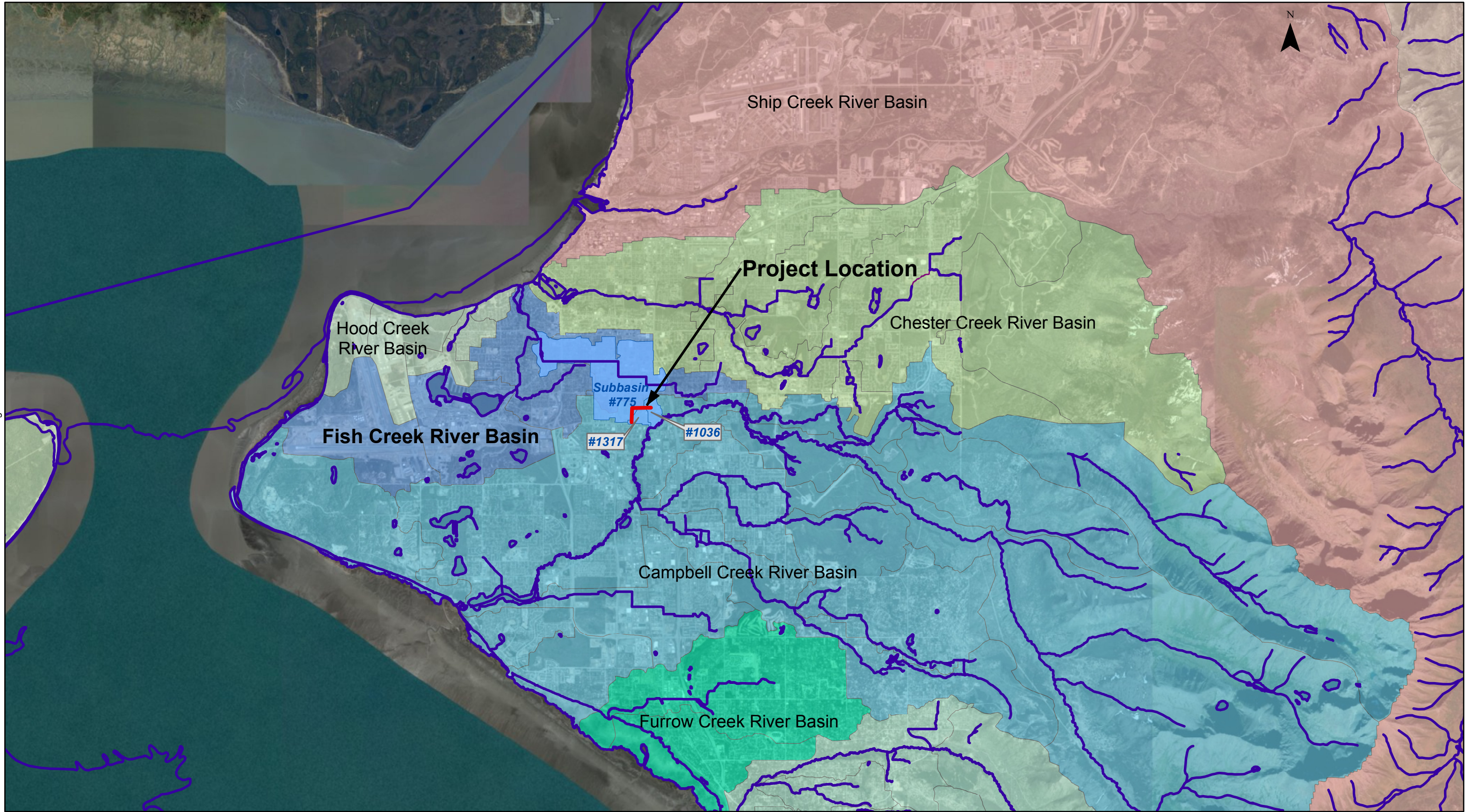


Storm Drain Modeling Data

Appendix E

J:\JobsData\10143.00 48th Ave and Cordova St Reconstruction\00 CADD\04 GIS\StormFig1.mxd



0 1 2 4 6 8 Miles

Project Location and Subbasin

**48th Avenue and Cordova Street
Design Study Report**

Date: July 2019

Figure: 1

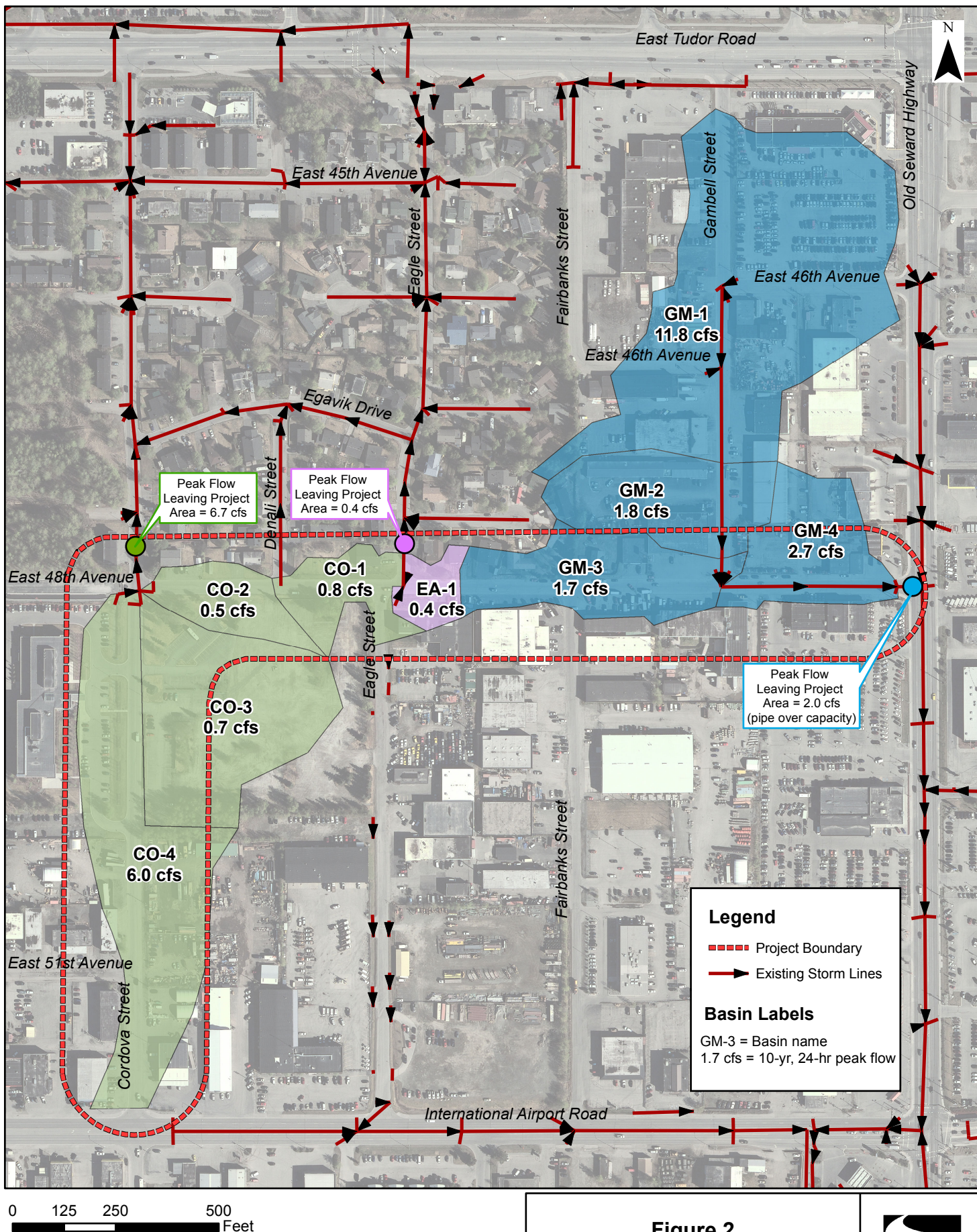
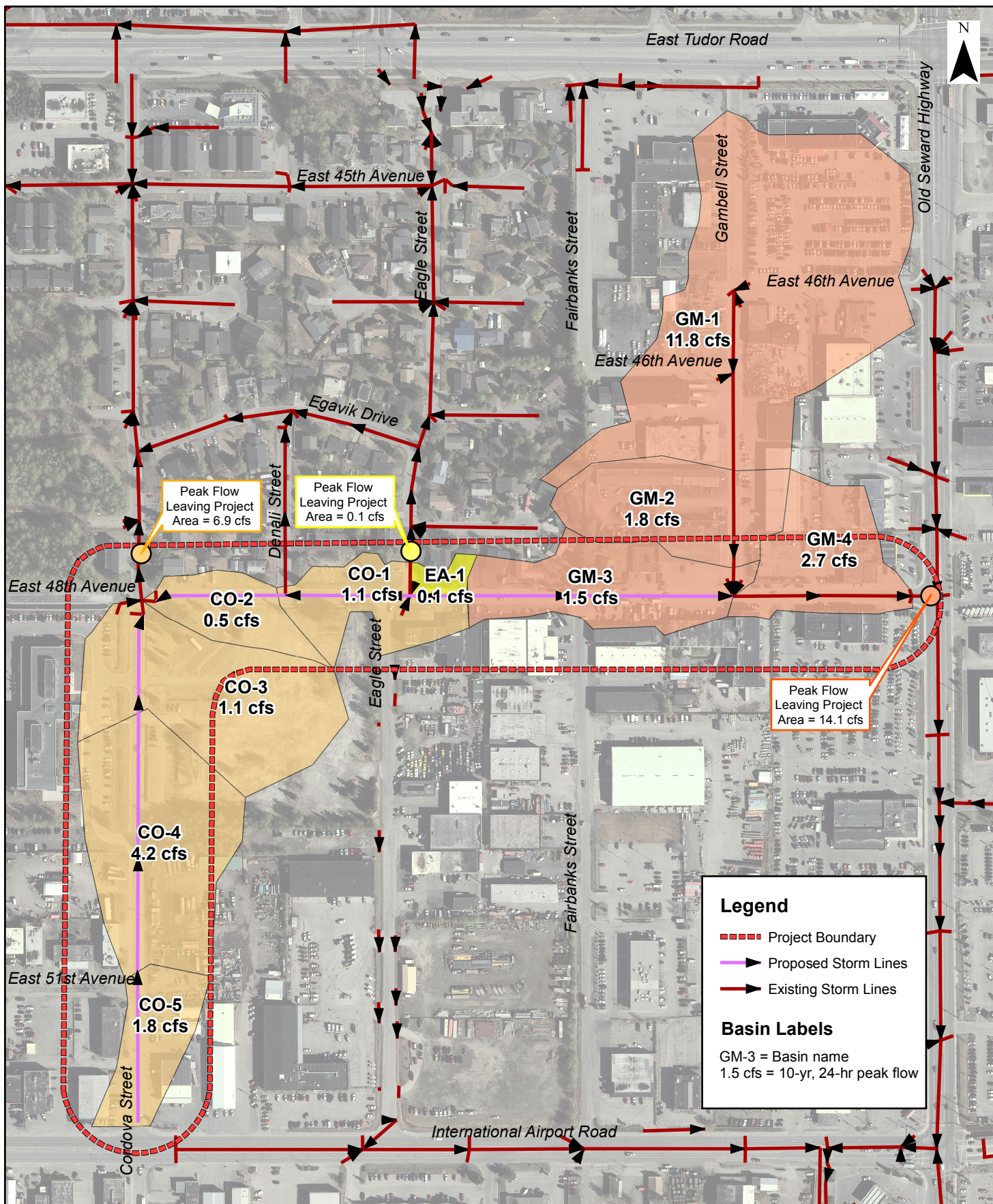


Figure 2
Existing Stormwater System
48th Avenue and Cordova Street



Date: July 2019



0 125 250 500
Feet

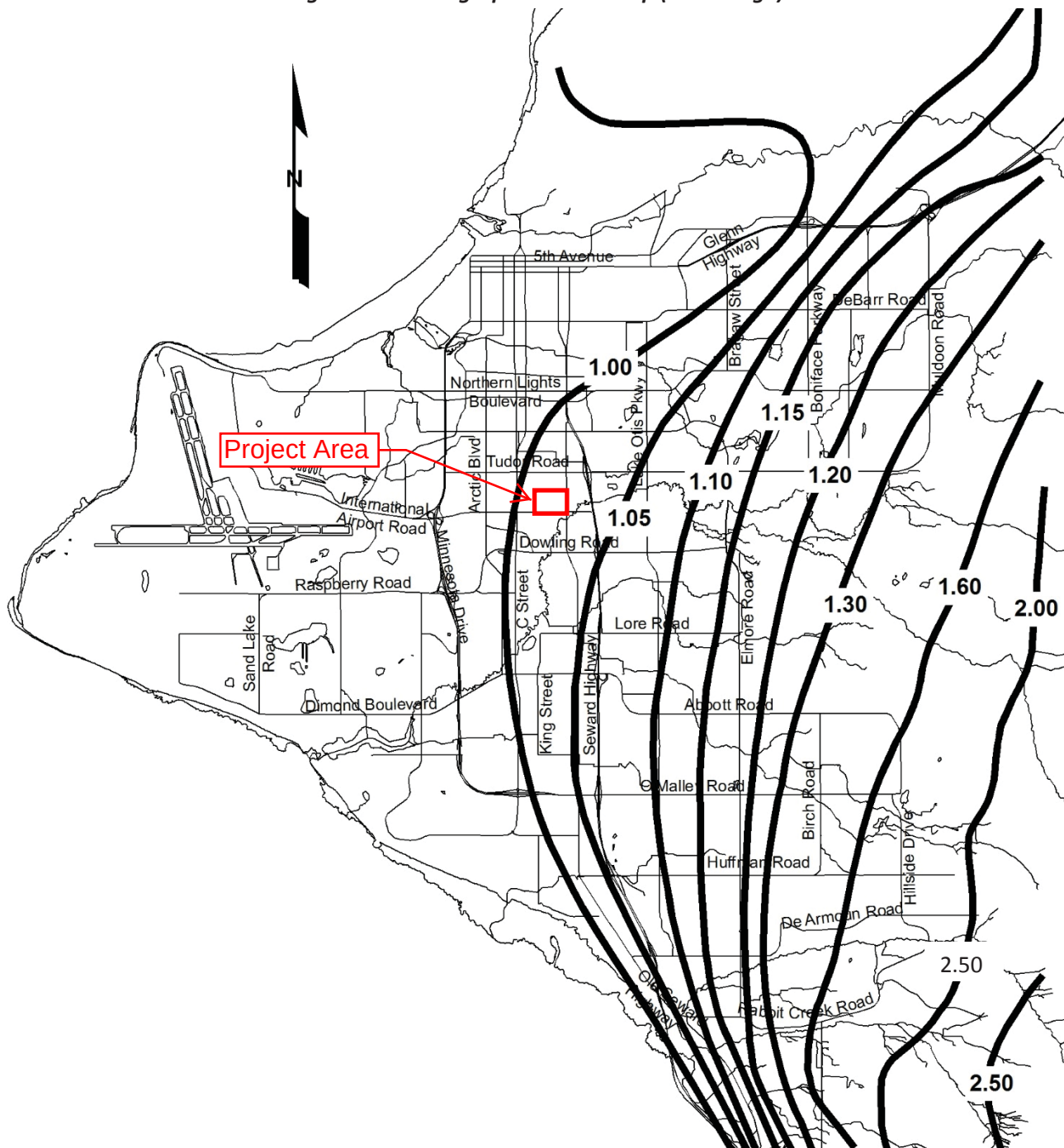
Figure 3
Proposed Stormwater System
 48th Avenue and Cordova Street



Date: July 2019

based on NOAA Atlas 14 data from AIA. A second distribution was developed for Girdwood based on data from the Alyeska station. The resulting hyetographs are presented in Appendix D.

Figure 4.2-3: Orographic Factor Map (Anchorage)



Project Description

File Name 10143 Existing SSA Storm Model.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-55
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Kinematic Wave
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Nov 12, 2018 00:00:00
End Analysis On Nov 13, 2018 00:00:00
Start Reporting On Nov 12, 2018 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

Qty
Rain Gages 1
Subbasins..... 9
Nodes..... 15
 Junctions 12
 Outfalls 3
 Flow Diversions 0
 Inlets 0
 Storage Nodes 0
Links..... 12
 Channels 0
 Pipes 12
 Pumps 0
 Orifices 0
 Weirs 0
 Outlets 0
Pollutants 0
Land Uses 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	10-yr, 24-hr	Cumulative	inches				0.00	

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	CO-1	1.20	82.40	2.33	0.89	1.07	0.84	0 00:05:00
2	CO-2	1.20	81.80	2.33	0.86	1.03	0.45	0 00:23:49
3	CO-3	4.20	77.00	2.33	0.63	2.66	0.65	0 00:58:34
4	CO-4	5.30	94.00	2.33	1.70	9.03	6.03	0 00:08:46
5	EA-1	0.60	83.00	2.33	0.93	0.56	0.44	0 00:05:00
6	GM-1	9.30	93.70	2.33	1.68	15.60	11.79	0 00:05:24
7	GM-2	2.50	92.35	2.33	1.56	3.90	1.78	0 00:22:37
8	GM-3	2.50	89.60	2.33	1.35	3.37	1.66	0 00:19:43
9	GM-4	2.10	94.00	2.33	1.70	3.58	2.73	0 00:05:00

Subbasin Hydrology

Subbasin : CO-1

Input Data

Area (ac) 1.20
Weighted Curve Number 82.40
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	1.08	C	83.00
Brush, Poor	0.12	C	77.00
Composite Area & Weighted CN	1.20		82.40

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 0.89
Peak Runoff (cfs) 0.84
Weighted Curve Number 82.40
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : CO-2

Input Data

Area (ac) 1.20
Weighted Curve Number 81.80
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	0.96	C	83.00
Brush, Poor	0.24	C	77.00
Composite Area & Weighted CN	1.20		81.80

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.08	0.00	0.00
Computed Flow Time (min) :	20.21	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.11	0.00	0.00
Computed Flow Time (min) :	3.00	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Channel Slope (%) :	2.7	0.00	0.00
Cross Section Area (ft ²) :	.21	0.00	0.00
Wetted Perimeter (ft) :	1.7	0.00	0.00
Velocity (ft/sec) :	4.05	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00
Total TOC (min)	23.83		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 0.86
Peak Runoff (cfs) 0.45
Weighted Curve Number 81.80
Time of Concentration (days hh:mm:ss) 0 00:23:50

Subbasin : CO-3

Input Data

Area (ac) 4.20
Weighted Curve Number 77.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	0.00	C	94.00
Brush, Poor	4.20	C	77.00
Composite Area & Weighted CN	4.20		77.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	52.45	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	250	0.00	0.00
Slope (%) :	.7	0.00	0.00
Surface Type :	Bare & untilled	Unpaved	Unpaved
Velocity (ft/sec) :	0.84	0.00	0.00
Computed Flow Time (min) :	4.96	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	220	0.00	0.00
Channel Slope (%) :	.85	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	3.13	0.00	0.00
Computed Flow Time (min) :	1.17	0.00	0.00
Total TOC (min)	58.58		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 0.63
Peak Runoff (cfs) 0.65
Weighted Curve Number 77.00
Time of Concentration (days hh:mm:ss) 0 00:58:35

Subbasin : CO-4

Input Data

Area (ac) 5.30
Weighted Curve Number 94.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	5.30	C	94.00
Composite Area & Weighted CN	5.30		94.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.02	0.00	0.00
Computed Flow Time (min) :	1.64	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	1300	0.00	0.00
Channel Slope (%) :	.8	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	3.04	0.00	0.00
Computed Flow Time (min) :	7.13	0.00	0.00
Total TOC (min)8.77			

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.70
Peak Runoff (cfs) 6.03
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:08:46

Subbasin : EA-1

Input Data

Area (ac) 0.60
Weighted Curve Number 83.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	0.60	C	83.00
Composite Area & Weighted CN	0.60		83.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 0.93
Peak Runoff (cfs) 0.44
Weighted Curve Number 83.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : GM-1

Input Data

Area (ac) 9.30
Weighted Curve Number 93.70
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	8.74	C	94.00
Gravel roads	0.56	C	89.00
Composite Area & Weighted CN	9.30		93.70

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.10	0.00	0.00
Computed Flow Time (min) :	2.27	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	30	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0.00	0.00
Computed Flow Time (min) :	0.17	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	270	0.00	0.00
Channel Slope (%) :	.2	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	2.96	0.00	0.00
Total TOC (min)	5.40		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.68
Peak Runoff (cfs) 11.79
Weighted Curve Number 93.70
Time of Concentration (days hh:mm:ss) 0 00:05:24

Subbasin : GM-2

Input Data

Area (ac) 2.50
Weighted Curve Number 92.35
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.13	C	94.00
1/4 acre lots, 38% impervious	0.38	C	83.00
Composite Area & Weighted CN	2.51		92.35

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.08	0.00	0.00
Computed Flow Time (min) :	20.21	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	320	0.00	0.00
Slope (%) :	3.4	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.98	0.00	0.00
Computed Flow Time (min) :	1.79	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Channel Slope (%) :	.5	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	2.40	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00
Total TOC (min)	22.63		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.56
Peak Runoff (cfs) 1.78
Weighted Curve Number 92.35
Time of Concentration (days hh:mm:ss) 0 00:22:38

Subbasin : GM-3

Input Data

Area (ac) 2.50
Weighted Curve Number 89.60
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	1.50	C	94.00
1/4 acre lots, 38% impervious	1.00	C	83.00
Composite Area & Weighted CN	2.50		89.60

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	80	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.08	0.00	0.00
Computed Flow Time (min) :	16.91	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	590	0.00	0.00
Channel Slope (%) :	2	0.00	0.00
Cross Section Area (ft ²) :	.21	0.00	0.00
Wetted Perimeter (ft) :	1.7	0.00	0.00
Velocity (ft/sec) :	3.48	0.00	0.00
Computed Flow Time (min) :	2.82	0.00	0.00
Total TOC (min)	19.73		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.35
Peak Runoff (cfs) 1.66
Weighted Curve Number 89.60
Time of Concentration (days hh:mm:ss) 0 00:19:44

Subbasin : GM-4

Input Data

Area (ac) 2.10
Weighted Curve Number 94.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.10	C	94.00
Composite Area & Weighted CN	2.10		94.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	1.3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.93	0.00	0.00
Computed Flow Time (min) :	2.69	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	2.5	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.21	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	220	0.00	0.00
Channel Slope (%) :	.9	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	3.22	0.00	0.00
Computed Flow Time (min) :	1.14	0.00	0.00
Total TOC (min)	4.46		

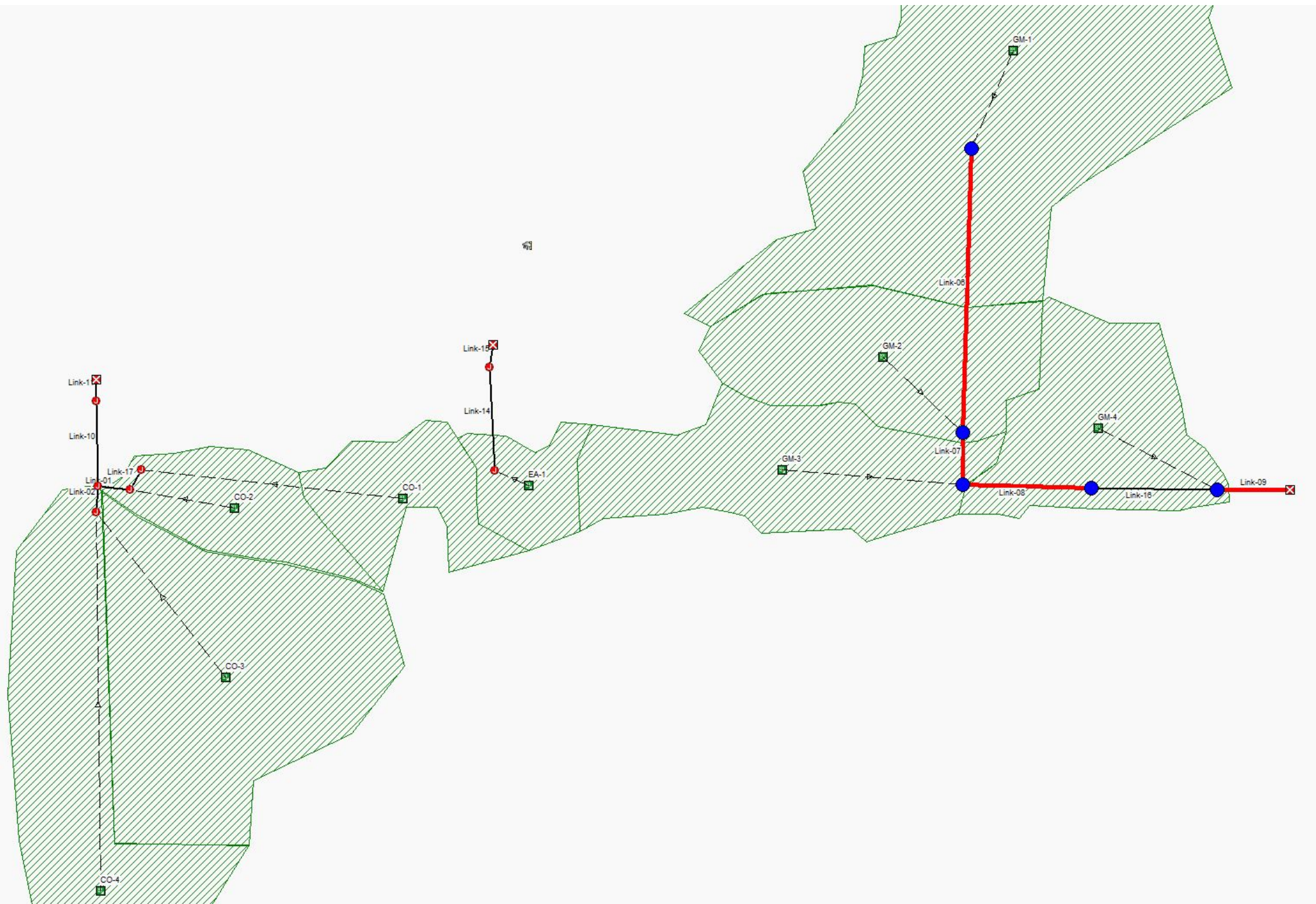
Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.70
Peak Runoff (cfs) 2.73
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:04:28

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	Link-01	0.99	0 12:10	12.31	0.08	4.20	0.15	0.29	0.19	0.00		Calculated
2	Link-02	5.87	0 12:15	11.63	0.50	6.60	0.07	0.75	0.50	0.00		Calculated
3	Link-06	1.88	0 11:51	1.74	1.08	1.71	4.31	1.25	1.00	46.00		SURCHARGED
4	Link-07	1.97	0 11:48	1.84	1.07	1.78	0.81	1.25	1.00	68.00		SURCHARGED
5	Link-08	2.51	0 12:08	2.32	1.08	2.22	1.57	1.25	1.00	38.00		SURCHARGED
6	Link-09	2.00	0 13:42	1.87	1.07	1.77	0.52	1.25	1.00	133.00		SURCHARGED
7	Link-10	6.72	0 12:15	11.77	0.57	6.90	0.19	0.81	0.54	0.00		Calculated
8	Link-11	6.72	0 12:15	7.59	0.89	4.85	0.07	1.10	0.73	0.00		Calculated
9	Link-14	0.38	0 12:11	1.06	0.36	1.27	2.12	0.41	0.41	0.00		Calculated
10	Link-15	0.38	0 12:11	3.07	0.12	2.66	0.13	0.22	0.24	0.00		Calculated
11	Link-16	2.47	0 12:51	2.30	1.07	2.26	1.61	1.15	0.93	0.00		> CAPACITY
12	Link-17	0.76	0 12:10	5.20	0.15	2.12	0.29	0.39	0.26	0.00		Calculated

Existing Model Pipe Layout



Project Description

File Name 10143 Proposed SSA Storm Model.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-55
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods YES

Analysis Options

Start Analysis On Jun 24, 2019 00:00:00
End Analysis On Jun 25, 2019 00:00:00
Start Reporting On Jun 24, 2019 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 5 seconds

Number of Elements

Qty
Rain Gages 1
Subbasins..... 10
Nodes..... 39
 Junctions 37
 Outfalls 2
 Flow Diversions 0
 Inlets 0
 Storage Nodes 0
Links..... 37
 Channels 0
 Pipes 37
 Pumps 0
 Orifices 0
 Weirs 0
 Outlets 0
Pollutants 0
Land Uses 0

Rainfall Details

SN	Rain Gage	Data	Data Source	Rainfall	Rain	State	County	Return	Rainfall	Rainfall
	ID	Source	ID	Type	Units			Period	Depth	Distribution
								(years)	(inches)	
1	Rain Gage-01	Time Series	10-yr, 24-hr storm	Cumulative	inches				0.00	

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	CO-1	1.50	82.52	2.33	0.90	1.35	1.06	0 00:05:00
2	CO-2	1.20	81.80	2.33	0.86	1.03	0.45	0 00:23:39
3	CO-3	4.00	84.31	2.33	1.00	4.00	1.11	0 00:55:56
4	CO-4	4.10	89.24	2.33	1.32	5.42	4.23	0 00:05:22
5	CO-5	1.40	94.00	2.33	1.70	2.39	1.82	0 00:05:00
6	EA-1	0.20	83.00	2.33	0.92	0.18	0.14	0 00:05:00
7	GM-1	9.30	93.70	2.33	1.68	15.60	11.79	0 00:05:24
8	GM-2	2.50	92.35	2.33	1.56	3.90	1.78	0 00:22:37
9	GM-3	2.50	89.60	2.33	1.35	3.37	1.53	0 00:23:22
10	GM-4	2.10	94.00	2.33	1.70	3.58	2.73	0 00:05:00

Subbasin Hydrology

Subbasin : CO-1

Input Data

Area (ac) 1.50
Weighted Curve Number 82.52
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	1.38	C	83.00
Brush, Poor	0.12	C	77.00
Composite Area & Weighted CN	1.50		82.52

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Slope (%) :	2.2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.03	0.00	0.00
Computed Flow Time (min) :	1.45	0.00	0.00
Shallow Concentrated Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	2.8	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.40	0.00	0.00
Computed Flow Time (min) :	0.34	0.00	0.00
Channel Flow Computations	Subarea	Subarea	Subarea
	A	B	C
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	225	0.00	0.00
Channel Slope (%) :	2.2	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	5.04	0.00	0.00
Computed Flow Time (min) :	0.74	0.00	0.00
Total TOC (min)	2.54		

Subbasin Runoff Results

Total Rainfall (in)	2.33
Total Runoff (in)	0.90
Peak Runoff (cfs)	1.06
Weighted Curve Number	82.52
Time of Concentration (days hh:mm:ss)	0 00:02:32

Subbasin : CO-2

Input Data

Area (ac) 1.20
Weighted Curve Number 81.80
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	0.96	C	83.00
Brush, Poor	0.24	C	77.00
Composite Area & Weighted CN	1.20		81.80

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.08	0.00	0.00
Computed Flow Time (min) :	20.21	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	2.5	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.11	0.00	0.00
Computed Flow Time (min) :	3.00	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Channel Slope (%) :	2.7	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	5.58	0.00	0.00
Computed Flow Time (min) :	0.45	0.00	0.00
Total TOC (min)	23.66		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 0.86
Peak Runoff (cfs) 0.45
Weighted Curve Number 81.80
Time of Concentration (days hh:mm:ss) 0 00:23:40

Subbasin : CO-3

Input Data

Area (ac) 4.00
Weighted Curve Number 84.31
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Brush, Poor	2.28	C	77.00
Urban commercial, 85% imp	1.72	C	94.00
Composite Area & Weighted CN	4.00		84.31

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	52.45	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	290	0.00	0.00
Slope (%) :	2.8	0.00	0.00
Surface Type :	Bare & untilled	Unpaved	Unpaved
Velocity (ft/sec) :	1.67	0.00	0.00
Computed Flow Time (min) :	2.89	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	4.16	0.00	0.00
Computed Flow Time (min) :	0.60	0.00	0.00
Total TOC (min)	55.94		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.00
Peak Runoff (cfs) 1.11
Weighted Curve Number 84.31
Time of Concentration (days hh:mm:ss) 0 00:55:56

Subbasin : CO-4

Input Data

Area (ac) 4.10
Weighted Curve Number 89.24
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.95	C	94.00
Brush, Poor	1.15	C	77.00
Composite Area & Weighted CN	4.10		89.24

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	1.3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.93	0.00	0.00
Computed Flow Time (min) :	2.69	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	520	0.00	0.00
Channel Slope (%) :	.9	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	3.22	0.00	0.00
Computed Flow Time (min) :	2.69	0.00	0.00
Total TOC (min)	5.38		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.32
Peak Runoff (cfs) 4.23
Weighted Curve Number 89.24
Time of Concentration (days hh:mm:ss) 0 00:05:23

Subbasin : CO-5

Input Data

Area (ac) 1.40
Weighted Curve Number 94.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	1.40	C	94.00
Composite Area & Weighted CN	1.40		94.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.70
Peak Runoff (cfs) 1.82
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : EA-1

Input Data

Area (ac) 0.20
Weighted Curve Number 83.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	0.20	C	83.00
Composite Area & Weighted CN	0.20		83.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 0.92
Peak Runoff (cfs) 0.14
Weighted Curve Number 83.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : GM-1

Input Data

Area (ac) 9.30
Weighted Curve Number 93.70
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	8.74	C	94.00
Gravel roads	0.56	C	89.00
Composite Area & Weighted CN	9.30		93.70

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.10	0.00	0.00
Computed Flow Time (min) :	2.27	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	30	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0.00	0.00
Computed Flow Time (min) :	0.17	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	270	0.00	0.00
Channel Slope (%) :	.2	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	2.96	0.00	0.00
Total TOC (min)5.40			

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.68
Peak Runoff (cfs) 11.79
Weighted Curve Number 93.70
Time of Concentration (days hh:mm:ss) 0 00:05:24

Subbasin : GM-2

Input Data

Area (ac) 2.50
Weighted Curve Number 92.35
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.13	C	94.00
1/4 acre lots, 38% impervious	0.38	C	83.00
Composite Area & Weighted CN	2.51		92.35

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.08	0.00	0.00
Computed Flow Time (min) :	20.21	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	320	0.00	0.00
Slope (%) :	3.4	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.98	0.00	0.00
Computed Flow Time (min) :	1.79	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Channel Slope (%) :	.5	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	2.40	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00
Total TOC (min)	22.63		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.56
Peak Runoff (cfs) 1.78
Weighted Curve Number 92.35
Time of Concentration (days hh:mm:ss) 0 00:22:38

Subbasin : GM-3

Input Data

Area (ac) 2.50
Weighted Curve Number 89.60
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	1.50	C	94.00
1/4 acre lots, 38% impervious	1.00	C	83.00
Composite Area & Weighted CN	2.50		89.60

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	80	0.00	0.00
Slope (%) :	6	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.08	0.00	0.00
Computed Flow Time (min) :	16.91	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	590	0.00	0.00
Channel Slope (%) :	.2	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	6.47	0.00	0.00
Total TOC (min)	23.38		

Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.35
Peak Runoff (cfs) 1.53
Weighted Curve Number 89.60
Time of Concentration (days hh:mm:ss) 0 00:23:23

Subbasin : GM-4

Input Data

Area (ac) 2.10
Weighted Curve Number 94.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.10	C	94.00
Composite Area & Weighted CN	2.10		94.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	1.3	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.93	0.00	0.00
Computed Flow Time (min) :	2.69	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	2.5	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.21	0.00	0.00
Computed Flow Time (min) :	0.62	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	220	0.00	0.00
Channel Slope (%) :	.9	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2.5	0.00	0.00
Velocity (ft/sec) :	3.22	0.00	0.00
Computed Flow Time (min) :	1.14	0.00	0.00
Total TOC (min)	4.46		

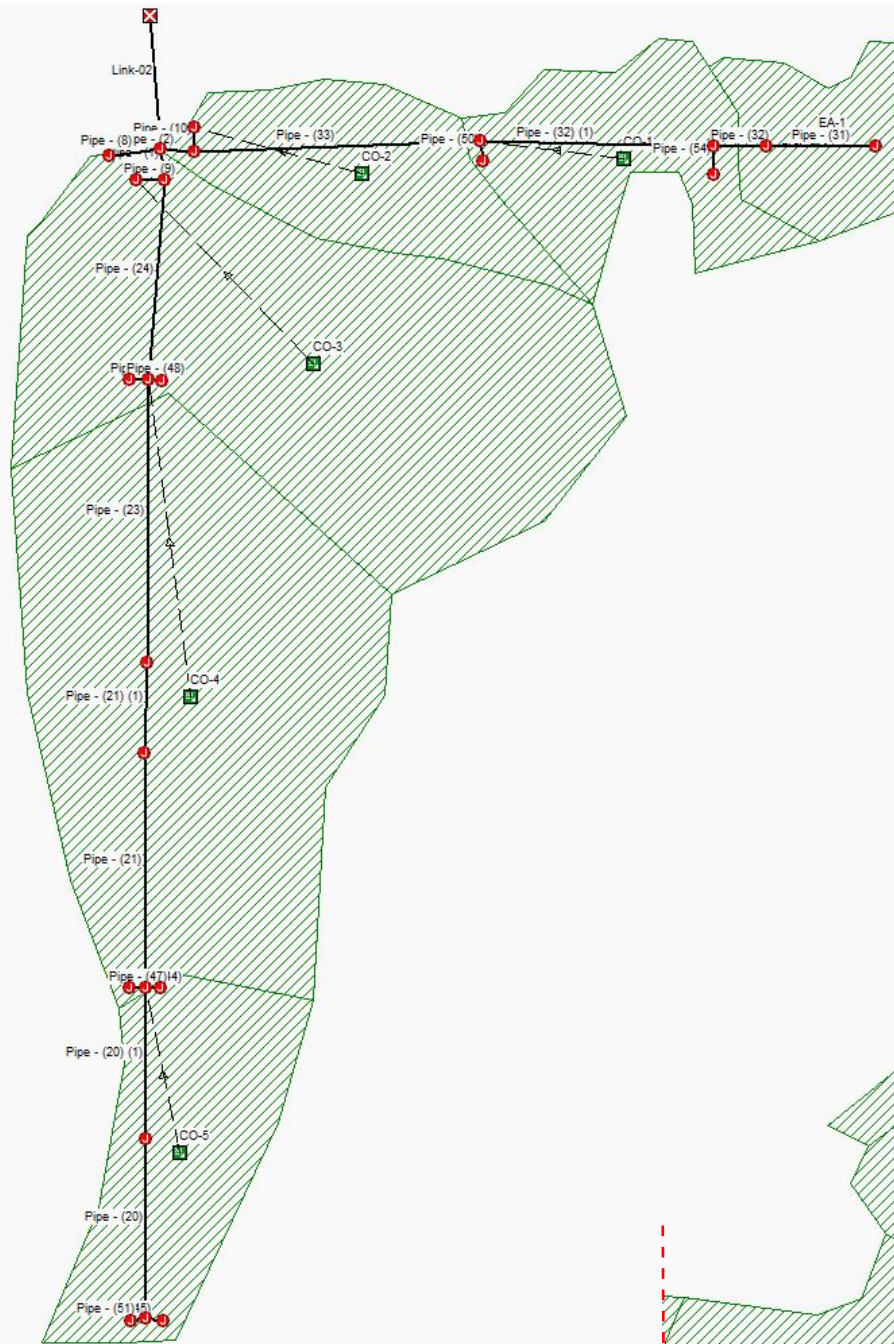
Subbasin Runoff Results

Total Rainfall (in) 2.33
Total Runoff (in) 1.70
Peak Runoff (cfs) 2.73
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:04:28

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-02	6.85	0 12:12	7.27	0.94	4.54	0.29	1.12	0.80	0.00		Calculated
2 Link-03	11.25	0 12:12	11.68	0.96	4.71	0.18	1.17	0.49	0.00		Calculated
3 Link-04	10.36	0 12:11	11.35	0.91	2.83	2.60	1.68	0.70	0.00		Calculated
4 Pipe - (1)	5.58	0 12:11	11.71	0.48	5.27	0.10	0.86	0.63	0.00		Calculated
5 Pipe - (10)	0.44	0 12:20	3.22	0.14	2.61	0.17	0.27	0.27	0.00		Calculated
6 Pipe - (2)	1.29	0 12:11	10.33	0.12	3.55	0.17	0.37	0.26	0.00		Calculated
7 Pipe - (20)	0.00	0 00:00	10.91	0.00	0.00		0.00	0.00	0.00		Calculated
8 Pipe - (20) (1)	0.00	0 00:00	7.85	0.00	0.00		0.21	0.14	0.00		Calculated
9 Pipe - (21)	1.60	0 12:11	6.72	0.24	3.10	1.33	0.49	0.33	0.00		Calculated
10 Pipe - (21) (1)	1.60	0 12:11	10.93	0.15	4.14	0.38	0.39	0.27	0.00		Calculated
11 Pipe - (23)	1.59	0 12:11	12.52	0.13	3.54	1.40	0.45	0.31	0.00		Calculated
12 Pipe - (24)	5.23	0 12:10	13.81	0.38	5.69	0.62	0.75	0.52	0.00		Calculated
13 Pipe - (25)	1.50	0 12:20	19.08	0.08	2.68	1.86	0.70	0.47	0.00		Calculated
14 Pipe - (26)	12.21	0 12:13	19.82	0.62	6.01	0.73	1.21	0.62	0.00		Calculated
15 Pipe - (27)	12.21	0 12:13	21.41	0.57	5.47	0.48	1.32	0.67	0.00		Calculated
16 Pipe - (28)	14.13	0 12:13	22.61	0.62	6.44	0.16	1.30	0.66	0.00		Calculated
17 Pipe - (29)	11.25	0 12:12	48.72	0.23	7.18	0.10	0.99	0.51	0.00		Calculated
18 Pipe - (30)	0.00	0 00:00	14.00	0.00	0.00		0.09	0.06	0.00		Calculated
19 Pipe - (31)	0.00	0 00:00	10.90	0.00	0.00		0.01	0.00	0.00		Calculated
20 Pipe - (32)	0.13	0 12:10	11.87	0.01	2.16	0.43	0.11	0.07	0.00		Calculated
21 Pipe - (32) (1)	0.13	0 12:11	12.59	0.01	1.79	2.28	0.13	0.09	0.00		Calculated
22 Pipe - (33)	1.04	0 12:11	16.77	0.06	5.18	0.97	0.25	0.17	0.00		Calculated
23 Pipe - (40)	0.00	0 00:00	8.84	0.00	0.00		0.37	0.39	0.00		Calculated
24 Pipe - (42)	0.02	0 12:09	5.89	0.00	0.11	2.73	0.52	0.56	0.00		Calculated
25 Pipe - (43)	0.00	0 00:00	11.94	0.00	0.00		0.43	0.44	0.00		Calculated
26 Pipe - (44)	0.00	0 00:00	11.23	0.00	0.00		0.00	0.00	0.00		Calculated
27 Pipe - (45)	0.00	0 00:00	12.40	0.00	0.00		0.00	0.00	0.00		Calculated
28 Pipe - (46)	0.00	0 00:00	18.62	0.00	0.00		0.03	0.03	0.00		Calculated
29 Pipe - (47)	0.00	0 00:00	10.61	0.00	0.00		0.00	0.00	0.00		Calculated
30 Pipe - (48)	0.00	0 00:00	21.64	0.00	0.00		0.03	0.03	0.00		Calculated
31 Pipe - (49)	0.00	0 00:00	14.17	0.00	0.00		0.32	0.34	0.00		Calculated
32 Pipe - (50)	0.00	0 00:00	4.58	0.00	0.00		0.00	0.00	0.00		Calculated
33 Pipe - (51)	0.00	0 00:00	13.71	0.00	0.00		0.00	0.00	0.00		Calculated
34 Pipe - (52)	0.00	0 00:00	12.60	0.00	0.00		0.43	0.44	0.00		Calculated
35 Pipe - (54)	0.00	0 00:00	26.44	0.00	0.00		0.00	0.00	0.00		Calculated
36 Pipe - (8)	0.08	0 12:16	3.65	0.02	0.19	4.71	0.80	0.85	0.00		Calculated
37 Pipe - (9)	1.11	0 12:45	3.88	0.29	3.74	0.13	0.40	0.40	0.00		Calculated

Proposed Model Pipe Layout



Continues Below

Continues Above

