BSI Consultants, Inc.

ENGINEERING DESIGN REPORT

FOR A

SUPPLEMENTAL STORM DRAIN SYSTEM

IN

MISSION GORGE ROAD

FOR THE

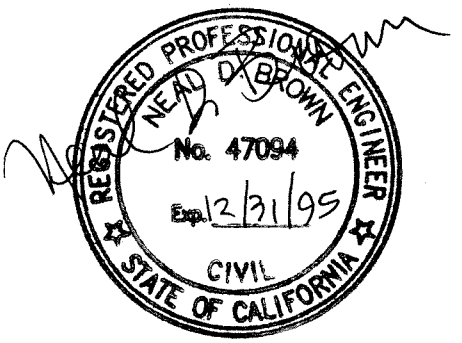
CITY OF SANTEE

Job No. 07423.00

August 1992

ENGINEERING DESIGN REPORT
FOR A
SUPPLEMENTAL STORM DRAIN SYSTEM
IN
MISSION GORGE ROAD

FOR THE
CITY OF SANTEE



Job No. 07423.00

B.S.I. Consultants, Inc.
16880 West Bernardo Drive
San Diego, California 92127
(619) 451-6100

TABLE OF CONTENTS

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.

"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    Flow rate       TC              Rainfall Intensity
 No.        (CFS)        (min)                   (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    Flow rate       TC            Rainfall Intensity
 No.        (CFS)        (min)                  (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    Flow rate       TC            Rainfall Intensity
 No.        (CFS)        (min)                  (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, Ap = 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, Ap = 0.950
Time of concentration computed by the
natural watersheds nomograph (App X-A)
TC = [11.9*length(Mi)^3)/(elevation change)]^.385 *60(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)*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      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    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                (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 coefficiènt 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    Flow rate       TC              Rainfall Intensity
 No.        (CFS)        (min)                  (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
CONTIBUTION 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)*distance^.5)/(% 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   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (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    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (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    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (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    Flow rate       TC              Rainfall Intensity
 No.        (CFS)        (min)                  (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    Flow rate       TC              Rainfall Intensity
 No.        (CFS)        (min)                  (In/Hr)


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


1        57.221     19.60                  2.729
2         5.268     13.26                  3.511
Qmax(1) =
            1.000 *    1.000 *    57.221) +
            0.777 *    1.000 *     5.268) + =      61.315
Qmax(2) =
            1.000 *    0.677 *    57.221) +
            1.000 *    1.000 *     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, Ap = 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, Ap = 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    Flow rate       TC              Rainfall Intensity
 No.        (CFS)        (min)                  (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*length(Mi)^3)/(elevation change)]^.385 *60(min/hr) + 10 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 min. =    15.02 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    Flow rate      TC            Rainfall Intensity
 No.        (CFS)       (min)                 (In/Hr)


1       824.408      17.78                  2.906
2        19.481      24.49                  2.364
Qmax(1) =
            1.000 *    1.000 *   824.408) +
            1.000 *    0.726 *    19.481) + =      838.555
Qmax(2) =
            0.814 *    1.000 *   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, Ap = 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.)
```

"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

F0515P

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIERS	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	4			4.50														
CD	2	2	0	.00	7.00	5.50			1.00										
CD	3	4			2.50														
CD	4	3	0	.00	3.58	4.02	.00	.00	.00										
CD	5	2	0	.00	7.00	4.02			.00										
CD	6	4			2.00														
CD	7	3	0	.00	2.75	3.05	.00	.00	.00										
CD	8	2	0	.00	7.00	4.00			.00										

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET

U/S DATA	STATION	INVERT	SECT	W S ELEV
	100.00	326.40	1	330.90

ELEMENT NO 2 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2600.00	333.90	1	.013	.00	.00	.00	3

ELEMENT NO 3 IS A WALL ENTRANCE

U/S DATA	STATION	INVERT	SECT	FP
	2600.00	333.90	2	.500

ELEMENT NO 4 IS A JUNCTION

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	2606.00	333.92	4	3	0	.013	20.0	.0	333.92	.00	90.00	.00

ELEMENT NO 5 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2699.00	334.51	4	.024	.00	20.00	.00	0

ELEMENT NO 6 IS A WALL ENTRANCE

U/S DATA	STATION	INVERT	SECT	FP
	2699.00	334.51	4	.500

ELEMENT NO 7 IS A JUNCTION

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	2705.00	334.53	4	5	0	.024	9.7	.0	334.53	.00	90.00	.00

ELEMENT NO 8 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2730.00	334.70	4	.024	.00	70.00	.00	0

ELEMENT NO 9 IS A WALL ENTRANCE

U/S DATA	STATION	INVERT	SECT	FP
	2730.00	334.70	5	.500

ELEMENT NO 10 IS A JUNCTION

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	2736.00	334.72	7	6	0	.024	29.7	.0	334.72	.00	90.00	.00

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 11 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2836.00	334.90	7	.024	.00	.00	.00	0

ELEMENT NO 12 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	2836.00	334.90	8	.500

ELEMENT NO 13 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2840.00	335.00	8	.014	.00	.00	.00	0

ELEMENT NO 14 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	2840.00	335.00	8	.00

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

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 / NORM DEPTH	HGT/ DIA	BASE/ ID NO.	ZL / ZR	NO PIER	AVBPR
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		

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

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

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

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

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

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 / NORM 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 - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIERS	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	4			4.50														
CD	2	2	0	.00	7.00	5.50			1.00										
CD	3	4			2.00														
CD	4	3	0	.00	3.92	4.44	.00	.00	.00										
CD	5	2	0	.00	7.00	5.44			.00										
CD	6	4			2.00														
CD	7	3	0	.00	2.42	2.69	.00	.00	.00										
CD	8	3	0	.00	3.58	4.02	.00	.00	.00										
CD	9	3	0	.00	3.58	4.02	.00	.00	.00										
CD	10	2	0	.00	7.00	5.00			.00										
CD	11	2	0	.00	7.00	5.00			.00										

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	100.00	326.40	1	330.90

ELEMENT NO 2 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2600.00	333.90	1	.013	.00	.00	.00	3

ELEMENT NO 3 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	2600.00	333.90	2	.500

ELEMENT NO 4 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	2606.00	333.92	4	3	0	.013	2.7	.0	333.92	.00	90.00	.00

ELEMENT NO 5 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	2900.00	334.79	4	.024	.00	90.00	.00	0

ELEMENT NO 6 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	2900.00	334.79	5	.500

ELEMENT NO 7 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	2906.00	334.81	4	6	0	.013	1.8	.0	334.81	.00	90.00	.00

ELEMENT NO 8 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	3276.00	335.69	4	.024	.00	.00	.00	0

ELEMENT NO 9 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	3276.00	335.69	5	.500

ELEMENT NO 10 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	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 11 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	3700.00	336.79	9	.024	.00	.00	.00	1

ELEMENT NO 12 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	3700.00	336.79	10	.500

ELEMENT NO 13 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	3704.00	337.00	10	.014	.00	.00	.00	0

ELEMENT NO 14 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	3704.00	337.00	10	.00

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

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 / NORM 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		

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

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

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		

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	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH		HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	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 -

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 LATERAL

HEADING LINE NO 3 IS -

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

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING

CARD CODE	SECT NO	CHN TYPE	NO OF PIERS	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	3	0	.00	2.42	2.69	.00	.00	.00										
CD	2	2	0	.00	7.00	3.50			.00										
CD	3	4			2.50														
CD	4	4			2.50														
CD	5	2	0	.00	7.00	3.00			.00										
CD	6	4			3.50														
CD	7	2	0	.00	5.00	4.00			.00										

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	100.00	335.70	1	339.02

ELEMENT NO 2 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	170.00	336.05	1	.024	.00	.00	.00	0

ELEMENT NO 3 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	170.00	336.05	2	.500

ELEMENT NO 4 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	174.00	336.15	1	0	0	.013	.0	.0	.00	.00	.00	.00

ELEMENT NO 5 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	194.00	336.23	1	.024	.00	.00	.00	0

ELEMENT NO 6 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	194.00	336.23	2	.500

ELEMENT NO 7 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	200.00	336.30	2	.014	.00	.00	.00	0

ELEMENT NO 8 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	200.00	336.30	2	.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

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

CARD CODE	SECT NO	CHN TYPE	NO OF PIERS	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	4			3.00														
CD	2	2	0	.00	7.00	3.50			.00										
CD	3	4			2.50														
CD	4	4			2.50														
CD	5	2	0	.00	7.00	3.00			.00										
CD	6	4			3.50														
CD	7	2	0	.00	5.00	4.00			.00										

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	100.00	335.70	1	339.02

ELEMENT NO 2 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	194.00	336.23	1	.013	.00	.00	.00	0

ELEMENT NO 3 IS A WALL ENTRANCE *

U/S DATA	STATION	INVERT	SECT	FP
	194.00	336.23	2	.500

ELEMENT NO 4 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	200.00	336.30	2	.014	.00	.00	.00	0

ELEMENT NO 5 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	200.00	336.30	2	.00

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

WATER SURFACE PROFILE LISTING

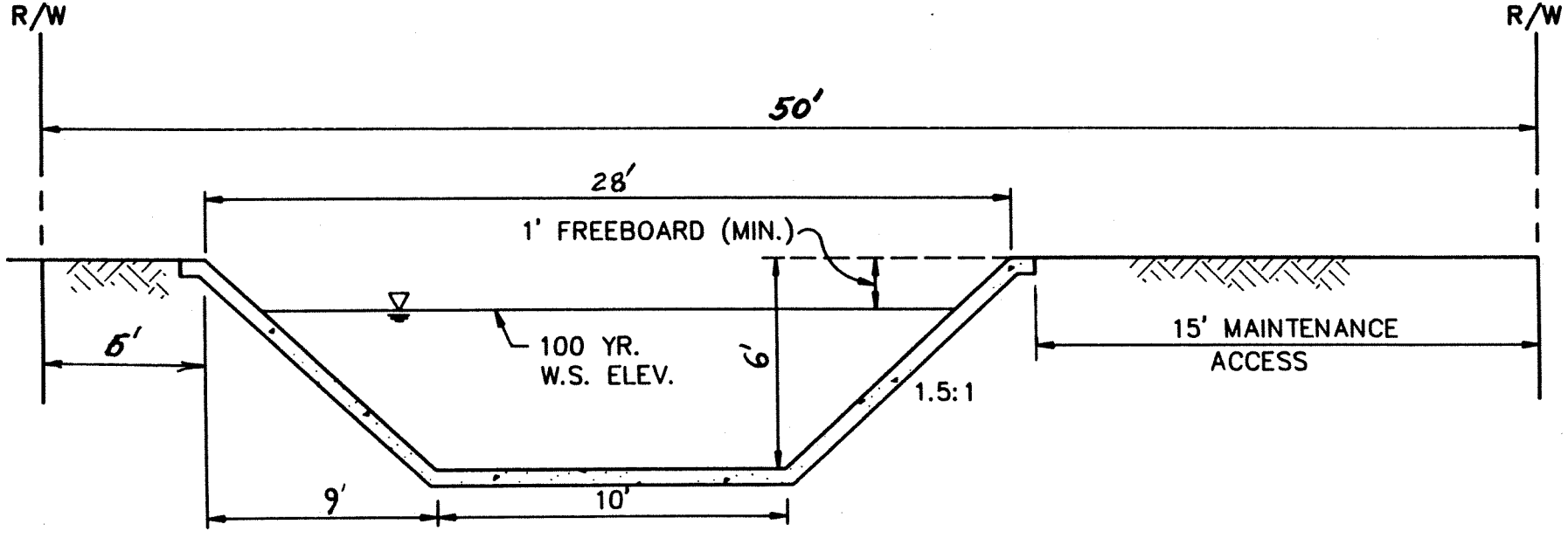
File: NMGLAP.WSP Study Date: 12 - 2 - 1991 Time: 16:33:59

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

TO DETERMINE CAPACITY AND PROPOSED CONDITIONS OF SYSTEM LATERAL

STATION / 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 / NORM DEPTH	HGT/ DIA	BASE/ ID NO.	ZL / ZR	NO PIER	AVBPR
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



ROJECT: LINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TRAPEZOIDAL CHANNEL TIME: 11:46:08

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

ROJECT: LINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TRAPEZOIDAL CHANNEL TIME: 11:46:40

NVERT WIDTH (feet) ...	10.00	MANNINGS n	.014
LOPE (feet/foot)	.0020	Q (cfs)	824.40
EFT SIDE LOPE (X to 1)	1.50	RIGHT SIDE SLOPE (X to 1)	1.50
EPTH (feet)	4.81	TOP WIDTH (feet) ...	24.44
ELOCITY (fps)	9.94	VEL. HEAD (feet) ...	1.53
REA (square feet)	82.93	P + M (pounds)	26599
RITICAL DEPTH	4.69	CRITICAL SLOPE	0.0022
RITICAL 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 SLOPE (X to 1)	1.50	RIGHT SIDE 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

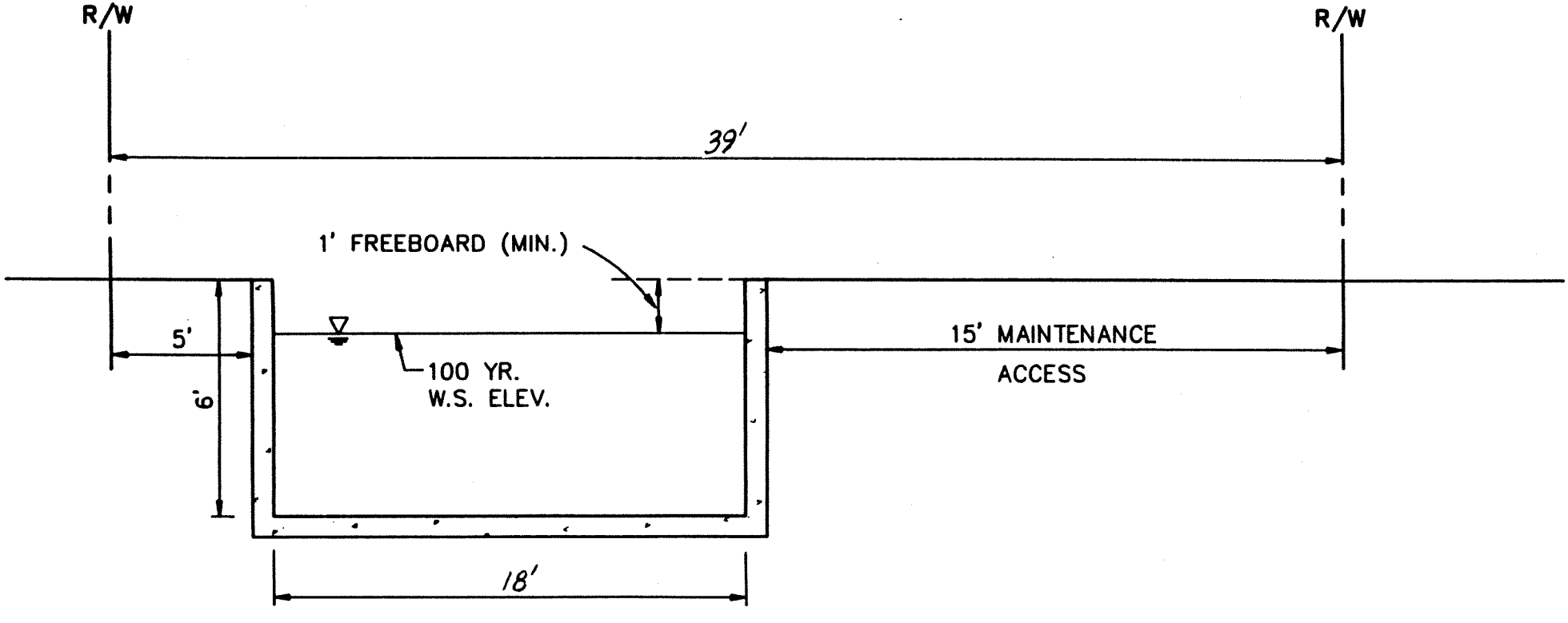
PROJECT: LINED TRAPEZOIDAL CHANNEL

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 SLOPE (X to 1)	1.50	RIGHT SIDE 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



'ROJECT: LINED RECTANGULAR CHANNEL

DATE: 08-14-1992
TIME: 12:48:08

RECTANGULAR CHANNEL

:NVERT WIDTH (feet) ...	18.00	MANNINGS n	.014
;LOPE (feet/foot)	.0020	Q (cfs)	758.10
.EFT SIDE ;LOPE (X to 1)	0.00	RIGHT SIDE SLOPE (X to 1)	0.00
)EPTH (feet)	4.34	TOP WIDTH (feet) ...	18.00
'ELOCITY (fps)	9.71	VEL. HEAD (feet) ...	1.46
\REA (square feet)	78.07	P + M (pounds)	24830
:RITICAL DEPTH	3.80	CRITICAL SLOPE	0.0029
:RITICAL VELOCITY	11.07	FROUDE NUMBER	0.82

?ROJECT: LINED RECTANGULAR CHANNEL

DATE: 08-14-1992
TIME: 12:48:31

RECTANGULAR CHANNEL

[NVERT WIDTH (feet) ...	18.00	MANNINGS n	.014
;LOPE (feet/foot)	.0020	Q (cfs)	824.40
.EFT SIDE ;LOPE (X to 1)	0.00	RIGHT SIDE SLOPE (X to 1)	0.00
)EPTH (feet)	4.60	TOP WIDTH (feet) ...	18.00
/ELOCITY (fps)	9.97	VEL. HEAD (feet) ...	1.54
\REA (square feet)	82.73	P + M (pounds)	27783
:RITICAL DEPTH	4.02	CRITICAL SLOPE	0.0029
:RITICAL VELOCITY	11.38	FROUDE NUMBER	0.82

)JECT: LINED RECTANGULAR CHANNEL

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

RECTANGULAR CHANNEL

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

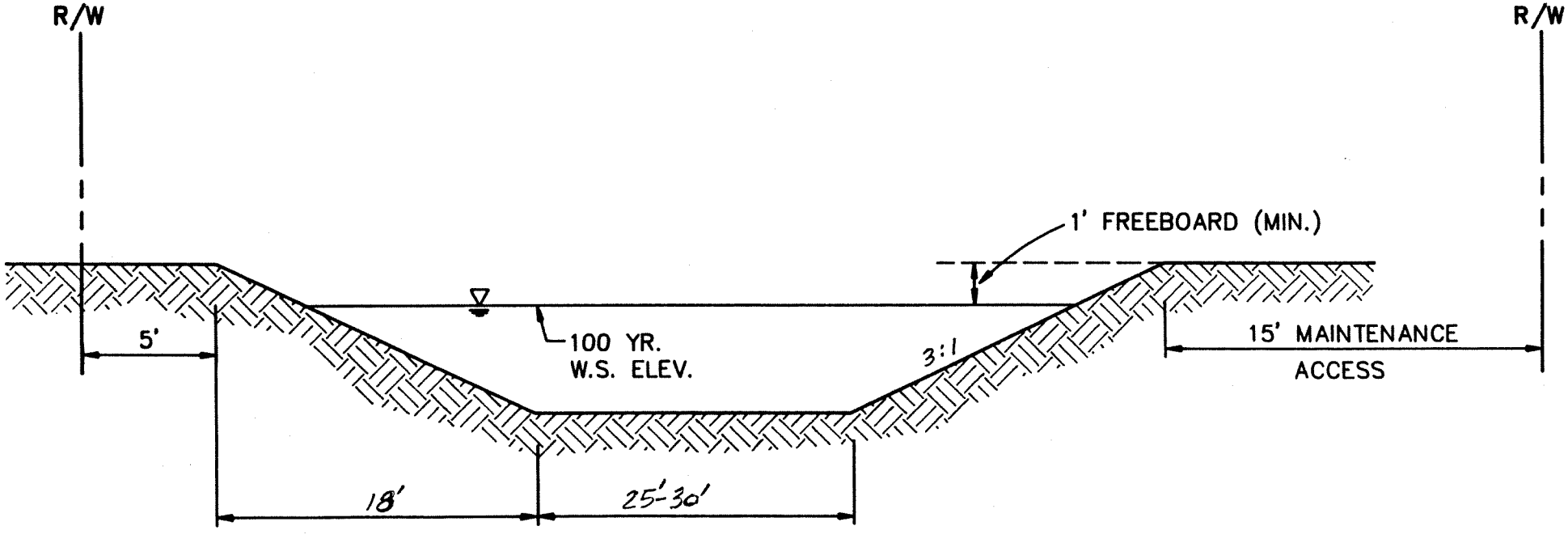
ROJECT: LINED RECTANGULAR CHANNEL

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

RECTANGULAR CHANNEL

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

ALTERNATE 3 - UNLINED TRAPEZOIDAL CHANNEL



ROJECT: UNLINED TRAPEZOIDAL CHANNEL

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

TRAPEZOIDAL CHANNEL

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

ROJECT: UNLINED TRAPEZOIDAL CHANNEL

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

TRAPEZOIDAL CHANNEL

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

ROJECT: UNLINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TIME: 12:54:50

TRAPEZOIDAL CHANNEL

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

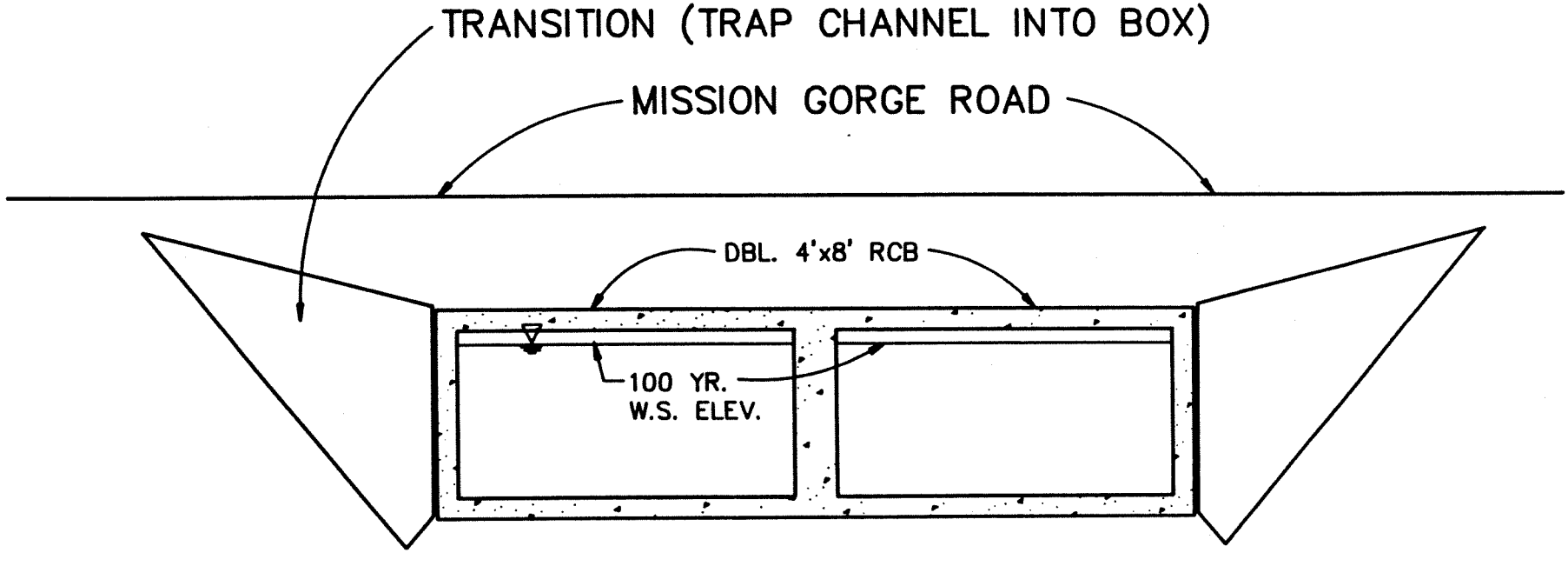
ROJECT: UNLINED TRAPEZOIDAL CHANNEL

DATE: 08-14-1992
TIME: 12:55:26

TRAPEZOIDAL CHANNEL

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

DOUBLE BOX CULVERT



PROJECT: 4X8 BOX CULVERT

DATE: 08-14-1992
TIME: 13:09:33

RECTANGULAR CHANNEL

INVERT WIDTH (feet) ...	8.00	MANNINGS n	.013
SLOPE (feet/foot)	.0070	Q (cfs)	325.00
LEFT SIDE SLOPE (X to 1)	0.00	RIGHT SIDE 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

SUMMARY OF ESTIMATED COSTS

ALTERNATE NO. 1

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

ALTERNATE NO. 2

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

ALTERNATE NO. 3

Double 4'x8' R.C. Box Culvert		$ 440,000
Grass Lined Trap. Channel		$ 94,600
	Subtotal	$ 534,600
Secondary RCP Pipeline		$ 427,000
	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 =	$ 5,000
			$357,400
		10% Contingency	$ 35,700
		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 =	$ 5,000
			$338,650
		10% Contingency	$ 33,850
		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 =	$ 13,500
			$ 86,000
		10% Contingency	$ 8,600
		Total	$ 94,600

DOUBLE 4'x8' RC BOX CULVERT

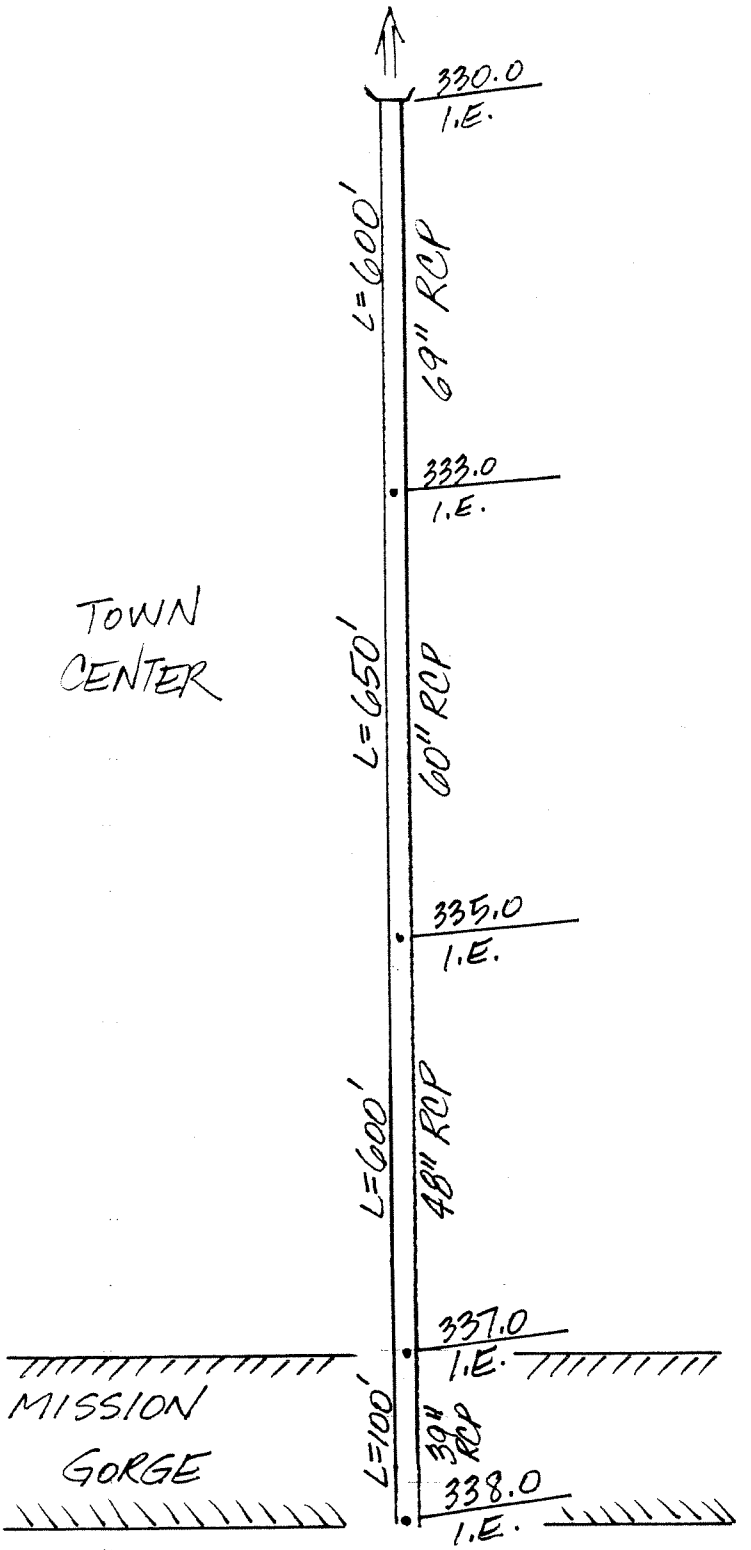
Quantities : 29.2 C.Y./L.F. @ $500/C.Y. = $540/L.F. (CONC.)
280 LB/L.F. @ $0.50/LB = $140/L.F. (STEEL)

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 =	$ 30,000
			$400,000
		10% Contingency	$ 40,000
		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 =	$ 12,000
			$388,000
		10% Contingency	$ 38,800
		Total	$426,800

~ SAN DIEGO RIVER ~



Q = 270.2
S = 0.005

Q = 144.3 CFS
S = 0.003

Q = 82.6
S = 0.003

Q = 78.6 CFS
S = 0.01

SUMMARY ~SAN DIEGO RIVER~