24196**	**24196**	**24196**
7/27/2011	**24196**	129970	14136	57940
8/3/2011	19863	46110	12033	24196
8/11/2011	**24196**	**24196**	**24196**	24196
8/17/2011	19863	**24196**	6488	**24196**
Geomean	42591.12	57069.33	32351.93	38593.85

Bold indicates the actual value is greater than the value given.

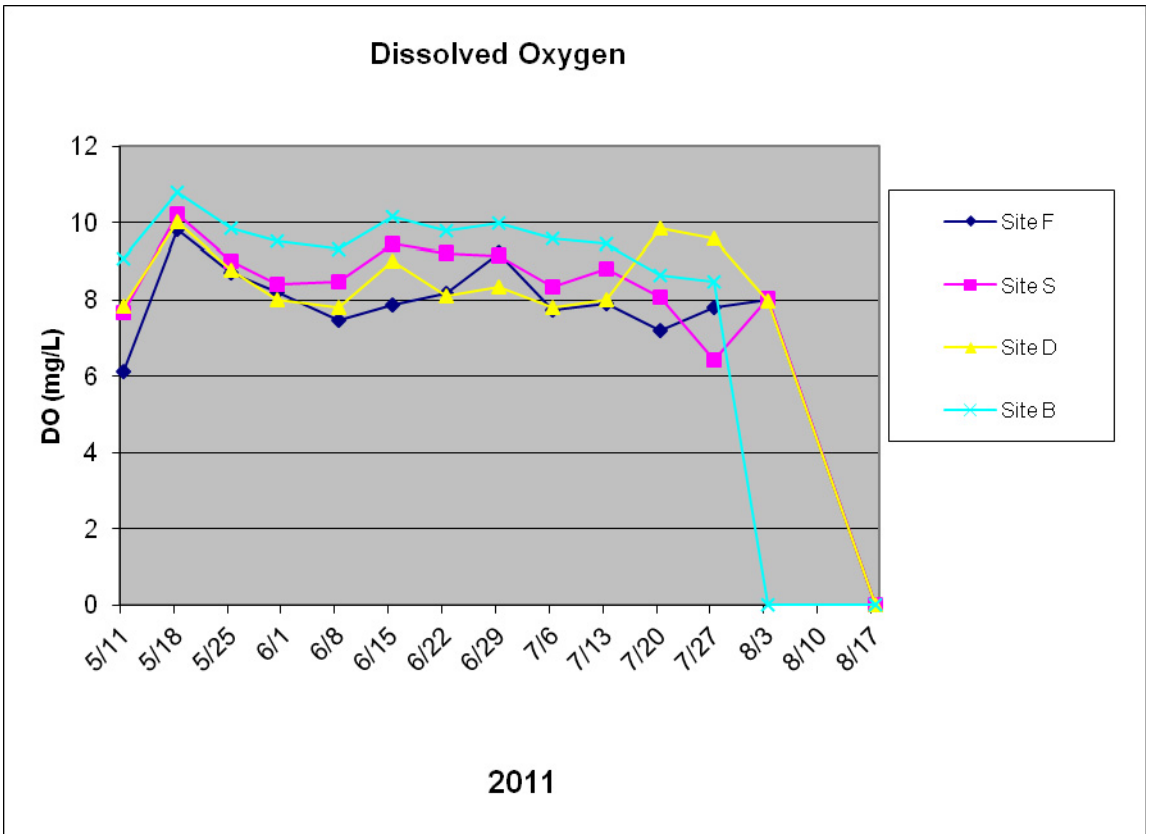




ATTACHMENT E

Dissolved Oxygen 2011

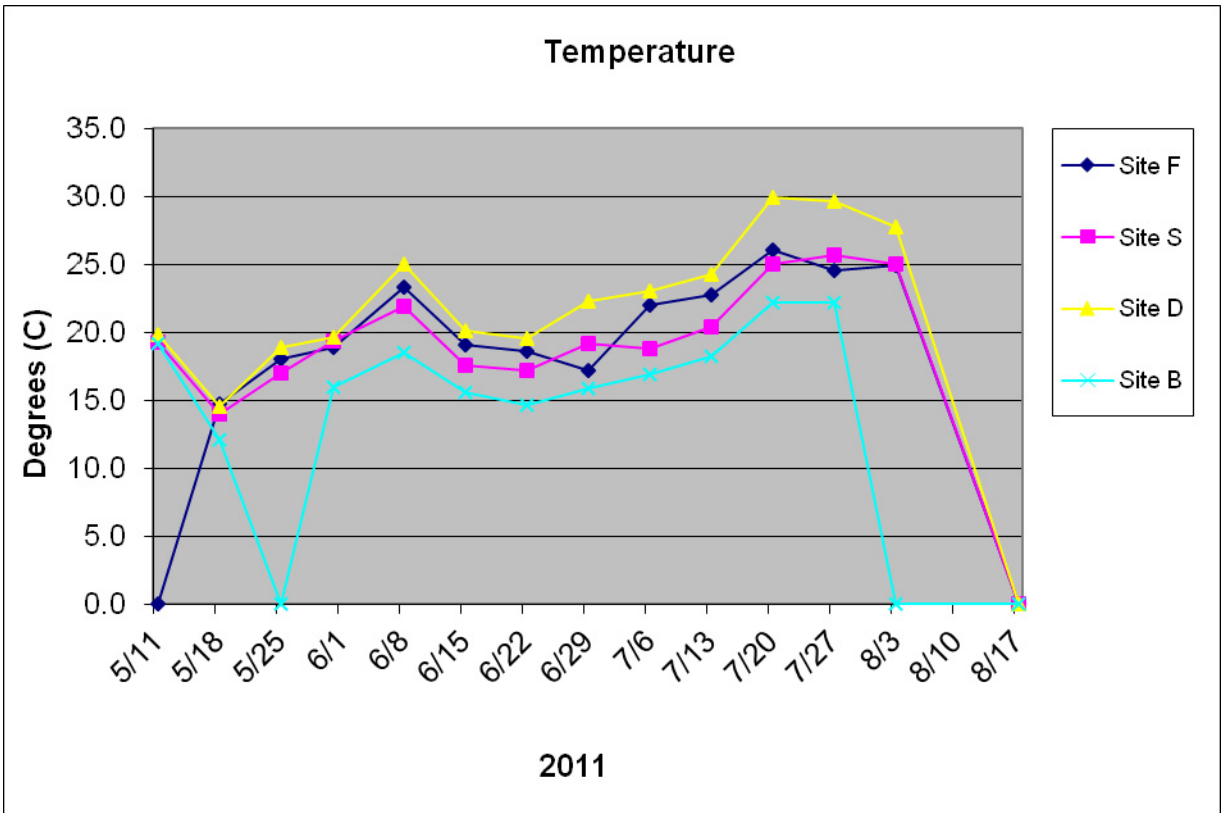
	Site F	Site S	Site D	Site B
5/11/2011	6.13	7.68	7.84	9.09
5/18/2011	9.81	10.22	10.02	10.78
5/25/2011	8.72	9.02	8.78	9.87
5/31/2011	8.2	8.41	7.99	9.51
6/8/2011	7.47	8.47	7.8	9.32
6/15/2011	7.87	9.45	9	10.16
6/22/2011	8.17	9.23	8.09	9.8
6/29/2011	9.23	9.14	8.34	9.99
7/6/2011	7.74	8.35	7.8	9.59
7/13/2011	7.9	8.8	7.99	9.46
7/20/2011	7.2	8.06	9.84	8.66
7/27/2011	7.81	6.43	9.59	8.49
8/3/2011	8.02	8.05	7.97	---
8/17/2011	---	---	---	---
Average	8.02	8.56	8.54	9.56



ATTACHMENT E

Temperature 2011

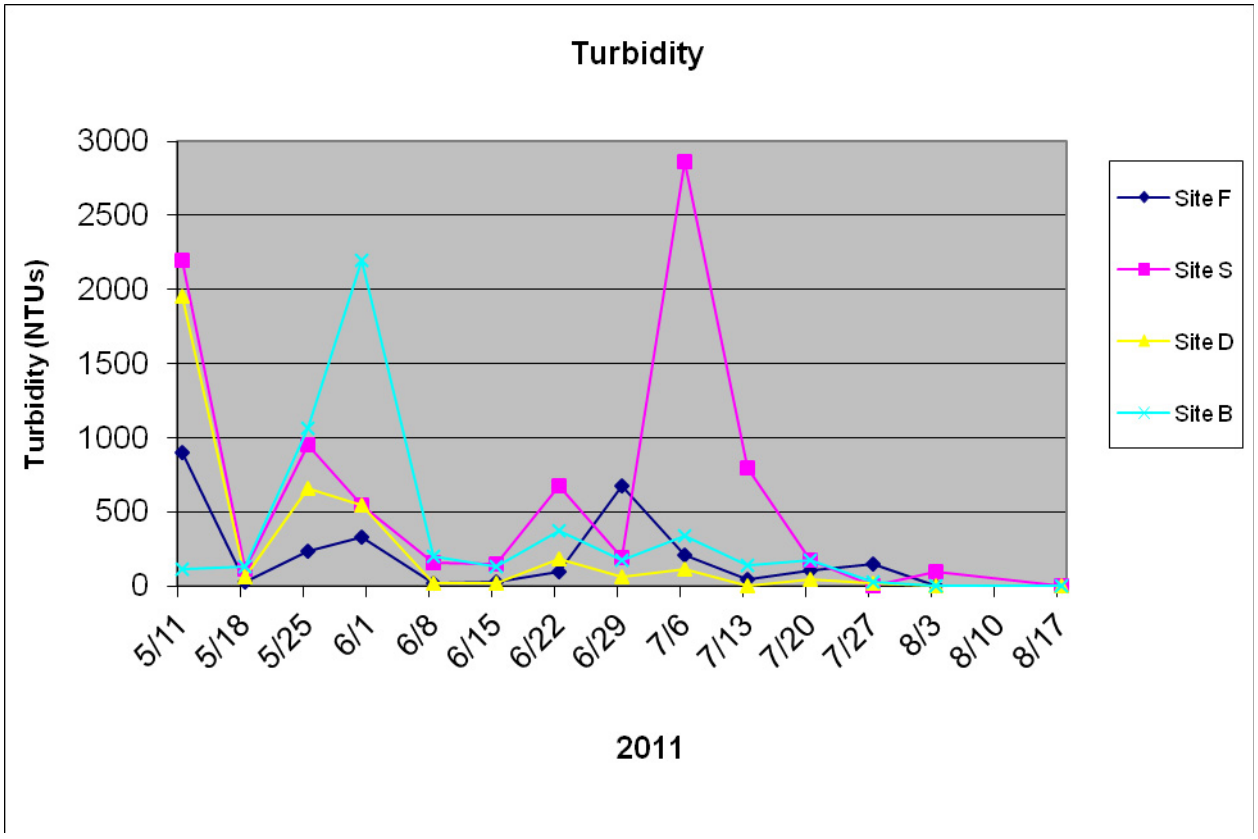
	Site F	Site S	Site D	Site B
5/11/2011	---	19.27	19.87	19.16
5/18/2011	14.77	14.01	14.52	12.1
5/25/2011	18.08	17.03	18.87	---
5/31/2011	18.86	19.34	19.66	15.97
6/8/2011	23.32	21.96	25.06	18.51
6/15/2011	19.07	17.57	20.1	15.57
6/22/2011	18.62	17.24	19.54	14.67
6/29/2011	17.24	19.19	22.26	15.92
7/6/2011	21.98	18.83	23.03	16.94
7/13/2011	22.78	20.37	24.26	18.19
7/20/2011	26.02	25	29.96	22.24
7/27/2011	24.57	25.65	29.68	22.24
8/3/2011	24.95	24.99	27.72	---
8/17/2011	---	---	---	---
Average	20.86	20.03	22.66	17.41



ATTACHMENT E

Turbidity 2011

	Site F	Site S	Site D	Site B
5/11/2011	898	2200	1957.5	119.5
5/18/2011	26.6	112.9	61.9	133.1
5/25/2011	240.7	954.6	657.8	1064.9
5/31/2011	335.2	551.6	545.7	2196.4
6/8/2011	21.5	159.8	25.5	199.5
6/15/2011	28.9	148.4	22.8	137.4
6/22/2011	102.2	679.1	186.4	371.9
6/29/2011	679.1	191.4	67.5	173.1
7/6/2011	212.3	2862.6	112.8	339.3
7/13/2011	46.4	797.9	3.7	146.3
7/20/2011	106.7	174	51	173.9
7/27/2011	154.2	--	20.6	31
8/3/2011	0.70	102.50	5.70	---
8/17/2011	---	---	---	---
Total Average	219.423077	744.566667	286.06923	423.858333



ATTACHMENT E

Annual Loading Analysis

Big Papillion Creek at 76th street and L street at Omaha, NE		
Site S		2011 Loadings
Ammonia	(kg/yr as N)	39,777
Biochemical Oxygen Demand	(kg/yr)	272,239
Dissolved Phosphorus	(kg/yr)	10,972
Nitrite	(kg/yr as N)	3,864
Nitrite + Nitrate	(kg/yr as N)	425,056
Total Dissolved Solids	(kg/yr)	36,191,329
Total Kjeldahl Nitrogen	(kg/yr as N)	140,154
Total Nitrogen	(kg/yr as N)	591,151
Total Phosphorus	(kg/yr)	33,686
Total Solids	(kg/yr)	75,954,560
Total Suspended Solids	(kg/yr)	12,980,252
Total Discharge	(ft^3/yr)	2,664,109,998

Big Papillion Creek at 168th Street and Hwy 36		
Site B		2011 Loadings
Ammonia	(kg/yr as N)	32,950
Biochemical Oxygen Demand	(kg/yr)	133,585
Dissolved Phosphorus	(kg/yr)	9,100
Nitrite	(kg/yr as N)	2,946
Nitrite + Nitrate	(kg/yr as N)	398,792
Total Dissolved Solids	(kg/yr)	22,417,191
Total Kjeldahl Nitrogen	(kg/yr as N)	61,992
Total Nitrogen	(kg/yr as N)	468,903
Total Phosphorus	(kg/yr)	21,238
Total Solids	(kg/yr)	39,843,739
Total Suspended Solids	(kg/yr)	9,605,205
Total Discharge	(ft^3/yr)	1,695,342,726

Papillion Creek at Capehart road and highway 75 at Bellevue, NE		
Site D		2011 Loadings
Ammonia	(kg/yr as N)	3,528,035
Biochemical Oxygen Demand	(kg/yr)	18,499,543
Dissolved Phosphorus	(kg/yr)	546,855
Nitrite	(kg/yr as N)	224,524
Nitrite + Nitrate	(kg/yr as N)	15,762,544
Total Dissolved Solids	(kg/yr)	2,222,181,334
Total Kjeldahl Nitrogen	(kg/yr as N)	6,885,489
Total Nitrogen	(kg/yr as N)	23,921,332
Total Phosphorus	(kg/yr)	1,307,133
Total Solids	(kg/yr)	3,421,398,944
Total Suspended Solids	(kg/yr)	211,197,559
Total Discharge	(ft^3/yr)	165,120,196,302

Little Papillion Creek at 64th street and L street at Omaha, NE		
Site F		2011 Loadings
Ammonia	(kg/yr as N)	14,040
Biochemical Oxygen Demand	(kg/yr)	94,010
Dissolved Phosphorus	(kg/yr)	2,003
Nitrite	(kg/yr as N)	1,405
Nitrite + Nitrate	(kg/yr as N)	43,087
Total Dissolved Solids	(kg/yr)	14,196,638
Total Kjeldahl Nitrogen	(kg/yr as N)	30,598
Total Nitrogen	(kg/yr as N)	75,477
Total Phosphorus	(kg/yr)	5,109
Total Solids	(kg/yr)	17,088,567
Total Suspended Solids	(kg/yr)	721,541
Total Discharge	(ft^3/yr)	909,024,615

ATTACHMENT E

Instantanous Loading Analysis

Site Name	Date	Time (CT)	Discharge (cfs)	Ammonia (g/s as N)	Biochemical Oxygen Demand (g/s)	Dissolved Phosphorus (g/s)	Nitrite (g/s as N)	Nitrite + Nitrate (g/s as N)	Total Dissolved Solids (g/s)	Total Kjeldahl Nitrogen (g/s as N)	Total Nitrogen (g/s)	Total Phosphorus (g/s)	Total Solids (g/s)	Total Suspended Solids (g/s)
Site B	01/19/11	11:45	22	0.32	1.3	0.08	0.01	5.25	304	0.16	5.41	0.13	334	30
Site B	02/16/11	10:15	239	8.79	162.2	7.37	0.68	34.47	5,265	49.07	83.54	20.82	11,957	6,692
Site B	03/16/11	10:20	35	0.00	1.0	0.12	0.03	8.52	533	0.68	9.21	0.32	644	111
Site B	04/13/11	10:05	30	0.42	0.8	0.05	0.05	5.86	348	0.21	6.29	0.11	374	25
Site B	05/11/11	10:15	40	0.57	2.3	0.15	0.19	7.36	536	0.82	8.18	0.37	691	155
Site B	05/18/11	10:00	47	0.67	1.3	0.19	0.11	10.78	614	1.17	11.95	0.53	940	326
Site B	05/25/11	10:05	174	7.88	29.6	0.84	0.44	40.40	1,784	20.45	60.85	7.34	7,869	6,085
Site B	05/31/11	10:10	172	2.44	29.2	0.73	0.44	33.12	867	20.89	54.01	10.86	10,145	9,278
Site B	06/08/11	10:10	59	0.84	1.7	0.23	0.15	16.21	758	1.14	17.34	0.85	1,353	595
Site B	06/15/11	9:55	61	0.86	1.7	0.26	0.12	16.24	822	0.43	17.10	0.59	1,109	287
Site B	06/22/11	10:05	113	1.60	6.4	0.61	0.16	35.20	1,741	5.66	40.86	3.17	4,313	2,573
Site B	06/29/11	10:25	106	1.50	3.0	0.48	0.18	30.62	1,513	3.06	33.68	1.56	2,659	1,147
Site B	07/06/11	10:00	88	1.25	7.5	0.35	0.17	21.18	1,081	3.49	24.67	1.59	2,492	1,410
Site B	07/13/11	10:10	71	1.01	2.0	0.36	0.16	19.10	953	1.71	20.81	0.86	1,339	386
Site B	07/20/11	10:45	53	0.75	1.5	0.24	0.11	14.56	711	1.22	15.77	0.66	1,048	336
Site B	07/27/11	10:15	49	0.69	1.4	0.22	0.08	13.04	638	0.89	13.93	0.51	907	269
Site B	08/03/11	10:20	41	0.58	1.2	0.21	0.07	10.68	538	0.77	11.45	0.39	744	207
Site B	08/10/11	10:10	43	0.61	1.2	0.19	0.05	11.20	539	0.91	12.12	0.35	711	172
Site B	08/17/11	10:00	39	2.98	1.1	0.18	0.06	9.94	549	0.89	10.83	0.39	717	168
Site B	09/13/11	9:45	32	0.45	0.9	0.14	0.05	7.34	421	0.23	7.79	0.24	517	95
Site B	10/18/11	10:18	25	0.35	0.7	0.11	0.04	5.59	310	0.18	5.95	0.18	344	34
Site B	11/15/11	10:00	23	0.33	0.7	0.08	0.03	4.62	283	0.16	4.95	0.14	310	27
Site B	12/13/11	10:28	23	0.33	2.6	0.10	0.03	4.75	324	0.53	5.29	0.20	388	63

ATTACHMENT E

Instantanous Loading Analysis

Site Name	Date	Time (CT)	Discharge (cfs)	Ammonia (g/s as N)	Biochemical Oxygen Demand (g/s)	Dissolved Phosphorus (g/s)	Nitrite (g/s as N)	Nitrite + Nitrate (g/s as N)	Total Dissolved Solids (g/s)	Total Kjeldahl Nitrogen (g/s as N)	Total Nitrogen (g/s)	Total Phosphorus (g/s)	Total Solids (g/s)	Total Suspended Solids (g/s)
Site S	01/19/11	11:10	35	0.50	2.0	0.09	0.03	6.54	701	0.25	6.79	0.24	729	29
Site S	02/16/11	9:30	387	12.05	252.0	7.89	0.99	44.93	9,589	101.59	146.52	41.31	28,438	18,849
Site S	03/16/11	9:35	54	0.00	1.5	0.15	0.05	10.70	823	0.90	11.61	0.37	939	116
Site S	04/13/11	9:30	47	0.67	1.3	0.07	0.05	6.92	596	0.33	7.25	0.13	626	29
Site S	05/11/11	9:40	68	0.96	25.0	0.05	0.13	2.31	930	11.94	14.25	4.72	4,078	3,148
Site S	05/18/11	9:20	74	1.05	2.1	0.25	0.15	12.78	937	1.74	14.52	0.71	1,308	371
Site S	05/25/11	9:25	282	3.99	39.9	0.88	0.64	35.93	3,018	33.86	69.79	10.30	10,764	7,746
Site S	05/31/11	9:30	278	3.94	31.5	0.94	0.63	37.00	2,480	13.30	50.30	7.32	10,234	7,754
Site S	06/08/11	9:30	93	1.32	2.6	0.37	0.24	21.07	1,201	1.82	22.88	1.11	1,804	603
Site S	06/15/11	9:20	97	1.37	5.5	0.38	0.19	20.33	1,335	1.87	22.19	1.04	1,906	571
Site S	06/22/11	9:30	178	2.52	15.1	0.76	0.35	40.32	2,122	10.89	51.21	5.90	7,656	5,534
Site S	06/29/11	9:45	167	2.36	4.7	0.61	0.28	33.58	2,279	5.39	38.97	2.18	3,480	1,201
Site S	07/06/11	9:25	140	1.98	31.7	0.24	0.40	13.88	4	28.11	41.98	7.49	13,637	14,034
Site S	07/13/11	9:31	111	1.57	12.6	0.47	0.22	19.80	1,270	6.41	26.21	2.39	2,999	1,729
Site S	07/20/11	9:30	86	1.22	2.4	0.39	0.10	19.73	1,193	1.66	21.38	0.93	1,559	365
Site S	07/27/11	9:40	76	1.08	6.5	0.32	0.09	15.06	960	2.24	17.30	0.84	1,446	486
Site S	08/03/11	9:47	64	0.91	1.8	0.29	0.07	13.23	855	1.16	14.39	0.51	1,040	185
Site S	08/10/11	9:30	69	0.98	2.0	0.29	0.06	13.68	922	1.35	15.03	0.51	1,051	129
Site S	08/17/11	9:23	59	0.84	1.7	0.25	0.07	11.36	854	1.02	12.38	0.45	982	129
Site S	09/13/11	9:10	50	0.71	1.4	0.21	0.06	8.50	678	0.35	8.85	0.28	722	44
Site S	10/18/11	9:35	39	0.55	2.2	0.13	0.03	6.07	465	0.65	6.73	0.20	484	19
Site S	11/15/11	9:25	36	0.51	1.0	0.10	0.04	5.61	490	0.54	6.15	0.15	500	9
Site S	12/13/11	9:50	36	0.51	3.1	0.10	0.03	4.69	837	0.59	5.28	0.21	891	54

ATTACHMENT E

Instantanous Loading Analysis

Site Name	Date	Time (CT)	Discharge (cfs)	Ammonia (g/s as N)	Biochemical Oxygen Demand (g/s)	Dissolved Phosphorus (g/s)	Nitrite (g/s as N)	Nitrite + Nitrate (g/s as N)	Total Dissolved Solids (g/s)	Total Kjeldahl Nitrogen (g/s as N)	Total Nitrogen (g/s)	Total Phosphorus (g/s)	Total Solids (g/s)	Total Suspended Solids (g/s)
Site F	01/19/11	9:55	15	0.21	1.3	0.01	0.02	1.06	662	0.11	1.17	0.03	663	1
Site F	02/16/11	9:05	22	0.31	9.3	0.18	0.03	1.37	343	2.63	4.00	0.91	730	386
Site F	03/16/11	9:10	20	0.00	1.1	0.01	0.02	1.25	404	0.14	1.39	0.03	406	2
Site F	04/13/11	9:10	13	0.18	0.4	0.01	0.01	0.48	219	0.09	0.57	0.03	220	1
Site F	05/11/11	9:20	99	1.40	36.4	0.07	0.36	2.80	1,180	15.45	18.25	4.82	3,386	2,206
Site F	05/18/11	9:00	16	0.23	0.5	0.03	0.04	0.95	217	0.11	1.06	0.06	230	14
Site F	05/25/11	9:10	53	1.50	9.0	0.12	0.06	1.50	323	3.35	4.85	0.63	693	371
Site F	05/31/11	9:10	18	0.25	4.1	0.04	0.04	0.51	128	0.95	1.46	0.28	310	181
Site F	06/08/11	9:05	22	0.62	0.6	0.04	0.08	1.37	299	0.36	1.73	0.10	316	17
Site F	06/15/11	9:00	20	0.28	2.3	0.05	0.08	1.30	285	0.72	2.03	0.11	302	18
Site F	06/22/11	9:15	25	0.35	1.4	0.06	0.04	0.85	214	0.53	1.38	0.17	272	58
Site F	06/29/11	9:28	20	0.28	1.1	0.01	0.03	1.19	275	0.72	1.91	0.10	311	36
Site F	07/06/11	9:05	192	2.72	21.7	0.38	0.43	6.52	1,468	7.56	14.08	1.85	2,436	968
Site F	07/13/11	9:13	17	0.24	0.5	0.04	0.03	0.82	211	0.47	1.29	0.09	232	21
Site F	07/20/11	9:10	10	0.14	0.3	0.02	0.01	0.45	137	0.16	0.61	0.05	145	8
Site F	07/27/11	9:25	18	0.25	3.6	0.05	0.05	0.82	231	0.80	1.61	0.12	239	7
Site F	08/03/11	9:23	10	0.14	0.3	0.02	0.01	0.48	143	0.07	0.55	0.04	146	3
Site F	08/10/11	9:15	10	0.14	0.3	0.03	0.01	0.54	130	0.29	0.83	0.05	135	5
Site F	08/17/11	9:10	22	0.31	0.6	0.06	0.02	1.12	284	0.50	1.63	0.08	288	4
Site F	09/13/11	8:50	18	0.25	0.5	0.06	0.04	1.38	327	0.13	1.50	0.07	333	6
Site F	10/18/11	9:18	14	0.20	1.6	0.03	0.01	0.59	186	0.25	0.84	0.08	189	3
Site F	11/15/11	9:05	13	0.18	0.4	0.01	0.01	0.66	179	0.20	0.86	0.04	180	1
Site F	12/13/11	9:30	13	0.18	1.5	0.02	0.01	0.55	539	0.23	0.78	0.04	543	5

ATTACHMENT E
Instantanous Loading Analysis

Site Name	Date	Time (CT)	Discharge (cfs)	Ammonia (g/s as N)	Biochemical Oxygen Demand (g/s)	Dissolved Phosphorus (g/s)	Nitrite (g/s as N)	Nitrite + Nitrate (g/s as N)	Total Dissolved Solids (g/s)	Total Kjeldahl Nitrogen (g/s as N)	Total Nitrogen (g/s)	Total Phosphorus (g/s)	Total Solids (g/s)	Total Suspended Solids (g/s)
Site D	01/19/11	9:15	59	0.84	5.0	0.13	0.07	7.53	2,031	0.42	7.95	0.22	2,061	30
Site D	02/16/11	8:30	268	7.60	167.1	3.27	0.53	24.31	1,808	75.59	99.91	33.96	30,830	29,022
Site D	03/16/11	8:35	40	0.00	2.3	0.07	0.03	4.96	633	0.28	5.24	0.14	649	16
Site D	04/13/11	8:35	58	0.81	3.3	0.10	0.07	5.37	778	0.41	5.78	0.23	857	78
Site D	05/11/11	8:40	3,529	49.97	1299.2	2.50	7.00	79.95	23,286	707.58	787.54	407.76	81,952	58,665
Site D	05/18/11	8:25	504	7.14	14.3	1.86	1.00	57.14	6,514	8.43	65.56	3.29	7,399	886
Site D	05/25/11	8:35	1,320	41.11	261.6	3.36	1.87	63.53	5,382	128.56	192.09	33.26	18,088	12,707
Site D	05/31/11	8:40	2,863	40.53	729.6	6.49	5.67	129.71	22,617	175.10	304.81	74.58	67,609	44,992
Site D	06/08/11	8:35	3,889	198.22	110.1	15.42	8.81	605.67	52,087	27.53	633.20	26.43	54,840	2,753
Site D	06/15/11	8:30	8,735	123.67	742.0	37.10	19.79	1360.38	125,650	61.84	1422.22	51.94	130,597	4,947
Site D	06/22/11	8:35	14,733	208.60	834.4	45.89	29.20	1168.18	125,996	421.38	1589.56	116.82	171,889	45,893
Site D	06/29/11	8:58	15,675	221.94	443.9	48.83	22.19	1731.13	179,771	324.03	2055.16	75.46	196,638	16,867
Site D	07/06/11	8:35	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Site D	07/13/11	8:43	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Site D	07/20/11	8:35	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Site D	07/27/11	8:30	12,436	176.07	1408.6	8.80	17.61	1549.41	141,911	366.22	1915.63	42.26	147,194	5,282
Site D	08/03/11	8:50	10,486	148.47	296.9	41.57	14.85	1425.28	149,357	172.22	1597.50	59.39	153,811	4,454
Site D	08/10/11	8:50	8,942	126.60	253.2	37.98	12.66	886.19	85,581	265.86	1152.05	55.70	94,190	8,609
Site D	08/17/11	8:35	8,709	665.87	246.6	36.99	7.40	1060.46	131,201	165.23	1225.69	49.32	134,160	2,959
Site D	09/13/11	8:15	1,980	28.04	56.1	7.85	1.68	235.50	29,718	14.02	249.52	8.97	30,391	673
Site D	10/18/11	8:45	21	0.29	2.9	0.08	0.02	1.47	250	0.51	1.98	0.16	271	21
Site D	11/15/11	8:40	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Site D	12/13/11	8:55	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

ATTACHMENT F

PERFORMANCE ASSESSMENT OF TWO STORMWATER BEST MANAGEMENT PRACTICES FOR INFILTRATION, WATER QUALITY, AND VEGETATIVE GROWTH

A REPORT COMPLETED FOR THE CITY OF OMAHA, NEBRASKA

BY

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AND
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FEBRUARY 2012

EXECUTIVE SUMMARY

Bioretention gardens examined by the City of Omaha in 2011 demonstrated unexpected results. Infiltration rates were slower than expected in the native soils, and much more rapid than expected in the amended sand-compost soil mix used at both sites. The results of this assessment of Best Management Practice (BMP) performance indicate that changes in design parameters need to be considered closely with attention to small details that can dramatically affect their performance, and that adjustments to existing BMPs may be appropriate to improve function and performance to achieve the intended goals of stormwater control and water quality improvement.

The purpose of this assessment was to examine infiltration and percolation of stormwater in and near established BMPs during the growing season. The original intent of this assessment grew during the project time to assess overall performance of one particular bioretention garden that demonstrated initial results different from what had originally been assumed; that being that stormwater was effectively infiltrating into the native soils as well as percolating through an infiltration cell comprised of a sand-compost mix. During the course of this project, this assessment included examination of water quality improvements and vegetative growth of the garden in addition to infiltration.

Two sites were selected for the BMP assessment: a bioretention garden constructed at Orchard Park in north-central Omaha in 2009, and a series of bioretention gardens constructed at the Under the Sink facility in west Omaha in 2008. The bioretention gardens at the two sites have different designs that allowed examination of variability in bioretention garden performance. The bioretention garden at Orchard Park consisted of two gardens separated by a sidewalk, but connected by pipes extending under the sidewalk. The gardens were established in native silty clay loam soil, with 20 foot long by 5 foot wide by 2 foot deep infiltration cells filled with a sand-compost mix, and drained through perforated 4-inch PVC pipe. The bioretention gardens at the Under the Sink facility were constructed in native silty clay loam soils with a sand-compost mix filling the entire structure to a depth of 2.5 feet. Each garden is drained by flexible, perforated pipes laid in an oval shape near the perimeter of the gardens. All of the gardens are vegetated with vegetation native or adapted to the eastern Nebraska region.

Infiltration was measured using double ring infiltrometers and mini-infiltrometers three times during the growing season (May, July, and September). In addition to measurement of infiltration using the double ring infiltrometers and mini-infiltrometers, the Orchard Park bioretention gardens were flooded three times during the summer to simulate actual stormwater conditions and infiltration. After the first series of infiltration measurements in May, valves were installed at Orchard Park to control the rate of discharge through the underdrain system. No alterations to the structures at the Under the Sink facility were made as these gardens already had valves on the underdrains.

The results of this assessment of BMP performance include the following:

1. The sand/compost soil mix used for BMPs – whether for the entire base of the BMP, or for individual infiltration cells – is very permeable, with infiltration rates typically more than 40 inches per hour
2. Native soils in most locations are slowly permeable and highly prone to compaction that will slow infiltration even more. Root growth in the native soils at Orchard Park varied by location within the bioretention garden, with the roots in some areas of the garden deep with strong vertical growth, while in other parts of the garden, the root growth was stunted by very dense soils.

3. Infiltration in native soils is enhanced in very close proximity to plants and their associated roots. Infiltration through vegetated native soil was found to be approximately 3.0 to 3.5 inches per hour. On soil without vegetation, even if only several inches away from vegetation, infiltration was very slow.

4. During stormwater simulations, water quality data show release of nitrogen and phosphorous with water percolating through the sand-compost soil mix of the infiltration cell with uncontrolled flow through the BMP (short retention time). This finding is consistent with other water quality measurements conducted around the U.S. and in a study conducted at the University of Minnesota. A reduction of nitrate nitrogen, total Kjeldahl nitrogen, and total phosphorous was observed in samples collected after water was resident in one BMP for 24 hours when compared to the samples collected after no retention time in the same BMP.

5. Vegetation performance of the BMPs was found to be good. Native plants at both sites showed vigorous, healthy growth. Root growth and extension into the sand-compost mixes was observed to be very good, and root growth into the native soils was also very good, with root depths to 12 inches. Even in compacted soils root growth extended to depths of near 8 inches below the ground, although the roots of plants growing in the compacted soil were not as thick as roots in the non-compacted soils.

6. The total time of inundation plays a significant role in plant performance. During the first two seasons of the Orchard Park bioretention gardens, no valve was on the underdrain systems; as a result they drained excessively and dried in a short period of time. The addition of a valve and adjustment of flow out of the garden to extend residence time to 24 hours stressed the little and big bluestem plants that were located in the frequent inundation area. Those plants above that level performed better, emphasizing the need to site plants appropriately within the garden.

7. The combination of these extremes highlights the importance of fine details in installation, limiting compaction during construction, and in design, detailing a valve assembly to control the flow out of the underdrain system.

1.0 INTRODUCTION

According to the U.S. Environmental Protection Agency, "The best way to mitigate stormwater impacts from new developments is to use practices to treat, store, and infiltrate runoff onsite before it can affect water bodies downstream. " In keeping with this philosophy, the City of Omaha conducted an assessment of stormwater Best Management Practices (BMPs) performance as represented by two bioretention garden systems in 2011.

1.1 Purpose

The purpose of this study was to assess infiltration and percolation of stormwater in and near established BMPs during the growing season, and determine if improvements or adjustments in the BMPs are needed.

A primary goal of the study was to determine differences in infiltration between the established BMP and nearby (non-BMP) soil conditions, and potential changes in infiltration and percolation during the growing season. The study measurements are intended to provide data that will help designers more effectively estimate the volume of stormwater that can be treated in these BMPs. Because infield observations and measurements elucidated unexpected BMP performance issues, the original intent of this study shifted from looking at infiltration differences between BMPs and the surrounding areas, and instead became focused on infiltration management and adjustment in bioretention gardens with different design elements. Through the process of evaluating BMP performance, the project had the opportunity to examine:

- Infiltration
    - in separate native and manufactured soil types
    - in simulated conditions and manipulated drainage
- Water quality
- Vegetation performance

Data quality in this study is limited to direct measurements of observed or manipulated field conditions to test BMP performance and infiltration rates.

1.2 Background

To comply with requirements of the U.S. EPA for stormwater management, the City of Omaha requires capture and treatment of the first one-half inch of stormwater runoff to improve water quality and reduce stormwater runoff peak volumes on renovation projects and new developments. One of the best methods for accomplishing this goal is the implementation of stormwater BMPs that capture and detain rainfall runoff, promote infiltration into the soil within 24 hours, and slowly conveying excess stormwater through and out of the garden. The depth of the BMP and the infiltration rate of both the native soil and any amended soil used are intrinsically related. Shallow BMPs can function properly with slower infiltration rates, with a minimum rate of at least 0.5 inches per hour. Deeper BMPs require more rapid infiltration and drainage to assure drawdown necessary to empty the BMP above ground storage in a 24-hour period.

2.0 SITE DESCRIPTIONS

Two sites were selected for study: a bioretention garden constructed at Orchard Park in 2009, and bioretention gardens constructed at the Under the Sink (UTS) facility constructed in 2008. Orchard Park is located in north-central Omaha at North 66th Street between Sorenson Boulevard and Hartman Street, consisting of approximately 14 acres bisected by Cole Creek. Orchard Park is set in a dominantly suburban residential area, and the park is used for active and passive recreation. The Orchard Park bioretention garden investigated for this study is part of a two-cell structure that collects and treats stormwater runoff from N. 66th Street. Stormwater enters the first cell through curbcuts along the street, and overflows through pipes into the larger cell that was the focus of this assessment (Figure 2-1).

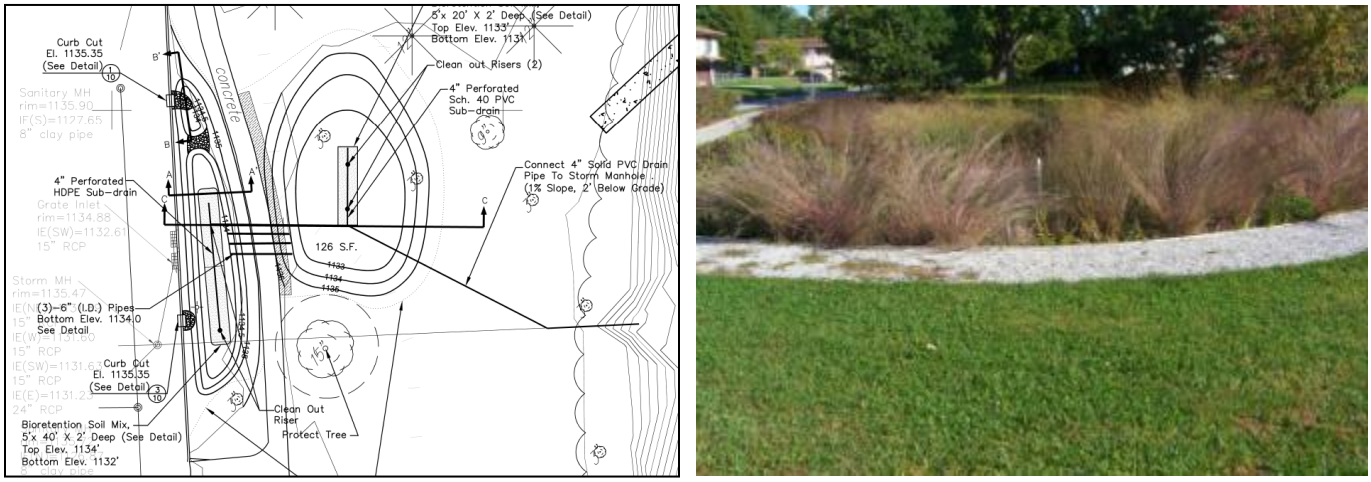

Figure 2-1: The Orchard Park Bioretention cell, with design features shown, and the primary structure showing plant growth in the third year of operation

The primary (larger) garden examined for this project averages approximately 50 feet in diameter and is approximately 30 inches deep, with a ponding depth of approximately 18 inches. Most of the garden is established in the native silty clay loam soil, with an "infiltration cell" that consists of a sand/compost soil mixture in a trench 5-feet wide, 20 feet long, and 24 inches deep, and that is drained by perforated 4-inch PVC pipe.

The Orchard Park bioretention garden exhibits very good vegetative establishment and growth. In 2011, the garden was entering its third year of growth. Grasses planted in the garden including big blue stem, switch grass, Indian grass, little blue stem, bulrush, and herbaceous plants such as black-eyed susan, liatrus, monarda, and prairie cone flower, were well-established. Little blue stem on the north and west sides of the garden does not exhibit growth vigorous as grasses on the south and east sides of the garden, and grasses in the middle of the garden, within the "infiltration cell" demonstrate excellent growth and establishment.

The Under the Sink facility is a household hazardous waste collection facility operated by the City of Omaha located at 4001 South 120th Street, occupying approximately 5.5 acres. The land has moderate slope to the west, and consists primarily of the building, parking lots, and turf lawn. A series of 15 bioretention gardens were constructed in 2008 at the site along the west and south boundaries of the property, adjacent to 120th Street (Figure 2-2).

Figure2-2: Under the Sink Bioretention Gardens (aerial photo source: Google Earth)

The bioretention gardens are generally about 20 feet in diameter, and were constructed in a silty clay loam soil. The bioretention gardens were constructed with flexible, perforated drainage pipe installed in an oval configuration at the bottom of each garden, connected with a solid four inch drainage pipe that runs to the nearest storm sewer inlet. Pea gravel was installed over the perforated pipe, geotextile laid over top of the aggregate and stapled down, and then backfilled with a compost/sand mixture. The ponding depth of each garden is approximately six inches. Vegetative growth in the bioretention gardens was observed to be good at the time of sampling, with some sparsely vegetated areas in two of the gardens. Vegetation in the gardens included Helen's Flower, New England Aster, Bee Balm, Spiderwort, and Golden Alexanders.

3.0 DATA COLLECTION AND RESULTS

Infiltration measurements were collected using double ring infiltrometers and mini-infiltrometers. Double ring infiltrometers have long been used by soil scientists and engineers to determine infiltration rates in soils. The device consists of two concentric rings, one inside the other, that are filled with water, with the drop of the water level in the inner ring measured with time (falling head measurement). The mini-infiltrometer is a smaller version of the double ring infiltrometer. When possible, subsoil conditions and root development of plants were examined to help understand the flow rates in the BMPs.

Infiltration and percolation measurements were conducted three times during the growing season: early May; mid-July; and September. Samples were initially collected within the BMP structures and from areas nearby the BMPs, but as initial data demonstrated variable characteristics within the BMPs, the subsequent measurement periods focused on the bioretention garden structures to determine if seasonal changes with plant growth or changing soil conditions might occur. Infiltration testing was initiated on May 9, with subsequent testing completed on July 12/13, and September 21, 2011. At both locations, measurements included infiltration within the gardens, and from nearby turf lawns.

In addition to measurement of infiltration using double ring infiltrometers and mini-infiltrometers, the Orchard Park bioretention garden was flooded three times during the summer season to simulate actual

storm runoff conditions. The objective was to measure the 24 hour infiltration rate of the garden from a staff gauge placed in the center of the garden. After the 24 hour infiltration readings were taken, the valves on each garden were opened one at a time to assess the rate of flow out of the garden through the underdrain system. Concurrent to the second and third simulations, water quality samples were collected and analyzed to assess the bioretention garden's performance in removing pollutants.

Vegetation condition was observed and noted during each sampling period at both sites. Along with observation of vegetation conditions, infiltration related to bioretention garden vegetation was measured twice at Orchard Park using the double ring infiltrometer in which the center ring of the infiltrometer was placed over a stalk of native grass (little bluestem both times), and measurements of infiltration rate recorded from the center ring.

4.1 Orchard Park

The original intent of infiltration measurement at Orchard Park was to measure the differences in infiltration within the bioretention garden compared to infiltration outside the garden and if infiltration would increase with plant growth through the summer. During the first testing period in May, it was observed that infiltration in most areas within the bioretention garden and outside of the infiltration cell was very slow; generally less than 0.5 inches per hour (see Section 3.0). Infiltration within the garden and within the footprint of the infiltration cell was excessively fast, measured at a rate in excess of 24 inches per hour.

4.1.1 Infiltration

Infiltration measurements were collected at Orchard Park at varying locations within the bioretention garden in approximately similar locations, or in locations to determine if amendments to soil conditions or plantings affected infiltration. Approximate testing locations are shown in Figure 4-1.
At Orchard Park, the premise that the infiltration rates for the bioretention garden may increase with new vegetative growth through the summer was a constant measurement objective. After the first

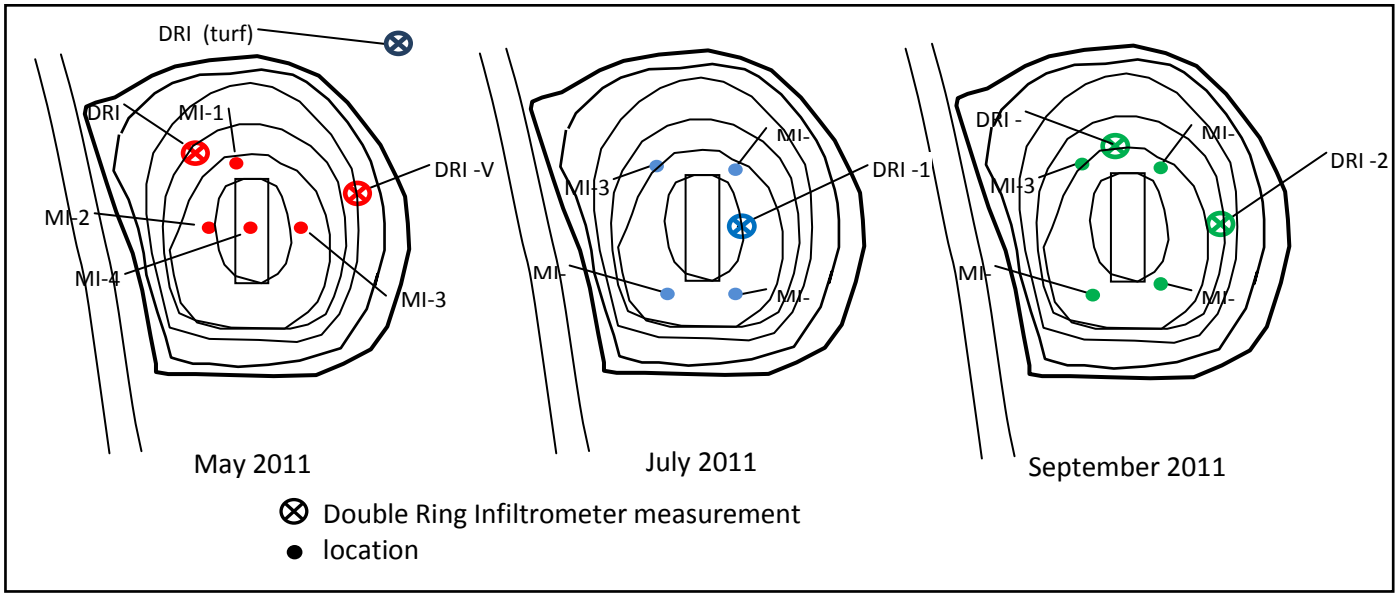

Figure 4-1: Infiltration measurement locations – Orchard Park Bioretention Garden

measurements in May the native soil condition was examined for bulk density to determine if this factor could be influencing infiltration rates. The bulk density of the bioretention garden was measure as high as 1.8 grams per cubic centimeter (g/cc) from the surface to approximately eight inches below the surface, reflecting a high degree of compaction. The project approach was amended to determine if remedial actions to break compacted, dense soils would improve infiltration.

Throughout the measurement periods, the infiltration tests using the double ring infiltrometers demonstrated very slow infiltration. Infiltration rates measured at Orchard Park are provided in Table 4-1. To determine if infiltration were equally slow near or with vegetation, infiltration was measured on soil occupied by native grass (little bluestem).

Table 4-1: Infiltration Measurement Results
Orchard Park, May-July-September 2011

Measurement Location	May 9	July 12	Sept 21
DRI – Turf	0.38 in/hr	No Measure	No Measure
DRI	0.25 in/hr	<0.10 in/hr	<0.10 in/hr
DRI – Vegetation	3.00 in/hr	No Measure	3.50 in/hr
MI – 1	0.38 in/hr	0.62 in/hr	8.20 in/hr
MI – 2	0.75 in/hr	1.12 in/hr	0.13 in/hr
MI – 3	0.81 in/hr	0.18 in/hr	0.76”/hr
MI – 4	>40 in/hr *	0.00 in/hr	9.75”/hr

In general, the infiltration rates in the native soil of the Orchard Park bioretention garden ranged from 0.38 inches per hour on the north side of the infiltration cell, to 0.75 to 0.81 inches per hour on the west and east sides of the cell, and greater than 40 inches per hour within the sand/compost mix of the infiltration cell. The infiltration rate in native soil between plants averaged approximately 0.41 inches per hour, or 1.65 inches per hour including the two very rapid infiltration measurements shown in Table 4-1. The average infiltration rate excluding the two very rapid measurements is nearly equal the rate measured in the nearby park turf grass area (0.38 inches per hour). The data show that infiltration incorporating vegetation in the measurement showed a rate of 3.0 inches per hour.

The data show very slow infiltration rates, with variability in the rates of infiltration measured at different locations in the garden. Measurements from the south end of the bioretention garden had faster infiltration than readings collected on the north (0.62 – 1.12 in/hr on the south end compared to 0.00 to 0.18 in/hr on the north end in July. The garden also had typically faster infiltration on the west side (southwest and northwest corners) of the infiltration cell compared to the east side of the infiltration cell.

4.1.2 Stormwater Drainage Simulation

Valve assemblies were installed on both of the bioretention garden underdrains in May, 2011 when it was realized that drainage through the infiltration cells was too fast. To assess the infiltration of the garden as a whole, three simulated rain events were conducted by closing the underdrain valves and then flooding the garden with water from a nearby fire hydrant. These simulations took place on May

25th, June 30th, and August 17th. During the first simulation, the drop in water elevation of ponded water in the larger, primary garden was less than 3 inches over a 24-hour period. When the valve was open, the garden drained within 75 minutes, or 10.92 inches per hour, showing the affect of the infiltration cell on the performance of the bioretention garden. The second and third simulations were 12.12 and 14.64 inches per hour respectively.

During the storm event simulations, the valves were shut completely and the outfall was capped to ensure no loss of water. The 24 hour infiltration rate of water into the native soil of the primary bioretention garden was consistent for the May 25th, June 30th, and August 17th simulations, with measured infiltration rates of approximately 0.10 to 0.125 inches per hour (Table 4-2). The data indicate slight movement upward in the infiltration rate over the course of the growing season, but not significantly.

Table 4-2: Bioretention Garden Flooding Infiltration Results June and August 2011

	Water Elevation 0 hr (ft)	**Water Elevation 24 hr** (ft)	**Drop** (ft)	**Drop** (inches)	**Infiltration Rate** (in/hr)
June 30, 2011					
24 hr infiltration (ft):	1.7	1.47	0.23	2.76	0.115
August 17, 2011					
24 hr infiltration (ft):	1.465	1.22	0.245	2.94	0.123

4.1.3 Water Quality Analysis

Water samples were collected at Orchard Park during the second and third rainfall flooding simulations to provide a preliminary assessment of BMP performance for water quality improvement. Composite samples were collected for the influent entering the first curb-side garden and grab samples were collected as water first entered the larger, primary bioretention garden. Effluent grab samples were taken from both gardens independently to assess each gardens performance. Water samples were then collected from the effluent discharged from the primary garden at 0 hour, and again after 24 hours of residence time.

Samples were analyzed for nitrate/nitrite nitrogen, Total Kjeldahl Nitrogen (TKN), total phosphorous (TP), total dissolved phosphorous (TDP), heavy metals, and hydrocarbons. E coli, total suspended solids (TSS), and total solids (TS) were also tested, but due to errors in the field and lab, usable data was not obtained.

Water quality analytical results are shown in Table 4-3. The data show increases in nitrogen and phosphorous concentrations as the simulated stormwater filters through the bioretention garden. This is not unexpected, as microbial activity will free nitrogen and phosphorus from its bound form in organic matter, making it susceptible for leaching with incoming water. These results are consistent with the findings of other infiltration BMPs listed on the U.S. BMP Database maintained by the U.S. EPA in which similar BMPs show slight increases of nitrogen and phosphorous in effluent.

Table 4-3: Water Quality Analytical Results Orchard Park – June 2011					
	Nitrate/Nitrite Nitrogen	Total Kjeldahl Nitrogen	Total Phosphorous	Nitrite	Total Dis. Phosphorous
Influent (mg/l)	0.03	2.39	0.44	0	0
0-hr effluent (mg/l)	0.52	2.54	0.71	0	0.62
24-hr effluent (mg/l)	0.90	2.00	0.76	0.02	0.63
U.S. median influent (mg/l)[a]	0.59	01.80	0.25	NA	0.09
U.S. median effluent (mg/l)[a]	0.60	1.51	0.34	NA	.044
a. Median of 57 infiltration BMPs nationwide. Source: USEPA National BMP Database, May 2011					

It may be reasonable to assume that the pollutant removal capabilities of the Orchard Park and other BMPs in Omaha will show similar results for effective filtering of sediments, metals, and hydrocarbons. Bioretention gardens have been reported to effectively remove metal pollutants and hydrocarbons from stormwater under simulated conditions, while also releasing consistent concentrations of phosphorous. A study conducted at the University of Minnesota showed good uptake of cadmium, zinc, and copper by compost-amended sand in bioretention gardens, while releasing phosphorous at rates of approximately 0.29 mg/l through several hundred simulated rainfall infiltrations (Morgan, Gulliver, and Hozalski, University of Minnesota, Science and Engineering Update, Nov. 2011)

4.1.4 Vegetation

The plant material within the primary garden has performed quite well since its installation in early 2009 and has continued to perform well in 2011. Observations during the course of this study include:

- Root growth was good, with plants within the infiltration cell showing excellent root growth and structure. Plants growing in the native silty clay soil also showed very good growth, with roots found as deep as 12 inches below the ground surface. Roots of little bluestem growing in areas of the garden that have compacted soils also showed root growth to depths of 6- to 8 inches below the ground surface (bgs), demonstrating the hardiness of these plants to grow even in difficult soil conditions (Figure 4-2).

- Little bluestem grass that encompasses the majority of the north, east and south sides of the primary bioretention garden exhibited stunted growth where inundation occurred more frequently, typically toward the bottom of the garden. It is likely that while root growth was observed as deep as 8 inches bgs, high bulk density of the native soil and poor drainage contributed to stunted growth of the plant and its roots.

Figure 4-2: Root growth in uncompacted native soil (left) and compacted native soil (right)

- In late August, a 4- to 7-inch rainfall occurred in the Omaha area. Both gardens that comprise the bioretention structure were filled to capacity, with 12" of ponding in the first garden and 26 inches of ponding in the primary garden. The valve in the primary garden was partially closed to allow for a slow drawdown. In the bottom of the garden, Big Blue Lobelia had been performing well, but prolonged submersion during this event led to die-back of this plant. Lobelia plants that were able to stay above the ponding level remained viable and approximately two weeks after this event, new growth was noted at the base of the plants.

- New England Aster has exhibited strong colonization throughout the gardens and into the adjacent naturalized areas.

- Black-eyed susans and prairie cone flowers exhibited less vigorous growth than the first two years. This is not unusual, as the typical growth pattern of these plants is two years, followed by new growth from seed. The overall population of black-eyed susans and prairie cone flowers was lower in 2011, but improvements are expected in 2012.

- Penstemon and Prairie Blazing Star growth improved in the smaller, curb-side garden from decreases in populations in 2010 primarily the result of extensive vole damage.

The original design for the Orchard Park bioretention garden included drier, upland vegetation such as little bluestem in the bottom of the garden with the expectation of dry conditions during mid- to late-summer. The rapid drainage of the garden due to the highly permeable infiltration cell kept conditions dry and allowed the upland plants to do well. After the drain valves were installed in the garden, and

drainage slowed, the dryland vegetation such as little bluestem and great blue lobelia suffered due to the wetter conditions.

4.2 Under the Sink

Infiltration measurements were collected at the Under the Sink facility in the four bioretention gardens in the northwest corner of the property. Whereas the initial infiltration measurements at Orchard Park demonstrated very slow movement of water into the soil, infiltration into the Under the Sink bioretention garden soils was very fast. Observation of the four gardens showed that the first garden (BG-1) has a layer of silt over the top of the amended soil mix approximately 1.5 to 2 inches thick. It was determined to measure infiltration through the silt, as well as with the silt scraped aside. The remaining three gardens (BG-2, BG-3, and BG-4) were not covered with discernable silt. Measurements were collected in each garden as shown in Figure 4-3.

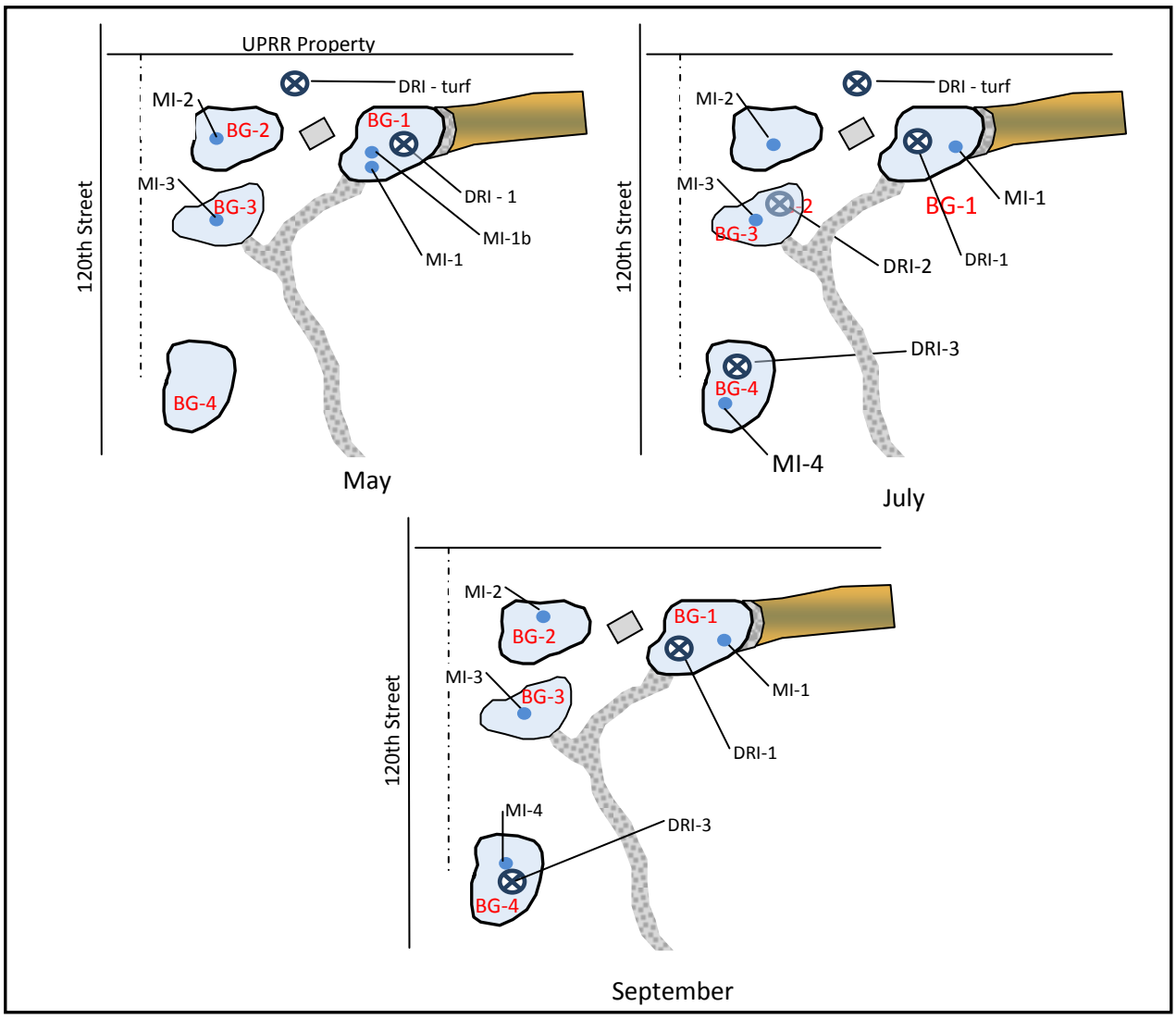

Figure 4-3: Infiltration Measurement Locations at the Under the Sink Bioretention Gardens

Because of the very porous nature of the bioretention amended soil at the Under the Sink facility, infiltration measurements from May through September were conducted to determine if there would be changes in infiltration rates with increased plant growth through the summer (including root mass) and/or possible silt deposition that could occur with rainfall runoff. Infiltration measurements were also collected in the turfgrass area near the BMPs at the Under the Sink facility. Infiltration rate measurement results are shown in Table 4-4.

Table 4-4: Infiltration Measurement Results Under the Sink, May-July-September 2011

Measurement Location	May 9	July 12	Sept 21
DRI – Turf	1.00 in/hr	0.90 in/hr	No Measure
DRI – 1	3.9 in/hr *	16.2 in/hr*	9.10 in/hr
DRI – 2	No Measure	>40 in/hr*	No Measure
DRI – 3	No Measure	>40 in/hr*	>40 in/hr*
MI – 1	2.31 in/hr	3.50 in/hr	6.50 in/hr
MI – 1b	>40 in/hr *		
MI – 2	21.5 in/hr*	28.0 in/hr*	5.50 in/hr
MI – 3	>40 in/hr *	>40 in/hr*	>40 in/hr*
MI – 4		>40 in/hr*	>40 in/hr*
*interpolated infiltration rate from last time measurement			

Infiltration measurements collected at the Under the Sink facility in May included examination of the northeast-most bioretention garden (BG-1) that had been covered with approximately 1.5 – 2 inches of silt. Infiltration measurements in this garden, collected with the silt in place, demonstrated reasonable infiltration rates (3.9 in/hr using the double ring infiltrometer, and 2.3 in/hr using the mini-infiltrometer). Infiltration rates in this same garden in July and September showed variable infiltration rates through the silt-covered material, including rates of 16.2 in/hr and 9.1 in/hr with the double ring infiltrometer, and 3.5 in/hr and 6.5 in/hr with the mini-infiltrometer. The variability in these measurements likely reflects varying thickness of the silt as well as possible edge effects from water seeping along the sides of the infiltrometer tools used. An additional measurement of infiltration into the garden with silt scraped away (MI-1b) resulted in an excessively rapid rate, greater than 40 in/hr.

Infiltration measurements collected in the two adjacent gardens, where silt had not accumulated were 21.5 in/hr in BG-2 (MI-2 in Figure 4), and greater than 40 in/hr in BG-3. Infiltration remained rapid in July and September in BG-2 (28 in/hr and 5.5 in/hr, respectively) and BG-3 (>40 in/hr in both July and September). The fourth garden (BG-4) had infiltration rates greater than 40 in/hr for both mini-infiltrometer and double ring infiltrometer measurements in July and September.

The two infiltration readings collected on the turf area at the Under the Sink facility were generally consistent between the two readings, with infiltration approximately 0.90 to 1.0 inches per hour. The data show, then, that the rapid rate of infiltration in the Under the Sink bioretention gardens is substantially greater than the existing turf, and even infiltration through the silt-covered garden was more rapid than infiltration into the existing turfgrass areas.

5.0 DATA INTERPRETATION AND DISCUSSION

When the bioretention gardens are considered as complete structures, information obtained during this assessment demonstrates that BMPs improve drainage of stormwater by diverting water away from storm sewer inlets and slowing its discharge. From this study, it was observed that variability in design and construction significantly affects the rates of stormwater infiltration and drainage in the bioretention gardens and their performance.

Infiltration rates on turf grass lawn areas near BMPs studied ranged from 0.38 inches per hour to approximately 1.0 inches per hour, based on a limited number of measurements collected. Typically, infiltration rates in the BMPs studied ranged from 0.125 inches per hour during storm event simulations at the Orchard Park primary bioretention garden, to an average of 6.9 inches per hour in the silt-covered bioretention garden at the Under the Sink facility, and to greater than 20 inches per hour in the other three gardens examined at Under the Sink.

5.1 Stormwater Infiltration at Orchard Park

While data collected at Orchard Park demonstrated increased stormwater drainage rates overall when compared to background conditions, the data does not indicate an increased rate of infiltration of stormwater into the natural soil at this location. The data showed that the sand/compost soil mix used for the infiltration cell is excessively permeable, with infiltration rates greater than 40 inches per hour based on interpolation of timed infiltration within the limits of equipment used. Infiltration in the native soil surrounding the infiltration cell averaged 1.6 inches per hour, however, two infiltration measurements were extraordinarily high (9.75 and 8.2 inches per hour) skew this average. Without these measurements, the average infiltration rate into the native soil averaged 0.4 inches per hour, with a range (excluding the two high measurements) from 0 to 1.12 inches per hour. The infiltrometer measurements were consistent with the results of a simulation in which the BMP was flooded with water from a fire hydrant. When the underdrain system was closed at the Orchard Park gardens, the 24 hour infiltration rate into the surrounding native soils was very slow, approximately 3 inches, or 0.125" per hour. When the underdrain valves were open, the bioretention garden completely drained in 70 minutes.

The measured variability in infiltration rates on the native soil likely reflects differences in soil density and/or proximity of the measurement to vegetation. The influence of vegetation on infiltration rates in the bioretention garden, however, was demonstrated with two measurements showing rates of 3.0 to 3.5 inches per hour. This highlights the importance vegetation plays in the overall function of bioretention gardens. It also brings notice that their influence on excessively compacted and poor soil conditions is slow to evolve, with infiltration rates between plants showing little increased infiltration as compared to those taken directly over the plant material.

5.2 Under the Sink

The 50/50 fine sand and compost mix used as the base soil of the bioretention gardens at the Under the Sink facility exhibited very high infiltration rates in all four of the gardens studied during all of the measurement periods. Only a covering of silt on BG-1 modified and slowed the infiltration into the garden. The extent of root growth in the Under the Sink bioretention gardens was not examined to

determine if the roots have extended into the native subsoil and may be promoting infiltration into the deeper soil depths.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The results of this study did more to expose potential design and construction flaws that can occur with bioretention gardens than to observe changes or improvements in stormwater infiltration over the course of the growing season. The results of this study will contribute to improved BMP design to enhance infiltration and water quality.

Essential findings of this study include:

1. The sand/compost soil mix used for BMPs – whether for the entire base of the BMP, or for individual infiltration cells – is very permeable. The rate of measured infiltration into this soil mix is typically more than 40 inches per hour. Root growth into the sand/compost mix at Orchard Park was inspected, with plants roots within the infiltration cell showing excellent growth (approximately 24 inches or more).

2. Native soils in most locations are slowly permeable and highly prone to compaction that will exacerbate slow infiltration even more. Root growth in the native soils at Orchard Park overall was good but varied by location within the bioretention garden, with the roots in some areas of the garden deep with strong vertical growth, while in other parts of the garden, the root growth was acceptable, but stunted by very dense soils.

3. Infiltration in native soils is enhanced in very close proximity to plants and their associated roots. Infiltration on soil without vegetation, even if only several inches away from vegetation, was very slow, whereas infiltration measurements that incorporated native grasses within the infiltrometer demonstrated higher rates of infiltration.

4. Water quality data show release of nitrogen and phosphorous when water percolates through the sand-compost soil mix of the infiltration cell. This finding is consistent with other water quality measurements conducted around the U.S. and in a study conducted at the University of Minnesota. It's reasonable to assume, based on other studies conducted on bioretention gardens that other pollutants such as sediments, metals, and hydrocarbons will be removed from stormwater in bioretention gardens, but nitrogen and phosphorous will be released with water discharged from the gardens. No data was found to determine if higher concentrations of nitrogen or phosphorous in water entering the garden would be reduced in concentration in discharged water.

5. The total time of inundation plays a significant role in plant performance. During the first two seasons of the Orchard Park bioretention gardens, no valve was on the underdrain systems; as a result they drained excessively and dried in a short period of time. The addition of a valve and adjustment of flow out of the garden to extend residence time to 24 hours stressed the little

and big bluestem plants that were located in the frequent inundation area. Plants above that level performed better, emphasizing the need to site plants appropriately within the garden.

The findings of this study should be considered in the future design elements of new stormwater BMPs, as well as the management of existing BMPs in Omaha. Observations and measurements of infiltration at Orchard Park and the Under the Sink facility, combined with knowledge of the BMP structures, provides the following design and construction recommendations for BMPs:

1. Because of the high infiltration and permeability rates of the sand/compost infiltration mix, this material should be limited in application for bioretention gardens. Three strategies for design with the manufactured soil mix include:

    a. Limit the extent of sand/compost mix to areas immediately above drainage pipes. The areal extent of the sand/compost mix can be determined by calculation of the volume or column of water that can pass into and through the infiltration cell assuming an infiltration/percolation rate of at least 20 inches per hour. The BMP designer should determine the true infiltration rate of the sand/compost mix prior to conducting calculations. It must be noted that bench-scale tests of sand/compost mix infiltration rates indicated infiltration rates of approximately 3.5 inches per hour, far less than what was measured in the field.

    b. Install a valve at the discharge point of the drainage pipes of the BMP that can be open and closed as appropriate to control drainage from the BMP.

    c. Install a reducer (1-2”) between the perforated and solid drainage pipes to restrict the flow out of the system if a valve is not utilized.

2. Water quality benefits are likely greater with longer residence time of water within the soil, which can be controlled with slower drainage through a valved underdrain system. The valve can be adjusted to slow or increase flow rate out of the system as needed. It can also be adjusted over time to account for increased infiltration into the native soils as a result of plant root establishment, increasing the effectiveness of the garden.

3. Manage native soils in the BMP carefully. During construction, limit access over the base of the BMP by equipment and foot traffic when and where possible. If heavy equipment must be used within the BMP area, the soils should be tilled to a depth of 8- to 12 inches (minimum) to break any compaction, and compost worked into a depth of at least 6 inches at a rate of approximately 1 cubic yard per 100 square feet. If a rototiller is utilized for blending of compost into the native soils, randomly dig holes throughout the tilled area deeper than the tilling depth. This will help to reduce the potential of an impermeable layer forming where the depths of the tines of the tiller reach to. Smearing and compacting of native soils can occur with tines striking at the same consistent depth during operation.

4. In existing or new BMPs, where compaction is found to be a problem, the compaction can be broken between plants using either an auger or a hand shovel to a depth of at least 12 inches, and backfill the hole with the native soil and compost mixed at a 1:1 rate. This will enable plant roots to grow more freely, and will also help to reduce the compaction of nearby soils. Compaction must be broken as much as possible in as many locations in the BMP as possible.

5. Maximize plant density. Plants and their root growth are the single most important factor in maximizing water infiltration into the soil in the BMP. Plant density should be carefully considered, however, as too high of a planting density can stunt plant growth. Not enough plants, however, will reduce the effectiveness of the BMP. Consider targeted spreading of seed from established plants within the garden. This can help to establish a full garden sooner with plants germinating in desired locations.

6. Monitor BMPs for infiltration performance regularly. If infiltration is not occurring as planned, adjustments to the BMP structure, whether by the amending soil conditions, increasing plant density, or installing a valve to control discharge can remediate problems and increase the performance and function of the BMP.