ChangConsultants
Civil Engineering◦Hydrology◦Hydraulics◦Sedimentation

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January 11, 2024

Sean Oberbauer
Land Use & Environmental Planner
County of San Diego
Planning & Development Services
5510 Overland Avenue Suite 310
San Diego, CA 92123

Subject: Good Shepherd Catholic Cemetery – Phase 1 Drainage Certification
Record ID (Permit) Number: PDS2020-MUP-20-004

Dear Sean:

Phase 1 of the Good Shepherd Catholic Cemetery project proposes 3.13 acres of grave site area adjacent to Keys Place, a temporary gravel parking area, and a paved vehicle hammerhead turnaround at the existing Keys Place terminus. The project will create less than 5,000 square feet of impervious area. The impervious area will be 2,855 square feet of asphalt concrete pavement for the hammerhead turnaround. Five tree wells will be incorporated into Phase 1 to meet water quality requirements and attenuate flows.

I hereby certify that there will be no increase in the volume or velocity, and no diversion of flows off-site to the detriment of downstream property owners consistent with Section 1.3 of the San Diego County September 2014 *Hydraulic Design Manual*.

Sincerely,

Wayne W. Chang, M.S., P.E.

CEQA DRAINAGE STUDY

FOR

GOOD SHEPHERD CATHOLIC CEMETERY

November 16, 2021

Wayne W. Chang, MS, PE 46548

ChangConsultants

Civil Engineering ◦ Hydrology ◦ Hydraulics ◦ Sedimentation

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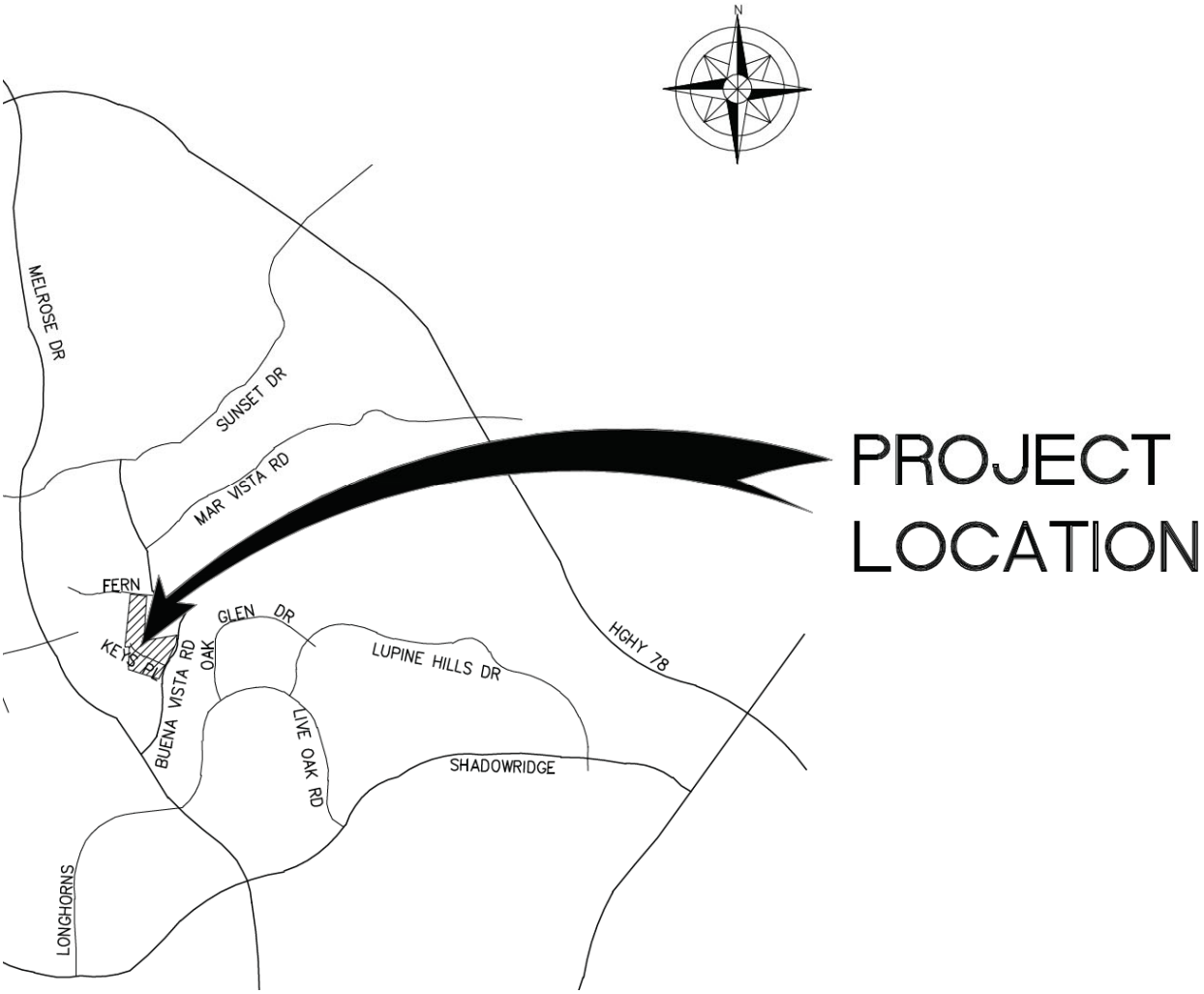
TABLE OF CONTENTS

APPENDIX

MAP POCKET

INTRODUCTION

The Good Shepherd Catholic Cemetery project will be located on the west side of Buena Vista Drive at Keys Place in the county of San Diego (see the Vicinity Map). The 14.49-acre site was historically used for agricultural activities and is on a moderately sloping hillside. The majority of the site has been disturbed by the agricultural use and contains pervious cover. The impervious surfaces include a single-family residence with driveway/hardscape at the southeast corner of the site, a few standalone accessory structures at various locations within the site, and Keys Place.



Vicinity Map

The discretionary Major Use Permit site, grading, and utility plans are being prepared by Hofman Planning + Engineering. The project proposes a cemetery with an administration/office building, warehouse, and grave sites. The single-family residence will remain and be used as the administration/office building. A new driveway with parking, walkways, and landscaping will be constructed around the administration/office building. The driveway and parking will consist of permeable pavement. The other existing structures will be demolished and removed. Keys Place

will be demolished and replaced with new street access to the grave site areas. Storm runoff from the impervious surfaces (administration/office area, warehouse, and streets) and permeable pavement will be conveyed in the proposed streets and storm drain system to a single biofiltration basin (BMP 1) near the northwest corner of the site for pollutant and flow control. The grave site areas will meet self-mitigating criteria, so storm runoff from these areas will flow off-site without commingling with the drainage areas tributary to the biofiltration basin.

Under existing conditions, storm runoff from the site flows over the natural ground and pavement surfaces in a northerly to northwesterly direction. The runoff is conveyed to an unnamed natural drainage course with the northerly portion of the site. The drainage course flows northwest and ultimately to Calavera Creek, Agua Hedionda Creek, Agua Hedionda Lagoon, and the Pacific Ocean. Under proposed conditions, the project runoff will continue to be directed to the unnamed natural drainage course.

The project is required to install half-street improvements along the west side of Buena Vista Drive (curb, gutter, sidewalk, and 7± feet of widening. Runoff is conveyed south down the street. The majority of the runoff is directed onto the site by an existing spillway on the west end of the street. There is a recent single-family subdivision near the top of Buena Vista Drive (south end) that discharges a portion of its runoff onto the street. The subdivision was designed by Pasco Laret Suiter & Associates and approved by the city of Vista. Their approved hydrologic data was obtained and used for this report (see Appendix A). A biofiltration basin (BMP 2) near the northeast corner of the site will provide pollutant and flow control for the Buena Vista Drive improvements.

This report contains preliminary CEQA-level existing and proposed condition hydrologic analyses for entitlement purposes.

HYDROLOGIC ANALYSES

The County of San Diego's 2003 *Hydrology Manual* rational method procedure was used for the 100-year hydrologic analyses. The existing and proposed condition rational method input parameters are summarized as follows:

- Precipitation: The 100-year, 6- and 24-hour precipitation values are 3.0 and 6.5 inches, respectively. The isopluvials are included in Appendix A.

- Drainage areas: The existing condition drainage areas were delineated from 1-foot contour interval topographic mapping prepared for the project. A site visit was performed to verify the drainage area delineation. The proposed condition on-site drainage areas were delineated from the preliminary grading plan. The Existing Condition Rational Method Work Map and Proposed Condition Rational Method Work Map are included in Appendix A. There is an off-site multi-family residential development to the southwest that is tributary to the site. The overall existing and proposed condition drainage areas were set equal to allow comparison of the results.

For Buena Vista Drive, the hydrology work map and results for the subdivision to the south were obtained from Pasco Laret Suiter & Associates. Their work map is inserted on the Existing and Proposed Condition Rational Method Work Maps. The detained 100-year flow rate of 3.3 cubic feet per second (cfs) that flows south along Buena Vista Drive was entered as user-input data in the existing and proposed condition models.

- Hydrologic soil groups: The hydrologic soil groups were determined from the National Resources Conservation Service's "Web Soil Survey." The site contains soil groups C and D, which are delineated on the work maps.

- Runoff coefficients: On-site runoff coefficients were established for each drainage subarea based on the estimated impervious percentage, land use, and the underlying soil group. The existing condition land uses primarily include undisturbed natural terrain for the agricultural areas. In addition, the on-site residential development was modeled with a low-density residential (2 DU/Ac) land use and the off-site multi-family development was modeled with a high-density residential (24 DU/Ac) land use. These categories are from Table 3-1 of the County *Hydrology Manual.*

  For proposed conditions, the administration/office building was modeled with a high-density residential (24 DU/Ac) land use, streets were modeled with an industrial (general industrial) land use, and the grave sites and undeveloped areas were modeled as undisturbed natural terrain.

  For off-site Buena Vista Drive, the proposed street was assumed to be 95 percent impervious and existing street to be 90 percent impervious.

- Flow lengths and elevations: The flow lengths and elevations were digitized and obtained from the topographic mapping and grading plan.

The 100-year existing and proposed condition rational method results are in Appendix A. The analyses were performed using CivilDesign's San Diego County Rational Hydrology Program. Separate analyses were performed for existing and proposed conditions of the on-site area and for Buena Vista Drive. The overall existing condition drainage area was set equal to the overall proposed condition drainage area to allow a comparison of the existing and proposed condition results. Table 1 summarizes the 100-year results. Table 1 shows that the project will increase the 100-year runoff from the on-site area by 1.6 cfs.

Study Area	Conditions	C	I, in/hr	A, ac	V_{100}, cfs	Q_{100}, cfs
On-site	Existing	0.40	5.19	21.45	5.6	44.5
On-site	Proposed	0.42	5.24	20.86	8.5	46.1
Buena Vista Drive	Existing	0.59	2.98	6.08	4.3	10.7
Buena Vista Drive	Proposed	0.58	2.98	6.67	10.1	11.5

Note: The proposed condition Q_{100} will be mitigated to the existing condition Q_{100}, as needed.

Table 1. Rational Method Results

The small on-site and Buena Vista Drive flow increases from Table 1 can be mitigated by the two proposed biofiltration basins, if needed. A preliminary detention analysis was performed to estimate the storage volume needed to attenuate the on-site 100-year flow entering the northwest biofiltration basin (proposed condition rational method node 14) from 9.7 to 8.1 cfs. Another preliminary detention analysis was performed to estimate the storage volume needed to attenuate the Buena Vista Drive 100-year flow entering northeast biofiltration basin (proposed condition rational method node 64) from 9.5 to 8.7 cfs. The proposed condition peak flows into each biofiltration basin were converted to a hydrograph using the County's rational method hydrograph procedure. The hydrographs were entered into separate HEC-1 models for the detention analyses. For the entitlement-level conceptual analyses, stage-storage and stage-discharge data is not needed. HEC-1 determines the required volume based on unit storage (i.e., storage depth of 1-foot) and the target outflow. The HEC-1 results are included in Appendix A and show that at least 0.045 acre-feet (1,960 cubic feet) of storage is needed in the northwest basin and 0.044 acre-feet (1,917 cubic feet) is needed in the northeast basin. Since the basins are proposed for conjunctive use, they are required to meet Section 6.2.7 of the *Hydraulic Design Manual*. The flood storage volume shall be provided in addition to the storage volume designated for water quality treatment. The basin will also have to provide a minimum 1-foot of freeboard to meet the requirements for a detention basin. More detailed analyses with stage-storage and stage-discharge data will be performed for final engineering. On the other hand, the flow increases are so small that the final engineering analyses may reveal that the incidental storage provides sufficient flow attenuation.

CONCLUSION

Hydrologic analyses have been performed for the Good Shepherd Catholic Cemetery project being designed by Hofman Planning + Engineering. The analyses have been used to determine the preliminary existing and proposed condition 100-year flow rates. The project will primarily create pervious grave sites, so there is a minor increase in runoff. This can be mitigated by the proposed biofiltration basins, if needed, either through storage attenuation or a lengthened time of concentration.

The existing drainage patterns within the project footprint will be altered, which is typical for development projects. Storm runoff will be conveyed in the proposed streets, drainage facilities, biofiltration basins, and grave sites. The streets and drainage facilities are being designed to convey the 100-eyar flow. Riprap will be installed at the outlets of the proposed storm drain systems in accordance with County standards to prevent erosion. The project will not increase (flow control as well as 100-year detention in a biofiltration basin, as needed, will be provided) or impact the off-site flows. Under existing and proposed conditions, the site runoff is captured by an on-site unnamed natural drainage course that continues off-site. The unnamed natural drainage course will be directed around the proposed biofiltration basin. However, the location where the unnamed natural drainage course leaves the site and the 100-year flow rate in the unnamed natural drainage course at this location will not be altered by the project, so there will be no off-site flooding nor erosion/siltation impacts. The on-site drainage facilities will be designed to adequately convey the design storm, so there will be no on-site flooding.

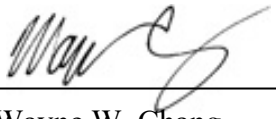
In addition, the site will not substantially alter the existing drainage patterns of the site or area. The majority of the runoff will remain as sheet flow over the naturally sloping terrain. The flow patterns of the minor on-site drainage courses are generally maintained. This in conjunction with the riprap at storm drain outlets will prevent substantial erosion or siltation on- and off-site.

Since the project will not increase the off-site 100-year flow rate, the project will not create nor contribute runoff that will impact the current capacity of existing nor proposed capacity of planned storm water drainage systems. The project will not place structures in a 100-year flood hazard area because there are no proposed structures and there are no such hazard areas mapped at the site by FEMA or the County. There are no dams nor levees that affect the site.

DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the civil 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 design.

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



November 16, 2021

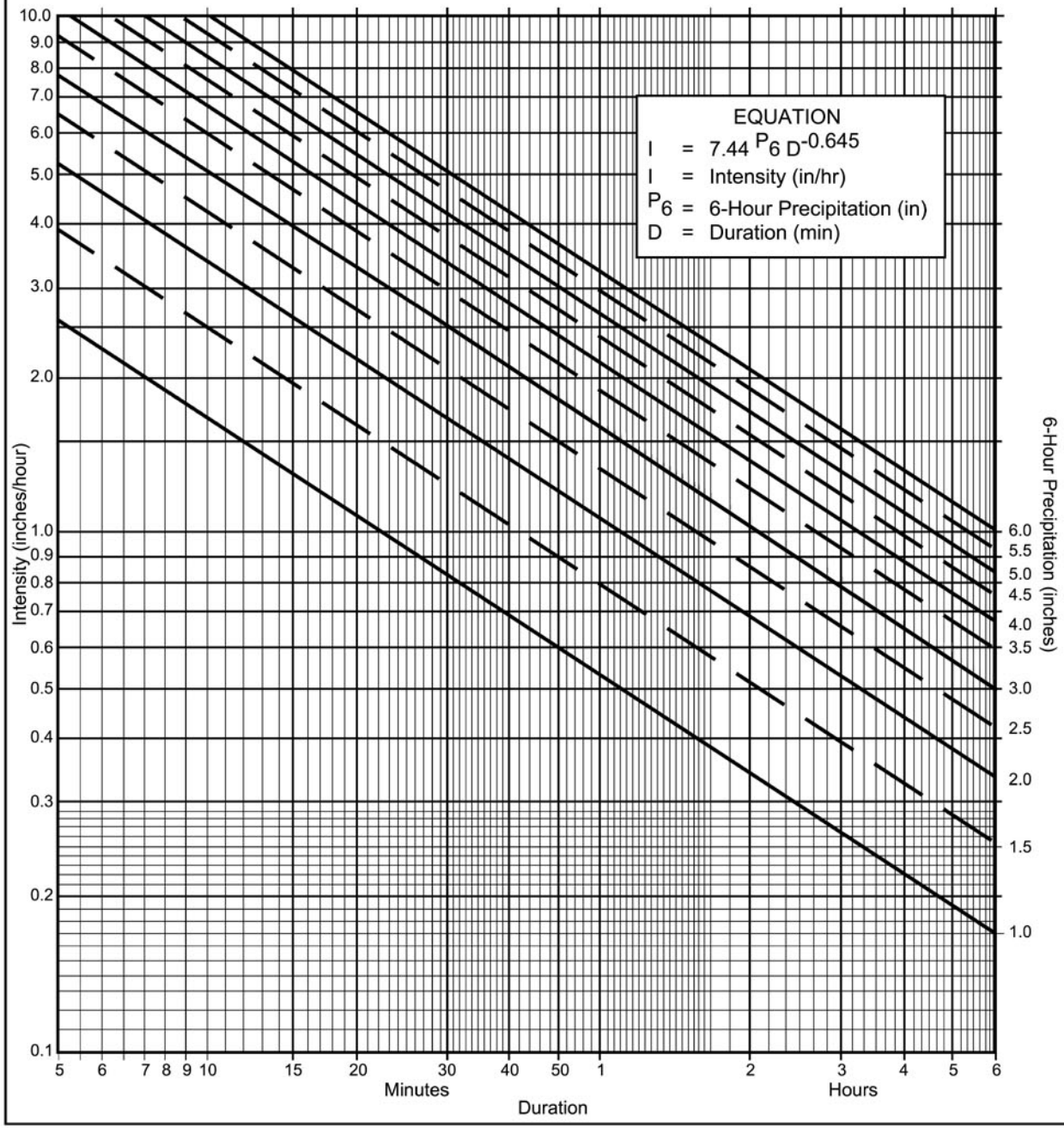
Wayne W. Chang
RCE 46548
Exp. June 30, 2023

Date

APPENDIX A

100-YEAR RATIONAL METHOD DATA AND RESULTS

100-YEAR DETENTION ANALYSIS



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100- year

(b) P_6 = 3.0 in., P_{24} = 6.5, $\frac{P_6}{P_{24}}$ = 46 %(2)

(c) Adjusted P_6(2) = 3.0 in.

(d) t_x = _____ min.

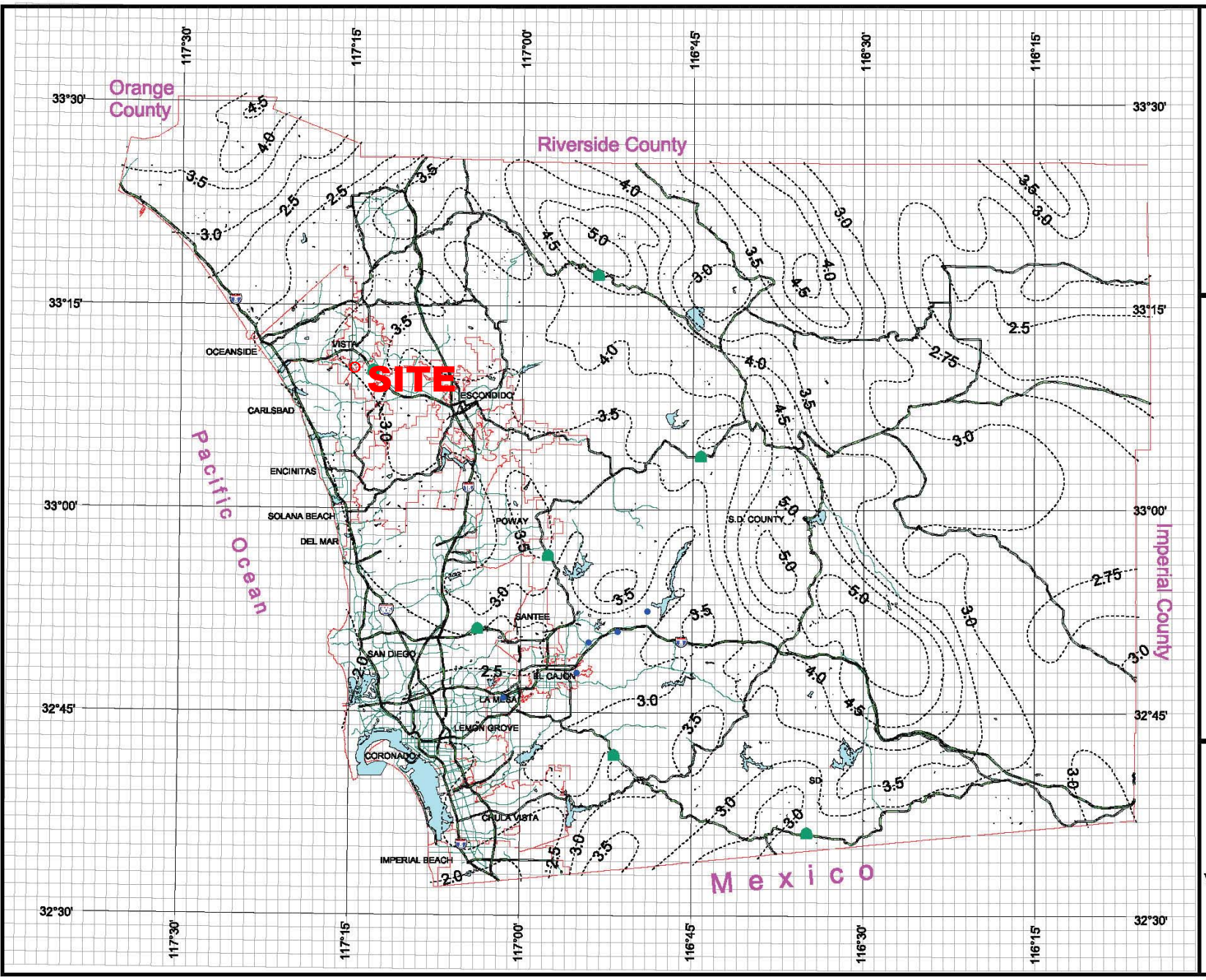
(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P6 = 3.0"

DPW GIS
Department of Public Works
Geographic Information Services

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N
W E
S

3 0 3 Miles

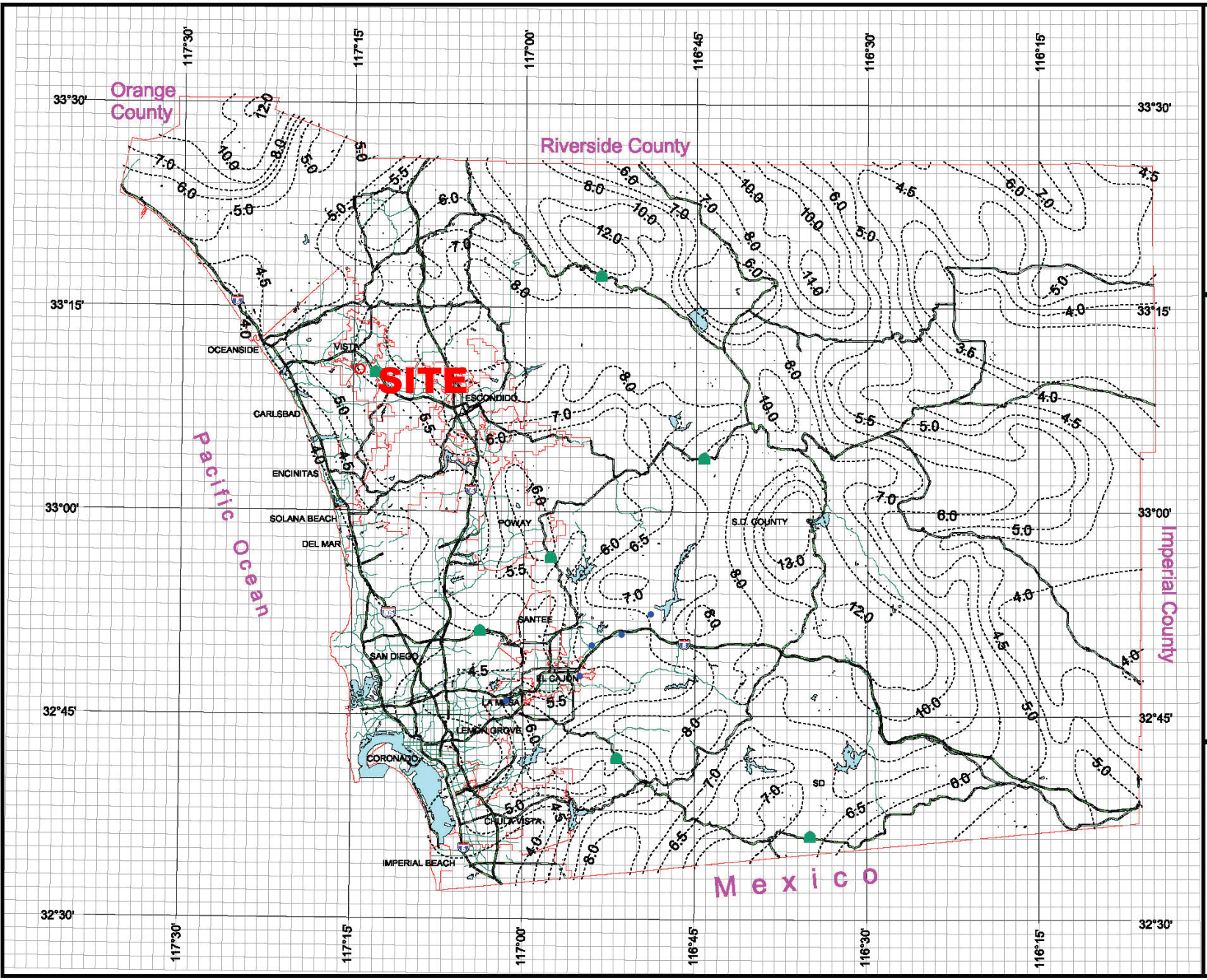
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

P24 = 6.5"



DPW GIS — Department of Public Works, Geographic Information Services

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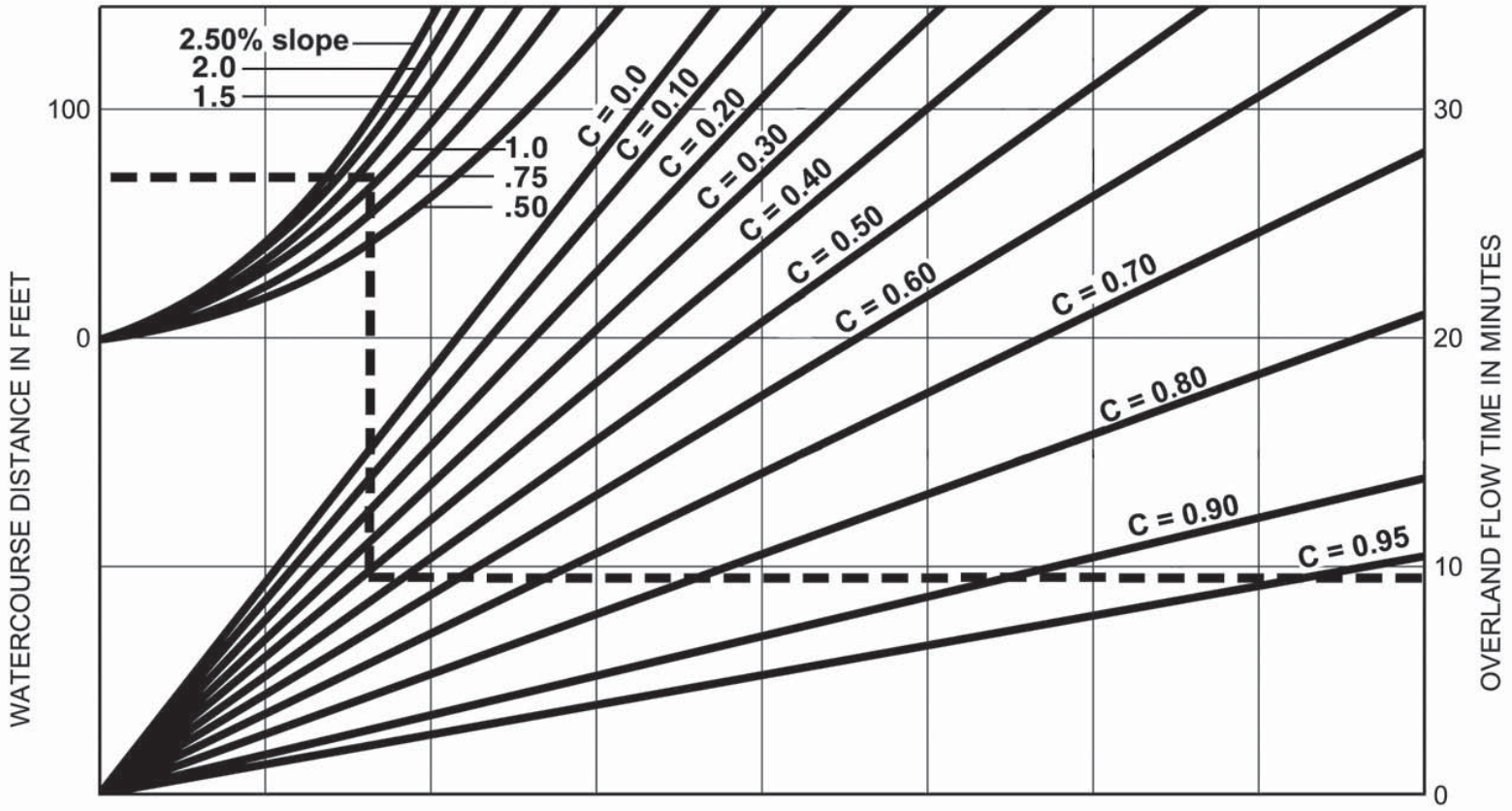
N W E S

3 0 3 Miles

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

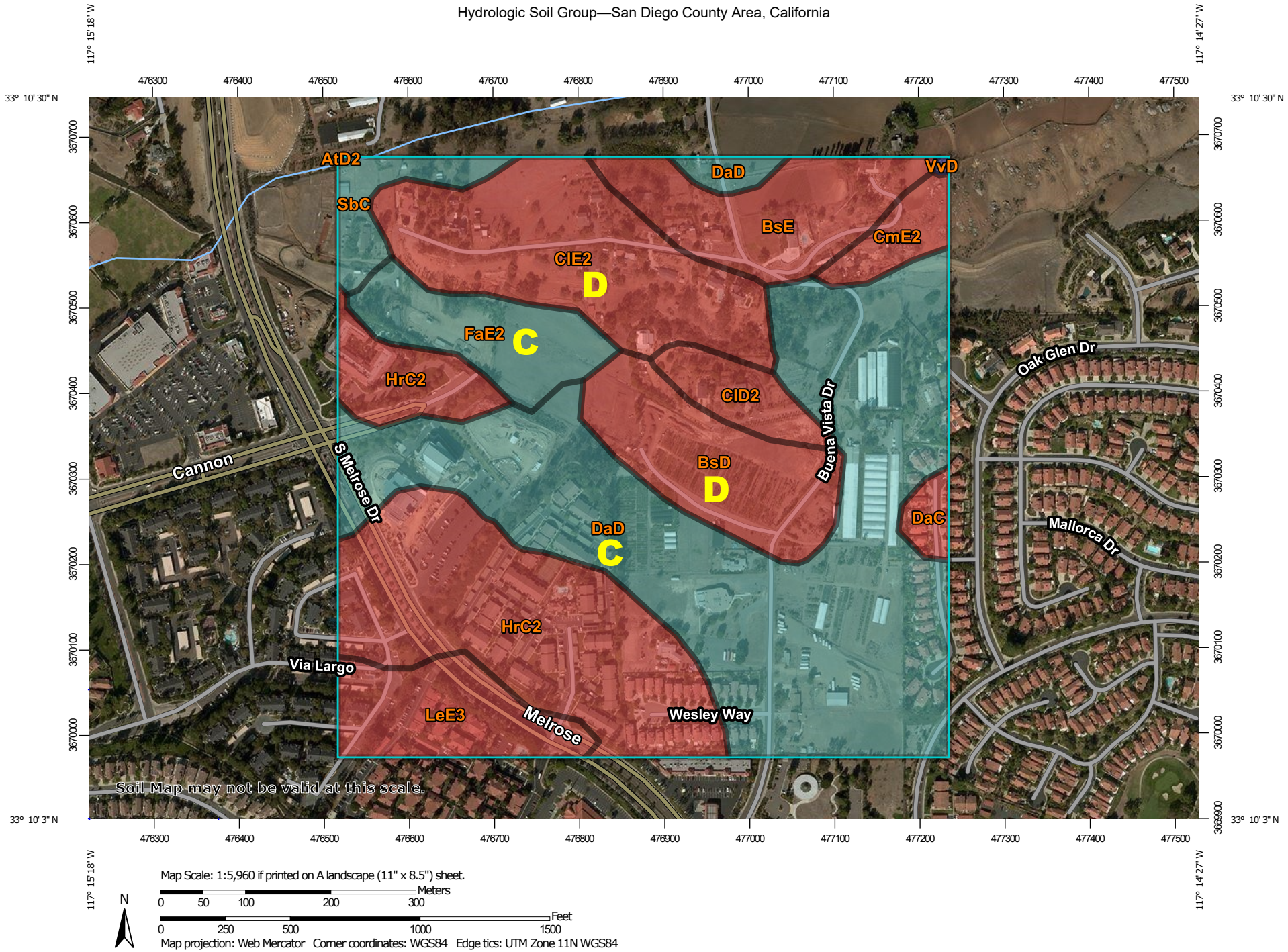
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



Map Scale: 1:5,960 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

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: San Diego County Area, California
Survey Area Data: Version 13, Sep 12, 2018

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

Date(s) aerial images were photographed: Nov 3, 2014—Nov 22, 2014

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
AtD2	Altamont clay, 9 to 15 percent slopes, eroded	D	0.0	0.0%
BsD	Bosanko clay, 9 to 15 percent slopes	D	9.5	7.6%
BsE	Bosanko clay, 15 to 30 percent slopes	D	8.7	6.9%
ClD2	Cieneba coarse sandy loam, 5 to 15 percent slopes, eroded	D	3.1	2.5%
ClE2	Cieneba coarse sandy loam, 15 to 30 percent slopes, eroded	D	15.7	12.5%
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded	D	2.4	2.0%
DaC	Diablo clay, 2 to 9 percent slopes	D	1.1	0.9%
DaD	Diablo clay, 9 to 15 percent slopes, warm MAAT, MLRA 20	C	44.9	35.9%
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded	C	6.4	5.1%
HrC2	Huerhuero loam, 5 to 9 percent slopes, eroded	D	23.6	18.9%
LeE3	Las Flores loamy fine sand, 9 to 30 percent slopes, severely eroded	D	6.7	5.4%
SbC	Salinas clay loam, 2 to 9 percent slopes	C	2.9	2.3%
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes	B	0.1	0.1%
Totals for Area of Interest			**125.2**	**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

Excerpts from PLSA Report
(see map pocket for drainage exhibit)

HYDROLOGY STUDY

FOR

MLC Buena Vista Final Engineering

CITY OF VISTA, CA

PREPARED FOR:

Meritage Homes of California, Inc
5 Peters Canyon Road, Suite 310
Irvine, CA 92606
(949) 372-3305

PREPARED BY:

PASCO LARET SUITER & ASSOCIATES, INC.
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(858) 259-8212

Prepared: May 2017
Revised: September 2017
Revised: October 2017
Revised: August 2018
Revised: October 2018
Revised: December 2018

William J. Suiter, RCE 68964 — DATE 12/5/18

PLSA 2531

In the proposed condition, onsite storm water runoff will be collected in proposed storm drain and conveyed to the proposed HMP Biofiltration basins (BMPs). The southeastern corner of the site will drain easterly to BMP-1. BMP-1 will discharge to a proposed wet well pump facility which will pump flow to a proposed tank which is designed with an outlet structure that provides hydromodification flow control. Flow will discharge from the tank via proposed storm drain and curb outlet to Buena Vista Drive and continue southerly. The southwestern corner of the site will drain northerly to BMP-2. BMP-2 will discharge via proposed storm drain to Buena Vista Drive and flow northerly along Buena Vista Drive. The remainder of the site will drain northerly and easterly to BMP-3. Flow from BMP-3 will discharge to a proposed wet well pump facility which will pump flow to a proposed tank which is designed with an outlet structure that provides hydromodification flow control. Flow will discharge from the tank via proposed storm drain and curb outlet to Buena Vista Drive and continue northerly. BMP-1 and BMP-3 are also designed with spillways which in the event of an emergency will direct overflow to Buena Vista Drive. Refer to Appendix B for the 100-year storm event detention analysis and Appendix C for the pump details.

The BMPs will provide hydromodification management flow control and storm water pollutant control to meet the requirements the California Regional Water Quality Control Board San Diego Region municipal storm water permit (Order No. R9-2013-0001, referred to as MS4 Permit). For detailed pollutant control and HMP calculations refer to the report titled “Priority Development Project Storm Water Quality Management Plan for MLC Buena Vista Final Engineering” dated October 2018, prepared by Pasco Laret Suiter & Associates. The BMPs will also provide mitigation for the 100-year storm event peak discharge. Refer to Section 3.3, 3.4 and Appendix B of this report for detailed detention calculations.

Area weighted runoff coefficients were calculated using the methodology described in section 3.2.1 of the San Diego County Hydrology Manual and Table 3-1 Runoff Coefficients for Urban Areas. Using the Rational Method Procedure outlined in the San Diego County Hydrology Manual, a peak flow rate was calculated for the post-development 100-year, 6-hour storm event. For the proposed undetained condition, the north and south peak flow rates for the 100-year, 6-hour storm were determined to be 14.22 cfs and 2.62 cfs, respectively. For the proposed detained condition, the north and south peak flow rates for the 100-year, 6-hour storm were determined to be 3.3 cfs and 1.2 cfs, respectively. Refer to the proposed undetained and detained hydrologic calculations included in Section 3.2 and 3.4 of this report for detailed analysis.

1.4 Conclusions

Based upon the analyses included in this report, the proposed HMP Biofiltration basins, wet well pump facilities, and tanks are sized to accommodate the increase in peak runoff in the proposed condition and are designed to meet the requirements of the MS4 Permit for both pollutant control and hydromodification management.

create the proposed detained condition model. Refer to Section 3.4 for the detained AES output.

Based on the results of the HydroCAD analysis, mitigation for the 100-year storm event peak flow rate is provided, detaining the north and south peak flow rates in the proposed condition to 3.3 cfs and 1.2 cfs, respectively which are below the existing condition Q_{100} of 7.97 cfs and 5.02 cfs, respectively. Refer to Appendix B for the HydroCAD detention detailed output.

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2009 Version 7.8

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 11/16/21

Church of the Good Shepherd
Catholic Cemetery
Existing Conditions
100-Year Flow Rate

********* Hydrology Study Control Information **********

Program License Serial Number 4028

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.000
24 hour precipitation(inches) = 6.500
P6/P24 = 46.2%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 10.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.980
Decimal fraction soil group D = 0.020
[LOW DENSITY RESIDENTIAL]
(2.0 DU/A or Less)
Impervious value, Ai = 0.200
Sub-Area C Value = 0.421
Initial subarea total flow distance = 243.000(Ft.)
Highest elevation = 461.000(Ft.)
Lowest elevation = 456.000(Ft.)
Elevation difference = 5.000(Ft.) Slope = 2.058 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of 2.06 %, in a development type of
2.0 DU/A or Less
In Accordance With Figure 3-3

```
Initial Area Time of Concentration =   8.86 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4208)*(  85.000^.5)/(   2.058^(1/3)]=   8.86
The initial area total distance of  243.00 (Ft.) entered leaves a
remaining distance of  158.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.72 minutes
for a distance of 158.00 (Ft.) and a slope of  2.06 %
with an elevation difference of   3.25(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.717 Minutes
Tt=[(11.9*0.0299^3)/(  3.25)]^.385=  1.72
Total initial area Ti =   8.86 minutes from Figure 3-3 formula plus
  1.72 minutes from the Figure 3-4 formula =  10.58 minutes
Rainfall intensity (I) =      4.875(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.421
Subarea runoff =      0.862(CFS)
Total initial stream area =        0.420(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   454.000(Ft.)
Downstream point elevation =   371.900(Ft.)
Channel length thru subarea  =  1113.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =      6.330(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      6.330(CFS)
Depth of flow =   0.339(Ft.), Average velocity =   3.970(Ft/s)
Channel flow top width =    6.395(Ft.)
Flow Velocity =    3.97(Ft/s)
Travel time  =    4.67 min.
Time of concentration =   15.25 min.
Critical depth =      0.410(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      3.850(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.450
Decimal fraction soil group D = 0.550
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.328
Rainfall intensity =      3.850(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.332  CA =      3.046
```

```
Subarea runoff =     10.864(CFS) for      8.760(Ac.)
Total runoff =     11.725(CFS)   Total area =       9.180(Ac.)
Depth of flow =   0.466(Ft.), Average velocity =   4.723(Ft/s)
Critical depth =      0.570(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      9.180(Ac.)
Runoff from this stream =     11.725(CFS)
Time of concentration =   15.25 min.
Rainfall intensity =     3.850(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       22.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.600
Decimal fraction soil group D = 0.400
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.698
Initial subarea total flow distance  =  615.000(Ft.)
Highest elevation =  482.100(Ft.)
Lowest elevation =  449.500(Ft.)
Elevation difference =   32.600(Ft.) Slope =  5.301 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 95.00 (Ft)
for the top area slope value of   5.30 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.04 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6980)*(  95.000^.5)/(   5.301^(1/3)]=   4.04
The initial area total distance of  615.00 (Ft.) entered leaves a
remaining distance of  520.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.99 minutes
for a distance of 520.00 (Ft.) and a slope of  5.30 %
with an elevation difference of  27.57(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.986 Minutes
Tt=[(11.9*0.0985^3)/( 27.57)]^.385=  2.99
Total initial area Ti =   4.04 minutes from Figure 3-3 formula plus
```

```
  2.99 minutes from the Figure 3-4 formula =   7.03 minutes
Rainfall intensity (I) =      6.344(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.698
Subarea runoff =     18.333(CFS)
Total initial stream area =        4.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       24.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   449.500(Ft.)
Downstream point/station elevation =   394.000(Ft.)
Pipe length  =   270.00(Ft.) Slope =   0.2056  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    18.333(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    18.333(CFS)
Normal flow depth in pipe =    8.60(In.)
Flow top width inside pipe =   14.84(In.)
Critical depth could not be calculated.
Pipe flow velocity =     25.19(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     7.21 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   394.000(Ft.)
Downstream point elevation =   371.900(Ft.)
Channel length thru subarea  =   358.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.040
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     18.333(CFS)
Depth of flow =   0.666(Ft.), Average velocity =   5.511(Ft/s)
Channel flow top width =    6.994(Ft.)
Flow Velocity =    5.51(Ft/s)
Travel time  =    1.08 min.
Time of concentration =    8.29 min.
Critical depth =      0.805(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
```

```
Stream flow area =      4.140(Ac.)
Runoff from this stream =     18.333(CFS)
Time of concentration =    8.29 min.
Rainfall intensity =     5.704(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                  (In/Hr)


1       11.725     15.25            3.850
2       18.333      8.29            5.704
Qmax(1) =
        1.000 *    1.000 *    11.725) +
        0.675 *    1.000 *    18.333) + =      24.100
Qmax(2) =
        1.000 *    0.544 *    11.725) +
        1.000 *    1.000 *    18.333) + =      24.708

Total of 2 main streams to confluence:
Flow rates before confluence point:
      11.725      18.333
Maximum flow rates at confluence using above data:
       24.100       24.708
Area of streams before confluence:
        9.180        4.140


Results of confluence:
Total flow rate =     24.708(CFS)
Time of concentration =     8.292 min.
Effective stream area after confluence  =     13.320(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   371.900(Ft.)
Downstream point elevation =   358.200(Ft.)
Channel length thru subarea  =   411.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     34.571(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     34.571(CFS)
Depth of flow =   1.066(Ft.), Average velocity =   5.235(Ft/s)
Channel flow top width =    9.394(Ft.)
Flow Velocity =    5.23(Ft/s)
Travel time  =    1.31 min.
```

```
Time of concentration =    9.60 min.
Critical depth =      1.125(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.189(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.500
Decimal fraction soil group D = 0.500
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.325
Rainfall intensity =      5.189(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.400  CA =      8.578
Subarea runoff =     19.805(CFS) for      8.130(Ac.)
Total runoff =     44.513(CFS)   Total area =      21.450(Ac.)
Depth of flow =   1.203(Ft.), Average velocity =   5.597(Ft/s)
Critical depth =      1.273(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       60.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
________________________________________________________________________
User specified 'C' value of 0.658 given for subarea
Rainfall intensity (I) =      3.265(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  19.69 min.  Rain intensity =       3.27(In/Hr)
Total area =        4.100(Ac.)  Total runoff =     3.300(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       62.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   458.700(Ft.)
End of street segment elevation =   431.900(Ft.)
Length of street segment  =   547.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.500(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0180
 Manning's N from grade break to crown =  0.0180
```

```
Estimated mean flow rate at midpoint of street =      6.283(CFS)
Depth of flow =   0.325(Ft.), Average velocity =   4.501(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.509(Ft.)
Flow velocity =   4.50(Ft/s)
Travel time =    2.03 min.     TC =   21.72  min.
 Adding area flow to street
Rainfall intensity (I) =      3.065(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.300
Decimal fraction soil group D = 0.700
[INDUSTRIAL area type                         ]
(Limited Industrial       )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.847
Rainfall intensity =      3.065(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.676  CA =      3.054
Subarea runoff =      6.060(CFS) for      0.420(Ac.)
Total runoff =      9.360(CFS)   Total area =       4.520(Ac.)
Street flow at end of street =      9.360(CFS)
Half street flow at end of street =      9.360(CFS)
Depth of flow =   0.365(Ft.), Average velocity =   4.946(Ft/s)
Flow width (from curb towards crown)=  13.495(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       62.000 to Point/Station       64.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   431.900(Ft.)
Downstream point elevation =   417.200(Ft.)
Channel length thru subarea  =   237.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =     10.074(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     10.074(CFS)
Depth of flow =   0.451(Ft.), Average velocity =   4.254(Ft/s)
Channel flow top width =    7.508(Ft.)
Flow Velocity =    4.25(Ft/s)
Travel time  =    0.93 min.
Time of concentration =   22.64 min.
Critical depth =      0.527(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      2.984(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.050
```

```
Decimal fraction soil group D = 0.950
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.347
Rainfall intensity =      2.984(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.591  CA =      3.596
Subarea runoff =      1.368(CFS) for      1.560(Ac.)
Total runoff =     10.728(CFS)   Total area =       6.080(Ac.)
Depth of flow =   0.465(Ft.), Average velocity =   4.329(Ft/s)
Critical depth =      0.547(Ft.)
End of computations, total study area =          27.530 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2009 Version 7.8

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 11/16/21

Church of the Good Shepherd
Catholic Cemetery
Proposed Conditions
100-Year Flow Rate

********* Hydrology Study Control Information **********

Program License Serial Number 4028

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.000
24 hour precipitation(inches) = 6.500
P6/P24 = 46.2%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 1.000 to Point/Station 5.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL]
(24.0 DU/A or Less)
Impervious value, Ai = 0.650
Sub-Area C Value = 0.690
Initial subarea total flow distance = 311.000(Ft.)
Highest elevation = 460.600(Ft.)
Lowest elevation = 457.200(Ft.)
Elevation difference = 3.400(Ft.) Slope = 1.093 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of 1.09 %, in a development type of
24.0 DU/A or Less
In Accordance With Figure 3-3

```
Initial Area Time of Concentration =   5.78 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6900)*(  65.000^.5)/(   1.093^(1/3)]=   5.78
The initial area total distance of  311.00 (Ft.) entered leaves a
remaining distance of  246.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   3.08 minutes
for a distance of 246.00 (Ft.) and a slope of  1.09 %
with an elevation difference of   2.69(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    3.081 Minutes
Tt=[(11.9*0.0466^3)/(  2.69)]^.385=  3.08
Total initial area Ti =   5.78 minutes from Figure 3-3 formula plus
  3.08 minutes from the Figure 3-4 formula =   8.86 minutes
Rainfall intensity (I) =      5.466(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.690
Subarea runoff =      2.338(CFS)
Total initial stream area =        0.620(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       10.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   453.000(Ft.)
Downstream point/station elevation =   451.700(Ft.)
Pipe length  =    88.00(Ft.) Slope =   0.0148  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.338(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.338(CFS)
Normal flow depth in pipe =    6.28(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    7.85(In.)
Pipe flow velocity =      5.62(Ft/s)
Travel time through pipe =    0.26 min.
Time of concentration (TC) =     9.12 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       12.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   451.700(Ft.)
End of street segment elevation =   373.000(Ft.)
Length of street segment  =  1011.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  12.000(Ft.)
Distance from crown to crossfall grade break  =   5.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   0.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
```

```
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.500(In.)
 Manning's N in gutter =  0.0130
 Manning's N from gutter to grade break =  0.0180
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      5.913(CFS)
Depth of flow =   0.298(Ft.), Average velocity =   5.365(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  10.153(Ft.)
Flow velocity =   5.36(Ft/s)
Travel time =    3.14 min.     TC =   12.26  min.
 Adding area flow to street
Rainfall intensity (I) =      4.432(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.380
Decimal fraction soil group D = 0.620
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Rainfall intensity =      4.432(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.827  CA =      2.124
Subarea runoff =      7.077(CFS) for      1.950(Ac.)
Total runoff =      9.416(CFS)   Total area =       2.570(Ac.)
Street flow at end of street =      9.416(CFS)
Half street flow at end of street =      9.416(CFS)
Depth of flow =   0.339(Ft.), Average velocity =   6.025(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  12.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
_____________________________________________________________________________
Upstream point/station elevation =   368.000(Ft.)
Downstream point/station elevation =   363.300(Ft.)
Pipe length  =    53.00(Ft.) Slope =   0.0887  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.416(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     9.416(CFS)
Normal flow depth in pipe =    8.80(In.)
Flow top width inside pipe =   10.61(In.)
Critical depth could not be calculated.
Pipe flow velocity =     15.26(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    12.32 min.


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Process from Point/Station       14.000 to Point/Station       14.000
**** SUBAREA FLOW ADDITION ****
____________________________________________________________________________
Rainfall intensity (I) =      4.419(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Time of concentration =    12.32 min.
Rainfall intensity =      4.419(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.782  CA =      2.196
Subarea runoff =      0.290(CFS) for      0.240(Ac.)
Total runoff =      9.705(CFS)   Total area =       2.810(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
____________________________________________________________________________
Upstream point/station elevation =   362.000(Ft.)
Downstream point/station elevation =   361.000(Ft.)
Pipe length  =    58.00(Ft.) Slope =   0.0172  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.705(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     9.705(CFS)
Normal flow depth in pipe =   11.13(In.)
Flow top width inside pipe =   17.49(In.)
Critical Depth =   14.43(In.)
Pipe flow velocity =      8.45(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =    12.43 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
____________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      2.810(Ac.)
Runoff from this stream =      9.705(CFS)
Time of concentration =   12.43 min.
Rainfall intensity =     4.393(In/Hr)
Program is now starting with Main Stream No. 2


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```
Process from Point/Station       20.000 to Point/Station       22.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.560
Decimal fraction soil group D = 0.440
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.322
Initial subarea total flow distance  =  257.000(Ft.)
Highest elevation =  454.200(Ft.)
Lowest elevation =  441.200(Ft.)
Elevation difference =   13.000(Ft.) Slope =  5.058 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   5.06 %, in a development type of
 Permanent Open Space
In Accordance With Table 3-2
Initial Area Time of Concentration =   8.70 minutes
 (for slope value of   5.00 %)
The initial area total distance of  257.00 (Ft.) entered leaves a
remaining distance of  157.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.21 minutes
for a distance of 157.00 (Ft.) and a slope of  5.06 %
with an elevation difference of   7.94(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.209 Minutes
Tt=[(11.9*0.0297^3)/(  7.94)]^.385=  1.21
Total initial area Ti =   8.70 minutes from Table 3-2 plus
  1.21 minutes from the Figure 3-4 formula =   9.91 minutes
Rainfall intensity (I) =      5.085(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.322
Subarea runoff =      0.917(CFS)
Total initial stream area =        0.560(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       24.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   441.200(Ft.)
Downstream point/station elevation =   440.200(Ft.)
Pipe length  =    30.00(Ft.) Slope =   0.0333  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.917(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.917(CFS)
Normal flow depth in pipe =    4.43(In.)
Flow top width inside pipe =    5.27(In.)
Critical Depth =    5.55(In.)
Pipe flow velocity =      5.90(Ft/s)
```

```
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     9.99 min.


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Process from Point/Station       24.000 to Point/Station       26.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   440.200(Ft.)
Downstream point elevation =   428.500(Ft.)
Channel length thru subarea  =   156.000(Ft.)
Channel base width    =    1.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      1.324(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =      1.324(CFS)
Depth of flow =   0.263(Ft.), Average velocity =   3.297(Ft/s)
Channel flow top width =    2.053(Ft.)
Flow Velocity =    3.30(Ft/s)
Travel time  =    0.79 min.
Time of concentration =   10.78 min.
Critical depth =      0.307(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.815(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.650
Decimal fraction soil group D = 0.350
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.318
Rainfall intensity =      4.815(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.320  CA =      0.349
Subarea runoff =      0.762(CFS) for      0.530(Ac.)
Total runoff =      1.678(CFS)   Total area =       1.090(Ac.)
Depth of flow =   0.298(Ft.), Average velocity =   3.526(Ft/s)
Critical depth =      0.352(Ft.)


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Process from Point/Station       26.000 to Point/Station       28.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   428.500(Ft.)
Downstream point/station elevation =   420.500(Ft.)
Pipe length  =    72.00(Ft.) Slope =   0.1111  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.678(CFS)
Nearest computed pipe diameter  =      6.00(In.)
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```
Calculated individual pipe flow  =     1.678(CFS)
Normal flow depth in pipe =    4.44(In.)
Flow top width inside pipe =    5.26(In.)
Critical depth could not be calculated.
Pipe flow velocity =     10.78(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =    10.89 min.


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Process from Point/Station       28.000 to Point/Station       30.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   420.500(Ft.)
Downstream point elevation =   408.500(Ft.)
Channel length thru subarea  =   162.000(Ft.)
Channel base width    =    5.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =      2.949(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      2.949(CFS)
Depth of flow =   0.175(Ft.), Average velocity =   2.872(Ft/s)
Channel flow top width =    6.748(Ft.)
Flow Velocity =    2.87(Ft/s)
Travel time  =    0.94 min.
Time of concentration =   11.83 min.
Critical depth =      0.205(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.535(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      4.535(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.338  CA =      0.926
Subarea runoff =      2.521(CFS) for      1.650(Ac.)
Total runoff =      4.199(CFS)   Total area =       2.740(Ac.)
Depth of flow =   0.214(Ft.), Average velocity =   3.233(Ft/s)
Critical depth =      0.256(Ft.)


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Process from Point/Station       30.000 to Point/Station       32.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
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Upstream point/station elevation =   408.500(Ft.)
Downstream point/station elevation =   405.800(Ft.)
Pipe length  =    48.00(Ft.) Slope =   0.0562  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.199(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     4.199(CFS)
Normal flow depth in pipe =    5.98(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =   10.37(In.)
Pipe flow velocity =     10.74(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =    11.91 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station       34.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   405.800(Ft.)
Downstream point elevation =   372.000(Ft.)
Channel length thru subarea  =   405.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =      5.256(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      5.256(CFS)
Depth of flow =   0.255(Ft.), Average velocity =   4.811(Ft/s)
Channel flow top width =    5.554(Ft.)
Flow Velocity =    4.81(Ft/s)
Travel time  =    1.40 min.
Time of concentration =   13.31 min.
Critical depth =      0.371(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      4.203(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.050
Decimal fraction soil group D = 0.950
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.347
Rainfall intensity =      4.203(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.342  CA =      1.489
Subarea runoff =      2.059(CFS) for      1.620(Ac.)
Total runoff =      6.259(CFS)   Total area =       4.360(Ac.)
Depth of flow =   0.281(Ft.), Average velocity =   5.067(Ft/s)
Critical depth =      0.406(Ft.)
```

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Process from Point/Station       32.000 to Point/Station       34.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      4.360(Ac.)
Runoff from this stream =      6.259(CFS)
Time of concentration =   13.31 min.
Rainfall intensity =     4.203(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       40.000 to Point/Station       42.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.600
Decimal fraction soil group D = 0.400
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.698
Initial subarea total flow distance  =  615.000(Ft.)
Highest elevation =  482.100(Ft.)
Lowest elevation =  449.500(Ft.)
Elevation difference =   32.600(Ft.) Slope =  5.301 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 95.00 (Ft)
for the top area slope value of   5.30 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.04 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6980)*(  95.000^.5)/(   5.301^(1/3)]=   4.04
The initial area total distance of  615.00 (Ft.) entered leaves a
remaining distance of  520.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.99 minutes
for a distance of 520.00 (Ft.) and a slope of  5.30 %
with an elevation difference of  27.57(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.986 Minutes
Tt=[(11.9*0.0985^3)/( 27.57)]^.385=  2.99
Total initial area Ti =   4.04 minutes from Figure 3-3 formula plus
  2.99 minutes from the Figure 3-4 formula =   7.03 minutes
Rainfall intensity (I) =      6.344(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.698
Subarea runoff =     18.333(CFS)
Total initial stream area =        4.140(Ac.)
```

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Process from Point/Station       42.000 to Point/Station       44.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   449.500(Ft.)
Downstream point/station elevation =   394.000(Ft.)
Pipe length  =   270.00(Ft.) Slope =   0.2056  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    18.333(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    18.333(CFS)
Normal flow depth in pipe =    8.60(In.)
Flow top width inside pipe =   14.84(In.)
Critical depth could not be calculated.
Pipe flow velocity =     25.19(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     7.21 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       44.000 to Point/Station       46.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   394.000(Ft.)
Downstream point elevation =   379.000(Ft.)
Channel length thru subarea  =   182.000(Ft.)
Channel base width    =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     20.583(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    3.000(Ft.)
Flow(q) thru subarea =     20.583(CFS)
Depth of flow =   0.749(Ft.), Average velocity =   6.468(Ft/s)
Channel flow top width =    6.495(Ft.)
Flow Velocity =    6.47(Ft/s)
Travel time  =    0.47 min.
Time of concentration =    7.68 min.
Critical depth =      0.961(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.994(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.200
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.310
Rainfall intensity =      5.994(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.537  CA =      3.798
Subarea runoff =      4.431(CFS) for      2.930(Ac.)
```

```
Total runoff =     22.765(CFS)   Total area =       7.070(Ac.)
Depth of flow =   0.786(Ft.), Average velocity =   6.642(Ft/s)
Critical depth =      1.008(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       46.000 to Point/Station       48.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
____________________________________________________________________________
Upstream point/station elevation =   379.000(Ft.)
Downstream point/station elevation =   375.400(Ft.)
Pipe length  =   105.00(Ft.) Slope =   0.0343  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    22.765(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    22.765(CFS)
Normal flow depth in pipe =   13.90(In.)
Flow top width inside pipe =   19.87(In.)
Critical Depth =   19.80(In.)
Pipe flow velocity =     13.48(Ft/s)
Travel time through pipe =    0.13 min.
Time of concentration (TC) =     7.81 min.


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Process from Point/Station       48.000 to Point/Station       34.000
**** IMPROVED CHANNEL TRAVEL TIME ****
____________________________________________________________________________
Upstream point elevation =   375.400(Ft.)
Downstream point elevation =   372.000(Ft.)
Channel length thru subarea  =    70.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     22.765(CFS)
Depth of flow =   0.605(Ft.), Average velocity =   4.154(Ft/s)
Channel flow top width =   15.107(Ft.)
Flow Velocity =    4.15(Ft/s)
Travel time  =    0.28 min.
Time of concentration =    8.09 min.
Critical depth =      0.664(Ft.)


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Process from Point/Station       48.000 to Point/Station       34.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      7.070(Ac.)
Runoff from this stream =     22.765(CFS)
Time of concentration =    8.09 min.
```

```
Rainfall intensity =     5.796(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        6.259     13.31            4.203
2       22.765      8.09            5.796
Qmax(1) =
        1.000 *    1.000 *     6.259) +
        0.725 *    1.000 *    22.765) + =      22.768
Qmax(2) =
        1.000 *    0.608 *     6.259) +
        1.000 *    1.000 *    22.765) + =      26.568

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.259      22.765
Maximum flow rates at confluence using above data:
       22.768       26.568
Area of streams before confluence:
        4.360        7.070
Results of confluence:
Total flow rate =     26.568(CFS)
Time of concentration =     8.089 min.
Effective stream area after confluence =     11.430(Ac.)


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Process from Point/Station       34.000 to Point/Station       16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   372.000(Ft.)
Downstream point elevation =   359.000(Ft.)
Channel length thru subarea  =   327.000(Ft.)
Channel base width    =    3.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =     29.353(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     29.353(CFS)
Depth of flow =   0.844(Ft.), Average velocity =   4.820(Ft/s)
Channel flow top width =   11.437(Ft.)
Flow Velocity =    4.82(Ft/s)
Travel time  =    1.13 min.
Time of concentration =    9.22 min.
Critical depth =      0.906(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.327(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
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Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.300
Decimal fraction soil group D = 0.700
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.335
Rainfall intensity =      5.327(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.441  CA =      6.051
Subarea runoff =      5.663(CFS) for      2.280(Ac.)
Total runoff =     32.231(CFS)   Total area =      13.710(Ac.)
Depth of flow =   0.881(Ft.), Average velocity =   4.939(Ft/s)
Critical depth =      0.953(Ft.)


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Process from Point/Station       34.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     13.710(Ac.)
Runoff from this stream =     32.231(CFS)
Time of concentration =    9.22 min.
Rainfall intensity =     5.327(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station       52.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.200
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.310
Initial subarea total flow distance  =  425.000(Ft.)
Highest elevation =  413.000(Ft.)
Lowest elevation =  372.000(Ft.)
Elevation difference =   41.000(Ft.) Slope =  9.647 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   9.65 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.68 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
```

```
TC = [1.8*(1.1-0.3100)*( 100.000^.5)/(   9.647^(1/3)]=   6.68
The initial area total distance of  425.00 (Ft.) entered leaves a
remaining distance of  325.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.65 minutes
for a distance of 325.00 (Ft.) and a slope of  9.65 %
with an elevation difference of  31.35(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.651 Minutes
Tt=[(11.9*0.0616^3)/( 31.35)]^.385=  1.65
Total initial area Ti =   6.68 minutes from Figure 3-3 formula plus
  1.65 minutes from the Figure 3-4 formula =   8.33 minutes
Rainfall intensity (I) =      5.687(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.310
Subarea runoff =      1.692(CFS)
Total initial stream area =        0.960(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       52.000 to Point/Station       54.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   372.000(Ft.)
Downstream point/station elevation =   368.000(Ft.)
Pipe length  =    59.00(Ft.) Slope =   0.0678  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.692(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.692(CFS)
Normal flow depth in pipe =    3.92(In.)
Flow top width inside pipe =    8.92(In.)
Critical Depth =    7.16(In.)
Pipe flow velocity =      9.16(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     8.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       54.000 to Point/Station       16.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   368.000(Ft.)
Downstream point elevation =   359.000(Ft.)
Channel length thru subarea  =   210.000(Ft.)
Channel base width    =    1.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      4.392(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      4.392(CFS)
Depth of flow =   0.504(Ft.), Average velocity =   3.466(Ft/s)
Channel flow top width =    4.026(Ft.)
Flow Velocity =    3.47(Ft/s)
```

```
Travel time  =    1.01 min.
Time of concentration =    9.45 min.
Critical depth =      0.523(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.243(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.850
Decimal fraction soil group D = 0.150
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.308
Rainfall intensity =      5.243(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.308  CA =      1.337
Subarea runoff =      5.318(CFS) for      3.380(Ac.)
Total runoff =      7.010(CFS)   Total area =       4.340(Ac.)
Depth of flow =   0.624(Ft.), Average velocity =   3.909(Ft/s)
Critical depth =      0.656(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       54.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      4.340(Ac.)
Runoff from this stream =      7.010(CFS)
Time of concentration =    9.45 min.
Rainfall intensity =     5.243(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        9.705     12.43            4.393
2       32.231      9.22            5.327
3        7.010      9.45            5.243
Qmax(1) =
         1.000 *    1.000 *     9.705) +
         0.825 *    1.000 *    32.231) +
         0.838 *    1.000 *     7.010) + =      42.157
Qmax(2) =
         1.000 *    0.742 *     9.705) +
         1.000 *    1.000 *    32.231) +
         1.000 *    0.976 *     7.010) + =      46.269
Qmax(3) =
         1.000 *    0.760 *     9.705) +
         0.984 *    1.000 *    32.231) +
```

```
        1.000 *    1.000 *     7.010) + =      46.112

Total of 3 main streams to confluence:
Flow rates before confluence point:
       9.705      32.231       7.010
Maximum flow rates at confluence using above data:
       42.157       46.269       46.112
Area of streams before confluence:
        2.810       13.710        4.340


Results of confluence:
Total flow rate =     46.112(CFS)
Time of concentration =     9.448 min.
Effective stream area after confluence  =     20.860(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       60.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
________________________________________________________________________
User specified 'C' value of 0.658 given for subarea
Rainfall intensity (I) =      3.265(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  19.69 min.  Rain intensity =       3.27(In/Hr)
Total area =        4.100(Ac.)  Total runoff =     3.300(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       62.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   458.700(Ft.)
End of street segment elevation =   427.000(Ft.)
Length of street segment  =   727.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.500(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0180
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      6.320(CFS)
Depth of flow =   0.331(Ft.), Average velocity =   4.311(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.811(Ft.)
```

```
Flow velocity =   4.31(Ft/s)
Travel time =    2.81 min.     TC =   22.50  min.
 Adding area flow to street
Rainfall intensity (I) =      2.996(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.300
Decimal fraction soil group D = 0.700
[INDUSTRIAL area type                         ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Rainfall intensity =      2.996(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.682  CA =      3.150
Subarea runoff =      6.138(CFS) for      0.520(Ac.)
Total runoff =      9.438(CFS)   Total area =       4.620(Ac.)
Street flow at end of street =      9.438(CFS)
Half street flow at end of street =      9.438(CFS)
Depth of flow =   0.372(Ft.), Average velocity =   4.741(Ft/s)
Flow width (from curb towards crown)=  13.854(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       62.000 to Point/Station       64.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   427.000(Ft.)
Downstream point/station elevation =   420.000(Ft.)
Pipe length  =    50.00(Ft.) Slope =   0.1400  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.438(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     9.438(CFS)
Normal flow depth in pipe =    7.45(In.)
Flow top width inside pipe =   11.64(In.)
Critical depth could not be calculated.
Pipe flow velocity =     18.41(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =    22.55 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       64.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      2.992(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
```

```
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Time of concentration =    22.55 min.
Rainfall intensity =      2.992(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.678  CA =      3.168
Subarea runoff =      0.040(CFS) for      0.050(Ac.)
Total runoff =      9.478(CFS)   Total area =       4.670(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       66.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   420.000(Ft.)
Downstream point/station elevation =   418.000(Ft.)
Pipe length  =    68.00(Ft.) Slope =   0.0294  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.478(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     9.478(CFS)
Normal flow depth in pipe =   10.68(In.)
Flow top width inside pipe =   13.59(In.)
Critical Depth =   14.04(In.)
Pipe flow velocity =     10.14(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =    22.66 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       66.000 to Point/Station       66.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      2.982(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.020
Decimal fraction soil group D = 0.980
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.349
Time of concentration =    22.66 min.
Rainfall intensity =      2.982(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.580  CA =      3.866
Subarea runoff =      2.052(CFS) for      2.000(Ac.)
Total runoff =     11.529(CFS)   Total area =       6.670(Ac.)
End of computations, total study area =          27.530 (Ac.)
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   14MAY21  TIME  21:22:24   *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X              X
XXXXXXX  XXXX    X       XXXXX  X
X     X  X       X              X
X     X  X       X     X        X
X     X  XXXXXXX   XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

                       *DIAGRAM
*** FREE ***
              1        ID   CHURCH OF THE GOOD SHEPHERD
              2        ID   PRELIMINARY DETENTION ANALYSIS FOR BMP 1
              3        ID   100-YEAR STORM EVENT
              4        IT       2 01JAN90    1200     200
              5        IO       5       2

              6        KK    BMP1
              7        KM   RATIONAL METHOD HYDROGRAPH PROGRAM
              8        KM   100-YEAR, 6-HOUR RAINFALL IS 3.0 INCHES
              9        KM   RATIONAL METHOD RUNOFF COEFFICIENT IS 0.78
             10        KM   RATIONAL METHOD TIME OF CONCENTRATION IS 12.32 MINUTES
             11        BA  0.0044
             12        IN      12 01JAN90    1154
             13        QI       0     0.4     0.4     0.4     0.4     0.5     0.5     0.5     0.5     0.6
             14        QI     0.6     0.6     0.7     0.7     0.8     0.9       1     1.2     1.3       2
             15        QI     2.9     9.7     1.6       1     0.8     0.7     0.6     0.5     0.5     0.4
             16        QI     0.4       0       0       0       0       0       0       0       0       0
             17        QI       0       0

             18        KK  DETAIN
             19        RS       1    STOR      -1
             20        SV       0   0.045
             21        SQ       0     8.1
             22        SE     100     101
             23        ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    6        BMP1
               V
               V
   18      DETAIN
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   17NOV21  TIME  08:45:54   *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

CHURCH OF THE GOOD SHEPHERD
PRELIMINARY DETENTION ANALYSIS FOR BMP 1
100-YEAR STORM EVENT

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	2	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	2	MINUTES IN COMPUTATION INTERVAL
IDATE	1JAN90	STARTING DATE
ITIME	1200	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1JAN90	ENDING DATE
NDTIME	1838	ENDING TIME
ICENT	19	CENTURY MARK

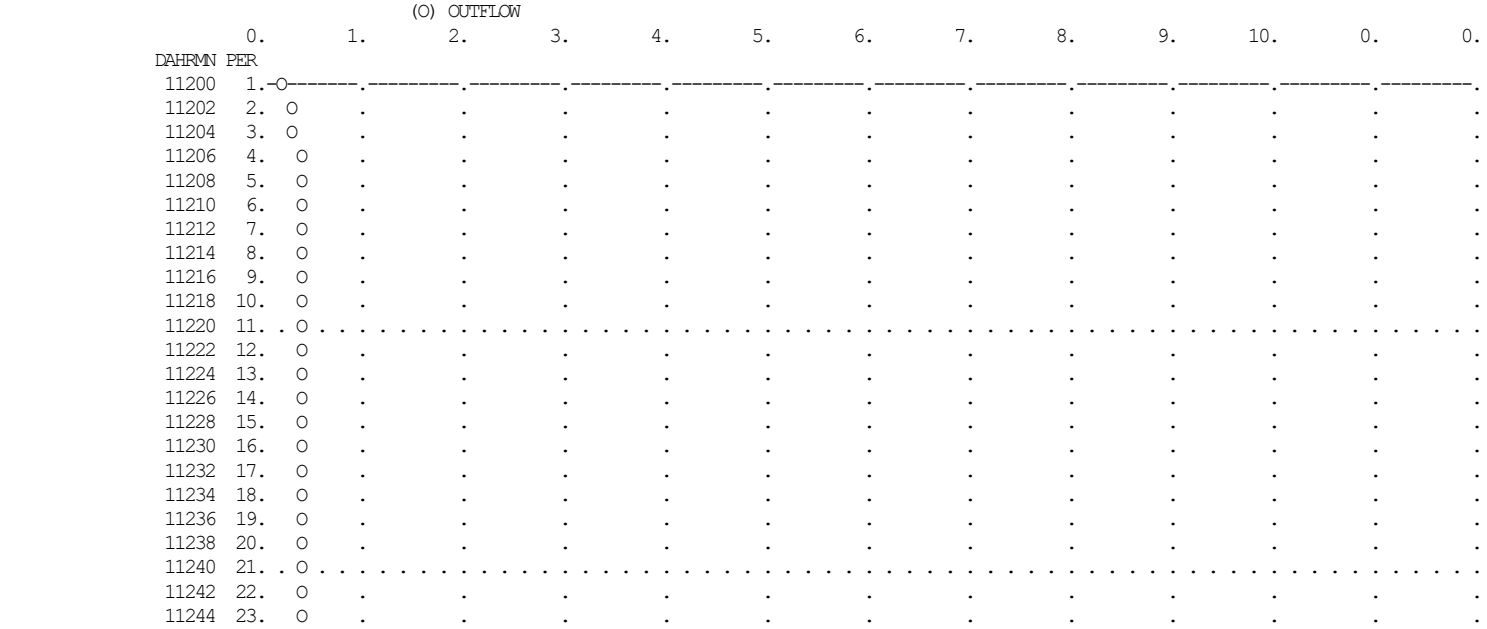
COMPUTATION INTERVAL .03 HOURS
TOTAL TIME BASE 6.63 HOURS

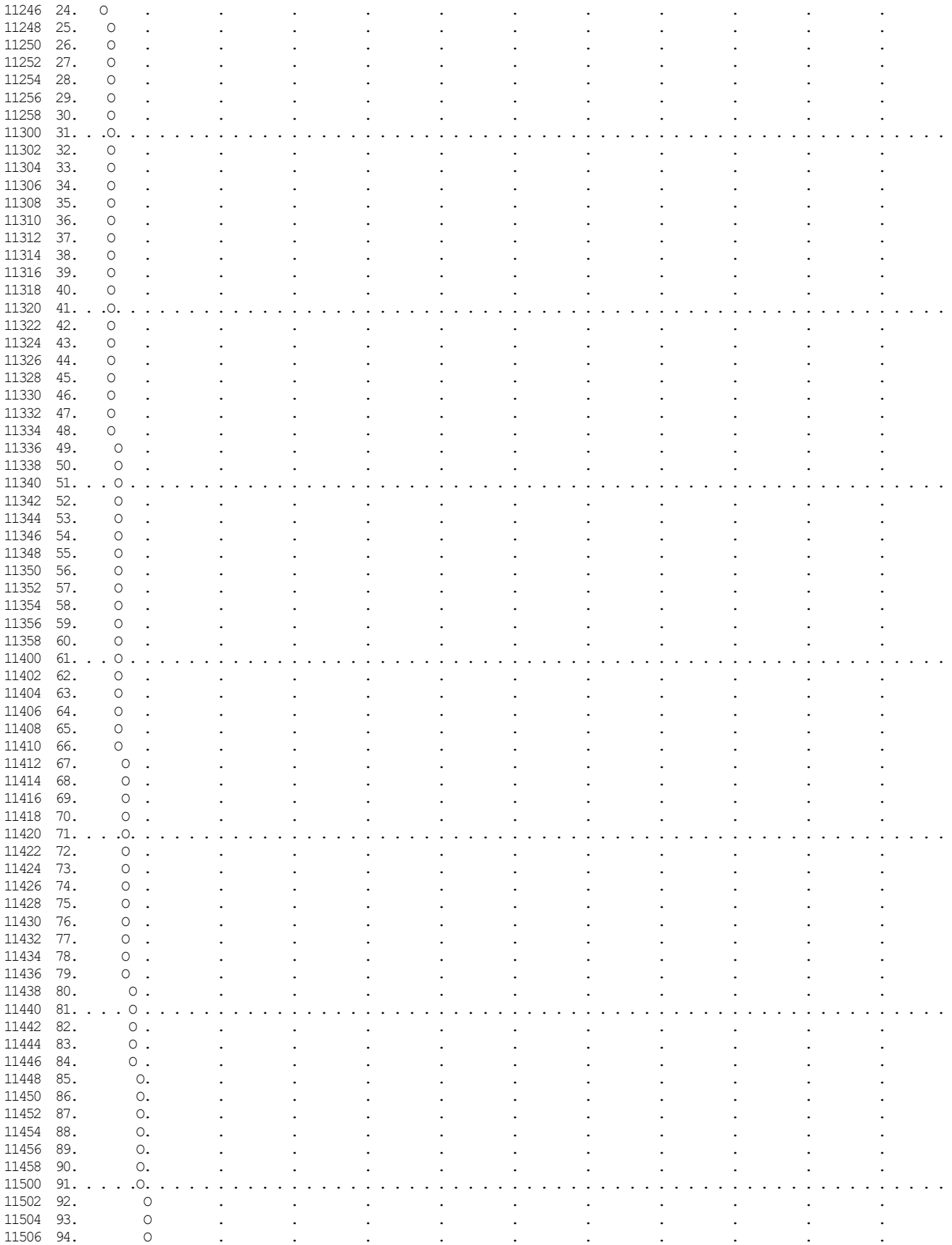
ENGLISH UNITS

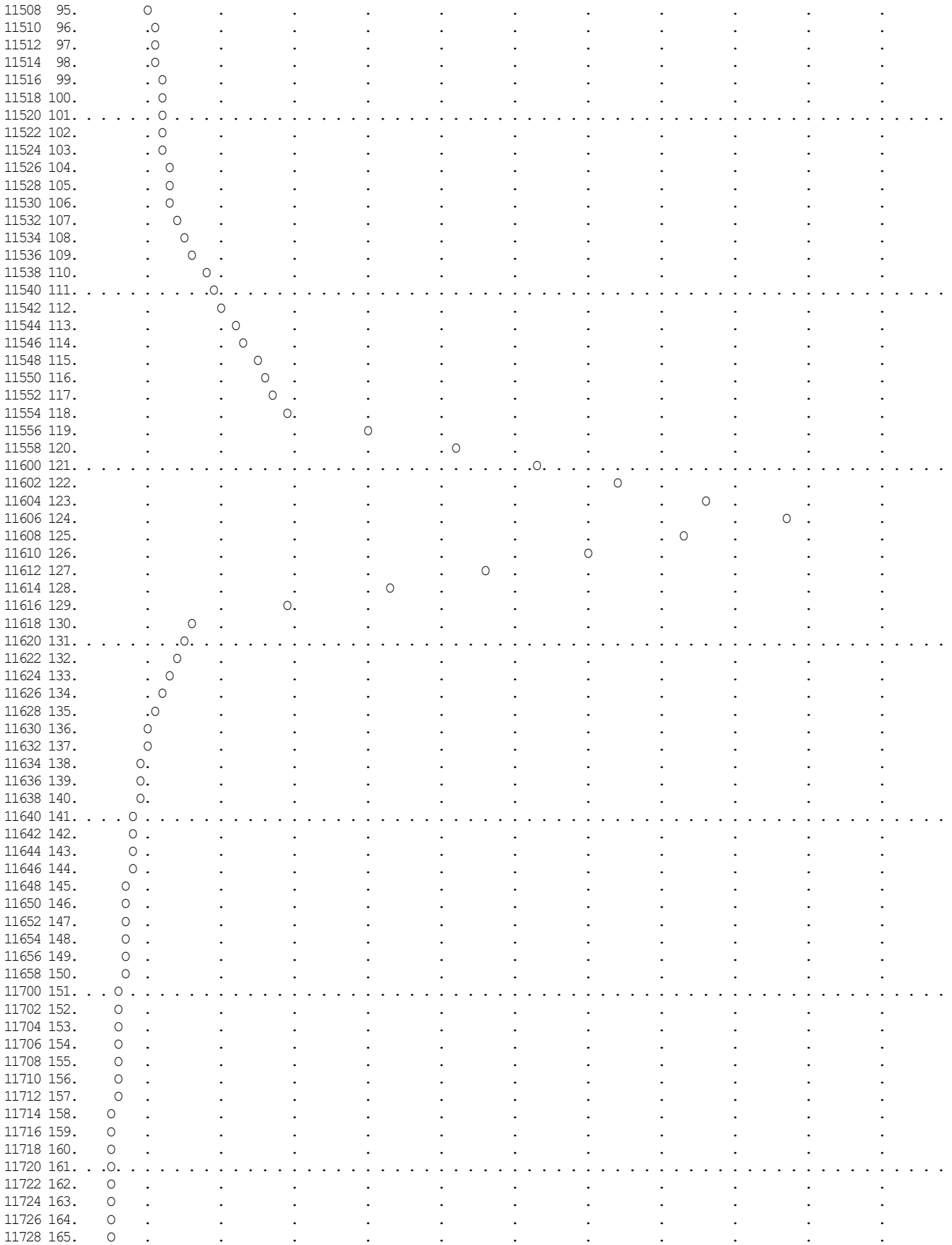
DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

STATION BMP1

(O) OUTFLOW



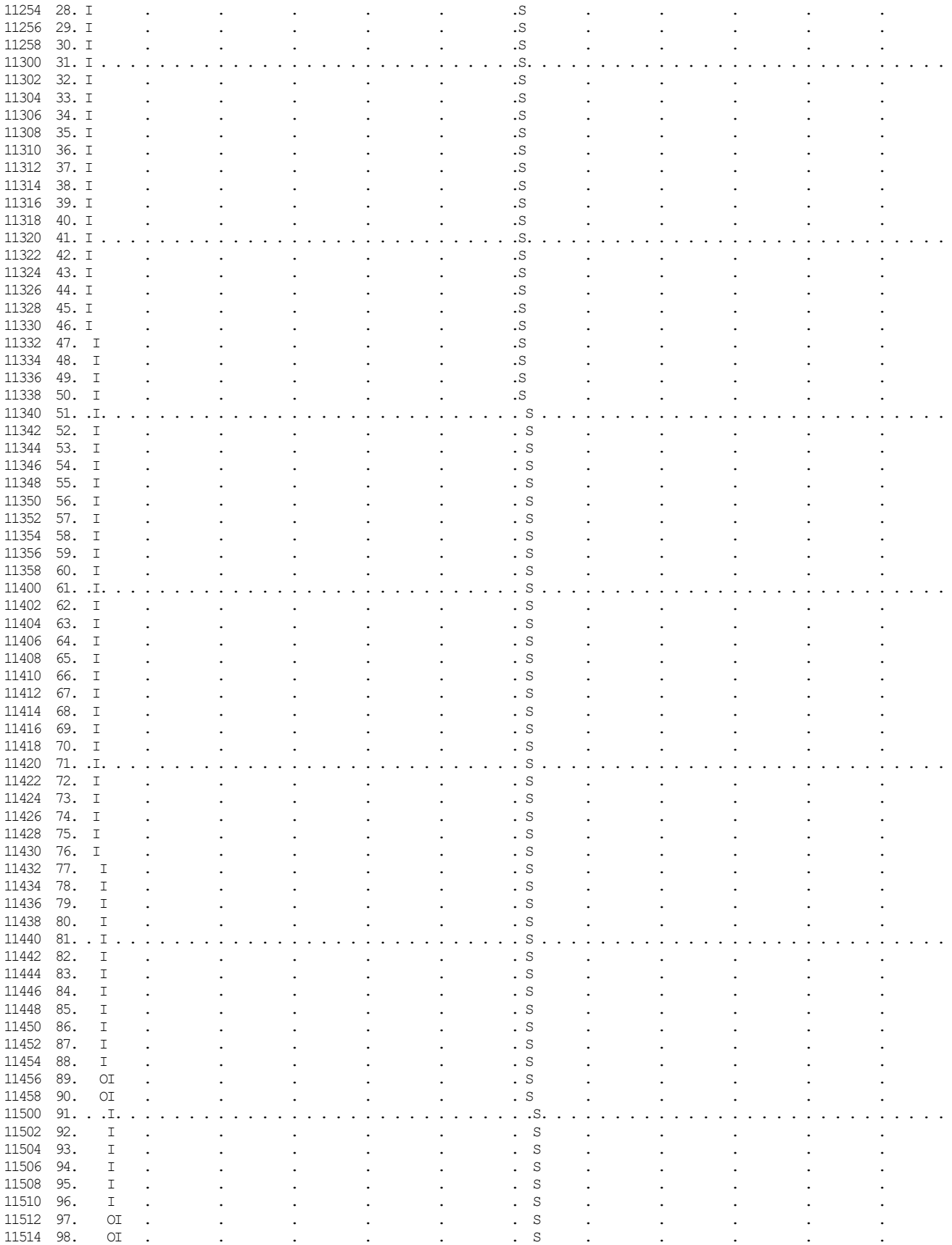


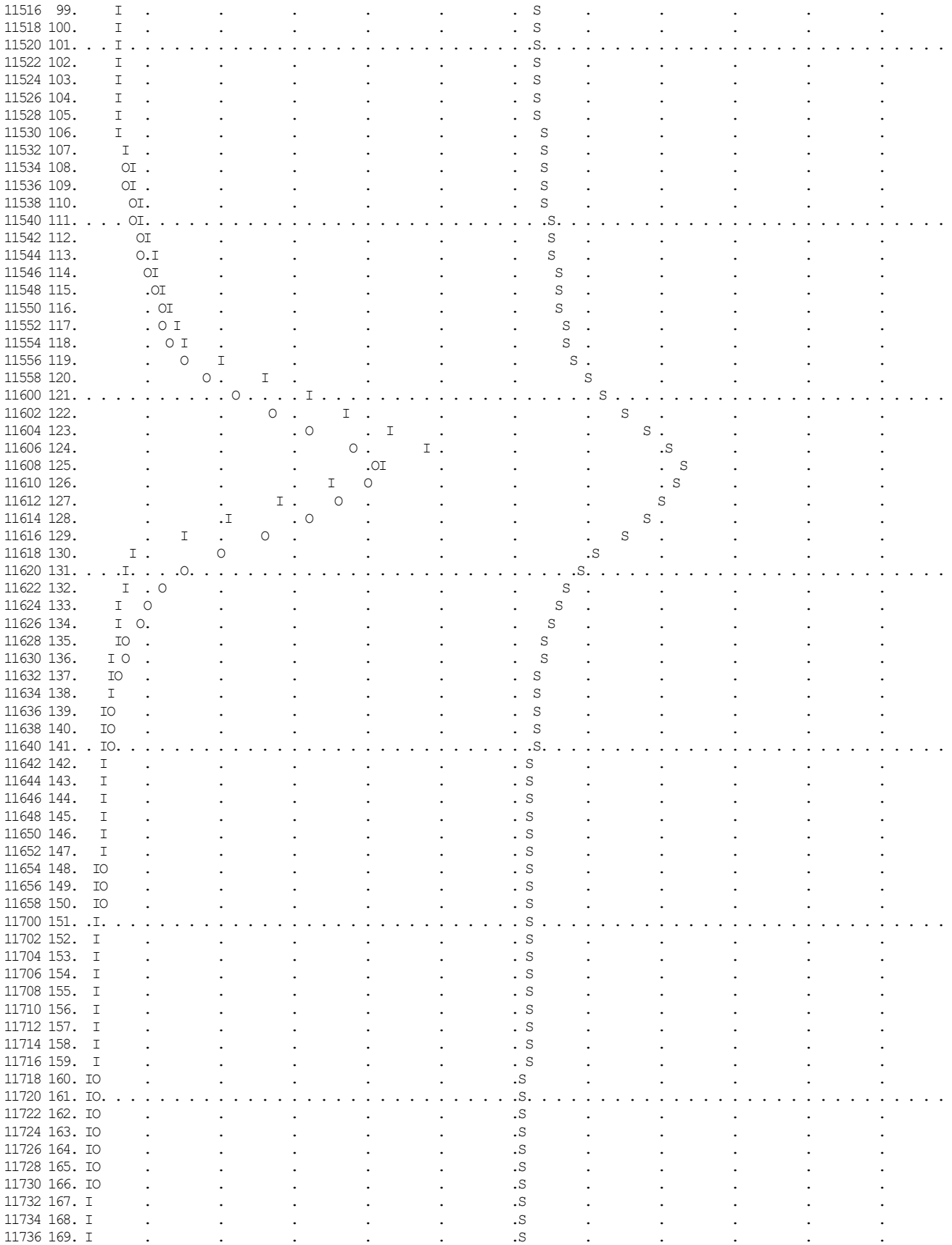


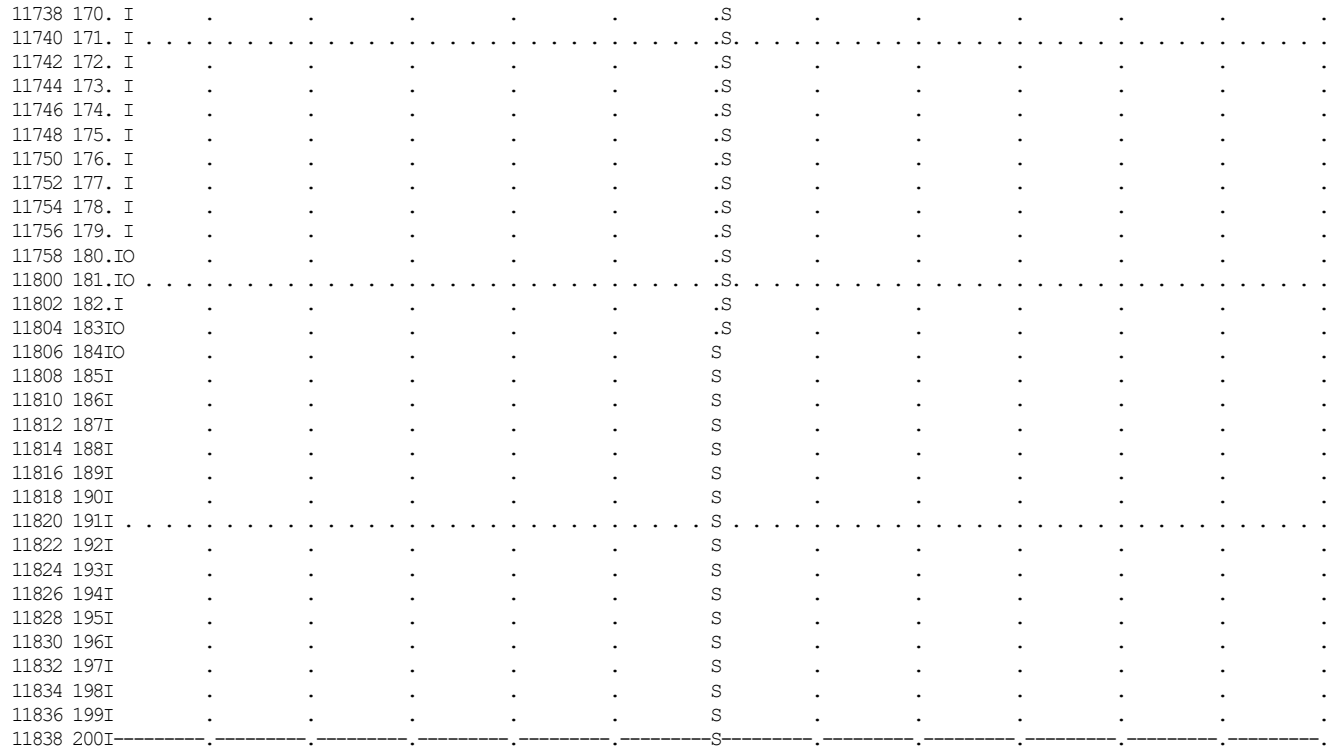
```
11730 166.    O    .       .       .       .       .       .       .       .       .       .       .       .
11732 167.    O    .       .       .       .       .       .       .       .       .       .       .       .
11734 168.    O    .       .       .       .       .       .       .       .       .       .       .       .
11736 169.   O     .       .       .       .       .       .       .       .       .       .       .       .
11738 170.   O     .       .       .       .       .       .       .       .       .       .       .       .
11740 171. . O . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11742 172.   O     .       .       .       .       .       .       .       .       .       .       .       .
11744 173.   O     .       .       .       .       .       .       .       .       .       .       .       .
11746 174.   O     .       .       .       .       .       .       .       .       .       .       .       .
11748 175.   O     .       .       .       .       .       .       .       .       .       .       .       .
11750 176.   O     .       .       .       .       .       .       .       .       .       .       .       .
11752 177.   O     .       .       .       .       .       .       .       .       .       .       .       .
11754 178.   O     .       .       .       .       .       .       .       .       .       .       .       .
11756 179.  O      .       .       .       .       .       .       .       .       .       .       .       .
11758 180.  O      .       .       .       .       .       .       .       .       .       .       .       .
11800 181. O . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11802 182.O        .       .       .       .       .       .       .       .       .       .       .       .
11804 183.O        .       .       .       .       .       .       .       .       .       .       .       .
11806 184O         .       .       .       .       .       .       .       .       .       .       .       .
11808 185O         .       .       .       .       .       .       .       .       .       .       .       .
11810 186O         .       .       .       .       .       .       .       .       .       .       .       .
11812 187O         .       .       .       .       .       .       .       .       .       .       .       .
11814 188O         .       .       .       .       .       .       .       .       .       .       .       .
11816 189O         .       .       .       .       .       .       .       .       .       .       .       .
11818 190O         .       .       .       .       .       .       .       .       .       .       .       .
11820 191O . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
11822 192O         .       .       .       .       .       .       .       .       .       .       .       .
11824 193O         .       .       .       .       .       .       .       .       .       .       .       .
11826 194O         .       .       .       .       .       .       .       .       .       .       .       .
11828 195O         .       .       .       .       .       .       .       .       .       .       .       .
11830 196O         .       .       .       .       .       .       .       .       .       .       .       .
11832 197O         .       .       .       .       .       .       .       .       .       .       .       .
11834 198O         .       .       .       .       .       .       .       .       .       .       .       .
11836 199O         .       .       .       .       .       .       .       .       .       .       .       .
11838 200O---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.---------.
```

WARNING --- ROUTED OUTFLOW (8.) IS GREATER THAN MAXIMUM OUTFLOW (8.) IN STORAGE-OUTFLOW TABLE
STATION   DETAIN

```
                    (I) INFLOW,   (O) OUTFLOW
       0.       2.       4.       6.       8.       10.       0.       0.       0.       0.       0.       0.       0.
                                                                          (S) STORAGE
      .00      .00      .00      .00      .00      .00       .00      .02      .04      .06      .00      .00      .00
DAHRMN PER
 11200   1.I--------.---------.---------.---------.---------.---------.S--------.---------.---------.---------.---------.---------.
 11202   2.I        .         .         .         .         .         .S       .         .         .         .         .         .
 11204   3.OI       .         .         .         .         .         .S       .         .         .         .         .         .
 11206   4.OI       .         .         .         .         .         .S       .         .         .         .         .         .
 11208   5. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11210   6. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11212   7. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11214   8. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11216   9. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11218  10. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11220  11. I . . . . . . . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . . . . . . .
 11222  12. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11224  13. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11226  14. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11228  15. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11230  16. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11232  17. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11234  18. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11236  19. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11238  20. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11240  21. I . . . . . . . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . . . . . . .
 11242  22. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11244  23. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11246  24. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11248  25. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11250  26. I       .         .         .         .         .         .S       .         .         .         .         .         .
 11252  27. I       .         .         .         .         .         .S       .         .         .         .         .         .
```







RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BMP1	9.7	4.10	1.	1.	1.	.00		
+	ROUTED TO	DETAIN	8.1	4.13	1.	1.	1.	.00		
+									101.00	4.13

*** NORMAL END OF HEC-1 ***

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN  1998               *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   17NOV21  TIME  07:50:55  *
*                                      *
****************************************
```


```
************************************
*                                  *
*    U.S. ARMY CORPS OF ENGINEERS  *
*    HYDROLOGIC ENGINEERING CENTER *
*         609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616    *
*           (916) 756-1104         *
*                                  *
************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X              X
XXXXXXX  XXXX    X       XXXXX  X
X     X  X       X              X
X     X  X       X     X        X
X     X  XXXXXXX   XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

                       *DIAGRAM
*** FREE ***
             1         ID   CHURCH OF THE GOOD SHEPHERD
             2         ID   PRELIMINARY DETENTION ANALYSIS FOR BMP 2
             3         ID   100-YEAR STORM EVENT
             4         IT       2 01JAN90    1200     200
             5         IO       5       2

             6         KK    BMP2
             7         KM   RATIONAL METHOD HYDROGRAPH PROGRAM
             8         KM   100-YEAR, 6-HOUR RAINFALL IS 3.0 INCHES
             9         KM   RATIONAL METHOD RUNOFF COEFFICIENT IS 0.68
            10         KM   RATIONAL METHOD TIME OF CONCENTRATION IS 22.55 MINUTES
            11         BA  0.0073
            12         IN      23 01JAN90    1136
            13         QI       0     0.4     0.6     0.6     0.7     0.7     0.8     0.9     1.1     1.3
            14         QI     1.9     2.5     9.5     1.5       1     0.8     0.7       0       0       0
            15         QI       0       0       0       0       0       0       0       0

            16         KK  DETAIN
            17         RS       1    STOR      -1
            18         SV       0   0.044
            19         SQ       0     8.7
            20         SE     100     101
            21         ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    6        BMP2
               V
               V
   16      DETAIN
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   17NOV21  TIME  07:50:55   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

CHURCH OF THE GOOD SHEPHERD
PRELIMINARY DETENTION ANALYSIS FOR BMP 2
100-YEAR STORM EVENT

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	2	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	2	MINUTES IN COMPUTATION INTERVAL
IDATE	1JAN90	STARTING DATE
ITIME	1200	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1JAN90	ENDING DATE
NDTIME	1838	ENDING TIME
ICENT	19	CENTURY MARK

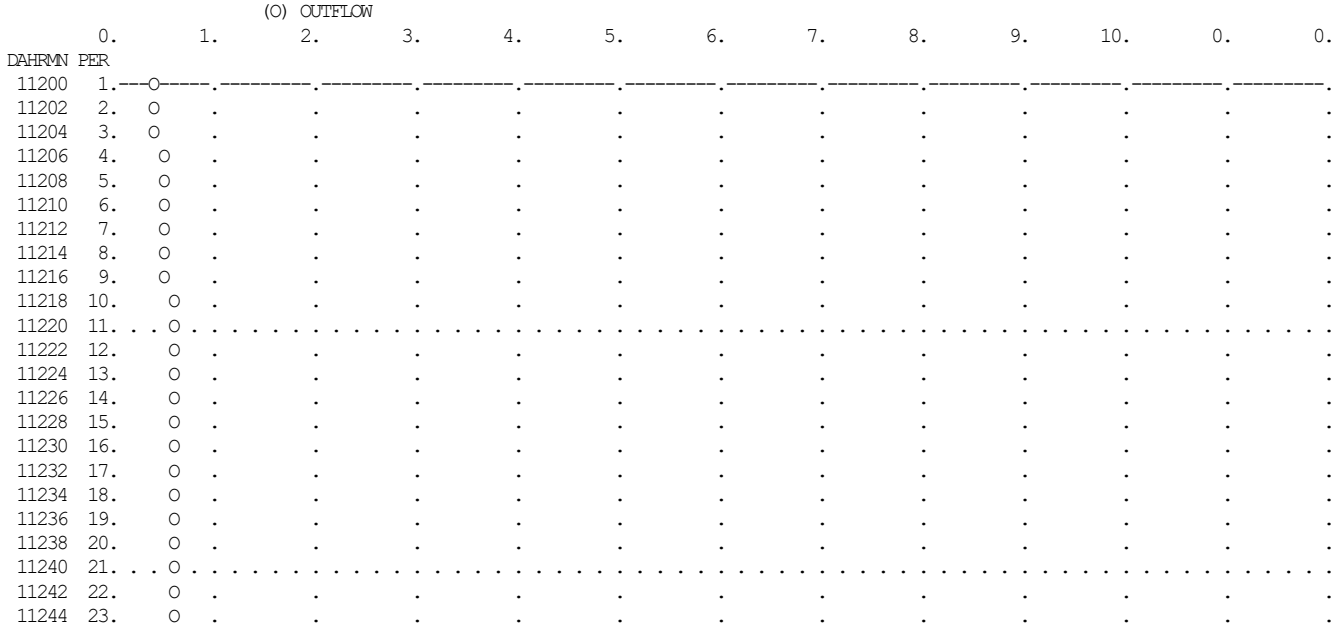
COMPUTATION INTERVAL .03 HOURS
TOTAL TIME BASE 6.63 HOURS

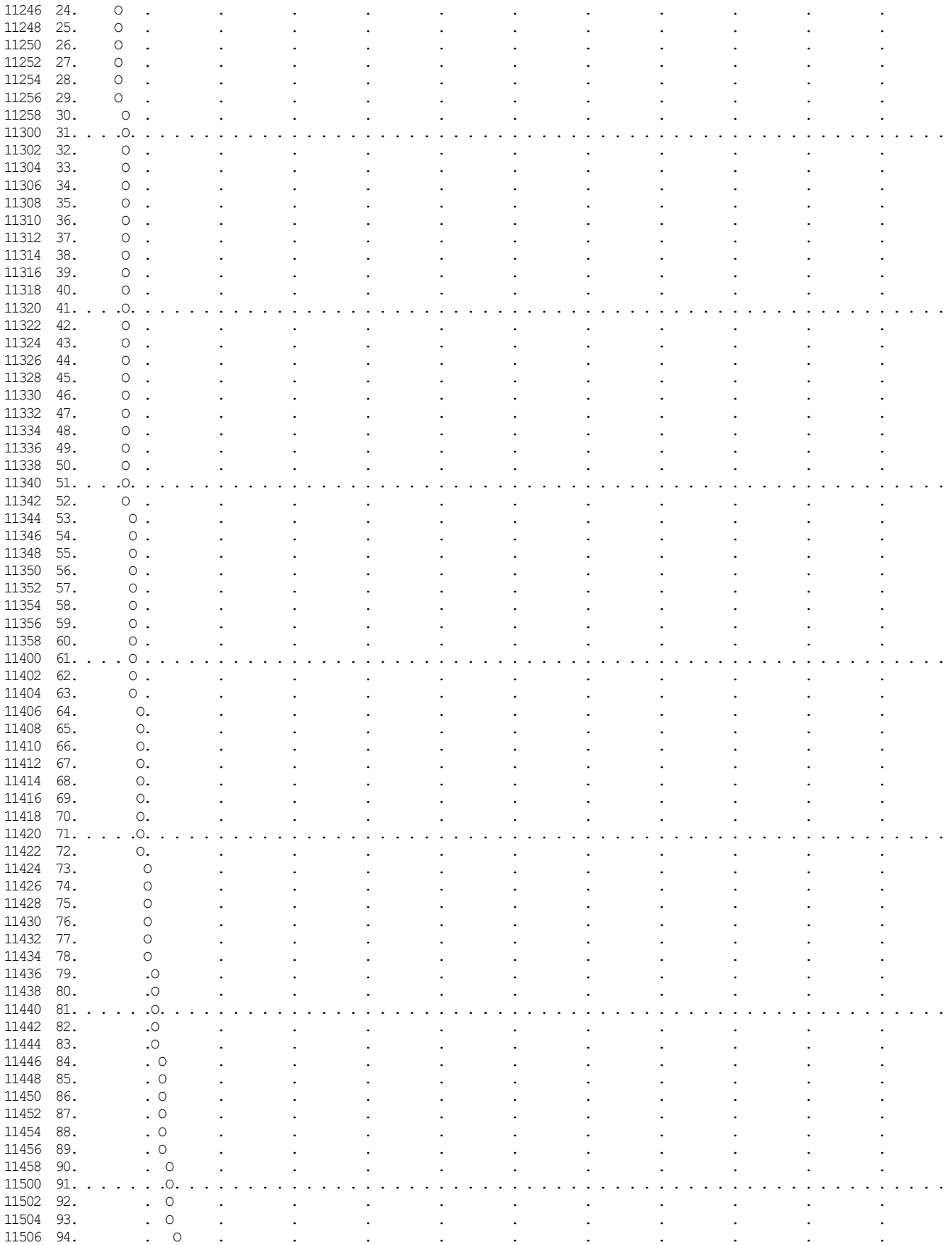
ENGLISH UNITS

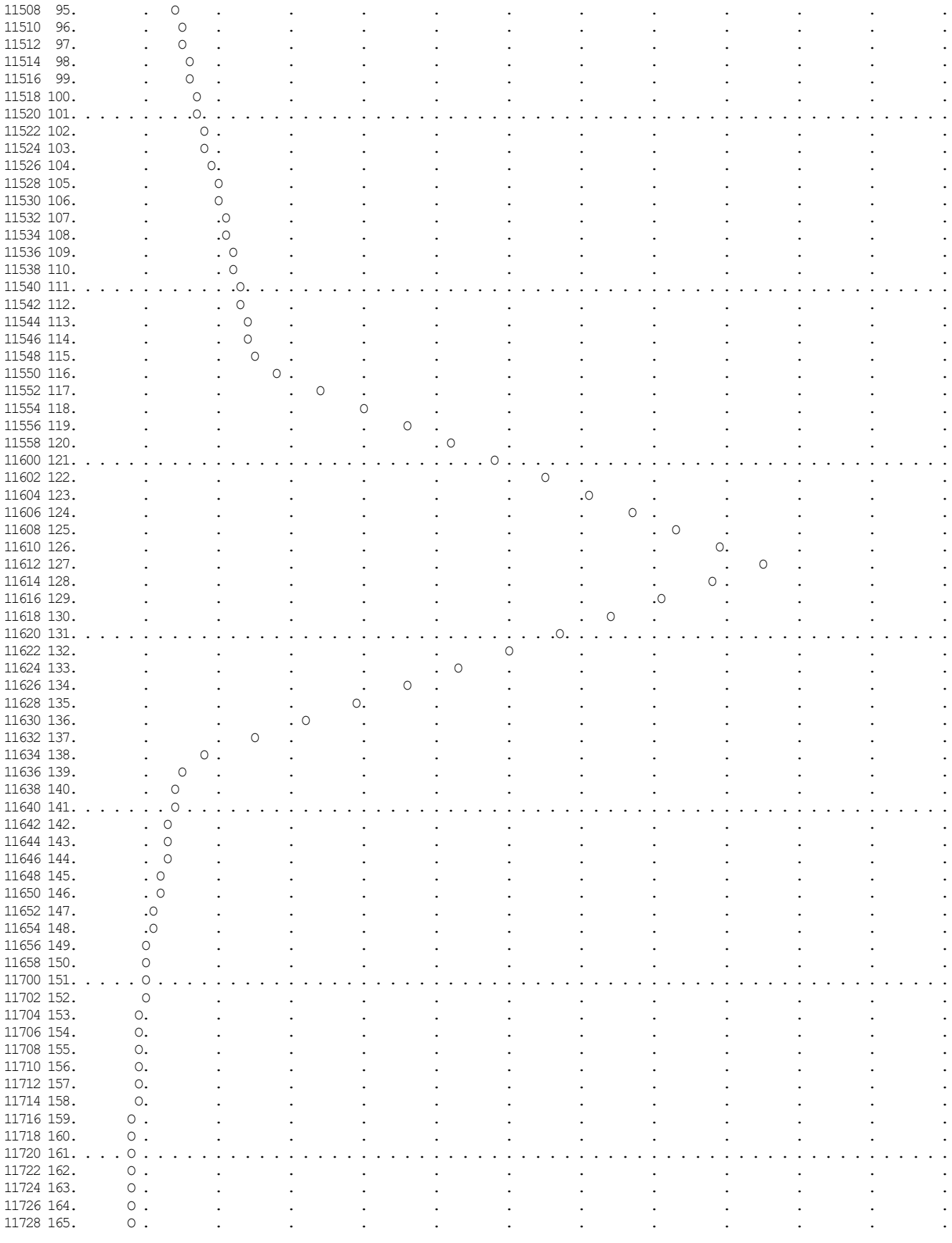
DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

STATION BMP2

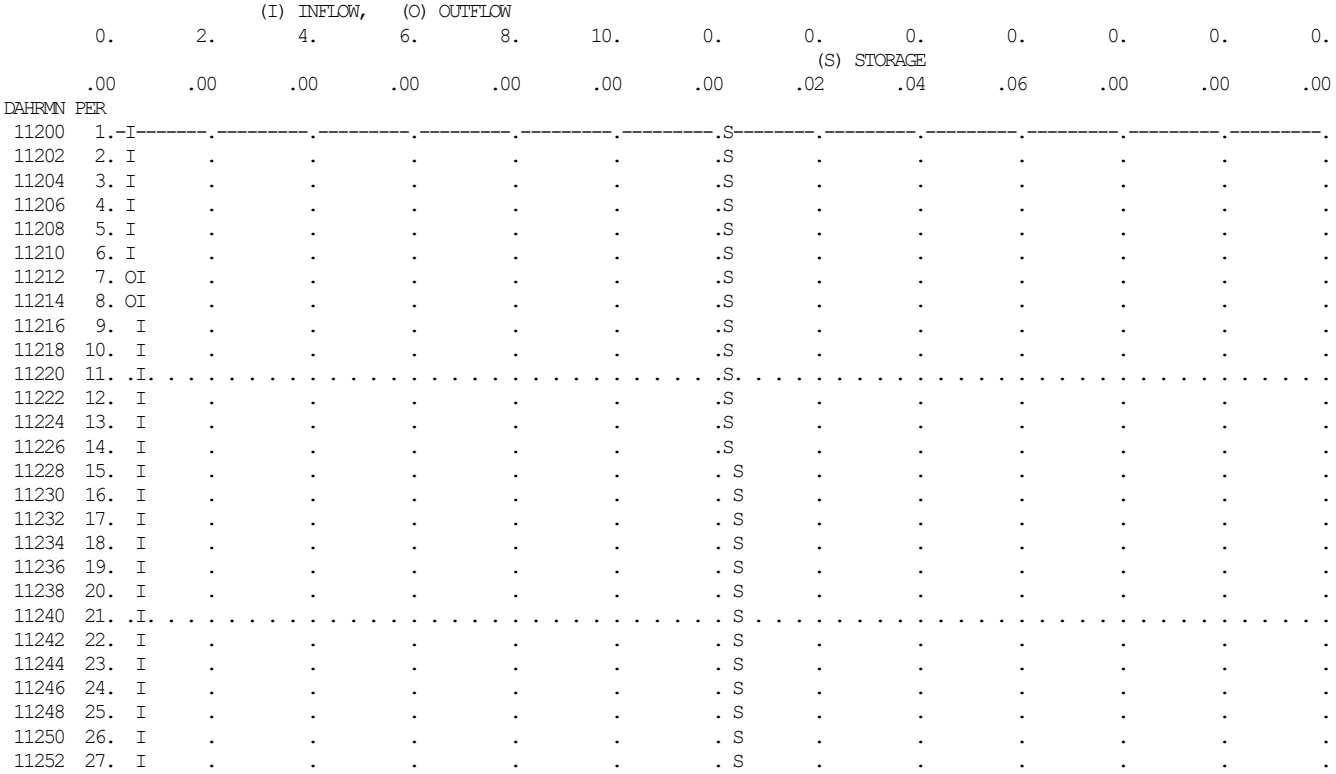
(O) OUTFLOW







WARNING --- ROUTED OUTFLOW (9.) IS GREATER THAN MAXIMUM OUTFLOW (9.) IN STORAGE-OUTFLOW TABLE
STATION DETAIN



```
11254  28.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11256  29.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11258  30.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11300  31. .I. . . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11302  32.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11304  33.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11306  34.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11308  35.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11310  36.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11312  37.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11314  38.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11316  39.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11318  40.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11320  41. .I. . . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11322  42.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11324  43.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11326  44.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11328  45.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11330  46.  I     .       .       .       .       .       .S      .       .       .       .       .       .
11332  47.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11334  48.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11336  49.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11338  50.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11340  51. . I . . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11342  52.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11344  53.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11346  54.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11348  55.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11350  56.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11352  57.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11354  58.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11356  59.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11358  60.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11400  61. . I . . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11402  62.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11404  63.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11406  64.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11408  65.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11410  66.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11412  67.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11414  68.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11416  69.   I    .       .       .       .       .       .S      .       .       .       .       .       .
11418  70.   OI   .       .       .       .       .       .S      .       .       .       .       .       .
11420  71. . .I. . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11422  72.    I   .       .       .       .       .       .S      .       .       .       .       .       .
11424  73.    I   .       .       .       .       .       .S      .       .       .       .       .       .
11426  74.    I   .       .       .       .       .       .S      .       .       .       .       .       .
11428  75.    I   .       .       .       .       .       .S      .       .       .       .       .       .
11430  76.    I   .       .       .       .       .       .S      .       .       .       .       .       .
11432  77.    I   .       .       .       .       .       . S     .       .       .       .       .       .
11434  78.    I   .       .       .       .       .       . S     .       .       .       .       .       .
11436  79.    I   .       .       .       .       .       . S     .       .       .       .       .       .
11438  80.    I   .       .       .       .       .       . S     .       .       .       .       .       .
11440  81. . .OI . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11442  82.    OI  .       .       .       .       .       . S     .       .       .       .       .       .
11444  83.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11446  84.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11448  85.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11450  86.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11452  87.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11454  88.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11456  89.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11458  90.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11500  91. . . I . . . . . . . . . . . . . . . . . . . . . .S. . . . . . . . . . . . . . . . . . . . . . . .
11502  92.     I  .       .       .       .       .       . S     .       .       .       .       .       .
11504  93.     OI .       .       .       .       .       . S     .       .       .       .       .       .
11506  94.      I .       .       .       .       .       . S     .       .       .       .       .       .
11508  95.      I .       .       .       .       .       . S     .       .       .       .       .       .
11510  96.      I .       .       .       .       .       .  S    .       .       .       .       .       .
11512  97.      OI.       .       .       .       .       .  S    .       .       .       .       .       .
11514  98.      OI.       .       .       .       .       .  S    .       .       .       .       .       .
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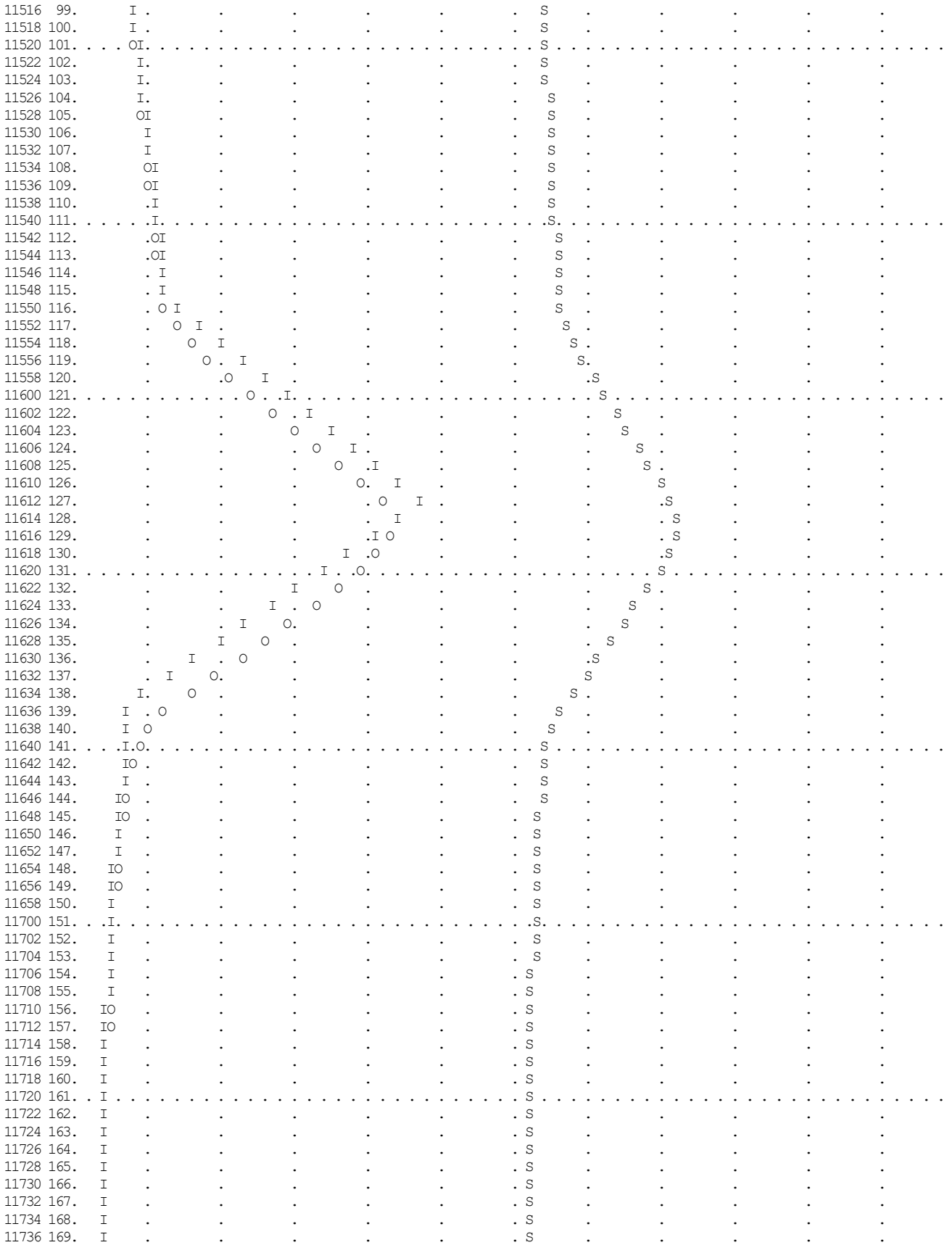
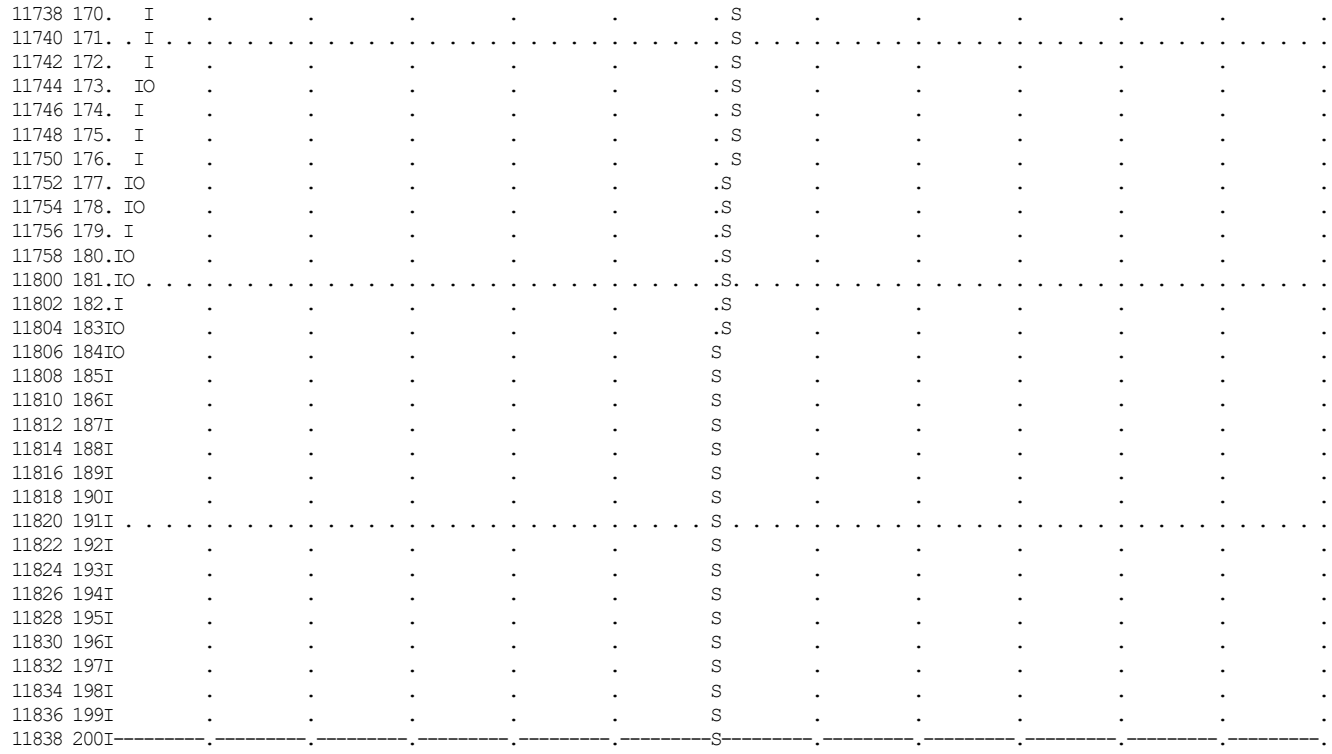
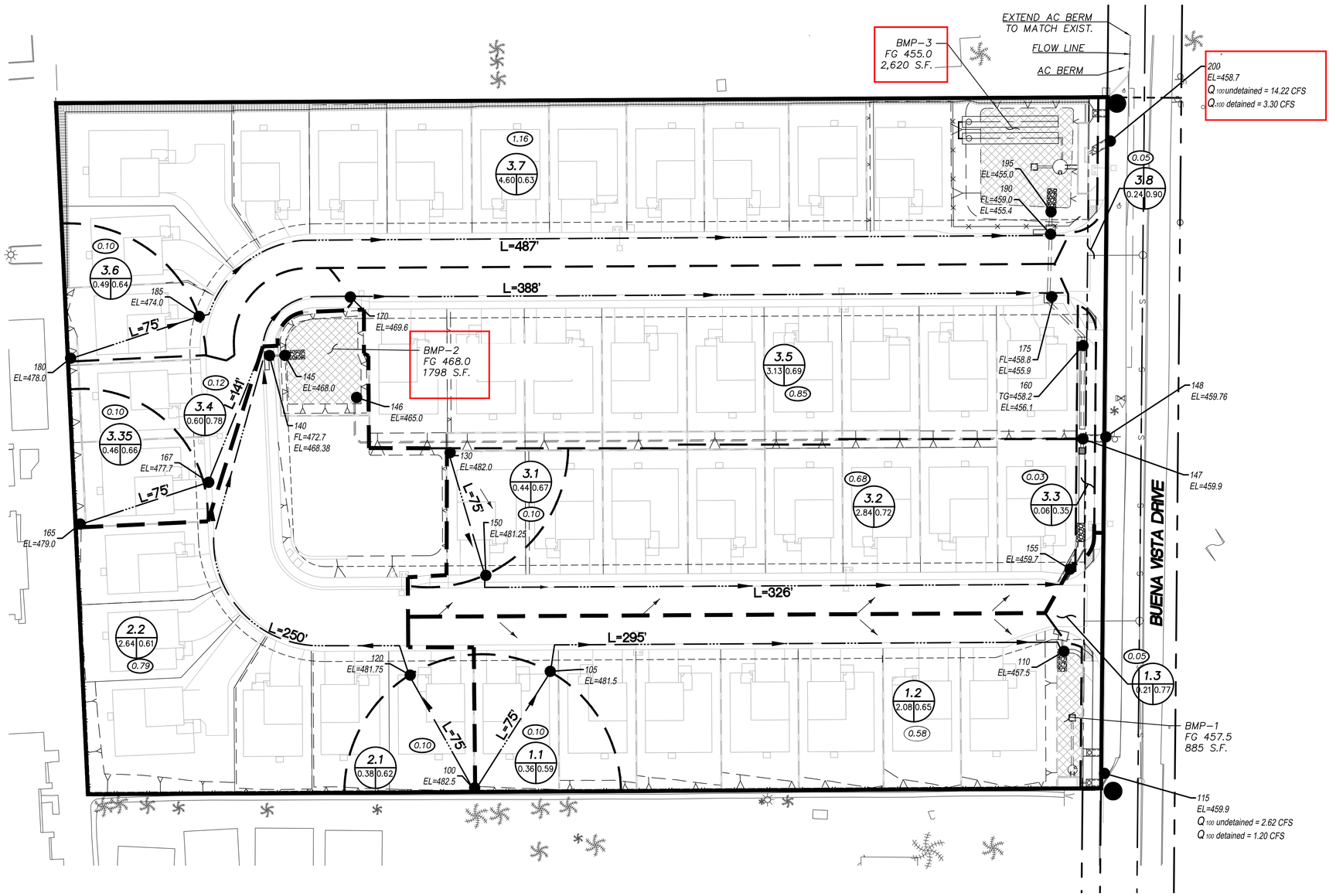




RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		BMP2	9.5	4.20	2.	1.	1.	.01		
	ROUTED TO									
+		DETAIN	8.7	4.23	2.	1.	1.	.01		
+									101.00	4.23

*** NORMAL END OF HEC-1 ***



LEGEND:

SUB–BASIN NO.
SURFACE RUNOFF — 1.1 / 1.0 / 0.3 (Q100 / C COEFFICIENT)
BASIN AREA (ACRES) — 0.11
BASIN LIMIT
SUB–BASIN LIMIT
FLOWPATH

PROPOSED CONDITION DRAINAGE EXHIBIT

MLC BUENA VISTA
1525 BUENA VISTA DRIVE, VISTA , CA
PROJECT NUMBER: PE 2531
SCALE: 1" = 30'
DATE: DECEMBER 2018
SHEET 1 OF 1

PASCO LARET SUITER & ASSOCIATES
CIVIL ENGINEERING + LAND PLANNING + LAND SURVEYING
535 North Highway 101, Ste A, Solana Beach, CA 92075
ph 858.259.8212 | fx 858.259.4812 | plsaengineering.com

SAVE DATE: 10/16/2018 ~ PLOT DATE: 12/5/2018 ~ FILE NAME: P:\Active Jobs\2531 MLC BUENA VISTA\CIVIL\REPORTS\HYDROLOGY\2531 – Proposed Condition Exhibit.dwg

1" = 100'

0 100

NODE 16
Q100=44.5 CFS
A=21.45 AC

NODE 64
Q100=10.7 CFS
A=6.08 AC

8.13 AC

8.76 AC

4.14 AC

1.56 AC

0.42 AC

4.10 AC

0.42 AC

BUENA VISTA DRIVE

LEGEND:

- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW PATH
- 4.14 AC DRAINAGE BASIN AREA
- 10 RATIONAL METHOD NODE NUMBER
- (D) HYDROLOGIC SOIL GROUP
- EXISTING DRAINAGE FACILITY

EXISTING CONDITION
RATIONAL METHOD WORK MAP

1" = 100'

0 100

NODE 16
Q100=46.1 CFS
A=20.86 AC
Q100 MITIGATED
= 44.5 CFS

NODE 66
Q100=11.5 CFS
A=6.67 AC
Q100 MITIGATED
= 10.7 CFS

BUENA VISTA DRIVE

LEGEND:

- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW PATH
- 12" PROPOSED DRAINAGE FACILITY AND DIAMETER
- 4.14 AC DRAINAGE BASIN AREA
- 10 RATIONAL METHOD NODE NUMBER
- (D) HYDROLOGIC SOIL GROUP
- EXISTING DRAINAGE FACILITY

PROPOSED CONDITION
RATIONAL METHOD WORK MAP