DRAINAGE REPORT

RETURN TO:
Land Development
101 West Costilla, Suite 122
Colorado Springs, CO 80903

FOR

Ford

FAIRLANE TECHNOLOGY PARK

COLORADO SPRINGS, COLORADO

FORD MOTOR LAND DEVELOPMENT CORPORATION

FORD COLORADO PROPERTIES

RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
SUBDIVISION ENGINEERING
30 SOUTH NEVADA AVE., SUITE 702
COLORADO SPRINGS, CO 80903
(719) 385-5979

URS
CORPORATION
MAKING TECHNOLOGY WORK
1040 SOUTH 8th STREET
COLORADO SPRINGS, COLORADO
(303) 634-6699

MAY 1986

MASTER SUBDIVISION DRAINAGE REPORT
FAIRLANE TECHNOLOGY PARK
URS PROJECT NO. 6301

MAY 1986

Prepared for: FORD MOTOR LAND DEVELOPMENT CORP.
One Parklane Blvd.
Suite 1500 East
Dearborn, Michigan 48126

Prepared by: URS Corporation
1040 South 8th Street
Colorado Springs, CO 80906

September 4, 1986

City of Colorado Springs
Department of Public Works
Engineering Division
P.O. Box 1575
Colorado Springs, CO 80901

RE: Fairlane Technology Park
Master Subdivision Drainage Report
URS Project No. 6301

Gentlemen:

In accordance with the requirements of the City of Colroado Springs Subdivision Ordinance, a Master Subdivision Drainage Report and Plan has been prepared for the proposed Fairlane Technology Park . The site is located in Northern Colorado Springs. This report has been prepared under the current City of Colorado Springs Draiange Criteria.

Six complete copies of the drainage report and plan are hereby submitted for your review and approval. If there are any questions or comments concerning this report, please contact the undersigned.

Very truly yours,

Arnold H. Niemeyer, P.E.
Assistant Project Engineer

AHN/th

Fairlane Technology Park
Drainage Report and Plan
URS Project No. 6301 Drainage Report Statement

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports. I accept responsibility for any liability caused by the negligent acts, errors, or omissions on my part in preparing this report.

URS CORPORATION

Arnold H. Niemeyer, P.E., Colorado 22281

COLORADO REGISTERED PROFESSIONAL ENGINEER ARNOLD H. NIEMEYER 22281 9-9-86

DEVELOPER'S STATEMENT:

The Developer has read and will comply with all the requirements specified in this drainage report and plan.

FORD COLORADO PROPERTIES

By: ______

Title: Gen. Mgr.

Address: 102 So. Tejon Ste. 700

Colorado Springs, Co. 80901

CITY OF COLORADO SPRINGS:

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980 as amended.

City Engineer ______ Date 9/11/86

Conditions: SEE FOLLOWING PAGES

FLOOD PLAIN STATEMENT

Fairlane Technology Park is situated between the Black Squirrel Creek Drainage Basin and the Kettle Creek Drainage Basin. It does not exist within the limits of a defined 100 year flood plain.

CONDITIONS OF APPROVAL:

1. SUBJECT TO THE REQUIREMENTS OF THE COLORADO DEPARTMENT OF HIGHWAYS, EL PASO COUNTY AND THE U.S. AIR FORCE ACADEMY.
2. SUBJECT TO FINAL DESIGN REQUIREMENTS.
3. FOR THE RUNOFF DISCHARGED FROM SUB-BASIN "C", WRITTEN PERMISSION IS TO BE OBTAINED FROM DOWNSTREAM OWNERS ACCEPTING DEVELOPED FLOWS OR AN OUTFALL FACILITY ACCEPTABLE TO THE CITY AND COUNTY IS TO BE CONSTRUCTED TO AN ESTABLISHED OUTFALL POINT AT KETTLE CREEK. IN LIEU OF THE ABOVE, RUNOFF FROM THIS SUB-BASIN IS TO BE LIMITED TO HISTORIC RATES AND FORM.

FAIRLANE TECHNOLOGY PARK
SUBDIVISION DRAINAGE REPORT

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APPENDIX

FAIRLANE TECHNOLOGY PARK SUBDIVISION DRAINAGE REPORT

I. PURPOSE AND SCOPE

The purpose of this study is to define the general nature of existing historic runoff conditions and the impact of the development of the Fairlane Technology Park on existing downstream drainage facilities. This study will also determine proposed drainage facilities which will be designed to accommodate both offsite and onsite runoff across Fairlane Technology Park.

The proposed development and drainage basin is situated between the Black Squirrel Creek drainage basin to the north and Kettle Creek to the south. Although portions of this site drain to Kettle Creek, the majority of the runoff drains directly into Monument Creek across the Air Force Academy. The area involved in this study creates little or no impact on the adjacent drainage basins and there exists no approved master plan for this area.

Aside from the Ford Aerospace and Microelectronics Facilities, Colorado Highway 83 and the adjacent county roads, the majority of this site is presently undeveloped. In the developed condition this site will consist mostly of commercial office buildings, warehouse, and light industrial development. Design of proposed drainage facilities is based on the concept plan for Ford Colorado Properties, as prepared by Nolan E. Schriner, Inc.

Runoff quantities and proposed drainage facilities have been calculated and designed utilizing the City of Colorado Springs drainage design criteria.

The need to define drainage parameters and facilities addressed in this study was triggered by pending improvements to State Highway 83 and Fairlane Parkway and Interchange. The improvement of State Highway 83 to a 4-lane section, Fairlane Parkway road to a 2 lane paved section, and a new interchange on I-25 at Fairlane Parkway are improvements mandated by the City of Colorado Springs in the Ford Annexation Agreement. Drainage structures in State Highway 83 and the interchange and Old Ranch Road need be installed in their permanent and ultimate configuration to eliminate future reconstruction in the State Right-of-Way.

Additionally downstream facilities, primarily concrete lined channels and detention ponds need be constructed at this time to accomodate reconfigured drainage patterns.

II. STUDY AREA DESCRIPTION

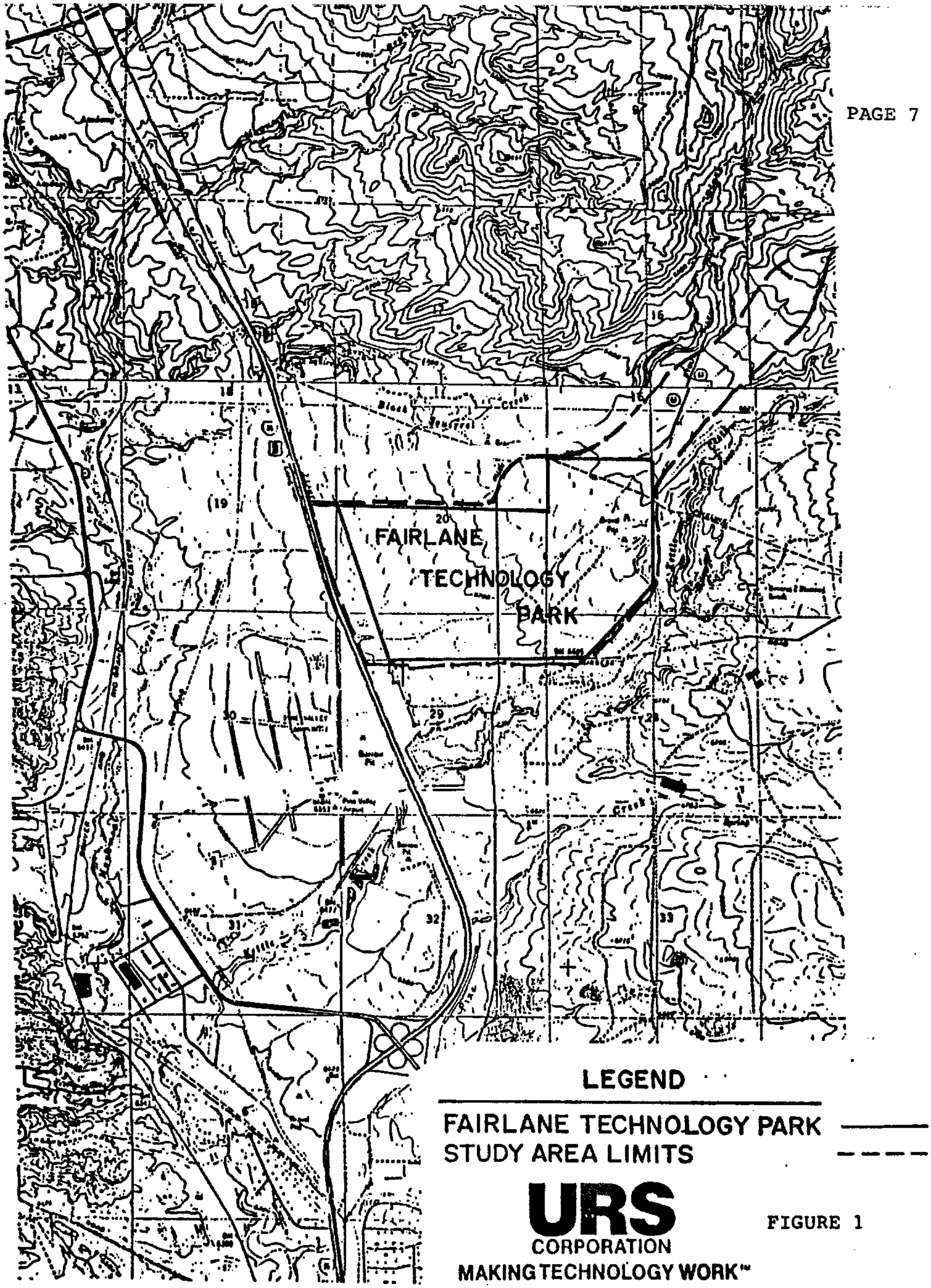
The project study area is situated in Sections 15, 16, 20, 21, 28, and 29, Township 12 South, Range 66 West of the Sixth Principal Meridian. The Fairlane Technology Park contains approximately 666 acres or 1.04 square miles. The offsite area to the northeast contains approximately 227 acres or 0.35 square miles. The interchange project site includes 22 acres. The study area is bounded on the west by Interstate 25, on the north by existing Stout Allen Road and State Highway 83, on the South by Old Ranch Road and on the East by the Kettle Creek Drainage Basin. The study area is bisected by the existing Colorado Highway 83.

The topography of the site consists of moderately sloping hills which slope generally from northeast to southwest at an average of slightly greater than 2%. Existing drainageways within the basin are not clearly defined by swales or erosion, indicating that runoff generated by this basin is generally in the form of sheet flows. The existing network of roadways within the study area appears to have had minimal effect on the historic drainage patterns.

Although the majority of the study area drains to Monument Creek to the west, a small portion of the Fairlane Technology Park, approximately 79.2 acres along the east and southeast boundary, drains directly to Kettle Creek. Portions of this area have experienced mining operations for gravel extraction.

Historically, the Fairlane Technology Park received offsite runoff from an area of about 227 acres to the northeast of the property. This area is currently undeveloped pasture land. A small ridge line along the southerly limits of the basin prevents this runoff from reaching Kettle Creek.

Vegetation within the basin boundaries consists mostly of prairie grasses with some small stands of trees and scrub oak. For the purpose of this study the area has been considered as pasture or range land.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LEGEND
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STUDY AREA LIMITS
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FIGURE 1

III. SPECIAL STUDY AREA CONSIDERATIONS

A. Hydrologic Constraints

Two separate, distinctly different criteria exist for considering runoff within the study area. The majority of the site drains to Monument Creek through the Air Force Academy (AFA) property. The Academy requires that runoff accepted at their property line be limited to historic levels. This AFA policy differs from the City of Colorado Springs criteria which is based on the safe and adequate conveyance of developed runoff flows. Drainage facilities as outlined in this report are designed to transport developed runoff from the entire tributary area through Fairlane Technology Park. Detention ponds have been sized to limit the runoff from the study area (onsite and offsite) to 5 and 100 year historic levels except where additional constraints exist which require additional detention for the 100 year storm. Developments upstream from Fairlane Technology Park will not be required to provide detention ponding.

Portions of Fairlane Technology Park drain directly to Kettle Creek. This basin was investigated by the U.S. Army Corp of Engineers. For their "Report on Hydrologic Investigations, Flood Insurance Study for Colorado Springs and El Paso County, Colorado", and for the design of the Kettle Creek detention facility. The flood study estimated the 100 year peak runoff to be 9500 cfs. Because of its location near the downstream end of the basin, Fairlane Technology Park's peak discharge will pass through to the detention facility long before the peak runoff arrives from the remaining portion of the basin. Based on the expected runoff determined in the Corp of Engineer's Report, Kettle Creek's existing and proposed structures should adequately handle the increased runoff from this portion of Fairlane Technology Park. It is also felt that allowing runoff from this area to pass as quickly as possible will have the least effect on the peak 100 year flows from the entire basin. Runoff from this area will therefore be discharged from the site under standard Colorado Springs drainage criteria. Excerpts of the Corp's study are included in the appendix of this report.

The area included in the proposed interchange at Fairlane Parkway (Stout Allen Road) has also been included in this report since it is felt that it is also an integral part of the development.

As the tributary area to Monument creek is developed and platted, other detailed subdivision drainage reports will be prepared and approved by the City of Colorado Springs. Detailed drainage studies associated with these future subdivisions could identify changes to the assumptions stated in this report and should be evaluated on a case by case basis with respect to existing and/or approved drainage facilities as discussed in this report.

B. Basin Constraints

Fairlane Technology Park does not exist within the limits of a defined drainage basin recognized by The City of Colorado Springs. Portions of the study area drain to Monument Creek and the remaining area drains to Kettle Creek. The proposed storm sewer system in Fairlane Technology Park will be designed and built to accommodate not only onsite runoff, but runoff from the area north and east of Fairlane Technology Park, Old State Highway 83, realigned SH83, Fairlane Parkway, Stout Allen Road, and Old Ranch Road, and will be considered as public improvements. The developer will construct these improvements at his cost. As stated in the annexation agreement for this property, this will be considered a closed drainage basin and is therefore exempt from drainage fees or reimbursements.

IV. STUDY AREA GEOLOGY AND SOILS

Basin soil classifications have been determined using the "Soil Survey of El Paso County Area, Colorado" by the Soil Conservation Service. The majority of the area comprising Fairlane Technology Park consists of either Blakeland Loamy Sand and Columbine gravelly, sandy, loam (see Figure 6 and Table 1). These are considered to be a part of the Hydrologic Soils Group A. The majority of the offsite contributing areas and a part of Fairlane Technology Park at the northwest corner of the site are classified as Peyton Pring Complex, Pring Coarse Sandy Loam, Stapleton Sandy Loam or Stapleton-Bernal-Sandy Loam, all included in the Hydrologic Soils Group B. These soils have evolved from material weathered from Arkosic sedimentary rock. Arkosic sedimentary rock is considered a sandstone with granitic source for sand. The sand sized Feldspar particles are much stronger than the cementing material in the sandstone and remain as discrete particles after loss of cementation in the rock. The result is a granular soil which is easily erodable by surface water runoff.

Basin soil and land use characteristics directly affect the relationship between rainfall and runoff within a basin. The

U.S. Soil Conservation Service classifies soils into four hydrologic groups (A, B, C, and D) according to a soil's runoff potential. Group A soils exhibit high infiltration rates when thoroughly wetted and are considered to have low runoff potential. Group B soils exhibit moderate infiltration rates when thoroughly wetted. Group C soils exhibit slow infiltration rates when thoroughly wetted. Group D soils exhibit very slow infiltration rates when thoroughly wetted and are considered to have high runoff potential.

Soil types within this basin are listed in Table 1 and delineated in Figure 1. Approximately 50% of the basin is hydrologic soil Group B soils with the remaining 50% being Group A.

The soil types within the basin also influence the potential siting locations for reservoirs. Almost all of the soils within the basin are well drained and erode easily. Detention storage reservoirs constructed in this basin's soils may experience seepage. Final design of detention ponds and embankments should consider these problems and require detailed soils investigations. Almost all of the soils are expected to have moderate potential for frost action.

TABLE I
SOIL TYPES

SOIL ID. NUMBER	SOIL NAME	SLOPE %	HYDROLOGIC SOIL GROUP
8	Blakeland Loamy Sand	1-9	A
19	Columbine Gravelly Sandy Loam	0-3	A
68	Peyton - Pring Complex	3-8	B
71	Pring Coarse Sandy Loam	3-8	B
83	Stapleton Sandy Loam	3-8	B
85	Stapleton - Bernal Sandy Loams	3-20	B

V. EXISTING DRAINAGE FACILITIES

Several small culverts exist under Colorado State Highway 83 and Stout Allen Road to the north. These culverts accommodate historical runoff from the north east to the south west. The redevelopment of Highway 83 and the increase in runoff generated by the development will preclude the utilization of these culverts in the developed condition. Additionally, the planned development and its resulting road network and the requirement for detention indicate a reconfigured drainage network eliminating these culverts.

Sub-basin boundaries have been delineated on Figure 6 (Historic Drainage Map) to determine the quantity of runoff at the culverts which exist under Interstate 25. Five culverts exist along the Interstate which are affected by areas included in this report. At the extreme southwest corner of the Fairlane Technology Park, there exists 48" and 60" Reinforced Concrete Pipes (RCP). The 48" RCP drains the ditches along Old Ranch Road and the area south to the northern limits of the Kettle Creek Basin. The 60" RCP drains the major portion of the basin. To the north and just south of the proposed Stout Allen Interchange is a 24" RCP which drains the northern portion of Fairlane Technology Park. North of the proposed Stout Allen Interchange are two 24" culverts. These drain the offsite area to the north.

The 60" RCP appears to have more than sufficient capacity to carry the historic flows which are experienced at this point. The 24" RCP directly north of the 60" RCP appears to be somewhat undersized to carry historic flows. Historically, the excess runoff that is experienced at this point probably flowed to the 24" RCP to the north or ponded behind the interstate embankment. With the construction of the Stout Allen Interchange this will not be possible so detention facilities will be required to limit runoff to the pipe capacity.

VI. STUDY AREA HYDROLOGY

Determining runoff for a particular drainage basin needs to consider the effects of many different variables. In the absence of a reliable historic record of rainfall, runoff, and other pertinent variables, it is usually necessary to use a synthetic unit hydrograph method to determine the runoff that will occur for a given rainfall event. The SCS method of determining peak flood flows and hydrographs was used to estimate direct runoff. "The design of small dams" Bureau of Reclamation Method was used to determine hydrographs for detention ponds.

Present City of Colorado Springs criteria require that the design of facilities where the 100-year storm exceeds 500 cfs to be for the 100-year design flow. Facilities where the 100-year storm is less than 500 cfs shall be designed for the 5-year storm with a provision that the 100-year storm shall be conveyed to the major facilities without damage to buildings or structures. For example, a 5-year storm sewer may be built and the 100-year storm will be contained within a street right-of-way or a drainage easement. Criteria for the major facilities (500 cfs) will require the design to be for the greater of the peak flows determined for the 100-year, 24-hour storm and the 100-year, 6-hour storm. Design of minor facilities (500 cfs) shall be for the 5-year, 6-hour storm. Detention ponds shall be calculated using the SCS method as outlined in the "SCS National Engineering Handbook, Section 4" and appropriate routing technique for the 100-year, 24-hour storm with Type IIA rainfall distribution. Flows for sub basins should be calculated using the modified SCS method as delineated in the "Subdivision Policy Manual" for the City of Colorado Springs.

The drainage basin boundaries were determined from the topography on USGS 7-1/2 minute quadrangle maps. The subbasin boundaries and design points determined for fully developed conditions are shown on Figure 3 (attached). The hydrologic soil groups were then determined for each subbasin. Ground cover and existing land use was determined for each subbasin. For historic (present) conditions, a weighted curve number was determined for each subbasin based on soil types, and type of cover. For future developed conditions, a weighted curve number was determined based on soil types, type of cover, and taking into account projected development.

Time of concentration for the subbasins was determined by the following equation:

$$TC = \left[\frac{11.9\ (L)^3}{H}\right]^{.385}$$

where
TC = time of concentration in hours
L = length of longest watercourse in miles
H = elevation difference in feet

Intermediate times of concentration were determined using pipe flow or street velocities.

Rainfall depths of 2.7 and 4.6 inches were obtained from isopluvials for the project area for the 5-year, 24-hour and 100-year, 24-hour storm events respectively. The rainfall depths of 2.1 and 3.5 inches were obtained from the aforementioned "Subdivision Policy Manual" for the 5-year, 6-hour and 100-year, 6 hour storm events, respectively.

VII. Proposed Facilities and Recommendations

Based on the proposed master planning of the Fairlane Technology Park, three developed drainage basins have been delineated to determine drainage and detention facilities. For purposes of description, these basins have been designated as Basins A, B, & C. (see Figure 7, Attached) All of the following described basins generally follow historic drainage patterns. All drainage channels not in a public right-of-way will be contained in a public drainage easement.

BASIN A

BASIN A is the largest of the Basin and includes the offsite contributing area, basins 0-1 and 0-2 to the northeast. The storm sewer through basin A and the remaining portions of Fairlane Technology Park is designed to carry the entire 5 year developed storm runoff. In some instances where residual capacity exists in the storm sewer pipe above that required for the 5 year storm, inlet capacity has been increased to reduce street flows for larger storms. The 100 year storm will be carried in the streets or grass swales through the park to the detention ponds.

Developed runoff from basin 0-1 will be collected in the proposed realignment of Highway 83 and flow to design point 1. It is assumed that 60% of the runoff from the 5 year storm will be collected in an inlet and flow in a 24" RCP westerly in realigned state Highway 83. Similarly runoff from basin 0-2 will be collected in Fairlane Road and flow to design point 1 where it will combine with runoff from basin A-1.

Two (2) 12.0' curb opening inlets along with a 12" inlet in S.H. 83 will drain the 5 year developed runoff from subbasin A-1, combining it with the offsite 5 year developed flows in a 42" RCP which will proceed westerly in the proposed alignment of Highway 83 to the intersection of Road B (Design Pt.2).

Runoff from subbasin A-2 will be collected in a 22' inlet at the low point of the street and drain to the 42" RCP in the proposed alignment of Highway 83. From this point a 42" RCP will proceed southerly in Road B to its intersection with Road A (Design Point 3). Runoff from Subbasin A-3 will be picked up in 4 - 20' inlets in the intersection. A 48" RCP will proceed westerly in Road A to a low point located directly east of State Highway 83 (Design Pt 4). Runoff from subbasin A-4 along with runoff from the east side of State Highway 83 will be collected in 2-8.0' curb opening inlets located on both sides of the Road A near the low point. Runoff in excess of the 5 year developed storm will overtop the south flowline at this point and drain in a private graded grass swale along the east line of State Highway 83. A 48" RCP will also proceed south in an easement along the east right of way line of State Highway 83 to design point 5 at the intersection of Fairlane Road.

At design point 5 a box inlet (8' X 10') will be installed to accept runoff in the upstream 48" RCP and the remaining overland 100 year developed flows. Routed peak flows at this point exceed 500 cfs (514 cfs), therefore all downstream facilities have been sized to accept 100 year developed runoff. The inlet will be drained by an 8' X 5' concrete box culvert which will be installed along the east line of State Highway 83, under the proposed Fairlane Road to a concrete channel to the south.

Subbasin A6.1 and A6.2 will drain to 12' inlets located at each PCR of the northeast curb return of the intersection of Fairlane Road and Road C. A 24" RCP will carry this flow and connect to the 8' X 5' box culvert from the inlet. Overland flows from subbasin A-6 along with runoff from the east one half of State Highway 83 will flow to a low point in Fairlane Road just east of the highway. Ten foot curb opening inlets on each side of Fairlane Road will collect the 5 year flows with the excess draining over the curb to the south.

A concrete channel south from Fairlane Road along the east right-of-way line of Highway 83 will accept flows from the box culvert and subbasin A6.1 and A6.2, and will be located in a public easement. This channel will flow to a 9' X 6' concrete box culvert under State Highway 83 to the west (Design Pt. 7). The box culvert will also accept 100 year developed runoff from subbasins A7.1 and A7.2. The flows from the box culvert are transported to pond A by means of a concrete channel which also drains the 100 year runoff from the northern half of Old Ranch Road. The Rip Rap lined ditch along Old Ranch Road east of SH 83 will drain storm runoff from the road and as such is a public facility.

Subbasins A-8, A-9, A-10, and A-11 also drain to Detention Pond A. A-9 and A-10 drain to Fairlane Road and their runoff is conveyed to the pond by means of a 36" RCP. A-8.2 and A-11 drain directly to the pond.

Detention storage requirements for Pond A have been determined by developing a storm hydrograph based on a 24 hour storm for all of Basin A. It was determined that 55.8 acre feet of storage will be required. The 5 year storm release rate will be 22.7 cfs, through an 18" RCP. Ponding will occur to a depth of 5.7 feet. The 100 year release rate will be 188 cfs. This flow will drain by means of a grated inlet in conjunction with the 18" RCP. The grate of the inlet will be set at an elevation 5.7 feet above the bottom of the pond. The inlet will drain by means of a 42" RCP acting under a maximum headwater depth of 13.0 feet. Due to the increased time of concentration, the downstream undetained area flows combined with the pond discharge do not exceed historic levels.

At the outlet of Pond A an energy dissipation system will be designed to limit velocities and control erosion potential. Upon leaving the energy dissipation system, the runoff will flow overland through a natural swale to the existing 60" RCP at Interstate 25. Based on a headwater to diameter ratio of 1.3 to 1 (C.D.O.H. Standard) this pipe has an allowable capacity of approximately 190 cfs. Final design of the energy dissipation system will be done with the design of the detention pond.

Should the outlet to the pond become plugged, a maximum discharge over the emergency spillway of 418 cfs is expected. This discharge is based on the pond inflow at the point where the pond volume is exceeded. It is expected that flow in excess of 190 cfs (60" capacity) will flow to the south to the existing 48" RCP under I-25. This pipe has an available headwater depth in excess of 12 feet yielding a theoretical capacity of greater than 220 cfs. The capacity of these two pipes along with the existing natural detention storage in the highway right-of-way should be more than sufficient to prevent flooding of Air Force Academy or overtapping of the northbound I-25 laneage.

BASIN B

Basin B exists to the north of proposed Basin A. Subbasins B-1 and B-2 are located north of the proposed State Highway 83 Realignment and east of present Highway 83. Runoff from B-1 (north 1/2 street) will be picked up in a 10' inlet in the proposed intersection of Fairlane Parkway alignment of State Highway 83 and connect to a 54" RCP under State Highway 83. B-2 will drain to the proposed 54" RCP. The 54" RCP will accommodate the 100 year developed storm for B-1 and B-2. This 54" RCP will discharge to a concrete channel which will be situated between the proposed Fairlane

Parkway and the existing Stout Allen Road. This facility will also carry runoff from the Fairlane Parkway which will be picked up in 10' inlets on each side of the street at the Fairlane Road intersection. At a point just east of the proposed interchange at Interstate 25 runoff from the channel will enter an 8' X 4' box culvert and drain to the south to Detention Pond B. Two 10' inlets will be installed in Fairlane Parkway east of the interchange to drain the roadway. Subbasins B-3 and B-4 along with runoff from the west one-half of Highway 83 will drain to a low point in Fairlane Road. Street capacities are sufficient to carry this runoff to this point. Two 14.0' curb opening inlets will collect the runoff at this point into a future 30" RCP which will drain to Pond B. A temporary grass swale (Private) in the same public easement will convey flows prior to development. Flows in excess of the 5 year storm will flow overland to the pond in the same swale.

Pond B will have a storage capacity of 37.0 acre feet and a maximum release rate of 25.9 cfs based on the allowable capacity of the existing 24" RCP under I-25. Detention is based on a developed storm hydrograph for subbasins B-1 through B-5. The release rate of 25.9 cfs occurs through an 18" RCP with a maximum headwater of 9.5 feet. Discharge from Pond B will occur through a similar energy dissipation system as that of Pond A and flow overland to an existing 24" RCP under Interstate 25 with an approximate capacity of 25 cfs (based on allowable HW/d=1.5 for new construction). This rate is approximately the same as the 5 year historic rate. Although 100 year historic rates are much higher, the capacity of this pipe dictates that detention be required to limit runoff to that of the capacity of this pipe. Since the 5 year detention levels will not pond to the maximum depth, 5 year discharge rates will be lower than historic.

It should be noted that the actual capacity of the existing 24" RCP under Interstate 25, based on an available headwater depth of approximately 5.5 feet, is 42 cfs. This discharge is approximately equal to the expected runoff for the 100 year undetained area west of the detention area. Routing the undetained area with the discharge from the detention pond yields a maximum runoff at the existing 24" pipe of 35.5 cfs. Although greater than the allowable capacity per C.D.O.H. standards for new construction, this runoff is less than the undetained peak runoff and the actual capacity of the pipe. To further reduce the discharge from the pond to accommodate the undetained area would require the installation of a flow metering oriface plate in front of the 18" RCP having an open area of approximately 1.0 square feet. Engineering judgement would dictate that this would greatly increase the chances for the outlet to become plugged and therefore overtop the dam.

It is therefore felt that since the pipe has the actual capacity to handle the detained and undetained flows, and even the historic flows have been greatly reduced, it would be counter productive to increase the detention and decrease the pond discharge to try to maintain the headwater depth previously mentioned.

Detention pond embankment for basins A & B will be designed to provide a broad crested weir overflow spillway, sized large enough to carry the peak 100 year runoff in the event the outlet structure becomes plugged. The bottom elevation of the weir will be set at the maximum ponding depth. The downstream side of the embankment at the overflow spillway will require erosion protection in the form of concrete or rip rap.

Should the outlet of Pond B become plugged, a discharge over the emergency spillway of approximately 65 cfs is expected. Between the natural detention in the Highway Right-of-Way and the 24" RCP, no flooding of the Air Force Academy West of I-25 should be expected.

BASIN C

Basin C exists at the easterly edge of the property and drains ultimately to Kettle Creek to the southeast. Since this area is not constrained by historic rate limits, detention ponding has not been provided. This basin has been divided into 4 subbasins, C-1 through C-4.

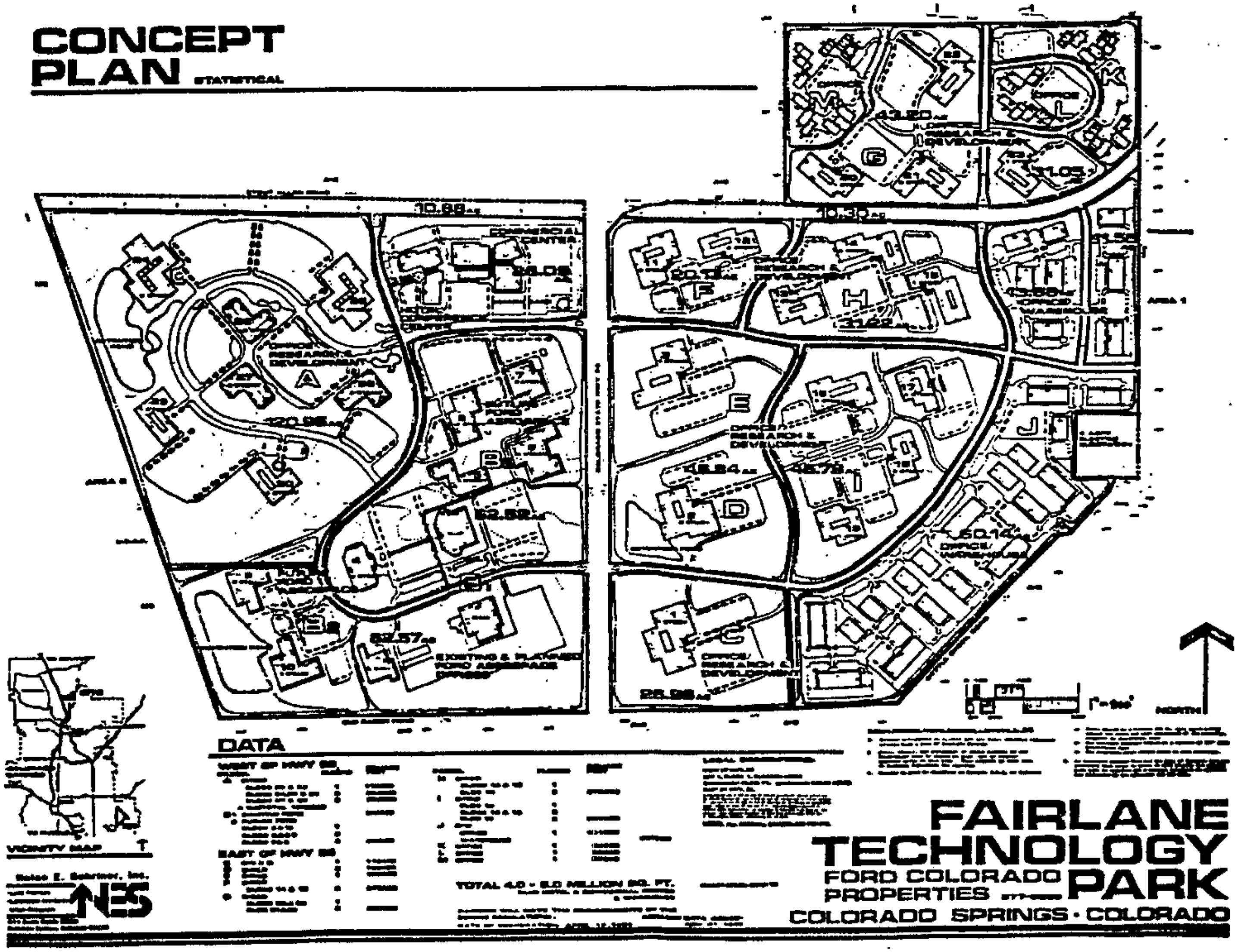
Subbasin C-1 drains to the intersection of Road A and Road D. Runoff at this point does not exceed the street capacity and will proceed easterly in Road A to the east property line picking up a portion of the runoff from subbasin C-2. This runoff is intercepted by a natural swale draining southerly along the east property line. Ultimately a concrete ditch along the east property line will collect runoff from subbasins C-1, C-2, and C-3. This ditch carries runoff from the Fairlane development as well as runoff from the property east of Fairlane Technology Park. With the downstream property owners concurrance, this runoff will be discharged from the site at the thalweg of the natural swale. Erosion protection will be provided at this point to limit the velocity of the runoff leaving the site.

Subbasin C-4 drains to the southeast corner of Fairlane Technology Park. The collection system for this runoff will be determined at the time of final site layout and design. This runoff historically flows to Kettle Creek. This runoff will be transported to Kettle Creek by either a roadside channel or a 36" RCP. County officials have indicated that if Old Ranch Road is upgraded to a major arterial in the future, a pipe would be required.

FAIRLANE PARKWAY INTERCHANGE

With the construction of the Fairlane Parkway Interchange, the existing 24" RCP under Interstate 25 will be situated within the interchange itself. That area north of Stout Allen Road which is tributary to this pipe will be accommodated by a 24" RCP to be installed under the north bound on-ramp to Interstate 25. Future detention will be required for this area to limit runoff to historic levels and to the capacity of the existing 24" pipe. This existing 24" RCP will also drain that area within the limits of the interchange itself (Basin I-1). The area south of Fairlane Parkway and north of the north-bound off-ramp will be graded to drain under the proposed bridge and to the existing 24" RCP. Basin I-3 contains flows not intercepted by pond 3 and which are intercepted by the I-25 embankment fill. Flows combine with pond 3 discharge and discharge through the existing 24" RCP at I-25.

Basin I-2 bounded by the eastbound ramp to Fairlane Parkway from I-25 will drain through the rampfill by means of a 24" RCP to the natural drainage way. Basin I-4 will drain to a 30" RCP in the natural drainage way to combine with flows from the existing 24" under I-25. Basin I-5 discharge a 100 year flow of 2 cfs through the minimum size 24" RCP through the rampfill. Discharges combine with sheet flows west of I-25 to travel to Monument Creek.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EXISTING & PLANNED FORD AEROSPACE OFFICES
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NORTH
TOTAL 4.0 - 5.0 MILLION SQ. FT.
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TECHNOLOGY
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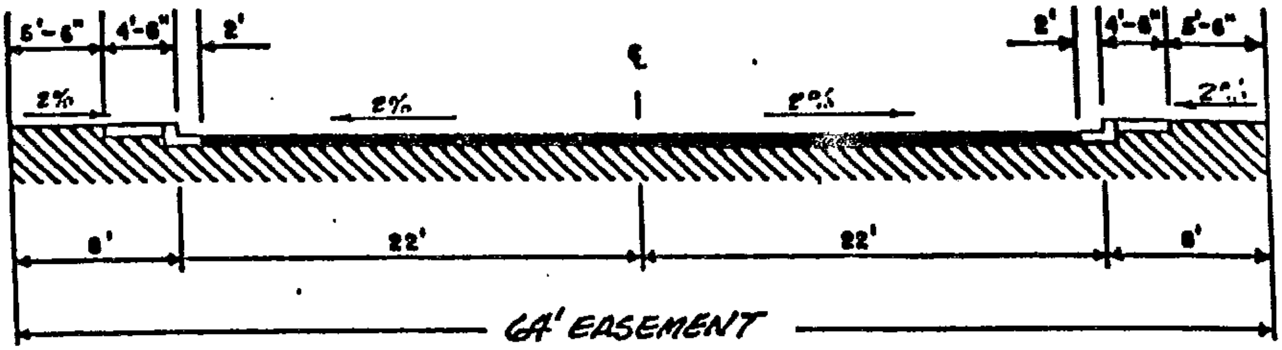
PROPERTIES
COLORADO SPRINGS · COLORADO

FIGURE 2



TYPICAL STREET SECTION
FIGURE 3

$$Q = \frac{1.486}{0.016}(8.04)\left(\frac{8.04}{22.01}\right)^{2/3} S^{1/2}$$

SLOPE %	REDUCTION FACTOR	5YR. CAPACITY (1/2 STREET)	5YR. CAPICITY (FULL STREET)	VELOCITY (FPS)
0.5	0.8	21.2	42.4	2.6
1.0	0.8	29.9	59.9	3.7
1.5	0.8	36.7	73.3	4.6
2.0	0.8	42.3	84.7	5.3
2.5	0.76	45.0	90.0	5.6
3.0	0.71	46.0	92.0	5.7
3.5	0.66	46.2	92.4	5.7
4.0	0.61	45.7	91.3	5.7
4.5	0.55	43.7	87.3	5.4

STREET CAPACITIES
TABLE 2

URS CORPORATION
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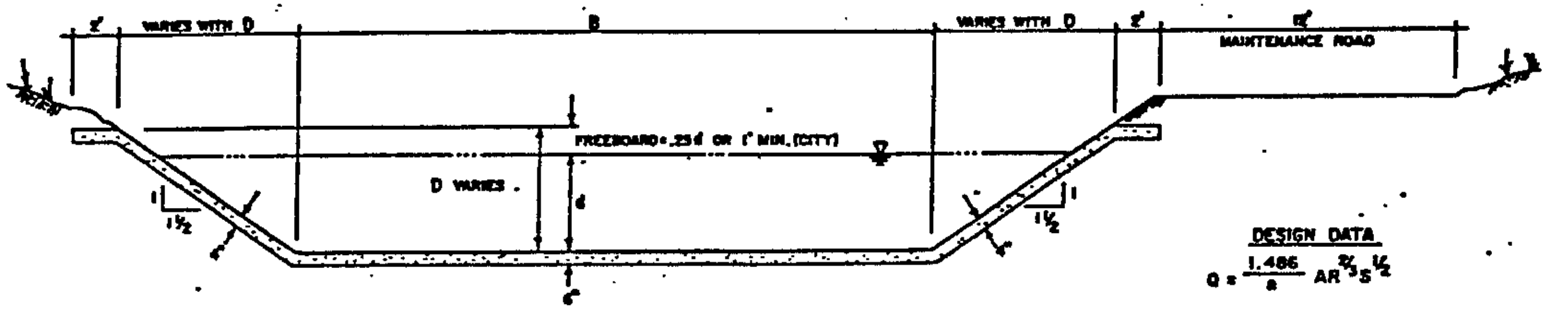
URS JOB NO. 6301 PAGE 23 OF

DATE BY AKN CHECKED BY (date)

CLIENT FORD LAND DEVELOPMENT CO.

PROJECT FAIRLANE TECHNOLOGY PARK

SUBJECT FIGURE 4



TYPICAL CONCRETE CHANNEL SECTION

nts

DESIGN DATA

$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$

$n = 0.015$

$V_{max} = 20$ fps

$F \geq 1.2$

NOTES

1. ALL FINAL DESIGN AND CONSTRUCTION SHALL BE TO CURRENT CITY OF COLORADO SPRINGS AND EL PASO COUNTY SPECIFICATIONS.

2. FINAL CHANNEL SIZING, TRANSITIONS, AND SUPERELEVATIONS ARE SUBJECT TO DETAILED DRAINAGE REPORTS OF THE SUBJECT AREA.

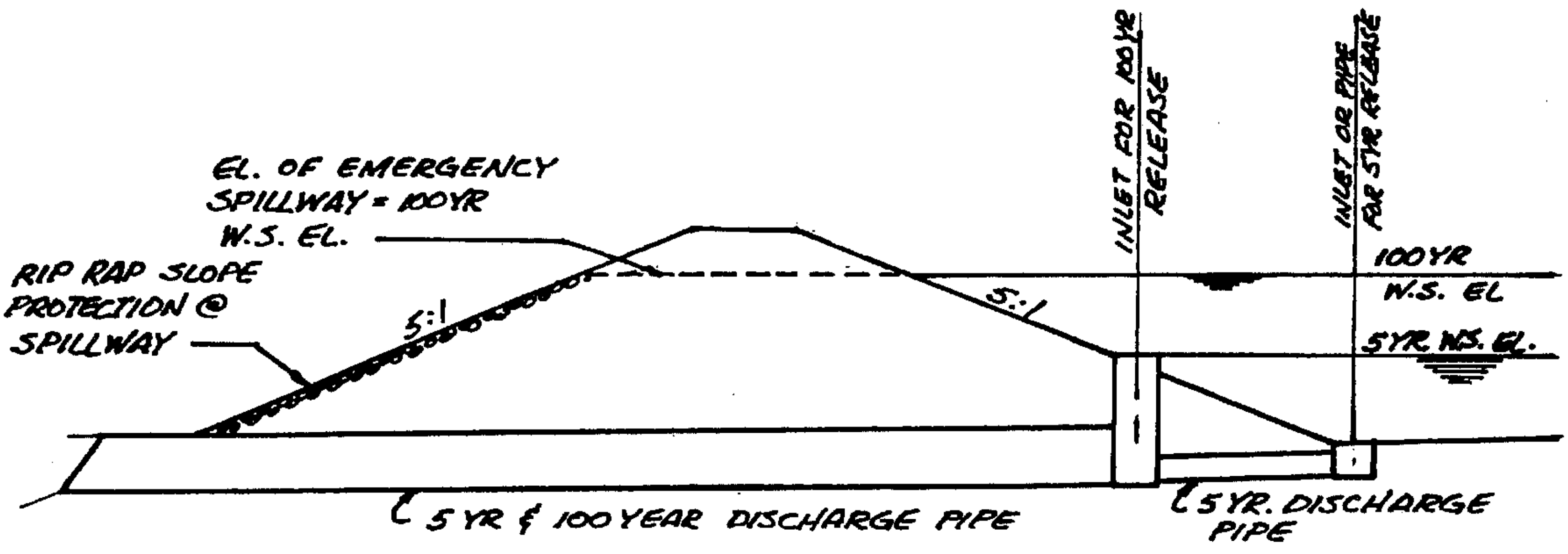
3. THIS DETAIL WAS USED FOR COST ESTIMATING PURPOSES FOR THIS MASTER PLAN ONLY.

SUBJECT TABLE 3 - CHANNEL DESIGN SUMMARY

DESIGN POINT	B_w (Ft)	WATER D (Ft)	A (Ft²)	WP (Ft)	$R^{2/3}$ (R=A/WP)	$S^{1/2}$ (Ft/Ft)	n	$\frac{1.486}{n}$	Q CAPACITY (cfs)
6 to 7 (SH 83)	6'	4.2'	51.66	21.14	1.81	0.07 0.5%	0.015	99.07	656.5 (637.5)
7 to 9 (OLD RANCH)	6	3.1	33.02	17.18	1.55	0.141 2%	0.015	99.07	715 (678.9)
15 to 17 (FAIRLANE BLVD)	6	2	18.0	13.21	1.23	0.158 2.5%	0.015	99.07	347 (225)
7 EAST (OLD RANCH)	6	2.1	15.0	11.6	1.19	0.118 1.4%	0.045	33.02	69.8 (66.8)
22 EAST (OLD RANCH)	4	2.5	19.37	13.01	1.30	0.07 0.5%	0.04	37.15	66.1 (42.7)

BASED ON MANNINGS EQUATION $Q = \frac{1.48}{n} A R^{2/3} S^{1/2}$

CHANNELS HAVE 1.5 : 1 SIDE SLOPES



POND	Q_{5YR} (cfs)	D_{5YR} (Ft)	Q_{100YR} (cfs)	D_{100YR} (Ft)	SPILLWAY HEIGHT (Ft)	STORAGE (Ac Ft)
A	22.7	5.7	188	9.2	9.2	55.8
B	17.6	5.3	25.9	9.5	9.5	37.0

* 100 YEAR DISCHARGE ≈ 5 YEAR HISTORIC THEREFORE 5 YEAR DISCHARGE WILL BE LESS THAN 5 YEAR HISTORIC.

VIII. DRAINAGE FEES

The estimated cost to construct drainage improvements for this project is $2,384,930.00. As stated in the annexation agreement for this property, (Appendix E) this area is considered a closed basin. The developer will construct all proposed on-site drainage facilities and will receive no reimbursement. Recent interpretations by the City Engineer have ratified the Annexation Agreement in as much as no portion of the property (including that in Kettle Creek Basin) are subject to City Drainage fees.

IX. BIBLIOGRAPHY

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Subdivision Policy Manual and Public Works Design Manual
City of Colorado Springs
May 1980
Including supplements and revisions

Black Squirrel Creek Drainage Basin
Master Drainage Plan
City of Colorado Springs and El Paso County
Prepared by URS Corporation, September 1985

Report on Hydrologic Investigations
Flood Insurance Study
Colorado Springs and El Paso County, Colorado
Albuquerque District, Corps of Engineers
Dated December 1986

APPENDIX A

HYDROLOGIC COMPUTATIONS

BASIN	Area (acres)	Geometry		Tc (HR)	Soil Type	CN	Q_p (cm/in)	Runoff (in)		Peak Flow (CFS)	
		Length	Height					5 yr	100 yr	5 yr	100 yr
A-1	341	16,200	457	0.90	59% A 41% B	57.2	535	0.044	0.422	19.9	190.8
A-2	41	6000	140	0.45	A	57*	770	0.04	0.415	2.0	20.5
B	258	7500	200	0.50	A 52% B 48%	60.3	730	0.085	0.54	25.0	158.9
C-1	42	1000	70	0.10	A 50% B 50%	59	1280	0.065	0.49	5.5	41.2
C-2	73	3500	80	0.30	A	56‡	920	0.03	0.38	3.1	39.9
O-3	80	5000	160	0.35	A 15% B 85%	66	860	0.18	0.8	19.4	86

* ASSUME 30% GRAVEL ROAD
‡ MINIMUM CN USED

Summary of Hydrologic Computations

HISTORIC RUNOFF FOR DETENTION POND DESIGN

URS ↑NES
811 E. 8th ST.
Suite # 1
Colorado Springs, CO.
80906
(303) 634-8690

STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

BASIN AND Design Point	BASIN AREA	SOIL GROUP A/B	CN	T_o (HRS)	PIPE FLOW TIME (HRS)	STREET FLOW TIME (HRS)	T_C (HRS)	CSM/IN.	RUNOFF 5 YR.	RUNOFF 100 YR.	PEAK RATE 5 YR.	PEAK RATE 100 YR.	Street: Slope %	Street: Allowable Capacity cfs	Pipe: Slope %	Pipe: Size in.	Pipe: Capacity cfs	Street: Design cfs	Street: Velocity fps	Pipe: Design cfs	Pipe: Velocity fps	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1A O-1	169.1	6/94	69	0			0.46	760	0.255	0.955	51.2	191.8	1.6	98.9	1.8%	24"	32	20.5		30.7		Assume 60% Pickup of
1B O-2	55	46/54	63	0			0.29	930	0.125	0.665	10	53.1	0.7	229				10.0				5 YEAR Q @ PT 1A
			INSTALL 12' INLET IN REALIGNED SH 83 @ PCR CAP=12.7 FOR Q5 & 12.9 for Q100																			A-1 ONLY
1 A-1	409	70/30	93.1	0			0.17	1110	0.735	1.86	53.6	152.0										
1 O-1 THRU A-1	765		70	0.46		0.03	0.49	740	0.25	1.01	85.8	309.5										
			AT POINT 1 INSTALL 12' INLETS EACH SIDE OF ROAD AT SUMP IN FAIRLANE RD																			
			CAP = 55.2 cfs (Tot.) — 100% PICKUP OF 5 YEAR STORM. FOR 100 YEAR STORM																			
			CARRY OVER TO SUMP INLET AT PT 12 = 210.7 cfs (309.5 - 98.8)																			
1 TO 2													1.6	98.9	1.6	42"	140	0	—	85.8	14.4	5 YEAR ROUTED
1 TO 2													1.6	—	1.6	42"	140	210.7	—	98.8	—	100 YEAR
																						A-2 only
2 A-2	20.7	22/78	83.7	0			0.13	1200	0.82	1.94	31.8	75.3										
2 O-1 THRU A-2	285.7		71	49	0.03		0.52	715	0.31	1.065	98.9	339.9										
			AT POINT 2 INSTALL 22' INLET AT SUMP IN REALIGNED SH 83 CAP = 54.2																			
			100% PICKUP OF 5 YEAR STORM (98.9 - 85.9 = 13.1) FOR 100 YEAR STORM,																			
			CARRY OVER FLOW DOWN ROAD 8 TO PT. 3 = 186.7 cfs																			
2 TO 3													2%	84.7	2%	42"	160	0	—	98.9	16.1	5 YEAR ROUTED
2 TO 3													2%	—	2%	42"	160	186.7		153.2		100 YEAR STORM
																						A-3 ONLY
3 A-3	35.3	96/4	81.3	0			0.19	1090	0.665	1.71	40.0	102.8										
3 O-1 THRU A-3	321		72	0.52	0.02		0.54	700	0.34	1.12	119.4	393.2										
			AT POINT 3 INSTALL 20' INLET EACH SIDE OF ROAD 3 & ROAD 4. CAP = (4x16).6 = 38.4																			
			60% Pickup (Tot) OF PEAK 5 YEAR STORM — 100% PICKUP OF ROUTED 5 YEAR STORM																			
			FOR 100 YEAR STORM — CARRY OVER FLOW IN ROAD A TO PT 4 = 197.1 cfs																			
			A POSITIVE 2% GRADE SHALL BE EXTENDED 10' BEYOND R.O.W LINE OF																			
			ROAD A TO INSURE SUFFICIENT STREET CAPACITY FOR 100 YEAR STORM.																			
3 TO 4													2%	84.7	2%	48"	210	0	—	119.4	14.6	5 YEAR ROUTED
3 TO 4															2%	48"	210	183.2		210		100 YEAR
																						A-4 ONLY
4 A-4	23.8	A	81	0			0.16	1150	0.665	1.71	28.4	73.1										INCLUDES EAST SIDE SH 83
4 O-1 THRU A-4	344.8		72	0.54	0.02		0.56	690	0.34	1.12	126.4	46.3										
			AT POINT 4 INSTALL 8.0' INLETS IN SUMP EACH SIDE ROAD A CAP = 2x18.4 = 36.8																			
			100% PICKUP 5 YEAR STORM CARRY OVER FOR 100 YEAR STORM WILL OVERTOP SOUTH FLOWLINE AND																			
			FLOW IN GRASSED GRASS SWALE TO POND 1																			

Wright-McLaughlin Engineers

FIGURE 6-1. TYPICAL FORM FOR STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

BASIN AND Design Point	BASIN AREA	SOIL GROUP A/C	CN	T_o (HRS)	PIPE FLOW TIME (HRS)	STREET FLOW TIME (HRS)	T_c (HRS)	6HR CSM/IN.	RUNOFF 5 YR.	RUNOFF 100 YR.	PEAK RATE 5 YR.	PEAK RATE 100 YR.	Street Slope %	Street Allowable Capacity cfs	Pipe Slope %	Pipe Size in.	Pipe Capacity cfs	Street Design cfs	Street Velocity fps	Pipe Design cfs	Pipe Velocity fps	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
4 TO 5													—	—	1.8	48"	200			106.4	15.9	5 YEAR ROUTED
4 TO 5													1.8%	260*	1.8	48"	200			200		100 YEAR ROUTED
													(SWALE)									
																						A-5.1 ONLY
5 A-5.1	10.2	A	81	0			0.1	1280	0.665	1.71	13.6	34.7										
5 O-1 THRU A5.1	255		73	0.56	0.02		0.58	575	0.57	1.18	138.5	441.8										
																						INCLUDES A-5.1
5 A-5	48	A	81	0			2.16	1150	0.665	1.71	57.4	147.5										
5 O-1 THRU A5	392.8	A	74				0.58	675	0.40	1.24	165.7	513.7										
			OVERLAND FLOWS DRAIN TO BOX INLET WHICH CONNECTS TO 8×5 CONC. BOX CULVERT																			
															0.5%	8×5	550	0		513	13.5	
6A.1 A-6.1	50.6	A	81	0	0	0.2	0.2	1070	0.665	1.71	34.0	87.5	TOTAL STREET CAPACITY NOT EXCEEDED									
				INSTALL 12' INLET @ PCR OF INTERSECTION CAP = 13.4 cfs																		
6A.2 A-6.2	18.4	A	71	0	0	0.2	0.2	1070	0.665	1.71	22.5	52.6										
													INSTALL 12' INLET @ PCR CAP = 10.4									
6A A-6.1+A6.2											54.5	140.1										
6.2A TO 6													1.8	57	1.8	24	32	30.7	—	23.8	10.2	5 YEAR ROUTED
6.2A TO 6																		116.2		23.8		100 YEAR
																						A-6.3 ONLY EXCLUDING SH-83
6 A6.3	4.6	A	81	0		0.1	0.10	1280	0.665	1.71	6.1	15.7										A-6.3 ONLY INCLUDING EAST
6 A6.3	7.9	A	88				0.1	1280	1.05	2.27	16.6	35.9										SIDE SH-83 FROM PT 4 SOUTH
																						ROUTED
6 A6.1 THRU A6.3	56.9	A	82	0.22	0.03		0.23	1040	0.71	1.78	65.6	164.6										
			AT POINT 6 INSTALL 12' INLETS EACH SIDE OF FAIRLANE ROAD IN SUMP																			
			CAPACITY = 27.6 cfs EACH (55.2 cfs) — 100% PICKUP OF 5 YEAR STORM																			
			100 YEAR FLOW IN EXCESS OF INLET CAPACITY WILL FLOW OVER SOUTH																			
			FLOWLINE INTO PROPOSED CONCRETE CHANNEL																			EQ SOUTH OF FAIRLANE
6 O-1 THRU A6.3	449.7		75	0.58			0.58	675	0.425	1.30	[illegible]	[illegible]										A7.1 ONLY
7A A-7.1	25.8	A	81	0		0.21	0.21	1050	0.665	1.71	28.1	72.4										
7A O-1 THRU A7.1	475.5		75	0.58	0.03		0.61	660	0.455	1.30	213.1	637.5										

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FIGURE 6-1. TYPICAL FORM FOR STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

BASIN AND Design Point	BASIN AREA	SOIL GROUP A/B	CN	T_o (HRS)	PIPE FLOW TIME (HRS)	STREET FLOW TIME (HRS)	T_c (HRS)	CSM/IN.	RUNOFF 5 YR.	RUNOFF 100 YR.	PEAK RATE 5 YR.	PEAK RATE 100 YR.	Street		Pipe			Street		Pipe		Remarks
													Slope %	Allowable Capacity cfs	Slope %	Size in.	Capacity cfs	Design cfs	Velocity fps	Design cfs	Velocity fps	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
7B A-7.2	23.8	A	81	0			0.20	1070	0.665	1.71	26.5	68.0										A-7.2 ONLY
7B O-1 THRU A7.2	106.5		75	-			0.65	660	0.455	1.30	229.0	609.4										
						REQUIRED CHANNEL CAPACITY ALONG OLD RANCH ROAD = 68cfs																
																						EAST SIDE OF SH 83
8 A-7.3	1.33	A	98	0		0.1	0.1	1280	1.87	3.27	7.2	12.6										
				AT POINT 8 INSTALL 15' TYPE R INLET CAPACITY ≈ 60% OF 13 cfs = 7.8cfs																		FROM PT 6 TO PT 8
				DRAINS TO BOX CULVERT																		
																						A 8.1 ONLY
9A A-8.1	18.9	A	81	0		0.22	0.22	1040	0.665	1.71	20.4	52.5										
9A O-1 THRU A8.1	518.2		75	0.61	0.03		0.64	645	0.455	1.30	281.2	678.9										
9B A 8.2	40.17	A	81	0		0.22	0.22	1040	0.665	1.71	43.4	111.6										A 8.2 ONLY
10 A9.1	18.0	A	81				0.1	1280	0.665	1.71	23.9	61.6	INSTALL 10' INLET @ PT 10 W/30" STUB TO N.E									FOR 30% PICKUP.
															2%	30"	60			39		PT 10 TO PT 11
11A A-9	33.5	A	81				0.17	1110	0.665	1.71	38.6	99.4										INCLUDES A 9.1
11B A-10	27.7	A	81				0.17	1110	0.665	1.71	32.1	82.4										& WEST SIDE HWY 83
				TOTAL RUNOFF AT POINT 11 — Q_5 = 70.7, Q_{100} = 181.8																		FROM ROAD A TO FAIRLANE
				INSTALL 10' INLET EACH SIDE OF FAIRLANE IN SUMP CAP = 23 cfs ea.																		
				100 YEAR EXCESS FLOWS WILL FLOW OVER AND TO POND 2																		
11 TO 12													—	—	2%	36"	99	—	—	70		5 YEAR STORM
																						A-11 ONLY
12A A-11	13.1	A	81				0.18	1090	0.665	1.71	14.8	38.2										
12 A9, A10, & A11	74.4	A	81				0.18	1090	0.665	1.71	84.3	216.7										

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FIGURE 6-1. TYPICAL FORM FOR STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

BASIN AND Design Point	BASIN AREA	SOIL GROUP A/B	CN	T_o (HRS)	PIPE FLOW TIME (HRS)	STREET FLOW TIME (HRS)	T_c (HRS)	CSM/IN.	RUNOFF 5 YR.	RUNOFF 100 YR.	PEAK RATE 5 YR.	PEAK RATE 100 YR.	Street Slope %	Street Allowable Capacity cfs	Pipe Slope %	Pipe Size in.	Pipe Capacity cfs	Street Design cfs	Street Velocity fps	Pipe Design cfs	Pipe Velocity fps	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
14 B-1	1.83	A&B	78				0.10	1280	1.87	3.27	6.8	12.0										B-1 ONLY REALIGNED 83
		AT POINT 14 INSTALL 10' INLET EACH SIDE REALIGNED SH 83																				
		CAP = (1.6)(11.5)(2) = 13.8 100% PICKUP OF 5 & 100 YEAR STORM																				
																						B-2 ONLY
15 B-2	59.4	~~80/14~~	82				0.24	1000	.71	1.78	65.9	165.2										
15 B1+B2	61.2		83				0.24	1000	0.76	1.86	72.7	177.9										
		AT POINT 15 INSTALL 54" RCP WITH HEADWALL																				
		REQD. HW FOR Q = 178 = 7.1 Feet																				
PT 15 TO PT 16	INSTALL CONCRETE CHANNEL W/6' BW 1½:1 SIDE SLOPES APPROX D=3 @ 2.5%																					
PT 16 B-3.1	41.3	"	77				0.27	960	1.87	3.27	11.6	20.3	INSTALL 10' TYPE R INLET EACH SIDE									B-3.1 ONLY
PT 16 B1-B3.1											84.5	198.2	CAP ≈ 12.7 cfs ea.									
		AT POINT 16 INSTALL 4×8 PRECAST BOX CULVERT																				
		REQUIRED HW FOR 198 cfs = 4'																				
17 B-3.2	5.8		78				0.30	900	1.87	3.27	15.6	27.3	INSTALL 10' TYPE R INLET EACH SIDE @ LOW POINT									B-3.2 ONLY
17 B-1 THRU B-3.2											99.9	225.5	DRAIN TO BOX CULVERT W/24" RCP									
		AT POINT 17 INSTALL 4x8 PRECAST BOX CULVERT																				
		REQD. H FOR 225.5 cfs = 4.60 ft±																				
																						B-4.1 ONLY
18 B-4.1	29.1	A	81	0			0.15	1160	0.665	1.71	35.1	90.2	2.5%	45								B-4.2 ONLY
18 B-4.2	11.6	A	81				0.15	1160	0.665	1.71	36	37.5	2.6	22.9								
18 B4.1+B4.2	40.7	A	81								49.7	127.7										
				AT POINT 18 INSTALL 14' INLET EACH SIDE OF FAIRLANE IN SUMP																		
				CAP = 69 cfs. Excess Flow to Flow overland to Pond 3																		
																						B5.1 ONLY
19A B-5.1	52.2	10/90	84				0.18	1090	0.82	1.94	72.9	172.5										
19 B-5	115.5	10/90	87.3				0.18	1090	0.985	2.185	93.8	429.8										B-5.2 ONLY
19 B4.1 THRU B5	156.5		85																			
19 B-1 THRU B-5.2	227.3		84				0.30	920	0.82	1.94	267.9	633.9										
				SEE APPENDIX B FOR POND B DETENTION CALCULATIONS																		

Wright-McLaughlin Engineers

FIGURE 6-1. TYPICAL FORM FOR STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

BASIN AND Design Point	BASIN AREA	SOIL GROUP A/B	CN	T_o (HRS)	PIPE FLOW TIME (HRS)	STREET FLOW TIME (HRS)	T_c (HRS)	CSM/IN.	RUNOFF 5 YR.	RUNOFF 100 YR.	PEAK RATE 5 YR.	PEAK RATE 100 YR.	Street: Slope %	Street: Allowable Capacity cfs	Pipe: Slope %	Pipe: Size in.	Pipe: Capacity cfs	Street: Design cfs	Street: Velocity fps	Pipe: Design cfs	Pipe: Velocity fps	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
20 C-1	17.0	A	81				0.18	1090	0.665	1.71	19.3	49.5	0.5	21.2				19.3	2.6			DOES NOT EXCEED STREET CAP
21 C-2	13.1	70/30	83				0.11	1250	0.76	1.86	19.4	47.6										
21 C-1+C-2	30.1		82	0.18		0.04	0.22	1020	0.71	1.78	34.1	85.4										
22 C-3	7.0	70/30	83	0		0	0.1	1280	0.765	1.86	12.2	29.8										
22 C-1 THRU C-3	37.1		82	0.22		0.04	0.26	970	0.71	1.78	40	102.8	INSTALL CONCRETE CHANNEL ALONG EAST RD. TO THALWEG									
													OF NATURAL SWALE WITH EROSION CONTROL									
23 C-4	41.1	A	81				0.24	1000	0.665	1.71	42.7	109.8										
				INSTALL 36" RCP UNDER DRIVE RQD H FOR 43 cfs ≈ 3.2 ft																		
24 O-3	50	35/65	66				0.35	860	0.18	0.80	19.4	86.0										
			SINCE 24" RCP HAS A CAPACITY OF APPROXIMATELY 24 cfs ASSUME DEVELOPED																			
			FLOWS ARE DETAINED TO THIS LEVEL. THEREFORE RELEASE TO INTERCHANGE																			
			AREA = Q_5 = 19.5, Q_{100} = 24.0																			
25 I-1	10.5	A	55				0.10	1280	0.02	0.35	0.4	7.4										I-1 ONLY
25 I-1	10.5	A	55				0.36	855	0.02	0.35	0.3	4.9										
25 I-1+O-3	[illegible]										19.7	90.9	(EXCEEDS 24" RCP CAPACITY AT PT 24. THEREFORE									
													ASSUME FLOW AT PT 25 TO BE 24.9) RQD H = 3									FOR EXISTING 24"
27 I-3	48.6	B	62				0.52	795	0.11	0.62	7.5	82.1	H REQD FOR Q = 82.1 = 6.3 ft									
					POND DISCHARGE NOT INCLUDED DUE TO MUCH GREATER TIME OF CONCENTRATION)																	
					FOR POND RELEASE																	
28 I-4	8.1	A	54				0.53	890	0.02	0.31	0.2	3.5										
28 I-3+I-4											7.7	45.6										
				INSTALL 36" RCP @ PT 27. H FOR Q = 45.6 = 3.5 ft																		
29 I-5	3.1	A	54				0.1	1280	0.02	0.31	0.1	2.0										
						INSTALL 24" RCP @ PT 28																
26 I-2	89	A	52				0.1	1280	0.007	0.25	0.12	4.5										
							INSTALL 24" RCP															

Wright-McLaughlin Engineers

FIGURE 6-1. TYPICAL FORM FOR STORM DRAINAGE SYSTEM PRELIMINARY DESIGN DATA

SUBJECT PEAK RUNOFF CALCULATIONS

BASIN O-1

AREA = 169.1 Ac.

SOILS 6% A 94% B

LAND USE: RESIDENTIAL 1/2 ACRE LOTS

$CN = 0.06(54) + .94(.70) = 69.04$

TIME OF CONCENTRATION

$L = 7300 \quad H = 230$

$$T_c = \left[\frac{11.9\left(\frac{7300}{5280}\right)^3}{230}\right]^{.385} = 0.46$$

$Q_5 = 169.1/640\ (760)(0.255) = 51.2$ cfs

$Q_{100} = 169.1/640\ (760)(0.955) = 191.8$ cfs

ASSUME 60% Pickup of 5 year Storm Flow

$Q = 0.6(51.2) = 30.7$ cfs

Use 24" RCP @ 1.8%

PIPE Flow From Pt 1-A T Pt 1

$T = 1210/12.1(3600) = 0.03$

T_c @ Pt 1 = 0.46 + 0.03 = 0.49

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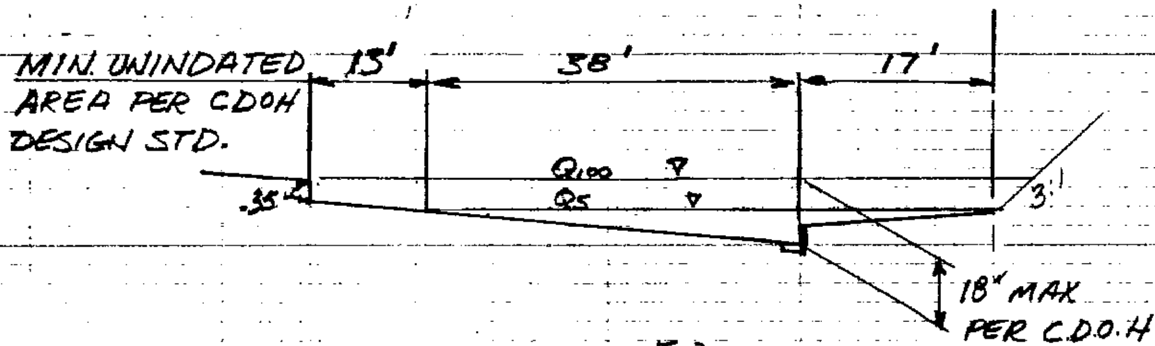
CHECK 5YR STORM STREET CAPACITY FROM PT 1A TO PT 1 - REALIGNED SH 83



AREA = 17.90 Ft²
WP = 55.52 Ft
S = 1.6%

$$Q = \frac{1.486}{0.016}(17.9)\left(\frac{17.9}{55.52}\right)^{2/3}(0.016)^{1/2}$$

Q = 98.9 cfs > 51.2 OK

FOR 100 YEAR STORM

A = 58.62
WP = 70.6
S = 1.6%

$$Q = \frac{1.486}{0.016}(58.62)\left(\frac{58.62}{70.6}\right)^{2/3}(0.016)^{1/2}$$

Q = 608.4 cfs > 191.8 cfs OK

THEREFORE 24" RCP REQUIRED AT UPSTREAM OWNERS DISCRETION

ALLOWABLE FLOW DEPTHS TAKEN FROM C.D.O.H. DESIGN MANUAL SECTION 804.2 PARAGRAPH F

BASIN O-2

AREA = 55 Ac
SOILS = 46% A 54% B
LAND USE = Residential 1/2 Acre lots

$\overline{CN}$ = .46(54) + .54(70) = 62.64

TIME OF CONCENTRATION

L = 3600 H = 87

$$T_C = \left[\frac{11.9\left(\frac{3600}{5280}\right)^3}{87}\right]^{.385} = 0.29$$

Q_5 = 55/640 (930)(0.125) = 10.0 cfs

Q_{100} = 55/640 (930)(0.665) = 53.1 cfs

FOR Q = 10.4 use 18" @ 2.0% cap = 16 cfs

STREET CAPACITY FOR 5 YEAR STORM
FOR 0.7% GRADE = 35.1 cfs
THEREFORE PIPE REQUIRED AT UPSTREAM
OWNERS DISCRETION

BASIN A-1

AREA = 40.9
SOILS = 70% A 30% B
LAND USE = INDUSTRIAL

$\overline{CN} = .7(81) + .3(88) = 83.1$

BASIN O-1 + O-2 + A-1

AREA = 265

CURVE NUMBER = $\frac{40.9(83.1) + 169.1(69.04) + 55(62.6)}{265} = 69.8\ (70)$

$T_c = 0.49$

$Q_5 = 265/640\,(740)(0.28) = 85.8$ cfs
$Q_{100} = 265/640\,(740)(1.01) = 309.5$ (108.4 PIPE) (201.1 STREET)

FOR Q = 85.8 USE 42" @ 1.61% CAP = 140 cfs
V = 14.4

INSTALL 12' INLET IN REALIGNED S.H. 83 AT EAST PCR. CAP = 12.3 cfs
INSTALL 2-12' INLETS IN SUMP IN FAIRLANE ROAD
Cap = 2 × 27.6 = 55.2 cfs

FOR 5 YEAR STORM
Q_{pipe} = 85.8 cfs
Q_{street} = 0 cfs

FOR 100 YEAR STORM
Q_{pipe} = 98.8
Q_{street} = 210.7

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SUBJECT

BASIN A-2

AREA = 20.7 ACRES
SOIL TYPE = A 62% B 38%
LAND USE = INDUSTRIAL
CURVE NUMBER = 0.62(81) + .38(88) = 83.7

BASIN O-1 THRU A-2

AREA = 285.7

$$CN = \frac{20.7(83.7) + 265(69.8)}{285.7} = 70.8 \quad (71)$$

TIME OF CONCENTRATION = 0.52 HRS

Q_5 = 285.7/640 (715) (0.31) = 98.9 cfs
Q_{100} = 285.7/640 (715)(1.065) = 339.9 cfs (153.2 - PIPE)

FOR Q = 98.9 cfs USE 42" @ 2% cap = 160
V = 16.1 fps

REQUIRED INLET CAPACITY = 12.2 cfs — INSTALL 22' SUMP INLET (Sh. 2)
ADDITIONAL INLET CAPACITY TO PICK UP 100 YEAR FLOWS
FOR RESIDUAL PIPE CAPACITY

Tc (P13) = 0.52 + 1045/16.1(3600) = 0.54 HRS

BASIN A-3

AREA = 35.3 Ac
SOIL TYPE = A 96% B 4%
LAND USE = INDUSTRIAL
CURVE NUMBER = .96(81) + .04(88) = 81.3

BASIN O-1 THRU A-3

AREA = 321 ACRES

$$\overline{CN} = \frac{35.3\,(81.3) + 285.7(70.8)}{321} = 71.9\ (72)$$

T_C = 0.54 HRS

$Q_5 = 321/640\,(700)(0.34) = 119.4$ cfs

$Q_{100} = 321/640\,(700)(1.12) = 393.2$ cfs

FOR Q = 119.4 USE 48" RCP @ 2% cap = 210
V = 14.6 fps

(Note: 42" PIPE IS SUFFICIENT TO CARRY 5 YEAR FLOWS HOWEVER 100 YEAR FLOWS ALREADY IN PIPE DICTATE USE OF LARGER PIPE)

AT Pt 3 INSTALL 20' INLET ALL 4 PCR'S OF INTERSECTION. THEORETICAL CAPACITY = (4×16)(.6) = 38.4
100% PICKUP OF ROUTED 5 YEAR STORM

FOR 100 YEAR STORM Q_{PIPE} = 210 cfs Q_{street} = 183.2

TIME OF CONCENTRATION AT PT 4

$T_C = 0.54 + 843/14.6\,(3600) = 0.56$ HRS

BASIN A-4

AREA = 23.8 Ac

SOIL TYPE = A 100%

LAND USE = INDUSTRIAL

CURVE NUMBER = 81

BASIN O-1 THRU A-4

AREA = 344.8

$CN = \frac{23.8(81) + 321(71.9)}{344.8} = 72.49 \ (72)$

$T_c = 0.56$

$Q_5 = 344.8/640\,(690)(0.34) = 126.4$ cfs

$Q_{100} = 344.8/640\,(690)(1.12) = 416.3$ cfs

FOR Q = 126.4 -- 48" RCP @ 1.8% cap = 200 fs
V = 15.9 fps

EXCESS 100 YEAR FLOW WILL OVER TOP SOUTH FE
AND DRAIN TO PRIVATE GRASS SWALE ALONG
EAST R.O.W. LINE OF SH 83
AT PT 4 INSTALL 2-8' INLETS CAP = 36.8 cfs

T_c @ Pt 5 = 0.56 + 1240/15.9(3600) = 0.58 HRS

BASIN A-5.1

AREA = 10.2 ACRES
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CURVE NUMBER = 81

BASIN O-1 THRU A-5

AREA = 355.0 ACRES

$CN = \frac{10.2(81) + 344.8(72.49)}{355.0} = 72.7 \ (73)$

$T_c = 0.56 + 1240/15.9(3600) = 0.58$

$Q_5 = 355.0/640\,(675)(0.37) = 138.5$ cfs

$Q_{100} = 355.0/640\,(675)(1.18) = 441.8$ cfs

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SUBJECT PEAK RUNOFF CALCULATIONS

BASIN A-5

AREA = 48 ACRES (INCLUDING A5.1)

SOIL TYPE = A

LAND USE = INDUSTRIAL

T_c = 0.58 HRS

$$CN = \frac{48(81) + 344.2(72.49)}{392.8} = 73.5\ (74)$$

$$Q_5 = (392.8/640)(675)(0.4) = 165.7$$

$$Q_{100} = (392.8/640)(675)(1.24) = 513.7$$

AT Pt 5, Overland 100year Flows will drain to an 8'x10' box inlet and combine with Flows in upstream 48"RCP. These Flows will exit box to a 8'x5' Concrete box culvert to the south.

$Q_{TOTAL} = 513$ cfs

$Q_{48''} = 200$ cfs

$Q_{overland} = 313$ cfs

Allowable H above grate = 4.0'

FOR $A = \frac{Q}{c\sqrt{2gh}}$

$A = \frac{313}{0.6\sqrt{64.4(4)}} = 32.5$

Allow for 50% Blockage

Required $A = 1.5(32.5) = 48.8$ Ft^2

FOR TRASH GRATE with 1" Bars @ 4" o.c LAT.
1" Bars @ 12" O.C LAT

Available Opening per $Ft^2 = \frac{3'' \times 11''}{144}(3) = 0.69$ Ft

INLET SIZE = $\frac{48.8}{.69} = 70.7$ Ft^2

ASSUME 10' x 8' inside dimension box & Grate

BASIN A-6.1 Pt 6A.1

AREA = 30.6 Ac
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CURVE NUMBER = 81
TIME OF CONCENTRATION:
l = 2330 LF H = 64 Ft

$$T_c = \left[\frac{11.9\left(\frac{2330}{5280}\right)^3}{64}\right]^{.385} = 0.20 \text{ HRS}$$

$Q_5 = 30.6/640\,(1070)(0.665) = 34.0$ cfs
$Q_{100} = 30.6/640\,(1070)(1.71) = 87.5$ INSTALL 12' INLET cap = 13.4 cfs

---

BASIN A-6.2 Pt 6A.2
AREA = 18.4 Ac
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CURVE NUMBER = 81
T_c = 0.20 HRS

$Q_5 = 18.4/640\,(1070)(0.665) = 20.5$ cfs
$Q_{100} = 18.4/640\,(1070)(1.71) = 52.6$ cfs
INSTALL 12' INLET – cap = 10.4 cfs
TOTAL RUNOFF @ Pt 6A
$Q_5 = 34 + 20.5 = 54.5$ cfs (23.8 cfs Pipe)
$Q_{100} = 87.5 + 52.6 = 140.1$ cfs

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BASIN A-6.3

AREA = 7.9 AC (INCLUDES EAST ½ SH 83 FROM ROAD A SOUTH)
SOIL TYPE = A 100%
LAND USE: 40% STREET 60% INDUSTRIAL
CURVE NUMBER: $\overline{CN} = 0.4(98) + 0.6(81) = 87.8$ (88)

BASIN A6.1 + A6.2 + A6.3

AREA = 56.9
SOIL TYPE A 100%
CURVE NUMBER: $\overline{CN} = \frac{7.9(88) + 49(81)}{56.9} = 81.9$ (82)

TIME OF CONCENTRATION = 0.2 + PIPE FLOW
$TC = 0.2 + 0.02 = 0.22$ HRS

$Q_5 = 56.9/640\ (1040)(0.71) = 65.6$ cfs (23.8 cfs pipe)
$Q_{100} = 56.9/640\ (1040)(1.78) = 164.6$ cfs

INSTALL 10' INLETS EACH SIDE OF FAIRLANE AT LOW POINT CAP = 2 × 23 = 46 cfs

BASIN O-1 THRU A6.3

AREA = 449.7 ACRES

$$\overline{CN} = \frac{56.9(81.9) + 392.8(73.5)}{449.7} = 74.6 \quad (75)$$

$T_c = 0.58$ HRS

$$Q_5 = (449.7/640)\ 675\ (0.435) = 206.3 \text{ cfs}$$

$$Q_{100} = (449.7/640)\ 675\ (1.30) = 616.6 \text{ cfs}$$

DETERMINE T_c FROM PT 6 TO PT 7A

ASSUME Q = 640 FOR CHANNEL
Slope = 0.5% SIDE SLOPES = 1.5:1
$b_w = 6'$

TRY d = 4.2

$$Q = \frac{1.486}{0.015}(51.66)\left(\frac{51.66}{21.14}\right)^{2/3}(0.005)^{1/2}$$

Q = 656 OK

$$V = \frac{656}{51.66} = 12.7 \text{ fps}$$

$$T_c = \frac{1100}{12.7} \times \frac{1}{3600} = 0.025 \text{ HRS}$$

T_c @ PT 7 = 0.58 + 0.025 = 0.61 HRS

BASIN A-7.1

AREA = 25.8
SOIL TYPE = A
LAND USE = INDUSTRIAL
CURVE NUMBER = 81
T_c = 0.25 (see BASIN A7.1 + A7.2)

BASIN 0-1 THRU A 7.1 Pt 7A

AREA = 475.5

$$CN = \frac{25.8(81) + 449.7(74.6)}{475.5} = 74.9\ (75)$$

T_c = 0.61

$$Q_5 = (475.5/640)(660)(0.435) = 213.1 \text{ cfs}$$

$$Q_{100} = (475.5/640)(660)(1.30) = 637.5 \text{ cfs}$$

FROM Pt 6 TO Pt 7A

CHANNEL SPECIFICATIONS

b_w = 6'
SS = 1.5:1
S = 0.5%
cap = 656 cfs

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BASIN A 7.2 Pt 7B

AREA = 23.8 Ac
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CN = 81

$$T_c = \left[\frac{11.9 \left(\frac{2000}{5280} \right)^3}{45} \right]^{.385} = 0.20 \text{ HRS}$$

$$Q_5 = (23.8/640)(1070)(0.665) = 26.5 \text{ cfs}$$

$$Q_{100} = (23.8/640)(1070)(1.71) = 68.0 \text{ cfs}$$

BASIN O-1 THRU A 7.2

AREA = 499.3

$$CN = \frac{475.5(74.9) + 28.3(81)}{499.3} = 75.2\ (75)$$

$T_c = 0.61$ HRS

$$Q_5 = (499.3/640)(660)(0.435) = 224 \text{ cfs}$$

$$Q_{100} = (499.3/640)(660)(1.30) = 669.4 \text{ cfs}$$

DETERMINE CHANNEL SIZE & T_c Pt 7 to Pt 9

$Q = 669.4$ $S = 2\%$ $b_w = 6$ $SS = 1.5:1$

TRY $d = 3'$

$$Q = \frac{1.486}{0.015}(31.5)\left(\frac{31.5}{16.82}\right)^{2/3}(0.02)^{1/2} = 670.5 \quad \text{ok}$$

$$V = \frac{670.5}{31.5} = 21.3$$

$$T_c \text{ @ Pt 9} = 0.61 + \frac{2400}{(21.3)(3600)} = 0.64 \text{ HRS}$$

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BASIN A-7.3

AREA = 1.33 ACRES (EAST 1/2 SH 83 FAIRLANE TO OLD RANCH)

SOIL TYPE = A

LAND USE = STREET

CN = 98

T_c = 0.10 HRS

$Q_5 = (1.33/640)(1280)(1.87) = 7.2$ cfs

$Q_{100} = (1.33/640)(1280)(3.27) = 12.6$ cfs

INSTALL 15' TYPE R INLET

CAP = 7.8 cfs

BASIN 8.1

AREA = 18.9 Ac

SOIL TYPE = A

LAND USE = INDUSTRIAL

CN = 81

T_c = 0.64 HRS

BASIN 0-1 THRU 8.1

AREA = 518.2 Ac

$$CN = \frac{18.9(81) + 499.3(75.2)}{518.2} = 75.4$$

$Q_5 = (518.2/640)(645)(0.435) = 227.2$ cfs

$Q_{100} = (518.2/640)(645)(1.30) = 678.9$ cfs

BASIN A-8.2

AREA = 40.17 ACRES
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CURVE No. = 81
T_C = 0.64 HRS

BASIN O-1 THRU A 8.2

AREA = 558.37

$$\overline{CN} = \frac{40.17(81) + 518.2(75.4)}{558.37}$$

$\overline{CN}$ = 75.8 (76)

$$Q_5 = \frac{558.37}{640}(645)(0.47) = 264.5 \text{ cfs}$$

$$Q_{100} = \frac{558.37}{640}(645)(1.36) = 765.3 \text{ cfs}$$

BASIN A-9

AREA - 33.5
SOIL TYPE - A 100%
LAND USE - INDUSTRIAL
CURVE NUMBER - 81

TIME OF CONCENTRATION: L = 2100 H = 72

$$T_C = \left[\frac{11.9 \times \left(\frac{2100}{5280}\right)^3}{72}\right]^{.385} = 0.17 \text{ HRS}$$

$$Q_5 = \frac{33.5}{640}(1110)(0.665) = 38.6 \text{ cfs}$$

$$Q_{100} = \frac{33.5}{640}(1110)(1.71) = 99.4 \text{ cfs}$$

BASIN A-10

AREA = 27.8 Ac
SOIL TYPE A 100%
LAND USE - INDUSTRIAL

CURVE No. 81
$T_c = 0.17$

$$Q_5 = \frac{27.8}{640}(1110)(0.665) = 32.1 \text{ cfs}$$
$$Q_{100} = \frac{27.8}{640}(1110)(1.71) = 82.4 \text{ cfs}$$

BASIN A-11

AREA = 13.1 Ac
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CURVE NUMBER = 81

BASIN A-9 THRU A-11

AREA = 74.4

CN = 81

$T_c = 0.18$

$$Q_5 = (74.4/640)\ 1090\ (0.665) = 84.3 \text{ cfs}$$
$$Q_{100} = (74.4/640)\ 1090\ (1.71) = 216.7 \text{ cfs}$$

BASIN B-2 (Pt 15)

AREA = 59.4

SOIL TYPE = A-86% B-14%

LAND USE = INDUSTRIAL

CURVE NUMBER = .86 (81) + .14(88) = 81.98 (82)

TIME OF CONCENTRATION:

$L = 2550 \quad H = 55$

$$T_c = \left[\frac{11.9\left(\frac{2550}{5280}\right)^3}{55}\right]^{.385} = 0.24 \text{ HRS}$$

$Q_5 = 59.4/640\,(1040)(0.71) = 68.5$ cfs

$Q_{100} = 59.4/640\,(1040)(1.78) = 171.8$ cfs

BASIN B-1 (Pt 14)

AREA = 1.83

SOIL TYPE = A & B

LAND USE = STREET

CN = 98

T_c = 0.24 (ASSUME SAME AS B-1)

$Q_5 = 1.83/640\,(1040)(1.87) = 5.6$ cfs

$Q_{100} = 1.83/640\,(1040)(3.27) = 9.72$

Total Runoff @ Pt 15 B-1 + B-2

$Q_5 = 74.1$

$Q_{100} = 181.5$

CULVERT UNDER SH 83 = 54" RCP @ 1.5%

CAPACITY FOR 100 YEAR STORM

DETERMINE FLOW TIME FROM PT 15 TO PT 16

54" RCP

L = 167 S = 1.5% Q = 181.5 cfs V_{full} = 15.1 fps
CAP = 260 cfs

$$\frac{Flow}{Flow\,(Full)} = \frac{181.5}{260} = 0.70$$

depth = 0.61 (From Figure 20 CONCRETE DESIGN MANUAL)

$$V = 1.08(15.1) = 16.30$$

$$T = 167/(16.30)(3600) = 0.003\ HRS$$

CHANNEL

L = 1500 L.F S = 2.5% Q ≈ 200 cfs
BW = 6.0' SS = 1.5:1 n = 0.015

FOR D = 1.5', $Q = \frac{1.486}{0.015}(12.38)\left(\frac{12.38}{11.41}\right)^{2/3}(0.025)^{1/2}$

Q = 204.6 OK

$$V = \frac{Q}{A} = \frac{204.6}{12.38} = 16.5$$

$$T = 1500/(16.5)(3600) = 0.03$$

$$T_c = 0.24 + 0.033 = 0.27$$

BASIN B-3.1

AREA = 4.13 CN = 98

$$Q_5 = (4.13/640)(960)(1.87) = 11.6\ cfs$$

$$Q_{100} = (4.13/640)(960)(3.27) = 20.3\ cfs$$

Σ B-1 THRU B3.5 — Q_5 = 84.3 cfs Q_{100} = 198.3 cfs

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BASIN B-3.2

AREA = 5.8 Ac. CN = 98

TIME OF CONCENTRATION = 0.27 + 2000/16.5x3600 = 0.30

$Q_5 = (58/640)(920)(1.87) = 15.6$ cfs
$Q_{100} = (5.8/640)(920)(3.27) = 27.3$ cfs

ΣQ B-1 THRU B-3.2
$Q_5 = 99.9$ cfs
$Q_{100} = 225.5$ cfs

BASIN B-4.1

AREA = 29.1
SOIL TYPE = A
LAND USE = INDUSTRIAL
CN = 81
TIME OF CONCENTRATION: L = 1650 H = 50

$$T_c = \left[\frac{11.9 \times \left(\frac{1650}{5280}\right)^3}{50}\right]^{.385} = 0.15$$

$Q_5 = (29.1/640)(1160)(0.665) = 35.1$ cfs
$Q_{100} = (29.1/640)(1160)(1.71) = 90.2$ cfs

BASIN B-4.2

AREA = 11.6 CN = 81 $T_c = 0.15$

$Q_5 = (11.6/640)(1160)(0.665) = 14.6$ cfs
$Q_{100} = (11.6/640)(1160)(0.665) = 37.5$ cfs

ΣQ B4.1 + B4.2
$Q_5 = 49.7$ cfs
$Q_{100} = 127.7$ cfs

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SUBJECT PEAK RUNOFF CALCULATIONS

BASIN B-5.1

AREA = 52.2

SOIL TYPE – 60% A 40% B

LAND USE – INDUSTRIAL

$CN = 0.6(81) + 0.4(88) = 84$

TIME OF CONCENTRATION

$L = 2100 \quad H = 65$

$$T_c = \left[\frac{11.9 \left(\frac{2100}{5280}\right)^3}{65} \right]^{.385} = 0.18$$

$Q_{100} = (52.2/640)(1090)(1.94) = 172.5$

Determine Size of GRASS LINED INTERCEPTOR DITCH (PRIVATE)

ASSUME : BW = 6
SS = 3:1
Slope = 0.5%
d = 3.2'

$$Q = \frac{1.486}{0.045}(49.92)\left(\frac{49.92}{26.23}\right)^{2/3}(0.005)^{1/2}$$

Q = 179 OK

BASIN B·5

AREA = 115.5 Ac.
SOIL TYPE — A 10% B 90%
LAND USE — INDUSTRIAL

CURVE NUMBER ($\overline{CN}$) = .10(81) + .9(88) = 87.3

TIME OF CONCENTRATION = 0.30 HRS (TC of B1 & B2 + CHANNEL TIME)

BASIN B4.1 + B4.2 + B5

AREA = 156.5 Ac. T_c = 30

$$\overline{CN} = \frac{115.5(87.3) + 40.7(81)}{156.5} = 85.2$$

Q_5 = 156.5/640 (920)(0.87) = 195.7 cfs

Q_{100} = 156.5/640 (920)(2.02) = 454.4 cfs

At Pt 18 FOR Q_5 = 49.7 Q_{100} =
INSTALL 14.0' INLETS EACH SIDE OF STREET
@ SUMP CAPACITY = 69.0 cfs

FROM PT 18 TO Pt 19

INSTALL 30" RCP @ 3%
CAPACITY ≈ 72 cfs 127.7 cfs

BASIN C-1

AREA = 17.0 Ac

SOIL TYPE = A 100%

LAND USE = INDUSTRIAL

CURVE NUMBER = 81

TIME OF CONCENTRATION

$L = 1300 \quad H = 15$

$$T_c = \left[\frac{11.9\left(\frac{1300}{5280}\right)^3}{15}\right]^{.385} = 0.18 \text{ HRS.}$$

$Q_5 = 17.0/640\ (1100)(0.665) = 19.4\ cfs$

$Q_{100} = 17.0/640\ (1100)(1.71) = 50.0\ cfs$

BASIN C-2

AREA = 13.1 (30.1 ACRES TOTAL)

SOIL TYPE A - 70% B - 30% LAND USE = INDUSTRIAL

CURVE NUMBER = $0.7(81) + 0.3(88) = 83.1$

$$\overline{CN} = \frac{17.0(81) + 13.1(83.1)}{30.1} = 81.9\ (82)$$

TIME OF CONCENTRATION = 0.18 + GUTTER FLOW TIME

$V \approx 3\ fps$

$$T_c = 0.18 + \frac{400}{3(3600)} = 0.22 \text{ HRS}$$

$Q_5 = 30.1/640\ (1020)(0.71) = 34.1$

$Q_{100} = 30.1/64\ (1020)(1.78) = 85.4$

BASIN C-3

AREA = 8.0 ACRES
SOIL TYPE = A 70% B 30% $CN = .7(81) + .3(88) = 83.1$
LAND USE = INDUSTRIAL $T_c = 0.22 + \frac{400}{3(3600)} = 0.26$ HRS
(ASSUME V = 3 fps)

BASIN C-1 THRU C-3
AREA = 38.1 $CN = \frac{8(83.1) + 30.1(81.9)}{38.1} = 82.2\ (82)$

$Q_5 = 38.1/640\ (970)(0.715) = 41.0$ cfs
$Q_{100} = 38.1/640\ (970)(1.78) = 102.8$ cfs

BASIN C-4

AREA = 41.1 Ac
SOIL TYPE = A 100%
LAND USE = INDUSTRIAL
CURVE NUMBER = 81
TIME OF CONCENTRATION — L = 2600 H = 57

$$T_c = \left[\frac{11.9\left(\frac{2600}{5280}\right)^3}{57}\right]^{.385} = 0.24$$

$Q_5 = 41.1/640\ (1000)(0.665) = 42.7$ cfs
$Q_{100} = 41.1/640\ (1000)(1.71) = 109.8$ cfs

URS COMPANY
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URS NO. 6301 BY AHN DATE 5-86 CHECKED BY ______ DATE ______

CLIENT FORD LAND DEV. CO PROJECT FAIRLANE TECHNOLOGY PARK

SUBJECT PEAK RUNOFF – INTERCHANGE

BASIN O-3 offsite north of Fairlane Pkwy

AREA = 80 Ac

SOIL TYPE = 15% A 85% B

LAND USE = PASTURE FAIR

$\overline{CN} = 0.15(49) + 0.85(69) = 66$

TIME OF CONCENTRATION

$L = 5000 \quad H = 160'$

$$T_c = \left[\frac{11.9 \left(\frac{5000}{5280}\right)^3}{160} \right]^{.385} = 0.35 \text{ HRS}$$

$Q_5 = (80/640)(860)(0.18) = 19.4$ cfs

$Q_{100} = (80/640)(860)(0.80) = 86$ cfs

Allowable Pipe Capacity FOR Existing 24" UNDER I-25 FOR $HW/D = 1.5$ is 25 cfs. THEREFORE ASSUME DETENTION FOR BASIN O-3 TO 25 cfs Maximum RELEASE

SUBJECT INTERCHANGE RUNOFF CALCULATIONS

BASIN I-1

AREA = 10.5 Ac
SOIL TYPE A - 100%
LAND USE = 12% ROAD 88% OPEN SPACE

CURVE NUMBER:

$$CN = .12(98) + .88(49) = 55$$

TIME OF CONCENTRATION

$T_c = 0.10$ FOR I-1

$T_c = 0.35 + 0.01 = 0.36$ FOR I-1 + O-3

FOR I-1

$$Q_5 = 10.5/640\ (1280)(0.02) = 0.4\ cfs$$

$$Q_{100} = 10.5/640\ (1280)(0.35) = 7.4\ cfs$$

FOR I-1 + O-3

Assume Max Release = 25 cfs (24" cap.)

$$Q_5 = 19.4 + 10.5/640\ (855)(0.02) = 0.3\ cfs$$

$$Q_{100} = 20 + 10.5/640\ (.855)(0.35) = 24.9\ cfs$$

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URS JOB NO. 6301 PAGE 32 OF 36
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PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT INTERCHANGE RUNOFF CALCULATIONS

BASIN I-2

AREA = 8.9 ACRES
SOIL TYPE = A 100%
LAND USE – 7% STREET 93% OPEN

CURVE NUMBER
$CN = 0.07(98) + .93(49) = 52$

TIME OF CONCENTRATION = 0.70 HRS

$Q_5 = 8.9/640 (1280)(0.007) = 0.12$ cfs
$Q_{100} = 8.9/640 (1280)(0.25) = 4.5$

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URS JOB NO. 6301
DATE 4-86 BY AHN CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT INTERCHANGE RUNOFF CALCULATIONS

BASIN I - 3

AREA = 48.6 ACRES
SOIL TYPE = B-100%
LAND USE = 2% ROAD 98% OPEN
CURVE NUMBER

$$CN = 0.02(98) + .98(61) = 62$$

TIME OF CONCENTRATION:

$$L = 2500 \quad H = 25$$

$$T_c = \left[\frac{11.9\left(\frac{2500}{5280}\right)^3}{25}\right]^{.385} = 0.32 \text{ HRS}$$

$$Q_5 = 486/640\,(.895)(0.11) = 7.5 \text{ cfs}$$

$$Q_{100} = 48.6/640\,(.895)(0.62) = 42.1 \text{ cfs}$$

Capacity of 24" RCP = 24 cfs HOWEVER EXISTING HEAD SUFFICIENT TO CARRY 100 YR FLOW.

BASIN I-3 + I-4

AREA = 8.1 ACRES
SOILS = 100% A
LAND USE = 10% ROADS 90% OPEN

$\overline{CN}$ = 0.1(98) + 0.90(49) = 54
TC = 0.32 + 0.01 = 0.33

Q_5 = 7.5 + 8.1/640 (890)(0.02) = 7.7 cfs
Q_{100} = 42.1 + 8.1/640 (890)(0.31) = 45.6 cfs

INSTALL 36" RCP

BASIN I-5

AREA = 3.1 ACRES
SOILS = 100% A
LAND USE = 10% ROADS 90% OPEN
$\overline{CN}$ = .1(98) + .9(49) = 54
TC = 0.1
Q_5 = 3.1/640 (1280)(0.02) = 0.10 cfs
Q_{100} = 3.1/640 (1280)(0.31) = 2.0 cfs

USE 24" RCP (MINIMUM SIZE)

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URS JOB NO. 6301 PAGE 35 OF 36
DATE 4-86 BY AHN CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECH. PARK
SUBJECT INLET DESIGN

SEE TABLE 6

DESIGN POINT	Q 5YR (cfs)	STREET GRADE	INLET SIZE	INLET CAPACITY	CARRY OVER
1	85.8-30.7=55.1	0	2-12' 1-12' (SH 83)	55.2 12.9	0 *
2	13.1	0	1-22'	54.2	0
3	20.5	2.0	4-20'	38.4	0
4	7+5.5=12.5	0	2-8'	36.8	0
6.1A	34.9	1.9	1-12'	13.2	21.7
6.2A	20.5	1.0	1-12'	12.3	8.2
6	11.1+26.9=38	0	2-10'	46	0
8	7.2	1.5	1-15	7.8	0
10	23.9	2.0%	1-10	12.9	0 ***
11	70.7-23.9=46.8	0	2-10'	46.0	0.8
14	9.72 **	1.6	2-10'	13.8	0
18	49.7	0	2-14	69	0

* 30.7 cfs ASSUMED IN PIPE @ NE PL

** 100 YEAR STORM DESIGN

*** NO OVERFLOW DUE TO 30" STUB OUT TO PROPOSED DEVELOPMENT

CURB OPENING INLET CAPACITIES (cfs)

Table 6 36 of 36

NOTE: This chart reflects approx. 60% pickup of street flows

Opening Length (ft.)	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0
Sump Capacity (cfs)	7.9	12.8	18.4	23.0	27.6	34.5	39.4	44.4	49.3	54.2
Street Slope %										
0.5	6.3	6.6	6.8	8.0	8.8	9.7	10.6	11.5	12.4	13.1
1.0	8.6	8.8	9.4	10.0	10.4	11.3	12.0	12.8	13.8	14.7
1.5	7.7	10.6	10.9	11.5	12.2	12.7	13.4	14.2	15.0	15.9
2.0	6.5	12.2	12.5	12.9	13.4	14.0	14.6	15.2	15.0	16.8
2.5	5.7	14.0	13.9	14.2	14.7	15.2	15.7	16.3	17.0	17.7
3.0	5.2	12.7	14.8	15.4	15.8	16.1	16.5	17.2	17.8	18.5
3.5	4.7	11.3	16.1	16.6	16.9	17.2	17.8	18.2	13.9	19.6
4.0	4.4	10.6	17.0	17.5	17.9	18.2	18.5	19.0	19.5	20.2
4.5	4.1	9.7	18.1	18.4	18.7	19.1	19.5	20.0	20.5	21.1
5.0	3.9	9.2	17.7	19.4	19.7	20.0	20.3	20.3	21.3	21.8
5.5	3.7	3.7	16.7	20.3	20.6	20.9	21.2	21.5	22.0	22.5
6.0	3.5	3.3	15.6	20.7	21.0	21.4	21.9	22.4	22.9	23.4
6.5	3.4	7.9	14.9	21.8	22.2	22.6	23.1	23.5	24.0	24.5
7.0	3.2	7.6	14.2	22.2	22.6	23.0	23.5	23.8	24.2	25.1
7.5	3.1	7.3	13.6	22.7	23.4	23.8	24.2	24.6	25.0	25.7
8.0	3.0	7.0	13.0	21.8	24.3	24.6	24.9	25.3	25.7	26.2
8.5	2.9	6.8	12.6	20.3	25.0	25.3	25.6	26.0	26.4	26.8
9.0	2.8	6.5	12.1	19.9	25.7	25.9	26.3	26.6	27.0	27.4
9.5	2.7	6.4	11.8	19.4	26.5	26.7	27.0	27.4	27.7	28.1
10.0	2.6	6.2	11.4	18.7	26.7	27.2	27.6	28.0	28.3	28.8

Revised: C.Aamold/5-16-74

APPENDIX B

DETENTION POND COMPUTATIONS

URS COMPANY
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URS NO. 6301 BY AHN DATE 6-86 CHECKED BY ______ DATE ______

CLIENT FORD LAND DEV. Co. PROJECT FAIRLANE TECH. PARK

SUBJECT 5 YEAR HYDROGRAPH CALCULATION
BUREC METHOD

PROJECT IS EAST OF 105th Meridian

D = 0.5 HRS

ZONE 4

P_5 = 2.7" (24HR)

P_5 = 2.55 (12 HR)

P_5 = 2.3 (6 HR)

TIME (HRS)	P (in)	ΔP (in)	RANK
0	0		
		0.69	1
.5	0.69		
		0.44	2
1.0	1.13		
		0.21	3
1.5	1.34		
		0.13	5
2.0	1.47		
		0.15	4
2.5	1.62		
		0.13	6
3.0	1.75		
		0.10	8
3.5	1.85		
		0.09	9
4.0	1.93		
		0.09	10
4.5	2.02		
		0.12	7
5.0	2.14		
		0.08	11
5.5	2.22		
		0.08	12
6.0	2.30		
		0.25	
12.0	2.55		
		0.15	
24.0	2.7		

DESIGN ARRANGEMENT BY RANK

12, 10, 8, 7, 5, 3, 2, 1, 4, 6, 9, 11

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URS JOB NO. 6301 PAGE 2 OF 2
DATE ______ BY AHW CHECKED BY ______ (date)
CLIENT FORD LAND DEVELOPMENT CO.
PROJECT ______

SUBJECT DETENTION POND CALCULATIONS - BUREC METHOD
100 YEAR

PROJECT IS EAST OF 105th MERIDIAN
D = 0.5 HRS
ZONE 4

P_{100} = 4.60" (24 HR)
P_{100} = 3.91" (6 HR)
P_{100} = 4.35" (12 HR)

TIME (HRS)	P (IN)	ΔP (IN)	RANK
0	0		
		1.17	1
0.5	1.17		
		0.75	2
1.0	1.92		
		0.35	3
1.5	2.27		
		0.23	5
2.0	2.50		
		0.26	4
2.5	2.76		
		0.21	6
3.0	2.97		
		0.16	8
3.5	3.13		
		0.15	10
4.0	3.28		
		0.16	9
4.5	3.44		
		0.20	7
5.0	3.64		
		0.15	11
5.5	3.79		
		0.12	12
6.0	3.91		
		0.44	
12.0	4.35		
		0.25	
24.0	4.60		

DESIGN ARRANGEMENT BY RANK

12, 11, 8, 7, 6, 5, 2, 1, 3, 4, 9, 10

DETENTION POND A

URS COMPANY
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URS NO. 6301 BY AHN DATE 6-86 CHECKED BY ______ DATE ______

CLIENT FORD LAND DEV. CO. PROJECT FAIRLANE TECH PARK

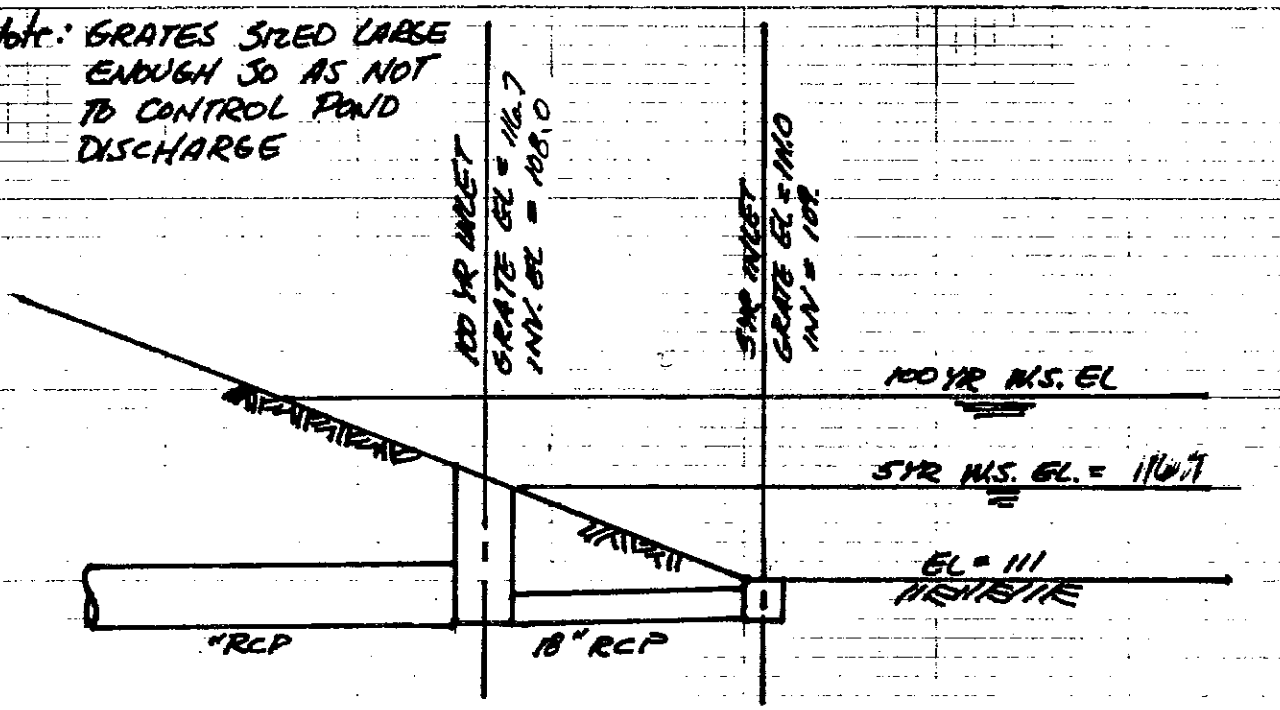
SUBJECT POND A DETENTION SPECIFICATIONS

DEPTH VS VOLUME VS RELEASE

DEPTH (ft)	VOLUME (ft^3)	18"RCP (cfs)	"RCP (cfs
1	5717	13	
2	48,346	17	
3	168,436	19	
4	414,331	21	
5	780,000	22	
6	1,150,000	—	148
7	1,525,000	—	160
8	1,880,000	—	170
9	2,260,000	—	185
10	2,635,405	—	194

SUBJECT POND B OUTLET STRUCTURE DESIGN

Note: GRATES SIZED LARGE ENOUGH SO AS NOT TO CONTROL POND DISCHARGE



DETERMINE 5 YEAR INLET GRATE SIZE

FOR Q = 13, C = 0.6 h = 1

$$a = \frac{Q}{C\sqrt{2gh}} = \frac{13}{.6\sqrt{64.4(1)}} = 2.7\ Ft^2$$

FOR Q = 22.7 C = 0.6 h = 5.7

$$a = \frac{22.7}{.6\sqrt{64.4(5.7)}} = 1.97\ Ft^2$$

USE 2.7 Ft² – ASSUME 50% BLOCKAGE
REQD a = 4.1 Ft² min

USE STD COLO SPGS GRATED INLET 2'-5" x 5'-0"

DETERMINE 100 YEAR INLET GRATE SIZE

AT d = 6.7 18" CAPACITY = 28 cFs
THEREFORE RQD Q = 148 – 28 = 120
FOR C = 0.6, h = 1.0

$$a = \frac{120}{.6\sqrt{64.4(1.0)}} = 24.9\ Ft^2$$

AT d = 10.0 ASSUME SAME 18" CAP. RQD Q = 194 – 28 = 166

FOR c = 0.6 h = 4.3

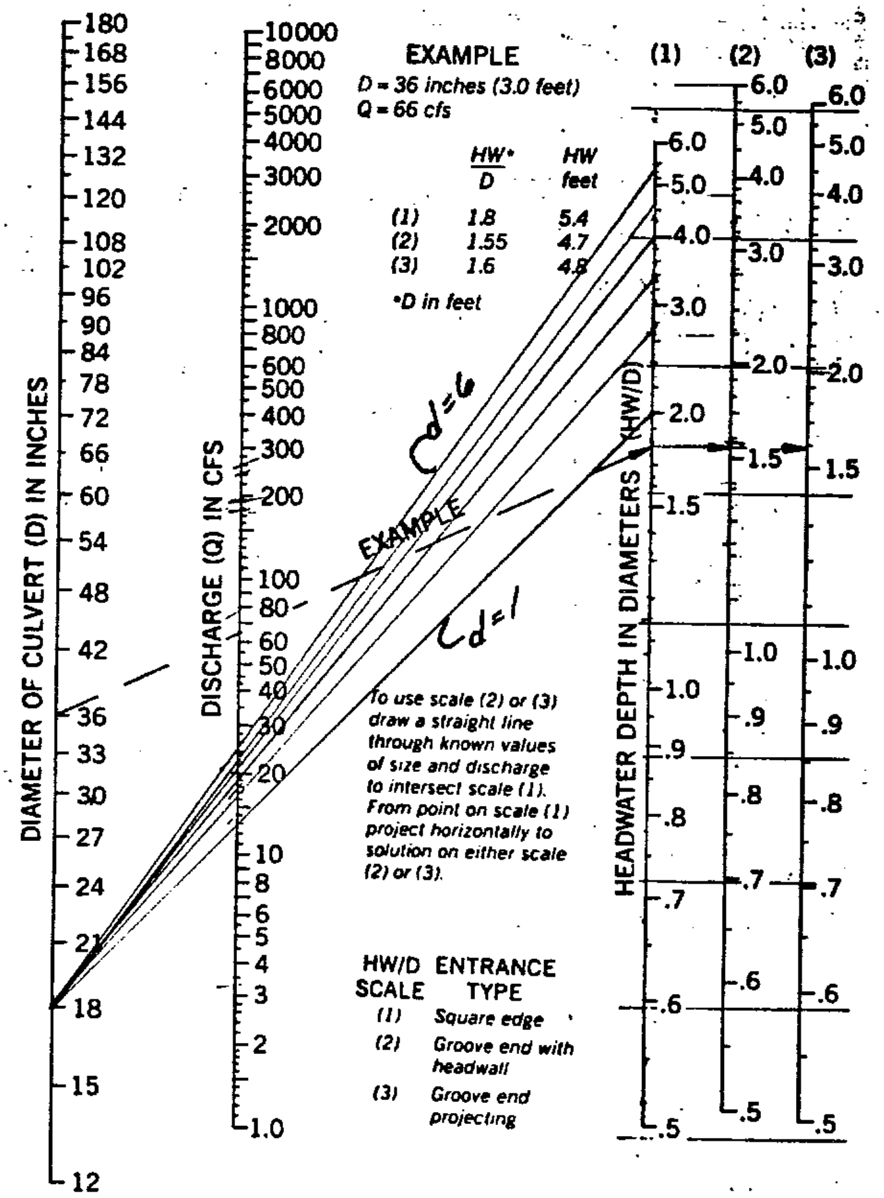
$$a = \frac{166}{.6\sqrt{64.4(4.3)}} = 16.6\ Ft^2$$

USE 24.9 x 1.5 = 37.35 USE 3 STD 2'-5" ~~x 10'~~ GRATES
W 7.5' x 10' BOX

FIGURE 33

18" RCP

HEADWATER DEPTH FOR CIRCULAR CONCRETE PIPE CULVERTS WITH INLET CONTROL



BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER SCALES 2&3
REVISED MAY 1964

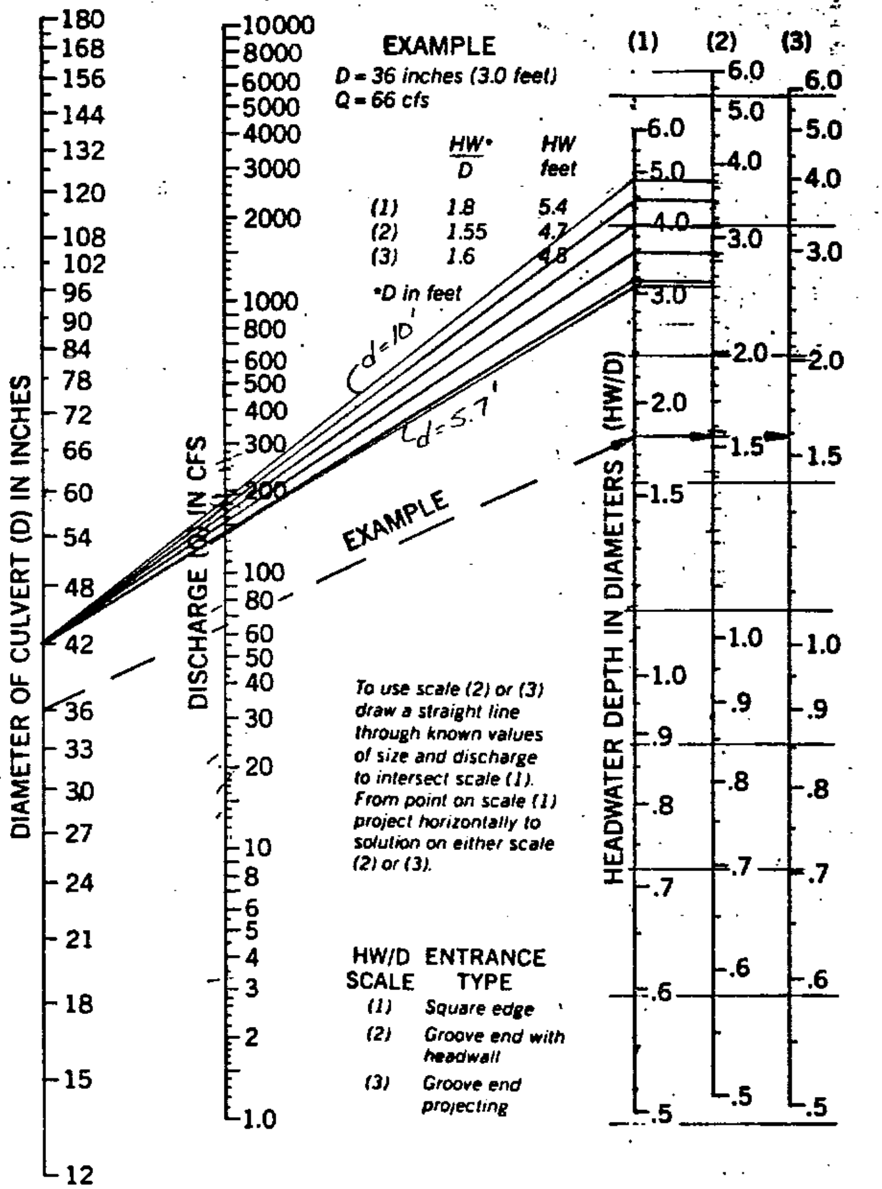
ENTRANCE TYPE 1 REQD.

d	Hw	Hw/d	Q
1	3	2.0	13
2	4	2.67	17
3	5	3.33	19
4	6	4.0	21
5	7	4.67	22
6	8	5.33	25

FIGURE 33

42" RCP

HEADWATER DEPTH FOR CIRCULAR CONCRETE PIPE CULVERTS WITH INLET CONTROL



BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER SCALES 2&3
REVISED MAY 1964

ENTRANCE TYPE 2

d	Hw	Hw/d	Q
5.7	8.7	2.49	140
6.0	9.0	2.57	148
7.0	10.0	2.86	160
8.0	11.0	3.14	170
9.0	12.0	3.48	185
10.00	13.0	3.71	194

$\overline{CN} = 76.4$ MIN LOSS RATE = 0.12 IN/HR

TIME (HRS)	P (IN)	ΔP (IN)	Q (IN)	ΔQ (IN)	LOSS (IN)
0	0				
		0.08			
0.5	0.08		0		
		0.09			
1.0	0.17		0		
		0.10			
1.5	0.27		0		
		0.12			
2.0	0.39		0		
		0.13			
2.5	0.52		0		
		0.21			
3.0	0.73		0		
		0.44		0.08	0.36
3.5	1.17		0.08		
		0.69		0.27	0.42
4.0	1.86		0.35		
		0.15		0.09	0.06
4.5	2.01		0.44		
		0.13		0.07	0.06
5.0	2.14		0.51		
		0.09		0.03	0.06
5.5	2.23		0.54		
		0.08		0.02	0.06
6.0	2.30		0.56		
		0.25		0	0.25
12.0	2.55		0.56		
		0.15			
24	2.70				

VOLUME OF RUNOFF = 0.56 (632.8)(1/12) = 29.5

$T_c = 0.64$

$T_p = D/2 + .6\,T_c = 0.63$

$T_b = 2.67\,T_p = 1.69$

$q_p = \frac{484\,A\,Q}{640\,T_p} = 759.6$

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URS JOB NO. 6301 PAGE 6 OF 14
DATE 4-86 BY AHN CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT POND A - 5 YEAR STORM

TIME ENDING HOUR	ΔQ (IN)	q_p (cfs)	Q (cfs)	BEGIN TIME	PEAK TIME	END TIME
0						
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						
3.5	0.08	759.6	60.8	3.0	3.63	4.69
4.0	0.27	759.6	205.1	3.5	4.13	5.19
4.5	0.09	759.6	68.4	4.0	4.63	5.69
5.0	0.07	759.6	53.2	4.5	5.13	6.19
5.5	0.03	759.6	22.8	5.0	5.63	6.69
6.0	0.02	759.6	15.2	5.5	6.13	7.19

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URS JOB NO. 6301 PAGE 7 OF 14

DATE 7-86 BY AHN CHECKED BY ____ (date)

CLIENT FORD LAND DEV. CO

PROJECT FAIRLANE TECHNOLOGY PARK

SUBJECT 5 YEAR POND A

TIME (HRS)	Q_i (cfs)	V_i (ft³)	$V_i - V_o$ (ft³)	d (ft)	Q_o (cfs)	V_o (ft³)
1.5						
1.6						
1.8						
2.0						
2.2						
2.4						
2.6						
2.8						
3.0	0	0				
3.2	19.3	6948	6948	1.1	14.6	5256
3.4	38.6	27,792	22,536	1.6	16.2	16,344
3.6	90.5	74,268	57,924	2.1	18.1	28,692
3.8	148.7	160,380	131,688	2.7	19.5	42,228
4.0	202.4	286,776	244,548	3.4	20.5	56,628
4.13	251.3	392,942	336,314	3.8	20.8	66,292
4.2	241.4	455,022	388,730	3.9	20.9	71,546
4.4	212.9	618,570	547,024	4.4	21.4	86,774
4.6	192.9	764,658	677,884	4.7	21.7	102,290
4.8	158.2	891,054	788,764	5.0	22.0	118,022
5.0	123.5	992,466	874,444	5.3	22.3	133,970
5.2	88.5	1,068,786	934,816	5.5	22.5	150,098
5.4	72.8	1,120,854	976,756	5.6	22.6	166,334
5.6	59.5	1,174,482	1,008,148	5.7	22.7	182,642
5.8	45.9	1,212,426	1,029,784	5.7	22.7	198,986
6.0	36.4	1,242,054	1,043,440	5.7	22.7	215,330
6.2	24.7	1,264,050	1,048,720	5.7	22.7	231,674
6.4	17.50	1,279,242	1,047,568	5.7	22.7	248,018
6.6	10.4	1,289,286	1,041,268	5.7	22.7	264,362
6.8	5.6	1,295,046	1,030,684	5.7	22.7	280,706
7.0	2.7	1,298,034	1,017,328	5.7	22.7	297,050
7.2	0	1,299,006	1,001,956	5.7	22.7	313,394
7.4			985,612			
7.6						
7.8						
8.0						
8.2						
8.4						
8.6						
8.8						
9.0						
9.2						
9.						

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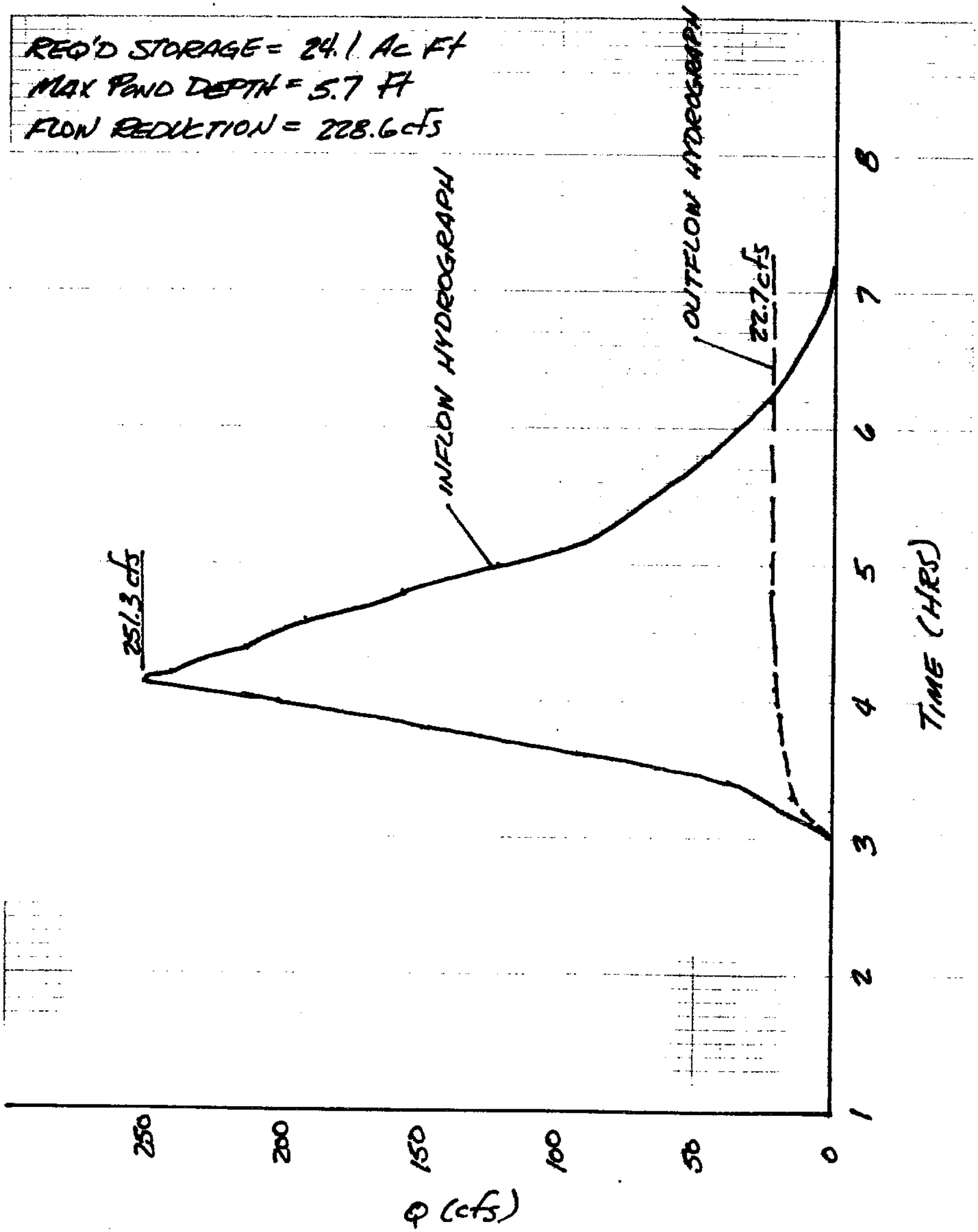
URS JOB NO. 6301 PAGE 8 OF 14
DATE 7-86 BY AHN CHECKED BY ______ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT POND · 5 YEAR STORM BASIN A

REQ'D STORAGE = 24.1 Ac Ft
MAX POND DEPTH = 5.7 Ft
FLOW REDUCTION = 228.6 cfs



URS COMPANY
Mailing Address:
3955 East Exposition Avenue • Suite 300 • Denver, Colorado 80209 • 303/744-1861

URS NO. 6301 BY AHN DATE 7-86 CHECKED BY ______ DATE ______

CLIENT FORD LAND DEV. CO PROJECT ELKHORNE ACRES

SUBJECT 100 YEAR POND A BUREC DETENTION CALCS

$\overline{CN} = 76.4$ MIN. LOSS RATE = 0.12 IN/HR

TIME (HR)	P(IN)	ΔP(IN)	Q (IN)	ΔQ(IN)	LOSS (IN)
0	0				
		0.12			
0.5	0.12		0		
		0.15			
1.0	0.27		0		
		0.16			
1.5	0.43		0		
		0.20			
2.0	0.63		0		
		0.21		0.01	0.20
2.5	0.84		0.01		
		0.23		0.04	0.19
3.0	1.07		0.05		
		0.75		0.29	0.46
3.5	1.82		0.34		
		1.17		0.68	0.49
4.0	2.99		1.02		
		0.35		0.25	0.10
4.5	3.34		1.27		
		0.26		0.19	0.07
5.0	3.60		1.46		
		0.16		0.10	0.06
5.5	3.76		1.56		
		0.15		0.09	0.06
6.0	3.91		1.64		
		0.44		0	0.44
12.0	4.35		1.64		
		0.25		0	0.25
24	4.60		1.64		

Volume of Runoff = 1.64 (632.8) 1/12 = 86.5 Ac Ft

$T_c = 0.64$

$T_p = D/2 + 0.6\,T_c = 0.63$

$T_b = 2.67\,T_p = 1.69$

$q_p = \dfrac{484\,\Delta Q}{640\,T_p} = 759.6$

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URS JOB NO. 6301 PAGE 10 OF 14
DATE 4-86 BY AHN CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT 100 YEAR – POND A BUREC DETENTION CALCS

TIME ENDING HOUR	ΔQ (IN)	qp (cfs)	Q (cfs)	BEGIN TIME	PEAK TIME	END TIME
0						
0.5						
1.0						
1.5						
2.0						
2.5	0.01	759.6	7.6	2.0	2.63	3.69
3.0	0.04	759.6	30.4	2.5	3.13	4.19
3.5	0.29	759.6	220.3	3.0	3.63	4.69
4.0	0.68	759.6	516.5	3.5	4.13	5.19
4.5	0.25	759.6	189.9	4.0	4.63	5.69
5.0	0.19	759.6	144.3	4.5	5.13	6.19
5.5	0.10	759.6	76.0	5.0	5.63	6.69
6.0	0.09	759.6	68.4	5.5	6.13	7.19

URS CORPORATION
MAKING TECHNOLOGY WORK™

URS JOB NO. 6301 PAGE 11 OF 14
DATE 7-86 BY AHN CHECKED BY ______ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT 100 YEAR - POND A BUREC DETENTION CALCS

TIME (HRS)	Q_i (cfs)	V_i (ft³)	$V_i - V_o$ (ft³)	d (ft)	Q_o (cfs)	V_o (ft³)
1.5						
1.6						
1.8						
2.0	0	0				
2.2	2.4	864	0	0.15	2.1	756
2.4	4.8	3456	2700	0.47	4.8	3240
2.6	12.0	9508	6268	1.05	12.0	9288
2.8	20.9	21348	12,060	1.3	15.2	19,080
3.0	29.0	39312	20,232	1.6	16.2	30,384
3.2	101.8	86,400	56,016	2.2	18.4	42,840
3.4	164.7	182,340	139,500	2.8	19.8	56,592
3.6	309.3	352,980	296,388	3.5	20.5	71,100
3.8	442.2	623,520	552,420	4.5	21.5	86,220
4.0	558.7	983,844	897,624	5.4	22.4	102,024
4.13	673.8	1,272,249	1,170,225	6.1	151.5	142,716
4.2	644.5	1,438,355	1,295,638	6.4	154.3	181,247
4.4	565.8	1,874,063	1,692,816	7.2	162	295,115
4.6	510.0	2,261,351	1,966,236	8.1	172	415,355
4.8	418.1	2,595,467	2,180,112	8.6	181	542,435
5.0	330.7	2,865,035	2,322,600	9.0	185	674,195
5.2	243.7	3,071,819	2,397,624	9.1	187	808,115
5.4	207.8	3,234,359	2,426,243	9.2	188	943,115
5.6	179.7	3,373,859	2,430,744	9.2	188	1,078,475
5.8	149.5	3,492,371	2,413,896	9.2	188	1,213,835
6.0	129.7	3,592,883	2,378,536	9.1	187	1,348,835
6.2	98.9	3,675,179	2,326,344	9.0	185	1,482,755
6.4	71.8	3,736,631	2,253,876	8.8	183	1,615,235
6.6	44.5	3,778,499	2,163,264	8.5	179.5	1,745,735
6.8	25.2	3,803,591	2,057,856	8.3	177.7	1,874,327
7.0	12.3	3,817,091	1,942,764	8.1	172	2,000,219
7.2	0	3,821,519	1,821,300			
7.4						
7.6						
7.8						
8.0						
8.2						
8.4						
8.6						
8.8						
9.0						
9.2						
9.						

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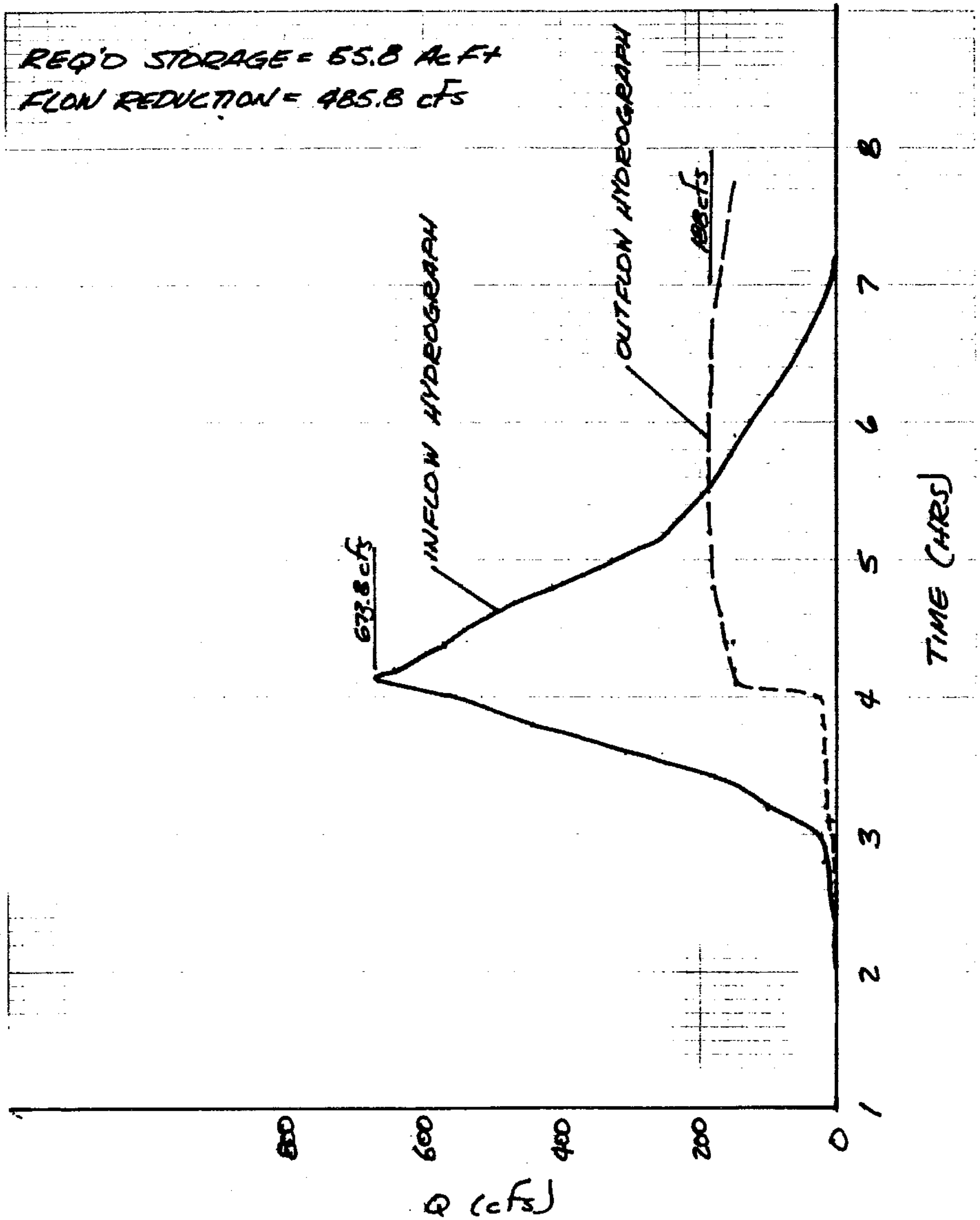
URS JOB NO. 6301 PAGE 12 OF 14

DATE 7-86 BY AWN CHECKED BY ____ (date)

CLIENT FORD LAND DEV. CO.

PROJECT FAIRLANE TECH. PARK

SUBJECT POND A, BASIN A 100 YR STM HYDROGRAPH



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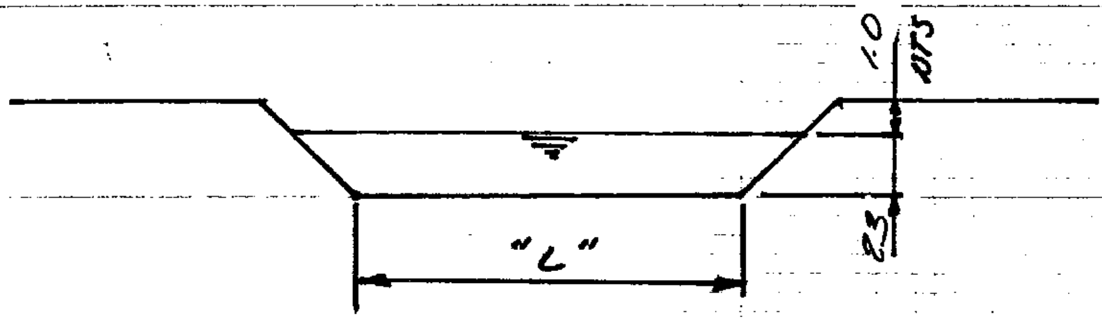
URS JOB NO. 6301 PAGE 13 OF 14
DATE 6-86 BY AWW CHECKED BY ______ (date)
CLIENT FORD LAND DEVELOPMENT CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT BROAD CRESTED WEIR DESIGN FOR POND [illegible] EMERGENCY SPILLWAY

FOR THE FOLLOWING CONDITIONS



BREADTH OF CREST = 17'

C = 2.63 FOR H = 2.3

Q = 418

FROM $Q = CLH^{3/2}$

$$L = \frac{Q}{CH^{3/2}}$$

$$L = \frac{418}{2.63(2.3^{3/2})}$$

$L = 45.6$ Ft

NOTE: Q is based on maximum pond inflow at point where pond volume is exceeded

SUBJECT ROUTED RUNOFF BASIN A POND DISCHARGE

FOR UNDETAINED AREA OF 12.9 Ac AND A CN = 49

$$Q_5 = (12.9/640)(csm/in)(0.025) = 0.0005$$

$$Q_{100} = (12.9/640)(CSM/in)(0.49) = 0.0099$$

FOR 5 YEAR STORM

T (HRS)	csm/in	Q_5 (cfs)	POND Disch. (cfs)	Q_5 TOT. (cfs)
3	175	0.1	0	0.1
4	148	0.1	20.5	20.6
5	113	0.1	22.3	22.4
6	0	0	22.7	22.7
7	0	0	22.7	22.7

FOR 100 YEAR STORM

2	244	2.4	0	2.4
3	175	1.7	16.2	17.9
4	148	1.5	22.4	23.9
5	113	1.1	185.0	186.1
6	0	0	187	187 < 190 OK
7	0	0	172	172

DETENTION POND B

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URS JOB NO. 6301 PAGE 1 OF 11
DATE 5-86 BY AHW CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT POND B - BASIN B

DEPTH VS VOLUME

DEPTH	AREA (in²)	AREA (ft²)	VOLUME (ft³)
1	1.65	16500	5500
2	6.54	65,400	43,750
3	14.77	147,700	147,544
5	20.3	203,000	496,781
7	24.68	246,800	945,868
9	28.47	284,700	1,476,917
10	29.79	297,900	1,768,192

DEPTH VS RELEASE

DEPTH	RELEASE (18" RCP) (INLET CONTROL)
1	3.4
2	9
3	13
4	15
5	17
6	19
7	21
8	23
9	25
10	27

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URS NO. 6301 BY AHN DATE 6-86 CHECKED BY ______ DATE ______

CLIENT FORD LAND DEV. CO PROJECT FAIRLANE TECHNOLOGY PARK

SUBJECT POND B 5YEAR STORM BASIN B

$\overline{CN} = 84$ MIN LOSS RATE = 0.12 IN/HR

TIME (HRS)	P (IN)	ΔP (IN)	Q (IN)	ΔQ (IN)	LOSS (IN)
0	0				
		0.08			
0.5	0.08		0		
		0.09			
1.0	0.17		0		
		0.10			
1.5	0.27		0		
		0.12			
2.0	0.39		0		
		0.13		0.01	0.12
2.5	0.52		0.01		
		0.21		0.05	0.16
3.0	0.73		0.06		
		0.44		0.17	0.27
3.5	1.17		0.23		
		0.69		0.42	0.27
4.0	1.86		0.65		
		0.15		0.09	0.06
4.5	2.01		0.74		
		0.13		0.07	0.06
5.0	2.14		0.81		
		0.09		0.03	0.06
5.5	2.23		0.84		
		0.08		0.02	0.06
6.0	2.30		0.86		
		0.25		0	0.25
12.0	2.55		0.86		
		0.15			
24	2.70				

VOLUME OF RUNOFF = 0.86 (227.3) 1/12 = 16.3 AcFt

T_c = 0.3 HRS

$T_p = D/2 + .6\, T_c = 0.43$ HRS

$T_b = 2.67\ T_p = 1.15$ HRS

$$q_p = \frac{484\,A\,Q}{640\,T_p} = 399.8 \text{ cfs}$$

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URS JOB NO. 6301 PAGE 3 OF 11
DATE 4-86 BY AHN CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT 5 YEAR POND B CALCULATIONS

TIME ENDING HOUR	ΔQ (IN)	q_p (cfs)	Q (cfs)	BEGIN TIME	PEAK TIME	END TIME
0						
0.5						
1.0						
1.5						
2.0						
2.5	0.01	399.8	4.0	2.0	2.43	3.15
3.0	0.05	399.8	20.0	2.5	2.93	3.65
3.5	0.17	399.8	68.0	3.0	3.43	4.15
4.0	0.42	399.8	167.9	3.5	3.93	4.65
4.5	0.09	399.8	36.0	4.0	4.43	5.15
5.0	0.07	399.8	28.0	4.5	4.93	5.65
5.5	0.03	399.8	12.0	5.0	5.43	6.15
6.0	0.02	399.8	8.0	5.5	5.93	6.65

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URS JOB NO. 6301 PAGE 4 OF 11
DATE 8-86 BY AHN CHECKED BY ______ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECH. PARK

SUBJECT POND B - 5 YEAR STORM

TIME (HRS)	Q_i (cfs)	V_i (ft³)	$V_i - V_o$ (ft³)	d (ft)	Q_o (cfs)	V_o (ft³)
1.5						
1.6						
1.8						
2.0	0	0	0	0	0	0
2.2	1.9	684	684	0.1	0.4	144
2.4	3.7	2700	2556	0.5	1.5	857
2.6	7.8	6840	5883	1.0	3.4	2650
2.8	15.9	15372	12722	1.2	4.5	5478
3.0	18.9	27,900	22421	1.5	5.9	9222
3.2	44.1	50,580	41,357	1.9	8.6	14,476
3.4	70.2	91,728	77,252	2.3	10.2	21,262
3.6	92.3	150,228	128,966	2.8	12.3	29,556
3.8	150.0	257,456	208,099	3.7	14.4	38,962
3.93	188.7	316,712	277,749	4.0	15.0	45,842
4.0	165.8	361,379	315,870	4.2	15.4	49,672
4.2	121.6	464,843	415,171	4.7	16.4	61,120
4.4	91.8	541,667	480,547	4.9	16.8	73,072
4.6	45.7	591,167	518,095	5.1	17.2	85312
4.8	31.0	620,939	535,627	5.2	17.4	97,768
5.0	32.8	646,067	548,299	5.25	17.5	110,332
5.2	23.1	666,191	555,859	5.3	17.6	122,968
5.4	20.9	682,051	559,063	5.3	17.6	135,640
5.6	13.0	694,255	558,595	5.3	17.6	148,312
5.8	11.4	703,019	554,707	5.3	17.6	160,984
6.0	9.7	710,615	549,631	5.25	17.5	173,620
6.2	5.0	715,907	542,287	5.2	17.4	186,184
6.4	2.8	718,715	532,531	5.2	17.4	198,712
6.6	0.6	719,723	521,011	5.2	17.4	211,240
6.8			508,483			
7.0						
7.2						
7.4						
7.6						
7.8						
8.0						
8.2						
8.4						
8.6						
8.8						
9.0						
9.2						
9.						

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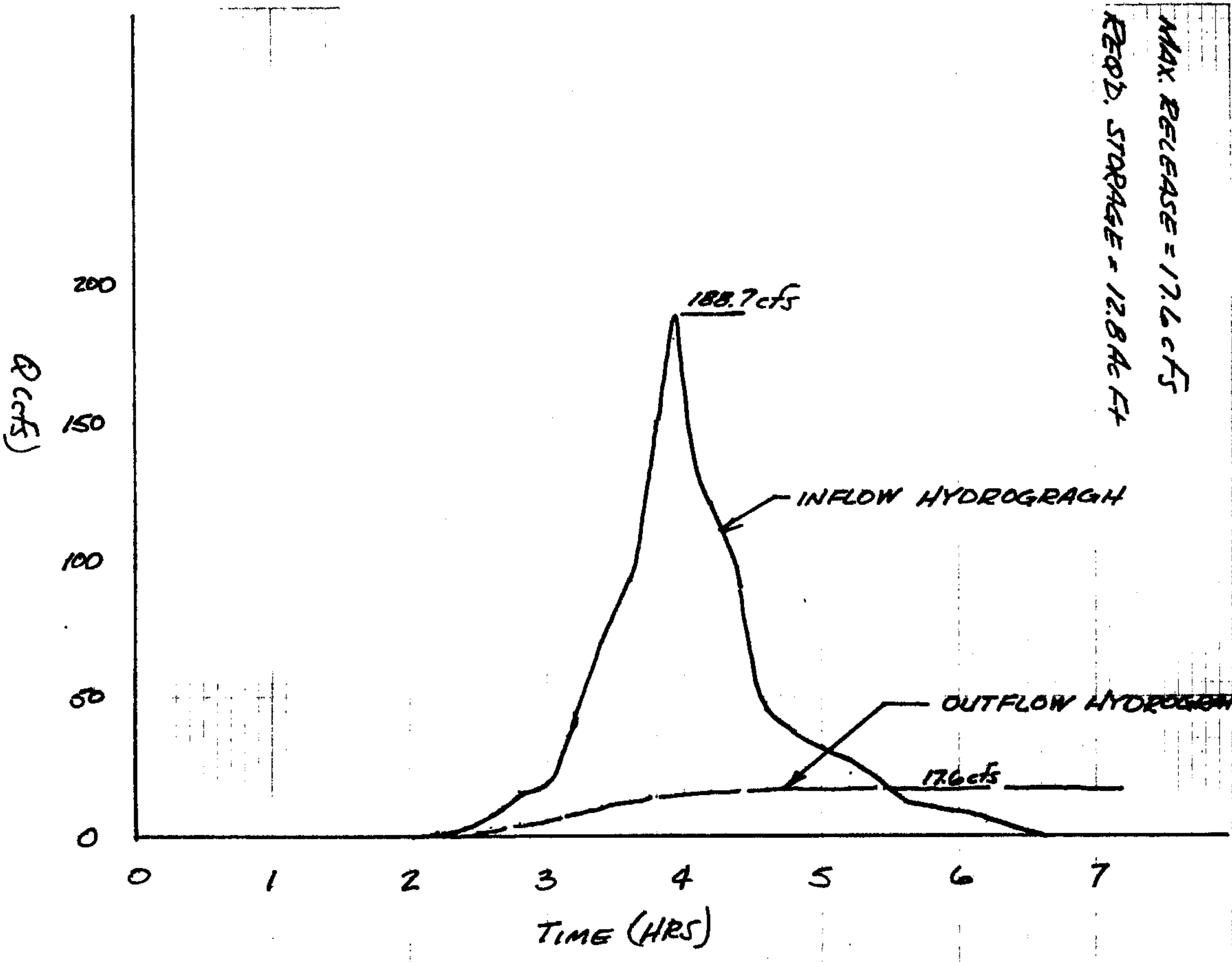
URS JOB NO. 6301 PAGE 5 OF 11
DATE 8-86 BY AHN CHECKED BY ______ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT 5 YEAR DEVELOPED HYDROGRAPH
POND B

MAX. RELEASE = 17.6 cfs
REQD. STORAGE = 12.8 Ac Ft



URS NO. 6301 BY AHN DATE ____ CHECKED BY ____ DATE ____
CLIENT FORD LAND DEV. CO PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT POND B - BASIN B 100 YR

$\overline{CN} = 84$ MIN. LOSS RATE = 0.12 IN/HR

TIME (HR)	P(IN)	ΔP(IN)	Q(IN)	ΔQ(IN)	LOSS(IN)
0	0				
		0.12			
0.5	0.12		0		
		0.15			
1.0	0.27		0		
		0.16			
1.5	0.43		0		
		0.20		0.05	0.15
2.0	0.63		0.05		
		0.21		0.06	0.15
2.5	0.84		0.11		
		0.23		0.10	0.13
3.0	1.07		0.21		
		0.75		0.45	0.30
3.5	1.82		0.66		
		1.17		0.92	0.25
4.0	2.99		1.58		
		0.35		0.29	0.06
4.5	3.34		1.87		
		0.26		0.20	0.06
5.0	3.60		2.07		
		0.16		0.10	0.06
5.5	3.76		2.17		
		0.15		0.09	0.06
6.0	3.91		2.26		
		0.44		0	0.44
12.0	4.35		2.26		
		0.25			
24	4.60				

Volume of Runoff = 2.26 (227.3) 1/12 = 42.8 Ac Ft

T_c = 0.3 HRS

$T_p = D/2 + 0.6\,T_c$ = 0.43 HRS

$T_b = 2.67\,T_p$ = 1.15 HRS

$q_p = \dfrac{484\,\Delta Q}{640\,T_p}$ = 399.8 cfs

SUBJECT POND B BASIN B 100 YR

TIME ENDING HOUR	ΔQ (IN)	q_p (cfs)	Q (cfs)	BEGIN TIME	PEAK TIME	END TIME
0						
0.5						
1.0						
1.5						
2.0	0.05	399.8	20.0	1.5	1.93	2.65
2.5	0.06	399.8	24.0	2.0	2.43	3.15
3.0	0.10	399.8	40.0	2.5	2.93	3.65
3.5	0.45	399.8	179.9	3.0	3.43	4.15
4.0	0.92	399.8	367.8	3.5	3.93	4.65
4.5	0.29	399.8	115.9	4.0	4.43	5.15
5.0	0.20	399.8	80.0	4.5	4.93	5.65
5.5	0.10	399.8	40.0	5.0	5.43	6.15
6.0	0.09	399.8	36.0	5.5	5.93	6.65

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URS JOB NO. 6301 PAGE 8 OF 11
DATE 5-86 BY AWW CHECKED BY ______ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT POND B BASIN R 100YR

TIME (HRS)	Q_i (cfs)	V_i (ft³)	$V_i - V_o$ (ft³)	d (ft)	Q_o (cfs)	V_o (ft³)
1.5	0	0	0	0	0	0
1.6	4.6	828	828	0.15	0.4	72
1.8	14.0	7524	7452	1.09	3.8	1584
2.0	18.1	19,080	17,496	1.31	5.1	4788
2.2	23.7	34,128	29,340	1.62	7.0	9144
2.4	29.2	53,172	44,028	2.0	9.0	14,904
2.6	32.0	75,204	60,300	2.15	9.6	21,600
2.8	39.6	100,980	79,380	2.34	10.3	28,764
3.0	41.1	130,032	101,268	2.55	11.1	36,468
3.2	108.7	183,960	147,492	3.0	13	45,144
3.4	181.2	288,324	243,180	3.8	14.5	55044
3.6	225.7	434,808	379,640	4.49	15.9	65,988
3.8	344.1	639,936	573,948	5.35	17.7	78,084
3.93	422.8	819,391	741,307	6.1	19.2	86,219
4.0	369.5	919,220	832,501	6.24	19.5	96,595
4.2	283.8	1,154,408	1,062,813	7.44	21.9	106,499
4.4	235.5	1,341,356	1,234,857	8.08	23.2	122,735
4.6	132.6	1,473,822	1,351,137	8.53	24.0	139,727
4.8	112.1	1,561,964	1,422,237	8.8	24.6	157,223
5.0	96.3	1,636,988	1,479,765	9.0	25	175,078
5.2	68.6	1,696,352	1,521,273	9.16	25.3	193,194
5.4	65.0	1,744,448	1,551,254	9.25	25.5	211,489
5.6	58.0	1,788,728	1,577,239	9.33	25.6	229,885
5.8	44.5	1,825,628	1,595,743	9.4	25.8	248,389
6.0	40.8	1,856,336	1,607,947	9.45	25.9	267,001
6.2	22.5	1,879,124	1,612,123	9.47	25.9	285,649
6.4	12.5	1,891,724	1,606,074	9.45	25.9	304,297
6.6	2.5	1,897,124	1,592,827	9.4	25.8	322,909
6.8		1,898,024	1,575,115	9.3	25.6	341,413
7.0						
7.2						
7.4						
7.6						
7.8						
8.0						
8.2						
8.4						
8.6						
8.8						
9.0						
9.2						
9.						

END TIME

$$1575115 = \frac{25.6(T)}{2} 3600$$

T = 34.2 HRS

END T = 34.2 + 6.8 = 41.0 HRS

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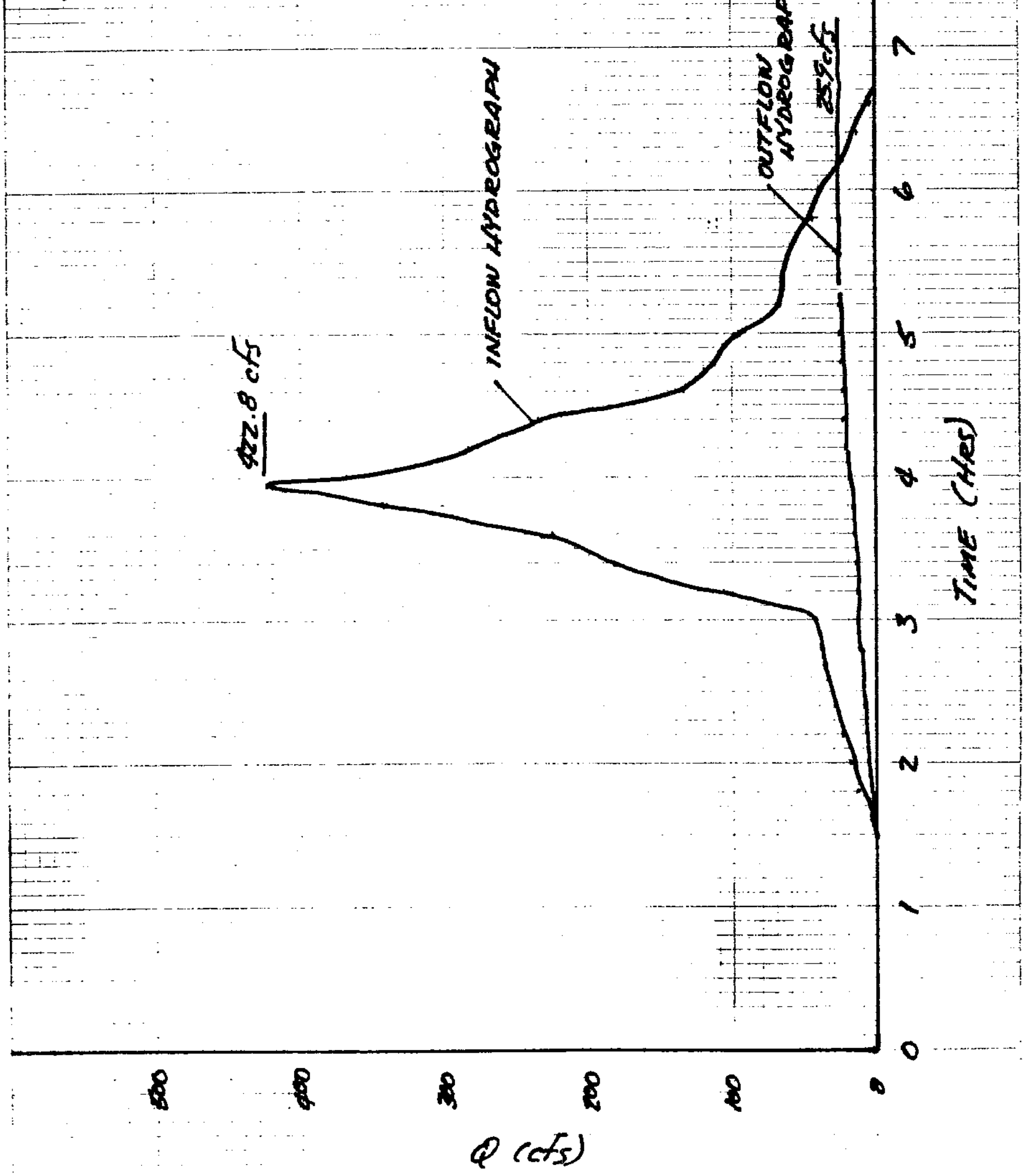
URS JOB NO. 6301 PAGE 9 OF 11
DATE 5-86 BY AHN CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT POND B - BASIN B

MAX RELEASE = 25.9 cfs
REQ'D STORAGE = 37.0 AcFt



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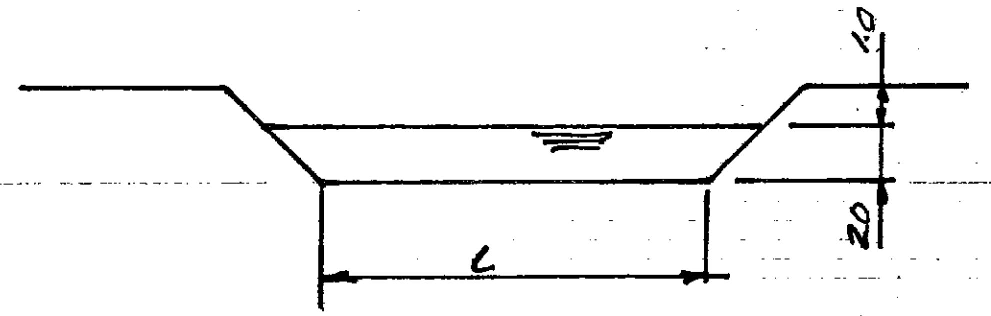
URS JOB NO. 6301 PAGE 10 OF 11
DATE 6-86 BY AHW CHECKED BY ____ (date)
CLIENT FORD LAND DEVELOPMENT CO.
PROJECT FAIRLANE TECH. PARK
SUBJECT BROAD CRESTED WEIR DESIGN FOR POND B EMERGENCY SPILLWAY

FOR THE FOLLOWING CONDITIONS:



BREADTH OF CREST = 17'

$C = 2.63$ FOR $H = 2$

$Q = 65$ cfs

FOR: $Q = CLH^{3/2}$

$$L = \frac{Q}{CH^{3/2}}$$

$$L = \frac{65}{2.63(2)^{3/2}}$$

$L = 8.7'$ minimum

NOTE: Q is Based on maximum inflow to pond at point where pond volume is exceeded.

URS CORPORATION
MAKING TECHNOLOGY WORK™

URS JOB NO. 6301
DATE 8-86 BY AWW CHECKED BY ____ (date)
CLIENT FORD LAND DEV. CO.
PROJECT FAIRLANE TECH PARK
SUBJECT ROUTED RUNOFF BASIN I-3 WITH POND B DISCHARGE

FOR
AREA = 48.6
$\overline{CN} = 62$

$Q_5 = (48.6/640)(csm/in)(0.29) = 0.022(csm/in)$

$Q_{100} = (48.6/640)(csm/in)(1.20) = 0.091(csm/in)$

FOR 5YEAR STORM

T (HRS)	csm/in	Q_5 (cfs)	POND DISCH. (cfs)	Q_5 TOTAL (cfs)
2	244	5.4	0	5.4
3	175	3.9	5.9	9.8
4	148	3.3	15.4	18.7
5	113	2.5	17.5	20.0 < 25.9 OK
6	0	0	17.6	17.6

FOR 100 YEAR STORM

2	244	22.2	5.1	27.3
3	175	15.9	11.1	27.0
4	148	13.5	19.5	33.0
5	113	10.3	25.0	35.5
6	0	0		

APPENDIX C

REPORT ON HYDROLOGIC INVESTIGATIONS

FLOOD INSURANCE STUDY

COLORADO SPRINGS AND EL PASO COUNTY, COLORADO

DECEMBER 1976

Incl 1

17Dec.

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1580
ALBUQUERQUE, NEW MEXICO 87103

SWAED-P

6 December 1976

SUBJECT: Report on Hydrologic Investigations, Flood Insurance Study, Colorado Springs and El Paso County, Colorado

Division Engineer, Southwestern
ATTN: SWDED-W

1. Transmitted for review and approval is "Report on Hydrologic Investigations, Colorado Springs and El Paso County, Colorado".

2. Hydraulic analysis for delineation of flood plains will be initiated when approval of the subject data is received. An early review is requested.

3. If additional information is desired or questions arise regarding data contained in this report, contact Frank Jaramillo or Alfredo Sanchez, FTS Number 474-2635.

FOR THE DISTRICT ENGINEER:

1 Incl
as

JASPER H. COOMBES, P.E.
Chief, Engineering Division

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

REPORT ON HYDROLOGIC INVESTIGATIONS

FLOOD INSURANCE STUDY

Colorado Springs and El Paso County, Colorado

1. Purpose. The purpose of this report is to present the basis and results of the hydrologic analysis required for a flood insurance study of areas in El Paso County, Colorado, subject to flooding from Fountain Creek, Monument Creek, and tributaries of these creeks, and from Big Sandy Creek and tributaries draining into the towns of Calhan and Ramah. Maps showing these areas are presented as Plates 1 and 2.

2. This report presents the results of a frequency analysis for Fountain Creek, Monument Creek, and tributaries of these creeks, and Big Sandy Creek and tributaries draining into the towns of Calhan and Ramah. Flow frequency parameters for non-urban areas were developed from "Manual for Estimating Flood Characteristics of Natural-Flow Streams in Colorado" by Jerald F. McCain and Robert D. Jarrett, U.S. Geological Survey. A description of the development of frequency parameters for urban areas and the combination of rural and urban areas is also presented.

3. Basin Characteristics. El Paso County is located at about the center of Colorado as shown in the vicinity map on Plate 1. The city of Colorado Springs is the principal population center in El Paso County. On the southern fringes of Colorado Springs are the unincorporated communities of Security and Widefield while on the northeast corner of El Paso County are the towns of Ramah and Calhan.

4. Three main creeks and their tributaries are the subject of these hydrologic investigations. They are Fountain Creek, Monument Creek, and Big Sandy Creek. Plates 2 thru 9 show these watersheds and their tributaries.

5. Fountain Creek originates about 7 miles northwest of Pikes Peak in the mountains of the Rampart Range northwest of Colorado Springs and flows in a southeasterly direction through a narrow steep-walled canyon where it emerges on the high plains at Colorado Springs. Elevations range from 14,110 feet at Pikes Peak, through 5,950 at the mouth of Monument Creek in Colorado Springs, to 5,150 feet at the southern county line. Ground cover in the higher areas include aspen, spruce, pine, and native grasses. The bedrock creek channel averages 50 feet in width above the foothills where the Rampart Range mountains transition into the high plains. This transitional area varies from rough ridge formations to more gently sloping, narrow-topped mesas that bear cedar, oak, pine, pinon, and native grasses as cover.

6. After leaving the urban area of Colorado Springs, Fountain Creek flows in a southern direction. Downstream of Colorado Springs, the Fountain's western watershed lies in the transitional foothill area as described in the preceding paragraph, while the eastern portion is primarily gently rolling high plains with a few rough areas and sparse vegetation including sage brush, cactus, and native grasses. The flood plain is scattered with clumps of cottonwood trees, salt cedar, and other thick undergrowth along the creek banks.

7. Areas in the study that drain into Fountain Creek are Camp Creek, Cheyenne Creek, Bear Creek, South Shooks Run, Spring Creek, Sand Creek, Peterson Field, Security Creek, Windmill Gulch, Widefield Creek, and Jimmy Camp Creek.

8. Monument Creek originates in the Rocky Mountains at an elevation of about 10,000 feet above mean sea level. The direction of flow is east out of the mountains for about eight miles, then south and parallel to the mountains for about 22 miles to the confluence with Fountain Creek at Colorado Springs as shown on Plate 2. The watershed west of the main stem of the creek is typical mountain terrain with steep rough slopes covered with vegetation ranging from coniferous trees to native grass and shrubs. The watershed east of the main stem of the creek up to the city limits is generally rolling hills with a covering of native grass with some shrubs and bushes. Areas in the study that drain into Monument Creek are Kettle Creek, Cottonwood Creek, Rockrimmon Basin, Douglas Creek, Mesa Basin, and Templeton Gap Floodway.

9. Big Sandy Creek originates in the high plains region of northeast El Paso County approximately four miles east of Rattlesnake Butte and traverses the county in a northeasterly direction before entering Elbert County, half a mile north of Ramah, Colorado. Big Sandy Creek, a main stem perennial, provides irrigation water for farms and communities located in a watershed that encompasses over 100 square miles of El Paso and Elbert Counties. The watershed is characterized by rolling

hills, which are generally steeper in the upper watershed, with a vegative cover of grass and some scrub brush typical of the Colorado high plains. The Big Sandy has a headwater elevation of 7100 feet that drops to 6000 feet at the point where the stream enters neighboring Elbert County.

10. Climate. A wide variation in climate occurs in the study area. In the mountainous areas, precipitation varies widely over relatively short distances and much of the total precipitation at higher elevations is in the form of snow. April through September is the wettest season for the contributing areas. Precipitation is caused by frontal action and air mass thunderstorms. The principal source of moisture is the Gulf of Mexico. Frontal activity occurs frequently during April and May. During June through August, the fronts tend to stall north of the area but some fronts do push south through the area. Isolated air mass thunder storms are frequent during the period June through August. During October and November, there is an increase in frontal activity but the inflow of moist air from the Gulf of Mexico is decreased. Consequently, precipitation over the area during this period is considerably less than during the summer months.

11. Temperatures in the study area also vary widely because of altitude differences. At Lake Moraine, elevation 10,210 feet, the mean annual maximum and minimum temperatures are about 47 and 24 degrees, respectively. At Colorado Springs, elevation 6,200 feet, the mean annual maximum and minimum temperatures are about 62 and 35 degrees, respectively.

Recorded extreme temperatures at these locations range from about 100 degrees at Colorado Springs to about -37 degrees at Lake Morraine. The average frost-free period is 8 May to 4 October at Colorado Springs and 24 June to 23 August at Lake Morraine.

12. Structures With Regulatory Effects: There are three structures in the study area that have significant water regulating facilities. They are Kettle Creek Diversion Dam, Big Johnson Reservoir, and Ramah Detention and Recreation Dam.

13. Kettle Creek Diversion Dam is owned by the U.S. Air Force. It is located north of Colorado Springs on Kettle Creek, a tributary of Monument Creek. The earth dam was constructed for flood control and controls runoff from about 16.3 square miles. The dam is shown on Plate 4. Pertinent data for the Kettle Creek Diversion Dam are shown on Plate 10.

14. Big Johnson Reservoir, also named Fountain Valley Reservoir-Dam No. 2, is located east of Security, Colorado on Widefield Creek, a tributary of Fountain Creek. The dam is shown on Plate 6. This old earth dam is owned by the Fountain Mutual Irrigation Co. and was last repaired in 1947. Its primary purpose is for irrigation. The drainage area behind the dam is about 3.1 square miles. Maximum capacity of this dam is 6,996 acre feet and the normal irrigation storage is 5,076 acre feet.

15. Ramah Detention and Recreation Dam was built by the Soil Conservation Service, U.S. Department of Agriculture. The earth dam, constructed in

1963, is for flood control and recreation. The structure controls runoff from about 67.8 square miles and is located on Big Sandy Creek upstream from the town of Ramah as shown on Plate 7. Pertinent data for Ramah Detention and Recreation Dam are shown on Plate 11.

16. There are several small earth dams, stock ponds, canals, and diversion ditches in the study area but they have no regulatory significance. They divert low flows for irrigation and have very little effect on major flows.

17. Historic Floods. Stream gages in the Monument Creek watershed are located on West Monument Creek at the U.S. Air Force Academy with data available from 1970 to current year; on West Monument Creek near Pikeview with data available from 1957 to 1970; and on Templeton Gap Floodway with data available from 1952 to current year. Flow records from these stations do not contain significant discharge measurements that would indicate major flooding.

18. Other records of flooding in the Monument Creek drainage basin are available. Table 1 lists the highest ten Monument Creek floods known to have caused damage. From available information, the floods of 1864, 1886, and 1935 would be classed as major in destructive capability. The May 1935 flood was the highest of record in Monument Creek. Eighteen people were listed as dead or missing and homes, railroads, roads, business buildings, parks, and sewers sustained heavy damage in this flood.

TABLE 1

HIGHEST TEN DAMAGING FLOODS IN ORDER OF OCCURRENCE

MONUMENT CREEK AT COLORADO SPRINGS, COLORADO

Order Number	Date of Crest	Estimated Peak Discharge c.f.s.
1	June 10, 1864	40,000
2	June 6, 1874	*
3	July 25, 1885	*
4	August 2, 1886	40,000
5	May 21, 1904	*
6	June 2, 1914	*
7	May 22, 1922	*
8	May 30-31, 1935	50,000
9	August 6, 1945	*
10	June 17, 1965	*

* No estimated discharge data available.

19. Stream flow records for Fountain Creek in the study reach are short, fragmentary, and generally limited to random measurements taken at the time of large flood occurrences. Records are available for Fountain Creek at three locations near Colorado Springs. One stream gaging station, Fountain Creek near Colorado Springs, has data available from 1958 to current year. Another, operational since 1965, is on Fountain

Creek at Security, and the third stream gaging station was established in 1939 and discontinued in 1954.

20. Estimates of large floods from Fountain Creek and tributaries in El Paso County are available. Table 2 lists the highest ten Fountain Creek floods known to have caused significant flooding.

TABLE 2

HIGHEST TEN DAMAGING FLOODS IN ORDER OF OCCURRENCE

FOUNTAIN CREEK FROM COLORADO SPRINGS TO FOUNTAIN, COLORADO

Order Number	Date of Crest	Estimated Peak Discharge c.f.s.
1	June 10, 1864	40,000
2	July 25, 1885	*
3	August 2, 1886	40,000
4	June 2, 1914	*
5	June 3, 1921	18,000
6	May 27-28, 1922	*
7	July 20, 1932	*
8	May 30-31, 1935	55,000
9	May 28, 1940	22,100
10	June 17, 1965	*

* No estimated discharge data available.

21. Streamflow data are not available for Big Sandy Creek near the Ramah and Calhan areas. There are no records of major flooding in these areas.

22. Hydrograph Analysis. Urbanization of a watershed can significantly alter the runoff characteristics of a basin. As urbanization takes place, natural ground and soil are replaced with impervious materials in the form of roads, roof tops, sidewalks, and parking lots. The result is that incident rainfall, which originally infiltrated into the natural ground cover, now runs off with little rainfall loss. Not only does more volume run off than under natural conditions, but the basin response to rainfall is generally faster because of storm drain systems and the increased hydraulic efficiency of paved surfaces. The net result of urbanization in terms of runoff is the generation of more runoff from the same series of storm events over what would be observed on an identical watershed.

23. Synthetic unit hydrographs were derived using lag time and time rate of change of runoff ("S" Curve) relationship as outlined in TM 4-550-3. Lack of recorded flood hydrographs in the study area made it necessary to find flood records of similar urbanized basins for hydrograph analysis. Four flood events representing urban conditions were selected for this purpose. Two of these are the flood of March 2, 1938, Alhambra Wash in Los Angeles, California, and the flood of March 2, 1938, Broadway Drain in Los Angeles, California. The other two are Bear Grass Creek and 17th Street Sewer in Louisville, Kentucky obtained from "Report of Sewer Runoff Investigation for Louisville, Kentucky," Corps of Engrs.,

Lousiville Dist., 1949. Unit hydrographs derived from these observed events were converted to summation hydrographs and subsequently reduced to dimensionless S-curve form by the technique outlined in TB 4-550-3. The adopted Average Urban S-curve, shown on Plate 12, is the average of these four curves and is considered representative of an average urban area in El Paso County.

24. Basin lag times are based on L, Lca and S values which are used to arrive at the geometric factor $L \cdot Lca/\sqrt{S}$ for each basin where L and Lca conform to the usual definition and are expressed in miles, and S is the overall basin slope in feet per mile. The geometric factor and the coefficient Kn were then inserted in the general equation $Lag = 24\ Kn\ (L \cdot Lca/\sqrt{S})^{.38}$ to compute basin lag time. Each basin's lag time and ultimate discharge were applied to the adopted dimensionless S-curve and resulted in a synthetic unit hydrograph for each basin. The coefficient Kn is equated to the weighted average Manning's n values for the principal water courses within a drainage basin. A Kn value of 0.03 was adopted for use for urban areas in this study and is based on field inspections of the study area and comparisons with other studies.

25. Synthetic unit hydrographs for non-urban areas, where required, are based on the average of two S-curves developed for Design Memorandum No. 1, Fountain Dam and Reservoir, Arkansas River Basin, Pueblo, Colorado. These are for the flood of 18-21 June 1965 on Apishapa River near Fowler, Colorado and the flood of 18-21 June 1965 on Frijole Creek near Alfalfa,

Colorado. This average S-curve is shown on plate 13. Lag times were based on Kn values ranging from 0.05 to 0.06 and were determined by field inspections and comparisons with other areas. Unit hydrographs are tabulated on Plates 14 and 15.

26. Loss Analysis. When considering rainfall infiltration losses under urbanized conditions, the sub-areas were separated into two parts - the pervious portion and the impervious portion. The pervious portion is that part of the developed area such as lawns, gardens, and other planting spaces susceptible to infiltration after development has taken place. The impervious portion is that part of the area covered by roofs, patios, sidewalks, driveways, alleys, and streets. Inspection of aerial photographs have shown that the degree of imperviousness may vary from about 20 percent in the case of low-density residential areas to about 90 percent in areas where business-commercial land use predominates. Table 3 is a listing of impervious area percentages that are considered typical for a given land use.

TABLE 3

LAND USE	% IMPERVIOUSNESS
LOW DENSITY RESIDENTIAL	20 - 30
MEDIUM DENSITY RESIDENTIAL	25 - 35
HIGH DENSITY RESIDENTIAL	30 - 40
BUSINESS - COMMERCIAL	40 - 90
LIGHT INDUSTRIAL	45 - 65
HEAVY INDUSTRIAL	50 - 70

27. In developing design floods the impervious portion of the basins were assigned an infiltration rate of 0.02 inch per hour. It may seem contradictory to say that infiltration may occur on impervious surfaces but studies of large concrete parking areas have shown that 100 percent runoff cannot be attained because of water percolating through joints and other discontinuities in an otherwise impervious surface.

28. Infiltration rates for the pervious areas of the study area were based on field observations and losses used by the Omaha District on watersheds near the study. A constant loss rate of 0.30 inch per hour was adopted for use in this study.

29. Frequency Analysis. The lack of adequate stream flow records in the study area necessitated adoption of "Manual for Estimating Flood Characteristics of Natural-Flow Streams in Colorado," by the U.S.G.S. for determining discharge-frequency relationships. The manual is applicable only to natural-flow streams. Therefore, another method was used for frequency analysis for urban areas. Rainfall from Technical Paper No. 40 was used and applied to each urban area's unit hydrograph. The resultant peak discharges were plotted on log-probability paper and resulted in a discharge frequency relationship for each urban area. An example of urban area rainfall amounts used in this study is shown on Plate 16.

30. Floods of Designated Frequency. The 10, 50, 100 and 500-year peak flows are required for the flood insurance study. They were obtained for non-urban areas by using the U.S.G.S. regression equations. Equations

for computing the peak flows as developed for the Plains Region of Colorado were used and are as follows:

$$Q_{10} = 144A^{0.528} S_B^{0.336}$$
$$Q_{50} = 891A^{0.482} S_B^{0.154}$$
$$Q_{100} = 1770A^{0.463} S_B^{0.086}$$
$$Q_{500} = 5770A^{0.432}$$

Where Q_{10} is the 10-year peak flow, Q_{50} is the 50-year peak flow, Q_{100} is the 100-year peak flow, Q_{500} is the 500-year flow in c.f.s., A is the drainage area in square miles, and S_B is the basin slope in feet per mile. Frequency curves were then obtained by plotting the peak flows on log-probability paper and drawing a curve through the points.

31. The 10, 25, and 100 year peak flows were obtained for the urban areas by using frequency rainfall from Technical Paper No. 40 by the method described previously. Frequency curves were then obtained by plotting the peak flows on log-probability paper and drawing a curve through the points.

32. For drainage areas having both urban and non-urban areas, runoff hydrographs were routed and combined to obtain 10, 25, and 100 year peak flows at designated concentration points. Frequency curves were obtained by plotting the peak flows on log-probability paper and drawing a curve through the points and are shown on plates 17 thru 36.

33. The 10, 25, 100, and 500 year runoff hydrographs were routed through Kettle Creek Diversion Dam and Ramah Detention and Recreation Dam and

then routed to the concentration point and combined with the intervening runoff. The capacity of Big Johnson Reservoir was large enough to control the 500-year flood. Therefore the drainage area behind the dam contributed only conduit releases to flows downstream.

34. Summary. Table 4 lists peak discharge figures for the concentration points shown on plates 2 thru 9.

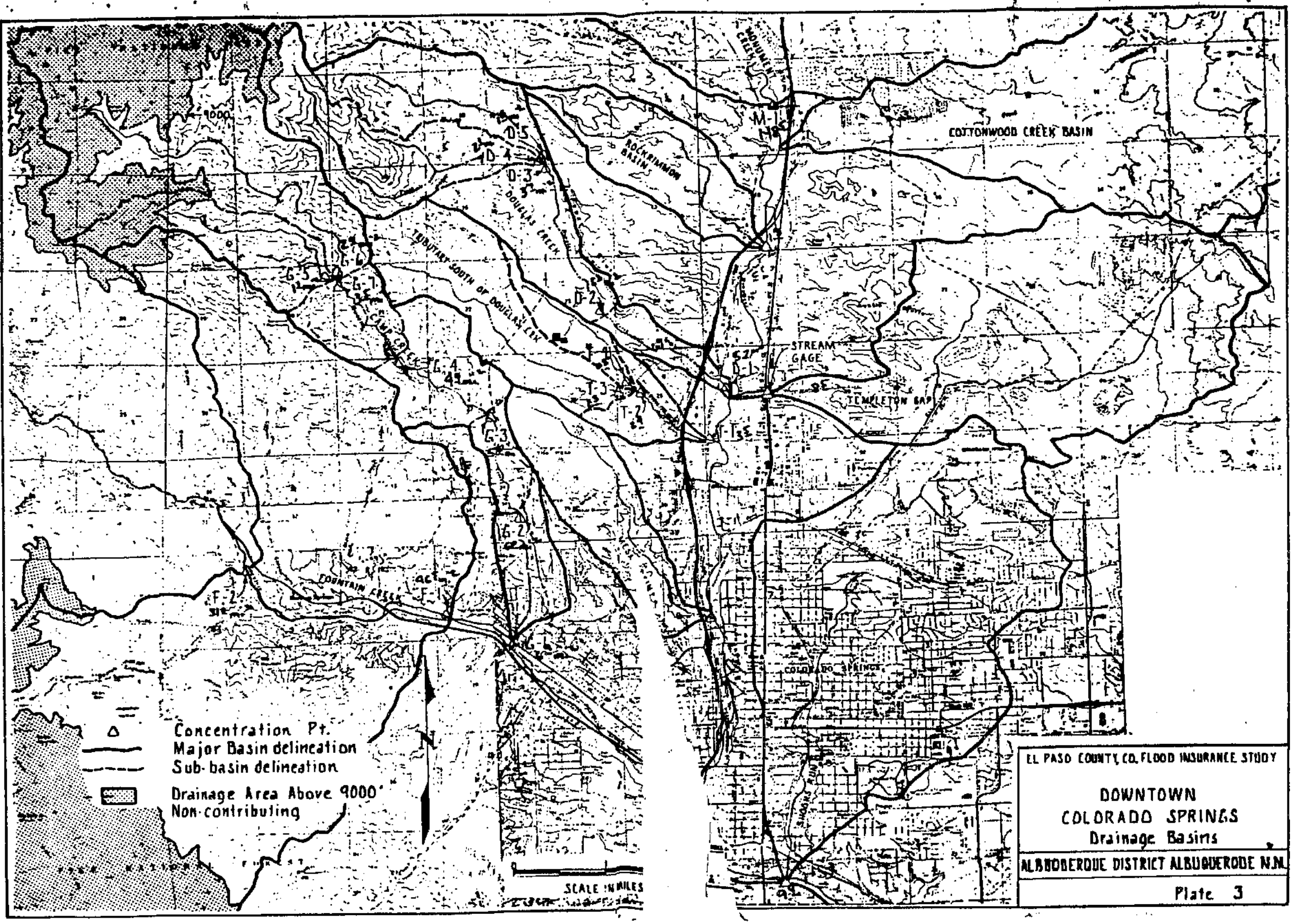
TABLE 4 (cont'd.)

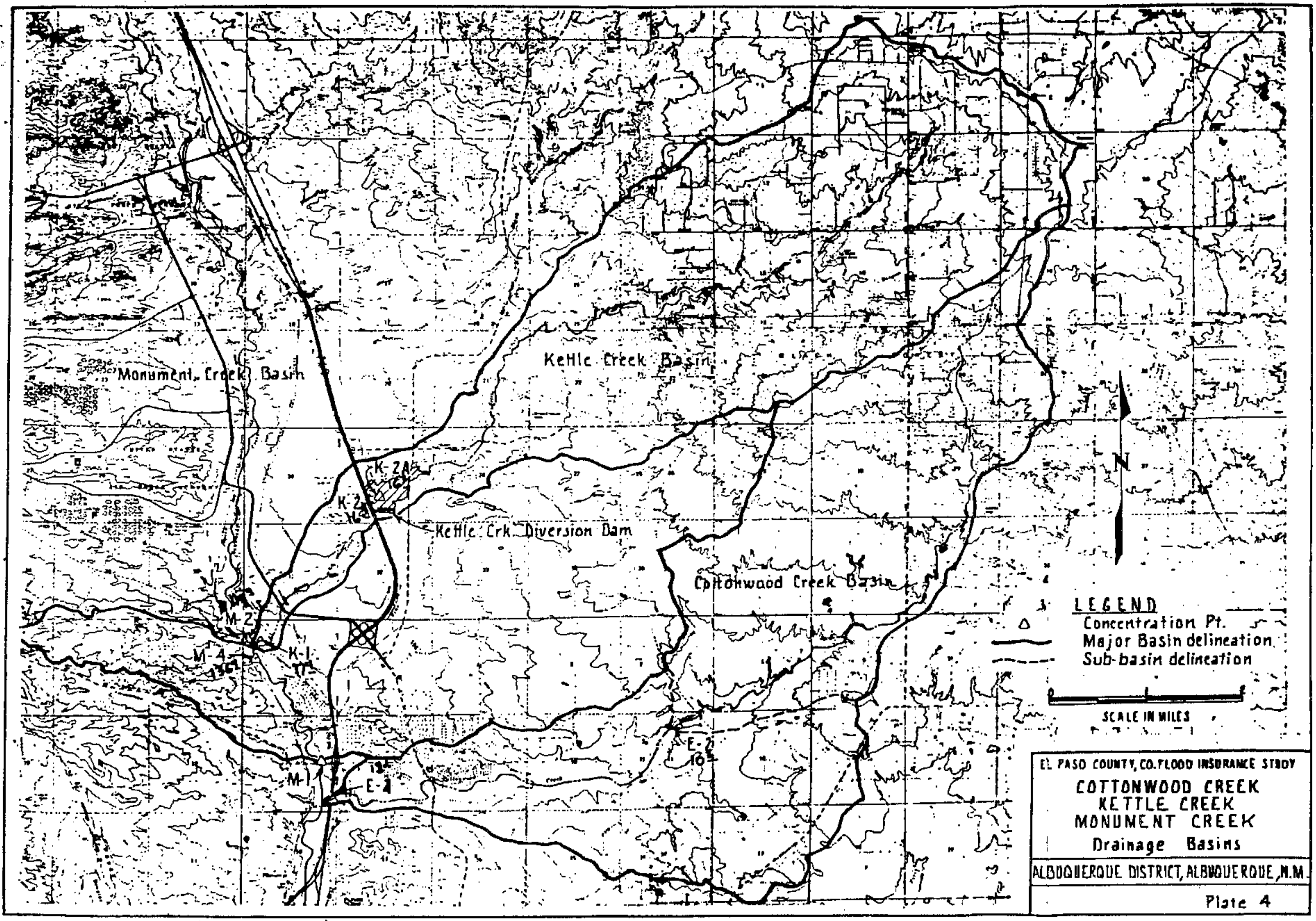
PERTINENT FLOOD DATA						
BASIN NAME	Concentration Point	Drainage Area (Sq. Mi.)	10-YR Peak Discharge (C.F.S.)	50-YR Peak Discharge (C.F.S.)	100-YR Peak Discharge (C.F.S.)	500-YR Peak Discharge (C.F.S.)
Jimmy Camp Creek	J 1	66.44	4,900	12,300	17,300	35,400
Monument Creek	M 1	148.51	10,200	20,700	27,200	49,000
	M 2	118.96	8,600	18,300	24,200	45,500
	M 4	136.41	9,700	19,900	26,000	47,000
Kettle Creek	K-1 (below dam)	17.45	1,500	2,000	2,900	7,000
	K-2 (below dam)	16.34	1,500	1,800	1,900	5,400
	K-2A (above dam)	16.34	2,900	6,900	9,500	19,300
Cottonwood Creek	E 1	18.10	3,100	7,300	10,000	20,200
	E 2	10.30	2,400	5,700	7,800	15,800
Rockrimmon Basin		1.77	1,100	2,600	3,600	7,400
Douglas Creek	D 1	5.70	2,500	4,700	6,000	11,000
	D 2	5.16	2,700	5,100	6,400	11,700
	D 3	3.69	2,400	4,500	5,600	10,100

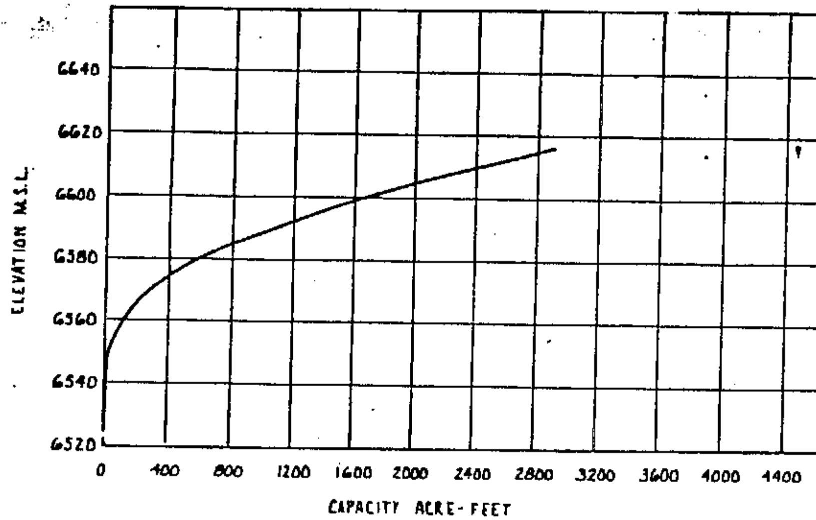
- cont'd. page 19 -

TABLE 4 (cont'd.)

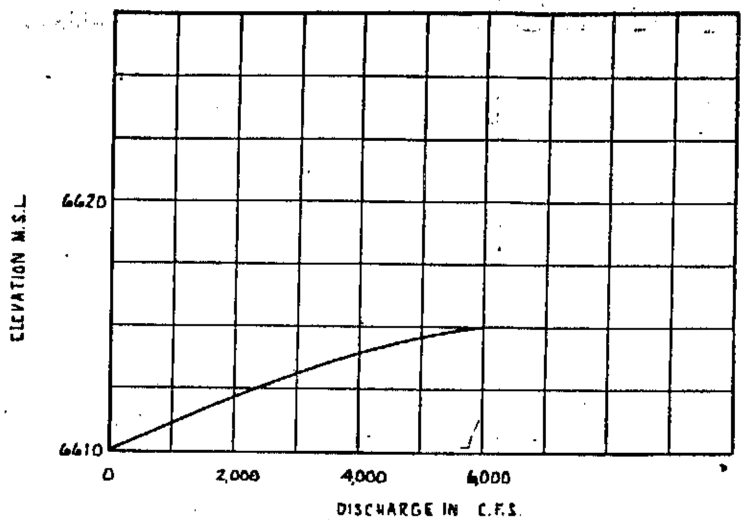
PERTINENT FLOOD DATA						
BASIN NAME	Concentration Point	Drainage Area (Sq. Mi.)	10-YR Peak Discharge (C.F.S.)	50-YR Peak Discharge (C.F.S.)	100-YR Peak Discharge (C.F.S.)	500-YR Peak Discharge (C.F.S.)
Douglas Creek (cont'd.)	D 4	2.05	1,800	3,400	4,300	7,900
	D 5	1.64	1,600	3,000	3,800	7,100
Trib. South of Douglas Crk.	T 1	3.52	1,600	3,700	5,000	9,900
	T 2	2.88	1,600	3,500	4,600	9,100
	T 3	2.34	1,400	3,100	4,200	8,300
	T 4	0.54	600	1,500	2,100	4,400
Templeton Gap Fldwy.		8.46	4,500	6,200	7,300	11,400
Mesa Basin		2.08	1,150	2,700	3,800	7,900
Trib. to Big Sandy @ Calhan	X 1	2.51	1,100	2,800	4,000	8,600
	X 1A	2.04	1,000	2,600	3,700	7,900
	X 2	0.47	500	1,350	1,900	4,200
	X 3	0.12	250	700	1,000	2,300
	X 4	0.29	400	1,050	1,500	3,400
	X 5	0.14	250	750	1,100	2,500


COTTONWOOD CREEK BASIN
ROCKRIMMON BASIN
DOUGLAS CREEK
TRIBUTARY SOUTH OF DOUGLAS CREEK
STREAM GAGE
TEMPLETON GAP
FOUNTAIN CREEK
COLORADO SPRINGS
9000
Concentration Pt.
Major Basin delineation
Sub-basin delineation
Drainage Area Above 9000'
Non-contributing
SCALE IN MILES
EL PASO COUNTY, CO. FLOOD INSURANCE STUDY
DOWNTOWN
COLORADO SPRINGS
Drainage Basins
ALBUQUERQUE DISTRICT ALBUQUERQUE N.M.
Plate 3

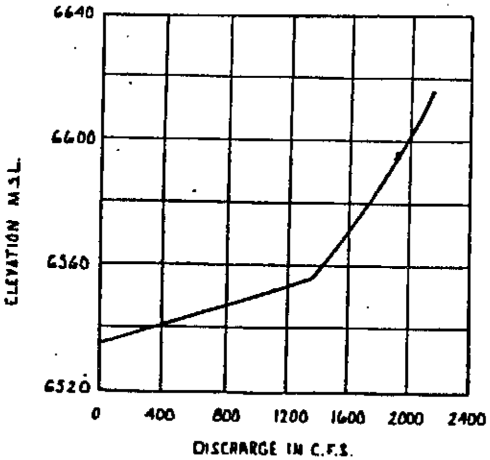

Monument Creek Basin
Kettle Creek Basin
Kettle Crk. Diversion Dam
Cottonwood Creek Basin
K-2A
K-2
M-2
M-4
K-1
M-1
E-1
E-2
N
LEGEND
Concentration Pt.
Major Basin delineation
Sub-basin delineation
SCALE IN MILES
EL PASO COUNTY, CO. FLOOD INSURANCE STUDY
COTTONWOOD CREEK
KETTLE CREEK
MONUMENT CREEK
Drainage Basins
ALBUQUERQUE DISTRICT, ALBUQUERQUE, N.M.
Plate 4



ELEVATION-CAPACITY CURVE



EMERGENCY SPILLWAY RATING CURVE



PRINCIPAL SPILLWAY RATING CURVE

PERTINENT DATA	
DAM CREST ELEV.	6615.0
EMERGENCY SPILLWAY CREST EL.	6610.0
PRINCIPAL SPILLWAY INVERT EL.	6535.3
DESIGN Q	24,000 C.F.S.
CONDUIT SIZE	1-9'-0" ⌀
EMERGENCY SPILLWAY BOTTOM WIDTH	200'

EL PASO COUNTY, CO. FLOOD INSURANCE STUDY

KETTLE CREEK DIVERSION DAM

CAPACITY AND DATA TABLES

ALBUQUERQUE DISTRICT, ALBUQUERQUE, N.M.

Plate 10

	Bear Creek @ B-1	Bear Creek @ B-2	Big Sandy Crk. @ R-5	Big Sandy Crk. @ R-4	Camp Crk. @ C-1	Camp Crk. @ C-2	Cheyenne Crk. @ C-1	Cheyenne Crk. @ C-2	Cheyenne Crk. @ C-3	Cheyenne Crk. @ C-5
Area (sq.mi.)	2.64	4.44	29.68	67.82	0.88	5.99	2.34	0.66	0.24	3.85
L (mi.)	3.50	5.5	7.2	16.10	1.47	8.10	4.27	1.97	1.36	5.48
Lca (mi.)	1.82	2.56	2.7	7.10	1.00	3.90	1.57	0.88	0.65	2.35
Slope (ft. mi.)	467.14	516.36	52.08	62.73	122.45	337.04	421.55	710.66	569.85	500.00
Lag (hrs.)	0.45	1.20	1.75	3.31	0.33	1.77	0.41	0.43	0.34	1.17
Kn	0.03	0.06	0.05	0.05	0.03	0.06	0.03	0.05	0.05	0.06
S-Curve	#2	#1	#1	#1	#2	#1	#2	#1	#1	#1
Time Period	5-min.	15-min	15-min	30-min	5-min.	15-min	5-min.	5-min.	5-min.	15-min
1	772	24	189	132	414	22	642	10	5	21
2	1586	146	220	315	813	42	1331	30	46	142
3	1943	973	938	1319	1138	181	1623	313	356	968
4	2615	2591	3544	5539	1030	662	2137	1031	471	2366
5	2442	2466	10687	14355	743	2071	2176	1053	386	2121
6	1882	1844	11576	13908	539	2312	1104	884	243	1566
7	1482	1238	11271	13058	411	2265	1345	611	141	1006
8	1182	759	9828	10487	329	1970	1080	383	89	636
9	965	508	7307	8027	266	1531	864	262	55	420
10	801	360	5669	5372	232	1111	731	189	33	276
11	676	231	3903	4072	201	814	618	121	19	177
12	603	144	3033	3039	177	633	501	82	9	117
13	545	82	2190	2353	148	451	521	55	5	55
14	472	46	1874	1666	125	387	428	30	2	33
15	435	24	1284	1279	96	271	388	18		21
16	396	19	1009	895	73	214	366	10		8
17	341		720	633	50	152	316	8		
18	315		527	374	23	103	281			
19	263		301	264	1	77	255			
20	218		219	158		44	217			
21	181		141	132		33	171			
22	140		110	103		22	153			
23	104		104			22	117			
24	58		8			6	94			
25	17						45			
26										
27										
28										
29										
30										
31										

	Cheyenne Crk. @ C-6	Douglas Crk. @ D-1	Douglas Crk. @ D-2	Kettle Crk. @ K-1	Kettle Crk. @ K-2	Monument Crk. @ M-1	Monument Crk. @ M-2	Sand Creek @ A-1	Sand Crk. @ A-1 Cont'd.	Sand Crk. @ A-3
Area (sq.mi.)	8.17	0.54	5.16	1.11	16.34	12.10	118.96	1.41		1.44
L (mi.)	5.23	1.80	6.06	2.82	10.68	7.23	17.81	2.59		3.41
Lca (mi.)	2.15	0.95	2.96	1.61	6.55	2.27	8.68	1.48		1.52
Slope (ft. mi.)	523.90	136.11	435.64	95.75	92.70	121.72	149.92	86.10		80.65
Lag (hrs.)	1.24	0.35	1.25	0.90	2.55	1.40	3.15	0.52		0.58
Kn	0.06	0.03	0.055	0.05	0.05	0.05	0.05	0.03		0.03
S-Curve	#1	#2	#1	#1	#1	#1	#1	#2		#2
Time Period	15-min.	5-min.	15-min.	10-min	30-min	15-min.	30-min.	5-min.		5-min.
1	43	240	27	8	41	56	244	332		272
2	231	470	142	34	206	204	661	699	Cont'd. @ Prd. #21	580
3	1498	632	916	191	1289	1132	2955	858		739
4	4419	645	2800	778	4251	4989	12821	1096		819
5	4466	460	2813	835	4343	5959	26933	1253		1090
6	3544	339	2234	743	3649	5419	26028	1065		1086
7	2405	258	1531	562	2521	4246	22436	840		909
8	1498	204	958	375	1583	2971	17130	678		745
9	1016	163	659	249	1080	1915	12809	558		610
10	708	151	451	169	779	1389	8561	465	134	519
11	411	123	305	127	500	997	6281	397	117	430
12	302	113	196	88	337	674	4855	339	97	380
13	199	93	130	56	226	416	3497	272	86	327
14	85	81	53	40	125	331	2631	296	68	297
15	59	66	39	16	74	200	1159	246	59	236
16	43	51	27	13	41	112	1224	221	32	251
17	13	38	11	8	32	66	815	203		220
18		25		6		56	488	190		199
19		7				21	303	164		183
20							244	152		180
21							170	Cont'd.		Cont'd. P. 15

S-Curve #1 Average of... Rural
Apishapa & Frijole Rivers

S-Curve #2 Average of... Urban
Alhambra Wash, Los Angeles, Ca.
Beargrass Crk. Louisville Ky.
Broadway Drain, Los Angeles, Ca.
17 th Street Sewer, Louisville, Ky.

EL PASO COUNTY, CO. FLOOD INSURANCE STUDY

UNIT HYDROGRAPHS

ALBUQUERQUE DISTRICT, ALBUQUERQUE, N.M.

Plate 14

	Sand Crk. @ A-3 - Cont'd.	Sand Creek @ A-4	Sand Creek @ A-5	Sand Creek @ A-6	Sand Creek @ A-7	Sand Creek @ A-8	Sand Creek @ A-9	Security Crk. @ S-1	Security Creek @ S-3	Security Creek @ S-4	Trib. to Secur. Crk. @ S-6	Skinner Hill Trib. @ Secur. @ S-7	Little Johnson Res. @ Secur. @ S-10	Security Creek @ S-11	Security Creek @ S-12	South Shook Run @ Fountain Crk.	Spring Creek @ Fountain Crk.	Templeton Gap @ Monument Crk.	Widefield Crk @ Security @ S-5	Widefield Crk. @ S-9	Windmill Gulch @ S-8
Area (sq.mi.)		1.49	1.10	7.01	1.45	23.20	14.30	0.26	3.68	0.76	0.35	0.48	0.98	2.67	0.16	9.43	6.94	8.46	1.19	3.07	4.34
L (mi.)		3.22	2.03	5.19	2.90	12.80	12.80	1.00	4.32	1.02	1.04	0.98	1.35	3.04	0.72	7.20	6.00	6.37	1.21	2.42	4.38
Lca (mi.)		1.50	1.04	2.44	1.48	7.19	6.12	0.72	2.31	0.87	0.63	0.49	0.38	1.04	0.55	3.65	2.98	3.54	0.57	1.02	2.30
Slope (ft./mi.)		80.75	86.21	109.83	125.17	90.63	102.34	60.00	41.67	78.43	129.81	188.78	103.70	46.05	97.22	95.83	70.00	99.84	82.65	115.70	84.48
Lag (hrs.)		0.57	0.68	0.77	0.50	2.84	2.61	0.49	0.85	0.30	0.41	0.34	0.39	0.54	0.21	1.04	0.96	0.98	0.45	0.69	1.24
Kn		0.03	0.05	0.03	0.03	0.05	0.05	0.05	0.03	0.03	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.05
S-Curve		#2	#1	#2	#2	#1	#1	#1	#2	#2	#1.	#1	#1	#2	#2	#2	#2	#2	#1	#1	#1
Time Period		5-min.	10-min.	10-min.	5-min.	30-min	30-min	5-min.	10-min	5-min.	5-min.	5-min.	5-min.	5-min.	5-min.	15-min.	15-min.	15-min.	5-min.	10-min.	15-min.
1		244	10	1317	359	53	35	3	594	430	6	9	16	580	137	1384	1172	1378	17	29	23
2		628	106	2594	751	177	164	11	1207	817	33	100	113	1229	304	2708	1273	2691	70	293	121
3	Cont'd.	787	826	3478	920	993	987	57	1515	1122	215	771	772	1516	260	3748	3165	3758	397	2275	784
4	from	959	1081	4045	1185	4458	3556	262	1980	881	597	953	1838	1906	156	3768	2707	3298	1645	3011	2368
5	R. 14.	1200	881	3147	1309	5623	3690	374	1688	609	579	737	1610	2302	104	2676	1906	2353	1786	2468	2370
6	@ Prd.	1121	551	2344	1085	5286	3256	354	1287	433	444	462	1193	2023	76	1987	1380	1704	1588	1551	1889
7	#21	925	320	1795	861	4077	2274	285	1002	332	301	268	750	1608	60	1504	1059	1309	1216	902	1282
8		762	203	1423	687	2941	1459	207	782	266	184	173	472	1321	48	1192	796	1008	815	567	801
9		623	125	1157	563	1917	1007	136	649	225	123	104	321	1099	37	946	740	880	536	352	549
10		524	74	938	470	1358	701	99	539	193	89	59	202	884	25	888	598	732	366	213	378
11		445	41	895	399	1021	489	69	442	163	58	31	132	779	14	723	525	650	278	118	255
12		383	20	743	350	696	327	52	429	138	35	15	87	659	2	654	437	543	190	56	163
13		333	10	676	286	493	215	38	359	108	22	9	35	585		548	374	473	124	29	108
14		283	5	580	288	331	132	25	326	82	11	2	23	492		479	297	375	84	16	45
15		279		508	245	228	71	17	297	55	6		16	497		387	228	289	38		32
16		249		437	224	105	41	9	253	29	5		4	425		300	152	216	29		23
17		221		357	214	78	35	7	230	4				392		228	83	133	17		8
18		206		285	185	53	7	3	191					369		156	14	37	13		
19		195		212	165	37		3	156					332		52					
20		176		145	154			1	129					294							
21	156	156		52	131				95					273							
22	141	145			109				67					240							
23	135	132			92				26					212							
24	115	116			75									179							
25	104	98			58									161							
26	89	83			42									128							
27	82	72			19									119							
28	68	59												67							
29	61	51																			
30	41	29																			

EL PASO COUNTY, CO. FLOOD INSURANCE STUDY

UNIT HYDROGRAPHS

ALBUQUERQUE DISTRICT, ALBUQUERQUE, N.M.

Plate 15

APPENDIX D

COST ESTIMATE

URS CORPORATION

1040 SOUTH EIGHTH STREET
COLORADO SPRINGS, COLORADO 80906
AN INTERNATIONAL PROFESSIONAL SERVICES ORGANIZATION

ENGINEERS ARCHITECTS PLANNERS

URS # 6301 PAGE 1 OF 2

BY ANN DATE 6-86

CHECKED BY ______ DATE ______

CLIENT FORD LAND DEV. CO. PROJECT FAIRLANE TECHNOLOGY PARK

SUBJECT STORM SEWER

COST ESTIMATE

ITEM NO.	ITEM DESCRIPTION	APPROX. QUANTITY	UNIT	UNIT COST		ITEM COST	TOTAL COST
1	18" RCP	630	L.F	24	00	15,120	
2	24" RCP	3508	L.F	34	50	121,026	
3	30" RCP	2900	L.F	40	00	116,000	
4	36" RCP	2444	L.F	55	00	134,420	
5	42" RCP	2675	L.F	70	00	187,250	
6	48" RCP	2633	L.F	75	00	197,475	
7	54" RCP	190	L.F	115	00	21,850	
8	8 x 4 PRECAST BOX CULVERT	580	L.F	220	00	127,600	
9	8' x 5 BOX CULVERT	408	LF	342	00	139,536	
10	5' DIA MANHOLE	8	EA	1,000	00	8,000	
11	6' DIA MANHOLE	11	EA	1,500	00	16,500	
12	8' DIOR INLET	2	EA	2,400	00	4,800	
13	10' DIOR INLET	5	EA	3,000	00	15,000	
14	10' TYPE R (M604)	6	EA	3,000	00	18,000	
15	12' DIOR INLET	5	EA	3,600	00	18,000	
16	14' DIOR INLET	2	EA	4,200	00	8,400	
17	15' TYPE R INLET (M604)	1	EA	4,500	00	4,500	
18	20' DIOR INLET	4	EA	5,200	00	20,800	
19	22' DIOR INLET	1	EA	5,800	00	5,800	
20	STD 5' GRATED INLET	1	EA	1000	00	1,000	
21	7.5 x 10' GRATED INLET	1	EA	4000	00	4,000	
22	10'-8' BOX INLET	1	EA	4000	00	4,000	
23	18" FLARED END SECTION	1	EA	275	00	275	
24	30" FLARED END SECTION	1	EA	400	00	400	
25	36" FLARED END SECTION	1	EA	510	00	510	
26	9' x 6' BOX CULVERT	202	EA	385		77,770	
27	HEADWALL FOR 18" RCP	2	EA	1000	00	2,000	
28	HEADWALL FOR 36" RCP	2	EA	1500	00	3,000	
29	HEAD WALL FOR 54" RCP	2	EA	2500	00	5,000	
30	Conc Channel d=3 bw=6	3310	L.F	42	00	139,020	
31	Conc Channel d=5.2 bw=6	720	L.F	74	00	53,280	

URS CORPORATION
1040 SOUTH EIGHTH STREET
COLORADO SPRINGS, COLORADO 80906
AN INTERNATIONAL PROFESSIONAL SERVICES ORGANIZATION

ENGINEERS ARCHITECTS PLANNERS

URS # 6301 PAGE 2 OF 2
BY AHN DATE 6-86
CHECKED BY ______ DATE ______

CLIENT FORD. LAND DEV. CO. PROJECT FAIRLANE TECHNOLOGY PARK
SUBJECT STORM SEWER

COST ESTIMATE

ITEM NO.	ITEM DESCRIPTION	APPROX. QUANTITY	UNIT	UNIT COST		ITEM COST	TOTAL COST
32	Conc. Channel d=4.3 bw=6	2400	LF	65	00	156,000	
33	GABION ENERGY DISSIPATOR	1	EA	7500		7500	
34	GABION ENERGY DISSIPATOR	1	EA	7500		7500	
35	Grouted Rip Rap Channel	2050	L.F	35	00	71,750	
38	POND 2 CUT	90,000	CY	1	50	135,000	
39	POND 2 FILL	14,000	CY	3	00	42,000	
40	POND 2 TRICKLE CHANNEL	1080	LF	7	50	8,100	
	(4' CONC.)						
41	POND 3 CUT	70,000	CY	1	50	105,000	
42	POND 3 FILL	10,000	CY	3	00	30,000	
43	POND 3 TRICKLE CHANNEL	900	LF	7	50	6,750	
	(4' Conc.)			0	04		
44	POND 2 seeding	360,000	SF	0	04	14,400	
45	POND 3 seeding	238,000	SF	0	04	9,520	
47	POND 2 RIPRAP SPILLWAY	300	CY	20	00	6,000	
48	POND 3 RIPRAP SPILLWAY	200	CY	20	00	4,000	
	SUB TOTAL						2,073,852
	Contingencies	10%					207,385
	Engineering	5%					103,693
	Total						2,384,930

APPENDIX E

ANNEXATION AGREEMENT

This Annexation Agreement dated the 26th day of October 1982, is between the City of Colorado Springs, a municipal corporation ("City"), and Ford Colorado Properties, Inc. and Ford Aerospace & Communications Corporation ("Owners").

I.

PRELIMINARY STATEMENT

Owners own real property located in El Paso County, Colorado, described in Exhibit A ("Property"). The property is presently zoned in El Paso County as PID and a Sketch Plan, Drainage Study, Preliminary Plan and a Plat (for a portion of the Property) have been filed and approved in El Paso County. The Property is presently served by Chapel Hills Water and Sanitation District, by Mountain View Electric and by Colorado Springs Public Utilities for natural gas service. The City and the Owners believe that it will be advantageous to orderly development of the City for the Property to be annexed to the City, and the Owners believe acquisition of City services and other benefits through annexation to the City will be of substantial benefit to the Owners. Therefore, in consideration of the mutual promises, covenants and agreements contained in this Annexation Agreement, the City and the Owners agree as follows:

II.

ANNEXATION

Owners have petitioned the City for annexation of the Property in accordance with the Constitution and Statutes of the State of Colorado and the Ordinance of the City of Colorado Springs. Annexation will be effective only following approval and execution of this Annexation Agreement by all parties and upon final approval of the Petition for Annexation after proper procedures have been followed and necessary findings have been determined.

III.

LAND USE ZONING AND PLATTING

Owners acknowledge that a Master Plan and a Phasing Plan for the Property should be developed and submitted to the City for approval similar to the Sketch Plan previously approved by El Paso County but modified to conform to requirements as set forth in Ordinances of the City of Colorado Springs. Such Master Plan and Phasing Plan should be prepared and submitted within ninety (90) days after the effective date of annexation. The Phasing Plan shall be updated at least annually. Zoning of the Property as approved by El Paso County is acknowledged to be PID. The parties agree the appropriate similar zoning category in the City of Colorado Springs is either PIP-1 or PIP-2 and that such zoning is appropriate for the Property. A portion of the Property has been platted as Elkhorn Acres No. 2. Such plat is acknowledged and accepted by the City. The Preliminary Plan and Elkhorn Acres No. 2 Plat as

CC Ands ...

Item No. 8

filed and approved provided for construction of buildings not to exceed 450,000 square feet (Phase I). Owners agree they shall not develop the Property to any extent beyond that approval for Phase I without first obtaining approval of the City. Owners state that it is their present intention to develop the Property and ultimately construct additional improvements within PIP-1 or PIP-2 capacities. Owners agree they shall seek no approvals for development beyond Phase I until the City shall have approved a road improvement construction schedule and phasing plan including a method for assessing and allocating transportation construction costs. Should such road improvement schedule require any land presently a part of the Property, Owners agree to dedicate the same for use as a public right-of-way and thoroughfare. Development and construction beyond Phase I may be approved without requirement of a new interchange at Stout Allen Road provided traffic studies demonstrate unused capacities in the Briargate Interchange to be constructed. Owners acknowledge an interchange at Stout Allen Road will be necessary to accomodate traffic when both Briargate and the Owners' Property are built to capacity.

IV

DRAINAGE

Owners have submitted a Drainage Study for the Property to El Paso County.

Promptly after annexation, the Owners will submit to the City a similar overall drainage concept for the Property. This will be a conceptual plan prepared in conformation with a plan to be submitted by Briargate to determine whether drainage on the Property can be handled as an integrated basin without materially increasing historic offsite flows. If such an integrated basin approach is practicable, and the City approves the overall drainage concept, the Owners, at their sole cost and expense and without any reimbursement, will provide drainage facilities in accordance with the drainage plan as approved by the City. No portion of the Property shall be submited to City drainage fees.

V.

UTILITY SERVICE

A. Gas. The City presently supplies gas to the site and shall continue to provide such service all in accordance with City ordinances and policies generally applicable to such service and to Colorado Public Utility Commission regulations, orders and tariffs, as same may exist or may subsequently be amended.

B. Electric Service. The City proposes to acquire certain facilities, installations and equipment from Mountain View Electric. Immediately following the effective date of annexation, the Owners will escrow with the City the sum of or letter of credit in such sum as may be determined and verified associated with the City's acquisition of such facilities, installations and equipment. Such escrow shall be for a period of five years provided that the Electric Division of the City shall annually review accounts and pay-back made on a yearly or a five-year basis if expectations of development are realized. If useage has not reached the proposed levels used in the cost benefit ratio analysis, the monies paid into escrow will be retained by the City as necessary to make up the deficit. This repayment process has been approved under existing electric tariffs approved by the Colorado Public Utilities Commission for any area requesting service.

The City agrees to serve the Property when such facilities, installation and equipment shall have been acquired from Mountain View Electric and when the Property shall have been annexed under tariffs, ordinances and regulations then effective.

C. Water. Through a complex series of agreements among Briargate, JVRC, Chapel Hills Water and Sanitation District, the City and others, the City proposes to acquire rights to use Chapel Hills Water distribution systems presently serving the Property. Following annexation and after acquisition of such rights, the City shall provide water service to the Property in accordance with its ordinances, regulations and tariffs as the same now exist or may be amended in the future. Such service for construction through Phase I shall be without requirement for tap fees. Owners shall pay applicable developer costs as required pursuant to City ordinances and policies. The Owners shall pay tap fees and necessary line extension costs for development beyond Phase I. Upon annexation, Owners shall abandon any right they now have to any specific allocation or quantity of water from Chapel Hills Water and Sanitation District. Owners shall receive back from JVRC those rights to underground water which were conveyed to Chapel Hills Water and Sanitation District in return for the specific allocation.

D. Wastewater. The City proposes to acquire wastewater facilities including a sewage lagoon presently operated by Chapel Hills Water and Sanitation District in the complex series of agreements referred to in paragraph V (C). The Owners and the City acknowledge that it is not the purpose of the City to operate the lagoon over a long term but rather to operate it only temporarily and then only after certain repairs and improvements have been made.

The Owners have committed at their sole cost to install a wastewater line of appropriate size and sufficient to provide service for construction through Phase I from the Property to the lagoon.

The Owners and Briargate have agreed to share in costs of a new wastewater line thereby eliminating the lagoon. It is required such construction shall be completed by July 1, 1986 and the lagoon shall then be abandoned and no longer used. In the event of environmentally detrimental discharge, seepage or otherwise, as determined by the City, or as a result of requirements by another governmental entity, Owners agree to repair the lagoon as required, or Owners shall cease use of the lagoon and commence construction of the sewer line. Owners and Briargate shall be entitled to cost recovery from third parties seeking to use said new line. In the event development of the Property prior to July 1, 1986 threatens (lagoon is then operating a 83 BOD) to exceed Colorado Department of Health permit limitations of the lagoon, or shall create any discharge from the lagoon, it shall be the responsibility of the Owners to justify and provide a means of wastewater disposition to the end that in no event shall any State permission for lagoon expansion be sought or requested.

VI.

FIRE PROTECTION

The Owners acknowledge that presently and for some reasonable future time, the City cannot fully provide such metropolitan services as police and fire protection within City response parameters because of the distance of the property from existing City services. The Owners acknowledge fire protection may be diminished for a reasonable time because of lack of water availability and sufficient pressures to adequately provide such protection. The Owners acknowledge and accept such temporarily limited City services.

VII

COMPLIANCE WITH ORDINANCES

The Owners will comply with ordinances of the City concerning subdivision and development of the Property beyond Phase 1 except as the requirements of otherwise applicable ordinances are expressly modified by this Annexation Agreement. Owners will also comply with zoning uses as set forth in zoning ordinances applicable to the Property.

VIII.

ASSIGNS

The term Owner shall also mean transferees, successors and assigns of any Owner and all such persons shall have obligations hereunder and the right to enforce the terms of this Annexation Agreement as if they were original parties hereto.

IX.

EFFECT OF ANNEXATION AGREEMENT

This Annexation Agreement shall be recorded in the records of El Paso County and shall be deemed to be convenants running with the land binding upon all persons who now or hereafter shall have any interest in the Property.

CITY OF COLORADO SPRINGS

APPROVED AS TO FORM:

By: ______________________

____
CITY ATTORNEY 4/26/84

FORD COLORADO PROPERTIES INC.

ATTEST:

BY: ______________________
President

____
City Clerk

FORD AEROSPACE & COMMUNICATIONS CORPORATION

By: R W Kuber
Vice President

STATE OF Michigan)
) ss.
COUNTY OF Wayne)

The foregoing instrument was acknowledged before me this 8th day of October, 1982, by J. Robert Anderson President of Ford Colorado Properties, Inc.

WITNESS MY HAND AND OFFICIAL SEAL.

Donna J. Gordon
Notary Public

One Parklane Boulevard
Dearborn, Michigan 48126
(Address)

My Commission expires: 10-13-84

STATE OF)
) ss.
COUNTY OF)

The foregoing instrument was acknowledged before me this 20th day of October, 1982, by R. W. Kuber, Vice President of Ford Aerospace & Communications Corporation.

WITNESS MY HAND AND OFFICIAL SEAL.

[signature]
Notary Public

My Commission Expires:
October 21, 1985