# CERTIFICATE OF AUTHENTICITY

**THIS IS TO CERTIFY THAT THE FOLLOWING ELECTRONIC RECORDS ARE TRUE AND ACCURATE REPRODUCTIONS OF THE ORIGINAL RECORDS OF JAMES CITY COUNTY GENERAL SERVICES DEPARTMENT- STORMWATER DIVISION; WERE SCANNED IN THE REGULAR COURSE OF BUSINESS PURSUANT TO GUIDELINES ESTABLISHED BY THE LIBRARY OF VIRGINIA AND ARCHIVES; AND HAVE BEEN VERIFIED IN THE CUSTODY OF THE INDIVIDUAL LISTED BELOW.**

**BMP NUMBER:** **PC079**

**DATE VERIFIED:** **May 31, 2012**

**QUALITY ASSURANCE TECHNICIAN:** **Leah Hardenbergh**

Leah Hardenbergh

**LOCATION: WILLIAMSBURG, VIRGINIA**

# Stormwater Division

## MEMORANDUM

**DATE:** February 24, 2010

**TO:** Michael J. Gillis, Virginia Correctional Enterprises Document Management Services

**FROM:** Jo Anna Ripley, Stormwater

**PO:** 270712

**RE:** Files Approved for Scanning

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**BMP ID or General File ID** PC079

**PIN:** 3040100002

**Subdivision, Tract, Business or Owner Name** (if known): Fords Colony

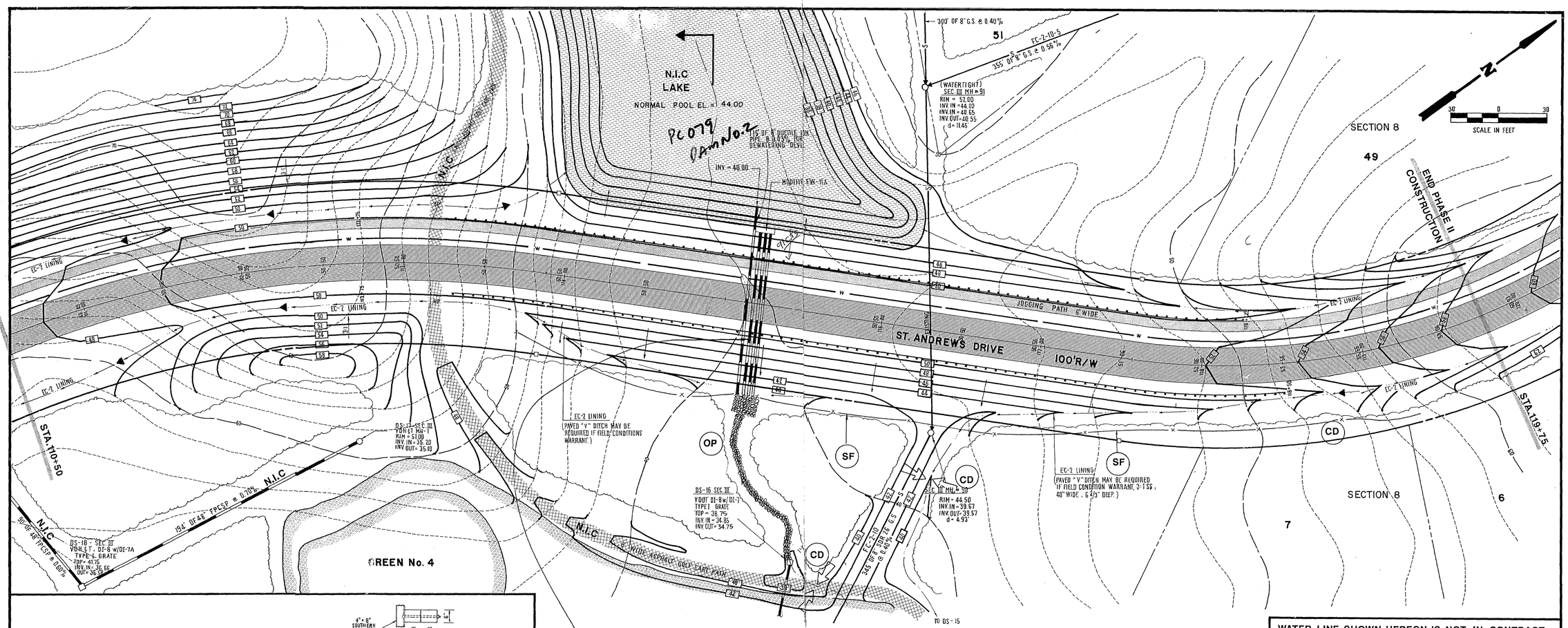
**Property Description:** Middle Plantation Parcel C Championship Blackheath Course Holes 1-18

**Site Address:**

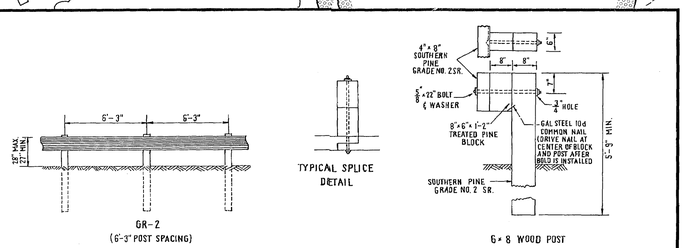
*(For internal use only)* **Box:** FC001 **Drawer:** 1

**Agreements:** (in file as of scan date) **N** **Book or Doc#:** **Page:**

**Comments:**

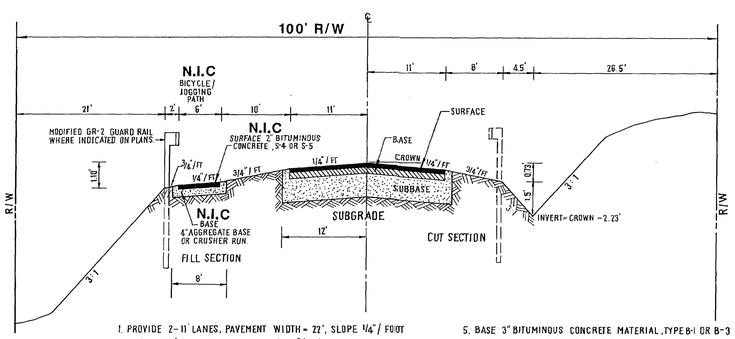



WATER LINE SHOWN HEREON IS NOT-IN-CONTRACT.
JOGGING PATH SHOWN HEREON IS NOT-IN-CONTRACT.




GUARDRAIL LOCATIONS SHOWN ON PLANS ARE APPROXIMATE ONLY AND CANBE ADJUSTED DURING CONSTRUCTION IF AND AS DIRECTED BY THE ENGINEER.

**MODIFIED GR-2 GUARD RAIL DETAIL**

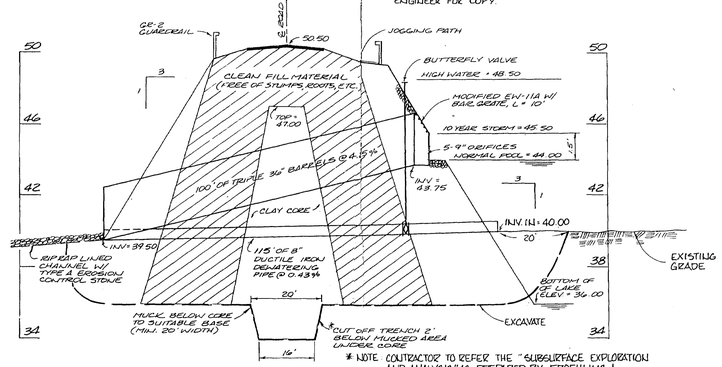



1. PROVIDE 2-11' LANES, PAVEMENT WIDTH = 22', SLOPE 1/4" / FOOT
2. PROVIDE 8' SHOULDER WIDTH, SLOPE 3/4" / FOOT
3. PROVIDE CBR = 10 OR GREATER
4. SUBBASE 12" AGGREGATE BASE OR SUBBASE MATERIAL
5. BASE 3" BITUMINOUS CONCRETE MATERIAL, TYPE B-1 OR B-3
6. SURFACE - 2.0" = BITUMINOUS CONCRETE, TYPE S-4 OR S-5
7. SIDE SLOPES - 4" PER FOOT (3:1) MAXIMUM

**TYPICAL SECTION - ST. ANDREW'S DRIVE, CATEGORY V, 100'R/W, SINGLE ROADWAY**

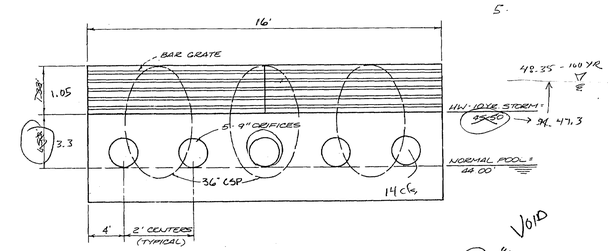
SCALE: 1"=10' HORIZONTAL 1"=3' VERTICAL

NOTE: SEE DAM CONSTRUCTION SPECIFICATIONS CONTACT ENGINEER FOR COPY.



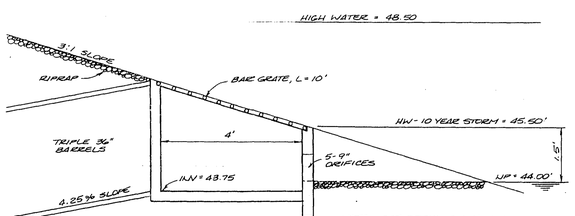

* NOTE: CONTRACTOR TO REFER THE "SUBSURFACE EXPLORATION AND ANALYSIS" AS PREPARED BY FROEHLING & ROBERTSON, INC. ON FEBRUARY 21, 1990, FOR SITE PREPARATION, KEY TRENCH CONSTRUCTION & CORE/SHELL MATERIALS TO BE USED. CONTACT ENGINEER FOR COPY OF ANALYSIS/REPORT

**DAM #2**
**SECTION AT SPILLWAY**
SCALE: 1" = 4' VERT. 1" = 20' HORIZ.




**ELEVATION**
N. T. S.

THIS PAGE VOID




NOTE: SEE DETAIL EW-11 FOR REINFORCING STEEL IN THE SEND AND BARRICE STALLWARES - VOLUME 1

**PROFILE**

**MODIFIED EW-11A**
SCALE: 1" = 2'

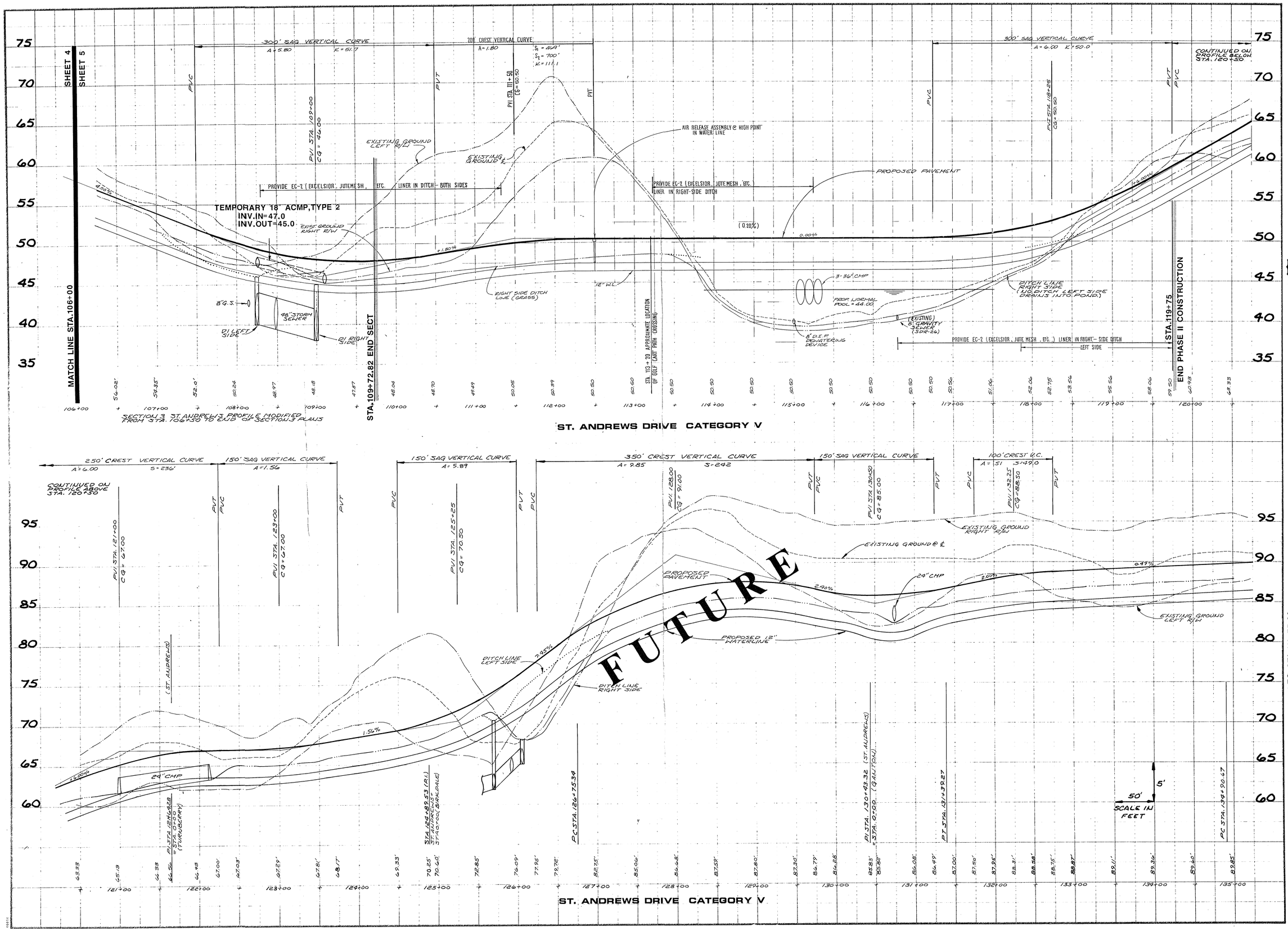

AES, a professional corporation
1761 Jamestown Road, Williamsburg, Va. 23185
804-253-0040
Architecture, Engineering, Surveying, Planning


DAM No. 2
ST. ANDREWS DRIVE
STA. 99+29.85 TO STA. 119+75.00
**FORD'S COLONY @ WILLIAMSBURG**
JAMES CITY COUNTY — VIRGINIA
POWHATAN DISTRICT

COMMONWEALTH OF VIRGINIA
PAUL C. SMALL
CERTIFICATE NO. 04267
CERTIFIED PROFESSIONAL ENGINEER

| No. | DATE | REVISION / COMMENT / NOTE | BY |
|---|---|---|---|
| 1 | 6/6/90 | REVISED PER DAM 2-4-90 SPECIAL PAGE LAKE INTO TOLD | |

| | |
|---|---|
| Designed JHB | Drawn BB |
| Scale 1"=30' | Date SEPT. 1986 |
| Project No. 5652 | |
| Drawing No. 3 of 7 | |




| No | DATE | REVISION / COMMENT / NOTE | BY |
|---|---|---|---|
| 1 | 5/6/90 | REVISED PER DAM MEETING FEBRUARY 27TH, 1990 | SBM |

COMMONWEALTH OF VIRGINIA
PAUL C. SMALL
CERTIFICATE NO. 042267
CERTIFIED PROFESSIONAL ENGINEER


AES, a professional corporation
1761 Jamestown Road
Williamsburg, Virginia 23185
804-253-0040
Engineering, Planning, Surveying


ST. ANDREWS DR. STA.99+29.85 TO STA.119+75.00

**ROAD PROFILE**

**FORD'S COLONY @ WILLIAMSBURG**

OWNER/DEVELOPER: FORD'S COLONY @ WILLIAMSBURG, INC.

POWHATAN DISTRICT JAMES CITY COUNTY VIRGINIA

| Designed | Drawn |
|---|---|
| LCA/AES | C.A.N. |
| Scale | Date |
| NOTED | SEPT. 198 |

Project No. 5652

Drawing No. 5 of 7

MATCH SHEET III D-D

EMERGENCY SPILLWAY
100' OF THREE 36" ULTRA FLOW ALUMINIZED CORRUGATED STEEL PIPES, TYPE 2 @ 4.25%, INV. IN = 43.75 INV. OUT = 39.50; PROVIDE MODIFIED VDOT EW-11A HEADWALL FOR 36" CMP. PROVIDE EROSION CONTROL STONE, TYPE A FROM OUTLET OF 36" CMP IN DITCHLINE TO DS-16. GROUT FIRST 10 LONG x 15 WIDE OF RIP-RAP APRON.

PC079 DAM NO. 2

EMERGENCY SPILLWAY #2
ENTRANCE SLOPE: 22.2%
CONTROL SLOPE: 0%
EXIT SLOPE: 11.7%
BOTTOM WIDTH: 8'-15'
NOTE: EMERGENCY SPILLWAY #2 INCORPORATES THE USE OF THE GOLF CART TUNNEL UNDER ST. ANDREW'S DRIVE

GREENWAY = 24
98,731 SF

EXIST. 18" CULVERT

EXIST. 15" CULVERT

N

0 100 200
SCALE IN FEET

## EROSION CONTROL LEGEND

- (TP) TREE PROTECTION
- (STB) STRAW BALE BARRIER
- (IP) INLET PROTECTION
- (SF) SILT FENCE
- (OP) OUTLET PROTECTION
- (CD) CHECK DAM

NOTE: STRAW BALE SILT BARRIERS SHALL BE INSTALLED ON 100' CENTERS ALONG ALL ROADS SIDE, MEDIAN, & REAR LOT DITCH LINES.

MATCH SHEET III D-A

AES, a professional corporation
1761 Jamestown Road, Williamsburg, Va. 23185
804-253-0040
Architecture, Engineering, Surveying, Planning

DRAINAGE PLAN
FORD'S COLONY AT WILLIAMSBURG
SECTION III
OWNER/DEVELOPER: FORD'S COLONY AT WILLIAMSBURG, INC.
JAMES CITY COUNTY VIRGINIA

MATCH SHEET III D-C

COMMONWEALTH OF VIRGINIA
PAUL C. SMALL
CERTIFICATE NO. 04267
CERTIFIED PROFESSIONAL ENGINEER

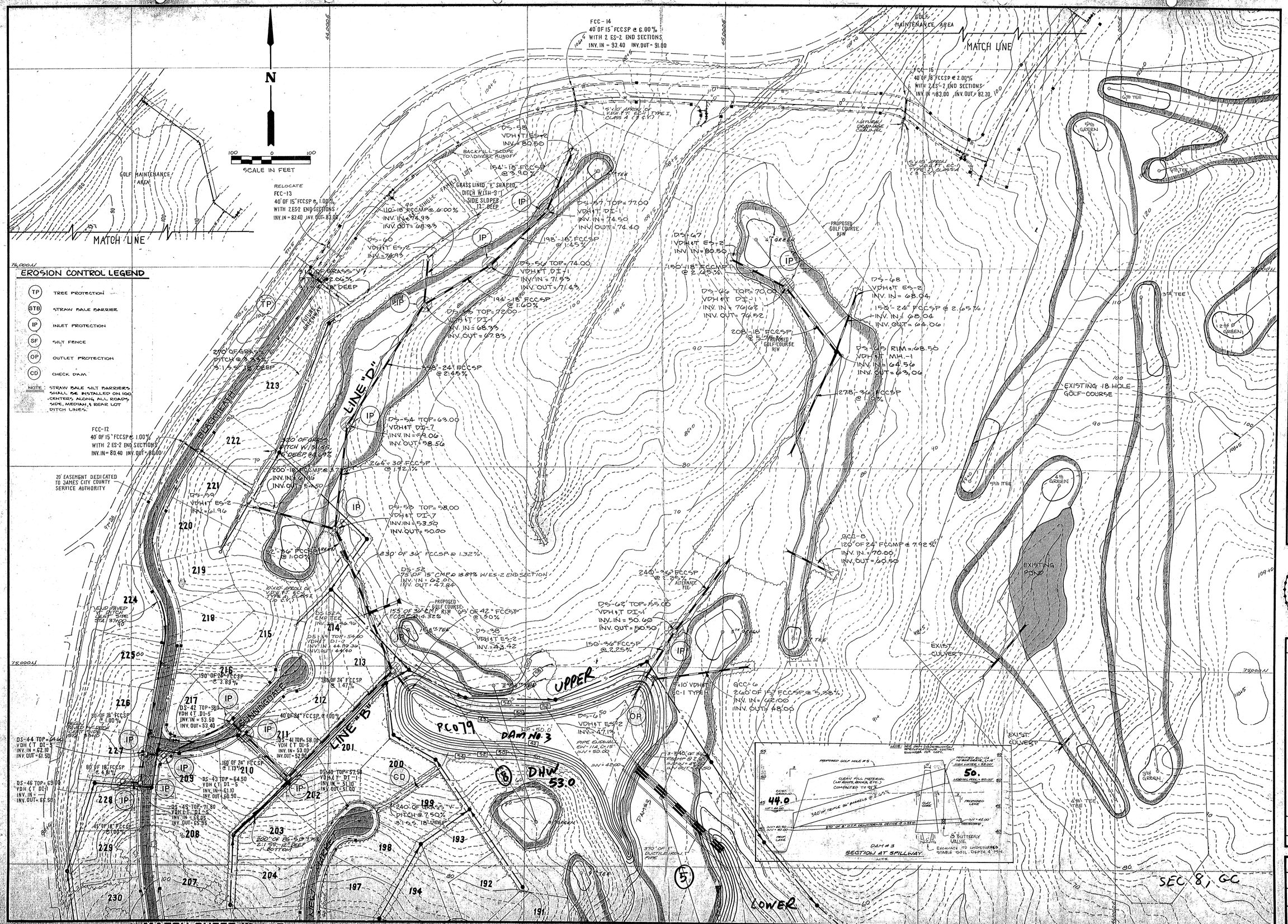
| No. | DATE | REVISION / COMMENT / NOTE | BY |
|---|---|---|---|
| 4 | 8/6/90 | REVISED PER TWO PIPES REPLACED TO ONE CAS PIPE TWO | SGW |
| 3 | 6/15/90 | REVISIONS PER DAM NO. 2 REVISIONS PER DAM NO. 2 DESIGN, ST. ANDREW'S DRIVE | SGW |
| 2 | 2/1/86 | ROAD NAME CHANGES PER OWNER/DEVELOPER | JHB |
| 1 | 9/85 | REVISIONS PER J.C.C. COMMENTS & L.C.A. | DRZ |

| | |
|---|---|
| Designed DAR | Drawn BB |
| Scale 1"=100' | Date JUNE 1985 |
| Project No. 5652 | |
| Drawing No. III D-B | |

VOID

21

PC079_FORDS_COLONY_FAIRWAY_5_&_8_DAM_2 - 005




AES, a professional corporation
1761 Jamestown Road, Williamsburg, Va. 23185
804-253-0040
Architecture, Engineering, Surveying, Planning

DRAINAGE PLAN
FORD'S COLONY AT WILLIAMSBURG
OWNER/DEVELOPER: FORD'S COLONY AT WILLIAMSBURG INC.
SECTION III
JAMES CITY COUNTY VIRGINIA

COMMONWEALTH OF VIRGINIA
PAUL C. SMALL
CERTIFICATE NO. 01267
CERTIFIED PROFESSIONAL ENGINEER

| No. | DATE | REVISION / COMMENT / NOTE | BY |
|---|---|---|---|
| 1 | 8/16/90 | REVISIONS PER J.C.C. COMMENTS & L.C.A. | DAR |
| 2 | 9/18/90 | REVISED TOP DAM, LAKE BOUNDARY, ETC. | DAR |

Designed DAR
Drawn DAR
Scale 1" = 100'
Date JUNE 88
Project No. 5652
Drawing No. III D-D



PC079_FORDS_COLONY_FAIRWAY_5_&_8_DAM_2 - 006

PC079 DAM NO. 2

PC079

DAM No. 2 FROM THE 5 & 6 Ft. Bmp

INV. IN = 53.50
INV. OUT = 50.00

52' - 36" FCCSP @ 1.00%

230' OF 36" FCCSP @ 1.32%

DS-52
75' OF 15" CMP @ 18.89% W/ES-2 END SECTION
INV. IN = 62.01
INV. OUT = 47.84

10'x10' APRON OF VDH&T EC-1 TYPE A CLASS I (10 C.Y.)

PROPOSED GOLF COURSE R/W

155' OF 36" CMP FCCSP @ 4.32%

60' OF 42" FCCSP @ 1.50%

DS+52A
CMP TEE
INV. 36" 46.96

DS-39 TOP = 54.00
VDH&T DI-7
INV. IN = 44.90 36"
INV. OUT = 44.40

DS-38
VDH&T ES-2
INV. = 43.42

8TH TEE

388' OF 24" FCCSP @ 1.47%

40' OF 24" FCCSP @ 1.00%

DS-41 TOP = 58.00
VDH&T DI-5
INV. IN = 53.00
INV. OUT = 52.90

24" FCCSP

DS-48 TOP = 57.50
VDH&T DI-1
INV. IN = 51.10
INV. OUT = 51.00

240' OF GRASS "V" DITCH @ 7.50%
3:1 S.S. 18" DEEP

200' OF RG-5 @ 7.75%
2:1 SS, 12" DEEP
1' BOTTOM

DS-62 TOP = 55.00
VDH&T DI-1
INV. IN = 50.60
INV. OUT = 50.50

240' - 36" FCCSP @ 2.25%
ALTERNATE TEE

150' - 36" FCCSP @ 2.25%

5TH GREEN

4TH TEE

7'x10' VDH&T EC-1 TYPE H

GCC-6
260' OF 15" FCCSP @ 5.38%
INV. IN = 62.00
INV. OUT = 48.00

DS-61
VDH&T ES-2
INV. = 47.13

H.P. = 50.0'

PIPE ENDWALL
EW-11A, L=15'
INV = 50.00

INV = 42.00

3-240' OF 36" FCCMP @ 2.6%
INV. IN = 4[illegible]
INV. OUT = [illegible].50

DAM #3

370' OF 8" DUCTILE IRON PIPE

9TH TEE

GCC-8
120' OF 24" FCCM
INV. IN = 70.00
INV. OUT = 60.FC

PROPOSED GOLF HOLE #5

CLEAN FILL MATERIAL (NO ROOTS, ROCKS, ETC.) COMPACTED TO 95%

EXIST. GROUND

H.P. = 44.50

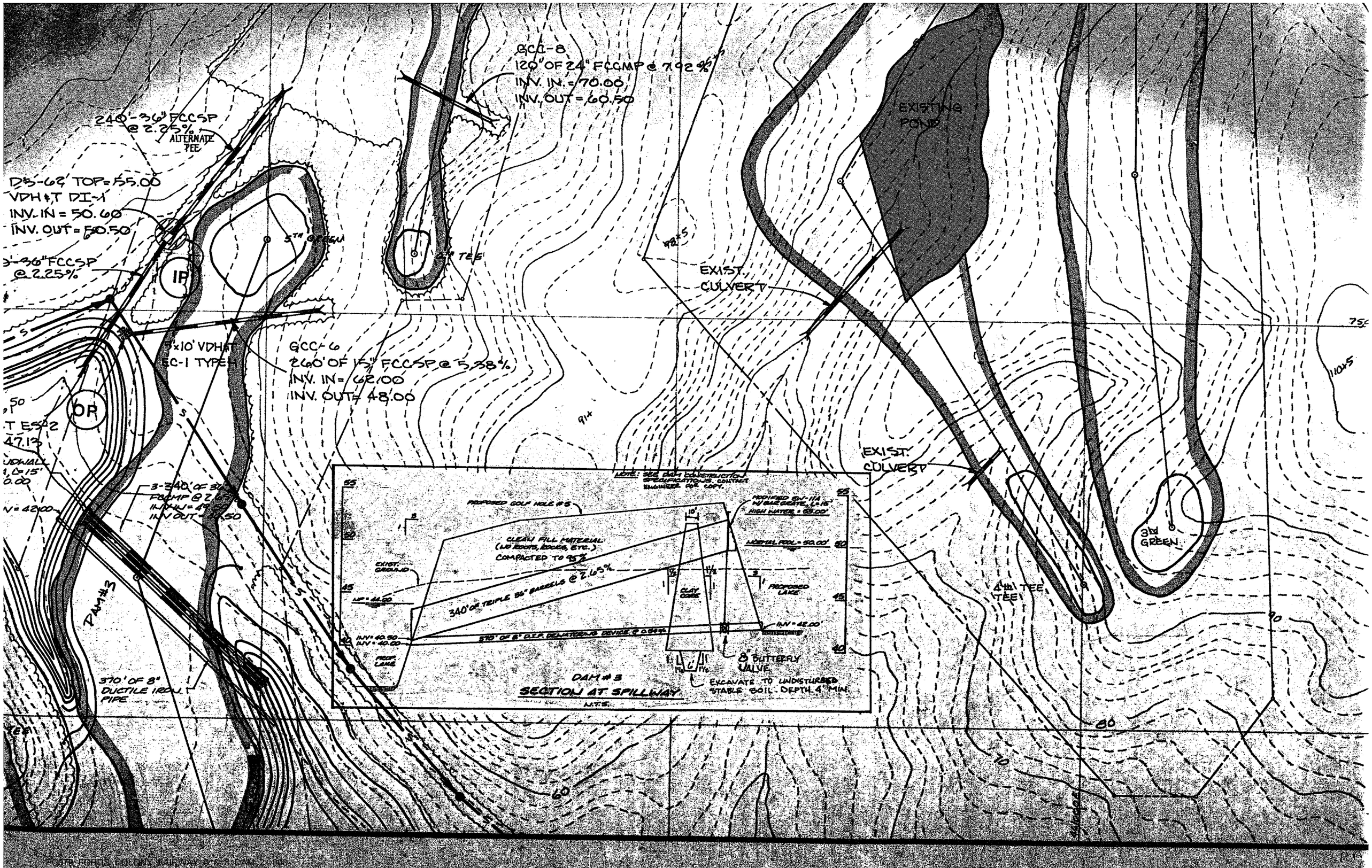
340' OF TRIPLE 36" BARRELS @ 2.65%

370' OF 8" D.I.P. DEWATERING DEVIC

INV = 40.50
INV = 40.00

PROP. LAKE

DAM # 3
SECTION AT 5
N.T.S.


GCC-8
120' OF 24" FCCMP @ 7.92%
INV. IN = 70.00
INV. OUT = 60.50
240'-36" FCCSP
@ 2.25%
ALTERNATE
TEE
D'S-6 TOP = 55.00
VDH & T DI-1
INV. IN = 50.60
INV. OUT = 50.50
-36" FCCSP
@ 2.25%
IP
OP
5TH GREEN
2ND TEE
EXISTING
POND
EXIST.
CULVERT
EXIST.
CULVERT
3RD
GREEN
4TH TEE
TEE
GCC-6
260' OF 15" FCCSP @ 5.38%
INV. IN = 62.00
INV. OUT = 48.00
VDH&T
EC-1 TYPE H
3-340' OF 30"
FCCMP @ 2.6
INV. IN = 4
INV. OUT = 41.50
DAM #3
370' OF 8"
DUCTILE IRON
PIPE
NOTE: SEE DAM CONSTRUCTION SPECIFICATIONS. CONTACT ENGINEER FOR COPY.
PROPOSED GOLF HOLE #8
CLEAN FILL MATERIAL
(NO ROOTS, ROCKS, ETC.)
COMPACTED TO 95%
EXIST. GROUND
340' OF TRIPLE 36" BARRELS @ 2.65%
370' OF 8" D.I.P. DEWATERING DEVICE @ 0.54%
INV = 40.50
INV = 40.00
PROP. LAKE
CLAY CORE
PROPOSED LAKE
INV = 42.00
8" BUTTERFLY VALVE
EXCAVATE TO UNDISTURBED STABLE SOIL. DEPTH 4' MIN.
MODIFIED DI-11A W/ BAR GRATE, C=15'
HIGH WATER = 63.00'
NORMAL POOL = 60.00'
DAM #3
SECTION AT SPILLWAY
N.T.S.

MATCH SHEET III D-D

EMERGENCY SPILLWAY
100' OF THREE 36" ULTRA FLOW ALUMINIZED CORRUGATED STEEL PIPES, TYPE 2 @ 4.25%; INV. IN = 43.75 INV. OUT = 39.50. PROVIDE MODIFIED VDOT EW-11A HEADWALL FOR 36" CMP. PROVIDE EROSION CONTROL STONE, TYPE A FROM OUTLET OF 36" CMP IN DITCHLINE TO DS-16. GROUT FIRST 10' LONG x 15' WIDE OF RIP-RAP APRON.

GCC-5
120' OF 24" FCCMP
@ 0.00%
INV. IN = 45.00
INV. OUT = 45.00
W/ TWIN ES-2

NOTE: FUTURE DEWATERING OF THE POND TO BE BY PUMP.

~~EMERGENCY SPILLWAY #2~~

~~EMERGENCY SPILLWAY #2~~
ENTRANCE SLOPE: 22.2%
CONTROL SLOPE: 0%
EXIT SLOPE: 11.7%
BOTTOM WIDTH: 8'-15'
NOTE: EMERGENCY SPILLWAY #2 INCORPORATES THE USE OF THE GOLF CART TUNNEL UNDER ST. ANDREW'S DRIVE

GCC-4
160' OF 24" FCCMP @ 6.56%
INV. IN = 58.00
INV. OUT = 47.50
W/ TWIN ES-2

DS-19 TOP = 45.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 37.30
INV. OUT = 37.20

DS-20 TOP = 43.00
VDH&T DI-5
INV. IN = 37.91
INV. OUT = 37.81

DS-24 TOP = 64.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 57.21
INV. OUT = 57.11

DS-23 RIM = 59.00
VDH&T MH-1
INV. IN = 51.08
INV. OUT = 50.98

402' - 30" FCCSP @ 1.50%

165' - 30" FCCSP @ 2.34%

DS-16
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 34.85
INV. OUT = 34.75

DS-15 TOP = 38.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. OUT = 35.50

DS-36
VDH&T ES-2
INV. = 37

DS-14 TOP = 3
VDH&T DI-8
W/ DI-7 TYPE I
INV. IN = 30.39
INV. OUT =

100' - 18" FCCSP
INV. IN = 37.00
INV. OUT = 31.10

230' OF 24" FCCSP
"SMOOTH FLOW"
@ 1.91%

110' - 30" FCCSP @ 1.73%

140' 30" FCCSP @ 1.53%

325' - 48" FPCSP "SMOOTH FLOW" @ 1.05%

240' - 48" FPCSP "SMOOTH FLOW" @ 1.25%

380' - 48" FPCSP "SMOOTH FLOW" @ 1.05%

90' - 48" FPCSP

40' OF 12" FCCSP @ 23.75%

DS-35
VDH&T ES-2
INV. = 35.5

FCC-6
30' OF 15" FCCMP @ 1.00%
INV. IN = 45.40
INV. OUT = 45.10
W/ TWIN ES-2

VDOT MH-1
RIM = 40.00

DS-21 TOP = 45.00
VDH&T DI-7 TYPE I
INV. IN = 41.30
INV. OUT = 39.86

DS-18
VDH&T DI-8
W/ DI-7X TYPE I GRATE
INV. IN = 36.66
INV. OUT = 36.58

DAM NO. 2

LINE "A"

EMERGENCY SPILLWAY
100' OF THREE 36" ULTRA FLOW ALUMINIZED CORRUGATED STEEL PIPES, TYPE 2 @ 4.25%; INV. IN = 43.75 INV. OUT = 39.50. PROVIDE MODIFIED VDOT EW-11A HEADWALL FOR 36" CMP. PROVIDE EROSION CONTROL STONE, TYPE A FROM OUTLET OF 36" CMP IN DITCHLINE TO DS-16. GROUT FIRST 10' LONG x 15' WIDE OF RIP RAP APRON.

GCC-5
120' OF 24" FCCMP
@ 0.00%
INV. IN = 45.00
INV. OUT = 45.00
W/ TWIN ES-2

NOTE: FUTURE DEWATERING OF THE POND TO BE BY PUMP.

~~EMERGENCY SPILLWAY #2~~

~~EMERGENCY SPILLWAY #2~~
ENTRANCE SLOPE 22.2%
CONTROL SLOPE 0%
EXIT SLOPE 11.7%
BOTTOM WIDTH 8'-15'
NOTE: EMERGENCY SPILLWAY #2 INCORPORATES THE USE OF THE GOLF CART TUNNEL UNDER ST. ANDREW'S DRIVE

~~DS-30~~
~~VDH&T MOD. MH-1~~
~~INV. OUT = 38.83~~ 39.31
~~TOP = 50.00~~

DAM-40

~~15"~~
~~360' OF 18" RCP CL. III @ 1.00%~~
~~INV. IN = 38.83~~ 39.31
~~INV. OUT = 38.83~~ 34.85

DS-16
~~DI-6~~ TOP = ~~38.75~~ 38.25
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = ~~33.75~~ 34.85
INV. OUT = ~~33.75~~ 32.10

~~DS-15 TOP = 37.50~~ 38.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
~~INV. IN = 31.85~~
INV. OUT = ~~31.85~~ 35.50

~~18"~~
100' ~~24"~~ FCCSP @ ~~2.70%~~ 5.90%
INV. IN = 37.00
INV. OUT = 31.10

DS-36
VDH&T ES-2
INV. = ~~36.99~~ 37.00

DS-14 TOP = 36.50
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = ~~30.39~~ 31.10
INV. OUT = ~~30.24~~ 31.00

DS-19 TOP = 45.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 37.30
INV. OUT = 37.20

DS-20 TOP = 43.00
VDH&T DI-5
INV. IN = 37.91
INV. OUT = 37.81

~~DS-21 TOP = 45.00~~
~~VDH&T DI-7 TYPE I~~
~~INV. IN = 41.30~~
~~INV. OUT = 39.80~~

~~DS-17 RIM~~
~~VDH&T MH-1~~
~~INV. IN = 35.20~~
~~INV. OUT = 35.15~~

~~84' 48" FPCSP~~
~~"SMOOTH FLOW"~~
~~@ 0.45%~~

~~DS-18~~
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 36.66
INV. OUT = 36.58

~~90' OF 18" FCCSP~~
~~@ 4.29%~~
~~INV. IN = 51.8~~
~~INV. OUT = 48.0~~
~~(IF NECESSARY)~~

~~165'~~ ~~120'~~ 30" FCCSP
~~@ 4.05%~~ 2.39%

90' - 48" FPCSP
"SMOOTH FLOW"
@ 0.60%

200' OF GRASS "V" DITCH @ 7.00%
3:1 S.S. 18" DEEP

~~230' OF 24" FCCSP~~
~~235' OF 24" FPCSP~~
"SMOOTH FLOW"
~~@ 0.45%~~ 1.91%

~~284' 60" FPCSP~~
~~"SMOOTH FLOW"~~
~~@ 0.45%~~

~~270' 48" FPCSP~~
~~"SMOOTH FLOW"~~
~~@ 0.45%~~

110' - 30" FCCSP
@ 1.73%

140' 30" FCCSP
@ 1.53%

325' - 48" FPCSP
"SMOOTH FLOW"
@ 1.05%

380' - 48" FPCSP
"SMOOTH FLOW"
@ 1.05%

240' - 48" FPCSP
"SMOOTH FLOW"
@ 1.25%

40' OF 12" FCCSP
~~90' OF 15" FCCMP~~
~~"SMOOTH FLOW"~~
~~@ 0.23%~~ 23.75%

DS-35
VDH&T ES-2
INV. = 35.5

DS-13 TOP = 36.00
~~VDH&T DI-8~~
W/ DI-7 TYPE I GRATE
INV. IN = ~~28.68~~ 26.00
INV. OUT = ~~28.58~~ 25.90

FCC-6
30' OF 15" FCCMP @ 1.00%
INV. IN = 45.40
INV. OUT = 45.10
W/ TWIN ES-8

VDOT MH-1
RIM = 40.00
INV. IN = 29.10
INV. OUT = 29.00

VDOT MH-1
RIM = 44.00
INV. IN = 32.61
INV. OUT = 32.51

200' OF GRASS "V" DITCH @ 4.80% 3:1 S.S. 18" DEEP

EXISTING 40' OF 30" CSP TO BE RELOCATED

LINE "A"

LINE "B"

DS-24 TOP = 64.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 57.21
INV. OUT = 57.11

DS-23 RIM = 59.00
VDH&T MH-1
INV. IN = 51.08
INV. OUT = 50.98

102' - 30" FCCSP
@ 1.50%

DS-49 TOP = 45.00
VDH&T DI-8
W/ DI-7 TYPE I GRATE
INV. IN = 37.30
INV. OUT = 37.20

DS-20 TOP = 43.00
VDH&T DI-5
INV. IN = 37.91
INV. OUT = 37.81

SF 112 IP 90 89 88 87 86 85 84 710 111



DRAINAGE PLAN

# RD'S COLONY AT WILLIAMSBU
# REALTEC INCORPORATED

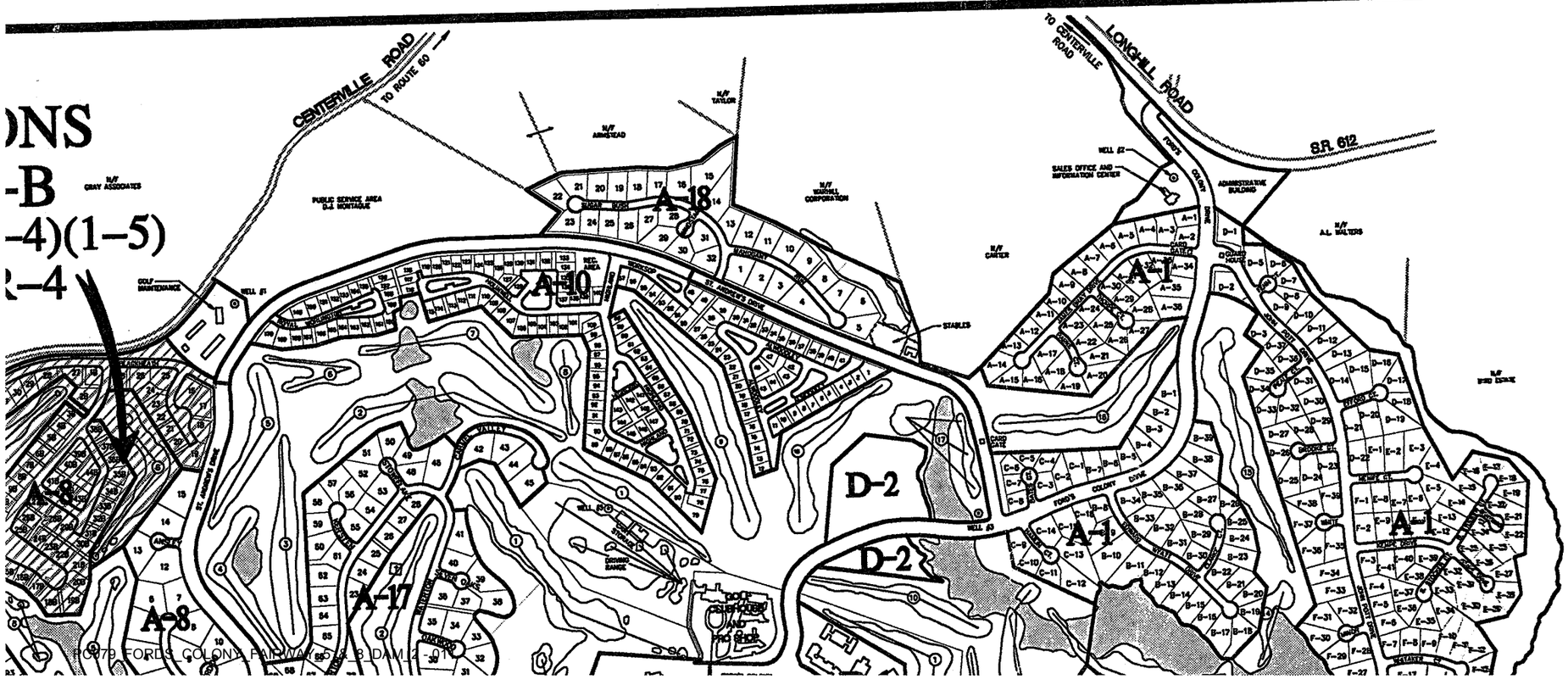
## JAMES CITY COUNTY, VIRGINIA
## POWHATAN DISTRICT
## SECTIONS 8 & 8–B
## CONSTRUCTION PLANS

TAKEN FROM:
5-5-99
FC SEC 8
PC 079

DAM #2

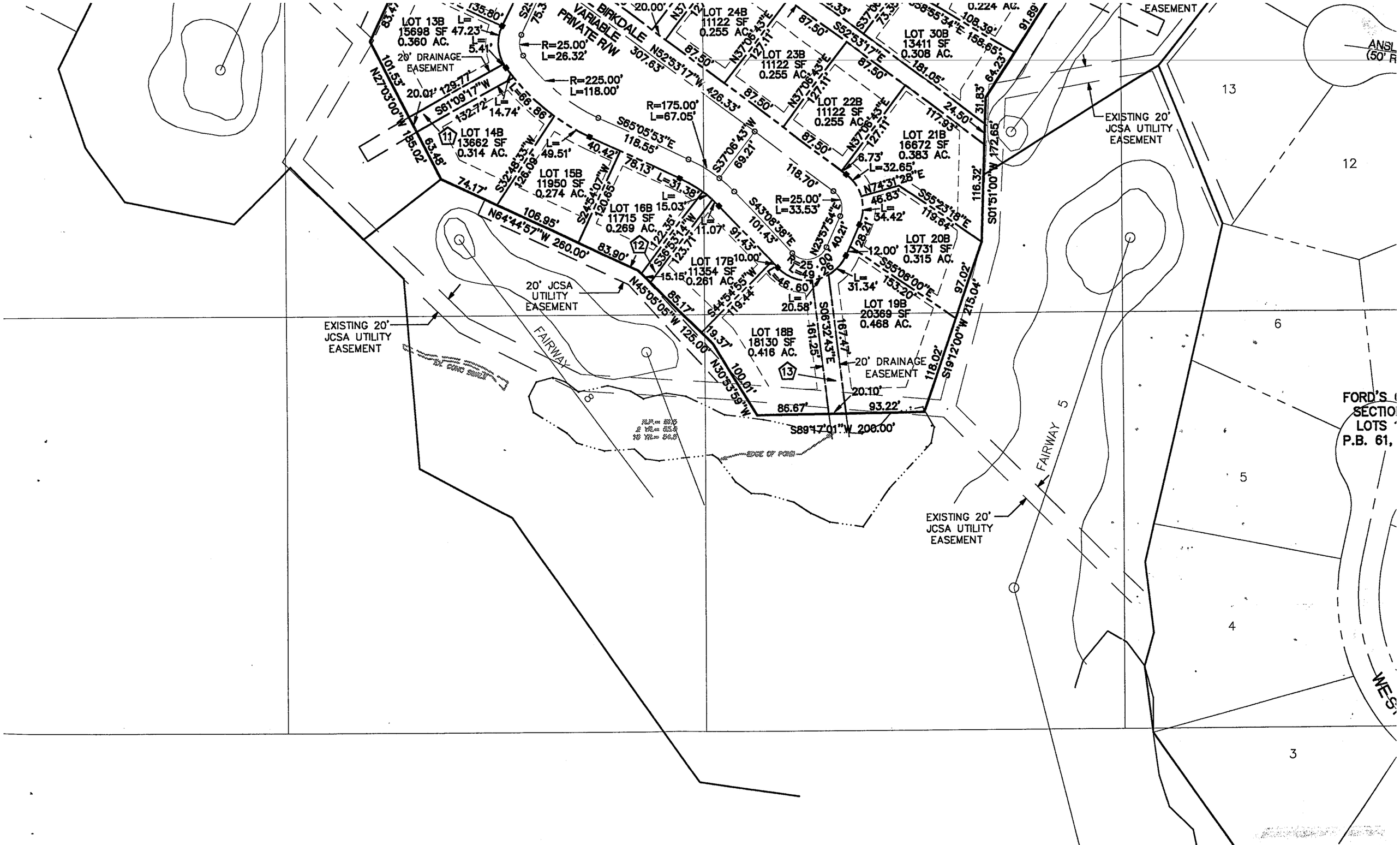
( BMP DESIGN NOT ON THIS PLAN. SEC 8 IS TRIBUTARY. LIMITED INFO SHOWN. )

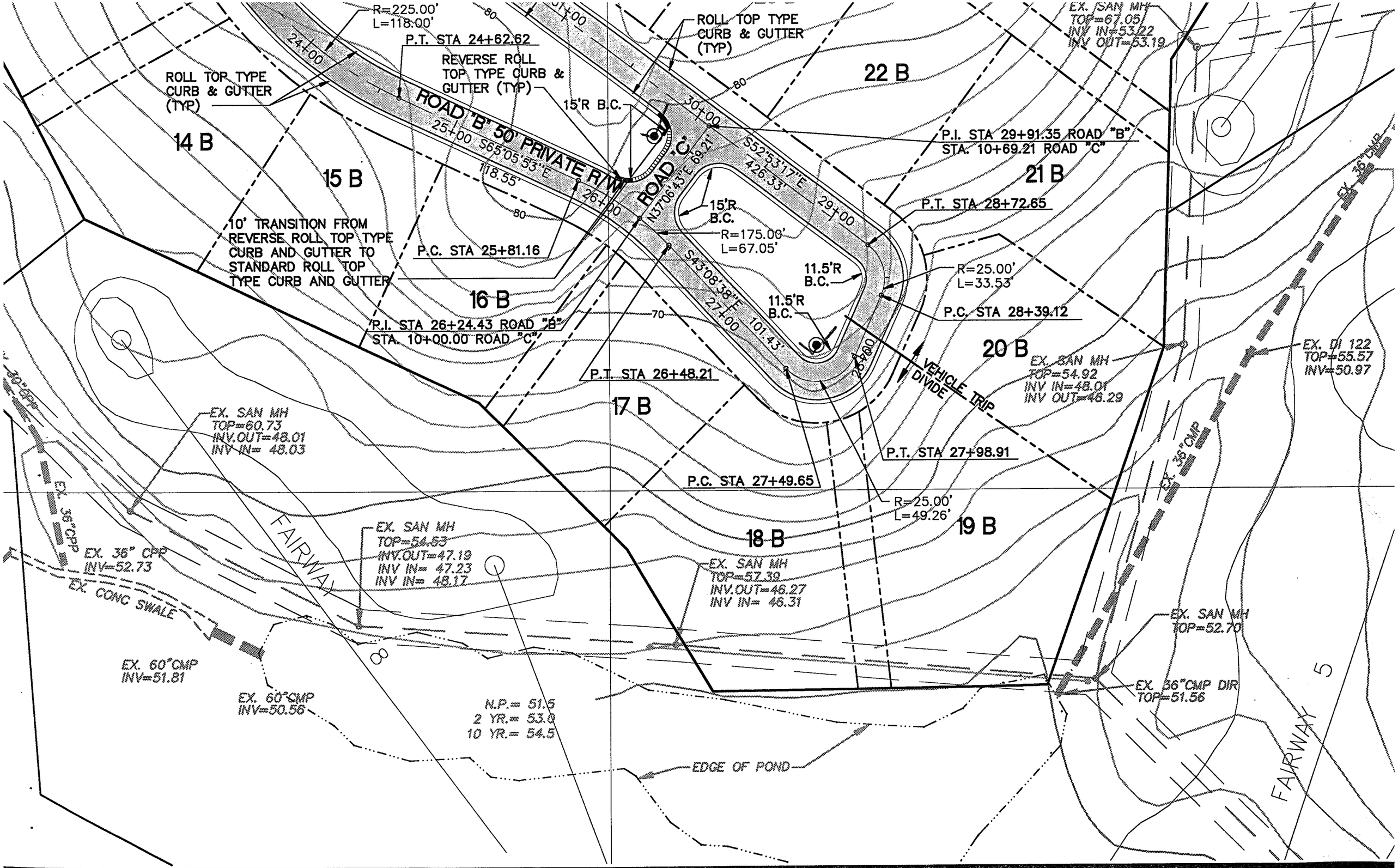
ONS
-B
-4)(1–5)
R–4

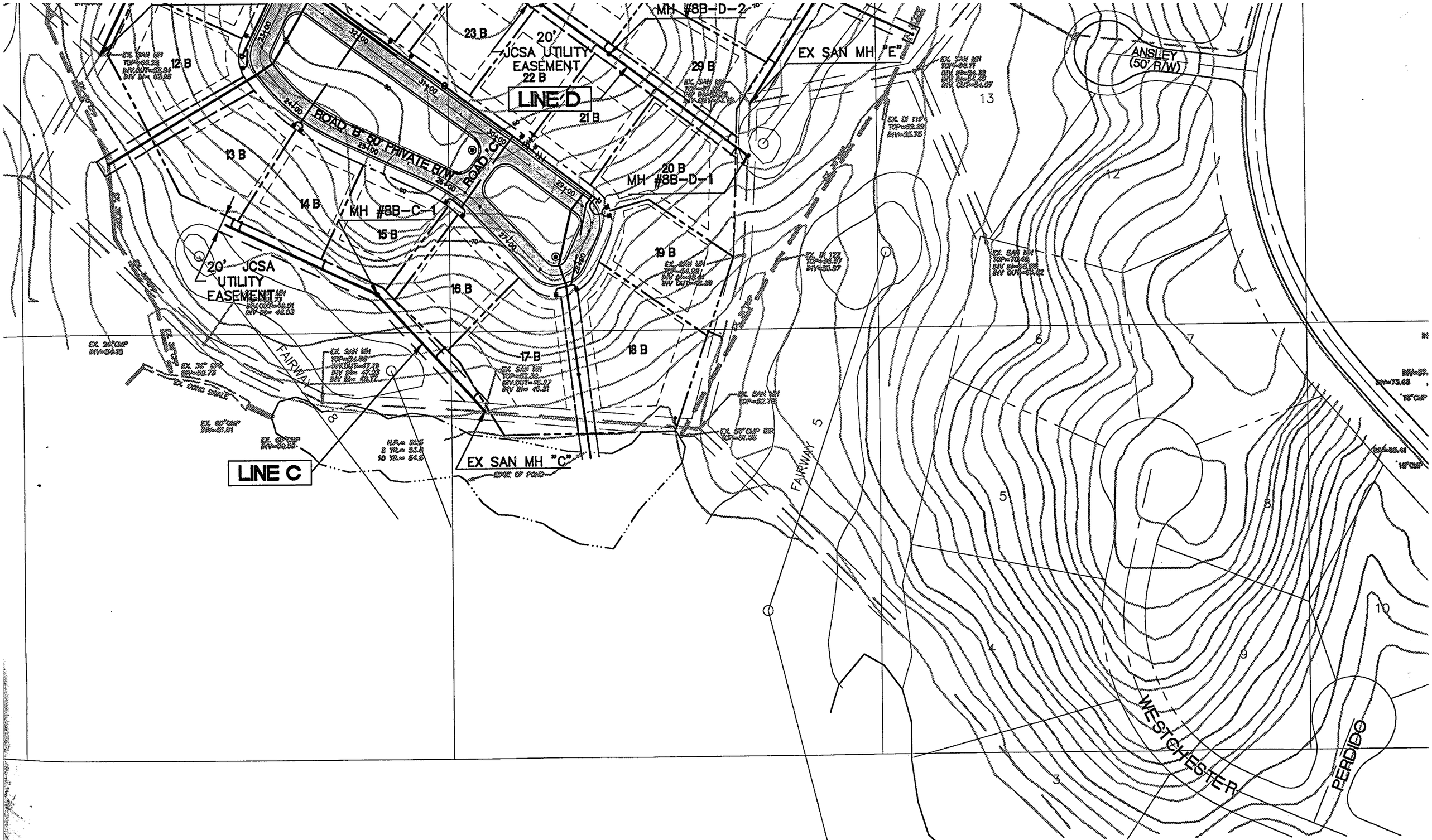


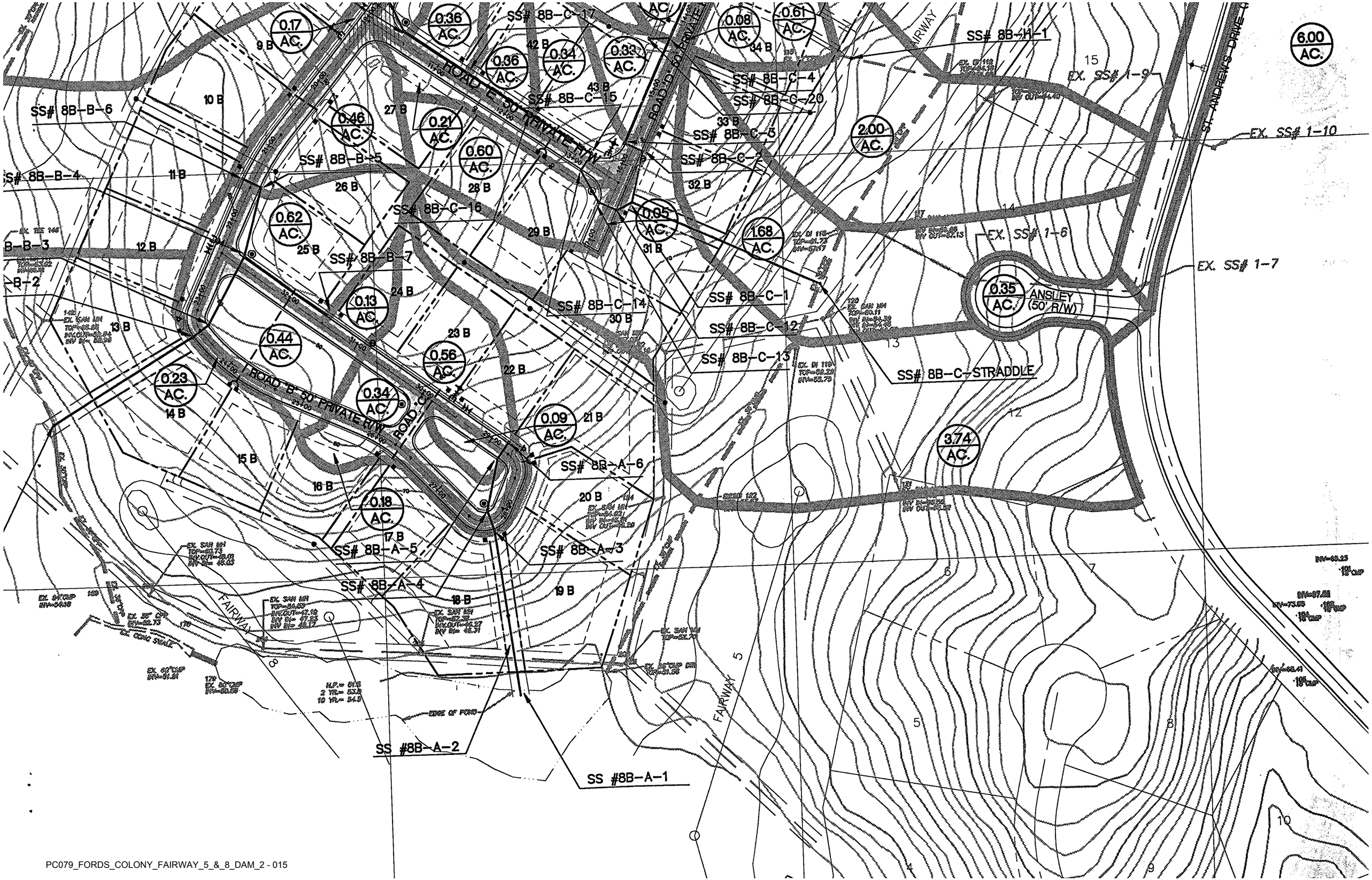

FORD'S COLO
WILLIAMSBU

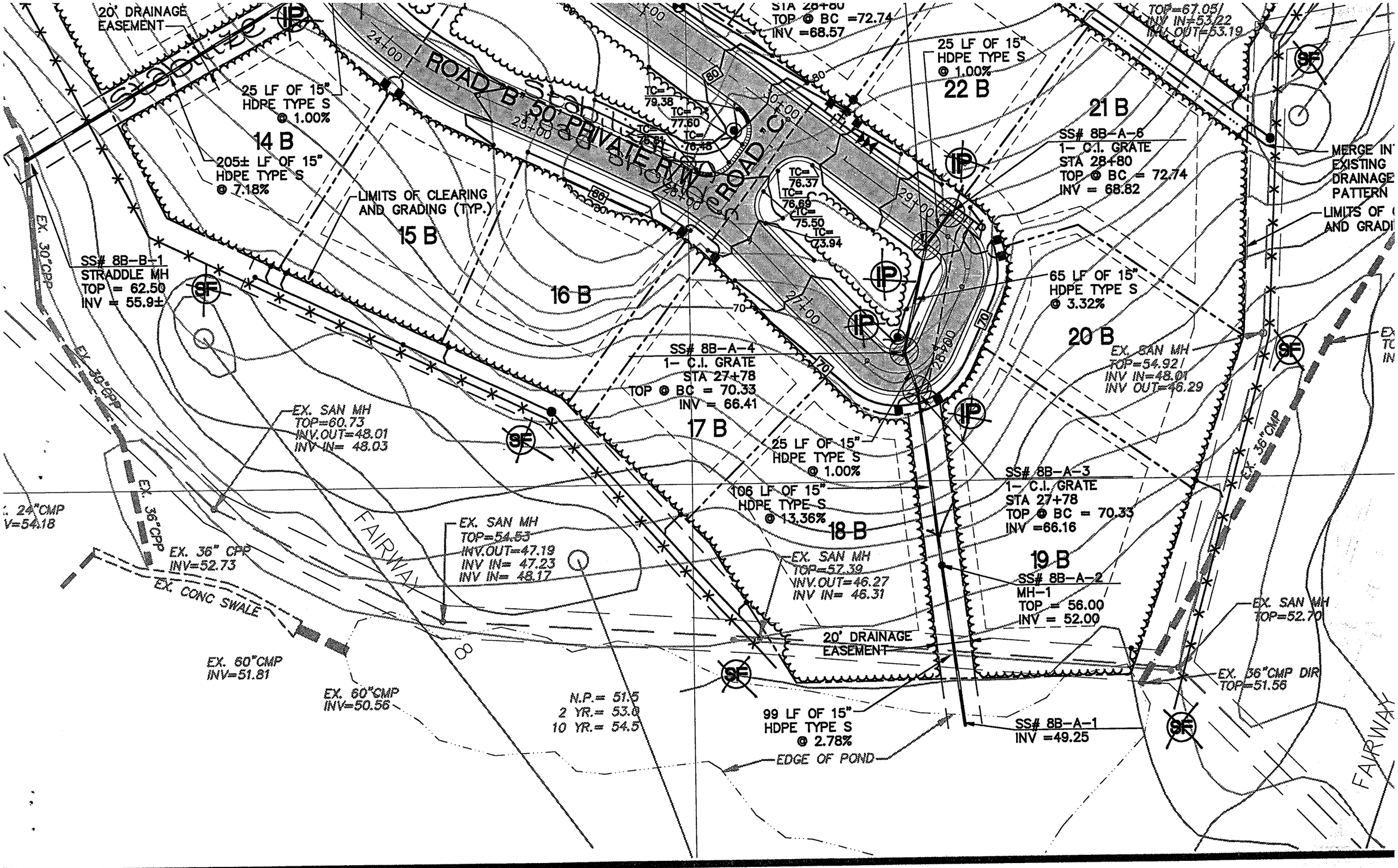
PC079 FORDS COLONY FAIRWAYS 5 & 8 DAM 2 - 01

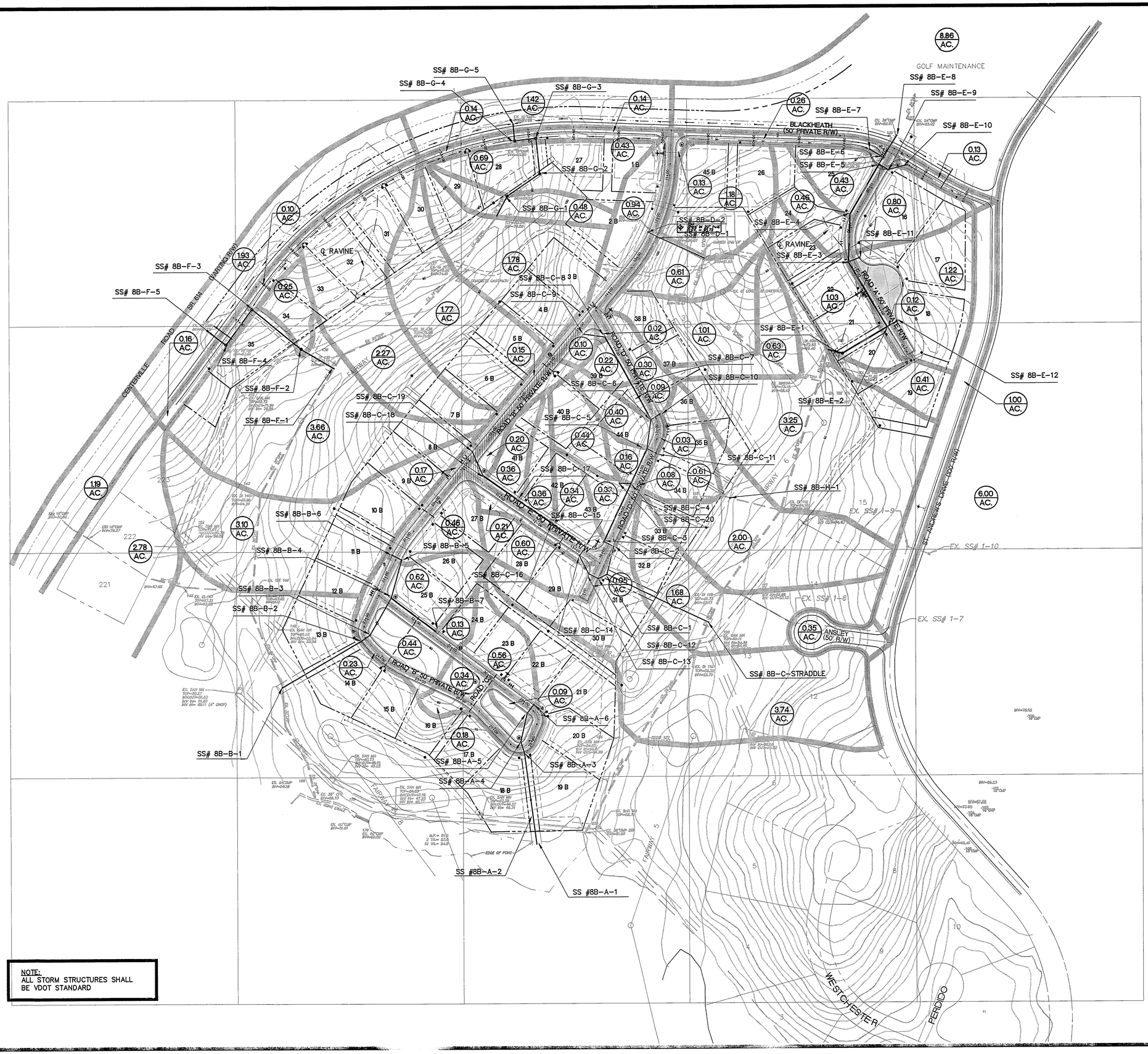

BIRKDALE
VARIABLE
PRIVATE R/W
LOT 13B
15698 SF
0.360 AC.
LOT 14B
13662 SF
0.314 AC.
LOT 15B
11950 SF
0.274 AC.
LOT 16B
11715 SF
0.269 AC.
LOT 17B
11354 SF
0.261 AC.
LOT 18B
18130 SF
0.416 AC.
LOT 19B
20369 SF
0.468 AC.
LOT 20B
13731 SF
0.315 AC.
LOT 21B
16672 SF
0.383 AC.
LOT 22B
11122 SF
0.255 AC.
LOT 23B
11122 SF
0.255 AC.
LOT 24B
11122 SF
0.255 AC.
LOT 30B
13411 SF
0.308 AC.
20' DRAINAGE EASEMENT
20' JCSA UTILITY EASEMENT
EXISTING 20' JCSA UTILITY EASEMENT
FAIRWAY
EASEMENT
13
12
6
5
4
3
FORD'S
SECTIO
LOTS
P.B. 61,
WES


R=225.00'
L=118.00'
P.T. STA 24+62.62
ROLL TOP TYPE CURB & GUTTER (TYP)
REVERSE ROLL TOP TYPE CURB & GUTTER (TYP)
ROLL TOP TYPE CURB & GUTTER (TYP)
ROAD "B" 50' PRIVATE R/W
ROAD "C"
24+00
25+00
26+00
27+00
28+00
29+00
30+00
S65°05'53"E
118.55'
N37°06'43"E 69.21'
S52°53'17"E
426.33'
S43°08'38"E
101.43'
15'R B.C.
15'R B.C.
R=175.00'
L=67.05'
11.5'R B.C.
11.5'R B.C.
R=25.00'
L=33.53'
P.I. STA 29+91.35 ROAD "B"
STA. 10+69.21 ROAD "C"
P.T. STA 28+72.65
P.C. STA 28+39.12
P.C. STA 25+81.16
10' TRANSITION FROM REVERSE ROLL TOP TYPE CURB AND GUTTER TO STANDARD ROLL TOP TYPE CURB AND GUTTER
P.I. STA 26+24.43 ROAD "B"
STA. 10+00.00 ROAD "C"
P.T. STA 26+48.21
P.C. STA 27+49.65
P.T. STA 27+98.91
R=25.00'
L=49.26'
VEHICLE TRIP DIVIDE
14 B
15 B
16 B
17 B
18 B
19 B
20 B
21 B
22 B
EX. SAN MH
TOP=67.05
INV IN=53.22
INV OUT=53.19
EX. SAN MH
TOP=54.92
INV IN=48.01
INV OUT=48.29
EX. DI 122
TOP=55.57
INV=50.97
EX. 36"CMP
EX. 36"CMP
EX. SAN MH
TOP=60.73
INV.OUT=48.01
INV IN= 48.03
EX. 36"CPP
EX. 36" CPP
INV=52.73
EX. CONC SWALE
EX. SAN MH
TOP=54.53
INV.OUT=47.19
INV IN= 47.23
INV IN= 48.17
EX. SAN MH
TOP=57.39
INV.OUT=46.27
INV IN= 46.31
EX. SAN MH
TOP=52.70
EX. 36"CMP DIR
TOP=51.56
EX. 60"CMP
INV=51.81
EX. 60"CMP
INV=50.56
N.P.= 51.5
2 YR.= 53.0
10 YR.= 54.5
EDGE OF POND
FAIRWAY 8
FAIRWAY 5


MH #8B-D-2
23 B
20' JCSA UTILITY EASEMENT
22 B
LINE D
21 B
EX SAN MH "E"
29 B
ANSLEY (50' R/W)
13
12
ROAD "B" 50' PRIVATE R/W
ROAD "C"
13 B
14 B
MH #8B-C-1
15 B
20 B
MH #8B-D-1
19 B
20' JCSA UTILITY EASEMENT
16 B
17 B
18 B
FAIRWAY 8
FAIRWAY 5
LINE C
EX SAN MH "C"
EDGE OF POND
6
7
5
8
10
4
9
3
WESTCHESTER
PERDIDO


0.17 AC.
0.36 AC.
0.36 AC.
0.34 AC.
0.33 AC.
0.08 AC.
0.61 AC.
6.00 AC.
0.46 AC.
0.21 AC.
0.60 AC.
2.00 AC.
0.62 AC.
0.05 AC.
1.68 AC.
0.35 AC.
ANSLEY (50' R/W)
0.13 AC.
0.44 AC.
0.56 AC.
0.23 AC.
0.34 AC.
0.09 AC.
3.74 AC.
0.18 AC.
SS# 8B-C-17
SS# 8B-H-1
SS# 8B-C-4
SS# 8B-C-20
SS# 8B-C-15
SS# 8B-C-5
SS# 8B-C-2
SS# 8B-B-6
SS# 8B-B-5
SS# 8B-B-4
SS# 8B-C-16
SS# 8B-B-7
SS# 8B-C-14
SS# 8B-C-1
SS# 8B-C-12
SS# 8B-C-13
SS# 8B-C-STRADDLE
SS# 8B-A-6
SS# 8B-A-5
SS# 8B-A-3
SS# 8B-A-4
SS #8B-A-2
SS #8B-A-1
ROAD 'E' 50' PRIVATE R/W
ROAD 'D' 50' PRIVATE
ROAD 'B' 50' PRIVATE R/W
ROAD 'C'
EX. SS# 1-9
EX. SS# 1-10
EX. SS# 1-6
EX. SS# 1-7
ST. ANDREWS DRIVE
FAIRWAY
EDGE OF POND


20' DRAINAGE EASEMENT
STA 28+80
TOP @ BC =72.74
INV =68.57
TOP=67.05
INV IN=53.22
INV OUT=53.19
25 LF OF 15" HDPE TYPE S @ 1.00%
22 B
ROAD "B" 50' PRIVATE R/W
ROAD "C"
25 LF OF 15" HDPE TYPE S @ 1.00%
14 B
205± LF OF 15" HDPE TYPE S @ 7.18%
LIMITS OF CLEARING AND GRADING (TYP.)
15 B
21 B
SS# 8B-A-6
1- C.I. GRATE
STA 28+80
TOP @ BC = 72.74
INV = 68.82
MERGE IN EXISTING DRAINAGE PATTERN
LIMITS OF AND GRADI
SS# 8B-B-1
STRADDLE MH
TOP = 62.50
INV = 55.9±
16 B
65 LF OF 15" HDPE TYPE S @ 3.32%
20 B
EX. SAN MH
TOP=54.92
INV IN=48.01
INV OUT=46.29
SS# 8B-A-4
1- C.I. GRATE
STA 27+78
TOP @ BC = 70.33
INV = 66.41
17 B
EX. SAN MH
TOP=60.73
INV.OUT=48.01
INV IN= 48.03
25 LF OF 15" HDPE TYPE S @ 1.00%
SS# 8B-A-3
1- C.I. GRATE
STA 27+78
TOP @ BC = 70.33
INV =66.16
106 LF OF 15" HDPE TYPE S @ 13.36%
18 B
EX. 24"CMP
INV=54.18
EX. 36"CPP
EX. 36" CPP
INV=52.73
EX. SAN MH
TOP=54.53
INV.OUT=47.19
INV IN= 47.23
INV IN= 48.17
FAIRWAY
EX. SAN MH
TOP=57.39
INV.OUT=46.27
INV IN= 46.31
19 B
SS# 8B-A-2
MH-1
TOP = 56.00
INV = 52.00
EX. CONC SWALE
EX. SAN MH
TOP=52.70
20' DRAINAGE EASEMENT
EX. 60"CMP
INV=51.81
EX. 60"CMP
INV=50.56
N.P.= 51.5
2 YR.= 53.0
10 YR.= 54.5
EX. 36"CMP DIR
TOP=51.56
99 LF OF 15" HDPE TYPE S @ 2.78%
SS# 8B-A-1
INV =49.25
EDGE OF POND
FAIRWAY
EX. 30"CPP
EX. 36"CMP




NOTE:
ALL STORM STRUCTURES SHALL BE VDOT STANDARD

| No. | DATE | REVISION / COMMENT / NOTE | BY |
|---|---|---|---|
| 1 | 3/12/99 | REVISION PER 3/2/99 JCC COMMENT LETTER | CBR |

COMMONWEALTH OF VIRGINIA
STEVEN O. WOODS
No. 019307
1/20/99
REGISTERED PROFESSIONAL ENGINEER


5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(757) 253-0040
Fax (757) 220-8994
CONSULTING ENGINEERS

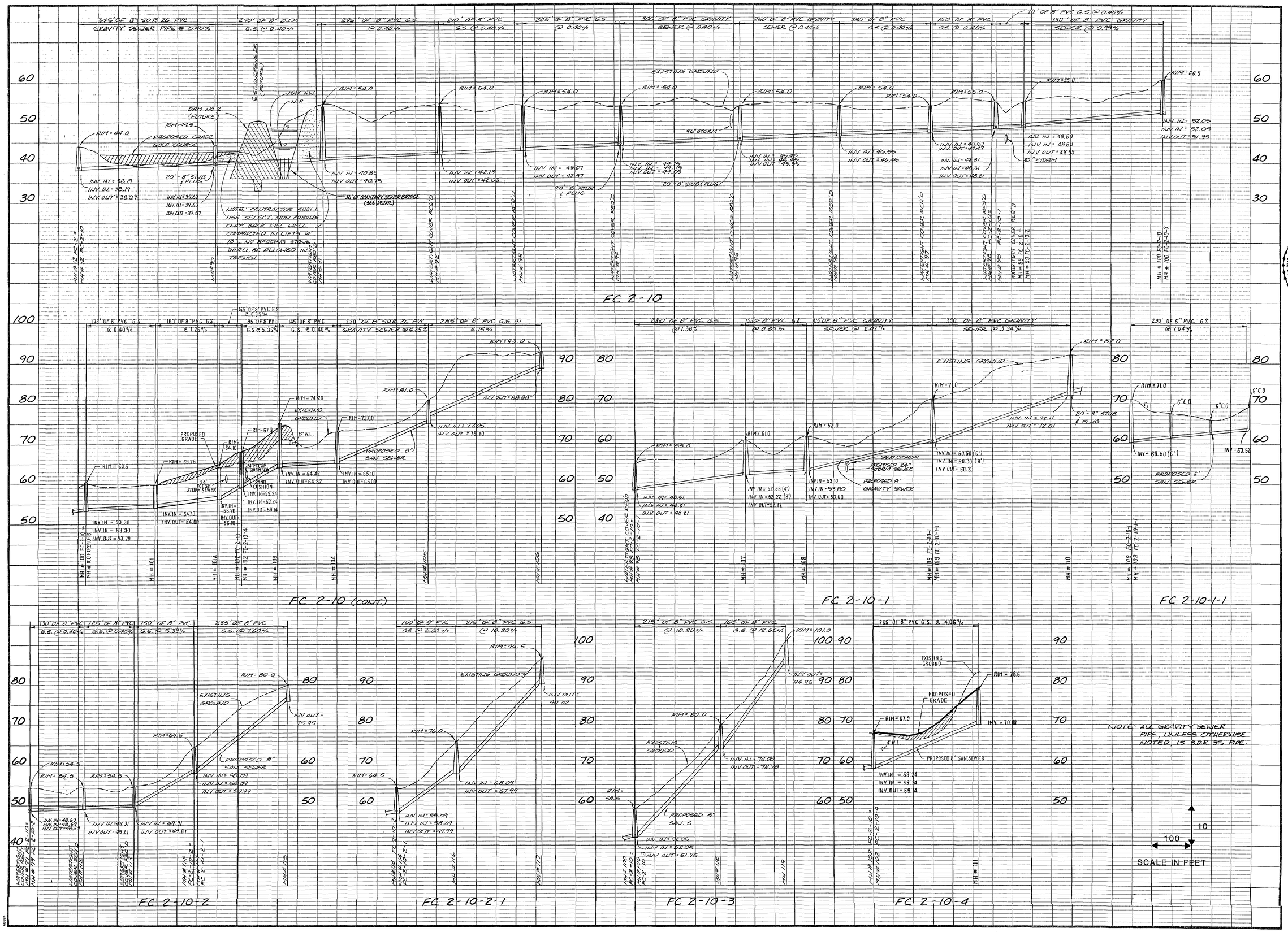

OVERALL DRAINAGE PLAN
# FORD'S COLONY AT WILLIAMSBURG
SECTIONS 8 AND 8-B
OWNER / DEVELOPER : REALTEC INCORPORATED
POWHATAN DISTRICT JAMES CITY COUNTY VIRGINIA

| Designed | Drawn |
|---|---|
| SOW | CWG |
| Scale | Date |
| 1"=100' | 1/20/99 |

Project No. 5652-8B

Drawing No. 10

PC079_FORDS_COLONY_FAIRWAY_5_&_8_DAM_2 - 017




| No. | DATE | REVISION / COMMENT / NOTE | BY |
|---|---|---|---|
| 2 | 8/6/90 | REVISED TO INCLUDE SEWER BRIDGE | SCM |
| 1 | 9/1/85 | REVISIONS PER J.C.C. COMMENTS & C.E.A. | DMR |

COMMONWEALTH OF VIRGINIA
PAUL C. SMALL
CERTIFICATE NO. 8426
CERTIFIED PROFESSIONAL ENGINEER


AES, a professional corporation
1761 Jamestown Road
Williamsburg, Virginia 23185
804-253-0040
Engineering, Planning, Surveying


SEWER PROFILES
# FORD'S COLONY AT WILLIAMSBURG
SECTION III
OWNER/DEVELOPER: FORD'S COLONY AT WILLIAMSBURG INC.
VIRGINIA
JAMES CITY COUNTY

| Designed | Drawn |
|---|---|
| DAR | VMB/RMS |
| Scale 1"=10' V 1"=100' H | Date JUN., 1985 |
| Project No. 5652 | |
| Drawing No. III SP-2 | |



PC079_FORDS_COLONY_FAIRWAY_5_& 8_DAM_2 - 018

LAKE WEST OF HOLE #5 #5652

1)

Fords Colony Sec 3

GIVEN:

1) DRAINAGE BASIN AT PRINCIPAL SPILLWAY = 106.77 Ac. ±

2) WEIGHTED COEFFICIENT OF RUNOFF FACTOR

| | | |
|---|---|---|
| a) ROADS AND RESIDENTIAL | 70.55 Ac @ 0.35 = | 24.69 |
| b) GOLF COURSE | 28.35 Ac @ 0.25 = | 7.09 |
| c) GOLF MAINTENANCE / PUBLIC SERVICE | 7.89 Ac @ 0.65 = | 5.13 |
| | 106.77 Ac | 36.91 |

POST DEVELOPMENT "C" = 36.91 / 106.77 = 0.346

PC 079
UPPER

3) TIME OF CONCENTRATION ($T_c$)

OVERLAND FLOW = 10 MINUTES

$\Delta H$ = 110 - 50 = 60'

LENGTH OF CHANNEL 2800', CHANNEL FLOW TIME: 16 MINUTES

AVERAGE VELOCITY = 2800/(16×60) = 2.92 FPS

COMBINED $T_c$ = 26 MINUTES

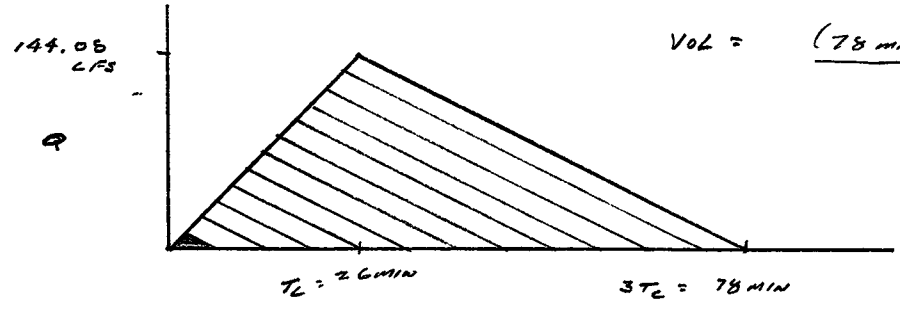
4) RAINFALL INTENSITY: CORRECTION FACTOR = 1.25 (100 YR EVENT)

$I_{10}$ = 3.9 IN/HR $\quad Q_{10}$ = (106.77)(3.9)(0.346) = 144.08 CFS

$I_{100}$ = 5.8 IN/HR $\quad Q_{100}$ = (106.77)(5.8)(0.346)(1.25) = 267.83 CFS

5) VOLUME OF RUNOFF (STORM LASTS 3 TIMES $T_c$)

FOR 10 YEAR EVENT

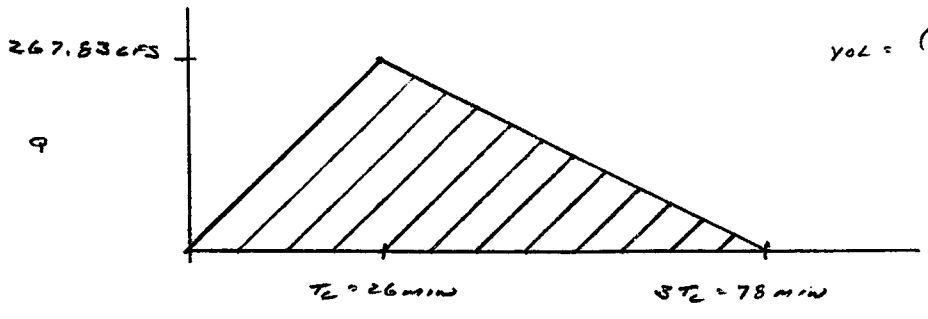



TIME OF CONCENTRATION

$$VOL = \frac{(78\ MIN)(60\ SEC/MIN)(144.08\ CFS)}{2} = 337,147\ CF$$

OR 7.74 AC·FT

FOR 100 YEAR EVENT




TIME OF CONCENTRATION

$$VOL = \frac{(78\ MIN)(60\ SEC/MIN)(267.83\ CFS)}{2}$$

= 626,728 CF OR 14.39 AC·FT

6) SURFACE AREA AT ELEVATION 50 = 1.01 ACRES
REQUIRES TOO MUCH RISE IN ELEVATION TO STORE ANY EVENT,
SO 10 YEAR EVENT WILL BE CARRIED TO LOWER POND.
$Q_{100}$ = 144.08 CFS.

WITH 3' OF HEAD TO ELEV. = 53.00'
A 36" PIPE WILL CARRY ≈ 60 CFS

300' OF TRIPLE 36" FCCMP @ 3.00%
INV. IN = 49.50'
INV. OUT = 40.50'

SIZE AN END WALL (EW-11A) TO PASS 10 YR FLOW RATE.
RECTANGULAR WEIR FLOW
$Q_{100}$ = 144.08 CFS $h_{ALLOWABLE}$ = 3.0 TO ELEV 53.00'

$Q = C(L - nkh)h^{1.5}$ $n = 2$ $k = .1$ $C = 3.33$

$144.08 = 3.33[L - (2)(.1)(3)](3)^{1.5}$ $L = 8.93$ FT.

ALLOW 1.5 SAFETY FACTOR $L = 13.39$ FT

# DAM #2

## PRE-DEVELOPMENT

DRAINAGE AREA = 152.39 Ac ±
C = 0.25

OVERLAND FLOW = 15 MINUTES
CHANNEL FLOW L = 3900' ΔELEV. = 110 - 44 = 66 Ft. S = 1.69%
$t_c$ = 22 MINUTES
TOTAL $T_c$ = 37 MINUTES
$I_2$ = 2.4 in/HR , $Q_2$ = 91.43 CFS
$I_{10}$ = 3.2 in/HR , $Q_{10}$ = 121.91 CFS
$I_{100}$ = 4.7 in/HR , $Q_{100}$ = 179.06 CFS

## POST-DEVELOPMENT

DRAINAGE AREA = 152.39 Ac ±

WEIGHTED C

| | | | | |
|---|---|---|---|---|
| a) ROADS AND RESIDENTIAL | 84.99 Ac | @ | 0.35 | = 29.75 |
| b) GOLF COURSE | 54.74 Ac | @ | 0.25 | = 13.69 |
| c) GOLF MAINTENANCE / PUBLIC SERVICE | 7.89 Ac | @ | 0.65 | = 5.13 |
| d) PONDS / LAKES | 4.77 Ac | @ | 0.98 | = 4.67 |
| | 152.39 Ac | | | 53.24 |

C = 53.24 / 152.39 = 0.349

$t_c$ - OVERLAND FLOW = 10 MINUTES
CHANNEL FLOW = 22 MINUTES
$t_c$ = 32 MINUTES

$$I = \frac{a}{b + t_c}$$

$a_{10}$ = 201.0 $b_{10}$ = 23.9
$a_{100}$ = 260.3 $b_{100}$ = 25.8

$I_{10}$ = 3.6 in/HR
$I_{100}$ = 4.5 in/HR

RELEASE 14.3 CFS FROM PREVIOUS STORM SEWER CALC

## CRITICAL STORM DURATION FOR 10 YR POST-DEV.

$$T_c = \sqrt{\frac{2CA_R(b - t_c/4)}{q_o}} - b = \sqrt{\frac{2(0.349)(152.39)(201.0)[23.9 - \frac{32}{4}]}{14.30}} - 23.9 \checkmark$$

$T_c$ = 130.28 MIN.

## PEAK INFLOW

$$Q_o = CA\left(\frac{a}{b + T_c}\right) = (0.349)(152.39)\left(\frac{201.0}{23.9 + 130.28}\right) = 69.33 \text{ CFS}$$

## REQUIRED STORAGE VOLUME FOR 10 YR STORM

$$VOL = \left(Q_o T_c + \frac{Q_o t_c}{4} - \frac{q_o T_c}{2} - \frac{3 q_o t_c}{4}\right) 60$$

$$VOL = \left[(69.33)(130.28) + \frac{(69.33)(32)}{4} - \frac{(14.30)(130.28)}{2} - \frac{3(14.30)(32)}{4}\right] 60$$

$$VOL = [9032.31 + 554.64 - 931.50 - 343.20]60$$

$$VOL = \underline{498,735\ FT^3} = \underline{11.45\ AC\cdot FT.}$$

CRITICAL STORM DURATION FOR 100 YR POST-DEV.

$$T_c = \sqrt{\frac{2(0.349)(152.39)(260.3)(25.8 - 32/4)}{14.30}} = 25.8$$

$T_c = 159.85$ MIN $\qquad Q_o = (0.349)(152.39)\left(\frac{260.3}{25.8 + 159.85}\right) = 74.57$ CFS

REQUIRED STORAGE VOLUME FOR 100 YR STORM

$$VOL = \left[(74.57)(159.85) + \frac{(74.57)(32)}{4} - \frac{(14.30)(159.85)}{2} - \frac{3(14.30)(32)}{4}\right] 60$$

$$VOL = [11,920.01 + 596.56 - 1142.93 - 343.20]60$$

$$VOL = \underline{661,826\ FT^3} = \underline{15.19\ AC.FT.}$$

| ELEV. | S.A. | STORAGE VOL. | |
|---|---|---|---|
| 44 | 3.1 AC | — | |
| 46 | 3.45 AC | 6.55 AC-FT | STORE 10 YR @ 47.30' |
| 48 | 3.85 AC | 13.90 AC-FT | |
| ∞ | 4.30 AC | 22.20 AC-FT | STORE 100 YR @ 48.35' |

ALLOWABLE RELEASE RATE = 14.30 CFS

SIZE ORIFICE FOR 2 YR PRE-DEV. RATE = 14.30 CFS @ h = 3.30'

$q_o = C_o a_o \sqrt{2gh}$ $\qquad q_o = 14.30$ CFS $\qquad C_o = 0.80 \qquad g = 32.2\ FT/SEC^2$

$14.30 = (0.80)(a)\sqrt{2(32.2)(3.3)} \qquad a_o = 1.23^{\square} \qquad a = \frac{\pi d^2}{4}$

$d = \sqrt{\frac{4}{\pi}(1.23)} = 1.25'$ $\qquad$ USE 1 - 15" HOLE IN CENTER $\qquad q = 14.30$ CFS

SIZE MODIFIED EW-11A TO PASS 100 YR RATE

$q = q_{100} - 14.30$ CFS $\qquad q = 74.57$ CFS $- 14.30$ CFS $= 60.27$ CFS

$q = c(L - nk_e h)h^{1.5} \qquad n = 2 \qquad k_e = 0.1 \qquad c = 3.33 \qquad h = 1.20'$ (ELEV. = 48.50)

$60.27 = 3.33[L - (2)(.1)(1.2)](1.2)^{1.5} \qquad L = 14.00'$

ALLOW 1.15 SAFETY FACTOR $\qquad \underline{L = 16.00'}$

OUTLET PIPES SHOULD CARRY 18.8..56 CFS w/ 4.5' OF HEAD.

3 - 36" RCPMP, 100' @ 4.50% $\qquad$ INV. IN = 44.00' $\qquad$ INV OUT = 39.50'

**AES, A PROFESSIONAL CORPORATION**
**Engineering And Surveying**
1761 Jamestown Road
WILLIAMSBURG, VIRGINIA 23185

(804) 253-0040

# LETTER OF TRANSMITTAL

| DATE | JOB NO. |
|---|---|
| AUG. 25, 1988 | 5652/6950 |

ATTENTION: DARRYL COOK

RE: FORD'S COLONY - DAM #2
POWHATAN CROSSING

TO JCC CODE COMPLIANCE

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

☐ Shop drawings ☒ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☒ CALCULATIONS

| COPIES | DATE | NO. | DESCRIPTION |
|---|---|---|---|
| 2 | | | DAM #2 DESIGN - FC |
| 1 | | | POWHATAN CROSSING - REVISED SHEETS #3B, #3C AND DRAINAGE CALCULATIONS - INSERT IN PREVIOUSLY SUBMITTED SET. |

THESE ARE TRANSMITTED as checked below:

☒ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☒ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☒ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

COPY TO _____ SIGNED: James H Bennett

*If enclosures are not as noted, kindly notify us at once.*

PC079_FORDS_COLONY_FAIRWAY_5_&_8_DAM_2 - 023

# DAM NO. 2 DESIGN CALCULATIONS


10/15/86
JN 5652
FORDS COLONY

GIVEN:

1. DRAINAGE BASIN AT PRINCIPAL SPILLWAY = 152.39 ACRES±
2. WEIGHTED COEFFICIENT OF RUNOFF FACTOR

4 TYPES OF AREAS CONTRIBUTE TO THE OVERALL DRAINAGE BASIN

| | | | RUN |
|---|---|---|---|
| a. ROADS AND RESIDENTIAL | 84.99 Ac. @ 0.35 | = 29.75 | 81 |
| b. GOLF COURSE | 50.88 Ac. @ 0.25 | = 12.72 | 74 |
| c. GOLF MAINTENANCE / PUBLIC SERVICE | 7.89 Ac. @ 0.65 | = 5.13 | 90 |
| d. PONDS / LAKES | 8.63 Ac. @ 0.98 | = 8.46 | 98 |
| | 152.39 Ac | 56.06 | AVG 80 |

POST DEVELOPMENT "C" = 56.06/152.39 = 0.368

Soil Types

| | |
|---|---|
| 17 | D |
| 29A | C |
| 15E | C |
| 10B | C |

FIL - FCDAM2.DAT

3. TIME OF CONCENTRATION ($T_c$)

ASSUME OVERLAND FLOW TIME = 10 MINUTES
$\Delta H = 110 - 50 = 60'$ (CHANNEL ELEVATION DIFFERENCE)
CHANNEL LENGTH = 3900', CHANNEL FLOW TIME = 23 MINUTES
AVERAGE VELOCITY = 3900/(23×60) = 2.83 FPS
COMBINED $T_c$ = 33 MINUTES

$Q_{10}$ = 226 cfs
$Q_{OUT}$ = 10 cfs
elev = 53.0
$V_s$ = 27.8

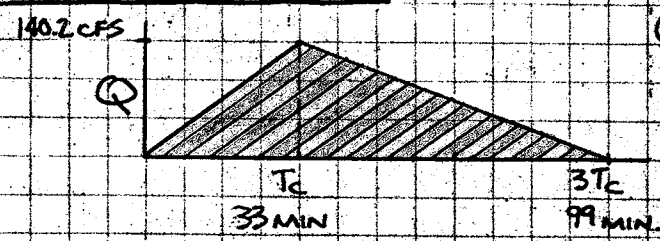
4. RAINFALL INTENSITY: CORRECTION FACTOR = 1.25 (100 YR. EVENT)

$I_2$ = 2.5 IN/HR  $Q_2$ = (152.39)(2.5)(0.368) = 140.20 CFS
$I_{10}$ = 3.4 IN/HR  $Q_{10}$ = (152.39)(3.4)(0.368) = 190.67 CFS
$I_{100}$ = 5.0 IN/HR  $Q_{100}$ = (152.39)(5.0)(0.368)(1.25) = 350.50 CFS

$Q_{100}$ = 403
$Q_{OUT}$ = 36
elev = 54.0
$V_s$ = 38.4

5. VOLUME OF RUNOFF: (ASSUME STORM LASTS 3 TIMES THE TIME OF CONCENTRATION)

FOR THE 2 YEAR EVENT

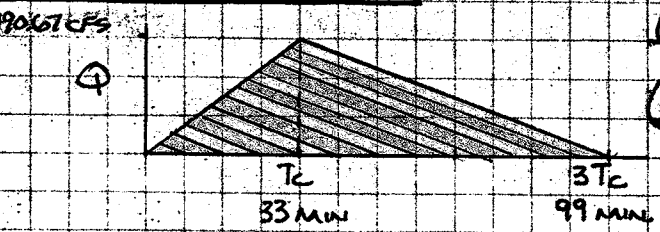



$\frac{(33\text{ MIN})(60\text{ SEC/MIN})(140.20\text{ CFS})}{2}$ = 138,798 CF

$\frac{(66\text{ MIN})(60\text{ SEC/MIN})(140.20\text{ CFS})}{2}$ = 277,596 CF

TOTAL VOLUME 2 YEAR = 416,394 CF OR 9.56 AC·FT

FOR THE 10 YEAR EVENT

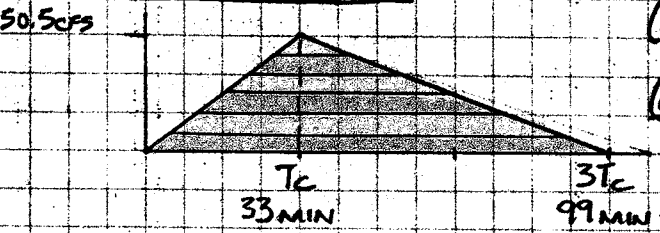



$\frac{(33\text{ MIN})(60\text{ SEC/MIN})(190.67\text{ CFS})}{2}$ = 188,763 CF

$\frac{(66\text{ MIN})(60\text{ SEC/MIN})(190.67\text{ CF})}{2}$ = 377,527 CF

TOTAL VOLUME 10 YEAR = 566,290 CF OR 13.00 AC·FT

FOR THE 100 YEAR EVENT




$\frac{(33\text{ MIN})(60\text{ SEC/MIN})(350.5\text{ CFS})}{2}$ = 346,995 CF

$\frac{(66\text{ MIN})(60\text{ SEC/MIN})(350.5\text{ CFS})}{2}$ = 693,990 CF

TOTAL VOLUME 100 YEAR = 1,040,985 CF OR 23.90 AC·FT

· DAM #2

FOR THE 500-YEAR EVENT, THE STORM FOR THE WILLIAMSBURG AREA IS 10 INCHES/DAY. THE VOLUME FOR THE 500-YEAR EVENT, THEREFORE, IS

$$V_{500} = \left[\frac{10 \text{ INCHES}}{12 \text{ IN/FT}}\right](0.368)(152.39)(1.25) = 58.42 \text{ AC·FT}$$

6. SURFACE AREA OF LAKE AT ELEVATION 50 = 7.72 ACRES
ALLOWABLE RISE IN LAKE = 3'± . EMERGENCY SPILLWAY SET @ ELEVATION 53.0
SURFACE AREA OF LAKE AT ELEVATION 52.0 = 9.70 ACRES
STORAGE IN LAKE = [(7.72 + 9.70)/2](2) = 17.42 AC·FT ∴ STORAGE IN EXCESS OF 10-YR. STORM
EXCESS VOLUME OF 500 YEAR STORM = 58.42 AC·FT − 17.42 AC·FT = 41.0 AC·FT

SURFACE AREA OF LAKE AT ELEVATION 53.0 = 11.05 ACRES
STORAGE IN LAKE = 17.42 AC·FT + [(9.70 + 11.05)/2](1) = 27.80 AC·FT ∴ STORAGE IN EXCESS OF 100-YEAR STORM
EXCESS VOLUME OF 500 YEAR STORM = 58.42 AC·FT − 27.80 AC·FT = 30.62 AC·FT

## PRINCIPAL SPILLWAY DESIGN

DESIGN PRINCIPAL SPILLWAY TO RETAIN/PASS 100-YEAR EVENT, EMERGENCY SPILLWAY TO BE UTILIZED ONLY FOR 100 YEAR+ STORM.

→ TRY 15" RCP CLASS III BARREL SECTION, 48" MANHOLE, AND AN ANTI-VORTEX COLLAR ON THE TOP OF MANHOLE

### GIVEN

INVERT OUT (15" RCP) FROM PRINCIPAL SPILLWAY DROP INLET STRUCTURE = 39.00
INVERT IN (ANTI-VORTEX COLLAR) = 50.0 (NORMAL POOL OF LAKE)
IGNORE ADDITIONAL HEAD FROM STORAGE OF WATER IN LAKE
LENGTH OF OUTLET PIPE = 230' SLOPE OF OUTLET PIPE = 1.34%
ELEVATION OF TAILWATER AT OUTLET = 37.16 (DRAINAGE STRUCTURE − 16)

CALCULATE VELOCITY OF FLOW IN 15" RCP (ASSUME MANHOLE IS FULL OF WATER TO NORMAL POOL OF POND; I.E. HEAD = 12.84' SUBMERGED INLET/SUBMERGED OUTLET

$$V^{*} = \sqrt{\frac{h}{\frac{1+K_e}{2g} + \frac{n^2 L}{(2.21)(r_H)^{4/3}}}}$$

WHERE
$h$ = HEAD ON OUTLET PIPE
$K_e$ = FRICTION LOSS COEFFICIENT (OPENING)
$g$ = ACCELERATION OF GRAVITY
$n$ = ROUGHNESS COEFFICIENT (PIPE)
$r_H$ = WETTED PERIMETER (DIA. OF PIPE)
$L$ = BARREL LENGTH

* EQUATION 21-73b PER STANDARD HANDBOOK FOR CIVIL ENGINEERS. SEE ATTACHED XEROX COPIES.

$$V = \sqrt{\frac{12.84}{\frac{1+0.56^{(2)}}{2(32.2)} + \frac{(0.012)^2\, 230^{(1)}}{(2.21)(1.25/4)^{4/3}}}} = 11.69 \text{ FPS}$$

$Q = V \cdot A = (11.69)(\pi)(0.625)^2 = 14.35$ CFS OR 28.45 AC·FT/DAY WHICH IS JUST 7% LESS THAN THE EXCESS VOLUME OF THE 500-YEAR EVENT! ONLY 7% OF THE 500 YEAR STORM PASSES THROUGH THE EMERGENCY SPILLWAY. THE REMAINDER IS RETAINED ABOVE DAM #2 AND SLOWLY RELEASED DOWNSTREAM.

TO PASS 14.35 CFS HOWEVER, THE MANHOLE MUST BE FULL OF WATER. THE MANHOLE WILL BECOME FULL AT SOME TIME AFTER THE ANTI-VORTEX COLLAR PERMITS MORE THAN 14.35 CFS INTO MANHOLE. ONCE THE MANHOLE IS FULL, THEN THE ANTI-VORTEX COLLAR (A.V.C) WILL PASS INTO THE MANHOLE WHAT THE BARREL IS DISCHARGING INTO DS-16. AFTER THE LAKE ELEVATION DROPS BELOW THE ELEVATION NECESSARY FOR THE A.V.C. TO PASS 14.35 CFS, THE DISCHARGE OUT OF THE BARREL WILL BEGIN TO DECREASE.

DETERMINE DEPTH NECESSARY FOR A.V.C. TO PASS 14.35 CFS. USE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK PLATE 1.26h TO DETERMINE DEPTH.

AT 14.35 CFS, HEAD FROM CREST OF RISER = 0.53' (WEIR FLOW) THEREFORE, AS THE DEPTH OF WATER IN THE LAKE INCREASES FROM NORMAL POOL @ ELEVATION 50.0 TO APPROXIMATELY 50.55, THE MANHOLE WILL FILL WITH WATER. AS THE LAKE LEVEL APPROACHES ELEVATION 50.55, THE OUTLET PIPE FLOW WILL INCREASE TO 14.35 CFS.

- DETERMINE EXCESS CAPACITY OF LAKE FOR 100 YEAR STORM

  FROM PAGE 1, $V_{100}$ = 23.90 AC·FT

  VOLUME OF LAKE TO EMERGENCY SPILLWAY (ELEV 53.0) = 27.80 AC·FT

  EXCESS VOLUME = 27.80 - 23.90 = 3.90 AC·FT OF EXCESS STORAGE OR LAKE STORAGE IS 116% OF 100 YEAR STORM. CONSEQUENTLY, UNLESS THE PRINCIPAL SPILLWAY MALFUNCTIONS, THE EMERGENCY SPILLWAY WILL NOT BE USED FOR THE 100 YEAR STORM EVENT.

## EMERGENCY SPILLWAY

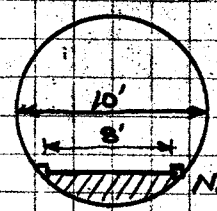
SPILLWAY INVERT = 53.0 TOP OF DAM = 54.98

CALCULATE FLOW THROUGH WEIR @ CONTROL SECTION - 20' WIDE, 1.5' DEEP

FOR BROAD CRESTED WEIR, $Q = 2.67(L)(H)^{3/2}$

$$Q = (2.67)(20)(1.5)^{3/2} = 98.1 \text{ CFS}$$

CHECK GOLF CART TUNNEL BEING USED AS PART OF EMERGENCY SPILLWAY FOR PIPE FLOW ADEQUACY. PIPE IS BASICALLY A PAVED DITCH ABOUT 8' WIDE - SEE SKETCHES BELOW

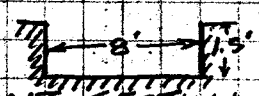



N.T.S.

60' LONG GOLF CART TUNNEL

INV IN 52.60 INV OUT 52.00

SLOPE = 1.00%




ASSUMED EQUIVALENT SECTION

@ DEPTH = 1.5'

$A = (8)(1.5) = 12$

$T = 8 + 1.5 + 1.5 = 11$

$R = A/T = 12/11 = 1.09$

$V = 1.486(1.09)^{2/3}(0.01)^{1/2}(0.015)^{-1} = 10.49$ FPS

$Q = V \cdot A = 125.9$ CFS THEREFORE GOLF CART TUNNEL IS ADEQUATE

EMERGENCY SPILLWAY FROM GOLF CART TUNNEL TO DRAINAGE STRUCTURE 16 WILL BE AN EIGHT FOOT WIDE ASPHALT PAVED CHANNEL. AVERAGE SLOPE ON THIS CHANNEL IS 4.33%. SIDE SLOPES ARE 3:1, GRASS-LINED. USE COMPOSITE n FACTOR OF $\frac{(8)(0.15)+(6)(0.50)}{14} = 4.2/14 = 0.30$ ASSUMES APPROX. DEPTH OF 1.0'.

$A = (8)(1) + \frac{1}{2}(2)(3)(1) = 11$

$T = 8 + (2)(3) = 14$

$R = A/T = 11/14 = 0.786$

$V = 1.486(0.786)^{2/3}(0.0433)^{1/2}(0.03)^{-1} = 8.78$ FPS

$Q = V \cdot A = (8.78)(11) = 96.6$ CFS $\approx Q_{WEIR}$ FLOW IN EMERGENCY SPILLWAY CHANNEL IS APPROXIMATELY 1' DEEP. LINE EACH SIDE OF GOLF CART PATH WITH 4' OF MIRAMAT EROSION CONTROL FABRIC.

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# DRAINAGE BASIN STORM FLOW CALCULATION USING TR-55 METHOD (TABULAR)

FIND: PEAK DISCHARGE FOR 10-YEAR STORM AND 100-YEAR STORM EVENTS USING TR-55 METHOD.

1. DRAINAGE AREA = 152.39 ACRES
   CHANNEL LENGTH = 3900 FEET SLOPE ON CHANNEL = 1.54%
   AVERAGE SLOPE FOR SURROUNDING BASIN = 5%

2. CN (RUNOFF CURVE NUMBERS) USING TABLE 5-3 50% B, 50% C

| | | | |
|---|---|---|---|
| 1/2 ACRE RESIDENTIAL LOTS | 84.99 Ac | CN = 75 | 6374.25 |
| GOLF COURSE | 50.88 Ac | CN = 67.5 | 3,434.40 |
| GOLF MAIN. / PUBLIC SERVICE | 7.89 Ac | CN = 89.5 | 706.16 |
| PONDS/LAKES | 8.63 Ac | CN = 98.0 | + 845.74 |
| | | | 11,360.55/152.39 = 74.5 |

USE WEIGHTED CN VALUE OF 75.

3. DETERMINE RUNOFF DEPTH AND VOLUME
   - 10 YEAR 24 hr. RAINFALL = 5.8 INCHES PLATE 5-10 UPPER
     RUNOFF DEPTH = 2.95 INCHES PLATE 5-12
     RUNOFF VOLUME$_{10}$ = (152.39)(2.95/12 IN/FT) = 37.47 AC·FT
   - 100 YEAR 24 hr. RAINFALL = 8.0 INCHES PLATE 5-11 LOWER
     RUNOFF DEPTH = 5.00 INCHES PLATE 5-12
     RUNOFF VOLUME$_{100}$ = (152.39)(5.00 INCHES/12 IN/FT) = 63.50 AC·FT

4. DETERMINE PEAK DISCHARGE RATE ADJUSTED FOR WATERSHED SHAPE.
   a. EQUIVALENT DRAINAGE AREA = 135 ACRES PLATE 5-8
   b. EQUIVALENT PEAK DISCHARGE$_{10}$ = 71 CFS/INCH × 2.95 IN. = 209.45 CFS
      EQ. PEAK DISCHARGE$_{100}$ = 71 CFS/INCH × 5.00 IN. = 355.00 CFS
      (FROM PLATE 5-14 GIVEN 5% MODERATE SLOPES AND CN = 75)
   c. ACTUAL PEAK DISCHARGE$_{10}$ = $Q_{10}$ = $209.45 \times \left(\frac{152.39}{135.0}\right) = \underline{236.43 \text{ CFS}}$

      ACTUAL PEAK DISCHARGE$_{100}$ = $Q_{100}$ = $355.00 \times \left(\frac{152.39}{135.0}\right) = \underline{400.73 \text{ CFS}}$

D.A. = 152.39/640 = 0.238 MI.² RUNOFF DEPTH = 2.95

Table 5-13 10 YEAR STORM EVENT

Source: USDA-SCS

TIME OF CONCENTRATION = 0.5 HOURS

| Tt | Hydrograph Time in Hours | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11.0 | 11.5 | 11.7 | 11.8 | 11.9 | 12.0 | 12.1 | 12.2 | 12.3 | 12.4 | 12.5 | 12.6 | 12.7 | 12.8 | 12.9 | 13.0 | 13.2 | 13.5 | 14.0 | 14.5 | 15.0 | 16.0 | 18.0 | 20.0 |
| 0 | 13 ~~18~~ | 25 ~~36~~ | 56 ~~88~~ | 117 ~~166~~ | 211 ~~287~~ | 304 ~~433~~ | 348 ~~496~~ | 333 ~~474~~ | 277 ~~395~~ | 217 ~~309~~ | 170 ~~242~~ | 136 ~~194~~ | 111 ~~158~~ | 91 ~~130~~ | 77 ~~109~~ | 66 ~~94~~ | 53 ~~75~~ | 40 ~~57~~ | 30 ~~43~~ | 25 ~~36~~ | 22 ~~31~~ | 18 ~~25~~ | 13 ~~18~~ | 11 ~~15~~ |
| 0.25 | 15 | 26 | 37 | 52 | 94 | 172 | 277 | 372 | 425 | 424 | 383 | 326 | 270 | 221 | 182 | 150 | 107 | 73 | 49 | 39 | 33 | 26 | 19 | 15 |
| 0.50 | 12 | 20 | 25 | 30 | 38 | 58 | 101 | 169 | 252 | 327 | 374 | 385 | 366 | 329 | 285 | 241 | 169 | 103 | 59 | 44 | 36 | 27 | 19 | 15 |
| 0.75 | 9 | 15 | 19 | 22 | 25 | 30 | 41 | 63 | 103 | 162 | 229 | 292 | 335 | 354 | 348 | 325 | 255 | 157 | 77 | 50 | 39 | 29 | 20 | 16 |
| 1.00 | 7 | 12 | 15 | 17 | 19 | 21 | 25 | 31 | 43 | 66 | 103 | 153 | 210 | 264 | 304 | 327 | 317 | 231 | 109 | 61 | 44 | 31 | 21 | 16 |
| 1.50 | 5 | 8 | 9 | 10 | 11 | 12 | 14 | 15 | 17 | 20 | 24 | 31 | 43 | 63 | 92 | 129 | 214 | 295 | 224 | 115 | 65 | 36 | 23 | 17 |
| 2.00 | 3 | 5 | 6 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 19 | 23 | 30 | 58 | 143 | 271 | 216 | 120 | 46 | 25 | 18 |
| 2.50 | 1 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 18 | 39 | 150 | 253 | 209 | 71 | 28 | 19 |
| 3.00 | 0 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 10 | 15 | 48 | 154 | 239 | 126 | 32 | 21 |
| 3.50 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 8 | 16 | 56 | 155 | 227 | 38 | 23 |
| 4.00 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 5 | 9 | 19 | 63 | 217 | 52 | 25 |

TIME OF CONCENTRATION = 0.75

| Tt | Hydrograph Time in Hours | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11.0 | 11.5 | 11.7 | 11.8 | 11.9 | 12.0 | 12.1 | 12.2 | 12.3 | 12.4 | 12.5 | 12.6 | 12.7 | 12.8 | 12.9 | 13.0 | 13.2 | 13.5 | 14.0 | 14.5 | 15.0 | 16.0 | 18.0 | 20.0 |
| 0 | 15 | 29 | 57 | 98 | 163 | 248 | 329 | 375 | 388 | 369 | 325 | 276 | 232 | 195 | 165 | 142 | 107 | 76 | 51 | 39 | 33 | 26 | 19 | 15 |
| 0.25 | 12 | 21 | 29 | 39 | 61 | 100 | 158 | 227 | 291 | 336 | 355 | 348 | 321 | 285 | 247 | 212 | 156 | 103 | 62 | 44 | 36 | 27 | 19 | 15 |
| 0.50 | 10 | 16 | 21 | 24 | 29 | 41 | 63 | 100 | 150 | 208 | 263 | 305 | 327 | 329 | 314 | 288 | 226 | 147 | 79 | 52 | 40 | 29 | 20 | 16 |
| 0.75 | 8 | 13 | 16 | 18 | 20 | 24 | 30 | 43 | 65 | 98 | 142 | 192 | 239 | 278 | 303 | 311 | 286 | 208 | 107 | 63 | 45 | 31 | 21 | 16 |
| 1.00 | 6 | 10 | 13 | 14 | 15 | 17 | 20 | 24 | 31 | 44 | 65 | 95 | 134 | 177 | 220 | 256 | 294 | 264 | 149 | 81 | 53 | 33 | 21 | 16 |
| 1.50 | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 19 | 23 | 31 | 42 | 60 | 83 | 147 | 269 | 248 | 152 | 85 | 40 | 23 | 17 |
| 2.00 | 2 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 16 | 18 | 23 | 39 | 97 | 251 | 235 | 153 | 56 | 26 | 19 |
| 2.50 | 1 | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 1 | 6 | 7 | 7 | 8 | 9 | 10 | 11 | 15 | 28 | 107 | 218 | 236 | 91 | 29 | 20 |
| 3.00 | 0 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 | 8 | 12 | 33 | 113 | 225 | 153 | 34 | 22 |
| 3.50 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 5 | 7 | 13 | 39 | 117 | 215 | 44 | 24 |
| 4.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 4 | 7 | 15 | 45 | 207 | 63 | 26 |

D.A. = 152.39/640 = 0.238 MI.²

Table 5-13 100 YEAR STORM EVENT

Source: USDA-SCS

TIME OF CONCENTRATION = 0.5 HOURS

Hydrograph Time in Hours

| Tt | 11.0 | 11.5 | 11.7 | 11.8 | 11.9 | 12.0 | 12.1 | 12.2 | 12.3 | 12.4 | 12.5 | 12.6 | 12.7 | 12.8 | 12.9 | 13.0 | 13.2 | 13.5 | 14.0 | 14.5 | 15.0 | 16.0 | 18.0 | 20.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 18 | 36 | 80 | 166 | 301 | 433 | 496 | 474 | 395 | 309 | 242 | 194 | 158 | 130 | 109 | 94 | 75 | 57 | 43 | 36 | 31 | 25 | 18 | 15 |
| 0.25 | 15 | 26 | 37 | 52 | 94 | 172 | 277 | 372 | 425 | 424 | 383 | 326 | 270 | 221 | 182 | 150 | 107 | 73 | 49 | 39 | 33 | 26 | 19 | 15 |
| 0.50 | 12 | 20 | 25 | 30 | 38 | 58 | 101 | 169 | 252 | 327 | 374 | 385 | 366 | 329 | 285 | 241 | 169 | 103 | 59 | 44 | 36 | 27 | 19 | 15 |
| 0.75 | 9 | 15 | 19 | 22 | 25 | 30 | 41 | 63 | 103 | 162 | 229 | 292 | 335 | 354 | 348 | 325 | 255 | 157 | 77 | 50 | 39 | 29 | 20 | 16 |
| 1.00 | 7 | 12 | 15 | 17 | 19 | 21 | 25 | 31 | 43 | 66 | 103 | 153 | 210 | 264 | 304 | 327 | 317 | 231 | 109 | 61 | 44 | 31 | 21 | 16 |
| 1.50 | 5 | 8 | 9 | 10 | 11 | 12 | 14 | 15 | 17 | 20 | 24 | 31 | 43 | 63 | 92 | 129 | 214 | 295 | 224 | 115 | 65 | 36 | 23 | 17 |
| 2.00 | 3 | 5 | 6 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 19 | 23 | 30 | 58 | 143 | 271 | 216 | 120 | 46 | 25 | 18 |
| 2.50 | 1 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 18 | 39 | 150 | 253 | 209 | 71 | 28 | 19 |
| 3.00 | 0 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 10 | 15 | 48 | 154 | 239 | 126 | 32 | 21 |
| 3.50 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 8 | 16 | 56 | 155 | 227 | 38 | 23 |
| 4.00 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 5 | 9 | 19 | 63 | 217 | 52 | 25 |

TIME OF CONCENTRATION = 0.75

Hydrograph Time in Hours

| Tt | 11.0 | 11.5 | 11.7 | 11.8 | 11.9 | 12.0 | 12.1 | 12.2 | 12.3 | 12.4 | 12.5 | 12.6 | 12.7 | 12.8 | 12.9 | 13.0 | 13.2 | 13.5 | 14.0 | 14.5 | 15.0 | 16.0 | 18.0 | 20.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 15 | 29 | 57 | 98 | 163 | 248 | 329 | 375 | 388 | 369 | 325 | 276 | 232 | 195 | 165 | 142 | 107 | 76 | 51 | 39 | 33 | 26 | 19 | 15 |
| 0.25 | 12 | 21 | 29 | 39 | 61 | 100 | 158 | 227 | 291 | 336 | 355 | 348 | 321 | 285 | 247 | 212 | 156 | 103 | 62 | 44 | 36 | 27 | 19 | 15 |
| 0.50 | 10 | 16 | 21 | 24 | 29 | 41 | 63 | 100 | 150 | 208 | 263 | 305 | 327 | 329 | 314 | 288 | 226 | 147 | 79 | 52 | 40 | 29 | 20 | 16 |
| 0.75 | 8 | 13 | 16 | 18 | 20 | 24 | 30 | 43 | 65 | 98 | 142 | 192 | 239 | 278 | 303 | 311 | 286 | 208 | 107 | 63 | 45 | 31 | 21 | 16 |
| 1.00 | 6 | 10 | 13 | 14 | 15 | 17 | 20 | 24 | 31 | 44 | 65 | 95 | 134 | 177 | 220 | 256 | 294 | 264 | 149 | 81 | 53 | 33 | 21 | 16 |
| 1.50 | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 19 | 23 | 31 | 42 | 60 | 83 | 147 | 269 | 248 | 152 | 85 | 40 | 23 | 17 |
| 2.00 | 2 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 16 | 18 | 23 | 39 | 97 | 251 | 235 | 153 | 56 | 26 | 19 |
| 2.50 | 1 | 2 | 3 | 3 | 4 | 4 | 4 | 5 | 1 | 6 | 7 | 7 | 8 | 9 | 10 | 11 | 15 | 28 | 107 | 218 | 236 | 91 | 29 | 20 |
| 3.00 | 0 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 | 8 | 12 | 33 | 113 | 225 | 153 | 34 | 22 |
| 3.50 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 5 | 7 | 13 | 39 | 117 | 215 | 44 | 24 |
| 4.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 4 | 7 | 15 | 45 | 207 | 63 | 26 |

# Pond @ Dam No. 2

Water Surface Areas:

| | | |
|---|---|---|
| Upper: | NP = 3.3 Ac | HW = 4.7 Ac |
| Lower: | = 4.7 Ac | = 6.9 Ac |
| Total | = 8 Ac | = 11.6 Ac |

Inflow From:

Line B, Line D, Line E
Culverts GC-1, GC-2, GC-3, GC-4
Dam No 6 Discharge
Sheet Flow

Route incoming Flow with allowable Water Rise of 3.0 ft (100 yr Storm) with minimal Discharge

| | CA | |
|---|---|---|
| LINE B | 5.08 | |
| LINE D | 7.70 | |
| LINE E | 14.21 | |
| GC-2 | .49 | |
| GC-3 | 1.155 | |
| GC-4 | 0.56 | |
| DAM No 6 | 3.675 | ASSUMES NO DETENTION |
| SHEET FLOW | 20.361 | (C=.33) |
| TOTAL | 53.231 | |

SATURATION FACTOR $C_f = 1.25$ FOR 100 YR ST.

$\therefore$ $CAC_f = 66.5388$ SAY

$\underline{\underline{66.54}}$

ASSUME 20 MIN $T_c$ $\therefore$ $I = 6.5$ IN/HR

PEAK INFLOW $\approx 66.54 \times 6.5 =$

432.51 CFS

SAY

430 CFS

# Flood Routing @ Dam No 2

| ΔH (to Rise) | Avg Pond Area | Detained Vol | Discharged Vol | Storm Vol | Time T |
|---|---|---|---|---|---|
| 0.1 | 8.06 | 35,110 | 275 | 36,288 | 7.50 |
| 0.2 | 8.18 | 71,265 | 1098 | 71,111 | 10.50 |
| 0.3 | 8.30 | 108,465 | 2593 | 113,240 | 13.25 |
| 0.4 | 8.42 | 146,710 | 4508 | 150,003 | 15.25 |
| 0.5 | 8.54 | | | | |
| 0.6 | 8.66 | | | | |
| 0.7 | 8.78 | | | | |
| 0.8 | 8.90 | | | | |
| 0.9 | 9.02 | | | | |
| 1.0 | 9.14 | | | | |
| 1.1 | 9.26 | | | | |
| 1.2 | 9.38 | | | | |
| 1.3 | 9.50 | | | | |
| 1.4 | 9.62 | | | | |
| 1.5 | 9.74 | | | | |
| 1.6 | 9.86 | 687,200 | | | |
| 1.7 | 9.98 | 739,040 | | | |
| 1.8 | 10.10 | 791,920 | | | |
| 1.9 | 10.22 | | | | |
| 2.0 | 10.34 | | | | |

LET CONTROL

WEIR FLOW eq = $Q_w = 9.739\, D_e H^{3/2}$, $D_e$ & H in ft.

$Q_w = (9.739)\,4\,(H)^{3/2}$

$Q_w = 38.956\,(H)^{3/2}$

@ MAX PIPE FLOW (MANNINGS) OF 11.4 cfs → $H = .4408$

∴ DISCHARGE PLOT CONTROLLED BY WEIR EQ TO $\Delta H = .5'$

OTHER EQS.:

$V_{IN} = V_{OUT} + V_{DET.}$

$Q_{IN} = 21.5\,T$ (0 → 20 min only)

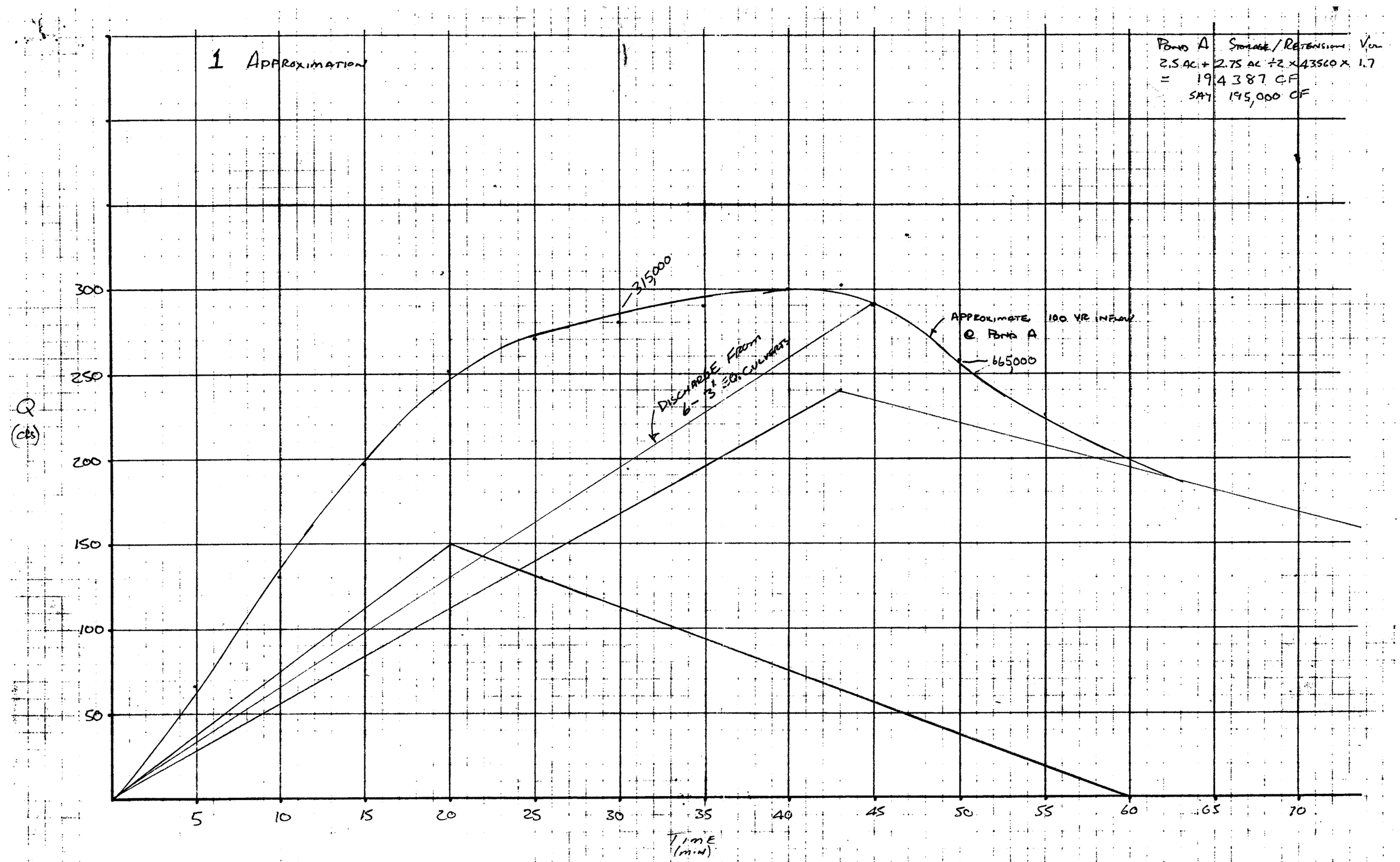
$V_{IN} = \frac{1}{2} Q_{IN}\, T$ (0 → 20 min only)

$V_{IN} = 0.1792\,T^2$ (T in sec)

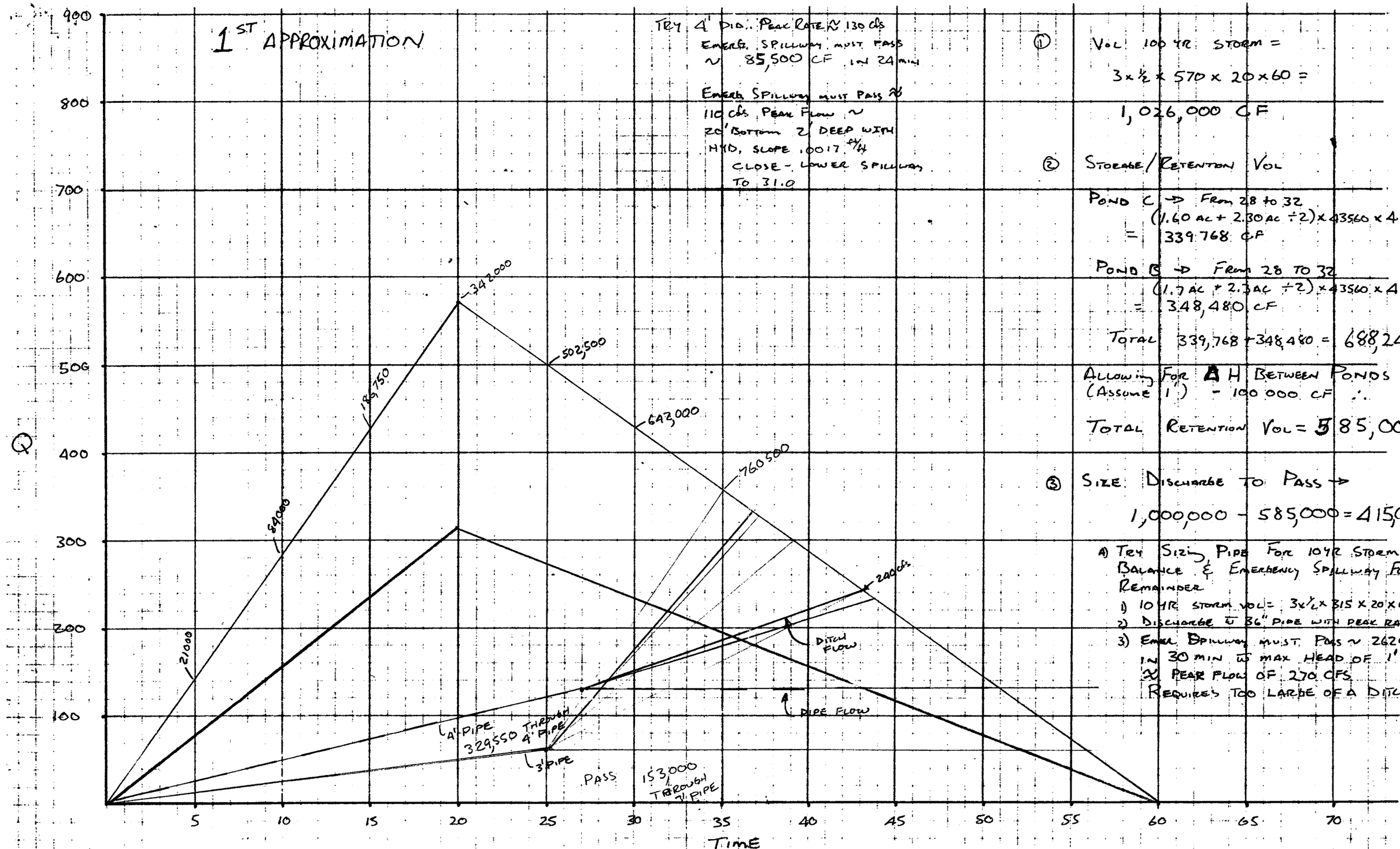
$V_{OUT} \approx \frac{1}{2} Q_w T$ (0 → .4' only)

$V_{OUT} \approx 19.478 (H)^{3/2} T$ (0 → .4' only)

$V_{DET} \approx 0.1792\,T^2 - 19.478 (H)^{3/2}\, T$ (0 → .4' only)


1 APPROXIMATION
POND A STORAGE/RETENSION Vcu
2.5 AC + 2.75 AC ÷ 2 × 43560 × 1.7
= 194387 CF
SAY 195,000 CF
315000
APPROXIMATE 100 YR INFLOW @ POND A
665000
DISCHARGE FROM 6-3' ⌀ CULVERTS
Q (cfs)
300
250
200
150
100
50
5
10
15
20
25
30
35
40
45
50
55
60
65
70
TIME (min)

POND A




TRY 4' DIA.. PEAK RATE ≈ 130 cfs
EMERG. SPILLWAY MUST PASS
~ 85,500 CF IN 24 min

EMERG. SPILLWAY MUST PASS ≈
110 cfs PEAK FLOW ~
20' BOTTOM 2' DEEP WITH
HYD. SLOPE .0017 ft/ft
CLOSE - LOWER SPILLWAY
TO 31.0

① VOL 100 YR STORM =
$3 \times \frac{1}{2} \times 570 \times 20 \times 60 =$
1,026,000 CF

② STORAGE/RETENTION VOL

POND C → FROM 28 to 32
$(1.60\text{ AC} + 2.30\text{ AC} \div 2) \times 43560 \times 4$
= 339,768 CF

POND B → FROM 28 TO 32
$(1.7\text{ AC} + 2.3\text{ AC} \div 2) \times 43560 \times 4$
= 348,480 CF

TOTAL 339,768 + 348,480 = 688,248

ALLOWING FOR Δ H BETWEEN PONDS
(ASSUME 1') - 100 000 CF ∴

TOTAL RETENTION VOL = 585,000 CF

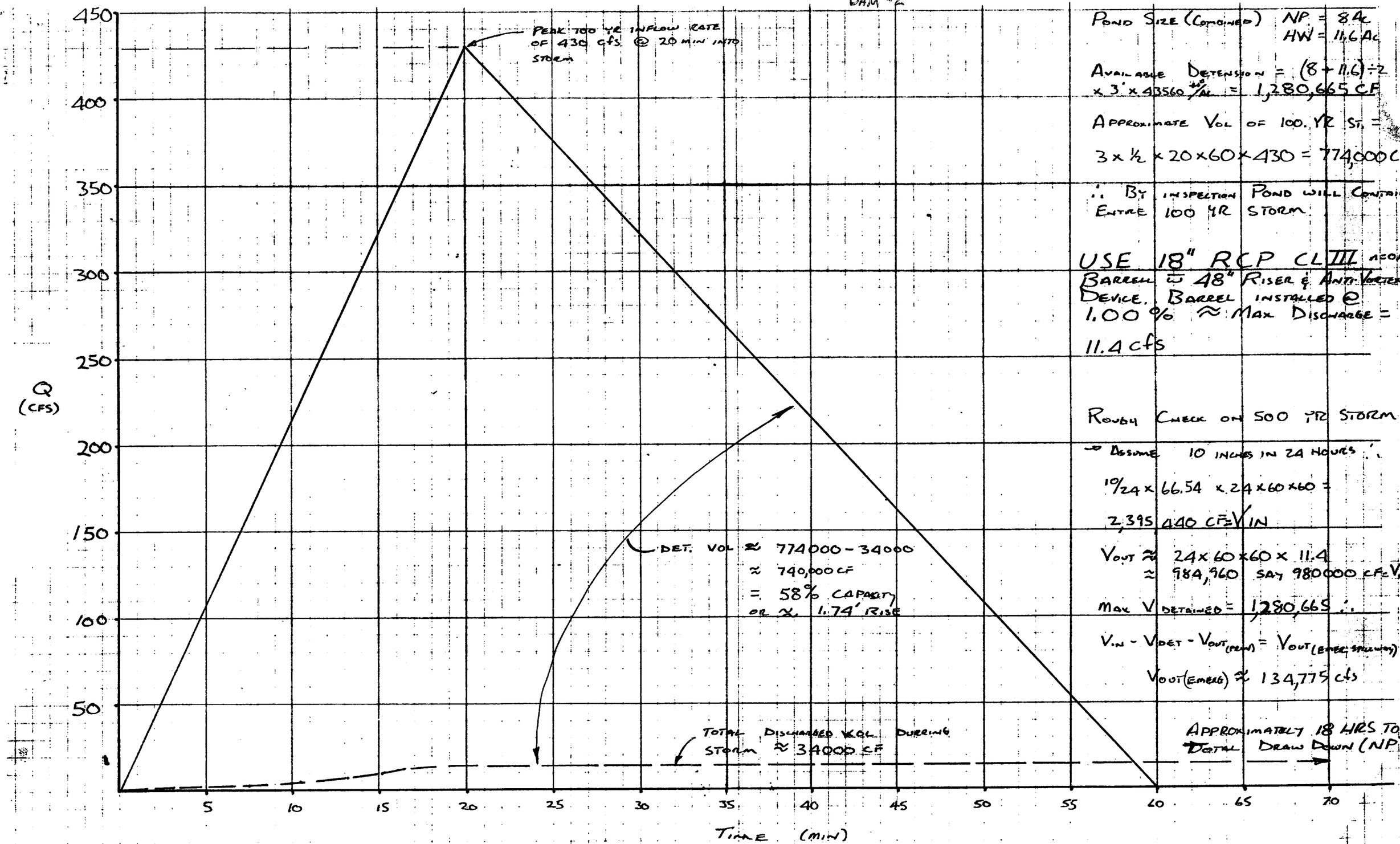
③ SIZE DISCHARGE TO PASS →

1,000,000 − 585,000 = 415,000 CF

A) TRY SIZING PIPE FOR 10 YR STORM
BALANCE & EMERGENCY SPILLWAY FOR
REMAINDER
1) 10 YR STORM VOL = $3 \times \frac{1}{2} \times 315 \times 20 \times 60 = 567,000$
2) DISCHARGE W/ 36" PIPE WITH PEAK RATE ≈ 600 cfs
3) EMER. SPILLWAY MUST PASS ~ 262000 CF
IN 30 MIN W/ MAX HEAD OF 1'
≈ PEAK FLOW OF 270 CFS
REQUIRES TOO LARGE OF A DITCH

PONDS B & C

DAM #2




POND SIZE (COMBINED) NP = 8 Ac
HW = 11.6 Ac

AVAILABLE DETENSION = (8 + 11.6) ÷ 2 × 3' × 43560 ft²/Ac = 1,280,665 CF

APPROXIMATE VOL OF 100. YR ST. =

3 × ½ × 20 × 60 × 430 = 774,000 CF

∴ BY INSPECTION POND WILL CONTAIN ENTIRE 100 YR STORM

USE 18" RCP CL III n=0.012 BARREL ≈ 48" RISER & ANTI-VORTEX DEVICE. BARREL INSTALLED @ 1.00 % ≈ MAX DISCHARGE = 11.4 cfs

ROUGH CHECK ON 500 YR STORM

→ ASSUME 10 INCHES IN 24 HOURS ∴

10/24 × 66.54 × 24 × 60 × 60 =

2,395,440 CF = $V_{IN}$

$V_{OUT}$ ≈ 24 × 60 × 60 × 11.4
≈ 984,960 SAY 980000 CF = $V_{OUT}$

MAX V DETAINED = 1,280,665 ∴

$V_{IN} - V_{DET} - V_{OUT(PIPE)} = V_{OUT(EMERG\ SPILLWAY)}$

$V_{OUT(EMERG)}$ ≈ 134,775 cfs

**Drainage Calculations for Section 8 & 8B**

Ford's Colony

Williamsburg, Va.

Submitted by : AES Consulting Engineers
5248 Olde Towne Rd.
Williamsburg, Va. 23188

(757) 253 0040

March 16, 1999

5-5-99
SECTIONS 8 & 8B

# Hydraflow Storm Sewer Tabulation

SYSTEM "A"



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | | Incr | Total | | Incr | Total | Inlet | Syst | | | | | Size | Slope | Up | Dn | Up | Dn | Up | Dn | |
| | | (ft) | (ac) | (ac) | (C) | | | (min) | (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | (in) | (%) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | |
| 1 | End | 99.0 | 0.00 | 1.17 | 0.00 | 0.00 | 0.64 | 0.0 | 21.2 | 3.9 | 2.45 | 10.76 | 2.00 | 15 | 2.78 | 52.00 | 49.25 | 54.64 | 54.50 | 56.00 | 50.75 | SS#8B-A-2 TO |
| 2 | 1 | 106.0 | 0.18 | 1.17 | 0.62 | 0.11 | 0.64 | 15.0 | 20.6 | 3.9 | 2.48 | 23.60 | 3.01 | 15 | 13.36 | 66.16 | 52.00 | 66.79 | 54.65 | 70.33 | 56.00 | SS#8B-A-3 TO |
| 3 | 2 | 25.0 | 0.34 | 0.99 | 0.58 | 0.20 | 0.52 | 15.0 | 20.5 | 3.9 | 2.05 | 6.46 | 1.80 | 15 | 1.00 | 66.41 | 66.16 | 67.42 | 67.41 | 70.33 | 70.33 | SS#8B-A-4 TO |
| 4 | 3 | 65.0 | 0.09 | 0.65 | 0.53 | 0.05 | 0.33 | 10.0 | 20.1 | 3.9 | 1.29 | 11.77 | 2.13 | 15 | 3.32 | 68.57 | 66.41 | 69.03 | 67.66 | 72.74 | 70.33 | SS#8B-A-5 TO |
| 5 | 4 | 25.0 | 0.56 | 0.56 | 0.50 | 0.28 | 0.28 | 20.0 | 20.0 | 4.0 | 1.11 | 6.46 | 0.98 | 15 | 1.00 | 68.82 | 68.57 | 69.82 | 69.82 | 72.74 | 72.74 | SS#8B-A-6 TO |

Project File: LINEA.stm | I-D-F File: Jcc.IDF | Total number of lines: 5 | Run Date: 03-16-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.50 (ft)

SYSTEMS "B, F & G"

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 1 | End | 250.0 | 0.00 | 24.34 | 0.00 | 0.00 | 10.77 | 0.0 | 31.3 | 3.2 | 44.88 | 46.18 | 10.16 | 30 | 1.27 | 55.90 | 52.73 | 58.13 | 54.74 | 62.50 | 55.73 | SS#8B-B-1 TO |
| 2 | 1 | 205.0 | 0.23 | 2.05 | 0.69 | 0.16 | 1.12 | 10.0 | 16.3 | 4.3 | 4.87 | 17.30 | 4.61 | 15 | 7.18 | 70.62 | 55.90 | 71.50 | 59.60 | 74.79 | 62.50 | SS#8B-B-2 TO |
| 3 | 2 | 25.0 | 0.44 | 1.82 | 0.51 | 0.22 | 0.97 | 10.0 | 16.2 | 4.3 | 4.20 | 6.46 | 4.56 | 15 | 1.00 | 70.87 | 70.62 | 71.69 | 71.57 | 74.79 | 74.79 | SS#8B-B-3 TO |
| 4 | 3 | 95.0 | 0.62 | 1.38 | 0.51 | 0.32 | 0.74 | 13.0 | 15.6 | 4.4 | 3.27 | 10.29 | 3.79 | 15 | 2.54 | 73.28 | 70.87 | 74.00 | 71.86 | 77.20 | 74.79 | SS#8B-B-4 TO |
| 5 | 4 | 87.0 | 0.46 | 0.63 | 0.52 | 0.24 | 0.36 | 15.0 | 15.1 | 4.5 | 1.60 | 14.22 | 2.46 | 15 | 4.85 | 77.50 | 73.28 | 78.01 | 74.31 | 82.02 | 77.20 | SS#8B-B-5 TO |
| 6 | 5 | 25.0 | 0.17 | 0.17 | 0.70 | 0.12 | 0.12 | 15.0 | 15.0 | 4.5 | 0.53 | 10.00 | 1.61 | 15 | 2.40 | 78.10 | 77.50 | 78.39 | 78.19 | 82.02 | 82.02 | SS#8B-B-6 TO |
| 7 | 4 | 123.0 | 0.13 | 0.13 | 0.51 | 0.07 | 0.07 | 5.0 | 5.0 | 7.0 | 0.46 | 9.51 | 1.39 | 15 | 2.17 | 75.95 | 73.28 | 76.22 | 74.31 | 79.87 | 77.20 | SS#8B-B-7 TO |
| 8 | 1 | 184.0 | 3.10 | 22.29 | 0.40 | 1.24 | 9.65 | 20.0 | 30.3 | 3.3 | 41.71 | 47.13 | 8.50 | 30 | 1.32 | 58.33 | 55.90 | 61.50 | 59.60 | 63.92 | 62.50 | DI-141 TO SS |
| 9 | 8 | 45.0 | 0.00 | 19.19 | 0.00 | 0.00 | 8.41 | 0.0 | 30.0 | 3.3 | 37.74 | 64.41 | 7.69 | 30 | 2.47 | 59.43 | 58.32 | 62.39 | 62.00 | 61.93 | 63.92 | TEE-146 TO D |
| 10 | 9 | 214.0 | 3.66 | 15.22 | 0.35 | 1.28 | 6.58 | 20.0 | 28.8 | 3.4 | 22.12 | 64.36 | 5.66 | 30 | 2.46 | 64.70 | 59.43 | 66.27 | 63.31 | 68.88 | 61.93 | DI-140 TO TE |
| 11 | 10 | 325.0 | 0.00 | 11.56 | 0.00 | 0.00 | 5.30 | 0.0 | 27.0 | 3.5 | 18.34 | 41.82 | 5.45 | 30 | 1.04 | 68.08 | 64.70 | 69.51 | 66.60 | 73.00 | 68.88 | SS#8B-F-1 TO |
| 12 | 11 | 34.0 | 2.27 | 9.12 | 0.40 | 0.91 | 3.95 | 20.0 | 24.3 | 3.6 | 14.32 | 22.95 | 4.69 | 24 | 1.03 | 68.43 | 68.08 | 70.22 | 70.13 | 74.11 | 73.00 | DI-139 TO SS |
| 13 | 12 | 149.0 | 1.77 | 6.85 | 0.40 | 0.71 | 3.04 | 20.0 | 23.5 | 3.7 | 11.20 | 32.78 | 4.67 | 24 | 2.10 | 71.56 | 68.43 | 72.75 | 70.49 | 75.98 | 74.11 | DI-138 TO DI |
| 14 | 13 | 168.0 | 1.78 | 5.08 | 0.40 | 0.71 | 2.33 | 20.0 | 22.5 | 3.8 | 8.75 | 14.61 | 5.59 | 18 | 1.93 | 74.81 | 71.56 | 75.94 | 72.98 | 78.29 | 75.98 | DI-137 TO DI |
| 15 | 14 | 154.0 | 0.48 | 3.30 | 0.42 | 0.20 | 1.62 | 15.0 | 21.7 | 3.8 | 6.18 | 16.45 | 4.63 | 18 | 2.45 | 78.59 | 74.81 | 79.54 | 76.03 | 83.64 | 78.29 | DI-136 TO DI |
| 16 | 15 | 54.0 | 0.69 | 2.82 | 0.40 | 0.28 | 1.42 | 15.0 | 21.4 | 3.8 | 5.44 | 19.75 | 4.63 | 18 | 3.54 | 80.50 | 78.59 | 81.39 | 79.60 | 83.50 | 83.64 | SS#8B-G-1 TO |
| 17 | 16 | 87.0 | 0.43 | 2.13 | 0.38 | 0.16 | 1.14 | 15.0 | 20.9 | 3.9 | 4.43 | 24.79 | 3.95 | 18 | 5.57 | 85.35 | 80.50 | 86.15 | 81.56 | 91.60 | 83.50 | SS#8B-G-2 TO |
| 18 | 17 | 79.0 | 0.14 | 1.70 | 0.70 | 0.10 | 0.98 | 10.0 | 20.5 | 3.9 | 3.83 | 7.47 | 3.41 | 18 | 0.51 | 85.75 | 85.35 | 86.55 | 86.43 | 92.50 | 91.60 | SS#8B-G-3 TO |
| 19 | 18 | 47.0 | 0.14 | 1.56 | 0.70 | 0.10 | 0.88 | 10.0 | 20.2 | 3.9 | 3.46 | 7.66 | 3.04 | 18 | 0.53 | 86.00 | 85.75 | 86.83 | 86.80 | 92.00 | 92.50 | SS#8B-G-4 TO |
| 20 | 19 | 35.0 | 1.42 | 1.42 | 0.55 | 0.78 | 0.78 | 20.0 | 20.0 | 4.0 | 3.09 | 46.49 | 3.23 | 18 | 19.60 | 92.86 | 86.00 | 93.53 | 87.02 | 94.36 | 92.00 | SS#8B-G-5 TO |
| 21 | 11 | 84.0 | 0.25 | 2.44 | 0.45 | 0.11 | 1.36 | 10.0 | 26.6 | 3.5 | 4.73 | 10.99 | 2.82 | 18 | 1.10 | 69.00 | 68.08 | 70.27 | 70.13 | 76.00 | 73.00 | SS#8B-F-2 TO |

Project File: WESTSYSTEM.stm | I-D-F File: Jcc.IDF | Total number of lines: 26 | Run Date: 03-04-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.74 (ft)

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | | Incr | Total | | Incr | Total | Inlet | Syst | | | | | Size | Slope | Up | Dn | Up | Dn | Up | Dn | |
| | | (ft) | (ac) | (ac) | (C) | | | (min) | (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | (in) | (%) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | |
| 22 | 21 | 142.0 | 0.10 | 2.19 | 0.70 | 0.07 | 1.24 | 10.0 | 25.8 | 3.5 | 4.40 | 27.87 | 3.65 | 18 | 7.04 | 79.00 | 69.00 | 79.80 | 70.29 | 83.25 | 76.00 | SS#8B-F-3 TO |
| 23 | 22 | 98.0 | 0.16 | 2.09 | 0.70 | 0.11 | 1.17 | 10.0 | 25.2 | 3.6 | 4.19 | 10.61 | 3.72 | 18 | 1.02 | 80.00 | 79.00 | 80.78 | 80.13 | 86.25 | 83.25 | SS#8B-F-4 TO |
| 24 | 23 | 40.0 | 1.93 | 1.93 | 0.55 | 1.06 | 1.06 | 25.0 | 25.0 | 3.6 | 3.80 | 46.37 | 3.55 | 18 | 19.50 | 87.80 | 80.00 | 88.54 | 81.10 | 89.30 | 86.25 | SS#8B-F-5 TO |
| 25 | 9 | 152.0 | 2.78 | 3.97 | 0.40 | 1.11 | 1.83 | 25.0 | 25.4 | 3.6 | 16.49 | 16.65 | 9.33 | 18 | 2.51 | 63.25 | 59.43 | 67.06 | 63.31 | 67.21 | 61.93 | DI-147 TO TE |
| 26 | 25 | 75.0 | 1.19 | 1.19 | 0.60 | 0.71 | 0.71 | 25.0 | 25.0 | 3.6 | 12.56 | 25.17 | 7.33 | 18 | 5.75 | 67.56 | 63.25 | 68.90 | 67.26 | 69.06 | 67.21 | CMP TO DI-14 |

Project File: WESTSYSTEM.stm | I-D-F File: Jcc.IDF | Total number of lines: 26 | Run Date: 03-04-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.74 (ft)

# Hydraflow Storm Sewer Tabulation

SYSTEMS "C,D&E"



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | | Incr | Total | | Incr | Total | Inlet | Syst | | | | | Size | Slope | Up | Dn | Up | Dn | Up | Dn | |
| | | (ft) | (ac) | (ac) | (C) | | | (min) | (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | (in) | (%) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | |
| 1 | End | 220.0 | 3.74 | 41.33 | 0.42 | 1.57 | 19.76 | 20.0 | 43.8 | 2.8 | 54.84 | 69.80 | 7.76 | 36 | 1.10 | 50.97 | 48.56 | 55.99 | 54.50 | 55.57 | 51.56 | DI-122 TO OU |
| 2 | 1 | 233.0 | 1.68 | 37.59 | 0.40 | 0.67 | 18.19 | 20.0 | 42.5 | 2.8 | 51.18 | 95.53 | 8.06 | 36 | 2.05 | 55.75 | 50.97 | 58.03 | 56.13 | 59.29 | 55.57 | DI-119 TO DI |
| 3 | 2 | 75.0 | 0.00 | 35.91 | 0.00 | 0.00 | 17.52 | 0.0 | 42.1 | 2.8 | 49.51 | 64.89 | 8.35 | 36 | 0.95 | 56.46 | 55.75 | 58.70 | 58.21 | 61.10 | 59.29 | C-STRADDLE T |
| 4 | 3 | 75.0 | 2.00 | 31.47 | 0.35 | 0.70 | 15.20 | 20.0 | 41.7 | 2.8 | 43.14 | 64.89 | 6.10 | 36 | 0.95 | 57.17 | 56.46 | 60.17 | 59.89 | 61.73 | 61.10 | DI-118 TO C- |
| 5 | 4 | 219.0 | 3.25 | 22.12 | 0.38 | 1.24 | 11.20 | 25.0 | 40.5 | 2.9 | 32.23 | 71.40 | 5.90 | 36 | 1.15 | 59.68 | 57.17 | 61.49 | 60.75 | 64.16 | 61.73 | DI-112 TO DI |
| 6 | 5 | 299.0 | 0.00 | 18.26 | 0.00 | 0.00 | 9.69 | 0.0 | 38.8 | 2.9 | 28.43 | 108.1 | 5.61 | 36 | 2.63 | 67.53 | 59.68 | 69.23 | 62.30 | 70.53 | 64.16 | TEE-107 TO D |
| 7 | 6 | 32.0 | 0.00 | 13.76 | 0.00 | 0.00 | 7.76 | 0.0 | 38.7 | 2.9 | 22.82 | 36.65 | 7.42 | 24 | 2.63 | 68.37 | 67.53 | 70.20 | 69.97 | 70.37 | 70.53 | TEE-111 TO T |
| 8 | 7 | 39.0 | 1.03 | 13.35 | 0.45 | 0.46 | 7.58 | 15.0 | 38.4 | 2.9 | 22.33 | 36.76 | 7.22 | 24 | 2.64 | 69.40 | 68.37 | 71.26 | 70.96 | 72.53 | 70.37 | DI-108 TO TE |
| 9 | 6 | 46.0 | 0.63 | 4.50 | 0.35 | 0.22 | 1.93 | 20.0 | 22.2 | 3.8 | 7.29 | 13.12 | 6.21 | 15 | 4.13 | 69.43 | 67.53 | 70.51 | 69.97 | 73.18 | 70.53 | DI-106 TO TE |
| 10 | 9 | 105.0 | 1.01 | 3.87 | 0.38 | 0.38 | 1.71 | 20.0 | 21.6 | 3.8 | 6.53 | 10.18 | 5.70 | 15 | 2.49 | 72.04 | 69.43 | 73.06 | 70.80 | 76.15 | 73.18 | DI-105 TO DI |
| 11 | 10 | 186.0 | 0.61 | 2.86 | 0.38 | 0.23 | 1.32 | 20.0 | 20.5 | 3.9 | 5.18 | 12.87 | 4.95 | 15 | 3.97 | 79.43 | 72.04 | 80.34 | 73.15 | 82.97 | 76.15 | DI-104 TO DI |
| 12 | 11 | 98.0 | 1.18 | 2.25 | 0.45 | 0.53 | 1.09 | 20.0 | 20.0 | 4.0 | 4.32 | 5.57 | 5.72 | 12 | 2.45 | 81.83 | 79.43 | 82.71 | 80.73 | 83.58 | 82.97 | DI-104 TO DI |
| 13 | 7 | 26.0 | 0.41 | 0.41 | 0.45 | 0.18 | 0.18 | 13.0 | 13.0 | 4.8 | 0.88 | 45.67 | 0.31 | 24 | 4.08 | 69.43 | 68.37 | 70.96 | 70.96 | 71.43 | 70.37 | DI-110 TO TE |
| 14 | 5 | 133.0 | 0.61 | 0.61 | 0.45 | 0.27 | 0.27 | 15.0 | 15.0 | 4.5 | 1.23 | 9.66 | 2.48 | 12 | 7.35 | 69.46 | 59.68 | 69.93 | 62.30 | 70.46 | 64.16 | CMP TO DI-11 |
| 15 | 4 | 176.0 | 0.35 | 7.35 | 0.70 | 0.24 | 3.30 | 15.0 | 37.5 | 3.0 | 9.83 | 47.12 | 4.31 | 24 | 4.34 | 64.81 | 57.17 | 65.92 | 60.75 | 69.50 | 61.73 | SS-1-6 TO DI |
| 16 | 15 | 195.0 | 0.00 | 7.00 | 0.00 | 0.00 | 3.05 | 0.0 | 36.4 | 3.0 | 9.22 | 21.67 | 6.37 | 18 | 4.26 | 73.30 | 65.00 | 74.46 | 66.13 | 82.75 | 69.50 | SS-1-7 TO SS |
| 17 | 16 | 197.0 | 1.00 | 7.00 | 0.65 | 0.65 | 3.05 | 25.0 | 35.3 | 3.1 | 9.35 | 14.96 | 5.81 | 18 | 2.03 | 77.40 | 73.40 | 78.57 | 74.98 | 81.46 | 82.75 | SS-1-9 TO SS |
| 18 | 17 | 50.0 | 6.00 | 6.00 | 0.40 | 2.40 | 2.40 | 35.0 | 35.0 | 3.1 | 7.38 | 10.50 | 4.23 | 18 | 1.00 | 78.00 | 77.50 | 79.41 | 79.19 | 81.46 | 81.46 | SS-1-10 TO S |
| 19 | 3 | 251.0 | 0.00 | 4.44 | 0.00 | 0.00 | 2.33 | 0.0 | 22.2 | 3.8 | 8.80 | 15.42 | 7.31 | 15 | 5.70 | 70.77 | 56.46 | 71.92 | 59.89 | 75.44 | 61.10 | SS#8B-C-1 TO |
| 20 | 19 | 65.0 | 0.08 | 2.17 | 0.70 | 0.06 | 1.12 | 5.0 | 21.4 | 3.8 | 4.32 | 9.87 | 4.25 | 15 | 2.34 | 72.29 | 70.77 | 73.12 | 72.78 | 77.06 | 75.44 | SS#8B-C-2 TO |
| 21 | 20 | 25.0 | 0.33 | 2.09 | 0.46 | 0.15 | 1.07 | 20.0 | 21.3 | 3.9 | 4.12 | 6.46 | 3.63 | 15 | 1.00 | 72.54 | 72.29 | 73.55 | 73.51 | 77.06 | 77.06 | SS#8B-C-3 TO |

Project File: LINECDE.stm | I-D-F File: Jcc.IDF | Total number of lines: 52 | Run Date: 03-15-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.50 (ft)

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 22 | 21 | 141.0 | 0.16 | 1.76 | 0.52 | 0.08 | 0.92 | 15.0 | 20.5 | 3.9 | 3.59 | 9.43 | 3.77 | 15 | 2.13 | 75.55 | 72.54 | 76.31 | 73.78 | 82.83 | 77.06 | SS#8B-C-4 TO |
| 23 | 22 | 85.0 | 0.40 | 1.16 | 0.50 | 0.20 | 0.64 | 20.0 | 20.0 | 4.0 | 2.52 | 14.13 | 3.12 | 15 | 4.79 | 79.62 | 75.55 | 80.25 | 76.64 | 84.14 | 82.83 | SS#8B-C-5 TO |
| 24 | 23 | 64.0 | 0.09 | 0.73 | 0.59 | 0.05 | 0.41 | 10.0 | 15.5 | 4.4 | 1.84 | 16.85 | 2.79 | 15 | 6.81 | 83.98 | 79.62 | 84.52 | 80.51 | 88.15 | 84.14 | SS#8B-C-6 TO |
| 25 | 24 | 88.0 | 0.22 | 0.34 | 0.53 | 0.12 | 0.19 | 15.0 | 15.0 | 4.5 | 0.86 | 17.87 | 2.02 | 15 | 7.66 | 90.72 | 83.98 | 91.09 | 84.67 | 94.64 | 88.15 | SS#8B-C-7 TO |
| 26 | 25 | 122.0 | 0.02 | 0.12 | 0.70 | 0.01 | 0.07 | 5.0 | 10.3 | 5.3 | 0.39 | 16.62 | 1.72 | 15 | 6.62 | 98.80 | 90.72 | 99.05 | 91.11 | 102.72 | 94.64 | SS#8B-C-8 TO |
| 27 | 26 | 46.0 | 0.10 | 0.10 | 0.60 | 0.06 | 0.06 | 10.0 | 10.0 | 5.3 | 0.32 | 19.86 | 1.74 | 15 | 9.46 | 103.15 | 98.80 | 103.38 | 99.11 | 107.07 | 102.72 | SS#8B-C-9 TO |
| 28 | 24 | 25.0 | 0.30 | 0.30 | 0.57 | 0.17 | 0.17 | 15.0 | 15.0 | 4.5 | 0.77 | 6.46 | 1.58 | 15 | 1.00 | 84.23 | 83.98 | 84.66 | 84.67 | 88.15 | 88.15 | SS#8B-C-10 T |
| 29 | 23 | 25.0 | 0.03 | 0.03 | 0.70 | 0.02 | 0.02 | 5.0 | 5.0 | 7.0 | 0.15 | 10.00 | 0.43 | 15 | 2.40 | 80.22 | 79.62 | 80.51 | 80.51 | 84.14 | 84.14 | SS#8B-C-11 T |
| 30 | 19 | 20.0 | 0.05 | 2.27 | 0.70 | 0.04 | 1.20 | 5.0 | 22.1 | 3.8 | 4.55 | 11.91 | 3.71 | 15 | 3.40 | 71.45 | 70.77 | 72.88 | 72.78 | 75.62 | 75.44 | SS#8B-C-12 T |
| 31 | 30 | 25.0 | 0.60 | 2.22 | 0.46 | 0.28 | 1.17 | 20.0 | 21.9 | 3.8 | 4.43 | 6.46 | 3.61 | 15 | 1.00 | 71.70 | 71.45 | 73.16 | 73.04 | 75.62 | 75.62 | SS#8B-C-13 T |
| 32 | 31 | 45.0 | 0.21 | 1.62 | 0.67 | 0.14 | 0.89 | 10.0 | 21.7 | 3.8 | 3.40 | 9.03 | 3.61 | 15 | 1.96 | 72.58 | 71.70 | 73.33 | 73.31 | 76.75 | 75.62 | SS#8B-C-14 T |
| 33 | 32 | 25.0 | 0.34 | 1.41 | 0.48 | 0.16 | 0.75 | 20.0 | 21.5 | 3.8 | 2.87 | 6.46 | 3.31 | 15 | 1.00 | 72.83 | 72.58 | 73.55 | 73.59 | 76.75 | 76.75 | SS#8B-C-15 T |
| 34 | 33 | 91.0 | 0.36 | 1.07 | 0.48 | 0.17 | 0.59 | 20.0 | 21.0 | 3.9 | 2.27 | 16.91 | 3.06 | 15 | 6.86 | 79.07 | 72.83 | 79.67 | 73.79 | 83.59 | 76.75 | SS#8B-C-16 T |
| 35 | 34 | 90.0 | 0.36 | 0.71 | 0.48 | 0.17 | 0.41 | 20.0 | 20.5 | 3.9 | 1.62 | 18.40 | 3.01 | 15 | 8.12 | 86.38 | 79.07 | 86.89 | 79.71 | 90.30 | 83.59 | SS#8B-C-17 T |
| 36 | 35 | 93.0 | 0.20 | 0.35 | 0.68 | 0.14 | 0.24 | 20.0 | 20.0 | 4.0 | 0.95 | 12.16 | 2.40 | 15 | 3.55 | 89.68 | 86.38 | 90.07 | 86.92 | 94.20 | 90.30 | SS#8B-C-18 T |
| 37 | 36 | 59.0 | 0.15 | 0.15 | 0.70 | 0.11 | 0.11 | 15.0 | 15.0 | 4.5 | 0.47 | 16.24 | 1.77 | 15 | 6.32 | 93.41 | 89.68 | 93.68 | 90.13 | 97.33 | 94.20 | SS#8B-C-19 T |
| 38 | 12 | 115.0 | 0.13 | 1.07 | 0.70 | 0.09 | 0.56 | 10.0 | 15.1 | 4.5 | 2.51 | 12.77 | 3.83 | 12 | 12.86 | 96.62 | 81.83 | 97.29 | 83.25 | 101.12 | 83.58 | SS#8B-D-1 TO |
| 39 | 38 | 25.0 | 0.94 | 0.94 | 0.50 | 0.47 | 0.47 | 15.0 | 15.0 | 4.5 | 2.11 | 3.56 | 3.82 | 12 | 1.00 | 96.87 | 96.62 | 97.49 | 97.34 | 101.12 | 101.12 | SS#8B-D-2 TO |
| 40 | 8 | 34.0 | 0.00 | 12.32 | 0.00 | 0.00 | 7.11 | 0.0 | 38.3 | 3.0 | 21.02 | 15.99 | 6.69 | 24 | 0.50 | 69.57 | 69.40 | 72.39 | 72.10 | 72.50 | 72.53 | SS#8B-E-1 TO |
| 41 | 40 | 114.0 | 0.12 | 12.32 | 0.70 | 0.08 | 7.11 | 5.0 | 37.6 | 3.0 | 21.18 | 19.76 | 6.74 | 24 | 0.76 | 70.44 | 69.57 | 73.91 | 72.91 | 75.11 | 72.50 | SS#8B-E-2 TO |
| 42 | 41 | 167.0 | 0.46 | 11.00 | 0.48 | 0.22 | 6.44 | 13.0 | 36.7 | 3.0 | 19.40 | 31.70 | 6.17 | 24 | 1.96 | 73.72 | 70.44 | 75.85 | 74.62 | 79.07 | 75.11 | SS#8B-E-3 TO |

Project File: LINECDE.stm | I-D-F File: Jcc.IDF | Total number of lines: 52 | Run Date: 03-15-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.50 (ft)

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 43 | 42 | 105.0 | 0.43 | 9.74 | 0.51 | 0.22 | 5.84 | 15.0 | 36.1 | 3.0 | 17.71 | 42.00 | 6.34 | 24 | 3.45 | 77.34 | 73.72 | 78.83 | 76.44 | 82.69 | 79.07 | SS#8B-E-4 TO |
| 44 | 43 | 127.0 | 0.02 | 9.31 | 0.07 | 0.00 | 5.62 | 3.0 | 35.4 | 3.1 | 17.19 | 34.65 | 6.32 | 24 | 2.35 | 80.32 | 77.34 | 81.79 | 79.18 | 87.33 | 82.69 | SS#8B-E-5 TO |
| 45 | 44 | 18.0 | 0.02 | 9.14 | 0.70 | 0.01 | 5.51 | 3.0 | 35.3 | 3.1 | 16.89 | 19.95 | 5.38 | 24 | 0.78 | 80.46 | 80.32 | 82.64 | 82.54 | 87.82 | 87.33 | SS#8B-E-6 TO |
| 46 | 45 | 34.0 | 0.26 | 0.26 | 0.70 | 0.18 | 0.18 | 15.0 | 15.0 | 4.5 | 0.82 | 28.75 | 1.72 | 15 | 19.82 | 87.20 | 80.46 | 87.56 | 83.09 | 88.45 | 87.82 | SS#8B-E-7 TO |
| 47 | 45 | 55.0 | 8.86 | 8.86 | 0.60 | 5.32 | 5.32 | 35.0 | 35.0 | 3.1 | 16.35 | 44.30 | 6.00 | 24 | 3.84 | 82.57 | 80.46 | 84.00 | 83.09 | 84.57 | 87.82 | SS#8B-E-8 TO |
| 48 | 44 | 25.0 | 0.02 | 0.15 | 0.70 | 0.01 | 0.10 | 3.0 | 10.2 | 5.3 | 0.55 | 21.76 | 1.46 | 15 | 11.36 | 83.16 | 80.32 | 83.46 | 82.54 | 87.33 | 87.33 | SS#8B-E-9 TO |
| 49 | 48 | 41.0 | 0.13 | 0.13 | 0.70 | 0.09 | 0.09 | 10.0 | 10.0 | 5.3 | 0.49 | 22.19 | 1.99 | 15 | 11.80 | 88.00 | 83.16 | 88.28 | 83.53 | 89.25 | 87.33 | SS#8B-E-10 T |
| 50 | 41 | 26.0 | 1.20 | 1.20 | 0.49 | 0.59 | 0.59 | 9.0 | 9.0 | 5.6 | 3.27 | 4.90 | 2.67 | 15 | 0.58 | 70.59 | 70.44 | 74.69 | 74.62 | 75.11 | 75.11 | SS38B-E-12 T |
| 51 | 42 | 26.0 | 0.80 | 0.80 | 0.48 | 0.38 | 0.38 | 9.0 | 9.0 | 5.6 | 2.14 | 11.54 | 1.74 | 15 | 3.19 | 74.55 | 73.72 | 76.47 | 76.44 | 79.07 | 79.07 | SS#8B-E-11 T |
| 52 | 22 | 26.0 | 0.44 | 0.44 | 0.45 | 0.20 | 0.20 | 8.0 | 8.0 | 5.8 | 1.16 | 18.04 | 7.69 | 12 | 25.65 | 85.50 | 78.83 | 85.96 | 79.01 | 86.50 | 82.83 | SS#8B-C-20 T |

Project File: LINECDE.stm | I-D-F File: Jcc.IDF | Total number of lines: 52 | Run Date: 03-15-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.50 (ft)

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(757) 253-0040
Fax: (757) 220-8994

PROJECT Ford's Colony - Section 8 & 8E
PROJECT NO. 5652-8B
SUBJECT DITCH CALCULATIONS
SHEET NO. 1 OF 1
CALCULATED BY CBE DATE 3/15/99

PROPOSED DITCH SECTION FOR THE DRAINAGE OF LOTS 39B-44B:

DA = 0.44 AC
C = 0.45

$T_c$ = 8 MIN
$i_2$ = 4.96 IN/HR
$i_{10}$ = 6.28 IN/HR

$S_L$ = 0.0549 FT/FT (COMPOSITE SLOPE)
L = 305 LF

$Q_2 = CI_2A$
= .45(4.96 IN/HR) 0.44 AC
= 0.98 CFS

USING FIG. 2.8.24 (VDOT DRAINAGE MANUAL)
$V_2$ = 1.05 FPS
$d_{10}$ = 10.5"

$Q_{10} = CI_{10}A$
= .45(6.28 IN/HR) 0.44 AC
= 1.24 CFS

USE GRASS-LINED DITCH WITH 1.5:1 SIDESLOPES AND A MINIMUM DEPTH OF 12"

PROPOSED DITCH SECTION FOR THE DRAINAGE OF LOTS 22B-29B:

D.A. = 1.03 AC
C = 0.45

$T_c$ = 8 MIN
$i_2$ = 4.96 IN/HR
$i_{10}$ = 6.28 IN/HR

$Q_2 = CI_2A$
= .45(4.96) 1.03
= 2.30 CFS

$S_L$ = 0.0763 FT/FT (COMPOSITE SLOPE)
L = 290 LF

$Q_{10}$ = 2.91 CFS

USING FIG. 2.8.24 (VDOT DRAINAGE)
$V_2$ = 1.4 FPS
$d_{10}$ = 13.5"

USE GRASS-LINED DITCH WITH 1.5:1 SIDE SLOPES AND A MINIMUM DEPTH OF 18"

BUCHART HORN, INC.

February 23, 1999

Engineers, Architects and Planners

460 McLaws Circle, Suite 250
Williamsburg, VA 23185-5628
757 229 3359
800-834-1038 (Peninsula)
FAX: 757 220 3721

Ankara, Turkey
Baltimore, MD
Eschborn, Germany
Kenner, LA
Lewisburg, PA
Marlton, NJ
Memphis, TN
Pittsburgh, PA
Scranton, PA
State College, PA
Williamsburg, VA
York, PA

**Mr. Darryl Cook, P.E.**
**James City County Environmental Division**
**101-E Mounts Bay Road**
**Williamsburg, VA 23187**

**RE: Site Plan Review Services**
**Ford's Colony - Sections 8 & 8B**
**JCC Site Plan No. S-5-99**
**BH #75133-41**

Dear Mr. Cook:

We have completed our site plan review of drawings received from you on 1/29/99 for environmental compliance of the above referenced project. Enclosed are the following documents for your review/records:

- One (1) set of red-lined site plan drawings dated 1/20/99 (DWG 1-13 and 17-26)
- One (1) set of red-lined site plan drawings of the "Sales Road and Drainage Plan" dated 1/20/99 (DWG 14-16)
- One (1) reviewed set of Drainage Calculations as submitted.
- One (1) completed "James City County Code Compliance Checklist".
- One (1) original of the review comments generated by our office.
- One (1) disk containing review comments in WordPerfect version 6.0.

On February 12, 1999, I conducted a field visit to verify existing site conditions. The site is currently wooded with limited undergrowth. Generally, the site plans reflect existing drainage patterns and systems correctly. The existing tree lines are not graphically depicted on the drawings. The sales road for Blackheath has already been constructed and Sales road "B" has been constructed up to station 13+50 (+/-) with clearing work to around station 19+00. Some erosion was noted in the existing drainage channel south of the Blackheath and Road "A" intersection.

I have reviewed the drawings in detail, however the following issues will need to be addressed by your office:

1) The design engineer has designed temporary settling bays in the ditch

using 67cy/ac in determining the volume. Was this previously allowed by JCC and is it acceptable?

2) The design engineer has shown 12" storm sewer segments greater than 50' (VDOT allows up to 50'). Since Ford's Colony is a private development, does JCC want to enforce this requirement?

3) The design engineer has shown HDPE for use as temporary culverts under the sales roads. Again was this previously allowed by JCC and is it acceptable?

4) Is ASCP (Aluminized Steel Corrugated Pipe) acceptable to JCC for use as storm sewer pipe?

If you should have any questions or comments concerning this review, please do not hesitate to call me at (757) 259-4689.

Sincerely,
**BUCHART-HORN, INC.**

**Timothy O. Fortune, P.E.**
**Senior Engineer**
TOF/tmb/2299DCook.ltr

BUCHART HORN, INC.

# FORD'S COLONY AT WILLIAMSBURG SECTIONS 8 & 8B

**To:** Darryl Cook P.E., JCC Environmental Director

**From:** Tim Fortune P.E., Buchart-Horn, Inc.

**Subject:** Ford's Colony at Williamsburg - Sections 8 & 8B

**Site Plan No.:** S - 5 - 99

**Plan Date:** 1/20/99

**Plans Received:** 1/29/99

**Review Date:** 2/22/99

**Comments:**

1. Water and sewer inspection fees must be paid prior to the issuance of a Land Disturbing Permit.

2. A Land Disturbing Permit and Siltation Agreement, with surety, are required for this project.

3. A Subdivision Agreement, with surety, shall be executed with the County prior to recordation of lots.

4. Provide and label the limits of cut and fill slopes on the plan.

5. Show locations for temporary soil stockpile areas, staging and equipment storage areas. Silt fence shall be provided around soil stockpile areas outside of perimeter controls shown for this site. Identify any off-site land disturbing areas required with proper erosion control measures.

6. Indicate north arrow and graphic scale on Drawing #10.

7. On Drawing #2, under "Area Tabulation Blocks", correct the lot designations listed adjacent to Total Area of Section VIII & VIII-B. This should show "Lots 16-35" and "Lots 1-45".

8. On Drawing #2, should "Lot 9" be labeled as "Lot 9B".

9. On Drawings #3 thru 5, Road Categories Legend, depictions shown do not reflect shading/stippling of drawing.

10. Show benchmark location(s) on the drawings.

11. Provide profiles of proposed storm sewer systems with corresponding descriptions.

12. Provide a symbol and abbreviations legend on the cover sheet.

13. Provide final contours and spot elevations on the drawings.

14. On Cover Sheet, indicate the 100 year floodplain elevation for the site and the FEMA panel number. If site is outside the 100 year floodplain, label as such.

15. Provide 0.1 foot drop across all drainage structures. Indicate which structures are to receive inlet shaping. Include VDOT IS-1 detail on drawings.

16. Show existing vegetation to include tree lines.

17. On Drawings #11 thru 16, indicate locations for tree protection installation including interior roads.

18. On Drawing #13, correctly label the "Limits of Clearing".

19. Verify if a conflict occurs with the 4" waterline on Road "A" and the storm sewer segment SS# 8B-E-2 to SS# 8B-E-1.

20. For clarity, label the existing storm sewer structures (as denoted on the storm sewer tabulation report) on the drawings.

21. On Drawing #24, General Note #7, the current VDOT specifications and special provisions reference metric projects. Please clarify.

22. Indicate DI-1, DI-5, DI-7 and MH-1 storm sewer structures to be VDOT standard.

23. Label locations for installation of end sections. These are graphically shown but not labeled.

24. Provide typical section for sales road. Indicate ditch sideslopes/depth.

25. The detail on Drawing #24 for Settling Bays indicates "depth, width and length as specified on plans". These dimensions need to be provided on Drawings #14 thru 16.

26. On Drawings #14 thru 16, label the inverts on the temporary culverts. Provide calculations verifying culvert capacity for a 10 year storm.

27. Provide calculations verifying adequacy of temporary ditches (10 year storm) and ditch lining (2 year storm).

28. On Drawing #2, label the total disturbed area for this project.

29. Delineate drainage areas for settling bays.

30. Storm sewer calculations, System B, F & G, pipe lengths and slopes for line segments 7 to 4; 17 to 16; 21 to 11; 22 to 21; and 24 to 23 do not correspond with the drawings.

31. Storm sewer calculations, System C, D & E, line segment 20 to 19 shows a pipe size of 18 inch.

Drawings indicate a 15 inch pipe.

32. Storm sewer calculations, System C, D & E, pipe length and slopes for line segments 45 to 44; 46 to 45; 47 to 45 and 49 to 48 do not correspond with the drawings.

33. Storm sewer calculations, System C, D & E, label structure locations on Drawings for lines 15 thru 18. These segments are not apparent when reviewing calcs/drawings.

34. Provide calculations establishing tailwater elevation at storm sewer outfalls.

35. Per VDOT Technical Supplement TS-98-1 (dated 8/14/98), drop inlet openings/grated inlets shall be designed for a rainfall intensity of 4.0 inches per hour. Revise calculations to reflect this.

TOF/tmb/75133/docs/sitereview.feb

Provide stlite on Road A @ Lots 21/22

# JAMES CITY COUNTY CODE COMPLIANCE CHECKLIST

## I. EROSION AND SEDIMENT CONTROL PLAN

### A. Site Plan

X Vicinity Map - A small map locating the site in relation to the surrounding area. Include any landmarks which might assist in locating the site.

NTP Indicate North - The direction of north in relation to the site.

X Limits of Clearing and Grading - Areas which are to be cleared and graded.

NTP Limits of Cut and Fill Slopes

NTP Areas and Amount of Disturbance (in acres or square feet).

X Existing Contours - The existing contours of the site at no more than 5-foot intervals.

NTP Final Contours - Changes to the existing contours, including final drainage patterns at no more than 2 foot intervals.

NTP Existing and Proposed Spot Elevations - To supplement existing contour information. Proposed spot elevations may replace final contours in some instances.

NTP Existing Vegetation - The existing tree lines, grassed areas, or unique vegetation.

X Soils - The boundaries of different soil types.

X Environmental Inventory - In accordance with Chesapeake Bay Ordinance, Sect. 19B-10B. For wetlands, include documentation from approving agency.

X Existing and Proposed Drainage Patterns - The dividing lines and the direction of flow for the different drainage areas. Include the size (acreage) of each drainage area.

NTP 100 Year Floodplain Limits.

X Professional Seal - Signed upon approval of plan.

X Critical Erosion Areas - Areas with potentially serious erosion problems. (See VESCH, Chapter 6 for criteria.)

X - CHECKLIST ITEM PROVIDED

NTP - CHECKLIST ITEM "NEEDS TO BE PROVIDED"

N/A - CHECKLIST ITEM "NOT APPLICABLE"



PC079_FORDS_COLONY_HAIRWAY_ST_& STEAM_2 - 046

X Site Development - Show all improvements such as buildings, parking lots, access roads, utility construction, etc.

X Location of Practices - The locations of erosion and sediment controls, tree protection, and stormwater management practices used on the site. Use the standard symbols and abbreviations in Chapter 3 of the 1992 edition of the Virginia Erosion and Sediment Control Handbook.

NTP Temporary Stockpile Areas - Staging and equipment storage areas.

NTP Off-site Areas - Identify any off-site land-disturbing activities (e.g., borrow sites, waste areas, etc.). Show location of erosion controls. (Is there sufficient information to assure adequate protection and stabilization?)

N/A Sediment Basin Design Data Sheet - Submitted along with cross-section through embankment for all basins.

X Detail Drawings - Any structural practices used that are not referenced to the E&S handbook or local handbooks should be explained and illustrated with detailed drawings. Also include standard detail along with site specific details required to construct measures such as sediment traps, outlet protection, etc.

X Maintenance - A schedule of regular inspections and repair of erosion and sediment control structures should be set forth.

N/A Trench Dewatering - Details and specifications (per VESCH).

X Standard County Erosion and Sediment Control Notes

X Phasing Plan - (if required)

X Construction Sequence - (if required) Generally supplied by contractor prior to preconstruction conference.

**B. Narrative Plan (if required)**

X Project Description - Briefly describes the nature and purpose of the land-disturbing activity, and the areas (acres) to be disturbed.

X Existing Site Conditions - A description of the existing topography, vegetation, and drainage.

X Calculations - Detailed calculations for design of temporary sediment basins and traps permanent diversion, channels, outfall protection, etc. Include calculations for pre- and post-development runoff.

X Adjacent Areas - A description of neighboring areas such as streams, lakes, residential areas, roads, etc., which might be affected by the land disturbance.

NTP Off-site Areas - Describe any off-site land-disturbing activities that will occur (including borrow sites, waste or surplus areas, etc.). Will any other areas be disturbed?

X Soils - A brief description of the soils on the site giving such information as soil name, mapping unit, erodibility, permeability, depth, texture, and soil structure.

X Critical Areas - A description of areas on the site which have potentially serious erosion problems (e.g., steep slopes, channels, wet weather/underground springs, etc.).

X Erosion and Sediment Control Measures - A description of the methods which will be used to control erosion and sedimentation on the site. (Controls should meet the specifications in Chapter 3 of the VESCH.)

X Permanent Stabilization - A brief description, including specifications, of how the site will be stabilized after construction is completed.

X Stormwater Runoff Considerations - Describe the strategy to control stormwater runoff.

## II. STORMWATER MANAGEMENT

### A. STORMWATER TREATMENT SYSTEM

N/A Drainage Area Map at a maximum scale of 1"=200' showing drainage area boundaries for pre- and post-development conditions and pre- and post-development time of concentration flow paths. For multiphased projects, the map must include all future phases for the project.

N/A Soil Map with site and drainage area outlined.

N/A Receiving Channel and Pipe System Adequacy Determinations. All stormwater must be discharged to an adequate, well-defined receiving system.

N/A Worksheet for BMP Point System to determine need for and type of structural BMPs required as well as Natural Open Space BMP points.

N/A Stormwater Detention Basin Design Checklist completed for each structure.

N/A Conservation Easements required for all Natural Open Space Points claimed in BMP Worksheet.

N/A Infiltration Device Design, Detail and Specification. Must include results of a soil test to verify, a minimum infiltration rate of 0.27 inches per hour at the trench location to a depth of 5 feet below the bottom of the trench.

N/A Stormwater Management Facility Easements including a 20-foot wide access easement and a 15-foot wide maintenance easement from the 100-year storm elevation and include the dam and outlet structure.

## B. STORMWATER CONVEYANCE SYSTEMS

X Drainage Area Map to support the design of all conveyance systems; culverts, roadside ditches, storm drain systems, etc.

NTP Culvert Calculations, inlet and outlet control, existing and proposed based on 10-year storm.

X Storm Sewer Calculations to include hydraulic grade line, inlet, and spread calculations for 10-year storm.

NTP Open Ditch Calculations, lining determined based on 2-year peak velocity and capacity based on 10-year peak discharge, existing, and proposed.

X Slope Requirements, minimum longitundinal street slope requirement is 0.75% for grass-lined ditch, 0.5% for paved ditch, and 0.3% for closed (curb and gutter) section.

____ Outlet Protection required for all outfalls in accordance with Chapter 3, VESCH.

escpsts.txt

SYSTEM "A"

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 1 | End | 99.0 | 0.00 | 1.17 | 0.00 | 0.00 | 0.64 | 0.0 | 21.2 | 3.9 | 2.45 | 10.76 | 2.00 | 15 | 2.78 | 52.00 | 49.25 | 54.14 | 54.00 | 50.75 | 56.00 | SS#8B-A-2 TO |
| 2 | 1 | 106.0 | 0.18 | 1.17 | 0.62 | 0.11 | 0.64 | 15.0 | 20.6 | 3.9 | 2.48 | 23.60 | 3.01 | 15 | 13.36 | 66.16 | 52.00 | 66.79 | 54.15 | 56.00 | 70.33 | SS#8B-A-3 TO |
| 3 | 2 | 25.0 | 0.34 | 0.99 | 0.58 | 0.20 | 0.52 | 15.0 | 20.5 | 3.9 | 2.06 | 6.46 | 1.80 | 15 | 1.00 | 66.41 | 66.16 | 67.42 | 67.41 | 70.33 | 70.33 | SS#8B-A-4 TO |
| 4 | 3 | 63.0 | 0.09 | 0.65 | 0.53 | 0.05 | 0.33 | 10.0 | 20.1 | 3.9 | 1.29 | 11.96 | 2.13 | 15 | 3.43 | 68.57 | 66.41 | 69.03 | 67.66 | 70.33 | 72.74 | SS#8B-A-5 TO |
| 5 | 4 | 25.0 | 0.56 | 0.56 | 0.50 | 0.28 | 0.28 | 20.0 | 20.0 | 4.0 | 1.11 | 6.46 | 0.98 | 15 | 1.00 | 68.82 | 68.57 | 69.82 | 69.82 | 72.74 | 72.74 | SS#8B-A-6 TO |

Project File: LINEA.stm | I-D-F File: Jcc.IDF | Total number of lines: 5 | Run Date: 01-20-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.00 (ft)

AES CONSULTING ENGINEERS
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PROJECT FC SECTION 8&8B
PROJECT NO. 5652-8B
SUBJECT DRAINAGE CALCS.
SHEET NO. 9 OF 11
CALCULATED BY _____ DATE _____

A-6

STA 28+80 ROAD B (R) GRADE

D.A. = 0.56 AC ✓ C = 0.50 i = 3.5 IN/HR

$Q_T$ = 0.98 CFS ✓ $S_L$ = 0.0450 FT/FT

D = 0.110' < 0.14' ALL. ∴ OK K = 23.8

$Q_i$ = 0.60 CFS → USE 2 GRATES $Q_i$ = 1.20 CFS

$Q_i$ = 1.20 CFS > $Q_T$ = 0.98 CFS ∴ OK

A-5

STA 28+80 ROAD B (L) GRADE

D.A. = 0.09 AC C = 0.53 i = 3.5 IN/HR

$Q_T$ = 0.17 CFS ✓ $S_L$ = 0.0450 FT/FT

D = 0.057' < 0.14' ALL. ∴ OK K = 23.8

$Q_i$ = 0.20 CFS

$Q_i$ = 0.20 > $Q_T$ = 0.17 ∴ OK

A-3

STA 27+78 ROAD B (R) SUMP

D.A. = 0.18 AC C = 0.62 i = 3.5 IN/HR

$Q_T$ = 0.39 CFS ✓

$Q_i$ = 1.34 CFS

$Q_i$ = 1.34 > $Q_T$ = 0.39 ∴ OK

A-4

STA 27+78 ROAD B (L) SUMP

D.A. = 0.34 AC C = 0.58 i = 3.5 IN/HR

$Q_T$ = 0.69 CFS

$Q_i$ = 1.34 CFS

$Q_i$ = 1.34 > $Q_T$ = 0.69 ∴ OK ✓

SYSTEMS "C, D, & E"

# Hydraflow Storm Sewer Tabulation



| Station Line | Station To Line | Len (ft) | Drng Area Incr (ac) | Drng Area Total (ac) | Rnoff coeff (C) | Area x C Incr | Area x C Total | Tc Inlet (min) | Tc Syst (min) | Rain (I) (in/hr) | Total flow (cfs) | Cap full (cfs) | Vel (ft/s) | Pipe Size (in) | Pipe Slope (%) | Invert Elev Up (ft) | Invert Elev Dn (ft) | HGL Elev Up (ft) | HGL Elev Dn (ft) | Grnd / Rim Elev Up (ft) | Grnd / Rim Elev Dn (ft) | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | End | 220.0 | 3.74 | 39.31 | 0.42 | 1.57 | 18.79 | 20.0 | 43.8 | 2.8 | 52.17 | 69.80 | 7.38 | 36 | 1.10 | 50.97 | 48.56 | 55.35 | 54.00 | 51.56 | 55.57 | DI-122 TO OU |
| 2 | 1 | 233.0 | 1.68 | 35.57 | 0.40 | 0.67 | 17.22 | 20.0 | 42.5 | 2.8 | 48.47 | 95.53 | 7.75 | 36 | 2.05 | 55.75 | 50.97 | 57.97 | 55.47 | 55.57 | 59.29 | DI-119 TO DI |
| 3 | 2 | 75.0 | 0.00 | 33.89 | 0.00 | 0.00 | 16.55 | 0.0 | 42.1 | 2.8 | 46.79 | 64.89 | 8.12 | 36 | 0.95 | 56.46 | 55.75 | 58.64 | 58.14 | 59.29 | 61.10 | |
| 4 | 3 | 75.0 | 2.00 | 29.47 | 0.35 | 0.70 | 14.22 | 20.0 | 41.7 | 2.8 | 40.40 | 64.89 | 5.78 | 36 | 0.95 | 57.17 | 56.46 | 60.00 | 59.76 | 61.10 | 61.73 | DI-118 TO DI |
| 5 | 4 | 219.0 | 3.25 | 20.12 | 0.38 | 1.24 | 10.23 | 25.0 | 40.4 | 2.9 | 29.45 | 71.40 | 5.57 | 36 | 1.15 | 59.68 | 57.17 | 61.41 | 60.53 | 61.73 | 64.16 | DI-112 TO DI |
| 6 | 5 | 299.0 | 0.00 | 16.26 | 0.00 | 0.00 | 8.72 | 0.0 | 38.8 | 2.9 | 25.59 | 108.1 | 5.35 | 36 | 2.63 | 67.53 | 59.68 | 69.14 | 62.17 | 64.16 | 70.53 | TEE-107 TO D |
| 7 | 6 | 32.0 | 0.00 | 11.76 | 0.00 | 0.00 | 6.79 | 0.0 | 38.6 | 2.9 | 19.98 | 36.65 | 6.92 | 24 | 2.63 | 68.37 | 67.53 | 69.95 | 69.82 | 70.53 | 70.37 | TEE TO TEE-1 |
| 8 | 7 | 39.0 | 1.03 | 1.03 | 0.45 | 0.46 | 0.46 | 15.0 | 15.0 | 4.5 | 2.08 | 36.76 | 0.81 | 24 | 2.64 | 69.40 | 68.37 | 70.69 | 70.69 | 70.37 | 72.53 | DI-108 TO TE |
| 9 | 6 | 46.0 | 0.63 | 4.50 | 0.35 | 0.22 | 1.93 | 20.0 | 22.2 | 3.8 | 7.29 | 13.12 | 6.21 | 15 | 4.13 | 69.43 | 67.53 | 70.51 | 69.82 | 70.53 | 73.18 | DI-106 TO TE |
| 10 | 9 | 105.0 | 1.01 | 3.87 | 0.38 | 0.38 | 1.71 | 20.0 | 21.6 | 3.8 | 6.53 | 10.18 | 5.70 | 15 | 2.49 | 72.04 | 69.43 | 73.06 | 70.80 | 73.18 | 76.15 | DI-105 TO DI |
| 11 | 10 | 186.0 | 0.61 | 2.86 | 0.38 | 0.23 | 1.32 | 20.0 | 20.5 | 3.9 | 5.18 | 12.87 | 4.95 | 15 | 3.97 | 79.43 | 72.04 | 80.34 | 73.15 | 76.15 | 82.97 | DI-104 TO DI |
| 12 | 11 | 98.0 | 1.18 | 2.25 | 0.45 | 0.53 | 1.09 | 20.0 | 20.0 | 4.0 | 4.32 | 5.57 | 5.72 | 12 | 2.45 | 81.83 | 79.43 | 82.71 | 80.73 | 82.97 | 83.58 | DI-104 TO DI |
| 13 | 7 | 26.0 | 0.41 | 10.73 | 0.45 | 0.18 | 6.33 | 13.0 | 38.5 | 2.9 | 18.64 | 45.67 | 6.58 | 24 | 4.08 | 69.43 | 68.37 | 70.96 | 70.69 | 70.37 | 71.43 | DI-110 TO TE |
| 14 | 5 | 133.0 | 0.61 | 0.61 | 0.45 | 0.27 | 0.27 | 15.0 | 15.0 | 4.5 | 1.23 | 9.66 | 2.48 | 12 | 7.35 | 69.46 | 59.68 | 69.93 | 62.17 | 64.16 | 70.46 | CMP TO DI-11 |
| 15 | 4 | 176.0 | 0.35 | 7.35 | 0.70 | 0.24 | 3.30 | 15.0 | 37.5 | 3.0 | 9.83 | 47.12 | 4.31 | 24 | 4.34 | 64.81 | 57.17 | 65.92 | 60.53 | 61.73 | 69.50 | SS-1-6 TO DI |
| 16 | 15 | 195.0 | 0.00 | 7.00 | 0.00 | 0.00 | 3.05 | 0.0 | 36.4 | 3.0 | 9.22 | 21.67 | 6.37 | 18 | 4.26 | 73.30 | 65.00 | 74.46 | 66.13 | 69.50 | 82.75 | SS-1-7 TO SS |
| 17 | 16 | 197.0 | 1.00 | 7.00 | 0.65 | 0.65 | 3.05 | 25.0 | 35.3 | 3.1 | 9.35 | 14.96 | 5.81 | 18 | 2.03 | 77.40 | 73.40 | 78.57 | 74.98 | 82.75 | 81.46 | SS-1-9 TO SS |
| 18 | 17 | 50.0 | 6.00 | 6.00 | 0.40 | 2.40 | 2.40 | 35.0 | 35.0 | 3.1 | 7.38 | 10.50 | 4.23 | 18 | 1.00 | 78.00 | 77.50 | 79.41 | 79.19 | 81.46 | 81.46 | SS-1-10 TO S |
| 19 | 3 | 251.0 | 0.00 | 4.42 | 0.00 | 0.00 | 2.32 | 0.0 | 22.2 | 3.8 | 8.79 | 15.42 | 7.30 | 15 | 5.70 | 70.77 | 56.46 | 71.92 | 59.76 | 61.10 | 75.44 | SS#8B-C-1 TO |
| 20 | 19 | 65.0 | 0.08 | 2.01 | 0.70 | 0.06 | 1.06 | 5.0 | 21.4 | 3.8 | 4.05 | 18.96 | 3.37 | 18 | 3.26 | 72.89 | 70.77 | 73.66 | 72.78 | 75.44 | 77.06 | SS#8B-C-2 TO |
| 21 | 20 | 25.0 | 0.61 | 1.93 | 0.46 | 0.28 | 1.00 | 20.0 | 21.3 | 3.9 | 3.85 | 6.46 | 4.06 | 15 | 1.00 | 73.14 | 72.89 | 73.93 | 73.97 | 77.06 | 77.06 | SS#8B-C-3 TO |

HERE

DRAWINGS SHOW 15"

29

Project File: East1.stm | I-D-F File: Jcc.IDF | Total number of lines: 49 | Run Date: 01-20-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.00 (ft)

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 22 | 21 | 141.0 | 0.16 | 1.32 | 0.52 | 0.08 | 0.72 | 15.0 | 20.5 | 3.9 | 2.82 | 8.44 | 3.30 | 15 | 1.71 | 75.55 | 73.14 | 76.22 | 74.27 | 77.06 | 82.83 | SS#8B-C-4 TO |
| 23 | 22 | 85.0 | 0.40 | 1.16 | 0.50 | 0.20 | 0.64 | 20.0 | 20.0 | 4.0 | 2.52 | 14.73 | 3.75 | 15 | 5.20 | 79.97 | 75.55 | 80.60 | 76.26 | 82.83 | 84.14 | SS#8B-C-5 TO |
| 24 | 23 | 64.0 | 0.09 | 0.73 | 0.59 | 0.05 | 0.41 | 10.0 | 15.5 | 4.4 | 1.84 | 16.16 | 2.79 | 15 | 6.27 | 83.98 | 79.97 | 84.52 | 80.86 | 84.14 | 88.15 | SS#8B-C-6 TO |
| 25 | 24 | 88.0 | 0.22 | 0.34 | 0.53 | 0.12 | 0.19 | 15.0 | 15.0 | 4.5 | 0.86 | 17.87 | 2.02 | 15 | 7.66 | 90.72 | 83.98 | 91.09 | 84.67 | 88.15 | 94.64 | SS#8B-C-7 TO |
| 26 | 25 | 122.0 | 0.02 | 0.12 | 0.70 | 0.01 | 0.07 | 5.0 | 10.3 | 5.3 | 0.39 | 16.62 | 1.72 | 15 | 6.62 | 98.80 | 90.72 | 99.05 | 91.11 | 94.64 | 102.72 | SS#8B-C-8 TO |
| 27 | 26 | 46.0 | 0.10 | 0.10 | 0.60 | 0.06 | 0.06 | 10.0 | 10.0 | 5.3 | 0.32 | 19.86 | 1.74 | 15 | 9.46 | 103.15 | 98.80 | 103.38 | 99.11 | 102.72 | 107.07 | SS#8B-C-9 TO |
| 28 | 24 | 25.0 | 0.30 | 0.30 | 0.57 | 0.17 | 0.17 | 15.0 | 15.0 | 4.5 | 0.77 | 6.46 | 1.59 | 15 | 1.00 | 84.23 | 83.98 | 84.66 | 84.67 | 88.15 | 88.15 | SS#8B-C-10 T |
| 29 | 23 | 25.0 | 0.03 | 0.03 | 0.70 | 0.02 | 0.02 | 5.0 | 5.0 | 7.0 | 0.15 | 6.46 | 0.20 | 15 | 1.00 | 80.22 | 79.97 | 80.85 | 80.86 | 84.14 | 84.14 | SS#8B-C-11 T |
| 30 | 19 | 20.0 | 0.05 | 2.41 | 0.70 | 0.04 | 1.27 | 5.0 | 22.1 | 3.8 | 4.81 | 11.91 | 3.92 | 15 | 3.40 | 71.45 | 70.77 | 72.89 | 72.78 | 75.44 | 75.62 | SS#8B-C-12 T |
| 31 | 30 | 25.0 | 0.60 | 2.36 | 0.46 | 0.28 | 1.23 | 20.0 | 21.9 | 3.8 | 4.69 | 6.46 | 3.82 | 15 | 1.00 | 71.70 | 71.45 | 73.20 | 73.07 | 75.62 | 75.62 | SS#8B-C-13 T |
| 32 | 31 | 45.0 | 0.21 | 1.76 | 0.67 | 0.14 | 0.96 | 10.0 | 21.7 | 3.8 | 3.66 | 9.03 | 3.55 | 15 | 1.96 | 72.58 | 71.70 | 73.43 | 73.37 | 75.62 | 76.75 | SS#8B-C-14 T |
| 33 | 32 | 25.0 | 0.48 | 1.55 | 0.48 | 0.23 | 0.82 | 20.0 | 21.5 | 3.8 | 3.13 | 6.46 | 3.27 | 15 | 1.00 | 72.83 | 72.58 | 73.64 | 73.65 | 76.75 | 76.75 | SS#8B-C-15 T |
| 34 | 33 | 91.0 | 0.36 | 1.07 | 0.48 | 0.17 | 0.59 | 20.0 | 21.0 | 3.9 | 2.27 | 17.70 | 2.99 | 15 | 7.52 | 79.67 | 72.83 | 80.27 | 73.85 | 76.75 | 83.59 | SS#8B-C-16 T |
| 35 | 34 | 90.0 | 0.36 | 0.71 | 0.48 | 0.17 | 0.41 | 20.0 | 20.5 | 3.9 | 1.62 | 17.63 | 3.01 | 15 | 7.46 | 86.38 | 79.67 | 86.89 | 80.31 | 83.59 | 90.30 | SS#8B-C-17 T |
| 36 | 35 | 93.0 | 0.20 | 0.35 | 0.68 | 0.14 | 0.24 | 20.0 | 20.0 | 4.0 | 0.95 | 13.22 | 2.40 | 15 | 4.19 | 90.28 | 86.38 | 90.67 | 86.92 | 90.30 | 94.20 | SS#8B-C-18 T |
| 37 | 36 | 59.0 | 0.15 | 0.15 | 0.70 | 0.11 | 0.11 | 15.0 | 15.0 | 4.5 | 0.47 | 14.87 | 1.77 | 15 | 5.31 | 93.41 | 90.28 | 93.68 | 90.73 | 94.20 | 97.33 | SS#8B-C-19 T |
| 38 | 12 | 115.0 | 0.13 | 1.07 | 0.70 | 0.09 | 0.56 | 10.0 | 15.1 | 4.5 | 2.51 | 12.91 | 3.83 | 12 | 13.15 | 96.95 | 81.83 | 97.62 | 83.25 | 83.58 | 101.12 | SS#8B-D-1 TO |
| 39 | 38 | 25.0 | 0.94 | 0.94 | 0.50 | 0.47 | 0.47 | 15.0 | 15.0 | 4.5 | 2.11 | 3.56 | 3.82 | 12 | 1.00 | 97.20 | 96.95 | 97.82 | 97.67 | 101.12 | 101.12 | SS#8B-D-2 TO |
| 40 | 13 | 28.0 | 0.00 | 10.32 | 0.00 | 0.00 | 6.14 | 0.0 | 38.3 | 3.0 | 18.13 | 15.99 | 5.77 | 24 | 0.50 | 69.57 | 69.43 | 71.83 | 71.65 | 71.43 | 72.50 | SS#8B-E-1 TO |
| 41 | 40 | 122.0 | 0.12 | 10.32 | 0.70 | 0.08 | 6.14 | 5.0 | 37.6 | 3.0 | 18.28 | 19.10 | 5.82 | 24 | 0.71 | 70.44 | 69.57 | 73.02 | 72.22 | 72.50 | 75.11 | SS#8B-E-2 TO |
| 42 | 41 | 167.0 | 0.46 | 10.20 | 0.48 | 0.22 | 6.06 | 13.0 | 36.7 | 3.0 | 18.24 | 34.83 | 6.48 | 24 | 2.37 | 74.40 | 70.44 | 75.91 | 73.54 | 75.11 | 79.07 | SS#8B-E-3 TO |

Project File: East1.stm | I-D-F File: Jcc.IDF | Total number of lines: 49 | Run Date: 01-20-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.00 (ft)

# Hydraflow Storm Sewer Tabulation



| Station Line | Station To Line | Len (ft) | Drng Area Incr (ac) | Drng Area Total (ac) | Rnoff coeff (C) | Area x C Incr | Area x C Total | Tc Inlet (min) | Tc Syst (min) | Rain (I) (in/hr) | Total flow (cfs) | Cap full (cfs) | Vel (ft/s) | Pipe Size (in) | Pipe Slope (%) | Invert Elev Up (ft) | Invert Elev Dn (ft) | HGL Elev Up (ft) | HGL Elev Dn (ft) | Grnd / Rim Elev Up (ft) | Grnd / Rim Elev Dn (ft) | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 43 | 42 | 105.0 | 0.43 | 9.74 | 0.51 | 0.22 | 5.84 | 15.0 | 36.1 | 3.0 | 17.70 | 42.97 | 6.42 | 24 | 3.61 | 78.19 | 74.40 | 79.68 | 76.27 | 79.07 | 82.69 | SS#8B-E-4 TO |
| 44 | 43 | 127.0 | 0.02 | 9.31 | 0.07 | 0.00 | 5.62 | 3.0 | 35.4 | 3.1 | 17.19 | 38.24 | 6.32 | 24 | 2.86 | 81.82 | 78.19 | 83.29 | 80.03 | 82.69 | 87.33 | SS#8B-E-5 TO |
| 45 | 44 | 22.0 | 0.02 | 9.14 | 0.70 | 0.01 | 5.51 | 3.0 | 35.3 | 3.1 | 16.89 | 23.13 | 5.38 | 24 | 1.05 | 82.05 | 81.82 | 84.16 | 84.04 | 87.33 | 87.82 | SS#8B-E-6 TO |
| 46 | 45 | 31.0 | 0.26 | 0.26 | 0.70 | 0.18 | 0.18 | 15.0 | 15.0 | 4.5 | 0.82 | 26.32 | 1.72 | 15 | 16.61 | 87.20 | 82.05 | 87.56 | 84.61 | 87.82 | 88.45 | SS#8B-E-7 TO |
| 47 | 45 | 52.0 | 8.86 | 8.86 | 0.60 | 5.32 | 5.32 | 35.0 | 35.0 | 3.1 | 16.35 | 22.62 | 5.21 | 24 | 1.00 | 82.57 | 82.05 | 84.89 | 84.61 | 87.82 | 84.57 | SS#8B-E-8 TO |
| 48 | 44 | 25.0 | 0.02 | 0.15 | 0.70 | 0.01 | 0.10 | 3.0 | 10.2 | 5.3 | 0.55 | 14.95 | 0.53 | 15 | 5.36 | 83.16 | 81.82 | 84.04 | 84.04 | 87.33 | 87.33 | SS#8B-E-9 TO |
| 49 | 48 | 38.0 | 0.13 | 0.13 | 0.70 | 0.09 | 0.09 | 10.0 | 10.0 | 5.3 | 0.49 | 23.05 | 1.45 | 15 | 12.74 | 88.00 | 83.16 | 88.28 | 84.04 | 87.33 | 89.25 | SS#8B-E-10 T |

Project File: East1.stm | I-D-F File: Jcc.IDF | Total number of lines: 49 | Run Date: 01-20-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.00 (ft)

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PROJECT Ford's Colony Sections 8 & 8B
PROJECT NO. 5652-8B
SUBJECT Drainage Calcs
SHEET NO. 1 OF 11
CALCULATED BY DPW DATE 1-12-99

D-2

STA 12+38 ROAD B (R) SUMP

DA = 0.94 AC ✓ C = 0.5 i = 3.5 in/hr

$Q_T = CiA = 1.64$ CFS ✓

P = GRATE PERIMETER = 9.75' A = FREE OPEN AREA = 1.6 SF

ORIFICE FLOW: $Q_{io} = .6A\sqrt{2gh}$

h = allowable depth w/ 6.5' spread = 0.14' (max.)

$Q_{io} = 2.88$ CFS ✓

WEIR FLOW: $Q_{iw} = 3.3P(h)^{1.5}$

$Q_{iw} = 1.34$ CFS ✓

LOWER VALUE DOMINATES FOR SUMP ∴ WEIR

$Q_T = 1.64$ CFS > 1.34 CFS

USE 2 GRATES

$Q_T = 1.64$ CFS < 2.68 CFS OK

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(757) 253-0040
Fax: (757) 220-8994

PROJECT FC Sections 8 & 8B
PROJECT NO. 5652-8B
SUBJECT Drainage Calcs
SHEET NO. 2 OF 11
CALCULATED BY DPW/CBR DATE 1/12/99

D-1

STA 12+38 ROAD B (L) SUMP

DA. = 0.13 AC  C = 0.7  i = 3.5 IN/HR

$Q_T$ = 0.32 CFS < 1.34 CFS OK

C-9

STA. 15+07 ROAD B (L) GRADE

D.A. = 0.10 AC  C = 0.6  i = 3.5 IN/HR

$Q_T$ = 0.21 CFS  $S_L$ = 0.0250 FT/FT

$$Q_T = \frac{0.56}{0.016}(48)(D)^{8/3}(0.0250)^{1/2}$$

D = 0.069' < 0.14' ALL. OK

K = 20

$Q_i$ = 0.24 CFS

$Q_i$ = 0.24 > $Q_T$ = 0.21 OK

C-8

STA. 10+60 ROAD D (R) GRADE

D.A. = 0.02 AC  C = 0.70  i = 3.5 IN/HR

$Q_T$ = 0.05 CFS  $S_L$ = 0.0657 FT/FT

D = 0.033'  < 0.14' ALL. OK  K = 26

$Q_i$ = 0.09 CFS

$Q_i$ = 0.09 > $Q_T$ = 0.05 ∴ OK

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PROJECT FC SECTIONS 8 & 8B
PROJECT NO. 5652-8B
SUBJECT DRAINAGE CALCS
SHEET NO. 3 OF 11
CALCULATED BY CBR DATE 1/12/99

C-7
STA. 11+82 ROAD D (R) GRADE
D.A. = 0.22 AC ✓ C = 0.53 ✓ i = 3.5 IN/HR
$Q_T$ = 0.41 CFS ✓ $S_L$ = 0.0657 FT/FT
D = 0.074' < 0.14' ALL. ∴ OK K = 26
$Q_i$ = 0.34 CFS
$Q_i$ = 0.34 < $Q_T$ = 0.41 ∴ CARRYOVER = 0.07 CFS ✓

C-10
STA. 12+70 ROAD D (L) GRADE
D.A. = 0.30 AC ✓ C = 0.57 ✓ i = 3.5 IN/HR
$Q_T$ = 0.60 CFS ✓ $S_L$ = 0.0780 FT/FT
D = 0.082' < 0.14' ALL. ∴ OK K = 26.5
$Q_i$ = 0.41 CFS
$Q_i$ = 0.41 < $Q_T$ = 0.60 ∴ CARRYOVER = 0.19 CFS

C-6
STA 12+70 ROAD D (R) GRADE
D.A. = 0.09 AC ✓ C = 0.59 ✓ i = 3.5 IN/HR ✓
$Q_T$ = 0.19 ✓ + 0.07 ✓ (FROM 11+82) = 0.26 CFS ✓ $S_L$ = 0.0780 FT/FT
D = 0.060' < 0.14' ALL. ∴ OK K = 26.5
$Q_i$ = 0.25 CFS
$Q_i$ = 0.25 < $Q_T$ = 0.28 ∴ CARRYOVER = 0.03 CFS

C-11
STA. 13+50 ROAD D (L) GRADE
D.A. = 0.03 AC ✓ C = 0.7 ✓ i = 3.5 IN/HR
$Q_T$ = 0.07 ✓ + 0.19 ✓ (FROM 12+70) = 0.26 CFS ✓ $S_L$ = 0.0780 FT/FT
D = 0.060' < 0.14' ALL. ∴ OK K = 26.5
$Q_i$ = 0.25 CFS
$Q_i$ = 0.25 < $Q_T$ = 0.26 ∴ CARRYOVER = 0.01 CFS

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PROJECT FC SECTIONS 8&8B
PROJECT NO. 5652-8B
SUBJECT DRAINAGE CALCS
SHEET NO. 4 OF 11
CALCULATED BY CBR DATE 1/12/99

C-5

STA. 13+50 ROAD D (R) GRADE

D.A. = 0.40 AC. C = 0.50 i = 3.5 IN/HR

$Q_T$ = 0.70 + 0.03 (FROM 12+70) = 0.73 CFS $S_L$ = 0.0780 FT/FT

D = 0.089' < 0.14' ALL. K = 26.5

$Q_i$ = 0.47 CFS → USE 2 GRATES $Q_i$ = 0.94 CFS

$Q_i$ = 0.94 > $Q_T$ = 0.73 ∴ OK

C-4

STA. 14+35 ROAD D (R) GRADE

D.A. = 0.16 AC C = 0.52 i = 3.5 IN/HR

$Q_T$ = 0.29 CFS $S_L$ = 0.0083 FT/FT

D = 0.095' < 0.14' ALL. OK K = 14

$Q_i$ = 0.28 CFS

$Q_i$ = 0.28 < $Q_T$ = 0.29 ∴ CARRYOVER = 0.01 CFS

C-2

STA. 15+76 ROAD D (L) GRADE

D.A. = 0.08 AC C = 0.7 i = 3.5 IN/HR

$Q_T$ = 0.20 + 0.01 (FROM 13+50) = 0.21 CFS $S_L$ = 0.06000 FT/FT

D = 0.058' < 0.14' ALL. ∴ OK K = 25.8

$Q_i$ = 0.23 CFS

$Q_i$ = 0.23 > $Q_T$ = 0.21 ∴ OK

C-3

STA 15+76 ROAD D (R) GRADE

D.A. = 0.61 AC C = 0.46 i = 3.5 IN/HR

$Q_T$ = 0.98 + 0.01 (FROM 14+35) = 0.99 CFS $S_L$ = 0.06000 FT/FT

D = 0.104' < 0.14' ALL. ∴ OK K = 25.8

$Q_i$ = 0.60 CFS → USE 2 GRATES $Q_i$ = 1.20 CFS

$Q_i$ = 1.20 > $Q_L$ = 0.99 CFS ∴ OK

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PROJECT FC SECTIONS 8 & 8B
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SUBJECT DRAINAGE CALCS
SHEET NO. 5 OF 11
CALCULATED BY CBR DATE 1/12/99

C-19
STA. 18+63 ROAD B (R) GRADE
D.A. = 0.15 AC ✓ C = 0.7 ✓ i = 3.5 IN/HR
$Q_T$ = 0.37 CFS ✓ $S_L$ = 0.0533 FT/FT
D = 0.074' < 0.14' ALL. ∴ OK K = 24.5
$Q_i$ = 0.32 CFS
$Q_i$ = 0.32 < $Q_T$ = 0.37 ∴ CARRY OVER = 0.05 CFS ✓

C-18
STA. 10+42 ROAD E (L) GRADE
D.A. = 0.20 AC C = 0.68 i = 3.5 IN/HR
$Q_T$ = 0.48 CFS ✓ $S_L$ = 0.0533 FT/FT
D = 0.081' < 0.14' ALL. ∴ OK K = 24.5
$Q_i$ = 0.37 CFS → USE 2 GRATES $Q_i$ = 0.74 CFS
$Q_i$ = 0.74 > $Q_T$ = 0.48 ∴ OK

C-17
STA. 11+35 ROAD E (L) GRADE
D.A. = 0.36 AC ✓ C = 0.48 ✓ i = 3.5 IN/HR
$Q_T$ = 0.60 CFS ✓ $S_L$ = 0.0208 FT/FT
D = 0.105' < 0.14' ALL. ∴ OK K = 19.5
$Q_i$ = 0.46 CFS
$Q_i$ = 0.46 < $Q_T$ = 0.60 ∴ CARRYOVER = 0.14 CFS ✓

C-16
STA. 12+25 ROAD E (L) GRADE
D.A. = 0.36 AC ✓ C = 0.48 ✓ i = 3.5 IN/HR ✓
$Q_T$ = 0.60 CFS + 0.14 CFS = 0.74 CFS ✓ $S_L$ = 0.0753 FT/FT
D = 0.090' < 0.14' ALL. ∴ OK K = 26.5
$Q_i$ = 0.47 CFS → USE 2 GRATES $Q_i$ = 0.94 CFS
$Q_i$ = 0.94 > $Q_T$ = 0.74 ∴ OK

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PROJECT FC SECTION 8 & 8B
PROJECT NO. 5652-8B
SUBJECT DRAINAGE CALCS
SHEET NO. 6 OF 11
CALCULATED BY CBR DATE 1/12/99

C-5 STA. 13+16 ROAD E (L) SUMP

D.A. = 0.48 AC ✓ C = 0.48 ✓ i = 3.5 IN/HR

$Q_T$ = 0.81 CFS ✓

$Q_i$ = 1.34 CFS

$Q_T$ = 0.81 < $Q_i$ = 1.34 ∴ OK

C-14

STA. 13+16 ROAD E (R) GRADE

D.A. = 0.21 AC ✓ C = 0.67 ✓ i = 3.5 IN/HR

$Q_T$ = 0.49 CFS ✓ $S_L$ = 0.0753 FT/FT

D = 0.077' < 0.14' ALL. ∴ OK K = 26.5

$Q_i$ = 0.37 CFS

$Q_i$ = 0.37 < $Q_T$ = 0.49 ∴ CARRYOVER = 0.12 CFS ✓

C-13

STA. 16+55 ROAD D (R) SUMP

D.A. = 0.60 AC C = 0.46 ✓ i = 3.5 IN/HR

$Q_T$ = 0.97 CFS + 0.12 CFS (FROM 13+16) = 1.09 CFS ✓

$Q_T$ = 1.09 < 1.34 CFS ∴ OK

C-12

STA. 16+55 ROAD D (L) SUMP

D.A. = 0.05 AC ✓ C = 0.7 ✓ i = 3.5 IN/HR

$Q_T$ = 0.12 CFS ✓

$Q_T$ = 0.12 < 1.34 CFS ∴ OK

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PROJECT FC SECTION 8 & 8B
PROJECT NO. 5652 - 8B
SUBJECT DRAINAGE CALCS
SHEET NO. 10 OF 11
CALCULATED BY CBR DATE 1/12/99

E-4

STA 11+74 ROAD A (R) GRADE

D.A. = 0.43 AC ✓ c = 0.51 ✓ i = 3.5 IN/HR

$Q_T$ = 0.77 CFS ✓ $S_L$ = 0.0365 FT/FT

D = 0.104' < 0.14' ALL. ∴ OK K = 22

$Q_i$ = 0.51 CFS → USE 2 GRATES $Q_i$ = 1.02 CFS

$Q_i$ = 1.02 > $Q_T$ = 0.77 ∴ OK

E-3

STA 12+73 ROAD A (R) GRADE

D.A. = 0.46 AC ✓ c = 0.48 ✓ i = 3.5 IN/HR

$Q_T$ = 0.77 CFS ✓ $S_L$ = 0.0365 FT/FT

D = 0.104' < 0.14' ALL. ∴ OK K = 22

$Q_i$ = 0.51 CFS → USE 2 GRATES $Q_i$ = 1.02 CFS

$Q_i$ = 1.02 > $Q_T$ = 0.77 ∴ OK

E-11

STA 12+73 ROAD A (L) GRADE

D.A. = 0.80 AC ✓ c = 0.48 i = 3.5 IN/HR

$Q_T$ = 1.34 CFS $S_L$ = 0.0365 FT/FT

D = 0.128' < 0.14' ALL. ∴ OK K = 22

$Q_i$ = 0.72 CFS → USE 2 GRATES $Q_i$ = 1.44 CFS

$Q_i$ = 1.44 > $Q_T$ = 1.34 ∴ OK

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PROJECT FC SECTION 8 & 8B
PROJECT NO. 5652 - 8B
SUBJECT DRAINAGE CALCS.
SHEET NO. 11 OF 12
CALCULATED BY CBR DATE 1/12/99

E-12
STA. 14+38 ROAD A (L) SUMP
D.A. = 1.20 AC C = 0.44 i = 3.5 IN/HR
$Q_T$ = 2.06 CFS

$Q_i$ = 1.34 CFS → USE 2 GRATES $Q_i$ = 2.68 CFS

$Q_i$ = 2.68 > $Q_T$ = 2.06 CFS ∴ OK

E-2
STA. 14+38 ROAD A (R) SUMP
D.A. = 0.12 AC C = 0.7 i = 3.5 IN/HR
$Q_T$ = 0.29 CFS

$Q_i$ = 1.34 CFS

$Q_i$ = 1.34 > $Q_T$ = 0.29 CFS ∴ OK

SYSTEMS "B, F & G"

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 1 | End | 250.0 | 0.00 | 24.34 | 0.00 | 0.00 | 10.77 | 0.0 | 31.3 | 3.2 | 44.90 | 75.10 | 9.63 | 36 | 1.27 | 55.90 | 52.73 | 58.04 | 54.42 | 55.73 | 62.50 | SS#8B-B-1 TO |
| 2 | 1 | 205.0 | 0.23 | 2.05 | 0.69 | 0.16 | 1.12 | 10.0 | 16.3 | 4.3 | 4.87 | 17.30 | 4.61 | 15 | 7.18 | 70.62 | 55.90 | 71.50 | 59.12 | 62.50 | 74.79 | SS#8B-B-2 TO |
| 3 | 2 | 25.0 | 0.44 | 1.82 | 0.51 | 0.22 | 0.97 | 10.0 | 16.2 | 4.3 | 4.20 | 6.46 | 4.56 | 15 | 1.00 | 70.87 | 70.62 | 71.69 | 71.57 | 74.79 | 74.79 | SS#8B-B-3 TO |
| 4 | 3 | 95.0 | 0.62 | 1.38 | 0.51 | 0.32 | 0.74 | 13.0 | 15.6 | 4.4 | 3.27 | 10.29 | 3.79 | 15 | 2.54 | 73.28 | 70.87 | 74.00 | 71.86 | 74.79 | 77.20 | SS#8B-B-4 TO |
| 5 | 4 | 87.0 | 0.46 | 0.63 | 0.52 | 0.24 | 0.36 | 15.0 | 15.1 | 4.5 | 1.60 | 14.80 | 2.46 | 15 | 5.25 | 77.85 | 73.28 | 78.36 | 74.31 | 77.20 | 82.02 | SS#8B-B-5 TO |
| 6 | 5 | 25.0 | 0.17 | 0.17 | 0.70 | 0.12 | 0.12 | 15.0 | 15.0 | 4.5 | 0.53 | 6.46 | 1.09 | 15 | 1.00 | 78.10 | 77.85 | 78.53 | 78.54 | 82.02 | 82.02 | SS#8B-B-6 TO |
| 7 | 4 | 123.0 | 0.13 | 0.13 | 0.51 | 0.07 | 0.07 | 5.0 | 5.0 | 7.0 | 0.46 | 9.51 | 1.39 | 15 | 2.17 | 75.95 | 73.28 | 76.22 | 74.31 | 77.20 | 79.87 | SS#8B-B-7 TO |
| 8 | 1 | 184.0 | 3.10 | 22.29 | 0.40 | 1.24 | 9.65 | 20.0 | 30.2 | 3.3 | 41.73 | 47.13 | 8.50 | 30 | 1.32 | 58.32 | 55.90 | 61.02 | 59.12 | 62.50 | 63.92 | DI-141 TO SS |
| 9 | 8 | 45.0 | 0.00 | 19.19 | 0.00 | 0.00 | 8.41 | 0.0 | 30.0 | 3.3 | 37.76 | 64.41 | 7.71 | 30 | 2.47 | 59.43 | 58.32 | 61.88 | 61.53 | 63.92 | 61.93 | TEE-146 TO D |
| 10 | 9 | 214.0 | 3.66 | 15.22 | 0.35 | 1.28 | 6.58 | 20.0 | 28.8 | 3.4 | 22.13 | 64.36 | 5.66 | 30 | 2.46 | 64.70 | 59.43 | 66.27 | 62.81 | 61.93 | 68.88 | DI-140 TO TE |
| 11 | 10 | 325.0 | 0.00 | 11.56 | 0.00 | 0.00 | 5.30 | 0.0 | 27.0 | 3.5 | 18.35 | 41.82 | 5.45 | 30 | 1.04 | 68.08 | 64.70 | 69.51 | 66.60 | 68.88 | 73.00 | SS#8B-F-1 TO |
| 12 | 11 | 34.0 | 2.27 | 9.12 | 0.40 | 0.91 | 3.95 | 20.0 | 24.3 | 3.6 | 14.32 | 22.95 | 4.70 | 24 | 1.03 | 68.43 | 68.08 | 70.22 | 70.13 | 73.00 | 74.11 | DI-139 TO SS |
| 13 | 12 | 149.0 | 1.77 | 6.85 | 0.40 | 0.71 | 3.04 | 20.0 | 23.5 | 3.7 | 11.20 | 32.78 | 4.67 | 24 | 2.10 | 71.56 | 68.43 | 72.75 | 70.49 | 74.11 | 75.98 | DI-138 TO DI |
| 14 | 13 | 168.0 | 1.78 | 5.08 | 0.40 | 0.71 | 2.33 | 20.0 | 22.5 | 3.8 | 8.75 | 14.61 | 5.59 | 18 | 1.93 | 74.81 | 71.56 | 75.94 | 72.98 | 75.98 | 78.29 | DI-137 TO DI |
| 15 | 14 | 154.0 | 0.48 | 3.30 | 0.42 | 0.20 | 1.62 | 15.0 | 21.7 | 3.8 | 6.18 | 16.45 | 4.64 | 18 | 2.45 | 78.59 | 74.81 | 79.54 | 76.03 | 78.29 | 83.64 | DI-136 TO DI |
| 16 | 15 | 54.0 | 0.69 | 2.82 | 0.40 | 0.28 | 1.42 | 15.0 | 21.4 | 3.8 | 5.44 | 19.75 | 4.63 | 18 | 3.54 | 80.50 | 78.59 | 81.39 | 79.60 | 83.64 | 83.50 | SS#8B-G-1 TO |
| 17 | 16 | 85.0 | 0.43 | 2.13 | 0.38 | 0.16 | 1.14 | 15.0 | 20.9 | 3.9 | 4.43 | 29.83 | 3.95 | 18 | 8.07 | 87.36 | 80.50 | 88.16 | 81.56 | 83.50 | 91.60 | SS#8B-G-2 TO |
| 18 | 17 | 79.0 | 0.14 | 1.70 | 0.70 | 0.10 | 0.98 | 10.0 | 20.5 | 3.9 | 3.83 | 7.47 | 3.43 | 18 | 0.51 | 87.76 | 87.36 | 88.55 | 88.44 | 91.60 | 93.20 | SS#8B-G-3 TO |
| 19 | 18 | 47.0 | 0.14 | 1.56 | 0.70 | 0.10 | 0.88 | 10.0 | 20.2 | 3.9 | 3.46 | 7.50 | 3.00 | 18 | 0.51 | 88.00 | 87.76 | 88.85 | 88.81 | 93.20 | 92.00 | SS#8B-G-4 TO |
| 20 | 19 | 35.0 | 1.42 | 1.42 | 0.55 | 0.78 | 0.78 | 20.0 | 20.0 | 4.0 | 3.09 | 39.13 | 3.22 | 18 | 13.89 | 92.86 | 88.00 | 93.53 | 89.02 | 92.00 | 94.36 | SS#8B-G-5 TO |
| 21 | 11 | 87.0 | 0.25 | 2.44 | 0.45 | 0.11 | 1.36 | 10.0 | 26.5 | 3.5 | 4.73 | 14.11 | 3.70 | 18 | 1.80 | 69.65 | 68.08 | 70.48 | 70.13 | 73.00 | 76.50 | SS#8B-F-2 TO |

95

8

84

2.84

1.87

Project File: WESTSYSTEM.stm | I-D-F File: Jcc.IDF | Total number of lines: 26 | Run Date: 01-20-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.42 (ft)

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 22 | 21 | 138.0 142 | 0.10 | 2.19 | 0.70 | 0.07 | 1.24 | 10.0 | 25.7 | 3.5 | 4.40 | 27.70 | 4.33 | 18 | 6.96 6.76 | 79.25 | 69.65 | 80.05 | 70.53 | 76.50 | 83.25 | SS#8B-F-3 TO |
| 23 | 22 | 98.0 | 0.16 | 2.09 | 0.70 | 0.11 | 1.17 | 10.0 | 25.2 | 3.6 | 4.19 | 18.37 | 3.72 | 18 | 3.06 | 82.25 | 79.25 | 83.03 | 80.38 | 83.25 | 86.25 | SS#8B-F-4 TO |
| 24 | 23 | 35.0 | 1.93 | 1.93 | 0.55 | 1.06 | 1.06 | 25.0 | 25.0 | 3.6 | 3.80 | 41.82 | 3.55 | 18 | 15.86 13.88 | 87.80 | 82.25 | 88.54 | 83.35 | 86.25 | 89.30 | SS#8B-F-5 TO |
| 25 | 9 | 152.0 | 2.78 | 3.97 | 0.40 | 1.11 | 1.83 | 25.0 | 25.4 | 3.6 | 16.49 | 16.65 | 9.33 | 18 | 2.51 | 63.25 | 59.43 | 66.56 | 62.81 | 61.93 | 67.21 | DI-148 TO TE |
| 26 | 25 40 | 75.0 | 1.19 | 1.19 | 0.60 | 0.71 | 0.71 | 25.0 | 25.0 | 3.6 | 12.56 | 25.17 | 7.33 | 18 | 5.75 | 67.56 | 63.25 | 68.90 | 66.77 | 67.21 | 69.06 | CMP TO DI-14 |

Project File: WESTSYSTEM.stm | I-D-F File: Jcc.IDF | Total number of lines: 26 | Run Date: 01-20-1999

NOTES: Intensity = 17.05 / (Tc + 1.50) ^ 0.48; Return period = 10 Yrs. ; Initial tailwater elevation = 54.42 (ft)

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PROJECT FC SECTION 8 & 8B
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SUBJECT DRAINAGE CALCS
SHEET NO. 7 OF 11
CALCULATED BY CBR DATE 1/12/99

B-5

STA. 21+50 ROAD B (L) GRADE

D.A. = 0.46 AC ✓ C = 0.52 ✓ i = 3.5 IN/HR

$Q_T$ = 0.84 CFS ✓ $S_L$ = 0.0533 FT/FT

D = 0.10' < 0.14' ALL. ∴ OK K = 24.5

$Q_i$ = 0.53 CFS ⇒ USE 2 GRATES $Q_i$ = 1.06 CFS

$Q_i$ = 1.06 > $Q_T$ = 0.84 ∴ OK

B-6

STA. 21+50 ROAD B (R) GRADE

D.A. = 0.17 AC ✓ C = 0.7 ✓ i = 3.5 IN/HR

$Q_T$ = 0.42 ✓ + 0.05 (FROM 18+63) = 0.47 CFS $S_L$ = 0.0533 FT/FT

D = 0.081' < 0.14 ALL. ∴ OK K = 24.5

$Q_i$ = 0.37 CFS

$Q_i$ = 0.37 < $Q_T$ = 0.47 ∴ CARRYOVER = 0.10 CFS

B-7

STA. 31+51 ROAD B (R) GRADE

D.A. = 0.13 AC ✓ C = 0.51 i = 3.5 IN/HR

$Q_T$ = 0.23 CFS ✓ $S_L$ = 0.0217 FT/FT

D = 0.073' < 0.14' ALL. ∴ OK K = 19.5

$Q_i$ = 0.25 CFS

$Q_i$ = 0.25 > $Q_T$ = 0.23 ∴ OK

B-4

STA. 32+74 ROAD B (R) SUMP

D.A. = 0.62 AC ✓ C = 0.51 ✓ i = 3.5 IN/HR

$Q_T$ = 1.11 CFS ✓

$Q_i$ = 1.34 CFS

$Q_i$ = 1.34 > $Q_T$ = 1.11 ∴ OK

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PROJECT FC. SECTION 8 & 8B
PROJECT NO. 5652-8B
SUBJECT DRAINAGE CALCS
SHEET NO. 8 OF 11
CALCULATED BY CBR DATE 1/12/99

B-2

STA 23+46 ROAD B (R) SUMP

D.A. = 0.23 AC ✓ C = 0.69 ✓ i = 3.5 IN/HR

$Q_T$ = 0.56 + 0.10 (FROM 21+50) = 0.66 CFS

$Q_i$ = 1.34 CFS

$Q_i$ = 1.34 > $Q_T$ = 0.66 ∴ OK

B-3

STA. 23+46 ROAD B (L) SUMP

D.A. = 0.44 AC ✓ C = 0.51 ✓ i = 3.5 IN/HR

$Q_T$ = 0.79 CFS ✓

$Q_i$ = 1.34 CFS

$Q_i$ = 1.34 > $Q_T$ = 0.79 ∴ OK

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PROJECT FORD'S COLONY - SEC 8 & 8B
PROJECT NO. 5652-8B
SUBJECT SETTLING BAY DESIGN
SHEET NO. 1 OF 4
CALCULATED BY CBR DATE 1/21/99

SETTLING BAY @ ROAD "A" STA 14+38 L:

DISTURBED DRAINAGE AREA = 0.47 AC

⟹ ASSUME RQD ∀ OF BAY = 67 CY/AC

67 CY/AC (0.47 AC) = 32 CY = 850 CF ∀ RQD

TYP. BAY DIMENSIONS → 3'D x 6'W x 30'L
→ 540 CF

TRY BAY @ ROAD "A" STA 12+75 L:

APPROX. AREA = 0.16 AC ∴ 290 CF ∀ RQD

USE 3'D x 5'W x 20'L → 300 CF > 290 CF RQD ∴ OK
(11.1 CY)

BAY @ ROAD "A" STA 14+38 L:

NOW APPROX. AREA = 0.29 AC ∴ 525 CF ∀ RQD

USE 3'D x 6'W x 30'L → 540 CF > 525 CF ∴ OK
(20 CY)

SETTLING BAY @ ROAD "A" STA 14+38 R:

DDA = 0.31 AC

∴ 561 CF ∀ RQD

USE 4'D x 6'W x 25'L → 600 CF > 561 CF RQD ∴ OK
(22.2 CY)

SETTLING BAY @ ROAD "B" STA 12+38 R:

DDA = 0.34 AC

∴ 612 CF ∀ RQD

TRY BAY @ ROAD "B" STA 13+80 R:

APPROX. AREA = 0.12 AC

∴ 217 CF ∀ RQD

USE 3'D x 5'W x 15'L → 225 CF > 217 CF RQD ∴ OK
(8.3 CY)

BAY @ ROAD "B" STA 12+38 R:

NOW APPROX. AREA = 0.22 AC

∴ 398 CF ∀ RQD

USE 3'D x 6'W x 25'L → 450 CF > 398 CF RQD ∴ OK
(16.7 CY)

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PROJECT FORD'S COLONY - SEC 8 & 8B
PROJECT NO. 5652-8B
SUBJECT SETTLING BAY DESIGN
SHEET NO. 2 OF 4
CALCULATED BY CBR DATE 1/21/99

SETTLING BAY @ ROAD "B" STA 12+38 L:

DDA = 0.26 AC ∴ 470 CF ∀ RQD

USE 3'D x 6'W x 30'L → 540 CF > 470 CF ∀ RQD ∴ OK
(20 CY)

SETTLING BAY @ ROAD "B" STA 18+50 L:

DDA = 0.15 AC ∴ 271 CF ∀ RQD

USE 3'D x 5'W x 20'L → 300 CF > 271 CF ∀ RQD ∴ OK
(11.1 CY)

SETTLING BAY @ ROAD "D" STA 13+03 R:

DDA = 0.26 AC ∴ 470 CF ∀ RQD

USE 3'D x 6'W x 30'L → 540 CF > 470 CF ∀ RQD ∴ OK
(20 CY)

SETTLING BAY @ ROAD "D" STA 13+65 L:

DDA = 0.21 AC ∴ 380 CF ∀ RQD

USE 3'D x 6'W x 25'L → 450 CF > 380 CF ∀ RQD ∴ OK
(16.7 CY)

SETTLING BAY @ ROAD "D" STA 15+80 R:

DDA = 0.36 AC ∴ 651 CF ∀ RQD

USE 4'D x 6'W x 30'L → 720 CF > 651 CF ∀ RQD ∴ OK
(26.7 CY)

SETTLING BAY @ ROAD "D" STA 16+55 R:

DDA = 0.24 AC ∴ 434 CF ∀ RQD

USE 3'D x 6'W x 25'L → 450 CF > 434 CF ∀ RQD ∴ OK
(16.7 CY)

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(757) 253-0040
Fax: (757) 220-8994

PROJECT Ford's Colony - Sec 8 & 8B
PROJECT NO. 5652-813
SUBJECT Settling Bay Design
SHEET NO. 3 OF 4
CALCULATED BY CBR DATE 1/22/99

SETTLING BAY @ ROAD "D" STA. 16+38 L:

DDA = 0.21 AC ∴ 380 CF ∀ RQD

USE 3'D x 6'W x 25'L → 450 CF > 380 CF ∀ RQD ∴ OK
(16.7 CY)

SETTLING BAY @ ROAD "B" STA. 20+00 R:

DDA = 0.24 AC ∴ 434 CF ∀ RQD

USE 3'D x 6'W x 25'L → 450 CF > 434 CF ∀ RQD ∴ OK
(16.7 CY)

SETTLING BAY @ ROAD "B" STA 23+50 R:

DDA: 0.29 AC ∴ 525 CF ∀ RQD

USE 3'D x 6'W x 30'L → 540 CF > 525 CF ∀ RQD ∴ OK
(20.0 CY)

SETTLING BAY @ ROAD "B" STA 32+80 R:

DDA = 0.28 AC ∴ 507 CF ∀ RQD

USE 3'D x 6'W x 30'L → 540 CF > 507 CF ∀ RQD ∴ OK
(20.0 CY)

SETTLING BAY @ ROAD "B" STA 23+50 L:

DDA = 0.27 AC ∴ 489 CF ∀ RQD

USE 3'D x 6'W x 30'L → 540 CF > 489 CF ∀ RQD ∴ OK
(20.0 CY)

SETTLING BAY @ ROAD "B" STA 26+00 L:

DDA = 0.11 AC ∴ 199 CF ∀ RQD

USE 3'D x 6'W x 15'L → 270 CF > 199 CF ∀ RQD ∴ OK
(10.0 CY)

SETTLING BAY @ ROAD "B" STA 21+75 L:

DDA = 0.28 AC ∴ 507 CF ∀ RQD

USE 3'D x 6'W x 30'L = 540 CF > 507 CF ∀ RQD ∴ OK
(20.0 CY)

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(757) 253-0040
Fax: (757) 220-8994

PROJECT Ford's Colony - Sec 8 & 8B
PROJECT NO. 5652-8B
SUBJECT Settling Bay Design
SHEET NO. 4 OF 4
CALCULATED BY CBB DATE 1/22/99

SETTLING BAY @ ROAD "B" STA 27+75 R

DDA = 0.32 AC ∴ STOCK ∀ REQD

USE 4' D x 6' W x 25' L → 600 CF > 579 CF ∀ REQD ∴ OK
(22.2 CY)

SINCE F&R 1881

# SUBSURFACE EXPLORATION

PROPOSED DAM NO. 2

FORD'S COLONY

WILLIAMSBURG, VIRGINIA

PREPARED FOR

AES

WILLIAMSBURG, VIRGINIA

PREPARED BY

FROEHLING & ROBERTSON, INC.

833 PROFESSIONAL PLACE, WEST

CHESAPEAKE, VIRGINIA 23320

(804) 436-1111

PC079

F&R #Q-61-600

February 21, 1990

SINCE 1881

**FROEHLING & ROBERTSON, INC.**
FULL SERVICE LABORATORIES • ENGINEERS & CHEMISTS
*"OVER ONE HUNDRED YEARS OF SERVICE"*

833 Professional Place, W.
Chesapeake, Virginia 23320
Telephone: (804) 436-1111

FAX (804) 436-1674

February 21, 1990

AES
5248 Olde Towne Road
Suite 1
Williamsburg, Virginia 23185

Attn: Mr. James H. Bennett, P.E.

Re: DAM No. 2
Ford's Colony
Williamsburg, Virginia
F&R Record No.: Q-61-600

Dear Mr. Bennett:

As per your request, Froehling and Robertson, Inc., has completed the subsurface exploration and analysis for the referenced project.

The purpose of our investigation was to evaluate the existing soils relative to support capacity and permeability.

## Project Information

We understand that the proposed dam will be an earth fill with an impervious core. The dam will have a length of approximately 600 feet along its top. St. Andrews Drive and a jogging path will extend along the top of the dam.

The top of the dam will be at approximately elevation 55. The north end of the dam will rise slightly to match existing grades. The bottom of the existing ravine is at approximately elevation 38. The normal pool elevation will be 50.00.

## Scope of Exploration

Six soil test borings were performed on November 3 through 6, 1989 to depths of 25 to 30 feet below the existing ground surface. The borings were performed along the proposed centerline of the core at 70 to 100 foot spacing. Borings B-1 and B-6 were located on opposite abutments at approximately the normal pool elevation.



HEADQUARTERS: 3015 DUMBARTON ROAD • BOX 27524 • RICHMOND, VA. 23261 • TELEPHONE AREA CODE (804) 264-2701
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The borings were located at the site by the senior driller based on existing survey stakes. The elevations noted on the boring logs and in the text of this report were extrapolated from the topographic site plan prepared by AES, Drawing No. 3 of 7, dated September 1986. It appears that the fill for the roadway was placed after this topographic plan was prepared.

The borings were logged and recorded by a senior driller. Standard Penetration tests were performed in general accordance with applicable American Society for Testing and Materials (ASTM) procedures. These tests were performed continuously from the existing ground surface to a depth of approximately six feet and thereafter at five foot intervals. A disturbed split spoon sample was collected with each test and subsequently visually examined and classified in accordance with the Unified Soil Classification System (Appendix A) by a geotechnical engineer. The boring logs (Appendix A) show the subsurface conditions encountered on the dates and at the approximate locations indicated. We do not warrant that they are representative of the subsurface conditions at other times or locations. The boring logs should not be separated from the body of this report under any circumstances.

Laboratory tests consisting of sieve analyses and Atterberg limits were performed on selected split spoon soil samples. The purpose of these tests were to provide data for correlations with support strength and permeability properties. The results of these tests are included in Appendix B.

Soil samples will be retained for sixty days from the date of this report unless we are directed otherwise.

## Subsurface Conditions

The following is our interpretation of the soil stratigraphy and subsurface conditions, based on the soil borings and tests. The lines designating strata breaks on the boring logs represent approximate boundaries between soil types, as the transition may be gradual or may occur between samples. The interpretation necessarily assumes uniform subsurface conditions across the site, which is probably, but not necessarily,, correct. The subsurface conditions may also change with time and groundwater fluctuations.

Borings B-2 through B-6 encountered the recently placed fill for the roadway to depths of 3.0 to 4.5 feet. This material generally consisted of a stiff to very stiff orangish brown fine sandy CLAY (CL), interbedded with a loose to medium dense clayey fine to medium SAND (SC). Subsequent references to depths at the locations of borings B-2 through B-6 will be referenced to the estimated original ground surface.

STRATUM I: Silty fine SAND (SM) with trace amounts of organics and roots was encountered at borings B-1 and B-6 to depths of 1.5 feet (elevation 48). This material was found to be dense at B-1 and loose at B-6.

The permeability of the silty sand is estimated to be on the order of $1 \times 10^{-3}$ to $1 \times 10^{-4}$ cm/sec.

STRATUM II: Soft to stiff, dark brown to black, organic silty CLAY (CL-OL) to PEAT (PT) was encountered near the center of the ravine at borings B-3 and B-4. These materials were encountered to depths of 3.0 feet (Elev. 37) at B-3 and 7.5 feet (Elev. 34.5) at B-4. These materials are highly compressible and are expected to be unstable under slopes. Similar soils were also encountered at boring B-5 to a depth of 1.5 feet.

The permeability of these organic soils is estimated to be on the order of $1 \times 10^{-3}$ to $1 \times 10^{-7}$ cm/sec. It is important to note that the permeability is greatly affected by the organic matter and that piping can also develop within these materials.

STRATUM III: The soils encountered beneath the fill and organics was found to vary considerably across the site. These variations occurred to elevations of 32 to 33 at B-1 and B-2 (right abutment), to elevations of 31 to 23 at B-3 and B-4 (center) and to elevations of 35 to 38 at B-5 and B-6 (left abutment). For the purpose of this discussion, each of these areas will be discussed independently.

B-1 and B-2 (right abutment) - The soils encountered in this area primarily consisted of stiff to very stiff, fine sandy to silty CLAYS (CL) and medium dense to loose clayey fine to medium SANDS (SC). The permeability of the clays is estimated to be on the order of $1 \times 10^{-5}$ to $1 \times 10^{-7}$ cm/sec. The permeability of the clayey sands is estimated to be on the order of $1 \times 10^{-4}$ to $1 \times 10^{-5}$ cm/sec.

B-3 and B-4 (center) - The soils in this area consisted of loose to medium dense, fine to medium SANDS (SP & SM) with varying amounts of silt. The permeability of the silty sands (SM) is estimated to be on the order of $1 \times 10^{-3}$ to $1 \times 10^{-4}$ cm/sec. The cleaner sands (SP) are estimated to possess a permeability on the order of $1 \times 10^{-2}$ to $1 \times 10^{-3}$ cm/sec.

B-5 and B-6 (left abutment) - The soils in this area predominantly consisted of loose to medium dense silty fine SANDS (SM). The permeability of these sands is estimated to be on the order of $1 \times 10^{-3}$ to $1 \times 10^{-4}$ cm/sec.

STRATUM IV: Medium dense silty fine SANDS (SM) and silty CLAYS (CL & CH) with varying amounts of shell fragments were encountered below the Stratum III soils to the boring termination depths.

The permeability of these soils will vary based on the shell fragment contents and are estimated to be on the order of $1 \times 10^{-3}$ to $1 \times 10^{-5}$ cm/sec.

Groundwater was encountered at depths 4.0 to 8.5 feet, as measured from the existing roadway at the boring locations. These depths generally correspond to elevations of 39 to 42 (elevation 44 at B-6, left abutment).

Groundwater levels may fluctuate with seasonal changes, temperature variations, periods of heavy or little rainfall and other factors. Therefore, our field measurements should not be taken as absolute.

## EVALUATIONS AND RECOMMENDATIONS

### Site Preparation

The soils that were placed for the roadway should be removed from the site. These soils could be stockpiled and re-used as either core or shell material, provided that they are free of organics and other deleterious materials.

The organic layers and peat that were encountered near the center portion (bottom) of the ravine should also be removed from the dam location. Based on the borings, this removal of material is expected to be on the order of 3 to 8 feet below the original grades. The organic soils are expected to be deepest near the center of the ravine.

The walls of the excavation for the removal of the organic soils should be sloped to a maximum of 1 horizontal to 1 vertical. Shallower slopes may be required where heavy concentrations of organics are present.

The dewatering of the excavation will be necessary in order to provide a stable base for the placement of backfill material. This dewatering could be accomplished with a sump and pump method.

The removal of the unsuitable organic soils should extend a minimum of 20 feet past the upstream and downstream toes of the dam. The purpose of this additional removal of material outside of the actual dam location is for slope stability purposes.

The organic soils would not be suitable for re-use in construction of the dam. These soils could possibly be used as topsoil, however, additional testing would be necessary to confirm the suitability of these soils for this purpose.

In addition, all tree stumps present at the dam location should be removed and the resulting depressions should be properly backfilled with compacted soil.

Suitable soils for backfill should classify and be placed in accordance with the recommendations as outlined in the General Soils Notes (Appendix C) for the respective location within the dam.

## Key Trench

The key trench should extend a minimum of three feet into the Stratum III soils. The base of the key trench is anticipated to generally be on the order of 4 to 5 feet below the original site grades. The clean sands (SP) encountered at boring B-3 to a depth of approximately 9 feet should also be removed at the location of the key trench. The removal of these soils is primarily recommended due to their relatively high permeability.

Although the clean sands would probably not be suitable for construction of the dam, they could be stockpiled and possibly be used as structural fill on other projects. These soils could also be considered for use as a roadway subbase.

The base of the key trench should have a minimum width of 20 feet, as presently designed. The excavation of the key trench should be performed with either an excavator or drag line in order to minimize disturbance of the natural soils at the base of the excavation.

## Core and Shell Materials

Recommendations regarding suitable materials and their placement are included in the General Soils Notes, Appendix C.

Most of the soils to be excavated for the key trench could be re-used in the construction of the core or shell, with the exception of the previously discussed organic soils and clean sands (SP). In addition, previously observed cut materials from the construction of Edinburgh Drive would be suitable for construction of either the core or shell.

# LIMITATIONS

This report has been prepared for the exclusive use of AES or their designated agents for specific application to the referenced project in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Our evaluations and recommendations are based on design information furnished to us, the information obtained from the previously described subsurface exploration program and our previous experience. These evaluations and recommendations do not reflect the nature or extent of variations in subsurface conditions which could exist in unexplored areas of the site. Should such variations become apparent during construction, it

will be necessary to re-evaluate our evaluations and recommendations based upon an on site observation of the conditions. In the event that changes are made in the nature, design or location of the proposed dam, the evaluations and recommendations presented in this report shall not be considered valid unless the changes are reviewed by our firm and this reports evaluations and recommendations modified or verified in writing. Our firm should be given the opportunity to perform a general review of the grading plan and project specifications when the design is completed.

We recommend that this report, in its entirety, be made available to the prospective contractors for informational purposes. The boring logs and appendices should not be separated from this report.

| | |
|---|---|
| APPENDIX A | Subsurface Profile<br>Boring Logs<br>Field Exploration Procedures<br>Key to Boring Log Classification<br>Unified Soil Classification |
| APPENDIX B | Laboratory Test Results |
| APPENDIX C | General Soils Notes |
| APPENDIX D | Important Information about Your Geotechnical Engineering Report |

**ACKNOWLEDGMENT**

Froehling and Robertson, Inc. appreciates the opportunity to work with you on this project. If there are any questions or if we may be of further service, please contact our firm.

Respectfully Submitted,
**FROEHLING & ROBERTSON, INC.**

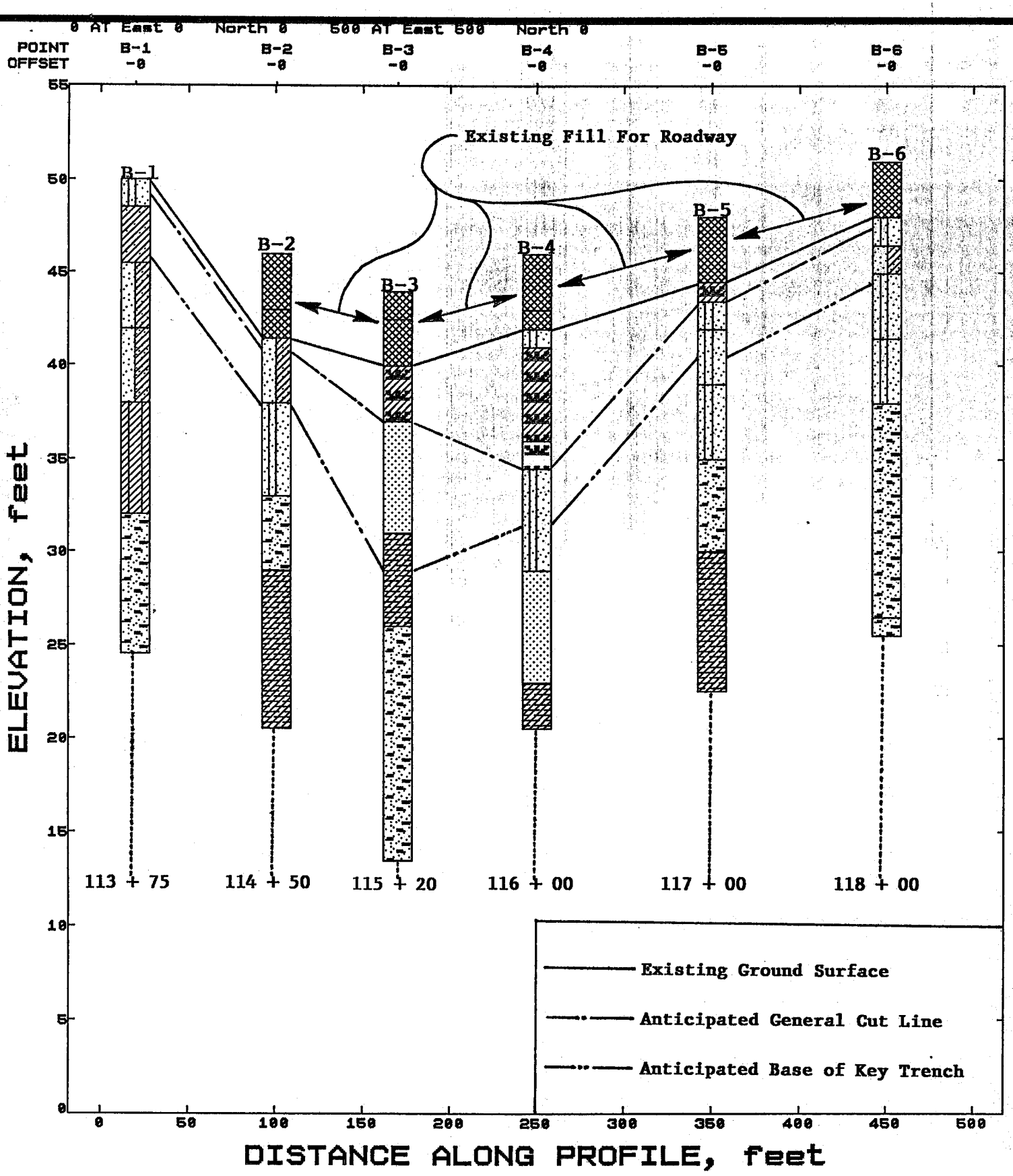
John P. Sensabaugh, P.E.
GEOTECHNICAL ENGINEER

Bruce R. Spiro, P.E.
DIRECTOR OF GEOTECHNICAL SERVICES

COMMONWEALTH OF VIRGINIA
BRUCE R. SPIRO
NO. 015791
PROFESSIONAL ENGINEER

FILE: DAM2.AES,A
3cc: AES

# APPENDIX A




**SUBSURFACE PROFILE** **FIGURE 1**

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"OVER ONE HUNDRED YEARS OF SERVICE"

CLIENT : AES
PROJECT : Dam No. 2; Ford's Colony;
LOCATION : Williamsburg, Virginia
F & R RECORD NO. : Q-61-600

# BORING LOG

SINCE 1881

**FROEHLING & ROBERTSON, INC.**
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Report No.: Q-61-600

DATE: January 25, 1990

Client: AES

Project: Dam No. 2; Ford's Colony; Williamsburg, Virginia

Boring No.: B-1 (1 of 1) | Total Depth 25.5' | Elev: 50± (Roadway) | Location: Station 113+70, Centerline

Type of Boring: Hollow Stem Auger | Started: 11/6/89 | Completed: 11/6/89 | Driller: Hill/Plum

| Elevation | Depth | DESCRIPTION OF MATERIALS (Classification) | * Sample Blows | Sample Depth (Feet) | | REMARKS |
|---|---|---|---|---|---|---|
| 48.5 | 1.5 | Dense Brown to Tan Silty Fine SAND with trace of organics, dry (SM) | 13/15/19 | 0.0 | | |
| | | | | 1.5 | | |
| | | | 10/9/13 | | | |
| | | Very Stiff Orangish Brown Fine Sandy CLAY, moist (CL) | | 3.0 | | |
| 45.5 | 4.5 | | 5/6/7 | | | |
| | | | | 4.5 | | |
| | | Medium-Dense Orangish Brown Clayey Fine to Medium SAND with trace of pebbles, wet (SC) | 9/7/7 | | | |
| | | | | 6.0 | | |
| 42.0 | 8.0 | | | | | |
| | | Loose Orangish Brown Clayey Fine to Medium SAND, wet (SC) | | 9.0 | | Groundwater encountered at a depth of 8.5 feet during drilling |
| | | | 4/3/4 | | | |
| | | | | 10.5 | | |
| 38.0 | 12.0 | | | | | |
| | | Stiff Reddish Brown Silty CLAY, wet (CL) | | | | |
| | | | | 14.0 | | |
| | | | 4/7/7 | | | |
| | | | | 15.5 | | |
| 32.0 | 18.0 | | | | | |
| | | Medium Dense to Loose Tan Silty Fine SAND and SHELL FRAGMENTS, wet (SM) | | 19.0 | | |
| | | | 4/5/5 | | | |
| | | | | 20.5 | | |
| | | | | 24.0 | | |
| | | | 5/4/5 | | | |
| 24.5 | 25.5 | | | 25.5 | | |
| | | Boring Terminated at 25.5' | | | | |

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

# BORING LOG

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*"OVER ONE HUNDRED YEARS OF SERVICE"*

Report No.: Q-61-600

DATE: January 25, 1990

Client: AES

Project: Dam No. 2; Ford's Colony; Williamsburg, Virginia

Boring No.: B-2 (1 of 1) | Total Depth 25.5' | Elev: 46± (Roadway) | Location: STA 114+50, Centerline

Type of Boring: Hollow Stem Auger | Started: 11/6/89 | Completed: 11/6/89 | Driller: Hill/Plum

| Elevation | Depth | DESCRIPTION OF MATERIALS (Classification) | * Sample Blows | Sample Depth (Feet) | | REMARKS |
|---|---|---|---|---|---|---|
| | | Stiff Orangish Brown Fine Sandy CLAY, dry (FILL, CL) | 8/6/6 | 0.0 | | |
| | | | | 1.5 | | |
| | | | 6/4/3 | | | |
| 43.0 | 3.0 | | | 3.0 | | |
| | | Soft Orangish Brown Silty CLAY with trace of fine sand, moist (FILL, CL) | 2/2/1 | | | |
| 41.5 | 4.5 | | | 4.5 | | |
| | | | 2/2/1 | | | |
| | | | | 6.0 | | |
| | | Very Loose Dark Gray Clayey Fine SAND with trace of shell fragments, moist (SC) | | | | |
| 38.0 | 8.0 | | | | | Groundwater encountered at a depth of 7.0 feet during drilling |
| | | | | 9.0 | | |
| | | Loose Dark Gray Silty Fine SAND with pockets of organics, wet (SM) | 3/3/3 | | | |
| | | | | 10.5 | | |
| 33.0 | 13.0 | | | | | |
| | | Medium Dense Tan Silty Fine SAND and SHELL FRAGMENTS, wet (SM) | | 14.0 | | |
| | | | 5/4/6 | | | |
| | | | | 15.5 | | |
| 29.0 | 17.0 | | | | | |
| | | Very Stiff Gray Silty CLAY with little shell fragments and fine sand, wet (CH) | | | | |
| | | | | 19.0 | | |
| | | | 4/6/8 | | | |
| | | | | 20.5 | | |
| | | | | 24.0 | | |
| | | | 5/7/10 | | | |
| 20.5 | 25.5 | | | 25.5 | | |
| | | Boring Terminated at 25.5' | | | | |

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

# BORING LOG

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Report No.: Q-61-600

DATE: January 25, 1990

Client: AES

Project: Dam No. 2; Ford's Colony; Williamsburg, Virginia

Boring No.: B-3 (1 of 1) | Total Depth 30.5' | Elev: 44± (Roadway) | Location: STA 115+20, 10' Right of C.L.

Type of Boring: Hollow Stem Auger | Started: 11/4/89 | Completed: 11/6/89 | Driller: Hill/Plum

| Elevation | Depth | DESCRIPTION OF MATERIALS (Classification) | * Sample Blows | Sample Depth (Feet) | | REMARKS |
|---|---|---|---|---|---|---|
| 42.5 | 1.5 | Medium Dense Orangish Brown Clayey Fine to Medium SAND, dry (FILL, SC) | 11/7/7 | 0.0 | | |
| | | | 9/8/8 | 1.5 | | |
| 40.0 | 4.0 | Very Stiff Orangish Brown Fine to Medium Sandy CLAY, dry (FILL, CL) | 5/5/4 | 3.0 | | |
| | | | 2/1/3 | 4.5 | | Groundwater encountered at a depth of 4.0 feet during drilling |
| 37.0 | 7.0 | Soft to Stiff Dark Brown to Black Organic Fine Sandy CLAY, wet (CL-OL) | 2/4/5 | 6.0 | | |
| | | Loose Gray Fine to Medium SAND with trace of silt, wet (SP) | | 7.5 | | |
| | | | 4/2/5 | 9.0 | | |
| 31.0 | 13.0 | | | 10.5 | | |
| | | Firm Gray Silty CLAY with little Fine Sand and trace of shell fragments, wet (CL) | 3/2/3 | 14.0 | | |
| 26.0 | 18.0 | | | 15.5 | | |
| | | Medium Dense Gray Clayey Fine SAND and SHELL FRAGMENTS, wet | 4/5/9 | 19.0 | | |
| | | | 5/6/11 | 20.5 | | |
| | | | | 24.0 | | |
| | | | | 25.5 | | |
| | | | 5/5/10 | 29.0 | | |
| 13.5 | 30.5 | | | 30.5 | | |
| | | Boring Terminated at 30.5' | | | | |

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

# BORING LOG

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Report No.: Q-61-600

DATE: January 25, 1990

Client: AES

Project: Dam No. 2; Ford's Colony; Williamsburg, Virginia

Boring No.: B-4 (1 of 1) | Total Depth 25.5' | Elev: 46± (Roadway) | Location: STA 116+00, Centerline

Type of Boring: Hollow Stem Auger | Started: 11/3/89 | Completed: 11/3/89 | Driller: Hill/Plum

| Elevation | Depth | DESCRIPTION OF MATERIALS (Classification) | * Sample Blows | Sample Depth (Feet) | | REMARKS |
|---|---|---|---|---|---|---|
| | | Very Stiff Orangish Brown Fine Sandy CLAY, moist (FILL, CL) | 13/10/10 | 0.0 | | |
| | | | | 1.5 | | |
| | | | 9/9/12 | | | |
| 43.0 | 3.0 | | | 3.0 | | |
| 42.0 | 4.0 | Loose Orangish Brown Clayey Fine SAND, moist (FILL, SC) | 5/3/4 | | | |
| 41.0 | 5.0 | | | 4.5 | | |
| | | | 2/4/4 | | | Groundwater encountered at a depth of 4.0 feet during drilling |
| | | Loose Dark Brown to Black Silty Fine SAND with organics, wet (SM) | | 6.0 | | |
| | | Firm Dark Brown to Black Organic Silty CLAY with roots, wet (CL-OL) | | 9.0 | | |
| 36.0 | 10.0 | | 2/1/3 | | | |
| | | Black PEAT, wet (PT) | | 10.5 | | |
| 34.5 | 11.5 | | 3/4/4 | | | |
| | | Loose to Medium Dense Gray Silty Fine SAND, with lenses of peat @ 12', wet (SM) | | 12.0 | | |
| | | | | 14.0 | | |
| | | | 5/6/9 | | | |
| | | | | 15.5 | | |
| 29.0 | 17.0 | | | | | |
| | | Medium Dense Gray Fine to Medium SAND with trace of silt, wet (SP) | | 19.0 | | |
| | | | 7/9/7 | | | |
| | | | | 20.5 | | |
| 23.0 | 23.0 | | | | | |
| | | Stiff Gray Silty CLAY and SHELL FRAGMENTS with little fine sand, wet (CL) | | 24.0 | | |
| 20.5 | 25.5 | | 4/5/5 | 25.5 | | |
| | | Boring Terminated at 25.5' | | | | |

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

# BORING LOG

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Report No.: Q-61-600

DATE: January 25, 1990

Client: AES

Project: Dam No. 2; Ford's Colony; Williamsburg, Virginia

Boring No.: B-5 (1 of 1) | Total Depth 25.5' | Elev: 48± (Roadway) | Location: STA 117+00 Centerline

Type of Boring: Hollow Stem Auger | Started: 11/3/89 | Completed: 11/3/89 | Driller: Hill/Plum

| Elevation | Depth | DESCRIPTION OF MATERIALS (Classification) | * Sample Blows | Sample Depth (Feet) | | REMARKS |
|---|---|---|---|---|---|---|
| | | Very Stiff to Stiff Orangish Brown Fine Sandy CLAY, moist (FILL, CL) | 12/10/10 | 0.0 | | |
| | | | | 1.5 | | |
| | | | 6/5/5 | | | |
| 44.5 | 3.5 | | | 3.0 | | |
| 43.5 | 4.5 | Firm Dark Brown and Black Organic Silty CLAY with trace of fine sand, moist (CL) | 3/2/5 | 4.5 | | |
| 42.0 | 6.0 | | 2/1/2 | 6.0 | | |
| | | Very Loose Dark Brown Silty Fine SAND with trace of clay, moist (SM) | 3/4/5 | 7.5 | | Groundwater encountered at a depth of 7.0 feet during drilling |
| 39.0 | 9.0 | Loose Gray Silty Fine SAND, Moist (SM) | | 9.0 | | |
| | | Medium Dense Tan Silty Fine SAND, wet (SM) | 6/6/5 | 10.5 | | |
| 35.0 | 13.0 | | | | | |
| | | Loose Gray Silty Fine SAND and SHELL FRAGMENTS, wet (SM) | | 14.0 | | |
| | | | 5/5/4 | 15.5 | | |
| 30.0 | 18.0 | | | | | |
| | | Stiff Gray Silty CLAY with trace of fine sand and shell fragments, moist (CH) | | 19.0 | | |
| | | | 5/6/7 | 20.5 | | |
| | | | | 24.0 | | |
| 22.5 | 25.5 | | 4/6/6 | 25.5 | | |
| | | Boring Terminated at 25.5' | | | | |

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

# BORING LOG

SINCE 1881

**FROEHLING & ROBERTSON, INC.**
FULL SERVICE LABORATORIES • ENGINEERS & CHEMISTS
*"OVER ONE HUNDRED YEARS OF SERVICE"*

Report No.: Q-61-600 DATE: January 25, 1990

Client: AES

Project: Dam No. 2; Ford's Colony; Williamsburg, Virginia

Boring No.: B-6 (1 of 1) | Total Depth 25.5' | Elev: 51± (Roadway) | Location: STA 118+00 Centerline

Type of Boring: Hollow Stem Auger | Started: 11/3/89 Completed: 11/3/89 | Driller: Hill/Plum

| Elevation | Depth | DESCRIPTION OF MATERIALS (Classification) | * Sample Blows | Sample Depth (Feet) | | REMARKS |
|---|---|---|---|---|---|---|
| | | Very Stiff to Stiff Orangish Brown Fine Sandy CLAY, moist (FILL, CL) | 9/14/10 | 0.0 | | |
| | | | | 1.5 | | |
| | | | 5/6/7 | | | |
| 48.0 | 3.0 | | | 3.0 | | |
| | | Loose Gray Silty Fine SAND with trace of roots, moist (SM) | 5/5/4 | | | |
| 46.5 | 4.5 | | | 4.5 | | |
| | | | 3/2/2 | | | |
| 45.0 | 6.0 | | | 6.0 | | |
| | | Loose Dark Brown Clayey Fine SAND with trace of roots, moist (SC) | | | | Groundwater encountered at a depth of 7.0 feet during drilling |
| | | Loose Gray Silty Fine SAND, wet (SM) | | 9.0 | | |
| 41.5 | 9.5 | | 3/3/2 | | | |
| | | Loose Tan Silty Fine SAND, wet (SM) | | 10.5 | | |
| 38.0 | 13.0 | | | | | |
| | | Medium Dense Tan Silty Fine SAND and SHELL FRAGMENTS, wet (SM) | | 14.0 | | |
| | | | 5/8/11 | 15.5 | | |
| | | | | 19.0 | | |
| | | | 5/5/5 | 20.5 | | |
| | | | | 24.0 | | |
| 26.5 | 24.5 | | 7/9/10 | | | |
| 25.5 | 25.5 | | | 25.5 | | |
| | | Medium Dense Gray Silty Fine SAND and SHELL FRAGMENTS, wet (SM) | | | | |
| | | Boring Terminated at 25.5' | | | | |

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

## FIELD EXPLORATION PROCEDURES

### Disturbed Sampling

Soil test borings were drilled in accordance with ASTM D-1586 procedures with a CME-55 truck mounted drill rig, by mechanically advancing hollow stem auger flights into the ground. At regular intervals, the plug was removed from the auger head, and soil samples were obtained with a standard 1.4" I.D., 2" O.D. 20" long split tube sampler. The sampler was attached to the end of "AW" size drill rods and lowered through the augers to sampling elevation. The sampler was first seated to penetrate loose cuttings and disturbed soil, then driven an additional foot with blows of a 140 lb. hammer falling 30". The sampler was then extracted from the soil, the plug reinserted into the auger head, and the auger advanced to the next sampling elevation. The number of blows required to drive the sampler each 6" increment of penetration was recorded and is shown on the boring logs. The number of blows required to drive the sampler the final 12" is termed the penetration resistance. The penetration resistance, when properly evaluated, is an index to soil density, strength and foundation support capacity.

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1881

# KEY TO BORING LOG SOIL CLASSIFICATIONS

## Soils Identification

IDENTIFICATION OF SOIL TYPE IS MADE ON THE BASIS OF AN ESTIMATE OF PARTICLE SIZE FOR PREDOMINANTLY COARSE-GRAINED SOILS AND ON THE BASIS OF COHESIVENESS (PLASTICITY) FOR PREDOMINANTLY FINE-GRAINED SOILS. WHEN A SOIL SAMPLE CONSISTS OF TWO OR MORE SOIL TYPES, THE PERCENTAGES OF THE TYPES ARE ESTIMATED BY WEIGHT AND INDICATED BY DESCRIPTIVE TERMINOLOGY.

| Soil Type | Particle Size |
|---|---|
| Boulder | > 12 in. |
| Cobble | 3 - 12 in. |
| Gravel-Coarse | 3/4 - 3 in. |
| -Fine | #4 - 3/4 in. |
| Sand - Coarse | #10 - #4 |
| - Medium | #40 - #10 |
| - Fine | #200 - #40 |
| Silt (non-cohesive) | < #200 |
| Clay (cohesive) | < #200 |

| Soil Component | Descriptive Term | Percentage |
|---|---|---|
| Major | Uppercase Letters | > 50 % |
| Secondary | Adjective | 20 - 50 % |
| Others | Some | 20 - 35 % |
| | Little | 10 - 20 % |
| | Trace | 0 - 10 % |

Notes: 1) Particle size is designated by U.S. Standard Sieve Sizes.

2) Atterberg Limit determinations are often used to classify fine-grained soils (silts and clays).

## Relative Density or Consistency

THE STANDARD PENETRATION RESISTANCE VALUES (N-VALUES) ARE USED TO DESCRIBE THE RELATIVE DENSITY OF COARSE-GRAINED SOILS OR THE CONSISTENCY OF FINE-GRAINED SOILS.

RELATIVE DENSITY

| Term | N-Value |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 5 - 10 |
| Medium-Dense | 11 - 30 |
| Dense | 31 - 50 |
| Very Dense | > 50 |

CONSISTENCY

| Term | N-Value |
|---|---|
| Very Soft | 0 - 1 |
| Soft | 2 - 4 |
| Firm | 5 - 8 |
| Stiff | 9 - 15 |
| Very Stiff | 16 - 30 |
| Hard | > 30 |

Notes: 1) The N-value is the number of blows of a 140 lb. hammer freely falling 30 inches required to drive a standard split spoon sampler (2.0 in. O.D., 1 3/8 in I.D.) 12 inches into the soil after properly seating the sampler into undisturbed soils.

2) Large gravel size particles are often not recovered by the standard split-spoon sampler and therefore the true percentage of gravel not accurately estimated.

3) When encountered, large gravel size particles often increase the N-value of the standard penetration test.

# APPENDIX B

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# LABORATORY TEST RESULTS

| Boring | B-1 | B-1 | B-2 | B-3 | B-4 | B-4 |
|---|---|---|---|---|---|---|
| Depth (ft.) | 3.0-4.5 | 9.0-10.5 | 4.5-6.0 | 4.5-6.0 | 4.5-5.0 | 11.5-12.0 |
| Percent Passing Sieve Size | | | | | | |
| 3/8" | | | 100 | | | |
| No. 4 | 100 | 100 | 99 | | | |
| No. 10 | 99 | 97 | 95 | 100 | 100 | |
| No. 20 | 95 | 87 | 93 | 98 | 99 | 100 |
| No. 40 | 88 | 73 | 89 | 93 | 95 | 97 |
| No. 60 | 81 | 59 | 61 | 82 | 84 | 89 |
| No.100 | 67 | 47 | 40 | 65 | 63 | 70 |
| No.200 | 54.6 | 38.0 | 27.4 | 50.0 | 38.0 | 43.8 |
| Liquid Limit | 50 | 56 | 36 | 29 | 24 | — |
| Liquid Limit* | — | — | — | 22 | 24 | — |
| Plasticity Index | 25 | 36 | 20 | 17 | 3 | — |
| Classification | CL | SC | SC | CL-OL | SM | — |

* Oven Dry

NP - denotes non-plastic

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# LABORATORY TEST RESULTS

| Sample Location | B-5 | B-6 | B-3 | B-4 |
|---|---|---|---|---|
| Sample Depth (ft.) | 6.0-7.5 | 4.5-6.0 | 9.0-10.5 | 14.0-15.5 |
| **Percent Passing Sieve Size** | | | | |
| No. 10 | 100 | 100 | 100 | |
| No. 20 | 98 | 99 | 99 | 100 |
| No. 40 | 90 | 93 | 82 | 99 |
| No. 60 | 71 | 80 | 31 | 86 |
| No.100 | 43 | 60 | 6.3 | 51 |
| No.200 | 27.3 | 39.5 | 1.9 | 26.5 |
| Liquid Limit: | NP | 38 | NP* | NP |
| Plasticity Index: | — | — | NP | NP |
| Classification: | SM | SC | SP | SM |

* Denotes non-plastic

# APPENDIX C

## GENERAL SOILS NOTES

1. Suitable soils shall classify in accordance with the Unified Soil Classification as follows:

   Core: SM or SC with minimum of 35% passing the number 200 sieve, or CL

   Shell: SM, SC, ML or CL

2. All soils shall be compacted to a minimum of 95% of the maximum dry density as defined by ASTM D-698.

3. All soils shall be placed in lifts of maximum thickness of 8 inches.

4. Moisture content of soils during placement and compaction shall be within the following ranges:

   Core: -1% to +3% of optimum as defined by ASTM D-698. Moisture content of core soils after placement shall be maintained during construction.

   Shell: -3% to +3% of optimum as defined by ASTM D-698.

5. All subgrade soils at base of excavation for key trench and all foundation soils at the dam, shall be inspected by the geotechnical engineer prior to the placement of fill soils.

6. Field density tests shall be performed in accordance with ASTM D-2922 or D-1556 procedures. One test shall be performed per 5,000 square feet of lift, with a minimum of 4 tests per lift.

# APPENDIX D

# IMPORTANT INFORMATION
## ABOUT YOUR
# GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

## A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used*:

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

*Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.*

## MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

## SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

## GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

## A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

## BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

## READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

## OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

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0788/3M

| | | | | | |
|---|---|---|---|---|---|
| WATERSHED | PC | MAINTENANCE PLAN | No | CTRL STRUC DESC | |
| BMP ID NO | 079 | SITE AREA acre | 2400 | CTRL STRUC SIZE Inches | |
| PLAN NO | SP-7-86 | LAND USE | SF Residential | OTLT BARRL DESC | |
| TAX PARCEL | (30-4)(1-2) | old BMP TYP | Wet Pond | OTLT BARRL SIZE Inch | |
| PIN NO | 3040100002 | JCC BMP CODE | | | |
| CONSTRUCTION DATE | | POINT VALUE | 6 | EMERG SPILLWAY | No |
| PROJECT NAME | Fords Colony Dam No. 2 | | | DESIGN HW ELEV | |
| FACILITY LOCATION | Fairway # 5 & # 8 at St. Andrews Drive | | | PERM POOL ELE | |
| CITY-STATE | Williamsburg, VA | SVC DRAIN AREA acres | 147 | 2-YR OUTFLOW cfs | |
| CURRENT OWNER | Fords Colony Country Club Inc. | | | 10-YR OUTFLOW cfs | |
| OWNER ADDRESS | 240 Fords Colony Drive | | | REC DRAWING | No |
| OWNER ADDRESS 2 | | SERVICE AREA DESCRI | SF Lots, Roads, Woods Sec 8 | | |
| CITY-STATE-ZIP CODE | Williamsburg, VA 23188 | IMPERV AREA acres | | CONSTR CERTI | No |
| OWNER PHONE | | RECV STREAM | UT of Powhatan Creek | | |
| MAINT AGREEMENT | Yes | EXT DET-WQ-CTRL | No | LAST INSP DATE | 8/28/2000 |
| EMERG ACTION PLAN | No | WTR QUAL VOL acre-ft | 43.2 | INTERNAL RATING | 4 |
| | | CHAN PROT CTRL | No | MISC/COMMENTS | |
| | | CHAN PROT VOL acre-ft | 0 | Limited Info. Design Type 5. Sec 8B S-5-99. | |
| | | SW/FLOOD CONTROL | Yes | | |
| | | GEOTECH REPORT | No | | |

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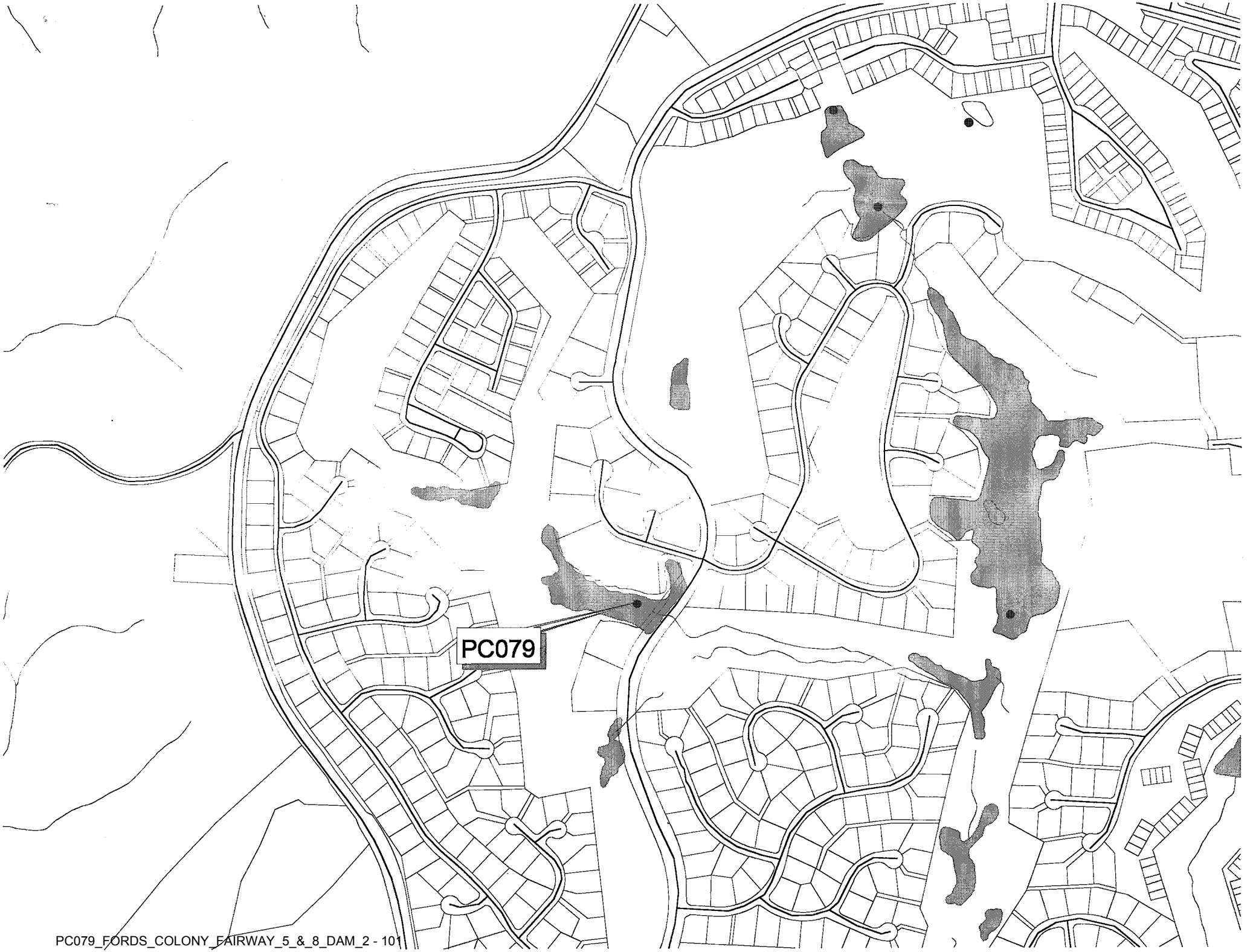


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