Appendix E: Preliminary Hydrology Report

CA ENGINEERING, INC.

Planning • Engineering • Surveying

PRELIMINARY HYDROLOGY REPORT

FOR

T.T.M. 19273

City of Garden Grove

Preparation Date: May 4, 2023

PLANS PREPARED UNDER THE SUPERVISION OF:

6-1-23

Fred Cornwell, P.E. - R.C.E 45591 Date

CA ENGINEERING, INC.

13821 Newport Ave., Ste. 110 • Tustin, CA 92780 • Phone (949) 724-9480 • Fax (949) 724-9484

TABLE OF CONTENTS:

SITE DESCRIPTION (Section 1.1)

Existing Site

The project site is located in the City of Garden Grove, California, and is comprised of approximately 1.22 acres. The site currently has a Marie Calendars restaurant on the westerly portion of the site and an open lot on the easterly side.
The proposed project is surrounded by Central Ave. to the North, Brookhurst St. to the west, a retail car facility to the South and residential homes to the east..

The project site is rectangular in shape and has a generally flat topography with a gentle fall of two to three feet over a 180 foot distance. Surface drainage is directed to the north to Central Ave and then flows to the west to Brookhusrst St. and then north down Brookhurst St.

There are no runoff flows from the neighboring sites and all flows flow to existing streets.

Proposed Site

The drainage for the proposed project generally follows the existing flow characteristics. The site has been divided into two drainage areas identified as A1-A2. These drainage areas drain to the two access drive aisles then northerly to Central Ave. Before the flows enter Central Ave, they are collected in a storm drain system that conveys them to a storage pipe located on the westerly side of the proposed site. The storage facility is sized to collect the Design Capture Volume (DCV) as defined in the Technical Guidance Document for the WQMP. This volume is them pumped into a bio-planter that is designed in conformance with BIO-1 Bio Planter fact sheet.

The flows will be treated in the raised planter and then released via a parkway culvert into Brookhurst Street.

METHODOLOGY (Section 1.2)

The hydrology calculations for the study were completed using AES software based on the Orange County Hydrology Manual methods. The Rational Method was used to determine the peak discharges for the pre-and post-developed conditions. These rates will be compared in the results portion of the report for the 2, 10 and 100 year storm events.

In the hydrology calculations (Sections 3.1 & 3.2), we determined the flows for both the existing and proposed conditions. The sub areas and are shown on the hydrology maps (Sections 2.1 & 2.2).

The BMP facilities will be sized to capture and treat the design capture volume (DCV) per the Technical Guidance Document as published by the County of Orange.

There are no hydraulic conditions of concern (HCOC) so we will not have to detain the flows.

RESULTS (Section 1.3)

The results of the Existing and Proposed conditions for the existing site outlet location as shown on the hydrology maps are as follows:

	Existing Condition			Proposed Condition			Increase/ (Decrease)
	A1	A2	TOTAL	A1	A2	TOTAL	
Area	0.27 AC	0.95 AC	1.22 AC	0.42 AC	0.80 AC	1.22 AC	
2 Year Storm	0.30 CFS	1.55 CFS	**1.85 CFS**	0.70 CFS	1.17 CFS	**1.87 CFS**	0.02 CFS
10 Year Storm	0.60 CFS	2.80 CFS	**3.40 CFS**	1.28 CFS	2.14 CFS	**3.42 CFS**	0.02 CFS
100 Year Storm	0.98 CFS	4.28 CFS	**7.16 CFS**	1.96 CFS	3.28 CFS	**5.24 CFS**	(1.92) CFS

Under proposed conditions, flows for the 2 year storm is increased 1%, for the 10 year storm is increased 0.6% and for the 100 year storm is decreased 27% when compared to existing conditions.

CONCLUSION (Section 1.4)

As with existing conditions, drainage for the proposed project will outlet onto Central Ave. on the northern border except for the flows diverted to the storage pipe which is sized to capture and treat the design capture volume (DCV) and then conveyed to Brookhurst St.

During a 100 year storm event, existing flows (7.16 CFS) will be decreased by 1.92 CFS under proposed conditions (5.67 CFS), for the 10 year storm event, existing flows (3.40 CFS) will be increased by 0.02 CFS under proposed conditions (3.42 CFS) and), for the 2 year storm event, existing flows (1.85 CFS) will be increased by 0.02 CFS under proposed conditions (1.87 CFS)

Since proposed flows are slightly increased from the existing flows for the lesser storm events and decreased for the larger storm event, the proposed project site will have no significant impact on the existing surrounding drainage facilitates.

HYDROLOGY MAPS

(SECTION 2)

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EXISTING HYDROLOGY MAP

(SECTION 2.1)

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GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

NORTH

CA

CENTRAL AVENUE

SS WT

N89°47'35"E 280.00'

N44°52'55"E 21.25

S00°01'45"E 165.00'

N00°01'45"W 180.00'

N89°47'35"E 295.00'

PARCEL 1

PARCEL 2

PARCEL 3

B

L=259'

L=190'

A2
0.95

A1
0.27

2 ELEV= 74.5
Q_2 =0.30
Q_{10}=0.60
Q_{100}=0.90
Tc=9.69

4 ELEV= 74.3
Q_2 =1.55
Q_{10}=2.80
Q_{100}=4.28
Tc=7.16

3 ELEV= 76.7

1 ELEV= 77.7

LEGEND:

DISCHARGE AT NODE (Q_{100} cfs)

NODE NUMBER

Q=13.41 EL= 527.8
Tc=11.37 4

TIME OF CONCENTRATION

F.S. ELEVATION AT NODE(ft)

SUBAREA BOUNDARY

L=205'

FLOWPATH

ENTIRE SITE = SOIL TYPE B

SUBAREA DESIGNATION

A2
1.83

TRIBUTARY AREA (AC.)

CITY OF GARDEN GROVE

HYDROLOGY MAP
(EXISTING CONDITION)
CENTRAL AVE., GARDEN GROVE

S:\491-21 Garden Grove - Marie Calendar's\HYDRO\491-21 HYDRO EX.dwg Last Modified: 04 May 2023 - 4:28pm
Plotted on: 04 May 2023 - 6:40pm by tcornwell

PROPOSED HYDROLOGY MAP

(SECTION 2.2)

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GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

NORTH

CA

LEGEND:

DISCHARGE AT NODE (Q_{100} cfs)

NODE NUMBER

Q=13.41 EL=
Tc=11.37 527.8 (4)

TIME OF CONCENTRATION

F.S. ELEVATION AT NODE(ft)

SUBAREA BOUNDARY

L=205'

FLOWPATH

ENTIRE SITE = SOIL TYPE B

A2
1.83

SUBAREA DESIGNATION

TRIBUTARY AREA (AC.)

4 ELEV= 73.9 Q_2 =1.17 Q_{10}=2.14 Q_{100}=3.28 Tc=8.32

2 ELEV= 74.1 Q_2 =0.70 Q_{10}=1.28 Q_{100}=1.96 Tc=6.69

3 ELEV= 76.7

1 ELEV= 77.7

A1
0.42

A2
0.80

A1
B

L=315'

L=238'

RELOCATE NO PARKING SIGN

6" VCP

6" WT

EX. TREE TO REPLACED

10' R/W TO BE DEDICATED

42" WALL

SD

PL 1

PL 2

PL 3

ADA

FF=75.5

FF=76.1

FF=76.2

FF=76.5

FF=76.6

FF=77.0

LOW FLOW PUMP

RISER POLE

POWER POLE

POWER POLE

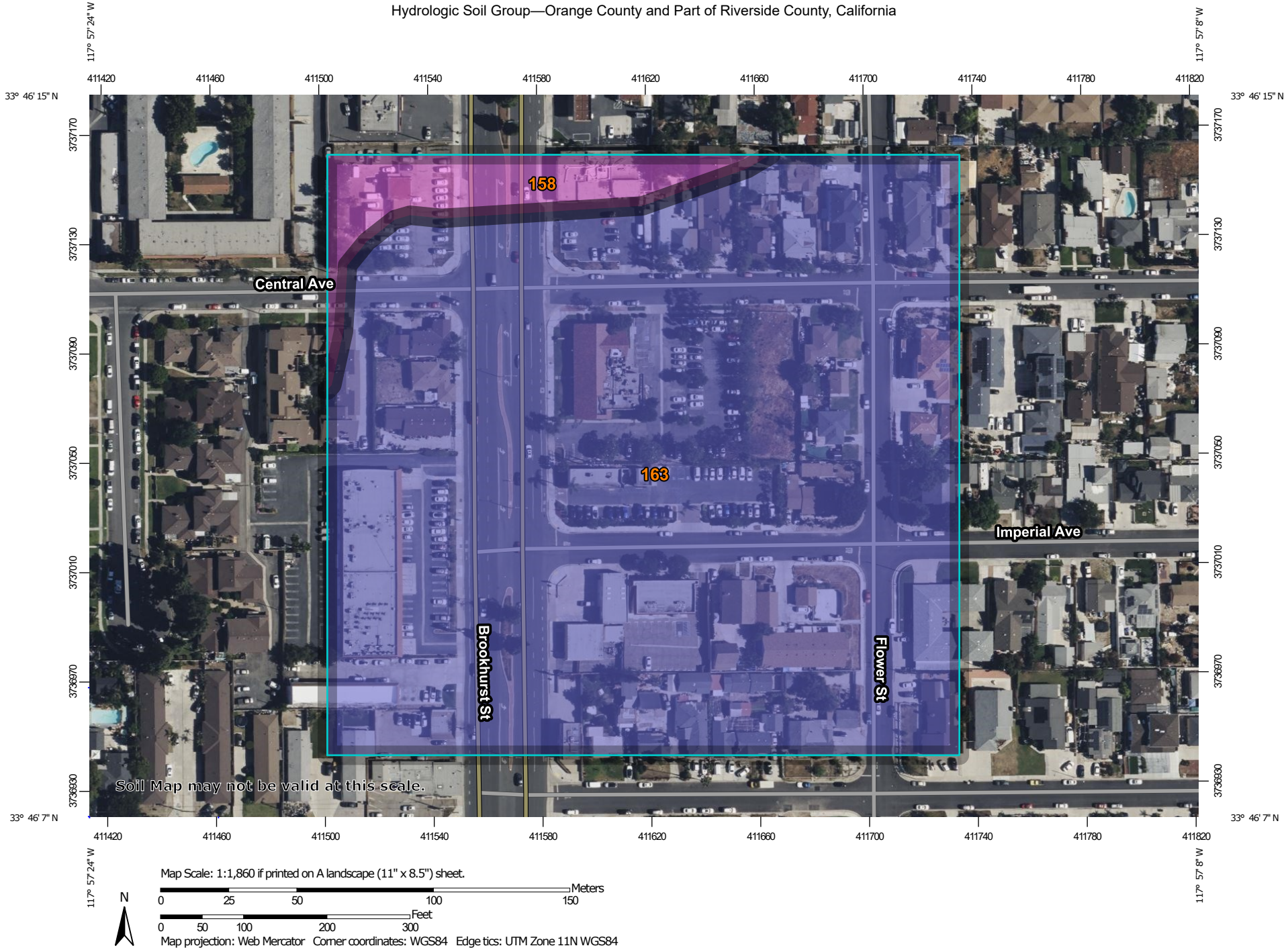
CITY OF GARDEN GROVE

HYDROLOGY MAP
(PROPOSED CONDITION)
CENTRAL AVE., GARDEN GROVE

S:\491-21 Garden Grove - Marie Calendar's\HYDRO\491-21 HYDRO PRO.dwg Last Modified: 04 May 2023 - 4:58pm
Plotted on: 04 May 2023 - 6:39pm by tcornwell

SOIL MAP

(SECTION 2.3)


117° 57' 24" W
117° 57' 8" W
411420
411460
411500
411540
411580
411620
411660
411700
411740
411780
411820
33° 46' 15" N
33° 46' 7" N
3737170
3737130
3737090
3737050
3737010
3736970
3736930
158
163
Central Ave
Imperial Ave
Brookhurst St
Flower St
Soil Map may not be valid at this scale.
Map Scale: 1:1,860 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 25 50 100 150
Feet
0 50 100 200 300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 16, Sep 6, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 14, 2022—Apr 23, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
158	Hueneme fine sandy loam, drained	A	0.9	6.9%
163	Metz loamy sand	B	11.8	93.1%
Totals for Area of Interest			**12.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

EXISTING HYDROLOGY CALCULATIONS

RATIONAL METHOD

(SECTION 3.1)

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```
 ************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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              Ver. 15.0  Release Date: 04/01/2008  License ID 1420

                           Analysis prepared by:

                               CA Engineering
                           13821 Newport Ave., Ste 110
                                Tustin, Ca. 92780


  ************************** DESCRIPTION OF STUDY *************************
 * EXISTING CONDITION                                                     *
 * 2 YR STORM                                                             *
 *                                                                        *
  ************************************************************************

   FILE NAME: 491-22EX.DAT
   TIME/DATE OF STUDY: 14:06 05/04/2023
 ========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
   *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 0.0313 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      1.00 TO NODE      2.00 IS CODE =  21
 ------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ========================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
   ELEVATION DATA: UPSTREAM(FEET) =     77.70  DOWNSTREAM(FEET) =     74.50

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.691
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.548
   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.)
   NATURAL POOR COVER
   "GRASS"                    B        0.27      0.30     1.000    61    9.69
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.30
  TOTAL AREA(ACRES) =      0.27   PEAK FLOW RATE(CFS) =      0.30

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   259.00
  ELEVATION DATA: UPSTREAM(FEET) =     76.70  DOWNSTREAM(FEET) =     74.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.158
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.842
  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                  B        0.95      0.30     0.100    36    7.16
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.55
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      1.55
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.9  TC(MIN.) =      7.16
  EFFECTIVE AREA(ACRES) =      0.95  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       1.55
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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                               CA Engineering
                           13821 Newport Ave., Ste 110
                                Tustin, Ca. 92780


  ************************** DESCRIPTION OF STUDY **************************
 * EXISTING CONDITION                                                     *
 * 10 YR STORM                                                            *
 *                                                                        *
  ************************************************************************

   FILE NAME: 491-22EX.DAT
   TIME/DATE OF STUDY: 14:07 05/04/2023
 ============================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ============================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =   10.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
   *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

   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      1.00 TO NODE      2.00 IS CODE =  21
 ----------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
   ELEVATION DATA: UPSTREAM(FEET) =     77.70  DOWNSTREAM(FEET) =     74.50

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.691
   *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.778
   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.)
   NATURAL POOR COVER
   "GRASS"                    B        0.27      0.30     1.000    78    9.69
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.27   PEAK FLOW RATE(CFS) =      0.60

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   259.00
  ELEVATION DATA: UPSTREAM(FEET) =     76.70  DOWNSTREAM(FEET) =     74.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.158
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.305
  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                 B        0.95      0.30     0.100    56    7.16
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.80
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      2.80
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.9  TC(MIN.) =      7.16
  EFFECTIVE AREA(ACRES) =      0.95  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       2.80
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
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                           Analysis prepared by:

                               CA Engineering
                           13821 Newport Ave., Ste 110
                                Tustin, Ca. 92780


  ************************** DESCRIPTION OF STUDY ************************
 * EXISTING CONDITION                                                     *
 * 100 YR STORM                                                           *
 *                                                                        *
  ************************************************************************

   FILE NAME: 491-22EX.DAT
   TIME/DATE OF STUDY: 14:07 05/04/2023
 ========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ========================================================================
                       --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =  100.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
   *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 0.0313 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      1.00 TO NODE      2.00 IS CODE =  21
 ------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ========================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
   ELEVATION DATA: UPSTREAM(FEET) =     77.70  DOWNSTREAM(FEET) =     74.50

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.691
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.235
   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.)
   NATURAL POOR COVER
   "GRASS"                    B        0.27      0.30     1.000    93    9.69
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.96
  TOTAL AREA(ACRES) =      0.27   PEAK FLOW RATE(CFS) =      0.96

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   259.00
  ELEVATION DATA: UPSTREAM(FEET) =     76.70  DOWNSTREAM(FEET) =     74.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.158
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.037
  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                 B        0.95      0.30     0.100    76    7.16
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.28
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      4.28
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.9  TC(MIN.) =      7.16
  EFFECTIVE AREA(ACRES) =      0.95  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       4.28
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

PROPOSED HYDROLOGY CALCULATIONS

RATIONAL METHOD

(SECTION 3.2)

CA ENGINEERING, INC.
13821 Newport Ave., Ste. 110 • Tustin, CA 92780 • Phone (949) 724-9480 • Fax (949) 724-9484

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

                                  CA Engineering
                              13821 Newport Ave., Ste 110
                                   Tustin, Ca. 92780


  ************************** DESCRIPTION OF STUDY ************************
 * PROPOSED CONDITION                                                     *
 * 2 YR STORM                                                             *
 *                                                                        *
  ************************************************************************

   FILE NAME: 491-21PR.DAT
   TIME/DATE OF STUDY: 16:16 05/04/2023
 ========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ========================================================================
                       --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
   *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 0.0313 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      1.00 TO NODE      2.00 IS CODE =  21
 ------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ========================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
   ELEVATION DATA: UPSTREAM(FEET) =     77.70  DOWNSTREAM(FEET) =     74.10

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.687
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.916
   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.)
   APARTMENTS                 B        0.42      0.30      0.200    36    6.69
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.70
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      0.70

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   315.00
  ELEVATION DATA: UPSTREAM(FEET) =     76.70  DOWNSTREAM(FEET) =     73.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.320
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.690
  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.)
  APARTMENTS                 B        0.80      0.30     0.200    36    8.32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.17
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      1.17
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.8  TC(MIN.) =      8.32
  EFFECTIVE AREA(ACRES) =      0.80  AREA-AVERAGED Fm(INCH/HR)=  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       1.17
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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

                               CA Engineering
                           13821 Newport Ave., Ste 110
                                Tustin, Ca. 92780


  ************************** DESCRIPTION OF STUDY **************************
 * PROPOSED CONDITION                                                     *
 * 10 YR STORM                                                            *
 *                                                                        *
  ************************************************************************

   FILE NAME: 491-21PR.DAT
   TIME/DATE OF STUDY: 16:15 05/04/2023
 ========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =   10.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
   *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

   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      1.00 TO NODE      2.00 IS CODE =  21
 ------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ========================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
   ELEVATION DATA: UPSTREAM(FEET) =     77.70  DOWNSTREAM(FEET) =     74.10

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.687
   *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.437
   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.)
   APARTMENTS                 B        0.42      0.30      0.200    56    6.69
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
```

```
  SUBAREA RUNOFF(CFS) =      1.28
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.28

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   315.00
  ELEVATION DATA: UPSTREAM(FEET) =     76.70  DOWNSTREAM(FEET) =     73.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.320
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.032
  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.)
  APARTMENTS                  B        0.80      0.30     0.200    56    8.32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.14
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      2.14
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.8  TC(MIN.) =      8.32
  EFFECTIVE AREA(ACRES) =      0.80  AREA-AVERAGED Fm(INCH/HR)=  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       2.14
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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

                               CA Engineering
                          13821 Newport Ave., Ste 110
                               Tustin, Ca. 92780


  ************************** DESCRIPTION OF STUDY **************************
 * PROPOSED CONDITION                                                     *
 * 100 YR STORM                                                           *
 *                                                                        *
  ************************************************************************

   FILE NAME: 491-21PR.DAT
   TIME/DATE OF STUDY: 16:14 05/04/2023
 ========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =  100.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
   *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 0.0313 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      1.00 TO NODE      2.00 IS CODE =  21
 ------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ========================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.00
   ELEVATION DATA: UPSTREAM(FEET) =     77.70  DOWNSTREAM(FEET) =     74.10

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.687
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.238
   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.)
   APARTMENTS                 B        0.42      0.30      0.200    76    6.69
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
```

```
  SUBAREA RUNOFF(CFS) =      1.96
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.96

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   315.00
  ELEVATION DATA: UPSTREAM(FEET) =     76.70  DOWNSTREAM(FEET) =     73.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.320
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.622
  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.)
  APARTMENTS                 B        0.80      0.30     0.200    76    8.32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.28
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      3.28
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =        0.8  TC(MIN.) =      8.32
  EFFECTIVE AREA(ACRES) =      0.80  AREA-AVERAGED Fm(INCH/HR)=  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       3.28
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```