TECHNICAL SUMMARY

Determination and Treatment of Substances in Runoff in a Controlled Highway System (Cross Lake)

Summary of Report Number 346

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INTRODUCTION

Because bridges usually span bodies of water, quantifying and controlling non-point pollutant flux from them will take on added significance as federal regulations begin to address non-point contamination of the environment. This study examined the quality and quantity of the non-point contamination coming from the Cross Lake bridge and examined the effectiveness of a detention pond (Holding Pond) in removing contaminants from the run-off.

The Cross Lake Bridge is 10,000 feet long. It may be considered completely impervious with a surface area of approximately 880,000 square feet. The bridge presumably has a closed drainage system and all runoff is conveyed to a concrete-lined holding pond located at the east end of the bridge. An American Sigma series 950 flowmeter/sampler measured and logged the runoff flow rate entering the pond. In addition, it could be programmed to collect samples across the runoff hydrograph. A recording rain gauge, mounted on top of the sampler enclosure, recorded rainfall amounts over time in increments of .01 inch. The pond itself has an average surface area of 40,000 square feet with a maximum depth of 6 to 8 feet depending on location. The pond bottom slopes toward the outlet.

OBJECTIVES

Research is needed to develop a methodology to:

1. Determine a correlation between traffic flow and water runoff quality for this bridge and similar settings,
2. Determine the relationship between water runoff quality from the bridge and effluent quality from the detention pond. Develop a predictive relationship for similar settings,
3. Quantify pollutant loads entering and leaving the Cross Lake Holding Pond,
4. Assess the efficiency of the Cross Lake Holding Pond in removing contaminants from bridge runoff, and
5. Develop recommendations for further investigation.

SCOPE

The scope of this report consisted of monitoring as many runoff events as possible from the Cross Lake Bridge between November 1996 and June 2000. In addition, discharge of stored runoff from the Cross Lake holding pond was monitored between August 1997 and June 2000. Rainfall amounts were measured for all runoff events. This was accomplished using American Sigma programmable sampler/flow meters and data-logging rain gauges. Discrete samples were collected and analyzed for several conventional pollutants. Flow rate and rainfall data were logged and periodically downloaded to a laptop computer for additional analysis.

METHODOLOGY

The scope and methodology changed as the project progressed because of the several different funding sources as well as experience gained and difficulties encountered during the course of the project. The initial scope of work was developed

jointly by personnel from the Department of Natural Resources (DNR) and LTRC and concentrated on sampling the quantity and quality of flow entering the basin. The initial sampling period was to begin February 1, 1996. The American Sigma flowmeter/sampler was not delivered to the Cross Lake site until November of 1996. Eight runoff events were sampled and analyzed from November 1 to December 31, 1996. In addition, the scope of work called for traffic data to be obtained from traffic counters installed in both lanes of the bridge. These counters were not available during the life of this project. A final report was prepared from these nine events, submitted to DNR, and accepted. LTRC funds in FY 96/97 increased the budget of this project and the sampling period lasted until early 1999. In addition, funds were received from a NCHRP (NCHRP Project 25-12) project. With these additional funds, the project proceeded along two fronts for a time. A second sampler was installed at the pond outlet that allowed mass balance calculations to be done on the liquid volume and pollutant mass entering and leaving the pond. This allowed the efficiency of the pond to be quantified. Concurrently, analysis of runoff events entering the pond also continued. Analysis of runoff entering the pond centered on several areas:

1. The nature of the contaminants, form, and concentration,
2. Relationships, if any, which existed between contaminants entering the pond and characteristics of the rainfall events which produced them, and
3. The extent to which the "first flush" phenomenon occurred at this site. The project proceeded in this fashion until January 1998.

From January 1998 until the project ended in June of 1999, the project concentrated on measuring the efficiency of the pond in removing conventional water pollution constituents such as BOD, COD, TSS, and nutrients. However, during this time Louisiana Tech purchased a computer-controlled atomic absorption spectrophotometer that is used to measure the concentration of metals. Because of the minimal additional cost to the project, some samples of pond contents (both liquid and deposited sediment) were collected and analyzed for a suite of heavy metals.

CONCLUSIONS

1. Holding ponds such as that at Cross Lake can be very effective (mean TSS removal 85%) in removing sediment and sediment-bound contaminants, such as heavy metals, from runoff.
2. Holding ponds are relatively simple, low maintenance systems that could be employed as a best management practice (BMP) at a number of DOTD facilities and be a major factor in reducing non-point contamination at existing DOTD facilities such as district offices and maintenance yards.
3. Holding ponds appear to be a simple, and relatively inexpensive way to comply with upcoming federal and state mandates regarding export of non-point contamination from DOTD facilities.

IMPLEMENTATION

Holding ponds such as the one at Cross Lake can be operated and maintained in such a way as to reliably remove sediment (mean removal efficiency 85%) as well as pollutants commonly associated with sediment from runoff such as COD (71%), total phosphorous (55%) and heavy metals (partitioning coefficients > 1 000). The ability to store and release runoff as desired (fill and draw operations) makes the pond an ideal settling basin. Installation of these type facilities at DOTD District offices and other outlying facilities would serve as a "best management practice" (BMP) for the control of non-point contamination. This is significant since recent court decisions have forced EPA to mandate discharge requirements for non-point discharges.