MOEHRING & ASSOCIATES ——— CONSULTING ENGINEERS

SKYWAY INDUSTRIAL PARK

SEDGWICK COUNTY, KANSAS

HYDROLOGY EVALUATION

&

DRAINAGE CONCEPT

MOEHRING & ASSOCIATES
CONSULTING ENGINEERS
WICHITA

OCTOBER 1996

433 S. HYDRAULIC ——— WICHITA, KANSAS 67211 ——— 263-8291

SUMMARY

The area being platted as Skyway Industrial Park contains four (4) principal drainage basins under existing or pre-developed conditions.

Basin "A" originates within the property and flows generally to the North toward the South road side ditch of 31st St., and then East in the ditch toward two (2) existing 24" CMP culverts under 31st St. Under existing conditions, the peak discharge from Basin "A" to the culverts under 31st St. is 15.53 cfs.

The drainage in Basin "B" originates off-site, West of Maize Road. The area of the off-site basin West of Maize Rd. is presently in cultivation, and contains 72.63 acres. The discharge from the off-site basin is conveyed thru 3-30"RCP culvert pipes under Maize Road, into the area being platted. On-site Basin "B" flows to the East and then North toward the South road side ditch of 31st Street, discharging thru the 2-24" CMP culverts under 31st Street. The peak discharge from Basin "B" (including the off-site contribution) to the existing culverts is 47.32 cfs.

With both Basins "A" and "B" contributing to the same culvert installation, the hydrographs for both basins have been combined (and based on the difference in the time to peak) the resulting composite hydrograph indicates a peak discharge of 47.6 cfs, under existing conditions.

Under post-developed conditions of runoff, and with the detention provided by the West detention pond, the resulting peak discharge from both Basins "A" and "B", will be 43.85 cfs, which is less than for pre-developed conditions.

Basin "C" originates within the property and flows generally to the North toward two (2) existing 18" CMP culvert pipes under 31st Street, located approximately 10' East of the Northeast corner of the platting area. The peak discharge from Basin "C" to the culvert installation under 31st St. is 16.6 cfs, under pre-developed conditions.

Under post-developed conditions of runoff, and with the detention provided by the East pond, the resulting peak discharge Basin "C", will be 16.04 cfs which is slightly less than for pre-developed conditions of runoff.

Basin "D" originates off-site, in the area platted as Dugan Industrial 3rd Addition, and flows generally East toward the East side of the plat. The peak discharge from Basin "D" at the East side of the plat is 35.67 cfs, under pre-developed conditions.

Under post-developed conditions, part of the runoff is intercepted by the road side ditches of Tyler Rd., and directed South toward K-42 Highway.

The post-developed runoff intercepted and conveyed in the West ditch of Tyler Rd. to a proposed 42" RCP culvert under Tyler Rd., at the North ditch of K-42, is calculated to be 50.66 cfs, which is less than full pipe flow for the proposed culvert.

The peak flow for that part of Basin "D", conveyed in the East ditch of Tyler Road to the North ditch of K-42, is calculated to be 11.16 cfs.

The combined peak discharge from both the East and West ditches (50.66 + 11.16 = 61.82 cfs) of Tyler Rd. will flow East to an existing 5' x 2' RCBC under K-42 Highway, which has an approximate capacity of 80 cfs, with the available headwater depth of 3.75 feet.

Under post- developed conditions, the remainder of Basin "D" East of Tyler Rd., flowing East to the East property line of the plat, has been calculated to 25.41 cfs, which is approximately 56% less than the pre-developed peak discharge of 58.27 cfs, flowing off-site to the East.

From the above, it may be seen that the creation of on-site detention facilities will result in a reduction of peak rates of discharge onto properties North of 31st St. Properties to the South will not be adversly affected by runoff from the proposed development. Runoff onto property lying East of the proposed plat, will experience a reduction of more than 50% from existing conditions. The post-developed runoff that is intercepted by Tyler Rd., and diverted toward K-42 Highway will be conveyed by road side ditches and thru drainage structures designed for that purpose.

Respectfully Submitted,

Morhring & Associates
Consulting Engineers

Don C. Moehring II

PREFACE

Attached hereto are the hydrology evaluations, computations and exhibits for the drainage analysis for Skyway Industrial Park.

The computations and subsequent computer print-outs contained in this report employed portions of the computer programs entitled "Quick TR-55, Hydrology for Small Watersheds" and also "Pond-2, Detention Pond Design and Analysis", both of which have been compiled and published by Haestad Methods, Inc., Waterbury, CT.

The "Quick TR-55" computer program is based upon methodologies established in Technical Release No. 55, "Urban Hydrology for Small Watersheds" as developed by the United States Soil Conservation Service. The TR-55 methodology is particularly applicable to the conversion of rural land to urban use.

The "Quick TR-55" program contains not only the Graphical Peak and the Tabular Hydrograph methods as developed by the S.C.S., but also the Modified Rational Method for determination of peak discharge from small watersheds. The Graphical Peak Method does not yield a hydrograph for routing purposes, while the Tabular Hydrograph Method does not lend itself to the configuration of the watershed that is here being evaluated.

Therefore, the option of the Modified Rational Method has been utilized to determine the peak discharge, and at the same time generate a hydrograph by use of the SCS Dimensionless Unit Hydrograph template, which expresses the ratio of incremental discharge to the peak discharge (Q/Qp), for each corresponding time increment to the time to peak (T/Tp).

Also, the "Quick TR-55" program has been used for the calculation of the time of concentration (Tc), which in this case is the sum of the travel times for overland sheet flow, shallow concentrated flow and open channel flow, or the appropriate combination thereof.

The design storm rainfall intensities, for each respective time of concentration (Tc), are based on the Intensity-Duration-Frequency (I-D-F) values for this area, based upon data from the NOOA Technical Memorandum, NWS-HYDRO - 35, as published by the National Weather Service.

The Soil Survey for Sedgwick County, published by the SCS, was used to determine the hydrologic soil groups (HSG) for this site.

The City of Wichita "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation" was used as a source of Rational "C" values for the various land uses, correlated to each hydrologic soil group.

PURPOSE

Ideally, the goal of good storm water management is to limit the peak rate of runoff from a given site, resulting from post-developed conditions, to be equal to or less than the runoff from that site under existing or pre-developed conditions. This would serve to preserve the capacity of water courses downstream, natural or manmade. To achieve this goal may require detention facilities for some of the basins within the site. Not all basins within the development site can effectively employ detention facilities, due to topography.

Plans for the re-location of Tyler Rd., through this property, will intercept drainage from the West, part of which will be directed toward the Northeast corner of the property and part will be directed South toward K-42 Highway which is presently being improved. Both existing and proposed drainage structures will be evaluated with respect to the post-developed runoff directed toward them.

The conversion of rural land to urban use usually increases the rate of discharge and volume of storm water runoff in a watershed. Urbanization changes a watersheds response to precipitation, the most common effects are reduced infiltration and decreased travel times through the watershed, which may significantly increase the rate and volume of runoff from a given storm.

Runoff is determined primarily by the amount of precipitation and by infiltration characteristics related to soil type, impervious surfaces, and surface detention/retention.

Travel time is determined primarily by slope, length of flow path, depth of flow and roughness of flow surface.

Peak discharges are then based on the relationship of these parameters, and on the drainage area of the watershed, the location of the development, the affect of any natural or man made storage, and the time distribution of the rainfall during a given storm event.

Then, the objective of this report will be to evaluate the peak discharge rate from the site under both "pre" and "post" developed conditions. The difference between these peak discharge rates, reflects the change in the watersheds response, resulting from the design storm event.

INITIAL DATA

The area being evaluated in this report is being platted as "Skyway Industrial Park", and is located in the N.W. Quarter of Section 8, Twp. 28 S., Rg. 1 W. of the 6th P.M., Sedgwick County, Kansas, and is generally located East of Maize Road and South of 31st Street, South.

This property lies within the watershed contributing to Cowskin Creek. There are no FEMA flood plains within this property. Presently, the entire property is in cultivation, the crop is milo.

The gross are of the land being platted is determined as follows:

N.W. Quarter of Section 8	=	155.19 Ac.
Less, Dugan Industrial 3rd Add'n.	=	15.92
Less, K-42 Hgw'y R/W	=	3.05
Less, Exception Area (adj. to K-42 R/W)	=	3.17
Area of Plat	=	133.05 Ac.

Enclosed Exhibit 1, is a print of the topographic survey of this area, on which the on-site drainage basins (A thru D) are identified (solid lines), together with the principle flow paths and hydrologic soil groups (outlined with dashed lines), representing pre- developed conditions.

The areas of Basins A thru D, within the area of the proposed plat, have been determined by planimeter survey, as follows:

Basin A	=	18.18 Ac.
Basin B	=	41.20
Basin C	=	26.59
Basin D	=	47.08
Total Area Basins (A thru D)	=	133.05 Ac.

The time of concentration (Tc) for Basin A has been determined for the principle flow, with 300' of overland sheet flow (A to B) originating near the South edge of the basin; followed by 720' of shallow concentrated flow (B to C) to the South road side ditch of 31st Street; and then East 750' as open channel flow (C to D) discharging off-site thru 2-24" CMP culverts under 31st Street.

The time of concentration (Tc) for Basin C has been determined for the principle flow path, with 300' of overland sheet flow (A to B) originating near the Southwest corner of the basin; followed by 1450' (B to C) of shallow concentrated flow, to the South road side ditch of 31st Street near the Northeast corner of the plat, discharging under 31st Street thru 2 - 18" CMP culverts.

The time of concentration (Tc) for Basin D has been determined for the principle flow path, with 300' of overland sheet flow (A to B) originating near the West end of the Basin, in Dugan Industrial 3rd Add'n.; followed by 2200' of shallow concentrated flow (B to C) to the East property line of the plat.

An off-site drainage area lying West of Maize Rd., contributes to Basin B, and is shown on the enclosed enlargement of a part of the U.S.G.S. Quadrangle covering this area.

This contributing area has been determined to be 72.63 Ac., and the time of concentration is determined as 300' of overland sheet flow (A to B); 2100 feet of shallow concentrated flow to the West road side ditch of Maize Rd. (B to C); followed by 600' of channel flow to the North along the West ditch (C to D), discharging thru 3 - 30" RCP culvert pipes under Maize Rd. to the upstream end of Basin B. Down stream of the culvert installation, the flow path thru Basin B continues as 1030' (D to E) of shallow concentrated flow, followed by 1270' of open channel

flow (E to F), discharging off-site thru 2 - 24" CMP culvert pipes under 31st Street, South.

Additionally, 5.12 Acres of off-site contribution from Dugan Industrial 3rd Add'n., contributes to Basin B

An off-site drainage area of 8.39 Acres in Dugan Industrial 3rd Add'n., contributes to Basin D.

Then, for determination of pre-developed peak runoff, the total drainage area of Basin B will be 118.95 Ac., and the total drainage area for Basin D will be 55.47 Acres.

Enclosed Exhibit 2 (at the back of this report) is a print of the Preliminary Plat on which the site topography, revised drainage basins and flow paths for post-developed conditions are indicated.

The Rational "C" values used in this study are taken from the City of Wichita "Drainage Policy", and for the 5 yr. design storms is as follows:

Land Use / HSG	5 yr.
Cultivated - "B" Soil	0.22
Cultivated - "C" Soil	0.31
Cultivated - "D" Soil	0.37
Undeveloped Urban Analysis	0.54
Light Industrial	0.69

COMPUTATION PROCEDURE

For Pre-developed Conditions - -

The following computer print-out pages, C-1 and C-2 are the computations to determine the time of concentration (Tc), and the corresponding peak discharge (Q) for Basin "A", under pre-developed conditions for the 5yr. rainfall event. Page C-3 exhibits the resulting hydrograph ordinates for this event.

Pages C-4, C-5 and C-6 are the computations to determine the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for Basin "B" (including off-site drainage areas), under pre-developed conditions for the 5 yr. rainfall event.

Page C-7 lists and combines the hydrographs for Basin "A" and "B". It may be seen that the discharge from Basin "A" will have peaked and passed prior to the peak from Basis "B". Page C-8 lists the resulting ordinates for the combined hydrograph.

Pages C-9, C-10 and C-11 are the computations to determine the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for Basin "C" under pre-developed conditions for the 5yr. rainfall event.

Pages C-12, C-13 and C-14 are the computations to determine the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for Basin "D", under pre-developed conditions for the 5yr. rainfall event.

To check the capacity of the 3 - 30" RCP culverts under Maize Rd., Pages C-15 and C-16 are the computations to determine the time of concentration (Tc) and the peak discharge (Q) for the off-site drainage area of 72.63 Acres, lying West of Maize Rd., under pre-developed conditions for the 5yr. rainfall event. With a head water depth of 30", this culvert installation has the capacity of 75 cfs. which is greater than the peak discharge of 56.48 cfs from the off-site drainage area.

For Post-developed Conditions - -

Pages C-17, C-18 and C-19 are the computations to determine the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for Basin "A", under post developed conditions for the 5yr. rainfall event.

Pages C-20, C-21 and C-22 are the computations to determine the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for Basin "B", under post-developed conditions for the 5 yr. rainfall event.

Page C-23 combines the post-developed hydrographs for Basins "A" and "B", for the flow directed to the West detention pond. Page C-24 is the pond volume file, Page C-25 is the input data for a 36" RCP outlet structure, and Page C-26 is the outflow rating table for that structure.

Pages C-27 and C-28 are the pond routing computations. Page C-29 is the summary of the routing computations, and Page C-30 is the graphical exhibit of the inflow/outflow relationship.

Page C-31, C-32 and C-33 are the determinations for the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for post-developed Basin "C", for the flow directed to the East detention pond.

Pages C-34, thru C-40 contain the input data for the 21" RCP outlet structure for the East detention pond, the pond volume data, the outflow rating table for the 21" RCP, the routing computations, the summary of the routing computation, and the graphical exhibit of the inflow/ outflow relationship .

Pages C-41, C-42 and C-43 are the determinations for the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for that part of post-developed Basin "D" lying West of Tyler Rd., and flowing South toward K-42 Highway.

Pages C-44, C-45 and C-46 are the determinations for the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for that part of post-developed Basin "D" lying East of Tyler Rd., and flowing South toward K-42 Highway.

Pages C-47, C-48 and C-49 are the determinations for the time of concentration (Tc), the peak discharge (Q), and the hydrograph ordinates for that part of post-developed Basin "D", lying East of Tyler Rd., discharging toward the East property line.

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:08:18 08-12-1996 DIPREA.TCT

DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "A"

Tc COMPUTATIONS FOR:

SHEET FLOW (Applicable to Tc only)

Segment ID		A-B	
Surface description		CULT. MILO	
Manning's roughness coeff., n		0.0600	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0025	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.42	= 0.42

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	720.0	
Watercourse slope, s	ft/ft	0.0064	
$Avg.V = Csf * (s)^{0.5}$	ft/s	1.2908	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.15	= 0.15

CHANNEL FLOW

Segment ID		C-D	
Cross Sectional Flow Area, a	sq.ft	20.00	
Wetted perimeter, Pw	ft	16.65	
Hydraulic radius, r = a/Pw	ft	1.201	
Channel slope, s	ft/ft	0.0083	
Manning's roughness coeff., n		0.0350	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	4.3826	
Flow length, L	ft	750	
T = L / (3600*V)	hrs	0.05	= 0.05

TOTAL TIME (hrs) 0.62

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DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "A"

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
CULT. MILO B	0.220	5.31						
CULT. MILO C	0.310	9.72						
CULT. MILO D	0.370	0.68						
MAIZE RE."D"	0.479	0.22						
MAIZE RD."C"	0.453	1.03						
S1/2 31ST"C"	0.295	1.22						
			37.20	0.295	0.295	2.894	18.18	15.53

Quick TR-55 Ver.5.43 S/N:1240540379
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DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "A"

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.295 Area= 18.180 acres Tc = 37.20 minutes

Adjusted C = 0.295 Tc= 37.20 min. I= 2.89 in/hr Qp= 15.53 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPREA .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.120	1.48	10.15	15.53	12.06	6.00	3.17	1.63
1.870	0.84	0.44	0.23	0.13	0.06	0.00	

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 19:26:26 08-27-1996 DIPREBWO.TCT

DUGAN INDUSTRIAL ADD'N
PRE-DEVELOPED CONDITIONS
BASIN "B", INCLUDING OFF-SITE D.A. WEST OF MAIZE ROAD

Tc COMPUTATIONS FOR: BASIN "B"

SHEET FLOW (Applicable to Tc only)

		A - B		
Segment ID				
Surface description		CULT. - MILO		
Manning's roughness coeff., n		0.0600		
Flow length, L (total < or = 300)	ft	300.0		
Two-yr 24-hr rainfall, P2	in	3.500		
Land slope, s	ft/ft	0.0010		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.60	=	0.60

SHALLOW CONCENTRATED FLOW

		B - C		D - E		
Segment ID						
Surface (paved or unpaved)?		Unpaved		Unpaved		
Flow length, L	ft	1900.0		1030.0		
Watercourse slope, s	ft/ft	0.0010		0.0040		
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.5102		1.0204		
where: Unpaved Csf = 16.1345						
Paved Csf = 20.3282						
T = L / (3600*V)	hrs	1.03	+	0.28	=	1.31

CHANNEL FLOW

		C - D		E - F		
Segment ID						
Cross Sectional Flow Area, a	sq.ft	20.00		49.28		
Wetted perimeter, Pw	ft	16.65		123.21		
Hydraulic radius, r = a/Pw	ft	1.201		0.400		
Channel slope, s	ft/ft	0.0020		0.0054		
Manning's roughness coeff., n		0.0350		0.0400		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.1513		1.4860		
Flow length, L	ft	600		1270		
T = L / (3600*V)	hrs	0.08	+	0.24	=	0.31

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TOTAL TIME (hrs) 2.23

Quick TR-55 Ver.5.43 S/N:1240540379
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DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "B", INCLUDING OFF-SITE D.A. WEST OF MAIZE ROAD
AND OFF-SITE FROM DUGAN IND. 3RD

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
CULTI.MILO	C							
	0.310	80.60						
CULT. MILO	B							
	0.220	10.67						
CULT. MILO	D							
	0.370	24.35						
MAIZE RD.R/W								
	0.479	3.33						
			133.80	0.319	0.319	1.247	118.95	47.32

Quick TR-55 Ver.5.43 S/N:1240540379
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DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "B", INCLUDING OFF-SITE D.A. WEST OF MAIZE ROAD
AND OFF-SITE FROM DUGAN IND. 3RD

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.319 Area= 118.950 acres Tc = 133.80 minutes

Adjusted C = 0.319 Tc= 133.80 min. I= 1.25 in/hr Qp= 47.32 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPREBWO.HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.230	1.52	5.38	10.54	17.66	26.87	36.05	42.74
1.980	46.50	47.32	46.50	43.20	39.32	34.62	28.74
3.730	23.06	18.96	15.70	13.09	11.16	9.32	7.73
5.480	6.41	5.35	4.48	3.69	3.09	2.54	2.14
7.230	1.78	1.49	1.25	1.03	0.87	0.71	0.60
8.980	0.51	0.44	0.38	0.31	0.25	0.20	0.14
10.730	0.09	0.04	0.00				

POND-2 Version: 5.14 S/N: 1220510530

Executed 08-31-1996 16:45:27

Data directory: \PONDPACK*.HYD

File Summary for Composite Hydrograph

Time (hrs)	DIPREA (cfs)	DIPREBWO (cfs)	ATPIPE (Total)
0.00	Missing	Missing	0.0
0.25	6.0	1.8	7.8
0.50	12.9	5.8	18.7
0.75	13.7	11.1	24.8
1.00	8.9	18.4	27.3
1.25	4.5	27.6	32.1
1.50	2.4	36.6	39.0
1.75	1.2	43.0	44.3
2.00	0.6	46.6	47.2
2.25	0.3	47.3	47.6
2.50	0.2	46.2	46.4
2.75	0.1	42.9	43.0
3.00	0.0	38.9	39.0
3.25	0.0	34.1	34.1
3.50	0.0	28.3	28.3
3.75	0.0	22.7	22.7
4.00	0.0	18.7	18.7
4.25	0.0	15.5	15.5
4.50	0.0	12.9	12.9
4.75	0.0	11.0	11.0
5.00	0.0	9.2	9.2
5.25	0.0	7.6	7.6
5.50	0.0	6.3	6.3
5.75	0.0	5.3	5.3
6.00	0.0	4.4	4.4
6.25	0.0	3.6	3.6
6.50	0.0	3.0	3.0
6.75	0.0	2.5	2.5
7.00	0.0	2.1	2.1
7.25	0.0	1.8	1.8
7.50	0.0	1.5	1.5
7.75	0.0	1.2	1.2
8.00	0.0	1.0	1.0
8.25	0.0	0.9	0.9
8.50	0.0	0.7	0.7
8.75	0.0	0.6	0.6
9.00	0.0	0.5	0.5
9.25	0.0	0.4	0.4
9.50	0.0	0.4	0.4
9.75	0.0	0.3	0.3

`>>>>>>>>>>>>>>>> SUMMATION WARNING <<<<<<<<<<<<<<<<
eaks were missed during interpolation for the following files:
DIPREA .HYD DIPREBWO.HYD

POND-2 Version: 5.14 S/N: 1220510530

>>>>> HYDROGRAPH PRINTOUT <<<<<

08-31-1996 16:54:30

Hydrograph file: \PONDPACK\ATPIPE .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.000	0.00	7.82	18.74	24.84	27.31	32.13	38.95
1.750	44.26	47.20	47.59	46.41	42.98	38.97	34.15
3.500	28.29	22.73	18.70	15.49	12.94	11.01	9.19
5.250	7.62	6.33	5.28	4.42	3.64	3.05	2.51
7.000	2.11	1.76	1.47	1.23	1.02	0.86	0.70
8.750	0.59	0.50	0.44	0.37	0.31	0.25	

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:41:52 08-12-1996 DIPREC.TCT

DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "C"

Tc COMPUTATIONS FOR:

SHEET FLOW (Applicable to Tc only)

		A-B CULT. MILO	
Segment ID			
Surface description			
Manning's roughness coeff., n		0.0600	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0100	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.24	= 0.24

SHALLOW CONCENTRATED FLOW

		B-C	
Segment ID			
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1450.0	
Watercourse slope, s	ft/ft	0.0058	
$Avg.V = Csf * (s)^{0.5}$	ft/s	1.2288	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.33	= 0.33

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.57

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 11:23:38 08-31-1996

DUGAN INDUSRTIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "C"

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
CULT. MILO B								
	0.220	21.11						
CULT. MILO C								
	0.310	1.81						
S1/2 R/W,(N)								
	0.295	0.87						
			34.20	0.230	0.230	3.038	23.79	16.60

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 11:23:38 08-31-1996

DUGAN INDUSRTIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "C"

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.230 Area= 23.790 acres Tc = 34.20 minutes

Adjusted C = 0.230 Tc= 34.20 min. I= 3.04 in/hr Qp= 16.60 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPREC .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.070	0.76	9.74	16.60	12.30	5.70	2.86	1.39
1.820	0.67	0.33	0.17	0.08	0.01		

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 08:40:53 08-28-1996 DIPRED.TCT

DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "D"

Tc COMPUTATIONS FOR: BASIN D

SHEET FLOW (Applicable to Tc only)

Segment ID		A-B	
Surface description		CULT. MILO	
Manning's roughness coeff., n		0.0600	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0033	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.37	= 0.37

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	2200.0	
Watercourse slope, s	ft/ft	0.0045	
$Avg.V = Csf * (s)^{0.5}$	ft/s	1.0823	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.56	= 0.56

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

TOTAL TIME (hrs) 0.94

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:40:56 09-01-1996

DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "D"

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
CULT. MILO B	0.220	24.05						
CULT. MILO C	0.310	34.22						
			56.40	0.273	0.273	2.244	58.27	35.67

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:40:56 09-01-1996

DUGAN INDUSTRIAL ADD'N.
PRE-DEVELOPED CONDITIONS
BASIN "D"

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.273 Area= 58.270 acres Tc = 56.40 minutes

Adjusted C = 0.273 Tc= 56.40 min. I= 2.24 in/hr Qp= 35.67 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPRED .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.190	3.64	14.94	30.59	35.67	31.53	22.89	13.96
1.940	9.16	6.00	3.85	2.50	1.62	1.05	0.69
3.690	0.45	0.31	0.20	0.10	0.00		

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 17:46:18 08-18-1996 DIPREW.TCT

DUGAN INDUSTRIAL ADDITION
PRE-DEVELOPED CONDITIONS
72.63 aC. DRAINAGE AREA WEST OF MAIZE RD.
CHECK ON CAPACITY OF 3 - 30" RCP'S

Tc COMPUTATIONS FOR: W. OF MAIZE RD.

SHEET FLOW (Applicable to Tc only)

		A - B	
Segment ID			
Surface description		CULT - MILO	
Manning's roughness coeff., n		0.0600	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0010	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.60	= 0.60

SHALLOW CONCENTRATED FLOW

		B - C	
Segment ID			
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	2100.0	
Watercourse slope, s	ft/ft	0.0010	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.5102	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	1.14	= 1.14

CHANNEL FLOW

		C - D	
Segment ID			
Cross Sectional Flow Area, a	sq.ft	20.00	
Wetted perimeter, Pw	ft	16.65	
Hydraulic radius, r = a/Pw	ft	1.201	
Channel slope, s	ft/ft	0.0020	
Manning's roughness coeff., n		0.0350	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.1513	
Flow length, L	ft	600	
T = L / (3600*V)	hrs	0.08	= 0.08

::

TOTAL TIME (hrs) 1.82

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:14:26 08-18-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS / UNDEVELOPED URBAN ANALYSIS (C OF W)
72.63 AC. DRAINAGE AREA WEST OF MAIZE RD.
CHECK ON CAPACITY OF 3 - 30" RCP'S

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
UUA	0.540	72.63						
			110.00	0.540	0.540	1.440	72.63	56.48

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 08:22:49 10-22-1996 DIPOSA.TCT

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS

Tc COMPUTATIONS FOR: BASIN "A"

SHEET FLOW (Applicable to Tc only)

		A - B	
Segment ID			
Surface description		SHORT GRASS	
Manning's roughness coeff., n		0.1500	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0033	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.77	= 0.77

SHALLOW CONCENTRATED FLOW

		B - C	
Segment ID			
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	795.0	
Watercourse slope, s	ft/ft	0.0024	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.7904	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.28	= 0.28

CHANNEL FLOW

		C - D	
Segment ID			
Cross Sectional Flow Area, a	sq.ft	18.75	
Wetted perimeter, Pw	ft	15.81	
Hydraulic radius, r = a/Pw	ft	1.186	
Channel slope, s	ft/ft	0.0030	
Manning's roughness coeff., n		0.0350	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.6124	
Flow length, L	ft	730	
T = L / (3600*V)	hrs	0.08	= 0.08

::

TOTAL TIME (hrs) 1.13

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 08:25:22 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "A"

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A

Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
LT. INDUSTRL	0.690	14.34						
70' ST. R/W	0.460	1.36						
60' ST. R/W	0.422	1.25						
50' ST. R/W	0.453	1.23						
			67.80	0.638	0.638	2.023	18.18	23.47

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 08:25:22 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "A"

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.638 Area= 18.180 acres Tc = 67.80 minutes

Adjusted C = 0.638 Tc= 67.80 min. I= 2.02 in/hr Qp= 23.47 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPOSA .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.130	0.95	5.48	13.60	21.28	23.47	21.48	17.31
1.880	11.65	7.96	5.66	3.96	2.75	1.91	1.31
3.630	0.92	0.65	0.45	0.32	0.23	0.17	0.11
5.380	0.06	0.00					

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS

Tc COMPUTATIONS FOR: BASIN "B"

SHEET FLOW (Applicable to Tc only)

		A - B	
Segment ID			
Surface description		CULT.	MILO
Manning's roughness coeff., n			0.0600
Flow length, L (total < or = 300)	ft		300.0
Two-yr 24-hr rainfall, P2	in		3.500
Land slope, s	ft/ft		0.0010
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.60	= 0.60

SHALLOW CONCENTRATED FLOW

		B - C	
Segment ID			
Surface (paved or unpaved)?			Unpaved
Flow length, L	ft		1900.0
Watercourse slope, s	ft/ft		0.0010
$Avg.V = Csf * (s)^{0.5}$	ft/s		0.5102

where: Unpaved Csf = 16.1345
Paved Csf = 20.3282

T = L / (3600*V)	hrs	1.03	= 1.03

CHANNEL FLOW

		C - D	D - E
Segment ID			
Cross Sectional Flow Area, a	sq.ft	20.00	32.00
Wetted perimeter, Pw	ft	16.65	24.49
Hydraulic radius, r = a/Pw	ft	1.201	1.307
Channel slope, s	ft/ft	0.0028	0.0048
Manning's roughness coeff., n		0.0350	0.0350
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.5455	3.5252
Flow length, L	ft	600	1950
T = L / (3600*V)	hrs	0.07 + 0.15	= 0.22

::

TOTAL TIME (hrs) 1.85

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:02:12 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "B" (INCLUDING OFF-SITE CONTRIBUTIONS FROM WEST OF MAIZE RD.
AND FROM DUGAN IND. 3RD ADD'N.)

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
CULT.MILO"D"	0.370	9.46						
CULT.MILO"C"	0.310	63.17						
LT. INDUSTRL	0.690	33.30						
LT.IND. O/S	0.690	4.59						
60' ST. R/W	0.468	1.67						
70' ST. R/W	0.550	4.27						
DET. POND	1.000	5.00						
			111.00	0.472	0.472	1.429	121.46	81.96

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 15:02:12 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "B" (INCLUDING OFF-SITE CONTRIBUTIONS FROM WEST OF MAIZE RD.
AND FROM DUGAN IND. 3RD ADD'N.)

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.472 Area= 121.460 acres Tc = 111.00 minutes

Adjusted C = 0.472 Tc= 111.00 min. I= 1.43 in/hr Qp= 81.96 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPOSB .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.100	1.33	7.58	17.97	33.21	53.25	69.89	79.42
1.850	81.96	79.42	72.19	63.49	51.75	39.70	31.43
3.600	25.16	20.52	16.57	13.24	10.63	8.50	6.84
5.350	5.48	4.34	3.51	2.84	2.27	1.83	1.47
7.100	1.17	0.95	0.80	0.66	0.53	0.40	0.29
8.850	0.18	0.07	0.00				

POND-2 Version: 5.14 S/N: 1220510530

Executed 10-22-1996 10:05:49

Data directory: \PONDPACK*.HYD

File Summary for Composite Hydrograph

Time (hrs)	DIPOSA (cfs)	DIPOSB (cfs)	DIPOSAB (Total)
0.00	Missing	Missing	0.0
0.25	3.1	5.1	8.2
0.50	9.4	13.8	23.2
0.75	17.3	27.1	44.4
1.00	22.3	45.2	67.6
1.25	22.5	63.2	85.7
1.50	19.5	75.6	95.1
1.75	14.6	80.9	95.5
2.00	9.9	80.4	90.3
2.25	6.9	75.1	81.9
2.50	4.8	67.0	71.8
2.75	3.4	56.4	59.8
3.00	2.3	44.5	46.9
3.25	1.6	34.7	36.4
3.50	1.1	27.7	28.8
3.75	0.8	22.4	23.2
4.00	0.6	18.1	18.7
4.25	0.4	14.6	15.0
4.50	0.3	11.7	12.0
4.75	0.2	9.4	9.6
5.00	0.1	7.5	7.6
5.25	0.1	6.0	6.1
5.50	0.0	4.8	4.8
5.75	0.0	3.8	3.8
6.00	0.0	3.1	3.1
6.25	0.0	2.5	2.5
6.50	0.0	2.0	2.0
6.75	0.0	1.6	1.6
7.00	0.0	1.3	1.3
7.25	0.0	1.0	1.0
7.50	0.0	0.9	0.9
7.75	0.0	0.7	0.7
8.00	0.0	0.6	0.6
8.25	0.0	0.5	0.5
8.50	0.0	0.3	0.3
8.75	0.0	0.2	0.2
9.00	0.0	0.1	0.1
9.25	0.0	0.0	0.0
9.50	0.0	0.0	0.0
9.75	0.0	0.0	0.0

>>>>>>>>>>>>>>>> SUMMATION WARNING <<<<<<<<<<<<<<<<
eaks were missed during interpolation for the following files:
DIPOSA .HYD DIPOSB .HYD

POND-2 Version: 5.14
S/N: 1220510530

DUGAN INDUSTRIAL ADDITION
WEST POND PLANIMETER FILE

CALCULATED 09-03-1996 10:45:50
DISK FILE: \PONDPACK\WPOND .VOL

Planimeter scale: 1 inch = 60 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)		* Volume (acre-ft)	Volume Sum (acre-ft)
19.00	0.95	0.08	0.00		0.00	0.00
20.00	20.58	1.70	2.14		0.71	0.71
21.00	52.00	4.30	8.70		2.90	3.62
22.00	*I*	4.50	13.19	4.40		8.01
23.00	*I*	4.70	13.49	9.00		12.61
24.00	59.41	4.91	13.80		13.80	17.42

I ---> Interpolated area from closest two planimeter readings.

$$IA = (sq.rt(Area1) + ((Ei-E1)/(E2-E1))*(sq.rt(Area2)-sq.rt(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Outlet Structure File: WPOND .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

****

DUGAN INDUSTRIAL ADDITION
STRUCTURE FILE-WEST POND

****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

CULVERT-CR
Circular Culvert (With Inlet Control)

E1 elev.(ft)?	19.00
E2 elev.(ft)?	24.00
Diam. (ft)?	3
Inv. el.(ft)?	19.00
Slope (ft/ft)?	.004
T1 ratio?	
T2 ratio?	
K Coeff.?	.0078
M Coeff.?	2.0
c Coeff.?	.0292
Y Coeff.?	.74
Form 1 or 2?	1
Slope factor?	-0.5

Outlet Structure File: WPOND .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

****

DUGAN INDUSTRIAL ADDITION
STRUCTURE FILE-WEST POND

****

Outflow Rating Table for Structure #1
CULVERT-CR Circular Culvert (With Inlet Control)

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages		
19.00	0.0	No headwater		
19.25	0.4	Equ.1: HW =.25	dc=.189	Ac=.186
19.50	1.5	Equ.1: HW =.5	dc=.382	Ac=.525
19.75	3.2	Equ.1: HW =.750	dc=.561	Ac=.913
20.00	5.5	Equ.1: HW =1.0	dc=.737	Ac=1.347
20.25	8.4	Equ.1: HW =1.25	dc=.914	Ac=1.821
20.50	11.8	Equ.1: HW =1.5	dc=1.091	Ac=2.322
20.75	15.3	Equ.1: HW =1.75	dc=1.246	Ac=2.775
21.00	19.1	Equ.1: HW =2.0	dc=1.4	Ac=3.234
21.25	23.3	Equ.1: HW =2.25	dc=1.554	Ac=3.695
21.50	27.5	Equ.1: HW =2.5	dc=1.694	Ac=4.116
21.75	31.7	Equ.1: HW =2.75	dc=1.825	Ac=4.501
22.00	36.0	Equ.1: HW =3.0	dc=1.952	Ac=4.869
22.25	40.4	Equ.1: HW =3.25	dc=2.07	Ac=5.203
22.50	45.7	Transition: HW =3.5		
22.75	51.1	Submerged: HW =3.75		
23.00	55.3	Submerged: HW =4.0		
23.25	59.1	Submerged: HW =4.25		
23.50	62.6	Submerged: HW =4.5		
23.75	66.0	Submerged: HW =4.75		
24.00	0.0	E = or > E2=24.00		

Used Unsubmerged Equ. Form (1) for elev. less than 22.4 ft
Used Submerged Equation for elevations greater than 22.62 ft
HW=Headwater (ft) dc=Critical depth (ft) Ac=Area (sq.ft) at dc

Transition flows interpolated from the following values:
E1=22.4 ft; Q1=42.85 cfs; Dc=2.13 ft; E2=22.62 ft; Q2=48.97 cfs

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 10-22-1996 10:06:21

****
* *
* DUGAN INDUSTRIAL ADDITION *
* WEST POND ROUTING THRU 36" RCP *
* 5 YEAR STORM *
* BASINS A & B *
* *
****

Inflow Hydrograph: \PONDPACK\DIPOSAB .HYD
Rating Table file: \PONDPACK\WPOND .PND

----INITIAL CONDITIONS----
Elevation = 19.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
19.00	0.0	0.000
19.25	0.4	0.043
19.50	1.5	0.155
19.75	3.2	0.368
20.00	5.5	0.715
20.25	8.4	1.206
20.50	11.8	1.841
20.75	15.3	2.638
21.00	19.1	3.616
21.25	23.3	4.696
21.50	27.5	5.789
21.75	31.7	6.895
22.00	36.0	8.013
22.25	40.4	9.143
22.50	45.7	10.286
22.75	51.1	11.442
23.00	55.3	12.611
23.25	59.1	13.793
23.50	62.6	14.988
23.75	66.0	16.196

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
4.2	4.6
15.0	16.5
35.6	38.8
69.2	74.7
116.7	125.1
178.2	190.0
255.3	270.6
350.0	369.1
454.6	477.9
560.4	587.9
667.4	699.1
775.6	811.6
885.1	925.5
995.7	1041.4
1107.6	1158.7
1220.8	1276.1
1335.2	1394.3
1450.8	1513.4
1567.7	1633.7

Time increment (t) = 0.250 hrs.

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 10-22-1996 10:06:21

Pond File: \PONDPACK\WPOND .PND
Inflow Hydrograph: \PONDPACK\DIPOSAB .HYD
Outflow Hydrograph: \PONDPACK\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.000	0.00	-----	0.0	0.0	0.00	19.00
0.250	8.20	8.2	6.7	8.2	0.74	19.33
0.500	23.19	31.4	31.8	38.1	3.15	19.74
0.750	44.40	67.6	85.6	99.4	6.92	20.12
1.000	67.57	112.0	173.3	197.5	12.13	20.52
1.250	85.75	153.3	291.7	326.6	17.46	20.89
1.500	95.09	180.8	426.3	472.5	23.09	21.24
1.750	95.54	190.6	559.8	617.0	28.60	21.57
2.000	90.31	185.9	678.7	745.6	33.48	21.85
2.250	81.94	172.3	775.9	850.9	37.52	22.09
2.500	71.81	153.8	848.4	929.6	40.59	22.26
2.750	59.83	131.6	894.3	980.1	42.90	22.37
3.000	46.87	106.7	913.3	1001.0	43.85	22.41
3.250	36.36	83.2	909.2	996.5	43.65	22.40
3.500	28.79	65.2	889.1	974.4	42.64	22.36
3.750	23.17	52.0	858.8	941.1	41.11	22.28
4.000	18.70	41.9	821.8	900.7	39.44	22.20
4.250	14.96	33.7	780.1	855.5	37.70	22.10
4.500	11.95	26.9	735.3	807.0	35.82	21.99
4.750	9.55	21.5	689.0	756.8	33.91	21.88
5.000	7.65	17.2	642.3	706.2	31.97	21.77
5.250	6.11	13.8	595.9	656.0	30.07	21.65
5.500	4.83	10.9	550.4	606.8	28.22	21.54
5.750	3.84	8.7	506.3	559.1	26.40	21.43
6.000	3.11	6.9	463.9	513.2	24.65	21.33
6.250	2.50	5.6	423.6	469.5	22.98	21.23
6.500	2.01	4.5	385.3	428.1	21.38	21.14
6.750	1.61	3.6	349.2	389.0	19.87	21.05
7.000	1.29	2.9	315.2	352.1	18.45	20.96
7.250	1.04	2.3	283.3	317.6	17.11	20.87
7.500	0.86	1.9	253.5	285.2	15.86	20.79
7.750	0.72	1.6	225.8	255.1	14.63	20.70
8.000	0.58	1.3	200.3	227.1	13.41	20.62
8.250	0.45	1.0	176.8	201.3	12.29	20.54
8.500	0.33	0.8	155.2	177.5	11.15	20.45
8.750	0.22	0.6	135.8	155.8	10.01	20.37
9.000	0.11	0.3	118.2	136.1	8.98	20.29
9.250	0.03	0.1	102.3	118.3	8.01	20.22
9.500	0.00	0.0	88.1	102.3	7.09	20.14
9.750	0.00	0.0	75.6	88.1	6.27	20.07
10.000	0.00	0.0	64.5	75.6	5.55	20.00

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 10-22-1996 10:06:21

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

Pond File: \PONDPACK\WPOND .PND
Inflow Hydrograph: \PONDPACK\DIPOSAB .HYD
Outflow Hydrograph: \PONDPACK\OUT .HYD

Starting Pond W.S. Elevation = 19.00 ft

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

Peak Inflow	=	95.54 cfs
Peak Outflow	=	43.85 cfs
Peak Elevation	=	22.41 ft

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

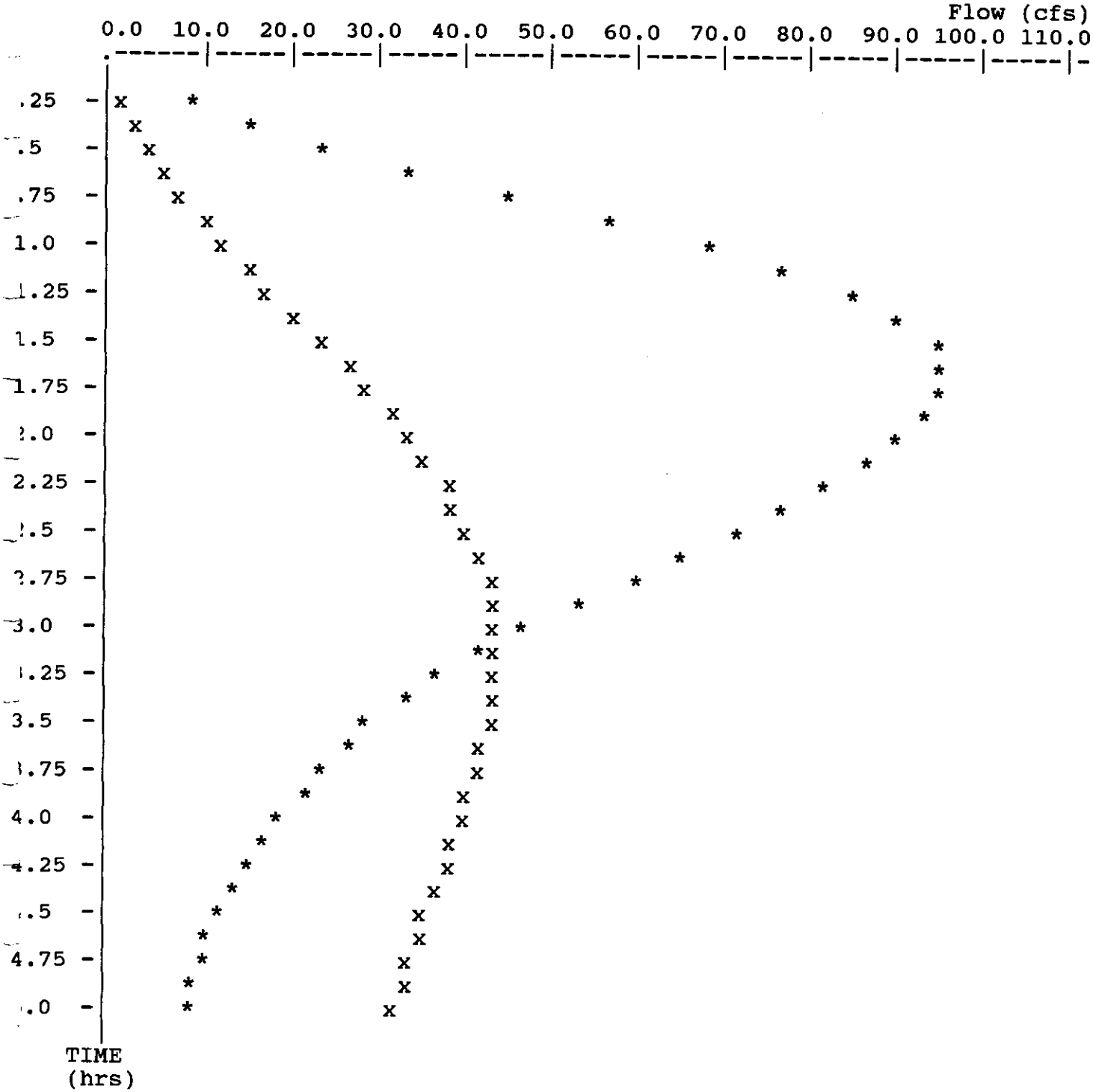
Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	9.89 ac-ft
Total Storage in Pond	=	9.89 ac-ft

POND-2 Version: 5.14 S/N: 1220510530 Page 4

Pond File: \PONDPACK\WPOND .PND
Inflow Hydrograph: \PONDPACK\DIPOSAB .HYD
Outflow Hydrograph: \PONDPACK\OUT .HYD

EXECUTED: 10-22-1996
10:06:21

Peak Inflow = 95.54 cfs
Peak Outflow = 43.85 cfs
Peak Elevation = 22.41 ft



* File: \PONDPACK\DIPOSAB .HYD Qmax = 95.5 cfs
x File: \PONDPACK\OUT .HYD Qmax = 43.8 cfs

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:08:41 10-23-1996 DIPOSC.TCT

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS

Tc COMPUTATIONS FOR: BASIN "C"

SHEET FLOW (Applicable to Tc only)

		A - B	
Segment ID			
Surface description		SHORT GRASS	
Manning's roughness coeff., n		0.1500	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0053	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.64	= 0.64

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

		B - C	C - D		
Segment ID					
Cross Sectional Flow Area, a	sq.ft	18.75	45.00		
Wetted perimeter, Pw	ft	15.81	28.62		
Hydraulic radius, r = a/Pw	ft	1.186	1.573		
Channel slope, s	ft/ft	0.0020	0.0043		
Manning's roughness coeff., n		0.0350	0.0350		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.1331	3.7531		
Flow length, L	ft	927	650		
T = L / (3600*V)	hrs	0.12	+ 0.05	=	0.17

TOTAL TIME (hrs) 0.81

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:07:53 10-23-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "C"

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
LT. INDUSTRL	0.690	24.90						
180' ST. R/W	0.357	6.76						
70' ST. R/W	0.484	2.63						
DET. POND	1.000	2.00						
			48.60	0.630	0.630	2.459	36.29	56.23

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:07:53 10-23-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "C"

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.630 Area= 36.290 acres Tc = 48.60 minutes

Adjusted C = 0.630 Tc= 48.60 min. I= 2.46 in/hr Qp= 56.23 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPOSC .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.060	1.25	16.27	45.33	56.23	47.97	30.52	17.83
1.810	11.06	6.66	4.01	2.42	1.48	0.88	0.56
3.560	0.35	0.17	0.00				

POND-2 Version: 5.14
S/N: 1220510530

DUGAN INDUSTRIAL ADDITION
EAST POND PLANIMETER FILE

CALCULATED 09-03-1996 10:46:16
DISK FILE: \PONDPACK\EPOND .VOL

Planimeter scale: 1 inch = 60 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (acres)	A1+A2+sqr(A1*A2) (acres)		* Volume (acre-ft)	Volume Sum (acre-ft)
17.00	3.32	0.27	0.00		0.00	0.00
18.00	11.26	0.93	1.71		0.57	0.57
19.00	23.38	1.93	4.20		1.40	1.97
20.00	*I*	2.07	6.00	2.00		3.97
21.00	*I*	2.21	6.22	4.14		6.11
22.00	28.59	2.36	6.43		6.43	8.40

I ---> Interpolated area from closest two planimeter readings.

$$IA = (sq.rt(Area1) + ((Ei-E1)/(E2-E1))*(sq.rt(Area2)-sq.rt(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Outlet Structure File: EPOND .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

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DUGAN INDUSTRIAL ADDITION
EAST POND STRUCTURE FILE

****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

CULVERT-CR
Circular Culvert (With Inlet Control)

E1 elev.(ft)?	17.00
E2 elev.(ft)?	22.00
Diam. (ft)?	1.75
Inv. el.(ft)?	17.00
Slope (ft/ft)?	.004
T1 ratio?	
T2 ratio?	
K Coeff.?	.0078
M Coeff.?	2.00
c Coeff.?	.0292
Y Coeff.?	.74
Form 1 or 2?	1
Slope factor?	-0.5

Outlet Structure File: EPOND .STR

POND-2 Version: 5.14 S/N: 1220510530
Date Executed: Time Executed:

****

DUGAN INDUSTRIAL ADDITION
EAST POND STRUCTURE FILE

****

Outflow Rating Table for Structure #1
CULVERT-CR Circular Culvert (With Inlet Control)

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages		
17.00	0.0	No headwater		
17.25	0.3	Equ.1: HW =.25	dc=.19	Ac=.142
17.50	1.0	Equ.1: HW =.5	dc=.366	Ac=.365
17.75	2.3	Equ.1: HW =.750	dc=.547	Ac=.643
18.00	3.8	Equ.1: HW =1.0	dc=.712	Ac=.919
18.25	5.5	Equ.1: HW =1.25	dc=.865	Ac=1.186
18.50	7.4	Equ.1: HW =1.5	dc=1.01	Ac=1.437
18.75	9.3	Equ.1: HW =1.75	dc=1.137	Ac=1.655
19.00	11.3	Transition: HW =2.0		
19.25	13.7	Submerged: HW =2.25		
19.50	15.4	Submerged: HW =2.5		
19.75	17.0	Submerged: HW =2.75		
20.00	18.4	Submerged: HW =3.0		
20.25	19.7	Submerged: HW =3.25		
20.50	20.9	Submerged: HW =3.5		
20.75	22.0	Submerged: HW =3.75		
21.00	23.2	Submerged: HW =4.0		
21.25	24.2	Submerged: HW =4.25		
21.50	25.2	Submerged: HW =4.5		
21.75	26.2	Submerged: HW =4.75		
22.00	0.0	E = or > E2=22.00		

Used Unsubmerged Equ. Form (1) for elev. less than 18.98 ft
Used Submerged Equation for elevations greater than 19.11 ft
HW=Headwater (ft) dc=Critical depth (ft) Ac=Area (sq.ft) at dc

Transition flows interpolated from the following values:
E1=18.98 ft; Q1=11.14 cfs; Dc=1.24 ft; E2=19.11 ft; Q2=12.73 cfs

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 10-23-1996 18:05:31


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**************************************
*                                    *
*     DUGAN INDUSTRIAL ADDITION      *
*  EAST POND ROUTING THRU 21" RCP    *
*           5 YEAR STORM             *
*                                    *
*                                    *
**************************************
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Inflow Hydrograph: \PONDPACK\DIPOSC .HYD
Rating Table file: \PONDPACK\EPOND .PND

----INITIAL CONDITIONS----
Elevation = 17.00 ft
Outflow = 0.00 cfs
Storage = 0.00 ac-ft

GIVEN POND DATA

ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (ac-ft)
17.00	0.0	0.000
17.25	0.3	0.084
17.50	1.0	0.203
17.75	2.3	0.363
18.00	3.8	0.570
18.25	5.5	0.829
18.50	7.4	1.146
18.75	9.3	1.524
19.00	11.3	1.971
19.25	13.7	2.459
19.50	15.4	2.955
19.75	17.0	3.459
20.00	18.4	3.973
20.25	19.7	4.495
20.50	20.9	5.026
20.75	22.0	5.566
21.00	23.2	6.115
21.25	24.2	6.673
21.50	25.2	7.240
21.75	26.2	7.817

INTERMEDIATE ROUTING COMPUTATIONS

2S/t (cfs)	2S/t + O (cfs)
0.0	0.0
8.1	8.4
19.7	20.7
35.1	37.4
55.2	59.0
80.3	85.8
110.9	118.3
147.6	156.9
190.8	202.1
238.0	251.7
286.0	301.4
334.8	351.8
384.5	402.9
435.1	454.8
486.5	507.4
538.8	560.8
591.9	615.1
645.9	670.1
700.9	726.1
756.7	782.9

Time increment (t) = 0.250 hrs.

POND-2 Version: 5.14 S/N: 1220510530
EXECUTED: 10-23-1996 18:05:31

Pond File: \PONDPACK\EPOND .PND
Inflow Hydrograph: \PONDPACK\DIPOSC .HYD
Outflow Hydrograph: \PONDPACK\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.060	1.25	-----	0.0	0.0	0.00	17.00
0.310	16.27	17.5	15.9	17.5	0.82	17.44
0.560	45.33	61.6	67.5	77.5	4.97	18.17
0.810	56.23	101.6	149.4	169.1	9.84	18.82
1.060	47.97	104.2	226.1	253.6	13.77	19.26
1.310	30.52	78.5	273.6	304.6	15.50	19.52
1.560	17.83	48.3	289.8	321.9	16.05	19.60
1.810	11.06	28.9	286.8	318.7	15.95	19.59
2.060	6.66	17.7	273.5	304.5	15.50	19.52
2.310	4.01	10.7	254.6	284.2	14.81	19.41
2.560	2.42	6.4	233.0	261.0	14.02	19.30
2.810	1.48	3.9	210.9	236.9	12.98	19.18
3.060	0.88	2.4	189.6	213.3	11.84	19.06
3.310	0.56	1.4	169.4	191.0	10.81	18.94
3.560	0.35	0.9	150.5	170.3	9.89	18.82
3.810	0.17	0.5	133.0	151.0	9.01	18.71
4.060	0.00	0.2	116.9	133.2	8.13	18.60

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

Pond File: \PONDPACK\EPOND .PND
Inflow Hydrograph: \PONDPACK\DIPOSC .HYD
Outflow Hydrograph: \PONDPACK\OUT .HYD

Starting Pond W.S. Elevation = 17.00 ft

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

Peak Inflow	=	56.23 cfs
Peak Outflow	=	16.05 cfs
Peak Elevation	=	19.60 ft

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

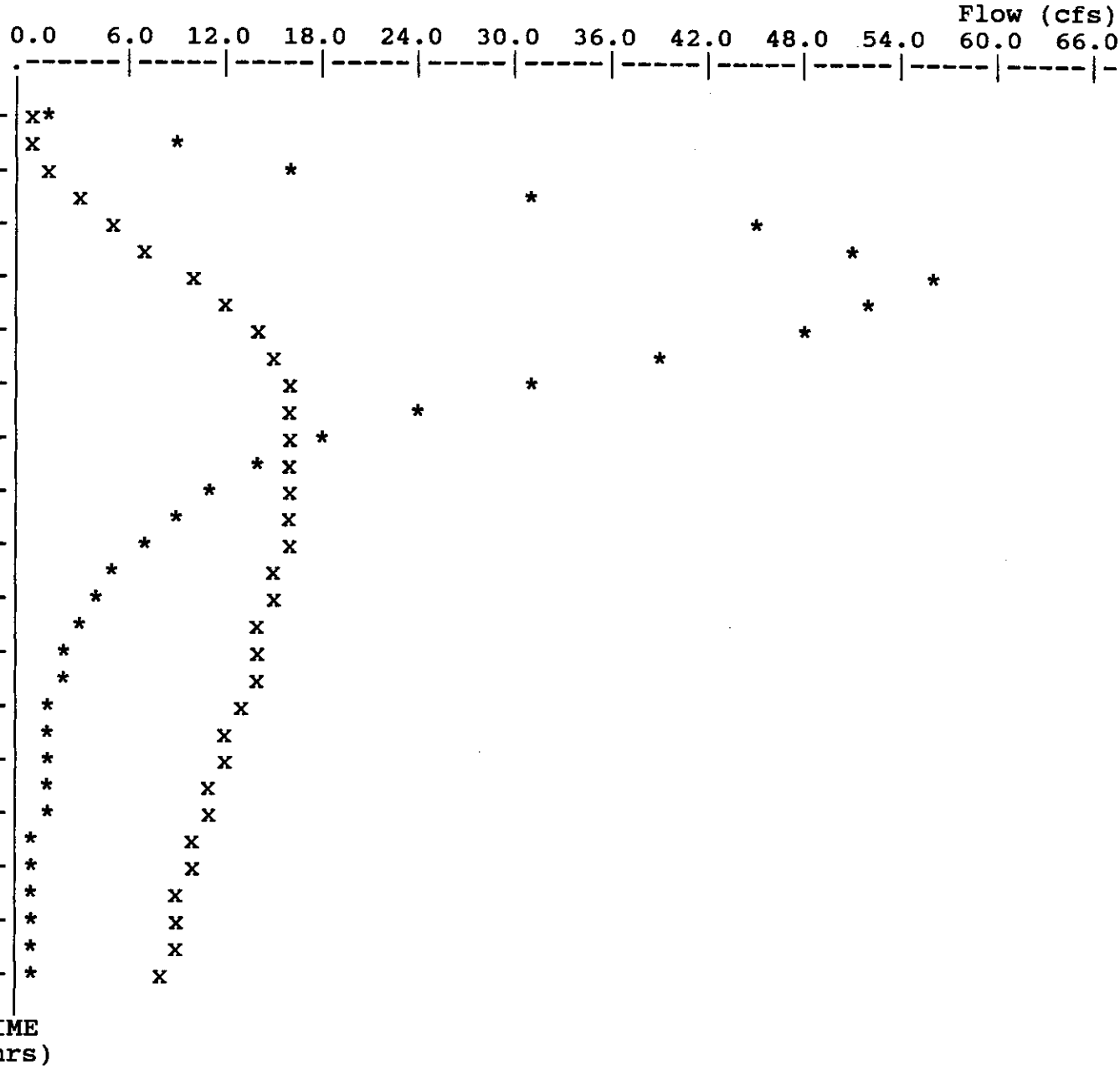
Initial Storage	=	0.00 ac-ft
Peak Storage From Storm	=	3.16 ac-ft
Total Storage in Pond	=	3.16 ac-ft

Warning: Inflow hydrograph truncated on left side.

Pond File: \PONDPACK\EPOND .PND
Inflow Hydrograph: \PONDPACK\DIPOSC .HYD
Outflow Hydrograph: \PONDPACK\OUT .HYD

EXECUTED: 10-23-1996
18:05:31

Peak Inflow = 56.23 cfs
Peak Outflow = 16.05 cfs
Peak Elevation = 19.60 ft



* File: \PONDPACK\DIPOSC .HYD Qmax = 56.2 cfs
x File: \PONDPACK\OUT .HYD Qmax = 16.0 cfs

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 17:48:34 10-22-1996 DIPOSDU.TCT

DUGAN INDUSTRIAL ADDITION
POST DEVELOPED CONDITIONS - BASIN "D" WEST OF TYLER RD.
FLOW SOUTH TO K-42 HIGHWAY

Tc COMPUTATIONS FOR: LT. INDUSTRIAL

SHEET FLOW (Applicable to Tc only)

Segment ID		A - B	
Surface description		70% IMPERV.	
Manning's roughness coeff., n		0.0790	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0042	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.42	= 0.42

SHALLOW CONCENTRATED FLOW

Segment ID		B - C	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1230.0	
Watercourse slope, s	ft/ft	0.0054	
$Avg.V = Csf * (s)^{0.5}$	ft/s	1.1856	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.29	= 0.29

CHANNEL FLOW

Segment ID		C - D	
Cross Sectional Flow Area, a	sq.ft	32.00	
Wetted perimeter, Pw	ft	24.49	
Hydraulic radius, r = a/Pw	ft	1.307	
Channel slope, s	ft/ft	0.0016	
Manning's roughness coeff., n		0.0350	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	2.0351	
Flow length, L	ft	150	
T = L / (3600*V)	hrs	0.02	= 0.02

TOTAL TIME (hrs) 0.73

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:04:42 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST DEVELOPED CONDITIONS
BASIN "D" - WEST OF TYLER RD. R/W - DISCHARGE DIRECTED TO 42" RCP
ON NORTH SIDE OF K-42 @ TYLER RD. (BEING INSTALLED BY K.D.O.T.)

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
LT.INDUSTRL	0.690	14.94						
70' R/W	0.460	1.87						
W1/2TYLER RD	0.430	2.32						
LNDSCP.RESRV	0.310	2.13						
LT.IND. O/S	0.690	9.36						
			43.80	0.630	0.630	2.627	30.62	50.66

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:04:42 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST DEVELOPED CONDITIONS
BASIN "D" - WEST OF TYLER RD. R/W - DISCHARGE DIRECTED TO 42" RCP
ON NORTH SIDE OF K-42 @ TYLER RD. (BEING INSTALLED BY K.D.O.T.)

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.630 Area= 30.620 acres Tc = 43.80 minutes

Adjusted C = 0.630 Tc= 43.80 min. I= 2.63 in/hr Qp= 50.66 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPODU .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.230	10.54	38.10	50.66	41.85	24.07	13.68	7.91
1.980	4.57	2.58	1.48	0.85	0.51	0.30	0.12
3.730	0.00						

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 17:42:08 10-22-1996 DIPOSDS.TCT

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
BASIN "D" - EAST OF C.L. OF TYLER RD., FLOWING SOUTH TO K-42

Tc COMPUTATIONS FOR: LT. INDUSTRIAL

SHEET FLOW (Applicable to Tc only)

Segment ID		A - B	
Surface description		70% IMPERV.	
Manning's roughness coeff., n		0.0790	
Flow length, L (total < or = 300)	ft	120.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0040	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.21	= 0.21

SHALLOW CONCENTRATED FLOW

Segment ID			
Surface (paved or unpaved)?			
Flow length, L	ft	0.0	
Watercourse slope, s	ft/ft	0.0000	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.0000	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.00	= 0.00

CHANNEL FLOW

Segment ID		B - C	
Cross Sectional Flow Area, a	sq.ft	32.00	
Wetted perimeter, Pw	ft	24.49	
Hydraulic radius, r = a/Pw	ft	1.307	
Channel slope, s	ft/ft	0.0008	
Manning's roughness coeff., n		0.0350	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	1.4391	
Flow length, L	ft	750	
T = L / (3600*V)	hrs	0.14	= 0.14

TOTAL TIME (hrs) 0.35

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 17:43:13 10-22-1996

DUGAN INDUSTRIAL ADDITION
PART OF BASIN "D" & E. 1/2 OF TYLER RD., FLOWING S. TO K-42
POST-DEVELOPED CONDITIONS

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
E.1/2 TYLER								
	0.430	2.07						
LT. INDUSTRL								
	0.690	2.85						
			21.00	0.581	0.581	3.905	4.92	11.16

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 17:43:13 10-22-1996

DUGAN INDUSTRIAL ADDITION
PART OF BASIN "D" & E. 1/2 OF TYLER RD., FLOWING S. TO K-42
POST-DEVELOPED CONDITIONS

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.581 Area= 4.920 acres Tc = 21.00 minutes

Adjusted C = 0.581 Tc= 21.00 min. I= 3.90 in/hr Qp= 11.16 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPOSDS .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.100	1.98	11.16	5.02	1.58	0.49	0.15	0.05
1.850	0.00						

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:09:16 10-22-1996 DIPOSDL.TCT

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
PART OF BASIN "D" - FLOWING OFFSITE TO THE EAST PROP. LINE

Tc COMPUTATIONS FOR: LT. INDUSTRIAL

SHEET FLOW (Applicable to Tc only)

Segment ID		A - B	
Surface description		70% IMPERV.	
Manning's roughness coeff., n		0.0790	
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0060	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.36	= 0.36

SHALLOW CONCENTRATED FLOW

Segment ID		B - C	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	580.0	
Watercourse slope, s	ft/ft	0.0017	
$Avg.V = Csf * (s)^{0.5}$	ft/s	0.6652	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.24	= 0.24

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

TOTAL TIME (hrs) 0.61

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Executed: 18:11:00 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
PART OF BASIN "D" - FLOWING OFFSITE TO EAST PROPERTY LINE

* * * * * * SUMMARY OF RATIONAL METHOD PEAK DISCHARGES * * * * * *

Q = adj * C * I * A
Where: Q=cfs, C=Weighted Runoff Coefficient, I=in/hour, A=acres
adj = 'C' adjustment factor for each return frequency

RETURN FREQUENCY = 5 years
'C' adjustment, k = 1
Adj. 'C' = Wtd.'C' x 1

Subarea Descr.	Runoff 'C'	Area acres	Tc (min)	Wtd. 'C'	Adj. 'C'	I in/hr	Total acres	Peak Q (cfs)
LT. INDUSTRL								
	0.690	12.60						
			36.60	0.690	0.690	2.923	12.60	25.41

Quick TR-55 Ver.5.43 S/N:1240540379
Executed: 18:11:00 10-22-1996

DUGAN INDUSTRIAL ADDITION
POST-DEVELOPED CONDITIONS
PART OF BASIN "D" - FLOWING OFFSITE TO EAST PROPERTY LINE

**** Rational Method Hydrograph Using Q/Qp Template *****
Weighted C = 0.690 Area= 12.600 acres Tc = 36.60 minutes

Adjusted C = 0.690 Tc= 36.60 min. I= 2.92 in/hr Qp= 25.41 cfs

RETURN FREQUENCY: 5 year storm Adj.factor = 1.00
Q/Qp Template: IDF Output file: DIPOSDE .HYD

HYDROGRAPH ORDINATES (cfs)
Time increment = 0.250 Hours
Time on left represents time for first Q in each row.

Time Hours							
0.110	2.19	16.30	25.41	19.57	9.61	5.04	2.57
1.860	1.30	0.68	0.35	0.19	0.08	0.00	