SURFACE WATER MANAGEMENT CALCULATIONS

MARQUESA

CITY OF MARGATE, BROWARD COUNTY, FLORIDA

HSQ PROJECT No.: 1703-18

Prepared For:

TC MC MARGATE APARTMENTS, LLC.
7480 Southwest 40th Street, Suite #700
Miami, Florida 33155

Prepared By:

HSQ GROUP, INC.
Engineers ● Planners ● Surveyors
5951 Northwest 173rd Drive, Suite 4
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DATE: AUGUST 25, 2018

PRE-DEVELOPMENT CALCULATIONS

Prepared By:

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GIVEN:

A. LAND USE SUMMARY:

1.	Lake Area =	0.000	ac.
2.	Buildings =	1.538	ac.
3.	Pavement & Others =	5.623	ac.
4.	Green Areas =	0.952	ac.
5.	**Total =**	**8.113**	

DESIGN CRITERIA:

A. WATER QUALITY CRITERIA:

1. If a wet detention system, then whichever is the greater of the following:
   a. The first inch of runoff from the entire project site.
   b. The amount of 2.5 inches times the percent impervious for the project site.

2. If a dry detention system, then 75% of the volume required for the wet detention system.

3. If a retention system, then 50% of the volume required.

4. If the property is zoned "Commercial", at least 0.5 inches of retention or dry detention pre-treatment will be required.

5. Any detention system shall be designed to discharge no more than 0.5 inches of the detained volume per day.

B. WATER QUANTITY CRITERIA:

1. DESIGN EVENTS AND RAINFALL AMOUNTS:

a. Design Event for Minimum Road Elevation:

Frequency:	10	year
Duration:	1	day
Amount:	9.00	inches

b. Design Event for Minimum Discharge Elevation:

Frequency:	25	year
Duration:	3	day
Amount:	15.00	inches

c. Design Event for Minimum Finish Floor Elevation:

Frequency:	100	year
Duration:	3	day
Amount:	20.00	inches

2. ADDITIONAL DESIGN INFORMATION:

a.	Design Water / Control Elevation:	6.50 NAVD.
b.	Drainage Basin / Canal Number:	S.F.W.M.D. C-14 BASIN

COMPUTATIONS:

A. WATER QUALITY COMPUTATIONS:

1. Compute the first inch of runoff from the entire developed project site:
   = 1.00 inch X 8.113 acres X (1 foot / 12 inches)
   = **0.676 ac-ft for the first inch of runoff**

2. Compute 2.5 inches times the percent impervious for the developed project site:
   a. Site area for water quality pervious / impervious calculations only:
      = Total Project - (Lake Area + Buildings)
      = 8.113 acres - (0.000 acres + 1.538 acres)
      = **6.575 acres of site area for water quality calculations**

   b. Impervious area for water quality pervious / impervious calculations only:
      = Site area for water quality - Pervious area
      = 6.575 acres - 0.952 acres
      = **5.623 acres of impervious area for water quality calculations**

   c. Percentage of impervious area for water quality:
      = Impervious area for water quality / Site area for water quality X 100%
      = 5.623 acres / 6.575 acres X 100%
      = **85.52 % Impervious**

   d. For 2.5 inches times the percentage of impervious area:
      = 2.5 inches X 85.52 %
      = **2.138 inches to be treated**

   e. Compute volume required for quality detention:
      = Inches to be treated X (Total Site Area - Lake Area)
      = 2.138 inches X (8.113 acres - 0.000 acres) X (1 foot / 12 inches)
      = **1.445 ac-ft required for detention storage**

3. The first inch of runoff from the entire developed site = 0.676 ac-ft
   2.5 inches times the percentage of impervious area = 1.445 ac-ft

   The volume of 1.445 ac-ft controls

4. If the project is zoned "Commercial" or if the project were discharging directly to a sensitive receiving body and is more than 40% impervious, 0.5 inches of dry detention pre-treatment must be provided:

      = 0.5 inches X (Total Site Area - Lake Area)
      = 0.5 inches X (8.113 acres - 0.000 acres) X (1 foot / 12 inches)
      = **0.338 ac-ft required for pre-treatment**

5. Compute credit for using one of the following systems:

   a. Wet detention volume to be provided:
      = Total required detention - Pre-treatment
      = 1.445 ac-ft - 0.338 ac-ft
      = **1.107 ac-ft of volume required for wet detention**

   b. Dry detention volume to be provided (75% of the total required detention volume):
      = Total required detention volume X 75%
      = 1.445 ac-ft X 75%
      = **1.084 ac-ft of volume required for dry detention**

   c. Dry retention volume to be provided (50% of the total required detention volume):
      = Total required detention volume X 50%
      = 1.445 ac-ft X 50%
      = **0.723 ac-ft of volume required for dry retention**

B. SUMMARY OF WATER QUALITY COMPUTATIONS:

Item:	Description:	Quantity:	
A.1	First inch of runoff from entire project site =	0.676	ac-ft
A.2	2.5 inches times percent impervious =	1.445	ac-ft
A.3	Volume to be treated =	1.445	ac-ft
A.4	Pre-treatment required for commercial site =	0.338	ac-ft
A.5.a	Wet detention volume required =	1.107	ac-ft
A.5.b	Dry detention volume required =	1.084	ac-ft
A.5.c	Dry retention volume required =	0.723	ac-ft
A.5.d	Exfiltration trench volume required =	1.445	ac-ft

C. STAGE ELEVATION INFORMATION:

Item:	Description:	S type	Area ac.	Low ft.	High ft.	I %	C %	Total Area %
1	n / a	V						0.00
2	n / a	L						0.00
3	n / a	V						0.00
4	n / a	L						0.00
5	n / a	V						0.00
6	n / a	L						0.00
7	n / a	L						0.00
8	Green Areas	L	0.952	10.40	12.80	0	50	11.73
9	Pavement Areas	L	5.332	10.55	12.80	100	100	65.72
10	Sidewalk Areas	L	0.291	12.00	12.50	100	100	3.59
11	Building Coverage Area	V	1.538	12.19	12.64	100	100	18.96
	Total:		**8.113**	**10.40**	**12.80**	**88.27**	**94.13**	**100.0**

* Abbreviations:

S = Storage; (V = Vertical Storage & L = Linear Storage)
I = Impervious
C = Compaction; (Use the following compaction factors: 0%, 50%, 100%)

D. SCS CURVE NUMBER AND SOIL STORAGE CALCULATIONS:

1. Soil Moisture Storage Table:
Existing Soil Type: **3** **DEPRESSIONAL**

Depth to Water Table ft.	Cumulative Water Storage (Pre.-Dev.) in.	Compacted Water Storage (Post 50%) in.	Compacted Water Storage (Post 100%) in.
1	0.60	0.53	0.45
2	2.10	1.84	1.58
3	4.40	3.85	3.30
4	6.80	5.95	5.10

2. Available Soil Storage Calculation:

Item:	Description:	Elev. ft.	S in.	Area acres	Stored ac-in
1	n / a	0.00	0.00	0.000	0.00
2	n / a	0.00	0.00	0.000	0.00
3	n / a	0.00	0.00	0.000	0.00
4	n / a	0.00	0.00	0.000	0.00
5	n / a	0.00	0.00	0.000	0.00
6	n / a	0.00	0.00	0.000	0.00
7	n / a	0.00	0.00	0.000	0.00
8	Green Areas	11.60	5.95	0.952	5.66
9	Pavement Areas	11.68	5.10	0.000	0.00
10	Sidewalk Areas	12.25	5.10	0.000	0.00
11	Building Coverage Area	12.42	5.10	0.000	0.00
	Total:	**11.60**	**21.25**	**0.952**	**5.66**

* Abbreviations: S = Soil Storage
P = Pervious

3. Moisture Storage Calculation (S):
= Available soil storage / Total Site Area
= 5.66 ac-in / 8.113 acres
= **0.70 inches**

4. SCS Curve Number Calculation (CN):
= 1000 / (S + 10)
= 1000 / (0.698 + 10)
= **93**

E. SURFACE STORAGE CALCULATIONS:

1. Stage vs. Storage Calculations:

		STORAGE (ac-ft)											
Stage ft.	Item:	1 ac-ft	2 ac-ft	3 ac-ft	4 ac-ft	5 ac-ft	6 ac-ft	7 ac-ft	8 ac-ft	9 ac-ft	10 ac-ft	T ac-ft	Total ac-ft
6.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09
7.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.19
8.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.28
8.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.37
9.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.47
9.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.56
10.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.56
10.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.56
11.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.24	0.00	0.56	0.87
11.25		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.58	0.00	0.56	1.28
11.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.07	0.00	0.56	1.87
11.75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	1.71	0.00	0.56	2.63
12.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	2.49	0.00	0.56	3.56
12.25		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	3.42	0.02	0.56	4.68
12.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.87	4.51	0.07	0.56	6.01
12.75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	5.73	0.15	0.56	7.54
13.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	7.06	0.22	0.56	9.18
13.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.81	9.73	0.36	0.56	12.46
14.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.28	12.40	0.51	0.56	15.75

* Abbreviations: T = Exfiltration Trench

F. MINIMUM BUILDING FINISH FLOOR ELEVATION CALCULATIONS (ZERO DISCHARGE):

1. The rainfall amount for the 100-Year, 3-Day storm event:
   = **20.00 in.**

2. Compute inches of runoff, Q:
   = (P - (0.2 S)) ^2 / (P + (0.8 X S))
   = (20.00 in. - (0.2 X 0.70 in.)) ^2 / 20.00 in. + (0.8 X 0.70 in.))
   = **19.19 inches of runoff**

3. Compute volume of runoff:
   = (Inches of Runoff) X (Project Area)
   = 19.19 inches X 8.113 acres X (1 foot / 12 inches)
   = **12.97 ac-ft of storage required (zero discharge)**

4. From the stage vs storage curve, **12.97** ac-ft corresponds to elevation **13.58** **NAVD.**

G. MINIMUM DISCHARGE ELEVATION CALCULATIONS (ZERO DISCHARGE):

1. The rainfall amount for the 25-Year, 3-Day storm event:
   = **15.00 in.**

2. Compute inches of runoff, Q:
   = (P - (0.2 S)) ^2 / (P + (0.8 X S))
   = (15.00 in. - (0.2 X 0.70 in.)) ^2 / 15.00 in. + (0.8 X 0.70 in.))
   = **14.19 inches of runoff**

3. Compute volume of runoff:
   = (Inches of Runoff) X (Project Area)
   = 14.19 inches X 8.113 acres X (1 foot / 12 inches)
   = **9.60 ac-ft of storage required (zero discharge)**

4. From the stage vs storage curve, **9.60** ac-ft corresponds to elevation **13.06** **NAVD.**

H. MINIMUM ROAD CROWN ELEVATION CALCULATIONS (ZERO DISCHARGE):

1. The rainfall amount for the 10-Year, 1-Day storm event:
   = **9.00 in.**

2. Compute inches of runoff, Q:
   = (P - (0.2 S)) ^2 / (P + (0.8 X S))
   = (9.00 in. - (0.2 X 0.70 in.)) ^2 / 9.00 in. + (0.8 X 0.70 in.))
   = **8.21 inches of runoff**

3. Compute volume of runoff:
   = (Inches of Runoff) X (Project Area)
   = 8.21 inches X 8.113 acres X (1 foot / 12 inches)
   = **5.55 ac-ft of storage required (zero discharge)**

4. From the stage vs storage curve, **5.55** ac-ft corresponds to elevation **12.41** **NAVD.**

I. EXFILTRATION TRENCH CALCULATIONS:

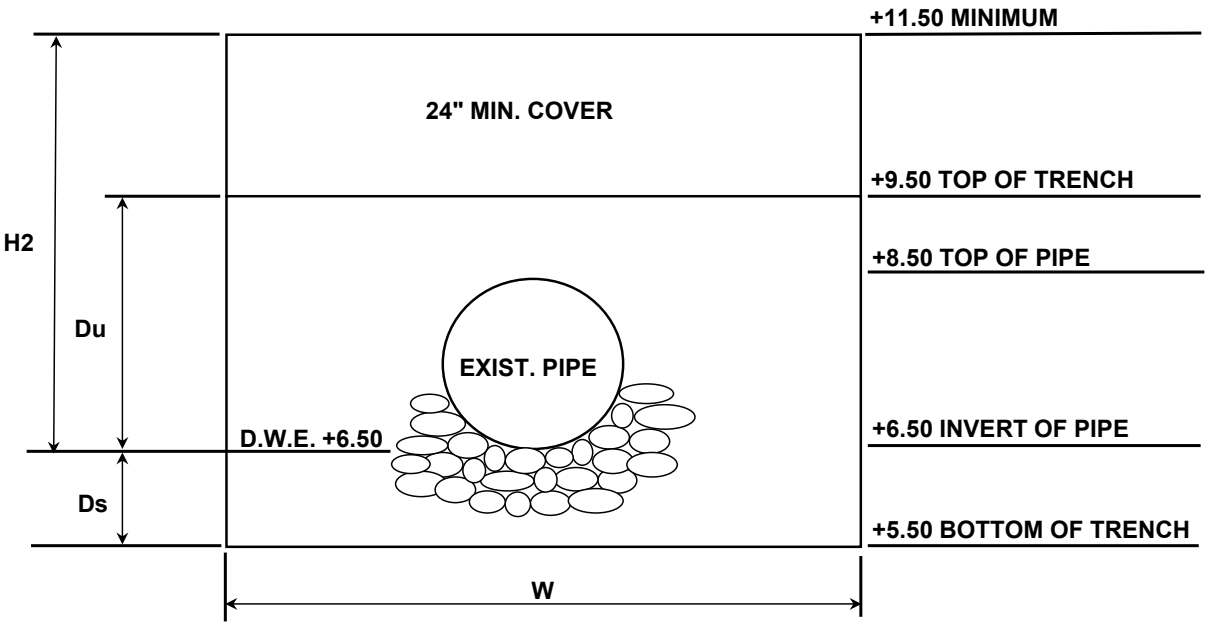
1. Design Formula: L = (FS ((%WQ*V1) + V2)) / (K((2*H2*Du) - (Du^2) + (2*H2*Ds)) + (1.39x10^4*W*Du))

2. Design Information:

V1 = Exfiltrated Volume (Pre-treatment):	0.00	ac-in
V2 = Exfiltrated Volume (Additional Storage):	0.00	ac-in
W = Trench Width:	10.00	ft.
K = Hydraulic Conductivity:	1.00E-04	cfs/sq-ft per ft head
H2 = Depth of Water Table:	5.00	ft.
Du = Non-Saturated Trench Depth:	3.00	ft.
Ds = Saturated Trench Depth:	1.00	ft.

3. Existing Exfiltration Trench: **1,850 ft.**

4. Exfiltration Trench Storage Provided: **6.72 ac-in** or **0.56 ac-ft**



POST-DEVELOPMENT CALCULATIONS

Prepared By:

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(786) 534-3621 Phone

GIVEN:

A. LAND USE SUMMARY:

1.	Lake Area =	0.000	ac.
2.	Buildings =	1.706	ac.
3.	Pavement & Others =	3.877	ac.
4.	Green Areas =	2.530	ac.
5.	**Total =**	**8.113**	

DESIGN CRITERIA:

A. WATER QUALITY CRITERIA:

1. If a wet detention system, then whichever is the greater of the following:
   a. The first inch of runoff from the entire project site.
   b. The amount of 2.5 inches times the percent impervious for the project site.

2. If a dry detention system, then 75% of the volume required for the wet detention system.

3. If a retention system, then 50% of the volume required.

4. If the property is zoned "Commercial", at least 0.5 inches of retention or dry detention pre-treatment will be required.

5. Any detention system shall be designed to discharge no more than 0.5 inches of the detained volume per day.

B. WATER QUANTITY CRITERIA:

1. DESIGN EVENTS AND RAINFALL AMOUNTS:

a. Design Event for Minimum Road Elevation:

Frequency:	10	year
Duration:	1	day
Amount:	9.00	inches

b. Design Event for Minimum Discharge Elevation:

Frequency:	25	year
Duration:	3	day
Amount:	15.00	inches

c. Design Event for Minimum Finish Floor Elevation:

Frequency:	100	year
Duration:	3	day
Amount:	20.00	inches

2. ADDITIONAL DESIGN INFORMATION:

a.	Design Water / Control Elevation:	6.50 NAVD.
b.	Drainage Basin / Canal Number:	S.F.W.M.D. C-14 BASIN

COMPUTATIONS:

A. WATER QUALITY COMPUTATIONS:

1. Compute the first inch of runoff from the entire developed project site:
   = 1.00 inch X 8.113 acres X (1 foot / 12 inches)
   = **0.676 ac-ft for the first inch of runoff**

2. Compute 2.5 inches times the percent impervious for the developed project site:
   a. Site area for water quality pervious / impervious calculations only:
      = Total Project - (Lake Area + Buildings)
      = 8.113 acres - (0.000 acres + 1.706 acres)
      = **6.407 acres of site area for water quality calculations**

   b. Impervious area for water quality pervious / impervious calculations only:
      = Site area for water quality - Pervious area
      = 6.407 acres - 2.530 acres
      = **3.877 acres of impervious area for water quality calculations**

   c. Percentage of impervious area for water quality:
      = Impervious area for water quality / Site area for water quality X 100%
      = 3.877 acres / 6.407 acres X 100%
      = **60.51 % Impervious**

   d. For 2.5 inches times the percentage of impervious area:
      = 2.5 inches X 60.51 %
      = **1.513 inches to be treated**

   e. Compute volume required for quality detention:
      = Inches to be treated X (Total Site Area - Lake Area)
      = 1.513 inches X (8.113 acres - 0.000 acres) X (1 foot / 12 inches)
      = **1.023 ac-ft required for detention storage**

3. The first inch of runoff from the entire developed site = 0.676 ac-ft
   2.5 inches times the percentage of impervious area = 1.023 ac-ft

   The volume of 1.023 ac-ft controls

4. If the project is zoned "Commercial" or if the project were discharging directly to a sensitive receiving body and is more than 40% impervious, 0.5 inches of dry detention pre-treatment must be provided:

   = 0.5 inches X (Total Site Area - Lake Area)
   = 0.5 inches X (8.113 acres - 0.000 acres) X (1 foot / 12 inches)
   = **0.338 ac-ft required for pre-treatment**

5. Compute credit for using one of the following systems:

   a. Wet detention volume to be provided:
      = Total required detention - Pre-treatment
      = 1.023 ac-ft - 0.338 ac-ft
      = **0.685 ac-ft of volume required for wet detention**

   b. Dry detention volume to be provided (75% of the total required detention volume):
      = Total required detention volume X 75%
      = 1.023 ac-ft X 75%
      = **0.767 ac-ft of volume required for dry detention**

   c. Dry retention volume to be provided (50% of the total required detention volume):
      = Total required detention volume X 50%
      = 1.023 ac-ft X 50%
      = **0.511 ac-ft of volume required for dry retention**

B. SUMMARY OF WATER QUALITY COMPUTATIONS:

Item:	Description:	Quantity:	
A.1	First inch of runoff from entire project site =	0.676	ac-ft
A.2	2.5 inches times percent impervious =	1.023	ac-ft
A.3	Volume to be treated =	1.023	ac-ft
A.4	Pre-treatment required for commercial site =	0.338	ac-ft
A.5.a	Wet detention volume required =	0.685	ac-ft
A.5.b	Dry detention volume required =	0.767	ac-ft
A.5.c	Dry retention volume required =	0.511	ac-ft
A.5.d	Exfiltration trench volume required =	1.023	ac-ft

C. STAGE ELEVATION INFORMATION:

Item:	Description:	S type	Area ac.	Low ft.	High ft.	I %	C %	Total Area %
1	n / a	V						0.00
2	n / a	L						0.00
3	n / a	V						0.00
4	n / a	L						0.00
5	n / a	V						0.00
6	n / a	L						0.00
7	n / a	L						0.00
8	Green Areas	L	2.530	11.00	12.50	0	50	31.18
9	Pavement Areas	L	3.167	11.00	12.50	100	100	39.04
10	Sidewalk Areas	L	0.710	11.50	13.00	100	100	8.75
11	Building Coverage Area	V	1.706	13.00	13.50	100	100	21.03
	Total:		**8.113**	**11.00**	**13.50**	**68.82**	**84.41**	**100.0**

* Abbreviations:

S = Storage; (V = Vertical Storage & L = Linear Storage)
I = Impervious
C = Compaction; (Use the following compaction factors: 0%, 50%, 100%)

D. SCS CURVE NUMBER AND SOIL STORAGE CALCULATIONS:

1. Soil Moisture Storage Table:
Existing Soil Type: **3** **DEPRESSIONAL**

Depth to Water Table ft.	Cumulative Water Storage (Pre.-Dev.) in.	Compacted Water Storage (Post 50%) in.	Compacted Water Storage (Post 100%) in.
1	0.60	0.53	0.45
2	2.10	1.84	1.58
3	4.40	3.85	3.30
4	6.80	5.95	5.10

2. Available Soil Storage Calculation:

Item:	Description:	Elev. ft.	S in.	Area acres	Stored ac-in
1	n / a	0.00	0.00	0.000	0.00
2	n / a	0.00	0.00	0.000	0.00
3	n / a	0.00	0.00	0.000	0.00
4	n / a	0.00	0.00	0.000	0.00
5	n / a	0.00	0.00	0.000	0.00
6	n / a	0.00	0.00	0.000	0.00
7	n / a	0.00	0.00	0.000	0.00
8	Green Areas	11.75	5.95	2.530	15.05
9	Pavement Areas	11.75	5.10	0.000	0.00
10	Sidewalk Areas	12.25	5.10	0.000	0.00
11	Building Coverage Area	13.25	5.10	0.000	0.00
	Total:	**11.75**	**21.25**	**2.530**	**15.05**

* Abbreviations: S = Soil Storage
P = Pervious

3. Moisture Storage Calculation (S):
= Available soil storage / Total Site Area
= 15.05 ac-in / 8.113 acres
= **1.86 inches**

4. SCS Curve Number Calculation (CN):
= 1000 / (S + 10)
= 1000 / (1.855 + 10)
= **84**

E. SURFACE STORAGE CALCULATIONS:

1. Stage vs. Storage Calculations:

		STORAGE (ac-ft)											
Stage ft.	Item:	1 ac-ft	2 ac-ft	3 ac-ft	4 ac-ft	5 ac-ft	6 ac-ft	7 ac-ft	8 ac-ft	9 ac-ft	10 ac-ft	T ac-ft	Total ac-ft
6.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
7.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.26
8.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.39
8.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.52
9.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.65
9.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.78
10.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.78
10.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.78
11.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.78
11.25		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07	0.00	0.78	0.90
11.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.26	0.00	0.78	1.26
11.75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.59	0.01	0.78	1.87
12.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	1.06	0.06	0.78	2.74
12.25		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	1.65	0.13	0.78	3.88
12.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	2.38	0.24	0.78	5.29
12.75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.53	3.17	0.37	0.78	6.85
13.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.16	3.96	0.53	0.78	8.44
13.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.43	5.54	0.89	0.78	11.64
14.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.69	7.13	1.24	0.78	14.84

* Abbreviations: T = Exfiltration Trench

F. MINIMUM BUILDING FINISH FLOOR ELEVATION CALCULATIONS (ZERO DISCHARGE):

1. The rainfall amount for the 100-Year, 3-Day storm event:
   = **20.00 in.**

2. Compute inches of runoff, Q:
   = (P - (0.2 S)) ^2 / (P + (0.8 X S))
   = (20.00 in. - (0.2 X 1.86 in.)) ^2 / 20.00 in. + (0.8 X 1.86 in.))
   = **17.93 inches of runoff**

3. Compute volume of runoff:
   = (Inches of Runoff) X (Project Area)
   = 17.93 inches X 8.113 acres X (1 foot / 12 inches)
   = **12.12 ac-ft of storage required (zero discharge)**

4. From the stage vs storage curve, **12.12** ac-ft corresponds to elevation **13.58** **NGVD.**

G. MINIMUM DISCHARGE ELEVATION CALCULATIONS (ZERO DISCHARGE):

1. The rainfall amount for the 25-Year, 3-Day storm event:
   = **15.00 in.**

2. Compute inches of runoff, Q:
   = (P - (0.2 S)) ^2 / (P + (0.8 X S))
   = (15.00 in. - (0.2 X 1.86 in.)) ^2 / 15.00 in. + (0.8 X 1.86 in.))
   = **12.98 inches of runoff**

3. Compute volume of runoff:
   = (Inches of Runoff) X (Project Area)
   = 12.98 inches X 8.113 acres X (1 foot / 12 inches)
   = **8.78 ac-ft of storage required (zero discharge)**

4. From the stage vs storage curve, **8.78** ac-ft corresponds to elevation **13.05** **NGVD.**

H. MINIMUM ROAD CROWN ELEVATION CALCULATIONS (ZERO DISCHARGE):

1. The rainfall amount for the 10-Year, 1-Day storm event:
   = **9.00 in.**

2. Compute inches of runoff, Q:
   = (P - (0.2 S)) ^2 / (P + (0.8 X S))
   = (9.00 in. - (0.2 X 1.86 in.)) ^2 / 9.00 in. + (0.8 X 1.86 in.))
   = **7.10 inches of runoff**

3. Compute volume of runoff:
   = (Inches of Runoff) X (Project Area)
   = 7.10 inches X 8.113 acres X (1 foot / 12 inches)
   = **4.80 ac-ft of storage required (zero discharge)**

4. From the stage vs storage curve, **4.80** ac-ft corresponds to elevation **12.41** **NGVD.**

I. EXFILTRATION TRENCH CALCULATIONS:

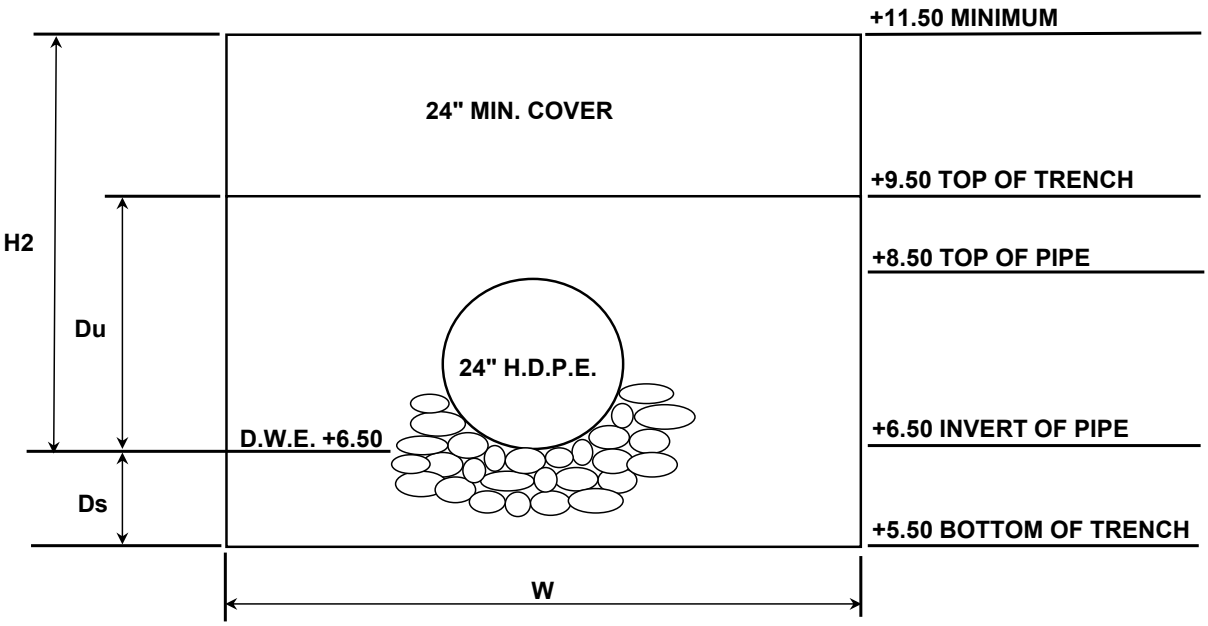
1. Design Formula: L = (FS ((%WQ*V1) + V2)) / (K((H2*W) + (2*H2*Du) - (Du^2) + (2*H2*Ds)) + (1.39x10^4*W*Du))

2. Design Information:

V1 = Exfiltrated Volume (Pre-treatment):	0.00	ac-in
V2 = Exfiltrated Volume (Additional Storage):	0.00	ac-in
W = Trench Width:	8.00	ft.
K = Hydraulic Conductivity:	1.00E-04	cfs/sq-ft per ft head
H2 = Depth of Water Table:	5.00	ft.
Du = Non-Saturated Trench Depth:	3.00	ft.
Ds = Saturated Trench Depth:	1.00	ft.

3. Exfiltration Trench Provided: **1,800 ft.**

4. Exfiltration Trench Storage Provided: **9.39 ac-in** or **0.78 ac-ft**



J. PRE VS. POST DEVELOPMENT CALCULATION SUMMARY:

MARQUESA (NAVD.)			
PHASE	10 Y - 1 D	25 Y - 3 D	100 Y - 3D
PRE-DEVELOPMENT	12.41	13.06	13.58
POST-DEVELOPMENT	12.41	13.05	13.58

REFERENCE MATERIAL

Prepared By:

HSQ GROUP, INC.
Engineers ● Planners ● Surveyors
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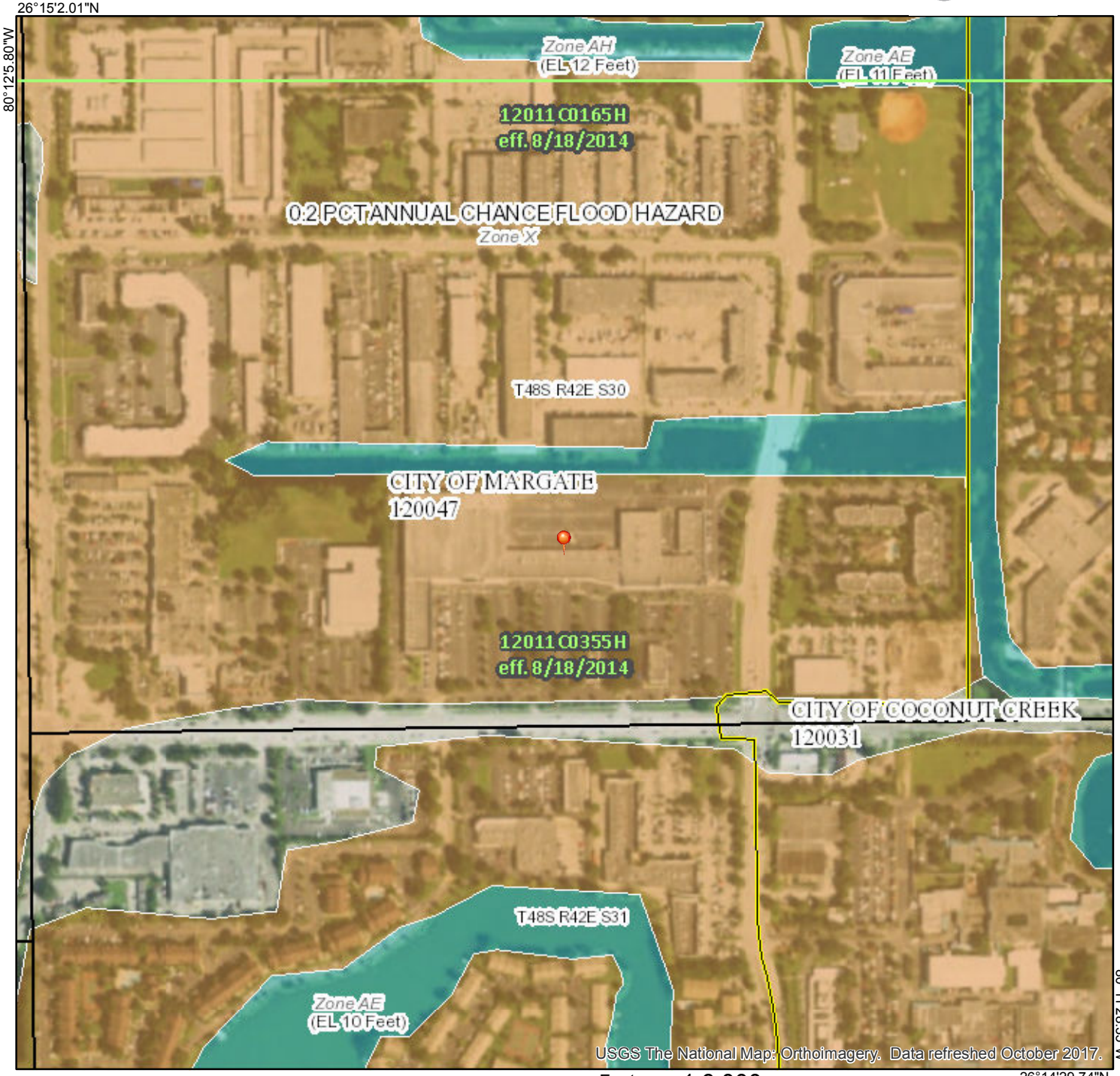
National Flood Hazard Layer FIRMette

FEMA



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/25/2018 at 9:34:25 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

DRAINAGE DISTRICTS

Legend

Drainage Districts

- Bonaventure Development District
- Broward County Water Control District #2
- Broward County Water Control District #3
- Broward County Water Control District #4
- Central Broward Water Control District
- Cocomar Water Control District
- Coral Bay Community Development District
- Coral Springs Improvement District
- Cypress Cove Community Development District
- Indian Trace Development District
- Lauderdale Isles Water Management District
- North Lauderdale Water Control District
- North Springs Improvement District
- Oakridge Community Development District
- Old Plantation WaterControl District
- Pine Tree Water Control District
- Plantation Acres Improvement District
- South Broward Drainage District
- Sunshine Water Control District
- Tindall Hammock Irrigation and Soil Conservation District
- Turtle Run Community Development District
- Twin Lakes Water Control District
- West Lake Community Development District
- Dependent Drainage Districts

Data Source: The drainage district data is from the Broward County Environmental Engineering & Licensing Section.

NSID
Pine Tree
Turtle Run
Cocomar
Sunshine
Coral Springs
Coral Bay
Cypress Cove
Broward WCD #2
Broward WCD #3
Broward WCD #4
North Lauderdale
Plantation Acres
Old Plantation
Bonaventure
Indian Trace
Central Broward
Tindall Hammock
Lauderdale Isles
Oakridge
West Lake
South Broward
Twin Lakes

PROJECT LOCATION

Water Conservation Area

Atlantic Ocean

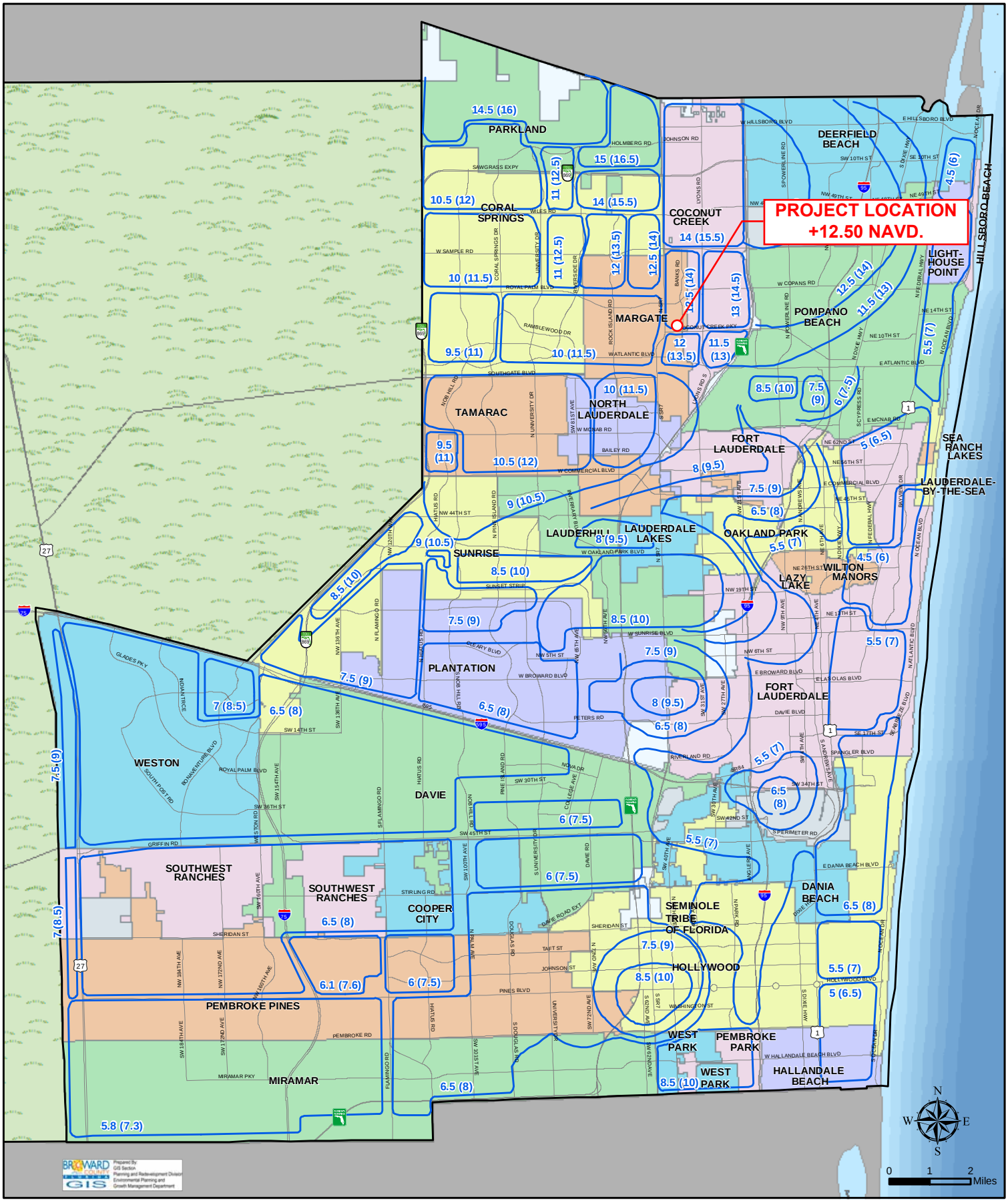
Prepared by:
Surface Water Management Licensing Section
Environmental Licensing and Building Permitting Division
Environmental Protection and Growth Management Dept.

This map is for conceptual purposes only and should not be used for legal boundary determinations.

Miles 0 1 2

dlugo #12544 1/28/2014

BROWARD COUNTY 100 YEAR FLOOD ELEVATIONS



100 Year Flood Contours NAVD (NGVD)
Example: 6.5 (8)

This map is for conceptual purposes only and should not be used for legal boundary determinations.

Elevations converted from NGVD to NAVD using the FEMA approved conversion factor for Broward County of (-)1.5, based on 1997 FEMA Flood Data

#12729 SNowicki 10/2014

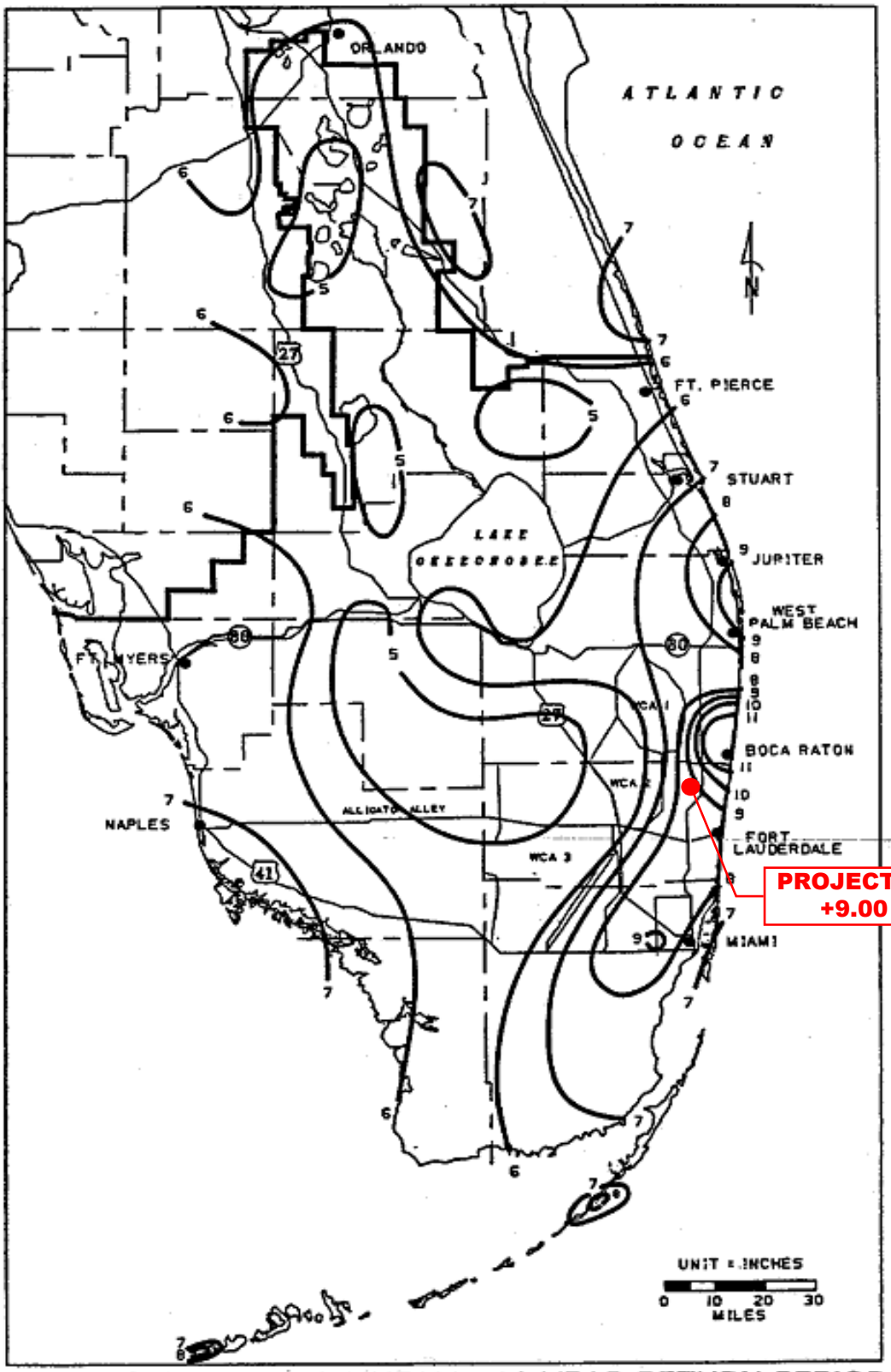


FIGURE C-4. 1-DAY RAINFALL: 10-YEAR RETURN PERIOD

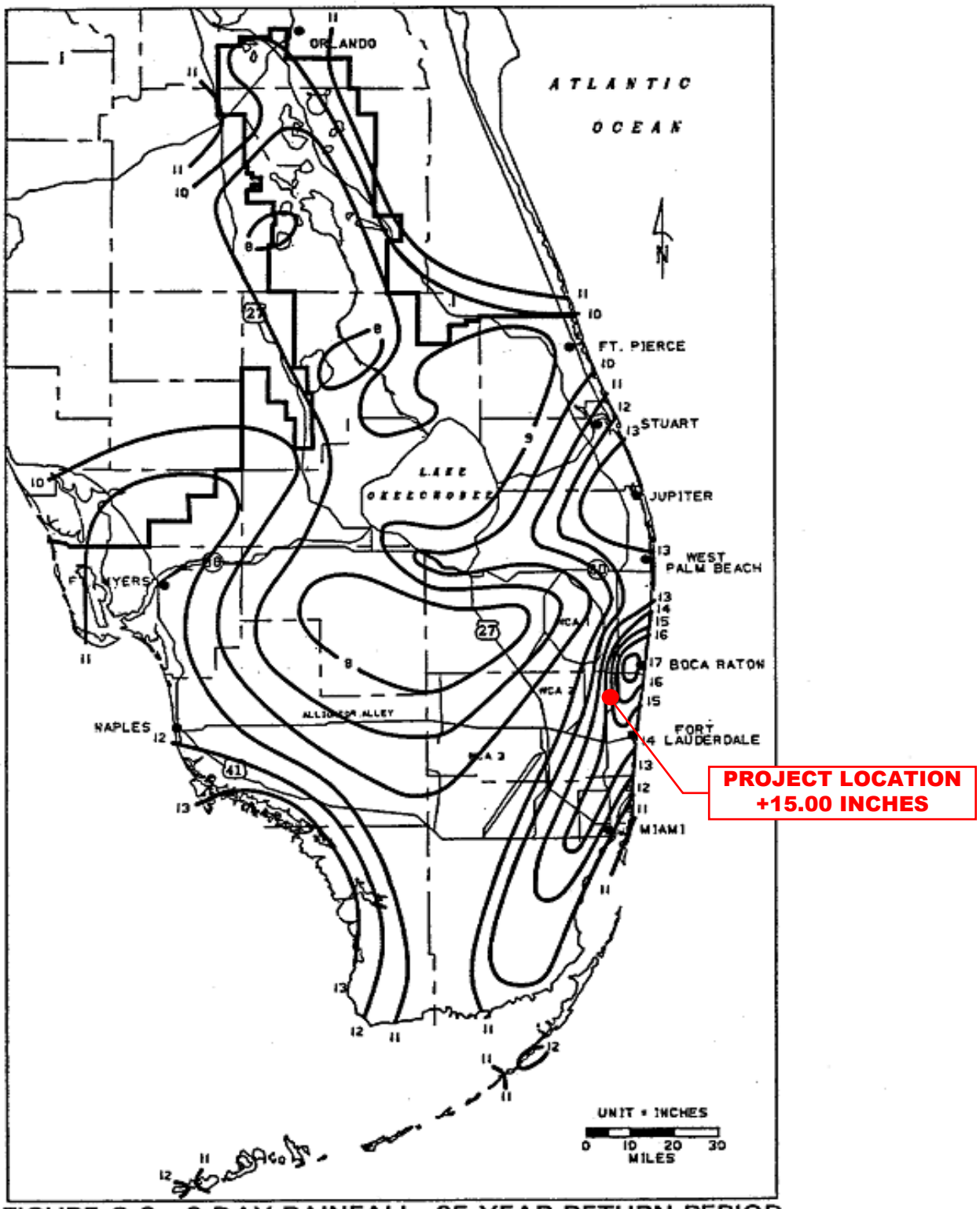


FIGURE C-8. 3-DAY RAINFALL: 25-YEAR RETURN PERIOD

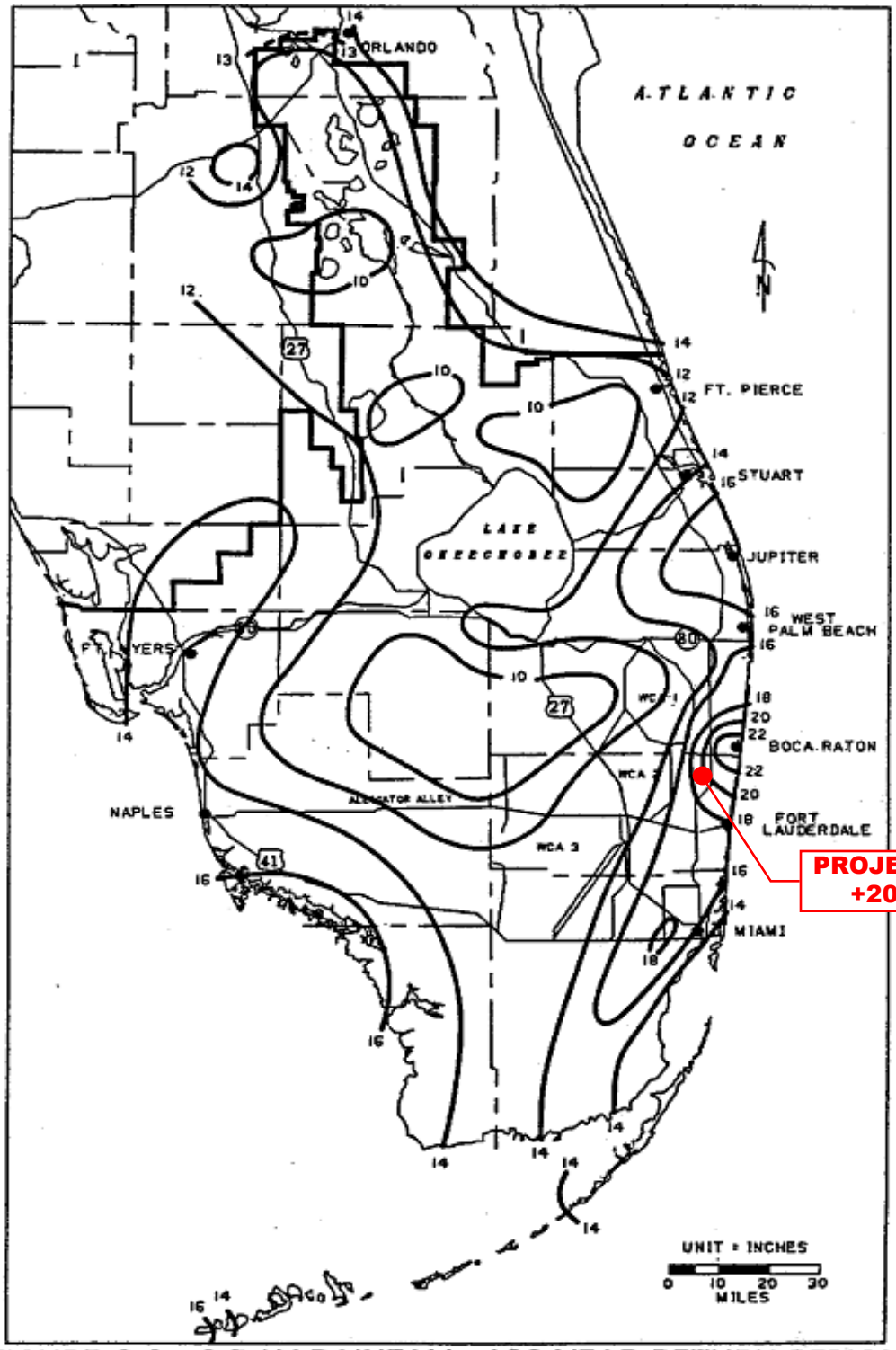


FIGURE C-9. 3-DAY RAINFALL: 100-YEAR RETURN PERIOD