

THE CITY OF KNOXVILLE TENNESSEE

NPDES Permit Annual Report



National Pollutant Discharge Elimination System
Stormwater Discharge Permit TNS068055
July 1, 2000 - June 30, 2001

Signature and Certification

NPDES STORMWATER PERMIT TNS068055 2000/2001 MUNICIPAL ANNUAL REPORT

FOR: City of Knoxville, Tennessee

Federal regulations, 40 CFR 122.22 (a) (3) and 122.22 (d), require the application and reports for the NPDES permit to be signed and certified as follows:

For a municipality, State, Federal, or other public facility, by either a principal executive officer or ranking elected official.

"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 gather and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

XXXXXXXX XXXXXXXX	12/19/01
_____ Victor H. Ashe Mayor	_____ Date
XXXXXXXX XXXXXXXX	12/19/01
_____ Samuel L. Parnell, Jr., P.E. Director of Engineering	_____ Date
XXXXXXXX XXXXXXXX	12/19/01
_____ Michael Kelley Law Director	_____ Date
XXXXXXXX XXXXXXXX	12/19/01
_____ Randolph B. Vineyard Finance Director	_____ Date



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1.0 INTRODUCTION

The Tennessee Department of Environment and Conservation, Division of Water Pollution Control issued the City of Knoxville a National Pollutant Discharge Elimination System (NPDES) Permit (TNS068055) for the discharge of stormwater from the municipal separate storm sewer system (MS4). Stormwater from the City of Knoxville discharges directly to the Tennessee River and to major creeks that drain to the Tennessee River. Only a small portion of the MS4 runoff will drain to sinkholes, ponds, and lakes throughout the area. The current NPDES Permit was issued on July 1, 1996 and expired on June 28, 2001.

The NPDES Permit requires annual reporting of the progress of the Stormwater Management Program outlined in the Part I and Part II applications. The Annual Report was completed in accordance with the reporting requirements of Part VI of the permit and will complete the requirements for the fifth permit year from July 1, 2000 through June 30, 2001.

The Stormwater Quality Section of the City of Knoxville Engineering Department coordinated preparation and submittal of the system-wide Annual Report and Reapplication. Information for the annual report has been provided by the Engineering Department, Public Service Department, Parks and Recreation Department, Knoxville Area Transit (KAT), Knoxville/Knox County Emergency Management Agency (KEMA), and the Knoxville Utilities Board (KUB). The Engineering Department has compiled the available information into the format outlined in Part VI of the current NPDES Permit.

2.0 CONTACTS LIST

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3.0 STORMWATER MANAGEMENT PROGRAM (SWMP) EVALUATION

The objective of the City of Knoxville's SWMP is to protect the taxpayer's health, safety, and welfare through an economically viable comprehensive stormwater quality and quantity program. The City is proud to report some of the major accomplishments related to the SWMP that occurred during the fifth year of the NPDES permit term. Although it would be impossible to list all of the City's water quality related accomplishments in this report, the City has listed some of the significant water quality achievements during year five.

- ▶ In an effort to reduce the amount of floating trash, oil, and other pollution entering the Tennessee River, industrial grade calm water skimmers were installed at the outlets of Knoxville's most urban watersheds. A partnership with the Izaak Walton League was developed to install and maintain the floating skimmers. The City purchased the skimmers with penalty funds collected from polluters.



- ▶ The City extended the greenway/buffer zones along major waterways throughout the city to include a total of 20.74 miles of trail distributed over 14 greenways/buffers. These linear parks help protect the adjacent waterways and riparian zones.
- ▶ The first edition of the City of Knoxville's Best Management Practices manual was completed and may be accessed at www.ci.knoxville.tn.us/engineering/bmp_manual/ for viewing or download. The manual was introduced and distributed to local engineers during a new development workshop during year five.

- ▶ The City continued to reduce illegal dumping into storm drains by raising public awareness of the separate storm and sanitary systems. A new standard design was implemented on January 1, 2001 for all new curb irons and solid stormwater manhole covers. Each of the stormwater castings must now include a "No Dumping – Drains to River" message permanently cast into the iron structure. In addition to the new irons on newly developed sites, over 2000 small plastic disks with a "No Dumping" message were glued to existing curb irons throughout the city by students and volunteers.

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- ▶ The City continues to sponsor and support an Americorps Water Quality team. The Water Quality team assists the City with community water quality education, creekbank stabilization projects, water quality testing, and creek cleanups. Americorps coordinates the Adopt-a-Watershed program in eight area schools.
- ▶ The City sponsored Ijams Nature Center to coordinate the 12th Annual River Rescue event to help cleanup trash and debris from the waterways throughout the area. The spring 2001 event attracted 835 volunteers who collected approximately 17.7 tons of trash and 167 tires from 36 sites on 100 miles of river/lake shoreline.
- ▶ Over 101 tons of Household Hazardous Waste (HHW) was processed last year at the permanent HHW facility. The facility is available to residents Tuesday through Saturday.
- ▶ A pipe camera was acquired during year five to improve our illicit discharge inspections program. During the first few months of operation, the camera has helped the City locate several discharges to the MS4. Soon after the camera was put into operation, an illegal sewer connection to the MS4 was discovered from a private home and a fuel line cross connection was discovered under a freight company's parking lot.



During the first five years of the stormwater quality program, the City defined a baseline by which future improvements and/or degradations may be measured. Although the improvements can not be measured quantitatively at this time, many programs initiated during the first five years have undeniably made improvements in the state of water quality throughout the city. The long-term results should become apparent in future years. The City implemented many of the SWMP tasks beyond the minimum permit requirements and will continue to advance the water quality programs beyond the NPDES Permit requirements as economically feasible.

4.0 STORMWATER MANAGEMENT PROGRAM SUMMARY TABLE

SWMP activity summary tables for the fifth year of the NPDES permit program were compiled in accordance with the reporting requirements specified in Part VI(A)(2)(c) of the permit. Although the following summary tables concisely document many program activities, some activities could not be quantified and have therefore been omitted.

4.0 STORMWATER MANAGEMENT PROGRAM SUMMARY TABLE

MONITORING TASKS WET/DRY WEATHER	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Repeat High Parameter Sites	35 Outfalls repeated from year two	Yes	27	Each outfall tested atleast four times this year
Field Screening Industrial Outfalls	Visits to all Industrial outfalls	Yes	55	Continued retesting outfalls from Industrial areas (four times)
Total Field Screening Outfalls	High Parameter repeats + 30 to 40	Yes	137	All field data sheets available for inspection. Outfalls tested four times this year.
Full Suite Stormwater Analysis (one station per year)	One Station pr year	Yes	1	This year's site was our Second Creek Monitoring Station
Storms Sampled at 5 monitoring stations	3 to 4 Storms / Quarter / 5 Sites	No	44	Summer: 8 storms, Fall: 9 storms, Winter: 18 storms, Spring: 9 storms

STORMWATER MANAGEMENT & INDUSTRIAL PROGRAM TASKS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Stormwater Quantity Requests for Service (Received / Resolved)	As Needed	Yes	534/504	Complaints are investigated as received and resolved as solutions or resources are available
Stormwater Quality Requests for Service (Received / Resolved)	As Needed	Yes	346/361	Complaints are investigated as received and resolved as solutions or resources are available
Construction Site Erosion & Sediment Control Workshops	Annually	Yes	90 attendees	Included Engineers, contractors, developers, etc. involved in land disturbing activities.
Water Quality / NPDES / Development Program Summaries	As Required	Yes	Approx. 100 attendees at 2 presentations	Included Engineers, contractors, developers, planners, city managers, environmentalist, and other government officials
Spills Response & Emergency Management Coordination	As Required	Yes	11 accidents	The Knoxville Emergency Mgmt. Agency responded to spills and trained COK staff.
Collect KUB Industrial Inspection Reports	Every Two Years	No	0	KUB stopped supplying inspection reports. The City will develop an alternate program as soon as possible.
Collect NOI's for Industries	Collect in Year 1 plus ongoing	Yes	2	All NOI's were collected in year 1. Two new NOI's were received this year.
Industrial Investigations	As Needed	Yes	9	These are a combination of random inspections and complaint based request for service.

4.0 STORMWATER MANAGEMENT PROGRAM SUMMARY TABLE

EDUCATIONAL PROGRAM TASKS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Publicize Hotline Number	Within 24 Months	Yes	Undetermined	Hotline number has been published in phone book, on road signs, pamphlets, magnets, etc.
River Rescue	Annual Event	Yes	1 day event	17.7 tons of trash removed by 835 volunteers from 100 miles of shoreline at 36 sites.
Adopt-a-Creek	As Accepted	Yes	throughout year	1042 volunteers removed 18.75 tons of trash at 32 sites along urban creeks
Water Quality Forum	Meets Monthly and Quarterly	Yes	Undetermined	Three committees meet monthly to plan projects focused on urban water quality.
Storm Drain Marking	As Needed or by volunteers	Yes	Approx. 2000	Catch Basins marked with decals labeled "Dump No Waste-Drains to Waterway"
Volunteer Creek Cleanups	Volunteers	Yes	Multiple days on several creeks	Over 175 volunteers at 10 sites removed 15.75 tons of trash from local creeks
Waterfest	Annual Event	Yes	1 Day Educational Event	A unique community event dedicated to educate citizens about water quality. 900 youths from 15 different schools participated.

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NEW DEVELOPMENT PROGRAM TASKS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
New Development Inspections	As Required	Yes	2500	As Required
Building Permits Issued	As Required	Yes	886	As Required
Grading Permits Inspected	As Required	Yes	105	As Required
Right of Way Permits Investigated	As Required	Yes	520	As Required
Citizen Concerns Investigated	As Required	Yes	Approx. 150	Development Complaints include erosion, sediment, grading, dumping, etc.

4.0 STORMWATER MANAGEMENT PROGRAM SUMMARY TABLE

STRUCTURAL CONTROLS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Stabilization of Creek/River Banks for Erosion Control	As Needed	Yes	Various	1,641 native species planted. 1300 ft. of channel stabilized.
Street Cleaning	Daily/Bi-Weekly	Yes	32,760 Miles	Daily for downtown streets. Frequency varies for other streets.
Litter Pick-up, Hand	As Needed	Yes	93,540 Bags	Routine Schedule
Curb and Gutter Repair	As Needed	Yes	11 Feet	Per work order and requests
Catch Basin Cleaning and Repair	As Needed	Yes	3,520 Jobs	Per work order and requests
Ditching: Hand, Truck, & Track/Gradall	As Needed	Yes	32,637 Feet	Per work order and requests
Storm Sewer Installation & Repair	As Needed	Yes	98 Jobs	Per work order and requests
Brush & Leaf Pick-up	Bi-Weekly	Yes	15,007 Tons	Bi-Weekly curb pick-up
Seed/Sod, ROW	As Needed	Yes	27 Feet	Per work order and requests
Storm Sewer Cleaning	As Needed	Yes	14,131 Feet	Per work order and requests
Grate Replacement	As Needed	Yes	53 Jobs	As Needed
Field Inventory & Inspection of On-Site Detention Facilities	Within 60 Months	Yes	100% of City Completed	All new facilities are mapped after construction is complete. Existing facility's inventory is complete.
Creek Cleaning by Creek Restoration Crew	As Needed	Yes	204 Jobs	Creeks are inspected and cleaned on a routine schedule
Tree and Plant Planting	When Applicable	Yes	2,467 trees and plants	About 50% planted by Americorp volunteers
Total Waste Recycled	As Brought In	Yes	Over 29,378 Tons	4,849 tons of paper, metal, plastic, glass, etc. and over 24,528 tons of yard wastes



5.0 NARRATIVE REPORT

The following narrative report is divided into the five main programs of the SWMP. The SWMP is described in the program element schedules listed in Part II of the permit application and Part III of the permit. The main programs are listed as follows:

- 5.1 Residential and Commercial Program (RC).
- 5.2 Illicit Discharges and Improper Disposal Program (ILL).
- 5.3 Industrial and Related Facilities Program (IN).
- 5.4 Construction Site Runoff Program (CS).
- 5.5 Educational Activities and Public Outreach.

Each of the above programs are further divided into separate program elements and related tasks that correspond to the Implementation Schedules listed in Part IV of the Permit and to the requirements listed in 40 CFR 122.26(d)(2)(iv). Each specific task will be briefly discussed in accordance with the reporting guidelines outlined in Part VI of the NPDES Permit.

5.1 RESIDENTIAL AND COMMERCIAL PROGRAM (RC)

Program of Structural and Source Controls for Reducing Pollutants to the Municipal Separate Storm Sewer System, 40 CFR 122.26(d)(2)(iv)(A).

RC-1 Maintenance Activities for Structural Controls

SWMP Task: Continue Existing Maintenance Activities from Part 2 application, pp. 5-5 to 5-9.

Status: Ongoing

The City's Public Service Department (PSD) currently performs maintenance of the municipal stormwater system. The PSD has developed and maintains an extensive database to track work tasks performed during the year. The database not only tracks labor category (e.g., Equipment Operator) and labor hours devoted to each task, but also includes equipment type and costs. The PSD database produces summary reports for monthly and annual work production and costs. The database includes more than 80 task activities of which 18 were identified as relating directly or indirectly to stormwater management. Only a small portion of the stormwater conveyance system is located on public rights-of-way and city-held easements. The City generally assumes no responsibility for maintenance or improvements on private property even though the new creek crew may work in some of those areas.

Maintenance by the City within rights-of-way and easements is normally performed on an as-needed basis by the PSD. Approximately 75 percent of the storm drainage system maintenance work performed by the PSD is in response to direct calls from property owners and requests from the Engineering Department. The remainder of the storm drainage system maintenance work is in response to maintenance needs detected by the PSD, such as repairing collapsed pipes. Under normal conditions, the PSD can respond to all complaints that are the responsibility of the City as



defined by the City's stormwater policy.

Under the current system, the PSD has divided the City into six geographic maintenance zones, for routine work. Duties performed in each zone relating to stormwater are brush collection, leaf collection, street sweeping, and the cleaning of curb inlets. Catch basins are inspected annually. Cleaning and maintenance of catch basins are performed "as-needed". Most drainage facility maintenance is performed in response to complaints or known problems. The PSD logs all complaints by address and by category into the computerized database. The Construction Division of the PSD performs non-routine storm drain maintenance and installation.

Two seven-person crews perform storm drain installation. Their primary responsibilities include installing various sizes of corrugated metal pipe and reinforced concrete pipe, major repair to existing storm drains, and building catch basins. Each of the two crews has seven employees, a backhoe, two single-axle dump trucks, and one 3/4-ton pickup truck. A 12-ton tool truck services both crews. These crews also provide emergency response in the event of flooding. The Storm Drain Maintenance Crew has five employees. They perform such tasks as: clearing culverts of debris, flushing storm drains, hand and mechanical ditching, and performing minor catch basin repair. A Storm Drain Vacuum Machine, a ditching machine, and a 3/4-ton pickup truck with a small crane are used to perform these tasks.

SWMP Task: Stream Restoration and Channel Maintenance Program. Status: Ongoing

Stream restoration and channel maintenance has been addressed with two new programs during the first permit cycle. These programs include stream bank stabilization projects to reduce erosion and sediment and a creek restoration crew to remove litter, debris, and flow blockages.

In the first five years, several bank stabilization projects have been completed with the help of TDEC, TVA, USCOE, UTK, and CAC Americorps along urban creeks throughout the city. The first demonstration project was completed Fall 1997 at Inskip Ball field by using natural fiber coconut rolls and jute fiber mats and a synthetic mattress to protect the grass and live stakes during high water. Similar projects have been completed on Goose Creek at Mary James Park in South Knoxville, on First Creek at the new greenway site near Luttrell Street and Hoitt Avenue, on Love Creek near Holston Middle School, and along Second Creek above the Worlds Fair Park.

During year five, the City contracted with the University of Tennessee Agricultural Department to help restore the riparian zone on two different areas of First Creek. The work on the First Creek Greenway location included removing invasive plants and replacing with native vegetation. The City also repaired approximately 1300 feet of a deep eroding channel (see photo) at the headwaters of Fourth Creek along East Weisgarber Road. The channel had eroded in some locations to ten feet deep and 20 feet wide. The channel was successfully stabilized by the PSD.



Since sediment is one of the most common non-point source pollutants in our urban creeks, the City will continue to complete at least two bank stabilization projects per year during the new permit term. Although these projects will certainly vary in scope, biostabilization techniques will be used instead of concrete or riprap. Whenever possible, the adjacent riparian zone will be



enhanced with trees and native vegetation to provide cooling effects and help restore habitat. The City will work with TDEC to obtain the appropriate ARAP permits before work begins.

The 4-person Creek Restoration Crew was added to the PSD in August 1996. This crew is primarily responsible for implementing a routine schedule of inspections and maintenance on the major creeks and tributaries. It has a knuckle boom and a single-axle dump truck assigned to aid in performing these duties. The crew routinely removes trash and debris from habitual dumpsites and responds to citizen requests and specific work orders. Often the crew is used to assist with illicit discharge investigations in the MS4.

This program will continue to focus on stream restoration and channel maintenance along the major creeks and the riverfront in the city. The creek crew has a laminated GIS field book, which contains every urban creek within the city limits. Each creek has been further divided into workable sections or map pages that show significant surrounding details such as topography, planimetrics, stormwater features, outfalls, streets, and addresses. This allows the crew to efficiently inspect and clear each segment of the creek before moving on to the next task. The PSD field crews have been instructed to document and report signs or incidences of illicit discharges and/or improper disposal as they are identified. The creek crew's superintendent reports the progress of this crew at the Stormwater Management weekly planning meetings.

The City continued to support Ijams Nature Center and the "Adopt-a-Stream" program that organizes volunteers to periodically pick up trash and debris along stream reaches within the City. The PSD crews assist volunteers by providing receptacles for collecting trash and debris and removal of these receptacles. The City provides Adopt-a-Stream volunteers with safety information, trash bags, pickup sticks, and assistance with coordination. Because the Adopt-a-Stream volunteers are not able to handle larger items, the PSD crews use the appropriate equipment needed to remove these items. The Engineering Department will coordinate the Adopt-a-Stream program directly or by contract with Ijams Nature Center.

SWMP Task: Implement structural controls to prevent floating discharges to the TN River.

Status: Ongoing.

Since the summer of 1999, the City has been coordinating with TVA, UTK, TDEC, USACOE, the Isaac Walton League, Keep America Beautiful and area businesses to reduce the



amount of floating pollution entering the river from the urban creeks. The City has studied and identified several possible solutions. Short-term solutions have included increasing the frequency of the creek crew maintenance at the mouths of the major creeks, adding more trash receptacles at bus stops, increasing public awareness, installing temporary skimmers, etc. Long-term solutions have been researched and may include permanent skimmers on the major creeks, increased manpower on the river, and improved public awareness/participation. Current activities include working with volunteers to distribute BMPs and

pollution prevention information to area restaurants and businesses. The City donated a new boat



to help Isaac Walton League volunteers collect litter and debris along the riverfront within the city limits. Although the focus of this initiative has largely been to reduce unsightly trash from entering the river, several spills on First Creek were effectively detained by the floating trash skimmer at the mouth of the creek until remediation personnel could respond.

This ongoing cooperative effort will continue to be defined by the committee of Water Quality Forum member agencies that meet monthly to plan, discuss, and implement pollution controls. The progress of this floating pollution initiative will be reported annually throughout the new permit term.

SWMP Task: Standard Maintenance Agreement for On-site Facilities. Status: Ongoing.

Since 1997, Permanent Maintenance Agreements have been required for all new stormwater detention facilities and special pollution abatement devices (i.e. oil/water separators). The Stormwater and Street Ordinance Section 22A-33 requires the owner of the property to sign a covenant and have that covenant recorded on the plat before the construction permit is approved. Although the ordinance may be updated in the next permit term, the requirements for maintenance agreements will remain or be updated, but not removed.

The City will retain the right to inspect and insure that the stormwater facilities are properly maintained, however, the responsibility for the maintenance of stormwater facilities will remain with the property owner unless legally transferred to another person or entity by a properly recorded legal agreement. If the property owner does not maintain the facility properly, the City may authorize the maintenance to be completed and place a lien against the property for double the cost. The standard agreement for underground facilities (i.e. detention or oil/water separators) requires a minimum of quarterly visual inspections, annual cleaning, and annual reporting.

SWMP Task: Require Routine / major maintenance of BMP facilities. Status: Ongoing.

All stormwater facilities constructed since 1997 must have maintenance agreements and must be maintained according to the specific requirements in that agreement. All other stormwater ponds or water quality facilities must be maintained as required by the Stormwater & Street Ordinance Section 22A-33. At a minimum, woody vegetation must be cut annually and sediment must be removed as necessary to maintain proper function of the facility.

As described in the Part II application, the City may continue to investigate the feasibility of assuming direct maintenance responsibility for large regional structural detention ponds that serve multiple upstream developments. The current stormwater funding structure does not allow resources sufficient to maintain all BMP facilities at this time. The City may continue to evaluate the possibility of assisting property owners with maintenance in the future but currently the maintenance responsibility will remain with the property owner.

Sediment from the maintenance of detention/water quality ponds or from stream restoration activities must be removed from the stormwater facility and disposed in a proper classified landfill or used as fill outside the stormwater drainage system. The City does not propose to duplicate TDEC's efforts to regulate contaminated sediments.



RC-2 Planning for New Development

SWMP Task: Revise and Implement Stormwater Detention Ordinance to incorporate water quality considerations and to require water quality BMP's for New Development.

Status: Complete.

- ▶ The City of Knoxville adopted a new Stormwater and Street Ordinance during year one and revised in year two. There were no changes during year five. The revised ordinance was included in previous annual reports and may be accessed on the Engineering Department web page at www.ci.knoxville.tn.us/engineering/. A brief summary of the current development requirements for stormwater detention and water quality control is included below.

When a stormwater quantity detention pond is required, the engineer must design the pond to control the runoff from the 1-year, 2-year, 5-year, and 10-year storm events. In First Creek and Whites Creek, the 100-year storm must also be controlled. Quantity ponds may not be mandatory on developments discharging directly into a main stream (i.e. TN River) if the engineer submits supporting hydrologic and hydraulic computations.

Water quality control is required for residential development with five lots and/or five acres, commercial development of one acre or more, or any development or redevelopment that includes one-half acre of impervious surface. The standard management method includes first flush control outlets in the quantity pond or in a separate quality pond. The quality pond must be designed to collect the first one-half inch of direct runoff from the contributing drainage basin or the first 4000 cubic feet of stormwater runoff, whichever is greater, and attenuate that runoff for a minimum 24-hour period. Alternate treatment methods are accepted if they provide equivalent or better pollutant removal efficiencies than the standard first flush detention ponds. The target removal efficiencies for the first flush treatment were estimated from the chart provided by the Metropolitan Washington Council of Governments' 1987 report titled "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs." The target removal efficiencies are as follows: TSS – 76%, Lead – 81%, Zinc – 47%, Total Phosphorus – 44%, COD – 40%, and Total Nitrogen – 33%.

In addition to first flush treatment, Section 22A-36 of the ordinance requires special pollution abatement for certain land uses that are known to contribute a disproportionate amount of stormwater pollution. The typical special pollution abatement requirement has been a minimum of an oil/water separator for large parking lots of 400 spaces or 120,000 square feet of area. Other special land uses include any type of vehicle maintenance, fueling, washing, storage, or scrap facilities. Most of these land uses are expected to have a much higher potential for oil, grease, or other floatable hydrocarbon runoff that will not be collected in a standard first flush pond. However, the City may include other development types when special control is warranted.

SWMP Task: Implement Master Plan pursuant to Part II, Application.

Status: Complete

The comprehensive management program submitted for TDEC approval on May 13, 1993 as Section 5 of the Part II Application, has been implemented by the City as required by the



federal regulations except as amended by the NPDES Permit effective on July 1, 1996.
SWMP Task: Plan and site location for regional BMP facilities for areas of new development.
Status: Ongoing

During the term of the permit, the City will target large development projects or strategically located smaller developments that are suitable for siting regional BMPs. Regional BMPs would serve multiple upstream developments and typically have drainage areas ranging from 50 acres to several hundred acres. Currently the City is investigating the possibility of implementing a stormwater fee. If a stormwater utility is implemented, the City may consider offering incentives to developers to site regional BMP facilities. Incentives may include:

- ▶ cost share arrangements whereby the City contributes a share of the construction costs and recoups these costs from other upstream developments;
- ▶ City maintenance of regional BMPs;
- ▶ City provides assistance with design or other in-kind contributions.

Since most development activity within the City is primarily "infill" that occurs on the limited number of remaining vacant parcels, there are limited opportunities for siting regional BMPs without impacting existing developments.

In response to the unusual floods that hit Knoxville in the spring of 1998, the City has contracted a consultant to study the First Creek watershed for possible channel improvements and regional detention locations. The consultants May 1999 report identified five regional detention alternatives in the First Creek and Whites Creek watersheds that may relieve flooding. Future studies will be an ongoing portion of the City's stormwater management program.

SWMP Task: Develop guidance criteria for BMP's. Status: Ongoing

The City has successfully completed the first edition of a comprehensive BMP manual. The manual may be accessed at www.ci.knoxville.tn.us/engineering/ on the Engineering Departments web page. The guidance criteria describe acceptable types of BMPs, design standards, and maintenance requirements for BMPs to be used throughout the City to meet the requirements of the new Stormwater and Street Ordinance. The guidance criteria will be kept on file in the Engineering Department and distributed to developers as the official reference to ensure proper selection, design and maintenance criteria for BMPs.

Because maintenance of BMPs is critical to their long-term effectiveness in reducing pollutant loading from stormwater, the guidance criteria incorporates maintenance considerations with the design criteria to ensure that effective and maintainable BMPs are constructed in the City. The guidance criteria addresses the goals of the NPDES stormwater program by only allowing BMPs which are effective in reducing pollutants targeted by the NPDES stormwater regulations.

This manual is intended to be a live document that changes as new technology or future needs develop. Therefore, the website version is the preferred method of distribution for free while CDs and paper copies will be made available for a fee at a local copy center. The website and BMP content will be updated at least annually.



RC-3 Maintenance Activities for Public Streets, Roads, and Highways

SWMP Task: Street maintenance activities outlined in Part 2 application, p. 5-8.

Status: Ongoing

Street cleaning is performed daily for downtown streets and less frequently for all other streets. Streets with curbing are swept, while streets without curbing are flushed. Mowing is performed on a two to four week schedule between the months of April and September.

Snow removal, anti-icing and de-icing of roadways is performed by the PSD and is an essential program to ensure public safety. Sodium chloride, stored undercover at the Loraine Street facility, mixed with liquid calcium chloride is applied to highways and streets by spreaders as necessary. Application of de-icing/anti-icing materials targets highways and major arteries first, and residential streets secondarily. Priorities follow the adopted Major Roads Plan of the City of Knoxville. Because of the importance of maintaining public safety and public commerce, the City aggressively pursues its road clearing operations.

RC-4 Evaluation of Flood Management Projects

SWMP Task: Evaluate regional BMP facilities for water quality retrofit. Status: Ongoing

Only two regional detention facilities that were built prior to 1997 still exist today. Those facilities include the detention pond adjacent to Middlebrook Pike and Weisgarber Road at the Acker Place development and the detention pond located at Knoxville Center Mall. Although the regional detention basins were designed for flood control, it may be possible to retrofit these facilities to achieve additional water quality benefits. All ponds built since 1997 were required to comply with the water quality requirements for new development.

The City has studied the feasibility of adding other regional ponds to the First Creek watershed as part of a major flood control project. Any newly constructed regional ponds will address water quality in the design.

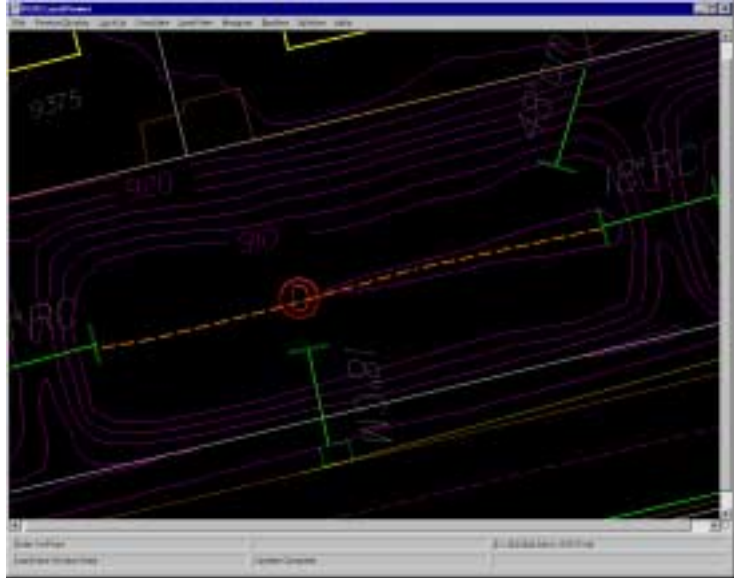
The City has assumed the responsibility of continued maintenance and water quality improvements at the large regional pond (Acker Place) in the Fourth Creek Watershed. The City restored a large section of Fourth Creek downstream of the pond in the first permit term. In order to reduce the vast amount of sediment in the stormwater effluent and to prevent future accumulation of sediment down stream, two rock check dams and an 18-inch weir plate were placed in the pond's low flow channel. These velocity dissipaters allow the sediment time to settle out of the stormwater while still in the pond. The sediment is removed annually to prevent migration into Fourth Creek. A riparian zone vegetation farm has been planted in the pond with red osier, silky dogwood, black willow, willow oak, and bank willow in addition to the existing species of white pine, cedar, and red oak trees. This new farm may provide a reliable source of viable cuttings for future bank stabilization and riparian zone projects throughout the area.



SWMP Task: Plan and implement inspection program to inventory on-site facilities.

Status: Complete.

During the last five years, the City has implemented a systematic method of inventorying the existing detention ponds by using a GIS grid of the city. Field crews inspected drainage features in each map grid and recorded the detention facilities in the GIS with a circled D. Since all new development must be certified to confirm that constructed facilities were built as planned, any new stormwater facilities will be properly recorded in the GIS after construction.



Engineering staff will maintain and update the existing inventory of ponds, pipes, water quality facilities and other drainage features as part of an ongoing GIS maintenance program.

RC-5 Monitoring of Solid Waste Facilities

This program is described in the management section IN-3 for industrial facilities.

RC-6 Management Program for Pesticides, Herbicides, and Fertilizer

SWMP Task: Evaluate effect of fertilizers as part of the City's ongoing monitoring program.

Status: Ongoing.

Pesticides, herbicides, and fertilizer used by the City are stored in a building at the Loraine Street Operations Center. This building is in compliance with all regulations regarding the storage of hazardous materials. The PSD Division of Horticulture and Grounds Maintenance is responsible for the application of pesticides, herbicides, and fertilizer. The herbicide "Roundup" is applied annually to City parks and rights-of-way to control unwanted weed growth. PSD personnel, who have been certified and licensed by the University of Tennessee, spray the herbicide. Fertilizer is only used for minor landscaping projects and stormwater runoff from these projects is not considered a threat to receiving water quality.

The City does not currently require registration by commercial applicators; however, commercial applicators must be licensed under State and Federal Regulations. There are no regulations restricting the use of these substances by individual land owners; however, a household hazardous waste collection facility has been opened to collect all types of hazardous wastes including pesticides, herbicides, and fertilizer.

For pesticide, herbicide, and fertilizer pollutants, the control program is difficult to define since the presence of pesticides, herbicides, and fertilizers in urban runoff is not always evident.



Current problems with pesticide, herbicide, and fertilizer pollutants are not believed to be significant. As part of the ongoing stormwater-monitoring program, the City will continue to monitor the significance of these pollutants. Pesticides, PCBs, and nutrients are tested as part of the ongoing monitoring program described in Sections 5.5 and 6.0 of this report. To date, no significant traces of pesticides have been detected in the annual full-suite grab sample.

SWMP Task: Public education program as part of the illicit connection and improper disposal program. Status: Ongoing.

Public education programs for pesticides, herbicides, and fertilizer use have already been implemented in conjunction with City public education programs for collection and recycling of household hazardous waste. In addition to the solid waste and household hazardous waste informational programs, the City has developed a stormwater pollution program that includes helpful information regarding pesticide and fertilizer use.

The HHW collection program, which includes collection of pesticide, herbicide, and fertilizer waste material, was officially implemented when the facility opened on April 22, 1997. More information about the HHW facility is included in the Illicit Discharges and Improper Disposal Program section ILL-6.

5.2 THE ILLICIT DISCHARGES AND IMPROPER DISPOSAL PROGRAM

Program to Detect and Remove Illicit and Improper Discharges to the Municipal Storm Sewer System, 40 CFR 122.26(d)(2)(iv)(B).

ILL-1 Ordinances

SWMP Task: Develop/Implement New City Ordinances Prohibiting Non-stormwater Discharges Status: Complete.

The Stormwater and Street Ordinance was developed and implemented during the first permit term to specifically prohibit non-stormwater discharges, increase penalties for illegal discharges, and to provide water quality regulations for new development. The ordinance may be accessed on the Internet at www.ci.knoxville.tn.us/engineering/.

The ordinance section 22A-52 specifically prohibits illicit discharges and illegal dumping to any portion of the MS4 or any area draining to the MS4. Illicit discharges were defined according to 40 CFR 122.26(b)(2) as any non-stormwater discharge to the MS4. This definition, along with the \$5,000 penalty for violations, has formed the cornerstone of our successful enforcement program and will remain in place during the next permit term.

Exemptions to this prohibition were listed in the ordinance in accordance with the list in 40 CFR 122.26(d)(2)(iv)(B)(1). Although most categories in this list were exempted in the first ordinance, the City will reevaluate these exemptions and update the ordinance if necessary.

City Council was advised that the ordinance may need to be updated approximately every five years to accommodate any changes or additional requirements in each new NPDES permit.



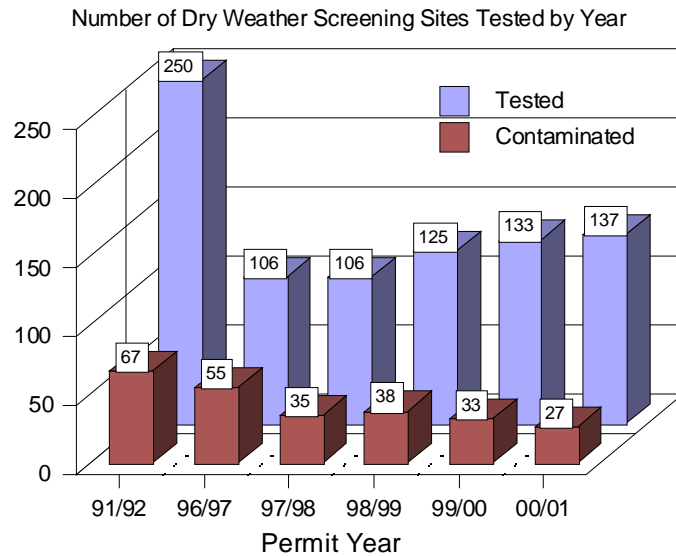
ILL-2 Field Screening

SWMP Task: Perform follow-up analysis at all high-risk field screening sites.

Status: Ongoing.

The Dry-Weather Screening Program was developed and implemented during the first permit term to evaluate both randomly chosen outfalls and high-risk outfalls that were tested the previous year. Each of the high-risk stormwater outfalls was checked for flow after a period of dry weather. If flow was present, the discharge was tested with a Chemetrics colorimetric field test kit for the following parameters: phenols, ammonia, detergents, copper, chlorine, pH, turbidity, color, temperature, and flow rate. If ammonia is greater than one part per million, then a fecal coliform sample is collected for laboratory testing. The outfall test was repeated again between four and forty-eight hours after the first test. After one month, this process was repeated for each outfall to complete a total of four tests each year.

Since this program has successfully identified many illegal dumps and illicit discharges during the first permit term, the City will continue to annually retest all sites that have high



parameters or signs of illegal dumping until the outfall is clean during all four annual visits. Once the outfall has tested clean during four site visits in a single year, it will only be retested if randomly selected from the list of inventoried outfalls. The City has previously developed and submitted the standard inspection guidelines for investigating illicit connections or illegal dumping in the first annual report. Any changes to these standard guidelines will be reported as they are implemented. As illustrated by the bar graph, the number of high-risk outfalls continues to decrease each year since the program began in 1996. The number of high-risk outfalls that need to

be retested each year will obviously vary depending on the tested results of the previous year.

As required by Part VI(A)(2)(f)(ii) of the NPDES permit, the results of the dry-weather screening are included in the appendix of this report. Of the 2679 outfall visits since the beginning of the program, only 947 outfall visits observed flow from the outfall. The results from each of those 947 screenings are tabulated by outfall identification number, testing date, and visit number.



SWMP Task: Investigate 30 to 40 new field screening sites per year. Status: Ongoing.

To insure that all outfalls are eventually tested, the City will continue to monitor a minimum of 150 outfalls each year in the new permit cycle. The current permit required testing of the original 67 contaminated outfalls plus 40 additional sites. The City met the minimum criteria by testing 137 outfalls during year five. The tested outfalls consisted of the previous year's 27 high-risk outfalls and 110 randomly selected outfalls from the general outfall inventory. The randomly selected sites were selected from areas of primarily industrial use and from areas that had not been previously tested. The City selected outfalls throughout the city with some preference given to the highly developed areas. This method should continue well into the next permit term before all outfalls have been tested.

The Engineering Department has developed an outfall database to maintain the testing data and site information for each outfall in the inventory. This outfall database is linked to the GIS to allow data access geographically for a single point or by report/query functions for many outfalls at a time. By maintaining a history of each outfall, illicit discharge trends may become apparent and therefore be resolved with education or enforcement.

The dry-weather-screening program has been one of the most successful programs in the current permit term and will continue to be a high priority in the new permit cycle.



ILL-3 Investigation of the Storm Drain System

SWMP Task: Develop and implement procedures for mapping, field surveys, and upstream source identification. Status: Complete.

The procedures for mapping, field surveys and upstream source identification were developed and included in the Part II Application section 5.3.5. These procedures were adopted as policy and successfully implemented during the first permit term. The City will continue to utilize and modify these procedures to increase the effectiveness of the Illicit Discharge and Illegal Dumping Program. These updated procedures for the first permit term were included for



the Division's review in monitoring section 6.1.3 of the first annual report. Any updates during the first year of the new permit cycle will be included in the following annual report.

SWMP Task: Implement enforcement procedures and follow-up monitoring/ inspections.

Status: Complete.

The schedule for this task appropriately coincided with the schedule for ordinance revisions. The Stormwater and Street Ordinance defined the existing enforcement procedures. An Enforcement policy was implemented immediately after the ordinance was effective in 1997.

Depending on the violation, a first-time offender is usually educated and asked to remediate the damage or correct the violation if possible. This is usually followed up with a letter to inform the violator of the City's expectations and to provide helpful BMPs to prevent future problems. More severe or repeated violations will merit a Notice of Violation (NOV) which is issued in the field directly to the violator. Copies of the NOV are distributed to the property owner or developer, the City Law Department, and the Engineering Department. The NOV may order specific remedies and require the violator to submit reports and/or pollution prevention plans. Penalties, if any, are only issued after the NOV expires so the violation and remedies may be fully evaluated.

A violator may appeal their penalty before a five-member Environmental Appeals Board. The five volunteer members of the Environmental Appeals Board were appointed by the Mayor and consists of individuals with an expertise as follows:

- 1) One licensed professional engineer with civil engineering expertise.
- 2) One licensed professional engineer.
- 3) One representative of the development or industrial community.
- 4) One neighborhood representative.
- 5) One member at large.

Board members will serve a 5-year term and may be reappointed at the end of their term. Follow-up monitoring and inspections will be a combination of City, KUB, and self-inspections by industries. Enforcement actions resulting from the dry-weather screening program will be followed as defined within that program as a minimum. Any outfall that is tested for high parameters or identified as an illicit connection/ illegal dump source, will be tested four times a year, every year, until the outfall is dry or clean on all four visits. Sources of pollution identified by other means will be monitored as needed or specified for the individual situation.

SWMP Task: Coordinate with Knoxville Utility Board (KUB) sanitary sewer inspections.

Status: Ongoing.

The City will continue to coordinate with KUB to identify and correct sanitary sewer discharges. A standard procedure has been developed to insure that each possible contamination source is investigated after a problem is identified during dry weather screening. When high ammonia or fecal coliform levels are detected in the MS4, KUB and City personnel cooperate to identify the contamination source through dye testing or manhole by manhole testing. Once a source has been identified, KUB will correct problems in the main sanitary sewer system while the City will work with property owners to correct problems on private property. KUB has been



reluctant to share their five-year plans and annual reports with the City, but TDEC has been able to provide that information from the field office. The City will try to resolve this issue to allow better coordination and timely resolution of sanitary sewer overflows and cross connections.

The City does coordinate illicit connection investigations with KUB when appropriate. These inspections have identified private residences, industries, and businesses that had plumbing or floor drains connected to the MS4 instead of the sanitary sewer system. This type of close coordination is essential for solving illicit discharges to the MS4.

ILL-4 Spill Response Program

SWMP Task: Coordinate with Knoxville Emergency Response Team (KERT) and TDEC.

Status: Ongoing.

The City of Knoxville Stormwater Quality Section of the Engineering Department will continue to coordinate with both the KERT and TDEC during emergency situations. Each agency has specific roles to play during an emergency event. The City Stormwater Quality Section will assist in information gathering, investigations, GIS support, follow-up monitoring, and enforcement when necessary.

The Knoxville- Knox County Emergency Management Agency coordinates most major spills when they are called in to 911. KEMA also coordinates routine training and simulations for various situations throughout the year. Workshops are provided to simulate real scenarios and allow coordination of the field teams and the Emergency Operations Center (EOC). Engineering Department staff participates in the EOC while the Fire Department, Police Department, and Rural Metro units perform the field exercises.

The City of Knoxville Fire Department and Engineering Department coordinate to respond to small spills and possible hazards as they are reported. The two departments will continue to work closely together to contain and remediate discharges in the street, stormdrain system, creeks or wherever necessary. The Knoxville Fire Department maintains a fire boat downtown on the waterfront to assist with spills discharging into the river. When a responsible party is identified, the Engineering Department staff will follow normal investigation and enforcement procedures to order the containment and remediation at the violator's expense.

Engineering staff will continue to closely coordinate with other emergency personnel at the monthly Local Emergency Planning Committee meetings and by maintaining a supervisor on call after hours and weekends to help respond to water quality emergencies as they occur.

ILL-5 Reporting of Illicit Discharges

SWMP Task: Establish and monitor "Water Quality Hotline" for public reporting.

Status: Ongoing.

The Water Quality Hotline for public reporting of water quality concerns was established as planned during the first permit term. The hotline was operational in November of 1996 but did not receive mass publicity until December 1996. The hotline phone number is a local Greater Knoxville Area number listed in the blue pages as follows:



WATER QUALITY HOTLINE-
To Report Illegal Dumping Into Ditches
Creeks Or Catch Basins 24-Hours/Day.....215-4147

The hotline has receives a variety of calls including: industrial discharges, gray water discharges, broken laterals, commercial washing, neighbors dumping, etc. The hotline has been a popular and successful method for callers to anonymously report problems that they have witnessed or created. Common calls are from neighbors or dissatisfied employees of polluters. This program has been very successful and will be continued throughout the new permit term.

The Water Quality Hotline is a dedicated phone line attached to a phone in the Stormwater Quality Section of the Engineering Department. Employees in the section also have the hotline as a linked as a second line on their individual phones so anyone may answer the phone during the day. After hours and on weekends, the messages are recorded and routinely retrieved by the on-call supervisor. If the water quality concern is within the City limits, the Engineering Department investigates the problem. Otherwise, the problem is referred to the Knox County Health Department, TDEC field office, or other appropriate agency.

SWMP Task: Publicize the “Water Quality Hotline”.

Status: Ongoing.

The objective of this task is to increase the public awareness of the City’s role in water quality issues and to create a quick and anonymous method for citizens to report water quality concerns. The publicity of the hotline has already provided a consistent and convenient resource for concerned citizens.

The City currently publicizes the Water Quality Hotline on the Engineering Department's website at www.ci.knoxville.tn.us/engineering/ and annually in the blue pages of the Greater Knoxville Area BellSouth phone book. KUB assisted this program in year five by including the hotline advertisement with the utility bills for several months.

The City includes the hotline number in thousands of mass produced stormwater pollution prevention educational handouts such as magnets, brochures, presentations, and routine correspondence with residents. The hotline is prominently displayed at the bottom of the Second Creek watershed boundary road signs to let travelers know where they may report water quality concerns.

The City will continue to seek out and develop innovative methods to advertise this successful program as a method for citizens to anonymously report complaints. Future opportunities to advertise may include: utility bills, public access TV, radio PSAs, signs on city buses, refrigerator magnets, pamphlets, brochures, BMP manual CDs, permits, etc. The innovative methods of publicity will vary each year as opportunities are developed.

ILL-6 Used Oil & Toxic Materials Program

SWMP Task: Implementation and Coordination of Recycling Program.

Status: Ongoing.

The Solid Waste Division manages the City of Knoxville’s recycling program. The entire annual report of these programs is included in the appendix of this report.



SWMP Task: Maintain and Operate Household Hazardous Waste Facility. Status: Ongoing.

The City continues to operate the Household Hazardous Waste (HHW) Collection Center, which first opened on April 22, 1997. This is the first permanent HHW Collection Center in the State of Tennessee, which is open five days a week. The center accepts HHW from both Knoxville and Knox County residents. Knox County shares the annual costs of operation. The capital expenditures associated with construction of this facility were paid for through a \$500,000 grant from the State of Tennessee. Activities at the center include:

- ▶ diverting reusable products;
- ▶ collecting, blending and recycling latex paint;
- ▶ collecting car batteries, oil and antifreeze;
- ▶ diverting selected acid and bases to waste water treatment;
- ▶ venting aerosol containers and recycling the empty containers;
- ▶ bulking flammable materials;
- ▶ packing miscellaneous HHW materials for safe shipment and disposal.

Upon entering the HHW Collection Center, individuals pull into a covered drive-through where staff removes HHW from vehicles. Material that is collected and is still "good" is separated and made available for pickup by the public free of charge. "Good" material includes containers that have never been opened or material that has not exceeded its useful shelf life. The staff then processes materials that are not reusable. This includes testing of unknown materials, diverting selected acids and bases to the wastewater treatment facility, venting aerosols, bulking flammable materials, lab packing, and blending paint. Latex paint is sent to a local firm to be re-manufactured and returned for use by the City. After the material is processed, it is put into 55-gallon drums, which are placed in one of two prefabricated storage units. Each of these units has electronic monitoring and security, fire suppression systems, and drainage/spill containment systems. The hazardous materials are then stored in the units and held until sufficient quantities are collected. The City has hired a chemist and technician to operate the collection center. Due to the capital investment and success of this program, the facility will be maintained and operated throughout the next permit term.

ILL-7 Control Infiltration

SWMP Task: Assess Rehabilitation Study from outside consultant & recommend capital improvements.

Status: Complete.

Since the KUB and other small utilities maintain control and operation of the City's municipal sanitary sewer, compliance with the requirement to control infiltration is reflected in the City's maintenance of adequate legal authority over illicit discharges from the KUB and others. Although the City does engage in some communications with KUB to resolve any illicit connections or unauthorized discharges to the MS4, KUB maintains complete control over capital project planning and scheduling. Any suggested changes to the schedule are typically resisted or ignored by KUB unless the City provides project specific funding. The City has recommended and provided funding for several sanitary sewer rehabilitation projects during the permit term.



5.3 THE INDUSTRIAL AND RELATED FACILITIES PROGRAM (IN)

Program to Monitor and Control Runoff from TSD and Industrial Facilities Subject to SARA Title III, Section 313, requirements, 40 CFR 122.26(d)(2)(iv)(C).

IN-1 Ordinances

SWMP Task: Develop/Implement New City Ordinance Prohibiting Non-stormwater Discharges.
Status: Complete.

The Stormwater and Street Ordinance was developed during the year one to specifically prohibit non-stormwater discharges, increase penalties for illegal discharges, and to provide water quality regulations for new development. The ordinance may be accessed on the Engineering Department web page at www.ci.knoxville.tn.us/engineering/.

The ordinance section 22A-52 specifically prohibits illicit discharges and illegal dumping to any portion of the MS4 or any area draining to the MS4. Illicit discharges were defined according to 40 CFR 122.26(b)(2) as any non-stormwater discharge to the MS4. This definition, along with the \$5,000 penalty for violations, has formed the cornerstone of our successful enforcement program and will remain in place during the next permit term.

IN-2 Inspection Element

SWMP Task: Collect and analyze NOIs from Industrial Permit applicants. Status: Ongoing.

During year five, the City continued to coordinate with TDEC and industrial facilities to ensure that all Notices of Intent (NOIs) are received by the City. As the NOIs are received, the City reviews and evaluates the NOIs for the potential impact of stormwater runoff to the municipal storm drain system. In the past, the NOIs have been instrumental in locating and removing discharges from local industries. During inspections or enforcement actions with an industry, the City will verify that an NOI has been filed. If an NOI has not been filed, the City will coordinate with TDEC to obtain the NOI. Future NOIs may be obtained annually from TDEC in bulk. This will be coordinated once the new industrial permit rules are finalized.

An electronic database will be completed during the next permit term that should allow geographical linkages to the GIS. The prototype industrial database has been developed and will be converted to the City's new Sierra Permit Tracking system. Since several City Departments are converting databases to this system, there is no way to determine when the industrial database will be completed. The current industrial information is maintained by hard copies on file.

SWMP Task: Collect and analyze KUB inspection reports. Assess impact to the MS4.
Status: Program Terminated.

As part of the sanitary sewer pretreatment program, KUB inspectors did perform industrial facilities inspections every other year. KUB had agreed to provide the City with the one-page inspection reports at the end of the year in which they were collected. This year, KUB



notified the City that the inspection reports would no longer be collected. Since the City was not notified until after year five expired, an alternate inspection could not be conducted. Since the inspection reports had been collected in previous years from the same industries, it is not likely that any significant new information would have been gathered. This program will be replaced during the new permit term.

SWMP Task: Identify potential industrial discharges through Illicit Connection and Improper Disposal Program. (Both stormwater & non-stormwater discharges). Status: Ongoing.

The illicit connection and improper disposal program defined in the City's Part II NPDES stormwater permit application and in the previous section of this reapplication, primarily addresses runoff from industrial facilities. The majority of dry weather screening occurs from areas of industrial use or outfalls indicated by a "300" in the identification number. Illicit connections or improper disposal from industrial facilities which are discovered while inspecting the storm drain system under this program are recorded in the facilities' file in the database. The City contacts the industrial facility directly, along with KUB or TDEC if necessary, to identify the problem and work on an appropriate solution. If enforcement action is necessary, the City will track the situation until the illicit connection is corrected, the illegal dumping stopped, or until the facility receives a valid NPDES permit for the discharge.

In addition to the illicit connection and improper disposal program inspections, the City routinely performs inspections at commercial and industrial sites through a random selection process using the MPC inventory of industrial space and in response to citizen concerns reported to the water quality hotline. Some inspections have occurred as the City gains experience with common sources of pollution. Since areas such as loading docks, food distributors, fuel storage/sales, restaurants, and car lots have become reoccurring areas for enforcement, they are now being targeted for education and inspection to prevent discharges before they occur. Some of these land uses are targeted during the pre-development phase with the new Special Pollution Abatement Permit. This will be an ongoing program in the new permit term.

SWMP Task: Develop inspection program as part of Pollution Prevention Plans for Municipal Industrial Facilities. Conduct annual inspections at MIFs. Status: Ongoing.

During the first permit term, the City developed an inspection and pollution prevention program for municipal industrial facilities. Currently only four municipal industrial facilities are operated in the City. These facilities include:

- the Solid Waste Management Facility (SWMF) on Baxter Avenue, and
- the fleet truck & heavy equipment garage on Loraine Street, and
- the fleet and police garage at Prosser Road, and
- the Knoxville Area Transit (KAT bus station) on Magnolia Avenue.

Each facility has been evaluated and inspected regularly by Engineering personnel during the first permit term and will continue to be inspected at least annually in the future. Since the bus terminal is owned by the City but managed by KAT, they developed their own PPP, which was submitted in the first annual report in 1997.



Some structural pollution control measures have been implemented at several MIF sites. The bus station had two large Stormceptor stormwater treatment devices installed in November 1999. The total project cost was nearly \$300,000. A strip of the concrete parking lot along First Creek was removed and replaced with a slope directed away from the creek. The reversed slope and a large curb prevent the runoff from entering First creek directly. The runoff is routed through the two oil/water separators before being discharged. Other measures at KAT include their commitment for ongoing fleet upgrades to new lower pollution buses.

The SWMF has installed some above ground filters and catch basin inserts to mitigate potential pollution. The entire transfer facility is covered and the drain in the loading dock for the transfer trucks is routed to the sanitary sewer system. Both garages have adopted spill protection policies and all mechanical work is done inside. A hydrocarbon absorbent boom is maintained in a trench drain at the police garage as a secondary control for emergency spills.

IN-3 Monitoring Element

SWMP Task: Collect Monitoring Data from permitted industrial stormwater dischargers and/or from TDEC. Assess impacts to the storm drain system. Status: Ongoing.

As part of the NPDES Permit for stormwater discharges associated with industrial activity, applicants are required to monitor, at least annually, all stormwater outfalls identified on the facilities' Pollution Prevention Plans. Applicants must monitor in accordance with TDEC Rule 1200-4-10-.04. The City currently receives copies of the results of the industrial outfall self-monitoring from some of the regulated industries. The City will continue to work with TDEC or directly with the industrial discharger to obtain copies of the information, as it becomes available. The City will maintain this information in the City's industrial files, and will assess the impact of the monitored discharges on the water quality of the storm drain system on an annual basis. If the City determines that additional data needs to be provided in the monitoring program for an industry (reports on additional parameters, etc.), requirements for an expanded program for subsequent monitoring events will be coordinated with TDEC and/or the industrial discharger.

The Stormwater and Street Ordinance authorizes the City to require additional monitoring from industries not covered under the TDEC programs whenever necessary. This will usually be required in conjunction with some enforcement action after a problem has been observed.

SWMP Task: Develop ongoing monitoring program pursuant to 40 CFR 122.26(d)(2)(iv)(c)(2). Identify pollutants/sources as applicable. Status: Ongoing.

In the first permit cycle, the City's Ongoing Monitoring Program, defined in the Part 2 NPDES stormwater permit application, included the monitoring of stormwater runoff from two areas of industrial facilities (e.g. industrial parks). Stormwater samples were collected, analyzed, and recorded for 12 to 15 storms per year per site using flow weighted composites from ISCO monitoring stations. Each of the monitoring locations received runoff from small watersheds approximately 1/4 square mile with several different industries included. Therefore specific pollutants were not easily traced back to a specific industry but the general data did allow implementation of industry wide BMPs.



In addition to the stormwater sampling above, all outfalls from industrial areas have been tested as part of the dry weather field-screening program to identify potential specific sources of the pollutants. Each year the City will continue to choose random outfalls from industrial areas as the primary dry weather screening locations. These outfalls are tested with field screening kits with additional laboratory tests as necessary.

Additional monitoring and reports from TSDs and industrial facilities subject to SARA Title III, Section 313 may be required when a problem has occurred, when the City has reason to believe a pollution problem exists, when TDEC or EPA do not already require sufficient testing, or if the City is mandated to test and report those facilities. The Stormwater & Street Ordinance Section 22A-54 states, "*The Director of Engineering may require any person engaging in any activity or owning any property, building or facility (including but not limited to a site of industrial activity) to undertake such reasonable monitoring of any discharge(s) to the stormwater system operated by the City and to furnish periodic reports of such discharges.*" The City will maintain this legal authority to require monitoring from all facilities necessary when the Stormwater & Street Ordinance is updated in the next permit term.

SWMP Task: Analyze results from ongoing monitoring program.

Status: Complete.

A summary of the analysis from the ongoing monitoring program is included in the appendix of this report. Some routine parameters associated with industrial activities have been extremely low or non-existent. Phenols were essentially below non-detection limits for the first three years of sampling and were therefore removed from the monitoring program.

Although oil, grease, and hydrocarbons are not routine parameters, analysis and investigation of visual inspections have helped the City trace several problems back to the industrial source. Problems at freight terminals and bulk fuel facilities have been resolved during year five and throughout the permit term.

SWMP Task: Develop, Manage, and Conduct Monitoring Program at MIFs.

Status: Ongoing.

The monitoring program for the municipal industrial facilities was developed during the first permit term and was included in the 96/97 annual report. The program specified that the only municipal industries included in the City's monitoring program will be limited to the Knoxville Area Transit station, the Prosser Road fleet and passenger vehicle garage, and the Lorraine Street maintenance and storage facility. However, the City also began monitoring and testing the parking lot runoff from the Solid Waste Management Facility (SWMF) on Elm Street. This monitoring program was developed as a Best Management Practices test site to evaluate the usefulness and effectiveness of catch basin filters on ultra-urban land uses. The City partnered with the University of Tennessee Civil & Environmental Engineering Department and with Remedial Solutions to put two catch basin filters in place. One filter was installed at the SWMF and one was located on Phillip Fulmer Way outside Neyland Stadium.

During year five, each MIF outfall was inspected at least once for non-stormwater flow in dry weather. This monitoring will be conducted at least annually and will be expanded in the new permit term.



5.4 THE CONSTRUCTION SITE RUNOFF PROGRAM (CS)

Program to Implement and Maintain BMP Plans to Reduce Construction Site Runoff to the Municipal Storm Sewer System, 40 CFR 122.26(d)(2)(iv)(D).

CS-1 Site Planning

SWMP Task: Revise City Ordinances to require construction sites greater than 10,000-sq. ft. to submit Erosion and Sediment (E&S) Control Plans. Status: Complete.

The Stormwater and Street Ordinance was developed during the first permit term to specifically require construction sites greater than 10,000 square feet to provide an erosion and sediment control plan according to section 22A-28(4)(c). The ordinance may be accessed on the Internet at www.ci.knoxville.tn.us/engineering/ for review or download.

SWMP Task: Require Site Plans Submittals per Tennessee E & S Control Handbook. Status: Complete.

The Stormwater and Street Ordinance requires all erosion and sediment control plan submittals and all site development work to comply with the Erosion and Sediment Control Handbook produced by TDEC, dated July 1992, or as amended by TDEC or its successor and any supplemental regulations by the Engineering Department.

SWMP Task: Develop minimum criteria for plan review and checklists. Status: Complete.

Although the TDEC Erosion and Sediment Control Handbook does provide a checklist for review of Erosion and Sediment Control Plans, the City developed a list of minimum criteria to supplement the State checklist for various categories of site plans (residential, commercial, etc.). The City plans review staff uses the minimum criteria and checklists to insure consistency in the plan review process.

SWMP Task: Provide training for City plans review staff. Status: Ongoing.

In an effort to fully train the Stormwater Management staff, the City has participated in several stormwater seminars around the region during year five. Most staff members at the Engineer level will attend at least one, but typically more, seminars or training workshops annually. Typical seminars attended in year five include: SWMM modeling, NAFSMA conference, TMDL updates, NPDES updates, ASCE seminars, Haestad Methods workshops, and others. In addition to the stormwater management seminars attended, the Engineering staff have sponsored, planned, and presented a series of annual workshops/seminars to better educate the staff and development community about the development and plans review processes. Some of the topics of the City sponsored development process training sessions include:

- ***Technical Requirements of the Stormwater & Street Ordinance***



- ▶ *Erosion and Sediment Control on plans and construction sites.*
- ▶ *Site Development Permit Review Seminar*
- ▶ *Performance and Indemnity Agreements, Permanent Maintenance Agreements for Stormwater Facilities*
- ▶ *Plat Review Process and Procedures*

The City will continue to provide training to the Engineering staff by participating in seminars locally and outside the city; in-house training by professional engineers; tuition reimbursement for university engineering classes; cooperating with TDOT, TDEC, TVA, UTK, and other agencies to provide professional training for the staff. Training of the plans review and inspections staff is an ongoing program within the Engineering Department.

CS-2 BMP Requirements

SWMP Task: Require Construction BMPs from the TN E&S Control Handbook.

Status: Complete.

As outlined in the new Stormwater and Street Ordinance Section 22A-28(b)(4), all erosion and sediment control plans must comply with the Erosion and Sediment Control Handbook produced by TDEC, dated July 1992, or as amended by TDEC or its successor and any supplemental regulations by the Engineering Department.

SWMP Task: Require construction site “good housekeeping” practices.

Status: Ongoing.

To ensure that construction sites are kept clean and orderly, and to minimize pollutants in stormwater runoff as a result of other construction activities, the City will continue to require good housekeeping measures on all active construction sites. The good housekeeping regulations included in the new BMP manual address the following considerations:

- ▶ Designated areas for construction equipment maintenance and repair and prohibiting discharges of oil and grease into the storm drain system or receiving waters.
- ▶ Designated areas for construction equipment washing provided with a gravel or rock base and ensuring the wash waters are discharged to a regularly maintained temporary holding basin or sediment control device.
- ▶ Provision of storage areas for construction materials and receptacles for liquids (solvents, paints, acids) and solids in accordance with manufacturers recommendations.
- ▶ Provision of adequate waste storage areas and ensuring that the locations for collection of waste materials do not receive concentrated runoff.
- ▶ Provision of adequate sanitary facilities on construction sites in accordance with Health Department Regulations.

Many of these “good housekeeping” issues will be reviewed with the contractor, engineer, and developer during the pre-construction assistance meeting.



SWMP Task: Evaluate additional BMP requirements and design modifications.

Status: Ongoing.

The Stormwater and Street Ordinance Section 22A-22 entitles the Engineering Department to compose a development design manual as the standard for which the ordinance requirements will be met. The new BMP manual may be accessed on the Engineering Department web site at www.ci.knoxville.tn.us/engineering/.

The guidance criteria in the new manual describes acceptable types of BMPs, design standards, and maintenance requirements for BMPs to be used throughout the City to meet the requirements of the new Stormwater and Street Ordinance. The guidance criteria is maintained on the Internet and distributed to developers as the official reference to ensure proper selection, design and maintenance criteria for BMPs. To ensure that effective and maintainable BMPs are constructed in the City, a standard maintenance covenant is executed before any construction plans are approved. The guidance criteria addresses the goals of the NPDES stormwater program by allowing only BMPs, which are effective in reducing pollutants, targeted in the NPDES stormwater regulations.

CS-3 Inspection / Enforcement

SWMP Task: Expand inspections program to include smaller (single family) construction sites.

Status: Ongoing.

In the first year of the permit term, the City of Knoxville expanded new development construction inspections to include single family residential sites. These single-family residential inspections will continue as an ongoing program during the next permit term.

SWMP Task: Increase penalties for violations to: \$5000.

Status: Complete

The Stormwater and Street Ordinance, Section 22A-8 Penalties, increased the penalty for violations up to \$5,000 per day per violation. This ordinance was effective during year one and was included in that report. The ordinance was revised in year two and may be accessed on the Internet at www.ci.knoxville.tn.us/engineering/.

SWMP Task: Implement Scheduled Site inspections: rough grading, E&S control installation, final grading, and final stabilization.

Status: Ongoing.

The Engineering Department continues to implement site inspections for subdivision and commercial developments. These inspections are not a new program and have been occurring since at least 1994. Inspections are performed during rough grading, final grading, and at various other times during the construction process. Although the site inspections are not scheduled with the contractor or developer, the City staff may visit the construction sites approximately every week. The time frame for some project inspections will vary due to the specific project.

These inspections are performed to insure compliance with the erosion and sediment control plan, good housekeeping, and the approved design plan.



CS-4 Training Programs

SWMP Task: Co-Sponsor E&S Control Practice Seminars for City staff, developers, Engineers and contractors. Status: Annually.

The City and other Water Quality Forum members have developed and presented free erosion and sediment control workshops throughout the first permit term. To maximize participation the workshops are typically presented in the early spring or late fall while construction activities are least intense. The workshops have been very successful and will be continued annually. In addition to the City of Knoxville, the Water Quality Forum partners involved with the planning, sponsorship, and presentation of the workshops have included: TVA, TDEC, TDOT, NRCS, Knox County, Ijams Nature Center, UTK, and the UT Water Resources Research Center. Private sponsors have included consulting firms and erosion control product vendors.

During year five, the City assisted UT and TDEC with review, promotion and presentation of the new TDEC erosion control certification program.

SWMP Task: Evaluate training materials from other jurisdictions. Status: Ongoing.

During the first permit term, the City of Knoxville Engineering Department has evaluated training materials and programs from various Federal, State, and local jurisdictions around the country. This program will continue throughout the next permit term in an effort to continuously improve training programs provided and cosponsored by the City. The City will continue to evaluate training programs and materials to incorporate into the SWMP. This ongoing task should allow the City's SWMP to stay comparable with the other MS4's in the region.

In addition to the Tennessee E&S Control Handbook, some of the training materials already compiled, reviewed, and used by the City include but are not limited to:

- ASCE & IECA Soil Erosion & Sediment Control Videos
- Beaufort County Manual for Stormwater Best Management Practices
- California Stormwater Best Management Practices Handbooks
- Caltrans Stormwater Quality Handbook
- Charlotte-Mecklenburg Stormwater Management/ Land Development Manual
- Chattanooga Stormwater Management BMP Manual (1993)
- Fairfax County, Virginia E&S Control Inspector Training Video
- Kentucky Best Management Practices for Construction Activities
- MSD Erosion Prevention and Sediment Control
- Nashville Storm Water Management Manual
- North Carolina Erosion and Sediment Control Practices Video Modules (1991)
- North Carolina Sediment Control Planning and Design Manual (1988)
- Ohio Department of Natural Resources Keeping Soil on Construction Sites Video
- State of Florida Department of Environmental Regulation, The Florida Development Manual: A Guide to Sound Land and Water Management



- State of Maine Stormwater Best Management Practices Manual
- USEPA Developing Pollution Prevention Plans and Best Management Practices for Storm Water Management for Construction Activities (1992)
- USEPA NPDES Best Management Practices Manual (1993)
- Virginia Erosion and Sediment Control Handbook (Third Edition, 1992)

5.5 EDUCATIONAL ACTIVITIES and PUBLIC OUTREACH

Water Quality Education activities at Ijams Nature Center

Status: Ongoing.

Ijams Nature Center facilitates and coordinates several water quality education programs in the Knoxville/Knox County area. Each program has a specific water focus and targets a community-based audience. Ijams is an 80-acre City park and environmental education center located within the city limits of Knoxville, Tennessee. The mission of Ijams Nature center is to increase the knowledge, understanding, and appreciation of the natural world by providing quality educational experiences throughout the region. Throughout the last permit term, the City has sponsored the following programs through an annual contract with Ijams Nature Center.

Adopt-a-Creek

The Adopt-a-Creek program was implemented as a compliment to the annual River Rescue program (see next item) to raise awareness of the state of our waterways in the community and to begin to address the problem through volunteer work in and near the creeks and streams that feed the Tennessee River. The long-term goal of the Adopt-a-Creek program is to have every accessible section of creek adopted by neighborhood, school, business, and civic groups. Adoption responsibilities include:

- ▶ a one year commitment to do two cleanups,
- ▶ monitoring physical conditions after each cleanup, and
- ▶ keeping a record of participants and debris weight from each cleanup.

In the six years since the inception of this volunteer program, eleven miles of stream have been adopted and more than 142 tons of litter and debris have been picked up. Several adopters have performed water testing and population studies to further their knowledge of their adopted section. Adopt-a-Creek is supported by the City of Knoxville and coordinated by Ijams.

River Rescue

Status: Ongoing

The year 2001 was the 12th year for the River Rescue. The spring 2001 River Rescue attracted 835 volunteers who collected 17.7 tons of trash and 167 tires from the shores of the Tennessee River. This annual event is coordinated through Ijams Nature Center in cooperation with the City of Knoxville and Sea Ray Boats and more than 20 other partners, including members of the business community, government agencies, private organizations, and individuals. There are 32 sites or "zones" that stretch from the forks of the river above Knoxville to Fort Loudoun Dam. River Rescue is also held in partnership with Lake User groups on Watts



Bar Lake, Melton Hill Lake, and the Clinch River. Ijams Water Quality Specialists plan for this event throughout the year by recruiting volunteers, surveying river bank conditions, securing additional sponsors, and pinpointing areas in need of cleanup.

Operation Storm Drain

Status: Ongoing

The Blue Thumb Coalition started this ongoing program in 1994. The message "DUMP NO WASTE, DRAINS TO STREAM" has been stenciled on over 10,600 drains. During year five, the City and Ijams has replaced the stenciling program with DAS curb markers. These brightly colored plastic disks are affixed to the curbs and carry the message "Dump no Wastes, Drains to Stream". Operation Storm Drain attempts to educate citizens and reduce the amount of pollutants dumped into our waterways.



Water Quality Forum

Status: Ongoing

The Water Quality Forum was initiated in 1990 by the City of Knoxville as a cooperative network of organizations and agencies charged with monitoring and regulating regional water quality. Currently the Forum consists of 35 participating groups including but not limited to the City, CAC Americorps, TVA, KUB, UTK-WRRC, USGS, NRCS, TDEC, KKB, etc. The Forum meets quarterly as a large group and monthly within the committees.

Adopt-a-Watershed

Status: Ongoing

Currently, ten area high schools are participating in the program. The City of Knoxville has helped provided training, participation, and supplies to the schools and has helped implement the goals of the program and increase public awareness of water quality issues. The primary goals of the program include:

- ▶ Characterizing the school's watershed using, at minimum, two AAW characterization tools (e.g., watershed inventory, watershed mapping, windshield survey, stream walk).
- ▶ Monitor the school's watershed stream(s), conducting, at minimum, chemical testing twice and a biological (i.e. macroinvertebrate and/or fish) assessment once.
- ▶ Conduct at least one water quality improvement activity (e.g., tree planting, storm drain stenciling, stream cleanup, stream bank restoration, presentations to school groups/community organizations on the "state of the watershed" as determined by the students' characterization/monitoring efforts).

The City will continue working with the schools and provide support such as information, solid waste support for cleanups, GIS maps, stencils, testing supplies, training, and etc.



6.0 MONITORING REPORTS SUMMARY

6.1 DRY-WEATHER SCREENING PROGRAM - NEW OUTFALL INVENTORY

During the past Permit year, nine outfalls were added to the City's outfall inventory. Outfall 01-400-0397 is an outlet to a detention pond that collects runoff from a commercial parking lot. Outfalls 01-400-0236 and 01-200-0238 outlet from a commercial parking lot. Outfalls 13-300-0181, 13-300-0182, and 13-300-0184 discharge stormwater collected at the City's maintenance and service center on Loraine Street. Outfalls 13-300-0226, 13-300-0227, and 13-300-0228 discharge stormwater collected at Knoxville's Household Hazardous Waste Disposal Center. All outfalls are clearly marked on the inventory map located in the Appendix of this report.

During year five, outfall number 01-900-0216 was removed from First Creek. This outfall was previously reported in the year three report as a confirmed sanitary sewer overflow



maintained by KUB near the intersection of Fourth Street and Hoitt Avenue. This outfall was confirmed as a 6" pipe installed to prevent overflows from the sanitary sewer manholes in the street by directing the flow into First Creek. The "900" series of outfalls were added to the outfall inventory numbering system to account for this TDEC regulated discharge pipe. However, with the removal of this sewer

overflow pipe, the City no longer has any confirmed "900" series outfalls in the inventory.

The dry weather screening of major outfalls throughout the MS4 did provide some indication on improvements since the baseline data was collected at the outfalls during the permit application process in 1991/1992. Please refer to section 5.2 of this report for details on the program.

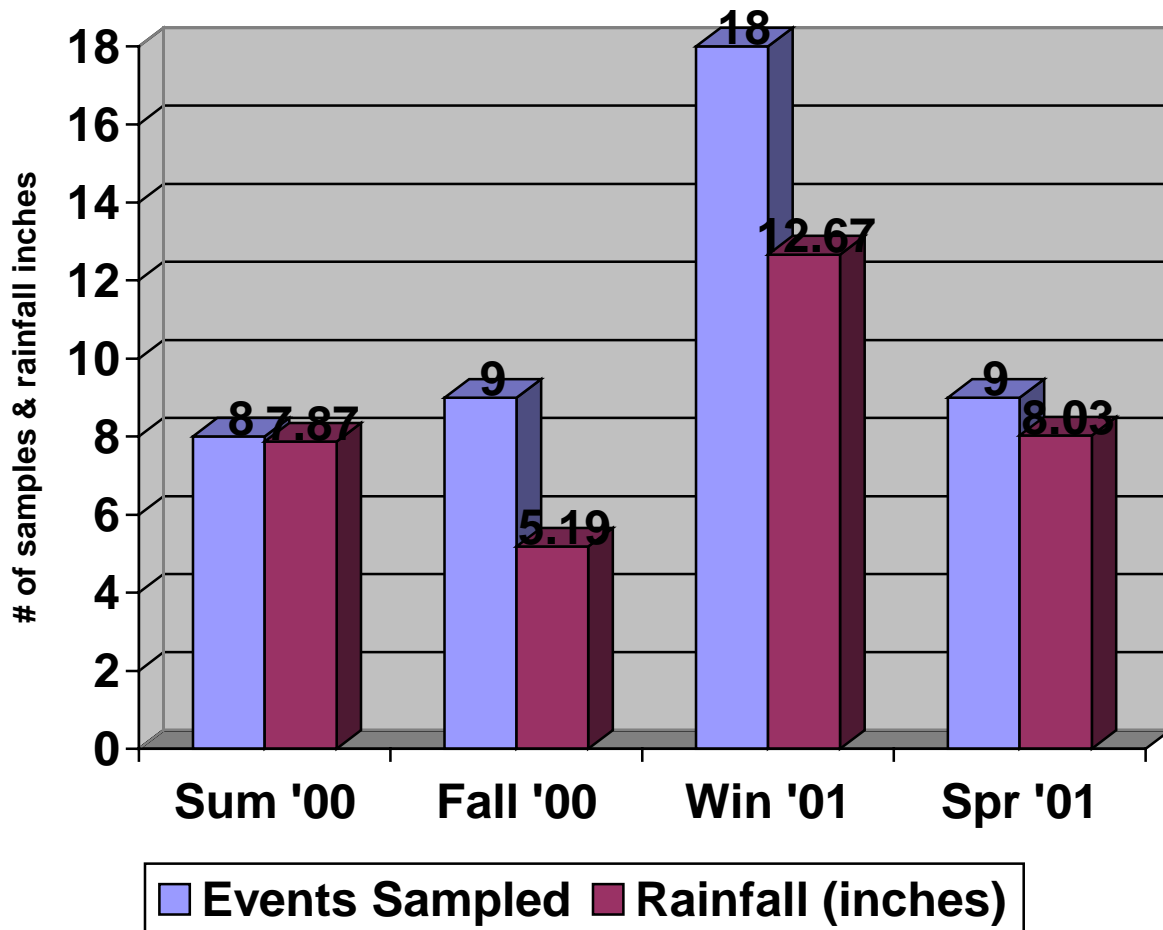


6.2 ONGOING STORMWATER MONITORING PROGRAM

6.2.1 Area Rainfall Data & Storm Event Summary.

During the July 1, 2000 to June 30, 2001 monitoring period an average of 33.76 inches of rain was recorded and 44 storm events were sampled from the City's five ISCO monitoring stations. The sampling frequency requirements as described in section V of the NPDES Permit were not met for the year (see noncompliance section 6.2.3). The graph below shows the relationship between the amount of rainfall and the number of events sampled per season. Notice the number of storm events sampled are proportional to the amount of rain and rain events occurring during that quarter. Monitoring data summaries for each of the sampling locations are included for TDEC's review on the following pages.

Rainfall & Storm Event Summary



6.2.2 Laboratory Analysis Summary - Seasonal Sampling Program
July 1, 2000 thru June 30, 2001

Site	Quarter	pH	# of Events	Average Sampled Volume	Average Rainfall per Event	BOD	COD	TSS	TDS	Nitrate + Nitrite nitrogen	Total ammonia nitrogen	Organic nitrogen + total ammonia	Total Nitrogen	Total recoverable lead	Total recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
AP	Sum. '00	9.2	2	154935	0.40	5	20.9	278	159.3	0.3	<0.21	3.4	<0.9	<0.007	0.158	0.033	0.042	
	Fall '00	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Wtr. '01	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Spr. '01	7	3	3917	0.30	2.7	50.1	99.3	175	0.5	<0.2	0	<3.35	<0.007	0.108	0.067	0.115	
FC	Sum. '00	9	2	363276	0.69	12	13.4	528	180	0.6	<0.2	0.7	2.1	0.1	0.121	0.062	0.059	
	Fall '00	6.8	4	228238	0.74	5.3	5.9	249.8	110.3	0.7	<0.2	1.9	0.7	<0.027	0.111	0.189	0.578	
	Wtr. '01	7	2	228735	0.50	6.5	13	482	138	0.3	<0.2	1.8	<0.7	0.042	0.163	0.019	0.184	
	Spr. '01	7	2	80214	0.25	6.5	49.3	131	168	0.9	<0.2	0	2.4	0.01	0.097	0.074	0.1	
LC	Sum. '00	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Fall '00	6.7	3	177957	0.49	2.7	3.5	65.7	218.7	0.6	<0.2	0.9	1	<0.007	0.051	0.055	0.349	
	Wtr. '01	7	6	440195	0.46	4.5	3.6	38.5	284.2	0.5	<0.2	1	<0.85	<0.007	0.039	0.012	0.023	
	Spr. '01	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
SC	Sum. '00	8.2	1	1330380	0.33	8	5	142.0	158	0.5	<0.2	4.20	1.5	0.017	0.138	-	0.055	
	Fall '00	7	1	4919728	0.95	11	5	104.0	89	0.8	<0.2	2.80	0.6	0.009	0.065	0.081	0.502	
	Wtr. '01	6.8	5	3322455	0.80	5.6	4.1	153.8	137.2	0.5	<0.2	1.1	<0.6	<0.018	0.113	0.047	0.083	
	Spr. '01	7	4	695023	0.47	6.8	105.5	137.5	199.5	1.2	<0.2	4.9	8.5	0.03	0.166	0.09	0.138	
WD	Sum. '00	9.1	3	548323	0.23	7	11.84	90	201.67	0.53	<0.2	1.68	<0.6	<0.002	0.13	0.03	0.045	
	Fall '00	6	1	775250	0.77	6	2.4	188	102	0.4	<0.2	0.84	0.2	<0.007	0.047	0.031	0.071	
	Wtr. '01	7	5	609480	0.48	4.8	5.4	137.6	224.2	0.4	<0.2	1	<0.76	<0.011	0.086	0.04	0.065	
	Spr. '01	7	1	295602	0.93	5	39.7	590	129	0.287	<0.2	0	<0.6	0.019	0.23	0.17	0.17	
National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	0.46	
Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 -	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

The above chart is comprised of seasonal averages from the data collected from each individual storm event.

- Winter (Jan., Feb., and March); Spring (April, May, and June); Summer (July, Aug., and Sept.); Fall (Oct., Nov., and Dec.)

- The Characteristics of Urban Stormwater and National NURP Study Average data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS

AP = Acker Place Monitoring Station

LC = Loves Creek Monitoring Station

FC = First Creek Monitoring Station

WD = Walden Drive Monitoring Station

SC = Second Creek Monitoring Station

6.2.2 Acker Place Monitoring Site

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2000	Ap073100	Composite	9.7	221882	0.47	3	3.30	34.0	152	0.3	0.4	2.52	<0.3	<mdl	0.097	0.028	0.044	
	Ap081000	Composite	8.6	87988	0.33	7	38.50	522.0	167	0.3	<.02	4.20	1.5	0.014	0.219	0.037	0.040	
Quarter Average			9.2	154935	0.40	5.0	20.9	278.0	159.5	0.3	<0.21	3.4	<0.9	<0.007	0.158	0.033	0.042	

*National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	0.46
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SPRING 2001	Ap060601	Composite	7.0	8232	0.31	4	93.50	32.0	112	0.5	<0.2	0.00	3.8	<0.007	0.128	0.020	0.030	
	Ap062501	Composite	7.0	2964	0.41	2	32.80	256.0	295	0.7	<0.2	0.00	<0.6	<0.007	0.111	0.100	0.200	
	Ap063001	Composite	7.0	554	0.19	2	24.00	10.0	118	0.3	<.02	0.00	6.2	<0.007	0.084	0.080		
Quarter Average			7.0	3917	0.3	2.7	50.1	99.3	175.0	0.5	<0.2	0.0	<3.35	<0.007	0.108	0.067	0.115	

*National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	0.46
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 First Creek Monitoring Station

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2000	Fc081000	Composite	9.00	660855	0.85	14	17	928.0	172	0.6	<0.2	0.56	2.1	0.057	0.213	0.049	0.056	
	Fc092000	Composite	9.00	65697	0.53	10	10	128.0	188	0.6	<0.2	0.84	<0.3	<mdl	0.028	0.074	0.061	
	Quarter Average			9.0	363276	0.69	12.0	13.4	528.0	180.0	0.6	<0.2	0.70	2.1	0.1	0.121	0.062	0.059
Fall 2000	Fc110800	Composite	7.00	191642	0.78	6	6	134.0	88	0.7	<0.2	3.08	0.3	0.026	0.155	0.080	0.651	
	Fc111600	Composite	7.00	120755	0.48	5	6	97.0	117	0.9	<0.2	2.52	0.6	0.027	0.078	0.408	0.962	
	Fc121300	Composite	7.00	242268	0.85	5	2	252.0	107	0.6	<0.2	0.84	1.3	<0.007	0.050	0.079	0.122	
	Fc121600	Composite	6.00	358286	0.84	5	10	516.0	129		<0.2	1.12		0.047	0.161			
	Quarter Average			6.8	228238	0.74	5.3	5.9	249.8	110.3	0.7	<0.2	1.9	0.7	<0.027	0.111	0.189	0.578
*National NURP Study Average						11.9	90.8	na	na	na	****	2.35	3.31	0.18	0.176	0.160	0.460	
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Winter 2001	Fc021301	Composite	7.00	365921	0.49	5.0	9.5	274.0	160.0	0.3	<0.2	1.40	<0.6	0.029	0.146	0.023	0.027	
	Fc031201	Composite	7.00	91549	0.51	8.0	16.5	690.0	116.0	0.3	<0.2	2.24	0.8	0.054	0.180	0.014	0.340	
	Quarter Average			7.0	228735	0.50	6.5	13.0	482.0	138.0	0.3	<0.2	1.8	<0.7	0.042	0.163	0.019	0.184
Spring 2001	Fc050601	Composite	7.00	91512	0.31	9	96	180.0	178	1.7	<0.2	0.00	0.6	0.007	0.122	0.137	0.129	
	Fc060701	Composite	7.00	68916	0.19	4	2	82.0	158	0.2	<0.2	0.00	4.2	0.013	0.072	0.010	0.070	
	Quarter Average			7.0	80214	0.25	6.5	49.3	131.0	168.0	0.9	<0.2	0.0	2.4	0.010	0.097	0.074	0.100
*National NURP Study Average						11.9	90.8	na	na	na	****	2.35	3.31	0.18	0.176	0.160	0.460	
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Loves Creek Monitoring Station

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Fall 2000	Lc111600	Composite	6.00	2405	0.49	2	3	18.0	228	1.1	<0.2	0.84	0.6	<0.007	0.042	0.103	0.487	
	Lc120300	Composite	7.00	15286	0.33	2	3	1.0	279	0.3	<0.2	0.84	0.1	<0.007	0.088	0.037	0.039	
	Lc121300	Composite	7.00	516181	0.65	4	5	178.0	149	0.3	<0.2	1.12	2.3	<0.007	0.022	0.025	0.522	
Quarter Average			6.7	177957	0.49	2.7	3.5	65.7	218.7	0.6	<0.2	0.9	1.0	<0.007	0.051	0.055	0.349	
*National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.160	0.460	
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Winter 2001	Lc010801	Composite	7.00	11285	0.31	4	4	10.0	466	0.4	<0.2	0.84	<0.6	<0.007	0.023	0.025	0.009	
	Lc011701	Composite	7.00	10587	0.14	4	4	7.0	310	0.4	<0.2	0.84	<0.6	<0.007	0.030	0.005	<0.001	
	Lc021301	Composite	7.00	301463	0.59	5	2	22.0	234	0.3	<0.2	1.40	2.1	<0.007	0.049	<0.001	0.006	
	Lc022401	Composite	7.00	2018892	0.71	3	5	126.0	211	0.5	<0.2	2.24	<0.6	<0.005	0.052	<0.001	<0.001	
	Lc031201	Composite	7.00	209579	0.43	6	4	41.0	256	0.7	<0.2	0.84	<0.6	<0.007	0.037	<0.413	<0.001	
	Lc032901	Composite	7.00	89364	0.57		2	25.0	228	0.5	<0.2	0.00	<0.6	<0.007	0.044	0.007	0.054	
Quarter Average			7.0	440195	0.46	4.5	3.6	38.5	284.2	0.5	<0.2	1.0	<0.85	<0.007	0.039	0.012	0.023	
*National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.160	0.460	
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Second Creek Monitoring Station

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total phenols	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER	Sc081000	Composite	8.20	1330380	0.33	8	5	142.0	158	0.5	<0.2	4.20	1.5	0.06	0.017	0.138		0.055	
Quarter Average			8.2	1330380	0.33	8	5	142.0	158	0.5	<0.2	4.20	1.5	0.06	0.017	0.138		0.055	
Fall 2000	Sc110800	Composite	7.00	4919728	0.95	11	5	104.0	89	0.8	<0.2	2.80	0.6		0.009	0.065	0.081	0.502	
Quarter Average			7.00	4919728	0.95	11	5	104.0	89	0.8	<0.2	2.80	0.6		0.009	0.065	0.081	0.502	
*National NURP Study Average						11.9	90.8	na	na	na	****	2.35	3.31	na	0.18	0.176	0.160	0.460	
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 0.2	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total phenols	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus	
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Winter 2001	Sc011701	Composite	6.00	6828343	1.82	6	4	278.0	114	0.4	<0.2	0.00	<0.6		0.058	0.194	0.029	0.021	
	Sc021301	Composite	7.00	2495017	1.20	5	2	178.0	118	0.4	<0.2	1.68			0.010	0.086	<0.001	0.003	
	Sc022401	Composite	7.00	3961628	0.63	4	5	135.0	129	0.4	<0.2	1.96	<0.6		0.028	0.131	<0.001	0.001	
	Sc031201	Composite	7.00	1664012	0.25	7	5	88.0	168	0.4	<0.2	1.96	<0.6		<0.007	0.061	0.080	0.360	
	Sc032901	Composite	7.00	1663277	0.10		4	90.0	157	1.0	<0.2	0.00	<0.6		<0.007	0.091	0.031	0.032	
Quarter Average			6.8	3322455	0.80	5.6	4.1	153.8	137.2	0.5	<0.2	1.1	<0.6		<0.018	0.113	0.047	0.083	
Spring 2001	Sc050601	Composite	7.00	886575	0.32	7	154	102.0	176	1.4	<0.2	0.00	12.8		0.011	0.104	0.040	0.050	
	Sc052101	Grab	7.00		0.62	6	80	94.0	183	1.1	0.2	0.00	5.7	<0.01	0.013	0.082	0.140	0.120	
	Sc062001	Composite	7.00	564679	0.65	11	81	188.0	168	1.4	<0.2	9.80	3.3		0.048	0.238	0.100	0.100	
	Sc062501	Composite	7.00	633815	0.27	3	107	166.0	271	0.8	<0.2	9.80	12.2		0.048	0.238	0.080	0.280	
Quarter Average			7.0	695023	0.47	6.8	105.5	137.5	199.5	1.2	<0.2	4.9	8.5	<0.01	0.030	0.166	0.090	0.138	
*National NURP Study Average						11.9	90.8	na	na	na	****	2.35	3.31	na	0.18	0.176	0.160	0.460	
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 0.2	0.0 - 1.9	na	0.1 - 10	0.1 - 125	

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Walden Drive Monitoring Station

Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Summer 2000	Wd072300	Composite	9.30	419533	0.10	6	4	34	198.00	0.3	<0.2	1.96	<0.5	<mdl	0.052	0.011	0.027
	Wd081000	Composite	9.10	940704	0.46	7	8	175	154.00	0.4	<0.2	0.56	0.3	<mdl	0.178	0.038	0.046
	Wd082000	Composite	9.00	284732	0.14	8	23	61	253.00	0.9	<0.2	2.52	1.0	<0.007	0.161	0.042	0.061
Quarter Average			9.13	548323	0.23	7.00	11.84	90.00	201.67	0.53	<0.2	1.68	<0.6	<.002	0.130	0.030	0.045
Fall 2000	Wd121300	Composite	6.00	775250	0.77	6.0	2.4	188.0	102.00	0.4	<0.2	0.84	0.2	<0.007	0.047	0.031	0.071
	Quarter Average			6.00	775250	0.77	6.0	2.4	188.0	102.00	0.4	<0.2	0.84	0.2	<0.007	0.047	0.031
*National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	0.46
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125

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Quarter	Date and Sample ID #	Type	pH	Flow	Rainfall amount	BOD	COD	TSS	TDS	Nitrate + Nitrate nitrogen	Total ammonia nitrogen	Organic nitrogen + Total nitrogen	Total nitrogen	Total Recoverable lead	Total Recoverable zinc	Dissolved phosphorus	Total phosphorus
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Winter 2001	Wd010801	Composite	7.0	210003	0.28	5	4.0	104	523.0	0.3	<0.2	0.56	0.7	<0.007	0.043	0.013	0.072
	Wd021301	Composite	7.0	1083499	0.52	5	10.0	45	180.0	0.4	<0.2	3.08	<0.6	0.023	0.105	<0.001	<0.001
	Wd022401	Composite	7.0	902234	0.68	3	3.2	314	131.0	0.4	<0.2	1.12	1.3	0.007	0.114	<0.001	0.143
	Wd031201	Composite	7.0	402540	0.42	6	5.1	148	138.0	0.4	<0.2	0.28	<0.6	<0.007	0.079	0.087	0.010
	Wd032901	Composite	7.0	449127	0.48		4.7	77	149.0	0.6	<0.2	0.00	<0.6	0.009	0.089	0.019	0.035
Quarter Average			7.0	609480	0.48	4.8	5.4	137.6	224.2	0.4	<0.2	1.0	<0.76	<0.011	0.086	0.040	0.065
Spring 2001	Wd060601	Composite	7.0	294602	0.93	5	39.7	590	129.0	0.287	<0.2	0.000	<0.6	0.019	0.230	0.170	0.170
	Quarter Average			7.0	294602	0.93	5	39.7	590	129.0	0.287	<0.2	0.000	<0.6	0.019	0.230	0.170
*National NURP Study Average						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	0.46
*Characteristics of Urban Stormwater Range						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	0.1 - 125

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Seasonal Ambient Grab Samples 2000-2001

Fall 2000	BOD	COD	TSS	TDS	Nitrate + Nitrite Nitrogen	Total Ammonia Nitrogen	Organic Nitrogen + Total Ammonia	Total Nitrogen	Total Recoverable Lead	Total Recoverable Zinc	Dissolved Phosphorus	Total Phosphorus
Acker Place												
First Creek	2	3.2	15	251	0.4	<0.2	5.6	<0.2	<0.007	0.02	0.014	0.069
Loves Creek	2	3.8	15	317	0.5	<0.2	2.52	0.3	0.01	0.012	0.05	0.02
Second Creek	2	3.3	1	305	1.1	<0.2	0	1.2	<0.007	0.021	0.035	0.046
Walden Drive	2	3.1	3	261	0.5	<0.2	0	0.2	<0.007	0.021	0.139	0.069
Average	2	3.4	9	284	0.6	<0.2	2	<0.6	<0.01	0.02	0.06	0.05

Winter 2001	BOD	COD	TSS	TDS	Nitrate + Nitrite Nitrogen	Total Ammonia Nitrogen	Organic Nitrogen + Total Ammonia	Total Nitrogen	Total Recoverable Lead	Total Recoverable Zinc	Dissolved Phosphorus	Total Phosphorus
Acker Place	1	3.7	2	252	0.4	<0.2	0	1.2	<0.005	0.025		0.022
First Creek	1	<1.0	6	267	0.4	<0.2	0	<0.6	0.01	0.036	0.005	<0.001
Loves Creek	1	10.5	5	327	1	<0.2	0	0.9	0.01	0.01	0.004	0.017
Second Creek	2	2	5	284	0.4	<0.2	0.84	0.9	<0.007	0.018	<0.001	0.054
Walden Drive	2	<1.0	5	261	0.4	<0.2	0	5	<0.007	0.022	<0.007	<0.001
Special	1	4	15	310	0.3	<0.2	0	<0.6	<0.007	0.033	0.013	0.034
Average	1	<4.5	6	284	0.5	<0.2	0	<1.5	<0.007	0.02	<0.006	<0.022

Spring 2001	BOD	COD	TSS	TDS	Nitrate + Nitrite Nitrogen	Total Ammonia Nitrogen	Organic Nitrogen + Total Ammonia	Total Nitrogen	Total Recoverable Lead	Total Recoverable Zinc	Dissolved Phosphorus	Total Phosphorus
Acker Place	2	<0.1	2	201	0.4	<0.2	0	<0.6	<0.005	0.04	0.018	0.044
First Creek	2	<0.1	2	255	1.2	<0.2	0	<0.6	<0.005	0.033	0.044	0.034
Loves Creek	2	<0.1	5	285	1	<0.2	0	<0.6	<0.005	0.053	0.05	0.082
Second Creek	2	6.2	3	307	1.2	<0.2	0	<0.6	0.016	0.061	0.07	0.043
Walden Drive	2	<0.1	3	265	0.9	<0.2	0	<0.6	0.013	0.066	0.026	0.053
Average	2	<1.3	3	263	0.9	<0.2	0	<0.6	<0.008	0.05	0.04	0.05



6.2.3 Noncompliance.

The City of Knoxville has complied with all monitoring requirements during year five with the exception of the target number of stormwater samples collected from the monitoring stations. The permit requires sample collection from five monitoring locations for 12 to 15 storm events per year. Due to the unusually low amount of rainfall during year five, only 44 storm samples were collected from all five stations. The following table illustrates the relationship between numbers of storm samples collected and total rainfall for the last four permit years.

Permit Year	Total Yearly Rainfall	Total Samples Collected
2000-2001	33.76 inches	44
1999-2000	41.31 inches	66
1998-1999	42.99 inches	72
1997-1998	54.77 inches	76

The number of samples collected does rely on the amount of rainfall and the distribution of the individual rain events. Although the 1997-1998 rainfall total exceeded the norm by 12 inches, the qualifying rain events did not. Many events were lost due to a lack of a dry period in between events. During year five, the rain events simply did not occur or lacked sufficient duration to provide a valid composite sample.

The KUB did not provide the industrial inspection reports during year five as required by the Industrial and Related Facilities Program IN-2. KUB stopped collecting the industrial inspection reports but did not inform the City until after year five had been completed. The City will replace this program task with an appropriate task in the new permit term. Since the inspection reports had been collected in previous years from the same industries, it is not likely that any significant new information would have been gathered.

6.2.4 Estimated Runoff from Major Watersheds within the MS4 Area.

Part VI (A)(2)(e)(i)(3) of the NPDES permit requires an estimate of the total volume of urban runoff discharged by the City of Knoxville for the year. This estimate is to be based on total rainfall for the year and the estimated imperviousness of different land uses. The total rainfall for year five was determined to be an average of the annual rainfall recorded during year five from the five City of Knoxville monitoring stations located throughout the city and the National Weather Service rain gage at the McGhee Tyson Airport. During year five, the average annual rainfall amount is 33.76 inches.

To estimate the total runoff volume, the City utilized the GIS to determine approximate areas for each watershed within the city limits along with the corresponding land uses. Each land use is assigned an approximated impervious percentage according to the Camp Dresser and McKee Watershed Management Model described in the Part 2 application, pages 4-14 to 4-18.

It was assumed for each watershed that 95 percent of the rainfall from the impervious fraction, and 15 percent of the rainfall from the pervious fraction of each land use was converted to runoff. Therefore the impervious runoff coefficient and the pervious runoff coefficient were assumed to be 0.95 and 0.15, respectively. For example, based upon an average annual rainfall



volume of 42.99 inches/year, the average annual runoff from a single family residential land use (25% impervious) is 15.05 in/yr ($42.99 * [(0.15 * 0.75) + (0.95 * 0.25)]$). The runoff coefficient for a single land use is the sum of the impervious percentage multiplied times the impervious runoff coefficient plus the pervious percentage multiplied by the pervious runoff coefficient. For the previous example, the average runoff coefficient for the single family residential land use is 0.35 ($[0.15 * 0.75] + [0.95 * 0.25]$). For a watershed, the average runoff coefficient is an area weighted average of each land use runoff coefficients times the percentage of the area of each land use.

The runoff from the major watersheds within the MS4 area was estimated by a formula in Camp Dresser & McKee's Watershed Management Module shown below:

$$Q_i = P \times C_i \times A_i$$

Where,

P = total precipitation (inches/year) = 33.76 in./yr. = 2.813 ft./yr.

C = land use area weighted runoff coefficient = $0.15 * \text{Pervious}\% + 0.95 * \text{Impervious}\%$

A = drainage area (acres) = acres $\times (4.35E4 \text{ ft}^2/\text{acre}) = \text{ft}^2$

Q = $\sum Q_i$ = total runoff rate / $E6 = \text{Mgal}$

Please find the analysis for the each watershed and for the entire city in table 6.2.4 on the following page.

6.3 IN-STREAM AMBIENT MONITORING PROGRAM

Ambient monitoring has evolved throughout the permit term from field testing at many locations on several creeks to laboratory analysis of grab samples. During year four, the storm event monitoring stations were relocated to in-stream locations to enhance the ambient monitoring program. Beginning in year four and throughout year five, quarterly grab samples were taken at the monitoring station locations and delivered to the KUB laboratory for analysis. The samples were analyzed for all of the routine parameters listed in the seasonal monitoring program requirements. By collecting the ambient samples from the same locations and analyzing them for the same parameters as the storm event samples, a baseline will be established to compare the wet and dry flows. The ambient sampling results from year five are included in the previous section of this report.

6.4 BIOLOGICAL SAMPLING PROGRAM

During year five, the City continued to rely on IBI study data performed by TVA. Two sites were sampled in the city but one was on July 9, 2001 and will be reported next year. The IBI that did occur within the city during year five was on Third Creek near West High School. The IBI score was 20 (very poor). These results will be included with the biological sampling data compiled during year one and maintained in the Engineering Department. The City has encouraged TVA to continued selecting sites within the urban environment to help track any improvement or degradation of the urban streams. Although TVA will continue to be the primary source of biological testing data, the City of Knoxville will identify opportunities to expand or supplement the existing TVA biological sampling program in the permit term.

6.2.4 ESTIMATED RUNOFF FROM MAJOR WATERSHEDS WITHIN THE MS4

Watershed	Agricul./ Forest/ Vacant, Public Parks	Vacant (>10)	Rural Res.	Single Family Res.	Private Rec., Public Land	Multi-Family Res., Church	Insti-tutional	Mining, Office/ Service	Manu-facturing/ Whole-sale	Commer., Trans./ Utility/ Commun.	Major Roads/ Hwys/ ROWs	Under Const.	Not Loaded	Total Acres in Watershed	Acres in the City Limits	Est. % Impervious	C Value	Rainfall during Permit year 99/00 (in./yr)	Total Runoff for 99/00 (Mgal/yr)
Baker Cr.	412	2	107	640	90	77	32	1	1	3	269	13	27	1,674	1,674	32	0.41	33.76	625
East Fork	313	0	10	475	302	78	73	31	195	235	584	33	180	2,509	2,509	53	0.57	33.76	1315
First Cr.	724	0	300	3,152	544	501	110	157	127	556	1,412	51	116	7,750	7,750	44	0.50	33.76	3541
Fourth Cr.	965	57	423	2,026	468	406	93	206	201	568	881	61	414	6,769	5,920	41	0.48	33.76	2587
Goose Cr.	639	40	126	669	213	67	8	21	77	131	327	34	29	2,381	1,755	35	0.43	33.76	687
Grassy Cr.	2,230	176	561	610	215	24	0	14	31	95	211	39	95	4,301	433	17	0.29	33.76	113
Holston R.	2,362	69	371	1,222	417	45	5	2	219	33	805	32	50	5,632	2,455	28	0.37	33.76	834
Inman Br.	563	33	214	138	4	12	0	0	0	0	145	0	34	1,143	99	21	0.31	33.76	29
Knob Cr.	1,719	195	481	843	125	84	1	19	1	29	296	4	169	3,966	989	19	0.30	33.76	275
Knob Fork	1,659	26	398	675	182	56	5	93	6	124	257	19	252	3,752	823	22	0.33	33.76	247
Love Cr.	1,735	102	505	1,625	311	212	51	94	178	408	1,038	46	103	6,408	5,090	36	0.44	33.76	2055
Second Cr.	443	0	90	1,281	346	247	29	107	140	542	1,161	35	82	4,503	4,498	53	0.57	33.76	2351
Sinking Cr.	1,614	146	459	1,266	284	90	17	33	31	267	881	12	347	5,447	2,434	33	0.41	33.76	925
Swanpond C	3,892	303	833	604	121	36	4	79	240	232	457	65	285	7,151	499	19	0.30	33.76	139
Ten Mile Cr.	1,879	0	638	3,421	165	895	55	115	58	615	1,500	24	641	10,006	3,921	38	0.45	33.76	1617
Third Cr.	1,757	79	436	3,003	406	512	184	124	225	443	1,252	98	220	8,739	8,417	37	0.45	33.76	3442
TN River	7,197	503	2,269	4,681	2,910	403	187	72	170	238	990	121	1,113	20,854	8,232	22	0.33	33.76	2467
Toll Cr.	535	69	154	222	42	26	1	0	37	4	93	42	4	1,229	767	22	0.32	33.76	227
Turkey Cr.	3,353	235	603	2,693	264	343	121	104	91	442	1,161	68	738	10,216	1,677	29	0.38	33.76	590
Whites Cr.	2,733	154	782	1,298	575	59	31	11	49	126	608	51	578	7,055	1,634	23	0.34	33.76	504
Williams Cr.	358	11	47	561	46	96	125	17	10	61	276	3	30	1,641	1,605	37	0.45	33.76	661
Woods Cr.	1,220	106	281	371	0	26	0	2	140	43	261	1	157	2,608	143	23	0.33	33.76	44
Sink-East	1,226	0		728	9	17	0	17	3	27	0	0	0	2,027	91	12	0.24	33.76	20
Beaver Cr	21,174	0	0	21,230	1,292	845	4	259	283	712	0	160	0	45,959	162	16	0.28	33.76	41
Tuckahoe	4,293	0	0	1,829	18	14	0	8	2	1	0	4	0	6,169	229	8	0.22	33.76	46
Fr.Broad riv	8,954	0	0	2,744	73	40	24	24	497	117	0	166	0	12,639	551	11	0.24	33.76	120
COK Total	73,949	2,306	10,088	58,007	9,422	5,211	1,160	1,610	3,012	6,052	14,865	1,182	5,664	192,528	64,357	25	0.35	33.76	25504

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The runoff from the major watersheds within the MS4 area was estimated by a formula in Camp Dresser & Mckee's Watershed Management Module. $Q = P \times C \times A$

- where, P = total precipitation (inches/year) = 33.76 in./yr. = 2.8133 ft./yr.
- C = land use area weighted runoff coefficient = $0.15 \times \text{Pervious}\% + 0.95 \times \text{Impervious}\%$
- A = drainage area (acres) = acres in watershed $\times (4.35E4 \text{ ft}^2/\text{acre}) = A_i \text{ ft}^2$
- Q = total runoff rate = sum of each watershed's Q_i .

Total estimated runoff for Year Five = 25,504 Mgal

Approximate area and land use for each watershed was determined through the City's GIS. Total yearly rainfall amount was determined by averaging the amount of rain collected from the City's five monitoring stations located throughout the city (refer to map in appendix). Runoff coefficient (C) was calculated by adding 15 % of the pervious fraction to 95% of the impervious fraction in each watershed. This assumes that the fraction of rainfall producing runoff is 15% and 95% from pervious and impervious surfaces respectively. The summary of the runoff calculations are provided in the table above. Calculations for some of the watersheds were left out due to the insignificant amount of runoff that would be produced.



7.0 ASSESSMENT OF CONTROLS: **ESTIMATED POLLUTANT LOADING REDUCTIONS FROM THE MS4**

During the first five years of the NPDES permit, the City of Knoxville has developed and implemented all of the programs scheduled. The Ongoing Monitoring Program was started in January of 1997 and resulted in the collection of 54 months of storm event data through year five. The dry weather-screening program was implemented in year one and has continued throughout the permit term.

Any quantitative estimates of pollutant loading reductions or groundwater impacts from the MS4 may still be premature or impossible to make at this point in the program. However, as described in the dry weather-screening program (ILL-2), noticeable reductions in contaminated outfalls have been observed in the first five years.

Although no testing data is available to substantiate all the illicit discharges and illegal dumping problems resolved, the qualitative effect on water quality within the MS4 and waters-of-the State is irrefutable. Several industries have removed illicit discharges, sections of leaking or broken sanitary sewers have been repaired and/or replaced, the last known sections of the combined sewers have been separated, unknown combined sewer systems have been located and planned for repair, creek restoration and cleanup activities have begun, and many educational and volunteer programs have been sponsored, conducted, and/or coordinated to reduce dumping.

Recent structural controls include the two Stormceptor oil/water separators installed at the KAT facility on First Creek, trash skimmers near the mouth of First Creek, and two catch basin inserts at the Solid Waste Transfer Station and outside Neyland Stadium. All new development of over ½ acre since 1997 has been required to install some structural controls for water quality control. These water quality facilities must be maintained and/or replaced forever.

All of the programs implemented to improve water quality in the creeks and river throughout the city should provide some quantitative evidence of improvement in future years. This data will be reported, as it becomes apparent. The appendix of this report contains the updated estimate for seasonal pollutant loading and event mean concentrations for each of the major watersheds throughout the city.

8.0 SUMMARY OF MODIFICATIONS TO THE SWMP

Many modifications of the SWMP are planned for year one of the new permit cycle. The updated summary tables of tasks for each of the new permit programs is included in the appendix. These tables reflect the modifications proposed to accommodate the TMDL requirements after the reapplication was submitted last year. The stormwater monitoring parameters, listed in the monitoring table, reflect the latest proposal for the next five years. Future modifications to the new SWMP will be made in accordance with 40 CFR 122.62, 122.63, 124.5 and with Part VIII of the NPDES Permit or as negotiated when the new permit is issued.

During the first year of the new permit, the City plans to relocate one of the five monitoring stations. Four of the five monitoring stations are currently located in major streams throughout the city. Since the remaining station is located in a dry stormwater channel, ambient sampling data can not be collected for direct comparison to the storm event data. In an effort to



improve the Ambient Sampling program and to provide additional data for the TMDL program, the station will likely be relocated to Goose Creek or Third Creek during year one. The new location will be coordinated with the TDEC Knoxville Field Office after some initial site surveys are completed. Maps of the current monitoring sites are included in the appendix of this report.

9.0 FISCAL ANALYSIS

The Fiscal Analysis for the fifth annual report will list the fifth permit year budget sources and amounts along with estimates for year one of the new permit. Sources of funds are listed for each major program. Due to complexity, all of the support activities such as purchasing, payroll, legal support, information systems, fleet management, and human resources are not reflected in the table. Actual funding sources for future years are subject to change in the new permit cycle due to the possibility of implementing a stormwater utility fee.

Program Description	Fund Source	Actual FY 00/01	Est. FY 01/02
Solid Waste Recycling (includes: composting, education, staff, etc.)	General Fund	\$ 1,194,000	\$ 1,253,000
Household Hazardous Waste Facility & Operation	General & Grant Funds	\$ 117,000	\$ 120,000
Stormwater Management Operating expenses	501 Fund	\$ 656,880	\$ 701,390
Service Department Operating/Maint. Maintenance (including: brush, leaf, & litter pickup; street cleaning; curb & gutter repair; catch basin cleaning and repair; ditching; storm drain repair, installation, & cleaning; seed/ sod in R.O.W.; grate replacement; water pumping; tree trimming, removal, and planting.	General Fund	\$ 2,854,007	\$ 2,997,000
Sequoyah Hills Combined Sewer	Bond Funds	\$ 668,021	\$ 0
First Creek Flood Improvement Project	Bond Funds	\$ 2,871,688	\$ 400,000
Other Capital Improvements	Bond Funds	\$ 1,326,814	\$ 400,000
Total Estimated Stormwater Management Program Costs		<u>\$ 9,688,410</u>	<u>\$ 5,871,390</u>