Appendix H2

Drainage Study

Drainage Study

Sunrise

Prepared: April 2, 2018

PREPARED FOR

The Sunrise Garden Project Owner

PROJECT ENGINEER

William Lundstrom, R.C.E.

PREPARED BY

Lundstrom

Engineering and Surveying, Inc.

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project. That I have exercised responsible charge over the design of the project as defined in Section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the City of Escondido is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

04/02/2018

William Lundstrom
Registered Civil Engineer 061630
Exp. Date: 06/30/19

Date

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Introduction

Purpose and Scope

To provide guidelines for preparation and review of hydrology/ drainage study associated with discretionary projects under various City/County Ordinances.

Development of permanent improved drainage facilities relies in part, on early identification of any adverse drainage conditions that are caused or worsened by new development projects. To avoid sub-standard drainage facilities (difficult and costly to replace) sufficient information is needed early, when the project is being considered for approval. The City/County subdivision, zoning and other related ordinances and County of San Diego Flood Control Act provides for incorporation of drainage facility protection in design of private projects from early start. The City/County's application process provides for a preliminary hydrology/ drainage study on all development projects at time of application. This study provides the needed information to ensure proposed drainage facilities are located appropriately. The preliminary hydrology/ drainage study is also part of the full CEQA and public hearing reviews on all discretionary projects. This eliminates the need for later CEQA reviews when proposed drainage facilities conform to that previously reviewed and circumstances have not changed.

The City/County requires a hydrology/drainage study. The study compares storm runoff under existing conditions versus existing-plus-project conditions (100-year events) and identifies existing drainage problems that may be caused, or aggravated, by project development. The study is further used to analyze project impacts under the California Environmental Quality Act (CEQA) and to identify any proposed mitigation measures.

Section 1. Project Information

1.1. Project Description

1.1.1 Project Location

The subject property is located at an address of 2351 Meyers Avenue in the City of San Marcos.

1.1.2 Project Activities Description

The 14.40 acre property is undeveloped land bordered by a mobile home park to the north and west; and commercial development to the south and east. See Existing Condition Exhibit in Appendix B.

In the existing undeveloped condition, runoff generated on-site surface flows to the southeast corner of the site and to the northeast corner from two drainage basins. An existing concrete ditch located at the southeast corner of the site, collects and conveys site runoff to an existing storm drain inlet in Corporate Drive. Site runoff that is convey to the northeast surface flows across an existing undeveloped commercial lot onto Meyers Avenue. Runoff from the project site flows 500–feet north along Meyers Avenue to existing public curb inlets located at Meyers Avenue and Barham Drive.

The project proposes a 14.40 acre multifamily development consisting of approximately 35 apartment buildings, private roads and private storm drain systems.

See Proposed Condition Exhibit in Appendix B.

1.1.3 Watershed

The project site is located in the San Marcos Hydrologic Area, Richland Hydrologic Sub-Area (904.52) and Carlsbad Hydrologic Unit (HU 904.00).

1.1.4 Soil and Vegetation Conditions

Based on bore hole logs in Geotechnical Evaluation by EEI dated August 3, 2017, this drainage study utilized hydrological soil group D for hydrology calculations.

The project site is categorized as having non-native vegetation developed or unvegetated habitat.

1.1.5 Impervious Cover

The 14.40 acre property has no existing impervious area. In the developed condition the impervious footprint is approximately 10.00 acres (70% impervious).

1.2. Proposed Runoff Management Facilities

The proposed facilities managing runoff from the site include:

- Appropriate grading of pads to direct runoff away from structures on the site.
- Concrete drainage ditches to convey run-on around the project perimeter.
- Storm drain systems to direct on-site runoff to appropriate outfalls.
- Biofiltration basins with hydromodification flow control.

Section 2. Design Criteria and Methodology

This section summarizes the design criteria and methodology applied during drainage analysis of the project site. The design criteria and methodology follow the County of San Diego County Hydrology Manual (June 2003), San Diego County Hydraulic Drainage Design Manual (May 2005), and Storm Water Standards as appropriate for the project site.

2.1.Hydrologic Design Methodology

2.1.1 Rational Method: Peak Flow

Runoff calculations for this study were accomplished using the Rational Method. The Rational Method is a physically-based numerical method where runoff is assumed to be directly proportional to rainfall and area, less losses for infiltration and depression storage. Flows were computed based on the Rational formula:

$$Q = C\,i\,A$$

where ... Q = Peak discharge (cfs);
C = runoff coefficient, based on land use and soil type;
i = rainfall intensity (in/hr);
A = watershed area (acre)

The runoff coefficient represents the ratio of rainfall that runs off the watershed versus the portion that infiltrates to the soil or is held in depression storage. The runoff coefficient is dependent on the land use coverage and soil type.

For a typical drainage study, rainfall intensity varies with the watershed time of concentration. The watershed time of concentration at any given point is defined as the time it would theoretically take runoff to travel from the most upstream point in the watershed to a concentration point, as calculated by equations in the San Diego County Hydrology Manual.

Table 2-1 Rational Method Runoff Coefficients.

		RUNOFF COEFFICIENT			
	(%)	Hydrologic Soil Type			
LAND USE (County Elements)	**Imperv.**	**A**	**B**	**C**	**D**
Permanent Open Space		0.20	0.25	0.30	0.35
Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Neighborhood Commercial	80	0.76	0.77	0.78	0.79
General Commercial	85	0.80	0.80	0.81	0.82
Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Limited Industrial	90	0.83	0.84	0.84	0.85
General Industrial	95	0.87	0.87	0.87	0.87

Rational Method calculations were accomplished using the Advanced Engineering Software Rational Method Analysis (Southern California County Methods) (AES-RATSCx) computer software packages. Peak discharges were computed for 50-year, 10-year, and 2-year hypothetical storm return frequencies. Detention routing calculations were accomplished by inputting results from AES (Time of Concentration, Runoff Coefficient, and area) into Pond Pack Detention Pond Modeling Software.

2.1.2 Time of Concentration

The Time of Concentration (T_c) is the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The T_c is composed of two components: initial time of concentration (T_i) and the travel time (T_t). The T_i is the time required for runoff to travel across the surface of the most remote subarea in the study, or "initial subarea". Guidelines for designation the initial subarea are provided within the discussion of computation of T_i. The T_i is the time required for the runoff to flow in a watercourse (e.g., swale, channel, gutter, pipe) or series of watercourses from the initial subarea to the point of interest. For the Rational Method, the T_c at any point within the drainage area is given by:

$$T_c = T_i + T_t$$

Methods of calculation differ for natural watersheds (nonurbanized) and for urban drainage systems. When analyzing storm drain systems, the designer must consider the possibility that an existing natural watershed may become urbanized during the useful life of the storm drain system. Future land uses must be used for T_c and runoff calculations, and can be determined from the local Community General Plan.

2.1.3 Initial Time of Concentration

The initial time of concentration is typically based on sheet flow at the upstream end of a drainage basin. The Overland Time of Flow is approximated by an equation developed by the Federal Aviation Agency (FAA) for analyzing flow on runways (FAA, 1970). The usual runway configuration consists of a crown, like most freeways, with sloping pavement that directs flow to either side of the runway. This type of flow is uniform in the direction perpendicular to the velocity and is very shallow. Since these depths are ¼ of an inch in magnitude, the relative roughness is high. Some higher relative roughness values for overland flow are presented in the *HEC-1 Flood Hydrograph Package User's Manual* (USACE, 1990).

The sheet flow that is predicted by the FAA equation is limited to conditions that are similar to runway topography. Some considerations that limit the extent to which the FAA equation applies are identified below:

- Urban Areas – This "runway type" runoff includes:
    - Flat roofs, sloping at 1% +/-
    - Parking lots at the extreme upstream drainage basin boundary (at the "ridge" of a catchment area.) Even a parking lot is limited in the amounts of sheet flow. Parked or moving vehicles would "break-up" the sheet flow, concentrating runoff into streams that are not characteristic of sheet flow.
    - Driveways are constructed at the upstream end of catchment areas in some developments. However, if flow from a roof is directed to a driveway through a downspout or other conveyance mechanism, flow would be concentrated.
    - Flat slopes are prone to meandering flow that tends to be disrupted by minor irregularities and obstructions. Maximum Overland Flow lengths are shorter for the flatter slopes.
- Rural or Natural Areas –The FAA equation is applicable to these conditions since (0.5% to 10%) slopes that are uniform in width of flow have slow velocities consistent with the equation. Irregularities in terrain limit the length of application.
    - Most hills and ridge lines have a relatively flat area near the drainage divide. However, with flat slopes of 0.5% +/-, minor irregularities would cause flow to concentrate into streams.

- Parks, lawns and other vegetated areas would have slow velocities that are consistent with the FAA Equation.

The Initial Time of Concentration is reflective of the general land-use at the upstream end of a drainage basin.

2.1.4 Travel Time

The T_t is the time required for the runoff to flow in a watercourse or series of watercourses from the initial subarea to the point of interest. The T_t is computed by dividing the length of the flow path by the computed flow velocity. Since the velocity normally changes as a result of each change in flow rate or slope, such as at an inlet or grade break, the total T_t must be computed as the sum of the T_t's for each section of the flow path.

Section 3. Characterization of Project Runoff

3.1.Hydrologic Effects of Project

The proposed project will not significantly alter the overall drainage scheme for the site. **Exhibit C** illustrates the proposed condition hydrology map. **Table 3-1** summarizes the hydrologic effects of the project.

Table 3-1 Summary of Hydrology Analysis.

EXISTING

NODE	C	TC (MIN.)	INTENSITY (IN/HR)	AREA (ACRES)	VELOCITY (FPS)	RUN-OFF (CFS)
4 (SE corner)	0.35	8.3	6.3	4.4	5.7	9.6
7 (NE corner)	0.35	6.0	7.8	9.0	8.7	24.3

PROPOSED

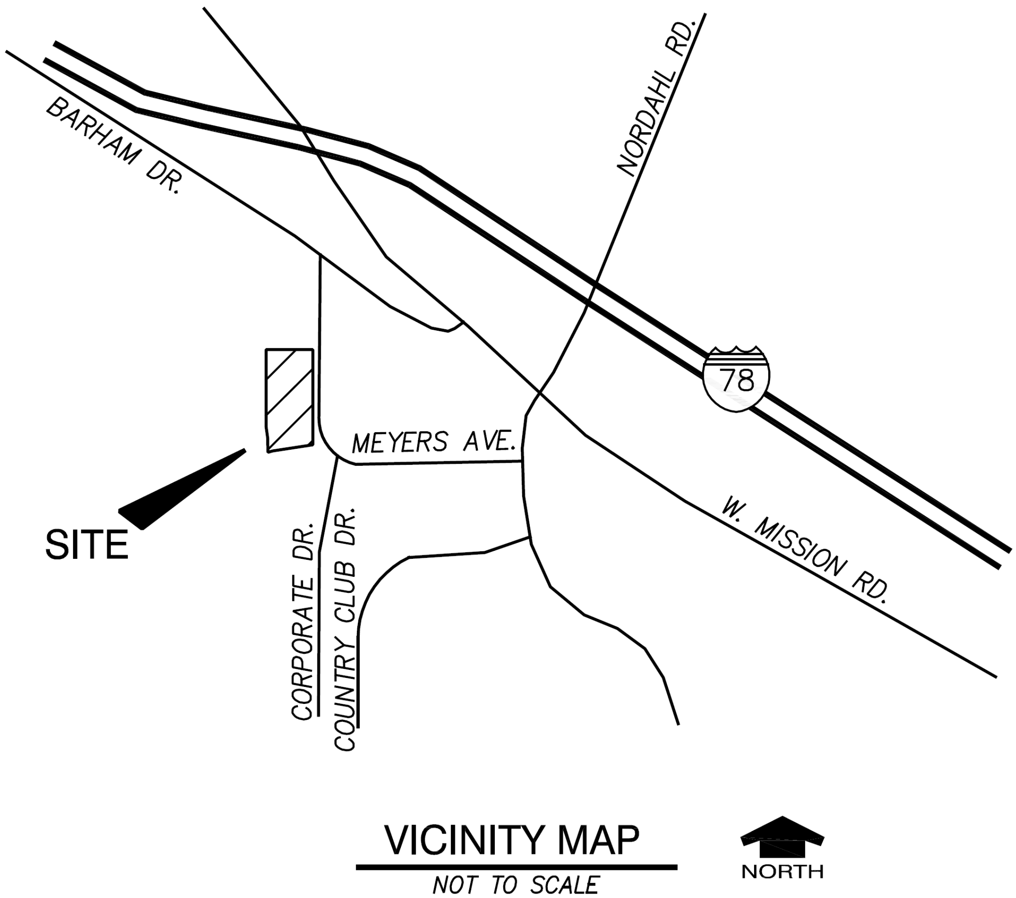
NODE	C	TC (MIN.)	INTENSITY (IN/HR)	AREA (ACRES)	VELOCITY (FPS)	MITIGATED RUN-OFF (CFS)	UNMITIGATED RUN-OFF (CFS)
7 (SE corner)	0.79	8.9	6.4	4.8	8.0	9.1	24.4
12 (NE corner)	0.79	7.2	6.9	8.4	20.4	24.2	45.9

Section 4. Summary and Conclusions

This hydrology and hydraulic study has evaluated the potential effects on runoff of the proposed project. In addition, the report has addressed the methodology used to analyze the pre- and post-construction condition, which was based on the San Diego County Hydrology and Design Manual. This section provides a summary discussion that evaluates the potential effects of the proposed project.

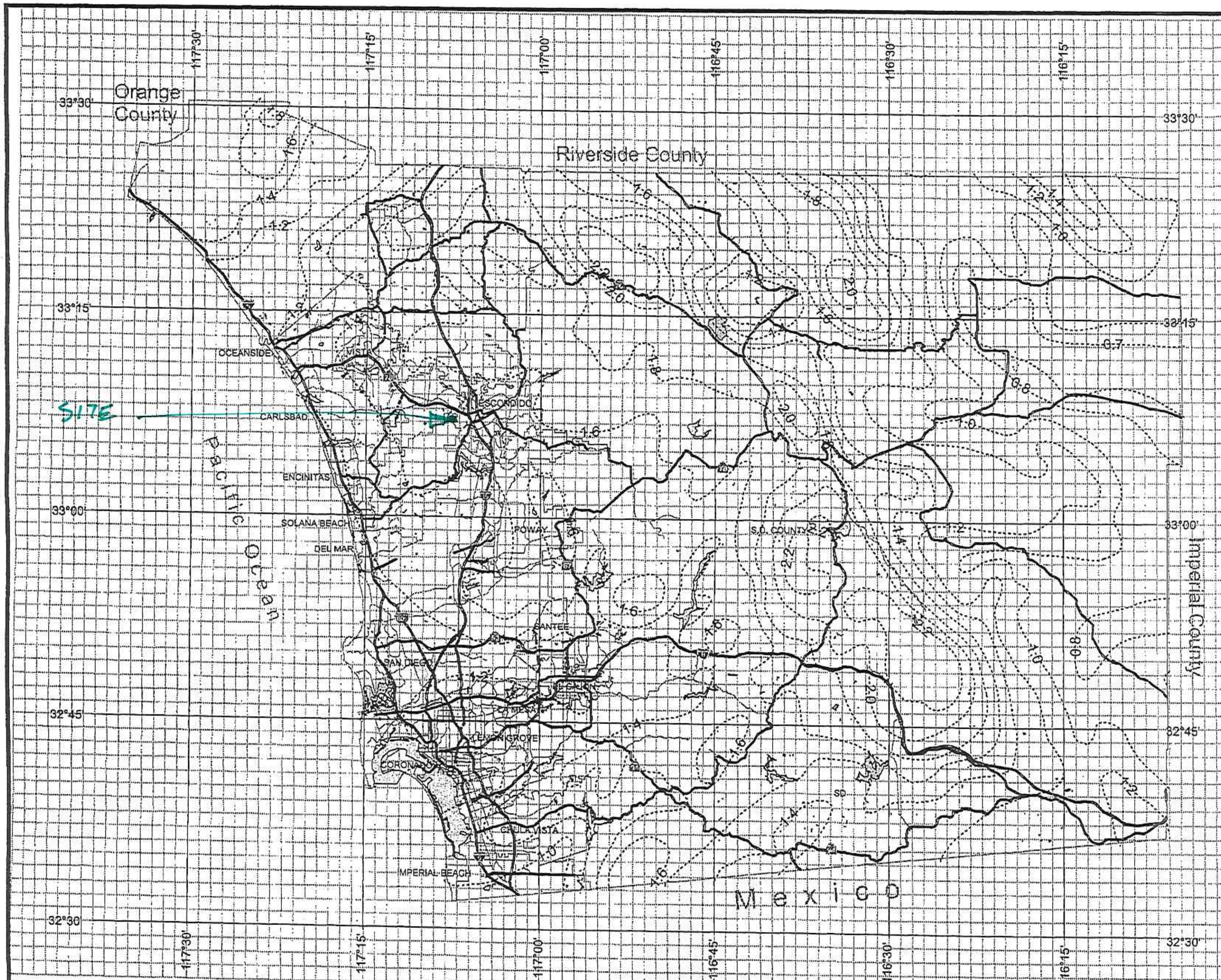
- Proposed storm drain facilities are design to collect and convey the 100-year design storm.
- The proposed storm drain and biofiltration basins will mitigate peak flow rates to pre-project conditions. The proposed project will not have any negative hydraulic impacts to downstream storm drain systems.
- The proposed project will not significantly alter drainage patterns on the site.

APPENDIX A
Hydrologic Information



VICINITY MAP

NOT TO SCALE



County of San Diego Hydrology Manual

Rainfall Isopluvials

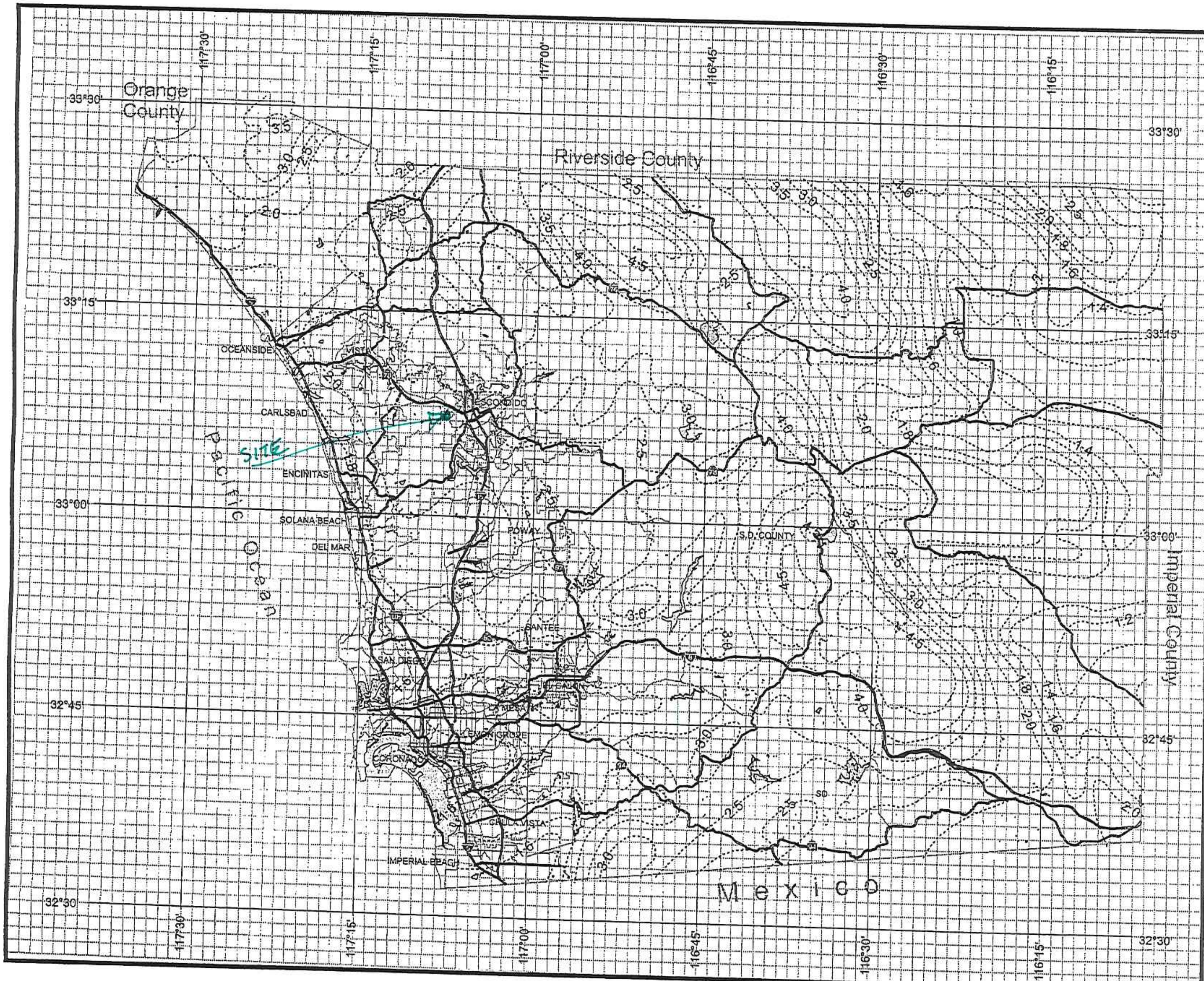
2 Year Rainfall Event - 6 Hours

-------- Isopluvial (Inches)

$P_{6_{2yr}} = 1.5$

DPW GIS
Department of Public Works
SanGIS
We Have San Diego Covered!

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluviais

2 Year Rainfall Event - 24 Hours

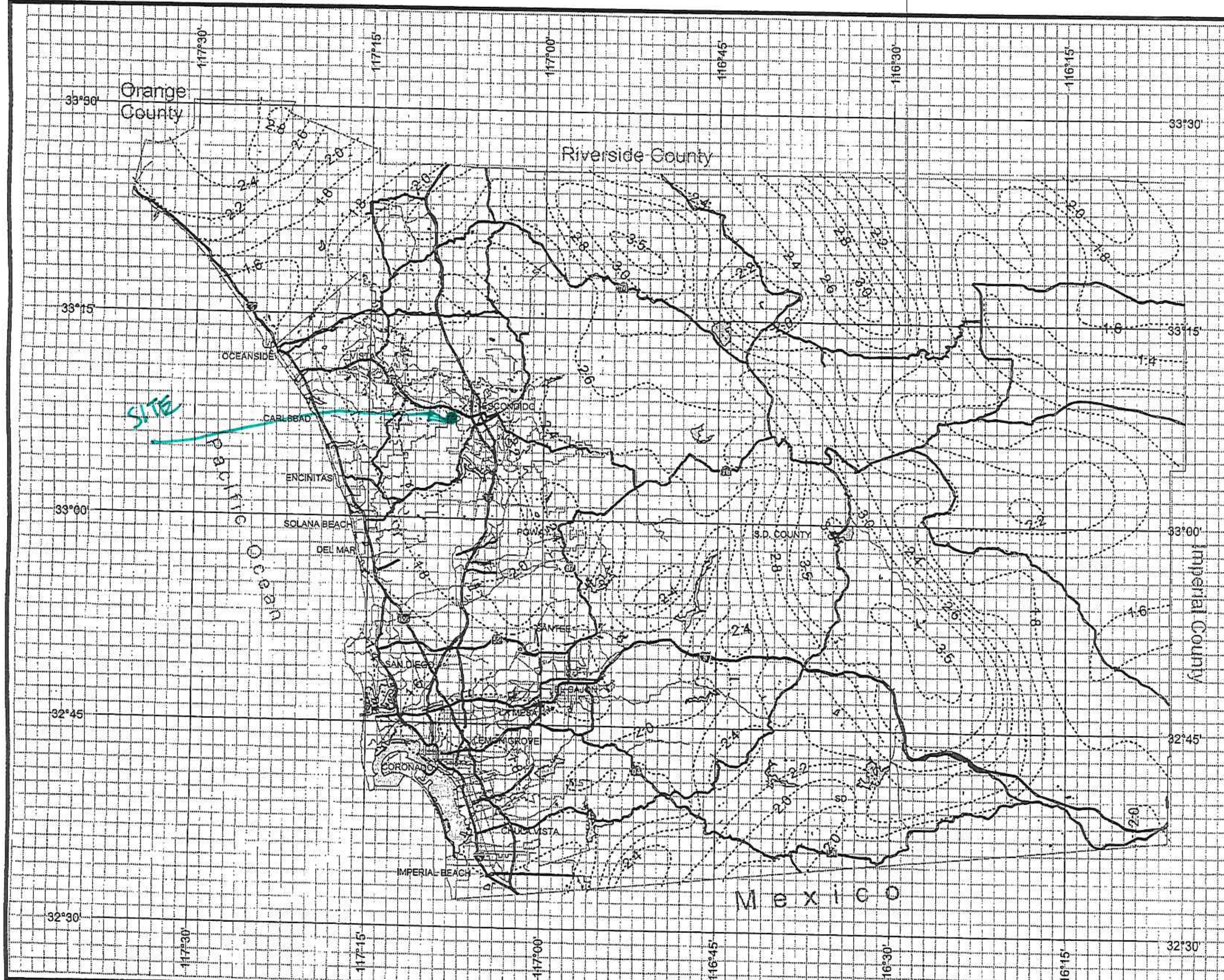
········	Isopluvial (inches)

$P_{24\ 2yr} = 2.4$

DPW GIS Department of Public Works Geographic Information Services

SanGIS We Have San Diego Covered!

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluviais

10 Year Rainfall Event - 6 Hours

-------- Isopluvial (Inches)

$P_{6\ 10yr} = 2.1$

DPW GIS

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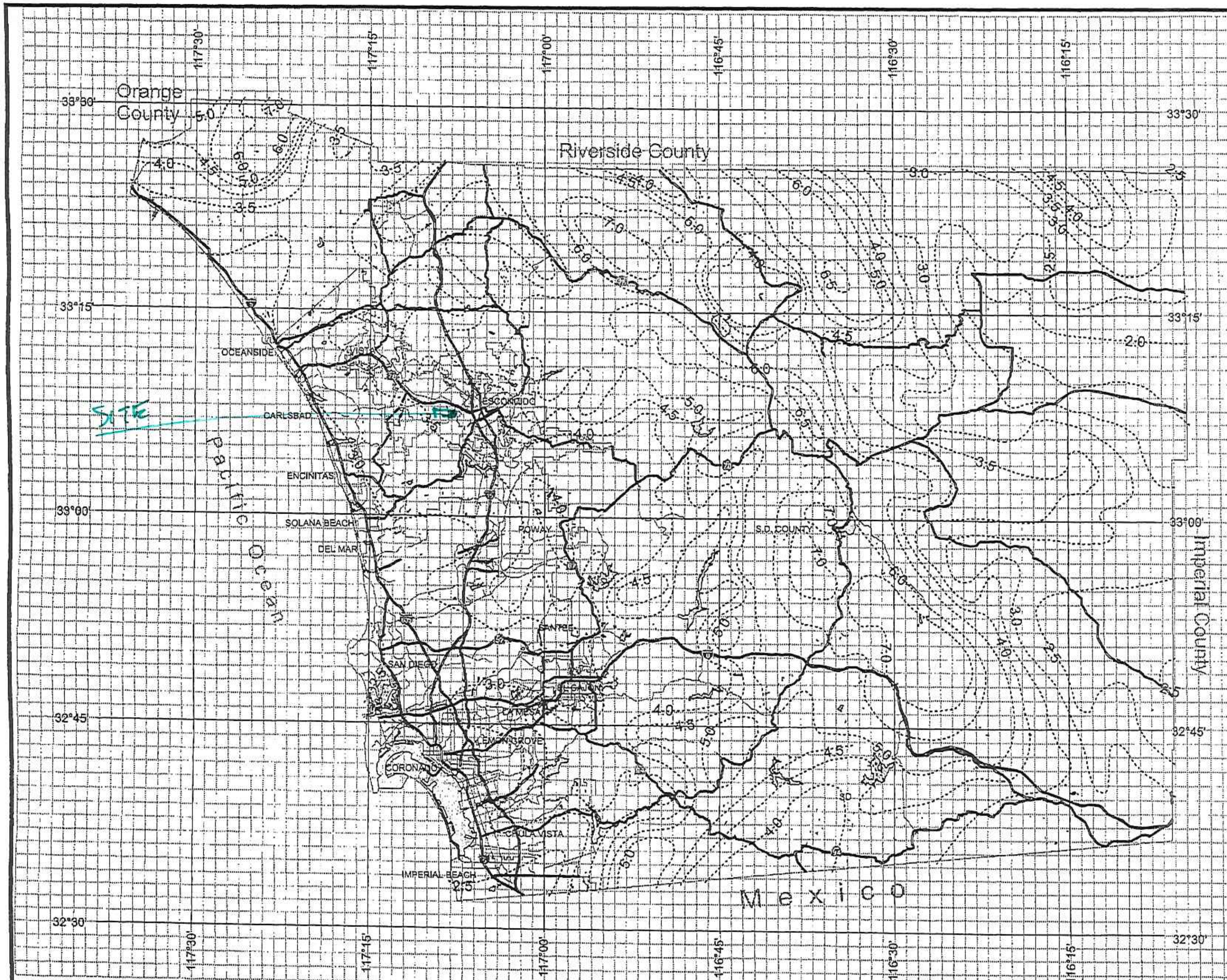
N E S W

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 24 Hours

-------- Isopluvial (inches)

$P_{24_{10yr}} = 3.8$

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W E
S

-3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

50 Year Rainfall Event - 6 Hours

-------- Isopluvial (inches)

$P_{6\ 50yr} = 2.8$

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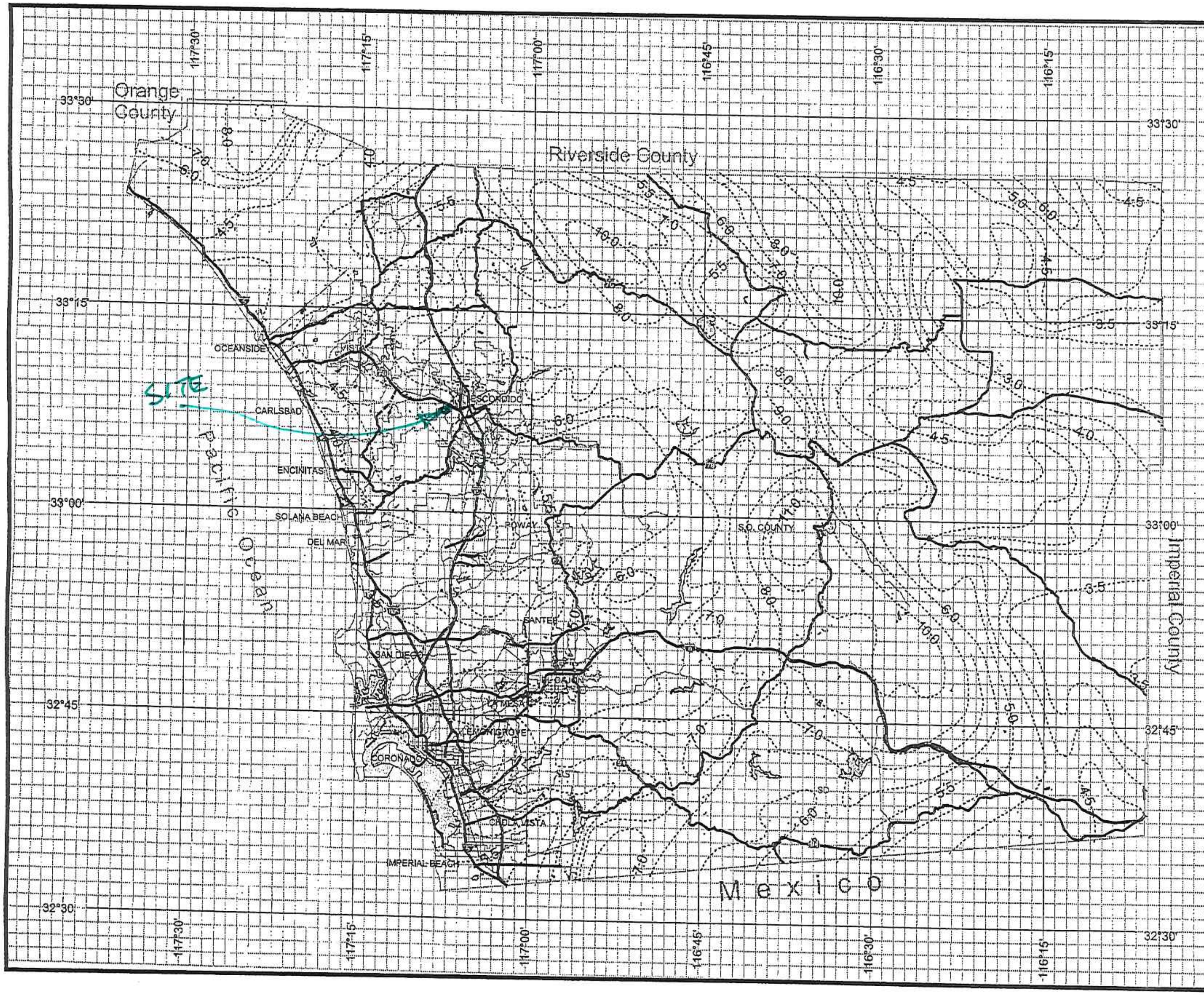
N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

50 Year Rainfall Event - 24 Hours

------- Isopluvial (inches)

P_{24} 50yr = 5.7

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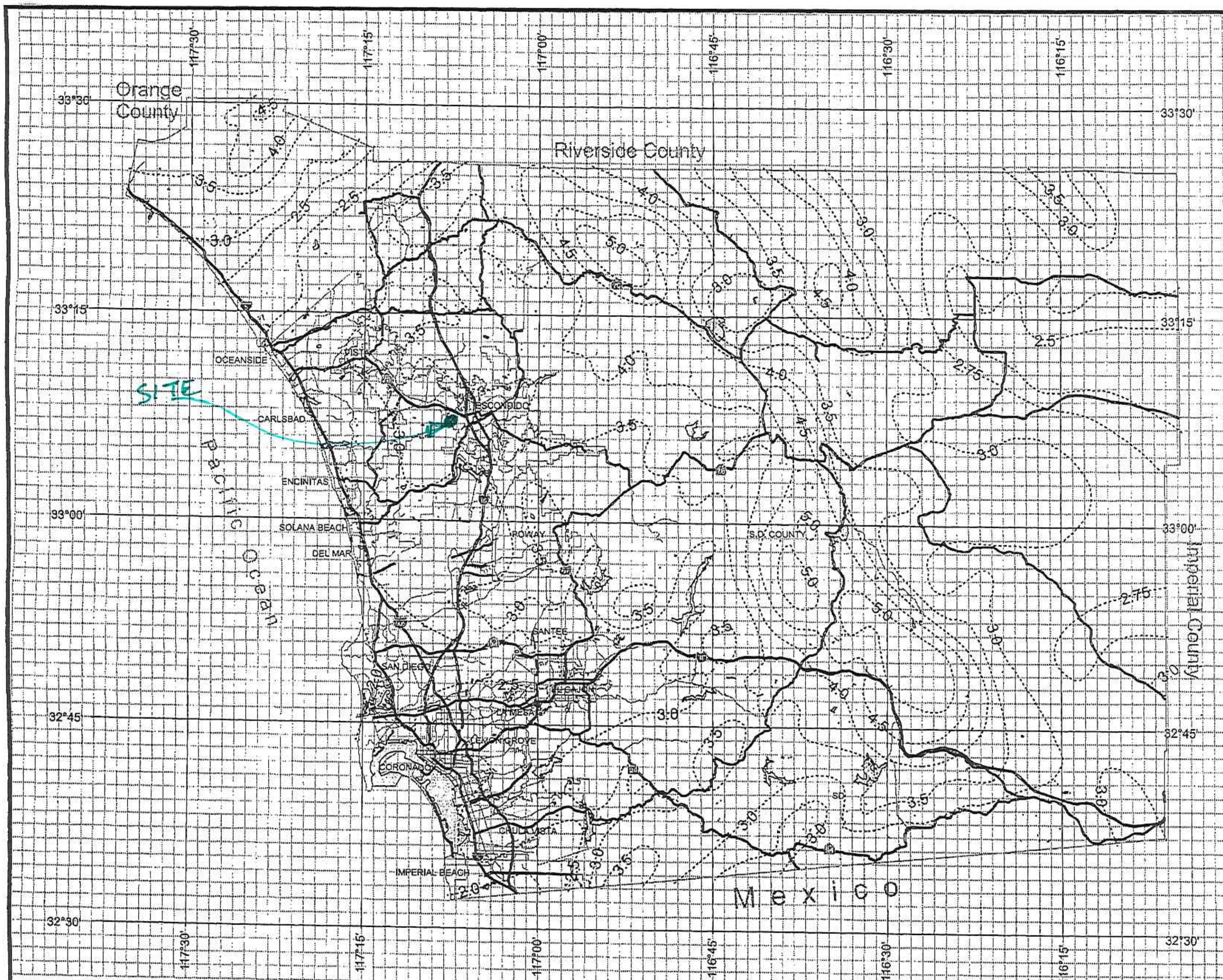
N E S W

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

-------- Isopluvial (inches)

$P_{6\ 100yr} = 3.3$

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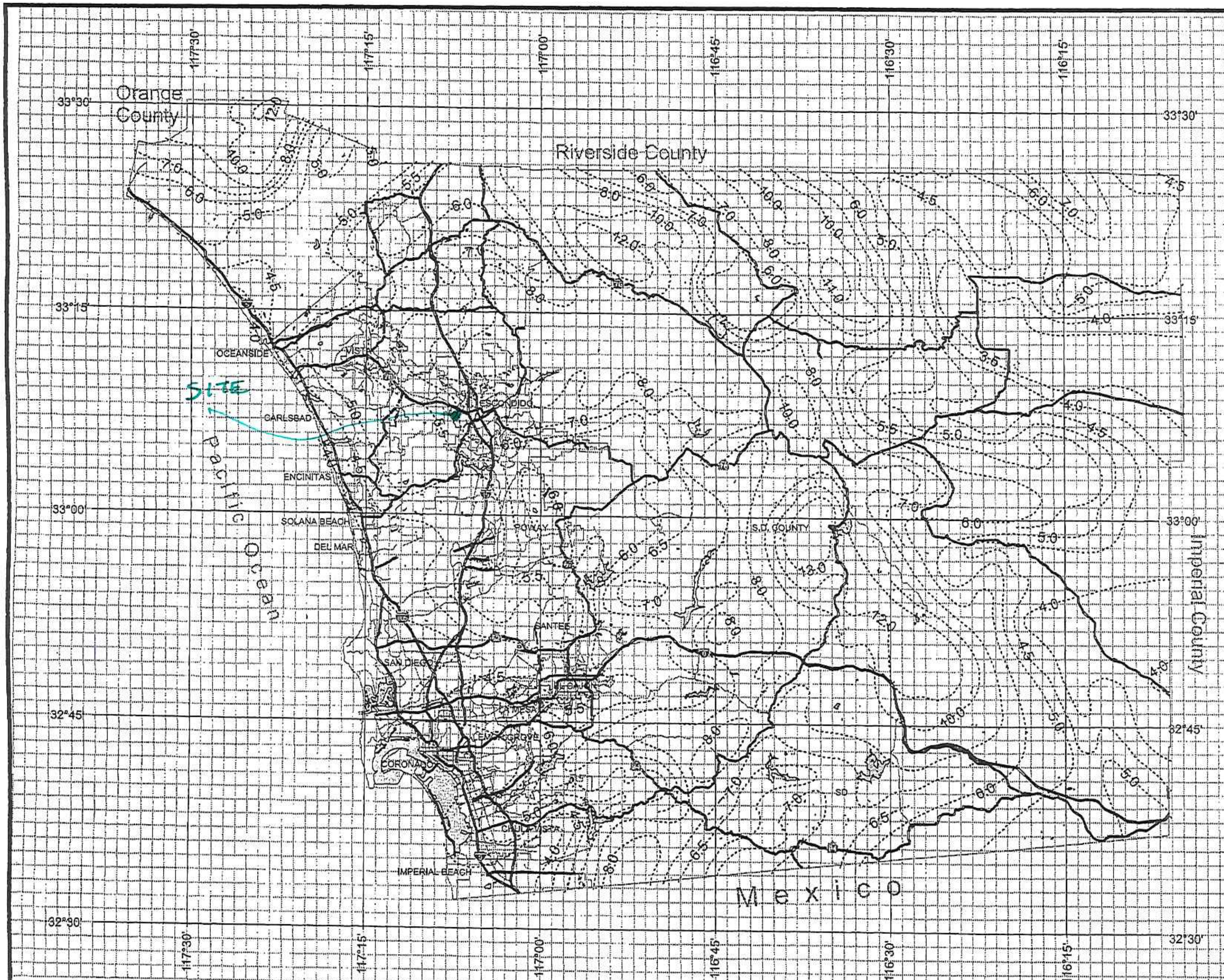
W E
S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

-------- Isopluvial (inches)

$P_{24\ 100\,yr} = 6.8$

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N S E W

3 0 3 Miles

APPENDIX B
Hydrologic Calculations

This Section Contains:

- Existing Condition Analysis
- Proposed Condition Analysis

Lundstrom
Engineering and Surveying, Inc.
5333 Mission Center Road, #115 • San Diego, CA 92108
Phone (619) 814-1220 • Fax (619) 641-5910

SUNRISE – ORIX
EXISTING SITE CONDITION

JOB NO.: L300–09	SCALE: 1"=60'	SHEET: 1 OF 1

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

              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
              Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2006 Advanced Engineering Software (aes)
               Ver. 2.0 Release Date: 06/01/2005  License ID 1553

                              Analysis prepared by:



                                    LUNDSTROM







  ************************** DESCRIPTION OF STUDY
**************************
 * EXISTING CONDITION
*
 * 100 YEAR STORM EVENT
*
 *
*

****************************************************************************
*

   FILE NAME: C:\300EX100.DAT
   TIME/DATE OF STUDY: 08:37 04/06/2018
 ---------------------------------------------------------------------------
----
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ---------------------------------------------------------------------------
----
   2003 SAN DIEGO MANUAL CRITERIA

   USER SPECIFIED STORM EVENT(YEAR) = 100.00
   6-HOUR DURATION PRECIPITATION (INCHES) =   3.300
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
0.09
   SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
   NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
```

```
   *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.*


*************************************************************************
***
   FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
 ------------------------------------------------------------------------
----
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=========================================================================
===
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    40.00
   UPSTREAM ELEVATION(FEET) =    814.00
   DOWNSTREAM ELEVATION(FEET) =    813.00
   ELEVATION DIFFERENCE(FEET) =      1.00
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.291
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.497
   SUBAREA RUNOFF(CFS) =      0.26
   TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.26


*************************************************************************
***
   FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
 ------------------------------------------------------------------------
----
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =    813.00  DOWNSTREAM(FEET) =
776.00
```

```
   CHANNEL LENGTH THRU SUBAREA(FEET) =   220.00   CHANNEL SLOPE =  0.1682
   CHANNEL BASE(FEET) =    1.00   "Z" FACTOR =   4.000
   MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.000
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.61
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.19
   AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   0.71
   Tc(MIN.) =   7.00
   SUBAREA AREA(ACRES) =     1.10       SUBAREA RUNOFF(CFS) =    2.69
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.350
   TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =
2.94

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   5.99
   LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     260.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  51
 ------------------------------------------------------------------------
----
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =    776.00  DOWNSTREAM(FEET) =
740.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   440.00   CHANNEL SLOPE =  0.0818
   CHANNEL BASE(FEET) =    1.00   "Z" FACTOR =   4.000
   MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.274
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.44
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.67
   AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =   1.29
   Tc(MIN.) =   8.29
   SUBAREA AREA(ACRES) =     3.18       SUBAREA RUNOFF(CFS) =    6.98
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.350
   TOTAL AREA(ACRES) =        4.4         PEAK FLOW RATE(CFS) =
9.62

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.51   FLOW VELOCITY(FEET/SEC.) =   6.28
   LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     700.00
FEET.
```

```
**********************************************************************
***
   FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  13
 ---------------------------------------------------------------------
----
   >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<

======================================================================
===


**********************************************************************
***
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 ---------------------------------------------------------------------
----
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

======================================================================
===
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    40.00
   UPSTREAM ELEVATION(FEET) =    813.00
   DOWNSTREAM ELEVATION(FEET) =    810.00
   ELEVATION DIFFERENCE(FEET) =      3.00
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.362
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.695
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.30
   TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.30


**********************************************************************
***
   FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  51
 ---------------------------------------------------------------------
----
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

======================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =    810.00  DOWNSTREAM(FEET) =
737.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   690.00   CHANNEL SLOPE =  0.1058
   CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
   MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.759
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      12.39
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.17
```

```
   AVERAGE FLOW DEPTH(FEET) =   0.45   TRAVEL TIME(MIN.) =   1.60
   Tc(MIN.) =   5.97
   SUBAREA AREA(ACRES) =     8.85       SUBAREA RUNOFF(CFS) =   24.03
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.350
   TOTAL AREA(ACRES) =        9.0         PEAK FLOW RATE(CFS) =
24.31

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.62   FLOW VELOCITY(FEET/SEC.) =   8.69
   LONGEST FLOWPATH FROM NODE      5.00 TO NODE      7.00 =     730.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE =  51
 ------------------------------------------------------------------------
----
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =    735.00  DOWNSTREAM(FEET) =
697.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   600.00   CHANNEL SLOPE =  0.0633
   CHANNEL BASE(FEET) =    1.00   "Z" FACTOR =   4.000
   MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.824
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      30.28
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.61
   AVERAGE FLOW DEPTH(FEET) =   0.88   TRAVEL TIME(MIN.) =   1.31
   Tc(MIN.) =   7.28
   SUBAREA AREA(ACRES) =     5.00       SUBAREA RUNOFF(CFS) =   11.94
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.350
   TOTAL AREA(ACRES) =       14.0         PEAK FLOW RATE(CFS) =
33.32

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.91   FLOW VELOCITY(FEET/SEC.) =   7.85
   LONGEST FLOWPATH FROM NODE      5.00 TO NODE      8.00 =    1330.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  81
 ------------------------------------------------------------------------
----
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==========================================================================
===
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.824
   USER-SPECIFIED RUNOFF COEFFICIENT = .8200
   S.C.S. CURVE NUMBER (AMC II) =  95
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.3628
   SUBAREA AREA(ACRES) =    0.39   SUBAREA RUNOFF(CFS) =    2.18
   TOTAL AREA(ACRES) =       14.3   TOTAL RUNOFF(CFS) =      35.50
   TC(MIN.) =   7.28


**************************************************************************
***
   FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  81
 -------------------------------------------------------------------------
----
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

==========================================================================
===
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.824
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
   S.C.S. CURVE NUMBER (AMC II) =  88
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.3623
   SUBAREA AREA(ACRES) =    0.52   SUBAREA RUNOFF(CFS) =    1.24
   TOTAL AREA(ACRES) =       14.9   TOTAL RUNOFF(CFS) =      36.74
   TC(MIN.) =   7.28


**************************************************************************
***
   FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  13
 -------------------------------------------------------------------------
----
   >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<

==========================================================================
===


**************************************************************************
***
   FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   7
 -------------------------------------------------------------------------
----
   >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<

==========================================================================
===
   USER-SPECIFIED VALUES ARE AS FOLLOWS:
   TC(MIN) =   5.00   RAIN INTENSITY(INCH/HOUR) =  8.69
   TOTAL AREA(ACRES) =     0.93   TOTAL RUNOFF(CFS) =      2.80
```

```
================================================================================
===
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)      =         0.9  TC(MIN.) =       5.00
   PEAK FLOW RATE(CFS)    =        2.80

================================================================================
===

================================================================================
===
   END OF RATIONAL METHOD ANALYSIS
```

Prop Proposed Condition Analysis

Lundstrom
Engineering and Surveying, Inc.
5333 Mission Center Road, #115 • San Diego, CA 92108
Phone (619) 814-1220 • Fax (619) 641-5910

SUNRISE – ORIX
PROPOSED ROUGH GRADED SITE CONDITION

JOB NO.: L300-09 | SCALE: 1"=60' | SHEET: 1 OF 1

```
____________________________________________________________________________
___

****************************************************************************
***

             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2006 Advanced Engineering Software (aes)
              Ver. 2.0 Release Date: 06/01/2005  License ID 1553

                            Analysis prepared by:



                                  LUNDSTROM






  ************************** DESCRIPTION OF STUDY
**************************
 * PROPOSED 100 YEAR STORM EVENT
*
 *
*
 *
*

****************************************************************************
*

   FILE NAME: C:\300PR100.DAT
   TIME/DATE OF STUDY: 15:46 04/05/2018
 ---------------------------------------------------------------------------
----
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ---------------------------------------------------------------------------
----
   2003 SAN DIEGO MANUAL CRITERIA

   USER SPECIFIED STORM EVENT(YEAR) = 100.00
   6-HOUR DURATION PRECIPITATION (INCHES) =   3.300
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =
0.85
   SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
   NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
```

```
   *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.*


****************************************************************************
***
   FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
 ----------------------------------------------------------------------------
----
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
===
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
   UPSTREAM ELEVATION(FEET) =    798.10
   DOWNSTREAM ELEVATION(FEET) =    797.40
   ELEVATION DIFFERENCE(FEET) =      0.70
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.499
   WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
            THE MAXIMUM OVERLAND FLOW LENGTH =    65.00
            (Reference: Table 3-1B of Hydrology Manual)
            THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.695
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      1.03
   TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      1.03


****************************************************************************
***
   FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  62
 ----------------------------------------------------------------------------
----
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
```

```
================================================================================
===
   UPSTREAM ELEVATION(FEET) =  797.40  DOWNSTREAM ELEVATION(FEET) =
793.00
   STREET LENGTH(FEET) =   280.00   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 =  2
   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) =  0.33
     HALFSTREET FLOOD WIDTH(FEET) =    9.59
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.72
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.91
   STREET FLOW TRAVEL TIME(MIN.) =   1.71   Tc(MIN.) =   6.21
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.557
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.790
   SUBAREA AREA(ACRES) =    1.50      SUBAREA RUNOFF(CFS) =    8.96
   TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       9.85

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.39   HALFSTREET FLOOD WIDTH(FEET) =  12.54
   FLOW VELOCITY(FEET/SEC.) =  3.08   DEPTH*VELOCITY(FT*FT/SEC.) =   1.19
   LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =    350.00
FEET.


****************************************************************************
***
   FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  62
 ----------------------------------------------------------------------------
----
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

================================================================================
===
   UPSTREAM ELEVATION(FEET) =  793.00  DOWNSTREAM ELEVATION(FEET) =
767.50
   STREET LENGTH(FEET) =   585.00   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 =  2
   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) =      17.92
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.39
     HALFSTREET FLOOD WIDTH(FEET) =   13.01
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.26
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.08
   STREET FLOW TRAVEL TIME(MIN.) =   1.86   Tc(MIN.) =   8.07
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.386
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.790
   SUBAREA AREA(ACRES) =    3.19      SUBAREA RUNOFF(CFS) =   16.10
   TOTAL AREA(ACRES) =        4.8        PEAK FLOW RATE(CFS) =      24.43

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.43   HALFSTREET FLOOD WIDTH(FEET) =  14.88
   FLOW VELOCITY(FEET/SEC.) =  5.62   DEPTH*VELOCITY(FT*FT/SEC.) =   2.41
   LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     935.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  31
 ------------------------------------------------------------------------
----
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =   764.00  DOWNSTREAM(FEET) =   760.00
   FLOW LENGTH(FEET) =   400.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.2 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   8.07
   ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      24.43
   PIPE TRAVEL TIME(MIN.) =   0.83    Tc(MIN.) =   8.90
   LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =    1335.00
FEET.


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

```
   FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =  13
 ----------------------------------------------------------------------------
----
   >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<

============================================================================
===


****************************************************************************
***
   FLOW PROCESS FROM NODE      8.00 TO NODE      9.00 IS CODE =  21
 ----------------------------------------------------------------------------
----
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
===
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
   UPSTREAM ELEVATION(FEET) =    796.70
   DOWNSTREAM ELEVATION(FEET) =    796.00
   ELEVATION DIFFERENCE(FEET) =      0.70
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.499
   WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
            THE MAXIMUM OVERLAND FLOW LENGTH =    65.00
            (Reference: Table 3-1B of Hydrology Manual)
            THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.695
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      1.03
   TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      1.03


****************************************************************************
***
   FLOW PROCESS FROM NODE      9.00 TO NODE     10.00 IS CODE =  62
 ----------------------------------------------------------------------------
----
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
===
   UPSTREAM ELEVATION(FEET) =  796.00  DOWNSTREAM ELEVATION(FEET) =
793.20
   STREET LENGTH(FEET) =   320.00   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 =  2
   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) =      10.85
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.43
     HALFSTREET FLOOD WIDTH(FEET) =   14.80
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.52
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.08
   STREET FLOW TRAVEL TIME(MIN.) =   2.11   Tc(MIN.) =   6.61
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.260
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.790
   SUBAREA AREA(ACRES) =    3.40      SUBAREA RUNOFF(CFS) =   19.50
   TOTAL AREA(ACRES) =        3.6        PEAK FLOW RATE(CFS) =      20.36

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.18
   FLOW VELOCITY(FEET/SEC.) =  2.93   DEPTH*VELOCITY(FT*FT/SEC.) =   1.48
   LONGEST FLOWPATH FROM NODE      8.00 TO NODE     10.00 =     390.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  31
 ------------------------------------------------------------------------
----
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =   787.00  DOWNSTREAM(FEET) =   738.00
   FLOW LENGTH(FEET) =   600.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.5 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =  17.12
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      20.36
   PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =   7.20
   LONGEST FLOWPATH FROM NODE      8.00 TO NODE     11.00 =     990.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =  81
 ------------------------------------------------------------------------
----
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==========================================================================
===
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.874
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
   SUBAREA AREA(ACRES) =    4.89   SUBAREA RUNOFF(CFS) =   26.57
   TOTAL AREA(ACRES) =        8.4   TOTAL RUNOFF(CFS) =      45.85
   TC(MIN.) =   7.20


**************************************************************************
***
   FLOW PROCESS FROM NODE     11.00 TO NODE     11.00 IS CODE =  13
 -------------------------------------------------------------------------
----
   >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<

==========================================================================
===


**************************************************************************
***
   FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =   7
 -------------------------------------------------------------------------
----
   >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<

==========================================================================
===
   USER-SPECIFIED VALUES ARE AS FOLLOWS:
   TC(MIN) =   7.20   RAIN INTENSITY(INCH/HOUR) =  6.87
   TOTAL AREA(ACRES) =     8.40   TOTAL RUNOFF(CFS) =     24.30


**************************************************************************
***
   FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  31
 -------------------------------------------------------------------------
----
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

==========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =   730.00  DOWNSTREAM(FEET) =   687.00
   FLOW LENGTH(FEET) =  1300.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.8 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =  12.52
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      24.30
   PIPE TRAVEL TIME(MIN.) =   1.73    Tc(MIN.) =   8.93
```

```
   LONGEST FLOWPATH FROM NODE      8.00 TO NODE     13.00 =    2290.00
FEET.


****************************************************************************
***
   FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =  81
 ---------------------------------------------------------------------------
----
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
===
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.981
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.4654
   SUBAREA AREA(ACRES) =    1.15   SUBAREA RUNOFF(CFS) =    5.43
   TOTAL AREA(ACRES) =        9.5   TOTAL RUNOFF(CFS) =      26.58
   TC(MIN.) =   8.93


****************************************************************************
***
   FLOW PROCESS FROM NODE     13.00 TO NODE     14.00 IS CODE =  31
 ---------------------------------------------------------------------------
----
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =   687.00  DOWNSTREAM(FEET) =   678.00
   FLOW LENGTH(FEET) =   500.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =  10.14
   ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      26.58
   PIPE TRAVEL TIME(MIN.) =   0.82    Tc(MIN.) =   9.75
   LONGEST FLOWPATH FROM NODE      8.00 TO NODE     14.00 =    2790.00
FEET.


****************************************************************************
***
   FLOW PROCESS FROM NODE     14.00 TO NODE     14.00 IS CODE =  13
 ---------------------------------------------------------------------------
----
   >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<

============================================================================
===
```

```
*************************************************************************
***
   FLOW PROCESS FROM NODE     15.00 TO NODE     16.00 IS CODE =  21
 ------------------------------------------------------------------------
----
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=========================================================================
===
   USER-SPECIFIED RUNOFF COEFFICIENT = .7900
   S.C.S. CURVE NUMBER (AMC II) =  94
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
   UPSTREAM ELEVATION(FEET) =    745.50
   DOWNSTREAM ELEVATION(FEET) =    721.00
   ELEVATION DIFFERENCE(FEET) =     24.50
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.590
   WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
            THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
            (Reference: Table 3-1B of Hydrology Manual)
            THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.695
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      3.92
   TOTAL AREA(ACRES) =      0.57   TOTAL RUNOFF(CFS) =      3.92


*************************************************************************
***
   FLOW PROCESS FROM NODE     16.00 TO NODE     17.00 IS CODE =  31
 ------------------------------------------------------------------------
----
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=========================================================================
===
   ELEVATION DATA: UPSTREAM(FEET) =   721.00  DOWNSTREAM(FEET) =   714.00
   FLOW LENGTH(FEET) =   150.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.3 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   9.07
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       3.92
   PIPE TRAVEL TIME(MIN.) =   0.28    Tc(MIN.) =   2.87
   LONGEST FLOWPATH FROM NODE     15.00 TO NODE     17.00 =     350.00
FEET.


*************************************************************************
***
   FLOW PROCESS FROM NODE     17.00 TO NODE     18.00 IS CODE =  62
 ------------------------------------------------------------------------
----
```

```
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

==========================================================================
===
   UPSTREAM ELEVATION(FEET) =  714.00  DOWNSTREAM ELEVATION(FEET) =
696.00
   STREET LENGTH(FEET) =   530.00   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) =       5.36
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.36
     HALFSTREET FLOOD WIDTH(FEET) =   10.98
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.22
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.51
   STREET FLOW TRAVEL TIME(MIN.) =   2.09   Tc(MIN.) =   4.96
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.695
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   USER-SPECIFIED RUNOFF COEFFICIENT = .8500
   S.C.S. CURVE NUMBER (AMC II) =  96
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.814
   SUBAREA AREA(ACRES) =    0.39      SUBAREA RUNOFF(CFS) =    2.88
   TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       6.80

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  12.23
   FLOW VELOCITY(FEET/SEC.) =  4.45   DEPTH*VELOCITY(FT*FT/SEC.) =   1.69
   LONGEST FLOWPATH FROM NODE     15.00 TO NODE     18.00 =     880.00
FEET.


**************************************************************************
***
   FLOW PROCESS FROM NODE     18.00 TO NODE     18.00 IS CODE =  81
 -------------------------------------------------------------------------
----
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

==========================================================================
===
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.695
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   USER-SPECIFIED RUNOFF COEFFICIENT = .3500
```

```
   S.C.S. CURVE NUMBER (AMC II) =  88
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.4327
   SUBAREA AREA(ACRES) =    4.43   SUBAREA RUNOFF(CFS) =   13.48
   TOTAL AREA(ACRES) =        5.4   TOTAL RUNOFF(CFS) =      20.28
   TC(MIN.) =   4.96

==========================================================================
===
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =        5.4  TC(MIN.) =      4.96
   PEAK FLOW RATE(CFS)   =      20.28

==========================================================================
===

==========================================================================
===
   END OF RATIONAL METHOD ANALYSIS
```

RATIONAL METHOD HYDROGRAPH PROGRAM
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PROPOSED 100 YEAR HYDROGRAPH

@ NODE #11 (INFLOW)

RUN DATE 4/4/2018
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 7 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 8.4 ACRES
RUNOFF COEFFICIENT 0.79
PEAK DISCHARGE 45.85 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 7	DISCHARGE (CFS) = 1.3
TIME (MIN) = 14	DISCHARGE (CFS) = 1.3
TIME (MIN) = 21	DISCHARGE (CFS) = 1.4
TIME (MIN) = 28	DISCHARGE (CFS) = 1.4
TIME (MIN) = 35	DISCHARGE (CFS) = 1.4
TIME (MIN) = 42	DISCHARGE (CFS) = 1.4
TIME (MIN) = 49	DISCHARGE (CFS) = 1.5
TIME (MIN) = 56	DISCHARGE (CFS) = 1.5
TIME (MIN) = 63	DISCHARGE (CFS) = 1.6
TIME (MIN) = 70	DISCHARGE (CFS) = 1.6
TIME (MIN) = 77	DISCHARGE (CFS) = 1.6
TIME (MIN) = 84	DISCHARGE (CFS) = 1.7
TIME (MIN) = 91	DISCHARGE (CFS) = 1.7
TIME (MIN) = 98	DISCHARGE (CFS) = 1.8
TIME (MIN) = 105	DISCHARGE (CFS) = 1.9
TIME (MIN) = 112	DISCHARGE (CFS) = 1.9
TIME (MIN) = 119	DISCHARGE (CFS) = 2
TIME (MIN) = 126	DISCHARGE (CFS) = 2
TIME (MIN) = 133	DISCHARGE (CFS) = 2.2
TIME (MIN) = 140	DISCHARGE (CFS) = 2.2
TIME (MIN) = 147	DISCHARGE (CFS) = 2.4
TIME (MIN) = 154	DISCHARGE (CFS) = 2.4
TIME (MIN) = 161	DISCHARGE (CFS) = 2.6
TIME (MIN) = 168	DISCHARGE (CFS) = 2.7
TIME (MIN) = 175	DISCHARGE (CFS) = 2.9
TIME (MIN) = 182	DISCHARGE (CFS) = 3.1
TIME (MIN) = 189	DISCHARGE (CFS) = 3.4
TIME (MIN) = 196	DISCHARGE (CFS) = 3.6
TIME (MIN) = 203	DISCHARGE (CFS) = 4.1
TIME (MIN) = 210	DISCHARGE (CFS) = 4.5
TIME (MIN) = 217	DISCHARGE (CFS) = 5.5
TIME (MIN) = 224	DISCHARGE (CFS) = 6.3
TIME (MIN) = 231	DISCHARGE (CFS) = 9.2
TIME (MIN) = 238	DISCHARGE (CFS) = 13.5
TIME (MIN) = 245	DISCHARGE (CFS) = 45.85
TIME (MIN) = 252	DISCHARGE (CFS) = 7.4
TIME (MIN) = 259	DISCHARGE (CFS) = 4.9
TIME (MIN) = 266	DISCHARGE (CFS) = 3.9
TIME (MIN) = 273	DISCHARGE (CFS) = 3.2
TIME (MIN) = 280	DISCHARGE (CFS) = 2.8
TIME (MIN) = 287	DISCHARGE (CFS) = 2.5
TIME (MIN) = 294	DISCHARGE (CFS) = 2.3
TIME (MIN) = 301	DISCHARGE (CFS) = 2.1
TIME (MIN) = 308	DISCHARGE (CFS) = 1.9
TIME (MIN) = 315	DISCHARGE (CFS) = 1.8
TIME (MIN) = 322	DISCHARGE (CFS) = 1.7
TIME (MIN) = 329	DISCHARGE (CFS) = 1.6
TIME (MIN) = 336	DISCHARGE (CFS) = 1.5
TIME (MIN) = 343	DISCHARGE (CFS) = 1.5
TIME (MIN) = 350	DISCHARGE (CFS) = 1.4
TIME (MIN) = 357	DISCHARGE (CFS) = 1.3
TIME (MIN) = 364	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

PROPOSED 100 YEAR HYROGRAPH
@ NODE # 7

RUN DATE 1/15/2018
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 10 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 5 ACRES
RUNOFF COEFFICIENT 0.41
PEAK DISCHARGE 11.4 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 10	DISCHARGE (CFS) = 0.4
TIME (MIN) = 20	DISCHARGE (CFS) = 0.4
TIME (MIN) = 30	DISCHARGE (CFS) = 0.4
TIME (MIN) = 40	DISCHARGE (CFS) = 0.4
TIME (MIN) = 50	DISCHARGE (CFS) = 0.5
TIME (MIN) = 60	DISCHARGE (CFS) = 0.5
TIME (MIN) = 70	DISCHARGE (CFS) = 0.5
TIME (MIN) = 80	DISCHARGE (CFS) = 0.5
TIME (MIN) = 90	DISCHARGE (CFS) = 0.5
TIME (MIN) = 100	DISCHARGE (CFS) = 0.5
TIME (MIN) = 110	DISCHARGE (CFS) = 0.6
TIME (MIN) = 120	DISCHARGE (CFS) = 0.6
TIME (MIN) = 130	DISCHARGE (CFS) = 0.6
TIME (MIN) = 140	DISCHARGE (CFS) = 0.7
TIME (MIN) = 150	DISCHARGE (CFS) = 0.7
TIME (MIN) = 160	DISCHARGE (CFS) = 0.8
TIME (MIN) = 170	DISCHARGE (CFS) = 0.8
TIME (MIN) = 180	DISCHARGE (CFS) = 0.9
TIME (MIN) = 190	DISCHARGE (CFS) = 1
TIME (MIN) = 200	DISCHARGE (CFS) = 1.1
TIME (MIN) = 210	DISCHARGE (CFS) = 1.3
TIME (MIN) = 220	DISCHARGE (CFS) = 1.5
TIME (MIN) = 230	DISCHARGE (CFS) = 2.3
TIME (MIN) = 240	DISCHARGE (CFS) = 3.2
TIME (MIN) = 250	DISCHARGE (CFS) = 11.4
TIME (MIN) = 260	DISCHARGE (CFS) = 1.8
TIME (MIN) = 270	DISCHARGE (CFS) = 1.2
TIME (MIN) = 280	DISCHARGE (CFS) = 0.9
TIME (MIN) = 290	DISCHARGE (CFS) = 0.8
TIME (MIN) = 300	DISCHARGE (CFS) = 0.7
TIME (MIN) = 310	DISCHARGE (CFS) = 0.6
TIME (MIN) = 320	DISCHARGE (CFS) = 0.6
TIME (MIN) = 330	DISCHARGE (CFS) = 0.5
TIME (MIN) = 340	DISCHARGE (CFS) = 0.5
TIME (MIN) = 350	DISCHARGE (CFS) = 0.4
TIME (MIN) = 360	DISCHARGE (CFS) = 0.4
TIME (MIN) = 370	DISCHARGE (CFS) = 0

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = C:\pondpack\
 Inflow  HYG file = NONE STORED - BASIN        IN  100
 Outflow HYG file = NONE STORED - BASIN        OUT 100

 Pond Node   Data = BASIN
 Pond Volume Data = BASIN
 Pond Outlet Data = Outlet 1

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   728.50 ft
 Starting Volume    =        0 cu.ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =     1.00 min


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     45.85 cfs    at    245.00 min
 Peak Outflow      =     24.25 cfs    at    249.00 min
 -----------------------------------------------------
 Peak Elevation    =    741.64 ft
 Peak Storage =          55257 cu.ft
 =====================================================


 MASS BALANCE (cu.ft)
 --------------------------
+ Initial Vol  =          0
+ HYG Vol IN   =      78645
- Infiltration =          0
- HYG Vol OUT  =      42693
- Retained Vol =      35952
                 ----------
 Unrouted Vol = -            cu.ft  (.000% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = C:\pondpack\
 Inflow  HYG file = NONE STORED - BASIN        IN  100
 Outflow HYG file = NONE STORED - BASIN        OUT 100

 Pond Node   Data = BASIN
 Pond Volume Data = BASIN
 Pond Outlet Data = Outlet 1

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   754.50 ft
 Starting Volume    =        0 cu.ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =     1.00 min


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     24.40 cfs    at    252.00 min
 Peak Outflow      =      9.11 cfs    at    259.00 min
 -----------------------------------------------------
 Peak Elevation    =    763.44 ft
 Peak Storage =          27139 cu.ft
 =====================================================


 MASS BALANCE (cu.ft)
 --------------------------
+ Initial Vol  =          0
+ HYG Vol IN   =      45198
- Infiltration =          0
- HYG Vol OUT  =      36699
- Retained Vol =       8499
                 ----------
 Unrouted Vol = -            cu.ft  (.000% of Inflow Volume)
```