Stormwater Division

MEMORANDUM

DATE: March 4, 2010

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

FROM: Jo Anna Ripley, Stormwater

PO: 270712

RE: Files Approved for Scanning

General File ID or BMP ID: 99113

PIN: 3210100012

Subdivision, Tract, Business or Owner Name (if known): Warhill Tract

Property Description: General Files

Site Address: 5700 Warhill Trail and 4615 Opportunity Way

(For internal use only) **Box** 5 **Drawer:** 3

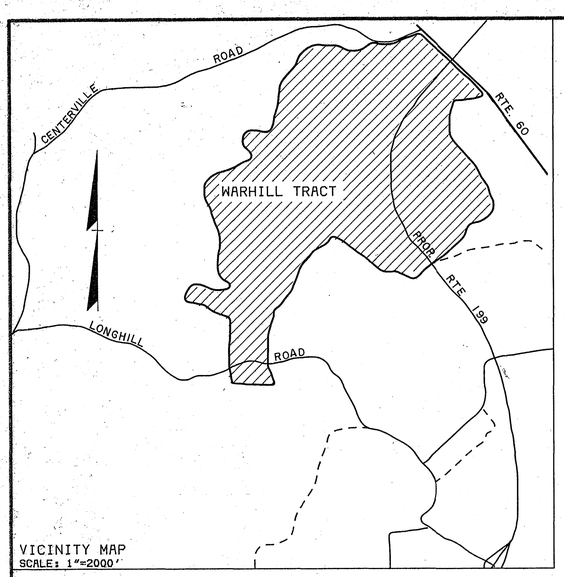
Agreements: (in file as of scan date) N **Book or Doc#:** **Page:**

Comments
Master Plan, Warhill Lakes Plan, Warhill Tract Erosion and Sediment Control Plan

Contents for Stormwater Management Facilities As-built Files

Each File is to contain:

- ☐ 1. Maintenance Agreement
- ☐ 2. Construction certification
- ☐ 3. As-Built plan
- ☐ 4. Design Calculations
- ☐ 6. Correspondence
- ☐ 7. Inspection records
- ☐ 8. Miscellaneous



VICINITY MAP
SCALE: 1"=2000'

LEGEND

- 25' PAVEMENT
- SUB DISTRICT BOUNDARY
- PROPERTY LINE

NOTE: ALL R/W WIDTHS ARE 50' UNLESS OTHERWISE NOTED

PLAN SCALE: 1"= 400'

EXHIBIT 4

Scale = 1:400

MASTER PLAN SCHEDULE – PUDR DISTRICT

AREA	ACREAGE	USEAGE	PHASING	DENSITY	ALLOWABLE UNITS
1	6	C	I	16units/acre	96
2	8	B	I	13	105
3	15	A	I	5.5	82
4	14	B	I	13	182
5	186	A	II	5.5 - 7.5	1087
6	18	B	II	13	234
7	25	D	II	18	450
8	31	E	II	–	–
9	25	D	II	18	450
TOTAL	328				2686

REVISIONS

WARHILL TRACT

MASTER PLAN

DESIGN | DRAWN | CHECKED | PROJ. MGR.

DATE | APPROVED BY: | SCALE AS SHOWN | DATE

BALDWIN & GRIGG
ENGINEERS • SURVEYORS • PLANNERS

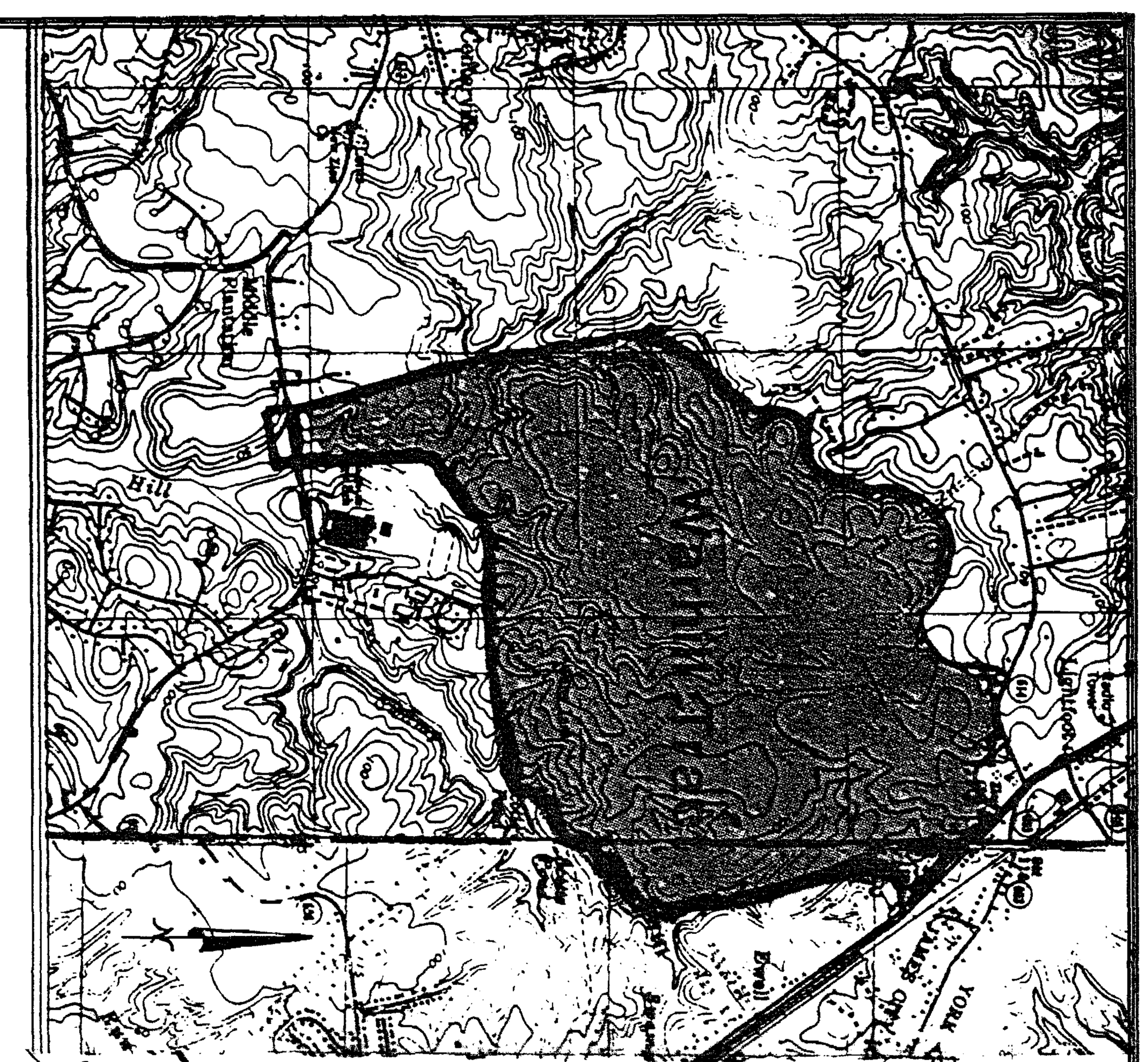
JOB NO:

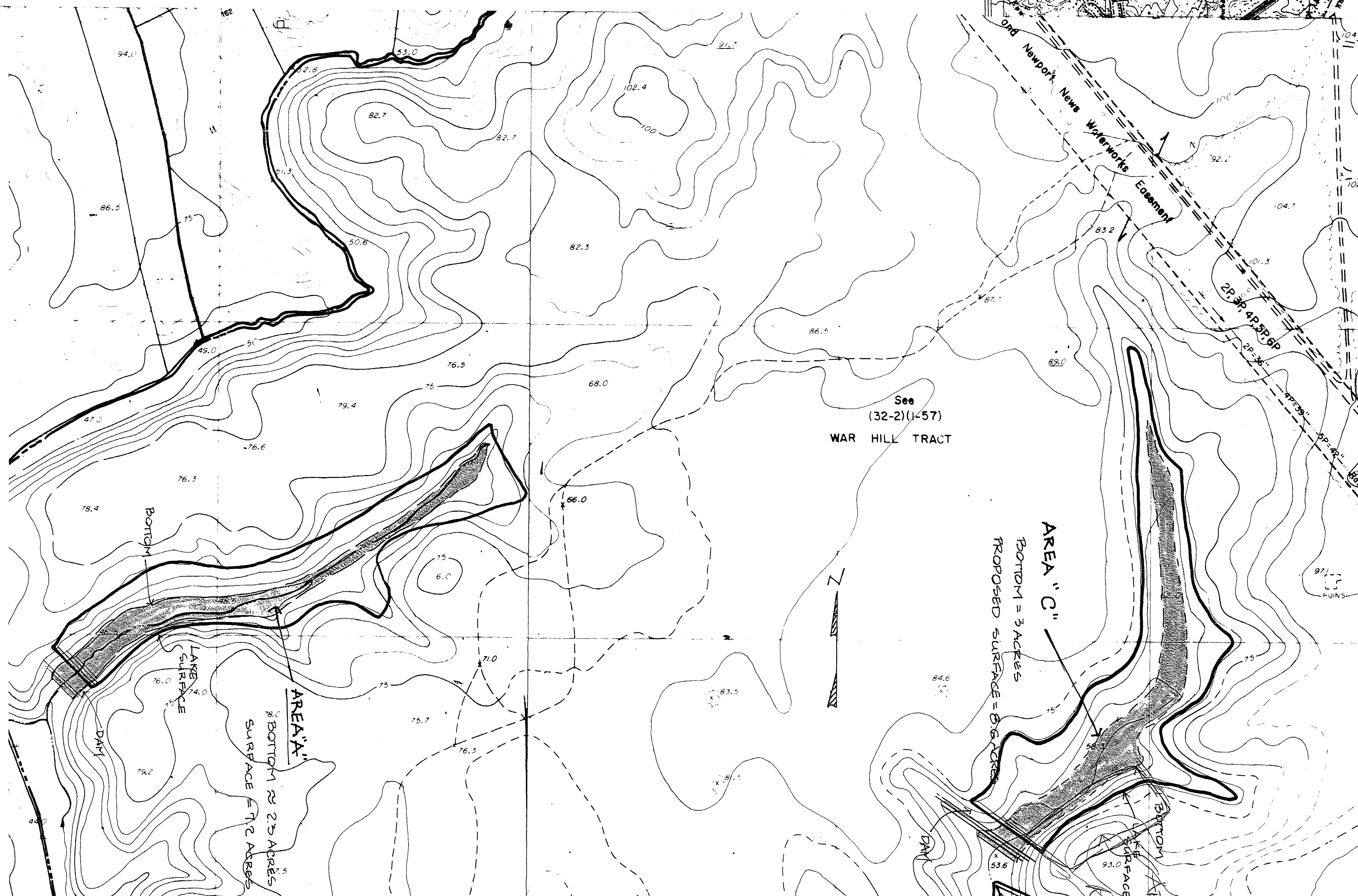
DRAWING NO:

SHEET OF

F.B.

VICINITY MAP
SCALE: 1" = 2,000'





Job Number 87169	WARHILL LAKES PLAN
Sheet No. 1 of 1	JAMES CITY COUNTY VIRGINIA

No.	By	Revision	App.	Date

Rickmond Engineering, Inc.
1643-C Merrimac Trail
Williamsburg VA 23185
(804)229-1776 or 875-1785
Civil Engineering
Environmental Engineering
Land Development Planning

Designed By:	Drawn By:	Approved By:	Scale:	Date:	Job No.:
RCS	RCS	DCR	1" = 200'	10/12/87	87169

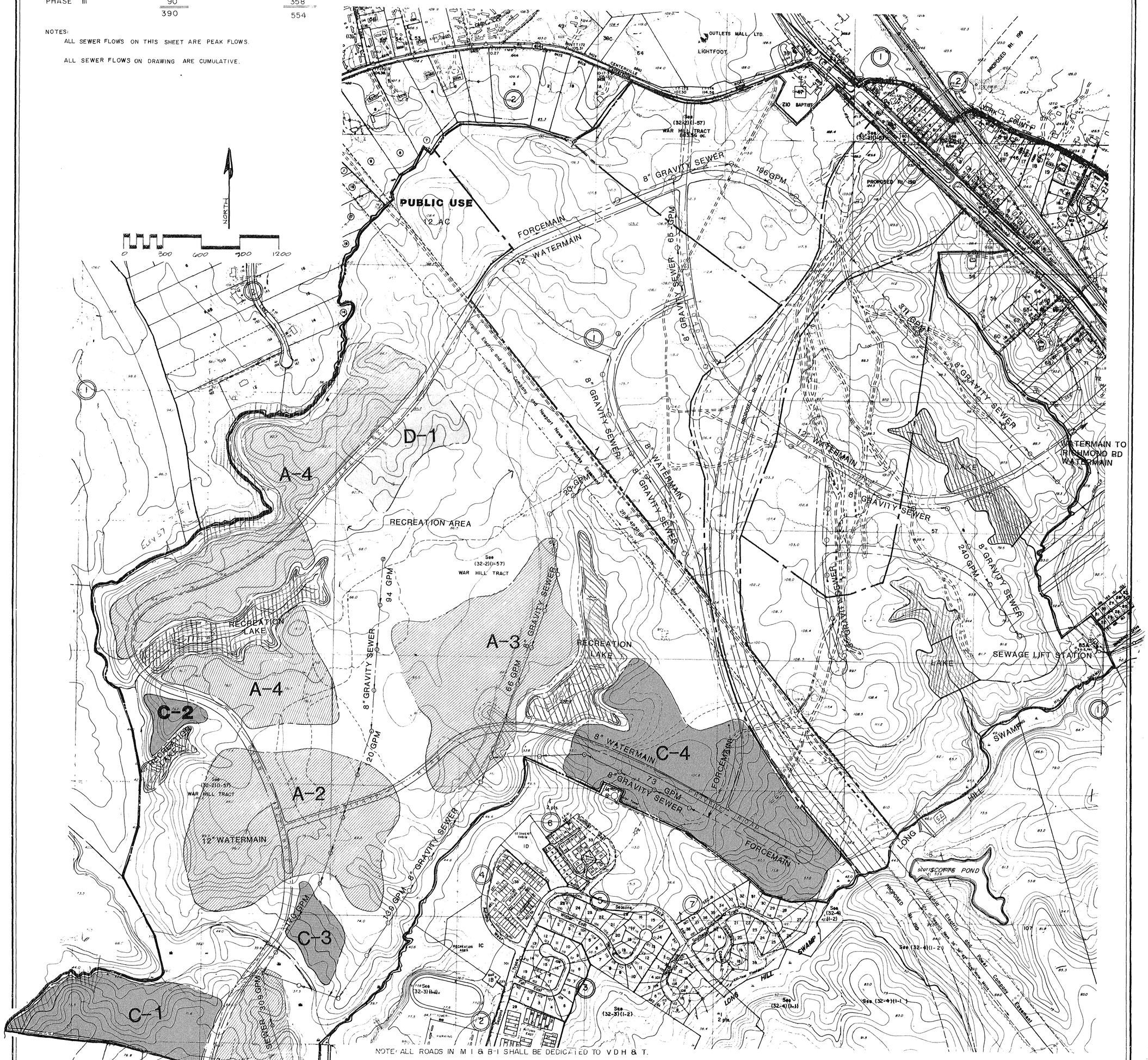
PHASE PLAN FOR SANITARY SEWER SYSTEM

	LONGHILL ROAD SIDE (GPM)	SEWAGE LIFT STATION ON RICHMOND ROAD (GPM)
PHASE I	285	88
PHASE II	15	108
PHASE III	90	358
	390	554

NOTES:

ALL SEWER FLOWS ON THIS SHEET ARE PEAK FLOWS.

ALL SEWER FLOWS ON DRAWING ARE CUMULATIVE.



NOTE: ALL ROADS IN M I & B-I SHALL BE DEDICATED TO VDH & T.

RESIDENTIAL PHASING STATISTICS

SECTION	NO. OF UNITS/LOT	AREA (ACRES)	DENSITY (UNITS/ACRE)
PHASE I (0-5years)			
A-1	70	27	2.59
A-2	90	39	2.30
A-3	120	35	3.43
A-4 (Seven Springs)	195	60	3.25
C-1 (Beaver Lake)	100	17	5.88
C-2 (Deer Lake)	20	4	5.00
D-1	100	9	11.11
PHASE II (5-10years)			
C-3	40	6	6.67
PHASE III (10-20years)			
C-4	192	42	4.57
C-5	41	9	4.56
TOTAL RESIDENTIAL	968	248	3.90
TOTAL SITE	968	484	2.00

(INCLUDES NON RESIDENTIAL AMENITY, GOLF COURSES, LAKES & OPEN SPACES & PUBLIC USE.)

GENERAL BUSINESS & INDUSTRIAL PHASING STATISTICS

SECTION	SQUARE FOOTAGE	ACREAGE
PHASE I (0-5 years)		
GENERAL COMMERCIAL (B-1)	200,000	14
OFFICE PARK (B-1)	60,000	5
INDUSTRIAL (M-1)	300,000	28
PHASE II (5-10years)		
GENERAL COMMERCIAL (B-1)	200,000	14
OFFICE PARK (B-1)	60,000	5
INDUSTRIAL (M-1)	300,000	28
PHASE III (10-20 years)		
GENERAL COMMERCIAL (B-1)	816,750	37
OFFICE PARK (B-1)	272,250	13
INDUSTRIAL (M-1)	784,080	98
TOTALS		
30% (ROADS, STREETS, PUBLIC USE, ETC.)		103
GENERAL COMMERCIAL (B-1)	1,216750	65
OFFICE PARK (B-1)	392,250	23
TOTAL (B-1)	1,609,000	88
INDUSTRIAL (M-1)	1,384,080	154
RT. 199 R.O.W.		69
TOTAL		414

PROJ. MASTER PLAN | DATE 12-17-86 | SCALE 1" = 300' | PROJ MAN RCS | DR NO. 8617G | DWN CER | APP DCR

1986 PHASING PLAN & SECTION STATISTICS

WARHILL TRACT

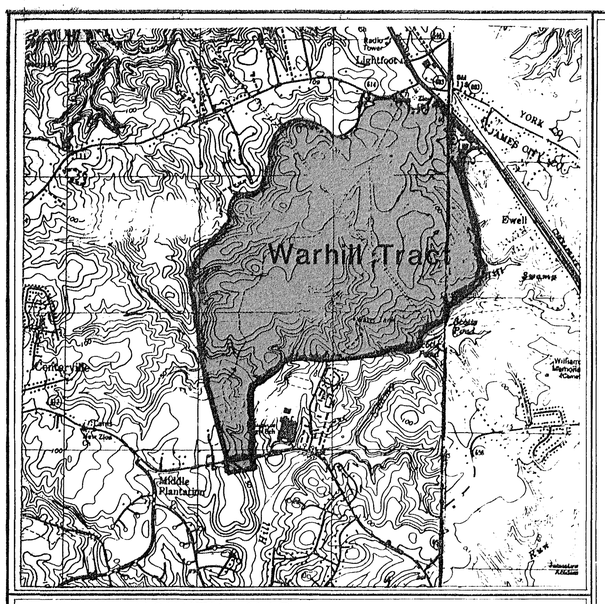
OWNER/DEVELOPER: JACK SCRUGGS, VIRGINIA INTERNATIONAL REALTY

POWHATAN DISTRICT | JAMES CITY COUNTY | EXHIBIT 4 | VIRGINIA

NO.	DATE	REVISIONS	BY	APP
2	2-2-87	REVISED PER MEMO DTD 1-27-87, COUNTY	BMc	DCR
1	1-20-87	REVISED PER COMMENTS	CER	DCR

COMMONWEALTH OF VIRGINIA — D. C. RICKMOND, JR. — No. 9648 — PROFESSIONAL ENGINEER

RICKMOND ENGINEERING INC.
208 C PACKETS COURT
WILLIAMSBURG, VA 23185
(804) 229-1776
CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING



VICINITY MAP SCALE: 1" = 2000'

NORTH

0 300 600 900 1200

GRAPHIC SCALE

CENTERVILLE ROAD

TO RICHMOND

ROUTE 60

TO WILLIAMSBURG

BUFFER ZONE

AREA RESERVED FROM DEVELOPMENT UNTIL EXACT LOCATION OF ROAD CAN BE DETERMINED

GENERAL BUSINESS

PUBLIC USE
12 AC

LIGHT INDUSTRIAL PARK

VIRGINIA POWER & CITY OF NEWPORT NEWS WATERWORKS EASEMENT

PROPOSED ROUTE 199

GENERAL BUSINESS

BUFFER ZONE

LOOP ROAD

LAKE

LAKE

LIGHT INDUSTRIAL PARK

BUFFER ZONE

SWAMP

BUFFER ZONE

LONG HILL

GOLF CLUB.
PRO SHOP.
SWIM/TENNIS CLUB

PRIVATE ROAD

RECREATION LAKE

RECREATION LAKE

RECREATION LAKE

PRIVATE ROAD

PRIVATE ROAD

PRIVATE ROAD

PRIVATE ROAD

RECREATIONAL AREA

RECREATIONAL AREA

A

A

A

A

A

C

C

C

C

D

NOTE: ALL ROADS IN M-1 & B-1 SHALL BE DEDICATED TO VDH & T.

POND (TYP)

BERM (TYP)

LONG HILL RD.

RESIDENTIAL LAND USE TABULATION

RESIDENTIAL "A"

TOTAL NUMBER OF LOTS	475 LOTS
GROSS AREA OF RESIDENTIAL "A"	161 Ac.
PERMITTED DENSITY	4 LOTS/ACRE
LOT DENSITY	2.95 LOTS/ACRE

RESIDENTIAL "C"

TOTAL NUMBER OF UNITS	393 UNITS
GROSS AREA OF RESIDENTIAL "C"	78 Ac.
PERMITTED DENSITY	12 UNITS/ACRE
UNIT DENSITY	5.04 UNITS/ACRE

RESIDENTIAL "D"

TOTAL NUMBER OF UNITS	100 UNITS
GROSS AREA OF RESIDENTIAL "D"	9 Ac.
PERMITTED DENSITY	18 UNITS/ACRE
UNIT DENSITY	11.11 UNITS/ACRE

OPEN SPACE

PUBLIC USE	12 Ac.
NON RESIDENTIAL AMENITY AND SERVICE SITES	12 Ac.
GOLF COURSE, LAKES AND BUFFERS, MARSH RESERVE	212 Ac.
OPEN SPACE WITHIN RESIDENTIAL AREAS	9 Ac.
TOTAL AREA OF OPEN SPACE	245 Ac.
TOTAL AREA OF PROJECT	484 Ac.
% OF OPEN AREA	51 %

OVERALL DENSITY

TOTAL PROJECT AREA	484 Ac.
TOTAL NUMBER OF RESIDENTIAL UNITS	968 UNITS
OVERALL PROJECT DENSITY	2.00 UNITS/ACRE

COMMERCIAL LAND USE TABULATION

GENERAL BUSINESS & INDUSTRIAL

GENERAL COMMERCIAL	1,216,750 S.F.	65 Ac
OFFICE PARK	392,250 S.F.	23 Ac.
INDUSTRIAL	1,384,080 S.F.	154 Ac.
RT. 199 R.O.W.		69 Ac.
30 % (ROADS, STREETS, ETC.)		103 Ac.
TOTAL		414 Ac.

RECEIVED FEB 1987 PLANNING DEPARTMENT

SHEET 1 OF 2

PROJ MASTER PLAN | DATE 12-17-86 | JOB NO 86176 | SCALE 1"= 300' | DWN CER | PROJMAN RCS | APP DCR

1986 MASTER PLAN

WARHILL TRACT

OWNER/DEVELOPER: JACK SCRUGGS , VIRGINIA INTERNATIONAL REALTY

POWHATAN DISTRICT JAMES CITY COUNTY EXHIBIT 4 VIRGINIA

NO	DATE	REVISIONS	BY	APP
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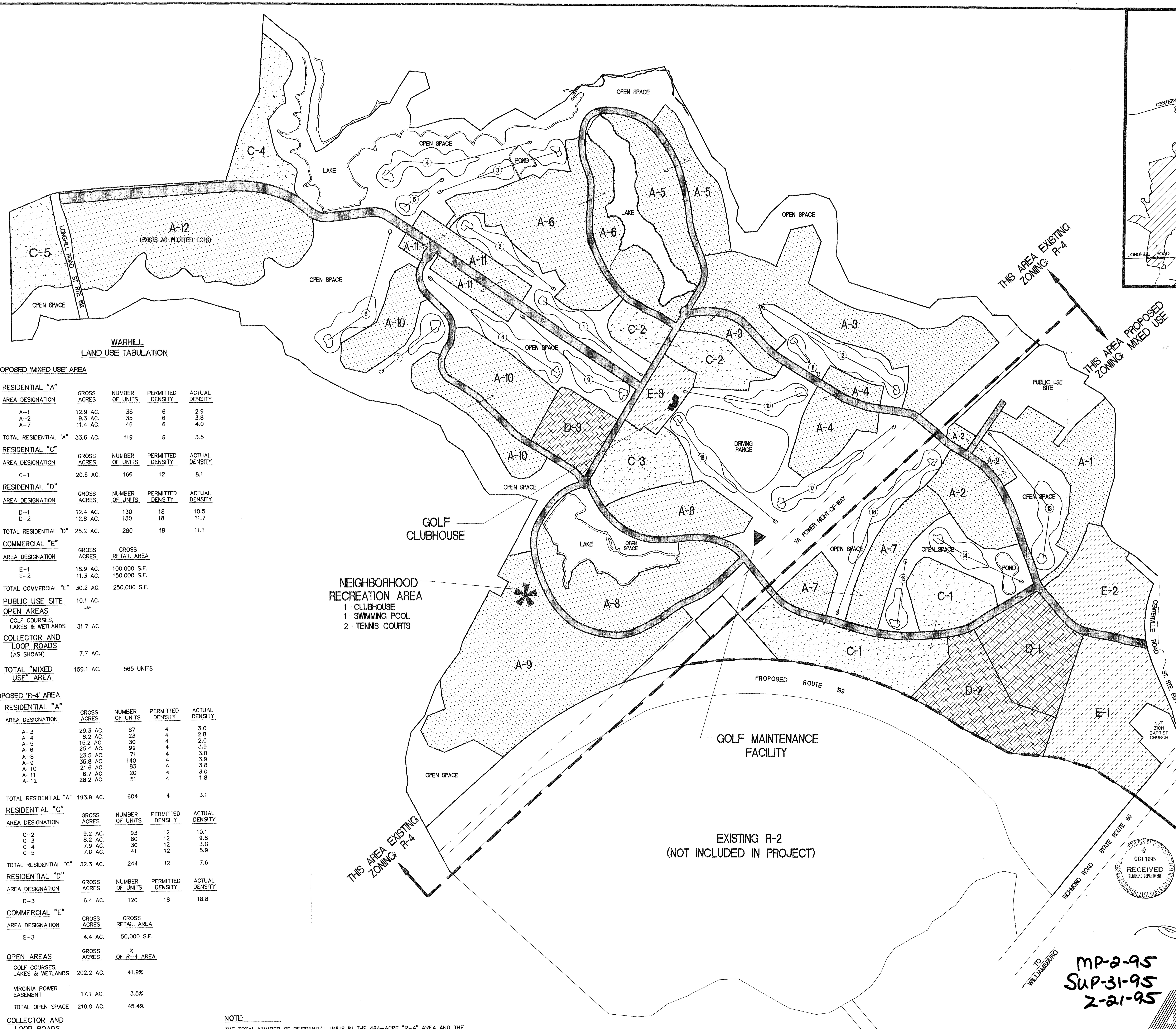

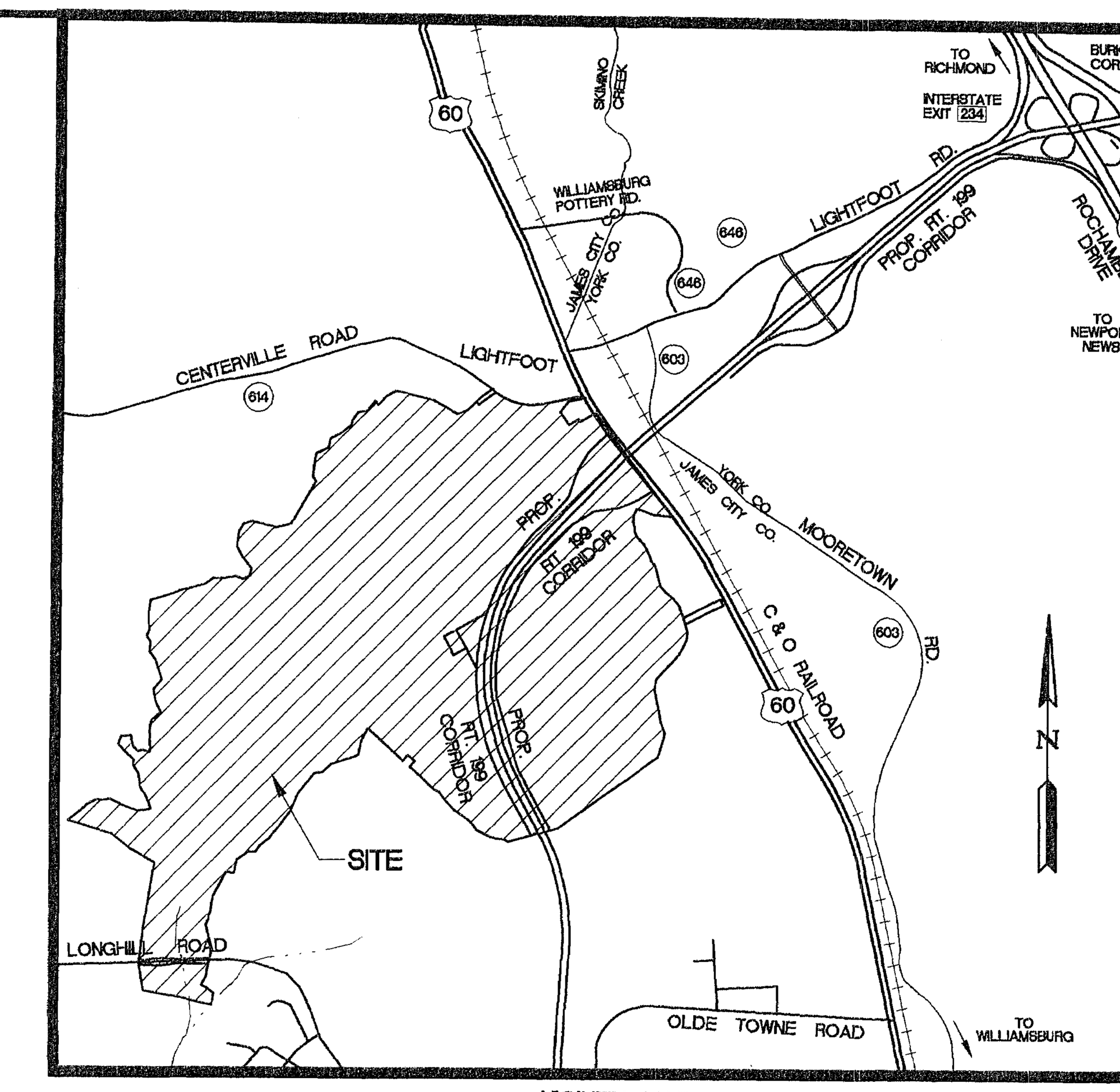

VICINITY MAP
SCALE: 1" = 2,000'

WARHILL
LAND USE TABULATION

PROPOSED "MIXED USE" AREA

RESIDENTIAL "A"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
A-1	12.9 AC.	38	6	2.9
A-2	9.3 AC.	35	6	3.8
A-7	11.4 AC.	46	6	4.0
TOTAL RESIDENTIAL "A"	33.6 AC.	119	6	3.5

RESIDENTIAL "C"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
C-1	20.6 AC.	166	12	8.1

RESIDENTIAL "D"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
D-1	12.4 AC.	130	18	10.5
D-2	12.8 AC.	150	18	11.7
TOTAL RESIDENTIAL "D"	25.2 AC.	280	18	11.1

COMMERCIAL "E"

AREA DESIGNATION	GROSS ACRES	GROSS RETAIL AREA
E-1	18.9 AC.	100,000 S.F.
E-2	11.3 AC.	150,000 S.F.
TOTAL COMMERCIAL "E"	30.2 AC.	250,000 S.F.

PUBLIC USE SITE	10.1 AC.	
OPEN AREAS		
GOLF COURSES, LAKES & WETLANDS	31.7 AC.	
COLLECTOR AND LOOP ROADS (AS SHOWN)	7.7 AC.	
TOTAL "MIXED USE" AREA	159.1 AC.	565 UNITS

PROPOSED "R-4" AREA

RESIDENTIAL "A"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
A-3	29.3 AC.	87	4	3.0
A-4	8.2 AC.	23	4	2.8
A-5	15.2 AC.	30	4	2.0
A-6	25.4 AC.	99	4	3.9
A-8	23.5 AC.	71	4	3.0
A-9	35.8 AC.	140	4	3.9
A-10	21.6 AC.	83	4	3.8
A-11	6.7 AC.	20	4	3.0
A-12	28.2 AC.	51	4	1.8
TOTAL RESIDENTIAL "A"	193.9 AC.	604	4	3.1

RESIDENTIAL "C"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
C-2	9.2 AC.	93	12	10.1
C-3	8.2 AC.	80	12	9.8
C-4	7.9 AC.	30	12	3.8
C-5	7.0 AC.	41	12	5.9
TOTAL RESIDENTIAL "C"	32.3 AC.	244	12	7.6

RESIDENTIAL "D"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
D-3	6.4 AC.	120	18	18.8

COMMERCIAL "E"

AREA DESIGNATION	GROSS ACRES	GROSS RETAIL AREA
E-3	4.4 AC.	50,000 S.F.

OPEN AREAS	GROSS ACRES	% OF R-4 AREA
GOLF COURSES, LAKES & WETLANDS	202.2 AC.	41.9%
VIRGINIA POWER EASEMENT	17.1 AC.	3.5%
TOTAL OPEN SPACE	219.9 AC.	45.4%

COLLECTOR AND LOOP ROADS (AS SHOWN)	27.1 AC.	
TOTAL "R-4" AREA	484.0 AC.	968 UNITS

NOTE:

THE TOTAL NUMBER OF RESIDENTIAL UNITS IN THE 484-ACRE "R-4" AREA AND THE 159-ACRE "MIXED USE" AREA AREA SHALL NOT EXCEED 1533 UNITS. THE NUMBER OF UNITS FOR EACH RESIDENTIAL AREA DESIGNATED ARE APPROXIMATE. THE ACTUAL NUMBER OF UNITS WIHTIN EACH AREA DESIGNATION SHALL NOT VARY BY MORE THAN FIFTEEN PERCENT (15%) FROM THE NUMBER OF UNITS SHOWN.

MASTER PLAN "WARHILL"

OCTOBER, 1995

MP-2-95
SUP-31-95
Z-21-95

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(804) 253-0040
Fax (804) 220-8994

EXISTING JCSA 12" WATER MAIN CONSTRUCTED WITH SECTION 1 OF WARHILL.

EXISTING JCSA 8" WATER MAIN LOCATED ON THE NORTH SIDE OF LONGHILL ROAD

PROPOSED WATER MAIN ALIGNMENT

C-4

LAKE

OPEN SPACE

POND

A-5

A-6

A-12
(EXISTS AS PLATTED LOTS)

C-5

LONGHILL ROAD ST. RTE 612

OPEN SPACE

A-11

A-10

C-2

A-3

E-3

D-3

A-4

DRIVING RANGE

PUBLIC USE SITE

THIS AREA EXISTING ZONING: R-4

THIS AREA PROPOSED ZONING: MIXED USE

A-2

A-1

C-3

A-8

VA. POWER RIGHT-OF-WAY

A-7

C-1

E-2

JAMES CITY SERVICE AUTHORITY - SEASON'S TRACE ELEVATED STORAGE TOWER LOCATION (250,000 GALLON CAPACITY)

EXISTING JCSA 12" WATER MAIN LOCATED ON THE SOUTH SIDE OF CENTERVILLE ROAD

CENTERVILLE ROAD ST. RTE 614

A-9

D-1

D-2

E-1

N/F ZION BAPTIST CHURCH

PROPOSED ROUTE 199

CONNECTION TO PROPOSED JCSA WATERMAIN

THIS AREA PROPOSED ZONING: MIXED USE

THIS AREA EXISTING ZONING: R-4

EXISTING JCSA 16" WATER MAIN LOCATED ON THE SOUTH SIDE OF RICHMOND ROAD

EXISTING R-2
(NOT INCLUDED IN PROJECT)

RICHMOND ROAD STATE ROUTE 60

TO WILLIAMSBURG

GRAPHIC SCALE
300' 0' 300' 600'
SCALE: 1" = 300'

MASTER WATER PLAN
"WARHILL"

OCTOBER, 1995

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(804) 253-0040
Fax (804) 220-8994

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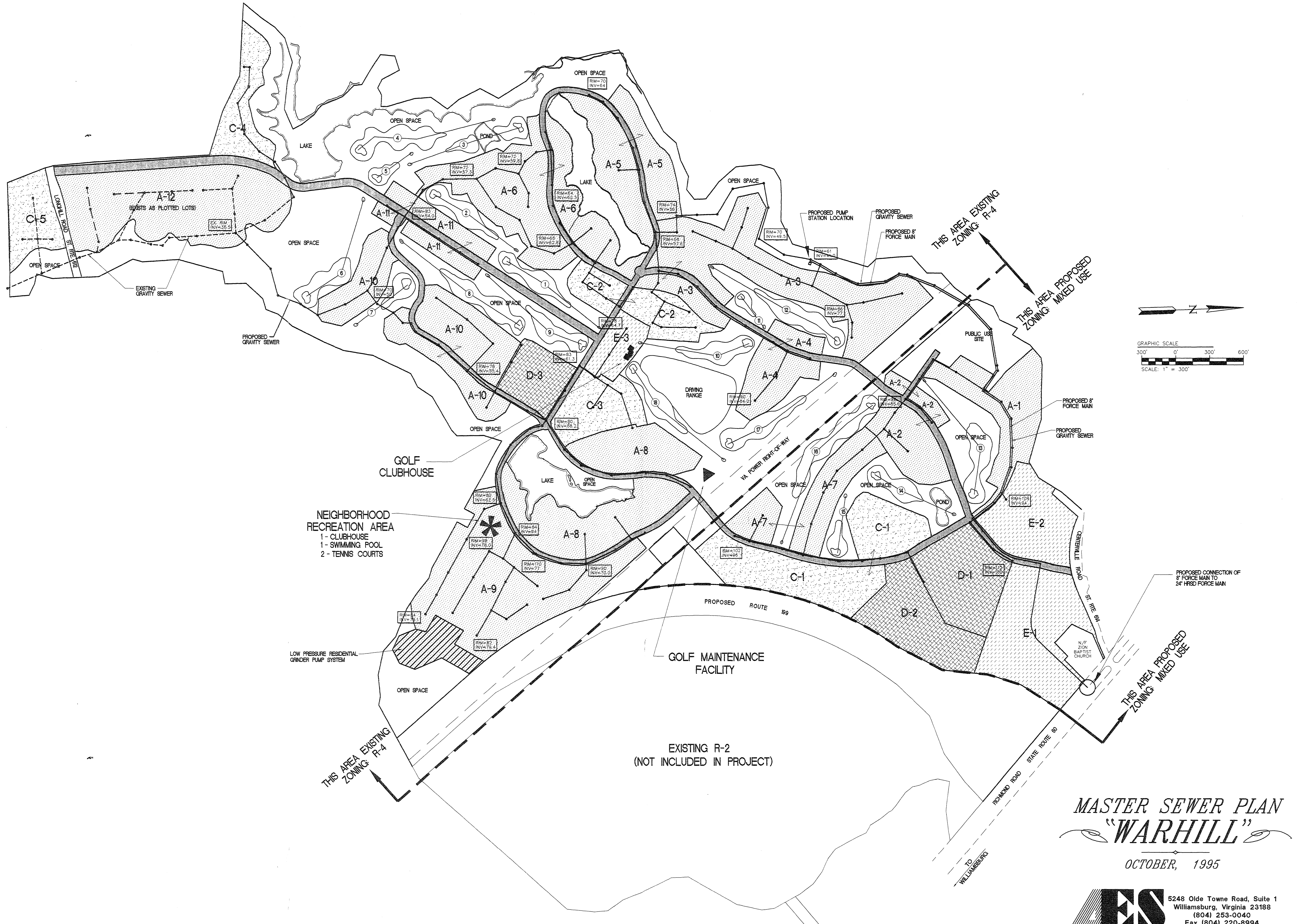

MASTER SEWER PLAN
"WARHILL"

OCTOBER, 1995

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
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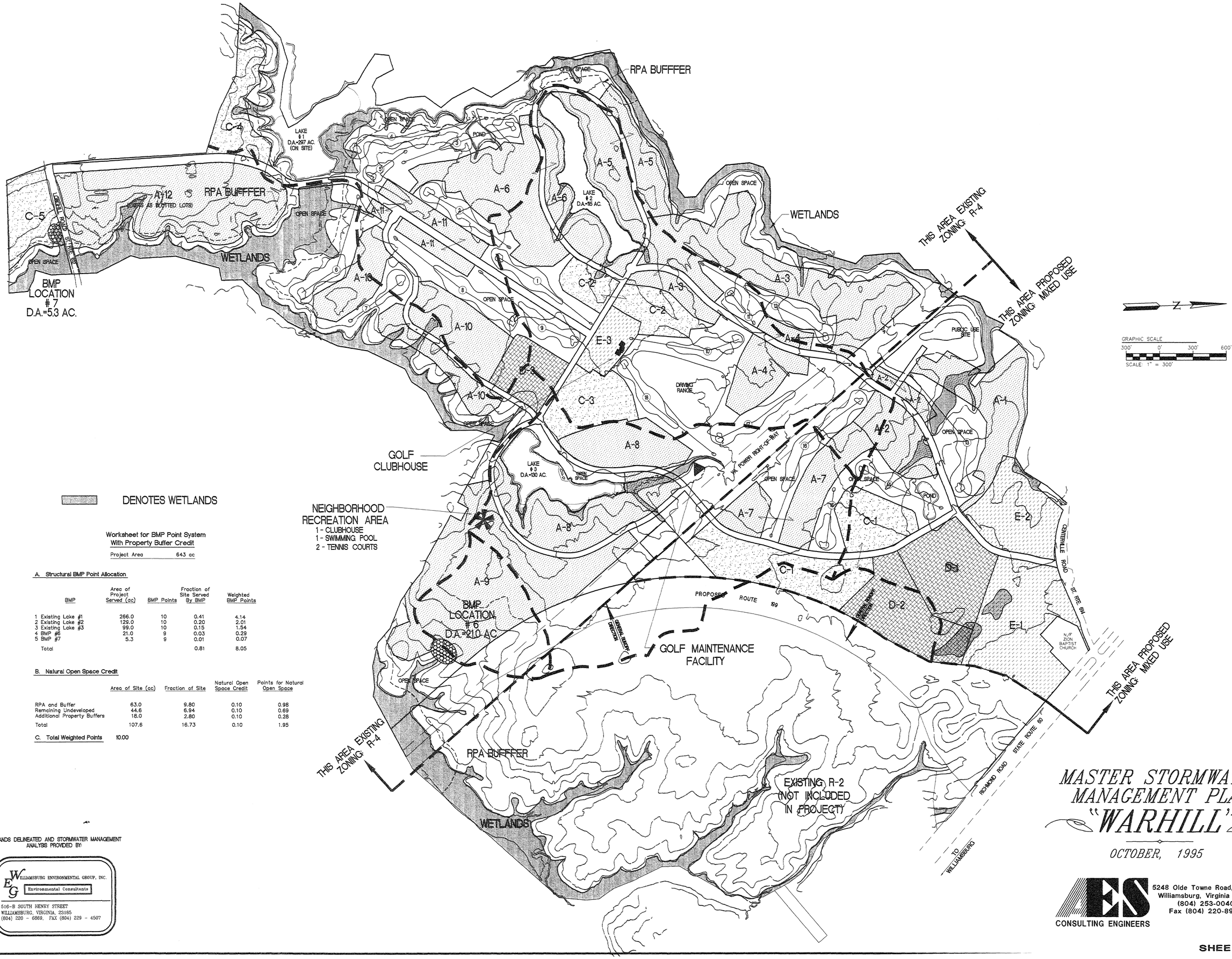

DENOTES WETLANDS

Worksheet for BMP Point System
With Property Buffer Credit

Project Area 643 ac

A. Structural BMP Point Allocation

BMP	Area of Project Served (ac)	BMP Points	Fraction of Site Served By BMP	Weighted BMP Points
1 Existing Lake #1	266.0	10	0.41	4.14
2 Existing Lake #2	129.0	10	0.20	2.01
3 Existing Lake #3	99.0	10	0.15	1.54
4 BMP #6	21.0	9	0.03	0.29
5 BMP #7	5.3	9	0.01	0.07
Total			0.81	8.05

B. Natural Open Space Credit

	Area of Site (ac)	Fraction of Site	Natural Open Space Credit	Points for Natural Open Space
RPA and Buffer	63.0	9.80	0.10	0.98
Remaining Undeveloped	44.6	6.94	0.10	0.69
Additional Property Buffers	18.0	2.80	0.10	0.28
Total	107.6	16.73	0.10	1.95

C. Total Weighted Points 10.00

WETLANDS DELINEATED AND STORMWATER MANAGEMENT ANALYSIS PROVIDED BY:

WILLIAMSBURG ENVIRONMENTAL GROUP, INC.
Environmental Consultants
516-B SOUTH HENRY STREET
WILLIAMSBURG, VIRGINIA, 23185
(804) 220 - 6869, FAX (804) 229 - 4507

MASTER STORMWATER MANAGEMENT PLAN "WARHILL"

OCTOBER, 1995

CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(804) 253-0040
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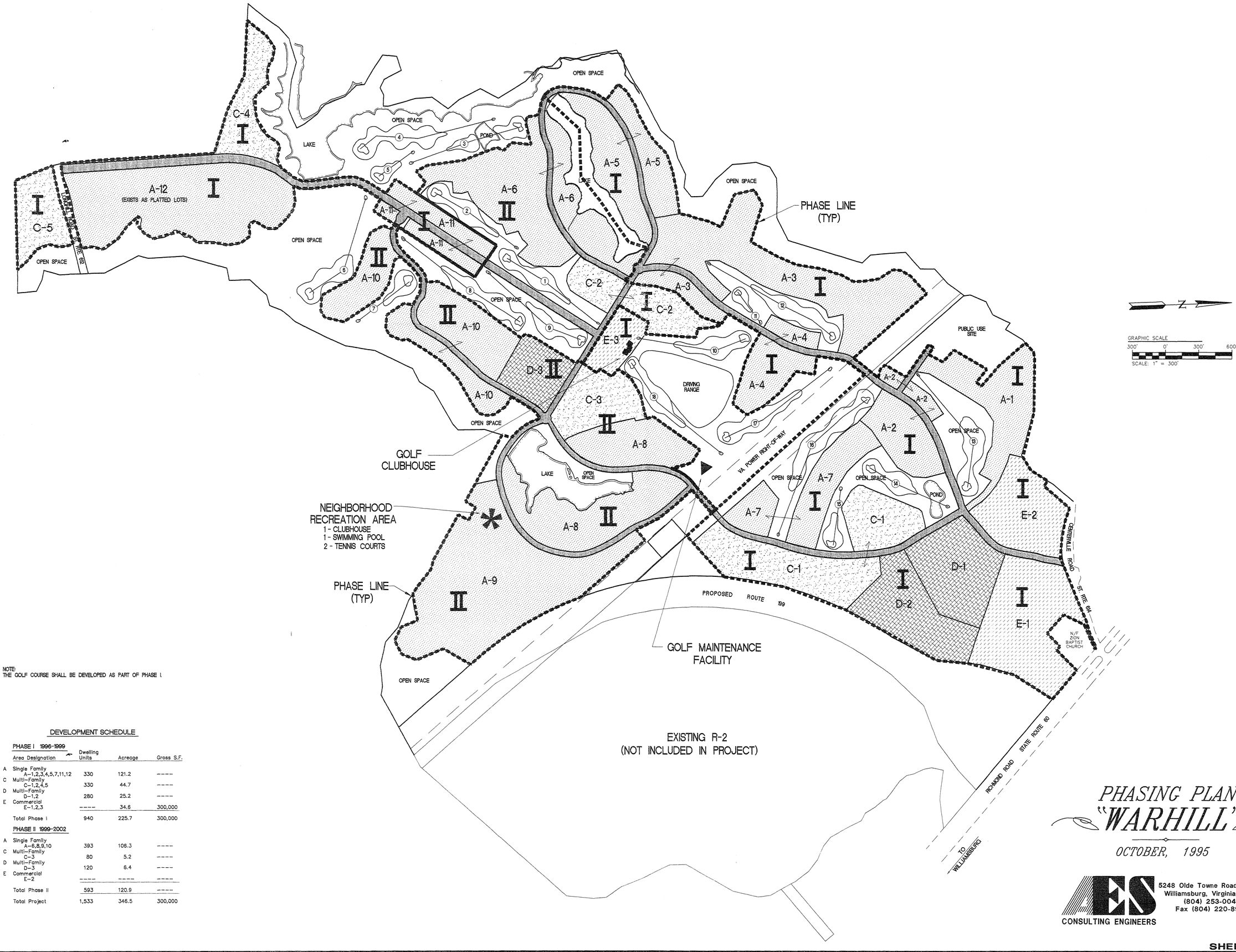

NOTE:
THE GOLF COURSE SHALL BE DEVELOPED AS PART OF PHASE I

DEVELOPMENT SCHEDULE

	Area Designation	Dwelling Units	Acreage	Gross S.F.
	PHASE I 1996-1999			
A	Single Family A-1,2,3,4,5,7,11,12	330	121.2	----
C	Multi-Family C-1,2,4,5	330	44.7	----
D	Multi-Family D-1,2	280	25.2	----
E	Commercial E-1,2,3	----	34.6	300,000
	Total Phase I	940	225.7	300,000
	PHASE II 1999-2002			
A	Single Family A-6,8,9,10	393	106.3	----
C	Multi-Family C-3	80	5.2	----
D	Multi-Family D-3	120	6.4	----
E	Commercial E-2	----	----	----
	Total Phase II	593	120.9	----
	Total Project	1,533	346.5	300,000

PHASING PLAN "WARHILL"

OCTOBER, 1995

ES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(804) 253-0040
Fax (804) 220-8994

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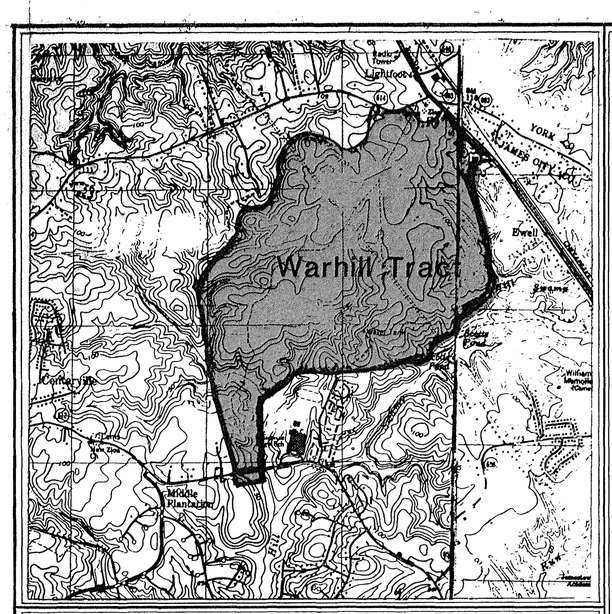

VICINITY MAP SCALE : 1" = 2000'

NORTH

0 30 60 90 120

GRAPHIC SCALE

NOTE: ALL ROADS IN M-1 & B-1 SHALL BE DEDICATED TO JAMES CITY COUNTY.

RESIDENTIAL LAND USE TABULATION

RESIDENTIAL "A"

TOTAL NUMBER OF LOTS	505 LOTS
GROSS AREA OF RESIDENTIAL "A"	212 Ac.
PERMITTED DENSITY	4 LOTS/ACRE
LOT DENSITY	2.38 LOTS/ACRE

RESIDENTIAL "C"

TOTAL NUMBER OF UNITS	560 UNITS
GROSS AREA OF RESIDENTIAL "C"	78 Ac.
PERMITTED DENSITY	12 UNITS/ACRE
UNIT DENSITY	7.18 UNITS/ACRE

RESIDENTIAL "D"

TOTAL NUMBER OF UNITS	100 UNITS
GROSS AREA OF RESIDENTIAL "D"	9 Ac.
PERMITTED DENSITY	18 UNITS/ACRE
UNIT DENSITY	11.1 UNITS/ACRE

COMMERCIAL LAND USE TABULATION

GENERAL BUISNESS & INDUSTRIAL

GENERAL COMMERCIAL	1,216,750 S.F.	65 Ac
OFFICE PARK	392,250 S.F.	23 Ac.
INDUSTRIAL	1,384,080 S.F.	154 Ac.
PUBLIC USE	522,720 S.F.	12 Ac.
RT. 199 R.O.W.		69 Ac.
30 % (ROADS, STREETS, ETC.)		103 Ac.
TOTAL		414 Ac.

NON RESIDENTIAL AMENITY & SERVICE SITES

1. GOLF CLUB, PRO SHOP, SWIM AND TENNIS CLUB	12 Ac.
2. GOLF MAINTENANCE	10 Ac.
TOTAL	22 Ac.

OPEN SPACE

NON RESIDENTIAL AMENITY AND SERVICE SITES	22 Ac.
GOLF COURSE, LAKES AND BUFFERS, MARSH RESERVE	214 Ac.
OPEN SPACE WITHIN RESIDENTIAL AREAS	9 Ac.
TOTAL AREA OF OPEN SPACE	245 Ac.
TOTAL AREA OF PROJECT	484 Ac.
% OF OPEN AREA	51 %

OVERALL DENSITY

TOTAL PROJECT AREA	484 Ac.
TOTAL NUMBER OF RESIDENTIAL UNITS	1165 UNITS
OVERALL PROJECT DENSITY	2.41

SHEET 1 OF 2

PROJ MASTER PLAN | DATE 12-17-86 | JOB NO 86176 | SCALE 1" = 300' | DWN CER | PROJ MAN RCS | APP DCR

1986 MASTER PLAN

WARHILL TRACT

OWNER/DEVELOPER: JACK SCRUGGS, VIRGINIA INTERNATIONAL REALTY

POWHATAN DISTRICT JAMES CITY COUNTY EXHIBIT 4 VIRGINIA

NO	DATE	REVISIONS	BY	APP

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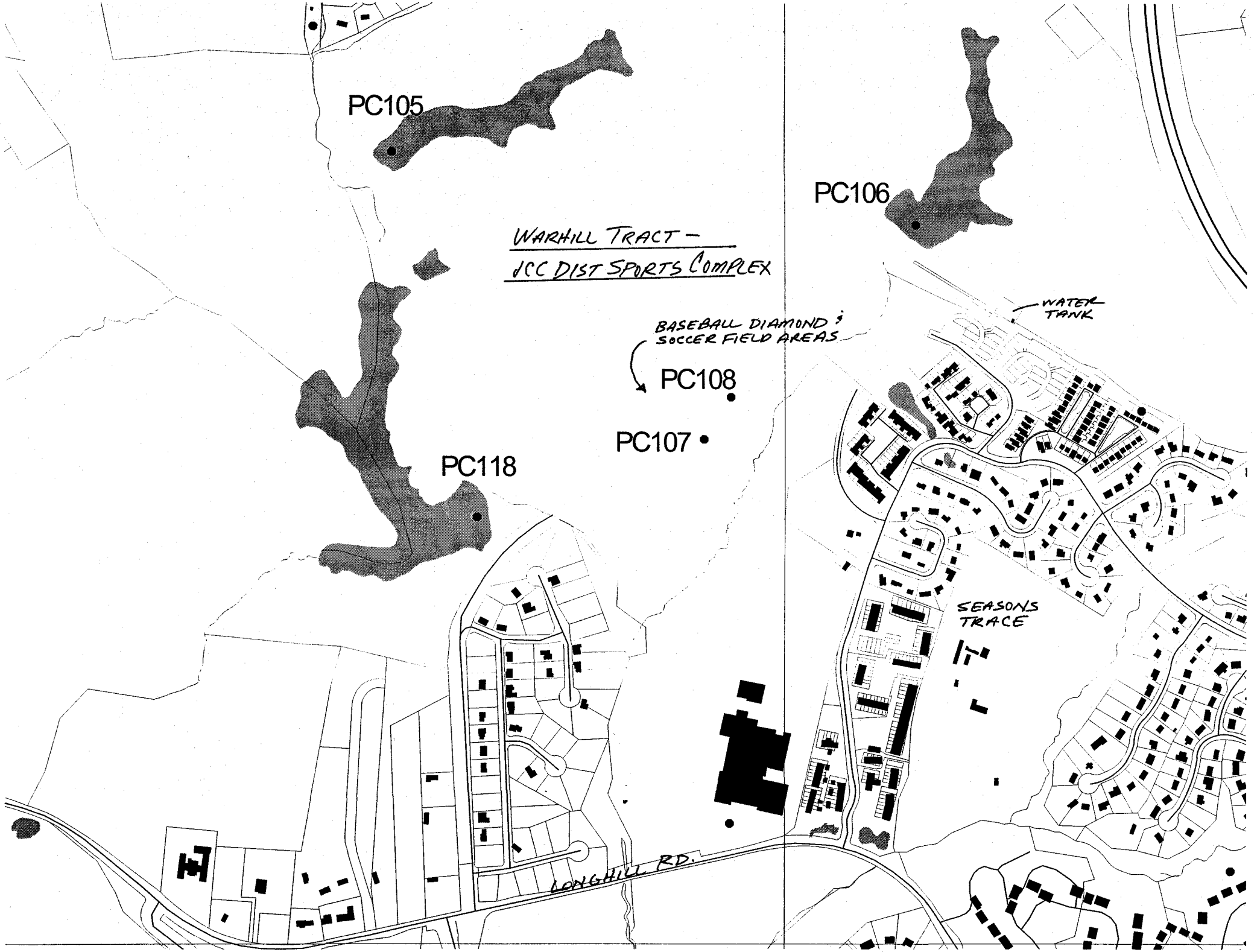
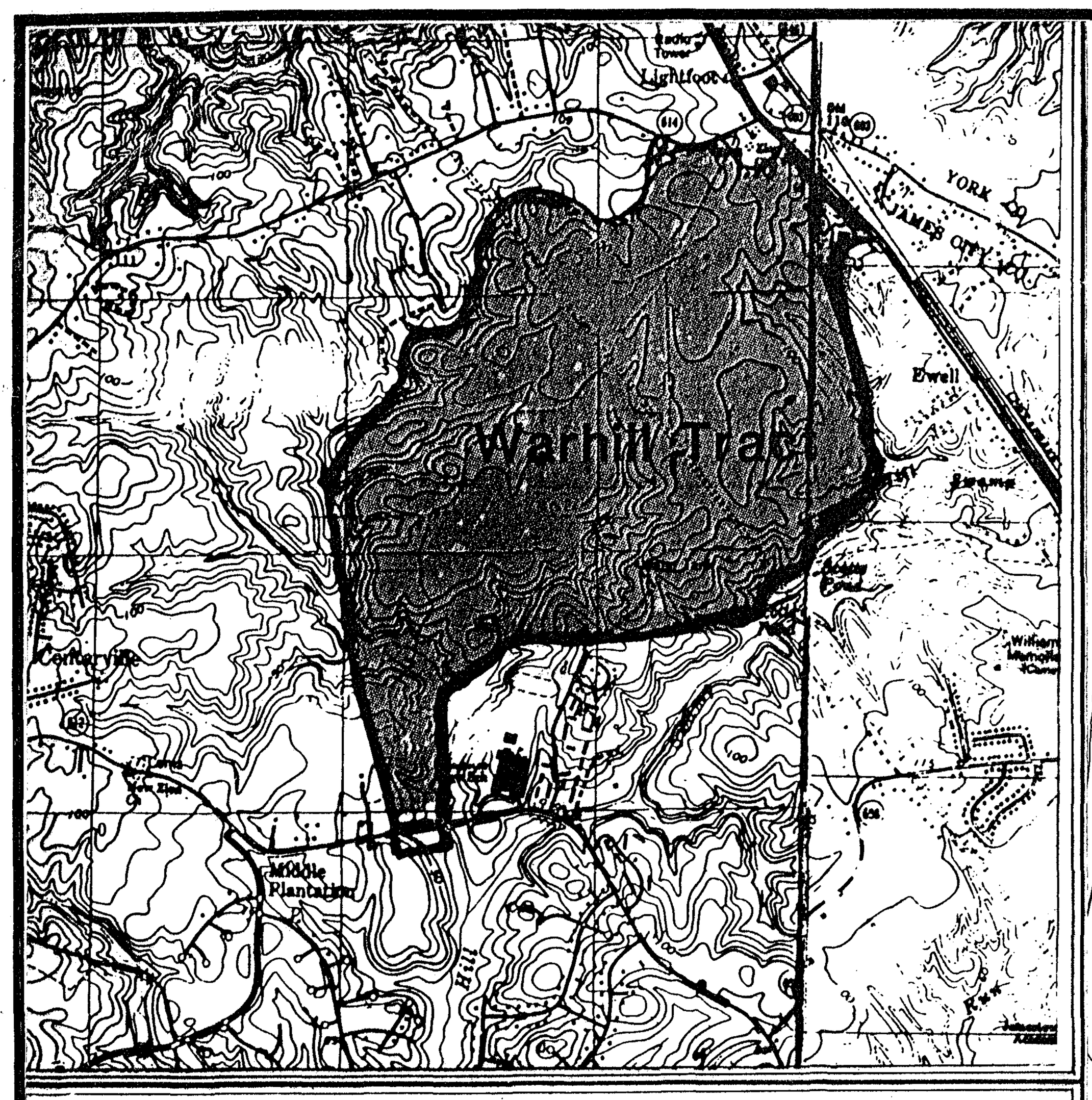
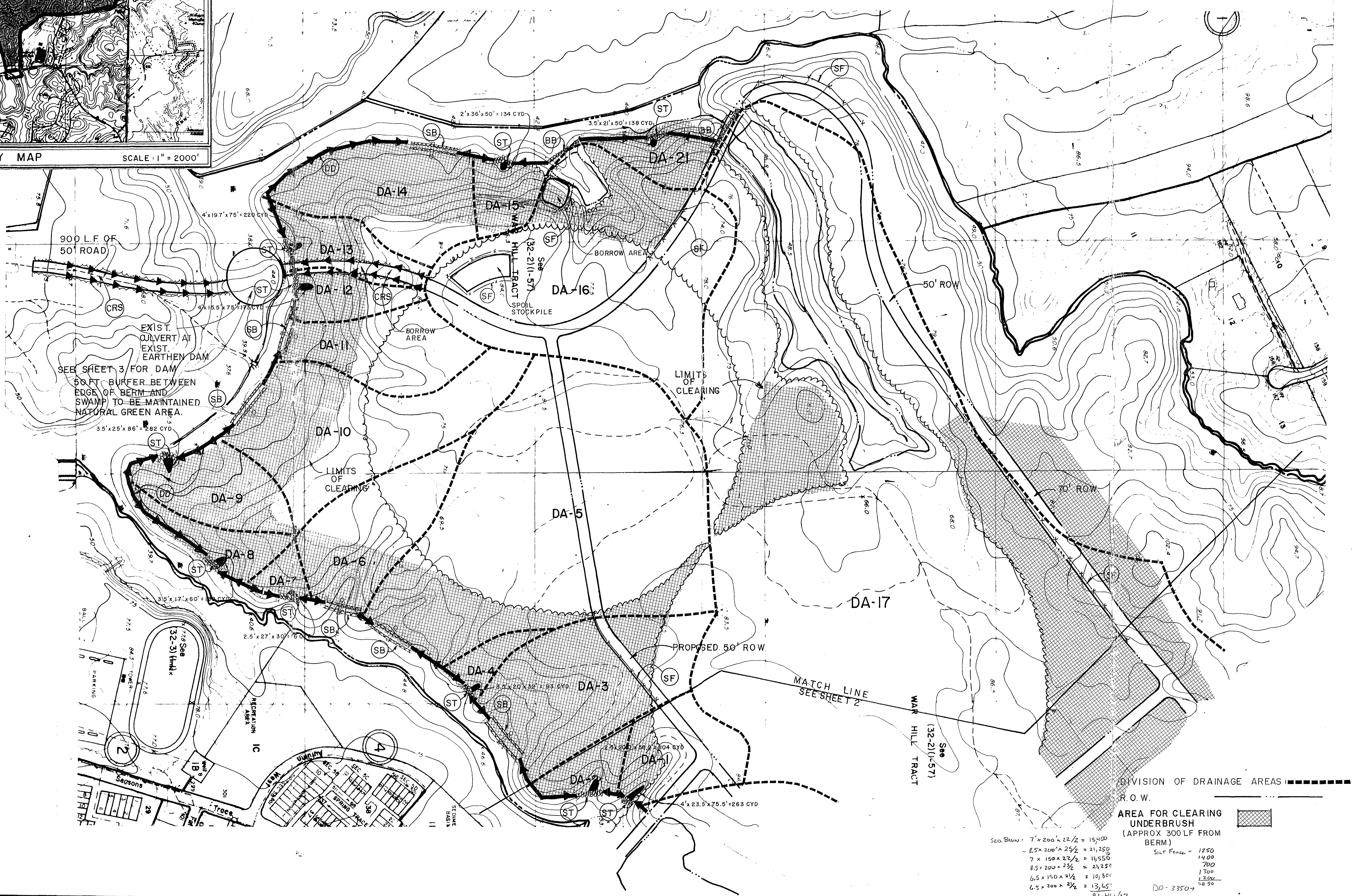
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING


PC105
PC106
WARHILL TRACT –
JCC DIST SPORTS COMPLEX
WATER TANK
BASEBALL DIAMOND & SOCCER FIELD AREAS
PC108
PC107
PC118
SEASONS TRACE
LONGHILL RD.



VICINITY MAP SCALE : 1" = 2000'

	CLEARING UNDERBRUSH	CLEARING R.O.W.	CLEARING LAKE AREA
R-4	130.60 Ac	8.56 Ac	7.79 Ac
B-1	0 Ac	1.04 Ac	0 Ac
M-1	0 Ac	1.97 Ac	0 Ac



DIVISION OF DRAINAGE AREAS
R.O.W.
AREA FOR CLEARING UNDERBRUSH (APPROX 300 LF FROM BERM)

SED. BASIN - 7' x 200' x 22/2 = 15,400
8.5 x 200' x 25/2 = 21,250
7 x 150 x 22/2 = 11,550
8.5 x 200 x 25/2 = 21,250
6.5 x 150 x 21/2 = 10,300
6.5 x 200 x 21/2 = 13,650
93,400/27

SILT FENCE - 1250
1400
700
1300
1200
5850

DP-3350+

Rickmond Engineering, Inc.
1643-C Merrimac Trail
Williamsburg VA 23185
(804)229-1776 or 875-1785
Civil Engineering
Environmental Engineering
Land Development Planning

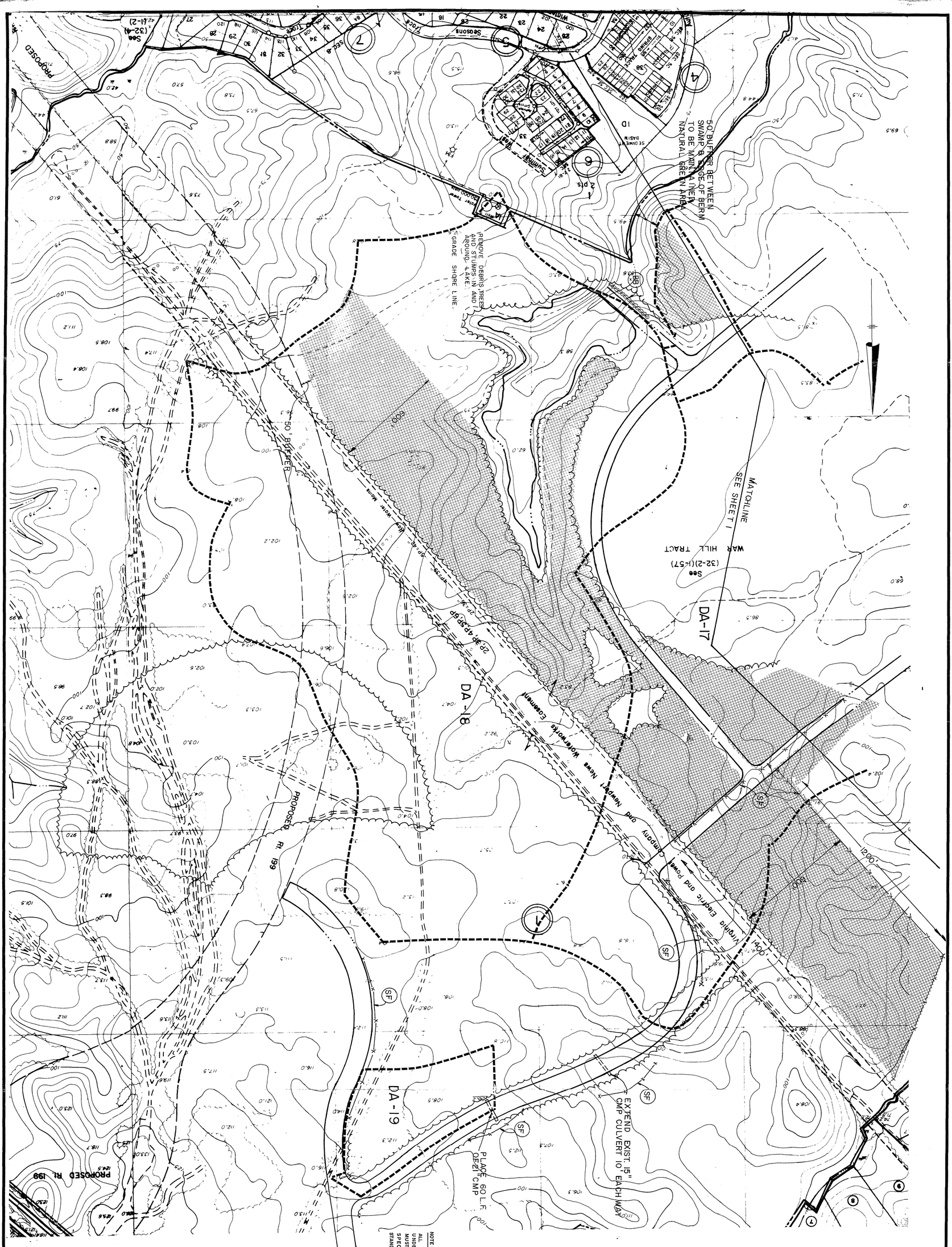
Designed By:	Drawn By:	Approved By:	Scale:	Date:	Job No.:
RS	CEC	DCR	1" = 200'	11/3/87	87169

COMMONWEALTH OF VIRGINIA
D. C. RICKMOND, JR.
No. 9648
PROFESSIONAL ENGINEER

No.	By	Revision	App.	Date
3	BMc	Rev. per Telecon. Dtd. 2-22-88	DCR	2-22-88
2	BMc	Rev. per Ltr. from Co. Rcv'd. 2-4-88 Reloc. of Dam, Add. of Borrow Area/Stockpile	DCR	2-8-88
1	BMc	Rev. per Ltr. from Co. Dtd. 12-07-87 Sed. Trap Dim.	DCR	12-10-87

WARHILL TRACT
EROSION & SEDIMENT CONTROL PLAN
JAMES CITY COUNTY VIRGINIA

Job Number	Sheet No.
87169	1



Job Number 87169

Sheet No. 2

WARHILL TRACT

EROSION & SEDIMENT CONTROL PLAN

JAMES CITY COUNTY VIRGINIA

No.	By	Revision	App.	Date
3	BMc	Rev. per Telecon Dtd. 2-22-88	DCR	2-22-88
2	BMc	Rev. as per Ltr. from Co. Rev'd. 2-4-88 Pipe Size Change	DCR	2-8-88
1	BMc	Rev. as per Ltr. Dtd. 12-07-87 from Co. DA-19, DA-20 Deleted	DCR	12-10-87

COMMONWEALTH OF VIRGINIA
O. C. RICKMOND, JR.
No. 9648
PROFESSIONAL ENGINEER

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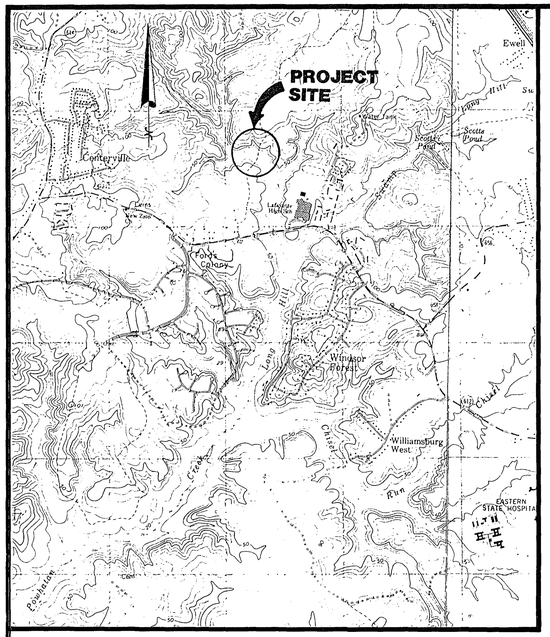
Land Development Planning

Designed By:	Drawn By:	Approved By:	Scale:	Date:	Job No.:
RS	CEC	DCR	1" = 200'	11/3/87	87169



VICINITY MAP

SCALE: 1" = 2000'

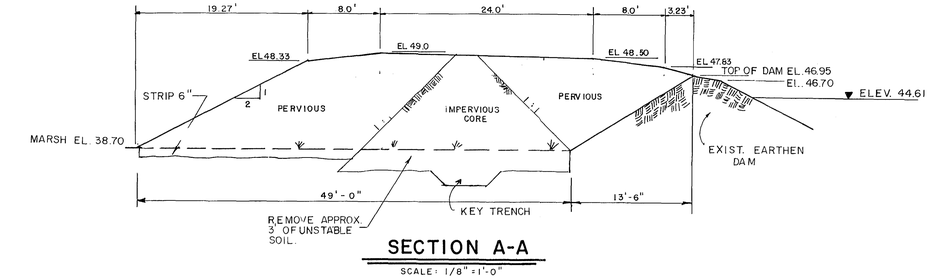
EROSION & SEDIMENTATION CONTROL MEASURES

ALL EROSION & SEDIMENTATION CONTROL MEASURES SHALL BE IN ACCORDANCE WITH JAMES CITY COUNTY EROSION AND SEDIMENTATION CONTROL ORDINANCE. THE CONTRACTOR SHALL SECURE A COPY OF THE VIRGINIA EROSION & SEDIMENT CONTROL HANDBOOK AND THOROUGHLY FAMILIARIZE HIMSELF WITH ALL APPLICABLE MEASURES CONTAINED THEREIN WHICH MAY BE PERTINENT TO THIS PROJECT.

THE PURPOSE OF SUCH MEASURES INCLUDING (BUT NOT LIMITED TO) THOSE SHOWN ON THIS PLAN SHALL BE TO PRECLUDE THE TRANSPORT OF ALL WATERBORNE SEDIMENTS RESULTING FROM CONSTRUCTION ACTIVITIES FROM ENTERING ONTO ADJACENT PROPERTIES OR INTO STATE WATERS. ALL SEDIMENTS MUST BE CONFINED TO THE PROJECT SITE AT THE LOCATIONS SHOWN ON THIS PLAN.

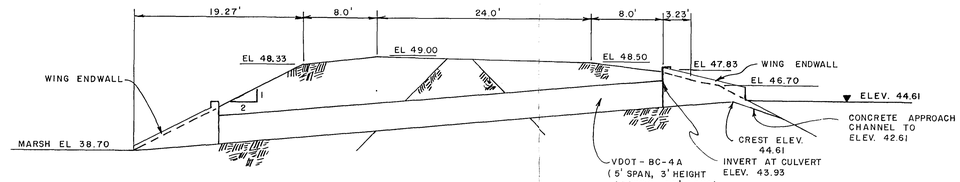
THE FOLLOWING SEQUENCE OF EVENTS AND EROSION CONTROL MEASURES SHALL BE INCORPORATED INTO THE CONSTRUCTION SCHEDULE FOR THIS PROJECT AND SHALL APPLY TO ALL CONSTRUCTION ACTIVITIES WITHIN THE PROJECT LIMITS:

1. LAND CLEARING AND GRUBBING (IF REQUIRED) SHALL BE LIMITED TO AREAS OF WORKABLE SIZE.
2. TEMPORARY SEDIMENT BASINS, DIKES, EROSION CONTROL STONE, STRAW BALE BARRIERS, ETC., SHALL BE PLACED DURING CLEARING, GRUBBING, EARTH MOVING, AND ROUGH GRADING ACTIVITIES. ALL TEMPORARY STRUCTURES SHALL BE CHECKED PERIODICALLY AND CLEANED AS NECESSARY.
3. THE CONTRACTOR SHALL STOCKPILE CLEARING AND GRUBBING DEBRIS AT THE LOCATION(S) INDICATED ON THIS PLAN OR APPROVED BY THE ENGINEER.
4. THE CONTRACTOR SHALL STRIP AND STOCKPILE TOPSOIL AT THE LOCATIONS SHOWN ON THIS PLAN OR AS DIRECTED BY THE ENGINEER. STRAW BALE BARRIERS SHALL BE PLACED AT THE TOE OF THE STOCKPILE AFTER STRIPPING OF TOPSOIL IS COMPLETE.
5. THE CONTRACTOR SHALL COMPLETE DRAINAGE FACILITIES WITHIN 30 DAYS FOLLOWING COMPLETION OF ROUGH GRADING AT ANY POINT WITHIN THE PROJECT.
6. ALL TEMPORARY EROSION CONTROL MEASURES (SEDIMENT BASINS, STRAW BALE BARRIERS, DIKES, ETC.) SHALL HAVE BEEN INSTALLED PRIOR TO OR DURING CLEARING, GRUBBING AND/OR ROUGH GRADING ACTIVITIES.
7. TEMPORARY VEGETATIVE COVER SHALL BE PROVIDED IN ALL DISTURBED AREAS WHICH ARE NOT DESIGNATED FOR PAVING, UNDERGROUND UTILITIES OR STRUCTURAL USES. SUCH AREAS SHALL NOT BE EXPOSED FOR PERIODS EXCEEDING 30 DAYS. TEMPORARY VEGETAL COVER SHALL CONSIST OF SEEDING WITH RYE GRASS AT 140#/ACRE AND MULCHING. TEMPORARY VEGETAL COVER MAY BE ELIMINATED IN FAVOR OF FINAL VEGETAL COVER IF CONSTRUCTION CONDITIONS PERMIT AND THE CONTRACTOR IS SO DIRECTED BY THE OWNER OR ENGINEER. APPLY FERTILIZER AND MULCH IN ACCORDANCE WITH NOTE 10.
8. ALL AREAS DESIGNATED FOR PAVING, UNDERGROUND UTILITIES, AND STRUCTURAL USE SHALL BE STABILIZED AS SOON AS PRACTICAL BUT NOT EXCEEDING 30 DAYS FOLLOWING INSTALLATION. NO MORE THAN 300' OF SANITARY SEWER, STORM SEWER OR WATER LINES ARE TO BE OPEN AT ANY ONE TIME. BASE COURSE MATERIAL SHALL BE PLACED IN ALL STREET AREAS WITHIN 30 DAYS OF FINAL GRADING.
9. OUTFALL DITCHES FROM DRAINAGE STRUCTURES SHALL BE STABILIZED IMMEDIATELY AFTER CONSTRUCTION OF SAME. EROSION CONTROL STONE SHALL ALSO BE INSTALLED WHERE CALLED FOR IMMEDIATELY AFTER CONSTRUCTION OF DITCHES WHERE VELOCITIES EXCEED 10 FPS.
10. FINAL VEGETATIVE COVER (STABILIZATION) SHALL CONSIST OF TOPSOILING, LIMING, FERTILIZING, SEEDING, AND MULCHING TO ASSURE A FIRM STAND OF GRASS AS SOON AS PRACTICAL. SEDIMENT BASINS AND OTHER TEMPORARY EROSION MEASURES ARE TO BE REMOVED ONLY WHEN STABILIZATION IS COMPLETE. FINAL VEGETAL COVER SHALL BE PROVIDED IN ACCORDANCE WITH THE FOLLOWING:
    - TOPSOIL: AT LEAST 4" THICKNESS OBTAINED FROM STOCKPILES ON SITE, FREE OF LARGE DEBRIS.
    - LIME: 4,000 #/ACRE
    - SEED: KENTUCKY 31 TALL FESCUE, 60#/ACRE
    - FERTILIZER: 10/10/10 MIX, 1000 #/ACRE
    - MULCH: STRAW OR HAY, 2000 #/ACRE
11. ALL STORM WATER MANAGEMENT FACILITIES INCLUDING EROSION CONTROL STONE ARE TO BE INSTALLED AND MADE OPERATION WITHIN 30 DAYS FOLLOWING THE START OF CONSTRUCTION. THE INSTALLATION OF DRAINAGE FACILITIES SHALL TAKE PRECEDENCE OVER ALL OTHER UNDERGROUND UTILITIES.
12. ROCK FOR DITCHES SHALL BE VDOT, TYPE A, EC-1.
13. SEEDING SPECIFICATIONS:
    - LIME: 4,000 #/ACRE
    - SEED: KENTUCKY 31 TALL FESCUE - 250 #/ACRE
    - FERTILIZER: 10/20/10 AT 1,000 #/ACRE
    - MULCH: STRAW OR HAY AT 4,000 #/ACRE
14. TEMPORARY SLOPE DRAINS SHALL BE INSTALLED IN THE SAME LOCATION AS THE PAVED SWALES, AND SHALL BE USED UNTIL THE PERMANENT CONCRETE PAVED SWALE CAN BE INSTALLED.
15. CHECK DAMS SHALL BE PLACED EVERY 100' APART



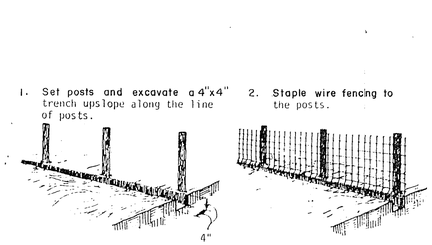
SECTION A-A

SCALE: 1/8" = 1'-0"



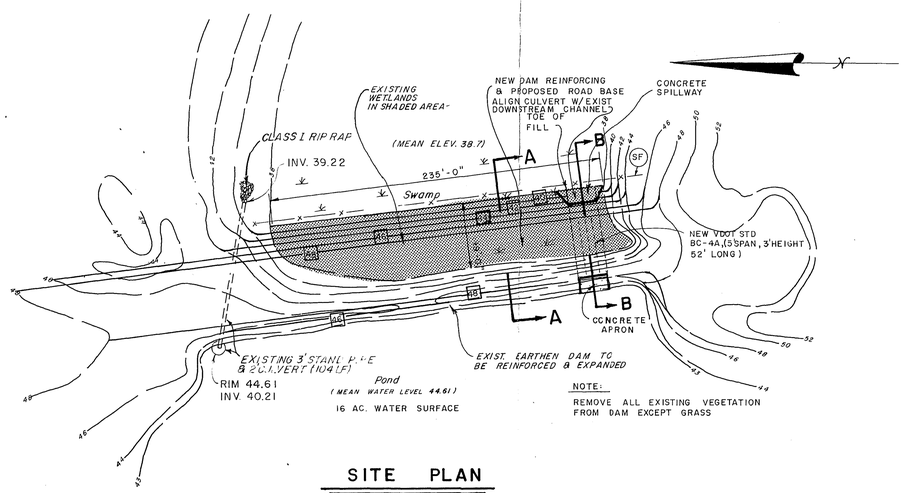
SECTION B-B

SCALE: 1/8" = 1'-0"



SILT FENCE

NTS



SITE PLAN

SCALE: 1" = 50'

LEGEND

- 40 — EXISTING CONTOURS
- 40 — NEW CONTOURS
- SF — SILT FENCE

Rickmond Engineering, Inc.
Civil Engineering
Environmental Engineering
Land Development Planning
1643-C Merrimac Trail
Williamsburg VA 23185
(804)229-1776 or 875-1785

Designed By:	Drawn By:	Approved By:	Scale:	Date:	Job No.:
RS	B Mc	DCR	As Noted	11-12-87	87169

COMMONWEALTH OF VIRGINIA — D. C. REMMO, JR. — No. 9648 — PROFESSIONAL ENGINEER

No.	By	Revision	Date	App.
4	CEC	Rev. per Telecon by DC dtd 2-25-88	2-25-88	RCS
3	BMc	Rev per Telecon Dtd 2-22-88	2-22-88	DCR
2	BMc	Rev. SEC. B-B Added Ltr. from Co. Revd 2-4-88	2-08-88	DCR
1	BMc	NEW SHEET ADDED	12-10-87	DCR

BEAVER DAM LAKE

JAMES CITY COUNTY VIRGINIA

Job Number	Sheet No.
87169	3

EROSION & SEDIMENTATION CONTROL MEASURES

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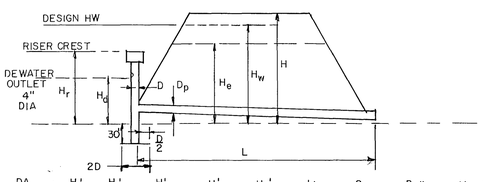
9. ALL STORM WATER MANAGEMENT FACILITIES INCLUDING EROSION CONTROL STONE ARE TO BE INSTALLED AND MADE OPERATIONAL WITHIN 30 DAYS FOLLOWING THE START OF CONSTRUCTION. THE INSTALLATION OF DRAINAGE FACILITIES SHALL TAKE PRECEDENCE OVER ALL OTHER UNDERGROUND UTILITIES.
10. FINAL VEGETABLE COVER (STABILIZATION) SHALL CONSIST OF TOPSOILING, LIMING, FERTILIZING, SEEDING, AND MULCHING TO ASSURE A FIRM STAND OF GRASS AS SOON AS PRACTICAL. SEDIMENT BASINS AND OTHER TEMPORARY EROSION CONTROL MEASURES ARE TO BE REMOVED ONLY WHEN STABILIZATION IS COMPLETE.
11. SEEDING SPECIFICATIONS:
    LIME: 4000 POUNDS PER ACRE
    SEED: KENTUCKY 31 TALL FESCUE - 250 POUNDS PER ACRE
    FERTILIZER: 10/20/10 AT 1000 POUNDS PER ACRE
    MULCH: STRAW OR HAY AT 4000 POUNDS PER ACRE.
12. ROCK FOR DITCHES SHALL BE VDH&T, TYPE A, EC-1.

DRAINAGE AREA DATA

DA	AREA	I_2	c	Q_2	DISTURBED AREA (AC)
1	3.92	3.4	.15	2.00	1.25
2	1.55	3.4	.15	0.80	1.55
3	10.22	2.8	.15	4.30	8.54
4	1.24	2.7	.15	0.50	1.24
5	30.50	2.4	.15	11.00	5.30
6	7.20	2.9	.15	3.20	2.32
7	1.13	3.5	.15	0.60	1.13
8	1.97	2.7	.15	080	1.97
9	4.20	2.9	.15	1.83	3.92
10	11.40	2.6	.15	4.45	3.36
11	5.33	3.2	.15	2.60	1.41
12	2.57	3.3	.15	1.27	1.48
13	3.28	2.9	.15	1.43	1.89
14	6.70	2.6	.15	2.61	5.69
15	2.00	3.3	.15	1.00	1.95
16	21.05	2.8	.15	8.85	4.42
17	112.65	1.4	.15	23.70	28.87
18	126.07	1.3	.15	24.60	25.71
19	10.84	3.4	.15	5.60	0
~~20~~	~~1.03~~	~~4.8~~	~~.15~~	~~0.75~~	~~0~~ DELETED
21	2.05	3.4	.15	1.05	2.05

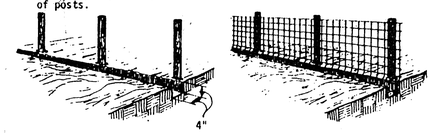
NOTE: 8" P.V.C. RISER FOR DA-16 POND SHALL BE REPLACED WITH AN 18" CORRUGATED METAL PIPE.



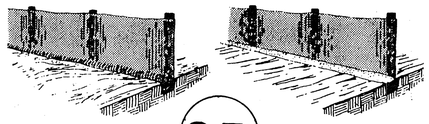
DA	H'	H'_w	H'_e	H'_r	H'_d	L'	S	D_p"	Vcyd	D"
3	7	6	5	4	3	38	2.6	10	685	15
5	8.5	7.5	6.5	5.5	4.5	44	2.3	15	2044	18
6	7	6	5	4	3	38	2.6	8	483	12
10	8.5	7.5	6.5	5.5	4.5	40	2.5	15	764	15
11	6.5	5.5	4.5	3.5	2.5	32	3.1	8	358	12
14	6.5	5.5	4.5	3.5	2.5	32	3.1	8	449	12

SEDIMENT BASIN DATA

1. Set posts and excavate a 4"x4" trench upslope along the line of posts.
2. Staple wire fencing to the posts.

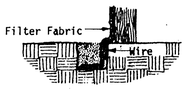


3. Attach the filter fabric to the wire fence and extend it into the trench.
4. Backfill and compact the excavated soil.

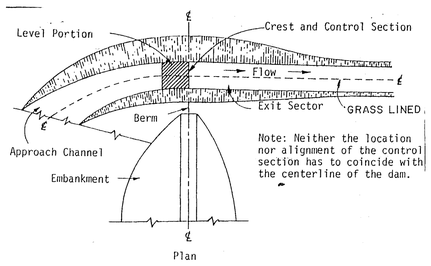


S.F.

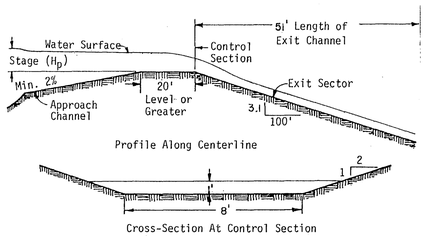
Extension of fabric and wire into the trench.



CONSTRUCTION OF A SILT FENCE



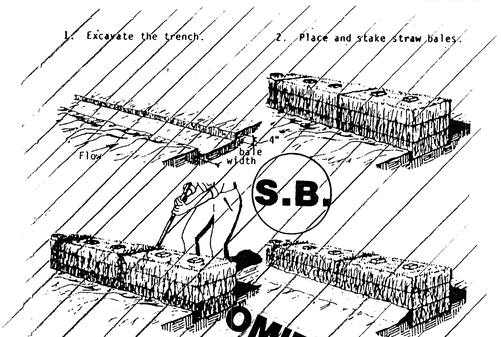
Note: Neither the location nor alignment of the control section has to coincide with the centerline of the dam.



DA	Vfps	Qcfs
3	.46	3.65
5	1.20	9.50
6	.23	1.81
10	.58	4.62
11	.30	2.38
14	.27	2.16

EMERGENCY SPILLWAY

1. Excavate the trench.
2. Place and stake straw bales.

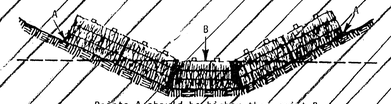


S.B.

OMIT

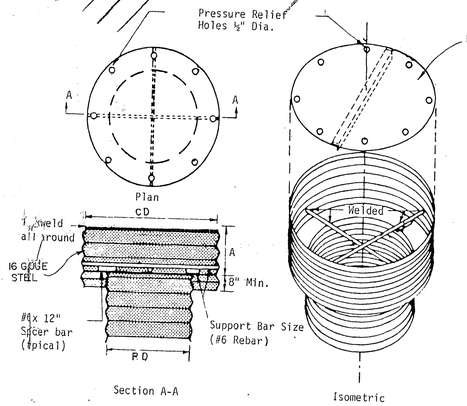
3. Wedge loose straw between bales.
4. Backfill and compact the excavated soil.

CONSTRUCTION OF STRAW BALE BARRIER



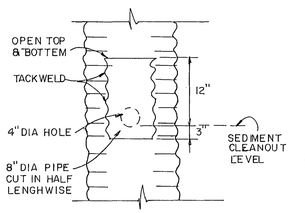
Points A should be higher than point B

PROPER PLACEMENT OF STRAW BALE BARRIER IN DRAINAGE WAY

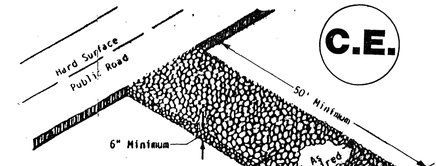


A	CD	A	RD
	18	6	10
	27	8	18
	18	6	10
	18	6	10
	18	6	10
	18	6	10

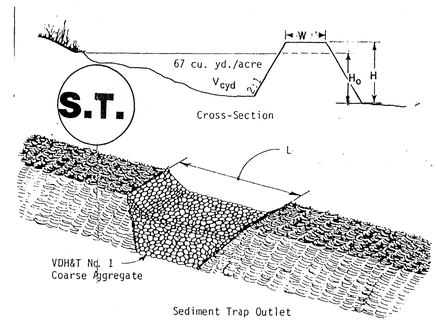
ANTI-VORTEX DEVICE



DEWATERING OUTLET

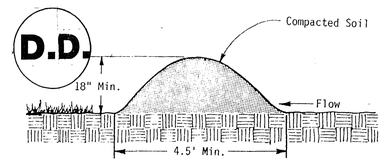


GRAVEL CONSTRUCTION ENTRANCE



SEDIMENT TRAP

(SEE TABLE BELOW FOR DIMENSIONS)



DIVERSION DIKE

SEDIMENT TRAP DATA

DA	H_o	H	W	L	Vcyd
1	4.0	5.0	4.5	23.5	263
2	2.5	3.5	3.0	20.0	104
4	3.5	4.5	4.0	20.0	83
7	2.5	3.5	3.0	27.0	76
8	2.5	3.5	3.0	17.0	132
9	2.5	3.5	3.0	25.2	282
12	4.0	5.0	4.5	15.5	173
13	4.0	5.0	4.5	19.7	220
15	2.0	3.0	2.5	36.0	134
21	3.5	4.5	4.0	21.0	138

RICKMOND ENGINEERING INC.
CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING
1643-C MERRIMAC TRAIL
WILLIAMSBURG, VA. 23185
(804) 229-1776/875-1785

Designed By: RS | Drawn By: B Mc | Approved By: DCR | Scale: NTS | Date: 7-23-87 | Job No. 87169

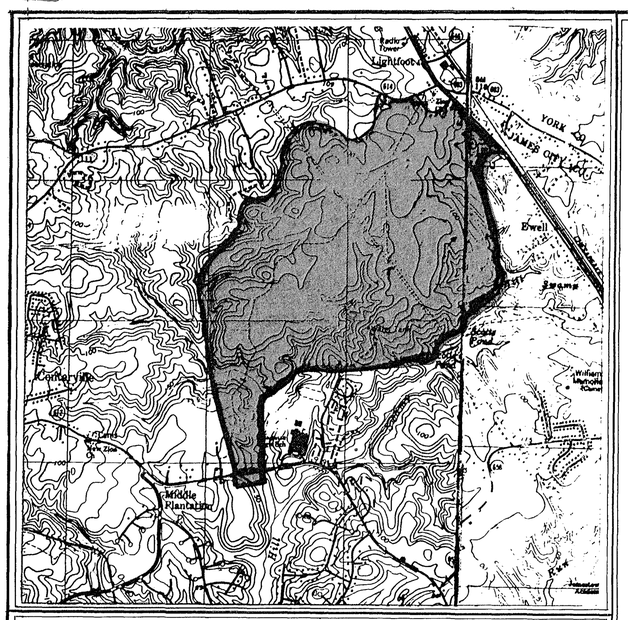
COMMONWEALTH OF VIRGINIA — E. C. RICKMOND, JR. — No. 9648 — PROFESSIONAL ENGINEER

No.	By	Revision	Comments	Dtd.	App.	Date
4	B Mc	Rev. per Telecon	Dtd. 2-22-88		DCR	2-22-88
3	B Mc	Rev. as per Comments from Co. Ltr.	Dtd. 12-07-87	DATA	INFO	D.C.R. 12-10-87
2	B Mc	Revised per County	Comments		DCR	8-11-87
1	B Mc	Revised per Co. Ltr. from Co. Rev'd. 2-4-88 - Note at Drainage Data			DCR	2-08-88

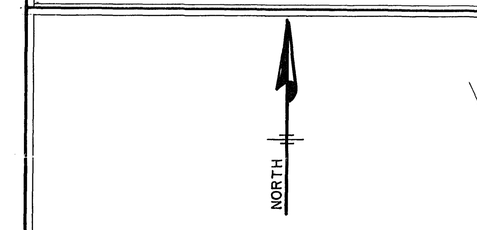
WARHILL TRACT
EROSION & SEDIMENT CONTROL PLAN

JAMES CITY COUNTY VIRGINIA

Job Number 87169 | Sheet No. 4



VICINITY MAP SCALE : 1" = 2000'



RESIDENTIAL LAND USE TABULATION

RESIDENTIAL "A"

TOTAL NUMBER OF LOTS	505 LOTS
GROSS AREA OF RESIDENTIAL "A"	161 Ac.
PERMITTED DENSITY	4 LOTS/ACRE
LOT DENSITY	3.14 LOTS/ACRE

RESIDENTIAL "C"

TOTAL NUMBER OF UNITS	495 UNITS
GROSS AREA OF RESIDENTIAL "C"	69 Ac.
PERMITTED DENSITY	12 UNITS/ACRE
UNIT DENSITY	7.17 UNITS/ACRE

RESIDENTIAL "D"

TOTAL NUMBER OF UNITS	209 UNITS
GROSS AREA OF RESIDENTIAL "D"	18 Ac.
PERMITTED DENSITY	18 UNITS/ACRE
UNIT DENSITY	11.61 UNITS/ACRE

COMMERCIAL LAND USE TABULATION

GENERAL BUISNESS & INDUSTRIAL

GENERAL COMMERCIAL	1,216,750 S.F.	87 Ac
OFFICE PARK	392,250 S.F.	29 Ac.
INDUSTRIAL	1,384,080 S.F.	128 Ac.
PUBLIC USE	522,720 S.F.	12 Ac.
RT. 199 R.O.W.		40 Ac.
30 % (ROADS, STREETS, ETC.)		111 Ac.
TOTAL		407 Ac.

NON RESIDENTIAL AMENITY & SERVICE SITES

1. GOLF CLUB, PRO SHOP, SWIM AND TENNIS CLUB	12 Ac.
2. GOLF MAINTENANCE	10 Ac.
TOTAL	22 Ac.

OPEN SPACE

NON RESIDENTIAL AMENITY AND SERVICE SITES	22 Ac.
GOLF COURSE, LAKES AND BUFFERS, MARSH RESERVE	219 Ac.
OPEN SPACE WITHIN RESIDENTIAL AREAS	9 Ac.
TOTAL AREA OF OPEN SPACE	250 Ac.
TOTAL AREA OF PROJECT	489 Ac.
% OF OPEN AREA	51 %

OVERALL DENSITY

TOTAL PROJECT AREA	489 Ac.
TOTAL NUMBER OF RESIDENTIAL UNITS	1200 UNITS
OVERALL PROJECT DENSITY	2.45

SHEET 1 OF 2

PROJ MASTER PLAN | DATE 12-17-86 | SCALE 1" = 300' | PROJ MAN. RCS | JOB NO 86176 | DWN CER | APP DCR

1986 MASTER PLAN

WARHILL TRACT

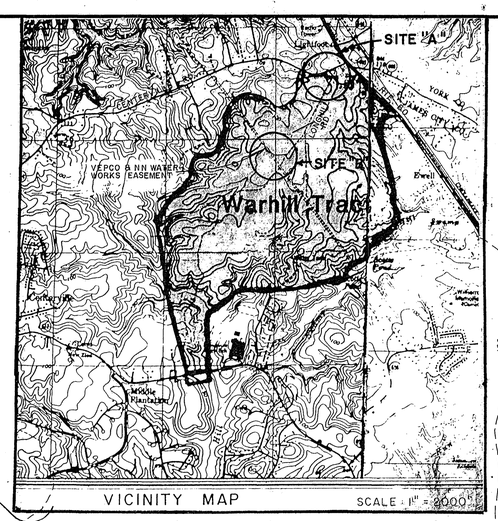
OWNER/DEVELOPER: JACK SCRUGGS , VIRGINIA INTERNATIONAL REALTY

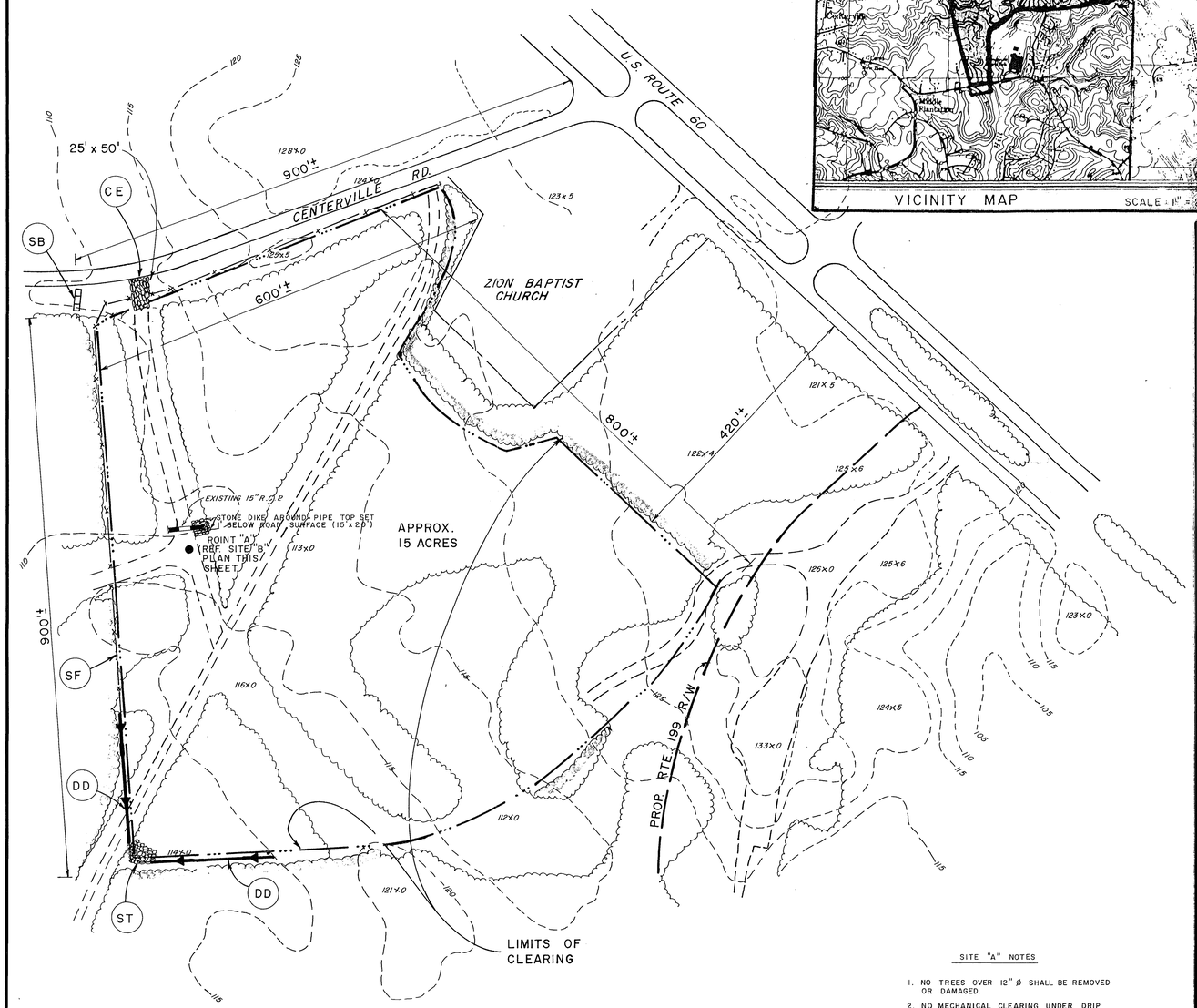
POWHATAN DISTRICT JAMES CITY COUNTY EXHIBIT 4 VIRGINIA

NO	DATE	REVISIONS	BY	APP

COMMONWEALTH OF VIRGINIA
O. C. RICKMOND, JR.
No. 9648
PROFESSIONAL ENGINEER

RICKMOND ENGINEERING INC.
208 C RICKETS COURT
WILLIAMSBURG, VA 23185
(804) 29-1776
CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING



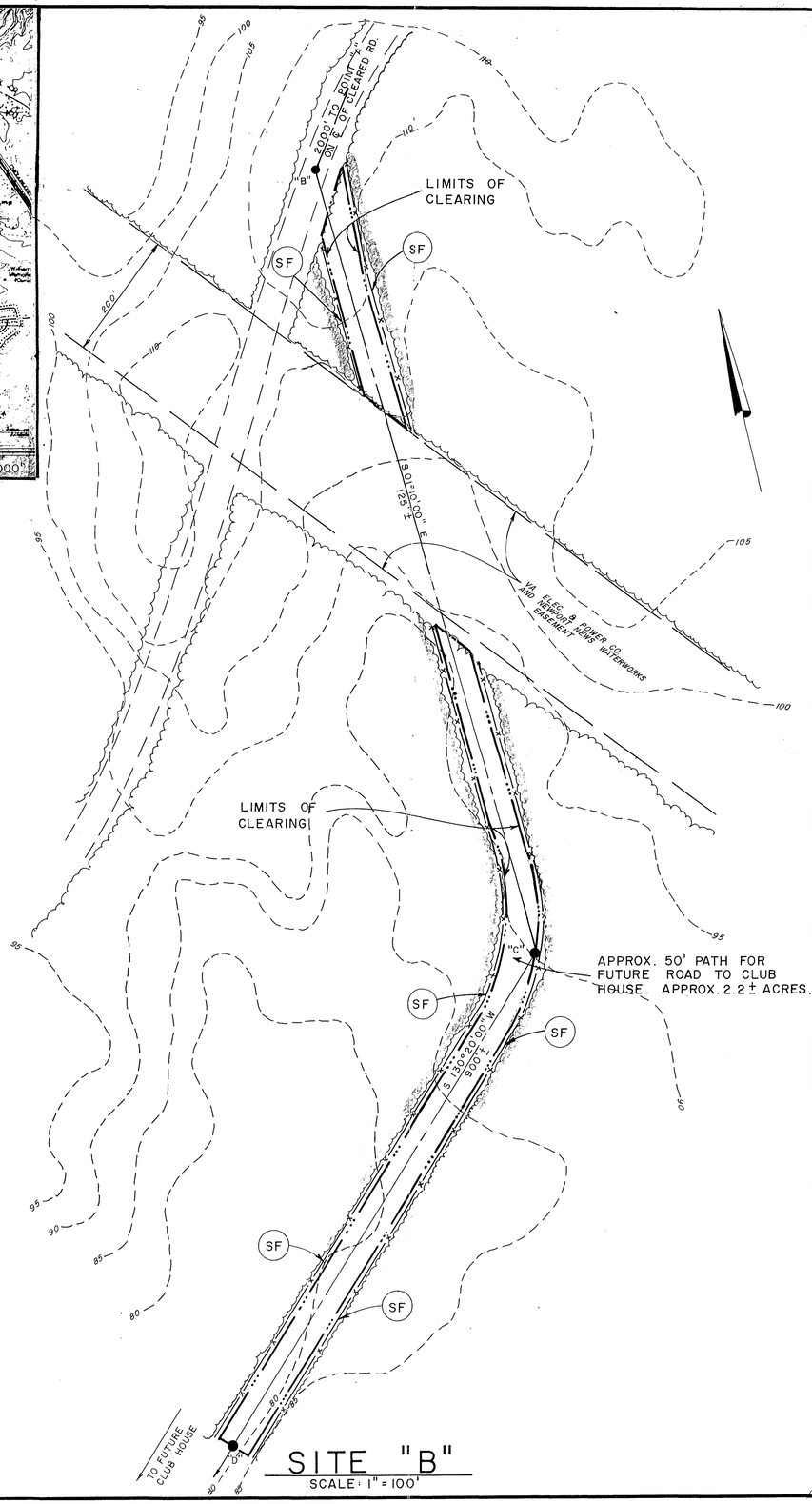


SITE "A" NOTES

1. NO TREES OVER 12" Ø SHALL BE REMOVED OR DAMAGED.
2. NO MECHANICAL CLEARING UNDER DRIP LINE OF 12" Ø TREES OR LARGER.
3. NO MORE THAN 20% OF 6" Ø TO 12" Ø TREES SHALL BE REMOVED.
4. THERE SHALL BE NO GRADING OF SITE.

SITE "A"

SCALE: 1" = 100'



SITE "B"

SCALE: 1" = 100'

RICKMOND ENGINEERING INC.

CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING

1643-C MERRIMAC TRAIL
WILLIAMSBURG, VA. 23185
(804) 229-1776/ 875-1785

Designed By:	Drawn By:	Approved By:	Scale:	Date:	Job No.
RS	B Mc	DCR	1" = 100'	7-23-87	87163 & 87164

No.	By	Revision	Dsp.	Date
3.	BMc	Revised per County Comments	DCR	8-11-87
2.	BMc	Revised per Telecon W/J Scruggs, J Phillips, R. Sisserman	RS	8-6-87
1.	B McI	Revised As per Engineer	DCR	8-5-87

WARHILL TRACT
EROSION & SEDIMENT CONTROL PLAN
SITES "A" & "B"

JAMES CITY COUNTY, VIRGINIA

Job Number	Sheet No.
87163	1

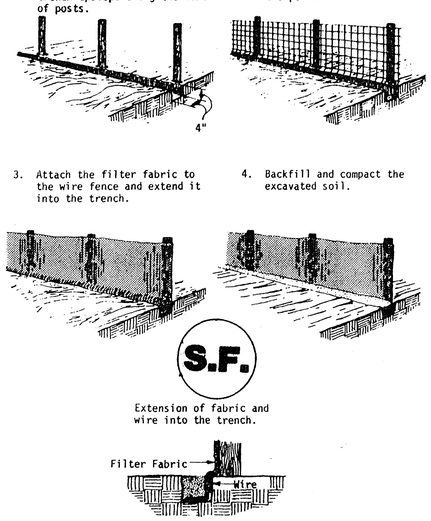
EROSION & SEDIMENTATION CONTROL MEASURES

ALL EROSION & SEDIMENTATION CONTROL MEASURES SHALL BE IN ACCORDANCE WITH THE JAMES CITY COUNTY EROSION AND SEDIMENTATION CONTROL ORDINANCE. THE CONTRACTOR SHALL SECURE A COPY OF THE VIRGINIA EROSION & SEDIMENT CONTROL HANDBOOK AND THOROUGHLY FAMILIARIZE HIMSELF WITH ALL APPLICABLE MEASURES CONTAINED THEREIN WHICH MAY BE PERTINENT TO THIS PROJECT.

THE PURPOSE OF SUCH MEASURES INCLUDING (BUT NOT LIMITED TO) THOSE SHOWN ON THIS PLAN SHALL BE TO PRECLUDE THE TRANSPORT OF ALL WATERBORNE SEDIMENTS RESULTING FROM CONSTRUCTION ACTIVITIES FROM ENTERING ONTO ADJACENT PROPERTIES OR INTO STATE WATERS. ALL SEDIMENTS MUST BE CONFINED TO THE PROJECT SITE AT THE LOCATIONS SHOWN ON THIS PLAN.

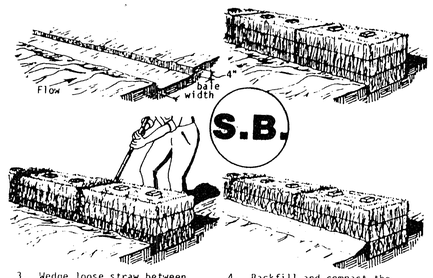
1. LAND CLEARING AND GRUBBING (IF REQUIRED)SHALL BE LIMITED TO AREAS OF WORKABLE SIZE.
2. TEMPORARY SEDIMENT BASINS, DIKES, EROSION CONTROL STONE, STRAW BALE BARRIERS, ETC., SHALL BE PLACED DURING CLEARING, GRUBBING, EARTH MOVING, AND ROUGH GRADING ACTIVITIES.
3. THE CONTRACTOR SHALL STRIP AND STOCKPILE TOPSOIL AT THE LOCATIONS SHOWN ON THIS PLAN OR AS DIRECTED BY THE OWNER. STRAW BALE BARRIERS SHALL BE PLACED AT TOE OF THE STOCKPILE AFTER STRIPPING OF TOPSOIL IS COMPLETE.
5. THE CONTRACTOR SHALL COMPLETE DRAINAGE FACILITIES WITHIN 30 DAYS FOLLOWING COMPLETION OF ROUGH GRADING AT ANY POINT WITHIN THE PROJECT.
6. ALL TEMPORARY EROSION CONTROL MEASURES (SEDIMENT BASINS, STRAW BALE BARRIERS, DIKES, ETC.), SHALL HAVE BEEN INSTALLED PRIOR TO OR DURING CLEARING, GRUBBING AND/OR ROUGH GRADING ACTIVITIES.
7. TEMPORARY VEGETABLE COVER SHALL BE PROVIDED IN ALL DISTURBED AREAS WHICH ARE NOT DESIGNATED FOR PAVING, UNDERGROUND UTILITIES OR STRUCTURAL USES. SUCH AREAS SHALL NOT BE EXPOSED FOR PERIODS EXCEEDING 30 DAYS. TEMPORARY VEGETAL COVER MAY BE ELIMINATED IN FAVOR OF FINAL VEGETAL COVER IF CONSTRUCTION CONDITIONS PERMIT AND THE CONTRACTOR IS SO DIRECTED BY THE OWNER.
8. ALL AREAS DESIGNATED FOR PAVING, UNDERGROUND UTILITIES, AND STRUCTURAL USE SHALL BE STABILIZED AS SOON AS PRACTICAL BUT NOT EXCEEDING 30 DAYS FOLLOWING INSTALLATION. NO MORE THAN 300' OF SANITARY SEWER, STORM SEWER, OR WATER LINES ARE TO BE OPEN AT ANY ONE TIME. BASE COURSE MATERIAL SHALL BE PLACED IN ALL STREET AREAS WITHIN 30 DAYS OF FINAL GRADING.
9. ALL STORM WATER MANAGEMENT FACILITIES INCLUDING EROSION CONTROL STONE ARE TO BE INSTALLED AND MADE OPERATIONAL WITHIN 30 DAYS FOLLOWING THE START OF CONSTRUCTION. THE INSTALLATION OF DRAINAGE FACILITIES SHALL TAKE PRECEDENCE OVER ALL OTHER UNDERGROUND UTILITIES.
10. FINAL VEGETABLE COVER (STABILIZATION) SHALL CONSIST OF TOPSOILING, LIMING, FERTILIZING, SEEDING, AND MULCHING TO ASSURE A FIRM STAND OF GRASS AS SOON AS PRACTICAL. SEDIMENT BASINS AND OTHER TEMPORARY EROSION CONTROL MEASURES ARE TO BE REMOVED ONLY WHEN STABILIZATION IS COMPLETE.
11. SEEDING SPECIFICATIONS:
    LIME: 4000 POUNDS PER ACRE
    SEED: KENTUCKY 31 TALL FESCUE - 250 POUNDS PER ACRE
    FERTILIZER: 10/20/10 AT 1000 POUNDS PER ACRE
    MULCH: STRAW OR HAY AT 4000 POUNDS PER ACRE.
12. ROCK FOR DITCHES SHALL BE VDH&T, TYPE A, EC-1.

1. Set posts and excavate a 4"x4" trench upslope along the line of posts.
2. Staple wire fencing to the posts.
3. Attach the filter fabric to the wire fence and extend it into the trench.
4. Backfill and compact the excavated soil.

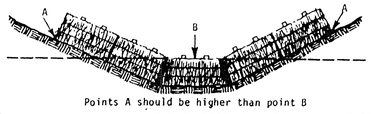


CONSTRUCTION OF A SILT FENCE

1. Excavate the trench.
2. Place and stake straw bales.
3. Wedge loose straw between bales.
4. Backfill and compact the excavated soil.

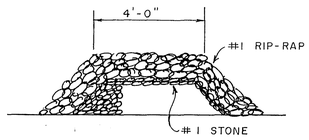


CONSTRUCTION OF STRAW BALE BARRIER

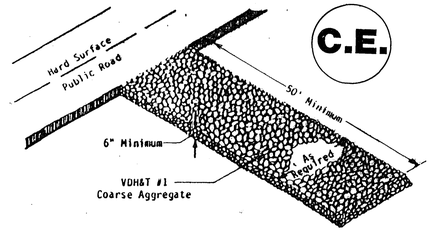


Points A should be higher than point B

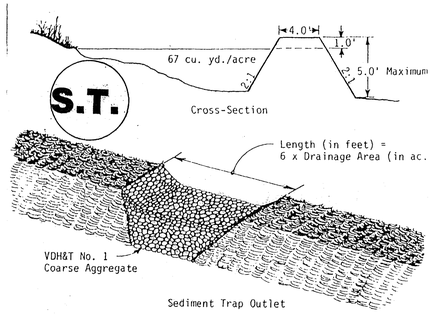
PROPER PLACEMENT OF STRAW BALE BARRIER IN DRAINAGE WAY



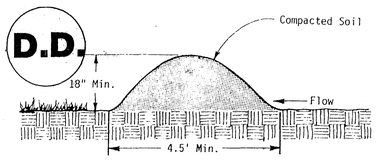
STONE DIKE



GRAVEL CONSTRUCTION ENTRANCE



SEDIMENT TRAP



DIVERSION DIKE

RICKMOND ENGINEERING INC.
CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING
1643-C MERRIMAC TRAIL
WILLIAMSBURG, VA. 23185
(804) 229-1776/ 875-1785

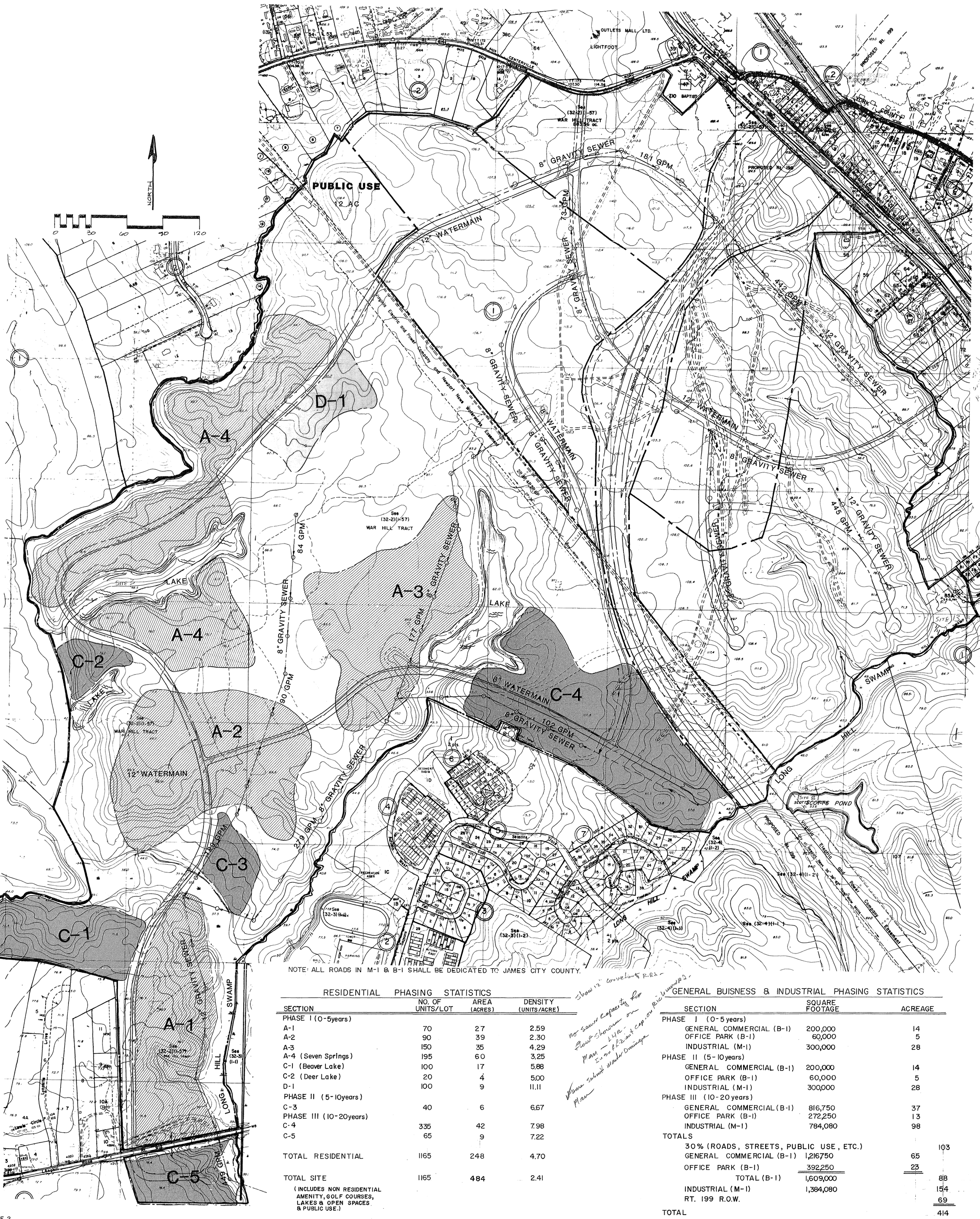
Designed By:	Drawn By:	Approved By:	Scale:	Date:	Job No.
RS	B Mc	DCR	NTS	7-23-87	87163 & 87164

No.	By	Revision	Date
1	BMc	Revised per County Comments	DCR 8-11-87

WARHILL TRACT
EROSION & SEDIMENT CONTROL PLAN
SITES "A" & "B"

JAMES CITY COUNTY VIRGINIA

Job Number	Sheet No.
87163	2



NOTE: ALL ROADS IN M-1 & B-1 SHALL BE DEDICATED TO JAMES CITY COUNTY.

RESIDENTIAL PHASING STATISTICS

SECTION	NO. OF UNITS/LOT	AREA (ACRES)	DENSITY (UNITS/ACRE)
PHASE I (0-5years)			
A-1	70	27	2.59
A-2	90	39	2.30
A-3	150	35	4.29
A-4 (Seven Springs)	195	60	3.25
C-1 (Beaver Lake)	100	17	5.88
C-2 (Deer Lake)	20	4	5.00
D-1	100	9	11.11
PHASE II (5-10years)			
C-3	40	6	6.67
PHASE III (10-20years)			
C-4	335	42	7.98
C-5	65	9	7.22
TOTAL RESIDENTIAL	1165	248	4.70
TOTAL SITE	1165	484	2.41

(INCLUDES NON RESIDENTIAL AMENITY, GOLF COURSES, LAKES & OPEN SPACES & PUBLIC USE.)

Show 12" connection to R.R.A.

No sewer capacity for flows shown on plan - LWR - Is on P.C. list on RICHMOND. Must submit Master Drawings plan

GENERAL BUISNESS & INDUSTRIAL PHASING STATISTICS

SECTION	SQUARE FOOTAGE	ACREAGE	
PHASE I (0-5 years)			
GENERAL COMMERCIAL (B-1)	200,000	14	
OFFICE PARK (B-1)	60,000	5	
INDUSTRIAL (M-1)	300,000	28	
PHASE II (5-10years)			
GENERAL COMMERCIAL (B-1)	200,000	14	
OFFICE PARK (B-1)	60,000	5	
INDUSTRIAL (M-1)	300,000	28	
PHASE III (10-20 years)			
GENERAL COMMERCIAL (B-1)	816,750	37	
OFFICE PARK (B-1)	272,250	13	
INDUSTRIAL (M-1)	784,080	98	
TOTALS			
30% (ROADS, STREETS, PUBLIC USE, ETC.)			103
GENERAL COMMERCIAL (B-1)	1,216,750	65	
OFFICE PARK (B-1)	392,250	23	
TOTAL (B-1)	1,609,000		88
INDUSTRIAL (M-1)	1,384,080		154
RT. 199 R.O.W.			69
TOTAL			414

SHEET 2 OF 2

PROJ. MASTER PLAN | DATE 12-17-86 | SCALE 1"=300' | PROJ. MAN. RCS | JOB NO 86176 | DWN CER | APP DCR

1986 PHASING PLAN & SECTION STATISTICS

WARHILL TRACT

OWNER/DEVELOPER: JACK SCRUGGS, VIRGINIA INTERNATIONAL REALTY

POWHATAN DISTRICT · JAMES CITY COUNTY · EXHIBIT 4 · VIRGINIA

NO	DATE	REVISIONS	BY	APP

COMMONWEALTH OF VIRGINIA
D. C. RICKMOND, JR.
No. 9648
PROFESSIONAL ENGINEER

RICKMOND ENGINEERING INC.
208 C PACKETS COURT
WILLIAMSBURG, VA 23185
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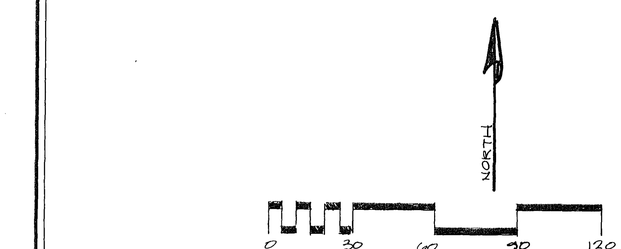
LAND DEVELOPMENT PLANNING



RESIDENTIAL PHASING STATISTICS

SECTION	NO. OF UNITS/LOT	AREA (ACRES)	DENSITY (UNITS/ACRE)
PHASE I (0-5years)			
A-1	70	58	1.37
A-2	90	30	3.0
A-3	150	39	3.85
A-4 (Seven Springs)	195	85	2.29
C-1 (Beaver Lake)	100	15	6.67
C-2 (Deer Lake)	20	2	10.0
D-1	100	8	12.5
PHASE II (5-10years)			
C-3	40	4	10.0
PHASE III (10-20years)			
C-4	335	53	6.32
D-2	100	7	14.29
TOTAL RESIDENTIAL	1200	294	4.08
TOTAL SITE	1200	489	2.45

(INCLUDES NON RESIDENTIAL AMENITY, GOLF COURSES, LAKES & OPEN SPACES)

GENERAL BUISNESS & INDUSTRIAL PHASING STATISTICS

SECTION	SQUARE FOOTAGE	ACREAGE	
PHASE I (0-5 years)			
GENERAL COMMERCIAL (B-1)	200,000	14	
OFFICE PARK (B-1)	60,000	5	
INDUSTRIAL (M-1)	300,000	28	
PHASE II (5-10years)			
GENERAL COMMERCIAL (B-1)	200,000	14	
OFFICE PARK (B-1)	60,000	5	
INDUSTRIAL (M-1)	300,000	28	
PHASE III (10-20 years)			
GENERAL COMMERCIAL (B-1)	816,750	59	
OFFICE PARK (B-1)	272,250	19	
INDUSTRIAL (M-1)	784,080	74	
TOTALS			
30% (ROADS, STREETS, PUBLIC USE, ETC.)			123
GENERAL COMMERCIAL (B-1)	1,216750	87	
OFFICE PARK (B-1)	392,250	29	
TOTAL (B-1)	1,609,000		116
INDUSTRIAL (M-1)	1,384,080		128
RT. 199 R.O.W.			40
TOTAL			407

SHEET 2 OF 2

PROJ. MASTER PLAN | DATE 12-17-86 | JOB NO. 86176 | SCALE 1"=300' | DWN CER | PROJ. MAN. RCS | APP DCR

1986 PHASING PLAN & SECTION STATISTICS

WARHILL TRACT

OWNER/DEVELOPER: JACK SCRUGGS, VIRGINIA INTERNATIONAL REALTY

POWHATAN DISTRICT — JAMES CITY COUNTY — EXHIBIT 4 — VIRGINIA

NO	DATE	REVISIONS	BY	APP

COMMONWEALTH OF VIRGINIA — D. C. RICKMOND, JR. — No. 9648 — PROFESSIONAL ENGINEER

RICKMOND ENGINEERING INC.

208 C PACKETS COURT
WILLIAMSBURG, VA 23185
(804) 229-1776

CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
LAND DEVELOPMENT PLANNING

Warhill Tract
James City County, Virginia

Fiscal and Economic Impact Study

October, 1995

Prepared for:

TMB Service Corporation
Mission, Kansas

Prepared by:

The Wessex Group, Ltd.
479 McLaw's Circle, Suite 1
Williamsburg, Virginia 23185
(804) 253-5606

Executive Summary

Warhill Tract
James City County, Virginia

Fiscal and Economic Impact Study

EXECUTIVE SUMMARY

TMB Service Corporation ("the developer") plans to develop a tract of land in James City County, Virginia, known as the **Warhill Tract**. Development plans include single and multi-family dwellings, a golf course, and retail space. Recreational open space, conservation acres, and the necessary infrastructure also are included in the plans. The development schedule spans seven years and represents the developer's estimates of the property's potential.

This report from ***The Wessex Group, Ltd.*** (TWG) provides estimates of the fiscal and economic impacts on James City County as this development proceeds. The *fiscal* impact estimates in this report pertain to incremental revenues and expenditures of the local government of James City County. *Economic* impacts are measured by estimating incremental jobs that the proposed development will generate county-wide, along with incremental retail spending that will occur around the county as the development grows. All dollar figures are expressed in 1995 dollars.

It is estimated that investment in the development of the Warhill Tract will exceed $330 million. Plans are to develop 250,000 square feet of retail space, more than 1,500 residential units, and an 18 hole golf course. The population of the project is projected to reach approximately 3,500 persons at buildout.

Direct Employment

The development of this portion of the Warhill Tract will provide both temporary construction jobs (ranging from 370 to more than 1,000 jobs a year) and 580 permanent positions on site. Of these 580 permanent jobs, it is estimated that 200 will be incremental positions in the county. Total annual payroll for these incremental positions is estimated to range from $8.1 to $24.2 million a year during development, then will be an estimated $2.7 million a year for permanent jobs at buildout.

Local Government Revenues

Incremental revenues for James City County's government will have numerous sources, including sales tax, property taxes, and permits, fees and business licenses. Annual revenues generated by the project are expected to range from about $1.5 million at the beginning of development activities, then level at $5 million after buildout.

Local Government Expenditures

James City County will have incremental expenditures as a direct result of the proposed development, generated both by new employment and by the residential population on the site. In

particular, the cost of operating public schools and the debt service required to build new schools will have a significant impact, as projections of incremental population exceed 3,500 persons in more than 1,500 households. At buildout, estimates of incremental government expenditures are approximately $5 million per year.

Impact on James City County Schools

The incremental number of students expected to attend Williamsburg-James City County public schools as a result of the development was determined separately for elementary, middle and high schools so that costs may be determined individually by type of school. The results of the projections are summarized below.

Warhill Tract
Projected Number of School Age Children, by Type of School

Year	Based on # of Households	Elementary (K-5)	Middle (6-8)	High School (9-12)	Total (K-12)
1997	293	54	25	28	107
1999	791	145	66	75	286
2001	1,243	228	104	118	450
2003	1,403	258	118	133	509

To finance construction of new schools, James City County currently is eligible for $19,700,000 in low interest loans (4%) through the Virginia Literary Loan Fund. A second source is the Virginia Public School Authority, which issues 20 year loans at an interest rate of 6.5%. Based on the financing arrangements allowed through these two sources, total annual debt service for school construction attributable to the Warhill Tract is estimated as follows:

Williamsburg-James City County Public Schools
Summary of Debt Service

Year	Debt service Attributable to Warhill Tract
1997	$104,195
1999	$278,453
2001	$438,138
2003	$495,545

Net Fiscal Impact

Fiscal impact is calculated simply by subtracting incremental expenditures from incremental revenues to determine if the locality faces a net gain or a net loss as the direct result of a development project. In this case, projections show that James City County would have a positive cash flow in the early years of the proposed project, ranging from approximately $1 million to $2 million a year. As the residential population increases in the development and requires public services and public education, the net financial impact of the development is estimated to be about at the breakeven point or slightly negative, a condition likely to continue into the future after buildout is reached.

Economic Impact

Economic impact is measured by incremental retail sales and new jobs that will be created county-wide as a result of the proposed development of the Warhill Tract. As the wages and retail sales directly generated by the project circulate through James City County's economy, the total impact as measured by retail sales is estimated to grow from $2.9 million early in the project's development stages to more than $20 million annually. The economic activity is expected to generate up to 1,300 jobs county-wide while development progresses. At buildout, the economic measurement is estimated at 280 jobs throughout James City County.

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Warhill Tract
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Fiscal and Economic Impact Study

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Section One

Warhill Tract
James City County, Virginia

Fiscal and Economic Impact Study

Section 1

INTRODUCTION

TMB Service Corporation ("the developer") plans to develop a tract of land located in James City County, Virginia. The property on which this development will take place is referred to as the **Warhill Tract**. Included in development plans are a golf course, retail space, residential areas, recreational open space and conservation acres. This report from ***The Wessex Group, Ltd.*** (TWG) provides estimates of the fiscal and economic impacts on James City County as this development proceeds.

The *fiscal* impact estimates in this report pertain to incremental revenues and expenditures of the local government of James City County. Incremental revenues, for example, will include property taxes and sales tax directly generated by homes and businesses located in the planned development. The types of incremental expenditures that the development will generate for the county include the cost of services such as police protection for the proposed development and the local contribution to public education required to educate the school age population residing in the development.

Economic impacts are measured by estimating incremental jobs that the proposed development will generate county-wide, along with incremental retail spending that will occur around the county as the development grows. Economic measures have two components: direct impact and indirect impact. For example, the direct impact of employment includes all of the construction worker positions required for building the roads, homes, and businesses in the Warhill Tract. Direct employment also includes the permanent employment positions of those who will work in the businesses that locate in the development. In a similar manner, direct retail sales reflect estimates of the sales of the businesses located in the project, as well as the retail spending of the residents in the project off-site but still within James City County.

Indirect economic impacts, on the other hand, are the economic benefits caused by the circulation of direct impacts. Consider, for instance, one dollar of wages paid to a retail employee working at a store in the Warhill Tract. This employee spends part of that dollar on groceries at a store located elsewhere in James City County, and it becomes revenue for the grocery store owner. The grocery store owner uses part of that revenue to pay his employees and part to purchase inventory from local growers. The grocery store employees and local growers, in turn, spend part of their wage or revenue locally, and so on. Eventually all of the original one dollar is spent outside of James City County, and then its economic benefit to the county has expired. While it circulates from hand to hand, however, it helps create jobs and retail sales. Its original value of $1.00 multiplies within the economy during its circulation, and the indirect benefit has been created.

Methodology

The development schedule spans seven years (assumed to be 1996 - 2002) and represents the developer's estimates of the property's potential. The eighth year following the start of the project also is included in the analysis to indicate the ongoing impacts after development is completed. The estimates in this report are based on data and information gathered from numerous sources. Sources are identified in relevant portions of the text.

All dollar estimates in this report are in 1995 dollars. General economic inflation is certain to occur over the eight year period examined for this study, but expressing estimates in constant dollars provides a less complicated frame of reference that can be related more easily to other secondary data.

Overview of the Report

Section Two of this report presents the development schedule for the Warhill Tract, including estimates of the investment in infrastructure and construction. Section Three considers direct employment from the planned project, including both temporary construction employment and permanent employment. Section Four covers the fiscal impact of the proposed development as it pertains to incremental revenues and expenditures for the local government of James City County. The last section, Section Five, presents an analysis of the economic impact of the project.

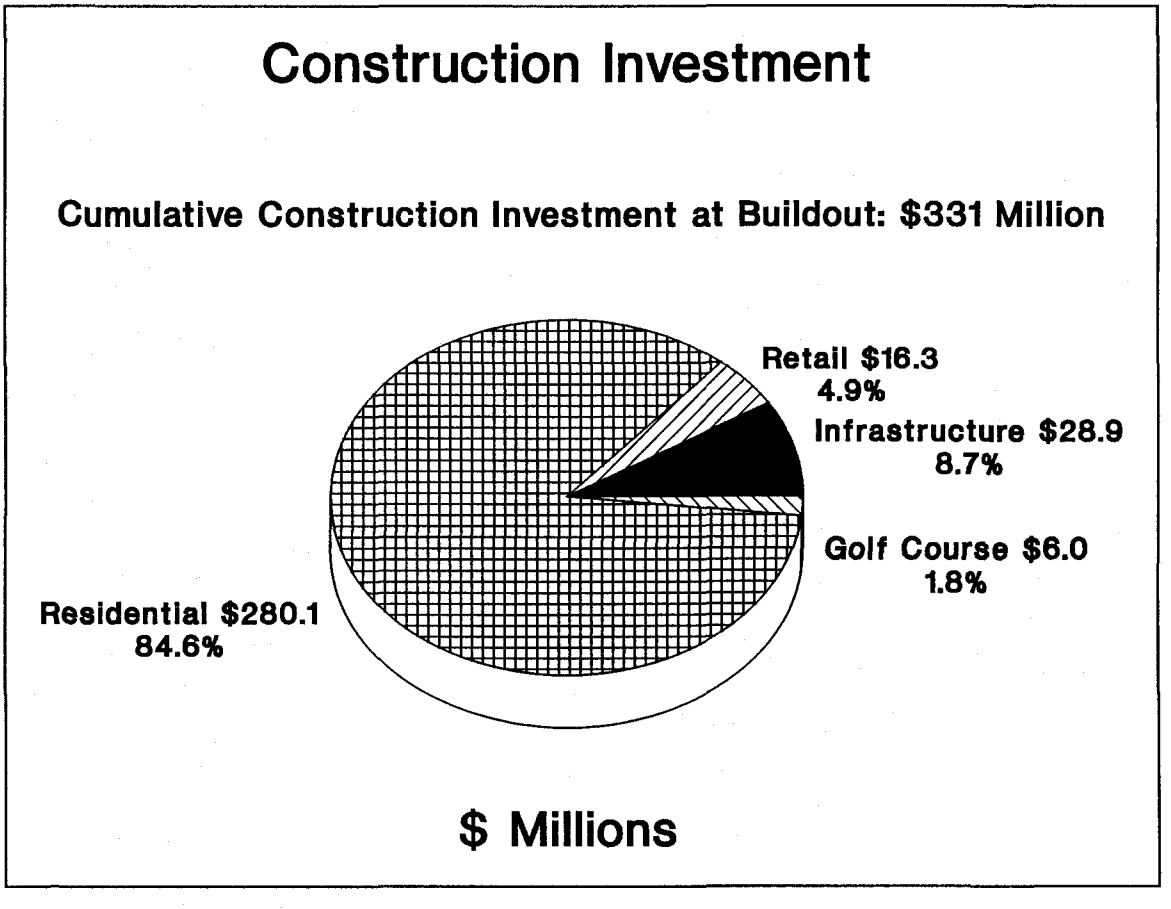
Section Two

Section 2

DEVELOPMENT SCHEDULE

The developer estimates that buildout of the Warhill Tract will require seven years. For this study, the progress of the development is described at four points in time: Year 2 (1997), Year 4 (1999), Year 6 (2001), and the year following buildout (2003). The developer's plans for the Warhill Tract include a golf course, 250,000 square feet of retail development, and single and multi-family residential development. Details of the development schedule used for this study are presented in Table 1 on the following page. At buildout, the developer estimates that more than 1,500 housing units will be developed on site. The estimated construction investment is illustrated in Figure 2-1.

Figure 2-1



Warhill Development

Table 1

DEVELOPMENT SCHEDULE

Cumulative Units	1997	1999	2001	2003 (Buildout + 1 Yr.)
Retail Square Footage	0	250,000	250,000	250,000
Residential Units:				
Apartments	0	0	150	150
Assisted Living	0	130	130	130
Condominiums	0	120	120	120
Single Family	191	427	613	723
Townhomes	102	244	360	410
Total Residential Units	293	921	1,373	1,533
Residential Population	212	1,417	2,815	3,526
Cumulative Construction Investment:				
Infrastructure	$10,529,100	$22,902,900	$26,950,900	$28,903,000
Retail	0	16,250,000	16,250,000	16,250,000
Golf Course	6,000,000	6,000,000	6,000,000	6,000,000
Residential:				
Apartments	0	0	4,714,400	4,714,400
Assisted Living	0	8,276,300	8,276,300	8,276,300
Condominiums	0	11,640,000	11,640,000	11,640,000
Single Family	56,577,500	121,972,500	171,842,500	201,510,000
Townhomes	13,138,000	31,589,000	47,057,000	53,967,000
Total Construction Investment	$86,244,600	$218,630,700	$292,731,100	$331,260,700

Run date: 27–Oct–95

Golf Course Development

The developer plans to design an 18 hole golf course with amenities (club house, pro shop, etc.) for the Warhill Tract. Although the course will help promote the concept of a golf course community for marketing purposes, it is slated for public play. For this analysis, it is assumed that construction will commence in 1996 and be complete by mid-1997 when golf course operations will begin. The estimated cost of $6 million to build this golf course and its amenities were determined using data from a major golf course developer.

Retail Development

Retail development is part of the plans for the Warhill Tract. Most retail space will be clustered in one area of the site. Also, very small retail operations to service the residential development on the tract (possibly a convenience store or small restaurant), are planned for an appropriate location on the property.

Investment in retail development is expected to exceed $16 million, plus approximately $3 million for site work. This estimate is based on an average cost of $100,000 per acre for all site work (including roads, parking lots, etc.) and $65 per square foot for vertical structures. These cost estimates have been recommended by several area developers and commercial realtors, and square footage estimates have been supplied by the developer.

Residential Development

The developer of the Warhill Tract plans to build both single family and multi-family housing units. Current plans call for approximately 1,530 units, of which 44% will be multi-family housing (apartments, condominiums and townhouses), 8% will be assisted living for seniors, and 48% single family units. Development costs for the residential sector of the project (excluding infrastructure and lot development) are estimated at $280 million over the 12 year period.

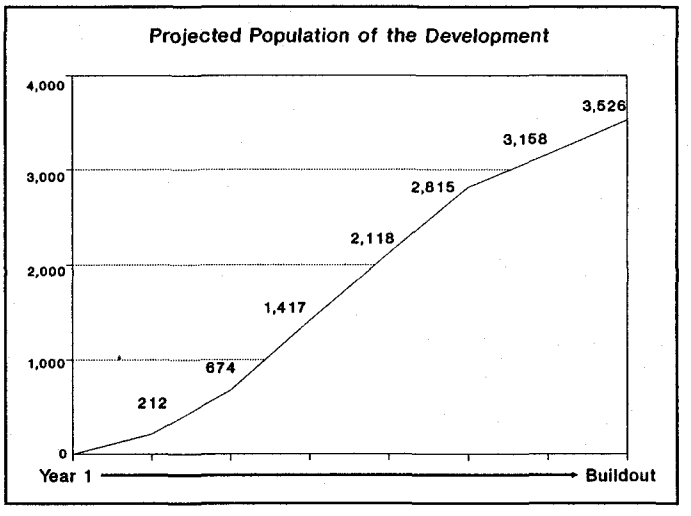
The developer is planning for a mix of home sizes and locations. Estimated values of housing units are dependent upon several factors, including location (on or off a golf course), lot size and unit type. Lot prices are expected to range from $25,000 for some townhouses to $80,000 for the largest single family unit lots. Expected housing unit prices range from $90,000 for a condominium to $320,000 for the largest single family units on a prime location (e.g., golf course fairway).

The value of rental apartments and assisted living housing units that are included in the development plan has been estimated by examining comparable complexes located in James City County. Apartment units are valued at $31,430 each (lot and structure), and assisted living units are valued at $63,664 for lot and structure.

James City County's *1995-1996 Adopted Budget* indicates that, county-wide, average household size currently is 2.6 persons, down from 2.8 in 1990. This history indicates a trend toward households with fewer residents in this county. During the period from 1988 to 1994, the county's population has grown by 7,130 persons. During the same period, the number of households has grown by 3,288. The average household size for the new population in James City County since 1988

is 2.17 persons. Also, a study by ***The Wessex Group*** of household sizes relative to housing values around the state of Virginia shows that the higher the housing value the smaller the household size. The mean housing value planned for this development is approximately $183,000. James City County reports that in the county the "average existing home...will be valued at $102,312 in FY 96," a figure just over half as large as the Warhill Development's mean value of homes. Therefore, for this analysis ***The Wessex Group*** has used an average household size of 2.3 persons for all units planned, resulting in an incremental population figure of 3,526 persons at buildout (Figure 2-2).

Figure 2-2



Infrastructure

Roads, water and sewer will be required for the Warhill Tract. The initial infrastructure required for ongoing development is scheduled to begin in 1996. This basic infrastructure will require more than $10 million in investment, and completion is scheduled for mid-1999.

Other interior roads, lot development, and water and sewer lines for individual parcels, will be completed as development proceeds. The estimated investment in this additional infrastructure is approximately $15.7 million.

An additional $3 million in investment will be required to prepare acreage for retail development. Approximately 30 acres of retail development are planned, and site costs are estimated at $100,000 per acre. This estimate has been supplied by area developers and commercial realtors.

Section Three

Warhill Tract
James City County, Virginia

Fiscal and Economic Impact Study

Section 3

DIRECT EMPLOYMENT

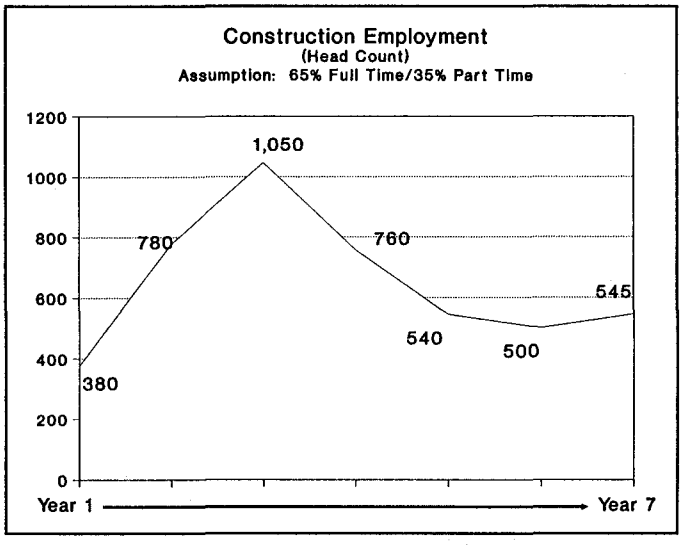
Direct employment is that generated on the site of the Warhill Tract, either by construction or permanent operations, and also includes jobs from direct retail spending of site employees. The *economic* impact estimates in Section Five of this report consider both direct and indirect (i.e., all other off-site) employment. For the *fiscal* impact analysis, however, only direct employment is relevant.

Table 2 following contains estimates of direct employment. Construction employment is listed separately, as it is considered to be temporary employment that ends at buildout. Permanent employment represents jobs at the retail facilities, as well as jobs created by the golf course, along with jobs created in the county by the direct retail spending of on-site employees. Full Time Equivalent (FTE) employment and payroll for all direct employment also are calculated, as these are the basis of some fiscal revenues and expenses described in Section Four of this report.

Construction Employment

Construction employment is calculated by using the investment in construction (see Table 1 in Section Two) as the basis. Several area contractors say that labor typically is 32% of total construction costs. The average wage for a full time construction worker in Virginia is $29,000 (*Virginia Statistical Abstract*, 1992-93 Edition, Center for Public Service, University of Virginia). For this analysis, it is assumed that 65% of construction labor is full time and 35% part time. Also, it is assumed that part time labor works half time. Figure 3-1 illustrates the progression of construction employment throughout the development of the project.

Figure 3-1



Permanent Employment

The numbers of permanent employment positions that will be available if the Warhill Tract is developed as proposed are generated by the golf course

Warhill Development

Table 2

EMPLOYMENT SCHEDULE

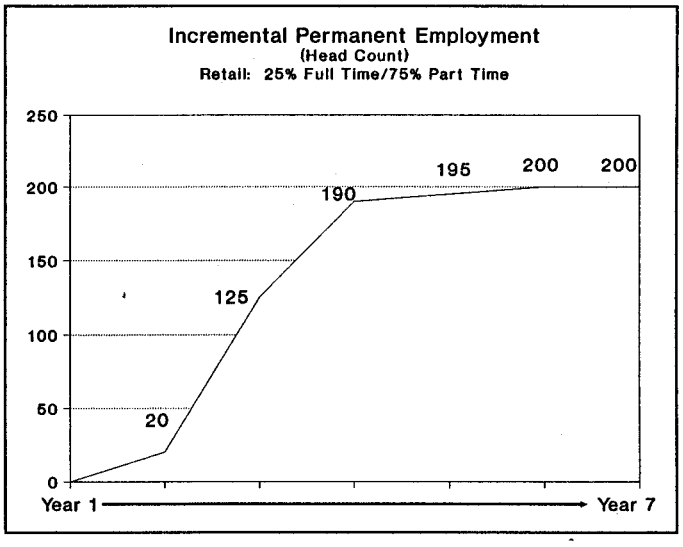
	1997	1999	2001	2003 (Buildout + 1 Yr.)
Annual Construction Employment				
Full Time Jobs	510	490	320	0
Part Time Jobs	270	270	170	0
Total Construction Jobs	780	760	490	0
Annual Permanent Employment				
Full Time Jobs	10	60	60	60
Part Time Jobs	10	130	140	140
Total Permanent Jobs	20	190	200	200
Annual FTE Employment	590	680	500	130
Annual Payroll	$17,004,600	$18,823,600	$13,377,800	$2,703,400

Run date: 27–Oct–95

and the retail development on site, as well as by the direct retail spending of these employees (Figure 3-2).

This analysis considers **incremental** permanent employment in James City County. The level of permanent employment is expected to continue at approximately 200 total positions after buildout. The source for estimated full time and part time employment at the golf course is a major golf course development company.

Figure 3-2

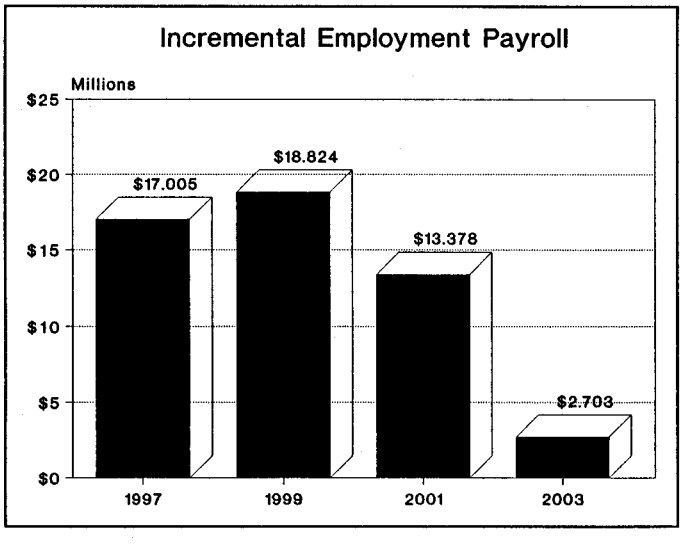


For retail development, major retailers indicate that average employment is 2.2 positions for every 1,000 square feet. For this analysis, it is assumed that 75% of retail labor is part time and 25% is full time.

Payroll

Payroll has been calculated separately for each employment category described above. For construction labor, payroll is assumed to be 32% of total construction investment. Payroll for the golf course has been estimated by using data from the golf course development company previously referenced. Major retailers report that the average wage per position is approximately $12,500. Estimated payroll levels are illustrated in Figure 3-3.

Figure 3-3



Section Four

Section 4

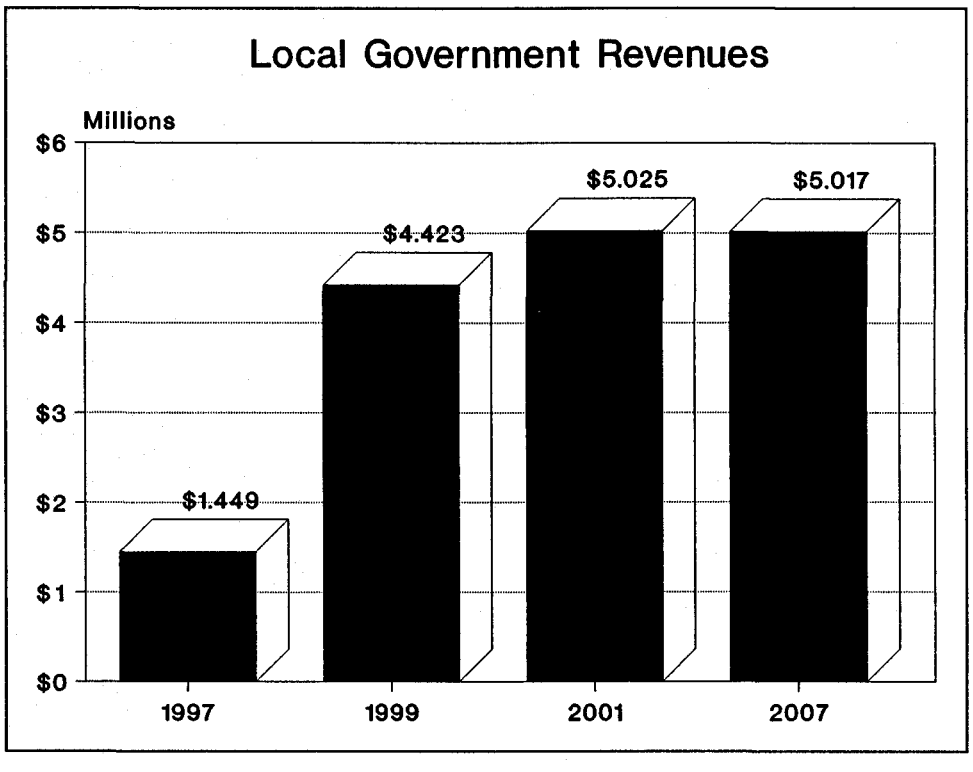
LOCAL GOVERNMENT REVENUES AND EXPENDITURES

This section presents the estimates of the *fiscal* impact of the proposed Warhill Tract on James City County — the incremental local government revenues and expenditures. The **net** fiscal impact is determined by subtracting expenditures from revenues.

Local Government Revenues

Incremental revenues that the proposed project will generate for James City County have several sources. These are listed on Table 3 following, and Figure 4-1 illustrates the estimated revenue stream. Explanations and assumptions underlying the estimates are given below.

Figure 4-1



Warhill Development

Table 3

LOCAL GOVERNMENT REVENUES

	1997	1999	2001	2003 (Buildout + 1 Yr.)
Total Retail Sales	$2,009,800	$54,241,100	$53,696,500	$52,629,100
Incremental Government Revenues:				
Sales Tax	$20,100	$170,000	$173,100	$166,600
Real Estate Tax	583,700	1,602,000	2,190,400	2,497,700
Personal Property Tax	119,600	1,606,100	1,776,400	1,836,600
Building Permits	175,300	281,000	129,900	0
Business License Tax	461,700	550,000	404,800	117,100
Other Local Revenues	89,100	214,300	350,900	399,100
Total Government Revenues	$1,449,500	$4,423,400	$5,025,500	$5,017,100

Run date: 27–Oct–95

Sales Tax

For this analysis, sales tax generated directly by the development has two components: payroll of direct employees and the sales of retail facilities on site. The state returns 1% of taxable sales collected in sales tax to the locality generating the sale. The figures in Table 3 reflect this 1% return. As a point of reference, an estimate of **total** retail sales also is presented on Table 3. Local government revenues in this category should increase steadily as development progresses, finally reaching approximately $167,000 by buildout.

In Virginia another 1% is dedicated to a pool for public education, then allocated to cities and counties on the basis of need. This source of funding is not included in the sales tax revenue figures. The implications of public education funding are discussed in more detail in this section under **Local Government Expenditures**.

- Sales Tax From Payroll: In the state of Virginia, employees and residents typically spend approximately 33% of their income in the locality in which they work or live (Bureau of Business Research). To provide conservative estimates and to avoid "double counting" the taxable retail sales of on site development, only 10% of direct payroll (see Table 2) are considered as a source of incremental retail sales in James City County.
- Sales Tax From Retail Development: For new retail facilities planned for the Warhill Tract, sales are estimated at $207 per square foot, the average of neighborhood shopping centers in the Southeastern region of the United States (*Dollars and Cents of Shopping Centers*, 1993, Urban Land Institute). To estimate the portion of these sales that are incremental (as opposed to those that are simply shifted from existing retail business in the county), the proportion of the population of the City of Williamsburg, the Bruton District of York County, and the proposed Warhill Development has been compared to the sum of these populations plus James City County's projected 1996 population. This proportion is assumed to represent incremental sales that would have taken place outside of James City County if the proposed Warhill Development was not there.
- Sales Tax From the Golf Course: On golf courses, the majority of sales tax is generated by the pro shops and the clubhouse. Using data on projected retail sales from a major golf course development company, retail sales for the course on the Warhill Tract are estimated at $618,750 per year.

Real Estate Tax

Real estate tax is one of the major components of local government revenues. James City County's *Adopted 1995-96 Budget* is based on a tax rate of $0.84 per $100 of assessed value, and no change in this rate is assumed for this analysis. The value of real estate is calculated separately for residential and non-residential development. Market values of residential development are discussed in Section Two if this report. The market value of non-residential development is assumed to be the total development cost. No property appreciation is included in this analysis, a conservative assumption, although real appreciation in property value is very likely to occur. Incremental government revenue from real estate taxes is expected to grow from less than $600,000 a year to nearly $2.5 million at buildout and beyond. Currently, the tax bill for the Warhill Tract is more than

$67,000. This amount has been subtracted from estimated revenues in this category so that only incremental revenues are considered in the analysis.

Personal Property Tax

Personal property tax is calculated by assuming values of $5.00 per square foot for retail space (a national average verified by representatives of major retail chains), along with data from the golf course developer. For residential tax revenue, the personal property tax payment per household is assumed to be $376.60. The calculation for this assumption is based on 80% of the county's projected collections for personal property in FY 96 divided by the projected number of households in the county for 1996. By buildout of the Warhill Tract, incremental personal property tax revenues for the county are estimated to exceed $1.8 million a year.

Building Permit Revenue

Public records provide the number of residential and commercial building permits issued in each Virginia locality, as well as the value of the new construction for which the permits were issued (*Virginia Statistical Abstract*). Using this data, along with James City County's historical revenue from building permits, the average new housing unit provides $872 in building permit revenue to the county. For commercial property proposed for the Warhill Tract, building permit revenue is estimated at $0.15 per square foot. While the Warhill Tract is under development, revenue from building permits is estimated at approximately $130,000 to $280,000 annually.

Business License Revenue

To estimate local government revenue from business license taxes, James City County's 1993 revenue was divided by the number of people who worked at businesses in James City County that year (Hampton Roads Planning District Commission). This calculation results in business license tax revenue of $581.26 per employee. This figure is multiplied by the number of incremental employees that would be generated by the development of the Warhill Tract. During the construction period, business license tax revenue ranges from approximately $400,000 to $550,000 annually. After buildout, the estimated revenue is $117,000 per year.

Other Local Revenues

Estimates of other local revenues pertain to recording taxes from the sale of residential property, including an assumption of a 5% turnover per year in residential units after existing for five years, and a per capita allocation of various revenue amounts listed in the county's most recent budget. Examples of such miscellaneous revenue categories include fines and forfeitures, motor vehicle licenses, and animal licenses. Projections of the incremental population are explained in Section Two of this report. For recording taxes, it is assumed that James City County will collect the maximum amount allowed by § 58.1 of the Code of Virginia, Chapter 8: a deed recording tax of $0.05 per $100 of the sale price, an additional recording tax of $0.05 per $100 of the sale price, and a deed of trust recording tax of $0.05 per $100 of the face value of the mortgage (assumed to be 80% of the sale price).

Local Government Expenditures

The increase in both residential and commercial activity on the Warhill Tract site will generate incremental expenditures for James City County's local government. Expenditures estimates are calculated separately for residential and non-residential development, then are added together to produce the figures contained in Table 4 and illustrated in Figure 4-2. Figure 4-3 shows the proportions of types of expenditures projected at buildout. Incremental expenditures are relatively small initially - under $400,000 per year - when the residential portion of the Warhill Tract is still under development. By buildout, however, estimated expenditures are expected to total more than $5 million per year.

Figure 4-2

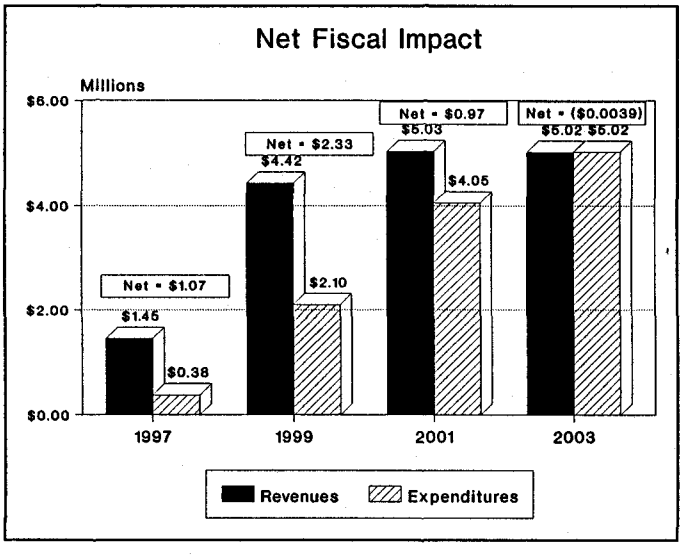
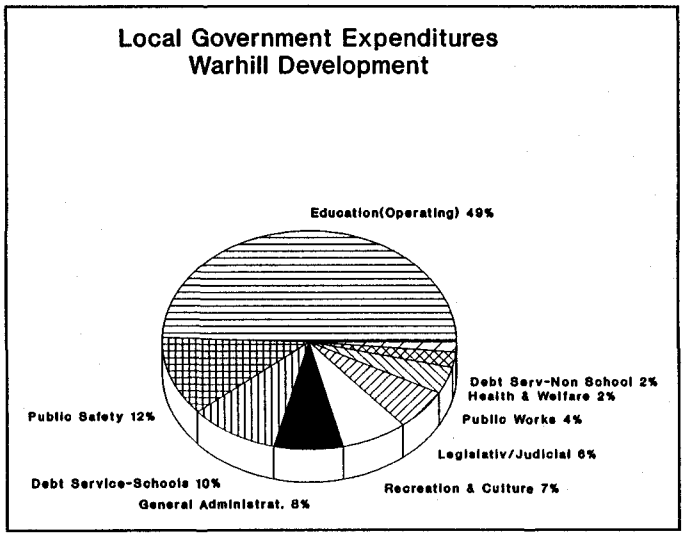


Figure 4-3



Warhill Development

Table 4

LOCAL GOVERNMENT EXPENDITURES & NET FISCAL IMPACT

	1997	1999	2001	(Buildout + 1 Yr.) 2003
Local Government Revenues (Table 3)	$1,449,500	$4,423,400	$5,025,500	$5,017,100
Government Expenditures:				
General Administration	$23,000	$153,700	$305,500	$382,600
Legislative & Judicial	18,500	124,100	246,500	308,800
Public Safety & Corrections	35,600	238,700	474,200	593,900
Public Works	12,200	82,000	162,900	204,000
Health & Welfare	6,900	46,400	92,200	115,400
Recreation & Culture	21,700	145,400	288,900	361,800
Education	148,900	997,100	1,981,300	2,481,500
Debt Service: Schools	104,200	278,500	438,100	495,500
Debt Service: Non-School	4,700	31,100	61,900	77,500
Total Expenditures	$375,700	$2,097,000	$4,051,500	$5,021,000
Net Fiscal Impact	$1,073,800	$2,326,400	$974,000	($3,900)

Run date: 27-Oct-95

Expenditures From Non-Residential Development

To project the incremental expenditures that non-residential development will create, the Employment Anticipation Method (Robert W. Burchell) has been used. This is a method of marginal costing that is based on an extensive study of the increase in a locality's government costs generated by new, non-residential development. The Employment Anticipation Method predicts the change in municipal costs by using the coefficients developed in the study by Dr. Burchell, the per capita cost of government, and the number of incremental FTE employment positions. For this analysis, coefficients for industrial activity have been applied to construction employment, and coefficients for commercial activity have been applied to permanent employment of all other non-residential development on the site. For each category of local government expenditures listed on Table 4 (with the exception of those relating to public education), there is a separate coefficient.

Expenditures from Residential Development

Over the seven years of development of the Wårhill Tract, the population of the development is expected to grow to more than 3,500 persons. In this analysis, it is assumed that all of this population is incremental to the county. With the exception of debt service for public schools (discussed below), incremental government expenditures from this development are calculated on a per capita basis, using the county's most recent budget.

Impact on James City County Schools

The incremental number of students expected to attend Williamsburg-James City County public schools as a result of the development was determined separately for elementary, middle and high schools. The analysis was conducted using a listing of the school enrollment, by grade, for James City County, and the City of Williamsburg. The enrollment figures then were divided by the number of family households in the county and city, resulting in a ratio of elementary, middle, and high school students per family household.

Projections of the developer's real estate sales were used to determine the number of homes in the proposed development. Assisted living homes are assumed not to include any children. These values were converted into a projection of the number of students using the method detailed above. The chart below summarizes the results.

Projected Number of School Age Children, by Type of School

Year	Based on # of Households	Elementary (K-5)	Middle (6-8)	High School (9-12)	Total (K-12)
1997	293	54	25	28	107
1999	791	145	66	75	286
2001	1,243	228	104	118	450
2003	1,403	258	118	133	509

The current enrollment in the Williamsburg-James City County system as reported by the Department of Education, as well as the maximum current capacity of schools in the system, is summarized below.

Williamsburg James City County Schools
Current Enrollment vs. School Capacity

Type of school	Elementary K-5	Middle 6-8	High School 9-12
Current Enrollment	3,662	1,674	1,886
Capacity	4,157	1,926	1,760

Consultations with the Department of Education have resulted in estimates on the cost and capacity of new school facilities. The Department of Education recommends target sizes for new schools as follows: 700 students in an elementary school, 1,000 in a middle school and 1,200 in a high school. The cost of a new elementary school is estimated at about $8 million, a middle school $12 million, and $15 million for a new high school.

Debt Service on School Construction

To finance construction of new schools, James City County is eligible for $19.7 million in low interest loans (4%) through the Virginia Literary Loan Fund. This fund is limited to $5 million per school building and the term of the loan is 20 years. The balance required for new schools can be financed through the Virginia Public School Authority, which may issue 20 year loans at an interest rate of 6.5%. Assuming Williamsburg-James City County Public Schools will finance new construction using the maximum permissible funding through the Virginia Literary Loan fund (i.e., $5 million per school), annual debt service for each type of school can be estimated as follows:

Annual Debt Service, by New School

Type of School and Cost	Financed through VA Literary Loan Fund @ 4%	Financed through VA Public School Authority @ 6.5%	Annual Debt Service	Annual Debt Service per Student
Elementary - $8 million	$5 million	$3 million	$640,178	$914
Middle - $12 million	$5 million	$7 million	$1,003,204	$1,003
High School -$15 million	$5 million	$10 million	$1,275,473	$1,063

The amount of debt service attributable to the proposed Warhill Tract development is summarized below. The calculation was made by multiplying the annual debt service for each type of school by the projected number of students in each type of school for the given year. These results have been incorporated into the fiscal impact estimates itemized in Table 4.

Williamsburg James City County Public Schools
Summary of Estimated Debt Service

Year	Debt Service Attributable to Warhill Tract
1997	$104,195
1999	$278,453
2001	$438,138
2003	$495,545

Net Fiscal Impact

As previously explained, the *net fiscal impact* on a locality is estimated simply by subtracting incremental government expenditures from incremental government revenues to determine if there is likely to be a positive financial effect or a deficit. For the Warhill Tract, the projections indicate that local government will have positive cash flow during the seven years of development activities. Once the residential population grows to the maximum estimated, the estimated cost of public services will be approximately equal to or a little higher than the estimated revenues from the development. Table 4 contains the estimates, which also are illustrated above in Figure 4-2.

Section Five

Section 5

ECONOMIC IMPACT

As previously described, measures of economic impact are county-wide and not restricted to the development site in the manner of fiscal impact analysis. In this report, economic impacts are measured in two ways: (1) by the level of incremental retail sales, and (2) by the number of new employment positions generated in all of James City County. Table 5 lists estimates of these two measures.

Sales and jobs will be generated as dollars circulate throughout the economy of James City County. For example, an employee working for a business located in the county spends part of his or her wages at other businesses located in James City County. Using that employee's dollars, these businesses pay wages to their employees and purchase some supplies and inventory from local vendors. Thus, other local vendors receive part of the employee's wages. Eventually, all of the dollars are spent outside of the locality, and the economic impact of the initial employee spending has expired. While those dollars circulate, however, they help create jobs and retail sales.

To estimate the total economic impact of retail sales and new jobs as the retail and payroll dollars cycle through the process described above, a multiplier of 0.42 has been applied to direct retail sales estimated for the Warhill Tract, and a multiplier of 0.33 has been applied to incremental employment positions (Bureau of Business Research). Direct retail sales expected from the proposed development are described in more detail in Section Four of this report, and employment is discussed in Section Three.

The employment estimates in Table 5 represent both part time and full time positions that will be generated in James City County. As indicated, the total number of employment positions is estimated at more than 1,000 during development and at 280 at buildout. The employment includes up to 1,000 permanent and construction positions projected to be generated directly on site.

The most important implication of the economic impact, in contrast to the fiscal impact, is that the proposed Warhill Tract, if developed and occupied as planned, will generate retail sales and jobs all over James City County, as well as generating a both sales and jobs directly on the site.

Warhill Development

Table 5

ECONOMIC IMPACT

	1997	1999	2001	(Buildout + 1 Yr.) 2003
Direct Retail Sales	$2,009,800	$16,995,400	$17,308,600	$16,662,200
Indirect Impact	844,100	7,138,100	7,269,600	6,998,100
Total Impact–Retail Sales	$2,853,900	$24,133,500	$24,578,200	$23,660,300
Direct Employment	790	950	700	200
Indirect Impact	300	360	260	80
Total Impact–Employment	1,090	1,310	960	280

Run date: 27–Oct–95

Community Impact Statement

WARHILL TRACT

JAMES CITY COUNTY, VIRGINIA

Rickmond
Engineering
Inc.

F. IMPACT OF CONSTRUCTION AND PERMANENT CHANGES IN LAND USE

The development of the 898 acre Warhill Tract will have significant impacts on land use within the County. Referencing the County's Land Development Concept Map, the County has identified the "Warhill" Tract area for major commercial and residential development. The proposed project meets the anticipated development of the area as envisioned by the County and is, therefore, judged to be in compliance with County development policy.

However, the development of this tract will have some effect upon the existing environment and it is the purpose of this section to anticipate potential impacts and to demonstrate how those impacts will be ameliorated.

1. EXISTING CONDITIONS*

a. Topography

The vast majority of the "Warhill" Tract has a relatively flat to moderately rolling topographical relief that generally falls toward the south. The topographic elevation change within the site is 97 feet, ranging from a high point of 134 feet above MSL (Mean Sea Level) at the northern end of the property to a low point of 37 feet above MSL at the southern end of the property in the Longhill Swamp.

*Reference: RTKL Associates, Inc. - Disposition Strategy Study: Warhill Tract, 1977.

In terms of slope gradients, the "Warhill" Tract is predominantly composed of gently slope conditions that are suitable for development. A particular attribute of the property is that large consolidated areas with relatively flat to moderately rolling slope conditions are located within the central body of the property. The "Warhill" Tract's eastern and western boundaries correspond to streambeds which are natural site boundary features. Steeper slope areas not well-suited for development are limited to peripheral areas of the site that fall into these streambed boundaries.

b. Hydrology

The general hydrological character of the region is characterized by plentiful groundwater resources through the present time. Water table conditions exist relatively near the surface and to depths of 100 feet. These groundwater supplies tend to be acidic or hard. Typically, well water supplies tap acquifers at depths between 100 and 300 feet. Artesian conditions exist at depths ranging from 110 to 250 feet below the ground. At depths greater than 400 feet, large quantities of water exist.

c. Surface Drainage

The "Warhill" Tract generally falls southward and eventually drains into the James River via the Longhill Swamp and Powhatan Creek. The property is composed primarily of high ground draining into streambeds that form the property's boundaries. The northern half of the property drains from a central north-south ridgeline into a series of drainage swales, emptying into the

streambeds along the property's eastern and western boundaries. The natural drainage system only bisects the property once, creating a natural division of the tract's southern end from the main body of the property. This natural subdivision is created when the streambed forming the western boundary of the site merges with the Longhill Swamp along the eastern boundary of the site.

d. Geology

The geology of the region is predominantly composed of sand, gravel and clay foundations over a granite bedrock. Soil cover is relatively deep with a depth-to-bedrock ranging from 800 to 1,400 feet below Mean Sea Level.

e. Soils

The soils of the "Warhill" Tract are composed of sand, loams and clay soils. The texture and composition of these soils include mixed complexes, loamy fine sand, fine sandy loams and loamy sands.

f. Vegetation

Site vegetation provides a valuable environmental and aesthetic amenity. It is instrumental in controlling water runoff and soil erosion. It provides a habitat for wildlife. It can be used to buffer the harsh effects of the sun, wind, and adjacent traffic noise. It also provides an aesthetic amenity for residential development, that maximizes sales and rental value potentials.

Site vegetation on the "Warhill" Tract varies in type, maturity and value. There are five basic vegetative associations present within the property:

- Mature Pine Stands

  Several acres of dense mature pine stands are present on the site. The primary one is located in the central section of the property. Timbering operations over the past decade have reduced much of the stand.

- Maturing Hardwood Stands

  A fairly dense hardwood area is located along the western portions of the property south of the utility easement. In addition, a limited area exists along the northern property line, adjacent to Route 60. The dense hardwood areas are comprised mostly of oak, hickory, sweet gum, beech, as well as a number of tulip poplars. There is also a large quantity of mature American holly and a mature understory of dogwoods, laurel, inkberry and ferns. The area was last timbered approximately 30 - 50 years ago and the existing hardwoods now average about 18 - 24 inches in caliper with some specimen trees reaching a 36-inch plus caliber. These areas cover approximately 16% of the property.

- Wetlands

  Drainage areas along the eastern and western boundaries of the property, as well as the swampy area in the southern part of the property, are covered with a fairly dense deciduous tree cover consisting primarily of poplar, sweet gum, red maple and oaks with a dense weedy understory.

Average tree sizes range from 12 inches to 18 inches in caliper. The vegetation is generally healthy, except in several instances where the water course has been dammed and has created flooding around the base of some trees. If this situation persists, these trees will eventually decline and die. These areas cover approximately 10% of the property.

- Timbered Areas

  Extensive areas within the property have been partially timbered and/or virtually clear-cut over the past 25 years. These areas are generally scrubby in character, with only 10 - 30% of the old tree cover remaining . The existing random species include oak, hickory, beech, sweetgum and tulip poplar with a few large pines interspersed. Generally, a thick understory exists, consisting mostly of grasses and briars. These areas cover approximately 48% of the property.

- Cleared Areas

  These areas have been completely timbered within the past 20 years with only random hardwoods remaining as tree cover. These areas consist mostly of tall grasses and briars. Throughout these areas there are many young pines approximately 5 - 6 feet tall which are well established. These areas cover approximately 20% of the property.

2. POTENTIAL DEVELOPMENTAL IMPACTS

The streams that flow through the project area can affect the quantity of the area's water resources.

Increased runoff and sedimentation from development could cause irregular flow and impede interaction with groundwater resources. Additionally, the streams could also affect the quality of water resources in that they are an important source for groundwater recharge and reservoir storage.

Development of the "Warhill" Tract could alter the relationship between the streams and groundwater by affecting the peak and base flows of the streams. An increase in impervious surfaces, such as roads and roofs, accelerates runoff by releasing precipitation which would otherwise be absorbed by the soil. Also, the heat from the surfaces increases the melting rate of snow and ice. Additionally, the destruction of vegetation, which assists in absorbing some precipitation, will also increase the rate of runoff. Consequently, precipitation could pass too quickly through groundwater channels, increasing the rate of stream flow, making it irregular with low base flows and high peak flows. Therefore, dependent groundwater reservoirs could also fluctuate.

The intensity of development could also increase the level of flooding by altering the character of the watershed, so that large amounts of water run off at one time. In association with this increased runoff, sedimentation could occur and be deposited along the streambed, raising the bed and contributing to the increased flooding.

Streams transport soils created by weathering or dislodged by running water from upland portions of watersheds and deposit them along stream banks downstream. The amount of sediment or suspended

particles a stream can carry depends in large upon the rate of flow. Rapidly flowing water is capable of carrying more particles than slower moving water and, therefore, is associated with erosion and sedimentation problems.

Streams could be affected by increased erosion and highly irregular flow. Increased turbidity (amount of suspended particles in the water) lessens the amount of light penetrating the lower portions of the stream, thereby killing many species of plants and animals. Such organic debris, including that added by runoff, increases the amount of decomposing bacteria which absorb the available oxygen, thus contributing to additional stream pollution and resulting in accelerated algal growth and a biologically depleted stream. Increased sedimentation of a streambed increases flood levels and interferes with groundwater recharge, and it can also alter the entire course of the stream.

The causes of increased sedimentation lie in the type and intensity of development. The type and intensity of development in the project area could increase runoff and erosion by removing vegetation, by applying construction methods or by removing topsoil and leaving large areas of land bare and vulnerable to erosion during construction.

Sedimentation problems usually occur during the early periods of construction when topsoil is stripped and is subjected to erosion from running water. The severity of the problem is conditioned upon previous land use, the gradient, the length of the slope and the types of impervious and pervious cover. As the degree of slope and its length increases, so does the potential for erosion.

Rapid runoff if not curtailed, can accelerate the process of erosion; it also increases the erosive power of the stream itself by increasing its rate of flow. Rapid runoff increases the velocity of a stream, which in turn may cause the stream to cut deeply into its banks, adding increased sedimentation, thereby destroying bank stability and shading. As a stream cuts into its banks, it widens its bed, slowly reducing the flow of water and accelerating sediment deposition.

In addition to the loss of shading vegetation as a result of stream bank erosion, impervious surfaces can also increase thermal pollution of a stream. While natural soil and vegetative cover moderate the temperature from solar radiation, roads, buildings, parking lots, and other impervious surface do not and, therefore, increase temperature extremes since they return their heat more rapidly.

The intensity of land use within the project area could also contribute to chemical and organic pollution and increases sedimentation. Parking lots and streets can add petroleum products to runoff water, as well as significant amounts of salts and chemicals used in melting snow and ice.

In their natural condition, the soils and organic litter, wetlands, and the flow of stream act to filter the runoff that passes through them. Removal of vegetation, loss of soils through erosion, destruction of wetlands, increases in impervious surfaces, and alteration of stream flow can impair these natural methods of purifying runoff. Impervious surfaces are particularly hazardous since they not only increase the

amount and rate of polluted runoff, but also bypass the natural filters of the soil. It should not be assumed that the project area's natural filtration system is capable of purifying all types or large amounts of pollutants, however, it can purify some runoff pollutants and, if maintained in a healthy state and care is taken not to exceed its assimilative capacity, the natural features of the project area and its various filters can significantly moderate pollution resulting from the proposed development.

3. VEGETATION

The importance of preserving the remaining vegetation, or more appropriately woodlots, in the project area centers on the use of these suburban forests in maintaining overall environmental health, preserving the environmental integrity of the area and associated soils, improving water and air quality, buffering the audio and visual aspects of development, and influencing the micro-climate affecting the surrounding area.

The existing vegetation fosters protection for the area in general and specifically the soils. This vegetation has a moderating effect on wind and storms, stabilizes and enriches the soil, and decreases the amount of runoff from precipitation, thereby allowing more moisture to seep into groundwater reserves after being filtered through the woodland floor. The effects of this natural process result in decreasing runoff and increasing groundwater infiltration and, therefore, reduce the impact of flooding in the area.

Woodlands are effective buffers to the sights and sounds of man-made development. They reduce the level of noise generated by traffic on roads and highways and in concentrated areas of industrial and commercial activity, while contributing to the reduction of some air pollution.

The micro-climate of a woodland area, created in part by the shade of the trees and the transpiration of water from the leaves, keeps surrounding air at an even temperature, thereby moderating climatic extremes. Cooler in the day, and warmer at night, the temperatures of woodland areas fluctuate less than unforested areas.

4. PROPOSED PROJECT

The proposed project would seek to control the overall negative impacts of development in numerous ways:

During the construction phase of the project, it is anticipated that minor short-term air and noise pollution will occur. This will be the result of typical construction activities. It is anticipated that contractors will adhere to standard practices of reducing the impact of these short term effects. This would include reasonable hours of operation, dust and debris control, and following existing County requirements relative to burning. A Soil Erosion Control Plan, prepared in accordance with the Virginia Soil Erosion Control Manual, will reduce the effect of soil erosion.

Past development practices sought to eliminate excess surface water after precipitation as quickly as possible

through a closed system. The cumulative effect of such an approach has been the cause of increased frequency of downstream flooding, often accompanied by diminishing groundwater supplies; or has necessitated the development of large flood control projects downstream.

The proposed Warhill development will employ the most stringent stormwater management practices to reduce impacts associated with large scale development. The emphasis placed on the proposed stormwater management practices for the "Warhill" site will center on the detention of stormwater on site by the use of ponds and preservation of open space and natural conditions through the Residential Planned Community (R-4) concept. (Refer Exhibit 4) Stormwater would be released from the site at a gradual rate, thereby reducing the amount and velocity of water entering the natural drainage systems in the area.

Overall density in the project's R-4 district is approximately 2.0 dwelling units (DU's) per acre. This density factor is consistent with the existing James City County Comprehensive Plan which designates the "Warhill" site for low density development at four (4) dwelling units per acre. (Refer James City County Land Use Element - 1981 Update to the Comprehensive Plan and James City County Land Use Concept Map)

Referencing Exhibit 4, steep slopes and stream valleys will remain in their present natural state. Existing trees and other vegetation will be retained to buffer the proposed development where it abuts adjoining properties and to sustain the existing micro-environment. Open space will enhance the visual quality

of life and recreational opportunities for the residents, in addition to absorbing rainfall thereby contributing to a reduction in stormwater impacts.

Planning Summary Report
and
Community Impact Statement
for

"WARHILL"

Prepared for:

TMB Service Corporation
c/o Mission Bank
5201 Johnson Drive
Mission, Kansas 66205

Prepared by:

CONSULTING ENGINEERS

5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(804) 253-0040
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October 2, 1995

EXECUTIVE SUMMARY

TMB Service Corporation, owner of the Warhill Tract located in James City County, is proposing a Master Plan Amendment and Rezoning for 643 Acres of the original 898 Acre Tract. The subject area is bounded by U.S. Route 60 to the north, Longhill Road to the south, and proposed S.R. 199 to the east. The subject property is divided into two distinct parcels by the 200' wide Virginia Power Easement. The parcel to the north of the easement is currently Zoned B-1 and M-1 with proffers. The southern parcel is currently Zoned R-4 with proffers.

The southern parcel is proposed to remain R-4 with an amended Master Plan. The amended plan proposes the same density as the current Master Plan (2 units per acre) but with a superior concept. EDAW, a nationally recognized land planning firm, has proposed a plan which focuses on creating a quality golf community based around a main street/town center concept. The Town Center focuses on the golf clubhouse and associated amenities with some minor retail and multi-family uses clustered around the Golf Club and "Main Street." TMB plans to market this project at more affordable prices than are currently available in planned golf course communities in James City County.

The northern parcel is proposed to be rezoned to Mixed Use with proffers, from M-1 and B-1. The Master Plan for the proposed mixed use area retains 30.2 acres of commercial with the balance of the acreage to be several types of residential. Simultaneously with the rezoning request is a request for a Special Use Permit (SUP) to allow 4 holes of golf within the area now zoned M-1.

The predominate factor which necessitates the rezoning of the M-1/B-1 parcel is traffic. The Centerville Road (S.R. 614) - Richmond Road (U.S. Route 60) intersection can only handle a finite amount of traffic under any reasonable roadway improvement scenario. Under the current zoning, the project cannot be built to its maximum potential due to the traffic failure of the Centerville/Route 60 intersection. This plan proposes a compromise between commercial and

residential while allowing beneficial use of the entire parcel of land. The attached Traffic Impact Study proposes substantial improvements to the Route 60/Centerville intersection given a reasonable amount of improvements and both the study of the existing zoning and the proposed zoning assume this high level of road improvements.

The proposed plan, due to the lower amount of commercial development and higher residential development, results in a higher level of traffic service than the level of service D allowed under the existing proffers, but keeps enough commercial development to allow a basically break even fiscal impact on the County as shown in the attached fiscal impact study. In the early years of development the impact is positive, but as the project nears buildout, the impact reaches an equilibrium at a break even to slightly negative condition, a condition likely to continue into the future.

In summary, TMB Service Corporation is proposing a superior plan which allows for beneficial use of the entire property while providing lessened traffic impact than the current zoning. The mitigation of the traffic impact is the driving force behind the proposed Master Plan, a Master Plan which is more compatible with surrounding development than the current plan.

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I. INTRODUCTION

The property known as the Warhill Tract, located entirely within James City County, consists of 898 acres and is currently zoned R-2, R-4, M-1 and B-1 all with proffers. The tract is now owned by TMB Service Corporation (the Owner) for the purpose of developing the tract over the next 7 years. The Owner proposes to modify the existing Master Plan in order to achieve development objectives which reflect projected market conditions and County goals. Accordingly, the Owner is requesting a simultaneous rezoning, special use permit and master plan amendment for 643 acres of the original 898 acre Warhill Tract. The project area is bounded by Richmond Road (U.S. Route 60) to the north, Centerville Road (S.R. 614) to the northwest, Longhill Road (S.R. 612) to the south and proposed S.R. 199 to the east. The remainder of the original tract consists of proposed S.R. 199 and the R-2 property west of proposed S.R. 199.

The 643 acres in question is divided into two distinct parcels by the 200' wide Virginia Power Easement which bisects the project into a northern parcel and a southern parcel. The Owner is applying to rezone the northern parcel from B-1 and M-1, with proffers, to Mixed Use, with proffers and a Special Use Permit to allow four holes of golf, while the southern parcel, which is currently zoned R-4, Residential Planned Community, is to remain R-4 while requesting a master plan and proffer amendment.

The purpose of this planning report is to summarize and organize the planning efforts of the project team into a cohesive package which addresses the pertinent planning issues while addressing the requirements of the R-4 and Mixed Use zoning districts.

II. THE PROJECT TEAM

The following organizations are involved in the planning and development of the Warhill Tract.

- TMB Service Corporation - Owner, Mission, Kansas
- Cabear Corporation - Developer, Annapolis, Maryland
- Geddy, Harris and Geddy - Legal Counsel, Williamsburg, Virginia
- AES Consulting Engineers - Civil Engineering, Williamsburg, Virginia
- EDAW, Inc. - Land Planning, Alexandra, Virginia
- Langley and McDonald, P.C. - Traffic Planning, Virginia Beach, Virginia
- The Wessex Group - Fiscal Impact, Williamsburg, Virginia
- Williamsburg Environmental Group - Environmental, Williamsburg, Virginia

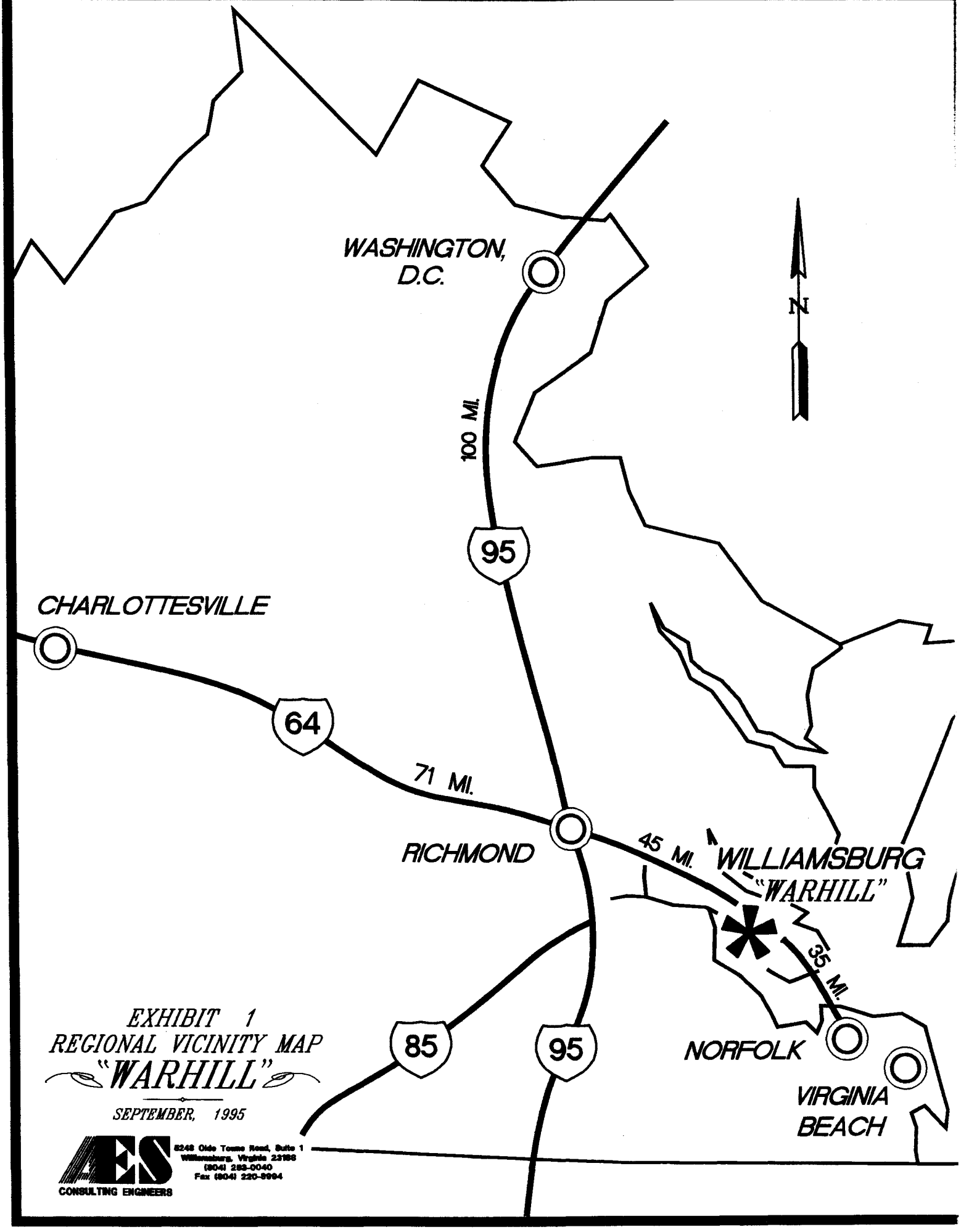

EXHIBIT 1
REGIONAL VICINITY MAP
"WARHILL"

SEPTEMBER, 1995

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(804) 253-0040
Fax (804) 220-9994

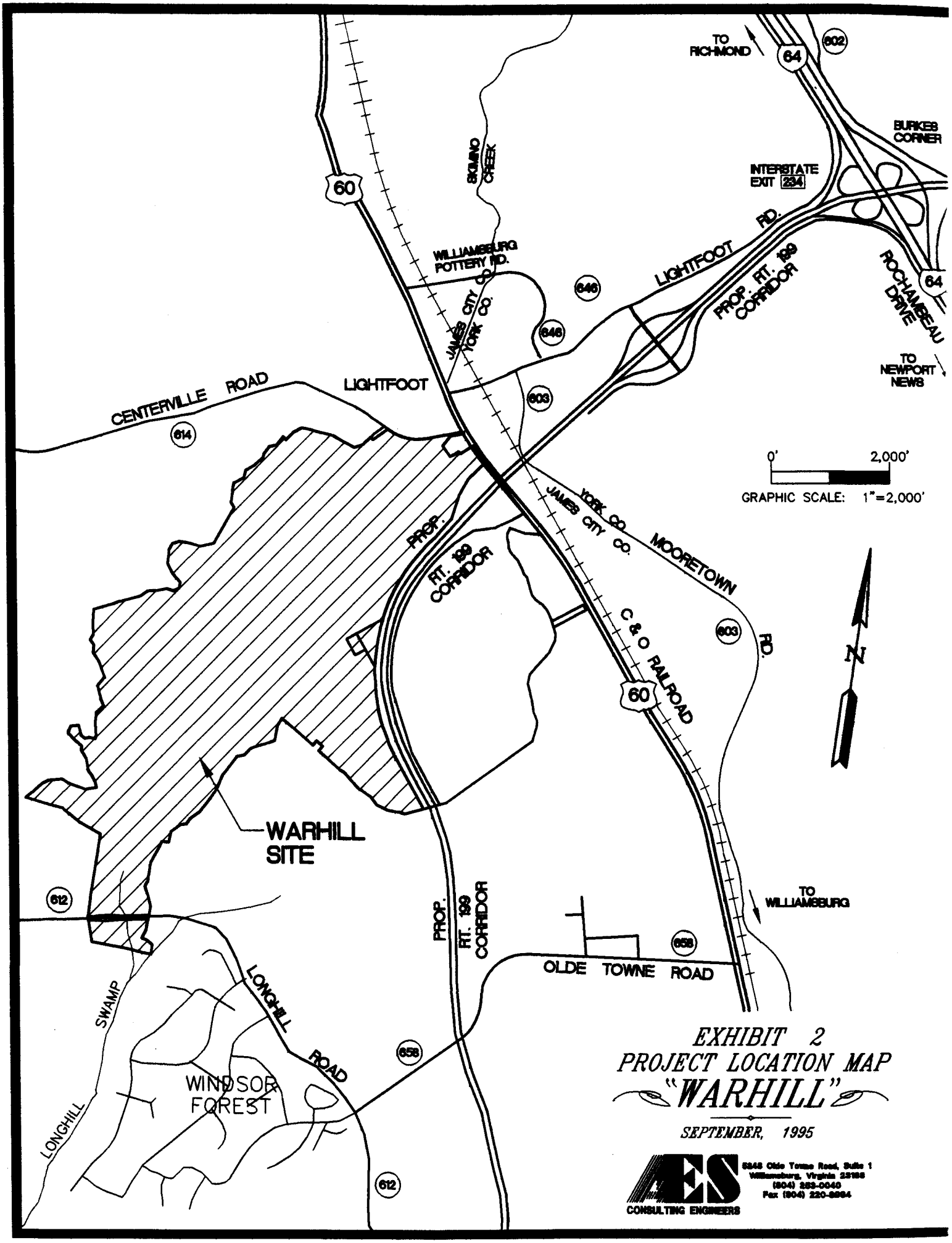

EXHIBIT 2

PROJECT LOCATION MAP

"WARHILL"

SEPTEMBER, 1995

CONSULTING ENGINEERS

5248 Olde Towne Road, Suite 1
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(804) 253-0040
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III. EXISTING ZONING

The 159 acres north of the Virginia Power easement is currently broken into two (2) zoning classifications. The thirty-eight acres located northern most and bounded by Richmond Road (U.S. Route 60) and Centerville Road (S.R. 614) is currently zoned B-1 General Business with proffers. The 94 acres between the B-1 parcel and the Virginia Power easement is currently zoned M-1, Limited Business/Industrial with proffers. Also shown as part of the northern parcel on the 1986 Warhill Tract Master Plan is a 10 acre public use site.

Under the existing proffers the B-1/M-1 property is to be developed in two phases. Phase one development consists of up to 60,000 s.f. of office, 150,000 s.f. of retail and 300,000 s.f. of industrial, all of which may be constructed by right. Further development in this area requires an amendment to the proffers to increase the amount of permitted development.

The total acreage of the B-1, M-1 and public use areas, as depicted on the 1986 Master Plan, is 142 acres. This total is 17 acres less than indicated in the opening sentence. The reason for this is due to the final alignment of proposed S.R. 199 which now yields a total of 159 acres to the north of the Virginia Power easement.

The 484 acres south of the Virginia Power easement is currently zoned R-4 with proffers. Approximately 28 acres of this has been previously developed and recorded as 58 single-family lots. None of these lots have been built on and all are currently owned by TMB Service Corporation. Therefore, this area is included as part of the proposed Master Plan area.

Under the existing proffers the R-4 portion of the property is to be developed in three phases. Phase I, which consists of 425 dwelling units and the golf course, may be developed by right. Development of Phase II (up to 775 dwelling units) and Phase III (up to 968 dwelling units) is contingent upon the owner submitting traffic studies indicating the applicable level of development can be accommodated by the surrounding road network with proffered improvements at a level of service "D".

The northern parcel of 159 acres together with the southern parcel of 484 acres yields a total project area of 643 acres.

IV. PROPOSED ZONING AND DENSITY

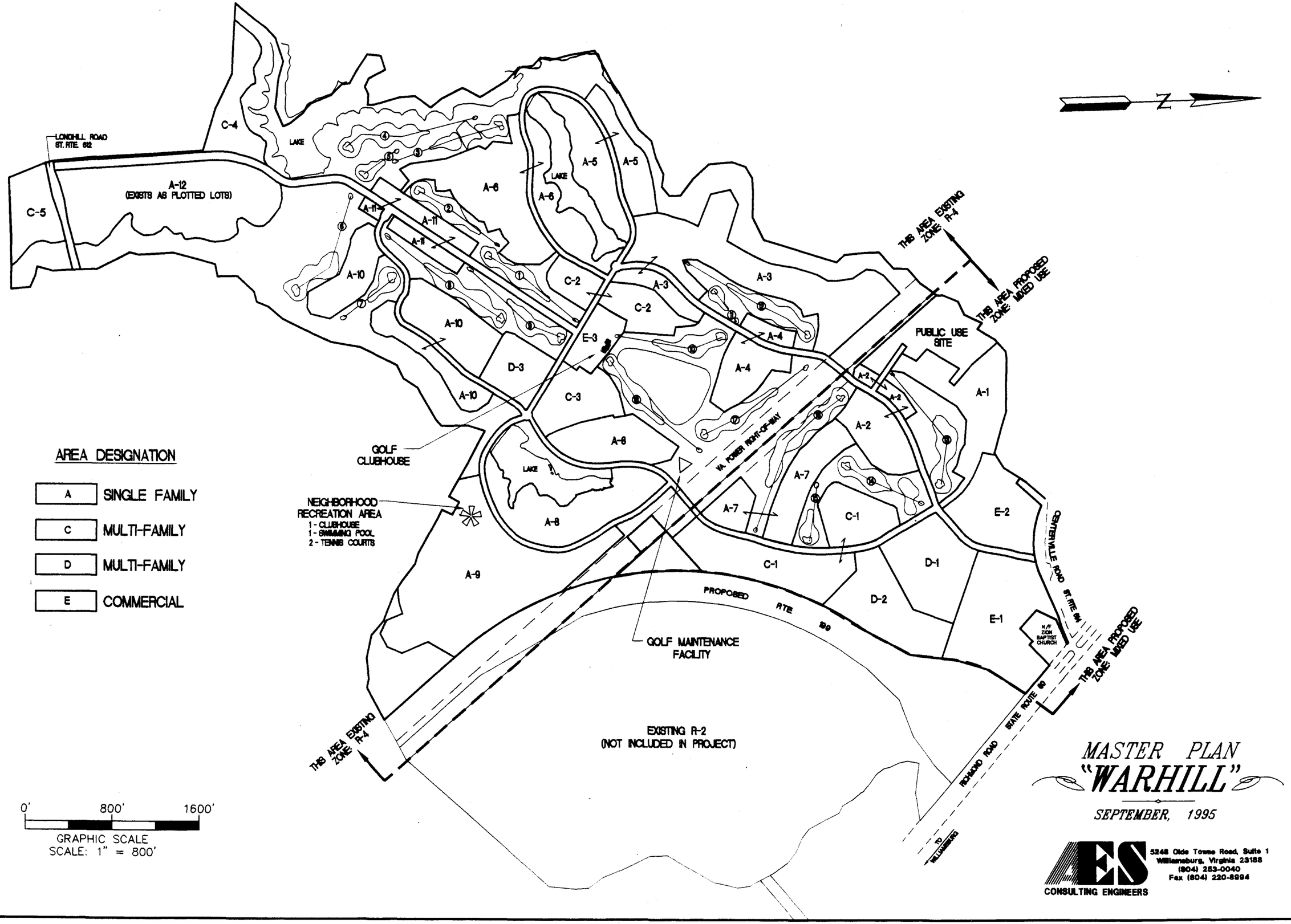
The project is proposed to be zoned into two zoning classifications. The 484 acres to the south of the Virginia Power Easement is proposed to remain R-4 with amended proffers and an amended Master Plan. The 159 acres to the north of the Virginia Power easement is proposed to be rezoned to Mixed Use with proffers. The owner is also applying for a Special Use Permit (SUP) to allow 4 holes of golf in this area.

The 159 acres to be zoned Mixed Use consists of 30.2 acres of land designated for commercial uses, with the balance of the area designated for residential uses. The proposal represents a decrease of 8 acres from its current B-1 zoning and eliminates the 94 acre industrial district altogether. A 10 acre public use site is retained in the same general location as shown on the 1986 Master Plan. In place of the Industrial and 8 acres of commercial, are single family residential lots (Residential A), townhouses (residential C), apartments or assisted living (residential D), 4 holes of golf and associated open space.

The reasons for the zoning change from industrial and scaling back the commercial are traffic access and lack of market. The traffic that would be generated by the full buildout of the approved Master Plan cannot be accommodated by the Centerville Road/Richmond Road intersection under any reasonable roadway improvement scenario.

Under the proposed zoning and associated Master Plan, significant road and intersection improvements are required in order to provide an adequate level of service at the Richmond Road/Centerville Road intersection. For a detailed analysis and description of the proposed improvements, please see the separately bound Traffic Impact Analysis.

The 484 acres to the south is to remain R-4 with proffers, and TMB is proposing an amended Master Plan which coordinates with the proposed Mixed Use area. The 1995 Master Plan for the R-4 area retains the same overall density as the 1986 Master Plan which is two dwelling units per gross acre. See table 1 for the overall project land use tabulation and Table 2 for the development schedule.



AREA DESIGNATION

A	SINGLE FAMILY
C	MULTI-FAMILY
D	MULTI-FAMILY
E	COMMERCIAL

0' 800' 1600'

GRAPHIC SCALE
SCALE: 1" = 800'

MASTER PLAN
"WARHILL"

SEPTEMBER, 1995

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CONSULTING ENGINEERS

09.29.95--11:04 81081117

LAW

TABLE 1
WARHILL
LAND USE TABULATION

PROPOSED "MIXED USE" AREA

RESIDENTIAL "A"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY DU/AC.	ACTUAL DENSITY DU/AC.
A-1	12.9 AC.	38	6	2.9
A-2	9.3 AC.	35	6	3.8
A-7	11.4 AC.	46	6	4.0
TOTAL RESIDENTIAL "A"	33.6 AC.	119	6	3.5

RESIDENTIAL "C"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
C-1	20.6 AC.	166	12	8.1

RESIDENTIAL "D"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
D-1	12.4 AC.	130	18	10.5
D-2	12.8 AC.	150	18	11.7
TOTAL RESIDENTIAL "D"	25.2 AC.	280	18	11.1

COMMERCIAL "E"

AREA DESIGNATION	GROSS ACRES	GROSS RETAIL AREA
E-1	18.9 AC.	150,000 S.F.
E-2	11.3 AC.	100,000 S.F.
TOTAL COMMERCIAL "E"	30.2 AC.	250,000 S.F.
PUBLIC USE SITE	10.1 AC.	
OPEN AREAS GOLF COURSES, LAKES & WETLANDS	31.7 AC.	
COLLECTOR AND LOOP ROADS (AS SHOWN)	7.7 AC.	
TOTAL "MIXED USE" AREA	**159.1 AC.**	**565 UNITS**

TABLE I (Continued)

PROPOSED "R-4" AREA

RESIDENTIAL "A"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
A-3	29.3 AC.	87	4	3.0
A-4	8.2 AC.	23	4	2.8
A-5	15.2 AC.	30	4	2.0
A-6	25.4 AC.	99	4	3.9
A-8	23.5 AC.	71	4	3.0
A-9	35.8 AC.	140	4	3.9
A-10	21.6 AC.	83	4	3.8
A-11	6.7 AC.	20	4	3.0
A-12	28.2 AC.	51	4	1.8
TOTAL RESIDENTIAL "A"	193.9 AC.	604	4	3.1

RESIDENTIAL "C"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
C-2	9.2 AC.	93	12	10.1
C-3	8.2 AC.	80	12	9.8
C-4	7.9 AC.	30	12	3.8
C-5	7.0 AC.	41	12	5.9
TOTAL RESIDENTIAL "C"	32.3 AC.	244	12	7.6

RESIDENTIAL "D"

AREA DESIGNATION	GROSS ACRES	NUMBER OF UNITS	PERMITTED DENSITY	ACTUAL DENSITY
D-3	6.4 AC.	120	18	18.8

TABLE I (Continued)

COMMERCIAL "E"

AREA DESIGNATION	GROSS ACRES	GROSS RETAIL AREA S.F.
E-3	4.4 AC.	50,000 % OF R-4 AREA

OPEN SPACE	GROSS ACRES	% OF R-4 AREA
OPEN AREAS GOLF COURSES, LAKES & WETLANDS	202.8 AC.	41.9%
VIRGINIA POWER EASEMENT	17.1 AC.	3.5%
TOTAL OPEN SPACE	219.9 AC.	45.4%
COLLECTOR AND LOOP ROADS (AS SHOWN)	27.1 AC.	
TOTAL "R-4" AREA	**968.0 AC.**	

TABLE 2

WARHILL
DEVELOPMENT SCHEDULE

PHASE I 1996-1999

	Area Designation	Dwelling Units	Acreage	Gross S.F.
A	Single Family			
	A-1,2,3,4,5,7, 11, 12	330	121.2	----
C	Multi-Family			
	C-1,2,4,5	330	44.7	----
D	Multi-Family			
	D-1,2	280	25.2	----
E	Commercial			
	E-1,2,3	----	34.6	300,000
	Total Phase I	940	225.7	300,000

PHASE II 1999-2002

A	Single Family			
	A-6,8,9,10	393	106.3	----
C	Multi-Family			
	C-3	80	8.2	----
D	Multi-Family			
	D-3	120	6.4	----
E	Commercial			
	E-2	----	----	----
	Total Phase II	593	120.9	----
	Total Project	1,533	346.6	300,000

The 1995 Master Plan offers a concept change from the 1986 Master Plan. The 1995 Master Plan focuses on creating a quality golf course community based around a main street/town center concept, but at more affordable prices than are currently available in planned golf course communities in James City County. The "Town Center" consists of the golf clubhouse and associated recreational amenities as the focal point of the community with some minor retail/office space available at the street frontage. Also included in close proximity to the town center are varying types of multi-family housing which are within walking distance of the "Main Street". Please see Exhibit 3 or the separately bound Master Plan drawings for the project Master Plan.

V. ANALYSIS OF EXISTING PUBLIC FACILITIES AND SERVICES

A. SEWER

Sewer service is readily available to the north and south of the site. To the south the Longhill Swamp interceptor, a 12" diameter gravity sewer, has been extended to the site and currently serves Land Bay A-12 which was developed by the previous owner. This gravity sewer may be extended to serve significant portions of the site.

To the north along U.S. Route 60 there currently exists a 24" diameter HRSD force main. The portions of the site to the north and northwest, which do not readily gravity feed to the south, will be serviced by a sewage pumping station located in the northwest (please see the separately bound Master Sewer Plan). This sewage pumping station will discharge to the 24" HRSD force main. There is a significant area which can be serviced by either the extension of the Longhill Swamp interceptor or by the proposed sewage pumping station. Of this area, which may be serviced by either system (basically the Mixed Use Area), it is anticipated that the most efficient system to serve the area, in terms of phasing, will be the proposed sewage pumping station.

The original Warhill Tract has 650 prepaid sewer connections and 550 sewer connections with a fixed fee of $400.00 each, which are currently dedicated to the Longhill Swamp sewer interceptor. Another 222 sewer connections are available at a discount of $400.00 each. These connections are available in the Richmond Road force main system. TMB will request that approximately 450 of the 1,200 connections to the Longhill Swamp interceptor be transferred to the 24" HRSD Richmond Road force main to facilitate the phasing of the project.

The impact of the proposed zoning on the JCSA system sewer is positive. The proposed zoning produces less sewage flow than the existing zoning. Please see Table 3 for the comparison. For comparison purposes only the 159 acres (proposed Mixed Use Area) to the north are analyzed, since no density change is proposed in the R-4 area to the south.

B. WATER

There are numerous points of connection to the JCSA water distribution system located adjacent to the Warhill Tract. An existing 8" water main is located along Longhill Road, a 12" water main is located in Centerville Road and a 16" water main is located along Richmond Road. In addition, the Season's Trace elevated storage tank is adjacent to Land Bay A-9. The above listed existing facilities are of more than adequate size to service the Warhill Development.

The Master Water Plan (Master Water Plan included in Master Plan Drawing Set) provides for a 12" interconnection (spine main) between the 8" water main on Longhill Road and the 12" water main on Centerville Road. Additionally, a 12" interconnect directly from the Season's Trace elevated storage tank to the 12" spine main is indicated. An additional 12" main is provided across Land Bay A-9 to interconnect the Season's Trace elevated storage tank to a future JCSA main which will be extended along proposed S.R. 199.

C. SCHOOLS

James City County and the City of Williamsburg jointly operate a consolidated school system. The system provides educational instruction for kindergarten through grade twelve in six elementary schools, three middle schools, one high school. Total student enrollment for the 1995-1996 school year is expected to be 7,285*. For an analysis of the impacts anticipated, refer to the separately bound Fiscal and Economic Impact Study as prepared by the Wessex Group Ltd.

* James City County/Williamsburg School District projected enrollment for 1995.

WARHILL TRACT, JAMES CITY COUNTY
SEWAGE FLOW COMPARISON
EXISTING ZONING VS. CURRENTLY PROPOSED ZONING (MIXED USE)
AREA BETWEEN RT. 199 RIGHT OF WAY AND VA POWER EASEMENT
DATE: 09-29-95

AES CONSULTING ENGINEERS
5248 OLDE TOWNE ROAD
WILLIAMSBURG, VA.
(804) 253-0040
BY: GDG

TABLE 3

FLOW PARAMETERS:

RESIDENTIAL DWELLING UNITS, (D.U.)	300	GAL/24 HR. DAY/D.U.
COMMERCIAL BUILDINGS, (S.F.)	200	GAL/12 HR. DAY/1000 S.F.
INDUSTRIAL, (AC.)	2500	GAL/24 HR. DAY/AC.
FLOW PEAKING FACTOR	2.5	AVERAGE FLOW TO PEAK FLOW

FLOW CALCULATIONS FOR CURRENTLY PROPOSED DEVELOPMENT:

SOURCE:	UNITS	AVERAGE FLOWS	PEAK FLOWS
AREA A-1	38 D.U.	7.9	19.8
AREA A-2	35 D.U.	7.3	18.2
AREA A-7	46 D.U.	9.6	24.0
AREA C-1	166 D.U.	34.6	86.5
AREA D-1	130 D.U.	27.1	67.7
AREA D-2	150 D.U.	31.3	78.1
AREA E-1	100,000 S.F.	27.8	69.4
AREA E-2	150,000 S.F.	41.7	104.2
PUBLIC USE SITE	10 AC.	10.0	25.0
TOTAL FLOWS:		197 GPM	493 GPM

FLOW CALCULATIONS FOR FORMERLY PROPOSED DEVELOPMENT:

SOURCE:	UNITS	AVERAGE FLOWS	PEAK FLOWS
COMMERCIAL DEVELOPMENT	315,000 S.F. (38 AC.)	87.5	218.8
INDUSTRIAL DEVELOPMENT	94 AC.	163.2	408.0
PUBLIC USE SITE	10 AC.	10.0	25.0
TOTAL FLOWS:		261 GPM	652 GPM

D. FIRE PROTECTION AND EMERGENCY MEDICAL SERVICES (EMS)

There are currently four fire stations providing fire protection and EMS services to James City County. In addition, there exists a mutual aid agreement with the City of Williamsburg and York County for backup assistance. The closest fire station is located on Olde Towne Road, is less than two miles from the "Warhill" Tract. Additionally, there is a fire station at Route 60 and Olde Forge Road in Toano, and a York County Fire Station on Lightfoot Road (Route 646) north of I-64 which is approximately 2.3 miles from the Warhill development. The physical locations of these stations in respect to Warhill should provide more than adequate response times for fire protection and EMS services.

E. SOLID WASTE

The Warhill Development will generate significant quantities of solid waste that will require collection and disposal to ensure a safe and healthful environment. Collection of solid waste in the Warhill development will be by private contract with reputable haulers acting in accordance with local health standards. This waste will be transported to the James City County Solid Waste transfer station about 3.5 miles from the Centerville Road entrance to the project. Based on historical data, the projected solid waste generation rate for the County has been categorized by James City Service Authority staff as follows:

Source of Solid Waste	Percentage of Rate	Solid Waste Generation Rate (1lb./person/day)
Residential	24%	1.95
Commercial	45%	3.65
Industrial	17%	1.38
Governmental	14%	1.13
	100%	8.11

Assuming three persons per residential unit, the Warhill Development will generate the following amounts of solid waste based on the proposed phases of the project.

Projected Solid Waste Quantities

Year	Dwelling Units (Cumulative)	Population 3 x Dwelling Units	Annual Solid Waste Generated Tons/Year = Population x 8.11 x 365/2000
1999	940	2,820	4,174
2002	1,533	4,599	6,807

The impact of 6,807 tons/year of solid waste, at buildout, on the JCSA transfer station is minimal.

VI. TRAFFIC IMPACT STUDY

As stated earlier in the report, the traffic impact is the key element in choosing the mix of land uses as depicted on the Master Plan. Please refer to the separately bound Traffic Impact analysis as prepared by Langley and McDonald P.C.

VII. FISCAL AND ECONOMIC IMPACT STUDY

Please refer to the separately bound Fiscal and Economic Impact Study as prepared by the Wessex Group Ltd.

VIII. IMPACT OF CONSTRUCTION AND PERMANENT CHANGES IN LAND USE UPON SURROUNDING PROPERTIES

A. LAND USE

The Warhill Development proposes a combination of Residential Planned Community and Mixed Use zones. Much of the surrounding properties mirror this use. To the south and southeast, existing residential planned communities abut in the form of Season's Trace and Ford's Colony. Adjacent properties to the west include several undeveloped tracts as well as several smaller subdivisions. To the northwest there is commercial (retail) development in the form of the Williamsburg Outlet Mall which is directly adjacent to the proposed commercial area as designated on the Master Plan. The only incompatible land use in the area would be the Mt.

Zion Baptist Church which is located at the intersections of Richmond Road and Centerville Road.

The portion of Warhill north of Virginia Power is designated Mixed Use on the County's Comprehensive Plan. The R-4 section is designated Low Density Residential. In addition to being consistent with surrounding development, the proposed Warhill Master Plan is in general compliance with the current James City County comprehensive plan. Due to its compatibility with surrounding development and with the comprehensive plan, it is felt that the proposed Warhill Master Plan will have no impact on adjacent properties from a land use standpoint

B. ENVIRONMENTAL - EXISTING CONDITIONS

The Warhill Tract has moderately flat to rolling topography which generally falls from the north to the south. Elevation varies from a high of 134 feet to a low of 37 feet above MSL (Mean Sea Level). The vegetation on the site varies and is as follows:

Mature Pine Stands

Several acres of dense mature pine stands are present on the site. The primary one is located in the central section of the property. Timbering operations over the past decade have reduced much of the stand.

Maturing Hardwood Stands

A fairly dense hardwood area is located along the western portions of the property south of the utility easement. In addition, a limited area exists along the northern property line, adjacent to Route 60. The dense hardwood areas are comprised mostly of oak, hickory, sweet gum, beech, as well as a number of tulip poplars. There is also a large quantity of mature American holly and a mature understory of dogwoods, laurel, inkberry and ferns. The area was last timbered approximately 30-50 years ago and the existing hardwoods now average about 18-24 inches in caliper with some specimen trees reaching a 36-inch plus caliber. These areas cover approximately 16% of the property.

Wetlands

Drainage areas along the eastern and western boundaries of the property, as well as the swampy area in the southern part of the property, are covered with a fairly dense deciduous tree cover consisting primarily of poplar, sweet gum, red maple and oaks with a dense weedy understory. Average tree sizes range from 12 inches to 18 inches in caliper. The vegetation is generally healthy, except in several instances where the water course has been dammed and has created flooding around the base of some trees. Many of these trees have died or are in decline. These areas cover approximately 10% of the property.

Timbered Areas

Extensive areas within the property have been partially timbered and/or virtually clear-cut over the past 25 years. These areas are generally scrubby in character, with only 10-30% of the old tree cover remaining. The existing random species include oak, hickory, beech, sweet gum and tulip poplar with a few large pines interspersed. Generally, a thick understory exists, consisting mostly of grasses and briars. These areas cover approximately 48% of the property.

Cleared Areas

These areas have been completely timbered within the past 20 years with only random hardwoods remaining as tree cover.

These areas are currently in agricultural production and are producing field corn and soybeans. The cleared portion covers approximately 20% of the site.

ENVIRONMENTAL - PROPOSED DEVELOPMENT IMPACTS

Development of the Warhill Tract could have detrimental effects on the environment if not properly mitigated. Erosion due to construction activities, pollution and increase in storm water runoff due to the addition of impervious surfaces are all hazards of developing an undeveloped area.

Through compliance with James City County's Chesapeake Bay Preservation Ordinance, these potential hazards can be adequately mitigated. The following stormwater management analysis, prepared by the Williamsburg Environmental Group, depicts in concept the proposed methods to mitigate the effects of development, in terms of stormwater management, on the environment.

Evaluation Criteria

James City County has implemented a 3-step, 10-point BMP method to demonstrate compliance with the County's Chesapeake Bay Preservation Ordinance. The County allocates open space credit for land which is not developed and structural BMP credit for all portions of the site which drain to an adequately sized structural BMP. Structural BMP's are assigned anywhere from 4 points to 10 points, depending on design and storage volume. Highly efficient wet pond or marsh BMP's receive 9 or 10 points of credit. The total point value for the site is obtained by multiplying the fraction of the site served by a structural BMP or open space credit by its assigned point value and summing the values. Ten points for the site are necessary to meet the County's ordinance.

Evaluation

The portion of the Warhill Tract currently under consideration for rezoning occupies approximately 643 acres of currently undeveloped land immediately north of Longhill Road, south of State Route 60, east of Route 614, and west of future Route 199. A Preliminary Master Plan prepared by EDAW indicates the land will be developed with a combination of land uses

including: commercial, golf, single family residential, and multi-family residential.

— calculations need to be based on full parcel acreage of 898 ac.

Approximately 63 acres (10%) of the site is designated as Resource Protection Area (RPA) or RPA buffer. Furthermore, approximately 45 acres (7%) of the site contain jurisdictional wetlands and adjacent steep slopes. These features have limited developability and have been designated as open space for this analysis. This area represents 108 acres (17%) of the site and 1.67 points are gained by taking open space credit for these areas.

The site also contains three existing lakes ranging in size from 5.5 acres to 18 acres with storage volumes of approximately 28 acre-feet to 92 acre-feet respectively. These lakes have been evaluated as potential BMPs for the site. The three lakes collectively drain 494 acres (77%) of the site. Based on estimated lake volumes and County recognized sizing techniques, these ponds will serve as highly efficient BMPs (10 points) for ultimate onsite buildout of the watershed draining to each structure. The existing lakes therefore provide 7.69 additional points for the overall 10-point plan.

Structural credit for the existing onsite lakes and open space credit for the undevelopable portion of the site provide a total of 9.36 points towards the 10-point plan, creating a 0.64 point deficit. The remaining 0.64 point deficit can be mitigated by providing: 1) additional open space, 2) additional structural BMPs, or 3) a combination of these two. WEG identified two additional BMP sites which can serve substantial onsite drainage areas. These BMPs collectively treat 26.3 acres (4%) of the site and provide an additional 0.36 points towards the 10-point total.

The remaining 0.28 point deficit can be made up by allocating 18 acres of open space. Most of this open space can likely be obtained from roadway buffers or buffers to adjacent property. Table 1 presents alternatives for achieving 10 points. If the developer cannot find additional open space locations, additional structural BMPs can be incorporated into the plan to provide 10 points.

Conclusion

Based on the stormwater evaluation performed by WEG, it is feasible to meet the criteria specified in the James City County Chesapeake Bay Preservation Ordinance as part of the development of the Warhill Tract. WEG has demonstrated that 10 points can be achieved by: 1) taking open space credit for undevelopable land, 2) taking structural BMP credit for the three existing onsite lakes, 3) providing two additional 9-point structural BMPs, and 4) providing an additional 18 acres of open space.

The investigation focused only on stormwater quality treatment and hydrologic modeling will be required to address stormwater quantity issues. In general, the structural BMPs identified in this report can be upgraded to provide peak attenuation necessary to meet state requirements regarding stormwater quantity.

Table 4

Worksheet for BMP Point System

With Property Buffer Credit

A. Structural BMP Point Allocation

Project Area 643 ac 898 ac

BMP	Area of Project Served (ac)	BMP Points	Fraction of Site Served By BMP	Weighted BMP Points
1 Existing Lake #1	266	10	0.41	4.14
2 Existing Lake #2	129	10	0.20	2.01
3 Existing Lake #3	99	10	0.15	1.54
4 BMP #6	21	9	0.03	0.29
5 BMP #7	5.3	9	0.01	0.07
Total			0.81	**8.05**

B. Natural Open Space Credit

	Area of Site (ac)	Fraction of Site	Natural Open Space Credit	Points for Natural Open Space
RPA and Buffer	63	9.80	0.10	**0.98**
Remaining Undeveloped	44.6	6.94	0.10	**0.69**
Additional Property Buffers	18	2.80	0.10	**0.28**
Total	107.60	16.73	0.10	**1.95**

C. **Total Weighted Points** **10.00**

IX. EMPLOYMENT OPPORTUNITIES

The development of the Warhill Tract will provide permanent as well as temporary jobs to James City County. Please refer to the Fiscal and Economic Impact Study for an in-depth analysis of the employment opportunities which are projected from the development of the Warhill Tract.

PLAN REVIEW COMMENTS

Warhill Tract Erosion and Sediment Control Plan DEC

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

2. Show the existing pond to which DA-16 drains. Provide calculations to verify that this pond has at least 67 cubic yards per acre of sediment storage for the 21 acres that drains to this pond. Also, provide calculations regarding the hydraulic performance of the outlet structure for this pond.

3. Revise Sediment Basin 3 to provide a 10-inch barrel pipe and a 15-inch riser.

4. Increase the diameter of the risers for Sediment Basins 6, 11 and 14 from 10-inch to 12-inch.

5. For Sediment Basin 5, the Hr elevation needs to be revised to 5.5 feet from 5.3 feet.

6. The riser for Sediment Basin 10 needs to be increased from 10-inches to 15-inches in diameter.

7. Provide design information for the DA-17 pond concerning sediment storage available and also the hydraulic performance of the outlet structure. Provide the same information for the pond at DA-18.

8. DA-19 is not labeled on the plans.

9. The wetlands issue regarding the pond for DA-18 will have to be resolved with the Army Corps of Engineers before it can be used as a sediment pond.

10. Provide dimensions for all sediment traps on the plan and provide a scale drawing for each basin on the plan.

11. Provide the calculations for Culverts DA-19, 20 and 21 if they are to remain as permanent structures. If they are to be permanent, they will need to be designed for ultimate development conditions.

DEC/skc
3708c

CALCULATIONS FOR EROSION & SEDIMENT CONTROL FOR WARHILL TRACT

12/29/87
KMS

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JOB 87169

SHEET NO. _____ OF _____

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DRAINAGE AREA DATA

DA	AREA	I_2	C	Q_2	Page
1	3.92	3.4	.15	2.00	1
2	1.55	3.4	.15	0.80	3
3	10.22	2.8	.15	4.30	5
4	1.24	2.7	.15	0.50	11
5	30.50	2.4	.15	11.00	13
6	7.20	2.9	.15	3.20	19
7	1.13	3.5	.15	0.60	25
8	1.97	2.7	.15	0.80	27
9	4.20	2.9	.15	1.83	29
10	11.40	2.6	.15	4.45	31
11	5.33	3.2	.15	2.60	37
12	2.57	3.3	.15	1.27	43
13	3.28	2.9	.15	1.43	45
14	6.70	2.6	.15	2.61	47
15	2.00	3.3	.15	1.00	53
16	21.05	2.8	.15	8.85	55
17	112.65	1.4	.15	31.60	59
18	126.07	1.3	.15	33.70	63
19	10.84	3.4	.15	5.60	67
~~20~~	~~1.03~~	~~4.8~~	~~.15~~	~~0.75~~	DELETED
21	2.05	3.4	.15	1.05	69
Beaver Lake	1302			225	71

Appendix A — Drainage Area Data
Appendix B — Sediment Trap Data
Appendix C — Sediment Basin Data

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DA - I

A = 3.92 Ac
c = .15

Overland Flow

L = 540'
S = 4.3%
T_c = 21 min

Channel Flow

H = 5'
L = 50'
T_c < 1 min

T_c = 21 min

i_2 = 3.4 "/hr

$Q = CAi = (.15)(3.92)(3.4)$

Q = 2.00 cfs

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Design of ST for DA-I

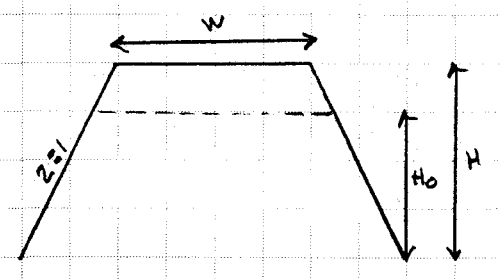
$V = 0.4 \times A \times D$

$V = (67\ yd^3 \times 3.92\ Ac) = 263\ yd^3 \times 27\ ft^3/yd^3 = 7{,}101\ ft^3$

Try $D = 4'$

$7{,}101\ ft^3 = (0.4)(4{,}500)(4)$

$7{,}101\ ft^3 < 7{,}200\ ft^3$



$H = 5.0'$
$H_o = 4.0'$
$W = 4.5'$
$L = 23.5'$

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DA - II

A = 1.55 Ac
C = .15

Overland Flow

L = 400'
S = 3.25%
T_c = 20 min

Channel Flow

H = 10'
L = 100'
T_c = < 1 min

T_c = 20 min

i_2 = 3.4 "/hr

$Q = CAi = (.15)(1.55)(3.4)$

$Q = .80 cfs$

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SCALE NTS

Design of ST for DA-II

$V = 0.4 \times A \times D$

$V = (67\ yd^3)(1.55) = 104\ yd^3 \times 27\ ft^3/yd^3 = 2{,}808\ ft^3$

Try $D = 3'$

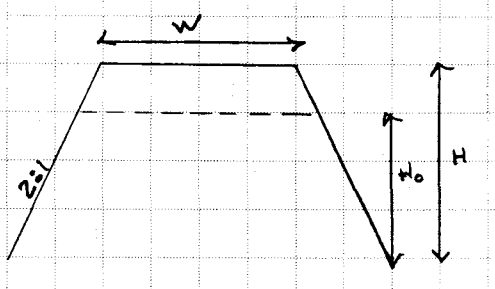
$2808 = (.4)(4{,}000)(3)$

$2808\ ft^3 < 4{,}800\ ft^3$

Try $D = 2.5'$

$2808 = (.4)(3000)(2.5)'$

$2808\ ft^3 < 3000\ ft^3$ OK



$H = 3.5'$
$H_o = 2.5'$
$W = 3.0'$
$L = 20$

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DA-III

A = 10.22 Ac
C = .15

Overland Flow

L = 660'
S = 2.0%
T_c = 26 min

Channel Flow

H = 18'
L = 300'
T_c = 1.75 min

T_c = 27.75 min

i_2 = 2.8 "/hr

$Q = CAi = (.15)(10.22)(2.8)$

Q = 4.30 cfs

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SCALE NTS

Design of SB for OA-III
(Follow Procedure in "Virginia ESC Control Handbook")

1. Basin Volume

$V = .4 \times A \times D$

$V = (67\ yd^3 \times 10.22\ Ac) = 685\ yd^3 \times 27\ ft^3/yd^3 = 18,495\ ft^3$

Try $D = 10'$

$18495 = (.4)(154,000)(10)$

$18,495 < 616,000$

Try $D = 5'$

$18495 = (.4)(16,800)(5)$

$18495 ft^3 < 33,600 ft^3$

Try $D = 4'$

$18,495 = .4\,(13,440)(4)$

$18,495 ft^3 < 21,504 ft^3$ OK

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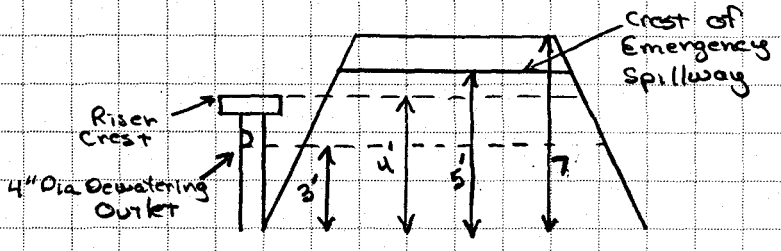
SCALE NTS

2. Basin Shape

Length to width ratio = 2:1

3. Elevation of Design high water



4. Determine Q_{10}

$T_c = 27.75$ min

$i_{10} = 3.7$ "/hr

$Q_{10} = CAi = (.75)(10.22)(3.7)$

$Q_{10} = 5.7$ cfs

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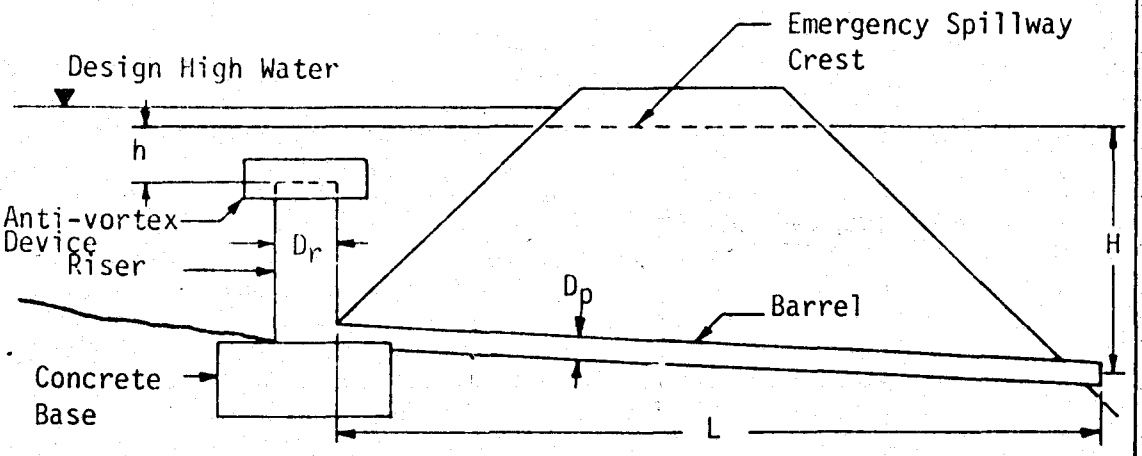
SCALE NTS

5. Principal Spillway Design

PRINCIPAL SPILLWAY DESIGN



H = Head on pipe through embankment
h = Head over riser crest
L = Length of pipe through embankment
D_p = Diameter of pipe through embankment
D_r = Diameter of riser

I) $Q_p = (.2\ cfs/ac)(10.22\ ac) = 2.05\ cfs$

II) $D_r = 15''$

III) $H = 6'$
$L = 38'$
Use corrugated metal $n = .025$

$D_p = 10''$

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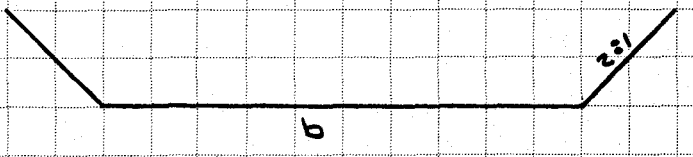
SCALE NTS

6. Emergency Spillway Design

$Q_e = Q_w - Q_p$

$Q_e = 5.7\text{cfs} - 2.05\text{cfs}$

$Q_e = 3.65\text{ cfs}$

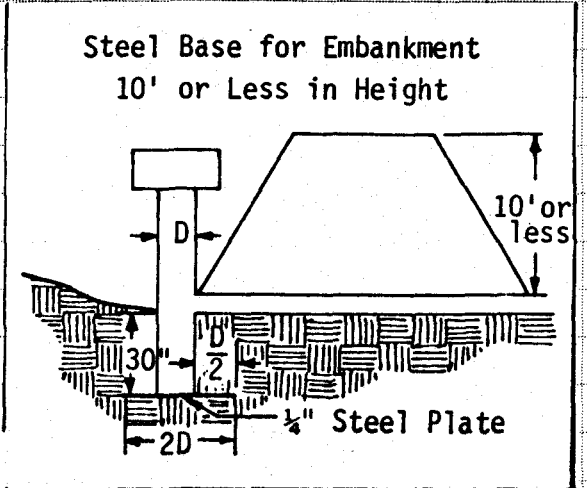


b; bottom width = 8'
s; slope exit channel = 3.1%
x; length exit channel = 51'
V_{max} = 4.0fps use grass lined spillway

7. Design of anti-Vortex device + trash rack

Cylinder Diameter = 18"
Thickness, gage = 16
Height, in = 6"
Minimum size support bar = #6 Reban
Minimum Top, Thickness = 16 gage

8. Anchoring the Principal Spillway



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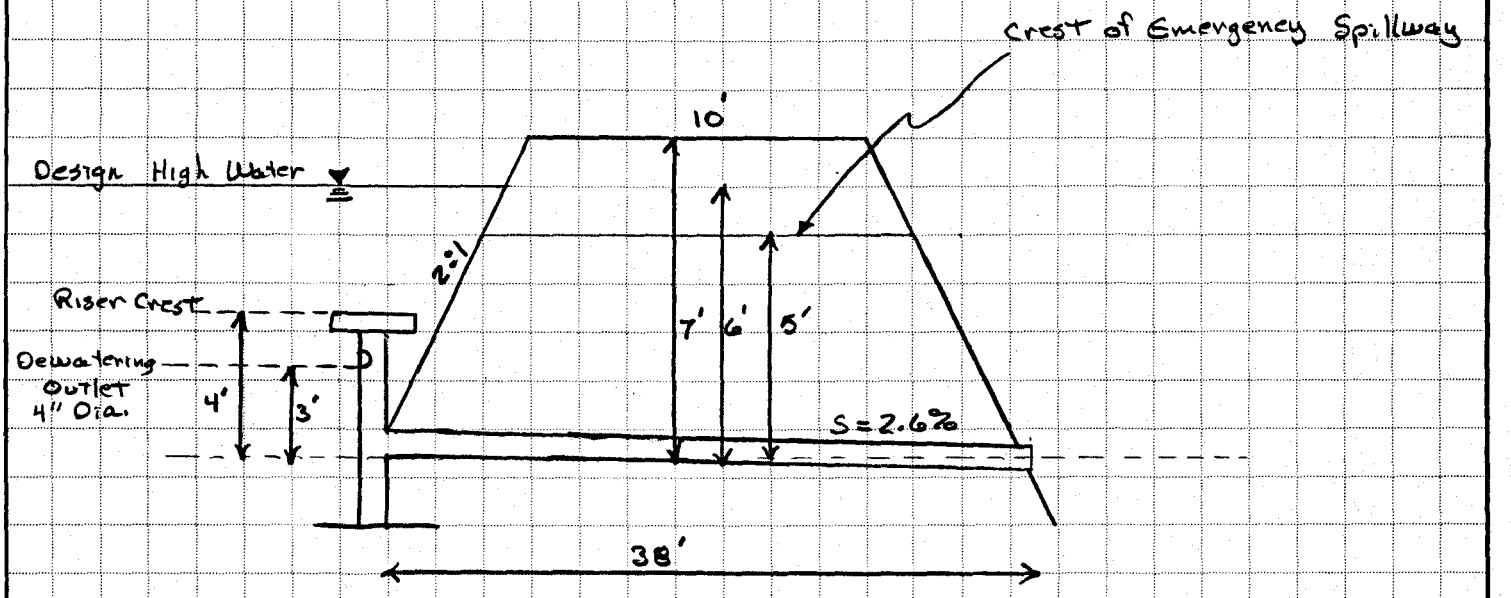

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DA-IV

A = 1.24 Ac
c = .15

Overland Flow

L = 400'
S = 3.5%
T_c = 20 min

Channel Flow

H = 10'
L = 150'
T_c = 1 min

T_c = 21 min

i_2 = 2.7 in/hr

$Q = CAi = (.15)(1.24)(2.7)$

Q = .50 cfs

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Design of ST for OA - IV

$V = .4 \times A \times D$

$V = (67\ yd^3)(1.24) = 83\ yd^3 \times 27\ ft^3/yd^3 = 2241\ ft^3$

Try $D = 4'$

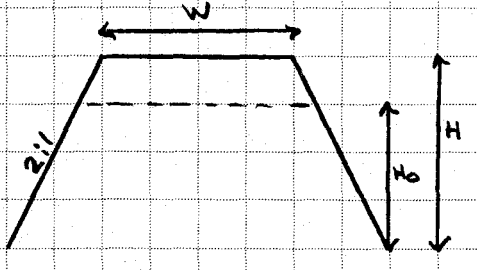
$2241 = (.4)(2000)(4)$

$2241 < 3200$

Try $D = 3.5'$

$2241 = (.4)(1715)(3.5)$

$2241\ ft^3 < 2401\ ft^3$ OK



$H = 4.5'$
$H_o = 3.5'$
$W = 4.0'$
$L = 20'$

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DA-V

A= 30.5 Ac
C=.15

Overland Flow

L= 1600
S= 1.6%
T_c= 35 min

Channel Flow

N/A

T_c= 38 min

i_2= 2.4 in/hr

$Q = CAi = (.15)(30.5)(2.4)$

Q= 11.0 cfs

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Design of SB for DA-V
(Follow Procedure in "Virginia E+S Control Handbook")

1. Basin Volume

$V = .4 \times A \times D$

$V = (67\ yd^3/ac)(30.5\ Ac) = 2,044\ yd^3 \times 27\ ft^3/yd^3 = 55,175\ ft^3$

Try D = 10'

$55,175\ ft^3 = .4(56,133)(10)$
$55,175\ ft^3 < 224,533\ ft^3$

Try D = 7.5

$55,175\ ft^3 = .4(36,400)(7.5)$
$55,175 < 109,200.$

Try D = 5.5'

$55,175\ ft^3 = (.4)(27,800)(5.5)$

$55,175\ ft^3 < 61,160\ ft^3$ OK

2) Basin Shape

Length to width ratio = 2:1

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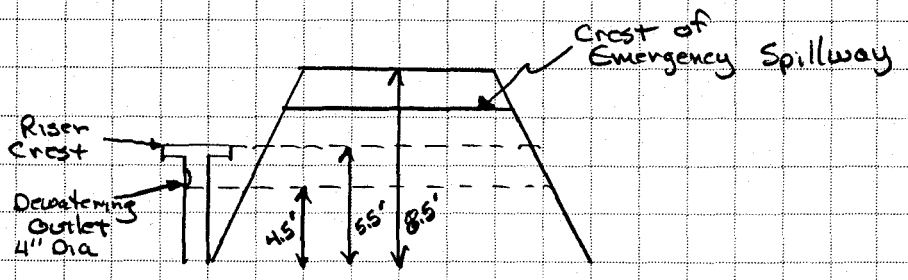
3. Elevation of Design highwater



4. Determine Q_{10}

$T_c = 35$ min

$i_{10} = 3.4$ "/hr

$Q_{10} = CAi = (.15)(30.5)(3.4)$

$Q_{10} = 15.6$ cfs

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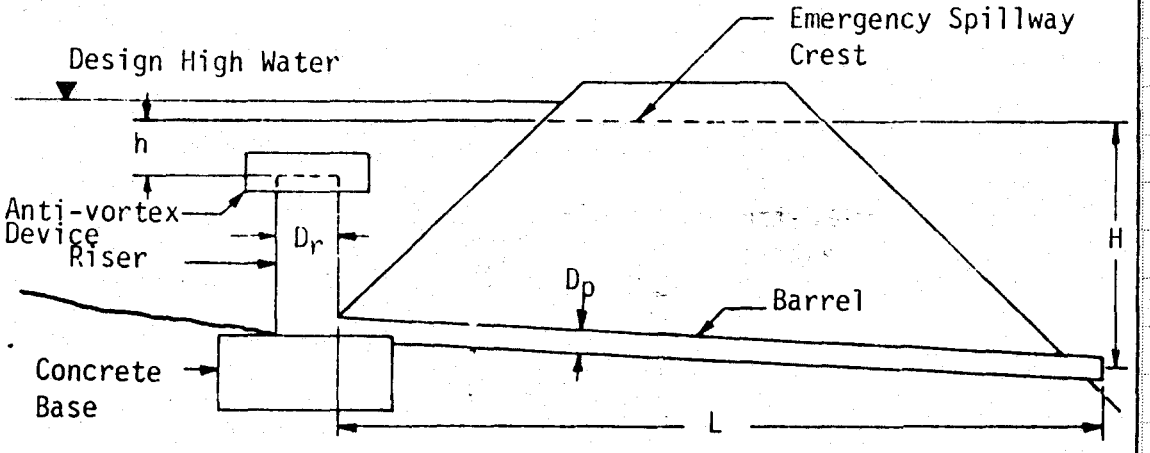
SCALE NTS

5. Principal Spillway Design

PRINCIPAL SPILLWAY DESIGN



H = Head on pipe through embankment
h = Head over riser crest
L = Length of pipe through embankment
D_p = Diameter of pipe through embankment
D_r = Diameter of riser

I) $Q_p = (1.2\ cfs/ac)(30.5) = 6.1\ cfs$

II) $D_r = 18''$

III) $H = 7.5'$
$L = 44'$
Use corrugated metal $n = .025$

$D_p = 18''$

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SHEET NO. 17 OF 82
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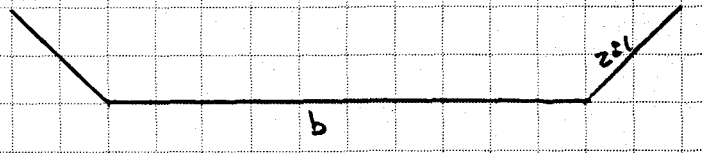
SCALE NTS

6. Emergency Spillway Design

$Q_e = Q_{10} - Q_p$

$Q_e = 15.6_{cfs} - 6.1_{cfs}$

$Q_e = 9.5_{cfs}$



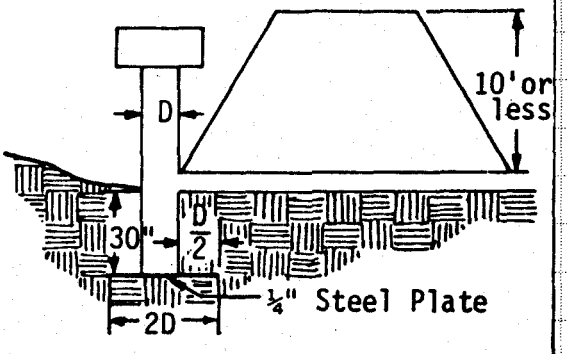
b; bottom width = 8'
s; slope exit channel = 3.1%
x; length exit channel = 51'
$V_{max} = 4.0_{fps}$

7. Design of anti-vortex device & trash rack

Cylinder Diameter = 27"
Thickness, gage = 16
Height, in = 8"
Min. size support bar = #6 Rebar
Min Top; thickness = 16 gage

8. Anchoring the Principal Spillway

Steel Base for Embankment
10' or Less in Height



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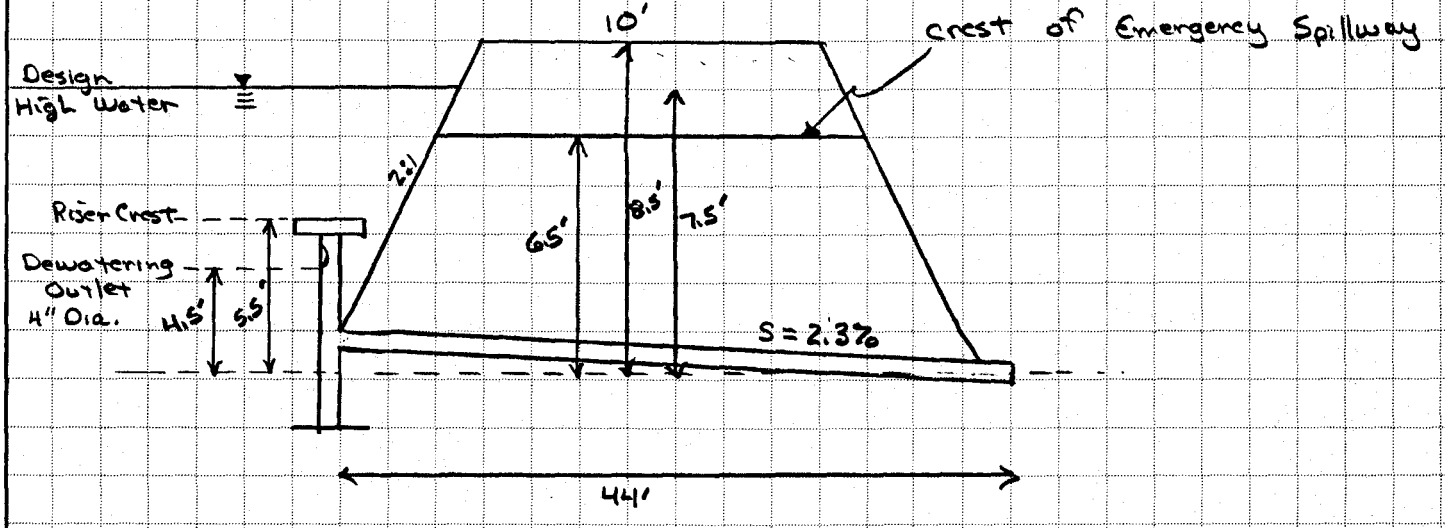

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SHEET NO. 19 OF 82
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SCALE NTS

DA - VI

A= 7.2 Ac
C= .15

Overland Flow

L=900'
S= 3.3%
T_c= 26 min

Channel Flow

N/A

T_c=26 min

i_2 = 2.9 "/hr

Q=CAi = (.15X7.2)(2.9)

Q= 3.2 cfs

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SCALE NTS

Design of SB for DA-VI
(Follow Procedure in "Virginia E+S Control Handbook")

1. Basin Volume

$V = .4 \times A \times D$

$V = (67\ yd^3/ac)(7.2\ Ac) = 483\ yd^3 \times 27\ ft^3/yd^3 = 13,041\ ft^3$

Try D=10'

$13,041\ ft^3 = (.4)(29700)(10)$
$13,041 < 118,800$

Try D=5'

$13,041\ ft^3 = (.4)(11,300)(5)$
$13,041\ ft^3 < 22,600\ ft^3$

Try D=4'
$13,041 \leq (.4)(9,000)(4)$
$13,041\ ft^3 < 14,400\ ft^3$ OK

2. Basin Shape

Length to Width ratio = 2:1

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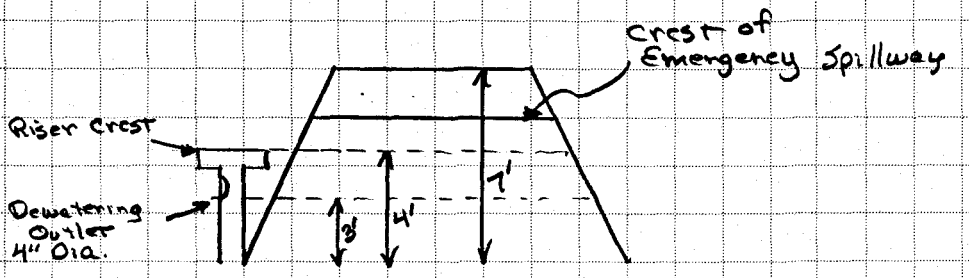
SCALE NTS

3. Elevation of Design Highwater



4. Determine Q_{10}

$T_c = 26$ min

$i_{10} = 3.0$ "/hr

$Q_{10} = CRi = .15(7.2)(3.0)$

$Q_{10} = 3.25$ cfs

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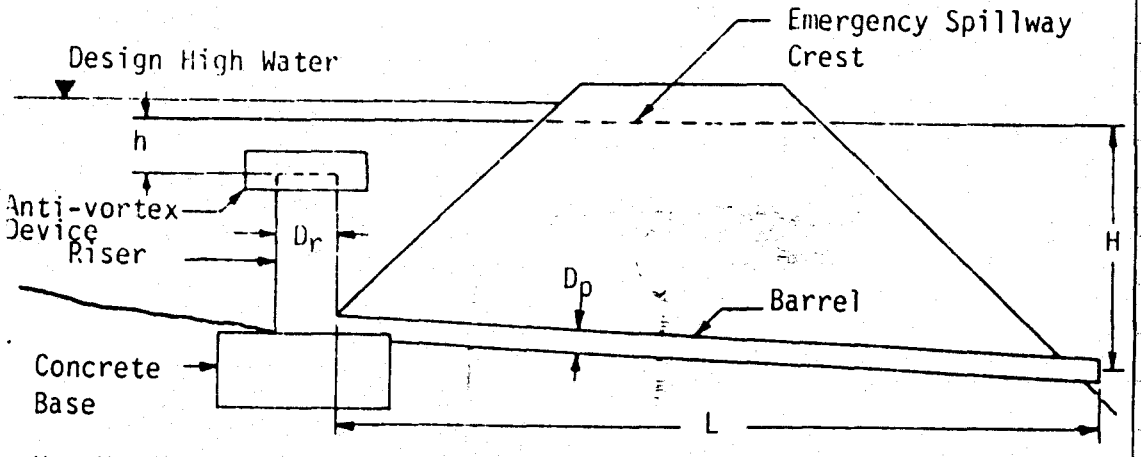
SCALE NTS

5. Principal Spillway Design

PRINCIPAL SPILLWAY DESIGN



H = Head on pipe through embankment
h = Head over riser crest
L = Length of pipe through embankment
D_p = Diameter of pipe through embankment
D_r = Diameter of riser

I) $Q_p = (.2\ cfs/ac)(7.2\ ac) = 1.44\ cfs$

II) $D_r = 12''$

III) $H = 6'$
$L = 38'$
Use corrugated metal $n = .025$

$D_p = 8''$

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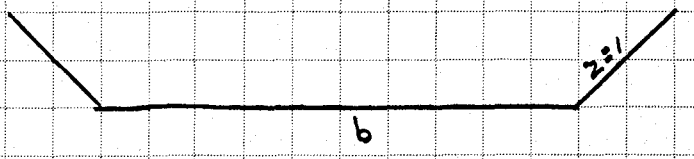
6. Emergency Spillway Design

$Q_e = Q_{10} - Q_p$

$Q_e = 3.25\text{cfs} - 1.44\text{cfs}$

$Q_e = 1.81\text{ cfs}$



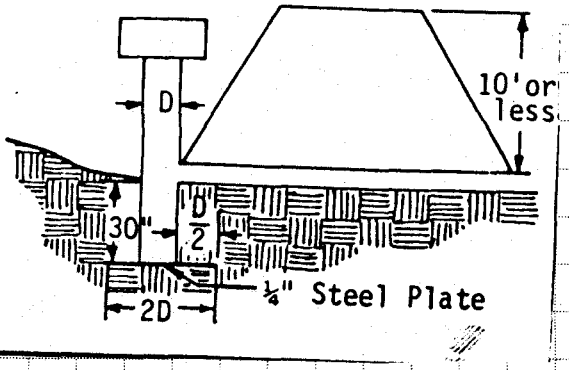
b; bottom width = 8'
s; slope exit channel = 3.1%
x; length exit channel = 51'
V_{max} = 4.0fps

7. Design of anti-vortex device & trash rack

Cylinder Diameter = 18"
Thickness, gage = 16
Height, in = 6"
Min. size support bar = #6 Rebar
Min Top, thickness = 16 gage.

8. Anchoring of Principal Spillway

Steel Base for Embankment
10' or Less in Height



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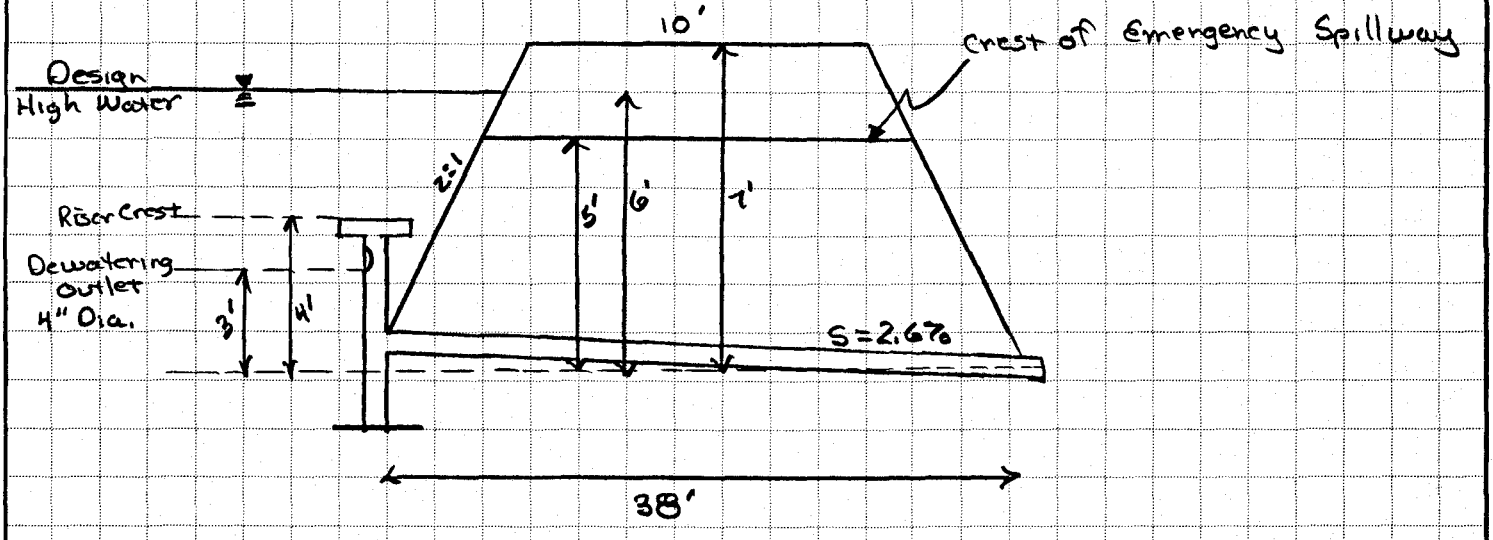

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DA- VII

A= 1.13 Ac
c= .15

Overland Flow

L= 300'
S= 4.7%
T_c= 16.5 min

Channel Flow

H= 10
L= 200'
T_c= 1.5 min

T_c= 18 min

i_2 = 3.5 "/hr

$Q = CAi = (.15)(1.13)(3.5)$

Q= .60 cfs

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Design of ST for OA-VII

$V = .4 \times A \times D$

$V = (67 yd^3)(1.13 Ac) = 75.7 yd^3 \times 27 ft^3/yd^3 = 2,045 ft^3$

Try D = 4'

$2,045 = (.4)(3600)(4)$

$2,045 < 5760$

Try D = 3'

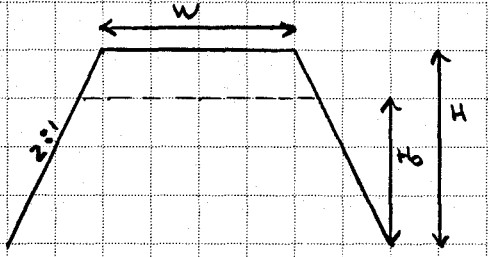
$2045 = (.4)(2700)(3)$

$2045 < 3240$

Try D = 2.5

$2045 = (.4)(2250)(2.5)$

$2045 ft^3 < 2250 ft^3$ OK



H = 3.5'
H_o = 2.5'
W = 3.0'
L = 27'

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OA - VIII

A= 1.97Ac
C=.15

Overland Flow

L= 720'
S= 3.3%
T_c= 24.5 min

Channel Flow

H= 5'
L= 480'
T_c= 5 min

T_c= 29.5 min

i_2 = 2.7 "/hr

Q=CAi = (.15)(1.97X2.7)

Q= .80cfs

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Design of ST for QA-VIII

$V = .4 \times A \times D$

$V = (67\ yd^3 \times 1.97\ Ac) = 132\ yd^3 \times 27\ ft^3/yd^3 = 3,564\ ft^3$

Try $D = 4'$

$3564 = (.4)(7,200)(4)$

$3564\ ft^3 < 11,520\ ft^3$

Try $D = 3'$

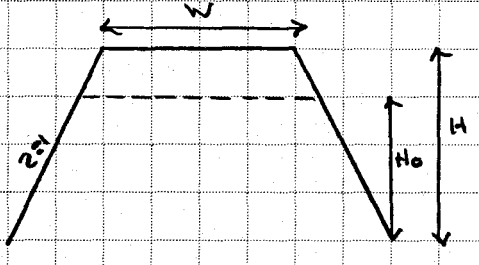
$3564 = (.4)(5400)(3)$

$3564\ ft^3 < 6480\ ft^3$

Try $D = 2.5$

$3564 = (.4)(4500)(2.5)$

$3564\ ft^3 < 4500\ ft^3$ OK



$H = 3.5'$
$H_o = 2.5'$
$W = 3.0'$
$L = 17'$

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DA-IV

A= 4.20 Ac
C= .15

Overland Flow

L= 700'
S= 3.4%
T_c= 24 min

Channel Flow

H= 10'
L= 400'
T_c= 3 min

T_c= 27 min

i_2 = 2.9"/hr

Q=CAi = (.15)(4.20)(2.9)

Q= 1.83 cfs

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Design of ST for OA-IX

$V = .4 \times A \times D$

$V = (67 yd^3)(4.20) = 282 yd^3 \times 27 ft^3/yd^3 = 7614 ft^3$

Try $D = 4'$

$7614 = .4(14{,}800)(4)$

$7614 < 23{,}680$

Try $D = 3'$

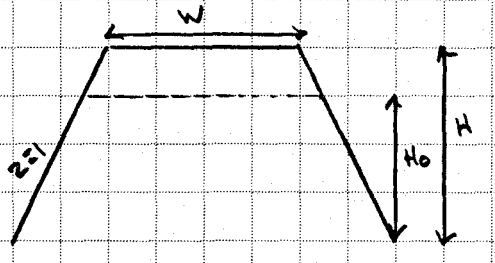
$7614 ft^3 = (.4)(11{,}100)(3)$

$7614 < 13{,}320$

Try $D = 2.5$

$7614 ft^3 = (.4)(9250)(2.5)$

$7{,}614 ft^3 < 9{,}250 ft^3$ OK



$H = 3.5'$
$H_o = 2.5'$
$W = 3.0'$
$L = 25.2'$

$L = G \times Ac = G(4.2) = 25.2'$

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OA-X

A = 11.4 Ac
C = .15

Overland Flow

L = 1850'
S = 3.0%
Tc = 31 min

Channel Flow

N/A

Tc = 25.5 min

I_2 = 2.6 "/hr

Q = CAI = (.15)(11.4)(2.6)

Q = 4.45 cfs

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SCALE NTS

Design of SB for DA-I
(Follow Procedure in "Virginia E+S Control Handbook")

$V = .4 \times A \times D$

$V = 67 yd^3 * 11.4\ Ac = 764 yd^3 \times 27 ft^3/yd^3 = 20,628\ ft^3$

Try D=10'

$20,628 ft^3 = (.4)(22,000)(10)$

$20,628 < 88,000$

Try D=7.5'

$20,628 ft^3 = (.4)(13,600)(7.5)$

$20,628 < 40,800$

Try D=5.5

$20,628 ft^3 = (.4)(10,000)(5.5)$,

$20,628 ft^3 < 22,000 ft^3$ OK

2. Basin Shape

Length to width ratio = 2:1

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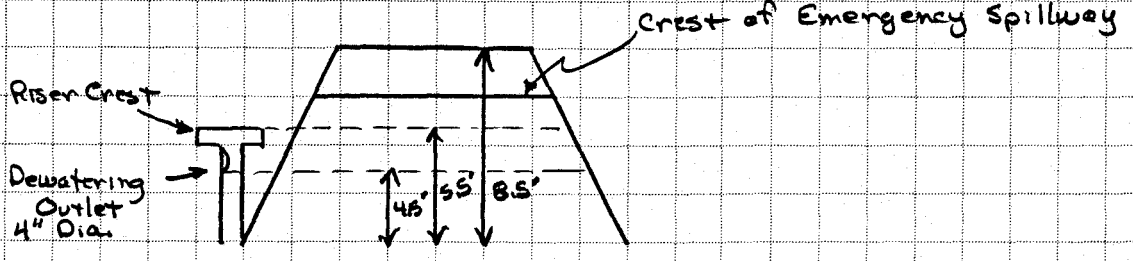
3. Elevation of Design Highwater



4. Determine Q_{10}

$T_c = 25.3$ min

$i_{10} = 4.0$ "/hr

$Q = CAi = (.15)(11.4)(4)$

$Q_{10} = 6.9$ cfs

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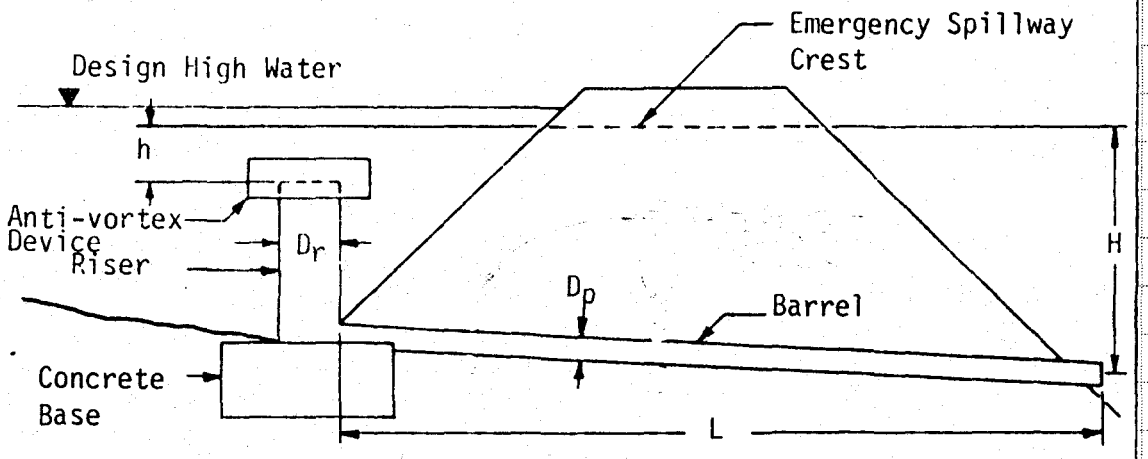
SCALE NTS

5. Principal Spillway Design

PRINCIPAL SPILLWAY DESIGN



H = Head on pipe through embankment
h = Head over riser crest
L = Length of pipe through embankment
D_p = Diameter of pipe through embankment
D_r = Diameter of riser

I) $Q_p = (.2\ cfs/ac)(11.4\ ac) = 2.28\ cfs$

II) $D_r = 15''$

III) $H = 7.5'$
$L = 40'$
Use corrugated metal $n = .025$

$D_p = 10''$

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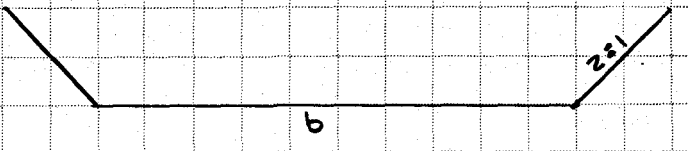
6. Emergency Spillway Design

$Q_e = Q_{10} - Q_p$

$Q_e = 6.9\text{cfs} - 2.28\text{cfs}$

$Q_e = 4.62\text{cfs}$



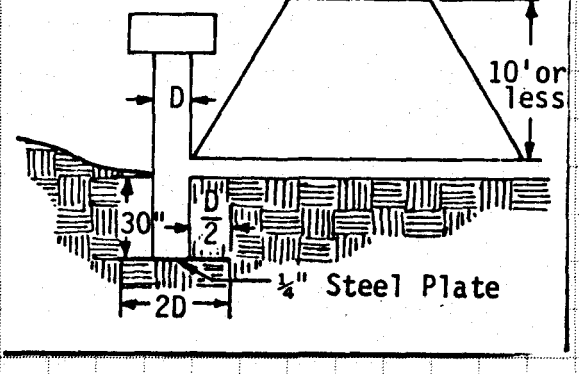
b; bottom width = 8'
S; slope exit channel = 3.1%
X; length exit channel = 51'
V_{max} = 4.0fps

7. Design of anti-vortex device & trash rack

Cylinder Diameter = 18"
Thickness, gage = 16
Height, in = 6"
Min. size support bar = #6 Rebar
Min Top. Thickness = 16 gage

8. Anchoring of Principal Spillway

Steel Base for Embankment
10' or Less in Height



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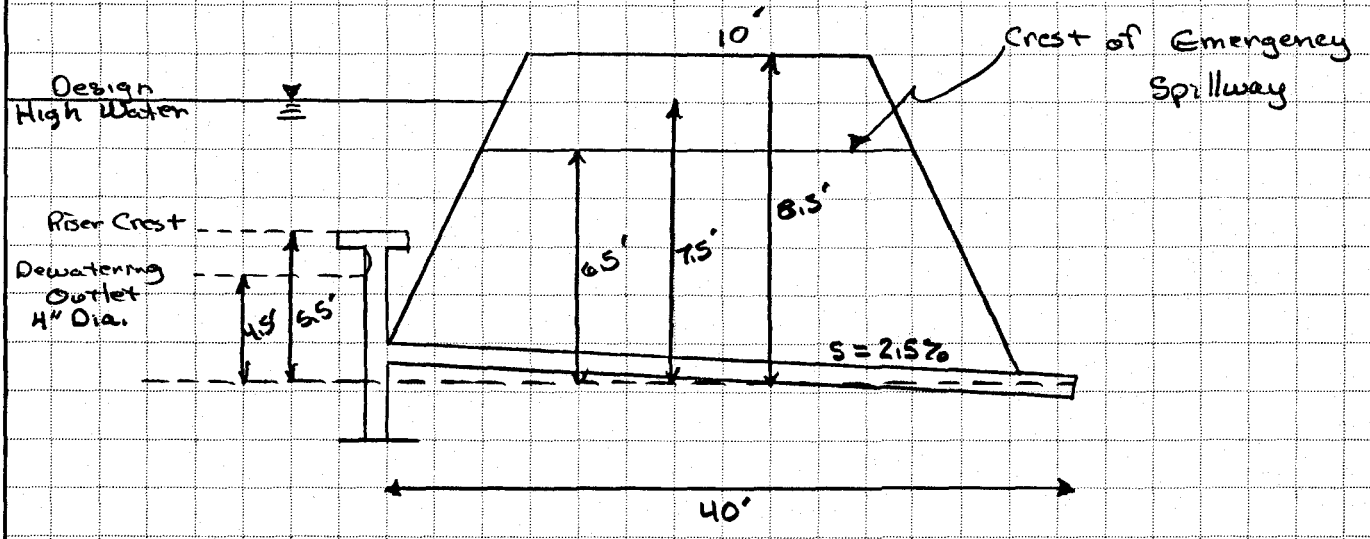

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DA-XI

A= 5.33 Ac
C=.15

Overland Flow

L= 620'
S= 6.6%
T_c = 20.5 min

Channel Flow

H= 3'
L= 150'
T_c = 1.5 min

T_c = 22 min

i_2 = 3.2 "/hr

Q = CAi = (.15)(5.33)(3.2)

Q = 2.60 cfs

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Design of SB for DA-II
(Follow Procedure in "Va. E&S Control Handbook")

$V = .4 \times A \times D$

$V = (67 yd^3 \times 5.33 Ac) = 358 yd^3 \times 27 ft^3/yd^3 = 9{,}666 ft^3$

Try $D = 10'$

$9{,}666 = .4(29{,}866)(10)$

$9{,}666 < 119{,}466$

Try $D = 5'$

$9{,}666 ft^3 = .4(15{,}900)(5)$
$9{,}666 ft^3 < 31{,}800 ft^3$

Try $D = 3.5'$

$9{,}666 ft^3 = .4(10{,}000)(3.5)$
$9{,}666 ft^3 < 14{,}000 ft^3$ OK

2. Basin Shape

Length to Width ratio = 2:1

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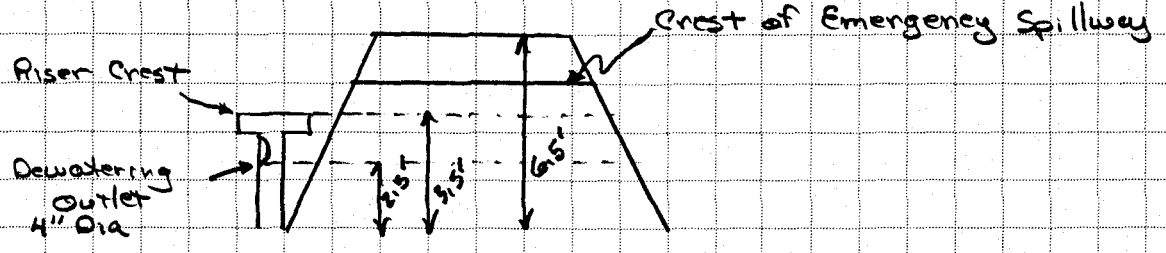
3. Elevation of Design Highwater



4. Determine Q_{10}

$T_c = 22$ min

$i_{10} = 4.3$ in/hr

$Q = CAi = (.15)(5.33)(4.3)$

$Q_{10} = 3.45$ cfs

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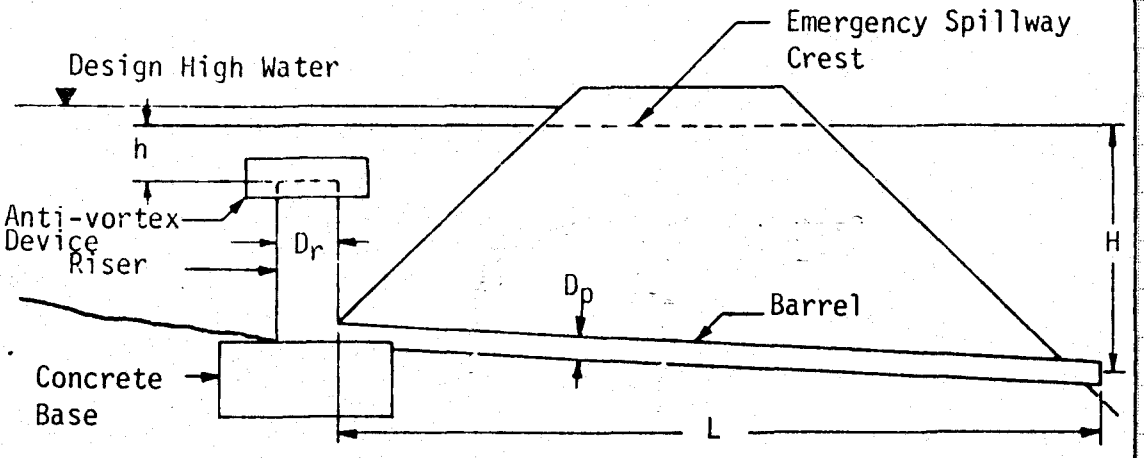
5. Principal Spillway Design

PRINCIPAL SPILLWAY DESIGN



H = Head on pipe through embankment
h = Head over riser crest
L = Length of pipe through embankment
D_p = Diameter of pipe through embankment
D_r = Diameter of riser

I) $Q_p = (.2\ cfs/ac)(5.33\ ac) = 1.07\ cfs$

II) $D_r = 12''$

III) $H = 5.5'$
$L = 32.0'$
Use corrugated metal, $n = .025$

$D_p = 8''$

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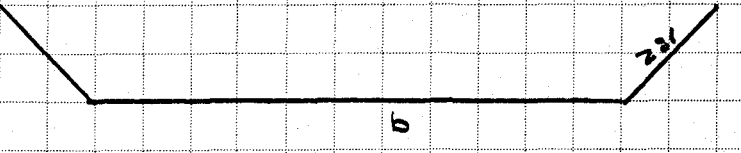
6. Emergency Spillway Design

$Q_e = Q_{10} - Q_p$

$Q_e = 3.45 cfs - 1.07$

$Q_e = 2.38 cfs$

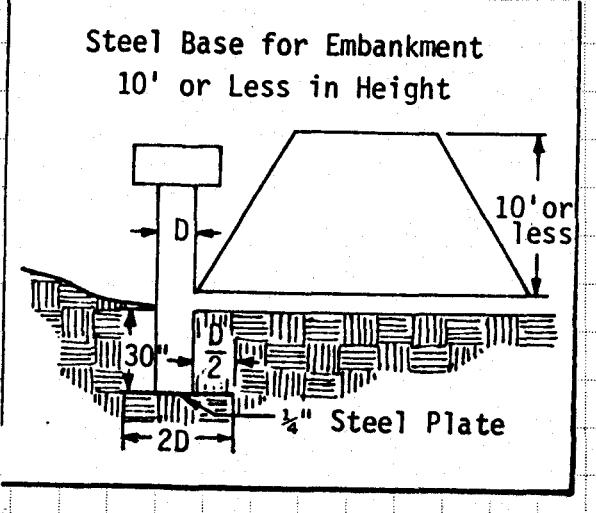


b; bottom width = 8'
s; slope exit channel = 3.1%
x; length exit channel = 51'
V_{max} = 4.0 fps

7. Design of anti-vortex device & trash rack

Cylinder Diameter = 18"
Thickness, gage = 16
Height, in = 6"
Min size support bar = #6 Rebar
Min Top, Thickness = 16 gage

8. Anchoring of Principal Spillway



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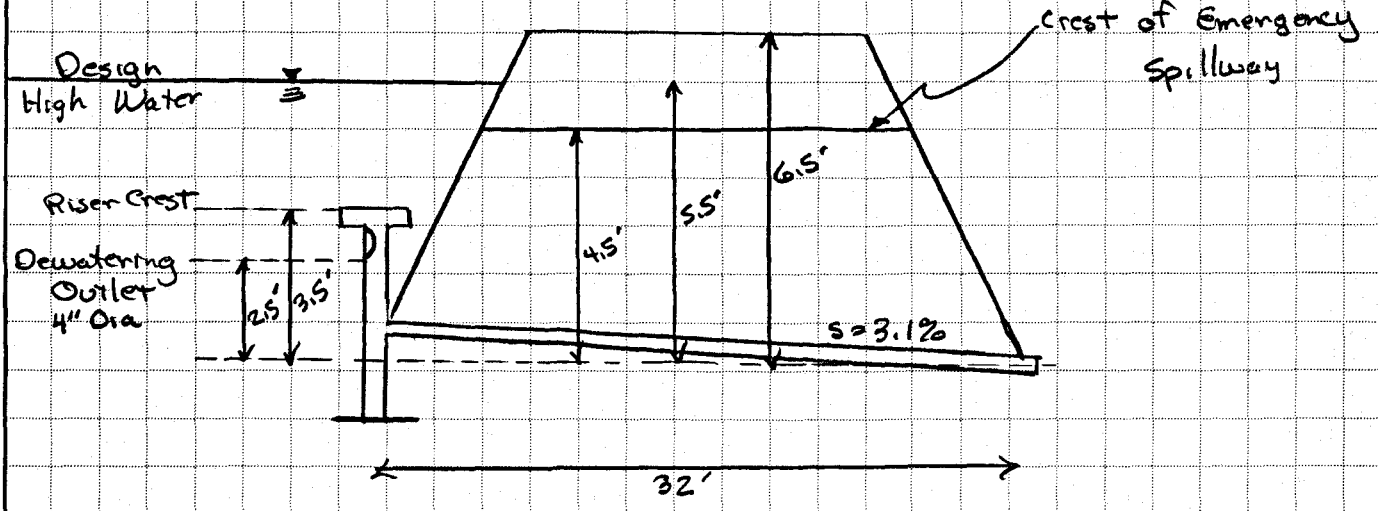

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OA - XII

A = 2.57 Ac
C = .15

Overland Flow

L = 600'
S = 6.8%
T_c = 20 min

Channel Flow

H = 2'
L = 100'
T_c = 1.25 min

T_c = 21.25 min

i_2 = 3.3 "/hr

$Q_2 = CAi = (.15)(2.57)(3.3)$

Q = 1.27 cfs

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Design of ST for DA - XII

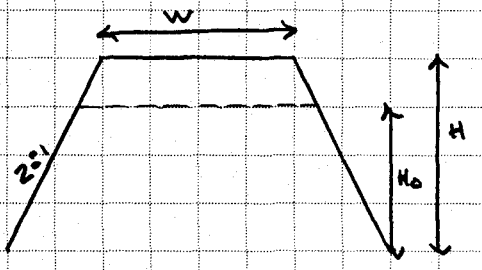
$V = .4 \times A \times D$

$V = (67\ yd^3)(2.57\ Ac) = 173\ yd^3 \times 27\ ft^3/yd^3 = 4,671\ ft^3$

Try $D = 4$

$4,671\ ft^3 = .4(3,200)(4)$

$4671\ ft^3 = 5120\ ft^3$ OK



$H = 5'$
$H_o = 4'$
$W = 4.5'$
$L = 15.5'$

$L = 6 \times A_c = 6(2.57) = 15.5'$

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DA- XIII

A= 3.28 Ac
C=.15

Overland Flow

L= 800'
S= 4.9%
T_c= 24 min

Channel Flow

H= 8'
L= 250'
T_c= 2 min

T_c= 26 min

i_2 = 2.9"/hr

$Q = CA_i = (.15)(3.28)(2.9)$

Q= 1.43 cfs

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Design of ST for OA - XIII

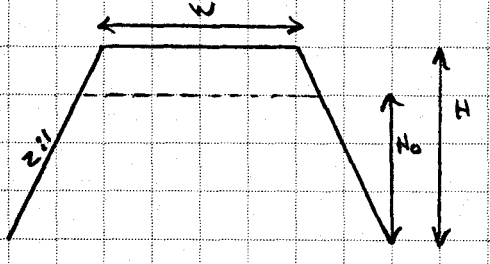
$V = .4 \times A \times D$

$V = (67 yd^3)(3.28 Ac) = 220 yd^3 \times 27 ft^3/yd^3 = 5940 ft^3$

Try D = 4'

$5940 ft^3 = (.4)(3800)(4)$

$5940 ft^3 < 6080 ft^3$ OK



$H = 5.0'$
$H_o = 4.0'$
$W = 4.5'$
$L = 19.7$

$L = 6 \times Ac = 6(3.28) = 19.7'$

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DA-XIV

A = 6.7Ac
C = .15

Overland Flow

L = 800'
S = 4.9%
T_c = 24 min

Channel Flow

H = 5'
L = 700'
T_c = 8.5 min

T_c = 32.5 min

i_2 = 2.6 "/hr

$Q = CAC = (.15)(6.7)(2.6)$

Q_2 = 2.61 cfs

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Design of SB for OA- ~~XIV~~
(Follow Procedure in "Va ESC Control Handbook)

$V = .4 \times A \times D$

$V = (67.0^3)(0.7) = 449\ yd^3 \times 27\ ft^3/yd^3 = 12,123\ ft^3$

Try D=4'

$12,123\ ft^3 = (.4)(13,200)(4)$

$12,123 < 21,120$

Try D= 3.5

$12,123 = (.4)(11,550)(3.5)$

$12,123 < 16,170$ OK

2. Basin Shape

Length to width Ratio = 2:1

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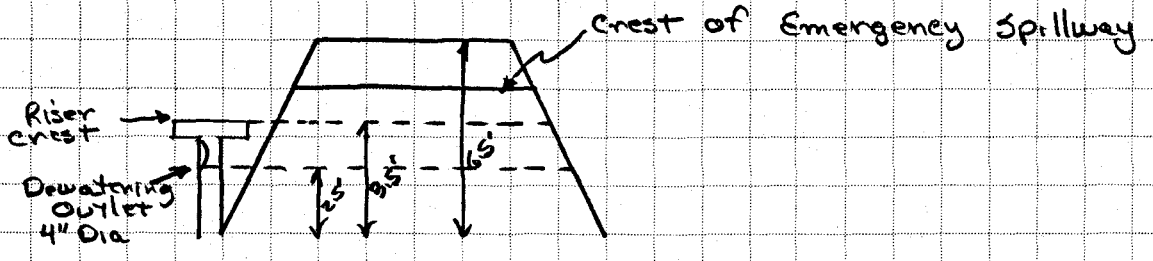
3. Elevation of Design Highwater



4. Determine Q_{10}

$T_c = 32.5 \text{ min}$

$i_{10} = 3.5 \text{ "/hr}$

$Q = CAi = (.15)(67.7 \text{ AC})(3.5)$

$Q_{10} = 35 \text{ cfs}$

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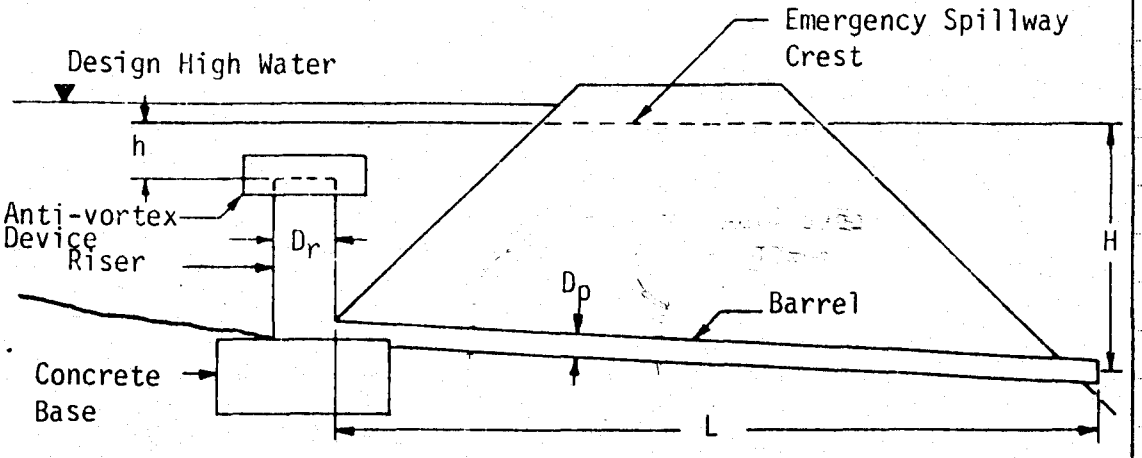
5. Principal Spillway Design

PRINCIPAL SPILLWAY DESIGN



H = Head on pipe through embankment
h = Head over riser crest
L = Length of pipe through embankment
D_p = Diameter of pipe through embankment
D_r = Diameter of riser

I) $Q_p = (1.2\ cfs/ac \times 1.7\ Ac) = 1.34\ cfs$

II) $D_r = 12''$

III) $H = 5.5'$
$L = 32'$
Use corrugated metal, $n = .025$

$D_p = 8''$

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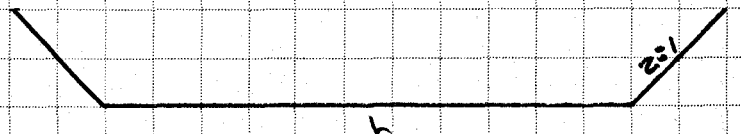
6. Emergency Spillway Design

$Q_e = Q_{10} - Q_p$

$Q_e = 3.5\,cfs - 1.34\,cfs$

$Q_e = 2.16\,cfs$



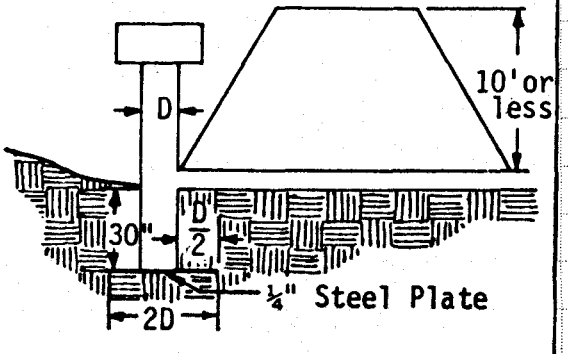
b; bottom width = 8'
S; slope exit channel = 3.1%
x; length exit channel = 51'
V_{max} = 4.0 fps

7. Design of anti-vortex device & trash rack

Cylinder Diameter = 18"
Thickness, gage = 16
Height, in = 6"
Min size support bar = #6 Rebar
Min Top, Thickness = 16 gage

8. Anchoring of Principal Spillway

Steel Base for Embankment
10' or Less in Height



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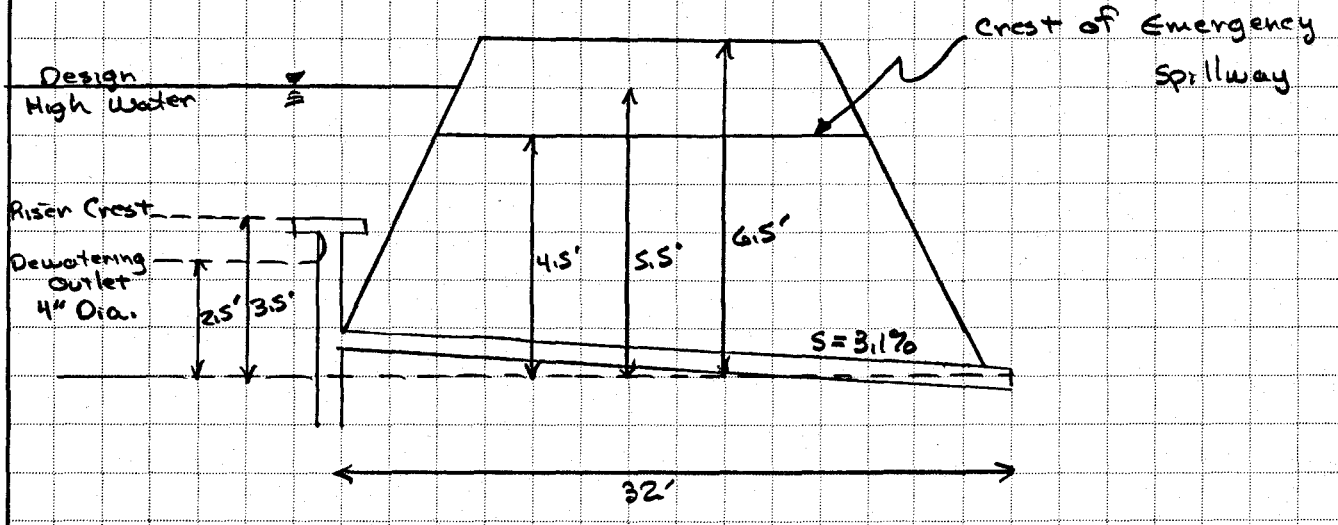

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OA- XV

A= 2.00
C=.15

Overland Flow

L= 400'
S= 7.75%
T_c= 17 min

Channel Flow

H= 2'
L= 100'
T_c= 1.25 min

T_c= 18.25 min

i_2= 3.3 "/hr

$Q = CAi = (.15)(2.0)(3.3)$

Q= 1.0 cfs

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Design of ST for OA - XV

$V = .4 \times A \times D$

$V = (67 yd^3)(2.00 Ac) = 134\ yd^3 \times 27 ft^3/yd^3 = 3,618\ ft^3$

Try $D = 4'$

$3618 = (.4)(10,400)(4)$

$3618 < 16,640$

Try $D = 2'$

$3618 = (.4)(5200)(2)$

$3618\ ft^3 < 4160\ ft^3$ OK

$H = 3'$
$H_o = 2'$
$W = 2.5'$
$L = 36'$

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OA - XVI

A = 21.05 Ac.
C = .15

Overland Flow

L = 1000'
S = 3.1%
T_c = 27 min

Channel Flow

N/A

T_c = 27 min

i_2 = 2.8 "/hr

$Q = CAi = (.15)(21.05)(2.8)$

Q = 8.85 cfs

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Design SB for OA XVI

$V = .4 \times A \times D$

$V = (67\ yd^3)(21.05\ Ac) = 1,411\ yd^3 \times 27\ ft^3/yd^3 = 38,097\ ft^3$

Volume of Lake = Top Ac × Ht. Dam × 0.4
= (1.86)(43560)(10)(.4)
= 149,846 cF > 38,097 cF OK

Storage = 2.2'

Storage = 2.2' × 1.86 Ac × 43,560 ft³/Ac = 88,416 CF

Volume Storage Required

T_c = 27 min

- Predevelopment Rainfall Intensity:
tc = 27 min

$$I = \frac{a}{b+tc} = \frac{189.2}{22.1+27} = 3.85\ in/hr$$

- Allowable Peak Q after development

$q_o = CAi = (.15)(21.05)(3.85)$
q_o = 12.16 cfs

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- Critical Storm Duration:

$$T_c = \sqrt{\frac{2CA_a(b - t_c/4)}{q_o}} - b$$

Overland Flow
L = 650'
S = 3.1%
t_c = 25 min

$$T_c = \sqrt{\frac{2(.65)(21.05)(189.2)(22.1 - 25/4)}{12.16}} - 22.1$$

T_c = 60 min

- Peak Inflow using Critical Storm Duration

$Q_o = CAi$

$$I = \frac{a}{b + T_c} = \frac{189.2}{22.1 + 60} = 2.30 \text{ "/hr}$$

$Q_o = (.65)(21.05)(2.30)$
Q_o = 31.47 cfs

- Required Storage

$$V = \left[Q_o T_c + \frac{q_o t_c}{4} - \frac{q_o T_c}{2} - \frac{3 q_o t_c}{4}\right] 60$$

$$V = \left[(31.47)(60) - \frac{(12.16)(25)}{4} - \frac{(12.16)(60)}{2} - \frac{3(12.16)(25)}{4}\right] 60$$

$$V = \left[1888.2 + 76 - 364.8 - 228\right] 60$$

V = 82,284 CF < 82,416 CF OK

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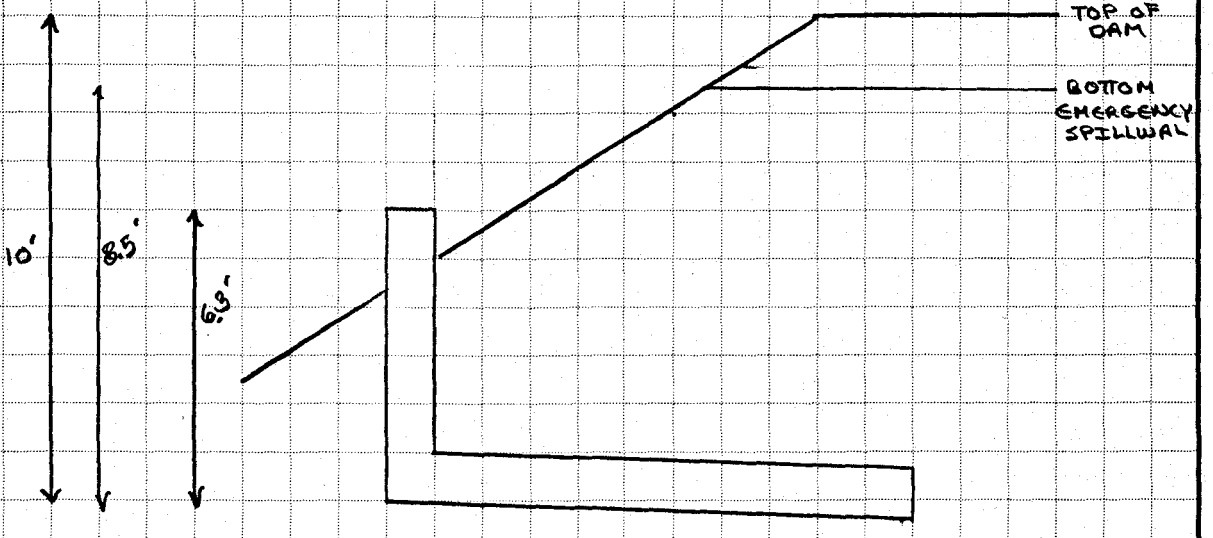

CK Culvert Capacity: (12" pipe) Q_{10} = LAM

orifice eqn.

$Q = CA\sqrt{2gh}$

N/A

$Q = (.65)(\pi(.5)^2)\sqrt{2(32.2)(9)}$

~~$Q =$~~ 12.29 cfs $Q \approx$ 5.5 cfs

CK Riser Capacity: (8" pipe) - PVC

$Q = \frac{2}{3} b\sqrt{2g}\, h^{3/2}$

$Q = \frac{2}{3}(2\pi(.33))\sqrt{2(32.2)(2.2)^{3/2}}$

~~$Q =$~~ 20.03 cfs

$Q_D = 3.782\, D_r^2 H^{1/2}$
$= 2.5$ cfs @ 2.2'

$Q_{culvert} < Q_{Riser}$

$Q_{culvert}$ controls

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DA- XVII

A= 112.65 Ac
C=.15 (WOODLANDS)

Overland Flow

$l = 2900$
$Y = 2.07\%$

$$L = \frac{l^{.8}(S+1)^{0.7}}{1900\ Y^{.5}}$$

$$S = \frac{1000}{CN} - 10 \qquad CN = (.75 \times 72) + (.25 \times 45) = 65$$

$$S = \frac{1000}{65} - 10$$

$S = 5.38$

$$L = \frac{(2900)^{.8}(5.38+1)^{.7}}{1900\ (2.07)^{.5}} = .79 \text{ hrs}$$

$T_c = 1.67 L = 1.67(.79)$

$T_c = 79$ minutes

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JOB 8769
SHEET NO. 60 OF 82
CALCULATED BY KMS DATE 12/10/87
CHECKED BY DATE
SCALE NTS

Design of SB for DA- XVII

$V = .4 \times A \times D$

$V = (67\ yd^3 \times 112.65\ Ac) = 8218\ yd^3 \times 27\ ft^3/yd^3 = 221,873\ ft^3$

Volume of Lake = Top Acreage x Height Dam x .4
$= (7.2\ Ac) \times (13.36\ ft) \times 0.4$
$= (7.2)(43,560)(13.36)(0.4)$
$= 1,676,050\ ft^3$

$1,676,050\ ft^3 > 221,873\ ft^3$ OK

Storage = 2.56 ft

Storage $= 2.56' \times 7.2\ Ac \times 43,560\ ft^2/Ac = 802,898\ ft^3$

Volume Storage Required

Tc: undeveloped = 79 min

- Predevelopment Rainfall Intensity:
- $tc = 79$ min

$$I = \frac{a}{b + Tc} = \frac{189.2}{22.1 + 79} = 1.87\ in/hr$$

- Allowable Peak Q after development:
$Q_o = CAI = (.15)(112.65)(1.87)$
$Q_o = 31.60\ cfs$

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- Critical Storm Duration:

$$T_c = \sqrt{\frac{2CA_a(b - t_c/4)}{q_o}} - b$$

t_c — Overland Flow
L = 16000
S = 2.75%
t_c = 21 min

$$T_c = \sqrt{\frac{2(.65)(112.65)(189.2)(22.1 - 21/4)}{3T.60}} - 22.1$$

T_c = 99 min

- Peak Inflow using Critical Storm Duration

$$Q_o = CAi$$

$$I = \frac{a}{b + T_c} = \frac{189.2}{22.1 + 99} = 1.56 \text{ in/hr}$$

$$Q_o = (.65)(112.65)(1.56)$$

$$Q_o = 114.2 \text{ cfs}$$

- Required Storage:

$$V = \left[Q_o T_c + \frac{Q_o t_c}{4} - \frac{q_o T_c}{2} - \frac{3 q_o t_c}{4} \right] 60$$

$$V = \left[(114.2)(99) + \frac{(114.2)(21)}{4} - \frac{(31.60)(99)}{2} - \frac{3(31.6)(21)}{4} \right] 60$$

$$V = [11,306 + 600 - 1,564 - 498)60$$

V = 590,640 CF < 802,898 CF ok

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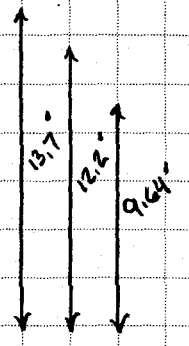

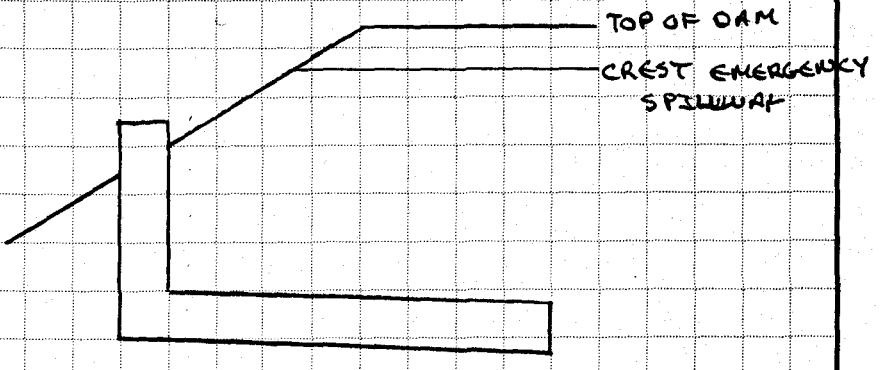

CK Culvert Capacity: (12" pipe)

$Q = CA\sqrt{2gh}$

$Q = (.65)(\pi(.5)^2)\sqrt{2(32.2)(12.7)}$

$Q = 14.6$ cfs

CK Riser Capcity: (18" pipe)

$Q = \frac{2}{3} b \sqrt{2gh^{2/3}}$

$Q = \frac{2}{3}(2\pi(.5))\sqrt{2(32.2)(2.56)^{2/3}}$

$Q = 23.0$ cfs

$Q_{culvert} < Q_{RISER}$

$Q_{culvert}$ Controls

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SCALE NTS

OA - XVIII

A = 126.07 Ac
c = .15

Overland Flow

$\ell = 2000'$
Y = 2.75%

$$L = \frac{\ell^{.8}(S+1)^{.7}}{1{,}900\ Y^{.5}}$$

$$S = \frac{1000}{CN} - 10 \qquad CN = 45$$

S = 12.2

$$L = \frac{(2000)^{.8}(12.2+1)^{.7}}{1{,}900\ (2.75)^{.5}} = .84\ hr$$

$T_c = 1.67\,(.84)$

$T_c = 84$ min

$i_2 = 1.3$"/hr

$Q = CAi = (.15)(126.07)(1.3)$

Q = 24.6 cfs

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SCALE NTS

Design of SB for DA-~~XVIII~~

$V = .4 \times A \times D$

$V = (67 yd^3)(126.07) = 8447\ yd^3 \times 27 ft^3/yd^3 = 228,069\ ft^3$

Volume of Lake = Top Acreage x Height Dam x .4
= (7.4 Ac)(43,560 ft^2/Ac)(14'X.4)
= 1,805,126 CF > 228,069 CF OK

Storage = 2.20'

Storage = 2.2' x 7.4 x 43,560 = 709,157 CF

Volume Storage Required

Tc: undeveloped = 84 min

- Predevelopment Rainfall Intensity:

$$I = \frac{a}{b+Tc} = \frac{189.2}{22.1+84} = 1.78\ "/hr$$

- Allowable Peak Q after development:

$q_o = CAi = (.15)(126.07)(1.78)$
$q_o = 33.7\ cfs$

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CHECKED BY _____ DATE _____
SCALE NTS

- Critical Storm Duration:

$$T_c = \sqrt{\frac{2CA_a(b - t_c/4)}{80}} - b$$

$$T_c = \sqrt{\frac{2(.65)(126.07)(189.2)(22.1 - 84/4)}{145.8}} - 22.1$$

$T_c = -6.8$ if $T_c < t_c$ then $T_c = t_c$

$T_c = 84$ min

- Peak Inflow using Critical Storm Duration

$Q_o = CIA$

$$I = \frac{a}{b + T_c} = \frac{189.2}{22.1 + 84} = 1.78 \text{ in/hr}$$

$Q_o = (.65)(126.07)(1.78) = 145.8$ cfs

- Required Storage:

$$V = \left[Q_o T_c + \frac{Q_o t_c}{4} - \frac{80 T_c}{2} - \frac{3 g_o t_c}{4}\right] 60$$

$$V = \left[(145.8)(84) + \frac{(145.8)(84)}{4} - \frac{33.7(84)}{2} - \frac{3(33.7)(84)}{4}\right] 60$$

$V = (12,247.2 + 3061.8 - 1415.4 - 2,123.1)60$

$V = 706,230$ CF $< 709,157$ CF OK

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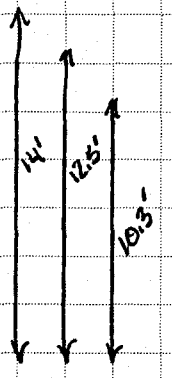

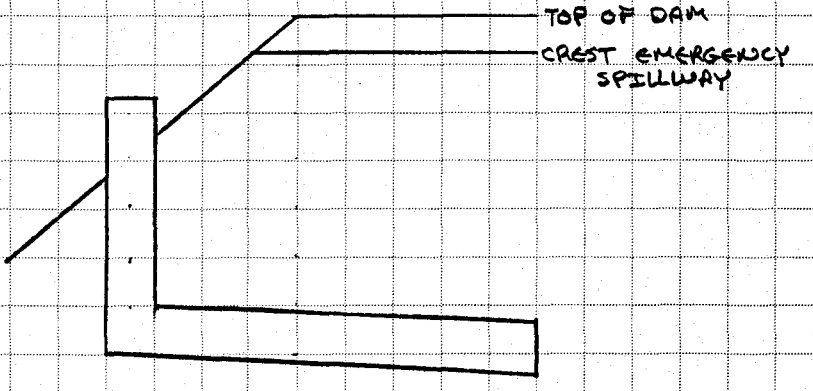

CK Culvert Capacity: (12" pipe)

$$Q = CA\sqrt{2gh}$$

$$Q = (.65)(\pi(.5)^2)\sqrt{2(32.2)(13.0)}$$

$$Q = 14.88 \text{ cfs}$$

CK Riser Capacity: (18" pipe)

$$Q = \tfrac{2}{3} b \sqrt{2g\, h^{3/2}}$$

$$Q = \tfrac{2}{3}(2\pi(1.5))\sqrt{2(32.2)(2.2)}$$

$$Q = 25.0 \text{ cfs}$$

$Q_{culvert} < Q_{riser}$

$Q_{culvert}$ controls

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JOB 87169
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CHECKED BY _____ DATE _____
SCALE NTS

DA- IX

A=11.69 ac
c=.65 (light industry, for future development)

Overland Flow

L= 700'
S= 1.5%
T_c = 29 min

Channel Flow

N/A

T_c = 29 min

i_{10} = 3.5 "/hr

Q=CAi = (.65)(11.69)(3.5)

Q_{10} = 17.50 cfs

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SCALE NTS

Culvert Design for DA-~~IX~~

$Q_{10} = 17.50$ cfs
HW = 2.10 (flooding to edge of pavement)

Corrugated Metal Pipe

Inlet Control:

D = 15" or 1.25'

$HW/D = 1.65$ $HW = (1.65)(1.25) = 2.06' < 2.10'$ OK

*Note for $HW/D = 1.65$, $Q = 7.5$ cfs so a lake will be built to keep Q at 7.5 cfs.

Determine Outlet Velocity:

Full Flow = 8.5 cfs
Full Flow Velocity = 7 fps

$\frac{Q_{10}}{Q_{Full}} = \frac{7.5}{8.5} = .88$

$\frac{V_{10}}{V_{Full}} = 1.13$

$V_{10} = (1.13)(7) = 7.91$ fps

Use 15" CMP

18" below shoulder
HW/D ≤ 1.5

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SHEET NO. _____ OF _____
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SCALE NTS

DA- XX

A=1.03 Ac
C=.65 (light industry, for future development)

Overland Flow

L= 100'
S= 2%
T_c= 13 min

Channel Flow

H= 3'
L= 300'
T_c= 4 min

T_c= 17 min

i_{10} = 4.8 in/hr

$Q = CAi = (.65)(1.03)(4.8)$

Q_{10} = 3.21 cfs

DA- XX incorporated into
DA- IXX

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SCALE NTS

Culvert Design for DA-XX

Q_{10} = 3.21 cfs
HW = 2.10 (flooding to edge of pavement)
Corrugated Metal Pipe

Inlet Control:

D = 15 in or 1.25 ft

HW/D = .85 HW = (.85)(1.25) = 1.07 ft < 2.0 ft OK

Determine Outlet Velocity:

Full Flow = 7.0 cfs
Full Flow Velocity = 5.75 fps

$\frac{Q_{10}}{Q_{Full}} = \frac{.75}{7.0} = .11$

$\frac{V_{10}}{V_{Full}} = .67$

$V_{10} = (5.75)(.67)$

$V_{10} = 3.85$ fps

Use 15" CMP

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SHEET NO. 69 OF 82
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CHECKED BY _____ DATE _____
SCALE NTS

DA - ~~XXI~~

A = 2.05 Ac

c = .15

Overland Flow

L = 500'

S = 4.8%

T_c = 19 min.

Channel Flow

H = 5'

L = 200'

T_c = 2 min

T_c = 21 min

i_2 = 3.4 "/hr

$Q = CAi = (.15)(2.05)(3.4)$

Q_{10} = 1.05 cfs

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JOB 87169
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CHECKED BY _____ DATE _____
SCALE NTS

Design of ST for OA XXI

$V = 0.4 \times A \times D$

$V = (67\ yd^3)(2.05\ Ac) = 138\ yd^3 \times 27\ ft^3/yd^3 = 3726\ ft^3$

Try D = 4'

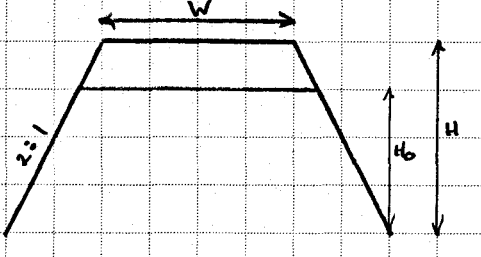
$3726\ ft^3 = (.4)(3{,}600)(4)$

$3{,}726\ ft^3 < 5{,}760\ ft^3$

Try D = 3.5

$3{,}726\ ft^3 = (.4)(3150)(3.5)$

$3{,}726\ ft^3 < 4{,}410\ ft^3$ OK



$H_o = 3.5'$
$H = 4.5'$
$W = 4.0$
$L = 21'$

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JOB 87169
SHEET NO. 71 OF 82
CALCULATED BY RCS DATE 17 Dec 87
CHECKED BY _____ DATE _____
SCALE _____

BEAVER LAKE DAM
DESIGN

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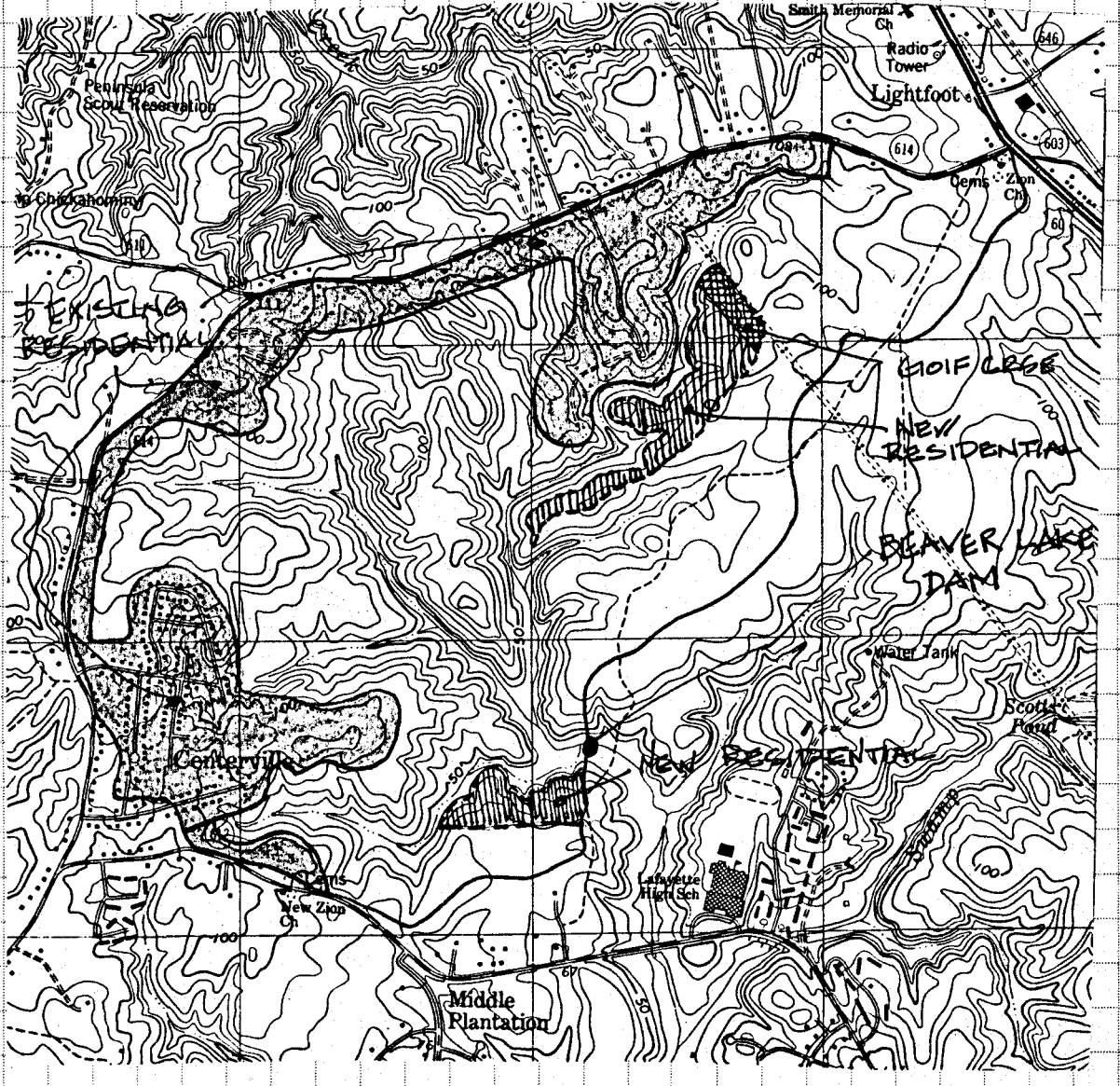
JOB WARHILL TRACT E&S PLAN
SHEET NO. 72 OF 82
CALCULATED BY RCS DATE 17 DEC 87
CHECKED BY _____ DATE _____
SCALE 1" = 2000'

I. DETERMINE PRE & POST DEVELOPMENT FLOW

1. DATA: DRAINAGE AREA = 1302 AC
HYDRAULIC LENGTH = 12,900 FT
AVERAGE SLOPE = 2%

2. CALCULATE CURVE NUMBER: "SOIL GROUP B"



	PREDEVELOPMENT				POST DEVELOPMENT			
	%	×	CN	= CN	%	×	CN	= CN
RESIDENTIAL:	26	×	70	= 1820	31	×	70	= 2170
WOODLAND:	74	×	55	= 4070	68.8	×	55	= 3784
GOLF CREE:	0			= 0	0.2	×	65	= 13.0
	100			5890	100			5968

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JOB YARHILL TRACT E&S PLAN
SHEET NO. 73 OF 82
CALCULATED BY RCS DATE 17 DEC 87
CHECKED BY _____ DATE _____
SCALE NTS

2 (cont).

$$CN_{PRE} = \frac{5890}{100} = 59$$

$$CN_{POST} = \frac{5968}{100} = 60$$

FROM DRAINAGE STUDY

TR-55 APPENDIX "D" PEAK DISCHARGE COMPUTATION SHEET

10 YEAR STORM

Project BEAVER LAKE DAM Watershed Condition PRE DEVELOPMENT

By RCS Date 12/16/87

Checked by _____ Date _____

INPUT

1. 1302 ac — Drainage Area (DA)
2. 12,900 ft — Hydraulic Length
3. 2.0 % — Watershed Slope
4. F (F M or S) — Slope Class
5. 59 — Runoff Curve No.
6. 5.75 in (24-hour) (10 -yr. freq.) — Rainfall
7. 2.7 % — Ponds, Swamps
8. 10 % — Impervious
9. 0 % — Hyd. Length Mod.

Figure E-1 → 10. 964 ac — Equivalent DA

11. 1302 ac / 964 ac — Actual DA / Equiv. DA

12. PEAK FACTOR: 1.35 — Shape Adj.

Table E-1 → 13. X 1.31 — Slope Adj.

Figure D-2 → 14. X 100 cfs/in — Basic Peak Disch.

Table 2-1 or Figure 10 → 15. X 1.68 in — Runoff Volume

Table E-2, E-3 or E-4 (Location determines table) → 16. X .72 — Ponds, Swamps Adj.

Figure 4-1 → 17. X 1.05 — Impervious Area Adj.

Figure 4-2 → 18. X 1.0 — Hyd. Length Adj.

19. = ADJUSTED PEAK DISCHARGE 225 cfs

TR-55 APPENDIX "D" PEAK DISCHARGE COMPUTATION SHEET

10 YEAR STORM

Project BEAVER LAKE DAM Watershed Condition POST DEVELOPMENT

By RCS Date 12/16/87

Checked by _____ Date _____

INPUT

1302 ac — Drainage Area (DA)

12,900 ft — Hydraulic Length

Figure E-1

10. 964 ac — Equivalent DA

11. 1302 ac / 964 ac — Actual DA / Equiv. DA

12. PEAK FACTOR: 1.35 — Shape Adj.

2.0 % — Watershed Slope

Table E-1

13. X 1.31 — Slope Adj.

F — F M or S — Slope Class

Figure D-2

14. X 100 cfs/in — Basic Peak Disch.

60 — Runoff Curve No.

5.15 in — Rainfall (24-hour) (10 -yr. freq.)

Table 2-1 or Figure 10

15. X 1.75 in — Runoff Volume

Table E-2, E-3 or E-4 (Location determines table)

16. X 0.72 — Ponds, Swamps Adj.

7. 2.7 % — Ponds, Swamps

Figure 4-1

17. X 1.06 — Impervious Area Adj.

12 % — Impervious

Figure 4-2

18. X 1.06 — Hyd. Length Adj.

9 % — Hyd. Length Mod.

ADJUSTED PEAK DISCHARGE

19. = 250 cfs

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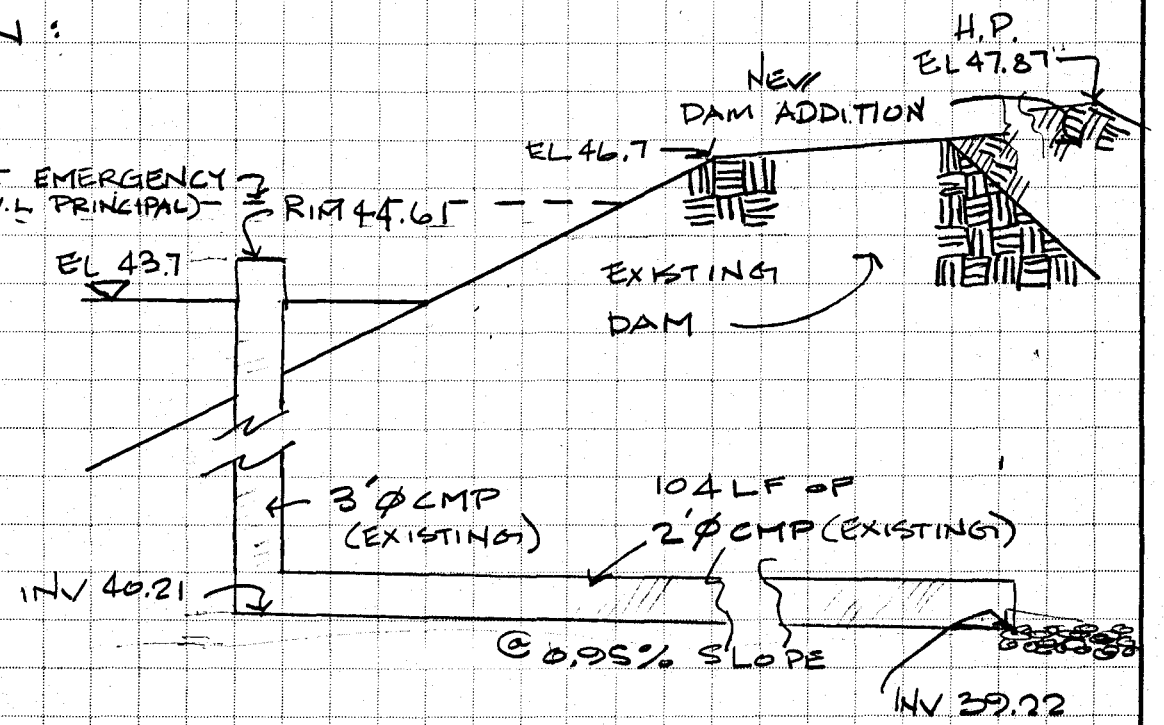
JOB 87169
SHEET NO. 76 OF 82
CALCULATED BY RCS DATE 12/17/87
CHECKED BY DATE
SCALE NTS

II. DETERMINE Q OUT OF EXISTING PIPES.

1. GIVEN:



2. Ck RISER CAPICITY

$$Q = \frac{2}{3} b \sqrt{2g} (h)^{3/2}$$

$$= \frac{2}{3} (2\pi(4.5)) \sqrt{2g} (1)^{3/2}$$

$$= 50 \text{ CFS}$$

3. Ck CULVERT CAPACITY
ASSUME TYPE 5 FLOW:

$$Q = C A_o \sqrt{2g (h_1 - Z)}$$

$$= (0.62)(\pi(1)^2) \sqrt{2g (6.39 - 2.9)}$$

$$= 36 \text{ CFS}$$

$Q_{CULVERT} < Q_{RISER}$

CONTROLS $Q = 36$ CFS

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III DETERMINE STORAGE REQUIREMENT FOR 10 YEAR STORM:

Q_i (POST DEVELOPMENT) = 250 − 36 = 214 CFS

Q_o (PRE DEVELOPMENT ≈ ALLOWABLE) = 225 CFS

∴ SINCE $Q_o > Q_i$ NO STORAGE REQUIRED FOR 10 YEAR STORM.

IV DETERMINE STORAGE REQUIREMENT FOR 100 YEAR STORM (TO DETERMINE SPILLWAY NEEDS @ THIS STORM):

1. FLOW THRU PRINCIPAL SPILLWAY WILL CHANGE DUE TO H.W.L. (1' BELOW EMBANKMENT CREST) @ 46.87:

CK $Q_{CULVERT}$ W/ $h_1 = 7.65$

$$Q = CA_o\sqrt{2g(h_1 - z)}$$

$$= (0.62)(\pi(1)^2)\sqrt{2g(7.65 - .99)}$$

$$= 40 \text{ CFS}$$

2. TIME OF CONCENTRATION

$L = 12,900'$

$$S = \frac{1000}{CN} - 10$$

$$= \frac{1000}{60} - 10$$

$$= 6.67$$

$$L = \frac{(12900)^{0.8}(6.67+1)^{0.7}}{1900(2)^{0.5}}$$

$$= 3$$

$$T_c = 1.67L = 1.67(3) = 5.03 \text{ MIN}$$

TR-55 APPENDIX "D" PEAK DISCHARGE COMPUTATION SHEET

100 YR STORM

Project BEAVER LAKE DAM Watershed Condition POST DEVELOPMENT

By RCS Date 12/16/87

Checked by _____ Date _____

INPUT

1302 ac — Drainage Area (DA)

12900 ft — Hydraulic Length — Figure E-1 → 10. 964 ac Equivalent DA

11. 1302 ac / 964 ac Actual DA / Equiv. DA

12. PEAK FACTOR: 1.35 Shape Adj.

2.0 % — Watershed Slope — Table E-1 → 13. X 1.31 Slope Adj.

4. F — F M or S Slope Class — Figure D-2 → 14. X 100 cfs/in Basic Peak Disch.

60 — Runoff Curve No. — Table 2-1 or Figure 10 → 15. X 3.45 in Runoff Volume

8 in — Rainfall (24-hour) (100 -yr. freq.) → 16. X 0.82 Ponds, Swamps Adj.

7. 2.7 % — Ponds, Swamps — Table E-2, E-3 or E-4 (Location determines table)

10 % — Impervious — Figure 4-1 → 17. X 1.06 Impervious Area Adj.

9. 9 % — Hyd. Length Mod. — Figure 4-2 → 18. X 1.06 Hyd. Length Adj.

ADJUSTED PEAK DISCHARGE 19. = 562 cfs

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JOB 87169
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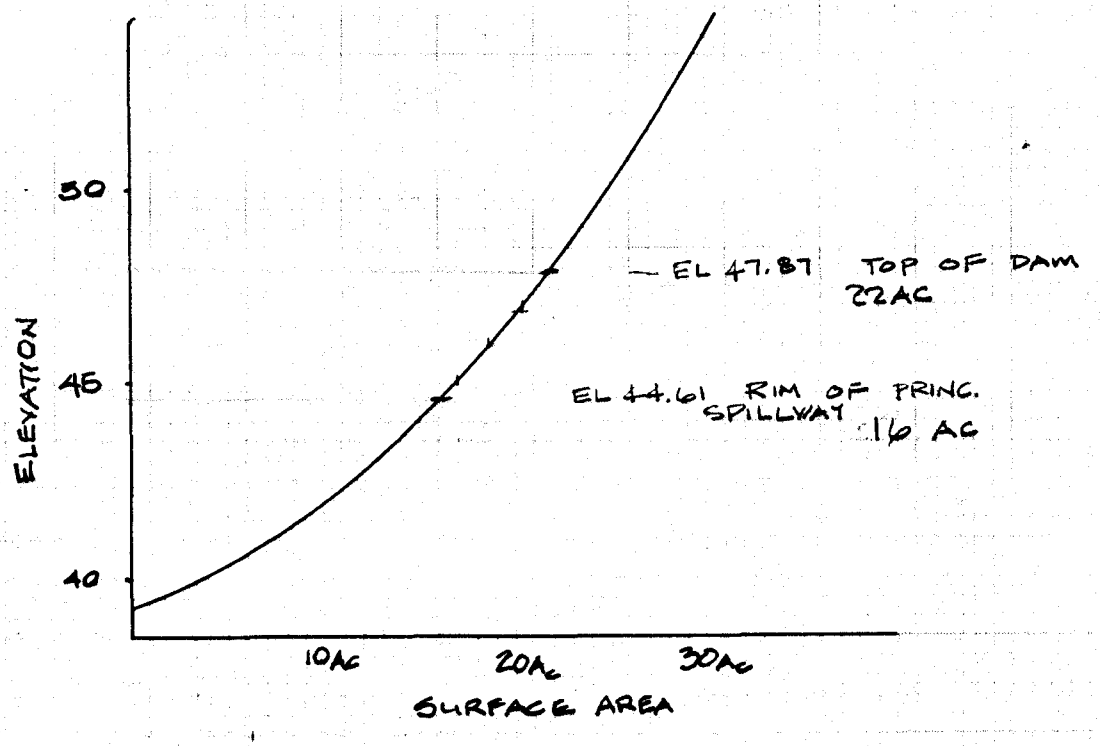
SCALE NTS

3. DETERMINE THE AVAILABLE STORAGE EXISTING BETWEEN THE RIM OF THE PRINCIPAL SPILLWAY @ 44.61 AND ONE FOOT BELOW THE CREST OF TH DAM. USING THE GRAPH BELOW OF BEAVER LAKE.



(.87)(21.4) = 18.62 AC @ 46.87

(1)(18.7) = 18.70 AC

(.39)(17) = 6.63 AC @ 44.61

43.95 AC-FT OR 1914462 FT³

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CHECKED BY _____ DATE _____
SCALE NTS

4. FIND FLOW OUT TO PREVENT H.W.L. FROM EXCEEDING EL 46.87.

$$S = 1.25\ T_p\ (Q_i - Q_o)$$

$$\therefore\quad Q_o = Q_i - \frac{S}{1.25\ T_p}$$

$$Q_i = 562 - 40 = 522$$

$$Q_o = 522 - \frac{1,914,462}{1.25\,(5.03)\,(3600\ \text{SEC/HR})}$$

$$= 437\ \text{CFS}$$

DESIGN EMERGENCY SPILLWAY FOR Q = 437 CFS

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SCALE NTS

V EMERGENCY SPILLWAY:

1. WEIR DESIGN

$$Q = C_s\, b\, (H)^{3/2}$$

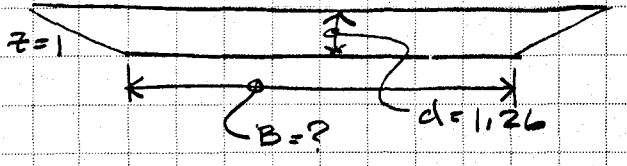
$$\therefore \quad b = \frac{Q}{C_s (H)^{3/2}}$$

$$= \frac{437}{4(1.26)^{3/2}}$$

$$\approx 77'$$

2. OPEN CHANNEL DESIGN (TRAPEZOIDAL)

$S = 3\%$



$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

$$\therefore AR^{2/3} = \frac{Qn}{1.49 S^{1/2}}$$

$$= \frac{437(0.053)}{1.49(0.0266)^{1/2}}$$

$$= 101.8$$

TRY: TRY $B = 40'$ $AR^{2/3} = 673$

TRY $B = 10'$ $AR^{2/3} = 92.9$

CLOSE ENOUGH $\underline{B = 10'}$

Larger controlled by velocity
see next page

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CHECKED BY DATE
SCALE NTS

3. CK VELOCITY:

$$V = \frac{Q}{A} = \frac{437}{14.84} = 29.4 \text{ FPS}$$

TOO FAST

REVERSE PROCEDURE ($V_{permissible} = 6$ FPS)

$$A = \frac{Q}{V} = \frac{437}{6} = 73 \text{ FT}^2$$

$B = 56'$

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JOB 87169
SHEET NO. Appendix A OF
CALCULATED BY RMS DATE 10/30/87
CHECKED BY DATE
SCALE NTS

DRAINAGE AREA DATA

DA		Area (AC)	i_2 (in/hr)	C	Q_2 (cfs)
I	1	3.92	3.4	.15	2.00
II	2	1.55	3.4	.15	0.80
III	3	10.22	2.8	.15	4.30
IV	4	1.24	2.7	.15	0.50
V	5	30.50	2.4	.15	11.00
VI	6	7.20	2.9	.15	3.20
VII	7	1.13	3.5	.15	0.60
VIII	8	1.97	2.7	.15	0.80
IX	9	4.20	2.9	.15	1.83
X	10	11.40	2.6	.15	4.45
XI	11	5.33	3.2	.15	2.60
XII	12	2.57	3.3	.15	1.27
XIII	13	3.28	2.9	.15	1.43
XIV	14	6.70	2.6	.15	2.61
XV	15	2.00	3.3	.15	1.00
XVI	16	21.05	2.8	.15	8.85
XVII	17	112.65	1.4	.15	31.60
XVIII	18	126.07	1.3	.15	33.70
XIX		10.84	3.4	.15	5.60
~~XX~~		~~1.03~~	~~4.8~~	~~.15~~	~~0.75~~ DELETED
XXI		2.05	3.4	.15	1.05

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SHEET NO. Appendix B OF
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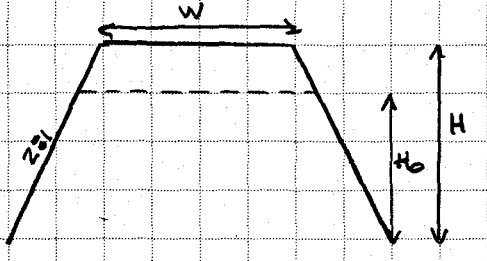
Sediment Trap Data

DA		H_o (ft)	H (ft)	W (ft)	L (ft)	V (yd^3)
I	1	4.0	5.0	4.5	23.5	263
II	2	2.5	3.5	3.0	9.3	104
IV	4	3.5	4.5	4.0	7.5	83
VII	7	2.5	3.5	3.0	6.8	76
VIII	8	2.5	3.5	3.0	12.0	132
IX	9	2.5	3.5	3.0	25.2	282
XII	12	4.0	5.0	4.5	15.5	173
XIII	13	4.0	5.0	4.5	19.7	220
XV	15	2.0	3.0	2.5	13.0	134



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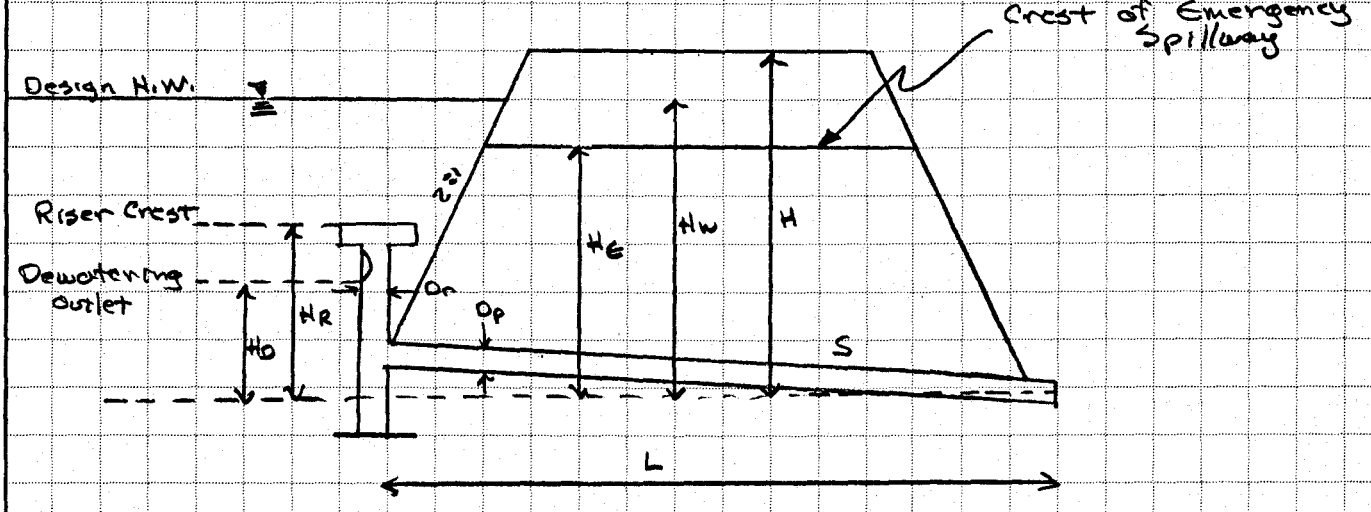
SEDIMENT BASIN DATA

DA	H (Ft)	H_W (Ft)	H_E (Ft)	H_R (Ft)	H_D (Ft)	L (Ft)	S (%)
III 3	7	6	5	4	3	38	2.6
V 5	8.5	7.5	6.5	5.5	4.5	44	2.3
VI 6	7	6	5	4	3	38	2.6
X 10	8.5	7.5	6.5	5.5	4.5	40	2.5
XI 11	6.5	5.5	4.5	3.5	2.5	32	3.1
XIV 14	6.5	5.5	4.5	3.5	2.5	32	3.1



DA	D_r (in)	D_p (in)	V (yd³)
III 3	10	15	685
V 5	18	15	2,044
VI 6	10	8	483
X 10	10	10	764
XI 11	10	8	358
XIV 14	10	8	449

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JOB WAKEHILL
SHEET NO. 1 OF
CALCULATED BY MW DATE 1/28/86
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SCALE

Q PRESENT:

A = 898 Ac

TOTAL AC. = 898

OPEN FIELDS = 300 AC = 33.4 %

WOODED = 598 AC = 66.6 %

Q_{100} = 787 cfs

DA = 898

(1) C = .30 OPEN C = .4 agric.
C = .15 WOODLANDS C = .2

300 x .30 = 90
598 x .15 = 89.7
179.7

$\frac{179.7}{898} = .20 = C$

(2) T_c = 65 MIN C = .265

(3) $i_{100} = 3.5 \approx 3.4$

$Q = .2(3.5)(898) = 628.60$ cfs

Elev. 43.4'
100yr Q = 787
Depth = 10.5'
$V = \frac{Q}{A} = \frac{787}{5200} = .15$ fps
A = cross sect'n = 5200 sq ft

A = Future w/ FILL = 4900 sq ft

$V = \frac{Q}{A} = \frac{628.6}{5200}$

$V = 0.12$ ft/sec

$V = \frac{Q}{A} = \frac{787}{4900} = .16$ fps

$Z_B + D_B + \alpha \frac{V_B^2}{2g} = Z_A + D_A + \frac{V^2}{2g}$ (1.0)

$10.5 + \frac{.15^2}{2 \times 32.2} = D_A + \frac{.16^2}{2 \times 32.2}$

$10.50035 = D_A + .0004$

W/ FILL

$V = \frac{Q}{A} = \frac{725.94}{4900} = 0.15$ ft/sec

MAINTAIN V constant, E, Q const

A = constant Depth = 10.5'

Width = 650'

300 SF = x (650' + 20x)

$A = \frac{650 + (650 + 20x)}{2} \times$

$= (650 + 10x)x$

d = .45'

1' depth = 20' wide

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JOB WARHILL
SHEET NO. 2 OF
CALCULATED BY MW DATE 1/28/86
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SCALE

I. Q FUTURE = SECTION I = 100 YR STORM 40 Ac ±

"A" Q_{100} = 0.237 (9)(4.12) = 8.78 cfs

"B" Q_{100} = 0.167 (9) (11.1) = 16.68 "

"C" Q_{100} = 0.214 (9) (3.35) = 6.45 "

"D" Q_{100} = 0.191 (9) (3.56) = 6.12 "

"E" Q_{100} = 0.201 (9) (10.8) = 19.53 "

"F" Q_{100} = 0.158 (9) (5.43) = 7.72 "

SUBTOTAL = 65.28 cfs

II. Q FUTURE - REMAINING SECTIONS - 858 AC ±

DRAINAGE AREA = 858 Ac

ROADS = ~ 98 Ac × .80 = 78.4
WOODLANDS = ~ 760 Ac × .15 = 114.0
192.4

$C = \frac{192.4}{858} = 0.22$

TIME OF CONCENTRATION = 65 MIN
i = 100 YR STORM = 3.5

Q = C i A = 0.22 (3.5) (858) = 660.6 cfs

TOTAL 725.94 cfs

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JOB WARHILL
SHEET NO. 3 OF
CALCULATED BY MW DATE 1/29
CHECKED BY DATE
SCALE

I Q_{FUTURE} = 725.94
$Q_{PRESENT}$ = 628.60
97.34 cfs

Q FROM "FLOOD HAZARD ANALYSES" BOOK
CROSS SECTION 46A - LONG HILL SWAMP
PAGE A-6 = 787 cfs (100 YR FLOOD)

∴ NET CHANGE TO LONG HILL SWAMP WITH WARHILL FULLY DEVELOPED = 37.28 cfs =
Q = 787 + 97.34 = 884.34 cfs

II $Q = VA$ or $A = \frac{Q}{V}$

$A = \frac{884.34}{.15} = 5,895$ sq.ft. = CROSS SECTION AREA (ADDITIONAL)

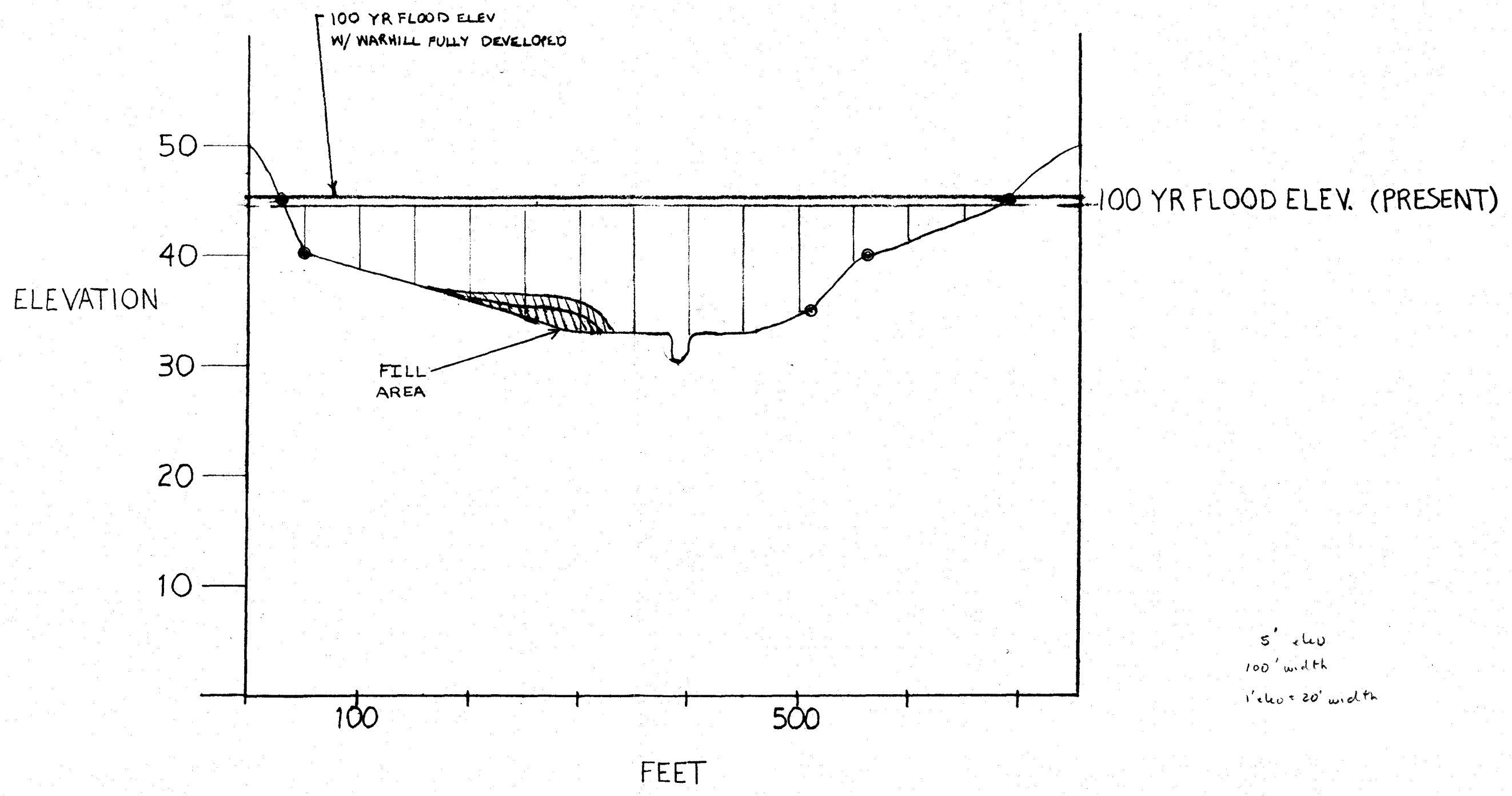
∴ THE ADDITIONAL AREA = 5895 − 4900 = 995 sq.ft.

⇒ 100 YR FLOOD ELEV RAISED TOTAL OF − 1.0 ft.,
WITH WARHILL FULLY DEVELOPED

$Q_{2\ pres}$ = .265 × 898 × 1.6 = 381 cfs

$Q_{2\ DEV}$ = C = .4 × 40 + 858 × .265 = 0.27
= .27 × 898 × 1.6 = 388 cfs

$Q_{2\ DEV}$ = 610 cfs



5' elev
100' width
1' elev = 20' width