LETTER OF TRANSMITTAL

McGill, Smith, Punshon
International, Inc.
Consulting Engineers
Architects
Planners
Surveyors
Landscape Architects

11231 Cornell Park Drive
Cincinnati, Ohio 45242-1811
(513) 489-0731

DATE 2/24/88 | JOB NO. 87261.00/04

ATTENTION Mr. Greg Wilkens

RE: Proposed Development
SR. 747 & Smith Rd.
J.T. Adams Prop.

TO Butler Co. Engineer

GENTLEMEN:

WE ARE SENDING YOU..... ☒ Attached..... ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☒ Study

COPIES	DATE	NO.	DESCRIPTION
4	2/23/88		Prelim. Drainage Study

RECEIVED
FEB 29 1988
BUTLER COUNTY
ENGINEERS OFFICE

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REMARKS:

COPY TO _____

FORM LT–352

SIGNED: William J. Oesterle, P.E.

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE!

McGill, Smith, Punshon
International, Inc.

Preliminary Drainage Study

Proposed Development at SR 747 & Smith Rd.

J.T. Adams Properties

J.T. Adams Properties intends to develop approximately 88 acres of property at SR 747 and Smith Road. A combination of commercial and residential property is proposed for 68 acres west of SR 747, and commercial development is proposed for 20 acres east of SR 747.

An existing bridge on SR 747 over Mill Creek south of the proposed development currently is subject to periodic flooding. Representatives of Butler Couty are concerned over potential impacts of the development upon the existing problem. They have requested a study to determine if adverse impacts will occur, and to determine measures to alleviate those impacts. Because of the size and complexity of the watershed tributary to the bridge, a full drainage study will not be completed. A study of this nature should be performed on a regional basis, with study participation by all entities sharing the watershed.

The following study examines two areas of consideration on a preliminary basis:

1. Runoff directly attributable to the proposed project and potential mitigative measures.

2. Relationship of proposed project runoff to total runoff of watershed tributary to Bridge on SR 747.

1. Determine runoff increase for proposed development and plan of detention in project area, so as not to increase runoff from conditions that now exist at Mill Creek and SR 747. (13,340 acres watershed).

   1st area of study: east side of SR 747 and north of Smith Road. (20.8 acre proposed retail commercial development)

   Calculate runoff increase by rational method: store proposed 50 year storm, releasing ex. 10 year storm @ 43.3 minute duration to basin.

   → Parameters: Q50 in = 44.62 CFS, release rate out = 21.22 CFS @ 43.3 min. duration
   Maximum detention storage time = 60.3 min.
   Q10 ex @ 60.3 min.= CA I10 = (8.290) (2.04) = 16.92 CFS
   Stor. vol. req'd = 97,434 cu.ft. (sht. 3)

   Conclusion: Since rel. rate 21.22 CFS is greater than Q10 ex @ max. storage 16.92 CFS, the release must be reduced so that the rel. rate @ max. storage duration equals Q10 ex. @ max. storage duration, storage volume will then be increased.

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Preliminary Drainage Study

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   Conclusion: Since rel. rate 21.22 CFS is greater than Q10 ex @ max. storage 16.92 CFS, the release must be reduced so that the rel. rate @ max. storage duration equals Q10 ex. @ max. storage duration, storage volume will then be increased.

Results: Q50 in = 35.10 CFS, rel. rate = 13.00 CFS @ max. storage duration of 84.02 min.
Q10 ex @ 84.02 min = (8.2900) (1.59) = 13.18 CFS.
Stor. vol req'd = 125,168 cu.ft. (sht.4)
increase in stor. vol = 28.5% with 6018 cu.ft./acre
Runoff from basin release will always be less than existing runoff conditions.

2nd area of study: west side of SR 747
(68.3 acre proposed retail commercial, residential apartments, single family condominiums, and single family residential)

Calculate runoff increase by S.C.S. TR.#55 method.
Store proposed 50 year storm, releasing ex. 10 year storm @ max. detention storage time.

The easterly portion of site (15.5 ac) will drain to the east without detention. The increase in runoff from this area will be compensated for in the westerly detention area by reducing the release rate and increasing the storage volume.

Easterly parameters:
Prop. Q50 = 88.0 CFS
Q10 ex. @ max. duration = 31.0 CFS Runoff increase = 57.0 CFS
Storage vol. req'd = 86,597 cu.ft. (sht.20)

Westerly detention area: (52.8 acres)
Prop. Q50 in. = 224.0 CFS (sht.13)
Rel. rate = westerly Q10 ex. 68.0 CFS minus runoff increase easterly area 57.0 CFS = 11.00 CFS

Req'd storage vol. = Easterly 86,597 cu.ft. + westerly 276,746 cu.ft. = 363,343 cu.ft. total @ max stor. duration
(sht.13)

Storage = 5320 cu.ft./acre

Runoff from westerly basin release and direct runoff from easterly area will always be less than existing runoff conditions.

2. The overall watershed tributary to the bridge at SR 747 is approximately 13,000 acres of industrial, commercial, residential and agricultural land located in Butler and Hamilton Counties. The hydrograph peak for Mill Creek at the bridge is estimated at 5 to 8 hours from the beginning of the storm event. Maximum detention storage time for the proposed project is calculated at 84 minutes. Maximum travel time is calculated at 26 minutes. Tc to the bridge is 110 minutes or 1.84 hours. Thus runoff from the proposed project arrives at the bridge several hours before the hydrograph peak, and hence is not a significant contribution to the flooding condition. In addition, the total runoff from the proposed project represents 0.68% of the total watershed runoff.

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Amelia, Ohio 45102
(513) 753-4430

JOHN ADAMS - PROP. DEVELOPMENT
S.R. 747 & SMITH ROAD.
2-16-88 87261

EAST SIDE OF S.R. 747, NORTH OF SMITH ROAD:

EXISTING CONDITION:

	A	C	CA
ROADS	0.60	0.95	0.5700
CROPLAND	17.40	0.40	6.9600
WOODLAND	0.40	0.40	0.1600
GRASSLAND	2.40	0.25	0.6000
	20.8Ac.	- 0.399	- 8.2900

$I_{10} = \frac{170}{Tc + 23}$

$Tc = \frac{\text{OVERLAND}}{300'} = 22.5 \text{ MIN}$ EL. 626

$\frac{1500}{1.2(60)} = 20.8 \text{ MIN}$ EL. 617

43.3 MIN.

$\frac{9.0}{1800'} = 0.50\%$

$Q_{10EX} = CAI_{10} = (8.2900)(2.56) = 21.22 \text{ CFS}$ (43.3 MIN)

PROPOSED CONDITION:

300' LT INLET = 10.00 MIN

$\frac{1500'}{3.5(60)}$ 7.14 MIN

17.14 MIN

COMMERCIAL - 80% IMPERVIOUS C = 0.75

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RATIONAL METHOD OF
RETENTION BASIN DESIGN OF STORAGE VOLUME

(30 acres or less)

EAST SIDE OF S.R.747, NORTH OF SMITH ROAD

Calculate 10 yr. existing flow qo=ACi

Drainage area, A= 20.8 Ac. → 20.8 acres

Runoff coefficient, C=

H.S - 0.60 . 0.95 - 0.5700
CROPLAND - 17.40 (2%) - 0.40 - 6.9600
WOODLAND - 0.40 (7%) - 0.40 - 0.1600
GRASSLAND - 2.40 (2%) - 0.25 - 0.6000
20.8 - 0.399 - 8.2900

→ 0.399

Calculate intensity, i

i = a/b + tc
a = 170
b = 23
tc = 43.3
i = 170 / (23 + 43.3)
i = 2.56

Tc: OVERLAND 300' - 22.5 MIN
1500' / 1.2(60) - 20.8 MIN
43.3 MIN

EL. 626
EL. 617
9.0 / 1800' - 0.50%

→ 2.56

The allowable release rate, qo, is → 21.22 c.f.s.

Calculate the 50 yr. proposed flow Qo=ACI max

$T_{c\ PROP} = \frac{300'}{1500/3.5(60)} = 10\ MIN + 7.14 = 17.14\ MIN$

Drainage area, A= 20.8 → 20.8 acres

Runoff coefficient, C= 0.75 COMMERCIAL @ 0.80% SLOPE → 0.75

Calculate maximum time of concentration, TC max

a= 250
b= 27

$$Tcmax = \sqrt{\frac{A \times C \times a \times b}{\frac{2 \times qo}{3} - \frac{qo^2 \times tc}{6 \times C \times A \times a}}} - b$$

$$Tcmax = \sqrt{\frac{20.8 \times 0.75 \times 250 \times 27}{\frac{2 \times 21.22}{3} - \frac{21.22^2 \times 17.14}{0.75 \times 20.8 \times 250 \times 6}}} - 27$$

Tcmax = 60.30

EAST SIDE OF S.R. 747, NORTH OF SMITH ROAD

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Calculate maximum intensity, I max

$$Imax = \frac{a}{b+Tcmax}$$

a= 250
b= 27

Tcmax = 60.30

$$Imax = \frac{250}{27+60.30}$$

Imax = 2.86

A = 20.8 acre
x
C = 0.75
x
Imax = 2.86
=
44.67 c.f.s

The flow at maximum duration, Qo is

CALCULATE STORAGE VOLUME NEEDED

$$Vol = 60 \times Qo \times Tcmax - \frac{2 \times qo \times (TCmax + tc) \times 60}{3} + \frac{qo^2 \times tc \times 60}{6 \times Qo}$$

$$Vol = 60 \times 44.62 \times 60.30 - \frac{2 \times 21.3 \times (60.30 + 17.14) \times 60}{3} + \frac{21.3^2 \times 17.14 \times 60}{6 \times 44.67}$$

Vol = 97,434 cubic feet

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DETENTION RESERVOIR DESIGN FOR STORAGE VOLUME

50 YEAR STORM FREQUENCY

EAST SIDE OF S.R. 747, NORTH OF SMITH ROAD.

q_o = RELEASE RATE = 13.00 C.F.S.

Q_{10} EX. @ 84.02 MIN = (8.2900)(1.59 @ 84.02 MIN) = 13.18 CFS

DETENTION RESERVOIR STORAGE - ORIFICE CONTROL.

PROPOSED CONDITIONS: 50 YEAR STORM

AREA INTENSITY = $I_{50} = \frac{a}{b + t_c} = \frac{250}{27 + t_c}$

$a = 250$

$b = 27$

$A = 20.8$ ACRES

C = RUNOFF COEF. = 0.75

$CA = 15.6000$

t_c = STORM DURATION TO BASIN = 17.14 MIN.

T_c = STORM DURATION PRODUCING MAXIMUM DETENTION STORAGE

$$T_c = \sqrt{\frac{CA\,a\,b}{\frac{2q_o}{3} - \frac{(q_o)^2 t_c}{6CAa}}} - b = \sqrt{\frac{(15.6000)(250)(27)}{\frac{2(13.00)}{3} - \frac{(13.00)^2(17.14)}{6(15.6000)(250)}}} - 27 =$$

$$T_c = \sqrt{\frac{(105300.000)}{(8.667) - (0.124)}} - 27 = (111.02) - 27 = 84.02 \text{ MIN.}$$

I_{50} @ MAX. DURATION = $\frac{250}{27 + T_c} = \frac{250}{27 + (84.02)} = 2.25$ IN./HR.

Q_o @ MAX. DURATION

$Q_o = CA\,I_{50} = (15.6000)(2.25) = 35.10$ C.F.S.

DETENTION STORAGE:

$$V_{ORIFICE} = 60\,Q_o\,T_c - \frac{2q_o(T_c + t_c)(60)}{3} + \frac{(q_o)^2(t_c)(60)}{6\,Q_o} =$$

$$V = (60)(35.10)(84.02) - \frac{2(13.00)(84.02 + 17.14)(60)}{3} + \frac{(13.00)^2(17.14)(60)}{6(35.10)} =$$

$V = (176{,}946) - (52603) + (825) = 125{,}168$ CU.FT.

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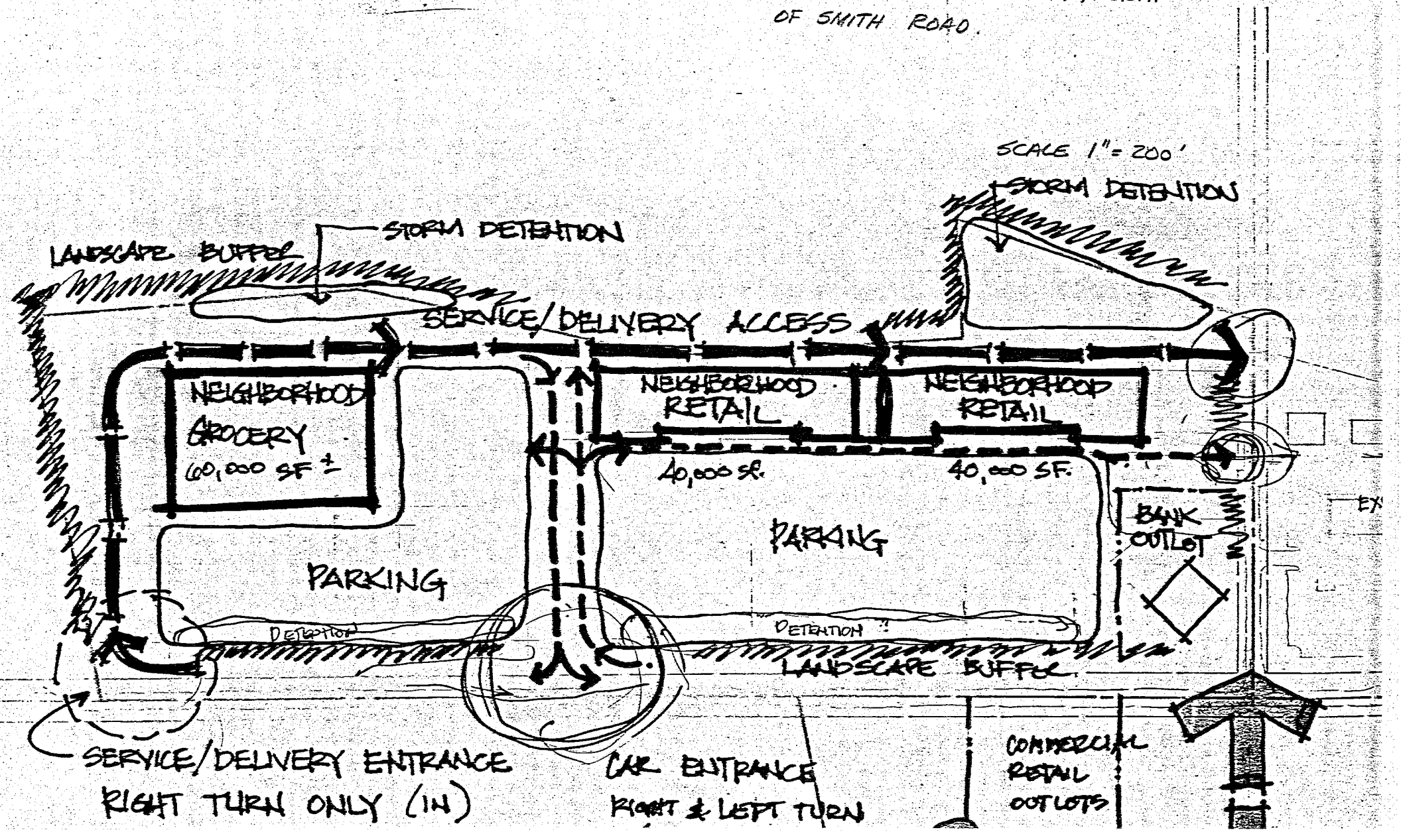
5/21

EAST SIDE OF S.R. 747, NORTH OF SMITH ROAD.



TOTAL

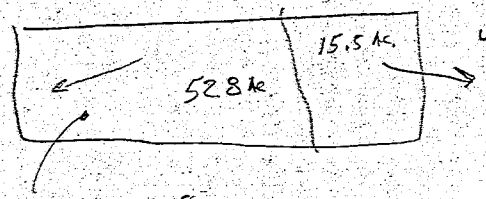
$Q_{50\,10} = 224$ CFS

$Q_{10\,out} = 68$ CFS $-$ (88 CFS − 31 CFS) = 11 CFS

57 CFS

STOR = 276,746 + 86,597 = 363,343 cu ft

5320 cu ft / Ac



w/o DET.

$Q_{50\,10} = 88.0$ CFS

$Q_{10\,out} = 31.0$ CFS

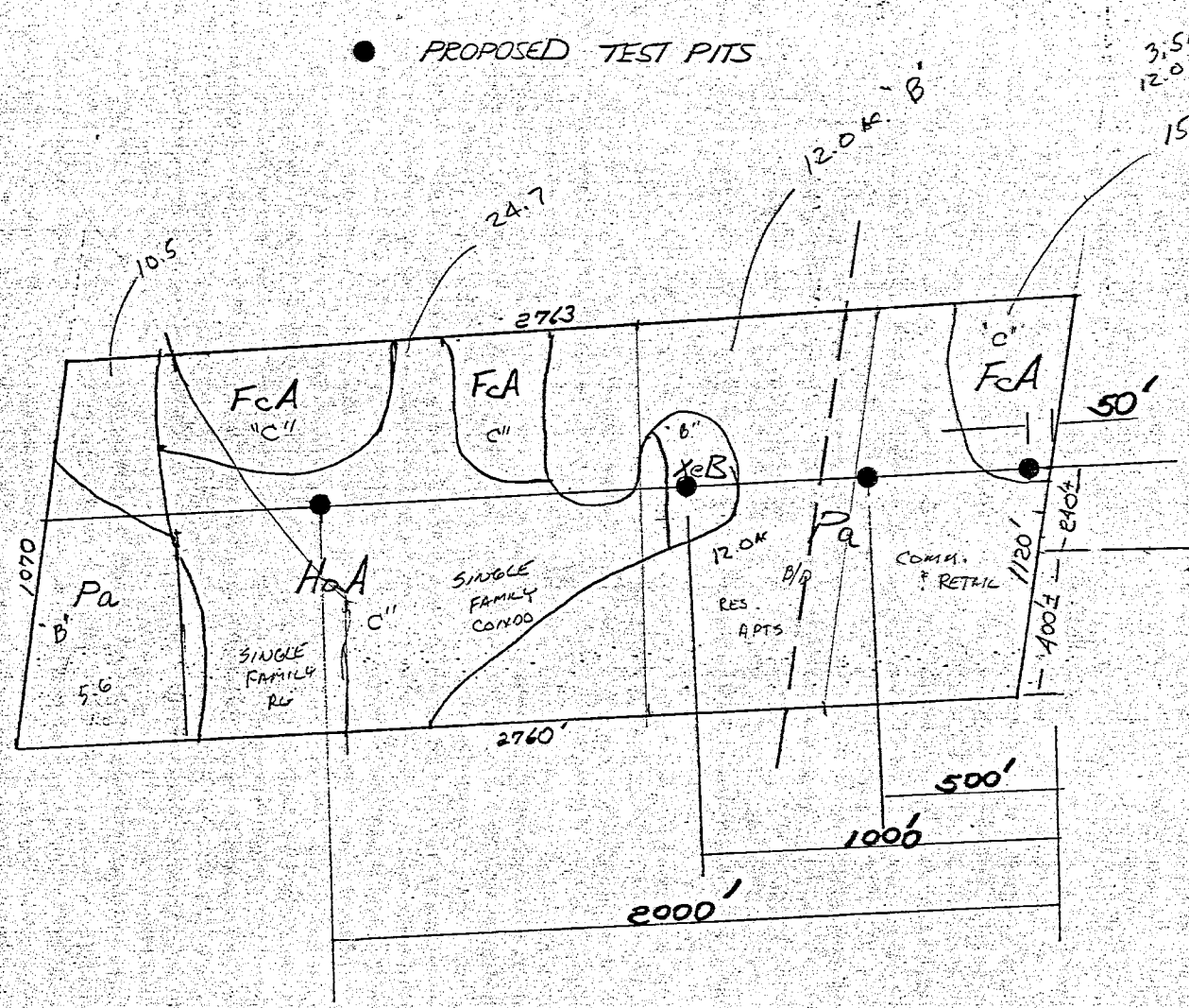
86,597 cu ft.

$Q_{50\,10} = 224$ CFS

$Q_{10\,out} = 68$ CFS

276,746 cu ft.

● PROPOSED TEST PITS



68.3 TOTAL

WEST SIDE OF S.F. 747

SCALE: 1" = 500'

6/21

WEST SIDE OF S.R. 747

7/21

Worksheet 2: Runoff curve number and runoff

Project JOHN ADAMS DEVELOPMENT By ____ Date ____

Location WESTERLY PORTION Checked ____ Date 2-16-88

Circle one: Present (Developed)

51.3 ACRES

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1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
HSG. "B"	RESIDENTIAL APARTMENT	92			12.0	1104
HSG. "B"	SINGLE FAMILY CONDO'S	88			3.5	308
HSG. "C"	SINGLE FAMILY CONDO'S	91			21.2	1929
HSG. "B"	SINGLE FAMILY RESIDENTIAL	85			3.00	255
HSG "C"	SINGLE FAMILY RESIDENTIAL	90			7.5	675
HSG. "B"	WOODED AREA	55			5.6	308

1/ Use only one CN source per line. Totals = 52.8 4579

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4579}{52.8} = 86.7$; Use CN = 87

2. Runoff

	Storm #1	Storm #2	Storm #3	Storm #4
Frequency ..... yr	100	50	25	10
Rainfall, P (24-hour) ..... in	5.6	5.2	4.8	4.1
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	4.2	3.8	3.4	2.8

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8/21

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

WEST SIDE OF S.R. 747

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location WESTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

	Segment ID			
Sheet flow (Applicable to T_c only)				
1. Surface description (table 3-1)				
2. Manning's roughness coeff., n (table 3-1)				
3. Flow length, L (total L ≤ 300 ft) ft				
4. Two-yr 24-hr rainfall, P_2 in				
5. Land slope, s ft/ft				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t hr		+		=
Shallow concentrated flow	Segment ID			
7. Surface description (paved or unpaved)				
8. Flow length, L ft				
9. Watercourse slope, s ft/ft				
10. Average velocity, V (figure 3-1) ft/s				
11. $T_t = \frac{L}{3600\, V}$ Compute T_t hr		+		=
Channel flow	Segment ID			
12. Cross sectional flow area, a ft^2				
13. Wetted perimeter, p_w ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft				
15. Channel slope, s ft/ft				
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V ft/s				
18. Flow length, L ft				
19. $T_t = \frac{L}{3600\, V}$ Compute T_t hr		+		=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr				

STORM SEWER SYSTEM: 300' → 1ST INLET = 10.00 MIN.

5.92 MIN

15.92 MIN

1600 / 45(60)

WEST SIDE OF S.R. 747

9/21

Worksheet 4: Graphical Peak Discharge method

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Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location WESTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)

1. Data:

Drainage area ..... A_m = 0.0825 mi^2 (acres/640) 52.8 acres

Runoff curve number .... CN = 87 (From worksheet 2)

Time of concentration .. T_c = 0.27 hr (From worksheet 3) 15.92 min

Rainfall distribution type = II (I, IA, (II), III)

Pond and swamp areas spread throughout watershed ..... = — percent of A_m (____ acres or mi^2 covered)

			Storm #1	Storm #2	Storm #3	Storm #4
2. Frequency	yr		100	50	25	10
3. Rainfall, P (24-hour)	in		5.6	5.2	4.8	4.1
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in		0.299	0.299	0.299	0.299
5. Compute I_a/P			0.053	0.058	0.062	0.072
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-____)	csm/in		715	715	715	715
7. Runoff, Q ..... (From worksheet 2).	in		4.2	3.8	3.4	2.8
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)			—	—	—	—
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs		248	224	201	165

WEST SIDE OF S.R. 747

(10/21)

Worksheet 2: Runoff curve number and runoff

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location WESTERLY PORTION Checked ____ Date ____

Circle one: (Present) Developed

McGill, Smith, Punshon International, Inc. 11231 Cornell Park Drive Cincinnati, Ohio 45242 (513) 489-0731

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☒ mi²	Product of CN x area
ON-SITE HSG-"C"	CULTIVATED LANDS SG-SR	83			24	1992
ON-SITE HSG "B"	CULTIVATED LANDS SG-SR	76			28.8	2189
	Totals =				52.8	4181

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4181}{52.8} = 79.19$; Use CN = 79

2. Runoff

Storm #1	Storm #2	Storm #3	STORM # 4
100	50	25	10
5.6	5.2	4.8	4.1
3.41	2.97	2.63	2.04

Frequency ..... yr

Rainfall, P (24-hour) ..... in

Runoff, Q ..... in
(Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)

WEST SIDE OF S.R. 747.

(11/21)

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Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location WESTERLY PORTION Checked ____ Date ____

Circle one: (Present) Developed

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)			CULT. SOIL			
2. Manning's roughness coeff., n (table 3-1)			0.06			
3. Flow length, L (total L ≤ 300 ft)	ft		300			
4. Two-yr 24-hr rainfall, P_2	in		3.0			
5. Land slope, s	ft/ft		0.005			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.34	+		=
Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft		2000			
9. Watercourse slope, s	ft/ft		0.005			
10. Average velocity, V (figure 3-1)	ft/s		1.2			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.46	+		=
Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.80	+		=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					

WEST SIDE OF S.R. 747

(12/21)

Worksheet 4: Graphical Peak Discharge method

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(513) 489-0731

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location WESTERLY PORTION Checked ____ Date ____

Circle one: (Present) Developed

1. Data:

   Drainage area ..... A_m = 0.0825 mi^2 (acres/640) 52.8 ACRES

   Runoff curve number .... CN = 79 (From worksheet 2)

   Time of concentration .. T_c = 0.80 hr (From worksheet 3)

   Rainfall distribution type = II (I, IA, (II), III)

   Pond and swamp areas spread throughout watershed ..... = — percent of A_m (____ acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3	STORM #4
2. Frequency	yr	100	50	25	10
3. Rainfall, P (24-hour)	in	5.6	5.2	4.8	4.1
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.532	0.532	0.532	0.532
5. Compute I_a/P		0.095	0.10	0.11	0.13
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-____)	csm/in	415	415	410	400
7. Runoff, Q ..... (From worksheet 2).	in	3.41	2.97	2.63	2.04
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		—	—	—	—
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	117	102	89	68

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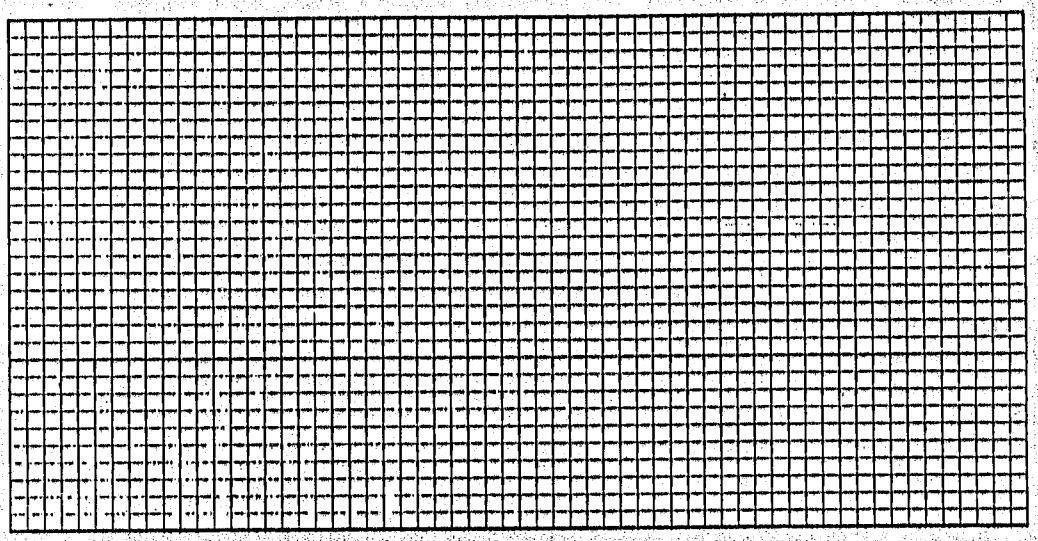
WEST SIDE OF S.R. 747

Worksheet 6a: Detention basin storage, peak outflow discharge (q_o) known

Project JOHN ADAMS DEVELOPMENT By ____ Date 2.16.88

Location WESTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)



Q50 DEVEL. IN ; Q10EX OUT

Detention basin storage

		1st stage	2nd stage
1.	Data: Drainage area ..... A_m = 52.8 Acres = 0.0825 mi^2; Rainfall distribution type (I, IA, (II), III) = II		
2.	Frequency ..... yr	50	
3.	Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	224	
4.	Peak outflow discharge, q_o .... cfs 1/	68	
5.	Compute $\frac{q_o}{q_i}$	68/224 = 0.30	
6.	$\frac{V_s}{V_r}$ ..... (Use $\frac{q_o}{q_i}$ with figure 6-1)	0.38	
7.	Runoff, Q ..... in (From worksheet 2)	3.8	
8.	Runoff volume, V_r ..... ac-ft ($V_r = QA_m 53.33$)	16.719	
9.	Storage volume, V_s ..... ac-ft ($V_s = V_r(\frac{V_s}{V_r})$)	6.353 = 276,746 cuFT	
10.	Maximum stage, E_{max} (From plot)		

1/ 2nd stage q_o includes 1st stage q_o.

WEST SIDE OF S.R. 747

(14/21)

Worksheet 2: Runoff curve number and runoff

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location EASTERLY PORTION Checked ____ Date ____

Circle one: (Present) Developed

15.5 ACRES

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x area
HSG "C"	CULTIVATED LANDS SR SR	84			3.5	294
HSG "B"	SR SR	76			12.0	912
Totals =					15.5	1206

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1206}{15.5} = 77.81$; Use CN = 78

2. Runoff

Storm #1	Storm #2	Storm #3	STORM #4
100	50	25	10
5.6	5.2	4.8	4.1
3.3	2.9	2.5	2.0

Frequency ..... yr

Rainfall, P (24-hour) ..... in

Runoff, Q ..... in
(Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)

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WEST SIDE OF S.R. 747

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

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Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location EASTERLY PORTION 15.5 ACRES Checked ____ Date ____

Circle one: (Present) Developed

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)			CULT. SOIL		
2. Manning's roughness coeff., n (table 3-1)			0.06		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P_2	in		3.0		
5. Land slope, s	ft/ft		0.010		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$ Compute T_t	hr		0.26	+	=
Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)			UNPAVED		
8. Flow length, L	ft		160		
9. Watercourse slope, s	ft/ft		0.01		
10. Average velocity, V (figure 3-1)	ft/s		1.6		
11. $T_t = \frac{L}{3600\, V}$ Compute T_t	hr		0.03	+	=
Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\, V}$ Compute T_t	hr		0.29	+	=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				

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WEST SIDE OF S.R. 747

Worksheet 4: Graphical Peak Discharge method

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location EASTERLY PORTION Checked ____ Date ____

Circle one: (Present) Developed

15.5 Acres?

1. Data:

Drainage area ..... A_m = 0.0242 mi^2 (acres/640)

Runoff curve number .... CN = 78 (From worksheet 2)

Time of concentration .. T_c = 0.29 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, (II), III)

Pond and swamp areas spread throughout watershed ..... = — percent of A_m (____ acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3	Storm #4
2. Frequency	yr	100 YR	50YR	25 YR.	10 YR
3. Rainfall, P (24-hour)	in	5.6	5.2	4.8	4.1
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.564	0.564	0.564	0.564
5. Compute I_a/P		0.10	0.11	0.12	0.14
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-____)	csm/in	690	680	660	640
7. Runoff, Q ..... (From worksheet 2).	in	3.3	2.9	2.5	2.0
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		—	—	—	—
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	55	48	40	31

WEST SIDE OF S.R. 747

(17/21)

Worksheet 2: Runoff curve number and runoff

Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location EASTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)

15.5 ACRES

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☒ acres ☐ mi²	Product of CN x area
HSG "C"	COMMERCIAL & RETAIL	94			3.5	329
HSG "B"	COMMERCIAL & RETAIL	92			12.0	1104
	Totals =				15.5	1433

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1433}{15.5} = 92.45$; Use CN = 93

2. Runoff

	Storm #1	Storm #2	Storm #3	STORM #4
Frequency ..... yr	100YR	50YR	25YR	10YR
Rainfall, P (24-hour) ..... in	5.6	5.2	4.8	4.1
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	4.9	4.4	4.0	3.3

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Worksheet 3: Time of concentration (T_c) or travel time (T_t)

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Project JOHN ADAMS DEVELOPMENT By ____ Date 2-16-88

Location EASTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

		Segment ID		
Sheet flow (Applicable to T_c only)				
1.	Surface description (table 3-1)			
2.	Manning's roughness coeff., n (table 3-1) ..			
3.	Flow length, L (total L ≤ 300 ft) ..... ft			
4.	Two-yr 24-hr rainfall, P_2 ..... in			
5.	Land slope, s ..... ft/ft			
6.	$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t ..... hr		+	=
Shallow concentrated flow		Segment ID		
7.	Surface description (paved or unpaved)			
8.	Flow length, L ..... ft			
9.	Watercourse slope, s ..... ft/ft			
10.	Average velocity, V (figure 3-1) ..... ft/s			
11.	$T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr		+	=
Channel flow		Segment ID		
12.	Cross sectional flow area, a ..... ft^2			
13.	Wetted perimeter, p_w ..... ft			
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... ft			
15.	Channel slope, s ..... ft/ft			
16.	Manning's roughness coeff., n			
17.	$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... ft/s			
18.	Flow length, L ..... ft			
19.	$T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr		+	=
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr			

STORM SEWER 300' 1ST INLET = 10.0 MIN.
1.33 / 11.33 MIN
160' / 2.0'/sec

WEST SIDE OF S.R. 747

(19/21)

Worksheet 4: Graphical Peak Discharge method

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Project JOHN ADAMS DEVELOPMENT By ____ Date 2-18-88

Location EASTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)

1. Data:

Drainage area ..... 15.5 ACRES A_m = 0.0242 mi^2 (acres/640)

Runoff curve number .... CN = 93 (From worksheet 2)

Time of concentration .. T_c = 0.19 hr (From worksheet 3) 11.33 min

Rainfall distribution type = II (I, IA, (II), III)

Pond and swamp areas spread throughout watershed ..... = — percent of A_m (____ acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3	Storm #4
2. Frequency	yr	100	50	25	10
3. Rainfall, P (24-hour)	in	5.6	5.2	4.8	4.1
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.151	0.151	0.151	0.151
5. Compute I_a/P		0.027	0.029	0.031	0.036
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in	825	825	825	825
7. Runoff, Q ..... (From worksheet 2).	in	4.9	4.4	4.0	3.3
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		—	—	—	—
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	98	88	80	66

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Worksheet 6a: Detention basin storage, peak outflow discharge (q_o) known

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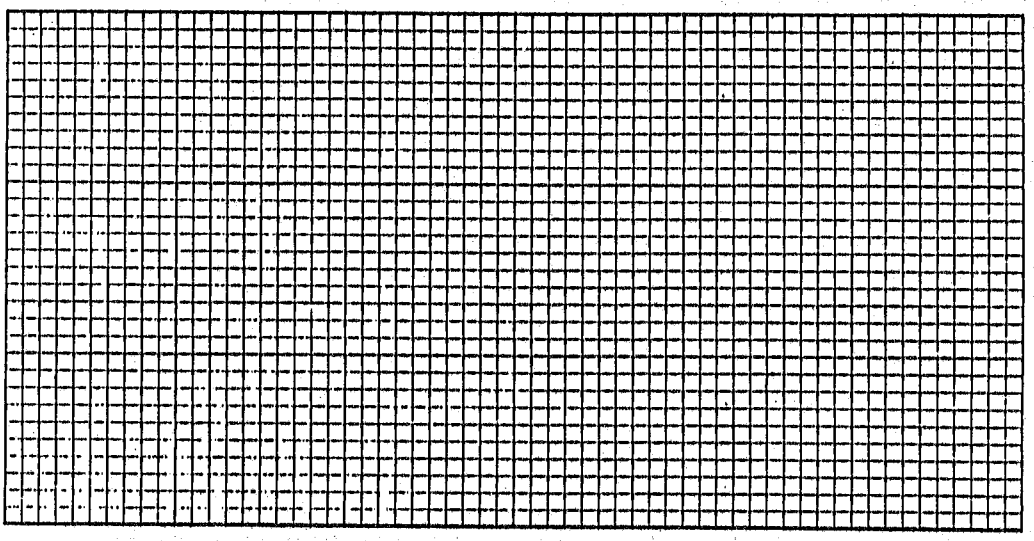
Location EASTERLY PORTION Checked ____ Date ____

Circle one: Present (Developed)



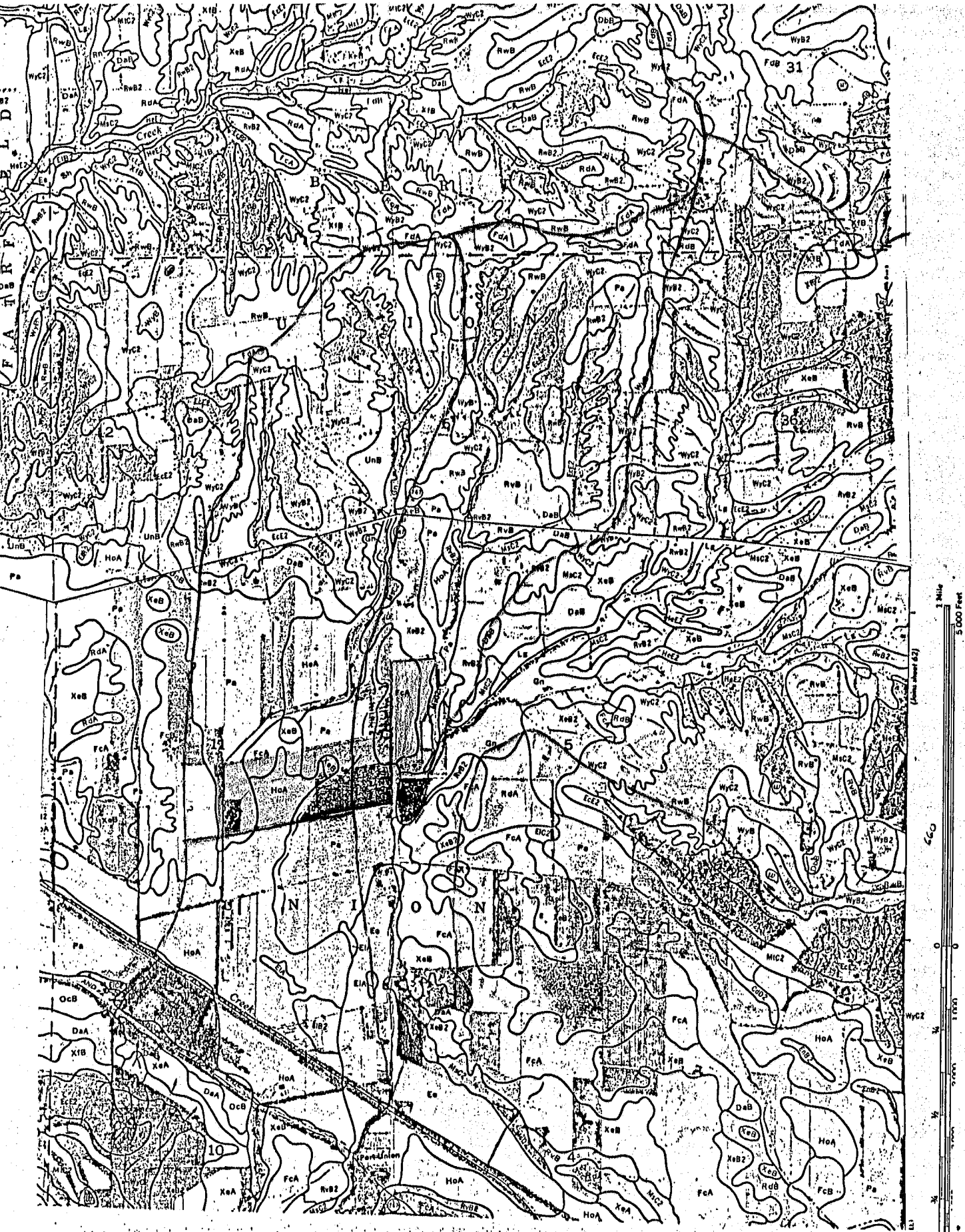
Q_{50} DEVL. IN | Q_{10} EX. OUT

Detention basin storage

1. Data:
   Drainage area 15.51ac ..... A_m = 0.0242 mi^2
   Rainfall distribution type (I, IA, (II), III) = II

	1st stage	2nd stage
2. Frequency ..... yr	50	
3. Peak inflow discharge, q_i .... cfs (From worksheet 4 or 5b)	88	
4. Peak outflow discharge, q_o .... cfs 1/	31	
5. Compute $\frac{q_o}{q_i}$ $\frac{31}{88}$	0.35	
6. $\frac{V_s}{V_r}$ ..... (Use $\frac{q_o}{q_i}$ with figure 6-1)	0.35	
7. Runoff, Q ..... in (From worksheet 2)	4.4	
8. Runoff volume, V_r ..... ac-ft ($V_r = QA_m 53.33$)	5.678	
9. Storage volume, V_s ..... ac-ft ($V_s = V_r(\frac{V_s}{V_r})$)	1.988	
	86,597 cu FT.	
10. Maximum stage, E_{max} (From plot)		

1/ 2nd stage q_o includes 1st stage q_o.


SCALE 1"= 2000'
1 Mile
5 000 Feet
660
0
Point Union
Creek