Appendix B
Monitoring Plan

WASTEWATER COLLECTION SYSTEM MONITORING PLAN

City of Lancaster, Ohio

February 1996
Project: 0491-028

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

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CITY OF LANCASTER, OHIO

WASTEWATER COLLECTION SYSTEM MONITORING PLAN

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1.0 OBJECTIVES

The purpose of this plan is to outline a wastewater collection system monitoring program for the Lancaster Wastewater Treatment Plant (WWTP). The requirements for the monitoring program are as follows:

- Provides adequate data to characterize and model the collection system and combined sewer overflows (CSOs)
- Supports development and implementation of the minimum control measures for CSOs
- Supports development and implementation of a long-term control plan
- Allows the effectiveness of the control measures to be evaluated.

The schedule and methodology for gathering data on the collection system will be presented in the monitoring plan. The following data collection procedures will be specifically addressed in the plan:

- Determination of baseline and wet weather flow volumes from different areas of the collection system
- Determination of magnitude and duration of overflows in relation to a measured rainfall event
- Collection of samples at selected CSOs
- Analysis of the samples
- Distribution of basement flooding questionnaire

Malcolm Pirnie Inc. and the City of Lancaster will perform the flow monitoring and sampling as outlined in this plan. The City of Lancaster will perform the required analysis at the WWTP laboratory as outlined in this plan. A basement flooding questionnaire has been distributed to residents with their regular utility bill. This questionnaire should provide additional insight into

potential areas of concern. The monitored flow data, rainfall information and questionnaire will then be used to develop and calibrate a Storm and Wastewater Management Model (SWMM) for the City's combined sewer system. The initial model was developed for pipe sizes 12 inches and larger. The model and the sampling data will be used to characterize the flow in the combined sewer system and CSOs.

2.0 DESCRIPTION OF MONITORING AREA

This plan will focus on monitoring the City of Lancaster's wastewater collection system and CSOs. The individual sewer subsystems which are tributary to the combined sewer overflows and which are isolated from the remainder of the collection system were delineated. Figure 2-1, a sewer map which outlines the wastewater collection subsystems, is included at the end of this document.

The City of Lancaster sewer collection area services approximately 50,000 people and a collection area of approximately 18 square miles. The sewer system can be divided into 13 different collection areas. The flow from these different areas is transported to the WWTP in one of 3 major interceptors. The major interceptor sizes and collection areas are outlined below:

- 36" collects wastewater from the north and east areas of the city
- 27" collects wastewater from the west and central areas of the city
- 36" collects wastewater from the north, south and west areas of the city

The wastewater collection system also consists of five pump stations, four siphons, and 34 CSO locations. The CSOs discharge to either the Hocking River, Baldwin Run, Fetters Run or Hunters Run through one of 20 head walls.

3.0 FLOW MONITORING

3.1 General Methodology

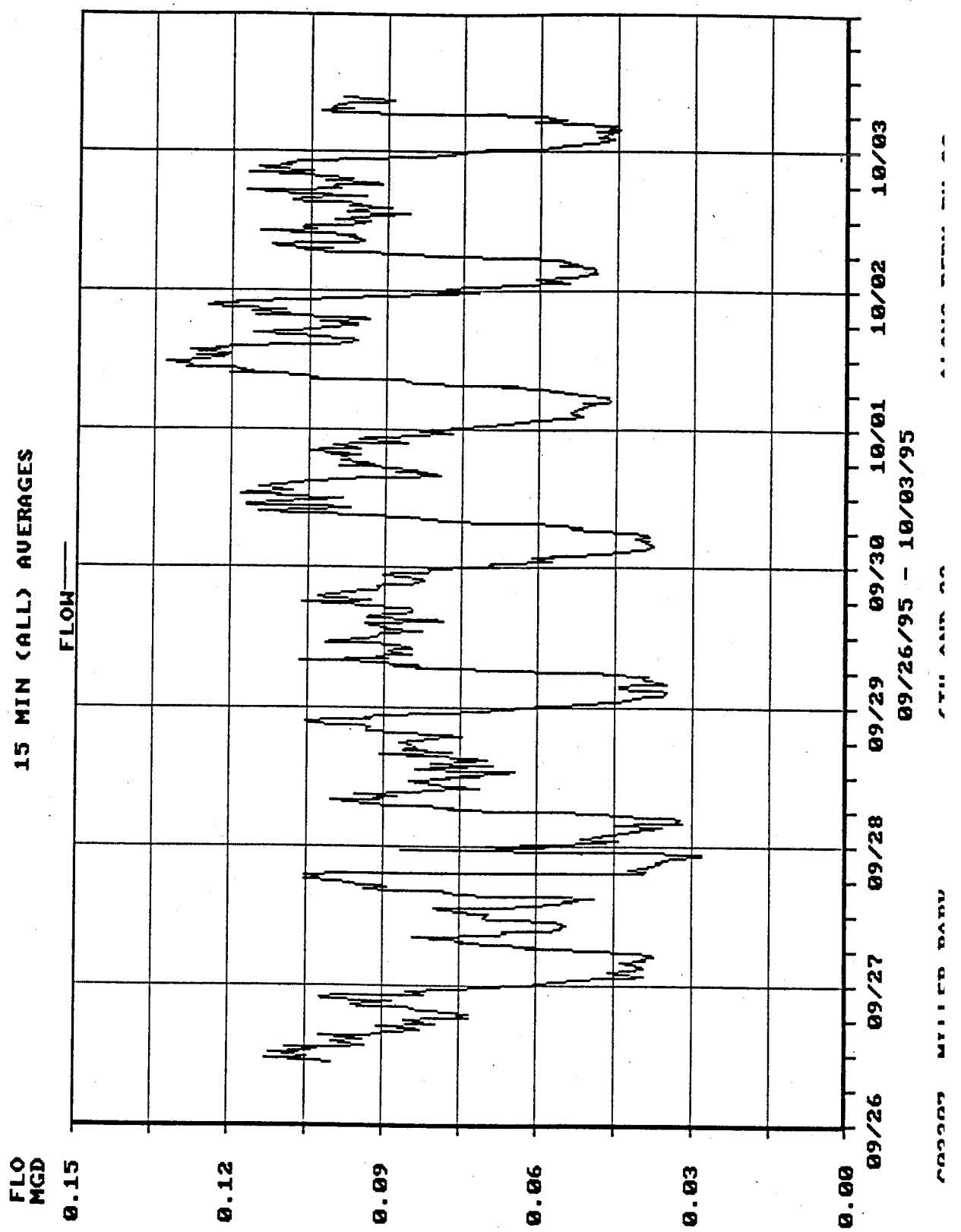
The wastewater flow rates will be measured at several locations throughout the collection system. The flowrates within the collection system will be measured during dry and wet weather periods. A portion of the flow monitoring has been conducted during dry weather periods to obtain baseline flow conditions within the sewer system. The rest of the flow data will be wet weather measurements collected during rainfall events within the sewer system and at the CSOs.

The flow rates will be measured using a portable flow data acquisition system. It is planned to use the "Flo-Tote" system, manufactured by Marsh-McBirney, Inc. Based on flow velocity and water surface level data, the system calculates the volumetric flow rates at each time increment measurements are taken. The system can measure a wide range of flow regimes and can be configured for both full pipe (pressure) and open channel (gravity) flow applications. The system consists of several components:

- flow meter
- sensor with mounting band
- portable computer
- computer software

A sensor is installed at the bottom of each pipe being monitored and is held in place with a mounting band. Each mounting band is sized to fit the inside diameter of the pipe being monitored. The sensor is used to measure velocity and level of the fluid flowing through the pipe. An electromagnetic velocity transducer is used to detect velocity and a solid-state piezoresistive pressure transducer measures water surface level. The flow meter collects the data from the sensor. The flow meter is generally mounted in a manhole or structure adjacent to the monitoring point.

A portable computer with software is required to program the site specific monitoring parameters at each flow meter. After the flow monitoring is completed at a each location, the data collected at the flow meter is uploaded onto the computer using the flow monitoring software. The software can then be used to process and print out various data reports. The flow rates can be plotted versus time as shown on the example graph in Figure 3-1.


15 MIN (ALL) AVERAGES
FLOW
09/26/95 - 10/03/95
FLO
MGD
0.15
0.12
0.09
0.06
0.03
0.00
09/26
09/27
09/28
09/29
09/30
10/01
10/02
10/03

3.2 Baseline Flow Measurements

The baseline wastewater flow rates are flow measurements taken during periods of dry weather. The time schedule for baseline flow monitoring was October through December 1995. If required, additional flow measurements may be collected during March through May 1996. Each flow meter was installed at a location for a period of one week to record flow rates. Any flow rates measured on a day with rainfall or two days after the rainfall was considered invalid baseline flow measurements. A minimum of four dry weather days at each location was required to establish a typical baseline flow measurement. The baseline flows will be used to develop the baseline conditions for the sewer model.

The dry weather flow monitoring locations are shown on Table 3-1. These 31 locations are key manholes or structures throughout the combined sewer system that convey flow to the WWTP. The flow meters were installed in combined and sanitary sewers at the designated locations. The manholes are located at the end of each sewer subsystem, before the flow merges with another subsystem.

3.3 Wet Weather Flow Measurements

The wet weather flow rates will be measured during and immediately following rainfall events. The time period scheduled for wet weather flow monitoring is March through May 1996. Flow will be measured during at least two different rainfall events at each location. A rainfall which creates any overflow may be used as one of the required rainfall events. The data will provide insight into how the combined sewer system responds to a rainfall of known intensity and duration. The baseline flow quantity will be subtracted from the wet weather flow at each location to calculate the quantity of storm water flow. The dry weather and wet weather flow rates will be used to calibrate the sewer model.

The wet weather flow monitoring locations are shown on Table 3-2. All 28 monitoring points will be used for wet weather monitoring. Combined sewer overflow discharges will be monitored by placing flow meters upstream and downstream of the CSO. The overflow volume and flowrate will be calculated using the upstream and downstream monitors.

The 36" east interceptor collects flows from the north and east areas of the city. Flows from several subsystems (combined and separated) enter this interceptor. This 36" interceptor does not

have a CSO structure, but there are several CSOs located within the subsystems that overflow prior to entering the 36" interceptor.

The 36" west interceptor collects flows from the south, west and northwest areas of the city. This sewer does not have an overflow structure, but several subsystems entering into the 36" have CSO structures to relieve themselves prior to entering the 36" line.

The 27" west interceptor collects flows from the west and central areas of the city. This sewer does not have an overflow structure, but several subsystems entering into the 27" have CSO structures to relieve themselves prior to entering the 27" line

TABLE 3-1
DWF COLLECTION SYSTEM MONITORING LOCATIONS

Date	Location	Pipe Size	Sheet No.
9/26/95	Lake and Edgemont	30 inch	F-6
9/26/95	Miller Park	15 inch	F-6
9/26/95	Canal and High	27 inch	H-6
10/10/95	Mary Burnham Park	10 inch	G-7
10/10/95	Park and Memorial Dr.	15 inch	F-5
10/10/95	S. of Memorial Dr. Behind Kmart	30 inch	F-5
10/18/95	Locust and Ewing Run	15 inch	G-7
10/18/95	Penn. RR and Ewing Run	30 inch	G-7
10/18/95	Walnut and Memorial Dr.	27 inch	G-6
10/24/95	Zane and 8th	10 inch	F-5
10/24/95	Thomas, S. of Wheeling	36 inch	G-5
10/24/95	Cherry and Sheridan	12 inch	F-7
10/31/95	Beacon and Hocking	10 inch	F-5
10/31/95	C&O RR and Hocking River	12 inch	H-6
10/31/95	Brooks, 1st alley S. of Main	15 inch	G-7
11/7/95	E. of King N. of Mulberry	24 inch	G-7
11/7/95	E. of Ewing Run S. of Mulberry	24 inch	G-7
11/7/95	Chestnut and Della	15 inch	G-7
11/14/95	Mulberry and George	18 inch	G-5
11/14/95	Union and George	15 inch	G-5
11/14/95	Sycamore and Hocking River (Canal Street)	36 inch	H-6
11/21/95	Keep monitors in same locations as week 11/14/95		
11/28/95	Mulberry East of Maple	24 inch	G-6

TABLE 3-1
DWF COLLECTION SYSTEM MONITORING LOCATIONS

Date	Location	Pipe Size	Sheet No.
12/5/95	Lawrence and Wheat	18 inch	G-6
12/5/95	SE of Pershing & Memorial Dr.	18 inch	E-5/F-5
12/5/95	SE of Chestnut & Pleasant	24 inch	G-6
12/5/95	Wyandot and Lawrence *Not enough flow to monitor*	24 inch	G-6
12/12/95	Flow coming out of 60" overflow S. of RR tracks	24 inch	G-7
12/12/95	Redo Union and Hocking	15 inch	G-5
12/12/95	Redo Carpenter St.	12 inch	H-6

TABLE 3-2
WWF COLLECTION SYSTEM MONITORING LOCATIONS

East Side
Week 1 and 2

Date	Location	Pipe Size	Sheet No.
3/19/96	NE corner Mary Burnham Park	10"	G-7
	S of Main W of Baldwin Run	27"	G-7
through	NE of Chestnut and Pleasant	24"	G-6
	Mulberry E of Maple	24"	G-6
4/1/96	Maple and Mulberry	48"	G-6
	SE corner Mary Burnham Park	60"	G-7
	SE corner Mary Burnham Park	18"	G-7
	E of King and Cherry	24"	G-7
	Behind Kroger	24"	G-7
	W of Fetters Run and 6th	48"	F-7
	E of Fetters Run and 6th	8"	F-7
	Della and Chestnut	15"	G-7
	N of Brooks and Chestnut	15"	G-7
	W of Brooks and Chestnut	15"	G-7
	Fulkerson and Penn. R.R.	30"	G-7

West Side - 27 Inch Sewer
Weeks 3 and 4

Date	Location	Pipe Size	Sheet No
4/1/96	Lawrence and Wheat	18"	G-6
	E of Wheat St. overflow	27"	G-6
though	W of Hocking River and RR	27"	G-6
	S of Walnut and Whiley	27"	G-6
4/15/96	Walnut and Memorial	27"	G-6
	S of Union and Memorial	16"	G-6
	E of Union and Memorial	30"	G-6
	Miller Park (S of 5th)	15"	F-6
	5th and Forest Rose	36"	F-6
	E of 6th and Memorial	20"	F-6
	S of 6th and Memorial	15"	F-6
	Memorial and South Broad	24"	H-6
	Memorial and South Broad	30"	H-6
	Witte and Center	24"	G-5
	Lake and Edgemont	30"	F-6
	Use Wheeling St. Pump Station		G-5

TABLE 3-2
WWF COLLECTION SYSTEM MONITORING LOCATIONS

West Side - 36 Inch and Problem Areas
Week 5 and 6

Date	Location	Pipe Size	Sheet No.
4/15/96	W of Canal and High	36"	H-6
	S of 8th and Hocking	36"	F-5
through	Allen and Memorial	18"	F-6
	Allen prior to YMCA P.S.	12"	F-5
4/29/96	W of Park and 33	30"	F-5
	W of Park and 33	16"	F-5
	Thomas N of Main	36"	G-5
	Hocking and Wheeling	18"	G-5
	High and Canal	10"	H-6
	E end of Carpenter	12"	H-6
	8th and Zane	10"	F-5
	Wheeling and Fulkerson	12"	G-7
	NE Wheeling and Livingston	12"	G-7
	Locust and Baldwin Run	15"	G-7
	YMCA Pump Station		F-5
	Broad St. Pump Station		H-6

Additional Considerations

Hocking and Harrison	30"		F-5
Pershing and Arlington	18"	E-5	
Zimmer and Meda	24"	F-5	
Zimmer and Meda	18"	F-5	
S of 8th and Hocking	36"	F-5	

4.0 RAINFALL DATA COLLECTION

The rainfall data will be collected with rain gauges. The gauges will be situated at four locations to compensate for any disparity between rainfall in different parts of the city.

The City currently utilizes two rain gauges. The gauges are the tipping bucket type with a continuous recording system. One is located at the WWTP and the other at the Water Treatment Plant (WTP). The WWTP is located on the southeast side of the city, while the WTP is on the southwest side of the city.

Two additional rain gauges will be rented and installed in the northwest and northeast areas of the city for the duration of wet weather monitoring. The locations for these two meters are the Highway Patrol Department and the city water storage tank. The four rain gauge locations are shown on attached Figure 2-1.

5.0 SAMPLING AND ANALYSIS

5.1 CSO Sampling

The combined wastewater/storm water overflow will be sampled during the wet weather flow monitoring at certain CSO locations. The overflow will be sampled while the flow rate is being measured. Therefore, a minimum of two rainfall events will be sampled at each selected location. At this time, manual grab sampling will be the method utilized. However, based on the availability of equipment, the city may opt to install flow initiated auto samplers in lieu of grab sampling.

During an overflow event, an initial sample will be taken immediately when the overflow begins. The flow will be sampled at 15 minute intervals for the duration of the overflow or up to a maximum of 6 hours. All five samples collected during he first hour will be analyzed. This frequency will provide a representative example of the pollutant concentrations in the "first flush" overflow from the combined sewer system. The condition of the water (ie. clarity, color, etc.) will be documented for all samples. Based on the water condition, at least one sample from each of the remaining hours will be analyzed. Therefore, a minimum of six samples will be analyzed at each location during each rainfall event lasting two hours.

As indicated on Table 3-2, overflow samples will be taken at two flow monitoring points: CSO 1019 (SE corner of Mary Burnham Park) and CSO 1014 (Allen St. overflow). The locations were chosen because they were identified as being more active in terms of frequency and volume of overflows. Overflow from CSO 1019 discharges directly to the Baldwin Run River. The combined flow which overflows at CSO 1014 discharges directly to the Hocking River near the YMCA lift station.

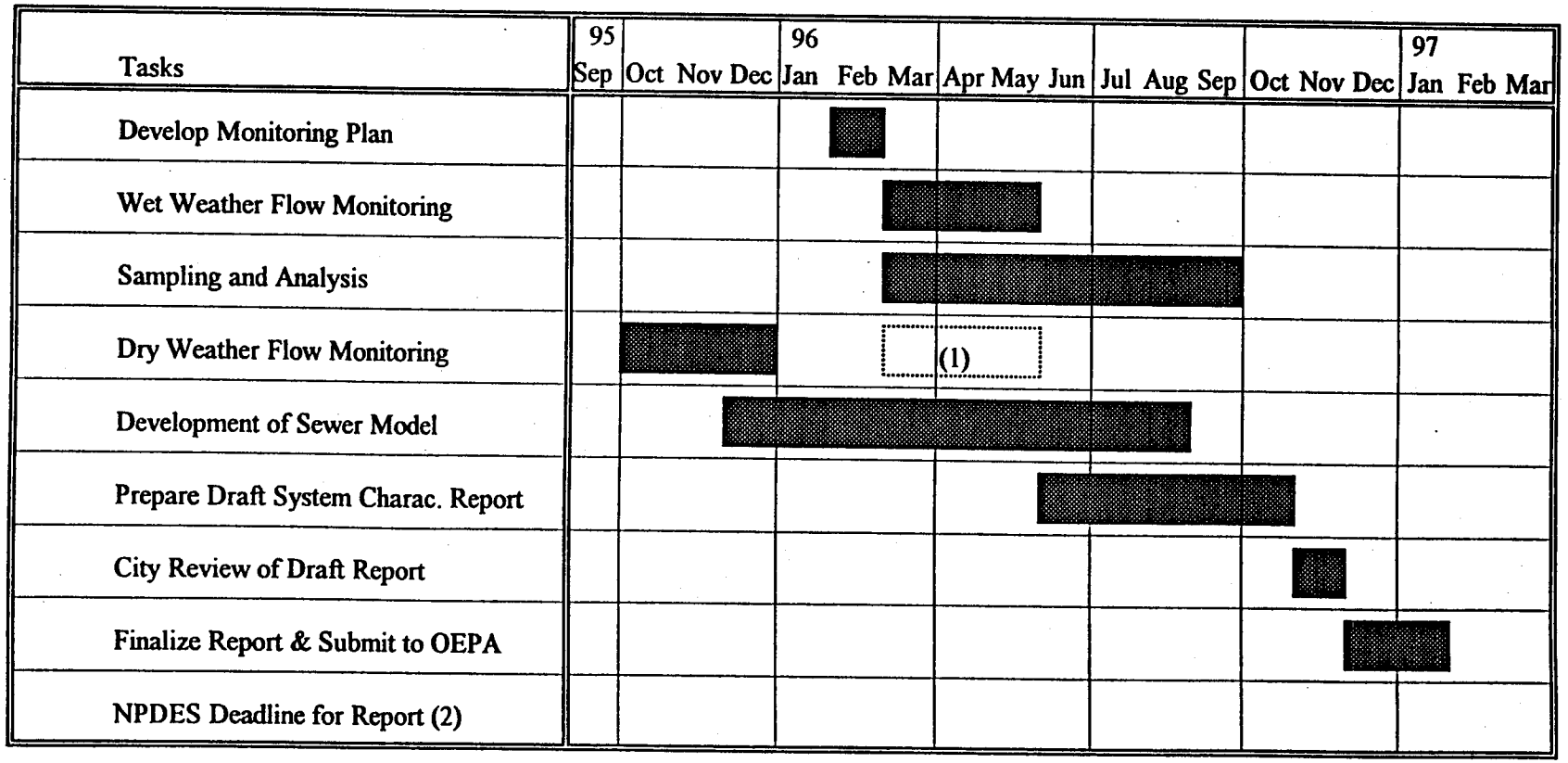
5.2 Laboratory Analysis

The CSO samples taken will be analyzed at the WWTP laboratory. All samples will be analyzed for carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS), Total Kjeldahl nitrogen (TKN), cadmium (Cd), zinc (Zn), lead (Pb) and copper (Cu). The results of this analysis will provide insight as to composition of CSO discharges.

6.0 MONITORING AND CHARACTERIZATION SCHEDULE

The schedule for completing the monitoring and characterization of the wastewater collection system is shown on Table 6-1.

TABLE 6-1
COLLECTION SYSTEM MONITORING AND CHARACTERIZATION SCHEDULE



Notes:

1. If all wet weather flow data is not collected in spring 1996, additional data could be collected in spring 1997 for input into the mod
2. The deadline for submission of System Characterization Report to Ohio EPA has not been determined.