FUSCOE
ENGINEERING

PRELIMINARY DRAINAGE STUDY

BELLA MAR

PREPARED FOR

RED TAIL ACQUISITIONS, LLC
2082 MICHELSON DRIVE, 4TH FLOOR
IRVINE, CA 92612

FUSCOE ENGINEERING, INC
6390 GREENWICH DR. STE 170
SAN DIEGO, CA 92122

PROJECT MANAGER:
BRYAN D. SMITH , P.E.

DATE PREPARED: JANUARY 2020
FEI# 1621-001-01

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PRELIMINARY DRAINAGE STUDY

BELLA MAR APARTMENTS

408 HOLLISTER STREET
SAN DIEGO, CA 92154

APN#627-100-09-00

Prepared by Jesus Garcia Under the Responsible Charge of:

Bryan D. Smith, PE RCE 75822 EXP: 06-30-20

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For

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FEBRUARY 2019
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1. INTRODUCTION

The purpose of this preliminary drainage study is to present the preliminary drainage design for the Bella Mar Entitlements Project (Project) and to demonstrate that the project will comply with the City of San Diego Drainage Design Manual (SDDDM) 2017 Criteria.

1.1 Project Description

The project proposes entitlements including a rezone and Tentative Map to support a medium density residential development including 380 units on approximately 14.1 acres located at 408 Hollister Street, San Diego, California. The site is bordered by Hollister Street on the east, Interstate 5 on the west, Otay River on the north, and an existing driving range on the south.

The project does not propose to dredge or fill any waters of the U.S.; therefore, the project is not required to obtain approval from the Regional Water Quality Board under Federal Clean Water Act Section 401 or 404.

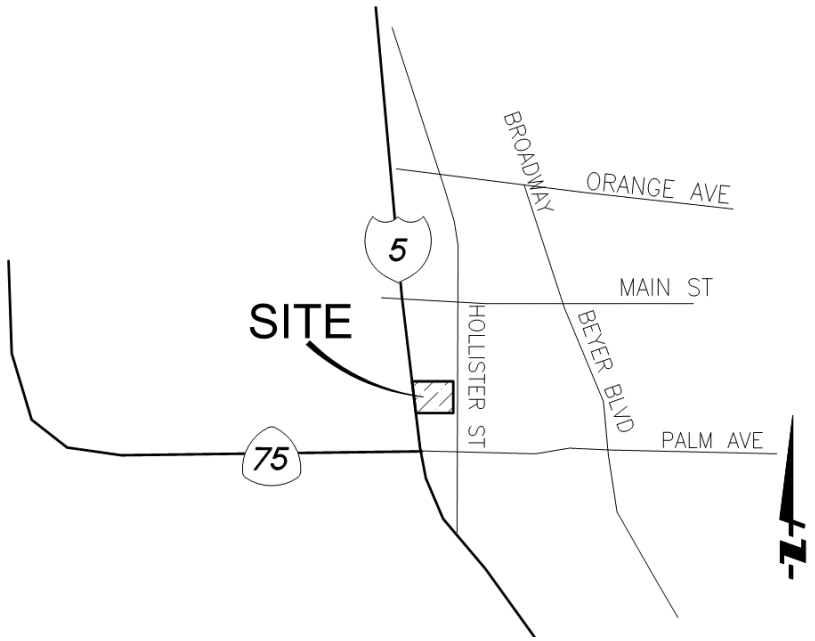

Figure 1. Vicinity Map

1.2 Existing Conditions

The existing project site is a vacant rural lot south of the Otay River which was previously developed as a go-kart race track. The site is mostly pervious and is covered by light vegetation with mild slopes averaging less than 1%. Refer to the Existing Conditions Drainage Map in Appendix 1.

Most of the site (identified by Basin A) flows west towards I-5 to an existing 24" culvert that ultimately discharges into the Otay River west of I-5 and is analyzed in this report as Point of Compliance (POC)-1. The south neighboring property has a small area (identified as Basin B) that drains north onto the project site. Both Basins A & B are tributary to the analysis point, POC-1. The northern project site area adjacent to the Otay River sheet flows into the river is identified as Basin C and is analyzed as POC-2.

The point of analysis, POC-3, represents the cross-lot drainage to the south neighboring property from the on-site Hollister Street frontage area and the public Hollister Street runoff identified as Basins E & F. POC-3 analysis the cross-lot runoff due south and ultimately towards an existing 36" RCP culvert crossing the I-5 and into the Otay River.

Hollister Street, public street drainage Basins E & F do not have a defined storm drainage system. The street is crowned with low points along the project frontage. Runoff ponds between Hollister and the MTS property until it overtops the crown and drains through the neighboring south property at analysis point POC-3. The north end of Hollister Street (Basin G) sheet flows north into the Otay River at analysis point POC-4.

1.3 Proposed Conditions

The project proposes to entitle the site for mixed use residential (RM-2-5) with 380 units over 15 buildings with associated recreation facilities, parking, and infrastructure as shown in the Tentative Parcel Map (TPM) included in Appendix 2. The project also includes modifications to Hollister to widen the road to a two-lane collector along the project frontage.

The project is located within the FEMA Floodplain and will fill the site to provide 2 feet of freeboard above the 100-year flood base elevations per City of San Diego Municipal Code requirements. A No-Rise Certification will be required to be processed with FEMA.

The Project will maintain existing drainage patterns to the maximum extend practical. Onsite Basins A-1 through A-5 will be collected and conveyed west to a biofiltration basin which will provide treatment and peak flow attenuation before discharging at analysis point POC-1. Also tributary to POC-1 is Basin B, which represents the cross lot drainage from the south property onto the project site, will be collected and conveyed directly to POC-1. Basin C, which sheet flows directly into the Otay River at POC-2, will be increased in area by approximately 1 acre to maintain a drainage delineation for the MHPA area. Per Section 404 of the CWA, no dredged or fill material is proposed to be discharged into waters of the United States or wetlands. As such, Section 401 also does not apply since no CWA Section 404 permit needs to be obtained.

The cross-lot drainage on the south neighboring property, analyzed as POC-3 will be reduced by approximately 95% by eliminating the Hollister St public drainage (Basins E & F) with new storm drain construction, and reducing the area of the onsite Basin D to an isolated south boundary site slope. In proposed conditions drainage Basin H is created by also subtracts from the existing drainage Basin D.

Basins H,E, F, and G will be conveyed into a proposed public storm drain within Hollister St and will tie-into the Otay River culvert crossing analyzed at POC-4.

1.4 Proposed Green Street Improvements for Hollister Street

The improvements to Hollister Street include the road widening to a two-lane collector along the project frontage, installing curb & gutter, sidewalk, public storm drain system, and implementing Green Street BMP's to meet the PDP Exemption Category 2 for redevelopment of existing paved streets under The City of San Diego Storm Water Standards BMP Design Manual, October 2018 Edition. Bioretention basins have been sized to treat the entire street frontage area and proposed to be installed in the parkway with pop-outs in the parking lanes. Opposite the site frontage, impervious area dispersion is being implemented for redundancy by allowing half the street to sheet flow into hydrologic type A soils for 10-year storm runoff events, while higher flows are collected into a catch basin. See the separate preliminary SQWMP report for this project.

2. METHODOLOGY

2.1 Rational Method

The site is inundated for the 100-year storm event of the Otay River, however for the period before the Otay River's peak time of concentration, this report analyses the proposed developed storm runoff for the site's relatively smaller time of concentration. Runoff was calculated using the Modified Rational Method equation below:

$Q = C \times I \times A$

Where:
Q = Flow rate in cubic feet per second (cfs)
C = Runoff coefficient
I = Rainfall Intensity in inches per hour (in/hr)
A = Drainage basin area in acres, (ac)

Modified Rational Method calculations were performed using the Advanced Engineering Software AES 2014) computer program. To perform the hydrology routing, the total watershed area was divided into sub-areas which discharge at designated nodes. The procedure for the sub-area summation model is as follows:

(1) Subdivide the watershed into an initial sub-area (generally 1 lot) and subsequent sub-areas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers to each sub-area.

(2) Estimate an initial T_c by using the appropriate nomograph or overland flow velocity estimation. The minimum T_c considered is 5.0 minutes.

(3) Using the initial T_c, determine the corresponding values of I. Then Q = CIA.

(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to particular channel or conduit linking the two nodes. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The AES 2014 computer software sub-area menu is as follows:

SUBAREA HYDROLOGIC PROCESS

1. Confluence analysis at node.
2. Initial sub-area analysis (including time of concentration calculation).
3. Pipe flow travel time (computer estimated).
4. Pipe flow travel time (user specified).
5. Trapezoidal channel travel time.
6. Street flow analysis through sub-area.
7. User-specified information at node.
8. Addition of sub-area runoff to main line.
9. V-gutter flow through area.
10. Copy main stream data to memory bank
11. Confluence main stream data with a memory bank
12. Clear a memory bank

At the confluence point of two or more basins, the following procedure is used to combine peak flow rates to account for differences in the basin's times of concentration. This adjustment is based on the assumption that each basin's hydrographs are triangular in shape.

(1). If the collection streams have the same times of concentration, then the Q values are directly summed,

$$Q_p = Q_a + Q_b;\ T_p = T_a = T_b$$

(2). If the collection streams have different times of concentration, the smaller of the tributary Q values may be adjusted as follows:

(i). The most frequent case is where the collection stream with the longer time of concentration has the larger Q. The smaller Q value is adjusted by a ratio of rainfall intensities.

$$Q_p = Q_b + Q_a\,(I_b/I_a);\ T_p = T_a$$

(ii). In some cases, the collection stream with the shorter time of concentration has the larger Q. Then the smaller Q is adjusted by a ratio of the T values.

$$Q_p = Q_b + Q_a\,(T_b/T_a);\ T_p = T_b$$

2.2 Runoff Coefficient

A weighted runoff coefficient was determined for both existing and proposed conditions based on the Table A-1 in the SDDDM. In existing conditions, the site is mostly vacant and undeveloped. The rural runoff coefficient C=0.45 was used for existing conditions for onsite conditions and the offsite area just south of the site (Basin B). A runoff design coefficient of C=0.50 was used for the existing and proposed conditions as a minimum set limit for the Hollister Street (Basin E, F, and H) since actual impervious calculations for pre- and post-development deviated significantly and both weighted C values resulted lower than the allowed (impervious) minimum per the SDDM. The proposed conditions, the site is considered multi-unit residential corresponding to an equivalent percentage of impervious. Therefore, the onsite runoff coefficient of C=0.70 was used per Table 1 in the SDDDM. The runoff coefficient for the northern portion of the site (Basin C) and southern portion adjacent to the site (Basin B) will remain the same as existing conditions C=0.45. See Appendix 3 for runoff coefficient calculations.

2.3 Rainfall Intensity

Rainfall intensity was determined by AES using the Intensity-Duration Chart per Figure A-1 of the SDDDM.

2.4 Tributary Areas

Drainage basins are delineated on the Existing and Proposed Hydrology Condition Maps in Appendix 1. Bold lines graphically portray the tributary area for the drainage basin.

2.5 Hydraulic Calculations

Autodesk Hydraflow Hydrographs was used to design & analyze the proposed detention basin and its outlet control structure in order to attenuate the developed onsite runoff conditions for the 100-year, 6-hour storm event. The detention basin is a dual purpose design providing mitigation for the increased onsite runoff and storm water treatment for the proposed development. For the analysis results see section 3.1.

A hydraulic analysis using FlowMaster was performed to check the capacity of the proposed public storm drain in Hollister Street. For the analysis results see section 3.2.

3. CALCULATIONS/RESULTS

3.1 Peak Flow Comparison

The project results in a decrease of the total 100-year storm runoff by 2.24 cfs by implementing a private onsite detention basin and installing a public storm drain system in Hollister Street. The Hollister drainage improvements will eliminate the long-term ponding along Hollister and the uncontrolled conveyance of public drainage through private property.

Tables 1 & 2 summarize the existing and proposed peak flow rates at each point of compliance (POC). Table 2 presents the mitigated conditions flowrate. The detention basin results are summarized in Table 3.

Table 1. EXISTING CONDITIONS HYDROLOGY SUMMARY FOR 100-YR STORM EVENT

POC	**NODE**	**BASIN (Description)**	**AREA (ac)**	**Q100 (cfs)**
POC-1 (24" Culvert under I-5)	100	A +B (Onsite + South Offsite)	11.11	17.75
POC-2 (Otay River)	300	C (Site Along Otay River)	1.22	1.88
POC-3 (Cross Lot Drainage onto South Property)	400	D+E+F (Site Frontage + Hollister)	5.44	8.42
POC-4 (Hollister & Otay River Culvert)	600	G (Hollister)	0.31	0.63
PROJECT TOTAL			18.08	28.68

Table 2. PROPOSED CONDITIONS HYDROLOGY SUMMARY FOR 100-YR STORM EVENT

POC	**NODE**	**BASIN (Description)**	**AREA (ac)**	**Q100 (cfs)**
POC-1 (24" Culvert under I-5)	100	A +B (Onsite + South Offsite)	12.07	17.52 (Mitigated)
POC-2 (Otay River)	300	C (Site Along Otay River)	2.29	3.52
POC-3 (Cross Lot Drainage onto South Property)	400	D (South Site Slope)	0.09	0.15
POC-4 (Hollister & Otay River Culvert)	600	E+F+G+H (Site Frontage + Hollister)	3.63	5.25
PROJECT TOTAL			18.08	26.44
DIFFERENCE FROM EXISTING			0	- 2.24

At POC-1, the flowrate is mitigated to below existing conditions with the construction of a private detention basin. At POC-2 the surface sheet flowrate into the Otay River is increased by 1.64cfs. With the completion of the project the existing cross-lot peak drainage onto the south property at POC-3 will be reduced by about 98%. At POC-4, the Hollister St box culvert, the increase of 100-year storm runoff is about 4.62cfs and equates to less than a 0.02% of the existing Otay River flowrate of 22,000 cfs per the FEMA floodway studies (see appendix 10). Therefore, this impact is considered negligible.

3.2 Private Detention Basin

The private detention basin is designed to provide stormwater treatment and attenuate the 100-year storm runoff for the proposed development. The total basin depth provided is 2 feet from bottom elevation of 19.2 feet. The bottom 6" of the basin are reserved to meet the ponding requirement for water quality treatment, therefore outlet riser/control structure is raised a minimum of 6" from the basin bottom. The remaining 18" of the basin stores 100-year storm runoff volume and mitigate the proposed flowrate below existing conditions. Per the routing analysis the detention basins fills about 12" above the grate and leaves about 6" of freeboard. The basin storage volume used is 8,446 cf.

Table 3. DETENTION BASIN ATTENUATION FOR 100-YR STORM EVENT AT POC-1

POC	NODE	BASIN (Description)	EXISTING AREA (ac)	PROPOSED AREA (ac)	EXISTING Q100 (cfs)	UNMITIGATED Q100 (cfs)	MITIGATED Q100 (cfs)
POC-1 (24" Culvert under I-5)	105	A (Onsite)	10.20	10.97	16.53	21.95	15.86
POC-1 (24" Culvert under I-5)	200	B (South Slope + Offsite)	0.91	1.10	1.39	1.68	1.68 (no attenuation)
POC-1 CONFLUENCE TOTAL	100	A +B (Onsite + South Offsite)	11.11	12.07	17.75	23.61	17.52
DIFFERENCE FROM EXISTING				+0.96		+5.69	- 0.40

Basin attenuation occurs at Node 105 of the hydrology analysis for proposed conditions. Per table 3, at Node 105 the acreage is increased by 0.77 acres but the proposed runoff is mitigated down by 6.09 cfs. At Node 100 (representing POC-1), the mitigated basin outlet flow (for Basins A1-A4) is confluence with the offsite Basin B and additional south slopes. When compared to existing conditions, the development results (at POC-1) is an increase of 0.96 acres but a decreased flowrate by 0.40 cfs.

3.3 Public Storm Drain

A hydraulic analysis using FlowMaster was performed to check the capacity of the proposed public storm drain in Hollister Street. At a minimum slope of 0.3% an 18" RCP pipe is 84% full with the

project's proposed flow rates. See Appendix 7 for the results.

4. CONCLUSION

The project will match existing drainage patterns to the maximum extent feasible. The project will result in a total net decrease of 2.24 cfs in the 100-year peak runoff from the studied area of 18.08 acres by providing an onsite private detention system and installing a public storm drain in Hollister. The existing cross-lot peak drainage onto the south property at POC-3 will be reduced by about 98%. The buildings will be elevated a minimum 2ft above the FEMA 100-year water surface elevation. A No-Rise Certification will be processed to document the unchanged FEMA 100-year water surface elevation.

The project is anticipated to improve the drainage conditions of the site by reducing the peak flowrate through the detention basins, alleviating long term ponding along Hollister Ave, and eliminating the uncontrolled public drainage flowing through private property.

APPENDIX 1

EXISTING HYDROLOGY MAP

PROPOSED HYDROLOGY MAP

OTAY RIVER

INTERSTATE 5

HOLLISTER ST

MHPA LINE

NODE 600/POC-4:
A=0.31ac
Tc=6.95MIN
Q_{100}=0.63CFS

NODE 300/POC-2:
A=1.22ac
Tc=10.57MIN
Q_{100}=1.88CFS

NODE 100:
A=10.20ac
Tc=14.27MIN
Q_{100}=16.53CFS

POC-1:
A=11.11ac
Tc=14.27MIN
Q_{100}=17.75CFS

NODE 200:
A=0.91ac
Tc=11.83MIN
Q_{100}=1.39CFS

NODE 400:
A=2.73ac
Tc=14.76MIN
Q_{100}=4.34CFS

NODE 500:
A=2.71ac
Tc=13.56
Q_{100}=4.12CFS

POC-3:
A=5.44ac
Tc=15.07MIN
Q_{100}=8.42CFS

BASIN A
10.20 AC

BASIN B
0.91 AC

BASIN C
1.22 AC

BASIN D
2.73 AC

BASIN E
1.55 AC

BASIN F
1.16 AC

BASIN G
0.31 AC

EX 24" RCP SD
PER CALTRANS
CONTRACT NO. 122404
DOCUMENT NO. A-0002600

EX 36" RCP SD

L=50'
A=1.02ac

L=155'
A=0.20ac

L=100'
A=0.40ac

L=730'
A=9.8ac

L=360'

L=90'
A=0.71ac

A=0.20ac L=180'

L=460'
A=2.13ac

L=350' A=0.93ac

L=75'
A=0.21ac

L=100'
A=0.25ac

L=170'
A=0.60ac

L=500' A=1.30ac

L=100'
A=0.23ac

LEGEND

EXISTING CONTOURS
BASIN LIMITS
SUB-BASIN LIMITS
INTIAL AREA LIMITS
FLOW PATH
FLOW DIRECTION
HYDROLOGY NODE
EXISTING STORM DRAIN

60' 0' 30' 60'
SCALE: 1" = 60'

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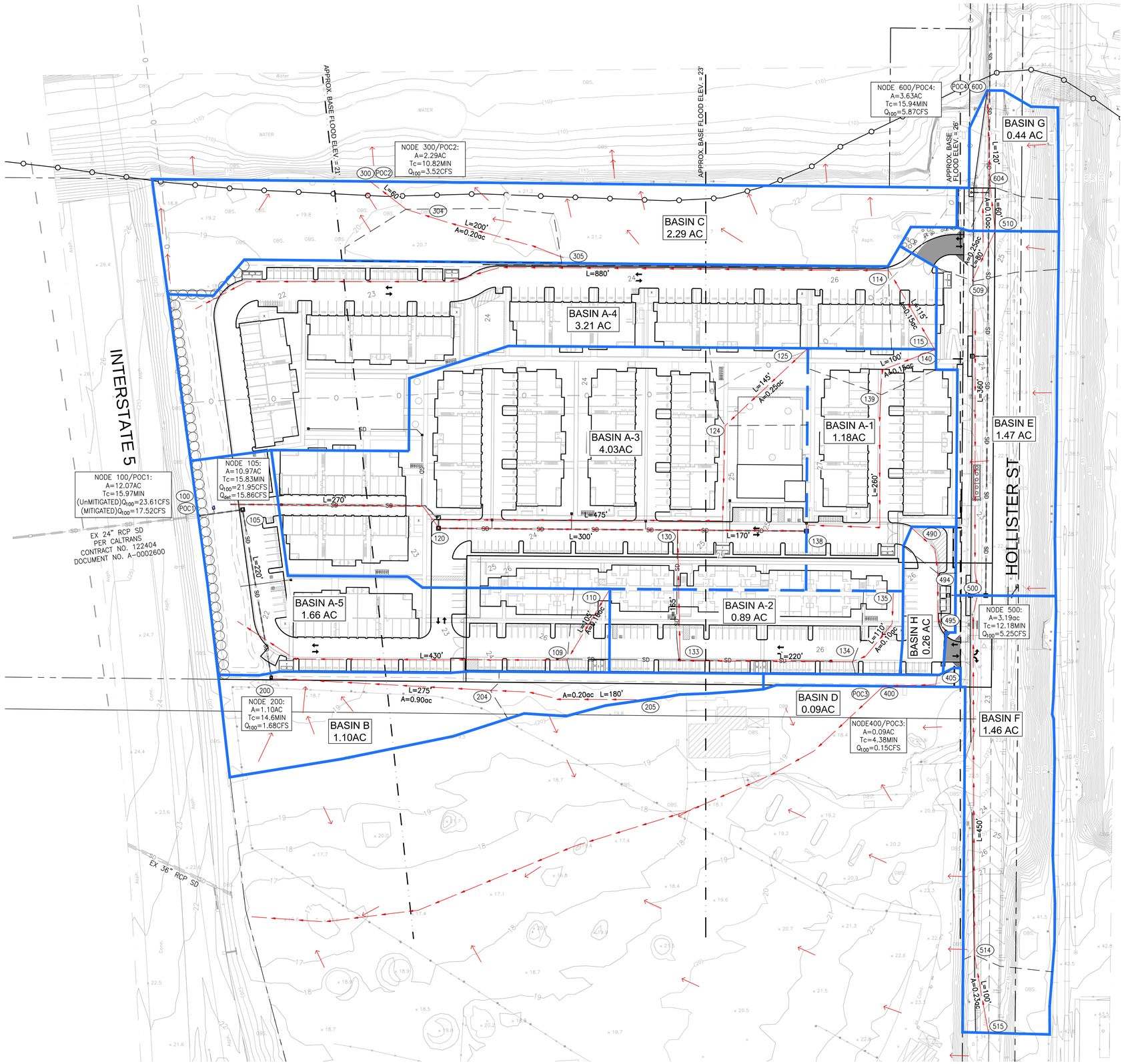
EXISTING HYDROLOGY MAP

BELLA MAR
FEBRUARY 2019



LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- BASIN LIMITS
- SUB-BASIN LIMITS
- INTIAL AREA LIMITS
- FLOW PATH
- FLOW DIRECTION
- HYDROLOGY NODE
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN

60' 0' 30' 60'

SCALE: 1" = 60'

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PROPOSED HYDROLOGY MAP

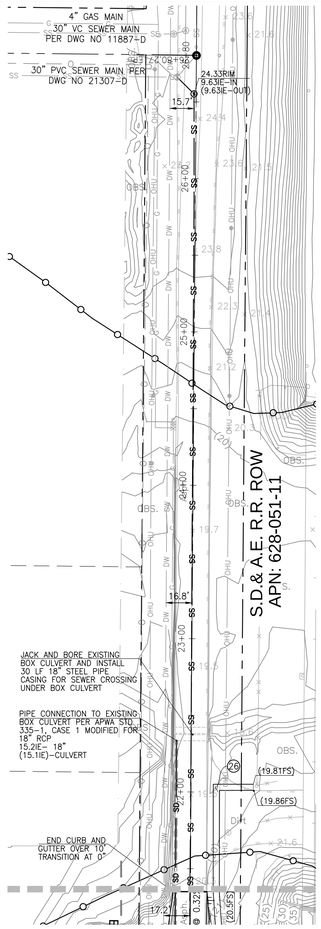
BELLA MAR
FEBRUARY 2019

F:\Projects\1621\001_Support Files\Reports\Hydrology\Figures\Proposed Hydrology.dwg (7/16/2019 11:25 AM) Plotted by: Brianna VanGorder

APPENDIX 2

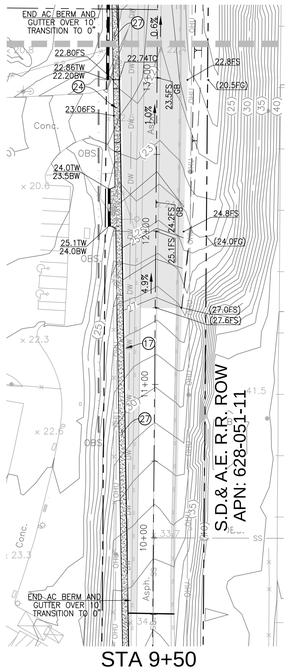
TM GRADING & SITE CROSS SECTIONS

STA 21+40
SEE UPPER LEFT

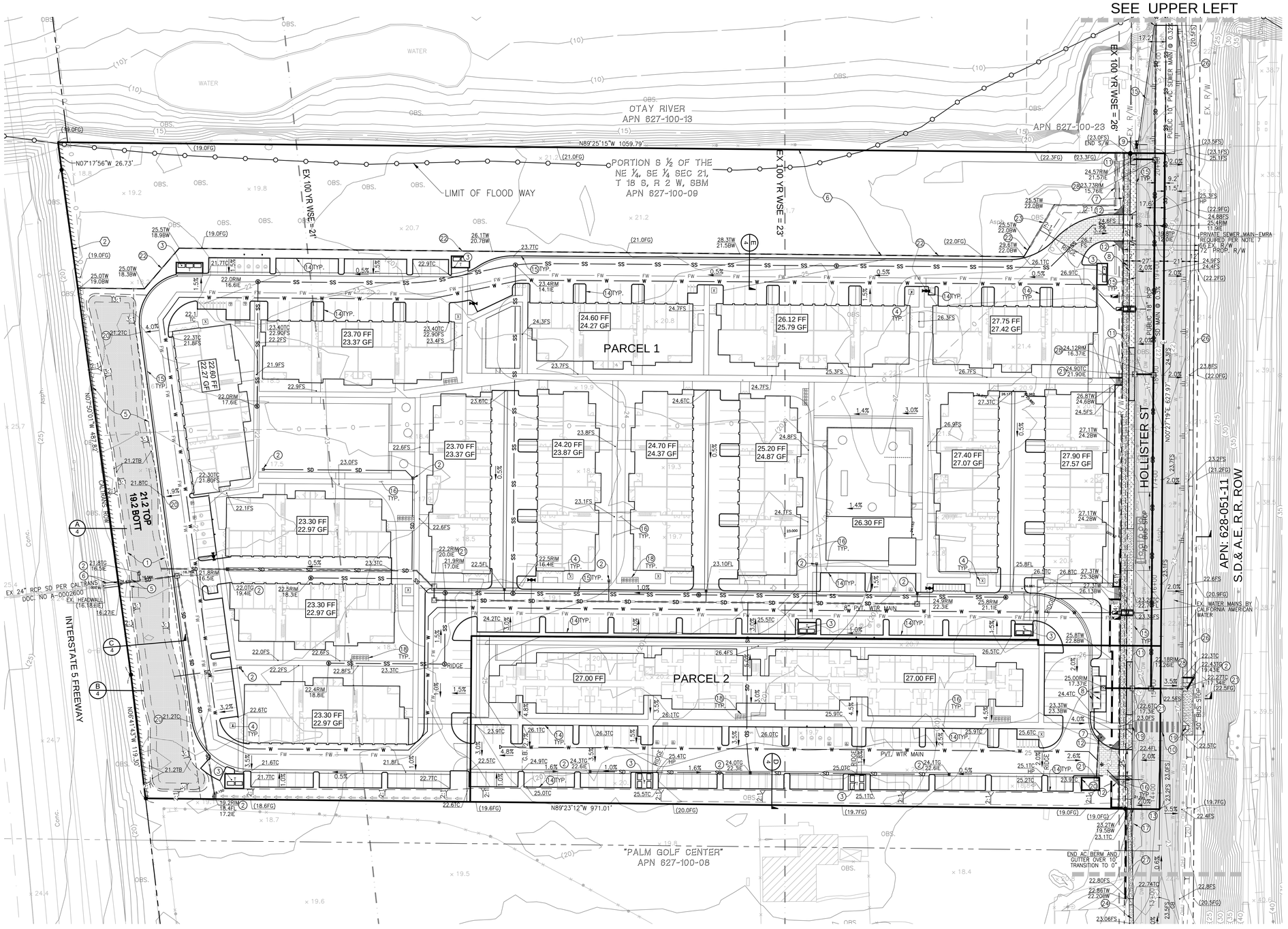


STA 21+40
SEE RIGHT

STA 12+90
SEE RIGHT



STA 9+50
SEE SHEET 4 OF 5



STA 12+90
SEE LOWER LEFT

CONSTRUCTION NOTES

1. BIOFILTRATION BASIN PER DETAIL C/4
2. CATCH BASIN PER RSD D-8
3. TRASH ENCLOSURE
4. ELECTRICAL TRANSFORMER
5. SPILLWAY PER DETAIL C/4
6. HEADWALL TO DISCHARGE TO 4.5' WIDE CONCRETE DRAINAGE DITCH TO EX. CULVERT (CALTRANS ENCROACHMENT)
7. PROPRIETARY MODULAR WETLAND BIOFILTRATION BMP
8. UNDERGROUND DETENTION VAULTS
9. RELOCATE EX. FH
10. CONTINENTAL CROSSWALK PER SDM-116
11. BIOFILTRATION PLANTER PER STD DWG GS-3.1
12. VISIBILITY AREA TRIANGLES. NO OBSTRUCTION INCLUDING SOLID WALLS IN THE VISIBILITY AREA SHALL EXCEED 3FT IN HEIGHT
13. TRANSITION FROM C&G TO TEMP AC BERM
14. 6" CURB PER SDG-150
15. 6" CURB AND GUTTER PER SDG-151
16. 4" PCC SIDEWALK PER SDG-155
17. TEMPORARY 6" TYPE 'A' AC BERM PER G-05
18. BIKE RACKS PER LANDSCAPE PLANS
19. CURB RAMP TYPE 'B' PER SDG-133
20. 3' CURB OPENING
21. CURB INLET PER RSD D-1
22. RETAINING WALL WITH 3' FREESTANDING WALL AND FENCING PER DETAIL E/4
23. 3' FREESTANDING WALL AND FENCING PER LANDSCAPE ARCH PLANS
24. EXISTING 35' DRIVEWAY TO BE MODIFIED PER SDG-162
25. CURB RAMP TYPE 'C' PER G-29
26. 4' WIDE MULTI-USE DG PATH PER DETAIL J/4
27. TEMPORARY 4" AC SIDEWALK PER SDG-155
28. STORM DRAIN CLEANOUT PER RSD D-9

EASEMENT NOTES

(2) ABUTTER'S RIGHTS OF INGRESS AND EGRESS TO OR FROM THE STREET, HIGHWAY, OR FREEWAY ABUTTING THE WESTERLY BOUNDARY OF SAID PROPERTY RECORDED IN BOOK 3918, PAGE 199 O.R. RECORDED JANUARY 3, 1951.

(5) AN EASEMENT, OF VARIABLE WIDTH, GRANTED TO THE CITY OF SAN DIEGO FOR STORAGE OF FLOOD WATERS PER DOC. REC. SEP. 22, 2010 AS DOC. NO. 2010-0503414 O.R.

(6) AN EASEMENT, OF VARIABLE WIDTH, GRANTED TO THE CITY OF SAN DIEGO FOR CONSERVATION PURPOSES WITH THE RIGHT OF INGRESS AND EGRESS PER DOC. REC. SEP. 22, 2010 AS DOC. NO. 2010-0503415 O.R.

(7) A 5.0' EASEMENT GRANTED TO THE CITY OF SAN DIEGO FOR PUBLIC UTILITIES PER DOC. REC. SEP. 22, 2010 AS DOC. NO. 2010-0503416 O.R. TO BE QUITCLAIMED.

(8) AN IRREVOCABLE OFFER TO DEDICATE AN EASEMENT OVER A PORTION OF LAND FOR PUBLIC STREET PER DOC. REC. SEP. 22, 2010 AS DOC. NO. 2010-0503417 O.R.

(9) AN EASEMENT GRANTED TO SPRINT COMMUNICATIONS COMPANY L.P., FOR PERMANENT TELECOMMUNICATIONS EASEMENT AND INCIDENTAL PURPOSES PER DOC. REC. DECEMBER 12, 2013 AS DOC. NO. 2013-0717457 O.R.

NOTE:

1. ALL FINISHED FLOORS DESIGNED 2' ABOVE EXISTING 100 YEAR WSE
2. NO PERMITS SHALL BE ISSUED FOR GRADING OR OTHER WORK IN THE FLOODPLAIN OF THE OTAY RIVER UNTIL THE PERMITTEE OBTAINS AN APPROVED NO RISE CERTIFICATION PER THE CITY OF SAN DIEGO
3. WHEN AS-BUILT GRADING AND PUBLIC IMPROVEMENT PLANS ARE AVAILABLE, THE PERMITTEE MUST SUBMIT A REQUEST FOR THE FINAL LOMA OR FINAL LOMR TO FEMA VIA THE FLOODPLAIN MANAGEMENT SECTION OF THE DEVELOPMENT SERVICES DEPARTMENT. THE PERMITTEE MUST PROVIDE ALL DOCUMENTATION, ENGINEERING CALCULATIONS, AND FEES WHICH ARE REQUIRED BY FEMA
4. THE BOND FOR THIS PROJECT WILL NOT BE RELEASED UNTIL THE FINAL LOMA OR FINAL LOMR IS ISSUED BY FEMA. THE FLOODPLAIN MANAGEMENT SECTION OF THE CITY OF SAN DIEGO'S PUBLIC WORKS/ENGINEERING AND CAPITAL PROJECTS WILL NOTIFY THE DEVELOPMENT SERVICES DEPARTMENT OF SUCH ISSUANCE AS SOON AS IT IS INFORMED BY FEMA
5. THE PROPOSED PROJECT WILL COMPLY WITH ALL THE REQUIREMENTS OF THE CURRENT CITY OF SAN DIEGO STORM WATER STANDARDS MANUAL BEFORE A GRADING OR BUILDING PERMIT IS ISSUED. IT IS THE RESPONSIBILITY OF THE OWNER/DESIGNER/APPLICANT TO ENSURE THAT THE CURRENT STORM WATER PERMANENT BMP DESIGN STANDARDS ARE INCORPORATED INTO THE PROJECT
6. ALL PRIVATE ENCROACHMENTS IN THE ROW WILL REQUIRE AN EMRA WITH PUBLIC IMPROVEMENT PLANS
7. ALL PROPOSED IMPROVEMENTS WITHIN THE ROW SHALL BE CONSTRUCTED PER CURRENT CITY OF SAN DIEGO STANDARDS.

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40' 0' 20' 40'
SCALE: 1" = 40'

TENTATIVE PARCEL MAP NO. 2361780

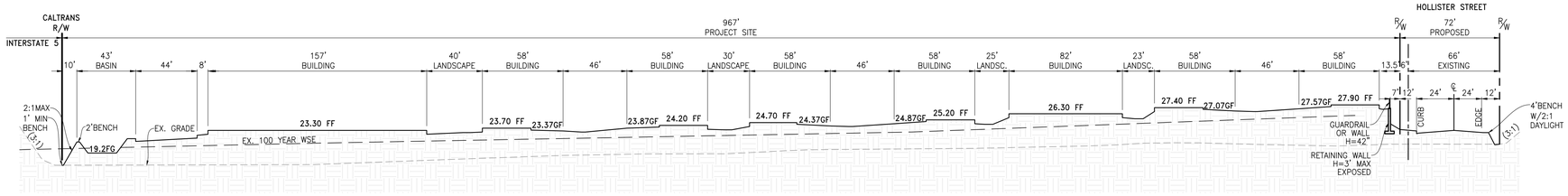
BELLA MAR

CONCEPTUAL GRADING & UTILITIES

SHEET 3 OF 5 SHEETS

DESCRIPTION	BY	DATE

I.O. NO.	24007769
PTS NO.	631240
T.P.M. NO.	2361780
1794-6299	NAD83 COORDINATES
154-1739	LAMBERT COORDINATES



CROSS SECTION — A/4
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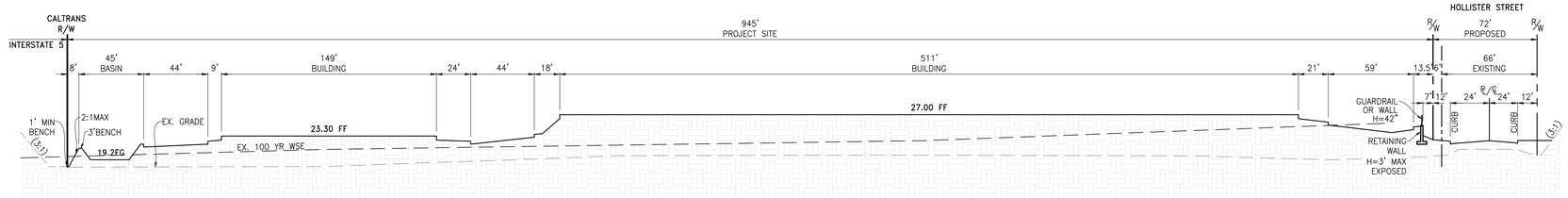
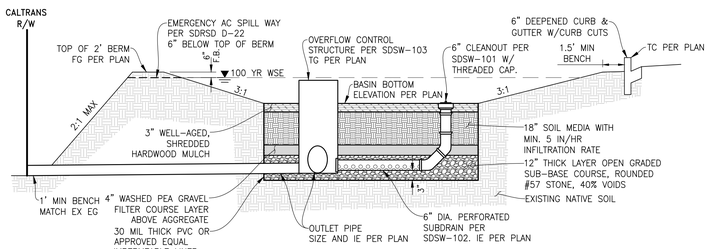
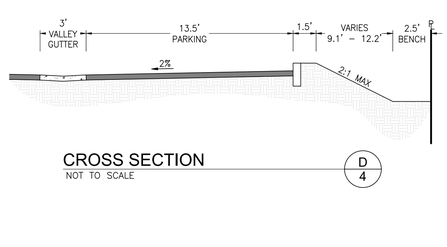


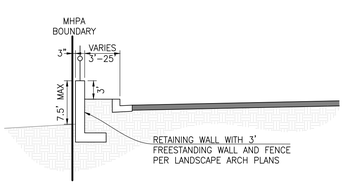
CROSS SECTION — B/4
NOT TO SCALE



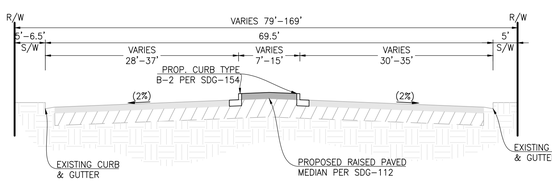
BIOFILTRATION BASIN DETAIL — C/4
NOT TO SCALE



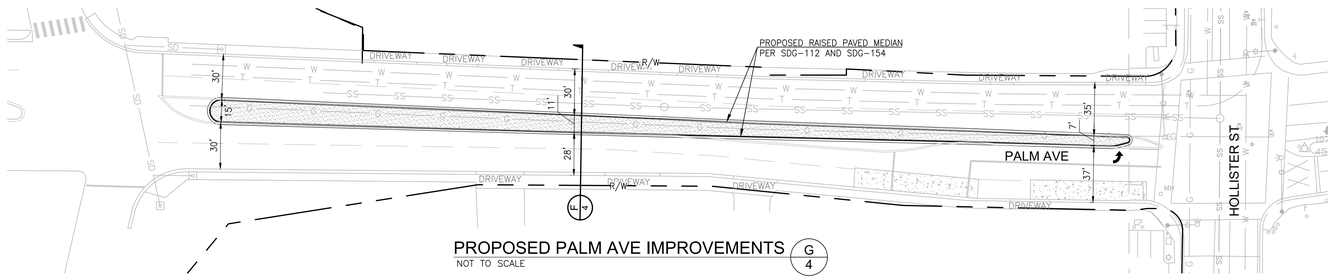
CROSS SECTION — D/4
NOT TO SCALE



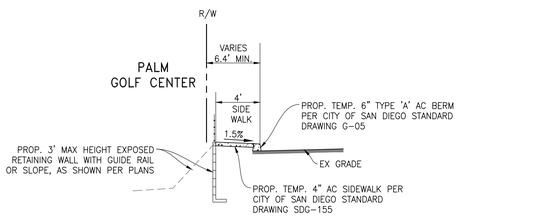
CROSS SECTION — E/4
NOT TO SCALE



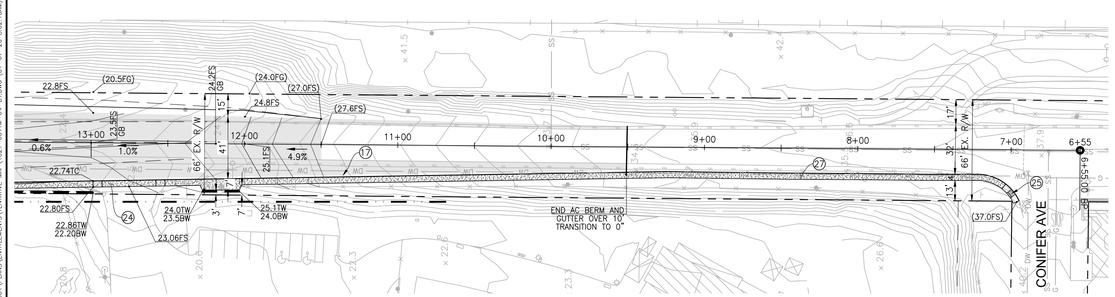
CROSS SECTION — F/4
NOT TO SCALE



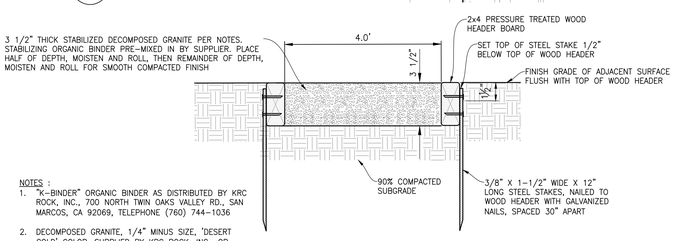
PROPOSED PALM AVE IMPROVEMENTS — G/4
NOT TO SCALE



HOLLISTER ST TEMPORARY SIDEWALK CROSS SECTION — H/4
FROM STA 7+3.35 - 14+8.19
NOT TO SCALE



HOLLISTER AVE STA 6+55 TO STA 13+50 — I/4
SCALE: 1"=40'



NOTES :
1. "K-BINDER" ORGANIC BINDER AS DISTRIBUTED BY KRC ROCK, INC., 700 NORTH TWIN OAKS VALLEY RD., SAN MARCOS, CA 92069, TELEPHONE (760) 744-1036
2. DECOMPOSED GRANITE, 1/4" MINUS SIZE, "DESERT GOLD" COLOR, SUPPLIED BY KRC ROCK, INC., OR EQUIVALENT APPROVED BY LANDSCAPE ARCHITECT.

MULTI-USE DG PATH — J/4
NOT TO SCALE

CONSTRUCTION NOTES

(17) TEMPORARY 6" TYPE 'A' AC BERM PER G-05
(24) EXISTING 35' DRIVEWAY TO BE MODIFIED PER SDG-162
(25) CURB RAMP TYPE 'C' PER G-29
(27) TEMPORARY 4" AC SIDEWALK PER SDG-155

REGISTERED PROFESSIONAL ENGINEER — BRIAN D. SMITH — C 75822 — EXP. 06-30-20 — CIVIL — STATE OF CALIFORNIA

FUSCOE ENGINEERING
6390 Greenwich Drive, Suite 170
San Diego, California 92122
tel 858.554.1500 ◦ fax 858.597.0335
www.fuscoe.com

TENTATIVE PARCEL MAP NO. 2361780

BELLA MAR

CONCEPTUAL CROSS SECTIONS

SHEET 4 OF 5 SHEETS

DESCRIPTION	BY	DATE

I.O. NO.	24007769
PTS NO.	631240
T.P.M. NO.	2361780
	1794-6299
	NAD83 COORDINATES
	154-1739
	LAMBERT COORDINATES

APPENDIX 3

RUNOFF COEFFICIENT CALCULATIONS

FUSCOE ENGINEERING

Job Name: BELLA MAR
Job #: 1621-001
Date: 2/12/2019

Runoff Coefficient Calculations

Runoff Coefficent Variables Per City of San Diego Drainage Design Manual (January '17)

Assumptions: D soils per City Drainage Manual

EXISTING CONDITIONS: RURAL (ONSITE)

Rural C =	0.45	Per Drainage Design Manual Appendix A Table A-1

EXISTING CONDITIONS: RURAL (OFFSITE (SOUTH))

Rural C =	0.45	Per Drainage Design Manual Appendix A Table A-1

EXISTING CONDITIONS: HOLLISTER ST (OFFSITE)

Area Impervious =	32620	sf	25%
Area Pervious =	98980	sf	75%
Total Area =	131600	sf	

Industrial C =	0.95	Per Drainage Design Manual Appendix A Table A-1
Tabulated % Impervious =	90%	
Acutal % Impervious =	25%	
Calculated Cweighted =	0.26	
**Design C =	0.50	

** Per Note (2) of Table A-1, no weighed C for commerical or industrial shall be less than C=0.5

PROPOSED CONDITIONS: MULTI-USE RESIDENTIAL (ONSITE)

Area Impervious =	373370	sf	73%
Area Pervious =	138210	sf	27%
Total Area =	511580	sf	

Multi-Use Residential C=	0.70	Per Drainage Design Manual Appendix A Table A-1
Acutal % Impervious =	73%	
Design C=	0.70	

PROPOSED CONDITIONS: RURAL (OFFSITE)

Rural C =	0.45	Per Drainage Design Manual Appendix A Table A-1

PROPOSED CONDITIONS: HOLLISTER ST (OFFSITE)

Area Impervious =	55540	sf	38%
Area Pervious =	91120	sf	62%
Total Area =	146660	sf	

Industrial C =	0.95	Per Drainage Design Manual Appendix A Table A-1
Tabulated % Impervious =	90%	
Acutal % Impervious =	38%	
Calculated Cweighted =	0.40	
**Design C =	0.50	

** Per Note (2) of Table A-1, no weighed C for commerical or industrial shall be less than C=0.5

APPENDIX 4

EXISTING HYDROLOGY CALCULATIONS

FUSCOE ENGINEERING

Job Name: BELLA MAR
Job #: 1621-001
Run Name: BMEX
Date: 11/13/2018

EXISTING HYDROLOGY - 100 YR

Node to Node		Code	Elev 1 (feet)	Elev 2 (feet)	Length (feet)	Runoff Coeff.	Area (ac.)	Comments	BANK		
									1	2	3
105	104	2	22.9	21.9	100.0	0.45	0.10	Basin A: Initial Area			
104	100	5	21.9	16.7	801.0	0.45	9.83	Sheet Flow			
100	100	1						Node 100 Confluence: 1 of 2			
205	204	2	19.5	19.1	100.0	0.45	0.13	Basin B: Initial Area (offsite)			
204	200	5	19.1	18.9	154.0	0.45	0.41	Sheet Flow (offsite)			
200	100	5	18.9	16.7	240.0	0.00	0.00	Sheet Flow			
100	100	1						Node 100 Confluence: 2 of 2			
305	304	2	23.0	21.9	216.0	0.45	0.07	Basin C: Initial Area			
304	300	5	21.9	18.8	803.0	0.45	1.11	Sheet Flow (flows offsite)			
405	404	2	23.0	22.5	75.0	0.45	0.09	Basin D: Initial Area			
404	400	5	22.5	18.7	597.0	0.45	2.95	Sheet Flow (flows offsite)			
400	400	1						Confluence 400: 1 of 3			
505	504	2	23.8	23.0	60.0	0.50	0.09	Basin E: Initial Area (Hollister St)			
504	500	5	23.0	19.5	396.0	0.50	1.08	Sheet Flow (road)			
500	400	5	19.5	18.7	202.0	0.45	0.00	Sheet Flow			
400	400	1						Confluence 400: 2 of 3			
605	604	2	31.5	28.5	65.0	0.50	0.09	Basin F: Initial Area (Hollister St)			
604	600	5	28.5	19.0	286.0	0.50	1.20				
600	400	5	19.0	18.7	106.0	0.45	0.00				

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2014 Advanced Engineering Software (aes)
              Ver. 21.0 Release Date: 06/01/2014  License ID 1355

                              Analysis prepared by:

                                Fuscoe Engineering
                           6390 Greenwich Drive, Suite 170
                                 San Diego, CA 92122


 ************************* DESCRIPTION OF STUDY *************************
* BELLA MAR                                                             *
* EXISTING CONDITIONS - 100 YR                                          *
*                                                                       *
 *************************************************************************

  FILE NAME: BMEX.DAT
  TIME/DATE OF STUDY: 14:39 11/21/2018
-------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
-------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 10
   1)   5.000;  4.400
   2)  10.000;  3.450
   3)  20.000;  2.500
   4)  30.000;  2.000
   5)  40.000;  1.700
   6)  50.000;  1.500
   7)  60.000;  1.310
   8) 120.000;  0.860
   9) 180.000;  0.660
  10) 240.000;  0.560
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
```

NO.	(FT)	(FT)	SIDE / SIDE/ WAY	(FT)	(FT)	(FT)	(FT)	(n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    104.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =     22.90
  DOWNSTREAM ELEVATION(FEET) =     21.90
  ELEVATION DIFFERENCE(FEET) =      1.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    9.789
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    70.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.490
  SUBAREA RUNOFF(CFS) =      0.16
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.16

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     21.90  DOWNSTREAM(FEET) =     16.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   801.00   CHANNEL SLOPE =  0.0065
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.278
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.37
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.91
```

```
 AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =  14.64
 Tc(MIN.) =   24.43
 SUBAREA AREA(ACRES) =     9.83       SUBAREA RUNOFF(CFS) =   10.08
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.450
 TOTAL AREA(ACRES) =        9.9         PEAK FLOW RATE(CFS) =      10.18

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.22   FLOW VELOCITY(FEET/SEC.) =   1.12
 LONGEST FLOWPATH FROM NODE    105.00 TO NODE    100.00 =     901.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    100.00 TO NODE    100.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   24.43
 RAINFALL INTENSITY(INCH/HR) =   2.28
 TOTAL STREAM AREA(ACRES) =     9.93
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     10.18

****************************************************************************
 FLOW PROCESS FROM NODE    205.00 TO NODE    204.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
 S.C.S. CURVE NUMBER (AMC II) =   0
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
 UPSTREAM ELEVATION(FEET) =     19.50
 DOWNSTREAM ELEVATION(FEET) =     19.10
 ELEVATION DIFFERENCE(FEET) =      0.40
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.423
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.410
 SUBAREA RUNOFF(CFS) =      0.20
 TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.20

****************************************************************************
 FLOW PROCESS FROM NODE    204.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
```

```
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.10  DOWNSTREAM(FEET) =     18.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   154.00   CHANNEL SLOPE =  0.0013
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.458
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.43
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.25
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =  10.42
  Tc(MIN.) =   20.85
  SUBAREA AREA(ACRES) =     0.41       SUBAREA RUNOFF(CFS) =    0.45
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.450
  TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       0.60

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.08   FLOW VELOCITY(FEET/SEC.) =   0.27
  LONGEST FLOWPATH FROM NODE    205.00 TO NODE    200.00 =     254.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.00  DOWNSTREAM(FEET) =     16.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   240.00   CHANNEL SLOPE =  0.0096
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.60
  FLOW VELOCITY(FEET/SEC.) =   0.57   FLOW DEPTH(FEET) =   0.04
  TRAVEL TIME(MIN.) =   6.97   Tc(MIN.) =   27.82
  LONGEST FLOWPATH FROM NODE    205.00 TO NODE    100.00 =     494.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    100.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   27.82
  RAINFALL INTENSITY(INCH/HR) =   2.11
  TOTAL STREAM AREA(ACRES) =     0.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.60
```

```
  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       10.18    24.43        2.278          9.93
      2        0.60    27.82        2.109          0.54

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       10.71    24.43       2.278
      2       10.02    27.82       2.109

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.71   Tc(MIN.) =   24.43
  TOTAL AREA(ACRES) =       10.5
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    100.00 =     901.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    304.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   216.00
  UPSTREAM ELEVATION(FEET) =     23.00
  DOWNSTREAM ELEVATION(FEET) =     21.90
  ELEVATION DIFFERENCE(FEET) =      1.10
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.398
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.37
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.412
  SUBAREA RUNOFF(CFS) =      0.11
  TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.11

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    300.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =     21.90  DOWNSTREAM(FEET) =     18.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   803.00   CHANNEL SLOPE =  0.0039
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.300   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.599
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.29
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.06
  AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) = 206.31
  Tc(MIN.) =  216.71
  SUBAREA AREA(ACRES) =     1.11       SUBAREA RUNOFF(CFS) =    0.30
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.450
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       0.32

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.14   FLOW VELOCITY(FEET/SEC.) =   0.07
  LONGEST FLOWPATH FROM NODE    305.00 TO NODE    300.00 =    1019.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    405.00 TO NODE    404.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =     23.00
  DOWNSTREAM ELEVATION(FEET) =     22.50
  ELEVATION DIFFERENCE(FEET) =      0.50
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.082
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    56.67
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.442
  SUBAREA RUNOFF(CFS) =      0.14
  TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.14

****************************************************************************
  FLOW PROCESS FROM NODE    404.00 TO NODE    400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     22.50  DOWNSTREAM(FEET) =     18.70
```

```
 CHANNEL LENGTH THRU SUBAREA(FEET) =   597.00   CHANNEL SLOPE =  0.0064
 CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
 MANNING'S FACTOR = 0.300   MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.978
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
 S.C.S. CURVE NUMBER (AMC II) =   0
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.90
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.11
 AVERAGE FLOW DEPTH(FEET) =   0.21   TRAVEL TIME(MIN.) =  94.20
 Tc(MIN.) =  104.28
 SUBAREA AREA(ACRES) =     2.95       SUBAREA RUNOFF(CFS) =    1.30
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.450
 TOTAL AREA(ACRES) =        3.0         PEAK FLOW RATE(CFS) =       1.34

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   0.12
 LONGEST FLOWPATH FROM NODE    405.00 TO NODE    400.00 =     672.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    400.00 TO NODE    400.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  104.28
 RAINFALL INTENSITY(INCH/HR) =   0.98
 TOTAL STREAM AREA(ACRES) =     3.04
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.34

****************************************************************************
 FLOW PROCESS FROM NODE    505.00 TO NODE    504.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (7.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
 S.C.S. CURVE NUMBER (AMC II) =   0
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
 UPSTREAM ELEVATION(FEET) =     23.80
 DOWNSTREAM ELEVATION(FEET) =     23.00
 ELEVATION DIFFERENCE(FEET) =      0.80
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.601
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.906
 SUBAREA RUNOFF(CFS) =      0.18
 TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.18
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    504.00 TO NODE    500.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     23.00  DOWNSTREAM(FEET) =     19.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   396.00   CHANNEL SLOPE =  0.0088
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.300   MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.345
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (7.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.58
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.13
  AVERAGE FLOW DEPTH(FEET) =   0.28   TRAVEL TIME(MIN.) =  50.58
  Tc(MIN.) =   58.18
  SUBAREA AREA(ACRES) =     1.08       SUBAREA RUNOFF(CFS) =    0.73
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.500
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       0.79

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.32   FLOW VELOCITY(FEET/SEC.) =   0.14
  LONGEST FLOWPATH FROM NODE    505.00 TO NODE    500.00 =     456.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.50  DOWNSTREAM(FEET) =     18.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   202.00   CHANNEL SLOPE =  0.0040
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.79
  FLOW VELOCITY(FEET/SEC.) =   0.45   FLOW DEPTH(FEET) =   0.07
  TRAVEL TIME(MIN.) =   7.47   Tc(MIN.) =   65.65
  LONGEST FLOWPATH FROM NODE    505.00 TO NODE    400.00 =     658.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    400.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
```

```
  TIME OF CONCENTRATION(MIN.) =   65.65
  RAINFALL INTENSITY(INCH/HR) =   1.27
  TOTAL STREAM AREA(ACRES) =     1.17
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.79

****************************************************************************
  FLOW PROCESS FROM NODE    605.00 TO NODE    604.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (7.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =     31.50
  DOWNSTREAM ELEVATION(FEET) =     28.50
  ELEVATION DIFFERENCE(FEET) =      3.00
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.230
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.356
  SUBAREA RUNOFF(CFS) =      0.20
  TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.20

****************************************************************************
  FLOW PROCESS FROM NODE    604.00 TO NODE    600.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     28.50  DOWNSTREAM(FEET) =     19.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   286.00   CHANNEL SLOPE =  0.0315
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.722
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (7.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.32
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.43
  AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   3.34
  Tc(MIN.) =    8.57
  SUBAREA AREA(ACRES) =     1.20       SUBAREA RUNOFF(CFS) =    2.23
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.500
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       2.40

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   1.69
  LONGEST FLOWPATH FROM NODE    605.00 TO NODE    600.00 =     351.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    400.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.00  DOWNSTREAM(FEET) =     18.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   406.00   CHANNEL SLOPE =  0.0007
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.40
  FLOW VELOCITY(FEET/SEC.) =   0.34   FLOW DEPTH(FEET) =   0.19
  TRAVEL TIME(MIN.) =  20.14   Tc(MIN.) =   28.71
  LONGEST FLOWPATH FROM NODE    605.00 TO NODE    400.00 =     757.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    400.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   28.71
  RAINFALL INTENSITY(INCH/HR) =   2.06
  TOTAL STREAM AREA(ACRES) =     1.29
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.40

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        1.34   104.28        0.978          3.04
      2        0.79    65.65        1.268          1.17
      3        2.40    28.71        2.065          1.29

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        3.11    28.71       2.065
      2        3.10    65.65       1.268
      3        3.08   104.28       0.978

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       3.11   Tc(MIN.) =   28.71
  TOTAL AREA(ACRES) =        5.5
```

```
                                        BMEX
  LONGEST FLOWPATH FROM NODE    605.00 TO NODE    400.00 =     757.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =         5.5  TC(MIN.) =     28.71
  PEAK FLOW RATE(CFS)   =       3.11
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX 5

PROPOSED HYDROLOGY CALCULATIONS

FUSCOE ENGINEERING

Job Name: BELLA MAR
Job #: 1621-001
Run Name: BMPR
Date: 2/11/2019

UNMITIGATED PROPOSED HYDROLOGY - 100 YR

Node to Node		Code	Elev 1 (feet)	Elev 2 (feet)	Length (feet)	Runoff Coeff.	Area (ac.)	Comments	BANK 1	BANK 2	BANK 3
140	139	2	27.4	27.3	100.0	0.70	0.15	Basin A-1: Initial Area			
139	138	5	27.3	24.7	260.0	0.70	1.03	Open Channel Flow			
138	130	3	22.3	20.0	170.0			Pipe Flow			
130	130	1						Confluence: 1 of 2			
135	134	2	26.3	25.8	110.0	0.70	0.10	Basin A-2: Initial Area			
134	133	5	25.8	24.7	220.0	0.70	0.79	Open Channel Flow			
133	130	3	22.3	21.5	168.0			Pipe Flow			
130	130	1						Confluence: 2 of 2			
130	120	3	21.5	20.0	300.0			Pipe Flow			
120	120	1						Confluence: 1 of 2			
125	124	2	25.6	24.5	145.0	0.70	0.25	Basin A-3: Initial Area			
124	120	5	24.5	22.2	475.0	0.70	3.78	Open Channel Flow			
120	120	1						Confluence: 2 of 2			
120	105	3	20.0	16.5	270.0			Pipe Flow			
105	105	1						Confluence: 1 of 3			
115	114	2	27.0	26.1	115.0	0.70	0.15	Basin A-4: Initial Area			
114	105	5	26.1	21.7	880.0	0.70	3.06	Open Channel Flow			
105	105	1						Confluence: 2 of 3			
110	109	2	26.3	25.6	105.0	0.70	0.10	Basin A-5: Initial Area			
109	105	5	25.6	21.7	430.0	0.70	1.56	Open Channel Flow			
105	105	1						Confluence: 3 of 3			
							10.97	Total Tributary Area to Basin			
105	100	3	16.5	16.3	50.0			Pipe Flow			
100	100	1						Confluence: 1 of 2			
205	204	2	20.0	19.8	180.0	0.45	0.20	Basin B: Initial Area			
204	204	8				0.45	0.90	Addition Subarea			
204	200	5	19.8	18.6	275.0			Open Channel Flow			
200	100	3	17.1	16.3	220.0			Pipe Flow			
100	100	1						Confluence: 2 of 2: POC1			
							12.07	Total Tributary Area to POC1			
305	304	2	21.0	20.1	200.0	0.45	0.20	Basin C: Initial Area			
304	304	8				0.45	2.09	Addition Subarea			
304	300	5	20.1	19.1	60.0			Open Channel Flow: POC2			

Job Name: BELLA MAR
Job #: 1621-001
Run Name: BMPR
Date: 2/11/2019

UNMITIGATED PROPOSED HYDROLOGY - 100 YR

Node to Node		Code	Elev 1 (feet)	Elev 2 (feet)	Length (feet)	Runoff Coeff.	Area (ac.)	Comments	BANK 1	BANK 2	BANK 3
405	400	2	24.0	18.7	60.0	0.45	0.09	Basin D: Initial Area : POC3			
490	494	2	26.8	25.4	70.0	0.70	0.10	Basin H: Initial Area			
494	495	5	25.4	23.2	75.0	0.70	0.16	Open Channel Flow			
495	500	3	18.3	17.5	80.0			Pipe Flow			
500	500	1						Confluence: 1 of 3			
510	509	2	25.0	23.4	80.0	0.58	0.25	Basin E: Initial Area			
509	500	6	23.4	22.1	360.0	0.58	1.22	Street Flow			
500	500	1						Confluence: 2 of 3			
515	514	2	34.8	31.4	100.0	0.58	0.23	Basin F: Initial Area			
514	500	6	31.4	22.1	450.0	0.58	1.23	Street Flow			
500	500	1						Confluence: 3 of 3			
500	600	3	17.2	15.4	750.0			Pipe Flow			
600	600	1						Confluence: 1 of 2			
510	604	2	25.0	23.5	60.0	0.58	0.10	Basin G: Initial Area			
604	600	5	23.5	20.3	120.0	0.58	0.34	Open Channel Flow			
600	600	1						Confluence: 2 of 2			
							3.63	Total Tributary Area to POC2			

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2014 Advanced Engineering Software (aes)
              Ver. 21.0 Release Date: 06/01/2014  License ID 1355

                              Analysis prepared by:

                                Fuscoe Engineering
                               6390 Greenwich Drive
                                    Suite 170
                               San Diego, CA 92122

 ************************* DESCRIPTION OF STUDY *************************
* BELLA MAR                                                             *
* UNMITIGATED DEVELOPED CONDITIONS - 100 YR                             *
*                                                                       *
 *************************************************************************

  FILE NAME: BMPR.DAT
  TIME/DATE OF STUDY: 08:11 02/12/2019
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 20
   1)   5.000;  4.400
   2)   6.000;  4.200
   3)   7.000;  3.900
   4)   8.000;  3.750
   5)   9.000;  3.600
   6)  10.000;  3.450
   7)  11.000;  3.300
   8)  12.000;  3.200
   9)  14.000;  3.000
  10)  15.000;  2.900
  11)  16.000;  2.800
  12)  17.000;  2.700
  13)  19.000;  2.600
  14)  20.000;  2.550
  15)  25.000;  2.230
```

```
  16)  30.000;  2.000
  17)  40.000;  1.700
  18)  50.000;  1.500
  19)  60.000;  1.310
  20) 120.000;  0.860
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  =====  ======  =====  =======
  1   27.0     22.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    140.00 TO NODE    139.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =     27.40
  DOWNSTREAM ELEVATION(FEET) =     27.30
  ELEVATION DIFFERENCE(FEET) =      0.10
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.414
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.076
  SUBAREA RUNOFF(CFS) =      0.43
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.43

****************************************************************************
  FLOW PROCESS FROM NODE    139.00 TO NODE    138.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =     27.30  DOWNSTREAM(FEET) =     24.70
 CHANNEL LENGTH THRU SUBAREA(FEET) =   260.00   CHANNEL SLOPE =  0.0100
 CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.431
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.68
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.17
 AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   3.71
 Tc(MIN.) =   10.12
 SUBAREA AREA(ACRES) =     1.03       SUBAREA RUNOFF(CFS) =    2.47
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.700
 TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       2.83

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   1.46
 LONGEST FLOWPATH FROM NODE    140.00 TO NODE    138.00 =     360.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    138.00 TO NODE    130.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    22.30  DOWNSTREAM(FEET) =    20.00
 FLOW LENGTH(FEET) =   170.00   MANNING'S N =  0.011
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.21
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       2.83
 PIPE TRAVEL TIME(MIN.) =   0.46    Tc(MIN.) =   10.58
 LONGEST FLOWPATH FROM NODE    140.00 TO NODE    130.00 =     530.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   10.58
 RAINFALL INTENSITY(INCH/HR) =   3.36
 TOTAL STREAM AREA(ACRES) =     1.18
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.83

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

```
 FLOW PROCESS FROM NODE    135.00 TO NODE    134.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   110.00
 UPSTREAM ELEVATION(FEET) =     26.30
 DOWNSTREAM ELEVATION(FEET) =     25.80
 ELEVATION DIFFERENCE(FEET) =      0.50
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.414
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.076
 SUBAREA RUNOFF(CFS) =      0.29
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.29

****************************************************************************
 FLOW PROCESS FROM NODE    134.00 TO NODE    133.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     25.80  DOWNSTREAM(FEET) =     24.70
 CHANNEL LENGTH THRU SUBAREA(FEET) =   220.00   CHANNEL SLOPE =  0.0050
 CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.343
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.23
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.85
 AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   4.30
 Tc(MIN.) =   10.72
 SUBAREA AREA(ACRES) =     0.79       SUBAREA RUNOFF(CFS) =    1.85
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.700
 TOTAL AREA(ACRES) =        0.9         PEAK FLOW RATE(CFS) =       2.08

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   1.04
 LONGEST FLOWPATH FROM NODE    135.00 TO NODE    133.00 =     330.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    133.00 TO NODE    130.00 IS CODE =  31
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    22.30  DOWNSTREAM(FEET) =    21.50
  FLOW LENGTH(FEET) =   168.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.85
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.08
  PIPE TRAVEL TIME(MIN.) =   0.73    Tc(MIN.) =   11.44
  LONGEST FLOWPATH FROM NODE    135.00 TO NODE    130.00 =     498.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    130.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.44
  RAINFALL INTENSITY(INCH/HR) =   3.26
  TOTAL STREAM AREA(ACRES) =     0.89
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.08

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.83    10.58        3.363          1.18
      2        2.08    11.44        3.256          0.89

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        4.76    10.58       3.363
      2        4.83    11.44       3.256

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.83   Tc(MIN.) =   11.44
  TOTAL AREA(ACRES) =        2.1
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    130.00 =     530.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    120.00 IS CODE =  31
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    21.50  DOWNSTREAM(FEET) =    20.00
  FLOW LENGTH(FEET) =   300.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.74
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.83
  PIPE TRAVEL TIME(MIN.) =   1.05    Tc(MIN.) =   12.50
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    120.00 =     830.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    120.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.50
  RAINFALL INTENSITY(INCH/HR) =   3.15
  TOTAL STREAM AREA(ACRES) =     2.07
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.83

****************************************************************************
  FLOW PROCESS FROM NODE    125.00 TO NODE    124.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   145.00
  UPSTREAM ELEVATION(FEET) =     25.60
  DOWNSTREAM ELEVATION(FEET) =     24.50
  ELEVATION DIFFERENCE(FEET) =      1.10
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    9.000
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    57.76
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.600
  SUBAREA RUNOFF(CFS) =      0.45
  TOTAL AREA(ACRES) =      0.25   TOTAL RUNOFF(CFS) =      0.45

****************************************************************************
  FLOW PROCESS FROM NODE    124.00 TO NODE    120.00 IS CODE =  51
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     24.50  DOWNSTREAM(FEET) =     22.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   475.00   CHANNEL SLOPE =  0.0048
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.869
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
  S.C.S. CURVE NUMBER (AMC II) =  45
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.25
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.25
  AVERAGE FLOW DEPTH(FEET) =   0.11   TRAVEL TIME(MIN.) =   6.31
  Tc(MIN.) =   15.31
  SUBAREA AREA(ACRES) =     3.78       SUBAREA RUNOFF(CFS) =    7.59
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.688
  TOTAL AREA(ACRES) =        4.0         PEAK FLOW RATE(CFS) =       7.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   1.52
  LONGEST FLOWPATH FROM NODE    125.00 TO NODE    120.00 =     620.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    120.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.31
  RAINFALL INTENSITY(INCH/HR) =   2.87
  TOTAL STREAM AREA(ACRES) =     4.03
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.95

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        4.83    12.50        3.150          2.07
      2        7.95    15.31        2.869          4.03

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
```

```
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       11.31    12.50       3.150
      2       12.35    15.31       2.869

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      12.35   Tc(MIN.) =   15.31
  TOTAL AREA(ACRES) =        6.1
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    120.00 =     830.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    20.00  DOWNSTREAM(FEET) =    16.50
  FLOW LENGTH(FEET) =   270.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.61
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.35
  PIPE TRAVEL TIME(MIN.) =   0.52    Tc(MIN.) =   15.83
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    105.00 =    1100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.83
  RAINFALL INTENSITY(INCH/HR) =   2.82
  TOTAL STREAM AREA(ACRES) =     6.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     12.35

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    114.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   115.00
  UPSTREAM ELEVATION(FEET) =     27.00
  DOWNSTREAM ELEVATION(FEET) =     26.10
  ELEVATION DIFFERENCE(FEET) =      0.90
```

```
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.975
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    58.48
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.205
 SUBAREA RUNOFF(CFS) =      0.44
 TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.44

****************************************************************************
 FLOW PROCESS FROM NODE    114.00 TO NODE    105.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     26.10  DOWNSTREAM(FEET) =     21.70
 CHANNEL LENGTH THRU SUBAREA(FEET) =   880.00   CHANNEL SLOPE =  0.0050
 CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
 MANNING'S FACTOR = 0.011   MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.880
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.61
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.59
 AVERAGE FLOW DEPTH(FEET) =   0.08   TRAVEL TIME(MIN.) =   9.23
 Tc(MIN.) =   15.20
 SUBAREA AREA(ACRES) =     3.06       SUBAREA RUNOFF(CFS) =    6.17
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.700
 TOTAL AREA(ACRES) =        3.2         PEAK FLOW RATE(CFS) =       6.47

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.11   FLOW VELOCITY(FEET/SEC.) =   1.87
 LONGEST FLOWPATH FROM NODE    115.00 TO NODE    105.00 =     995.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   15.20
 RAINFALL INTENSITY(INCH/HR) =   2.88
 TOTAL STREAM AREA(ACRES) =     3.21
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.47

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

```
 FLOW PROCESS FROM NODE    110.00 TO NODE    109.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   105.00
 UPSTREAM ELEVATION(FEET) =     26.30
 DOWNSTREAM ELEVATION(FEET) =     25.60
 ELEVATION DIFFERENCE(FEET) =      0.70
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.112
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    55.00
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.166
 SUBAREA RUNOFF(CFS) =      0.29
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.29

****************************************************************************
 FLOW PROCESS FROM NODE    109.00 TO NODE    105.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     25.60  DOWNSTREAM(FEET) =     21.70
 CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0091
 CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.205
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.06
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.23
 AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   5.84
 Tc(MIN.) =   11.95
 SUBAREA AREA(ACRES) =     1.56       SUBAREA RUNOFF(CFS) =    3.50
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.700
 TOTAL AREA(ACRES) =        1.7         PEAK FLOW RATE(CFS) =       3.72

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   1.50
 LONGEST FLOWPATH FROM NODE    110.00 TO NODE    105.00 =     535.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   1
```

```
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.95
  RAINFALL INTENSITY(INCH/HR) =   3.20
  TOTAL STREAM AREA(ACRES) =     1.66
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.72

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       12.35    15.83        2.817          6.10
      2        6.47    15.20        2.880          3.21
      3        3.72    11.95        3.205          1.66

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       19.66    11.95       3.205
      2       21.89    15.20       2.880
      3       21.95    15.83       2.817

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      21.95   Tc(MIN.) =   15.83
  TOTAL AREA(ACRES) =       11.0
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    105.00 =    1100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    100.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    16.50  DOWNSTREAM(FEET) =    16.30
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  22.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.30
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      21.95
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =   15.97
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    100.00 =    1150.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    100.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.97
  RAINFALL INTENSITY(INCH/HR) =   2.80
  TOTAL STREAM AREA(ACRES) =    10.97
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     21.95

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    204.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  UPSTREAM ELEVATION(FEET) =     20.00
  DOWNSTREAM ELEVATION(FEET) =     19.80
  ELEVATION DIFFERENCE(FEET) =      0.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.423
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.387
  SUBAREA RUNOFF(CFS) =      0.30
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.30

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.387
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =  45
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4500
  SUBAREA AREA(ACRES) =    0.90   SUBAREA RUNOFF(CFS) =    1.37
  TOTAL AREA(ACRES) =        1.1   TOTAL RUNOFF(CFS) =       1.68
  TC(MIN.) =   10.42

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

```
 FLOW PROCESS FROM NODE    204.00 TO NODE    200.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     19.80  DOWNSTREAM(FEET) =     18.60
 CHANNEL LENGTH THRU SUBAREA(FEET) =   275.00   CHANNEL SLOPE =  0.0044
 CHANNEL FLOW THRU SUBAREA(CFS) =       1.68
 FLOW VELOCITY(FEET/SEC) =   1.10 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   4.18   Tc(MIN.) =   14.60
 LONGEST FLOWPATH FROM NODE    205.00 TO NODE    200.00 =     455.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    200.00 TO NODE    100.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    17.10  DOWNSTREAM(FEET) =    16.30
 FLOW LENGTH(FEET) =   220.00   MANNING'S N =  0.011
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.32
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.68
 PIPE TRAVEL TIME(MIN.) =   1.11    Tc(MIN.) =   15.71
 LONGEST FLOWPATH FROM NODE    205.00 TO NODE    100.00 =     675.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    100.00 TO NODE    100.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   15.71
 RAINFALL INTENSITY(INCH/HR) =   2.83
 TOTAL STREAM AREA(ACRES) =     1.10
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.68

 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1       21.95    15.97        2.803         10.97
     2        1.68    15.71        2.829          1.10

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.
```

```
  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       23.43    15.71       2.829
      2       23.61    15.97       2.803

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      23.61   Tc(MIN.) =   15.97
  TOTAL AREA(ACRES) =       12.1
  LONGEST FLOWPATH FROM NODE    140.00 TO NODE    100.00 =    1150.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    304.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  UPSTREAM ELEVATION(FEET) =     21.00
  DOWNSTREAM ELEVATION(FEET) =     20.10
  ELEVATION DIFFERENCE(FEET) =      0.90
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.423
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.387
  SUBAREA RUNOFF(CFS) =      0.30
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.30

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    304.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.387
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =  45
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4500
  SUBAREA AREA(ACRES) =    2.09   SUBAREA RUNOFF(CFS) =    3.22
  TOTAL AREA(ACRES) =        2.3   TOTAL RUNOFF(CFS) =       3.52
  TC(MIN.) =   10.42

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

```
 FLOW PROCESS FROM NODE    304.00 TO NODE    300.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =     20.10  DOWNSTREAM(FEET) =     19.10
 CHANNEL LENGTH THRU SUBAREA(FEET) =    60.00   CHANNEL SLOPE =  0.0167
 CHANNEL FLOW THRU SUBAREA(CFS) =       3.52
 FLOW VELOCITY(FEET/SEC) =   2.51 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   0.40   Tc(MIN.) =   10.82
 LONGEST FLOWPATH FROM NODE    305.00 TO NODE    300.00 =     260.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    405.00 TO NODE    400.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
 S.C.S. CURVE NUMBER (AMC II) =  45
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
 UPSTREAM ELEVATION(FEET) =     24.00
 DOWNSTREAM ELEVATION(FEET) =     18.70
 ELEVATION DIFFERENCE(FEET) =      5.30
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.384
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.18
 TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.18

****************************************************************************
 FLOW PROCESS FROM NODE    490.00 TO NODE    494.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
 S.C.S. CURVE NUMBER (AMC II) =  45
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    70.00
 UPSTREAM ELEVATION(FEET) =     26.80
 DOWNSTREAM ELEVATION(FEET) =     25.40
 ELEVATION DIFFERENCE(FEET) =      1.40
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.781
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.400
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.31
 TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.31
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    494.00 TO NODE    495.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     25.40  DOWNSTREAM(FEET) =     23.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =    75.00   CHANNEL SLOPE =  0.0293
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  99.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.242
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (24. DU/AC OR LESS) RUNOFF COEFFICIENT = .7000
  S.C.S. CURVE NUMBER (AMC II) =  45
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.55
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.24
  AVERAGE FLOW DEPTH(FEET) =   0.02   TRAVEL TIME(MIN.) =   1.01
  Tc(MIN.) =    5.79
  SUBAREA AREA(ACRES) =     0.16       SUBAREA RUNOFF(CFS) =    0.48
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.700
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.77

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.03   FLOW VELOCITY(FEET/SEC.) =   1.33
  LONGEST FLOWPATH FROM NODE    490.00 TO NODE    495.00 =     145.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    495.00 TO NODE    500.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    18.30  DOWNSTREAM(FEET) =    17.50
  FLOW LENGTH(FEET) =    80.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.02
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.77
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =    6.12
  LONGEST FLOWPATH FROM NODE    490.00 TO NODE    500.00 =     225.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    500.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
```

```
  TIME OF CONCENTRATION(MIN.) =    6.12
  RAINFALL INTENSITY(INCH/HR) =   4.16
  TOTAL STREAM AREA(ACRES) =     0.26
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.77

****************************************************************************
  FLOW PROCESS FROM NODE    510.00 TO NODE    509.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (14.5 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =     25.00
  DOWNSTREAM ELEVATION(FEET) =     23.40
  ELEVATION DIFFERENCE(FEET) =      1.60
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.667
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.800
  SUBAREA RUNOFF(CFS) =      0.47
  TOTAL AREA(ACRES) =      0.25   TOTAL RUNOFF(CFS) =      0.47

****************************************************************************
  FLOW PROCESS FROM NODE    509.00 TO NODE    500.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   23.40  DOWNSTREAM ELEVATION(FEET) =   22.10
  STREET LENGTH(FEET) =   360.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 27.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  22.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.45
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    9.86
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.33
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.43
  STREET FLOW TRAVEL TIME(MIN.) =   4.51   Tc(MIN.) =   12.18
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.182
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (14.5 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
 S.C.S. CURVE NUMBER (AMC II) =  45
 AREA-AVERAGE RUNOFF COEFFICIENT =  0.500
 SUBAREA AREA(ACRES) =    1.22      SUBAREA RUNOFF(CFS) =    1.94
 TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       2.34

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  12.00
 FLOW VELOCITY(FEET/SEC.) =  1.50   DEPTH*VELOCITY(FT*FT/SEC.) =   0.55
 LONGEST FLOWPATH FROM NODE    510.00 TO NODE    500.00 =     440.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    500.00 TO NODE    500.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   12.18
 RAINFALL INTENSITY(INCH/HR) =   3.18
 TOTAL STREAM AREA(ACRES) =     1.47
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.34

****************************************************************************
 FLOW PROCESS FROM NODE    515.00 TO NODE    514.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (14.5 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
 S.C.S. CURVE NUMBER (AMC II) =  45
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
 UPSTREAM ELEVATION(FEET) =     34.80
 DOWNSTREAM ELEVATION(FEET) =     31.40
 ELEVATION DIFFERENCE(FEET) =      3.40
 URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.889
 WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
          THE MAXIMUM OVERLAND FLOW LENGTH =    92.00
          (Reference: Table 3-1B of Hydrology Manual)
          THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.933
 SUBAREA RUNOFF(CFS) =      0.45
 TOTAL AREA(ACRES) =      0.23   TOTAL RUNOFF(CFS) =      0.45

****************************************************************************
 FLOW PROCESS FROM NODE    514.00 TO NODE    500.00 IS CODE =  62
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =   31.40  DOWNSTREAM ELEVATION(FEET) =   22.10
  STREET LENGTH(FEET) =   450.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 27.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  22.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.53
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    6.76
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.66
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.70
  STREET FLOW TRAVEL TIME(MIN.) =   2.82   Tc(MIN.) =    9.71
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.493
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (14.5 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =  45
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.500
  SUBAREA AREA(ACRES) =    1.23      SUBAREA RUNOFF(CFS) =    2.15
  TOTAL AREA(ACRES) =        1.5        PEAK FLOW RATE(CFS) =       2.55

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   8.57
  FLOW VELOCITY(FEET/SEC.) =  2.99   DEPTH*VELOCITY(FT*FT/SEC.) =   0.89
  LONGEST FLOWPATH FROM NODE    515.00 TO NODE    500.00 =     550.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    500.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.71
  RAINFALL INTENSITY(INCH/HR) =   3.49
  TOTAL STREAM AREA(ACRES) =     1.46
```

```
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.55

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.77     6.12        4.164          0.26
      2        2.34    12.18        3.182          1.47
      3        2.55     9.71        3.493          1.46

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        3.56     6.12       4.164
      2        5.06     9.71       3.493
      3        5.25    12.18       3.182

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.25   Tc(MIN.) =   12.18
  TOTAL AREA(ACRES) =        3.2
  LONGEST FLOWPATH FROM NODE    515.00 TO NODE    500.00 =     550.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    600.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    17.20  DOWNSTREAM(FEET) =    15.40
  FLOW LENGTH(FEET) =   750.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.33
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.25
  PIPE TRAVEL TIME(MIN.) =   3.76    Tc(MIN.) =   15.94
  LONGEST FLOWPATH FROM NODE    515.00 TO NODE    600.00 =    1300.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.94
  RAINFALL INTENSITY(INCH/HR) =   2.81
```

```
  TOTAL STREAM AREA(ACRES) =     3.19
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.25

****************************************************************************
  FLOW PROCESS FROM NODE    510.00 TO NODE    604.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (14.5 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =  45
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     25.00
  DOWNSTREAM ELEVATION(FEET) =     23.50
  ELEVATION DIFFERENCE(FEET) =      1.50
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.164
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.151
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE    604.00 TO NODE    600.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     23.50  DOWNSTREAM(FEET) =     20.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   120.00   CHANNEL SLOPE =  0.0267
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.788
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (14.5 DU/AC OR LESS) RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =  45
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.53
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.26
  AVERAGE FLOW DEPTH(FEET) =   0.02   TRAVEL TIME(MIN.) =   1.59
  Tc(MIN.) =    7.75
  SUBAREA AREA(ACRES) =     0.34       SUBAREA RUNOFF(CFS) =    0.64
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.500
  TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       0.83

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.03   FLOW VELOCITY(FEET/SEC.) =   1.41
  LONGEST FLOWPATH FROM NODE    510.00 TO NODE    600.00 =     180.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    600.00 IS CODE =   1
```

```
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.75
  RAINFALL INTENSITY(INCH/HR) =   3.79
  TOTAL STREAM AREA(ACRES) =     0.44
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.83

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        5.25    15.94        2.806          3.19
      2        0.83     7.75        3.788          0.44

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        4.72     7.75       3.788
      2        5.87    15.94       2.806

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.87   Tc(MIN.) =   15.94
  TOTAL AREA(ACRES) =        3.6
  LONGEST FLOWPATH FROM NODE    515.00 TO NODE    600.00 =    1300.00 FEET.
==========================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.6  TC(MIN.) =     15.94
  PEAK FLOW RATE(CFS)   =       5.87
==========================================================================
==========================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX 6

PROPOSED MITIGATED HYDROLOGY CALCULATIONS

Job Name: BELLA MAR
Job #: 1621-001
Run Name: BMPR
Date: 2/11/2019

MITIGATED PROPOSED HYDROLOGY - 100 YR

Node to Node		Code	Elev 1 (feet)	Elev 2 (feet)	Length (feet)	Runoff Coeff.	Area (ac.)	Comments	BANK 1	2	3
105	105	7	A=10.97	Tc=15.83	Q=15.86		**10.97**	**Detention Basin Outflow**			
105	100	3	16.5	16.3	50.0			Pipe Flow			
100	100	1						Confluence: 1 of 2			
205	204	2	20.0	19.8	180.0	0.45	0.20	Basin B: Initial Area			
204	204	8				0.45	0.90	Addition Subarea			
204	200	5	19.8	18.6	275.0			Open Channel Flow			
200	100	3	17.1	16.3	220.0			Pipe Flow			
100	100	1						Confluence: 2 of 2: POC1			
							12.07	**Total Tributary Area to POC1**			

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2014 Advanced Engineering Software (aes)
              Ver. 21.0 Release Date: 06/01/2014  License ID 1355

                              Analysis prepared by:

                                Fuscoe Engineering
                               6390 Greenwich Drive
                                    Suite 170
                               San Diego, CA 92122

 ************************* DESCRIPTION OF STUDY *************************
* BELLA MAR                                                             *
* MITIGATED DEVELOPED CONDITIONS - 100 YR                               *
* DETENTION AT NODE 105                                                 *
 *************************************************************************

  FILE NAME: BMPRMIT.DAT
  TIME/DATE OF STUDY: 07:38 02/13/2019
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  RAINFALL-INTENSITY ADJUSTMENT FACTOR = 1.000
  *USER SPECIFIED:
  NUMBER OF [TIME,INTENSITY] DATA PAIRS = 20
   1)   5.000;  4.400
   2)   6.000;  4.200
   3)   7.000;  3.900
   4)   8.000;  3.750
   5)   9.000;  3.600
   6)  10.000;  3.450
   7)  11.000;  3.300
   8)  12.000;  3.200
   9)  14.000;  3.000
  10)  15.000;  2.900
  11)  16.000;  2.800
  12)  17.000;  2.700
  13)  19.000;  2.600
  14)  20.000;  2.550
  15)  25.000;  2.230
```

```
  16)  30.000;  2.000
  17)  40.000;  1.700
  18)  50.000;  1.500
  19)  60.000;  1.310
  20) 120.000;  0.860
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: ONLY PEAK CONFLUENCE VALUES CONSIDERED
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   27.0     22.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =   7
----------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
  USER-SPECIFIED VALUES ARE AS FOLLOWS:
  TC(MIN) =  15.83   RAIN INTENSITY(INCH/HOUR) =  2.82
  TOTAL AREA(ACRES) =    10.97   TOTAL RUNOFF(CFS) =     15.86

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    100.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    16.50  DOWNSTREAM(FEET) =    16.30
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  19.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.82
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.86
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =   15.97
  LONGEST FLOWPATH FROM NODE      0.00 TO NODE    100.00 =      50.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    100.00 IS CODE =   1
----------------------------------------------------------------------------
```

```
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.97
  RAINFALL INTENSITY(INCH/HR) =   2.80
  TOTAL STREAM AREA(ACRES) =    10.97
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     15.86

******************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    204.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  UPSTREAM ELEVATION(FEET) =     20.00
  DOWNSTREAM ELEVATION(FEET) =     19.80
  ELEVATION DIFFERENCE(FEET) =      0.20
  URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.423
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.387
  SUBAREA RUNOFF(CFS) =      0.30
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.30

******************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.387
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4500
  SUBAREA AREA(ACRES) =    0.90   SUBAREA RUNOFF(CFS) =    1.37
  TOTAL AREA(ACRES) =        1.1   TOTAL RUNOFF(CFS) =       1.68
  TC(MIN.) =   10.42

******************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    200.00 IS CODE =  52
------------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.80  DOWNSTREAM(FEET) =     18.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   275.00   CHANNEL SLOPE =  0.0044
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.68
  FLOW VELOCITY(FEET/SEC) =   1.10 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   4.18   Tc(MIN.) =   14.60
  LONGEST FLOWPATH FROM NODE    205.00 TO NODE    200.00 =     455.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    100.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    17.10  DOWNSTREAM(FEET) =    16.30
  FLOW LENGTH(FEET) =   220.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.32
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.68
  PIPE TRAVEL TIME(MIN.) =   1.11    Tc(MIN.) =   15.71
  LONGEST FLOWPATH FROM NODE    205.00 TO NODE    100.00 =     675.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    100.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.71
  RAINFALL INTENSITY(INCH/HR) =   2.83
  TOTAL STREAM AREA(ACRES) =     1.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.68

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       15.86    15.97        2.803         10.97
      2        1.68    15.71        2.829          1.10

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
```

```
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       17.27    15.71       2.829
      2       17.52    15.97       2.803

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      17.52   Tc(MIN.) =   15.97
  TOTAL AREA(ACRES) =       12.1
  LONGEST FLOWPATH FROM NODE    205.00 TO NODE    100.00 =     675.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       12.1  TC(MIN.) =     15.97
  PEAK FLOW RATE(CFS)   =      17.52
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX 7

HYDRAULIC CALCULATIONS

DETENTION BASIN ATTENUATION

HOLLISTER PUBLIC STORM DRAIN PIPE

DETENTION BASIN 100-YR STORM ATTENUATION

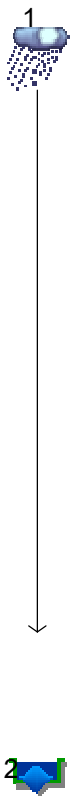
DETENTION BASIN INFLOW HYDROGRAPH

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 2/12/2019
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 16 MIN.
6 HOUR RAINFALL 2.5 INCHES
BASIN AREA 10.97 ACRES
RUNOFF COEFFICIENT 0.7
PEAK DISCHARGE 21.95 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 16	DISCHARGE (CFS) = 1.1
TIME (MIN) = 32	DISCHARGE (CFS) = 1.2
TIME (MIN) = 48	DISCHARGE (CFS) = 1.2
TIME (MIN) = 64	DISCHARGE (CFS) = 1.3
TIME (MIN) = 80	DISCHARGE (CFS) = 1.4
TIME (MIN) = 96	DISCHARGE (CFS) = 1.5
TIME (MIN) = 112	DISCHARGE (CFS) = 1.6
TIME (MIN) = 128	DISCHARGE (CFS) = 1.8
TIME (MIN) = 144	DISCHARGE (CFS) = 1.9
TIME (MIN) = 160	DISCHARGE (CFS) = 2.1
TIME (MIN) = 176	DISCHARGE (CFS) = 2.3
TIME (MIN) = 192	DISCHARGE (CFS) = 2.8
TIME (MIN) = 208	DISCHARGE (CFS) = 3.2
TIME (MIN) = 224	DISCHARGE (CFS) = 4.7
TIME (MIN) = 240	DISCHARGE (CFS) = 8.6
TIME (MIN) = 256	DISCHARGE (CFS) = 21.95
TIME (MIN) = 272	DISCHARGE (CFS) = 3.8
TIME (MIN) = 288	DISCHARGE (CFS) = 2.5
TIME (MIN) = 304	DISCHARGE (CFS) = 2
TIME (MIN) = 320	DISCHARGE (CFS) = 1.7
TIME (MIN) = 336	DISCHARGE (CFS) = 1.4
TIME (MIN) = 352	DISCHARGE (CFS) = 1.3
TIME (MIN) = 368	DISCHARGE (CFS) = 1.2
TIME (MIN) = 384	DISCHARGE (CFS) = 0

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Manual	Unmitigated Inflow
2	Reservoir	Mitigated

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

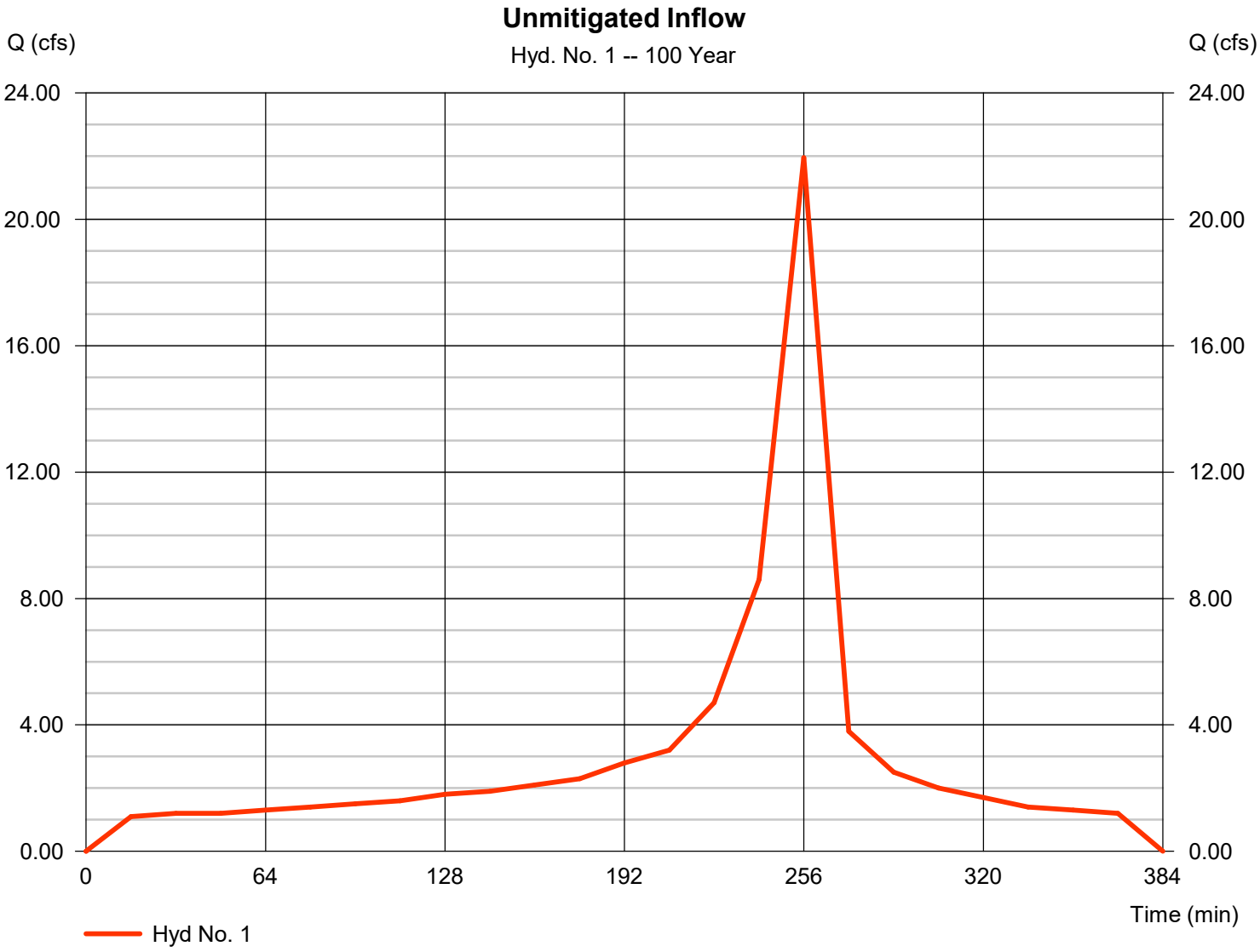
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	21.95	16	256	69,648	------	------	------	Unmitigated Inflow
2	Reservoir	15.86	16	256	69,644	1	20.51	8,446	Mitigated

Hydrograph Report

Hyd. No. 1

Unmitigated Inflow

Hydrograph type	= Manual	Peak discharge	= 21.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 256 min
Time interval	= 16 min	Hyd. volume	= 69,648 cuft



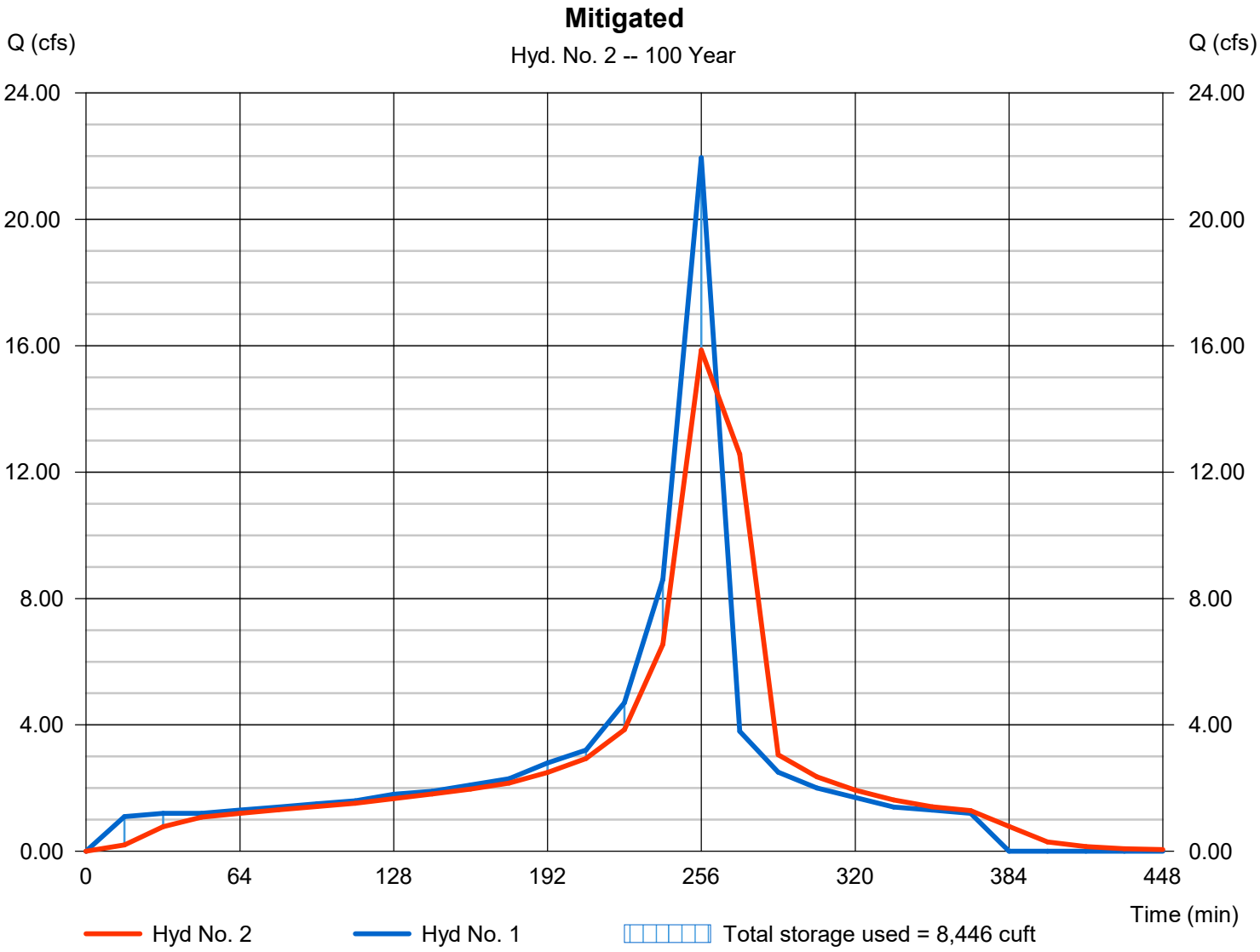
Hydrograph Report

Hyd. No. 2

Mitigated

Hydrograph type	=	Reservoir	Peak discharge	=	15.86 cfs
Storm frequency	=	100 yrs	Time to peak	=	256 min
Time interval	=	16 min	Hyd. volume	=	69,644 cuft
Inflow hyd. No.	=	1 - Unmitigated Inflow	Max. Elevation	=	20.51 ft
Reservoir name	=	Detention	Max. Storage	=	8,446 cuft

Storage Indication method used.



Pond No. 2 - Detention

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 19.70 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	19.70	12,740	0	0
0.10	19.80	13,045	1,289	1,289
0.20	19.90	13,350	1,320	2,609
0.30	20.00	13,660	1,351	3,960
0.40	20.10	13,965	1,381	5,341
0.50	20.20	14,273	1,412	6,753
0.60	20.30	14,581	1,443	8,195
0.70	20.40	14,890	1,474	9,669
0.80	20.50	15,200	1,505	11,173
0.90	20.60	15,510	1,536	12,709
1.00	20.70	15,820	1,567	14,275
1.10	20.80	16,132	1,598	15,873
1.20	20.90	16,444	1,629	17,502
1.30	21.00	16,756	1,660	19,162
1.40	21.10	17,069	1,691	20,853
1.50	21.20	17,382	1,723	22,576

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 16.35	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 9.83	0.00	0.00	0.00
Crest El. (ft)	= 19.70	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	19.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.10	1,289	19.80	23.19 ic	---	---	---	1.04	---	---	---	---	---	1.035
0.20	2,609	19.90	23.19 ic	---	---	---	2.93	---	---	---	---	---	2.928
0.30	3,960	20.00	23.19 ic	---	---	---	5.38	---	---	---	---	---	5.379
0.40	5,341	20.10	23.19 ic	---	---	---	8.28	---	---	---	---	---	8.281
0.50	6,753	20.20	23.19 ic	---	---	---	11.57	---	---	---	---	---	11.57
0.60	8,195	20.30	23.19 ic	---	---	---	15.21	---	---	---	---	---	15.21
0.70	9,669	20.40	23.19 ic	---	---	---	19.17	---	---	---	---	---	19.17
0.80	11,173	20.50	23.35 ic	---	---	---	23.35 s	---	---	---	---	---	23.35
0.90	12,709	20.60	24.92 ic	---	---	---	24.92 s	---	---	---	---	---	24.92
1.00	14,275	20.70	25.94 ic	---	---	---	25.93 s	---	---	---	---	---	25.93
1.10	15,873	20.80	26.74 ic	---	---	---	26.74 s	---	---	---	---	---	26.74
1.20	17,502	20.90	27.42 ic	---	---	---	27.42 s	---	---	---	---	---	27.42
1.30	19,162	21.00	28.02 ic	---	---	---	28.02 s	---	---	---	---	---	28.02
1.40	20,853	21.10	28.57 ic	---	---	---	28.56 s	---	---	---	---	---	28.56
1.50	22,576	21.20	29.07 ic	---	---	---	29.07 s	---	---	---	---	---	29.07

Hydraflow Table of Contents

Hydraulic Calculation for Public 18" RCP SD in Hollister

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Diameter	1.50	ft
Discharge	5.87	ft³/s

Results

Normal Depth	1.26	ft
Flow Area	1.58	ft²
Wetted Perimeter	3.47	ft
Hydraulic Radius	0.46	ft
Top Width	1.10	ft
Critical Depth	0.94	ft
Percent Full	83.9	%
Critical Slope	0.00616	ft/ft
Velocity	3.71	ft/s
Velocity Head	0.21	ft
Specific Energy	1.47	ft
Froude Number	0.55	
Maximum Discharge	6.19	ft³/s
Discharge Full	5.75	ft³/s
Slope Full	0.00312	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	83.92	%
Downstream Velocity	Infinity	ft/s

Hydraulic Calculation for Public 18" RCP SD in Hollister

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	0.94	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.00616	ft/ft

Cross Section for Public 18" RCP SD in Hollister

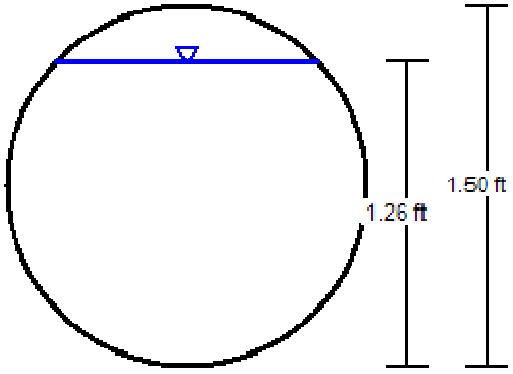
Project Description

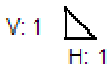
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00300	ft/ft
Normal Depth	1.26	ft
Diameter	1.50	ft
Discharge	5.87	ft³/s

Cross Section Image





APPENDIX 8

AS-BUILT REFERENCES

ATTACHMENT 1
SITE PLAN

ATTACHMENT 2
CALTRANS AS-BUILT

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	5	4.4/9.0	42	437

DISTRICT DESIGN ENGINEER Henry R. Obrecht REGISTERED CIVIL ENGINEER No. 15768
DATE APPROVED July 27, 1970

14.9' IE-OUT (NAVD 88)

16.2' IE-IN (NAVD 88)

L0
Δ = 04° 36' 28"
R = 10,000'
T = 402.32'
L = 804.21'

275+59.38 EC L0

Otay Riv Br
Br. No. 57-246R/L

Otay Riv Overflow Br
Br. No. 57-263R/L

R/W

S Dike

Graded "V" Gutter 2:1 SS

N06°54'00"W 285

2693.09'

Profile Grade

Ground Line

-0.38%

NOTE
Profile Grade is 15' Lt & Rt of ℄ L0

U.S.C & G.S. Datum

"AS BUILT"
CONTRACT 122404
YEAR COMPLETED 8-1-73

DRAINAGE DETAILS AND CONTOUR GRADING PLANS

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date

AS BUILT PLANS
Contract No. 11-122404
Date Completed 07-70
Document No. 11-000260

FORM WH23A-PF

4

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

DATE 8-26-74 SIGNATURE [signature] TITLE [illegible]

SCALE 1"=50' MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM
SCALE 1"=20' MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM
SCALE 1"=10' or 1"=100' MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM
SCALE 1"=40' MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

ATTACHMENT 3 :
FLOOD INSURANCE
STUDY

CHARLES AVENUE

LOURET AVENUE

INTERSTATE HIGHWAY 5

INTERSTATE HIGHWAY 5

14.9' 10 YEAR FLOOD ELEVATION @ OUTLET

15.1' 10-YEAR FLOOD ELEVATION @ INLET

200'

ELEVATION IN FEET (NAVD)

30

20

10

0

2600 2800 3000 3200 3400 3600 3800 4000 4200 4400 4600 4800 5000 5200

STREAM DISTANCE IN FEET ABOVE CROSS SECTION A

D E F G

LEGEND

- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

OTAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA
(AND INCORPORATED AREAS)

259P

APPENDIX 9

FEMA FLOOD MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). this information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2009.

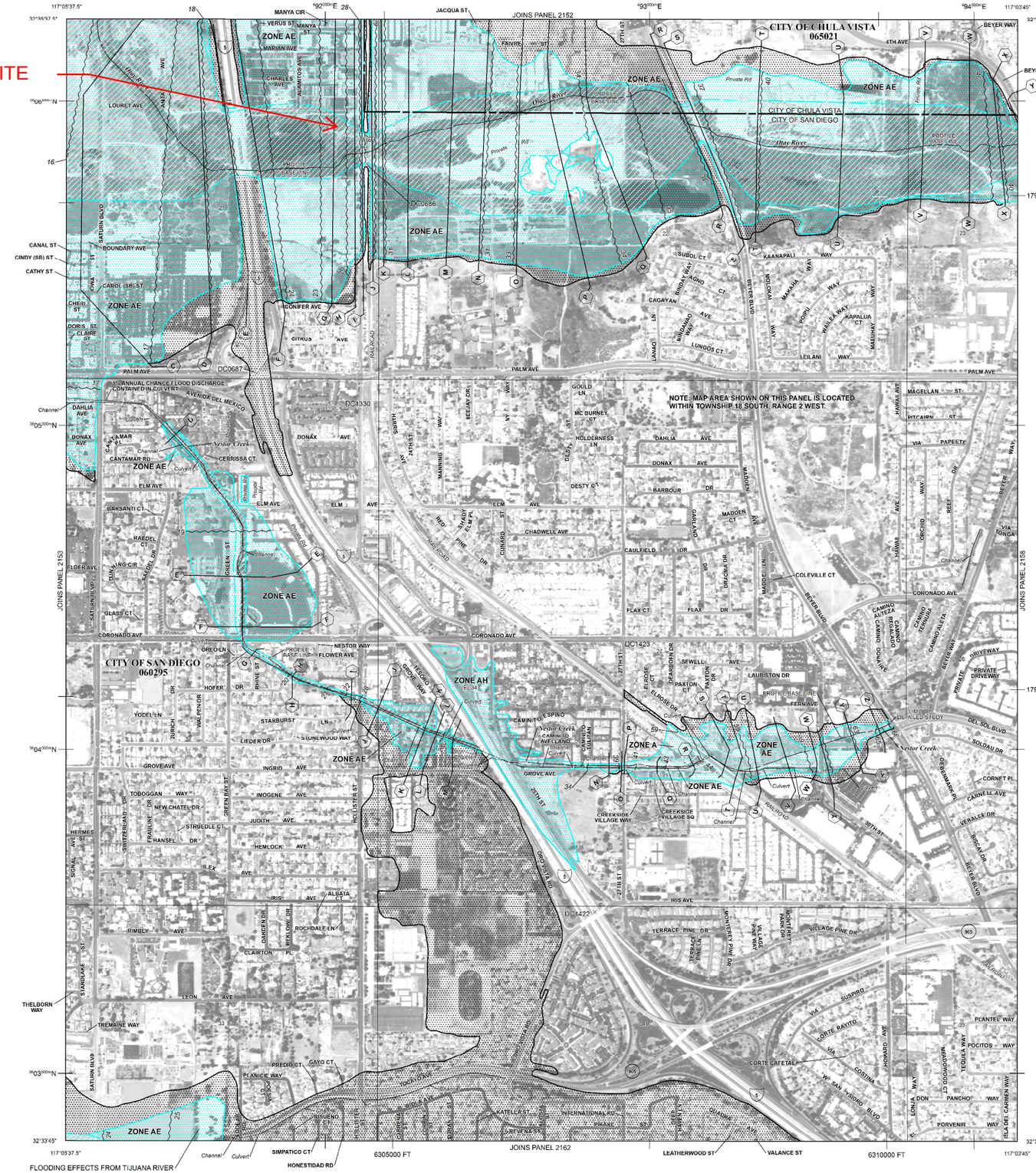
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

The **"profile base lines"** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line", in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities

513 (EL 987) Base Flood Elevation line and value; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

Cross section line

Transect line

97°07'30", 32°22'30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

4275000mE 1000-meter Universal Transverse Mercator grid ticks, zone 11

6000000 FT 5000-foot grid values: California State Plane coordinate system, Zone VI (FIPSZONE = 406), Lambert projection

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 19, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
May 16, 2012 - to update corporate limits, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to update map elevations to North American Vertical Datum of 1988.
April 5, 2016 - to remove Provisionally Accredited Levee note

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 250 500 750 1,000 FEET
150 0 150 200 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2154H

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 2154 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CHULA VISTA, CITY OF	065021	2154	H
SAN DIEGO, CITY OF	060295	2154	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06073C2154H

MAP REVISED APRIL 5, 2016

Federal Emergency Management Agency

APPENDIX 10

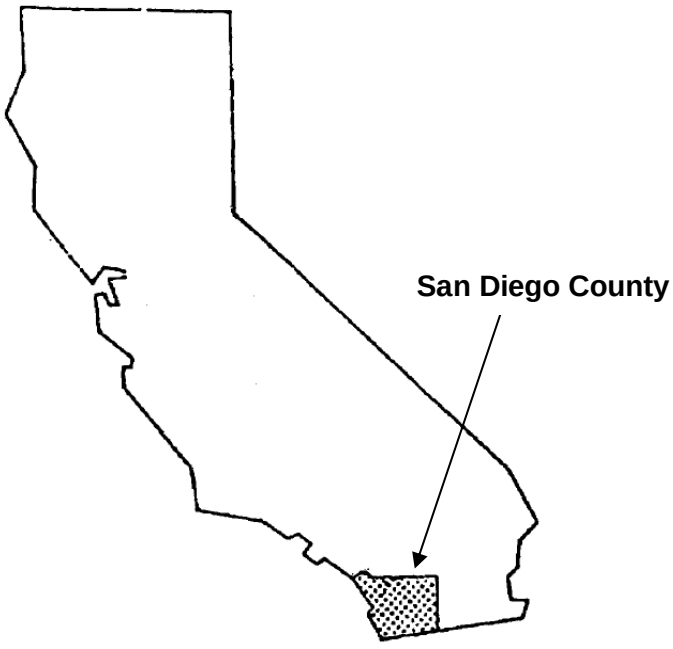
FEMA FLOOD STUDIES

FLOOD INSURANCE STUDY

SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

VOLUME 1 OF 11

Community Name	Community Number
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284
CARLSBAD, CITY OF	060285
CHULA VISTA, CITY OF	065021
CORONADO, CITY OF	060287
DEL MAR, CITY OF	060288
EL CAJON, CITY OF	060289
ENCINITAS, CITY OF	060726
ESCONDIDO, CITY OF	060290
IMPERIAL BEACH, CITY OF	060291
LA MESA, CITY OF	060292
LEMON GROVE, CITY OF	060723
NATIONAL CITY, CITY OF	060293
OCEANSIDE, CITY OF	060294
POWAY, CITY OF	060702
SAN DIEGO, CITY OF	060295
SAN MARCOS, CITY OF	060296
SANTEE, CITY OF	060703
SOLANA BEACH, CITY OF	060725
VISTA, CITY OF	060297



REVISED
4/5/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06073CV001D

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EXHIBITS

EXHIBIT 1 – FLOOD PROFILES

Table of Contents – Volume 8

EXHIBITS

EXHIBIT 1 – FLOOD PROFILES

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second) 10% Annual-Chance	2% Annual-Chance	1% Annual-Chance	0.2% Annual-Chance
At 19th Street	--	--	--	864[4]	--
At Elm Avenue	2.45	--	--	796[4]	--
At Coronado Avenue	2.33	--	--	698[4]	--
At Hollister Street	1.99	--	--	496[4]	--
At 25th Street/Interstate 5	1.71	--	--	456[4]	--
At San Diego and Arizona Eastern Railroad	1.40	555	860	1,015	2,295
North Avenue Tributary					
Approximately 1,730 feet upstream of North Broadway	0.5	--	--	440	--
North Branch Poway Creek					
At Sycamore Canyon Road	4.5	650	2,000	3,000	7,200
North Tributary to Santa Maria					
At Mouth	1.6	100	600	1,100	2,900
Olive Creek					
At Mouth	1.0	--	--	1,370	--

-- Data Not Available

[4] Decrease Due to Construction of "Lot 6 Detention Basin" Upstream of Railroad

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Otay River								
A	0	2,533	4,688	4.7	13.2	13.2	13.2	0.0
B	1,390	2,110	9,474	2.3	15.2	15.2	16.1	0.9
C	2,490	2,300	4,084	5.4	16.3	16.3	16.8	0.5
D	3,720	1,662	7,917	2.8	18.2	18.2	18.9	0.7
E	4,040	642	1,928	11.4	19.3	19.3	19.4	0.1
F	4,270	722	3,819	5.8	20.6	20.6	20.6	0.0
G	5,100	641	2,883	7.6	24.0	24.0	24.0	0.0
H	5,350	360	1,767	12.4	25.7	25.7	25.7	0.0
I	5,390	320	2,711	8.1	28.0	28.0	28.0	0.0
J	5,500	304	2,359	9.3	28.9	28.9	28.9	0.0
K	5,600	440	4,010	5.5	30.8	30.8	30.8	0.0
L	5,880	740	4,511	4.9	30.8	30.8	30.9	0.1
M	6,280	1,020	7,451	2.9	30.9	30.9	31.5	0.6
N	6,610	1,225	7,933	2.8	30.9	30.9	31.7	0.8
O	7,012	1,243	4,824	4.6	32.8	32.8	32.9	0.1
P	7,330	1,035	3,833	5.7	33.3	33.3	33.8	0.5
Q	7,670	1,204	6,208	3.5	34.3	34.3	35.3	1.0
R	8,780	451	3,132	7.0	36.4	36.4	37.3	0.9
S	8,875	432	2,553	8.6	36.6	36.6	37.6	1.0
T	9,525	1,060	7,231	3.0	39.7	39.7	39.9	0.2
U	10,375	1,110	9,424	2.3	40.1	40.1	40.3	0.2
V	11,275	935	8,841	2.5	40.3	40.3	40.5	0.2
W	11,825	917	8,300	2.6	40.3	40.3	40.6	0.3
X	12,085	670	6,494	3.4	40.4	40.4	40.7	0.3
Y	12,395	403	1,798	12.2	42.9	42.9	42.9	0.0
Z	12,579	476	3,279	6.8	45.4	45.4	45.4	0.0

[1] Feet above Cross Section A

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

FLOODWAY DATA

OTAY RIVER

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the finalization of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

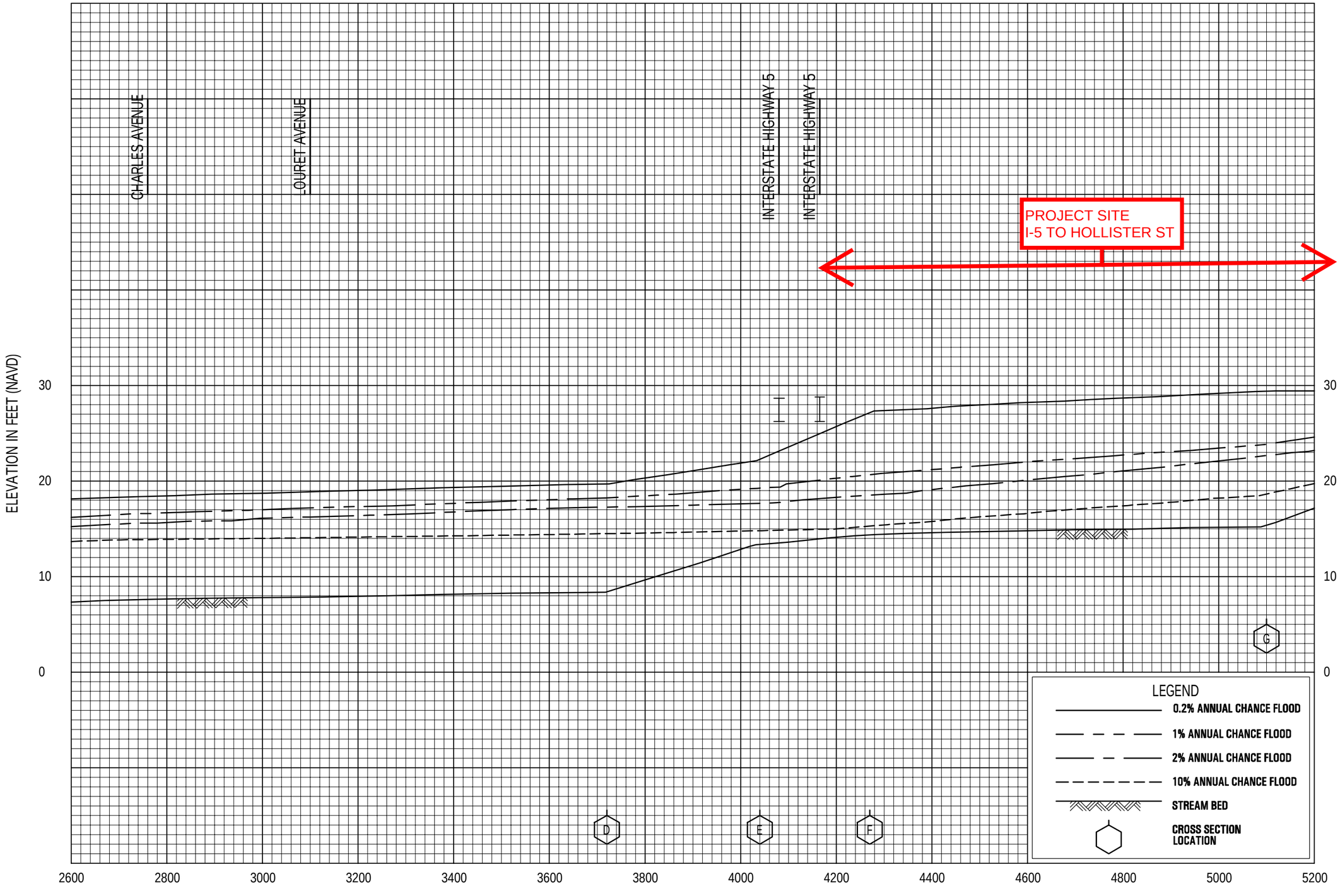
All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD, with exception of two panels: 06073C2151F and 06073C2152F. These panels were not updated with this revision and are referenced to NGVD. Flooding sources on the non-updated FIRMs include Nestor Creek, Otay River, San Diego Bay, Telegraph Canyon Creek, and Tijuana River. The profile panels and floodway data tables that contain information corresponding with the non-updated panels have been included in NGVD, in addition to all of the data being presented in NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base (1-percent-annual-chance) Flood Elevations (BFEs) across the corporate limits between the communities. The conversion factor for each flooding source studied by detailed methods is shown below in Table 12 "Flooding Source Conversion Factor."

TABLE 12: FLOODING SOURCE DATUM SHIFT VALUES

Stream Name	Elevation (feet NAVD above NGVD)
Adobe Creek	+2.2
Agua Hedionda Creek	+2.2
Agua Hedionda Creek (At City of Carlsbad)	+2.2
Agua Hedionda Creek (At City of Vista)	+2.3
Alvarado Creek	+2.1
Beaver Hollow Creek	+2.2
Beeler Creek	+2.1
Broadway Creek	+2.1
Buena Creek	+2.3
Buena Vista Creek	+2.3
Buena Vista Creek Tributary 1	+2.3
Buena Vista Creek Tributary 3	+2.3
Calavera Creek	+2.2
Carmel Valley Creek	+2.1
Carroll Canyon Creek	+2.1
Coleman Creek	+2.5
County Ditch Creek	+2.1

TABLE 12: FLOODING SOURCE DATUM SHIFT VALUES

Stream Name	Elevation (feet NAVD above NGVD)
Moosa Creek (North Branch)	+2.3
Moosa Creek (South Branch)	+2.3
Murphy Canyon Creek	+2.1
Murray Canyon Creek	+2.1
Nestor Creek	+2.1
North Avenue Tributary	+2.3
North Branch Poway Creek	+2.1
North Tributary to Santa Maria Creek	+2.2
Olive Creek	+2.4
Otay River	+2.2
Pala Mesa Creek	+2.2
Paradise Creek	+2.1
Paradise Creek – Valley Road Branch	+2.1
Pilgrim Creek	+2.3
Poggi Canyon Creek	+2.2
Pomerado Creek	+2.1
Poway Creek	+2.1
Rainbow Creek (Main Branch)	+2.3
Rainbow Creek (West Branch)	+2.3
Rattlesnake Creek	+2.1
Rattlesnake Creek Split Flow at Heritage Hills	+2.1
Rattlesnake Creek Split Flow at Midland Road	+2.1
Reidy Creek	+2.3
Reidy Creek Split Flow	+2.3
Rice Canyon Creek	+2.1
Rincon Avenue Tributary	+2.3
Rose Canyon Creek	+2.1
Samagutuma Creek	+2.4
San Clemente Canyon Creek	+2.1
San Diego Bay	+2.2
San Diego River	+2.1
San Dieguito River	+2.1
San Elijo Creek	+2.2
San Luis Rey River	+2.3
San Marcos Creek	+2.3
San Marcos Creek (Below Lake San Marcos)	+2.3
San Marcos Creek Highway 78 Split Flow	+2.3



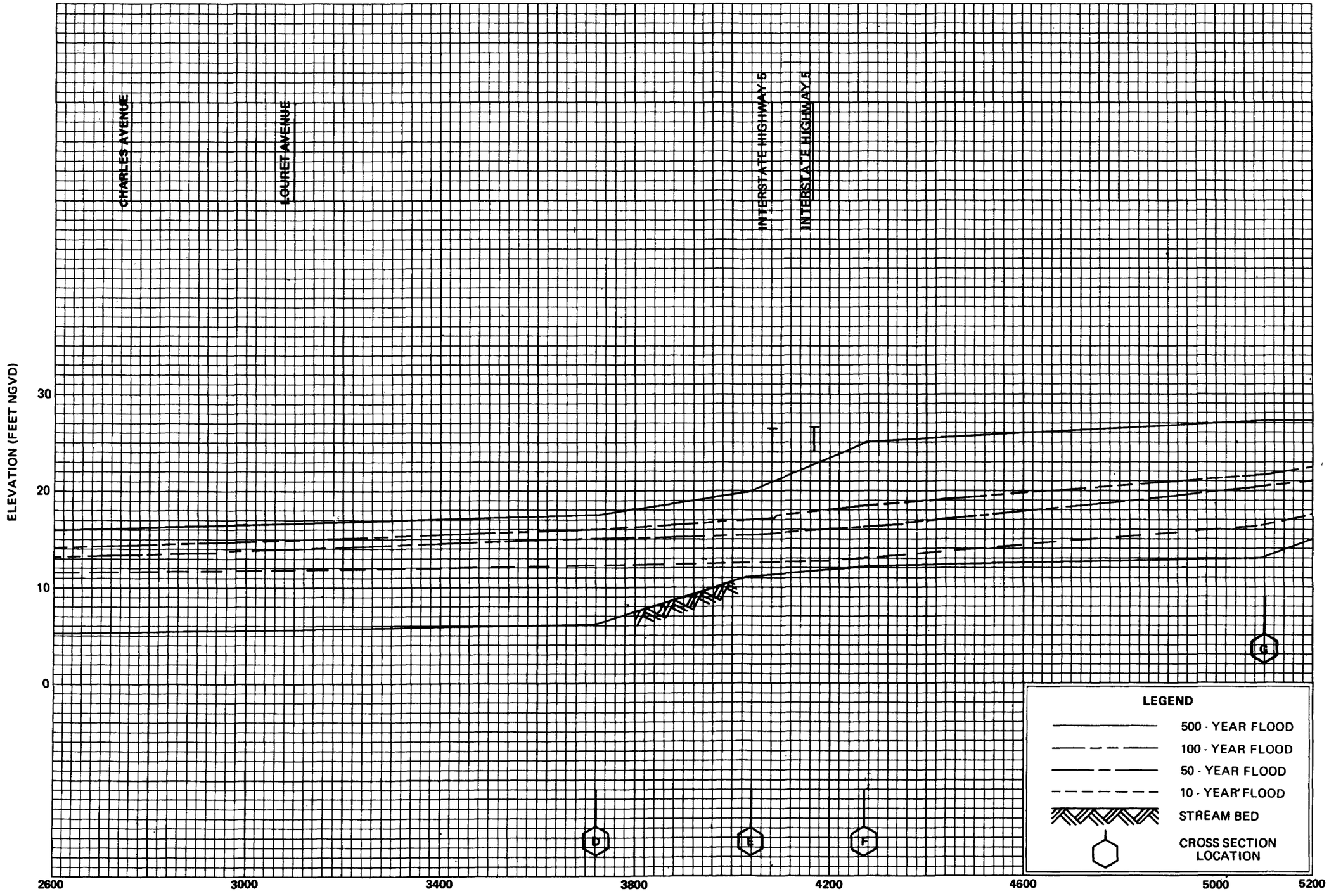
FLOOD PROFILES

OTAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA
(AND INCORPORATED AREAS)

259AP



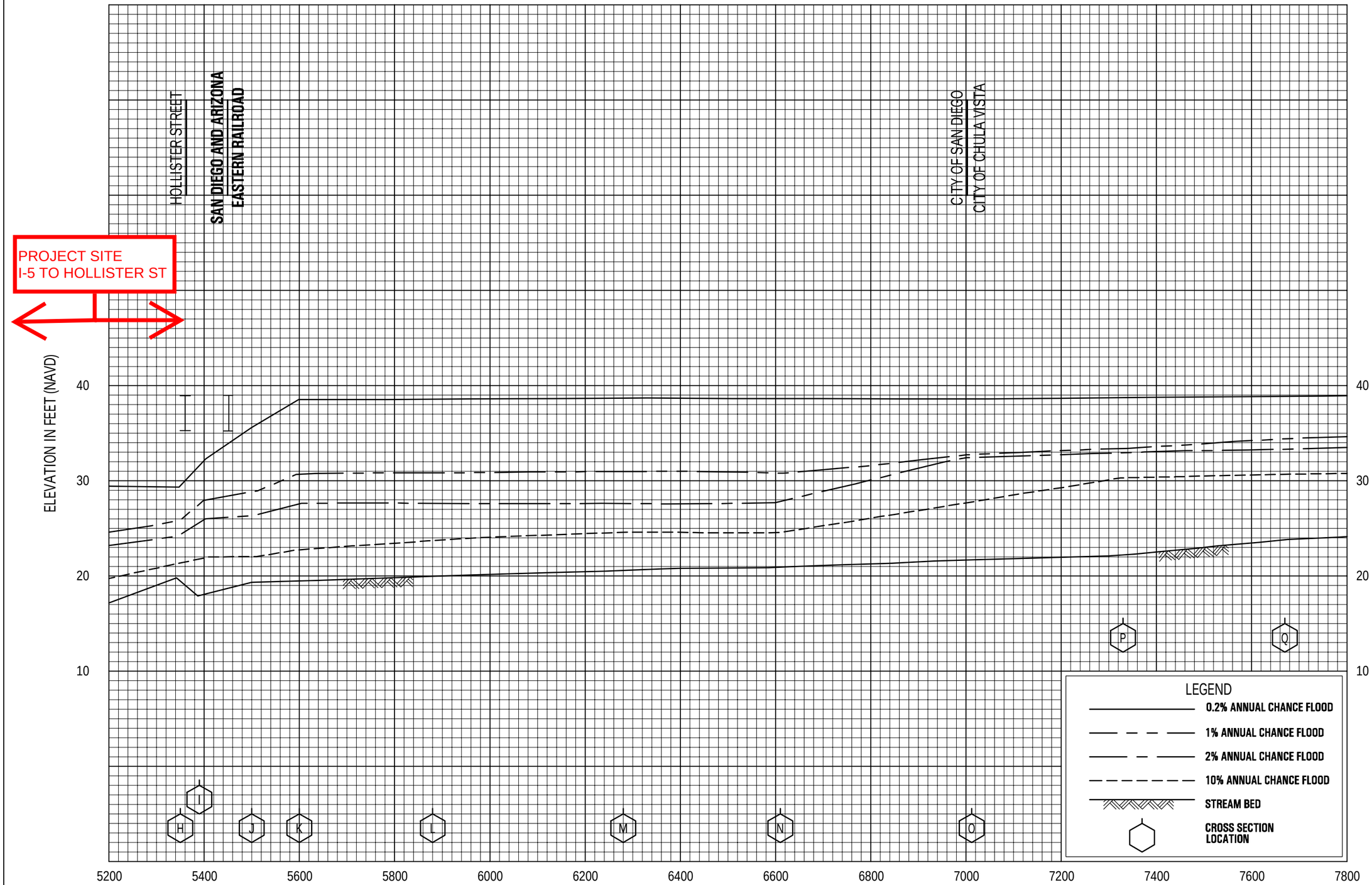
FLOOD PROFILES

OTAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA AND INCORPORATED AREAS

259BP



FLOOD PROFILES

OTAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA
(AND INCORPORATED AREAS)

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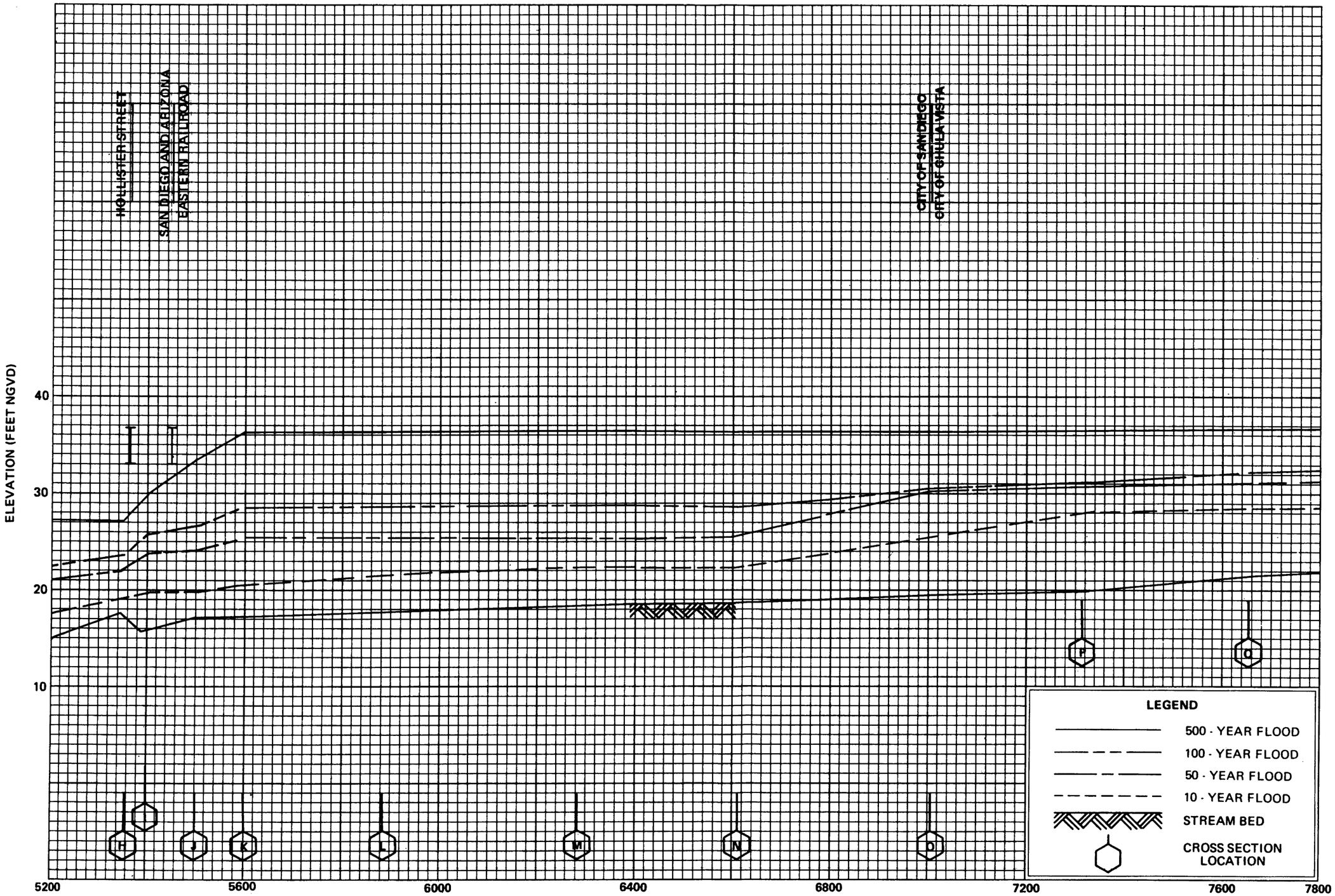


FLOOD PROFILES

OTAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA AND INCORPORATED AREAS

260BP

FEMA Engineering Library
Digitized Data Index

CID:060284

Community:SAN DIEGO COUNTY *

County:SAN DIEGO COUNTY

State:CALIFORNIA

0250976

Box:

Doc:

Case Number/ Study ID:060284-19780223

Description:1d. Type 15 Study

Revision Status:

Flooding Source(s):Otay River

Effective Date:10/20/1981

Contents:17. Misc. ref.: Other reference materials 24. Final FIS/FIRM/FHBM

Notes:060284-19780223_FIS

Scanned by:

Scan Date:

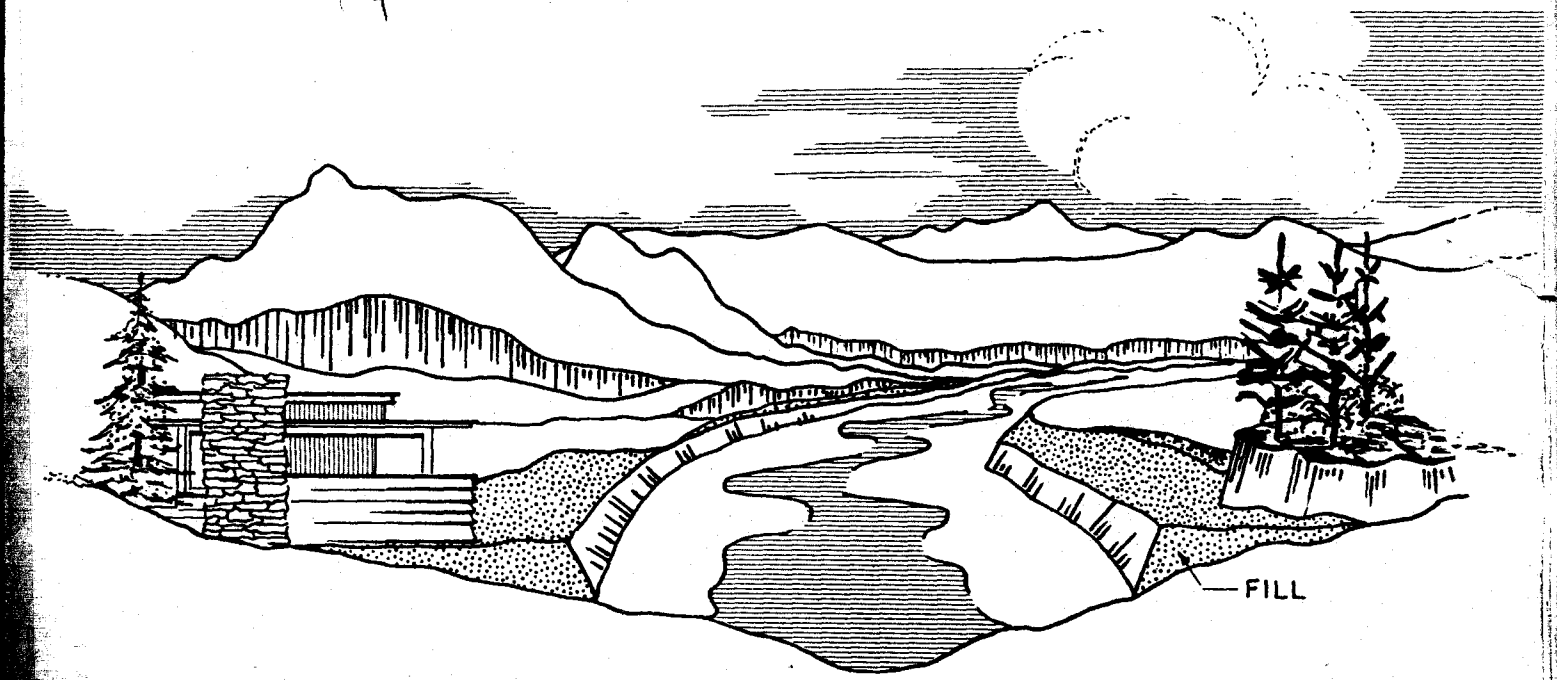
QC Staff:

QC Date:

FLOODWAY INFORMATION STUDY

OTAY RIVER

SAN DIEGO COUNTY, CALIFORNIA



PREPARED FOR
SAN DIEGO COUNTY
BY THE
DEPARTMENT OF THE ARMY, LOS ANGELES DISTRICT, CORPS OF ENGINEERS
LOS ANGELES, CALIFORNIA

DECEMBER 1974

FLOOD INSURANCE STUDY

OTAY RIVER

SAN DIEGO COUNTY, CALIFORNIA

PREPARED FOR THE

DEPARTMENT OF WATER RESOURCES

STATE OF CALIFORNIA

BY THE

DEPARTMENT OF SANITATION AND FLOOD CONTROL

SAN DIEGO COUNTY

COMPLETED Joseph C Hill DATE 23 Feb 78

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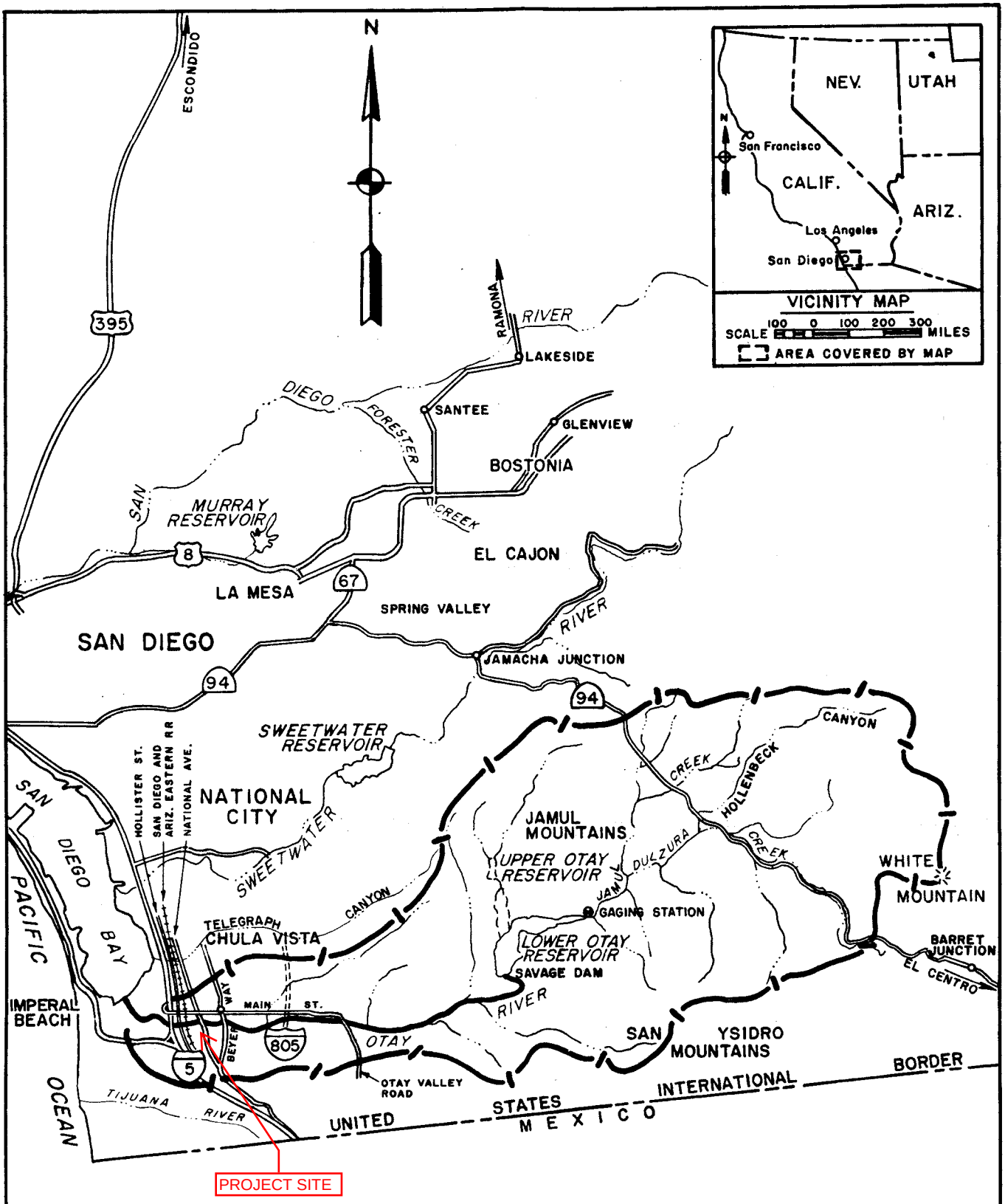


DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
LOS ANGELES, CALIFORNIA

FLOODWAY INFORMATION
OTAY RIVER
SAN DIEGO BAY TO SAVAGE DAM
SAN DIEGO COUNTY, CALIFORNIA

GENERAL MAP

DECEMBER 1974

LEGEND

REACH COVERED BY THIS REPORT.

BOUNDARY OF PROJECT DRAINAGE AREA.

PLATE 1

TABLE 1

Bridges and Culverts Within Study Area

Identification	Location (a)	Elevation (b) Streambed	Low Chord (c)	Roadway (d)	10 Yr (e)	IRF (e)
Interstate 5 Bridge	2.59	11.7	23.5	26.5	13.7	21.8
Hollister Street (4 - 2' CMP)	2.82	15.5	17.5	19.0	20.1	22.3
San Diego and Arizona Eastern Railroad	2.84	16.2	33.0	36.5	20.8	24.0
National Ave. Bridge	3.50	24.7	38.0	40.5	31.1	34.2
Beyer Way Bridge	4.19	32.6	52.5	58.1	37.4	40.0
Interstate 805 Bridge	5.80	74.2	116.0	127.0	79.2	84.6
Otay Valley Rd (2 - 2' CMP)	7.89	132.2	135.2	136.2	138.7	142.4

(a) Miles upstream from mouth
(b) All elevations are in feet, mean sea level datum
(c) Elevation of bottom of bridge structure or top of culvert
(d) Average elevation
(e) Computed water surface elevation based on estimated flow and existing channel and structures.

Although specific flood forecasts are not made for the Otay River drainage basin, daily weather forecasts applicable to the Otay area are issued by the National Weather Service office in San Diego. When weather conditions warrant, storm and probable flood warnings from the San Diego County area are issued by the National Weather Service River District office in San Diego. Local news media and law enforcement agencies disseminate these warnings to the public.

Flood fighting and emergency evacuation plans – There are no specific flood fighting or emergency evacuation plans for the Otay River area. If the need arises, State and local law enforcement agencies, local fire departments and civil defense groups, and street and highway maintenance crews could assist in the rescue of stranded persons and perform other flood fighting activities. The California Department of Water Resources, through its Flood Operation Center, coordinates flood fighting activities throughout the State and is authorized to receive requests from local public agencies for assistance during floods. During emergencies, the San Diego County Civil Defense and Disaster Office coordinates activities of local law enforcement agencies, and of fire, health, and sanitation departments.

The Corps of Engineers responds to requests from the State Disaster Office for assistance in flood fighting and rescue work when flood emergencies are beyond the capabilities of State and local governmental agencies.

FUTURE FLOODS

Although floods of the same magnitude as those that have occurred in the past could recur in the future, discussion of the future floods in this report is limited primarily to those that have been designated as the intermediate regional and 10-year frequency floods. The 10-year frequency flood could occur on the average of once every 10 years, and has a 10 percent chance of being equalled or exceeded in any year. Most storm drains and culverts in San Diego County are designed to pass the 10-year flood without damage to these structure or to adjacent property.

The intermediate regional flood is one that could occur about once every 100 years on the average, and has a 1 percent chance of being equalled or exceeded in any year. Since there are no streamflow records for the study reach, it was necessary to analyze precipitation and streamflow records of other stream basins having hydrologic, meteorologic, and physiographic characteristics similar to those of the Otay River basin. Studies were made to transpose the information, thus derived, to the study basin and to compute peak flows for the 10-year-frequency and intermediate regional floods. Peak flows developed for the 10-year-flood and intermediate regional flood at selected points in the study area are shown in table 2.

TABLE 2

Peak Flows for 10-Year-Frequency and
Intermediate Regional Floods

Location on Otay River	Total Drainage Area (sq. miles)	10-Year Flood* (cfs)	IRF (cfs)
At I-5 Bridge	139.2	3,700	22,000
Beyer Way Bridge	135.9	3,280	22,000
Otay Valley Road Crossing	122.7	2,850	22,000
Downstream of Savage Dam	98.6	2,000	22,000

*Flow values determined by San Diego County.

The future floods discussed herein are of the general winter local storm type. During floods, debris collecting on bridges and culverts could decrease their carrying capacity and cause greater water depths (backwater effect) upstream from these structures. The occurrence and amount of debris are indeterminate factors; however, a limited amount of debris was considered in preparing the profiles of the intermediate regional and the 10-year-frequency floods. Similarly, the maps of flooded areas show the backwater effect of obstructive bridges and culverts, and reflect increased water surface elevations that could be caused by limited amounts of debris collecting against the structures.

Hazards of Large Floods

The amount and extent of damage caused by any flood depends on the topography of the area flooded, depth, and duration of flooding, velocity of flow, and developments on the flood plain. An intermediate regional flood on the Otay River would result in inundation of most of the riverine lands.

Deep floodwater flowing at a high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater 3 or more feet deep and flowing at a velocity of 3 or more feet per second could sweep a person off his feet, thus creating definite dangers of injury or drowing. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged. Decaying flood-deposited garbage or other organic materials could create health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

Flooded Areas and Flood Damages

The areas along the Otay River that would be flooded by the intermediate regional flood are shown on plates 2 and 3. Also, larger scaled maps (1" = 200') which are on file with the San Diego County Department of Sanitation and Flood Control show the area that would be flooded by the intermediate regional flood and a designated floodway. Coordinates of the south and west margin of these maps are referenced on plates 2 and 3 and conform to the California Rectangular Grid (Zone VI).

Due to the wider flood plain, greater depth of flooding, higher velocity flow, and longer duration of flooding during an intermediate regional flood, damage would be more severe than during the 10-year-frequency flood. Streets, bridges, culverts, and public utilities would be severely damaged by high velocity floodflows. Extensive deposits of silt and debris would occur in many parts of the flooded areas. Plates 4 through 10 show water surface profiles of the intermediate regional and 10-year-frequency floods. Depth of flow in the channel can be estimated from these profiles.

Inundation of structures by the intermediate regional flood would be mostly limited to areas downstream of National Avenue. Flooding of cultivated fields and some industrial and residential properties just upstream of the San Diego and Arizona Eastern Railroad would occur. Flooding of a trailer park, some residences, cultivated fields, and a sewage treatment plant would also occur downstream of the I-5 bridge. Erosion of the dikes forming the salt evaporators would occur in areas where they are overtopped by floodwaters. All of the sand and gravel operations located in the Otay River channel and flood plain would be flooded. Future development of the flood plain which does not take into account the flood hazard would result in greater damages during future floods.

Obstructions – Several bridges and roads cross the Otay flood plain. As can be seen in table 1 and on plates 4 through 9, none of the bridges will be overtopped by the intermediate regional flood. However, stability analysis of these bridges under scour action is beyond the scope of this study, and it is possible that some of these bridges would collapse during a major flood. The two roads which cross the flood plain, namely Hollister Street and Otay Valley Road would be washed out during a major flood. Numerous depressions, dirt road crossings, and mounds of earth in the channel would impede floodflows during the earlier period of a flood, but their effects during the peak stages of major floods would probably be negligable.

Velocities of flow – The slope of the streambed, the shape of the cross sections, and the roughness of the areas in the channel and overbank are major factors that govern the velocity of floodflow. During a flood, velocities of flow would change with time due to bank erosion, sediment transport, and deposition of debris as the discharge increases and decreases. The average velocities of flow for the entire reach studied during peak flows of the intermediate regional flood in the channel and overbank are 9 and 5 feet per second respectively. However, the velocity at any given point along the study reach can vary from 2 to 21 feet per second in the channel and from 1 to 11 feet per second in the overbank.

Photographs, future flood heights – The levels that the intermediate regional flood is expected to reach at various locations on the Otay River flood plain are indicated in figures 8 through 10.

NOTE:

RED NUMBERS INDICATED IN GRID RECTANGLES CORRESPOND WITH THE SAN DIEGO COUNTY MAP NUMBERING SYSTEM. THE COUNTY MAPS ARE ON FILE WITH THE SAN DIEGO COUNTY DEPARTMENT OF SANITATION AND FLOOD CONTROL, 5555 OVERLAND AVE., SAN DIEGO, CALIFORNIA, 92123. THE COUNTY MAPS DELINIATE THE INTERMEDIATE REGIONAL FLOOD PLAIN AND ITS PRELIMINARY FLOODWAY AT A SCALE OF 1" = 200'

Harbor Side

DOWNSTREAM LIMIT OF STUDY

South San Diego

154-1737

154-1743

154-1749

154-1755

154-1761

150-1737

150-1743

150-1749

I-805 BRIDGE UNDER CONSTRUCTION

PROJECT SITE
= 2.8 MILES FROM MOUTH

LEGEND

RIVER MILES

STREAMS

AREA FLOODED BY INTERMEDIATE REGIONAL FLOOD

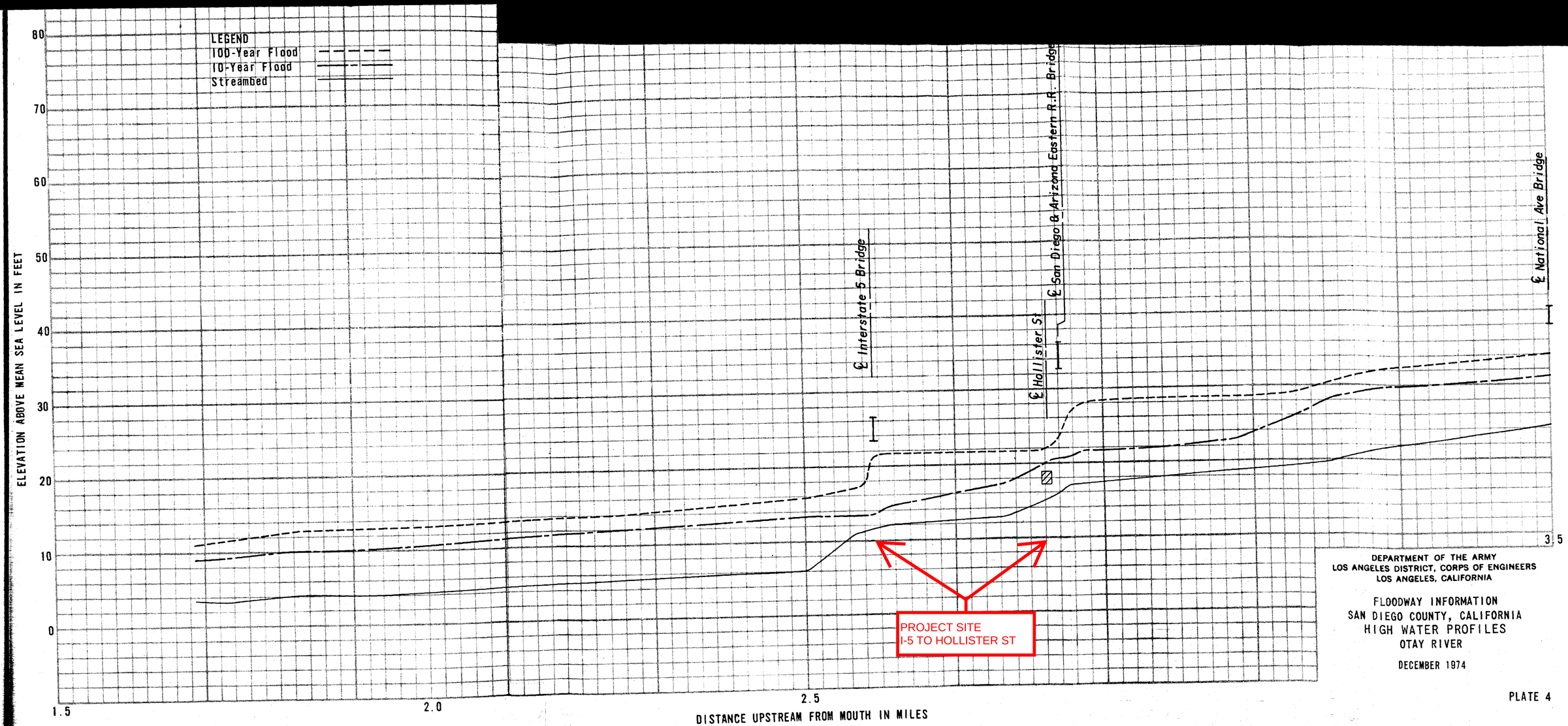
150-1737 SAN DIEGO COUNTY TOPOGRAPHIC MAP INDEX NUMBER

SCALE 1000 0 1000 2000 3000 FEET

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
LOS ANGELES, CALIFORNIA

FLOODWAY INFORMATION
OTAY RIVER
SAN DIEGO COUNTY, CALIFORNIA
INDEX MAP - FLOODED AREA
DECEMBER 1974

PLATE 2



DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
LOS ANGELES, CALIFORNIA

FLOODWAY INFORMATION
SAN DIEGO COUNTY, CALIFORNIA
HIGH WATER PROFILES
OTAY RIVER

DECEMBER 1974

PLATE 4