



BSI Consultants, Inc.

ENGINEERING DESIGN REPORT

**FOR A
SUPPLEMENTAL STORM DRAIN SYSTEM
IN
MISSION GORGE ROAD**

**FOR THE
CITY OF SANTEE**

Job No. 07423.00

August 1992

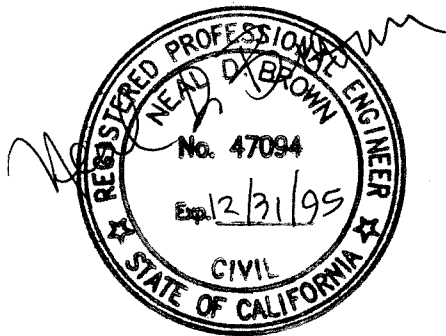
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B.S.I. Consultants, Inc.
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INTRODUCTION

The Santee Citywide Drainage Study prepared by BSI Consultants, Inc. in February 1990, identifies the area south of Mission Gorge Road and west of Cottonwood Avenue as having many deficient storm drain facilities. This area consists mainly of commercial and light industrial complexes interspersed with single and multi-family housing.

Storm runoff from this rapidly developing area drains northerly toward the San Diego River and is intercepted by existing storm drain systems located in and around Mission Gorge Road. However, the existing system is undersized and the slope of the systems within Mission Gorge Road are minimal. The existing storm drainage facilities are therefore unable to adequately convey the storm runoff.

The City of Santee wishes to determine what improvements could be implemented to carry this excess runoff to the river. The purpose of this study is to define improvements, establish design criteria and associated costs, for improvements that can adequately convey the flow to the river.

BSI has prepared a detailed hydrology study of the tributary drainage basin between Magnolia Avenue and Cuyamaca Street to determine the storm flow quantities generated during a 100-year storm event. This study identifies locations and amounts of contributory flows. Results from the hydrology analysis were then used to define possible alternates.

A hydraulic analysis was performed to approximate the capacity of a portion of the existing storm drain system in Mission Gorge Road between Cuyamaca Street and Magnolia Avenue to determine how much of the contributory area's flow can be collected and conveyed to the river without overloading the system.

The technical information has been used to identify several design options, easement needs, and preliminary construction costs of supplemental systems. The information herein can then be utilized for final design and preparation of construction plans.

SYSTEM ANALYSIS

Research for this report consisted of collecting existing hydrology studies, topographic maps, and improvement plans. Field investigations have been done to verify and supplement much of this information, especially in the determination of basin boundaries and direction of flow.

The hydrology study presented in Section I of this study uses the CivilCADD/CivilDESIGN Rational Method computer software for hydrologic analysis. Storm flow quantities entering the existing Mission Gorge Road storm drainage system being studied have been determined by this analysis. The results compare well with those in the Citywide Drainage Study for similar basin areas.

Hydrology

A 200 scale hydrology map, Exhibit "A", (Map Pocket) has been prepared using information from the recently updated 1" = 100' topographic mapping of the City. This map shows drainage basin boundaries, basin areas, flow arrows, concentration points and design storm runoff quantities for a 100-year storm.

The contributing area was divided into several major basins. The boundary of each basin was determined dependent upon where it contributed to the Mission Gorge system. Each area is contributory to a particular area or drain entrance. For purposes of this study, it is assumed that the existing inlets at the various points are adequate to collect the flows generated.

Land uses characteristics were determined using July 1990 city land use and zoning maps. Soil types selected for this study are from the Soil Conservation Service hydrologic ground cover and soil group maps. Both the land use and the soil groups are shown on Exhibit "C". The 100 year storm is based on an adjusted 6 hour precipitation. The 6 and 24 hour precipitation rates are from San Diego County Department of Sanitation and Flood control maps prepared in 1975. The assumed direction of runoff in the Town Center development is shown on the hydrology map and is toward the concentration points.

Seven hydrologic runs have been provided in Part I. These runs are identified as follows:

1. "PROSPE" - This basin begins near Prospect Avenue and Magnolia Avenue. This run estimates the flow eastward along Prospect, north along Railroad Avenue, east along Buena Vista Avenue, then north to Node 190 at Mission Gorge. This is the largest of the contributing areas generating approximately 650 cubic feet per second (cfs).

2. "MSGRRD" - This run computes the flows directed toward Mission Gorge at Mission Greens Road. This basin begins east of Cuyamaca, north of Buena Vista Avenue at Node 200. This area is mainly residential as per the zoning map. A flow of approximately 41 cfs is generated from this area.
3. "CUYAMA" - This run estimates the runoff flowing north along Cuyamaca, south of Mission Gorge. Beginning just south of Buena Vista at Node 300, the basin proceeds north collecting flow from both sides of Cuyamaca Street as it flows. The estimated flow rate is 57.2 cfs in Cuyamaca along with an additional 5.3 cfs from a 2.0 acre site at the intersection of Cuyamaca and Mission Gorge.
4. "MGS400" - This runs computes the flows generated and directed to Mission Gorge and then through the proposed Town Center development just east of Mission Greens Road. The runoff from the area just south of here is joined with flows from along Mission Gorge and then routed through the Town Center in a pipe. The pipe is sized to accommodate the additionally expected flows that will be generated from the Town Center. This system outlets to the San Diego River at Node 830 with a flow rate of approximately 270 cfs.
5. "MGS500" - This run estimates the flows tributary to the eastern proposed alternate channels through the Town Center development. Beginning to the east near Magnolia Avenue and Mission Gorge, the basin continues to collect runoff as it flows westward along Mission Gorge. At its confluence with the alternate channels at Node 630, its flow rate is approximately 110 cfs.
6. "MGS700" - Beginning along Mission Gorge between Cuyamaca Street and Cottonwood Avenue, this run estimates the flow collected and directed north along Cuyamaca in the twin 54" pipes. "User addition" commands are used to include the other systems previously computed along this reach. The outflow for the northern pipe system is about 49 cfs, while the southern pipe is approximately 61 cfs. These amounts are estimates for the proposed changes indicated in the hydraulics discussion of this report.
7. "MGS900" - This run computes the flow that can be expected to occur in the proposed alternate channels along the eastern portion of the Town Center development. This run includes user inputs from several of the other systems including the 649 cfs from the first run. The total estimated runoff into the San Diego River, including area from the Town Center development is 899 cfs at Node 930.

Hydraulics

The hydraulics of the existing storm drainage system in Mission Gorge Road has been modelled using the WSPG computer software which computes the hydraulic grade line throughout the storm drain system. This reach of Mission Gorge Road currently has two parallel systems running in the street that has many interconnections. Both of these systems end in 54" RCPs outletting to the San Diego River. Provided in the back cover is Exhibit "B", a plan view of the existing system within Mission Gorge Road compiled from record information and City comments and Exhibit "D", which shows a partial profile.

Initial computations indicated that the existing 54" RCPs in Cuyamaca Street and Mission Gorge Road have a low carrying capacity due to lack of slope throughout their reach. Most of the pipe slopes within Mission Gorge Road are 0.3 percent or less.

In many reaches, the pipe will already be full when water from the upper watershed reaches the inlets along Mission Gorge Road and is unable to enter the underground system, thereby causing the flooding so typical to the area. Assuming soffit control at the outlet, it was estimated that the 54" pipes will have a capacity of approximately 50 to 70 cfs before they would become full, and the resulting backwater would cause the familiar flooding.

It is recommended that these connecting pipes be adjusted to control the amount of inflow being accepted. In order to control the amount of flow into the existing systems, it is proposed to abandon or remove several of the interconnecting lines while constructing new additional outlets. This will allow the existing systems to handle an amount of flow within their capacities, thereby reducing the flooding. The existing storm drain lines proposed for abandonment are shown on Exhibit "B" and Exhibit "D" in the back cover.

The water surface elevation for each of the two 54" RCP systems was determined using the WSPG program. Four computer runs were made to determine water surface elevations within the existing systems. These runs are included in Part II of the report and are described as follows:

1. "EX-SMG" - Computes the water surface elevation of the existing system, assuming soffit control, using the flow rates as determined from the hydrologic analysis.
2. "EX-NMG" - Computes the water surface elevation of the existing system, assuming soffit control, using the flow rates as determined from the hydrologic analysis.
3. "NMGLAT" - Computes the water surface elevation in the connecting lateral crossing Mission Gorge toward Mission Greens Road using the existing pipe already in place and the hydraulic grad line from run #2 at the junction.

4. "NMGLAP" - Computes the water surface elevation in the connecting lateral crossing Mission Gorge toward Mission Greens Road using a proposed 42" RCP. The beginning hydraulic grade line is again from run #2 at the junction.

Hydrology indicates that Nodes 330 and 730 will generate approximately 64 cfs and that approximately 50 cfs will be generated by Nodes 710 through 722 and Node 240. Results from computer runs 1 and 2 show that by using these amounts of flow, proper freeboard at inlet entrances can be achieved. It is proposed therefore that approximately 64 cfs be collected into the southern system and approximately 50 cfs into the northern system.

Computer runs 3 and 4 estimate the water surface elevation in the connecting lateral to the Mission Greens inlets. Looking at Run 3, which uses the existing 42" x 29" CMPA, it can be easily seen that the existing lateral pipe does not have the needed capacity to handle the 42 cfs being concentrated at Mission Greens and Mission Gorge Roads. Therefore computer run 4 was prepared to estimate the size of a replacement pipe for this lateral. Using a 42" RCP allows the water to enter the system with minimal, if any, ponding as now occurs. The difference in water surface elevations at the entrance between the two runs is 2.1 feet.

In addition to abandonment of some lines, we propose the addition of two additional outlets to the San Diego River. These outlets will be located near Nodes 630 and 800. The proposed underground system at Node 630 will consist of a closed conduit ranging in size from 39" to 69" carrying 58 to 270 cfs respectfully.

Three different open channel alternates are proposed for the eastern outlet. An open channel has been selected for several reasons: (1) the amount of water needed to carry is large (up to 899 cfs) and would require a large underground structure; and (2) the cover over such a structure would probably be minimal due to the flat slopes and require additional strength in the top slab. Both of these would lead to substantially increased costs to the City. All three channel alternates have a maximum planned depth of 5.0 feet.

The first channel is a concrete lined trapezoid channel. This requires a large amount of right-of-way (50') but would be easier to construct than the second alternate. This channel has relatively high velocities (10 - 12 feet per second (fps)).

The second channel is a concrete lined rectangular channel. This channel requires the least amount of right-of-way (39') which would allow maximum development of the site. This channel has velocities 10 - 12 fps.

The third channel is a natural grass lined open channel. This channel requires the greatest amount of right-of-way (83'), has the slowest velocities (4 - 5 fps), and is the easiest to construct.

DISCUSSION AND RECOMMENDATIONS

Our analysis indicates that three storm drain systems are needed to outlet the expected 100-year flows draining to Mission Gorge Road between Cuyamaca Street and Magnolia Avenue. These three systems are the existing dual 54" RCPs in Cuyamaca, a proposed 39" to 69" underground pipe located 700' east of Mission Greens Road, and a third open channel system approximately 600' west of Cottonwood Avenue.

Hydrology shows that the 54" dual pipe system running down Cuyamaca could handle the flows delivered from Nodes 240, 330, 730, and 722. This system has capacity to carry the 110 cfs that would be expected to reach these nodes during a 100-year storm. This would allow for adequate freeboard in the catch basins.

The second system would handle the flows generated from Nodes 430, 440, a small area of Mission Gorge Road, and a portion of the Town Center development. The third system would handle flows generated from the remaining eastern portion of the drainage basin and the eastern portion of the Town Center development.

It is our recommendation to use a double 4' x 8' Reinforced Concrete Box (RCB) culvert beneath Mission Gorge Road emptying into the third system to convey the flows from Node 190 because of the lack of cover and necessary capacity requirements.

It is also recommended that the double 4'x8' RCB culvert, or an open channel of equivalent capacity be extended to Node 180. The current system south of Mission Gorge is only capable of transporting half of the 100 year flow.

The Master Drainage Study prepared in 1990 suggested an interconnection between Buena Vista and Mission Gorge Road using Cottonwood Avenue to relieve the deficient system. This would have required an additional 1300 feet of storm drain in Cottonwood Avenue as well as an additional 600 feet along Mission Gorge Road to connect to the double 4'x8' RCB crossing Mission Gorge Road. The system suggested in this report will require less construction in the public street and will better take advantage of future development. For example, the undeveloped property north of Buena Vista Avenue and west of Cottonwood Avenue currently flows open and needs a 48" pipe or equivalent using the current slopes. This construction will be able to take place concurrently with the new development.

A "Summary of Estimated Costs" is included as Section III. This section includes approximate costs for each of the cost elements associated with the three different alternates. The cost of the underground system is shown separately to allow for easy cost comparison of the three channel alternates. The first alternate includes construction of the box culvert and a concrete lined trapezoidal section. The second uses a lined rectangular section for the downstream reach, and the third alternate uses a natural unlined trapezoidal section.

The estimates to construct the eastern channel range from \$833,000 for Alternate I (Concrete-lined rectangular channel) to \$535,000 for Alternate III (Grass-lined rectangular channel). These estimates do not include \$427,000 for construction of the secondary underground system or an associated cost for any removal or abandonment of existing systems. Estimates do include a 10% contingency for proposed facilities.

BSI

"PROSPE"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/13/92

MISSION GORGE STORM DRAIN SYSTEM 100
CONTRIBUTORY TO THE OPEN CHANNEL INLET AT NODE 190
FILENAME : PROSPE PREPARED 8/13/92

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

+++++
Process from Point/Station 100.000 to Point/Station 110.000
**** 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
[INDUSTRIAL area type]
Initial subarea flow distance = 700.00(Ft.)
Highest elevation = 410.00(Ft.)
Lowest elevation = 392.00(Ft.)
Elevation difference = 18.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 6.95 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9000)*(700.00^.5)/(2.57^(1/3)]= 6.95
Rainfall intensity (I) = 5.325 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.900
Subarea runoff = 15.816(CFS)
Total initial stream area = 3.300(Ac.)

+++++
Process from Point/Station 110.000 to Point/Station 115.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 392.000(Ft.)
End of street segment elevation = 384.000(Ft.)
Length of street segment = 350.000(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 = 18.000(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 = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 23.005(CFS)
 Depth of flow = 0.550(Ft.)
 Average velocity = 4.997(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.03(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 5.00(Ft/s)
 Travel time = 1.17 min. TC = 8.12 min.
 Adding area flow to street
 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
 [INDUSTRIAL area type]
 Rainfall intensity = 4.818(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.900
 Subarea runoff = 13.008(CFS) for 3.000(Ac.)
 Total runoff = 28.824(CFS) Total area = 6.30(Ac.)
 Street flow at end of street = 28.824(CFS)
 Half street flow at end of street = 28.824(CFS)
 Depth of flow = 0.587(Ft.)
 Average velocity = 5.412(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.04(Ft.)
 Flow width (from curb towards crown)= 20.000(Ft.)

++++++
 Process from Point/Station 115.000 to Point/Station 120.000
 **** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 384.000(Ft.)
 End of street segment elevation = 380.000(Ft.)
 Length of street segment = 350.000(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 = 18.000(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 = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 47.812(CFS)
 Depth of flow = 0.774(Ft.)
 Average velocity = 5.259(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.14(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 5.26(Ft/s)
 Travel time = 1.11 min. TC = 9.23 min.

Adding area flow to street
 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
 [INDUSTRIAL area type]
 Note: user entry of impervious value, Ap = 0.950
 Rainfall intensity = 4.436(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
 Subarea runoff = 34.978(CFS) for 8.300(Ac.)
 Total runoff = 63.803(CFS) Total area = 14.60(Ac.)
 Street flow at end of street = 63.803(CFS)
 Half street flow at end of street = 63.803(CFS)
 Depth of flow = 0.862(Ft.)
 Average velocity = 5.875(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.18(Ft.)
 Flow width (from curb towards crown) = 20.000(Ft.)

++++++
 Process from Point/Station 120.000 to Point/Station 120.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
 Stream flow area = 14.600(Ac.)
 Runoff from this stream = 63.803(CFS)
 Time of concentration = 9.23 min.
 Rainfall intensity = 4.436(In/Hr)

++++++
 Process from Point/Station 119.000 to Point/Station 119.000
 **** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.200
 Decimal fraction soil group D = 0.800
 [MOBILE HOMES area type]
 Initial subarea flow distance = 450.00(Ft.)
 Highest elevation = 405.00(Ft.)
 Lowest elevation = 397.00(Ft.)
 Elevation difference = 8.00(Ft.)
 Time of concentration calculated by the urban
 areas overland flow method (App X-C) = 14.81 min.

$TC = [1.8*(1.1-C)*distance^{.5})/(\% slope^{(1/3)})]$
 $TC = [1.8*(1.1-0.6300)*(450.00^{.5})/(1.78^{(1/3)})]= 14.81$
 Rainfall intensity (I) = 3.269 for a 100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.630
 Subarea runoff = 10.503(CFS)
 Total initial stream area = 5.100(Ac.)

++++++
 Process from Point/Station 119.000 to Point/Station 120.000
 **** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 397.000(Ft.)
 End of street segment elevation = 380.000(Ft.)
 Length of street segment = 1000.000(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 = 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 [2] side(s) of the street
 Distance from curb to property line = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(In.)
 Manning's N in gutter = 0.0120
 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 = 18.536(CFS)
 Depth of flow = 0.419(Ft.)
 Average velocity = 4.227(Ft/s)
 Note: depth of flow exceeds top of street crown.
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 12.000(Ft.)
 Flow velocity = 4.23(Ft/s)
 Travel time = 3.94 min. TC = 18.76 min.

Adding area flow to street
 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
 [INDUSTRIAL area type]
 Rainfall intensity = 2.807(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.900
 Subarea runoff = 19.708(CFS) for 7.800(Ac.)
 Total runoff = 30.212(CFS) Total area = 12.90(Ac.)
 Street flow at end of street = 30.212(CFS)
 Half street flow at end of street = 15.106(CFS)
 Depth of flow = 0.490(Ft.)
 Average velocity = 4.949(Ft/s)
 Note: depth of flow exceeds top of street crown.
 Flow width (from curb towards crown)= 12.000(Ft.)

++++++
 Process from Point/Station 120.000 to Point/Station 120.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 12.900(Ac.)

Runoff from this stream = 30.212(CFS)
 Time of concentration = 18.76 min.
 Rainfall intensity = 2.807(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	63.803	9.23	4.436
2	30.212	18.76	2.807
Qmax(1) =			
	1.000 *	1.000 *	63.803) +
	1.000 *	0.492 *	30.212) + = 78.667
Qmax(2) =			
	0.633 *	1.000 *	63.803) +
	1.000 *	1.000 *	30.212) + = 70.591

Total of 2 streams to confluence:

Flow rates before confluence point:

63.803 30.212

Maximum flow rates at confluence using above data:

78.667 70.591

Area of streams before confluence:

14.600 12.900

Results of confluence:

Total flow rate = 78.667(CFS)

Time of concentration = 9.229 min.

Effective stream area after confluence = 27.500(Ac.)

++++
 Process from Point/Station 120.000 to Point/Station 122.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 369.00(Ft.)
 Downstream point/station elevation = 366.00(Ft.)
 Pipe length = 380.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 78.667(CFS)
 Nearest computed pipe diameter = 39.00(In.)
 Calculated individual pipe flow = 78.667(CFS)
 Normal flow depth in pipe = 35.63(In.)
 Flow top width inside pipe = 21.93(In.)
 Critical Depth = 33.49(In.)
 Pipe flow velocity = 9.89(Ft/s)
 Travel time through pipe = 0.64 min.
 Time of concentration (TC) = 9.87 min.

++++
 Process from Point/Station 120.000 to Point/Station 122.000
 **** SUBAREA FLOW ADDITION ****

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
 [INDUSTRIAL area type]
 Note: user entry of impervious value, Ap = 0.950
 Time of concentration = 9.87 min.

Rainfall intensity = 4.248(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 1.003
Subarea runoff = 19.170(CFS) for 4.500(Ac.)
Total runoff = 97.837(CFS) Total area = 32.00(Ac.)

++++
Process from Point/Station 122.000 to Point/Station 123.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 366.00(Ft.)
Downstream point/station elevation = 362.00(Ft.)
Pipe length = 410.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 97.837(CFS)
Nearest computed pipe diameter = 42.00(In.)
Calculated individual pipe flow = 97.837(CFS)
Normal flow depth in pipe = 33.84(In.)
Flow top width inside pipe = 33.23(In.)
Critical Depth = 36.52(In.)
Pipe flow velocity = 11.77(Ft/s)
Travel time through pipe = 0.58 min.
Time of concentration (TC) = 10.45 min.

++++
Process from Point/Station 124.000 to Point/Station 123.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.900
[INDUSTRIAL area type]
Note: user entry of impervious value, Ap = 0.950
Time of concentration = 10.45 min.
Rainfall intensity = 4.094(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.997
Subarea runoff = 16.337(CFS) for 4.000(Ac.)
Total runoff = 114.174(CFS) Total area = 36.00(Ac.)

++++
Process from Point/Station 125.000 to Point/Station 123.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.400
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.600
[INDUSTRIAL area type]
Note: user entry of impervious value, Ap = 0.950
Time of concentration = 10.45 min.
Rainfall intensity = 4.094(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.961
Subarea runoff = 25.564(CFS) for 6.500(Ac.)
Total runoff = 139.738(CFS) Total area = 42.50(Ac.)

++++
Process from Point/Station 123.000 to Point/Station 130.000

**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 362.00(Ft.)
Downstream point/station elevation = 359.00(Ft.)
Pipe length = 390.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 139.738(CFS)
Nearest computed pipe diameter = 51.00(In.)
Calculated individual pipe flow = 139.738(CFS)
Normal flow depth in pipe = 39.42(In.)
Flow top width inside pipe = 42.73(In.)
Critical Depth = 42.04(In.)
Pipe flow velocity = 11.87(Ft/s)
Travel time through pipe = 0.55 min.
Time of concentration (TC) = 11.00 min.

+++++
Process from Point/Station 131.000 to Point/Station 130.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 11.00 min.
Rainfall intensity = 3.962(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 16.184(CFS) for 4.300(Ac.)
Total runoff = 155.922(CFS) Total area = 46.80(Ac.)

+++++
Process from Point/Station 132.000 to Point/Station 130.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.900
[INDUSTRIAL area type]
Note: user entry of impervious value, Ap = 0.950
Time of concentration = 11.00 min.
Rainfall intensity = 3.962(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.997
Subarea runoff = 32.010(CFS) for 8.100(Ac.)
Total runoff = 187.932(CFS) Total area = 54.90(Ac.)

+++++
Process from Point/Station 130.000 to Point/Station 135.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 359.00(Ft.)
Downstream point/station elevation = 355.00(Ft.)
Pipe length = 700.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 187.932(CFS)
Nearest computed pipe diameter = 60.00(In.)
Calculated individual pipe flow = 187.932(CFS)
Normal flow depth in pipe = 46.88(In.)

Flow top width inside pipe = 49.61(In.)
Critical Depth = 47.06(In.)
Pipe flow velocity = 11.41(Ft/s)
Travel time through pipe = 1.02 min.
Time of concentration (TC) = 12.02 min.

++++
Process from Point/Station 130.000 to Point/Station 135.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 12.02 min.
Rainfall intensity = 3.741(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 26.655(CFS) for 7.500(Ac.)
Total runoff = 214.587(CFS) Total area = 62.40(Ac.)

++++
Process from Point/Station 135.000 to Point/Station 135.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 62.400(Ac.)
Runoff from this stream = 214.587(CFS)
Time of concentration = 12.02 min.
Rainfall intensity = 3.741(In/Hr)

++++
Process from Point/Station 136.000 to Point/Station 137.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[MOBILE HOMES area type]
Initial subarea flow distance = 900.00(Ft.)
Highest elevation = 550.00(Ft.)
Lowest elevation = 430.00(Ft.)
Elevation difference = 120.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 13.66 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(%\ slope^{(1/3)})]$
TC = $[1.8*(1.1-0.5000)*(900.00^{.5})/(13.33^{(1/3)})]= 13.66$
Rainfall intensity (I) = 3.444 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.500
Subarea runoff = 9.988(CFS)
Total initial stream area = 5.800(Ac.)

++++
Process from Point/Station 137.000 to Point/Station 138.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 430.000(Ft.)
 End of street segment elevation = 374.000(Ft.)
 Length of street segment = 900.000(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 = 18.000(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 = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 21.181(CFS)
 Depth of flow = 0.463(Ft.)
 Average velocity = 7.175(Ft/s)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 16.809(Ft.)
 Flow velocity = 7.17(Ft/s)
 Travel time = 2.09 min. TC = 15.75 min.
 Adding area flow to street
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.300
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.700
 [MOBILE HOMES area type]
 Rainfall intensity = 3.142(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.605
 Subarea runoff = 24.711(CFS) for 13.000(Ac.)
 Total runoff = 34.699(CFS) Total area = 18.80(Ac.)
 Street flow at end of street = 34.699(CFS)
 Half street flow at end of street = 34.699(CFS)
 Depth of flow = 0.537(Ft.)
 Average velocity = 7.994(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.02(Ft.)
 Flow width (from curb towards crown)= 20.000(Ft.)

++++++
 Process from Point/Station 138.000 to Point/Station 135.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 369.00(Ft.)
 Downstream point/station elevation = 355.00(Ft.)
 Pipe length = 220.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 34.699(CFS)
 Nearest computed pipe diameter = 21.00(In.)
 Calculated individual pipe flow = 34.699(CFS)
 Normal flow depth in pipe = 15.12(In.)
 Flow top width inside pipe = 18.86(In.)
 Critical depth could not be calculated.
 Pipe flow velocity = 18.71(Ft/s)
 Travel time through pipe = 0.20 min.
 Time of concentration (TC) = 15.95 min.

+++++
Process from Point/Station 135.000 to Point/Station 135.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 18.800(Ac.)
Runoff from this stream = 34.699(CFS)
Time of concentration = 15.95 min.
Rainfall intensity = 3.117(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	214.587	12.02	3.741
2	34.699	15.95	3.117
Qmax(1) =			
	1.000 *	1.000 *	214.587) +
	1.000 *	0.754 *	34.699) + = 240.734
Qmax(2) =			
	0.833 *	1.000 *	214.587) +
	1.000 *	1.000 *	34.699) + = 213.487

Total of 2 streams to confluence:
Flow rates before confluence point:
214.587 34.699
Maximum flow rates at confluence using above data:
240.734 213.487
Area of streams before confluence:
62.400 18.800
Results of confluence:
Total flow rate = 240.734(CFS)
Time of concentration = 12.019 min.
Effective stream area after confluence = 81.200(Ac.)

+++++
Process from Point/Station 135.000 to Point/Station 140.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 355.00(Ft.)
Downstream point/station elevation = 351.00(Ft.)
Pipe length = 650.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 240.734(CFS)
Nearest computed pipe diameter = 63.00(In.)
Calculated individual pipe flow = 240.734(CFS)
Normal flow depth in pipe = 53.81(In.)
Flow top width inside pipe = 44.47(In.)
Critical Depth = 52.32(In.)
Pipe flow velocity = 12.22(Ft/s)
Travel time through pipe = 0.89 min.
Time of concentration (TC) = 12.91 min.

+++++
Process from Point/Station 135.000 to Point/Station 140.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 12.91 min.
Rainfall intensity = 3.573(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 22.744(CFS) for 6.700(Ac.)
Total runoff = 263.478(CFS) Total area = 87.90(Ac.)

++++
Process from Point/Station 140.000 to Point/Station 140.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 87.900(Ac.)
Runoff from this stream = 263.478(CFS)
Time of concentration = 12.91 min.
Rainfall intensity = 3.573(In/Hr)

++++
Process from Point/Station 141.500 to Point/Station 141.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.250
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
[MOBILE HOMES area type]
Initial subarea flow distance = 1200.00(Ft.)
Highest elevation = 480.00(Ft.)
Lowest elevation = 380.00(Ft.)
Elevation difference = 100.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 14.99 min.
TC = $[1.8*(1.1-C)*distance^{.5})/(\% slope^{(1/3)})]$
TC = $[1.8*(1.1-0.6125)*(1200.00^{.5})/(8.33^{(1/3)})]= 14.99$
Rainfall intensity (I) = 3.244 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.613
Subarea runoff = 12.915(CFS)
Total initial stream area = 6.500(Ac.)

++++
Process from Point/Station 141.000 to Point/Station 140.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 380.00(Ft.)
Downstream point/station elevation = 351.00(Ft.)
Pipe length = 900.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 12.915(CFS)
Nearest computed pipe diameter = 18.00(In.)
Calculated individual pipe flow = 12.915(CFS)
Normal flow depth in pipe = 10.93(In.)
Flow top width inside pipe = 17.58(In.)
Critical Depth = 16.19(In.)

Pipe flow velocity = 11.49 (Ft/s)
 Travel time through pipe = 1.31 min.
 Time of concentration (TC) = 16.30 min.

++++
 Process from Point/Station 140.000 to Point/Station 140.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 6.500 (Ac.)
 Runoff from this stream = 12.915 (CFS)
 Time of concentration = 16.30 min.
 Rainfall intensity = 3.074 (In/Hr)
 Summary of stream data:

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

1	263.478	12.91	3.573
2	12.915	16.30	3.074

Qmax(1) =
 1.000 * 1.000 * 263.478) +
 1.000 * 0.792 * 12.915) + = 273.704

Qmax(2) =
 0.860 * 1.000 * 263.478) +
 1.000 * 1.000 * 12.915) + = 239.565

Total of 2 streams to confluence:
 Flow rates before confluence point:
 263.478 12.915
 Maximum flow rates at confluence using above data:
 273.704 239.565
 Area of streams before confluence:
 87.900 6.500

Results of confluence:
 Total flow rate = 273.704 (CFS)
 Time of concentration = 12.906 min.
 Effective stream area after confluence = 94.400 (Ac.)

++++
 Process from Point/Station 141.000 to Point/Station 140.000
 **** SUBAREA FLOW ADDITION ****

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
 [INDUSTRIAL area type]
 Note: user entry of impervious value, Ap = 0.950
 Time of concentration = 12.91 min.
 Rainfall intensity = 3.573 (In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 1.003
 Subarea runoff = 20.066 (CFS) for 5.600 (Ac.)
 Total runoff = 293.769 (CFS) Total area = 100.00 (Ac.)

++++

Process from Point/Station 140.000 to Point/Station 150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 351.00(Ft.)
Downstream point/station elevation = 348.00(Ft.)
Pipe length = 650.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 293.769(CFS)
Nearest computed pipe diameter = 72.00(In.)
Calculated individual pipe flow = 293.769(CFS)
Normal flow depth in pipe = 60.47(In.)
Flow top width inside pipe = 52.81(In.)
Critical Depth = 56.19(In.)
Pipe flow velocity = 11.59(Ft/s)
Travel time through pipe = 0.93 min.
Time of concentration (TC) = 13.84 min.

+++++
Process from Point/Station 151.000 to Point/Station 150.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 13.84 min.
Rainfall intensity = 3.416(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 48.997(CFS) for 15.100(Ac.)
Total runoff = 342.766(CFS) Total area = 115.10(Ac.)

+++++
Process from Point/Station 150.000 to Point/Station 160.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 348.00(Ft.)
Downstream point/station elevation = 345.00(Ft.)
Pipe length = 430.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 342.766(CFS)
Nearest computed pipe diameter = 72.00(In.)
Calculated individual pipe flow = 342.766(CFS)
Normal flow depth in pipe = 57.09(In.)
Flow top width inside pipe = 58.35(In.)
Critical Depth = 60.24(In.)
Pipe flow velocity = 14.25(Ft/s)
Travel time through pipe = 0.50 min.
Time of concentration (TC) = 14.34 min.

+++++
Process from Point/Station 161.000 to Point/Station 160.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]

Note: user entry of impervious value, $A_p = 0.950$
Time of concentration = 14.34 min.
Rainfall intensity = 3.338(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, $Q=KCIA$, $C = 1.003$
Subarea runoff = 53.555(CFS) for 16.000(Ac.)
Total runoff = 396.321(CFS) Total area = 131.10(Ac.)

++++
Process from Point/Station 160.000 to Point/Station 170.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 345.00(Ft.)
Downstream point/station elevation = 344.00(Ft.)
Pipe length = 330.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 396.321(CFS)
Nearest computed pipe diameter = 87.00(In.)
Calculated individual pipe flow = 396.321(CFS)
Normal flow depth in pipe = 73.50(In.)
Flow top width inside pipe = 63.00(In.)
Critical Depth = 62.46(In.)
Pipe flow velocity = 10.65(Ft/s)
Travel time through pipe = 0.52 min.
Time of concentration (TC) = 14.86 min.

++++
Process from Point/Station 170.000 to Point/Station 170.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 131.100(Ac.)
Runoff from this stream = 396.321(CFS)
Time of concentration = 14.86 min.
Rainfall intensity = 3.263(In/Hr)

++++
Process from Point/Station 171.000 to Point/Station 161.000
**** INITIAL AREA EVALUATION ****

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
[INDUSTRIAL area type]
Note: user entry of impervious value, $A_p = 0.950$
Time of concentration computed by the
natural watersheds nomograph (App X-A)
 $TC = [11.9 * \text{length}(\text{Mi})^3 / (\text{elevation change})]^{.385} * 60(\text{min/hr})$
Initial subarea flow distance = 850.00(Ft.)
Highest elevation = 366.00(Ft.)
Lowest elevation = 360.00(Ft.)
Elevation difference = 6.00(Ft.)
 $TC = [(11.9 * 0.1610^3) / (6.00)]^{.385} = 9.47$
Rainfall intensity (I) = 4.362 for a 100.0 year storm
Effective runoff coefficient used for area ($Q=KCIA$) is $C = 1.003$
Subarea runoff = 36.742(CFS)
Total initial stream area = 8.400(Ac.)

Process from Point/Station 161.000 to Point/Station 172.000
*** PIPEFLOW TRAVEL TIME (Program estimated size) ***

Upstream point/station elevation = 355.00(Ft.)
Downstream point/station elevation = 353.00(Ft.)
Pipe length = 500.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 36.742(CFS)
Nearest computed pipe diameter = 36.00(In.)
Calculated individual pipe flow = 36.742(CFS)
Normal flow depth in pipe = 25.99(In.)
Flow top width inside pipe = 32.26(In.)
Critical Depth = 23.65(In.)
Pipe flow velocity = 6.72(Ft/s)
Travel time through pipe = 1.24 min.
Time of concentration (TC) = 10.71 min.

Process from Point/Station 161.000 to Point/Station 172.000
*** SUBAREA FLOW ADDITION ***

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
[INDUSTRIAL area type]
Time of concentration = 10.71 min.
Rainfall intensity = 4.029(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 29.092(CFS) for 7.600(Ac.)
Total runoff = 65.834(CFS) Total area = 16.00(Ac.)

Process from Point/Station 172.000 to Point/Station 173.000
*** PIPEFLOW TRAVEL TIME (Program estimated size) ***

Upstream point/station elevation = 353.00(Ft.)
Downstream point/station elevation = 352.00(Ft.)
Pipe length = 180.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 65.834(CFS)
Nearest computed pipe diameter = 39.00(In.)
Calculated individual pipe flow = 65.834(CFS)
Normal flow depth in pipe = 35.44(In.)
Flow top width inside pipe = 22.47(In.)
Critical Depth = 30.99(In.)
Pipe flow velocity = 8.31(Ft/s)
Travel time through pipe = 0.36 min.
Time of concentration (TC) = 11.07 min.

Process from Point/Station 172.000 to Point/Station 173.000
*** SUBAREA FLOW ADDITION ***

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
[INDUSTRIAL area type]
Time of concentration = 11.07 min.
Rainfall intensity = 3.944(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 10.492(CFS) for 2.800(Ac.)
Total runoff = 76.326(CFS) Total area = 18.80(Ac.)

Process from Point/Station 173.000 to Point/Station 174.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 352.00(Ft.)
Downstream point/station elevation = 349.00(Ft.)
Pipe length = 650.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 76.326(CFS)
Nearest computed pipe diameter = 45.00(In.)
Calculated individual pipe flow = 76.326(CFS)
Normal flow depth in pipe = 34.31(In.)
Flow top width inside pipe = 38.30(In.)
Critical Depth = 32.31(In.)
Pipe flow velocity = 8.45(Ft/s)
Travel time through pipe = 1.28 min.
Time of concentration (TC) = 12.36 min.

Process from Point/Station 173.000 to Point/Station 174.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 12.36 min.
Rainfall intensity = 3.675(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 25.487(CFS) for 7.300(Ac.)
Total runoff = 101.812(CFS) Total area = 26.10(Ac.)

Process from Point/Station 174.000 to Point/Station 170.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 349.00(Ft.)
Downstream point/station elevation = 344.00(Ft.)
Pipe length = 700.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 101.812(CFS)
Nearest computed pipe diameter = 45.00(In.)
Calculated individual pipe flow = 101.812(CFS)
Normal flow depth in pipe = 36.75(In.)
Flow top width inside pipe = 34.82(In.)
Critical Depth = 37.05(In.)
Pipe flow velocity = 10.55(Ft/s)
Travel time through pipe = 1.11 min.
Time of concentration (TC) = 13.46 min.

Process from Point/Station 174.000 to Point/Station 170.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 13.46 min.
Rainfall intensity = 3.477(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
Subarea runoff = 17.509(CFS) for 5.300(Ac.)
Total runoff = 119.321(CFS) Total area = 31.40(Ac.)

Process from Point/Station 170.000 to Point/Station 170.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 31.400(Ac.)
Runoff from this stream = 119.321(CFS)
Time of concentration = 13.46 min.
Rainfall intensity = 3.477(In/Hr)

Process from Point/Station 175.000 to Point/Station 175.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 250.00(Ft.)
Highest elevation = 354.00(Ft.)
Lowest elevation = 352.00(Ft.)
Elevation difference = 2.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 16.86 min.
TC = $[1.8 * (1.1 - C) * \text{distance}^{.5}] / (\% \text{ slope}^{(1/3)})$
TC = $[1.8 * (1.1 - 0.5500) * (250.00^{.5})] / (0.80^{(1/3)}) = 16.86$
Rainfall intensity (I) = 3.007 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 1.654(CFS)
Total initial stream area = 1.000(Ac.)

Process from Point/Station 175.000 to Point/Station 176.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 352.000(Ft.)
End of street segment elevation = 351.000(Ft.)
Length of street segment = 550.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 15.000(Ft.)

Distance from crown to crossfall grade break = 13.000(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 [2] side(s) of the street
 Distance from curb to property line = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 5.293(CFS)
 Depth of flow = 0.421(Ft.)
 Average velocity = 1.157(Ft/s)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 14.696(Ft.)
 Flow velocity = 1.16(Ft/s)
 Travel time = 7.92 min. TC = 24.78 min.
 Adding area flow to street
 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
 [SINGLE FAMILY area type]
 Rainfall intensity = 2.346(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.550
 Subarea runoff = 5.677(CFS) for 4.400(Ac.)
 Total runoff = 7.331(CFS) Total area = 5.40(Ac.)
 Street flow at end of street = 7.331(CFS)
 Half street flow at end of street = 3.665(CFS)
 Depth of flow = 0.460(Ft.)
 Average velocity = 1.277(Ft/s)
 Note: depth of flow exceeds top of street crown.
 Flow width (from curb towards crown)= 15.000(Ft.)

++++++
 Process from Point/Station 176.000 to Point/Station 177.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 349.00(Ft.)
 Downstream point/station elevation = 348.00(Ft.)
 Pipe length = 250.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 7.331(CFS)
 Nearest computed pipe diameter = 21.00(In.)
 Calculated individual pipe flow = 7.331(CFS)
 Normal flow depth in pipe = 13.34(In.)
 Flow top width inside pipe = 20.22(In.)
 Critical Depth = 12.03(In.)
 Pipe flow velocity = 4.55(Ft/s)
 Travel time through pipe = 0.92 min.
 Time of concentration (TC) = 25.70 min.

++++++
 Process from Point/Station 176.000 to Point/Station 177.000
 **** SUBAREA FLOW ADDITION ****

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
 [SINGLE FAMILY area type]
 Time of concentration = 25.70 min.
 Rainfall intensity = 2.292(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.550
 Subarea runoff = 5.672(CFS) for 4.500(Ac.)
 Total runoff = 13.002(CFS) Total area = 9.90(Ac.)

+++++
 Process from Point/Station 177.000 to Point/Station 170.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 348.00(Ft.)
 Downstream point/station elevation = 346.00(Ft.)
 Pipe length = 270.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 13.002(CFS)
 Nearest computed pipe diameter = 21.00(In.)
 Calculated individual pipe flow = 13.002(CFS)
 Normal flow depth in pipe = 16.41(In.)
 Flow top width inside pipe = 17.36(In.)
 Critical Depth = 16.11(In.)
 Pipe flow velocity = 6.45(Ft/s)
 Travel time through pipe = 0.70 min.
 Time of concentration (TC) = 26.39 min.

+++++
 Process from Point/Station 177.000 to Point/Station 170.000
 **** SUBAREA FLOW ADDITION ****

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
 [SINGLE FAMILY area type]
 Time of concentration = 26.39 min.
 Rainfall intensity = 2.252(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.550
 Subarea runoff = 9.662(CFS) for 7.800(Ac.)
 Total runoff = 22.665(CFS) Total area = 17.70(Ac.)

+++++
 Process from Point/Station 170.000 to Point/Station 170.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3
 Stream flow area = 17.700(Ac.)
 Runoff from this stream = 22.665(CFS)
 Time of concentration = 26.39 min.
 Rainfall intensity = 2.252(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	396.321	14.86	3.263

2	119.321	13.46		3.477
3	22.665	26.39		2.252
Qmax(1) =				
	1.000 *	1.000 *	396.321)	+
	0.938 *	1.000 *	119.321)	+
	1.000 *	0.563 *	22.665)	+ = 521.031
Qmax(2) =				
	1.000 *	0.906 *	396.321)	+
	1.000 *	1.000 *	119.321)	+
	1.000 *	0.510 *	22.665)	+ = 489.898
Qmax(3) =				
	0.690 *	1.000 *	396.321)	+
	0.648 *	1.000 *	119.321)	+
	1.000 *	1.000 *	22.665)	+ = 373.552

Total of 3 streams to confluence:
Flow rates before confluence point:
396.321 119.321 22.665
Maximum flow rates at confluence using above data:
521.031 489.898 373.552
Area of streams before confluence:
131.100 31.400 17.700
Results of confluence:
Total flow rate = 521.031(CFS)
Time of concentration = 14.860 min.
Effective stream area after confluence = 180.200(Ac.)

+++++
Process from Point/Station 178.000 to Point/Station 170.000
**** SUBAREA FLOW ADDITION ****

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
[MULTI - UNITS area type]
Time of concentration = 14.86 min.
Rainfall intensity = 3.263(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.700
Subarea runoff = 5.938(CFS) for 2.600(Ac.)
Total runoff = 526.969(CFS) Total area = 182.80(Ac.)

+++++
Process from Point/Station 179.000 to Point/Station 170.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 14.86 min.
Rainfall intensity = 3.263(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 6.378(CFS) for 2.300(Ac.)
Total runoff = 533.348(CFS) Total area = 185.10(Ac.)

+++++
Process from Point/Station 170.000 to Point/Station 180.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 343.00(Ft.)
Downstream point elevation = 342.00(Ft.)
Channel length thru subarea = 600.00(Ft.)
Channel base width = 15.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 10.000(Ft.)
Flow(q) thru subarea = 533.348(CFS)
Depth of flow = 4.438(Ft.)
Average velocity = 8.012(Ft/s)
Channel flow top width = 15.000(Ft.)
Flow Velocity = 8.01(Ft/s)
Travel time = 1.25 min.
Time of concentration = 16.11 min.
Critical depth = 3.406(Ft.)

+++++
Process from Point/Station 180.000 to Point/Station 180.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 185.100(Ac.)
Runoff from this stream = 533.348(CFS)
Time of concentration = 16.11 min.
Rainfall intensity = 3.097(In/Hr)

+++++
Process from Point/Station 181.000 to Point/Station 182.000
**** INITIAL AREA EVALUATION ****

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
[INDUSTRIAL area type]
Initial subarea flow distance = 800.00(Ft.)
Highest elevation = 372.00(Ft.)
Lowest elevation = 351.00(Ft.)
Elevation difference = 21.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.54 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(%\ slope^{(1/3)})]$
TC = $[1.8*(1.1-0.9500)*(800.00^{.5})/(2.63^{(1/3)})]$ = 5.54
Rainfall intensity (I) = 6.168 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff = 48.635(CFS)
Total initial stream area = 8.300(Ac.)

+++++
Process from Point/Station 182.000 to Point/Station 183.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 351.000(Ft.)
 End of street segment elevation = 350.000(Ft.)
 Length of street segment = 250.000(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 = 18.000(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 = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 67.386(CFS)
 Depth of flow = 1.090(Ft.)
 Average velocity = 4.351(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.30(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 4.35(Ft/s)
 Travel time = 0.96 min. TC = 6.49 min.
 Adding area flow to street
 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
 [INDUSTRIAL area type]
 Rainfall intensity = 5.565(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
 Subarea runoff = 33.834(CFS) for 6.400(Ac.)
 Total runoff = 82.470(CFS) Total area = 14.70(Ac.)
 Street flow at end of street = 82.470(CFS)
 Half street flow at end of street = 82.470(CFS)
 Depth of flow = 1.191(Ft.)
 Average velocity = 4.706(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.35(Ft.)
 Flow width (from curb towards crown)= 20.000(Ft.)

++++++
 Process from Point/Station 183.000 to Point/Station 180.000
 *** PIPEFLOW TRAVEL TIME (Program estimated size) ***

Upstream point/station elevation = 345.00(Ft.)
 Downstream point/station elevation = 342.00(Ft.)
 Pipe length = 900.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 82.470(CFS)
 Nearest computed pipe diameter = 48.00(In.)
 Calculated individual pipe flow = 82.470(CFS)
 Normal flow depth in pipe = 39.09(In.)
 Flow top width inside pipe = 37.32(In.)
 Critical Depth = 33.04(In.)
 Pipe flow velocity = 7.52(Ft/s)

Travel time through pipe = 1.99 min.
 Time of concentration (TC) = 8.49 min.

++++
 Process from Point/Station 180.000 to Point/Station 180.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 14.700(Ac.)
 Runoff from this stream = 82.470(CFS)
 Time of concentration = 8.49 min.
 Rainfall intensity = 4.682(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	533.348	16.11	3.097
2	82.470	8.49	4.682
Qmax(1) =			
	1.000 *	1.000 *	533.348) +
	0.661 *	1.000 *	82.470) + = 587.899
Qmax(2) =			
	1.000 *	0.527 *	533.348) +
	1.000 *	1.000 *	82.470) + = 363.492

Total of 2 streams to confluence:
 Flow rates before confluence point:
 533.348 82.470
 Maximum flow rates at confluence using above data:
 587.899 363.492
 Area of streams before confluence:
 185.100 14.700
 Results of confluence:
 Total flow rate = 587.899(CFS)
 Time of concentration = 16.108 min.
 Effective stream area after confluence = 199.800(Ac.)

++++
 Process from Point/Station 183.000 to Point/Station 180.000
 **** SUBAREA FLOW ADDITION ****

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
 [COMMERCIAL area type]
 Time of concentration = 16.11 min.
 Rainfall intensity = 3.097(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 42.648(CFS) for 16.200(Ac.)
 Total runoff = 630.548(CFS) Total area = 216.00(Ac.)

++++
 Process from Point/Station 180.000 to Point/Station 190.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 342.00(Ft.)
Downstream point elevation = 338.00(Ft.)
Channel length thru subarea = 600.00(Ft.)
Channel base width = 6.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 10.000(Ft.)
Flow(q) thru subarea = 630.548(CFS)
Depth of flow = 7.766(Ft.)
Average velocity = 13.533(Ft/s)
Channel flow top width = 6.000(Ft.)
Flow Velocity = 13.53(Ft/s)
Travel time = 0.74 min.
Time of concentration = 16.85 min.
Critical depth = 7.000(Ft.)

++++
Process from Point/Station 190.000 to Point/Station 190.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.100
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.900
[COMMERCIAL area type]
Time of concentration = 16.85 min.
Rainfall intensity = 3.009(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.840
Subarea runoff = 18.450(CFS) for 7.300(Ac.)
Total runoff = 648.998(CFS) Total area = 223.30(Ac.)
End of computations, total study area = 223.30 (Ac.)

"MSGRRD"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/07/92

MISSION GORGE STORM DRAIN SYSTEM 200
CONTRIBUTARY TO MISSION GORGE ROAD AT MISSION GREENS ROAD
FILENAME : MSGRRD PREPARED 8/7/91

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

+++++
Process from Point/Station 200.000 to Point/Station 205.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 250.00(Ft.)
Highest elevation = 355.00(Ft.)
Lowest elevation = 353.00(Ft.)
Elevation difference = 2.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 16.86 min.
TC = [1.8*(1.1-C)*distance^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.5500)*(250.00^.5)/(0.80^(1/3))]= 16.86
Rainfall intensity (I) = 3.007 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 1.654(CFS)
Total initial stream area = 1.000(Ac.)

+++++
Process from Point/Station 205.000 to Point/Station 210.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 353.000(Ft.)
End of street segment elevation = 351.000(Ft.)
Length of street segment = 520.000(Ft.)

Height of curb above gutter flowline = 6.0(In.)
 Width of half street (curb to crown) = 15.000(Ft.)
 Distance from crown to crossfall grade break = 13.000(Ft.)
 Slope from gutter to grade break (v/hz) = 0.200
 Slope from grade break to crown (v/hz) = 0.200
 Street flow is on [2] side(s) of the street
 Distance from curb to property line = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 4.962(CFS)
 Depth of flow = 0.467(Ft.)
 Average velocity = 2.500(Ft/s)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 3.501(Ft.)
 Flow velocity = 2.50(Ft/s)
 Travel time = 3.47 min. TC = 20.33 min.
 Adding area flow to street
 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
 [SINGLE FAMILY area type]
 Rainfall intensity = 2.665(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.550
 Subarea runoff = 5.864(CFS) for 4.000(Ac.)
 Total runoff = 7.518(CFS) Total area = 5.00(Ac.)
 Street flow at end of street = 7.518(CFS)
 Half street flow at end of street = 3.759(CFS)
 Depth of flow = 0.565(Ft.)
 Average velocity = 2.761(Ft/s)
 Warning: depth of flow exceeds top of curb
 Distance that curb overflow reaches into property = 0.03(Ft.)
 Flow width (from curb towards crown)= 3.992(Ft.)

++++++
 Process from Point/Station 210.000 to Point/Station 220.000
 *** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ***

Top of street segment elevation = 351.000(Ft.)
 End of street segment elevation = 350.000(Ft.)
 Length of street segment = 300.000(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 = 18.000(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 = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 10.375(CFS)

Depth of flow = 0.577(Ft.)
 Average velocity = 2.023(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.04(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 2.02(Ft/s)
 Travel time = 2.47 min. TC = 22.80 min.

Adding area flow to street
 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
 [SINGLE FAMILY area type]
 Rainfall intensity = 2.475(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.550
 Subarea runoff = 5.174(CFS) for 3.800(Ac.)
 Total runoff = 12.692(CFS) Total area = 8.80(Ac.)
 Street flow at end of street = 12.692(CFS)
 Half street flow at end of street = 12.692(CFS)
 Depth of flow = 0.612(Ft.)
 Average velocity = 2.176(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.06(Ft.)
 Flow width (from curb towards crown) = 20.000(Ft.)

++++++
 Process from Point/Station 220.000 to Point/Station 220.000
 **** SUBAREA FLOW ADDITION ****

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
 [COMMERCIAL area type]
 Time of concentration = 22.80 min.
 Rainfall intensity = 2.475(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 6.943(CFS) for 3.300(Ac.)
 Total runoff = 19.635(CFS) Total area = 12.10(Ac.)

++++++
 Process from Point/Station 220.000 to Point/Station 230.000
 **** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 350.000(Ft.)
 End of street segment elevation = 344.000(Ft.)
 Length of street segment = 650.000(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 = 18.000(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 [2] side(s) of the street
 Distance from curb to property line = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000

Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 26.288(CFS)
 Depth of flow = 0.535(Ft.)
 Average velocity = 3.061(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.02(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 3.06(Ft/s)
 Travel time = 3.54 min. TC = 26.34 min.

Adding area flow to street
 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
 [SINGLE FAMILY area type]
 Rainfall intensity = 2.255(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, $Q=KCIA$, $C = 0.550$
 Subarea runoff = 10.172(CFS) for 8.200(Ac.)
 Total runoff = 29.807(CFS) Total area = 20.30(Ac.)
 Street flow at end of street = 29.807(CFS)
 Half street flow at end of street = 14.903(CFS)
 Depth of flow = 0.553(Ft.)
 Average velocity = 3.197(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.03(Ft.)
 Flow width (from curb towards crown) = 20.000(Ft.)

++++++
 Process from Point/Station 230.000 to Point/Station 240.000
 *** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ***

Top of street segment elevation = 344.000(Ft.)
 End of street segment elevation = 341.000(Ft.)
 Length of street segment = 600.000(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 = 18.000(Ft.)
 Slope from gutter to grade break (v/hz) = 0.020
 Slope from grade break to crown.020
 Street flow is on [2] side(s) of the street
 Distance from curb to property line = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 37.809(CFS)
 Depth of flow = 0.650(Ft.)
 Average velocity = 2.865(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.

Distance that curb overflow reaches into property = 0.08(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 2.86(Ft/s)
 Travel time = 3.49 min. TC = 29.83 min.
 Adding area flow to street
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.500
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.500
 [SINGLE FAMILY area type]
 Rainfall intensity = 2.081(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.500
 Subarea runoff = 11.344(CFS) for 10.900(Ac.)
 Total runoff = 41.151(CFS) Total area = 31.20(Ac.)
 Street flow at end of street = 41.151(CFS)
 Half street flow at end of street = 20.575(CFS)
 Depth of flow = 0.668(Ft.)
 Average velocity = 2.956(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.08(Ft.)
 Flow width (from curb towards crown) = 20.000(Ft.)
 End of computations, total study area = 31.20 (Ac.)

"CUYAMA"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/07/92

MISSION GORGE STORM DRAIN SYSTEM 300
CONTRIBUTARY TO MISSION GORGE ROAD AT CUYAMACA NODE 330
FILENAME : CUYAMA PREPARED 8/7/92

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

+++++
Process from Point/Station 300.000 to Point/Station 310.000
**** INITIAL AREA EVALUATION ****

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
[COMMERCIAL area type]
Initial subarea flow distance = 800.00(Ft.)
Highest elevation = 352.00(Ft.)
Lowest elevation = 348.00(Ft.)
Elevation difference = 4.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 16.04 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*(800.00^.5)/(0.50^(1/3)]= 16.04
Rainfall intensity (I) = 3.106 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff = 15.577(CFS)
Total initial stream area = 5.900(Ac.)

+++++
Process from Point/Station 310.000 to Point/Station 320.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 341.00(Ft.)
Downstream point/station elevation = 338.00(Ft.)
Pipe length = 670.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 15.577(CFS)
Nearest computed pipe diameter = 24.00(In.)
Calculated individual pipe flow = 15.577(CFS)
Normal flow depth in pipe = 20.34(In.)
Flow top width inside pipe = 17.25(In.)
Critical Depth = 17.08(In.)
Pipe flow velocity = 5.48(Ft/s)
Travel time through pipe = 2.04 min.
Time of concentration (TC) = 18.07 min.

++++
Process from Point/Station 310.000 to Point/Station 320.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.200
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.800
[COMMERCIAL area type]
Time of concentration = 18.07 min.
Rainfall intensity = 2.876(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.830
Subarea runoff = 30.312(CFS) for 12.700(Ac.)
Total runoff = 45.889(CFS) Total area = 18.60(Ac.)

++++
Process from Point/Station 320.000 to Point/Station 330.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 338.00(Ft.)
Downstream point/station elevation = 336.00(Ft.)
Pipe length = 600.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.889(CFS)
Nearest computed pipe diameter = 39.00(In.)
Calculated individual pipe flow = 45.889(CFS)
Normal flow depth in pipe = 30.75(In.)
Flow top width inside pipe = 31.86(In.)
Critical Depth = 25.93(In.)
Pipe flow velocity = 6.55(Ft/s)
Travel time through pipe = 1.53 min.
Time of concentration (TC) = 19.60 min.

++++
Process from Point/Station 320.000 to Point/Station 330.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.950
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.050
[COMMERCIAL area type]
Time of concentration = 19.60 min.
Rainfall intensity = 2.729(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.755
Subarea runoff = 11.332(CFS) for 5.500(Ac.)
Total runoff = 57.221(CFS) Total area = 24.10(Ac.)

Process from Point/Station 331.000 to Point/Station 330.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 346.00(Ft.)
Lowest elevation = 340.00(Ft.)
Elevation difference = 6.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 13.26 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(%\ slope^{(1/3)})]$
TC = $[1.8*(1.1-0.7500)*(500.00^{.5})/(1.20^{(1/3)})]= 13.26$
Rainfall intensity (I) = 3.512 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.750
Subarea runoff = 5.268(CFS)
Total initial stream area = 2.000(Ac.)
End of computations, total study area = 26.10 (Ac.)

"MGS400"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/07/92

MISSION GORGE STORM DRAIN SYSTEM 100
CONTRIBUTION TO MISSION GORGE TOWNE CENTER
FILENAME : MGS400 PREPARED 8/7/92

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

+++++
Process from Point/Station 400.000 to Point/Station 410.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.650 given for subarea
Initial subarea flow distance = 400.00(Ft.)
Highest elevation = 355.00(Ft.)
Lowest elevation = 348.00(Ft.)
Elevation difference = 7.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 13.44 min.
TC = $[1.8 * (1.1 - C) * \text{distance}^{.5} / (\% \text{ slope}^{(1/3)})]$
TC = $[1.8 * (1.1 - 0.6500) * (400.00^{.5}) / (1.75^{(1/3)})] = 13.44$
Rainfall intensity (I) = 3.480 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.650
Subarea runoff = 4.298(CFS)
Total initial stream area = 1.900(Ac.)

+++++
Process from Point/Station 410.000 to Point/Station 420.000
**** IMPROVED CHANNEL TRAVEL TIME ****

'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 3.000(Ft.)
Flow(q) thru subarea = 4.298(CFS)
Depth of flow = 0.342(Ft.)
Average velocity = 3.138(Ft/s)
Channel flow top width = 4.000(Ft.)
Flow Velocity = 3.14(Ft/s)

Travel time = 3.08 min.
Time of concentration = 16.52 min.
Critical depth = 0.328(Ft.)

++++
Process from Point/Station 410.000 to Point/Station 420.000
**** SUBAREA FLOW ADDITION ****

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
[MOBILE HOMES area type]
Time of concentration = 16.52 min.
Rainfall intensity = 3.047(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.650
Subarea runoff = 28.518(CFS) for 14.400(Ac.)
Total runoff = 32.816(CFS) Total area = 16.30(Ac.)

++++
Process from Point/Station 420.000 to Point/Station 430.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 345.00(Ft.)
Downstream point elevation = 337.00(Ft.)
Channel length thru subarea = 620.00(Ft.)
Channel base width = 4.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 32.816(CFS)
Depth of flow = 0.969(Ft.)
Average velocity = 8.467(Ft/s)
Channel flow top width = 4.000(Ft.)
Flow Velocity = 8.47(Ft/s)
Travel time = 1.22 min.
Time of concentration = 17.74 min.
Critical depth = 1.281(Ft.)

++++
Process from Point/Station 420.000 to Point/Station 430.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.750
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.250
[COMMERCIAL area type]
Time of concentration = 17.74 min.
Rainfall intensity = 2.910(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.775
Subarea runoff = 17.365(CFS) for 7.700(Ac.)
Total runoff = 50.181(CFS) Total area = 24.00(Ac.)

++++

Process from Point/Station 430.000 to Point/Station 440.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 338.00(Ft.)
Downstream point/station elevation = 337.00(Ft.)
Pipe length = 200.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 50.181(CFS)
Nearest computed pipe diameter = 36.00(In.)
Calculated individual pipe flow = 50.181(CFS)
Normal flow depth in pipe = 32.25(In.)
Flow top width inside pipe = 21.99(In.)
Critical Depth = 27.65(In.)
Pipe flow velocity = 7.51(Ft/s)
Travel time through pipe = 0.44 min.
Time of concentration (TC) = 18.19 min.

+++++
Process from Point/Station 440.000 to Point/Station 440.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.250
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
[MULTI - UNITS area type]
Time of concentration = 18.19 min.
Rainfall intensity = 2.864(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.650
Subarea runoff = 8.005(CFS) for 4.300(Ac.)
Total runoff = 58.186(CFS) Total area = 28.30(Ac.)

+++++
Process from Point/Station 440.000 to Point/Station 440.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 28.300(Ac.)
Runoff from this stream = 58.186(CFS)
Time of concentration = 18.19 min.
Rainfall intensity = 2.864(In/Hr)

+++++
Process from Point/Station 523.000 to Point/Station 523.000
**** INITIAL AREA EVALUATION ****

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
[MULTI - UNITS area type]
Initial subarea flow distance = 200.00(Ft.)
Highest elevation = 350.00(Ft.)
Lowest elevation = 348.00(Ft.)
Elevation difference = 2.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 10.18 min.
TC = [1.8*(1.1-C)*distance^.5]/(% slope^(1/3))

TC = $[1.8*(1.1-0.7000)*(200.00^{.5})/(1.00^{(1/3)})]$ = 10.18
Rainfall intensity (I) = 4.163 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 2.914(CFS)
Total initial stream area = 1.000(Ac.)

++++
Process from Point/Station 523.000 to Point/Station 525.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 348.000(Ft.)
End of street segment elevation = 346.000(Ft.)
Length of street segment = 700.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 30.000(Ft.)
Distance from crown to crossfall grade break = 28.000(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 = 5.000(Ft.)
Slope from curb to property line (v/hz) = 2.000
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(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 = 5.975(CFS)
Depth of flow = 0.504(Ft.)
Average velocity = 1.622(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 0.00(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 18.859(Ft.)
Flow velocity = 1.62(Ft/s)
Travel time = 7.19 min. TC = 17.37 min.

Adding area flow to street
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.200
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.800
[MULTI - UNITS area type]
Rainfall intensity = 2.950(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.660
Subarea runoff = 4.088(CFS) for 2.100(Ac.)
Total runoff = 7.003(CFS) Total area = 3.10(Ac.)
Street flow at end of street = 7.003(CFS)
Half street flow at end of street = 7.003(CFS)
Depth of flow = 0.529(Ft.)
Average velocity = 1.675(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property = 0.01(Ft.)
Flow width (from curb towards crown) = 20.136(Ft.)

++++
Process from Point/Station 525.000 to Point/Station 702.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 341.00(Ft.)

Downstream point/station elevation = 340.00(Ft.)
 Pipe length = 300.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 7.003(CFS)
 Nearest computed pipe diameter = 21.00(In.)
 Calculated individual pipe flow = 7.003(CFS)
 Normal flow depth in pipe = 13.76(In.)
 Flow top width inside pipe = 19.96(In.)
 Critical Depth = 11.73(In.)
 Pipe flow velocity = 4.19(Ft/s)
 Travel time through pipe = 1.19 min.
 Time of concentration (TC) = 18.57 min.

++++++
 Process from Point/Station 701.000 to Point/Station 702.000
 **** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.600
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.400
 [COMMERCIAL area type]
 Time of concentration = 18.57 min.
 Rainfall intensity = 2.826(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.790
 Subarea runoff = 11.386(CFS) for 5.100(Ac.)
 Total runoff = 18.388(CFS) Total area = 8.20(Ac.)

++++++
 Process from Point/Station 702.000 to Point/Station 440.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 340.00(Ft.)
 Downstream point/station elevation = 338.00(Ft.)
 Pipe length = 475.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 18.388(CFS)
 Nearest computed pipe diameter = 27.00(In.)
 Calculated individual pipe flow = 18.388(CFS)
 Normal flow depth in pipe = 20.30(In.)
 Flow top width inside pipe = 23.33(In.)
 Critical Depth = 17.99(In.)
 Pipe flow velocity = 5.73(Ft/s)
 Travel time through pipe = 1.38 min.
 Time of concentration (TC) = 19.95 min.

++++++
 Process from Point/Station 440.000 to Point/Station 440.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 8.200(Ac.)
 Runoff from this stream = 18.388(CFS)
 Time of concentration = 19.95 min.
 Rainfall intensity = 2.698(In/Hr)
 Summary of stream data:

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

1	58.186	18.19	2.864
2	18.388	19.95	2.698
Qmax(1) =			
	1.000 *	1.000 *	58.186) +
	1.000 *	0.912 *	18.388) + = 74.950
Qmax(2) =			
	0.942 *	1.000 *	58.186) +
	1.000 *	1.000 *	18.388) + = 73.205

Total of 2 streams to confluence:
Flow rates before confluence point:
58.186 18.388
Maximum flow rates at confluence using above data:
74.950 73.205
Area of streams before confluence:
28.300 8.200

Results of confluence:
Total flow rate = 74.950(CFS)
Time of concentration = 18.187 min.
Effective stream area after confluence = 36.500(Ac.)

++++
Process from Point/Station 440.000 to Point/Station 800.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 338.00(Ft.)
Downstream point/station elevation = 337.00(Ft.)
Pipe length = 100.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 74.950(CFS)
Nearest computed pipe diameter = 39.00(In.)
Calculated individual pipe flow = 74.950(CFS)
Normal flow depth in pipe = 29.16(In.)
Flow top width inside pipe = 33.88(In.)
Critical Depth = 32.81(In.)
Pipe flow velocity = 11.28(Ft/s)
Travel time through pipe = 0.15 min.
Time of concentration (TC) = 18.34 min.

++++
Process from Point/Station 800.000 to Point/Station 800.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 36.500(Ac.)
Runoff from this stream = 74.950(CFS)
Time of concentration = 18.34 min.
Rainfall intensity = 2.849(In/Hr)

++++
Process from Point/Station 630.000 to Point/Station 640.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 300.00(Ft.)
Highest elevation = 348.00(Ft.)
Lowest elevation = 346.00(Ft.)
Elevation difference = 2.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.49 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(\% slope^{(1/3)})]$
TC = $[1.8*(1.1-0.7500)*(300.00^{.5})/(0.67^{(1/3)})]= 12.49$
Rainfall intensity (I) = 3.649 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.750
Subarea runoff = 2.190(CFS)
Total initial stream area = 0.800(Ac.)

+++++
Process from Point/Station 700.000 to Point/Station 710.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 341.00(Ft.)
Downstream point/station elevation = 340.00(Ft.)
Pipe length = 270.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.190(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 2.190(CFS)
Normal flow depth in pipe = 8.00(In.)
Flow top width inside pipe = 14.97(In.)
Critical Depth = 7.09(In.)
Pipe flow velocity = 3.29(Ft/s)
Travel time through pipe = 1.37 min.
Time of concentration (TC) = 13.86 min.

+++++
Process from Point/Station 700.000 to Point/Station 710.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Time of concentration = 13.86 min.
Rainfall intensity = 3.413(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.750
Subarea runoff = 1.792(CFS) for 0.700(Ac.)
Total runoff = 3.981(CFS) Total area = 1.50(Ac.)

+++++
Process from Point/Station 710.000 to Point/Station 800.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 340.00(Ft.)
Downstream point/station elevation = 337.00(Ft.)
Pipe length = 500.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.981(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 3.981(CFS)

Normal flow depth in pipe = 10.10(In.)
 Flow top width inside pipe = 14.07(In.)
 Critical Depth = 9.69(In.)
 Pipe flow velocity = 4.52(Ft/s)
 Travel time through pipe = 1.84 min.
 Time of concentration (TC) = 15.70 min.

++++
 Process from Point/Station 800.000 to Point/Station 800.000
 **** CONFLUENCE OF MINOR STREAMS ****

 Along Main Stream number: 1 in normal stream number 2

Stream flow area = 1.500(Ac.)
 Runoff from this stream = 3.981(CFS)
 Time of concentration = 15.70 min.
 Rainfall intensity = 3.149(In/Hr)

Summary of stream data:

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

1	74.950	18.34	2.849
2	3.981	15.70	3.149

Qmax(1) =

1.000 *	1.000 *	74.950) +	
0.905 *	1.000 *	3.981) + =	78.552

Qmax(2) =

1.000 *	0.856 *	74.950) +	
1.000 *	1.000 *	3.981) + =	68.161

Total of 2 streams to confluence:

Flow rates before confluence point:

74.950 3.981

Maximum flow rates at confluence using above data:

78.552 68.161

Area of streams before confluence:

36.500 1.500

Results of confluence:

Total flow rate = 78.552(CFS)

Time of concentration = 18.335 min.

Effective stream area after confluence = 38.000(Ac.)

++++
 Process from Point/Station 800.000 to Point/Station 810.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

 Upstream point/station elevation = 337.00(Ft.)
 Downstream point/station elevation = 335.00(Ft.)
 Pipe length = 600.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 78.552(CFS)
 Nearest computed pipe diameter = 48.00(In.)
 Calculated individual pipe flow = 78.552(CFS)
 Normal flow depth in pipe = 37.22(In.)
 Flow top width inside pipe = 40.06(In.)
 Critical Depth = 32.21(In.)
 Pipe flow velocity = 7.51(Ft/s)
 Travel time through pipe = 1.33 min.

Time of concentration (TC) = 19.67 min.

++++
Process from Point/Station 810.000 to Point/Station 810.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 38.000(Ac.)
Runoff from this stream = 78.552(CFS)
Time of concentration = 19.67 min.
Rainfall intensity = 2.723(In/Hr)

++++
Process from Point/Station 811.000 to Point/Station 812.000
**** INITIAL AREA EVALUATION ****

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
[COMMERCIAL area type]
Initial subarea flow distance = 350.00(Ft.)
Highest elevation = 340.00(Ft.)
Lowest elevation = 339.00(Ft.)
Elevation difference = 1.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.78 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(\% slope^{(1/3)})]$
TC = $[1.8*(1.1-0.8500)*(350.00^{.5})/(0.29^{(1/3)})]= 12.78$
Rainfall intensity (I) = 3.595 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff = 7.029(CFS)
Total initial stream area = 2.300(Ac.)

++++
Process from Point/Station 812.000 to Point/Station 813.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 341.000(Ft.)
End of street segment elevation = 340.000(Ft.)
Length of street segment = 700.000(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 = 18.000(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 = 5.000(Ft.)
Slope from curb to property line (v/hz) = 2.000
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(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 = 19.254(CFS)
Depth of flow = 0.812(Ft.)
Average velocity = 1.954(Ft/s)

Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 0.16(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 20.000(Ft.)
Flow velocity = 1.95(Ft/s)
Travel time = 5.97 min. TC = 18.75 min.

Adding area flow to street
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
[COMMERCIAL area type]
Rainfall intensity = 2.808(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 19.095(CFS) for 8.000(Ac.)
Total runoff = 26.124(CFS) Total area = 10.30(Ac.)
Street flow at end of street = 26.124(CFS)
Half street flow at end of street = 26.124(CFS)
Depth of flow = 0.912(Ft.)
Average velocity = 2.198(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 0.21(Ft.)
Flow width (from curb towards crown) = 20.000(Ft.)

++++
Process from Point/Station 813.000 to Point/Station 810.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 336.00(Ft.)
Downstream point/station elevation = 335.00(Ft.)
Pipe length = 700.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 26.124(CFS)
Nearest computed pipe diameter = 36.00(In.)
Calculated individual pipe flow = 26.124(CFS)
Normal flow depth in pipe = 30.84(In.)
Flow top width inside pipe = 25.22(In.)
Critical Depth = 19.80(In.)
Pipe flow velocity = 4.05(Ft/s)
Travel time through pipe = 2.88 min.
Time of concentration (TC) = 21.63 min.

++++
Process from Point/Station 814.000 to Point/Station 810.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 21.63 min.
Rainfall intensity = 2.561(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 22.203(CFS) for 10.200(Ac.)
Total runoff = 48.327(CFS) Total area = 20.50(Ac.)

+++++
 Process from Point/Station 810.000 to Point/Station 810.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 20.500(Ac.)
 Runoff from this stream = 48.327(CFS)
 Time of concentration = 21.63 min.
 Rainfall intensity = 2.561(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	78.552	19.67	2.723
2	48.327	21.63	2.561
Qmax(1) =	1.000 *	1.000 *	78.552) +
	1.000 *	0.909 *	48.327) + = 122.494
Qmax(2) =	0.940 *	1.000 *	78.552) +
	1.000 *	1.000 *	48.327) + = 122.204

Total of 2 streams to confluence:
 Flow rates before confluence point:
 78.552 48.327
 Maximum flow rates at confluence using above data:
 122.494 122.204
 Area of streams before confluence:
 38.000 20.500

Results of confluence:
 Total flow rate = 122.494(CFS)
 Time of concentration = 19.667 min.
 Effective stream area after confluence = 58.500(Ac.)

+++++
 Process from Point/Station 815.000 to Point/Station 810.000
 **** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.850 given for subarea
 Time of concentration = 19.67 min.
 Rainfall intensity = 2.723(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 21.757(CFS) for 9.400(Ac.)
 Total runoff = 144.250(CFS) Total area = 67.90(Ac.)

+++++
 Process from Point/Station 810.000 to Point/Station 820.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 335.00(Ft.)
 Downstream point/station elevation = 333.00(Ft.)
 Pipe length = 650.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 144.250(CFS)
 Nearest computed pipe diameter = 60.00(In.)
 Calculated individual pipe flow = 144.250(CFS)

Normal flow depth in pipe = 49.13(In.)
Flow top width inside pipe = 46.23(In.)
Critical Depth = 41.30(In.)
Pipe flow velocity = 8.39(Ft/s)
Travel time through pipe = 1.29 min.
Time of concentration (TC) = 20.96 min.

++++
Process from Point/Station 820.000 to Point/Station 820.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 67.900(Ac.)
Runoff from this stream = 144.250(CFS)
Time of concentration = 20.96 min.
Rainfall intensity = 2.614(In/Hr)

++++
Process from Point/Station 821.000 to Point/Station 822.000
**** INITIAL AREA EVALUATION ****

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
[COMMERCIAL area type]
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 342.00(Ft.)
Lowest elevation = 341.00(Ft.)
Elevation difference = 1.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 17.21 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(%\ slope^{(1/3)})]$
TC = $[1.8*(1.1-0.8500)*(500.00^{.5})/(0.20^{(1/3)})]= 17.21$
Rainfall intensity (I) = 2.968 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff = 8.830(CFS)
Total initial stream area = 3.500(Ac.)

++++
Process from Point/Station 822.000 to Point/Station 823.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 341.000(Ft.)
End of street segment elevation = 339.000(Ft.)
Length of street segment = 850.000(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 = 18.000(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 [2] side(s) of the street
Distance from curb to property line = 5.000(Ft.)
Slope from curb to property line (v/hz) = 2.000
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(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 = 22.076(CFS)
 Depth of flow = 0.618(Ft.)
 Average velocity = 1.852(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.06(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 20.000(Ft.)
 Flow velocity = 1.85(Ft/s)
 Travel time = 7.65 min. TC = 24.86 min.

Adding area flow to street
 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
 [COMMERCIAL area type]
 Rainfall intensity = 2.341(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 20.896(CFS) for 10.500(Ac.)
 Total runoff = 29.726(CFS) Total area = 14.00(Ac.)
 Street flow at end of street = 29.726(CFS)
 Half street flow at end of street = 14.863(CFS)
 Depth of flow = 0.679(Ft.)
 Average velocity = 2.068(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.09(Ft.)
 Flow width (from curb towards crown) = 20.000(Ft.)

++++++
 Process from Point/Station 824.000 to Point/Station 823.000
 **** SUBAREA FLOW ADDITION ****

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
 [COMMERCIAL area type]
 Time of concentration = 24.86 min.
 Rainfall intensity = 2.341(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 39.801(CFS) for 20.000(Ac.)
 Total runoff = 69.527(CFS) Total area = 34.00(Ac.)

++++++
 Process from Point/Station 823.000 to Point/Station 820.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 336.00(Ft.)
 Downstream point/station elevation = 333.00(Ft.)
 Pipe length = 700.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 69.527(CFS)
 Nearest computed pipe diameter = 42.00(In.)
 Calculated individual pipe flow = 69.527(CFS)
 Normal flow depth in pipe = 37.03(In.)
 Flow top width inside pipe = 27.13(In.)

Critical Depth = 31.34(In.)
 Pipe flow velocity = 7.74(Ft/s)
 Travel time through pipe = 1.51 min.
 Time of concentration (TC) = 26.36 min.

++++
 Process from Point/Station 820.000 to Point/Station 820.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 34.000(Ac.)
 Runoff from this stream = 69.527(CFS)
 Time of concentration = 26.36 min.
 Rainfall intensity = 2.254(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	144.250	20.96	2.614
2	69.527	26.36	2.254
Qmax(1) =			
	1.000 *	1.000 *	144.250) +
	1.000 *	0.795 *	69.527) + = 199.522
Qmax(2) =			
	0.862 *	1.000 *	144.250) +
	1.000 *	1.000 *	69.527) + = 193.933

Total of 2 streams to confluence:
 Flow rates before confluence point:
 144.250 69.527
 Maximum flow rates at confluence using above data:
 199.522 193.933
 Area of streams before confluence:
 67.900 34.000
 Results of confluence:
 Total flow rate = 199.522(CFS)
 Time of concentration = 20.959 min.
 Effective stream area after confluence = 101.900(Ac.)

++++
 Process from Point/Station 825.000 to Point/Station 820.000
 **** SUBAREA FLOW ADDITION ****

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
 [COMMERCIAL area type]
 Time of concentration = 20.96 min.
 Rainfall intensity = 2.614(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 22.660(CFS) for 10.200(Ac.)
 Total runoff = 222.181(CFS) Total area = 112.10(Ac.)

++++

Process from Point/Station 827.000 to Point/Station 820.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 20.96 min.
Rainfall intensity = 2.614(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 17.994(CFS) for 8.100(Ac.)
Total runoff = 240.176(CFS) Total area = 120.20(Ac.)

+++++
Process from Point/Station 828.000 to Point/Station 820.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 20.96 min.
Rainfall intensity = 2.614(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 29.991(CFS) for 13.500(Ac.)
Total runoff = 270.166(CFS) Total area = 133.70(Ac.)

+++++
Process from Point/Station 820.000 to Point/Station 830.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 333.00(Ft.)
Downstream point/station elevation = 330.00(Ft.)
Pipe length = 600.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 270.166(CFS)
Nearest computed pipe diameter = 69.00(In.)
Calculated individual pipe flow = 270.166(CFS)
Normal flow depth in pipe = 57.19(In.)
Flow top width inside pipe = 51.98(In.)
Critical Depth = 54.50(In.)
Pipe flow velocity = 11.73(Ft/s)
Travel time through pipe = 0.85 min.
Time of concentration (TC) = 21.81 min.
End of computations, total study area = 133.70 (Ac.)

"MGS500"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/07/92

MISSION GORGE STORM DRAIN SYSTEM 500 AND 600
CONTRIBUTARY TO THE EASTERN CHANNEL THROUGH TOWNE CENTER
FILENAME : MGS500 PREPARED 8/7/92

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

+++++
Process from Point/Station 500.000 to Point/Station 510.000
**** INITIAL AREA EVALUATION ****

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
[COMMERCIAL area type]
Initial subarea flow distance = 900.00(Ft.)
Highest elevation = 380.00(Ft.)
Lowest elevation = 368.00(Ft.)
Elevation difference = 12.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.27 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*(900.00^.5)/(1.33^(1/3)]= 12.27
Rainfall intensity (I) = 3.692 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff = 28.875(CFS)
Total initial stream area = 9.200(Ac.)

+++++
Process from Point/Station 510.000 to Point/Station 515.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 361.00(Ft.)
Downstream point/station elevation = 355.00(Ft.)
Pipe length = 730.00(Ft.) Manning's N = 0.013

No. of pipes = 1 Required pipe flow = 28.875(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 28.875(CFS)
Normal flow depth in pipe = 22.88(In.)
Flow top width inside pipe = 19.43(In.)
Critical Depth = 22.38(In.)
Pipe flow velocity = 8.03(Ft/s)
Travel time through pipe = 1.51 min.
Time of concentration (TC) = 13.78 min.

+++++
Process from Point/Station 510.000 to Point/Station 515.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 13.78 min.
Rainfall intensity = 3.425(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 13.975(CFS) for 4.800(Ac.)
Total runoff = 42.850(CFS) Total area = 14.00(Ac.)

+++++
Process from Point/Station 515.000 to Point/Station 520.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 355.00(Ft.)
Downstream point/station elevation = 343.00(Ft.)
Pipe length = 1100.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 42.850(CFS)
Nearest computed pipe diameter = 30.00(In.)
Calculated individual pipe flow = 42.850(CFS)
Normal flow depth in pipe = 24.61(In.)
Flow top width inside pipe = 23.04(In.)
Critical Depth = 26.23(In.)
Pipe flow velocity = 9.95(Ft/s)
Travel time through pipe = 1.84 min.
Time of concentration (TC) = 15.62 min.

+++++
Process from Point/Station 515.000 to Point/Station 520.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 15.62 min.
Rainfall intensity = 3.159(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 19.333(CFS) for 7.200(Ac.)
Total runoff = 62.183(CFS) Total area = 21.20(Ac.)

+++++
Process from Point/Station 520.000 to Point/Station 520.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 21.200(Ac.)
Runoff from this stream = 62.183(CFS)
Time of concentration = 15.62 min.
Rainfall intensity = 3.159(In/Hr)

+++++
Process from Point/Station 521.000 to Point/Station 522.000
**** INITIAL AREA EVALUATION ****

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
[INDUSTRIAL area type]
Initial subarea flow distance = 800.00(Ft.)
Highest elevation = 372.00(Ft.)
Lowest elevation = 360.00(Ft.)
Elevation difference = 12.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 6.67 min.
TC = $[1.8*(1.1-C)*distance^{.5}/(\% slope^{(1/3)})]$
TC = $[1.8*(1.1-0.9500)*(800.00^{.5})/(1.50^{(1/3)})]$ = 6.67
Rainfall intensity (I) = 5.469 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff = 30.133(CFS)
Total initial stream area = 5.800(Ac.)

+++++
Process from Point/Station 522.000 to Point/Station 520.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 353.00(Ft.)
Downstream point/station elevation = 343.00(Ft.)
Pipe length = 900.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 30.133(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 30.133(CFS)
Normal flow depth in pipe = 20.46(In.)
Flow top width inside pipe = 23.13(In.)
Critical Depth = 22.80(In.)
Pipe flow velocity = 9.32(Ft/s)
Travel time through pipe = 1.61 min.
Time of concentration (TC) = 8.28 min.

+++++
Process from Point/Station 522.000 to Point/Station 520.000
**** SUBAREA FLOW ADDITION ****

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
 [INDUSTRIAL area type]
 Time of concentration = 8.28 min.
 Rainfall intensity = 4.757(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.950
 Subarea runoff = 16.270(CFS) for 3.600(Ac.)
 Total runoff = 46.403(CFS) Total area = 9.40(Ac.)

+++++
 Process from Point/Station 520.000 to Point/Station 520.000
 **** SUBAREA FLOW ADDITION ****

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
 [INDUSTRIAL area type]
 Note: user entry of impervious value, Ap = 0.950
 Time of concentration = 8.28 min.
 Rainfall intensity = 4.757(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 1.003
 Subarea runoff = 11.449(CFS) for 2.400(Ac.)
 Total runoff = 57.852(CFS) Total area = 11.80(Ac.)

+++++
 Process from Point/Station 520.000 to Point/Station 520.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 11.800(Ac.)
 Runoff from this stream = 57.852(CFS)
 Time of concentration = 8.28 min.
 Rainfall intensity = 4.757(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	62.183	15.62	3.159
2	57.852	8.28	4.757
Qmax(1) =	1.000 * 0.664 *	1.000 *	62.183) + 57.852) + = 100.598
Qmax(2) =	1.000 * 1.000 *	0.530 * 1.000 *	62.183) + 57.852) + = 90.813

Total of 2 streams to confluence:
 Flow rates before confluence point:
 62.183 57.852
 Maximum flow rates at confluence using above data:
 100.598 90.813
 Area of streams before confluence:
 21.200 11.800
 Results of confluence:
 Total flow rate = 100.598(CFS)
 Time of concentration = 15.623 min.

Effective stream area after confluence = 33.000(Ac.)

Process from Point/Station 520.000 to Point/Station 630.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 343.00(Ft.)
Downstream point/station elevation = 342.00(Ft.)
Pipe length = 550.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 100.598(CFS)
Nearest computed pipe diameter = 57.00(In.)
Calculated individual pipe flow = 100.598(CFS)
Normal flow depth in pipe = 48.94(In.)
Flow top width inside pipe = 39.73(In.)
Critical Depth = 34.78(In.)
Pipe flow velocity = 6.21(Ft/s)
Travel time through pipe = 1.48 min.
Time of concentration (TC) = 17.10 min.

Process from Point/Station 630.000 to Point/Station 630.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 33.000(Ac.)
Runoff from this stream = 100.598(CFS)
Time of concentration = 17.10 min.
Rainfall intensity = 2.980(In/Hr)

Process from Point/Station 610.000 to Point/Station 620.000
**** INITIAL AREA EVALUATION ****

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
[COMMERCIAL area type]
Note: user entry of impervious value, $A_p = 0.850$
Initial subarea flow distance = 400.00(Ft.)
Highest elevation = 354.00(Ft.)
Lowest elevation = 349.00(Ft.)
Elevation difference = 5.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 6.58 min.
 $TC = [1.8*(1.1-C)*distance^{.5}]/(%\ slope^{(1/3)})]$
 $TC = [1.8*(1.1-0.9031)*(400.00^{.5})/(1.25^{(1/3)})] = 6.58$
Rainfall intensity (I) = 5.518 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is $C = 0.903$
Subarea runoff = 9.967(CFS)
Total initial stream area = 2.000(Ac.)

Process from Point/Station 620.000 to Point/Station 630.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 343.00(Ft.)
 Downstream point/station elevation = 336.00(Ft.)
 Pipe length = 500.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 9.967(CFS)
 Nearest computed pipe diameter = 18.00(In.)
 Calculated individual pipe flow = 9.967(CFS)
 Normal flow depth in pipe = 12.20(In.)
 Flow top width inside pipe = 16.82(In.)
 Critical Depth = 14.61(In.)
 Pipe flow velocity = 7.82(Ft/s)
 Travel time through pipe = 1.07 min.
 Time of concentration (TC) = 7.65 min.

++++++
 Process from Point/Station 620.000 to Point/Station 630.000
 **** SUBAREA FLOW ADDITION ****

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
 [COMMERCIAL area type]
 Time of concentration = 7.65 min.
 Rainfall intensity = 5.009(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
 Subarea runoff = 5.109(CFS) for 1.200(Ac.)
 Total runoff = 15.076(CFS) Total area = 3.20(Ac.)

++++++
 Process from Point/Station 630.000 to Point/Station 630.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 3.200(Ac.)
 Runoff from this stream = 15.076(CFS)
 Time of concentration = 7.65 min.
 Rainfall intensity = 5.009(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	100.598	17.10	2.980
2	15.076	7.65	5.009
Qmax(1) =			
	1.000 *	1.000 *	100.598) +
	0.595 *	1.000 *	15.076) + = 109.569
Qmax(2) =			
	1.000 *	0.447 *	100.598) +
	1.000 *	1.000 *	15.076) + = 60.057

Total of 2 streams to confluence:
 Flow rates before confluence point:
 100.598 15.076
 Maximum flow rates at confluence using above data:
 109.569 60.057
 Area of streams before confluence:

33.000 3.200
Results of confluence:
Total flow rate = 109.569(CFS)
Time of concentration = 17.099 min.
Effective stream area after confluence = 36.200(Ac.)
End of computations, total study area = 36.20 (Ac.)

"MGS700"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/07/92

MISSION GORGE STORM DRAIN SYSTEM IN CUYAMACA NORTH OF MISSION GORGE
INCLUDES SYSTEMS 200 AND 300 FLOW INTO THE TWIN 54" PIPES
FILENAME : MGS700 PREPARED 8/7/92

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

+++++
Process from Point/Station 710.000 to Point/Station 720.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.850
Initial subarea flow distance = 800.00(Ft.)
Highest elevation = 344.00(Ft.)
Lowest elevation = 342.00(Ft.)
Elevation difference = 2.00(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 24.50 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7969)*(800.00^.5)/(0.25^(1/3))]= 24.50
Rainfall intensity (I) = 2.363 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.797
Subarea runoff = 3.578(CFS)
Total initial stream area = 1.900(Ac.)

+++++
Process from Point/Station 720.000 to Point/Station 721.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 342.000(Ft.)
End of street segment elevation = 341.000(Ft.)

Length of street segment = 400.000(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 = 18.000(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 = 5.000(Ft.)
 Slope from curb to property line (v/hz) = 2.000
 Gutter width = 2.000(Ft.)
 Gutter hike from flowline = 2.000(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 = 4.426(CFS)
 Depth of flow = 0.469(Ft.)
 Average velocity = 1.450(Ft/s)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 17.106(Ft.)
 Flow velocity = 1.45(Ft/s)
 Travel time = 4.60 min. TC = 29.10 min.
 Adding area flow to street
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 [COMMERCIAL area type]
 Note: user entry of impervious value, Ap = 0.850
 Rainfall intensity = 2.115(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.797
 Subarea runoff = 1.517(CFS) for 0.900(Ac.)
 Total runoff = 5.095(CFS) Total area = 2.80(Ac.)
 Street flow at end of street = 5.095(CFS)
 Half street flow at end of street = 5.095(CFS)
 Depth of flow = 0.490(Ft.)
 Average velocity = 1.490(Ft/s)
 Flow width (from curb towards crown)= 18.147(Ft.)

++++++
 Process from Point/Station 721.000 to Point/Station 721.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
 Stream flow area = 2.800(Ac.)
 Runoff from this stream = 5.095(CFS)
 Time of concentration = 29.10 min.
 Rainfall intensity = 2.115(In/Hr)

++++++
 Process from Point/Station 240.000 to Point/Station 721.000
 **** USER DEFINED FLOW INFORMATION AT A POINT ****

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
 [COMMERCIAL area type]
 Rainfall intensity (I) = 2.081 for a 100.0 year storm

User specified values are as follows:

TC = 29.83 min. Rain intensity = 2.08 (In/Hr)
Total area = 31.20 (Ac.) Total runoff = 41.15 (CFS)

++++
Process from Point/Station 721.000 to Point/Station 721.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 31.200 (Ac.)
Runoff from this stream = 41.151 (CFS)
Time of concentration = 29.83 min.
Rainfall intensity = 2.081 (In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	5.095	29.10	2.115
2	41.151	29.83	2.081
Qmax(1) =	1.000 *	1.000 *	5.095) +
	1.000 *	0.975 *	41.151) + = 45.234
Qmax(2) =	0.984 *	1.000 *	5.095) +
	1.000 *	1.000 *	41.151) + = 46.165

Total of 2 streams to confluence:
Flow rates before confluence point:
5.095 41.151
Maximum flow rates at confluence using above data:
45.234 46.165
Area of streams before confluence:
2.800 31.200

Results of confluence:
Total flow rate = 46.165 (CFS)
Time of concentration = 29.830 min.
Effective stream area after confluence = 34.000 (Ac.)

++++
Process from Point/Station 721.000 to Point/Station 722.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 341.000 (Ft.)
End of street segment elevation = 340.000 (Ft.)
Length of street segment = 700.000 (Ft.)
Height of curb above gutter flowline = 8.0 (In.)
Width of half street (curb to crown) = 40.000 (Ft.)
Distance from crown to crossfall grade break = 38.000 (Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.015
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) = 2.000
Gutter width = 2.000 (Ft.)
Gutter hike from flowline = 2.000 (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 = 47.319(CFS)
 Depth of flow = 0.991(Ft.)
 Average velocity = 2.118(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.16(Ft.)
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width = 40.000(Ft.)
 Flow velocity = 2.12(Ft/s)
 Travel time = 5.51 min. TC = 35.34 min.

Adding area flow to street
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000

[COMMERCIAL area type]
 Note: user entry of impervious value, Ap = 0.850
 Rainfall intensity = 1.866(In/Hr) for a 100.0 year storm
 Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.797
 Subarea runoff = 2.528(CFS) for 1.700(Ac.)
 Total runoff = 48.693(CFS) Total area = 35.70(Ac.)
 Street flow at end of street = 48.693(CFS)
 Half street flow at end of street = 48.693(CFS)
 Depth of flow = 1.001(Ft.)
 Average velocity = 2.142(Ft/s)
 Warning: depth of flow exceeds top of curb
 Note: depth of flow exceeds top of street crown.
 Distance that curb overflow reaches into property = 0.17(Ft.)
 Flow width (from curb towards crown)= 40.000(Ft.)

++++++
 Process from Point/Station 330.000 to Point/Station 722.000
 **** USER DEFINED FLOW INFORMATION AT A POINT ****

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
 [COMMERCIAL area type]
 Rainfall intensity (I) = 2.729 for a 100.0 year storm
 User specified values are as follows:
 TC = 19.60 min. Rain intensity = 2.73(In/Hr)
 Total area = 24.10(Ac.) Total runoff = 57.22(CFS)

++++++
 Process from Point/Station 330.000 to Point/Station 722.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
 Stream flow area = 24.100(Ac.)
 Runoff from this stream = 57.221(CFS)
 Time of concentration = 19.60 min.
 Rainfall intensity = 2.729(In/Hr)

+++++

Process from Point/Station 331.000 to Point/Station 722.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[COMMERCIAL area type]
Rainfall intensity (I) = 3.511 for a 100.0 year storm
User specified values are as follows:
TC = 13.26 min. Rain intensity = 3.51 (In/Hr)
Total area = 2.00 (Ac.) Total runoff = 5.27 (CFS)

+++++
Process from Point/Station 331.000 to Point/Station 722.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 2.000 (Ac.)
Runoff from this stream = 5.268 (CFS)
Time of concentration = 13.26 min.
Rainfall intensity = 3.511 (In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	57.221	19.60	2.729
2	5.268	13.26	3.511
Qmax(1) =	1.000 * 0.777 *	1.000 * 1.000 *	57.221) + 5.268) + = 61.315
Qmax(2) =	1.000 * 1.000 *	0.677 * 1.000 *	57.221) + 5.268) + = 43.980

Total of 2 streams to confluence:
Flow rates before confluence point:
57.221 5.268
Maximum flow rates at confluence using above data:
61.315 43.980
Area of streams before confluence:
24.100 2.000
Results of confluence:
Total flow rate = 61.315 (CFS)
Time of concentration = 19.600 min.
Effective stream area after confluence = 26.100 (Ac.)

+++++
Process from Point/Station 722.000 to Point/Station 723.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 332.84 (Ft.)
Downstream point/station elevation = 329.24 (Ft.)
Pipe length = 1200.00 (Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 61.315 (CFS)
Nearest computed pipe diameter = 33.00 (In.)

Calculated individual pipe flow = 30.658(CFS)
Normal flow depth in pipe = 29.25(In.)
Flow top width inside pipe = 20.95(In.)
Critical Depth = 22.09(In.)
Pipe flow velocity = 5.51(Ft/s)
Travel time through pipe = 3.63 min.
Time of concentration (TC) = 23.23 min.

++++
Process from Point/Station 723.000 to Point/Station 723.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.500
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Note: user entry of impervious value, $A_p = 0.850$
Time of concentration = 23.23 min.
Rainfall intensity = 2.446(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, $Q=KCIA$, $C = 0.770$
Subarea runoff = 8.289(CFS) for 4.400(Ac.)
Total runoff = 69.604(CFS) Total area = 30.50(Ac.)

++++
Process from Point/Station 724.000 to Point/Station 723.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Note: user entry of impervious value, $A_p = 0.850$
Time of concentration = 23.23 min.
Rainfall intensity = 2.446(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, $Q=KCIA$, $C = 0.744$
Subarea runoff = 1.819(CFS) for 1.000(Ac.)
Total runoff = 71.423(CFS) Total area = 31.50(Ac.)
End of computations, total study area = 67.20 (Ac.)

"MGS900"

San Diego County Rational Hydrology Program

CivilCADD/CivilDESIGN Engineering Software, (c) 1990 Version 2.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/13/92

MISSION GORGE STORM DRAIN SYSTEM 900
EASTERN CHANNEL THROUGH THE TOWNE CENTER DEVELOPMENT
FILENAME : MGS900 PREPARED 8/7/92

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

BSI Consultants Inc., San Diego, California - S/N 567

Rational hydrology study storm event year is 100.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.500
24 hour precipitation(inches) = 4.900
Adjusted 6 hour precipitation (inches) = 2.500
P6/P24 = 51.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++++
Process from Point/Station 190.000 to Point/Station 525.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.009 for a 100.0 year storm
User specified values are as follows:
TC = 16.85 min. Rain intensity = 3.01(In/Hr)
Total area = 223.30(Ac.) Total runoff = 649.00(CFS)

++++
Process from Point/Station 525.000 to Point/Station 630.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Covered channel
Upstream point elevation = 338.00(Ft.)
Downstream point elevation = 336.00(Ft.)
Channel length thru subarea = 300.00(Ft.)
Channel base width = 17.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 4.000(Ft.)
Flow(q) thru subarea = 648.998(CFS)
Depth of flow = 2.848(Ft.)

Average velocity = 13.404(Ft/s)
 Channel flow top width = 17.000(Ft.)
 Flow Velocity = 13.40(Ft/s)
 Travel time = 0.37 min.
 Time of concentration = 17.22 min.
 Critical depth = 3.563(Ft.)

++++++
 Process from Point/Station 630.000 to Point/Station 630.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
 Stream flow area = 223.300(Ac.)
 Runoff from this stream = 648.998(CFS)
 Time of concentration = 17.22 min.
 Rainfall intensity = 2.966(In/Hr)

++++++
 Process from Point/Station 620.000 to Point/Station 630.000
 **** USER DEFINED FLOW INFORMATION AT A POINT ****

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
 [COMMERCIAL area type]
 Rainfall intensity (I) = 2.980 for a 100.0 year storm
 User specified values are as follows:
 TC = 17.10 min. Rain intensity = 2.98(In/Hr)
 Total area = 36.20(Ac.) Total runoff = 109.57(CFS)

++++++
 Process from Point/Station 630.000 to Point/Station 630.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 36.200(Ac.)
 Runoff from this stream = 109.569(CFS)
 Time of concentration = 17.10 min.
 Rainfall intensity = 2.980(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	648.998	17.22	2.966
2	109.569	17.10	2.980
Qmax(1) =			
	1.000 *	1.000 *	648.998) +
	0.995 *	1.000 *	109.569) + = 758.057
Qmax(2) =			
	1.000 *	0.993 *	648.998) +
	1.000 *	1.000 *	109.569) + = 753.894

Total of 2 streams to confluence:
 Flow rates before confluence point:

648.998 109.569
Maximum flow rates at confluence using above data:

758.057 753.894
Area of streams before confluence:
223.300 36.200

Results of confluence:
Total flow rate = 758.057(CFS)
Time of concentration = 17.223 min.
Effective stream area after confluence = 259.500(Ac.)

+++++
Process from Point/Station 630.000 to Point/Station 910.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 336.00(Ft.)
Downstream point elevation = 335.40(Ft.)
Channel length thru subarea = 300.00(Ft.)
Channel base width = 15.000(Ft.)
Slope or 'Z' of left channel bank = 1.500
Slope or 'Z' of right channel bank = 1.500
Manning's 'N' = 0.015
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 758.057(CFS)
Depth of flow = 4.027(Ft.)
Average velocity = 8.948(Ft/s)
Channel flow top width = 27.080(Ft.)
Flow Velocity = 8.95(Ft/s)
Travel time = 0.56 min.
Time of concentration = 17.78 min.
Critical depth = 3.750(Ft.)

+++++
Process from Point/Station 900.000 to Point/Station 910.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 17.78 min.
Rainfall intensity = 2.906(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.850
Subarea runoff = 17.537(CFS) for 7.100(Ac.)
Total runoff = 775.594(CFS) Total area = 266.60(Ac.)

+++++
Process from Point/Station 920.000 to Point/Station 910.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.850
Time of concentration = 17.78 min.

Rainfall intensity = 2.906(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.903
Subarea runoff = 48.813(CFS) for 18.600(Ac.)
Total runoff = 824.408(CFS) Total area = 285.20(Ac.)

++++
Process from Point/Station 910.000 to Point/Station 910.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 285.200(Ac.)
Runoff from this stream = 824.408(CFS)
Time of concentration = 17.78 min.
Rainfall intensity = 2.906(In/Hr)

++++
Process from Point/Station 950.000 to Point/Station 950.000
**** INITIAL AREA EVALUATION ****

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
[RURAL (greater than 1/2 acre) area type]
Time of concentration computed by the
natural watersheds nomograph (App X-A)
TC = $[11.9 * \text{length}(\text{Mi})^3 / (\text{elevation change})]^{.385} * 60(\text{min/hr}) + 10 \text{ min.}$
Initial subarea flow distance = 600.00(Ft.)
Highest elevation = 368.00(Ft.)
Lowest elevation = 357.00(Ft.)
Elevation difference = 11.00(Ft.)
TC = $[(11.9 * 0.1136^3) / (11.00)]^{.385} = 5.02 + 10 \text{ min.} = 15.02 \text{ min.}$
Rainfall intensity (I) = 3.241 for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff = 5.250(CFS)
Total initial stream area = 3.600(Ac.)

++++
Process from Point/Station 950.000 to Point/Station 960.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 357.000(Ft.)
End of street segment elevation = 352.000(Ft.)
Length of street segment = 750.000(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 = 18.000(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 [2] 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 = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150

Estimated mean flow rate at midpoint of street = 13.781(CFS)
Depth of flow = 0.447(Ft.)
Average velocity = 2.563(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 16.005(Ft.)
Flow velocity = 2.56(Ft/s)
Travel time = 4.88 min. TC = 19.89 min.

Adding area flow to street
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
[RURAL (greater than 1/2 acre) area type]
Rainfall intensity = 2.703(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, Q=KCIA, C = 0.450
Subarea runoff = 14.231(CFS) for 11.700(Ac.)
Total runoff = 19.481(CFS) Total area = 15.30(Ac.)
Street flow at end of street = 19.481(CFS)
Half street flow at end of street = 9.740(CFS)
Depth of flow = 0.495(Ft.)
Average velocity = 2.762(Ft/s)
Flow width (from curb towards crown)= 18.440(Ft.)

+++++
Process from Point/Station 960.000 to Point/Station 970.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 352.00(Ft.)
Downstream point elevation = 350.00(Ft.)
Channel length thru subarea = 600.00(Ft.)
Channel base width = 3.000(Ft.)
Slope or 'Z' of left channel bank = 1.000
Slope or 'Z' of right channel bank = 1.000
Manning's 'N' = 0.030
Maximum depth of channel = 3.000(Ft.)
Flow(q) thru subarea = 19.481(CFS)
Depth of flow = 1.547(Ft.)
Average velocity = 2.770(Ft/s)
Channel flow top width = 6.093(Ft.)
Flow Velocity = 2.77(Ft/s)
Travel time = 3.61 min.
Time of concentration = 23.50 min.
Critical depth = 0.977(Ft.)

+++++
Process from Point/Station 970.000 to Point/Station 910.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 350.00(Ft.)
Downstream point/station elevation = 335.40(Ft.)
Pipe length = 650.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 19.481(CFS)
Nearest computed pipe diameter = 21.00(In.)
Calculated individual pipe flow = 19.481(CFS)
Normal flow depth in pipe = 14.48(In.)
Flow top width inside pipe = 19.43(In.)
Critical Depth = 19.03(In.)
Pipe flow velocity = 11.02(Ft/s)

Travel time through pipe = 0.98 min.
Time of concentration (TC) = 24.49 min.

++++
Process from Point/Station 970.000 to Point/Station 910.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 15.300(Ac.)
Runoff from this stream = 19.481(CFS)
Time of concentration = 24.49 min.
Rainfall intensity = 2.364(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	824.408	17.78	2.906
2	19.481	24.49	2.364
Qmax(1) =	1.000 * 824.408) +	1.000 * 0.726 * 19.481) + =	838.555
Qmax(2) =	0.814 * 824.408) +	1.000 * 1.000 * 19.481) + =	690.174

Total of 2 streams to confluence:
Flow rates before confluence point:
824.408 19.481
Maximum flow rates at confluence using above data:
838.555 690.174
Area of streams before confluence:
285.200 15.300
Results of confluence:
Total flow rate = 838.555(CFS)
Time of concentration = 17.782 min.
Effective stream area after confluence = 300.500(Ac.)

++++
Process from Point/Station 910.000 to Point/Station 920.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 335.40(Ft.)
Downstream point elevation = 333.90(Ft.)
Channel length thru subarea = 750.00(Ft.)
Channel base width = 18.000(Ft.)
Slope or 'Z' of left channel bank = 1.500
Slope or 'Z' of right channel bank = 1.500
Manning's 'N' = 0.015
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 838.555(CFS)
Depth of flow = 3.901(Ft.)
Average velocity = 9.013(Ft/s)
Channel flow top width = 29.702(Ft.)
Flow Velocity = 9.01(Ft/s)
Travel time = 1.39 min.
Time of concentration = 19.17 min.

Critical depth = 3.656(Ft.)

+++++
Process from Point/Station 930.000 to Point/Station 920.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Note: user entry of impervious value, $A_p = 0.850$
Time of concentration = 19.17 min.
Rainfall intensity = 2.768(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, $Q=KCIA$, $C = 0.903$
Subarea runoff = 49.005(CFS) for 19.600(Ac.)
Total runoff = 887.560(CFS) Total area = 320.10(Ac.)

+++++
Process from Point/Station 920.000 to Point/Station 930.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 333.90(Ft.)
Downstream point elevation = 332.00(Ft.)
Channel length thru subarea = 700.00(Ft.)
Channel base width = 18.000(Ft.)
Slope or 'Z' of left channel bank = 1.500
Slope or 'Z' of right channel bank = 1.500
Manning's 'N' = 0.015
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 887.560(CFS)
Depth of flow = 3.696(Ft.)
Average velocity = 10.199(Ft/s)
Channel flow top width = 29.088(Ft.)
Flow Velocity = 10.20(Ft/s)
Travel time = 1.14 min.
Time of concentration = 20.31 min.
Critical depth = 3.781(Ft.)

+++++
Process from Point/Station 940.000 to Point/Station 930.000
**** SUBAREA FLOW ADDITION ****

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
[COMMERCIAL area type]
Time of concentration = 20.31 min.
Rainfall intensity = 2.667(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method, $Q=KCIA$, $C = 0.850$
Subarea runoff = 11.561(CFS) for 5.100(Ac.)
Total runoff = 899.121(CFS) Total area = 325.20(Ac.)
End of computations, total study area = 325.20 (Ac.)

BSI

"EX-SMG"

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

HEADING LINE NO 2 IS -

TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM

HEADING LINE NO 3 IS -

BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	DESCRIPTION	U/S DATA	STATION	INVERT	SECT	W S ELEV								
1	IS A SYSTEM OUTLET		100.00	326.40	1	330.90								
2	IS A REACH		2600.00	333.90	1	N					RADIUS	ANGLE	ANG PT	MAN H
						.013					.00	.00	.00	3
3	IS A WALL ENTRANCE		2600.00	333.90	2	FP								
						.500								
4	IS A JUNCTION		2606.00	333.92	4	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4		
						.013	20.0	.0	333.92	.00	90.00	.00		
5	IS A REACH		2699.00	334.51	4	N					RADIUS	ANGLE	ANG PT	MAN H
						.024					.00	20.00	.00	0
6	IS A WALL ENTRANCE		2699.00	334.51	4	FP								
						.500								
7	IS A JUNCTION		2705.00	334.53	4	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4		
						.024	9.7	.0	334.53	.00	90.00	.00		
8	IS A REACH		2730.00	334.70	4	N					RADIUS	ANGLE	ANG PT	MAN H
						.024					.00	70.00	.00	0
9	IS A WALL ENTRANCE		2730.00	334.70	5	FP								
						.500								
10	IS A JUNCTION		2736.00	334.72	7	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4		
						.024	29.7	.0	334.72	.00	90.00	.00		

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	DESCRIPTION	U/S DATA	STATION	INVERT	SECT		RADIUS	ANGLE	ANG PT	MAN H
ELEMENT NO 11	IS A REACH					N				
			2836.00	334.90	7	.024	.00	.00	.00	0
ELEMENT NO 12	IS A WALL ENTRANCE					FP				
			2836.00	334.90	8	.500				
ELEMENT NO 13	IS A REACH					N				
			2840.00	335.00	8	.014	.00	.00	.00	0
ELEMENT NO 14	IS A SYSTEM HEADWORKS									
			2840.00	335.00	8					

W S ELEV
.00

 For: BSI Consultants, Inc., San Diego, CA - S/N 562

* WARNING NO. 2 ** - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC
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WATER SURFACE PROFILE LISTING

File: EX-SMG.WSP Study Date: 12 - 2 - 1991 Time: 16:41:40
 CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM
 BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

STATION	INVERT	DEPTH	W.S.	Q	VEL	VEL	ENERGY	SUPER	CRITICAL	HGT/	BASE/	ZL	NO	AVBPR
L/ELEM	ELEV	OF FLOW	ELEV			HEAD	GRD.EL.	ELEV	DEPTH	DIA	ID NO.	ZR	PIER	
	SO					SF AVE	HF		NORM DEPTH					
100.00	326.40	4.500	330.900	66.8	4.20	.274	331.174	.00	2.381	4.50	.00	.00	0	.0
.00	.00300					.001147	.00		2.565			.00		
202.27	.00300					.001074	.22		2.565			.00		
302.27	327.01	4.082	331.089	66.8	4.41	.301	331.390	.00	2.381	4.50	.00	.00	0	.0
108.35	.00300					.001045	.11		2.565			.00		
410.62	327.33	3.840	331.172	66.8	4.62	.331	331.503	.00	2.381	4.50	.00	.00	0	.0
89.26	.00300					.001131	.10		2.565			.00		
499.89	327.60	3.640	331.240	66.8	4.85	.365	331.604	.00	2.381	4.50	.00	.00	0	.0
78.90	.00300					.001244	.10		2.565			.00		
578.79	327.84	3.465	331.301	66.8	5.08	.401	331.703	.00	2.381	4.50	.00	.00	0	.0
72.19	.00300					.001381	.10		2.565			.00		
650.98	328.05	3.308	331.361	66.8	5.33	.441	331.802	.00	2.381	4.50	.00	.00	0	.0
68.47	.00300					.001541	.11		2.565			.00		
719.44	328.26	3.164	331.422	66.8	5.59	.485	331.908	.00	2.381	4.50	.00	.00	0	.0
67.11	.00300					.001726	.12		2.565			.00		
786.56	328.46	3.030	331.490	66.8	5.86	.534	332.024	.00	2.381	4.50	.00	.00	0	.0
66.62	.00300					.001940	.13		2.565			.00		
853.18	328.66	2.906	331.566	66.8	6.15	.587	332.153	.00	2.381	4.50	.00	.00	0	.0
71.50	.00300					.002185	.16		2.565			.00		
924.67	328.87	2.789	331.663	66.8	6.45	.646	332.309	.00	2.381	4.50	.00	.00	0	.0
84.89	.00300					.002465	.21		2.565			.00		

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WATER SURFACE PROFILE LISTING

File: EX-SMG.WSP Study Date: 12 - 2 - 1991 Time: 16:41:40

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM
 BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR
1009.57	329.13	2.679	331.808	66.8	6.76	.711	332.518	.00	2.381	4.50	.00	.00	0	.0
149.42	.00300					.002786	.42			2.565		.00		
1158.99	329.58	2.576	332.153	66.8	7.09	.782	332.935	.00	2.381	4.50	.00	.00	0	.0
98.48	.00300					.002973	.29			2.565		.00		
1257.47	329.87	2.565	332.437	66.8	7.13	.790	333.227	.00	2.381	4.50	.00	.00	0	.0
1342.53	.00300					.002989	4.01			2.565		.00		
2600.00	333.90	2.565	336.465	66.8	7.13	.790	337.255	.00	2.381	4.50	.00	.00	0	.0
WALL ENTRANCE												.00		
UNCT STR	.00334					.000662	.00					.00		
2606.00	333.92	3.842	337.762	46.8	3.25	.164	337.927	.00	1.615	3.58	4.02	.00	0	.0
82.02	.00634					.002967	.24			2.264		.00		
2688.02	334.44	3.580	338.020	46.8	3.25	.164	338.185	.00	1.615	3.58	4.02	.00	0	.0
10.98	.00634					.002007	.02			2.264		.00		
WALL ENTRANCE												.00		
2699.00	334.51	3.534	338.044	46.8	3.29	.169	338.213	.00	1.615	3.58	4.02	.00	0	.0
UNCT STR	.00333					.001949	.01					.00		
2705.00	334.53	3.653	338.183	37.1	2.58	.103	338.286	.00	1.384	3.58	4.02	.00	0	.0
17.88	.00680					.001864	.03			1.852		.00		
2722.88	334.65	3.580	338.232	37.1	2.58	.103	338.335	.00	1.384	3.58	4.02	.00	0	.0
7.12	.00680					.001257	.01			1.852		.00		
2730.00	334.70	3.537	338.237	37.1	2.61	.106	338.343	.00	1.384	3.58	4.02	.00	0	.0

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WATER SURFACE PROFILE LISTING

File: EX-SMG.WSP Study Date: 12 - 2 - 1991 Time: 16:41:40

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM
 BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR

WALL ENTRANCE													.00			
UNCT STR	.00333						.000731	.00								.00
2736.00	334.72	3.904	338.624	7.4	.88	.012	338.636	.00	.568		2.75	3.05	.00	0	.0	
100.00	.00180						.000313	.03		1.202					.00	
2836.00	334.90	3.755	338.655	7.4	.88	.012	338.668	.00	.568		2.75	3.05	.00	0	.0	
WALL ENTRANCE													.00			
4.00	.02500						.000015	.00		.280					.00	
2840.00	335.00	3.673	338.673	7.4	.50	.004	338.677	.00	.474		7.00	4.00	.00	0	.0	

WATER SURFACE PROFILE LISTING

File: EX-SMG.WSP Study Date: 12 - 2 - 1991 Time: 16:41:40
 CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM
 BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR
100.00	326.40	4.500	330.900	77.4	4.87	.368	331.268	.00	2.572	4.50	.00	.00	0	.0
.00	.00300					.001539	.00			2.823		.00		
244.03	.00300					.001442	.35			2.823		.00		
344.03	327.13	4.082	331.214	77.4	5.10	.405	331.619	.00	2.572	4.50	.00	.00	0	.0
126.16	.00300					.001402	.18			2.823		.00		
470.20	327.51	3.840	331.351	77.4	5.35	.445	331.796	.00	2.572	4.50	.00	.00	0	.0
104.93	.00300					.001518	.16			2.823		.00		
575.13	327.83	3.640	331.465	77.4	5.61	.489	331.955	.00	2.572	4.50	.00	.00	0	.0
94.79	.00300					.001670	.16			2.823		.00		
669.92	328.11	3.465	331.575	77.4	5.89	.538	332.113	.00	2.572	4.50	.00	.00	0	.0
90.00	.00300					.001854	.17			2.823		.00		
759.92	328.38	3.308	331.688	77.4	6.18	.592	332.280	.00	2.572	4.50	.00	.00	0	.0
91.06	.00300					.002069	.19			2.823		.00		
850.98	328.65	3.164	331.817	77.4	6.48	.652	332.468	.00	2.572	4.50	.00	.00	0	.0
100.93	.00300					.002318	.23			2.823		.00		
951.91	328.96	3.030	331.986	77.4	6.79	.717	332.702	.00	2.572	4.50	.00	.00	0	.0
132.31	.00300					.002604	.34			2.823		.00		
1084.22	329.35	2.906	332.259	77.4	7.13	.788	333.047	.00	2.572	4.50	.00	.00	0	.0
224.24	.00300					.002875	.64			2.823		.00		
1308.45	330.03	2.823	332.848	77.4	7.37	.843	333.692	.00	2.572	4.50	.00	.00	0	.0
1291.55	.00300					.002992	3.86			2.823		.00		

WATER SURFACE PROFILE LISTING

File: EX-SMG.WSP Study Date: 12 - 2 - 1991 Time: 16:41:40
 CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM
 BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR
2600.00	333.90	2.823	336.723	77.4	7.37	.843	337.566	.00	2.572	4.50	.00	.00	0	.0
WALL ENTRANCE												.00		
UNCT STR	.00334					.000899	.01					.00		
2606.00	333.92	4.128	338.048	57.4	3.99	.247	338.295	.00	1.851	3.58	4.02	.00	0	.0
93.00	.00634					.004463	.42		2.648			.00		
WALL ENTRANCE												.00		
2699.00	334.51	3.976	338.486	57.4	3.99	.247	338.733	.00	1.851	3.58	4.02	.00	0	.0
UNCT STR	.00333					.003773	.02					.00		
2705.00	334.53	4.131	338.661	47.7	3.31	.171	338.832	.00	1.636	3.58	4.02	.00	0	.0
25.00	.00680					.003082	.08		2.237			.00		
2730.00	334.70	4.069	338.769	47.7	3.31	.171	338.939	.00	1.636	3.58	4.02	.00	0	.0
WALL ENTRANCE												.00		
UNCT STR	.00333					.001574	.01					.00		
2736.00	334.72	4.526	339.246	18.0	2.15	.072	339.318	.00	1.027	2.75	3.05	.00	0	.0
100.00	.00180					.001851	.19		2.362			.00		
2836.00	334.90	4.531	339.431	18.0	2.15	.072	339.503	.00	1.027	2.75	3.05	.00	0	.0
WALL ENTRANCE												.00		
4.00	.02500					.000055	.00		.495			.00		
2840.00	335.00	4.537	339.537	18.0	.99	.015	339.552	.00	.857	7.00	4.00	.00	0	.0

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WATER SURFACE PROFILE LISTING

File: EX-SMG.WSP Study Date: 12 - 2 - 1991 Time: 16:41:40

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

TO DETERMINE CAPACITY AND PROPOSED CONDITION OF EXISTING SYSTEM

BSI# 07423.00 FILENAME : EX-SMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR

"EX-NMG"

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

HEADING LINE NO 2 IS -

TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM

HEADING LINE NO 3 IS -

BSI# 07423.00 FILENAME : EX-NMG DATED 11/25/91

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	DESCRIPTION	STATION	INVERT	SECT	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4	RADIUS	ANGLE	ANG PT	MAN H
1	IS A SYSTEM OUTLET	100.00	326.40	1								330.90			
2	IS A REACH	2600.00	333.90	1		.013				.00	.00	.00	.00	.00	3
3	IS A WALL ENTRANCE	2600.00	333.90	2		.500									
4	IS A JUNCTION	2606.00	333.92	4	3	0	.013	2.7	.0	333.92	.00	90.00	.00		
5	IS A REACH	2900.00	334.79	4		.024				.00	90.00	.00	.00	.00	0
6	IS A WALL ENTRANCE	2900.00	334.79	5		.500									
7	IS A JUNCTION	2906.00	334.81	4	6	0	.013	1.8	.0	334.81	.00	90.00	.00		
8	IS A REACH	3276.00	335.69	4		.024				.00	.00	.00	.00	.00	0
9	IS A WALL ENTRANCE	3276.00	335.69	5		.500									
10	IS A JUNCTION	3280.00	335.71	9	7	0	.013	42.3	.0	335.71	.00	90.00	.00		

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	DESCRIPTION	U/S DATA	STATION	INVERT	SECT		RADIUS	ANGLE	ANG PT	MAN H
11	IS A REACH					N				
			3700.00	336.79	9	.024	.00	.00	.00	1
12	IS A WALL ENTRANCE					FP				
			3700.00	336.79	10	.500				
13	IS A REACH					N				
			3704.00	337.00	10	.014	.00	.00	.00	0
14	IS A SYSTEM HEADWORKS									
			3704.00	337.00	10		W S ELEV			.00

 For: BSI Consultants, Inc., San Diego, CA - S/N 562

** WARNING NO. 2 ** - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC
 F0515P CD Vers 2.0 PAGE 1

WATER SURFACE PROFILE LISTING
 File: ex-nmg.WSP Study Date: 12 - 4 - 1991 Time: 14:12: 7
 CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM
 BSI# 07423.00 FILENAME : EX-NMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR
100.00	326.40	4.500	330.900	51.1	3.21	.160	331.060	.00	2.069	4.50	.00	.00	0	.0
.00	.00300					.000671	.00		2.182			.00		
169.05	.00300					.000629	.11		2.182			.00		
269.05	326.91	4.082	330.989	51.1	3.37	.176	331.166	.00	2.069	4.50	.00	.00	0	.0
93.93	.00300					.000611	.06		2.182			.00		
362.98	327.19	3.840	331.029	51.1	3.53	.194	331.223	.00	2.069	4.50	.00	.00	0	.0
77.24	.00300					.000662	.05		2.182			.00		
440.22	327.42	3.640	331.061	51.1	3.71	.213	331.274	.00	2.069	4.50	.00	.00	0	.0
67.63	.00300					.000728	.05		2.182			.00		
507.85	327.62	3.465	331.089	51.1	3.89	.235	331.323	.00	2.069	4.50	.00	.00	0	.0
60.92	.00300					.000808	.05		2.182			.00		
568.77	327.81	3.308	331.114	51.1	4.08	.258	331.373	.00	2.069	4.50	.00	.00	0	.0
56.33	.00300					.000902	.05		2.182			.00		
625.09	327.98	3.164	331.139	51.1	4.28	.284	331.423	.00	2.069	4.50	.00	.00	0	.0
53.07	.00300					.001010	.05		2.182			.00		
678.17	328.13	3.030	331.165	51.1	4.49	.312	331.477	.00	2.069	4.50	.00	.00	0	.0
49.74	.00300					.001135	.06		2.182			.00		
727.91	328.28	2.906	331.190	51.1	4.70	.344	331.533	.00	2.069	4.50	.00	.00	0	.0
48.00	.00300					.001279	.06		2.182			.00		
775.92	328.43	2.789	331.217	51.1	4.93	.378	331.595	.00	2.069	4.50	.00	.00	0	.0
46.36	.00300					.001443	.07		2.182			.00		

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 WATER SURFACE PROFILE LISTING
 File: ex-nmg.WSP Study Date: 12 - 4 - 1991 Time: 14:12: 7

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM

BSI# 07423.00 FILENAME : EX-NMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR
822.28	328.57	2.679	331.246	51.1	5.17	.416	331.662	.00	2.069	4.50	.00	.00	0	.0
44.85	.00300					.001630	.07			2.182		.00		
867.12	328.70	2.576	331.277	51.1	5.43	.457	331.735	.00	2.069	4.50	.00	.00	0	.0
45.26	.00300					.001845	.08			2.182		.00		
912.39	328.84	2.478	331.315	51.1	5.69	.503	331.818	.00	2.069	4.50	.00	.00	0	.0
46.95	.00300					.002091	.10			2.182		.00		
959.34	328.98	2.385	331.363	51.1	5.97	.553	331.917	.00	2.069	4.50	.00	.00	0	.0
53.50	.00300					.002371	.13			2.182		.00		
1012.84	329.14	2.296	331.435	51.1	6.26	.609	332.043	.00	2.069	4.50	.00	.00	0	.0
74.86	.00300					.002691	.20			2.182		.00		
1087.70	329.36	2.212	331.575	51.1	6.57	.670	332.245	.00	2.069	4.50	.00	.00	0	.0
82.42	.00300					.002925	.24			2.182		.00		
1170.12	329.61	2.182	331.792	51.1	6.68	.694	332.486	.00	2.069	4.50	.00	.00	0	.0
1429.88	.00300					.002988	4.27			2.182		.00		
2600.00	333.90	2.182	336.082	51.1	6.68	.694	336.776	.00	2.069	4.50	.00	.00	0	.0
WALL ENTRANCE												.00		
UNCT STR	.00334					.000516	.00					.00		
2606.00	333.92	3.165	337.085	48.4	3.44	.184	337.269	.00	1.546	3.92	4.44	.00	0	.0
199.04	.00296					.002312	.46			2.805		.00		
2805.04	334.51	3.017	337.526	48.4	3.61	.203	337.729	.00	1.546	3.92	4.44	.00	0	.0
94.96	.00296					.002506	.24			2.805		.00		

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WATER SURFACE PROFILE LISTING

File: ex-nmg.WSP Study Date: 12 - 4 - 1991 Time: 14:12: 7

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM

BSI# 07423.00 FILENAME : EX-NMG DATED 11/25/91

STATION L/ELEM	INVERT ELEV SO	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD SF AVE	ENERGY GRD.EL. HF	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL ZR	NO PIER	AVBPR
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2900.00	334.79	2.968	337.758	48.4	3.67	.210	337.967	.00	1.546	3.92	4.44	.00	0	.0
WALL ENTRANCE												.00		
ACT STR	.00333					.000449	.00					.00		
2906.00	334.81	3.219	338.029	46.6	3.26	.165	338.194	.00	1.507	3.92	4.44	.00	0	.0
370.00	.00238					.002043	.76		2.964			.00		
3276.00	335.69	3.079	338.769	46.6	3.41	.180	338.950	.00	1.507	3.92	4.44	.00	0	.0
WALL ENTRANCE												.00		
UNCT STR	.00500					.000149	.00					.00		
3280.00	335.71	3.550	339.260	4.3	.30	.001	339.262	.00	.329	3.58	4.02	.00	0	.0
64.66	.00257					.000018	.00		.580			.00		
3344.66	335.88	3.385	339.261	4.3	.32	.002	339.263	.00	.329	3.58	4.02	.00	0	.0
61.70	.00257					.000020	.00		.580			.00		
3406.37	336.03	3.228	339.263	4.3	.33	.002	339.264	.00	.329	3.58	4.02	.00	0	.0
58.88	.00257					.000023	.00		.580			.00		
3465.25	336.19	3.077	339.264	4.3	.35	.002	339.266	.00	.329	3.58	4.02	.00	0	.0
56.20	.00257					.000026	.00		.580			.00		
3521.45	336.33	2.934	339.265	4.3	.36	.002	339.267	.00	.329	3.58	4.02	.00	0	.0
53.64	.00257					.000029	.00		.580			.00		
3575.09	336.47	2.798	339.266	4.3	.38	.002	339.269	.00	.329	3.58	4.02	.00	0	.0
51.21	.00257					.000033	.00		.580			.00		

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WATER SURFACE PROFILE LISTING

File: ex-nmg.WSP Study Date: 12 - 4 - 1991 Time: 14:12: 7

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUJAMACA HYDRAULIC STUDY
TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM

BSI# 07423.00 FILENAME : EX-NMG DATED 11/25/91

STATION	INVERT	DEPTH	W.S.	Q	VEL	VEL	ENERGY	SUPER	CRITICAL	HGT/	BASE/	ZL	NO	AVBPR
L/ELEM	ELEV	OF FLOW	ELEV		HEAD	GRD.EL.	ELEV	ELEV	DEPTH	DIA	ID NO.	PIER		
	SO				SF AVE	HF				NORM DEPTH		ZR		

3626.29	336.60	2.667	339.268	4.3	.40	.002	339.270	.00	.329	3.58	4.02	.00	0	.0
48.90	.00257					.000037	.00		.580			.00		
3675.19	336.73	2.543	339.269	4.3	.42	.003	339.272	.00	.329	3.58	4.02	.00	0	.0
24.81	.00257					.000041	.00		.580			.00		
WALL ENTRANCE												.00		

3700.00	336.79	2.485	339.275	4.3	.35	.002	339.277	.00	.284	7.00	5.00	.00	0	.0
2.20	.05250					.000008	.00			.136		.00		
3702.20	336.91	2.369	339.275	4.3	.36	.002	339.277	.00	.284	7.00	5.00	.00	0	.0
1.80	.05250					.000010	.00			.136		.00		
3704.00	337.00	2.274	339.274	4.3	.38	.002	339.277	.00	.284	7.00	5.00	.00	0	.0

"NMGLAT"

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

HEADING LINE NO 2 IS -

HEADING LINE NO 3 IS -

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM LATERAL

BSI #07423.00 FILENAME : NMGLAT DATED 12/2/91



WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	DESCRIPTION	U/S DATA	STATION	INVERT	SECT	W S ELEV	RADIUS	ANGLE	ANG PT	MAN H
1	IS A SYSTEM OUTLET									
			100.00	335.70	1	339.02				
2	IS A REACH									
			170.00	336.05	1	.024	.00	.00	.00	0
3	IS A WALL ENTRANCE									
			170.00	336.05	2	.500				
4	IS A JUNCTION									
			174.00	336.15	1	0	0	.013	.0	.0
									.00	.00
5	IS A REACH									
			194.00	336.23	1	.024	.00	.00	.00	0
6	IS A WALL ENTRANCE									
			194.00	336.23	2	.500				
7	IS A REACH									
			200.00	336.30	2	.014	.00	.00	.00	0
8	IS A SYSTEM HEADWORKS									
			200.00	336.30	2					

 For: BSI Consultants, Inc., San Diego, CA - S/N 562

** WARNING NO. 2 ** - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC
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WATER SURFACE PROFILE LISTING

File: NMGLAT.WSP Study Date: 12 - 2 - 1991 Time: 16:38:39

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF EXISTING SYSTEM LATERAL
 BSI #07423.00 FILENAME : NMGLAT DATED 12/2/91

STATION	INVERT	DEPTH	W.S.	Q	VEL	VEL	ENERGY	SUPER	CRITICAL	HGT/	BASE/	ZL	NO	AVBPR
L/ELEM	ELEV	OF FLOW	ELEV			HEAD	GRD.EL.	ELEV	DEPTH	DIA	ID NO.	ZR	PIER	
	SO					SF AVE	HF		NORM DEPTH					
100.00	335.70	3.320	339.020	42.3	6.50	.656	339.676	.00	1.973	2.42	2.69	.00	0	.0
70.00	.00500					.020096	1.41			2.419		.00		
170.00	336.05	4.377	340.427	42.3	6.50	.656	341.082	.00	1.973	2.42	2.69	.00	0	.0
WALL ENTRANCE												.00		
UNCT STR	.02500					.003083	.01					.00		
174.00	336.15	4.819	340.969	42.3	6.50	.656	341.625	.00	1.973	2.42	2.69	.00	0	.0
20.00	.00400					.020096	.40			2.419		.00		
194.00	336.23	5.141	341.371	42.3	6.50	.656	342.027	.00	1.973	2.42	2.69	.00	0	.0
WALL ENTRANCE												.00		
6.00	.01166					.000233	.00			1.286		.00		
200.00	336.30	6.043	342.343	42.3	2.00	.062	342.405	.00	1.656	7.00	3.50	.00	0	.0

"NMGLAP"

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY

HEADING LINE NO 2 IS -

TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF SYSTEM LATERAL

HEADING LINE NO 3 IS -

BSI #07423.00 FILENAME: NMGLAP DATED 12/2/91



WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	DESCRIPTION	U/S DATA	STATION	INVERT	SECT	W S ELEV	RADIUS	ANGLE	ANG PT	MAN H
1	IS A SYSTEM OUTLET									
		100.00	335.70		1	339.02				
2	IS A REACH									
		194.00	336.23		1		.00	.00	.00	0
3	IS A WALL ENTRANCE									
		194.00	336.23		2					
4	IS A REACH									
		200.00	336.30		2		.00	.00	.00	0
5	IS A SYSTEM HEADWORKS									
		200.00	336.30		2					

** WARNING NO. 2 ** - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC
 F0515P CD Vers 2.0 PAGE 1

WATER SURFACE PROFILE LISTING

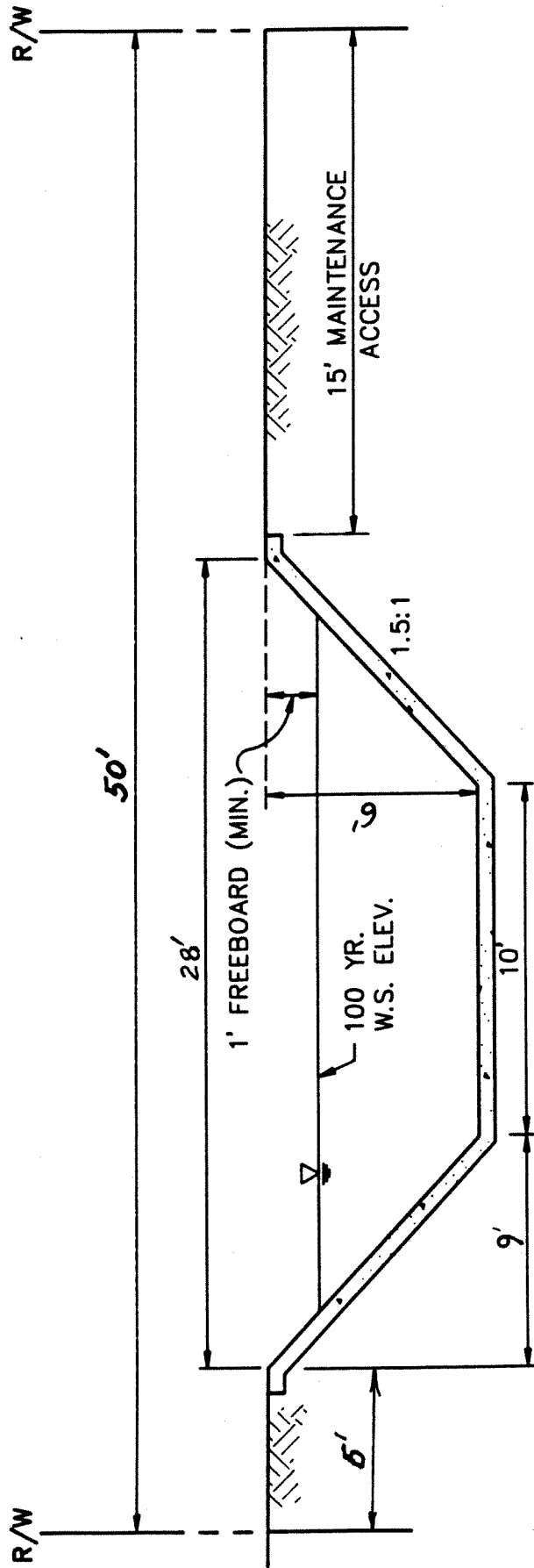
File: NMGLAP.WSP Study Date: 12 - 2 - 1991 Time: 16:33:59

CITY OF SANTEE C.I.P. 91-20 MISSION GORGE / CUYAMACA HYDRAULIC STUDY
 TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF SYSTEM LATERAL

STATION	INVERT	DEPTH	W.S.	Q	VEL	VEL	ENERGY	SUPER	CRITICAL	HGT/	BASE/	ZL	NO	AVBPR
L/ELEM	ELEV	OF FLOW	ELEV			HEAD	GRD.EL.	ELEV	DEPTH	DIA	ID NO.	ZR	PIER	
	SO					SF AVE	HF							

100.00	335.70	3.320	339.020	42.3	5.98	.556	339.576	.00	2.118	3.00	.00	.00	0	.0
94.00	.00564					.004022	.38		2.113			.00		
194.00	336.23	3.168	339.398	42.3	5.98	.556	339.954	.00	2.118	3.00	.00	.00	0	.0
WALL ENTRANCE												.00		
6.00	.01166					.000641	.00		1.286			.00		
200.00	336.30	3.919	340.219	42.3	3.08	.148	340.367	.00	1.656	7.00	3.50	.00	0	.0

ALTERNATE 1 - LINED TRAPEZOIDAL CHANNEL



PROJECT: LINED TRAPEZOIDAL CHANNEL

TRAPEZOIDAL CHANNEL

DATE: 08-14-1992

TIME: 11:46:08

INVERT WIDTH (feet) ...	10.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0020	Q (cfs)	758.10
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	1.50	SLOPE (X to 1)	1.50
DEPTH (feet)	4.61	TOP WIDTH (feet) ...	23.84
VELOCITY (fps)	9.72	VEL. HEAD (feet) ...	1.47
AREA (square feet)	78.03	P + M (pounds)	23971
CRITICAL DEPTH	4.48	CRITICAL SLOPE	0.0022
CRITICAL VELOCITY	10.14	FROUDE NUMBER	0.95

PROJECT: LINED TRAPEZOIDAL CHANNEL

TRAPEZOIDAL CHANNEL

DATE: 08-14-1992

TIME: 11:46:40

INVERT WIDTH (feet) ...	10.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0020	Q (cfs)	824.40
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	1.50	SLOPE (X to 1)	1.50
DEPTH (feet)	4.81	TOP WIDTH (feet) ...	24.44
VELOCITY (fps)	9.94	VEL. HEAD (feet) ...	1.53
AREA (square feet)	82.93	P + M (pounds)	26599
CRITICAL DEPTH	4.69	CRITICAL SLOPE	0.0022
CRITICAL VELOCITY	10.33	FROUDE NUMBER	0.95

PROJECT: LINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TIME: 12:59:59

TRAPEZOIDAL CHANNEL

INVERT WIDTH (feet) ...	10.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0030	Q (cfs)	887.60
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	1.50	SLOPE (X to 1)	1.50
DEPTH (feet)	4.50	TOP WIDTH (feet) ...	23.51
VELOCITY (fps)	11.76	VEL. HEAD (feet) ...	2.15
AREA (square feet)	75.49	P + M (pounds)	29408
CRITICAL DEPTH	4.88	CRITICAL SLOPE	0.0022
CRITICAL VELOCITY	10.51	FROUDE NUMBER	1.16

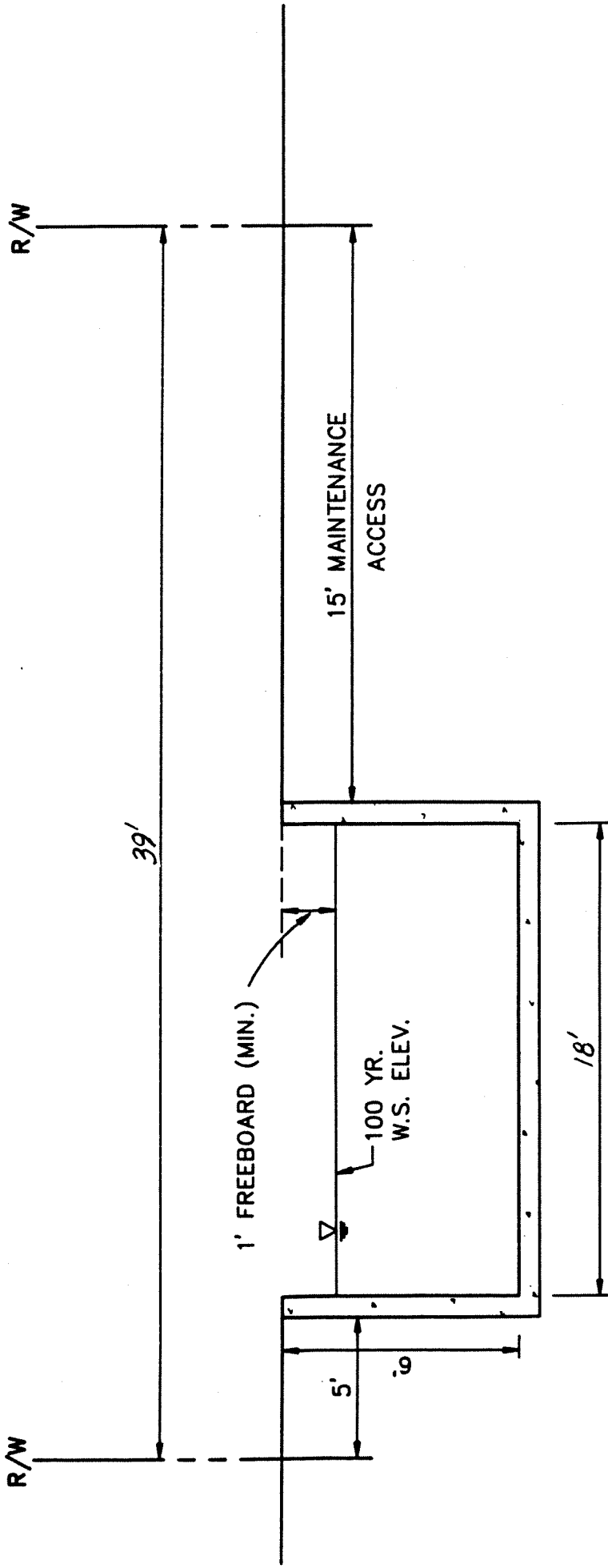
PROJECT: LINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TIME: 13:00:18

TRAPEZOIDAL CHANNEL

INVERT WIDTH (feet) ...	10.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0025	Q (cfs)	899.10
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	1.50	SLOPE (X to 1)	1.50
DEPTH (feet)	4.75	TOP WIDTH (feet) ...	24.26
VELOCITY (fps)	11.04	VEL. HEAD (feet) ...	1.89
AREA (square feet)	81.44	P + M (pounds)	29639
CRITICAL DEPTH	4.91	CRITICAL SLOPE	0.0022
CRITICAL VELOCITY	10.54	FROUDE NUMBER	1.06

ALTERNATE 2 - LINED RECTANGULAR CHANNEL



PROJECT: LINED RECTANGULAR CHANNEL

DATE: 08-14-1992

RECTANGULAR CHANNEL

TIME: 12:48:08

INVERT WIDTH (feet) ...	18.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0020	Q (cfs)	758.10
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	0.00	SLOPE (X to 1)	0.00
DEPTH (feet)	4.34	TOP WIDTH (feet) ...	18.00
VELOCITY (fps)	9.71	VEL. HEAD (feet) ...	1.46
AREA (square feet)	78.07	P + M (pounds)	24830
CRITICAL DEPTH	3.80	CRITICAL SLOPE	0.0029
CRITICAL VELOCITY	11.07	FROUDE NUMBER	0.82

PROJECT: LINED RECTANGULAR CHANNEL

DATE: 08-14-1992

RECTANGULAR CHANNEL

TIME: 12:48:31

INVERT WIDTH (feet) ...	18.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0020	Q (cfs)	824.40
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	0.00	SLOPE (X to 1)	0.00
DEPTH (feet)	4.60	TOP WIDTH (feet) ...	18.00
VELOCITY (fps)	9.97	VEL. HEAD (feet) ...	1.54
AREA (square feet)	82.73	P + M (pounds)	27783
CRITICAL DEPTH	4.02	CRITICAL SLOPE	0.0029
CRITICAL VELOCITY	11.38	FROUDE NUMBER	0.82

PROJECT: LINED RECTANGULAR CHANNEL

DATE: 08-14-1992
TIME: 12:58:11

RECTANGULAR CHANNEL

VERTICAL WIDTH (feet) ...	18.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0030	Q (cfs)	887.60
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	0.00	SLOPE (X to 1)	0.00
DEPTH (feet)	4.20	TOP WIDTH (feet) ...	18.00
VELOCITY (fps)	11.73	VEL. HEAD (feet) ...	2.14
AREA (square feet)	75.69	P + M (pounds)	30101
CRITICAL DEPTH	4.23	CRITICAL SLOPE	0.0030
CRITICAL VELOCITY	11.67	FROUDE NUMBER	1.01

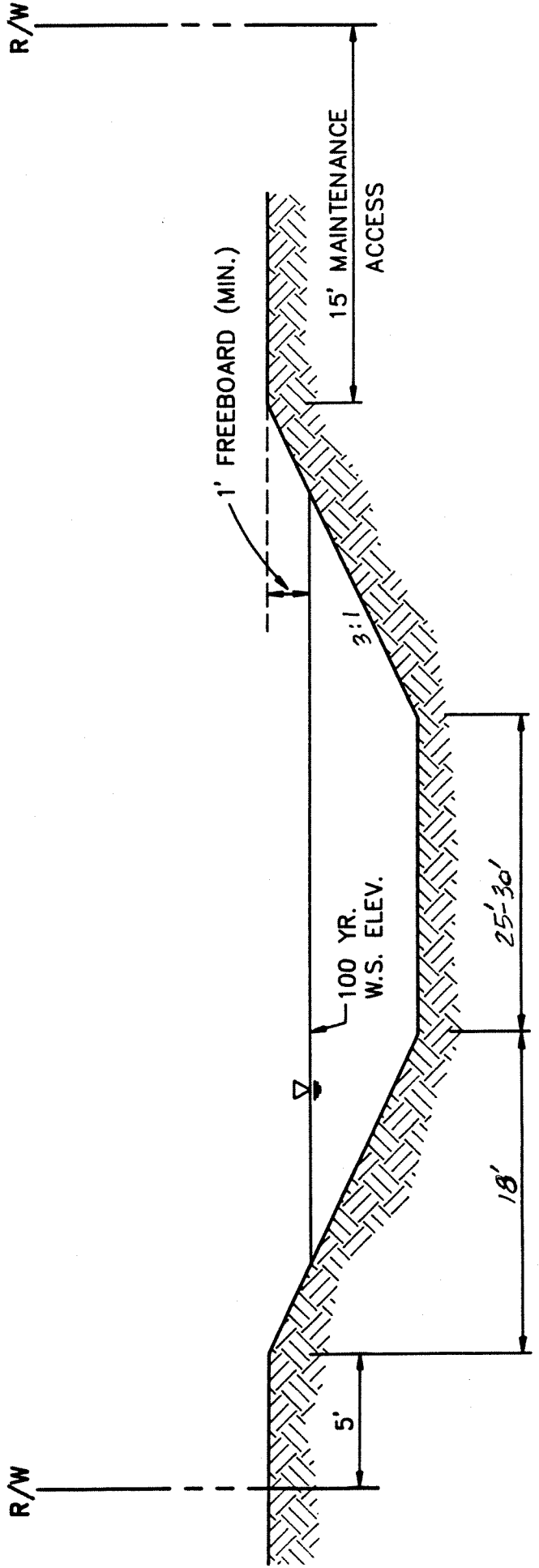
PROJECT: LINED RECTANGULAR CHANNEL

DATE: 08-14-1992
TIME: 12:58:29

RECTANGULAR CHANNEL

VERTICAL WIDTH (feet) ...	18.00	MANNINGS n .....	.014
SLOPE (feet/foot) .....	.0025	Q (cfs)	899.10
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	0.00	SLOPE (X to 1)	0.00
DEPTH (feet)	4.52	TOP WIDTH (feet) ...	18.00
VELOCITY (fps)	11.06	VEL. HEAD (feet) ...	1.90
AREA (square feet)	81.32	P + M (pounds)	30727
CRITICAL DEPTH	4.26	CRITICAL SLOPE	0.0030
CRITICAL VELOCITY	11.71	FROUDE NUMBER	0.92

ALTERNATE 3 - UNLINED TRAPEZOIDAL CHANNEL



PROJECT: UNLINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TIME: 12:52:22

TRAPEZOIDAL CHANNEL

INVERT WIDTH (feet) ...	25.00	MANNINGS n .....	.035
SLOPE (feet/foot) .....	.0020	Q (cfs)	758.10
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	3.00	SLOPE (X to 1)	3.00
DEPTH (feet)	4.62	TOP WIDTH (feet) ...	52.74
VELOCITY (fps)	4.22	VEL. HEAD (feet) ...	0.28
AREA (square feet)	179.69	P + M (pounds)	29034
CRITICAL DEPTH	2.72	CRITICAL SLOPE	0.0141
CRITICAL VELOCITY	8.39	FROUDE NUMBER	0.40

PROJECT: UNLINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TIME: 12:52:38

TRAPEZOIDAL CHANNEL

INVERT WIDTH (feet) ...	25.00	MANNINGS n .....	.035
SLOPE (feet/foot) .....	.0020	Q (cfs)	824.40
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	3.00	SLOPE (X to 1)	3.00
DEPTH (feet)	4.83	TOP WIDTH (feet) ...	53.99
VELOCITY (fps)	4.32	VEL. HEAD (feet) ...	0.29
AREA (square feet)	190.79	P + M (pounds)	32143
CRITICAL DEPTH	2.86	CRITICAL SLOPE	0.0140
CRITICAL VELOCITY	8.57	FROUDE NUMBER	0.41

PROJECT: UNLINED TRAPEZOIDAL CHANNEL

TRAPEZOIDAL CHANNEL

DATE: 08-14-1992

TIME: 12:54:50

INVERT WIDTH (feet) ...	30.00	MANNINGS n .....	.035
SLOPE (feet/foot) .....	.0030	Q (cfs)	887.60
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	3.00	SLOPE (X to 1)	3.00
DEPTH (feet)	4.18	TOP WIDTH (feet) ...	55.07
VELOCITY (fps)	4.99	VEL. HEAD (feet) ...	0.39
AREA (square feet)	177.71	P + M (pounds)	29481
CRITICAL DEPTH	2.73	CRITICAL SLOPE	0.0140
CRITICAL VELOCITY	8.51	FROUDE NUMBER	0.49

PROJECT: UNLINED TRAPEZOIDAL CHANNEL

TRAPEZOIDAL CHANNEL

DATE: 08-14-1992

TIME: 12:55:26

INVERT WIDTH (feet) ...	30.00	MANNINGS n .....	.035
SLOPE (feet/foot) .....	.0025	Q (cfs)	899.10
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	3.00	SLOPE (X to 1)	3.00
DEPTH (feet)	4.42	TOP WIDTH (feet) ...	56.51
VELOCITY (fps)	4.70	VEL. HEAD (feet) ...	0.34
AREA (square feet)	191.15	P + M (pounds)	31858
CRITICAL DEPTH	2.75	CRITICAL SLOPE	0.0139
CRITICAL VELOCITY	8.54	FROUDE NUMBER	0.45

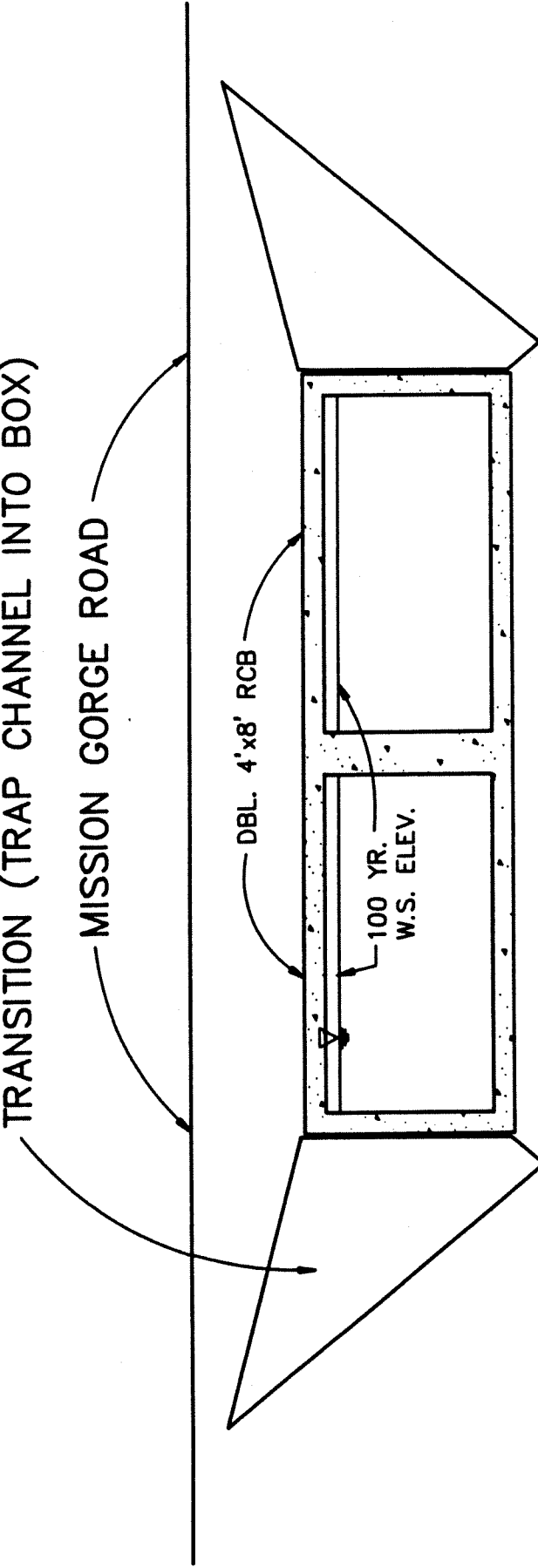
DOUBLE BOX CULVERT

TRANSITION (TRAP CHANNEL INTO BOX)

MISSION GORGE ROAD

DBL. 4'x8' RCB

100 YR.
W.S. ELEV.



PROJECT: 4X8 BOX CULVERT

DATE: 08-14-1992

RECTANGULAR CHANNEL

TIME: 13:09:33

INVERT WIDTH (feet) ...	8.00	MANNINGS n .....	.013
SLOPE (feet/foot) .....	.0070	Q (cfs)	325.00
LEFT SIDE		RIGHT SIDE	
SLOPE (X to 1)	0.00	SLOPE (X to 1)	0.00
DEPTH (feet)	2.98	TOP WIDTH (feet) ...	8.00
VELOCITY (fps)	13.65	VEL. HEAD (feet) ...	2.89
AREA (square feet)	23.81	P + M (pounds)	10808
CRITICAL DEPTH	3.71	CRITICAL SLOPE	0.0038
CRITICAL VELOCITY	10.94	FROUDE NUMBER	1.39

BSI

SUMMARY OF ESTIMATED COSTS

ALTERNATE NO. 1

Double 4'x8' R.C. Box Culvert	\$ 440,000
Concrete Lined Trap. Channel	\$ <u>393,000</u>
Subtotal	\$ 833,000
Secondary RCP Pipeline	\$ <u>427,000</u>
Total	\$1,260,000

ALTERNATE NO. 2

Double 4'x8' R.C. Box Culvert	\$ 440,000
Concrete Lined Rect. Channel	\$ <u>372,500</u>
Subtotal	\$ 812,500
Secondary RCP Pipeline	\$ <u>427,000</u>
Total	\$1,239,500

ALTERNATE NO. 3

Double 4'x8' R.C. Box Culvert	\$ 440,000
Grass Lined Trap. Channel	\$ <u>94,600</u>
Subtotal	\$ 534,600
Secondary RCP Pipeline	\$ <u>427,000</u>
Total	\$ 961,600

CHANNEL ALTERNATE NO. 1 - Concrete Lined Trap.

Clearing & Grubbing	2.5 AC	@ \$ 2,000 =	\$ 4,200
Excavation	9,100 CY	@ \$ 4.00 =	\$ 36,400
Conc. Channel Lining	68,000 SF	@ \$ 4.50 =	\$306,000
RCB Transition	1 EA	@ \$5,000 =	\$ 5,000
Outlet Structure	1 EA.	@ \$5,000 =	<u>\$ 5,000</u>
			\$357,400
		10% Contingency	<u>\$ 35,700</u>
		Total	\$393,000

CHANNEL ALTERNATE NO. 2 - Concrete Lined Rectangular

Clearing & Grubbing	2.0 AC	@ \$ 2,000 =	\$ 4,000
Excavation	8,600 CY	@ \$ 5.00 =	\$ 34,400
Conc. Channel Lining	64,500 SF	@ \$ 5.00 =	\$290,250
RCB Transition	1 EA	@ \$5,000 =	\$ 5,000
Outlet Structure	1 EA	@ \$5,000 =	<u>\$ 5,000</u>
			\$338,650
		10% Contingency	<u>\$ 33,850</u>
		Total	\$372,500

CHANNEL ALTERNATE NO. 3 - Grass Lined Channel

Clearing & Grubbing	4.0 AC	@ \$ 2,000 =	\$ 8,000
Excavation	21,500 CY	@ \$ 3.00 =	\$ 64,500
Seeding	135 KSF	@ \$ 100 =	<u>\$ 13,500</u>
			\$ 86,000
		10% Contingency	<u>\$ 8,600</u>
		Total	\$ 94,600

DOUBLE 4'x8' RC BOX CULVERT

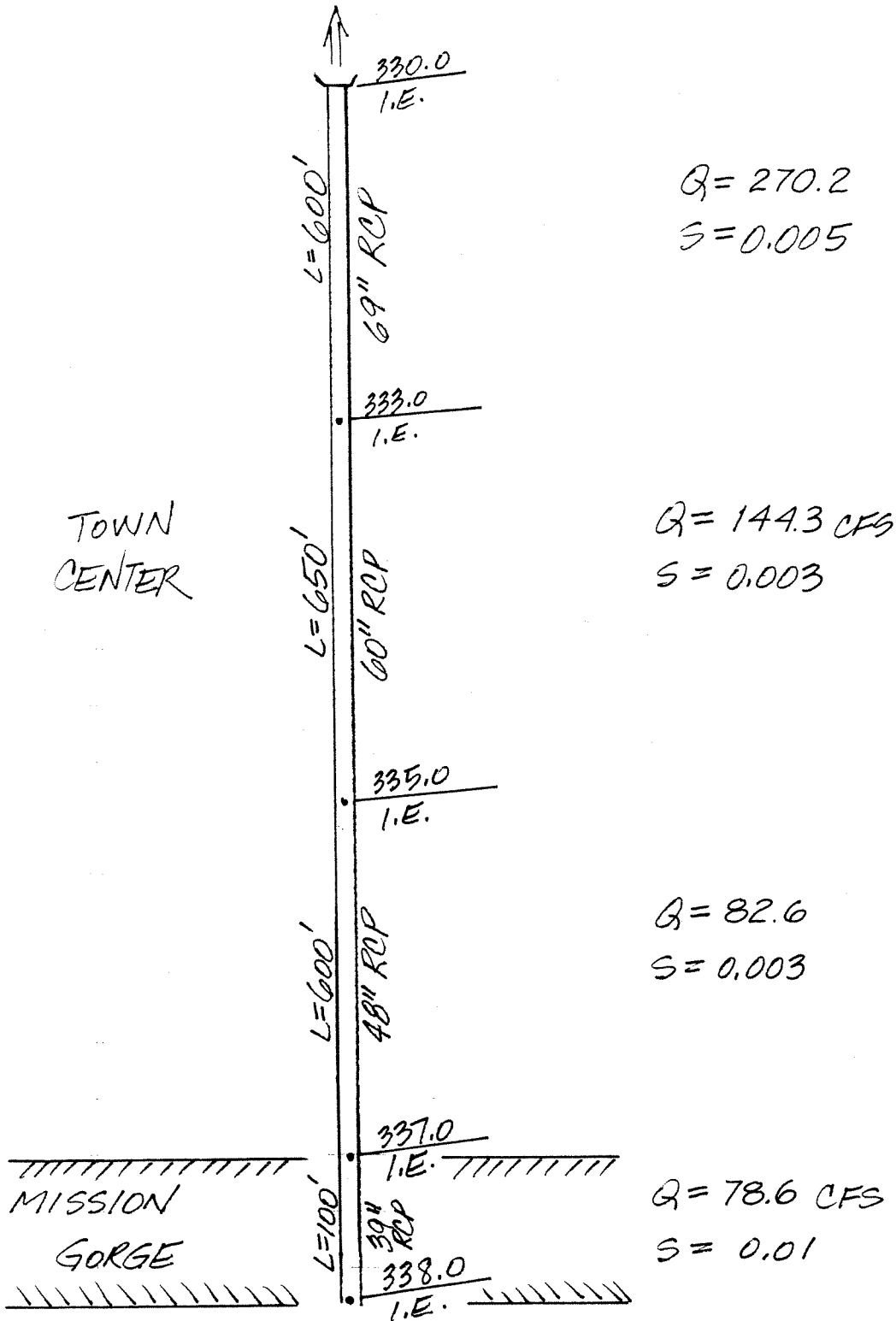
Quantities : 29.2 C.Y./L.F. @ \$500/C.Y. = \$540/L.F. (CONC.)
 280 LB/L.F. @ \$0.50/LB = \$140/L.F. (STEEL)

Clearing & Grubbing	1 LS	@ \$10,000 =	\$ 10,000
Excavation	2,000 CY	@ \$ 5.00 =	\$ 10,000
Pipe Connection	2 EA	@ \$ 5,000 =	\$ 10,000
Double 4'X 8' RCB	450 LF	@ \$ 680 =	\$306,000
Backfill	400 CY	@ \$ 10 =	\$ 4,000
Headwall	2 EA	@ \$ 5000 =	\$ 10,000
Repair Ex. Surface Impr.	2,000 SF	@ \$ 10 =	\$ 20,000
Traffic Control	1 LS	@ \$30,000 =	<u>\$ 30,000</u>
			\$400,000
		10% Contingency	<u>\$ 40,000</u>
		Total	\$440,000

SECONDARY RCP PIPELINE OUTLET

39" RCP	100 LF	@ \$ 135 =	\$ 13,500
48" RCP	600 LF	@ \$ 150 =	\$ 90,000
60" RCP	650 LF	@ \$ 200 =	\$130,000
69" RCP	600 LF	@ \$ 225 =	\$135,000
Headwall	1 EA	@ \$ 4,000 =	\$ 4,000
Cleanout (48" pipeline)	1 EA	@ \$ 3,500 =	\$ 3,500
Junction Structure	2 EA	@ \$ 6,000 =	<u>\$ 12,000</u>
			\$388,000
		10% Contingency	<u>\$ 38,800</u>
		Total	\$426,800

~ SAN DIEGO RIVER ~



SUMMARY ~ SAN DIEGO RIVER ~

