CLARKSBURG TOWN CENTER
PHASE 1A PART I
('M' CONTRACT)
WATER QUALITY CONTROL COMPS

Project 29-101

Prepared by: RA
November, 2002
Rev. JAN, 2003

CPJ Associates

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CLARKSBURG TOWN CENTER Phase I, Part I
WATER QUALITY COMPUTATIONS

NARRATIVE

The BMP's proposed on Phase I, Part I are a bioretention and a recharge facility combined with an underground storage and two storm filter cells. These facilities will provide quality control for the first 1" of runoff from impervious area.

BIORETENTION #1 (BR #1)

This facility is surface fed and linked to the storm drain system by a yard inlet. It will control a drainage area of 0.65 acres with a total impervious area of 0.36 acres.

Sizing

Bioretention area = 5% of A x C

IMP AREA = 0.36 acres
GRASS = 0.29 acres

$A \times C = 0.36 \times 0.90 + 0.29 \times 0.25 = 0.40$ acres

BIORET AREA = $0.05 \times 0.40 \times 43560 = 863.6$

AREA PROVIDED = 3150.0 sq. ft o.k

BIORETENTION VOLUME

$WQ_v = Imp \times \frac{1''}{12} \times 43560 =$

$= 0.36 \times \frac{1}{12} \times 43560 = 1307.0$ cu-ft

CTC, Phase I, Part I
WATER QUALITY COMPUTATION

VOLUME PROVIDED = AREA × $\frac{6''}{12}$

= 3150 × 0.5 = 1575.0 cu-ft > 10
O.K.

UNDERDRAIN:

USE 6" PERFORATED PVC, SCH 40 @ 0%

PIPE LENGTH = 0.05 A = 0.05 × 3150 = 157.5

PIPE LENGTH PROVIDED = 158.0'

DRAWDOWN TIME

STORAGE VOLUME = 1575.0
DRAWDOWN TIME = 12 hour
WQV EL = 650.5
DRAWDOW PIPE INV = 646.5

$h_o = \frac{650.5 - 646.5}{2}$

$h_o = 2.0$ FT

$Q = \frac{V}{T} = \frac{1575.0}{12 \times 60 \times 60} = 0.0365$ cfs

Using ORIFICE EQUATION

$q_o = 0.6 A_o \sqrt{2g h_o}$

$\Rightarrow A_o = \frac{q_o}{0.6\sqrt{2g h_o}} = \frac{0.0365}{0.6\sqrt{64.4 \times 2}} = 0.0054$ ft²

$A_o = \pi \cdot r^2 \Rightarrow r = \sqrt{\frac{A}{\pi}} = \sqrt{\frac{0.0054}{\pi}} = 0.0413$ ft
$= 0.49''$

USE A WATER TIGHT UNDERDRAIN CAP (6" PVC)
WITH A 1" DIAMETER OPENING @ 646.5

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STORM SEWER SYSTEM DESIGN 90 REV 1.14MC

DATE: 09-17-02
TIME: 13:39:12
PAGE: 1

"CTC, M CONTRACT File Name MPRVT.inp OUT: 466-462.OUT"

TABLE 1.1 INPUT VERIFICATION - STRUCTURE DATA

STRUCTURE DEFINITION		RUNOFF DEFINITION		
STRUCTURE NUMBER	PIPE LENGTH (FT)	TRIBUTARY AREA (AC)	RUNOFF COEFFICIENT	TIME OF CONCENTRATION (MIN)
466	36	.650	.690	7.000
464	115	.350	.690	7.000
462	103	4.550	.629	11.680
460	0	.000	.000	.000

YARD INLET AT BIORETENTION

10 Yr PONDING AT BIORETENTION (STR # 466)

SLOTS = { ELEV. = 650.5'
OPENING { L = 2 x 30" = 60" = 5.0'
h = 5"

FROM STORM DRAIN COMPS

$Q_{10} = 2.93$ cfs

USING WEIR EQUATION

$$Q_w = 3.1\, L_w\, H^{1.5} \Rightarrow H^{1.5} = \frac{Q_w}{3.1 \times L} = \frac{2.93}{3.1 \times 5} = 0.19$$

$H = 0.33'$ 10 Yr WSEL = 650.5 + 0.33

10Yr WSEL = 650.83'

"CTC, M CONTRACT File Name MPRVT.inp OUT: 466-462.OUT"

TABLE 1.2 INPUT VERIFICATION - PIPE LINE DATA

END STRUCTURES						.1% SLOPE
UPSTREAM NO.	DOWNSTREAM NO.	PIPE SIZE (IN)	MANNINGS COEFFICIENT	LINE TYPE CODE	HORIZONTAL ANGLE	OPTION 1 = YES 0 = NO
466	464	15	.013	2	53.00	0
464	462	15	.013	2	90.00	0
462	460	21	.013	2	17.00	0

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STORM SEWER SYSTEM DESIGN 90 REV 1.14MC

DATE: 09-17-02
TIME: 13:39:12
PAGE: 3

"CTC, M CONTRACT File Name MPRVT.inp OUT: 466-462.OUT"

TABLE 2.2 FINAL DESIGN OUTPUT - 10 YEAR STORM

LINE DEFINITION DATA										DESIGN DETAIL DATA						
FROM NO.	TO NO.	AREA INCR. (AC)	AREA TOTAL (AC)	R COEFF	A*R INCR.	A*R TOTAL	TIME OF CONCEN. (M)	RAIN INTENS. (IN/HR)	Q (CFS)	PIPE SIZE (IN)	SLOPE (%)	VEL (F/S)	LENGTH (FT)	TIME (SEC)	STRUCT. NO.	HEAD LOSS (FT)
466	464	.65	.65	.69	.45	.45	7.00	6.52	2.93	15	.205	2.38	36	15.1	466	.00
464	462	.35	1.00	.69	.24	.69	7.25	6.46	4.46	15	.476	3.63	115	31.7	464	.42
462	460	4.55	5.55	.63	2.86	3.55	11.68	5.53	19.66	21	1.539	8.17	103	12.6	462	1.28

CTC, PHASE I, PART I

WATER QUALITY COMPUTATION

RECHARGE FACILITY #1

THIS FACILITY IS LOCATED OFF-LINE OF THE PROPOSED STORM DRAIN SYSTEM AND WILL BE FED BY A SPLITTER STRUCTURE (STR #194). THE DIVERTED RUNOFF WILL PASS THRU A SECOND SPLITTER STRUCTURE (STR #193) WHICH WILL DIVIDE THE 1" FIRST FLUSH PER IMPERVIOUS AREA RUNOFF INTO TWO; ONE 1/2" OF RUNOFF WILL GO DIRECTLY TO THE RECHARGE FACILITY #1 and THE OTHER 1/2" OF RUNOFF WILL PASS THRU THE UNDERGROUND SYSTEM, AND STORM FILTERS AND FINALLY IT WILL ALSO BE DISCHARGE INTO THE RECHARGE FACILITY #1.

CTC, PHASE I, PART I
Water Quality Computation

Recharge Facility # 1

This facility is located off line of the proposed storm drain system and will be fed by a splitter structure (STR # 194). The diverted runoff will pass thru a 84" CMP and two storm filters which will have the capacity to store 1/2" of runoff before entering the recharge facility which also has the capacity to store 1/2" of runoff. The two systems will be able to accommodate a total of 1" first flush per impervious area runoff.

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M SEWER SYSTEM DESIGN 90 REV 1.14MC

DATE: 06-13-02
TIME: 15:39:52
PAGE: 4

M CONTRACT File Name M.inp OUT: 486-194.OUT"
TABLE 2.2 FINAL DESIGN OUTPUT - 10 YEAR STORM

LINE DEFINITION DATA										DESIGN DETAIL DATA						
FROM NO.	TO NO.	AREA INCR. (AC)	AREA TOTAL (AC)	R COEFF	A*R INCR.	A*R TOTAL	TIME OF CONCEN. (M)	RAIN INTENS. (IN/HR)	Q (CFS)	PIPE SIZE (IN)	SLOPE (%)	VEL (F/S)	LENGTH (FT)	TIME (SEC)	STRUCT. NO.	HEAD LOSS (FT)
486	484	.32	.32	.76	.24	.24	7.00	6.52	1.59	15	.060	1.29	36	27.8	486	.00
484	482	.86	1.18	.60	.52	.76	10.00	5.85	4.44	15	.473	3.62	18	5.0	484	.45
482	478	.00	1.18	.00	.00	.76	10.08	5.84	4.44	15	.473	3.62	252	69.6	482	.29
480	478	.30	.30	.67	.20	.20	7.00	6.52	1.31	15	.041	1.07	26	24.3	480	.00
478	474	.92	2.40	.62	.57	1.53	11.24	5.61	8.59	15	1.769	7.00	23	3.3	478	.96
476	474	.92	.92	.55	.51	.51	10.00	5.85	2.96	15	.210	2.41	130	53.9	476	.00
474	472	.44	3.76	.52	.23	2.27	11.30	5.60	12.69	18	1.460	7.18	25	3.5	474	.70
472	470	.32	4.08	.81	.26	2.52	11.36	5.59	14.12	18	1.807	7.99	18	2.3	472	.69
470	468	.00	4.08	.00	.00	2.52	11.39	5.59	14.12	18	1.807	7.99	138	17.3	470	.40
468	462	.47	4.55	.71	.33	2.86	11.68	5.53	15.82	21	.997	6.58	88	13.4	468	.13
466	464	1.00	1.00	.69	.69	.69	7.00	6.52	4.50	15	.486	3.67	22	6.0	466	.00
464	462	.00	1.00	.00	.00	.69	7.10	6.50	4.50	15	.486	3.67	113	30.8	464	.29
462	460	.00	5.55	.00	.00	3.55	11.90	5.49	19.50	21	1.514	8.11	103	12.7	462	.72
460	198	.71	6.26	.61	.43	3.98	12.12	5.46	21.73	24	.923	6.92	15	2.2	460	.19
454	452	8.97	8.97	.67	6.01	6.01	7.00	6.52	39.21	30	.914	7.99	25	3.1	454	.00
452	450	.79	9.76	.67	.53	6.54	7.05	6.51	42.58	33	.648	7.17	35	4.9	452	.21
450	448	.26	10.02	.67	.17	6.71	7.13	6.49	43.57	33	.679	7.34	51	7.0	450	.70
448	446	.00	10.02	.00	.00	6.71	7.25	6.46	43.57	33	.679	7.34	35	4.8	448	.37
446	444	.00	10.02	.00	.00	6.71	7.33	6.44	43.57	33	.679	7.34	76	10.4	446	.42
444	442	.78	10.80	.66	.51	7.23	7.50	6.40	46.27	33	.765	7.79	258	33.1	444	.45
442	198	.39	11.19	.75	.29	7.52	8.05	6.27	47.16	33	.795	7.94	31	3.9	442	.32
198	196	.00	17.45	.00	.00	11.50	12.15	5.45	62.70	36	.884	8.87	47	5.3	198	.51
196	194	.63	18.08	.75	.47	11.97	12.24	5.44	65.09	36	.952	9.21	33	3.6	196	1.00
194	190	.46	18.54	.76	.35	12.32	12.30	5.43	66.87	36	1.005	9.46	225	23.8	194	1.02

OFF-SITE DA = 9.76 Ac
SPLITTER STRUCTURE # 194
ON-SITE DRAINAGE AREA @ STR #194 = 18.54 - 9.76 = 8.78 Ac
ON-SITE IMPERVIOUS = 5.13 Ac (58.4%)

CR, Phase I, Part I

SPLITTER STRUCTURE # 194

Flow rate required = $\frac{\text{IMP. AREA}}{640 \frac{Ac}{sq\ mile}} \times R \times 1010$ csm

IMP AREA = 5.13 ACRES

R = 1"

$Q_{SPLIT} = \frac{5.13}{640} \times 1 \times 1010 = 8.1$ cfs

SPLITTER PIPE DIA = 18 in.

SPLITTER PIPE AREA = 1.766 sq. ft

INVERT OF SPLITTER PIPE = 625.72'

INVERT OF OUTGOING STORM DRAIN = 627.56

HEAD ON SPLITTER = Δ INV $- \frac{DIA}{2 \times 12}$ =

$h_o = (627.56 - 625.72) - \frac{18}{2 \times 12} = 1.09'$

SPLITTER FLOW RATE = $0.6 A_o \sqrt{2 g h_o}$

$Q_{spli} = 0.6 \times 1.766 \sqrt{64.4 \times 1.09} = 8.88$ cfs

$> Q_{SPLIT} = 8.1$

RECHARGE FACILITY #1

$WQ_v = (P R_v A) \frac{1}{12}$;

$A = 8.78$ Ac

$R_v = 0.05 + 0.009 I$

$I_M = 5.13$ Ac.

$I = \frac{5.13}{8.78} = 0.584 \times 100$

$R_v = 0.05 + 0.009 \times 58.4$

$R_v = 0.58$

$WQ_v = (0.5 \times 0.58 \times 8.78) \frac{1}{12} = 0.21$ Ac-ft

$= 9,147.6$ cu-ft

Using a void ratio of 40%, then

Volume Required $= \frac{9147.6}{0.4} = 22870.0$ cu-ft

Recharge Area Provided (Foot print area)

Re Area Provd = 6030 sq-ft

Providing 4FT depth TRENCH Plus 1' COVER

VOLUME PROVIDED = 6030 × 4 = 24,120. cu-ft

> Vol REQ'D OK

TOP OF TRENCH 620.00

STORAGE ELEV = 619.00

BOTTOM OF TRENCH = 615.0

StormFilter Sizing Based on the MDE Design Methodology

Project Name: Clarksburg Town Center - SF1

Date: 9/26/02

Input

Result

SITE CHARACTERISTIC INPUT

Design Storm, P (inches) *	0.50	*(1.0 if in Eastern rainfall zone, 0.9 if in Western rainfall zone)
Total Area, A_T (acres)	8.78	
Impervious Area, A_I (acres)	5.13	
Percent of WQv to be temporarily stored in system	100%	

WQv CALCULATIONS

Percent Impervious Cover, I	58%	
Volumetric Runoff Coefficient, Rv	0.58	
Water Quality Volume, WQv (ac-ft)	0.211	
Water Quality Volume, WQv (cu ft)	9,177	
Required Storage Volume (% of WQv) (cu ft) *	9,177	*(This is the volume that the entire system is required to temporarily hold prior to filtration, including both pretreatment and treatment)

STORMFILTER DESIGN CONSTANTS (PER MDE MANUAL)

Filter Bed Depth, D_f (ft)*	0.58	*(0.58 for StormFilter)
Coeff. of Perm. of Filter Media, k (ft/day)*	8.7	*(8.7 ft/day for Leaf Compost)
Avg. Height of Water above Filter Bed, H_f (ft)*	0.75	*(0.75 for StormFilter)
Design Filter Bed Drain Time, T_f (days)*	1.67	*(1.67 days recommended)
Surface Area of StormFilter Cartridge (sq ft)*	7.1	*(7.1 sq ft for standard cartridge)

SIZING CALCULATIONS

Surface Area of Equivalent Filter Bed (sq ft)	275.4
Number of Cartridges Required	39
Size of StormFilter Required	(2) 8' x 16' precast StormFilters

STORAGE CALCULATIONS

Storage Volume within StormFilter Vault (cu ft)*	373	*(Assumes 20" depth in inlet and cartridge bays)
Pretreatment Storage Required (cu ft)*	8,803	*(Required storage vol minus storage within SF)
Diameter of Storage Pipe (in)	84	
Length of Storage Pipe Required (ft)	229	

STORMFILTER SYSTEM SIZING: 229 linear feet of 84" diameter pipe followed by (FULL) (2) 8' x 16' precast StormFilters with 39 cartridges

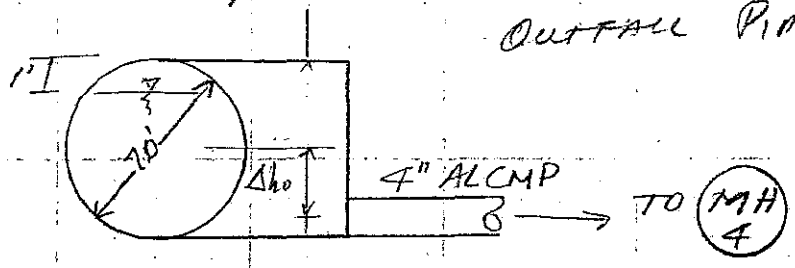
PROVIDING 1FT FREEBOARD USE 262.0 FT

5'ϕ → A_0 = 19.6

332 FT

CTC, Phase 1, Part 1

Underground STORAGE TO STORM FILTERS
OUTFALL PIPE



$A_{WET} = \pi r^2 - \frac{1}{2} r^2 (\phi - \sin\phi)$

$= 38.48 - 4.88 =$

$= 33.60$ sq-ft

$L_{RED} = 8{,}803 / 33.60 = 262.0$ ft

PIPE TO STORM FILTER 4" ϕ ; $A_o = 0.0873$ sq.

RELEASE RATE TO STORM FILTER

$\Delta h_o =$ (Max. WSEL - DEAD STORAGE ELEV.)/2

$= 625.62 - 621.52)/2 = 2.05$

then $q_o = 0.6\, A_o \sqrt{2g\, \Delta h_o}$

$= 0.6 \times 0.0873 \sqrt{64.4 \times 2.05} = \underline{0.60}$ cfs

TIME TO RF#1 $T = \frac{V}{q} = \frac{8803}{60 \times 60 \times 0.60} = 4.0$ hrs to RF#1

then

OPENING TO STORMFILTER = 4" ϕ

19.64 -

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Prepared By: BKD
Checked By:
Date: 10/02

Engineer's Preliminary Cost Estimate
For

Clarksburg Town Center
Phase 1A1 - Part 1
Water Quality SWM Estimate

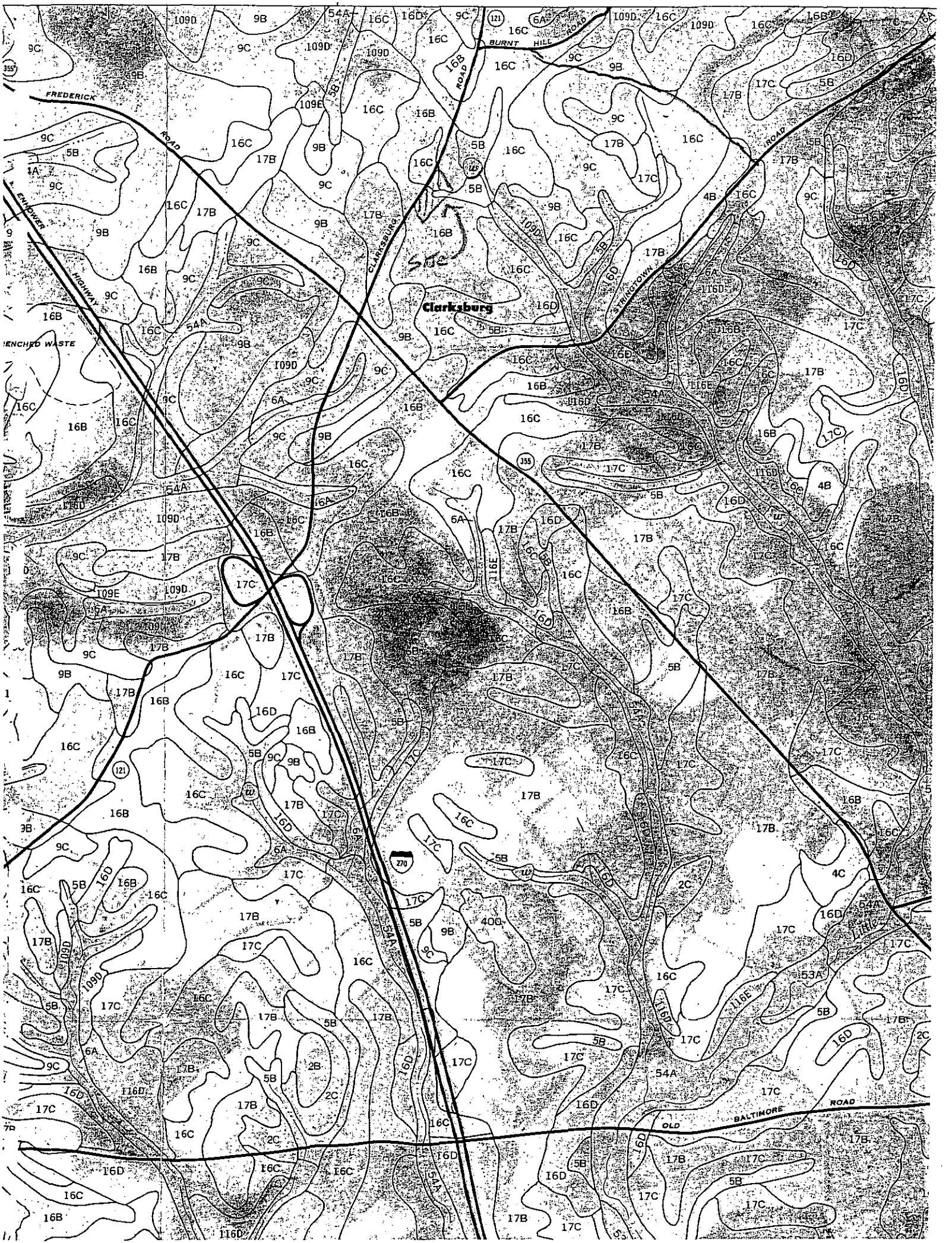
Job Number

Sheet 1 of 1

ITEM	UNIT	APPROXIMATE QUANTITY	APPROXIMATE UNIT PRICE	APPROXIMATE COST
Bioretention BR# 1				
Borrow	CY	175	$ 8.00	$ 1,400.00
Gravel	CY	120	$ 20.00	$ 2,400.00
Sand	CY	40	$ 18.00	$ 720.00
6" PVC	LF	127	$ 12.00	$ 1,524.00
Inlet # 466	EA	1	$ 2,500.00	$ 2,500.00
Plantings	LS	1	$ 6,000.00	$ 6,000.00
Pea gravel diaphram	CY	16	$ 25.00	$ 400.00
			Subtotal	**$ 14,944.00**
Recharge Facility # 1				
Diversion Str. # 194	EA	1	$ 4,000.00	$ 4,000.00
Diversion Str. # 193	EA	1	$ 3,000.00	$ 3,000.00
84" CMP	LF	230	$ 200.00	$ 46,000.00
Storm Filter # 1	LS	1	$ 35,000.00	$ 35,000.00
Storm Filter # 2	LS	1	$ 35,000.00	$ 35,000.00
12" PVC	LF	115	$ 16.00	$ 1,840.00
18" PVC	LF	24	$ 20.00	$ 480.00
12" ALCMP	LF	6	$ 30.00	$ 180.00
Bank Run Gravel	CY	2100	$ 18.00	$ 37,800.00
Sand	CY	135	$ 22.00	$ 2,970.00
			Subtotal	**$ 166,270.00**
			Total	**$ 181,214.00**
			Say	**$ 185,000.00**

NOTE

This estimate is prepared as a guide only, is based upon preliminary information, and is subject to possible change. Charles P. Johnson & Associates makes no warranty, either express or implied, that actual quantities and costs will not vary from the amounts indicated and assumes no liability for such variances.



FREDERICK ROAD
BURNT HILL ROAD
CLARKSBURG ROAD
STRINGTOWN ROAD
Clarksburg
ENHOWER HIGHWAY
OLD BALTIMORE ROAD
Little

17. (L A TER RES

("Flooding," "water table," and terms such as "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1B, 1C---------- Gaila	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
2A, 2B, 2C-------- Glenelg	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
2UB*, 2UC*:												
Glenelg----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
Urban land.												
4B, 4C---------- Elioak	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
5A, 5B---------- Glenville	C	None---------	---	---	0.5-3.0	Perched	Nov-Apr	60-99	---	High-----	High-----	Moderate.
6A---------- Baile	D	None---------	---	---	0-0.5	Apparent	Nov-Apr	>60	---	High-----	High-----	High.
7UB*, 7UC*:												
Gaila----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	High.
Urban land.												
9B*, 9C*:												
Linganore--------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Moderate.
Hyattstown-------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate	Low.
16B*, 16C*, 16D*:												
Brinklow---------	B	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate	High.
Blocktown--------	C/D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate	Low.
17B, 17C---------- Occoquan	B	None---------	---	---	>6.0	---	---	40-60	Soft	Moderate	Moderate	High.

See footnote at end of table.