APPENDIX E
Hydrology and Hydraulic Study

PROPOSED CONDITION PRELIMINARY HYDROLOGY AND HYDRAULIC REPORT

MODJESKA GRADE ROAD

Orange County, CALIFORNIA

SEPTEMBER 30, 2021

PREPARED FOR:

MARK THOMAS AND ORANGE COUNTY DEPARTMENT OF PUBLIC WORKS

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PURPOSE

This report presents the results of a preliminary hydrology and hydraulic analysis of the proposed drainage facilities shown on sheets D-01 through D-05 of the construction plans titled, *Modjeska Grade Road Improvements Sta 10+00 to Sta 25+50* by Mark Thomas. A copy of sheets D-01 through D-05 are included in Appendix A of this report. 25-yr peak discharges at all proposed inlets were calculated. The discharges were used for a preliminary hydraulic analysis to confirm the size of proposed storm drain pipes and v-ditches. Spread calculations were also performed at critical locations. Results from this preliminary hydrology and hydraulics analysis can be used for the development of the final construction plans for Modjeska Grade Road.

This report follows the format outlined for rational method studies in the Orange County Hydrology Manual (OCHM) dated October 1986.

GENERAL DESCRIPTION OF DRAINAGE AREA

Modjeska Grade Road is located approximately 13 miles southeast of Santa Ana as shown in Figure 1. Modjeska Grade Road is approximately 1.3 miles long and connects Santiago Canyon Road on the south end to Modjeska Canyon Road on the north end as shown in Figure 2. The project area is rural with primarily low-density single family residential land use (maximum density of 1 dwelling unit per acre). The roadway is steep (as much as 13.5 %) and winding with steep embankments and cut slopes adjacent to the roadway. There are existing drainage facilities along the roadway consisting of roadside ditches, cross culverts, and down drains. The project proposes to replace much of the existing storm drain facilities.

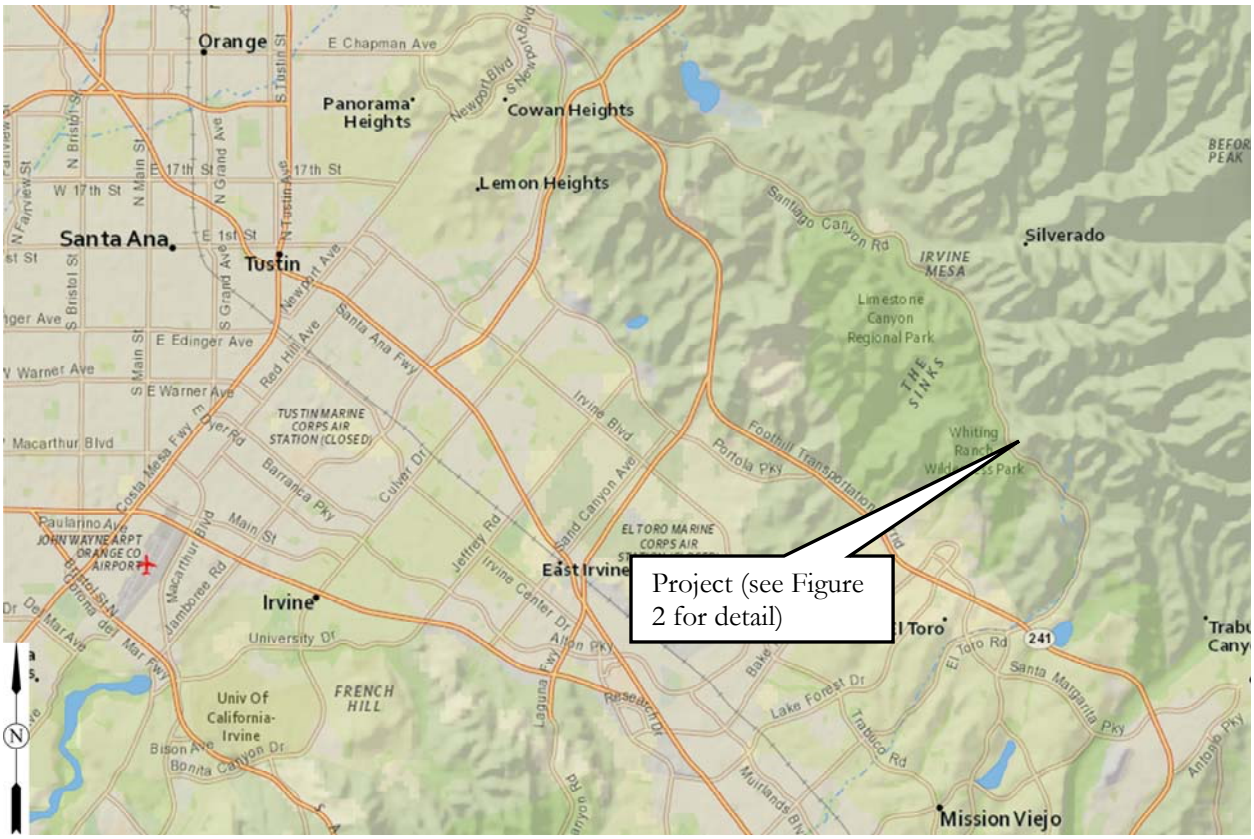

Figure 1. Vicinity Map

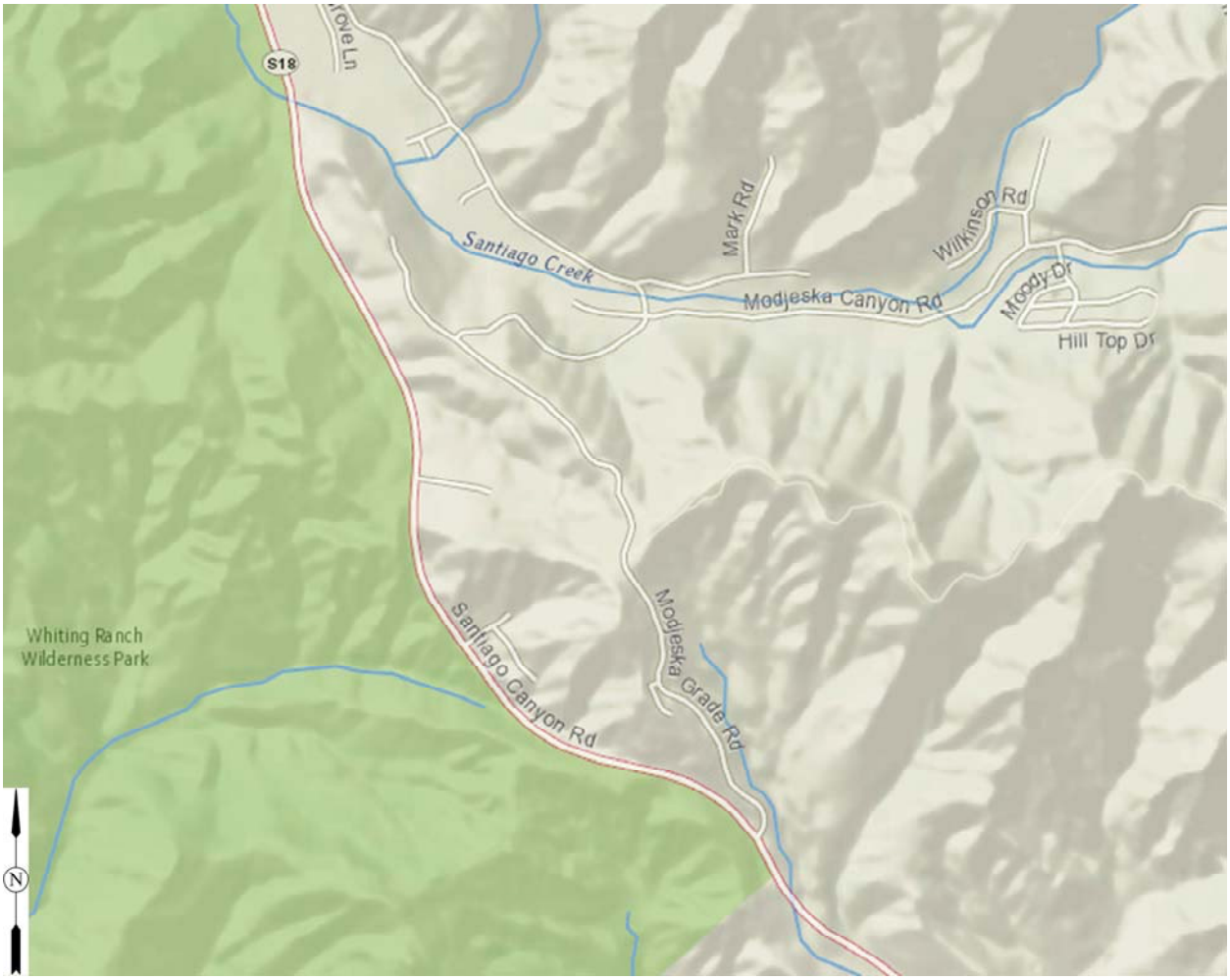

Figure 2. Close up of Vicinity Map

METHODOLOGY

Hydrology

Peak 25-yr discharges were calculated using the Rational Method as outlined in the OCHM. Initial times of concentration were determined using Figure D-1, 'Time of Concentration Nomograph for Initial Subarea', in the OCHM. Travel times for concentrated flows in the roadway were calculated by dividing estimated flow velocities by the distance traveled. Travel times in pipes were calculated by dividing estimated velocities using mannings equation divided by the pipe length. 25-yr rainfall intensities were computed using the regression equations shown on Figure B-3, 'Mean Precipitation Intensities for Non-mountainous Areas', in the OCHM.

The percentage of impervious area within each watershed area was determined by visual inspection of Google Satellite imagery. Hydrologic soil groups were determined using the web-based application, Web Soil Survey[1] (USDA Natural Resources Conservation Service).

Profiles of storm drain pipes were not available for this stage of design. Minimum slopes were determined for the calculated discharges using a variation of mannings equation that calculates the friction slope (slope of the pipe at full capacity before going under pressure flow). The minimum slope was assumed to be 0.002 ft/ft. Mannings n-values of 0.014 and 0.025 were used for RCP and CMP pipes respectively. Hydraulic grade lines, junction losses, and available freeboard will be determined at a later stage of the design process when profiles have been established. The equation for friction slope is:

$$Sf = (\frac{2.148\ Q\ n}{d^{\frac{8}{3}}})\text{^}2$$

Where:

S_f = friction slope (ft/ft)
Q = discharge (cfs)
n = mannings roughness coefficient
d = diameter (ft)

Spread calculations were performed by trial and error using mannings equation. An initial flow depth was assumed and the wetted perimeter and flow area was calculated using Autocad Civil 3D. A composite n-value was calculated if the spread extended into the paved area using 0.014 for concrete and 0.022 for pavement. Mannings equation was used to calculate the velocity for the assumed flow depth and the discharge calculated using the equation Q = Velocity x Area. The flow depth was adjusted until the calculated discharge matched the design discharge. A typical section showing how spread is measured is shown in Figure 3.

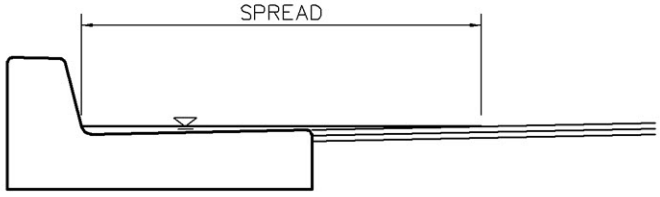

Figure 3. Typical section of calculated spread

[1] https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

V-ditch capacity calculations were performed using mannings equation with an n-value of 0.020 for the concrete ditch. The capacity calculations assumed 3-inches of freeboard as shown in Figure 4.

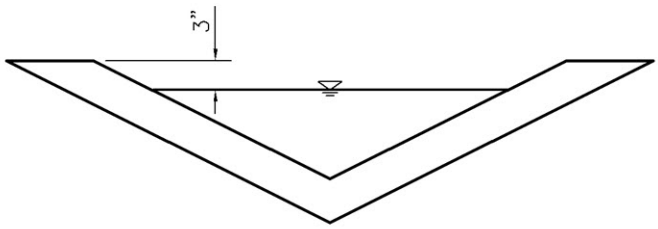

Figure 4. Typical section of V-ditch for capacity calculation

DRAINAGE AREA

The overall drainage areas for the project are shown in Figure 5.

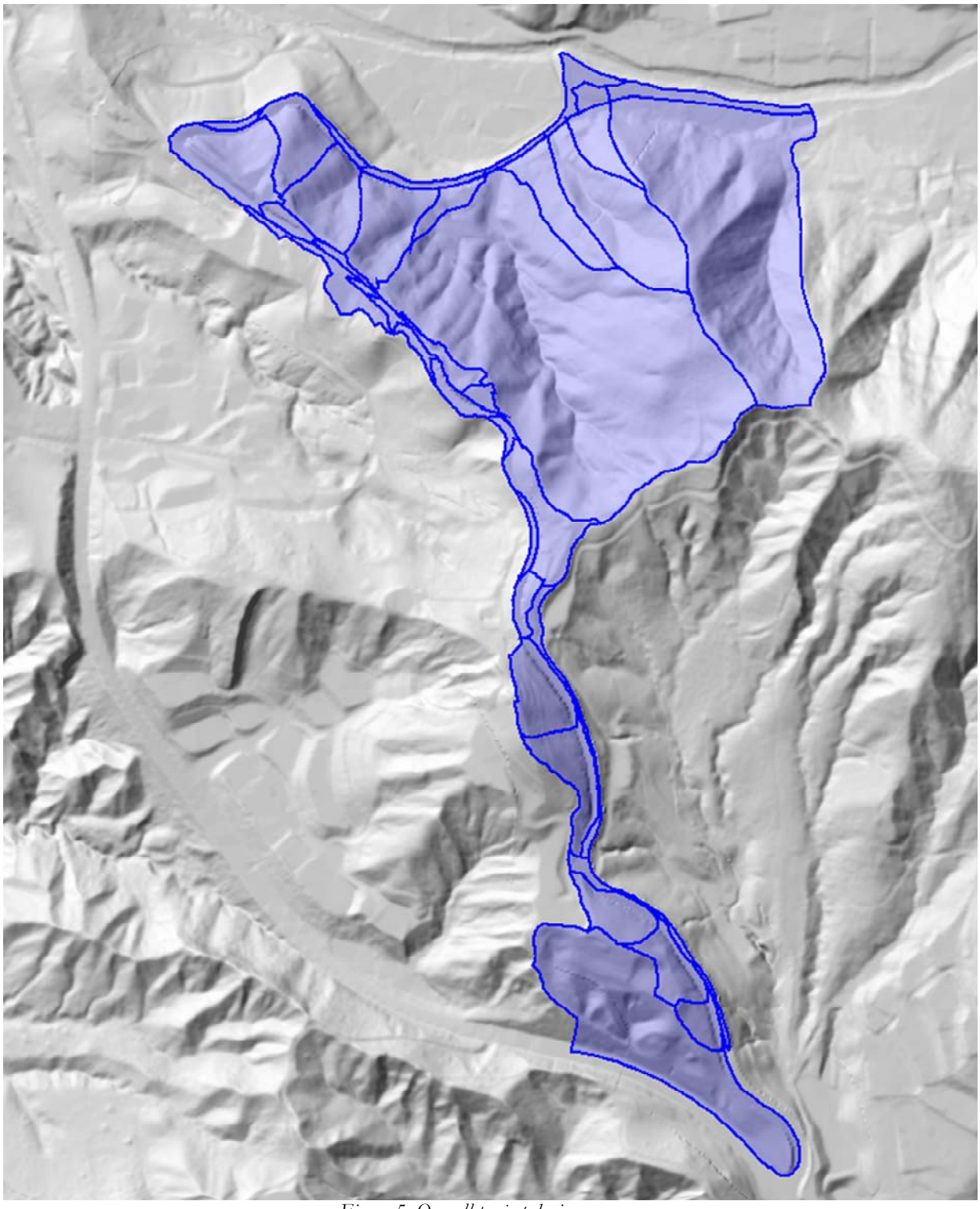

Figure 5. Overall project drainage areas

The hydrologic soils groups for the overall project drainage area are shown in Figure 6.

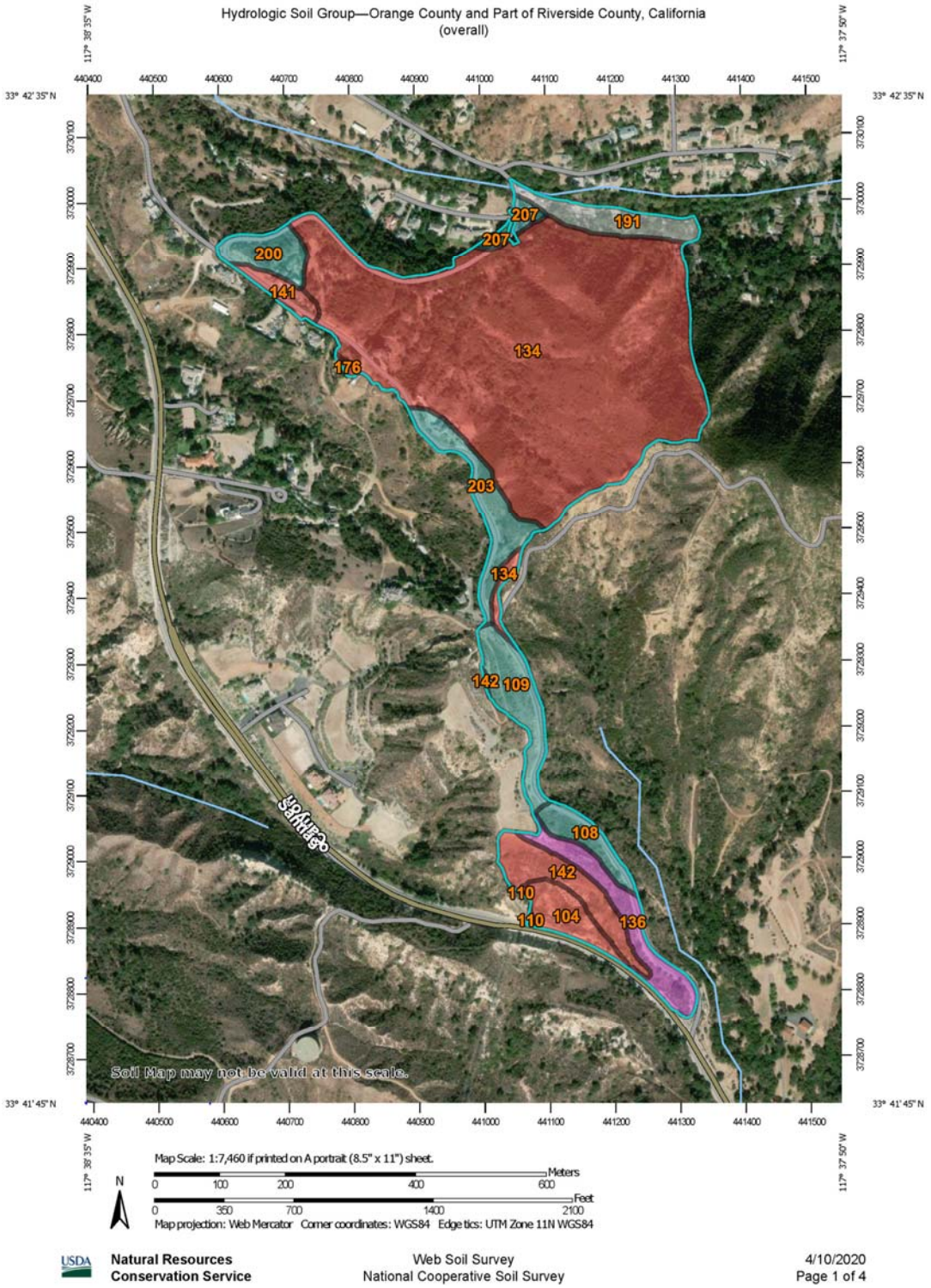

Figure 6. Hydrologic Soils Groups (USDA NRCS) Magenta = Class A, Aqua = Class C, Salmon = Class D

RATIONAL METHOD CALCULATIONS

Points of Concentration (POC) correspond with the approximate roadway station shown on the drainage plans. If more than one POC occurs at the same station, the designation of LT (left) or RT (right) is used to describe the side of the road the POC is located (looking upstation along the roadway). Drainage area maps for each POC are included in Appendix B of this report. Initial time of concentration nomographs for each POC are also included in Appendix B. Flow path and elevations used for the initial time of concentration nomograph for each POC are shown on the drainage area maps.

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL

STUDY NAME: MODJESKA GRADE ROAD 25-YEAR STORM RATIONAL METHOD STUDY

Calculated by: TER Date: 9.24.21
Checked by: _____ Date: _____
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Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
10+80	7.0	7.0	A/C	OPEN SPACE	4.0	12.8	2.83		0.281	16.1	765	0.04	3.2	Initial T = 8.8
10+80 FOR V-DITCH	0.5	0.5	A	ROAD	1.2	6.2	4.27		0.232	1.8	560	0.115	8.0	Initial T = 5.0
LINE A														
16+84 LT	0.54	0.54	A/C	OPEN	0.2	5.2	4.72		0.302	2.2	110	0.12	8.0	Initial T = 5.0
16+84 RT	0.23	0.77	A/C	OPEN/ ROAD	0.1	5.3	4.67		0.116	3.1	18" RCP 29	0.002	3.7	
FOR SPREAD 16+84 RT	0.23	0.23	A/C	ROAD		5.2	4.72		0.239	1.0				
LINE B														
18+77	1.0	1.0	A/C/D	OPEN/ ROAD	0.4	6.1	4.31		0.264	3.6	193	0.10	8.0	Initial T = 5.7
LINE C														
22+18	1.0	1.0	A/C	OPEN/ ROAD	0.7	7.4	3.86		0.231	3.3	325	0.12	8.0	Initial T = 6.7
LINE D														
24+20	0.20	0.2	C	ROAD		5.0	4.82		0.067	0.8	NA			Initial T = 5

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY	Calculated by JER Date 9.24.21 Checked by ____ Date ____ Page 2 of 9

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE E														
					0.7						330	0.10	8.0	Initial T=5.5
27+01 LT	1.30	1.30	C	OPEN/ ROAD		6.2	4.27		0.201	4.8				
					0.1						36	18" RCP 0.002	4.5	
26+82 RT	0.16	1.46	C	ROAD		6.3	4.23		0.187	5.3				
FOR SPREAD														
														Initial T=6.3
26+82 RT	0.16	0.16	C	ROAD		6.3	4.23		0.089	0.6				
LINE F														
					0.8						365	0.12	8.0	Initial T=6.1
31+33 LT	1.38	1.38	C/D	OPEN/ ROAD		6.9	4.02		0.208	4.7				
					0.1						26	18" RCP 0.002	4.7	
31+33 RT	0.31	1.69	C/D	OPEN/ ROAD		7.0	3.99		0.203	5.8				
FOR SPREAD														
					0.6						310	0.12	8.0	Initial T=7.4
31+33 RT	0.31					8.0	3.70		0.179	1.0				
LINE G														
					7.4									Initial T=7.4
37+84	0.36	0.36	C/D	OPEN/ ROAD		7.4	3.86		0.150	1.2				
												18" RCP 0.002	3.1	

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY	Calculated by TER Date 9.24.21 Checked by ____ Date ____ Page 3 of 9

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE H														
41+03	0.17	0.17	C	ROAD		5.1	4.77		0.000	0.8				Initial T=5.1
												18" RCP 0.002	2.7	
LINE I					0.9						430	0.093	8.0	Initial T=9.4
43+03	1.43	1.43	C/D	OPEN/ ROAD		10.3	3.20		0.220	3.9		18" RCP 0.002	4.4	
LINE J														Initial T=5.0
44+32	0.13	0.13	C	ROAD		5.0	4.82		0.071	0.5		18" RCP 0.002	2.4	
LINE K														Initial T=6.6
44+66	0.20	0.20	C/D	SF RES		6.6	4.12		0.173	0.7		18" RCP 0.002	2.7	
LINE L														Initial T=6.0
47+60	0.35	0.35	C	OPEN/ ROAD		6.0	4.35		0.132	1.3		18" RCP 0.002	3.1	

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY	Calculated by: JER Date: 9.24.21 Checked by: ____ Date: ____ Page 4 of 9

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE M														
49+46	0.18	0.18	C/D			5.0	4.82		0.072	0.8				Initial T = 5.0
50+98	0.13	0.31	D		0.3	5.3	4.67		0.065	1.3	150	18" RCP 0.12	7.8	
52+01	0.06	0.37	D		0.2	5.5	4.57		0.057	1.5	103	18" RCP 0.12	9.0	
54+61	0.69	1.06	D		0.5	6.0	4.35		0.112	4.0	259	18" RCP 0.11	9.2	
56+55	0.09	1.15	D		0.3	6.3	4.23		0.109	4.3	194	18" RCP 0.12	12.0	
												18" RCP		→ OUTFALL
FOR SPREAD														
50+98	0.13	0.13	D			5.0	4.82		0.056	0.5				Initial T = 5.0
52+01	0.06	0.06	D			5.0	4.82		0.020	0.3				Initial T = 5.0
54+61	0.69	0.69	D		0.4	5.4	4.67		0.140	2.8	175	0.11	8.0	Initial T = 5.0
56+55	0.09	0.09	D			5.0	4.82		0.079	0.4				Initial T = 5.0

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY	Calculated by JER Date 9.24.21 Checked by ____ Date ____ Page 5 of 9

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
EX 12" CMP														
49+53	0.42	0.42	C/D		0.3	6.3	4.23		0.130	1.6	150	0.12	8.0	Initial T=6.0
10" PVC EX DW CULVERT														
53+84	0.14	0.14	D			7.5	3.83		0.176	0.5				Initial T=7.5
56+23	0.32	0.46	D		0.5	8.0	3.70		0.116	1.5	240	0.12	8.0	CURB FLOW/
												EX 12" STL ?		→ OUTFALL

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY	Calculated by TER Date 9.24.21 Checked by ____ Date ____ Page 6 of 9

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE N														
					1.4						685	0.11	8.0	Initial T = 5.0
63+97 RT	2.09	2.09	C/D			6.4	4.19		0.166	7.6				
					0.1						26	18" RCP 0.008	5.7	
63+97 LT	0.14	2.22	C			6.5	4.16		0.158	8.0				
					0.5						363	18" RCP 0.075	11.5	
67+58	1.34	3.56	C/D			7.0	3.99		0.167	12.2				
											143	18" RCP 0.075	12.5	→ LINE O
														Initial T = 5.0
FOR SPREAD 63+97 LT	0.14	0.14	C			5.0	4.82		0.030	0.6				
					0.7						290	0.075	7.0	Initial T = 6.1
FOR V-DITCH 67+58	1.34	1.34	C/D			6.8	4.05		0.178	4.7				
LINE O														
					0.3						125	0.06	6.0	Initial T = 5.9
68+96	1.74	1.74	D			6.2	4.27		0.196	6.4		EX 24" CMP		→ MH
					0.2									
ADD LINE N MH	0	5.30				7.2	3.92		0.178	17.9				
					0						18	24" RCP 0.18	17.0	
69+04	0.14	5.44	D			7.2	3.92		0.174	18.4				
												24" RCP 0.008	6.0	→ OUTFALL
FOR SPREAD														
					0									Initial T = 5.0
69+04	0.14	0.14	D			5.0	4.82		0.020	0.6				

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL

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Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE P														
					0.1						50	0.11	9.0	Initial T = 6.7
71+90	1.86	1.86	D			6.8	4.05		0.193	6.5	186	18" RCP 0.095	12.0	→ MH 73+76
					0.3						140	0.093	7.0	Initial T=5.3
73+69	0.45	0.45	D			5.6	4.52		0.160	1.8		18" RCP 0.002	3.5	
					0									Initial T=6.3
73+74	0.29	0.29	D			6.3	4.23		0.052	1.1		18" RCP 0.002	3.0	
					0.3									
COMBINED AT MH 73+76		2.61				7.1	3.96		0.172	8.9	45	18" RCP 0.075	11.7	→ DIV STR. 76+40
					0.9						455	0.138	8.0	Initial T = 10.2
74+04						11.1	3.07		0.200	54.7	20	36" RCP 0.008	7.7	→ DIV STR 76+40
COMBINED														
					0									
DIVERSION STRUCTURE 76+40		23.77				11.1	3.07		0.196	61.5	218	36" RCP 0.052	12.1	
						DIVERT 30 cfs to Channel								
									(-30) ⇒ 31.5					

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL	STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY	Calculated by TER Date 9.24.21 Checked by ____ Date ____ Page 8 of 9

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE P (cont.)														
76+39) RT	1.43	1.43	C/D		0.3	8.3	3.62		0.197	4.4	110	0.052	6.0	Initial T=8.0
												18" RCP 0.002	4.6	
76+39 LT	0.11	0.11	C/D			5.0	4.82		0.000	0.5				Initial T=5.0
												18" 0.002		
MH 76+39 COMBINE		25.31			0.3	11.4	3.03		0.196	64.5				
									(-30)	⇒ 34.5	96	36" 0.052	12.4	
77+33	3.28	3.28	C/D		0.2	9.0	3.46		0.200	9.6	70	0.06	6.0	Initial T=8.8
											15	18" RCP 0.025	8.5	→ MH 77+37
MH 77+37 COMBINE		28.59			0.1	11.5	3.01		0.196	72.4				
									(-30)	⇒ 42.4	95	36" RCP 0.022	10.5	→ MH LINE Q

Figure D-4

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY MANUAL

STUDY NAME: 25-YEAR STORM RATIONAL METHOD STUDY

Calculated by TER Date 9.24.21
Checked by _____ Date _____
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Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I_{25} in/hr	Fm in/hr	Fm avg.	Q_{25} Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
LINE Q														
77+60	0.85	0.85	C/D			6.2	4.27		0.185	3.1				Initial T=6.2
											66	18" RCP 0.016	5.7	→ MH 78+04
					3.0						820	varies	avg 4.5	Initial T=9.4
MCR CB 1	12.56	12.56	D			12.4	2.88		0.194	30.4				
					0						12	36" RCP 0.003	7.0	
MCR CB 2	0.65	13.21	D			12.4	2.88		0.190	32.0				
											93	36" RCP 0.003	7.0	→ MH 78+04
MH 78+04 COMBINE		14.06			0.2	12.6	2.86		0.19	33.9				
					0.1						30	36" RCP 0.003	7.0	
78+15	0.23	14.29	C/D			12.7	2.85		0.189	34.2				
											37	36" RCP 0.003	7.0	→ MH 78+34
MH 78+34 COMBINE		42.88			0.1	12.8	2.83		0.194	101.9				
LINE P									(-30)	⇒71.9	8	48" RCP 0.003	5.7	
78+38	0.49	43.37	C/D			12.8	2.83		0.193	103.1				
									(-30)	⇒73.1		48" RCP 0.003	5.8	→ OUTFALL

Figure D-4

Table 1 shows the minimum pipe slopes to be used for establishing profiles. Existing pipes that are not being replaced were not included. A diversion structure is proposed at station 76+40 to divert a portion of the flow to an existing channel. The analysis of the diversion structure will be a part of a later design phase. It is assumed that the flow diverted to the channel will be 30 cfs. The existing channel runs parallel to the road and crosses Shadowland Circle in double 18" culverts. The double 18" culverts will be replaced with a box culvert. The analysis of the channel and proposed box culvert will be a part of a later design phase.

Table 1. Minimum pipe slopes for final design.

POC	Diameter (in)	Q_{25} (cfs)	S_f (ft/ft)	Minimum slope (ft/ft)
16+84 LT	18	2.2	0.0005	0.0020
16+84 RT	18	3.1	0.0010	0.0020
18+77	18	3.6	0.0014	0.0020
22+18	18	3.6	0.0011	0.0020
24+20	18	0.8	0.0001	0.0020
27+01 LT	18	4.8	0.0024	0.0024
26+82 RT	18	5.3	0.0030	0.0030
31+33 LT	18	4.7	0.0023	0.0023
31+33 RT	18	5.8	0.0035	0.0035
37+84	18	1.2	0.0002	0.0020
41+03	18	0.8	0.0001	0.0020
43+03	18	3.9	0.0016	0.0020
44+32	18	0.5	0.0000	0.0020
44+66	18	0.7	0.0001	0.0020
47+60	18	1.3	0.0002	0.0020
49+46	18	0.8	0.0001	0.0020
50+98	18	1.3	0.0002	0.0020
52+01	18	1.5	0.0002	0.0020
54+61	18	4.0	0.0017	0.0020
56+55	18	4.3	0.0019	0.0020
63+97 RT	18	7.6	0.0061	0.0061
63+97 LT	18	8.0	0.0067	0.0070
67+58	18	12.2	0.0156	0.0156
69+00 (MH)	24	17.9	0.0073	0.0073
69+04	24	18.4	0.0077	0.0080
71+90	18	6.5	0.0044	0.0044
73+69	18	1.8	0.0003	0.0020
73+74	18	1.1	0.0001	0.0020
73+96 (MH)	18	8.9	0.0083	0.0083

74+04	36	54.7	0.0078	0.0080
76+40 (Diversion Structure)	36	31.5	0.0026	0.0026
76+39 RT	18	4.4	0.0020	0.0020
76+39 LT	18	0.5	0.0000	0.0020
76+39 (MH)	36	34.5	0.0031	0.0031
77+33	18	9.6	0.0097	0.0100
77+37 (MH)	36	42.4	0.0047	0.0050
77+60	18	3.1	0.0010	0.0020
MCR CB 1	36	30.4	0.0024	0.0025
MCR CB 2	36	32.0	0.0027	0.0027
78+04 (MH)	36	33.9	0.0030	0.0030
78+15	36	34.2	0.0030	0.0030
78+34 (MH)	48	71.9	0.0029	0.0030
78+38	48	73.1	0.0030	0.0030

HYDRAULIC ANALYSES – SPREAD CALCULATIONS

Table 2 shows the calculated spread at proposed inlets with concentrated street flow. Inlets in the vicinity of the Shadowland Circle and Modjeska Canyon Road intersection were not analyzed due to insufficient design details. These locations will be analyzed at a later design phase.

Table 2. Spread at inlets with concentrated street flow

POC	Type	Longitudinal Slope (ft/ft)	Q_{25} (cfs)	Spread (ft)
16+84 RT	C&G	0.122	1.0	5.0
24+20	C&G	0.105	0.8	4.8
26+82 RT	C&G	0.050	0.6	5.0
31+33 RT	C&G	0.117	1.0	5.1
37+84	C&G	0.025	1.2	6.1
41+03	C&G	0.060	0.8	3.3
44+32	C&G	0.111	0.5	2.8
47+60	C&G	0.080	1.3	5.4
49+46	C&G	0.115	0.8	2.9
50+98	C&G	0.120	0.5	2.6
52+01	C&G	0.095	0.3	2.3
54+61	C&G	0.107	2.8	7.4
56+55	C&G	0.118	0.4	3.8
63+97 LT	AC Dike	0.052	0.6	5.3
69+04	C&G	0.086	0.6	2.8
73+74	C&G	0.080	1.1	3.0
76+39	C&G	0.045	0.5	2.7

HYDRAULIC ANALYSES – V-DITCHES

Table 3 shows the proposed POC's that will collect concentrated flow from v-ditches. The capacity of the v-ditch assumes 3 inches of freeboard. If the capacity of the v-ditch at the POC is greater than the calculated discharge at the location, then the v-ditch is considered adequate.

Table 3. V-ditch capacities

POC	Longitudinal Slope (ft/ft)	Q_{25} (cfs)	V-Ditch Capacity (cfs)
10+80	0.09	1.8	12.2
16+84 LT	0.128	2.2	14.5
18+77	0.122	3.6	14.2
22+18	0.095	3.3	12.5
27+01 LT	0.040	4.8	8.1
31+33 LT	0.082	4.7	11.7
43+03	0.058	3.9	9.8
49+53	0.108	1.6	13.4
56+23	0.120	1.5	14.1
63+97 RT	0.112	7.6	13.6
67+58	0.068	4.7	10.6
68+96	0.062	6.4	10.1
71+90	0.111	6.5	13.6
73+69	0.093	1.8	12.4
76+39 RT	0.045	4.4	8.6
77+33	0.059	9.6	9.9

APPENDIX A – DRAINAGE PLANS (MARK THOMAS)

COUNTY OF ORANGE CALIFORNIA
MARK
DESCRIPTION
DATE
APPR
PREPARED UNDER THE RESPONSIBLE CHARGE OF:
DATE
DESIGNED BY
DRAWN BY
CHECKED BY
DRAWING NO.
FILE NAME
PLOT DATE
SCALE
AS SHOWN
PREPARED BY:
THOMAS
MARK
County of Orange
OC PublicWorks
MODJESKA GRADE ROAD
IMPROVEMENTS
STA 10+00 TO STA 25+50
DRAINAGE
PLAN
SHEET
D-01
14 OF 23
CONSTRUCTION DRAIN NOTES
01 CONSTRUCT INLET (TYPE GO) PER CALTRANS STD. PLAN D72E AND D72F.
03 CONSTRUCT INLET MODIFIED WITH SIDE OPENING. SEE DETAIL ON SHEET D-1.
06 CONSTRUCT 18" R.C.P.
13 CONSTRUCT OUTLET DISSIPATION
14 ABANDON PIPE
REMOVALS:
(1) PROTECT IN PLACE
(2) REMOVE, PER PLAN
PIPE OPENING
DITCH/SWALE SIDE OPENING
03 INLET MODIFIED WITH SIDE OPENING
NO SCALE
N
MATCHLINE STA 17+50
SEE BELOW
LINE A
"A" LINE
MODJESKA GRADE RD
SANTIAGO CYN RD
EXIST 24" CMP
12" CMP
R/W
MATCHLINE STA 25+50
SEE SHEET D-02
LINE D
LINE C
LINE B
16" CMP
MATCHLINE STA 17+50
SEE ABOVE

MODJESKA GRADE ROAD
IMPROVEMENTS
STA 25+50 TO STA 41+50
DRAINAGE
PLAN
SHEET
D-02
15 OF 23
County of Orange
PublicWorks
MARK THOMAS
CONSTRUCTION DRAIN NOTES
01 CONSTRUCT INLET (TYPE GO) PER CALTRANS STD. PLAN D72E AND D72F.
03 CONSTRUCT INLET MODIFIED WITH SIDE OPENING. SEE DETAIL ON SHEET D-1.
06 CONSTRUCT 18" R.C.P.
13 CONSTRUCT OUTLET DISSIPATION
14 ABANDON PIPE
REMOVALS:
(2) REMOVE, PER PLAN
MATCHLINE STA 33+50
SEE BELOW
SEE SHEET D-01
MATCHLINE STA 25+50
MATCHLINE STA 41+50
SEE SHEET D-03
SEE ABOVE
MATCHLINE STA 33+50
LINE E
LINE F
LINE G
LINE H
MODJESKA GRADE RD
SANTIAGO TRUCK TRAIL
UNKNOWN PIPE SIZE
18" CMP
12" CMP
PLAN
1" = 40'

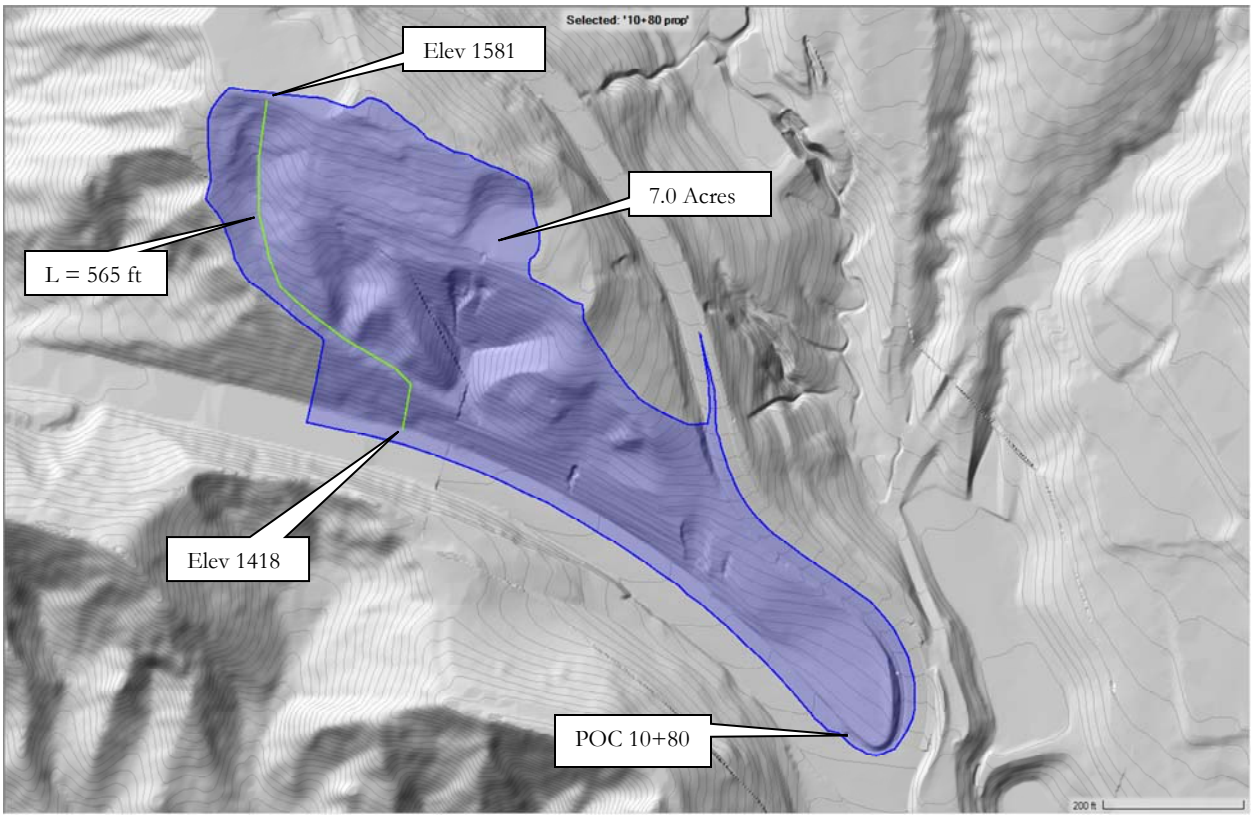
COUNTY OF ORANGE VINTAGE CALIFORNIA
MARK
DESCRIPTION
DATE
APPR.
THOMAS
PREPARED BY:
County of Orange
PublicWorks
MODJESKA GRADE ROAD
IMPROVEMENTS
STA 41+50 TO STA 55+50
DRAINAGE
PLAN
SHEET
D-03
16 OF 23
CONSTRUCTION DRAIN NOTES:
01 CONSTRUCT INLET (TYPE GO) PER CALTRANS STD. PLAN D72E AND D72F.
03 CONSTRUCT INLET MODIFIED WITH SIDE OPENING. SEE DETAIL ON SHEET D-1.
04 CONSTRUCT FLARED END INLET
06 CONSTRUCT 18" R.C.P.
07 CONSTRUCT JUNCTION STRUCTURE
13 CONSTRUCT OUTLET DISSIPATION
14 ABANDON PIPE
REMOVALS:
1 PROTECT IN PLACE
2 REMOVE, PER PLAN
N
MATCHLINE STA 49+50
SEE BELOW
R/W
LINE M
LINE L
LINE K
LINE J
LINE I
MODJESKA GRADE RD
12" CMP
18" CMP
UNKNOWN CMP
SEE SHEET D-02
MATCHLINE STA 41+50
PLAN
1" = 40'
SEE SHEET D-04
MATCHLINE STA 55+50
4" PVC
10" PVC
SEE ABOVE
MATCHLINE STA 45+50

SHEET
D-04
17 OF 23
MODJESKA GRADE ROAD
IMPROVEMENTS
STA 55+50 TO STA 67+50
DRAINAGE
PLAN
PREPARED BY:
MARK THOMAS
County of Orange
PublicWorks
CONSTRUCTION DRAIN NOTES
01 CONSTRUCT INLET (TYPE GO) PER CALTRANS STD. PLAN D72E AND D72F.
03 CONSTRUCT INLET MODIFIED WITH SIDE OPENING. SEE DETAIL ON SHEET D-1.
06 CONSTRUCT 18" R.C.P.
07 CONSTRUCT JUNCTION STRUCTURE
13 CONSTRUCT OUTLET DISSIPATION
REMOVALS:
(1) PROTECT IN PLACE
(2) REMOVE, PER PLAN
CANYON HEIGHTS DR
MODJESKA GRADE RD
LINE M
LINE N
MATCHLINE STA 61+50
SEE SHEET D-05
MATCHLINE STA 55+50
SEE SHEET D-03
SEE ABOVE
SEE BELOW
18" STL
12" STL
6" PVC
D1
R/W
PLAN
1" = 40'

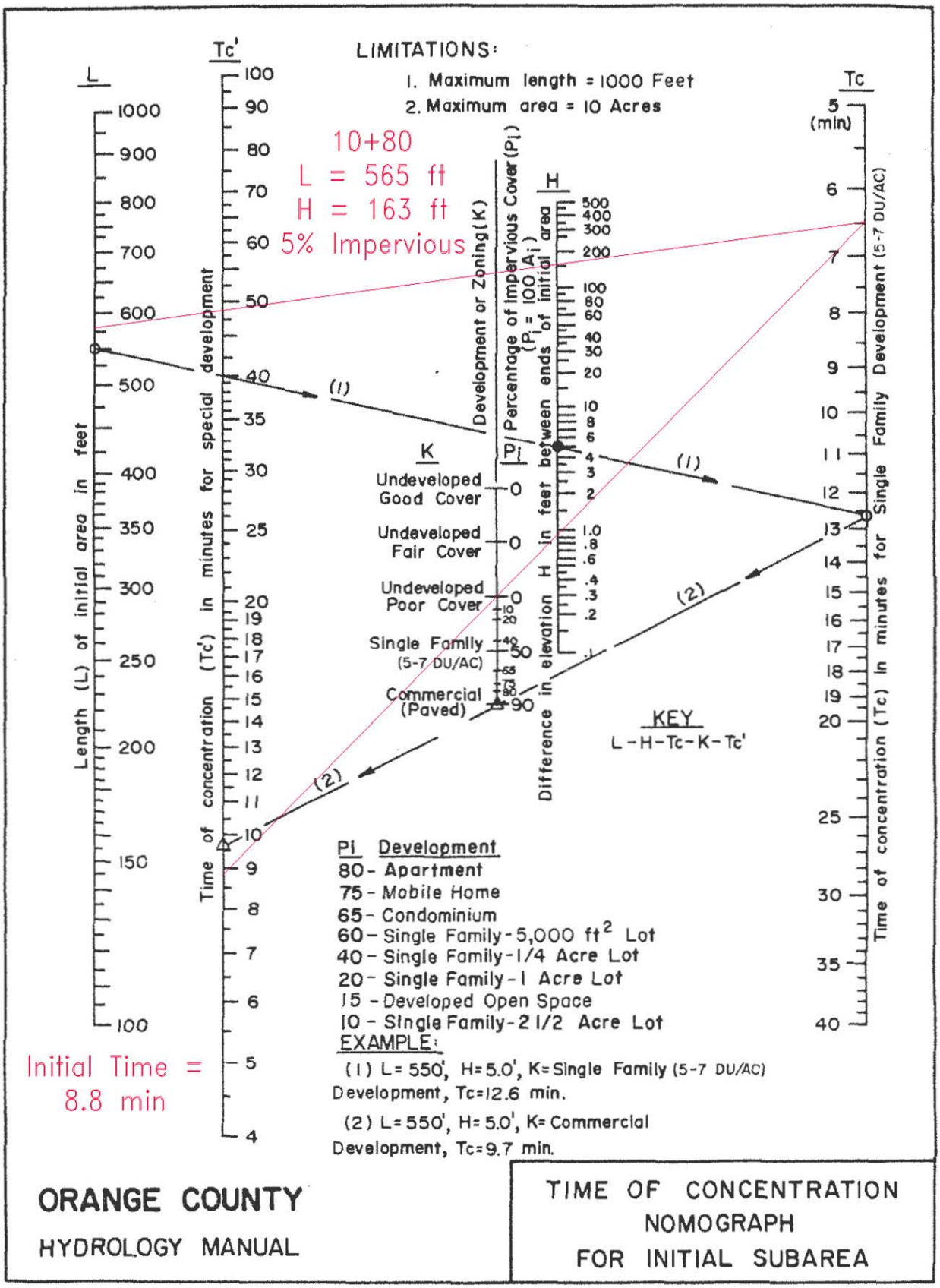
MODJESKA GRADE ROAD
IMPROVEMENTS
STA 67+50 TO STA 80+00
DRAINAGE PLAN
SHEET
D-05
18 OF 23
County of Orange
PUBLIC WORKS
MARK THOMAS
PREPARED BY:
CONSTRUCTION DRAIN NOTES
01 CONSTRUCT INLET (TYPE GO) PER CALTRANS STD. PLAN D72E AND D72F.
03 CONSTRUCT INLET MODIFIED WITH SIDE OPENING. SEE DETAIL ON SHEET D-1.
05 CONSTRUCT 36" R.C.P.
06 CONSTRUCT 18" R.C.P.
07 CONSTRUCT JUNCTION STRUCTURE
08 CONSTRUCT 24" R.C.P.
09 CONSTRUCT DIVERSION STRUCTURE
10 CONSTRUCT 48" R.C.P.
11 CONSTRUCT R.C.B.
12 CONSTRUCT INLET (TYPE TBD)
13 CONSTRUCT OUTLET DISSIPATION
REMOVALS:
(1) PROTECT IN PLACE
(2) REMOVE, PER PLAN
MATCHLINE STA 74+50 SEE BELOW
PORTION OF 12" CMP
12" CMP
D1 & PORTION OF 12" CMP
LINE P
LINE O
18" CMP
PIPE INLET
MODJESKA GRADE RD
LINE N
SEE SHEET D-04 MATCHLINE STA 67+50
PLAN 1" = 40'
MARKUSON RD
MODJESKA CYN RD
SANTIAGO CREEK
12" STL
LINE Q
18" CMP (2)
SHADOWLAND CIRCLE
POSSIBLE UNDERGROUND DETENTION
ALTERNATE PIPE ALIGNMENT
SEE ABOVE MATCHLINE STA 74+50
PLAN 1" = 40'

APPENDIX B – DRAINAGE MAPS AND INITIAL TOC NOMOGRAPHS

Drainage maps and initial TOC nomograpghs appear in order as shown on hydrology calculation sheets (initial time flow paths shown in green).

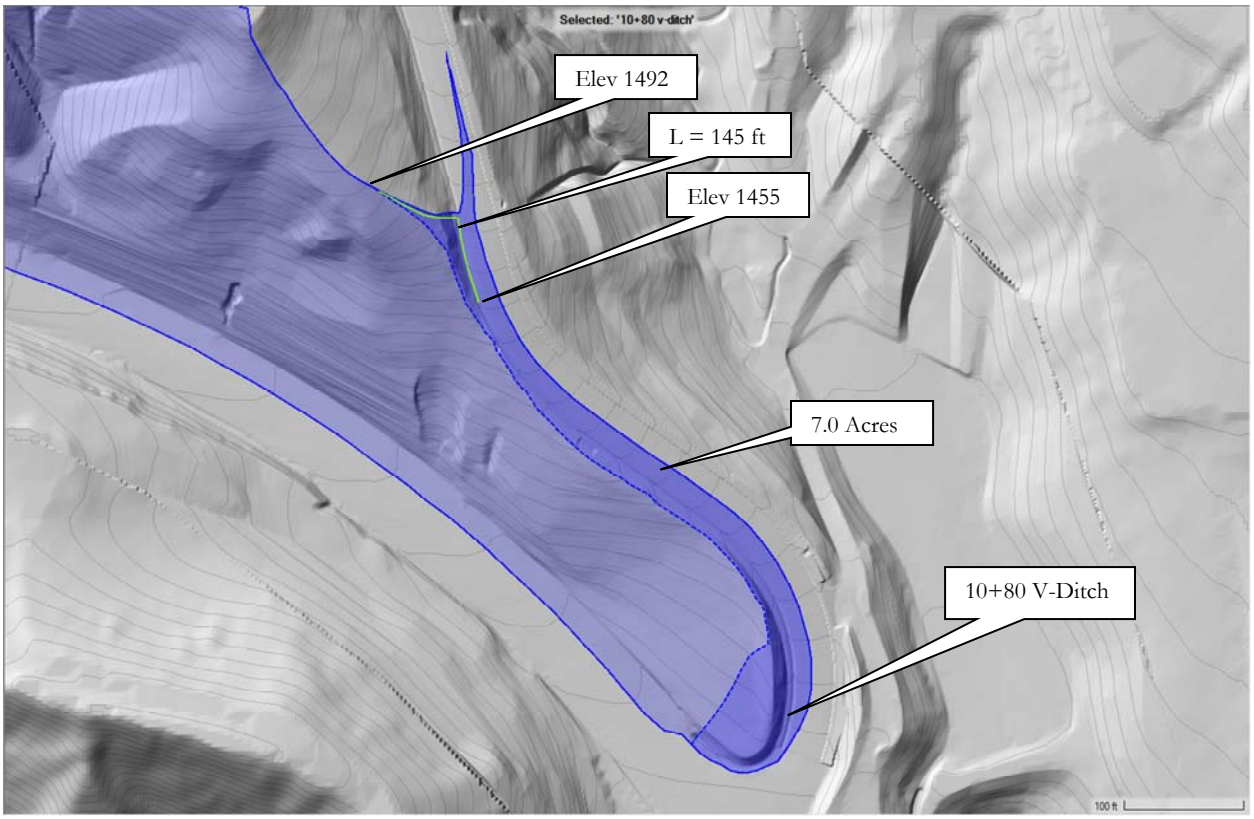


POC 10+80

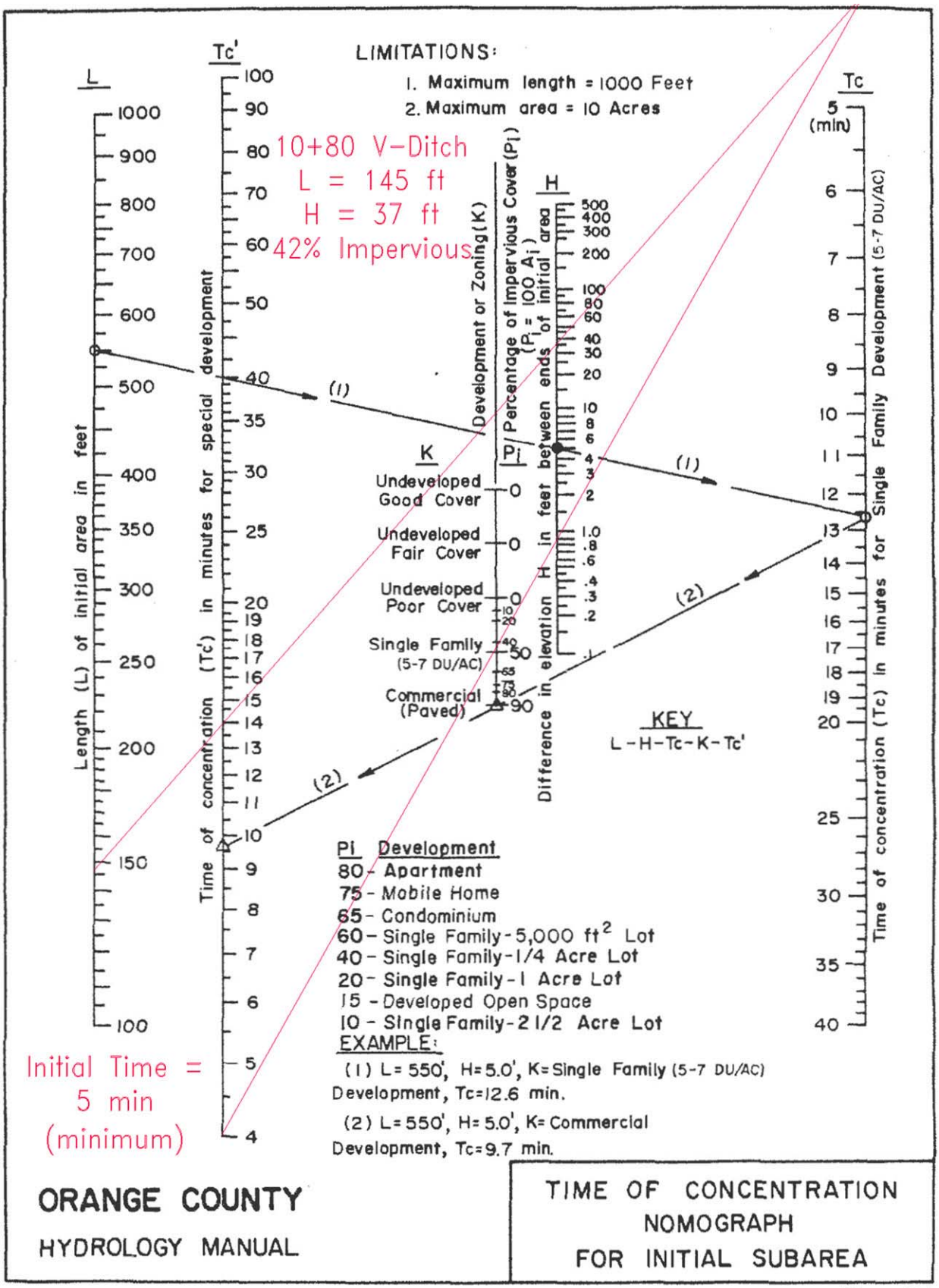

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
10+80
L = 565 ft
H = 163 ft
5% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 8.8 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

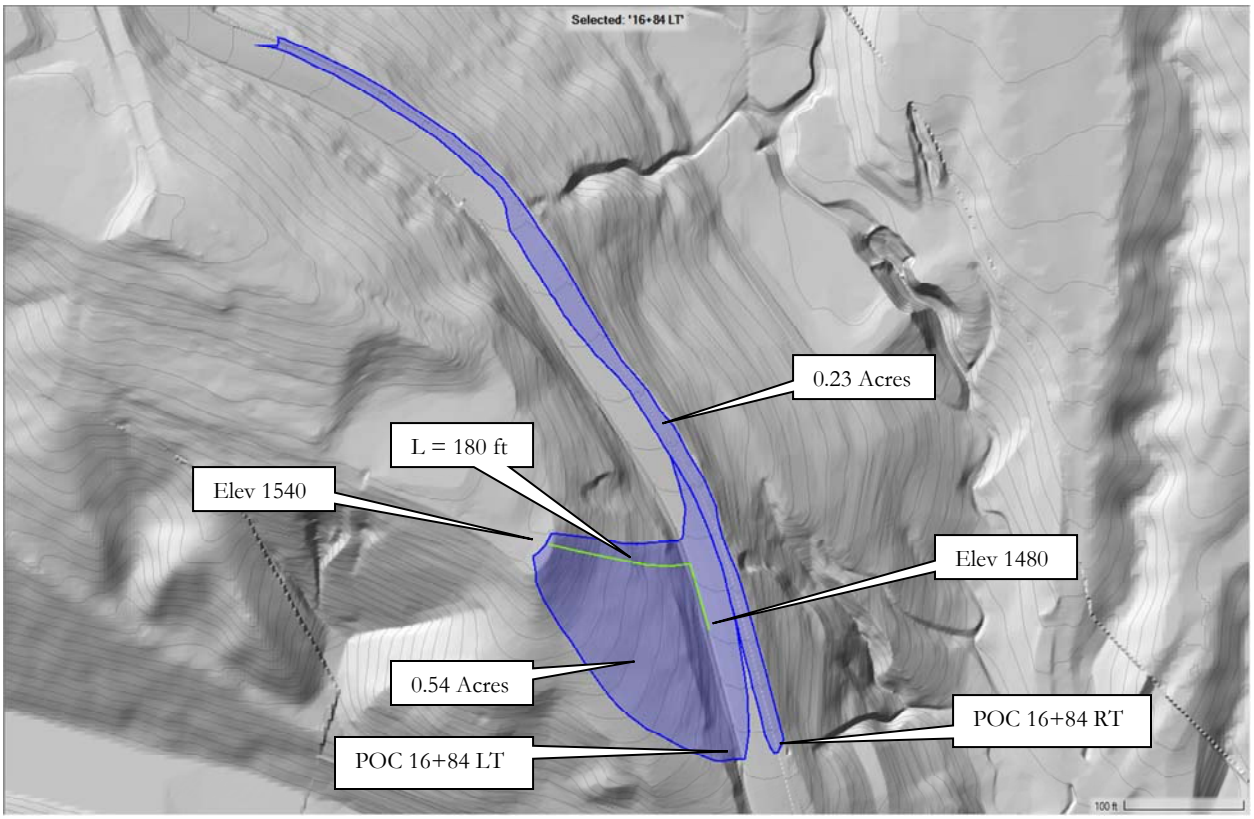


10+80 V-Ditch (sub-area of 10+80)

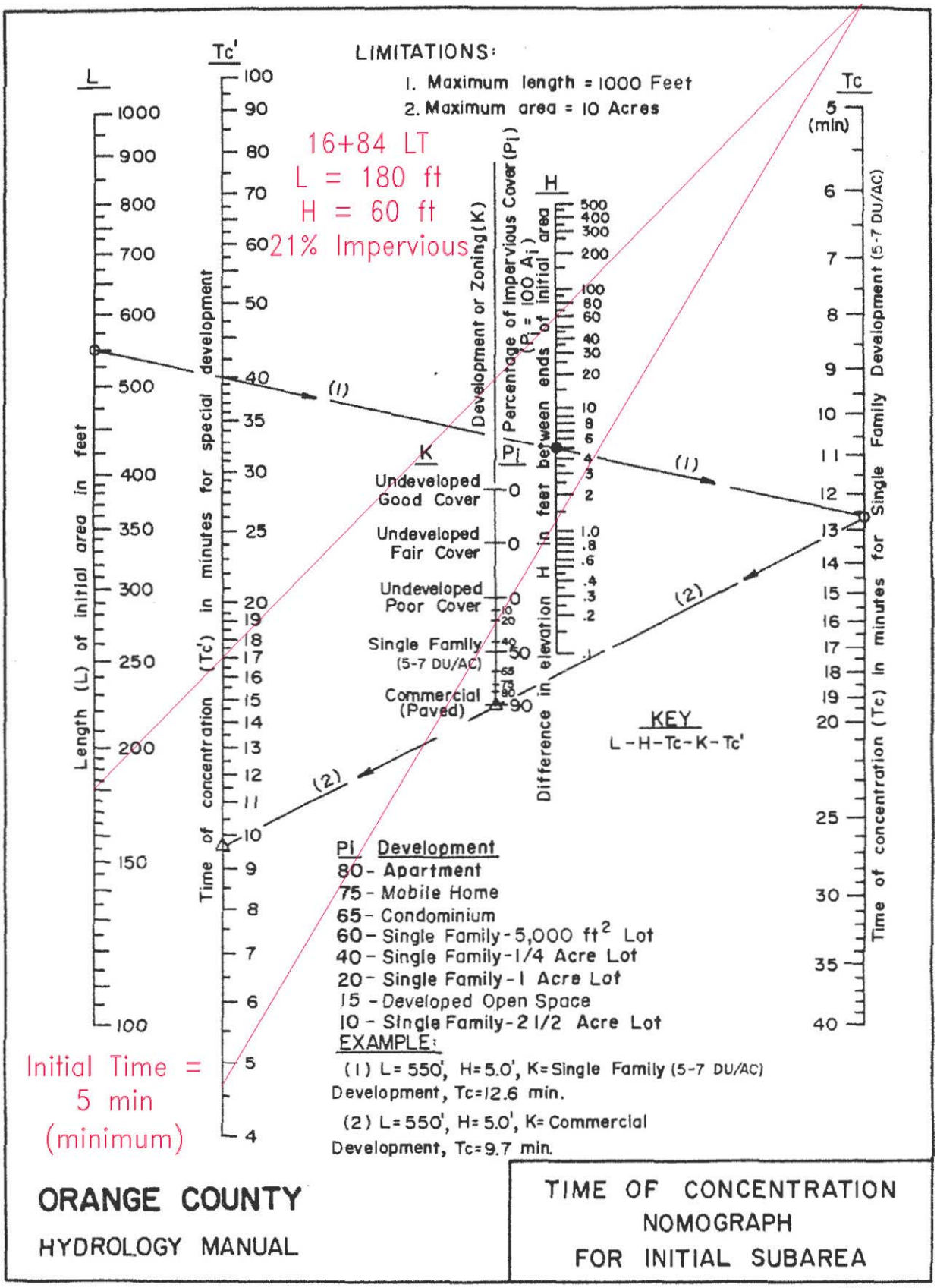

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
10+80 V-Ditch
L = 145 ft
H = 37 ft
42% Impervious
Initial Time = 5 min (minimum)
L
Tc'
Tc
K
H
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

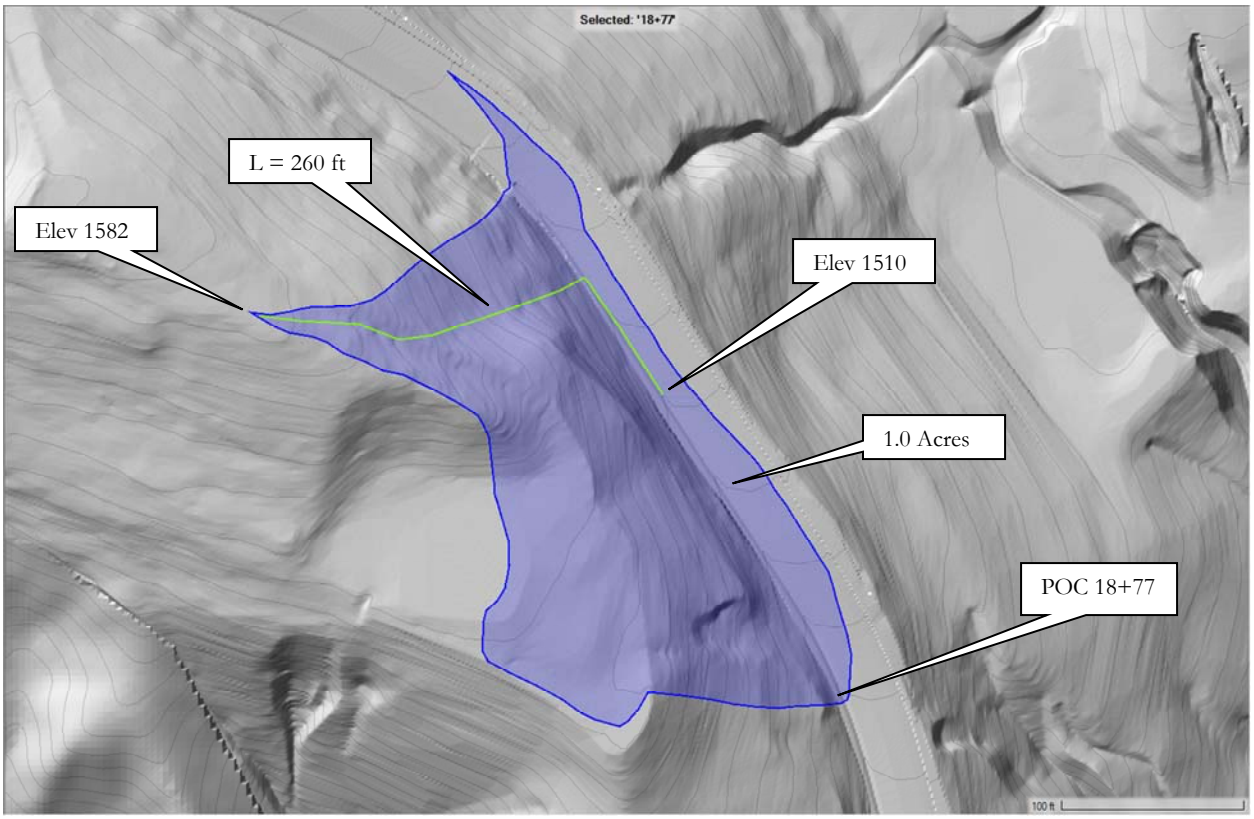


16+84 LT and RT

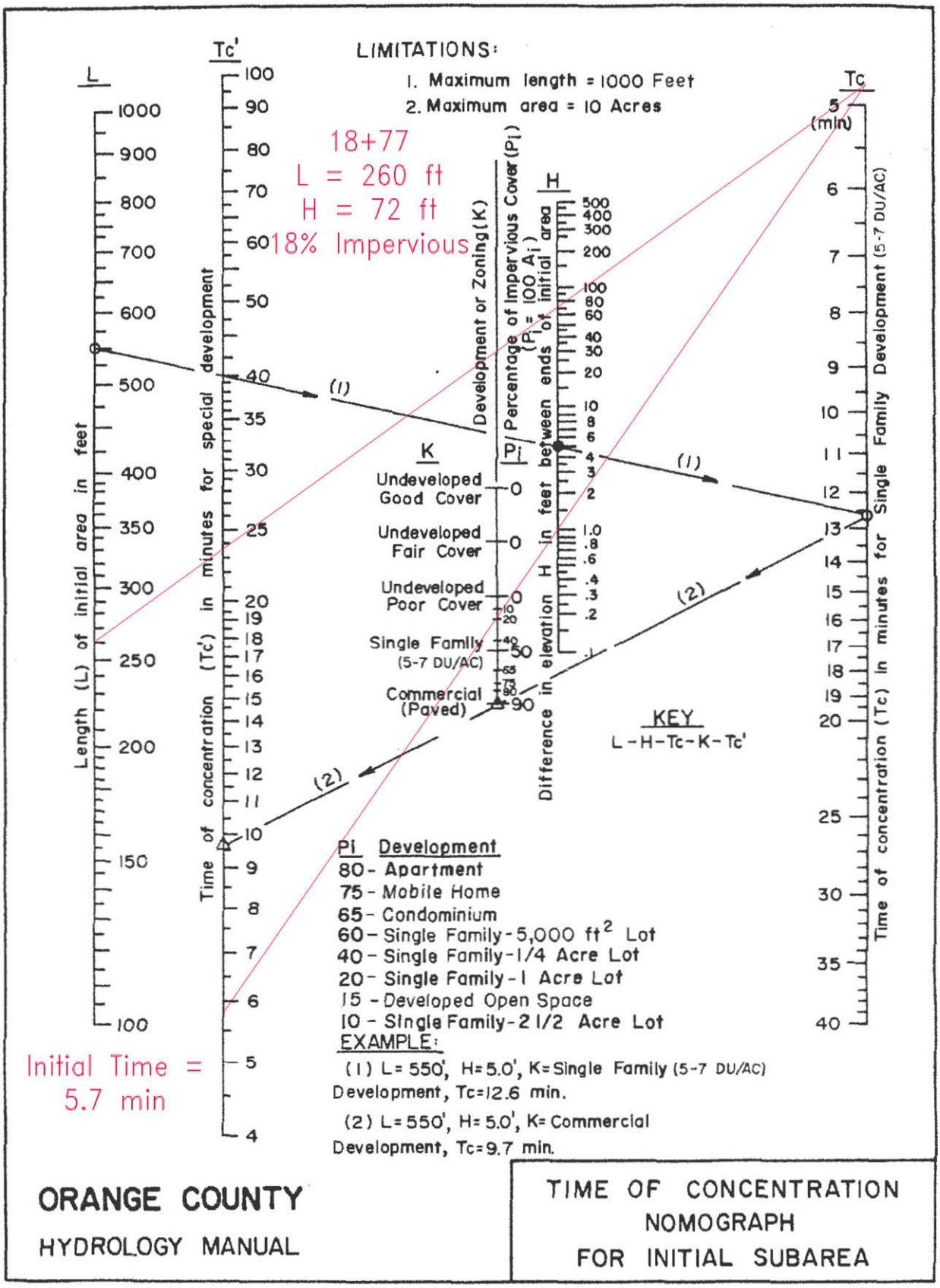

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
16+84 LT
L = 180 ft
H = 60 ft
21% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5 min (minimum)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1


Selected: '18+77'
L = 260 ft
Elev 1582
Elev 1510
1.0 Acres
POC 18+77
100 ft

18+77

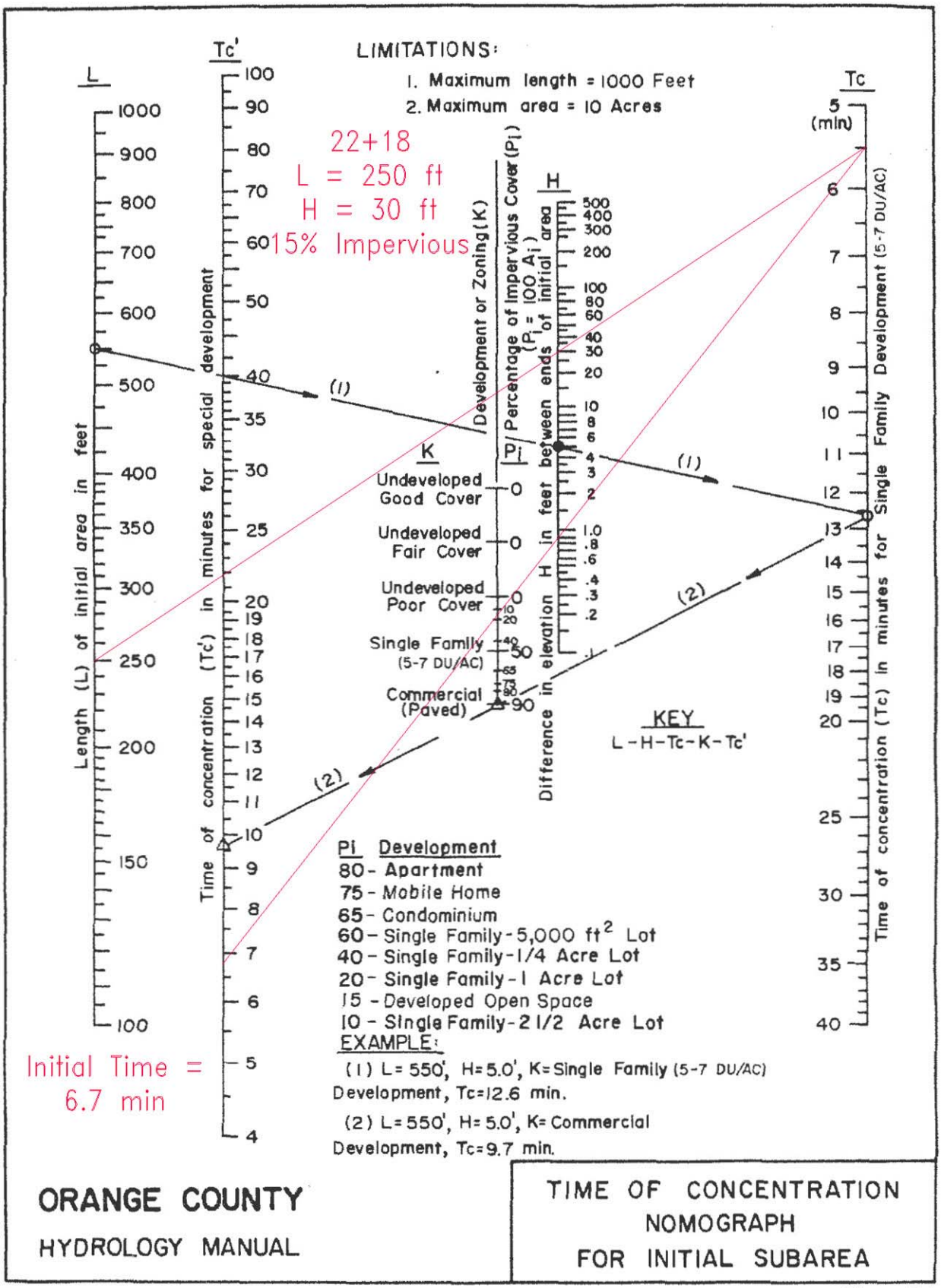

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
18+77
L = 260 ft
H = 72 ft
18% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Ai = area of initial area
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5.7 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

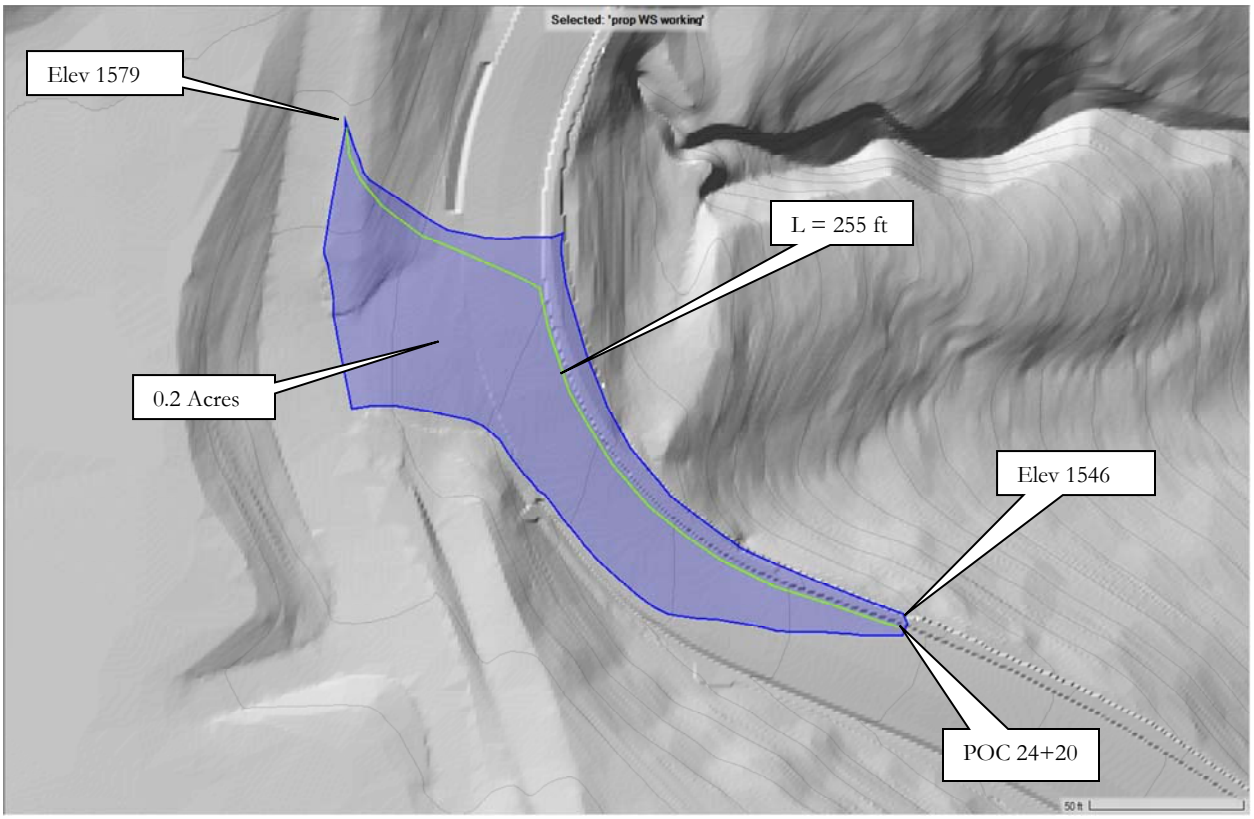

Selected: '22+18'
L = 250 ft
Elev 1561.5
1.0 Acres
Elev 1591.5
POC 22+18
50 ft

22+18

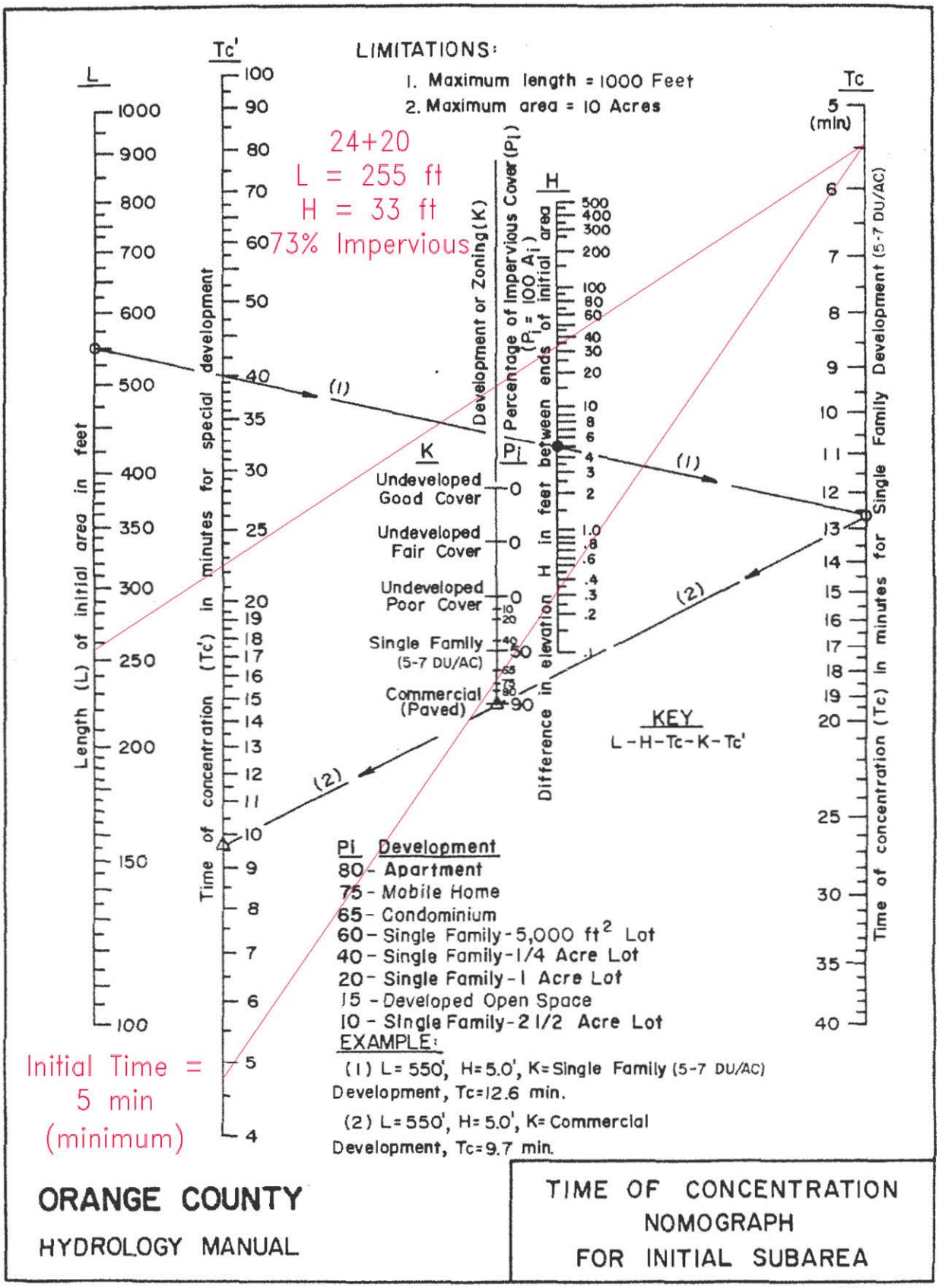

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
22+18
L = 250 ft
H = 30 ft
15% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pi / Percentage of Impervious Cover (Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 6.7 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

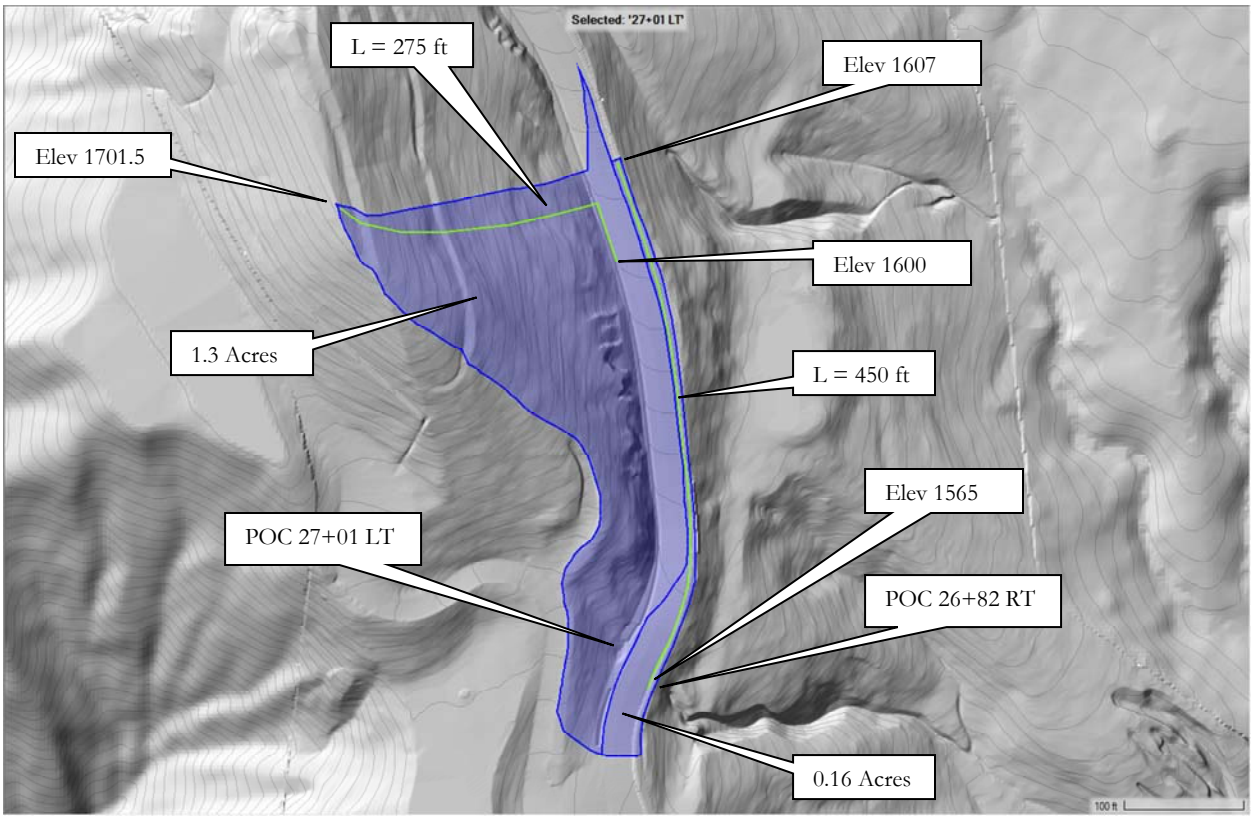

Selected: 'prop WS working'
Elev 1579
L = 255 ft
0.2 Acres
Elev 1546
POC 24+20
50 ft

24+20

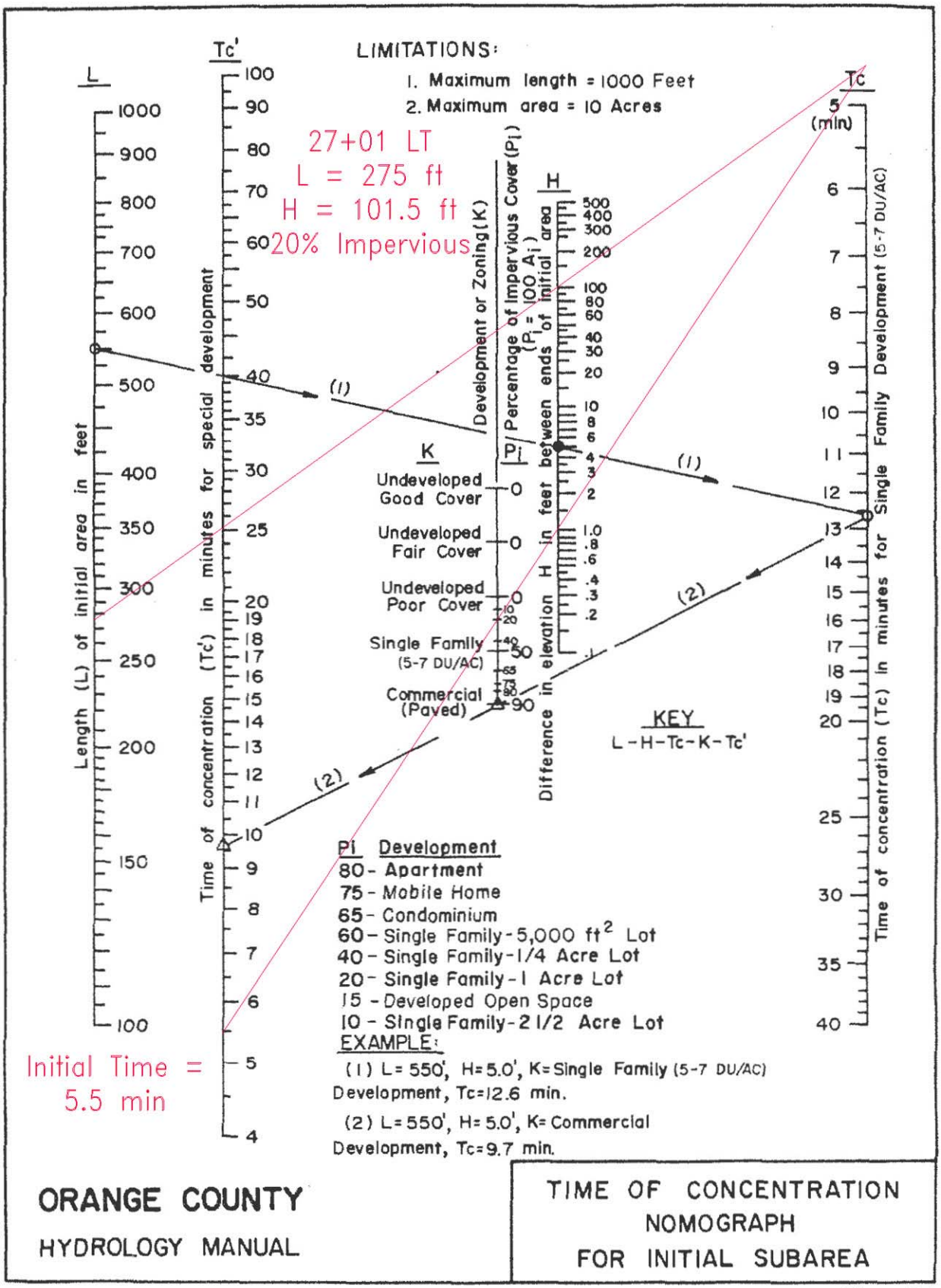

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
24+20
L = 255 ft
H = 33 ft
73% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pi = Percentage of Impervious Cover
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
(1)
(2)
KEY
L-H-Tc-K-Tc'
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
Initial Time = 5 min (minimum)
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

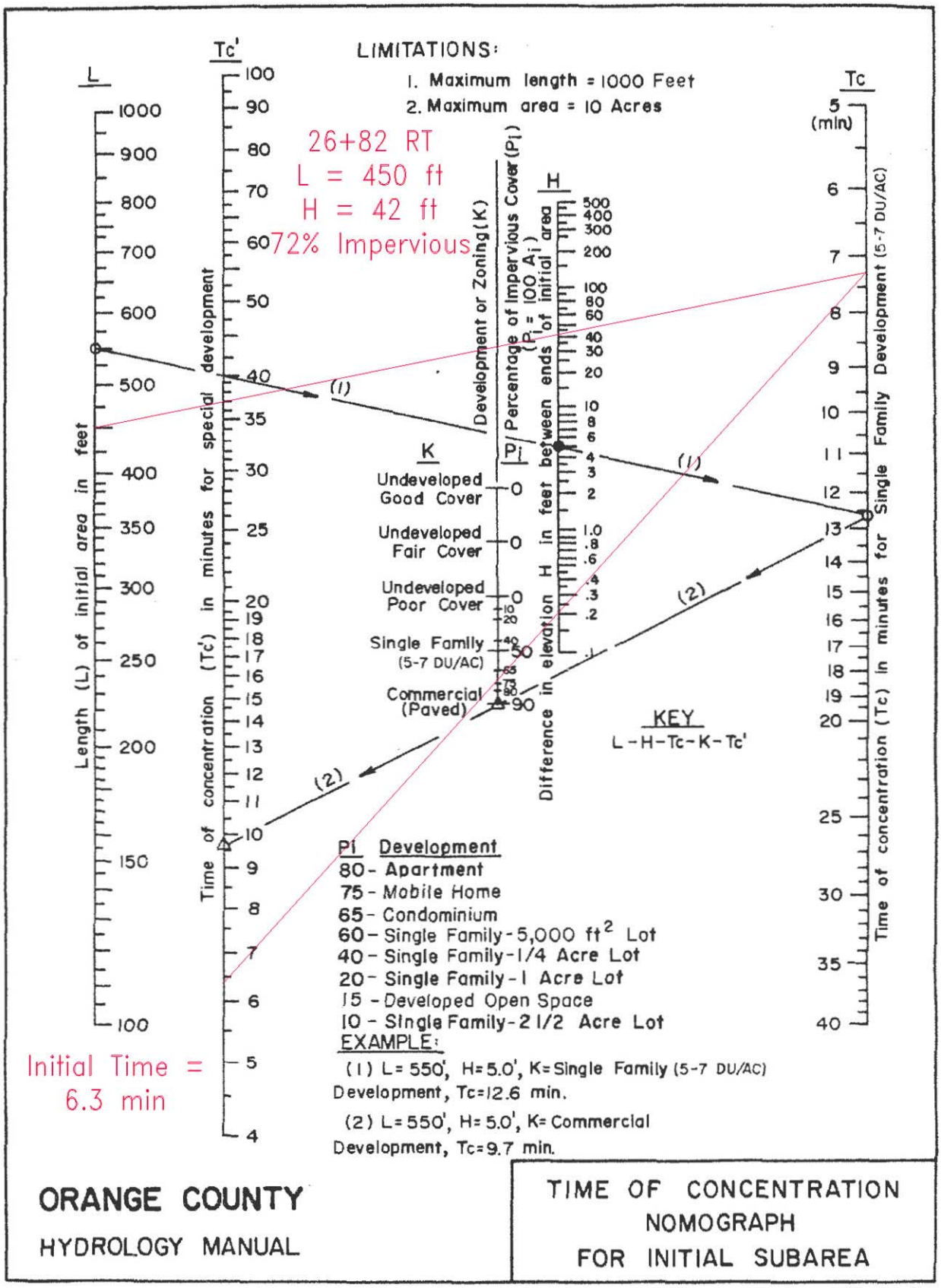


27+01 LT and 26+82 RT


LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
27+01 LT
L = 275 ft
H = 101.5 ft
20% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Ai = area of initial area
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
(min)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
(1)
(2)
KEY
L-H-Tc-K-Tc'
Initial Time = 5.5 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

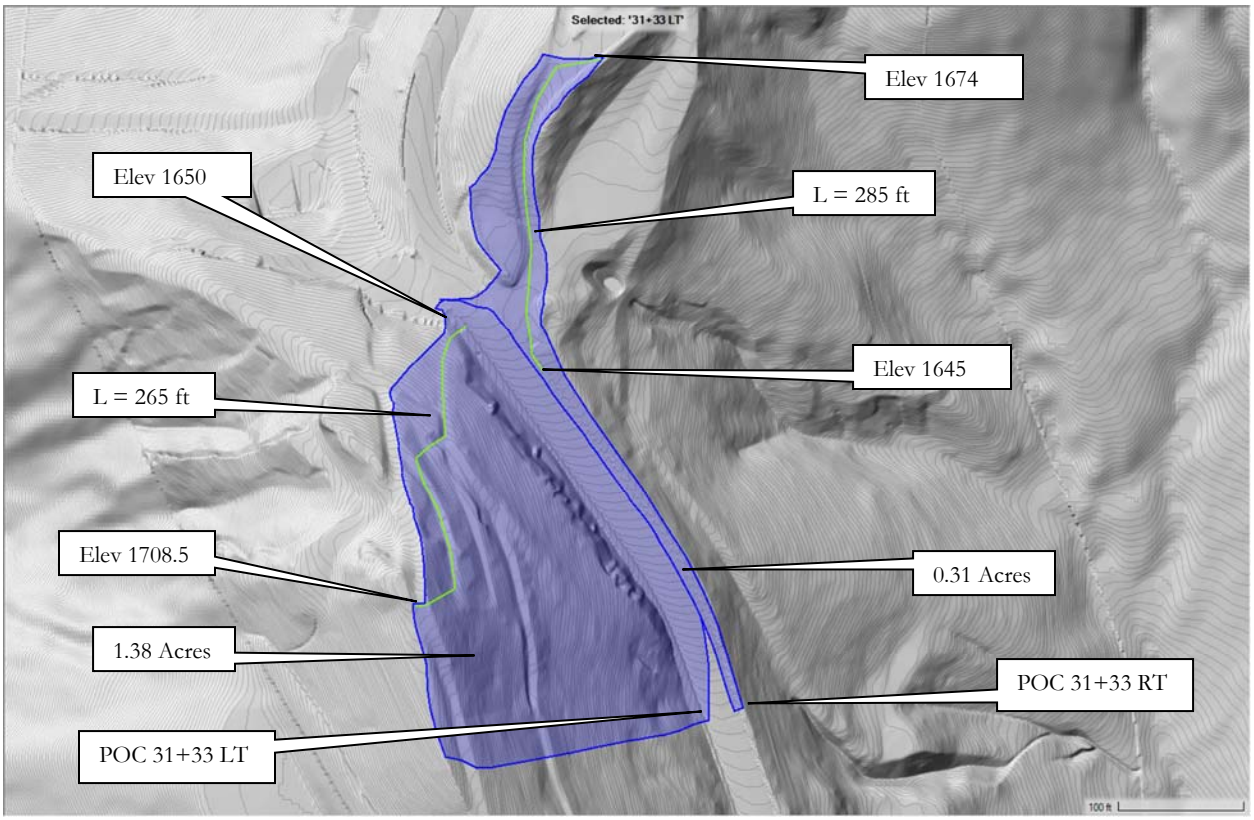
D-4

Figure D-1

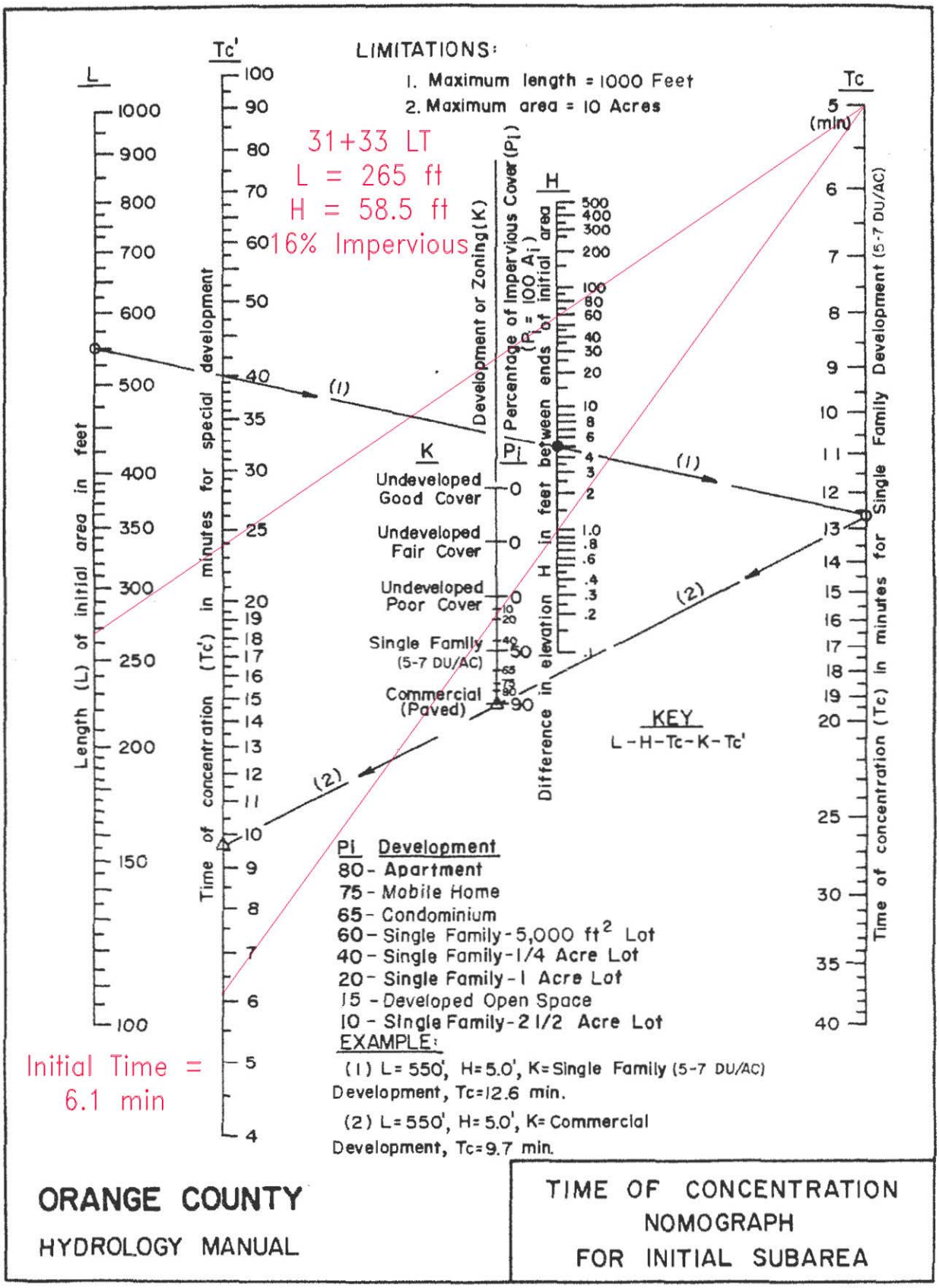

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
26+82 RT
L = 450 ft
H = 42 ft
72% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Ai = area of initial
H
Difference in elevation H in feet between ends
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 6.3 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

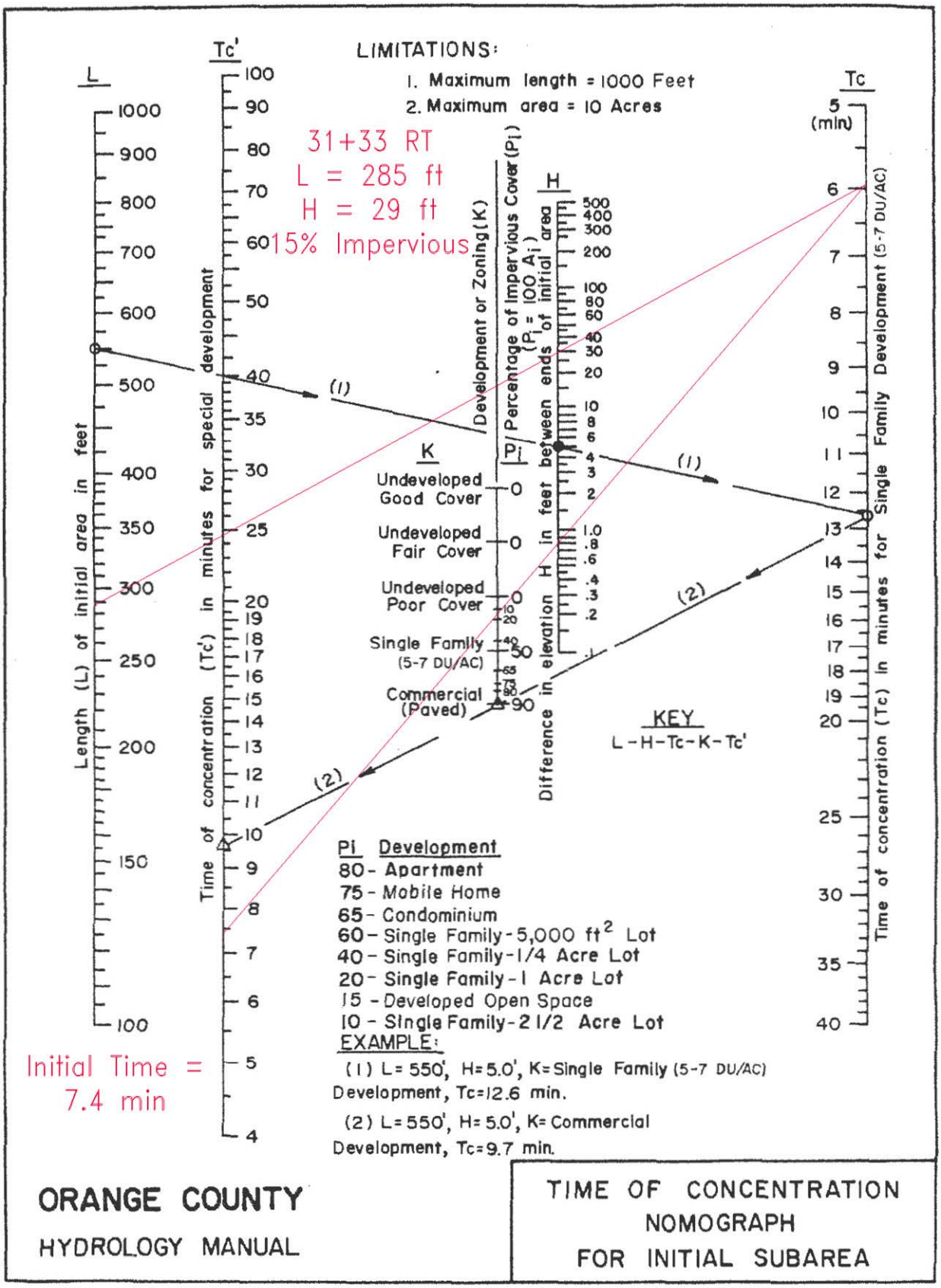


31+33 LT and 31+33 RT


LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
31+33 LT
L = 265 ft
H = 58.5 ft
16% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 6.1 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

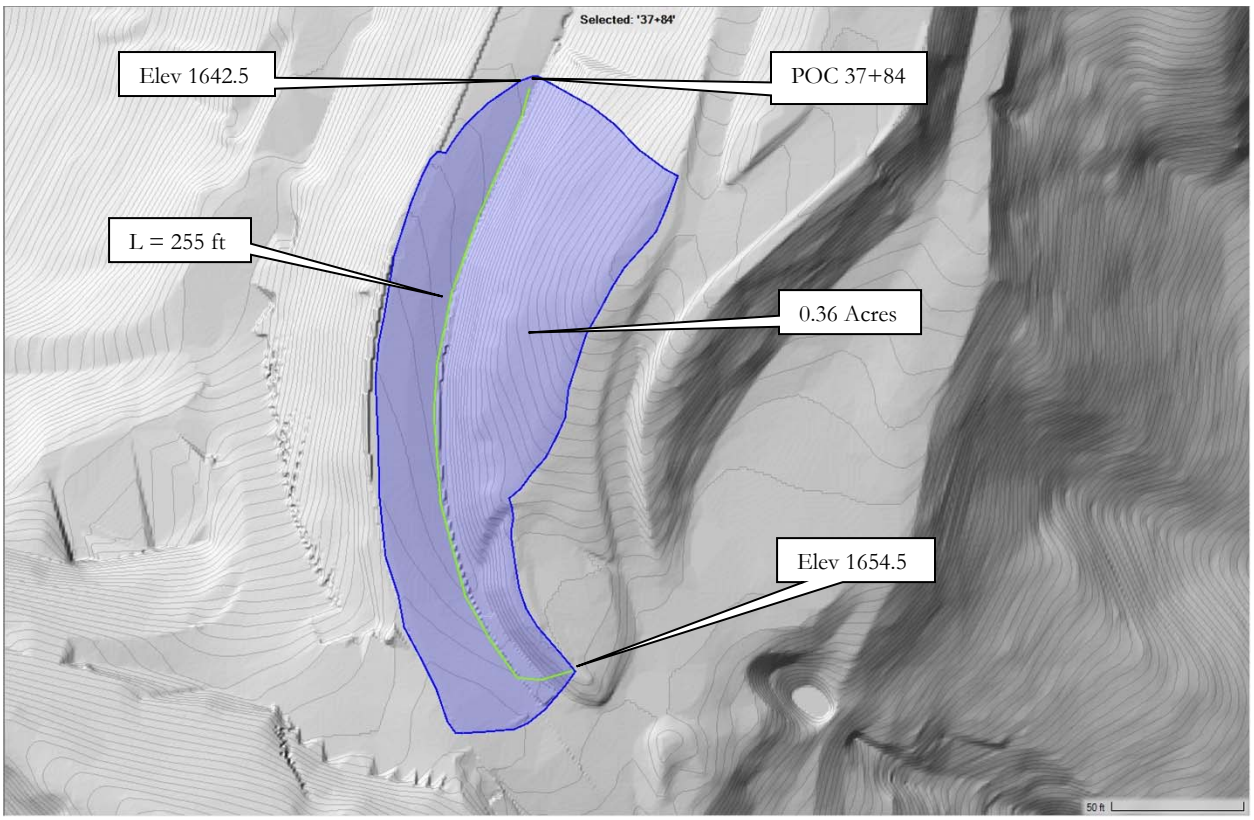
D-4

Figure D-1

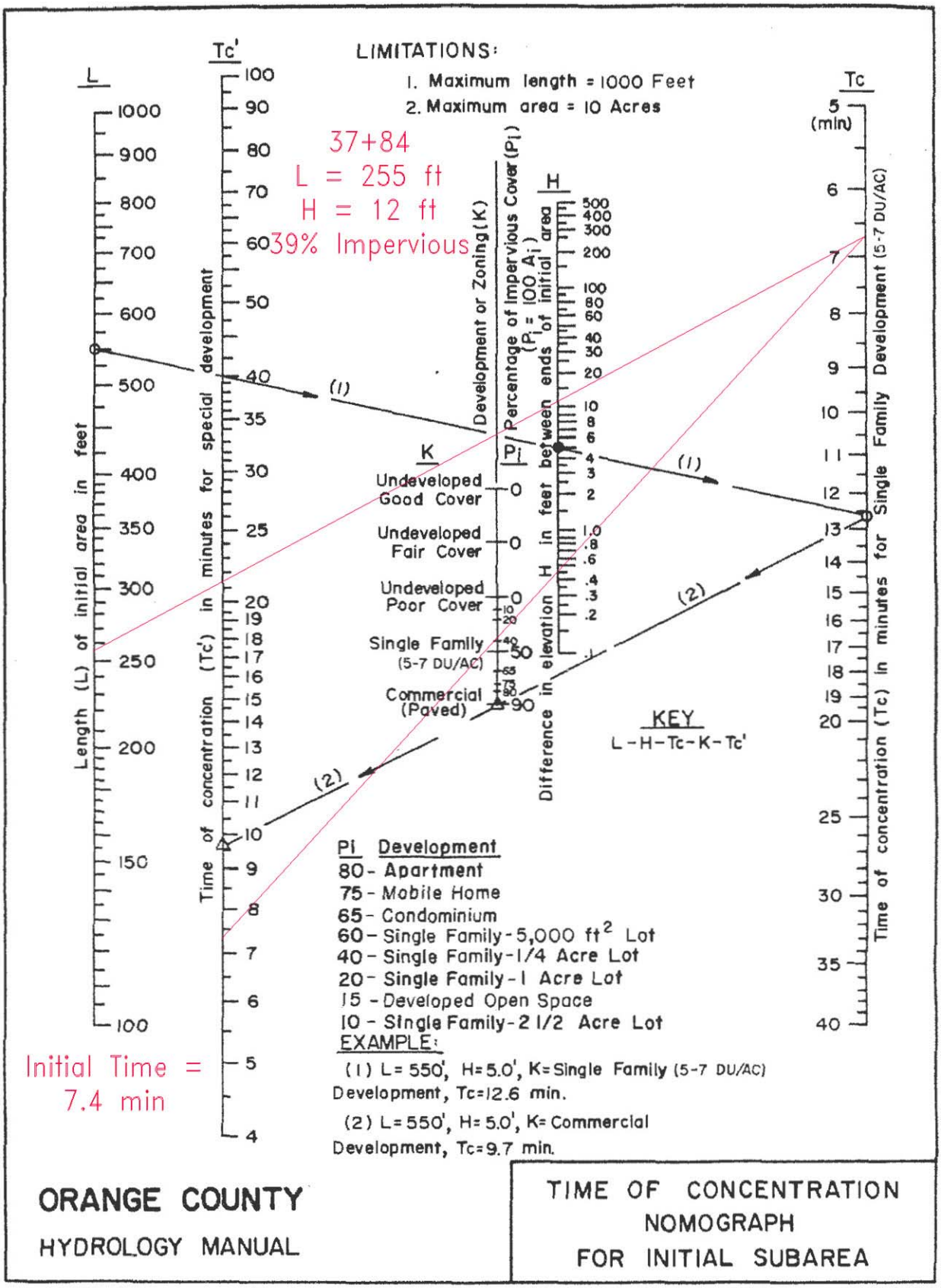

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
31+33 RT
L = 285 ft
H = 29 ft
15% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 7.4 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

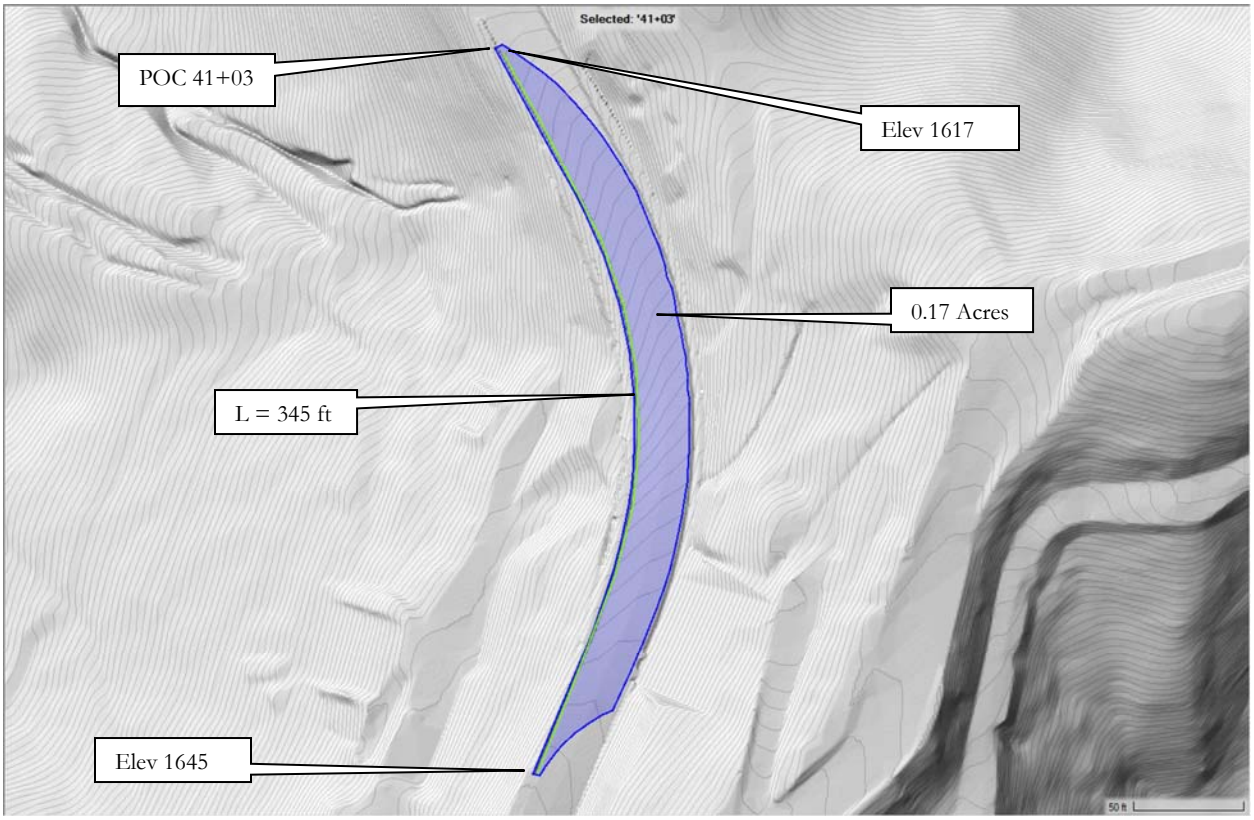

Selected: '37+84'
Elev 1642.5
POC 37+84
L = 255 ft
0.36 Acres
Elev 1654.5
50 ft

37+84

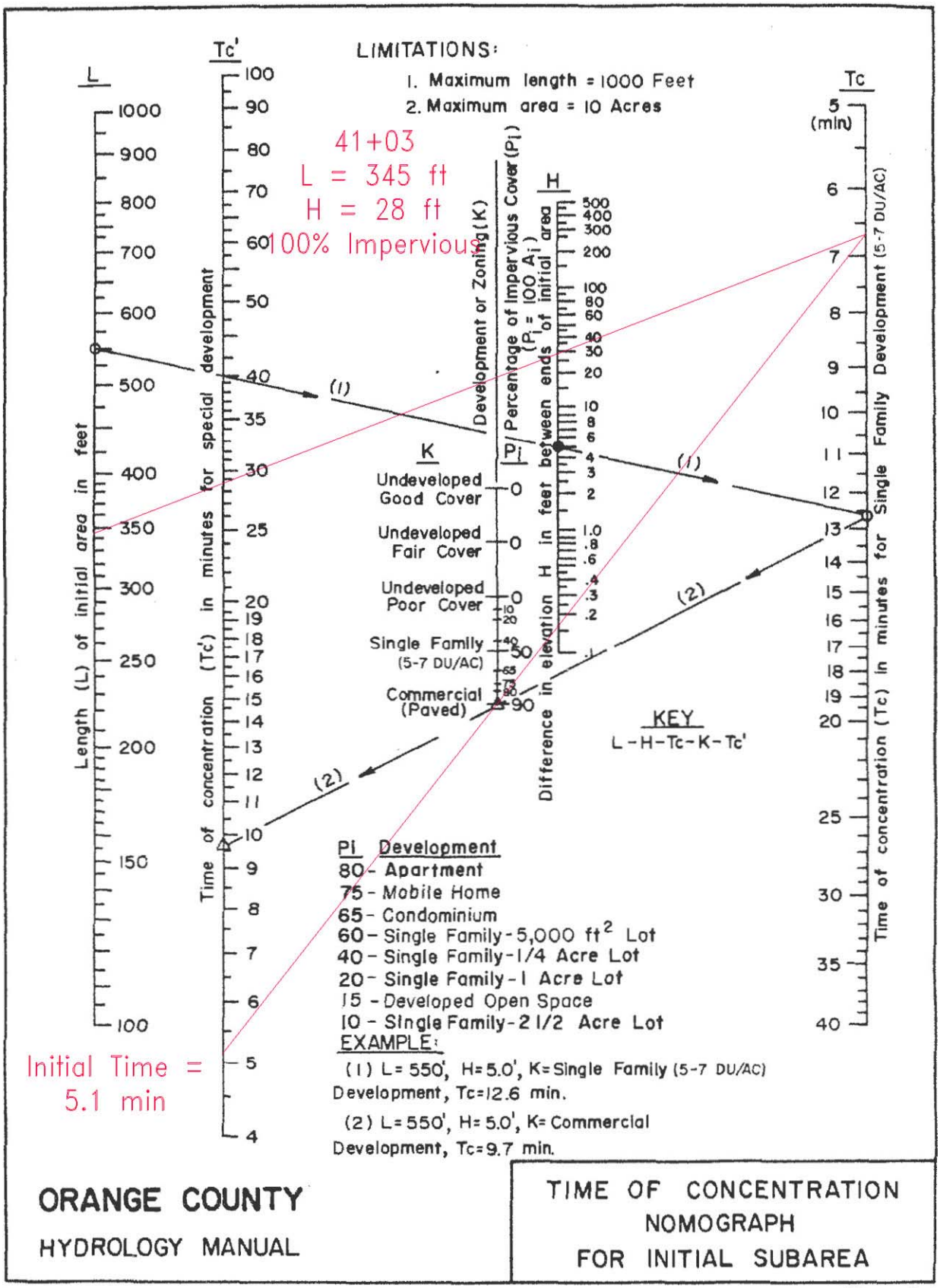

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
37+84
L = 255 ft
H = 12 ft
39% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
(min)
K
Pi
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 7.4 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

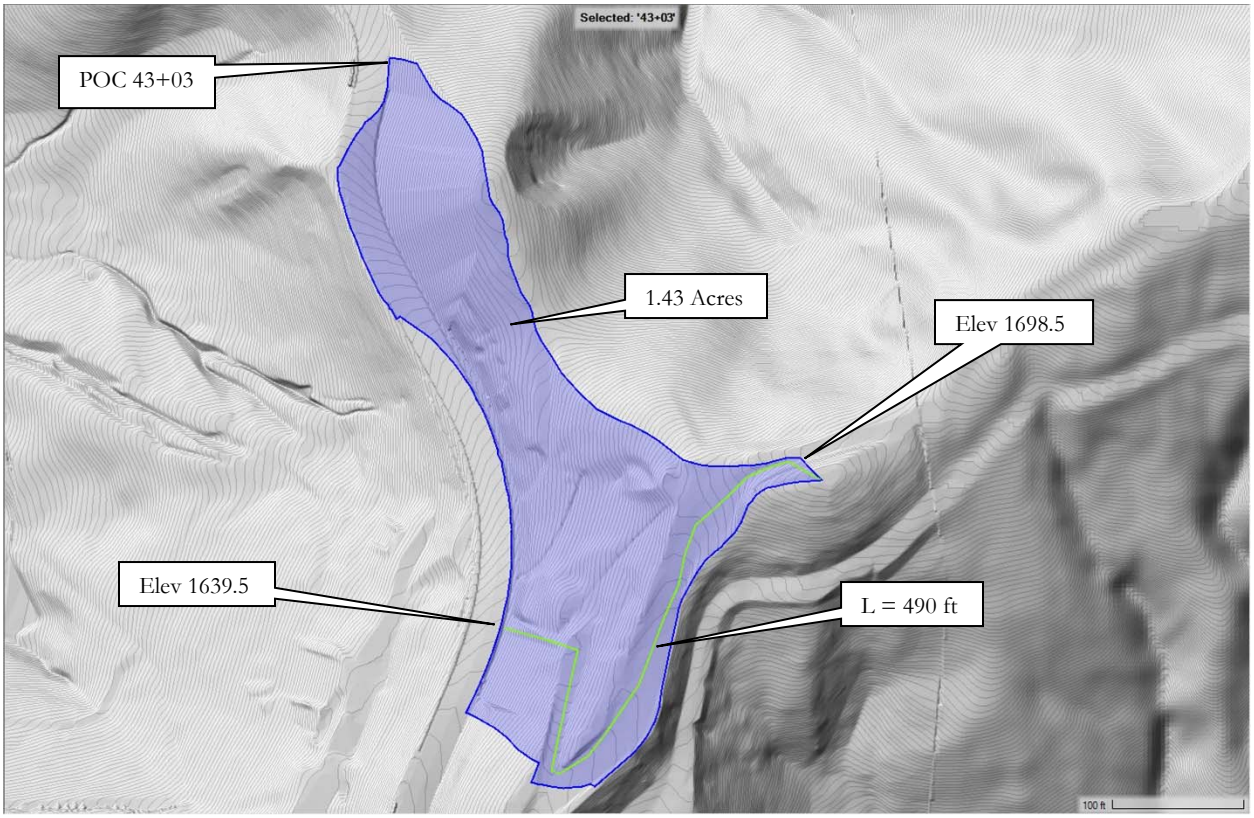

Selected: '41+03'
POC 41+03
Elev 1617
0.17 Acres
L = 345 ft
Elev 1645
50 ft

41+03

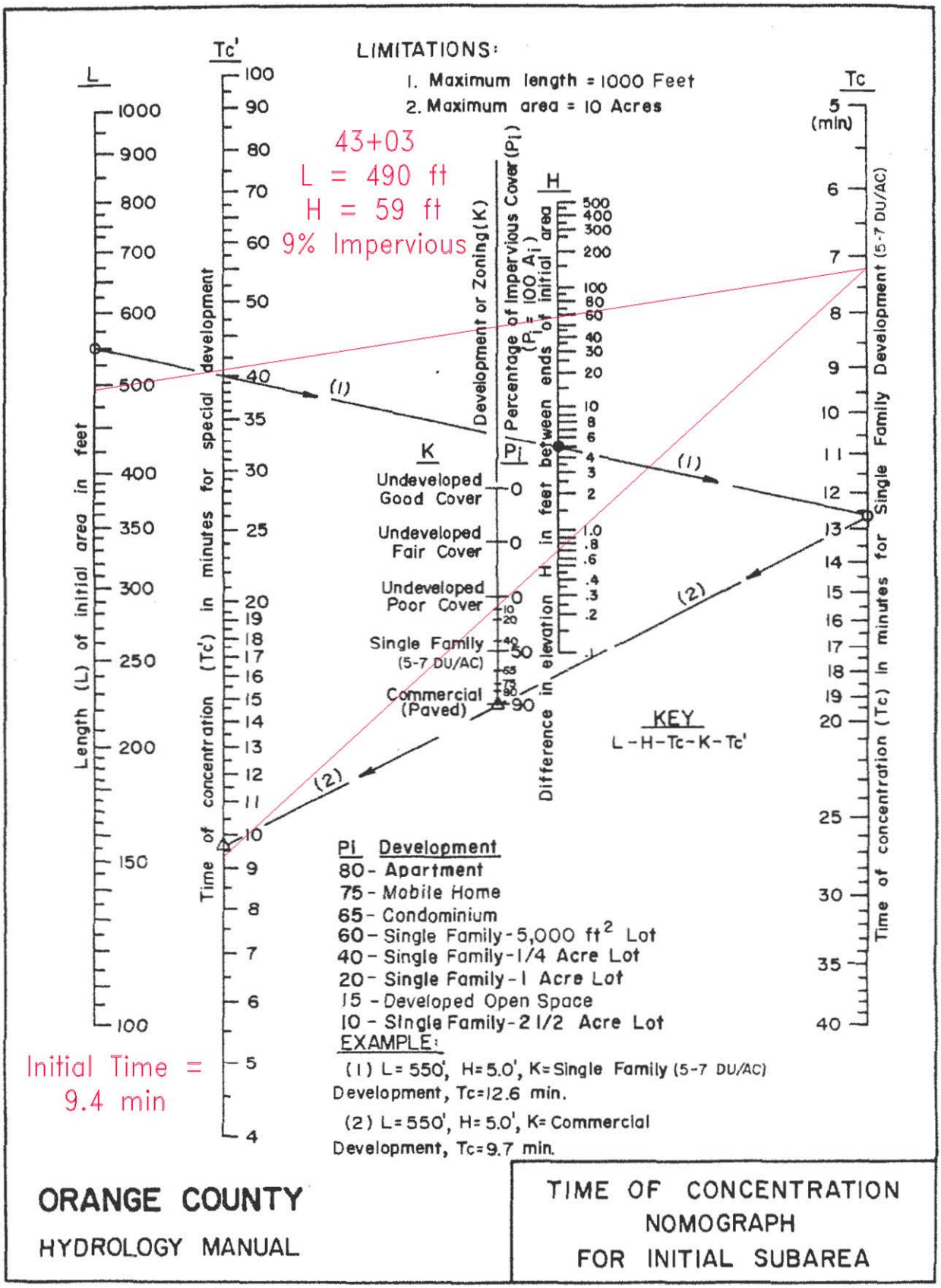

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
41+03
L = 345 ft
H = 28 ft
100% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5.1 min
PI Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

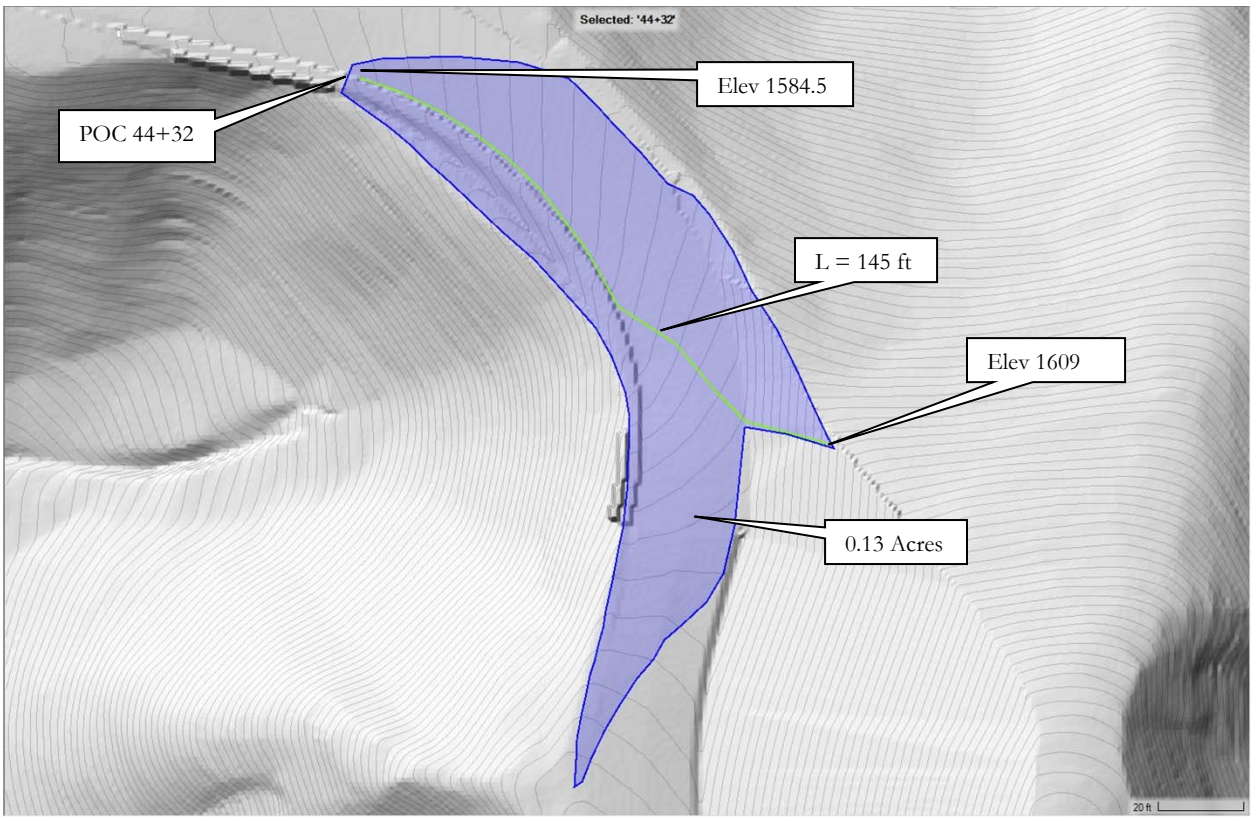

Selected: '43+03'
POC 43+03
1.43 Acres
Elev 1698.5
Elev 1639.5
L = 490 ft
100 ft

43+03

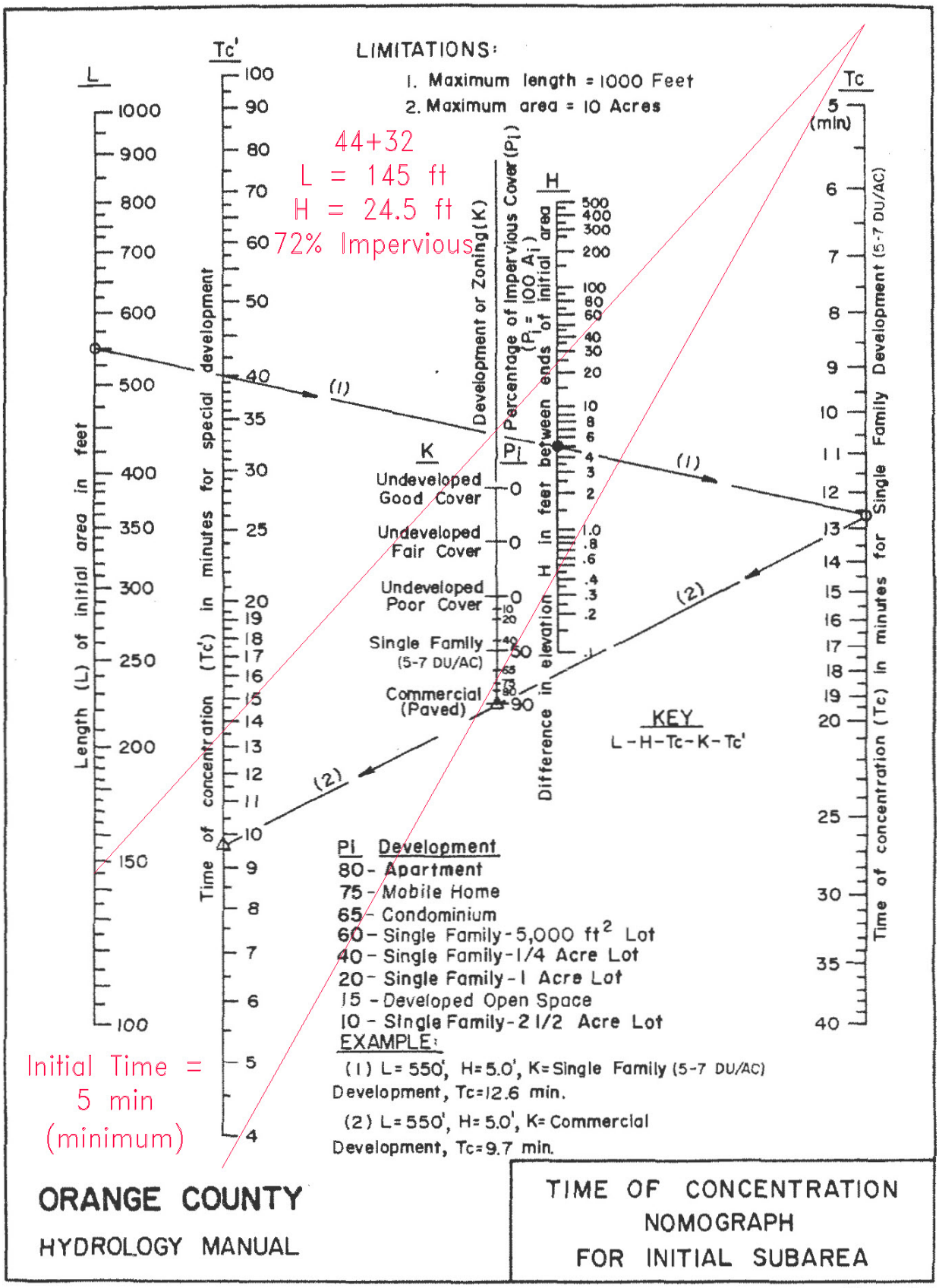

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
43+03
L = 490 ft
H = 59 ft
9% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 9.4 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

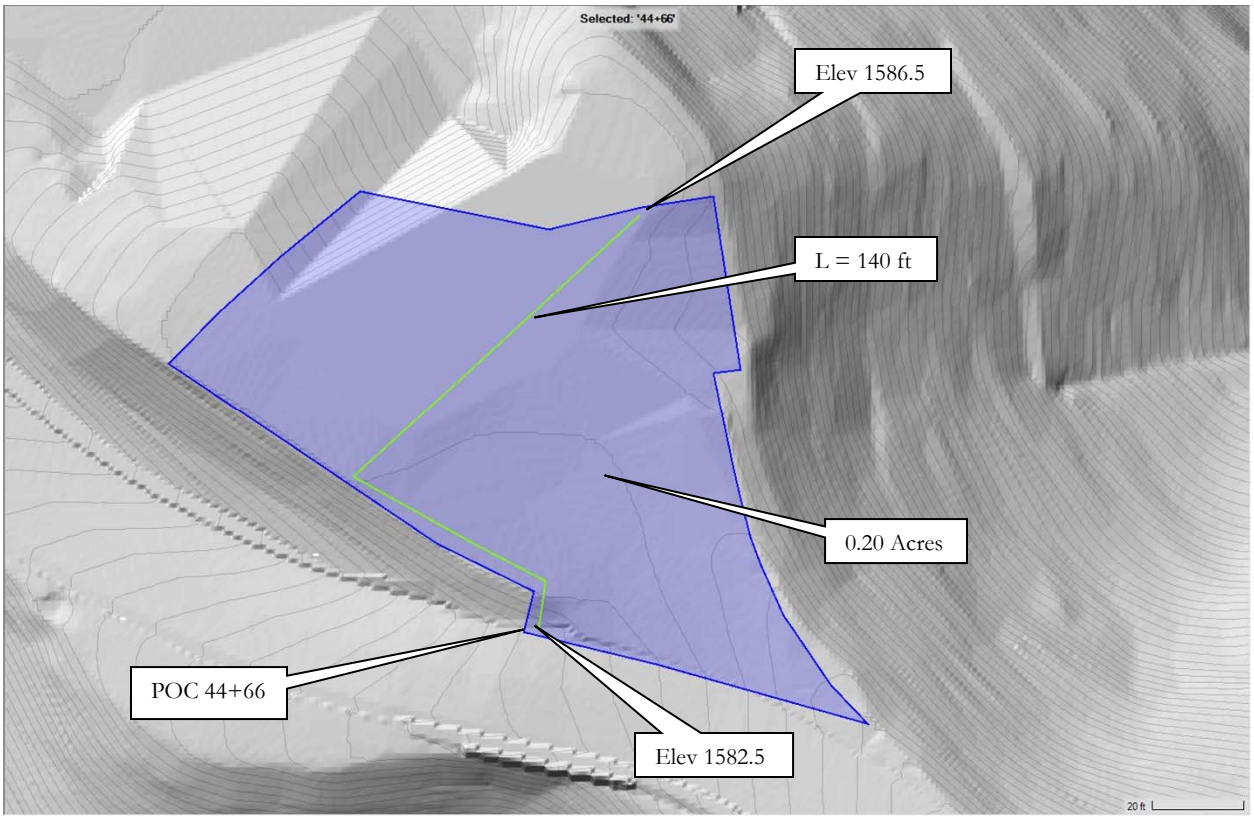

Selected: '44+32'
Elev 1584.5
POC 44+32
L = 145 ft
Elev 1609
0.13 Acres
20 ft

44+32

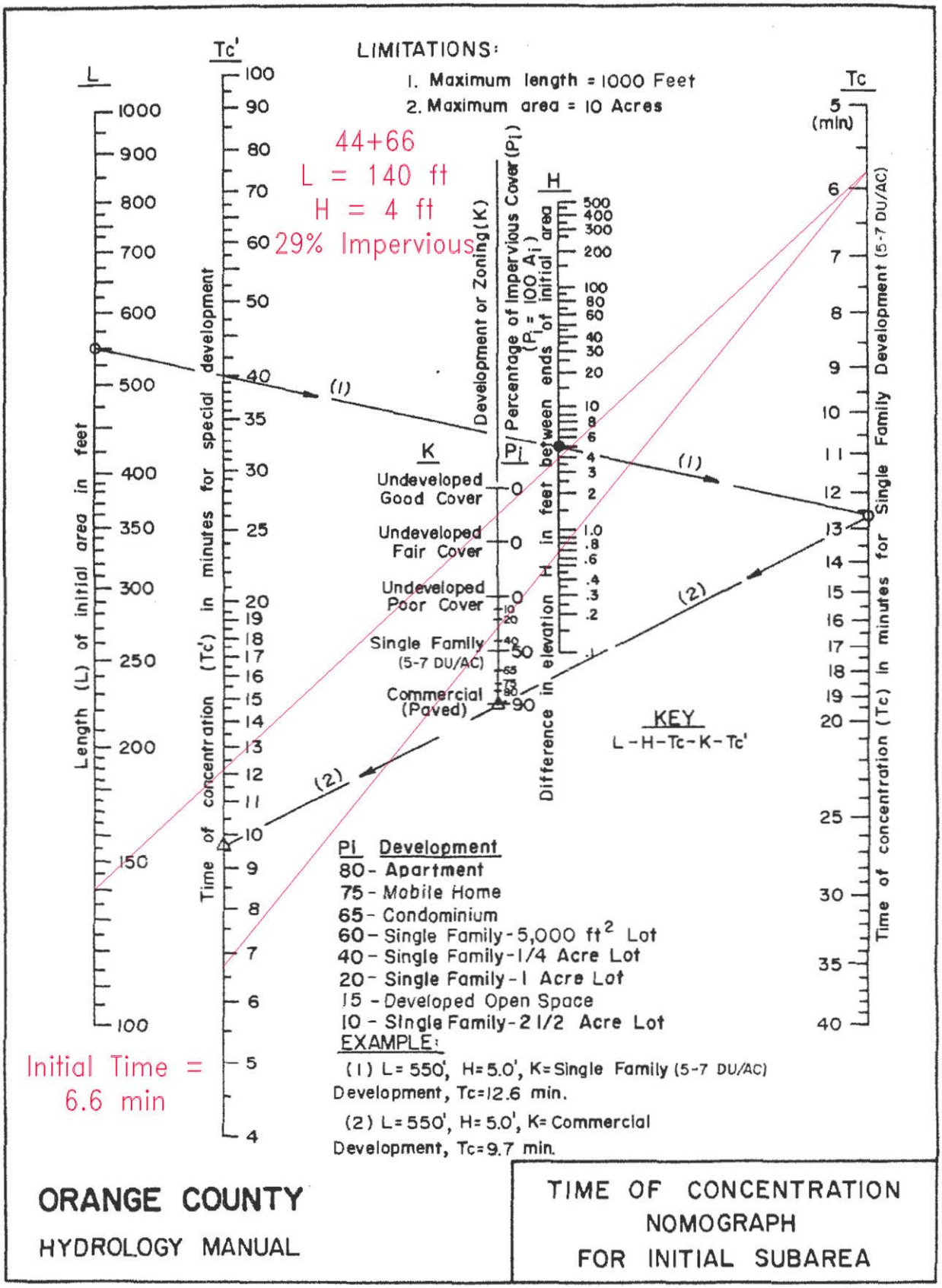

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
44+32
L = 145 ft
H = 24.5 ft
72% Impervious
L
Tc'
Tc
K
Pi
H
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5 min (minimum)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

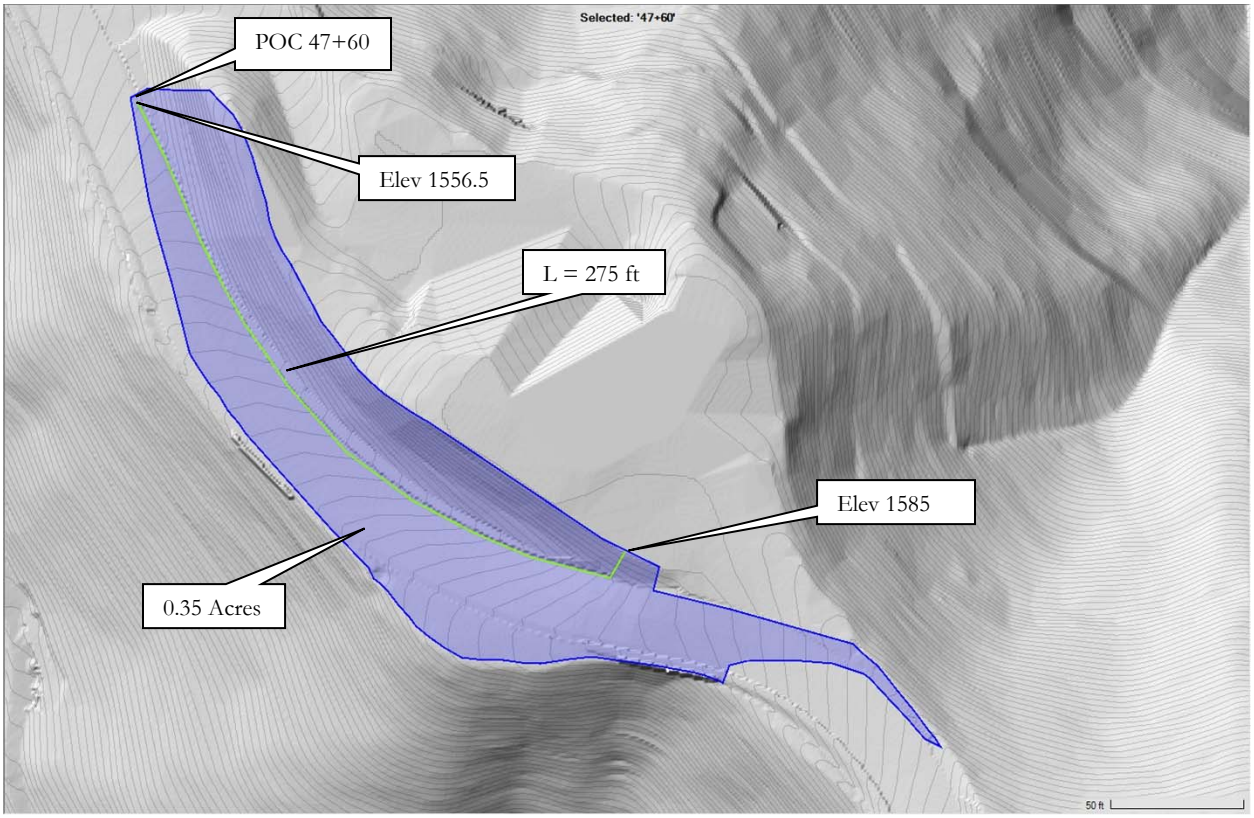

Selected: '44+66'
Elev 1586.5
L = 140 ft
0.20 Acres
POC 44+66
Elev 1582.5
20 ft

44+66

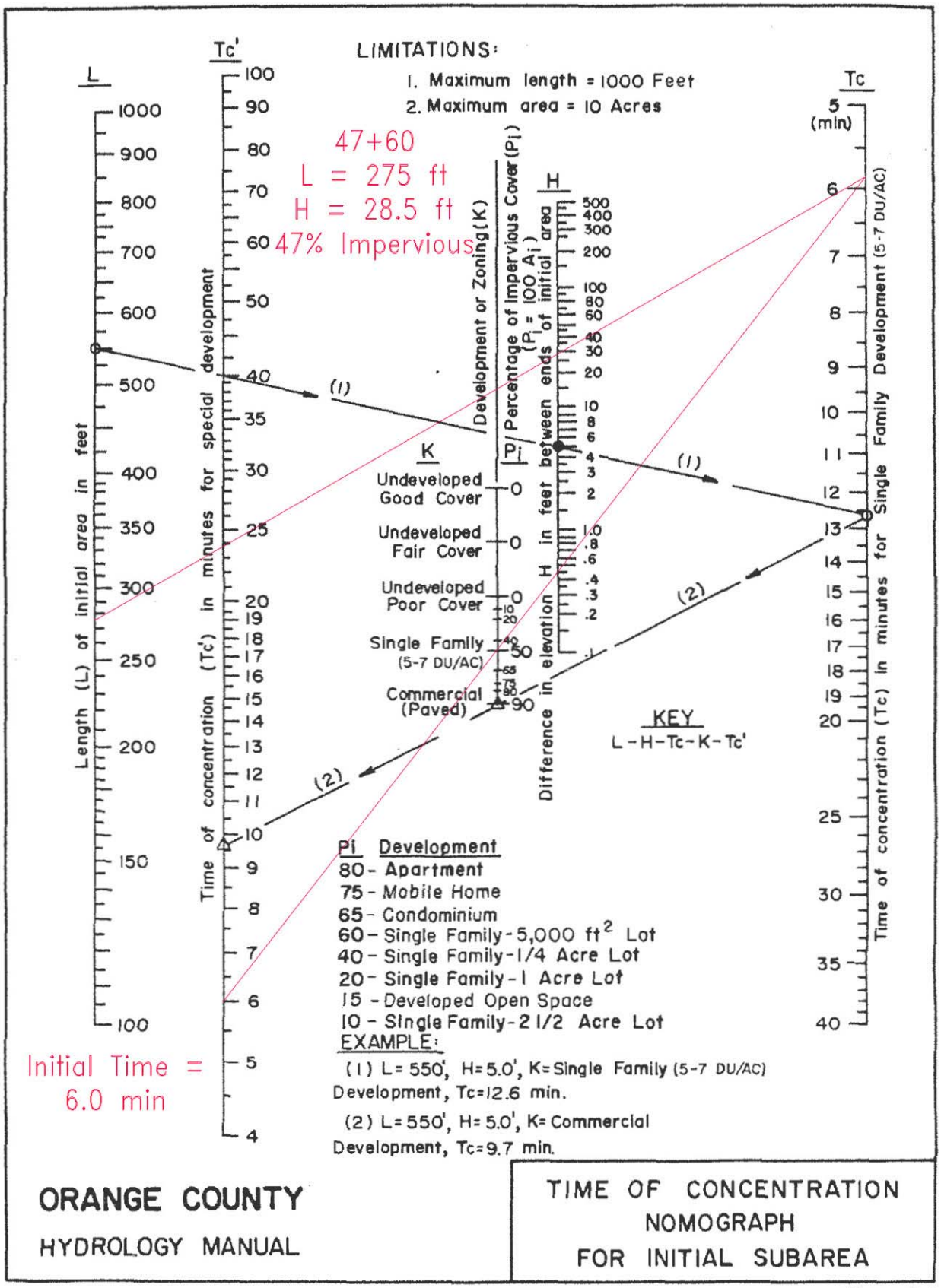

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
44+66
L = 140 ft
H = 4 ft
29% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 6.6 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

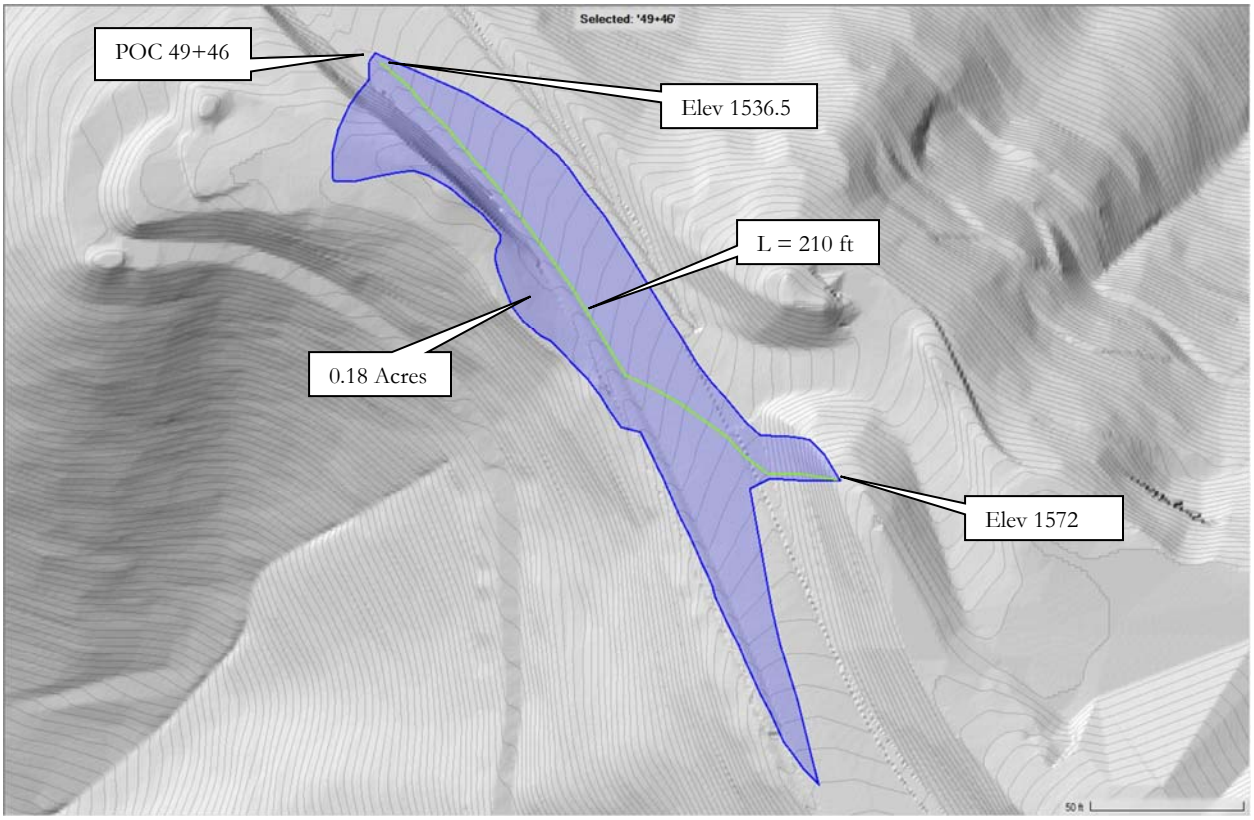

Selected: '47+60'
POC 47+60
Elev 1556.5
L = 275 ft
Elev 1585
0.35 Acres
50 ft

47+60

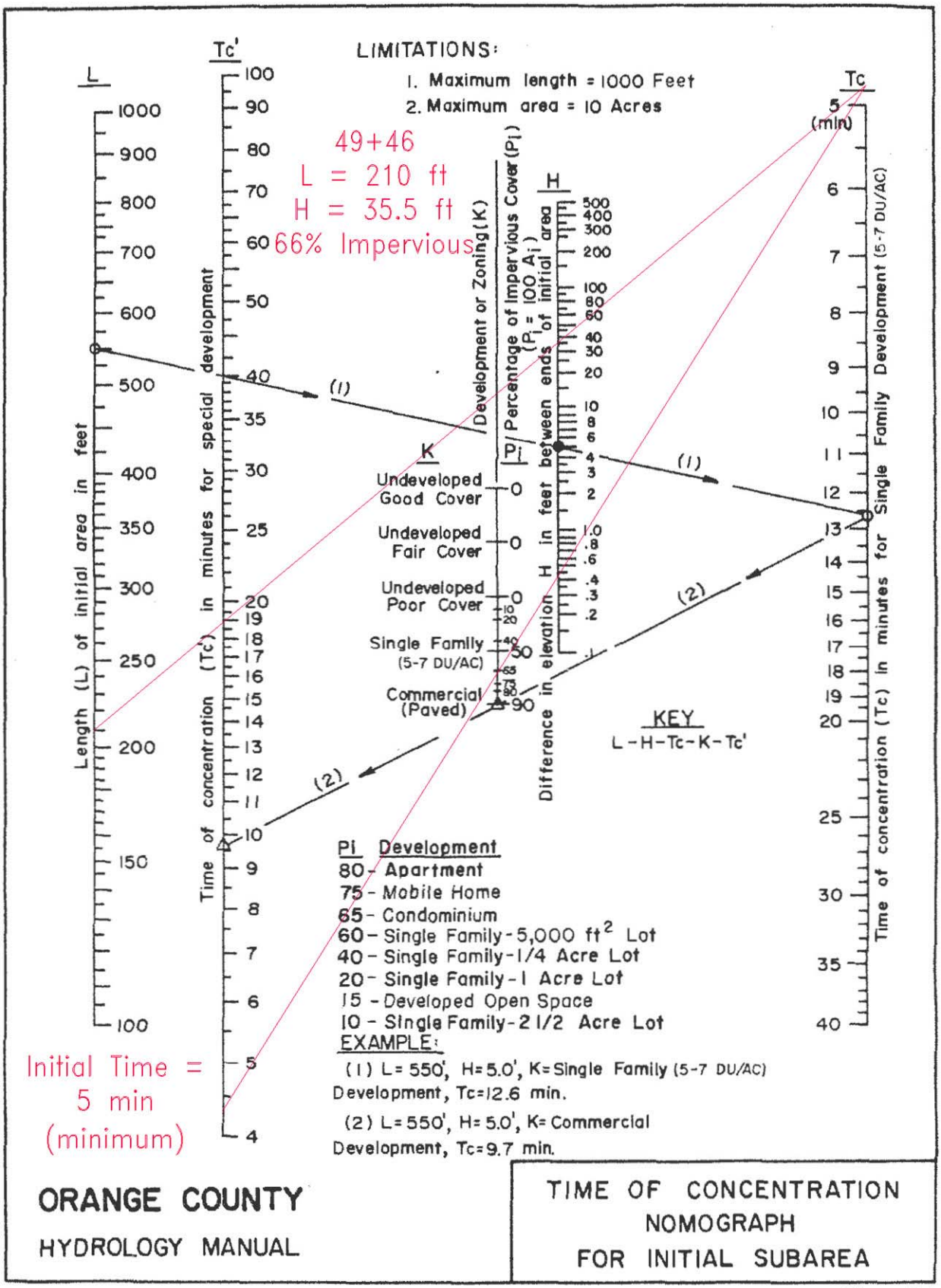

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
47+60
L = 275 ft
H = 28.5 ft
47% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 6.0 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

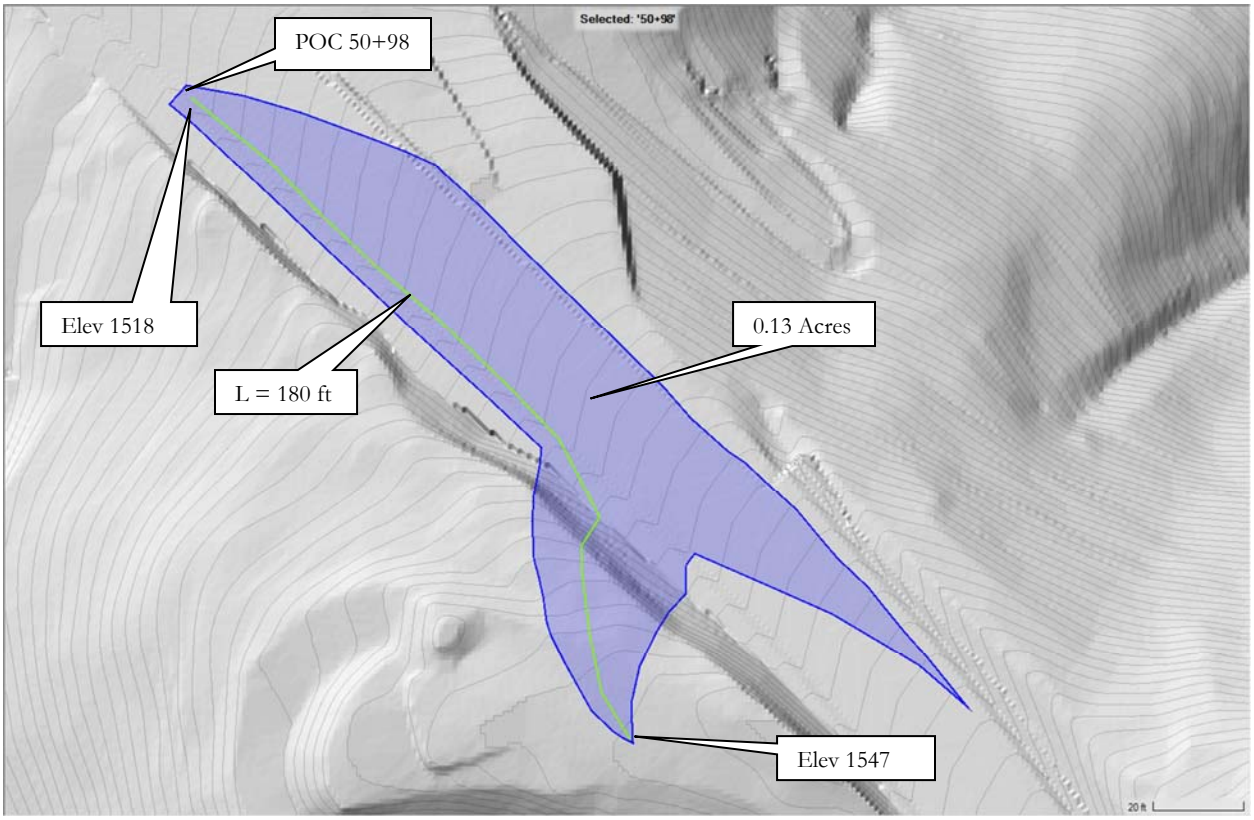

Selected: '49+46'
POC 49+46
Elev 1536.5
L = 210 ft
0.18 Acres
Elev 1572
50 ft

49+46

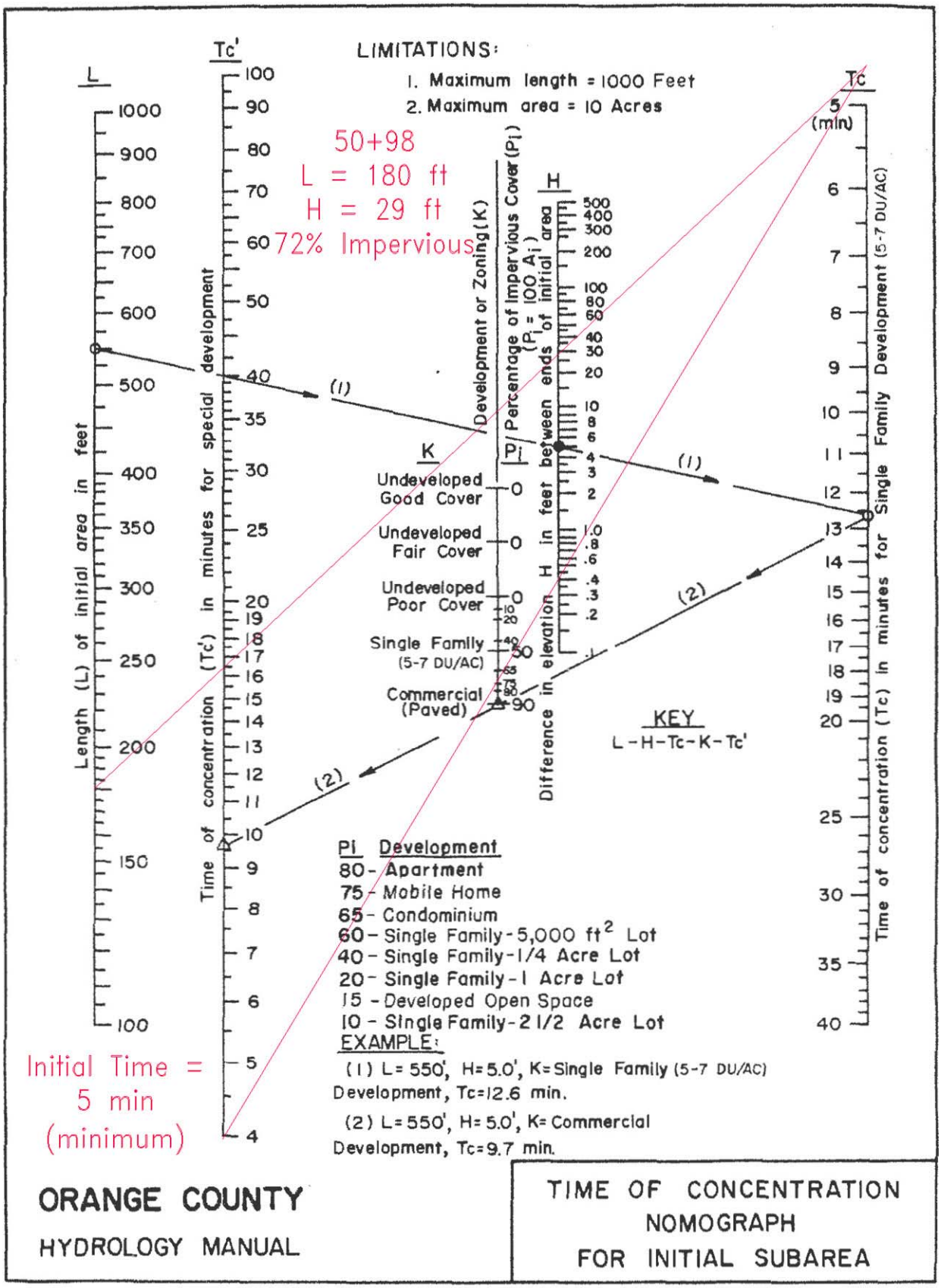

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
49+46
L = 210 ft
H = 35.5 ft
66% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
Initial Time = 5 min (minimum)
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

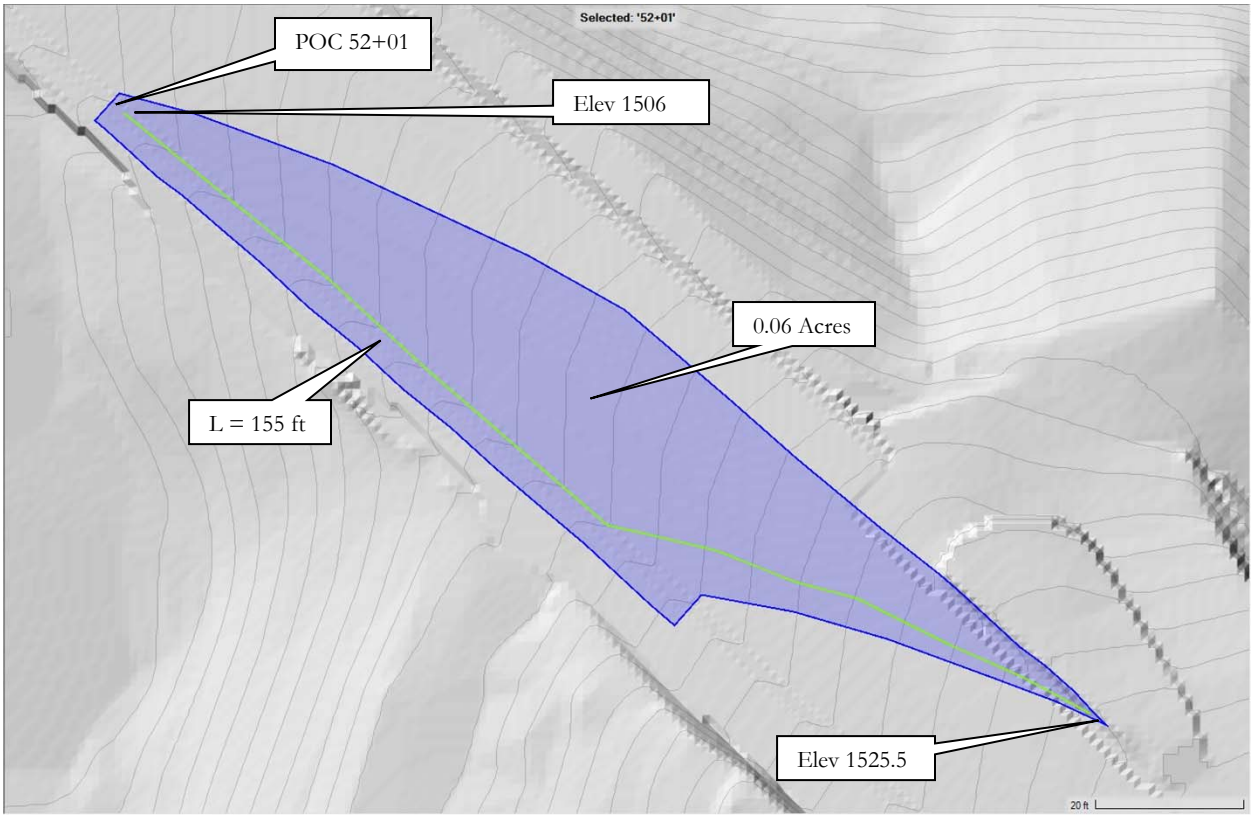

Selected: '50+98'
POC 50+98
Elev 1518
L = 180 ft
0.13 Acres
Elev 1547
20 ft

50+98

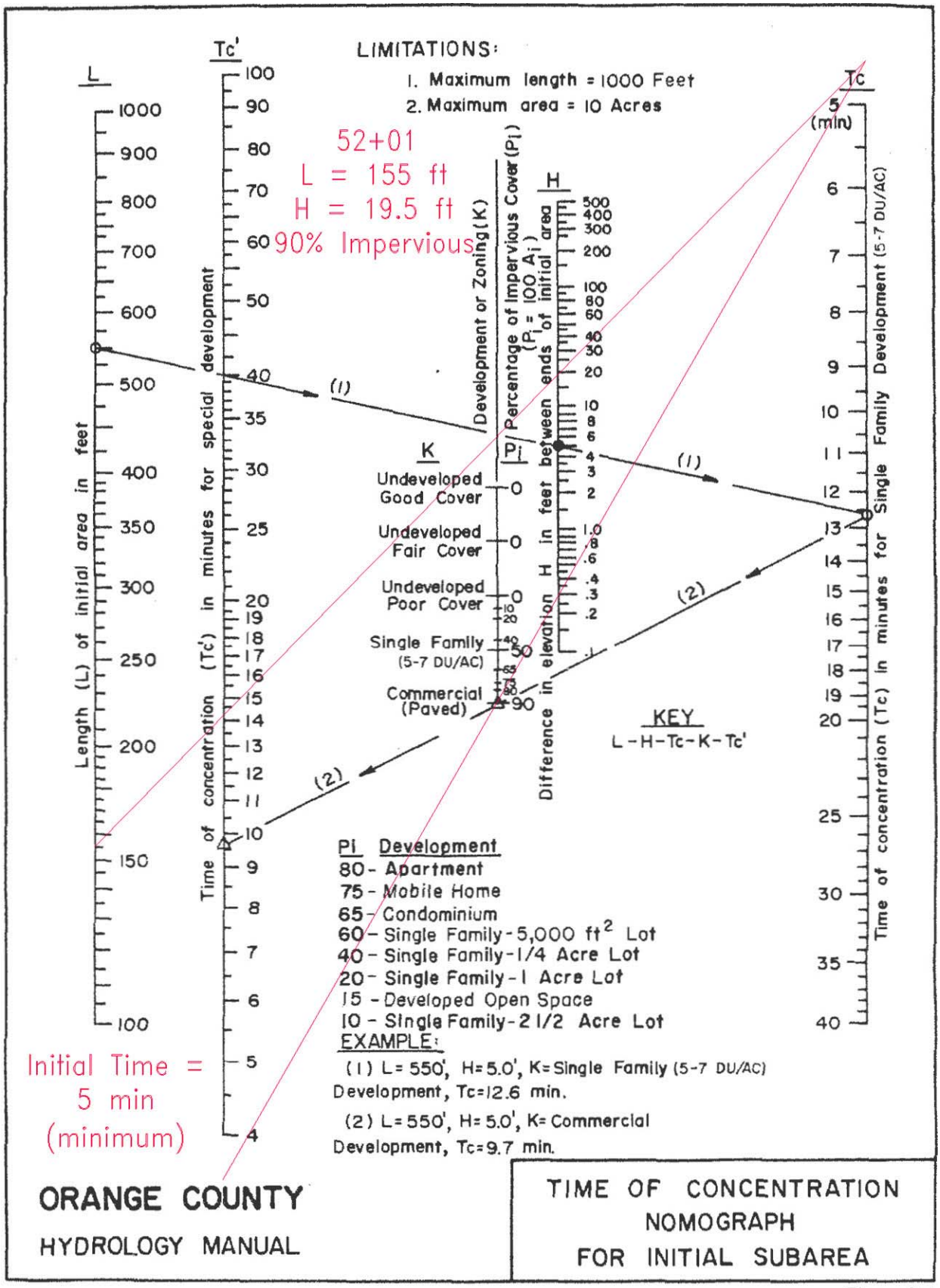

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
50+98
L = 180 ft
H = 29 ft
72% Impervious
L
Tc'
Tc
K
Pi
H
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
Initial Time = 5 min (minimum)
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

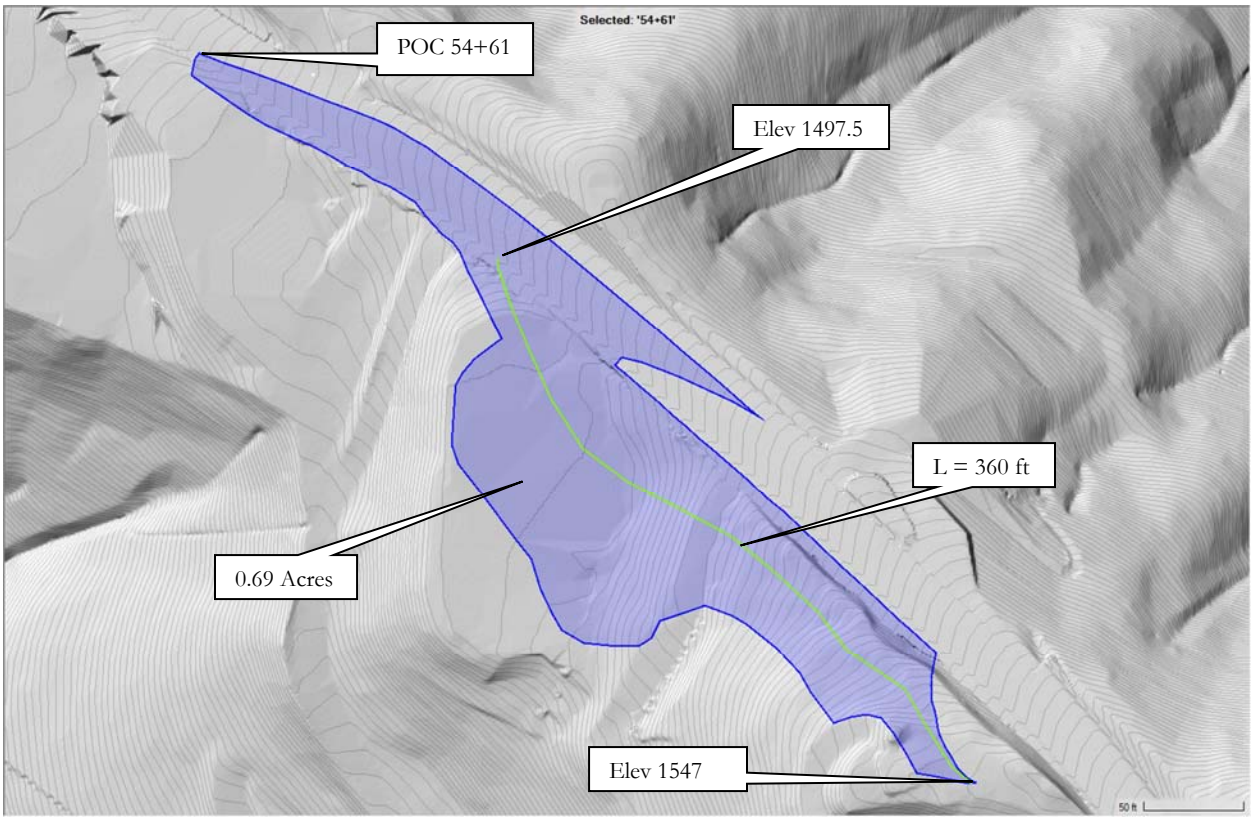

Selected: '52+01'
POC 52+01
Elev 1506
0.06 Acres
L = 155 ft
Elev 1525.5
20 ft

52+01

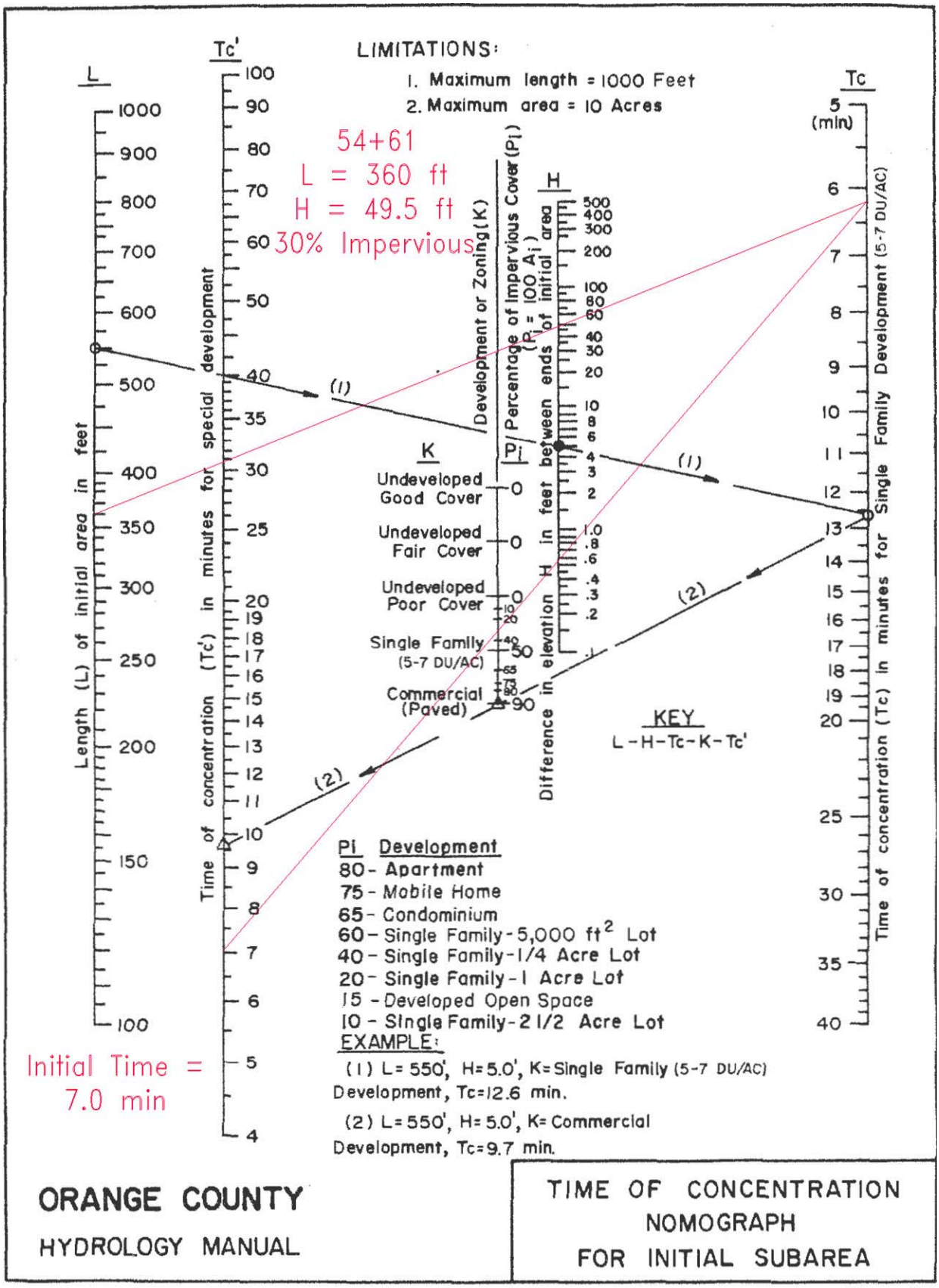

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
52+01
L = 155 ft
H = 19.5 ft
90% Impervious
Initial Time = 5 min (minimum)
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

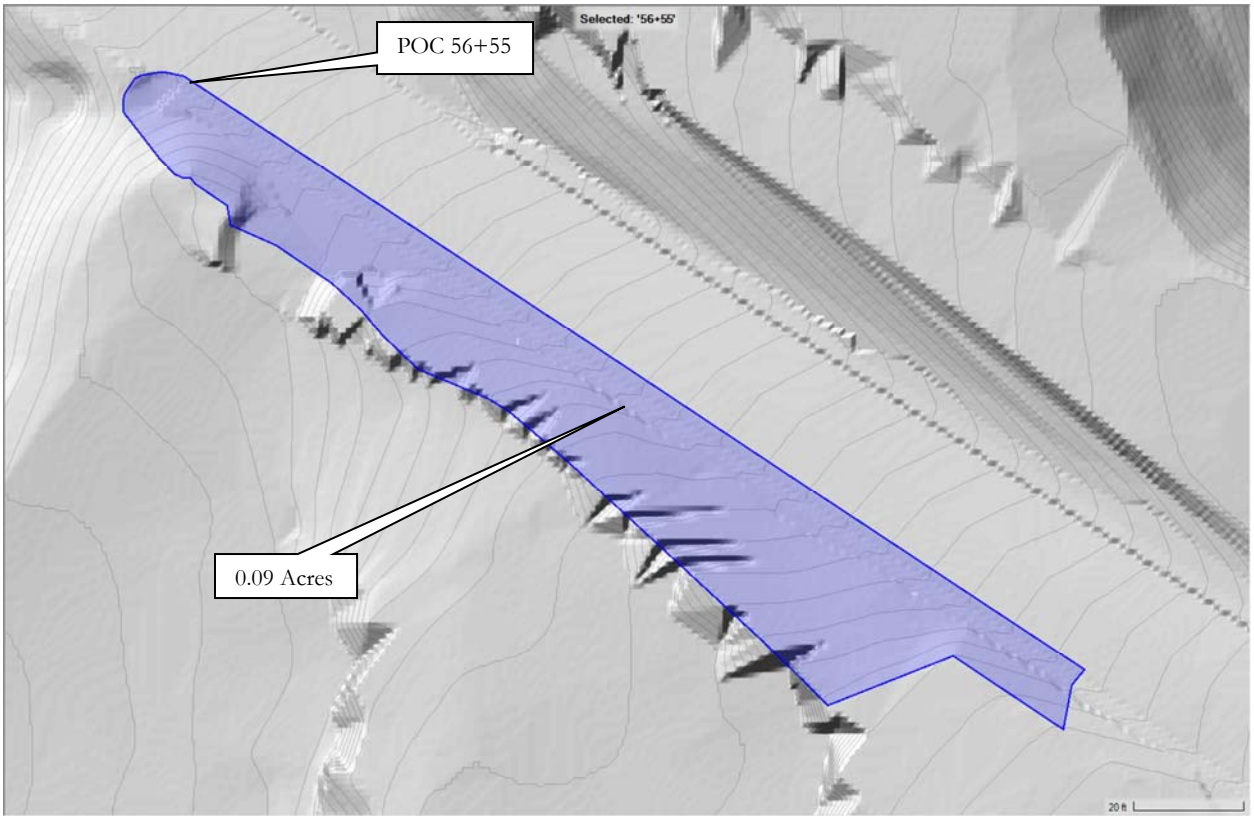

Selected: '54+61'
POC 54+61
Elev 1497.5
L = 360 ft
0.69 Acres
Elev 1547
50 ft

54+61

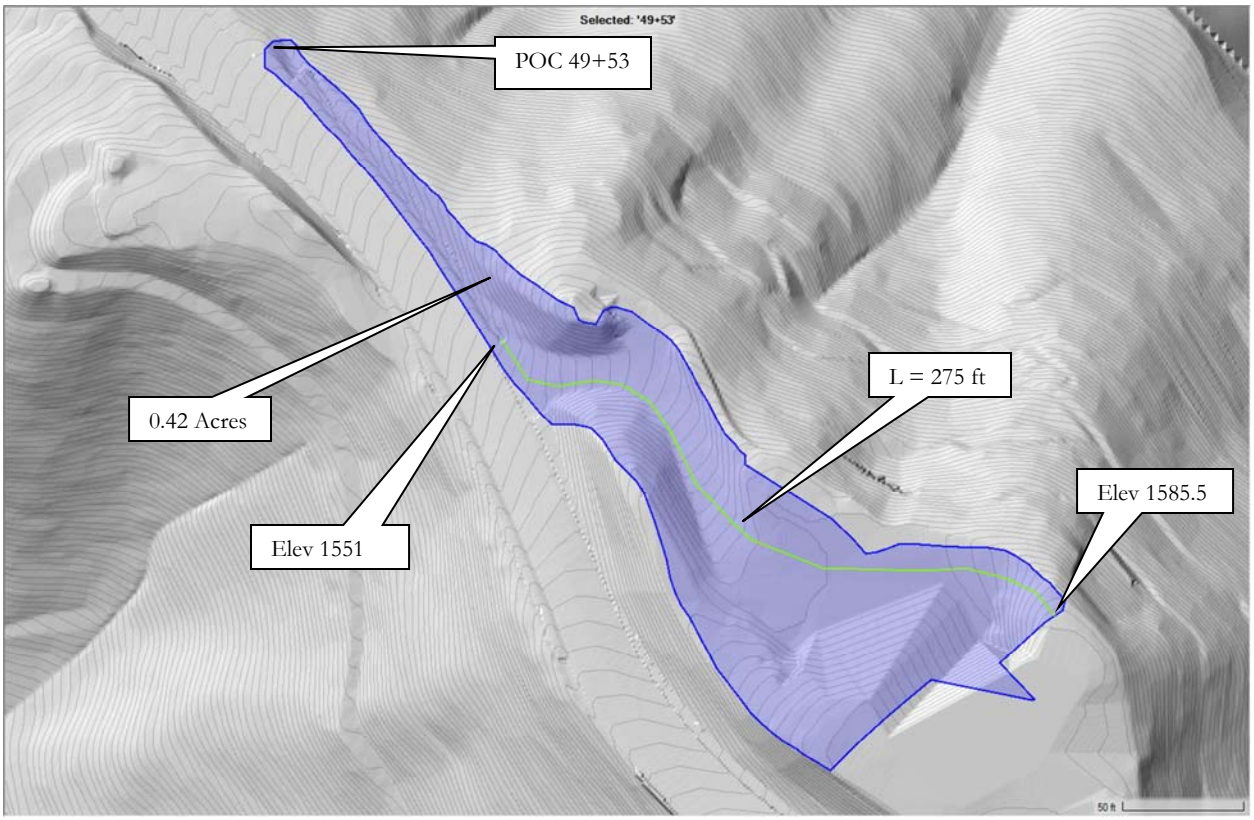

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
54+61
L = 360 ft
H = 49.5 ft
30% Impervious
Initial Time = 7.0 min
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Ai = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

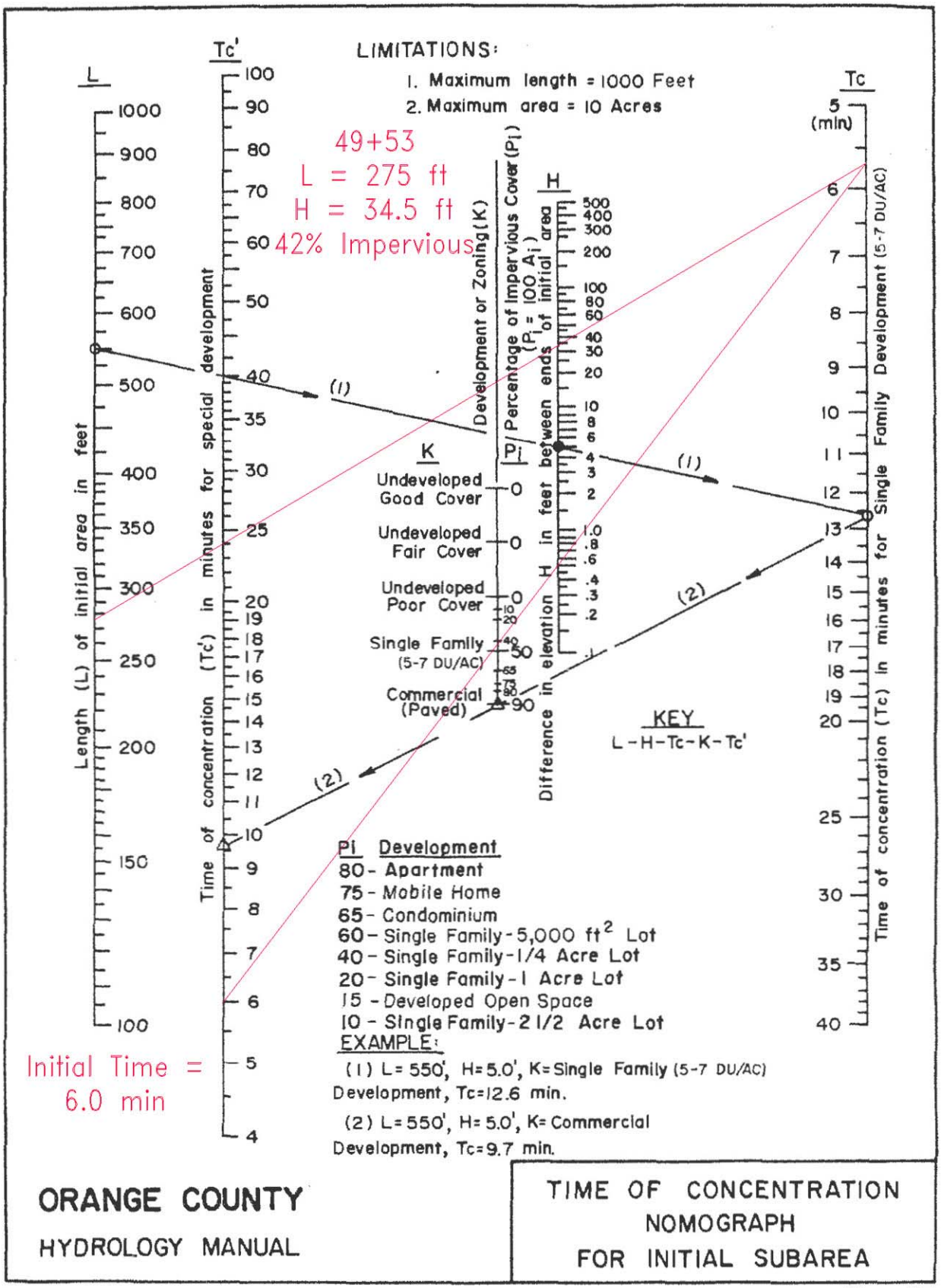
Figure D-1



56+55

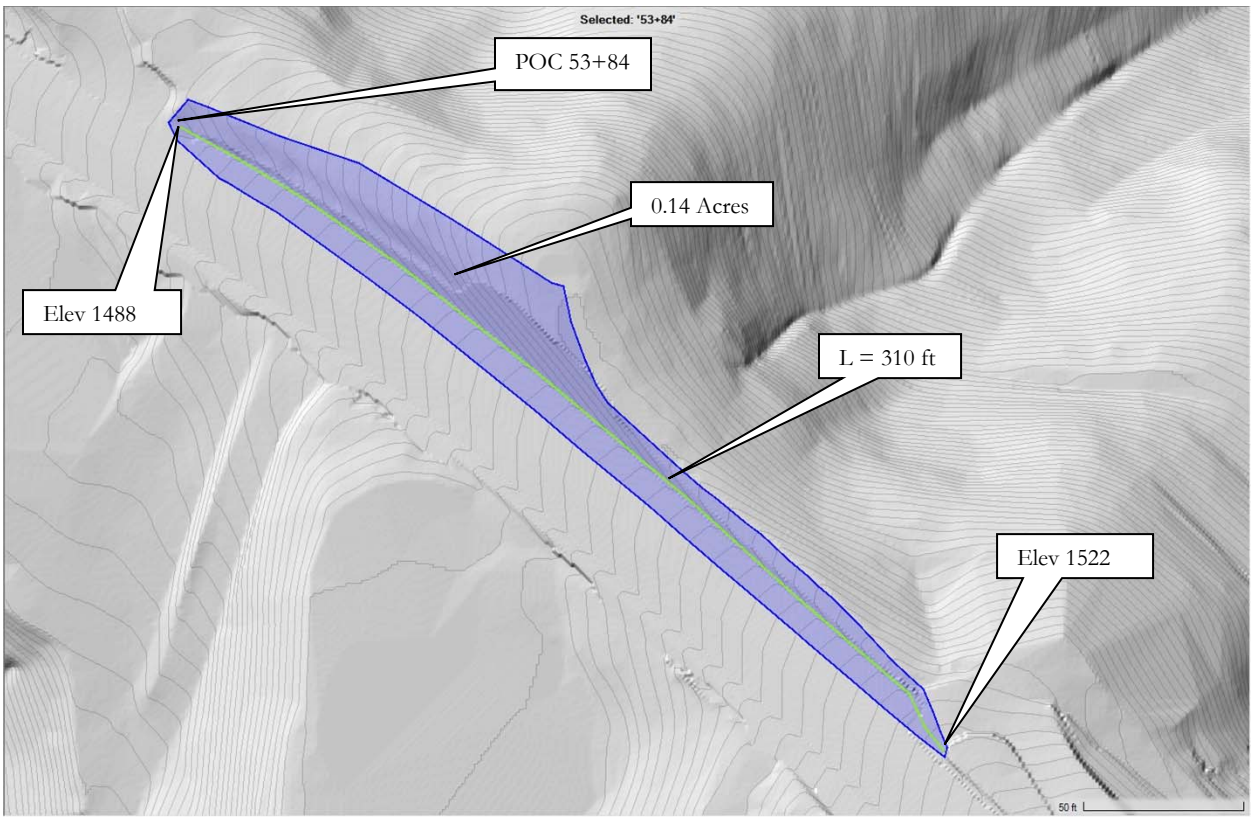

Selected: '49+53'
POC 49+53
0.42 Acres
Elev 1551
L = 275 ft
Elev 1585.5
50 ft

49+53

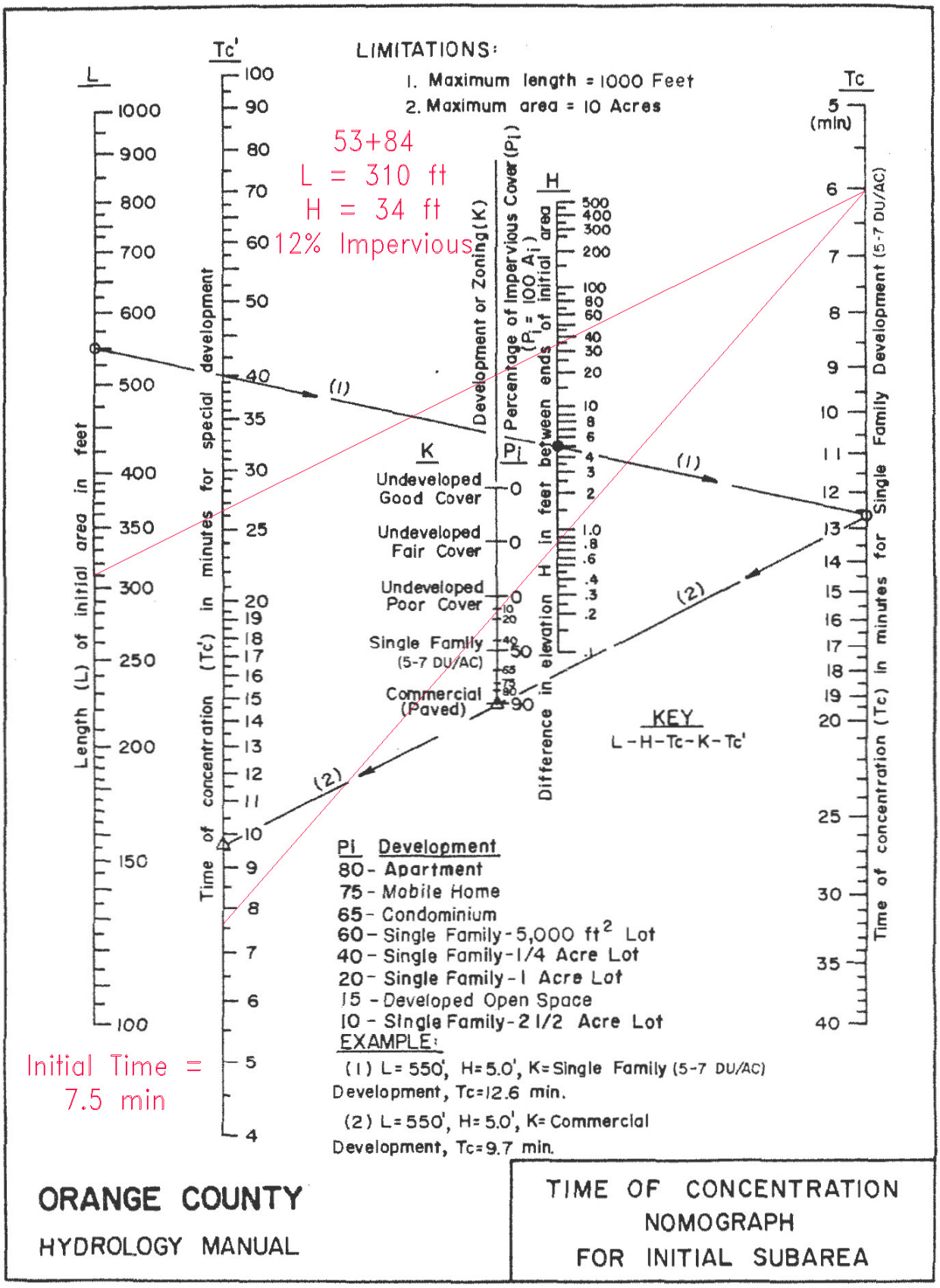

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
49+53
L = 275 ft
H = 34.5 ft
42% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
Initial Time = 6.0 min
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

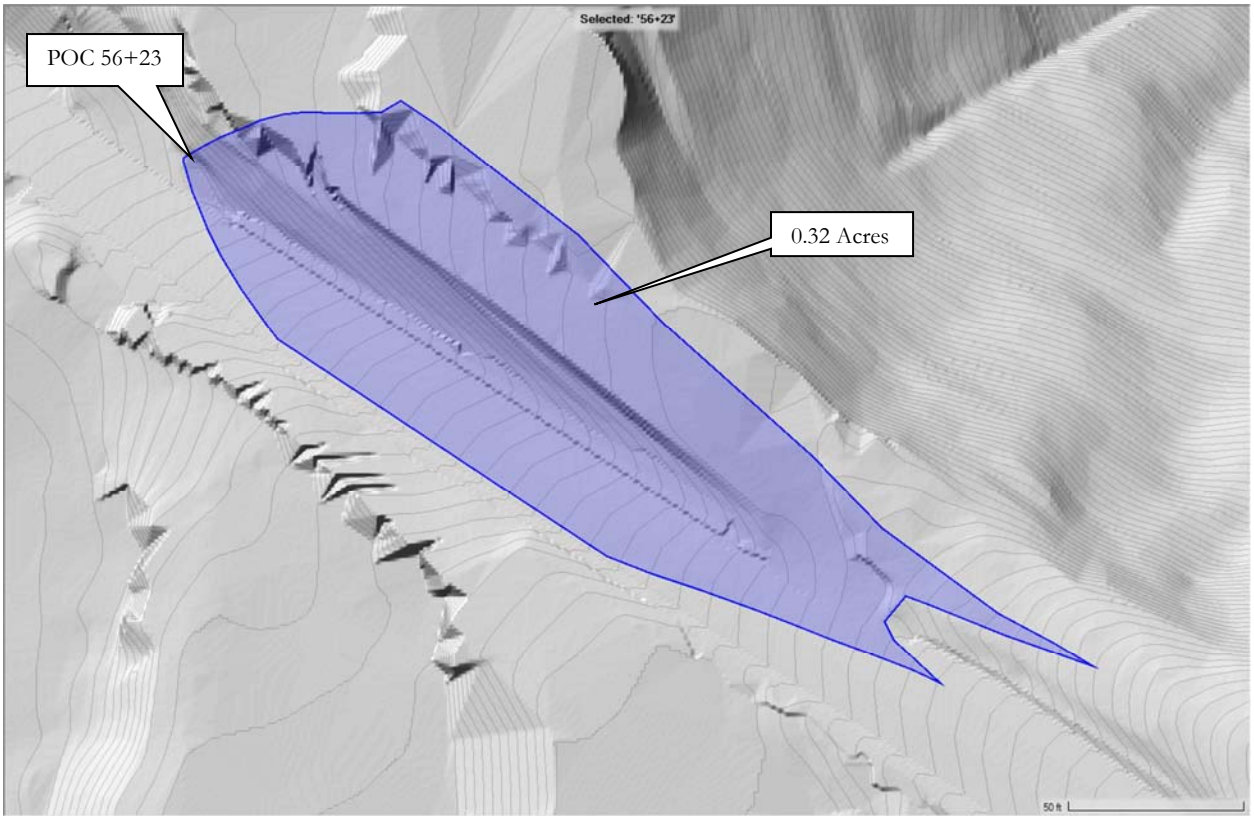

Selected: '53+84'
POC 53+84
0.14 Acres
Elev 1488
L = 310 ft
Elev 1522
50 ft

53+84

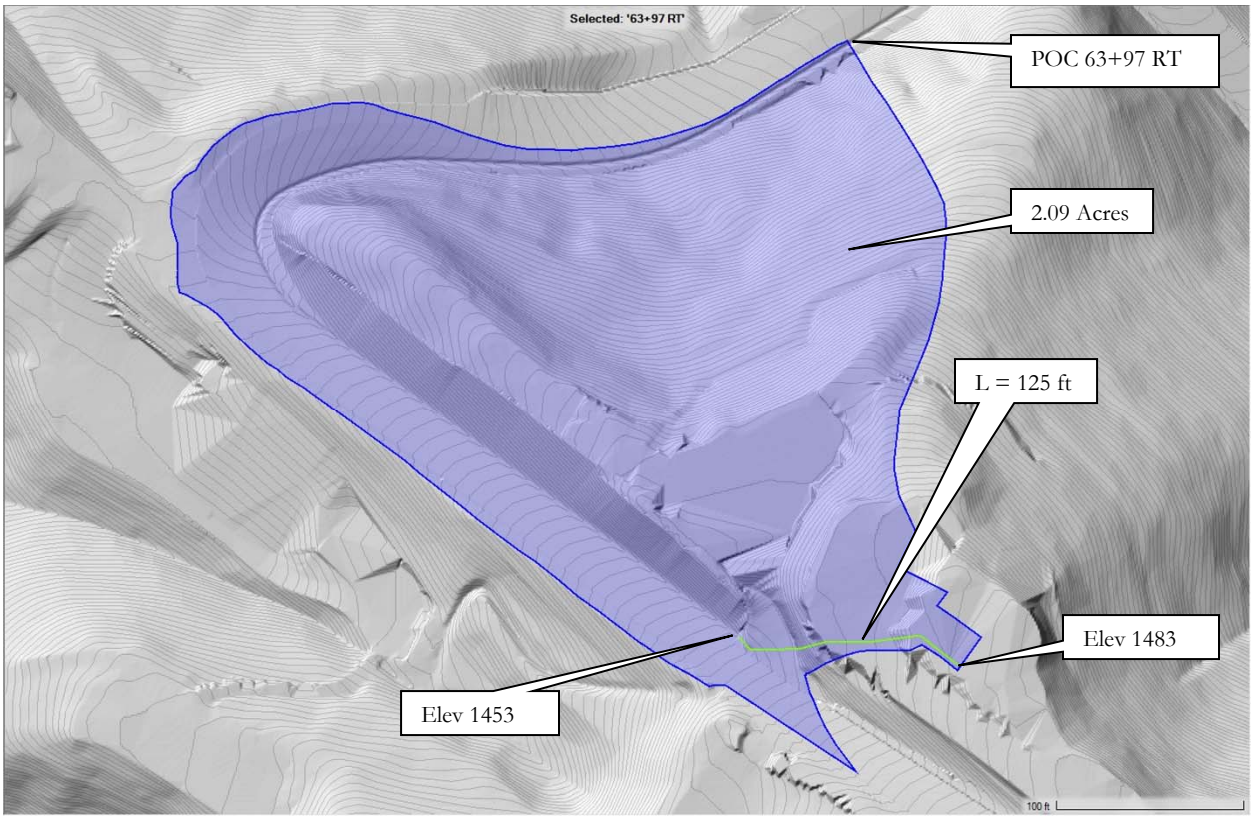

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
53+84
L = 310 ft
H = 34 ft
12% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pi / Percentage of impervious Cover (Pi)
(Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 7.5 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

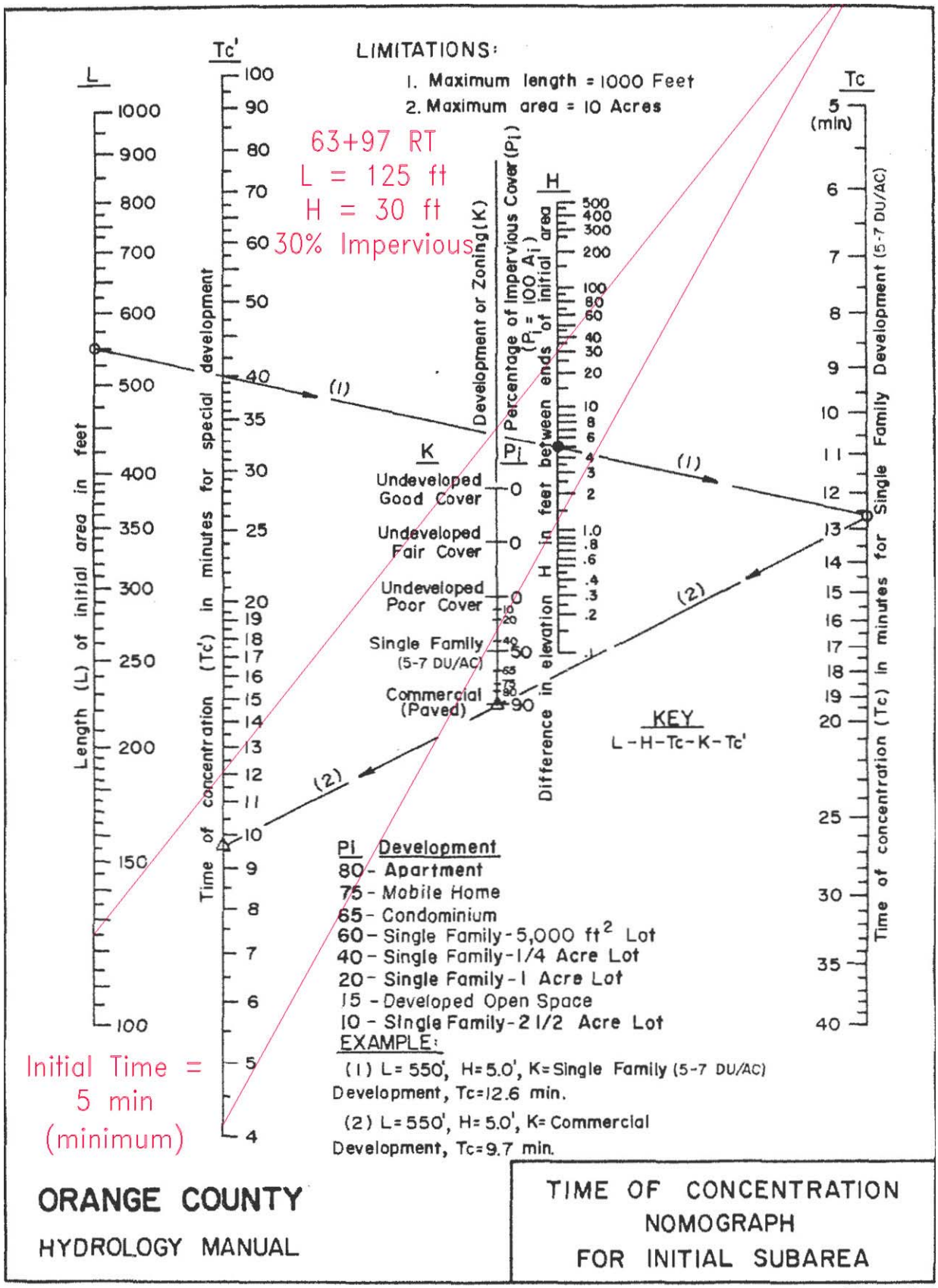
Figure D-1



56+23

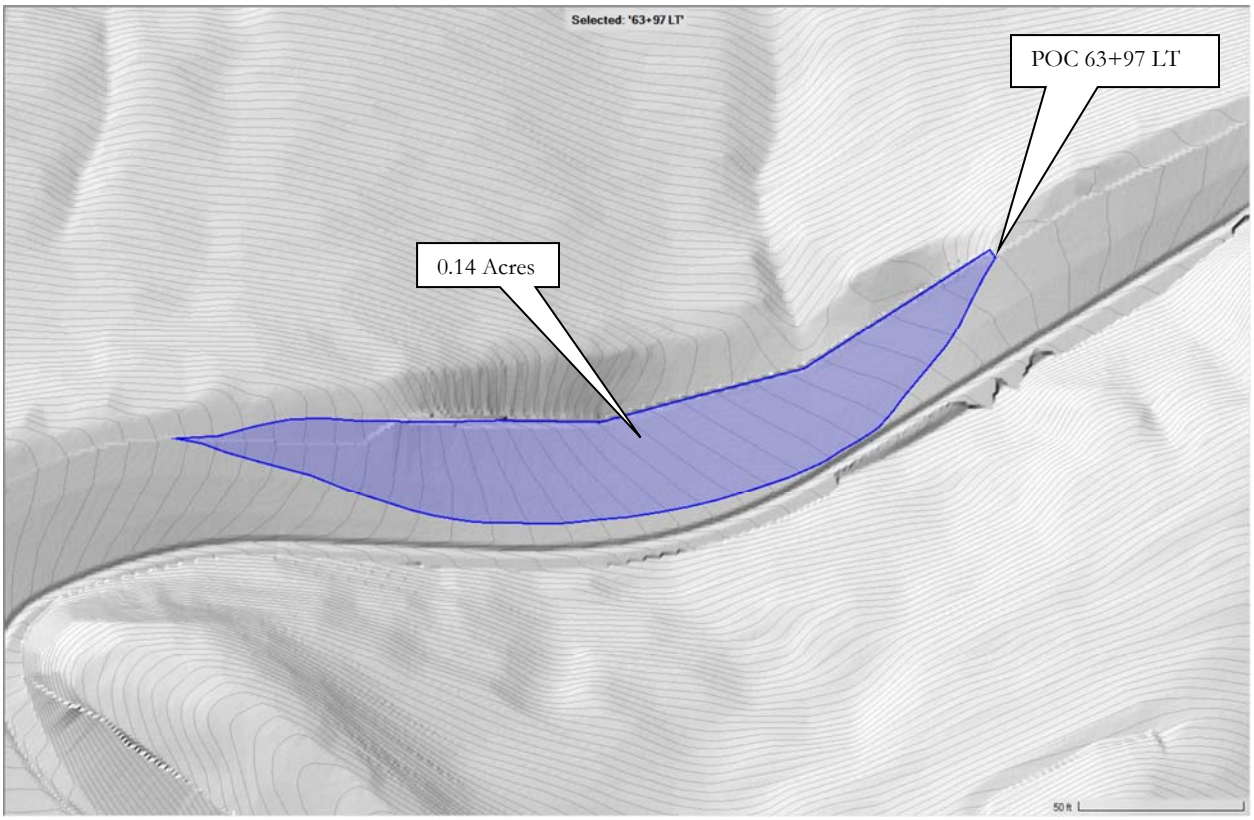

Selected: '63+97 RT'
POC 63+97 RT
2.09 Acres
L = 125 ft
Elev 1483
Elev 1453
100 ft

63+97 RT

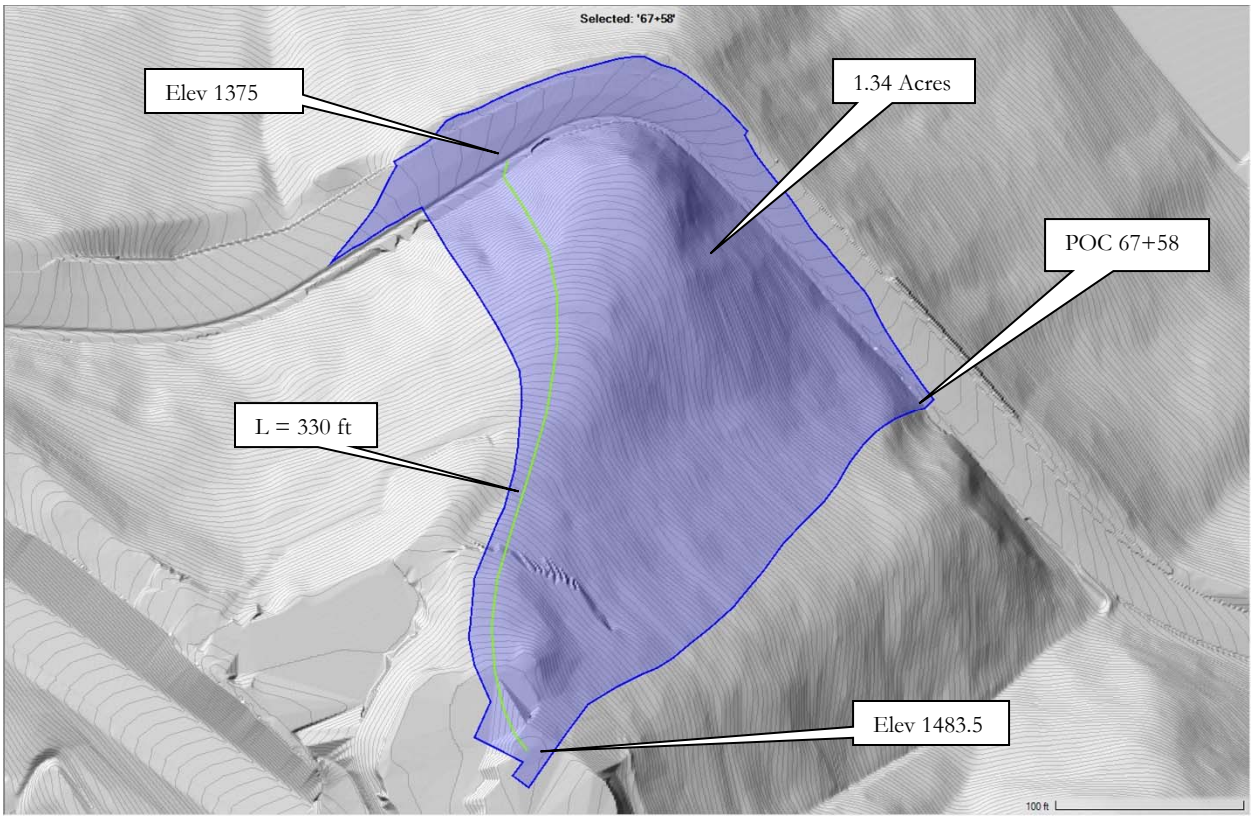

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
63+97 RT
L = 125 ft
H = 30 ft
30% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5 min (minimum)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

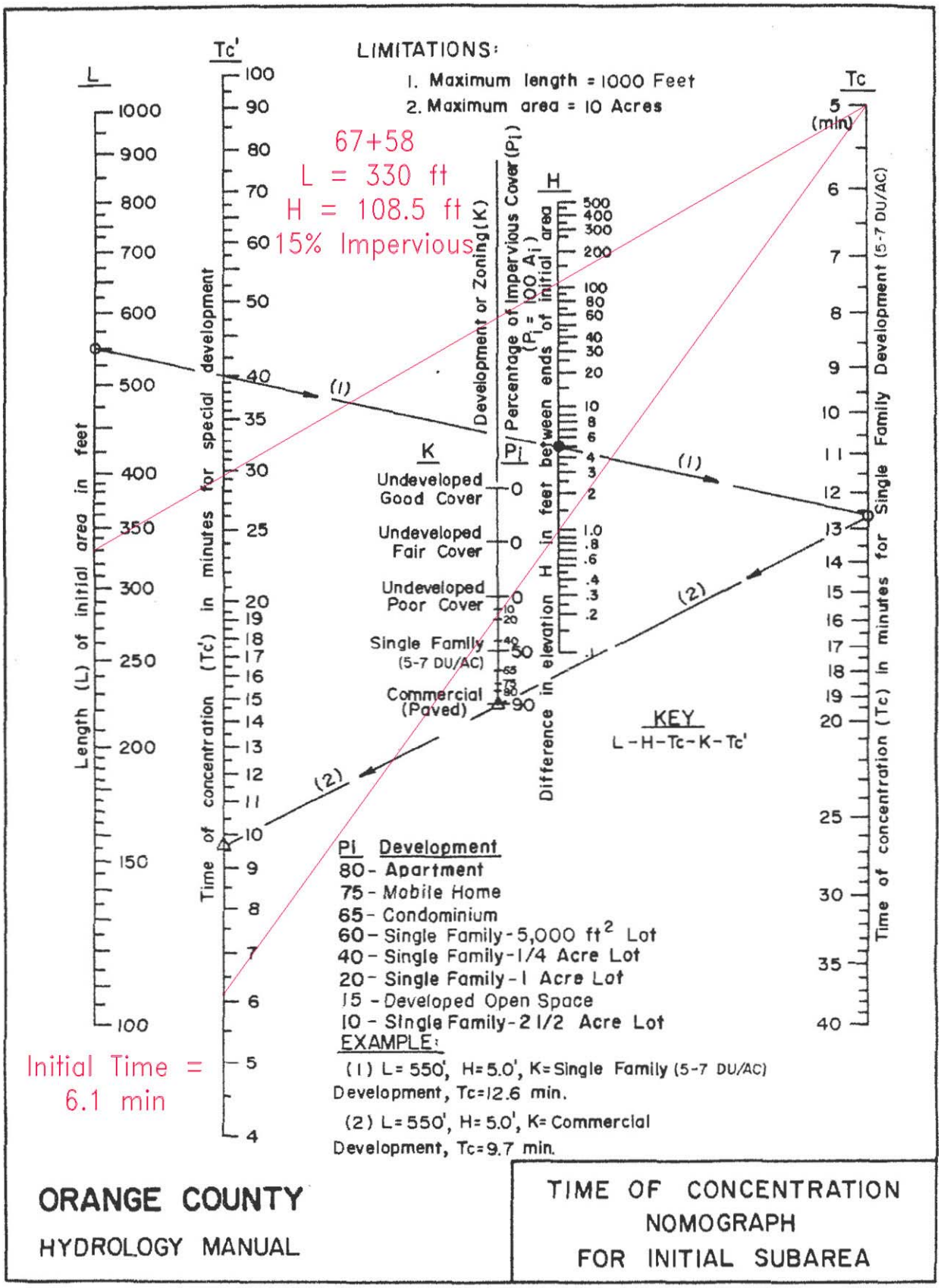
Figure D-1



63+97 LT

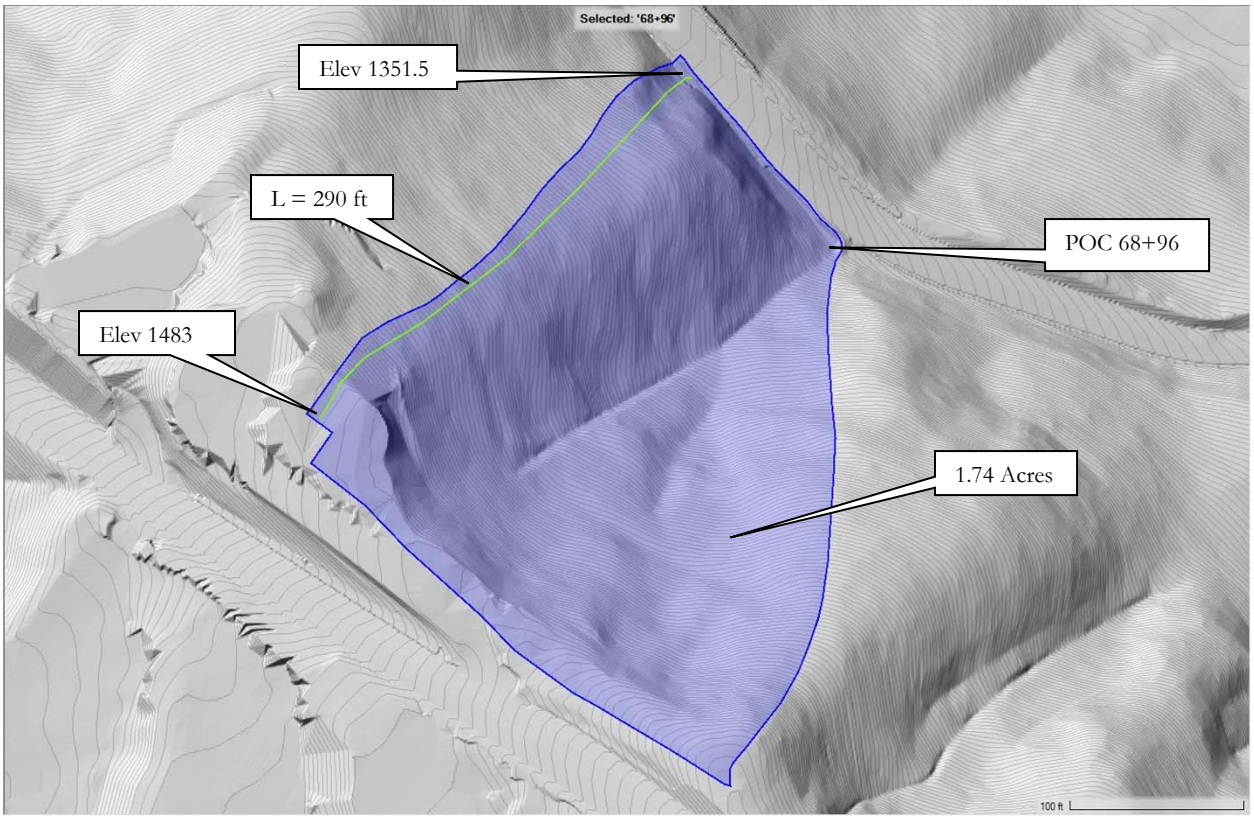

Selected: '67+58'
Elev 1375
1.34 Acres
POC 67+58
L = 330 ft
Elev 1483.5
100 ft

67+58

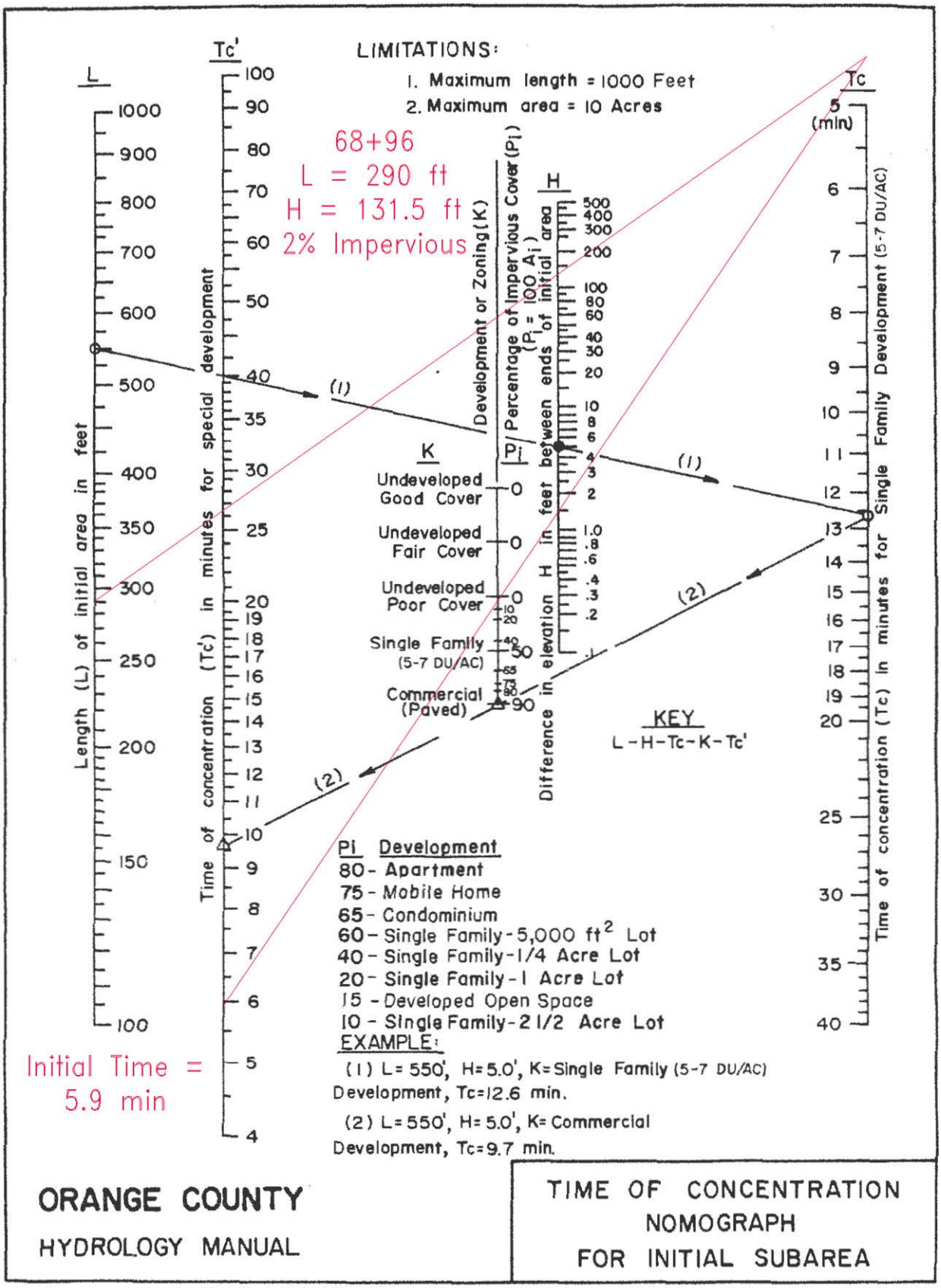

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
67+58
L = 330 ft
H = 108.5 ft
15% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
H
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
(min)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 6.1 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

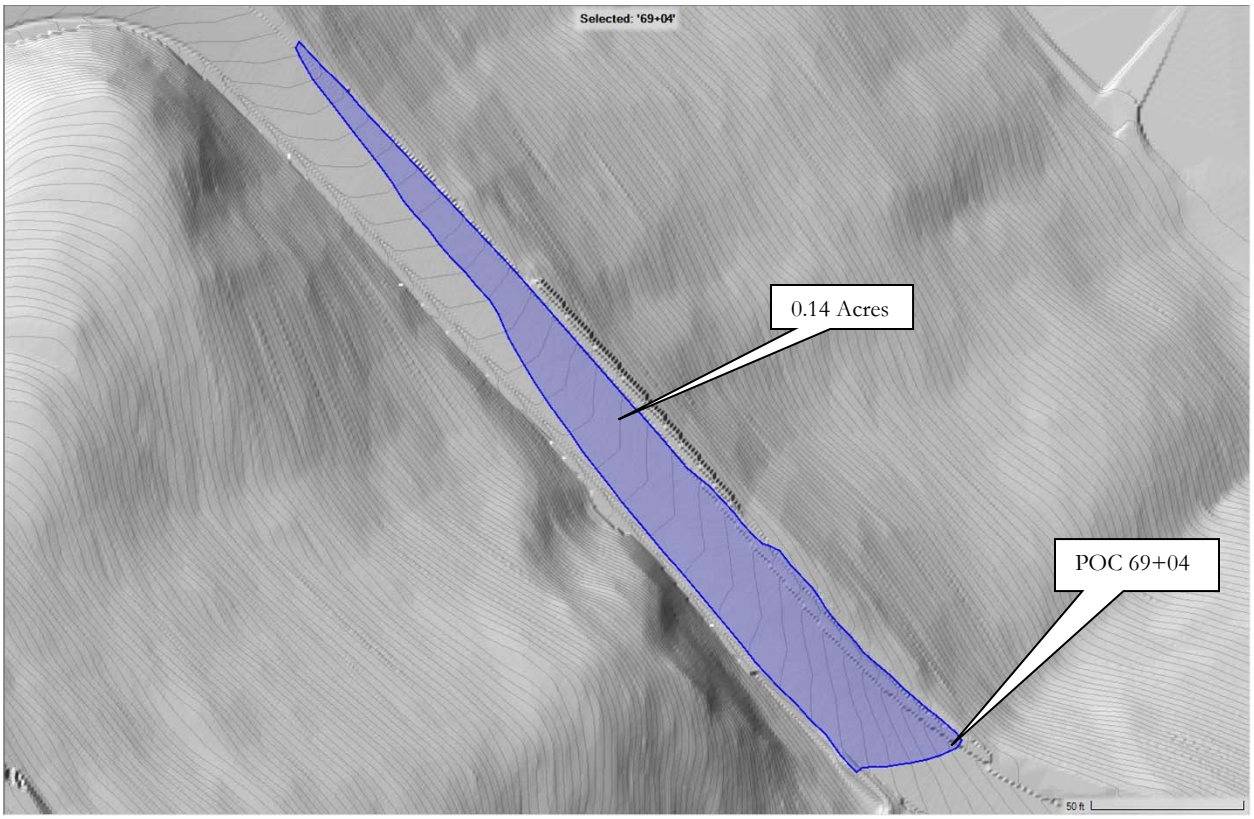

Selected: '68+96'
Elev 1351.5
L = 290 ft
POC 68+96
Elev 1483
1.74 Acres
100 ft

68+96

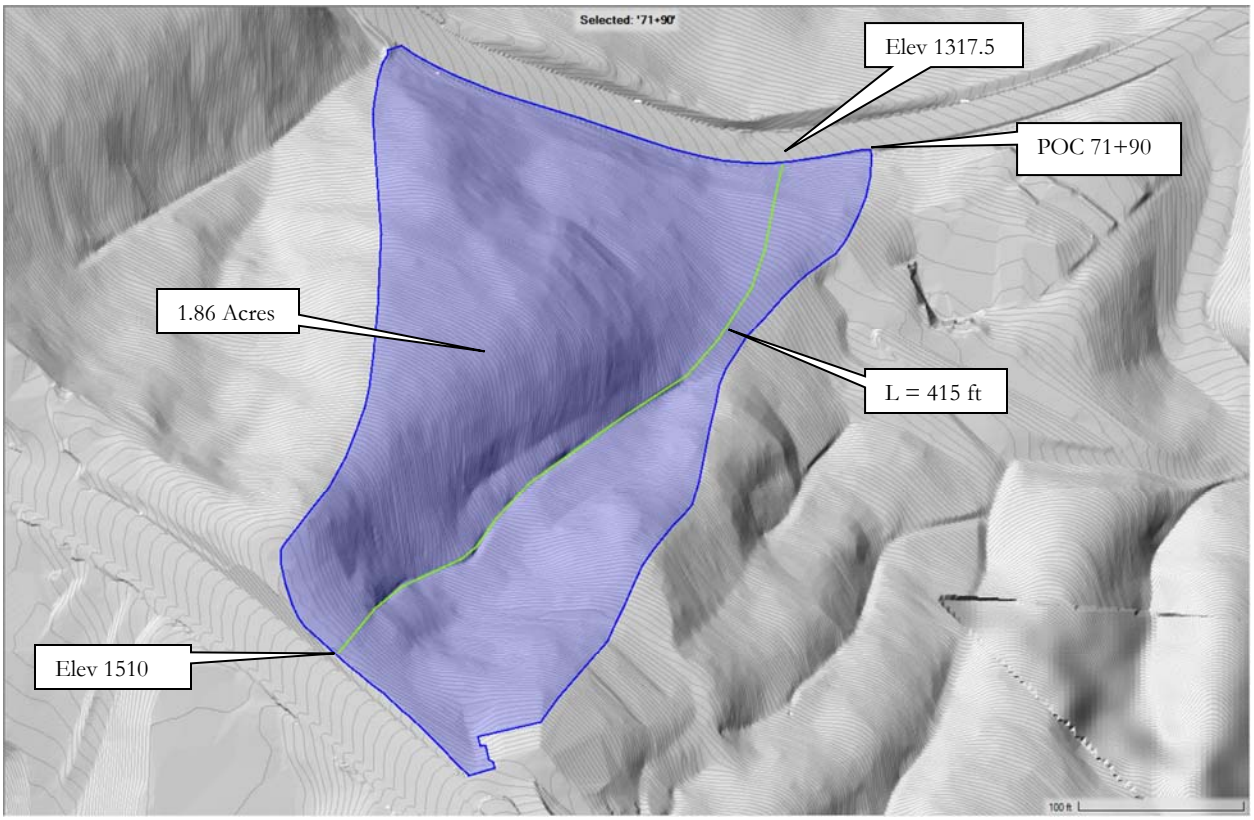

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
68+96
L = 290 ft
H = 131.5 ft
2% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pi = Percentage of Impervious Cover
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
(1)
(2)
KEY
L-H-Tc-K-Tc'
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
Initial Time = 5.9 min
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1



69+04


Selected: '71+90'
Elev 1317.5
POC 71+90
1.86 Acres
L = 415 ft
Elev 1510
100 ft

71+90

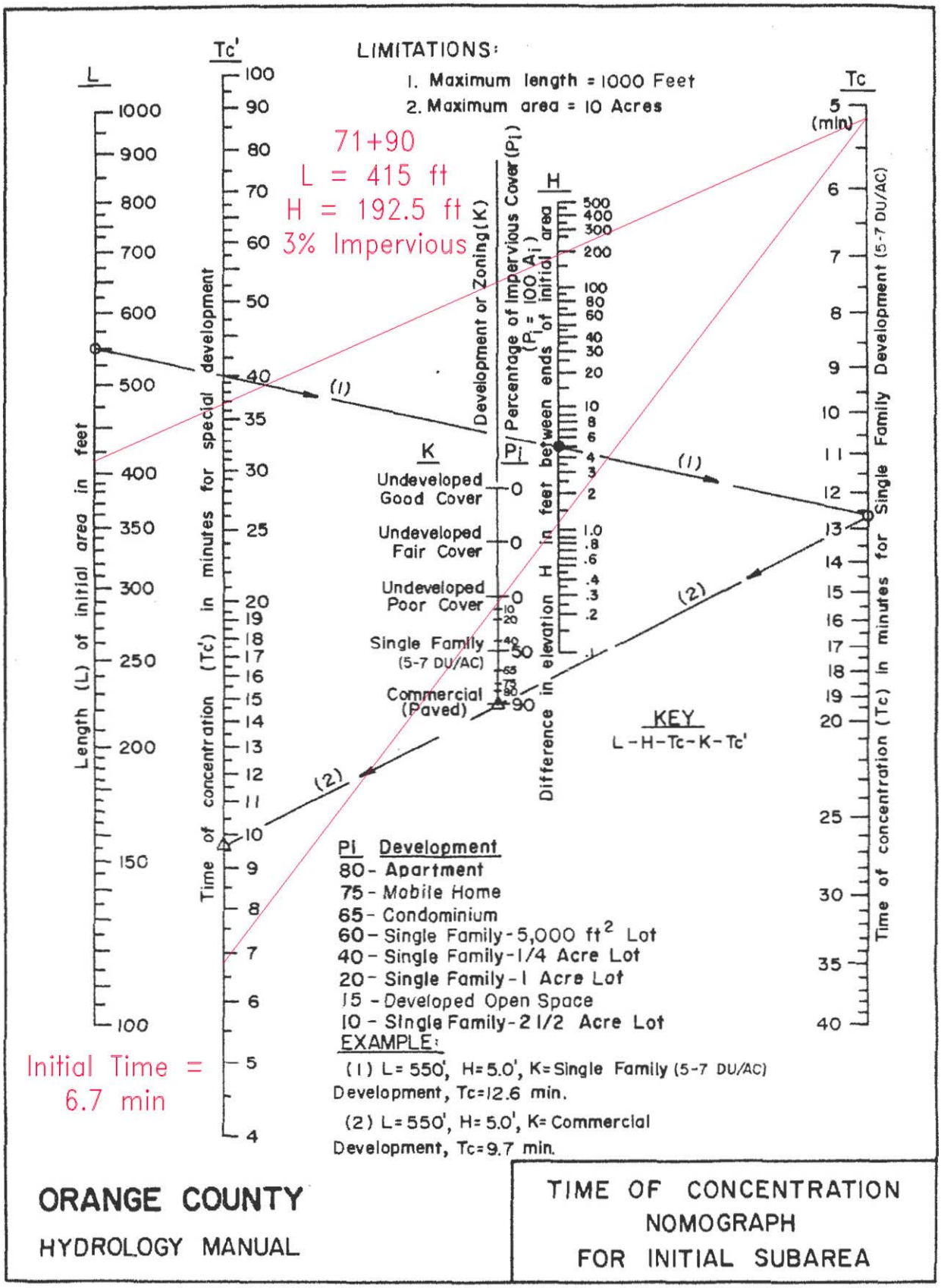
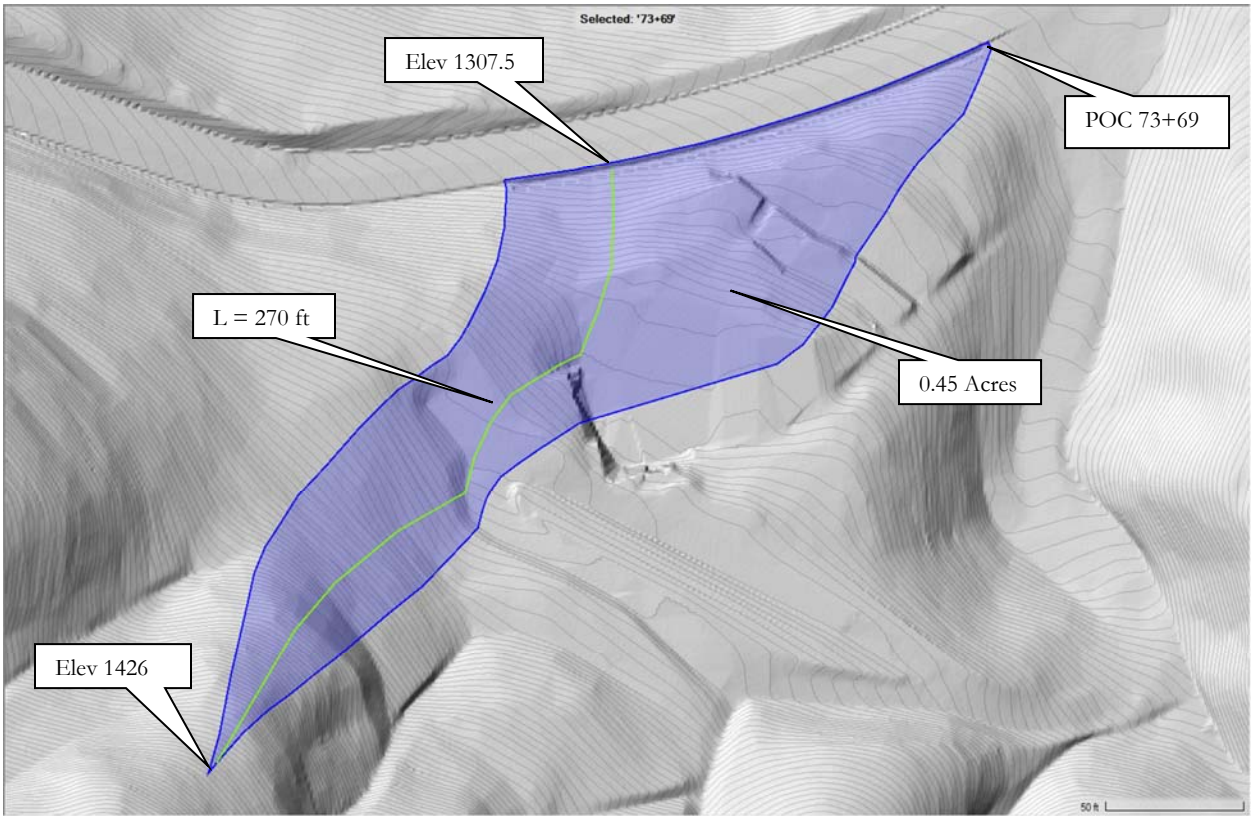
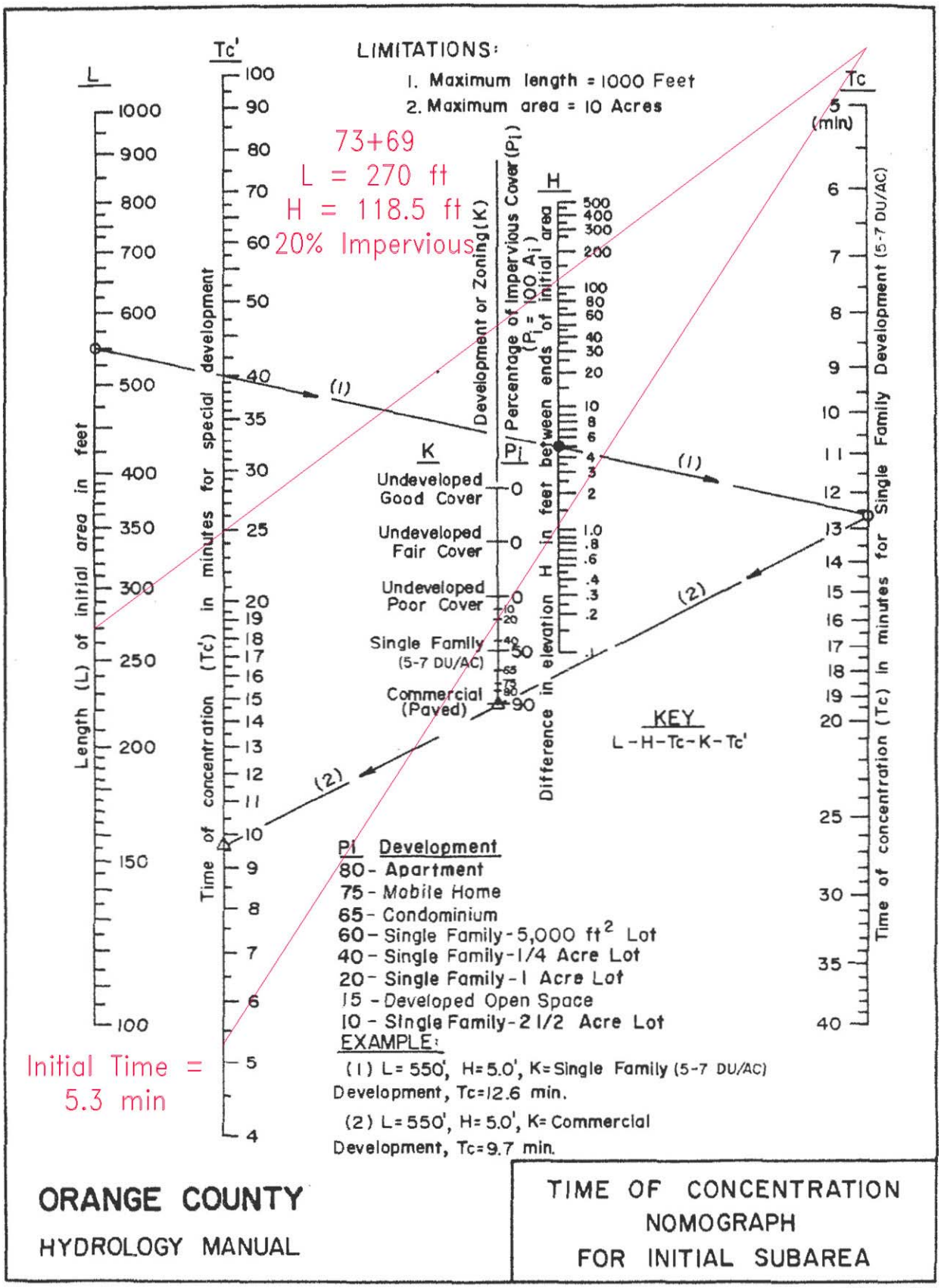

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
71+90
L = 415 ft
H = 192.5 ft
3% Impervious
L
Tc'
H
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pi / Percentage of impervious Cover (Pi)
(Pi = 100 Ai)
Ai = area of initial area
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
(min)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
(1)
(2)
KEY
L-H-Tc-K-Tc'
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
Initial Time = 6.7 min
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

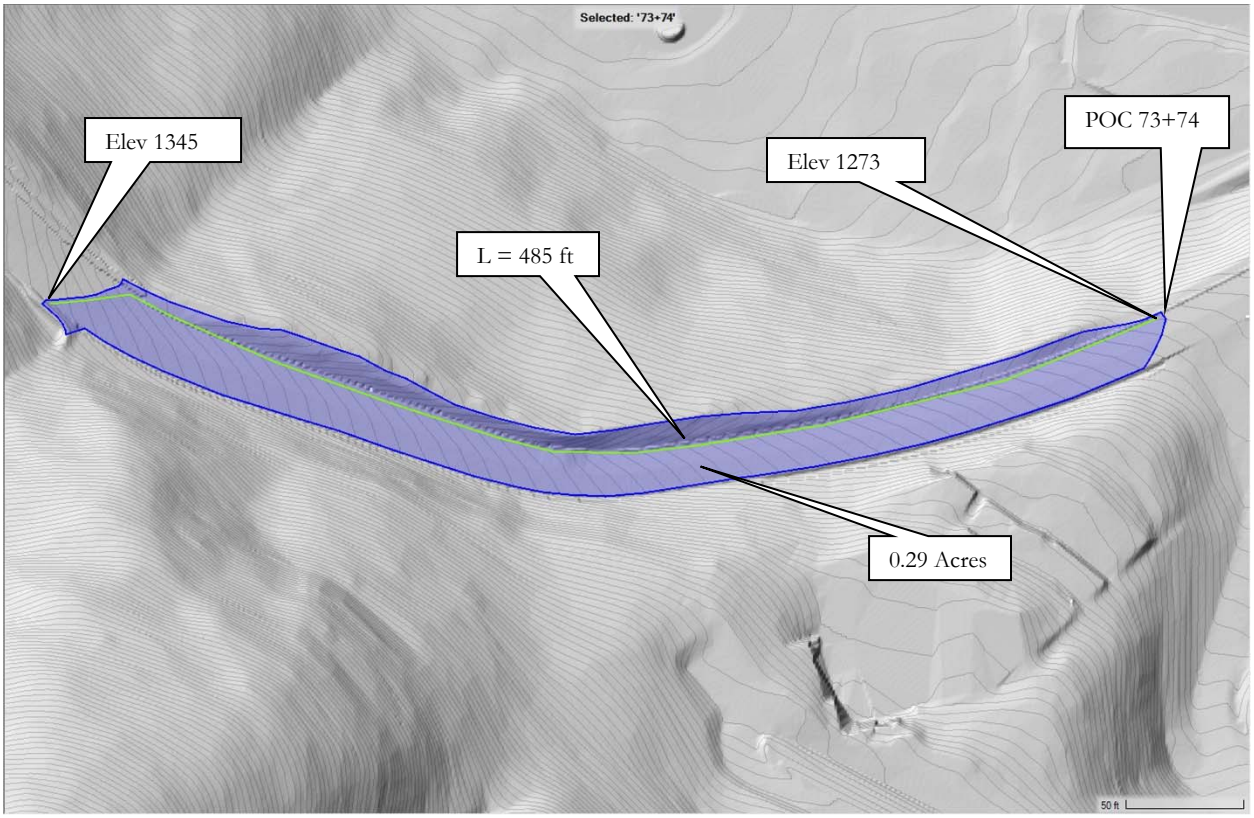

Selected: '73+69'
Elev 1307.5
POC 73+69
L = 270 ft
0.45 Acres
Elev 1426
50 ft

73+69


LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
73+69
L = 270 ft
H = 118.5 ft
20% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of impervious Cover (Pi) (Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
(min)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5.3 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1


Selected: '73+74'
Elev 1345
Elev 1273
POC 73+74
L = 485 ft
0.29 Acres
50 ft

73+74

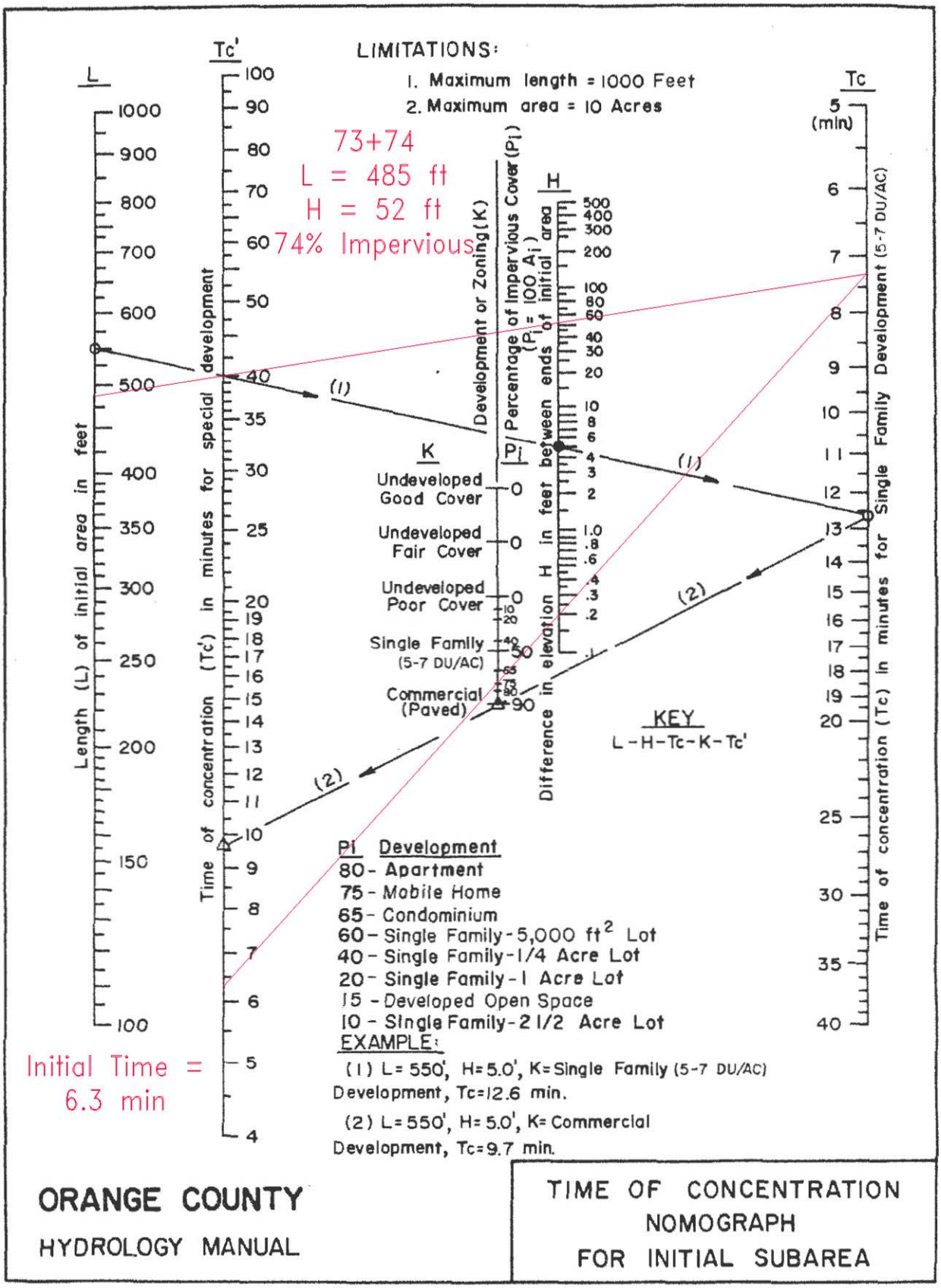
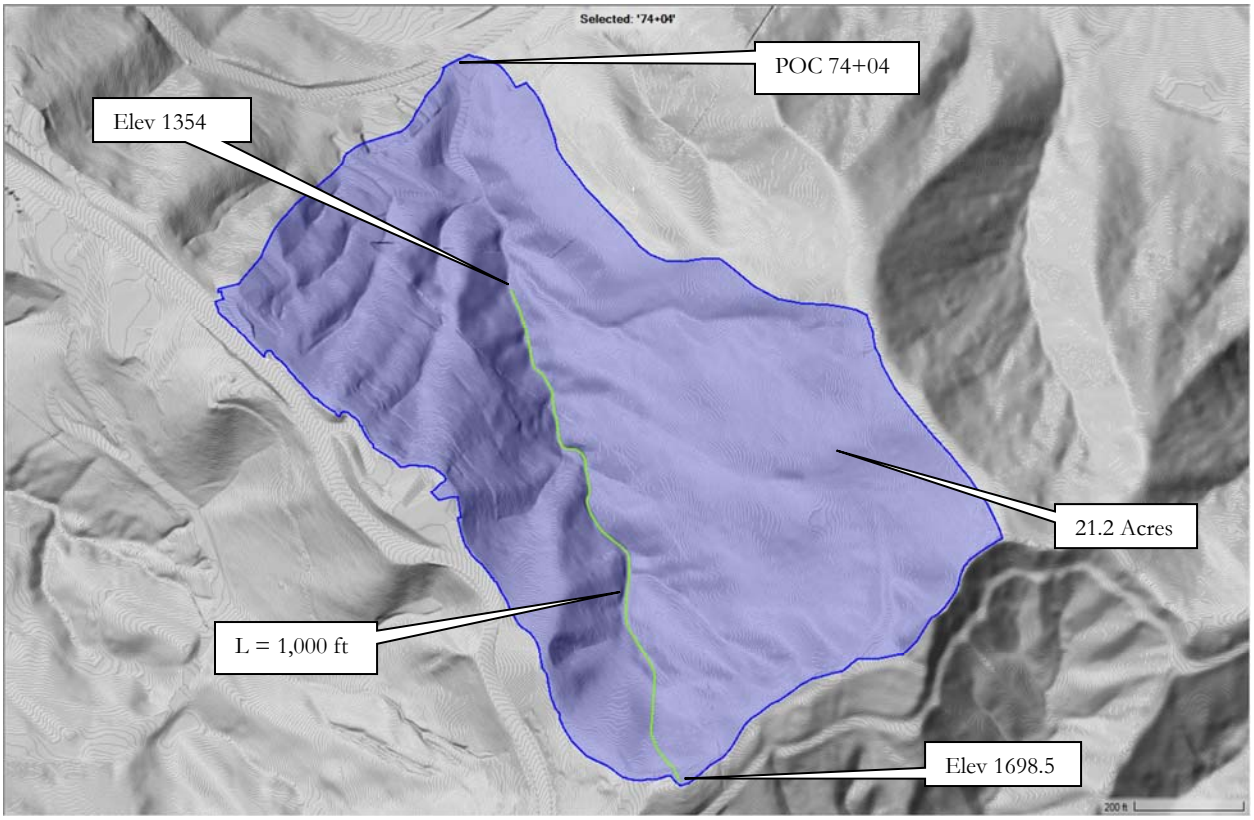
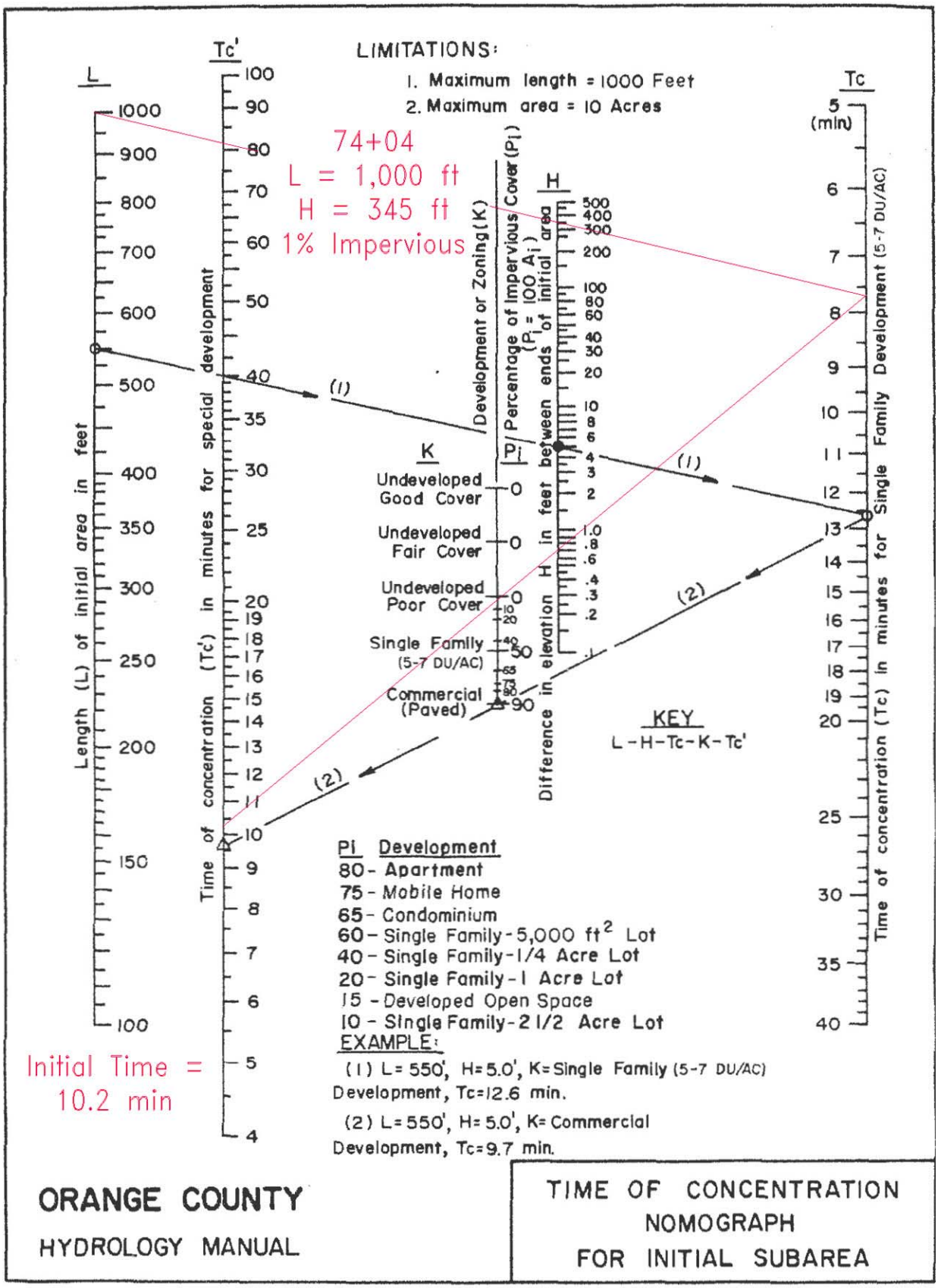

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
73+74
L = 485 ft
H = 52 ft
74% Impervious
L
Tc'
H
Tc
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
Initial Time = 6.3 min
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

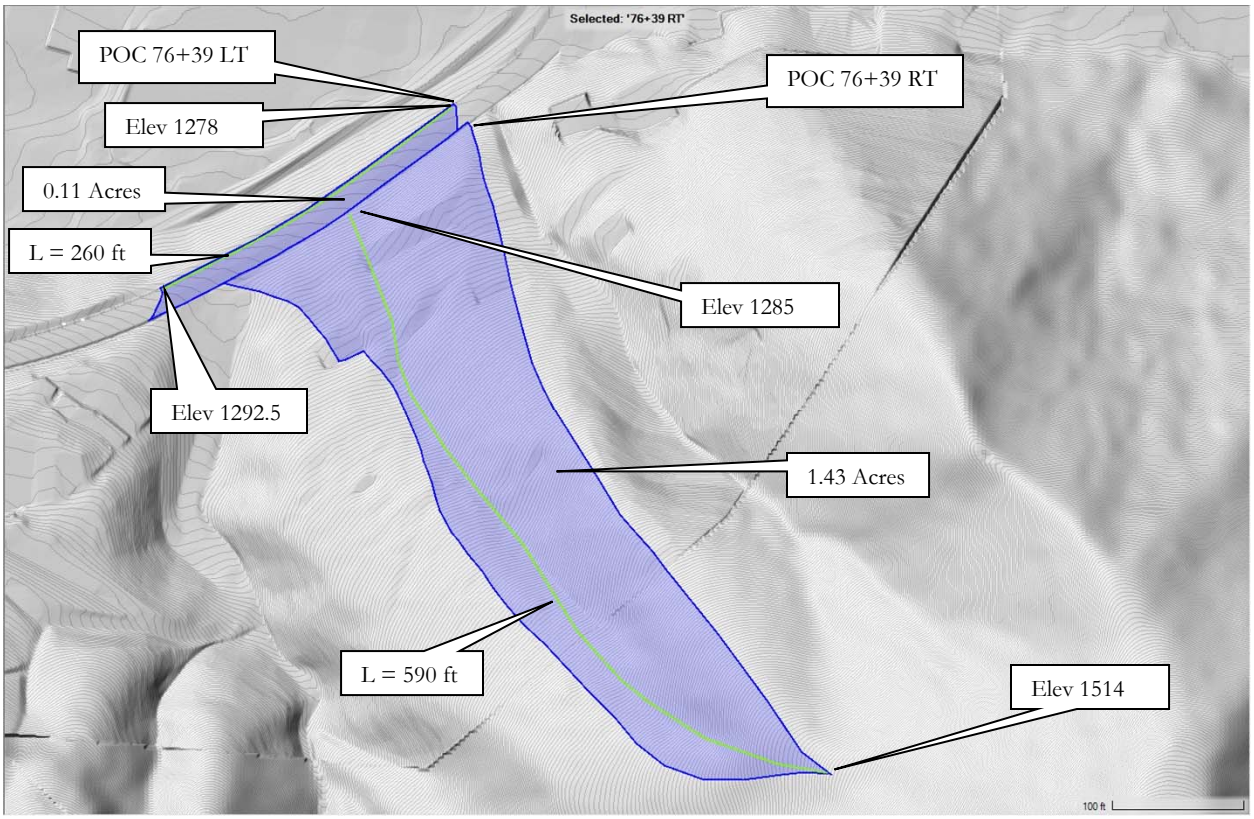

Selected: '74+04'
POC 74+04
Elev 1354
21.2 Acres
L = 1,000 ft
Elev 1698.5
200 ft

74+04

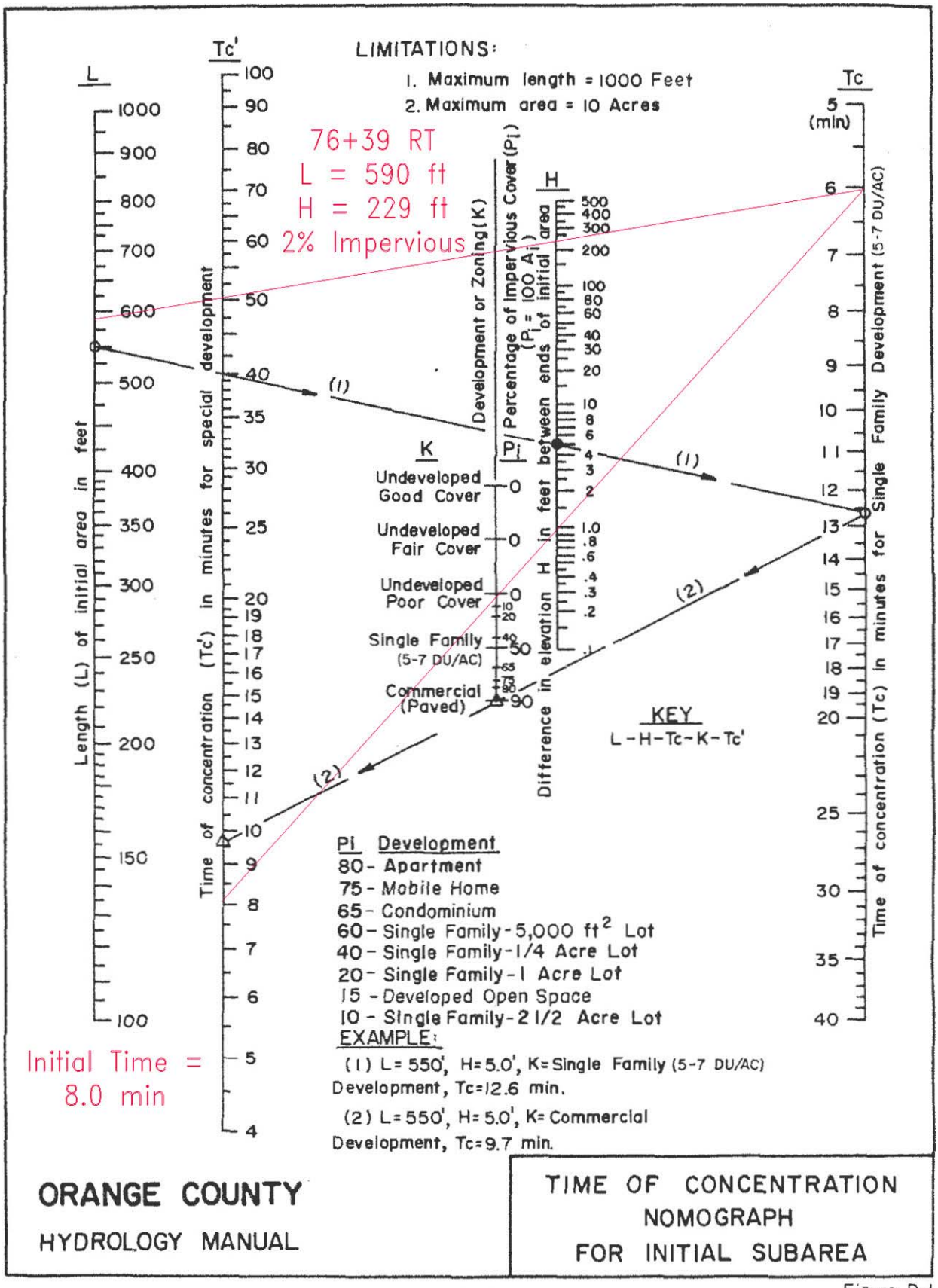

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
74+04
L = 1,000 ft
H = 345 ft
1% Impervious
Initial Time = 10.2 min
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

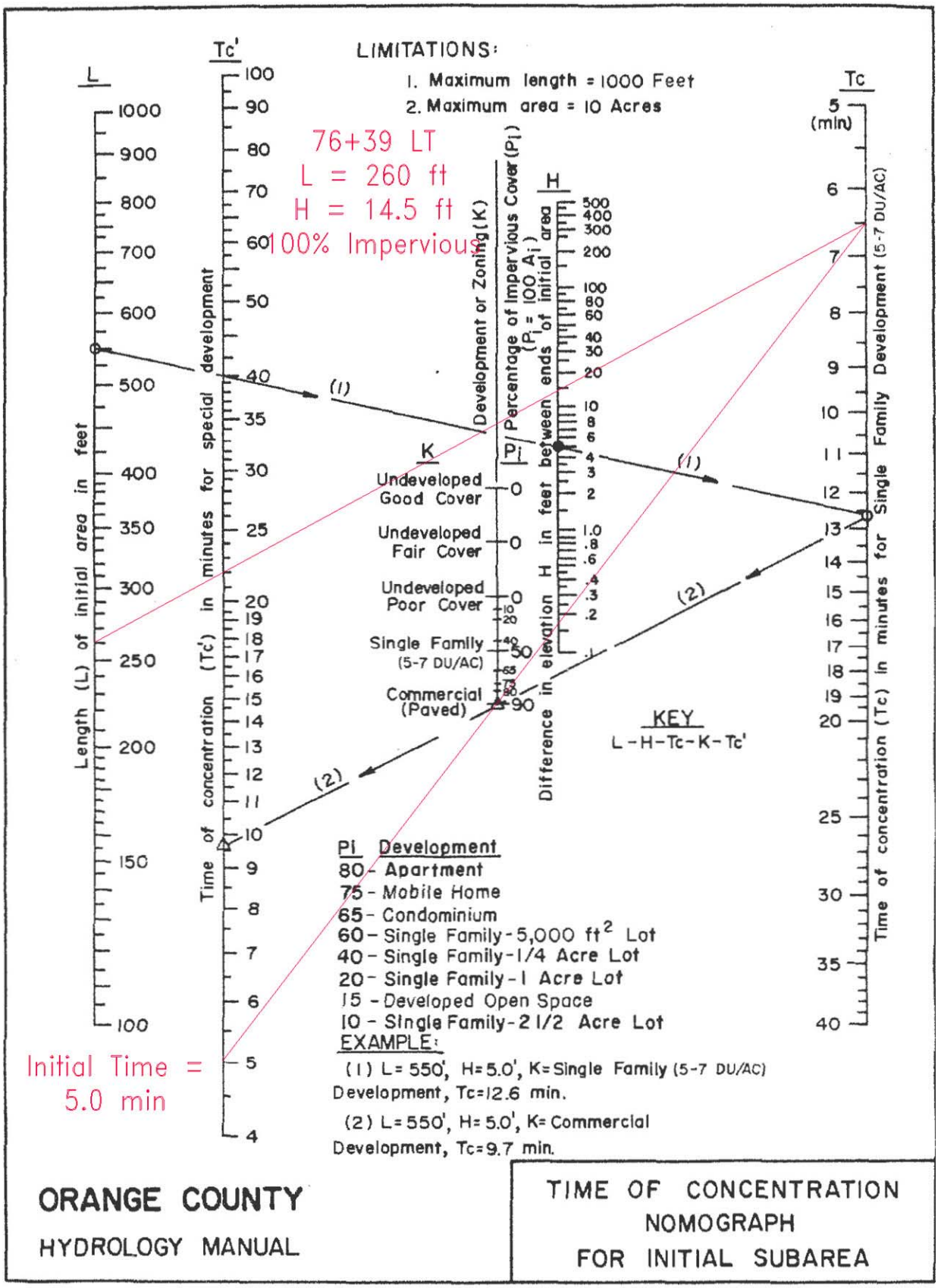


76+39 LT and 76+39 RT


LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
76+39 RT
L = 590 ft
H = 229 ft
2% Impervious
L
Tc'
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pi / Percentage of Impervious Cover (Pi)
(Pi = 100 Ai / area)
H
Difference in elevation H in feet between ends of initial
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 8.0 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

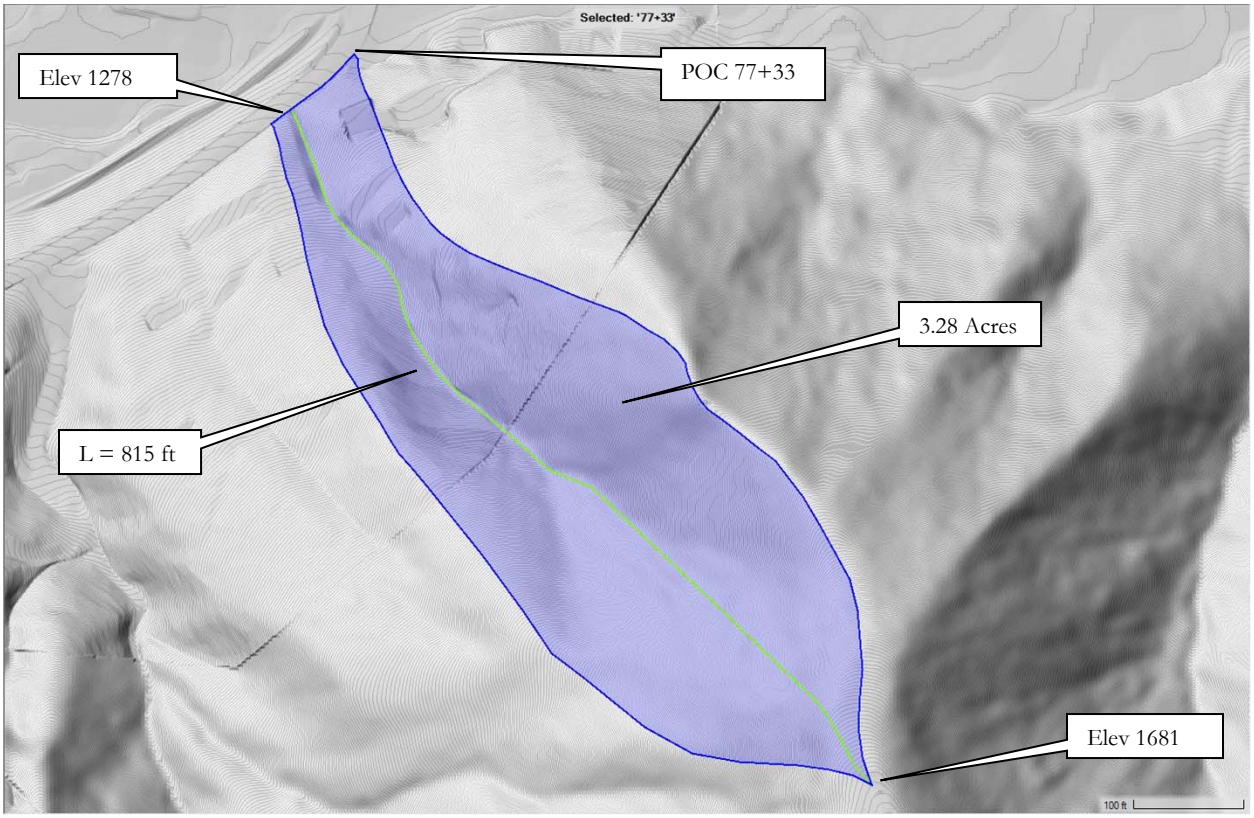
D-4

Figure D-1

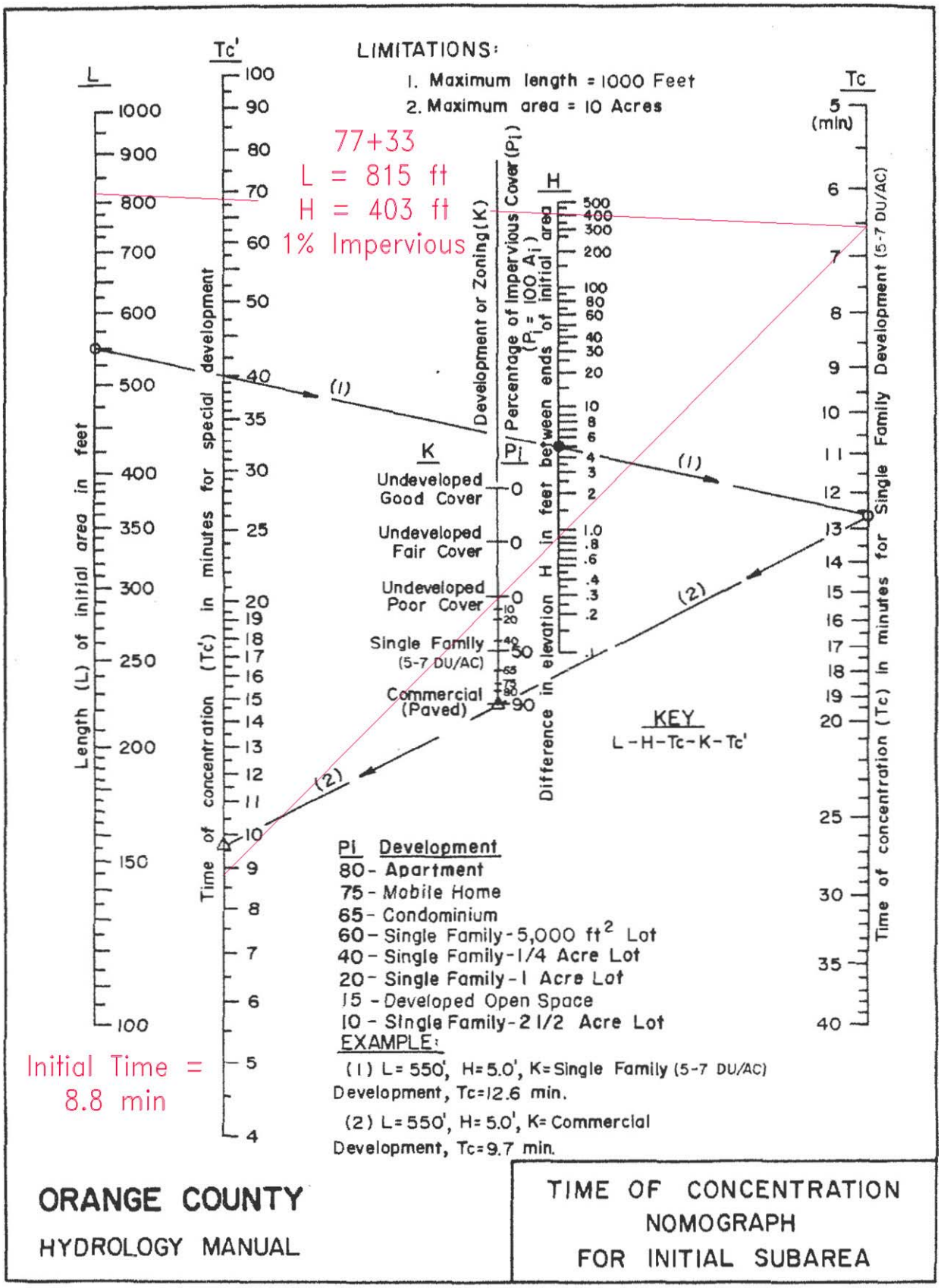

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
76+39 LT
L = 260 ft
H = 14.5 ft
100% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 5.0 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

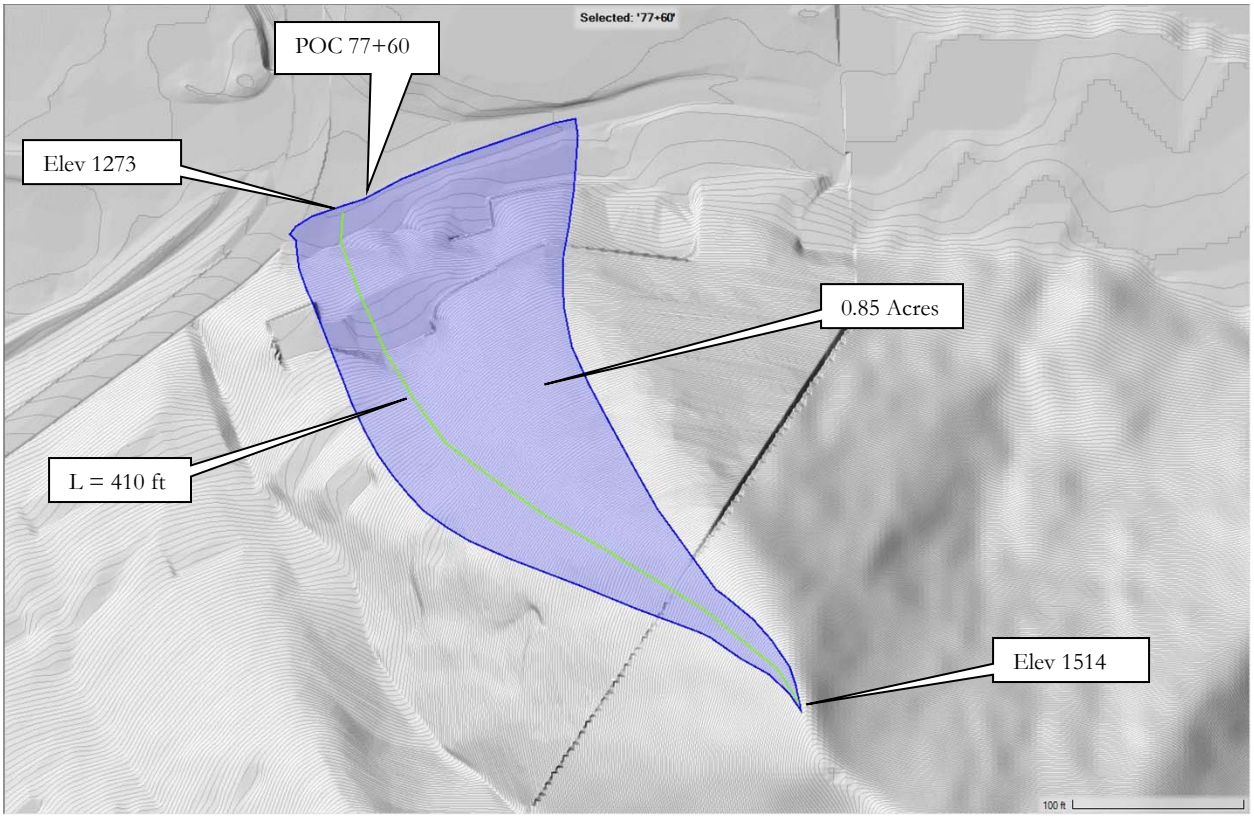

Selected: '77+33'
Elev 1278
POC 77+33
3.28 Acres
L = 815 ft
Elev 1681
100 ft

77+33

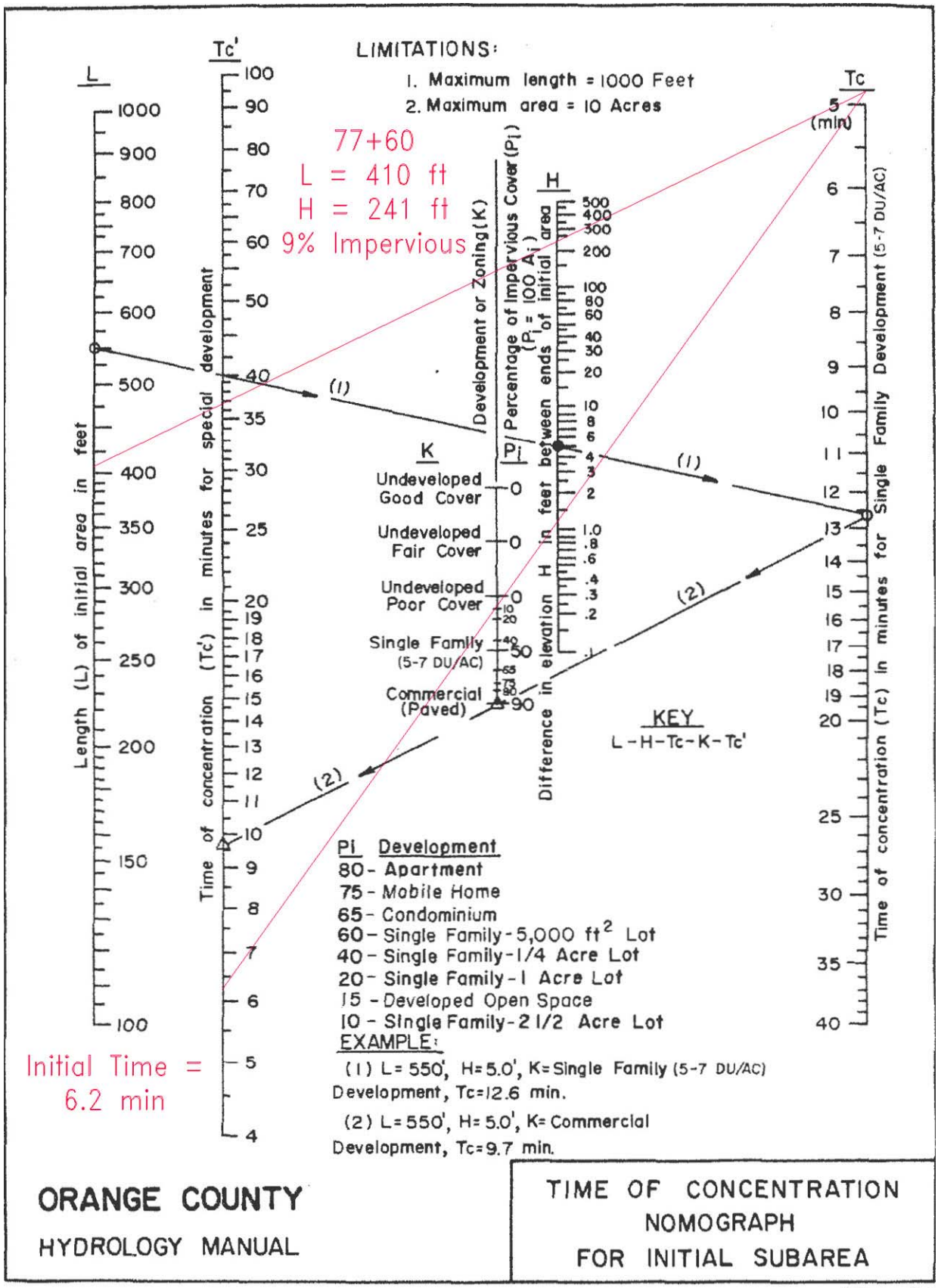

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
77+33
L = 815 ft
H = 403 ft
1% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi) (Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Initial Time = 8.8 min
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1

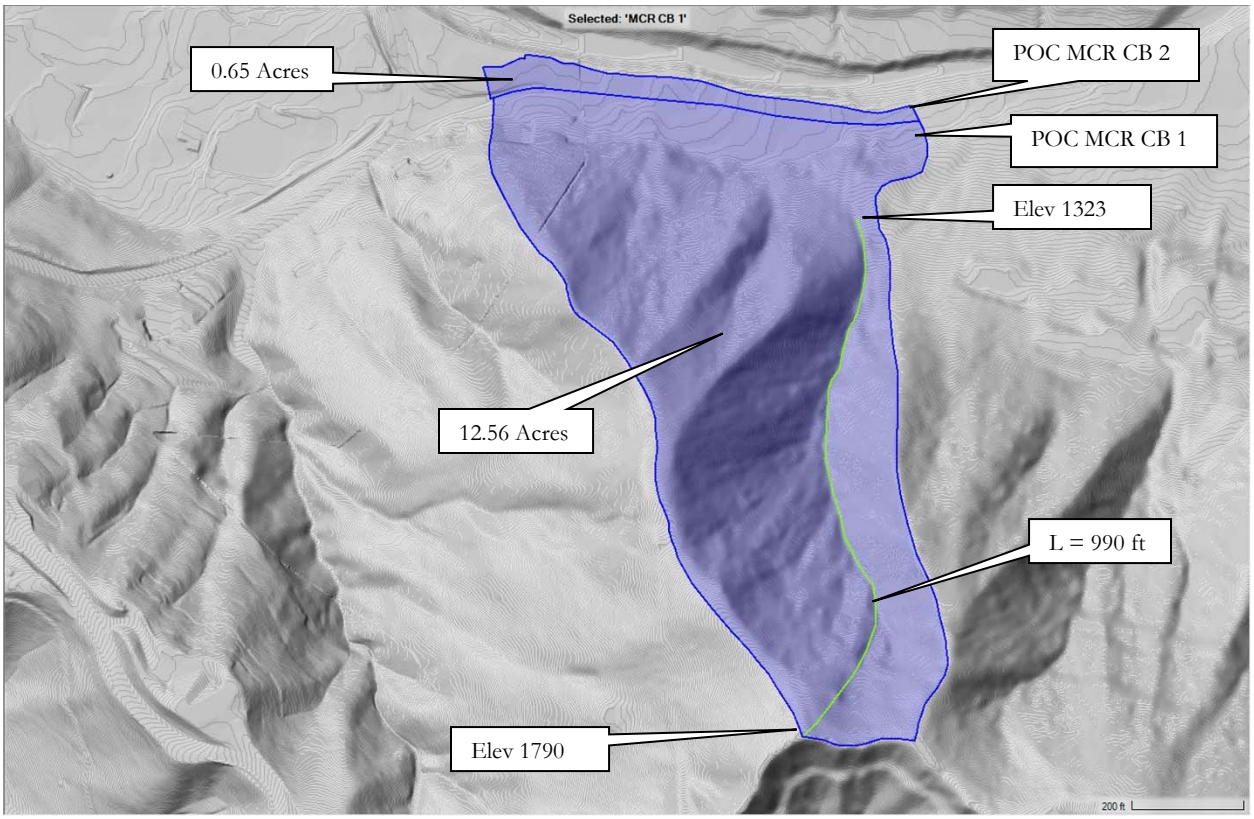

Selected: '77+60'
POC 77+60
Elev 1273
0.85 Acres
L = 410 ft
Elev 1514
100 ft

77+60

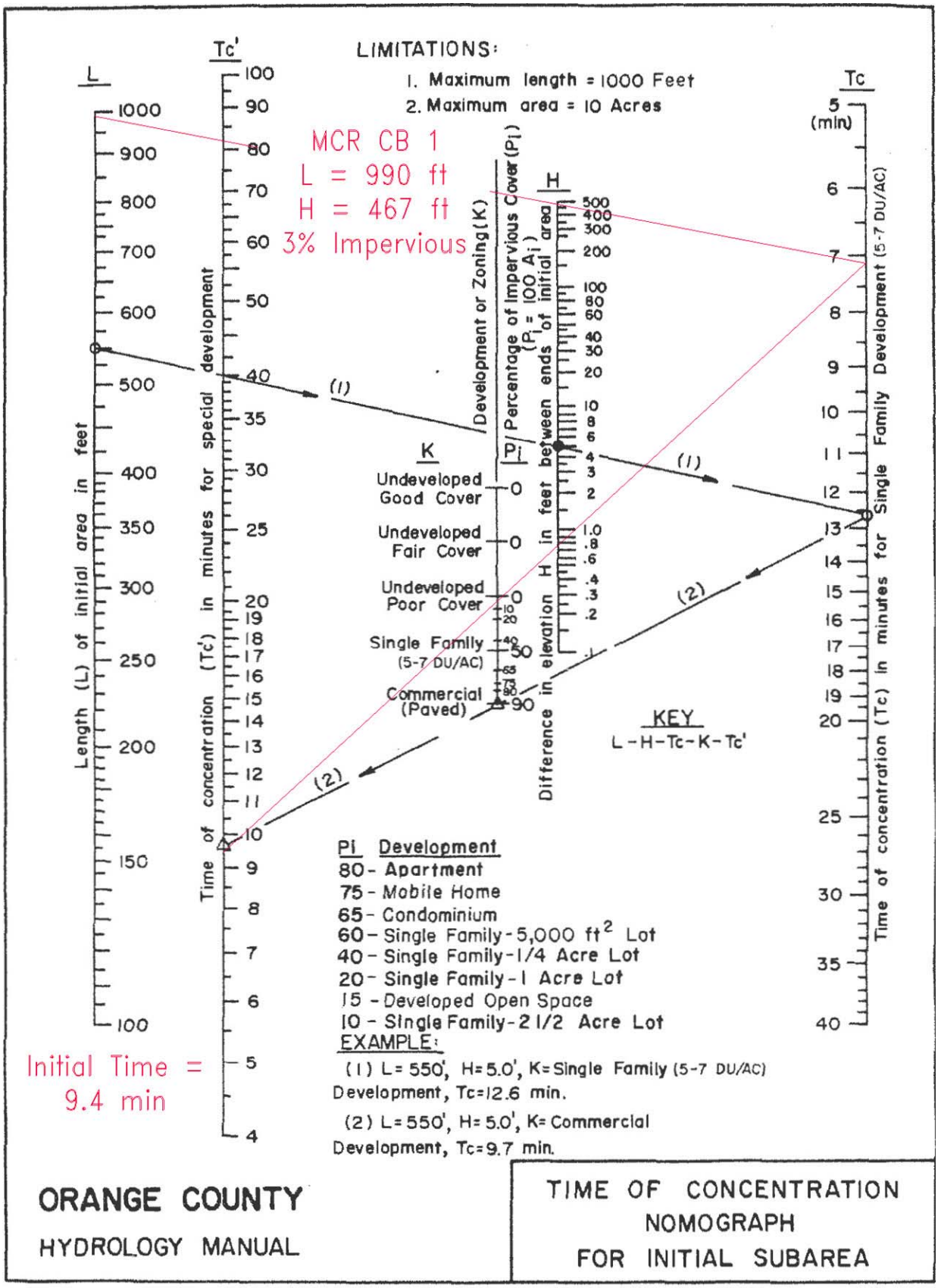

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
77+60
L = 410 ft
H = 241 ft
9% Impervious
L
Tc'
Tc
H
K
Pi
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.
Initial Time = 6.2 min
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

D-4

Figure D-1



MCR CB 1 and MCR CB 2


LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
MCR CB 1
L = 990 ft
H = 467 ft
3% Impervious
Initial Time = 9.4 min
L
Tc'
H
Tc
Length (L) of initial area in feet
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Percentage of Impervious Cover (Pi)
(Pi = 100 Ai)
Difference in elevation H in feet between ends of initial area
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
KEY
L-H-Tc-K-Tc'
(1)
(2)
Pi Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft² Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
15 - Developed Open Space
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
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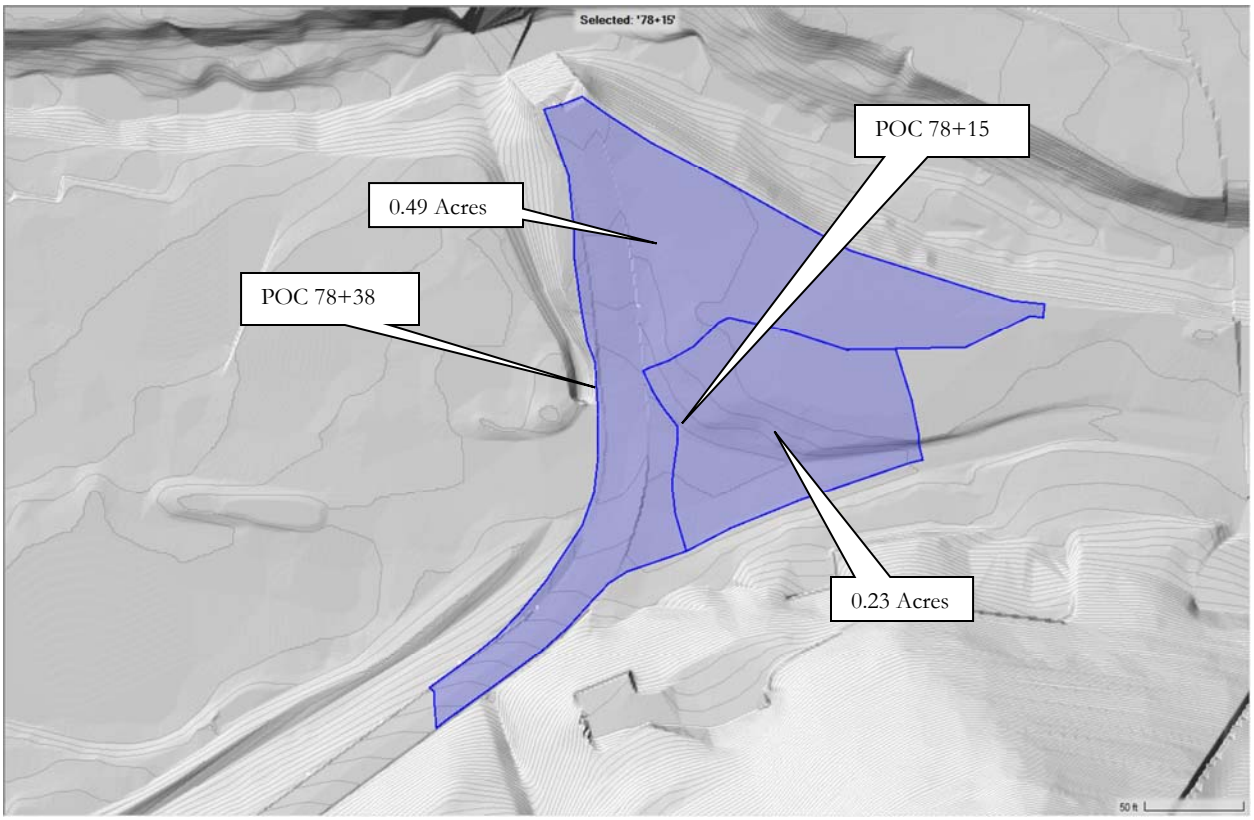
ORANGE COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



78+15 and 78+38

County of Orange
Stormwater Requirements Template

INTERNAL PROJECTS ONLY

TRANSMITTAL PAGE

Include this document at the charter of every project.
Submit a new transmittal page at each 35%, 65%, 90%, and 100% Design stages, as applicable.

Project Name:	**Modjeska Grade Road, Road and Drainage Improvements**			
Project File No:	EQ17009D			
Project Location:	Modjeska Grade Road		Check One:	
	Silverado, CA	92676	☒ North OC	☒ South OC
Project Description:	The Project will address critical pavement and drainage deficiencies along Modjeska Grade Road. It will reconstruct the asphalt concrete pavement by removing the existing structural section and installing a new one for the entire length of the Project.			

Project Area (total area associated with the Project or total area of the right-of-way):	5.98	acres
Area to be disturbed by the Project (Project Footprint):	5.98	acres
Project Proposed Impervious Area (subset of Project Footprint)	4.84	acres
Project Proposed Pervious Area (subset of Project Footprint)	1.15	acres
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition:	+19	%
Identify the Project type below (refer to the WQMP Applicability Checklist):	Place "X" in only one box below	
Type 1: Priority Project – WQMP required	☐	
Type 2: Green Street Project – WQMP required	☒	
Type 3: Non-Priority Project – WQP required (North OC) or NPP required (South OC)	☐	
Type 4: Maintenance/Other Project – No WQMP required, no WQP/NPP required	☐	

Additional Permits	Yes	No
Does the Project require coverage under a Construction General Permit?	☒	☐
Does the Project require coverage under the Clean Water Act, i.e., Section 401/404?	☐	☒
Does the Project require a California Department of Fish and Wildlife Permit?	☐	☒
Does the Project require a Dewatering Permit?	☐	☒

65% Submittal - February 12, 2024

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North Orange County
WQMP Applicability Checklist

1. Is the Project located in North Orange County (NOC)?
   - ☒ Yes; proceed to Question 2
   - ☐ No; please refer to the South Orange County WQMP Applicability Checklist

2. Is the Project proposing streets, roads, highways, freeways, sidewalks, and/or bikeways of 5,000 square feet or more of new paved impervious surface?
   - ☒ Yes; proceed to Question 12
   - ☐ No; proceed to Question 3

3. Is the Project a below-ground linear drainage or utility construction project, such as storm drains, sewers, and water lines, that will result in the replacement of more than 5,000 square feet of impervious surface within a developed public street, road, or highway?
   - ☐ Yes; proceed to Question 4
   - ☐ No; proceed to Question 6

4. Will the Project maintain original line and grade, and hydraulic capacity/original purpose of the facility?
   - ☐ Yes; proceed to Question 13
   - ☐ No; proceed to Question 5

5. Is the Project occurring in response to an emergency to protect public health and safety?
   - ☐ Yes; **Type 3: Non-Priority Project**, WQP required; proceed to Section 1
   - ☐ No; proceed to Question 14

6. Is the Project a new development project that creates 10,000 square feet or more of impervious surfaces (collectively over the entire project site)?
   - ☐ Yes; **Type 1: Priority Project**, WQMP required; proceed to Section 1
   - ☐ No; proceed to Question 7

7. Is the Project a redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces)?
   - ☐ Yes; proceed to Question 14
   - ☐ No; proceed to Question 8

8. Is the Project a new or redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the entire project site), and consist primarily of one or more of the following uses:
   i. Restaurants. This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification (SIC) code 5812). Information and an SIC search function are available at https://www.osha.gov/pls/imis/sicsearch.html.
   ii. Hillside development projects. This category includes development on any natural slope that is twenty-five percent or greater.
   iii. Parking lots. This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
   iv. Automotive repair shops. This category is defined as a facility that is categorized in any one of the following SIC codes: 5013, 5014, 5541, 7532-7534, or 7536-7539. Information and an SIC search function are available at https://www.osha.gov/pls/imis/sicsearch.html.
   v. Retail gasoline outlets. This category includes Retail gasoline outlets that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic of 100 or more vehicles per day.
   - ☐ Yes; proceed to Question 14
   - ☐ No; proceed to Question 9

9. Is the Project a new or redevelopment project that creates and/or replaces 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharges directly to an Environmentally Sensitive Area (ESA)?

   Note: "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the Project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the Project to the ESA (i.e. not comingled with flows from adjacent lands). For projects adjacent to an ESA, but not discharging to an ESA, the 2,500 sq-ft threshold does not apply as long as the Project does not physically disturb the ESA and the ESA is upstream of the Project.

   ☐ Yes; proceed to Question 14 ☐ No; proceed to Question 10

10. Will the Project require discretionary action (grading permit, building permit, etc.) that will include a precise plan of development, except for those projects exempted by the Permittee Water Quality Ordinance (as applicable)?

    ☐ Yes; **Type 3: Non-Priority Project**, WQP required; proceed to Section 1 ☐ No; proceed to Question 11

11. Will the Project require issuance of a non-residential plumbing permit for pipelines conveying hazardous materials (e.g. gasoline) as defined in the Permittee Water Quality/Stormwater Ordinance?

    ☐ Yes; **Type 3: Non-Priority Project**, WQP required; proceed to Section 1 ☐ No; **Type 4: Maintenance/Other Project**, no WQP or WQMP required; proceed to Section 1

12. Is the Project a Maintenance Project (a routine activity that is conducted to maintain the original line and grade, hydraulic capacity, or original purpose of the facility)?

    ☐ Yes; **Type 4: Maintenance/Other Project**, no WQP or WQMP required; proceed to Section 1 ☒ No; **Type 2: Green Street Project**; modified WQMP required; proceed to Section 1

13. Is the Project a Maintenance Project (a routine activity that is conducted to maintain the original line and grade, hydraulic capacity, or original purpose of the facility)?

    ☐ Yes; **Type 4: Maintenance/Other Project**, no WQP or WQMP required; proceed to Section 1 ☐ No; **Type 3: Non-Priority Project**; WQP required; proceed to Section 1

14. Is the Project a Maintenance Project (a routine activity that is conducted to maintain the original line and grade, hydraulic capacity, or original purpose of the facility)?

    ☐ Yes; **Type 4: Maintenance/Other Project**, no WQP or WQMP required; proceed to Section 1 ☐ No; **Type 1: Priority Project**; WQMP required; proceed to Section 1

South Orange County
WQMP Applicability Checklist

1. Is the Project located in South Orange County (SOC)?

☒ Yes; proceed to Question 2 ☐ No; please refer to the North Orange County WQMP Applicability Checklist

2. Is the Project proposing new or retrofitting 5,000 square feet of existing paved sidewalks, bicycle lanes, or trails that meet the following criteria:
   a. Designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas; OR
   b. Designed and constructed to be hydraulically disconnected from paved streets or roads; OR
   c. Designed and constructed with permeable pavements or surfaces

☐ Yes; proceed to Question 11 ☒ No; proceed to Question 3

3. Is the Project proposing retrofitting or redevelopment of 5,000 square feet of existing paved alleys, streets, or roads?

☒ Yes; proceed to Question 11 ☐ No; proceed to Question 4

4. Is the Project a new development project that creates 10,000 square feet or more of impervious surfaces (collectively over the entire project site)?

☐ Yes; proceed to Question 12 ☐ No; proceed to Question 5

5. Is the Project a redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces)?

☐ Yes; proceed to Question 12 ☐ No; proceed to Question 6

6. Is the Project a new or redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the entire project site), and consist primarily of one or more of the following uses:
   i. Restaurants. This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification (SIC) code 5812). Information and an SIC search function are available at https://www.osha.gov/pls/imis/sicsearch.html.
   ii. Hillside development projects. This category includes development on any natural slope that is twenty-five percent or greater.
   iii. Parking lots. This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
   iv. Automotive repair shops. This category is defined as a facility that is categorized in any one of the following SIC codes: 5013, 5014, 5541, 7532-7534, or 7536-7539. Information and an SIC search function are available at https://www.osha.gov/pls/imis/sicsearch.html.
   v. Retail gasoline outlets. This category includes Retail gasoline outlets that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic of 100 or more vehicles per day.

☐ Yes; proceed to Question 12 ☐ No; proceed to Question 7

7. Is the Project a new or redevelopment project that creates and/or replaces 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharges directly to an Environmentally Sensitive Area (ESA)?

   Note: "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the Project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the Project to the ESA (i.e. not comingled with flows from adjacent lands). For projects adjacent to an ESA, but not discharging to an ESA, the 2,500 sq. ft threshold does not apply as long as the Project does not physically disturb the ESA and the ESA is upstream of the Project.

   ☐ Yes; proceed to Question 12 ☐ No; proceed to Question 8

8. Is the Project proposing permeable pavement surfaces?

   ☐ Yes; proceed to Question 9 ☐ No; proceed to Question 10

9. If the proposed permeable pavement surfaces were tabulated as impervious surface, would the Project qualify as a Priority Project per Questions 4-7 above?

   ☐ Yes; proceed to Question 13 ☐ No; proceed to Question 10

10. Is the Project resulting in the disturbance of one or more acres of total land (impervious or pervious) **and** expected to generate pollutants (as identified in Section 2.3.4.1 and 2.3.4.2 of the 2017 SOC WQMP Technical Guidance Document (TGD)) post-construction?

    ☐ Yes; **Type 1: Priority Project**, WQMP required; proceed to Section 1

    ☐ No; **Type 4: Maintenance/Other Project**, no NPP or WQMP required; proceed to Section 1

11. Will the Project propose ONLY routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair?

    ☐ Yes; **Type 4: Maintenance/Other Project**, no NPP or WQMP required; proceed to Section 1

    ☒ No; **Type 2: Green Street Project**; modified WQMP required; proceed to Section 1

12. Will the Project propose ONLY routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair?

    ☐ Yes; **Type 4: Maintenance/Other Project**, no NPP or WQMP required; proceed to Section 1

    ☐ No; **Type 1: Priority Project**; WQMP required; proceed to Section 1

13. Will the Project propose ONLY routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair?

    ☐ Yes; **Type 4: Maintenance/Other Project**, no NPP or WQMP required; proceed to Section 1

    ☐ No; **Type 3: Non-Priority Project**; NPP required; proceed to Section 1

Acronyms

A_{df}	Cross sectional area at design flow depth
A_I	Infiltrating surface area
A_{IMP}	Impervious area
A_P	Pervious area
A_R	Retention area
A_T	Trench footprint area
A_{TT}	Total tributary area
ac	Acres
ac-ft	Acre-feet
b	Swale bottom width
BMP	Best Management Practice
C	Simple runoff coefficient
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
cf	Cubic-feet
D_{24}	Daily harvest water demand
d_{48}	48-hour drawdown time
d_{85}	85th percentile storm event rainfall depth
$d_{effective}$	Effective ponding depth
d_b	Basin depth
d_f	Flow depth
$d_{filtered}$	Depth of water filtered during the design capture storm
d_g	Gravel layer depth
d_{HSC}	Effective storm retention depth
d_m	Bioretention media depth
d_O	Depth of water at overflow
d_P	Ponding depth
d_{PM}	Maximum ponding depth
d_r	Depth of water routed through media
d_R	Aggregate reservoir depth
D_R	Retention depth
d_{RM}	Maximum aggregate reservoir depth
d_T	Trench fill depth
DCV	Design Capture Volume
DCV_i	Initial Design Capture Volume
DCV_{UR}	Upstream Design Capture Volume Reduction
DD	Drawdown time
DD_g	Drawdown time for gravel layer
DD_P	Drawdown time for ponded water
DMA	Drainage Management Area
DQ	Design Flow Rate
E	Capture Efficiency

E_R	Green/Brown Roof Extensiveness
E_{Red}	Reduction Efficiency
ESA	Environmentally Sensitive Area
ET	Evapotranspiration
f_{ED}	Fraction of effective ponding depth to design capture storm depth
f_{EV}	Effective volume factor
f_{PD}	Fraction of design ponding depth to design capture storm depth
FS	Factor of Safety
ft	feet
GIS	Geographic Information System
HCOC	Hydrologic Condition of Concern
hr	Hour
HSC	Hydrologic Source Control
I	Design storm intensity
I_{85}	85^{th} percentile storm event rainfall intensity
I_{full}	Gradient across filter bed assuming storage is full
IA_{HSC}	Impervious area covered by hydrologic source controls
ID	Identification
in	Inch
K_d	Design infiltration rate
K_L	Landscape coefficient
K_{media}	Media design infiltration rate
K_{obs}	Observed saturated infiltration rate
K_{sat}	Design saturated hydraulic conductivity
K_{screen}	Feasibility screening infiltration rate
L	Length
L_{min}	Minimum length
LID	Low Impact Development
min	Minute
MRD_{min}	Minimum required moisture retention depth
MS4	Municipal Separate Storm Sewer System
n	Manning's roughness coefficient
n_g	Porosity of gravel layer
n_m	Porosity of bioretention media
n_R	Porosity of aggregate reservoir fill
n_T	Porosity of trench fill
NA	Not applicable
NOC	North Orange County
NPDES	National Pollutant Discharge Elimination System
NPP	Non-Priority Project Water Quality Plan
NRCS	Natural Resources Conservation Service
OC	Orange County
O&M	Operations and Maintenance
PE	Professional Engineer
Q	Flow rate

R	Ratio of pervious to impervious area
R_{SD}	Percent volume reduction based on soil depth
S	Longitudinal slope
SACF	Surface area Correction Factor
SARWQCB	Santa Ana Regional Water Quality Control Board
SD	Soil depth
SD_{min}	Minimum soil depth
SDRWQCB	San Diego Regional Water Quality Control Board
sf	Square-feet
SIC	Standard Industrial Classification
SOC	South Orange County
T_{HR}	Minimum hydraulic residence time
T_R	Assumed storm duration
Tc	Time of concentration
$Tc_{2\text{-yr, POST}}$	Time of concentration for the 2-year, 24-hour storm under post-development conditions
$Tc_{2\text{-yr, PRE}}$	Time of concentration for the 2-year, 24-hour storm under pre-development conditions
TGD	Technical Guidance Document
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
v	Velocity
$V_{2\text{-yr, POST}}$	Runoff volume for the 2-year, 24-hour storm under post-development conditions
$V_{2\text{-yr, PRE}}$	Runoff volume for the 2-year, 24-hour storm under pre-development conditions
$V_{cistern}$	Cistern volume
V_{max}	Maximum volume
$V_{storage}$	Dead storage volume
w	Filter strip width
WIHMP	Watershed Infiltration and Hydromodification Management Plan
WQMP	Water Quality Management Plan
WQP	Water Quality Plan
yr	Year

1. Required Documents Checklist

A Draft WQMP/WQP/NPP is required at each phase of the Project (Initiation, 35% Design, 65% Design, and 90% Design, as applicable) with the Final WQMP submitted at Project Completion. Based on the Project type identified by the WQMP Applicability Checklist, select the relevant **Required Documents Checklist** from pages below. Along with the checklist, drafts shall include only the required sections as indicated in the "Project Phase" column, as well as updated documents from every preceding project phase. All sections will be required for the final WQMP at the 100% Design phase. In addition, some attachments may be required. An updated Attachments Checklist should be included at every applicable stage of the Project.

Note that a submittal is required for Type 4: Maintenance/Other Projects. See the **Required Documents Checklist for Type 4 Projects** below.

1.1 Required Documents Checklist for Type 1 Projects

Type 1: Priority Project Water Quality Management Plan (WQMP)

Sections Required			Page	Project Phase	For Internal Use Only
☐	-	Transmittal Page	i	Initiation	
☐	-	WQMP Applicability Checklist	iii-iv or vi-vii	Initiation	
☐	1	Required Documents Checklist 1.1 Required Documents Checklist for Type 1 Projects 1.5 Attachment Checklist	1-1	Initiation	
☐	2	Project Description	2-1	Initiation	
☐	3	Site and Watershed Characterization 3.1 Site Characterization 3.2 Watershed Characterization 3.3 Preliminary Infiltration Investigation Preliminary Infiltration Investigation	3-1	Initiation	
☐	5	Site Design and Drainage Plan 5.1 Project Performance Criteria – NOC Only 5.2 DMA Delineation and BMP Site Selection 5.3 Additional Investigations for Priority Projects	5-1	35% Design	
☐	6	Site Design BMPs for Priority Projects 6.1 Selection of Site Design BMPs 6.2 Site Design BMP Calculations 6.3 Inventory of BMPs	6-1	35% Design	
☐	8	Hydromodification BMPs	8-1	35% Design	
☐	9	BMP Exhibit	9-1	35% Design	
☐	10	Source Control BMPs	10-1	65% Design	
☐	11	Educational Material	11-1	100% Design	
☐	12	Routine Inspections, Operations, and Maintenance 12.1 Inspection / Maintenance Responsibilities 12.2 Operations and Maintenance Plan	12-1	100% Design	
☐	13	Discretionary Permits and Water Quality Conditions 13.1 Discretionary Permits 13.2 Water Quality Conditions	13-1	100% Design	

1.2 Required Documents Checklist for Type 2 Projects

Type 2: Green Streets Project

		Sections Required	Page	Project Phase	For Internal Use Only
☒	-	Transmittal Page	i	Initiation	
☒	-	WQMP Applicability Checklist	ii-iii or iv-v	Initiation	
☒	1	Required Documents Checklist 1.2 Required Documents Checklist for Type 2 Projects 1.5 Attachment Checklist	1-1	Initiation	
☒	2	Project Description	2-1	Initiation	
☒	3	Site and Watershed Characterization 3.1 Site Characterization 3.2 Watershed Characterization	3-1	Initiation	
☒	5	Site Design and Drainage Plan 5.1 Project Performance Criteria – NOC Only 5.2 DMA Delineation	5-1	35% Design	
☒	7	Site Design BMPs for Green Street Projects	7-1	35% Design	
☒	8	Hydromodification BMPs	8-1	35% Design	
☒	9	BMP Exhibit	9-1	35% Design	
☐	12	Routine Inspections, Operations, and Maintenance 12.1 Inspection / Maintenance Responsibilities 12.2 Operations and Maintenance Plan	12-1	100% Design	
☐	13	Discretionary Permits and Water Quality Conditions 13.1 Discretionary Permits 13.2 Water Quality Conditions	13-1	100% Design	

1.3 Required Documents Checklist for Type 3 Projects

Type 3: Non-Priority Project Water Quality Plan (WQP/NPP)

Sections Required			Page	Project Phase	For Internal Use Only
☐	-	Transmittal Page	i	Initiation	
☐	-	WQMP Applicability Checklist	ii-iii or iv-v	Initiation	
☐	1	Required Documents Checklist 1.3 Required Documents Checklist for Type 3 Projects 1.5 Attachment Checklist	1-1	Initiation	
☐	2	Project Description	2-1	Initiation	
☐	3	Site and Watershed Characterization 3.1 Site Characterization 3.2 Watershed Characterization	3-1	Initiation	
☐	4	Site Design BMPs for Non-Priority Projects 4.1 Site Design BMPs 4.2 Other BMPs	4-1	35% Design	
☐	9	BMP Exhibit	9-1	35% Design	
☐	10	Source Control BMPs	10-1	65% Design	
☐	12	Routine Inspections, Operations, and Maintenance 12.1 Inspection / Maintenance Responsibilities	12-1	100% Design	

1.4 Required Documents Checklist for Type 4 Projects

Type 4: Maintenance/Other Projects

Sections Required			Page	Project Phase	For Internal Use Only
☐	-	Transmittal Page	i	Initiation	
☐	-	WQMP Applicability Checklist	ii-iii or iv-v	Initiation	
		Required Documents Checklist	1-1		
☐	1	1.4 Required Documents Checklist for Type 4 Projects		Initiation	

1.5 Attachment Checklist

Identify the attachments included in this submittal. Refer to the appropriate sections to determine if attachments are necessary.

Attachment		Section	Included
Attachment 1	Preliminary Infiltration Investigation Report	3.3	☐
Attachment 2	WIHMP Criteria and Opportunities (NOC Only)	5.1	☐
Attachment 3	Additional DMA Delineation Tables	5.2	☐
Attachment 4	DCV Calculations	5.2	☒
Attachment 5	Supplementary Infiltration Investigation Report	5.3.1	☐
Attachment 6	Additional Infiltration and Harvest and Use Feasibility Tables	5.3.3	☐
Attachment 7	Priority Project BMP Conformance Analysis Tables	6.2	☐
Attachment 8	DCV Reduction Calculations	6.2	☐
Attachment 9	Green Street Project BMP Conformance Analysis Tables	7	☐
Attachment 10	Hydromodification Exhibits and Calculations	8	☐
Attachment 11	Hydromodification Management Plan	8	☐
Attachment 12	BMP Exhibit	9	☐
Attachment 13	Additional Educational Material	11	☐
Attachment 14	Additional BMP Inspection and Maintenance Responsibility Tables	12.1	☐
Attachment 15	Operations and Maintenance Plan	12.2	☐
Attachment 16	BMP Inspection Record	14	NA[1]

[1] A BMP Inspection Record is not to be completed by the Plan Developer or submitted with the WQMP/WQP/NPP. A BMP Inspection Record form is provided to allow the Plan Developer to review items that will be inspected and ensure BMPs are designed in a manner that aligns with the requirements identified in the form.

2. Project Description

Section 2 is required for ***Type 1: Priority Projects, Type 2: Green Street Projects,*** and ***Type 3: Non-Priority Projects***.

Describe the Project in a manner that matches the legal description of the Project used as part of project approval. The description shall also identify Project features and attributes relevant for water quality and hydromodification management planning. The purpose of this information is to:

1. Legally define what is meant by the "Project" for the purpose of discretionary and subsequent approval; and
2. Provide a general introduction to proposed development patterns, land uses, site activities as they relate to determining applicable stormwater management provisions.

This section shall not provide a detailed description of the existing or proposed site. That information will be catalogued in more detail as part of Section 3: Site and Watershed Characterization. The Project Description Section of the WQMP/WQP/NPP shall include:

- Project location, parcel numbers, and legal address, as applicable;
- Legal boundaries of the proposed Project;
- Project acreage;
- Proposed land uses and site activities, including associated quantification (e.g., acreages, units);
- Off-site improvements as part of the overall Project action; and
- General description of site grading and drainage modifications as part of proposed development.

Project Description		
Project Area (total area associated with the Project or total area of the right-of-way):	5.98	acres
	260,699	sq. ft.
Area to be disturbed by the Project (Project Footprint):	5.98	acres
	260,699	sq. ft.
Project Proposed Impervious Area (subset of Project Footprint)	4.84	acres
	210,666	sq. ft.
Project Proposed Pervious Area (subset of Project Footprint)	1.15	acres
	50,033	sq. ft.
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition:	+19	%

* Proposed impervious area, for this table, includes only full depth reconstructed areas, including road surface, curbs, gutters, and dikes. Proposed impervious area

1. **Project location, parcel numbers, and legal address, as applicable.**

   Modjeska Grade Road
   Silverado, CA 92676

2. **Legal boundaries of the proposed Project.**

   The boundary of the Project lies within the existing County right-of-way for Modjeska Grade Road from Santiago Canyon Road on the south to Modjeska Canyon Road/Shadowland Circle on the north, and for Modjeska Canyon Road between the Santiago Creek bridge and Modjeska Grade Road.

3. **Project acreage.**

   The Project area is 5.98 acres.

4. **Proposed land uses and site activities, including associated quantification**

   The site is a 1.3-mile two-lane rural highway. The Project focuses on entire 1.3 miles of Modjeska Canyon Road. 100 percent of the Project is within a land use area reserved for transportation.

5. **General description of site grading and drainage modifications as part of proposed development.**

   The Project site under both existing and proposed conditions is an asphalt concrete roadway providing access to several single-family residences and to a popular mountain biking trail leading into Cleveland National Forest. Under proposed conditions, the road will be generally located in the same place, but the roadway will be regraded, parallel drainage ditches will be upgraded, and inlets will be added.

   The structural section of the roadway will be redesigned and replaced entirely. The proposed road will include additional proposed drainage inlets to redirect flow. There will be a series of v-ditches to capture offsite drainage from the uphill slopes.

   The roadway and the ditches will continue to follow roughly the same profile as under existing conditions. Steep longitudinal slopes greater than 6% are present in over 90% of the Project, and the slopes approach 17% in some locations. The right-of-way for the Project is also limited by slopes, cliffs, and private property improvements.

3. Site and Watershed Characterization

Section 3 is required for ***Type 1: Priority Projects, Type 2: Green Street Projects,*** and ***Type 3: Non-Priority Projects***.

The purpose of this Section is to describe the Project site conditions that will inform the selection and design of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. The Plan Developer shall conduct appropriate investigations to characterize the site and watershed in a manner that supports informed and appropriate decisions about site design, source control, Low Impact Development (LID), and hydromodification BMPs as part of subsequent steps. The Project WQMP/WQP/NPP shall clearly and comprehensively document the investigations completed and describe the site and watershed conditions in a manner that provides appropriate support for subsequent selection of site design, source control, LID and hydromodification BMPs.

3.1 Site Characterization

The Project Site Characterization Section of the WQMP/WQP/NPP shall include:

- Physical setting
  - Address
  - Planning Area/Land Use Designation/Zoning
- Site characteristics
- Topography
- Soil type and geology
- Groundwater considerations
- Geotechnical considerations
- Off-site drainage
- Existing utilities
- Proposed site development activities (including pollutants to be generated)
- Project land uses

Additional information regarding these topics can be found in Section 2.3 of the 2013 OC WQMP TGD (NOC WQMP TGD) and Section 2.3 of the SOC WQMP TGD.

Site Characterization

Identify the pollutant(s) expected to be generated by the Project.

- ☒ Metals
- ☒ Nutrients
- ☒ Oil and grease
- ☒ Pathogens (bacteria and viruses)
- ☒ Suspended solids / sediment
- ☒ Toxic organic compounds (pesticides, solvents, and hydrocarbons)
- ☒ Trash and debris

1. Physical Setting

The Project is located on and along Modjeska Grade Road, between Santiago Canyon Road to the south and Modjeska Canyon Road/Shadowland Circle on the north and includes a short stretch of Modjeska Canyon Road between the Santiago Creek bridge and Modjeska Grade Road.

2. Site Characteristics

The total area to be disturbed by the Project is 5.98 acres (ac). The total amount of new impervious surface, will be 4.84 ac. The total amount of pervious surface is 1.15 ac. The width of the graded area of the Project is narrow, leaving only enough room to place drainage structures and roadway surfacing in most places.

3. Topography

The topography of the site is mountainous with a maximum grade of 16% and a 375-foot elevation change from high point to low point. The topographic high point is near the middle of the Project, where Oriole Street and Santiago Truck Trail meet. The topographic low point is at the southern end of the Project where Modjeska Grade Road merges with Santiago Canyon Road. Another topographic low point is found at the northern end of the Project where Modjeska Grade Road merges into Modjeska Canyon Road and Shadowland Circle.

4. Soil Type and Geology

The Project is located in an area of Type D soils, according to Figure XVI-2a in the Orange County WQMP Technical Guidance Document (OC TGD). A geotechnical analysis was conducted in May 2020 by Diaz Yourman and Associates that compiled prior geotechnical data for the site and included a site reconnaissance. The geotechnical analysis found sandstone formations and alluvium deposits throughout the Project. The geotechnical analysis did not include an infiltration test since type D soil impedes water infiltration.

5. Groundwater Considerations

Groundwater was not encountered during the geotechnical field investigation. The site is not in an Orange County Water District (OCWD) Groundwater Basin Protection Boundary, according to Figure XVI-2e in the OC TGD. Groundwater quality is expected to be good in this location, as there are no nearby groundwater plumes.

6. Geotechnical Considerations

The site is located in a potential landslide area, according to Figure XVI-2c of the OC TGD. Erosion is a known concern within and around the Project. The geotechnical analysis found that unpaved shoulders that drain toward the roadway, loose alluvial soils, steep slopes, and surficial slope instabilities are the primary contributors to the erosion problems along the Project alignment. Infiltration BMPs would be difficult to construct and maintain in this location, and they may exacerbate the existing erosion and sedimentation concerns.

7. Offsite Drainage

Offsite drainage enters the Project from uphill slopes. The flow will be intercepted with V-ditches and redirected through proposed inlets. This will prevent the flow from crossing onto the roadway surface.

8. Existing Utilities

Subsurface utilities exist and are located underneath the existing/proposed pavement in many locations, particularly in the north half of the Project. These utilities include electric and telecommunication conduits, as well as water mains and water service lines.

9. Proposed Site Development Activities

The site will continue to be used for vehicular access to adjoining properties and for cycling, equestrian, and pedestrian access to trails within Cleveland National Forest. New storm drains will be installed as part of the Project to better manage runoff.

10. Project Land Uses

The Project will continue to be used as a roadway.

3.2 Watershed Characterization

The Project Watershed Characterization Section of the WQMP/WQP/NPP shall include:

- Watershed
- Receiving waters
- Water quality impairments and TMDLs
- Pollutants of concern
- Methods for determining stream susceptibility
- Environmentally sensitive areas (ESAs) and areas of special biological concern
- Potential hydrologic conditions of concern (HCOC)

Additional information regarding these topics can be found in Section 2.3 of the NOC WQMP TGD and Section 2.3 of the SOC WQMP TGD.

Watershed Characterization

Identify the watershed(s) applicable to the Project.

- ☒ Aliso Creek
- ☐ Anaheim Bay – Huntington Harbor
- ☐ Dana Point Coastal Streams
- ☐ Laguna Coastal Streams
- ☐ Newport Bay
- ☐ Newport Coastal Streams
- ☐ San Clemente Coastal Streams
- ☐ San Gabriel – Coyote Creek
- ☐ San Juan Creek
- ☐ San Mateo Creek
- ☒ Santa Ana River

1. Watershed

The northern half of the Project is in the Santa Ana River Watershed (by way of Santiago Creek) and the southern half is in the Aliso Creek Watershed. As such, the Project contains Drainage Management Areas (DMAs) located in both the North Orange County Watershed Management Area and the South Orange County Watershed Management Area. Specifically, DMA-1 is in the Aliso Creek watershed, while DMA-2 is in the Santiago Creek watershed. Please see Attachment 12 for the BMP Exhibit which shows where the DMAs are located.

2. Receiving waters

The northern end of the Project drains into Santiago Creek Reach 4, then to Reach 3 and into Irvine Lake. Irvine Lake discharges to Santiago Creek Reach 1, and from there flows to the Santa Ana River, Reach 1. Water from the Santa Ana River connects to the Pacific Ocean south of Huntington State Beach.

The southern end of the Project drains into the Aliso Creek. Aliso Creek connects to the Pacific Ocean north of Aliso Beach.

3. Water quality impairments and TMDLs

The 2020/2022 EPA 303(d) list for the Project receiving waters are shown in the table below.

Pollutant	TMDL Requirement Status*	TMDL Approval Date or Scheduled Completion Date
Santiago Creek, Reach 4		
Salinity/TDS/Chlorides	5A	2019
Toxicity	5A	2027
Aliso Creek		
Benthic Community Effects	5A	2025
Indicator Bacteria	5B	2011
Malathion	5A	2029
Nitrogen	5A	2019
Phosphorus	5A	2019
Selenium	5A	2021
Toxicity	5A	2019

Pollutant	TMDL Requirement Status*	TMDL Approval Date or Scheduled Completion Date
Aliso Creek (Mouth)		
Indicator Bacteria	5B	2011
Toxicity	5A	2027
Pacific Ocean Shoreline, Aliso HAS at Aliso Creek Mouth		
Indicator Bacteria	5A	2025
Toxicity	5A	2029

* Category 5A indicates a water segment where standards are not met and a TMDL is required, but where a TMDL has not yet been approved by USEPA. Category 5B indicates a water segment where standards are not met and a TMDL is required, and where the pollutant is currently being addressed by a USEPA-approved TMDL.

4. Pollutants of concern

The Site Characterization table in Section 3.1 lists the pollutants expected to be generated from the site. The pollutants of concern are pollutants expected to be generated from the site that are also contributing to water quality impairments in the receiving waters downstream of the site. The pollutants of concern are as follows:

- Metals (Aliso Creek, Santiago Creek Reach 4)
- Nutrients (Aliso Creek)
- Pathogens (Aliso Creek, Aliso Creek (Mouth), Pacific Ocean Shoreline, Aliso HAS at Aliso Creek Mouth)
- Toxic Organic Compounds (Santiago Creek Reach 4, Aliso Creek, Aliso Creek (Mouth), Pacific Ocean Shoreline, Aliso HAS at Aliso Creek Mouth)

5. Methods for determining stream susceptibility

Downstream channels are considered susceptible to hydromodification if any downstream conveyance channels that will receive runoff from the Project are not engineered, hardened, or regularly maintained to ensure design flow capacity. Both the Santiago Creek and Aliso Creek are not engineered or hardened and are susceptible to hydromodification according to the TGD Susceptibility Analysis Map and South Orange County Engineered Channel Exemption Areas Map.

6. Environmentally sensitive areas (ESAs) and Areas of Special Biological Significance (ASBS)

The Project does not discharge directly to an ESA or an ASBS.

7. Potential hydrologic conditions of concern (HCOC)

Though the downstream channels are susceptible to hydromodification, the difference between the pre-project volume and time of concentration and the post-project volume and time of concentration for a 2-year 24-hour storm do not exceed the 5% threshold. Hydromodification Exhibits and Calculations are included in Attachment 10.

3.3 Preliminary Infiltration Investigation

Section 3.3 is required only for ***Type 1: Priority Projects***.

A preliminary infiltration investigation is required for all Type 1: Priority Projects. Infiltration BMPs are prioritized on the hierarchy of BMPs; therefore, infiltration testing is necessary to determine feasibility for full or partial infiltration.

Testing shall seek to characterize the infiltration rates at the likely elevation of the infiltration BMPs, but it is recognized that design-level BMP elevations may not be known at this time. Spacing of tests shall be determined based on the variability of conditions. This can be informed by other information about the soils and geology within the Project, such as previous geotechnical investigations. In sites with uniform conditions, a minimum of three tests per site is recommended, coupled with review of other information to interpolate or extrapolate from test results. For larger or more varied sites, additional tests may be needed. Testing locations shall be focused where other soils and geologic data suggests that infiltration is most likely to be feasible.

As described in Section 2.3.1.3 of the SOC WQMP TGD, the goal of this investigation shall be to identify potentially suitable areas for infiltration. **Table 3-1** below, correlates feasibility potential to ranges for the feasibility screening infiltration rate (K_{screen}) and is intended to guide decision making. Note that K_{screen} is equivalent to the observed saturated infiltration rate (K_{obs}) divided by a factor of 2.

Table 3-1 Preliminary Infiltration Feasibility as Indicated by K_{screen}

Infiltration Rate	Indication	Infiltration BMP Category
K_{screen} > 2 in/hr	Highest potential for full infiltration	Full Infiltration
0.3 in/hr < K_{screen} < 2 in/hr	Full infiltration BMPs may be possible, but conditions may be marginal and require more thorough analysis or contingency planning as part of BMP selection	Full Infiltration or Partial Infiltration
0.05 in/hr < K_{screen} < 0.3 in/hr	Incidental infiltration may be possible	Partial Infiltration
K_{screen} < 0.05 in/hr	Negligible infiltration potential	No Infiltration

As part of the planning/screening phase, review of Natural Resources Conservation Service (NRCS) soils maps (provided in Appendix N.1 of the SOC WQMP TGD) and available information may be conducted by the Project design professional. Simple open pit testing may also be conducted by the Project design professional. These forms of testing do not require a report separate from the WQMP. Other types of tests must be conducted by a licensed professional geotechnical engineer or registered geologist. These types of testing require reporting.

A Preliminary Infiltration Investigation Report shall be included as **Attachment 1,** and it shall include a description of methods, identification of other data source uses, geologic setting, testing locations, testing results, interpretation of findings, and a graphical identification of ranges of infiltration rate (if applicable). The Report shall also discuss findings related to seasonal high groundwater, infiltrating into plumes or hazardous areas, and groundwater wells and associated buffer areas. Section 4.2.2.1 of the SOC WQMP TGD provides additional factors related to infiltration feasibility, if applicable, shall be included in the Report.

The results from the Preliminary Infiltration Investigation will be necessary for determining Infiltration Feasibility within the drainage management areas (DMAs) identified in **Section 5.2**.

4. Site Design BMPs for Non-Priority Projects

Section 4 is required for *Type 3: Non-Priority Projects*.

The purpose of this Section is to document the selected and implemented site design BMPs and source control BMPs.

4.1 Site Design BMPs

Site Design BMPs reduce the volume of stormwater runoff generated on a project site as well as improve the quality of runoff that leaves the site, and are required for all proposed Non-Priority Projects. Descriptions of the most common Site Design BMPs are provided in the NOC and SOC WQMP TGDs. Complete **Table 4-1** below. All incorporated site design BMPs must be included in the BMP Exhibit, further discussed in **Section 9**, and on the construction plan set.

Table 4-1 Site Design BMPs for Non-Priority Projects

Site Design BMP	Included	Brief Description
Hydrologic Source Controls (HSCs)		
Localized On-Lot Infiltration[1]	☐	
Impervious Area Dispersion[2]	☐	
Street Trees[3]	☐	
Amended Soils Over Tight Underlying Soils	☐	
Residential Rain Barrels (Not Actively Managed)	☐	
Infiltration		
Bioretention without Underdrains	☐	
Rain Gardens	☐	
Porous Landscaping	☐	
Infiltration Planters	☐	
Retention Swales	☐	

[1] Also known as Downspout Infiltration, Retention Grading, French Drains, or On-Lot Rain Gardens
[2] Also known as Downspout Dispersion, Downspout Disconnection, Impervious Area Disconnection, or Sheet Flow Dispersion
[3] Also known as Canopy Interception

Site Design BMP	Included	Brief Description
Infiltration Trenches	☐	
Infiltration Basins	☐	
Subsurface Infiltration Galleries	☐	
French Drains	☐	
Permeable Asphalt	☐	
Permeable Concrete	☐	
Permeable Concrete Pavers	☐	
Evapotranspiration		
Green Roofs, Brown Roofs, Blue Roofs	☐	
Rainwater Harvesting		
Above-ground Rain Barrels	☐	
Above-ground Cisterns	☐	
Underground Tanks	☐	
Biotreatment		
Bioretention with Underdrains	☐	
Stormwater Planter Boxes with Underdrains	☐	
Rain Gardens with Underdrains	☐	
Constructed Wetlands	☐	
Vegetated Swales	☐	
Vegetated Filter Strips	☐	
Compost-Amended Road Shoulders	☐	
Proprietary (Ready-To-Install) Vegetated Biotreatment Systems	☐	

4.2 Other BMPs

Other BMPs, such as Treatment Control BMPs (sand filters, cartridge media filters) or Pretreatment BMPs (hydrodynamic separation devices, catch basin inserts), may be appropriate under certain conditions. Please provide details on any other BMPs selected for this Project. All incorporated BMPs must be included in the BMP Exhibit, further discussed in Section 9, and on the construction plan set.

Other BMPs
INSERT DETAILS HERE OR INSERT N/A

5. Site Design and Drainage Plan

Section 5 is required for ***Type 1: Priority Projects*** and ***Type 2: Green Street Projects***.

The purpose of this Section is to develop the site design and drainage plan incorporating all applicable site design BMPs and source control BMPs, and to determine the locations for structural BMPs by dividing the site into separate drainage management areas (DMAs). For Priority Projects in NOC, this section will also establish Project performance criteria and document conformance with performance criteria.

5.1 Project Performance Criteria – NOC Only

Section 5.1 is required for ***NOC Type 1: Priority Projects and Type 2: Green Street Projects***.

Project Performance Criteria	
1. Is there an approved Watershed Infiltration and Hydromodification Management Plan (WIHMP)[1] or equivalent for the Project area that includes more stringent LID feasibility criteria or opportunities identified for implementing LID on regional or sub-regional basis? If so, describe the WIHMP feasibility criteria or regional/sub-regional LID opportunities:	
☐	A WIHMP applies. A description will be included as **Attachment 2**.
☒	A WIHMP is not applicable.
2. If HCOCs exist, identify applicable hydromodification control performance criteria. Check all that apply.	
☐	Post-development runoff volume for the 2-year, 24-hr storm event ($V_{2\text{-yr, POST}}$) exceeds that of the pre-development condition ($V_{2\text{-yr, PRE}}$) by more than 5%, thereby requiring hydromodification controls.
☐	Post-development time of concentration for the 2-year, 24-hr storm event ($Tc_{2\text{-yr, POST}}$) is less than that of the pre-development condition ($Tc_{2\text{-yr, PRE}}$) by more than 5%, thereby requiring hydromodification controls.
☒	HCOC do not exist within the Project area. Exhibits and/or calculations will be provided as **Attachment 10** demonstrating as such.
3. List applicable LID performance criteria. Check all that apply.	
☐	Selected BMPs will infiltrate, harvest and use, or evapotranspire the runoff from the 85th percentile, 24-hour storm event (Design Capture Volume, or DCV).
☒	Infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full DCV; and therefore a properly designed biotreatment system will be considered to treat the runoff from the 85th percentile, 24-hour storm event.
4. List applicable structural treatment control BMP performance criteria.	
☐	Implemented LID BMPs (including biotreatment) are insufficient in treating the full DCV; therefore, structural treatment control BMPs are necessary and will treat the 85th percentile, 24-hour storm event.
☐	The full DCV is treated by LID BMPS; therefore, structural treatment control BMPs are not necessary.

[1]As of December 2019, no WIHMP exists in Orange County.

5.2 DMA Delineation and BMP Site Selection

Section 5.2 is required for all *Type 1: Priority Projects and Type 2: Green Street Projects*.

The Project site shall be delineated into DMAs per guidance provided in Section 2.4.2.2. of the NOC WQMP TGD or per Section 2.4.3.3 of the SOC WQMP TGD and shall be shown on the BMP Exhibit, further discussed in **Section 9**. Upon delineation, locations for proposed structural BMPs within each DMA shall be identified. These locations, along with areas of potential pollutant generation, impervious and pervious areas, any sensitive environmental features, and infiltration rates (if applicable) shall all be included in the BMP Exhibit. DMAs shall be summarized in **Attachment 3**, referencing the IDs shown in the exhibit and providing the total area, percent impervious, and Design Capture Volume (DCV). BMPs shall be summarized in Table 5-2 below, providing the BMP ID as shown in the exhibit, infiltration feasibility, the DMA(s) for which it is providing treatment, and total DCV. Refer to the Preliminary Infiltration Investigation conducted per **Section 3.3** of this template to determine infiltration feasibility for each BMP. Infiltration Feasibility is not required for Type 2: Green Street Projects. Additional tables are provided in and are to be appended to the WQMP as **Attachment 3.** Instructions on how to calculate DCV are provided in Appendix III of the NOC WQMP TGD (Equation III.1) and Appendix E of the SOC WQMP TGD (Equation E.2). Calculations are to be included as **Attachment 4.**

Table 5-1 DMA Summary

DMA ID	Total Area	Imperviousness	DCV
	sf	%	cf
DMA-1	109,002	80.6%	6,852
DMA-2	151,697	81.0%	9,573

Table 5-2 BMP Summary

BMP ID	Infiltration BMP Category			Associated DMA(s)	Total DCV
	Full	Partial	No Infiltration	-	ac-ft
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		

A narrative is to be provided describing the rationale behind the selected drainage and site plan. At a minimum, the narrative shall include the following:

- Provide rationale and methodology for how the site was divided into DMAs and how BMP placement was selected;
- Describe how DMAs and BMP sites were located to maximize retention and site BMPs where infiltration is most feasible, to the extent practicable; and
- Describe any overriding factors affecting drainage and BMP location at the site.

DMA Delineation and BMP Justification

1. **Provide rationale and methodology for how the site was divided into DMAs and how BMP placement was selected.**

   DMA delineations were determined by delineating the portion of the disturbed area tributary to each waterbody (Aliso Creek for the South County portion of the Project, and Santiago Creek for the North County portion of the Project).

   The BMP Exhibit included in Attachment 12 and described in Section 9 shows the delineation of each DMA, and includes calculations for the amount of impervious surfaces and Design Capture Volume (DCV) calculations.

2. **Describe how DMAs and BMP sites were located to maximize retention and site BMPs where infiltration is most feasible, to the extent practicable.**

   The alignment and location of Modjeska Grade Road are constricted by right-of-way and topographic features. The roadway will be reconstructed to minimum widths to allow for vehicular traffic, as well as provide for a shoulder where feasible and drainage structures where required. The location of the project, in the canyons of Orange County, prevents the Project from implementing any BMPs that take up space. However, the extent of disturbed area on the Project was kept to a minimum, which minimizes the water quality impacts of the Project.

5.3 Additional Investigations for Priority Projects

Section 5.3 is required for all *Type 1: Priority Projects*.

The SOC WQMP TGD defines a hierarchy for BMP prioritization with full infiltration BMPs ranking first. Additionally, the TGD requires consideration of harvest and use for any BMPs for which full infiltration is not feasible. Therefore, to determine the feasibility of each, additional investigations are necessary. The flow chart in **Figure 5-1** below will guide the Plan Developer in determining which investigations are necessary. The sections below provide guidance related to these investigations.

5.3.1 Supplemental Infiltration Investigation

Infiltration BMPs are to be prioritized over any and all other LID BMPs. Therefore, for any BMPs for which "Full Infiltration" or "Partial Infiltration" is feasible, additional infiltration testing is required. This will provide more accurate infiltration rates compared to those provided by the Preliminary Infiltration Investigation. For BMPs for which "No Infiltration" was identified, additional testing is not necessary; however, documentation must be provided demonstrating the unlikelihood of infiltration feasibility. Refer to the NOC and SOC WQMP TGDs for appropriate criteria related to infeasibility and attach all relevant documentation as **Attachment 5**.

Infiltration testing must be conducted or overseen by a qualified professional; either a Professional Engineer (PE) or Registered Geologist licensed in the State of California, and shall be conducted at the location of the proposed BMP. The elevation of the tests shall correspond to the facility elevation, plus 1 to 2 feet to account for soil amendments or decompacted zones under the infiltration system. If a confining layer, or soil with a greater percentage of fines, is observed during the subsurface investigation to be within 6 feet of the bottom of the planned infiltration system, the testing shall be conducted within that confining layer. The boring logs shall continue to at least 15 feet below the invert of the proposed BMP. Borings shall be conducted at each test location.

The recommended number of infiltration tests depends up on the footprint size and the soil variability. The following guidance is provided to estimate the number of tests per BMP:

- Three infiltration tests shall be conducted for every Full Infiltration BMP, conducted within the proposed BMP footprint or within 20 feet of the perimeter in representative soil formations.
- For Full Infiltration BMPs with footprints larger than 10,000 square feet, conduct one additional test for every 10,000 square feet of BMP footprint area after the first 10,000 square feet. For example, if a large BMP had an infiltration area of 30,000 square feet, 5 tests shall be conducted (3 for the first 10,000 square feet, 1 for the next 10,000, and 1 for the next 10,000).
- One test for every 100 lineal feet of infiltration facility.
- In general, no more than five valid tests are required per BMP of any footprint, unless more tests would be valuable or necessary (at the discretion of the qualified professional assessing the site, as well as the reviewing jurisdiction).

These recommendations may need to be reduced or increased at the discretion of the Plan Developer and reviewing jurisdiction depending on the complexity and variability of the site.

Reporting shall include:

- Name and qualifications of preparer;
- Scope of investigation, including description of methods, identification of other data source uses;
- Geologic setting;
- Testing locations and depths;
- Testing results;
- Testing records and description of specific measurements;

- Interpretation of findings, including consideration of limiting horizons or groundwater conditions that could limit full scale infiltration;
- Confirmation or adjustment of preliminary infiltration screening (i.e. Is it acceptable to utilize full infiltration BMPs?); and
- Recommended component of the overall factor of safety that is appropriate to account for variability or uncertainty in testing.

For each BMP-site-specific K_{obs} provided by the Supplementary Infiltration Investigation, calculate the updated K_{screen}. Then, using **Table 5-3** below, identify the updated infiltration feasibility the K_{screen} correlates to. Record results in **Table 5-4.**

Table 5-3 Updated Infiltration Feasibility

Infiltration Rate	Infiltration BMP Category
K_{screen} > 2 in/hr	Full Infiltration
0.3 in/hr < K_{screen} < 2 in/hr	Full Infiltration or Partial Infiltration
0.05 in/hr < K_{screen} < 0.3 in/hr	Partial Infiltration
K_{screen} < 0.05 in/hr	No Infiltration

5.3.2 Harvest and Use Investigation

As discussed, full infiltration BMPs shall be implemented wherever feasible; however in the case that full infiltration is not feasible, harvest and use must first be considered before any biotreatment BMP can be considered. For BMPs for which "Partial Infiltration" or "No Infiltration" was identified, either in Table 5-2 or by the Supplemental Infiltration Investigation, harvest and use feasibility must be determined. Harvest and use feasibility criteria is provided in Section 4.2.3 of the SOC WQMP TGD. Record results in **Table 5-4** below. Note that harvest and use is not required if found feasible.

5.3.3 Results from Additional Investigations

In **Table 5-4** below, summarize the results from the investigations conducted per **Section 5.3.1** and **Section 5.3.2**. Additional tables are provided in and shall be attached as **Attachment 6**.

Table 5-4 Infiltration and Harvest and Use Feasibility

BMP ID	Infiltration Feasibility			Harvest and Use Feasibility		
	Full	Partial	No Infiltration	Feasible	Not Feasible	NA
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐

6. Site Design BMPs for Priority Projects

Section 6 is required for *Type 1: Priority Projects*.

Site Design BMPs reduce the volume of stormwater runoff generated on a project site as well as improve the quality of runoff that leaves the site. Site Design BMPs are required for all proposed Priority Projects and shall be included in the BMP Exhibit, discussed further in **Section 9**, and the construction plan set.

6.1 Selection of Site Design BMPs

Refer to Section 2.5 of the SOC WQMP TGD for BMP selection Guidance.

6.2 Site Design BMP Calculations

Attachment 7 contains Priority Project BMP Conformance Analysis Tables for NOC and SOC. One set of tables must be completed for each DMA listed in **Section 5.2** above. Note that a single set of tables may be completed for multiple DMAs if BMPs are shared (i.e. one BMP is designed to treat runoff from multiple DMAs). Be sure to include the DMA ID (or list of DMA IDs) and the corresponding DCV (or sum of DCVs) in each table.

This WQMP Template includes just one set of BMP Conformance Analysis Tables for NOC and SOC. The Plan Developer must include as many sets of tables as necessary to evaluate all DMAs. Each additional set of tables is to be appended within **Attachment 7**.

All calculations are to be included in **Attachment 8**. Calculation procedures shall be in accordance with Appendix E of the SOC WQMP TGD for South Orange County projects, and with Appendix III of the NOC WQMP TGD for North Orange County projects.

6.3 Inventory of BMPs

Using **Table 6-1** below, provide a summary of all HSCs, LID BMPs, Treatment Controls, and/or Regional/Sub-Regional BMPs implemented by the Project. Include the BMP type, treatment capacity, associated DMA(s), and corresponding DCV/Total DCV.

Table 6-1 Priority Project BMP Inventory

BMP ID	BMP Type	Treatment Capacity / DCV Reduction	Associated DMA(s)	DCV / Total DCV
		ac-ft	-	ac-ft
Total DCV Reduction =	ac-ft	Is compliance achieved? ☐ Yes ☐ No		
Total DCV =	ac-ft			

7. Site Design BMPs for Green Street Projects

Section 7 is required for *Type 2: Green Street Projects*.

Generally, Green Street Projects must follow the same criteria as Type 1: Priority Projects regarding site design and drainage management area assessments (see **Section 3** of this template). Green Street Projects must also delineate drainage management areas and determine the DCV for each DMA (see **Section 5** of this template).

The Municipal Separate Storm Sewer System (MS4) Permit cites the requirement that Plan Developers utilize the USEPA municipal handbook "Managing Wet Weather with Green Infrastructure – Green Streets" as guidance for selecting appropriate BMPs. Because street projects typically feature more constraints in terms of utilities, structures, and traffic flow, certain BMPs are a better choice than others for Green Street Projects. The MS4 Permit requires that Plan Developers of applicable Green Streets Projects shall select BMPs consistent with the USEPA Green Streets guidance to the "Maximum Extent Practicable". The "Maximum Extent Practicable" standard is intended to be a relatively stringent standard. Developers of Green Streets Projects must follow a BMP prioritization and selection process for each DMA and must exhaust every physical possibility before declaring that capturing and treating the DCV is not possible.

The following steps are used to size LID BMPs for applicable Green Street Projects.

1. Complete site and watershed characterization (**Section 3**).
2. Delineate DMAs and compute the DCV per each DMA (**Section 5**)
3. For each DMA identified in Step 2, select one or more BMPs consistent with USEPA Green Streets guidance. Refer to Section 2.9.4 of the SOC WQMP TGD for more information. Selected BMPs shall be included in the BMP Exhibit (discussed further in **Section 9)**, and the construction plan set.
4. Complete the tables in **Attachment 9** for each DMA identified in Step 2. Note that a single set of tables may be completed for multiple DMAs if BMPs are shared (i.e. one BMP is designed to treat runoff from multiple DMAs). Be sure to include the DMA ID (or list of DMA IDs) and the corresponding DCV (or sum of DCVs) in each table. This WQMP Template includes just one set of BMP Conformance Analysis Tables. The Plan Developer must include as many sets of tables as necessary to evaluate all DMAs. Each additional set of tables is to be appended within **Attachment 9**. All calculations are to be included in **Attachment 8**. Calculation procedures shall be in accordance with Appendix E of the SOC WQMP TGD for South Orange County projects, and with Appendix III of the NOC WQMP TGD for North Orange County projects.
5. If LID or hydromodification sizing criteria cannot be achieved, document the constraints that override the application of BMPs, and provide the largest portion of the sizing criteria that can be reasonably provided given constraints.

7.1 Inventory of BMPs

Using **Table 7-1** below, provide a summary of all HSCs, LID BMPs, and/or Treatment Controls BMPs implemented by the Project. Include the BMP type, treatment capacity, associated DMA(s), and corresponding DCV/Total DCV.

Table 7-1 Green Street Project BMP Inventory

BMP ID	BMP Type	Treatment Capacity / DCV Reduction	Associated DMA(s)	DCV / Total DCV
		CF	-	CF
N/A				
Total DCV Reduction =	0 CF	Is compliance achieved? ☐ Yes ☒ No		
Total DCV =	16,425 CF			
See documented constraints on the following page and in Attachment 9				

Documented Constraints for Green Street BMPs

Hydrologic Source Controls (HSCs)

HSC-3: Street Trees:
Street trees are infeasible for the Project because there is insufficient room to plant street trees, and they are out of character for the Project area.

Open Graded Friction Course:
The County has confirmed that open graded friction course is not feasible due to issues with mudslides and debris.

Infiltration BMPs

Infiltration BMPs are infeasible on the Project due to soils within Hydrologic Soil Group D, and due to areas of the Project being within a potential landslide area, according to NOC TGD Figures XVI-2b and XVI-2c.

LID BMPs (Biotreatment)

BIO-1: Bioretention with Underdrains:
Bioretention facilities are infeasible on the Project because there is insufficient room to provide BMPs while adhering to landslide hazards and setback requirements. The longitudinal profile of the Project is hilly and steep, and the slopes outside of the roadway prism are even steeper.

BIO-2: Vegetated Swale:
Vegetated swales require a minimum bottom width of two feet and a maximum longitudinal slope of 6%. Steep longitudinal slopes greater than 6% are present in over 90% of the Project, and the slopes approach 17% in some locations. For the remaining 10% of the Project with longitudinal slopes less than 6%, the narrow right-of-way of the Project prevents a swale design of adequate width. Therefore, vegetated swales are infeasible on the Project.

BIO-3: Vegetated Filter Strip:
Vegetated swales require slopes between 1% and 6% in the direction of flow, with a cross slope perpendicular to the flow of less than 2%. They require a minimum of 15 feet of length in the direction of flow. These conditions are not available at any point within the Project due to the Project's narrow right-of-way and steep longitudinal and cross slopes.

BIO-7: Proprietary Biotreatment:
Proprietary biotreatment structures are manufactured devices made to treat stormwater, and typically include infiltration media with a high infiltration rate. They are especially susceptible to clogging and should not be used in areas that will continue to receive elevated sediment loading from open space areas. They are also more typically found in urban environments, where their concrete-box-like appearance is more in character with the surroundings. Because the Project is located in a landslide hazard area, and there are known erosion and sedimentation issues at the site, proprietary biotreatment is infeasible on the Project.

Treatment Control BMPs

TRT-1: Sand Filter:
Sand filters have the same space requirements as bioretention basins. Sand filters are therefore infeasible on the Project because of the insufficient right-of-way and steep slopes.

TRT-2: Cartridge Media Filter
Cartridge media filters are manufactured devices similar to proprietary biotreatment units. Cartridge media filters are infeasible due to the high likelihood of erosion and sedimentation on the Project, and they are out of character for the Project area.

Summary

Table 2-14 in the SOC TGD lists BMP types and opportunity criteria applicable to Type 2: Green Streets Projects. Each of the BMPs listed in that table was covered in the preceding section and was deemed infeasible for each DMA on the Project. The Maximum Extent Practicable standard is achieved for the Project, as no post-construction BMPs are feasible given the Project's many constraints.

8. Hydromodification BMPs

Section 8 is required for *Type 1: Priority Projects* and *Type 2: Green Street Projects*.

Priority Projects and Green Street Projects are required to determine whether HCOCs exist as a result of the Project. Use the appropriate table below to identify whether or not HCOCs exist and whether a Hydromodification Management Plan is necessary. Note that criteria for NOC and SOC are different.

Determination of HCOCs within NOC			
Do HCOCs exist?		**Reasoning**	
☒	No	☒	The volumes and the time of concentration of storm water runoff for the post-development condition do not significantly exceed those of the pre-development condition for a two-year frequency storm event (a difference of 5% or less is considered insignificant). This may be achieved through site design and source control BMPs.
		☐	All downstream conveyance channels that will receive runoff from the Project are engineered, hardened, and regularly maintained to ensure design flow capacity, and no sensitive stream habitat areas will be affected.
☐	Yes	☐	None of the conditions above are met.

Determination of HCOCs within SOC			
Do HCOCs exist?		**Reasoning**	
☐	No	☐	Project discharges directly to a protected conveyance (bed and bank are concrete lined the entire way from the point(s) of discharge to a receiving lake, reservoir, embayment, or the Ocean.
		☐	Project discharges directly to storm drains which discharge directly to a reservoir, lake, embayment, ocean, or protected conveyance.
		☐	The Project discharges to an area identified in the Water Management Area Analysis as exempt from hydromodification concerns.
☒	Yes	☒	None of the conditions above are met.

If HCOCs do not exist for the Priority Project or Green Streets Project, exhibits and/or calculations must be provided as **Attachment 10** demonstrating such.

If HCOCs do exist, additional documentation demonstrating mitigation of possible hydromodification is necessary. Include said documentation as **Attachment 11**. Structural BMPs, if incorporated, shall be included in the BMP Exhibit, discussed further in **Section 9**, and the construction plan set. Note that SOC, specifically, requires a Hydromodification Management Plan. Refer to the SOC WQMP TGD for additional information.

9. BMP Exhibit

Section 9 is required for ***Type 1: Priority Projects, Type 2: Green Street Projects,*** and ***Type 3: Non-Priority Projects***.

An exhibit is to be included with the WQMP/WQP/NPP beginning with the Draft submission due at the 65% Design phase and is to be updated for all submissions up to the Final WQMP/WQP/NPP due at Project completion. Exhibit elements vary depending on the required document type (WQMP, WQP, or NPP) and Project location. Refer to the checklist below for exhibit requirements. Note that items in bold should also be including in the Project's construction plan set.

BMP Exhibit Requirements	
☒	Minimum 24" x 36" sheet
☒	Title block including the Project name, Project file number (as assigned by County), and grading/building or planning application permit numbers, as applicable
☐	Project location (including address, drainage plot plan, tract/lot number(s), etc.)
☒	Legend, north arrow, and scale
☐	Plan Developer name and stamp
☒	Site boundary
☐	Downstream receiving water(s) of the Project, any 303(d) listed or TMDL water bodies, and any hydromodification susceptible water bodies
☐	Land uses and land covers, as applicable
☒	**Each facility and its intended function**
☒	Areas of outdoor activities, as applicable
☒	**Drainage delineations and flow information**
☒	**Key topographic features, environmentally sensitive features, natural drainage courses, and other relevant information**
☒	Relationship between onsite drainage and offsite drainage including all drainage connections
☒	**Stormwater management infrastructure including storm drain facilities**
☐	Conditions relevant to infiltration feasibility findings (as applicable), such as, but not limited to, surficial soil properties, depth to groundwater, and geotechnical hazards, locations of infiltration testing, factors influencing demonstrated space constraints or vertical constraints
☒	**Locations and types of all structural BMPs including, as applicable**
☒	**GIS coordinates for all structural BMPs, as applicable**
☒	**BMP details with detailed design parameters relevant to sizing calculations, as applicable**

10. Source Control BMPs

Section 10 is required for ***Type 1: Priority Projects, Type 2: Green Street Projects,*** and ***Type 3: Non-Priority Projects***.

Source Control BMPs, both non-structural and structural, are required for Priority Projects, Green Street Projects, and Non-Priority Projects where applicable to Project features. Please identify the applicable Source Control BMPs within **Table 10-1** and **Table 10-2** below. For any BMP marked "Not Included", an explanation is required and shall be provided at the bottom of the table. All structural BMPs marked "included" shall be included in the BMP Exhibit discussed in **Section 9**, and in the construction plan set.

Table 10-1 Structural Source Control BMPs

Identifier	Name	Included	Not Included	Not Applicable
S1	Provide storm drain system stenciling and signage	☒	☐	☐
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☐	☒
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☐	☒
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☐	☐	☒
S5	Protect slopes and channels and provide energy dissipation	☒	☐	☐
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☐	☒
S6	Dock areas	☐	☐	☒
S7	Maintenance bays	☐	☐	☒
S8	Vehicle wash areas	☐	☐	☒
S9	Outdoor processing areas	☐	☐	☒
S10	Equipment wash areas	☐	☐	☒
S11	Fueling areas	☐	☐	☒
S12	Hillside landscaping	☐	☐	☒
S13	Wash water control for food preparation areas	☐	☐	☒
S14	Community car wash racks	☐	☐	☒
For any Source Control BMPs marked "Not Included" briefly state reasoning:				
INSERT REASONING HERE				
Describe implementation frequency for each Source Control BMP.				
INSERT DESCRIPTION HERE				

Table 10-2 Non-Structural Source Control BMPs

Identifier	Name	Included	Not Applicable	Not Included
N1	Education for Property Owners, Tenants and Occupants	☐	☒	☐
N2	Activity Restrictions	☐	☒	☐
N3	Common Area Landscape Management	☐	☒	☐
N4	BMP Maintenance	☐	☒	☐
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	☐
N6	Local Industrial Permit Compliance	☐	☒	☐
N7	Spill Contingency Plan	☐	☒	☐
N8	Underground Storage Tank Compliance	☐	☒	☐
N9	Hazardous Materials Disclosure Compliance	☐	☒	☐
N10	Uniform Fire Code Implementation	☐	☒	☐
N11	Common Area Litter Control	☐	☒	☐
N12	Employee Training	☐	☒	☐
N13	Housekeeping of Loading Docks	☐	☒	☐
N14	Common Area Catch Basin Inspection	☐	☒	☐
N15	Street Sweeping Private Streets and Parking Lots	☐	☒	☐
N16	Retail Gasoline Outlets	☐	☒	☐
For any Source Control BMPs marked "Not Included" briefly state reasoning:				
INSERT REASONING HERE				
Describe implementation frequency for each Source Control BMP.				
INSERT DESCRIPTION HERE				

11. Educational Material

Section 11 is required for ***Type 1: Priority Projects***.

Educational materials specifically applicable to the Project must be identified. Identify the applicable educational materials below. Listed materials are available in the provided web links and are not to be included in the WQMP submission; however, additional materials specific to the Project may be included and must be attached as **Attachment 13**.

Educational Material	
Title	**Check If Applicable**
Residential Material (https://h2oc.org/resources/view-order-brochures/resident-brochures/)	
The Ocean Begins at Your Front Door	☐
Tips for Protecting Your Watershed	☐
Proper Disposal of Household Hazardous Waste	☐
Homeowners Guide for Sustainable Water Use	☐
Household Tips	☐
Tips for the Home Mechanic	☐
Recycle at Your Local Used Oil Collection Center (North County)	☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐
Recycle at Your Local Used Oil Collection Center (South County)	☐
Tips for the Home Improvement Projects	☐
Tips for Using Concrete and Mortar	☐
Tips for Projects Using Paint	☐
Sewage Spill Reference Guide for Private Property Owners	☐
Tips for Maintaining a Septic Tank System	☐
Tips for Landscaping and Gardening	☐
Tips to Prevent Overwatering	☐
Responsible Pest Control	☐
Tips for Pet Care	☐
Tips for Horse Care	☐
Tips for Pool Maintenance	☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐
Children's Watershed Workbook	☐
Coloring and Activity Booklet Brochure	☐
Tips for Car Wash Fundraisers	☐
Business Material (https://h2oc.org/resources/view-order-brochures/business-brochures/)	
Tips for the Automotive Industry	☐
Tips for the Food Service Industry	☐
Proper Maintenance Practices for Your Business	☐
Compliance BMPs for Mobile Businesses	
Water Quality Requirements for Land Development	

Other Material	Check if Attached
	☐
	☐
	☐
	☐
	☐

12. Routine Inspections, Operations, and Maintenance

Section 12 must be completed for ***Type 1: Priority Projects, Type 2: Green Street Projects,*** and ***Type 3: Non-Priority Projects***.

12.1 Inspection / Maintenance Responsibilities

Structural BMPs implemented by Priority Projects, Green Street Projects, and Non-Priority Projects must be regularly inspected and maintained post-construction for proper effectiveness into perpetuity. For each BMP implemented by the Project, document inspection and maintenance information within **Table 12-1**. Additional tables are provided in and are to be appended as **Attachment 14**.

Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agency.

12.2 Operations and Maintenance Plan

Section 12.2 must be completed for ***Type 1: Priority Projects and Type 2: Green Street Projects***.

Plan Developers of Type 1: Priority Projects and Type 2: Priority Green Street Projects are required to prepare a comprehensive O&M Plan for structural BMPs implemented as part of the Final WQMP submittal. Refer to Section 7 of the NOC WQMP TGD, and Section 2.8 of the SOC WQMP TGD for guidance related to the O&M Plan.

The O&M Plan submitted at the 100% Design phase of the final WQMP must describe the designated party responsible for maintenance, inspection/maintenance activities required, and maintenance frequency. The O&M Plan included in the WQMP is intended to be a starting point for maintenance activities that will take place in the future. Site specific conditions will determine the final maintenance requirements of the site over time, and that ultimately maintenance frequency is set by OC Public Works' asset management system.

The O&M Plan is to be included as **Attachment 15.**

Table 12-1 BMP Inspection and Maintenance Responsibilities

BMP	DMA	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities

13. Discretionary Permits and Water Quality Conditions

Section 13 is required for *Type 1: Priority Projects* and *Type 2: Green Street Projects*.

13.1 Discretionary Permits

List the discretionary permit(s) applicable to the Project and provide the site address or lot and tract/parcel map number describing the property for which the permit was issued.

Permit	Site Address/Lot and Tract/Parcel Map Number
INSERT PERMIT NAME HERE	INSERT ADDRESS HERE
INSERT PERMIT NAME HERE	INSERT ADDRESS HERE
INSERT PERMIT NAME HERE	INSERT ADDRESS HERE
INSERT PERMIT NAME HERE	INSERT ADDRESS HERE
INSERT PERMIT NAME HERE	INSERT ADDRESS HERE

13.2 Water Quality Conditions

List the conditions verbatim, any Water Quality Conditions, including the condition requiring preparation of WQMP, if applicable. Water Quality Conditions may be included as mitigation measures in California Environmental Quality Act (CEQA) documents for the Project. For example, a Mitigation Monitoring and Report Program adopted in a certified CEQA document may include Project Design Features, Standard Conditions, and Mitigation Measures related to water quality protection.

Water Quality Condition
DESCRIBE CONDITION HERE
DESCRIBE CONDITION HERE
DESCRIBE CONDITION HERE
DESCRIBE CONDITION HERE
DESCRIBE CONDITION HERE

14. Submittal Process

A Draft WQMP/WQP/NPP is required at each phase of the Project (Initiation, 35% Design, 65% Design, 90% Design, as applicable) with the Final WQMP submitted at 100% Design. Drafts shall include all required sections as detailed in **Section 1** and shall be submitted at the specified Project Phase as well as the phases that follow. All sections shall be updated prior to each Draft and the Final submission to reflect the latest Project design.

The OC Environmental Resources Division and Operations and Maintenance Division will review the WQMP/WQP/NPP at all stages of design. Upon completion and submission of the Final WQMP/WQP/NPP, both Divisions will review the plan and if approved, no further action is required of the Plan Developer. If the plan is not approved, comments will be provided to the Plan Developer which shall be addressed prior to resubmission. It is expected that the ultimate owner of these public facilities will be involved throughout the design phase.

During construction, the OC Construction Division will conduct inspections on all construction processes related to the structural BMPs identified in the Final WQMP/WQP/NPP. Inspections will monitor construction processes to ensure that the BMPs are designed according to the approved plan. Inspection forms must be completed and submitted to the OC Construction Division by the Inspector for every required inspection. A BMP Inspection Record, available in **Attachment 16**, shall be kept on site by the Contractor and updated following each inspection. Provided that BMPs are constructed according to the approved design plan and modifications are not necessary post construction, responsibility for maintenance of the BMPs will be transferred to the parties identified in **Section 12**.

Following the transfer of responsibility, the following forms will be sent to and filed by the following departments. The Transmittal Page shall be included with every submittal.

Table 14-1 Document Transfer Guide

Recipient	Document(s)
During Project Design	
OC Environmental Resources OC Operations and Maintenance Division OC Facilities Maintenance	➢ All Sections
After Plan Approval, Before Construction Completion	
OC Construction Division	➢ Section 9 – BMP Exhibit ➢ Attachment 12 – BMP Exhibit ➢ Attachment 16 – BMP Inspection Record
After Construction Completion and Project Acceptance by County	
OC Operations and Maintenance Division (for Type 1: Priority Projects not involving buildings or parking lots; all Type 2: Green Street Projects)	➢ Table 6-1 / Table 7-1 - BMP Inventory ➢ Section 9 – BMP Exhibit ➢ Section 10 – Source Control BMPs ➢ Section 12 – Routine Inspections, Operations, and Maintenance ➢ Attachment 12 – BMP Exhibit ➢ Attachment 14 – Additional BMP Inspection and Maintenance Responsibility Tables ➢ Attachment 15 – Operations and Maintenance Plan
OC Facilities Maintenance (for Type 1: Priority Projects involving buildings or parking lots)	➢ Table 6-1 – BMP Inventory ➢ Section 9 - BMP Exhibit ➢ Section 10 – Source Control BMPs ➢ Section 12 – Routine Inspections, Operations, and Maintenance ➢ Attachment 12 – BMP Exhibit ➢ Attachment 14 – Additional BMP Inspection and Maintenance Responsibility Tables ➢ Attachment 15 – Operations and Maintenance Plan
OC Parks Maintenance (for Type 1: Priority Projects and Type 2: Green Street Projects involving bikeways)	➢ Table 6-1 / Table 7-1 - BMP Inventory ➢ Section 9 – BMP Exhibit ➢ Section 10 – Source Control BMPs ➢ Section 12 – Routine Inspections, Operations, and Maintenance ➢ Attachment 12 – BMP Exhibit ➢ Attachment 14 – Additional BMP Inspection and Maintenance Responsibility Tables ➢ Attachment 15 – Operations and Maintenance Plan

15. Attachments

The following attachments may be required as part of the Project WQMP/WQP/NPP submittal. Refer to sections outlined below for more information.

Attachment		Section
Attachment 1	Preliminary Infiltration Investigation Report	3.3
Attachment 2	WIHMP Criteria and Opportunities (NOC Only)	5.1
Attachment 3	Additional DMA Delineation Tables	5.2
Attachment 4	DCV Calculations	5.2
Attachment 5	Supplementary Infiltration Investigation Report	5.3.1
Attachment 6	Additional Infiltration and Harvest and Use Feasibility Tables	5.3.3
Attachment 7	Additional Priority Project BMP Conformance Analysis Tables	6.2
Attachment 8	DCV Reduction Calculations	6.2
Attachment 9	Additional Green Street Project BMP Conformance Analysis Tables	7
Attachment 10	Hydromodification Exhibits and Calculations	8
Attachment 11	Hydromodification Management Plan	8
Attachment 12	BMP Exhibit	9
Attachment 13	Additional Educational Material	11
Attachment 14	Additional BMP Inspection and Maintenance Responsibility Tables	12.1
Attachment 15	Operations and Maintenance Plan	12.2
Attachment 16	BMP Inspection Record	14

Attachment 4

DCV Calculations

DCV Calculations – All DMAs

Impervious area = A_{imp}
Pervious area = A_{perv}
Total area = A = A_{imp} + A_{perv}

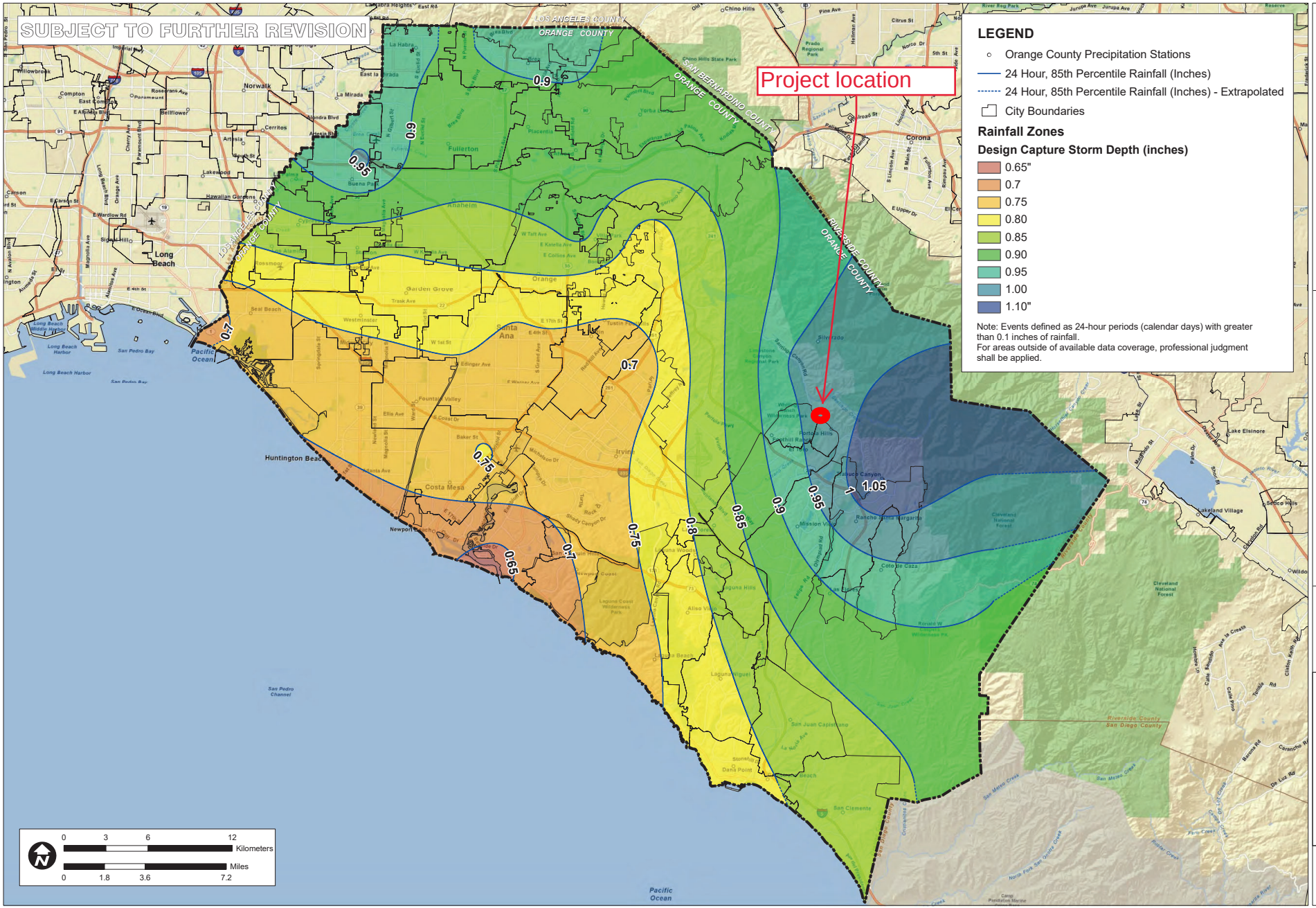
Impervious percentage = IMP = A_{imp} / A

Runoff coefficient = C = 0.75 × IMP + 0.15

85th percentile rainfall depth = d_{85} = 1.00" (see figure)

Design Capture Volume (cubic feet) = DCV = (C × d_{85} × A) / 12

DMA ID	A_{imp}	A_{perv}	A	IMP	C	DCV
	SF	SF	SF	%		CF
DMA-1	87,839	21,163	109,002	80.6%	0.754	6,852
DMA-2	122,827	28,870	151,697	81.0%	0.757	9,573
Total	**210,666**	**50,033**	**260,699**	**80.8%**		**16,425**



P:\9526\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

TITLE
RAINFALL ZONES

JOB
ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT
CA
ORANGE CO.

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/29/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-1

Attachment 9

Green Street Project BMP Conformance Analysis Tables

GREEN STREET PROJECT BMP CONFORMANCE ANALYSIS

DMA ID: All DMAs		**DCV =**	16,425 CF	
Hydrologic Source Controls				
Included	Site Design BMP		Fact Sheet	DCV Reduction
☐	Street Trees[4]		HSC-3	0 CF
Low Impact Development BMPs | Infiltration				
☐	Infiltration Trench[5]		INF-2	0 CF
☐	Bioretention with no Underdrain[6]		INF-3	0 CF
☐	Bioinfiltration with Raised Underdrain		INF-4	0 CF
☐	Drywell[7]		INF-5	0 CF
☐	Permeable Pavement[8]		INF-6	0 CF
☐	Underground Infiltration[9]		INF-7	0 CF
Low Impact Development BMPs | Biotreatment				
☐	Bioretention with Underdrains[10]		BIO-1	0 CF
☐	Vegetated Swale[11]		BIO-2	0 CF
☐	Vegetated Filter Strip[12]		BIO-3	0 CF
☐	Proprietary Biotreatment[13]		BIO-7	0 CF
Treatment Control BMPs				
☐	Sand Filter[14]		TRT-1	0 CF
☐	Cartridge Media Filter[15]		TRT-2	0 CF
		Total DCV Reduction =	0	**CF**
		Remaining DCV = DCV –Total DCV Reduction =	16,425	**ac-ft**

[4] Also known as Canopy Interception.
[5] Also known as French Drain, Rock Trench, Exfiltration Trench, Soak-Aways, or Soakage Trench.
[6] Also known as Rain Garden or Infiltration Planter.
[7] Also known as Soak-Away Pits, Infiltration Sumps, Rock Sumps, or Underground Injection Controls. Calculations for determining DCV reduction provided by drywells is highly site-specific. No template is provided. Drywells must be designed to ensure a drawdown time of 48 hours. Calculations for DCV reduction are to be provided in **Attachment 8**.
[8] Also known as Pervious Pavement, Porous Concrete, Pavers, or Permeable Asphalt.
[9] Also known as Subsurface Infiltration Galleries, Infiltration Vault, or Recharge Vault. For underground infiltration devices with open pore volume (e.g. vaults, crates, pipe sections, etc.), refer to the Infiltration Basin BMP Template. For underground infiltration devices with pore space (e.g. aggregate reservoirs), refer to the permeable Pavement BMP Template.
[10] Also known as Rain Gardens with Underdrains, Vegetated Media Filter, or Downspout Planter Boxes.
[11] Also known as Bioswale, Biofiltration Swale, or Grass Swale.
[12] Also known as Buffer Strip or Vegetated Buffer.
[13] Also known as Catch Basin Planter Box, Bioretention Vault, or Tree Box Filter. A calculation template is not provided for Proprietary Biotreatment. If implemented, calculations are required to be included in **Attachment 8**.
[14] Also known as Bed Media Filter.
[15] Also known as Manufactured Media Filters.

Check only one of the two boxes below:	
☐ Remaining DCV = 0 ac-ft	The DCV for this DMA is fully captured by the LID BMP(s) checked above. No additional BMPs are necessary, except hydromodification control BMPs if applicable.
☒ Remaining DCV > 0 ac-ft	The DCV for this DMA cannot feasibly be fully captured by LID BMPs. If LID or hydromodification sizing criteria cannot be achieved, document the constraints here. See below.

Documented Constraints for Green Street BMPs

Hydrologic Source Controls (HSCs)

HSC-3: Street Trees:
Street trees are infeasible for the Project because there is insufficient room to plant street trees, and they are out of character for the Project area.

Open Graded Friction Course:
The County has confirmed that open graded friction course is not feasible due to issues with mudslides and debris.

Infiltration BMPs

Infiltration BMPs are infeasible on the Project due to soils within Hydrologic Soil Group D, and due to areas of the Project being within a potential landslide area, according to NOC TGD Figures XVI-2b and XVI-2c.

LID BMPs (Biotreatment)

BIO-1: Bioretention with Underdrains:
Bioretention facilities are infeasible on the Project because there is insufficient room to provide BMPs while adhering to landslide hazards and setback requirements. The longitudinal profile of the Project is hilly and steep, and the slopes outside of the roadway prism are even steeper.

BIO-2: Vegetated Swale:
Vegetated swales require a minimum bottom width of two feet and a maximum longitudinal slope of 6%. Steep longitudinal slopes greater than 6% are present in over 90% of the Project, and the slopes approach 17% in some locations. For the remaining 10% of the Project with longitudinal slopes less than 6%, the narrow right-of-way of the Project prevents a swale design of adequate width. Therefore, vegetated swales are infeasible on the Project.

BIO-3: Vegetated Filter Strip:
Vegetated swales require slopes between 1% and 6% in the direction of flow, with a cross slope perpendicular to the flow of less than 2%. They require a minimum of 15 feet of length in the direction

of flow. These conditions are not available at any point within the Project due to the Project's narrow right-of-way and steep longitudinal and cross slopes.

BIO-7: Proprietary Biotreatment:
Proprietary biotreatment structures are manufactured devices made to treat stormwater, and typically include infiltration media with a high infiltration rate. They are especially susceptible to clogging and should not be used in areas that will continue to receive elevated sediment loading from open space areas. They are also more typically found in urban environments, where their concrete-box-like appearance is more in character with the surroundings. Because the Project is located in a landslide hazard area, and there are known erosion and sedimentation issues at the site, proprietary biotreatment is infeasible on the Project.

Treatment Control BMPs

TRT-1: Sand Filter:
Sand filters have the same space requirements as bioretention basins. Sand filters are therefore infeasible on the Project because of the insufficient right-of-way and steep slopes.

TRT-2: Cartridge Media Filter
Cartridge media filters are manufactured devices similar to proprietary biotreatment units. Cartridge media filters are infeasible due to the high likelihood of erosion and sedimentation on the Project, and they are out of character for the Project area.

Summary

Table 2-14 in the SOC TGD lists BMP types and opportunity criteria applicable to Type 2: Green Streets Projects. Each of the BMPs listed in that table was covered in the preceding section and was deemed infeasible for each DMA on the Project. The Maximum Extent Practicable standard is achieved for the Project, as no post-construction BMPs are feasible given the Project's many constraints.

Attachment 10

Hydromodification Exhibits and Calculations


2—7
2—5
2—4
2—3
2—2
2—1
1—8
1—6
1—5
1—4
1—3
1—2
1—1

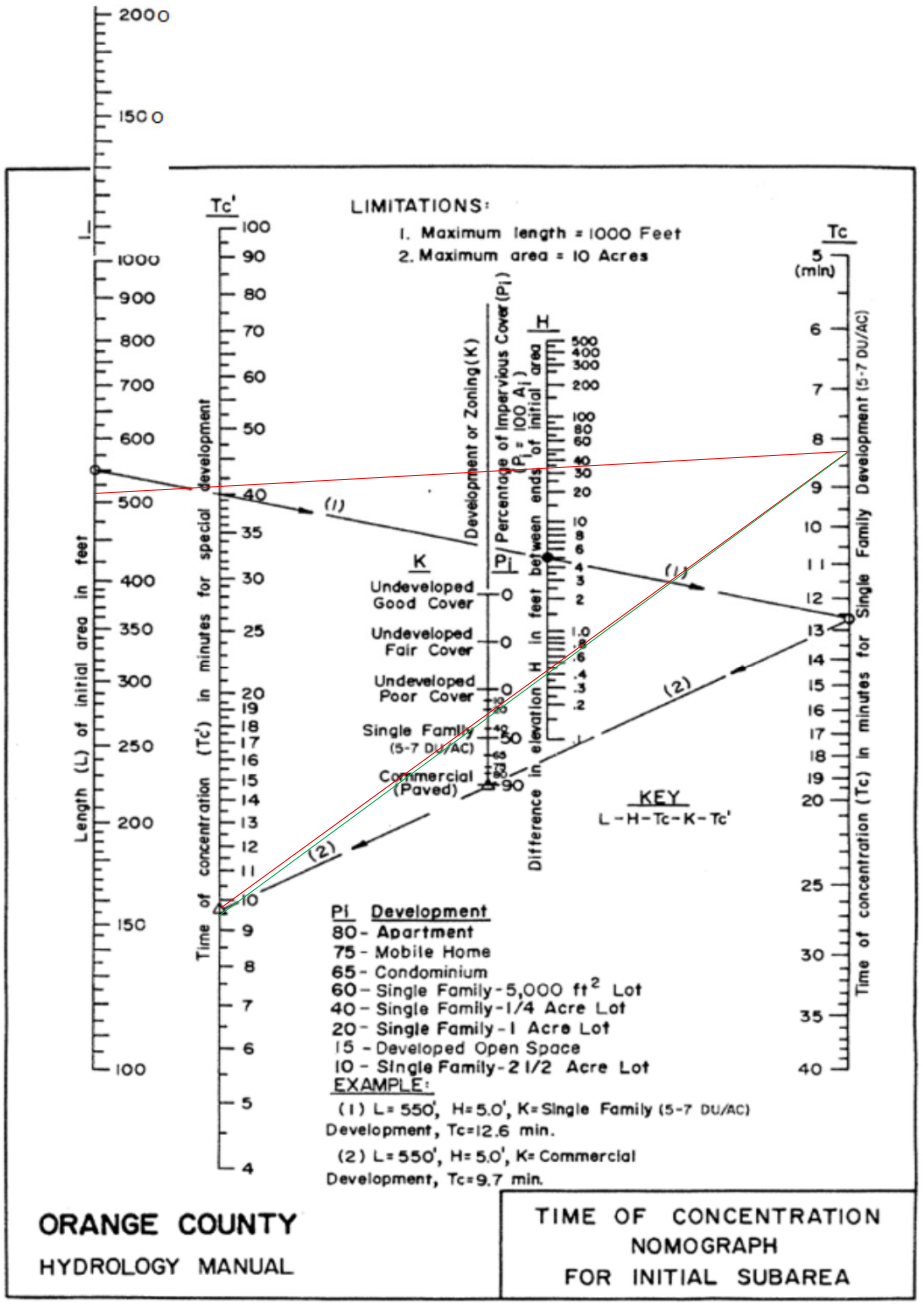
			Pre-Con	Post-Con					Pre-Con	Post-Con
	Drainage Area ID	Total Area (sf)	Impervious Area (sf)	Impervious Area (sf)	Longest Flowpath (ft)	Elev. hi	Elev. lo	Slope	Percent Impervious	Percent Impervious
	1-1	22,767	14,495	14,445	716	1467	1377	0.1257	63.7%	63.4%
	1-2	16,730	10,132	7,868	637	1474	1385.9	0.1384	60.6%	47.0%
Aliso	1-3	25,355	4,465	6,280	348	1542	1465.2	0.2210	17.6%	24.8%
Creek	1-4	43,520	7,423	10,443	501	1582	1487.9	0.1878	17.1%	24.0%
	1-5	140,213	24,323	27,225	908	1675	1514	0.1773	17.3%	19.4%
	1-6	57,206	11,433	14,588	655	1696	1564.2	0.2011	20.0%	25.5%
	1-8	71,686	9,487	13,122	435	1651	1605.3	0.1050	13.2%	18.3%
	2-1	51,977	12,366	13,838	512	1651	1618.4	0.0636	23.8%	26.6%
Santiago	2-2	22,821	6,321	7,333	375	1646	1594	0.1388	27.7%	32.1%
Creek	2-3	6,290	3,098	3,409	145	1602	1567	0.2414	49.3%	54.2%
	2-4	96,476	50,178	50,740	1,244	1586	1454.8	0.1055	52.0%	52.6%
	2-5	230,913	42,306	41,061	1,738	1507	1340	0.0961	18.3%	17.8%
	2-7	1,989,736	56,259	55,817	2,024	1788	1268	0.2569	2.8%	2.8%
	To Aliso Creek	377,476	81,758	93,971						
	To Santiago Creek	2,398,213	170,528	172,198						
	Total	2,775,689	252,287	266,170						

North County - per OC Hydrology Manual

	Drainage Area ID	Fp (in/hr)	Tc (pre) (min)	Tc (post) (min)	Difference in Tc (max allowable = -5.0%)	I (2-yr) (pre) (in/hr)	I (2-yr) (post) (in/hr)	C (2-yr) (pre)	C (2-yr) (post)	Precip (2-yr 24-hr) (in)	Volume (2-yr) (pre) (cf)	Volume (2-yr) (post) (cf)	Difference in Volume (max allowable = +5.0%)
	1-1	0.2											
	1-2	0.2											
Aliso	1-3	0.2											
Creek	1-4	0.2											
	1-5	0.2											
	1-6	0.2											
	1-8	0.2											
	2-1	0.2	9.7	9.6	-1.0%	1.55	1.56	0.8114	0.8152	2.05	7,204	7,238	+0.5%
Santiago	2-2	0.2	7.3	7	-4.1%	1.82	1.87	0.8286	0.8345	2.05	3,230	3,254	+0.7%
Creek	2-3	0.2	5.05	4.95	-2.0%	2.25	2.28	0.8594	0.8638	2.05	923	928	+0.5%
	2-4	0.2	10.8	10.75	-0.5%	1.45	1.46	0.8406	0.8415	2.05	13,855	13,869	+0.1%
	2-5	0.2	15.3	15.35	+0.3%	1.19	1.19	0.7766	0.7755	2.05	30,634	30,593	-0.1%
	2-7	0.2	14.5	14.5	+0.0%	1.23	1.23	0.7576	0.7576	2.05	257,529	257,518	-0.0%

D soils
Fp = 0.2
per hydro
manual

Drainage Area 2-1

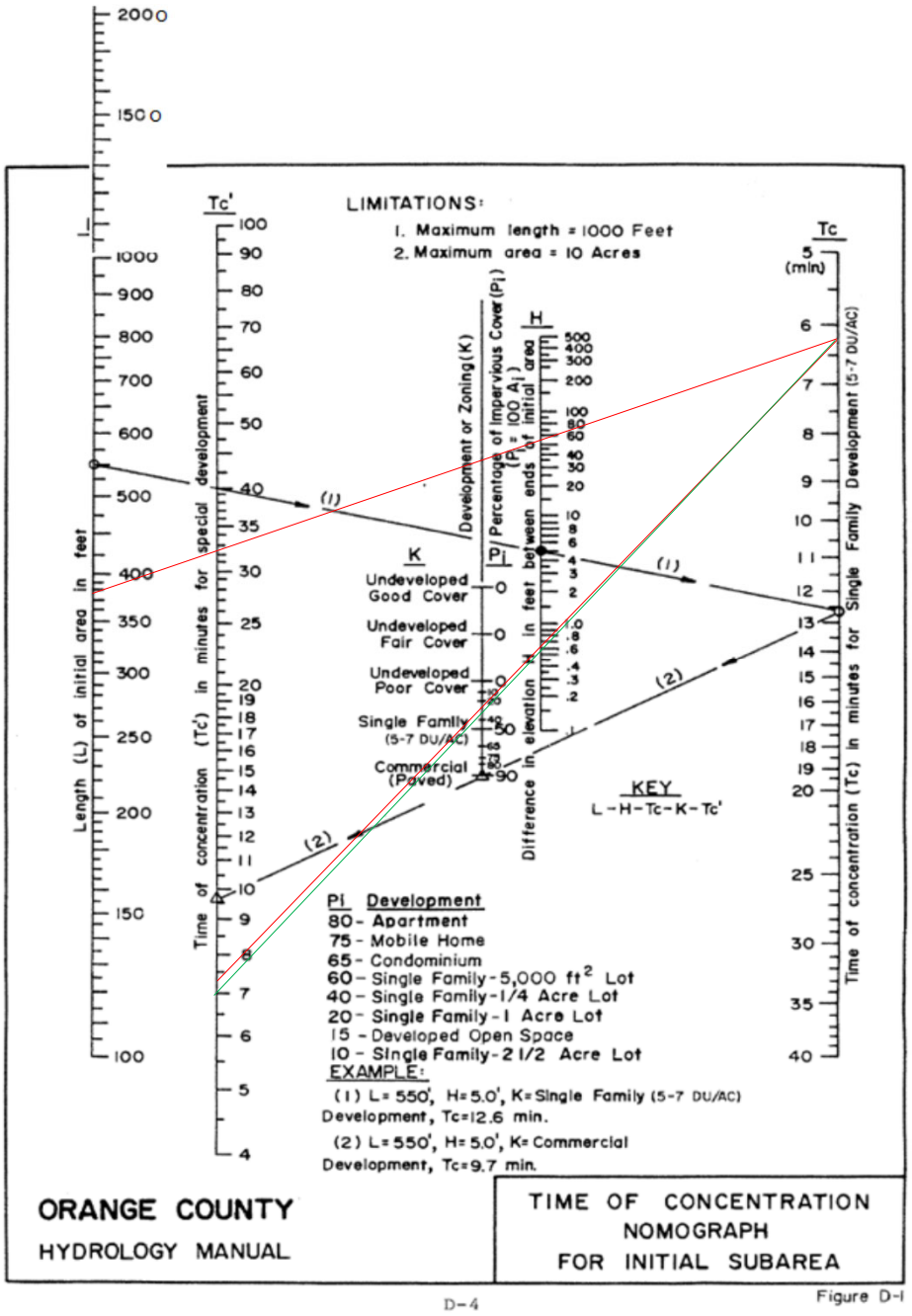


D-4

Figure D-1

L	512 ft	
ΔH	32.6 ft	
imp %	23.8%	(pre-construction)
imp %	26.6%	(post-construction)
Tc (pre)	9.7 min	(red line)
Tc (post)	9.6 min	(green line)

Drainage Area 2-2

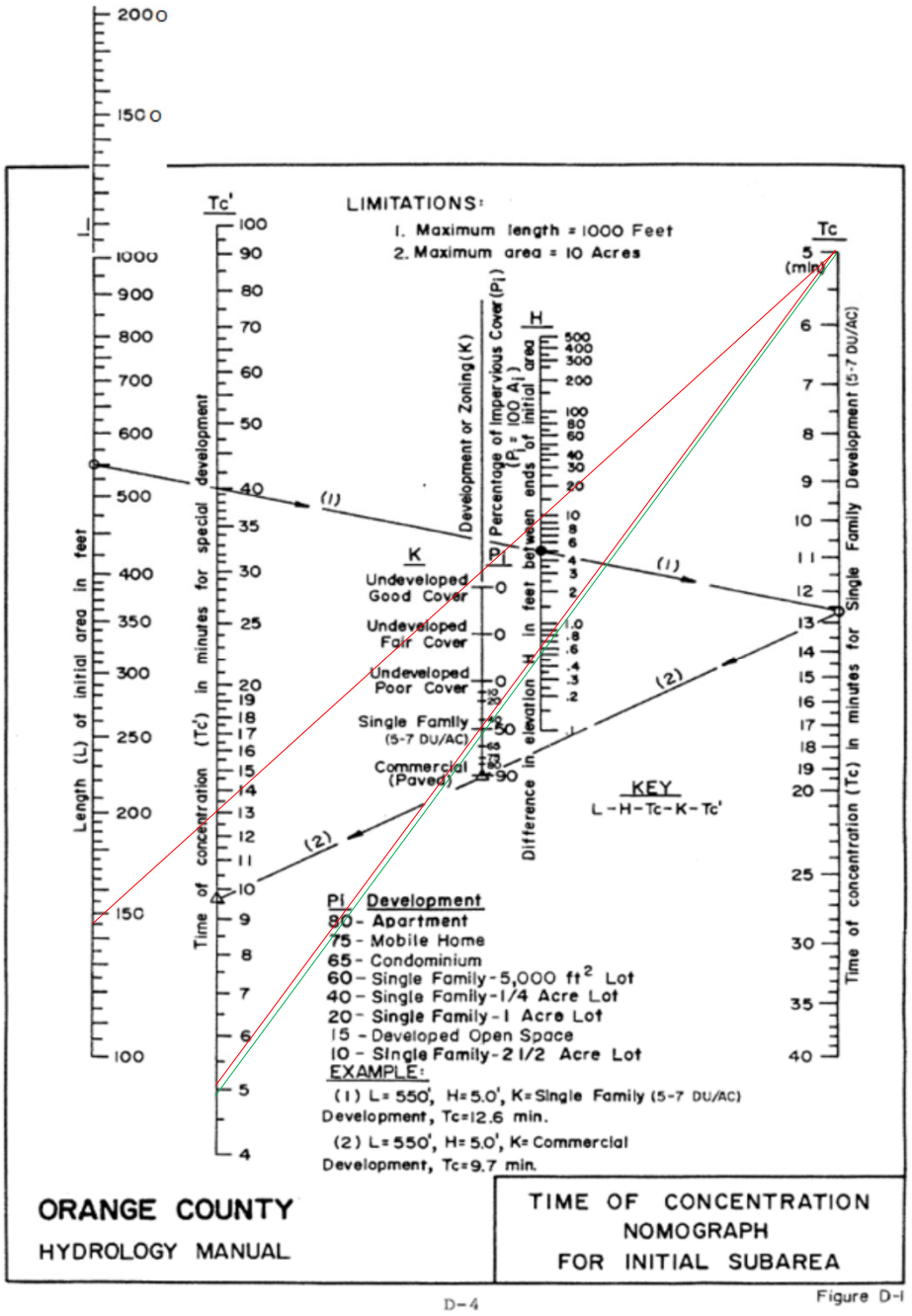


D-4

Figure D-1

L	375 ft	
ΔH	52 ft	
imp %	27.7%	(pre-construction)
imp %	32.1%	(post-construction)
Tc (pre)	7.3 min	(red line)
Tc (post)	7 min	(green line)

Drainage Area 2-3

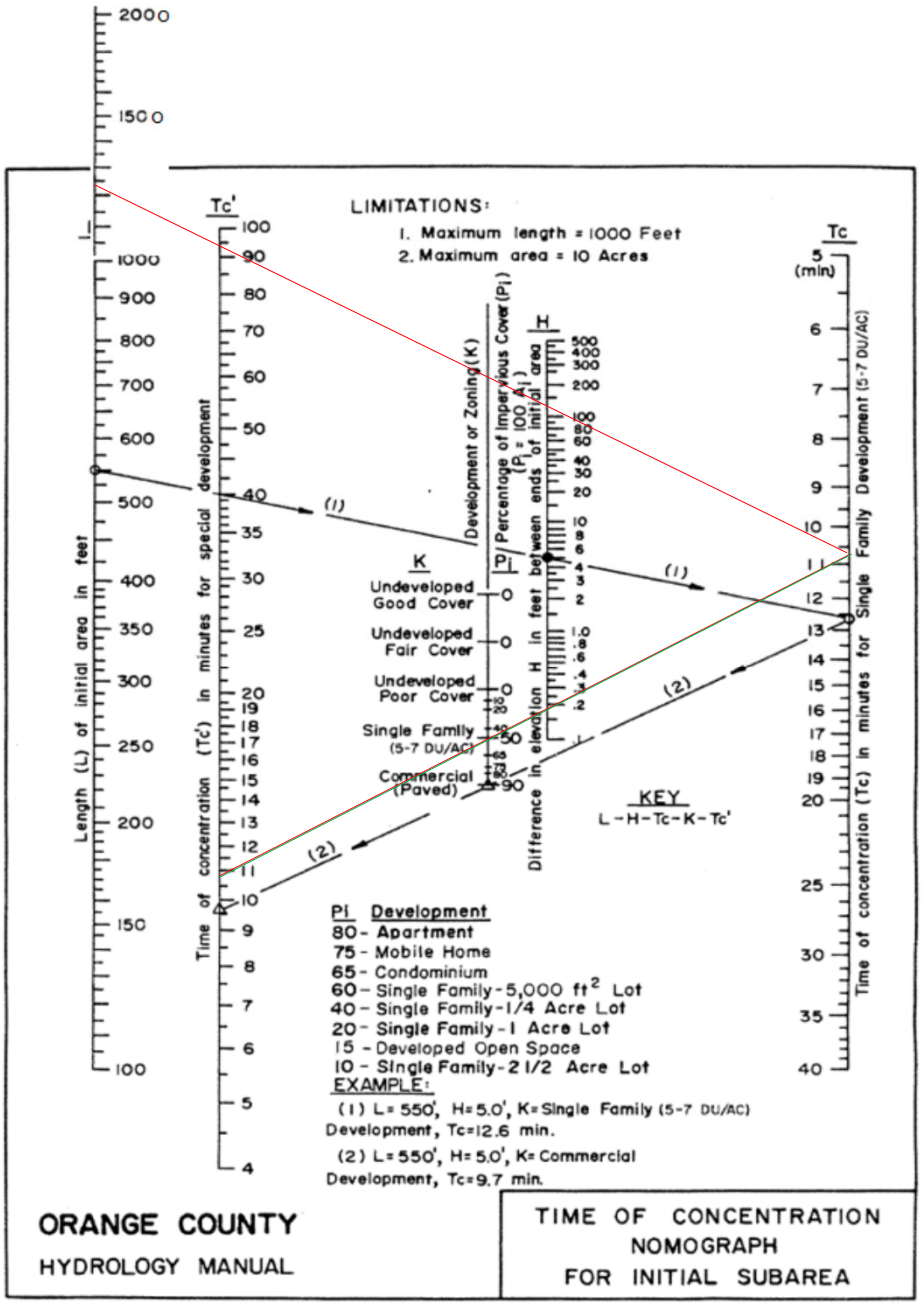


D-4

Figure D-1

L	145 ft	
ΔH	35 ft	
imp %	49.3%	(pre-construction)
imp %	54.2%	(post-construction)
Tc (pre)	5.05 min	(red line)
Tc (post)	4.95 min	(green line)

Drainage Area 2-4

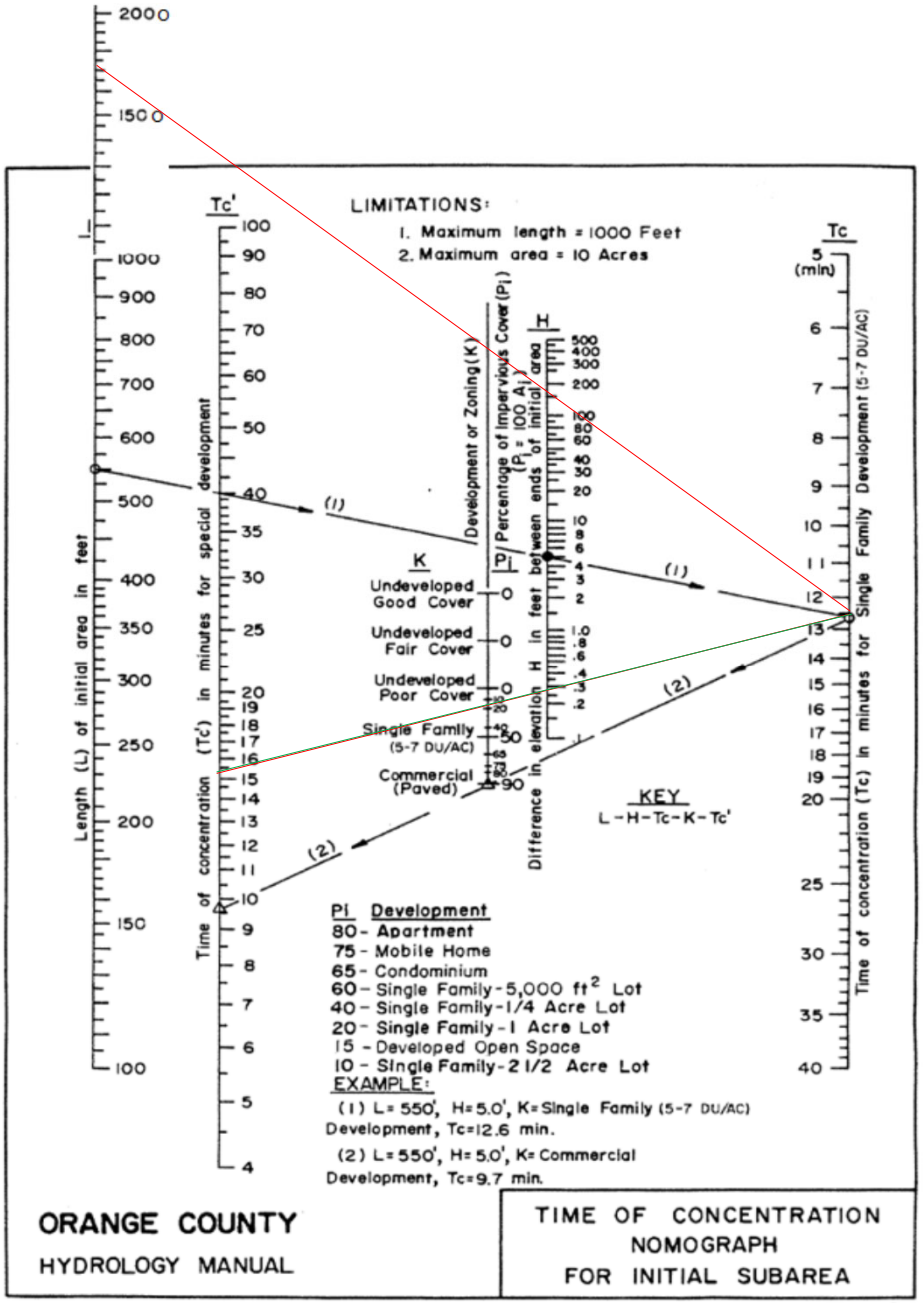


D-4

Figure D-1

L	1,244 ft	
ΔH	131.2 ft	
imp %	52.0%	(pre-construction)
imp %	52.6%	(post-construction)
Tc (pre)	10.8 min	(red line)
Tc (post)	10.75 min	(green line)

Drainage Area 2-5

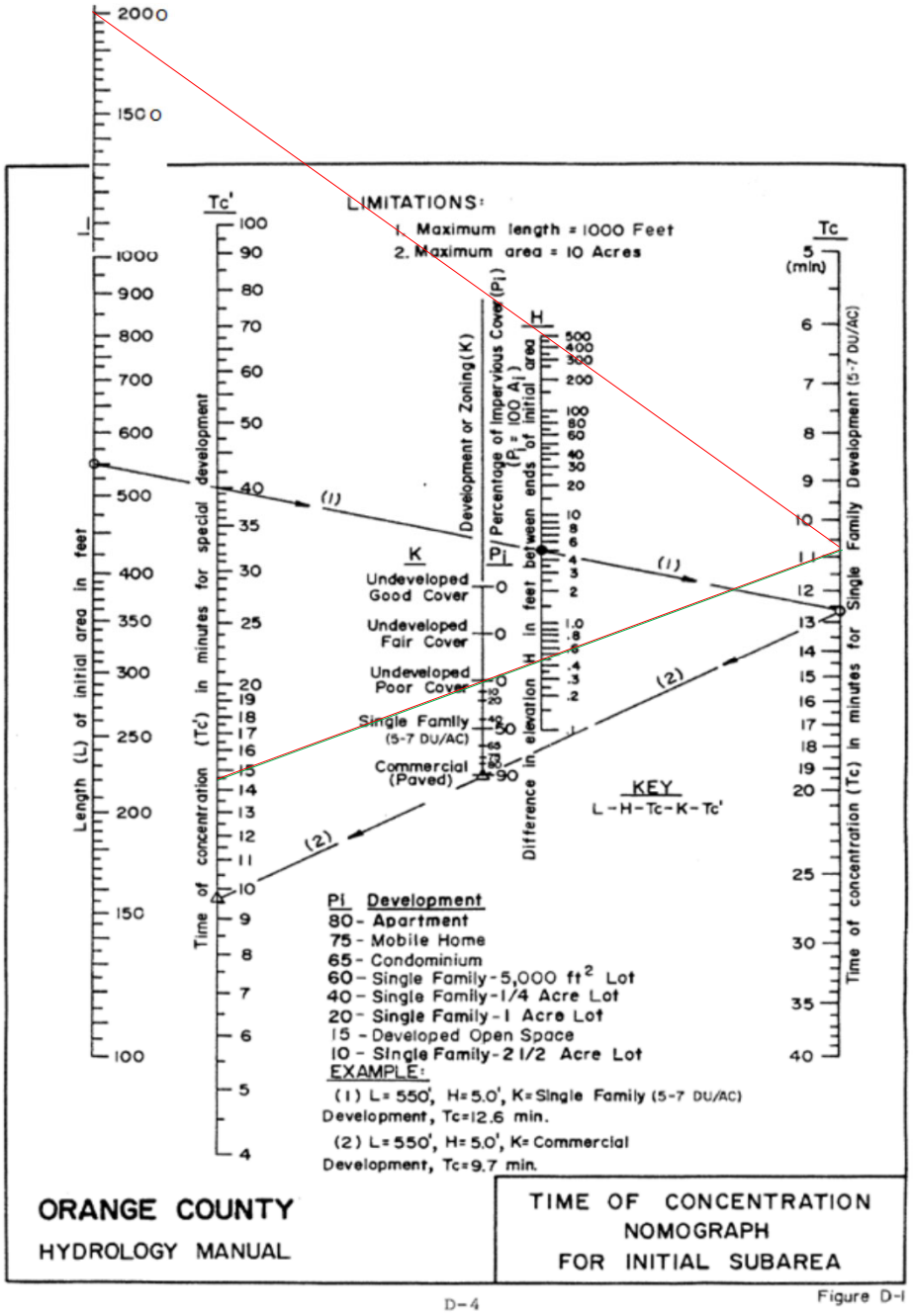


D-4

Figure D-1

L	1,738 ft	
ΔH	167 ft	
imp %	18.3%	(pre-construction)
imp %	17.8%	(post-construction)
Tc (pre)	15.3 min	(red line)
Tc (post)	15.35 min	(green line)

Drainage Area 2-7



D-4

Figure D-1

L	2,024 ft	
ΔH	520 ft	
imp %	2.8%	(pre-construction)
imp %	2.8%	(post-construction)
Tc (pre)	14.5 min	(red line)
Tc (post)	14.5 min	(green line)

Attachment 11

Hydromodification Management Plan

South County - for SOHM Analysis

	Drainage Area ID	Soil Type	Pre-const Scrub Acreage (Vsteep)	Pre-const Imp Acreage (steep)	Post-const Scrub Acreage (Vsteep)	Post-const Imp Acreage (steep)
	1-1	D	0.1899	0.3328	0.1910	0.3316
	1-2	D	0.1515	0.2326	0.2034	0.1806
Aliso	1-3	D	0.4796	0.1025	0.4379	0.1442
Creek	1-4	D	0.8287	0.1704	0.7593	0.2397
	1-5	D	2.6605	0.5584	2.5938	0.6250
	1-6	D	1.0508	0.2625	0.9784	0.3349
	1-8	D	1.4279	0.2178	1.3445	0.3012
	2-1	D	0.9093	0.2839	0.8756	0.3177
Santiago	2-2	D	0.3788	0.1451	0.3556	0.1684
Creek	2-3	D	0.0733	0.0711	0.0661	0.0783
	2-4	D	1.0629	1.1519	1.0499	1.1648
	2-5	D	4.3298	0.9712	4.3584	0.9426
	2-7	D	44.3865	1.2915	44.3967	1.2814

SOHM
PROJECT REPORT

Project Name: Modjeska Grade Road
Site Name: South County portions of Modjeska Grade Road project
Site Address: Modjeska Grade Road at Santiago Canyon Road
City : Silverado, CA 92676
Report Date: 2/12/2024
Gage : Trabuco Canyon
Data Start : 10/01/1958
Data End : 09/30/2005
Precip Scale: 1.00
Version Date: 2021/03/09

Low Flow Threshold for POC 1 : 10 Percent of the 2 Year

High Flow Threshold for POC 1: 10 year

PREDEVELOPED LAND USE

Name : DMA 1-1 Pre
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	.1899
Pervious Total	**0.1899**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.3328
Impervious Total	**0.3328**
Basin Total	**0.5227**

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-2 Pre
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	.1515

Pervious Total	**0.1515**

Impervious Land Use	**acre**
Imp,Steep (10-20%)	**0.2326**

Impervious Total	**0.2326**
Basin Total	**0.3841**

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : DMA 1-3 Pre
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
D,Scrub,VSteep(>15%)	**.4796**

Pervious Total	**0.4796**

Impervious Land Use	**acre**
Imp,Steep (10-20%)	**0.1025**

Impervious Total	**0.1025**
Basin Total	**0.5821**

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : DMA 1-4 Pre
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
D,Scrub,VSteep(>15%)	**.8287**

Pervious Total	**0.8287**

Impervious Land Use	**acre**
Imp,Steep (10-20%)	**0.1704**

Impervious Total	**0.1704**
Basin Total	**0.9991**

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-5 Pre
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	2.6605
Pervious Total	**2.6605**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.5584
Impervious Total	**0.5584**
Basin Total	**3.2189**

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-6 Pre
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	1.0508
Pervious Total	**1.0508**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.2625
Impervious Total	**0.2625**
Basin Total	**1.3133**

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-8 Pre
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	1.4279
Pervious Total	**1.4279**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.2178
Impervious Total	**0.2178**
Basin Total	**1.6457**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : DMA 1-1 Post
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	.191
Pervious Total	**0.191**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.3316
Impervious Total	**0.3316**
Basin Total	**0.5226**

Element Flows To:
Surface **Interflow** **Groundwater**

Name : DMA 1-2 Post
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
D,Scrub,VSteep(>15%)	**.2034**
Pervious Total	**0.2034**

Impervious Land Use	**acre**
Imp,Steep (10-20%)	**0.1806**
Impervious Total	**0.1806**
Basin Total	**0.384**

Element Flows To:
Surface **Interflow** **Groundwater**

Name : DMA 1-3 Post
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
D,Scrub,VSteep(>15%)	**.4379**
Pervious Total	**0.4379**

Impervious Land Use	**acre**
Imp,Steep (10-20%)	**0.1442**
Impervious Total	**0.1442**
Basin Total	**0.5821**

Element Flows To:
Surface **Interflow** **Groundwater**

Name : DMA 1-4 Post
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	.7593
Pervious Total	**0.7593**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.2397
Impervious Total	**0.2397**
Basin Total	**0.999**

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-5 Post
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	2.5938
Pervious Total	**2.5938**

Impervious Land Use	acre
Imp,Steep (10-20%)	0.625
Impervious Total	**0.625**
Basin Total	**3.2188**

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-6 Post
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	.9784
Pervious Total	0.9784

Impervious Land Use	acre
Imp,Steep (10-20%)	0.3349
Impervious Total	0.3349
Basin Total	1.3133

Element Flows To:

Surface	Interflow	Groundwater

Name : DMA 1-8 Post
Bypass: No

GroundWater: No

Pervious Land Use	acre
D,Scrub,VSteep(>15%)	1.3445
Pervious Total	1.3445

Impervious Land Use	acre
Imp,Steep (10-20%)	0.3012
Impervious Total	0.3012
Basin Total	1.6457

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Predeveloped Landuse Totals for POC #1
Total Pervious Area:6.7889
Total Impervious Area:1.877

Mitigated Landuse Totals for POC #1
Total Pervious Area:6.5083
Total Impervious Area:2.1572

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.542585
5 year	0.697761
10 year	0.752268
25 year	1.194989

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.542262
5 year	0.697321
10 year	0.751936
25 year	1.194683

POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0543	7393	7377	99	Pass
0.0613	6287	6264	99	Pass
0.0684	5328	5310	99	Pass
0.0754	4550	4539	99	Pass
0.0825	4021	4011	99	Pass
0.0895	3599	3591	99	Pass
0.0966	3233	3228	99	Pass
0.1036	2891	2881	99	Pass
0.1107	2559	2554	99	Pass
0.1177	2306	2297	99	Pass
0.1248	2067	2062	99	Pass
0.1318	1866	1862	99	Pass
0.1389	1689	1684	99	Pass
0.1459	1508	1505	99	Pass
0.1530	1361	1358	99	Pass
0.1600	1202	1198	99	Pass
0.1671	1091	1088	99	Pass
0.1741	1004	1000	99	Pass
0.1812	925	924	99	Pass
0.1882	847	846	99	Pass
0.1953	770	768	99	Pass
0.2023	720	719	99	Pass
0.2094	668	667	99	Pass
0.2164	612	611	99	Pass
0.2235	571	568	99	Pass
0.2305	514	512	99	Pass
0.2376	472	470	99	Pass

0.2446	441	439	99	Pass
0.2517	413	410	99	Pass
0.2587	388	385	99	Pass
0.2658	358	358	100	Pass
0.2728	337	336	99	Pass
0.2799	316	316	100	Pass
0.2869	300	299	99	Pass
0.2940	276	276	100	Pass
0.3010	259	257	99	Pass
0.3081	246	244	99	Pass
0.3151	226	226	100	Pass
0.3222	218	216	99	Pass
0.3292	196	196	100	Pass
0.3363	182	182	100	Pass
0.3433	169	169	100	Pass
0.3504	163	163	100	Pass
0.3574	151	150	99	Pass
0.3645	145	145	100	Pass
0.3715	139	139	100	Pass
0.3786	135	135	100	Pass
0.3856	128	128	100	Pass
0.3927	119	119	100	Pass
0.3997	114	114	100	Pass
0.4068	105	104	99	Pass
0.4138	99	99	100	Pass
0.4209	97	96	98	Pass
0.4279	89	89	100	Pass
0.4350	86	86	100	Pass
0.4420	76	75	98	Pass
0.4491	73	73	100	Pass
0.4561	66	66	100	Pass
0.4632	62	62	100	Pass
0.4702	59	57	96	Pass
0.4773	55	55	100	Pass
0.4843	53	53	100	Pass
0.4914	52	52	100	Pass
0.4984	52	52	100	Pass
0.5055	47	47	100	Pass
0.5125	46	46	100	Pass
0.5196	46	46	100	Pass
0.5266	44	44	100	Pass
0.5337	43	43	100	Pass
0.5407	40	40	100	Pass
0.5478	39	39	100	Pass
0.5549	39	39	100	Pass
0.5619	37	37	100	Pass
0.5690	36	36	100	Pass
0.5760	34	34	100	Pass
0.5831	34	34	100	Pass
0.5901	32	32	100	Pass
0.5972	31	31	100	Pass
0.6042	31	31	100	Pass
0.6113	29	29	100	Pass
0.6183	28	28	100	Pass
0.6254	26	26	100	Pass
0.6324	26	26	100	Pass
0.6395	26	26	100	Pass

0.6465	25	25	100	Pass
0.6536	22	22	100	Pass
0.6606	21	21	100	Pass
0.6677	21	21	100	Pass
0.6747	21	21	100	Pass
0.6818	20	20	100	Pass
0.6888	20	20	100	Pass
0.6959	20	19	95	Pass
0.7029	17	17	100	Pass
0.7100	15	14	93	Pass
0.7170	13	13	100	Pass
0.7241	13	13	100	Pass
0.7311	12	12	100	Pass
0.7382	11	11	100	Pass
0.7452	10	10	100	Pass
0.7523	10	10	100	Pass

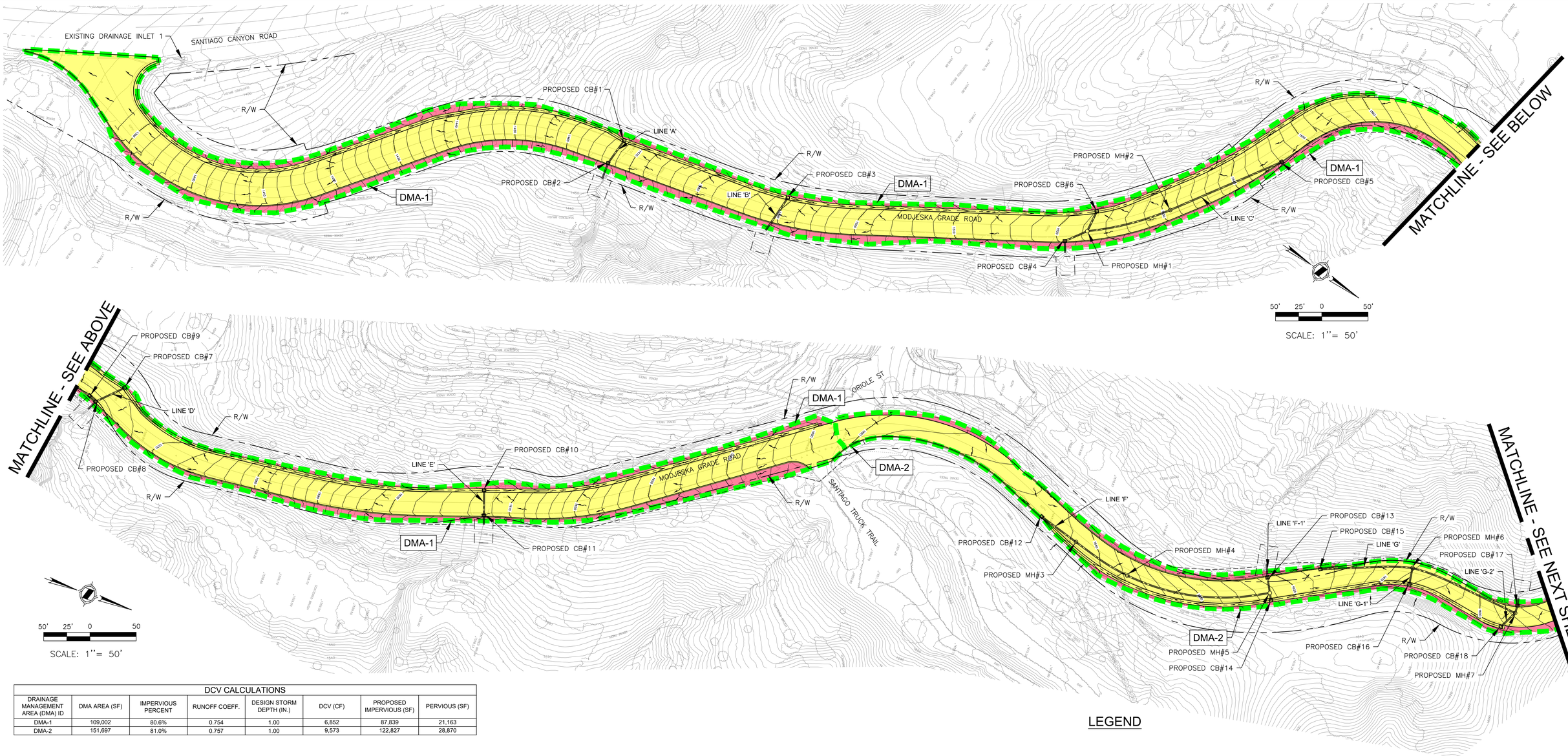
Drawdown Time Results

Perlnd and Implnd Changes

No changes have been made.

Attachment 12

BMP Exhibit



DCV CALCULATIONS							
DRAINAGE MANAGEMENT AREA (DMA) ID	DMA AREA (SF)	IMPERVIOUS PERCENT	RUNOFF COEFF.	DESIGN STORM DEPTH (IN.)	DCV (CF)	PROPOSED IMPERVIOUS (SF)	PERVIOUS (SF)
DMA-1	109,002	80.6%	0.754	1.00	6,852	87,839	21,163
DMA-2	151,697	81.0%	0.757	1.00	9,573	122,827	28,870

LEGEND

- FLOW DIRECTION
- DRAINAGE MANAGEMENT AREA (DMA) BOUNDARY
- NEW IMPERVIOUS SURFACES
- PERVIOUS SURFACES

PRELIMINARY DESIGN
NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS
6		
5		
4		
3		
2		
1		

DESIGNED BY: JD — DATE JAN 2024
CHECKED BY: SB — DATE JAN 2024

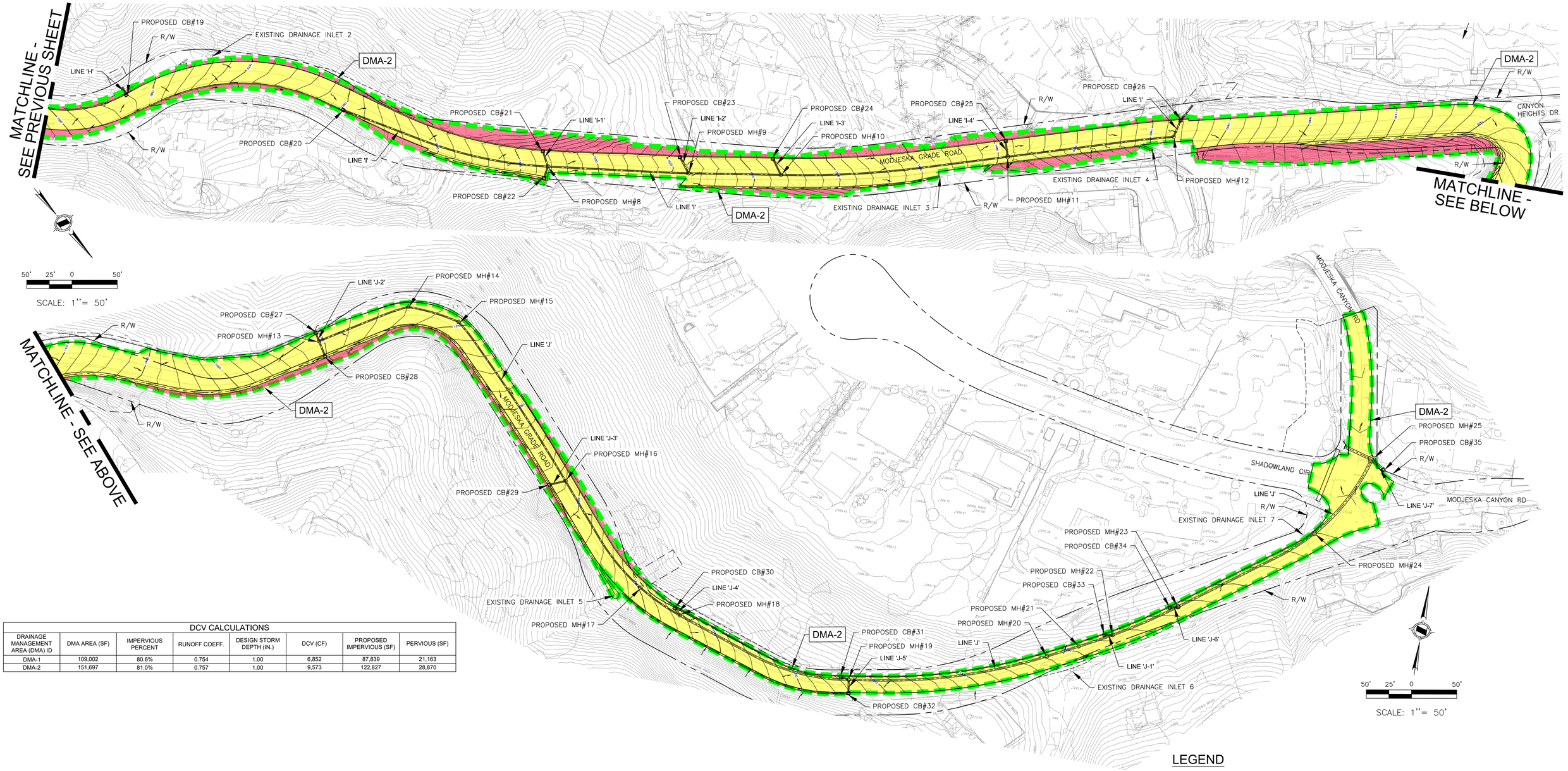
SEAL

PREPARED BY:
CWE
1561 E. ORANGETHORPE AVE.
SUITE 240
FULLERTON, CA 92831
TEL (714) 526-7500
www.cwecorp.com

PROJECT TITLE
MODJESKA GRADE ROAD
ROAD AND DRAINAGE IMPROVEMENTS

SHEET TITLE
BMP EXHIBIT

PROJECT NO. EQ17009D
DRWG NO.
SHEET 1
OF 2



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- NEW IMPERVIOUS SURFACES
- PERVIOUS SURFACES

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NOT FOR CONSTRUCTION

NO.	DATE	REVISIONS
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SHEET TITLE
BMP EXHIBIT

PROJECT NO. EQ17009D
DRWG NO.
SHEET 2
OF 2

Attachment 15

Operations and Maintenance Plan (To be included in 100% submittal)

Attachment 16

BMP Inspection Record
(To be included following construction)