CULVER DRIVE / ALTON PARKWAY

INTERSECTION IMPROVEMENT PROJECT

DRAINAGE REPORT

May 2020

Prepared for:

City of Irvine
1 Civic Center Plaza
Irvine, CA 92606

Prepared on Behalf of:

Kreuzer Consulting

Prepared by:

Stantec

38 Technology Drive
Irvine, CA, 92618

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1. INTRODUCTION

The City of Irvine has retained Stantec Consulting Services Inc. (Stantec), as a subconsultant to Kreuzer Consulting Group (KGC), to provide engineering services for the design of drainage improvements in support of improvements at the Culver Drive and Alton Parkway intersection in the City of Irvine, California. Improvements include widening of northbound Culver Drive and removal of a median island. This report is prepared to document the impact of proposed improvements at the Culver Alton Intersection site on the existing storm drain system and recommend any improvements required. The Culver Alton improvement impact area encompasses approximately 4.39 acres and is located at the intersection of Culver Drive and Alton Parkway. See Figures 1 and 2 for the Vicinity and Location Maps.

Existing and Proposed Conditions

In the existing condition, runoff from the overall drainage area of 9.87 acres generally flows in a northerly direction from the existing roadway to San Diego Creek. Runoff from the impacted street improvement area is proposed to flow via the existing storm drain system in the intersection with minimal adjustments to the two of the four catch basins that currently intercept runoff. The discharge of these facilities has been characterized in this report to assist in the ultimate design. This report also includes an analysis determining whether the development has Hydrologic Conditions of Concern (HCOC) per the fourth term MS4 (Municipal) permit. The report quantifies design outflow to San Diego Creek and the discharges to the existing storm drain line.

The existing site is located within a Special Flood Hazard Area (SFHA) of the San Diego Creek Watershed. This creates a potential Hydrologic Condition of Concern (HCOC) discussed herein below.

Hydrologic Conditions of Concern

Per Figure No. XVI.3, "North Orange County Hydromodification Susceptibility Maps, Figure No. 4," of the Orange County Technical Guidance Document, the entire San Diego Creek watershed has been described as a *Potential Area of Erosion, Habitat, and Physical Structure Susceptibility*. The project location is shown in reference to the San Diego Creek watershed in Figure No. 6. The project drains to susceptible waters and must be checked for Hydrologic Conditions of Concern and hydromodification. Post-project condition runoff volume and time of concentration do not exceed that of the pre-project condition by more than 5%. Therefore, HCOCs do not exist for this Project.

2. RATIONAL METHOD HYDROLOGIC ANALYSIS

The Orange County Hydrology Manual, published in 1986, (Hydrology Manual) and Addendum No.1, published in 1996, provided the guidelines and procedures for the Rational Method analysis. The parameters used for the Rational Method are summarized below.

- The existing and proposed condition hydrologic boundaries were based on the topography as depicted on Figure 3, Existing Condition Hydrology Map.
- The underlying hydrologic soil groups are Type A, B and D as shown on Figure 5, Soil Map.
- The existing condition land uses are road (commercial) and landscape (park).
- For the 2-year storm event, Antecedent Moisture Condition (AMC) AMC-I was used; for the 10 & 25-year storm events, Antecedent Moisture Condition (AMC) AMC-II was used; and for the 100-year storm event, AMC-III was used in accordance with the OC Hydrology Manual, page C-10.

The Rational Method analysis was performed with software developed by Advanced Engineering Software (AES) for the 2-year, 10-year, 25-year and 100-year storm events. The software was designed to accept watershed data and perform Rational Method analyses in accordance with the OC Hydrology Manual. The software defines subareas and routing paths by means of upstream and downstream node numbers, node elevations, travel distance, soil group, land uses and type of conveyance. The Hydrology Map Figures 3 and 4, show the locations of all node numbers used in the Rational Method analysis.

3. CATCH BASIN ANALYSIS

The four catch basins in improved areas were analyzed in accordance with the procedures provided in the Hydraulic Engineering Circular No. 12 (HEC-12) published by the U.S. Federal Highway Administration using the FlowMaster Version 8.0 (FlowMaster) Computer Program developed by Haestad Methods, Inc. The FlowMaster input includes street cross slope, gutter slope, local depression depth, and inlet length. The program calculates inlet efficiency, intercepted flow, bypass flow, depth of flow, and spread. The existing storm drains were also analyzed with FlowMaster.

Design criteria from the Orange County Local Drainage Manual are included in Appendix A.

Table 3-1A
Catch Basin Existing Conditions

Catch Basin Area	Existing Width (FT)	Inlet Condition	Tributary Area (AC)	25-Year Flow (CFS)	25-Year Tc (MIN)	10-Year Flow (CFS)	10-Year Tc (MIN)
1	10	Flow-by	2.2	5.76	11.62	4.74	11.76
2	5	Flow-by	1.8	4.83	10.15	3.99	10.24
3	7	Sump	2.4	6.30	10.44	5.18	10.60
4	10	Sump	3.4	8.75	11.49	7.14	11.72

Table 3-1B
Catch Basin Proposed Conditions

Catch Basin Area	Proposed Width (FT)	Inlet Condition	Tributary Area (AC)	25-Year Flow (CFS)	25-Year Tc (MIN)	10-Year Flow (CFS)	10-Year Tc (MIN)
1	10	Flow-by	2.2	5.75	11.63	4.73	11.75
2	5	Flow-by	1.8	4.83	10.15	3.99	10.24
3	14	Sump	2.4	6.31	10.44	5.19	10.60
4	14	Sump	3.4	8.85	11.48	7.24	11.71

4. RESULTS

Rational Method Results:

The summary of results of the existing condition and proposed condition Rational Method hydrology analyses are listed in table 4-1 below.

Table 4-1
Rational Method Hydrology Analysis 2, 10, 25, 100-Year Storm Summary
Culver Alton Intersection

		Rational Method Q (CFS)				
Storm Event	**Condition**	**Area 1**	**Area 2**	**Area 3**	**Area 4**	**Total**
2 YR	Existing	2.45	2.06	2.67	3.65	10.83
	Proposed	2.44	2.06	2.68	3.74	10.92
10 YR	Existing	4.74	3.99	5.18	7.14	21.05
	Proposed	4.73	3.99	5.19	7.24	21.15
25 YR	Existing	5.76	4.83	6.30	8.75	25.64
	Proposed	5.75	4.83	6.31	8.85	25.74
100 YR	Existing	7.50	6.30	8.23	11.53	33.56
	Proposed	7.49	6.30	8.23	11.62	33.64
Tributary Area (AC)		2.2	1.8	2.4	3.4	9.80

Area 1 refers to the drainage management area along streamline 1 on Hydrology Map Figures 3 & 4 draining to a catch basin on the north side of Alton Parkway, west of Culver Drive. Area 2 refers to the drainage management area along streamline 2 on Hydrology Map Figures 3 & 4 draining to a catch basin on the south side of Alton Parkway, west of Culver Drive. Area 3 refers to the drainage management area along streamlines 3 and 6 on Hydrology Map Figures 3 & 4 draining to a catch basin on the south side of Alton Parkway, east of Culver Drive. Area 4 refers to the drainage management area along streamlines 4 and 5 on Hydrology Map Figures 3 & 4 draining to a catch basin on the north side of Alton Parkway, east of Culver Drive.

Rational Method analyses are included in Appendix B.

Catch Basin Analysis Results:

The proposed project increases flow to the catch basin servicing Area 4 by 0.10 cfs in the 25-year storm event from 8.75 cfs to 8.85 cfs. In the location of the widened curb, a 14-foot-wide catch basin at the northeast corner of the proposed intersection along Alton per City of Irvine Standard Plans 200 Type A-2, 302, and 303 should be installed to conduct flow. The existing outlet 24" RCP is sufficient to convey increased flow (normal depth = 8.21", flowing 34% full).

At the southeast corner of the proposed intersection, a 14-foot-wide catch basin per City of Irvine Standard Plans 200 Type A-2, 302, and 303 should be installed along Alton to conduct flow in the proposed condition. This catch basin will service flow from Area 3, which increased by 0.01 cfs in the proposed condition from 6.30 cfs to 6.31 cfs in a 25-year storm event. The existing outlet 24" RCP is sufficient to convey increased flow (normal depth = 7.62", flowing 32% full).

Existing 24-inch R.C.P. to be extended at existing slope to proposed catch basin locations. Depth of catch basin to match projected invert of pipe.

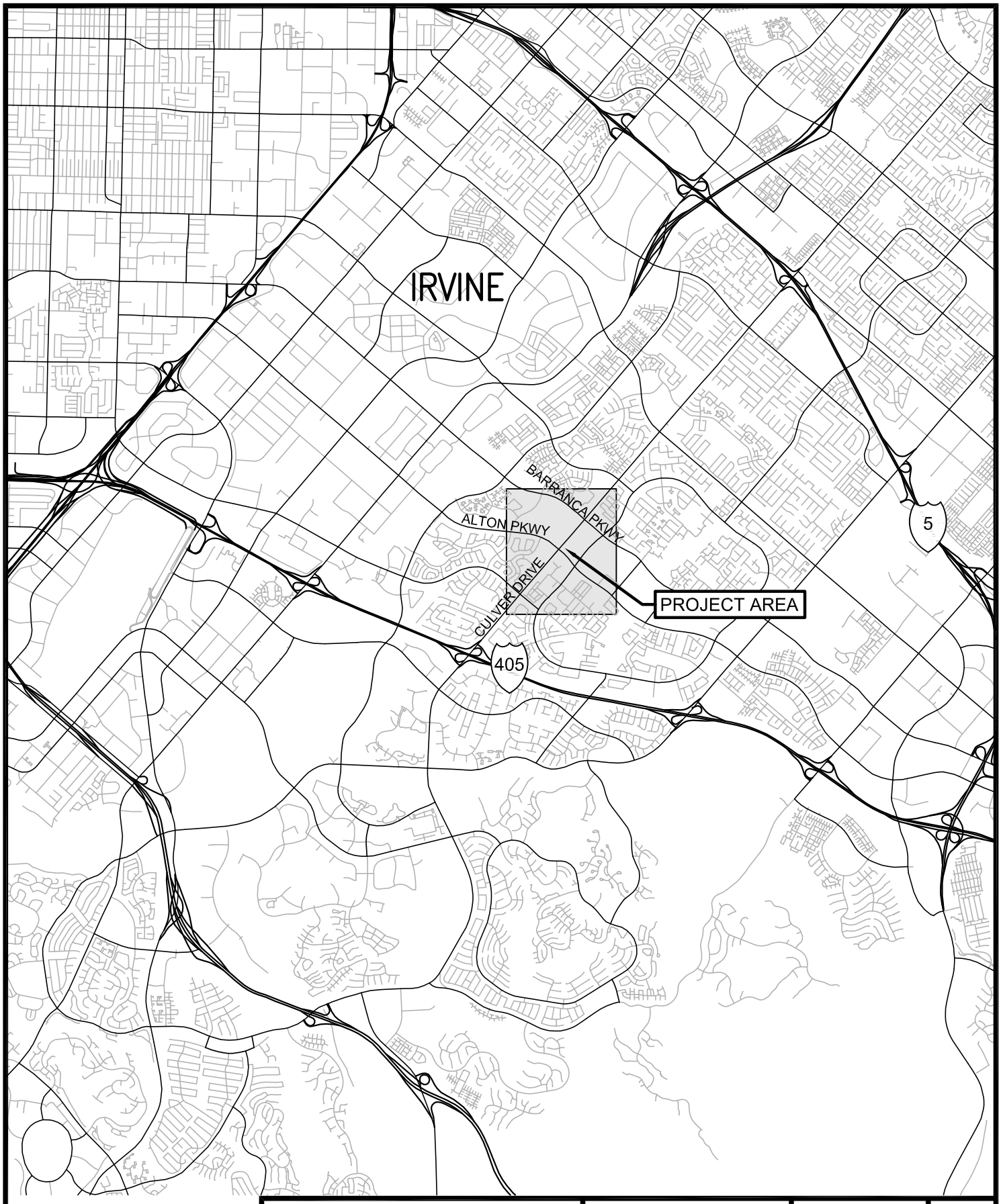
See Appendix C for supporting calculations.

Table 4-2
Catch Basin Results - FlowMaster

Catch Basin Area	Discharge (CFS)	Curb Opening Length (FT)	Spread (FT)	Depth (IN)	Gutter Depression (FT)	Total Depression (FT)
4	8.85	14	21.35	5.87	0.13	0.29
3	6.31	14	17.04	4.99	0.13	0.29

Hydrology for catch basins servicing Area 1 and Area 2 is unchanged. Therefore, no upsizing of catch basins or adjoining storm drains is required.

5. FIGURES



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IRVINE, CA 92618
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VICINITY MAP

DATE: 11/2019

FIGURE 1 OF 6

JOB NO. 2042558200

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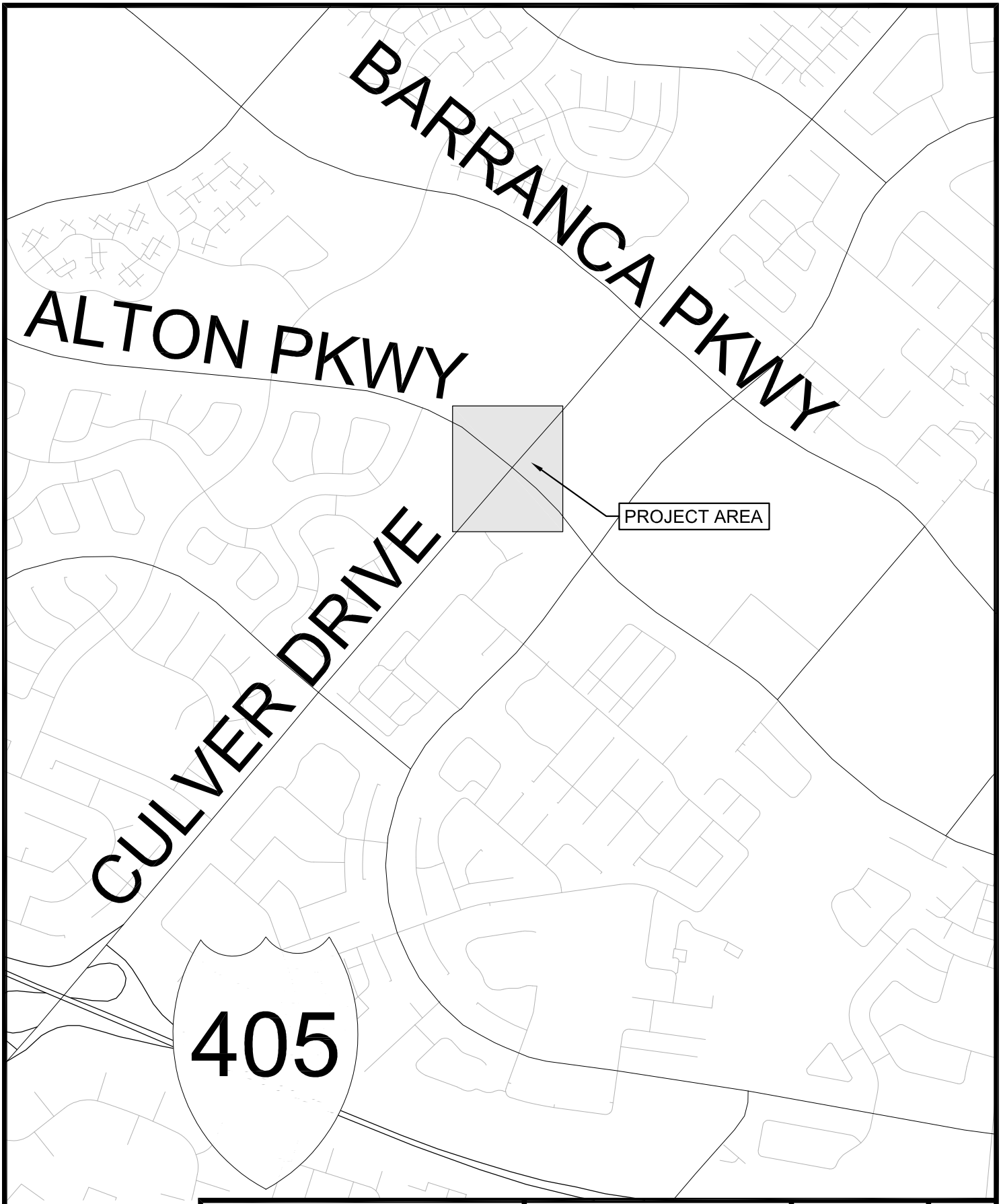

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LOCATION MAP

DATE: **11/2019**

FIGURE **2** OF **6**

JOB NO. **2042558200**

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Catch Basin Existing Conditions

Catch Basin Area	Existing Width (FT)	Inlet Condition	Tributary Area (AC)	25-Year Flow (CFS)	25-Year Tc (MIN)	10-Year Flow (CFS)	10-Year Tc (MIN)
1	10	Flow-by	2.2	5.76	11.62	4.74	11.76
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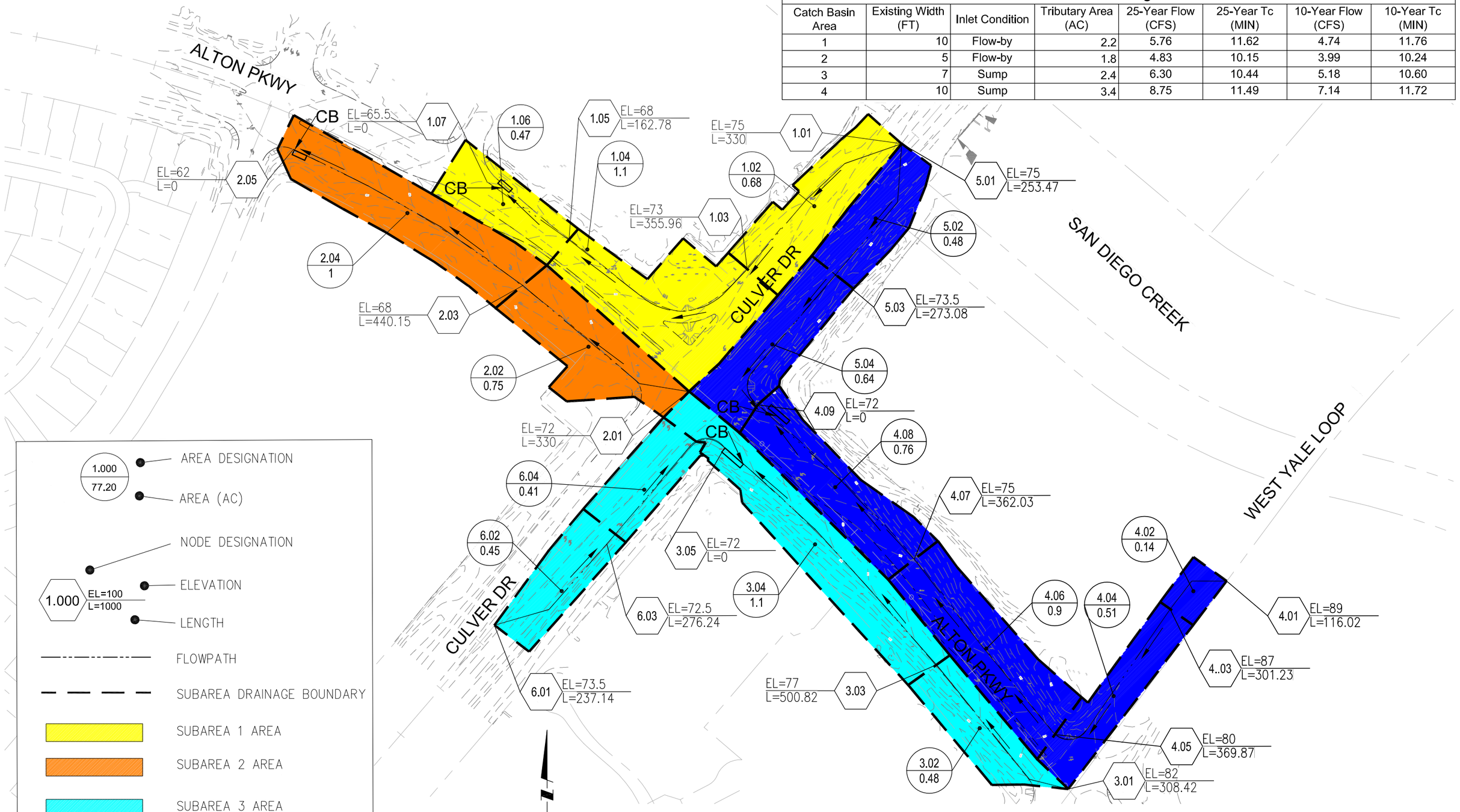

1.000 / 77.20 — AREA DESIGNATION; AREA (AC)

NODE DESIGNATION

1.000 EL=100 L=1000 — ELEVATION; LENGTH

FLOWPATH

SUBAREA DRAINAGE BOUNDARY

SUBAREA 1 AREA

SUBAREA 2 AREA

SUBAREA 3 AREA

SUBAREA 4 AREA

FLOW DIRECTION

GRAPHIC SCALE

150 0 150 300 600

(IN FEET)

1 inch = 150 ft.

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HYDROLOGY MAP
EXISTING CONDITION

DATE: 01/2020

FIGURE 3 OF 6

JOB NO. 2042558200

DRAWING: v:\2042\active\2042558200\drawing\exhibit_files\hydorology map_existing.dwg PLOTTED: 1/17/2020 12:07 PM BY: Simon, Elizabeth

Catch Basin Proposed Conditions

Catch Basin Area	Existing Width (FT)	Inlet Condition	Tributary Area (AC)	25-Year Flow (CFS)	25-Year Tc (MIN)	10-Year Flow (CFS)	10-Year Tc (MIN)
1	10	Flow-by	2.2	5.75	11.63	4.73	11.75
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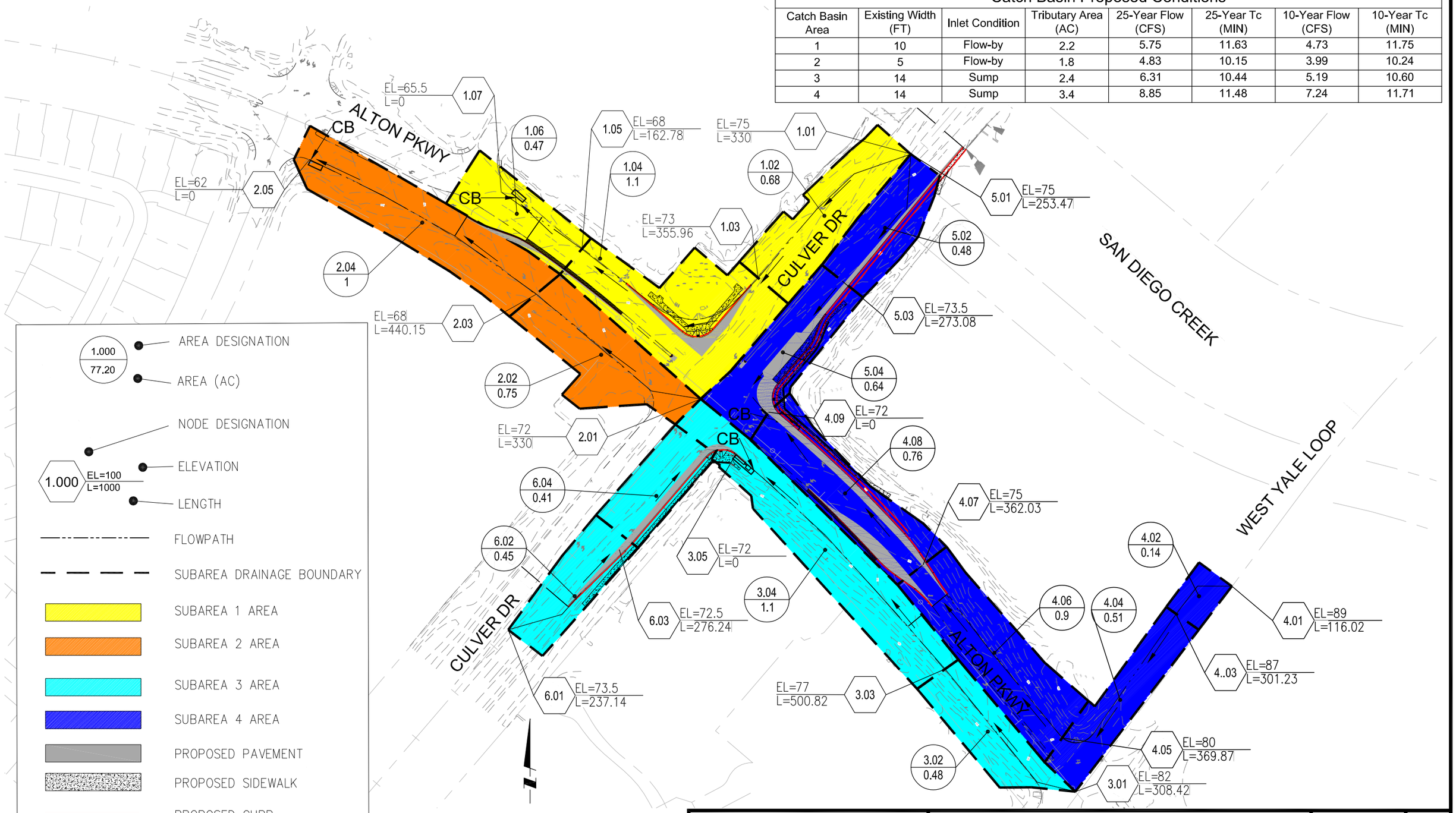
3	14	Sump	2.4	6.31	10.44	5.19	10.60
4	14	Sump	3.4	8.85	11.48	7.24	11.71



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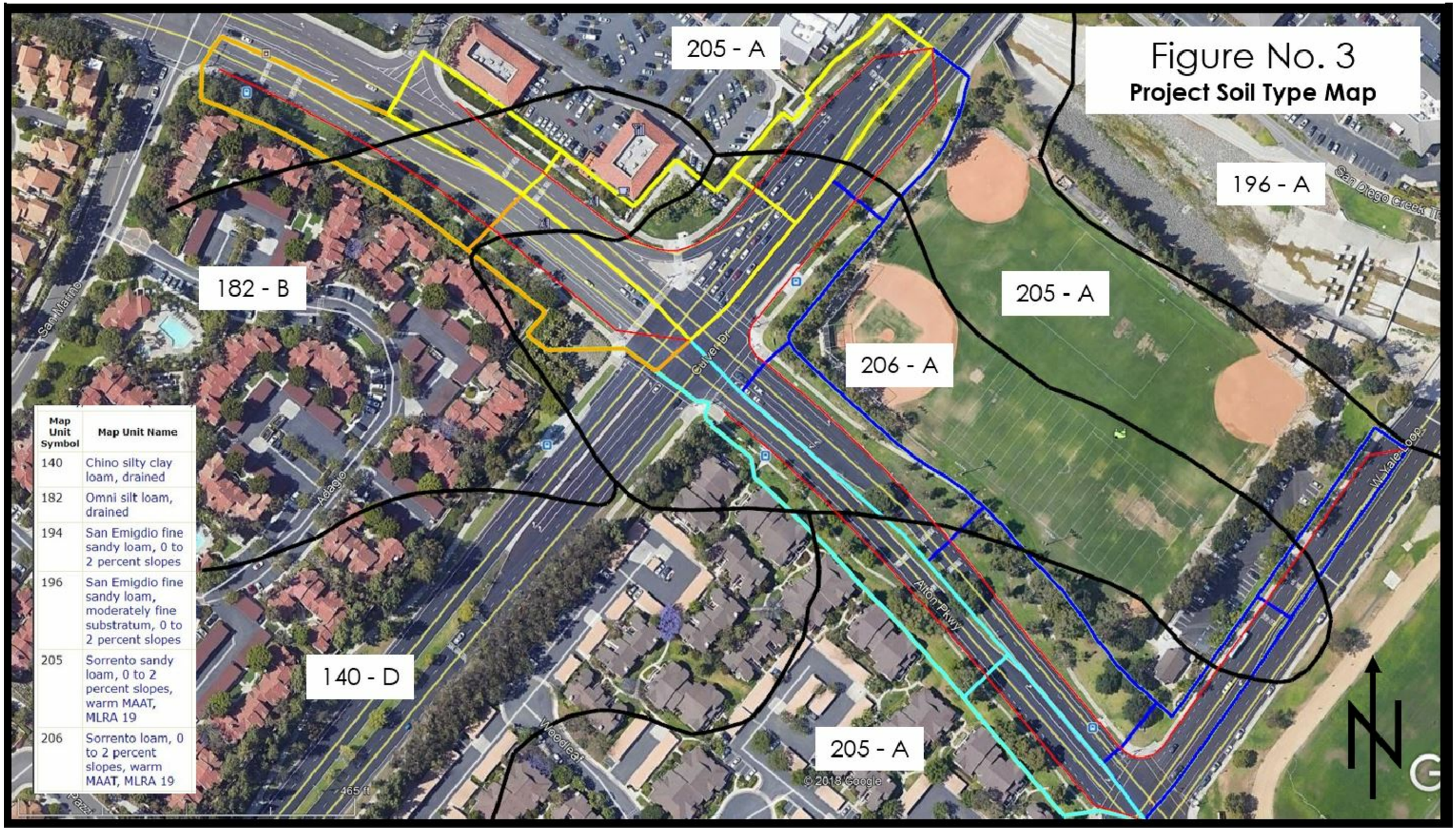
HYDROLOGY MAP
PROPOSED CONDITION

DATE: 01/2020

FIGURE 4 OF 6

JOB NO. 2042558200

Figure No. 3
Project Soil Type Map



Map Unit Symbol	Map Unit Name
140	Chino silty clay loam, drained
182	Omni silt loam, drained
194	San Emigdio fine sandy loam, 0 to 2 percent slopes
196	San Emigdio fine sandy loam, moderately fine substratum, 0 to 2 percent slopes
205	Sorrento sandy loam, 0 to 2 percent slopes, warm MAAT, MLRA 19
206	Sorrento loam, 0 to 2 percent slopes, warm MAAT, MLRA 19

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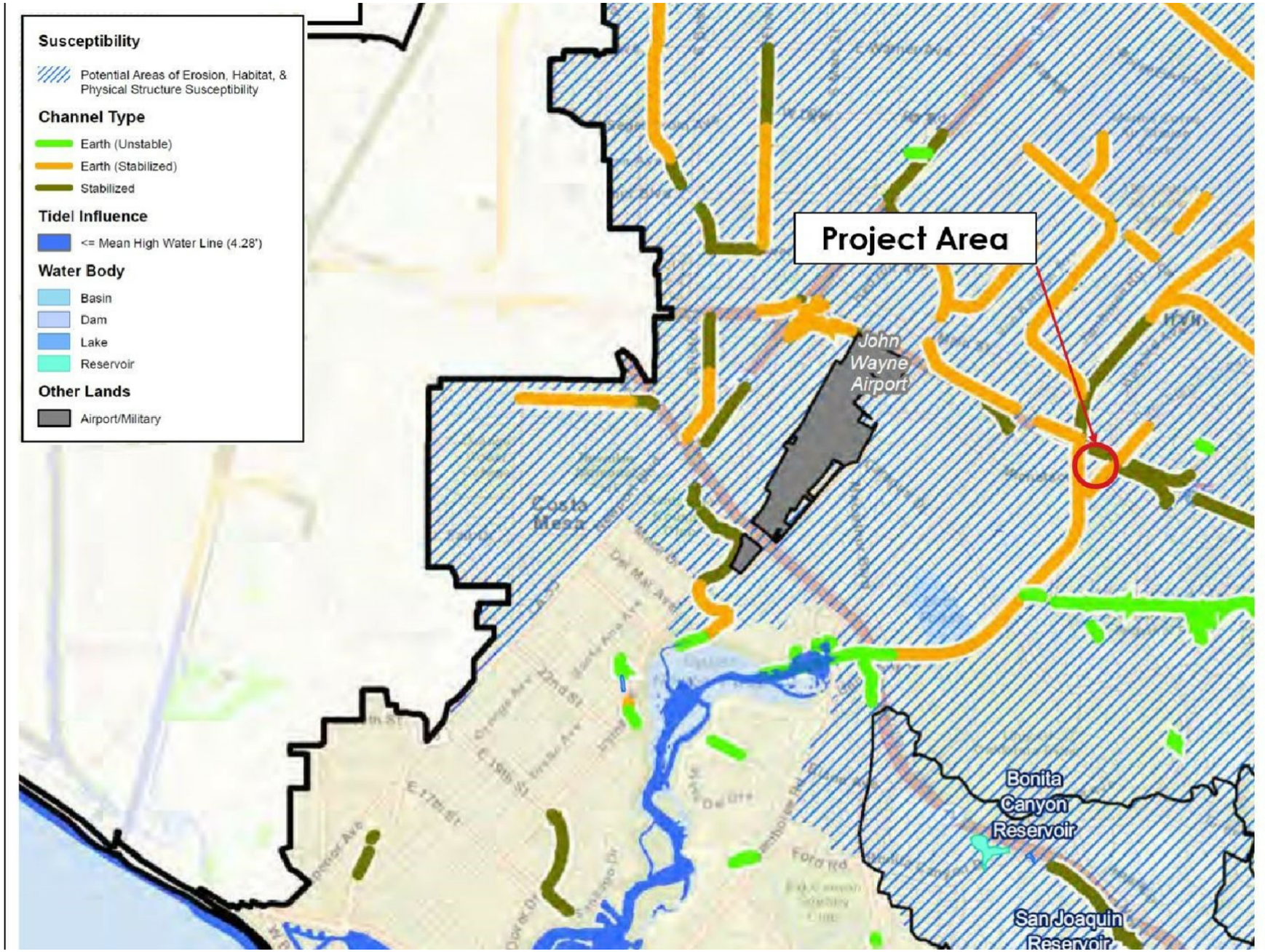
SOIL TYPE MAP

DATE: 11/2019

FIGURE 5 OF 6

JOB NO. 2042558200



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SAN DIEGO CREEK WATERSHED MAP

DATE: 11/2019

FIGURE 6 OF 6

JOB NO. 2042558200

6. TECHNICAL APPENDICES

APPENDIX A Orange County Hydrology Manual References

APPENDIX B Rational Method Hydrology Analysis

APPENDIX C Catch Basin Calculations

A.1 APPENDIX A – Orange County Manual References

Curve Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

ORANGE COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.

3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

ORANGE COUNTY

HYDROLOGY MANUAL

ACTUAL IMPERVIOUS COVER FOR DEVELOPED AREAS

Figure C-4

CHAPTER 1

DESIGN CRITERIA

The following design criteria shall be used for storm drain and local drainage structures built for dedication to the County of Orange, Orange County Flood Control District, or for private facilities within unincorporated Orange County.

Regional or Sub-Regional design storm frequencies are subject to individual review by the Agency and should be in accordance with the 1986 Hydrology Manual and Flood Protection Goals. This manual does not supersede any information contained within the Orange County Drainage Area Management Plan (DAMP), and is intended to be consistent with the DAMP.

I. PROTECTION LEVELS

A. Structures

The goal is to provide 100-year protection for all habitable structures pursuant to Public Services and Facilities Element of the General Plan.

B. Streets

Street criteria for 100-year storm flow is shown on the attached Figure 1-1, Flood Protection Goals.

1. Arterial Highway

   a. One travel lane (use 12 foot if not determined) shall be free from inundation in each direction in a 10-year storm.

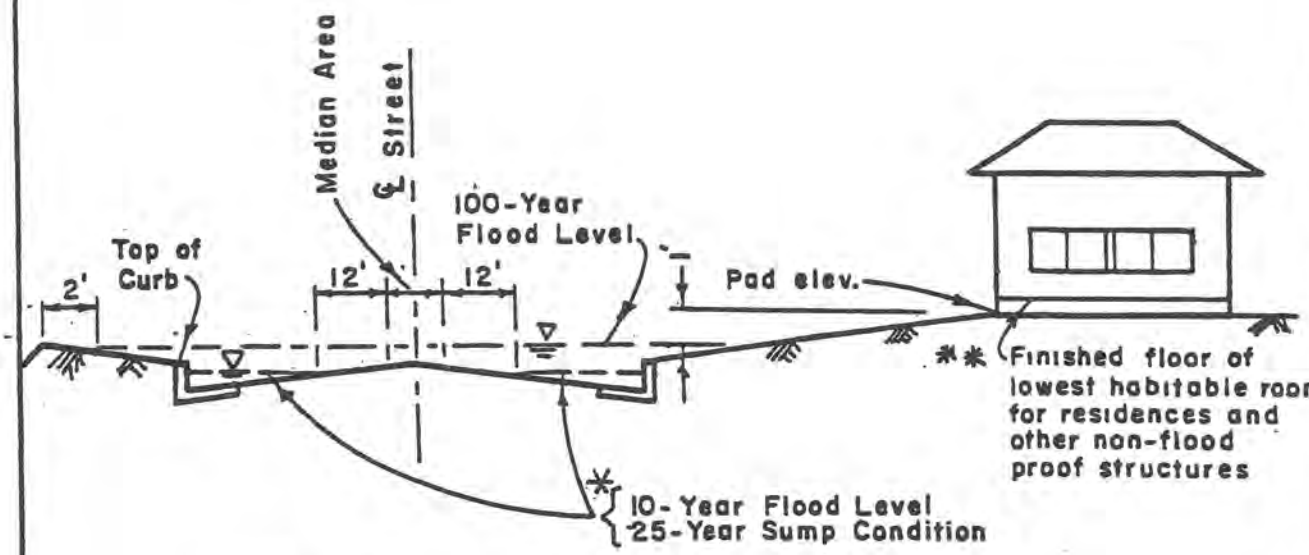
   b. In a sump condition, one travel lane (use 12 foot if not determined) shall be free from inundation in each direction in a 25-year storm.

   c. Median and left-turn pockets shall not be considered as a travel lane.

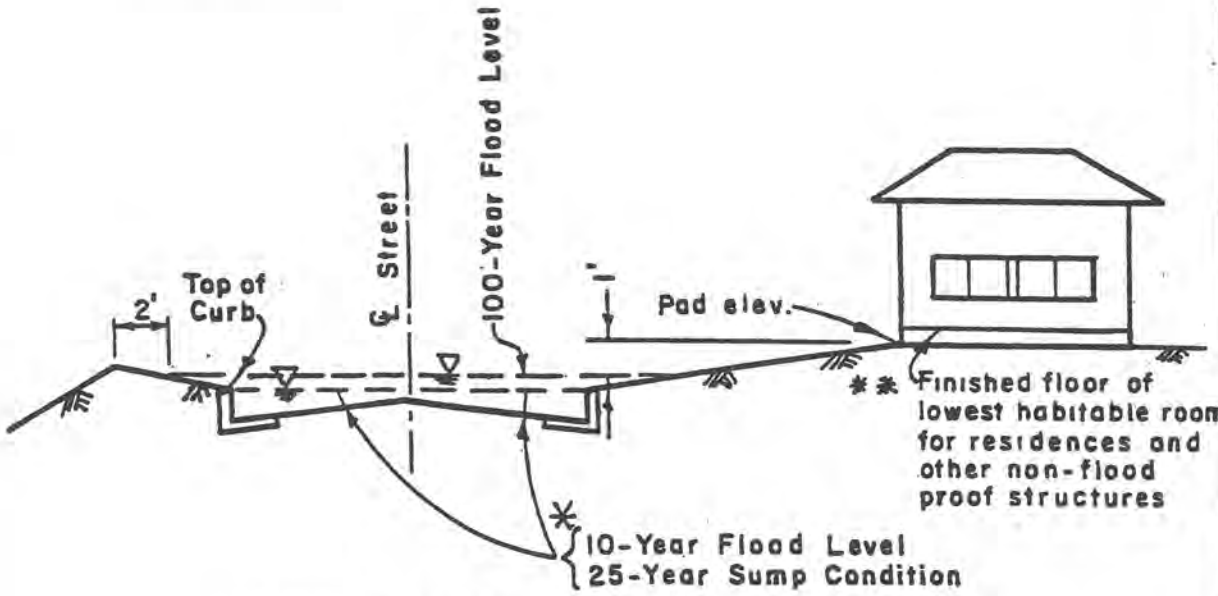
   d. In places where superelevation occurs on arterial highways an inlet shall be provided as necessary to preclude drainage across the travel lanes. The catch basin shall intercept a minimum of a 10-year storm. Local depressions are not to be used for inlets at medians; grate opening or side opening/grate combination (for which future paving overlap will not create a drop) are recommended. Flooding width from median curbs in superelevated sections shall not exceed two feet.

C. General Criteria

1. Storm drains with tributary areas of less than 640 acres are to be designed for a minimum of 10-year frequency below top of curb



ARTERIAL HIGHWAY



LOCAL STREET

NOTE

* For Arterial Hwy and Local Street, depth times velocity cannot exceed six

** The elevation of the lowest floor of buildings, including basements or cellars, must be at least 1 foot above the 100-year flood water surface elevation pursuant to Section 7-9-113.5 of the County Ordinance.

ORANGE COUNTY E.M.A.		
FLOOD PROTECTION GOALS		
1986	1 OF 1	

Figure 1-1

B.1 APPENDIX B – Rational Method Hydrology Calculations

Rational Method – 2-Year Storm Event: Existing Condition

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
       (c) Copyright 1983-2016 Advanced Engineering Software (aes)
           Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                        Analysis prepared by:

                              Stantec



 ************************ DESCRIPTION OF STUDY ************************
* Culver Alton - 2 Year Rational Method Study, Existing Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                 *
* 10/15/2019 - ECS                                                      *
 **************************************************************************

  FILE NAME: CA2DMA1.DAT
  TIME/DATE OF STUDY: 11:17 10/15/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.660
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    17    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    17   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      0.92
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      0.92

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.56
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    7.34
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.68
  STREET FLOW TRAVEL TIME(MIN.) =   2.57   Tc(MIN.) =   11.16
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.428
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    36
  COMMERCIAL                 A        0.56      0.40     0.100    17
  PUBLIC PARK                B        0.20      0.30     0.850    36
  PUBLIC PARK                A        0.22      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.386
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    1.28
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       2.05

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.53
  FLOW VELOCITY(FEET/SEC.) =  2.43   DEPTH*VELOCITY(FT*FT/SEC.) =   0.77
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.31
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    8.84
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.59
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.83
  STREET FLOW TRAVEL TIME(MIN.) =   1.05   Tc(MIN.) =   12.20
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.356
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    36
```

```
  COMMERCIAL                A        0.13      0.40     0.100    17
  PUBLIC PARK               B        0.10      0.30     0.850    36
  PUBLIC PARK               A        0.10      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    0.51
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       2.45

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   9.09
  FLOW VELOCITY(FEET/SEC.) =  2.63   DEPTH*VELOCITY(FT*FT/SEC.) =   0.85
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     12.20
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.397
  PEAK FLOW RATE(CFS)   =       2.45
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 2 Year Rational Method Study, Existing Conditions       *
* DMA 2: West Intersection Streamline, Alton                             *
* 10/15/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: CA2DMA2.DAT
  TIME/DATE OF STUDY: 11:21 10/15/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.797
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    36   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    17   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    36    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    17    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      1.11
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      1.11

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```
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.70
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.30
   HALFSTREET FLOOD WIDTH(FEET) =    7.72
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.34
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.70
 STREET FLOW TRAVEL TIME(MIN.) =   3.14   Tc(MIN.) =   10.61
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.470
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    36
 COMMERCIAL                 A        0.27      0.40     0.100    17
 PUBLIC PARK                B        0.23      0.30     0.850    36
 PUBLIC PARK                A        0.28      0.40     0.850    17
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    1.17
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       2.06

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.59
 FLOW VELOCITY(FEET/SEC.) =  2.41   DEPTH*VELOCITY(FT*FT/SEC.) =   0.76
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     10.61
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       2.06
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
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                        Analysis prepared by:

                              Stantec



 ************************ DESCRIPTION OF STUDY ************************
* Culver Alton - 2 Year Rational Method Study, Existing Conditions      *
* DMA 3: South Intersection Streamline, Alton                           *
* 11/07/2019 - ECS                                                      *
 ************************************************************************

  FILE NAME: 2DMA3E.DAT
  TIME/DATE OF STUDY: 16:41 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.887
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.26      0.40      0.100    17    6.86
  PUBLIC PARK                A        0.22      0.40      0.850    17   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      0.74
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      0.74

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.36
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.96
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.58
  STREET FLOW TRAVEL TIME(MIN.) =   4.26   Tc(MIN.) =   11.12
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.430
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    17
  PUBLIC PARK                A        0.57      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    1.22
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       1.76

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.59
  FLOW VELOCITY(FEET/SEC.) =  2.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.65
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.12
  RAINFALL INTENSITY(INCH/HR) =   1.43
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.76

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.718
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.07      0.20     0.850    57   12.85
  COMMERCIAL                 D        0.38      0.20     0.100    57    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.217
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.91
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.33
    HALFSTREET FLOOD WIDTH(FEET) =    9.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.91
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.30
  STREET FLOW TRAVEL TIME(MIN.) =   5.05   Tc(MIN.) =   13.14
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.300
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.03      0.40     0.850    17
  COMMERCIAL                A        0.25      0.40     0.100    17
  COMMERCIAL                B        0.09      0.30     0.100    36
  PUBLIC PARK               D        0.02      0.20     0.850    57
  COMMERCIAL                D        0.02      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.191
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    0.46
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       0.96

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =   9.72
  FLOW VELOCITY(FEET/SEC.) =  0.93   DEPTH*VELOCITY(FT*FT/SEC.) =   0.31
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   13.14
  RAINFALL INTENSITY(INCH/HR) =   1.30
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.96

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.76   11.12    1.430  0.40( 0.19) 0.48       1.6       3.01
      2        0.96   13.14    1.300  0.26( 0.05) 0.20       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.67   11.12    1.430  0.38( 0.15) 0.39       2.3       3.01
      2        2.54   13.14    1.300  0.37( 0.14) 0.38       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.67    Tc(MIN.) =    11.12
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     11.12
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.390
  PEAK FLOW RATE(CFS)   =       2.67

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.67   11.12    1.430  0.38( 0.15) 0.39       2.3       3.01
      2        2.54   13.14    1.300  0.37( 0.14) 0.38       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY ************************
* Culver Alton - 2 Year Rational Method Study, Existing Conditions       *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/07/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 2DMA4E.DAT
  TIME/DATE OF STUDY: 16:50 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK               A        0.01      0.40      0.850    17    7.29
  COMMERCIAL                A        0.13      0.40      0.100    17    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.28
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.28

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.70
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.66
  STREET FLOW TRAVEL TIME(MIN.) =   1.52   Tc(MIN.) =    6.52
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.944
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.07      0.40     0.850    17
  COMMERCIAL                A        0.44      0.40     0.100    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    0.86
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       1.09

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.25   HALFSTREET FLOOD WIDTH(FEET) =   4.72
  FLOW VELOCITY(FEET/SEC.) =  2.78   DEPTH*VELOCITY(FT*FT/SEC.) =   0.69
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.64
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.59
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.69
  STREET FLOW TRAVEL TIME(MIN.) =   2.66   Tc(MIN.) =    9.18
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.597
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.27      0.40     0.100    17
  PUBLIC PARK               A        0.63      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    1.09
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       1.98

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.41
  FLOW VELOCITY(FEET/SEC.) =  2.40   DEPTH*VELOCITY(FT*FT/SEC.) =   0.75
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.38
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.04
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.71
  STREET FLOW TRAVEL TIME(MIN.) =   2.95   Tc(MIN.) =   12.14
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.361
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.37      0.40     0.100    17
  PUBLIC PARK                A        0.39      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.485
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    0.80
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       2.45

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =  10.59
  FLOW VELOCITY(FEET/SEC.) =  2.05   DEPTH*VELOCITY(FT*FT/SEC.) =   0.72
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.14
  RAINFALL INTENSITY(INCH/HR) =   1.36
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.46
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.45

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.759
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.21      0.40     0.100    17    7.76
  PUBLIC PARK                A        0.27      0.40     0.850    17   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.522
  SUBAREA RUNOFF(CFS) =      0.67
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      0.67

******************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.05
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.46
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.44
  STREET FLOW TRAVEL TIME(MIN.) =   3.11   Tc(MIN.) =   10.88
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.449
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.43      0.40     0.100    17
  PUBLIC PARK                A        0.21      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.346
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    0.75
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       1.29

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.53
  FLOW VELOCITY(FEET/SEC.) =  1.53   DEPTH*VELOCITY(FT*FT/SEC.) =   0.48
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.88
  RAINFALL INTENSITY(INCH/HR) =   1.45
  AREA-AVERAGED Fm(INCH/HR) =  0.17
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  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.42
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.29

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.45   12.14    1.361  0.40( 0.18) 0.46       2.3       4.01
      2        1.29   10.88    1.449  0.40( 0.17) 0.42       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.65   10.88    1.449  0.40( 0.18) 0.44       3.2       5.01
      2        3.65   12.14    1.361  0.40( 0.18) 0.45       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.65    Tc(MIN.) =    12.14
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     12.14
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.445
  PEAK FLOW RATE(CFS)   =       3.65

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.65   10.88    1.449  0.40( 0.18) 0.44       3.2       5.01
      2        3.65   12.14    1.361  0.40( 0.18) 0.45       3.4       4.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method – 2-Year Storm Event: Proposed Condition

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**************************************************************************
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY ************************
* Culver Alton - 2 Year Rational Method Study, Proposed Conditions         *
* DMA 1: North Intersection Streamline, Culver to Alton                    *
* 11/07/2019 - ECS                                                         *
 **************************************************************************

  FILE NAME: 2DMA1P.DAT
  TIME/DATE OF STUDY: 16:58 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.660
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    17    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    17   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      0.92
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      0.92

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.55
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    7.28
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.33
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.68
  STREET FLOW TRAVEL TIME(MIN.) =   2.55   Tc(MIN.) =   11.13
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.430
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    36
  COMMERCIAL                 A        0.52      0.40     0.100    17
  PUBLIC PARK                B        0.20      0.30     0.850    36
  PUBLIC PARK                A        0.26      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.414
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    1.27
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       2.05

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.47
  FLOW VELOCITY(FEET/SEC.) =  2.45   DEPTH*VELOCITY(FT*FT/SEC.) =   0.77
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.30
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    8.84
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.58
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.83
  STREET FLOW TRAVEL TIME(MIN.) =   1.05   Tc(MIN.) =   12.19
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.357
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    36
```

```
  COMMERCIAL                A        0.13      0.40     0.100    17
  PUBLIC PARK               B        0.10      0.30     0.850    36
  PUBLIC PARK               A        0.10      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    0.51
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       2.44

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   9.09
  FLOW VELOCITY(FEET/SEC.) =  2.62   DEPTH*VELOCITY(FT*FT/SEC.) =   0.85
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     12.19
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.410
  PEAK FLOW RATE(CFS)   =       2.44
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 2 Year Rational Method Study, Proposed Conditions       *
* DMA 2: West Intersection Streamline, Alton                             *
* 10/25/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: CA2DMA2.DAT
  TIME/DATE OF STUDY: 14:06 10/25/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.797
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    36   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    17   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    36    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    17    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      1.11
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      1.11

**************************************************************************
```

```
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
--------------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.70
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.30
   HALFSTREET FLOOD WIDTH(FEET) =    7.72
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.34
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.70
 STREET FLOW TRAVEL TIME(MIN.) =   3.14   Tc(MIN.) =   10.61
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.470
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    36
 COMMERCIAL                 A        0.27      0.40     0.100    17
 PUBLIC PARK                B        0.23      0.30     0.850    36
 PUBLIC PARK                A        0.28      0.40     0.850    17
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    1.17
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       2.06

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.59
 FLOW VELOCITY(FEET/SEC.) =  2.41   DEPTH*VELOCITY(FT*FT/SEC.) =   0.76
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
================================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     10.61
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       2.06
================================================================================
================================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 2 Year Rational Method Study, Proposed Conditions       *
* DMA 3: South Intersection Streamline, Alton                             *
* 11/07/2019 - ECS                                                        *
 **************************************************************************

  FILE NAME: 2DMA3P.DAT
  TIME/DATE OF STUDY: 17:04 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.887
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                A        0.26      0.40      0.100    17    6.86
  PUBLIC PARK               A        0.22      0.40      0.850    17   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      0.74
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      0.74

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.36
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.96
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.58
  STREET FLOW TRAVEL TIME(MIN.) =   4.26   Tc(MIN.) =   11.12
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.430
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    17
  PUBLIC PARK                A        0.57      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    1.22
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       1.76

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.59
  FLOW VELOCITY(FEET/SEC.) =  2.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.65
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.12
  RAINFALL INTENSITY(INCH/HR) =   1.43
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.76

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.718
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.06      0.20     0.850    57   12.85
  COMMERCIAL                 D        0.39      0.20     0.100    57    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.91
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.33
    HALFSTREET FLOOD WIDTH(FEET) =    9.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.92
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.30
  STREET FLOW TRAVEL TIME(MIN.) =   5.02   Tc(MIN.) =   13.11
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.302
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.01      0.40     0.850    17
  COMMERCIAL                A        0.27      0.40     0.100    17
  COMMERCIAL                B        0.09      0.30     0.100    36
  PUBLIC PARK               D        0.01      0.20     0.850    57
  COMMERCIAL                D        0.03      0.20     0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.137
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    0.46
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       0.97

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =   9.78
  FLOW VELOCITY(FEET/SEC.) =  0.93   DEPTH*VELOCITY(FT*FT/SEC.) =   0.31
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   13.11
  RAINFALL INTENSITY(INCH/HR) =   1.30
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.17
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.97

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.76   11.12    1.430  0.40( 0.19) 0.48       1.6       3.01
      2        0.97   13.11    1.302  0.25( 0.04) 0.17       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.68   11.12    1.430  0.38( 0.14) 0.38       2.3       3.01
      2        2.56   13.11    1.302  0.38( 0.14) 0.37       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.68    Tc(MIN.) =    11.12
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     11.12
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.379
  PEAK FLOW RATE(CFS)   =       2.68

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.68   11.12    1.430  0.38( 0.14) 0.38       2.3       3.01
      2        2.56   13.11    1.302  0.38( 0.14) 0.37       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 2 Year Rational Method Study, Proposed Conditions       *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/07/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 2DMA4P.DAT
  TIME/DATE OF STUDY: 17:11 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK               A        0.01      0.40      0.850    17    7.29
  COMMERCIAL                A        0.13      0.40      0.100    17    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.28
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.28

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
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```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.70
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.66
  STREET FLOW TRAVEL TIME(MIN.) =   1.52   Tc(MIN.) =    6.52
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.944
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.07      0.40     0.850    17
  COMMERCIAL                A        0.44      0.40     0.100    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    0.86
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       1.09

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.25   HALFSTREET FLOOD WIDTH(FEET) =   4.72
  FLOW VELOCITY(FEET/SEC.) =  2.78   DEPTH*VELOCITY(FT*FT/SEC.) =   0.69
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.64
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.59
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.69
  STREET FLOW TRAVEL TIME(MIN.) =   2.66   Tc(MIN.) =    9.18
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.597
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.27      0.40     0.100    17
  PUBLIC PARK               A        0.63      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    1.09
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       1.98

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =   8.41
  FLOW VELOCITY(FEET/SEC.) =  2.40   DEPTH*VELOCITY(FT*FT/SEC.) =   0.75
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.40
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.51
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.04
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.71
  STREET FLOW TRAVEL TIME(MIN.) =   2.96   Tc(MIN.) =   12.14
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.360
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.54      0.40     0.100    17
  PUBLIC PARK                A        0.22      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.317
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    0.84
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       2.49

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =  10.66
  FLOW VELOCITY(FEET/SEC.) =  2.06   DEPTH*VELOCITY(FT*FT/SEC.) =   0.73
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.14
  RAINFALL INTENSITY(INCH/HR) =   1.36
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.49

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.759
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  A        0.24      0.40     0.100    17    7.76
  PUBLIC PARK                 A        0.24      0.40     0.850    17   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.475
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.08
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.72
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.44
  STREET FLOW TRAVEL TIME(MIN.) =   3.07   Tc(MIN.) =   10.84
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.452
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  A        0.57      0.40     0.100    17
  PUBLIC PARK                 A        0.07      0.40     0.850    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.182
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    0.79
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       1.34

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.72
  FLOW VELOCITY(FEET/SEC.) =  1.54   DEPTH*VELOCITY(FT*FT/SEC.) =   0.49
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.84
  RAINFALL INTENSITY(INCH/HR) =   1.45
  AREA-AVERAGED Fm(INCH/HR) =  0.12
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.31
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.34

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.49   12.14    1.360  0.40( 0.16) 0.40       2.3       4.01
      2        1.34   10.84    1.452  0.40( 0.12) 0.31       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.74   10.84    1.452  0.40( 0.15) 0.37       3.2       5.01
      2        3.74   12.14    1.360  0.40( 0.15) 0.37       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.74    Tc(MIN.) =    12.14
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     12.14
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.371
  PEAK FLOW RATE(CFS)   =       3.74

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.74   10.84    1.452  0.40( 0.15) 0.37       3.2       5.01
      2        3.74   12.14    1.360  0.40( 0.15) 0.37       3.4       4.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method – 10-Year Storm Event: Existing Condition

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Existing Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                  *
* 10/15/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: CA10DMA1.DAT
  TIME/DATE OF STUDY: 11:18 10/15/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.978
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    32    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    32   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      1.73
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      1.73

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.95
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =   10.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.63
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.91
  STREET FLOW TRAVEL TIME(MIN.) =   2.26   Tc(MIN.) =   10.84
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.605
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    56
  COMMERCIAL                 A        0.56      0.40     0.100    32
  PUBLIC PARK                B        0.20      0.30     0.850    56
  PUBLIC PARK                A        0.22      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.386
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.44
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       3.94

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.68
  FLOW VELOCITY(FEET/SEC.) =  2.79   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.43
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.38
    HALFSTREET FLOOD WIDTH(FEET) =   12.07
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.97
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   0.91   Tc(MIN.) =   11.76
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.487
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    56
```

```
  COMMERCIAL                A        0.13      0.40     0.100    32
  PUBLIC PARK               B        0.10      0.30     0.850    56
  PUBLIC PARK               A        0.10      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    0.99
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       4.74

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  12.38
  FLOW VELOCITY(FEET/SEC.) =  3.03   DEPTH*VELOCITY(FT*FT/SEC.) =   1.16
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     11.76
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.397
  PEAK FLOW RATE(CFS)   =       4.74
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Existing Conditions      *
* DMA 2: West Intersection Streamline, Alton                             *
* 10/15/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: CA10DMA2.DAT
  TIME/DATE OF STUDY: 11:22 10/15/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.224
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    56   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    32   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    56    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    32    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      2.08
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      2.08

**************************************************************************
```

```
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.21
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.35
   HALFSTREET FLOOD WIDTH(FEET) =   10.66
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.66
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.94
 STREET FLOW TRAVEL TIME(MIN.) =   2.76   Tc(MIN.) =   10.24
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.693
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    56
 COMMERCIAL                 A        0.27      0.40     0.100    32
 PUBLIC PARK                B        0.23      0.30     0.850    56
 PUBLIC PARK                A        0.28      0.40     0.850    32
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.27
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       3.99

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.76
 FLOW VELOCITY(FEET/SEC.) =  2.79   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     10.24
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       3.99
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Existing Conditions      *
* DMA 3: South Intersection Streamline, Alton                            *
* 11/20/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 10DMA3E.DAT
  TIME/DATE OF STUDY: 11:25 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.386
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                A        0.26      0.40      0.100    32    6.86
  PUBLIC PARK               A        0.22      0.40      0.850    32   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      1.39
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.39

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.60
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.24
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.78
  STREET FLOW TRAVEL TIME(MIN.) =   3.73   Tc(MIN.) =   10.60
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.640
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    32
  PUBLIC PARK                A        0.57      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.42
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       3.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  11.91
  FLOW VELOCITY(FEET/SEC.) =  2.38   DEPTH*VELOCITY(FT*FT/SEC.) =   0.89
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.60
  RAINFALL INTENSITY(INCH/HR) =   2.64
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.48

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.082
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.07      0.20     0.850    75   12.85
  COMMERCIAL                 D        0.38      0.20     0.100    75    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.217
  SUBAREA RUNOFF(CFS) =      1.23
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.23

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.66
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.54
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.04
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.40
  STREET FLOW TRAVEL TIME(MIN.) =   4.42   Tc(MIN.) =   12.51
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.400
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.03      0.40     0.850    32
  COMMERCIAL                A        0.25      0.40     0.100    32
  COMMERCIAL                B        0.09      0.30     0.100    56
  PUBLIC PARK               D        0.02      0.20     0.850    75
  COMMERCIAL                D        0.02      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.191
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    0.86
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       1.82

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.01
  FLOW VELOCITY(FEET/SEC.) =  1.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.42
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.51
  RAINFALL INTENSITY(INCH/HR) =   2.40
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.82

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.48   10.60    2.640  0.40( 0.19) 0.48       1.6       3.01
      2        1.82   12.51    2.400  0.26( 0.05) 0.20       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.18   10.60    2.640  0.38( 0.15) 0.39       2.3       3.01
      2        4.96   12.51    2.400  0.37( 0.14) 0.38       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.18    Tc(MIN.) =    10.60
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     10.60
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.390
  PEAK FLOW RATE(CFS)   =       5.18

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.18   10.60    2.640  0.38( 0.15) 0.39       2.3       3.01
      2        4.96   12.51    2.400  0.37( 0.14) 0.38       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Existing Conditions      *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/20/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 10DMA4E.DAT
  TIME/DATE OF STUDY: 11:28 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK               A        0.01      0.40      0.850    32    7.29
  COMMERCIAL                A        0.13      0.40      0.100    32    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.50

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.27
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    5.41
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.79
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.72
  STREET FLOW TRAVEL TIME(MIN.) =   1.80   Tc(MIN.) =    6.80
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.404
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.07      0.40     0.850    32
  COMMERCIAL                A        0.44      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    1.53
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       1.95

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   7.22
  FLOW VELOCITY(FEET/SEC.) =  2.95   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.01
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.35
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.62
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.91
  STREET FLOW TRAVEL TIME(MIN.) =   2.36   Tc(MIN.) =    9.16
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.870
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.27      0.40     0.100    32
  PUBLIC PARK               A        0.63      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    2.12
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       3.76

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.52
  FLOW VELOCITY(FEET/SEC.) =  2.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.00
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.54
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.41
    HALFSTREET FLOOD WIDTH(FEET) =   13.95
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.97
  STREET FLOW TRAVEL TIME(MIN.) =   2.56   Tc(MIN.) =   11.72
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.492
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.37      0.40     0.100    32
  PUBLIC PARK                A        0.39      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.485
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    1.57
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       4.80

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.26
  FLOW VELOCITY(FEET/SEC.) =  2.39   DEPTH*VELOCITY(FT*FT/SEC.) =   1.00
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.72
  RAINFALL INTENSITY(INCH/HR) =   2.49
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.46
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.80

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.155
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.21      0.40     0.100    32    7.76
  PUBLIC PARK                A        0.27      0.40     0.850    32   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.522
  SUBAREA RUNOFF(CFS) =      1.27
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.27

******************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.00
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.59
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.59
  STREET FLOW TRAVEL TIME(MIN.) =   2.72   Tc(MIN.) =   10.48
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.656
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.43      0.40     0.100    32
  PUBLIC PARK                A        0.21      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.346
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    1.45
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       2.51

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.76
  FLOW VELOCITY(FEET/SEC.) =  1.76   DEPTH*VELOCITY(FT*FT/SEC.) =   0.65
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.48
  RAINFALL INTENSITY(INCH/HR) =   2.66
  AREA-AVERAGED Fm(INCH/HR) =  0.17
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.42
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.51

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.80   11.72    2.492  0.40( 0.18) 0.46       2.3       4.01
      2        2.51   10.48    2.656  0.40( 0.17) 0.42       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.11   10.48    2.656  0.40( 0.18) 0.44       3.2       5.01
      2        7.14   11.72    2.492  0.40( 0.18) 0.45       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.14    Tc(MIN.) =    11.72
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     11.72
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.445
  PEAK FLOW RATE(CFS)   =       7.14

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.11   10.48    2.656  0.40( 0.18) 0.44       3.2       5.01
      2        7.14   11.72    2.492  0.40( 0.18) 0.45       3.4       4.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method – 10-Year Storm Event: Proposed Condition

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2016 Advanced Engineering Software (aes)
            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Proposed Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                  *
* 11/07/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 10DMA1P.DAT
  TIME/DATE OF STUDY: 16:56 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.978
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    32    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    32   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      1.73
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      1.73

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.94
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =   10.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.62
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.90
  STREET FLOW TRAVEL TIME(MIN.) =   2.26   Tc(MIN.) =   10.85
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.605
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    56
  COMMERCIAL                 A        0.52      0.40     0.100    32
  PUBLIC PARK                B        0.20      0.30     0.850    56
  PUBLIC PARK                A        0.26      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.414
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.43
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       3.93

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.60
  FLOW VELOCITY(FEET/SEC.) =  2.81   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.42
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.38
    HALFSTREET FLOOD WIDTH(FEET) =   11.99
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.99
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.13
  STREET FLOW TRAVEL TIME(MIN.) =   0.91   Tc(MIN.) =   11.75
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.488
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    56
```

```
  COMMERCIAL                A        0.13      0.40     0.100    32
  PUBLIC PARK               B        0.10      0.30     0.850    56
  PUBLIC PARK               A        0.10      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    0.99
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       4.73

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  12.38
  FLOW VELOCITY(FEET/SEC.) =  3.03   DEPTH*VELOCITY(FT*FT/SEC.) =   1.16
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     11.75
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.410
  PEAK FLOW RATE(CFS)   =       4.73
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Proposed Conditions      *
* DMA 2: West Intersection Streamline, Alton                             *
* 10/25/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: CA10DMA2.DAT
  TIME/DATE OF STUDY: 14:07 10/25/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.224
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    56   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    32   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    56    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    32    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      2.08
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      2.08

**************************************************************************
```

```
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.21
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.35
   HALFSTREET FLOOD WIDTH(FEET) =   10.66
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.66
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.94
 STREET FLOW TRAVEL TIME(MIN.) =   2.76   Tc(MIN.) =   10.24
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.693
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    56
 COMMERCIAL                 A        0.27      0.40     0.100    32
 PUBLIC PARK                B        0.23      0.30     0.850    56
 PUBLIC PARK                A        0.28      0.40     0.850    32
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.27
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       3.99

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.76
 FLOW VELOCITY(FEET/SEC.) =  2.79   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     10.24
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       3.99
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Proposed Conditions      *
* DMA 3: South Intersection Streamline, Alton                            *
* 11/20/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 10DMA3P.DAT
  TIME/DATE OF STUDY: 11:37 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.386
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                A        0.26      0.40      0.100    32    6.86
  PUBLIC PARK               A        0.22      0.40      0.850    32   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      1.39
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.39

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.60
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.24
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.78
  STREET FLOW TRAVEL TIME(MIN.) =   3.73   Tc(MIN.) =   10.60
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.640
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    32
  PUBLIC PARK                A        0.57      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.42
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       3.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  11.91
  FLOW VELOCITY(FEET/SEC.) =  2.38   DEPTH*VELOCITY(FT*FT/SEC.) =   0.89
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.60
  RAINFALL INTENSITY(INCH/HR) =   2.64
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.48

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.082
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.06      0.20     0.850    75   12.85
  COMMERCIAL                 D        0.39      0.20     0.100    75    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.23
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.23

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.67
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.54
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.04
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.40
  STREET FLOW TRAVEL TIME(MIN.) =   4.41   Tc(MIN.) =   12.50
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.401
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.01      0.40     0.850    32
  COMMERCIAL                A        0.27      0.40     0.100    32
  COMMERCIAL                B        0.09      0.30     0.100    56
  PUBLIC PARK               D        0.01      0.20     0.850    75
  COMMERCIAL                D        0.03      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.137
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    0.87
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       1.83

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.01
  FLOW VELOCITY(FEET/SEC.) =  1.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.42
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.50
  RAINFALL INTENSITY(INCH/HR) =   2.40
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.17
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.83

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.48   10.60    2.640  0.40( 0.19) 0.48       1.6       3.01
      2        1.83   12.50    2.401  0.25( 0.04) 0.17       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.19   10.60    2.640  0.38( 0.14) 0.38       2.3       3.01
      2        4.97   12.50    2.401  0.38( 0.14) 0.37       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.19    Tc(MIN.) =    10.60
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     10.60
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.379
  PEAK FLOW RATE(CFS)   =       5.19

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.19   10.60    2.640  0.38( 0.14) 0.38       2.3       3.01
      2        4.97   12.50    2.401  0.38( 0.14) 0.37       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 10 Year Rational Method Study, Proposed Conditions      *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/20/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 10DMA4P.DAT
  TIME/DATE OF STUDY: 11:40 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                A        0.01      0.40      0.850    32    7.29
  COMMERCIAL                 A        0.13      0.40      0.100    32    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.50

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.27
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    5.41
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.79
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.72
  STREET FLOW TRAVEL TIME(MIN.) =   1.80   Tc(MIN.) =    6.80
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.404
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.07      0.40     0.850    32
  COMMERCIAL                A        0.44      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    1.53
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       1.95

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   7.22
  FLOW VELOCITY(FEET/SEC.) =  2.95   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.01
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.35
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.62
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.91
  STREET FLOW TRAVEL TIME(MIN.) =   2.36   Tc(MIN.) =    9.16
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.870
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.27      0.40     0.100    32
  PUBLIC PARK               A        0.63      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    2.12
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       3.76

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.52
  FLOW VELOCITY(FEET/SEC.) =  2.72   DEPTH*VELOCITY(FT*FT/SEC.) =   1.00
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.57
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.41
    HALFSTREET FLOOD WIDTH(FEET) =   13.95
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.37
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.97
  STREET FLOW TRAVEL TIME(MIN.) =   2.55   Tc(MIN.) =   11.71
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.493
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.54      0.40     0.100    32
  PUBLIC PARK                A        0.22      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.317
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    1.62
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       4.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.34
  FLOW VELOCITY(FEET/SEC.) =  2.39   DEPTH*VELOCITY(FT*FT/SEC.) =   1.00
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.71
  RAINFALL INTENSITY(INCH/HR) =   2.49
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.85

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.155
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.24      0.40     0.100    32    7.76
  PUBLIC PARK                A        0.24      0.40     0.850    32   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.475
  SUBAREA RUNOFF(CFS) =      1.28
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.28

****************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.03
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =   10.66
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.68
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.59
  STREET FLOW TRAVEL TIME(MIN.) =   2.72   Tc(MIN.) =   10.48
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.657
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.57      0.40     0.100    32
  PUBLIC PARK                A        0.07      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.182
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    1.49
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       2.55

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  11.84
  FLOW VELOCITY(FEET/SEC.) =  1.77   DEPTH*VELOCITY(FT*FT/SEC.) =   0.66
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.48
  RAINFALL INTENSITY(INCH/HR) =   2.66
  AREA-AVERAGED Fm(INCH/HR) =  0.12
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```
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.31
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.55

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.85   11.71    2.493  0.40( 0.16) 0.40       2.3       4.01
      2        2.55   10.48    2.657  0.40( 0.12) 0.31       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.20   10.48    2.657  0.40( 0.15) 0.37       3.2       5.01
      2        7.24   11.71    2.493  0.40( 0.15) 0.37       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.24    Tc(MIN.) =    11.71
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     11.71
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.371
  PEAK FLOW RATE(CFS)   =       7.24

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.20   10.48    2.657  0.40( 0.15) 0.37       3.2       5.01
      2        7.24   11.71    2.493  0.40( 0.15) 0.37       3.4       4.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method – 25-Year Storm Event: Existing Condition

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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           Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                        Analysis prepared by:

                              Stantec



 ************************* DESCRIPTION OF STUDY ************************
* Culver Alton - 25 Year Rational Method Study, Existing Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                  *
* 11/20/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 25DMA1E.DAT
  TIME/DATE OF STUDY: 11:14 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.552
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    32    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    32   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      2.08
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      2.08

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.56
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.36
    HALFSTREET FLOOD WIDTH(FEET) =   11.13
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.74
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.99
  STREET FLOW TRAVEL TIME(MIN.) =   2.17   Tc(MIN.) =   10.75
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.127
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    56
  COMMERCIAL                 A        0.56      0.40     0.100    32
  PUBLIC PARK                B        0.20      0.30     0.850    56
  PUBLIC PARK                A        0.22      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.386
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.96
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       4.78

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.70
  FLOW VELOCITY(FEET/SEC.) =  2.92   DEPTH*VELOCITY(FT*FT/SEC.) =   1.14
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.38
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.12
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.24
  STREET FLOW TRAVEL TIME(MIN.) =   0.87   Tc(MIN.) =   11.62
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.993
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    56
```

```
  COMMERCIAL                A        0.13      0.40     0.100    32
  PUBLIC PARK               B        0.10      0.30     0.850    56
  PUBLIC PARK               A        0.10      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    1.20
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       5.76

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  13.48
  FLOW VELOCITY(FEET/SEC.) =  3.17   DEPTH*VELOCITY(FT*FT/SEC.) =   1.28
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     11.62
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.397
  PEAK FLOW RATE(CFS)   =       5.76
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 25 Year Rational Method Study, Existing Conditions      *
* DMA 2: West Intersection Streamline, Alton                             *
* 11/20/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 25DMA2E.DAT
  TIME/DATE OF STUDY: 11:19 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.842
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    56   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    32   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    56    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    32    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      2.49
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      2.49

**************************************************************************
```

```
  FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
--------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
  STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.87
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.68
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.74
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.02
  STREET FLOW TRAVEL TIME(MIN.) =   2.67   Tc(MIN.) =   10.15
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.231
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.22      0.30     0.100    56
  COMMERCIAL                 A        0.27      0.40     0.100    32
  PUBLIC PARK                B        0.23      0.30     0.850    56
  PUBLIC PARK                A        0.28      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
  SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.75
  EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       4.83

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.85
  FLOW VELOCITY(FEET/SEC.) =  2.90   DEPTH*VELOCITY(FT*FT/SEC.) =   1.14
  LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     10.15
  EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
  PEAK FLOW RATE(CFS)   =       4.83
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 25 Year Rational Method Study, Existing Conditions      *
* DMA 3: South Intersection Streamline, Alton                            *
* 11/07/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 25DMA3E.DAT
  TIME/DATE OF STUDY: 16:39 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.032
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.26      0.40      0.100    32    6.86
  PUBLIC PARK                A        0.22      0.40      0.850    32   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      1.67
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.67

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.15
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.34
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.85
  STREET FLOW TRAVEL TIME(MIN.) =   3.57   Tc(MIN.) =   10.44
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.181
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    32
  PUBLIC PARK                A        0.57      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.96
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       4.25

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.01
  FLOW VELOCITY(FEET/SEC.) =  2.49   DEPTH*VELOCITY(FT*FT/SEC.) =   0.99
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.44
  RAINFALL INTENSITY(INCH/HR) =   3.18
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.25

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.674
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.07      0.20     0.850    75   12.85
  COMMERCIAL                 D        0.38      0.20     0.100    75    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.217
  SUBAREA RUNOFF(CFS) =      1.47
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.47

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.99
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.55
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.09
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.44
  STREET FLOW TRAVEL TIME(MIN.) =   4.23   Tc(MIN.) =   12.32
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.895
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.03      0.40     0.850    32
  COMMERCIAL                A        0.25      0.40     0.100    32
  COMMERCIAL                B        0.09      0.30     0.100    56
  PUBLIC PARK               D        0.02      0.20     0.850    75
  COMMERCIAL                D        0.02      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.191
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    1.04
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       2.20

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  14.10
  FLOW VELOCITY(FEET/SEC.) =  1.12   DEPTH*VELOCITY(FT*FT/SEC.) =   0.46
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.32
  RAINFALL INTENSITY(INCH/HR) =   2.90
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.20

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.25   10.44    3.181  0.40( 0.19) 0.48       1.6       3.01
      2        2.20   12.32    2.895  0.26( 0.05) 0.20       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.30   10.44    3.181  0.38( 0.15) 0.39       2.3       3.01
      2        6.05   12.32    2.895  0.37( 0.14) 0.38       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.30    Tc(MIN.) =    10.44
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     10.44
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.390
  PEAK FLOW RATE(CFS)   =       6.30

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.30   10.44    3.181  0.38( 0.15) 0.39       2.3       3.01
      2        6.05   12.32    2.895  0.37( 0.14) 0.38       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2016 Advanced Engineering Software (aes)
            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 25 Year Rational Method Study, Existing Conditions      *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/07/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 25DMA4E.DAT
  TIME/DATE OF STUDY: 16:47 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK               A        0.01      0.40      0.850    32    7.29
  COMMERCIAL                A        0.13      0.40      0.100    32    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.60

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.52
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    6.16
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.85
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.78
  STREET FLOW TRAVEL TIME(MIN.) =   1.76   Tc(MIN.) =    6.76
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.066
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.07      0.40     0.850    32
  COMMERCIAL                A        0.44      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    1.83
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       2.33

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   7.97
  FLOW VELOCITY(FEET/SEC.) =  3.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.94
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.63
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.70
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.99
  STREET FLOW TRAVEL TIME(MIN.) =   2.29   Tc(MIN.) =    9.05
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.448
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.27      0.40     0.100    32
  PUBLIC PARK               A        0.63      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

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  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    2.59
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       4.56

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.54
  FLOW VELOCITY(FEET/SEC.) =  2.86   DEPTH*VELOCITY(FT*FT/SEC.) =   1.10
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.53
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.12
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.47
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.07
  STREET FLOW TRAVEL TIME(MIN.) =   2.44   Tc(MIN.) =   11.49
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.013
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.37      0.40     0.100    32
  PUBLIC PARK                A        0.39      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.485
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    1.93
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       5.88

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  15.51
  FLOW VELOCITY(FEET/SEC.) =  2.51   DEPTH*VELOCITY(FT*FT/SEC.) =   1.10
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.49
  RAINFALL INTENSITY(INCH/HR) =   3.01
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.46
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.88

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
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  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.761
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.21      0.40     0.100    32    7.76
  PUBLIC PARK                A        0.27      0.40     0.850    32   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.522
  SUBAREA RUNOFF(CFS) =      1.53
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.53

******************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.42
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.52
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.75
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.64
  STREET FLOW TRAVEL TIME(MIN.) =   2.60   Tc(MIN.) =   10.36
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.193
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.43      0.40     0.100    32
  PUBLIC PARK                A        0.21      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.346
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    1.76
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       3.05

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.77
  FLOW VELOCITY(FEET/SEC.) =  1.85   DEPTH*VELOCITY(FT*FT/SEC.) =   0.72
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.36
  RAINFALL INTENSITY(INCH/HR) =   3.19
  AREA-AVERAGED Fm(INCH/HR) =  0.17
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  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.42
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.05

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.88   11.49    3.013  0.40( 0.18) 0.46       2.3       4.01
      2        3.05   10.36    3.193  0.40( 0.17) 0.42       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.70   10.36    3.193  0.40( 0.18) 0.44       3.2       5.01
      2        8.75   11.49    3.013  0.40( 0.18) 0.45       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.75    Tc(MIN.) =    11.49
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     11.49
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.445
  PEAK FLOW RATE(CFS)   =       8.75

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.70   10.36    3.193  0.40( 0.18) 0.44       3.2       5.01
      2        8.75   11.49    3.013  0.40( 0.18) 0.45       3.4       4.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method – 25-Year Storm Event: Proposed Condition

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**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 25 Year Rational Method Study, Proposed Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                  *
* 11/20/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 25DMA1P.DAT
  TIME/DATE OF STUDY: 11:32 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.552
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    32    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    32   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      2.08
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      2.08

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
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```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.55
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.36
    HALFSTREET FLOOD WIDTH(FEET) =   11.13
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.73
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.99
  STREET FLOW TRAVEL TIME(MIN.) =   2.17   Tc(MIN.) =   10.76
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.127
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    56
  COMMERCIAL                 A        0.52      0.40     0.100    32
  PUBLIC PARK                B        0.20      0.30     0.850    56
  PUBLIC PARK                A        0.26      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.414
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.95
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       4.76

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.70
  FLOW VELOCITY(FEET/SEC.) =  2.92   DEPTH*VELOCITY(FT*FT/SEC.) =   1.14
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.37
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.09
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.11
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.23
  STREET FLOW TRAVEL TIME(MIN.) =   0.87   Tc(MIN.) =   11.63
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.992
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    56
```

```
  COMMERCIAL                A        0.13      0.40     0.100    32
  PUBLIC PARK               B        0.10      0.30     0.850    56
  PUBLIC PARK               A        0.10      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    1.20
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       5.75

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  13.48
  FLOW VELOCITY(FEET/SEC.) =  3.17   DEPTH*VELOCITY(FT*FT/SEC.) =   1.28
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     11.63
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.410
  PEAK FLOW RATE(CFS)   =       5.75
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 25 Year Rational Method Study, Proposed Conditions      *
* DMA 2: West Intersection Streamline, Alton                             *
* 11/20/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 25DMA2P.DAT
  TIME/DATE OF STUDY: 11:35 11/20/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.842
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    56   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    32   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    56    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    32    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      2.49
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      2.49

**************************************************************************
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 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.87
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.37
   HALFSTREET FLOOD WIDTH(FEET) =   11.68
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.74
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.02
 STREET FLOW TRAVEL TIME(MIN.) =   2.67   Tc(MIN.) =   10.15
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.231
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    56
 COMMERCIAL                 A        0.27      0.40     0.100    32
 PUBLIC PARK                B        0.23      0.30     0.850    56
 PUBLIC PARK                A        0.28      0.40     0.850    32
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.75
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       4.83

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.85
 FLOW VELOCITY(FEET/SEC.) =  2.90   DEPTH*VELOCITY(FT*FT/SEC.) =   1.14
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     10.15
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       4.83
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                        Analysis prepared by:

                              Stantec



 ************************ DESCRIPTION OF STUDY ************************
* Culver Alton - 25 Year Rational Method Study, Proposed Conditions      *
* DMA 3: South Intersection Streamline, Alton                            *
* 11/07/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 25DMA3P.DAT
  TIME/DATE OF STUDY: 17:03 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.032
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.26      0.40      0.100    32    6.86
  PUBLIC PARK                A        0.22      0.40      0.850    32   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      1.67
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.67

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.15
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.34
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.85
  STREET FLOW TRAVEL TIME(MIN.) =   3.57   Tc(MIN.) =   10.44
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.181
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    32
  PUBLIC PARK                A        0.57      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.96
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       4.25

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  13.01
  FLOW VELOCITY(FEET/SEC.) =  2.49   DEPTH*VELOCITY(FT*FT/SEC.) =   0.99
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.44
  RAINFALL INTENSITY(INCH/HR) =   3.18
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.25

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.674
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.06      0.20     0.850    75   12.85
  COMMERCIAL                 D        0.39      0.20     0.100    75    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.47
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.47

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.00
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.55
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.09
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.44
  STREET FLOW TRAVEL TIME(MIN.) =   4.22   Tc(MIN.) =   12.31
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.896
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.01      0.40     0.850    32
  COMMERCIAL                A        0.27      0.40     0.100    32
  COMMERCIAL                B        0.09      0.30     0.100    56
  PUBLIC PARK               D        0.01      0.20     0.850    75
  COMMERCIAL                D        0.03      0.20     0.100    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.137
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    1.05
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       2.21

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.18
  FLOW VELOCITY(FEET/SEC.) =  1.11   DEPTH*VELOCITY(FT*FT/SEC.) =   0.46
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.31
  RAINFALL INTENSITY(INCH/HR) =   2.90
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.17
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.21

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.25   10.44    3.181  0.40( 0.19) 0.48       1.6       3.01
      2        2.21   12.31    2.896  0.25( 0.04) 0.17       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.31   10.44    3.181  0.38( 0.14) 0.38       2.3       3.01
      2        6.06   12.31    2.896  0.38( 0.14) 0.37       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.31    Tc(MIN.) =    10.44
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     10.44
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.379
  PEAK FLOW RATE(CFS)   =       6.31

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.31   10.44    3.181  0.38( 0.14) 0.38       2.3       3.01
      2        6.06   12.31    2.896  0.38( 0.14) 0.37       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 25 Year Rational Method Study, Proposed Conditions      *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/07/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 25DMA4P.DAT
  TIME/DATE OF STUDY: 17:10 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                A        0.01      0.40      0.850    32    7.29
  COMMERCIAL                 A        0.13      0.40      0.100    32    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.60

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
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  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.52
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    6.16
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.85
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.78
  STREET FLOW TRAVEL TIME(MIN.) =   1.76   Tc(MIN.) =    6.76
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.066
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.07      0.40     0.850    32
  COMMERCIAL                A        0.44      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    1.83
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       2.33

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   7.97
  FLOW VELOCITY(FEET/SEC.) =  3.07   DEPTH*VELOCITY(FT*FT/SEC.) =   0.94
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.63
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.70
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.99
  STREET FLOW TRAVEL TIME(MIN.) =   2.29   Tc(MIN.) =    9.05
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.448
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.27      0.40     0.100    32
  PUBLIC PARK               A        0.63      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
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  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    2.59
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       4.56

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.54
  FLOW VELOCITY(FEET/SEC.) =  2.86   DEPTH*VELOCITY(FT*FT/SEC.) =   1.10
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.55
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.12
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.07
  STREET FLOW TRAVEL TIME(MIN.) =   2.43   Tc(MIN.) =   11.48
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.014
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.54      0.40     0.100    32
  PUBLIC PARK                A        0.22      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.317
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    1.97
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       5.93

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  15.59
  FLOW VELOCITY(FEET/SEC.) =  2.51   DEPTH*VELOCITY(FT*FT/SEC.) =   1.11
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.48
  RAINFALL INTENSITY(INCH/HR) =   3.01
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.93

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
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  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.761
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.24      0.40     0.100    32    7.76
  PUBLIC PARK                A        0.24      0.40     0.850    32   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.475
  SUBAREA RUNOFF(CFS) =      1.54
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.54

******************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.44
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   11.60
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.75
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.65
  STREET FLOW TRAVEL TIME(MIN.) =   2.60   Tc(MIN.) =   10.36
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.193
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.57      0.40     0.100    32
  PUBLIC PARK                A        0.07      0.40     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.182
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    1.80
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       3.09

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.93
  FLOW VELOCITY(FEET/SEC.) =  1.83   DEPTH*VELOCITY(FT*FT/SEC.) =   0.72
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.36
  RAINFALL INTENSITY(INCH/HR) =   3.19
  AREA-AVERAGED Fm(INCH/HR) =  0.12
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AREA-AVERAGED Fp(INCH/HR) = 0.40
AREA-AVERAGED Ap = 0.31
EFFECTIVE STREAM AREA(ACRES) = 1.12
TOTAL STREAM AREA(ACRES) = 1.12
PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.09

** CONFLUENCE DATA **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	5.93	11.48	3.014	0.40(0.16)	0.40	2.3	4.01
2	3.09	10.36	3.193	0.40(0.12)	0.31	1.1	5.01

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	8.79	10.36	3.193	0.40(0.15)	0.37	3.2	5.01
2	8.85	11.48	3.014	0.40(0.15)	0.37	3.4	4.01

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 8.85 Tc(MIN.) = 11.48
EFFECTIVE AREA(ACRES) = 3.43 AREA-AVERAGED Fm(INCH/HR) = 0.15
AREA-AVERAGED Fp(INCH/HR) = 0.40 AREA-AVERAGED Ap = 0.37
TOTAL AREA(ACRES) = 3.4
LONGEST FLOWPATH FROM NODE 4.01 TO NODE 4.09 = 1149.15 FEET.

==========

END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 3.4 TC(MIN.) = 11.48
EFFECTIVE AREA(ACRES) = 3.43 AREA-AVERAGED Fm(INCH/HR)= 0.15
AREA-AVERAGED Fp(INCH/HR) = 0.40 AREA-AVERAGED Ap = 0.371
PEAK FLOW RATE(CFS) = 8.85

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	8.79	10.36	3.193	0.40(0.15)	0.37	3.2	5.01
2	8.85	11.48	3.014	0.40(0.15)	0.37	3.4	4.01

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END OF RATIONAL METHOD ANALYSIS

Rational Method – 100-Year Storm Event: Existing Condition

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**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Existing Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                   *
* 10/25/2019 - ECS                                                        *
 **************************************************************************

  FILE NAME: 100DMA1.DAT
  TIME/DATE OF STUDY: 14:16 10/25/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.539
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.41      0.40      0.100    52    8.59
  PUBLIC PARK                A        0.27      0.40      0.850    52   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      2.68
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      2.68

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
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```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.60
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.46
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.91
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   2.04   Tc(MIN.) =   10.62
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.018
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    76
  COMMERCIAL                 A        0.56      0.40     0.100    52
  PUBLIC PARK                B        0.20      0.30     0.850    76
  PUBLIC PARK                A        0.22      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.386
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    3.84
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       6.20

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.18
  FLOW VELOCITY(FEET/SEC.) =  3.12   DEPTH*VELOCITY(FT*FT/SEC.) =   1.30
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.99
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.42
    HALFSTREET FLOOD WIDTH(FEET) =   14.65
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.40
  STREET FLOW TRAVEL TIME(MIN.) =   0.82   Tc(MIN.) =   11.44
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.850
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    76
```

```
  COMMERCIAL                A        0.13      0.40     0.100    52
  PUBLIC PARK               B        0.10      0.30     0.850    76
  PUBLIC PARK               A        0.10      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    1.57
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       7.50

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.43   HALFSTREET FLOOD WIDTH(FEET) =  15.12
  FLOW VELOCITY(FEET/SEC.) =  3.36   DEPTH*VELOCITY(FT*FT/SEC.) =   1.45
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     11.44
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.397
  PEAK FLOW RATE(CFS)   =       7.50
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Existing Conditions     *
* DMA 2: West Intersection Streamline, Alton                             *
* 10/25/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 100DMA2.DAT
  TIME/DATE OF STUDY: 13:44 10/25/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.914
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    76   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    52   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    76    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    52    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      3.22
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      3.22

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 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.02
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.40
   HALFSTREET FLOOD WIDTH(FEET) =   13.09
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.91
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.15
 STREET FLOW TRAVEL TIME(MIN.) =   2.52   Tc(MIN.) =    9.99
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.161
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    76
 COMMERCIAL                 A        0.27      0.40     0.100    52
 PUBLIC PARK                B        0.23      0.30     0.850    76
 PUBLIC PARK                A        0.28      0.40     0.850    52
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    3.59
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       6.30

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.41
 FLOW VELOCITY(FEET/SEC.) =  3.07   DEPTH*VELOCITY(FT*FT/SEC.) =   1.29
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =      9.99
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       6.30
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Existing Conditions     *
* DMA 3: South Intersection Streamline, Alton                            *
* 11/07/2019 - ECS                                                       *
 **************************************************************************

  FILE NAME: 100DMA3.DAT
  TIME/DATE OF STUDY: 12:42 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.160
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                A        0.26      0.40      0.100    52    6.86
  PUBLIC PARK               A        0.22      0.40      0.850    52   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      2.15
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      2.15

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.10
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.97
  STREET FLOW TRAVEL TIME(MIN.) =   3.36   Tc(MIN.) =   10.23
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.106
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    52
  PUBLIC PARK                A        0.57      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    3.87
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       5.57

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.57
  FLOW VELOCITY(FEET/SEC.) =  2.67   DEPTH*VELOCITY(FT*FT/SEC.) =   1.13
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.23
  RAINFALL INTENSITY(INCH/HR) =   4.11
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.57

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.697
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.07      0.20     0.850    91   12.85
  COMMERCIAL                 D        0.38      0.20     0.100    91    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.217
  SUBAREA RUNOFF(CFS) =      1.88
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.88

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.56
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.04
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.16
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.50
  STREET FLOW TRAVEL TIME(MIN.) =   3.98   Tc(MIN.) =   12.06
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.735
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.03      0.40     0.850    52
  COMMERCIAL                A        0.25      0.40     0.100    52
  COMMERCIAL                B        0.09      0.30     0.100    76
  PUBLIC PARK               D        0.02      0.20     0.850    91
  COMMERCIAL                D        0.02      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.191
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    1.35
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       2.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  15.74
  FLOW VELOCITY(FEET/SEC.) =  1.18   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.06
  RAINFALL INTENSITY(INCH/HR) =   3.74
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.85

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.57   10.23    4.106  0.40( 0.19) 0.48       1.6       3.01
      2        2.85   12.06    3.735  0.26( 0.05) 0.20       0.9       6.01
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.23   10.23    4.106  0.38( 0.15) 0.39       2.3       3.01
      2        7.89   12.06    3.735  0.37( 0.14) 0.38       2.4       6.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.23    Tc(MIN.) =    10.23
  EFFECTIVE AREA(ACRES) =       2.31   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        2.4
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.4  TC(MIN.) =     10.23
  EFFECTIVE AREA(ACRES) =      2.31  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.38  AREA-AVERAGED Ap = 0.390
  PEAK FLOW RATE(CFS)   =       8.23

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.23   10.23    4.106  0.38( 0.15) 0.39       2.3       3.01
      2        7.89   12.06    3.735  0.37( 0.14) 0.38       2.4       6.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Existing Conditions     *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver           *
* 11/07/2019 - ECS                                                       *
 ************************************************************************

  FILE NAME: 100DMA4E.DAT
  TIME/DATE OF STUDY: 15:10 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK               A        0.01      0.40      0.850    52    7.29
  COMMERCIAL                A        0.13      0.40      0.100    52    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.77
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.77

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.96
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    7.22
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.97
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.87
  STREET FLOW TRAVEL TIME(MIN.) =   1.69   Tc(MIN.) =    6.69
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.237
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A        0.07      0.40     0.850    52
  COMMERCIAL                 A        0.44      0.40     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    2.37
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       3.02

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   9.09
  FLOW VELOCITY(FEET/SEC.) =  3.24   DEPTH*VELOCITY(FT*FT/SEC.) =   1.05
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.73
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.87
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   2.15   Tc(MIN.) =    8.84
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.464
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.27      0.40     0.100    52
  PUBLIC PARK                A        0.63      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    3.41
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       5.98

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  14.10
  FLOW VELOCITY(FEET/SEC.) =  3.04   DEPTH*VELOCITY(FT*FT/SEC.) =   1.26
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.25
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.46
    HALFSTREET FLOOD WIDTH(FEET) =   16.91
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.64
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.23
  STREET FLOW TRAVEL TIME(MIN.) =   2.29   Tc(MIN.) =   11.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.912
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.37      0.40     0.100    52
  PUBLIC PARK                A        0.39      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.485
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    2.54
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       7.75

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  17.38
  FLOW VELOCITY(FEET/SEC.) =  2.68   DEPTH*VELOCITY(FT*FT/SEC.) =   1.27
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.13
  RAINFALL INTENSITY(INCH/HR) =   3.91
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.46
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.75

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.809
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.21      0.40     0.100    52    7.76
  PUBLIC PARK                A        0.27      0.40     0.850    52   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.522
  SUBAREA RUNOFF(CFS) =      1.99
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      1.99

******************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.13
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.93
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.86
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.73
  STREET FLOW TRAVEL TIME(MIN.) =   2.45   Tc(MIN.) =   10.21
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.109
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.43      0.40     0.100    52
  PUBLIC PARK                A        0.21      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.346
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    2.29
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.42
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       3.97

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.34
  FLOW VELOCITY(FEET/SEC.) =  1.96   DEPTH*VELOCITY(FT*FT/SEC.) =   0.82
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.21
  RAINFALL INTENSITY(INCH/HR) =   4.11
  AREA-AVERAGED Fm(INCH/HR) =  0.17
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  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.42
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.97

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.75   11.13    3.912  0.40( 0.18) 0.46       2.3       4.01
      2        3.97   10.21    4.109  0.40( 0.17) 0.42       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       11.46   10.21    4.109  0.40( 0.18) 0.44       3.2       5.01
      2       11.53   11.13    3.912  0.40( 0.18) 0.45       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      11.53    Tc(MIN.) =    11.13
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     11.13
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.445
  PEAK FLOW RATE(CFS)   =      11.53

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       11.46   10.21    4.109  0.40( 0.18) 0.44       3.2       5.01
      2       11.53   11.13    3.912  0.40( 0.18) 0.45       3.4       4.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Rational Method – 100-Year Storm Event: Proposed Condition

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Proposed Conditions      *
* DMA 1: North Intersection Streamline, Culver to Alton                   *
* 11/07/2019 - ECS                                                        *
 **************************************************************************

  FILE NAME: 100DMA1P.DAT
  TIME/DATE OF STUDY: 16:03 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.586
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.539
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                A        0.41      0.40      0.100    52    8.59
  PUBLIC PARK               A        0.27      0.40      0.850    52   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.398
  SUBAREA RUNOFF(CFS) =      2.68
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      2.68

**************************************************************************
  FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   73.00  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   355.96   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.60
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.46
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.91
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   2.04   Tc(MIN.) =   10.63
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.017
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.12      0.30     0.100    76
  COMMERCIAL                 A        0.52      0.40     0.100    52
  PUBLIC PARK                B        0.20      0.30     0.850    76
  PUBLIC PARK                A        0.26      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.36
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.414
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    3.83
  EFFECTIVE AREA(ACRES) =      1.78    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       6.19

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.18
  FLOW VELOCITY(FEET/SEC.) =  3.11   DEPTH*VELOCITY(FT*FT/SEC.) =   1.29
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     685.96 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   65.50
  STREET LENGTH(FEET) =   162.78   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.97
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.42
    HALFSTREET FLOOD WIDTH(FEET) =   14.65
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.40
  STREET FLOW TRAVEL TIME(MIN.) =   0.82   Tc(MIN.) =   11.45
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.849
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.14      0.30     0.100    76
```

```
  COMMERCIAL                A        0.13      0.40     0.100    52
  PUBLIC PARK               B        0.10      0.30     0.850    76
  PUBLIC PARK               A        0.10      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.419
  SUBAREA AREA(ACRES) =    0.47      SUBAREA RUNOFF(CFS) =    1.57
  EFFECTIVE AREA(ACRES) =      2.25    AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =        2.2        PEAK FLOW RATE(CFS) =       7.49

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.43   HALFSTREET FLOOD WIDTH(FEET) =  15.12
  FLOW VELOCITY(FEET/SEC.) =  3.35   DEPTH*VELOCITY(FT*FT/SEC.) =   1.45
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     848.74 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.2  TC(MIN.) =     11.45
  EFFECTIVE AREA(ACRES) =      2.25  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.410
  PEAK FLOW RATE(CFS)   =       7.49
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Proposed Conditions      *
* DMA 2: West Intersection Streamline, Alton                              *
* 10/25/2019 - ECS                                                        *
 **************************************************************************

  FILE NAME: 100DMA2.DAT
  TIME/DATE OF STUDY: 14:09 10/25/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     68.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.474
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.914
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.01      0.30      0.850    76   11.88
  PUBLIC PARK                A        0.27      0.40      0.850    52   11.88
  COMMERCIAL                 B        0.07      0.30      0.100    76    7.47
  COMMERCIAL                 A        0.40      0.40      0.100    52    7.47
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA RUNOFF(CFS) =      3.22
  TOTAL AREA(ACRES) =      0.75   PEAK FLOW RATE(CFS) =      3.22

**************************************************************************
```

```
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.05 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.00
 STREET LENGTH(FEET) =   440.15   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.02
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.40
   HALFSTREET FLOOD WIDTH(FEET) =   13.09
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.91
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.15
 STREET FLOW TRAVEL TIME(MIN.) =   2.52   Tc(MIN.) =    9.99
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.161
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.22      0.30     0.100    76
 COMMERCIAL                 A        0.27      0.40     0.100    52
 PUBLIC PARK                B        0.23      0.30     0.850    76
 PUBLIC PARK                A        0.28      0.40     0.850    52
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.483
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    3.59
 EFFECTIVE AREA(ACRES) =      1.75    AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       6.30

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.41
 FLOW VELOCITY(FEET/SEC.) =  3.07   DEPTH*VELOCITY(FT*FT/SEC.) =   1.29
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.05 =     770.15 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =      9.99
 EFFECTIVE AREA(ACRES) =      1.75  AREA-AVERAGED Fm(INCH/HR)=  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.37  AREA-AVERAGED Ap = 0.439
 PEAK FLOW RATE(CFS)   =       6.30
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Proposed Conditions      *
* DMA 3: South Intersection Streamline, Alton                             *
* 11/07/2019 - ECS                                                        *
 **************************************************************************

  FILE NAME: 100DMA3P.DAT
  TIME/DATE OF STUDY: 12:49 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   308.42
  ELEVATION DATA: UPSTREAM(FEET) =     82.00  DOWNSTREAM(FEET) =     77.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.864
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.160
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                A        0.26      0.40      0.100    52    6.86
  PUBLIC PARK               A        0.22      0.40      0.850    52   10.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.444
  SUBAREA RUNOFF(CFS) =      2.15
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      2.15

**************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   77.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   500.82   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.10
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.97
  STREET FLOW TRAVEL TIME(MIN.) =   3.36   Tc(MIN.) =   10.23
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.106
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.53      0.40     0.100    52
  PUBLIC PARK                A        0.57      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.489
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    3.87
  EFFECTIVE AREA(ACRES) =      1.58    AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.48
  TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       5.57

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.57
  FLOW VELOCITY(FEET/SEC.) =  2.67   DEPTH*VELOCITY(FT*FT/SEC.) =   1.13
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.05 =     809.24 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.23
  RAINFALL INTENSITY(INCH/HR) =   4.11
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.48
  EFFECTIVE STREAM AREA(ACRES) =       1.58
  TOTAL STREAM AREA(ACRES) =       1.58
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.57

****************************************************************************
  FLOW PROCESS FROM NODE      6.01 TO NODE      6.03 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   237.14
  ELEVATION DATA: UPSTREAM(FEET) =     73.50  DOWNSTREAM(FEET) =     72.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.089
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.697
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                D        0.06      0.20     0.850    91   12.85
  COMMERCIAL                 D        0.39      0.20     0.100    91    8.09
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.89
  TOTAL AREA(ACRES) =      0.45   PEAK FLOW RATE(CFS) =      1.89

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   72.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   276.24   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.57
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   15.12
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.15
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.50
  STREET FLOW TRAVEL TIME(MIN.) =   4.01   Tc(MIN.) =   12.09
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.730
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        0.01      0.40     0.850    52
  COMMERCIAL                A        0.27      0.40     0.100    52
  COMMERCIAL                B        0.09      0.30     0.100    76
  PUBLIC PARK               D        0.01      0.20     0.850    91
  COMMERCIAL                D        0.03      0.20     0.100    91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.34
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.137
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    1.36
  EFFECTIVE AREA(ACRES) =      0.86    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       2.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  15.74
  FLOW VELOCITY(FEET/SEC.) =  1.19   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
  LONGEST FLOWPATH FROM NODE      6.01 TO NODE      3.05 =     513.38 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.03 TO NODE      3.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.09
  RAINFALL INTENSITY(INCH/HR) =   3.73
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.17
  EFFECTIVE STREAM AREA(ACRES) =       0.86
  TOTAL STREAM AREA(ACRES) =       0.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.85

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.57   10.23    4.106  0.40( 0.19) 0.48       1.6       3.01
      2        2.85   12.09    3.730  0.25( 0.04) 0.17       0.9       6.01
```

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	8.23	10.23	4.106	0.38(0.14)	0.38	2.3	3.01
2	7.89	12.09	3.730	0.38(0.14)	0.37	2.4	6.01

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 8.23 Tc(MIN.) = 10.23
EFFECTIVE AREA(ACRES) = 2.31 AREA-AVERAGED Fm(INCH/HR) = 0.14
AREA-AVERAGED Fp(INCH/HR) = 0.38 AREA-AVERAGED Ap = 0.38
TOTAL AREA(ACRES) = 2.4
LONGEST FLOWPATH FROM NODE 3.01 TO NODE 3.05 = 809.24 FEET.

==========

END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.4 TC(MIN.) = 10.23
EFFECTIVE AREA(ACRES) = 2.31 AREA-AVERAGED Fm(INCH/HR)= 0.14
AREA-AVERAGED Fp(INCH/HR) = 0.38 AREA-AVERAGED Ap = 0.379
PEAK FLOW RATE(CFS) = 8.23

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	8.23	10.23	4.106	0.38(0.14)	0.38	2.3	3.01
2	7.89	12.09	3.730	0.38(0.14)	0.37	2.4	6.01

==========
==========

END OF RATIONAL METHOD ANALYSIS

```
**************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Culver Alton - 100 Year Rational Method Study, Proposed Conditions      *
* DMA 4: East Intersection Streamline, Yale to Alton to Culver            *
* 11/07/2019 - ECS                                                        *
 **************************************************************************

  FILE NAME: 100DMA4P.DAT
  TIME/DATE OF STUDY: 15:27 11/07/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   40.0     30.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.03 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.02
  ELEVATION DATA: UPSTREAM(FEET) =     89.00  DOWNSTREAM(FEET) =     87.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK               A        0.01      0.40      0.850    52    7.29
  COMMERCIAL                A        0.13      0.40      0.100    52    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.154
  SUBAREA RUNOFF(CFS) =      0.77
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.77

**************************************************************************
  FLOW PROCESS FROM NODE      4.03 TO NODE      4.05 IS CODE =  62
--------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   87.00  DOWNSTREAM ELEVATION(FEET) =   80.00
  STREET LENGTH(FEET) =   301.23   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.96
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =    7.22
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.97
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.87
  STREET FLOW TRAVEL TIME(MIN.) =   1.69   Tc(MIN.) =    6.69
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.237
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A        0.07      0.40     0.850    52
  COMMERCIAL                 A        0.44      0.40     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.203
  SUBAREA AREA(ACRES) =    0.51      SUBAREA RUNOFF(CFS) =    2.37
  EFFECTIVE AREA(ACRES) =      0.65    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       3.02

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   9.09
  FLOW VELOCITY(FEET/SEC.) =  3.24   DEPTH*VELOCITY(FT*FT/SEC.) =   1.05
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.05 =     417.25 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.05 TO NODE      4.07 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   80.00  DOWNSTREAM ELEVATION(FEET) =   75.00
  STREET LENGTH(FEET) =   369.87   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.73
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   12.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.87
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   2.15   Tc(MIN.) =    8.84
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.464
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.27      0.40     0.100    52
  PUBLIC PARK                A        0.63      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.625
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    3.41
  EFFECTIVE AREA(ACRES) =      1.55    AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       5.98

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  14.10
  FLOW VELOCITY(FEET/SEC.) =  3.04   DEPTH*VELOCITY(FT*FT/SEC.) =   1.26
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.07 =     787.12 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.07 TO NODE      4.09 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   75.00  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   362.03   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.27
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.46
    HALFSTREET FLOOD WIDTH(FEET) =   16.91
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.65
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.23
  STREET FLOW TRAVEL TIME(MIN.) =   2.28   Tc(MIN.) =   11.12
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.914
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.54      0.40     0.100    52
  PUBLIC PARK                A        0.22      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.317
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    2.59
  EFFECTIVE AREA(ACRES) =      2.31    AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       7.80

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  17.46
  FLOW VELOCITY(FEET/SEC.) =  2.68   DEPTH*VELOCITY(FT*FT/SEC.) =   1.27
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.09 TO NODE      4.09 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.12
  RAINFALL INTENSITY(INCH/HR) =   3.91
  AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =       2.31
  TOTAL STREAM AREA(ACRES) =       2.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.80

****************************************************************************
  FLOW PROCESS FROM NODE      5.01 TO NODE      5.03 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.47
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     73.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.763
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.809
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.24      0.40     0.100    52    7.76
  PUBLIC PARK                A        0.24      0.40     0.850    52   12.33
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.475
  SUBAREA RUNOFF(CFS) =      2.00
  TOTAL AREA(ACRES) =      0.48   PEAK FLOW RATE(CFS) =      2.00

******************************************************************************
  FLOW PROCESS FROM NODE      5.03 TO NODE      5.05 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =   73.50  DOWNSTREAM ELEVATION(FEET) =   72.00
  STREET LENGTH(FEET) =   273.08   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.16
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   13.01
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.85
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.73
  STREET FLOW TRAVEL TIME(MIN.) =   2.46   Tc(MIN.) =   10.22
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.108
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.57      0.40     0.100    52
  PUBLIC PARK                A        0.07      0.40     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.182
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    2.32
  EFFECTIVE AREA(ACRES) =      1.12    AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =        1.1        PEAK FLOW RATE(CFS) =       4.02

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  14.41
  FLOW VELOCITY(FEET/SEC.) =  1.96   DEPTH*VELOCITY(FT*FT/SEC.) =   0.82
  LONGEST FLOWPATH FROM NODE      5.01 TO NODE      5.05 =     526.55 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      5.05 TO NODE      4.09 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.22
  RAINFALL INTENSITY(INCH/HR) =   4.11
  AREA-AVERAGED Fm(INCH/HR) =  0.12
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.40
  AREA-AVERAGED Ap =  0.31
  EFFECTIVE STREAM AREA(ACRES) =       1.12
  TOTAL STREAM AREA(ACRES) =       1.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.02

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.80   11.12    3.914  0.40( 0.16) 0.40       2.3       4.01
      2        4.02   10.22    4.108  0.40( 0.12) 0.31       1.1       5.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       11.56   10.22    4.108  0.40( 0.15) 0.37       3.2       5.01
      2       11.62   11.12    3.914  0.40( 0.15) 0.37       3.4       4.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      11.62    Tc(MIN.) =    11.12
  EFFECTIVE AREA(ACRES) =       3.43   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        3.4
  LONGEST FLOWPATH FROM NODE      4.01 TO NODE      4.09 =    1149.15 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.4  TC(MIN.) =     11.12
  EFFECTIVE AREA(ACRES) =      3.43  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.371
  PEAK FLOW RATE(CFS)   =      11.62

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       11.56   10.22    4.108  0.40( 0.15) 0.37       3.2       5.01
      2       11.62   11.12    3.914  0.40( 0.15) 0.37       3.4       4.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

C.1 APPENDIX C – Catch Basin Calculations

Worksheet for Curb Inlet In Sag - DMA4

Project Description

Solve For	Spread

Input Data

Discharge		8.85	ft^3/s
Gutter Width		2.00	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		14.00	ft
Opening Height		5.50	in
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		2.00	ft
Throat Incline Angle		90.00	degrees

Results

Spread	21.35	ft
Depth	5.87	in
Gutter Depression	0.13	ft
Total Depression	0.29	ft

Worksheet for Circular Pipe - DMA4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02410	ft/ft
Diameter	24.00	in
Discharge	8.85	ft³/s

Results

Normal Depth	8.21	in
Flow Area	0.95	ft²
Wetted Perimeter	2.50	ft
Hydraulic Radius	4.56	in
Top Width	1.90	ft
Critical Depth	1.06	ft
Percent Full	34.2	%
Critical Slope	0.00501	ft/ft
Velocity	9.31	ft/s
Velocity Head	1.35	ft
Specific Energy	2.03	ft
Froude Number	2.32	
Maximum Discharge	37.78	ft³/s
Discharge Full	35.12	ft³/s
Slope Full	0.00153	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.22	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - DMA4

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	8.21	in
Critical Depth	1.06	ft
Channel Slope	0.02410	ft/ft
Critical Slope	0.00501	ft/ft

Worksheet for Curb Inlet In Sag - DMA3

Project Description

Solve For	Spread

Input Data

Discharge		6.31	ft^3/s
Gutter Width		2.00	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		14.00	ft
Opening Height		5.50	in
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		2.00	ft
Throat Incline Angle		90.00	degrees

Results

Spread	17.04	ft
Depth	4.99	in
Gutter Depression	0.13	ft
Total Depression	0.29	ft

Worksheet for Circular Pipe - DMA3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01630	ft/ft
Diameter	24.00	in
Discharge	6.31	ft³/s

Results

Normal Depth	7.62	in
Flow Area	0.86	ft²
Wetted Perimeter	2.39	ft
Hydraulic Radius	4.30	in
Top Width	1.86	ft
Critical Depth	0.89	ft
Percent Full	31.8	%
Critical Slope	0.00468	ft/ft
Velocity	7.36	ft/s
Velocity Head	0.84	ft
Specific Energy	1.48	ft
Froude Number	1.91	
Maximum Discharge	31.07	ft³/s
Discharge Full	28.88	ft³/s
Slope Full	0.00078	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	31.75	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - DMA3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	7.62	in
Critical Depth	0.89	ft
Channel Slope	0.01630	ft/ft
Critical Slope	0.00468	ft/ft