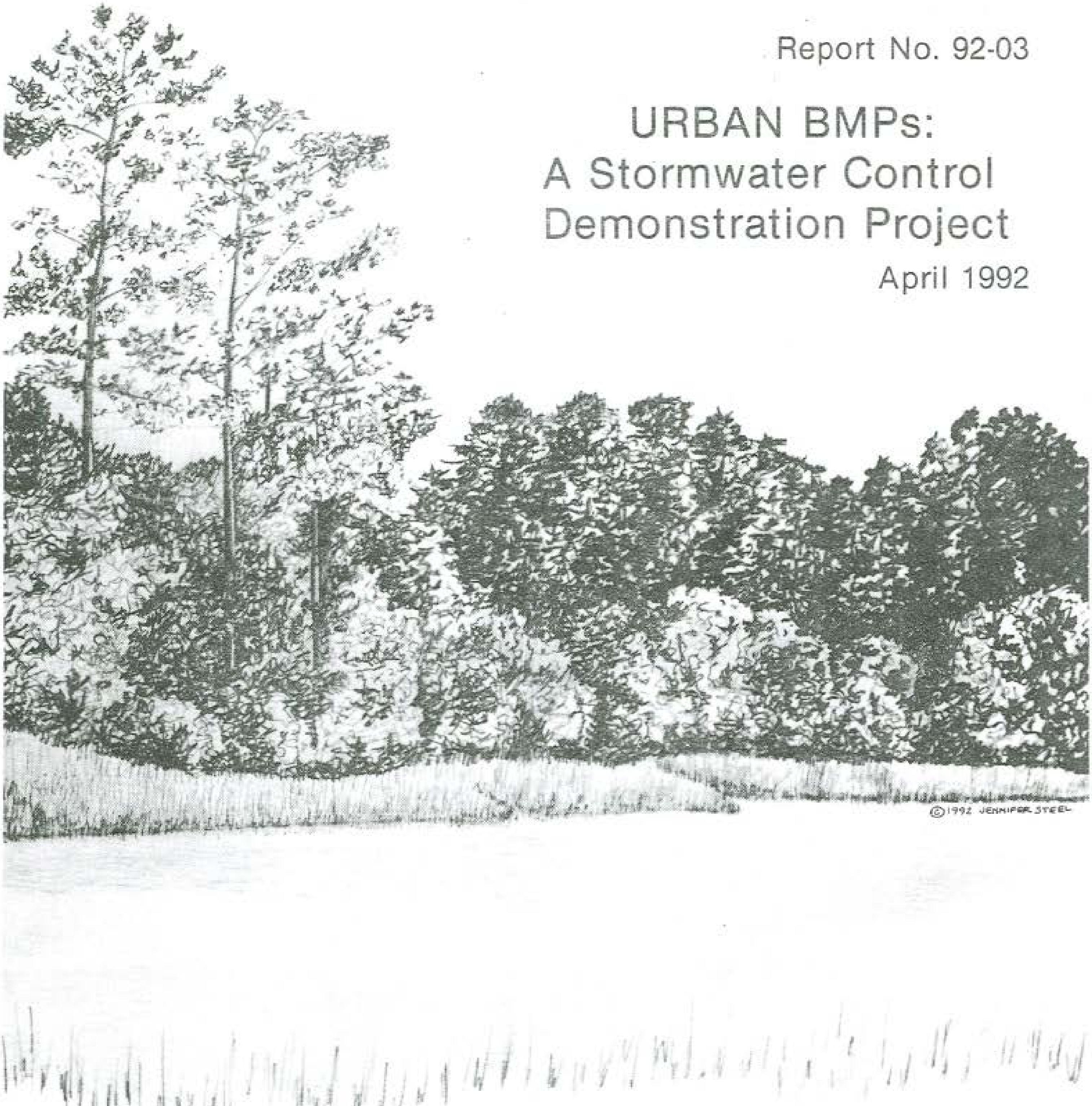
Report No. 92-03

URBAN BMPs: A Stormwater Control Demonstration Project

April 1992



ALBEMARLE-PAMLICO ESTUARINE STUDY

NC Department of
Environment, Health,
and Natural Resources

ALBEMARLE-PAMLICO

Environmental
Protection Agency
National Estuary Program

URBAN BMPs:

A STORMWATER CONTROL DEMONSTRATION PROJECT

by

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ABSTRACT

Urban nonpoint source pollution is a major water quality problem in the Pamlico-Tar River watershed. Urban stormwater runoff is a major contributor to the excessive nutrient inputs that plague the region's waterways. A critical need exists for communities within the watershed to implement best management practices (BMPs) as part of new development. The purpose of this project was to plan, construct, and maintain a 1.75-acre, 500,000 cubic foot stormwater detention pond. The facility will serve as a best management practice for removing nutrients and heavy metals from stormwater runoff within a 200-acre watershed that is representative of typical urban land uses. This project also provided a case study of the experiences of a municipal staff in the development, planning, and implementation of a stormwater BMP. This report discusses various administrative and logistical problems that were encountered during site selection, proposal development, and project start-up. An emphasis on interdepartmental and interagency cooperation resulted in the successful design and construction of the BMP. Project area descriptions and specifications are provided in detail. The completed facility will be the site of water quality and hydrologic research to be conducted by the East Carolina University Institute for Coastal and Marine Resources and the Water Resources Division of the United States Geological Survey. Analysis of data acquired from these studies will determine the effectiveness of the urban stormwater BMP in pollutant removal. This project has proven that the implementation of a watershed-based stormwater BMP is within the capability of the staff of a mid-sized municipality. Furthermore, this project will serve as model for regional stormwater quality control in the Pamlico-Tar River basin.

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INTRODUCTION

Urban nonpoint source pollution is a major water quality problem in the Pamlico-Tar River watershed. Nutrient loading has been of particular concern. In September, 1989, the North Carolina Environmental Management Commission approved designation of the Tar-Pamlico River as Nutrient Sensitive Waters (NSW). This designation is based on Division of Environmental Management (DEM) technical evaluations that indicate the River is subject to excessive, nuisance growth of algae and that nutrient inputs from wastewater treatment plant discharges, agricultural and silvicultural runoff, and urban nonpoint source runoff are known contributors. Research has shown that typical nutrient concentrations in urban runoff are more than sufficient to stimulate excess algal growth.[1]

Role of the City of Greenville

The City's project, **Urban BMPs: A Stormwater Control Demonstration Project,** will provide a case study of a medium-sized municipality (population 45,000, municipal staff, 450) and its experiences in planning, constructing, maintaining, and administering a stormwater management facility (detention pond) with the aid of a $150,000 demonstration project grant from the Albemarle-Pamlico Estuarine Study (APES).

There is a critical need for communities in the Pamlico-Tar watershed to implement water quality controls, or urban best management practices (BMPs) as part of new commercial and residential development. To date, no retrofit stormwater projects have been implemented in the watershed. As a result, there is a lack of information regarding the performance and cost of these techniques when used in the North Carolina coastal plain. Before local infrastructure managers are likely to advocate use of these nontraditional technologies, better information is needed on their design, construction, and effectiveness in coastal situations.

Once constructed, the purpose of this project will be to provide information on the stormwater characteristics of a "typical" urbanized drainage area in Eastern North Carolina. Ultimately, the project will provide data on the effectiveness of a watershed-based detention pond in removing a variety of pollutants, including nitrogen and phosphorus, from the initial flush of urban stormwater (see Institute for Coastal and Marine Resources). The data acquired on system effectiveness, performance, ease of construction, and operation and maintenance will provide resource managers with better information regarding appropriate controls for the coastal setting. The project will serve as a working model for study by researchers and resource managers.

The City will be responsible for the ongoing maintenance and security of the facility.

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[1]Schueler, T. R. 1987. Controlling urban runoff: a practical manual for planning and designing urban BMP's. Metropolitan Washington Council of Governments, Washington, D.C.

Role of the Institute for Coastal and Marine Resources

The City of Greenville's primary objective was the construction of the urban BMP. The City will not be directly involved with the water quality data collection and analyses that will determine the effectiveness of the stormwater project. However, the Institute for Coastal and Marine Resources (ICMR) of East Carolina University has developed a research program, also funded by APES, which will monitor the water quality of inflows and outflows from the stormwater facility.[2] The ICMR study will seek to determine the detention pond's efficiency in removing total suspended solids, nitrogen and phosphorus, biological oxygen demand (BOD), organic carbon, and fecal coliform bacteria. The presence of 29 heavy metals, in major, minor, and trace quantities will also be evaluated. Particular attention will be given to cadmium, chromium, copper, lead, nickel, and zinc, which are transported in runoff by suspended sediments. Copper, lead, and zinc are the most common metals detected in urban stormwater runoff[3]. Stormwater runoff samples will be collected just prior to the detention pond inflow structure and just beyond the point of discharge from the facility. Data will be collected and stored on an event basis at a fixed-interval schedule of one (1) to two (2) minutes, using ISCO™ Model 2700 automated samplers.

The ICMR study will also determine the rate of accumulation of the selected metals in detention basin sediments by collecting and analyzing soil cores at the completion of project construction and again at the end of the stormwater sampling period. Another facet of the ICMR study will be an analysis of land uses within the drainage area. Information on drainage area characteristics such as topography, pervious and impervious surfaces, lengths of streets and curbs, length and location of sewer lines, population density, and parking characteristics will be collected. The location of streets, houses, businesses, parking lots, forested and open areas and other features will be plotted on a base map, and the distribution of land use categories within the drainage area will be determined.

Role of the United States Geological Survey

The Water Resources Division of the United States Geological Survey (USGS) is working cooperatively with APES to measure inflows to and outflows from the stormwater detention pond. Without flow information, water quality data obtained from the ICMR study will be difficult to interpret. To evaluate the hydraulic characteristics of the pond, three types of flow will be monitored: (1) total discharge into the drainage area; (2) discharge from the detention pond; and (3) discharge into the pond. Water level in the pond will also be monitored.

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[2]Stanley, Donald W. 1990. An evaluation of pollutant removal by a demonstration urban stormwater detention pond. Proposal submitted to the Albemarle-Pamlico Estuarine Study (APES), Greenville, N.C.

[3]U.S. Environmental Protection Agency (USEPA). 1983. Results of the Nationwide Urban Runoff Program. Volume I, Final Report. Washington, D.C.

The volume of stormwater that bypasses the detention facility during large storm events will be calculated by determining the difference between total discharge from the drainage area and total discharge into the pond.

Data for the water quantity analysis will be collected using two stage recording devices. One device is placed adjacent to the pond outlet structure, while the other is set in the weir pool just beyond the discharge outlet pipe. Data is collected and stored on an event basis at intervals of one (1) to two (2) minutes.

PROJECT BACKGROUND AND HISTORY

In December 1988, City of Greenville staff became aware of the availability of APES funding for demonstration projects. The Albemarle-Pamlico Estuarine Study presented a unique opportunity for the involvement of a municipality in a project that could yield a multitude of environmental benefits. Stormwater issues are a priority concern to municipal officials nationwide, and City staff realized the advantages of developing a project where experience could be gained in technologies that might be required in future EPA-mandated stormwater regulations. Also, the City expects to reach a population of 50,000 by the mid-1990s. As growth continues, the negative impact of urban stormwater on overall water quality will increase. Stricter state water quality controls, particularly in one of North Carolina's most seriously degraded rivers, may become a reality in the near future. Experience gained in development of a stormwater management project would be valuable in achieving mandated land-use controls. Furthermore, the City of Greenville project may serve as an example of a regional stormwater control that can be implemented to meet the high-density development requirements under the Water Supply Watershed Protection Act.

Given these opportunities, City of Greenville staff established a Stormwater Committee to: (1) select a suitable location for an urban stormwater project; (2) develop a proposal for funding of the facility; and (3) oversee the planning, design, and implementation of the project upon approval of the grant. The Stormwater Committee consisted of representatives from the departments of Planning and Community Development, Public Works, Engineering and Inspections, as well as representatives from the Greenville Utilities Commission. The Committee began meeting on a weekly basis in order to expedite the funding proposal and project development.

Site Selection

Seven sites were initially studied for implementation of an urban stormwater BMP. After reviewing existing water quality concerns, property ownership patterns, potential beneficiaries, existing land uses in the drainage area, and potential for success, the Moyewood drainage ditch location (see Project Area Description) was selected as the site for the project. Although no water quality data was available on any of the sites under consideration, the Stormwater Committee ascertained that drainage in Moyewood was representative of stormwater runoff in a "typical" urban watershed. In addition, the Moyewood site had many of the attributes necessary for a successful stormwater control demonstration project. The area proposed for construction was publicly owned. The owner, the Greenville

Housing Authority (GHA), indicated a willingness to cooperate with the City, including negotiating a lease of the property. Severe, ongoing erosion problems at the Moyewood ditch had plagued the City, the Housing Authority, and adjoining property owners for several years. The ditch area was littered, overgrown, and unsightly; thus, any improvements would have been welcomed by all parties involved.

Proposal Development

During January 1989, the Committee met with representatives of the Greenville Housing Authority. This meeting served to provide information for the authority's Board of Directors, which would need to vote to approve the use of the site. Also, at its first meeting of the year, the City of Greenville Environmental Advisory Commission adopted a resolution supporting the project. The Stormwater Committee submitted a one-page project summary at mid-month, and by the end of January 1989, a preliminary application was forwarded to the Director of APES.

Revisions to the proposal were completed during the first quarter of calendar year 1989. In addition, the Stormwater Committee began preparation of the Quality Assurance (QA) Certification plan. In mid-May, the QA certification was approved by the EPA Region IV Quality Assurance Officer.

The site for the proposed project, an area of approximately 3.5 acres, was located behind a publicly funded day care center. The site was being used as a public park under the management of the Recreation and Parks Department. During May 1989, discussions were held with Recreation and Parks officials regarding the closing of the park. EPA had expressed concern about the reduction of available recreation space in this predominantly low-income section of the City. However, Recreation and Parks representatives stated that closure of Moyewood Park would allow for additional resources to be used toward improvement of Thomas Foreman Park, located across Memorial Drive on West Fifth Street. This proposal, along with the stormwater project proposal, was studied by the City of Greenville Recreation and Parks Commission, and approved in early November. The EPA was notified of the Commission's action.

In early June 1989, the EPA tentatively approved the City's application for a $150,000 grant, but further revisions were needed. City of Greenville staff returned a revised grant application on June 19. During August, a budgeting schedule was prepared and the City was notified of the EPA's tentative approval of the grant proposal. On October 13, 1989, the contract (No. C-1827) between City of Greenville and the State of North Carolina, Department of Environment, Health, and Natural Resources (DEHNR) for a $150,000 APES grant for Information Acquisition Project No. 89-90, entitled Urban BMPs: A Stormwater Control Demonstration Project, was received.

Delays Encountered

By November 1989, ironically, project efforts had stalled, and the Stormwater Committee was essentially defunct. This circumstance can only be attributed to unfortunate timing. Because of personnel turnover, no engineers remained on staff to provide technical support. Given this void of expertise, it became evident that the City would be forced to incur the additional expense of contracting with an outside firm for the project design. Subsequently, the City Council approved an expenditure of $20,000 to hire a firm to design the stormwater detention facility. In December 1989, Council approved the APES City of Greenville contract.

During the beginning of 1990, the project continued to languish because of personnel upheaval. The Planning Director resigned, and the Environmental Planner was promoted to Senior Planner, a change that entailed a shift of responsibilities. A new Environmental Planner was hired in March 1990, and was given the task of coordinating the project. One of his first duties was to arrange for the appraisal of the project site property. This would be required prior to acquisition from the Greenville Housing Authority. The Authority would decide on the basis of the appraisal whether to lease the parcel or donate it outright to the City.

The appraisal was completed by Sauter, Phelan and Associates, a local real estate appraisal and consulting firm, on April 24, 1990. The parcel's appraised value was determined to be $22,000, an unexpectedly high figure. Because the appraised value approached $10,000 per acre, GHA officials found it necessary to reassess their decision to lease the property at no cost. In May, the Housing Authority decided to forward the appraisal to the U.S. Department of Housing and Urban Development (HUD). HUD was to make a determination as to whether the Moyewood property would be donated or sold to the City at market value. The City was concerned that the high appraisal value would persuade HUD to ask that the parcel be purchased at market value. Budget constraints would have made such a purchase virtually impossible, thus potentially jeopardizing the project.

While awaiting HUD's determination, the City proceeded with forwarding letters to several local engineering firms requesting statements of interest and qualification for the design of the BMP facility. Furthermore, a public notice of the request was published in the Greenville Daily Reflector on July 15 and July 18, 1990.

In late August, the GHA received permission from HUD to enter into a lease agreement with the City for the use of the Moyewood property for an urban stormwater detention pond. At September 1990, the project was one year behind the work schedule submitted in the original grant proposal. On September 14, the City officially requested a one-year extension of the Project Schedule.

PROJECT DEVELOPMENT

Also on September 14, the City staff organized an interdepartmental meeting with representatives and department heads for the Public Works, Planning, and Engineering departments, and the City Manager. They were briefed on the status of the project. Discussion focused on the individual responsibilities of each department with regard to the BMP facility. Two major questions were posed at the meeting. One question concerned disposal of sediment that would accumulate in the detention basin. The Engineering Director and the Environmental Planner agreed to consult with the County Engineer about disposal of the sediment in the county landfill. The second question concerned the importance of getting the input of Dr. Stanley of ICMR in order to properly coordinate his requirements during the design and eventual construction of the facility. A Memorandum of Understanding concerning duties and responsibilities was to be drafted and submitted to the respective departments for review. During October 1990, discussions were held with the APES Director regarding revision of the Work Plan Schedule to accommodate the one-year extension. It was determined that the post-construction monitoring phase, which included water quality sampling and analyses to be conducted by Greenville Utilities, would be deleted from the project. The performance evaluation phase was also deleted. Since water quality analysis, land use analysis, and performance evaluation were to be incorporated into the ICMR study, research goals were not compromised. A one-year extension of the City of Greenville work plan was approved by EPA in November.

During October and November, a small committee had conducted interviews with four local engineering firms. On November 30, the City contracted with the firm of McKim and Creed for the design of the stormwater facility. Immediately, under the leadership of the Engineering Director, a schedule was established for meetings of the APES Design Team, which was to consist of key members involved with the project: City staff, Dr. Stanley of ICMR, and Jerad Bales of USGS, and representatives of McKim and Creed. In early December, the lease agreement between the City and the Greenville Housing Authority was executed, finally resolving the land acquisition issue. Nearly two years after the project was conceived, the design and construction phase of the City of Greenville Urban Stormwater project was set to begin.

Design Phase

Beginning on November 28, 1990, the APES Design Team began meeting on a regular basis. These meetings were facilitated by the Engineering Director, and were primarily a means of addressing: (1) technical details relating to design, particularly to accommodate the installation of monitoring equipment and sampling hardware for the ICMR and ECU studies; (2) time, equipment, and manpower constraints foreseen by the Public Works Department; and, (3) coordination of other City departments involved. The Design Team would meet throughout the winter and spring of 1991. A total of eleven (11) meetings were held.

To facilitate City departmental coordination, a Memorandum of Understanding (MOU) was drafted. Discussions continued during January 1991, and the agreement was finalized on January 31 (see Appendix C).

As the design process continued, it was discovered that the installation of a weir, to be used for USGS outflow measurements, and an outlet drainageway would require a small encroachment of approximately 200 square feet onto an adjoining property. The Engineering Director and Environmental Planner met with the adjoining property owner in March 1991 to discuss this issue. The owner was amenable to granting an easement. The easement was executed and filed in August.

Also in March, during a field inspection of the project site, a grave headstone was discovered on the eastern perimeter of the site, atop a small knoll. The headstone, dated 1914, was lying on its side. Judging from the lack of earth and leaf litter around the stone, it was apparently not in situ for a long period of time. Furthermore, the stone did not appear to be excessively weathered.

The existence of a possible burial plot on the APES project site would have presented a major delay to construction start-up. Therefore, the Environmental Planner spent a week researching the origin of the headstone. Also, Public Works Department personnel conducted a soil probe. Upon completion of this inquiry, a determination was made that no burial plot existed on the site. It was possible that the headstone had been moved to that location. Ultimately, a determination was made that excavation and vehicle transit could be accomplished without disturbing the site; thus, the headstone remains at its discovered location.

McKim and Creed completed the project design in May 1991. On May 21, the U.S. Army Corps of Engineers approved the firm's wetland delineation and provided authorization for discharge of fill material into less than 0.3 acres of wetlands, as permitted by Nationwide Permit No. 26. On June 17, as a condition of the Corps permit, the project received a Section 401 Water Quality Certification from the NC Department of Environmental Management. Approval of the project's erosion and sediment control plan was pending at month end, which limited excavation activities to less than 1 acre. Final approval was granted on July 3, 1991.

Also during June, the City made arrangements to transport soil material excavated during construction to the county landfill. The County Engineer had stated that the landfill operation was in constant need of suitable fill material, and agreed to pay the City $10.00 per dump truck-load. The Engineering Department hired an Engineer I in early June, and this person was given the responsibility of overseeing project construction. The Engineer I was able to devote 40% of his time to the project.

Construction Phase

Groundbreaking on the City's Urban Stormwater Project began on June 26, 1991, nearly 15 months after the project contract was approved by City Council, and almost 2 1/2 years since project conception. The Public Works Department's Street Maintenance Division conducted the excavation. During the last week of July and throughout August, excavation operations were underway on a full-time basis. From August 6 through 21, nearly 100 truckloads per day of excavated material were removed from the site.

The Street Maintenance Division utilized leased as well as City-owned equipment. The Division leased a new Case 1088 Excavator, intended for eventual purchase, along with a Case 1150 Bulldozer. City-owned equipment also included a Case 510 Backhoe, Gallion Motor Grader, Case 40 Drott Excavator, and several small dump trucks. At various times during the excavation operation, up to 10 tandem and triaxle dump trucks were rented from private firms.

Approximately one-third of Street Maintenance Division personnel were utilized on the APES project. Total project manhours exceeded 4,000. Site conditions were generally excellent. Only about five (5) working days were lost to inclement weather.

Biweekly construction progress meetings were held on site beginning in July. With the project now under the daily attention of the Engineer and Street Maintenance Division Supervisor, these meetings served as update sessions for the Planning Department, ICMR, USGS, and McKim and Creed.

By August 6, all outfall piping for the project had been installed, along with the weir footing and outfall junction box slab. Erosion control measures were installed by August 20.

By mid-September, 95% of the detention pond area had been excavated, and all piping and structures, including the weir and concrete spillway, were completed.

By late October, 1991, inlet and spillway rip-rap aprons were installed, and the detention pond was fine-graded and seeded. Security fencing on the pond perimeter was completed by mid-November. A pole light, power meter, and electrical panel were installed to provide a power source for ICMR's sampling and monitoring equipment.

The City of Greenville Urban Stormwater Demonstration Project was officially opened on November 20, 1991. The opening ceremony was conducted as a media event in order to draw publicity and recognition for the project and to heighten public awareness of the facility's environmental importance. The ceremony was highlighted by brief speeches by the Mayor, the Regional Manager of DEHNR, and the Director of the Albemarle-Pamlico Estuarine Study. It was attended by about 35 people, many of whom were Public Works employees who had been involved in construction of the project. The ceremony served another important purpose: it allowed the chief elected official an opportunity to publicly recognize the efforts of the construction workers and equipment operators who might otherwise have gone unrecognized for their contribution to the project.

Project Area Description

The urban stormwater demonstration project is located on a 3.5 acre parcel in the Moyewood section of Greenville off West Third Street, to the west of U.S. Highway 13/NC Highway 43 (Figure 1). The project site lies within an area that has been altered and developed for human activity for decades. Thus, the first several feet of the project basin were excavated from longstanding fill material. The site lies adjacent to low-lying wetlands of the Tar River, at an elevation[4] of approximately twenty-five (25) feet.

Prior to project construction, a deeply eroded channel (known as the Moyewood Ditch) adjoined the parcel on the eastern side. This channel drained an upstream area of approximately 200 acres (Figure 2). To the south of Third Street, drainage continues to be conveyed within a 42-inch diameter rolled concrete pipe (RCP). This pipe discharged into Moyewood Ditch a few feet north of Third Street. Approximately 100 feet downstream of this point, another 42-inch diameter corrugated metal pipe (CMP) discharged into the channel. Moyewood Ditch was highly unstabilized, with much evidence of scouring, slump failure, and tree undercutting along its banks. The ditch contained much debris. Items such as tires, shopping carts, and even discarded appliances, such as television sets and washing machines, exacerbated the erosion problem. Project construction included filling the Moyewood Ditch north of Third Street. Drainage is now conveyed within a 60-inch diameter CMP before it enters the detention basin. The project's spillway (see Project Specifications) discharges into the unfilled section of Moyewood Ditch on the basin's eastern side (Figure 3). The channel widens considerably as it enters the low-lying area to the north of the project site, and stormwater then drains through a forested wetland area and into the Tar River.

The total population within the project drainage area is 2,019 (1990 Census). The watershed is almost completely developed for urban activities. Land uses, as illustrated by a series of maps taken from reduced aerial orthophotographs, are shown in Figure 4. Medium density residential uses predominate. Single family and duplex dwellings are found on lots ranging between 4,000 and 8,000 square feet. U.S. Highway 13/NC Highway 43 (Memorial Drive), a major north-south route in Greenville, traverses the watershed. Average daily trips on the highway in 1990, at a point between Third Street and Fifth Street, numbered 21,700 vehicles.[5] A variety of highway-commercial and medical office uses within the project watershed have developed along this highway. Office and institutional uses are found along NC Highway 43 where it becomes a separate route.

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[4]USGS Topographic Quadrangle, Greenville SW, NC.

[5]NC Department of Transportation

Project Specifications

The City of Greenville urban stormwater control demonstration facility is a 1.75 acre excavated dry detention basin situated on a 3.5 acre site adjacent to the Tar River. Basin depths range from 7.5' in the northernmost corner to 11.0' at the inlet structure. The bottom of the basin has an average slope towards the outlet of 1.25%.

For reasons of liability and to protect monitoring equipment, access to the facility is controlled by way of a 6' high security fence. Vehicle access to the basin is provided at two locations directly off Third Street and West Conley Street. An earthen ramp allows access to the bottom of the pond. In addition, a 12' access road is provided around the basin perimeter. Lighting and electrical power have also been provided to the site.

The primary design function of the facility is to capture 92.7% of the first 1/2" of rainfall over the 200-acre urban watershed and discharge it, through a 6" orifice, at a peak rate of 2.6 cubic feet per second (cfs). This corresponds to a rainfall event just under the 2-year storm. Runoff volume exceeding 1/2" is discharged over a 45' trapezoidal concrete spillway. Storage capacity of the pond at the emergency spillway elevation is 7.76 acre-feet (338,026 cubic feet). The maximum storage available is 11.1 acre-feet (514,008 cubic feet). This corresponds to the peak storage required for the 100-year storm event. The peak discharge (Q_{pk}) during this storm is 382.18 cfs. The maximum time for the pond to draw down after a major storm event is 74.75 hours.

The inlet structure for the basin consists of a 60' concrete pipe with a flared end section and a 30-foot class "B" rip-rap apron. The outlet structure is a riser barrel configuration consisting of a 4' x 30" CMP (corrugated metal pipe) perforated riser connected to a 24" barrel with the 6" orifice plate attached. In addition, the pond is equipped with 24" hand operated emergency sluice gate. If required, the basin can be drained from the peak storage elevation in approximately fifteen (15) hours by opening the gate.

Basin inflow hydrographs, which measure discharge into the facility over a given time period for a specific storm event, provide a model of the watershed's runoff characteristics by analyzing its surface and subsurface drainage elements. The inflow hydrographs for the stormwater detention project were developed using the Soil Conservation Service Method Quick TR-55 and computed using the Haestad Methods Pond-2 computer program. The Soil Conservation Service has developed a method for estimating storm runoff volumes from small urban watersheds with various land use and surface cover characteristics. For each watershed and storm event, a curve number (CN) is chosen as a parameter to be used in computing the hydrograph. The curve number is an empirical rating of the hydrologic performance of a variety of urban land uses with varying percentages of impervious surface. Other parameters include time of concentration and travel time. Time of concentration (T_c) is the time it takes for runoff to travel from the most distant part of the watershed to the point of discharge into the pond. Travel time (T_t) is the time it takes runoff to flow from the outfall of a watershed subarea to the outfall of the entire watershed (the sum of the flow times through each of the eight downstream subareas). T_t should not be confused with T_c. For the computation of the inflow hydrographs, the 200-acre urban watershed has been divided into eight subareas. Each subarea is defined by natural topographic constraints and the existing structural drainage network (piping, drop inlets, ditches, etc.). Details of the inflow hydrographs, along with specific data on the subareas, are provided in Appendix A.

Storm routings, which compute incremental inflows, outflows and water surface elevations during the duration of the design storm, were also calculated using the Pond-2 program. Storm routings for the 2, 5, and 100-year design storm events can be found in Appendix B.

A complete set of reduced scale construction plans are provided by Figure 3. A project pictorial is contained in Appendix D.

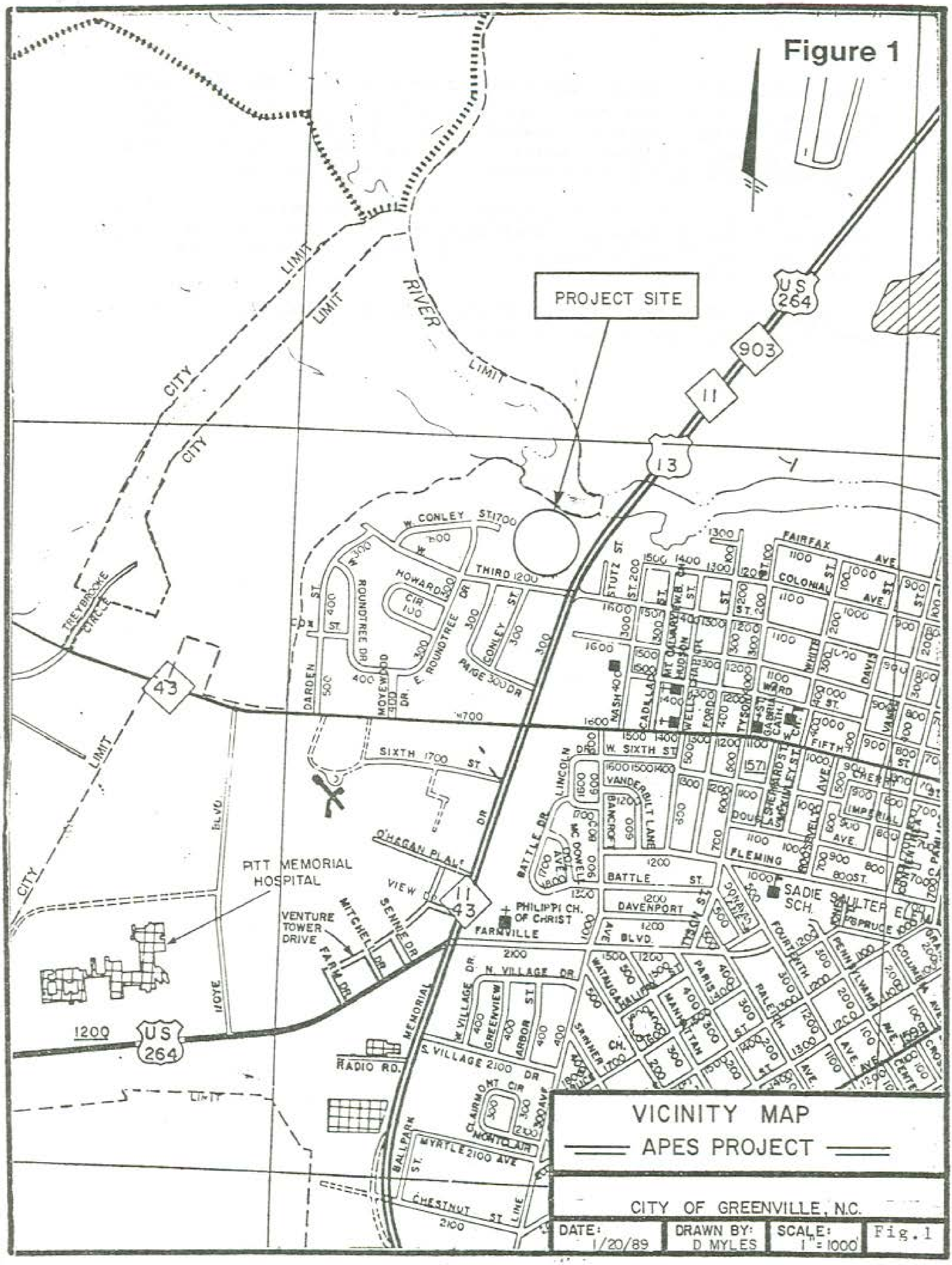


Figure 1
PROJECT SITE
CITY LIMIT
RIVER
US 264
903
11
13
43
W. CONLEY ST.
THIRD
HOWARD CIR.
ROUNDTREE DR
E. ROUNDTREE DR
DARDEN ST.
MOYEWOOD DR.
CONLEY ST.
PAIGE DR
TREYBROOKE CIRCLE
SIXTH ST
W. SIXTH ST
FIFTH
FAIRFAX AVE
COLONIAL AVE.
NASH
STUTZ ST.
VANDERBILT LANE
LINCOLN DR
BATTLE DR.
BATTLE ST.
DAVENPORT
FLEMING
O'HAGAN PL.
VIEW DR
SENNE DR
MITCHELL DR.
FARM DR.
VENTURE TOWER DRIVE
PITT MEMORIAL HOSPITAL
PHILIPPI CH. OF CHRIST
SADIE SAULTER SCH.
FARMVILLE BLVD.
MEMORIAL DR
N. VILLAGE DR
S. VILLAGE DR
W. VILLAGE DR.
GREENVIEW
ARBOR ST.
RADIO RD.
CLAIRMONT CIR
MONTCLAIR
MYRTLE AVE
CHESTNUT ST
BALLPARK ST.
MANHATTAN
PARIS
RALEIGH ST.
PENNSYLVANIA AVE.
TYSON ST.
WATAUGA AVE
SKINNER
BLVD.
MOYE
VICINITY MAP
APES PROJECT
CITY OF GREENVILLE, N.C.
DATE: 1/20/89
DRAWN BY: D MYLES
SCALE: 1" = 1000'
Fig.1

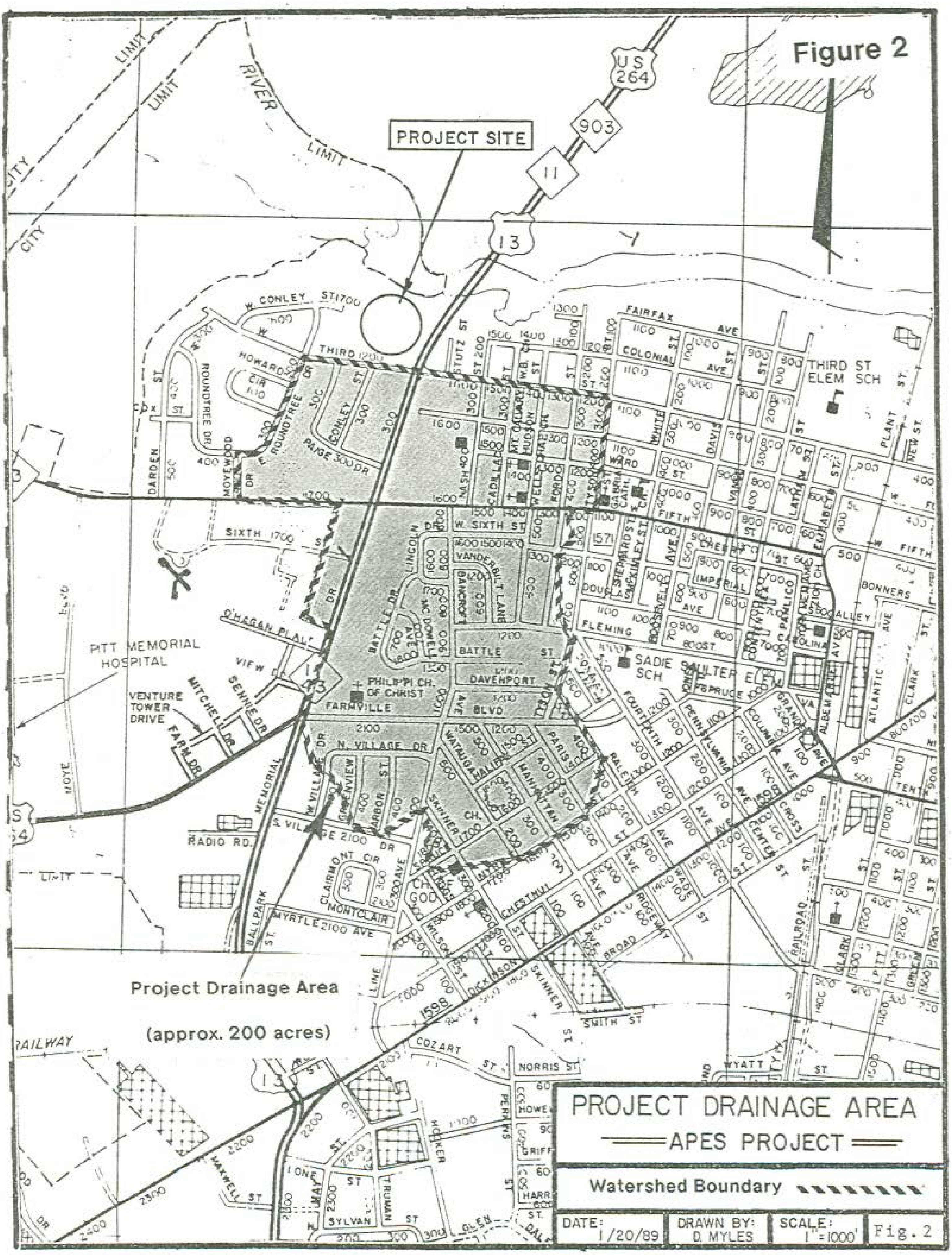
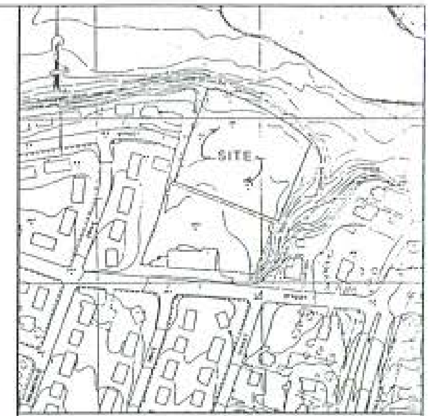


Figure 2
PROJECT SITE
US 264
903
11
13
CITY LIMIT
RIVER
PITT MEMORIAL HOSPITAL
VENTURE TOWER DRIVE
THIRD ST ELEM SCH
SADIE SAULTER EL SCH
PHILIPPI CH. OF CHRIST
Project Drainage Area
(approx. 200 acres)
PROJECT DRAINAGE AREA
APES PROJECT
Watershed Boundary
DATE: 1/20/89
DRAWN BY: D. MYLES
SCALE: 1"=1000'
Fig. 2



VICINITY MAP
SCALE: 1" = 200'

FIGURE 3

CITY OF GREENVILLE

APES STORMWATER PROJECT

CONSTRUCTION PLANS*

*Reduced scale drawings 45% of original size

INDEX TO SHEETS

Figure 3a	SITE/GRADING PLAN
Figure 3b	STORM DRAINAGE PROFILE
Figure 3c	WETLANDS DELINEATION MAP
Figure 3d	CROSS SECTION STA. 0+00 – STA. 2+50
Figure 3e	CROSS SECTION STA. 2+75 – STA. 3+35
Figure 3f	DETAILS
Figure 3g	DETAILS

PREPARED BY:

McKIM&CREED

ENGINEERS • PLANNERS • SURVEYORS
PHONE: (919) 756–5137
P.O. BOX 3371
GREENVILLE, NC 27834

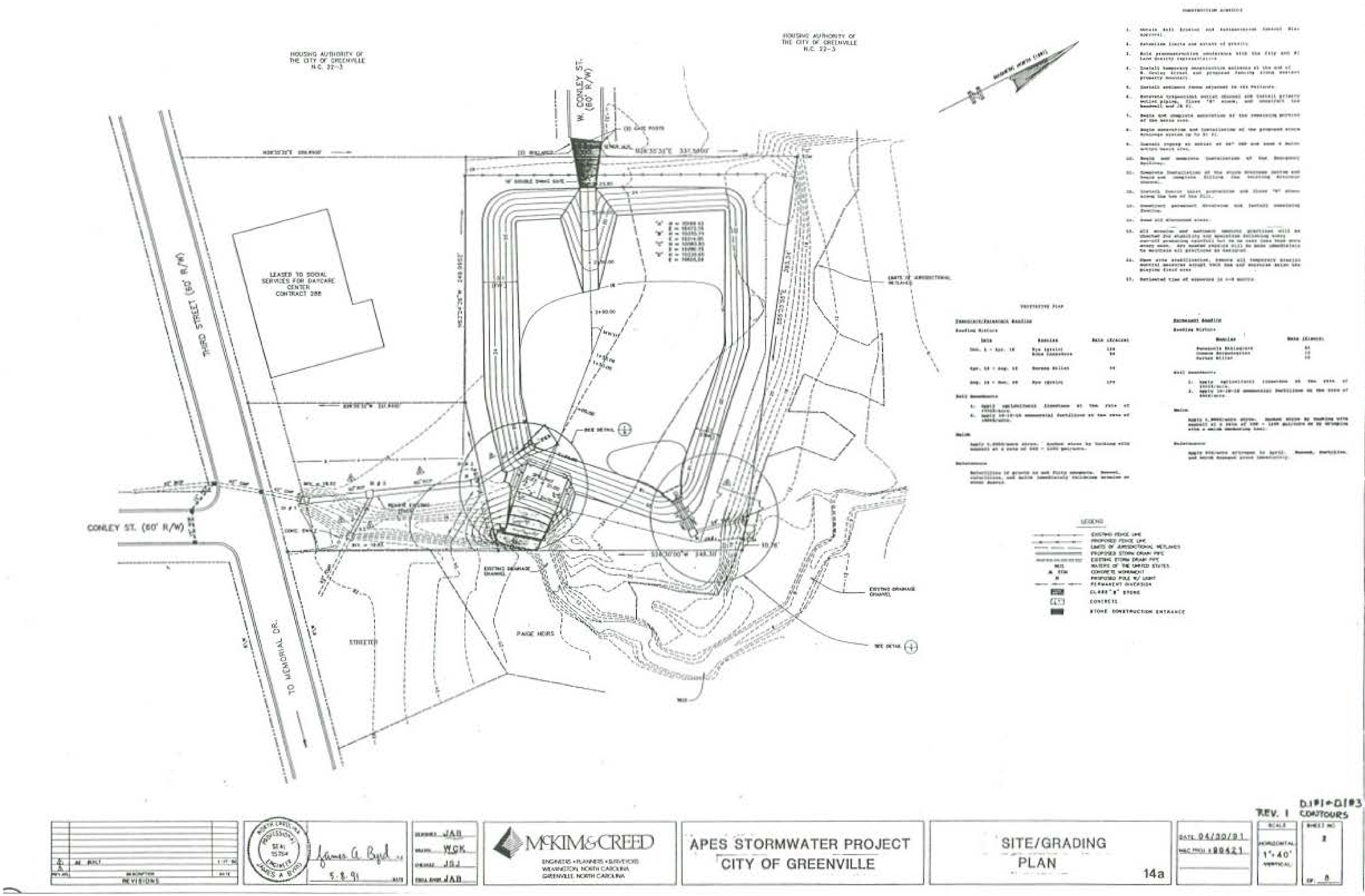

HOUSING AUTHORITY OF THE CITY OF GREENVILLE N.C. 22-3
HOUSING AUTHORITY OF THE CITY OF GREENVILLE N.C. 22-3
W. CONLEY ST. (60' R/W)
THIRD STREET (60' R/W)
CONLEY ST. (60' R/W)
TO MEMORIAL DR.
LEASED TO SOCIAL SERVICES FOR DAYCARE CENTER CONTRACT 288
STREETER
PAIGE HEIRS
EXISTING DRAINAGE CHANNEL
EXISTING DRAINAGE CHANNEL
SEE DETAIL
LEGEND
REV. 1
D.I#1-D.I#3 CONTOURS
REVISIONS
AS BUILT
5.8.91
MCKIM&CREED
ENGINEERS • PLANNERS • SURVEYORS
WILMINGTON, NORTH CAROLINA
GREENVILLE, NORTH CAROLINA
APES STORMWATER PROJECT
CITY OF GREENVILLE
SITE/GRADING PLAN
14a
DATE 04/30/91
1"=40'

Figure 3a

Figure 3b

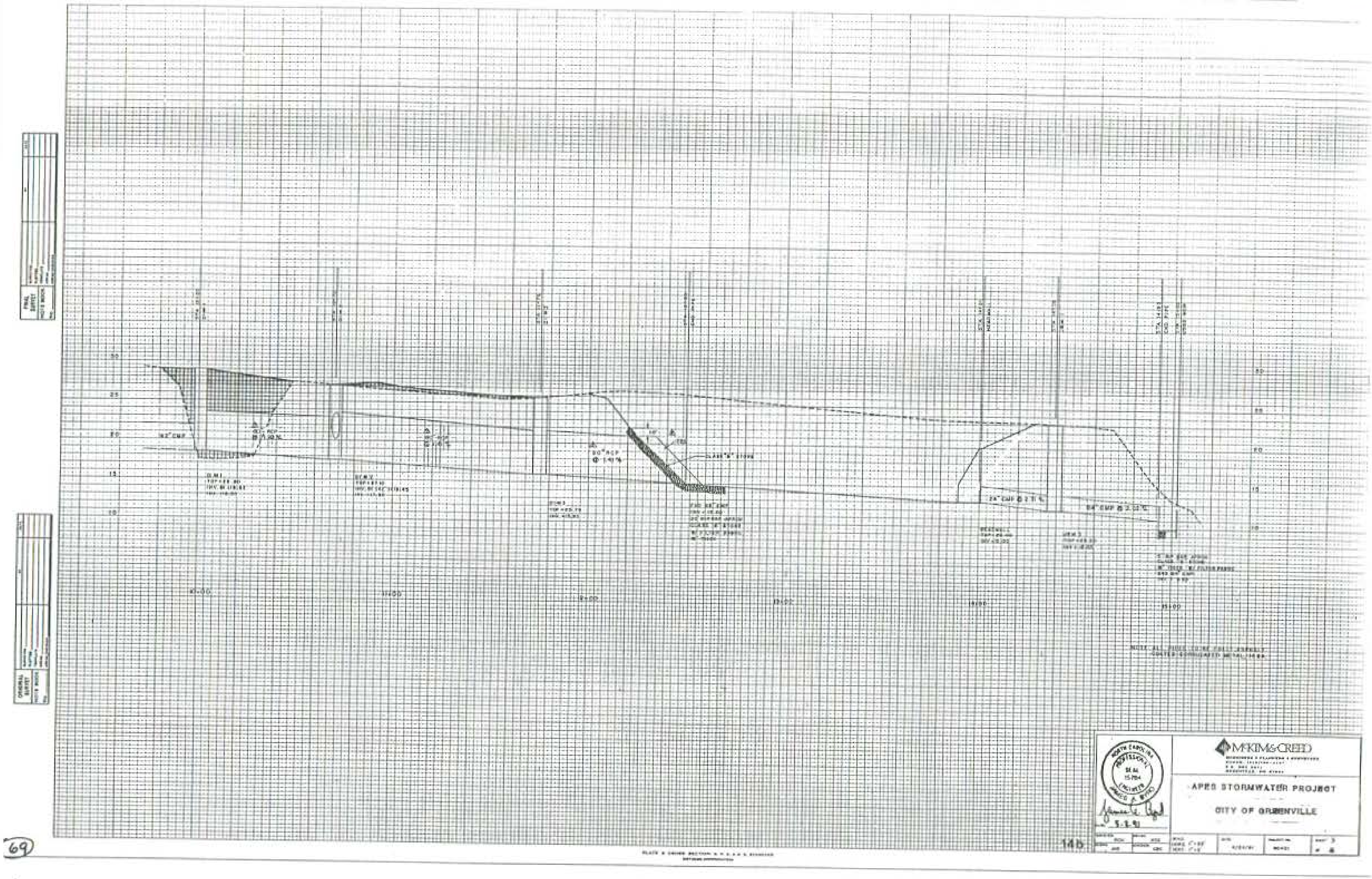
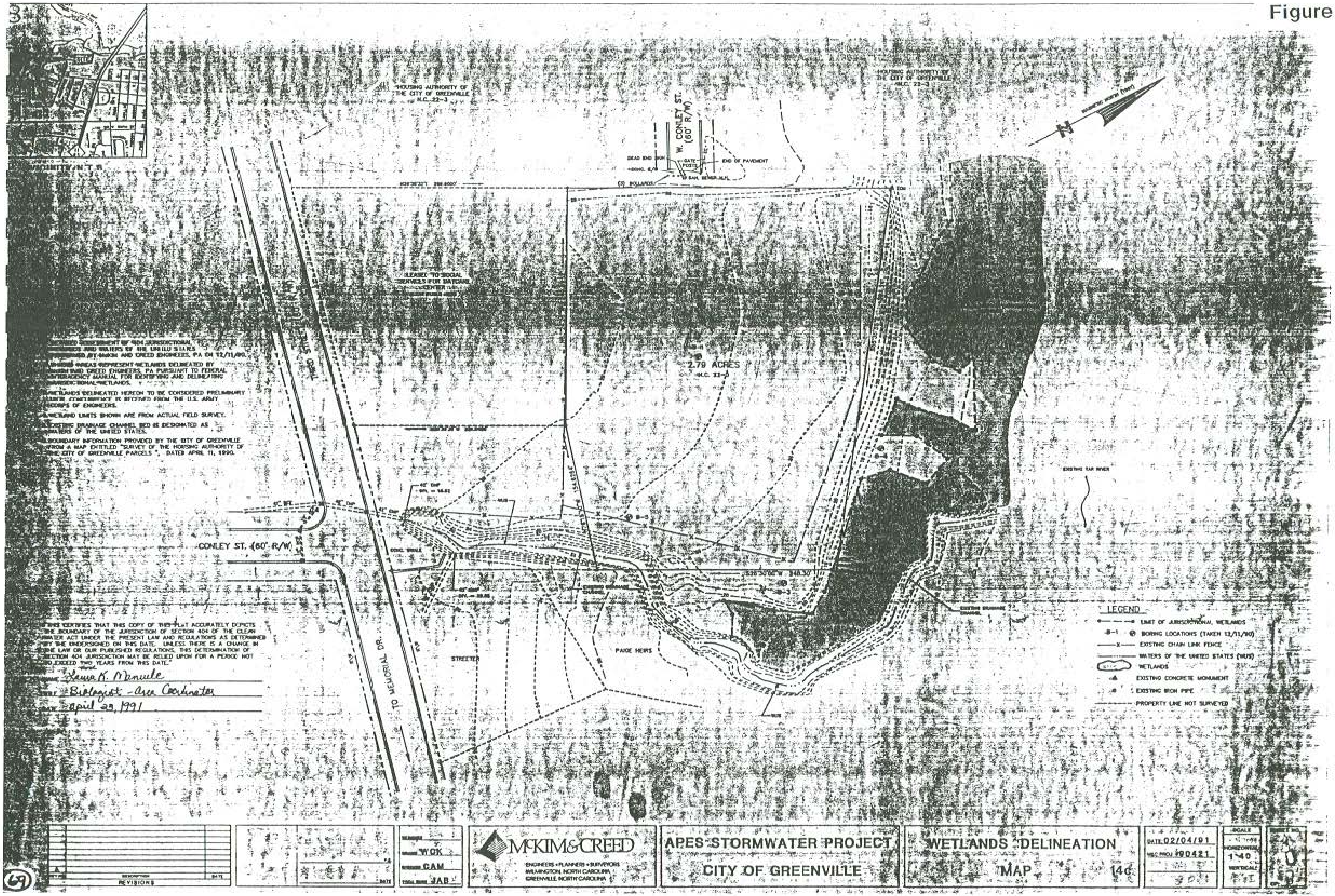

McKIM&CREED
APES STORMWATER PROJECT
CITY OF GREENVILLE
14b
24" CMP @ 2.11 %
CLASS "B" STONE

Figure 3c


HOUSING AUTHORITY OF THE CITY OF GREENVILLE H.L.C. 22-3
W. CONLEY ST. (60' R/W)
END OF PAVEMENT
LEASED TO SOCIAL SERVICES FOR DAYCARE CENTER
2.79 ACRES
CONLEY ST. (60' R/W)
TO MEMORIAL DR.
STREETER
PAIGE HEIRS
EXISTING TAR RIVER
LEGEND
LIMIT OF JURISDICTIONAL WETLANDS
BORING LOCATIONS (TAKEN 12/11/90)
EXISTING CHAIN LINK FENCE
WATERS OF THE UNITED STATES (WUS)
WETLANDS
EXISTING CONCRETE MONUMENT
EXISTING IRON PIPE
PROPERTY LINE NOT SURVEYED
REVISIONS
WOK
CAM
JAB
McKIM&CREED
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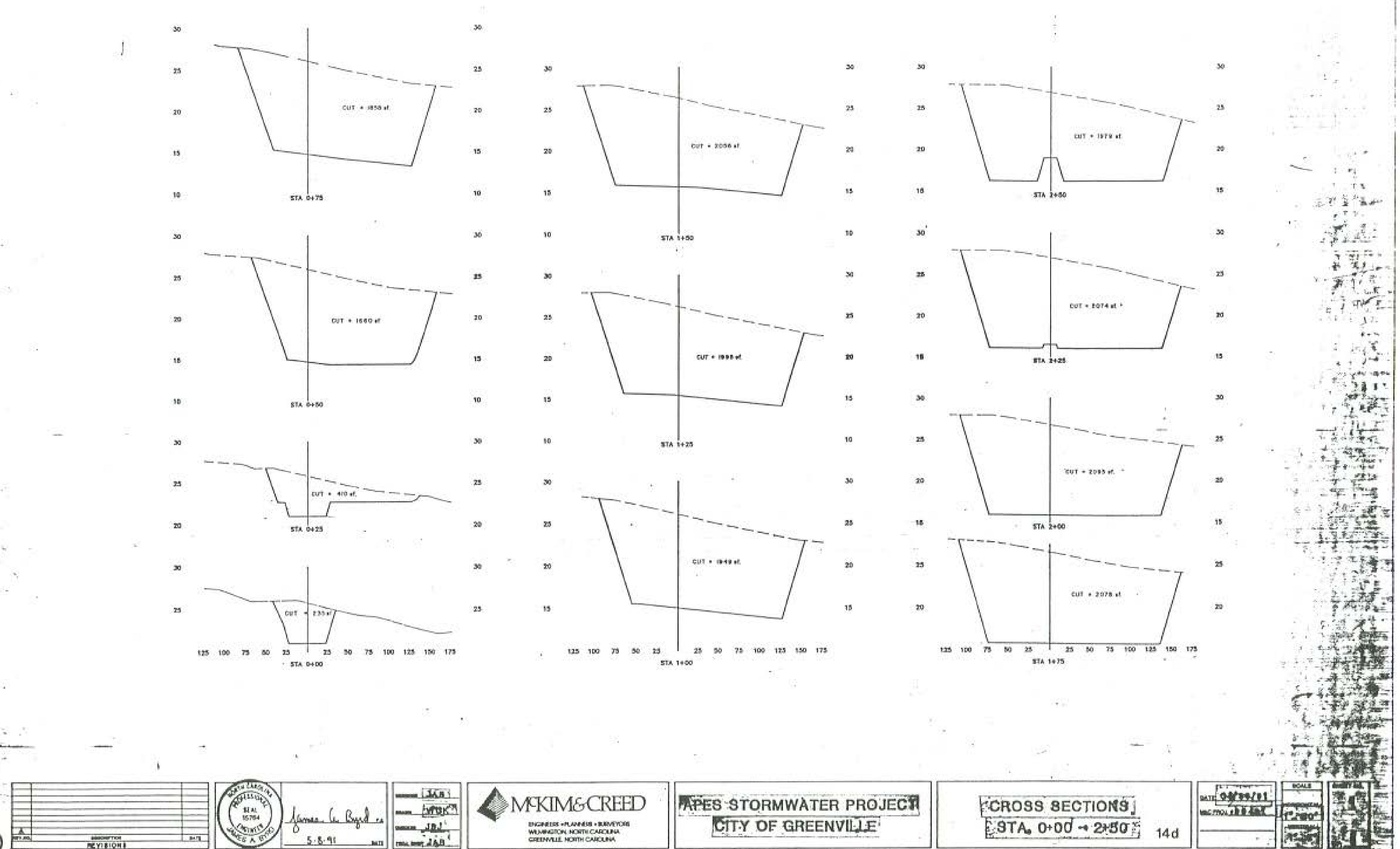
WILMINGTON, NORTH CAROLINA
GREENVILLE, NORTH CAROLINA
APES STORMWATER PROJECT
CITY OF GREENVILLE
WETLANDS DELINEATION MAP
14c
DATE 02/04/91
90421

Figure 3d



CUT = 1858 sf
STA 0+75
CUT = 1660 sf
STA 0+50
CUT = 410 sf
STA 0+25
CUT = 233 sf
STA 0+00
CUT = 2056 sf
STA 1+50
CUT = 1998 sf
STA 1+25
CUT = 1949 sf
STA 1+00
CUT = 1979 sf
STA 2+50
CUT = 2074 sf
STA 2+25
CUT = 2093 sf
STA 2+00
CUT = 2078 sf
STA 1+75
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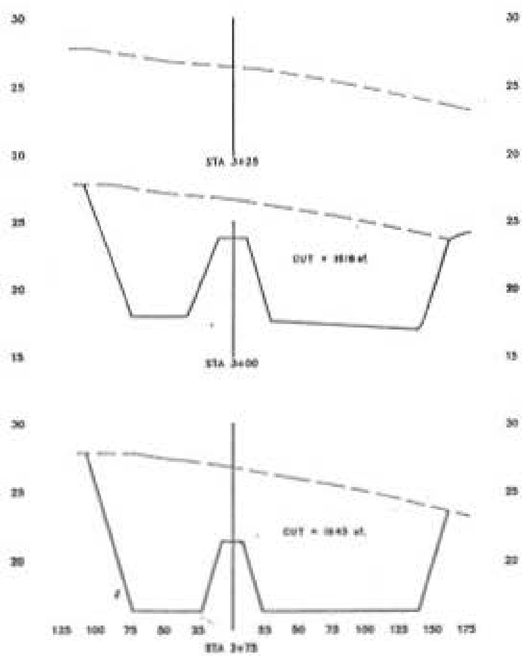
GREENVILLE, NORTH CAROLINA
APES STORMWATER PROJECT
CITY OF GREENVILLE
CROSS SECTIONS
STA. 0+00 → 2+50
14d
5-8-91

(69)

Figure 3e



(69)

REVISIONS

JAMES A. BYRD, PROFESSIONAL ENGINEER, NORTH CAROLINA, SEAL 15764

5-8-91

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WILMINGTON, NORTH CAROLINA
GREENVILLE, NORTH CAROLINA

TAPES STORMWATER PROJECT
CITY OF GREENVILLE

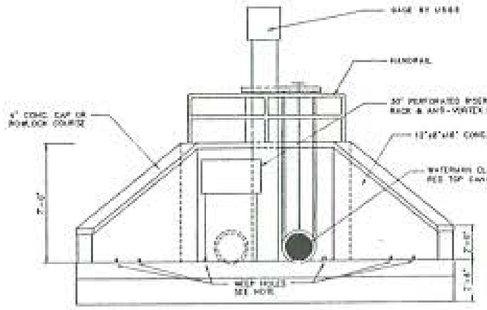
CROSS SECTIONS
STA. 2+75 → 3+35

14e

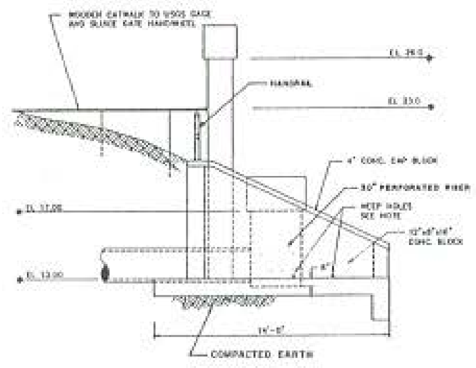
M&C PROJ. # 80421

SCALE: HORIZONTAL 1" = 40'

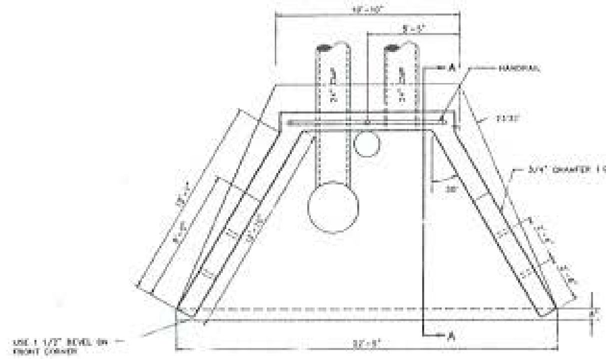
Figure 3f



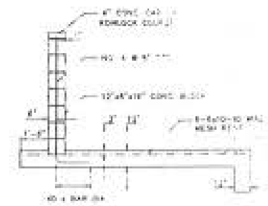
FRONT ELEVATION
SCALE: 1/4" = 1'



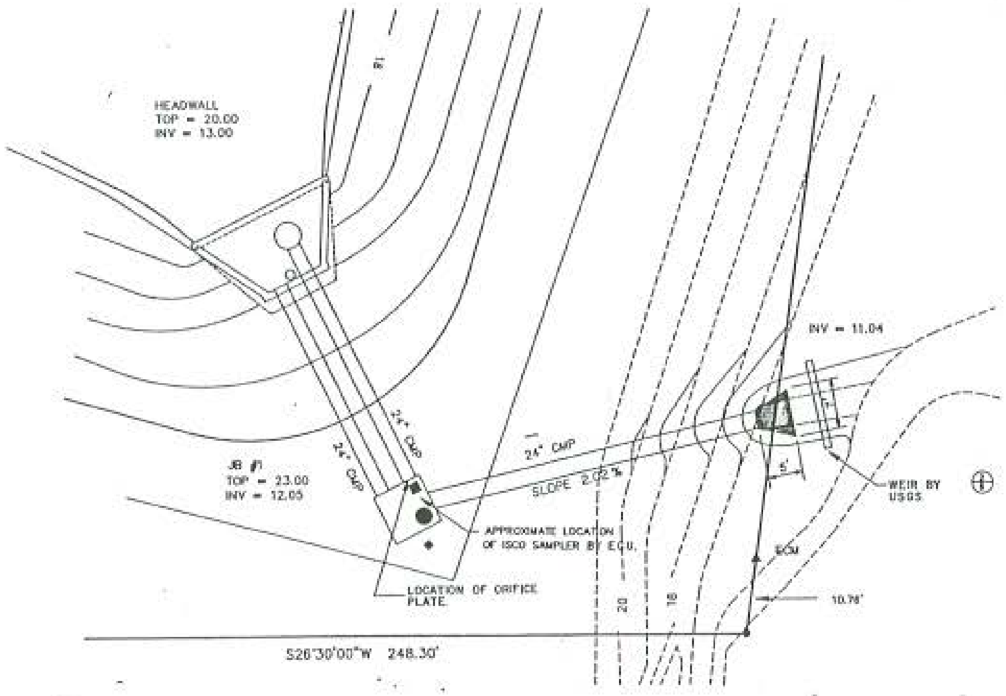
SIDE ELEVATION
SCALE: 1/4" = 1'



TOP ELEVATION
SCALE: 1/4" = 1'



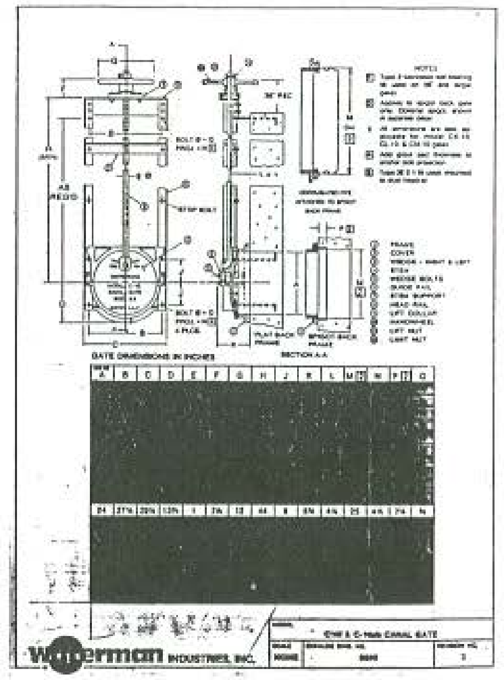
SECTION A–A
SCALE: 1/4" = 1'



1/7 OUTLET STRUCTURE DETAIL
SCALE: 1" = 30'

NOTE:

1. 1 CUBIC FOOT OF WASHED STONE REQUIRED BEHIND EACH WEEP HOLE.
2. ALL CONCRETE SHALL BE CLASS A 3000 PSI CONCRETE IN ACCORDANCE WITH SECTION 900 OF THE NCDOT "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES". CONCRETE SHALL NOT FALL MORE THAN THE HEIGHT OF 5 LAYERS OF BLOCK.



2/7 CANAL GATE
NTS

REVISIONS		

JAMES A. BYRD 15764 — 5-8-91

DESIGNED	JAB
DRAWN	KSG
CHECKED	JSJ
PROJ. MGR.	JAB

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GREENVILLE, NORTH CAROLINA

APES STORMWATER PROJECT
CITY OF GREENVILLE

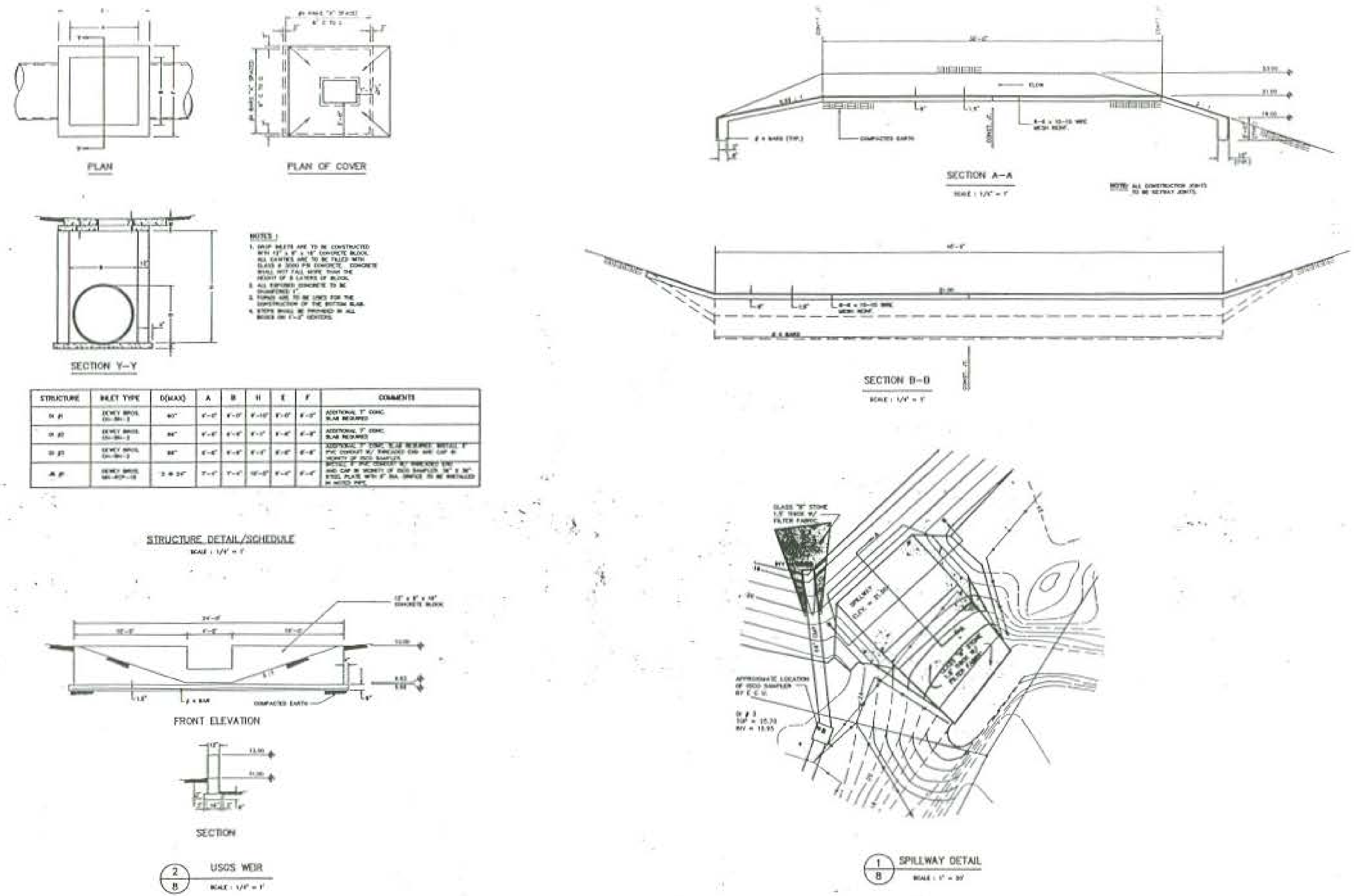
DETAILS 14f

DATE: 05/08/91
M&C PROJ. #00421

SCALE: HORIZONTAL: AS SHOWN; VERTICAL: —

SHEET NO. 7

Figure 3g



STRUCTURE	INLET TYPE	D(MAX)	A	B	H	E	F	COMMENTS
DI #1	DEWEY BROS. [illegible]	60"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ADDITIONAL 7" CONC. SLAB REQUIRED
DI #2	DEWEY BROS. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ADDITIONAL 7" CONC. SLAB REQUIRED
DI #3	DEWEY BROS. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JB #1	DEWEY BROS. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

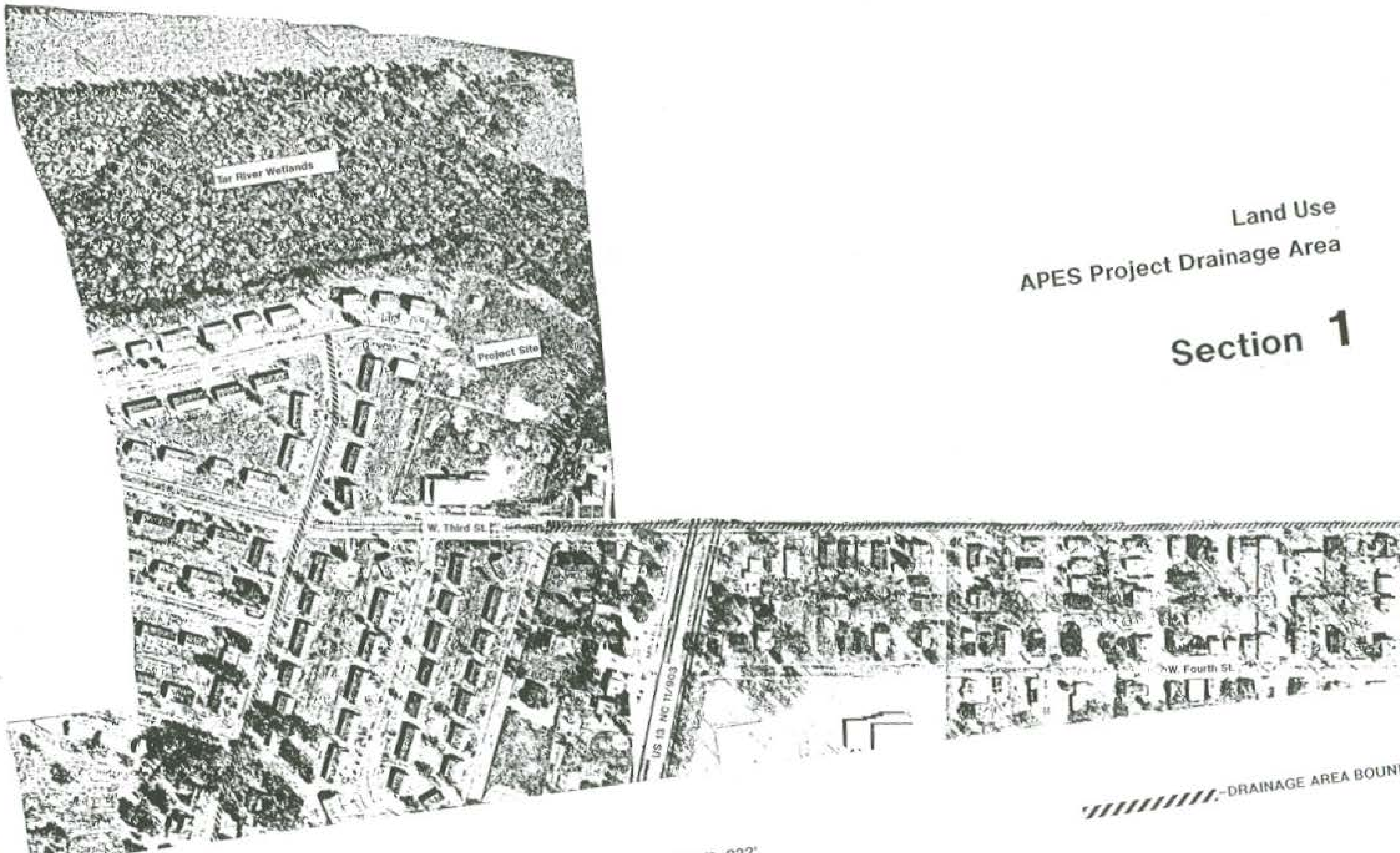
REVISIONS	James A. Byrd, 5-5-91	DESIGNED JAB; DRAWN DPM; CHECKED JSJ; PROJ. ENGR. JAB	McKIM & CREED — ENGINEERS • PLANNERS • SURVEYORS, WILMINGTON, NORTH CAROLINA, GREENVILLE, NORTH CAROLINA	APES STORMWATER PROJECT CITY OF GREENVILLE	DETAILS 14g
DATE 06/08/91	M&C PROJ. # 80421	SCALE: HORIZONTAL VARIES; VERTICAL	SHEET NO. 8 OF 10		

(69)

Land Use

APES Project Drainage Area

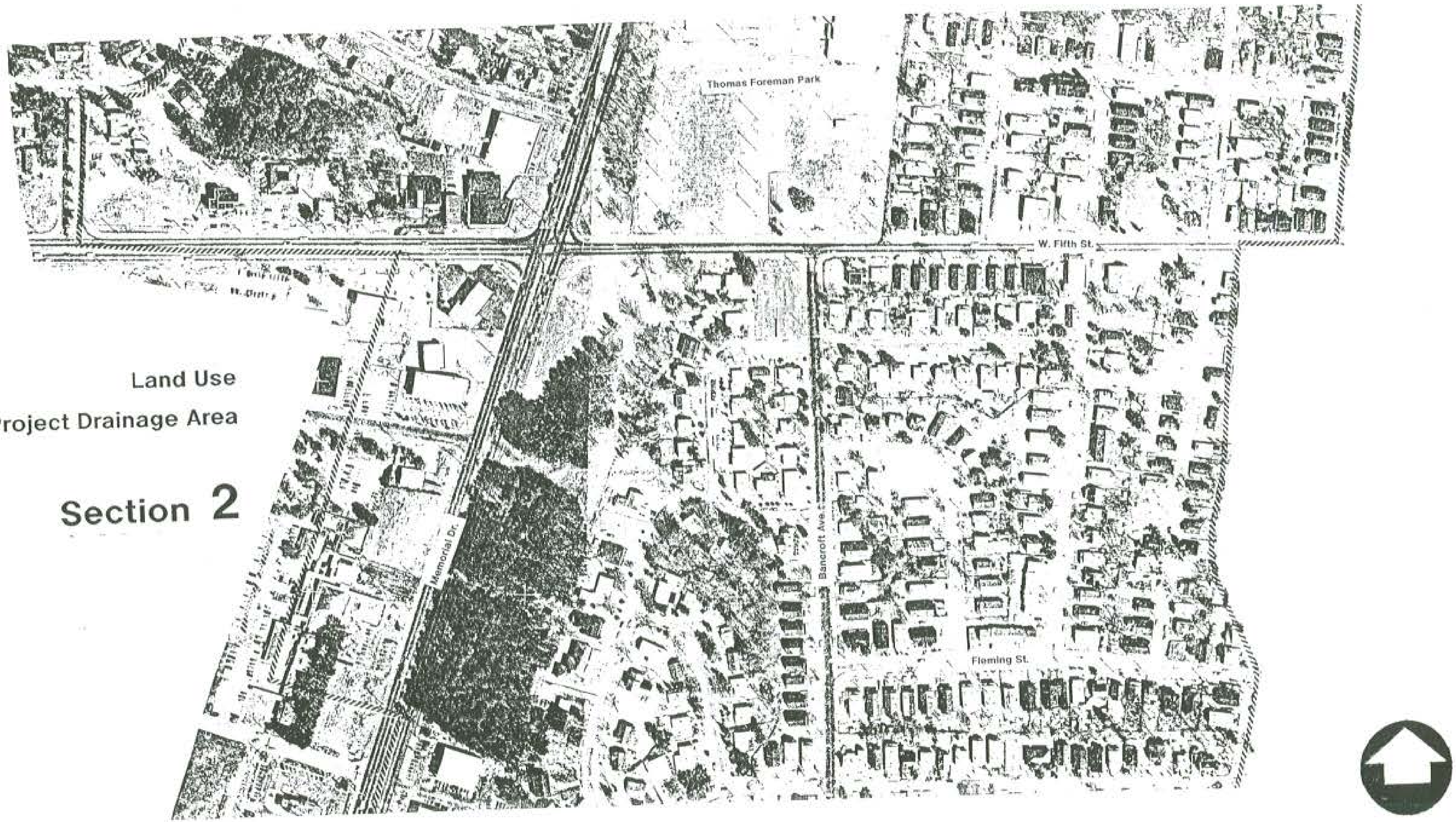
Section 1



-DRAINAGE AREA BOUNDARY

SCALE: 1"=222'

Figure 4b



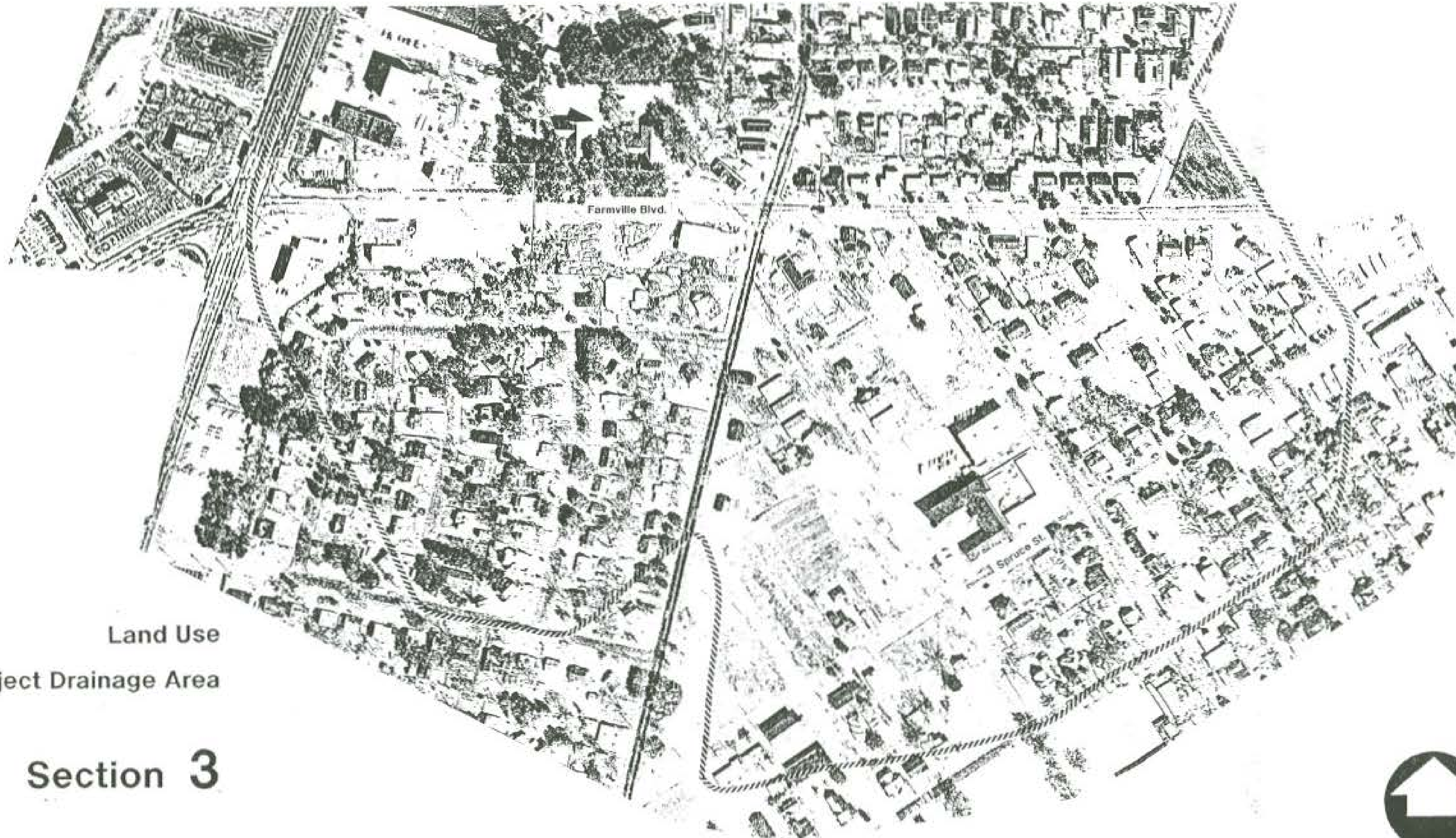
Land Use

APES Project Drainage Area

Section 2

SCALE: 1"=222'

-DRAINAGE AREA BOUNDARY



Land Use

APES Project Drainage Area

Section 3

NORTH

-DRAINAGE AREA BOUNDARY

SCALE: 1"=222'

SUMMARY AND RECOMMENDATIONS

Summary

The City of Greenville Urban Stormwater Control Demonstration Project provided a case study of the experiences of a municipal staff in the development, design, construction and implementation of an urban stormwater best management practice. Two agencies that will be involved in follow-up research at the facility, the Water Resources Division of the U.S. Geological Survey and the Institute for Coastal and Marine Resources at East Carolina University, were consistently involved and consulted during the design and construction phases of this project.

Development of the City of Greenville's original project proposal was primarily a staff function. Unanticipated personnel turnover and an unexpectedly high appraisal value on the project property led to a delay of nearly eighteen (18) months between proposal acceptance and project construction. However, once construction started, it proceeded efficiently, and the facility was constructed in less than four months.

To date, the BMP has performed satisfactorily, and no major problems in sampling or monitoring have been reported by USGS and ICMR. Unfortunately, there has been an incidence of vandalism, where the plastic pipe for the stage recorder in the weir pool was damaged. This was corrected, however, and additional security fencing has been erected to include the discharge outlet and weir pool.

The volume of surface litter and floatable debris captured within the pond has been much greater than anticipated. After each rainfall event, Public Works personnel must spend several hours in clean-up activities at the site. Although this leads to increased maintenance responsibilities, it demonstrates the facility's effectiveness in removing such debris. Furthermore, it illustrates the tremendous volume of solid waste present in urban stormwater runoff, which otherwise would be transported into the estuarine system.

Project Benefits

An immediate benefit upon completion of project construction was the improvement of a littered, unsightly drainageway. This was welcomed by the Greenville Housing Authority and adjacent property owners as a solution to a specific problem. Project construction rectified a dangerous, ongoing erosion problem and increased useable land area available to the day care center.

In addition to solving the erosion problem, The City's efforts toward implementation of the Urban Stormwater Control Demonstration Project has demonstrated the municipal government's commitment to the environment, and serves as a successful example of federal, state, and local cooperation in addressing river basin water quality issues. The project will prove its effectiveness in the years to come by providing a platform for scientific research. In addition to the water quality studies currently underway, the project can be the basis for an analysis of urban sediment deposition, a study of the economic impact of urban stormwater BMPs, a survey of citizen attitudes toward the BMP, a study on the effectiveness of a watershed-based environmental education campaign and litter control program, and a myriad of other projects related to urban stormwater management. The project will also serve as a valuable resource for other municipalities seeking to improve stormwater quality management.

Project Costs

Total costs for the planning, design and construction of the project are approximately $194,000 (see Table 2). The APES grant provided $150,000 of the total cost, while the remainder was provided through in-kind services. The City was able to derive revenues of $15,000 from project construction by selling the excavated soil to the county for use as fill material at the local solid waste disposal facility. These funds will be used for ongoing maintenance of the facility and to fund additional studies. A cost-benefit analysis will be undertaken to ascertain the direct benefits to the citizens of Greenville. Such an analysis will correlate the effectiveness of the facility in removing pollutants with potential improvements in the health of commercial fisheries, recreational opportunities, and other benefits from stormwater control at the watershed scale.

Recommendations

The U.S. Environmental Protection Agency (EPA) has developed extensive regulations concerning the discharge of stormwater. These requirements are likely to prove an expensive measure for local governments, and many communities will be required to construct stormwater treatment facilities. The City of Greenville Urban Stormwater Control Demonstration Project can serve as model for other municipalities that will be required to develop structural solutions to reduce urban nonpoint source pollution from commercial and industrial areas. Because it is designed to control runoff at the watershed scale, this project can help reduce the financial burden of implementing stormwater controls by spreading the costs over a large number of "users". Furthermore, this urban stormwater BMP could prove an attractive infrastructure option when communities establish a stormwater utility.

Implementing the model provided by the Greenville project will prove most feasible when the BMP is designed during the planning phase for large industrial, commercial, or residential projects, when land acquisition costs are less of a factor. When potential BMP sites cannot be selected from publicly-owned lands, municipalities can employ such techniques as transfers of development rights to acquire the site.

In conclusion, the City of Greenville Urban Stormwater Control Demonstration Project represents a technology that can be effectively adopted by mid-size and large municipalities throughout the Atlantic Coastal Plain.

TABLE 1

CITY OF GREENVILLE
URBAN STORMWATER CONTROL DEMONSTRATION PROJECT
COST SUMMARY

CATEGORY	AMOUNT
DESIGN[1]	**$20,800.00**
CONSTRUCTION	
CONCRETE BLOCK	1,728.00
CONCRETE	5,251.86
ELECTRICAL SUPPLIES	123.32
EQUIPMENT RENTAL	19,126.88
FENCING	9,470.00
GRATE INLETS	1,069.15
LUMBER	817.25
MISCELLANEOUS	1,656.42
PHOTOGRAPHY	80.90
PIPE	19,098.58
SEEDING	2,625.00
STONE	7,420.97
TRUCKING	42,460.50
	$110,928.87
CITY CONTRIBUTIONS TO CONSTRUCTION	
DIRECT LABOR[2]	38,515.62
EQUIPMENT	21,261.11
FUEL	2,578.01
	$62,354.74
GRAND TOTAL	**$194,083.61**
TOTAL MANHOURS (APPROXIMATE)[3]	4,000

[1]Separate appropriation for consultant's design services; not part of grant funds.

[2]Staff contributions to site selection and design are not included.

[3]Manhours reflect direct labor contribution.

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-10.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

APPENDIX A

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
Subarea #1	18.60	63.0	0.75	0.10	6.00	2.18	I.2	.20
Subarea #2	37.00	60.0	1.00	0.10	6.00	1.92	I.22	.22
Subarea #3	25.10	61.0	0.50	0.20	6.00	2.01	I.21	.21
Subarea #4	30.00	68.0	1.00	0.00	6.00	2.62	I.16	.16
Subarea #5	18.30	62.0	1.00	0.00	6.00	2.09	I.2	.20
Subarea #6	42.90	59.0	0.75	0.00	6.00	1.84	I.23	.23
Subarea ~~#6~~ 7	13.70	69.0	0.40	0.00	6.00	2.71	I.15	.15
Subarea #8	15.80	55.0	0.40	0.00	6.00	1.52	I.27	.27

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 201.40 acres or 0.3147 sq.mi
Peak discharge = 174 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.66	0.14	0.75	0.10	Yes	--
Subarea #2	0.89	0.14	1.00	0.10	Yes	--
Subarea #3	0.59	0.11	0.50	0.20	Yes	--
Subarea #4	0.84	0.09	1.00	0.00	Yes	--
Subarea #5	0.88	0.06	1.00	0.00	Yes	--
Subarea #6	0.64	0.00	0.75	0.00	Yes	--
Subarea ~~#6~~ 7	0.38	0.01	0.40	0.00	Yes	--
Subarea #8	0.42	0.00	0.40	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-10.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	19	12.8
Subarea #2	29	13.2
Subarea #3	28	12.8
Subarea #4	34	13.0
Subarea #5	16	13.0
Subarea #6	37	12.8
Subarea #~~6~~ 7	25	12.5
Subarea #8	15	12.5
Composite Watershed	174	12.8

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-10.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	1	1	1	1	1	2	2	3	6
Subarea #2	1	1	1	1	1	2	2	3	4
Subarea #3	1	1	1	1	2	2	4	6	11
Subarea #4	1	2	2	3	3	4	5	7	10
Subarea #5	0	1	1	1	1	1	2	3	4
Subarea #6	1	1	1	2	2	3	4	6	11
Subarea ~~#8~~ 7	1	1	2	3	4	6	10	16	23
Subarea #8	0	0	0	0	1	2	4	7	12
Total (cfs)	6	8	9	12	15	22	33	51	81

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	9	13	16	19	19	16	12	9	7
Subarea #2	7	11	15	20	27	29	26	21	17
Subarea #3	17	23	27	28	23	16	11	9	7
Subarea #4	14	19	25	30	34	32	26	21	16
Subarea #5	6	8	11	13	16	16	13	10	8
Subarea #6	18	27	34	37	36	29	21	16	13
Subarea ~~#8~~ 7	25	24	20	16	10	7	5	4	4
Subarea #8	15	14	13	11	7	5	4	3	3
Total (cfs)	111	139	161	174	172	150	118	93	75

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-10.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	6	5	4	4	3	3	2	2	2
Subarea #2	14	11	9	7	6	5	5	4	3
Subarea #3	6	5	5	4	4	3	3	2	2
Subarea #4	13	10	9	7	6	5	4	4	3
Subarea #5	7	5	4	4	3	3	2	2	2
Subarea #6	11	9	8	7	6	5	5	4	4
Subarea ~~#8~~ 7	4	3	3	3	2	2	2	1	1
Subarea #8	3	2	2	2	2	2	1	1	1
Total (cfs)	64	50	44	38	32	28	24	20	18

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	2	1	1	1	0
Subarea #2	3	2	2	2	0
Subarea #3	2	2	1	1	0
Subarea #4	3	2	2	2	0
Subarea #5	2	1	1	1	0
Subarea #6	3	3	2	2	0
Subarea ~~#8~~ 7	1	1	1	1	0
Subarea #8	1	1	1	1	0
Total (cfs)	17	13	11	11	0

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-10.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	6	14.8	41
11.1	7	14.9	39
11.2	7	15.0	38
11.3	8	15.1	37
11.4	8	15.2	36
11.5	9	15.3	34
11.6	9	15.4	33
11.7	10	15.5	32
11.8	11	15.6	31
11.9	12	15.7	30
12.0	15	15.8	30
12.1	22	15.9	29
12.2	33	16.0	28
12.3	51	16.1	27
12.4	81	16.2	26
12.5	111	16.3	26
12.6	139	16.4	25
12.7	161	16.5	24
12.8	174	16.6	23
12.9	173	16.7	22
13.0	172	16.8	22
13.1	161	16.9	21
13.2	150	17.0	20
13.3	134	17.1	20
13.4	118	17.2	19
13.5	106	17.3	19
13.6	93	17.4	18
13.7	84	17.5	18
13.8	75	17.6	18
13.9	69	17.7	18
14.0	64	17.8	17
14.1	59	17.9	17
14.2	55	18.0	17
14.3	50	18.1	17
14.4	48	18.2	16
14.5	46	18.3	16
14.6	44	18.4	15
14.7	43	18.5	15

Return Frequency: 10 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-10.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	15	22.4	10
18.7	14	22.5	10
18.8	14	22.6	9
18.9	13	22.7	9
19.0	13	22.8	9
19.1	13	22.9	9
19.2	13	23.0	8
19.3	12	23.1	8
19.4	12	23.2	8
19.5	12	23.3	7
19.6	12	23.4	7
19.7	12	23.5	7
19.8	11	23.6	7
19.9	11	23.7	6
20.0	11	23.8	6
20.1	11	23.9	6
20.2	11	24.0	6
20.3	11	24.1	5
20.4	11	24.2	5
20.5	11	24.3	5
20.6	11	24.4	4
20.7	11	24.5	4
20.8	11	24.6	4
20.9	11	24.7	4
21.0	11	24.8	3
21.1	11	24.9	3
21.2	11	25.0	3
21.3	11	25.1	2
21.4	11	25.2	2
21.5	11	25.3	2
21.6	11	25.4	2
21.7	11	25.5	1
21.8	11	25.6	1
21.9	11	25.7	1
22.0	11	25.8	1
22.1	11	25.9	0
22.2	10		
22.3	10		

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-25.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
Subarea #1	18.60	63.0	0.75	0.10	7.00	2.90	I.17	.17
Subarea #2	37.00	60.0	1.00	0.10	7.00	2.60	I.19	.19
Subarea #3	25.10	61.0	0.50	0.20	7.00	2.70	I.18	.18
Subarea #4	30.00	68.0	1.00	0.00	7.00	3.41	I.13	.13
Subarea #5	18.30	62.0	1.00	0.00	7.00	2.80	I.18	.18
Subarea #6	42.90	59.0	0.75	0.00	7.00	2.51	I.2	.20
Subarea #~~8~~ 7	13.70	69.0	0.40	0.00	7.00	3.51	I.13	.13
Subarea #8	15.80	55.0	0.40	0.00	7.00	2.12	I.23	.23

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 201.40 acres or 0.3147 sq.mi
Peak discharge = 240 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.66	0.14	0.75	0.10	Yes	--
Subarea #2	0.89	0.14	1.00	0.10	Yes	--
Subarea #3	0.59	0.11	0.50	0.20	Yes	--
Subarea #4	0.84	0.09	1.00	0.00	Yes	--
Subarea #5	0.88	0.06	1.00	0.00	Yes	--
Subarea #6	0.64	0.00	0.75	0.00	Yes	--
Subarea #~~8~~ 7	0.38	0.01	0.40	0.00	Yes	--
Subarea #8	0.42	0.00	0.40	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-25.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	26	12.8
Subarea #2	40	13.2
Subarea #3	38	12.8
Subarea #4	46	13.0
Subarea #5	22	13.0
Subarea #6	53	12.8
Subarea #6 7	33	12.5
Subarea #8	21	12.5
Composite Watershed	240	12.8

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-25.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	1	1	1	2	2	3	4	6	9
Subarea #2	1	1	2	2	3	3	4	5	7
Subarea #3	1	1	2	3	3	4	6	9	16
Subarea #4	2	3	3	4	5	6	7	10	14
Subarea #5	1	1	1	2	2	2	3	4	6
Subarea #6	1	2	2	3	4	5	7	11	18
Subarea ~~#6~~ 7	1	2	2	4	6	9	14	22	30
Subarea #8	0	1	1	1	2	3	6	12	18
Total (cfs)	8	12	14	21	27	35	51	79	118

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	13	18	23	26	26	21	15	12	9
Subarea #2	10	15	21	28	38	40	36	29	23
Subarea #3	24	32	37	38	32	22	15	11	9
Subarea #4	20	27	34	40	46	43	34	26	21
Subarea #5	8	12	15	19	22	21	17	13	11
Subarea #6	28	39	48	53	50	39	29	22	17
Subarea ~~#6~~ 7	33	31	26	21	12	8	6	5	5
Subarea #8	21	21	18	15	9	7	5	4	4
Total (cfs)	157	195	222	240	235	201	157	122	99

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-25.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	8	6	5	4	4	3	3	2	2
Subarea #2	19	14	12	9	8	7	6	5	4
Subarea #3	8	7	6	5	5	4	3	3	3
Subarea #4	17	13	11	9	7	6	5	4	4
Subarea #5	9	7	6	5	4	3	3	2	2
Subarea #6	15	12	11	9	8	7	6	5	5
Subarea ~~#6~~ 7	5	4	4	3	3	2	2	2	2
Subarea #8	4	3	3	3	2	2	2	2	1
Total (cfs)	85	66	58	47	41	34	30	25	23

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	2	2	1	1	0
Subarea #2	4	3	3	2	0
Subarea #3	2	2	2	1	0
Subarea #4	4	3	2	2	0
Subarea #5	2	2	1	1	0
Subarea #6	4	3	3	2	0
Subarea ~~#6~~ 7	1	1	1	1	0
Subarea #8	1	1	1	1	0
Total (cfs)	20	17	14	11	0

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-25.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	8	14.8	52
11.1	9	14.9	50
11.2	11	15.0	47
11.3	12	15.1	46
11.4	13	15.2	45
11.5	13	15.3	43
11.6	14	15.4	42
11.7	16	15.5	41
11.8	19	15.6	40
11.9	21	15.7	38
12.0	27	15.8	37
12.1	35	15.9	35
12.2	51	16.0	34
12.3	79	16.1	33
12.4	118	16.2	32
12.5	157	16.3	32
12.6	195	16.4	31
12.7	222	16.5	30
12.8	240	16.6	29
12.9	238	16.7	28
13.0	235	16.8	27
13.1	218	16.9	26
13.2	201	17.0	25
13.3	179	17.1	25
13.4	157	17.2	24
13.5	140	17.3	24
13.6	122	17.4	23
13.7	110	17.5	23
13.8	99	17.6	22
13.9	92	17.7	22
14.0	85	17.8	21
14.1	79	17.9	21
14.2	72	18.0	20
14.3	66	18.1	20
14.4	63	18.2	19
14.5	61	18.3	19
14.6	58	18.4	19
14.7	55	18.5	19

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-25.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	18	22.4	10
18.7	18	22.5	10
18.8	18	22.6	9
18.9	17	22.7	9
19.0	17	22.8	9
19.1	17	22.9	9
19.2	16	23.0	8
19.3	16	23.1	8
19.4	16	23.2	8
19.5	16	23.3	7
19.6	15	23.4	7
19.7	15	23.5	7
19.8	15	23.6	7
19.9	14	23.7	6
20.0	14	23.8	6
20.1	14	23.9	6
20.2	14	24.0	6
20.3	14	24.1	5
20.4	13	24.2	5
20.5	13	24.3	5
20.6	13	24.4	4
20.7	13	24.5	4
20.8	13	24.6	4
20.9	13	24.7	4
21.0	13	24.8	3
21.1	12	24.9	3
21.2	12	25.0	3
21.3	12	25.1	2
21.4	12	25.2	2
21.5	12	25.3	2
21.6	12	25.4	2
21.7	11	25.5	1
21.8	11	25.6	1
21.9	11	25.7	1
22.0	11	25.8	1
22.1	11	25.9	0
22.2	10		
22.3	10		

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-100.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
Subarea #1	18.60	63.0	0.75	0.10	9.00	4.47	I.13	.13
Subarea #2	37.00	60.0	1.00	0.10	9.00	4.10	I.15	.15
Subarea #3	25.10	61.0	0.50	0.20	9.00	4.22	I.14	.14
Subarea #4	30.00	68.0	1.00	0.00	9.00	5.09	I.1	.10
Subarea #5	18.30	62.0	1.00	0.00	9.00	4.35	I.14	.14
Subarea #6	42.90	59.0	0.75	0.00	9.00	3.98	I.15	.15
Subarea #~~6~~ 7	13.70	69.0	0.40	0.00	9.00	5.21	I.1	.10
Subarea #8	15.80	55.0	0.40	0.00	9.00	3.49	I.18	.18

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 201.40 acres or 0.3147 sq.mi
Peak discharge = 386 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.66	0.14	0.75	0.10	Yes	--
Subarea #2	0.89	0.14	1.00	0.10	Yes	--
Subarea #3	0.59	0.11	0.50	0.20	Yes	--
Subarea #4	0.84	0.09	1.00	0.00	No	Computed Ia/p < .1
Subarea #5	0.88	0.06	1.00	0.00	Yes	--
Subarea #6	0.64	0.00	0.75	0.00	Yes	--
Subarea #~~6~~ 7	0.38	0.01	0.40	0.00	No	Computed Ia/p < .1
Subarea #8	0.42	0.00	0.40	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-100.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	42	12.8
Subarea #2	66	13.2
Subarea #3	61	12.8
Subarea #4	71	13.0
Subarea #5	36	13.0
Subarea #6	88	12.8
Subarea ~~#8~~ 7	50	12.5
Subarea #8	36	12.5
Composite Watershed	386	12.8

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-100.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	2	2	3	4	5	6	7	10	15
Subarea #2	2	3	4	5	6	6	7	9	13
Subarea #3	2	3	4	5	6	8	11	16	25
Subarea #4	4	5	6	8	9	10	13	17	23
Subarea #5	1	2	2	3	4	4	5	7	10
Subarea #6	3	4	6	8	9	11	15	22	34
Subarea #~~6~~ 7	3	3	4	7	10	15	22	34	47
Subarea #8	1	1	2	3	5	8	13	22	32
Total (cfs)	18	23	31	43	54	68	93	137	199

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	22	31	37	42	41	32	23	17	13
Subarea #2	18	26	36	46	62	66	58	47	36
Subarea #3	38	51	59	61	51	35	24	17	14
Subarea #4	32	43	54	63	71	64	51	39	31
Subarea #5	15	20	26	31	36	33	27	21	16
Subarea #6	51	68	82	88	81	61	44	33	26
Subarea #~~6~~ 7	50	47	38	31	18	12	9	8	7
Subarea #8	36	35	30	24	15	10	8	7	6
Total (cfs)	262	321	362	386	375	313	244	189	149

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-100.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	11	9	8	6	6	5	4	3	3
Subarea #2	29	22	18	14	12	10	9	7	6
Subarea #3	12	10	9	8	7	6	5	4	4
Subarea #4	25	19	15	12	10	9	7	6	5
Subarea #5	13	10	8	7	6	5	4	4	3
Subarea #6	22	18	15	13	12	10	9	7	7
Subarea #7	6	6	5	5	4	3	3	2	2
Subarea #8	6	5	4	4	4	3	3	2	2
Total (cfs)	124	99	82	69	61	51	44	35	32

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	3	2	2	2	0
Subarea #2	6	5	4	3	0
Subarea #3	3	3	3	2	0
Subarea #4	5	4	3	3	0
Subarea #5	3	2	2	2	0
Subarea #6	6	5	4	3	0
Subarea #7	2	2	1	1	0
Subarea #8	2	2	1	1	0
Total (cfs)	30	25	20	17	0

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-100.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	18	14.8	75
11.1	20	14.9	72
11.2	21	15.0	69
11.3	23	15.1	67
11.4	26	15.2	66
11.5	28	15.3	64
11.6	31	15.4	63
11.7	35	15.5	61
11.8	39	15.6	59
11.9	43	15.7	57
12.0	54	15.8	55
12.1	68	15.9	53
12.2	93	16.0	51
12.3	137	16.1	50
12.4	199	16.2	48
12.5	262	16.3	47
12.6	321	16.4	45
12.7	362	16.5	44
12.8	386	16.6	42
12.9	381	16.7	40
13.0	375	16.8	39
13.1	344	16.9	37
13.2	313	17.0	35
13.3	278	17.1	34
13.4	244	17.2	34
13.5	217	17.3	33
13.6	189	17.4	33
13.7	169	17.5	32
13.8	149	17.6	32
13.9	136	17.7	31
14.0	124	17.8	31
14.1	116	17.9	30
14.2	107	18.0	30
14.3	99	18.1	30
14.4	93	18.2	29
14.5	88	18.3	29
14.6	82	18.4	28
14.7	79	18.5	28

Return Frequency: 100 years

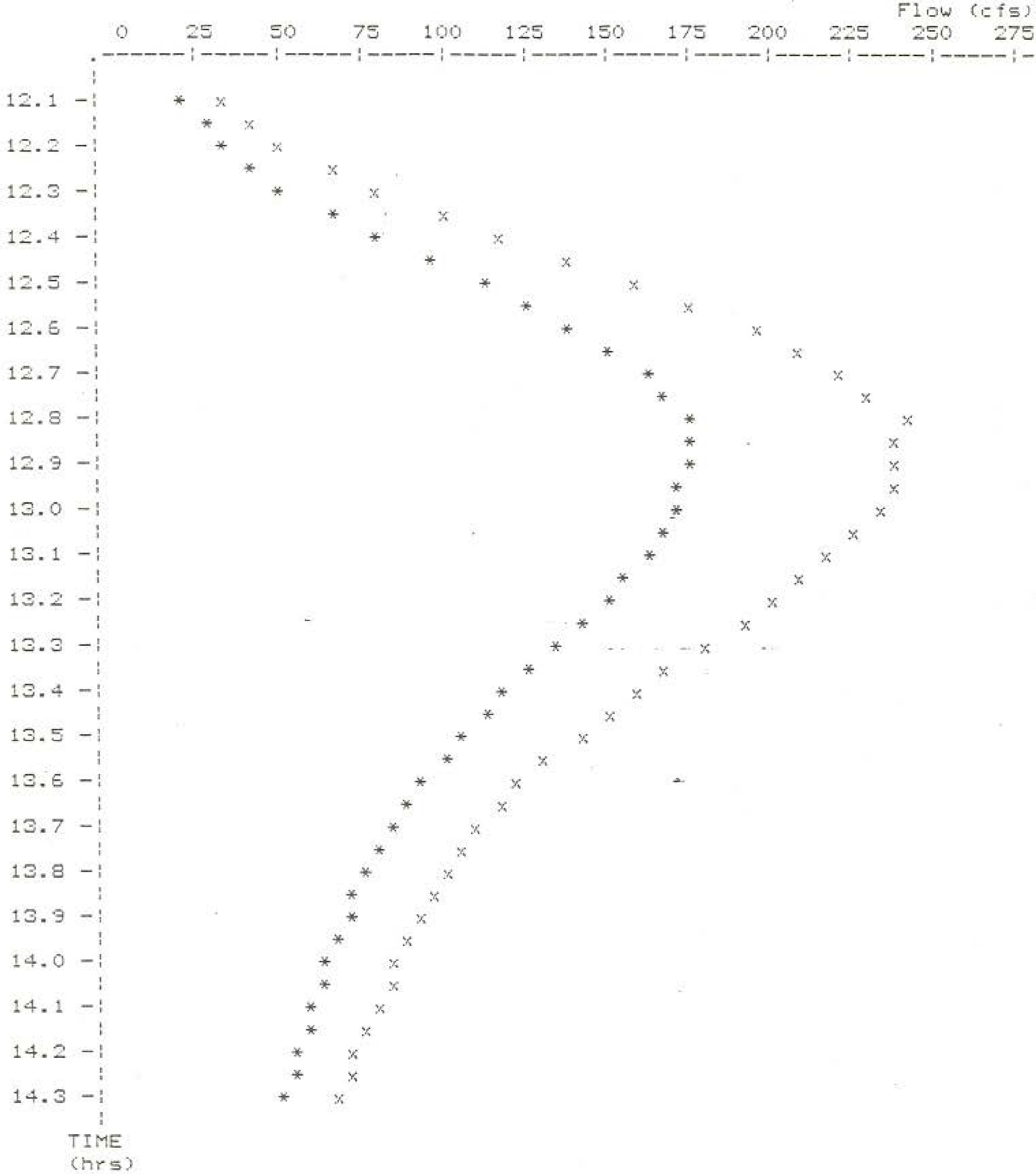
TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 12-20-1990 09:22:17
Watershed file: --> C:\HAESTAD\PONDPACK\APES .MOP
Hydrograph file: --> C:\HAESTAD\PONDPACK\APES-100.HYD

Apes Stormwater Project - City of Greenville
Developed Conditions

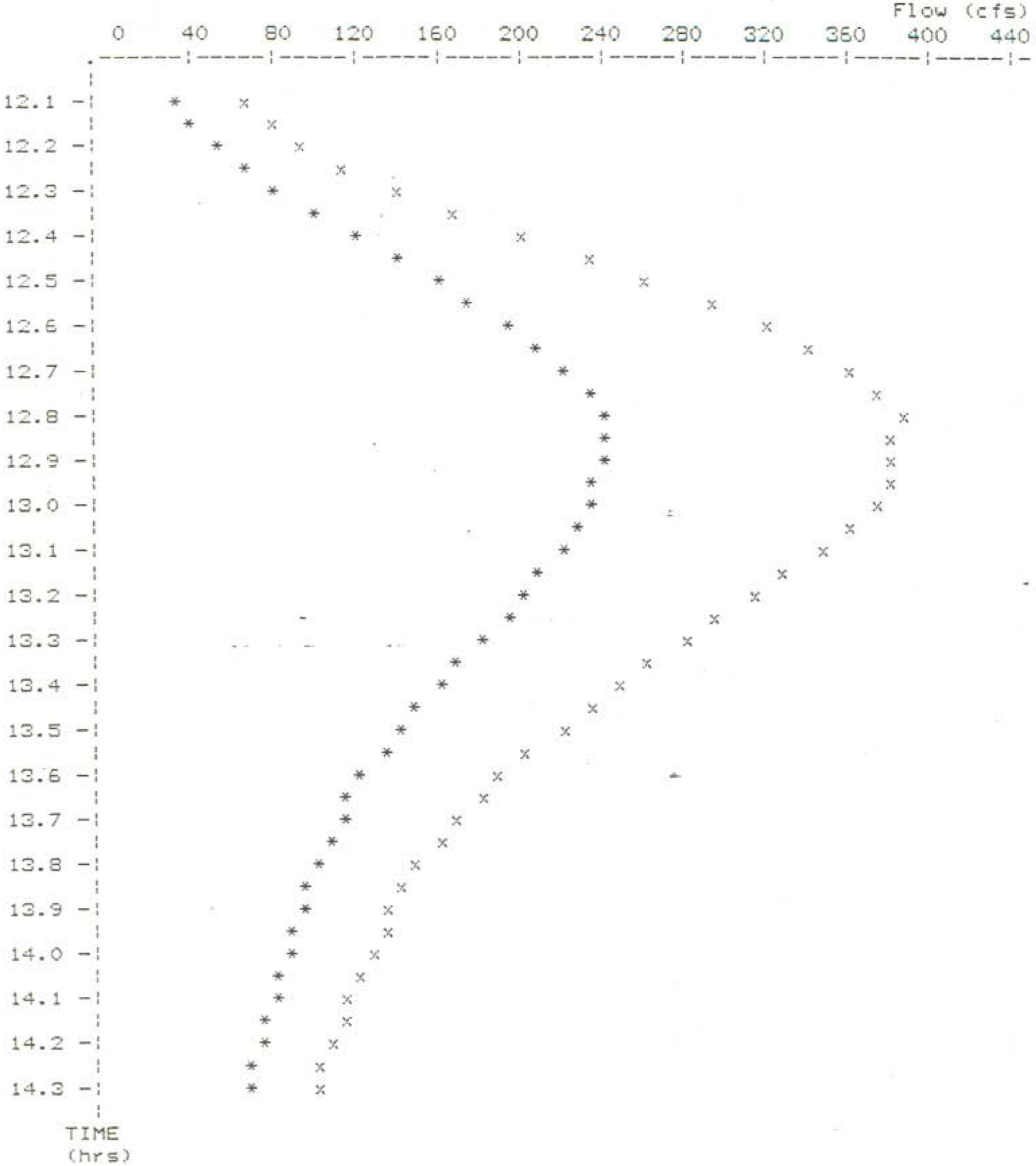
Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	27	22.4	15
18.7	27	22.5	15
18.8	26	22.6	14
18.9	26	22.7	14
19.0	25	22.8	14
19.1	25	22.9	13
19.2	24	23.0	13
19.3	24	23.1	12
19.4	23	23.2	12
19.5	23	23.3	11
19.6	22	23.4	11
19.7	22	23.5	11
19.8	21	23.6	10
19.9	21	23.7	10
20.0	20	23.8	9
20.1	20	23.9	9
20.2	20	24.0	9
20.3	20	24.1	8
20.4	19	24.2	8
20.5	19	24.3	7
20.6	19	24.4	7
20.7	19	24.5	6
20.8	19	24.6	6
20.9	19	24.7	6
21.0	19	24.8	5
21.1	18	24.9	5
21.2	18	25.0	4
21.3	18	25.1	4
21.4	18	25.2	3
21.5	18	25.3	3
21.6	18	25.4	3
21.7	17	25.5	2
21.8	17	25.6	2
21.9	17	25.7	1
22.0	17	25.8	1
22.1	17	25.9	0
22.2	16		
22.3	16		

Quick TR-55 Version: 5.44 S/N: 1315430018
Plotted: 12-20-1990 10:29:00



* File: c:\haestad\pondpack\APES-10 .HYD Qmax = 174.0 cfs
x File: c:\haestad\pondpack\APES-25 .HYD Qmax = 240.0 cfs

Quick TR-55 Version: 5.44 S/N: 1315430018
Plotted: 12-20-1990 10:26:30



* File: c:\haestad\pondpack\APES-25 .HYD Qmax = 240.0 cfs
x File: c:\haestad\pondpack\APES-100.HYD Qmax = 386.0 cfs

Quick TR-55 Ver.5.44 S/N:1315430018
Executed: 08:18:32 12-20-1990

Apes Stormwater Project
City of Greenville
Developed Condition CN's (8 Subareas)

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1/4 acre)	17.30	61	
Commercial	1.30	89	
COMPOSITE AREA --->	18.60	63.0	(63)

Composite Area: Subarea #2

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1/4 acre)	24.70	61	
Open, Fair Condition	9.50	49	
School	2.80	89	
COMPOSITE AREA --->	37.00	60.0	(60)

Composite Area: Subarea #3

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1/4 acre)	25.10	61	
COMPOSITE AREA --->	25.10	61.0	(61)

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Composite Area: Subarea #4

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1/4 acre)	20.70	61	
Commercial	7.80	89	
Open, Fair Condition	1.50	49	
COMPOSITE AREA --->	30.00	67.7	(68)

Composite Area: Subarea #5

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1/4 acre)	14.10	61	
Commercial	1.90	89	
Open, Fair Condition	2.30	49	
COMPOSITE AREA --->	18.30	62.4	(62)

Composite Area: Subarea #6

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1/4 acre)	32.00	61	
School	1.40	89	
Open, Fair Condition	9.50	49	
COMPOSITE AREA --->	42.90	59.3	(59)

Composite Area: Subarea #7

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1 acre)	7.20	51	
Commercial	6.50	89	
COMPOSITE AREA --->	13.70	69.0	(69)

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Composite Area: Subarea #8

SURFACE DESCRIPTION	AREA (acres)	CN	
Residential (1 acre)	14.10	51	
Commercial	1.70	89	
COMPOSITE AREA --->	15.80	55.1	(55)

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Apes Stormwater Project
City of Greenville
Developed Condition CN's (8 Subareas)

RUNOFF CURVE NUMBER SUMMARY

Subarea Description	Area (acres)	CN (weighted)
Subarea #1	18.60	63
Subarea #2	37.00	60
Subarea #3	25.10	61
Subarea #4	30.00	68
Subarea #5	18.30	62
Subarea #6	42.90	59
Subarea #7	13.70	69
Subarea #8	15.80	55

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Quick TR-55 Ver.5.44   S/N:1315430018
Executed: 08:03:01   12-20-1990    c:\haestad\pondpack\APES-10.TCT

              Apes Stormwater Project - City of Greenville
                 Developed Condition Tc's (8 Subareas)


                  Tc COMPUTATIONS FOR: Subarea #1

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                      A
     Surface description                       Short Grass
     Manning's roughness coeff., n                 0.1500
     Flow length, L (total < or = 300)    ft      150.0
     Two-yr 24-hr rainfall, P2            in      4.000
     Land slope, s                       ft/ft    0.0030
                            0.8
          .007 * (n*L)
     T =  --------------                  hrs      0.43              =  0.43
              0.5    0.4
            P2    *   s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                      B
     Surface (paved or unpaved)?                   Paved
     Flow length, L                       ft      550.0
     Watercourse slope, s                ft/ft    0.0015

                            0.5
     Avg.V =  Csf *  (s)                 ft/s    0.7873
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                     hrs      0.19              =  0.19

 CHANNEL FLOW
     Segment ID                                      C
     Cross Sectional Flow Area, a        sq.ft     3.14
     Wetted perimeter, Pw                 ft       6.28
     Hydraulic radius, r = a/Pw           ft      0.500
     Channel slope, s                    ft/ft    0.0040
     Manning's roughness coeff., n                0.0130

                      2/3     1/2
          1.49   *   r    *   s
     V =  --------------------           ft/s    4.5665
                      n

     Flow length, L                       ft        600

     T = L / (3600*V)                     hrs      0.04              =  0.04

     ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                               TOTAL TIME (hrs)        0.66
```

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Quick TR-55 Ver.5.44   S/N:1315430018
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              Apes Stormwater Project - City of Greenville
                 Developed Condition Tc's (8 Subareas)


                  Tc COMPUTATIONS FOR: Subarea #2

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                       A
     Surface description                        Short Grass
     Manning's roughness coeff., n                   0.1500
     Flow length, L (total < or = 300)     ft        225.0
     Two-yr 24-hr rainfall, P2             in        4.000
     Land slope, s                         ft/ft     0.0020
                        0.8
        .007 * (n*L)
     T = --------------                    hrs        0.70           =  0.70
             0.5    0.4
           P2   *  s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                        B
     Surface (paved or unpaved)?                     Paved
     Flow length, L                        ft        300.0
     Watercourse slope, s                  ft/ft     0.0017

                         0.5
     Avg.V =  Csf *  (s)                   ft/s      0.8382
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                      hrs        0.10           =  0.10


 CHANNEL FLOW
     Segment ID                                        C
     Cross Sectional Flow Area, a          sq.ft      3.14
     Wetted perimeter, Pw                  ft         6.28
     Hydraulic radius, r = a/Pw            ft        0.500
     Channel slope, s                      ft/ft     0.0025
     Manning's roughness coeff., n                   0.0130

                    2/3    1/2
        1.49  *  r    *  s
     V = --------------------              ft/s      3.6102
                    n

     Flow length, L                        ft         1200

     T = L / (3600*V)                      hrs        0.09           =  0.09

     ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                               TOTAL TIME (hrs)      0.89
```

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              Apes Stormwater Project - City of Greenville
                  Developed Condition Tc's (8 Subareas)


                    Tc COMPUTATIONS FOR: Subarea #3

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                       A
     Surface description                         Short Grass
     Manning's roughness coeff., n                    0.1500
     Flow length, L (total < or = 300)      ft        150.0
     Two-yr 24-hr rainfall, P2              in        4.000
     Land slope, s                          ft/ft     0.0050
                            0.8
          .007 * (n*L)
     T =  --------------                    hrs        0.35             =  0.35
               0.5    0.4
            P2     *  s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                       B
     Surface (paved or unpaved)?                       Paved
     Flow length, L                         ft        450.0
     Watercourse slope, s                   ft/ft     0.0010

                              0.5
     Avg.V =  Csf *  (s)                    ft/s      0.6428
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                       hrs        0.19             =  0.19

 CHANNEL FLOW
     Segment ID                                       C
     Cross Sectional Flow Area, a           sq.ft      1.77
     Wetted perimeter, Pw                   ft         4.71
     Hydraulic radius, r = a/Pw             ft        0.376
     Channel slope, s                       ft/ft     0.0060
     Manning's roughness coeff., n                    0.0130

                        2/3     1/2
          1.49   *  r    *  s
     V =  --------------------              ft/s      4.6233
                     n

     Flow length, L                         ft         750

     T = L / (3600*V)                       hrs        0.05             =  0.05

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                                                TOTAL TIME (hrs)       0.59
```

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Apes Stormwater Project - City of Greenville
Developed Condition Tc's (8 Subareas)

Tc COMPUTATIONS FOR: Subarea #4

SHEET FLOW (Applicable to Tc only)

Segment ID		A	
Surface description		Short Grass	
Manning's roughness coeff., n		0.1500	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	4.000	
Land slope, s	ft/ft	0.0026	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.80	= 0.80

SHALLOW CONCENTRATED FLOW

Segment ID		B	
Surface (paved or unpaved)?		Paved	
Flow length, L	ft	400.0	
Watercourse slope, s	ft/ft	0.0200	
Avg.V = $Csf * (s)^{0.5}$	ft/s	2.8748	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.04	= 0.04

CHANNEL FLOW

Segment ID		C	
Cross Sectional Flow Area, a	sq.ft	3.14	
Wetted perimeter, Pw	ft	6.28	
Hydraulic radius, r = a/Pw	ft	0.500	
Channel slope, s	ft/ft	0.0150	
Manning's roughness coeff., n		0.0130	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	8.8430	
Flow length, L	ft	225	
T = L / (3600*V)	hrs	0.01	= 0.01

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TOTAL TIME (hrs) 0.84

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              Apes Stormwater Project - City of Greenville
                 Developed Condition Tc's (8 Subareas)


                  Tc COMPUTATIONS FOR: Subarea #5

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                       A
     Surface description                         Short Grass
     Manning's roughness coeff., n                    0.1500
     Flow length, L (total < or = 300)      ft      200.0
     Two-yr 24-hr rainfall, P2              in      4.000
     Land slope, s                        ft/ft    0.0024
                             0.8
           .007 * (n*L)
     T =   --------------                  hrs       0.59                 =  0.59
              0.5     0.4
            P2    *   s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                       B
     Surface (paved or unpaved)?                       Paved
     Flow length, L                         ft      500.0
     Watercourse slope, s                 ft/ft    0.0010

                               0.5
     Avg.V =  Csf *   (s)                 ft/s    0.6428
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                      hrs       0.22                 =  0.22

 CHANNEL FLOW
     Segment ID                                       C
     Cross Sectional Flow Area, a         sq.ft      3.14
     Wetted perimeter, Pw                   ft       6.28
     Hydraulic radius, r = a/Pw             ft      0.500
     Channel slope, s                     ft/ft    0.0160
     Manning's roughness coeff., n                 0.0230

                          2/3     1/2
            1.49  *  r    *  s
     V =   --------------------           ft/s    5.1622
                     n

     Flow length, L                         ft       1350

     T = L / (3600*V)                      hrs       0.07                 =  0.07

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                                              TOTAL TIME (hrs)            0.88
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              Apes Stormwater Project - City of Greenville
                 Developed Condition Tc's (8 Subareas)


                  Tc COMPUTATIONS FOR: Subarea #6

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                        A
     Surface description                         Short Grass
     Manning's roughness coeff., n                    0.1500
     Flow length, L (total < or = 300)     ft        300.0
     Two-yr 24-hr rainfall, P2             in        4.000
     Land slope, s                         ft/ft    0.0080
                              0.8
          .007 * (n*L)
     T =  -------------                    hrs        0.51                 =   0.51
              0.5    0.4
            P2    *  s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                        B
     Surface (paved or unpaved)?                     Paved
     Flow length, L                        ft        500.0
     Watercourse slope, s                  ft/ft    0.0060

                              0.5
     Avg.V =  Csf *  (s)                   ft/s     1.5746
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                      hrs        0.09                 =   0.09

 CHANNEL FLOW
     Segment ID                                        C
     Cross Sectional Flow Area, a          sq.ft      3.14
     Wetted perimeter, Pw                  ft         6.28
     Hydraulic radius, r = a/Pw            ft        0.500
     Channel slope, s                      ft/ft    0.0170
     Manning's roughness coeff., n                  0.0130

                         2/3    1/2
          1.49  *  r    *  s
     V =  --------------------             ft/s     9.4141
                    n

     Flow length, L                        ft         1350

     T = L / (3600*V)                      hrs        0.04                 =   0.04

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                                                 TOTAL TIME (hrs)          0.64
```

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              Apes Stormwater Project - City of Greenville
                  Developed Condition Tc's (8 Subareas)


                    Tc COMPUTATIONS FOR: Subarea #7

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                      A
     Surface description                       Short Grass
     Manning's roughness coeff., n                  0.1500
     Flow length, L (total < or = 300)     ft      200.0
     Two-yr 24-hr rainfall, P2             in      4.000
     Land slope, s                        ft/ft   0.0200
                           0.8
          .007 * (n*L)
     T =  -------------                   hrs      0.25              =  0.25
             0.5    0.4
           P2    *  s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                      B
     Surface (paved or unpaved)?                   Paved
     Flow length, L                        ft      600.0
     Watercourse slope, s                 ft/ft   0.0200

                            0.5
     Avg.V =  Csf *  (s)                  ft/s   2.8748
     where:   Unpaved Csf = 16.1345
              Paved   Csf = 20.3282

     T = L / (3600*V)                     hrs      0.06              =  0.06


 CHANNEL FLOW
     Segment ID                                      C
     Cross Sectional Flow Area, a        sq.ft     1.77
     Wetted perimeter, Pw                  ft      4.71
     Hydraulic radius, r = a/Pw            ft     0.376
     Channel slope, s                     ft/ft   0.0200
     Manning's roughness coeff., n                0.0230

                         2/3     1/2
          1.49  *  r   *  s
     V =  --------------------            ft/s   4.7710
                    n

     Flow length, L                        ft      1100

     T = L / (3600*V)                     hrs      0.06              =  0.06

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                                               TOTAL TIME (hrs)      0.38
```

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Quick TR-55 Ver.5.44   S/N:1315430018
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              Apes Stormwater Project - City of Greenville
                 Developed Condition Tc's (8 Subareas)


                    Tc COMPUTATIONS FOR: Subarea #8

 SHEET FLOW (Applicable to Tc only)
     Segment ID                                     A
     Surface description                       Short Grass
     Manning's roughness coeff., n                  0.1500
     Flow length, L (total < or = 300)     ft       300.0
     Two-yr 24-hr rainfall, P2             in       4.000
     Land slope, s                        ft/ft     0.0200
                           0.8
          .007 * (n*L)
     T =  --------------                  hrs       0.35                 =  0.35
              0.5    0.4
            P2    *  s

 SHALLOW CONCENTRATED FLOW
     Segment ID                                     B
     Surface (paved or unpaved)?                    Paved
     Flow length, L                        ft       300.0
     Watercourse slope, s                 ft/ft     0.0200

                             0.5
     Avg.V =   Csf *   (s)                ft/s      2.8748
     where:    Unpaved Csf = 16.1345
               Paved   Csf = 20.3282

     T = L / (3600*V)                     hrs       0.03                 =  0.03


 CHANNEL FLOW
     Segment ID                                     C
     Cross Sectional Flow Area, a         sq.ft     3.14
     Wetted perimeter, Pw                  ft       6.28
     Hydraulic radius, r = a/Pw            ft       0.500
     Channel slope, s                     ft/ft     0.0080
     Manning's roughness coeff., n                  0.0130

                        2/3     1/2
          1.49   *   r    *   s
     V =  --------------------            ft/s      6.4580
                   n

     Flow length, L                        ft       900

     T = L / (3600*V)                     hrs       0.04                 =  0.04

    ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                   TOTAL TIME (hrs)         0.42
```

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Apes Stormwater Project - City of Greenville
Developed Condition Tc's (8 Subareas)

Subarea descr.	Tc or Tt	Time (hrs)
Subarea #1	Tc	0.66
Subarea #2	Tc	0.89
Subarea #3	Tc	0.59
Subarea #4	Tc	0.84
Subarea #5	Tc	0.88
Subarea #6	Tc	0.64
Subarea #7	Tc	0.38
Subarea #8	Tc	0.42

Quick TR-55 Ver.5.44 S/N:1315430018
Executed: 08:07:25 12-20-1990

Apes Stormwater Project - City of Greenville
Developed Condition Tt's (8 Subareas)

Tc or Tt DATA

::

Subarea: Subarea #1 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
42" CMP from node 0 to node 1	300	9.90	0.5	=	0.01
42" CMP from node 1 to node 4	910	5.60	2.7	=	0.05
42" CMP from node 4 to node 5	575	8.00	1.2	=	0.02
48" CMP from node 5 to node 6	200	9.60	0.3	=	0.01
42" CMP from node 6 to node 7	880	5.90	2.5	=	0.04
42" CM/RCP from node 7 to node 8	200	5.70	0.6	=	0.01
42" RCP from node 8 to node 9	275	12.40	0.4	=	0.01
42" RCP from node 9 to node 10	55	6.70	0.1	=	0.00
42" CMP from node 10 to node 11	40	15.50	0.0	=	0.00

	minutes		hours
TOTAL Tt --->	8.4	=	0.14

::::::::::::::::::::::::::::::::::::

Subarea: Subarea #2 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
42" CMP from node 0 to node 1	300	9.90	0.5	=	0.01
42" CMP from node 1 to node 4	910	5.60	2.7	=	0.05
42" CMP from node 4 to node 5	575	8.00	1.2	=	0.02
48" CMP from node 5 to node 6	200	9.60	0.3	=	0.01
42" CMP from node 6 to node 7	880	5.90	2.5	=	0.04
42" CM/RCP from node 7 to node 8	200	5.70	0.6	=	0.01
42" RCP from node 8 to node 9	275	12.40	0.4	=	0.01
42" RCP from node 9 to node 10	55	6.70	0.1	=	0.00
42" CMP from node 10 to node 11	40	15.50	0.0	=	0.00

	minutes		hours
TOTAL Tt --->	8.4	=	0.14

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Quick TR-55 Ver.5.44 S/N:1315430018
Executed: 08:07:25 12-20-1990

Subarea: Subarea #3 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
42" CMP from node 3 to node 4	450	5.60	1.3	=	0.02
42" CMP from node 4 to node 5	575	8.00	1.2	=	0.02
48" CMP from node 5 to node 6	200	9.60	0.3	=	0.01
42" CMP from node 6 to node 7	880	5.90	2.5	=	0.04
42" CM/RCP from node 7 to node 8	200	5.70	0.6	=	0.01
42" RCP from node 8 to node 9	275	12.40	0.4	=	0.01
42" RCP from node 9 to node 10	55	6.70	0.1	=	0.00
42" CMP from node 10 to node 11	40	15.50	0.0	=	0.00

	minutes		hours
TOTAL Tt --->	6.5	=	0.11

Subarea: Subarea #4 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
42" CMP from node 4 to node 5	575	8.00	1.2	=	0.02
48" CMP from node 5 to node 6	200	9.60	0.3	=	0.01
42" CMP from node 6 to node 7	880	5.90	2.5	=	0.04
42" CM/RCP from node 7 to node 8	200	5.70	0.6	=	0.01
42" RCP from node 8 to node 9	275	12.40	0.4	=	0.01
42" RCP from node 9 to node 10	55	6.70	0.1	=	0.00
42" CMP from node 10 to node 11	40	15.50	0.0	=	0.00

	minutes		hours
TOTAL Tt --->	5.2	=	0.09

Subarea: Subarea #5 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
42" CMP from node 6 to node 7	880	5.90	2.5	=	0.04
42" CM/RCP from node 7 to node 8	200	5.70	0.6	=	0.01
42" RCP from node 8 to node 9	275	12.40	0.4	=	0.01
42" RCP from node 9 to node 10	55	6.70	0.1	=	0.00
42" CMP from node 10 to node 11	40	15.50	0.0	=	0.00

	minutes		hours
TOTAL Tt --->	3.6	=	0.06

Quick TR-55 Ver.5.44 S/N:1315430018
Executed: 08:07:25 12-20-1990

Subarea: Subarea #6 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
Outfalls at design point	0	0.00	0.0	=	0.00
		TOTAL Tt --->	0.0	=	0.00

Subarea: Subarea #7 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
42" RCP from node 8 to node 9	275	12.40	0.4	=	0.01
42" RCP from node 9 to node 10	55	6.70	0.1	=	0.00
42" CMP from node 10 to node 11	40	15.50	0.0	=	0.00
		TOTAL Tt --->	0.5	=	0.01

Subarea: Subarea #8 DESCRIPTION	LENGTH (feet)	VELOCITY (ft/sec)	TIME minutes		TIME hours
Outfalls at design point	0	0.00	0.0	=	0.00
		TOTAL Tt --->	0.0	=	0.00

Quick TR-55 Ver.5.44 S/N:1315430018
Executed: 08:07:25 12-20-1990

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using Length/Velocity)

Apes Stormwater Project - City of Greenville
Developed Condition Tt's (8 Subareas)

Subarea descr.	Tc or Tt	Time (hrs)
Subarea #1	Tt	0.14
Subarea #2	Tt	0.14
Subarea #3	Tt	0.11
Subarea #4	Tt	0.09
Subarea #5	Tt	0.06
Subarea #6	Tt	0.00
Subarea #7	Tt	0.01
Subarea #8	Tt	0.00

APPENDIX B

STORM ROUTINGS

APES STORMWATER PROJECT

CITY OF GREENVILLE, N.C.

MAY 8, 1991

McKim & Creed Engineers, P.A.
201-C Fire Tower Road
P. O. Box 3371
Greenville, NC 27836

NORTH CAROLINA
PROFESSIONAL
SEAL
15764
ENGINEER
JAMES A. BYRD
5.8.91

McKIM&CREED

APES Stormwater Project - City of Greenville

TWO-YEAR STORM EVENT

Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Rating Table file: c:\haestad\pondpack\APESORF .PND

----INITIAL CONDITIONS----
Elevation = 13.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA / INTERMEDIATE ROUTING COMPUTATIONS

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + O (cfs)
13.00	0.0	0.000	0.0	0.0
14.00	0.9	0.040	3.9	4.8
14.25	1.0	0.078	7.5	8.5
14.50	1.1	0.132	12.8	13.9
14.75	1.2	0.207	20.0	21.2
15.00	1.3	0.305	29.5	30.8
15.25	1.4	0.429	41.5	42.9
15.50	1.4	0.583	56.4	57.8
15.75	1.5	0.769	74.5	76.0
16.00	1.6	0.992	96.0	97.6
16.25	1.6	1.240	120.0	121.6
16.50	1.7	1.499	145.1	146.8
16.75	1.8	1.770	171.3	173.1
17.00	1.8	2.053	198.7	200.5
17.25	1.9	2.349	227.4	229.3
17.50	1.9	2.658	257.3	259.2
17.75	2.0	2.980	288.4	290.4
18.00	2.0	3.315	320.9	322.9
18.25	2.1	3.659	354.2	356.3
18.50	2.1	4.008	387.9	390.0
18.75	2.2	4.361	422.2	424.4
19.00	2.2	4.720	456.9	459.1
19.25	2.3	5.083	492.0	494.3
19.50	2.3	5.451	527.7	530.0
19.75	2.4	5.824	563.7	566.1
20.00	2.4	6.202	600.3	602.7
20.25	2.5	6.584	637.4	639.9
20.50	2.5	6.972	674.9	677.4
20.75	2.5	7.364	712.9	715.4
21.00	2.6	7.762	751.3	753.9
21.25	19.6	8.164	790.3	809.9

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
21.50	50.8	8.572	829.8	880.6
21.75	91.0	8.984	869.7	960.7
22.00	138.5	9.402	910.1	1048.6
22.25	192.3	9.825	951.0	1143.3
22.50	251.6	10.252	992.4	1244.0
22.75	316.1	10.685	1034.3	1350.4
23.00	385.1	11.123	1076.7	1461.8

Time increment (t) = 0.250 hrs.

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	0.00	-----	0.0	0.0	0.00	13.00
11.250	0.00	0.0	0.0	0.0	0.00	13.00
11.500	0.00	0.0	0.0	0.0	0.00	13.00
11.750	1.00	1.0	0.6	1.0	0.19	13.21
12.000	2.00	3.0	2.3	3.6	0.68	13.76
12.250	9.50	11.5	11.6	13.8	1.10	14.49
12.500	36.00	45.5	54.3	57.1	1.40	15.49
12.750	59.50	95.5	146.3	149.8	1.71	16.53
13.000	65.00	124.5	267.0	270.8	1.94	17.59
13.250	55.50	120.5	383.3	387.5	2.10	18.48
13.500	44.00	99.5	478.2	482.8	2.27	19.17
13.750	33.00	77.0	550.5	555.2	2.37	19.67
14.000	28.00	61.0	606.6	611.5	2.42	20.06
14.250	23.00	51.0	652.6	657.6	2.50	20.37
14.500	21.00	44.0	691.6	696.6	2.50	20.63
14.750	20.00	41.0	727.6	732.6	2.54	20.86
15.000	18.00	38.0	753.3	765.6	6.13	21.05
15.250	17.00	35.0	762.2	788.3	13.04	21.15
15.500	16.00	33.0	764.9	795.2	15.14	21.18
15.750	15.00	31.0	765.2	795.9	15.36	21.19
16.000	14.00	29.0	764.6	794.2	14.84	21.18
16.250	12.50	26.5	763.3	791.1	13.87	21.17
16.500	11.00	23.5	761.6	786.8	12.58	21.15
16.750	11.00	22.0	760.4	783.6	11.62	21.13
17.000	11.00	22.0	759.9	782.4	11.24	21.13
17.250	10.50	21.5	759.5	781.4	10.94	21.12
17.500	10.00	20.5	759.0	780.0	10.52	21.12
17.750	9.50	19.5	758.4	778.5	10.05	21.11
18.000	9.00	18.5	757.7	776.9	9.57	21.10
18.250	8.50	17.5	757.1	775.2	9.07	21.10
18.500	8.00	16.5	756.5	773.6	8.57	21.09
18.750	7.50	15.5	755.8	772.0	8.07	21.08
19.000	7.00	14.5	755.2	770.3	7.57	21.07
19.250	7.00	14.0	754.7	769.2	7.22	21.07
19.500	6.00	13.0	754.1	767.7	6.78	21.06
19.750	6.00	12.0	753.5	766.1	6.31	21.05
20.000	6.00	12.0	753.3	765.5	6.12	21.05
20.250	6.00	12.0	753.2	765.3	6.05	21.05
20.500	6.00	12.0	753.2	765.2	6.02	21.05
20.750	5.00	11.0	752.8	764.2	5.70	21.05
21.000	5.00	10.0	752.2	762.8	5.28	21.04
21.250	5.00	10.0	752.0	762.2	5.11	21.04
21.500	4.00	9.0	751.5	761.0	4.74	21.03
21.750	4.00	8.0	750.9	759.5	4.29	21.02
22.000	4.00	8.0	750.7	758.9	4.11	21.02

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH / ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
22.250	4.00	8.0	750.6	758.7	4.04	21.02
22.500	4.00	8.0	750.6	758.6	4.02	21.02
22.750	3.00	7.0	750.2	757.6	3.70	21.02
23.000	3.00	6.0	749.6	756.2	3.28	21.01
23.250	3.00	6.0	749.4	755.6	3.11	21.01
23.500	2.00	5.0	748.9	754.4	2.74	21.00
23.750	2.00	4.0	747.7	752.9	2.60	20.99
24.000	2.00	4.0	746.5	751.7	2.59	20.99
24.250	2.00	4.0	745.4	750.5	2.59	20.98
24.500	2.00	4.0	744.2	749.4	2.59	20.97
24.750	1.00	3.0	742.0	747.2	2.58	20.96
25.000	1.00	2.0	738.9	744.0	2.57	20.94
25.250	1.00	2.0	735.7	740.9	2.57	20.92
25.500	0.00	1.0	731.6	736.7	2.56	20.89
25.750	0.00	0.0	726.5	731.6	2.54	20.86
26.000	0.00	0.0	721.5	726.5	2.53	20.82
26.250	0.00	0.0	716.5	721.5	2.52	20.79
26.500	0.00	0.0	711.4	716.5	2.50	20.76
26.750	0.00	0.0	706.4	711.4	2.50	20.72
27.000	0.00	0.0	701.4	706.4	2.50	20.69
27.250	0.00	0.0	696.4	701.4	2.50	20.66
27.500	0.00	0.0	691.4	696.4	2.50	20.63
27.750	0.00	0.0	686.4	691.4	2.50	20.59
28.000	0.00	0.0	681.4	686.4	2.50	20.56
28.250	0.00	0.0	676.4	681.4	2.50	20.53
28.500	0.00	0.0	671.4	676.4	2.50	20.49
28.750	0.00	0.0	666.4	671.4	2.50	20.46
29.000	0.00	0.0	661.4	666.4	2.50	20.43
29.250	0.00	0.0	656.4	661.4	2.50	20.39
29.500	0.00	0.0	651.4	656.4	2.50	20.36
29.750	0.00	0.0	646.4	651.4	2.50	20.33
30.000	0.00	0.0	641.4	646.4	2.50	20.29
30.250	0.00	0.0	636.4	641.4	2.50	20.26
30.500	0.00	0.0	631.5	636.4	2.49	20.23
30.750	0.00	0.0	626.5	631.5	2.48	20.19
31.000	0.00	0.0	621.6	626.5	2.46	20.16
31.250	0.00	0.0	616.7	621.6	2.45	20.13
31.500	0.00	0.0	611.8	616.7	2.44	20.09
31.750	0.00	0.0	607.0	611.8	2.42	20.06
32.000	0.00	0.0	602.1	607.0	2.41	20.03
32.250	0.00	0.0	597.3	602.1	2.40	20.00
32.500	0.00	0.0	592.5	597.3	2.40	19.96
32.750	0.00	0.0	587.7	592.5	2.40	19.93
33.000	0.00	0.0	582.9	587.7	2.40	19.90
33.250	0.00	0.0	578.1	582.9	2.40	19.86
33.500	0.00	0.0	573.3	578.1	2.40	19.83

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
33.750	0.00	0.0	568.5	573.3	2.40	19.80
34.000	0.00	0.0	563.7	568.5	2.40	19.77
34.250	0.00	0.0	558.9	563.7	2.39	19.73
34.500	0.00	0.0	554.2	558.9	2.38	19.70
34.750	0.00	0.0	549.5	554.2	2.37	19.67
35.000	0.00	0.0	544.7	549.5	2.35	19.63
35.250	0.00	0.0	540.1	544.7	2.34	19.60
35.500	0.00	0.0	535.4	540.1	2.33	19.57
35.750	0.00	0.0	530.8	535.4	2.32	19.54
36.000	0.00	0.0	526.2	530.8	2.30	19.51
36.250	0.00	0.0	521.6	526.2	2.30	19.47
36.500	0.00	0.0	517.0	521.6	2.30	19.44
36.750	0.00	0.0	512.4	517.0	2.30	19.41
37.000	0.00	0.0	507.8	512.4	2.30	19.38
37.250	0.00	0.0	503.2	507.8	2.30	19.34
37.500	0.00	0.0	498.6	503.2	2.30	19.31
37.750	0.00	0.0	494.0	498.6	2.30	19.28
38.000	0.00	0.0	489.4	494.0	2.30	19.25
38.250	0.00	0.0	484.8	489.4	2.29	19.21
38.500	0.00	0.0	480.3	484.8	2.27	19.18
38.750	0.00	0.0	475.7	480.3	2.26	19.15
39.000	0.00	0.0	471.2	475.7	2.25	19.12
39.250	0.00	0.0	466.8	471.2	2.23	19.09
39.500	0.00	0.0	462.3	466.8	2.22	19.05
39.750	0.00	0.0	457.9	462.3	2.21	19.02
40.000	0.00	0.0	453.5	457.9	2.20	18.99
40.250	0.00	0.0	449.1	453.5	2.20	18.96
40.500	0.00	0.0	444.7	449.1	2.20	18.93
40.750	0.00	0.0	440.3	444.7	2.20	18.90
41.000	0.00	0.0	435.9	440.3	2.20	18.86
41.250	0.00	0.0	431.5	435.9	2.20	18.83
41.500	0.00	0.0	427.1	431.5	2.20	18.80
41.750	0.00	0.0	422.7	427.1	2.20	18.77
42.000	0.00	0.0	418.3	422.7	2.20	18.74
42.250	0.00	0.0	414.0	418.3	2.18	18.71
42.500	0.00	0.0	409.6	414.0	2.17	18.67
42.750	0.00	0.0	405.3	409.6	2.16	18.64
43.000	0.00	0.0	401.0	405.3	2.14	18.61
43.250	0.00	0.0	396.7	401.0	2.13	18.58
43.500	0.00	0.0	392.5	396.7	2.12	18.55
43.750	0.00	0.0	388.3	392.5	2.11	18.52
44.000	0.00	0.0	384.1	388.3	2.10	18.49
44.250	0.00	0.0	379.9	384.1	2.10	18.46
44.500	0.00	0.0	375.7	379.9	2.10	18.42
44.750	0.00	0.0	371.5	375.7	2.10	18.39
45.000	0.00	0.0	367.3	371.5	2.10	18.36

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH | ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
45.250	0.00	0.0	363.1	367.3	2.10	18.33
45.500	0.00	0.0	358.9	363.1	2.10	18.30
45.750	0.00	0.0	354.7	358.9	2.10	18.27
46.000	0.00	0.0	350.5	354.7	2.10	18.24
46.250	0.00	0.0	346.3	350.5	2.08	18.21
46.500	0.00	0.0	342.2	346.3	2.07	18.18
46.750	0.00	0.0	338.1	342.2	2.06	18.14
47.000	0.00	0.0	334.0	338.1	2.05	18.11
47.250	0.00	0.0	329.9	334.0	2.03	18.08
47.500	0.00	0.0	325.9	329.9	2.02	18.05
47.750	0.00	0.0	321.9	325.9	2.01	18.02
48.000	0.00	0.0	317.9	321.9	2.00	17.99
48.250	0.00	0.0	313.9	317.9	2.00	17.96
48.500	0.00	0.0	309.9	313.9	2.00	17.93
48.750	0.00	0.0	305.9	309.9	2.00	17.90
49.000	0.00	0.0	301.9	305.9	2.00	17.87
49.250	0.00	0.0	297.9	301.9	2.00	17.84
49.500	0.00	0.0	293.9	297.9	2.00	17.81
49.750	0.00	0.0	289.9	293.9	2.00	17.78
50.000	0.00	0.0	285.9	289.9	2.00	17.75
50.250	0.00	0.0	281.9	285.9	1.99	17.71
50.500	0.00	0.0	278.0	281.9	1.97	17.68
50.750	0.00	0.0	274.0	278.0	1.96	17.65
51.000	0.00	0.0	270.1	274.0	1.95	17.62
51.250	0.00	0.0	266.3	270.1	1.94	17.59
51.500	0.00	0.0	262.4	266.3	1.92	17.56
51.750	0.00	0.0	258.6	262.4	1.91	17.53
52.000	0.00	0.0	254.8	258.6	1.90	17.50
52.250	0.00	0.0	251.0	254.8	1.90	17.46
52.500	0.00	0.0	247.2	251.0	1.90	17.43
52.750	0.00	0.0	243.4	247.2	1.90	17.40
53.000	0.00	0.0	239.6	243.4	1.90	17.37
53.250	0.00	0.0	235.8	239.6	1.90	17.34
53.500	0.00	0.0	232.0	235.8	1.90	17.30
53.750	0.00	0.0	228.2	232.0	1.90	17.27
54.000	0.00	0.0	224.4	228.2	1.90	17.24
54.250	0.00	0.0	220.6	224.4	1.88	17.21
54.500	0.00	0.0	216.9	220.6	1.87	17.17
54.750	0.00	0.0	213.2	216.9	1.86	17.14
55.000	0.00	0.0	209.5	213.2	1.84	17.11
55.250	0.00	0.0	205.8	209.5	1.83	17.08
55.500	0.00	0.0	202.2	205.8	1.82	17.05
55.750	0.00	0.0	198.6	202.2	1.81	17.01
56.000	0.00	0.0	195.0	198.6	1.80	16.98
56.250	0.00	0.0	191.4	195.0	1.80	16.95
56.500	0.00	0.0	187.8	191.4	1.80	16.92

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
56.750	0.00	0.0	184.2	187.8	1.80	16.88
57.000	0.00	0.0	180.6	184.2	1.80	16.85
57.250	0.00	0.0	177.0	180.6	1.80	16.82
57.500	0.00	0.0	173.4	177.0	1.80	16.79
57.750	0.00	0.0	169.8	173.4	1.80	16.75
58.000	0.00	0.0	166.2	169.8	1.79	16.72
58.250	0.00	0.0	162.7	166.2	1.77	16.68
58.500	0.00	0.0	159.1	162.7	1.76	16.65
58.750	0.00	0.0	155.7	159.1	1.75	16.62
59.000	0.00	0.0	152.2	155.7	1.73	16.58
59.250	0.00	0.0	148.7	152.2	1.72	16.55
59.500	0.00	0.0	145.3	148.7	1.71	16.52
59.750	0.00	0.0	141.9	145.3	1.69	16.49
60.000	0.00	0.0	138.6	141.9	1.68	16.45
60.250	0.00	0.0	135.2	138.6	1.67	16.42
60.500	0.00	0.0	131.9	135.2	1.65	16.39
60.750	0.00	0.0	128.7	131.9	1.64	16.35
61.000	0.00	0.0	125.4	128.7	1.63	16.32
61.250	0.00	0.0	122.2	125.4	1.62	16.29
61.500	0.00	0.0	119.0	122.2	1.60	16.26
61.750	0.00	0.0	115.8	119.0	1.60	16.22
62.000	0.00	0.0	112.6	115.8	1.60	16.19
62.250	0.00	0.0	109.4	112.6	1.60	16.16
62.500	0.00	0.0	106.2	109.4	1.60	16.12
62.750	0.00	0.0	103.0	106.2	1.60	16.09
63.000	0.00	0.0	99.8	103.0	1.60	16.06
63.250	0.00	0.0	96.6	99.8	1.60	16.02
63.500	0.00	0.0	93.4	96.6	1.60	15.99
63.750	0.00	0.0	90.2	93.4	1.58	15.95
64.000	0.00	0.0	87.1	90.2	1.57	15.91
64.250	0.00	0.0	84.0	87.1	1.55	15.88
64.500	0.00	0.0	80.9	84.0	1.54	15.84
64.750	0.00	0.0	77.9	80.9	1.52	15.81
65.000	0.00	0.0	74.8	77.9	1.51	15.77
65.250	0.00	0.0	71.9	74.8	1.49	15.73
65.500	0.00	0.0	68.9	71.9	1.48	15.69
65.750	0.00	0.0	66.0	68.9	1.46	15.65
66.000	0.00	0.0	63.1	66.0	1.44	15.61
66.250	0.00	0.0	60.2	63.1	1.43	15.57
66.500	0.00	0.0	57.4	60.2	1.41	15.53
66.750	0.00	0.0	54.6	57.4	1.40	15.49
67.000	0.00	0.0	51.8	54.6	1.40	15.45
67.250	0.00	0.0	49.0	51.8	1.40	15.40
67.500	0.00	0.0	46.2	49.0	1.40	15.35
67.750	0.00	0.0	43.4	46.2	1.40	15.31
68.000	0.00	0.0	40.6	43.4	1.40	15.26

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH / ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
68.250	0.00	0.0	37.8	40.6	1.38	15.20
68.500	0.00	0.0	35.1	37.8	1.36	15.15
68.750	0.00	0.0	32.5	35.1	1.34	15.09
69.000	0.00	0.0	29.8	32.5	1.31	15.03
69.250	0.00	0.0	27.2	29.8	1.29	14.98
69.500	0.00	0.0	24.7	27.2	1.26	14.91
69.750	0.00	0.0	22.2	24.7	1.24	14.84
70.000	0.00	0.0	19.8	22.2	1.21	14.78
70.250	0.00	0.0	17.5	19.8	1.18	14.70
70.500	0.00	0.0	15.2	17.5	1.15	14.62
70.750	0.00	0.0	12.9	15.2	1.12	14.54
71.000	0.00	0.0	10.8	12.9	1.08	14.46
71.250	0.00	0.0	8.7	10.8	1.04	14.35
71.500	0.00	0.0	6.7	8.7	1.00	14.26
71.750	0.00	0.0	4.8	6.7	0.95	14.13
72.000	0.00	0.0	3.0	4.8	0.90	14.00
72.250	0.00	0.0	1.9	3.0	0.56	13.62
72.500	0.00	0.0	1.2	1.9	0.35	13.39
72.750	0.00	0.0	0.7	1.2	0.22	13.24
73.000	0.00	0.0	0.4	0.7	0.14	13.15
73.250	0.00	0.0	0.3	0.4	0.08	13.09
73.500	0.00	0.0	0.2	0.3	0.05	13.06
73.750	0.00	0.0	0.1	0.2	0.03	13.04
74.000	0.00	0.0	0.1	0.1	0.02	13.02
74.250	0.00	0.0	0.0	0.1	0.01	13.01
74.500	0.00	0.0	0.0	0.0	0.01	13.01
74.750	0.00	0.0	0.0	0.0	0.00	13.01
75.000	0.00	0.0	0.0	0.0	0.00	13.00
75.250	0.00	0.0	0.0	0.0	0.00	13.00
75.500	0.00	0.0	0.0	0.0	0.00	13.00
75.750	0.00	0.0	0.0	0.0	0.00	13.00
76.000	0.00	0.0	0.0	0.0	0.00	13.00
76.250	0.00	0.0	0.0	0.0	0.00	13.00
76.500	0.00	0.0	0.0	0.0	0.00	13.00
76.750	0.00	0.0	0.0	0.0	0.00	13.00
77.000	0.00	0.0	0.0	0.0	0.00	13.00
77.250	0.00	0.0	0.0	0.0	0.00	13.00
77.500	0.00	0.0	0.0	0.0	0.00	13.00
77.750	0.00	0.0	0.0	0.0	0.00	13.00
78.000	0.00	0.0	0.0	0.0	0.00	13.00
78.250	0.00	0.0	0.0	0.0	0.00	13.00
78.500	0.00	0.0	0.0	0.0	0.00	13.00
78.750	0.00	0.0	0.0	0.0	0.00	13.00
79.000	0.00	0.0	0.0	0.0	0.00	13.00
79.250	0.00	0.0	0.0	0.0	0.00	13.00
79.500	0.00	0.0	0.0	0.0	0.00	13.00

EXECUTED: 01-23-1991 15:56:57

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-2 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
79.750	0.00	0.0	0.0	0.0	0.00	13.00
80.000	0.00	0.0	0.0	0.0	0.00	13.00
80.250	0.00	0.0	0.0	0.0	0.00	13.00
80.500	0.00	0.0	0.0	0.0	0.00	13.00
80.750	0.00	0.0	0.0	0.0	0.00	13.00
81.000	0.00	0.0	0.0	0.0	0.00	13.00
81.250	0.00	0.0	0.0	0.0	0.00	13.00
81.500	0.00	0.0	0.0	0.0	0.00	13.00
81.750	0.00	0.0	0.0	0.0	0.00	13.00
82.000	0.00	0.0	0.0	0.0	0.00	13.00
82.250	0.00	0.0	0.0	0.0	0.00	13.00
82.500	0.00	0.0	0.0	0.0	0.00	13.00
82.750	0.00	0.0	0.0	0.0	0.00	13.00
83.000	0.00	0.0	0.0	0.0	0.00	13.00
83.250	0.00	0.0	0.0	0.0	0.00	13.00
83.500	0.00	0.0	0.0	0.0	0.00	13.00
83.750	0.00	0.0	0.0	0.0	0.00	13.00
84.000	0.00	0.0	0.0	0.0	0.00	13.00

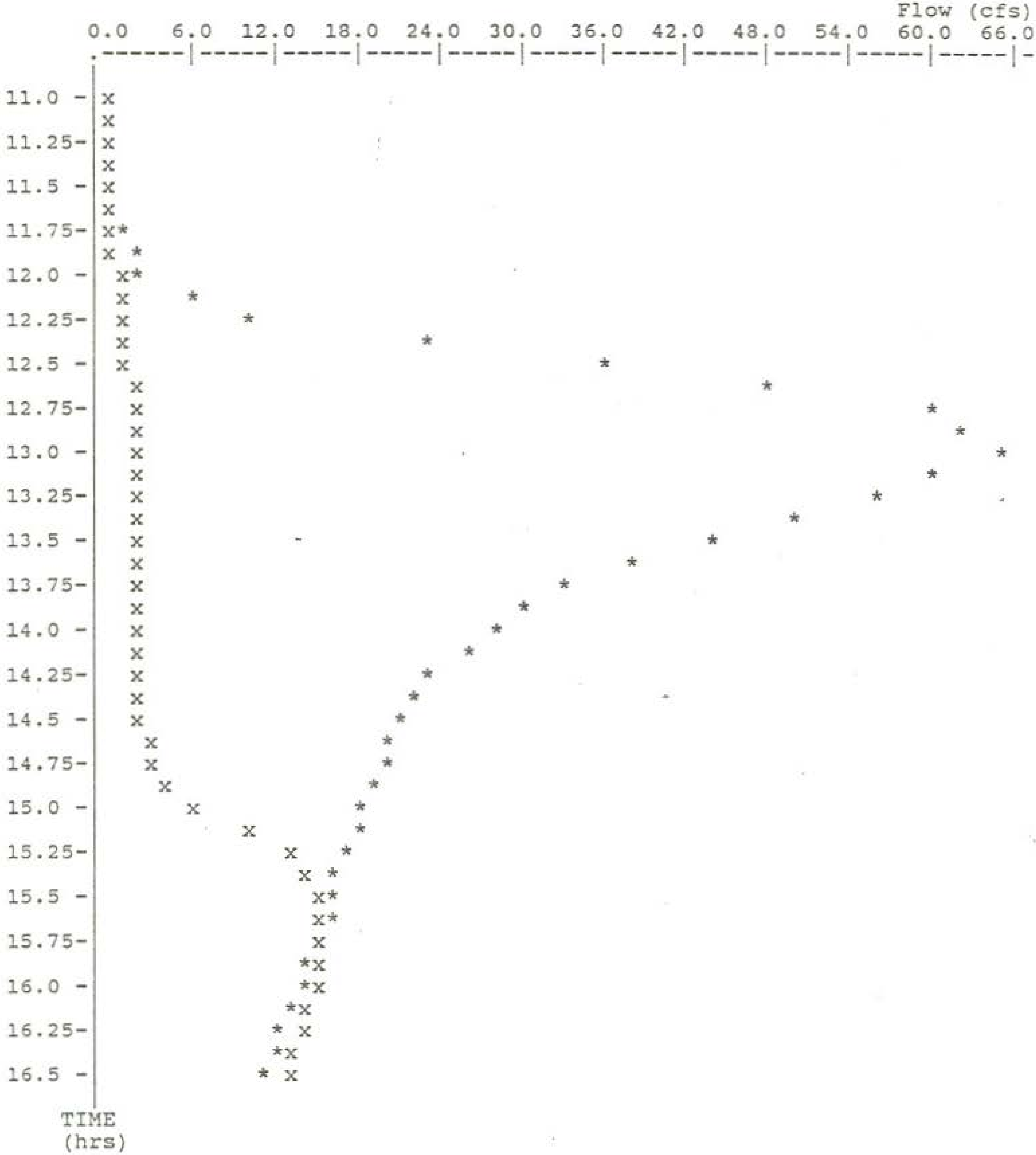
```
****************** SUMMARY OF ROUTING COMPUTATIONS ******************

Pond File:           c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph:   c:\haestad\pondpack\APES-2  .HYD
Outflow Hydrograph:  c:\haestad\pondpack\OUT     .HYD

Starting Pond W.S. Elevation =    13.00 ft

        ***** Summary of Peak Outflow and Peak Elevation *****

                 Peak Inflow    =    65.00 cfs
                 Peak Outflow   =    15.36 cfs
                 Peak Elevation =    21.19 ft

         ***** Summary of Approximate Peak Storage *****

             Initial Storage          =     0.00 ac-ft
             Peak Storage From Storm  =     8.06 ac-ft
                                         --------------
             Total Storage in Pond    =     8.06 ac-ft
```

```
Pond File:           c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph:   c:\haestad\pondpack\APES-2  .HYD
Outflow Hydrograph:  c:\haestad\pondpack\OUT     .HYD
                                                  EXECUTED: 01-23-1991
Peak Inflow    =     65.00 cfs                              15:56:57
Peak Outflow   =     15.36 cfs
Peak Elevation =     21.19 ft
```

```
                                                                 Flow (cfs)
      0.0   6.0  12.0  18.0  24.0  30.0  36.0  42.0  48.0  54.0  60.0  66.0
      .------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-
      |
11.0 -|x
      | x*
13.0 -|  x                                                              *
      |  x                       *
15.0 -|      x           *
      |              *x
17.0 -|           x
      |         *x
19.0 -|       *x
      |      x
21.0 -|     x
      |    x
23.0 -|   x
      |  *x
25.0 -| * x
      |*  x
27.0 -|* x
      |* x
29.0 -|* x
      |* x
31.0 -|* x
      |* x
33.0 -|* x
      |* x
35.0 -|* x
      |* x
37.0 -|* x
      |* x
39.0 -|* x
      |* x
41.0 -|* x
      |* x
43.0 -|* x
      |* x
45.0 -|* x
      |* x
47.0 -|* x
      |* x
49.0 -|* x
      |* x
51.0 -|* x
      |* x
53.0 -|* x
      |* x
55.0 -|* x
```

```
        | *  x
57.0  - | *  x
        | *  x
59.0  - | *  x
        | *  x
61.0  - | *  x
        | *  x
63.0  - | *  x
        | *  x
65.0  - | *  x
        | *x
67.0  - | *x
        | *x
69.0  - | *x
        | *x
71.0  - | *x
        | *x
        |
     TIME
     (hrs)

  *  File:   c:\haestad\pondpack\APES-2  .HYD   Qmax =      65.0 cfs
  x  File:   c:\haestad\pondpack\OUT     .HYD   Qmax =      15.4 cfs
```

POND-2 Version: 5.15 S/N: 1295130016
Plotted: 01-23-1991



* File: c:\haestad\pondpack\APES-2 .HYD Qmax = 65.0 cfs
x File: c:\haestad\pondpack\OUT .HYD Qmax = 15.4 cfs

```
**************************************************
*                                                *
*  APES Stormwater Project - City of Greenville  *
*              TEN-YEAR STORM EVENT              *
*                                                *
*                                                *
*                                                *
**************************************************
```

Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Rating Table file: c:\haestad\pondpack\APESORF .PND

----INITIAL CONDITIONS----
Elevation = 13.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
13.00	0.0	0.000	0.0	0.0
14.00	0.9	0.040	3.9	4.8
14.25	1.0	0.078	7.5	8.5
14.50	1.1	0.132	12.8	13.9
14.75	1.2	0.207	20.0	21.2
15.00	1.3	0.305	29.5	30.8
15.25	1.4	0.429	41.5	42.9
15.50	1.4	0.583	56.4	57.8
15.75	1.5	0.769	74.5	76.0
16.00	1.6	0.992	96.0	97.6
16.25	1.6	1.240	120.0	121.6
16.50	1.7	1.499	145.1	146.8
16.75	1.8	1.770	171.3	173.1
17.00	1.8	2.053	198.7	200.5
17.25	1.9	2.349	227.4	229.3
17.50	1.9	2.658	257.3	259.2
17.75	2.0	2.980	288.4	290.4
18.00	2.0	3.315	320.9	322.9
18.25	2.1	3.659	354.2	356.3
18.50	2.1	4.008	387.9	390.0
18.75	2.2	4.361	422.2	424.4
19.00	2.2	4.720	456.9	459.1
19.25	2.3	5.083	492.0	494.3
19.50	2.3	5.451	527.7	530.0
19.75	2.4	5.824	563.7	566.1
20.00	2.4	6.202	600.3	602.7
20.25	2.5	6.584	637.4	639.9
20.50	2.5	6.972	674.9	677.4
20.75	2.5	7.364	712.9	715.4
21.00	2.6	7.762	751.3	753.9
21.25	19.6	8.164	790.3	809.9

DISK FILES: APES-10 .HYD ; APESORF .PND

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
21.50	50.8	8.572
21.75	91.0	8.984
22.00	138.5	9.402
22.25	192.3	9.825
22.50	251.6	10.252
22.75	316.1	10.685
23.00	385.1	11.123

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + 0 (cfs)
829.8	880.6
869.7	960.7
910.1	1048.6
951.0	1143.3
992.4	1244.0
1034.3	1350.4
1076.7	1461.8

Time increment (t) = 0.250 hrs.

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH — ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	6.00	-----	0.0	0.0	0.00	13.00
11.250	7.50	13.5	11.3	13.5	1.09	14.48
11.500	9.00	16.5	25.3	27.8	1.27	14.92
11.750	10.50	19.5	42.0	44.8	1.40	15.28
12.000	15.00	25.5	64.6	67.5	1.45	15.63
12.250	42.00	57.0	118.4	121.6	1.60	16.25
12.500	111.00	153.0	267.5	271.4	1.94	17.60
12.750	167.50	278.5	541.3	546.0	2.34	19.61
13.000	172.00	339.5	778.9	880.8	50.93	21.50
13.250	142.00	314.0	765.6	1092.9	163.68	22.12
13.500	106.00	248.0	774.4	1013.6	119.58	21.90
13.750	79.50	185.5	778.7	959.9	90.62	21.75
14.000	64.00	143.5	778.8	922.2	71.69	21.63
14.250	52.50	116.5	778.9	895.3	58.21	21.55
14.500	46.00	98.5	778.6	877.4	49.41	21.49
14.750	41.50	87.5	777.3	866.1	44.41	21.45
15.000	38.00	79.5	776.2	856.8	40.29	21.42
15.250	35.00	73.0	775.3	849.2	36.94	21.39
15.500	32.00	67.0	774.5	842.3	33.90	21.36
15.750	30.00	62.0	773.8	836.5	31.34	21.34
16.000	28.00	58.0	773.3	831.8	29.27	21.33
16.250	26.00	54.0	772.7	827.3	27.27	21.31
16.500	24.00	50.0	772.2	822.7	25.26	21.30
16.750	22.00	46.0	771.7	818.2	23.26	21.28
17.000	20.00	42.0	771.1	813.7	21.26	21.26
17.250	19.00	39.0	770.7	810.1	19.71	21.25
17.500	18.00	37.0	769.9	807.7	18.94	21.24
17.750	17.50	35.5	768.9	805.4	18.22	21.23
18.000	17.00	34.5	768.2	803.4	17.63	21.22
18.250	16.00	33.0	767.3	801.2	16.94	21.21
18.500	15.00	31.0	766.1	798.3	16.07	21.20
18.750	14.00	29.0	764.9	795.1	15.11	21.18
19.000	13.00	27.0	763.6	791.9	14.13	21.17
19.250	12.50	25.5	762.6	789.1	13.29	21.16
19.500	12.00	24.5	761.7	787.1	12.66	21.15
19.750	11.50	23.5	761.0	785.2	12.11	21.14
20.000	11.00	22.5	760.4	783.5	11.59	21.13
20.250	11.00	22.0	759.9	782.4	11.23	21.13
20.500	11.00	22.0	759.7	781.9	11.09	21.12
20.750	11.00	22.0	759.6	781.7	11.04	21.12
21.000	11.00	22.0	759.6	781.6	11.01	21.12
21.250	11.00	22.0	759.6	781.6	11.01	21.12
21.500	11.00	22.0	759.6	781.6	11.00	21.12
21.750	11.00	22.0	759.6	781.6	11.00	21.12
22.000	11.00	22.0	759.6	781.6	11.00	21.12

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH — ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
22.250	10.00	21.0	759.2	780.6	10.70	21.12
22.500	10.00	20.0	758.7	779.2	10.27	21.11
22.750	9.00	19.0	758.0	777.7	9.80	21.11
23.000	8.00	17.0	757.0	775.0	9.01	21.09
23.250	7.50	15.5	756.0	772.5	8.25	21.08
23.500	7.00	14.5	755.3	770.5	7.64	21.07
23.750	6.00	13.0	754.4	768.3	6.95	21.06
24.000	6.00	12.0	753.6	766.4	6.37	21.06
24.250	5.00	11.0	752.9	764.6	5.84	21.05
24.500	4.00	9.0	751.9	761.9	5.03	21.04
24.750	3.50	7.5	750.9	759.4	4.25	21.02
25.000	3.00	6.5	750.1	757.4	3.64	21.02
25.250	2.00	5.0	749.2	755.1	2.95	21.01
25.500	1.00	3.0	747.0	752.2	2.60	20.99
25.750	1.00	2.0	743.8	749.0	2.59	20.97
26.000	0.00	1.0	739.7	744.8	2.58	20.94
26.250	0.00	0.0	734.5	739.7	2.56	20.91
26.500	0.00	0.0	729.4	734.5	2.55	20.87
26.750	0.00	0.0	724.4	729.4	2.54	20.84
27.000	0.00	0.0	719.3	724.4	2.52	20.81
27.250	0.00	0.0	714.3	719.3	2.51	20.78
27.500	0.00	0.0	709.3	714.3	2.50	20.74
27.750	0.00	0.0	704.3	709.3	2.50	20.71
28.000	0.00	0.0	699.3	704.3	2.50	20.68
28.250	0.00	0.0	694.3	699.3	2.50	20.64
28.500	0.00	0.0	689.3	694.3	2.50	20.61
28.750	0.00	0.0	684.3	689.3	2.50	20.58
29.000	0.00	0.0	679.3	684.3	2.50	20.55
29.250	0.00	0.0	674.3	679.3	2.50	20.51
29.500	0.00	0.0	669.3	674.3	2.50	20.48
29.750	0.00	0.0	664.3	669.3	2.50	20.45
30.000	0.00	0.0	659.3	664.3	2.50	20.41
30.250	0.00	0.0	654.3	659.3	2.50	20.38
30.500	0.00	0.0	649.3	654.3	2.50	20.35
30.750	0.00	0.0	644.3	649.3	2.50	20.31
31.000	0.00	0.0	639.3	644.3	2.50	20.28
31.250	0.00	0.0	634.3	639.3	2.50	20.25
31.500	0.00	0.0	629.3	634.3	2.49	20.21
31.750	0.00	0.0	624.4	629.3	2.47	20.18
32.000	0.00	0.0	619.5	624.4	2.46	20.15
32.250	0.00	0.0	614.6	619.5	2.45	20.11
32.500	0.00	0.0	609.7	614.6	2.43	20.08
32.750	0.00	0.0	604.9	609.7	2.42	20.05
33.000	0.00	0.0	600.1	604.9	2.41	20.01
33.250	0.00	0.0	595.3	600.1	2.40	19.98
33.500	0.00	0.0	590.5	595.3	2.40	19.95

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH | ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
33.750	0.00	0.0	585.7	590.5	2.40	19.92
34.000	0.00	0.0	580.9	585.7	2.40	19.88
34.250	0.00	0.0	576.1	580.9	2.40	19.85
34.500	0.00	0.0	571.3	576.1	2.40	19.82
34.750	0.00	0.0	566.5	571.3	2.40	19.79
35.000	0.00	0.0	561.7	566.5	2.40	19.75
35.250	0.00	0.0	556.9	561.7	2.39	19.72
35.500	0.00	0.0	552.2	556.9	2.37	19.69
35.750	0.00	0.0	547.4	552.2	2.36	19.65
36.000	0.00	0.0	542.7	547.4	2.35	19.62
36.250	0.00	0.0	538.1	542.7	2.34	19.59
36.500	0.00	0.0	533.4	538.1	2.32	19.56
36.750	0.00	0.0	528.8	533.4	2.31	19.52
37.000	0.00	0.0	524.2	528.8	2.30	19.49
37.250	0.00	0.0	519.6	524.2	2.30	19.46
37.500	0.00	0.0	515.0	519.6	2.30	19.43
37.750	0.00	0.0	510.4	515.0	2.30	19.40
38.000	0.00	0.0	505.8	510.4	2.30	19.36
38.250	0.00	0.0	501.2	505.8	2.30	19.33
38.500	0.00	0.0	496.6	501.2	2.30	19.30
38.750	0.00	0.0	492.0	496.6	2.30	19.27
39.000	0.00	0.0	487.4	492.0	2.29	19.23
39.250	0.00	0.0	482.9	487.4	2.28	19.20
39.500	0.00	0.0	478.3	482.9	2.27	19.17
39.750	0.00	0.0	473.8	478.3	2.25	19.14
40.000	0.00	0.0	469.3	473.8	2.24	19.10
40.250	0.00	0.0	464.9	469.3	2.23	19.07
40.500	0.00	0.0	460.4	464.9	2.22	19.04
40.750	0.00	0.0	456.0	460.4	2.20	19.01
41.000	0.00	0.0	451.6	456.0	2.20	18.98
41.250	0.00	0.0	447.2	451.6	2.20	18.95
41.500	0.00	0.0	442.8	447.2	2.20	18.91
41.750	0.00	0.0	438.4	442.8	2.20	18.88
42.000	0.00	0.0	434.0	438.4	2.20	18.85
42.250	0.00	0.0	429.6	434.0	2.20	18.82
42.500	0.00	0.0	425.2	429.6	2.20	18.79
42.750	0.00	0.0	420.8	425.2	2.20	18.76
43.000	0.00	0.0	416.4	420.8	2.19	18.72
43.250	0.00	0.0	412.1	416.4	2.18	18.69
43.500	0.00	0.0	407.8	412.1	2.16	18.66
43.750	0.00	0.0	403.5	407.8	2.15	18.63
44.000	0.00	0.0	399.2	403.5	2.14	18.60
44.250	0.00	0.0	394.9	399.2	2.13	18.57
44.500	0.00	0.0	390.7	394.9	2.11	18.54
44.750	0.00	0.0	386.5	390.7	2.10	18.50
45.000	0.00	0.0	382.3	386.5	2.10	18.47

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
45.250	0.00	0.0	378.1	382.3	2.10	18.44
45.500	0.00	0.0	373.9	378.1	2.10	18.41
45.750	0.00	0.0	369.7	373.9	2.10	18.38
46.000	0.00	0.0	365.5	369.7	2.10	18.35
46.250	0.00	0.0	361.3	365.5	2.10	18.32
46.500	0.00	0.0	357.1	361.3	2.10	18.29
46.750	0.00	0.0	352.9	357.1	2.10	18.26
47.000	0.00	0.0	348.7	352.9	2.09	18.22
47.250	0.00	0.0	344.6	348.7	2.08	18.19
47.500	0.00	0.0	340.4	344.6	2.06	18.16
47.750	0.00	0.0	336.3	340.4	2.05	18.13
48.000	0.00	0.0	332.2	336.3	2.04	18.10
48.250	0.00	0.0	328.2	332.2	2.03	18.07
48.500	0.00	0.0	324.2	328.2	2.02	18.04
48.750	0.00	0.0	320.2	324.2	2.00	18.01
49.000	0.00	0.0	316.2	320.2	2.00	17.98
49.250	0.00	0.0	312.2	316.2	2.00	17.95
49.500	0.00	0.0	308.2	312.2	2.00	17.92
49.750	0.00	0.0	304.2	308.2	2.00	17.89
50.000	0.00	0.0	300.2	304.2	2.00	17.86
50.250	0.00	0.0	296.2	300.2	2.00	17.83
50.500	0.00	0.0	292.2	296.2	2.00	17.79
50.750	0.00	0.0	288.2	292.2	2.00	17.76
51.000	0.00	0.0	284.2	288.2	1.99	17.73
51.250	0.00	0.0	280.2	284.2	1.98	17.70
51.500	0.00	0.0	276.3	280.2	1.97	17.67
51.750	0.00	0.0	272.4	276.3	1.95	17.64
52.000	0.00	0.0	268.5	272.4	1.94	17.61
52.250	0.00	0.0	264.6	268.5	1.93	17.57
52.500	0.00	0.0	260.8	264.6	1.92	17.54
52.750	0.00	0.0	257.0	260.8	1.91	17.51
53.000	0.00	0.0	253.2	257.0	1.90	17.48
53.250	0.00	0.0	249.4	253.2	1.90	17.45
53.500	0.00	0.0	245.6	249.4	1.90	17.42
53.750	0.00	0.0	241.8	245.6	1.90	17.39
54.000	0.00	0.0	238.0	241.8	1.90	17.35
54.250	0.00	0.0	234.2	238.0	1.90	17.32
54.500	0.00	0.0	230.4	234.2	1.90	17.29
54.750	0.00	0.0	226.6	230.4	1.90	17.26
55.000	0.00	0.0	222.8	226.6	1.89	17.23
55.250	0.00	0.0	219.0	222.8	1.88	17.19
55.500	0.00	0.0	215.3	219.0	1.86	17.16
55.750	0.00	0.0	211.6	215.3	1.85	17.13
56.000	0.00	0.0	207.9	211.6	1.84	17.10
56.250	0.00	0.0	204.3	207.9	1.83	17.06
56.500	0.00	0.0	200.7	204.3	1.81	17.03

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
56.750	0.00	0.0	197.1	200.7	1.80	17.00
57.000	0.00	0.0	193.5	197.1	1.80	16.97
57.250	0.00	0.0	189.9	193.5	1.80	16.94
57.500	0.00	0.0	186.3	189.9	1.80	16.90
57.750	0.00	0.0	182.7	186.3	1.80	16.87
58.000	0.00	0.0	179.1	182.7	1.80	16.84
58.250	0.00	0.0	175.5	179.1	1.80	16.80
58.500	0.00	0.0	171.9	175.5	1.80	16.77
58.750	0.00	0.0	168.3	171.9	1.80	16.74
59.000	0.00	0.0	164.7	168.3	1.78	16.70
59.250	0.00	0.0	161.2	164.7	1.77	16.67
59.500	0.00	0.0	157.7	161.2	1.75	16.64
59.750	0.00	0.0	154.2	157.7	1.74	16.60
60.000	0.00	0.0	150.7	154.2	1.73	16.57
60.250	0.00	0.0	147.3	150.7	1.71	16.54
60.500	0.00	0.0	143.9	147.3	1.70	16.50
60.750	0.00	0.0	140.5	143.9	1.69	16.47
61.000	0.00	0.0	137.2	140.5	1.68	16.44
61.250	0.00	0.0	133.8	137.2	1.66	16.40
61.500	0.00	0.0	130.5	133.8	1.65	16.37
61.750	0.00	0.0	127.3	130.5	1.64	16.34
62.000	0.00	0.0	124.0	127.3	1.62	16.31
62.250	0.00	0.0	120.8	124.0	1.61	16.27
62.500	0.00	0.0	117.6	120.8	1.60	16.24
62.750	0.00	0.0	114.4	117.6	1.60	16.21
63.000	0.00	0.0	111.2	114.4	1.60	16.17
63.250	0.00	0.0	108.0	111.2	1.60	16.14
63.500	0.00	0.0	104.8	108.0	1.60	16.11
63.750	0.00	0.0	101.6	104.8	1.60	16.07
64.000	0.00	0.0	98.4	101.6	1.60	16.04
64.250	0.00	0.0	95.2	98.4	1.60	16.01
64.500	0.00	0.0	92.0	95.2	1.59	15.97
64.750	0.00	0.0	88.9	92.0	1.57	15.94
65.000	0.00	0.0	85.8	88.9	1.56	15.90
65.250	0.00	0.0	82.7	85.8	1.55	15.86
65.500	0.00	0.0	79.6	82.7	1.53	15.83
65.750	0.00	0.0	76.6	79.6	1.52	15.79
66.000	0.00	0.0	73.6	76.6	1.50	15.76
66.250	0.00	0.0	70.6	73.6	1.49	15.72
66.500	0.00	0.0	67.6	70.6	1.47	15.68
66.750	0.00	0.0	64.7	67.6	1.45	15.64
67.000	0.00	0.0	61.9	64.7	1.44	15.60
67.250	0.00	0.0	59.0	61.9	1.42	15.56
67.500	0.00	0.0	56.2	59.0	1.41	15.52
67.750	0.00	0.0	53.4	56.2	1.40	15.47
68.000	0.00	0.0	50.6	53.4	1.40	15.43

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
68.250	0.00	0.0	47.8	50.6	1.40	15.38
68.500	0.00	0.0	45.0	47.8	1.40	15.33
68.750	0.00	0.0	42.2	45.0	1.40	15.29
69.000	0.00	0.0	39.4	42.2	1.39	15.24
69.250	0.00	0.0	36.7	39.4	1.37	15.18
69.500	0.00	0.0	34.0	36.7	1.35	15.12
69.750	0.00	0.0	31.3	34.0	1.33	15.07
70.000	0.00	0.0	28.7	31.3	1.30	15.01
70.250	0.00	0.0	26.2	28.7	1.28	14.95
70.500	0.00	0.0	23.7	26.2	1.25	14.88
70.750	0.00	0.0	21.2	23.7	1.23	14.81
71.000	0.00	0.0	18.8	21.2	1.20	14.75
71.250	0.00	0.0	16.5	18.8	1.17	14.67
71.500	0.00	0.0	14.2	16.5	1.14	14.59
71.750	0.00	0.0	12.0	14.2	1.10	14.51
72.000	0.00	0.0	9.9	12.0	1.06	14.41
72.250	0.00	0.0	7.8	9.9	1.03	14.31
72.500	0.00	0.0	5.8	7.8	0.98	14.20
72.750	0.00	0.0	4.0	5.8	0.93	14.07
73.000	0.00	0.0	2.5	4.0	0.75	13.83
73.250	0.00	0.0	1.6	2.5	0.47	13.52
73.500	0.00	0.0	1.0	1.6	0.29	13.32
73.750	0.00	0.0	0.6	1.0	0.18	13.20
74.000	0.00	0.0	0.4	0.6	0.11	13.13
74.250	0.00	0.0	0.2	0.4	0.07	13.08
74.500	0.00	0.0	0.1	0.2	0.04	13.05
74.750	0.00	0.0	0.1	0.1	0.03	13.03
75.000	0.00	0.0	0.1	0.1	0.02	13.02
75.250	0.00	0.0	0.0	0.1	0.01	13.01
75.500	0.00	0.0	0.0	0.0	0.01	13.01
75.750	0.00	0.0	0.0	0.0	0.00	13.00
76.000	0.00	0.0	0.0	0.0	0.00	13.00
76.250	0.00	0.0	0.0	0.0	0.00	13.00
76.500	0.00	0.0	0.0	0.0	0.00	13.00
76.750	0.00	0.0	0.0	0.0	0.00	13.00
77.000	0.00	0.0	0.0	0.0	0.00	13.00
77.250	0.00	0.0	0.0	0.0	0.00	13.00
77.500	0.00	0.0	0.0	0.0	0.00	13.00
77.750	0.00	0.0	0.0	0.0	0.00	13.00
78.000	0.00	0.0	0.0	0.0	0.00	13.00
78.250	0.00	0.0	0.0	0.0	0.00	13.00
78.500	0.00	0.0	0.0	0.0	0.00	13.00
78.750	0.00	0.0	0.0	0.0	0.00	13.00
79.000	0.00	0.0	0.0	0.0	0.00	13.00
79.250	0.00	0.0	0.0	0.0	0.00	13.00
79.500	0.00	0.0	0.0	0.0	0.00	13.00

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
79.750	0.00	0.0	0.0	0.0	0.00	13.00
80.000	0.00	0.0	0.0	0.0	0.00	13.00
80.250	0.00	0.0	0.0	0.0	0.00	13.00
80.500	0.00	0.0	0.0	0.0	0.00	13.00
80.750	0.00	0.0	0.0	0.0	0.00	13.00
81.000	0.00	0.0	0.0	0.0	0.00	13.00
81.250	0.00	0.0	0.0	0.0	0.00	13.00
81.500	0.00	0.0	0.0	0.0	0.00	13.00
81.750	0.00	0.0	0.0	0.0	0.00	13.00
82.000	0.00	0.0	0.0	0.0	0.00	13.00
82.250	0.00	0.0	0.0	0.0	0.00	13.00
82.500	0.00	0.0	0.0	0.0	0.00	13.00
82.750	0.00	0.0	0.0	0.0	0.00	13.00
83.000	0.00	0.0	0.0	0.0	0.00	13.00
83.250	0.00	0.0	0.0	0.0	0.00	13.00
83.500	0.00	0.0	0.0	0.0	0.00	13.00
83.750	0.00	0.0	0.0	0.0	0.00	13.00
84.000	0.00	0.0	0.0	0.0	0.00	13.00

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

```
Pond File:           c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph:   c:\haestad\pondpack\APES-10 .HYD
Outflow Hydrograph:  c:\haestad\pondpack\OUT     .HYD
```

Starting Pond W.S. Elevation = 13.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

```
Peak Inflow    =  172.00 cfs
Peak Outflow   =  163.68 cfs
Peak Elevation =   22.12 ft
```

***** Summary of Approximate Peak Storage *****

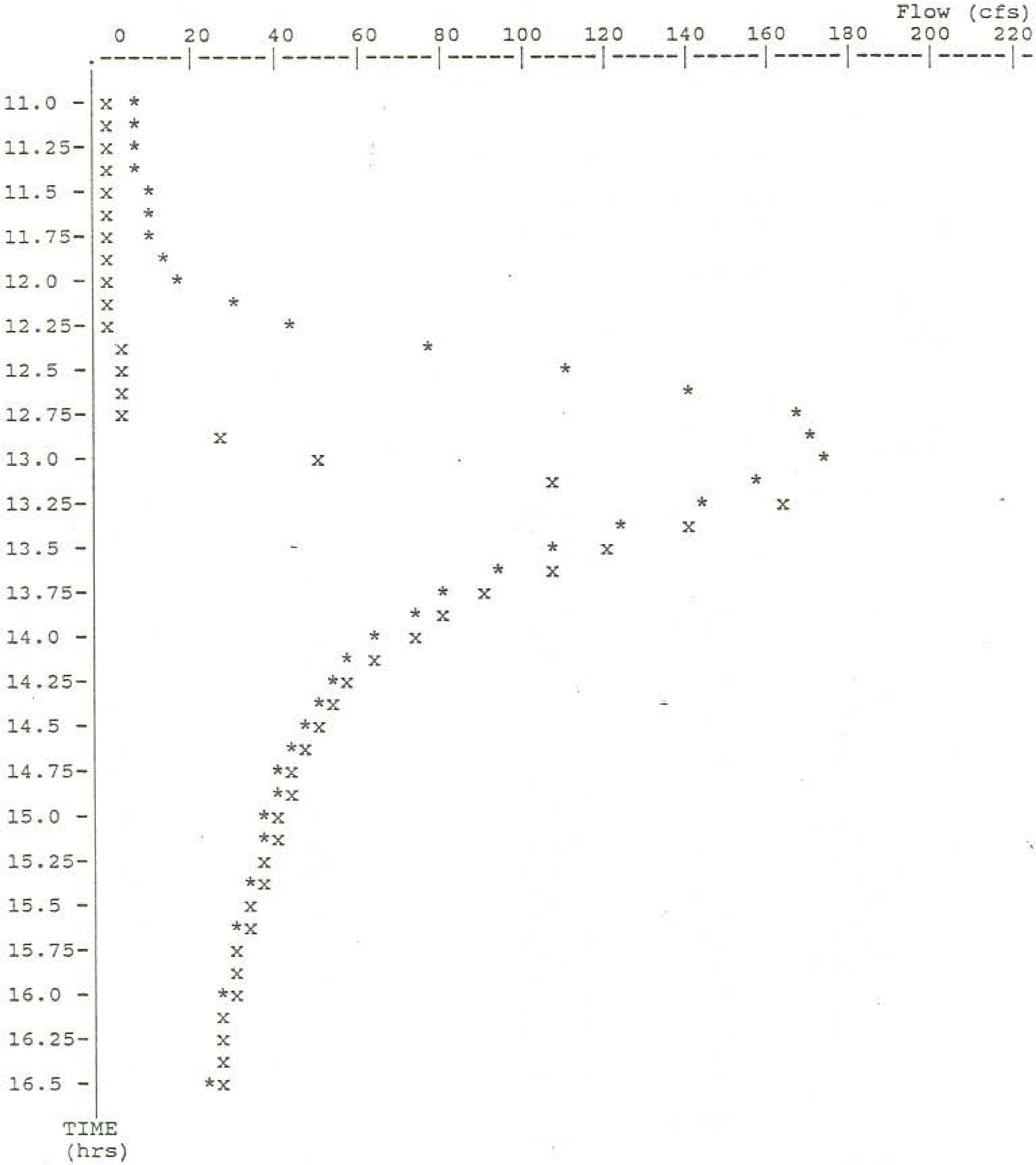
```
Initial Storage          =     0.00 ac-ft
Peak Storage From Storm  =     9.60 ac-ft
                            ---------------
Total Storage in Pond    =     9.60 ac-ft
```

Warning: Inflow hydrograph truncated on left side.

```
      POND-2 Version: 5.15 S/N: 1295130016                     Page 11

      Pond File:          c:\haestad\pondpack\APESORF .PND
      Inflow Hydrograph:  c:\haestad\pondpack\APES-10 .HYD
      Outflow Hydrograph: c:\haestad\pondpack\OUT     .HYD
                                                       EXECUTED: 01-23-1991
      Peak Inflow    =   172.00 cfs                                14:53:36
      Peak Outflow   =   163.68 cfs
      Peak Elevation =    22.12 ft

                                                                Flow (cfs)
        0    20    40    60    80   100   120   140   160   180   200   220
      .------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-

11.0 -|x *
      |x    *
13.0 -|               x                                   *
      |                   *  x
15.0 -|           *x
      |        *x
17.0 -|      x
      |     x
19.0 -|    x
      |   x
21.0 -|   x
      |   x
23.0 -|  *x
      |  x
25.0 -| x
      |*x
27.0 -|*x
      |*x
29.0 -|*x
      |*x
31.0 -|*x
      |*x
33.0 -|*x
      |*x
35.0 -|*x
      |*x
37.0 -|*x
      |*x
39.0 -|*x
      |*x
41.0 -|*x
      |*x
43.0 -|*x
      |*x
45.0 -|*x
      |*x
47.0 -|*x
      |*x
49.0 -|*x
      |*x
51.0 -|*x
      |*x
53.0 -|*x
      |*x
55.0 -|*x
```

```
        |*x
57.0 -  |*x
        |*x
59.0 -  |*x
        |*x
61.0 -  |*x
        |x
63.0 -  |x
        |x
65.0 -  |x
        |x
67.0 -  |x
        |x
69.0 -  |x
        |x
71.0 -  |x
        |x
        |
     TIME
     (hrs)

 *  File:  c:\haestad\pondpack\APES-10 .HYD   Qmax =   172.0 cfs
 x  File:  c:\haestad\pondpack\OUT     .HYD   Qmax =   163.7 cfs
```

POND-2 Version: 5.15 S/N: 1295130016
Plotted: 01-23-1991



* File: c:\haestad\pondpack\APES-10 .HYD Qmax = 172.0 cfs
x File: c:\haestad\pondpack\OUT .HYD Qmax = 163.7 cfs

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**************************************************
*                                                *
*  Apes Stormwater Project - City of Greenville  *
*                                                *
*          ONE HUNDRED-YEAR STORM EVENT          *
*                                                *
*                                                *
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Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Rating Table file: c:\haestad\pondpack\APESORF .PND

----INITIAL CONDITIONS----
Elevation = 13.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)	2S/t (cfs)	2S/t + 0 (cfs)
13.00	0.0	0.000	0.0	0.0
14.00	0.9	0.040	3.9	4.8
14.25	1.0	0.078	7.5	8.5
14.50	1.1	0.132	12.8	13.9
14.75	1.2	0.207	20.0	21.2
15.00	1.3	0.305	29.5	30.8
15.25	1.4	0.429	41.5	42.9
15.50	1.4	0.583	56.4	57.8
15.75	1.5	0.769	74.5	76.0
16.00	1.6	0.992	96.0	97.6
16.25	1.6	1.240	120.0	121.6
16.50	1.7	1.499	145.1	146.8
16.75	1.8	1.770	171.3	173.1
17.00	1.8	2.053	198.7	200.5
17.25	1.9	2.349	227.4	229.3
17.50	1.9	2.658	257.3	259.2
17.75	2.0	2.980	288.4	290.4
18.00	2.0	3.315	320.9	322.9
18.25	2.1	3.659	354.2	356.3
18.50	2.1	4.008	387.9	390.0
18.75	2.2	4.361	422.2	424.4
19.00	2.2	4.720	456.9	459.1
19.25	2.3	5.083	492.0	494.3
19.50	2.3	5.451	527.7	530.0
19.75	2.4	5.824	563.7	566.1
20.00	2.4	6.202	600.3	602.7
20.25	2.5	6.584	637.4	639.9
20.50	2.5	6.972	674.9	677.4
20.75	2.5	7.364	712.9	715.4
21.00	2.6	7.762	751.3	753.9
21.25	19.6	8.164	790.3	809.9

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
21.50	50.8	8.572
21.75	91.0	8.984
22.00	138.5	9.402
22.25	192.3	9.825
22.50	251.6	10.252
22.75	316.1	10.685
23.00	385.1	11.123

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + 0 (cfs)
829.8	880.6
869.7	960.7
910.1	1048.6
951.0	1143.3
992.4	1244.0
1034.3	1350.4
1076.7	1461.8

Time increment (t) = 0.250 hrs.

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Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH | ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	18.00	-----	0.0	0.0	0.00	13.00
11.250	22.00	40.0	37.2	40.0	1.38	15.19
11.500	28.00	50.0	84.1	87.2	1.55	15.88
11.750	37.00	65.0	145.7	149.1	1.71	16.52
12.000	54.00	91.0	232.9	236.7	1.90	17.31
12.250	115.00	169.0	397.7	401.9	2.13	18.59
12.500	262.00	377.0	756.9	774.7	8.89	21.09
12.750	374.00	636.0	708.1	1392.9	342.40	22.85
13.000	375.00	749.0	692.7	1457.1	382.18	22.99
13.250	295.50	670.5	715.2	1363.2	324.03	22.78
13.500	217.00	512.5	743.7	1227.7	241.96	22.46
13.750	159.00	376.0	761.9	1119.7	178.90	22.19
14.000	124.00	283.0	771.9	1044.9	136.52	21.99
14.250	103.00	227.0	775.6	998.9	111.65	21.86
14.500	88.00	191.0	778.2	966.6	94.20	21.77
14.750	77.00	165.0	778.7	943.2	82.23	21.70
15.000	69.00	146.0	778.8	924.7	72.97	21.64
15.250	65.00	134.0	778.8	912.8	66.98	21.60
15.500	61.00	126.0	778.9	904.8	62.99	21.58
15.750	56.00	117.0	778.9	895.9	58.49	21.55
16.000	51.00	107.0	778.9	885.9	53.48	21.52
16.250	47.50	98.5	778.6	877.4	49.42	21.49
16.500	44.00	91.5	777.7	870.1	46.18	21.46
16.750	39.50	83.5	776.7	861.2	42.27	21.43
17.000	35.00	74.5	775.5	851.2	37.84	21.40
17.250	33.50	68.5	774.7	844.0	34.67	21.37
17.500	32.00	65.5	774.2	840.2	32.97	21.36
17.750	31.00	63.0	773.9	837.2	31.67	21.35
18.000	30.00	61.0	773.6	834.9	30.64	21.34
18.250	28.50	58.5	773.3	832.1	29.41	21.33
18.500	28.00	56.5	773.0	829.8	28.39	21.32
18.750	26.00	54.0	772.7	827.0	27.16	21.31
19.000	25.00	51.0	772.3	823.7	25.69	21.30
19.250	24.00	49.0	772.0	821.3	24.64	21.29
19.500	22.00	46.0	771.7	818.0	23.19	21.28
19.750	21.50	43.5	771.3	815.2	21.92	21.27
20.000	20.00	41.5	771.0	812.8	20.89	21.26
20.250	20.00	40.0	770.8	811.0	20.10	21.25
20.500	19.00	39.0	770.7	809.8	19.58	21.25
20.750	19.00	38.0	770.2	808.7	19.23	21.24
21.000	18.00	37.0	769.7	807.2	18.79	21.24
21.250	18.00	36.0	769.0	805.7	18.31	21.23
21.500	18.00	36.0	768.8	805.0	18.12	21.23
21.750	17.00	35.0	768.3	803.8	17.74	21.22
22.000	17.00	34.0	767.7	802.3	17.29	21.22

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH — ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
22.250	16.00	33.0	767.1	800.7	16.81	21.21
22.500	15.00	31.0	766.1	798.1	16.01	21.20
22.750	14.00	29.0	764.9	795.1	15.09	21.18
23.000	13.00	27.0	763.6	791.9	14.13	21.17
23.250	11.50	24.5	762.2	788.1	12.99	21.15
23.500	11.00	22.5	760.8	784.7	11.93	21.14
23.750	9.50	20.5	759.5	781.3	10.91	21.12
24.000	8.00	17.5	757.8	777.0	9.60	21.10
24.250	7.50	15.5	756.3	773.3	8.48	21.09
24.500	6.00	13.5	755.0	769.8	7.43	21.07
24.750	5.50	11.5	753.7	766.5	6.41	21.06
25.000	4.00	9.5	752.4	763.2	5.40	21.04
25.250	3.00	7.0	750.9	759.4	4.25	21.02
25.500	2.00	5.0	749.5	755.9	3.19	21.01
25.750	1.00	3.0	747.3	752.5	2.60	20.99
26.000	0.00	1.0	743.1	748.3	2.59	20.96
26.250	0.00	0.0	738.0	743.1	2.57	20.93
26.500	0.00	0.0	732.9	738.0	2.56	20.90
26.750	0.00	0.0	727.8	732.9	2.55	20.86
27.000	0.00	0.0	722.7	727.8	2.53	20.83
27.250	0.00	0.0	717.7	722.7	2.52	20.80
27.500	0.00	0.0	712.7	717.7	2.51	20.76
27.750	0.00	0.0	707.7	712.7	2.50	20.73
28.000	0.00	0.0	702.7	707.7	2.50	20.70
28.250	0.00	0.0	697.7	702.7	2.50	20.67
28.500	0.00	0.0	692.7	697.7	2.50	20.63
28.750	0.00	0.0	687.7	692.7	2.50	20.60
29.000	0.00	0.0	682.7	687.7	2.50	20.57
29.250	0.00	0.0	677.7	682.7	2.50	20.53
29.500	0.00	0.0	672.7	677.7	2.50	20.50
29.750	0.00	0.0	667.7	672.7	2.50	20.47
30.000	0.00	0.0	662.7	667.7	2.50	20.44
30.250	0.00	0.0	657.7	662.7	2.50	20.40
30.500	0.00	0.0	652.7	657.7	2.50	20.37
30.750	0.00	0.0	647.7	652.7	2.50	20.34
31.000	0.00	0.0	642.7	647.7	2.50	20.30
31.250	0.00	0.0	637.7	642.7	2.50	20.27
31.500	0.00	0.0	632.7	637.7	2.49	20.24
31.750	0.00	0.0	627.7	632.7	2.48	20.20
32.000	0.00	0.0	622.8	627.7	2.47	20.17
32.250	0.00	0.0	617.9	622.8	2.45	20.14
32.500	0.00	0.0	613.0	617.9	2.44	20.10
32.750	0.00	0.0	608.1	613.0	2.43	20.07
33.000	0.00	0.0	603.3	608.1	2.41	20.04
33.250	0.00	0.0	598.5	603.3	2.40	20.00
33.500	0.00	0.0	593.7	598.5	2.40	19.97

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH — ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
33.750	0.00	0.0	588.9	593.7	2.40	19.94
34.000	0.00	0.0	584.1	588.9	2.40	19.91
34.250	0.00	0.0	579.3	584.1	2.40	19.87
34.500	0.00	0.0	574.5	579.3	2.40	19.84
34.750	0.00	0.0	569.7	574.5	2.40	19.81
35.000	0.00	0.0	564.9	569.7	2.40	19.77
35.250	0.00	0.0	560.1	564.9	2.40	19.74
35.500	0.00	0.0	555.3	560.1	2.38	19.71
35.750	0.00	0.0	550.6	555.3	2.37	19.68
36.000	0.00	0.0	545.9	550.6	2.36	19.64
36.250	0.00	0.0	541.2	545.9	2.34	19.61
36.500	0.00	0.0	536.5	541.2	2.33	19.58
36.750	0.00	0.0	531.9	536.5	2.32	19.55
37.000	0.00	0.0	527.3	531.9	2.31	19.51
37.250	0.00	0.0	522.7	527.3	2.30	19.48
37.500	0.00	0.0	518.1	522.7	2.30	19.45
37.750	0.00	0.0	513.5	518.1	2.30	19.42
38.000	0.00	0.0	508.9	513.5	2.30	19.38
38.250	0.00	0.0	504.3	508.9	2.30	19.35
38.500	0.00	0.0	499.7	504.3	2.30	19.32
38.750	0.00	0.0	495.1	499.7	2.30	19.29
39.000	0.00	0.0	490.5	495.1	2.30	19.26
39.250	0.00	0.0	485.9	490.5	2.29	19.22
39.500	0.00	0.0	481.4	485.9	2.28	19.19
39.750	0.00	0.0	476.8	481.4	2.26	19.16
40.000	0.00	0.0	472.3	476.8	2.25	19.13
40.250	0.00	0.0	467.9	472.3	2.24	19.09
40.500	0.00	0.0	463.4	467.9	2.22	19.06
40.750	0.00	0.0	459.0	463.4	2.21	19.03
41.000	0.00	0.0	454.6	459.0	2.20	19.00
41.250	0.00	0.0	450.2	454.6	2.20	18.97
41.500	0.00	0.0	445.8	450.2	2.20	18.94
41.750	0.00	0.0	441.4	445.8	2.20	18.90
42.000	0.00	0.0	437.0	441.4	2.20	18.87
42.250	0.00	0.0	432.6	437.0	2.20	18.84
42.500	0.00	0.0	428.2	432.6	2.20	18.81
42.750	0.00	0.0	423.8	428.2	2.20	18.78
43.000	0.00	0.0	419.4	423.8	2.20	18.75
43.250	0.00	0.0	415.0	419.4	2.19	18.71
43.500	0.00	0.0	410.7	415.0	2.17	18.68
43.750	0.00	0.0	406.4	410.7	2.16	18.65
44.000	0.00	0.0	402.1	406.4	2.15	18.62
44.250	0.00	0.0	397.8	402.1	2.13	18.59
44.500	0.00	0.0	393.5	397.8	2.12	18.56
44.750	0.00	0.0	389.3	393.5	2.11	18.53
45.000	0.00	0.0	385.1	389.3	2.10	18.49

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Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH — ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
45.250	0.00	0.0	380.9	385.1	2.10	18.46
45.500	0.00	0.0	376.7	380.9	2.10	18.43
45.750	0.00	0.0	372.5	376.7	2.10	18.40
46.000	0.00	0.0	368.3	372.5	2.10	18.37
46.250	0.00	0.0	364.1	368.3	2.10	18.34
46.500	0.00	0.0	359.9	364.1	2.10	18.31
46.750	0.00	0.0	355.7	359.9	2.10	18.28
47.000	0.00	0.0	351.5	355.7	2.10	18.25
47.250	0.00	0.0	347.4	351.5	2.09	18.21
47.500	0.00	0.0	343.2	347.4	2.07	18.18
47.750	0.00	0.0	339.1	343.2	2.06	18.15
48.000	0.00	0.0	335.0	339.1	2.05	18.12
48.250	0.00	0.0	330.9	335.0	2.04	18.09
48.500	0.00	0.0	326.9	330.9	2.02	18.06
48.750	0.00	0.0	322.8	326.9	2.01	18.03
49.000	0.00	0.0	318.8	322.8	2.00	18.00
49.250	0.00	0.0	314.8	318.8	2.00	17.97
49.500	0.00	0.0	310.8	314.8	2.00	17.94
49.750	0.00	0.0	306.8	310.8	2.00	17.91
50.000	0.00	0.0	302.8	306.8	2.00	17.88
50.250	0.00	0.0	298.8	302.8	2.00	17.85
50.500	0.00	0.0	294.8	298.8	2.00	17.81
50.750	0.00	0.0	290.8	294.8	2.00	17.78
51.000	0.00	0.0	286.8	290.8	2.00	17.75
51.250	0.00	0.0	282.9	286.8	1.99	17.72
51.500	0.00	0.0	278.9	282.9	1.98	17.69
51.750	0.00	0.0	275.0	278.9	1.96	17.66
52.000	0.00	0.0	271.1	275.0	1.95	17.63
52.250	0.00	0.0	267.2	271.1	1.94	17.60
52.500	0.00	0.0	263.4	267.2	1.93	17.56
52.750	0.00	0.0	259.5	263.4	1.91	17.53
53.000	0.00	0.0	255.7	259.5	1.90	17.50
53.250	0.00	0.0	251.9	255.7	1.90	17.47
53.500	0.00	0.0	248.1	251.9	1.90	17.44
53.750	0.00	0.0	244.3	248.1	1.90	17.41
54.000	0.00	0.0	240.5	244.3	1.90	17.38
54.250	0.00	0.0	236.7	240.5	1.90	17.34
54.500	0.00	0.0	232.9	236.7	1.90	17.31
54.750	0.00	0.0	229.1	232.9	1.90	17.28
55.000	0.00	0.0	225.3	229.1	1.90	17.25
55.250	0.00	0.0	221.6	225.3	1.89	17.22
55.500	0.00	0.0	217.8	221.6	1.87	17.18
55.750	0.00	0.0	214.1	217.8	1.86	17.15
56.000	0.00	0.0	210.4	214.1	1.85	17.12
56.250	0.00	0.0	206.7	210.4	1.83	17.09
56.500	0.00	0.0	203.1	206.7	1.82	17.05

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
56.750	0.00	0.0	199.5	203.1	1.81	17.02
57.000	0.00	0.0	195.9	199.5	1.80	16.99
57.250	0.00	0.0	192.3	195.9	1.80	16.96
57.500	0.00	0.0	188.7	192.3	1.80	16.92
57.750	0.00	0.0	185.1	188.7	1.80	16.89
58.000	0.00	0.0	181.5	185.1	1.80	16.86
58.250	0.00	0.0	177.9	181.5	1.80	16.83
58.500	0.00	0.0	174.3	177.9	1.80	16.79
58.750	0.00	0.0	170.7	174.3	1.80	16.76
59.000	0.00	0.0	167.1	170.7	1.79	16.73
59.250	0.00	0.0	163.5	167.1	1.78	16.69
59.500	0.00	0.0	160.0	163.5	1.76	16.66
59.750	0.00	0.0	156.5	160.0	1.75	16.63
60.000	0.00	0.0	153.0	156.5	1.74	16.59
60.250	0.00	0.0	149.6	153.0	1.72	16.56
60.500	0.00	0.0	146.2	149.6	1.71	16.53
60.750	0.00	0.0	142.8	146.2	1.70	16.49
61.000	0.00	0.0	139.4	142.8	1.68	16.46
61.250	0.00	0.0	136.1	139.4	1.67	16.43
61.500	0.00	0.0	132.7	136.1	1.66	16.39
61.750	0.00	0.0	129.5	132.7	1.64	16.36
62.000	0.00	0.0	126.2	129.5	1.63	16.33
62.250	0.00	0.0	123.0	126.2	1.62	16.30
62.500	0.00	0.0	119.7	123.0	1.61	16.26
62.750	0.00	0.0	116.5	119.7	1.60	16.23
63.000	0.00	0.0	113.3	116.5	1.60	16.20
63.250	0.00	0.0	110.1	113.3	1.60	16.16
63.500	0.00	0.0	106.9	110.1	1.60	16.13
63.750	0.00	0.0	103.7	106.9	1.60	16.10
64.000	0.00	0.0	100.5	103.7	1.60	16.06
64.250	0.00	0.0	97.3	100.5	1.60	16.03
64.500	0.00	0.0	94.1	97.3	1.60	16.00
64.750	0.00	0.0	91.0	94.1	1.58	15.96
65.000	0.00	0.0	87.8	91.0	1.57	15.92
65.250	0.00	0.0	84.7	87.8	1.55	15.89
65.500	0.00	0.0	81.7	84.7	1.54	15.85
65.750	0.00	0.0	78.6	81.7	1.53	15.82
66.000	0.00	0.0	75.6	78.6	1.51	15.78
66.250	0.00	0.0	72.6	75.6	1.50	15.74
66.500	0.00	0.0	69.6	72.6	1.48	15.70
66.750	0.00	0.0	66.7	69.6	1.46	15.66
67.000	0.00	0.0	63.8	66.7	1.45	15.62
67.250	0.00	0.0	60.9	63.8	1.43	15.58
67.500	0.00	0.0	58.1	60.9	1.42	15.54
67.750	0.00	0.0	55.3	58.1	1.40	15.50
68.000	0.00	0.0	52.5	55.3	1.40	15.46

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH | ROUTING COMPUTATIONS

TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
68.250	0.00	0.0	49.7	52.5	1.40	15.41
68.500	0.00	0.0	46.9	49.7	1.40	15.36
68.750	0.00	0.0	44.1	46.9	1.40	15.32
69.000	0.00	0.0	41.3	44.1	1.40	15.27
69.250	0.00	0.0	38.5	41.3	1.39	15.22
69.500	0.00	0.0	35.8	38.5	1.36	15.16
69.750	0.00	0.0	33.1	35.8	1.34	15.10
70.000	0.00	0.0	30.5	33.1	1.32	15.05
70.250	0.00	0.0	27.9	30.5	1.30	14.99
70.500	0.00	0.0	25.3	27.9	1.27	14.92
70.750	0.00	0.0	22.8	25.3	1.24	14.86
71.000	0.00	0.0	20.4	22.8	1.22	14.79
71.250	0.00	0.0	18.0	20.4	1.19	14.72
71.500	0.00	0.0	15.7	18.0	1.16	14.64
71.750	0.00	0.0	13.5	15.7	1.13	14.56
72.000	0.00	0.0	11.3	13.5	1.09	14.48
72.250	0.00	0.0	9.2	11.3	1.05	14.38
72.500	0.00	0.0	7.2	9.2	1.01	14.28
72.750	0.00	0.0	5.2	7.2	0.96	14.16
73.000	0.00	0.0	3.4	5.2	0.91	14.03
73.250	0.00	0.0	2.1	3.4	0.64	13.71
73.500	0.00	0.0	1.3	2.1	0.40	13.44
73.750	0.00	0.0	0.8	1.3	0.25	13.28
74.000	0.00	0.0	0.5	0.8	0.16	13.17
74.250	0.00	0.0	0.3	0.5	0.10	13.11
74.500	0.00	0.0	0.2	0.3	0.06	13.07
74.750	0.00	0.0	0.1	0.2	0.04	13.04
75.000	0.00	0.0	0.1	0.1	0.02	13.03
75.250	0.00	0.0	0.0	0.1	0.01	13.02
75.500	0.00	0.0	0.0	0.0	0.01	13.01
75.750	0.00	0.0	0.0	0.0	0.01	13.01
76.000	0.00	0.0	0.0	0.0	0.00	13.00
76.250	0.00	0.0	0.0	0.0	0.00	13.00
76.500	0.00	0.0	0.0	0.0	0.00	13.00
76.750	0.00	0.0	0.0	0.0	0.00	13.00
77.000	0.00	0.0	0.0	0.0	0.00	13.00
77.250	0.00	0.0	0.0	0.0	0.00	13.00
77.500	0.00	0.0	0.0	0.0	0.00	13.00
77.750	0.00	0.0	0.0	0.0	0.00	13.00
78.000	0.00	0.0	0.0	0.0	0.00	13.00
78.250	0.00	0.0	0.0	0.0	0.00	13.00
78.500	0.00	0.0	0.0	0.0	0.00	13.00
78.750	0.00	0.0	0.0	0.0	0.00	13.00
79.000	0.00	0.0	0.0	0.0	0.00	13.00
79.250	0.00	0.0	0.0	0.0	0.00	13.00
79.500	0.00	0.0	0.0	0.0	0.00	13.00

Pond File: c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph: c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
79.750	0.00	0.0	0.0	0.0	0.00	13.00
80.000	0.00	0.0	0.0	0.0	0.00	13.00
80.250	0.00	0.0	0.0	0.0	0.00	13.00
80.500	0.00	0.0	0.0	0.0	0.00	13.00
80.750	0.00	0.0	0.0	0.0	0.00	13.00
81.000	0.00	0.0	0.0	0.0	0.00	13.00
81.250	0.00	0.0	0.0	0.0	0.00	13.00
81.500	0.00	0.0	0.0	0.0	0.00	13.00
81.750	0.00	0.0	0.0	0.0	0.00	13.00
82.000	0.00	0.0	0.0	0.0	0.00	13.00
82.250	0.00	0.0	0.0	0.0	0.00	13.00
82.500	0.00	0.0	0.0	0.0	0.00	13.00
82.750	0.00	0.0	0.0	0.0	0.00	13.00
83.000	0.00	0.0	0.0	0.0	0.00	13.00
83.250	0.00	0.0	0.0	0.0	0.00	13.00
83.500	0.00	0.0	0.0	0.0	0.00	13.00
83.750	0.00	0.0	0.0	0.0	0.00	13.00
84.000	0.00	0.0	0.0	0.0	0.00	13.00

****************** SUMMARY OF ROUTING COMPUTATIONS ******************

```
Pond File:          c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph:  c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph: c:\haestad\pondpack\OUT     .HYD

Starting Pond W.S. Elevation =    13.00 ft
```

***** Summary of Peak Outflow and Peak Elevation *****

```
Peak Inflow    =   375.00 cfs
Peak Outflow   =   382.18 cfs
Peak Elevation =    22.99 ft
```

***** Summary of Approximate Peak Storage *****

```
Initial Storage          =     0.00 ac-ft
Peak Storage From Storm  =    11.10 ac-ft
                            ---------------
Total Storage in Pond    =    11.10 ac-ft
```

Warning: Inflow hydrograph truncated on left side.

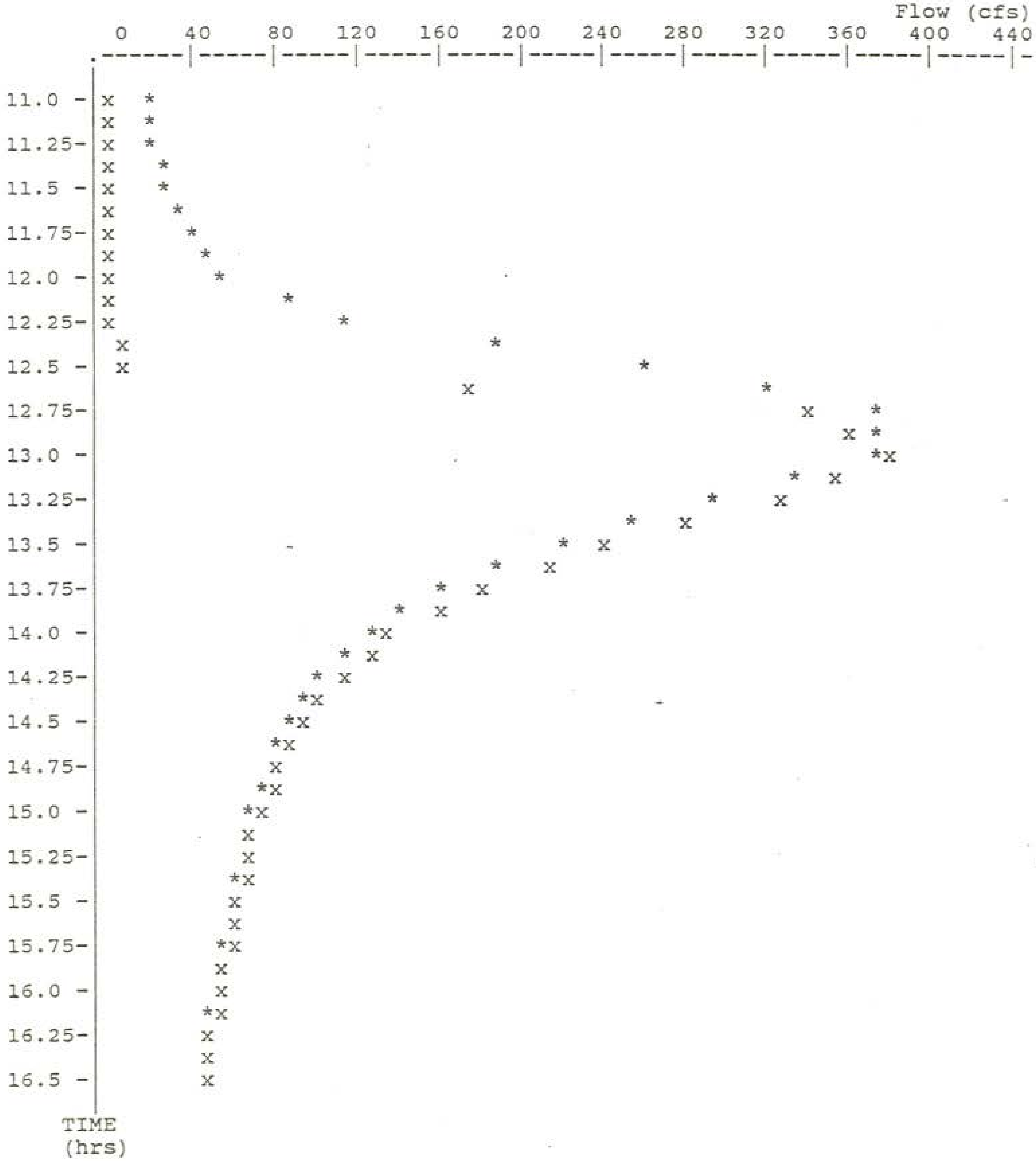
```
Pond File:            c:\haestad\pondpack\APESORF .PND
Inflow Hydrograph:    c:\haestad\pondpack\APES-100.HYD
Outflow Hydrograph:   c:\haestad\pondpack\OUT     .HYD
                                                    EXECUTED: 01-23-1991
Peak Inflow     =    375.00 cfs                               16:07:52
Peak Outflow    =    382.18 cfs
Peak Elevation  =     22.99 ft
```

```
                                                                 Flow (cfs)
        0    40     80    120   160   200   240   280   320   360   400   440
      .------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-
      |
11.0 -|x  *
      |x       *
13.0 -|                                                        *x
      |                   *x
15.0 -|          *x
      |        x
17.0 -|     *x
      |     x
19.0 -|    x
      |   x
21.0 -|   x
      |   x
23.0 -|  x
      | x
25.0 -| x
      |x
27.0 -|x
      |x
29.0 -|x
      |x
31.0 -|x
      |x
33.0 -|x
      |x
35.0 -|x
      |x
37.0 -|x
      |x
39.0 -|x
      |x
41.0 -|x
      |x
43.0 -|x
      |x
45.0 -|x
      |x
47.0 -|x
      |x
49.0 -|x
      |x
51.0 -|x
      |x
53.0 -|x
      |x
55.0 -|x
```

```
        |x
57.0 -  |x
        |x
59.0 -  |x
        |x
61.0 -  |x
        |x
63.0 -  |x
        |x
65.0 -  |x
        |x
67.0 -  |x
        |x
69.0 -  |x
        |x
71.0 -  |x
        |x
        |
    TIME
    (hrs)

 *  File:   c:\haestad\pondpack\APES-100.HYD   Qmax =    375.0 cfs
 x  File:   c:\haestad\pondpack\OUT     .HYD   Qmax =    382.2 cfs
```

POND-2 Version: 5.15 S/N: 1295130016
Plotted: 01-23-1991



* File: c:\haestad\pondpack\APES-100.HYD Qmax = 375.0 cfs
x File: c:\haestad\pondpack\OUT .HYD Qmax = 382.2 cfs

APPENDIX C

MEMORANDUM OF UNDERSTANDING

DEPARTMENTAL RESPONSIBILITIES REGARDING THE URBAN STORMWATER DETENTION POND. AS PART OF THE ALBEMARLE-PAMLICO ESTUARINE STUDY

Engineering and Inspections Department

Engineering and Inspections Department will work with the consultant to ensure the timely completion of the design of the stormwater detention pond. The Engineering and Inspections Department will provide technical assistance in the construction of the project to insure compliance with the approved design.

Public Works Department

Public Works will provide necessary equipment, manpower and supervision for the construction of the facility. Public Works will also be responsible for routine and emergency maintenance of the facility. This will include regular clean-up of accumulated trash and other debris from within the detention basin.

Public Works Department will remove accumulated sediment from the facility as needed. Sediment will be transported to the County Landfill for disposal. Public Works Department will mow side banks and bottom of the facility twice monthly from May through October. If needed, Public Works Department will perform mechanical raking of the bottom surface of the basin to prevent soil compaction and ensure good infiltration. Public Works Department will perform regular routine inspections of the facility. The facility will be checked for condition of the grass on the embankment, floor and perimeter of the pond. Outlet controls, debris racks, and outlet channels will be checked for clogging. The banks of the pond will be examined for deterioration, and rills and gullies will be filled, compacted, and reseeded immediately. The Public Works Department will also perform routine mosquito control operations at the facility.

In the interest of public safety, the integrity of the fence will be checked periodically. Because the project area may be considered unattractive given the fact the entire area will be fenced, the Department of Public Works will study the feasibility of screening and landscaping the area upon completion of the facility.

Department of Planning and Community Development

The Department of Planning and Community Development will be responsible for overall administration of the APES grant. Department staff will ensure the proper submission of status reports, requests for disbursements of funds, and manhour accounting reports. The Department of Planning and Community Development will be responsible for submission of a draft project report to the APES Contract Administrator by September 30, 1991, and a final project report by December 30, 1991.

The Department of Planning and Community Development will coordinate with the Institute of Coastal and Marine Resources of East Carolina University to ensure their timely start-up of water quality monitoring activities.

Planning and Community Development staff will ensure that the Department of Engineering and Inspections will be kept abreast of all forthcoming assessments of facility performance and provided with copies of all pertinent reports.

The Department of Planning and Community Development will ensure, with the cooperation of the Public Information Officer, that the public is informed of the status and effectiveness of this project and its importance to the citizens of Greenville and environs. This project is considered a `best management practice' for controlling pollution from urban stormwater runoff. It is a nontraditional technology, that is likely to be used increasingly in coastal North Carolina. When feasible, the Department of Planning and Community Development will provide articles for publication in appropriate technical and professional journals. This will ensure the recognition of the project within the scientific community and will reflect positively on the City of Greenville.

Ronald R. Kimble
City Manager

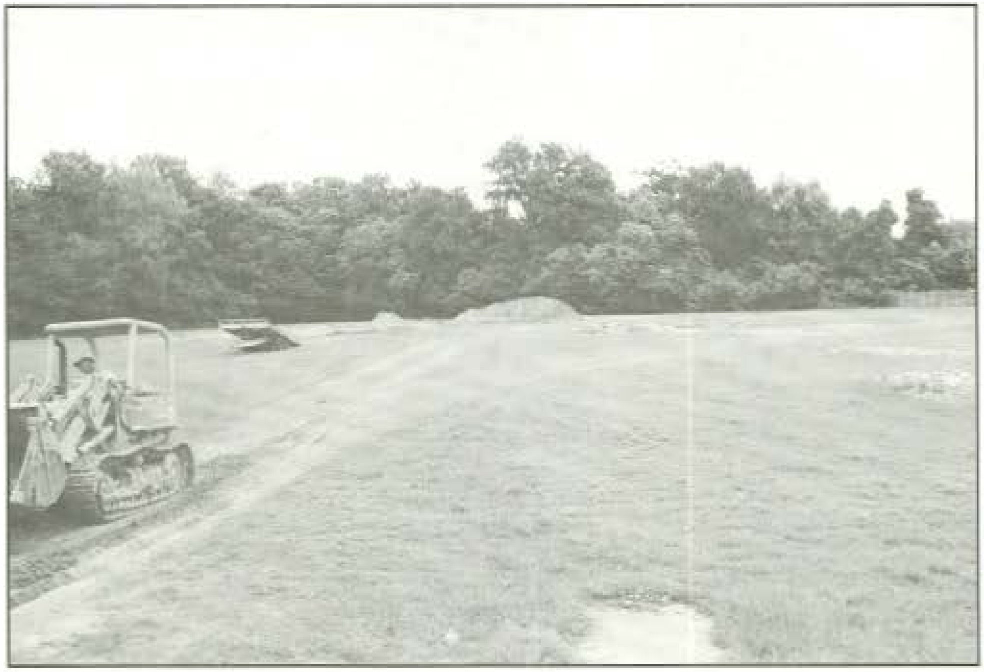
Thomas N. Tysinger, Jr., P.E. 2/1/91
Director of Engineering & Inspections

Mayo E. Allen
Director of Public Works

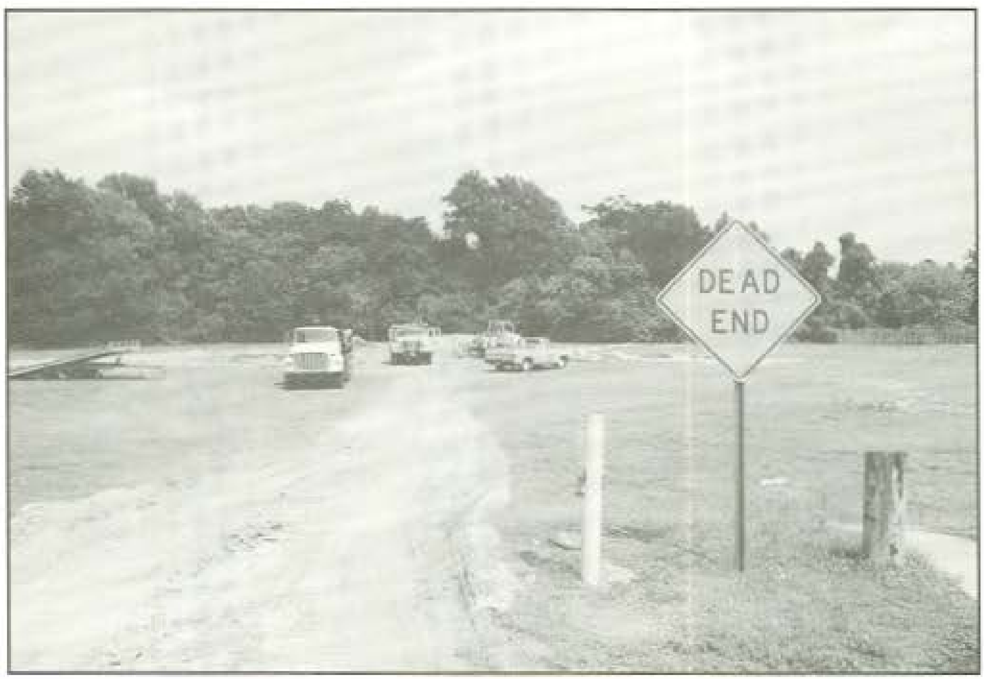
Andrew J. Harris 1-31-91
Director of Planning & Community Development

APPENDIX D

PROJECT PICTORIAL



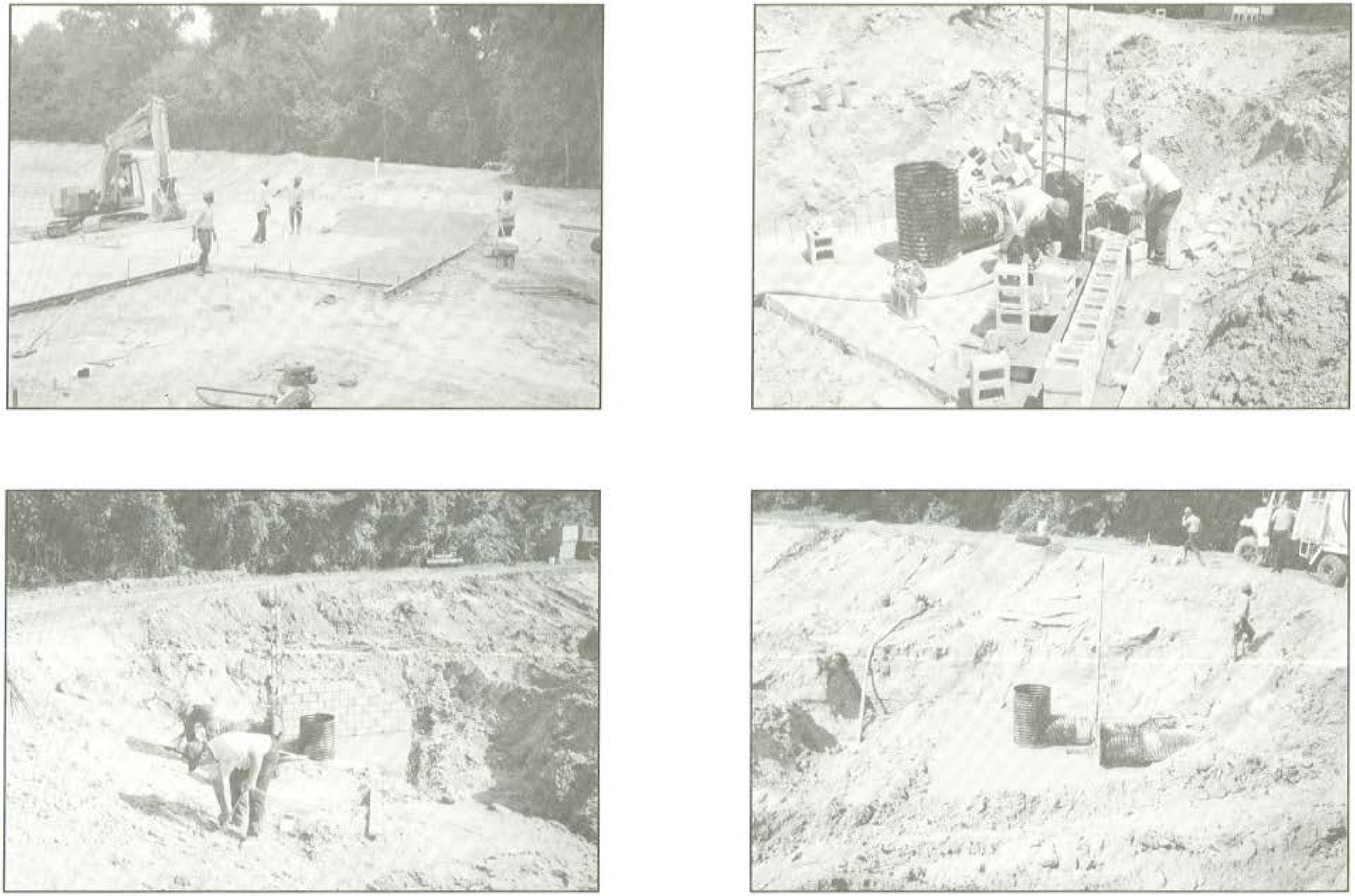
D.1. Excavation of detention pond begins.



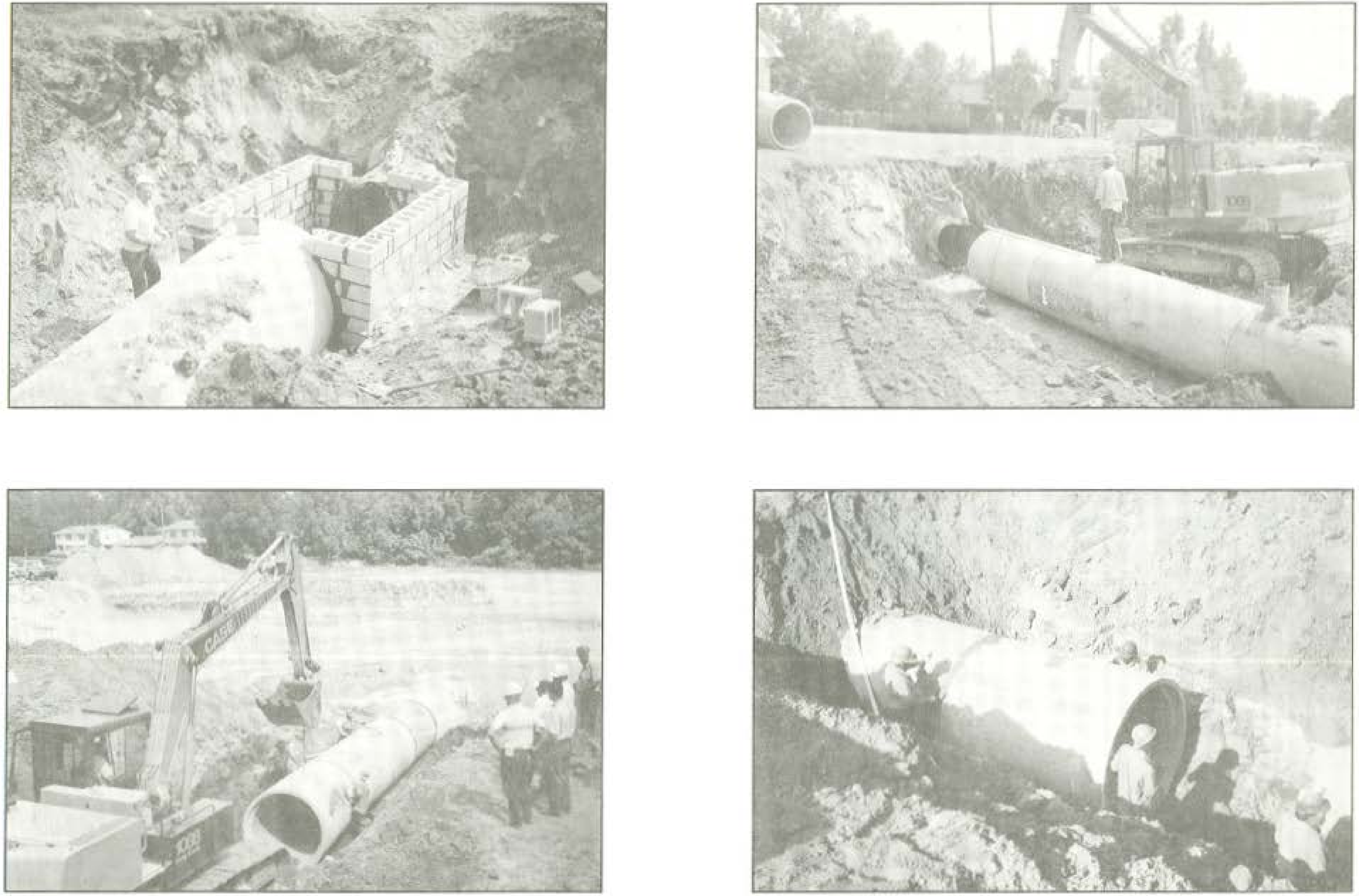
D.2. View of detention pond area from end of West Conley Street.

D.3. Moyewood Ditch. Daycare Center is in background.

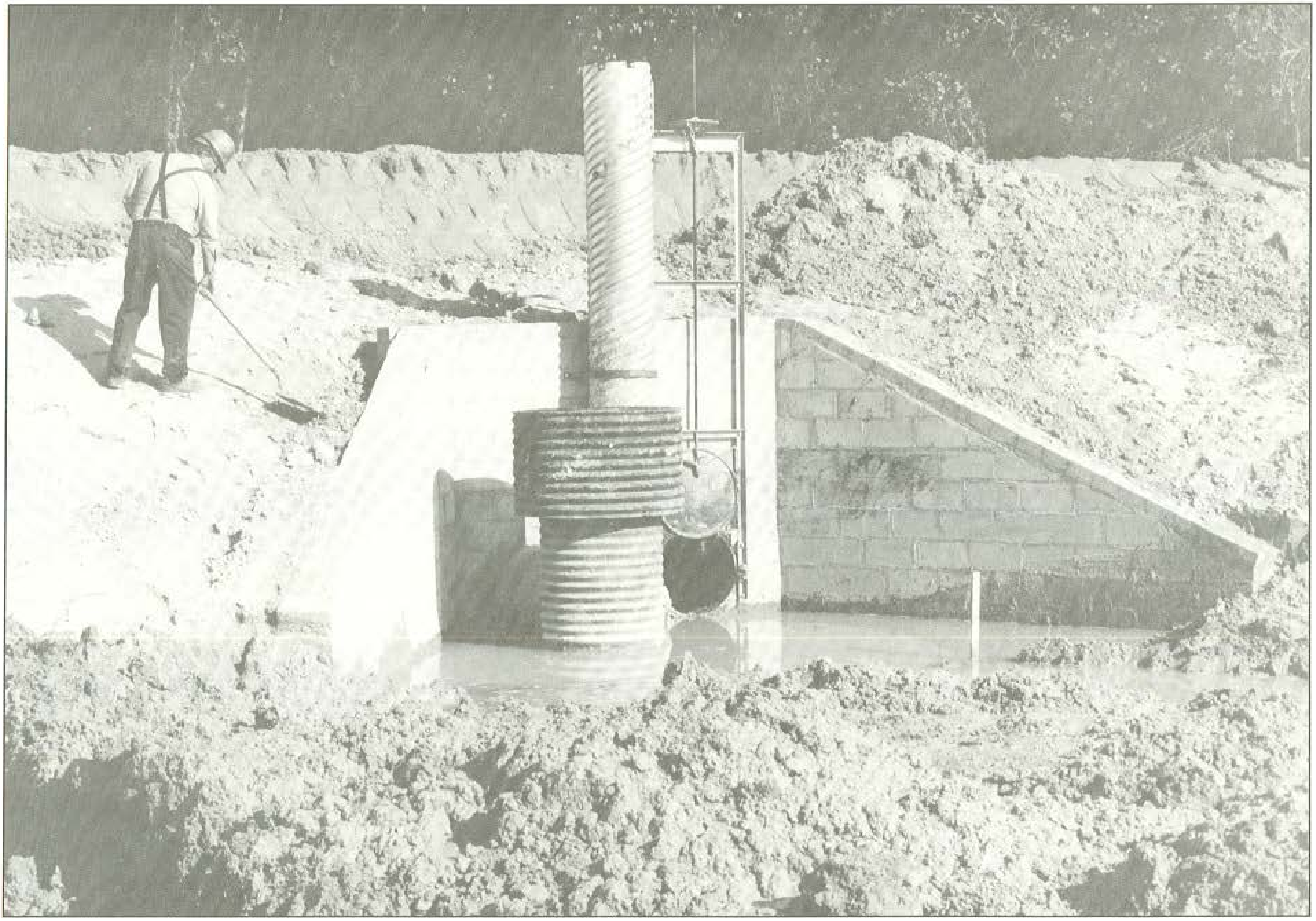
D.4. Land-clearing activities at Moyewood Ditch.



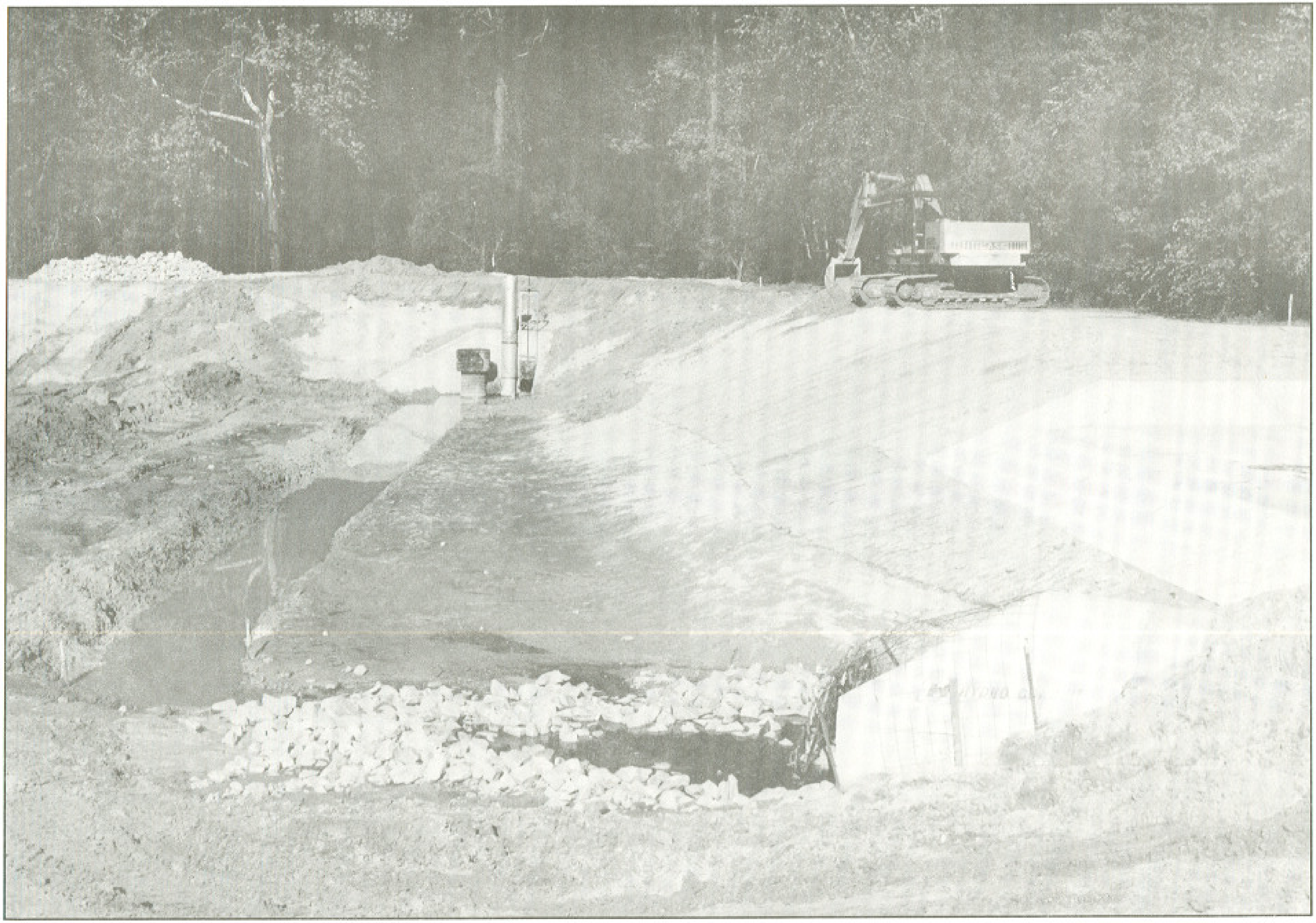
D.5. - D.8. Clockwise from top left: Public Works employees constructing concrete spillway; installation of riser structure and pond outlet discharge piping; site preparation for headwall and pipe installation.



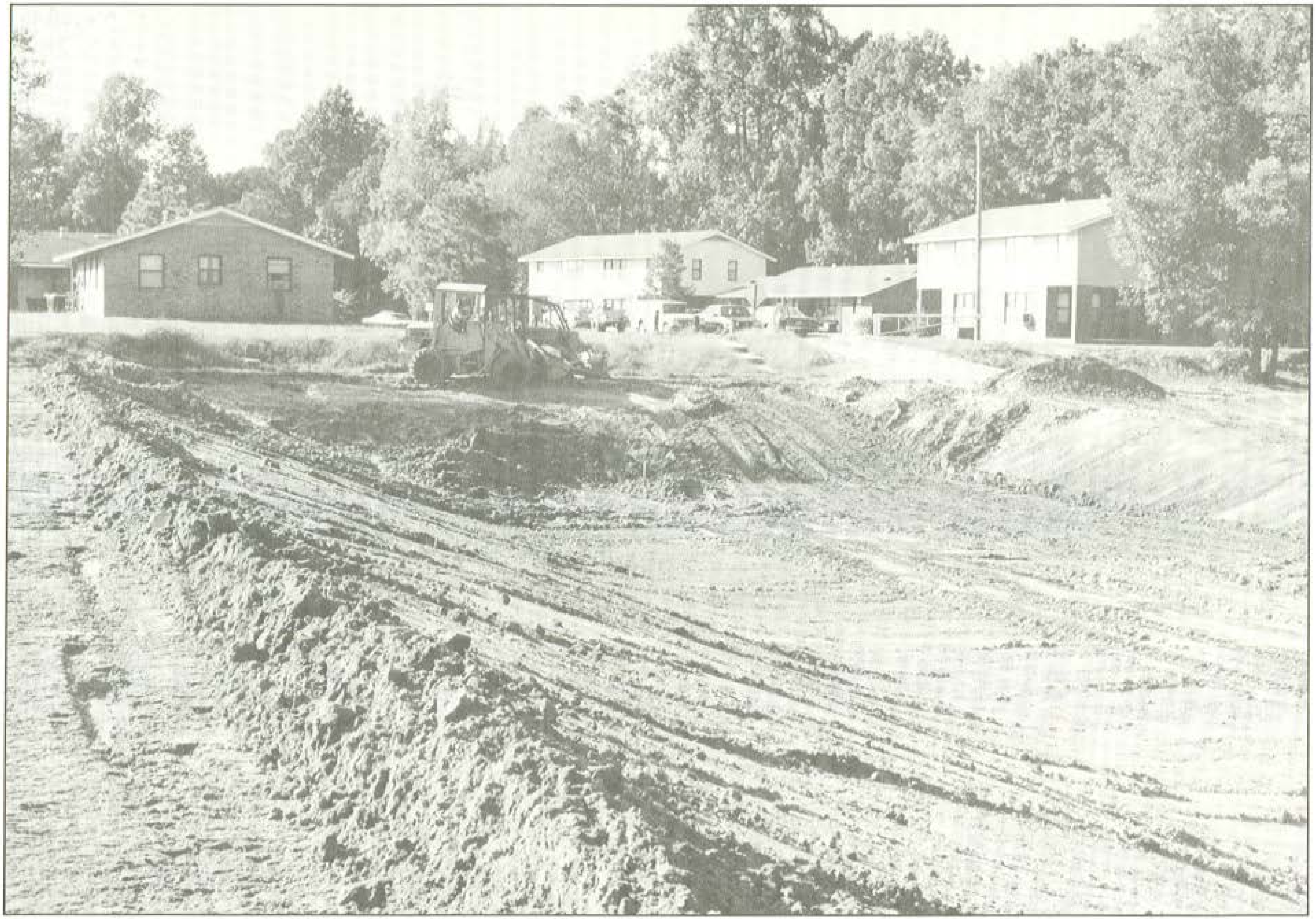
D.9. - D.12. Clockwise from top left: Drop inlet under construction; installation of pond inlet discharge pipe.



D.13. 30" perforated riser shown in center foreground. To the right of riser is handwheel-operated sluicegate.



D.14. Grading for spillway.



D.15. Excavation activities at West Conley entrance of detention basin.

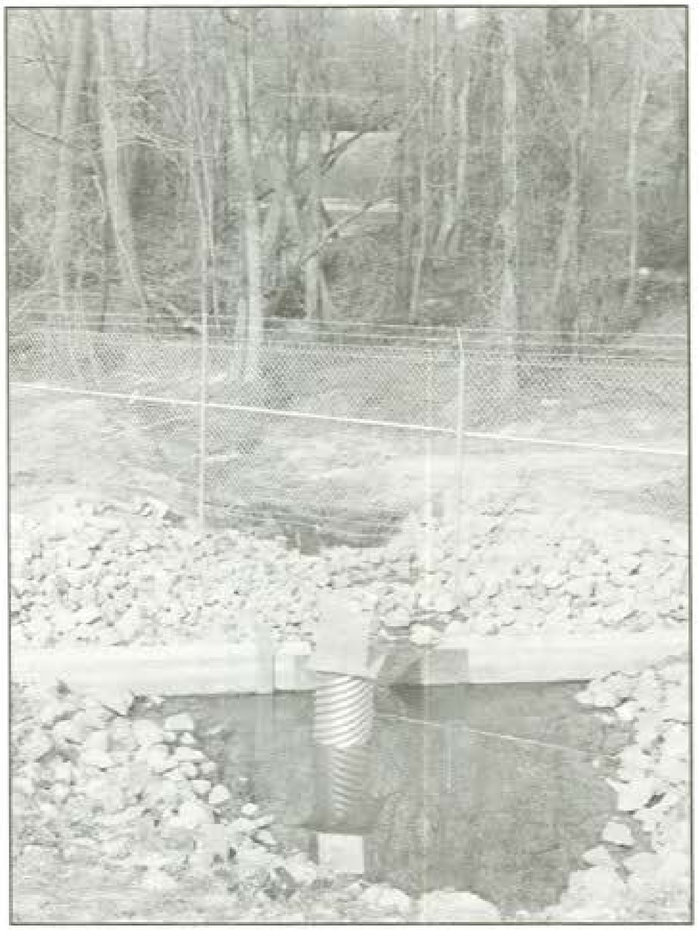
D.16. View from West Conley entrance. Outlet structure to left.
Spillway, inlet pipe at right.

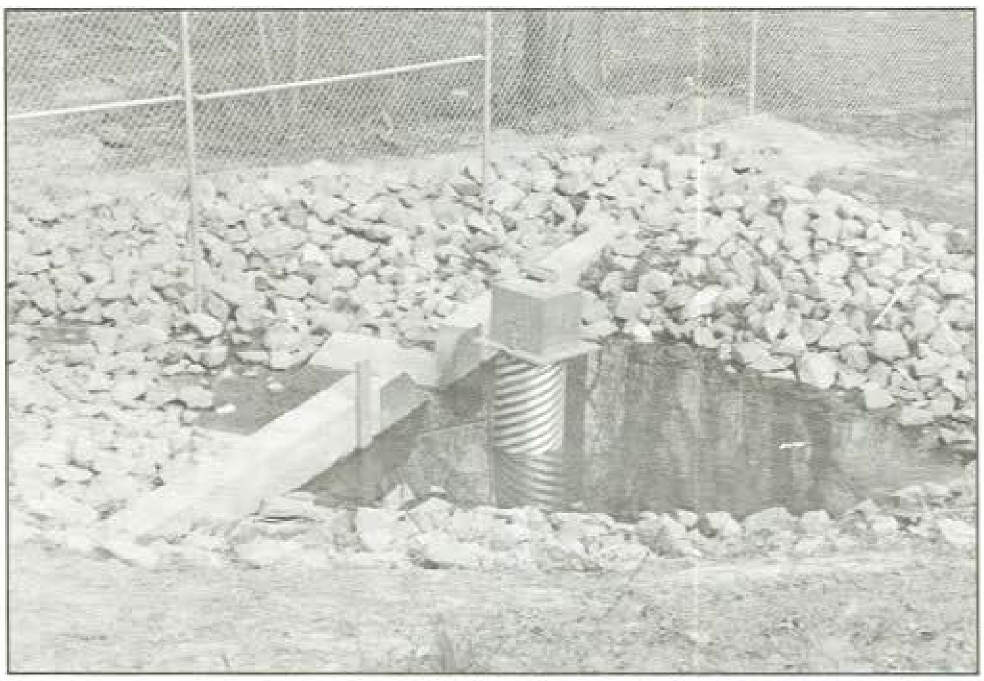
D.17. West Conley entrance to detention basin.

D.18. View of detention pond, facing West Third Street, showing concrete spillway, inlet discharge pipe. Storage shed contains ICMR sampling equipment.

D.19. Riprap on east side of detention basin, next to spillway. Existing drainageway in background.

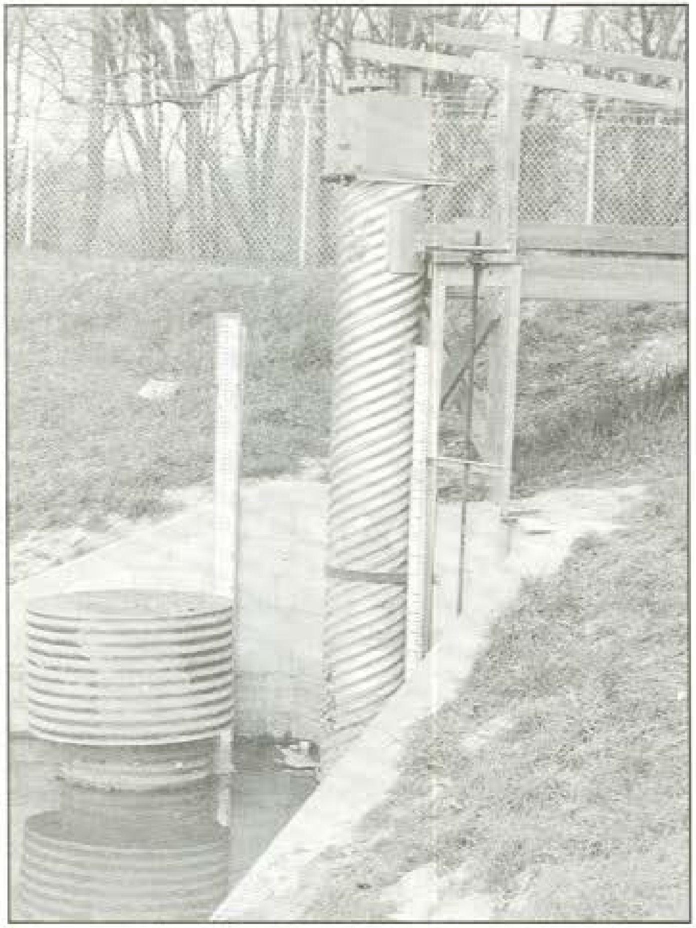
D.20. Outlet storage pool for USGS weir. Tar River wetlands in background.





D.21. USGS weir. Metal box atop corrugated pipe contains stage level recorder.

D.22. Pond discharge outlet structure. Metal box atop corrugated pipe contains USGS stage level recorder. Note wooden catwalk at right.



D.23. Storage shed behind outlet structure contains ICMR sampling equipment. Note outdoor lightpole. Inlet discharge pipe, trapezoidal spillway to right.