2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

SW 87 Ave (Area - 1)

from SW 142 St to south of SW 143 St

PREPARED FOR:

Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

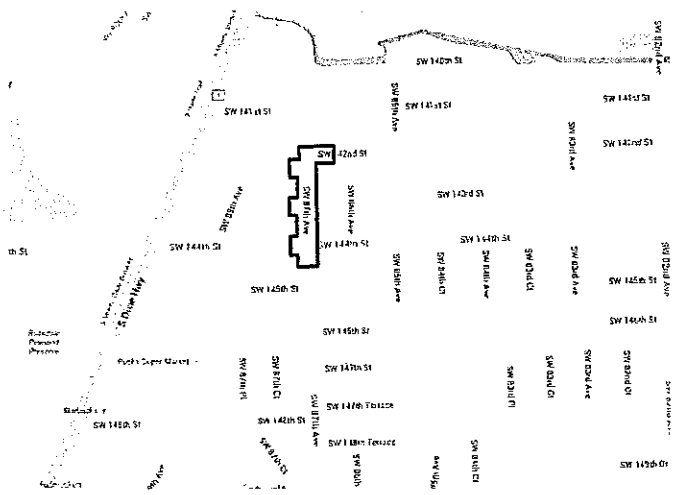
ne 8, 2016

VAUGHN SOARES
LICENSE
No. 56912
STATE OF FLORIDA
PROFESSIONAL ENGINEER

7/28/16

Vaughn Soares, P.E.
Florida Registered
No. 56912

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 87 Avenue from the intersections of SW 87 Ave and SW 142 Street to SW 143 Street and SW 87 Avenue. This is a residential neighborhood that experiences localized ponding during normal rain events. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales and surface drainage. The proposed drainage system includes proposed inlets, manholes and a **total of 80 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. This proposed system will remain a closed one (no outfall). This report and the drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= **101,204 sf** = **2.32** ac
Impervious Area	= **39,712 sf** = **0.91** ac
Pervious Area	= **61,492 sf** = **1.41** ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.50 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-1	3.13×10^{-3}

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 1	**5.5**	**2**	**11**	**80**

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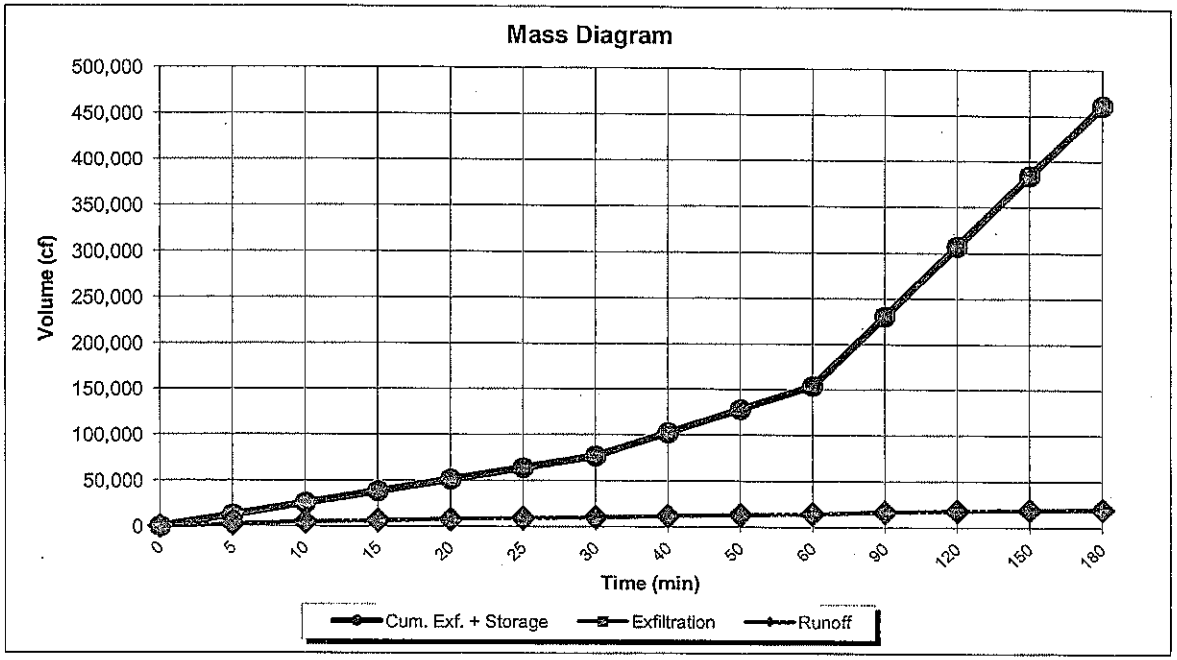
ATTACHMENTS

- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	0.91
Acres of pervious area:	1.41
Linear feet of Trench Provided:	80
Rate of exfiltration: (cfs/lf)	0.5339
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.54
Total drainage area (ac):	2.32
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	12
MDPW Project (Y/N)	N

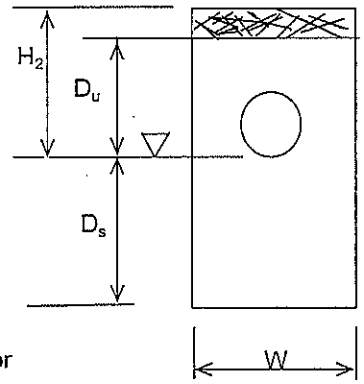


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	**0**	42.7	0	0	0
5	6.80	8.52	**2,556**	42.7	12,815	0	12,815
10	6.17	7.73	**4,637**	42.7	25,629	0	25,629
15	5.64	7.07	**6,364**	42.7	38,444	0	38,444
20	5.20	6.52	**7,820**	42.7	51,259	0	51,259
25	4.82	6.04	**9,065**	42.7	64,074	0	64,074
30	4.50	5.63	**10,140**	42.7	76,888	0	76,888
40	3.96	4.96	**11,907**	42.7	102,518	0	102,518
50	3.54	4.43	**13,297**	42.7	128,147	0	128,147
60	3.20	4.01	**14,419**	42.7	153,777	0	153,777
90	2.48	3.11	**16,779**	42.7	230,665	0	230,665
120	2.03	2.54	**18,274**	42.7	307,553	0	307,553
150	1.71	2.15	**19,307**	42.7	384,442	0	384,442
180	1.48	1.86	**20,062**	42.7	461,330	0	461,330

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	**0**
5	2,556	12,815	**0**
10	4,637	25,629	**0**
15	6,364	38,444	**0**
20	7,820	51,259	**0**
25	9,065	64,074	**0**
30	10,140	76,888	**0**
40	11,907	102,518	**0**
50	13,297	128,147	**0**
60	14,419	153,777	**0**
90	16,779	230,665	**0**
120	18,274	307,553	**0**
150	19,307	384,442	**0**
180	20,062	461,330	**0**

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	11.40
Trench Top	9.40
Weir Elev.	
October Water Elev.	3.50
Pipe Inv.	7.90
Pipe Dia. (ft)	1.50
Trench Bott	-3.60



W:	3.50	ft
H_2:	7.90	ft
Du:	5.90	ft
Ds:	7.10	ft
K:	3.13E-03	cfs/ft²/ft
Exf. Rate:	0.5339	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K*[H_2W + 2H_2D_u - D_u^2 + 2H_2D_s]$
Du < Ds $K*[(2H_2D_u) - D_u^2 + 2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
		Total Pipe Storage		**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
2.32 ac x 1 in. = **2.32** ac-in

2.5" Over the Percent Imperviousness
0.91 ac x 0.98 in. = **0.89** ac-in

INITIAL VOLUME TO TREAT **2.32** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr

$$i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$$

Storm Frequency (F)
Time to generate **2.32** ac-in $V = CiAt_t$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **8,422** cf

8,422 = C *i* A t /(60 min /hr)

$$= 0.540 \times \frac{308.5}{40.71 + 0.93t} \times 2.32 \text{ ac} * t * (60 \text{ sec/min})$$

$$8{,}422 = \frac{23{,}189\ t}{40.71 + 0.93t}$$

23,189 t - 7,829 t = 342,882

t = 23.00 min

Total Time = t_c + t = **33** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 33 min = 4.32 in/hr

V = **2.98** **ac-in**

WATER QUANTITY CALCULATIONS - SCS Method

Design Storm	5 yr	1 hr
Lowest Elevation	11.40 ft	
October Water Elevation	3.50 ft (NGVD)	
Depth to Water Table	7.90 ft	
Soil Storage (SS)	8.18 in	

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
1.41	0.91	2.32	8.18	11.53	4.971466	66.79

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 4.9714655
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.68** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **1.57** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **2.93** ft

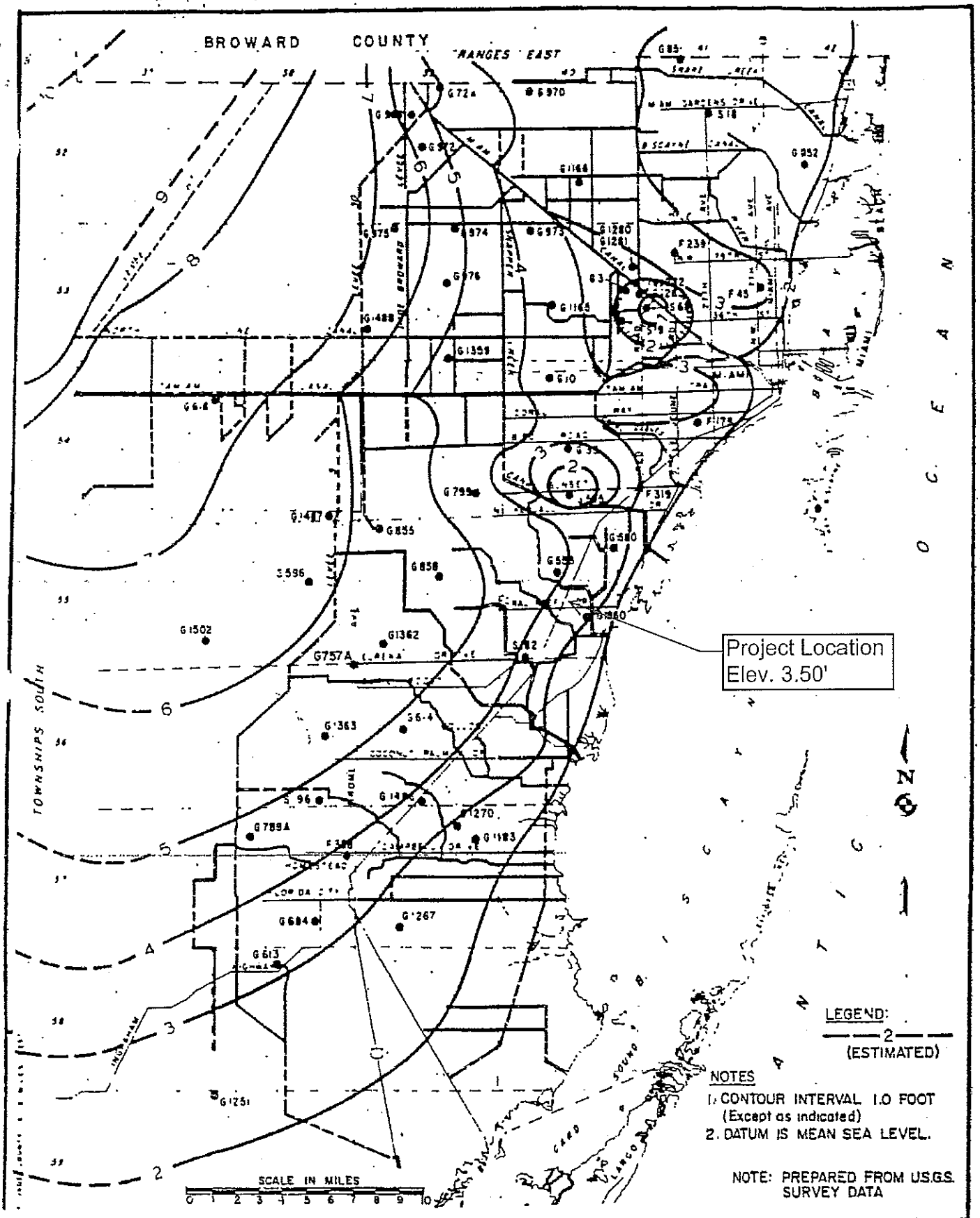
Use **3** ft

Du < Ds (Conservative)

$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5/72	REVISED 2/19/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960–75	W.C. 2.2 SHEET 1 OF 1

Appendix C: Isohyetal Maps
from SFWMD Technical Memorandum, *Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida*, Paul Trimble, October 1990.

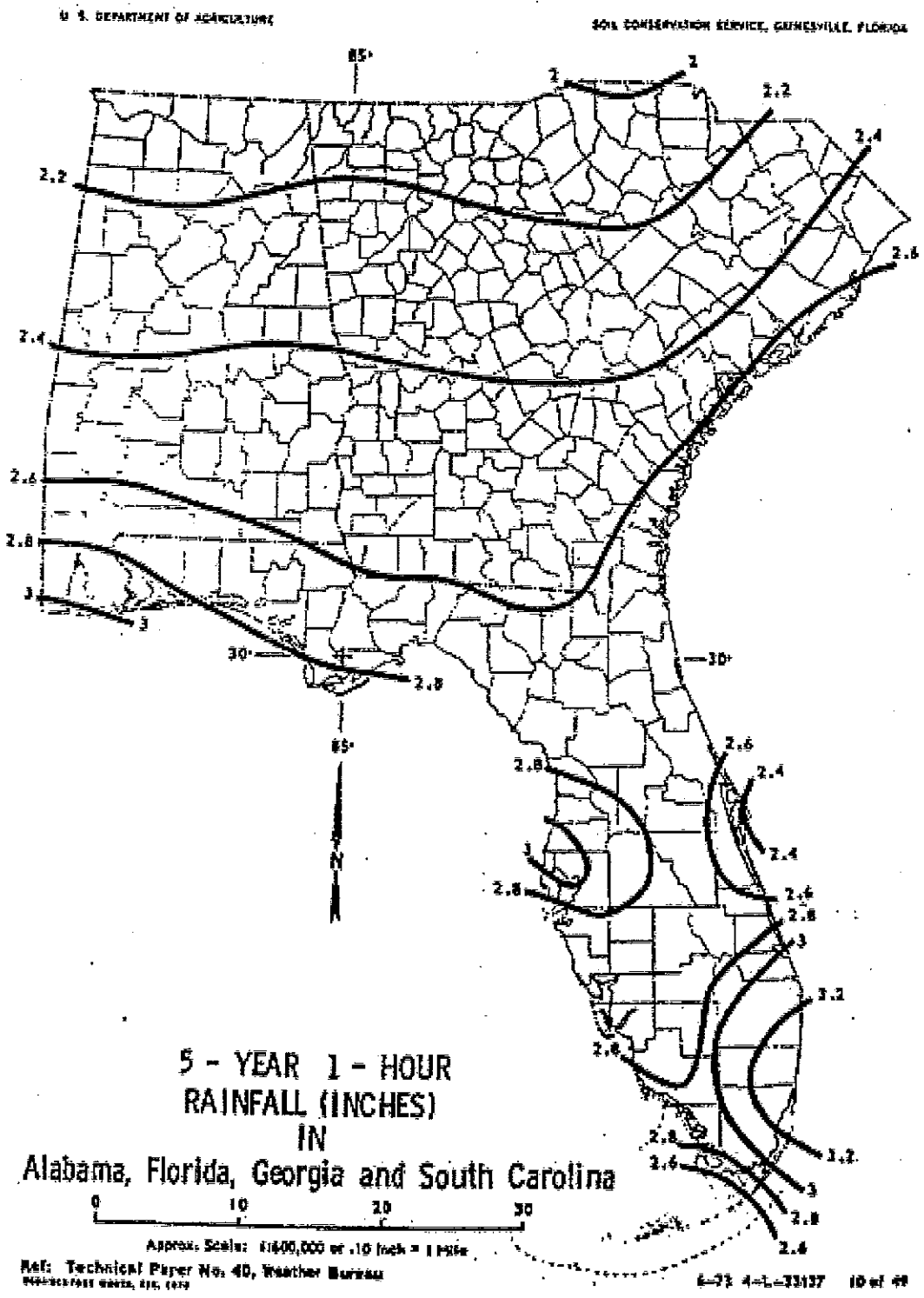


Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

Attention: Ms. Linda M. Bell, PE - President

Re: **Letter Report of Borehole Percolation Testing**
Proposed Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Dear Ms. Bell:

GEOSOL, Inc. (GEOSOL) is pleased to submit the enclosed letter report containing the results of the borehole percolation testing for the above-referenced project. These services were provided in accordance with our proposal No. P-216112 dated February 25, 2016. You provided authorization for our services on February 29, 2016.

Based on information you provided to us on February 25, 2016, we understand that the project consists of providing drainage improvements in the Village of Palmetto Bay, Florida. As requested, our scope of services was limited to performing seven (7) borehole percolation tests (P-1 through P-7) at depths of 15 feet below existing grades for use in drainage evaluations and design in the following areas:

- Along SW 87th Avenue, between SW 142nd Street and SW 143rd Street,
- In the vicinity of the property located at 16625 SW 80th Avenue,
- In the vicinity of the property located at 7990 SW 155th Street,
- Along SW 80th Avenue, between SW 152nd Street and SW 148th Street,
- Along SW 84th Court, between SW 147th Street and SW 147th Terrace,
- In the vicinity of the property located at 15735 SW 88th Court, and
- In the vicinity of the property located at 7330 SW 145th Terrace

The test locations were identified in the field utilizing the drainage map you provided, standard taping procedures and existing landmarks. A test location plan is presented in Sheet 1 attached to this letter.

The borehole percolation tests were performed in general accordance with the South Florida Water Management District (SFWMD) "Usual Open-Hole" constant head method. The borehole percolation tests were performed to determine the hydraulic conductivity values (k) of the subsurface materials at depths of 15 feet below existing ground surface. The boreholes were drilled by means of a 6¾-inch diameter tri-cone bit and water. Upon drilling the boreholes, we inserted a 6-inch diameter perforated PVC pipe in the ground and used a pump for purging the well prior to the start of each test. After completion of the borehole percolation tests, the boreholes were grouted and the sites were cleaned as required. The hydraulic conductivity values (k) were determined from the test results and are tabulated in Table 1 attached to this letter. The hydraulic conductivity values are reported in units of cubic feet per second per square foot of seepage area per foot of head (cfs/ft²-ft.).

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

3/17/16

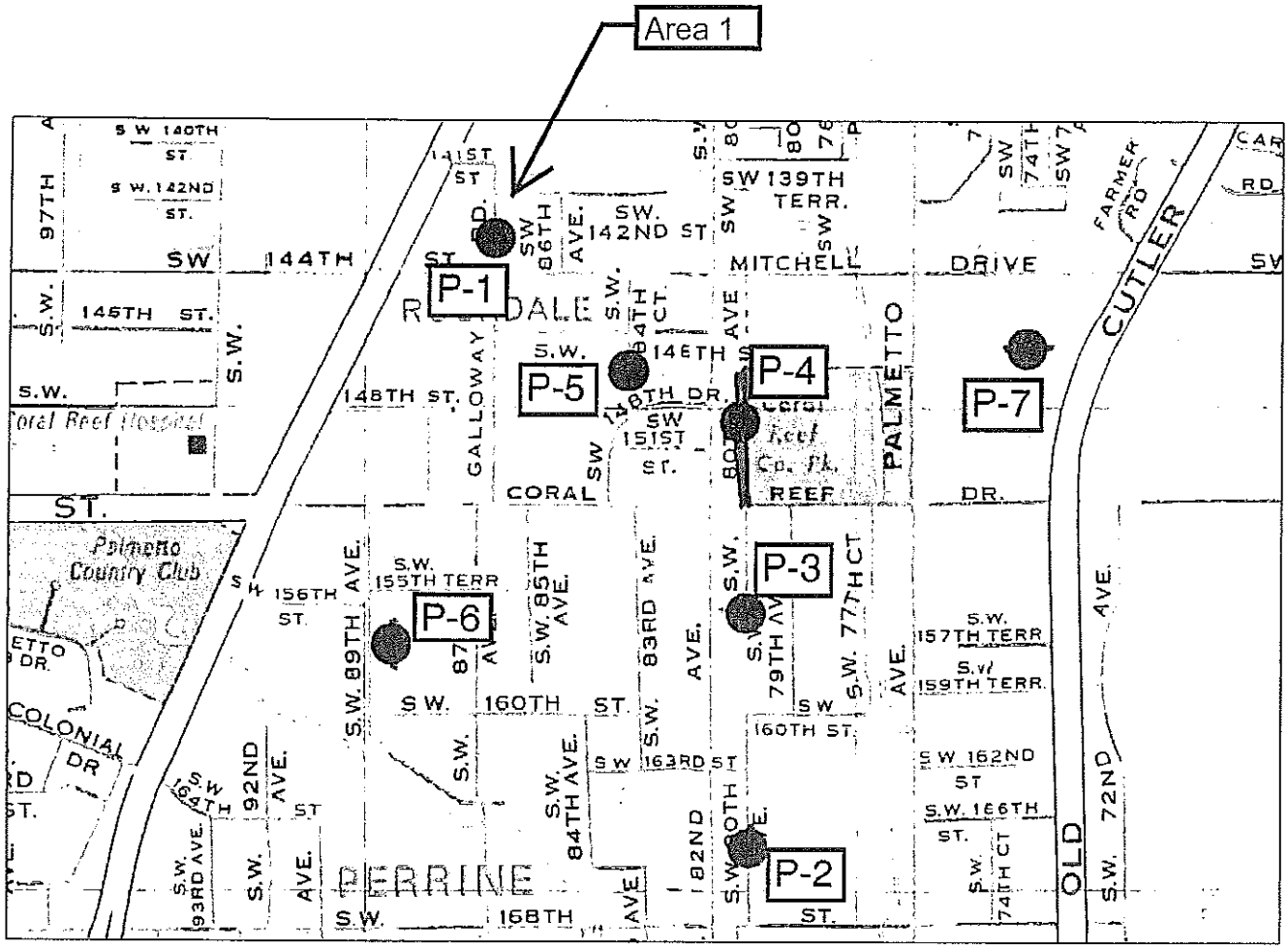
Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

GEOSOL, INC.
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	
OR	MAR., 2016	SHEET 1

TABLE 1 - SUMMARY OF CONSTANT HEAD PERCOLATION TEST RESULTS

Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Test No.	Date Performed	Diameter		Depth of Hole	Depth to Groundwater Level Below Ground Surface (Feet)		SATURATED HOLE DEPTH	Corrected Depth of	Average Flow Rate	K, Hydraulic Conductivity
		Casing (Inches)	Hole (Inches)	(Feet)	Prior to Test	During Test	Ds (Feet)	Hole (Feet)	(gpm)	(cfs/ft^2-Ft Head)
P-1	03/11/16	6.00	6.75	15	9.6	8.60	5.40	6.40	15.0	3.13E-03
P-2	03/14/16	6.00	6.75	15	7.0	6.00	8.00	9.00	14.8	2.16E-03
P-3	03/14/16	6.00	6.75	15	7.4	6.40	7.60	8.60	14.6	2.23E-03
P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
P-6	03/14/16	6.00	6.75	15	7.9	6.90	7.10	8.10	14.3	2.33E-03
P-7	03/14/16	6.00	6.75	15	8.2	7.20	6.80	7.80	15.0	2.54E-03

NOTES:

(1) The above hydraulic conductivity values are for a French drain installed to the same depth as the borehole tests. The values represent an ultimate value. The designer should decide on the required factor of safety.

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure as shown on the following page.

(3) The diameter of the CASING was used in the computation of the hydraulic conductivity values presented in the above table.

SUBSURFACE STRATIFICATION

TEST No.	TEST LOCATION (FEET)		DEPTH (FEET)		GENERAL MATERIAL DESCRIPTION
	NORTHING	EASTING	FROM	TO	
P-1	474526	875591	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	1.60	Brown Fine to Medium SAND
			1.60	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-2	466673	879380	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.30	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.30	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-3	470380	879198	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-4	472548	879041	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.00	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.00	1.50	Brown Fine to Medium SAND
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-5	473063	876849	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-6	469407	874855	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.40	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.40	2.00	Brown Sandy LIMESTONE
			2.00	15.00	Light Brown Sandy LIMESTONE
P-7	473846	882587	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	2.20	Brown Sandy LIMESTONE
			2.20	15.00	Light Brown Sandy LIMESTONE

2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

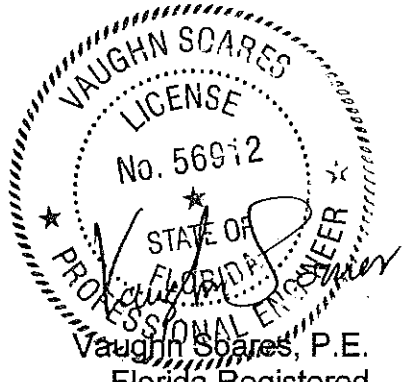
SW 84 Court (Area - 5)

from SW 147 Street to SW 147 Terrace

PREPARED FOR:

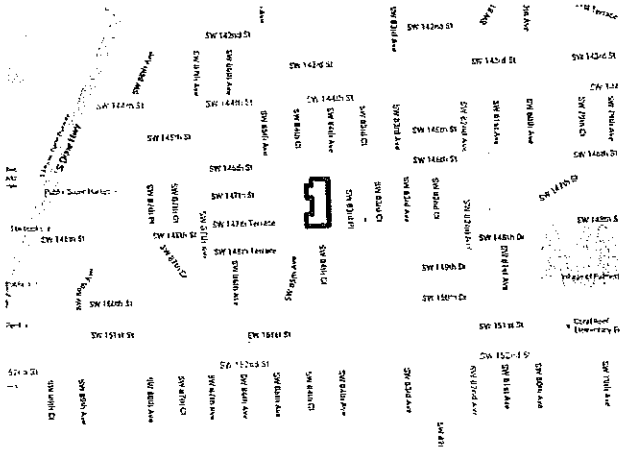
Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

June 8, 2016



Vaughn Soares, P.E.
Florida Registered
No. 56912
7/28/16

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 84 Court from SW 147 Street to SW 147 Terrace. This is a residential neighborhood that experiences localized ponding during normal rain events. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales and inlets, and exfiltration trenches. The proposed drainage system includes reconstructing swales, proposed inlets, and a **total of 40 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. This proposed system will remain a closed one (no outfall). This report and the drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= **53,094 sf = 1.22** ac
Impervious Area	= 22,323 **sf = 0.51** ac
Pervious Area	= 30,771 sf = 0.71 ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.50 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-5	2.69×10^{-3}

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 5	**3.5**	**2**	**7**	**40**

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ATTACHMENTS

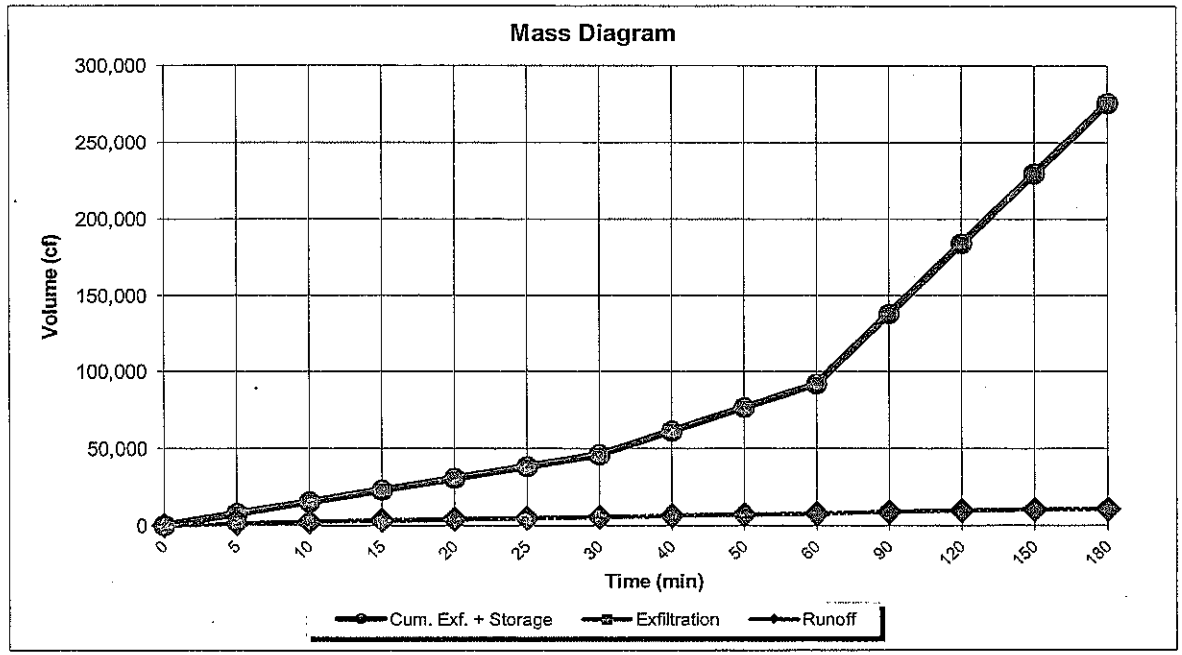
- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

CWI

Village of Palmetto Bay - SW 84 Court (Area - 5)
Water Quality - 5 yr.

6/9/2016

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	0.51
Acres of pervious area:	0.71
Linear feet of Trench Provided:	55
Rate of exfiltration: (cfs/lf)	0.4642
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.55
Total drainage area (ac):	1.22
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	7
MDPW Project (Y/N)	N

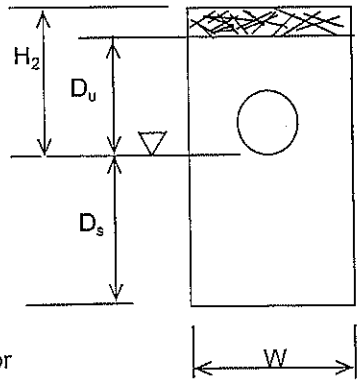


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	**0**	25.5	0	0	0
5	6.80	4.56	**1,369**	25.5	7,659	0	7,659
10	6.17	4.14	**2,483**	25.5	15,318	0	15,318
15	5.64	3.79	**3,408**	25.5	22,977	0	22,977
20	5.20	3.49	**4,188**	25.5	30,636	0	30,636
25	4.82	3.24	**4,855**	25.5	38,295	0	38,295
30	4.50	3.02	**5,431**	25.5	45,954	0	45,954
40	3.96	2.66	**6,377**	25.5	61,272	0	61,272
50	3.54	2.37	**7,122**	25.5	76,590	0	76,590
60	3.20	2.15	**7,723**	25.5	91,908	0	91,908
90	2.48	1.66	**8,987**	25.5	137,862	0	137,862
120	2.03	1.36	**9,788**	25.5	183,816	0	183,816
150	1.71	1.15	**10,341**	25.5	229,770	0	229,770
180	1.48	0.99	**10,745**	25.5	275,724	0	275,724

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	**0**
5	1,369	7,659	**0**
10	2,483	15,318	**0**
15	3,408	22,977	**0**
20	4,188	30,636	**0**
25	4,855	38,295	**0**
30	5,431	45,954	**0**
40	6,377	61,272	**0**
50	7,122	76,590	**0**
60	7,723	91,908	**0**
90	8,987	137,862	**0**
120	9,788	183,816	**0**
150	10,341	229,770	**0**
180	10,745	275,724	**0**

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	11.54
Trench Top	9.54
Weir Elev.	
October Water Elev.	3.50
Pipe Inv.	8.04
Pipe Dia. (ft)	1.50
Trench Bott	-3.46



W:	3.50	ft
H_2:	8.04	ft
Du:	6.04	ft
Ds:	6.96	ft
K:	2.69E-03	$cfs/ft^2/ft$
Exf. Rate:	0.4642	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K^*[H_2W + 2H_2D_u - D_u^2 + 2H_2D_s]$
Du < Ds $K^*[(2H_2D_u) - D_u^2 + 2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
		Total Pipe Storage		**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
1.22 ac x 1 in. = **1.22** ac-in

2.5" Over the Percent Imperviousness
0.51 ac x 1.05 in. = **0.53** ac-in

INITIAL VOLUME TO TREAT **1.22** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr

$$i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$$

Storm Frequency (F)
Time to generate **1.22** ac-in $V = CiAt_t$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **4,429** cf

4,429 = C *i* A t /(60 min /hr)

$$= 0.550 \times \frac{308.5}{40.71 + 0.93t} \times 1.22 \text{ ac} * t * (60 \text{ sec/min})$$

$$4{,}429 = \frac{12{,}420\ t}{40.71 + 0.93t}$$

12,420 t - 4,117 t = 180,308

t = 22.00 min

Total Time = t_c + t = **32** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 32 min = 4.38 in/hr

V = **1.57** **ac-in**

WATER QUANTITY CALCULATIONS - SCS Method

Design Storm 5 yr 1 hr
Lowest Elevation 11.54 ft
October Water Elevation 3.50 ft (NGVD)
Depth to Water Table 8.04 ft
Soil Storage (SS) 8.18 in

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
0.71	0.51	1.22	8.18	5.81	4.760492	67.75

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 4.7604918
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.72** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **0.88** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **1.88** ft

Use **2** ft

Du < Ds (Conservative)

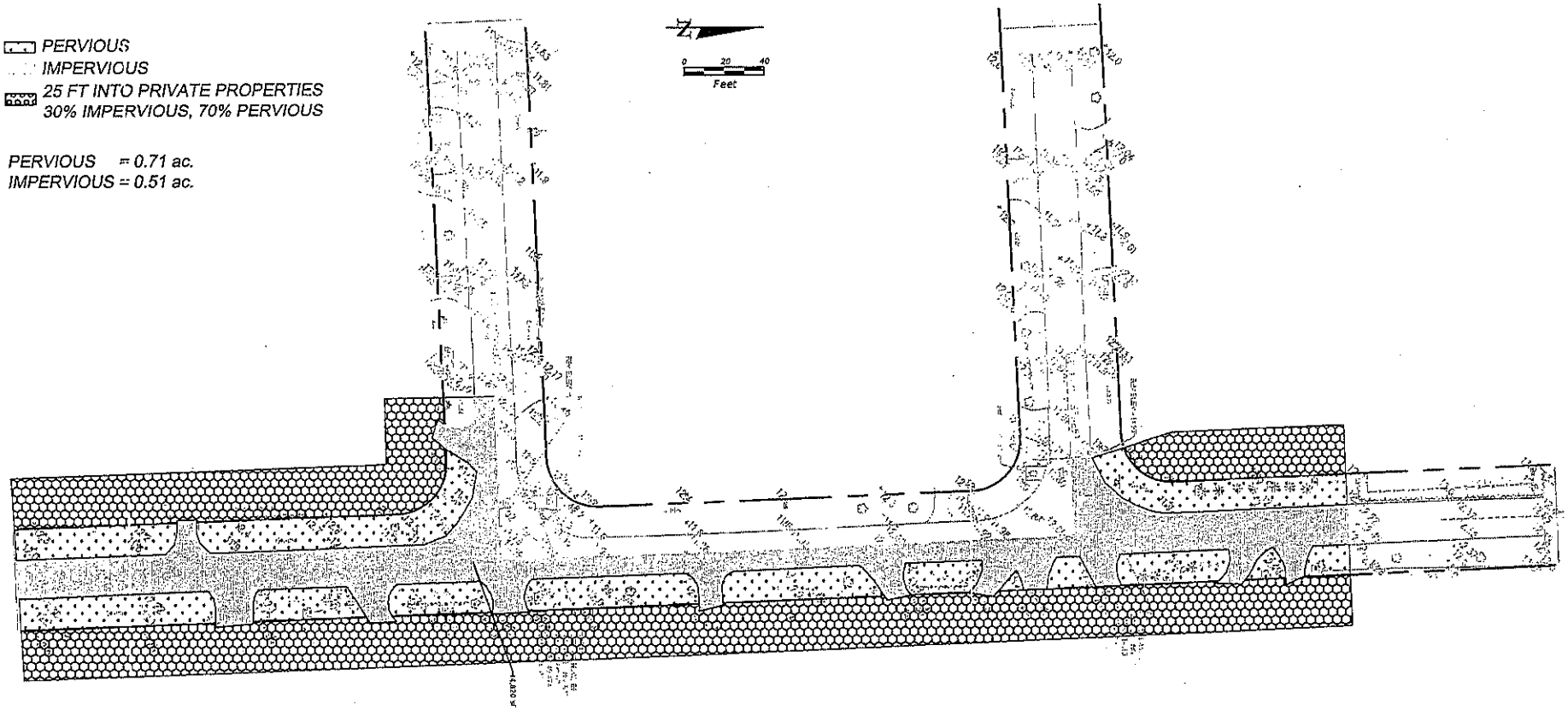
$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

PERVIOUS
IMPERVIOUS
25 FT INTO PRIVATE PROPERTIES
30% IMPERVIOUS, 70% PERVIOUS

PERVIOUS = 0.71 ac.
IMPERVIOUS = 0.51 ac.



SW 84 CT (AREA 5)

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Date 08/08/2016
Drawn HLR
Checked VS
Manager LINDA BELL, P.E.
Permit No. 7008

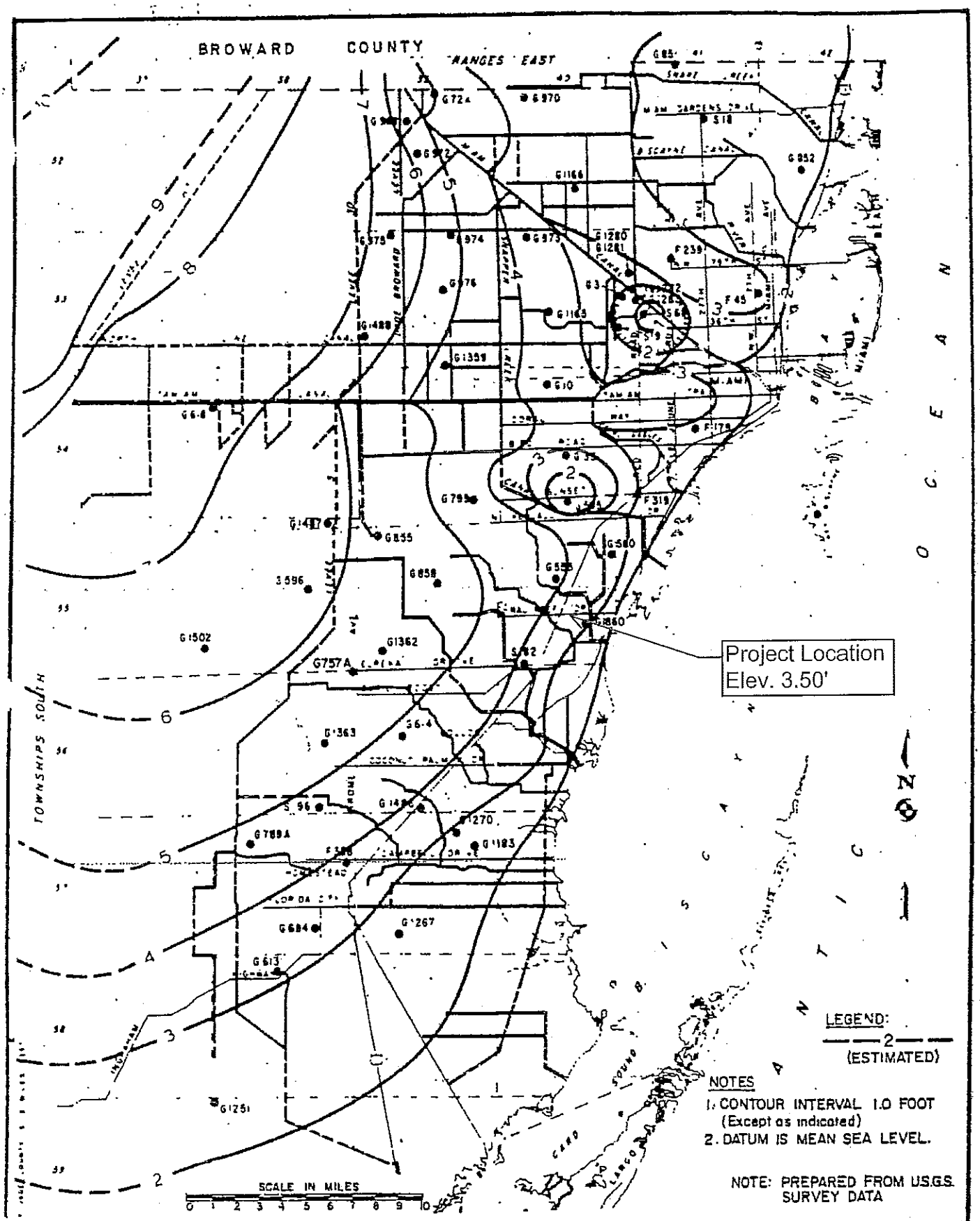
PUBLIC WORKS
9705 EAST HIBISCUS STREET
PALMETTO BAY, FL 33157
PH: (305) 259-1234 FAX: (305) 259-1290
www.palmetto-bay.org

LINDA BELL, P.E.
FL. NO. 58547

CWI Civil Works, Inc.
Consulting Engineers CA 07528
8491 N.W. 17 ST., Suite 108
Doral, FL. 33126 (305)591-4323

DRAINAGE SHEET

C-3



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5/72	REVISED 2/9/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960-75	W.C. 2.2 SHEET 1 OF 1

Appendix C: Isohyetal Maps
from SFWMD Technical Memorandum, *Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida*, Paul Trimble, October 1990.

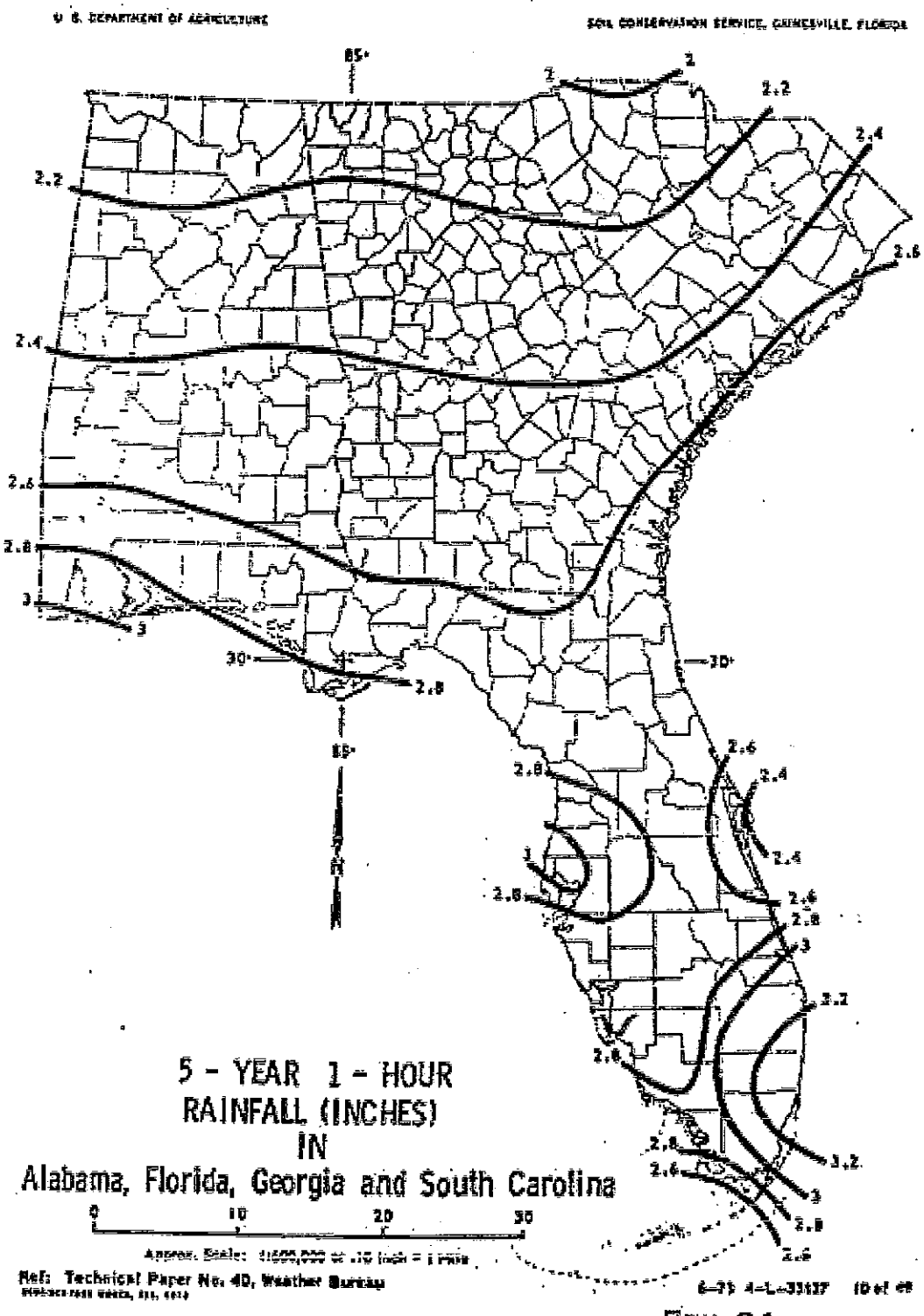


Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

Attention: Ms. Linda M. Bell, PE - President

Re: **Letter Report of Borehole Percolation Testing**
Proposed Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Dear Ms. Bell:

GEOSOL, Inc. (GEOSOL) is pleased to submit the enclosed letter report containing the results of the borehole percolation testing for the above-referenced project. These services were provided in accordance with our proposal No. P-216112 dated February 25, 2016. You provided authorization for our services on February 29, 2016.

Based on information you provided to us on February 25, 2016, we understand that the project consists of providing drainage improvements in the Village of Palmetto Bay, Florida. As requested, our scope of services was limited to performing seven (7) borehole percolation tests (P-1 through P-7) at depths of 15 feet below existing grades for use in drainage evaluations and design in the following areas:

- Along SW 87th Avenue, between SW 142nd Street and SW 143rd Street,
- In the vicinity of the property located at 16625 SW 80th Avenue,
- In the vicinity of the property located at 7990 SW 155th Street,
- Along SW 80th Avenue, between SW 152nd Street and SW 148th Street,
- Along SW 84th Court, between SW 147th Street and SW 147th Terrace,
- In the vicinity of the property located at 15735 SW 88th Court, and
- In the vicinity of the property located at 7330 SW 145th Terrace

The test locations were identified in the field utilizing the drainage map you provided, standard taping procedures and existing landmarks. A test location plan is presented in Sheet 1 attached to this letter.

The borehole percolation tests were performed in general accordance with the South Florida Water Management District (SFWMD) "Usual Open-Hole" constant head method. The borehole percolation tests were performed to determine the hydraulic conductivity values (k) of the subsurface materials at depths of 15 feet below existing ground surface. The boreholes were drilled by means of a 6¾-inch diameter tri-cone bit and water. Upon drilling the boreholes, we inserted a 6-inch diameter perforated PVC pipe in the ground and used a pump for purging the well prior to the start of each test. After completion of the borehole percolation tests, the boreholes were grouted and the sites were cleaned as required. The hydraulic conductivity values (k) were determined from the test results and are tabulated in Table 1 attached to this letter. The hydraulic conductivity values are reported in units of cubic feet per second per square foot of seepage area per foot of head (cfs/ft²-ft.).

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

ORACIO RICCOBONO LICENSE 49324 STATE OF FLORIDA

3/17/16

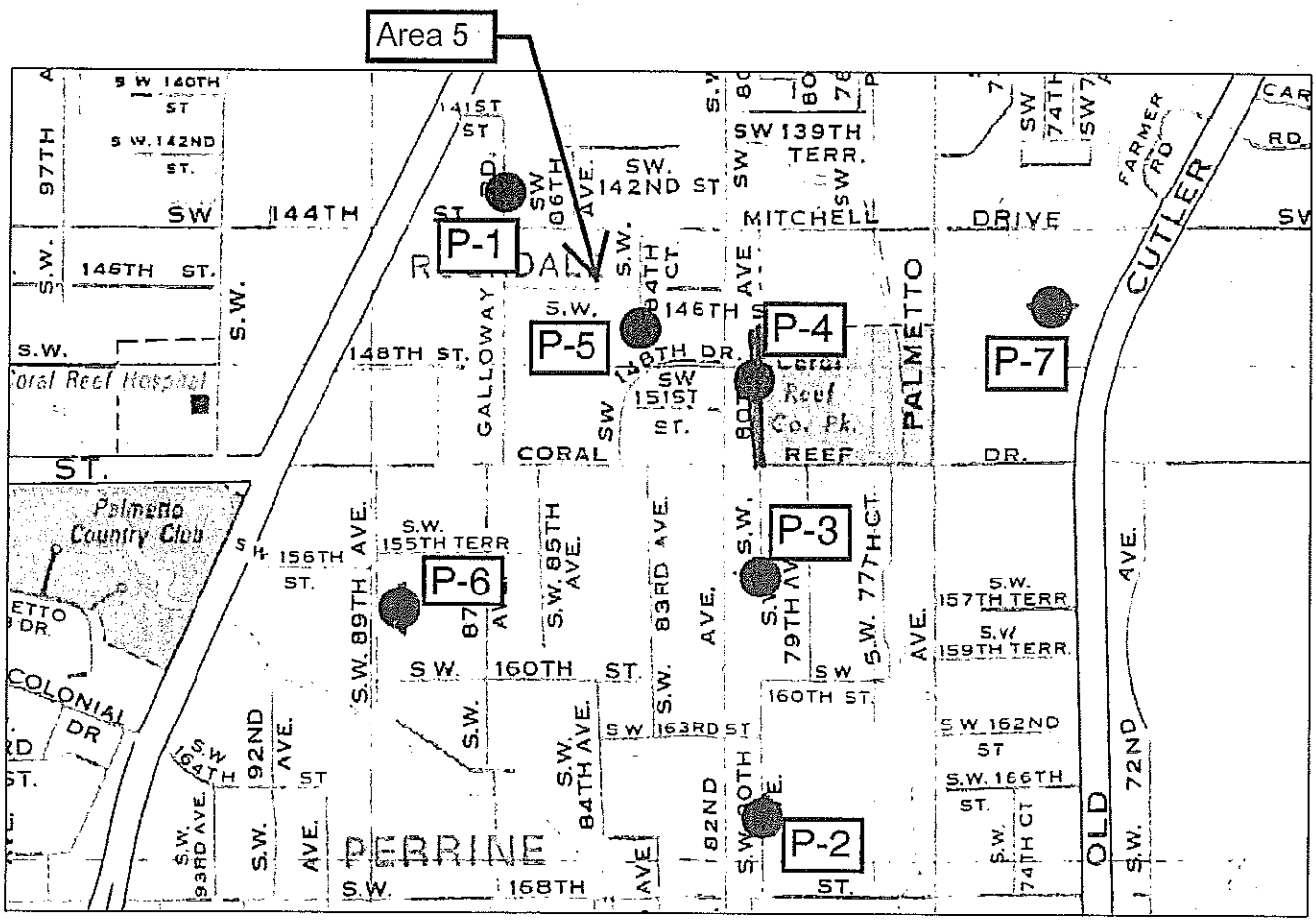
Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

GEOSOL, INC.
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	SHEET
OR	MAR., 2016	1

TABLE 1 - SUMMARY OF CONSTANT HEAD PERCOLATION TEST RESULTS

Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Test No.	Date Performed	Diameter		Depth of Hole (Feet)	Depth to Groundwater Level Below Ground Surface (Feet)		SATURATED HOLE DEPTH Ds (Feet)	Corrected Depth of Hole (Feet)	Average Flow Rate (gpm)	K, Hydraulic Conductivity (cfs/ft^2-Ft Head)
		Casing (Inches)	Hole (Inches)		Prior to Test	During Test				
P-1	03/11/16	6.00	6.75	15	9.6	8.60	5.40	6.40	15.0	3.13E-03
P-2	03/14/16	6.00	6.75	15	7.0	6.00	8.00	9.00	14.8	2.16E-03
P-3	03/14/16	6.00	6.75	15	7.4	6.40	7.60	8.60	14.6	2.23E-03
P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
P-6	03/14/16	6.00	6.75	15	7.9	6.90	7.10	8.10	14.3	2.33E-03
P-7	03/14/16	6.00	6.75	15	8.2	7.20	6.80	7.80	15.0	2.54E-03

NOTES:

(1) The above hydraulic conductivity values are for a French drain installed to the same depth as the borehole tests. The values represent an ultimate value. The designer should decide on the required factor of safety.

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure as shown on the following page.

(3) The diameter of the CASING was used in the computation of the hydraulic conductivity values presented in the above table.

SUBSURFACE STRATIFICATION

TEST No.	TEST LOCATION (FEET)		DEPTH (FEET)		GENERAL MATERIAL DESCRIPTION
	NORTHING	EASTING	FROM	TO	
P-1	474526	875591	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	1.60	Brown Fine to Medium SAND
			1.60	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-2	466673	879380	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.30	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.30	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-3	470380	879198	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-4	472548	879041	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.00	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.00	1.50	Brown Fine to Medium SAND
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-5	473063	876849	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-6	469407	874855	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.40	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.40	2.00	Brown Sandy LIMESTONE
			2.00	15.00	Light Brown Sandy LIMESTONE
P-7	473846	882587	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	2.20	Brown Sandy LIMESTONE
			2.20	15.00	Light Brown Sandy LIMESTONE

2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

SW 80 Avenue (Area - 4)

from SW 148 Street to SW 152 Street

PREPARED FOR:

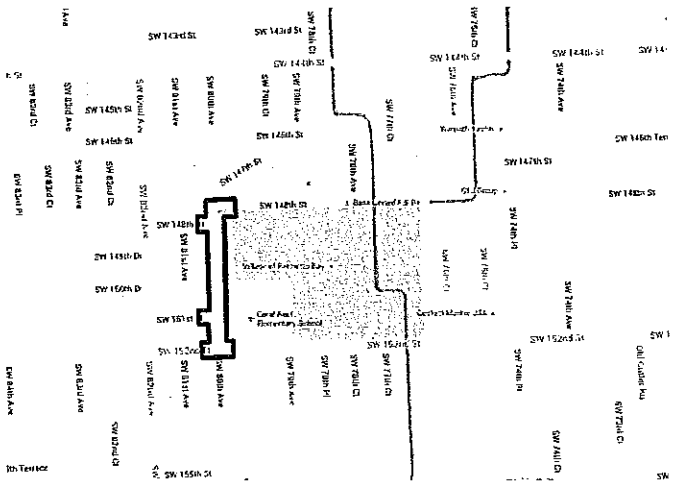
Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

June 8, 2016

VAUGHN SOARES
LICENSE
No. 56912
STATE OF FLORIDA
PROFESSIONAL ENGINEER

Vaughn Soares, P.E.
Florida Registered
No. 56912

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 80 Avenue from SW 148 Street to SW 152 Street. This is a residential neighborhood that experiences localized ponding during normal rain events. The location is bounded on the east side by Coral Reef Elementary School. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales, inlets and exfiltration trenches. The proposed drainage system includes reconstructing swales, proposed inlets, and a **total of 65 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. The new drainage system will connect to the existing system in one location. This proposed system will remain a closed one (no outfall). This report and drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= **139,478 sf** = **3.20** ac
Impervious Area	= **70,492 st** = **1.62** ac
Pervious Area	= **68,986 sf** = **1.58** ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.80 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-4	2.84×10^{-3}

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 4	**11.5**	**2**	**23**	**65**

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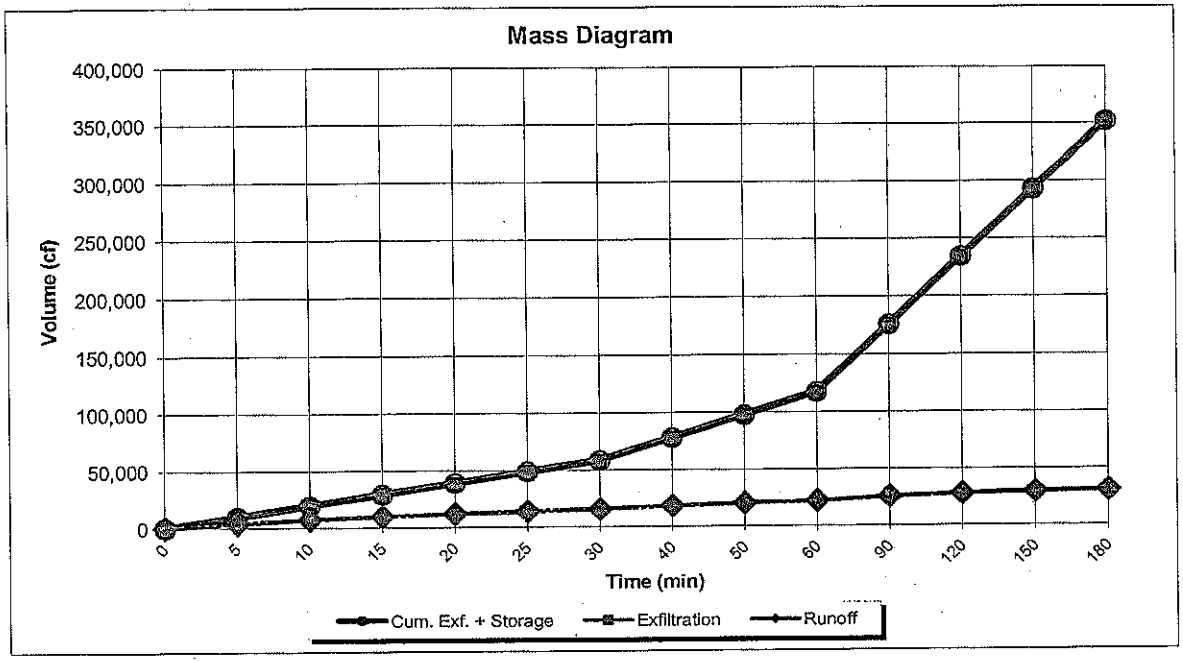
ATTACHMENTS

- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	1.62
Acres of pervious area:	1.58
Linear feet of Trench Provided:	85
Rate of exfiltration: (cfs/lf)	0.3831
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.60
Total drainage area (ac):	3.20
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	23
MDPW Project (Y/N)	N

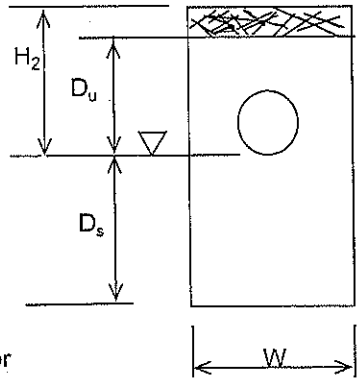


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	0	32.6	0	0	0
5	6.80	13.06	3,917	32.6	9,768	0	9,768
10	6.17	11.84	7,106	32.6	19,536	0	19,536
15	5.64	10.84	9,753	32.6	29,304	0	29,304
20	5.20	9.99	11,985	32.6	39,073	0	39,073
25	4.82	9.26	13,892	32.6	48,841	0	48,841
30	4.50	8.63	15,541	32.6	58,609	0	58,609
40	3.96	7.60	18,248	32.6	78,145	0	78,145
50	3.54	6.79	20,378	32.6	97,681	0	97,681
60	3.20	6.14	22,098	32.6	117,218	0	117,218
90	2.48	4.76	25,715	32.6	175,826	0	175,826
120	2.03	3.89	28,007	32.6	234,435	0	234,435
150	1.71	3.29	29,589	32.6	293,044	0	293,044
180	1.48	2.85	30,747	32.6	351,653	0	351,653

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	0
5	3,917	9,768	0
10	7,106	19,536	0
15	9,753	29,304	0
20	11,985	39,073	0
25	13,892	48,841	0
30	15,541	58,609	0
40	18,248	78,145	0
50	20,378	97,681	0
60	22,098	117,218	0
90	25,715	175,826	0
120	28,007	234,435	0
150	29,589	293,044	0
180	30,747	351,653	0

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	9.52
Trench Top	7.52
Weir Elev.	
October Water Elev.	3.80
Pipe Inv.	6.02
Pipe Dia. (ft)	1.50
Trench Bott	-5.48



W:	3.50	ft
H_2:	5.72	ft
Du:	3.72	ft
Ds:	9.28	ft
K:	2.84E-03	$cfs/ft^2/ft$
Exf. Rate:	0.3831	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K^*[H_2W + 2H_2D_u - D_u^2+2H_2D_s]$
Du < Ds $K^*[(2H_2D_u) - D_u^2+2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
		Total Pipe Storage		**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
3.20 ac x 1 in. = **3.20** ac-in

2.5" Over the Percent Imperviousness
1.62 ac x 1.27 in. = **2.05** ac-in

INITIAL VOLUME TO TREAT **3.20** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr $i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$

Storm Frequency (F)
Time to generate **3.20** ac-in $V = CiAt_r$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **11,616** cf

11,616 = C *i* A t /(60 min /hr)

$= 0.600 \times \frac{308.5}{40.71 + 0.93t} \times 3.2$ ac * t * (60 sec/min)

11,616 = $\frac{35,539\ t}{40.71 + 0.93t}$

35,539 t - 10,799 t = 472,940

t = 20.00 min

Total Time = t_c + t = **30** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 30 min = 4.50 in/hr

V = **4.32** **ac-in**

WATER QUANITY CALCULATIONS - SCS Method

Design Storm	5 yr	1 hr
Lowest Elevation	9.52 ft	
October Water Elevation	3.80 ft (NGVD)	
Depth to Water Table	5.72 ft	
Soil Storage (SS)	8.18 in	

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
1.58	1.62	3.20	8.18	12.92	4.038875	71.23

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 4.038875
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.89** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **2.85** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **7.40** ft

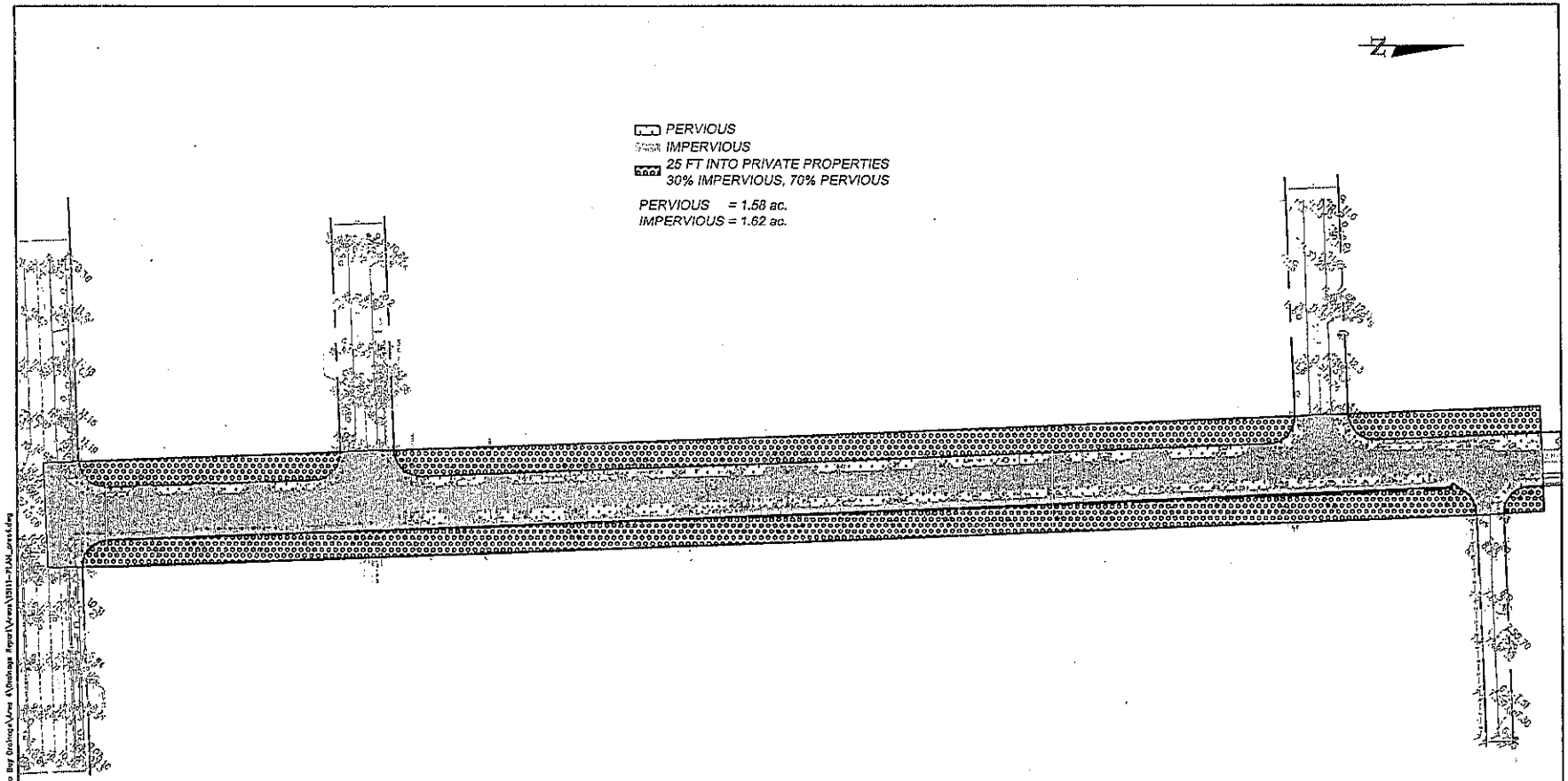
Use **8** ft

Du < Ds (Conservative)

$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$



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REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Date 06/08/2018
Drawn RLR
Checked VB
Manager Linda Bell, P.E.
Technician TROPE

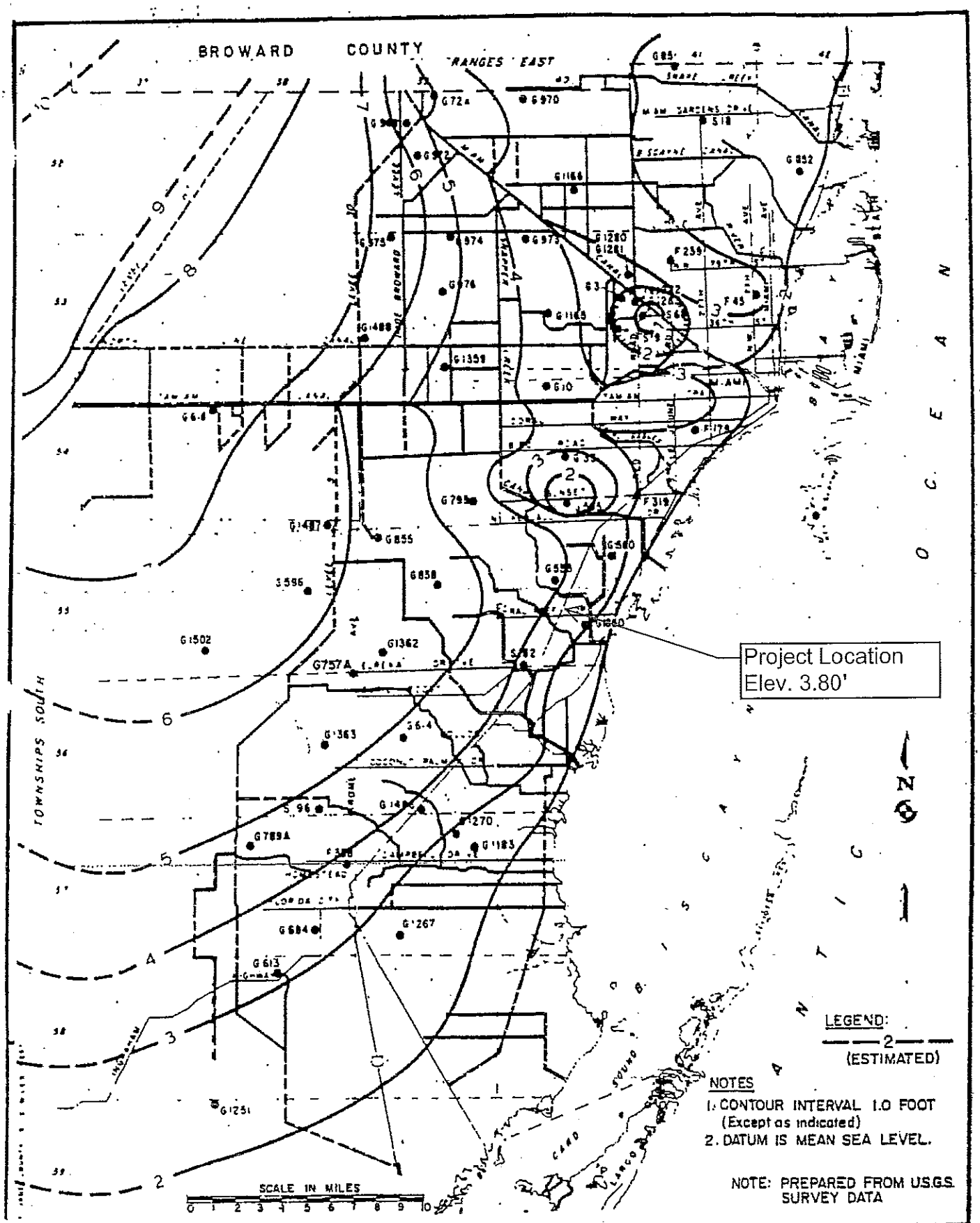
PUBLIC WORKS
9705 EAST HIBISCUS STREET
PALMETTO BAY, FL 33157
PH: (305) 259-1234 FAX: (305) 259-1250
www.palmettobay-fl.gov

LINDA BELL, P.E.
FL REG. #70542

CWI Civil Works, Inc.
Consulting Engineers CA 07518
8491 N.W. 17 ST., Suite 118
Doral, FL 33126 (305)591-4333

DRAINAGE SHEET

C-3



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5 72	REVISED 2/19/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960–75	W.C. 2.2 SHEET 1 OF 1

Appendix C: Isohyetal Maps
from SFWMD Technical Memorandum, *Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida*, Paul Trimble, October 1990.

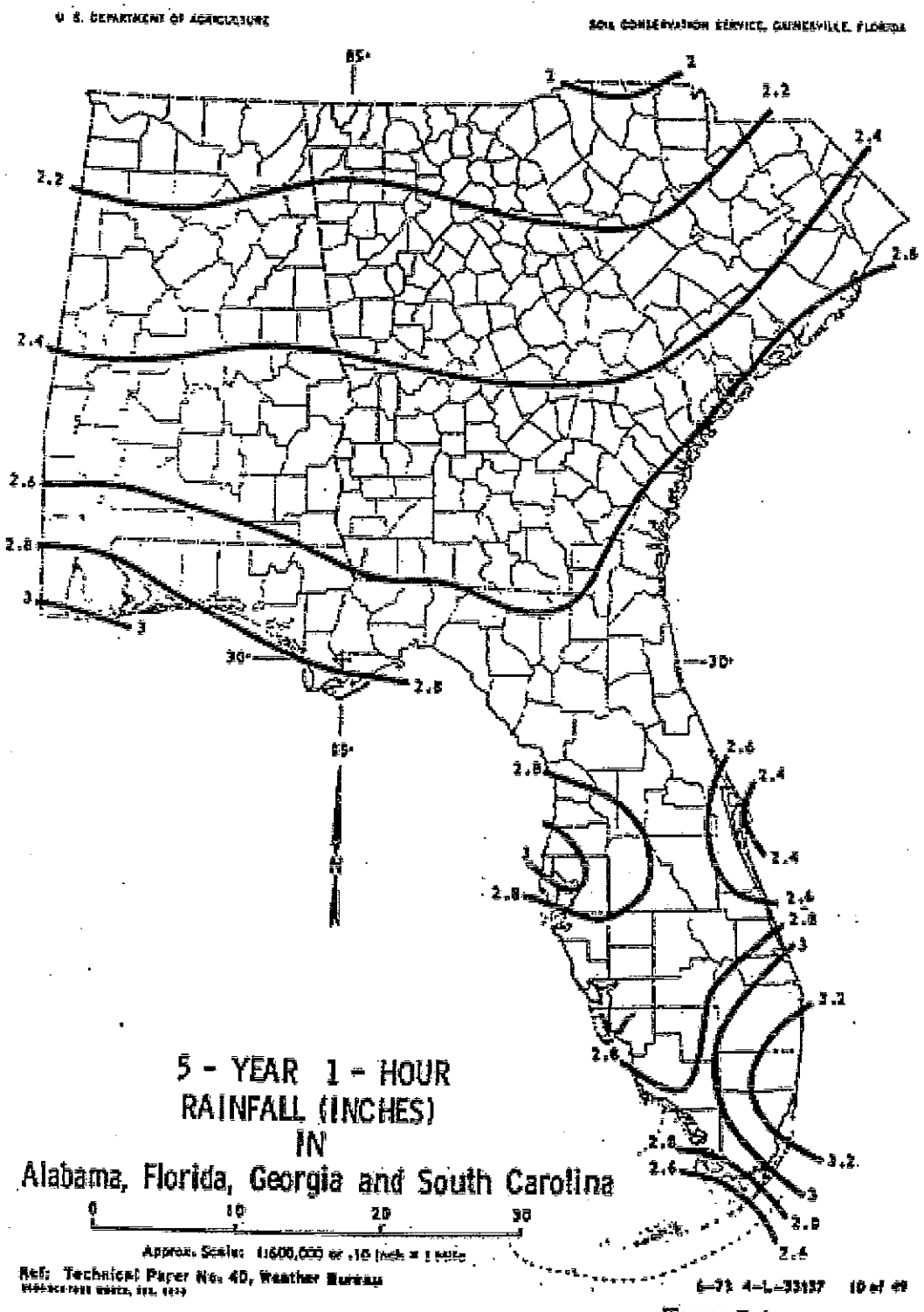


Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

Attention: Ms. Linda M. Bell, PE - President

Re: **Letter Report of Borehole Percolation Testing**
Proposed Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Dear Ms. Bell:

GEOSOL, Inc. (GEOSOL) is pleased to submit the enclosed letter report containing the results of the borehole percolation testing for the above-referenced project. These services were provided in accordance with our proposal No. P-216112 dated February 25, 2016. You provided authorization for our services on February 29, 2016.

Based on information you provided to us on February 25, 2016, we understand that the project consists of providing drainage improvements in the Village of Palmetto Bay, Florida. As requested, our scope of services was limited to performing seven (7) borehole percolation tests (P-1 through P-7) at depths of 15 feet below existing grades for use in drainage evaluations and design in the following areas:

- Along SW 87th Avenue, between SW 142nd Street and SW 143rd Street,
- In the vicinity of the property located at 16625 SW 80th Avenue,
- In the vicinity of the property located at 7990 SW 155th Street,
- Along SW 80th Avenue, between SW 152nd Street and SW 148th Street,
- Along SW 84th Court, between SW 147th Street and SW 147th Terrace,
- In the vicinity of the property located at 15735 SW 88th Court, and
- In the vicinity of the property located at 7330 SW 145th Terrace

The test locations were identified in the field utilizing the drainage map you provided, standard taping procedures and existing landmarks. A test location plan is presented in Sheet 1 attached to this letter.

The borehole percolation tests were performed in general accordance with the South Florida Water Management District (SFWMD) "Usual Open-Hole" constant head method. The borehole percolation tests were performed to determine the hydraulic conductivity values (k) of the subsurface materials at depths of 15 feet below existing ground surface. The boreholes were drilled by means of a 6¾-inch diameter tri-cone bit and water. Upon drilling the boreholes, we inserted a 6-inch diameter perforated PVC pipe in the ground and used a pump for purging the well prior to the start of each test. After completion of the borehole percolation tests, the boreholes were grouted and the sites were cleaned as required. The hydraulic conductivity values (k) were determined from the test results and are tabulated in Table 1 attached to this letter. The hydraulic conductivity values are reported in units of cubic feet per second per square foot of seepage area per foot of head (cfs/ft²-ft.).

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

ORACIO RICCOBONO LICENSE

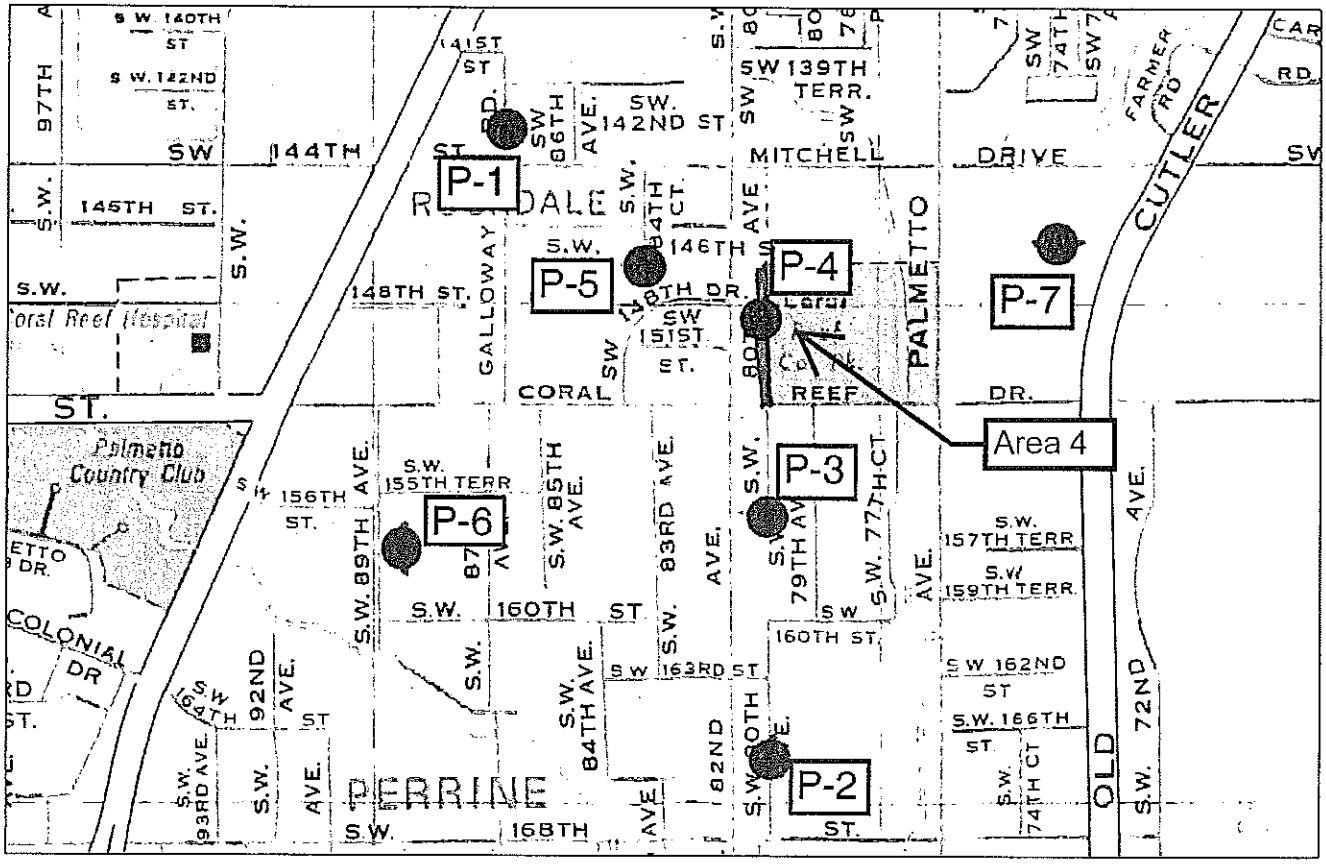
Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

GEOSOL, Inc.
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	
OR	MAR., 2016	SHEET 1

TABLE 1 - SUMMARY OF CONSTANT HEAD PERCOLATION TEST RESULTS

Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Test No.	Date Performed	Diameter		Depth of Hole	Depth to Groundwater Level Below Ground Surface (Feet)		SATURATED HOLE DEPTH	Corrected Depth of	Average Flow Rate	K, Hydraulic Conductivity
		Casing (Inches)	Hole (Inches)	(Feet)	Prior to Test	During Test	Ds (Feet)	Hole (Feet)	(gpm)	(cfs/ft^2-Ft Head)
P-1	03/11/16	6.00	6.75	15	9.6	8.60	5.40	6.40	15.0	3.13E-03
P-2	03/14/16	6.00	6.75	15	7.0	6.00	8.00	9.00	14.8	2.16E-03
P-3	03/14/16	6.00	6.75	15	7.4	6.40	7.60	8.60	14.6	2.23E-03
P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
P-6	03/14/16	6.00	6.75	15	7.9	6.90	7.10	8.10	14.3	2.33E-03
P-7	03/14/16	6.00	6.75	15	8.2	7.20	6.80	7.80	15.0	2.54E-03

NOTES:

(1) The above hydraulic conductivity values are for a French drain installed to the same depth as the borehole tests. The values represent an ultimate value. The designer should decide on the required factor of safety.

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure as shown on the following page.

(3) The diameter of the CASING was used in the computation of the hydraulic conductivity values presented in the above table.

SUBSURFACE STRATIFICATION

TEST No.	TEST LOCATION (FEET)		DEPTH (FEET)		GENERAL MATERIAL DESCRIPTION
	NORTHING	EASTING	FROM	TO	
P-1	474526	875591	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	1.60	Brown Fine to Medium SAND
			1.60	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-2	466673	879380	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.30	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.30	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-3	470380	879198	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-4	472548	879041	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.00	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.00	1.50	Brown Fine to Medium SAND
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-5	473063	876849	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-6	469407	874855	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.40	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.40	2.00	Brown Sandy LIMESTONE
			2.00	15.00	Light Brown Sandy LIMESTONE
P-7	473846	882587	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	2.20	Brown Sandy LIMESTONE
			2.20	15.00	Light Brown Sandy LIMESTONE

2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

SW 155 Street (Area - 3)

from east of SW 81 Ave to end of Cul de Sac (SW 79 Ave)

PREPARED FOR:

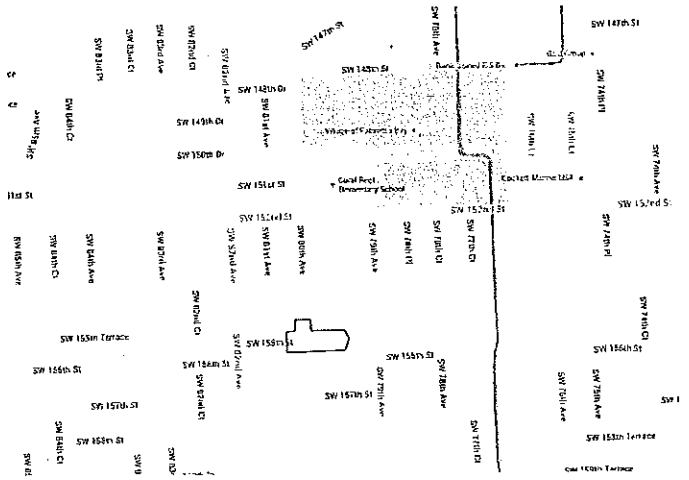
Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

June 8, 2016

VAUGHN SOARES
LICENSE
No. 56912
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Vaughn Soares, P.E.
Florida Registered
No. 56912

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 155 Street from east of SW 80 Avenue to the end of the Cul de Sac (approx. SW 79 Street). This is a residential neighborhood that experiences localized ponding during normal rain events. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales, inlets and exfiltration trenches. The proposed drainage system includes reconstructing swales, a proposed inlet, and a **total of 20 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. This proposed system will remain a closed one (no outfall). This report and the drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= 22,566 sf = 0.75 ac
Impervious Area	= 12,687 sf = 0.29 ac
Pervious Area	= 19,872 sf = 0.46 ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.20 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-3	2.23×10^{-3}

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 3	**3.5**	**2**	**7**	**20**

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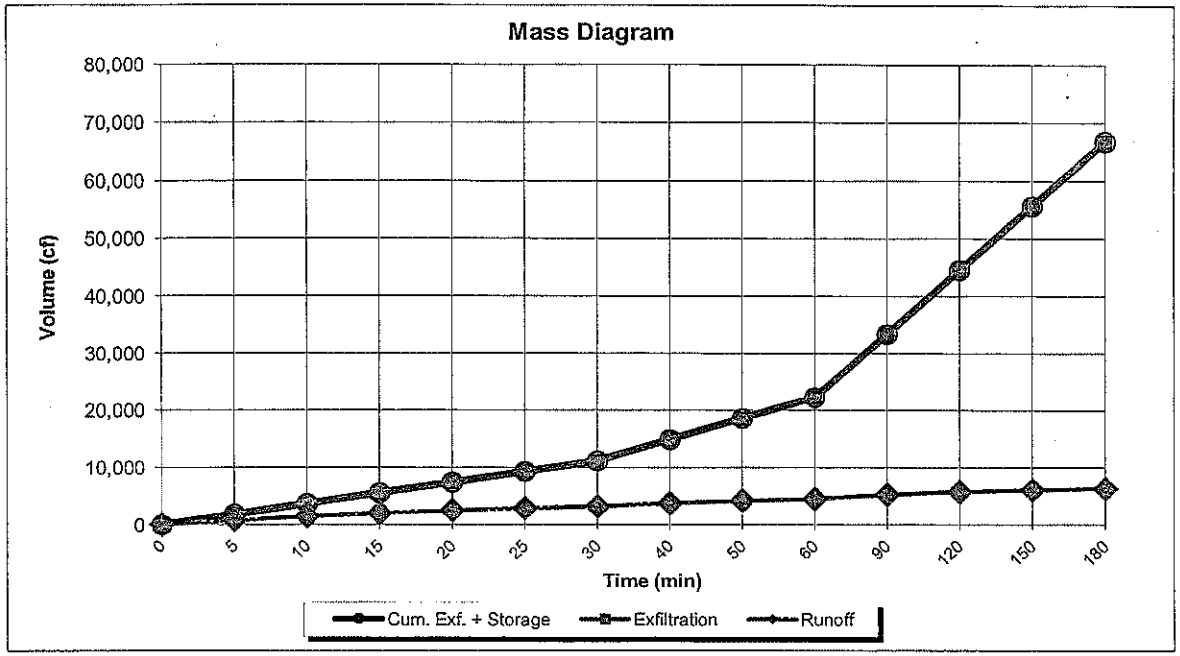
ATTACHMENTS

- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	0.29
Acres of pervious area:	0.46
Linear feet of Trench Provided:	20
Rate of exfiltration: (cfs/lf)	0.3094
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.53
Total drainage area (ac):	0.75
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	7
MDPW Project (Y/N)	N

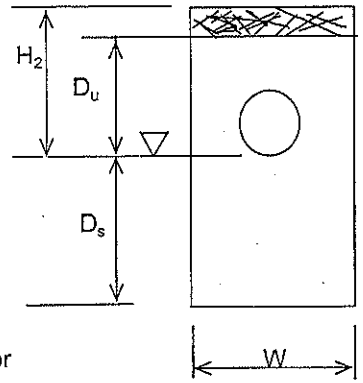


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	**0**	6.2	0	0	0
5	6.80	2.70	**811**	6.2	1,856	0	1,856
10	6.17	2.45	**1,471**	6.2	3,713	0	3,713
15	5.64	2.24	**2,019**	6.2	5,569	0	5,569
20	5.20	2.07	**2,481**	6.2	7,425	0	7,425
25	4.82	1.92	**2,876**	6.2	9,281	0	9,281
30	4.50	1.79	**3,217**	6.2	11,138	0	11,138
40	3.96	1.57	**3,778**	6.2	14,850	0	14,850
50	3.54	1.41	**4,219**	6.2	18,563	0	18,563
60	3.20	1.27	**4,575**	6.2	22,275	0	22,275
90	2.48	0.99	**5,324**	6.2	33,413	0	33,413
120	2.03	0.81	**5,798**	6.2	44,551	0	44,551
150	1.71	0.68	**6,126**	6.2	55,688	0	55,688
180	1.48	0.59	**6,366**	6.2	66,826	0	66,826

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	**0**
5	811	1,856	**0**
10	1,471	3,713	**0**
15	2,019	5,569	**0**
20	2,481	7,425	**0**
25	2,876	9,281	**0**
30	3,217	11,138	**0**
40	3,778	14,850	**0**
50	4,219	18,563	**0**
60	4,575	22,275	**0**
90	5,324	33,413	**0**
120	5,798	44,551	**0**
150	6,126	55,688	**0**
180	6,366	66,826	**0**

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	9.13
Trench Top	7.13
Weir Elev.	
October Water Elev.	3.20
Pipe Inv.	5.63
Pipe Dia. (ft)	1.50
Trench Bott	-5.87



W:	3.50	ft
H_2:	5.93	ft
Du:	3.93	ft
Ds:	9.07	ft
K:	2.23E-03	$cfs/ft^2/ft$
Exf. Rate:	0.3094	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K^*[H_2W + 2H_2D_u - D_u^2 + 2H_2D_s]$
Du < Ds $K^*[(2H_2D_u) - D_u^2 + 2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
		Total Pipe Storage		**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
0.75 ac x 1 in. = **0.75** ac-in

2.5" Over the Percent Imperviousness
0.29 ac x 0.97 in. = **0.28** ac-in

INITIAL VOLUME TO TREAT **0.75** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr

$$i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$$

Storm Frequency (F)
Time to generate **0.75** ac-in $V = CiAt_{1"}$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **2,723** cf

2,723 = C *i* A t /(60 min /hr)

$$= 0.530 \times \frac{308.5}{40.71 + 0.93t} \times 0.75 \text{ ac * t * (60 sec/min)}$$

$$2{,}723 = \frac{7{,}358\ t}{40.71 + 0.93t}$$

7,358 t - 2,531 t = 110,845

t = 23.00 min

Total Time = t_c + t = **33** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 33 min = 4.32 in/hr

V = **0.94** **ac-in**

WATER QUANTITY CALCULATIONS - SCS Method

Design Storm 5 yr 1 hr
Lowest Elevation 9.13 ft
October Water Elevation 3.20 ft (NGVD)
Depth to Water Table 5.93 ft
Soil Storage (SS) 8.18 in

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
0.46	0.29	0.75	8.18	3.76	5.017067	66.59

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 5.0170667
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.67** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **0.50** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **1.61** ft

Use **2** ft

Du < Ds (Conservative)

$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

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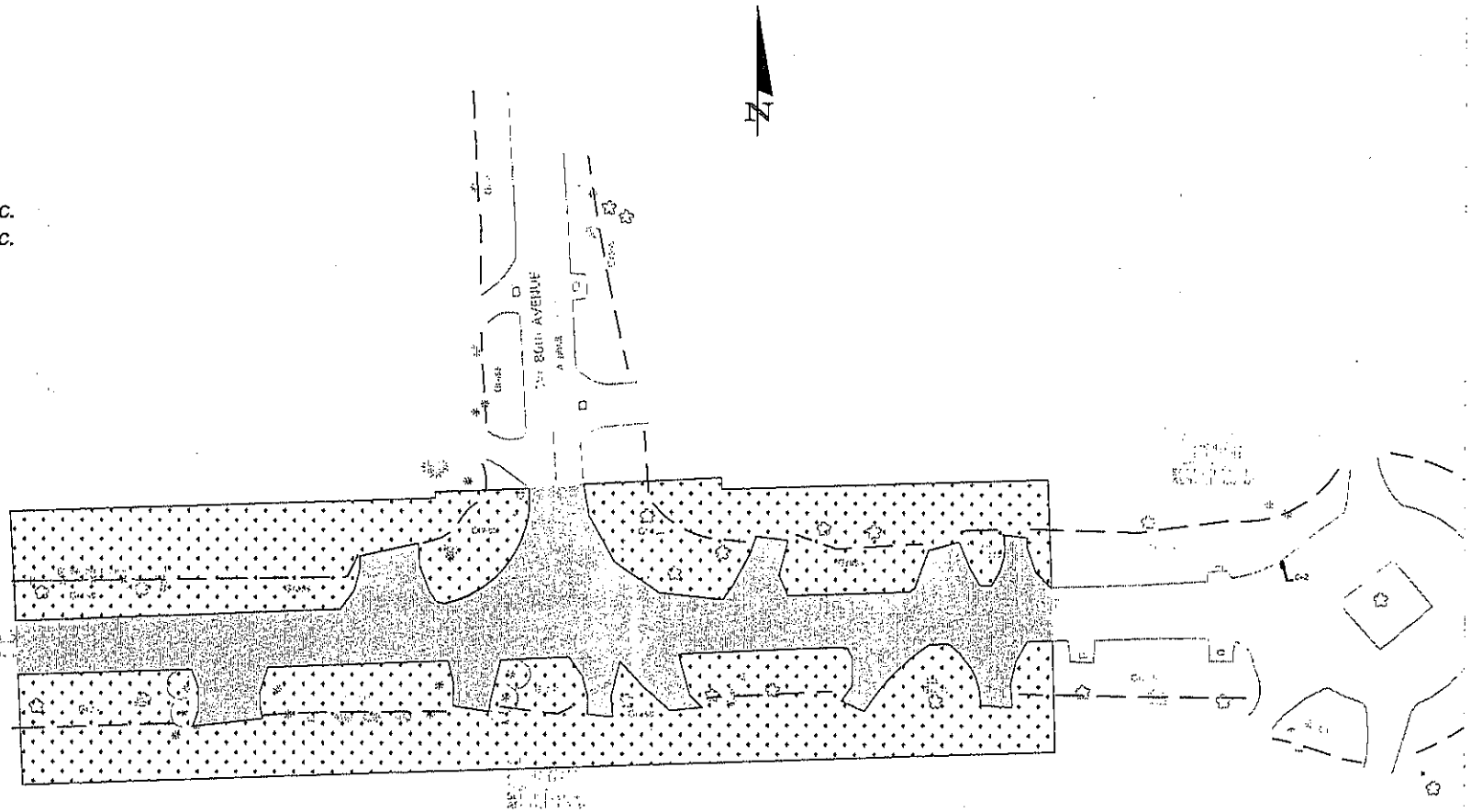
PERVIOUS
IMPERVIOUS

PERVIOUS = 0.46 ac.
IMPERVIOUS = 0.29 ac.



SW 155 ST (AREA 3)

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Date	06/08/2016
Reviewed	BLH
Checked	LB
Manager	Linda Bell, P.E.
Submittal	100%

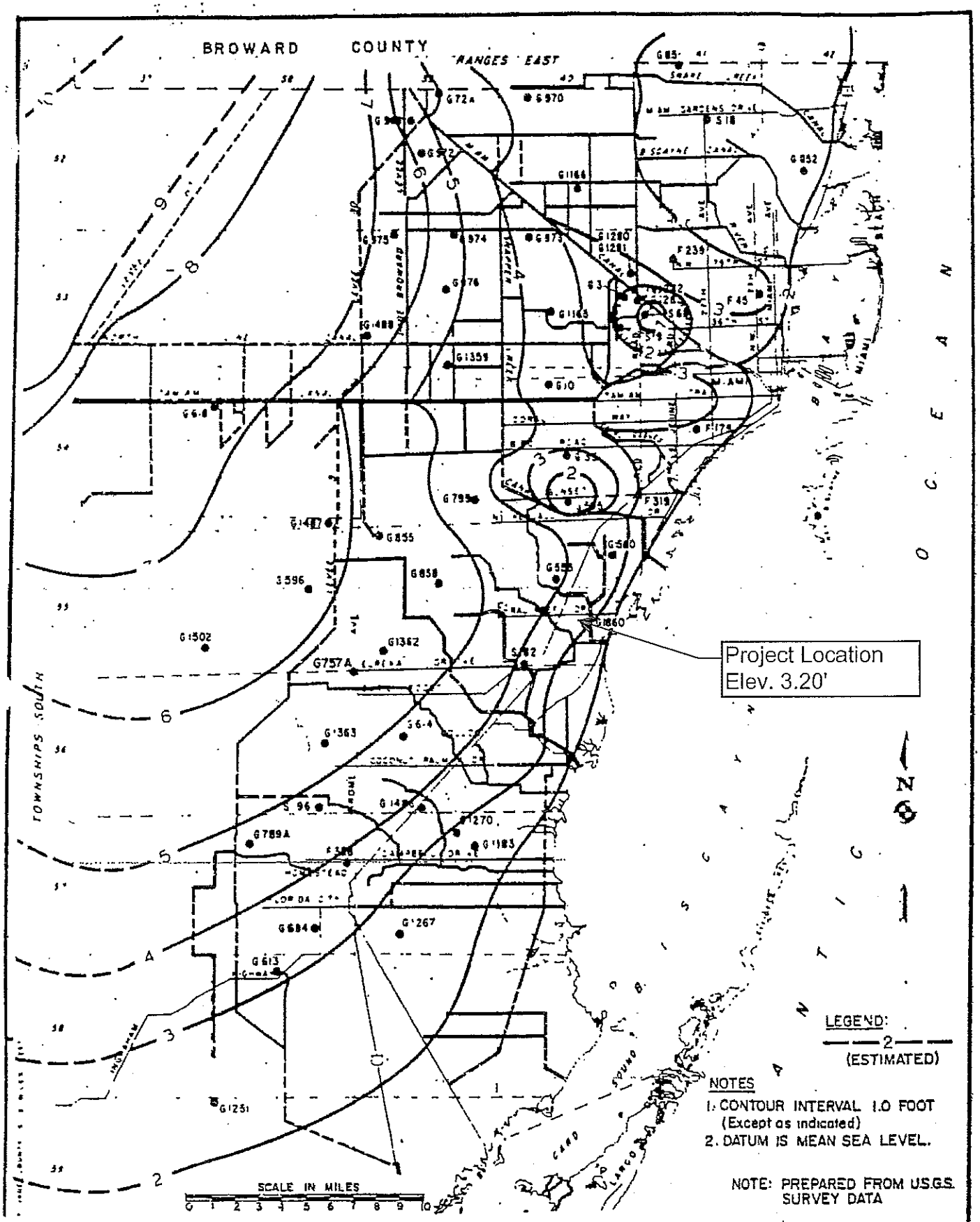
PUBLIC WORKS
9705 EAST HIBISCUS STREET
PALMETTO BAY, FL 33157
PH: (305) 235-1324 FAX: (305) 259-1236

LINDA BELL, P.E.
FL NO. 39542

CWI Civil Works, Inc.
Consulting Engineers CA 07528
8491 N.W. 17 ST., Suite 108
Doral, FL 33126 (305)591-4323

DRAINAGE SHEET

C-3



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5/72	REVISED 2/19/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960–75	W.C. 2.2 SHEET 1 OF 1

Appendix C: Isohyetal Maps
from SFWMD Technical Memorandum, *Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida*, Paul Trimble, October 1990.

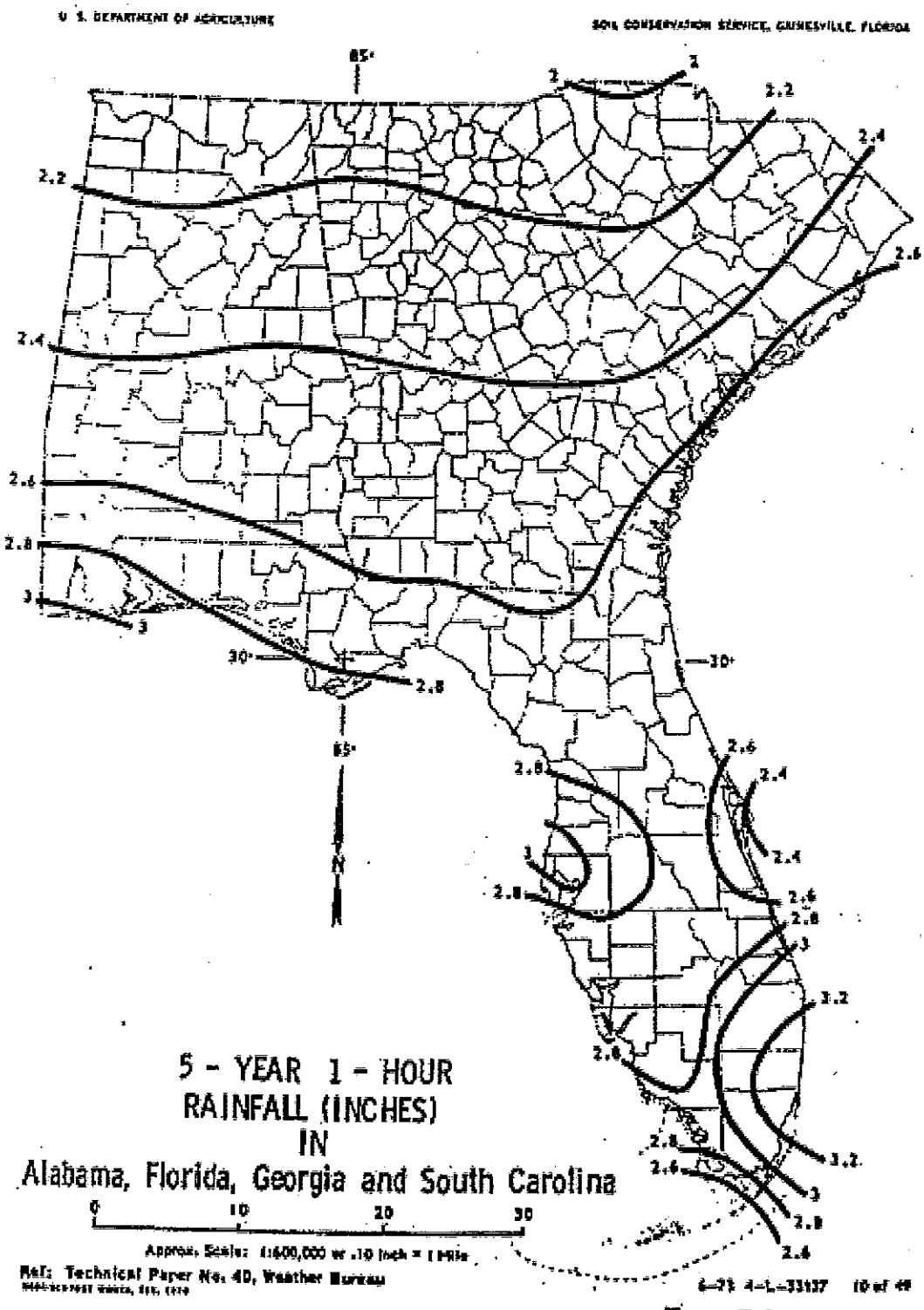


Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

Attention: Ms. Linda M. Bell, PE - President

Re: **Letter Report of Borehole Percolation Testing**
Proposed Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Dear Ms. Bell:

GEOSOL, Inc. (GEOSOL) is pleased to submit the enclosed letter report containing the results of the borehole percolation testing for the above-referenced project. These services were provided in accordance with our proposal No. P-216112 dated February 25, 2016. You provided authorization for our services on February 29, 2016.

Based on information you provided to us on February 25, 2016, we understand that the project consists of providing drainage improvements in the Village of Palmetto Bay, Florida. As requested, our scope of services was limited to performing seven (7) borehole percolation tests (P-1 through P-7) at depths of 15 feet below existing grades for use in drainage evaluations and design in the following areas:

- Along SW 87th Avenue, between SW 142nd Street and SW 143rd Street,
- In the vicinity of the property located at 16625 SW 80th Avenue,
- In the vicinity of the property located at 7990 SW 155th Street,
- Along SW 80th Avenue, between SW 152nd Street and SW 148th Street,
- Along SW 84th Court, between SW 147th Street and SW 147th Terrace,
- In the vicinity of the property located at 15735 SW 88th Court, and
- In the vicinity of the property located at 7330 SW 145th Terrace

The test locations were identified in the field utilizing the drainage map you provided, standard taping procedures and existing landmarks. A test location plan is presented in Sheet 1 attached to this letter.

The borehole percolation tests were performed in general accordance with the South Florida Water Management District (SFWMD) "Usual Open-Hole" constant head method. The borehole percolation tests were performed to determine the hydraulic conductivity values (k) of the subsurface materials at depths of 15 feet below existing ground surface. The boreholes were drilled by means of a 6 ¾ -inch diameter tri-cone bit and water. Upon drilling the boreholes, we inserted a 6-inch diameter perforated PVC pipe in the ground and used a pump for purging the well prior to the start of each test. After completion of the borehole percolation tests, the boreholes were grouted and the sites were cleaned as required. The hydraulic conductivity values (k) were determined from the test results and are tabulated in Table 1 attached to this letter. The hydraulic conductivity values are reported in units of cubic feet per second per square foot of seepage area per foot of head (cfs/ft²-ft.).

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

ORACIO RICCOBONO LICENSE

3/17/16

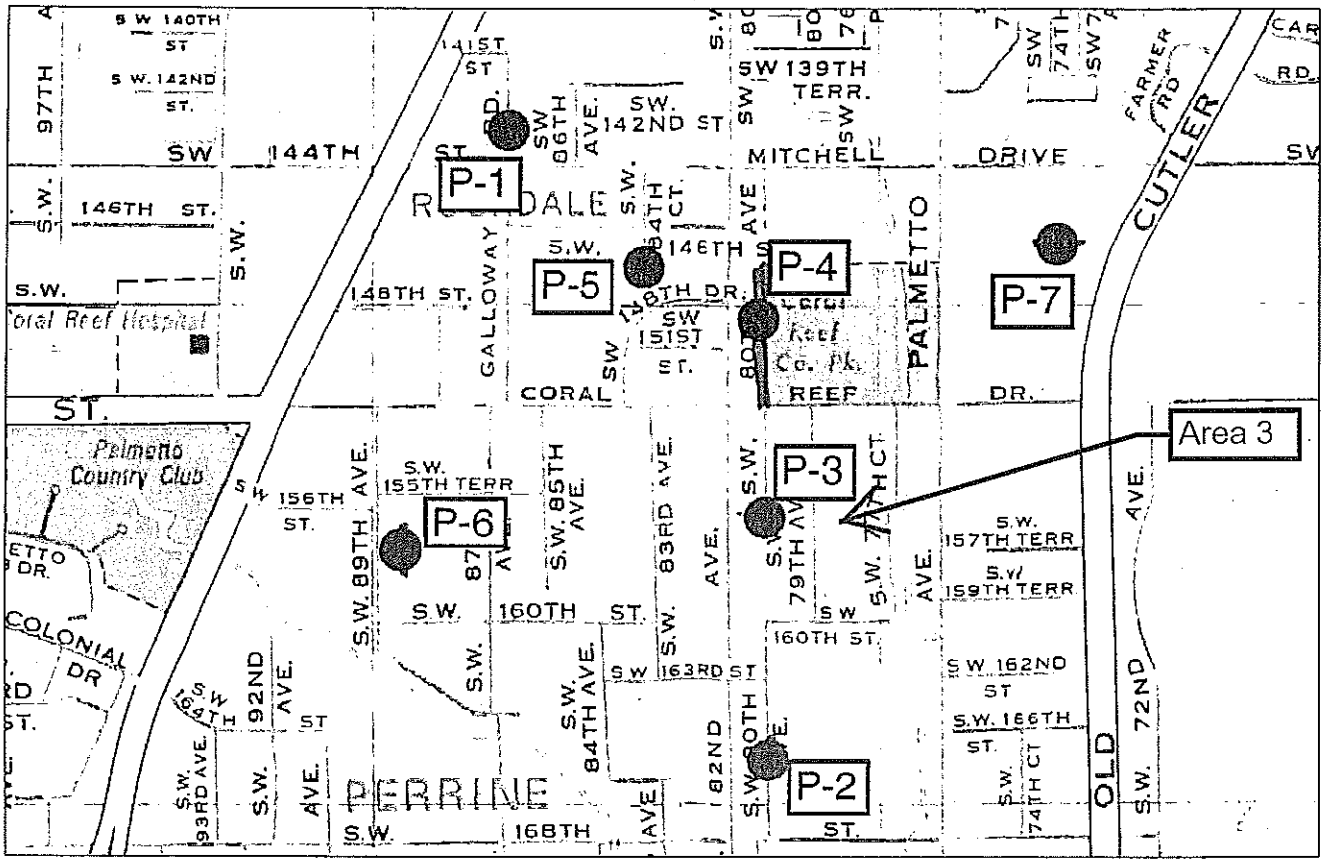
Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

GEOSOL, INC.
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	
OR	MAR., 2016	SHEET 1

TABLE 1 - SUMMARY OF CONSTANT HEAD PERCOLATION TEST RESULTS

Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Test No.	Date Performed	Diameter		Depth of Hole (Feet)	Depth to Groundwater Level Below Ground Surface (Feet)		SATURATED HOLE DEPTH Ds (Feet)	Corrected Depth of Hole (Feet)	Average Flow Rate (gpm)	K, Hydraulic Conductivity (cfs/ft^2-Ft Head)
		Casing (Inches)	Hole (Inches)		Prior to Test	During Test				
P-1	03/11/16	6.00	6.75	15	9.6	8.60	5.40	6.40	15.0	3.13E-03
P-2	03/14/16	6.00	6.75	15	7.0	6.00	8.00	9.00	14.8	2.16E-03
P-3	03/14/16	6.00	6.75	15	7.4	6.40	7.60	8.60	14.6	2.23E-03
P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
P-6	03/14/16	6.00	6.75	15	7.9	6.90	7.10	8.10	14.3	2.33E-03
P-7	03/14/16	6.00	6.75	15	8.2	7.20	6.80	7.80	15.0	2.54E-03

NOTES:

(1) The above hydraulic conductivity values are for a French drain installed to the same depth as the borehole tests. The values represent an ultimate value. The designer should decide on the required factor of safety.

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure as shown on the following page.

(3) The diameter of the CASING was used in the computation of the hydraulic conductivity values presented in the above table.

SUBSURFACE STRATIFICATION

TEST No.	TEST LOCATION (FEET)		DEPTH (FEET)		GENERAL MATERIAL DESCRIPTION
	NORTHING	EASTING	FROM	TO	
P-1	474526	875591	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	1.60	Brown Fine to Medium SAND
			1.60	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-2	466673	879380	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.30	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.30	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-3	470380	879198	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-4	472548	879041	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.00	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.00	1.50	Brown Fine to Medium SAND
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-5	473063	876849	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-6	469407	874855	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.40	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.40	2.00	Brown Sandy LIMESTONE
			2.00	15.00	Light Brown Sandy LIMESTONE
P-7	473846	882587	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	2.20	Brown Sandy LIMESTONE
			2.20	15.00	Light Brown Sandy LIMESTONE

2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

SW 80 Ave (Area - 2)

from SW 166 St to north of SW 168 St

PREPARED FOR:

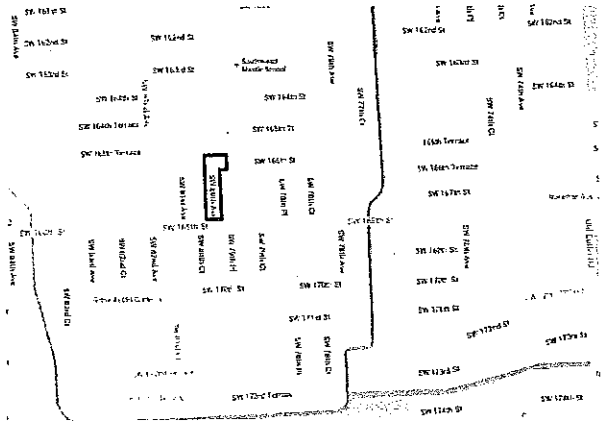
Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

June 8, 2016

VAUGHN SOARES
LICENSE
No. 56912
STATE OF FLORIDA
PROFESSIONAL ENGINEER

Vaughn Soares, P.E.
Florida Registered
No. 56912

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 80 Avenue from the intersection of SW 80 Ave and SW 166 Street to north of SW 168 Street. This is a residential neighborhood that experiences localized ponding during normal rain events. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales, inlets and exfiltration trenches. The proposed drainage system includes reconstructing swales, proposed inlets, and a **total of 40 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. This proposed system will remain a closed one (no outfall). This report and the drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= **0.84** ac
Impervious Area	= **11,041 sf** = **0.25** ac
Pervious Area	= **26,007 sf** = **0.59** ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.20 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-2	2.16×10^{-3}

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 2	**4**	**2**	**8**	**40**

2016-03-09 15111-DrnRprt_area2.docx

ATTACHMENTS

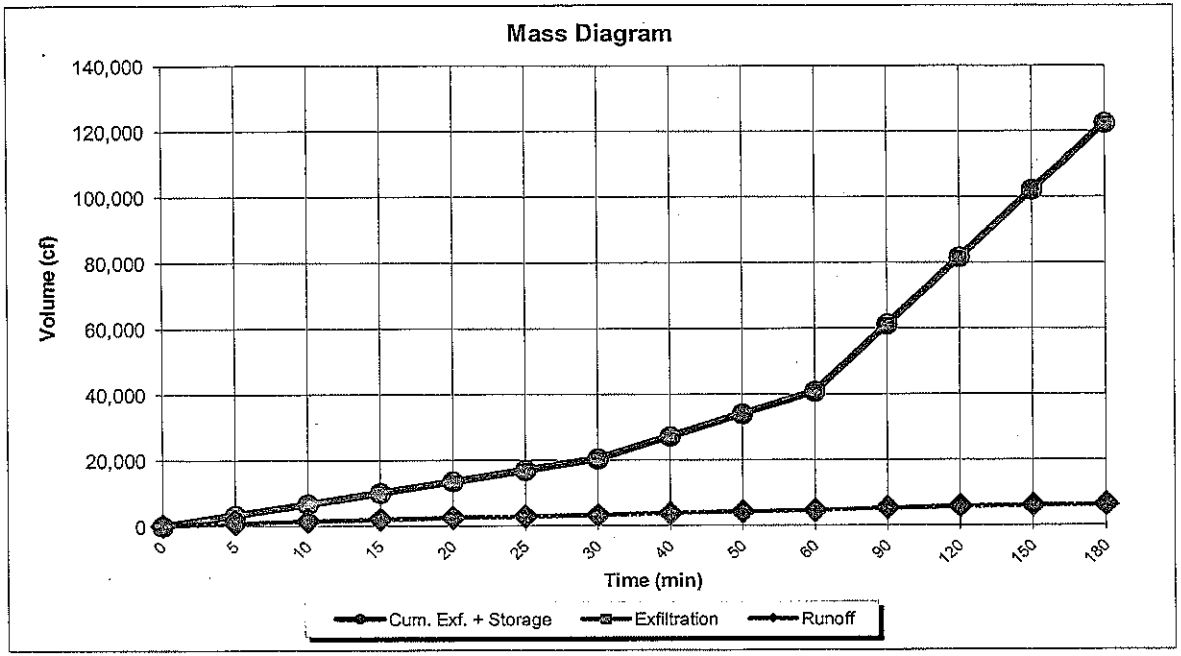
- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

CWI

Village of Palmetto Bay - SW 80 Ave. (Area - 2)
Water Quality - 5 yr.

6/9/2016

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	0.25
Acres of pervious area:	0.59
Linear feet of Trench Provided:	40
Rate of exfiltration: (cfs/lf)	0.2832
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.48
Total drainage area (ac):	0.84
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	8
MDPW Project (Y/N)	N

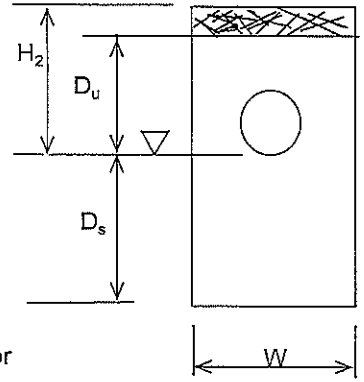


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	0	11.3	0	0	0
5	6.80	2.74	823	11.3	3,399	0	3,399
10	6.17	2.49	1,492	11.3	6,798	0	6,798
15	5.64	2.28	2,048	11.3	10,197	0	10,197
20	5.20	2.10	2,517	11.3	13,596	0	13,596
25	4.82	1.94	2,917	11.3	16,994	0	16,994
30	4.50	1.81	3,264	11.3	20,393	0	20,393
40	3.96	1.60	3,832	11.3	27,191	0	27,191
50	3.54	1.43	4,279	11.3	33,989	0	33,989
60	3.20	1.29	4,641	11.3	40,787	0	40,787
90	2.48	1.00	5,400	11.3	61,180	0	61,180
120	2.03	0.82	5,881	11.3	81,573	0	81,573
150	1.71	0.69	6,214	11.3	101,966	0	101,966
180	1.48	0.60	6,457	11.3	122,360	0	122,360

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	0
5	823	3,399	0
10	1,492	6,798	0
15	2,048	10,197	0
20	2,517	13,596	0
25	2,917	16,994	0
30	3,264	20,393	0
40	3,832	27,191	0
50	4,279	33,989	0
60	4,641	40,787	0
90	5,400	61,180	0
120	5,881	81,573	0
150	6,214	101,966	0
180	6,457	122,360	0

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	8.72
Trench Top	6.72
Weir Elev.	
October Water Elev.	3.20
Pipe Inv.	5.22
Pipe Dia. (ft)	1.50
Trench Bott	-6.28



W:	3.50	ft
H_2:	5.52	ft
Du:	3.52	ft
Ds:	9.48	ft
K:	2.16E-03	$cfs/ft^2/ft$
Exf. Rate:	0.2832	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K^*[H_2W + 2H_2D_u - D_u^2 + 2H_2D_s]$
Du < Ds $K^*[(2H_2D_u) - D_u^2 + 2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
			Total Pipe Storage	**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
0.84 ac x 1 in. = **0.84** ac-in

2.5" Over the Percent Imperviousness
0.25 ac x 0.74 in. = **0.19** ac-in

INITIAL VOLUME TO TREAT **0.84** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr $$i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$$

Storm Frequency (F)
Time to generate **0.84** ac-in $V = CiAt_t$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **3,049** cf

3,049 = C *i* A t /(60 min /hr)

$$= 0.480 \times \frac{308.5}{40.71 + 0.93t} \times 0.84 \text{ ac} * t * (60 \text{ sec/min})$$

3,049 = $\frac{7,463\ t}{40.71 + 0.93t}$

7,463 t - 2,835 t = 124,147

t = 27.00 min

Total Time = t_c + t = **37** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 37 min = 4.11 in/hr

V = **1.02** **ac-in**

WATER QUANTITY CALCULATIONS - SCS Method

Design Storm	5 yr	1 hr
Lowest Elevation	8.72 ft	
October Water Elevation	3.20 ft (NGVD)	
Depth to Water Table	5.52 ft	
Soil Storage (SS)	8.18 in	

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
0.59	0.25	0.84	8.18	4.83	5.745476	63.51

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 5.7454762
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.54** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **0.45** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **1.59** ft

Use **2** ft

Du < Ds (Conservative)

$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

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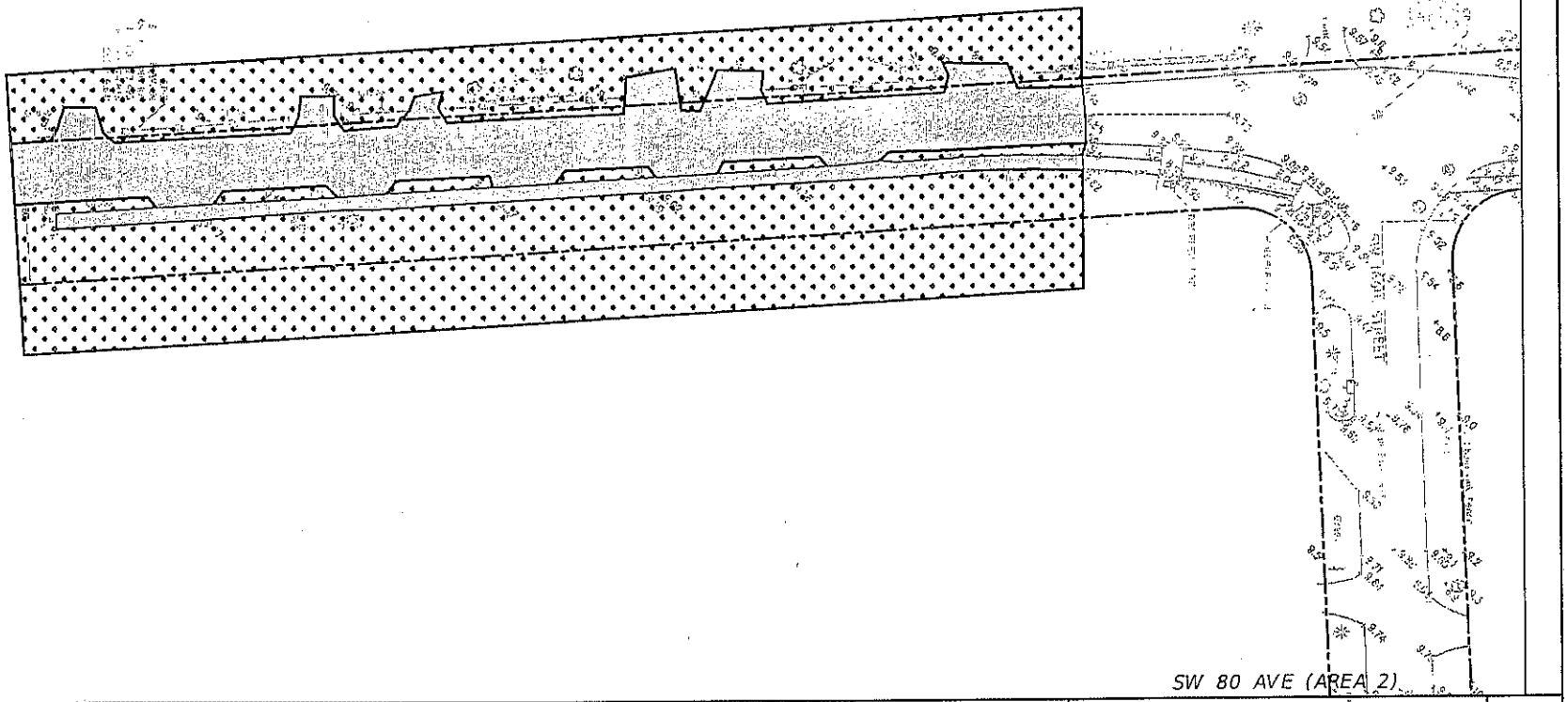
PERVIOUS

IMPERVIOUS

PERVIOUS = 0.59 ac.
IMPERVIOUS = 0.25 ac.



REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Date	06/09/2016
Drawn	RFB
Checked	LB
Manager	Linda Bell, P.E.
Submittal	Permit

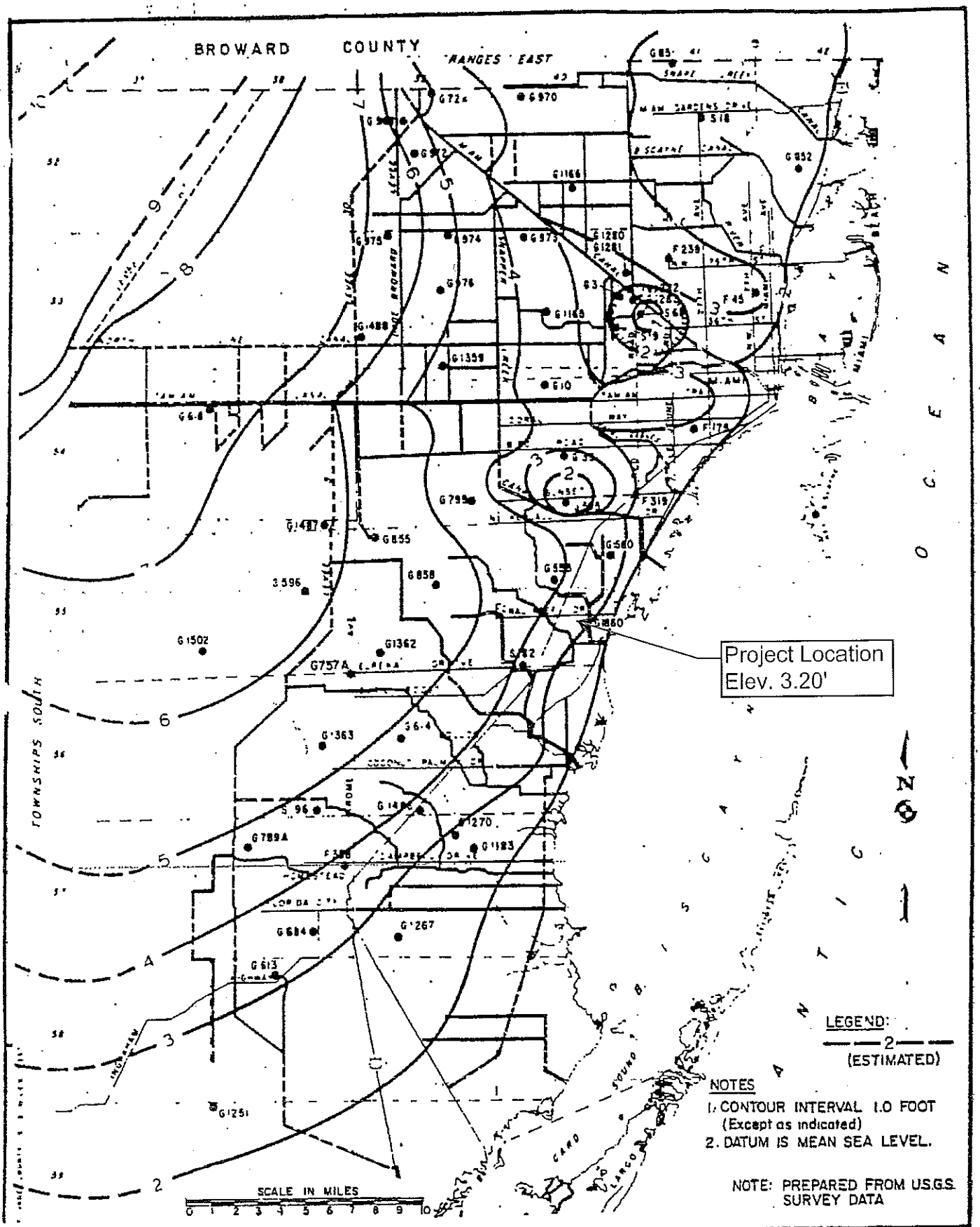
PUBLIC WORKS
9705 EAST HIBISCUS STREET
PALMETTO BAY, FL 33157
PH. (305) 259-1234 FAX (305) 259-1250

LINDA BELL, P.E.
FL REG. 39542

CWI Civil Works, Inc.
Consulting Engineers CA 07528
8491 N.W. 17 ST., Suite 108
Doral, FL 33126 (305)591-4522

DRAINAGE PLAN

C-3



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5 72	REVISED 2/19/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960–75	W.C. 2.2 SHEET 1 OF 1

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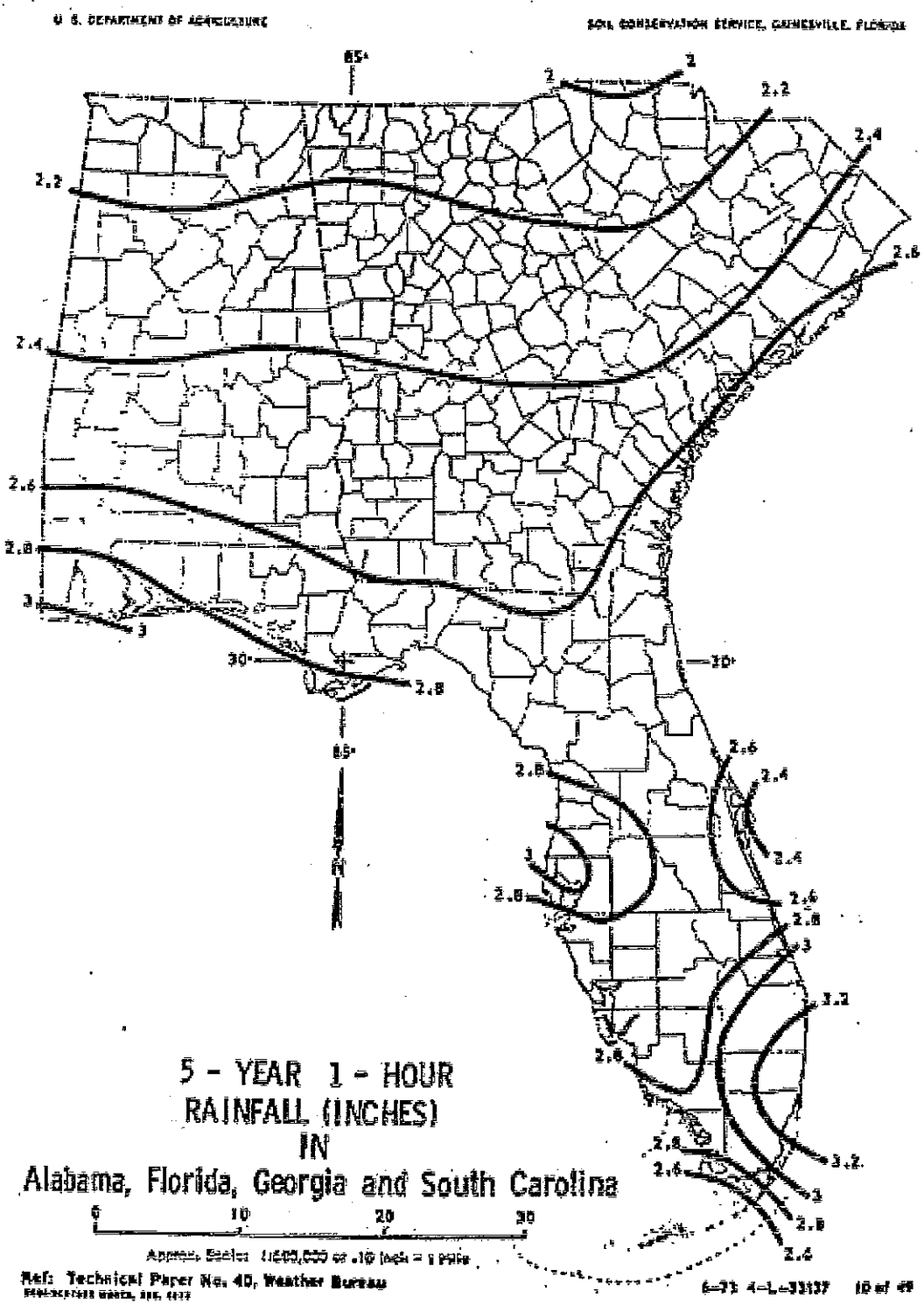

Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

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Village of Palmetto Bay, Florida
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We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

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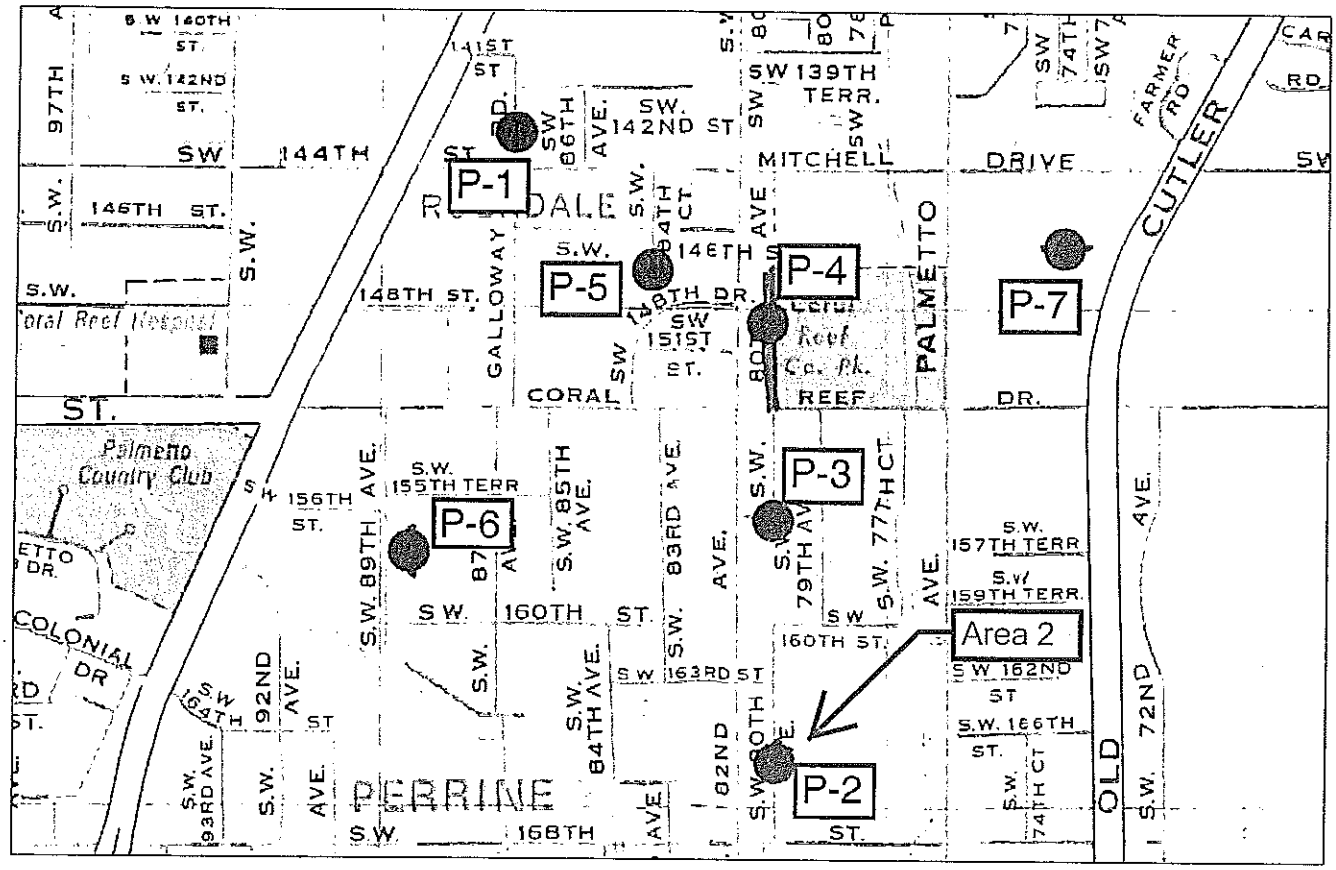
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	SHEET 1
OR	MAR., 2016	

TABLE 1 - SUMMARY OF CONSTANT HEAD PERCOLATION TEST RESULTS

Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Test No.	Date Performed	Diameter		Depth of Hole (Feet)	Depth to Groundwater Level Below Ground Surface (Feet)		SATURATED HOLE DEPTH Ds (Feet)	Corrected Depth of Hole (Feet)	Average Flow Rate (gpm)	K, Hydraulic Conductivity (cfs/ft^2-Ft Head)
		Casing (Inches)	Hole (Inches)		Prior to Test	During Test				
P-1	03/11/16	6.00	6.75	15	9.6	8.60	5.40	6.40	15.0	3.13E-03
P-2	03/14/16	6.00	6.75	15	7.0	6.00	8.00	9.00	14.8	2.16E-03
P-3	03/14/16	6.00	6.75	15	7.4	6.40	7.60	8.60	14.6	2.23E-03
P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
P-6	03/14/16	6.00	6.75	15	7.9	6.90	7.10	8.10	14.3	2.33E-03
P-7	03/14/16	6.00	6.75	15	8.2	7.20	6.80	7.80	15.0	2.54E-03

NOTES:

(1) The above hydraulic conductivity values are for a French drain installed to the same depth as the borehole tests. The values represent an ultimate value. The designer should decide on the required factor of safety.

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure as shown on the following page.

(3) The diameter of the CASING was used in the computation of the hydraulic conductivity values presented in the above table.

SUBSURFACE STRATIFICATION

TEST No.	TEST LOCATION (FEET)		DEPTH (FEET)		GENERAL MATERIAL DESCRIPTION
	NORTHING	EASTING	FROM	TO	
P-1	474526	875591	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	1.60	Brown Fine to Medium SAND
			1.60	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-2	466673	879380	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.30	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.30	2.50	Brown Sandy LIMESTONE
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			1.50	2.50	Brown Sandy LIMESTONE
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			2.30	15.00	Light Brown Sandy LIMESTONE
P-5	473063	876849	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
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P-6	469407	874855	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.40	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
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2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

SW 88 Court (Area - 6)

from SW 156 Terrace up to and including SW 159 Street

PREPARED FOR:

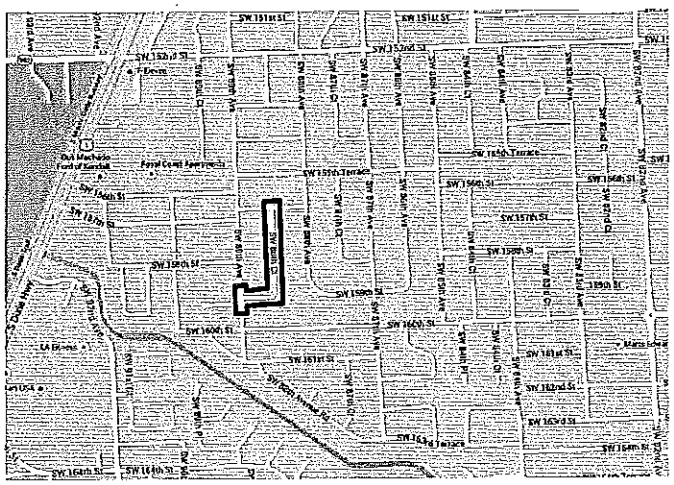
Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

June 8, 2016

VAUGHN SOARES
LICENSE
No. 56912
STATE OF FLORIDA
PROFESSIONAL ENGINEER
7/29/16

Vaughn Soares, P.E.
Florida Registered
No. 56912

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 88 Court from SW 156 Terrace up to and including SW 159 Street. This is a residential neighborhood that experiences localized ponding during normal rain events. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales and one inlet. The proposed drainage system includes proposed inlets, manholes and a **total of 200 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. This proposed system will remain a closed one (no outfall). This report and the drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= 138,752 sf = 3.19 ac
Impervious Area	= 59,432 sf = 1.36 ac
Pervious Area	= 79,320 sf = 1.83 ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.20 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-6	**2.33×10^{-3}**

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

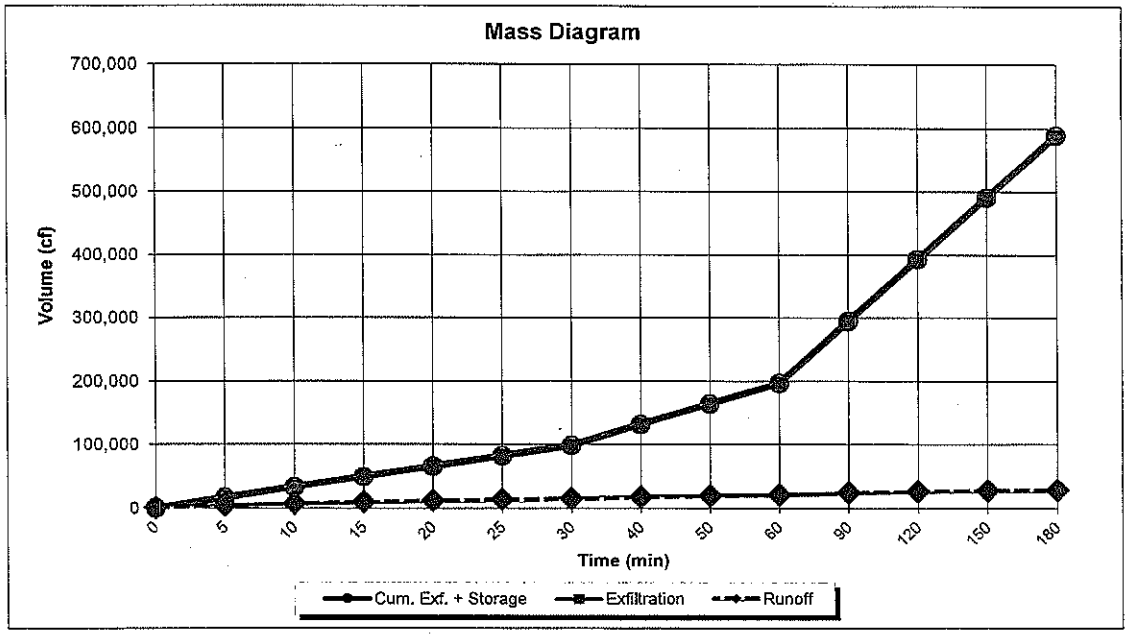
Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 6	15.5	2	31	200

2016-03-10 15111-DrnRprt_area5.docx

ATTACHMENTS

- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	1.36
Acres of pervious area:	1.83
Linear feet of Trench Provided:	200
Rate of exfiltration: (cfs/lf)	0.2725
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.56
Total drainage area (ac):	3.19
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	31
MDPW Project (Y/N)	N

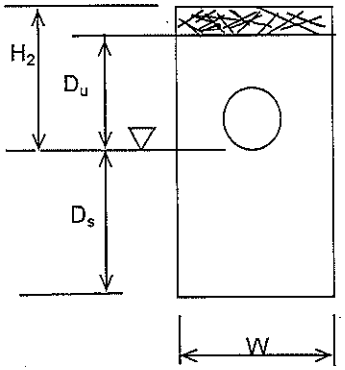


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	**0**	54.5	0	0	0
5	6.80	12.15	**3,645**	54.5	16,351	0	16,351
10	6.17	11.02	**6,612**	54.5	32,702	0	32,702
15	5.64	10.08	**9,074**	54.5	49,053	0	49,053
20	5.20	9.29	**11,151**	54.5	65,404	0	65,404
25	4.82	8.62	**12,925**	54.5	81,755	0	81,755
30	4.50	8.03	**14,460**	54.5	98,106	0	98,106
40	3.96	7.07	**16,979**	54.5	130,808	0	130,808
50	3.54	6.32	**18,960**	54.5	163,510	0	163,510
60	3.20	5.71	**20,561**	54.5	196,212	0	196,212
90	2.48	4.43	**23,926**	54.5	294,318	0	294,318
120	2.03	3.62	**26,058**	54.5	392,424	0	392,424
150	1.71	3.06	**27,530**	54.5	490,530	0	490,530
180	1.48	2.65	**28,608**	54.5	588,636	0	588,636

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	**0**
5	3,645	16,351	**0**
10	6,612	32,702	**0**
15	9,074	49,053	**0**
20	11,151	65,404	**0**
25	12,925	81,755	**0**
30	14,460	98,106	**0**
40	16,979	130,808	**0**
50	18,960	163,510	**0**
60	20,561	196,212	**0**
90	23,926	294,318	**0**
120	26,058	392,424	**0**
150	27,530	490,530	**0**
180	28,608	588,636	**0**

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	8.00
Trench Top	6.00
Weir Elev.	
October Water Elev.	3.20
Pipe Inv.	4.50
Pipe Dia. (ft)	1.50
Trench Bott	-7.00



W:	3.50	ft
H_2:	4.80	ft
Du:	2.80	ft
Ds:	10.20	ft
K:	2.33E-03	cfs/ft²/ft
Exf. Rate:	0.2725	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K^*[H_2W + 2H_2D_u - D_u^2 + 2H_2D_s]$
Du < Ds $K^*[(2H_2D_u) - D_u^2 + 2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
		Total Pipe Storage		**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
3.19 ac x 1 in. = **3.19** ac-in

2.5" Over the Percent Imperviousness
1.36 ac x 1.07 in. = **1.45** ac-in

INITIAL VOLUME TO TREAT **3.19** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr

$$i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$$

Storm Frequency (F)
Time to generate **3.19** ac-in $V = CiAt_{1"}$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **11,580** cf

11,580 = C *i* A t /(60 min /hr)

$$= 0.560 \times \frac{308.5}{40.71 + 0.93t} \times 3.19 \text{ ac} * t * (60 \text{ sec/min})$$

$$11{,}580 = \frac{33{,}066\ t}{40.71 + 0.93t}$$

33,066 t - 10,765 t = 471,462

t = 22.00 min

Total Time = t_c + t = **32** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 32 min = 4.38 in/hr

V = **4.17** **ac-in**

WATER QUANTITY CALCULATIONS - SCS Method

Design Storm	5 yr	1 hr
Lowest Elevation	8.00 ft	
October Water Elevation	3.20 ft (NGVD)	
Depth to Water Table	4.80 ft	
Soil Storage (SS)	8.18 in	

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
1.83	1.36	3.19	8.18	14.97	4.6926019	68.06

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 4.69260188
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.74** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **2.35** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **8.57** ft

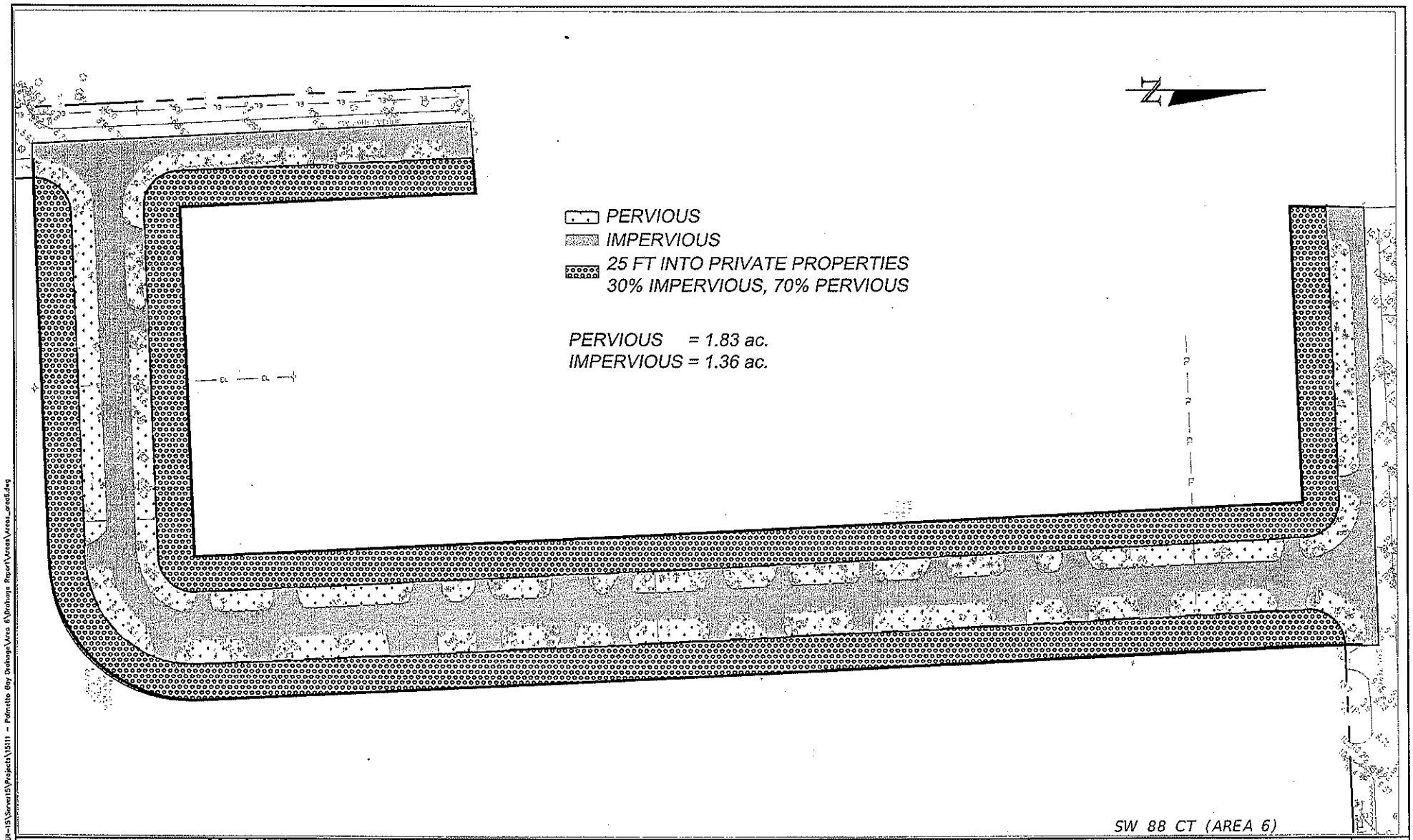
Use **9** ft

Du < Ds (Conservative)

$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$



REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Date	06/08/2016
Drawn	RLR
Checked	VS
Manager	Linda Bell, P.E.
Submitted	100%

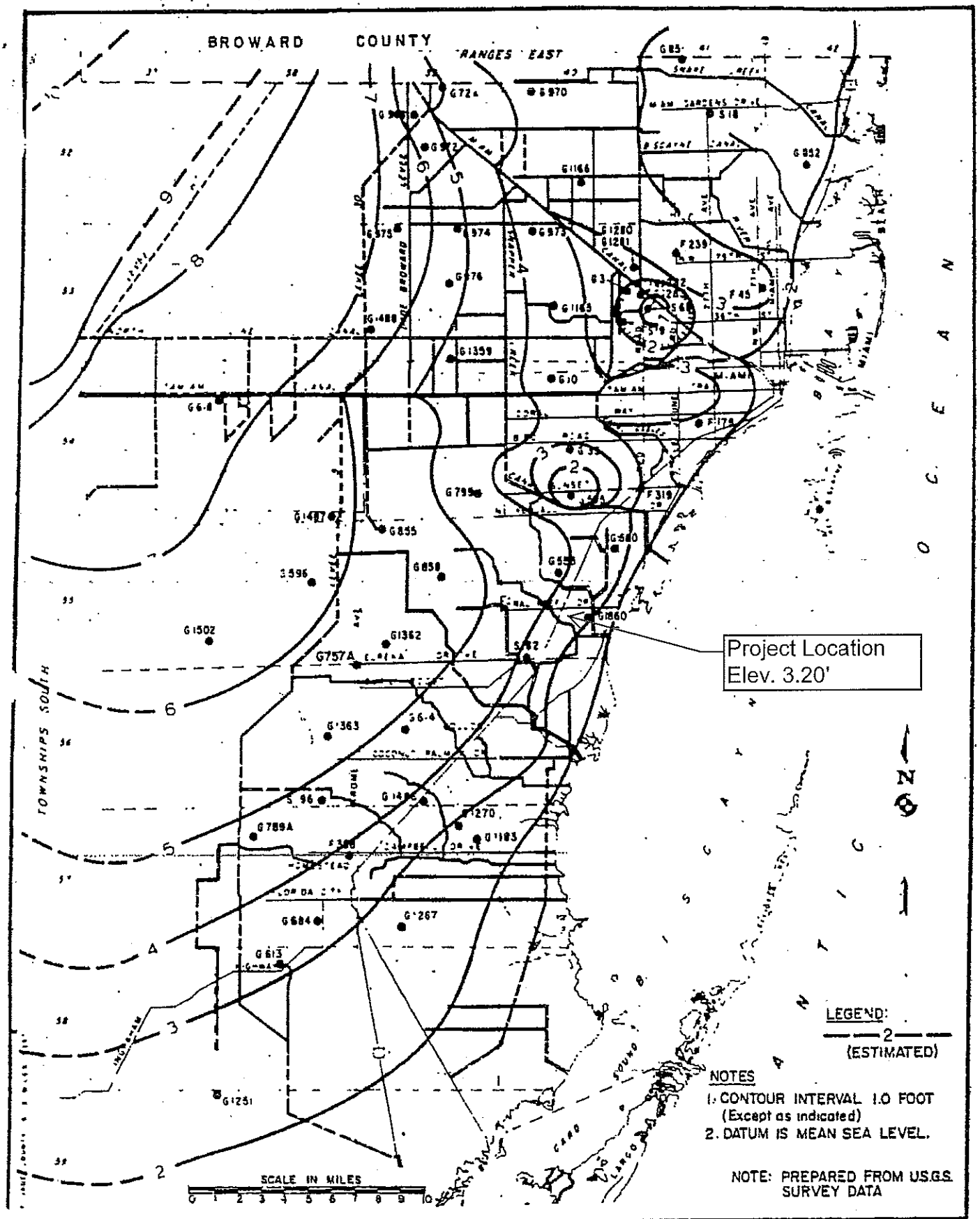
PUBLIC WORKS
9705 EAST HIBISCUS STREET
PALMETTO BAY, FL 33157
PH: (305) 259-1234 FAX: (305) 259-1236

LINDA BELL, P.E.
FL NO. 39547

CWI Civil Works, Inc.
Consulting Engineers CA. 07526
8691 N.W. 17 ST., Suite 108
Doral, FL 33126 (305)591-4323

DRAINAGE SHEET

C-3



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5/72	REVISED 2/19/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960–75	W.C. 2.2 SHEET 1 OF 1

Appendix C: Isohyetal Maps
from SFWMD Technical Memorandum, *Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida*, Paul Trimble, October 1990.

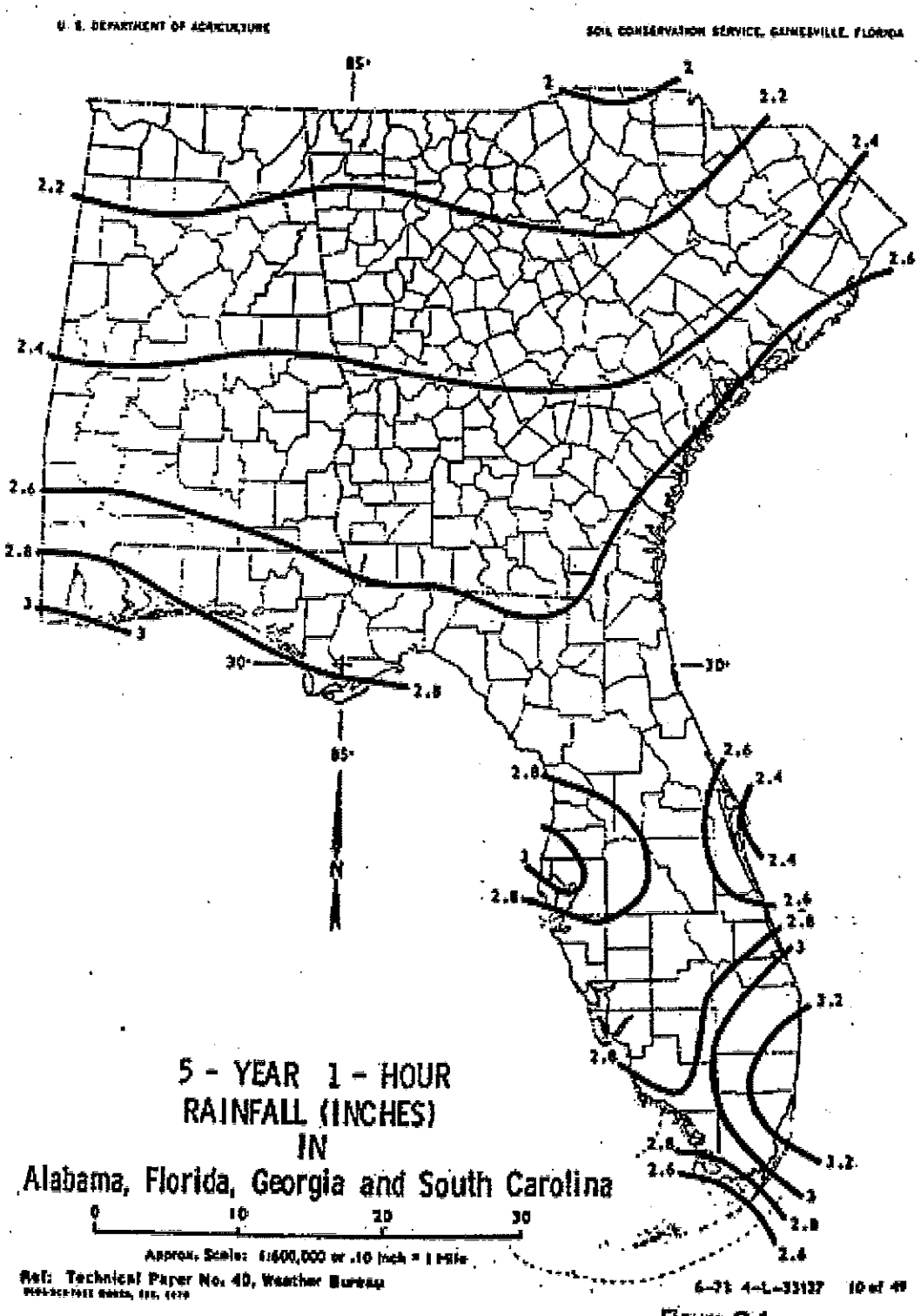


Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

Attention: Ms. Linda M. Bell, PE - President

Re: **Letter Report of Borehole Percolation Testing**
Proposed Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Dear Ms. Bell:

GEOSOL, Inc. (GEOSOL) is pleased to submit the enclosed letter report containing the results of the borehole percolation testing for the above-referenced project. These services were provided in accordance with our proposal No. P-216112 dated February 25, 2016. You provided authorization for our services on February 29, 2016.

Based on information you provided to us on February 25, 2016, we understand that the project consists of providing drainage improvements in the Village of Palmetto Bay, Florida. As requested, our scope of services was limited to performing seven (7) borehole percolation tests (P-1 through P-7) at depths of 15 feet below existing grades for use in drainage evaluations and design in the following areas:

- Along SW 87th Avenue, between SW 142nd Street and SW 143rd Street,
- In the vicinity of the property located at 16625 SW 80th Avenue,
- In the vicinity of the property located at 7990 SW 155th Street,
- Along SW 80th Avenue, between SW 152nd Street and SW 148th Street,
- Along SW 84th Court, between SW 147th Street and SW 147th Terrace,
- In the vicinity of the property located at 15735 SW 88th Court, and
- In the vicinity of the property located at 7330 SW 145th Terrace

The test locations were identified in the field utilizing the drainage map you provided, standard taping procedures and existing landmarks. A test location plan is presented in Sheet 1 attached to this letter.

The borehole percolation tests were performed in general accordance with the South Florida Water Management District (SFWMD) "Usual Open-Hole" constant head method. The borehole percolation tests were performed to determine the hydraulic conductivity values (k) of the subsurface materials at depths of 15 feet below existing ground surface. The boreholes were drilled by means of a 6 ¾ -inch diameter tri-cone bit and water. Upon drilling the boreholes, we inserted a 6-inch diameter perforated PVC pipe in the ground and used a pump for purging the well prior to the start of each test. After completion of the borehole percolation tests, the boreholes were grouted and the sites were cleaned as required. The hydraulic conductivity values (k) were determined from the test results and are tabulated in Table 1 attached to this letter. The hydraulic conductivity values are reported in units of cubic feet per second per square foot of seepage area per foot of head (cfs/ft²-ft.).

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

ORACIO RICCOBONO LICENSE 49324 STATE OF FLORIDA PROFESSIONAL ENGINEER

3/17/16

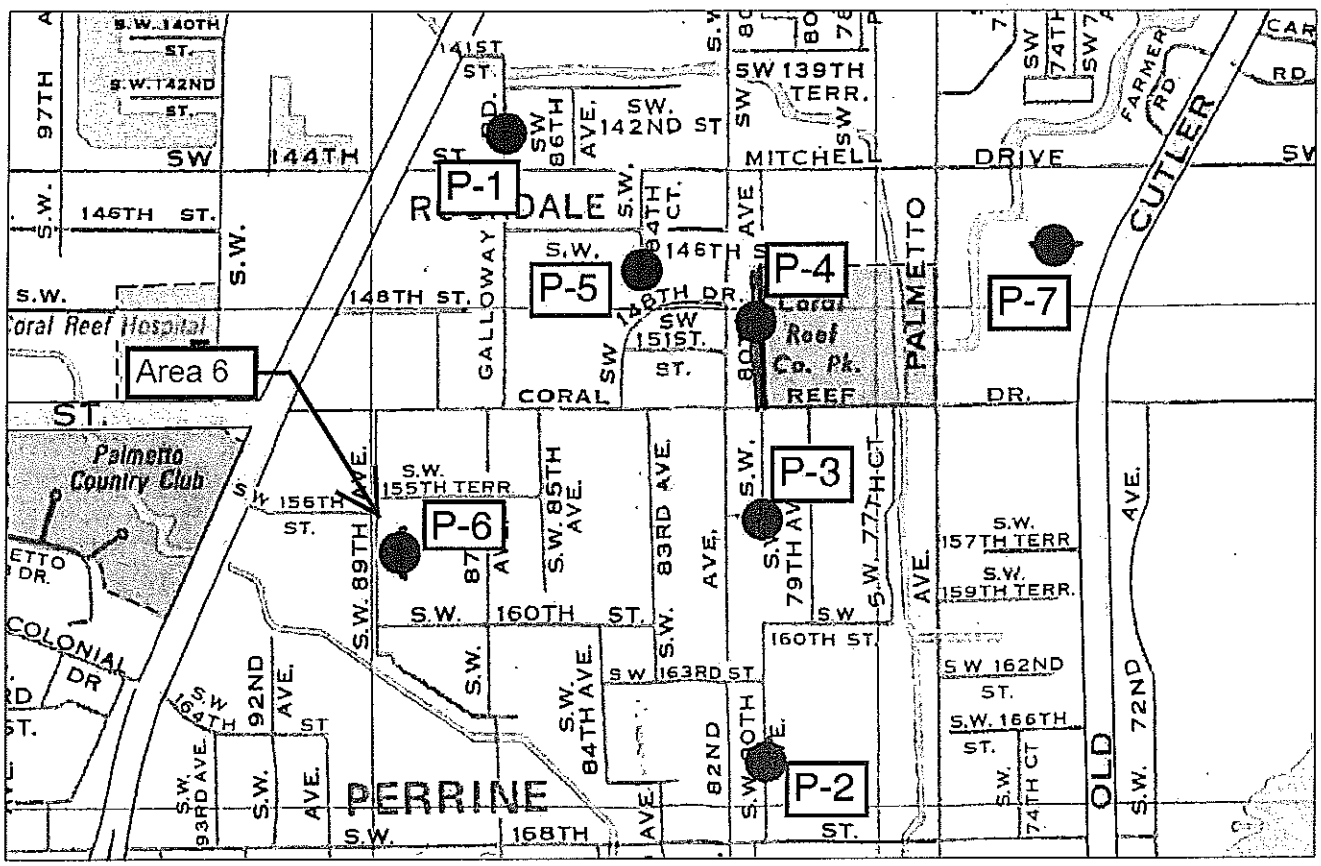
Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

GEOSOL, Inc.
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	
OR	MAR., 2016	SHEET 1

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Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

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P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
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			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	2.20	Brown Sandy LIMESTONE
			2.20	15.00	Light Brown Sandy LIMESTONE

2016

CWI *Civil Works, Inc.*
8491 NW 17 STREET, SUITE 108
DORAL, FL 33126
305-591-4323
Fax: 305-591-4074
CA 07528

DRAINAGE DESIGN REPORT

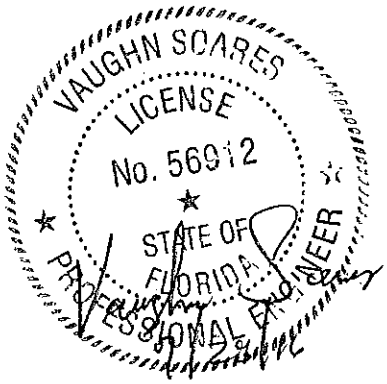
SW 145 Terrace (Area - 7)

from SW 73 Avenue to SW 74 Avenue

PREPARED FOR:

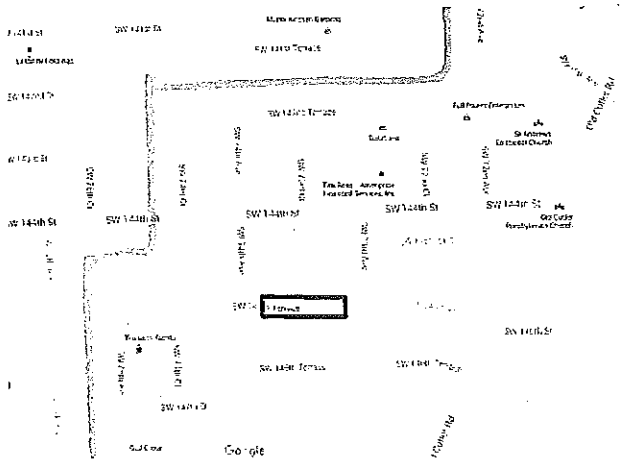
Village of Palmetto Bay
9705 East Hibiscus Street
Palmetto Bay, FL 33157

June 8, 2016



Vaughn Soares, P.E.
Florida Registered
No. 56912

I. Project Location and Narrative



This project is to improve a ponding issue located at SW 145 Terrace from SW 73 Avenue to SW 74 Avenue. This is a residential neighborhood that experiences localized ponding during normal rain events. The contributing drainage areas span the full right-of-way width plus an additional twenty five - (25) feet on each side of the right-of-way. The existing drainage system is comprised of swales, inlets and exfiltration trenches. The proposed drainage system includes reconstructing swales, proposed inlets, and a **total of 40 linear feet of exfiltration trench** to provide the stormwater quality and quantity requirements for a 5-year storm event. This proposed system will remain a closed one (no outfall). This report and drainage plans will show the adequacy of the proposed drainage system design.

II. PROJECT CHARACTERISTICS AND DATA

A. PROPOSED AREA BREAKDOWN

Total Area	= **51,167 sf** = **1.17** ac
Impervious Area	= **22,404 sf** = **0.51** ac
Pervious Area	= **28,763 sf** = **0.66** ac

B. HYDRO-GEOLOGICAL DATA

October Water Table Elevation = 3.20 N.G.V.D.
Source: Miami-Dade Public Works Department (MDPWD) WC 2.2

III. Exfiltration Trench Calculations

See attached 5-yr Exfiltration Trench Calculations for water quality and water quantity requirements.

IV. Percolation Test

One percolation test was done at this location. The hydraulic conductivity (k), is shown below.

Test No.	K, Hydraulic Conductivity
P-7	2.54×10^{-3}

See attached Borehole Percolation Test (March 2016)

IV. Summary

Below is a table showing the required length of exfiltration trenches. For water quality, a Factor or safety of 2 was applied.

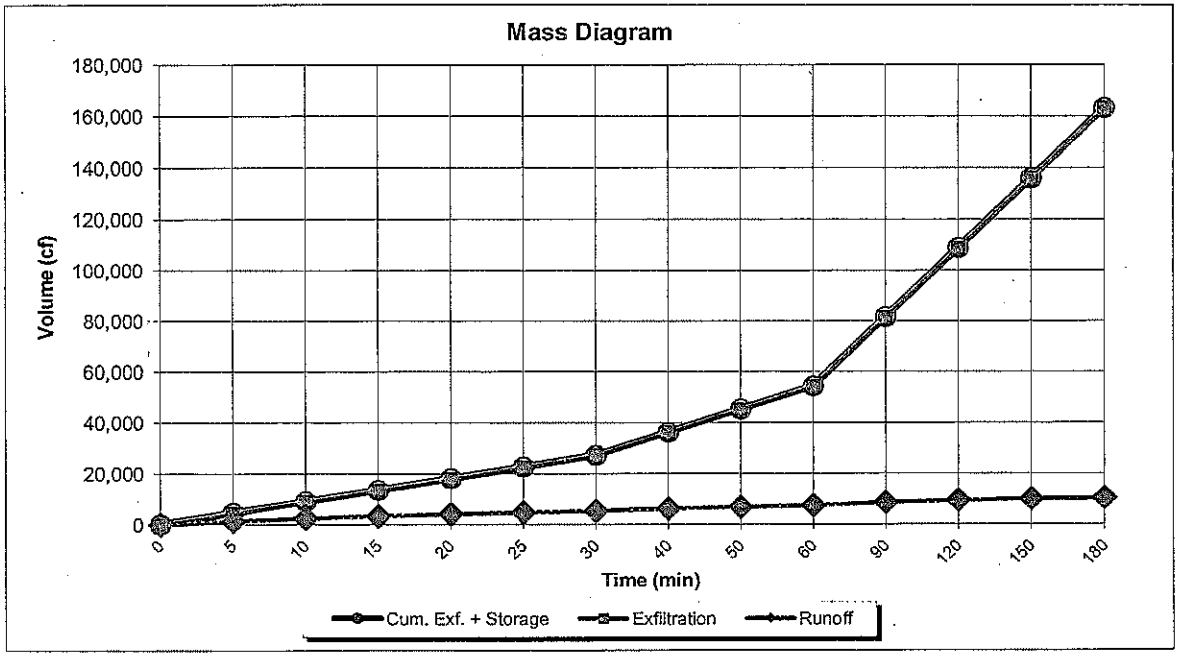
Basin Location	Required Length for Water Quality (ft)	**Factor Of Safety**	Required Water Quality With Factor Of Safety (ft)	Length Provided (ft)
Area - 7	4.5	2	9	40

2016-03-10 15111-DrnRprt_area5.docx

ATTACHMENTS

- 5-Yr Exfiltration Trench Calculations
- Impervious / Pervious Areas
- WC 2.2 Average October Ground Water Level
- 5-Year 1-Hour Rainfall (inches)
- Borehole Percolation Test (March 2016)

Enter Storm Duration (Yr):	5
C factor for impervious area:	0.9
C factor for pervious area:	0.3
Acres of impervious area:	0.51
Acres of pervious area:	0.66
Linear feet of Trench Provided:	40
Rate of exfiltration: (cfs/lf)	0.3778
Storage in the system (cf):	0
Weighted coeff. of runoff:	0.56
Total drainage area (ac):	1.17
Factor of Safety (geologic uncertainties)	2.00
SFWMD's EQUATION (req'd length):	9
MDPW Project (Y/N)	N

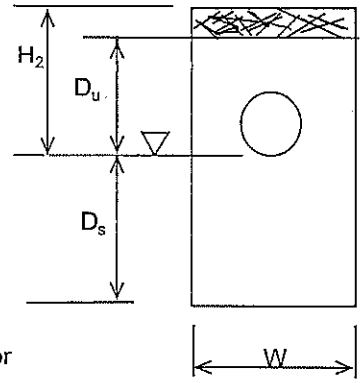


Time(min)	I (in/hr)	Runoff Rate (cfs)	Runoff Vol (cf)	Exf (cfs)	Cum.exf. (cf)	Storage (cf)	Cum. Exf. + Stor (cf)
0	0.00	0.00	0	15.1	0	0	0
5	6.80	4.46	1,337	15.1	4,534	0	4,534
10	6.17	4.04	2,425	15.1	9,068	0	9,068
15	5.64	3.70	3,328	15.1	13,602	0	13,602
20	5.20	3.41	4,090	15.1	18,136	0	18,136
25	4.82	3.16	4,741	15.1	22,670	0	22,670
30	4.50	2.95	5,303	15.1	27,203	0	27,203
40	3.96	2.59	6,227	15.1	36,271	0	36,271
50	3.54	2.32	6,954	15.1	45,339	0	45,339
60	3.20	2.09	7,541	15.1	54,407	0	54,407
90	2.48	1.63	8,775	15.1	81,610	0	81,610
120	2.03	1.33	9,557	15.1	108,814	0	108,814
150	1.71	1.12	10,097	15.1	136,017	0	136,017
180	1.48	0.97	10,492	15.1	163,220	0	163,220

Time(min)	Runoff Vol (cf)	Cum. Exf. + Stor (cf)	*Overflow (cf)*
0	0	0	0
5	1,337	4,534	0
10	2,425	9,068	0
15	3,328	13,602	0
20	4,090	18,136	0
25	4,741	22,670	0
30	5,303	27,203	0
40	6,227	36,271	0
50	6,954	45,339	0
60	7,541	54,407	0
90	8,775	81,610	0
120	9,557	108,814	0
150	10,097	136,017	0
180	10,492	163,220	0

EXFILTRATION RATE CALCULATIONS:

Lowest Rim Elev	9.70
Trench Top	7.70
Weir Elev.	
October Water Elev.	3.20
Pipe Inv.	6.20
Pipe Dia. (ft)	1.50
Trench Bott	-5.30



W:	3.50	ft
H_2:	6.50	ft
Du:	4.50	ft
Ds:	8.50	ft
K:	2.54E-03	cfs/ft²/ft
Exf. Rate:	0.3778	

H_2 = Weir Elev. - Oct. Water Elev., or
H_2 = Lowest Rim Elev.-Oct. Water Elev.
Trench Bottom = 15 ft below grade

SFWMD Vol IV
Du > Ds $K^*[H_2W + 2H_2D_u - D_u^2 + 2H_2D_s]$
Du < Ds $K^*[(2H_2D_u) - D_u^2 + 2H_2D_s]$

STORAGE VOLUME IN PIPE OF PROPOSED SYSTEM

Storage Volume of Pipe (pipe invert above Oct. Water Elev.)

Length (ft)	Dia. (in)	Dia. (ft)	Area (sf)	Vol. (cf)
	15	1.25	1.23	
	18	1.50	1.77	
	24	2.00	3.14	
	30	2.50	4.91	
	36	3.00	7.07	
	40	3.33	8.73	
	48	4.00	12.57	
	54	4.50	15.90	
	60	5.00	19.64	
		Total Pipe Storage		**0.00**

WATER QUALITY CALCULATIONS

1" Over Entire Basin
1.17 ac x 1 in. = **1.17** ac-in

2.5" Over the Percent Imperviousness
0.51 ac x 1.09 in. = **0.56** ac-in

INITIAL VOLUME TO TREAT **1.17** ac-in

TIME OF CONCENTRATION
Assume initial time of concentration (t_c) = 10 min.

Intensity = 5 yr

$$i = \frac{308.5}{48.6F^{-0.11} + t(0.5895 + F^{-0.67})}$$

Storm Frequency (F)
Time to generate **1.17** ac-in $V = CiAt_{1"}$

V = Water Quality Vol (ac-in)*(43,560 sf/ac)/(12 in/ft)= **4,247** cf

4,247 = C *i* A t /(60 min /hr)

$$= 0.560 \times \frac{308.5}{40.71 + 0.93t} \times 1.17 \text{ ac * t * (60 sec/min)}$$

$$4{,}247 = \frac{12{,}128\ t}{40.71 + 0.93t}$$

12,128 t - 3,948 t = 172,919

t = 22.00 min

Total Time = t_c + t = **32** **min**

TOTAL VOLUME TO TREAT

V = CiAt

i @ 32 min = 4.38 in/hr

V = **1.53** **ac-in**

WATER QUANTITY CALCULATIONS - SCS Method

Design Storm	5 yr	1 hr
Lowest Elevation	9.70 ft	
October Water Elevation	3.20 ft (NGVD)	
Depth to Water Table	6.50 ft	
Soil Storage (SS)	8.18 in	

Pervious Area (ac)	Impervious Area (ac)	Total Area (ac)	Soil Storage (SS)	Available Soil Storage (Perv. x SS)	Site Soil Storage (Avail Storage / Total Area) (S)	Curve Number [1000 / (S+10)]
0.66	0.51	1.17	8.18	5.40	4.614359	68.43

Soil Storage	
Depth to Water Table (ft.)	Compacted Soil Storage (in)
1	0.45
2	1.88
3	4.95
4	8.18

P = Rainfall (inches for design storm) 3.20 in
S = Site Soil Storage 4.614359
Q = Project Runoff
Q = (P - (0.2 x S))^2 / (P + (0.8 x S)) **0.75** in

Basin Runoff:
V = Total Basin Runoff in inches
[V = Q x Total Area] **0.88** ac-in/hr

Length of Trench Required for Water Quantity

Du < Ds L = **2.32** ft

Use **3** ft

Du < Ds (Conservative)

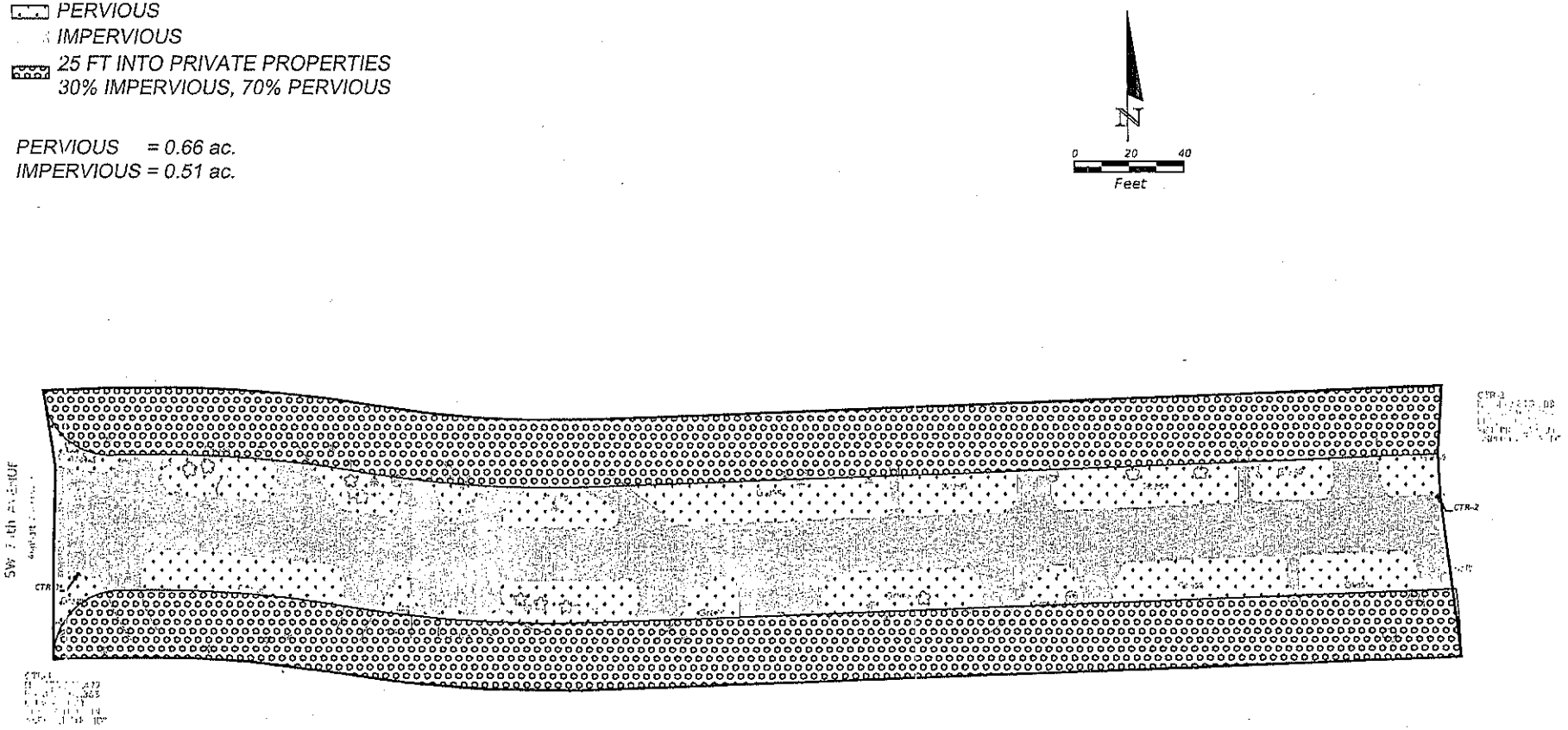
$$L = \frac{V}{K(2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

Du > Ds

$$L = \frac{V}{K(H_2W + 2H_2D_U - D_U^2 + 2H_2D_S) + (1.39x10^{-4})WD_U}$$

PERVIOUS
IMPERVIOUS
25 FT INTO PRIVATE PROPERTIES
30% IMPERVIOUS, 70% PERVIOUS

PERVIOUS = 0.66 ac.
IMPERVIOUS = 0.51 ac.



SW 145 TERR (AREA 7)

REVISIONS											
DATE	BY	DESCRIPTION		DATE	BY	DESCRIPTION					
							Date	06/08/2016			
							Drawn	RLR			
							Checked	DB			
							Manager	Linda Bell, P.E.			
							Submittal	100%			

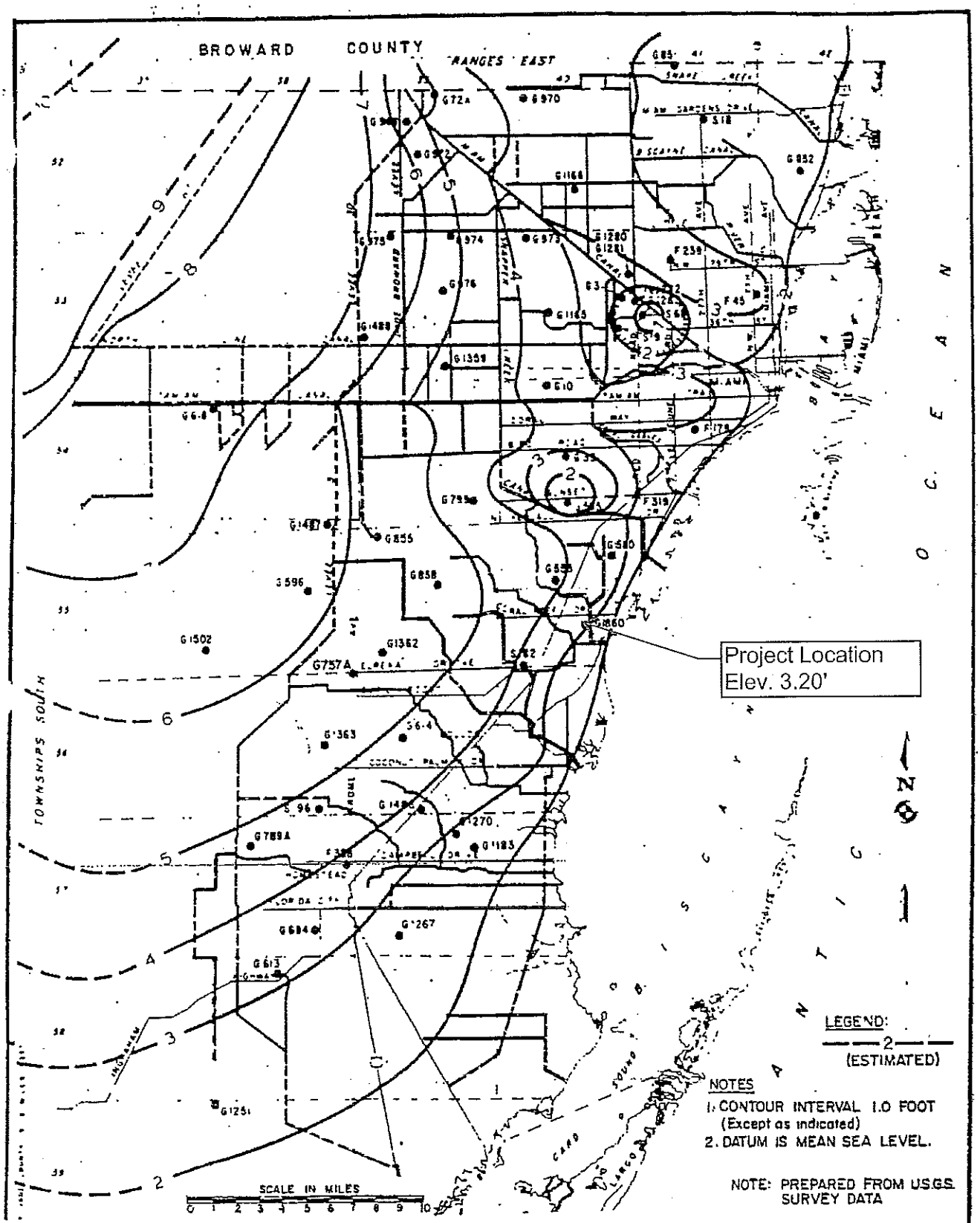
PUBLIC WORKS
9705 EAST HIBISCUS STREET
PALMETTO BAY, FL 33157
Ph: (305) 259-1234 FAX: (305) 259-1200
www.palmetto-fl.gov

LINDA BELL, P.E.
FL NO. 39542

CWI Civil Works, Inc.
Consulting Engineers CA 07528
8491 N.W. 17 ST., Suite 108
Doral, FL. 33126 (305)591-4323

DRAINAGE PLAN

C-3



METROPOLITAN DADE COUNTY PUBLIC WORKS DEPARTMENT	APPROVED 4/5 72	REVISED 2/19/75 4/14/77	DESIGN STANDARDS AVERAGE OCTOBER GROUND WATER LEVEL 1960–75	W.C. 2.2 SHEET 1 OF 1

Appendix C: Isohyetal Maps
from SFWMD Technical Memorandum, *Frequency Analysis of One and Three Day Rainfall Maxima for central and southern Florida*, Paul Trimble, October 1990.

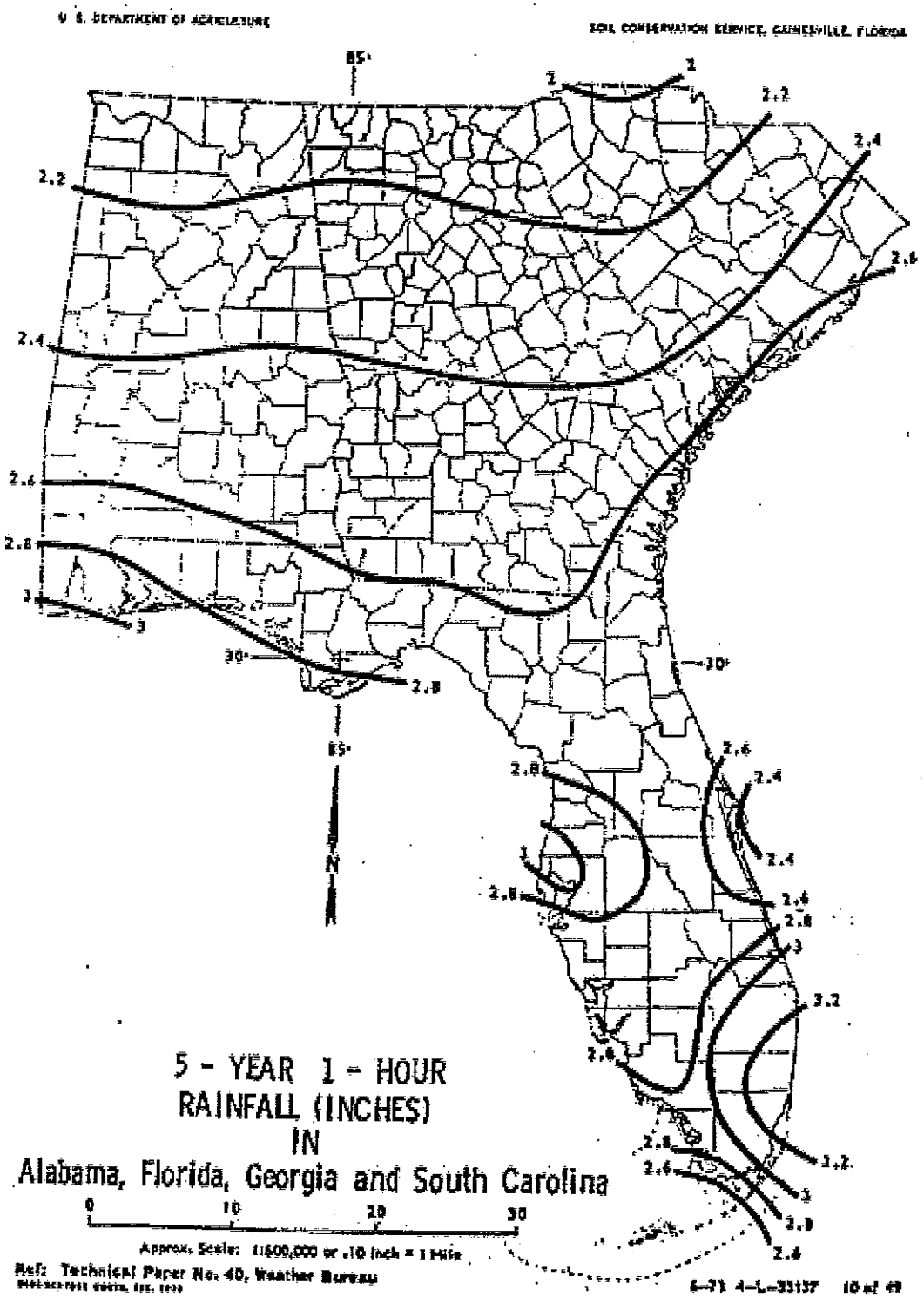


Figure C-1

Civil Works, Inc.
8491 NW 17th Street, Ste. 108
Doral, FL 33126

March 17, 2016

Attention: Ms. Linda M. Bell, PE - President

Re: **Letter Report of Borehole Percolation Testing**
Proposed Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Dear Ms. Bell:

GEOSOL, Inc. (GEOSOL) is pleased to submit the enclosed letter report containing the results of the borehole percolation testing for the above-referenced project. These services were provided in accordance with our proposal No. P-216112 dated February 25, 2016. You provided authorization for our services on February 29, 2016.

Based on information you provided to us on February 25, 2016, we understand that the project consists of providing drainage improvements in the Village of Palmetto Bay, Florida. As requested, our scope of services was limited to performing seven (7) borehole percolation tests (P-1 through P-7) at depths of 15 feet below existing grades for use in drainage evaluations and design in the following areas:

- Along SW 87th Avenue, between SW 142nd Street and SW 143rd Street,
- In the vicinity of the property located at 16625 SW 80th Avenue,
- In the vicinity of the property located at 7990 SW 155th Street,
- Along SW 80th Avenue, between SW 152nd Street and SW 148th Street,
- Along SW 84th Court, between SW 147th Street and SW 147th Terrace,
- In the vicinity of the property located at 15735 SW 88th Court, and
- In the vicinity of the property located at 7330 SW 145th Terrace

The test locations were identified in the field utilizing the drainage map you provided, standard taping procedures and existing landmarks. A test location plan is presented in Sheet 1 attached to this letter.

The borehole percolation tests were performed in general accordance with the South Florida Water Management District (SFWMD) "Usual Open-Hole" constant head method. The borehole percolation tests were performed to determine the hydraulic conductivity values (k) of the subsurface materials at depths of 15 feet below existing ground surface. The boreholes were drilled by means of a 6¾-inch diameter tri-cone bit and water. Upon drilling the boreholes, we inserted a 6-inch diameter perforated PVC pipe in the ground and used a pump for purging the well prior to the start of each test. After completion of the borehole percolation tests, the boreholes were grouted and the sites were cleaned as required. The hydraulic conductivity values (k) were determined from the test results and are tabulated in Table 1 attached to this letter. The hydraulic conductivity values are reported in units of cubic feet per second per square foot of seepage area per foot of head (cfs/ft²-ft.).

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact our office if you have any questions about the letter report or if you need additional information.

Sincerely,
GEOSOL, INC.

ORACIO D. RICCOBONO ... LICENSE ...

3/17/16

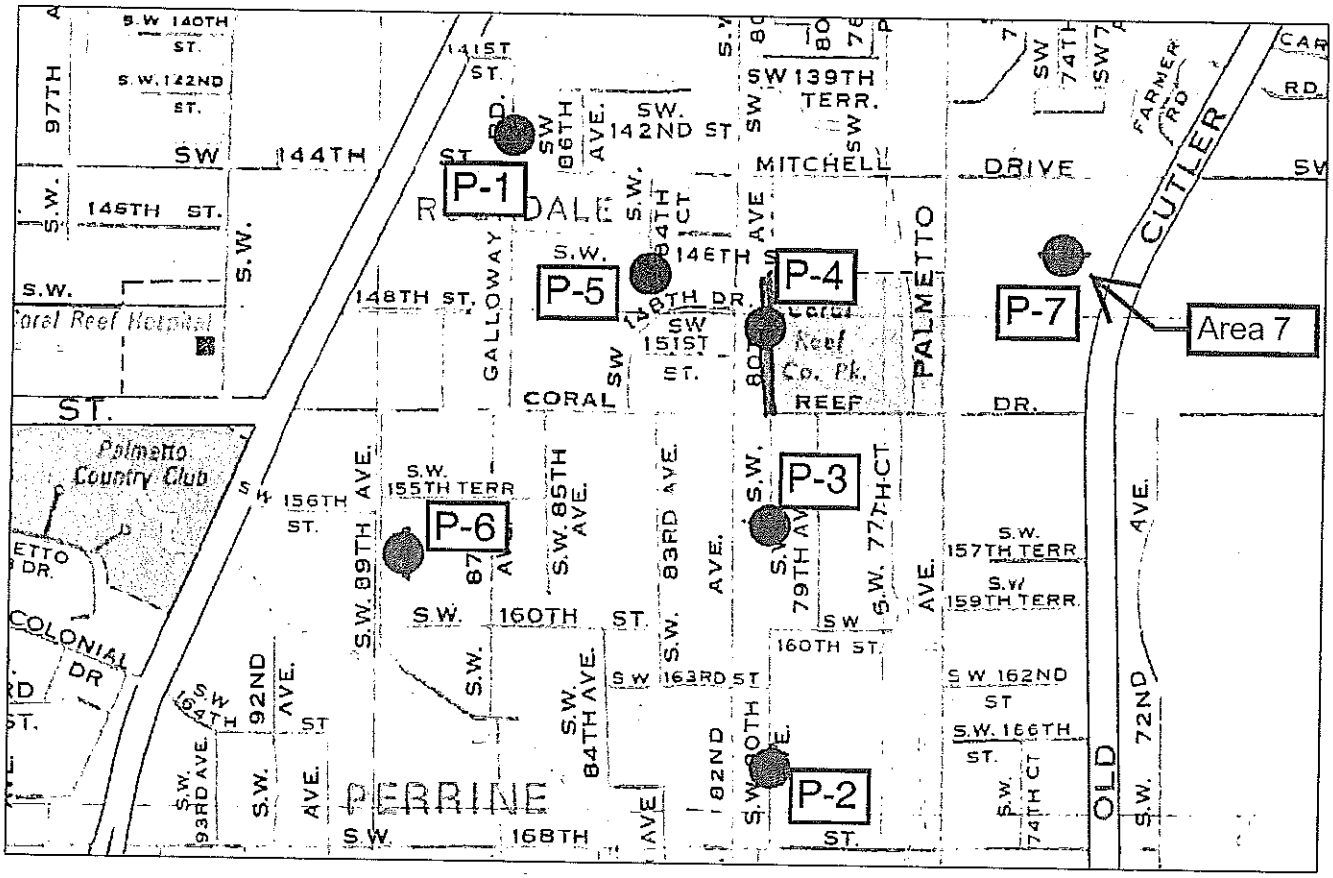
Oracio Riccobono, P.E.
Senior Geotechnical Engineer/President
Florida License No. 49324

Adnan Ismail, P.E.
Project Geotechnical Engineer
Florida License No. 76014

Attachments: 1) Sheet 1: Test Location Plan
2) Table 1 – Summary of Constant Head Percolation Test Results
3) Schematics of SFWMD's Usual Open-Hole Testing Procedures

cc: Addressee (4); File (1)

GEOSOL, Inc.
5795-A NW 151st Street
Miami Lakes, FL 33014
Phone (305) 828-4367; Fax (305) 828-4235
E-mail: geosolusa@bellsouth.net



TEST LOCATION PLAN

LEGEND

● P-I APPROXIMATE BOREHOLE PERCOLATION TESTING LOCATION

TEST LOCATION PLAN

PROPOSED PALMETTO BAY DRAINAGE IMPROVEMENT PROJECT

VILLAGE OF PALMETTO BAY, FLORIDA

DRAWN	SCALE	PROJ. No.
SZ	N.T.S.	216112
CHECKED	DATE	
OR	MAR., 2016	SHEET 1

TABLE 1 - SUMMARY OF CONSTANT HEAD PERCOLATION TEST RESULTS

Palmetto Bay Drainage Improvement Project
Village of Palmetto Bay, Florida
GEOSOL Project No. 216112

Test No.	Date Performed	Diameter		Depth of Hole (Feet)	Depth to Groundwater Level Below Ground Surface (Feet)		SATURATED HOLE DEPTH Ds (Feet)	Corrected Depth of Hole (Feet)	Average Flow Rate (gpm)	K, Hydraulic Conductivity (cfs/ft^2-Ft Head)
		Casing (Inches)	Hole (Inches)		Prior to Test	During Test				
P-1	03/11/16	6.00	6.75	15	9.6	8.60	5.40	6.40	15.0	3.13E-03
P-2	03/14/16	6.00	6.75	15	7.0	6.00	8.00	9.00	14.8	2.16E-03
P-3	03/14/16	6.00	6.75	15	7.4	6.40	7.60	8.60	14.6	2.23E-03
P-4	03/11/16	6.00	6.75	15	9.3	8.30	5.70	6.70	14.3	2.84E-03
P-5	03/11/16	6.00	6.75	15	8.9	7.90	6.10	7.10	14.4	2.69E-03
P-6	03/14/16	6.00	6.75	15	7.9	6.90	7.10	8.10	14.3	2.33E-03
P-7	03/14/16	6.00	6.75	15	8.2	7.20	6.80	7.80	15.0	2.54E-03

NOTES:

(1) The above hydraulic conductivity values are for a French drain installed to the same depth as the borehole tests. The values represent an ultimate value. The designer should decide on the required factor of safety.

(2) The hydraulic conductivity values were calculated based on the South Florida Water Management Districts's USUAL OPEN HOLE CONSTANT HEAD percolation test procedure as shown on the following page.

(3) The diameter of the CASING was used in the computation of the hydraulic conductivity values presented in the above table.

SUBSURFACE STRATIFICATION

TEST No.	TEST LOCATION (FEET)		DEPTH (FEET)		GENERAL MATERIAL DESCRIPTION
	NORTHING	EASTING	FROM	TO	
P-1	474526	875591	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	1.60	Brown Fine to Medium SAND
			1.60	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-2	466673	879380	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.30	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.30	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-3	470380	879198	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.50	Brown Sandy LIMESTONE
			2.50	15.00	Light Brown Sandy LIMESTONE
P-4	472548	879041	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.00	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.00	1.50	Brown Fine to Medium SAND
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-5	473063	876849	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.50	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.50	2.30	Brown Sandy LIMESTONE
			2.30	15.00	Light Brown Sandy LIMESTONE
P-6	469407	874855	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.40	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.40	2.00	Brown Sandy LIMESTONE
			2.00	15.00	Light Brown Sandy LIMESTONE
P-7	473846	882587	0.00	0.17	Dark Brown Organic Silty Fine SAND with Grass (TOPSOIL)
			0.17	1.20	Brown Slightly Silty Fine to Medium SAND with Some Limerock Fragments (FILL)
			1.20	2.20	Brown Sandy LIMESTONE
			2.20	15.00	Light Brown Sandy LIMESTONE