GUIDANCE CALCULATION PROCEDURE

WORKSHEET A : NEW DEVELOPMENT

OPTION TWO: VA. CHESAPEAKE BAY DEFAULT

1 **Compile site-specific data and determine site imperviousness (I_{site}).**

POST-DEVELOPMENT

A^* = 11.54 acres

I_i** structures = 1.60 acres

parking lot = [illegible] acres

roadway = 1.45 acres (INCL. DRIVEWAYS)

other = [illegible] acres

= _____ acres

= _____ acres

= _____ acres

total I_A = 3.05 acres

I_{site} = (total I_i/A) × 100 = 26 (percent expressed in whole numbers)

* Although the area subject to regulations may be only the area actually in a CBPA, some localities may require all of the site to comply with criteria.

** I_i represents the actual amount of impervious area.

2 **Determine the average land cover conditions ($I_{watershed}$).**

Use $I_{watershed} = I_{site}$=16 because $F_{average}$ = 0.45 lbs/ac/yr for Virginia's Chesapeake Bay Watershed. Use C_{pre} = 0.26 mg/l.

3 **Determine need to continue.**

I_{site} = 26 % (from Step 1)

$I_{watershed}$ = 16 % (from Step 2)

If $I_{site} \le I_{watershed}$, STOP and submit analysis to this point.
If $I_{site} > I_{watershed}$, CONTINUE.

4 **Set constants.**

P_j = unitless rainfall correction factor
= 0.9 for all of Tidewater Virginia

C = flow weighted mean concentration of total phosphorus
= 0.26 mg/l for all I_{site}

P = annual rainfall depth in inches
= 40 inches for Northern Virginia area
= 43 inches for Richmond Metropolian area
= 45 inches for Hampton Roads area

12 and 2.72 are used in the equation as unit conversion factors.

GUIDANCE CALCULATION PROCEDURE

WORKSHEET A : NEW DEVELOPMENT

OPTION TWO: VA. CHESAPEAKE BAY DEFAULT

5 **Calculate the pre-development load (L_{pre}).**

L_{pre} = P × P_j × [0.05 + (0.009 × $I_{watershed}$)] × C_{pre} × A × 2.72 / 12

= 43 × 0.9 × [0.05 + (0.009 × 16)] × 0.26 × 11.54 × 2.72 / 12

= 5.11 pounds per year

6 **Calculate the post-development load (L_{post}).**

L_{post} = P × P_j × [0.05 + (0.009 × I_{site})] × C × A × 2.72 /12

= 43 × 0.9 × [0.05 + (0.009 × 26)] × 0.26 × 11.54 × 2.72 /12

= 7.47 pounds per year

7 **Calculate the pollutant removal requirement (RR).**

RR = L_{post} - L_{pre}

= 7.47 - 5.11

= 2.36 pounds per year

To determine the overall BMP efficiency required (%RR) when selecting BMP options:

%RR = RR / L_{post} × 100

= (2.36 / 7.47) × 100

= 32 %

Fire Flow Estimation

(I.S.O. METHOD)

TYPE of CONSTRUCTION : CLASS 1 –FRAME

CLASS OF CONSTRUCTION COEF.= F : 1.5

GROUND FLOOR AREA = 1846 No. of STORIES : 2

TOTAL FLOOR AREA = A_f (effective area) : 2769 S.F.

FIRE AREA CONSIDERED

CONSTRUCTION FACTOR – C_i = 18(F)(A_i)$^{0.5}$ (ROUNDED TO NEAREST 250 gpm): 1500

NFF = $(C_i)(O_i)(X+P)_i$

TYPE OF OCCUPANCY : RESIDENTIAL

(WORST CASE) OCCUPANCY FACTOR = O_i : 0.85

EXPOSURE (X) and COMMUNICATION (P):

X_1+ P_1 = 0.13 X_4+ P_4 = ___

X_2+ P_2 = 0.18 X_5+ P_5 = ___

X_3+ P_3 = ___ X_6+ P_6 = ___

$(X+P)_i$ = 1.0 + $\sum_{(i=1)}^{n} (X_i + P_i)$ = 1.31

[MAX. $(X + P)_i$ = 1.75]
(n = NUMBER OF SIDES OF SUBJECT BUILDING)

NEEDED FIRE FLOW

NFF = $(C_i)(O_i)(X + P)_i$ = 1670

AUTOMATIC SPRINKLERS – NO ——— REDUCTION FACTOR 0 % x NNF = 0

TOTAL = 1670

REQUIRED FIRE FLOW (ROUNDED) = 1750 gpm

FIRE HYDRANTS REQUIRED ⟶ 2

I CERTIFY THAT THE ABOVE INFORMATION IS TRUE and CORRECT, Kenneth L. Barnes

BAY DESIGN GROUP, P.C.

WORKSHEET 3.06 – COMPLIANCE

DETERMINE THE POLLUTANT REMOVAL REQUIREMENT (RR) AS CALCULATED ON THE APPROPRIATE DEVELOPMENT SITUATION WORKSHEET (WORKSHEET 3.2, WORKSHEET 3.3, WORKSHEET 3.4, OR WORKSHEET 3.5).

RR = POLLUTANT REMOVAL REQUIREMENT
= 2.36 LBS/YR

CALCULATE THE POLLUTANT LOADING TO THE BMP ($L_{ON-SITE}$) FROM ON–SITE AREAS.

$A_{ON-SITE}$ = THE CONTRIBUTING ON–SITE DRAINAGE AREA TO THE BMP
= 3.21 ACRES

A_{IMP} = THE AMOUNT OF ON–SITE IMPERVIOUS COVER IN THE CONTRIBUTING DRAINAGE AREA
= 1.61 ACRES

$I_{ON-SITE}$ = THE PERCENTAGE OF ON–SITE IMPERVIOUS COVER FOR THE CONTRIBUTING DRAINAGE AREA TO THE BMP.
= (A_{IMP} / $A_{ON-SITE}$) X 100
= (1.61 / 3.21) X 100
= 50 %

$L_{ON-SITE}$ = THE PHOSPHORUS LOAD TO THE BMP.
$L_{ON-SITE}$ = [0.05 + (0.009 X $I_{ON-SITE}$)] X 2.28 X $A_{ON-SITE}$
= [0.05 + (0.009 X 50)] X 2.28 X 3.21
= 3.66 POUNDS PER YEAR

CALCULATE THE POLLUTANT LOADING TO THE BMP ($L_{OFF-SITE}$) FROM OFF–SITE AREAS.

$A_{OFF-SITE}$ = THE CONTRIBUTING OFF–SITE DRAINAGE AREA TO THE BMP
= ___ ACRES

$I_{OFF-SITE}$ = 16% (16% SHALL BE USED FOR ALL OFF–SITE DRAINAGE AREAS)

$L_{OFF-SITE}$ = THE OFF–SITE PHOSPHORUS LOAD TO THE BMP.
= [0.05 + (0.009 X $I_{OFF-SITE}$)] X 2.28 X $A_{OFF-SITE}$
= [0.05 + (0.009 X 16)] X 2.28 X ___
= ___ POUNDS PER YEAR

CALCULATE THE TOTAL POLLUTANT LOADING TO THE BMP (L_{TOTAL}).

L_{TOTAL} = $L_{ON-SITE}$ + $L_{OFF-SITE}$
= ___ + ___
= 3.66 POUNDS PER YEAR

CALCULATE THE TOTAL POLLUTANT LOAD REMOVED BY THE PROPOSED BMP(S) ($L_{REMOVED\ BY\ BMP}$). ACCEPTABLE BMP TYPES AND ASSOCIATED REMOVAL EFFICIENCIES ARE LISTED IN SECTION 3.6.1 OF THIS MANUAL.

SELECTED BMP TYPE	REMOVAL EFFICIENCY	X	L_{TOTAL}	=	$L_{REMOVED\ BY\ BMP(S)}$ (LBS/YR)
EXIST WET POND	65%	X	3.66	=	2.38
	TOTAL $L_{REMOVED\ BY\ BMP(S)}$			=	

FOR BMPs IN SERIES, THE L_{TOTAL} TREATED BY THE SECOND BASIN IS THE L_{TOTAL} FROM THE FIRST BASIN MINUS THE LOAD REMOVED BY THE FIRST BMP. WHEN THE OVERALL REMOVAL EFFICIENCY FOR BMPS IN SERIES EXCEEDS 65%, THE BMPs WILL BE TREATED AS ONE BMP WITH A REMOVAL EFFICENCY OF 65% ON THE COMPLIANCE WORKSHEET.

CALCULATE THE POLLUTANT LOAD REMOVED BY THE STREAM PROTECTION AREA ($L_{REMOVED\ BY\ SPA}$) PROVIDED. IN ORDER TO RECEIVE POLLUTANT REMOVAL CREDIT FOR THE STREAM PROTECTION AREA (SPA), THE SPA MUST BE FORESTED IN ACCORDANCE WITH MINIMUM STANDARD 9.10 AND ENERGY DISSIPATORS (EDs) PROVIDED IN ACCORDANCE WITH MINIMUM STANDARD 9.01.

STREAM PROTECTION AREA	Linear Feet Provided		Pollutant Removal (lb/yr/320)	=	$L_{REMOVED\ BY\ SPA}$ (lbs/yr)
		X	0.00029	=	

CALCULATE THE POLLUTANT LOAD REMOVED BY ENERGY DISSIPATORS ($L_{REMOVED\ BY\ ED}$) PROVIDED. IN ORDER TO RECEIVE POLLUTANT REMOVAL CREDIT FOR THE ENERGY DISSIPATORS(EDs), THE SPA MUST BE FORESTED IN ACCORDANCE WITH MINIMUM STANDARD 9.10 AND ENERGY DISSIPATORS (EDs) PROVIDED IN ACCORDANCE WITH MINIMUM STANDARD 9.01.

ENERGY DISSIPATORS	Number of Energy Dissipators		Pollutant Removal (lb/yr/ED)	=	$L_{REMOVED\ BY\ ED}$ (lbs/yr)
		X	0.10	=	

CALCULATE THE TOTAL POLLUTANT REMOVAL BY THE BMPs, SPA, AND EDs ($L_{REMOVED}$).

($L_{REMOVED}$) = $L_{REMOVED\ BY\ BMP(S)}$ + $L_{REMOVED\ BY\ SPA}$ + $L_{REMOVED\ BY\ ED}$
= ___ + ___ + ___
= ___ lbs/yr

IF THE TOTAL POLLUTANT LOAD REMOVED ($L_{REMOVED}$) IS GREATER THAN OR EQUAL TO THE POLLUTANT REMOVAL REQUIREMENT (RR). THE PROPOSED PROJECT COMPLIES WITH THE POLLUTANT LOAD REDUCTION CRITERIA.

$L_{REMOVED}$ ≥ RR
2.38 ≥ 2.36

Storm Sewer Design Comps

FROM POINT	TO POINT	AREA "A" Ac.	RUN-OFF COEF. C	CA INCR.	CA ACC.	INLET TIME MIN.	RAIN FALL IN/HR	RUN-OFF Q C.F.S.	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LEN. FT.	SLOPE Ft/Ft	DIA. IN.	CAPA-CITY C.F.S.	VEL. F.P.S.	FLOW TIME SEC.	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	2	0.25	0.5	0.13	0.13	5	7.2	0.94	12.67	12.20	95	0.0049	15	4.6	3.5		
2	3	0.20	0.7	0.14	0.27		7.1	1.92	12.10	11.87	46	0.005	15	4.6	3.5		
3	4	0.20	0.7	0.14	0.41		7.1	2.91	11.77	10.92	146	0.0058	15	5.0	3.6		
5A	5	0.74	0.4	0.30	0.30	5	7.2	2.16	12.67	12.02	130	0.005	15	4.6	3.5		
5	6	0.32	0.5	0.16	0.46		7.1	3.26	11.92	11.45	103.19	0.0046	15	4.6	3.5		
6	4	0.51	0.5	0.26	0.72		7.0	5.04	11.35	10.92	54.52	0.0079	15	5.7	4.5		
7	8	0.22	0.7	0.15	0.15	5	7.2	1.08	13.11	12.97	32	0.0044	15	4.6	3.5		
8	4	0.33	0.6	0.20	0.35		7.1	2.49	12.87	10.92	144.54	0.0135	15	7.5	6.0		
4	4A	0.50	0.7	0.35	1.83		6.9	12.63	10.67	8.27	146	0.0164	18	13.5	7.0		
9	13	0.2	0.6	0.12	0.12	5	7.2	0.86	14.55	12.07	125	0.0198	15	9.0	7.5		
10	11	0.30	0.6	0.18	0.18	5	7.2	1.3	14.08	13.67	48.59	0.0084	15	6	4.5		
11	12	0.10	0.50	0.05	0.23		7.1	1.63	13.57	12.41	42.75	0.0271	15	10.5	9		
12	13	0.60	0.5	0.30	0.53		7.0	3.71	12.31	12.07	50.52	0.0048	15	4.4	3.5		
13	15	0.52	0.5	0.26	0.91		6.9	6.27	11.97	10.94	84	0.0134	15	7.0	5.5		
14	15	0.52	0.5	0.26	0.26	5	7.2	1.87	12.67	10.94	106	0.0163	15	8.2	6.5		
15	16	0.46	0.5	0.23	1.40		6.8	9.52	10.44	9.66	153.63	0.0051	21	11.0	4.5		
16	17	0.42	0.5	0.21	1.61		6.7	10.78	9.56	8.84	120	0.006	21	12.0	5.0		
17	17A	0.10	0.5	0.05	1.66		6.7	11.12	8.74	7.76	140	0.007	21	12.0	5.0		
18	18A	0.20	0.5	0.10	0.10	5	7.2	0.72	12.67	11.37	130.62	0.01	15	6.5	4.5		

Storm Water Inlet Comps

INLET NUMBER	INLET TYPE	INLET LENGTH	STATION	DRAINAGE AREA (Ac.)	C	CA	ΣCA (W)	I IN./HR.	Q INCR. (CFS)	Q CARRY-OVER (CFS)	Q_T GUTTER	S GUTTER SLOPE (Ft/Ft)	S_X CROSS SLOPE (Ft/Ft)	T (SPREAD)	W (Ft)	W/T	Sw (Ft/Ft)	Sw/Sx	Eo (#10)	a	Sw = a/ (1+W)	Se(Ft/Ft) Sx + SwEo	LENGTH EFFECTIVE (LENGTH Ft)	L/L_T (RTO)	E(Ft/Ft)	Q_i INTER-CEPTED CFS	Qb CARRY-OVER T ≤ SPREAD T > SPREAD	REMARKS TOP	REMARKS HT
1	7			0.25	0.5	0.13		7.2	0.94		0.94																	15.5	2.83
2	3B	6		0.20	0.7	0.14		7.2	1.01		1.01	0.01	0.0208	5	2	0.4	0.0833	4.0	0.88	3.5	0.15	0.15	6.2	0.97	0.98	0.99	0.02	17.18	5.08
* 3	3B	6		0.20	0.7	0.14		7.2	1.01		1.01	0.01	0.0208	5	2	0.4	0.0833	4.0	0.88	3.5	0.15	0.15	6.2	0.97	0.98	0.99	0.02	17.00	5.23
* 4	4C	6		0.50	0.7	0.35		7.2	2.70	0.18	2.70	–	–	–	–	–	–	–	–	–	–	–	8.7	0.25	0.458	0.54	4	15.20	4.53
* 5	7			0.32	0.5	0.16		7.2	1.15		1.15												–					15.78	3.86
5A	7			0.74	0.4	0.3			2.16		2.16	–	–	–	–	–	–	–	–	–	–	–						15.80	3.13
* 6	3C	6		0.51	0.5	0.26		7.2	1.87	0.04	1.91												8.7	0.20	0.458	0.44	1.5	15.93	4.58
7	3B	6		0.22	0.7	0.15		7.2	1.08		1.08	0.01	0.0208	5	2	0.4	0.0833	4.0	0.88	3.5	0.15	0.15	6.2	0.97	0.98	0.99	0.02	17.03	3.92
* 8	3B	6		0.33	0.6	0.20		7.2	1.44		1.44	0.01	0.0208	7.5	2	0.27	0.0833	4.0	0.70	3.5	0.15	0.13	8	0.75	0.90	1.30	0.14	17.03	4.16
9	3A	2.5		0.2	0.6	0.12		7.2	0.86		0.86												6.2	0.17	0.458	0.37	0	17.30	2.75
10	3B	6		0.3	0.6	0.18		7.2	1.30		1.30	0.01	0.0208	6.3	2	0.32	0.0833	4.0	0.80	3.5	0.15	0.14	7	0.86	0.95	1.24	0.07	16.83	2.75
* 11	7			0.1	0.5	0.05		7.2	0.36		0.36																	16.50	2.93
* 12	3C	6		0.6	0.5	0.3		7.2	2.16		2.16												8.7	0.21	0.458	0.45	2	16.23	3.92
* 13	3C	6		0.52	0.5	0.26		7.2	1.87		1.87												8.7	0.20	0.458	0.45	2	16.23	4.26
14	7			0.52	0.5	0.21		7.2	1.87	0.26	1.87																	15.50	2.83
* 15	7			0.46	0.5	0.23		7.2	1.66		1.66																	15.50	5.06
* 16	7			0.42	0.5	0.21		7.2	1.51		1.51																	15.50	5.94
* 17	7			0.1	0.5	0.05																						17.0	8.16
18	7			0.2	0.5	0.10		7.2	0.72		0.72																	15.50	2.83

* INLET SHAPING REQUIRED

CULVERT COMPUTATIONS

HYDROLOGICAL DATA – AC C

2.95 SEC 4 0.45= 0.18

4.36 CONDOS 0.7 0.42

ΣCA 7.31 0.6

T_C = 30 MINS

I_{10} = 3.5

I_{100} = 0.6 X 5.0 X 7.31 X 1.25

AHW CONTROLS

100 YR. FLOOD PLAIN ELEV.=
DESIGN AHW DEPTH ELEV.=
STRUCTURES ELEV.=

FREQ. TW ELEV.
= STATION –
= JORDAN POINT RD.
= C/L ELEV.=
= SHOULDER ELEV.= 12.0
= 5.06 INV. ELEV.= 6.94
= SKEW 0° COVER 3.5'
= So = 0.049%
= L = 65'

INV. ELEV.= 3.75
ORIG. GROUND ELEV.=

DISCHARGES USED

Q_{10} = 15.4 cfs
Q_{25} = 17.54 CFS
Q_{100} = 27.41 CFS

RISK ASSESSMENT ADT –
DETOURS AVAILABLE – LENGTH –
OVERTOPPING STAGE –
FLOOD PLAIN MANAGEMENT –
CRITERIA and SIGNIFICANT IMPACT –

CULVERT TYPE & SIZE	Q	Q/B	HEADWATER COMPUTATIONS: INLET CONT. HW/D	HW	OUTLET CONTROL Ke	dc	(dc+D)/2	ho	H	LSo	HW	CONT. HW. ELEV.	OUTLET VELOCITY C.M.	Smooth	END TREAT.	COMMENTS
EXIST. CONC. 18"	15.4		3.0	4.5	0.5	1.4	1.45	1.45	3.0	3.19	1.26	111.44				EXIST. CULVERT ADEQUATE
																MS–19 MET
	17.54		3.2	4.8	0.5	1.5	1.5	1.5	3.6	3.19	1.91	111.74				Q_{25} = ADEQUATE
	27.41		5.0	9.0	0.5	1.7	1.8	1.8	9.5	3.19	8.11	115.9				Q_{100} = OVER TOPS RD.

SUMMARY and RECOMMENDATIONS

DESIGN FLOOD EXCEED PROB. ELEV.
OVERTOP FLOOD EXCEED PROB. ELEV.
BASE FLOOD 1% EXCEED PROB. ELEV.

Hydraulic Grade Line

INLET STATION	Outlet Water Surface Elev.	Do (in)	Qo (cfs)	Lo (ft)	Sfo %	Hf (ft)	JUNCTION LOSS: VO (cfs)	HO (ft)	Qi	Vi	QiVi	Vi2/2g	Hi	Angle (Degrees)	H	Ht	1.3 Ht	0.5 Ht	Final H	Inlet Water Surface Elev.	Rim Elev.
1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16	17	18	19	20	21
4	11.87	18	12.63	146	1.38	2.07	7.00	0.19	2.91	3.6	10.47	0.20	0.07	–	–	0.26	0.33		2.41	14.29	15.20
3	14.29	15	2.91	146	0.20	0.29	3.60	0.05	1.92	3.5	6.72	0.19	0.07	90	0.13	0.25	0.33		0.61	14.91	17.00
2	14.91	15	1.92	46	0.09	0.04	3.50	0.05	0.94	3.5	3.29	0.19	0.07	70	0.11	0.23	0.30		0.34	15.24	17.18
1	15.24	15	0.94	95	0.04	0.04	5.50	0.05	0.94	3.5	3.29	0.19	0.07	30	0.05	0.17	0.22		0.26	15.50	15.50
6	14.91	15	5.04	54	0.60	0.32	4.50	0.08	3.26	3.5	11.41	0.19	0.07	50	0.08	0.23	0.30	0.15	0.47	15.38	15.93
5	15.38	15	3.26	103	0.26	0.28	3.50	0.05	2.16	3.5	7.56	0.19	0.07	40	0.07	0.19	0.25	0.12	0.40	15.78	15.78
5A	15.78	15	2.16	130	0.10	0.13	3.50	0.05	2.16	3.5	7.56	0.19	0.07	90	0.13	0.25	0.33	0.18	0.29	16.07	15.80
8	14.29	15	2.49	144	0.14	0.20	6.00	0.14	1.08	3.5	3.78	0.19	0.07	80	0.13	0.34	0.44		0.64	14.93	17.03
7	14.93	15	1.08	32	0.04	0.01	3.50	0.05	1.08	3.5	3.78	0.19	0.07	90	0.13	0.37	0.48		0.49	15.24	17.03
17	9.26	21	11.12	140	0.49	0.69	5.00	0.10	10.78	5.00	53.90	0.39	0.14	–	–	0.24	0.31		1.00	10.26	17.00
16	10.26	21	10.78	120	0.44	0.53	5.00	0.10	9.52	4.50	42.80	0.31	0.11	40	0.12	0.33	0.43		0.96	11.22	15.50
15	11.22	21	9.52	153	0.35	0.55	4.50	0.08	6.27	5.50	34.49	0.47	0.16	40	0.18	0.42	0.55		1.10	12.31	15.50
13	12.31	15	6.27	84	0.90	0.77	5.50	0.12	3.71	3.50	12.99	0.19	0.07	90	0.13	0.32	0.42		1.19	13.50	16.23
12	13.50	15	3.71	51	0.33	0.16	3.50	0.05	1.63	9.00	14.67	1.26	0.44	–	0.0	0.49	0.64		0.80	14.30	16.23
11	14.30	15	1.63	43	0.06	0.02	9.00	0.31	1.30	4.50	5.85	0.31	0.11	30	0.09	0.51	0.66		0.68	14.98	16.50
10	14.98	15	1.30	49	0.04	0.02	4.50	0.08	1.30	4.50	5.85	0.31	0.11	50	0.14	0.33	0.43		0.45	14.98	16.50
14	12.31	15	1.87	106	0.04	0.04	6.50	0.16	1.87	6.50	12.15	0.66	0.23	15	0.07	0.46	0.60		0.64	12.94	15.50
9	13.50	15	0.96	125	0.04	0.05	7.50	0.22	0.86	7.50	6.45	0.87	0.31	90	0.61	1.14	1.29		1.34	14.84	17.30
18	12.00	15	0.72	131	0.04	0.06	5.50	0.12	0.72	5.50	3.96	0.47	0.16	–	–	0.28	0.37		0.43	12.43	TOP OF PIPE 12.37

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JOB NO. 04287–06

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FILED: 04287COMP

DESIGNED: GLW

CHECKED: KLB

DATE: OCT. 10, 2005

REVISED: MAR. 15, 2006 PER COUNTY COMMENTS

REVISED: MAY 3, 2006 PER COUNTY COMMENTS

REVISED:

REVISED:

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KENNETH L. BARNES
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5/9/06
PROFESSIONAL ENGINEER

PROJECT:

Waterside at Jordan Point

Condominiums

xxx district
Prince George county, virginia

SHEET:

Details and Computations

SHEET NO:

C20

JOB NO. 04287