A Proposal for:
BMP and Dry Weather Storm Drainage Assessment: Phase II

Purpose

The Federal Water Pollution Control Act (Clean Water Act) mandates that cities such as Lincoln obtain a National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges. The NPDES permit for stormwater discharges requires implementation of best management practices (BMPs) to assist in decreasing the amount of pollutants from stormwater discharges. The NPDES permit further requires that wet weather BMP monitoring be conducted to assess the effectiveness of the BMP control measures. This BMP Monitoring Plan is developed to satisfy the wet weather BMP monitoring requirements of the NPDES stormwater permit. Other BMP assessments (e.g., assessing the degree of implementation, quality of installation of BMPs, assessing the pollutant removal efficiency of specific BMPs) are not addressed in this monitoring plan. In addition, the NPDES permit requires dry weather monitoring to help identify illicit discharges and illegal dumping. This proposal addresses monitoring plans for the BMP and Dry Weather monitoring.

BMP Monitoring: Phase II

Goals and Rationale

The first goal of this project is to collect and interpret monitoring data to assess the effectiveness of the BMP program for the city of Lincoln. The second goal is to develop a base group of common stormwater contaminants and values which may be expanded upon and revised, depending on the performance results for each BMP tested. A third goal of this project is to conduct a thorough literature search for related stormwater monitoring information.

The primary purpose of the BMP monitoring component is to satisfy the requirements for BMP monitoring under the NPDES stormwater permit. Specifically, the primary goal, as stated in the permit, is "to assess the effectiveness of BMP control measures implemented under the Storm Water Management Plan (SWMP)". The BMP "monitoring shall be conducted to determine effectiveness of BMPs and to facilitate future SWMP planning. This shall include monitoring to assess BMP effectiveness with respect to impairment identified by the NDEQ pursuant to 303(d) of the Federal Clean Water Act".

Wet Weather Data to Assess Effectiveness of BMPs

There are several water bodies listed as "impaired" under 303(d) due at least in part to stormwater discharges from the city of Lincoln. These impaired waters and their impairing pollutants include:

- Salt Creek: ammonia, fecal coliform, low DO,
- Dead Man's Run: fecal coliform,
- Oak Creek: fecal coliform,

- Antelope Creek: fecal coliform, and
- Holmes Lake: sediments, nutrients.

The major impairing pollutants typically potentially associated with stormwater discharges are sediment, nutrients, and fecal coliform.

To develop a BMP monitoring plan that satisfies the stated goals, several monitoring issues have been considered:

- Monitoring results should be stated as event mean concentrations. This requires flow monitoring at the sampling sites so that appropriate sample compositing can be done.
- Monitoring should take into account the large variability that is likely from stormwater management BMPs. For example, discharges from two similar silt fences, even in the same field during the same storm, may have significantly different water quality. The variability expected within a BMP is so large that scores of sampling locations with numerous repetitions would be needed to collect sufficient data to assess the effectiveness of the specific application. This level of sampling and analysis is not within the scope of this effort.
- The monitoring plan should be able to accommodate the transient nature of many BMPs. For example, as different areas within a development progress through the development process, the specific BMPs are also likely to change (e.g., from silt fences to seeding to sodding).
- The BMP monitoring plan should be primarily focused on the effectiveness of the city's BMP program to provide adequate water quality in the stormwater discharges to local water bodies, rather than on the effectiveness of specific BMP applications for which considerable data have been developed (e.g., effectiveness of silt fences).
- Wet weather BMP monitoring should be implemented that assesses the applicable minimum measures. The minimum measures that are applicable to wet weather BMP monitoring are: construction site stormwater runoff control and post construction storm water management in new development and redevelopment (e.g., concrete channels, grass swales, detention basins, construction sites). Other minimum measures such as Public Outreach and Education and Public Involvement and Participation are more appropriately assessed in other ways.
- The wet weather BMP monitoring should assess the effectiveness of BMPs to protect the water quality in Holmes Lake.
- To assess the effectiveness of BMPs, the term effectiveness must be defined. For this monitoring effort, effectiveness is defined as the degree to which stormwater is treated by BMPs in relation to the water quality prior to the stormwater being treated and to water quality bench mark values for specified pollutants such as total suspended solids, nutrients, and fecal coliform.

Based on these considerations, the following monitoring plan is developed. Specifically, monitoring will be conducted primarily at the outlets of small sub-basins. Sub-basins will be selected based on land-use and BMP applications within the sub-basin. This scheme will assess the effectiveness of suites of BMPs applied to specific land uses.

Storm Water Quality Parameter Ranges

Stormwater quality values from various sources (e.g., literature, regulatory water quality standards) will be evaluated to develop stormwater constituent concentration ranges that can be used to evaluate the relative quality of Lincoln's stormwater discharges and the relative effectiveness of the BMPs.

Literature Search

A comprehensive literature search will be conducted to develop information related to BMP assessment. The literature search will develop information that will enable a meaningful evaluation and interpretation of the monitoring results.

Sampling Plan

Sampling Locations

Several small sub-basins have been identified that contain specific suites of BMPs for both construction site and post construction minimum measures. Of these, six sites will be selected for BMP monitoring. Sub-basins have been identified so that two basins have similar BMPs. This duplication is done so that results can be compared, and an evaluation of the variability between BMP applications can be evaluated. Note that the six final sampling locations will be determined based on consultation with the City of Lincoln personnel. Following are potential sampling locations with BMPs and minimum measure noted:

Location	BMP	BMP Type
74th Street north of Fox Hollow Road	Concrete-lined channel	Post construction
76th and Van Dorn	Concrete-lined channel	Post construction (drains into detention basin)
North of 78th & Pioneer	Grassed swale	Post construction
72nd & Holmes Park Rd	Retention Basin	Construction/Post construction
6151 S. 88th Street (south of Old Cheney)	Large detention basin	Post construction
76th and Van Dorn	Detention basin	Post construction
93rd Street and Forest Glen Rd	Silt fences, seeding	Construction site. (drains into detention basin)
71st and Pioneer Woods (north of Center Stage Spa)	Commercial development with silt fences, seeding	Construction site

Sample Collection

Sampling will be done using grab samples at the designated sampling locations. Grab samples will be collected from each BMP site throughout the runoff event. Where practicable, samples will be collected at both the inlets and outlets of the BMPs. Sampling will rotate through the BMP locations; i.e., BMP site 1 will be sampled, then

the team will move and sample BMP site 2 until all BMP sites are sampled. When all of the BMP sites have been sampled, the rotation will repeat. It is anticipated that each BMP site will be sampled approximately three times per storm event. The sampling sequence will be rotated for different storms for the sampling locations so that each site receives at least one first flush sample and so that sample bias due to sampling sequence will be minimized.

The time and location will be recorded for each sample and for each in-situ analysis (e.g., temperature, pH) so that the results can be correlated to storm conditions. Flow through the BMP will be estimated throughout the runoff event by measuring the depth at a control point (e.g., culvert inlet, weir).

Sampling Equipment

Samples will be collected using Whirl Pak samplers with 18 oz. sample-dedicated sample bottles. The use of the dedicated sample bottles will eliminate the need for sample equipment decontamination between samples. Bacterial samples will be collected in dedicated bottles supplied by the lab.

Sampling personnel will be equipped with proper rain gear, boots, and rubber gloves. Sample bags will be stored in ice chests until they can be transferred to refrigerators in the UNL lab.

Sample Handling

Sample containers will be placed in coolers loaded with ice and transported immediately to the UNL lab where they will be stored in refrigerators until analyses are conducted. The mean event concentrations for the storm will be estimated from sample analytical results and estimates of flow at the time that each sample was collected.

Sample containers will be labeled according to sample location and time of sampling. For example a sample taken at BMP site 2, at location b, on October 13 at 4:35 in the afternoon will be labeled 2b-10/13/03-1635.

Standard Chain of Custody forms will be maintained for each sample collected. The Chain of Custody forms will include date, time, location, sample location number, sample identification number, analyses to be conducted, name and signature of sampler

Field Notes

Field notes will be kept by the sampling team. Field notes will describe: time and date of storm, time interval from last storm, air temperature, wind, description of the stormwater (e.g., floating debris, oil sheen), and anything that is observed that could affect sample results. A copy of the "NPDES Form PE – Record of Physical Examination Observations Results" or similar type format, is required to be filled out for each outfall tested, the City of Lincoln will provide blank copies of this form.

Storm Tracking and Target Storms

A team leader (or designee) will be on-call at all times and will be responsible for predicting target storms based on local weather reports. A target storm is one which will produce runoff in quantities sufficient for sampling. It is anticipated that sufficient runoff will be present from storms of at least 0.5 inches.

Personnel

A team of ten samplers and sample handlers will be maintained. Six (three teams) of the team will be on call and available for any storm event. When a target storm begins the team leader or designee will make sure that six samplers are at the sampling sites. Samplers will work in teams of two samplers per team.

Sampling Schedule and Frequency

BMP monitoring will commence September 1, 2003 and end May 14, 2005 (i.e., years 2 and 3 of the NPDES permit). Phase I of the project will be between September 1, 2003 and April 15, 2004. Phase II will be from April 15, 2004 to August 31, 2004, and Phase III (to be proposed) will be from September 1, 2004 to May 14, 2005. Sampling locations and protocols will be finalized during the summer of 2003; however, adjustments may be made throughoutt the study period. Monitoring frequency will depend on storm frequency, but the goal is to sample six storms per year (i.e., 2 storms each during the fall, spring, and summer seasons) over the two-year period. Additional storms may be sampled during the summer. An attempt will be made to sample storms of various intensities and durations for each of the seasons. If practicable, one of the spring sampling events will be for a snow-melt event.

Analytical Plan

Grab samples will be analyzed for temperature, pH, fecal coliform, fecal streptococcus, nitrate, total phosphorus, total kjeldahl nitrogen, total suspended solids, and oil and grease. Prior to analysis, samples will be stored at 4°C. Other preservatives used are noted in the description of the analytical method for that parameter. The following analytical methods will be used for each analysis. The UNL Civil Engineering laboratory facilities will be used unless otherwise specified.

Temperature

The temperature of the grab samples will be measured in the field using an alcohol thermometer with 1°C temperature increments. The thermometer will be allowed to equilibrate and will be recorded to the nearest degree on the Chain of Custody sheet.

pH

The solution pH will be measured in the field using pocket pH meters by Hach. The pH meters are capable of measuring to the nearest 0.1 pH units, with a precision of about 0.2 pH units.

E. coli

E. coli samples will be analyzed by the State of Nebraska Health and Human Services Laboratory. Samples will be collected into sterile bottles, and dropped off for analysis within one hour of the rain event. Enumeration by the State Lab will be done using the coli-lert-QT (quanti-tray method). The maximum holding time allowed for the E. coli samples is 8 hours.

Fecal Streptococcus

Fecal streptococcus will be analyzed by the State of Nebraska Health and Human Services Laboratory. Samples will be collected into sterile bottles, and dropped off for analysis within one hour of the rain event. The maximum holding time allowed for the fecal streptococcus samples is 8 hours.

Oil and Grease

Samples for oil and grease will be analyzed by an external laboratory using EPA Method 1664. The maximum holding time allowed for oil and grease samples is 7 days.

Total Kjeldahl Nitrogen

Total kjeldahl nitrogen (TKN) will be analyzed by an external laboratory using EPA Method 351.3. This method can be used to measure TKN concentrations between 0 - 150 mg/L. The maximum holding time allowed for TKN is 24 hours.

Nitrate

Nitrate will be measured using Hach method 8171. Sample concentrations of 0 - 4.5 mg/L as N could be detected with a precision of +/- 0.1mg/L as N. The maximum holding time allowed for nitrate samples is 24 hours.

Total Phosphorus

Total phosphorus will be measured using Hach method 8048. This method is capable of determining total phosphorus concentrations of 0 - 2.5 mg/L with a precision of +/- 0.01 mg/L. The maximum holding time allowed for total phosphorus is 24 hours.

Total Suspended Solids

Total suspended solids will be measured following Standard Method 2540B. The maximum holding time allowed for solids samples is 7 days.

Quality Assurance, Quality Control

UNL Civil Engineering will test 25 percent of the samples in duplicate (over the course of the year) to estimate the "relative percentage error" for each analysis performed by UNL CE. At least 6 blank samples will be tested for each analysis performed by UNL CE. The Method Detection Limit [MDL] (following Standard Methods for Water and Wastewater Analysis) will be determined at the start of the sampling season for each analysis performed by UNL CE. At least 6 standard samples with known concentrations will be tested for each analysis performed by UNL CE. Revised MDLs will be determined using this data. Six

travel blanks will be taken to the field testing sites during one storm during the year and tested for all parameters. Six laboratory blanks will be analyzed for each parameter during the year.

Reports

UNL Civil Engineering will prepare a final report summarizing the field notes and water sample analysis data. The final report will include discussion of the data and evaluations of BMP effectiveness. The final report will include tables of analytical data by sampling site and sampling event. Computer disks will be attached to the final report containing excel spreadsheets of data.

Dry Weather Storm Drainage Assessment

Introduction

This work concerns monitoring of dry weather flows. The monitoring of dry weather flows from storm drains is to provide a field screening analysis for illicit connections and illegal dumping for either selected field screening points and major storm drain outfalls. Approximately 20% of the storm drain field sampling stations will be monitored during this period covered by this project.

Overall Scope of Work

This project will consist of three phases as discussed below.

Phase I. Visit Field Sampling Sites, Collect Samples and Record Observations.

1. UNL Civil Engineering will have a team of at least two students visit each of approximately 55 field sampling sites during the summer of 2004. Each site will be visited at least three days after a measurable rainfall. The field sites to be visited are listed in the "Dry-Weather Stormwater Monitoring for Summer 2003". No more than 5 additional sites will be added to the summer of 2004 monitoring reflecting new outfall sites in newly developed portions of Lincoln and site to be resampled from the past two years.
2. UNL Civil Engineering will provide new information found concerning the storm drain outfalls during sample collection to the City.
3. UNL Civil Engineering will report the following concerning each site:
   - time, day, and weather during site visit, and
   - a narrative description of site appearance (e.g., if it appears that dry weather flows may have occurred).
4. If there is flowing water at a field site, UNL Civil Engineering will
   - collect two grab samples of water during a 24 hour period, with a minimum of 4 hours between samples,
   - prepare a narrative description of the water for the color, odor, turbidity, presence of an oil sheen or surface scum as well as any other relevant observations regarding the potential presence of non-storm water discharges or illegal dumping, and
   - a description of the flow rate.
   - if hazardous materials are discovered the Lincoln Fire Department Hazardous Spills Response Unit should be notified immediately. Illicit discharges or illegal dumping need to be reported immediately to the City of Lincoln and Lancaster County Health Department (LLCHD).

Phase II. Analyze Samples and Perform Quality Control Analyses.

5. The analyses listed in Table 1 will be performed by UNL Civil Engineering (CE) on water samples collected from each field site with flowing water. The total copper analysis will be performed by the UNL Water Sciences Laboratory.

Table 1. Summary of Laboratory Analyses

Procedure	Method	Anticipated Minimum Detection Limit	Max. Sample Hold Time
Temperature	thermometer	NA	On-site testing
Flow Measurement		NA	On-site testing
pH	Probe	NA	4 hours
Chlorine	Hach 8167 (Std. Methods 4500)	0.07 mg/L	On-site testing
Chloride	Hach 8113	0.9 mg/L	7 days
Total Phenol	Hach 8047	0.02 mg/L	28 days
Total Copper	Std. Methods 3030 with Atomic Absorption	30 µg/L	3 months
Detergents / Surfactants	Hach 8028	0.02 mg/L	24 hours
Fluoride	Hach 8029 (US EPA 340.1)	0.5 mg/L	7 days
Nitrate	Hach	0.9 mg/L	7 days
Sulfate	Hach 8051 (US EPA 375.4)	3. mg/L	7 days

6. UNL Civil Engineering will test half the samples in duplicate (over the course of the summer) to estimate the "relative percentage error" for each analysis performed by UNL CE.
7. UNL Civil Engineering will test at least 7 blank samples (over the course of the summer) for each analysis performed by UNL CE.
8. UNL Civil Engineering will determine the Minimum Detection Limit [MDL] (following Standard Methods for Water and Wastewater Analysis) at the start of the summer for each analysis performed by UNL CE.
9. UNL Civil Engineering will test at least 8 standard samples with known concentrations (over the course of the summer) for each analysis performed by UNL CE. A new MDL will be determined using this data.
10. For at least 10 field sampling sites that have no flowing water, place a block of wood in the path of flow and return 24 to 48 hours later and determine if the block of wood has moved due to water flow.

Phase III. Prepare Final Report.

11. UNL Civil Engineering will prepare a final report summarizing the field notes and water sample analysis data collected in the first three Phases. The final report will include several pages of discussion of the data and engineering suggestions. The final report will include tables that make it easy to compare the 2004 results to those found in previous studies. Computer disks will be attached to the final report containing excel spreadsheets of data.

Budget Details:

The work will be performed primarily by a UNL undergraduate student during the summer of 2004. This undergraduate student will work on a full-time basis for about 14 weeks during the summer; this student will be paid at least $9.75/hour (with no benefits). The undergraduate student will be assisted in the field work by another undergraduate student (who will work on a part-time basis). Dr. Dvorak will supervise the project. A UNL graduate student will also assist the undergraduate student in the laboratory assistance and will provide some of the day-to-day supervision of the undergraduate student. All students who work on a full-time basis on this project during the summer will be paid at least $9.75/hour (without benefits). Some of Dr. Dvorak's salary may be redirected to cover the costs of the graduate student.

Other Items.

All equipment and supplies purchased for this project remain the property of UNL at the end of this project. This contract will be paid as a lump sum. This contract will be initiated as soon as possible after 1) appropriate approval by both UNL and the City of Lincoln, and 2) a qualified UNL student is recruited to carry out the work as specified above. The work will be carried out during the period between the approval date and March 30, 2005.

Budget Justification

Salaries and Wages. The budget for the proposed project requests financial support for one graduate student for 4.9 months to assist in the sample collection. A total of about 1.6 months of summer salary support will be provided to the Principal Investigators. About 760 hours for undergraduate hourly workers is included for both the dry weather monitoring and the storm sample collection. All undergraduate workers who will work full-time during the summer will be paid at least $9.75/hour.

Fringe Benefits. Fringe benefits for the graduate student researcher and the Principal Investigators are included in the proposed budget at a rate of 26% of salary costs and at 25% for the graduate students.

Materials and Supplies. Estimated expenses for field and laboratory supplies are included in the proposed budget. Supplies that are required for field sampling include sample containers and field test kits for microbiological and chemical water quality parameters. A limited number of water samples will be sent to the Nebraska Health and Human Services Department laboratory for microbiological testing. Some water samples will also be sent to laboratories on the UNL campus

for metals and nutrient testing. A small amount is included for general operating for photocopying, Internet connections, and long distance phone charges in included.

Travel. Travel funds are included to cover travel costs (both mileage and car rental) for the graduate student researcher and undergraduate research assistants to travel to the field sites within Lincoln. Funds are also included to pay for mileage for the graduate student to travel from Omaha to Lincoln to help collect BMP samples.

Indirect Costs. Standard UNL indirect costs (45.5%) have been reduced to an indirect cost of 10%.

Budget

COST CATEGORY	Agency
A) Personnel	
A1) Principal Investigator	$7,000
A2) Other Faculty	$4,000
A3) **Subtotal:** (A1 thru A2)	$11,000
A4) Fringe Subtotal = A3 x .26	$2,860
A5) (4.9 mo.) Graduate Students	$6,525
A6) Graduate Fringe = (A5 x .23)	$1,501
A7) Graduate Health Benefit ($750/student/year)	$300
A8) (760 hrs) Undergraduate Students	$7,228
Personnel & Benefits Total	$29,414
B) Materials & Supplies	$6,050
C) Travel	$900
TOTAL DIRECT COSTS (A-C)	$36,364
D) Indirect Costs Rate: x .10	$3,636
TOTAL PROJECT COSTS (A-D)	$40,000