APPENDIX C

INSTRUMENTATION

- Data Logger
- Rain Gauge
- Water Sampler

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DATA LOGGER

The water levels in the inflow and outflow flumes were measured and recorded using a Unidata model 6003 data logger and two model 6521j capacitive depth probes. The capacitive probes, which have a range of 0 to 1.64 feet, were installed in stilling wells attached two each of the 1.5-foot H-flumes. The resolution of this water level measuring system is 0.006 feet. During the sampling period, the accuracy of the water level recordings, based on comparisons between recorded stage and the stage measured using an engineering tape, was estimated at plus or minus 0.013. (The affect of this uncertainty in the measurement of water level in the flume is summarized in Figure C-1.)

The data logger, which was equipped with an eight-bit processor and 64K of memory, was programmed to scan system conditions and total flume inflow every 5 seconds. Through the use of a free-standing relay module, a 5-second pulse was sent to each of the two automatic samplers when the water level first reached a predetermined level (0.10 feet), and again each time a specified volume (40 cfs) had passed through the upstream flume. These signals initiated the subsample collection.

Date, time, and water level in each of the flumes; accumulated precipitation; and the number of pulses sent to the samplers; were recorded every 15 minutes. The data logger was uploaded after each storm event.

RAIN GAUGE

Precipitation was recorded at the study site using a Sierra Misco model 2501 tipping bucket rain gauge. Rainfall entering this instrument was recorded by the data logger in 0.01 inch increments and totaled every 15 minutes.

WATER SAMPLER

Two ISCO brand Model 2700 samplers were used. The Model 2700 is a portable device designed to collect either twenty-four separate sequential samples, or a single composite sample from a liquid source. The samples may be collected at equal time or flow increments. In this study, equal flow increments were used.

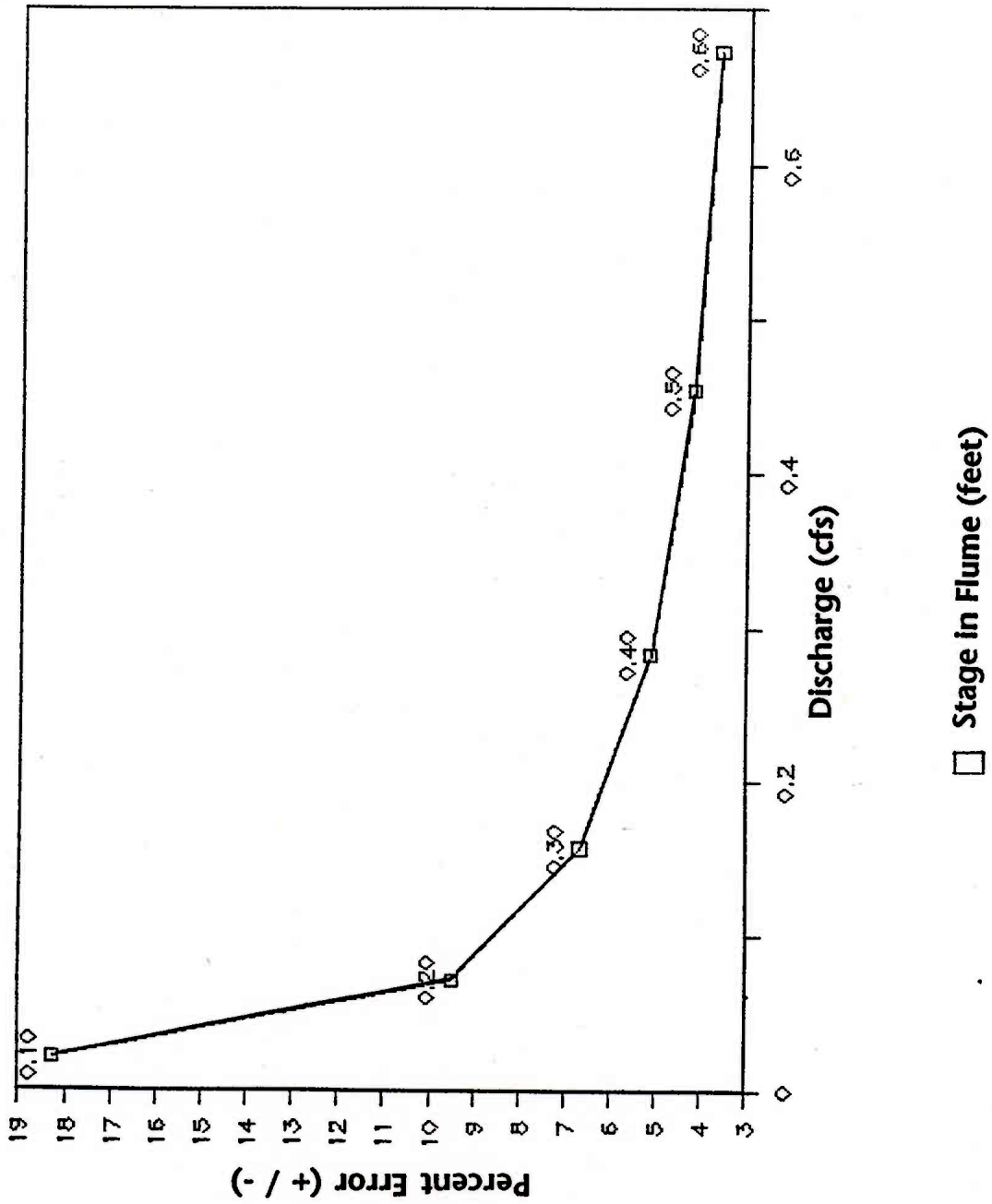


Figure C-1. Percent Error in Discharge Measurements as a Function of Stage and Discharge

Sample volumes of up to 990 ml at each sample trigger could be selected in 10 ml increments. The samples were collected and composited together in a 2.5 gallon glass jar. Composite sampling was terminated by using a float shutoff mechanism when the bottle was full.

The Model 2700 is a programmable unit that is set up using a keypad, a liquid crystal display, and a series of coded indicator lights. In operation, the display shows the status of the sampling program; for example, standby or run mode or the number of composite samples.

The Model 2700 uses the ISCO peristaltic pump system to transport the sample from the source to the sample bottle. The sample is under pumped flow at all times; there are no metering chambers or gravity fed internal tubing. The only materials in contact with the sample are the Teflon tubing suction line, the polypropylene and stainless steel inlet strainer, the silicone rubber pump tubing and the sample bottles. Each sampling cycle includes an air prepurge and postpurge to clear the suction line both before and after sampling.

The sampler is designed to operate over a temperature range of 32 to 120 degrees Fahrenheit. The electronics and mechanisms are housed in a rugged, watertight, high-impact strength, thick structural foam control unit enclosure. The sampler is made up of three sections which are held up together by a series of clasps. These are the cover, center section which contains the control unit, and the sample bottle tub. The samplers were powered using a 12-volt DC battery.

Water Sampler Programming

In programming the equipment for flow weighted composite sampling, both the flow meter and the water sampler have parameters that are programmed into each one of them based on the operating characteristics of the machine. However, there are three programming parameters that are common to all types of equipment and are based on storm characteristics. These are the flow quantity that passes by between each subsample, the total number of subsamples to be collected during the storm, and the volume of each of these subsamples. All of these are dependent on the characteristics of the storm to be sampled and the watershed sampled; how much it will rain, how long it will rain, and how much runoff will result (is the soiled saturated, how impervious is the watershed). Since the goal is to collect automatic samples (it rains most of the time when you are sleeping), it is important that the three programming parameters are broad enough to cover a wide range of conditions. It is also important to have the parameters designed for the "average" storm event. The procedure is to estimate the amount of runoff (volume of the storm in cubic feet) for the average storm event using any number of rainfall/runoff relationships. In this study we used the following rainfall/runoff relationship:

Average Storm Volume (feet)=Average Storm Rainfall Volume (feet) * Area ($feet^2$) * Runoff Coefficient

After the volume of the average storm event is estimated, it is related to the three parameters as follows:

$$\frac{\text{Average Storm Volume } (ft^3)}{\text{Flow Quantity between Subsamples } (ft^3)} = \text{Total Number of Subamples} = \frac{\text{Volume of Sample Container}}{\text{Volume of Individual Samples}}$$

This is an indeterminate equation, and therefore in order to solve it, one parameter must be assumed. From previous sampling studies by Metro and the City of Seattle, it was found that fifty samples was a representative number for compositing and so this number was used. Completing the calculations for the sampling site, the parameter were:

Total number subsamples:	50
Flow quantity between subsamples:	250 ft^3
Volume of subsamples:	200ml

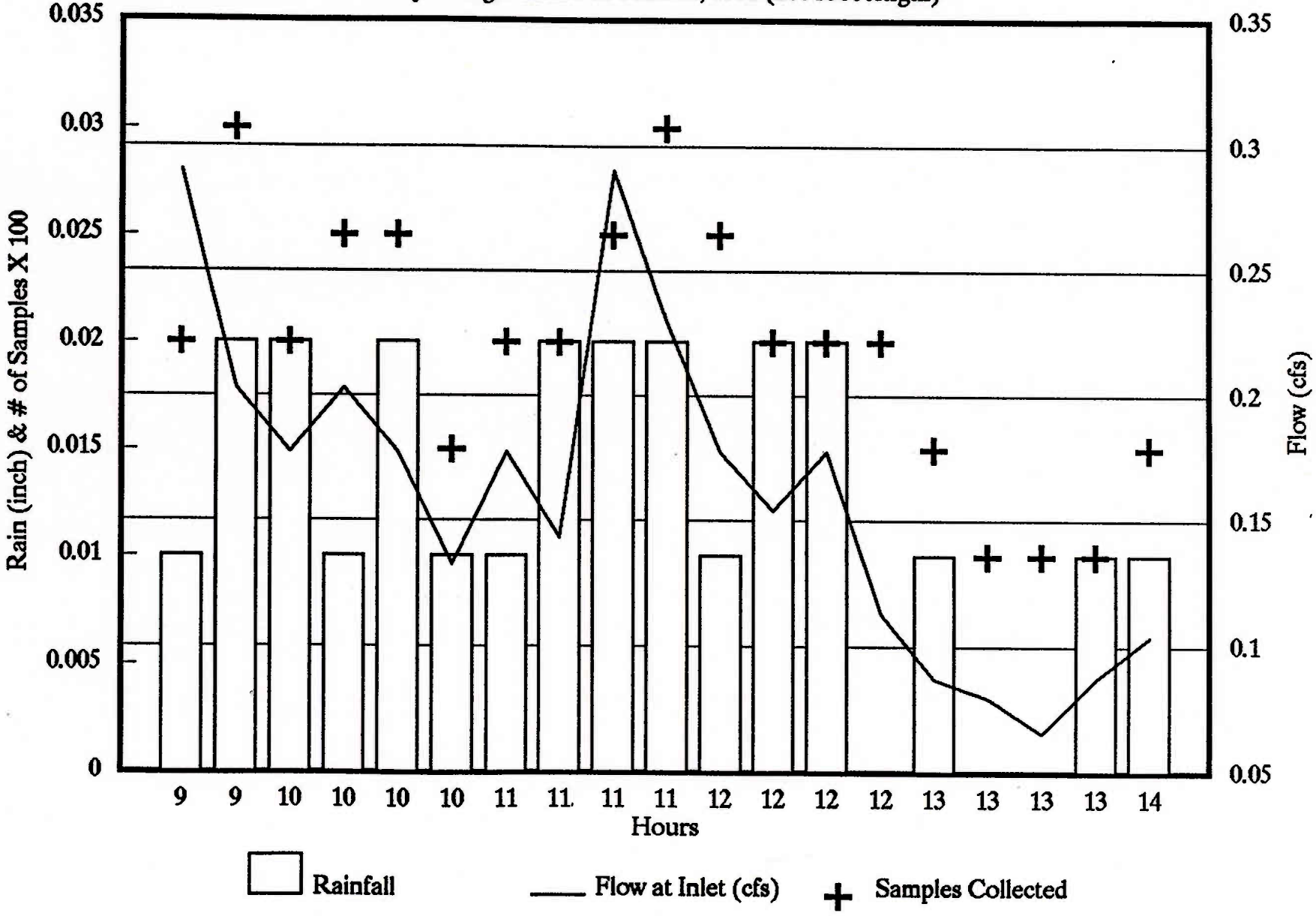
After a few storms, the flow files were examined to ensure these parameters were representative. Minor adjustments were made as needed to collect a representative sample.

APPENDIX D

STORM EVENT HYDROGRAPHS

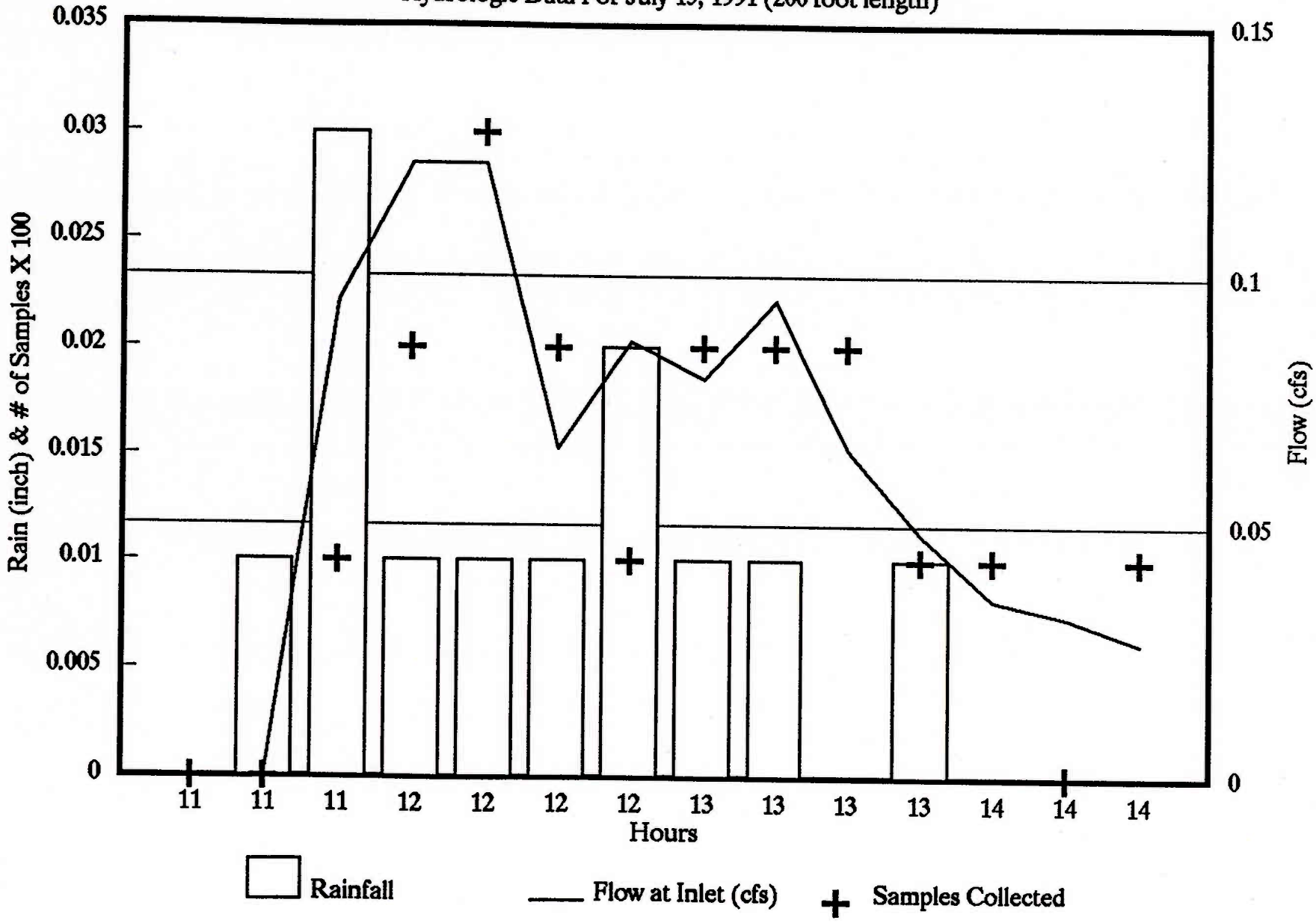
Biofiltration Swale Hydrograph

Hydrologic Data For June 20, 1991 (200 foot length)



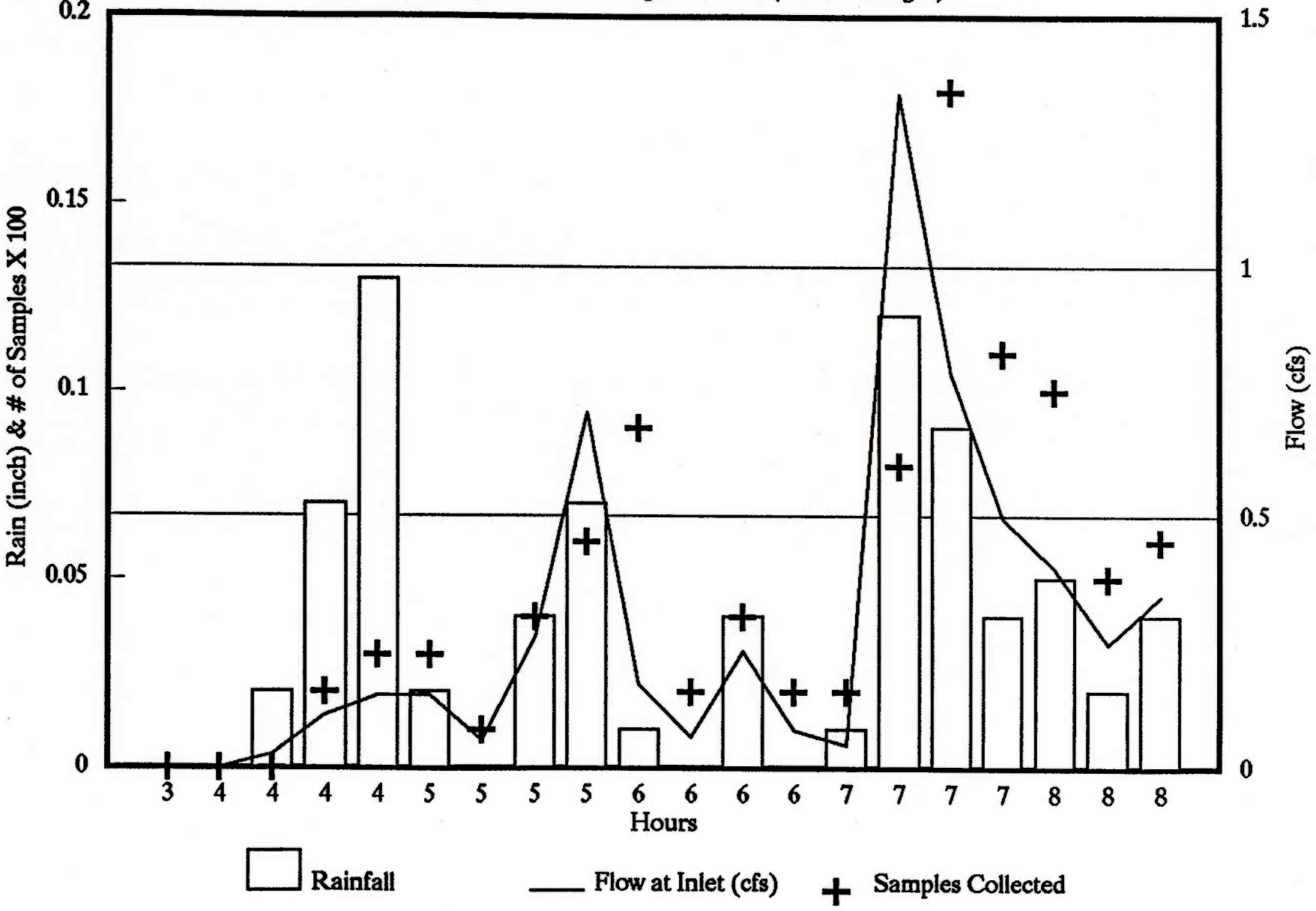
Biofiltration Swale Hydrograph

Hydrologic Data For July 15, 1991 (200 foot length)



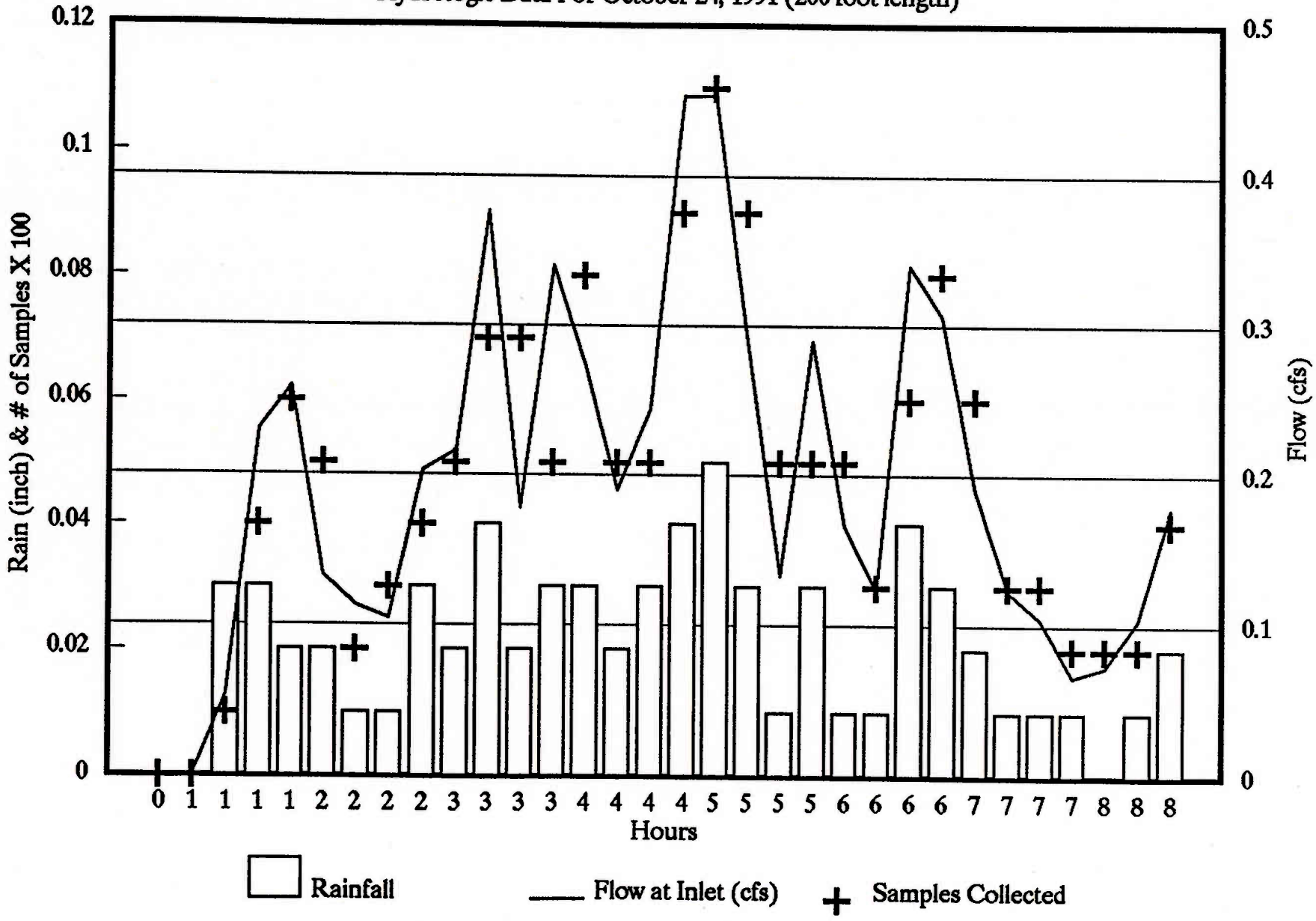
Biofiltration Swale Hydrograph

Hydrologic Data For August 9, 1991 (200 foot length)



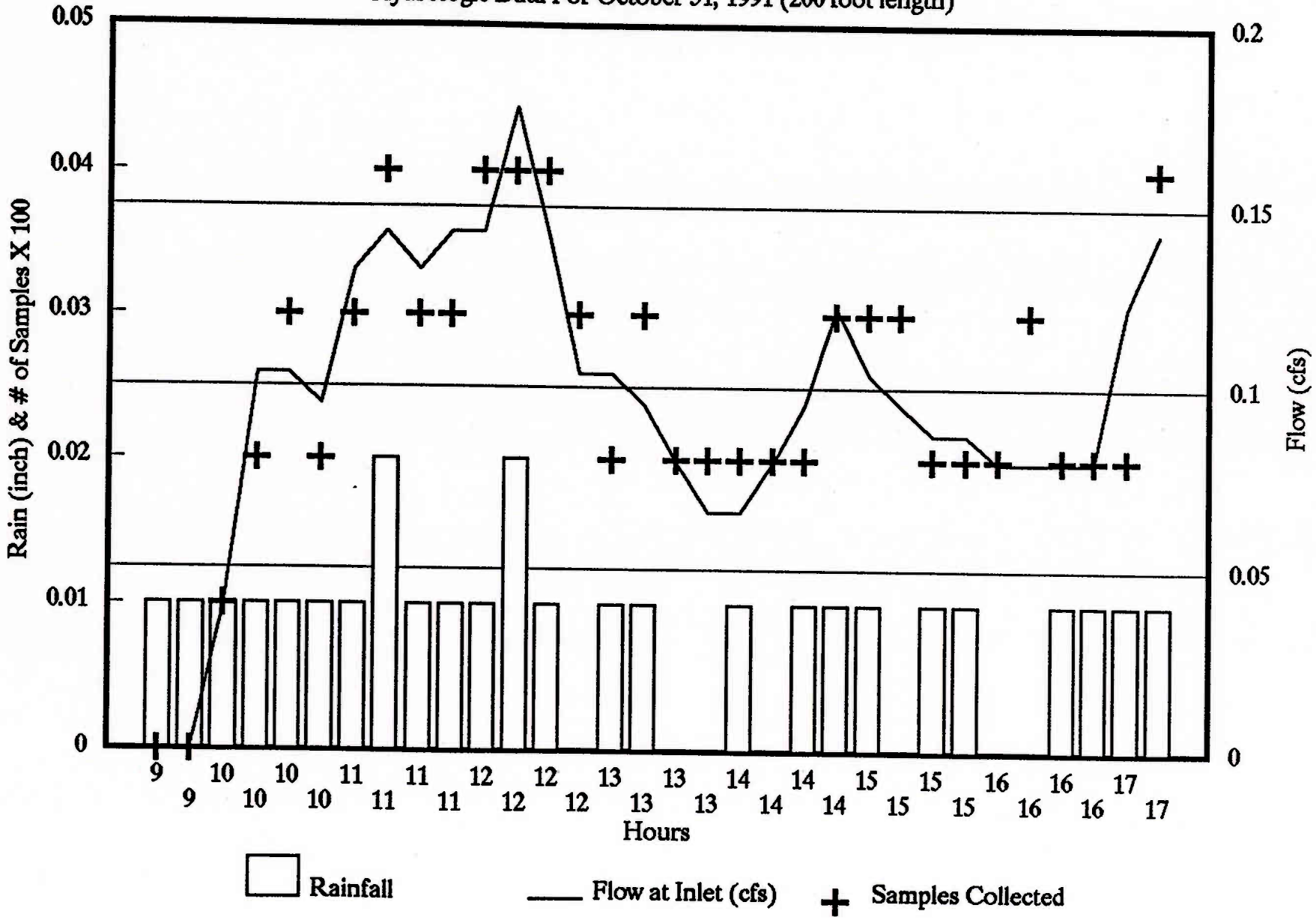
Biofiltration Swale Hydrograph

Hydrologic Data For October 24, 1991 (200 foot length)



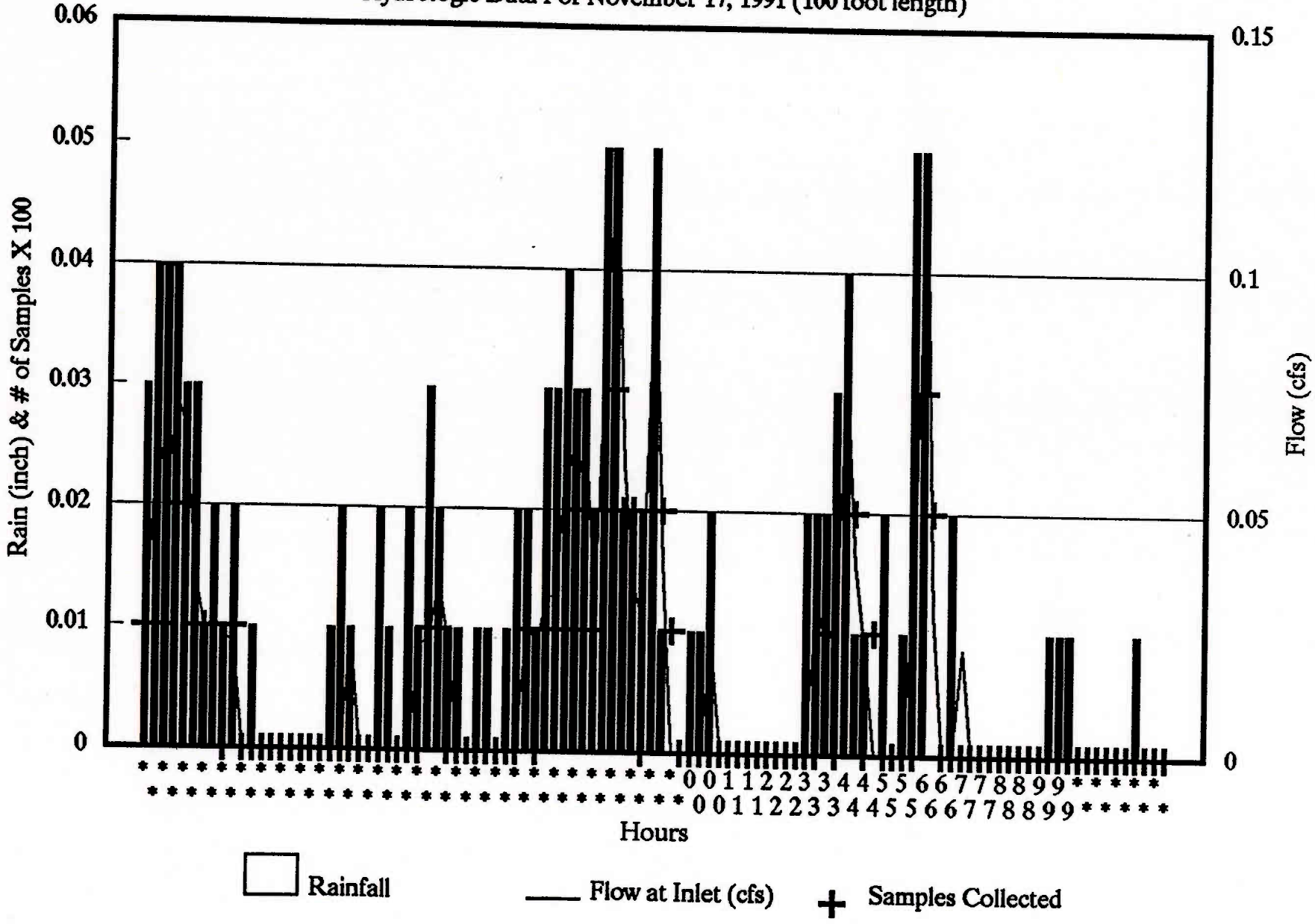
Biofiltration Swale Hydrograph

Hydrologic Data For October 31, 1991 (200 foot length)



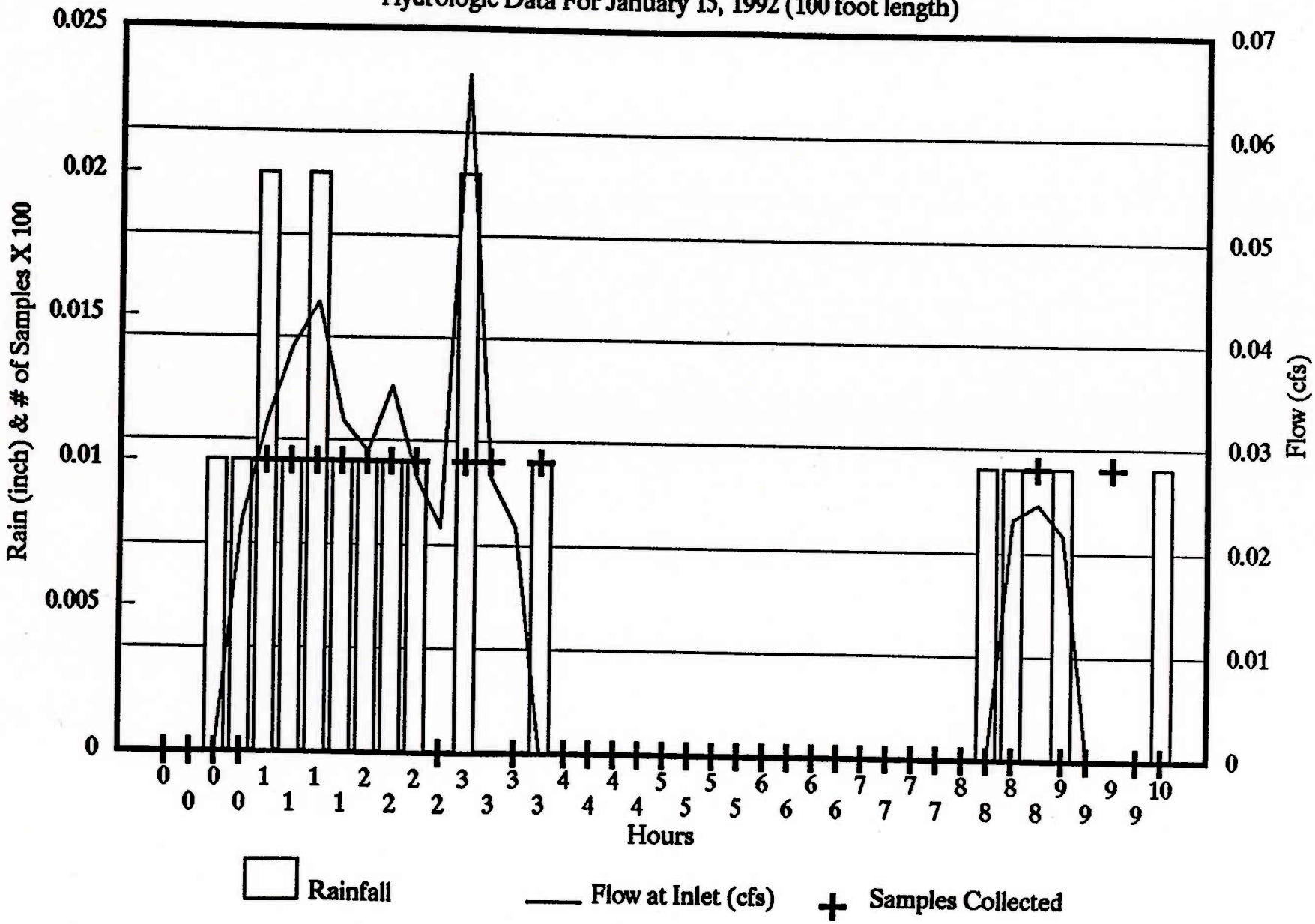
Biofiltration Swale Hydrograph

Hydrologic Data For November 17, 1991 (100 foot length)



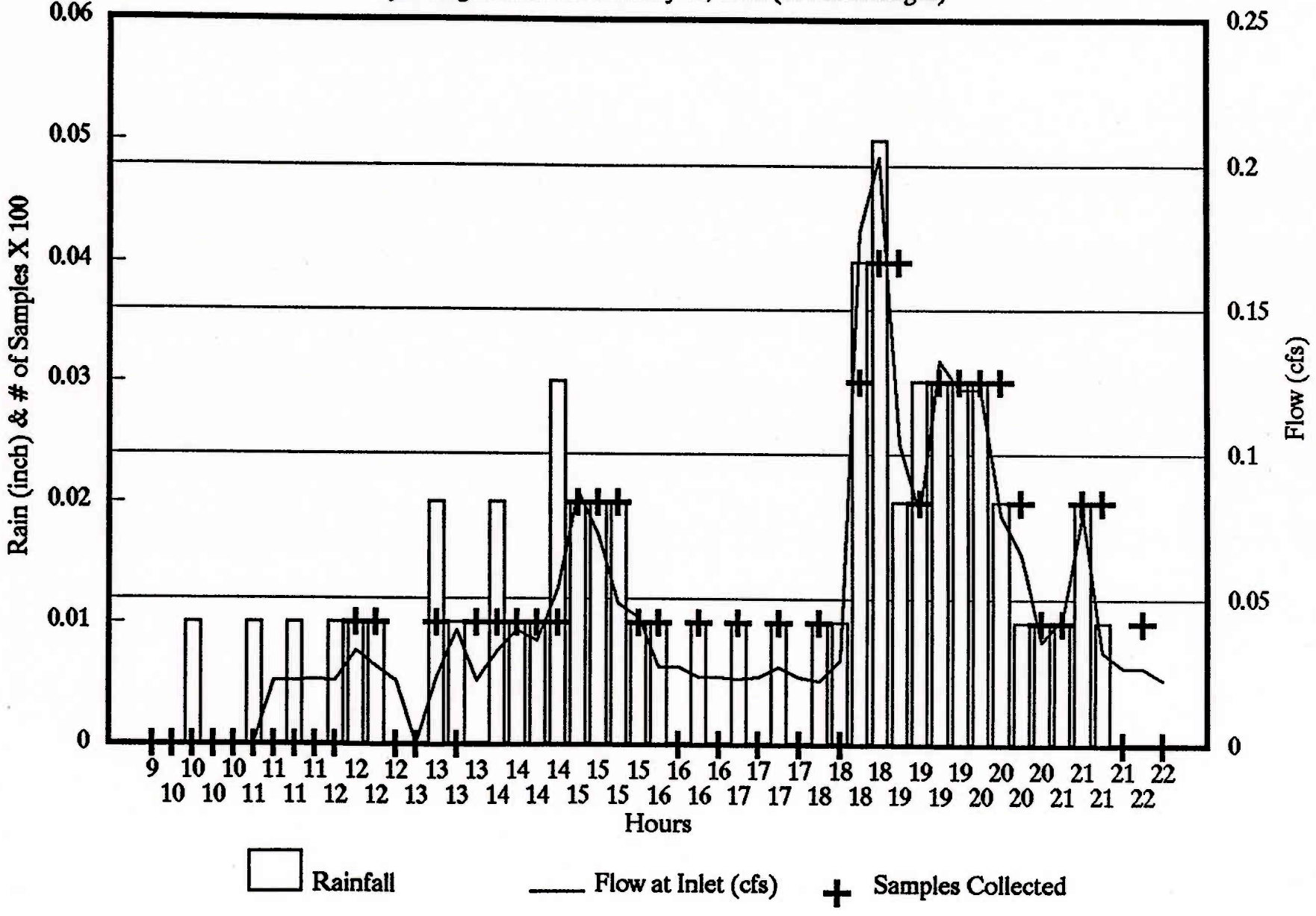
Biofiltration Swale Hydrograph

Hydrologic Data For January 15, 1992 (100 foot length)



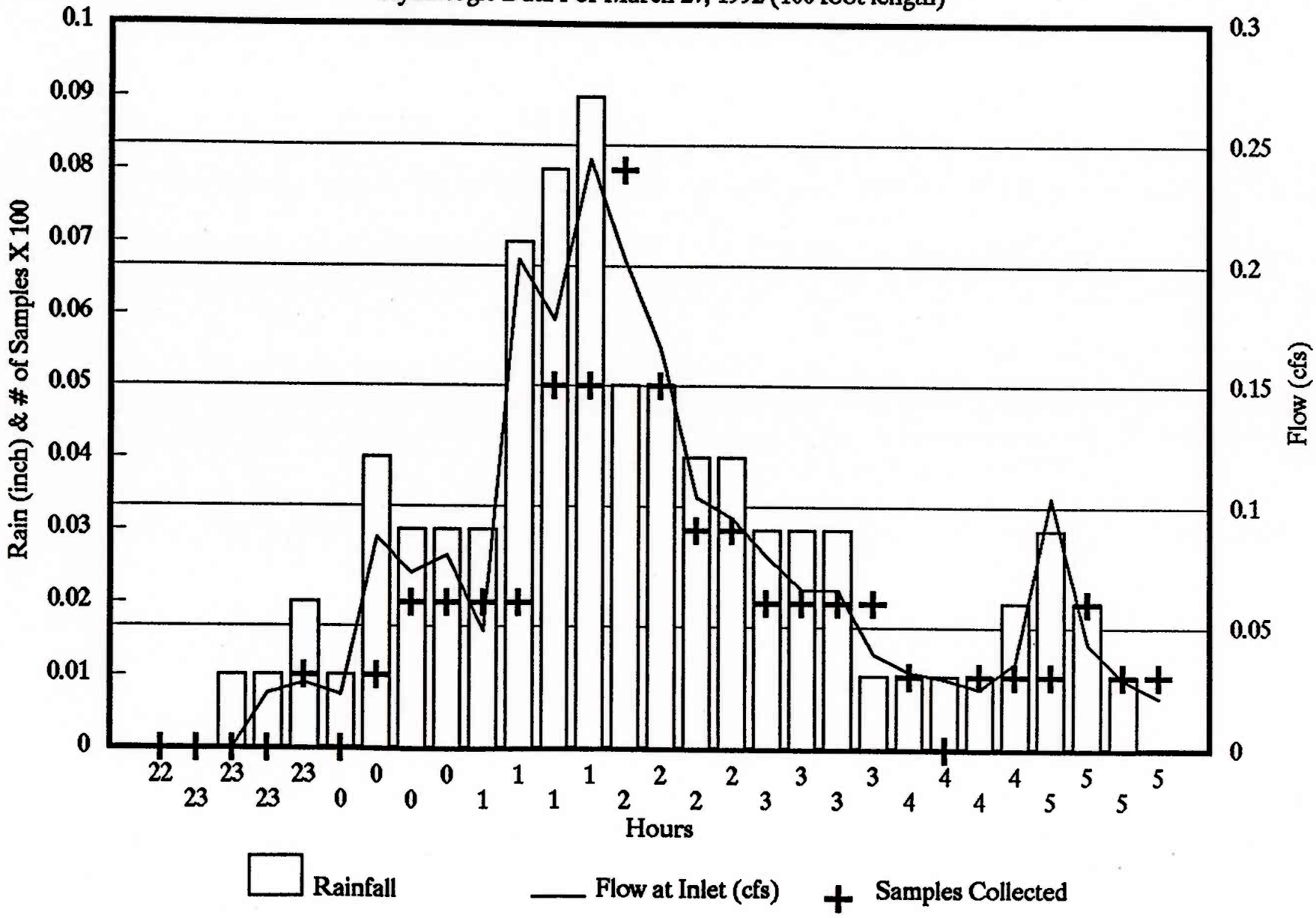
Biofiltration Swale Hydrograph

Hydrologic Data For January 23, 1992 (100 foot length)



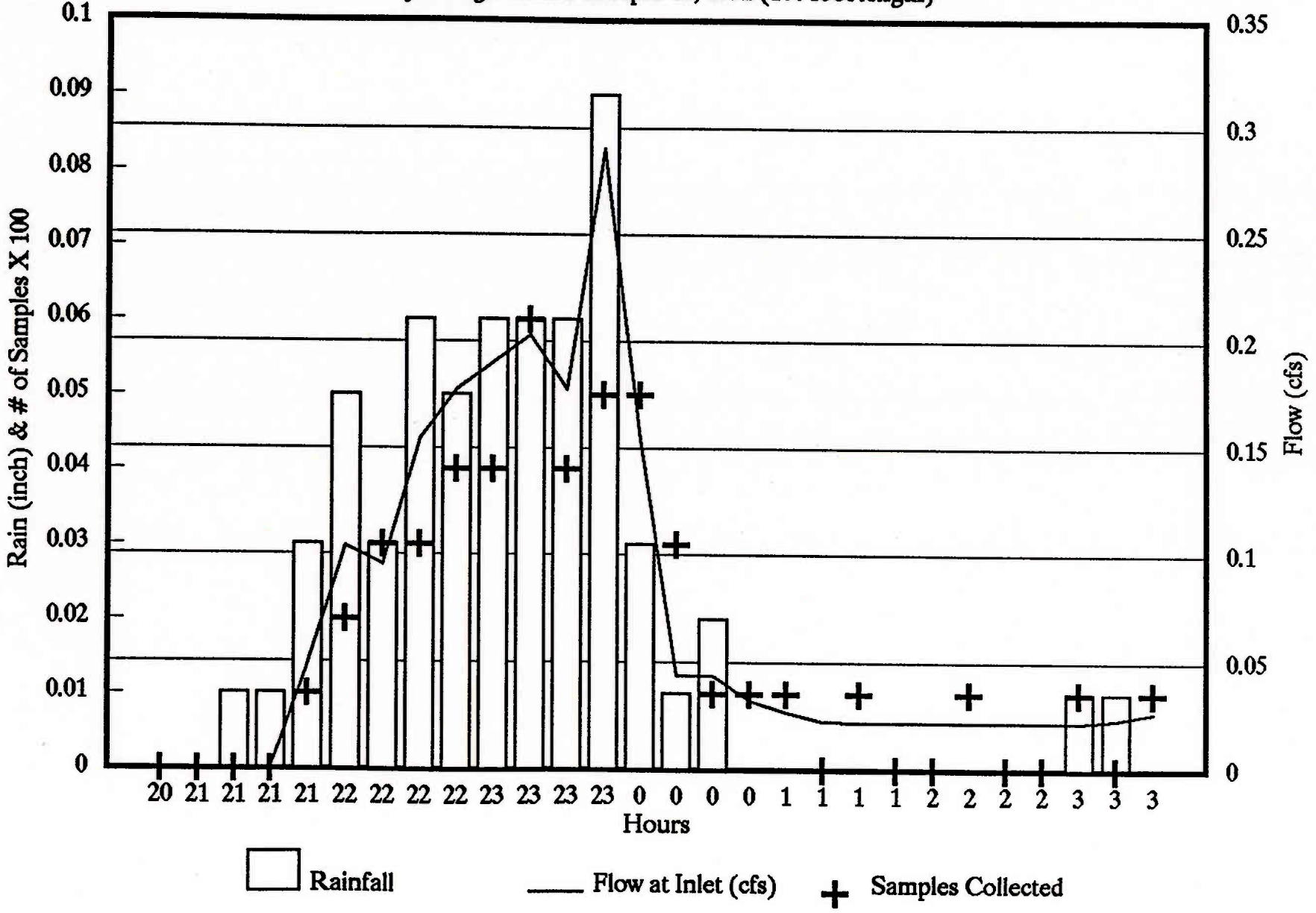
Biofiltration Swale Hydrograph

Hydrologic Data For March 27, 1992 (100 foot length)



Biofiltration Swale Hydrograph

Hydrologic Data For April 16, 1992 (100 foot length)



Biofiltration Swale Hydrograph

Hydrologic Data For April 29, 1992 (100 foot length)