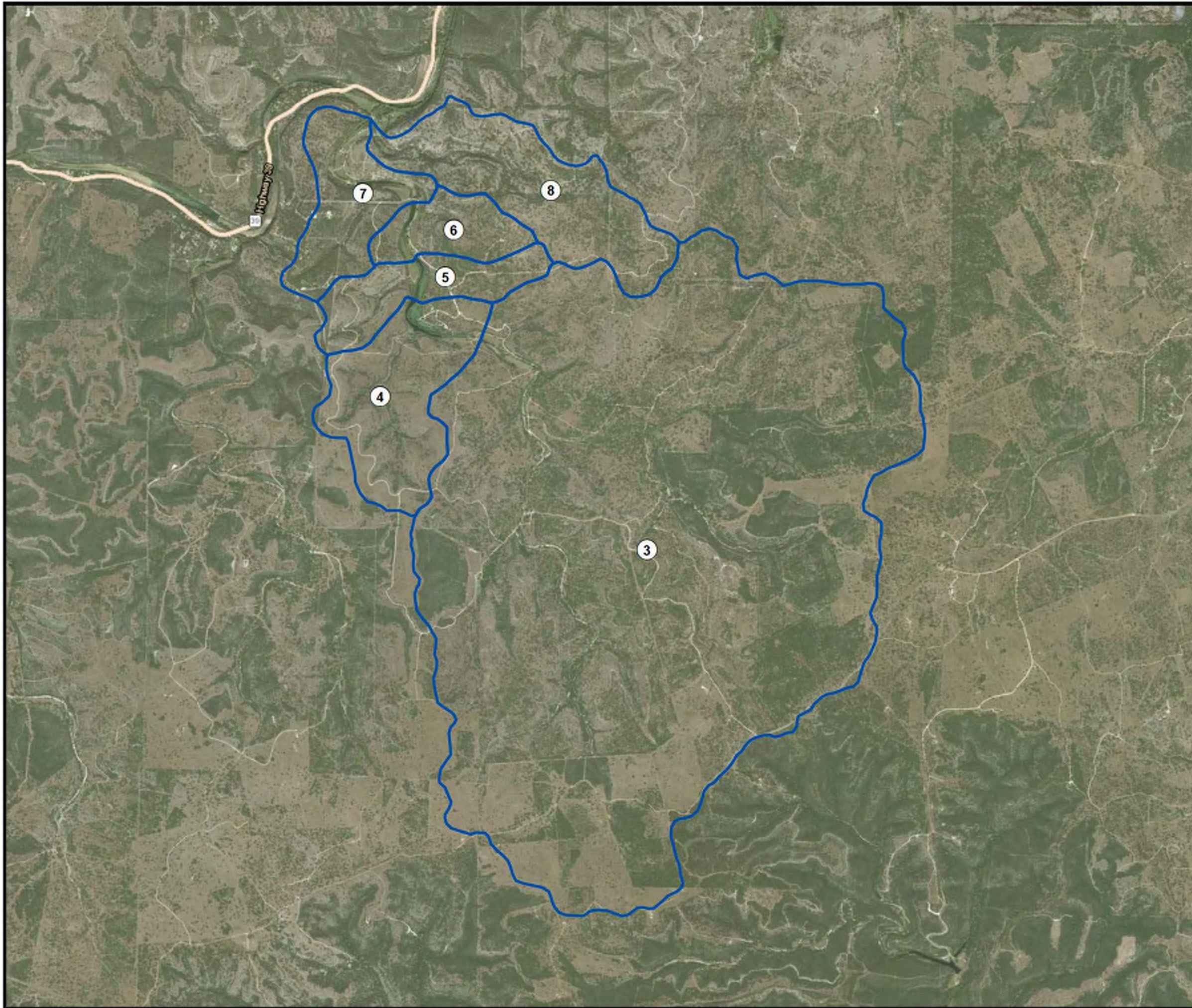




Legend



Drainage Areas

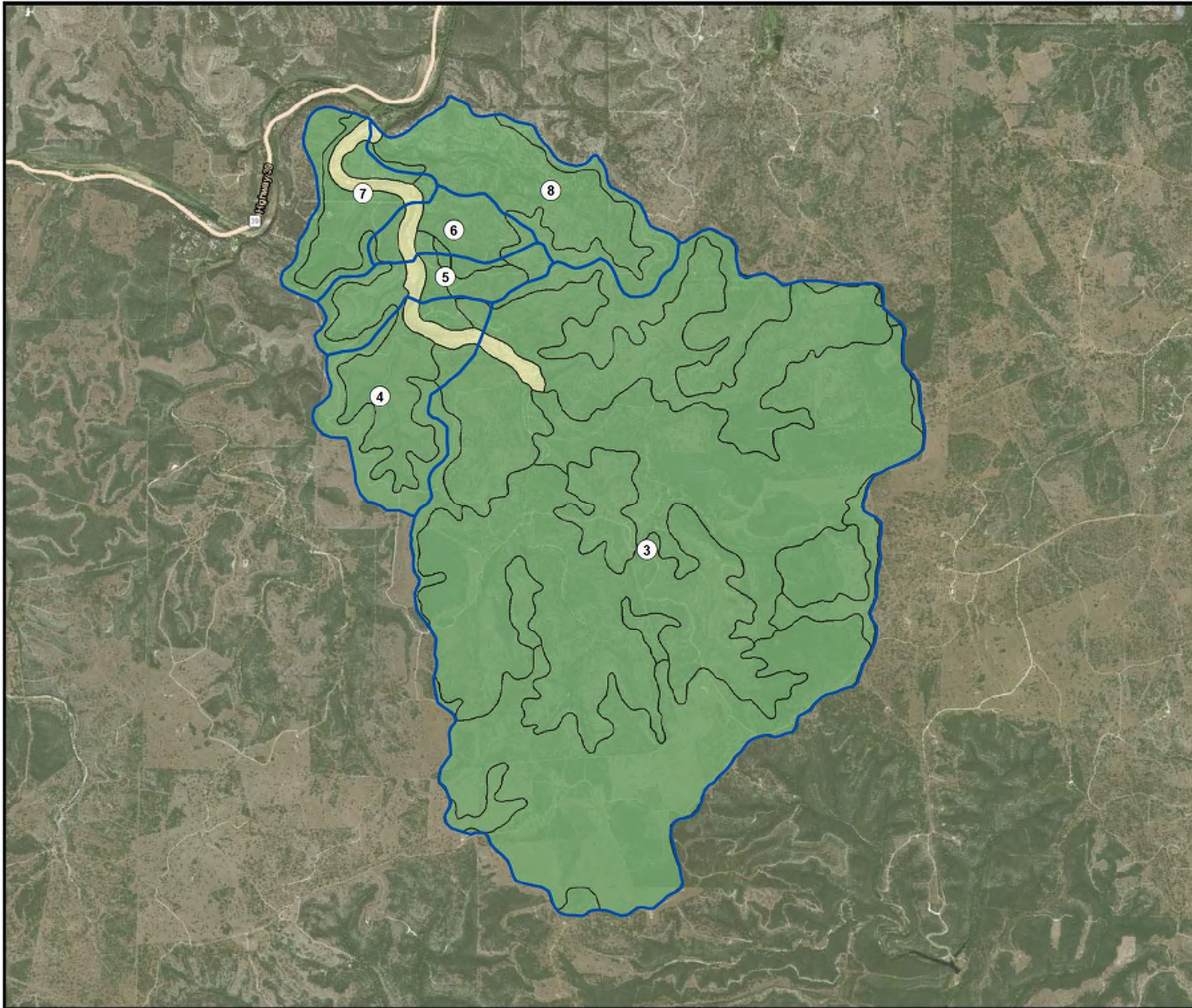


DRAINAGE AREA MAP

DRAINAGE STUDY
CAMP MYSTIC, KERR COUNTY, TEXAS

DATE: 10/30/2018

EXHIBIT
3



Legend



Drainage Areas

Hydrologic Soil Groups



B



D

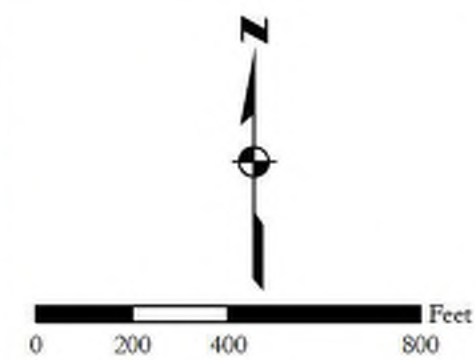
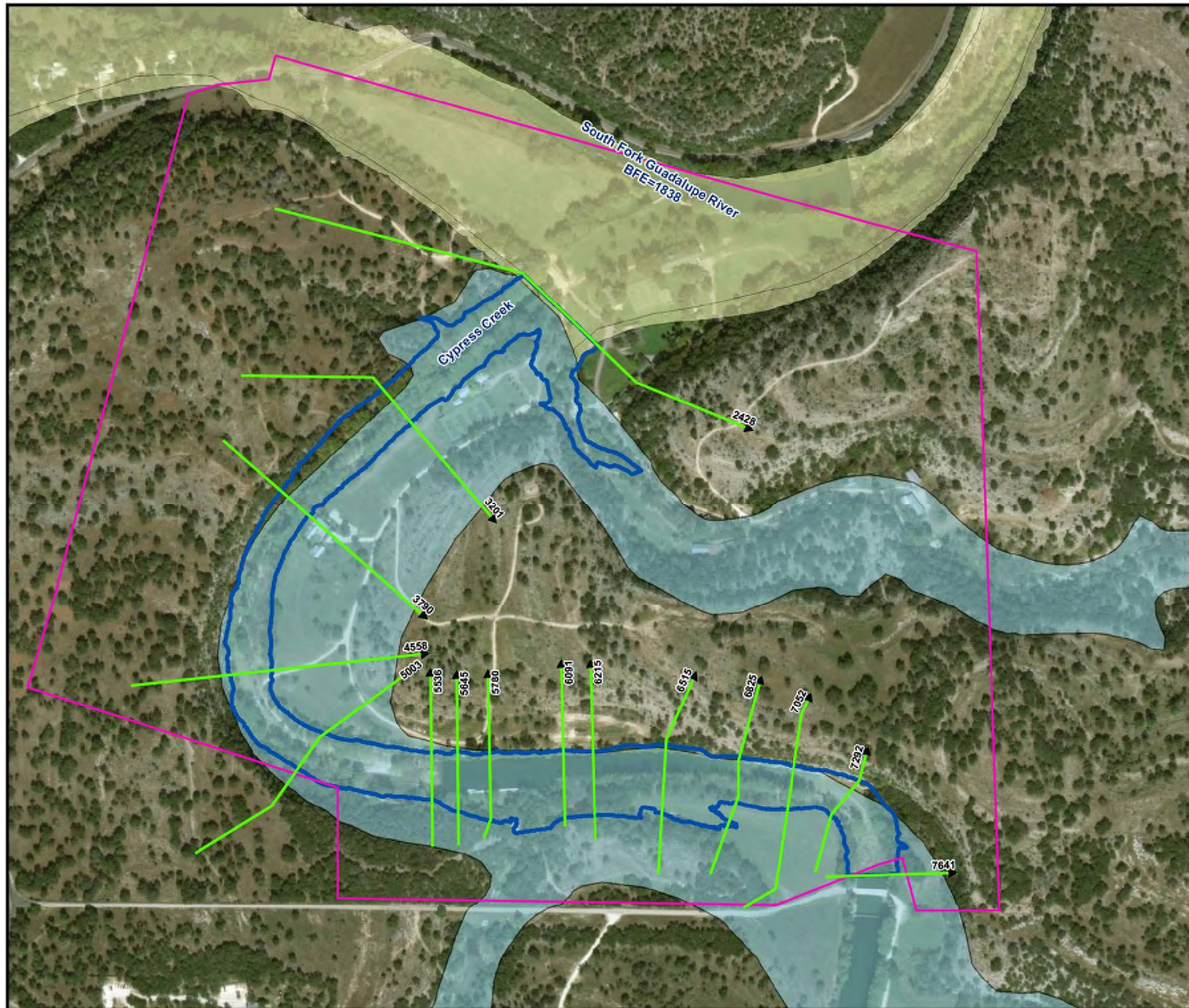


SOILS MAP

DRAINAGE STUDY
CAMP MYSTIC, KERR COUNTY, TEXAS

DATE: 10/30/2018

EXHIBIT
4



- Cross Sections
- Property
- 100-Year Floodplain from Detailed Study
- FEMA Floodplain**
 - Zone A (unstudied)
 - Zone AE (studied)

River Station	100-Year Q (cfs)	BFE (ft)
7641	21,239	1870.93
7292	21,239	1870.40
7052	21,239	1869.73
6825	21,239	1869.16
6515	21,239	1868.07
6215	21,239	1866.70
6091	21,239	1866.51
5780	21,239	1864.96
5645	21,239	1862.41
5585	Dam - Inline Weir	
5536	21,239	1857.51
5003	22,054	1854.89
4558	22,054	1851.45
3790	22,054	1847.10
3201	22,054	1845.34
2428	22,054	1844.47

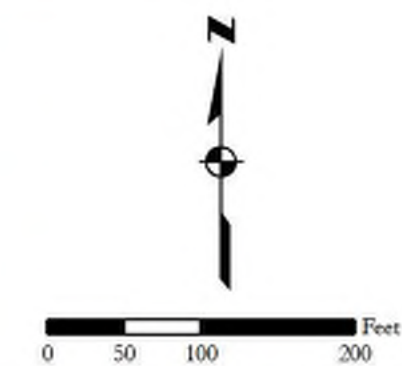
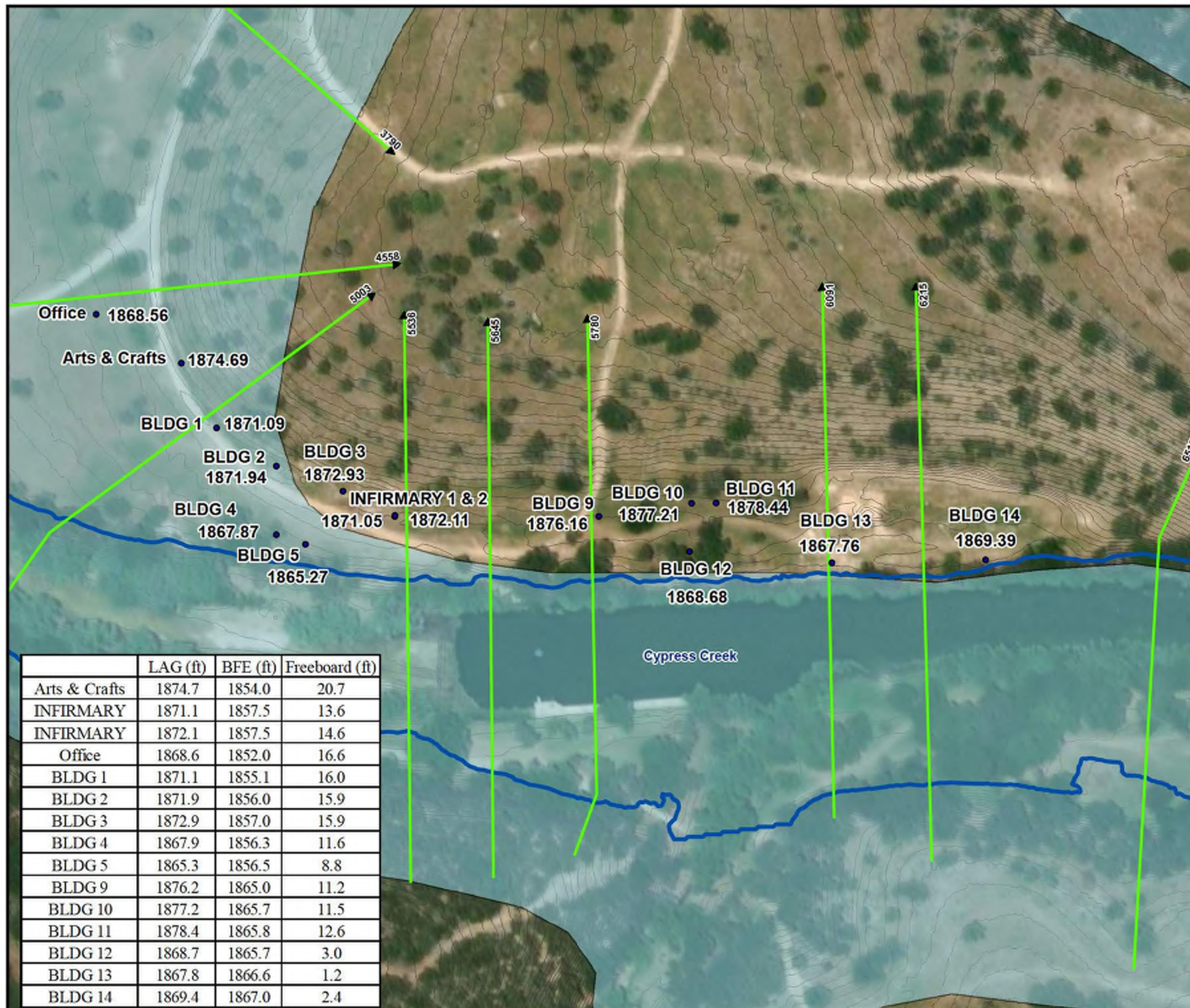
All elevations are based on NAVD 88 (North American Vertical Datum of 1988).

100-YEAR FLOODPLAIN AND BFEs

CAMP MYSTIC, CYPRESS CREEK, KERR COUNTY

DATE: 10/30/18

EXHIBIT
5



Legend

- LAGs
- Cross Sections
- 2-ft Contours
- 100-Year Floodplain from Detailed Study
- FEMA Floodplain**
 - Zone A (unstudied)

River Station	100-Year Q (cfs)	BFE (ft)
7641	21,239	1870.93
7292	21,239	1870.40
7052	21,239	1869.73
6825	21,239	1869.16
6515	21,239	1868.07
6215	21,239	1866.70
6091	21,239	1866.51
5780	21,239	1864.96
5645	21,239	1862.41
5585	Dam - Inline Weir	
5536	21,239	1857.51
5003	22,054	1854.89
4558	22,054	1851.45
3790	22,054	1847.10
3201	22,054	1845.34
2428	22,054	1844.47

All elevations are based on NAVD 88 (North American Vertical Datum of 1988).

LOWEST ADJACENT GRADES

CAMP MYSTIC, CYPRESS CREEK, KERR COUNTY

DATE: 09/22/19

LOMA

Cross Section map overlaid on structure map

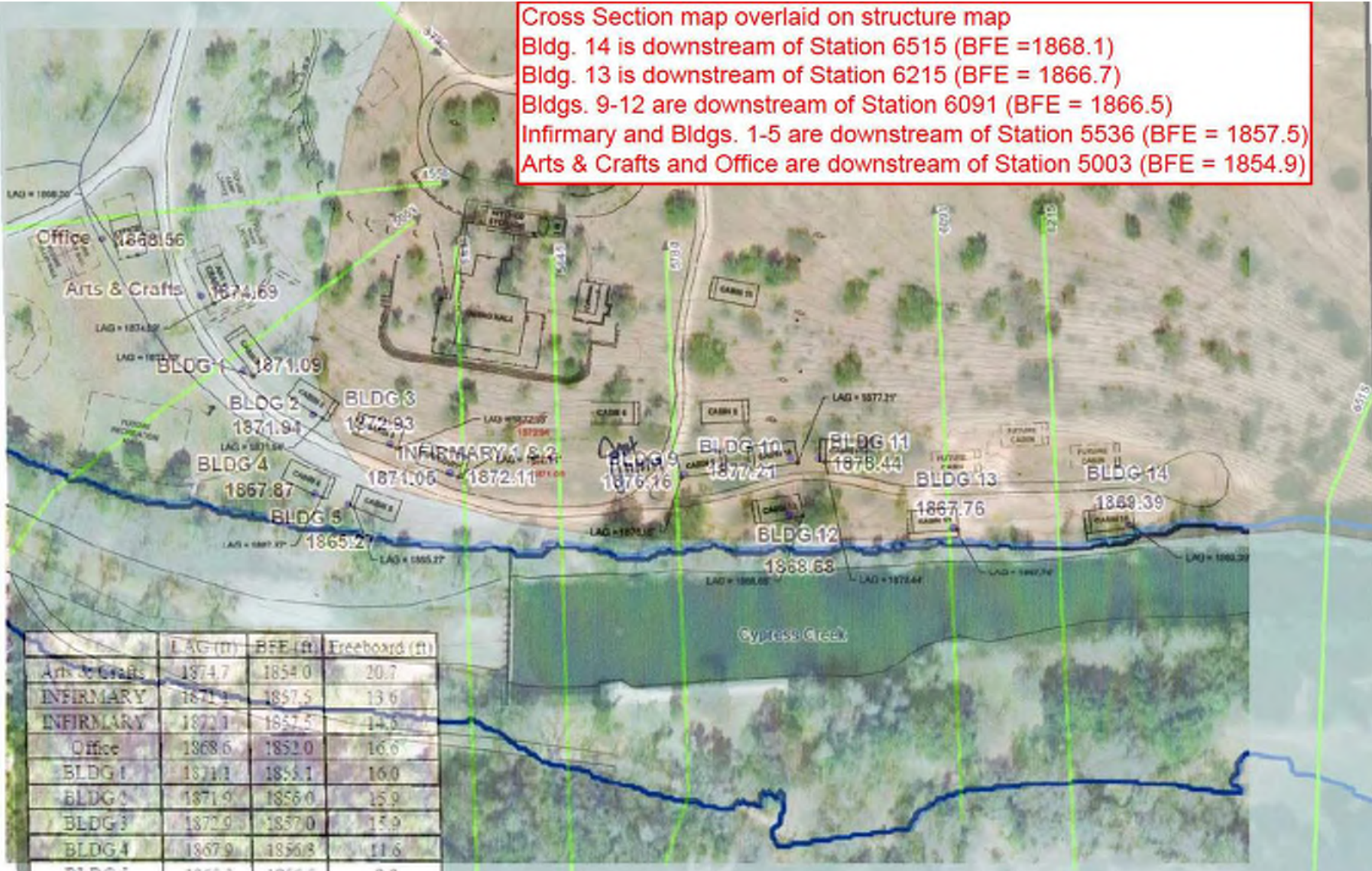
Bldg. 14 is downstream of Station 6515 (BFE = 1868.1)

Bldg. 13 is downstream of Station 6215 (BFE = 1866.7)

Bldgs. 9-12 are downstream of Station 6091 (BFE = 1866.5)

Infirmary and Bldgs. 1-5 are downstream of Station 5536 (BFE = 1857.5)

Arts & Crafts and Office are downstream of Station 5003 (BFE = 1854.9)



Appendix

Appendix A – Curve Number Calculations

Subbasin 3

Area_acres	HSG	Soil_Descr
29.9	B	Oakalla silty clay loam, occasionally flooded
349.0	D	Eckrant-Comfort association, gently undulating
75.8	D	Eckrant-Comfort association, gently undulating
3.7	D	Tarpley-Roughcreek association, gently undulating
679.9	D	Eckrant-Rock outcrop association, steep
0.2	D	Tarpley-Roughcreek association, gently undulating
1058.2	D	Eckrant-Comfort association, gently undulating
252.4	D	Tarpley-Roughcreek association, gently undulating
97.2	D	Spires-Tarpley association, gently undulating
143.6	D	Tarpley-Roughcreek association, gently undulating
1262.9	D	Eckrant-Rock outcrop association, steep
125.0	D	Tarpley-Roughcreek association, gently undulating
44.4	D	Eckrant-Comfort association, gently undulating
30.7	D	Eckrant-Comfort association, gently undulating
46.2	D	Eckrant-Comfort association, gently undulating
1201.2	D	Tarpley-Roughcreek association, gently undulating
18.4	D	Spires-Tarpley association, gently undulating
5418.8		

Hydrologic Soil Group	Area (acres)	Area Fraction	CN*	Weighted CN
A	0.0	0.000	57	0.0
B	29.9	0.006	73	0.4
C	0.0	0.000	82	0.0
D	5388.9	0.994	86	85.5
W	0.0	0.000	100	0.0
Total (excluding Water)	5418.8	1.000		86

* Assumptions:

Other agricultural land

Cover type: Woods/grass combination

Hydrologic condition: Poor

Reference: TR-55, Second Edition, June 1986, page 2-7

Subbasin 4

Area_acres	HSG	Soil_Descr
34.7	B	Oakalla silty clay loam, occasionally flooded
213.0	D	Eckrant-Rock outcrop association, steep
0.3	D	Eckrant-Comfort association, gently undulating
171.9	D	Eckrant-Comfort association, gently undulating
25.6	D	Doss silty clay, 1 to 5 percent slopes
16.7	D	Eckrant-Rock outcrop association, steep
0.6	D	Tarpley-Roughcreek association, gently undulating
24.3	D	Tarpley-Roughcreek association, gently undulating
487.1		

Hydrologic Soil Group	Area (acres)	Area Fraction	CN*	Weighted CN
A	34.7	0.071	57	4.1
B	0.0	0.000	73	0.0
C	0.0	0.000	82	0.0
D	452.5	0.929	86	79.9
W	0.0	0.000	100	0.0
Total (excluding Water)	487.1	1.000		84

* Assumptions:

Other agricultural land

Cover type: Woods/grass combination

Hydrologic condition: Poor

Reference: TR-55, Second Edition, June 1986, page 2-7

Curve Number Modification to Account for Antecedents:

$$RCNIII = 23 * RCNII / (10 + 0.13 * RCNII)$$

RCNIII =

92

Reference: TxDOT Hydraulic Design Manual, March 2004, pg 5-41

Subbasin 5

Area_acres	HSG	Soil_Descr
16.0	B	Oakalla silty clay loam, occasionally flooded
77.8	D	Eckrant-Rock outcrop association, steep
24.7	D	Eckrant-Comfort association, gently undulating
14.9	D	Eckrant-Rock outcrop association, steep
47.0	D	Eckrant-Comfort association, gently undulating
21.6	D	Doss silty clay, 1 to 5 percent slopes
0.1	D	Eckrant-Rock outcrop association, steep
50.9	D	Tarpley-Roughcreek association, gently undulating
253.1		

Hydrologic Soil Group	Area (acres)	Area Fraction	CN*	Weighted CN
A	0.0	0.000	57	0.0
B	16.0	0.063	73	4.6
C	0.0	0.000	82	0.0
D	237.0	0.937	86	80.5
W	0.0	0.000	100	0.0
Total (excluding Water)	253.1	1.000		85

* Assumptions:
 Other agricultural land
 Cover type: Woods/grass combination
 Hydrologic condition: Poor

Reference: TR-55, Second Edition, June 1986, page 2-7

Curve Number Modification to Account for Antecedents:

$$RCNIII = 23 * RCNII / (10 + 0.13 * RCNII) \quad \mathbf{RCNIII = 93}$$

Reference: TxDOT Hydraulic Design Manual, March 2004, pg 5-41

Subbasin 6

Area_acres	HSG	Soil_Descr
21.7	B	Oakalla silty clay loam, occasionally flooded
28.0	D	Eckrant-Rock outcrop association, steep
13.6	D	Eckrant-Comfort association, gently undulating
110.8	D	Eckrant-Rock outcrop association, steep
4.5	D	Eckrant-Comfort association, gently undulating
8.9	D	Doss silty clay, 1 to 5 percent slopes
3.8	D	Tarpley-Roughcreek association, gently undulating
191.3		

Hydrologic Soil Group	Area (acres)	Area Fraction	CN*	Weighted CN
A	0.0	0.000	57	0.0
B	21.7	0.113	73	8.3
C	0.0	0.000	82	0.0
D	169.6	0.887	86	76.2
W	0.0			0.0
Total (excluding Water)	191.3	1.000		85

* Assumptions:

Other agricultural land

Cover type: Woods/grass combination

Hydrologic condition: Poor

Reference: TR-55, Second Edition, June 1986, page 2-7

Curve Number Modification to Account for Antecedents:

$$RCNIII = 23 * RCNII / (10 + 0.13 * RCNII) \quad \quad \quad \mathbf{RCNIII = 93}$$

Reference: TxDOT Hydraulic Design Manual, March 2004, pg 5-41

Subbasin 7

Area_acres	HSG	Soil_Descr
50.1	B	Oakalla silty clay loam, occasionally flooded
134.4	D	Eckrant-Rock outcrop association, steep
9.5	D	Eckrant-Rock outcrop association, steep
90.3	D	Eckrant-Comfort association, gently undulating
31.8	D	Eckrant-Comfort association, gently undulating
316.1		

Hydrologic Soil Group	Area (acres)	Area Fraction	CN*	Weighted CN
A	0.0	0.000	57	0.0
B	50.1	0.158	73	11.6
C	0.0	0.000	82	0.0
D	266.0	0.842	86	72.4
W	0.0			0.0
Total (excluding Water)	316.1	1.000		84

* Assumptions:

Other agricultural land

Cover type: Woods/grass combination

Hydrologic condition: Poor

Reference: TR-55, Second Edition, June 1986, page 2-7

Curve Number Modification to Account for Antecedents:

$$RCNIII = 23 * RCNII / (10 + 0.13 * RCNII)$$

$$RCNIII = 92$$

Reference: TxDOT Hydraulic Design Manual, March 2004, pg 5-41

Subbasin 8

Area_acres	HSG	Soil_Descr
4.2	B	Oakalla silty clay loam, occasionally flooded
135.7	D	Eckrant-Comfort association, gently undulating
400.5	D	Eckrant-Rock outcrop association, steep
10.0	D	Eckrant-Comfort association, gently undulating
550.4		

Hydrologic Soil Group	Area (acres)	Area Fraction	CN*	Weighted CN
A	0.0	0.000	57	0.0
B	4.2	0.008	73	0.6
C	0.0	0.000	82	0.0
D	546.2	0.992	86	85.3
W	0.0			0.0
Total (excluding Water)	550.4	1.000		86

* Assumptions:

Other agricultural land

Cover type: Woods/grass combination

Hydrologic condition: Poor

Reference: TR-55, Second Edition, June 1986, page 2-7

Curve Number Modification to Account for Antecedents:

$$RCNIII = 23 * RCNII / (10 + 0.13 * RCNII) \quad \quad \quad \mathbf{RCNIII = 93}$$

Reference: TxDoT Hydraulic Design Manual, March 2004, pg 5-41

Appendix B – Time of Concentration Calculations

SCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION							
PROJECT	Camp Mystic						
LOCATION	Kerr County						
DATE	10/30/2018						
COND.	Existing						
BY:							
WSHED NAME	3						
SHEET FLOW:							
	N VALUE (SEE BELOW)		0.4				
Undeveloped				n value	% Land use	Inc n	
Conc., gravel, asphalt, bare soil				0.011	0	0	
Grass Short Prairie				0.15	0	0	
Grass dense				0.24	0	0	
Grass bermuda				0.41	0	0	
Woods Light Underbrush				0.4	100	0.4	
woods Dense underbrush				0.8	0	0	
based on information for imperviousness from Corps of Engineers							
Land Use		% Conc	% Grass	n value	% land use	INC N	
Low D.	Residential	25	75	0.21275	0	0	
Med. D.	Residential	41	59	0.16971	0	0	
High D.	Residential	47	53	0.15357	0	0	
Multifamily		70	30	0.0917	0	0	
Mobile Home Park		20	80	0.2262	0	0	
C.B.D.		95	5	0.02445	0	0	
Strip Commercial		90	10	0.0379	0	0	
Shopping Center		95	5	0.02445	0	0	
Institutional-Schools		40	60	0.1724	0	0	
Industrial		90	10	0.0379	0	0	
Highway ROW		35	65	0.18585	0	0	
Public Utilities		60	40	0.1186	0	0	
Vacant urban land and		6	84	0.23586	0	0	
Parks							
Other		0	0	0	0	0	
					TOT N VALUE		
			TOTAL		100	0.4	
	LENGTH		100	FT.	MAX 300'		
	2 YR 24 HOUR PRECIP		3.7	IN.	FROM TP40		
	SLOPE		0.01	FT/FT			

WSHED NAME	3 (continued)						
SHALLOW CONCENTRATED FLOW							
	1=PAVED 2=UNPAVED	2					
	LENGTH	1523	FT				
	SLOPE	0.044	FT/FT				
	COMPUTED VELOCITY FROM FIGURE 3.1=			3.383019			
CHANNEL FLOW 1							
				TOPWIDTH	200		
	XSECT AREA	625	SQ FT	BOTTOM	50		
				DEPTH	5		
	WETTED PERIMETER	200.33296	FT				
	SLOPE	0.013	FT/FT				
	MANNINGS N	0.06					
	COMPUTED VELOCITY			6.04563			
	LENGTH	13100	FT				
CHANNEL FLOW 2							
				TOPWIDTH	200		
	XSECT AREA	625	SQ FT	BOTTOM	50		
				DEPTH	5		
	WETTED PERIMETER	200.33296	FT				
	SLOPE	0.0076	FT/FT				
	MANNINGS N	0.06					
	COMPUTED VELOCITY			4.6224975			
	LENGTH	8029	FT				
SUMMARY:							
	WATERSHED NUMBER	3	Adjusted	SCS Method	Selected		
			Tc(Hrs)	Tc(Hrs)	Tc(Hrs)		
	SHEET FLOW	15 Min Max	0.25	0.4392	0.2500		
	SHALLOW FLOW	2 fps Min	0.2115	0.1251	0.1251		
	CHANNEL FLOW 1		0.6019	0.6019	0.6019		
	CHANNEL FLOW 2		0.4825	0.4825	0.4825		
		TC Total	1.5459	1.6486	1.4594	Adjusted	
			Corps' Lag	0.9892	0.8757	NRCS Lag	

SCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION							
PROJECT	Camp Mystic						
LOCATION	Kerr County						
DATE	10/30/2018						
COND.	Existing						
BY:							
WSHED NAME	4						
SHEET FLOW:							
	N VALUE (SEE BELOW)		0.15				
Undeveloped				n value	% Land use	Inc n	
Conc.,gravvel,asphalt,bare soil				0.011	0	0	
Grass Short Prairie				0.15	100	0.15	
Grass dense				0.24	0	0	
Grass bermuda				0.41	0	0	
Woods Light Underbrush				0.4	0	0	
woods Dense underbrush				0.8	0	0	
based on information for imperviousness from Corps of Engineers							
Land Use		% Conc	% Grass	n value	% land use	INC N	
Low D.	Residential	25	75	0.21275	0	0	
Med. D.	Residential	41	59	0.16971	0	0	
High D.	Residential	47	53	0.15357	0	0	
Multifamily		70	30	0.0917	0	0	
Mobile Home Pame Park		20	80	0.2262	0	0	
C.B.D.		95	5	0.02445	0	0	
Strip Commercial		90	10	0.0379	0	0	
Shopping Center		95	5	0.02445	0	0	
Institutional-Schools		40	60	0.1724	0	0	
Industrial		90	10	0.0379	0	0	
Highway ROW		35	65	0.18585	0	0	
Public Utilities		60	40	0.1186	0	0	
Vacant urban land and		6	84	0.23586	0	0	
Parks							
Other		0	0	0	0	0	
					TOT N VALUE		
			TOTAL		100	0.15	
	LENGTH		100	FT.	MAX 300'		
	2 YR 24 HOUR PRECIP		3.7	IN.	FROM TP40		
	SLOPE		0.01	FT/FT			

WSHED NAME	4 (continued)						
SHALLOW CONCENTRATED FLOW							
	1=PAVED 2=UNPAVED		2				
	LENGTH		1322	FT			
	SLOPE		0.148	FT/FT			
	COMPUTED VELOCITY FROM FIGURE 3.1=				6.2158306		
CHANNEL FLOW 1							
					TOPWIDTH	125	
	XSECT AREA		247.5	SQ FT	BOTTOM	40	
					DEPTH	3	
	WETTED PERIMETER		125.2115	FT			
	SLOPE		0.024	FT/FT			
	MANNINGS N		0.055				
	COMPUTED VELOCITY				6.6103794		
	LENGTH		5606	FT			
SUMMARY:				Adjusted	SCS Method	Selected	
	WATERSHED NUMBER		4	Tc(Hrs)	Tc(Hrs)	Tc(Hrs)	
	SHEET FLOW		15 Min Max	0.25	0.2004	0.2004	
	SHALLOW FLOW		2 fps Min	0.1836	0.0591	0.0591	
	CHANNEL FLOW 1			0.2356	0.2356	0.2356	
			TC Total	0.6692	0.4950	0.4950	Adjusted
				Corps' Lag	0.2970	0.2970	NRCS Lag

SCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION							
PROJECT	Camp Mystic						
LOCATION	Kerr County						
DATE	10/30/2018						
COND.	Existing						
BY:							
WSHED NAME	5						
SHEET FLOW:							
	N VALUE (SEE BELOW)		0.4				
Undeveloped				n value	% Land use	Inc n	
Conc., gravel, asphalt, bare soil				0.011	0	0	
Grass Short Prairie				0.15	0	0	
Grass dense				0.24	0	0	
Grass bermuda				0.41	0	0	
Woods Light Underbrush				0.4	100	0.4	
woods Dense underbrush				0.8	0	0	
based on information for imperviousness from Corps of Engineers							
Land Use		% Conc	% Grass	n value	% land use	INC N	
Low D.	Residential	25	75	0.21275	0	0	
Med. D.	Residential	41	59	0.16971	0	0	
High D.	Residential	47	53	0.15357	0	0	
Multifamily		70	30	0.0917	0	0	
Mobile Home Park		20	80	0.2262	0	0	
C.B.D.		95	5	0.02445	0	0	
Strip Commercial		90	10	0.0379	0	0	
Shopping Center		95	5	0.02445	0	0	
Institutional-Schools		40	60	0.1724	0	0	
Industrial		90	10	0.0379	0	0	
Highway ROW		35	65	0.18585	0	0	
Public Utilities		60	40	0.1186	0	0	
Vacant urban land and		6	84	0.23586	0	0	
Parks							
Other		0	0	0	0	0	
					TOT N VALUE		
			TOTAL		100	0.4	
	LENGTH		100	FT.	MAX 300'		
	2 YR 24 HOUR PRECIP		3.7	IN.	FROM TP40		
	SLOPE		0.005	FT/FT			
WSHED NAME	5 (continued)						
SHALLOW CONCENTRATED FLOW							
	1=PAVED 2=UNPAVED		2				
	LENGTH		1184	FT			
	SLOPE		0.05	FT/FT			
	COMPUTED VELOCITY FROM FIGURE 3.1=				3.607002		

CHANNEL FLOW 1							
					TOPWIDTH	100	
	XSECT AREA		125	SQ FT	BOTTOM	25	
					DEPTH	2	
	WETTED PERIMETER		100.10659	FT			
	SLOPE		0.035	FT/FT			
	MANNINGS N		0.055				
	COMPUTED VELOCITY				5.8770454		
	LENGTH		2422	FT			
CHANNEL FLOW 2							
					TOPWIDTH	80	
	XSECT AREA		75	SQ FT	BOTTOM	20	
					DEPTH	1.5	
	WETTED PERIMETER		80.074953	FT			
	SLOPE		0.103	FT/FT			
	MANNINGS N		0.055				
	COMPUTED VELOCITY				8.3230842		
	LENGTH		723	FT			
SUMMARY:				Adjusted	SCS Method	Selected	
	WATERSHED NUMBER		5	Tc(Hrs)	Tc(Hrs)	Tc(Hrs)	
	SHEET FLOW		15 Min Max	0.25	0.5795	0.2500	
	SHALLOW FLOW		2 fps Min	0.1644	0.0912	0.0912	
	CHANNEL FLOW 1			0.1145	0.1145	0.1145	
	CHANNEL FLOW 2			0.0241	0.0241	0.0241	
			TC Total	0.5530	0.8093	0.4798	Adjusted
				Corps' Lag	0.4856	0.2879	NRCS Lag

SCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION							
PROJECT	Camp Mystic						
LOCATION	Kerr County						
DATE	10/30/2018						
COND.	Existing						
BY:							
WSHED NAME	6						
SHEET FLOW:							
	N VALUE (SEE BELOW)		0.15				
Undeveloped				n value	% Land use	Inc n	
Conc., gravel, asphalt, bare soil				0.011	0	0	
Grass Short Prairie				0.15	100	0.15	
Grass dense				0.24	0	0	
Grass bermuda				0.41	0	0	
Woods Light Underbrush				0.4	0	0	
woods Dense underbrush				0.8	0	0	
based on information for imperviousness from Corps of Engineers							
Land Use		% Conc	% Grass	n value	% land use	INC N	
Low D.	Residential	25	75	0.21275	0	0	
Med. D.	Residential	41	59	0.16971	0	0	
High D.	Residential	47	53	0.15357	0	0	
Multifamily		70	30	0.0917	0	0	
Mobile Home Park		20	80	0.2262	0	0	
C.B.D.		95	5	0.02445	0	0	
Strip Commercial		90	10	0.0379	0	0	
Shopping Center		95	5	0.02445	0	0	
Institutional-Schools		40	60	0.1724	0	0	
Industrial		90	10	0.0379	0	0	
Highway ROW		35	65	0.18585	0	0	
Public Utilities		60	40	0.1186	0	0	
Vacant urban land and		6	84	0.23586	0	0	
Parks							
Other		0	0	0	0	0	
					TOT N VALUE		
			TOTAL		100	0.15	
	LENGTH		100	FT.	MAX 300'		
	2 YR 24 HOUR PRECIP		3.7	IN.	FROM TP40		
	SLOPE		0.005	FT/FT			
WSHED NAME	6 (continued)						
SHALLOW CONCENTRATED FLOW							
	1=PAVED 2=UNPAVED		2				
	LENGTH		1466	FT			
	SLOPE		0.027	FT/FT			
	COMPUTED VELOCITY FROM FIGURE 3.1=				2.6481455		

CHANNEL FLOW 1							
					TOPWIDTH	100	
	XSECT AREA		180	SQ FT	BOTTOM	20	
					DEPTH	3	
	WETTED PERIMETER		100.22468	FT			
	SLOPE		0.045	FT/FT			
	MANNINGS N		0.06				
	COMPUTED VELOCITY				7.78362		
	LENGTH		2783	FT			
SUMMARY:				Adjusted	SCS Method	Selected	
	WATERSHED NUMBER		6	Tc(Hrs)	Tc(Hrs)	Tc(Hrs)	
	SHEET FLOW		15 Min Max	0.25	0.2644	0.2500	
	SHALLOW FLOW		2 fps Min	0.2036	0.1538	0.1538	
	CHANNEL FLOW 1			0.0993	0.0993	0.0993	
			TC Total	0.5529	0.5175	0.5031	Adjusted
				Corps' Lag	0.3105	0.3019	NRCS Lag

SCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION							
PROJECT	Camp Mystic						
LOCATION	Kerr County						
DATE	10/30/2018						
COND.	Existing						
BY:							
WSHED NAME	7						
SHEET FLOW:							
	N VALUE (SEE BELOW)		0.6				
Undeveloped				n value	% Land use	Inc n	
Conc., gravel, asphalt, bare soil				0.011	0	0	
Grass Short Prairie				0.15	0	0	
Grass dense				0.24	0	0	
Grass bermuda				0.41	0	0	
Woods Light Underbrush				0.4	50	0.2	
woods Dense underbrush				0.8	50	0.4	
based on information for imperviousness from Corps of Engineers							
Land Use		% Conc	% Grass	n value	% land use	INC N	
Low D.	Residential	25	75	0.21275	0	0	
Med. D.	Residential	41	59	0.16971	0	0	
High D.	Residential	47	53	0.15357	0	0	
Multifamily		70	30	0.0917	0	0	
Mobile Home Park		20	80	0.2262	0	0	
C.B.D.		95	5	0.02445	0	0	
Strip Commercial		90	10	0.0379	0	0	
Shopping Center		95	5	0.02445	0	0	
Institutional-Schools		40	60	0.1724	0	0	
Industrial		90	10	0.0379	0	0	
Highway ROW		35	65	0.18585	0	0	
Public Utilities		60	40	0.1186	0	0	
Vacant urban land and		6	84	0.23586	0	0	
Parks							
Other		0	0	0	0	0	
					TOT N VALUE		
			TOTAL		100	0.6	
	LENGTH		100	FT.	MAX 300'		
	2 YR 24 HOUR PRECIP		3.7	IN.	FROM TP40		
	SLOPE		0.008	FT/FT			
WSHED NAME	7 (continued)						
SHALLOW CONCENTRATED FLOW							
	1=PAVED 2=UNPAVED		2				
	LENGTH		1001	FT			
	SLOPE		0.2	FT/FT			
	COMPUTED VELOCITY FROM FIGURE 3.1=				7.2290207		

CHANNEL FLOW 1							
					TOPWIDTH	120	
	XSECT AREA		240	SQ FT	BOTTOM	40	
					DEPTH	3	
	WETTED PERIMETER		120.22468	FT			
	SLOPE		0.018	FT/FT			
	MANNINGS N		0.06				
	COMPUTED VELOCITY				5.2823399		
	LENGTH		3297	FT			
CHANNEL FLOW 2							
					TOPWIDTH	160	
	XSECT AREA		500	SQ FT	BOTTOM	40	
					DEPTH	5	
	WETTED PERIMETER		160.41595	FT			
	SLOPE		0.0057	FT/FT			
	MANNINGS N		0.06				
	COMPUTED VELOCITY				4.0007113		
	LENGTH		3521	FT			
SUMMARY:				Adjusted	SCS Method	Selected	
	WATERSHED NUMBER		7	Tc(Hrs)	Tc(Hrs)	Tc(Hrs)	
	SHEET FLOW		15 Min Max	0.25	0.6642	0.2500	
	SHALLOW FLOW		2 fps Min	0.1390	0.0385	0.0385	
	CHANNEL FLOW 1			0.1734	0.1734	0.1734	
	CHANNEL FLOW 2			0.2445	0.2445	0.2445	
			TC Total	0.8069	1.1205	0.7063	Adjusted
				Corps' Lag	0.6723	0.4238	NRCS Lag

SCS TR55 METHOD TO COMPUTE TIME OF CONCENTRATION							
PROJECT	Camp Mystic						
LOCATION	Kerr County						
DATE	10/30/2018						
COND.	Existing						
BY:							
WSHED NAME	8						
SHEET FLOW:							
	N VALUE (SEE BELOW)		0.4				
Undeveloped				n value	% Land use	Inc n	
Conc., gravel, asphalt, bare soil				0.011	0	0	
Grass Short Prairie				0.15	0	0	
Grass dense				0.24	0	0	
Grass bermuda				0.41	0	0	
Woods Light Underbrush				0.4	100	0.4	
woods Dense underbrush				0.8	0	0	
based on information for imperviousness from Corps of Engineers							
Land Use		% Conc	% Grass	n value	% land use	INC N	
Low D.	Residential	25	75	0.21275	0	0	
Med. D.	Residential	41	59	0.16971	0	0	
High D.	Residential	47	53	0.15357	0	0	
Multifamily		70	30	0.0917	0	0	
Mobile Home Park		20	80	0.2262	0	0	
C.B.D.		95	5	0.02445	0	0	
Strip Commercial		90	10	0.0379	0	0	
Shopping Center		95	5	0.02445	0	0	
Institutional-Schools		40	60	0.1724	0	0	
Industrial		90	10	0.0379	0	0	
Highway ROW		35	65	0.18585	0	0	
Public Utilities		60	40	0.1186	0	0	
Vacant urban land and		6	84	0.23586	0	0	
Parks							
Other		0	0	0	0	0	
					TOT N VALUE		
			TOTAL		100	0.4	
	LENGTH		100	FT.	MAX 300'		
	2 YR 24 HOUR PRECIP		3.7	IN.	FROM TP40		
	SLOPE		0.005	FT/FT			
WSHED NAME	8 (continued)						
SHALLOW CONCENTRATED FLOW							
	1=PAVED 2=UNPAVED		2				
	LENGTH		1655	FT			
	SLOPE		0.09	FT/FT			
	COMPUTED VELOCITY FROM FIGURE 3.1=				4.8435696		

CHANNEL FLOW 1							
					TOPWIDTH	100	
	XSECT AREA		120	SQ FT	BOTTOM	20	
					DEPTH	2	
	WETTED PERIMETER		100.09994	FT			
	SLOPE		0.026	FT/FT			
	MANNINGS N		0.055				
	COMPUTED VELOCITY				4.9295942		
	LENGTH		3064	FT			
CHANNEL FLOW 2							
					TOPWIDTH	100	
	XSECT AREA		125	SQ FT	BOTTOM	25	
					DEPTH	2	
	WETTED PERIMETER		100.10659	FT			
	SLOPE		0.024	FT/FT			
	MANNINGS N		0.06				
	COMPUTED VELOCITY				4.4611013		
	LENGTH		7212	FT			
SUMMARY:				Adjusted	SCS Method	Selected	
	WATERSHED NUMBER		8	Tc(Hrs)	Tc(Hrs)	Tc(Hrs)	
	SHEET FLOW		15 Min Max	0.25	0.5795	0.2500	
	SHALLOW FLOW		2 fps Min	0.2299	0.0949	0.0949	
	CHANNEL FLOW 1			0.1727	0.1727	0.1727	
	CHANNEL FLOW 2			0.4491	0.4491	0.4491	
			TC Total	1.1016	1.2961	0.9666	Adjusted
				Corps' Lag	0.7777	0.5800	NRCS Lag

Appendix C – HEC-1 Input and Output

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1*****
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*
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
ENGINEERS *
* JUN 1998 *
ENGINEERING CENTER *
* VERSION 4.1 *
STREET *
*
CALIFORNIA 95616 *
* RUN DATE 30OCT18 TIME 13:44:16 *
756-1104 *
*
*
*****
*****

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*
*
* U.S. ARMY CORPS OF
*
* HYDROLOGIC
*
* 609 SECOND
*
* DAVIS,
*
* (916)
*

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X X XXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXX XXXX X XXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE

1

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID KERR COUNTY, TEXAS EXISTING CONDITIONS
2 ID Camp Mystic
3 ID
4 ID 24-Hour 100-Year FILE: CM100.dat
* =====
*
*
* SCS Dmensionless Unit Hydrograph
* SCS Type III Rainfall Distribution - 24-Hour Storm Duration
* THE LOSS RATE IS DETERMINED BY THE SCS RUNOFF CURVE NUMBER METHOD
*
* =====
5 IT 6 2000
6 IO 5
*
*

```

CWDAM100.OH1

```

7      KK      Sub 3
8      KM      Hydrograph Sub-Basin 3 upstream of Coolwater Dam No. 3
          * 5432 acres
9      BA      8.49
10     LS      0      86
11     UD      0.88
          *
          *
12     PB      12
13     IN      6
          *
14     PC      0.0000 0.0010 0.0020 0.0030 0.004 0.005 0.006 0.007 0.008 0.009
15     PC      0.01 0.011 0.012 0.013 0.014 0.015 0.016 0.017 0.018 0.019
16     PC      0.02 0.021 0.022 0.0231 0.0241 0.0252 0.0263 0.0274 0.0285 0.0296
17     PC      0.0308 0.0319 0.0331 0.0343 0.0355 0.0367 0.0379 0.0392 0.0404 0.0417
18     PC      0.043 0.0443 0.0456 0.047 0.0483 0.0497 0.0511 0.0525 0.0539 0.0553
19     PC      0.0567 0.0582 0.0597 0.0612 0.0627 0.0642 0.0657 0.0673 0.0688 0.0704
20     PC      0.072 0.0736 0.0753 0.077 0.0788 0.0806 0.0825 0.0844 0.0864 0.0884
21     PC      0.0905 0.0926 0.0948 0.097 0.0993 0.1016 0.104 0.1064 0.1089 0.1114
22     PC      0.114 0.1167 0.1194 0.1223 0.1253 0.1284 0.1317 0.135 0.1385 0.1421
23     PC      0.1458 0.1496 0.1535 0.1575 0.1617 0.1659 0.1703 0.1748 0.1794 0.1842
24     PC      0.189 0.194 0.1993 0.2048 0.2105 0.2165 0.2227 0.2292 0.2359 0.2428
25     PC      0.25 0.2578 0.2664 0.276 0.2866 0.298 0.3143 0.3394 0.3733 0.416
26     PC      0.5 0.584 0.6267 0.6606 0.6857 0.702 0.7134 0.724 0.7336 0.7422
27     PC      0.75 0.7572 0.7641 0.7708 0.7773 0.7835 0.7895 0.7952 0.8007 0.806
28     PC      0.811 0.8158 0.8206 0.8252 0.8297 0.8341 0.8383 0.8425 0.8465 0.8504
29     PC      0.8543 0.8579 0.8615 0.865 0.8683 0.8716 0.8747 0.8777 0.8806 0.8833
30     PC      0.886 0.8886 0.8911 0.8936 0.896 0.8984 0.9007 0.903 0.9052 0.9074
31     PC      0.9095 0.9116 0.9136 0.9156 0.9175 0.9194 0.9212 0.923 0.9247 0.9264
32     PC      0.928 0.9296 0.9312 0.9327 0.9343 0.9358 0.9373 0.9388 0.9403 0.9418
33     PC      0.9433 0.9447 0.9461 0.9475 0.9489 0.9503 0.9517 0.953 0.9544 0.9557
34     PC      0.957 0.9583 0.9596 0.9609 0.9621 0.9634 0.9646 0.9658 0.967 0.9682
35     PC      0.9694 0.9706 0.9718 0.9729 0.9741 0.9752 0.9764 0.9775 0.9786 0.9797
36     PC      0.9808 0.9818 0.9829 0.9839 0.985 0.986 0.987 0.988 0.989 0.99
37     PC      0.9909 0.9919 0.9928 0.9938 0.9947 0.9956 0.9965 0.9974 0.9983 0.9991
38     PC      1.0000
          *

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1
2

HEC-1 INPUT

PAGE

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

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39     KK      Dam3
40     KM      Route flows through Coolwater Dam No. 3
41     RS      1      ELEV 1913.12
42     SV      0      15      50      84      109      125      185      244      294      438
43     SE      1902.4      1905      1910 1913.12      1915 1916.22      1920      1923      1925      1930
44     SQ      0      0      0      0      877      2155      9450      20952      30273      59245
          *
          *
45     KK      Sub 4
46     KM      Hydrograph Sub-Basin 4
          * 489 acres
47     BA      0.76
48     LS      0      84
49     UD      0.30
          *
          *
50     KK      Comb4
51     KM      Combine hydrographs from sub-basin 3 and 4
52     HC      2
          *
          *

```

CWDAM100.OH1

53 KK Dam4
 54 KM Route flows through Dam No. 4
 55 RS 1 ELEV 1896
 56 SV 0 186 233 425 783
 57 SE 1880 1896 1900 1907 1920
 58 SQ 0 0 4792 34404 174565
 *
 *

59 KK Sub 5
 60 KM Hydrograph Sub-Basin 5
 * 253 acres
 61 BA 0.40
 62 LS 0 85
 63 UD 0.29
 *
 *

64 KK Comb5
 65 KM Combine hydrograhs from sub-basin 3, 4 and 5
 66 HC 2
 *
 *

67 KK Dam5
 68 KM Route flows through Dam No. 5
 69 RS 1 ELEV 1880
 70 SV 0 53 113 292 601
 71 SE 1870 1880 1885 1900 1915
 72 SQ 0 0 3461 61798 194036
 *
 *

1
 3

HEC-1 INPUT

PAGE

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

73 KK Sub 6
 74 KM Hydrograph Sub-Basin 6
 * 187 acres
 75 BA 0.29
 76 LS 0 85
 77 UD 0.30
 *
 *

78 KK Comb6
 79 KM Combine hydrograhs from sub-basin 3, 4, 5 and 6
 80 HC 2
 *
 *

81 KK Dam6
 82 KM Route flows through Dam No. 6
 83 RS 1 ELEV 1861
 84 SV 0 9 44 87 174 575
 85 SE 1860 1861 1865 1870 1880 1900
 86 SQ 0 0 4012 17068 62181 197608
 *
 *

87 KK RT7A
 88 KM Route Runoff hydrograph from sub-basin 6 through upstream routing reach of sub
 89 RD
 90 RC 0.06 0.065 0.06 2233 .0015
 91 RX 0 359 1066 1314 1434 1630 1936 2036

CWDAM100.OH1

92	RY	1980	1940	1900	1840	1840	1920	1953	1960
	*								
	*								
93	KK	Sub 7							
94	KM	Hydrograph Sub-Basin 7							
	*	321 acres							
95	BA	0.50							
96	LS	0	84						
97	UD	0.42							
	*								
	*								
98	KK	Comb7							
99	KM	Combine hydrograhs from sub-basin 3, 4, 5, 6 and 7							
100	HC	2							
	*								
	*								
101	KK	RT7B							
102	KM	Route Runoff hydrograph from sub-basin 6 and sub-basin 7 through downstream ro							
103	RD								
104	RC	0.06	0.065	0.06	3108	0.0016			
105	RX	284.81	286.38	312.39	326.62	338.54	548.6	726.73	836.72
106	RY	1900	1898.8	1880	1860	1840	1840	1860	1873.19
									894.19
									1137.97
									1880
									1899.77
	*								
	*								

1 HEC-1 INPUT PAGE
4

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

107	KK	Sub 8							
108	KM	Hydrograph Sub-Basin 8							
	*	551 acres							
109	BA	0.86							
110	LS	0	86						
111	UD	0.58							
	*								
	*								
112	KK	Comb8							
113	KM	Combine hydrograhs from sub-basin 3, 4, 5, 6, 7 and 8							
114	HC	2							
	*								
115	ZZ								

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1*****
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*                                     *
*                                     *
*   FLOOD HYDROGRAPH PACKAGE (HEC-1) *   U.S. ARMY CORPS OF
ENGINEERS *                               *
*   JUN 1998 *                               *   HYDROLOGIC
ENGINEERING CENTER *                               *
*   VERSION 4.1 *                               *   609 SECOND
STREET *                               *
*                                     *   DAVIS,
CALIFORNIA 95616 *                               *
*   RUN DATE 30OCT18 TIME 13:44:16 *                               *   (916)
756-1104 *                               *
*                                     *
*                                     *
*****
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KERR COUNTY, TEXAS EXISTING CONDITIONS
Camp Mystic

24-Hour 100-Year

FILE: CM100.dat

6 IO OUTPUT CONTROL VARIABLES

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN 6 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 2000 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 9 0 ENDING DATE
NDTIME 0754 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .10 HOURS

TOTAL TIME BASE 199.90 HOURS

ENGLISH UNITS

DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES
LENGTH, ELEVATION FEET
FLOW CUBIC FEET PER SECOND
STORAGE VOLUME ACRE-Feet
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

TIME OF MAX STAGE	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE
					6-HOUR	24-HOUR	72-HOUR		
+	HYDROGRAPH AT	Sub 3	19943.	12.90	7154.	2339.	780.	8.49	
+	ROUTED TO	Dam3	19855.	13.00	7152.	2339.	780.	8.49	1922.71
+	13.00								
+	HYDROGRAPH AT	Sub 4	2971.	12.30	632.	204.	68.	.76	
+	2 COMBINED AT	Comb4	20722.	13.00	7777.	2543.	848.	9.25	
+	ROUTED TO	Dam4	20563.	13.00	7775.	2543.	848.	9.25	1903.73
+	13.00								
+	HYDROGRAPH AT	Sub 5	1603.	12.30	336.	109.	36.	.40	
+	2 COMBINED AT								

					CWDAM100.OH1				
+		Comb5	21007.	13.00	8106.	2652.	884.	9.65	
	ROUTED TO								
+		Dam5	20953.	13.10	8098.	2651.	884.	9.65	
+									1889.50
	13.10								
	HYDROGRAPH AT								
+		Sub 6	1144.	12.30	244.	79.	26.	.29	
	2 COMBINED AT								
+		Comb6	21232.	13.10	8337.	2730.	910.	9.94	
	ROUTED TO								
+		Dam6	21259.	13.10	8335.	2730.	910.	9.94	
+									1870.93
	13.10								
	ROUTED TO								
+		RT7A	20608.	13.20	8334.	2733.	911.	9.94	
	HYDROGRAPH AT								
+		Sub 7	1698.	12.50	415.	134.	45.	.50	
	2 COMBINED AT								
+		Comb7	21239.	13.10	8739.	2867.	956.	10.44	
	ROUTED TO								
+		RT7B	20696.	13.30	8722.	2866.	955.	10.44	
	HYDROGRAPH AT								
+		Sub 8	2554.	12.60	727.	237.	79.	.86	
	2 COMBINED AT								
+		Comb8	22054.	13.20	9427.	3102.	1034.	11.30	
1									

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

INTERPOLATED TO

COMPUTATION INTERVAL

ISTAQ	ELEMENT	DT	PEAK	TIME TO	VOLUME	DT	PEAK	TIME TO	VOLUME
				PEAK				PEAK	
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
RT7A	MANE	6.00	20608.07	792.00	10.23	6.00	20608.07	792.00	10.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5416E+04 EXCESS= .0000E+00 OUTFLOW= .5421E+04 BASIN STORAGE= .1710E-03
 PERCENT ERROR= -.1

				CWDAM100.OH1				
RT7B	MANE	6.00	20696.33	798.00	10.21	6.00	20696.33	798.00 10.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5687E+04 EXCESS= .0000E+00 OUTFLOW= .5685E+04 BASIN STORAGE= .4356E-03
 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

Appendix D – HEC-RAS Summary Table

HEC-RAS Plan: 100-Year River: Cypress Reach: Cypress Profile: 100-Year

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/m)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Cypress	7641.43	100-Year	21239.00	1858.00	1870.93		1873.64	0.005059	14.47	1941.19	211.96	0.71
Cypress	7292.226	100-Year	21239.00	1854.44	1870.40		1872.02	0.002222	10.52	2282.06	193.66	0.46
Cypress	7051.78	100-Year	21239.00	1854.17	1869.73		1871.44	0.002489	11.33	2323.73	188.51	0.51
Cypress	6825.029	100-Year	21239.00	1854.17	1869.95		1870.66	0.002614	11.47	2371.49	219.54	0.52
Cypress	6515.248	100-Year	21239.00	1854.17	1868.07		1869.97	0.003040	11.65	2373.05	288.77	0.56
Cypress	6215.325	100-Year	21239.00	1854.17	1866.70		1868.89	0.004101	12.51	2200.37	272.10	0.63
Cypress	6090.585	100-Year	21239.00	1854.17	1866.51		1868.30	0.003367	11.37	2478.04	286.76	0.57
Cypress	5779.992	100-Year	21239.00	1854.17	1864.96	1862.65	1867.08	0.004474	11.97	2118.19	290.31	0.65
Cypress	5644.66	100-Year	21239.00	1854.17	1862.41	1862.41	1865.64	0.010337	15.34	1630.31	255.84	0.94
Cypress	5585.126	Inl Struct										
Cypress	5535.685	100-Year	21239.00	1841.60	1857.51		1859.46	0.005611	14.74	2126.56	196.85	0.67
Cypress	5003.494	100-Year	22054.00	1838.55	1854.89		1856.83	0.004358	11.43	2112.25	192.04	0.53
Cypress	4557.775	100-Year	22054.00	1836.95	1851.45		1854.31	0.007352	14.36	1782.62	176.31	0.69
Cypress	3789.646	100-Year	22054.00	1828.67	1847.10		1849.22	0.005423	13.12	2052.68	158.41	0.56
Cypress	3200.663	100-Year	22054.00	1826.61	1845.34		1846.53	0.002746	9.26	2674.93	188.85	0.40
Cypress	2428.469	100-Year	22054.00	1825.79	1844.47	1835.23	1844.64	0.001000	6.46	5195.02	436.86	0.27